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October 27, 2025

Mary Alice Evans, Director
State of Hawai'i
Office of Planning and Sustainable Development
Environmental Review Program
235 South Beretania Street, Suite 702
Honolulu, Hawai'i 96813

SUBJECT: Draft Environmental Impact Statement (EIS) for the Proposed Central Maui Wastewater Reclamation Facility Project; Maui, Hawai'i

Dear Ms. Evans,

On behalf of the County of Maui, Department of Environmental Management (DEM), Munekiyo Hiraga hereby submits the Draft EIS for the Proposed Central Maui Wastewater Reclamation Facility Project located in Central Maui, Hawai'i. In accordance with Hawai'i Administrative Rules (HAR) §11-200.1-5(e)(5)(C), the Draft EIS has been simultaneously filed with the DEM as the Accepting Authority.

We respectfully request the Draft EIS be published in the next available edition of The Environmental Notice. An electronic copy of this transmittal letter and the supporting documents as well as the original audio file of oral comments received during the EIS public scoping meeting have been uploaded to the Environmental Review Program online submittal form. As required by HAR §11-200.1-5(e)(5)(D), a hard copy of the Draft EIS has been submitted to both the Hawai'i Documents Center and the Wailuku Public Library.

Should you have any questions, please do not hesitate to contact me at (808) 983-1233. Thank you very much for your assistance with this request.

Very truly yours,

Yukino Uchiyama, AICP
Manager

YU:tn
cc: Shayne Agawa, P.E., Department of Environmental Management
Juan Rivera, P.E., Department of Environmental Management
K:\DATA\COM\DEM CMaui WW Infrastructure\Apps\0Draft EIS\ERP Submittals\DEIS ERP Transmittal Ltr.docx

From: dbedt.opsd.erp@hawaii.gov
To: DBEDT OPSD Environmental Review Program
Subject: New online submission for The Environmental Notice
Date: Thursday, October 30, 2025 1:19:26 PM

Action Name

Proposed Central Maui Wastewater Reclamation Facility

Type of Document/Determination

Draft environmental impact statement (DEIS)

HRS §343-5(a) Trigger(s)

- (1) Propose the use of state or county lands or the use of state or county funds
- (6) Propose any amendments to existing county general plans where the amendment would result in designations other than agriculture, conservation, or preservation
- (9)(A) Propose any wastewater treatment unit, except an individual wastewater system or a wastewater treatment unit serving fewer than fifty single-family dwellings or the equivalent

Judicial district

Wailuku, Maui

Tax Map Key(s) (TMK(s))

(2) 3-5-001:017; (2) 3-5-001:120; (2) 3-5-002:014; (2) 3-5-020:036; (2) 3-6-002:003; (2) 3-6-002:004; (2) 3-8-005:023; Waikapū Stream; Wai‘ale Road (Right-of-Way (ROW)); Waiko Road (ROW)

Action type

Agency

Other required permits and approvals

See Chapter X of Draft EIS

Proposing/determining agency

County of Maui, Department of Environmental Management

Agency jurisdiction

County of Maui

Agency contact name

Juan Rivera

Agency contact email (for info about the action)

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Agency contact phone

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Agency address

2200 Main Street
Suite 610
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United States
Map It

Accepting authority

County of Maui, Department of Environmental Management

Accepting authority contact name

Juan Rivera

Accepting authority contact email or URL

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Accepting authority contact phone

(808) 270-7268

Accepting authority address

2200 Main Street
Suite 610
Wailuku, Hawai'i 96793
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Is there a consultant for this action?

Yes

Consultant

Munekiyo Hiraga

Consultant contact name

Yukino Uchiyama

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Consultant contact phone

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Consultant address

305 High Street
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Wailuku, Hawai'i 96793
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Map It

Action summary

The County of Maui, Department of Environmental Management (DEM) is proposing to develop a new Central Maui Wastewater Reclamation Facility (WWRF) and onsite Soil Aquifer Treatment (SAT) system on approximately 14.9 acres of former agricultural lands between Honoapi'ilani Highway and Kūihelani Highway in Waikapū, as well as related offsite infrastructure improvements. Offsite improvements consist of a wastewater pump station (WWPS) near the existing master-planned Kehalani community, a sewage pipeline from the Kehalani

WWPS to the new WWRF, portions of sewage pipeline and R-1 recycled water pipeline to connect the WWRF and the future Waikapū Country Town development, and a WWRF access road. The proposed WWRF will service existing and planned developments throughout the Waikapū/Wailuku area, as well as State of Hawai‘i projects in Pūlehunui. Implementation of this new WWRF will reduce wastewater flows being handled and treated by the Wailuku-Kahului WWRF.

Attached documents (signed agency letter & EA/EIS)

- COM_DEM_CMaui_WW_Infrasture_transmittal_10.24.25.pdf
- COM_Central_Maui_Wastewater_Reclamation_Facility_Scoping-_Meeting_-Recording_2023_08_16.MP3
- COM_DEM_CMaui_Draft_EIS_Volume_II_of_II_Nov_2025.pdf
- COM_DEM_CMaui_Draft_EIS_Volume_I_of_II_Nov_2025.pdf

ADA Compliance certification (HRS §368-1.5):

The authorized individual listed below acknowledges that they retain the responsibility for ADA compliance and are knowingly submitting documents that are unlocked, searchable, and may not be in an ADA compliant format for publication. Audio files do not include transcripts, captions, or alternative descriptions. The project files will be published without further ADA compliance changes from ERP, with the following statement included below the project summary in The Environmental Notice: "If you are experiencing any ADA compliance issues with the above project, please contact (authorized individual submitting the project at email)."

Shapefile

- The location map for this Draft EIS is the same as the location map for the associated EIS Preparation Notice.

Action location map

- COM_Central_Maui_Wastewater_Reclamation_Facility_Draft_EIS.Shapefiles.zip

Authorized individual

Yukino Uchiyama

Authorized individual email

CentralMauiWWRF@munekiyohiraga.com

Authorized individual phone

(808) 983-1233

Authorization

- The above named authorized individual hereby certifies that he/she has the authority to make this submission.

VOLUME I OF II
(INCLUDING APPENDICES A TO F)

Draft Environmental Impact Statement

PROPOSED CENTRAL MAUI WASTEWATER RECLAMATION FACILITY, MAUI, HAWAIʻI

Prepared for:

County of Maui, Department of Environmental Management

Accepting Authority:

County of Maui, Department of Environmental Management

November 2025

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VOLUME I OF II
(INCLUDING APPENDICES A TO F)

Draft Environmental Impact Statement

PROPOSED CENTRAL MAUI WASTEWATER RECLAMATION FACILITY, MAUI, HAWAIʻI

Prepared for:

County of Maui, Department of Environmental Management

Accepting Authority:

County of Maui, Department of Environmental Management

This Draft Environmental Impact Statement and all ancillary documents were prepared under my direction or supervision, and the information submitted, to the best of my knowledge, fully addresses document content requirements set forth in Hawaiʻi Revised Statutes, Chapter 343 and Hawaiʻi Administrative Rules, §11-200.1, as applicable.

Michael D Petersen — Digitally signed by Michael D. Petersen (Deputy Director) for Shayne R. Agawa

for Shayne Agawa, P.E.
Director

October 28, 2028
Date

November 2025

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MUNEKIYO HIRAGA

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List of Acronyms

AFNSI	Anticipated Finding of No Significant Impact
AIA	Agricultural Impact Assessment
AIS	Archaeological Inventory Survey
ALISH	Agricultural Lands of Importance to the State of Hawai‘i
AM	ante meridiem
amsl	above mean sea level
ATA	Austin, Tsutsumi & Associates, Inc.
bgs	below ground surface
BMP	Best Management Practices
bmsl	below mean sea level
BNR	Biological Nutrient Removal
BOD_5	biochemical oxygen demand
CARs	Communities at Risk
CARV	Combination Air Release Valve
CDP	Census Designated Place
cf	cubic feet
cfs	cubic feet per second
CH_4	methane
CIA	Cultural Impact Assessment
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COZ	Change of Zoning
CPA	Community Plan Amendment
CSH	Cultural Surveys Hawai‘i
CSM	Conceptual Site Model
CTMP	Construction Traffic Management Plan
CWG	Core Working Group
CWPP	Community Wildfire Protection Plan
CWRM	State of Hawai‘i, Commission on Water Resource Management
DA	Department of the Army
DAR	State of Hawai‘i, Department of Land and Natural Resources, Division of Aquatic Resources
dBA	decibels with A-weighting
DBA	District Boundary Amendment
DBEDT	State of Hawai‘i, Department of Business, Economic Development and Tourism
DEM	Department of Environmental Management
DLNR	State of Hawai‘i, Department of Land and Natural Resources
DNL	Day-Night Average Sound Level
DOE	Department of Education
DOFAW	State of Hawai‘i, Department of Forestry and Wildlife
DOH	Department of Health
DPR	County of Maui, Department of Parks and Recreation
DPW	County of Maui, Department of Public Works
DWS	County of Maui, Department of Water Supply
EA	Environmental Assessment
EB	East Bound
EIS	Environmental Impact Statement

EISPN	Environmental Impact Statement Preparation Notice
ERP	Environmental Review Program
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
ft.	feet
FTE	full-time equivalent
GET	general excise tax
GHG	Greenhouse Gases
gpad	gallons per acre per day
gpd	gallons per day
gpm	gallons per minute
GPR	Ground Penetrating Radar
GPS	geographic point system
H_2S	hydrogen sulfide
HAR	Hawai‘i Administrative Rules
HC&S	Hawaiian Commercial & Sugar Company
HCZMP	Hawai‘i Coastal Zone Management Program
HDOT	State of Hawai‘i, Department of Transportation
HECO	Hawaiian Electric Company
HICRIS	Hawaii Cultural Resource Information System
HRS	Hawai‘i Revised Statutes
HWMO	Hawai‘i Wildfire Management Organization
IaA	Iao silty clay – 0 to 3 percent slopes
IAL	Important Agricultural Lands
IbB	Iao cobbly silt clay
IcB	Iao silty clay – 3 to 7 percent slopes
IMLR	internal mixed liquor recycle
IPaC	Information for Planning and Consultation
JaC	Jaucus sand – 0 to 15 percent slopes
JD	Jurisdictional Determination
KVA	kilovolt-ampere
kWh	kilowatt-hour
LOS	Level of Service
LRFI	Literature Review and Field Inspection
LSB	Land Study Bureau
LT	Left Turn
LUC	Land Use Commission
MBR	Membrane Bioreactor
MCC	Maui County Code
MCL	Maximum Contaminant Level
µg/L	micrograms per liter
µgN/L	micrograms of nitrogen per liter
mg	million gallon
mg/L	milligrams per liter
mgd	million gallons per day
mg N/L	milligrams of nitrate per liter
mgy	million gallons per year
MIP	Maui Island Plan
MLE	Modified Ludack-Ettinger
MPD	County of Maui, Police Department

mph	miles per hour
$MTCO_2e$	metric tons of carbon dioxide equivalent
N_2O	nitrous oxide
NB	North Bound
NEPA	National Environmental Policy Act
NHO	Native Hawaiian Organizations
NHPA	National Historic Preservation Act
NO_2	Nitrogen Dioxide
NOx	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
O&M	operating and maintenance
O_3	Ozone
OHWM	Ordinary High Water Mark
Pb	lead
PDR	Preliminary Drainage Report
PM	post meridiem
$PM_{2.5}$	Particulate Matter with diameter of 2.5 micrometers or less
por.	portion
PpA	Pulehu silt loam – 0 to 3 percent slopes
PpB	Pulehu silt loam – 3 to 7 percent slopes
ppd	pounds per day
PrB	Pulehu cobbly silt loam - 3 to 7 percent slopes
PSD	Prevention of Significant Deterioration
PtA	Pulehu cobbly clay loam – 0 to 3 percent slopes
PtB	Pulehu cobbly clay loam – 2 to 6 percent slopes
PV	Photovoltaic
PZUE	Puuone sand – 7 to 30 percent slopes
Qdo	Older dune deposits
Qkul	Kula Volcanics
QTao	Older alluvium
RAS	Return Activated Sludge
RGB	Rural Growth Boundaries
ROW	Right-of-way
RT	Right Turn
SAT	Soil Aquifer Treatment
SB	South Bound
SHPD	State Historic Preservation Division
SIHP	State Inventory of Historic Places
SIP	State Implementation Plan
SLR-XA	Sea Level Rise Exposure Area
SMA	Special Management Area
SO_2	Sulfur Dioxide
SRF	State Revolving Fund
STB	Small Town Boundaries
TACs	toxic air contaminants
TAHA	Terry A. Hayes Associates, Inc.
TIAR	Traffic Impact Assessment Report
TIC	Total inorganic carbon
TMK	Tax Map Key
TOC	Total organic carbon

tpy	tons per year
TSS	total suspended solids
U.S. EPA	United States Environmental Protection Agency
UGB	Urban Growth Boundary
UHMC	University of Hawai‘i Maui College
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Service
UV	ultraviolet light
VOC	Volatile organic compounds
VSS	volatile suspended solids
WB	West Bound
WQDV	Water Quality Design Volume
WUI	Wildland-Urban Interface
WWPS	Wastewater Pump Station
WWRD	Wastewater Reclamation Division
WWRF	Wastewater Reclamation Facility

Contents Checklist

Pursuant to §11-200.1-24, Hawai'i Administrative Rules (HAR), the Draft EIS, at a minimum, shall contain the following information:

11-200.1-24 Section	Requirement	Location
(d)	The draft EIS shall contain a summary that concisely discusses the following: (1) Brief description of the action; (2) Significant beneficial and adverse impacts; (3) Proposed mitigation measures; (4) Alternatives considered; (5) Unresolved issues; (6) Compatibility with land use plans and policies, and a list of approvals; and (7) A list of relevant EAs and EISs considered in the analysis of the preparation of the EIS.	Project Summary
(e)	The draft EIS shall contain table of contents	Contents
(f)	The draft EIS shall contain a separate and distinct section that includes the purpose and need for the proposed action.	Chapter I.C.
(g)	The draft EIS shall contain a description of the action that shall include the following information, but need not supply extensive detail beyond that needed for evaluation and review of the environmental impact: (1) A detailed map (such as a United States Geological Survey topographic map, Flood Insurance Rate Maps, Floodway Boundary Maps, or state sea level rise exposure area maps, as applicable) and a related regional map; (2) Objectives of the proposed action; (3) General description of the action's technical, economic, social, cultural, and environmental characteristics; (4) Use of state or county funds or lands for the action; (5) Phasing and timing of the action; (6) Summary technical data, diagrams, and other information necessary to enable an evaluation of potential environmental impact by commenting agencies and the public; and (7) Historic perspective.	 Figure 1 to Figure 16 Chapter I.C. Chapter II Chapter I.D. Chapter I.F. Chapter II Chapter II.A.15
(h)	The draft EIS shall describe in a separate and distinct section discussion of the alternative of no action as well as reasonable alternatives that could attain the objectives of the action. The section shall include a rigorous exploration and objective evaluation of the environmental impacts of all such alternative actions. Particular attention shall be given to alternatives that might enhance environmental quality or avoid, reduce, or minimize some or all of the adverse environmental effects, costs, and risks of the action. Examples of alternatives include:	Chapter IV

11-200.1-24 Section	Requirement	Location
	(1) Alternatives requiring actions of a significantly different nature that would provide similar benefits with different environmental impacts; (2) Alternatives related to different designs or details of the proposed action that would present different environmental impacts; and (3) Alternative locations for the proposed action. In each case, the analysis shall be sufficiently detailed to allow the comparative evaluation of the environmental benefits, costs, and risks of the proposed action and each reasonable alternative. For alternatives that were eliminated from detailed study, the section shall contain a brief discussion of the reasons for not studying those alternatives in detail. For any agency actions, the discussion of alternatives shall include, where relevant, those alternatives not within the existing authority of the agency.	
(i)	The draft EIS shall include a description of the environmental setting, including a description of the environment in the vicinity of the action, as it exists before commencement of the action, from both a local and regional perspective. Special emphasis shall be placed on environmental resources that are rare or unique to the region and the action site (including natural or human-made resources of historic, cultural, archaeological, or aesthetic significance); specific reference to related actions, public and private, existent or planned in the region shall also be included for purposes of examining the possible overall cumulative impacts of such actions. Proposing agencies and applicants shall also identify, where appropriate, population and growth characteristics of the affected area, any population and growth assumptions used to justify the proposed action, and any secondary population and growth impacts resulting from the proposed action and its alternatives. The draft EIS shall expressly note the sources of data used to identify, qualify, or evaluate any and all environmental consequences.	Chapter II, V, and VI
(j)	The draft EIS shall include a description of the relationship of the proposed action to land use and natural or cultural resource plans, policies, and controls for the affected area. Discussion of how the proposed action may conform or conflict with objectives and specific terms of approved or proposed land use and resource plans, policies, and controls, if any, for the affected area shall be included. Where a conflict or inconsistency exists, the draft EIS shall describe the extent to which the agency or applicant has reconciled its proposed action with the plan, policy, or control, and the reasons why the agency or applicant has decided to proceed, notwithstanding the absence of full reconciliation.	Chapter III

11-200.1-24 Section	Requirement	Location
(k)	The draft EIS shall also contain a list of necessary approvals required for the action from governmental agencies, boards, or commissions or other similar groups having jurisdiction. The status of each identified approval shall also be described.	Chapter X
(l)	The draft EIS shall include an analysis of the probable impact of the proposed action on the environment, and impacts of the natural or human environment on the action. This analysis shall include consideration of all phases of the action and consideration of all consequences on the environment, including direct and indirect effects. The interrelationships and cumulative environmental impacts of the proposed action and other related actions shall be discussed in the draft EIS. The draft EIS should recognize that several actions, in particular those that involve the construction of public facilities or structures (e.g., highways, airports, sewer systems, water resource actions, etc.) may well stimulate or induce secondary effects. These secondary effects may be equally important as, or more important than, primary effects, and shall be thoroughly discussed to fully describe the probable impact of the proposed action on the environment. The population and growth impacts of an action shall be estimated if expected to be significant, and an evaluation shall be made of the effects of any possible change in population patterns or growth upon the resource base, including but not limited to land use, water, and public services, of the area in question. Also, if the proposed action constitutes a direct or indirect source of pollution as determined by any governmental agency, necessary data regarding these impacts shall be incorporated into the EIS. The significance of the impacts shall be discussed in terms of subsections (m), (n), (o), and (p).	Chapter II, V, and VI
(m)	The draft EIS shall include in a separate and distinct section a description of the relationship between local short-term uses of humanity's environment and the maintenance and enhancement of long-term productivity. The extent to which the proposed action involves trade-offs among short-term and long-term gains and losses shall be discussed. The discussion shall include the extent to which the proposed action forecloses future options, narrows the range of beneficial uses of the environment, or poses long-term risks to health or safety. In this context, short-term and long-term do not necessarily refer to any fixed time periods, but shall be viewed in terms of the environmentally significant consequences of the proposed action.	Chapter VII

11-200.1-24 Section	Requirement	Location
(n)	The draft EIS shall include in a separate and distinct section a description of all irreversible and irretrievable commitments of resources that would be involved in the proposed action should it be implemented. Identification of unavoidable impacts and the extent to which the action makes use of non-renewable resources during the phases of the action, or irreversibly curtails the range of potential uses of the environment, shall also be included. The possibility of environmental accidents resulting from any phase of the action shall also be considered.	Chapter VI
(o)	The draft EIS shall address all probable adverse environmental effects that cannot be avoided. Any adverse effects such as water or air pollution, urban congestion, threats to public health, or other consequences adverse to environmental goals and guidelines established by environmental response laws, coastal zone management laws, pollution control and abatement laws, and environmental policy including those found in chapters 128D (Environmental Response Law), 205A (Coastal Zone Management), 342B (Air Pollution Control), 342C (Ozone Layer Protection), 342D (Water Pollution), 342E (Nonpoint Source Pollution Management and Control), 342F (Noise Pollution), 342G (Integrated Solid Waste Management), 342H (Solid Waste Recycling), 3421 (Special Wastes Recycling), 342J (Hazardous Waste, including Used Oil), 3421 (Underground Storage Tanks), 342P (Asbestos and Lead), and 344 (State Environmental Policy), HRS, and those effects discussed in this section that are adverse and unavoidable under the proposed action must be addressed in the draft EIS. Also, the rationale for proceeding with a proposed action, notwithstanding unavoidable effects, shall be clearly set forth in this section. The draft EIS shall indicate what other interests and considerations of governmental policies are thought to offset the adverse environmental effects of the proposed action. The draft EIS shall also indicate the extent to which these stated countervailing benefits could be realized by following reasonable alternatives to the proposed action that would avoid some or all of the adverse environmental effects.	Chapter V
(p)	The draft EIS shall consider mitigation measures proposed to avoid, minimize, rectify, or reduce impacts, including provision for compensation for losses of cultural, community, historical, archaeological, and fish and wildlife resources, including the acquisition of land, waters, and interests therein. Description of any mitigation measures included in the action plan to reduce significant, unavoidable, adverse impacts to insignificant levels, and the basis for considering these levels acceptable shall be included. Where a particular mitigation measure has been chosen from among several alternatives, the measures shall be discussed	Chapter II

11-200.1-24 Section	Requirement	Location
	and reasons given for the choice made. The draft EIS shall include, where possible, specific reference to the timing of each step proposed to be taken in any mitigation process, what performance bonds, if any, may be posted, and what other provisions are proposed to ensure that the mitigation measures will in fact be taken in the event the action is implemented.	
(q)	The draft EIS shall include a separate and distinct section that summarizes unresolved issues and contains either a discussion of how such issues will be resolved prior to commencement of the action, or what overriding reasons there are for proceeding without resolving the issues.	Chapter VIII
(r)	The draft EIS shall include a separate and distinct section that contains a list identifying all governmental agencies, other organizations and private individuals consulted in preparing the draft EIS, and shall disclose the identity of the persons, firms, or agency preparing the draft EIS, by contract or other authorization.	Chapter XI and List of Document Authors
(s)	The draft EIS shall include a separate and distinct section that contains: (1) Reproductions of all written comments submitted during the consultation period required in section 11-200.1-23; (2) Responses to all substantive written comments made during the consultation period required in section 11-200.1-23. (3) For comments that are form letters or petitions, that contain identical or near-identical language, and that raise the same issues on the same topic: (A) The response may be grouped (B) A single response may be provided that addresses all substantive comments within the form letter or petition and that includes a distinct section listing the individual commenters who submitted the form letter or petition. At least one representative sample of the form letter or petition shall be appended to the final document; and (4) A summary of any EIS public scoping meetings, including a written general summary of the oral comments made, and a representative sample of any handout provided by the proposing agency or applicant related to the action provided at any EIS public scoping meeting; (5) A list of those persons or agencies who were consulted and had no comment in a manner indicating that no comment was provided; and (6) A representative sample of the consultation request letter.	Chapter XI Appendix T Chapter XI Appendix U

Executive Summary

Project Name:
Proposed Central Maui Wastewater Reclamation Facility

Type of Document:
Draft Environmental Impact Statement (EIS)

Legal Authority:
Chapter 343, Hawai‘i Revised Statutes
Title 11, Chapter 200.1, Hawai‘i Administrative Rules

Determination:
EIS to be prepared

Applicable Chapter 343, HRS "Triggers":
Use of County Lands and State and County Funds
Amendments to County General Plans (Maui Island Plan and Community Plan Amendments), as may be applicable
Proposed Wastewater Treatment Unit

Location:
Maui Island, Central Maui
Tax Map Key (TMK) Nos. (2)3-5-001:017 (por.) and 120 (por.), (2)3-5-002:014 (por.), (2)3-5-020:036 (por.), (2)3-6-002:003(por.) and 004(por.), and (2)3-8-005:023 (por.), Waikapū Stream, Wai‘ale Road (Right-of-Way (ROW)), and Waiko Road (ROW)

Landowners:
County of Maui
Wai‘ale 905 Partners, LLC
Kehalani Holdings Company, Inc.
Waiko Baseyard LLC

Proposing Agency:
County of Maui
Department of Environmental Management
2200 Main Street, Suite 610
Wailuku, Hawai‘i 96793
Contact: Juan Rivera, P.E., Capital Improvements Projects Program Manager
Phone: (808) 270-7268

Accepting Authority:
County of Maui
Department of Environmental Management
2200 Main Street, Suite 610
Wailuku, Hawai‘i 96793
Contact: Juan Rivera, P.E., Capital Improvements Projects Program Manager
Phone: (808) 270-7268

Consultant:
Munekiyo Hiraga
305 High Street, Suite 104
Wailuku, Hawai‘i 96793
Contact: Yukino Uchiyama, AICP, Manager
Phone: (808) 983-1233
Email: CentralMauiWWRF@munekiyohiraga.com

Project Summary

PROJECT DESCRIPTION

The County of Maui, Department of Environmental Management (DEM) is proposing to develop a new Central Maui Wastewater Reclamation Facility (WWRF) and onsite Soil Aquifer Treatment (SAT) system on approximately 14.9 acres of former agricultural lands between Honoapiʻilani Highway and Kūihelani Highway in Waikapū, as well as related offsite infrastructure improvements. Offsite improvements consist of a wastewater pump station (WWPS) near the existing master-planned Kehalani community ("Kehalani WWPS"), a sewage pipeline from the Kehalani WWPS to the WWRF ("Kehalani Sewage Pipeline") in Wailuku, portions of sewage pipeline and R-1 recycled water pipeline that connect the WWRF and the future Waikapū Country Town development ("Waikapū Country Town Sewage Pipeline" and "Waikapū Country Town R-1 Recycled Water Pipeline"), and a WWRF access road. The total project area (onsite and offsite improvements) is approximately 21.5 acres.

The proposed WWRF will service existing and planned developments throughout the Waikapū/Wailuku area, as well as State of Hawaiʻi projects in Pūlehunui. Implementation of this new WWRF will reduce wastewater flows currently being handled and treated by the Wailuku-Kahului WWRF, the main wastewater treatment facility servicing the Central Maui region.

Most of the project components are located within undeveloped lands and rights-of-way (ROW) owned by the County of Maui, except for the Kehalani WWPS proposed to be located on the periphery of an existing stormwater basin parcel owned by the County of Maui and portions of pipeline alignments which are located on lands currently owned by private landowners.

COMPATIBILITY WITH LAND USE PLANS AND POLICIES

The WWRF and SAT project site is approximately 14.9 acres and is located on lands designated "Agricultural" by the State Land Use Commission, designated for "Agriculture" use in the Wailuku-Kahului Community Plan, and zoned "Agricultural" district by the County of Maui. According to the Maui Island Plan (MIP), the 14.9-acre WWRF and SAT site is located within the Urban Growth Boundary (UGB), and is designated by the MIP Planned Growth Areas Map as "Park" and labeled "Regional Park and County Facilities". The MIP Planned Protected Areas Map also designates the WWRF and SAT site as "Park Protected Area" with the label "Regional Park and County Facilities". Development of the WWRF and SAT will require County-processed State Land Use Commission District Boundary Amendment (DBA), Maui Island Plan (MIP) Amendment, Community Plan Amendment (CPA), and Change of Zoning (COZ) approvals. According to Section 15-15-77, Hawaiʻi Administrative Rules (HAR), a DBA for projects less than 15 acres will be processed by each County's land use decision-making authority. Inasmuch as the project site for the WWRF and SAT is less than 15 acres and located within the County of Maui, a DBA for the project will be required from the Maui County Council. In addition, MIP Amendment, CPA (as may be applicable), and COZ applications will be processed concurrently with the DBA and will

be reviewed by the County Council. It is noted that a Community Plan update request will be submitted as part of the Central Maui Community Plan update process, and a separate CPA may not be necessary. The DBA/MIP Amendment/CPA/COZ applications will be initiated by the Planning Director. Once completed, the Final EIS will act as the primary technical supporting document for the land use entitlement applications for the project.

CHAPTER 343, HAWAIʻI REVISED STATUTES COMPLIANCE

The proposed development involving use of County lands and County/State funds, a MIP Amendment, and a potential CPA are triggers for compliance with environmental review requirements pursuant to Chapter 343, Hawaiʻi Revised Statutes (HRS) and Chapter 200.1, Hawaiʻi Administrative Rules (HAR). Due to the scale and potential impacts of the proposed Central Maui WWRF Project, DEM has determined that an Environmental Impact Statement (EIS) should be prepared. The Accepting Authority will be DEM. In addition, the use of federal funds may be pursued for the proposed project. In such event that said funds are secured and utilized by the County of Maui, the DEM will work with the relevant federal agency to comply with the applicable provisions of the National Environmental Policy Act (NEPA) and any related consultation requirements.

SIGNIFICANT BENEFICIAL AND ADVERSE IMPACTS AND PROPOSED MITIGATION MEASURES

A. PHYSICAL SETTING

1. Topography and Soil Characteristics

Underlying the project area is the Pulehu-Ewa-Jaucus soil association, as classified by the U.S. Department of Agriculture (USDA). The Pulehu-Ewa-Jaucus soil association is described as deep and nearly level to moderately sloping.

A Hydrogeological Study prepared for the project by Geosyntec Consultants, Inc. (Geosyntec) developed a subsurface Conceptual Site Model (CSM), which is a framework for the vadose zone (i.e., unsaturated zone) and groundwater flow model to support SAT basin infiltration simulations. The vadose zone, an unsaturated area between the land surface and the saturated zone, consists of multiple layers, including older dune deposits (Qdo) (also known as Jaucas sand (JaC)), Older alluvium (QTao), and Kula Volcanics (Qkul). The Hydrogeological Study concluded that subsurface materials exhibit moderate to rapid infiltration properties suitable for future infiltration activities via the SAT basins.

During construction, temporary Best Management Practices (BMPs), such as temporary sedimentation basins, will be utilized to mitigate erosion and the release of sediment and other pollutants to existing storm drains, waterways, and adjacent properties. Permanent drainage improvements will also be implemented to reduce the post-development peak runoff volume and to improve stormwater quality to

mitigate potential adverse impacts to downstream properties and the environment. Grading design work for the project will respect existing topography, to the extent practicable, in order to minimize extensive cut and fill activity. Although landform transformations in terms of cut and fill will be required for project implementation, significant areas of the affected parcels will be left ungraded. All grading work will comply with applicable requirements of Chapter 20.08, Soil Erosion and Sedimentation of the Maui County Code (MCC).

2. <u>Groundwater and Nearshore Water Resources</u>

According to the Hydrogeological Study, the Central Maui WWRF and SAT site is located near the western boundary of the Kahului aquifer system of the Central Maui aquifer sector. Groundwater is anticipated to be encountered at an elevation of ~2.5 to 4 ft. above mean sea level (amsl). The groundwater is expected to be encountered within the underlying volcanic bedrock aquifer (Kula volcanics).

The Hydrogeological Study noted that due to past agricultural practices (fertilizer use for sugar cane production) and use of onsite disposal systems (i.e., cesspools and/or septic systems) in the site vicinity and overlying the modeled flow paths, baseline groundwater quality has already been impacted. Nitrate levels in groundwater are reported to be approximately 2.5 to 3.3 milligrams per liter (mg/L).

The Hydrogeological Study utilized vadose zone infiltration modeling and groundwater modeling to assess the effluent infiltration capacity of the proposed SAT basins as well as their potential environmental impacts. The Hydrogeological Study concluded that the nitrate concentration projections for groundwater at the shoreline at Māʻalaea Bay and the vicinity of the inland Keālia Pond National Wildlife refuge are sensitive to denitrification rates in the vadose zone and groundwater. The study noted that a program to enhance denitrification rates in the SAT basins and vadose zone, such as the use of biomass in the base of the SAT basins, would be useful to reduce nitrate discharge to groundwater and may ultimately allow for groundwater discharge to navigable waters at levels below the State of Hawaiʻi discharge limits.

Due to the amount of grading anticipated during construction, a National Pollutant Discharge Elimination System (NPDES) stormwater permit will be obtained for the construction phase to ensure that earthmoving activities will not result in adverse impacts to downstream properties and the Pacific Ocean.

3. <u>Streams and Wetlands</u>

The Waikapū Stream and Kaiapaokaʻīlio Stream intersect with the proposed Kehalani Sewage Pipeline for this project. The proposed project does not involve any work within wetlands. The proposed Kehalani Sewage Pipeline (along with

other utility lines) will be installed underground of the existing Waiʻale Road, as well as the future Waiʻale Road Extension proposed by the County of Maui, Department of Public Works (DPW). Where the Kaiapaokaʻīlio Stream intersects with the existing Waiʻale Road, there is an existing box culvert and headwalls, and the stream flows underground through the box culvert. The proposed Kehalani Sewage Pipeline is anticipated to be installed underneath the existing culvert, and therefore, this drainage feature is not anticipated to be impacted by the proposed action. The Waiʻale Road Extension project includes construction of a bridge for crossing over Waikapū Stream, and the utility lines will be installed on the bridge and will cross over Waikapū Stream. As such, the installation of the Kehalani Sewage Pipeline is not anticipated to involve any work within Waikapū Stream.

The Department of the Army (DA), U.S. Army Corps of Engineers (USACE) has been and will continue to be consulted for the project. A NPDES permit will be obtained for the construction phase to ensure that earthmoving activities related to the project will not result in adverse impacts to downstream properties, streams, and wetlands. Measures will be taken to reduce runoff and mitigate potential adverse impact on downstream waters or adjacent properties. To address potential adverse impacts to downstream properties, BMPs will be implemented during both the construction and operational phases of the project. During construction, temporary BMPs, such as temporary sedimentation basins, will be utilized to mitigate erosion and the release of sediment and other pollutants to existing storm drains, waterways, and adjacent properties. Potential permanent mitigation measures will include reduction of impervious surfaces, onsite retention ponds, infiltration basins, and vegetated swales.

From an ongoing operational standpoint, the County of Maui, DEM will provide appropriate training and guidance to staff operating the WWRF to prevent toxic and hazardous substances from flowing to downstream properties and wetlands resources.

4. Agriculture

The proposed Central Maui WWRF and SAT will be located on previously cultivated agricultural lands that are now vacant. An Agricultural Impact Assessment (AIA) titled *Central Maui Wastewater Reclamation Facility: Impacts on Agriculture* was prepared by Plasch Econ Pacific LLC. The purpose of the AIA was to address the potential impacts of the proposed project to existing agricultural enterprises on Maui and focused on the 14.9-acre WWRF and SAT site and the approximately 4-acre access and utility easement which will connect the future Waiʻale Road Extension and the WWRF and SAT site. The AIA indicated that the 14.9-acre WWRF and SAT site has poor soil for farming. However, about four (4) acres of the access and utility easement have favorable conditions for farming,

including good soils, moderate slopes, high solar radiation, the availability of irrigation water, and good access to markets. If not used by the County for the project or some other non-agricultural purpose (such as a larger regional park), the land could be used for growing crops as part of a larger farm on abutting private property. A standalone farm on the 4-acre easement could be challenging to cultivate due to the long narrow shape of the property (about 1,800 ft. by 100 ft.). The AIA states that the loss of about four (4) acres of good farmland is far too small to affect the growth of crop farming on Maui or statewide. The contraction and closure of plantations resulted in a supply of farmland far exceeding demand. Therefore, mitigation measures for the loss of agricultural land are not recommended by the AIA.

Further, the AIA assessed the project's potential impacts on the nearby agricultural operations. The AIA noted that development and operation of the project will not interfere with nor limit farming on abutting agricultural lands. Rather, the project will provide potential benefits to the nearby agricultural operations by lowering irrigation water costs to nearby farmers and will increase the supply of compost, however, the project could increase the risk of equipment and crop theft.

5. Flood, Tsunami and Sea Level Rise Hazards

The Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Map (FIRM) indicates that the majority of the project area is located within Flood Zone X (unshaded), an area of minimal flooding located outside the 0.2 percent annual chance floodplain. A portion of the proposed Kehalani Sewage Pipeline will cross Waikapū Stream, which is designated as Flood Zone AE. Zone AE includes areas subject to inundation by the 1-percent-annual-chance flood event. However, this portion of the pipeline will be installed on an elevated bridge. The Tsunami Evacuation Zone Map shows the project area as being within the Safe Zone in its entirety. Additionally, the proposed project is located inland, away from projected sea level rise impacts.

6. Flora and Fauna Resources

A site-specific Biological Resources Survey was carried out for the project. The wildlife within the project area is composed mostly of non-native species that are of no special conservation concern. Three (3) indigenous plants, ʻilima (*Sida fallax*), ʻuhaloa (*Waltheria indica*), and koali kuahulu (*Merremia aegyptia*) were found growing in the area, however, they are common occurrence throughout Hawaiʻi. No federally listed Endangered or Threatened plant or animal species were found. The Biological Resources Survey concluded that the proposed project is not expected to have significant negative impacts on the botanical resources within the region. Nevertheless, the U.S. Fish and Wildlife Service (USFWS) and State Department of Land and Natural Resources (DLNR), Division of Forestry and

Wildlife (DOFAW) recommended mitigation measures will be implemented, as applicable.

7. Greenhouse Gas Emissions

A Greenhouse Gas Emissions Impact Study was prepared by Terry A. Hayes Associates, Inc. (TAHA) for the project. The Study noted that the project would generate Greenhouse Gas (GHG) emissions during both construction and operational phases of the project through construction activities, energy use, new vehicle trips, aerobic liquid treatment processes, and aerobic sludge digestion. However, GHG emissions generated by the proposed project would be negligible when compared to existing emissions in the region. The proposed project would not interfere with the development of clean energy supplies. Therefore, there is no potential for a significant contribution to a cumulative GHG impact. It is noted that rooftop solar Photovoltaics (PV) panels are proposed to be installed on the Central Maui WWRF building to generate renewable energy to help supplement the electricity required for the wastewater treatment process. While detailed design of the solar PV and anticipated amount of energy generation will be determined during the design phase of the project, solar PV is anticipated to reduce the GHG emissions from the operation of the WWRF until the transition of energy sources to 100 percent renewable sources is completed in Hawai‘i.

8. Noise

An Acoustic Study was prepared by Y. Ebisu & Associates for the project. According to the study, existing background noise in the vicinity of the project area is principally attributed to vehicular traffic traversing through the area, and wind circulation. Noise levels were measured using the federal standard of Day-Night Average Sound Level (DNL), which reflects a person’s cumulative exposure to sound over a 24-hour period. DNL is based on sound levels measured in relative intensity of sound, or decibels with A-weighting (dBA), which is used to measure noise levels that have been adjusted to account for how humans hear. As a general rule, noise levels of 55 DNL or less occur in rural areas, or in areas which are removed from high volume roadways. In urbanized areas which are shielded from high volume streets, DNL levels generally range from 55 to 65 DNL, and are usually controlled by motor vehicle traffic noise. Residences which front major roadways are generally exposed to levels of 65 DNL, and as high as 75 DNL when the roadway is a high-speed freeway. In the project area, including the undeveloped lands for the WWRF and SAT site and underground pipelines, as well as the Kehalani Sewage Pipeline alignment along the existing Wai‘ale Road, traffic noise levels (as well as background noise levels) vary over a wide range between 50 to 65 DNL.

Potential construction noise levels at the closest residences near the proposed Kehalani WWPS could range between 78 to 92 dBA during the site preparation phase. During the building erection phase at the WWPS, average construction noise levels should be lower and between 65 to 79 dBA. Mitigation of construction noise impacts is administered by the Department of Health (DOH) through the issuance of Construction Noise Permits and through a curfew system, which limits noisy construction activities to normal work hours from Mondays through Saturdays, excluding holidays. Noise attenuation methods, such as walls, enclosures, or silencers, may be used to mitigate temporary, construction-related noise levels. In addition, maximum buffer distances should be used between construction activities and noise-sensitive uses.

In the long term, the proposed project will not exceed the State DOH noise limits. Enclosure of the noisy fixed equipment within concrete structures, with acoustically treated ventilation openings, are conventional means of mitigating noise emissions from noisy fixed equipment. Sound attenuation devices (acoustic louvers, duct silencers, exhaust and inlet air silencers, interior acoustical absorptive panels, etc.) should be included in the design of these facilities with a design goal of not exceeding the State DOH noise limits applicable at each facility.

9. <u>Scenic and Open Space Resources</u>

The project will provide open space relief and landscaping to break up the mass of buildings within the area. All structures will comply with the MCC's 40-foot height limit for the "Public/Quasi-public" zoning district. A View Analysis, providing "before" and "after" perspectives of the proposed WWRF and SAT site, as well as the Kehalani WWPS from public vantage points, has been prepared for the project. The analysis considered viewer sensitivity and visual changes and concluded that the potential view impacts from the selected vantage points would be low to moderate. The View Analysis recommended mitigation measures such as earth-tone finishes, low-profile building designs, and adherence to lighting regulations.

Additional potential visual mitigation strategies include creating a land buffer around the facility, adding walls or berms around the site, adding architectural embellishments to the facility, and landscaping. As recommended by the project's Central Maui WWRF Facility Plan, the landscaping will incorporate plants that are native to the environment in which the project site is located and will buffer the structures, particularly for motorists passing by on Kūihelani Highway.

10. <u>Archaeological and Historic Resources</u>

Through consultation with the Hawai'i State Historic Preservation Division (SHPD), an Archaeological Inventory Survey (AIS) was prepared for the project. A total of five (5) historic properties have been identified within the portions of the existing

Wai‘ale Road and future Wai‘ale Road Extension that overlap with the Central Maui WWRF project area. State Inventory of Historic Place (SIHP) # 50-50-04-05965 and -05966 are previously disturbed human skeletal remains that were discovered during archaeological monitoring within Wai‘ale Road for the Kehalani Mauka Subdivision Project. SIHP # 50-50-04-06668 is a post-Contact terrace that was previously documented and reidentified during the AIS for the Wai‘ale Road Extension. SIHP # 50-50-04-09167 (water control complex) and SIHP # 50-50-04-09168, a historic refuse disposal deposit (subsurface cultural deposits), also were identified during the AIS for the Wai‘ale Road Extension.

The significance assessment indicated that two (2) historic properties (SIHP #50-50-04-06668 and #50-50-04-09168) presently located within the project area are identified as significant. Due to the significant historic properties identified and potential for the project to impact these properties, the AIS recommends a project effect determination of "*effect, with proposed mitigation commitments*". Mitigation is proposed in the form of archaeological monitoring. The project will comply with all agreed upon recommendations from SHPD.

11. Cultural Resources

A Cultural Impact Assessment (CIA) was prepared by Cultural Surveys Hawai‘i (CSH) for the project to identify cultural practices, potential impacts and measures to mitigate potential impacts. A review of past CIAs covering the Waikapū and Wailuku ahupua‘a was conducted as background research for this assessment. Nine (9) previous cultural studies in the vicinity identified practices such as freshwater and herbal medicine gathering, agriculture, and burial traditions. Waikapū Stream has been identified as a culturally significant resource and is part of Nā Wai ‘Ehā, or Maui's "Four Great Waters", which is comprised of Waihe‘e River, Waiehu Stream, Wailuku River (formerly ‘Īao Stream), and Waikapū Stream. These streams, originating from the West Maui Mountains (Mauna Kahālāwai), were crucial in traditional times as a political and population hub. The Waikapū stream and soils supported highly productive agricultural practices, primarily the cultivation of kalo (taro). The Waikapū stream was known for resources like ‘o‘opu (goby), ‘opae (shrimp), hīhīwai (snail), and guppies. However, ‘o‘opu, which were previously more abundant, were noted to be small and not suitable for eating, and the stream used to have deeper holding ponds for shrimp survival. Additionally, cultural informants for previously conducted CIAs have described gathering of native plants used as lā‘au lapa‘au (Hawaiian medicine) along the stream.

In addition to archival research, outreach efforts by CSH involved contact to 45 individuals and groups including Native Hawaiian Organizations (NHOs), agencies, community members and descendants of the area, in order to identify individuals with cultural expertise and/or knowledge of the project area. Based on

information gathered from the cultural and historical background and community consultation for this project, Waikapū Stream and human remains were identified as significant cultural resources with the potential to be impacted by the project. In order to mitigate these concerns, groundwater flow modeling was conducted as part of the Hydrogeological Study to assess potential impacts to Waikapū stream. Modeling indicates that there will be no migration of infiltration flow from the proposed SAT system to the stream. In addition, an AIS has been conducted to identify potential archaeological findings, and archaeological monitoring is anticipated to be undertaken for the project.

B. SOCIO ECONOMIC ENVIRONMENT

1. Population, Demography, and Social Impacts

The proposed project is not a direct population generator; rather, the proposed Central Maui WWRF is needed to accommodate existing and projected population growth in the Central Maui region. Approximately 48 percent of the total Central Maui WWRF flow capacity will be allocated to service planned future developments in the Central Maui region, including housing/affordable housing projects and State and County facilities and approximately 44 percent of the Central Maui WWRF flows will be diverted from the existing Wailuku-Kahului WWRF. Approximately seven (7) percent of the total Central Maui WWRF capacity will be available for future potential developments in the region. In addition, the proposed project is expected to create short-term construction jobs and long-term operational jobs.

2. Economy and Labor Force

In the short term, the proposed project will generate positive economic impacts associated with construction-related spending and employment. From a long-term perspective, the project will create operational jobs and associated payroll during the operation of the WWRF. To quantify the estimated economic and fiscal impacts from the project, an Economic and Fiscal Impact Analysis was conducted.

Total construction expenditure is estimated at $130.6 million. According to the Economic and Fiscal Impact analysis, construction is anticipated to generate approximately 120 full-time equivalent (FTE) jobs on average per year with an annual payroll of approximately $12.7 million. In addition to direct construction spending and employment, the project will generate indirect spending and employment related to supplying goods and services to construction companies and to the families of construction workers. Indirect sales are expected to average $77.2 million per year and 180 FTE indirect jobs will be generated per year. When considering direct and indirect impacts together, earnings resulting from the $130-million construction project would total approximately $47.9 million over two (2) years.

During the construction period, the State will collect an estimated $5.5 million per year or $11.0 million cumulatively in tax income, including approximately $3.2 million per year in general excise tax (GET) revenues, $627,300 per year in corporate income tax revenues, and $1.6 million per year, in personal income tax revenues. Regarding fiscal impacts to the County of Maui, the development cost will be funded by a combination of funding sources, the breakdown of which is undetermined at this time, but is anticipated to include municipal funds backed by the County's Sewer Fund.

At full build-out, the operation of the proposed Central Maui WWRF is anticipated to generate 16 FTE jobs per year, and the total payroll is estimated to be $1.0 million per year. Assuming that 55 percent of the payroll will be spent in the local economy, the total consumption associated with the operation of the Central Maui WWRF is estimated to be $550,000.00.

During the operation period, the State would receive revenues from personal income tax, estimated to be approximately $67,600 annually, from the new jobs created by the operation of the Central Maui WWRF, and GET of approximately $22,000 per year generated by the consumption at local economy by the new workers and their families. For the County of Maui, the operating cost of the Central Maui WWRF and the Kehalani WWPS is estimated to be $7.1 million per year. The operating cost will be funded by the Sewer Fund where the service charges by the ratepayers will be deposited to.

A Rate Impact Analysis was prepared by Brown and Caldwell to evaluate the long-term impact of the proposed Central Maui WWRF project on sewer rates for the County's sewer service users. The impact on sewer rates is anticipated to be most significant during the first 10 years of the project because anticipated future developments that would connect to the Central Maui WWRF have not yet been fully constructed. Depending on the funding scenario, the potential increase in the sewer rate is anticipated to range between 3.9 percent to 15 percent when the impact is the highest.

C. PUBLIC SERVICES

1. Recreational Facilities

The proposed Central Maui WWRF and SAT site is located within an area labeled by the Maui Island Plan's (MIP) Growth Areas Map and Planned Protected Areas Map for "Regional Park and County Facilities". According to the MIP, a future regional park would be provided to the South of Waiʻale to provide a clear separation between the new community and Māʻalaea, and to allow for the placement of active and passive recreational opportunities, County baseyards, and County facilities. The DEM is aware that the County of Maui, Department of Parks

and Recreation (DPR) is in the early stages of planning a future regional park in the vicinity of the proposed WWRF and SAT site. DPR has expressed concerns of potential odors and view impacts from the proposed Central Maui WWRF that may impact a future regional park. The DEM will incorporate odor control and visual mitigation strategies at the proposed WWRF to minimize potential impacts to a future regional park. Proposed odor control measures include buffer land or walls/berms around the WWRF, enclosures on headworks, and a biotrickling filter (or similar process) at odor sources. In addition, the proposed visual mitigation measures include buffer land or walls/berms around the WWRF, landscaping, as well as architectural treatments.

2. Solid Waste

During the construction phase of the project, waste and recyclable materials will be transported to appropriate processing facilities. A construction waste management plan will be developed by DEM in coordination with the contractor to ensure waste is properly disposed of and to identify construction efficiency opportunities.

When the project is implemented and operational, the proposed WWRF will produce residual solids that will require management. The wastewater treatment process involves preliminary treatment and liquid treatment. The preliminary treatment includes screening and grit removal to remove coarse debris. Landfill disposal of grit and screenings from the preliminary treatment is a viable option for solid waste management at the Central Maui WWRF. Landfill disposal is the current method of grit and screening disposal across the Maui Island's WWRFs.

The liquid treatment process removes "wastewater solids" and "sewage sludge", which are concentrated waste materials present in sewage. The County has long relied on composting or landfilling for solids management for the Maui Island WWRFs.

The private composting operation, operated by Maui EKO Systems, is currently located at the Central Maui Landfill. Composting is considered to be a viable biosolids management option for the proposed Central Maui WWRF. Landfill disposal of dewatered sewage sludge is also an option when composting is not available. At full capacity, the Central Maui WWRF is anticipated to produce an average of approximately 40 cubic feet per day (ft^3/day) of screenings, 20 ft^3/day of grit, 12 pounds per day (ppd) of waste activated sludge (dry weight), and 600 ppd of tertiary solids (dry weight).

D. INFRASTRUCTURE

1. Roadways

In order to determine existing traffic conditions, traffic counts were conducted and evaluated by Level of Service (LOS). LOS is a qualitative measure used to describe the conditions of traffic flow at intersections, with values ranging from free-flow conditions at LOS A, to congested conditions at LOS F. Traffic was observed to proceed smoothly through all study intersections, with no significant or persistent congestion. A Traffic Impact Assessment Report (TIAR) prepared by Austin, Tsutsumi and Associates, Inc. for the project notes that all movements at all study intersections operate at LOS C or better across both peak hours for existing traffic conditions.

During construction, the traffic condition is anticipated to be impacted by construction deliveries and workers commuting to the project site. With construction traffic, it is anticipated that all movements will operate adequately at LOS D or better across both peak hours. The TIAR recommended that at the Waiʻale Road Extension/the project's access road intersection, adequate sight distance be maintained. No additional improvements are recommended as a result of construction traffic. In order to mitigate increased traffic during the construction of the proposed project, a Construction Traffic Management Plan has been prepared for implementation during the construction phase.

The Year 2029 was used to reflect the project's anticipated completion (late 2029). During normal operations of the proposed WWRF and WWPS, all movements are anticipated to continue to operate acceptably at LOS D or better across both AM and PM peak hours. The TIAR suggests adequate sight distance should be maintained at all times at the Waiʻale Road Extension/the project's access road intersection. No additional improvements are recommended as a result of project traffic when the facility is fully operational.

2. Water System

The project area is located within the County of Maui Department of Water Supply's (DWS) Central Maui water system. The proposed Kehalani WWPS site contains two (2) existing 2-inch water laterals supplied by the 12-inch water main under Olomea Street. The Central Maui WWRF site currently does not have water infrastructure available. The water source would come from the 3.0 million gallon (mg) capacity DWS ʻĪao Tank. The ʻĪao Aquifer System, in which the project is located, is a Ground and Surface Water Management Area, designated by the State of Hawaiʻi, Commission on Water Resource Management (CWRM). According to the CWRM's 2019 Water Resource Protection Plan, the sustainable

yield for the ʻĪao Aquifer System is 20 million gallons per day (mgd) with an average pumpage of 15 mgd.

Preliminary water demand calculations indicate that projected water demands at the proposed Kehalani WWPS are estimated at 4,000 gallons per day (gpd) on average, with peak day and peak hour demands reaching 6,000 gpd and 8.3 gallons per minute (gpm), respectively. For the WWRF, potable water will support functions such as restrooms, showers, drinking fountains, laboratory use, and safety stations, while R-1 recycled water generated at the facility will meet most operational needs like irrigation and process water. Daily potable water demand at the WWRF is estimated at 4,500 gpd, with peak demands reaching 6,800 gpd and 9.4 gpm. Additionally, fire protection requirements call for a separate supply capable of delivering 2,500 gpm for two (2) hours, totaling 300,000 gallons. All potable water infrastructure will adhere to the DWS's Water System Standards and require approval from the DWS prior to construction.

The treated effluent from the Central Maui WWRF will comply with the State of Hawai'i, DOH requirements for R-1 recycled water which is considered safe and suitable for any form of irrigation for landscaping and food crops. The primary method of disposal for the treated effluent from the WWRF will be to distribute R-1 Recycled water to surrounding properties in the Central Maui region for irrigation purposes, including parks, school yards, and streetscapes within the future Waikapū Country Town development, as well as nearby agricultural fields and County lands, as may be appropriate. Approximately 1,259 acres would potentially be irrigated from R-1 Recycled Water from the Central Maui WWRF.

3. Wastewater System

The Central Maui WWRF project is being proposed to alleviate pressure on the Wailuku-Kahului WWRF, which is nearing its design capacity of 7.9 mgd. The new WWRF can treat a portion of existing Wailuku and Waikapū wastewater flows, reducing the effluent disposal needs at the Wailuku-Kahului WWRF that is currently served by injection wells while also managing the wastewater generated by anticipated development projects within the growth area.

The Central Maui WWRF Facility Plan provides an overview of the proposed Central Maui WWRF, including the purposes and needs, service areas, recommended wastewater treatment and effluent management processes, and preliminary site plan. The development of the Central Maui WWRF project will provide treatment to approximately four (4) mgd of wastewater flows from the Central Maui region during average dry-weather conditions. The Central Maui WWRF will accept and treat approximately 1.78 mgd of existing wastewater currently treated at the Wailuku-Kahului WWRF and will provide approximately 1.9 mgd of wastewater treatment for future planned development. The process for

treating the effluent consists of preliminary treatment, effluent liquid treatment and effluent disposal, which is detailed in Chapter II, Section D.3 of this document.

4. Drainage System

The Central Maui WWRF Preliminary Drainage Report (PDR) was prepared for the project, which indicates that the overall post-development onsite drainage pattern is anticipated to be consistent with the existing condition. There will be no runoff from the areas containing the SAT basins as these basins are self-contained. Drainage improvements will be implemented to reduce runoff and mitigate any potential adverse impact on downstream or adjacent properties. Potential mitigation measures include reduction of impervious surfaces, onsite retention ponds, infiltration basins, or vegetated swales.

The Kehalani WWPS Siting and Feasibility Report prepared for the project notes that the Kehalani Makai Detention Basin has excess runoff storage capacity beyond what is required. A small portion of the basin will be filled to create an approximately 2.0 acre-foot embankment to accommodate the proposed WWPS. The report concluded that the basin would have sufficient capacity to accommodate the additional post-development runoff volume.

ALTERNATIVES CONSIDERED

The proposed Central Maui WWRF project is needed to alleviate pressure on the Wailuku-Kahului WWRF by diverting wastewater flows and to provide adequate wastewater treatment capacity to accommodate increased wastewater flows for both existing and planned developments in the region. The following alternatives were considered as part of selecting the preferred alternative:

No Action Alternative – With the no action alternative, a new WWRF for Central Maui would not be developed and the County of Maui, DEM would continue to rely on the existing Wailuku-Kahului WWRF to provide sewer service to the communities in the central valley. The existing facility has limited capacity to support planned growth. The no action alternative is not considered a viable scenario in the context of the limitations of the existing Wailuku-Kahului WWRF.

Location Alternatives – The preferred alternative location for the Central Maui WWRF and SAT is on a portion of land owned by the County of Maui and identified as Tax Map Key (TMK) (2)3-8-005:023. The predominant consideration for the selection process was the underlying soil type, Jaucas sand, which has favorable characteristics to support the SAT system. Other selection criteria included impacts to drinking water wells, parcel ownership (County owned parcels were preferred), proximity to planned developments in the Central Maui region, distance to roads and proposed developments for visual, noise, and odor buffers, and prevailing wind direction. The Preferred Alternative is considered the most appropriate location as it meets the selection criteria.

Based on preliminary engineering assessment, the preferred alternative for the Kehalani WWPS is the existing stormwater basin parcel for the master-planned Kehalani community owned by the County of Maui and identified as TMK (2)3-5-020:036. The DEM assessed various alternatives for the Kehalani WWPS location, which included a portion of Maui Community Correctional Center parking lot along Waiʻale Road (TMK (2)3-8-046:005 and 006) and a portion of the County of Maui baseyard at TMK (2) 3-4-003:001 and (2)3-4-003:022. These alternative locations were not selected due to their existing uses and the need for those existing uses to be relocated, as well as flood zone considerations.

Secondary Liquid Treatment Alternatives – There are two (2) alternative methods considered for secondary liquid treatment for the proposed WWRF. The first alternative liquid treatment method involves Biological Nutrient Removal (BNR) via Modified Ludack-Ettinger (MLE) Activated Sludge. The second alternative treatment method also uses BNR, however, the BNR is conducted via a Membrane Bioreactor (MBR). The two (2) alternatives are nearly identical. However, BNR via MBR leaves a smaller footprint than BNR via MLE. The Central Maui WWRF Facility Plan recommends further evaluation of these methods for secondary liquid treatment, and the preferred alternative will be determined during the design phase of the project.

Effluent Management Alternatives – Three (3) alternatives were considered for effluent management with all alternatives involving water recycling/re-use as the primary disposal method. The preferred alternative involves the use of an onsite SAT for back-up effluent disposal. Due to the soil in the project area, the SAT was determined to be the most suitable land treatment system and offers greater environmental protection when compared to other alternatives. Another alternative would be to use injection wells for effluent management, which is the method currently used at four (4) of the County operated WWRFs including the Wailuku-Kahului WWRF. However, State law prohibits the State DOH from issuing permits for construction of new injection wells if other options are feasible. A final alternative for effluent management involves effluent disposal via ocean outfall, which poses both ecological and human health risks. As such, the SAT has been selected as the most environmentally safe back-up disposal method for effluent management for the proposed WWRF.

UNRESOLVED ISSUES

The following unresolved issues have been identified for the project:

Project Design and Landscaping Plan – Detailed WWRF and WWPS plans will be designed, and a landscaping plan will be prepared.

Secondary Liquid Treatment Method – As noted in the alternatives section above, secondary liquid treatment methods will be further evaluated, and the preferred alternative will be determined during the design phase of the project.

Funding Sources – Funding sources have not been determined at this time by DEM.

Land Use Entitlements – A State Land Use Commission DBA, MIP Amendment, CPA, and COZ will be required before the project can proceed.

Chapter 6E, HRS Compliance - The SHPD is being consulted pursuant to HRS, Chapter 6E, and appropriate mitigation measures requested by the SHPD will be undertaken.

A LIST OF PERMITS AND APPROVALS

The following is a preliminary list of the permits and approvals that are anticipated to be required for implementation of the proposed project:

Federal:

1. National Environmental Policy Act (NEPA) compliance, as applicable, including related federal consultation requirements **(To be coordinated with applicable federal agency if determined to be required)**

State of Hawai'i:

1. Chapter 343, HRS, Environmental Impact Statement **(Final EIS to be prepared and published with the Environmental Review Program)**
2. Chapter 6E, HRS, Historic Preservation Compliance **(SHPD consultation has been initiated and in progress)**
3. National Pollutant Discharge Elimination System Permit **(To be submitted to State DOH following the completion of the EIS process)**
4. Noise Permit, as applicable **(To be coordinated with State DOH following the completion of the EIS process)**
5. HAR 11-62, Wastewater Systems, Approval to Construct **(To be submitted to State DOH following the completion of the EIS process)**
6. HAR 11-62, Wastewater Systems, Approval to Operate **(To be submitted to State DOH following the completion of the EIS process)**

County of Maui:

1. District Boundary Amendment/Maui Island Plan Amendment/Community Plan Amendment (as may be required)/Change of Zoning (for WWRF/SAT site which is less than 15 acres in area) **(To be initiated by the County of Maui, Planning Director following the completion of the EIS process)**
2. Building Permits **(To be submitted to the County of Maui, Department of Public Works (DPW) following the completion of the EIS process)**
3. Other Construction Permits (i.e., grading, electrical, plumbing) **(To be submitted to the County of Maui, DPW following the completion of the EIS process)**

RELEVANT EA AND EIS REPORTS CONTRIBUTING TO THE EIS

In addition to the technical studies included in this EIS as appendices, the following Environmental Assessments (EAs) and EISs were consulted during the preparation of this EIS.

- *Waikapū Country Town Final EIS*
  - https://files.hawaii.gov/dbedt/erp/EA_EIS_Library/2017-01-08-MA-FEIS-Waikapu-Country-Town.pdf
- *Waiʻale Road Extension Final EA*
  - Volume I: https://files.hawaii.gov/dbedt/erp/Doc_Library/2025-08-23-MA-FEA-Waiale-Road-Extension-Project-Vol-I-of-II.pdf
  - Volume II: https://files.hawaii.gov/dbedt/erp/Doc_Library/2025-08-23-MA-FEA-Waiale-Road-Extension-Project-Vol-II-of-II.pdf

List of Document Authors

Document Name	Consultant
Acoustic Study	Y. Ebisu & Associates
Agricultural Impact Assessment (AIA)	Plasch Econ Pacific, LLC
Air Quality Study	Terry A. Hayes Associates, Inc.
Archaeological Inventory Survey (AIS)	Cultural Surveys Hawai'i, Inc.
Biological Resources Survey	Robert W. Hobdy
Central Maui Wastewater Reclamation Facility Plan	Brown and Caldwell, Inc.
Construction Traffic Management Plan (CTMP)	Austin, Tsutsumi & Associates, Inc.
Cultural Impact Assessment (CIA)	Cultural Surveys Hawai'i, Inc.
Economic and Fiscal Impact Analysis	Munekiyo Hiraga
Environmental Impact Statement (EIS)	Munekiyo Hiraga
Greenhouse Gas Emissions Study	Terry A. Hayes Associates, Inc.
Hydrogeological Study	Geosyntec Consultants, Inc.
Kehalani Wastewater Pump Station Feasibility Study and Siting Analysis	Warren S. Unemori Engineering, Inc.
Kehalani Wastewater Pump Station Technical Memorandum	Brown and Caldwell, Inc.
Preliminary Drainage Report for Central Maui Wastewater Reclamation Facility	Brown and Caldwell, Inc.
Proposed Central Maui WWRF Potable Water Demand Technical Memorandum	Brown and Caldwell, Inc.
Rate Impact Analysis	Brown and Caldwell, Inc.
Traffic Impact Assessment Report (TIAR)	Austin, Tsutsumi & Associates, Inc.
View Impact Analysis	KC Environmental, Inc.

PROJECT OVERVIEW

1

I. PROJECT OVERVIEW

A. PROJECT LOCATION, LAND OWNERSHIP, AND EXISTING USE

The County of Maui, Department of Environmental Management (DEM) Wastewater Reclamation Division (WWRD) proposes to develop a new Central Maui Wastewater Reclamation Facility (WWRF) and onsite Soil Aquifer Treatment (SAT) system on approximately 14.9 acres of former agricultural lands between Honoapiʻilani Highway and Kūihelani Highway in the vicinity of Waikapū, as well as related offsite infrastructure improvements. Offsite improvements consist of a wastewater pump station (WWPS) near the existing master-planned Kehalani community ("Kehalani WWPS"), a sewage pipeline from the Kehalani WWPS to the WWRF ("Kehalani Sewage Pipeline"), portions of sewage pipeline and R-1 recycled water pipeline that connect the WWRF and the future Waikapū Country Town development ("Waikapū Country Town Sewage Pipeline" and "Waikapū Country Town R-1 Recycled Water Pipeline"), and a WWRF access road. The WWRF access road will be provided from the Waiʻale Road Extension proposed by the County of Maui, Department of Public Works. The total project area (onsite and offsite improvements) is approximately 21.5 acres.

The proposed WWRF will service existing and planned developments throughout the Waikapū/Wailuku area as well as State of Hawaiʻi projects in Pūlehunui. Implementation of this new WWRF will serve to reduce wastewater flows currently being treated by the Wailuku-Kahului WWRF, the primary wastewater treatment facility currently servicing the Central Maui region.

The majority of the proposed project components are located within undeveloped lands and Rights-of-Way (ROW) owned by the County of Maui, except for the Kehalani WWPS proposed to be located on the periphery of an existing stormwater basin parcel owned by the County of Maui and portions of pipeline alignments which will be located on lands currently owned by private landowners. The project components, locations, land ownership, and existing uses are summarized in **Table 1**, below. See **Figure 1** and **Figure 2**.

Table 1. Project Location and Land Ownership

Project Component	Tax Map Key (TMK) and/or Location	Land Ownership	Existing Use
Central Maui WWRF and Onsite SAT System	TMK (2)3-8-005:023 (por.)	County of Maui	Vacant
Kehalani Sewage Pipeline	Existing Waiʻale Road (ROW)	County of Maui	Roadway
	Existing Waiko Road (ROW)	County of Maui	Roadway
	TMK (2)3-5-001:017 (por.)	Kehalani Holdings Company, Inc.	Roadway
	TMK (2)3-5-001:120 (por.)	Kehalani Holdings Company, Inc.	Roadway
	TMK (2)3-5-002:014 (por.)	Waiko Baseyard LLC	Vacant
	TMK (2)3-5-002:888 (Waikapū Stream)	Unknown	Stream
	Future Waiʻale Road extension (by others) (TMK (2)3-6-002:003(por.))	Waiʻale 905 Partners, LLC	Vacant
	Future Waiʻale Road extension (by others) and access and utility corridor (TMK (2)3-6-002:004(por.))	County of Maui	Vacant
	TMK (2)3-5-020:036(por.)	County of Maui	Stormwater Basin
Kehalani WWPS	TMK (2)3-5-020:036 (por.)	County of Maui	Stormwater Basin
Waikapū Country Town Sewage Pipeline and R-1 Recycled Water Pipeline	Future Waiʻale Road extension (by others) (TMK (2)3-6-002:003 (por.))	Waiʻale 905 Partners, LLC	Vacant
	Future Waiʻale Road extension (by others) and access and utility corridor (TMK (2)3-6-002:004(por.))	County of Maui	Vacant
	TMK (2)3-8-005:023(por.)	County of Maui	Vacant

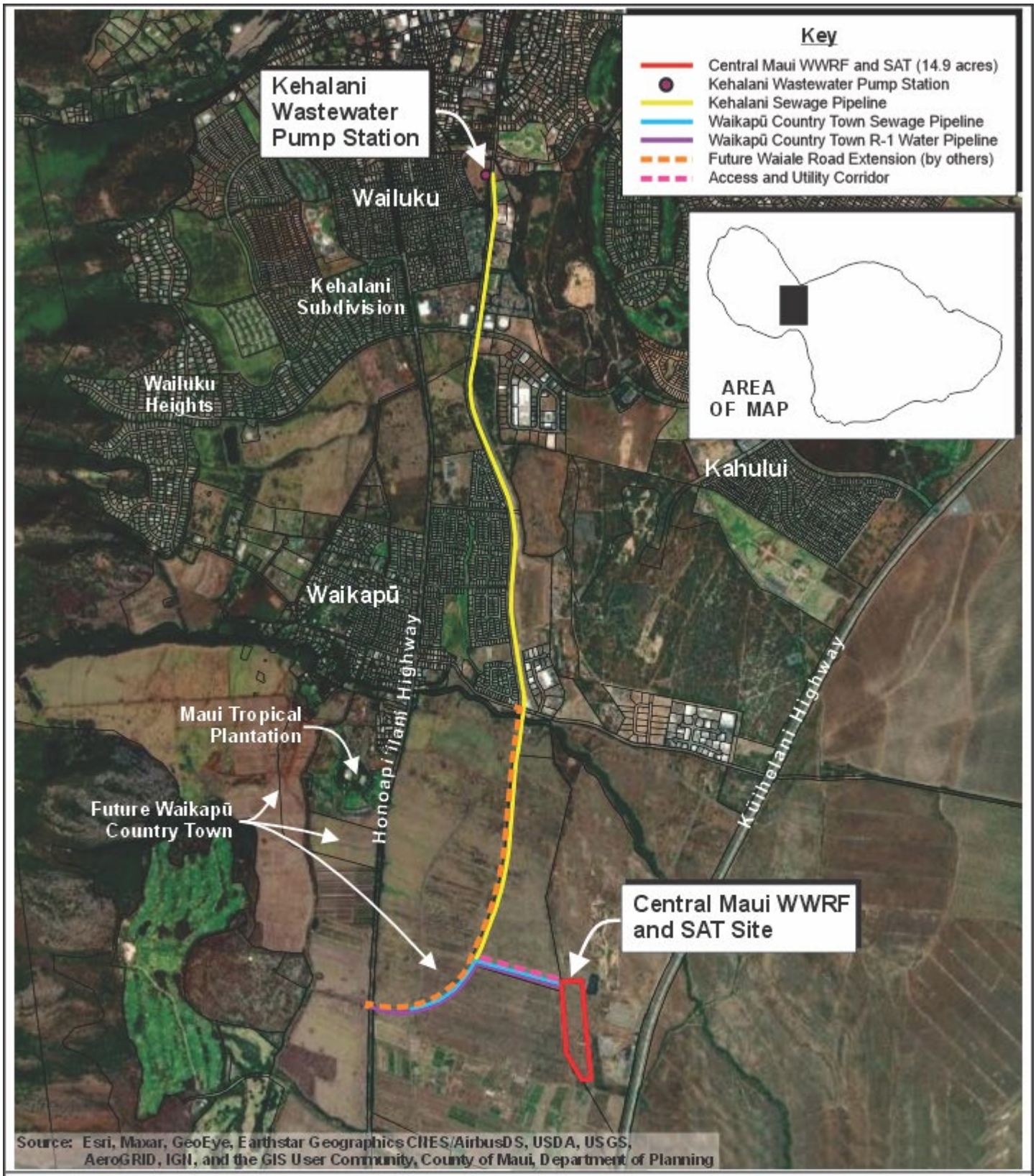


Figure 1 Proposed Central Maui Wastewater Reclamation Facility
Project Location Map

0 1250 Feet
625 2500

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO HIRAGA

COM/DEM Cmaui WW Infrastructure/Applications/Figures/ProjLoca

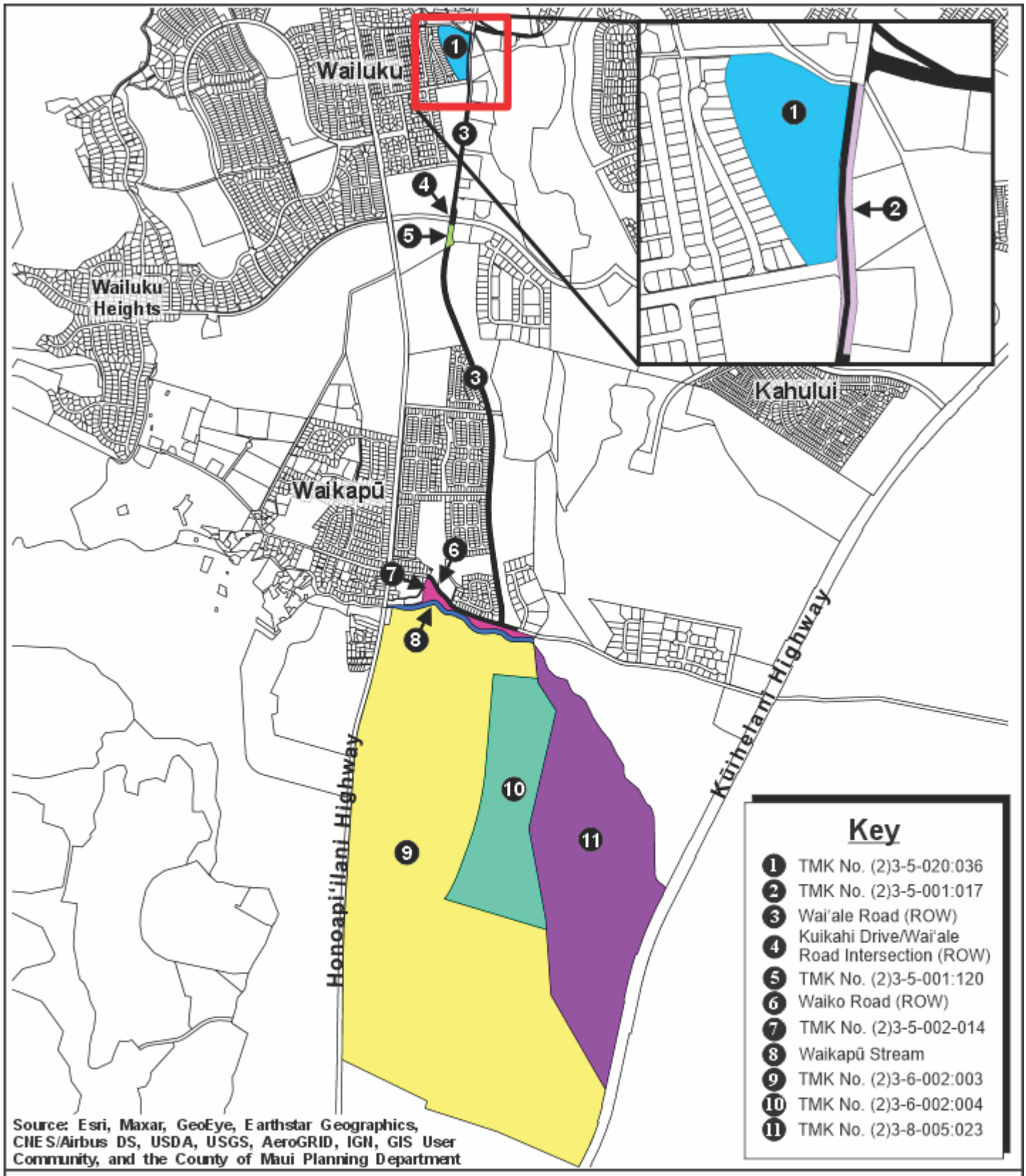


Figure 2 Proposed Central Maui Wastewater Reclamation Facility Affected TMK Parcels Map

0 1150 Feet
575 2300

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO HIRAGA

COM/DEM Cmaui WW Infrastructure/Applications/Figures/TMK Rev

B. PROPOSED ACTION

The proposed project components are described below:

1. Central Maui WWRF and Onsite SAT (14.9 acres)

The Central Maui WWRF Facility Plan has been prepared by Brown and Caldwell to establish design criteria and conceptual design for both treatment and disposal of wastewater flows from the Central Maui region. See **Appendix "A"**. The Central Maui WWRF and onsite SAT will be designed to accommodate four (4) million gallons per day (mgd) of wastewater and will consist of 10 components, which include (See **Figure 3**):

(1) Headworks (screening, grit removal, and septage receiving station)
(2) Activated Sludge
(3) Secondary Clarifiers
(4) R-1 Treatment Facility
(5) Aerobic Digesters
(6) Dewatering and Blower Building
(7) Effluent Pump Station
(8) Operating Building
(9) SAT Basins
(10) Return Activated Sludge (RAS) Pump Station
(11) 100-foot (ft.) Wide Access and Utility Corridor (Easement)

It is noted that odor control and visual mitigation measures will be incorporated at the proposed WWRF and SAT site. Proposed odor control measures will include buffer land or walls/berms around the WWRF, enclosures on headworks, and a biotrickling filter (or similar process) at odor sources. The proposed visual mitigation measures will include buffer land or walls/berms around the WWRF, landscaping, as well as architectural treatments. Details will be further developed during the design phase of the project.

a. Wastewater Treatment

Wastewater will be treated through the following process, which is further detailed in Chapter II, Section D.3. of this Environmental Impact Statement (EIS):

- **Preliminary treatment:** screening and grit removal to remove coarse debris prior to further treatment.

Figure 3

Proposed Central Maui Wastewater Reclamation Facility
Preliminary Site Plan

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO HIRAGA

- **Secondary liquid treatment:** a biological treatment process to remove oxygen and nutrients from wastewater.

- **Filtration and disinfection:** to remove suspended solids and turbidity and to inactivate bacteria and viruses from the effluent.

b. Solid Waste Management

The County of Maui currently disposes of solid waste from the screening and grit removal processes from all existing County WWRF facilities on Maui at the Central Maui Landfill. Residual solid waste from the liquid treatment processes (dewatered sludge) from the County's existing WWRF facilities has been mixed with green waste at the Central Maui Landfill to generate compost which is made available to local farmers, or landfilled. The composting process follows the U.S. Environmental Protection Agency (EPA) time and temperature criteria to produce a Class A biosolids compost product that can be used as a soil amendment on all types of land, including residential properties and food crops. Refer to **Appendix "A"**. Unused compost or remaining dewatered sludge will be disposed of at the Central Maui Landfill. The Facility Plan also recommends the same solid waste and sludge management system for the Central Maui WWRF. The proposed solid waste management is further discussed in Chapter II, Section C.5. of this EIS.

c. Effluent Management

The treated effluent from the Central Maui WWRF will comply with the State of Hawai'i, Department of Health (DOH) requirements for R-1 recycled water. According to the State DOH, R-1 water is suitable for, from a public health standpoint, any form of irrigation for landscaping as well as food crops, including all edible root crops, where the recycled water comes into contact with the edible portion of the crop (DOH, 2002). The primary method of disposing the treated effluent from the WWRF will be to distribute R-1 Recycled water to surrounding properties in the Central Maui region for irrigation purposes, including parks, school yards, and streetscapes within the future Waikapū Country Town development, as well as nearby agricultural fields and County lands, as may be appropriate. The recycled water from the proposed Central Maui WWRF will be delivered to a recycled water storage facility which is planned to be constructed within the future Waikapū Country Town development, located to the northwest of the proposed WWRF and SAT site. It is noted that the recycled water system and the wastewater system within the future Waikapū Country Town development have been assessed as part of the Final EIS for the Waikapū Country Town published in the January 8, 2017 edition of *The*

Environmental Notice. While the use of R-1 recycled water for nonpotable purposes is the primary method for effluent disposal, Chapter 11-62, Hawai'i Administrative Rules (HAR) and the DOH's Recycled Water Guidelines require a backup effluent disposal system for all water reuse applications. This backup system will be designed to allow for disposal of 100 percent of the WWRF flow to ensure effluent can be safely disposed of in the event that recycled water supply exceeds the demand, or if the recycled water fails to meet the required treatment specifications.

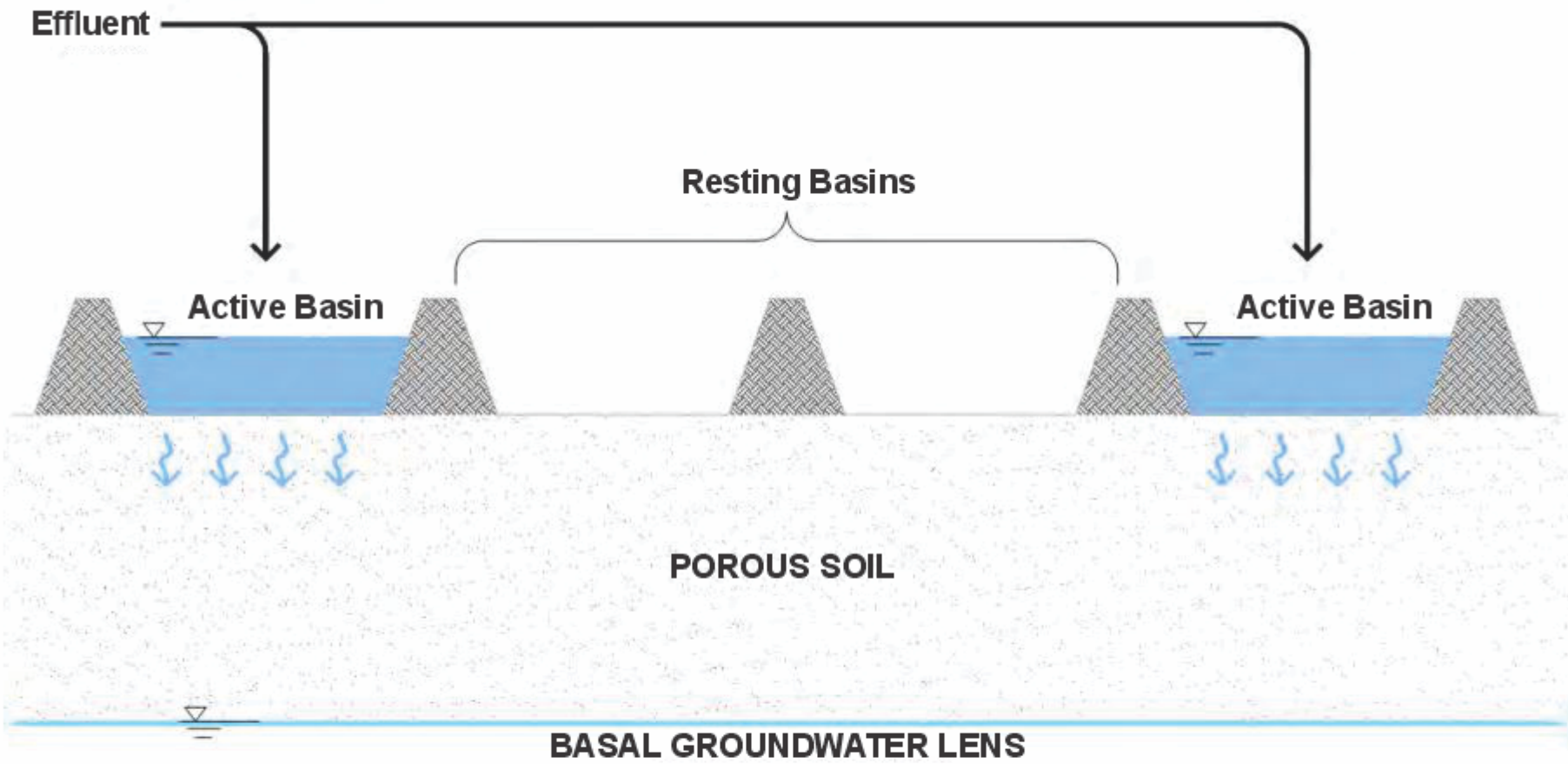
The SAT system has been selected as the most viable back-up effluent disposal approach for the Central Maui WWRF, which is considered the more environmentally sustainable alternative to injection wells. A SAT system consists of the intermittent application of effluent at high hydraulic loading rates to basins constructed in highly permeable soils, such as sand or gravel. Treatment in the SAT process is accomplished via biological, chemical, and physical interactions that occur as the water percolates through the soil matrix to groundwater. See **Figure 4**, a conceptual image of the SAT system. Treatment benefits can include nitrogen and phosphorus removal, heavy metal and trace organic removal, and removal of endocrine disrupting chemicals.

2. Access and Utility Corridor

A 100-foot-wide access and utility corridor (easement) on County-owned lands will also be created as part of the project in order to allow for vehicular access by DEM and contractors between the WWRF site and the future Wai'ale Road Extension. Refer to **Figure 1**.

3. Kehalani WWPS and Sewage Pipeline

The Kehalani WWPS will be designed to divert the existing 18-inch sewage pipeline in Wai'ale Road which currently conveys wastewater from the residential communities of Kehalani, Wailuku Heights, Pu'uhona, and Waikapū to the Wailuku-Kahului WWRF. A Feasibility Study and Siting Analysis was prepared in order to identify the most viable location for the Kehalani WWPS. See **Appendix "B**". The WWPS is proposed to be located at the south end of the parcel identified as Tax Map Key (TMK) No. (2)3-5-020:036 which contains an existing County-owned stormwater detention basin for the Kehalani community. In addition, a Technical Memorandum for the Kehalani WWPS has been prepared by Brown and Caldwell to provide a concept-level technical overview of the Kehalani WWPS. See **Appendix "C"**. Associated WWPS improvements include underground water and electrical systems, paved access with a parking lot, landscaping, and a perimeter fence. In addition, a packaged odor control system, including a fan, an activated



Source: Brown and Caldwell, 2024.

Figure 4

Proposed Central Maui Wastewater Reclamation Facility

Conceptual Image of SAT System

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO HIRAGA

COM\DEM CMaui WW Infrastructure\Applications\Figures\SATProc

carbon scrubber, and ductwork, will be provided onsite to mitigate potential for fugitive odors.

The wastewater pumped by the Kehalani WWPS will be delivered to the Central Maui WWRF via the Kehalani Sewage Pipeline, which will be approximately 3.3 miles long and be located along the existing and future Waiʻale Road. Refer to **Figure 1**.

4. <u>Waikapū Country Town Sewage Pipeline and R-1 Recycled Water Pipeline</u>

The Waikapū Country Town Sewage Pipeline involves the construction of approximately 3,200 linear feet of sewage pipeline by the County of Maui, which will be located within the planned Waiʻale Road Extension on County-owned and private lands. This sewage pipeline will allow the planned Waikapū Country Town development to connect to the new WWRF. The connection point to the Waikapū Country Town sewer system will be located east of Honoapiʻilani Highway on TMK No. (2)3-6-002:003. Refer to **Figure 1**.

The Waikapū Country Town R-1 Recycled Water Pipeline involves the construction of approximately 4,000 linear feet of R-1 recycled water pipeline by the County of Maui. This will be used to connect to the Waikapū Country Town R-1 recycled waterline to deliver R-1 recycled water to a recycled water storage facility which will be constructed within the future Waikapū Country Town development. The R-1 Recycled Water Pipeline will be located within the future Waiʻale Road Extension and the connection point to the Waikapū Country Town R-1 water system will be located near Honoapiʻilani Highway on TMK No. (2)3-6-002:003.

It is noted that the portions of sewage pipelines and R-1 recycled water pipeline proposed to be located under the future Waiʻale Road Extension will be installed during the construction of the future Waiʻale Road Extension. The Waiʻale Road Extension and related infrastructure improvements were assessed by a separate Environmental Assessment (EA) for the Waiʻale Road Extension project and Final EA and Finding of No Significant Impact (AFNSI) determination was issued in the August 23, 2025 edition of *The Environmental Notice*. It is noted that the proposed pipelines underneath the future Waiʻale Road Extension are included and discussed as part of this EIS to assess the overall impacts of the Central Maui WWRF project.

As mentioned previously, the wastewater system and recycled water system within the future Waikapū Country Town project have both been assessed as part of the Final EIS for the Waikapū Country Town project. As such, this EIS for the Central Maui WWRF Project will assess the portions of these components that will be constructed by the County of Maui outside of the Waikapū Country Town project.

The service areas of the proposed Central Maui WWRF are identified in **Figure 5** and summarized in **Table 2**. As shown below, approximately half of the flow (45 percent) is expected to originate from areas that currently contribute flow to the Wailuku-Kahului WWRF. Diversion of the flow from the Wailuku-Kahului WWRF to the Central Maui WWRF will reduce disposal volumes at the Wailuku-Kahului WWRF. The remaining half of the flow (48 percent) is projected to originate from new and future anticipated growth areas within the wastewater service areas. The future potential development shown in the table (7 percent) is not defined at this time, but is intended to accommodate potential future growth, which may include the existing Māʻalaea community if a decision is made to connect to the Central Maui WWRF.

Table 2. Anticipated Buildout Wastewater Flow from Developments in Service Area

Wastewater Flow Source	Average Dry Weather Flow (mgd)	Percent of Total Buildout Capacity of 4 (mgd)
Existing Development (Diverted Flow from Wailuku-Kahului WWRF)	1.78	45%
New Anticipated Development Growth	1.93	48%
Future Potential Development	0.29	7%
TOTAL	**4.00**	**100%**

Note: mgd = million gallons per day
Source: Brown and Caldwell, Inc.

C. PROJECT PURPOSE AND NEED

The Maui County Council approved Resolution No. 06-12 on February 17, 2006, regarding acceptance of the Central Maui Wastewater Reclamation Facility Study (Study) and concurring recommendations and long-term plan. The County identified three (3) primary concerns regarding the future of the existing Wailuku-Kahului WWRF: (1) remaining capacity; (2) shoreline erosion; and (3) potential impacts of tsunami. In order to address these concerns, the County completed a study of the Wailuku-Kahului WWRF to identify and develop a comprehensive list of conceptual treatment and disposal alternatives to meet the future wastewater infrastructure requirements for the Central Maui region. The preparation process included the involvement of a Core Working Group (CWG), comprised of a diverse group of community members to ensure meaningful and broad-based community participation.

Based on the Study and meetings with the CWG, the Department of Public Works and Environmental Management[1] recommended, and the County Council concurred, with the following:

(1) Leave the existing Wailuku-Kahului WWRF at the current site and expand in the future;

(2) Strengthen the existing Wailuku-Kahului WWRF to withstand a 100-year (20-foot-high) tsunami event;

(3) Mitigate shoreline erosion through the construction of shoreline erosion structures or beach nourishment; and

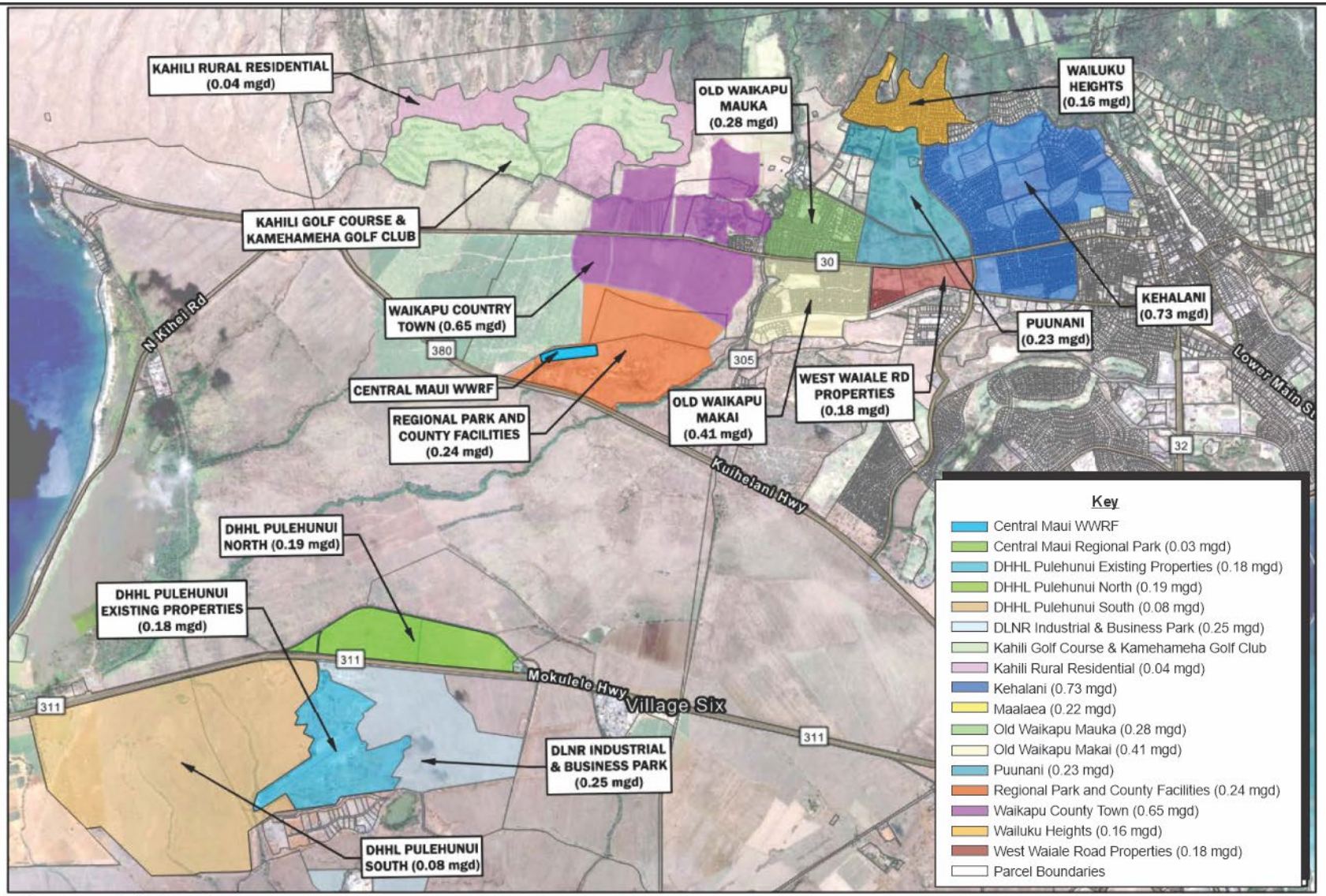
(4) Implement the long-term plan of action to service the Central Maui Service Area.

The DEM, WWRD conducted a Wailuku-Kahului WWRF Facility Plan, which was completed in May 2023, to address recommendation No. 1. The DEM, WWRD carried out the Tsunami Protection Project in 2010 to address recommendation No. 2. A Shoreline Erosion Protection Project was implemented in 2015 to address recommendation No. 3. The proposed Central Maui WWRF project (presented herein) is being proposed to address recommendation No. 4. As such, the objective of the Proposed Action is to provide wastewater treatment capacity for both existing and future uses in the Central Maui Service Area in an inland location away from coastal hazards.

As identified in **Figure 5**, there are a number of housing projects (including affordable housing) planned in the Central Maui region which are planned to be serviced by the proposed Central Maui WWRF. According to the *Hawai‘i Housing Demand: 2025-2035* prepared by the State of Hawai‘i, Department of Business, Economic Development and Tourism in March 2024, housing needed to meet the housing demand between 2025 and 2035 for Maui County is estimated at 5,138 units (an average based on two (2) different population projection methods). Development of the proposed Central Maui WWRF project will provide additional wastewater treatment capacity to support future housing development needs.

Development of the Central Maui WWRF is anticipated to encourage development of more affordable housing units in Central Maui. Waikapū Country Town, a planned development of nearly 1,500 homes, has agreed to add up to 213 workforce housing units (while removing the same number of market-rate units) under a public-private partnership with the County of Maui, which will allow the project to connect to the Central Maui WWRF,

[1]The Department of Public Works and Environmental Management is now separated into two (2) departments: the Department of Public Works (DPW) and the DEM. The DEM, WWRD is currently responsible for wastewater planning and management.



Source: Brown and Caldwell, Inc.

Figure 5

Proposed Central Maui Wastewater Reclamation Facility
Service Area Map

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

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instead of requiring the project to develop its own wastewater facility (Maui News, October 11, 2022).

Furthermore, in 2017, Act 25 was passed by the Hawai‘i State Legislature, which requires all cesspool owners to upgrade, convert, or connect to a sewer system before 2050. According to the 2017 State of Hawai‘i Department of Health’s report to the Legislature, data taken from 2009 to 2014 indicated there were 12,200 cesspools on Maui, discharging approximately 7.9 million gallons per day of raw sewage. The State has acknowledged the potential harm to public health and pollution of groundwater resources. Act 25 requires these cesspools to be upgraded to individual wastewater systems, or they will need to connect to a sewer system by 2050. The proposed project would have the ability to receive and treat septage from converted cesspools within the project’s service area should County septic service be provided.

D. ENVIRONMENTAL REVIEW REQUIREMENTS

1. Chapter 343, Hawai‘i Revised Statutes and Chapter 200.1, Hawai‘i Administrative Rules

Due to the development of a new wastewater treatment facility involving a Maui Island Plan (MIP) Amendment and a potential Community Plan Amendment (CPA), as may be applicable, the size of the project area, and the potential for significant environmental impacts, including those that may arise from the potential use of County lands and State/County funds, the County of Maui, DEM has determined through its judgment and expertise that an EIS should be prepared, and has initiated its environmental review through the publication of an Environmental Impact Statement Preparation Notice (EISPN) and preparation of this Draft EIS. The EISPN and Draft EIS have been prepared in accordance with Chapter 343, Hawai‘i Revised Statutes (HRS) and Chapter 200.1 of Title 11, HAR, EIS Rules.

Section 11-200.1-7, HAR states the following related to determining the accepting authority for an EIS for agency actions involving both State and County funds and lands:

> ***§11-200.1-7 Identification of approving agency and accepting authority.***
>
> *(b) For agency actions involving state and county lands, state and county funds, or both state and county lands and funds, the governor or the governor’s authorized representative shall have final authority to accept the EIS. In cases involving only county funds or lands, the mayor of the*

respective county or the mayor's authorized representative shall have final authority to accept the EIS.

The governor provided a letter dated June 2, 2023 designating the County of Maui, DEM as the authorized representative for reviewing and processing the EIS for the subject project for acceptability. As such, the DEM is the Accepting Authority for the EIS process. See **Appendix "D"**.

The EISPN, published in July 2023, provided public notification of the proposed project and to solicit public comments on the scope of impacts to be addressed in the Draft EIS. Community input on the project was solicited through the EISPN and a public scoping meeting. As per HAR §11-200.1-2, the term "EIS public scoping meeting" is defined as "*a meeting in which agencies, citizen groups, and the general public assist the proposing agency or applicant in determining the range of actions, alternatives, impacts, and proposed mitigation measures to be considered in the draft EIS and the significant issues to be analyzed in depth in the draft EIS.*" A summary of the public scoping meeting as well as a copy of the presentation and handout from the meeting is provided in **Appendix "T"**. Comment letters received in response to the EISPN, and response letters are provided in Chapter XI.

This Draft EIS describes the project, its purpose and need, and provides an analysis of the potential environmental consequences of the proposed project, and a discussion of alternatives considered. Significant short-term, long-term, and cumulative impacts on the human, natural, and built environment are also discussed.

This Draft EIS is being published in the Environmental Review Program's (ERP) *The Environmental Notice* bulletin and will be made available for a 45-day public review and comment period. Following this review process, the DEM will prepare a Final EIS document responding to comments received on the Draft EIS.

2. National Environmental Policy Act

The use of federal funds may be pursued for the proposed project. In such event that said funds are secured and utilized by the County of Maui, the DEM will work with the relevant lead federal agency to comply with the applicable provisions of the National Environmental Policy Act (NEPA) and any related consultation requirements, including, but not limited to Section 106 Consultation in compliance with the National Historic Preservation Act (NHPA) and Section 7 Consultation in compliance with the Endangered Species Act (ESA).

E. LAND USE ENTITLEMENTS REQUIREMENTS

The 14.9-acre project site for the Central Maui WWRF and onsite SAT is located on lands designated a "Agricultural" by the State Lands Use Commission (LUC), designated for "Agriculture" use in the Wailuku-Kahului Community Plan, and zoned "Agricultural" district by the County of Maui. According to the Maui Island Plan (MIP), the 14.9-acre WWRF and SAT site is located within the Urban Growth Boundary (UGB), and is designated by the MIP Planned Growth Areas Map as "Park" and labeled "Regional Park and County Facilities". The MIP Planned Protected Areas Map also designates the WWRF and SAT site as "Park Protected Area" with the label "Regional Park and County Facilities". It is noted that the sewage pipelines and R-1 recycled water pipeline alignments (except for the existing Waiʻale Road) are also located within the State "Agricultural" district, designated for "Agriculture" use in the Wailuku-Kahului Community Plan, and zoned "Agricultural" district by the County of Maui. The Kehalani WWPS is proposed to be located on a parcel within the State "Urban" district, designated for "Kehalani Project District - Open Space" use in the Wailuku-Kahului Community Plan, and zoned "Project District (Open Space)" by the County of Maui. The majority of the pipeline alignments are located within the MIP's UGB, except for a small portion of the Kehalani Sewage Pipeline (under the future Waiʻale Road Extension) located within the Small Town Boundary (STB). Small portions of the proposed Kehalani Sewage Pipeline along the future Waiʻale Road Extension are located within the Planned Growth Area and the Park and Preservation Protected Areas.

1. State Land Use Commission District Boundary Amendment

The 14.9-acre site for the WWRF and SAT is designated "Agricultural" by the State LUC. In order to address the proposed public/quasi-public land use objective of the project, a County-processed District Boundary Amendment (DBA) from the "Agricultural" district to the "Urban" district will be required. Pursuant to Section 205-3.1 (b), HRS, a DBA involving land areas of 15 acres or less shall be determined by the appropriate county land use decision-making authority. For the County of Maui, the Maui County Council is the decision-making authority for DBAs. Inasmuch as the proposed WWRF and SAT site is less than 15 acres, the DEM will seek a DBA from the Council. By letter dated February 10, 2023, the Department of Planning confirmed that the uses and areas of the proposed Central Maui WWRF and SAT site would qualify for DBA processing under the approval authority of the Council. See **Appendix "E"**. The DBA application will be initiated by the Planning Director.

2. Maui Island Plan Amendment

The 14.9-acre WWRF and SAT site is designated as "Park" and labeled "Regional Park and County Facilities" by the MIP Planned Growth Areas Map. The MIP

Planned Protected Areas Map also designates the WWRF and SAT site as “Park Protected Area” with the label “Regional Park and County Facilities”. Based on the consultation with the Department of Planning, an amendment to the MIP is anticipated to be required. For the MIP Planned Growth Areas Map, the “Park” designation for the 14.9-acre WWRF and SAT site will be amended to the “Planned Growth Areas” designation. For the MIP Planned Protected Areas map, the “Park” designation will be removed and no Planned Protected Areas will be assigned for the 14.9-acre project site. The narrative of the MIP will also be amended to include a County WWRF as an example of the County Facilities planned in the region. The MIP Amendment application will be initiated by the Planning Director.

3. County Community Plan Amendment

The 14.9-acre WWRF and SAT site is designated for “Agricultural” use in the Wailuku-Kahului Community Plan. To establish the proposed public/quasi-public use, an amendment to the Wailuku-Kahului Community Plan from “Agriculture” to “Public/Quasi-Public” use will also be required. The CPA application will be initiated by the Planning Director, or a request will be submitted as part of the Central Maui Community Plan update process.

4. County Change of Zoning

The 14.9-acre WWRF and SAT site is zoned “Agricultural” district by the County of Maui. A Change of Zoning (COZ) to “Public/Quasi-Public (P-1)” District will be required. The COZ application will be initiated by the Planning Director.

5. County Kehalani Project District Permitting Requirements

The Kehalani WWPS is proposed to be located on a parcel within the State “Urban” district, designated for “Kehalani Project District” and “Open Space” use in the Wailuku-Kahului Community Plan, and zoned “Project District” and “Open Space” by the County of Maui. Applicable Project District processing requirements will be complied with for this pump station in coordination with the Department of Planning.

The EIS will serve as the primary technical supporting document for the DBA, COZ, MIP Amendment, and CPA (as required) processes. As mentioned above, the sewage pipelines and R-1 recycled water pipeline alignments (not within the existing Waiʻale Road), and the WWRF access road are also located within the State “Agricultural” district, designated “Agriculture” by the Wailuku-Kahului Community Plan, and located in the County’s “Agricultural” zoning district. However, said uses are permitted uses within these land use designations, and, as such, DBA, COZ, and CPA will not be required for these project components.

Similarly, the MIP amendment is not anticipated to be required for the pipeline alignments.

F. PROJECT COST AND IMPLEMENTATION SCHEDULE

As noted previously, portions of sewage pipelines and R-1 recycled water pipeline proposed to be located under the future Waiʻale Road Extension are anticipated to be installed during the construction of the future Waiʻale Road Extension project. Construction of the proposed WWRF, SAT and other related system components will be constructed between 2027 and 2029 and the facility is expected to be operational in 2029. The planning-level cost for construction is approximately $130.6 million dollars (2025 dollars) (including the pipelines under the future Waiʻale Road Extension).

DESCRIPTION OF THE EXISTING ENVIRONMENT AND POTENTIAL IMPACTS

II

II. DESCRIPTION OF THE EXISTING ENVIRONMENT AND POTENTIAL IMPACTS

A. PHYSICAL SETTING

1. Existing and Surrounding Land Uses

a. Existing Conditions

From a regional perspective, the proposed project is located in Central Maui with Kahului Harbor to the north, Mā‘alaea Bay to the south, the West Maui Mountains to the west, and Haleakalā to the east.

The proposed project will be located on vacant, former agricultural lands in the vicinity of Waikapū, an existing roadway, and an existing stormwater basin owned by the County of Maui. The immediate area surrounding the proposed Central Maui Wastewater Reclamation Facility (WWRF) site contains a variety of uses including an adjacent County baseyard and mostly vacant, former agricultural lands which were used for the cultivation of sugar cane. Residential and light industrial/commercial uses are located further to the north in the community of Waikapū.

b. Potential Impacts and Mitigation Measures

The proposed action involves the development of a WWRF, onsite Soil Aquifer Treatment (SAT) system, a wastewater pump station (WWPS), sewage pipelines, an R-1 recycled water pipeline, and an access road.

The immediate surrounding area of the proposed WWRF and SAT system is in transition from former agricultural use to other uses. There are also various existing urban uses within the project’s vicinity, such as residential subdivisions, commercial and industrial uses, and County facilities. The project will be designed to be compatible with surrounding land uses by incorporating various odor control and visual mitigation measures.

From a future land use perspective, the WWRF and SAT site, as well as portions of the surrounding lands, are within the Urban Growth Boundary (UGB) of the Directed Growth Maps of the Maui Island Plan (MIP). The proposed project will serve to support both existing developments as well as growth areas supported by the MIP.

The proposed WWRF and SAT project site itself is located on land labeled by the MIP Planned Growth Areas Map and Planned Protected Areas Map

for “Regional Park and County Facilities”. According to the MIP, a regional park would be provided to the South of Waiʻale to provide a clear separation between the new community and Māʻalaea, and to allow for the placement of active and passive recreational opportunities, County baseyards, and County facilities. The County of Maui, Department of Environmental Management (DEM) is aware that the Department of Parks and Recreation (DPR) is in the early stages of planning a future regional park in the vicinity of the proposed WWRF and SAT site. As part of the Environmental Impact Statement Preparation Notice (EISPN) comment letter dated August 21, 2023, the DPR expressed concerns of potential odors and view impacts from the proposed Central Maui WWRF that may impact a future regional park, however, noted in the second comment letter dated December 19, 2024 that the proposed WWRF may be an accepted secondary use if appropriate mitigation measures are implemented to minimize adverse impacts to the surrounding future park uses.

The DEM will incorporate odor control and visual mitigation measures at the proposed WWRF to minimize potential impacts to a future regional park. Proposed odor control measures include buffer land or walls/berms around the WWRF, enclosures on headworks, and a biotrickling filter (or similar process) at odor sources. Detailed odor control strategies are discussed in Section A.11 of this Chapter. In addition, the proposed visual mitigation measures include buffer land or walls/berms around the WWRF, landscaping, as well as architectural treatments. The proposed visual mitigation measures are detailed in Section A.14 of this Chapter.

2. Climate

a. Existing Conditions

Maui is characterized by a semi-tropical climate containing a multitude of individual microclimates. The mean annual temperature of the island at all locations near sea level is approximately 75 degrees Fahrenheit. A high proportion of the rainfall that Maui receives each year falls on the northeast facing shores leaving the south and southwest coastal areas relatively dry.

The proposed WWRF and SAT site as well as the Waikapū Country Town Sewage Pipeline and R-1 Recycled Water Pipeline are located in the vicinity of Waikapū in Central Maui, and the proposed Kehalani Sewage Pipeline and WWPS span north towards Wailuku. Annual average temperatures in the region measured at the Kahului airport range from 68.1 to 86.1 degrees Fahrenheit. August and September are historically the

warmest months of the year, while the coolest months are January and February (County of Maui, Office of Economic Development, 2022).

Average rainfall distribution in the Waikapū region had an average of 12 inches of rain in 2022. Rainfall in the region is highly seasonal, with most of the precipitation occurring in the winter months (County of Maui, Office of Economic Development, 2022).

Historically, Hawai'i's climate has been characterized by reliable winds that move warm tropical air from the equator to the north and south, in high-altitude jet streams. Cooler air from the northeast is then pulled in to replace the hot air, collecting moisture and creating trade winds. From 1973 to 2019, winds in Hawai'i shifted from northeast to east, with northeast trade winds declining from 291 days/year to 150 days/year (County of Maui, Office of Climate Change Resiliency & Sustainability, 2022). Winds in Central Maui, as measured at the Kahului Airport average 12.8 miles per hour (State of Hawai'i, Department of Business, Economic Development, and Tourism (DBEDT), 2023).

b. Potential Impacts and Mitigation Measures

From an environmental standpoint, replacement of vegetative surfaces with hardscapes associated with the proposed project may yield a tendency towards slightly increasing ambient air temperatures. This phenomenon can be the result of a "heat island" effect, caused by urban structures. According to the United States Environmental Protection Agency (U.S. EPA), "*structures such as buildings, roads, and other infrastructure absorb and re-emit the sun's heat more than natural landscapes such as forests and water bodies*". (U.S. EPA, 2025) Urban areas, where structures are concentrated, and greenery is limited may become "islands" of higher temperatures relative to outlying areas. To address this potential "heat island" effect, open space areas, landscaping, and landscaped buffers will be integrated into the proposed project. Certain project components, such as pipelines will be subsurface and are not expected to impact climatic conditions.

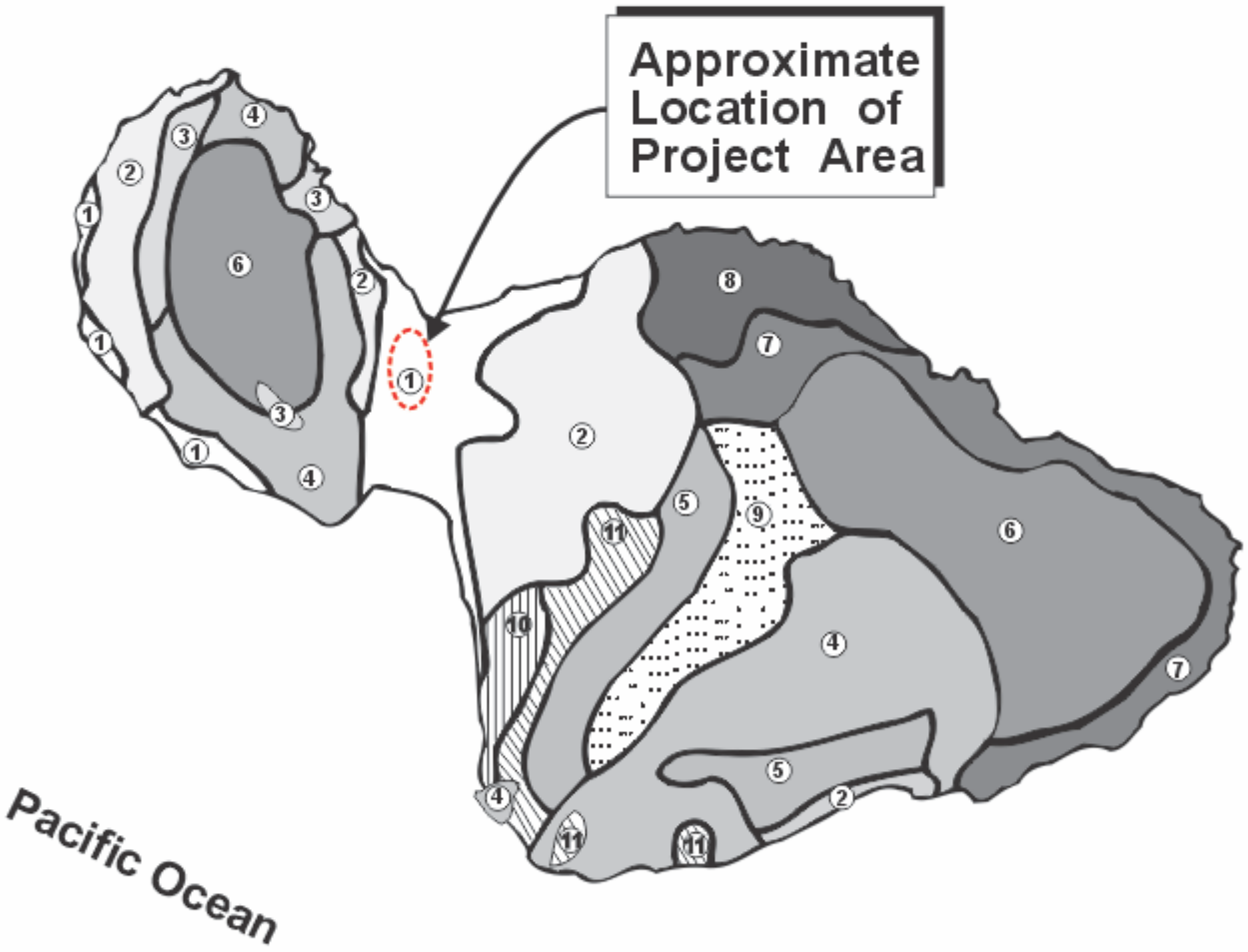
3. Topography and Soil Characteristics

a. Existing Conditions

The project area is located in Central Maui, which is the isthmus connecting the West Maui Mountains to Haleakalā. Underlying the project area is the Pulehu-Ewa-Jaucus soil association, as classified by the U.S. Department of Agriculture (USDA). See **Figure 6**. *The Soil Survey of the Islands of*

LEGEND

- ① Pulehu-Ewa-Jaucas association
- ② Waiakoa-Keahua-Molokai association
- ③ Honolua-Olelo association
- ④ Rock land-Rough mountainous land association
- ⑤ Puu Pa-Kula-Pane association
- ⑥ Hydrandepts-Tropaquods association
- ⑦ Hana-Makaalae-Kailua association
- ⑧ Pauwela-Haiku association
- ⑨ Laumaia-Kaipoipoi-Olinda association
- ⑩ Keawakapu-Makena association
- ⑪ Kamaole-Oanapuka association



Map Source: U.S. Department of Agriculture, Soil Conservation Service, 1972

Figure 6 Proposed Central Maui Wastewater Reclamation Facility
Soil Association Map

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

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Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii characterizes the soils of the Pulehu-Ewa-Jaucus soil association as deep, nearly level to moderately sloping. The underlying material is moderately fine textured to coarse-textured subsoil and range in elevation from nearly sea level to approximately 600 feet (ft.) above mean sea level (amsl) (Foote et. al., 1972). A description of the specific soil types underlying the project area is presented in **Figure 7** and **Table 3**.

A Hydrogeological Study prepared by Geosyntec Consultants, Inc. (Geosyntec) for the project specifically assessed the soils underlying the SAT basins to evaluate the soils, permeability and drainage potential for excess recycled water. See **Appendix "F"**. According to the Hydrogeological Study, the U.S. Geological Survey (USGS) classifies the surface soils of the SAT as "Older dune deposits" (Qdo), which is also referred to as Jaucas sands (JaC) by the USDA. The USGS characterizes Qdo soils as lithified calcareous sand or aeolianite that forms dune fields in the isthmus between West and East Maui.

The Hydrogeological Study developed a subsurface Conceptual Site Model (CSM), which is a framework for the vadose zone (i.e., unsaturated zone) and groundwater flow model development to support SAT basin infiltration simulations. In addition to using various published data sources, a site-specific subsurface investigation, with extensive geotechnical sampling and testing, was conducted for the underlying soils.

Figure 8 represents a conceptual subsurface profile near the center of the proposed SAT basins. The vadose zone, an unsaturated area between the land surface and the saturated zone, consists of multiple layers.

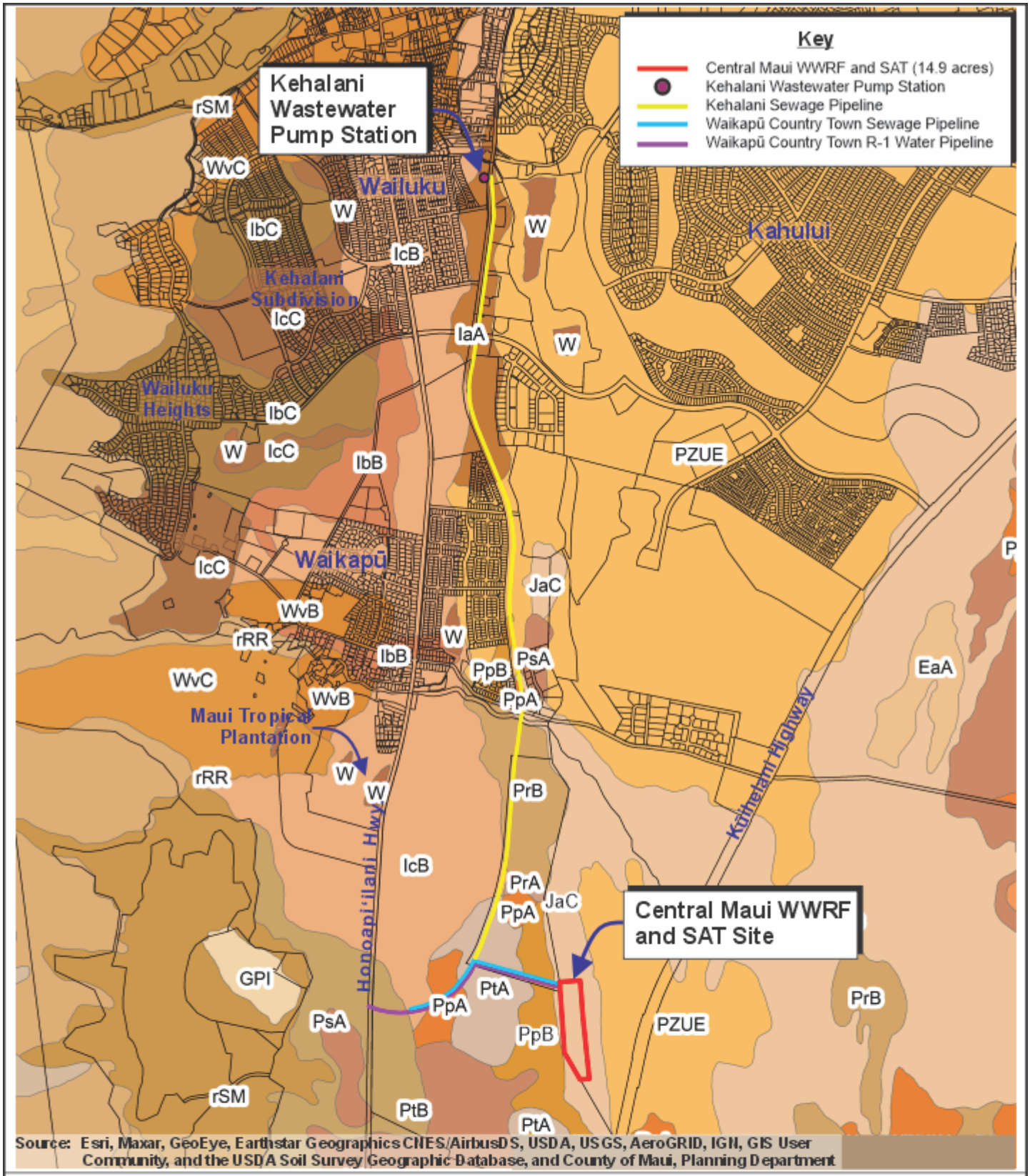

Figure 7 Proposed Central Maui Wastewater Reclamation Facility
Soil Classification Map

Prepared for: County of Maui, Department of Environmental Management

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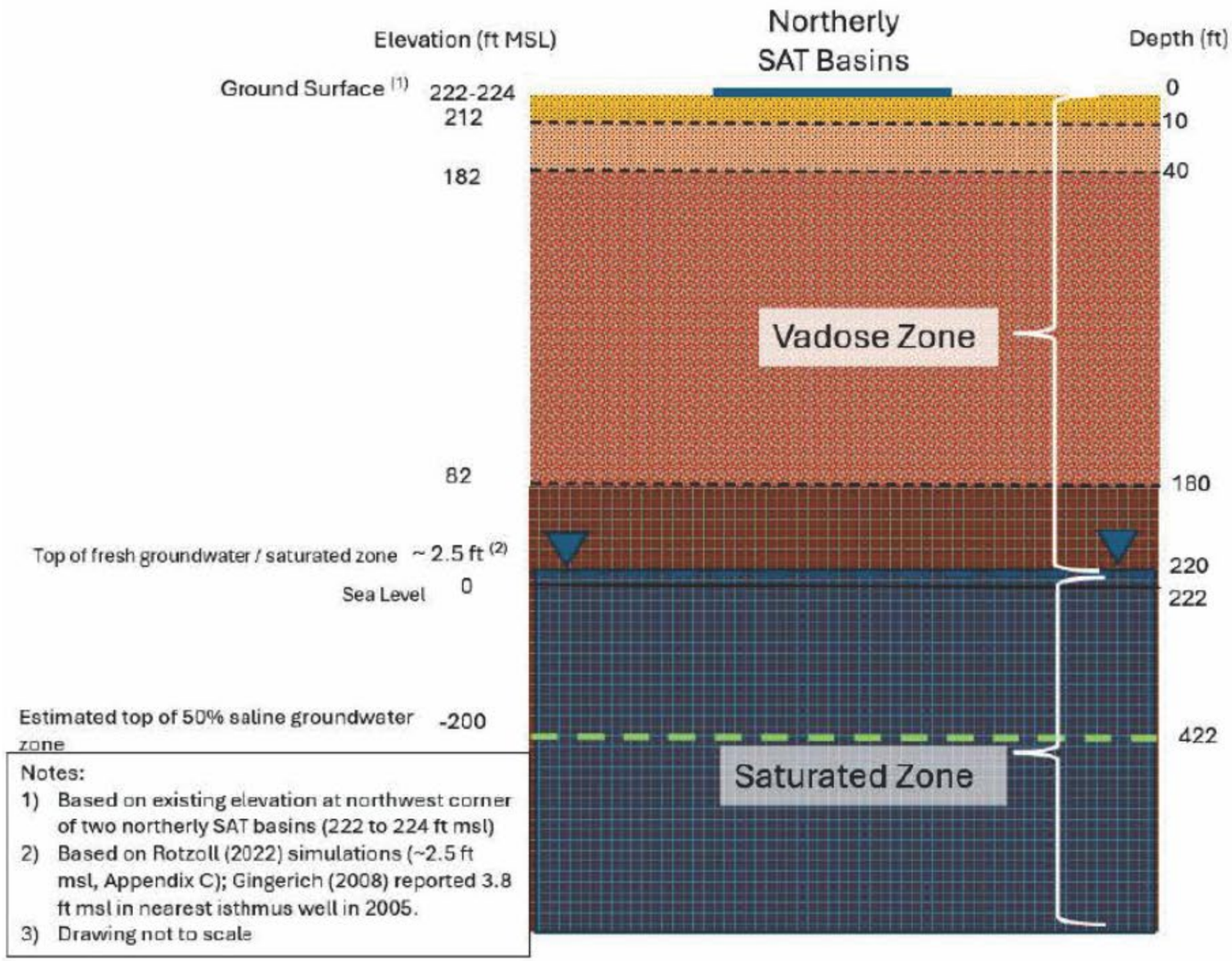
Table 3. Soil Types Underlying Project Area

Soil Symbol	Soil Name	Description	WWRF and SAT Site	Kehalani WWPS	Kehalani Sewage Pipeline	Waikapū Country Town Sewage Pipeline	Waikapū Country Town R-1 Recycled Water Pipeline
IaA	Iao silty clay, 0 to 3 percent slopes	IaA is a well-drained soil found on valley fill and alluvial lands. Runoff is slow and the erosion hazard is no more than slight.		X	X		
IcB	Iao silty clay, 3 to 7 percent slopes	IcB soil is similar to IaA soil and is found in valley fill and on smooth alluvial lands.			X	X	X
JaC	Jaucus sand, 0 to 15 percent slopes	JaC soil occurs as narrow strips on coastal plains near the ocean and is characterized by rapid permeability and very slow to slow runoff. JaC soil has a slight water erosion hazard with a severe wind erosion hazard where vegetation has been removed.	X		X	X	X
PtA	Pulehu cobbly clay loam, 0 to 3 percent slopes	PtA soils occur on alluvial fans, stream terraces, and in basins. Permeability is moderate, runoff is slow, and the erosion hazard is slight.			X	X	X
PtB	Pulehu cobbly clay loam, 2 to 6 percent slopes	PtB is found in small areas that have thin, stratified layers of sand and gravel at a depth of 20 to 36 inches. Runoff is slow and the erosion hazard is slight.					X
PpA	Pulehu silt loam, 0 to 3 percent slopes	PpA is made up of silt loam and has been used for sugarcane cultivation period. It is characterized by moderate permeability, slow runoff and no more than slight erosion hazard.			X	X	X
PpB	Pulehu silt loam, 3 to 7 percent slopes	PpB soil is characterized by a silt loam texture and a slight erosion hazard. Also included are small areas underlain by coral sand at a depth of 20 to 36 inches.			X	X	X

Soil Symbol	Soil Name	Description	WWRF and SAT Site	Kehalani WWPS	Kehalani Sewage Pipeline	Waikapū Country Town Sewage Pipeline	Waikapū Country Town R-1 Recycled Water Pipeline
PrB	Pulehu cobbly silt loam, 3 to 7 percent slopes	PrB soil has a silt loam texture, and the surface layer is cobbly. Runoff is slow, and the erosion hazard is slight.			X		
PZUE	Puuone sand, 7 to 30 percent slopes	PZUE soil occurs on sandhills near the ocean and is derived from coral and seashells. This soil has rapid permeability above a cemented layer with slow runoff and a moderate to severe wind erosion hazard.			X		



Description

Older Dune Sand (Qdo) / Jaucas Sand (JaC) - poorly graded, loose sand (SP), excessive draining
Qdo/JaC - calcareous sand dunes, partly consolidated, silty, fine grained calcareous sand (SM)

Older Alluvium (QTao) - consolidated alluvium deposits, heterogeneous mixture of gravel, sands, silts and clays, moderately drained sandy silt (ML)

Tertiary Kula and Honomanu Volcanics - flows of basalt and andesite, chiefly aa flows with, individual flows thin to approximately 50 feet thick in the isthmus area

Source: Geosyntec Consultants

Figure 8

Proposed Central Maui Wastewater Reclamation Facility
Conceptual Subsurface Profile of SAT Basins

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO HIRAGA

COM/DEM Cmaui WW Infrastructure/Applications/Figures/ConcSub SAT Basins

(1) Older dune deposits (Qdo)/Jaucas sand (JaC)

From depths of approximately 20 to 40 ft. below ground surface (bgs), are the Qdo/JaC sand materials, consisting of sands commonly intermixed with silt materials. The multiple lines of evidence (i.e., soil classification, surface permeability rating, in-borehole falling-head tests, double-ring infiltrometer test, plus lower Waikapū Stream infiltration rates) indicate that the approximately upper 40 ft. of the subsurface materials (Qdo/JaC) exhibit rapid infiltration and drainage potential.

(2) Older alluvium (QTao)

Below the Qdo/JaC layer from approximately 40 ft. to 180 ft. bgs, are Older alluvium (QTao) soils. The sediments were interpreted to be deposited as an alluvial fan emanating from the West Maui mountains along the Waikapū stream valley. The sediments were described in the field as a heterogeneous mixture of silts, sands, gravels, and clays. The material is dry to damp and dense. The gravels were typically surrounded by basalt clasts. The multiple lines of evidence (i.e., soil classification, surface water permeability rating, and in-borehole falling head tests) indicate that the approximately 140 ft. of QTao sediments are likely to exhibit "moderate" drainage rates, but somewhat lower than the overlying Qdo/JaC deposits.

(3) Kula Volcanics (Qkul)

Underlying the QTao sediments, from approximately 180 to 220 ft. bgs beneath the north SAT basins, are Kula Volcanics (Qkul) which were created from volcanic flows from both Haleakalā to the east and the West Maui mountains to the west. While no geotechnical or infiltration testing was done due to the depths at the site, the available published data suggest high hydraulic conductivity rates, and therefore likely rapid infiltration rates, within the vadose zone section of the tertiary volcanics underlying the site.

The Hydrogeological Study also assessed soil grab samples that were collected and analyzed as part of the subsurface investigation to establish baseline chemical trends before potential liquid infiltration from the future WWRF. The testing aimed to assess whether soils retain chemical impacts from past sugar cane production. Three (3) soil borings (G-1, G-2, and G-3) were sampled at three (3) depths: shallow (10-23 ft. bgs), intermediate (38-45 ft. bgs), and deep (52-58 ft. bgs). Chemical analyses included

ammonia, bromide, chloride, fluoride, nitrate-N, nitrite-N, and various phosphorus and carbon compounds. Results showed ammonia in G-1 and G-2 samples, but not in G-3. Nitrate-N, nitrite-N, total nitrate-nitrite, and other nitrogen compounds were undetected. Total inorganic carbon (TIC) and total organic carbon (TOC) were detected across all samples, but there was no clear depth trend in nitrogen or carbon concentrations. Data quality notes indicated that TOC levels in all samples were below the method reporting limit but above the detection limit.

b. Potential Impacts and Mitigation Measures

The proposed SAT basin treatment method has been selected as a backup method for effluent disposal and involves infiltrating excess recycled water (i.e., R-1 water) and occasional off-specification (off-spec) effluent into the subsurface. As further discussed in Section A. 4. of this Chapter below, the site-specific simulations indicated that infiltration is predominantly vertical with limited lateral migration. The Hydrogeological Study noted that there is no indication that advective liquids migration will reach Waikapū stream, located over 2,000 ft. from the site. The modeling did suggest chemical diffusion could occur in shallow soils along the SAT basin perimeter. The Hydrogeological Study recommended installation of a shallow vertical slurry wall or other barrier to mitigate this potential issue, which has been incorporated into the project's Facility Plan.

The Hydrogeological Study concluded that subsurface materials exhibit moderate to rapid infiltration properties suitable for future infiltration activities via the SAT basins.

With regard to changes of the drainage conditions due to increases of impermeable surfaces at the WWRF site and Kehalani WWPS site, a Preliminary Drainage Report (PDR) has been prepared for the proposed Central Maui WWRF. See **Appendix "G"**. In addition, the Feasibility Study and Siting Analysis for the Kehalani WWPS includes the drainage plan for the Kehalani WWPS site. Refer to **Appendix "B"**. During construction, temporary Best Management Practices (BMPs), such as temporary sedimentation basins, will be utilized to mitigate erosion and the release of sediment and other pollutants to existing storm drains, waterways, and adjacent properties. Permanent drainage improvements will also be implemented to reduce the post-development peak runoff volume and to improve stormwater quality to mitigate potential adverse impacts to downstream properties and the environment. Detailed discussion on drainage improvements are included in Section D.4. of this Chapter.

Grading design work for the project will respect existing topography, to the extent practicable, in order to minimize extensive cut and fill activity. Although landform transformations in terms of cut and fill will be required for project implementation, significant areas of the affected parcels will be left ungraded. All grading work will comply with applicable requirements of Chapter 20.08, Soil Erosion and Sedimentation of the Maui County Code (MCC).

4. Groundwater and Nearshore Water Resources

a. Existing Conditions

Groundwater resources have the potential to be affected by uses that occur on land, including wastewater treatment and disposal facilities. In addition, because much of Hawai‘i’s aquifers depend on recharge from rain events, the development of non-porous surfaces may have an effect on the availability and quality of groundwater resources in the area.

According to the Hydrogeological Study prepared for the project, the Central Maui WWRF and SAT site is located near the western boundary of the Kahului aquifer system of the Central Maui aquifer sector. Groundwater is anticipated to be encountered at an elevation of ~2.5 to 4 ft. amsl. The groundwater is expected to be encountered within the underlying volcanic bedrock aquifer (Kula volcanics). Refer to **Appendix “F”**.

The Hydrogeological Study noted that due to past agricultural practices (fertilizer use for sugar cane production) and use of onsite disposal systems (i.e., cesspools and/or septic systems) in the site vicinity, baseline groundwater quality has already been impacted. Existing Nitrate levels in groundwater are reported to be approximately 2.5 to 3.3 milligrams of nitrate per liter (mg N/L).

Nearshore waters and associated resources include Kahului Harbor to the north and Mā‘alaea Bay (including Keālia Pond and Wildlife Refuge) to the South.

b. Potential Impacts and Mitigation Measures

The Hydrogeological Study, prepared by Geosyntec, includes vadose zone infiltration modeling and groundwater modeling to assess the effluent infiltration capacity of the proposed SAT basins as well as their potential environmental impacts. Refer to **Appendix “F”**.

(1) Vadose Zone Infiltration Modeling

The recycled water disposed at the proposed SAT basins will first infiltrate through the vadose zone beneath the SAT basins. Refer to **Figure 8**. This modeling was conducted utilizing two (2) scenarios.

Scenario 1: Average Precipitation Year Infiltration Estimate

Scenario 1 simulates the anticipated long-term SAT basin excess recycled water infiltration rate, based on estimated average annual precipitation conditions, consisting of 1.15 million gallons per day (mgd) in January, and 4.0 mgd for 21 individual days in mid-month periods for months of February through December. The total excess recycled water infiltration is 120 million gallons per year (mgy). The simulation was conducted for the annual cyclical SAT basin infiltration of excess recycled water over a 10-year period.

The goals of this scenario are as follows:

- Establish the likely path of water applied to the SAT basins through the vadose zone and saturated zone to the Pacific Ocean.
- Establish potential environmental impacts from the SAT basin discharge.

The results of the vadose zone infiltration modeling showed that advective flow in the subsurface was predominantly vertical, with lateral migration estimated to be limited to between 20 to 40 meters (65 to 130 ft.). A very thin layer of solute concentration migration was projected at the land surface due to chemical diffusion. Thus, a perimeter vertical slurry wall may be warranted to mitigate this potential issue.

To evaluate recycled water chemical migration, Geosyntec used nitrate at 8 mg N/L as a chemical proxy for excess recycled water based on data from other WWRFs on Maui. Denitrification, a natural process where microorganisms reduce nitrate by consuming organic carbon, was considered in both conservative and enhanced scenarios (with organic carbon addition). Using a conservative denitrification rate, the nitrate concentration drops from 8 mg/L input at the SAT basin bottom to an average of approximately 4.6 mg/L at the interface with groundwater, a reduction of approximately 42 percent. Using a more rapid denitrification rate based on the

evaluation of data from the Kīhei and Lahaina WWRFs and the consideration of enhanced conditions through the addition of organic carbon via biomass in the SAT basins, the nitrate concentration drops from 8 mg/L input at the SAT basin bottom to an average of approximately 0.3 mg/L at the interface with groundwater, a reduction of approximately 96 percent. The Hydrogeological Study concluded that deploying methods to enhance denitrification rates, such as adding sources of organic carbon (i.e. biomass) can have a significant beneficial effect of lowering nitrate concentrations and mass in the subsurface.

Scenario 2: Wet Precipitation Year Infiltration Estimate

Scenario 2 simulates a potential worst-case SAT basin infiltration rate scenario due to a wet precipitation year, consisting of 3.1 mgd in December, 4.0 mgd in January, 1.0 mgd in February, and 21 individual days of off-spec infiltration in the mid-month period in March through November. The model simulation period is for one (1) year and follows the traditional water year cycle from October 1 through September 30.

The goals of this scenario are as follows:

- Establish the SAT's ability to dispose of the entire WWRF flow in accordance with Hawai'i Administrative Rules (HAR) 11-62-25 requirements for backup disposal systems.

- Evaluate the mounding potential above the restrictive layer in the vadose zone to establish the potential for impacts to nearby streams or other features.

The modeling did suggest that the SAT basins, as currently planned, have the capacity to infiltrate the wet year precipitation quantities. The lateral spread of infiltration liquids and solute is estimated to be approximately 130 ft. (40 meters) from the SAT basin perimeters. Given that the closest distance to Waikapū Stream is approximately 2,000 ft., the modeling suggested that there would be no infiltration flow migration to the stream.

It is noted that at the end of the input period of 31 days at 4.0 mgd (end of January), two (2) of the interior SAT basins exhibited a temporary period (approximately six (6) days) of saturated soils and positive head pressures. This result suggested that infiltration of these basins could be impeded for this short period of time. However, the north and south SAT basins retained capacity during

this period, and the Hydrogeological Study indicated that there may be a temporary need to allocate reduced infiltration rates in the interior basins and increase the rates in the north and south basins for an extended period of 4.0-mgd infiltration.

As with Scenario 1, there is the potential for chemical diffusion that could migrate laterally into near surface soils. A perimeter, vertical slurry wall can be useful to mitigate this issue.

(2) Groundwater Flow and Transport Modeling

This model was developed to simulate groundwater flow in the site vicinity and evaluate the nature and fate of excess recycled water following migration through the vadose zone as it mixes with groundwater and eventually reaches the shoreline over time. The nitrate concentrations from Scenario 1 (average year infiltration) using both conservative and enhanced vadose zone denitrification rates were used to simulate the groundwater flow. It is noted that regulatory framework was utilized to analyze the significance of the nitrate concentrations. This includes Section 11-54-6, HAR, which classifies Mā‘alaea Bay as a Class A Marine Water Embayment, with a discharge criterion of 0.15 mg N/L for Total Nitrogen, Inland Water Criteria under Section 11-54-5.2, HAR, with a discharge criterion of 0.25 mg N/L, as well as the drinking water Maximum Contaminant Level (MCL) for nitrate which is 10 mg N/L.

Groundwater Flow

The infiltration from the SAT basin has negligible impacts on the local groundwater level. In the horizontal direction, the infiltrated water flows southwards and towards the ocean at Mā’alaea Bay and near the Keālia Pond area. In the vertical direction, the water infiltrates to approximately 120 ft. below mean sea level (bmsl) locally.

Chemical Transport

With the conservative vadose zone denitrification rate, the infiltrated recycled water would contain nitrate levels of 4.6 mg N/L when it reaches the saturated zone/groundwater. Nitrate concentrations are anticipated to reach a steady state at the shoreline after approximately 25 to 30 years. With applying low and high denitrification rates in groundwater, steady-state nitrate concentrations of approximately 0.29 and 0.19 mg N/L (290 and

190 micrograms of nitrogen per liter) are simulated at the shoreline, respectively. Without denitrification in groundwater, the corresponding concentration is 0.33 mg N/L (330 micrograms of nitrogen per liter). Under all scenarios above, the concentration at the shoreline is slightly higher than the State of Hawai‘i Marine Waters Class A Shoreline Discharge Criteria (0.15 mg N/L) and much lower than the drinking water standard (10 mg N/L).

Similarly, low and high denitrification rates in groundwater were applied under the enhanced vadose zone denitrification rate scenario (by addition organic carbon (i.e. biomass) in the SAT basins). Under this scenario, the infiltrated recycled water would contain nitrate levels of 0.3 mg N/L when it reaches the saturated zone/groundwater. With the low/high denitrification rates in groundwater, nitrate concentrations of less than 0.05 mg N/L (50 µg/L) would be discharged at Mā’alaea Bay and in the vicinity of Keālia Pond, well below the State of Hawai’i discharge criteria for Class A Marine Water Embayments (0.15 mg/L), inland waters (0.25 mg/L), and the drinking water standard (10 mg/L).

These results highlight the importance of nitrate denitrification in the subsurface, both in the vadose zone and groundwater. It also illustrates that measures to enhance denitrification or increase hydraulic retention time in the vadose zone, such as adding organic carbon via biomass, can have an important role in mitigating nitrate impacts to environmental receptors.

The Hydrogeological Study provides a summary of potential environmental impacts as follows. Refer to **Appendix “F”**.

- The primary component of recycled water (i.e., dissolved nitrate) will undergo significant biological degradation in the vadose zone under the SAT basins via the process known as denitrification.

- Denitrification beneath the SAT basins will be facilitated by the naturally occurring organic carbon present in the soil, as well as organic carbon remaining in the treated effluent, but may also be further accelerated by operational amendments (e.g., addition of biomass to the base of the SAT basins).

- The significant thickness of the vadose zone of up to approximately 220 ft. provides an infiltration and residence time to support significant denitrification in the vadose zone prior to reaching groundwater.

- Vadose zone modeling forecasts that SAT basin infiltration will not migrate to Waikapū stream, which is located over 2,000 ft. from the basins.

- Under enhanced conditions (e.g. biomass addition to SAT basins), the nitrate impact to groundwater directly beneath the basins is projected to be limited (0.3 mgN/L or less) compared with the initial SAT basin concentration of 8 mgN/L (an approximate 96 percent reduction). This projected concentration is much lower than the existing measured levels of nitrate already in groundwater of 2.0 to 3.0 mgN/L that are a result of natural conditions, past agricultural fertilizer practices, and the regional use of domestic cesspools.

- The projected additive concentration of total nitrogen at the shoreline of Māʻalaea Bay, following approximately 2.5 miles of travel in the subsurface with attenuation due to denitrification, dispersion and dilution, is projected to be less than 0.02 mgN/L under enhanced conditions. This projection is below State discharge regulatory levels for total nitrogen in a Marine Class A embayment such as Māʻalaea Bay (0.15 mgN/L) and inland waters (0.25 mgN/L) such as Keālia Pond.

- Other residual chemicals that may not be attenuated in the WWRF facility prior to SAT basin infiltration and treatment, are modeled to undergo an approximate 93 percent reduction in concentration following infiltration and migration in groundwater to the shoreline. Residual low concentrations of chemicals such as pharmaceuticals and personal care products are forecasted to be below standard laboratory reporting limit levels at potential points of discharge.

- No known drinking water wells are in the projected flow path of the recycled water migration in groundwater.

- A regulatory agency-approved environmental monitoring program will be implemented to evaluate the projections provided herein, and if environmental conditions vary from this evaluation, additional mitigation measures can be deployed, if necessary.

Based on the foregoing, Geosyntec provided the following mitigation measures and recommendations. Refer to **Appendix "F"**.

Siting

- The facility is sited in an area of materials with "Fast" to "Moderate" infiltration rates and more the 2,000 ft. distance from the nearest perennial surface water body, Waikapū Stream.

Wastewater Treatment and Disposal

- The recycled water undergoes secondary, biological nutrient removal and tertiary treatment prior to being applied to the SAT basins and infiltration into the subsurface. For example, the influent recycled water nitrate concentration (8 mgN/L) at the SAT basins is expected to be below the nitrate drinking water maximum contaminant level of 10 mgN/L.

    - A significant proportion of recycled water will be used for offsite irrigation during 11 months of each average year. Thus, the average year SAT basin recycled water infiltration quantity is reduced and is expected to be limited to the month of January only, with potential intermittent, limited off-spec infiltration in other months.

Facility Design

- The use of biomass, such as wood chips, in the base of the SAT basins to increase available organic carbon that may increase denitrification rates, and thereby lower nitrate concentrations in the vadose zone, groundwater, and potential discharge at marine and inland waters.

- An installation of a perimeter vertical slurry wall around the SAT basins to mitigate chemical diffusion at land surface level.

Monitoring

- Implementation of a monitoring program to assess the degree of impact on groundwater quality and potential receptors.

SAT Operation

- Vadose zone modeling for the Wet Year infiltration rates indicated that towards the end of January (the wettest month), there may be a need to manage infiltration rates such that the north and south basins temporarily receive a higher relative infiltration volume. The normal SAT basin infiltration conditions (i.e., negative head pressure and partially saturated soils) recover rapidly under February infiltration rates.

Refer to **Appendix "F"**. The project's Facility Plan incorporates the above-noted recommendations. Refer to **Appendix "A"**.

Due to the amount of grading anticipated during construction, a National Pollutant Discharge Elimination System (NPDES) Stormwater permit will also be obtained for the construction phase to ensure that earthmoving

activities will not result in adverse impacts to downstream properties and the Pacific Ocean.

With implementation of the foregoing mitigation recommendations, potential impacts on Groundwater and Nearshore Water Resources from the proposed project are anticipated to be appropriately addressed.

5. Streams and Wetlands

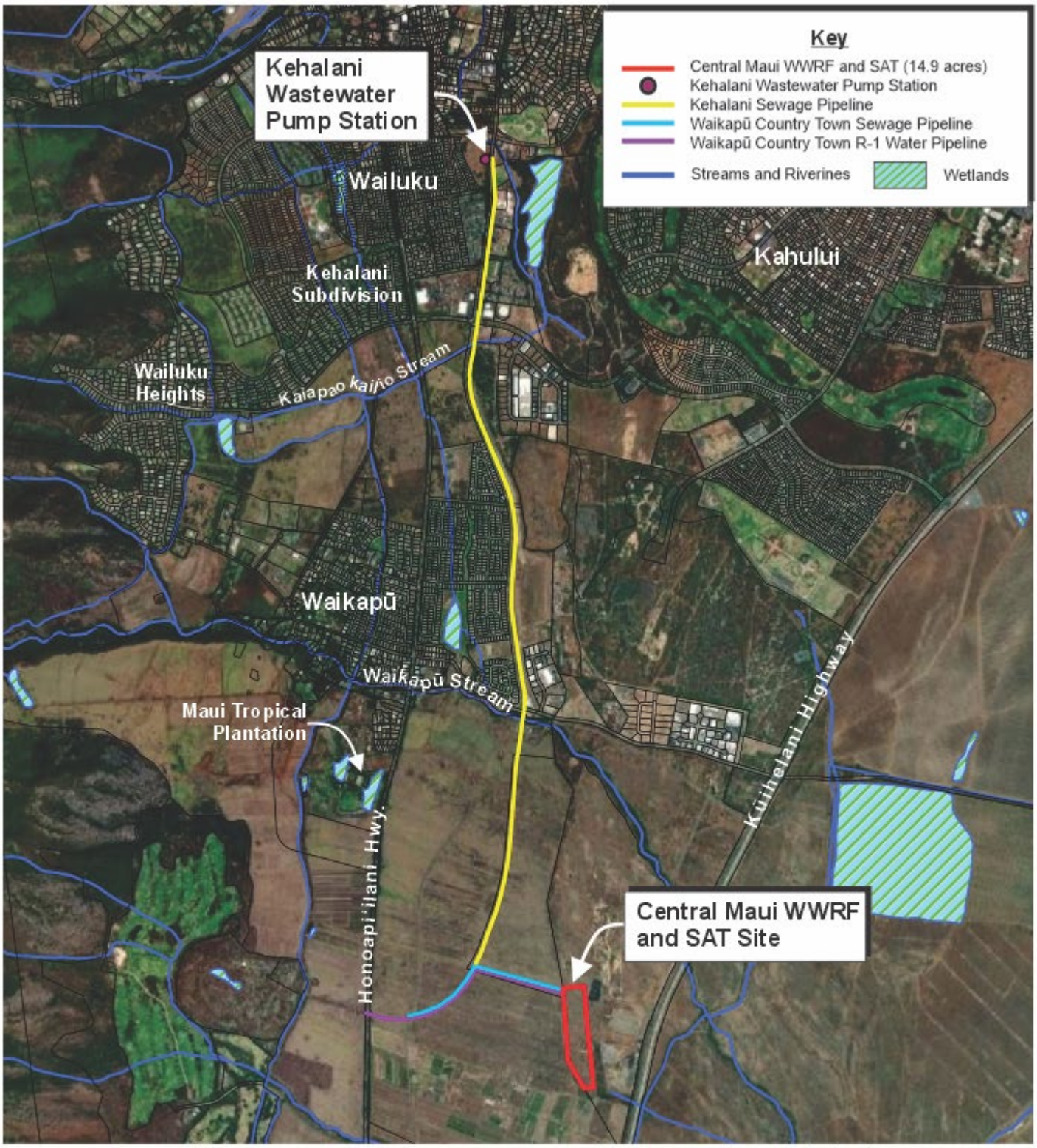
a. Existing Conditions

The Waikapū Stream and Kaiapaokaʻīlio Stream intersect with the proposed Kehalani Sewage Pipeline for this project. The proposed project does not involve any work within wetlands. See **Figure 9**.

Waikapū Stream is a perennial stream originating from the West Maui Mountains. Waikapū Stream is located approximately 2,000 ft. east of the proposed WWRF and SAT basin locations at its closest point. Waikapū Stream is considered to be a "losing stream", meaning the stream water infiltrates into the subsurface. A 2.4 mgd infiltration rate is estimated for an approximately 5-mile reach of lower Waikapū Stream north and east of the proposed WWRF and therefore, Waikapū Stream is considered a significant source of groundwater recharge in this portion of the central Maui isthmus area. Refer to **Appendix "F"**. The stream reach primarily infiltrates into JaC and Puuone sands (PZUE), and less commonly into Pulehu cobbly silt loam (PrB) and Iao cobbly silt clay (IbB). Since 2010, the streamflow in lower Waikapū Stream has been restored, with new streamflow standards set at 2.9 mgd.

The lower Waikapū Stream has been observed to have an incised channel with a 10-foot active stream flow bottom width. With an estimated average stream bed width of 30 ft., it is calculated that the stream infiltrates over 390,000 gallons of water per acre of stream bed. This infiltration is significant and suggests that similar surface soils in the area have a strong potential for liquid infiltration, including excess recycled water.

Kaiapaokaʻīlio Stream originates from West Maui mountains and flows through Wailuku Heights, parallel to Kuikahi Drive. At the crossing with the existing Waiʻale Road, there is an existing box culvert and headwalls which were constructed when the existing Waiʻale Road was built in support of the Waikapū Gardens subdivision. The stream continues to flow eastward underground in a drainline, crossing under Kuikahi Drive before discharging into the southern basin of Waiʻale Reservoir.



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community; U.S. Department of Interior, U.S. Fish and Wildlife Service, and State of Hawai'i, Department of Land and Natural Resources, Division of Aquatic Resources, and County of Maui, Planning Department

Figure 9 Proposed Central Maui Wastewater Reclamation Facility
Streams and Wetlands Map

0 625 1250 2500 Feet

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO HIRAGA

COM/DEM Cmaui WW Infrastructure/Applications/Figures/Streams and Wetlands

b. Potential Impacts and Mitigation Measures

As discussed previously, the vadose zone infiltration modeling conducted by Geosyntec as part of the Hydrogeological Study indicated that infiltration through the SAT basins is predominantly vertical with limited lateral migration. The lateral spread of infiltration liquids and solutes is estimated to extend about 100 ft. from the SAT basin perimeters. The Hydrogeological Study noted that even under the wet precipitation year condition (potential "worst-case" SAT basin infiltration rate scenario), since Waikapū stream is approximately 2,000 ft. away, modeling indicates that there will be no migration of infiltration flow to the stream. Refer to **Appendix "F"**.

The proposed Kehalani Sewage Pipeline (along with other utility lines) will be installed underground of the existing Waiʻale Road, as well as the future Waiʻale Road Extension proposed by the County of Maui, Department of Public Works (DPW). As noted previously, at the intersection of the existing Waiʻale Road with Kaiapaokaʻīlio Stream, the stream flows underground through a box culvert. The proposed Kehalani Sewage Pipeline is anticipated to be installed beneath the existing culvert and as such, will not affect this drainage feature.

The Waiʻale Road Extension project includes construction of a bridge for crossing over Waikapū Stream, and the utility lines will be installed to the bridge and will cross over Waikapū Stream. As such, the installation of the Kehalani Sewage Pipeline is not anticipated to involve any work within Waikapū Stream. While the Waiʻale Road Extension project and the Central Maui WWRF project are separate and distinct projects, DEM and DPW are working closely together to ensure that the design and construction of the proposed Kehalani Sewage Pipeline under the Waiʻale Road Extension are appropriately and efficiently coordinated.

Due to the bridge and utility crossing over Waikapū Stream as part of the Waiʻale Road Extension project, the Department of the Army (DA), U.S. Army Corps of Engineers (USACE) was consulted. The USACE provided a Preliminary Jurisdictional Determination (JD) letter dated June 9, 2023, and preliminarily determined that Waikapū Stream is a Water of the U.S. and under the USACE jurisdiction. See Chapter XI. Because the bridge and utility crossing will be designed to be located above the Ordinary High Water Mark (OHWM), the USACE will continue to be consulted in order to confirm that a DA permit will not be required for the proposed Waikapū Stream crossing. In addition, the USACE will be consulted for the applicability of DA permitting requirements for the Kaiapaokaʻīlio Stream

that intersects with the proposed Kehalani Sewage Pipeline which will be installed under the existing Wai‘ale Road. Refer to **Figure 9**.

As mentioned previously, a NPDES permit will be obtained for the construction phase to ensure that earthmoving activities related to the project will not result in adverse impacts to downstream properties, streams, and wetlands. Measures will be taken to reduce runoff and mitigate potential adverse impact on downstream waters or adjacent properties. To address potential adverse impacts to downstream properties, a program of BMPs will be implemented during both the construction and operational phases of the project. During construction, temporary BMPs, such as temporary sedimentation basins, will be utilized to mitigate erosion and the release of sediment and other pollutants to existing storm drains, waterways, and adjacent properties. Potential permanent mitigation measures will include reduction of impervious surfaces, onsite retention ponds, infiltration basins, and vegetated swales.

From an ongoing operational standpoint, the County of Maui, DEM will provide appropriate training and guidance to staff operating the WWRF to ensure onsite containment of toxic and hazardous substances. For further discussions related to toxic and hazardous substances, see Section A.4, Groundwater and Nearshore Water Resources, and Section A.17, Hazardous Materials.

With implementation of the foregoing mitigation measures, potential impacts on streams and wetland resources from the proposed project are anticipated to be appropriately addressed.

6. Agriculture

a. Existing Conditions

On the Island of Maui, approximately 235,770 acres have been designated as “Agricultural” by the State Land Use Commission (LUC), representing just over 50 percent of the island. The approximately 14.9-acre Central Maui WWRF and SAT site, access road, sewage pipelines, and R-1 recycled water pipeline alignments (except for the segment within the existing Wai‘ale Road) are all located within the State Agricultural District.

In 1977, the State Department of Agriculture developed a classification system to identify Agricultural Lands of Importance to the State of Hawai‘i (ALISH). The classification system is based primarily, though not exclusively, upon the soil characteristics of the land. The three (3) classes

of ALISH lands are: “Prime”, “Unique”, and “Other Important” agricultural land, with all remaining lands termed “Unclassified”.

When utilized with modern farming methods, “Prime” agricultural lands have a soil quality, growing season, and moisture supply necessary to produce sustained crop yields economically. “Unique” agricultural lands possess a combination of soil quality, growing season, and moisture supply to produce sustained high yields of a specific crop. “Other Important” agricultural lands include those that have not been rated as “Prime” or “Unique”, but are of state-wide or local importance for agricultural use. Approximately 62,000 acres, or 26 percent, of Maui’s 235,770 acres of State LUC designated “Agricultural” lands are characterized as “Prime” lands by the ALISH system. The project site for the WWRF and SAT is classified as “Other Important” by ALISH. The proposed sewage pipelines and R-1 recycled water pipeline traverse through lands rated “Prime” and “Other Important” by ALISH, however, these portions of the project area are either existing or future roadways, or easements that are not suitable for agricultural production. The Kehalani WWPS is proposed to be located on land rated “Prime” by ALISH, however, the land is utilized as an existing stormwater detention basin that serves the master-planned Kehalani community. See **Figure 10**.

The University of Hawai‘i, Land Study Bureau (LSB) developed the Overall Productivity Rating, which classified soils according to five (5) levels, with “A” representing the class of highest productivity soils and “E” representing the lowest. These letters are followed by numbers which further classify the soil types by conveying information such as texture, drainage, and stoniness. The ratings are based on soil properties, topography, climate, and other factors. On the island of Maui, LSB “A” and “B” designated lands comprise approximately 21 percent of the island’s State LUC “Agricultural” lands. A portion of the Kehalani Sewage Pipeline alignment (within the existing Wai‘ale Road) and the Kehalani WWPS site are not within the State Agricultural District and, therefore, not classified by the LSB. The WWRF and SAT project site is rated “E”, the lowest productivity level. The rest of the project area traverses through land containing soil ratings “A”, “B”, and “E”. However, as noted previously, these portions of the project area are either existing or future roadways or easements that are not suitable for agricultural production. See **Figure 11**.

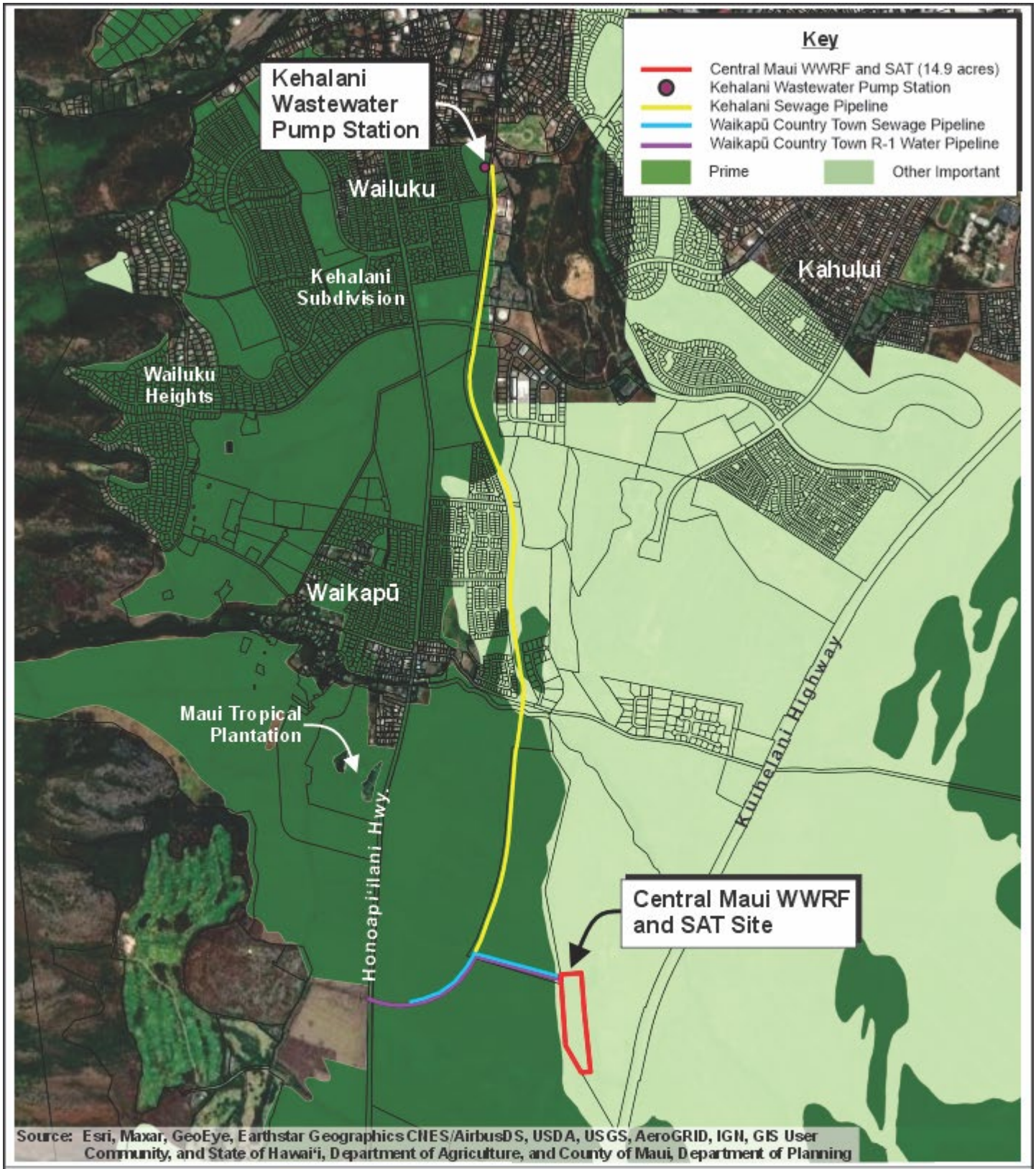


Figure 10 Proposed Central Maui Wastewater Reclamation Facility

Agricultural Lands of Importance in the State of Hawai'i Map

0 1250 Feet
625 2500

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO HIRAGA

COM/DEM Cmaui WW Infrastructure/Applications/Figures/ALISH

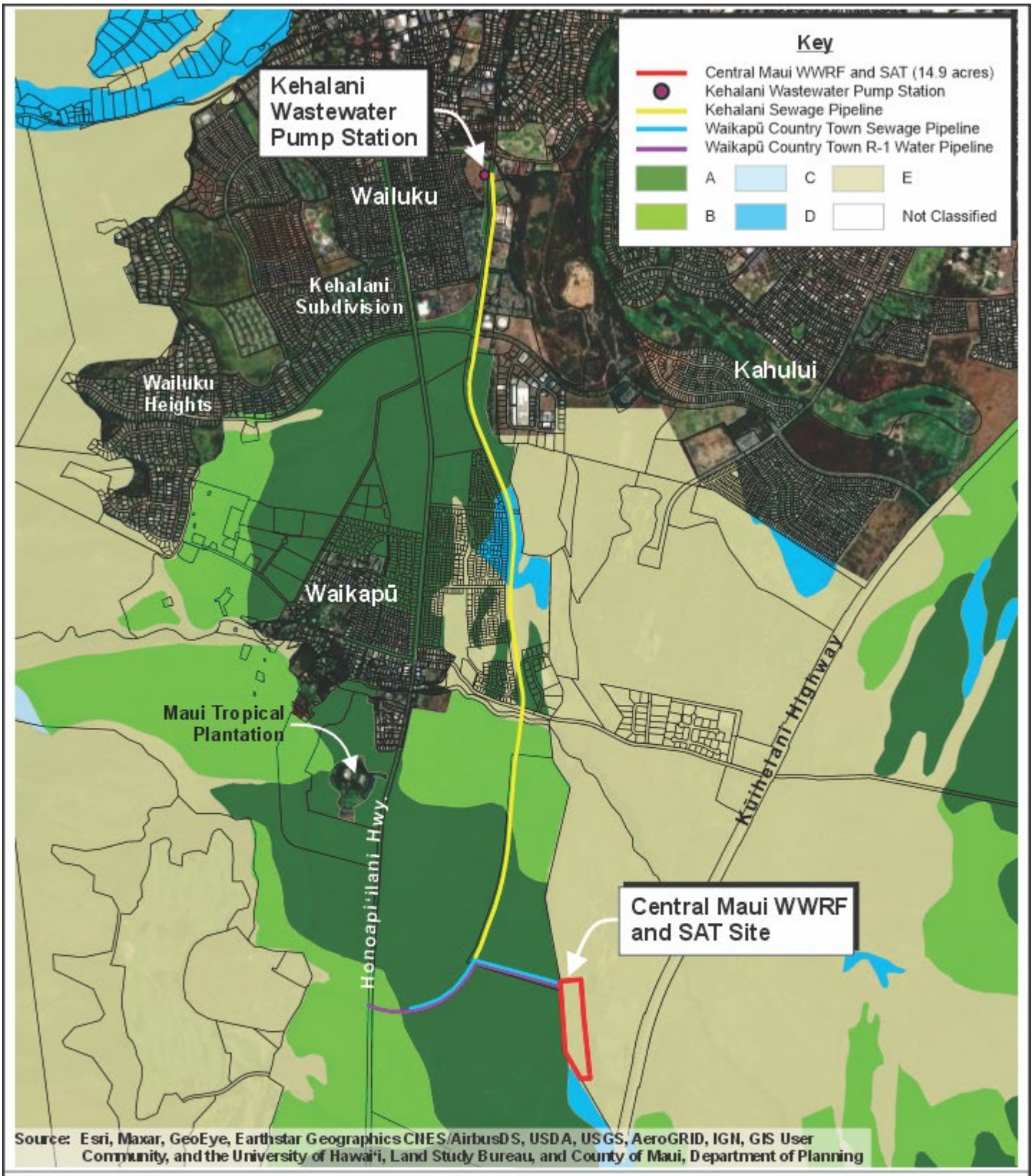


Figure 11 Proposed Central Maui Wastewater Reclamation Facility
Land Study Bureau Map

0 1250 Feet
625 2500

MUNEKIYO HIRAGA

Prepared for: County of Maui, Department of Environmental Management

COM\DEM CMaui WW Infrastructure\Applications\Figures\LSB

Chapter 205, HRS declared that the people of Hawai‘i have a substantial interest in conserving the agricultural resources of the State. The State calls for the identification of Important Agricultural Lands (IAL) to identify and plan for the maintenance of a strategic agricultural land resource base that can support a diversity of agricultural activities and opportunities that expand agricultural income. The proposed project is located outside of IAL. See **Figure 12**.

b. Potential Impacts and Mitigation Measures

An Agricultural Impact Assessment (AIA) titled *Central Maui Wastewater Reclamation Facility: Impacts on Agriculture* was prepared by Plasch Econ Pacific LLC, in April 2024. See **Appendix "H"**. The purpose of the AIA was to address the potential impacts of the proposed project to existing agricultural enterprises on Maui and focused on the 14.9-acre WWRF and SAT site and the approximately 4-acre access and utility easement which will connect the future Wai‘ale Road extension and the WWRF and SAT site. The AIA indicated that the 14.9-acre WWRF and SAT site has poor soil for farming. However, the four (4) acres of the access and utility easement have favorable conditions for farming, including good soils, moderate slopes, high solar radiation, the availability of irrigation water, and good access to markets. If not used by the County for the project or some other non-agricultural purpose (such as a larger regional park), the land could be used for growing crops as part of a larger farm on abutting private property. A standalone farm on the 4-acre easement could be challenging to cultivate due to the long narrow shape of the property (about 1,800 ft. by 100 ft.).

A summary of the AIA analyses is provided below:

(1) Impact on Onsite Agricultural Operations

The AIA indicated that the project would have no impact on existing agricultural operations within the WWRF site or the easement since these lands are vacant and currently host no farming or ranching activities.

(2) Impact on Nearby Agricultural Operations

The AIA noted that development and operation of the Central Maui WWRF, SAT, and related improvements will not interfere with nor limit farming on abutting agricultural lands. Rather, the project will provide potential benefits to the nearby agricultural operations by lowering irrigation water costs to nearby farmers and will increase

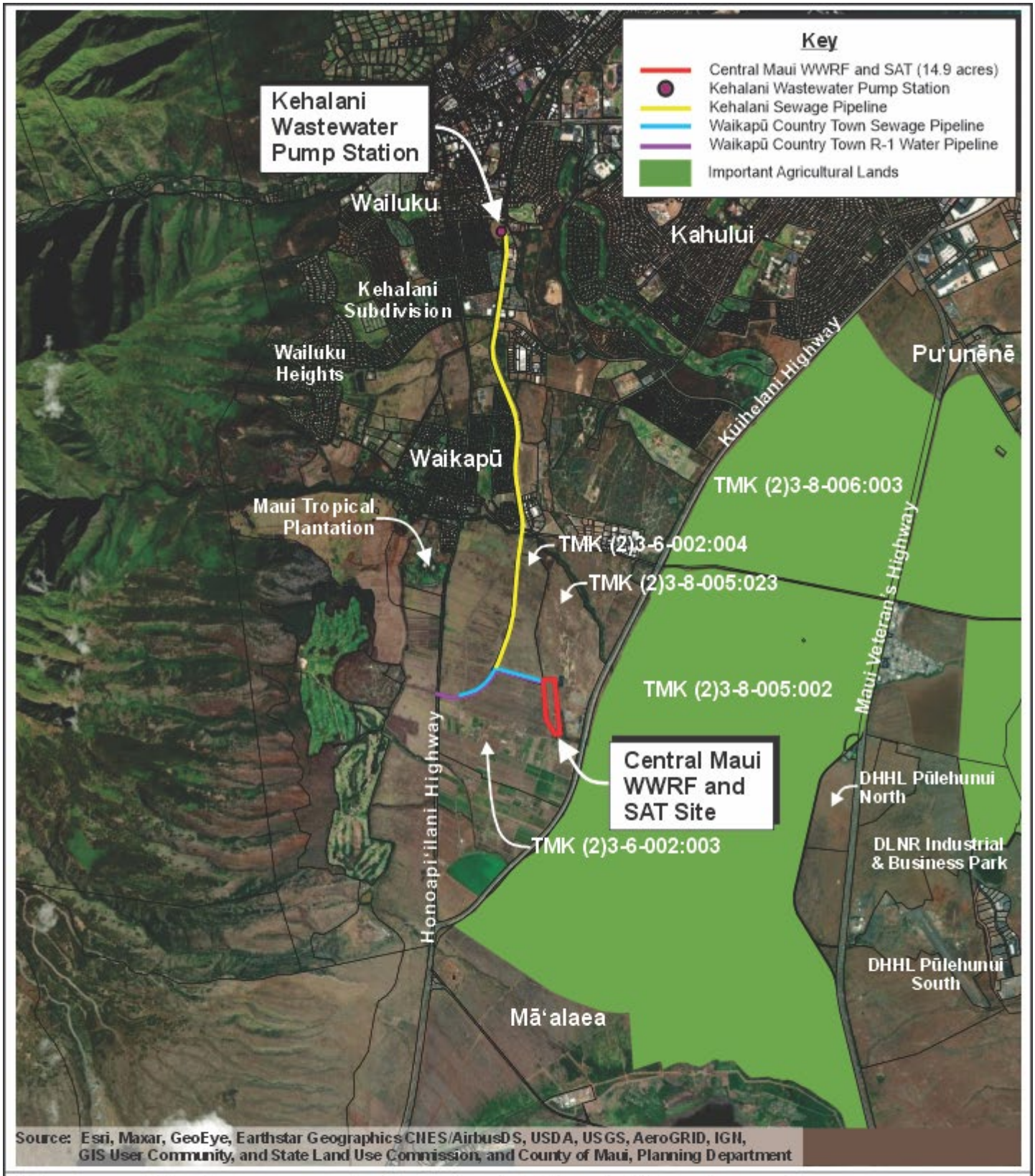


Figure 12 Proposed Central Maui Wastewater Reclamation Facility
Important Agricultural Lands Map

0 1125 2250 4500 Feet

MUNEKIYO HIRAGA

Prepared for: County of Maui, Department of Environmental Management

COM\DEM CMaui WW Infrastructure\Applications\Figures\Imp Ag Lands

the supply of compost, however, the project could increase the risk of equipment and crop theft.

Recycled Water

The primary method of disposing the treated effluent from the WWRF will be to distribute R-1 recycled water to surrounding properties in the Central Maui region for irrigation purposes. According to the State of Hawai'i, Department of Health (DOH), R-1 water is suitable for, from a public health standpoint, any form of irrigation for landscaping as well as food crops, including all edible root crops, where the recycled water comes into contact with the edible portion of the crop. (DOH, 2002). Details of the R-1 recycled water service areas are discussed in Section D.2, Water System, of this Chapter. According to the Final EIS for Waikapū Country Town, this development may use approximately 0.6 mgd of the recycled water for irrigating parks, school yards, and streetscapes. The remaining recycled water, anticipated to be about 3.4 mgd when fully operational, will be used to irrigate (1) nearby agricultural fields (about 1,077 acres available) and (2) a County regional park (about 100 acres).

An estimated 0.5 mgd will be required for the County park (100 acres x 5,000 gallons per acre per day (gpad) ÷ 1,000,000 = 0.5 mgd). Remaining water availability for agricultural use is approximately 2.9 mgd. This volume of water is sufficient to irrigate about 725 acres of land, assuming an average of approximately 4,000 gallons per day (gpd) (2.9 mgd x 1,000,000 gallons/mgd ÷ 4,000 gpad = 725 acres). This average encompasses fields that would be fallow between crop plantings, during which no water will be required. The estimated 725 acres irrigated with recycled water could encompass about 580 acres of farmland abutting and to the south of the WWRF, between Honoapi'ilani Highway and Kūihelani Highway. Most of this land is planned by Wai'ale 905 Partners for farming and about 420 acres are already being farmed, according to the AIA. The remaining 145 acres could be located west of Honoapi'ilani Highway (725 acres total – 580 acres to the south = 145 acres west of the highway). Nearly 500 acres west of the highway are planned for agriculture, and about 80 acres are being farmed.

Since the nearby fields are already supplied with irrigation water from Wailuku Water Company, no significant change in agricultural

activity is expected due to converting to R-1 recycled water. However, the farmers could save about 83 cents per 1,000 gallons of water used. The AIA states that $1.87 per 1,000 gallons is charged by Wailuku Water Company, whereas $1.04 per 1,000 gallons would be charged by the County (for Fiscal Year 2024). The AIA states the farmers could save approximately 83 cents per 1,000 gallons of water used. This translates to annual savings for farmers of about $880,000 per year due to lower water costs (based on an assumed 550 acres farmed (based on 2.9 mgd × 1,000,000 gallons/mgd × $0.83/1,000 gallons in lower water costs × 365 days/yr. = $878,555)).

Compost

The digested solids from the WWRF will be combined with green waste at the County's Central Maui Landfill to produce compost, a portion of which would be available to Maui farmers. The composting process will follow the the U.S. Environmental Protection Agency (EPA) time and temperature criteria to produce a Class A biosolids compost product that can be used as a soil amendment on all types of land, including residential properties and food crops. Refer to **Appendix "A"**.

Security

If open to the public, the easement access road could increase access to abutting farms which, in turn, could increase trespassing onto the farms and possible theft of equipment and crops.

The AIA recommended mitigation measures to address the risk of trespassing from the easement road onto abutting farms and possible theft of equipment and crop include:

- security fencing along the southern border of the easement
- security cameras at the western end of the easement
- possibly restricted public access to the easement road

(3) Impact on the Growth of Diversified-Crop Farming

Loss of Farmland

The project will result in a loss of about four (4) acres of good farmland to be used as the access and utility easement to the WWRF. Without the project, this land could be used for growing crops as part of a farm on abutting private property. As mentioned

above, a standalone farm on just the easement could be challenging to cultivate due to the long narrow shape of the property (about 1,800 ft. by 100 ft.). The AIA states that the loss of about four (4) acres of good farmland is far too small to affect the growth of crop farming on Maui or statewide. The contraction and closure of plantations resulted in a supply of farmland far exceeding demand. Therefore, no mitigation measures for the loss of agricultural land are recommended by the AIA.

7. Flood and Tsunami Hazards

a. Existing Conditions

The Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Map (FIRM) indicates that the majority of the project area is located within Flood Zone X (unshaded), an area of minimal flooding located outside the 0.2 percent annual chance floodplain. A portion of the proposed Kehalani Sewage Pipeline will cross Waikapū Stream, which is designated as Flood Zone AE. Zone AE includes areas subject to inundation by the 1-percent-annual-chance flood event. See **Figure 13**.

The updated County of Maui's Tsunami Evacuation Maps designate three (3) areas: 1) the Safe Zone, illustrated in green on the maps, identifies the safe area in the event of a tsunami; 2) the Extreme Tsunami Evacuation Zone, shown in yellow, designates areas which should be evacuated during an Extreme Tsunami Warning; and 3) the Tsunami Evacuation Zone, shown in orange, identifies areas which should be evacuated in the event of any type of Tsunami Warning. During a Tsunami Warning, destructive waves may inundate all coastlines, while during an Extreme Tsunami Warning waves may move more significantly inland. The Tsunami Evacuation Zone Map shows the project area as being within the Safe Zone in its entirety. See **Figure 14**.

b. Potential Impacts and Mitigation Measures

The proposed project, except for a portion of the Kehalani Sewage Pipeline where it crosses Waikapū Stream (designated as Flood Zone AE), is located outside of any flood prone areas, and all of the project components are outside of the Extreme Tsunami Evacuation Zone or Tsunami Evacuation Zone. As noted previously, as part of the future Waiʻale Road Extension project, a bridge and utility crossing will be installed across Waikapū Stream, which will reduce potential flood hazards. This component of the Waiʻale Road Extension project will comply with special

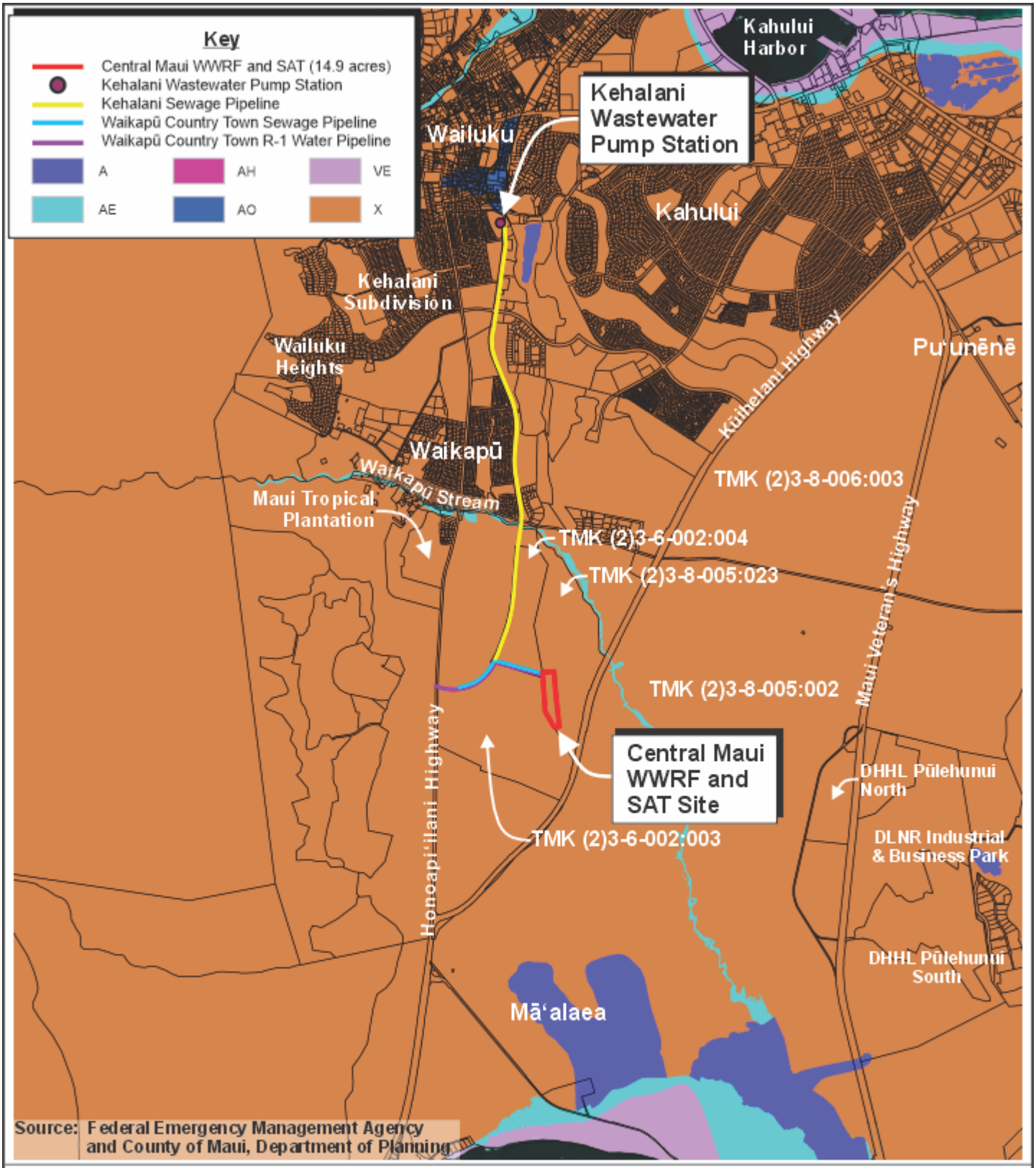


Figure 13 Proposed Central Maui Wastewater Reclamation Facility Flood Insurance Rate Map

0 2250 Feet
1125 4500

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO HIRAGA

COM/DEM Cmaui WW Infrastructure/Applications/Figures/FIRM

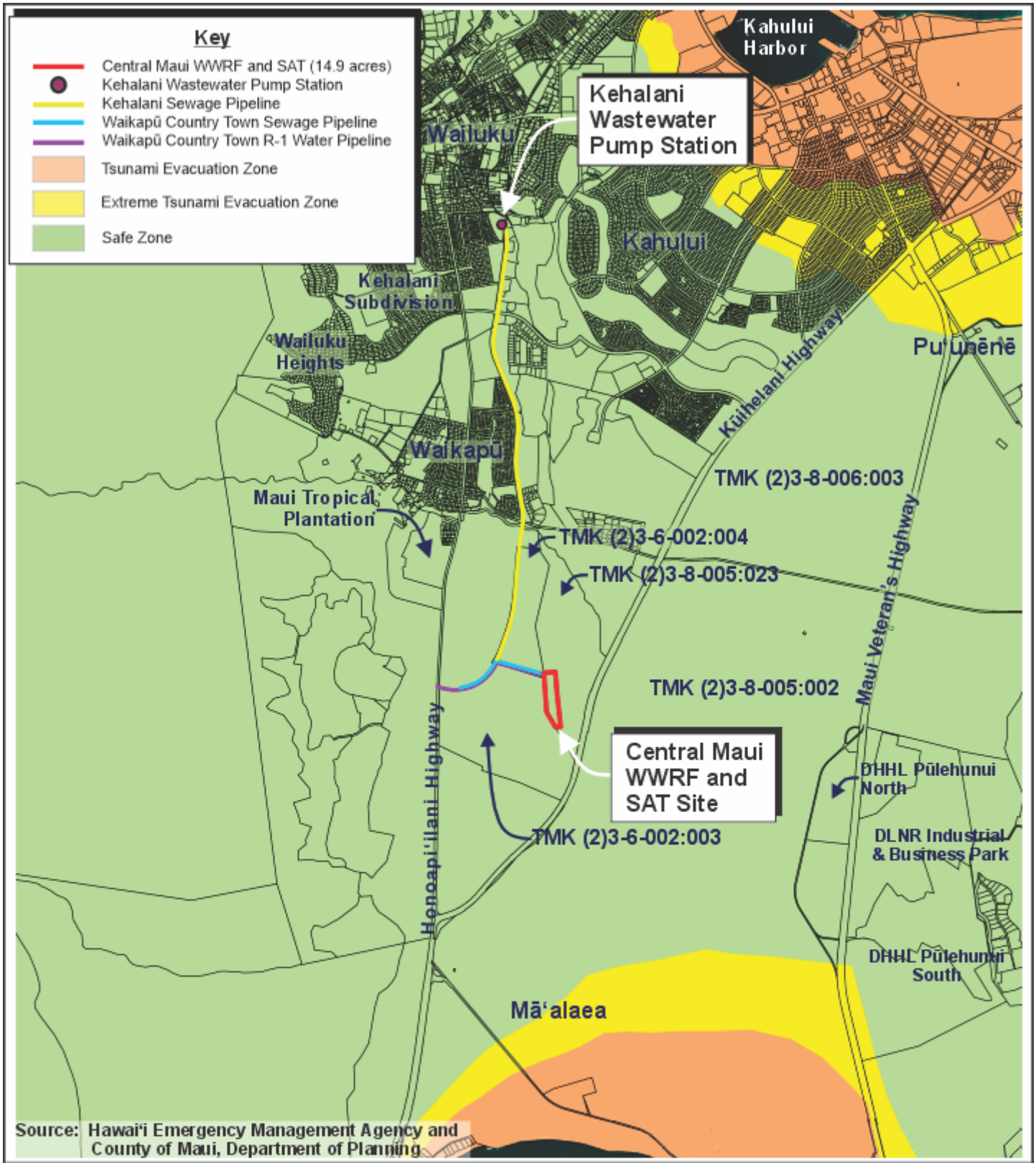


Figure 14 Proposed Central Maui Wastewater Reclamation Facility
Tsunami Evacuation Zones Map

0 2250 Feet
1125 4500

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO HIRAGA

COM/DEM Cmaui WW Infrastructure/Applications/Figures/Tsunami

flood hazard development area permitting requirements, as may be applicable.

It is noted that the existing Wailuku-Kahului WWRF is located in the coastal area of Kahului within Flood Zone AE and Tsunami Evacuation Zone and is nearing its design capacity of 7.9 mgd. In order to divert some of the existing wastewater flows currently flowing to the Wailuku-Kahului WWRF, the Kehalani WWPS is proposed to be constructed, which would divert an estimated existing and future flow of 1.78 mgd from the Wailuku-Kahului WWRF to the proposed Central Maui WWRF. The Central Maui WWRF is to be situated in an inland location and will be less susceptible to flood and tsunami impacts. The proposed project will help reduce potential impacts to the community in the event of facility damage caused by flooding or tsunami events.

8. Sea Level Rise

a. Existing Conditions

Due to Hawai‘i’s location in the Pacific, it is often faced with risks due to extreme weather events. Changing climatic patterns caused by global warming result in impacts, including rising sea levels, storm surge, increased flood potential, and beach erosion for oceanfront and shoreline parcels. To evaluate potential risks due to sea level rise, several resources that are available for planning for sea level rise in Hawai‘i were consulted. These include the Updated Hawai‘i Sea Level Rise Vulnerability and Adaptation Report that was prepared in 2022 by the Hawai‘i Climate Change Mitigation and Adaptation Commission that projects a 3.2-foot rise in sea level for the Hawaiian Islands by the mid-to-latter half of the 21st century. It is noted that the project sites are located inland and outside of the projected 3.2-foot Sea Level Rise Exposure Area (SLR-XA) (Hawai‘i Climate Change Mitigation and Adaptation Commission, 2022). See **Figure 15**.

b. Potential Impacts and Mitigation Measures

As the entire project site is located in an inland location outside of the projected 3.2-foot SLR-XA, no foreseeable impacts related to sea level rise or mitigation measures are anticipated. As noted previously, the Central Maui WWRF is proposing to divert an estimated existing and future flow of 1.78 mgd from the existing Wailuku-Kahului WWRF, which is located within the 3.2-foot SLR-XA. The proposed diversion to the Central Maui WWRF will reduce demand on the Wailuku-Kahului WWRF and help lower

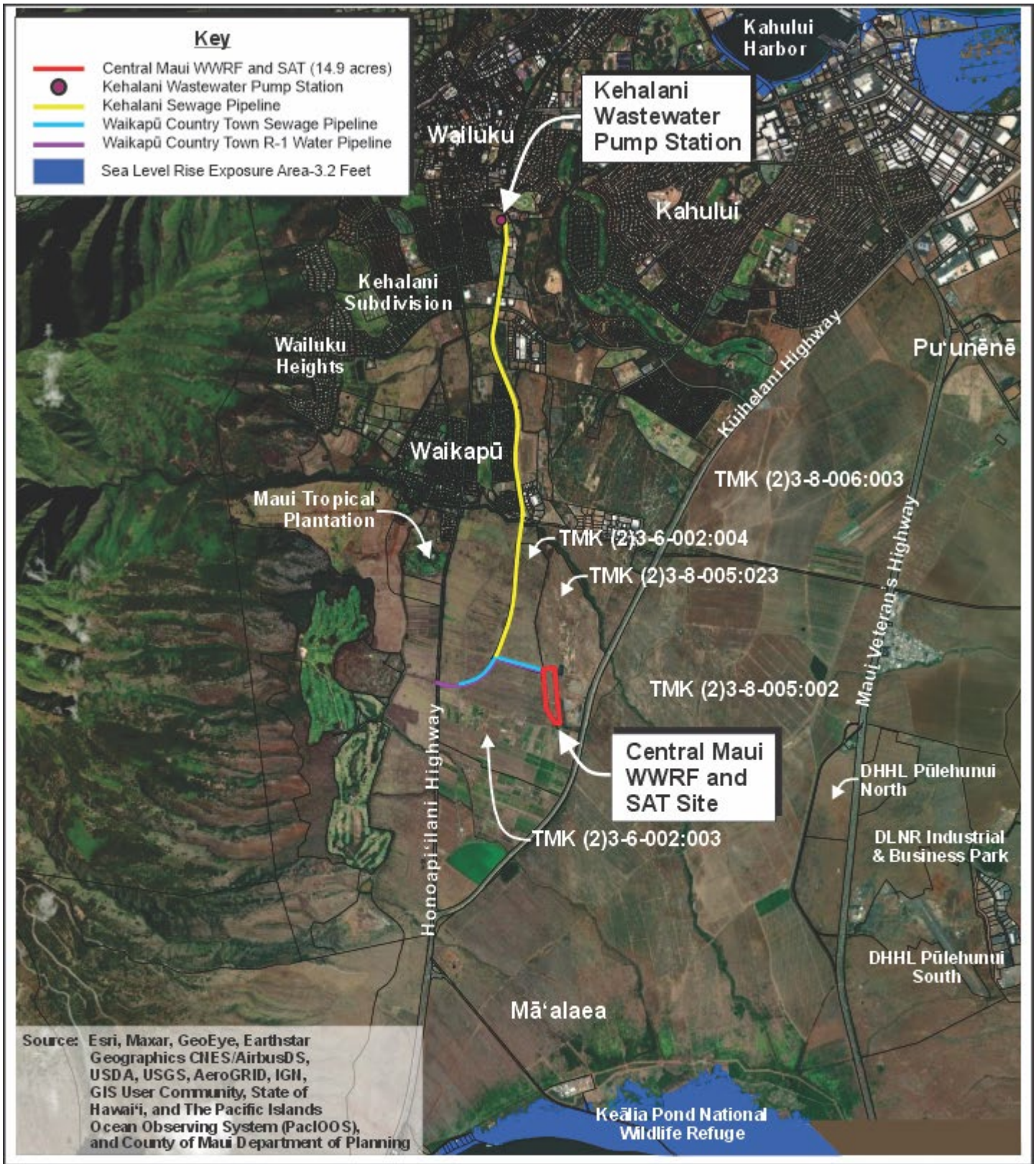


Figure 15 Proposed Central Maui Wastewater Reclamation Facility

3.2-Foot Sea Level Rise Exposure Area Map

0 2250 Feet
1125 4500

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO HIRAGA

COM/DEM Cmaui WW Infrastructure/Applications/Figures/SLRX

potential impacts to the community in the event of facility damage caused by coastal erosion or storm events, induced by climate change.

9. Flora and Fauna

a. Existing Conditions

The project area is mainly characterized as either former agricultural lands, the existing Waiʻale Road, or the existing stormwater detention basin owned by the County of Maui. A site-specific Biological Resources Survey was carried out for the project by an environmental consultant, Robert W. Hobdy, in March 2023. See **Appendix "I-1"**.

Vegetation

The vegetation in the existing Waiʻale Road is entirely a maintained landscape with mowed grass and a few ornamental street trees. The survey identified the undeveloped portions of the project area to be primarily covered by dense grassland dominated by two (2) plant species. Guinea grass (*Megathyrsus maximus*) was the most abundant, buffelgrass (*Cenchrus ciliaris*) is the next most common species. A total of 79 plant species were recorded during the survey. Besides the above two (2) grass species, 27 species were lightly dispersed within the survey area, and an additional 50 species were found sparingly.

Just three (3) of these species were native plants: ʻuhaloa (*Waltheria indica*), ʻilima (*Sida fallax*), and koali kuahulu (*Merremia aegyptia*). All three (3) of these are indigenous species, meaning that they occur naturally throughout the Hawaiian Islands, but also occur naturally in other parts of the world. All three (3) are quite common in Hawaiʻi and are of no environmental concern.

The remaining 76 plants recorded during the survey were non-native, many of which are known to be agricultural or roadside weeds in Hawaiʻi.

Mammals

The survey recorded three (3) non-native mammal species in the project area during three (3) site visits. Axis deer (*Axis axis*) tracks and droppings were observed in many areas within the undeveloped portions of the project area. Likewise, a few tracks of feral pigs (*Sus scropha*) were seen. Some mongooses (*Herpestes auropunctatus*) were also observed.

A special effort was made to detect the presence of the endemic ʻōpeʻapeʻa or Hawaiian hoary bat (*Lasiurus cinereus semotus*) by making an evening

survey at two (2) locations using a bat detector (Batbox III D) set to the frequency of 27 megahertz which these bats are known to emit when echolocating for nocturnal flying insects on which they prey. No bats were detected with the use of this device.

Other non-native mammals one might expect to occur in this habitat, but were not seen, include rats (*Rattus spp.*), mice (*Mus domesticus*), domestic dogs (*Canis familiaris*), and feral cats (*Felis catus*).

Birds

Nine (9) non-native bird species were recorded in the project area during three (3) site visits. One (1) species was common, the zebra dove (*Geopelia striata*). Five (5) other species were recorded in a few instances: spotted dove (*Streptopelia chinensis*), black francolin (*Francolinus francolinus*), common myna (*Acridotheres tristis*), house sparrow (*Passer domesticus*), and the nutmeg mannikin (*Lonchura punctulata*). Three (3) other species were recorded, but occurred sparingly.

The project area is not suitable for native seabirds, waterbirds, forest birds, or nēnē geese and none were seen.

Insects

Insects were represented by nine (9) non-native species, representing four (4) insect orders. Two (2) species were common: the long-tailed blue butterfly (*Lampides boeticus*) and the short-horned grasshopper (*Oedaleus abruptus*). Four (4) species were uncommon: dung fly (*Musca sorbens*), monarch butterfly (*Danaus plexippus*), large suphur butterfly (*Phoebis agarithe*), and the cabbage butterfly (*Pieris rapae*). Three (3) other species were of rare occurrences in the survey area. No native insects were recorded during the survey.

Three (3) young tree tobacco plants were found during the survey. Although the tree tobacco plant is not threatened or endangered, it is an important non-native host plant for the endemic and Endangered Blackburn's sphinx moth (*Manduca blackburni*) which lays its eggs on the plant and whose larvae feed upon the leaves and mature on them before pupating and completing their life cycle. The tree tobacco identified during the survey were examined, but the Blackburn's sphinx moth, eggs or larvae were not found on the host plants.

b. Potential Impacts and Mitigation Measures

The wildlife within the project area is composed mostly of non-native species that are of no special conservation concern. Three (3) indigenous plants, ʻilima (*Sida fallax*), ʻuhaloa (*Waltheria indica*), and koali kuahulu (*Merremia aegyptia*) were found growing in the area, however, they are common occurrence throughout Hawaiʻi. No federally listed Endangered or Threatened plant species were found, nor do any plants that are candidates for such status occur on the project area. The Biological Resources Survey concluded that the proposed project is not expected to have significant negative impacts on the botanical resources within the region.

While no federally protected seabirds are known to utilize the project area, the Biological Resources Survey noted that endangered ʻuaʻu or Hawaiian dark-rumped petrel (*Pterodroma sandwichensis*) and ʻakēʻakē or band-rumped storm petrel (*Oceanodroma castro*) as well as the threatened ʻaʻo or Newell's shearwater (*Puffinus newelli*) are known to fly over lowlands to and from their nesting burrows high in the mountains between the months of March and November. These birds are often distracted and confused by bright outdoor lighting which can cause them to crash to the ground where they are vulnerable to be run over by vehicles or killed by predators. Young birds taking their first fledging flights out to sea are particularly vulnerable. It was recommended that all outdoor lighting be shielded, so all light is directed toward the ground to address this danger.

In addition to the Biological Resources Survey's recommendations, the U.S. Fish and Wildlife Service (USFWS) recommended the use of their online tool, Information for Planning and Consultation (IPaC), to produce an official species list of endangered and threatened species that may be present in or near the project area. See **Appendix "I-2"**. It is noted that the project area does not contain any USFWS identified wildlife refuge lands, fish hatcheries or critical habitats. In addition, the State Division of Forestry and Wildlife (DOFAW) provided recommendations during the Environmental Impact Statement Preparation Notice (EISPN) comment period.

Through consultation with DOFAW and the USWFS, the project will implement the following avoidance and mitigation measures, as applicable and feasible.

Hawaiian goose (nēnē), (Branta (Nesochen) sandvicensis)

- Do not approach, feed, or disturb nēnē.
- If nēnē are observed loafing or foraging within the project area during the breeding season (September through April), have a biologist familiar with nēnē nesting behavior survey for nests in and around the project area prior to the resumption of any work. Repeat surveys after any subsequent delay of work of 3 or more days (during which the birds may attempt to nest).
- Cease all work immediately and contact the USFWS for further guidance if a nest is discovered within a radius of 150 ft. of the proposed project, or a previously undiscovered nest is found within the 150-foot radius after work begins. In areas where nēnē are known to be present, post and implement reduced speed limits, and inform project personnel and contractors about the presence of endangered species onsite.

Hawaiian Seabirds (Endangered Hawaiian petrel, Pterodroma sandwichensis; Threatened Newell's shearwater, Puffinus auricularis newelli; and Endangered Hawai'i Distinct Population Segment of the band-rumped storm-petrel, Oceanodroma castro):

- Fully shield all outdoor lights so the bulb can only be seen from below.
- Install automatic motion sensor switches and controls on all outdoor lights or turn off lights when human activity is not occurring in the lighted area.
- Avoid nighttime construction during the seabird fledging period, September 15 through December 15.

It is acknowledged that Hawaiian seabirds may traverse the project area at night during the breeding, nesting and fledging seasons (March 1 to December 15).

Hawaiian waterbirds (Hawaiian stilt, Himantopus mexicanus knudseni; Hawaiian coot, Fulica alai; Hawaiian common gallinule, Gallinula galeata sandvicensis; Hawaiian duck, Anas wyvilliana):

- In areas where waterbirds are known to be present, post and enforce reduced speed limits, and inform project personnel and contractors about the presence of endangered species onsite.

- Incorporate the USFWS' BMPs for Work in Aquatic Environments into the project design.

- Have a biological monitor that is familiar with the species' biology conduct Hawaiian waterbird nest surveys, where appropriate habitat occurs within the vicinity of the proposed project site, prior to project initiation. Repeat surveys again within three (3) days of project initiation and after any subsequent delay of work of three (3) or more days (during which the birds may attempt to nest). If a nest or active brood is found:

    - Contact the USFWS and DOFAW Maui Branch within 48 hours for further guidance.

    - Establish and maintain a 100-foot buffer around all active nests and/or broods until the chicks/ducklings have fledged.

    - Do not conduct potentially disruptive activities or habitat alteration within this buffer.

    - Have a biological monitor that is familiar with the species' biology present on the project site during all construction or earth moving activities until the chicks/ducklings fledge to ensure that Hawaiian waterbirds and nests are not adversely impacted.

Hawaiian hoary bat (Lasiurus cinereus semotus):

- Do not disturb, remove, or trim woody plants greater than 15 feet tall during the bat birthing and pup rearing season (June 1 through September 15).

- Do not use barbed wire for fencing.

It is noted that barbed wire fencing is not proposed as part of the project, and there will be no clearing of trees or shrubs taller than 15 feet.

Blackburn's sphinx moth (Manduca blackburni):

- A biologist familiar with the species should survey areas of proposed activities for Blackburn's sphinx moth and its larval host plants prior to work initiation.

- Surveys should be conducted during the wettest portion of the year (usually November-April or several weeks after a significant rain) and within 4-6 weeks prior to construction.

- Surveys should include searches for eggs, larvae, and signs of larval feeding (chewed stems, frass, or leaf damage).

- If native aiea or tree tobacco over three (3) feet tall, or adult Blackburn's sphinx moths are found during surveys, do not disturb them and contact the Service for additional guidance to avoid taking.

It is noted that the tree tobacco plant, although not threatened or endangered, is a host plant for the Blackburn's sphinx moth if it grows to be three (3) feet or taller. Tree tobacco can grow greater than three (3) feet tall in approximately six (6) weeks. As such, the USFWS recommends the following avoidance and mitigation measures be implemented:

- Remove any tree tobacco less than three (3) feet tall.

- Monitor the site every four (4) to six (6) weeks for new tree tobacco growth before, during, and after the proposed ground-disturbing activity. This monitoring can be completed by any staff, such as groundskeeper or regular maintenance crew, if they are provided with picture placards of tree tobacco at different life stages.

Endermic Pueo or Hawaiian Short-Eared Owl (Asio flammeus sandwichensis)

- While the endemic Short-eared owl or pueo (*Asio flammeus sandwichensis*) could potentially occur in the project's vicinity, the pedestrian Biological Resources Survey for the project did not identify pueo within or in the vicinity of the project area. Should a pueo nest be discovered, a minimum 100-meter buffer distance will be established until chicks are able to take flight

With the negative findings of the Biological Resources Survey prepared for the project and with implementation of the aforementioned avoidance and mitigation measures, the project will seek to minimize potential adverse impacts to threatened and endangered species. Refer to **Appendix "I-1"**. Furthermore, landscaping for the proposed project will utilize native and indigenous trees and shrubs to the extent practicable and will avoid use of invasive species.

10. Wildfire Hazards

a. Existing Conditions

Organizations such as the State DOFAW and the Hawai‘i Wildfire Management Organization (HWMO) have identified wildfires as an increasingly common hazard to communities and native ecosystems due to dry climatic conditions, non-native invasive species, increased commercial residential development, and more people living in close proximity to wildland areas. In Hawai‘i, wildfires have also been correlated to drought conditions; wildfire history data show an increase in ignition and the areas burned during the warmer drier months of summer (DOFAW, 2016).

The State’s Fire Management Program is part of the Watershed Protection and Management Section of DOFAW. DOFAW’s Fire Management Program continues to be at the forefront of wildfire and all other risk-management training throughout the State. DOFAW identifies Communities at Risk from wildfires (CARs) within the Wildland-Urban Interface (WUI) based on vegetation type, climatic regimes and history of wildfires. Across the continental United States, the WUI is roughly defined as the zone where natural areas and development meet. In Hawai‘i, this definition has been expanded. Steep slopes create linkages between upland wildland fires and downslope impacts on communities, coastal areas, and municipal resources. Conversely, wildfires that ignited near developed areas quickly spread into forested areas because of invasive grasses, putting threatened and endangered plant and animal species at risk. Hawai‘i is also unique in that the vegetation surrounding communities is rapidly undergoing changes that yield higher wildfire risk, in large part due to increased invasion by fire-prone species from changes in land uses, such as active agriculture becoming unmanaged fallow land (Hawai‘i Emergency Management Agency, 2023).

DOFAW has worked in partnership with the HWMO to address wildfire hazards, mitigation, and response efforts. HWMO has worked on developing Community Wildfire Protection Plans across the State. The majority of the project area is located within the Upcountry Maui Community Wildfire Protection Plan (CWPP), finalized in 2016 (and updated in 2024). While the Kehalani WWPS and a northern portion of the Kehalani Sewage Pipeline are located within the Kahului CWPP area, a CWPP for Kahului has not been prepared.

In 2020, the U.S. Department of Agriculture mapped wildfire risk to communities throughout Maui County with a risk level ranging from very low to very high. Wildfire risk was evaluated based on the likelihood and intensity of potential wildfires through fire behavioral modeling which simulates factors such as weather, topography, and ignitions in recent decades along with the presence of vegetative fuel. Other factors that contribute to wildfire risk are the interface of urban development adjacent to wildland vegetation. The WWRF and SAT sites are classified as having a moderate wildfire risk. The Kehalani WWPS site is clarified as having a very low to moderate risk. The pipelines proposed within areas of the existing Waiʻale Road and future Waiʻale Road Extension are identified as having a very low to moderate wildfire risk, except for a small area near Waikapū Stream which is identified as having a high wildfire risk. See **Figure 16**.

b. Potential Impacts and Mitigation Measures

The proposed WWRF and SAT site and related offsite improvement sites are not classified as having a high wildfire risk, except for a small area near Waikapū Stream. A portion of the proposed Kehalani Sewage Pipeline, which is located within the high wildfire risk area, is proposed to be located underground of the future Waiʻale Road Extension, and as such, potential wildfire impacts are not anticipated to be significant. However, there are very low to moderate risks of wildfire for the remainder of the project area. Refer to **Figure 16**. Specifically, the WWRF is proposed to be located amongst fallow, former agricultural fields which now consist of dense grassland. In order to reduce wildfire risk, hazard mitigation measures to reduce vegetative fuel for wildfires will be implemented. These measures include, but are not limited to, vegetation control, creation of fire breaks, planting of drought-tolerant, fire-resistant plants away from power lines, and removal of highly flammable materials such as scrap wood.

11. Air Quality

a. Existing Conditions

The project area, similar to the rest of Hawaiʻi, generally does not experience adverse air quality conditions. Notable point sources of air contaminants in the local area can be attributed to vehicle exhaust, as well as periodic events such as Hawaiʻi Island volcanic eruptions and Central Maui wildfires. The above-noted sources are relatively intermittent, however, the prevailing tradewinds disperse suspended particulates to maintain a relatively high level of air quality in and around the project area.

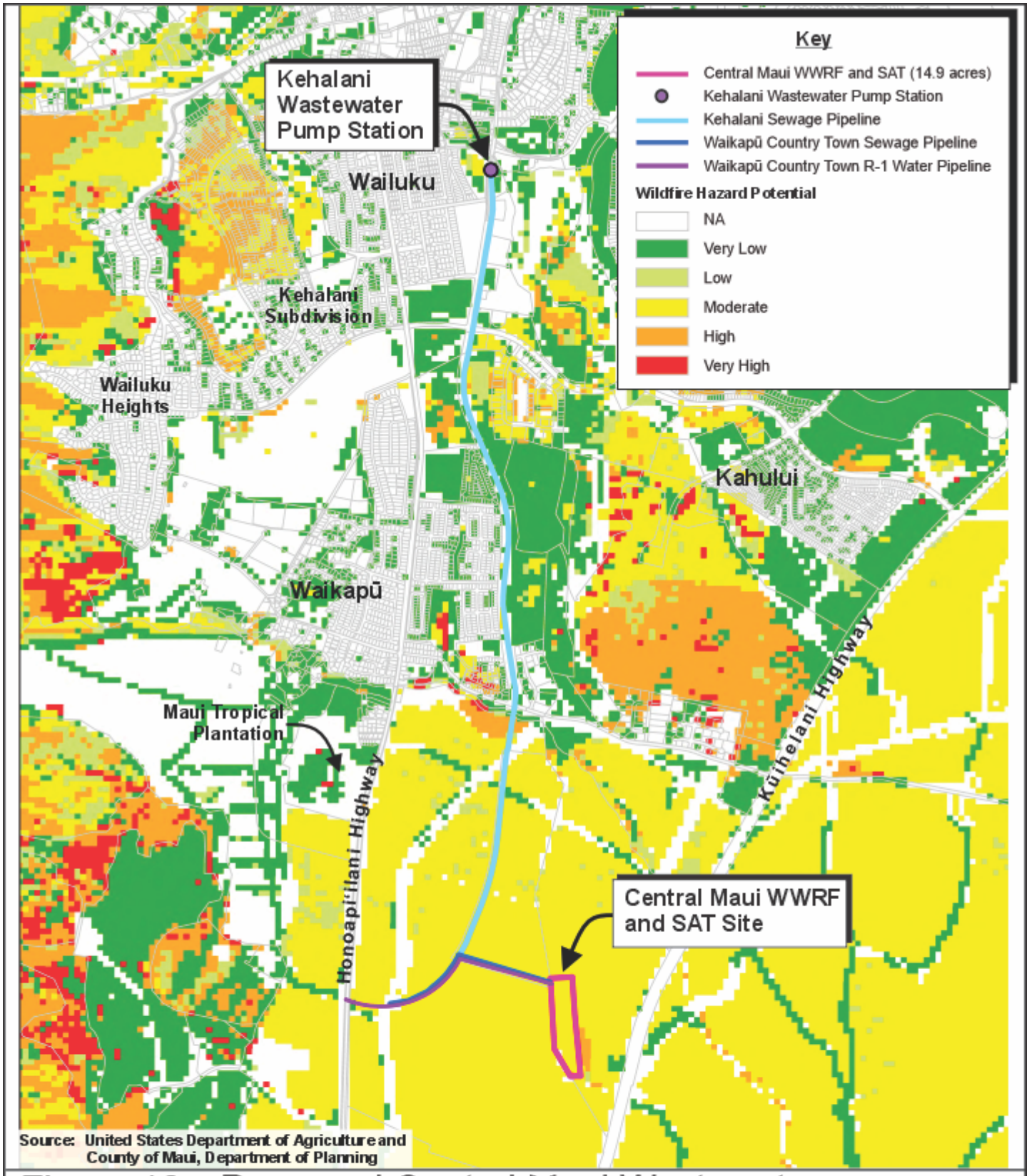


Figure 16 Proposed Central Maui Wastewater Reclamation Facility
Wildfire Hazard Potential Map

1250 0 Feet 625 2500

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO HIRAGA

COM/DEM Cmaui WW Infrastructure/Applications/Figures/Wildfire

A project-specific Air Quality Study report was prepared in November 2024 by Terry A. Hayes Associates, Inc. (TAHA). See Appendix "J". According to the Air Quality Study, air pollutants are regulated by the U.S. EPA at the federal level and by the State Clean Air Branch at the State level. Pollutants can be defined as daily emissions and pollutant concentrations. "Emissions" are the quantity of a pollutant emitted into the air measured in pounds per day or tons per day, while "concentrations" refer to the amount of pollutant material per volumetric unit of air. Air pollutants are known to have negative health impacts and may include Ozone (O_3) or smog, Nitrogen Dioxide (NO_2), Carbon Monoxide (CO), Sulfur Dioxide (SO_2), Particulate Matter (PM), lead (Pb), hydrogen sulfide (H_2S), toxic air contaminants (TACs) and odors and dust caused by industrial activity such as construction, agriculture, landfills, wastewater treatment plants or composting facilities. The U.S. EPA defines Prevention of Significant Deterioration (PSD) thresholds which apply to new major sources or major modifications at existing sources for pollutants. The relevant PSD thresholds in Hawai'i include Volatile organic compounds (VOC), nitrogen oxides (NOx), and CO, and the threshold for each pollutant is 250 tons per year (tpy).

According to the report and the DOH Clean Air Branch air quality data, the nearest DOH air quality monitoring site is located approximately two (2) miles from the WWRF and SAT site in Kahului. Data from the Kahului station indicates that ambient air quality is generally good and that air pollutants, $PM_{2.5}$, are well below the standards. This station only monitors $PM_{2.5}$ concentrations. It is noted that $PM_{2.5}$ refers to particulate matter with a diameter of 2.5 micrometers or less.

b. <u>Potential Impacts and Mitigation Measures</u>

The Air Quality Study report concluded that implementation of the project would not result in an adverse effect on the air quality both during construction and operation of the proposed WWRF and offsite improvements. Refer to **Appendix "J"**.

<u>Construction Air Pollutant Emissions</u>

Common sources of construction-related air pollution include equipment engine exhaust, as well as mobile source of vehicle trips, all of which are temporary in nature and do not represent permanent sources of air pollutants. Emissions often vary substantially from day to day, depending on the level of activity, the specific operations, and the prevailing meteorological conditions.

According to the Air Quality Study report, neither State nor the U.S. EPA have created a model for efficiently estimating construction emissions. Therefore, equipment inventories for each phase of the construction activities were populated by using the California Emissions Estimator Model to estimate emissions of VOC, NOx, and CO during each year of construction. Based on the estimated construction periods of 2025 to 2027 for the proposed pipelines underground of the Waiʻale Road Extension and 2027 to 2029 for the reminder of the project, the analysis indicated that the maximum annual emissions of VOC, NOx, and CO during the construction phase would remain substantially below all of the U.S. EPA PSD thresholds. See **Table 4**.

Table 4. Construction Emissions of VOC, NOx, and CO

Year	Annual Emissions (Tons per Year)		
	VOC	**NOx**	**CO**
2025	<0.1	0.2	0.5
2026	0.2	1.0	2.8
2027	0.5	3.6	5.8
2028	0.5	4.3	6.4
2029	7.6	0.8	1.3
Maximum Annual	**7.6**	**4.3**	**6.4**
USEPA PSD Threshold	250	250	250
Source: TAHA, 2024.			

Construction activities would also generate fugitive dust emissions during earthwork activities. The proposed project will implement BMPs during construction, such as periodic application of water onto exposed or disturbed ground areas and material stockpiles, dust and silt fencing for erosion control, maintaining equipment in accordance with manufacturer specifications, sweeping of dust track-out on surrounding roadways, and prompt revegetation of graded areas. Furthermore, the DOH Clean Air Branch published a Fugitive Dust Fact Sheet, which was last revised in April 2019 and includes reasonable precautions to reduce fugitive dust. Examples of these precautions include development/implementation of a dust control plan and use of water or suitable chemical compounds in the demolition of existing structures, construction operations, and grading or clearing of land. The project contractors will implement appropriate BMPs to reduce fugitive dust emissions and will comply with the fugitive dust rules.

Operational Air Pollutant Emissions

Electricity generation and vehicle exhaust associated with worker trips would be the primary sources of emissions during the operational phase of the project. It is estimated that the operation of the proposed project would require 11.7 million kilowatt-hours (kWh) of electricity annually. Tailpipe

emissions from on-road vehicle trips generated by WWRF workers would be distributed along the surrounding roadway network and would not be heavily concentrated in one location. The Air Quality Study report concluded that these emissions would not exceed the U.S. EPA PSD thresholds. See **Table 5**. The entirety of Maui is designated as attainment of the ambient air quality standards, and mobile source emissions from the proposed project vehicle trips would not have the potential to compromise the attainment of designations by deteriorating air quality.

Table 5. Annual Operational Emissions of VOC, NOx, and CO

Year	Annual Emissions (Tons per Year)		
	VOC	NOx	CO
2025	3.3	1.2	3.6
USEPA PSD Threshold	250	250	250
Source: TAHA, 2024.			

Regarding localized mobile source emissions, CO concentrations are often used as an indicator of pollutant exposure to sensitive receptors. The U.S. EPA has published guidance on prevention of CO "hot spots" at congested traffic intersections resulting from idling and slow-moving vehicles. The Air Quality Study concluded that the proposed project has no potential for the proposed project to result in a CO hotspot and, therefore, no potential for the proposed project to result in substantial concentrations of related exhaust pollutants.

Odors

Wastewater treatment plants can be a source of nuisance odors to the surrounding community if not properly designed/mitigated. Nuisance odors are typically associated with anaerobic conditions and with residual solids processing. In recognition of the proposed WWRF, sewage pipelines as well as the Kehalani WWPS located near residential areas, appropriate odor control systems will be used to reduce potential nuisance odors to the surrounding community. According to the Central Maui WWRF Facility Plan (refer to **Appendix "A"**), the following odor control measures will be incorporated at the WWRF:

- Headworks is commonly an odorous process area at WWRFs and will be covered or enclosed to facilitate foul odor collection. The air removed from the process will be treated in an odor control biotrickling filter (or similar process). Biotrickling filters consist of a vessel filled with plastic or ceramic media.

- Recycled water is distributed over the media using distribution piping, and the foul air is treated as it flows through the media. Biotrickling filters are capable of removing H_2S and a wide variety of other odorous compounds from the air.

- The liquid treatment processes within the wastewater treatment plant will not be a source of nuisance odors because the process tanks will be aerated to maintain dissolved oxygen concentrations at approximately 2.0 mg/L or greater at all times.

- Waste solids will be pumped to an aerobic digester for stabilization. The dissolved oxygen concentration in the aerobic digester will be maintained at 2.0 mg/L or greater at all times by aeration. The WWTP will include at least one redundant blower for each aeration system to ensure that aeration air can be provided at all times.

- The solid's dewatering process is another potential source of odors. The dewatering equipment will be enclosed in a room to facilitate foul air collection. The foul air will be routed to a biotrickling filter for treatment.

In addition, the Kehalani Wastewater Pump Station Technical Memorandum (refer to **Appendix "C"**) indicated potential odors from Kehalani WWPS will be mitigated with a packaged system consisting of a fan, an activated carbon scrubber, and ductwork. The fan will come with an acoustic enclosure to provide sound attenuation and keep ambient noise levels below maximum permissible sound levels.

The Kehalani Sewage Pipeline will be located underground but will be particularly close to residential areas along Waiʻale Road. According to the Technical Memorandum, the pipeline from the Kehalani WWPS to the Central Maui WWRF will be approximately 3.3 miles long and the velocity in the pipe will be relatively low. Low velocities in long pipelines provide a high residence time for sewage, which results in formation of dissolved sulfides that can be released as highly concentrated H_2S. The most common cause of nuisance odors from wastewater is when the pipeline flow changes from full (pumped) conditions to partially full (gravity) conditions. To mitigate potential odor impacts, air release will only occur when air pressure builds up in the pipeline at certain locations where Combination Air Release Valve (CARV) structures are located. Carbon cannisters can be connected to the CARV outlets for odor control. Refer to **Appendix "C"**.

With the above noted mitigation measures, potential impacts from nuisance odors will be minimized. Overall, the project will not significantly contribute to a cumulative air quality impact.

12. Greenhouse Gas Emissions

a. Existing Conditions

Within the State of Hawai‘i, the energy sector (including fossil fuel burning to produce electricity, transportation, waste incineration, and natural gas systems) is identified as the source of approximately 89 percent of greenhouse gas (GHG) emissions. Other sources of GHG emissions include industrial facilities, agriculture and forestry, and waste treatment such as landfills, composting, and wastewater treatment (State of Hawai‘i, Department of Health, 2021). On the island of Maui, the facilities operating at or above the 25,000 metric ton level include Hawaiian Electric Company’s Kahului Power Plant, Mā‘alaea Power Plant, the Hawaiian Commercial Sugar Company Industrial Waste Landfill, and the Central Maui Landfill (U.S. Environmental Protection Agency, 2025).

A Greenhouse Gas Emissions Impact Study was prepared by TAHA in November 2024 to evaluate the potential for GHG emission impacts associated with the proposed WWRF during both construction and operational phases of the project. See **Appendix** “**K**”. The primary land-use related GHGs are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Cumulative GHG emissions are believed to contribute to an increased greenhouse effect and global climate change, which may result in sea level rise and changes in precipitation, habitat, temperature, wildfires, air pollution levels, and in the frequency and intensity of weather-related events.

According to the DOH Hawai‘i Greenhouse Gas Emissions Report for 2021, the State of Hawai‘i is committed to reducing its contribution to global climate change and has taken efforts to reduce statewide GHG emissions. 2019 was used as a baseline for the statewide GHG inventory due to the impact on 2020 and 2021 emissions from the COVID-19 pandemic. In 2019, total GHG emissions in Hawai‘i were 22.01 million metric tons of carbon dioxide equivalent ($MTCO_2e$)/year. While total GHG emissions in Hawai‘i grew by 18.0 percent between 1990 and 2007, the emissions decreased by about 18.6 percent between 2007 and 2019. Relative to 2019, total emissions under the baseline scenario are projected to decrease by 16 percent by the year 2025, 21 percent by the year 2030, and 37 percent by the year 2045. This trend is largely driven by the

projected trend in emissions from energy facilities such as power plants and oil refineries, which are expected to decrease substantially between 2019 and 2045.

b. Potential Impacts and Mitigation Measures

The proposed project would generate GHG emissions during both construction and operational phases of the project through construction activities, energy use, new vehicle trips, aerobic liquid treatment processes, and aerobic sludge digestion.

Construction GHG Emissions

The State of Hawai'i has not created a predictive model for efficiently estimating construction emissions. Equipment inventories for each phase of construction were populated in the California Emissions Estimator Model, and the model was used to estimate the maximum annual emissions of CO_2, CH_4, N_2O, and CO_2 equivalent (CO_2e).

Construction activities are expected to generate an average of approximately 778 $MTCO_2e$ per year in the construction period from year 2025 through year 2029. See **Table 6**.

Table 6. Construction Related GHG Emissions

Year	Annual Emissions (Metric Tons per Year)			
	CO_2	CH_4	N_2O	$MTCO_2e$
2025	97	<0.1	<0.1	98
2026	511	<0.1	<0.1	517
2027	1,252	<0.1	0.1	1,268
2028	1,681	0.1	0.1	1,707
2029	294	<0.1	<0.1	298
Maximum Annual	**1,681**	**<0.1**	**<0.1**	**1,707**
Average Annual	**767**	**<1**	**<1**	**778**
Source: TAHA, 2024.				

Operational GHG Emissions

The primary sources of operational GHG emissions would be aerobic liquid treatment processes, aerobic sludge digestion, and the electricity generation required for these activities. Other sources of permanent emissions include electricity generation related to water distribution and waste disposal, on-road vehicles, and area sources. The GHG Emissions Study calculations indicate that operational activities of the proposed WWRF would generate approximately 33,568 metric tons of CO_2 emissions

at the time of opening in 2029. Hawai'i has enacted a law that mandates that all of the State's electricity comes from renewable sources no later than 2045, by which time the proposed project would be fully built out. By the year 2045, because of the transition of energy sources to 100 percent renewable sources, GHG emissions from the operations of the WWRF are expected to decrease to 29,932 metric tons of CO_2 emissions per year. See **Table 7**.

Table 7. Estimated Annual Greenhouse Gas Emissions

	Carbon Dioxide Equivalent (Metric Tons per Year)	
Scenario and Emission Source	**2029**	**2045**
Aerobic Sludge Digestion (Direct)	26,711	26,711
Energy Source Emissions (Indirect)	3,636	-
Aerobic Liquid Treatment Process (Direct)	2,572	2,572
Water Distribution Emissions (Indirect)	350	-
Waste Disposal Emissions (Indirect)	251	251
Mobile Source Emissions (Direct)	38	38
Area Source Emissions (Direct)	10	10
TOTAL	**33,568**	**29,932**

Source: TAHA, 2024.

GHG emissions generated by the proposed project would be negligible when compared to existing emissions. The proposed project would not interfere with the development of clean energy supplies. Therefore, there is no potential for a significant contribution to a cumulative GHG impact. It is noted that rooftop solar Photovoltaics (PV) panels are proposed to be installed on the Central Maui WWRF building to generate renewable energy to help supplement the electricity required for the wastewater treatment process. While detailed design of the solar PV and anticipated amount of energy generation will be determined during the design phase of the project, solar PV is anticipated to reduce the GHG emissions from the operation of the WWRF until the transition of energy sources to 100 percent renewable sources is completed in Hawai'i.

13. Noise

a. Existing Conditions

Existing background noise in the vicinity of the project area is principally attributed to vehicular traffic traversing through the area, and wind circulation. An Acoustic Study was prepared by Y. Ebisu & Associates for the project in April 2024. See **Appendix "L"**.

Noise levels were measured using the federal standard of Day-Night Average Sound Level (DNL), which reflects a person's cumulative exposure to sound over a 24-hour period. DNL is based on sound levels measured in relative intensity of sound, or decibels with A-weighting (dBA), which is used to measure noise levels that have been adjusted to account for how humans hear. As a general rule, noise levels of 55 DNL or less occur in rural areas, or in areas which are removed from high volume roadways. In urbanized areas which are shielded from high volume streets, DNL levels generally range from 55 to 65 DNL, and are usually controlled by motor vehicle traffic noise. Residences which front major roadways are generally exposed to levels of 65 DNL, and as high as 75 DNL when the roadway is a high-speed freeway. In the project area, including the undeveloped lands for the WWRF and SAT site and underground pipelines and the Kehalani Sewage Pipeline alignment along the existing Waiʻale Road, traffic noise levels (as well as background noise levels) vary over a wide range between 50 to 65 DNL.

Existing background noise levels along existing Waiʻale Road within the project environs are typically controlled by traffic noise at those receptor locations which are located on the east and west sides of that roadway. Existing residential developments are located primarily on the west side of Waiʻale Road with light industrial, commercial, and institutional uses on the east side of Waiʻale Road. Existing traffic noise levels along Waiʻale Road are probably at 65 DNL at 50 feet from the roadway centerline. With existing single-family residences at approximately 43 to 91 feet from that roadway centerline and generally shielded by existing walls, existing traffic noise levels at the front row residences are estimated to be within the 50 to 65 DNL category. The existing setback distances of the noise sensitive buildings on the east side of Waiʻale Road generally exceed 50 feet, however, sound attenuating walls are not present on that side of the roadway, and therefore, existing traffic noise levels at the front row buildings to the east are estimated to be in the range of 60 to 65 DNL.

At the currently undeveloped lands south of East Waiko Road, background noise levels are relatively low and typically controlled by the sounds from natural sources and human activities, distant traffic, and aircraft flyby events. Along East Waiko Road, the traffic noise could include heavy truck operations associated with the light industrial establishments along that roadway. Heavy truck operations are also audible at the materials handling and storage facility east of the planned Central Maui WWRF site. Between intermittent noise events from motor vehicles and aircraft flyby events, the steady background noise levels drop to the 35 dBA range, with average noise levels and DNL values estimated to be near 50 dBA or DNL. Residual

background noise levels during the nighttime tend to be very low along the existing roadways and undeveloped areas to the south and can drop to levels between 23 to 36 dBA during the quietest periods at the quietest locations. For this reason, noise producing sources are typically audible at very long distances and would only be masked along area roadways during infrequent passes of motor vehicles. Along the project area roadways, motor vehicles are a source of intermittent, short-term background noise, which causes levels to rise to levels similar to those from daytime motor vehicle activity and cause average nighttime noise levels to be in the order of 50 to 55 dBA rather than 23 to 36 dBA.

Traffic noise levels tend to be highest at the first row of dwellings which front the roadway and diminish at dwellings which are further removed from the roadway or shielded by the terrain and structures which block the visual lines of sight between the dwelling and roadway vehicles. Because of the dominating influence of traffic noise on existing background noise levels near the major roadways, existing background noise levels in the project environs can range from 70+ DNL at locations near a major roadway such as Honoapiʻilani Highway, to less than 55 DNL at locations removed or shielded from the major roadways.

During the nighttime and early morning hours, background noise levels tend to be lowest due to the reductions in motor vehicle traffic along the roadways, and due to the diminished levels of human activities. Traffic noise levels tend to be highest during the daytime hours, increasing rapidly during the morning commuting period, remaining relatively constant during the daytime hours, increasing slightly during the afternoon commuting period, and decreasing during the evening and nighttime period to its lowest level at 3:30 to 4:30 am. Existing average background noise levels during the nighttime hours are typically 5 to 10 dBA lower than those during the daytime hours. Because of the lower levels of background noise at night, noise sources (such as construction equipment) tend to be audible at longer distances during the quieter nighttime periods than during the noisier daytime periods.

b. <u>Potential Impacts and Mitigation Measures</u>

The following potential impacts were identified by the Acoustic Study, followed by the suggested mitigation measures. Refer to **Appendix "L"**.

<u>General Construction Noise</u>

Audible construction noise will probably be unavoidable during the entire project construction period. Construction noise levels and impacts are

expected to be dependent on the selected alignment of the planned sewer pipelines between the proposed Kehalani WWPS and the Central Maui WWRF for those existing and planned receptors located on the west and east sides of Waiʻale Road. The anticipated range of average construction noise levels at existing residences west of Waiʻale Road during trenching along the west shoulder of Waiʻale Road is between 61 to 88 dBA. When trenching along the east shoulder of Waiʻale Road, reduced noise levels of 62 to 75 dBA should result at existing residences west of Waiʻale Road. When trenching along the east shoulder of Waiʻale Road, noise sensitive receptors on the east side of Waiʻale Road will experience average noise levels ranging from 70 to 82 dBA.

Potential construction noise levels at the closest residences near the proposed Kehalani WWPS could range between 78 to 92 dBA during the site preparation phase. During the building erection phase at the WWPS, average construction noise levels should be lower and between 65 to 79 dBA. Typical levels of construction noise inside naturally ventilated and air-conditioned structures are approximately 10 and 20 dBA less, respectively, than the expected exterior noise levels provided previously outside the closest receptors to the various work areas.

Possible Noise Mitigation Measures for General Construction Noise Sources

Mitigation of construction noise impacts is administered by the DOH through the issuance of Construction Noise Permits and through a curfew system, which limits noisy construction activities to normal work hours from Mondays through Saturdays, excluding holidays. For construction work (such as sheet pile driving) which could generate very high noise levels at the closest residences, the DOH may include additional curfew restrictions on early morning and late afternoon work hours to further minimize risks of adverse construction noise impacts. The DOH construction noise permit system has been in use for a very long time and has generally been successfully applied. This is partially due to the efforts of contractors to minimize adverse noise impacts, the temporary nature of the very noisy construction activities at any one location, and the use of scheduling and resident notifications of anticipated noisy activities.

The relatively high noise levels during construction of the project are unavoidable, particularly at the relatively short setback distances to the closest residences. Mitigation of construction noise to inaudible levels will not be practical in all cases due to the intensity of construction noise sources (80 to 90+ dBA at 50 ft. distance), and due to the exterior nature of the work (excavating, grading and earth and spoils moving, trenching,

crane operations, hammering, etc.). The use of properly muffled construction equipment should be required on the job site. The anticipated noise levels during project construction activities are similar to other construction activities (exterior earthwork, open trenching, or building erection). Noise mitigation measures should be implemented for construction of the project. The following noise mitigation measures are recommended for inclusion within the project construction documents:

1. Provide sound attenuation treatments (walls, enclosures, or silencers) to reduce all steady, continuous noise sources (generators, pumps, blowers, etc.) which operate during the normally permitted daytime hours so that they do not exceed an 8-hour average value of 69 dBA at the closest residences. If this can be done, the 24-hour average DNL attributable to these continuous construction noise sources would be limited to the federal standard threshold of 65 DNL at these residences. The use of solid 3/4-inch plywood panels instead of fabric dust screens at these closest residences could provide approximately 5 to 10 dBA of sound attenuation at the closest residences who are expected to experience the highest construction noise levels.

2. For fixed or stationary equipment (generators, pumps, blowers, etc.) which need to operate 24 hours per day, provide sound attenuation treatments (walls, enclosures, or silencers) to reduce their noise levels to the allowable State DOH nighttime limits of 45 or 50 dBA at the closest residences.

3. In some instances where the sewage pipeline is extremely close to noise sensitive structures which are not shielded by an existing wall, consider the use of a temporary sound barrier wall during construction. Where a large number of noise sensitive structures are involved, consider the use of the far trench alignment for the force main.

4. Require the installation and use of broadband back-up alarms in place of high pitched, beeper-type back-up alarms for all mobile equipment operating on the project work sites. The broadband alarms should be less audible at longer distances and should be less annoying at all distances from the mobile construction equipment. Use broadband alarms which automatically adjust the alarm sound level for changes in background noise level.

5. Maximize the separation distances between residences and the heavy truck routes to and from the construction sites which are used for materials delivery or spoils removal.

6. Include construction noise mitigation measures for the construction contractors as follows:

- Use of the quietest equipment that is readily available, particularly in respect to factory quieted portable generators, pumps, and compressors; and the use of properly muffled and enclosed heavy equipment and vehicles;

- Use of the smallest sized equipment capable of performing the work and whose engine and exhaust pipe are below the top elevation of the existing walls along the residential property lines. This would maximize the sound attenuation benefits from the existing walls along the project corridor;

- The construction contractor should attempt to develop schedules of work within 50 feet of a residence which is mutually agreeable to all parties. This could allow residents to schedule their activities to avoid the anticipated construction periods of very high noise levels;

- The construction contractor should not schedule very noisy construction work which occurs simultaneously on more than two (2) sides of any residence within 50 feet of the work area. This will allow the resident to close the exterior windows and doors on the exposed sides of the home while allowing for natural ventilation via the other sides of the home;

- Provide weekly schedules of the location, date, and time of the anticipated noisy construction activities to residences within 500 feet of the scheduled work areas;

- Provide the cell phone number of the job site supervisor, who is responsible for responding to residents' complaints regarding the construction activities;

- Require the construction contractor to maintain a date and time log of all noise complaints, which includes the name and address of the complainant and the remedial measures taken; and

- Require the construction contractor to report all noise complaints received within one (1) working day of the receipt of the complaint to the Officer-In-Charge.

Noise from Operations at Central Maui WWRF and Kehalani WWPS and Possible Mitigation Measures

The loudest noise sources at the Central Maui WWRF and Kehalani WWPS are anticipated to be: emergency diesel generators; pumps; high pressure blowers, and odor control and ventilation fans. Potential adverse noise impacts associated with the normal operations of the new Kehalani WWPS and Central Maui WWRF will be mitigated during design of those facilities so as to comply with State DOH noise limits along the property lines of the two (2) facilities. These noise limits would be 70 dBA, 24 hours per day at the Central Maui WWRF, and 55 dBA between 7:00 am and 10:00 pm and 45 dBA between 10:00 pm and 7:00 am at the Kuhalani WWPS.

The Acoustic Study recommended that sound attenuation treatments be included with the design and construction of the Central Maui WWRF and Kehalani WWPS so as to not exceed the State DOH noise limits along the property boundary lines of both facilities. Enclosure of the noisy fixed equipment within concrete structures, with acoustically treated ventilation openings, are conventional means of mitigating noise emissions from noisy fixed equipment. Sound attenuation devices (acoustically louvers, duct silencers, exhaust and inlet air silencers, interior acoustical absorptive panels, etc.) should be included in the design of these facilities with a design goal of not exceeding the State DOH noise limits applicable at each facility. Refer to **Appendix "L"**.

With implementation of the foregoing mitigation recommendations, potential noise impacts from the proposed project are anticipated to be appropriately addressed.

14. Scenic and Open Space Resources

a. Existing Conditions

The new Central Maui WWRF and Kehalani WWPS are proposed within the Central Valley of Maui, which lies between the West Maui Mountains and Haleakalā and is characterized by its flat to gently sloping topography, open agricultural landscapes, and expansive views. Historically dominated by sugarcane plantations, the valley now consists of mixed uses including light industry, former agricultural fields, and emerging diversified agriculture. Visual elements in the area include flat grasslands, scattered trees, and distant mountain backdrops, with some higher-elevation residential vantage points, such as Wailuku Heights, offering panoramic views. The soils visible in the area are primarily volcanic, and much of the

original vegetation has been replaced with grasses and introduced tree species. The WWRF site is located on a portion of a large County-owned parcel, and the WWPS is proposed within an existing stormwater detention basin parcel adjacent to a master-planned Kehalani residential community. The visual character of the project area reflects an already altered, semi-industrial and agricultural environment, with a moderate level of existing visual complexity.

b. <u>Potential Impacts and Mitigation Measures</u>

The project will provide open space relief and landscaping to break up the mass of buildings within the area and all structures will comply with the MCC's 40-foot height limit for the "Public/Quasi-public" zoning district. A View Analysis, providing "before" and "after" perspectives of the proposed WWRF and SAT site, as well as the Kehalani WWPS from key public vantage points, has been prepared by KC Environmental in May 2025. See **Appendix "M"**.

The proposed WWRF will introduce new structural elements into the Central Valley landscape, with temporary construction impacts including visible cranes. These effects will be short-lived and largely screened by topography and vegetation. Operational impacts to highway users (e.g., Kūihelani and Honoapiʻilani Highways) will be minor due to moderate viewer sensitivity and partial screening. Refer to **Appendix "M"**. At the future Waiʻale Road extension, visual changes will be more noticeable due to closer proximity, but viewer sensitivity is low (primarily motorists), resulting in an overall moderate impact. From residential viewpoints such as Wailuku Heights, viewer sensitivity is higher, but the facility will be approximately 2.5 miles away and designed with low-reflectivity, pale colors to visually integrate with the landscape. Consequently, the potential view impact is classified as minor. Refer to **Appendix "M"**. Mitigation measures include earth-tone finishes, minimized structural heights where feasible, and adherence to lighting regulations to reduce glare and visibility at night.

The proposed Kehalani WWPS will be located on the periphery of a stormwater detention basin surrounded by the master-planned Kehalani residential development. The basin's existing walls, vegetation, and neighboring structures provide substantial screening. The WWPS will be single-story and painted in colors compatible with nearby homes, further reducing its visual prominence. Viewer sensitivity in the area is relatively high due to nearby residents and local road traffic, but the magnitude of change is limited by the structure's scale and siting. As a result, visual impacts from the WWPS are expected to be minimal to moderate at most.

Refer to **Appendix "M"**. Mitigation is proposed in the form of architectural blending through color selection, low-profile design, and use of existing screening features.

Additional potential visual mitigation strategies for the WWRF include creating a land buffer around the facility, adding walls or berms around the site, adding architectural embellishments to the facility, and landscaping. As recommended by the Central Maui WWRF Facility Plan, the landscaping will incorporate plants that are native to the environment in which the project site is located and will buffer the structures, particularly for motorists passing by on Kūihelani Highway. Refer to **Appendix "A"**.

Overall, neither the WWRF nor the WWPS will result in substantial adverse view impacts. The combination of distance, screening, and muted design elements ensures that changes to the visual environment remain minor or moderate across all key observation points. These findings indicate the project is visually compatible with its surroundings and will not significantly degrade scenic quality in Central Maui.

15. Archaeological and Historic Resources

a. Existing Conditions

The built environment of the project area includes areas of residential housing and retail businesses, with some peripheral developments consisting of light industrial yards, cemeteries, and paved roadways along the existing Waiʻale Road. The proposed project lies within fallow fields of sugarcane and overgrown field access roads. Existing structures within the proposed Central Maui WWRF site would primarily relate to commercial agriculture and/or water control infrastructure.

In order to assess the existing archaeological and historic features that may be present in the project area, Cultural Surveys Hawaiʻi (CSH) prepared a Literature Review and Field Inspection (LRFI) report in October 2023, based on the review of past archaeological investigations in the project vicinity and a reconnaissance-level pedestrian inspection of the project area. The LRFI was submitted to the Hawaiʻi Cultural Resource Information System (HICRIS) in order to support the request for Hawaiʻi State Historic Preservation Division (SHPD) review in accordance with HRS Chapter 6E-8. Following review of the LRFI, SHPD concurred that an Archaeological Inventory Survey (AIS) would be appropriate in order to identify potential impacts and mitigation measures for archaeological and historic resources. Following concurrence from SHPD, an AIS fieldwork strategy was prepared by CSH and approved by SHPD, allowing the AIS fieldwork to proceed.

See **Appendix "N"**, the AIS prepared for the project by CSH in October 2025.

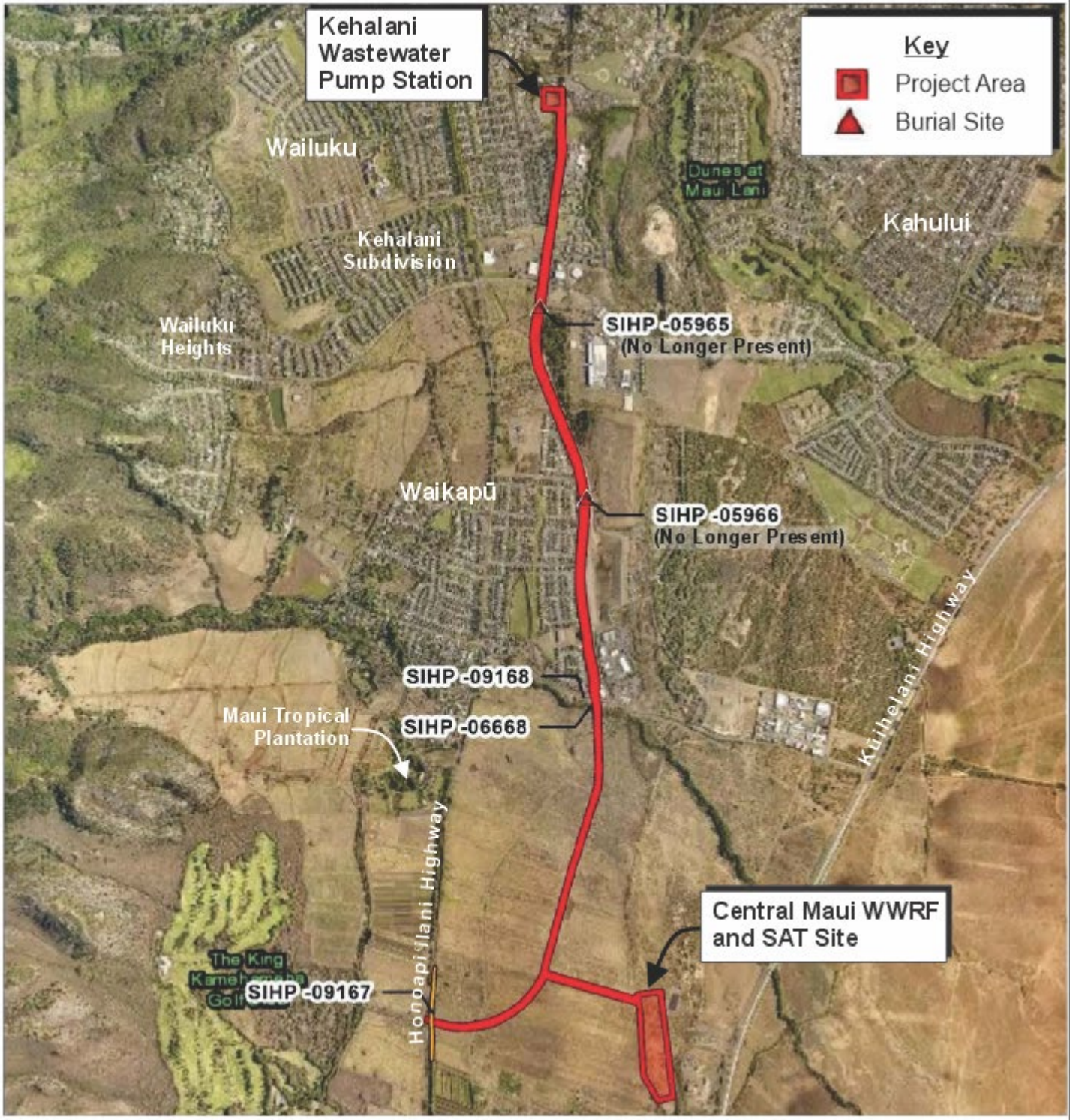
With regard to methodology, the AIS included background research, and a review of previous archaeological studies completed in the vicinity of the project area. Fieldwork for the AIS, focused on the 14.9-acre WWRF and SAT site as well as the access easement, consisted of a variety of testing strategies, including a one-hundred percent pedestrian inspection of the project area, geotechnical boring tests and double ring infiltrometer tests, a Ground Penetrating Radar (GPR) survey, subsurface testing and geographic point system (GPS) data collection. It is noted that a portion of the future Waiʻale Road Extension project overlaps with the project area. As such, the results from the draft AIS for the Waiʻale Road Extension Project, prepared by CSH in December 2024, were utilized in this project's AIS evaluation.

No significant archaeological features or cultural deposits were encountered during AIS testing within the 14.9-acre Central Maui WWRF and SAT site and the access corridor segments of the project area.

However, a total of five (5) historic properties have been identified within the portions of the existing Waiʻale Road and future Waiʻale Road Extension that overlap with the Central Maui WWRF project area. See **Figure 17**.

Three (3) historic properties were identified by previous archaeological studies. State Inventory of Historic Places (SIHP) #s 50-50-04-05965 and -05966 are previously disturbed human skeletal remains (burials) that were discovered during archaeological monitoring within Waiʻale Road for the Kehalani Mauka Subdivision Project. It is noted that SIHP #s -05965 and -05966 were disinterred during a previous archaeological study and are no longer present within the project area. SIHP # 50-50-04-06668 is a post-Contact terrace that was previously documented and reidentified. The AIS noted that the presence of previously documented pre-Contact burial sites within the project area is consistent with the history of land use of this portion of Wailuku Ahupuaʻa, known as Wailuku Sandhills, where numerous pre-Contact burials have been recorded.

Two (2) other historic properties were identified during the AIS investigation for the Waiʻale Road Extension project. These include SIHP # 50-50-04-09167, an irrigation ditch complex, and SIHP # 50-50-04-09168, a historic refuse disposal deposit (subsurface cultural deposits).



Source: Cultural Surveys Hawai'i, Inc.

Figure 17 Proposed Central Maui Wastewater Reclamation Facility
Historic Properties Map

NOT TO SCALE

MUNEKIYO HIRAGA

Prepared for: County of Maui, Department of Environmental Management

COM/DEM Cmaui WW Infrastructure/Applications/Figures/HistProp

b. Potential Impacts and Mitigation Measures

In addition to identification of historic properties, the AIS includes an evaluation of the historic properties' significance and recommendations for the project's effect on historic properties and mitigation measures. Refer toAppendix **"N"**. Historic property significance is evaluated and assessed based on the five (5) State of Hawai'i historic property significance criteria. To be considered significant, a historic property must possess integrity of location, design, setting, materials, workmanship, feeling, and/or association and meet one or more of the following broad cultural/historic significance criteria in accordance with Chapter 13-275-6, HAR:

a. Be associated with events that have made an important contribution to the broad patterns of our history;

b. Be associated with the lives of persons important in our past;

c. Embody the distinctive characteristics of a type, period, or method of construction, represent the work of a master, or possess high artistic value;

d. Have yielded, or is likely to yield, information important for research on prehistory or history; or

e. Have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group's history and cultural identity.

The AIS makes the following significant recommendations for the five (5) identified historic properties.

1. SIHP # 50-50-04-05965 is a partial human humerus that was previously documented during archaeological monitoring within the existing Wai'ale Road in 2006. CSH is unable to confirm whether SIHP # -05965 was previously assessed for significance. It is likely that SIHP # -05965 was significant pursuant to Criterion "e".

2. SIHP # 50-50-04-05966 is a partial subadult burial that was previously documented during archaeological monitoring within Wai'ale Road in 2006. CSH is unable to confirm whether SIHP # -05966 was previously assessed for significance.

It is likely that SIHP # -05966 was significant pursuant to Criterion "e".

3. SIHP # 50-50-04-06668, a post-Contact boulder terrace, was previously documented and redocumented by CSH during the separate AIS for the Waiʻale Road Extension Project in 2024. SIHP # -06668 was previously assessed as significant pursuant to Criterion "d" in 2010. The additional documentation of the historic property supports this assessment. The historic property retains the integrity of location, design, setting, materials, and workmanship, and has provided information important to research on historic land use.

4. SIHP # 50-50-04-09167 is an irrigation ditch complex identified by CSH during the AIS for the Waiʻale Road Extension Project in 2024. SIHP # 50-50-04-09167 is considered architectural and therefore, is a required assessment by a qualified architectural professional. Mr. Stanley Solamillo, an architectural historian, completed a site inspection of SIHP # -09167 in January 2025 to assess its architectural historic significance. Mr. Solamillo determined that, based on alterations or changes to design, setting, materials, and workmanship, the historic property is no longer significant.

5. SIHP # 50-50-04-09168 is a subsurface refuse disposal deposit identified by CSH during the AIS for the Waiʻale Road Extension Project in 2024. The cultural deposits contain an artifact assemblage of approximately 1,092 items including glass bottle fragments, ceramic fragments, metal fragments, buttons, and various other materials ranging from the early to mid-1900s. It was assessed as significant pursuant to Criterion "d". The historic property retains the integrity of location, materials, and workmanship, and has provided information important to research on historic land use.

Based on the foregoing, two (2) historic properties (SIHP #50-50-04-06668 and #50-50-04-09168) presently located within the project area are identified as significant. The project has the potential to affect these significant historic properties during project-related ground disturbance as SIHP #50-50-04-06668 and #50-50-04-09168 are located within approximately 50 meters of the roundabout proposed as part of the Waiʻale Road Extension project and will likely be impacted by project-related ground disturbance. In conclusion, the AIS recommends a project effect determination of "*effect, with proposed mitigation commitments"*. Mitigation is proposed in the form of archaeological monitoring. It is proposed that an archaeological monitoring program, beginning with the preparation of an archaeological monitoring plan, be developed to minimally include the following objectives:

- Onsite archaeological monitoring for all project-related ground disturbance within or adjacent to the Central Maui WWRF due to the area being entirely comprised of Jaucus Sand, which has a high potential for containing burials and buried A soil horizons containing cultural deposits.

- Onsite archaeological monitoring for all project-related ground disturbance within or adjacent to the SIHP # -09168 historic property boundary (Waiʻale Road Extension). Onsite archaeological monitoring will provide an opportunity to document project-related impacts on the historic property and, if applicable, record any additional significant information.

- Onsite archaeological monitoring for all project-related ground disturbance within the SIHP # -06668 historic property boundary (Waiʻale Road Extension/Waikapū Stream bank). Onsite archaeological monitoring will provide an opportunity to document project-related impacts on the historic property and, if applicable, record any additional significant information.

- Onsite archaeological monitoring for all project-related ground disturbance within Waikapū Stream. The stream corridor and associated deposits are culturally sensitive. Archaeological monitoring will ensure appropriate interim protection, notification to the SHPD, and subsequent mitigation for any potential inadvertent discoveries within Waikapū Stream.

- Onsite archaeological monitoring for all project-related ground disturbance occurring within the existing footprint of the Waiʻale Road portion within the current project area. Archaeological monitoring within this corridor previously documented SIHP #s -05965 (human skeletal remains) and -05966 (human skeletal remains) and there is the potential for additional human skeletal remains to be identified in this portion of the project area.

- On-call archaeological monitoring for the remainder of project-related excavation. An archaeologist will remain on-call and available to conduct archaeological monitoring in the event of significant findings. Additionally, the on-call archaeologist will conduct periodic site visits to inspect any changes in stratigraphy and document the construction process.

Coordination with SHPD will continue to obtain concurrence on the effect determination and the proposed mitigation measures. Upon concurrence by the SHPD, an archaeological monitoring plan will be prepared and submitted to the SHPD for review and approval. Refer to **Appendix "N"**. With implementation of the mitigation measures agreed upon with the SHPD, potential impacts on archaeological and historic resources from the proposed project are anticipated to be appropriately addressed.

16. Cultural Resources

a. Existing Conditions

A Cultural Impact Assessment (CIA) was prepared by CSH to *"analyze the impact of a proposed action on cultural practices and features associated with the project area"* and to determine applicable mitigation measures to protect cultural resources, practices and beliefs. See **Appendix "O"**. The CIA relied on archival and documentary research, as well as consultation with organizations and individuals having knowledge of the project area, its cultural resources and its practices and beliefs.

Waikapū, the ahupua'a in which the project is located, literally translates to "Water of the Conch". This is due to a cave within Waikapū Valley that supposedly housed a supernatural conch shell (named Kīhapū, blessed with the breath of Lono) that resided there until it was stolen by a supernatural dog named Puapualenalena. This conch shell, when blown, was said to resound throughout all the Hawaiian Islands.

A review of past CIAs covering the Waikapū and Wailuku ahupua'a was conducted as background research for this assessment. Nine (9) previous cultural studies in the vicinity identified practices such as freshwater and herbal medicine gathering, agriculture, and burial traditions. Waikapū Stream has been identified as a culturally significant resource and is part of Nā Wai 'Ehā, or Maui's "Four Great Waters", which is comprised of Waihe'e River, Waiehu Stream, Wailuku River (formerly 'Īao Stream), and Waikapū Stream. These streams, originating from the West Maui Mountains (Mauna Kahālāwai), were crucial in traditional times as a political and population hub. The Waikapū stream and soils supported highly productive agricultural practices, primarily the cultivation of kalo (taro). The Waikapū stream was known for resources like 'o'opu (goby), 'opae (shrimp), hīhīwai (snail), and guppies. However, 'o'opu, which were previously more abundant, were noted to be small and not suitable for eating, and the stream used to have deeper holding ponds for shrimp survival. Additionally, cultural informants for previously conducted CIAs have described gathering of native plants used as lā'au lapa'au (Hawaiian medicine) along the stream.

Many cultural informants in previous studies have pointed out the pu'uone sand dune system which is known to contain ancient burials and be the chosen burial grounds of Maui's Native Hawaiian communities. Hōkūao Pellegrino noted the cultural and historical significance of Pōhāki'o, a grinding stone and boundary marker near Old Government Road, although

its precise location and whether it has been moved are unknown. Pōhākiʻo served as a tool for finishing koʻi (adzes) and marked the northern boundary of the Waikapū ahupuaʻa. It appears on around 60 historic maps and is referenced in land documents as an important place name. Mr. Pellegrino also mentioned a historic bridge over Kahoi and Lapaleihua Gulches, visible on maps until 1939, and Scott Fisher reported finding old railroad pins on his farm. Additionally, Keahi Bustamente shared observations of cultural sites, including loʻi kalo, Keālia wetlands, Māʻalaea fishing grounds, and a Protestant Church.

b. <u>Potential Impacts and Mitigation Measures</u>

In addition to archival research, outreach efforts by CSH involved contact to 45 individuals and groups including Native Hawaiian Organizations (NHO), agencies, community members and descendants of the area, in order to identify individuals with cultural expertise and/or knowledge of the project area.

A meeting was held with Ms. Carol Lee Kamekona, a member and former president of ʻAhahui Kaʻahumanu Chapter IV, Wailuku, a member of Aha Moku o Wailuku, a Board Director and former Treasurer of Mālama Kakanilua, and kamaʻāina, along with Clare Apana, Ui Hotta, and another individual**.** The group was not in favor of the project location near Waikapū Stream. However, they were unwilling to provide and approve of information related to ongoing cultural practices or cultural impacts to the project area based on the information provided at the time of the meeting.

Written testimony from Mr. Skippy Hau, kamaʻāina and former Aquatic Biologist for the State of Hawaiʻi, Department of Land and Natural Resources, Division of Aquatic Resources (DAR), has revealed no ongoing cultural practices within the proposed Central Maui WWRF project area. He fully supports the proposed project, and his concerns are largely focused on the conditions of other wastewater facilities in the area, such as Kahului and Māʻalaea. He also noted concerns with increased drug use that could be present in the wastewater treated.

An interview with Dr. Scott Fisher, the Director of ʻĀina Stewardship with the Hawaiʻi Island Trust and the Chair of the Maui/Lānaʻi Island Burial Council did not reveal ongoing cultural practices in the project area. However, cultural practices and resources were identified within the project vicinity and it was noted there could be a high possibility of coming across burials in the project area. In addition to concerns regarding burials, Dr.

Fisher also expressed concern for impacts to Waikapū Stream and indirect impacts to Keālia Pond.

The results of community consultation, underscored by background research conducted for this CIA, inform the following mitigation possibilities promoting and preserving cultural beliefs, practices, and resources of Native Hawaiians and other ethnic groups:

(1) A number of concerns expressed by the community during consultation do not relate specifically to ongoing cultural practices within the project area but nonetheless should be considered during project planning and development. These concerns include the following:

   a) Dr. Fisher has suggested a statistical analysis be conducted for the issue of possibly having to reroute the new force main along Waiʻale Road if a burial were to be found. The corridors are very narrow and allow little to no room for changes.

(2) Dr. Fisher encourages project developers to be very sensitive to burials and identify them beforehand rather than recording them as inadvertent discoveries. Dr. Fisher has recommended a very thorough AIS and significant amounts of testing be conducted prior to construction.

(3) Project construction workers and all other personnel involved in the construction and related activities of the project should be informed of the possibility of inadvertent cultural finds, including human remains. In the event that any potential historic properties are identified during construction activities, all activities will cease and the SHPD will be notified pursuant to HAR §13-280-3. In the event that *iwi kūpuna* (ancestral remains) are identified, all earth moving activities in the area will stop, the area will be cordoned off, and the SHPD and Police Department will be notified pursuant to HAR §13-300-40. In addition, in the event of an inadvertent discovery of human remains, the completion of a burial treatment plan, in compliance with HAR §13-300 and HRS §6E-43, is recommended.

(4) In the event that *iwi kūpuna* and/or cultural finds are encountered during construction, project proponents should consult with cultural and lineal descendants of the area to develop a reinterment plan and cultural preservation plan for proper cultural protocol, curation, and long-term maintenance.

With implementation of the foregoing mitigation recommendations, potential impacts on cultural resources from the proposed project are anticipated to be appropriately addressed.

Incorporated in the CIA is a Ka Paʻakai analysis, which is a legal framework *"to help ensure the enforcement of traditional and customary Native Hawaiian rights while reasonably accommodating competition private development interests".* Refer to **Appendix "O"**. The following legal tests are applied:

1. *The identification of valued cultural, historic and natural resources in and surrounding the project area and the extent to which traditional and customary Native Hawaiian rights are exercised in the area;*

2. *The extent to which those resources—including traditional and customary Native Hawaiian rights—will be affected or impaired by the proposed action; and*

3. *The feasible action, if any, to be taken by the LUC to reasonably protect Native Hawaiian Rights if they are found to exist.*

The following analysis was conducted using the Ka Paʻakai framework:

Based on information gathered from the cultural and historical background and community consultation for this project, Waikapū Stream and human remains were identified as significant cultural resources with the potential to be impacted by the project. Traditionally and presently, Waikapū Stream has been used to cultivate kalo and ʻulu. There have been ongoing efforts by Hawaiian families in the Waikapū Ahupuaʻa to restore old kuleana ʻauwai and loʻi kalo for the revitalization of traditional agricultural practices of kalo cultivation. In terms of historically significant features, one (1) historic agricultural terrace (SIHP # -06669) was found along Waikapū Stream where the Waiʻale Road Extension portion of the project area and stream intersect. This portion of the project area is within fallow fields of sugarcane and overgrown field access roads. Surrounding this area are agricultural lands. Dr. Fisher, who was interviewed for this CIA, owns a 4-acre ʻulu farm south of the project area. Although no cultural practices were identified specifically within the project area, Waikapū Stream itself is a significant cultural, historical, and natural resource that may possibly be impacted by the proposed project. If Waikapū Stream is impacted by the proposed project, then Keālia Pond may be affected as well. Four (4) burials (SIHP #s -05966, -05965, -05680, and -08659) were also previously identified along the existing Waiʻale Road portion of the project area. Two (2) were reinterred (SIHP #s -05965 and -05966) and the other two (2) remained in situ with a concrete slab poured over them (SIHP #s -05680 and -08659). Other historic properties within the project vicinity and along Waiʻale Road included a sugar cane flume (SIHP # -05967), a historic

roadbed (SIHP # -05963), and cultural material (SIHP # -08017). The focus of concern is large impacts on Waikapū Stream and burials. Community consultants have recommended a thorough AIS prior to construction to avoid potential inadvertent discovery of burials within the project area. As discussed in Section A.15 of this Chapter, an AIS was prepared for the project and appropriate mitigation measures will be implemented to ensure that potential impacts to cultural and historic resources will be minimized. Refer to **Appendix "N"**.

17. Hazardous Materials

a. Existing Conditions

The project area consists of an existing roadway, an existing stormwater detention basin, and former agricultural lands. The project area includes undeveloped and heavily vegetated former agricultural lands, utilized for sugarcane cultivation until the end of 2016. As previously mentioned, due to the historical sugar cane operation, there may be limited potential for hazardous materials to be present within surrounding uses such as motor oil or fertilizers.

b. Potential Impacts and Mitigation Measures

The proposed Central Maui WWRF will receive wastewater and septage, which can be a potential hazard if not treated properly. According to the Facility Plan prepared for the Central Maui WWRF and SAT basins, data collected from the Wailuku-Kahului WWRF was utilized to assess effluent characteristics and identify organic and chemical compounds that would need to be reduced. Refer to **Appendix "A"**. These compounds include wastewater five-day biochemical oxygen demand (BOD_5), total and volatile suspended solids (TSS and VSS), and nitrogen species concentrations, as well as phosphorous, all of which can impact the environment if excess amounts are included in treated wastewater. At the proposed Central Maui WWRF, the wastewater will undergo a treatment and filtration process to remove and reduce biological and chemical compounds to acceptable levels.

Nitrogen and phosphorus in wastewater are caused by human waste, food, and certain personal hygiene and cleaning products. Nitrogen and phosphorous are common elements in fertilizers which can be beneficial at appropriate levels, but can cause environmental degradation and potential health risks to humans if excess amounts are contained. R-1 recycled water has been identified as the primary disposal method of treated effluent from the proposed WWRF. R-1 recycled water will contain nitrogen that will

provide fertilizer value to the vegetation that is irrigated, and the level of nitrogen will be controlled and will be less than the nutrient requirements of most vegetation grown in the tropical climate. As such, no adverse environmental impact is anticipated from the use of R-1 recycled water produced at the proposed WWRF.

As a backup effluent management system, an onsite SAT system will be utilized as a more environmentally sustainable alternative to injection wells that are currently utilized at County WWRFs. A SAT system consists of the intermittent application of effluent at high hydraulic loading rates to basins constructed in highly permeable soils, such as sand or gravel. The SAT process has been identified as effective in balancing nutrients and reducing concentrations of nitrogen and phosphorus. SAT can also effectively reduce pathogens and bacteria such as fecal coliform that is naturally occurring in human and animal waste, in addition to heavy metals and endocrine disruptors which originate from industrial, agricultural, and domestic sources. Endocrine disrupters include a combination of natural hormones, pharmaceutical products, and industrial chemicals.

According to the Countywide WWRF Land Treatment Study (Brown and Caldwell, 2018), the immediate reduction of phosphorus in groundwater that could potentially be realized by SAT basins would be significant when compared to injection wells. **Table 8** indicates the potential difference in phosphorus levels in pounds per day (ppd) between the current injection wells and potential implementation of SAT basins for the Wailuku-Kahului WWRF and the Central Maui region.

Table 8. Estimated SAT System Phosphorus Reduction

Description	Phosphorus
Current load to groundwater via injection wells	61 ppd
SAT average percolation	4.1 mgd
SAT percolate concentration	0.1 mg/L
Load to groundwater	3 ppd
Nutrient load reduction	94%
Source: Brown and Caldwell, 2018.	

In summary, the wastewater will undergo treatment and filtration processes to remove and reduce biological and chemical compounds to acceptable levels. In addition, the proposed SAT system is an effective process for reducing BOD_5, TSS, trace organics, endocrine disruptors, pathogens, phosphorus and heavy metals in treated effluent. Nitrogen removal can also be significant when systems are managed for that objective. Through the treatment and SAT processes, hazardous materials will be reduced and

managed to acceptable levels. The wastewater treatment process and SAT system will provide an environmentally friendly alternative to other effluent disposal methods utilized in the region, which may include injection wells, cesspools, and individual septic systems.

Finally, short-term and long-term drainage improvements will be implemented to protect downstream properties as well as streams and wetlands in the vicinity.

With the proposed wastewater treatment processes and the use of SAT basins as well as the drainage impacts, potential impacts related to hazardous materials from the proposed project are anticipated to be appropriately addressed.

B. SOCIO-ECONOMIC ENVIRONMENT

1. Regional Setting

a. Existing Conditions

From a regional standpoint, the project is located within the Wailuku-Kahului Community Plan area. The Wailuku-Kahului Community Plan region stretches from Poelua Bay on the northwestern shore of Kahakuloa to Baldwin Park in Pāʻia and extends south to Waikapū. The region is the population center of Maui and encompasses the island's commerce and industrial center, hosting the Kahului Harbor, the Kahului Airport, various government agencies, professional services, retail shopping centers, and residential communities.

b. Potential Impacts and Mitigation Measures

The proposed Central Maui WWRF will treat wastewater to achieve R-1 recycled water, which is the safest level of recycled water approved by the State of Hawaiʻi, DOH. R-1 recycled water can be utilized for irrigation that may come into contact with the public. While all R-1 recycled water from the WWRF is anticipated to be used for irrigation and other nonpotable purposes the majority of the time, a backup effluent disposal system is required in accordance with HAR Chapter 11-62 and the DOH's Recycled Water Guidelines. The Central Maui WWRF will include a SAT system for disposal of effluent when (1) effluent does not meet the R-1 standards due to process malfunction and/or (2) recycled water supply exceeds the demand (e.g. during periods of extended wet weather). This groundwater recharge system is a U.S. EPA recognized form of land treatment and will be the first SAT in Hawaiʻi. The process removes nutrients, metals, trace

organic compounds, and pharmaceuticals, and is considered as a more sustainable alternative to injection wells that are currently commonly used in the County WWRFs.

The location of the proposed Central Maui WWRF and SAT site was strategically selected in an inland location, avoiding coastal hazards, such as tsunami and sea level rise. The proposed project will be designed to be low profile and will be compatible with the surrounding agricultural lands and residential neighborhoods near Waikapū, Kehalani, and Wailuku. The proposed sewage pipelines and R-1 recycled water pipeline will be located underground. Potential visual mitigation strategies include creating a land buffer around the facility, adding walls or berms around the site, adding architectural embellishments to the facility, and landscaping.

The proposed site is located in the midst of the former agricultural lands, away from the existing residential and commercial uses to minimize potential impacts, such as odor and noise, from the operation of the WWRF. Nevertheless, wastewater treatment facilities can be a source of odors to the surrounding community if not properly designed and operated. Nuisance odors are most commonly associated with anaerobic (without oxygen) conditions and with residual solids processing. The design of the proposed WWRF will incorporate odor mitigation strategies such as providing enclosures to the headworks and solids dewatering equipment, and treating the air removed from the wastewater treatment process using biotrickling filters and/or granular activated carbon scrubbers. Other potential odor mitigation strategies include locating the facility downwind of public areas, creating a land buffer around the WWRF, and adding walls or berms around the site.

2. Population, Demography, and Social Impacts

a. Existing Conditions

According to the 2020 U.S. Census, the population of Maui County was 164,754, an increase of 6.4 percent since 2010, when the County had a population of 154,834 (U.S. Census Bureau, 2020). It is noted, however, that population growth over the past decade has been uneven, with stronger growth in the early part of the decade. The U.S. Census Bureau's annual population estimates data indicates that Maui County population grew steadily between 2010 and 2014, when annual population growth rates ranged from 1.2 percent to 1.3 percent. The estimated population in 2014 was 163,036. The 2020 U.S. Census resident count for Maui County

is lower than the Census Bureau's previous population estimates for 2016 to 2019 (U.S. Census Bureau, 2019).

The State of Hawai'i, Department of Business, Economic Development and Tourism (DBEDT) publishes population projections through 2050. According to the latest forecast, which was published in April 2024, Maui County's population is expected to grow to 184,867 by 2050 (State of Hawai'i, DBEDT, 2024).

As previously mentioned, the proposed project is located in Central Maui, within the Wailuku-Kahului Community Plan region. The population of the Wailuku-Kahului region was approximately 58,587, according to the 2020 Census (including Kahului Census Designated Place (CDP), Waihee-Waiehu CDP, Waikapū CDP, and Wailuku CDP) and accounted for approximately 35.5 percent of Maui County's population (U.S. Census Bureau, 2020).

b. <u>Potential Impacts and Mitigation Measures</u>

The proposed project is not a direct population generator; rather, the proposed Central Maui WWRF is needed to accommodate existing and projected population growth in the Central Maui region. As noted previously, according to the latest forecast by DBEDT from 2024, Maui County's population is expected to grow to 184,867 by 2050. Approximately 1.93 mgd, or 48 percent of the total Central Maui WWRF flow capacity, will be allocated to service planned future developments in the Central Maui region, including housing projects and State and County facilities, as identified in the Service Area Map. Refer to **Figure 5**. The 0.29 mgd, or seven (7) percent of the total Central Maui WWRF capacity, will be available for future potential developments in the region to help accommodate projected population growth by providing additional wastewater treatment capacity. In addition, the proposed project is expected to create short-term construction jobs and long-term operational jobs for Maui's existing and future population base, as further discussed in Section B.3 of this Chapter.

Lastly, approximately 45 percent, or 1.78 mgd of the total wastewater flows at the Central Maui WWRF will be diverted from the Wailuku-Kahului WWRF. The Wailuku-Kahului WWRF is located in the coastal area of Kahului, within Flood Zone AE and Tsunami Evacuation Zone. This diversion to the proposed Central Maui WWRF will help reduce potential impacts to the community in the event of facility damage caused by flooding or tsunami events at the Wailuku-Kahului WWRF as the Central

Maui WWRF will be located further inland and outside of flood zones and the Tsunami Evacuation Zone.

3. Economy and Labor Force

a. Existing Conditions

The economy of Maui is heavily dependent upon the visitor industry, and in turn, this industry fosters the retail and service industries. Hotel and resort amenities are primarily located in South and West Maui, with smaller, non-resort hotels in Central Maui. The Wailuku-Kahului region is the business and commercial center of the island and is anchored by government and professional services, commercial, retail and industrial uses.

Hawai‘i’s economy through 2019 was strong, with record-setting visitor arrivals and low unemployment. The COVID-19 pandemic had far-reaching impacts on the economy on Maui, in Hawai‘i, and across the nation. With the end of the pandemic and return of the visitor industry, Maui’s economy was growing through the first half of 2023. However, the tragic wildfires in August 2023 are expected to continue to have significant impacts on the economy for several years. The fire in Lahaina destroyed approximately 2,200 structures, displacing thousands of families and impacting many businesses. The fires have had a significant impact on the tourism industry, and the overall path to recovery will be a long-term process, dependent on the pace and manner of rebuilding. Although the project area was not directly impacted by the fires, the entire Maui community continues to experience economic disruption. For example, the unemployment rate in Maui County was 2.8 percent in July 2023, but rose to 8.4 percent by September 2023. As was the case with the pandemic, however, the economy is beginning to improve again after the fires. As of August 2025, the unemployment rate for the Maui County dropped to 2.8 percent, compared to the statewide rate of 2.7 percent (DBEDT, 2025).

b. Potential Impacts and Mitigation Measures

In the short term, the construction of the Central Maui WWRF and offsite improvements will generate positive economic impacts associated with construction-related spending and employment. The full build-out of the project is anticipated to take approximately two (2) years. From a long-term perspective, the project will create operational jobs and associated payroll during the operation of the WWRF. To quantify the effects described above, an Economic and Fiscal Impact Analysis was conducted for the proposed project. The report estimates how the construction and subsequent

operation of the Central Maui WWRF will influence the local economy, and measures creation of jobs and associated payroll, economic output, and potential impacts to the State and County General Funds. A summary of the analysis is given below. See **Appendix "P-1"**.

Economic and fiscal impacts from the Central Maui WWRF Project were analyzed for two (2) phases – for the development period and at full buildout.

Development-Related Economic and Fiscal Impacts

Total construction expenditure is estimated at $130.6 million. Construction is anticipated to generate approximately 120 full-time equivalent (FTE) jobs on average per year with an annual payroll of approximately $12.7 million. In addition to direct construction spending and employment, the project will generate indirect spending and employment related to supplying goods and services to construction companies and to the families of construction workers. Indirect sales are expected to average $77.2 million per year, and 180 FTE indirect jobs will be generated per year. When considering direct and indirect impacts together, earnings resulting from the $130 million construction project would total approximately $47.9 million over two (2) years.

During the construction period, the State will collect an estimated $5.5 million per year or $11.0 million cumulatively in tax income, including approximately $3.2 million per year in general excise tax (GET) revenues, $627,300 per year in corporate income tax revenues, and $1.6 million per year in personal income tax revenues.

With regard to fiscal impacts to the County of Maui, the development cost of the proposed Central Maui WWRF Project and related improvements will be funded by a combination of funding sources, which may include municipal bonds backed by the County's Sewer Fund, federal funds, and County's GET surcharge revenues. The breakdown of the funding sources is undetermined at the time of this EIS. The County's Sewer Fund is a type of special fund, and all revenues, including, but not limited to, service charges, surcharges, pumping of cesspools, septic tanks and pumps, fees for reclaimed water service and installation of reclaimed water meters, waste discharge permits, hauler permits and fines, are deposited into the Sewer Fund. Because a portion of the construction cost is anticipated to be paid by municipal bonds backed by the Sewer Fund, the construction of the project is anticipated to have some degree of impacts on the sewer rates for residents and businesses Countywide. A separate rate impact analysis has been prepared and will be further discussed below.

In terms of fiscal impacts to the County's General Fund, the State Legislature authorized the counties to adopt a surcharge on the GET and use tax by ordinance at a rate of no greater than 0.5 percent. As of January 1, 2024, the County of Maui initiated a GET surcharge at the rate of 0.5 percent for final sales. The GET surcharge is not imposed on indirect sales. The total GET surcharge revenue associated with the $130 million development budget would be approximately $361,600 per year or $723,200 over the 2-year development period for the County of Maui.

Economic and Fiscal Impacts at Full Build-out

At full build-out, the operation of the proposed Central Maui WWRF is anticipated to generate 16 FTE jobs per year, and the total payroll is estimated to be $1.0 million per year. Assuming that 55 percent of the payroll will be spent in the local economy, the total consumption associated with the operation of the Central Maui WWRF is estimated to be $550,000.00.

In terms of fiscal impacts, the State would receive revenues from personal income tax, estimated to be approximately $67,600 annually, from the new jobs created by the operation of the Central Maui WWRF, and GET of approximately $22,000 per year generated by the consumption or within the local economy by the new workers and their families.

For the County of Maui, the operating cost of the Central Maui WWRF and the Kehalani WWPS is estimated to be $7.1 million per year, which includes operating personnel, repair and maintenance costs, and other related expenses. The operating cost will be funded by the Sewer Fund where the service charges by the ratepayers will be deposited to, and as such, the operation of the Central Maui WWRF will not negatively impact the General Fund. A separate rate impact analysis was prepared by Brown and Caldwell and includes an analysis of the potential long-term rate impacts due to the debt service and operating and maintenance (O&M) cost for the Central Maui WWRF and Kehalani WWPS. The analysis is summarized in the section below. The GET surcharge at a rate of 0.5 percent is generated by the consumption in the local economy by the new workers and their families, and is estimated to be approximately $2,800 per year for the County. Refer to **Appendix "P-1"**.

Based on the foregoing, the Central Maui WWRF Project is anticipated to result in positive economic and fiscal impacts both during the development and operational phases of the project. Beyond the impacts quantified herein, the Central Maui WWRF will provide additional sewer capacity to

the Central Maui region to support the future population growth anticipated for the region as well as diverting a portion of the existing sewer treatment capacity from the Wailuku-Kahului WWRF which is located in the coastal area and currently utilizes injection wells as a method of disposing treated wastewater.

Rate Impact Analysis

As noted previously, a Rate Impact Analysis was prepared by Brown and Caldwell in April 2025 to evaluate the long-term impact of the proposed Central Maui WWRF project on sewer rates for the County' sewer service users. See **Appendix "P-2"**. A simple rate model was developed to approximate the average monthly sewer rate per connection. The model projects the average monthly sewer rate over 25 years to demonstrate the project's impact on sewer rates as the service area for the Central Maui WWRF develops. Two (2) rate scenarios were developed for comparison purposes, including (1) the baseline scenario and (2) the scenario that accounts for the development cost and O&M cost for the Central Maui WWRF project. For both scenarios, the average monthly sewer rate represents the average across all user types, including single family, multi-family, and commercial connections.

As noted previously, the breakdown of funding sources for development of the proposed WWRF is undetermined at this time, but a portion may be funded through municipal bonds backed by the Sewer Fund. As such, the impact was assessed for different funding scenarios, including the following:

- 100 percent bond funded
- 75 percent bond funded
- 50 percent bond funded
- 25 percent bond funded
- 0 percent bond funded

Table 9 below summarized the rate impact of the Central Maui WWRF project across these different bond funding scenarios, showing the percentage difference in average monthly sewer rates. This highlights the rate impact in Year 3 of the project, when the Central Maui WWRF begins operation. This represents the year of the highest rate impact to existing customers.

Table 9. Central Maui WWRF Rate Impacts

Description	Baseline	Capital Funding Scenario – Bond Funding Percentage				
		100%	75%	50%	25%	0%
Average monthly sewer rate when Central Maui WWRF begins operation	$222.49	$255.88	$249.73	$243.58	$237.43	$231.27
% Change	-	+15%	+12%	+9.5%	+6.7%	+3.9%
Source: Brown and Caldwell, April 2025.						

If the project is fully funded through bonds, the sewer rates will need to increase by approximately 15 percent more than in the baseline scenario to cover the debt service and O&M cost for the new Central Maui WWRF and Kehalani WWPS. However, if alternate capital funding sources that do not incur debt service are available, the impact on sewer rates is expected to be reduced.

In addition, a long-term rate impact over 25 years was also estimated using the assumption that 100 percent of the project's capital cost would be funded through bonds. As shown in **Figure 18**, the model demonstrates that the impact on sewer rates from the project is most significant during the first 10 years of the project because anticipated future developments that would connect to the Central Maui WWRF have not yet been fully constructed. Over time, the difference in two (2) scenarios is projected to be smaller and eventually become zero percent. Refer to **Appendix "P-2"**.

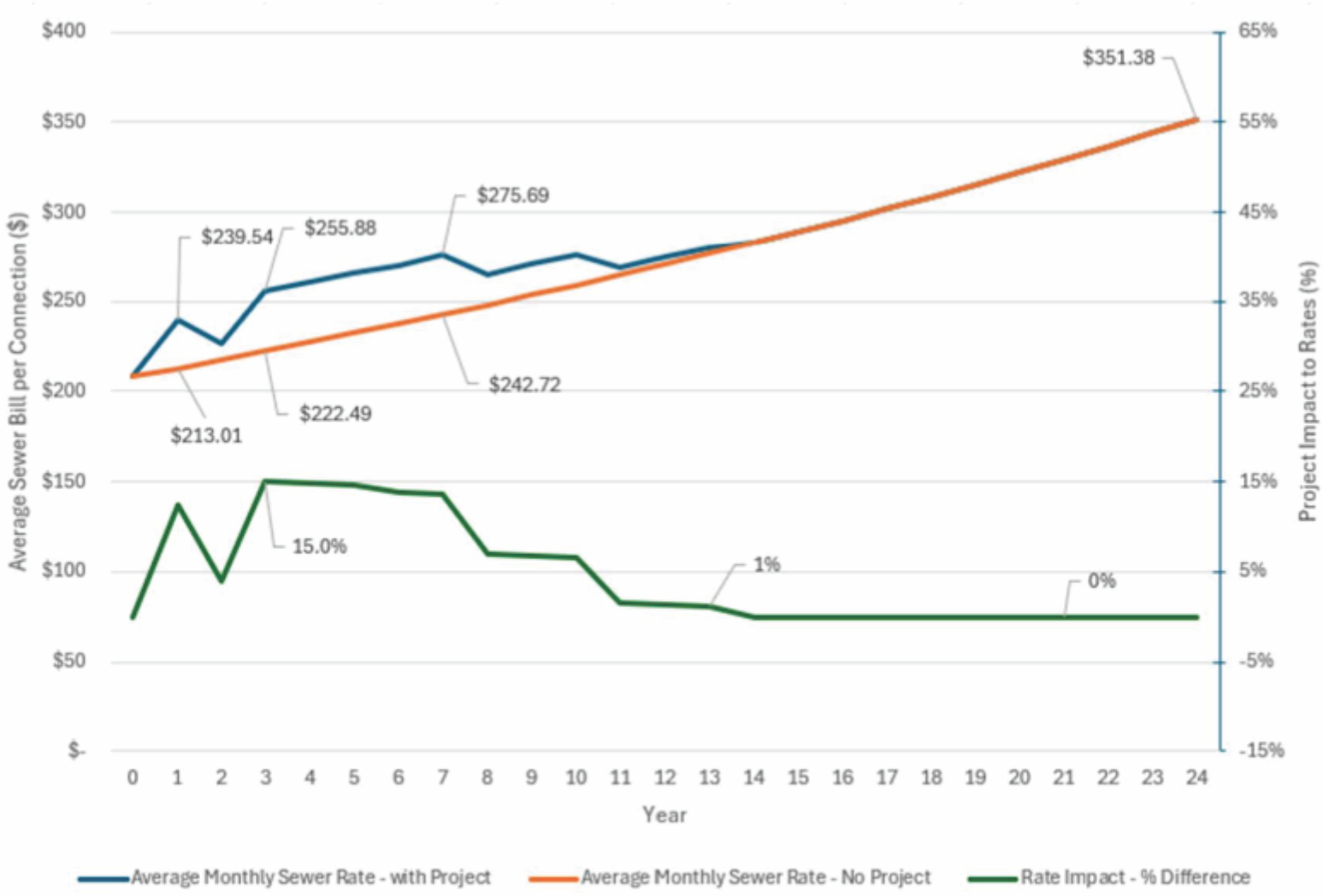
C. PUBLIC SERVICES

1. Police and Fire Protection

a. Existing Conditions

The headquarters of the County of Maui, Police Department (MPD) is located at its Wailuku Station. The department consists of several patrol, support, administrative, and investigative divisions that service the Hāna, Lānaʻi, Lahaina, Molokaʻi, Wailuku, and Kīhei regions. The MPD's Wailuku Station service the Wailuku-Kahului region.

Fire prevention, protection, and suppression services are provided by the County of Maui, Department of Fire and Public Safety. The department has two (2) stations to service the Wailuku-Kahului region. Wailuku Fire Station is located approximately 3.5 miles northwest of the proposed WWRF site in Wailuku. Kahului Fire Station is located approximately 4.0 miles northeast of the proposed WWRF site.



Source: Brown and Caldwell, Inc.

Figure 18 Proposed Central Maui Wastewater Reclamation Facility
Long-Term County Sewer Rate Impact

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

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b. Potential Impacts and Mitigation Measures

The project is located within the vicinity of existing communities in the central valley of Maui which are currently afforded similar services. The proposed project will not extend the service area for emergency service providers. The project is within the existing service area limits for these services and is not anticipated to adversely impact the service capabilities for emergency police and fire operations. It is noted that R-1 recycled water fire hydrants will be installed at the proposed WWRF site.

2. Medical Facilities

a. Existing Conditions

The only major medical facility on the island is Maui Memorial Medical Center, which is located in Wailuku. This 214-bed facility provides general, acute, and emergency care services.

In addition, smaller-scale clinics, doctors and dentist offices are situated throughout the central valley area, including Maui Medical Group and Kaiser Permanente, to provide health care for the Central Maui communities.

b. Potential Impacts and Mitigation Measures

The proposed project is a wastewater reclamation and treatment facility and related improvements and is not anticipated to adversely impact the service capabilities for emergency medical services. Medical facilities within the project's service area may be serviced by the Central Maui WWRF.

3. Education Facilities

a. Existing Conditions

The State Department of Education (DOE) operates several schools in the Wailuku-Kahului region. Public school facilities within the Wailuku-Kahului District area include: two (2) high schools, Henry Perrine Baldwin High and Maui High (grades 9 to 12); two (2) intermediate schools, ʻĪao Intermediate and Maui Waena Intermediate (grades 6 to 8); and six (6) elementary schools, Wailuku Elementary, Waiheʻe Elementary, Pōmaikaʻi Elementary, Kahului Elementary, Lihikai Elementary, and Puʻu Kukui Elementary (Grades K to 5). The area is also served by several privately operated schools providing education for elementary, intermediate, and high school

students. Privately operated schools serving the Wailuku-Kahului region include St. Anthony School (grades K to 12), Ka‘ahumanu Hou Christian School (grades K to 12), Emmanuel Lutheran School (preschool to grade 8), and Maui Adventist School (grades 1 to 8).

The University of Hawai‘i Maui College (UHMC), located in Kahului, is a branch of the University of Hawai‘i system. UHMC is the primary higher education institution serving Maui.

b. Potential Impacts and Mitigation Measures

The proposed project is not a direct population generator. Rather, the project will provide additional wastewater capacity to serve existing population by diverting wastewater flows from the Wailuku-Kahului WWRF as well as projected future population increase on Maui that would happen with or without the project. As such, the project is not anticipated to directly generate additional demand upon educational facilities in the Wailuku and Kahului regions. Schools within the project’s service areas are expected to be serviced by the proposed WWRF. It is noted that the proposed Waikapū Country Town development will include a 12-acre elementary school, which is anticipated to be serviced by the proposed WWRF. Furthermore, the DOE has been and will continue to be consulted on the proposed project during the EIS process.

4. Recreational Facilities

a. Existing Conditions

Within the Wailuku-Kahului Community Plan Region, there are many recreational activities, including shoreline and boating activities at the Kahului Harbor and adjoining beach parks, and organized recreational activities provided/offered at County Parks. In the vicinity of the Central Maui WWRF and SAT project site are Waikapū Park and Community Center as well as the Central Maui Regional Sports Complex. In Wailuku town are Wells Park, the Wailuku Elementary School Park, the ‘Īao Valley State Park, the Kehalani Mauka Park, the Velma McWayne Santos Community Center, Papohaku Park, War Memorial Athletic complex, Wailuku Little League baseball fields, the 65-acre Maui Regional Park, Maui Lani Parkway Park, Sakamoto Swimming Pool, and Keōpūolani Regional Park. In addition, there are several golf courses in the Wailuku-Kahului region. These include the Kamehameha Golf Course, The Dunes at Maui Lani Golf Course, and the Maui County-owned Waiehu Golf Course.

b. Potential Impacts and Mitigation Measures

The proposed Central Maui WWRF and SAT site is located within an area labeled by the MIP's Planned Growth Areas Map and Planned Protected Areas Map for “Regional Park and County Facilities”. According to the MIP, a regional park would be provided in the future to the South of Waiʻale to provide a clear separation between the new community and Māʻalaea, and to allow for the placement of active and passive recreational opportunities, County baseyards, and County facilities. The DEM is aware that the County of Maui, DPR is in the early stages of planning a potential future regional park in the vicinity of the proposed WWRF and SAT site. As part of the EISPN comment letter dated August 21, 2023, the DPR expressed concerns of potential odors and view impacts from the proposed Central Maui WWRF that may impact on a future regional park, however, noted in their second comment letter dated December 19, 2024 that the proposed WWRF may be an accepted secondary use if appropriate mitigation measures are implemented to minimize adverse impacts to the surrounding future park uses.

The DEM will incorporate odor control and visual mitigation strategies at the proposed WWRF to minimize potential impacts to a future regional park. Proposed odor control measures include buffer land or walls/berms around the WWRF, enclosures on headworks, and a biotrickling filter (or similar process) at odor sources. Detailed odor control strategies are discussed in Section A.11 of this Chapter. In addition, the proposed visual mitigation measures include buffer land or walls/berms around the WWRF, landscaping, as well as architectural treatments. Detailed visual mitigation measures are discussed in Section A.14 of this Chapter.

5. Solid Waste Collection

a. Existing Conditions

Single-family residential solid waste collection service is provided by the County of Maui. Residential solid waste collected by County crews is disposed of at the County’s Central Maui Landfill, located four (4) miles southeast of the Kahului Airport. In addition to County-collected refuse, the Central Maui Landfill also accepts commercial waste from private collection companies. In addition, a County-supported green waste recycling facility is located at the Central Maui Landfill.

b. Potential Impacts and Mitigation Measures

During the construction phase of the project, waste and recyclable materials will be transported to appropriate processing facilities. Construction contractors will be required to develop construction waste management plans for approval by the DEM to ensure waste is properly disposed of and to identify construction efficiency opportunities.

When the project is implemented and operational, the proposed WWRF will produce residual solids that will require management. The wastewater treatment process involves preliminary treatment and liquid treatment. The preliminary treatment includes screening and grit removal to remove coarse debris. Landfill disposal of grit and screenings from the preliminary treatment is a viable option for solid waste management at the Central Maui WWRF. Landfill disposal is the current method of grit and screening disposal across the Maui Island's WWRFs. As such, grit and screening debris from the project will be disposed of at the Central Maui Landfill.

The liquid treatment process removes "wastewater solids" and "sewage sludge", which are concentrated waste materials present in sewage. The County has long relied on composting or landfilling for solids management for the Maui Island WWRFs. The term "biosolids" is used to describe wastewater solids or sewage sludge that have undergone sufficient treatment process pursuant to the U.S. EPA standards to allow the material to be put to beneficial use, such as composting. "Class A" biosolids comply with the U.S. EPA's most stringent pathogen requirements, are virtually pathogen free, and can be used as a soil amendment on all types of land, including residential properties and food crops. Dewatered sludge from the liquid treatment process at the Maui Island WWRF has, in the past, been composted with green waste to create a Class A biosolids product. The private composting operation, operated by Maui EKO Systems, is currently located at the Central Maui Landfill. Composting is considered to be a viable biosolids management option for the proposed Central Maui WWRF. Landfill disposal of dewatered sewage sludge is also an option when composting is not available.

Solid waste projections for the full buildout of the proposed Central Maui WWRF were prepared for the project's Facility Plan and are presented in **Table 10**, below. Refer to **Appendix "A"**. In addition, while not quantified in **Table 10**, County workers at the proposed WWRF will generate a limited amount of regular trash (i.e. paper, food waste, containers).

Table 10. Solid Waste Projections at Full 4.0 mgd Capacity

Description	Average	Peak Month
Screenings	40 ft^3/day	48 ft^3/day
Grit	20 ft^3/day	24 ft^3/day
Waste Activated Sludge (Dry Weight)		
Total Solids	12,000 ppd	14,400 ppd
Volatile Solids	9,600 ppd	11,500 ppd
Fixed Solids	2,400 ppd	2,900 ppd
Tertiary Solids (Dry Weight)	600 ppd	700 ppd
*ppd = pounds per day Source: Brown and Caldwell, 2024		

D. INFRASTRUCTURE

1. Roadways

a. Existing Conditions

Access to the WWRF site is anticipated to be from an approximately 100-foot-wide paved driveway from the planned Waiʻale Road Extension. No access is planned from Kūihelani Highway. The proposed project also involves pipeline installations under the existing Waiʻale Road, the intersection of Waiʻale Road and Waiko Road, the future Waiʻale Road Extension, as well as the proposed access road to the WWRF site.

A Traffic Impact Analysis Report (TIAR) has been prepared by Austin, Tsutsumi & Associates, Inc. (ATA) to assess current and future traffic conditions in the project area, and the potential traffic impacts associated with the construction and operations of the proposed project. A copy of the project's TIAR is included herein as **Appendix "Q-1"**.

The following are brief descriptions of the existing roadways studied within the vicinity of the Project:

Honoapiʻilani Highway is generally a north-south, two-way, two-lane, undivided arterial highway with posted speed limits ranging between 30 miles per hour (mph) and 45 mph. Honoapiʻilani Highway begins to the north at its intersection with Keanu Street and High Street in Wailuku, and runs southward and then westward, generally following the coast, until it transitions into Kahekili Highway at its intersection with Honokohau Valley Road near the Honokohau Bay.

Waiʻale Road is a north-south, two-way, two-lane, undivided collector roadway with a posted speed limit of 20 mph in the study area. To the north,

Wai‘ale Road serves as the southern connection to Lower Main Street and extends past the Maui Community Correctional Center, Kehalani Village Center, and various residential subdivisions, and eventually terminates at a T-intersection with East Waiko Road.

Waiko Road is an east-west, two-way, two-lane, undivided collector roadway with a posted speed limit of 20 mph within the study area. East Waiko Road extends westward from Kūihelani Highway to Honoapi‘ilani Highway where it continues as West Waiko Road within the Waikapū residential neighborhood.

Kūihelani Highway is a north-south, two-way, four-lane, divided arterial highway with posted speed limits ranging from 30 mph to 55 mph. Kūihelani Highway begins as the continuation of Mayor Elmer F. Cravalho Way at the Pu‘unēnē Avenue/Maui Veterans Highway intersection and continues southward through Waikapū where it terminates at its intersection with Honoapi‘ilani Highway. The speed limit along the highway is 45 mph in the vicinity of East Waiko Road and increases to 55 mph near the project site.

Due to the proximity of the project area to these roadways, the following intersections were analyzed:

- Honoapi‘ilani Highway/Wai‘ale Road Extension (Unsignalized)
- Honoapi‘ilani Highway/Waiko Road (Signalized)
- East Waiko Road/Wai‘ale Road (Unsignalized)
- Kūihelani Highway/East Waiko Road (Signalized)

In order to determine existing traffic conditions, traffic counts were conducted in September 2022 and evaluated by Level of Service (LOS). LOS is a qualitative measure used to describe the conditions of traffic flow at intersections, with values ranging from free-flow conditions at LOS A, to congested conditions at LOS F. Traffic was observed to proceed smoothly through all study intersections, with no significant or persistent congestion. The TIAR notes that all movements at all study intersections operate at LOS C or better across both morning (AM) and afternoon (PM) peak hours for existing traffic conditions.

b. <u>Potential Impacts and Mitigation Measures</u>

The Year 2029 was selected to reflect the project’s anticipated completion (late 2029). The Base Year 2029 scenario represents the traffic conditions

within the study area without the project. The Future Year 2029 scenario represents the traffic conditions within the study area with the project.

Table 11 identifies the LOS Summary for all intersections in the morning and afternoon peak hours for the existing conditions, the Base Year 2029, the Future Year 2029 during construction, and the Future Year 2029 after construction.

Table 11. LOS Summary

Intersection	Existing 2022 Conditions		Base Year 2029		Future Year 2029 During Construction		Future Year 2029 After Construction	
	AM	PM	AM	PM	AM	PM	AM	PM
1: Honoapi‘ilani Highway & Wai‘ale Road Extension (w/traffic signal)								
NB TH	-	-	A	A	A	B	A	A
NB RT	-	-	A	A	A	A	A	A
WB LT	-	-	C	C	C	C	C	C
WB RT	-	-	B	B	B	B	B	B
SB LT	-	-	A	B	A	B	A	B
SB TH	-	-	A	A	A	A	A	A
OVERALL	-	-	A	A	A	B	A	A
2: Honoapi‘ilani Hwy. & W. Waiko Road/E. Waiko Road								
NB LT	A	A	A	A	A	A	A	A
NB TH/RT	B	A	B	B	B	B	B	B
EB LT/TH	C	C	C	C	C	C	C	C
EB RT	C	C	C	C	C	C	C	C
WB LT/TH/RT	C	C	C	D	C	D	C	D
SB LT	A	A	A	B	A	B	A	B
SB TH	A	A	B	B	B	B	B	B
SB RT	A	A	A	A	A	A	A	A
OVERALL	B	A	B	B	B	B	B	B
3: E. Waiko Road/Wai‘ale Road (w/traffic signal)								
NB LT	-	-	A	A	A	B	A	B
NB TH	-	-	B	B	C	B	C	B
NB RT	-	-	B	B	B	B	B	B
EB LT	A	A	B	B	B	B	B	B
EB TH/RT	-	-	C	B	C	B	C	B
WB LT	-	-	B	B	B	B	B	B
WB TH	-	-	B	B	B	B	B	B
WB RT	-	-	B	B	B	B	B	B
SB LT	-	-	B	A	B	A	B	A
SB TH/RT	-	-	A	A	A	B	A	B
SB LT/RT	B	B	-	-	-	-	-	-
OVERALL	-	-	B	B	B	B	B	B
4: Kuihelani Hwy. & E. Waiko Road								
NB LT	C	B	C	C	C	C	C	C
NB TH	A	A	A	A	A	A	A	A

Intersection	Existing 2022 Conditions		Base Year 2029		Future Year 2029 During Construction		Future Year 2029 After Construction	
	AM	PM	AM	PM	AM	PM	AM	PM
EB LT/RT	B	B	B	B	B	B	B	B
SB TH	A	A	B	B	B	B	B	B
SB RT	A	A	B	B	B	B	B	B
OVERALL	A	A	B	B	B	B	B	B
5: Wai'ale Road Extension & Main St. (w/roundabout)								
NB LT/TH/RT	-	-	A	A	A	A	A	A
EB LT/TH/RT	-	-	A	A	A	A	A	A
EB LT/RT	-	-	A	A	A	A	A	A
SB LT/TH/RT	-	-	A	A	A	A	A	A
OVERALL	-	-	A	A	A	A	A	A
6: Wai'ale Road Extension & Project Access								
WB LT/RT	-	-	-	-	B	B	B	B
SB LT	-	-	-	-	A	A	A	A
OVERALL	-	-	-	-	-	-	-	-

Source: Austin Tsutsumi & Associates, Inc.
Note: AM – ante meridiem / PM – post meridiem

Base Year 2029

The TIAR states that Base Year 2029 conditions, without the project, assume a number of known developments in the region were fully or partially completed, and the corresponding trips were added throughout the study network. In addition, a defacto growth rate of 0.5 percent to 0.9 percent per year was added along Honoapi'ilani Highway, Kūihelani Highway, Waiko Road and Wai'ale Road based on projections within the Maui Regional Travel Demand Model.

It is assumed that the Wai'ale Road Extension will be completed by the Year 2029. The Wai'ale Road Extension Final Environmental Assessment (EA), published in August 2025, considered both roundabout and traffic signal scenarios for the Wai'ale Road intersections with Waiko Road, and Honoapi'ilani Highway. Only roundabouts are considered for the Wai'ale Road intersections with the future Main Street (proposed as part of the future Waikapū Country Town development) and the future Makai Parkway (proposed as part of the future Waikapū Country Town development). For the purposes of this analysis, Phase I of the future Waikapū Country Town development was assumed to be completed by Year 2029, which is proposed to have access from the future Main Street. As such, the TIAR included the Wai'ale Road Extension/Main Street intersection as a roundabout in the analysis. For the Wai'ale Road intersections with Waiko Road and Honoapi'ilani Highway, the TIAR analyzed both single-lane roundabouts and traffic signals scenarios. Under the roundabout scenario, the TIAR presented overall LOS A for all roundabout intersections. **Table**

11 summarizes the traffic signal scenario. With Base Year 2029 conditions, all movements at all study intersections are anticipated to operate adequately at LOS D or better across both AM and PM peak hours.

Future Year 2029 During Construction

In addition to the traffic projections for Base Year 2029, the Future Year 2029 During Construction scenario assumes construction traffic for the subject project. Based on information provided by the DEM, a maximum of four (4) delivery trucks will arrive, unload, and depart from the project site during both the AM and PM peak hours of traffic. In addition, it was assumed that 161 workers would arrive during the AM peak hour and leave the site during the PM peak hour. It was assumed that deliveries and worker parking will initially be routed to the larger WWRF site and will be transported to and from the smaller Kehalani WWPS and sewage pipeline construction sites outside of the peak hours.

Trips generated by the construction workers were assigned throughout the study area generally based upon population data indicating where workers reside. All delivery trucks were assumed to originate from Kahului Harbor, and upon exiting the site, return to Kahului Harbor.

During construction, the project is anticipated to generate 169 trips during the AM peak hours and another 169 trips during the PM peak hours of traffic. With construction traffic, it is anticipated that all movements will operate adequately at LOS D or better across both peak hours. The TIAR recommended that at the Waiʻale Road Extension/the project's access road intersection, adequate sight distance be maintained. No additional improvements are recommended as a result of construction traffic.

In order to mitigate potential traffic impacts during the temporary construction period, a Construction Traffic Management Plan (CTMP) has been prepared for the project by ATA. See **Appendix "Q-2"**. The CTMP provides high-level recommendations for traffic management. The CTMP will be further updated as more detailed construction information becomes available. Preliminarily, the CTMP recommends the use of temporary traffic control devices and that community members and affected organizations be kept apprised of construction activity. BMPs such as the use of sediment traps, filter socks and regular cleaning of adjacent streets will be implemented to minimize tracking of mud and dirt onto surrounding roadways. In addition, the DEM will coordinate with the State of Hawaiʻi, Department of Transportation (HDOT) on the project construction schedule to minimize possible conflicts with HDOT's scheduled highway and maintenance projects in the area.

Future Year 2029 After Construction

In addition to the traffic projections for Base Year 2029, the Future Year 2029 After Construction scenario assumes operational traffic for the proposed Central Maui WWRF, SAT, as well as Kehalani WWPS. Under this scenario, it is assumed that there will be a small number of staff onsite to operate the WWRF once it is built out and fully operational and 10 septage haulers will enter and exit the WWRF site during business hours. The septage haulers were assumed to be evenly distributed over the course of the 8-hour business day, from 7:00 AM to 3:00 PM, and as a result, two (2) septage haulers are expected to enter and exit the site during the AM peak hours only, as the business day ends before the start of the PM peak hour. In addition, there will be one large truck to haul away solids from the WWRF site, with up to three (3) truckloads per day anticipated; however, these hauls are anticipated to occur outside of the AM and PM peak hours.

During normal operations of the site, staff and contractors may occasionally travel between the WWRF site and the Kehalani WWPS located near the Waiʻale Road/Olomea Street intersection; however, it is anticipated that these trips will be infrequent and will, therefore, have a negligible impact to volumes and operations overall. As a result, the TIAR projects that during normal operations, the project is anticipated to generate 20 trips during the AM peak hours and 16 trips during the PM peak hours of traffic.

All movements are anticipated to continue to operate acceptably at LOS D or better across both peak hours. Although the trips generated by the large truck are not anticipated to have a significant impact on operations, it is recommended that the hauling trips be coordinated to occur outside of the AM and PM peak hours to avoid interruption to traffic on adjacent streets.

The TIAR suggests adequate sight distance should be maintained at all times at the Waiʻale Road Extension/the project's access road intersection. No additional improvements are recommended as a result of project traffic, during or after construction, at the time when the facility is fully operational. Refer to **Appendix "Q-1"**.

With implementation of the foregoing mitigation recommendations, potential traffic impacts from the proposed project both during construction and operation are anticipated to be appropriately addressed.

2. Water System

a. Existing Conditions

The project area is located within the County of Maui Department of Water Supply's (DWS) Central Maui water system. The proposed Kehalani WWPS site contains two (2) existing 2-inch water laterals supplied by the 12-inch water main under Olomea Street. The Central Maui WWRF site does not have water infrastructure currently available. The water source would come from the 3.0 million gallon (mg) capacity DWS ʻĪao Tank. The ʻĪao Aquifer System, in which the project is located is a Ground and Surface Water Management Area, designated by the State of Hawaiʻi, Commission on Water Resource Management (CWRM). According to the CWRM's 2019 Water Resource Protection Plan, the sustainable yield for the ʻĪao Aquifer System is 20 mgd with an average pumpage of 15 mgd.

b. Potential Impacts and Mitigation Measures

For the wastewater treatment process, R-1 recycled water produced at the WWRF will be utilized for any wastewater treatment purposes, and as such, no potable water is anticipated to be required during normal operations of the WWRF itself. A limited amount of potable water will be needed for the WWRF staff bathrooms and break rooms. The proposed Waiʻale Road Extension project includes installation of underground utilities, including water lines, and the proposed WWRF project will install a water line under the proposed access and utility easement to connect to DWS's water system.

For potable water demands, a technical memorandum was prepared by Brown & Caldwell to address the potable water demands associated with the proposed Central Maui WWRF and the Kehalani WWPS. See **Appendix "R"**. For the proposed Kehalani WWPS, potable water will be needed primarily for sanitation, cleanup, and an odor control system. Projected water demands are estimated at 4,000 gpd on average, with peak day and peak hour demands reaching 6,000 gpd and 8.3 gallons per minute (gpm), respectively. For the WWRF, potable water will support functions such as restrooms, showers, drinking fountains, laboratory use, and safety stations, while R-1 recycled water generated at the facility will meet most operational needs like irrigation and process water. Daily potable water demand at the WWRF is estimated at 4,500 gpd, with peak demands reaching 6,800 gpd and 9.4 gpm. Additionally, fire protection requirements call for a separate supply capable of delivering 2,500 gpm for two (2) hours, totaling 300,000 gallons. All potable water infrastructure will

adhere to the DWS's Water System Standards and require approval from the DWS prior to construction.

The treated effluent from the Central Maui WWRF will comply with the State of Hawai'i, DOH requirements for R-1 recycled water. According to the State DOH, R-1 water is suitable for, from a public health standpoint, any form of irrigation for landscaping as well as food crops, including all edible root crops, where the recycled water comes into contact with the edible portion of the crop (DOH, 2002). The primary method of disposing the treated effluent from the WWRF will be to distribute R-1 Recycled water to surrounding properties in the Central Maui region for irrigation purposes, including parks, school yards, and streetscapes within the future Waikapū Country Town development, as well as nearby agricultural fields and a County park, as may be appropriate. Approximately 1,259 acres would be irrigated from R-1 Recycled Water from the Central Maui WWRF. See **Table 12**. The R-1 recycled water use area is identified in **Figure 19**. The recycled water from the proposed Central Maui WWRF is planned to be delivered to a recycled water storage facility which will be constructed within the future Waikapū Country Town development, located to the northwest of the proposed WWRF and SAT site. This R-1 recycled water initiative aims to conserve Maui's freshwater resources by using treated wastewater for non-drinking purposes, thereby reserving potable and raw water supplies.

Table 12. R-1 Recycled Water Use Areas – Estimated Acreage

Recycled Water Use Area	Acres
Waikapū Country Town Parks	32*
Waikapū County Town Greenbelts and Open Space	50*
Agricultural Reserve	1,077*
County Regional Park	100
Total	**1,259**

Source: Brown & Caldwell, 2024
*Source: Waikapū Country Town Final Environmental Impact Statement, January 2017.

3. Wastewater System

a. Existing Conditions

The DEM Wastewater Reclamation Division (WWRD) operates five (5) WWRFs in Maui County. The County WWRFs, including Lahaina, Kīhei, Wailuku-Kahului, and Kaunakakai WWRFs, have used injection wells for effluent management purposes for many years. Injection wells offer many advantages for wastewater agencies in Hawai'i, including low capital and operating costs and small land requirement. The highly porous volcanic

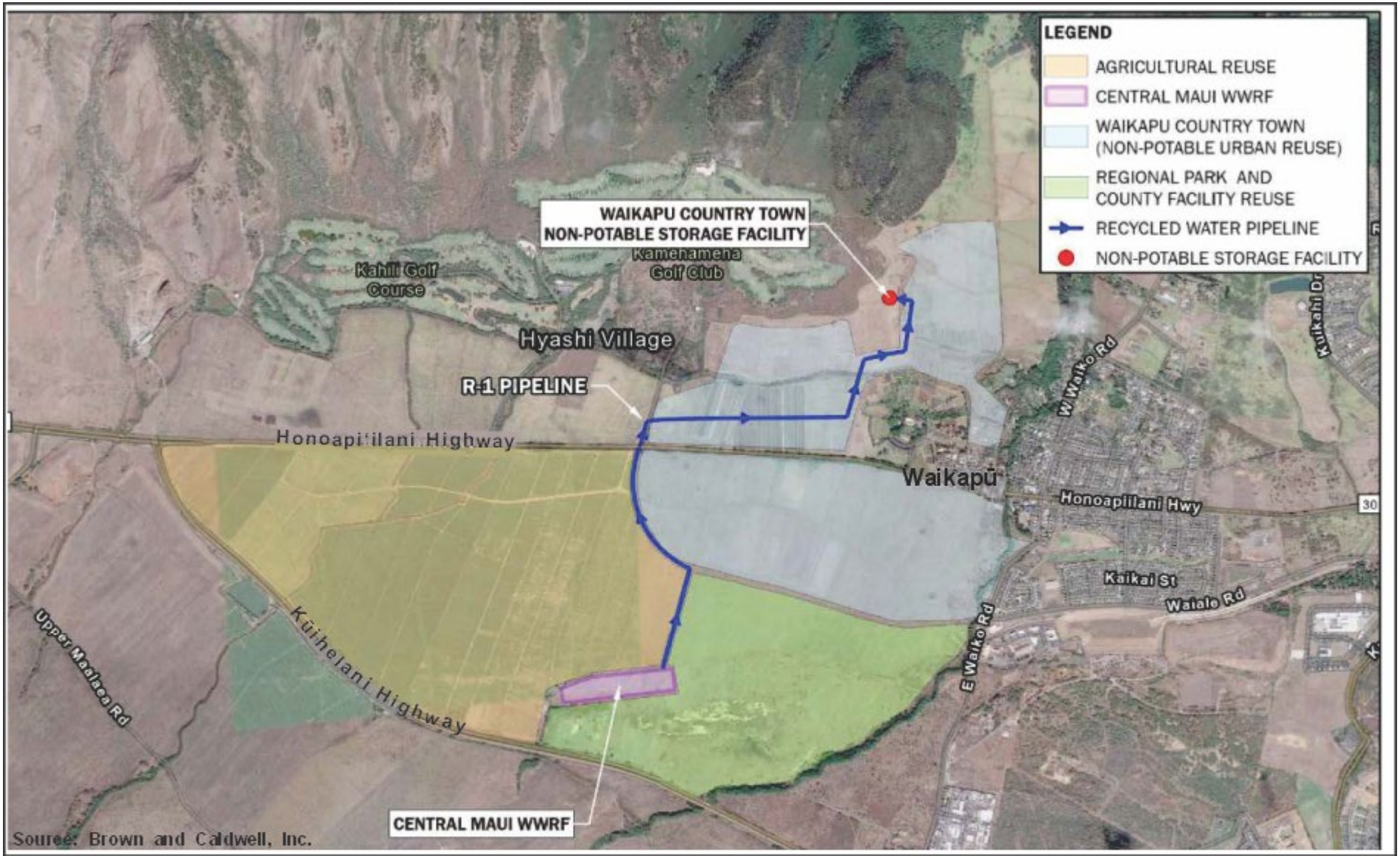

Figure 19

Proposed Central Maui Wastewater Reclamation Facility

R-1 Recycled Water Use Area Map

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

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COM\DEM CMaui WW Infrastructure\Applications\Figures\R1 Recycled Water

geology of Maui is especially conducive to injection well use because effluent can flow by gravity into the injection well, and pumping is not required. However, the injection wells have been controversial due to concerns over the potential impacts to near-shore reef environments, and the County has been subjected to lawsuits over their use. A Countywide WWRF Land Treatment Study was conducted by Brown and Caldwell, Inc. in April 2020 to explore land treatment as an alternative to the current effluent management method of injection wells. According to the Study, land treatment is defined as the application of appropriately pre-treated municipal and industrial wastewater to the land at a controlled rate in a designed and engineered setting to achieve treatment goals in a cost-effective and environmentally sound manner. The Study concluded that SAT and slow rate type 1 land treatment systems were identified as the most appropriate forms of land treatment to meet the County's needs. The soil characteristics at the land treatment site ultimately determines what type of system is appropriate, and a WWRF capacity determines how large the system must be. The Study assessed the feasibility of land treatment systems at each of the WWRFs and explored a new Central Maui WWRF as an option.

In regards to the Wailuku-Kahului Community Plan region in which the project is located, the Wailuku-Kahului WWRF located near the Kahului Harbor services the region and has the capacity to treat approximately 7.9 mgd. The MIP defines a Directed Growth Plan that outlines how Maui should grow through the year 2030 and directs urban growth to certain areas of Maui by establishing Urban, Small Town and Rural Growth Boundaries (UGB, STB, and RGB). Wastewater generated from residents and businesses located in the proposed growth areas will require management. Currently, wastewater generated from existing Central Maui communities (Wailuku, Waikapū, and Kahului) is conveyed to the Wailuku-Kahului WWRF for treatment and disposal. However, the Wailuku-Kahului WWRF does not have capacity to accommodate flow from all the proposed growth areas, and the DEM does not plan on expanding flow capacity of the Wailuku-Kahului WWRF due to land limitations at the site. Therefore, alternative wastewater management measures will be required for growth areas.

In order to estimate the likely influent characteristics for the proposed Central Maui WWRF, data from the existing Wailuku-Kahului WWRF was used. This data, collected daily from February 2020 to February 2021, included measurements of BOD_5, TSS and VSS, and nitrogen species concentrations. For a conservative design approach, the maximum value of the 30-day running average for each constituent was selected for the

analysis. In addition, A design total phosphorus concentration was determined using extra sampling data from a separate study by Kennedy Jenks. This study, which focused on influent characterization at the Wailuku-Kahului WWRF, was conducted over 14 days in October of 2020. See **Table 13**.

Table 13. Wailuku-Kahului WWRF Influent Characteristics

Parameter	Average Concentration (mg/L)
BOD_5	346
TSS	418
VSS	382
Nitrogen, Ammonia	33
Nitrogen, Organic	21
Nitrogen, Total Kjeldahl	55
Phosphorous, Total	6
Source: Brown and Caldwell, 2024	

In addition to wastewater, the Wailuku-Kahului WWRF is currently the septage receiving station for the island. Septage generated on Maui Island is treated and disposed of at the Wailuku-Kahului WWRF. Haulers currently discharge collected septage into a manhole just upstream of Wailuku Pump Station; there is not currently a way of separately tracking the volume and characteristics of septage that is received.

b. <u>Potential Impacts and Mitigation Measures</u>

The Central Maui WWRF project is being proposed to alleviate pressure on the Wailuku-Kahului WWRF, which is nearing its design capacity of 7.9 mgd. The new WWRF can treat a portion of existing Wailuku and Waikapū wastewater flows, reducing the effluent disposal needs at the Wailuku-Kahului WWRF that is currently served by injection wells while also managing the wastewater generated by anticipated future development projects within the growth area.

A Central Maui WWRF Facility Plan was prepared by Brown and Caldwell, Inc. in June 2024 to provide the overview of the proposed Central Maui WWRF, including the purposes and needs, service areas, recommended wastewater treatment and effluent management processes, and preliminary site plan. Refer to **Appendix "A"**. The development of the Central Maui WWRF project will provide treatment to approximately four (4) mgd of wastewater flows from the Central Maui region during average dry-weather conditions. The Central Maui WWRF will accept and treat approximately 1.78 mgd of existing wastewater currently treated at the

Wailuku-Kahului WWRF and will provide approximately 1.9 mgd of wastewater treatment for future planned development. See **Table 14**.

Table 14. Anticipated Buildout Flow from Developments in Service Area

Development Name	Average Dry Weather flow (mgd)	New Growth (mgd)	Existing Development Diverted Flow from Wailuku-Kahului WWRF (mgd)
Puʻuhona	0.30	0.30	
Kahili Rural Residential	0.04	0.04	
Waikapū Tropical Plantation Town	0.65	0.65	
Regional Parks and County Facilities	0.24	0.24	
West Waiʻale Road Properties	0.18		0.18
DHHL Pūlehunui North	0.19	0.19	
DHHL Pūlehunui South	0.08	0.08	
DHHL Pūlehunui – Existing Properties	0.18	0.18	
DLNR Industrial & Business	0.25	0.25	
Wailuku Heights	0.16		0.16
Kehalani	0.73		0.73
Old Waikapū – Makai	0.41		0.41
Old Waikapū - Mauka	0.28		0.28
Waiko Road Subdivision	0.02		0.02
Potential Future Connections	0.29		
Totals	4.0	1.93	1.78
Percentage of Total Flow	100%	48%	44%
Source: Brown and Caldwell, 2024			

As previously mentioned, the Wailuku-Kahului WWRF is nearing its design capacity of 7.9 mgd. In order to divert some of the existing wastewater flows currently flowing to the Wailuku-Kahului WWRF, the Kehalani WWPS is proposed to be constructed, which would divert an estimated flow of 1.78 mgd of existing and future flow to the Central Maui WWRF. The Central Maui WWRF will have an ultimate peak hour wet weather flow capacity of 16.1 mgd.

Historically, wastewater influent strength has increased due to water conservation efforts. The proposed wastewater system has been designed in anticipation of more concentrated wastewater characteristics due to increased use of water efficiency features. The "average day" mass load reflects expected levels based on design concentrations and average dry weather flow (4 mgd). The “peak month” mass load is the expected loading on a day during a peak month and is assumed to be approximately 20

percent greater than the average day mass load. In addition to wastewater, the Central Maui WWRF will serve as the island's disposal site for septage, instead of the Wailuku-Kahului WWRF.

The following processes for wastewater treatment are proposed at the Central Maui WWRF. The overall process is illustrated in **Figure 20**.

1. Preliminary Treatment

Preliminary treatment prepares the raw wastewater for downstream treatment by removing debris. Preliminary treatment involves a process of influent flow measurement, influent sampling, screening, and grit removal. It is noted that the screening process can result in undesirable odors. As such, foul air will be collected from the headworks channels and treated for odor control.

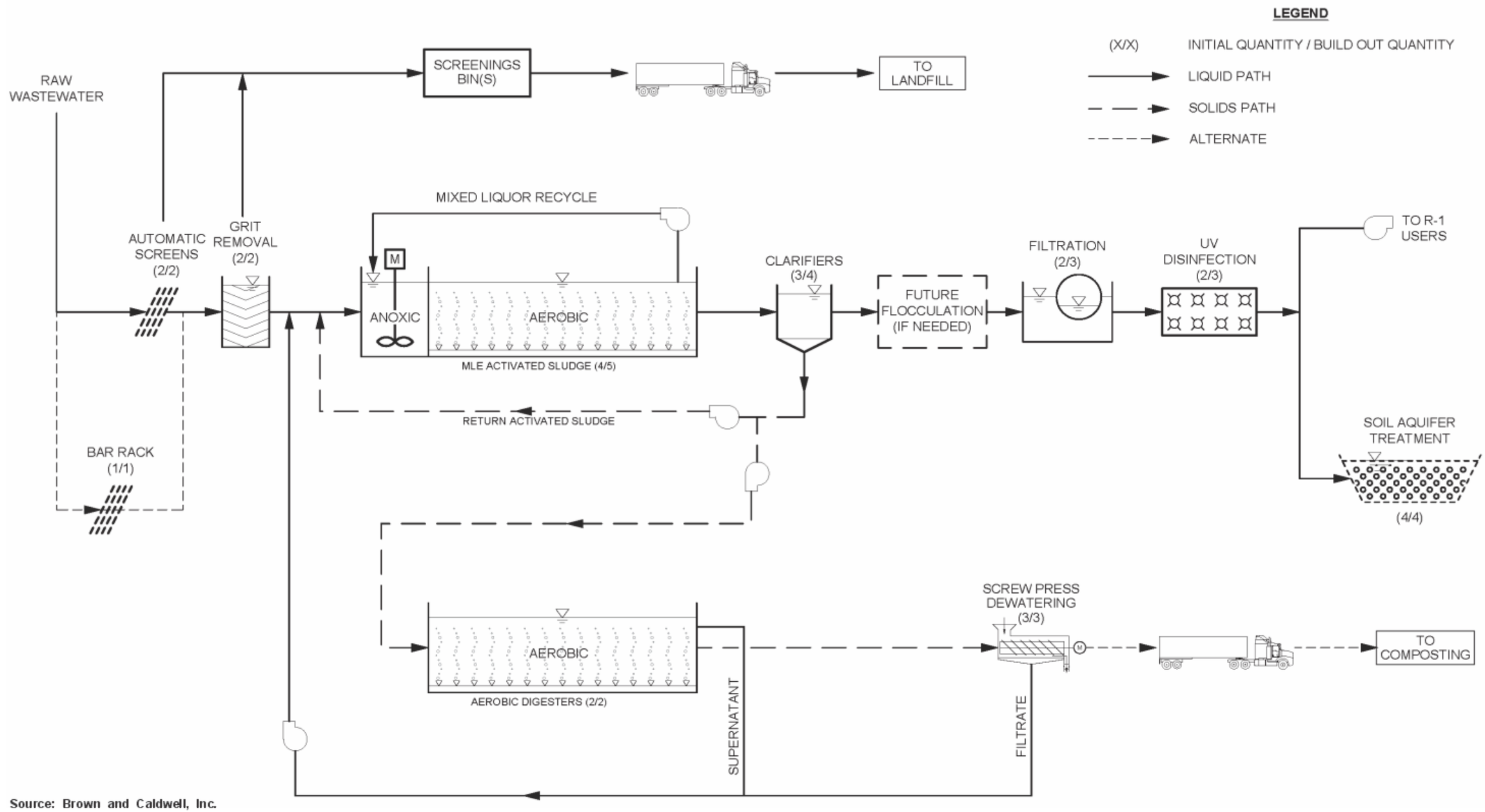
i. Influent Flow Metering and Sampling

In order to effectively monitor influent, influent flow measurement and sampling are needed. Influent flow measurement is a process to measure the rate and volume of wastewater entering the treatment process. Several technological options (i.e. Parshall flume, magnetic flow meter) are recommended by the Facility Plan, depending on the hydraulic conditions. Influent flow sampling is used to calculate influent mass loading rates to the WWRF to allow assessment of the treatment performance and optimization of aeration rates in the biological treatment process.

ii. Screening

The next step in the preliminary treatment process is screening, which involves removal of large objects, debris, and rags that may be present in wastewater.

For the Central Maui WWRF, the Facility Plan recommended using step screens with quarter-inch openings to ensure effective screening for downstream processes. Step screens utilize two (2) sets of inclined stepped plates. One (1) set of plates is fixed while the other set is movable. The movable set lifts the screenings to the next step via a circular movement of the movable plates each time the head loss reaches a designated amount. Screenings are discharged after they reach the top step.



Source: Brown and Caldwell, Inc.

Figure 20

Proposed Central Maui Wastewater Reclamation Facility
Overall Wastewater Treatment Process Diagram

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO HIRAGA

COM/DEM Cmaui WW Infrastructure/Applications/Figures/OverallProc

See **Figure 21**. A screenings trough or conveyor is required to transport the screenings from the screen to the washer Following the screening process, the screenings consisting of large objects, debris or rags will be sent to a washer/compacter to remove organic matter prior to disposal at the Central Maui Landfill.

iii. Grit Removal

Following the initial screening, grit removal takes place. Grit particles can consist of sand, gravel, pebbles, silt, cinders, ground bone, eggshells, coffee grounds, and other materials. Grit removal is an important step in preventing wear to mechanical equipment and removed grit must be washed, dewatered, and dispose.

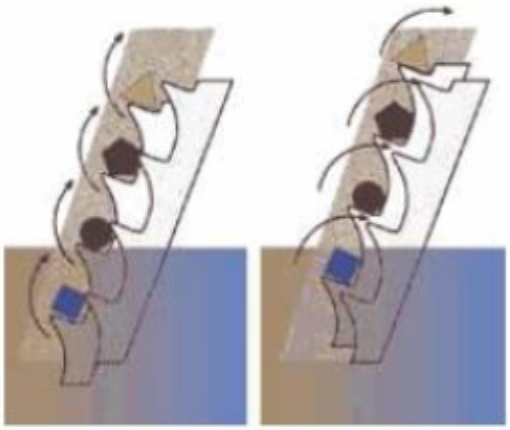
Lamella grit removal, a proprietary technology from Eutek called the HeadCell, is proposed for the Central Maui WWRF. Flow enters the tanks tangentially and establishes a vortex flow pattern. Solids settle onto each plate and fall toward an opening at the center of each plate. The grit collects at the cone shaped bottom of the tank where it is pumped to be washed and dewatered. Effluent flows out of the trays, over a weir, and into an effluent trough. See **Figure 22**. The HeadCell system can achieve a 95 percent capture rate of grit 75 microns and larger, which include the finest particles.

iv. Septage Receiving Station

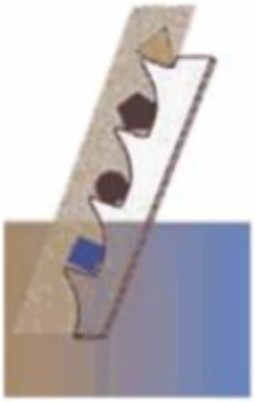
Septage manually hauled to the WWRF is proposed to enter a packaged septage receiving system. Packaged septage receiving systems with integral rock removal and screening are characteristic of the best-in-class septage receiving method. Received septage will be sent to the WWRF headworks along with the other wastewater influent to follow through the entire liquid treatment process. Because septage is much more concentrated than wastewater in terms of BOD_5 and solids, an equalization tank with metering pumps is recommended downstream of the septage receiving station to gradually feed the septage to the liquid treatment process to avoid shock loading the system.

Step 1 - Screenings are retained on the steps and form a screenings carpet.

Step 2 - The screenings carpet is lifted by rotation of the moveable plate.



Step 3 - The screenings carpet is placed on the next steps of the fixed plate. The lowest step is clean and ready for the formation of a new screenings carpet.



Source: Brown and Caldwell, Inc.

Figure 21 Proposed Central Maui Wastewater Reclamation Facility
Step Screens Diagram

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

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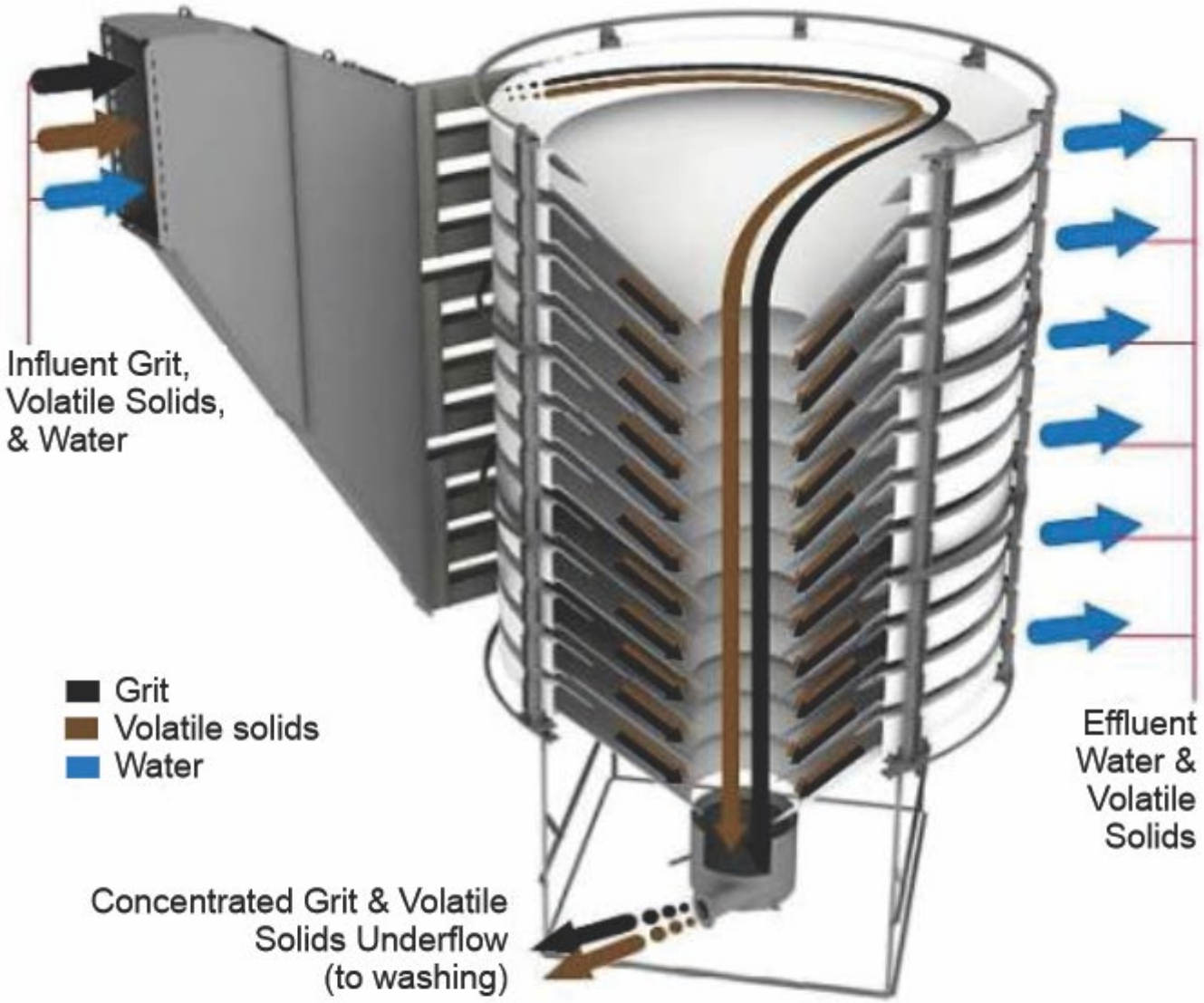

HeadCell Process Schematic

Source: Brown and Caldwell, Inc.

Figure 22 Proposed Central Maui Wastewater Reclamation Facility Grit Removal Diagram

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

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2. Liquid Treatment

i. Liquid Treatment- Primary

Primary liquid treatment can be conducted in order to remove the majority of suspended solids present in wastewater through simple physical settling. This can result in a less intensive secondary treatment process; however, wastewater treatment can be achieved with or without primary liquid treatment. For the Central Maui WWRF, no primary treatment is recommended, which is consistent with the other County WWRFs. Although a primary treatment process can reduce BOD_5**,** TSS and the intensity of a secondary treatment process, not having primary treatment results in reduced odor risk, operational complexity, maintenance complexity and capital costs. With the relatively small size of the Central Maui WWRF compared to other WWRFs, primary treatment is not recommended.

ii. Liquid Treatment- Secondary

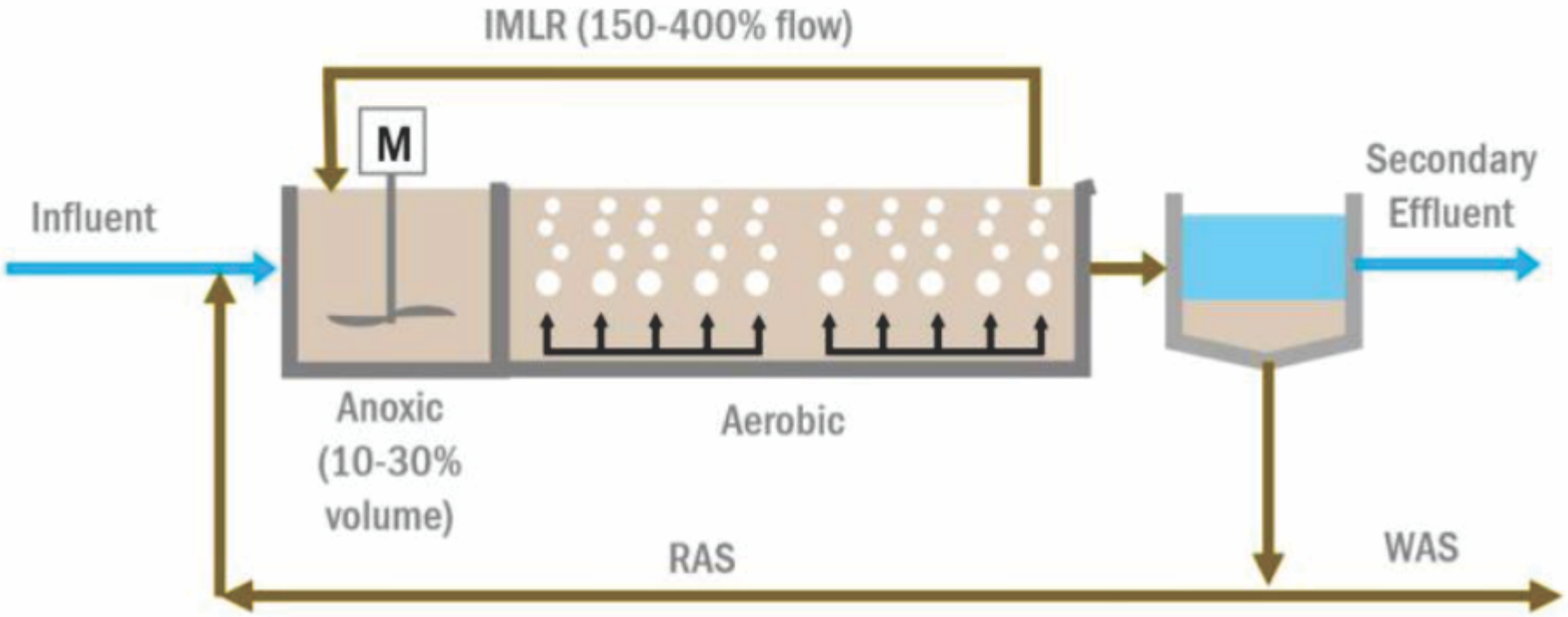
Secondary liquid treatment is a biological treatment process to remove BOD_5 and nutrients which are a form of organic pollutant. The Central Maui WWRF Facility Plan recommends further evaluation of the following methods for secondary liquid treatment:

- *Modified Ludzack-Ettinger (MLE) activated sludge*

  This is a modification from a conventional activated sludge system with the addition of an internal mixed liquor recycle (IMLR). Nitrification (ammonia removal) occurs in the aerobic zone. The mixed liquor, high in nitrate from nitrification, is recycled to the anoxic zone (by the internal recycle) for denitrification. See **Figure 23**.

  If the MLE activated sludge process is selected, the following activated sludge options can be considered during the preliminary design phase:

  - Activated sludge with anoxic selector
  - Anoxic step feed activated sludge
  - Ntensify



MLE Process Schematic

Source: Brown and Caldwell, Inc.

Figure 23

Proposed Central Maui Wastewater Reclamation Facility

MLE Activated Sludge Diagram

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Further details of these processes are included in the Facility Plan. Refer to **Appendix "A**".

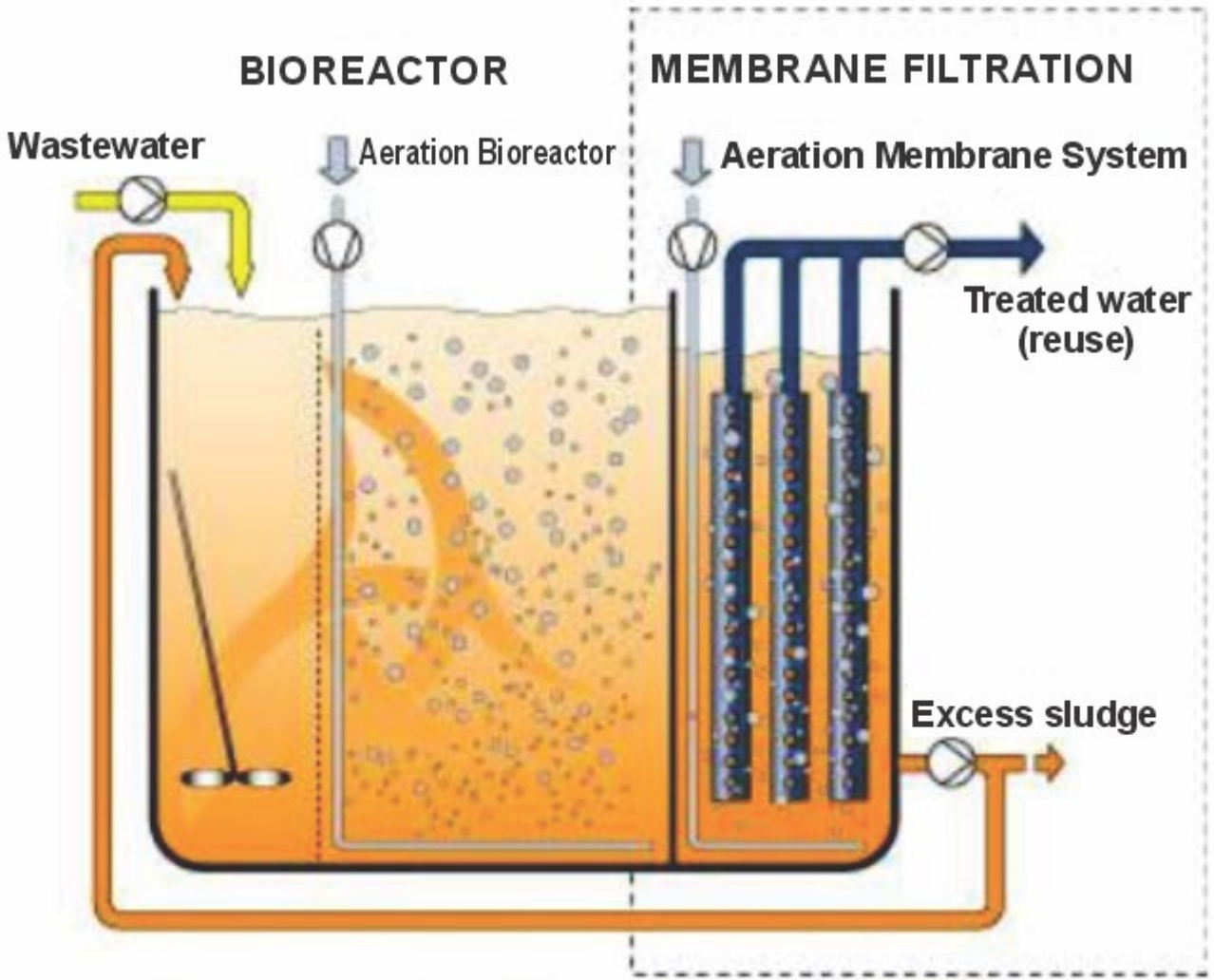
- *Membrane Bioreactor (MBR)*

  A membrane bioreactor (MBR) combines aeration with membrane filtration, eliminating the need for additional tertiary treatment if a very high-quality effluent is desiredfor water reuse purposes. MBRs filter out large particles, resulting in effluent with TSS concentrations typically below 1 mg/L, meeting strict turbidity standards without extra filtration. See **Figure 24**. A key difference between a MBR and other biological systems is how it separates bacteria from clean water. MBRs use thin membranes with tiny perforations (0.04 to 0.2 microns), which block most microorganisms while allowing water molecules to pass through.

iii. Liquid Treatment - Filtration and Disinfection

Filtration and disinfection are needed for the treated wastewater to meet State of Hawai'i, DOH standards for R-1 recycled water. The filtration process involves the use of a cloth media filter, which is a standard process used by the County of Maui WWRFs. The cloth disc filter process involves three (3) steps: filtration, backwash, and solids waste. During filtration, inlet wastewater enters the tank, fully submerging the cloth media. As solids are deposited on the media, the filtered water is collected within each disc and conveyed through a central shaft for discharge. A backwash cycle is triggered when the accumulation of solids on the cloth media increases head loss across the filter. During this process, the discs rotate slowly, using liquid suction to remove solids from both sides of each cloth media disc. Cleaning occurs in pairs, allowing the other discs to continue operating. Heavier solids naturally settle to the tank bottom, so a periodic waste cycle pumps accumulated solids from the filter.

The addition of chemical coagulants and/or flocculants upstream of media filtration may be necessary to aggregate small particles into larger ones that can be effectively removed by the filters. The County typically has not had to add chemicals upstream of cloth media filtration systems to



Source: Brown and Caldwell, Inc.

Figure 24

Proposed Central Maui Wastewater Reclamation Facility

Membrane Bioreactor Diagram

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO HIRAGA

COM\DEM CMaui WW Infrastructure\Applications\Figures\MembBio

meet the R-1 turbidity requirements. However, space will be set aside within the footprint and hydraulic profile for chemical addition systems at the Central Maui WWRF should they be required.

Disinfection will be needed for both the R-1 recycled water and disposal to the SAT basin. This can be achieved through chlorination or ultraviolet light (UV). A UV disinfection system consists of lamps, a reactor, and a control panel. Wastewater can flow either parallel or perpendicular to the lamps, while the control panel provides the necessary starting voltage and maintains continuous current. Most systems now include automated lamp cleaning to enhance efficiency.

3. Effluent Disposal

i. Primary Effluent Management Method – R-1 Recycled Water

As previously discussed, the primary effluent disposal method will be conversion to R-1 recycled water for nonpotable use. It is estimated that the Central Maui WWRF will produce the maximum of four (4) mgd of R-1 recycled water. Initially, most of the R-1 water will be used for the Waikapū Country Town development and surrounding agricultural reserve. Some of the R-1 water will also be used for the future County Regional Park. Refer to **Table 12** and **Figure 19**.

ii. Backup Effluent Disposal Method – Soil Aquifer Treatment (SAT)

Per Chapter 11-62, HAR and the DOH's Recycled Water Guidelines, a backup effluent disposal system is needed. The SAT system was evaluated to be a viable effluent disposal system for the Central Maui WWRF and would only be used when there is excess R-1 recycled water or if effluent is determined to be inadequate for conversion to R-1 recycled water. The SAT process involves applying effluent intermittently at high hydraulic loading rates to basins made of highly permeable soils like sand or gravel. This method treats water through biological, chemical, and physical interactions as it percolates into the groundwater.

Refer to **Figure 4**. Benefits of SAT include the removal of nitrogen, phosphorus, heavy metals, trace organics, and endocrine-disrupting chemicals.

In a typical SAT system, treated effluent is applied intermittently to a series of unlined earthen basins, creating saturated soil conditions followed by (resting) unsaturated soil conditions. The application periods are tailored to specific treatment objectives and can range from 1 to 12 days, depending on climate, pretreatment, and treatment objectives. Rotating between active and inactive basins allows for system maintenance while maintaining surface permeability.

The SAT system for the Central Maui WWRF will occupy approximately eight (8) acres of the WWRF site. Four (4) shallow basins will be constructed, each approximately the same size. The bottom area of each basin will be approximately 1.9 acres. The SAT system will be designed to ensure that the basins can simultaneously handle peak wastewater flows and wet weather events. Flows of treated effluent will first go to one (1) of the basins. During high flow periods, flows will be directed to a second and third basin, as needed, to ensure the effluent flow is safely disposed of.

4. Drainage System

a. Existing Conditions

Brown and Caldwell, Inc. prepared a Central Maui WWRF PDR in 2024 to analyze the existing drainage conditions and identify necessary drainage improvements for the Central Maui WWRF site. Refer to **Appendix "G"**. The existing peak onsite stormwater runoff was calculated for the 14.9-acre area for the Central Maui WWRF and SAT site, which consist of primarily flat terrain with poor vegetal cover. The 10-year stormwater flow for the existing condition is approximately 12.26 cubic feet per second (cfs).

The offsite watershed area contributing to runoff entering the site consists of 117.8 acres of agricultural land to the east of the WWRF site. Under the 100-year 24-hour design storm, the peak flow was estimated to be 257.63 cfs. This flow enters the project site along the western boundary and joins the onsite runoff.

For the Kehalani WWPS site, according to the Kehalani WWPS Feasibility Study and Siting Analysis report, surface runoff generated by the undeveloped 0.4-acre project site enters the existing Kehalani Makai Detention Basin for disposal, which eventually discharges into an existing underground drainage system that terminates at the Wailuku River (formerly known as ʻĪao Stream). The 10-year 1-hour peak flow rate generated by the project site in its current, undeveloped state is estimated to be 0.5 cfs. Refer to **Appendix "B"**.

b. Potential Impacts and Mitigation Measures

During construction, temporary BMPs, such as temporary sedimentation basins, will be utilized to mitigate erosion and the release of sediment and other pollutants to existing storm drains, waterways, and adjacent properties. Permanent drainage improvements are preliminarily identified as follows to reduce the post-development peak runoff volume and to improve stormwater quality to mitigate potential adverse impacts to the downstream properties and the environment:

Central Maui WWRF and SAT Site

The Central Maui WWRF PDR indicates that the overall post-development onsite drainage pattern is anticipated to be consistent with the existing condition. Runoff within the WWRF site, north of the SAT basins, will sheet flow in the predominant southeasterly direction before being channelized and conveyed to the existing drainage swale to the south of the site. There will be no runoff from the areas containing the SAT basins as these basins are self-contained. The report estimated that the stormwater runoff from the 10-year, 1-hour storm for the WWRF site is 16.57 cfs. As such, construction of the proposed WWRF will result in an increase in runoff of approximately 4.31 cfs (a 35 percent increase). This increase in peak flow and runoff volume is significant enough and drainage improvements will be required to reduce runoff and mitigate any potential adverse impact on downstream or adjacent properties. Potential mitigation measures include reduction of impervious surfaces, onsite retention ponds, infiltration basins, or vegetated swales. According to the Central Maui WWRF PDR, a basin of 0.102 acre-feet would be sufficient to reduce post development peak runoff to predevelopment levels and is anticipated to result in no adverse downstream impacts.

It is noted that the runoff calculation assumes that all areas contributing to runoff are 100 percent impervious. As the design advances, the total planned impervious area may be decreased and may result in a reduction of post-construction runoff.

Offsite runoff flows should be routed around and through the site via conveyance swales sized to pass the 100-year 24-hour storm. In order to reduce the required swale sizes, offsite flow entering the site north of the SAT basins can be passed through the site to join the onsite runoff channelized along the east boundary of the site. Offsite flow entering the site along the SAT basins can be channelized along the west boundary of the site and conveyed towards the existing drainage swale south of the site. These conveyance swales should discharge to the existing drainage channel that contributes to the Waiheʻe Canal. Swale size will be determined during the design phase of the project. Energy dissipation structures will be required to maintain discharge velocities at a similar level to existing conditions. Refer to **Appendix "G"**.

The first one-inch of runoff during a storm is referred to as the Water Quality Design Volume (WQDV) or the "first-flush" volume. This portion of the runoff from a storm contains measurably more suspended solids plus other contaminants per cubic foot than would be expected in runoff occurring later in the storm. The PDR estimated that the WQDV for the WWRF site is 15,484 cubic feet (cf). This volume of water must be treated to reduce pollutants in the runoff in order to minimize impacts to downstream properties and the environment. During the design phase of the project, stormwater quality treatment measures will be evaluated for feasibility to treat the estimated WQDV.

Kehalani WWPS Site

According to the Kehalani WWPS Technical Memorandum, as the proposed WWPS will be located on the berm of an existing detention basin (Kehalani Makai Detention Basin), a retaining wall will be constructed to provide adequate flattened space for the facility. The retaining wall will cut through the southernmost portion of the existing basin, and the area south of the retaining wall will be filled and graded to match the surrounding areas. Refer to **Appendix "C"**.

In the long term, the Kehalani WWPS is expected to produce a peak runoff volume of 2.2 cfs from a 10-year 1-hour storm once fully constructed. This represents a net increase of approximately 1.7 cfs due to the development of the WWPS. The Kehalani WWPS Feasibility Study and Siting Analysis report noted that the Kehalani Makai Detention Basin has additional storage capacity than the required storage capacity. A small portion of the basin will be filled to create an approximately 2.0 acre-feet embankment to accommodate the proposed WWPS. The report concluded that the basin

would have sufficient capacity to accommodate the additional post-development runoff volume. Refer to **Appendix "B"**.

With implementation of the foregoing drainage improvements, potential drainage impacts on downstream properties from the proposed project are anticipated to be appropriately addressed.

5. Electrical, Telephone, and Cable Television

a. Existing Conditions

Electrical power, telephone, and cable television services to the region are provided by Hawaiian Electric Company (HECO), Hawaiian Telcom, and Spectrum, respectively. There are no electrical, telephone, or cable television services currently available at the WWRF site. There are existing underground electric, telephone and cable television distribution lines that service the Kehalani WWPS site.

b. Potential Impacts and Mitigation Measures

A new electrical service from HECO will need to be brought to the WWRF and SAT site, either via overhead or underground lines from the Waiʻale Road and Waiko Road intersection, following the proposed Waiʻale Road Extension, or from Honoapiʻilani Highway. This service would provide 480V, 3-phase power to the Central Maui WWRF. While it may vary depending on the final design of the WWRF, preliminarily, the estimated total electrical load is approximately 4,200 kilovolt-ampere (KVA). A diesel generator with an above-ground fuel tank and an automatic transfer switch will be installed as a standby power source.

The electrical distribution components, such as the main switchgear, motor control centers, and standby power system, will be housed within the WWRF buildings. Additionally, auxiliary electrical rooms may be constructed throughout the facility to place motor starters closer to their respective devices. All electrical rooms will be climate-controlled to minimize the impact of heat and corrosion on the equipment.

The DEM and its design team will coordinate with HECO, Hawaiian Telcom and Spectrum to identify and implement necessary infrastructure improvements to bring these utility services to the WWRF site.

As noted previously, there are existing underground electric, telephone and cable television distribution lines that service the Kehalani WWPS parcel.

These services, as may be required, will be extended from the existing underground distribution lines to the new WWPS building.

E. CUMULATIVE AND SECONDARY IMPACTS

Cumulative impacts are defined by Title 11, Chapter 200.1, HAR, Environmental Impact Statement Rules as:

> *[T]he impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.*

"Secondary impacts" or "indirect effects" are defined by Title 11, Chapter 200.1, HAR as:

> *[E]ffects which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems including ecosystems.*

Secondary impacts are those which have the potential to occur later in time or farther in the distance but are still reasonably foreseeable. They can be viewed as actions of others that are taken because of the presence of the project. Secondary impacts from highway projects, for example, can occur because they can induce development by removing one of the impediments to growth.

The following discusses the Central Maui WWRF Project in the context of cumulative and secondary impact considerations.

1. Physical Setting

a. Agriculture

Lands in Central Maui, including the proposed WWRF and SAT site, were historically used for sugar cane cultivation. The proposed action involves the development of former agricultural lands to accommodate a new WWRF and related improvements in Central Maui. Development of the WWRF and SAT will require a State Land Use Commission District Boundary Amendment (DBA), Change of Zoning (COZ), MIP Amendment, and Community Plan Amendment (CPA) approvals, as required, to amend the current agricultural designations to the State Urban District and public/quasi-public zoning and community plan designations. While the project will reduce the amount of agricultural lands available on Maui, the

Agricultural Impact Assessment prepared for the project indicated that the 14.9-acre WWRF and SAT site has poor soil for farming. The assessment also noted that approximately four (4) acres of access and utility easement from the future Waiʻale Road Extension to the WWRF and SAT site has favorable conditions for farming, however, a standalone farm on the four (4)-acre easement could be challenging to cultivate due to the long narrow shape of the property. Refer to **Appendix "H"**.

While the project will result in a loss of about four (4) acres of good farmland to be used as the access and utility easement to the WWRF, the loss of four (4) acres of good farmland is far too small to affect the growth of crop farming on Maui or statewide. The contraction and closure of plantations resulted in a supply of farmland far exceeding demand. Therefore, mitigation measures for the loss of agricultural land are not recommended by the Agricultural Impact Assessment.

In addition, the WWRF and SAT site is located within the MIP's Urban Growth Boundary (UGB), and is labeled by the MIP Planned Protected Areas Map and Planned Growth Areas Map for "Regional Park and County Facilities". Based on the foregoing, the lands that would be occupied by the proposed WWRF and SAT are not envisioned to be used for agricultural purposes. Inasmuch as the proposed WWRF will incorporate visual, noise, and odor mitigation measures, the WWRF is considered compatible for use with a future regional park. Refer to Section C.4 of this Chapter.

Based on the foregoing, the proposed Central Maui WWRF Project is not anticipated to cumulatively impact the overall availability of the agricultural lands on Maui.

b. <u>Flora and Fauna</u>

The cumulative impacts of the proposed Central Maui WWRF Project and other known developments in the region include potential loss of endangered and threatened flora and fauna species. However, the historical sugar cane operation has altered the natural habitats, and existing flora and fauna species are primarily introduced species. The Biological Resources Survey report prepared for the project indicated that no State or Federally endangered or threatened flora and fauna species were observed during the field survey. Refer to **Appendix "I-1"**. During both construction and operation phases of the project, mitigation measures will be implemented to minimize potential adverse impacts on certain threatened or endangered species that may be present in the region, such as Hawaiian seabirds, Hawaiian goose, Hawaiian waterbirds, Hawaiian

hoary bats, and Blackburn's sphinx moth. The Central Maui WWRF Project is not expected to contribute to cumulative or secondary adverse impact on the existing flora and fauna resources of the region.

c. Archaeological and Historic Cultural Resources

As previously discussed, no significant archaeological features or cultural deposits were encountered during AIS that was undertaken for the 14.9-acre Central Maui WWRF and SAT site and the connection corridor segments of the project area. However, a total of five (5) historic properties have been identified within the portions of the existing Waiʻale Road and future Waiʻale Road Extension that overlap with the Central Maui WWRF project area. Of those, two (2) historic properties (SIHP #50-50-04-06668 and #50-50-04-09168) are identified as significant. Archaeological monitoring is recommended. The project will seek concurrence from SHPD on an archaeological monitoring plan and historic evaluation. Other development projects in the region will be subject to historic preservation review through SHPD. Cumulative impacts to regional archaeological and historic resources are, therefore, anticipated to be appropriately mitigated on a project-by-project basis through the HRS, 6E historic preservation consultation process.

The CIA prepared for the project identified Waikapū Stream and burials as significant cultural resources with the potential to be impacted by the project. Traditionally and presently, Waikapū Stream has been used to cultivate kalo and ʻulu. As further discussed in the section below, the Hydrogeological Study for the project indicated that the effluent from the WWRF is not anticipated to impact Waikapū Stream. As such, cumulative impacts to Waikapū Stream, as a cultural resource, are not anticipated. Further, cumulative impacts to burials will be minimized and mitigated through the HRS, 6E consultation process.

d. Groundwater Resources, Streams, and Wetlands

The proposed project is a new wastewater treatment facility in Central Maui, which will ensure protection of the environment, including groundwater resources, streams, and wetlands through expansion of sewer service to areas where cesspools or individual septic systems are currently used. Further, the SAT system is proposed as a more sustainable alternative to injection wells currently used at four (4) of the County operated WWRFs including the Wailuku-Kahului WWRF. Injection wells have been the subject of concern in recent years regarding potential impacts to near-shore reef environments. A Hydrogeological Study

prepared for the proposed SAT system indicated that through denitrification process via SAT basins, the nitrate concentration of the disposed effluent that reaches Mā‘alaea Bay will be reduced significantly, compared with the injection wells which inject treated effluent directly into the underground aquifer. The Study also indicated the effluent from the WWRF is not anticipated to impact Waikapū Stream and the Keālia Pond National Wildlife refuge area. As such, the Central Maui WWRF Project is not expected to contribute to cumulative or secondary adverse impacts on the groundwater resources, streams, and wetlands.

2. Socio-Economic Environment

a. Population, Demography and Social Impacts

The proposed Central Maui WWRF project is not a direct population generator. As such, the proposed project is not anticipated to contribute to a cumulative impact related to population, demography, and social impact.

The project's secondary impacts include its potential to support developments in the Central Maui region by others by providing additional wastewater treatment capacity. Approximately 1.93 million gallons per day (mgd), or 48 percent of the total Central Maui WWRF flow capacity, will be allocated to service planned future developments in the Central Maui region, including housing projects and State and County facilities, as identified in the Service Area Map. Refer to **Figure 5**. In addition, 0.29 mgd, or seven (7) percent of the total Central Maui WWRF capacity, will be available for future potential developments in the region to help accommodate projected population growth by providing additional wastewater treatment capacity. According to the 2020 U.S. Census, the population of Maui County was 164,754, and based on the latest forecast by DBEDT from 2024, Maui County's population is expected to grow to 184,867 by 2050. The Central Maui WWRF is proposed to accommodate the projected population growth on Maui, and as such, the project is not anticipated to result in a significant adverse secondary impact.

b. Economy and Labor Force

During the construction phase of the proposed project, construction jobs and associated earnings will be generated, and construction expenditure will also result in indirect and induced outputs associated with supplying goods and services to construction companies and to the families of construction workers. Upon completion of the construction, new operational jobs and associated earnings to operate the Central Maui WWRF, Kehalani WWPS, and related infrastructure will be created. In this

sense, the proposed action is anticipated to contribute to a positive cumulative impact on the local economy and labor force.

It is noted that secondary impacts associated with economic and fiscal impacts include a potential increase in the sewer rates for residential and business customers who connect to the County's wastewater system as a portion of the development cost and the entirety of the O&M cost are anticipated to be funded by the County's Sewer Fund. According to the Rate Impact Analysis prepared for the project, the impact on sewer rates is anticipated to be most significant during the first 10 years of the project because anticipated future developments that would connect to the Central Maui WWRF have not yet been fully constructed. Depending on the funding scenario, the potential increase in the sewer rate is anticipated to range between 3.9 percent to 15 percent when the impact is the highest.

3. <u>Public Services</u>

As noted previously, the proposed Central Maui WWRF project is not a direct population generator. As such, the proposed project is not anticipated to contribute to an adverse cumulative impact to public services, such as police and fire protection, medical facilities, educational facilities, and recreational facilities, available to the existing communities in the vicinity of the project. It is noted that the proposed WWRF will produce residual solids from the wastewater treatment process. During preliminary treatment, grit and screenings will be removed from the wastewater, which will be disposed of at the Central Maui Landfill, consistent with the solid waste disposal method at other WWRFs on Maui.

The project's secondary impacts include its potential to support developments in the Central Maui region by others by providing additional wastewater treatment capacity. These new developments will require additional public services. However, the Central Maui WWRF is proposed to accommodate the projected population growth for this area of Maui. This secondary impact will be mitigated by individual developers in the region to coordinate with respective service providers during the planning phase of the projects in order to expand other public services, as necessary, concurrently with the developments. In addition, an increase in tax revenues (i.e. property tax) generated from new developments will support any additional needs for such services and facilities.

Another secondary impact from the project is its impact on the DPR's planning process for a regional park. The DPR is currently in the early stages of planning a future regional park in Central Maui within the same parcel and adjacent to the proposed WWRF. However, with mitigation measures to minimize noise, visual, and odor impacts to the surrounding park use, the proposed WWRF is considered

justified due to the critical need to provide wastewater treatment services to accommodate planned developments in the Central Maui region.

4. Infrastructure

a. Traffic

The TIAR prepared for the Central Maui WWRF Project included a cumulative impact analysis for traffic projections for Year 2029 to reflect the project's anticipated completion year. The analysis considered the projected traffic conditions both during construction and operation of the proposed WWRF. Refer to **Appendix "Q-1"**. The analysis included 14 known projects in the Central Maui region and included a background traffic growth rate based on the Maui Regional Travel Demand Model growth for forecasted years.

Various traffic improvements are proposed by others, including Waiʻale Road Extension (proposed by the County of Maui, Department of Public Works) and various improvements at the Waiʻale Road/Waiko Road intersection and Honoapiʻilani Highway/Waiʻale Road Extension. By the year 2029, the 14 known projects and various traffic improvements proposed by others are anticipated to be completed. Under Base Year 2029 scenario (without the project), the majority of the study intersections are expected to operate at LOS D or better across both AM and PM peak hours.

During construction, the project will add construction traffic, such as delivery trucks and trips generated by construction workers. The TIAR recommended that adequate sight distance be maintained at the Waiʻale Road Extension/the project's access road intersection. No additional improvements are recommended as a result of construction traffic. A CTMP has been prepared and will be implemented to mitigate any construction traffic impact during construction. Refer to **Appendix "Q-2"**. After the construction is completed, operational traffic for the Central Maui WWRF, as well as the Kehalani WWPS, will be added to the regional traffic. However, the TIAR noted that these trips will be infrequent and will, therefore, have a negligible impact to volumes and operations overall.

With the traffic improvements to be completed by others, along with the implementation of the CTMP during the construction and maintaining adequate sight distance at the Waiʻale Road Extension/the project's access road intersection, the cumulative impacts to the traffic conditions in the region will be minimized.

b. Water System

While the Kehalani WWPS will require approximately 25 gpm of potable water for operation of the WWPS, the proposed Central Maui WWRF will utilize R-1 recycled water generated from the facility for wastewater treatment purposes, and as such, only a limited amount of potable water will be required at the WWRF. No significant cumulative impact to the potable water system is anticipated from the project.

Secondary impacts associated with the project include conservation of Maui's fresh water resources and cost saving for farmers in the vicinity by supplying R-1 recycled water at a lower cost. R-1 recycled water from the facility will be delivered to a recycled water storage facility which is planned to be constructed within the future Waikapū Country Town development and will be utilized in surrounding properties in the Central Maui region for irrigation purposes, including parks, school yards, and streetscapes within the future Waikapū Country Town development, as well as nearby agricultural fields and County lands. This would result in a positive secondary impact because the WWRF will help conserve Maui's fresh water resources by supplying treated wastewater for non-drinking purposes. In addition, as further discussed in Section A.6 of this Chapter, while the nearby agricultural fields are already supplied with irrigation water from Wailuku Water Company, the farmers could achieve cost saving by sourcing the irrigation water from the County.

c. Wastewater System

The proposed action is development of a new WWRF and related infrastructure in the Central Maui region. The project is not anticipated to contribute to cumulative impacts to the County of Maui's wastewater system. Rather, the project will be beneficial to the wastewater system by providing additional wastewater treatment capacity to the Central Maui region to support developments, in particular, housing projects, to accommodate the projected population growth on Maui.

As discussed previously, the project's secondary impacts include its potential to support developments in the Central Maui region by others by providing additional wastewater treatment capacity. However, the Central Maui WWRF is proposed to be constructed in order to accommodate the projected population growth on Maui, and the County has long envisioned development of the proposed WWRF as indicated in Resolution No. 06-12 (approved by the Maui County Council in February 2006), recommending implementation of the long-term plan of action to service the Central Maui

Service Area. As such, this secondary impact is not considered an adverse impact to Maui's communities.

d. Drainage

During construction, temporary BMPs, such as temporary sedimentation basins, will be utilized to mitigate erosion and the release of sediment and other pollutants to existing storm drains, waterways, and adjacent properties. Development of the proposed WWRF will result in an increase in impervious surfaces and as such, permanent drainage improvements to reduce an increase in peak flow and runoff volume as well as to control water quality will be implemented. Potential mitigation measures include reduction of impervious surfaces, onsite retention ponds, infiltration basins, or vegetated swales. At the Kehalani WWPS site, a small portion of the Kehalani Makai Detention Basin will be filled to create an approximately 2.0 acre-feet embankment to accommodate the proposed WWPS. However, the Kehalani Makai Detention Basin has additional storage capacity than the required storage capacity, and the basin will have sufficient capacity to accommodate post-development runoff volume. With implementation of the above noted drainage improvements, the proposed project would not contribute to cumulative adverse impacts to the downstream properties and regional drainage conditions.

In summary, appropriate mitigation measures and/or regulatory oversight processes have been identified to ensure that cumulative and secondary impacts for each key issue are managed, such that adverse conditions affecting the natural and man-made environments are mitigated and/or minimized where possible.

RELATIONSHIP TO GOVERNMENTAL PLANS, POLICIES, AND CONTROLS

III

III. RELATIONSHIP TO GOVERNMENTAL PLANS, POLICIES, AND CONTROLS

The following chapter sets forth the land use regulatory context for the implementation of the proposed project.

A. STATE LAND USE DISTRICTS

Pursuant to Chapter 205, Hawai'i Revised Statutes (HRS), all lands in the State have been placed into one (1) of four (4) land use districts by the State Land Use Commission (LUC). These land use districts have been designated "Urban", "Rural", "Agricultural", and "Conservation". The project site is designated "Agricultural" and the proposed public/quasi-public uses are not permitted within the State "Agricultural" District. See **Figure 25**.

In order to establish the proposed public/quasi-public uses, a State District Boundary Amendment (DBA) from the "Agricultural" district to the "Urban" district will be required from the State of Hawai'i LUC for a portion of the project area.

The offsite project components are also located within the State "Agricultural" district, except for the Kehalani Wastewater Pump Station (WWPS) located within the State "Urban" district. Pursuant to HRS, Chapter 205-4.5(7), sewage pipelines, pump stations, and roadways are considered permitted uses within the State "Agricultural" district:

> *"Public, private, and quasi-public utility lines and roadways, transformer stations, communications equipment buildings, solid waste transfer stations, major water storage tanks, and appurtenant small buildings such as booster pumping stations, but not including offices or yards for equipment, material, vehicle storage, repair or maintenance, treatment plants, corporation yards, or other similar structures."*

A DBA will be sought to designate the 14.9-acre Wastewater Reclamation Facility (WWRF) and Soil Aquifer Treatment (SAT) site as a State "Urban" District. Pursuant to Section 205-3.1 (b), HRS, a DBA involving land areas of 15 acres or less shall be determined by the appropriate county land use decision-making authority. For the County of Maui, the Maui County Council is the decision-making authority for DBAs. Inasmuch as the proposed WWRF and SAT site is less than 15 acres, the County of Maui, Department of Environmental Management (DEM) will seek a DBA from the Council. By letter dated February 10, 2023, the Department of Planning confirmed that the uses and areas of the proposed Central Maui WWRF and SAT site would qualify for DBA processing under the approval authority of the Council. Refer to **Appendix "E"**. In accordance with the criteria set forth in HRS and the Hawai'i Administrative Rules (HAR). An analysis of these criteria is provided below:

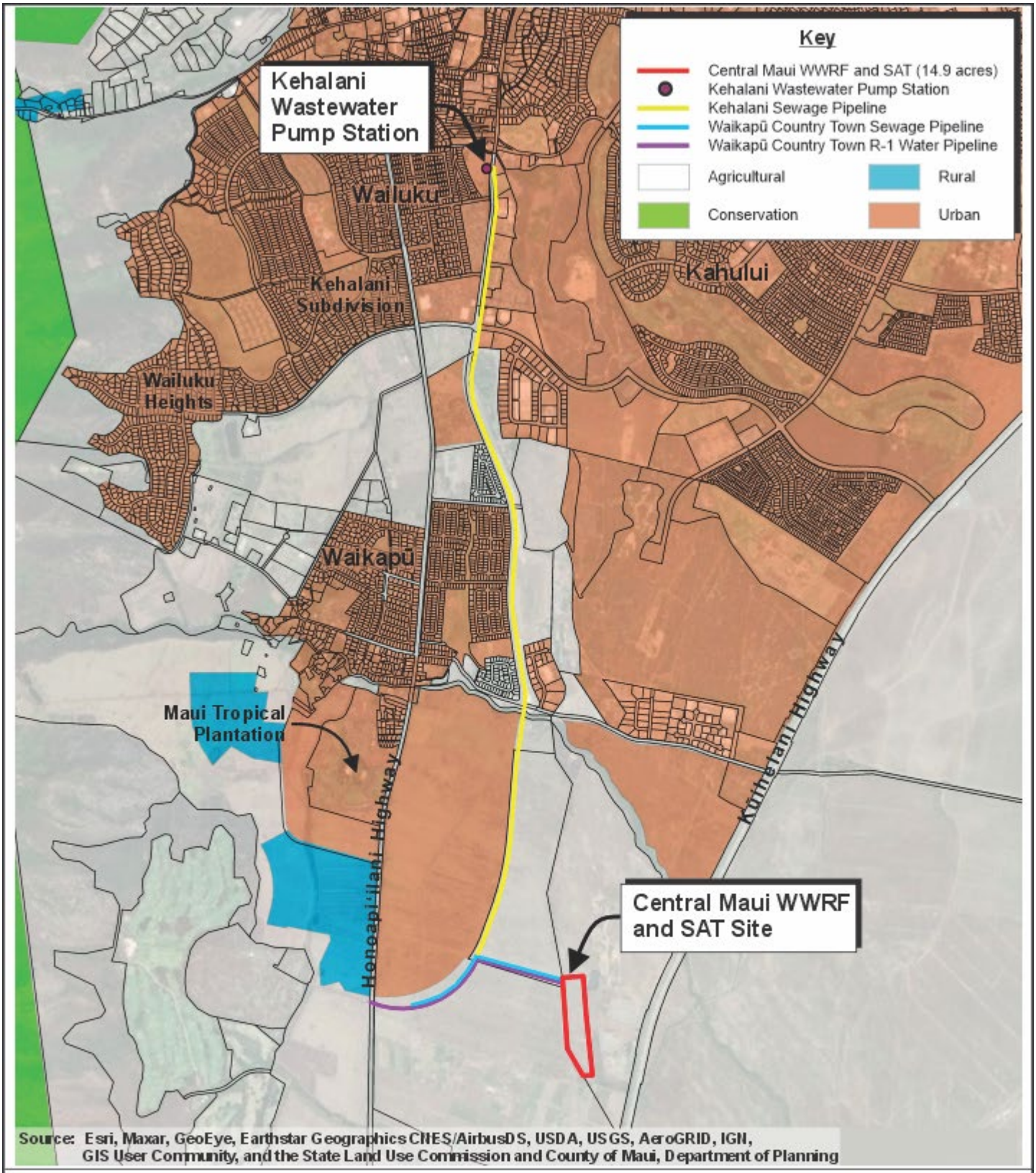


Figure 25 Proposed Central Maui Wastewater Reclamation Facility
State Land Use Districts Map

0 1250 Feet
625 2500

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO HIRAGA

COM/DEM Cmaui WW Infrastructure/Applications/Figures/SLUD

1. Land Use Commission Decision Making Criteria

As discussed below, the proposed Central Maui WWRF Project has been analyzed in this Environmental Impact Statement (EIS) with respect to LUC decision-making criteria, established in Section 205-17, HRS:

(1) The extent to which the proposed reclassification conforms to the applicable goals, objectives, and policies of the Hawai'i state plan and relates to the applicable priority guidelines of the Hawai'i state plan and the adopted functional plans;

Response: The proposed Central Maui WWRF Project's conformance with applicable goals, objectives, and policies of the Hawai'i State Plan and Functional Plans is detailed in Chapter III, Section B and Section C, respectively.

(2) The extent to which the proposed reclassification conforms to the applicable district standards;

Response: The extent to which the proposed reclassification conforms to the applicable standards for the Urban District is discussed below in Section A.3 of this Chapter.

(3) The impact of the proposed reclassification on the following areas of state concern:

(a) Preservation or maintenance of important natural systems or habitats;

Response: There is no critical habitat in the vicinity of the proposed project. A Biological Resources Survey was conducted in March 2023 for the proposed project. No endangered or threatened plant or animal species were observed during the survey. While no federally protected seabirds are known to utilize the project area, they are known to fly over lowlands to and from their nesting burrows high in the mountains between the months of March and November. In accordance with the recommendation by the Biological Resources Survey, all outdoor lighting will be shielded, so all light is directed towards the ground to avoid potential impacts to seabirds. In addition, recommended mitigation

measures from the U.S. Fish and Wildlife Service (USFWS) and the State Division of Forestry and Wildlife (DOFAW) to protect endangered and threatened species will be implemented as applicable and feasible. Discussion of the site's flora and fauna resources is presented in Chapter II, Section A.9 of this EIS.

(b) Maintenance of valued cultural, historical, or natural resources;

Response: Based on information gathered from the cultural and historical background and community consultation conducted as part of the Cultural Impact Assessment (CIA) prepared for the project, Waikapū Stream and human remains were identified as significant cultural resources with the potential to be impacted by the project. Although there are no known active cultural practices conducted in the project area, in order to mitigate these concerns, the hydrogeological modeling was conducted to assess potential impacts to Waikapū stream. Modeling indicates that there will be no migration of infiltration flow from the proposed SAT system to the stream. In addition, an Archaeological Inventory Survey (AIS) has been conducted to identify potential archaeological findings and burials before the project proceeds. Five (5) historic properties in the project area were identified in previously prepared archaeological investigations. Of those, two (2) historic properties (SIHP #50-50-04-06668 and #50-50-04-09168) are identified as significant. Mitigation for historic and archaeological features is proposed in the form of archaeological monitoring. The project will comply with all agreed upon recommendations from the State Historic Preservation Division (SHPD). Further discussion of cultural, historical, and natural resources is provided in Chapter II, Section A.15-16.

(c) Maintenance of other natural resources relevant to Hawai'i's economy, including agricultural resources;

Response: The 14.9-acre WWRF and SAT site was historically utilized for sugarcane cultivation, however, it is not currently being utilized for active agricultural cultivation. As discussed in Chapter II, Section A.6, an Agricultural Impact Assessment (AIA) conducted for the project indicated that the WWRF and SAT site has poor soil for farming. In addition, the Maui Island Plan (MIP) designates the WWRF and SAT within the Urban Growth Boundary (UGB), envisioning for future development. As such, the proposed development is not anticipated to have a significant adverse impact on agricultural resources within the State of Hawai'i.

(d) Commitment of state funds and resources;

Response: The Central Maui WWRF project is proposed by the County of Maui, DEM. The DEM is currently exploring different funding options for the project, and plans to utilize State funding.

(e) Provision for employment opportunities and economic development; and

Response: The development of the Central Maui WWRF Project will generate short-term economic benefits in the form of construction-related spending and employment. From a long-term perspective, the operation of the WWRF and related infrastructure will also support new employment. An Economic and Fiscal Impact Analysis was prepared for the proposed project, and is summarized in Chapter II, Section B.3.

(f) Provision for housing opportunities for all income groups, particularly the low, low-moderate, and gap groups;

Response: The proposed Central Maui WWRF Project will provide additional wastewater treatment capacity necessary to accommodate projected population growth in the Central Valley of Maui. A number of housing projects are included in the Service Area of the WWRF, including affordable housing projects.

(4) The standards and criteria for the reclassification or rezoning of important agricultural lands in section 205-50; and

Response: The lands proposed for reclassification do not include important agricultural lands as defined under Chapter 205, HRS.

(5) The representations and commitments made by the petitioner in securing a boundary change.

Response: DEM is committed to following through with the representations and commitments made for the Central Maui WWRF and SAT.

2. Decision Making Criteria for State Land Use District Boundary Amendments

As discussed below, the proposed project has also been analyzed with respect to decision-making criteria for boundary amendments, as established by Chapter 15-15-77, HAR.

(1) The extent to which the proposed reclassification conforms to the applicable goals, objectives, and policies of the Hawai'i state plan and relates to the applicable priority guidelines of the Hawai'i state plan and the adopted functional plans;

Response: The Central Maui WWRF Project's conformance with applicable goals, objectives, and policies of the Hawai'i State Plan and Functional Plans are detailed in Chapter III, Section B and Section C.

(2) The extent to which the proposed reclassification conforms to the applicable district standards;

Response: The extent to which the proposed reclassification conforms to the applicable standards for the Urban District is discussed below in Section A.3 of this Chapter.

(3) The impact of the proposed reclassification on the following areas of state concern:

(a) Preservation or maintenance of important natural systems or habitats;

(b) Maintenance of valued cultural, historical, or natural resources;

(c) Maintenance of other natural resources relevant to Hawai'i's economy, including agricultural resources;

(d) Commitment of state funds and resources;

(e) Provision for employment opportunities and economic development; and

(f) Provision for housing opportunities for all income groups, particularly the low, low-moderate, and gap groups;

Response: The impact of the proposed classification on the areas of State concern has been discussed above in Section A.1 of this Chapter.

(4) In establishing the boundaries of the districts in each county, the commission shall give consideration to the general plan of the county in which the land is located;

Response: The proposed WWRF and SAT site is located within the Park Protected Area identified by the MIP Planned Protected Areas Map and designated for "Park" by the MIP Planned Growth Areas Map. Both maps also indicate that the area where the 14.9-acre project site is envisioned for "Regional Park and County Facilities".

A MIP Amendment application will be filed with the Planning Department to amend the MIP Planned Growth Areas Map, Planned Protected Areas Map, and related narratives to make the MIP fully compatible with the proposed Central Maui WWRF. In addition, the WWRF and SAT site is located within the UGB. Further discussion of the project's conformance to the County's General Plan is discussed in Chapter III, Section E.

(5) The representations and commitments made by the petitioner in securing a boundary change, including a finding that the petitioner has the necessary economic ability to carry out the representations and commitments relating to the proposed use or development; and

Response: The proposed Central Maui WWRF is a critical infrastructure improvement for the County to accommodate future projected growth and

population increase on Maui. The County has envisioned the proposed Central Maui WWRF as a long-term plan of action to service the Central Maui Service Area as part of Resolution No. 06-12 that was approved by the Maui County Council in February 2006. As such, the County will secure necessary funding available to carry out the project.

(6) Lands in intensive agricultural use for two years prior to date of filing of a petition or lands with a high capacity for intensive agricultural use shall not be taken out of the agricultural district unless the commission finds either that the action:

(a) Will not substantially impair actual or potential agricultural production in the vicinity of the subject property or in the county or State; or

(b) Is reasonably necessary for urban growth.

Response: The proposed WWRF and SAT site has not been in intensive agricultural use historically or in the past two (2) years, nor does it have a high capacity for intensive agricultural use. As such, this criterion does not apply to the land identified for the WWRF and SAT.

3. Land Use Commission Rules, Chapter 15-15, HAR

Reclassification of the subject property must meet the following standards of the Urban District as set forth in the Land Use Commission Rules, Chapter 15-15-18, HAR:

1. It shall include lands characterized by "city-like" concentration of people, structure, streets, urban level of services and other related land uses.

Response: The subject action involves a reclassification of the State Agricultural District land to enable implementation of the Central Maui WWRF in an area identified for urban growth by the MIP. The project site is located in the vicinity of both existing and future urban land uses. The surrounding area, including the Waikapu community and future Waikapu Country Town project, is characterized as

having “city-like” structures, streets, and urban level of services.

2. *It shall take into consideration the following specific factors*

   A. Proximity to centers of trading and employment except where the development would generate new centers of trading and employment.

   B. Availability of basic services such as schools, parks, wastewater systems, solid waste disposal, drainage, water, transportation systems, public utilities, and police and fire protection

   C. Sufficient reserve areas for foreseeable urban growth

Response:

A. The Central Maui WWRF, SAT and offsite improvements are located in the vicinity of other urban uses including residential subdivisions, schools, business, and commercial centers. The proposed project will complement existing uses and planned growth, as envisioned by the MIP.

B. The project is located within the service area of local police, hospitals, and fire prevention services and would not extend their service boundaries. It is also accessible to utility services, and adjacent to major transportation routes. The Central Maui WWRF will provide additional wastewater treatment capacity to the region.

C. As previously noted, the MIP identified the Central Maui WWRF and SAT site as an appropriate area for urban growth and county facilities. It is noted that a MIP Amendment application will be initiated by the Planning Director to amend the MIP Planned Growth Areas Map, Planned Protected Areas Map, and related narratives to make the MIP fully compatible with the proposed Central Maui WWRF.

3. *It shall include lands with satisfactory topography, drainage, and reasonably free from danger of any flood, tsunami, unstable soil condition, and other adverse environmental effects.*

Response: The Central Maui WWRF and SAT site is described as being flat with an average slope of 1.4 percent and with average elevations ranging between 200 and 220 feet above mean sea level (amsl). The site primarily contains JaC soils with the offsite contributing watershed area predominantly contains a mix of Pulehu cobbly clay loam (PtA), Pulehu silt loam (PpB), Pulehu silt loam (PpA), Iao clay (IcB), Pulehu cobbly clay loam (PtB), and Jaucas sand (JaC). The proposed site was selected due to its location away from shoreline areas and the appropriate soil type (JaC) for the proposed SAT system. The subject property is located in Flood Zone X (unshaded) on the Flood Insurance Rate Map for the area, and not within the Tsunami Evacuation Area. As such, the site is reasonably free from danger of any flood, tsunami, unstable soil conditions and other adverse environmental effects.

4. *Land contiguous with existing urban areas shall be given more consideration than non-contiguous land, and particularly when indicated for future urban use on state or county general plans.*

Response: The subject property is designated for future urban use by the MIP's UGB. While the proposed WWRF and SAT site is not directly adjacent to the existing urban areas, the nearby urban areas that would be served by the new WWRF facility include Waikapū, Wailuku, and Kahului.

5. *It shall include lands in appropriate locations for new urban concentrations and shall give consideration to areas of urban growth as shown on the state and county general plans.*

Response: The project site is located within the UGB, identified by the MIP and is an appropriate area for the wastewater reclamation facility. It is noted that a MIP Amendment application will be initiated by the

Planning Director to amend the MIP Planned Growth Areas Map, Planned Protected Areas Map, and related narratives to make the MIP fully compatible with the proposed County WWRF.

6. *It may include lands which do not conform to the standards in paragraph (1) to (5):*

   A. *When surrounded by or adjacent to existing urban development; and*

   B. *Only when those lands represent a minor portion of this district*

   Response: The proposed Central Maui WWRF Project includes lands which conform to the standards in paragraphs (1) to (5). The 14.9-acre subject property represents a small portion, less than 0.01 percent, of the 235,280 acres of State Agricultural Land on Maui.

7. *It shall not include lands, the urbanization of which will not contribute toward scattered spot urban development, necessitating unreasonable investment in public infrastructure or support services.*

   Response: The proposed infrastructure project is intended to serve existing and planned urban development in Central Maui, including Waikapū Country Town. The urbanization of the 14.9-acre project area would not contribute towards scattered development, but would provide critical infrastructure in the vicinity of existing and planned development.

8. *It may include lands with a general slope of twenty percent or more if the commission finds that those lands are desirable and suitable for urban purposes and that the design and construction controls, as adopted by any federal, state or county agency, are adequate to protect the public health, welfare and safety, and the public's interest in the aesthetic quality of the landscape.*

   Response: This criterion is not applicable to the project. The project area is relatively flat, with an average slope of 1.4 percent.

B. HAWAIʻI STATE PLAN

Chapter 226, HRS, also known as the Hawaiʻi State Plan, is a long-range comprehensive plan which serves as a guide for the future long-term development of the State by identifying goals, objectives, policies, and priorities, as well as implementation mechanisms. The Plan consists of three (3) parts. Part I includes the Overall Theme, Goals, Objectives, and Policies; Part II includes Planning, Coordination, and Implementation; and Part III establishes Priority Guidelines. Inasmuch as Part II of the State Plan covers its administrative structure and implementation process, discussion of the proposed project's applicability to Part II is not considered appropriate in the context of Chapter 343, HRS analysis. Below is an analysis of the Central Maui WWRF's applicability to Part I and Part III of the Hawaiʻi State Plan.

The overall theme of the Hawaiʻi State Plan is governed by the following general principles.

1. Individual and family self-sufficiency

2. Social and economic mobility

3. Community or social well-being

In consonance with the foregoing principles, the Hawaiʻi State Plan identifies three (3) clarifying goals:

1. A strong, viable economy, characterized by stability, diversity, and growth, that enables the fulfillment of the needs and expectations of Hawaiʻi's present and future generations.

2. A desired physical environment, characterized by beauty, cleanliness, quiet, stable natural systems, and uniqueness, that enhances the mental and physical well-being of the people.

3. Physical, social, and economic well-being, for individuals and families in Hawaiʻi, that nourishes a sense of community responsibility, of caring, and of participation in community life.

This section of the EIS examines the applicability of the proposed action as it relates to the objectives, policies, and priority guidelines of the Hawaiʻi State Plan, as set forth in HRS Sections 226-5 through 226-27.

The table below summarizes the relationship between the proposed action and the goals of the Hawaiʻi State Plan. The relationship between the action and the goals are categorized into the following groups. More detailed analysis and discussion, including the methodology used, is presented in **Appendix "S-1"**.

1. **Directly applicable**: the action and its potential effects directly advances or promotes the objective, policy or priority guideline.

2. **Indirectly applicable**: the action and its potential effects indirectly supports or advances the objective, policy or priority guideline.

3. **Not applicable**: the action and its potential effects have no direct or indirect relationship to the objectives and policies of the Hawai'i State Plan.

In general, a proposed action's applicability to the objectives, policies and priority guidelines of the Hawai`i State Plan is judged on the basis of the action's direct or indirect relationship to the respective objectives, policies and priority directions. It is recognized that the categorization of "applicability" is subject to interpretation and should be appropriately considered in the context of local and regional conditions. The analysis presented in **Table 15** and summarized below focuses on key elements of the proposed action's relationship to the Hawai'i State Plan. Detailed discussion on the applicability of the proposed action to each goal and related objectives, policies, and implementing actions of the Hawai'i State Plan is provided in **Appendix "S-1"**.

Table 15. Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives, and Policies (HRS 226-1 to 226-27)

Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives and Policies **Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable**	**DA**	**IA**	**NA**
HRS 226-1: Findings and Purpose			
HRS 226-2: Definitions			
HRS 226-3: Overall Theme			
HRS 226-4: State Goals. In order to ensure, for the present and future generations, those elements of choice and mobility that ensure that individuals and groups may approach their desired levels of self-reliance and self-determination, it shall be the goal of the State to achieve: (1) A strong, viable economy, characterized by stability, diversity, and growth, that enables the fulfillment of the needs and expectations of Hawaii's present and future generations. (2) A desired physical environment, characterized by beauty, cleanliness, quiet, stable natural systems, and uniqueness, that enhances the mental and physical well-being of the people. (3) Physical, social, and economic well-being, for individuals and families in Hawaii, that nourishes a sense of community responsibility, of caring, and of participation in community life.			
Chapter 226-5 Objective and Policies for Population			
Objective:			
(a) It shall be the objective in planning for the State's population to guide population growth to be consistent with the achievement of physical, economic and social objectives contained in this chapter.	✓		
Chapter 226-6 Objectives and policies for the economy – – in general			
Objectives:			
(a) Planning for the State's economy in general shall be directed toward achievement of the			

Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
following objectives:			
(1) Increased and diversified employment opportunities to achieve full employment, increased income and job choice, and improved living standards for Hawaii's people, while at the same time stimulating the development and expansion of economic activities capitalizing on defense, dual-use, and science and technology assets, particularly on the neighbor islands where employment opportunities may be limited.		✓	
(2) A steadily growing and diversified economic base that is not overly dependent on a few industries, and includes the development and expansion of industries on the neighbor islands.		✓	
Chapter 226-7 Objectives and policies for the economy – – agriculture.			
Objectives:			
(a) Planning for the State's economy with regard to agriculture shall be directed towards achievement of the following objectives:			
(1) Viability of Hawaii's sugar and pineapple industries.			✓
(2) Growth and development of diversified agriculture throughout the State.		✓	
(3) An agriculture industry that continues to constitute a dynamic and essential component of Hawaii's strategic, economic, and social well-being.		✓	
Chapter 226-8 Objective and policies for the economy – – visitor industry.			
Objective:			
(a) Planning for the State's economy with regard to the visitor industry shall be directed towards the achievement of the objective of a visitor industry that constitutes a major component of steady growth for Hawaii's economy.			✓
Chapter 226-9 Objective and policies for the economy – – federal expenditures.			
Objective:			
(a) Planning for the State's economy with regard to federal expenditures shall be directed towards achievement of the objective of a stable federal investment base as an integral component of Hawaii's economy.		✓	
Chapter 226-10 Objective and policies for the economy – – potential growth and innovative activities.			
Objective:			
(a) Planning for the State's economy with regard to potential growth and innovative activities shall be directed towards achievement of the objective of development and expansion of potential growth and innovative activities that serve to increase and diversify Hawaii's economic base.		✓	
Chapter 226-10.5 Objectives and policies for the economy – – information industry.			
Objective:			
(a) Planning for the State's economy with regard to telecommunications and information technology shall be directed toward recognizing that			✓

Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
broadband and wireless communication capability and infrastructure are foundations for an innovative economy and positioning Hawaii as a leader in broadband and wireless communications and applications in the Pacific Region.			
Chapter 226-11 Objectives and policies for the physical environment – – land based, shoreline, and marine resources.			
Objectives:			
(a) Planning for the State's physical environment with regard to land-based, shoreline, and marine resources shall be directed towards achievement of the following objectives:			
(1) Prudent use of Hawaii's land-based, shoreline, and marine resources.	✓		
(2) Effective protection of Hawaii's unique and fragile environmental resources.		✓	
Chapter 226-12 Objective and policies for the physical environment – – scenic, natural beauty, and historic resources.			
Objective: (a) Planning for the State's physical environment shall be directed towards achievement of the objective of enhancement of Hawaii's scenic assets, natural beauty, and multi-cultural/historical resources.		✓	
Chapter 226-13 Objectives and policies for the physical environment – – land, air, and water quality.			
Objectives:			
(a) Planning for the State's physical environment with regard to land, air, and water quality shall be directed towards achievement of the following objectives.			
(1) Maintenance and pursuit of improved quality in Hawaii's land, air, and water resources.	✓		
(2) Greater public awareness and appreciation of Hawaii's environmental resources.			✓
Chapter 226-14 Objective and policies for facility systems – – in general.			
Objective:			
(a) Planning for the State's facility systems in general shall be directed towards achievement of the objective of water, transportation, sustainable development, climate change adaptation, sea level rise adaptation, waste disposal, and energy and telecommunication systems that support statewide social, economic, and physical objectives.	✓		
Chapter 226-15 Objectives and policies for facility systems – – solid and liquid waste.			
Objectives:			
(a) Planning for the State's facility systems with regard to solid and liquid wastes shall be directed towards the achievement of the following objectives:			
(1) Maintenance of basic public health and sanitation standards relating to treatment and disposal of solid and liquid wastes.	✓		
(2) Provision of adequate sewerage facilities for physical and economic	✓		

Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
activities that alleviate problems in housing, employment, mobility, and other areas.			
Chapter 226-16 Objective and policies for facility systems – – water.			
Objective:			
(a) Planning for the State's facility systems with regard to water shall be directed towards achievement of the objective of the provision of water to adequately accommodate domestic, agricultural, commercial, industrial, recreational, and other needs within resource capacities.	✓		
Chapter 226-17 Objectives and policies for facility systems – – transportation.			
Objectives:			
(a) Planning for the State's facility systems with regard to transportation shall be directed towards the achievement of the following objectives:			
(1) An integrated multi-modal transportation system that services statewide needs and promotes the efficient, economical, safe, and convenient movement of people and goods.			✓
(2) A statewide transportation system that is consistent with and will accommodate planned growth objectives throughout the State.			✓
Chapter 226-18 Objectives and policies for facility systems – – energy.			
Objectives:			
(a) Planning for the State's facility systems with regard to energy shall be directed toward the achievement of the following objectives, giving due consideration to all:			
(1) Dependable, efficient, and economical statewide energy systems capable of supporting the needs of the people;			✓
(2) Increased energy security and self-sufficiency through the reduction and ultimate elimination of Hawaii's dependence on imported fuels for electrical generation and ground transportation.			✓
(3) Greater diversification of energy generation in the face of threats to Hawaii's energy supplies and systems;		✓	
(4) Reduction, avoidance, or sequestration of greenhouse gas emissions from energy supply and use; and			✓
(5) Utility models that make the social and financial interests of Hawaii's utility customers a priority.			✓
Chapter 226-18.5 Objectives and policies for facility systems – – telecommunications.			
Objective:			
(a) Planning for the State's telecommunications facility systems shall be directed towards the achievement of dependable, efficient, and economical statewide telecommunications systems capable of supporting the needs of the people.			✓
Chapter 226-19 Objectives and policies for socio-cultural advancement – – housing.			
Objectives:			
(a) Planning for the State's socio-cultural advancement with regard to housing shall be directed toward the achievement of the following objectives:			

Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
(1) Greater opportunities for Hawaii's people to secure reasonably priced, safe, sanitary, and livable homes, located in suitable environments that satisfactorily accommodate the needs and desires of families and individuals, through collaboration and cooperation between government and nonprofit and for-profit developers to ensure that more affordable housing is made available to very low-, low- and moderate-income segments of Hawaii's population.		✓	
(2) The orderly development of residential areas sensitive to community needs and other land uses.		✓	
(3) The development and provision of affordable rental housing by the State to meet the housing needs of Hawaii's people.		✓	
Chapter 226-20 Objectives and policies for socio-cultural advancement – – health.			
Objectives:			
(a) Planning for the State's socio-cultural advancement with regard to health shall be directed towards achievement of the following objectives:			
(1) Fulfillment of basic individual health needs of the general public.			✓
(2) Maintenance of sanitary and environmentally healthful conditions in Hawaii's communities.		✓	
(3) Elimination of health disparities by identifying and addressing social determinants of health.			✓
Chapter 226-21 Objectives and policies for Socio-cultural advancement – – education.			
Objective:			
(a) Planning for the State's socio-cultural advancement with regard to education shall be directed towards achievement of the objective of the provision of a variety of educational opportunities to enable individuals to fulfill their needs, responsibilities, and aspirations.			✓
Chapter 226-22 Objective and policies for socio-cultural advancement – – social services.			
Objective:			
(a) Planning for the State's socio-cultural advancement with regard to social services shall be directed towards the achievement of the objective of improved public and private social services and activities that enable individuals, families, and groups to become more self-reliant and confident to improve their well-being.			✓
Chapter 226-23 Objective and policies for socio-cultural advancement – – leisure.			
Objective:			
(a) Planning for the State's socio-cultural advancement with regard to leisure shall be directed towards the achievement of the objective of the adequate provision of resources to accommodate diverse cultural, artistic, and recreational needs for present and future generations.			✓
Chapter 226-24 Objective and policies for socio-cultural advancement – – individual rights and personal well-being.			
Objective:			

Hawai'i State Plan, Chapter 226, HRS Part I. Overall Themes, Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
(a) Planning for the State's socio-cultural advancement with regard to individual rights and personal well-being shall be directed towards achievement of the objective of increased opportunities and protection of individual rights to enable individuals to fulfill their socio-economic needs and aspirations.			✓
Chapter 226-25 Objective and policies for socio-cultural advancement – – culture.			
Objective:			
(a) Planning for the State's socio-cultural advancement with regard to culture shall be directed toward the achievement of the objective of enhancement of cultural identities, traditions, values, customs, and arts of Hawaii's people.		✓	
Chapter 226-26 Objectives and policies for socio-cultural advancement – – public safety.			
Objectives:			
(a) Planning for the State's socio-cultural advancement with regard to public safety shall be directed towards the achievement of the following objectives:			
(1) Assurance of public safety and adequate protection of life and property for all people.			✓
(2) Optimum organizational readiness and capability in all phases of emergency management to maintain the strength, resources, and social and economic well-being of the community in the event of civil disruptions, wars, natural disasters, and other major disturbances.			✓
(3) Promotion of a sense of community responsibility for the welfare and safety of Hawaii's people.			✓
Chapter 226-27 Objectives and policies for socio-cultural advancement – – government.			
Objectives:			
(a) Planning the State's socio-cultural advancement with regard to government shall be directed towards the achievement of the following objectives:			
(1) Efficient, effective, and responsive government services at all levels in the State.		✓	
(2) Fiscal integrity, responsibility, and efficiency in the state government and county governments.			✓

The proposed project is directly and indirectly applicable to the State's goal to achieve a strong viable economy, objective and relevant policies for population, and relevant objectives and policies for the economy in general and related to agriculture, federal expenditures, and potential growth and innovative activities. The proposed project will provide expanded wastewater treatment capacity and services in Central Maui which will support future economic growth and development of market and affordable housing within areas envisioned for future growth. The proposed WWRF will provide R-1 recycled water to support the agricultural industry in Central Maui. Federal funding may be utilized for development of the WWRF and related improvements. In the short term, the proposed project will support construction jobs and material supply companies during construction.

In the long term, the proposed project will provide wastewater capacity to support business development in Central Maui, some of which may involve businesses that diversify Maui's economy from the tourism sector and potential growth in innovative activities. As a backup effluent management system, an innovative and sustainable technology, namely, SAT system, will be utilized.

The proposed project is directly and indirectly applicable to relevant objective and policies for the physical environment related to land based, shoreline and marine resources, scenic, natural beauty, historic resources, and land, air, and water quality. This EIS is being carried out on the proposed project to assess potential impacts and mitigation measures for the protection of environmental resources. The proposed project will involve the use of an onsite SAT to protect the quality of groundwater resources. The WWRF and SAT will be set back from public highways and transportation corridors and visually screened by landscaping buffers to ensure the visual and aesthetic enjoyment of mountains, ocean, and scenic landscapes will continue to be enjoyed by the public. A Biological Resources Survey was carried out on the proposed project to identify flora and fauna resources and inform applicable mitigation measures and protect endangered and threatened plant and animal species and their habitats. The EIS also includes an AIS and CIA to identify mitigation measures and ensure historic and cultural resources are not adversely impacted, to the extent possible. In addition, permanent drainage improvements will retain project related increases in stormwater runoff to be captured and retained in stormwater detention basins onsite to avoid impacts to downstream properties.

The proposed project is directly and indirectly applicable to relevant objective and policies for facility systems in general and related to solid and liquid waste, water, and energy. The proposed project involves development of a new WWRF with SAT system to ensure wastewater capacity and treatment are available in a timely manner to support planned and projected growth in Central Maui. The SAT is a sustainable, cost-effective system for effluent disposal which is considered a viable alternative to injection wells that are currently used at many County WWRFs. The WWRF will produce R-1 recycled water for irrigation purposes, which will in turn, save potable water resources on Maui. The proposed project will produce renewable energy sources in the form of solar photovoltaic (PV) panels at the WWRF.

The proposed project is also indirectly applicable to relevant objectives and policies for the socio-cultural advancement related to housing, health, culture, and government. The project will provide additional wastewater treatment capacity necessary for the construction of housing, including affordable housing. The project supports the State's objective for the maintenance of sanitary and environmentally healthful conditions in the community. A CIA and AIS have been conducted for the project, which helps to foster increased knowledge and understanding of Hawai‘i's ethnic and cultural heritages and history. The proposed project will be carried out by the County of Maui, DEM. A public scoping meeting has been carried out by DEM to ensure the action is sensitive to

community needs and concerns. The EIS process provides the public with information on the project and ensures openness and responsiveness to community concerns and comments.

The proposed project is not applicable to the goal, objective, and policies related to transportation, airports and harbors, and telecommunications and the socio-cultural advancement related to health, education, social services and individual rights, personal wellbeing, and public safety.

Priority Guidelines

"Priority guidelines" means those guidelines which shall take precedence when addressing areas of statewide concern. This section addresses applicability criteria to the priority guidelines set forth in HRS 226-103.

Priority guidelines of the Hawai'i State Plan covers the economy, population growth and land resources, crime and criminal justice, affordable housing, quality education, sustainability, and climate change adaptation.

Table 16 below summarizes the relationship between the proposed action and the priority guidelines of the Hawai'i State Plan. A more detailed discussion is presented in **Appendix "S-1"**.

Table 16. Hawai'i State Plan, Chapter 226, HRS Part III. Priority Guidelines (Chapters 226-101 to 226-109)

Hawai'i State Plan, Chapter 226, HRS Part III. Priority Guidelines Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	N/A
Chapter 226-101: Purpose. The purpose of this part is to establish overall priority guidelines to address areas of statewide concern.			
Chapter 226-102: Overall direction. The State shall strive to improve the quality of life for Hawaii's present and future population through the pursuit of desirable courses of action in seven major areas of statewide concern which merit priority attention: economic development, population growth and land resource management, affordable housing, crime and criminal justice, quality education, principles of sustainability, and climate change adaptation.			
Chapter 226-103: Economic priority guidelines.			
(a) Priority guidelines to stimulate economic growth and encourage business expansion and development to provide needed jobs for Hawaii's people and achieve a stable and diversified economy		✓	
(b) Priority guidelines to promote the economic health and quality of the visitor industry			✓
(c) Priority guidelines to promote the continued viability of the sugar and pineapple industries			✓
(d) Priority guidelines to promote the growth and development of diversified agriculture and aquaculture	✓		
(e) Priority guidelines for water use and development	✓		
(f) Priority guidelines for energy use and development			✓
(g) Priority guidelines to promote the development of the information industry			✓

Hawai'i State Plan, Chapter 226, HRS Part III. Priority Guidelines Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	N/A
Chapter 226-104: Population growth and land resources priority guidelines.			
(a) Priority guidelines to effect desired statewide growth and distribution	✓		
(b) Priority guidelines for regional growth distribution and land resource utilization		✓	
Chapter 226-105: Crime and criminal justice.			
Priority guidelines in the area of crime and criminal justice			✓
Chapter 226-106: Affordable housing.			
Priority guidelines for the provision of affordable housing		✓	
Chapter 226-107: Quality education.			
Priority guidelines to promote quality education			✓
CHAPTER 226-108: Sustainability			
Priority guidelines and principles to promote sustainability		✓	
CHAPTER 226-109: Climate change adaptation priority guidelines			
Priority guidelines to prepare the State to address the impacts of climate change, including impacts to the areas of agriculture; conservation lands; coastal and nearshore marine areas; natural and cultural resources; education; energy; higher education; health; historic preservation; water resources; the built environment, such as housing, recreation, transportation; and the economy shall:	✓		

The proposed project is directly and indirectly applicable to relevant economic priority guidelines set forth in HRS 226-103. In the short term, the proposed project will support construction jobs and material suppliers. In the long term, the proposed project will ensure wastewater services are adequately provided to both residents and businesses. The SAT technology is a sustainable way to dispose of treated effluent with minimal adverse impacts on the environment. The proposed WWRF will generate R-1 recycled water available for agricultural and irrigation uses and promote priority guidelines for development of diversified agriculture and water use and development.

The proposed project is directly and indirectly applicable to relevant population growth and land resources priority guidelines set forth in HRS 226-104. The proposed project will ensure the timely provision of wastewater services to support future housing and commercial development projects envisioned in Central Maui. Wastewater treatment and the use of SAT basins for disposal of treated effluent help prevent potential environmental contamination from untreated wastewater and represent a prudent use of natural resources.

The proposed project is also indirectly applicable to relevant affordable housing priority guidelines set forth in HRS 226-106. The project will indirectly support development of affordable housing in the Central Maui region by providing critical wastewater infrastructure necessary for housing development.

The proposed project is directly applicable to relevant priority guidelines for sustainability. The proposed project will be developed by the County DEM and the SAT is a sustainable process for disposing treated effluent from the WWRF and is considered a viable alternative to injection wells that are commonly used at the County WWRFs.

The proposed project is indirectly applicable to relevant priority guidelines for climate change adaptation. The location of the proposed Central Maui WWRF was selected to be outside of the 3.2-foot Sea Level Rise Exposure Area, tsunami evacuation zone, and Special Management Area, representing efforts to plan for the impacts of climate change and sea level rise, in particular. A sea level rise analysis was carried out on the proposed project to ensure the improvements would not be adversely impacted by climate change and sea level rise. Refer to Chapter II, Section A.8 of this EIS.

The proposed project is not applicable to the priority guidelines established for crime and criminal justice or quality education.

C. STATE FUNCTIONAL PLANS

A key element of the Statewide Planning System is the Functional Plans, which set forth the policies, statewide guidelines, and priorities within a specific field of activity. There are 13 Functional Plans which have been developed by the State agency primarily responsible for a given functional area. Together with the County General Plans, the State Functional Plans establish more specific strategies for implementation. In particular, State Functional Plans provide for the following:

- Identify major Statewide priority concerns
- Define current strategies for each functional area
- Identify major relationships among functional areas
- Provide direction and strategies for departmental policies, programs, and priorities
- Provide a guide for the allocation of resources
- Coordinate State and County roles and responsibilities in the implementation of the Hawai‘i State Plan

Table 17 provides an assessment of the relationship between the proposed action and each of the 13 Functional Plans.

Table 17. Relationship Between the Proposed Central Maui Wastewater Reclamation Facility and the State Functional Plans

	State Functional Plan	State Coordinating Agency	Purpose	Analysis
1	Agriculture Functional Plan (1991)	Department of Agriculture	Continued viability of agriculture throughout the State	The proposed project does not involve lands designated as Important Agricultural Lands (IAL). The Agriculture Functional Plan supports a system of standards, criteria, and procedures "*to redesignate parcels of 'important agricultural lands' to 'urban' or 'other use' upon a demonstrated change of economic or social conditions, where the requested redesignation will provide greater benefits to the public than its retention in the IAL district*" (State of Hawai'i, Department of Agriculture, 1991). Economic and social conditions have evolved in recent years, with plantation agriculture declining in Hawai'i, and the termination of sugar cane operations on Maui by Hawaiian Commercial & Sugar Company (HC&S). Furthermore, the proposed use of the lands for the Central Maui WWRF project would provide critical infrastructure to support planned and projected growth in the region. As such, the proposed redesignation of land from the State "Agricultural" district to the "Urban" district may provide greater benefits to the public than retaining the land in an underutilized agricultural designation. In this regard, the proposed action does not contravene the objectives and policies of this functional plan.

	State Functional Plan	State Coordinating Agency	Purpose	Analysis
2	Conservation Lands State Functional Plan (1991)	Department of Land and Natural Resources	Addresses issues of population and economic growth and its strain on current natural resources; broadening public use of natural resources while protecting lands and shorelines from overuse; additionally, promotes the aquaculture industry	The proposed project will not utilize any State Conservation lands. The proposed project will provide wastewater treatment, which if left untreated, may be harmful to the environment. Additionally, the proposed WWRF will divert wastewater that would otherwise be treated at the Wailuku-Kahului WWRF and be disposed of via injection wells.
3	Education State Functional Plan (1989)	Department of Education	Improvements to Hawai'i's educational curriculum, quality of educational staff, and access to adequate facilities	The proposed project will service the Department of Education (DOE) schools and facilities within the project service area. The proposed action, therefore, does not contravene the objectives and policies of this functional plan.
4	Employment State Functional Plan (1990)	Department of Labor and Industrial Relations	Improve the qualifications, productivity, and effectiveness of the State's workforce through better education and training of workers as well as efficient planning of economic development, employment opportunities, and training activities	The proposed action will result in the creation of jobs throughout the development period, as well as permanent jobs during the operational phase of the WWRF. This will provide local residents with opportunities to successfully compete in the workforce. The proposed actions are not anticipated to contravene the objectives and policies of this functional plan.
5	Energy State Functional Plan (1991)	Department of Business, Economic Development and Tourism	Lessen the reliance on petroleum and other fossil fuels in favor of alternative sources of energy so as to keep up with the State's increasing energy demands while also becoming a more sustainable island state; achieving dependable, efficient, and economical statewide energy systems	The proposed project involves the use of renewable energy sources in the form of solar photovoltaic (PV) panels. The proposed project is not anticipated to contravene the purpose of the Energy State Functional Plan.

	State Functional Plan	State Coordinating Agency	Purpose	Analysis
6	Health State Functional Plan (1989)	Department of Health	Improve health care system by providing for those who don't have access to private health care providers; increasing preventative health measures; addressing 'quality of care' elements in private and public sectors to cut increasing costs	The proposed actions are not anticipated to contravene the objectives and policies of this functional plan.
7	Higher Education Functional Plan (1984)	University of Hawai'i	Prepare Hawai'i's citizens for the demands of an increasingly complex world through providing technical and intellectual tools	The proposed actions are not anticipated to contravene the objectives and policies of this functional plan.
8	Historic Preservation State Functional Plan (1991)	Department of Land and Natural Resources	Preservation of historic properties, records, artifacts and oral histories; provide public with information/education on the ethnic and cultural heritages and history of Hawai'i	As documented by the AIS prepared for the project, five (5) historic properties were identified within the project area, of which two (2) historic properties (SIHP #50-50-04-06668 and #50-50-04-09168) are identified as significant, and the AIS recommended archaeological monitoring. The DEM will coordinate with SHPD on agreed upon mitigation for the proposed project. In addition, a CIA was prepared for the project, and noted through archival research and community input, that no traditional cultural practices are currently known to take place within the project area.
9	Housing State Functional Plan (2017)	Hawai'i Housing Finance and Development Corporation	Based largely on joint public/private efforts to finance, build, and maintain an adequate supply of affordable housing. It will be a working tool to guide the State, the counties, as well as the private sector in meeting the overall goal that every Hawaii resident will have the opportunity to live in a safe, decent and affordable home.	The proposed project will provide critical infrastructure for the planned development of affordable housing in Central Maui, indirectly advancing the objectives of the Housing State Function Plan.

	State Functional Plan	State Coordinating Agency	Purpose	Analysis
10	Human Services State Functional Plan (1989)	Department of Human Services	Refining support systems for families and individuals by improving elderly care, increasing preventative measures to combat child/spousal abuse and neglect; providing means for 'self-sufficiency'	The proposed actions are not anticipated to contravene the objectives and policies of this functional plan.
11	Recreation State Functional Plan (1991)	Department of Land and Natural Resources	Manage the use of recreational resources via addressing issues: (1) ocean and shoreline recreation, (2) mauka, urban, and other recreation opportunities, (3) public access to shoreline and upland recreation areas, (4) resource conservation and management, (5) management of recreation programs/facilities/areas, and (6) wetlands protection and management	The proposed action is not anticipated to contravene the objectives and policies of this functional plan. The County of Maui, Department of Parks and Recreation (DPR) is in the early stages of planning a regional park in the vicinity of the proposed WWRF and SAT site. The project will incorporate odor control and visual mitigation strategies at the proposed WWRF to minimize potential impacts to a future regional park.
12	Tourism State Functional Plan (1991)	Department of Business, Economic Development and Tourism	Balance tourism/economic growth with environmental and community concerns; development that is cognizant of the limited land and water resources of the islands; maintaining friendly relations between tourists and community members; development of a productive workforce and enhancement of career and employment opportunities in the visitor industry	The proposed action is not anticipated to contravene the objectives and policies of this functional plan.

	State Functional Plan	State Coordinating Agency	Purpose	Analysis
13	Transportation State Functional Plan (1991)	Department of Transportation	Development of a safer, more efficient transportation system that also is consistent with planned physical and economic growth of the state; construction of facility and infrastructure improvements; develop a transportation system balanced with new alternatives; pursue land use initiatives which help reduce travel demand	The project's Traffic Impact Analysis Report (TIAR) has been prepared to assess potential traffic impacts and applicable mitigation measures. A Construction Traffic Management Plan (CTMP) will be implemented to mitigate potential impacts from construction traffic. The State Department of Transportation is being consulted as part of the EIS process to ensure potential impacts to the State transportation system will be minimized.

D. HAWAIʻI 2050 SUSTAINABILITY PLAN

The Hawaiʻi 2050 Sustainability Plan is intended to serve as the State's climate and sustainability strategic action plan pursuant to HRS Section 226-65. The Hawaiʻi 2050 Sustainability Plan was developed using public engagement consistent with a community-driven approach in addition to collaboration with state and county stakeholder agencies.

The analysis to follow focuses on what the Plan describes as the Decade of Action. The Decade of Action is defined as 2020-2030, a timeframe in which the United Nations declared to accelerate sustainable solutions for the biggest climate challenges. This analysis looks at eight (8) Recommended Actions which contain 38 strategies intended to guide Hawaiʻi to a more sustainable future. **Table 18** outlines the ways in which the project meets the Recommended Actions outlined by the Plan.

Table 18. Hawaiʻi 2050 Sustainability Plan (HRS Section 226-65)

Hawaiʻi 2050 Sustainability Plan (HRS, Section 226-65) **DA = Directly Applicable, IA = Indirectly Applicable, N/A = Not Applicable**	**DA**	**IA**	**N/A**
1. Promote a Sustainable Economic Recovery			
Strategy 1: Support farmer livelihoods		✓	
Strategy 2: Support local markets for locally grown food		✓	
Strategy 3: Promote sustainable & resilient farmland, practices, and infrastructure		✓	
Strategy 4: Invest in green workforce development beginning with youth.			✓
Strategy 5: Foster the development of jobs that can sustain families financially.	✓		
Strategy 6: Support diversification of the economy.		✓	
Strategy 7: Reduce the environmental footprint of the tourism industry.			✓
Strategy 8: Support native Hawaiian culture and reduce impacts of the tourism industry to local communities.			✓
Analysis: **The proposed Central Maui WWRF Project is indirectly supportive of local farmers and sustainable and resilient agricultural practices. The proposed WWRF will provide R-1 recycled water available for agricultural irrigation to help conserve fresh water resources on Maui. The project will also create jobs that can sustain families financially and indirectly diversify the economy by providing supporting critical wastewater infrastructure in Central Maui. An Economic and Fiscal Impact Report was prepared for the project, which indicated that the project is anticipated to generate positive economic and fiscal impacts for both during construction and operation phases of the new WWRF.**			
2. Reduce Greenhouse Gas Emissions			
Strategy 9: Measure, manage, and plan for GHG emission reduction.			✓
Strategy 10: Incorporate climate change planning into decision-making processes.			✓
Strategy 11: Promote energy conservation and efficiency through outreach, communication, and community and public engagement.			✓
Strategy 12: Continue to invest in the deployment of clean energy technologies to reduce reliance on fossil fuels.	✓		

Hawai'i 2050 Sustainability Plan (HRS, Section 226-65) DA = Directly Applicable, IA = Indirectly Applicable, N/A = Not Applicable	DA	IA	N/A
Strategy 13: Expand the adoption of zero emission vehicles.			✓
Strategy 14: Promote alternative modes of transportation.			✓
Strategy 15: Reduce the generation of waste, including plastic waste.			✓
Strategy 16: Increase diversion of waste through recycling, reuse, and composting.	✓		
Analysis: **A Greenhouse Gas Emissions Impact Study was prepared for the project, which assessed project impacts related to greenhouse gas (GHG) emissions. The Study concluded that emissions from both construction and operational activities are negligible when compared to existing emissions, and there is no potential for a significant contribution to a cumulative GHG impact. The project will directly support the State's clean energy strategy as the proposed WWRF facility will be designed to incorporate solar PV systems to offset the electrical demand of the facility. In addition, the County has long relied on composting for solids management for the Maui Island WWRFs and solid waste from the proposed Central Maui WWRF will also be sent to a composting facility located at the Central Maui Landfill. As such, the project directly supports Strategy 16.**			
3. Improve Climate Resilience			
Strategy 17: Integrate climate change adaptation and resilience considerations into planning and implementation.	✓		
Strategy 18: Assess and communicate the impacts of climate change to residents, businesses, and communities most likely to be impacted.			✓
Strategy 19: Implement actions that improve the state's resilience to climate change.	✓		
Strategy 20: Increase the resilience of vulnerable populations to the impacts of climate change and other shocks and stressors.	✓		
Analysis: **The Central Maui WWRF is proposed to be located inland, away from flood hazard zones, Tsunami Evacuation Zone, and 3.2-foot Sea Level Rise Exposure Area (SLR-XA). This was an intentional decision by the County to protect this critical wastewater infrastructure from future climate change impacts. In addition, the proposed WWRF will divert a portion of existing wastewater flows from the Wailuku-Kahului WWRF which is located in the coastal area of Kahului within 3.2-foot SLR-XA Flood Zone AE, Tsunami Evacuation Zone. This diversion will help reduce potential impacts to the community in the event of facility damage caused by flooding, tsunami, or sea level rise at the Wailuku-Kahului WWRF. As such, the proposed project directly supports strategies to improve climate resiliency.**			
4. Advance Sustainable Communities			
Strategy 21: Advance smart growth initiatives and multimodal transportation systems.			✓
Strategy 22: Advance sustainability in school and university operations			✓
Strategy 23: Integrate sustainable design principles into new and existing buildings.			✓
Analysis: **The proposed action is not directly or indirectly applicable to strategies for advancing sustainable communities.**			
5. Advance Equity			
Strategy 24: Strengthen broadband access to support digital learning and online solutions in rural areas.			✓
Strategy 25: Continue to improve economic and social sustainability of individuals through access to affordable housing.		✓	

Hawai‘i 2050 Sustainability Plan (HRS, Section 226-65) DA = Directly Applicable, IA = Indirectly Applicable, N/A = Not Applicable	DA	IA	N/A
Strategy 26: Continue to implement strategies that reduce homelessness in Hawai‘i to enhance livelihoods.			✓
Strategy 27: Continue to advance opportunities for all, regardless of gender.			✓
Analysis: **The proposed Central Maui WWRF will provide additional wastewater capacity in Central Maui to support planned developments of the region, which is critical to accommodate projected population growth on Maui. The planned developments in Central Maui include affordable housing, and as such, the project indirectly supports the strategy to advance equity.**			
6. Institutionalize Sustainability Throughout Government			
Strategy 28: Invest in staff and other resources to coordinate and advance sustainability goals across state agencies and local governments.			✓
Strategy 29: Update state policies to reflect sustainability and climate change priorities.			✓
Strategy 30: Incorporate sustainability into government operations.			✓
Analysis: **While the proposed project is a government project, the proposed action is not directly or indirectly applicable to institutionalizing sustainability throughout government.**			
7. Preserve the Natural Environment			
Strategy 31: Improve water quality through reduced pollution and dumping.		✓	
Strategy 32: Support water reuse strategies to conserve water.	✓		
Strategy 33: Establish policies to protect Hawai‘i’s unique marine ecosystems.			✓
Strategy 34: Manage climate change impacts to marine resources.			✓
Strategy 35: Protect and manage watersheds.		✓	
Strategy 36: Continue to adopt strategies that protect land-based natural resources.		✓	
Strategy 37: Conserve working forest landscapes, protect forests from harm, and enhance public benefits from trees and forests.			✓
Analysis: **The proposed project is directly and indirectly applicable to preserving the natural environment. The primary disposal method of treated wastewater at the Central Maui WWRF will be the use of R-1 recycled water for nonpotable purposes, such as agricultural irrigation, which will support protection of valuable water on Maui. In addition, the back-up disposal method for treated wastewater at the WWRF is the SAT system, which is a more environmentally sustainable alternative to injection wells which are commonly used at the County WWRFs. This backup system will be designed to allow for disposal of 100 percent of the WWRF flow to ensure effluent can be safely disposed of in the event that recycled water supply exceeds the demand, or if the recycled water fails to meet the required treatment specifications. Construction Best Management Practices (BMPs) will be implemented during construction to reduce runoff from polluting downstream properties and nearshore waters. In addition, permanent drainage improvements will be implemented to protect downstream properties from increased runoff due to an increase of impervious surfaces. Finally, a Biological Resources Survey was conducted for the project areas and appropriate mitigation measures will be implemented to protect federally listed Endangered or Threatened flora and fauna species that may potentially exist in the vicinity of the project areas.**			
8. Perpetuate Traditional Ecological Knowledge and Values			
Strategy 38: Ground climate and sustainability strategies in our cultural foundation.			✓

Hawai'i 2050 Sustainability Plan (HRS, Section 226-65) DA = Directly Applicable, IA = Indirectly Applicable, N/A = Not Applicable	DA	IA	N/A
Analysis: **The proposed action is not directly or indirectly applicable to the strategy for perpetuating traditional ecological knowledge and values.**			

E. GENERAL PLAN OF THE COUNTY OF MAUI

As indicated by the Maui County Charter, the purpose of the general plan shall be to:

> *...indicate desired population and physical development patterns for each island and region within the county; shall address the unique problems and needs of each island and region; shall explain opportunities and the social, economic, and environmental consequences related to potential developments; and shall set forth the desired sequence, patterns and characteristics of future developments. The general plan shall identify objectives to be achieved, and priorities, policies, and implementing actions to be pursued with respect to population density, land use maps, land use regulations, transportation systems, public and community facility locations, water and sewage systems, visitor destinations, urban design, and other matters related to development.*

Chapter 2.80B of the Maui County Code, relating to the General Plan and Community Plans, implements the foregoing Charter provision through enabling legislation which calls for a Countywide Policy Plan and a Maui Island Plan.

1. Countywide Policy Plan

The Countywide Policy Plan was adopted in March 2010 and is a comprehensive policy document for the islands of Maui County to the year 2030. The plan replaces the General Plan of the County of Maui 1990 Update and provides the policy framework for the development of the Maui Island Plan as well as for updating the nine (9) detailed Community Plans. The Countywide Policy Plan provides broad goals, objectives, policies and implementing actions that portray the desired direction of the County's future. Goals are intended to describe a desirable condition of the County by the year 2030 and are intentionally general. Objectives tend to be more specific and may be regarded as milestones to achieve the larger goals. Policies are not intended as regulations, but instead provide a general guideline for County decision makers, departments, and collaborating organizations toward the attainment of goals and objectives. Implementing actions are specific tasks, procedures, programs, or techniques that carry out policy.

Table 19 below summarizes the relationship between the proposed action and the 11 goals of the Countywide Policy Plan. The relationship between the action and the goals are categorized into the following groups. More detailed analysis and discussion, including the methodology used, is presented in **Appendix "S-2"**.

1. **Directly applicable:** the action and its potential effects directly advances, promotes or affects the relevant goal, objective, or policy.

2. **Indirectly applicable:** the action and its potential effects indirectly supports, advances or affects the objective, policy or priority guideline.

3. **Not applicable:** the action and its potential effects have no direct or indirect relationship to the objectives and policies of the Countywide Policy Plan.

In general, a proposed action's applicability to the goals, objectives, policies and implementing actions of the Countywide Policy Plan is judged on the basis of the action's direct or indirect relationship to the respective objectives, policies and priority directions. It is recognized that the categorization of "applicability" is subject to interpretation and should be appropriately considered in the context of local and regional conditions. The analysis presented in **Table 19** and summarized below focuses on key elements of the proposed action's relationship to the Countywide Policy Plan. Detailed discussion on the applicability of the proposed action to each goal and related objectives, policies, and implementing actions of the Countywide Policy Plan is provided in **Appendix "S-2"**.

Table 19. Countywide Policy Plan

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
A. PROTECT THE NATURAL ENVIRONMENT			
Goal: Maui County's natural environment and distinctive open spaces will be preserved, managed, and cared for in perpetuity.		✓	
B. PRESERVE LOCAL CULTURES AND TRADITIONS			
Goal: Maui County will foster a spirit of pono and protect, perpetuate, and reinvigorate its residents' multi-cultural values and traditions to ensure that current and future generations will enjoy the benefits of their rich island heritage.		✓	
C. IMPROVE EDUCATION			
Goal: Residents will have access to lifelong formal and informal educational options enabling them to realize their ambitions.			✓
D. STRENGTHEN SOCIAL AND HEALTHCARE SERVICES			
Goal: Health and social services in Maui County will fully and comprehensively serve all segments of the population.			✓
E. EXPAND HOUSING OPPORTUNITIES FOR RESIDENTS			
Goal: Quality, island-appropriate housing will be available to all residents.		✓	
F. STRENGTHEN THE LOCAL ECONOMY			
Goal: Maui County's economy will be diverse, sustainable, and supportive of community values.		✓	
G. IMPROVE PARKS AND PUBLIC FACILITIES			
Goal: A full range of island-appropriate public facilities and recreational opportunities will be provided to improve the quality of life for residents and visitors.			✓

COUNTYWIDE POLICY PLAN (Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable)	DA	IA	NA
H. DIVERSIFY TRANSPORTATION OPTIONS			
Goal: Maui County will have an efficient, economical, and environmentally sensitive means of moving people and goods.			✓
I. IMPROVE PHYSICAL INFRASTRUCTURE			
Goal: Maui County's physical infrastructure will be maintained in optimum condition and will provide for and effectively serve the needs of the County through clean and sustainable technologies.	✓		
J. PROMOTE SUSTAINABLE LAND USE AND GROWTH MANAGEMENT			
Goal: Community character, lifestyles, economies, and natural assets will be preserved by managing growth and using land in a sustainable manner.	✓		
K. STRIVE FOR GOOD GOVERNANCE			
Goal: Government services will be transparent, effective, efficient, and responsive to the needs of residents.		✓	
L. MITIGATE CLIMATE CHANGE AND WORK TOWARD RESILIENCE			
Goal: Minimize the causes and negative effects of climate change.	✓		

The proposed project is indirectly applicable to protecting the natural environment and preserving local cultures and traditions. A Biological Resources Survey has been carried out to identify and minimize impacts to the environment as a result of the project. The Survey did not identify endangered or threatened species or their habitats. The proposed SAT disposal system is a managed soil aquifer recharge system in which the quality of the feed water (stormwater or wastewater treatment plant effluent) is further improved during soil passage in order to protect the quality of groundwater resources. Construction BMPs will be implemented to prevent erosion and stormwater runoff impacts to downstream properties. As well, drainage improvements will be carried out at the Central Maui WWRF site and the Kehalani WWPS site which will protect and avoid adverse impacts to nearshore reef environments and water quality. An AIS and CIA were carried out on the proposed project to identify potential impacts and mitigation measures and ensure protection of native Hawaiian rights and to ensure historic and cultural resources are not adversely impacted by the proposed project to the extent possible.

The proposed project is indirectly applicable to expanding housing opportunities for residents and strengthening the local economy. The proposed project will provide job opportunities during both construction and operational phases of the project and the increase in wastewater treatment capacity will indirectly support future economic growth and development of affordable housing in the Central Maui region.

The proposed project is indirectly applicable to strengthening the local economy. The proposed project will increase the capacity of wastewater treatment

infrastructure in Central Maui which will support future economic development. The proposed project represents an investment in infrastructure which will indirectly foster economic development and diversification. The proposed project is directly applicable to improving physical infrastructure. The Central Maui WWRF and SAT system is a clean and sustainable technology to treat wastewater effluent and will ensure wastewater treatment capacity is available to support future urban growth and development to accommodate projected population growth on Maui.

The proposed project is directly applicable to improving physical infrastructure and promoting sustainable land use and growth management. Increasing wastewater capacity in Central Maui will facilitate future development in designated growth areas, as identified in the Maui Island Plan. The project is anticipated tol benefit the surrounding agricultural land by providing the R-1 water for agricultural use.

The proposed project is indirectly applicable to the goal of striving for good governance. The proposed project has been planned in preparation of environmental shifts such as sea level rise resulting from global warming. The DEM conducted a scoping meeting in support of strengthening governmental planning, coordination, consensus building, and decision making on the proposed project.

The proposed project is directly applicable to mitigating climate change and work towards resilience. In Chapter II, Section A.8 of this EIS, an analysis on sea level rise was carried out to ensure the project will not be adversely impacted. The proposed WWRF will generate R-1 recycled water available for nonpotable and irrigation purposes in the surrounding properties, which will help conserve fresh water resources on Maui. The proposed SAT system is an environmentally friendly and sustainable technology and is proposed as an alternative effluent disposal method to injections wells.

2. <u>Maui Island Plan</u>

The Maui Island Plan is applicable to the island of Maui only, providing more specific policy-based strategies for population, land use, transportation, public and community facilities, water and wastewater systems, visitor destinations, urban design, and other matters related to future growth.

As provided by Chapter 2.80B, the MIP shall include the following components:

1. *An island-wide land use strategy, including a managed and directed growth plan*
2. *A water element assessing supply, demand and quality parameters*

3. *A nearshore ecosystem element assessing nearshore waters and requirements for preservation and restoration*

4. *An implementation program which addresses the County's 20-year capital improvement requirements, financial program for implementation, and action implementation schedule*

5. *Milestone indicators designed to measure implementation progress of the MIP*

It is noted that Ordinance No. 4004 does not address the component relating to the implementation program. Chapter 2.80B of the Maui County Code (MCC), relating to the General Plan, was amended via Ordinance No. 3979, October 5, 2012, to provide that the implementation program component be adopted no later than one (1) year following the effective date of Ordinance No. 4004. In December 2013 and March 2014, the Council approved time extensions for approval and adoption of the implementation chapter of the MIP. The implementation program component of the MIP was adopted as Ordinance No. 4126 on May 29, 2014.

The MIP addresses a number of planning categories with detailed policy analysis and recommendations which are framed in terms of goals, objectives, policies, and implementing actions. These planning categories address the following areas:

1. *Population*
2. *Heritage Resources*
3. *Natural Hazards*
4. *Economic Development*
5. *Housing*
6. *Infrastructure and Public Facilities*
7. *Land Use*

Among the directed growth management tools developed through the MIP process are maps delineating Urban Growth Boundaries (UGB), Small Town Boundaries (STB), and Rural Growth Boundaries (RGB). The respective boundaries identify areas appropriate for future growth and their corresponding intent with respect to development character. The WWRF and SAT project site, Kehalani WWPS site, and the majority of the Kehalani Sewage Pipeline are located within the UGB for the Wailuku-Kahului community, and a small portion of the Kehalani Sewage Pipeline is located within the STB. See **Figure 26**.

Another element of the MIP is its Directed Growth Plan, which provides a management framework for future growth in a manner that is fiscally, environmentally, and culturally prudent. The proposed project will serve to support both existing developments as well as growth areas supported by the MIP. The

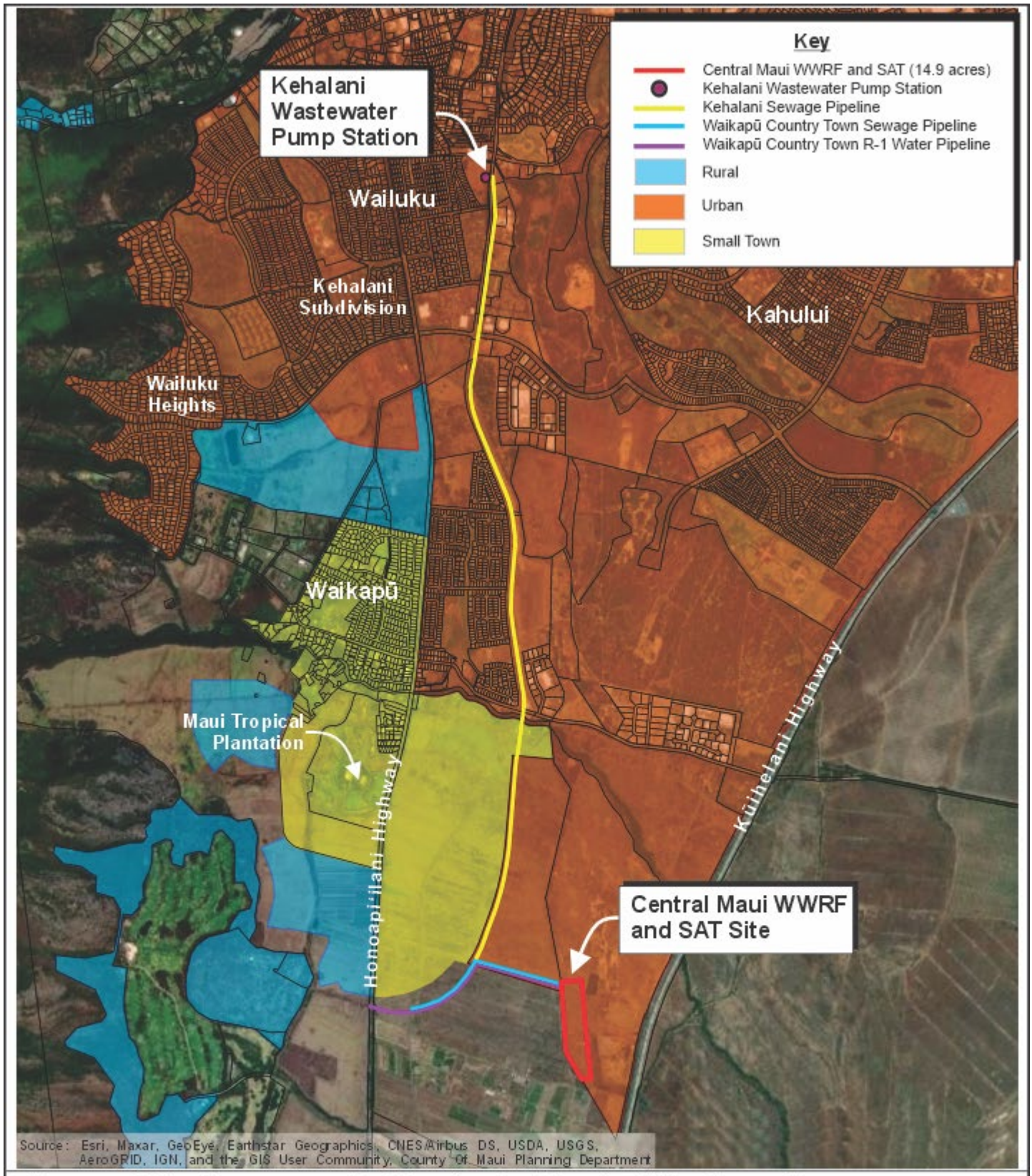


Figure 26 Proposed Central Maui Wastewater Reclamation Facility
Maui Island Plan Growth Boundaries Map

0 1250 Feet
625 2500

MUNEKIYO HIRAGA

Prepared for: County of Maui, Department of Environmental Management

COM/DEM Cmaui WW Infrastructure/Applications/Figures/MIP Growth Boundaries

proposed WWRF and SAT project site itself is located within “Park” designation on land labeled “Regional Park and County Facilities” by the MIP’s Planned Growth Areas Map. See **Figure 27**. The Department of Planning was consulted and it was determined that an amendment to the MIP's Planned Growth Areas Map would be required to amend the 14.9-acre WWRF and SAT site’s designation from “Park” to “Planned Growth Areas”.

The MIP’s Planned Protected Areas Map also identifies Preservation Areas, Parks, Greenways, Greenbelts, and Sensitive Land as Protected Areas for the island of Maui. The proposed WWRF and SAT project site is located within Park Protected Area on land labeled “Regional Park and County Facilities” by the MIP’s Protected Areas Map. Small portions of the proposed Kehalani Sewage Pipeline along the future Waiʻale Road Extension are located within the Park and Preservation Protected Area. See **Figure 28**. Similar to the MIP’s Planned Growth Areas Map, the Planned Protected Areas Map of the MIP will be amended to remove the “Park” designation. In addition, page 8-25 of the MIP provides examples of land uses for the area labeled as “Regional Park and County Facilities” as follows:

> *The Central Maui Regional Park may provide an area for the offices of the County Department of Parks and Recreation, a community center, County baseyards and like County facilities, and a location for the annual County Fair.*

This language is anticipated to be amended to include a County wastewater reclamation facility as one of the land uses envisioned in this area. It is noted that the MIP Amendment application will be initiated by the Planning Director and processed in accordance with Section 2.80B.060 of MCC.

According to the MIP, a regional park would be provided to the south of Waiʻale to provide a clear separation between the new community and Māʻalaea, and to allow for the placement of active and passive recreational opportunities, County baseyards, and County facilities. The DEM is aware that the County of Maui, DPR is in the early stages of planning a regional park in the vicinity of the proposed WWRF and SAT site. As part of the EISPN comment letter dated August 21, 2023, the DPR expressed concerns of potential odors and view impacts from the proposed Central Maui WWRF that may impact a potential future regional park, however, noted in the second comment letter dated December 19, 2024 that the proposed WWRF may be an accepted secondary use if appropriate mitigation measures are implemented to minimize adverse impacts to the surrounding future park uses. The DEM will incorporate odor control and visual mitigation strategies at the proposed WWRF to minimize potential impacts to a future regional park. Proposed odor control measures include buffer land or walls/berms around the WWRF, enclosures on headworks, and a biotrickling filter (or similar process) at

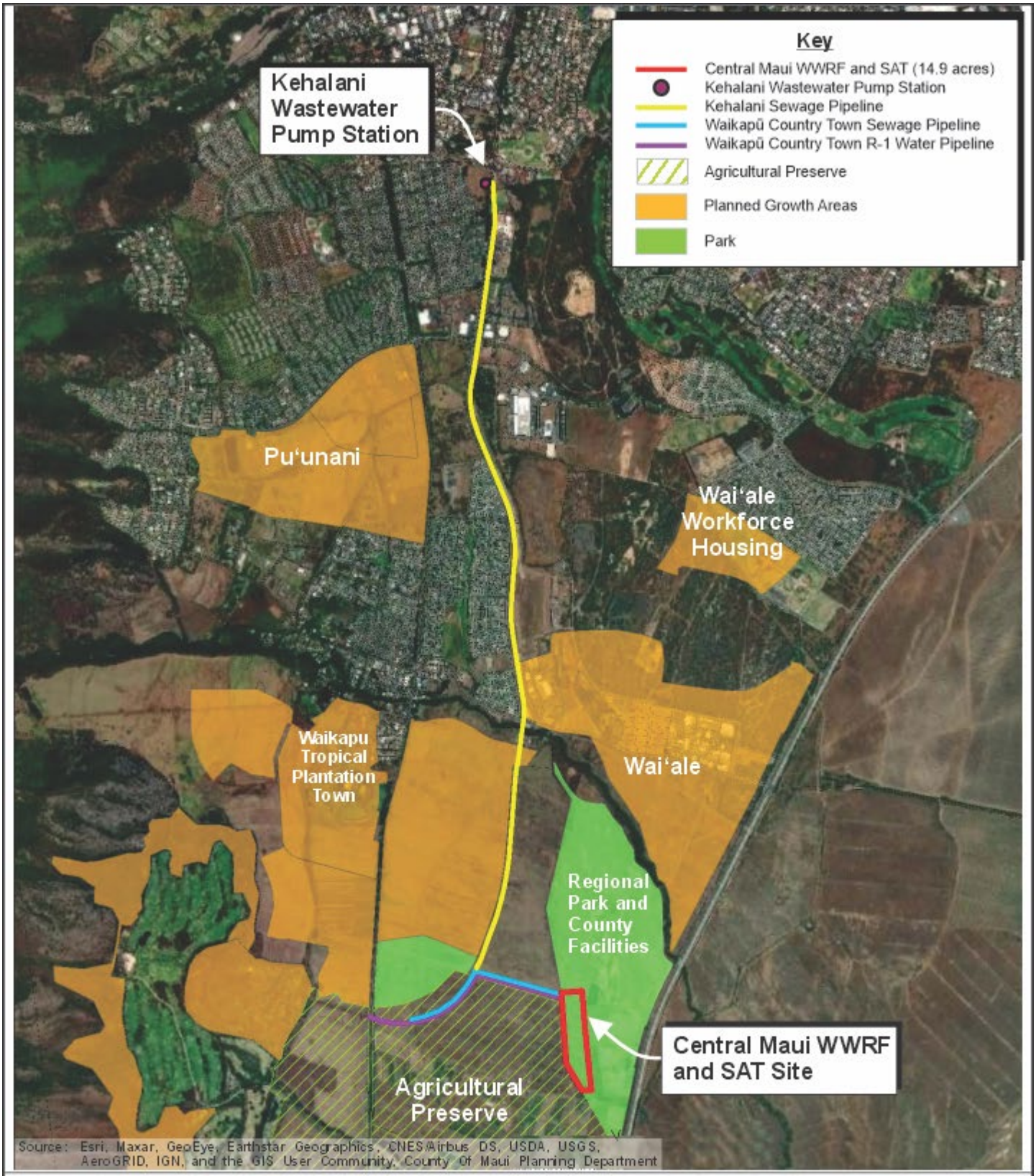


Figure 27 Proposed Central Maui Wastewater Reclamation Facility

Maui Island Plan Growth Areas Map

0 1250 625 2500 Feet

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO HIRAGA

COM/DEM Cmaui WW Infrastructure/Applications/Figures/MIP Growth Areas

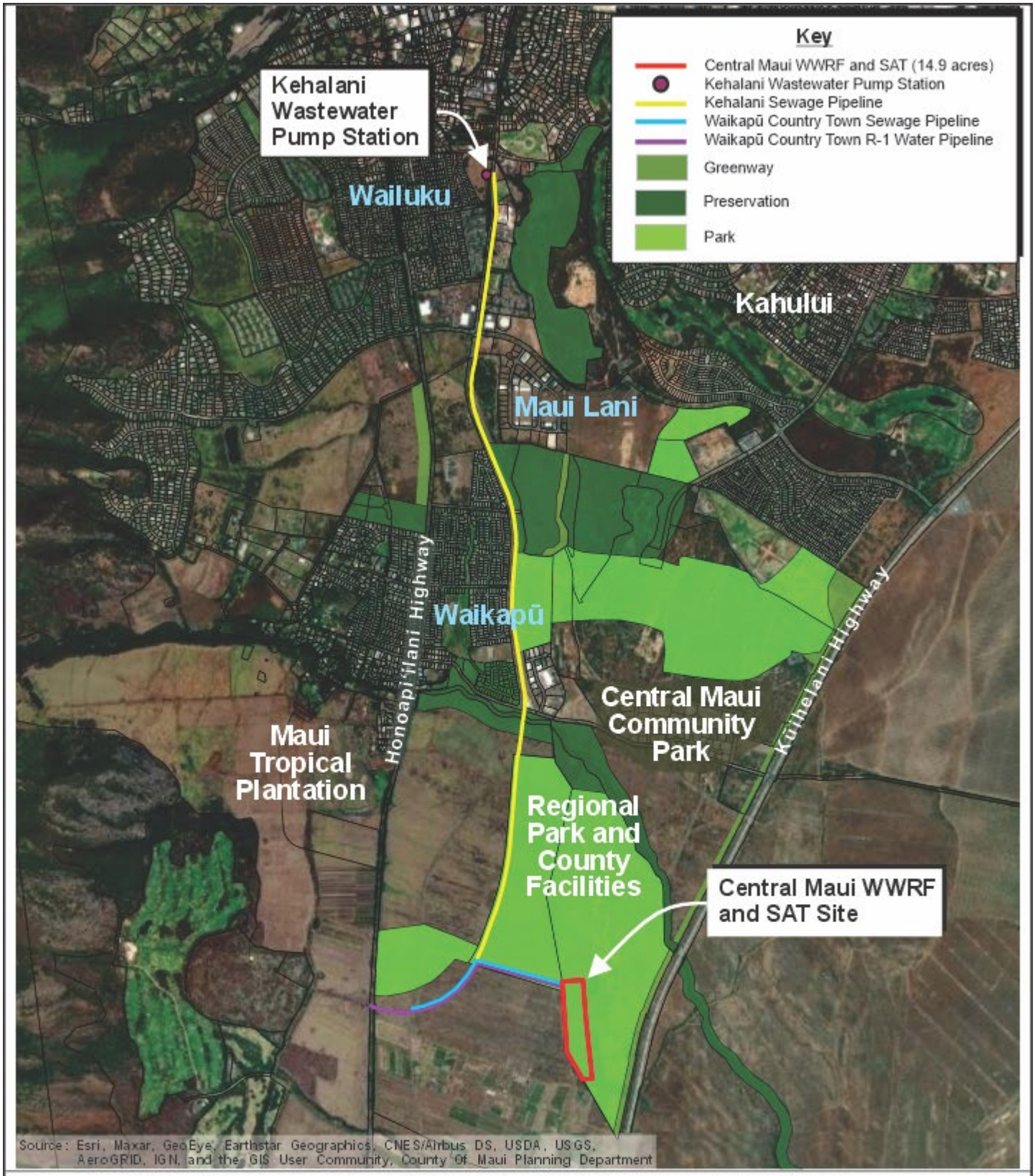


Figure 28 Proposed Central Maui Wastewater Reclamation Facility
Maui Island Plan Planned Protected Areas Map

0 625 1250 2500 Feet

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO HIRAGA

COM/DEM Cmaui WW Infrastructure/Applications/Figures/MIP Protected Areas

odor sources. In addition, the proposed visual mitigation measures include buffer land or walls/berms around the WWRF, landscaping, as well as architectural treatments. Refer to Chapter II, Section A.11, Air Quality and Section A. 14, Scenic and Open Space Resources for more detailed discussions and proposed mitigation measures related to potential odors and view impacts. **Table 20** below summarizes the relationship between the proposed action and the goals of the MIP. The relationship between the action and the goals are categorized into the following groups. More detailed analysis and discussion, including the methodology used, is presented in **Appendix "S-3"**.

1. **Directly applicable:** the action and its potential effects directly advances or promotes the objective, policy or priority guideline.

2. **Indirectly applicable:** the action's potential effects indirectly support or advance the objective, policy or priority guideline.

3. **Not applicable:** The action and its potential effects have no direct or indirect relationship to the objectives and policies of the Maui Island Plan.

In general, a proposed action's applicability to the MIP is judged on the basis of the action's direct or indirect relationship to the respective objectives, policies, and priority directions. It is recognized that the categorization of "applicability" is subject to interpretation and should be appropriately considered in the context of local and regional conditions. The analysis presented in **Table 20** and summarized below focuses on key elements of the proposed action's relationship to the MIP. Detailed discussion on the applicability of the proposed action to each goal and related objectives, policies, and implementing actions of the MIP is provided in **Appendix "S-3"**.

Table 20. Maui Island Plan Goals, Objectives, and Policies

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
CHAPTER 1 – POPULATION			
1.1 Maui's people, values, and lifestyles thrive through strong, healthy, and vibrant island communities.		✓	
CHAPTER 2 – HERITAGE RESOURCES			
CULTURAL, HISTORICAL, AND ARCHAEOLOGICAL RESOURCES ISSUES			
2.1 Our community respects and protects archaeological and cultural resources while perpetuating diverse cultural identities and traditions.		✓	
SHORELINE, REEFS, AND NEARSHORE WATERS			
2.2 An intact, ecologically functional system of reef, shoreline, and nearshore waters that are protected in perpetuity.	✓		
WATERSHEDS, STREAMS, AND WETLANDS ISSUES			

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
2.3 Healthy watersheds, streams, and riparian environments.		✓	
WILDLIFE AND NATURAL AREAS			
2.4 Maui's natural areas and indigenous flora and fauna will be protected.	✓		
SCENIC RESOURCES			
2.5 Maui will continue to be a beautiful island steeped in coastal, mountain, open space, and historically significant views that are preserved to enrich the residents' quality of life, attract visitors, provide a connection to the past, and promote a sense of place.		✓	
CHAPTER 3 – NATURAL HAZARDS			
3.1 Maui will be disaster resilient.	✓		
CHAPTER 4 – ECONOMIC DEVELOPMENT			
ECONOMIC DIVERSIFICATION			
4.1 Maui will have a balanced economy composed of a variety of industries that offer employment opportunities and well-paying jobs and a business environment that is sensitive to resident needs and the island's unique natural and cultural resources.		✓	
TOURISM			
4.2 A healthy visitor industry that provides economic well-being with stable and diverse employment opportunities.			✓
AGRICULTURE			
4.3 Maui will have a diversified agricultural industry contributing to greater economic, food, and energy security and prosperity.			✓
EMERGING SECTORS			
4.4 A diverse array of emerging economic sectors.		✓	
SMALL BUSINESS DEVELOPMENT			
4.5 Small businesses will play a key role in Maui's economy.			✓
HEALTH CARE SECTOR			
4.6 Maui will have a health care industry and options that broaden career opportunities that are reliable, efficient, and provide social well-being.			✓
EDUCATION AND WORKFORCE DEVELOPMENT			
4.7 Maui will have effective education and workforce development programs and initiatives that are aligned with economic development goals.			✓
CHAPTER 5 – HOUSING			
5.1 Maui will have safe, decent, appropriate, and affordable housing for all residents developed in a way that contributes to strong neighborhoods and a thriving island community.	✓		
CHAPTER 6 – INFRASTRUCTURE AND PUBLIC FACILITES			

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
SOLID WASTE			
6.1 Maui will have implemented the ISWMP thereby diverting waste from its landfills, extending their capacities.			✓
WASTEWATER			
6.2 Maui will have wastewater systems that comply with or exceed State and Federal regulations; meet levels-of-service needs; provide adequate capacity to accommodate projected demand; ensure efficient, effective, and environmentally sensitive operation; and maximize wastewater reuse where feasible.	✓		
WATER			
6.3 Maui will have an environmentally sustainable, reliable, safe, and efficient water system.		✓	
TRANSPORTATION			
6.4 An interconnected, efficient, and well-maintained, multimodal transportation system.			✓
TRANSIT			
6.5 An island-wide transit system that addresses the needs of residents and visitors and contributes to healthy and livable communities.			✓
PARKS			
6.6 Maui will have a diverse range of active and passive recreational parks, wilderness areas, and other natural-resource areas linked, where feasible, by a network of greenways, bikeways, pathways, and roads that are accessible to all.			✓
PUBLIC FACILITIES			
6.7 Maui will have adequate public facilities that meet the diverse needs of residents.			✓
SCHOOLS AND LIBRARIES			
6.8 Maui will have school and library facilities that meet residents' needs and goals.			✓
HEALTH CARE			
6.9 All of Maui residents will have the best possible health care to include healthy living, disease prevention, as well as acute and long-term care.			✓
ENERGY			
6.10 Maui will meet its energy needs through local sources of clean, renewable energy, and through conservation.		✓	
HARBORS AND AIRPORT			
6.11 Maui will have harbors and airports that will efficiently, dependably, and safely facilitate the movement of passengers and cargo.			✓
CHAPTER 7 – LAND USE			

Maui Island Plan Goals, Objectives and Policies Key: DA = Directly Applicable, IA = Indirectly Applicable, NA = Not Applicable	DA	IA	NA
AGRICULTURAL LANDS			
7.1 Maui will have a prosperous agricultural industry and will protect agricultural lands.		✓	
RURAL AREAS			
7.2 Maui will have a rural landscape and lifestyle where natural systems, cultural resources and farm lands are protected and development enhances and compliments the viability and character of rural communities.			✓
URBAN AREAS			
7.3 Maui will have livable human-scale urban communities, an efficient and sustainable land use pattern, and sufficient housing and services for Maui residents.		✓	
CHAPTER 8 – DIRECTED GROWTH PLAN			
URBAN AND SMALL TOWN GROWTH AREA			
8.1 Maui will have well-serviced, complete, and vibrant urban communities and traditional small towns through sound planning and clearly defined development expectations.	✓		
RURAL GROWTH AREA			
8.2 Maui will maintain opportunities for agriculture and rural communities through sound planning and clearly defined development expectations.			✓

The proposed project involves wastewater treatment capacity improvements to the Central Maui system and is indirectly applicable to the goal and relevant objectives and policies related to population. The proposed project will increase the wastewater treatment capacity in Central Maui that will support the future development of housing and other commercial land uses that will help the community meet its future housing and employment needs.

The proposed project is directly and indirectly applicable to the goal and related objectives and policies related to cultural, historical, and archaeological resources issues. To protect archaeological and cultural resources, an AIS and CIA were carried out to identify historic and cultural resources, potential impacts and appropriate mitigation measures.

The proposed project is both directly and indirectly applicable to protecting shoreline, reefs, and nearshore water quality as well as watersheds, streams, and wetlands. The SAT system for disposing treated effluent is a sustainable and more environmentally friendly alternative to injection wells. A Hydrogeological Study was prepared and concluded that the proposed SAT system is not anticipated to significantly adversely impact groundwater resources, nearby streams and wetlands, as well as nearshore waters. Implementation of the proposed project will

involve BMPs during construction such as temporary drainage swales and detention basins which will prevent increased stormwater runoff from impacting adjacent and downstream properties. In the long term, permanent drainage improvements will prevent increased stormwater runoff from entering adjacent and downstream properties. These drainage improvements, which may include swales and filters, will be incorporated to help prevent contamination of the nearshore marine environment.

The proposed project is also directly applicable to relevant Maui natural areas and indigenous flora and fauna protection. Chapter II of this EIS included a flora and fauna analysis to ensure rare, endangered, indigenous flora and fauna and their habitats are not adversely impacted by the proposed project. Post development drainage improvements will incorporate appropriate treatment methods to decrease non-point source pollution from the WWRF.

The proposed project is indirectly applicable to protecting Maui's scenic resources. A View Analysis has been prepared for the project to ensure that Maui's scenic and open space resources are protected.

The proposed project is also directly applicable to the goals and relevant objectives and policies related to natural hazards. The proposed project is located in an area that is not in a flood zone and outside the Tsunami Evacuation Zone. As such, this critical infrastructure facility will not be adversely impacted by flooding or tsunami inundation. Further, the proposed WWRF will divert existing wastewater flows from the Wailuku-Kahului WWRF which is located in the coastal area of Kahului within Flood Zone AE and the Tsunami Evacuation Zone. This diversion will help reduce potential impacts to the community in the event of facility damage caused by flooding, tsunami, or sea level rise at the Wailuku-Kahului WWRF. As such, the proposed project directly supports strategies to improve climate resiliency.

The proposed project is indirectly applicable to the goal and relevant objectives and policies related to economic development. During the construction phase, the project will support jobs in the construction industry. In long term, jobs will be created to operate the proposed WWRF and related infrastructure. In addition, the project will facilitate future economic growth and diversification through provision of wastewater treatment services to support expansion of commercial, business, industrial, and residential land use, including market and affordable housing developments, small businesses and emerging sectors of the economy in Central Maui.

The proposed project is directly and indirectly applicable to the goal and relevant objectives and policies related to housing. The proposed project will provide additional wastewater treatment capacity to support future development in Central

Maui including affordable housing developments. The proposed project is being planned and implemented to ensure wastewater infrastructure is developed in a timely manner in order to support the projected future growth in Central Maui. The service areas for the Central Maui WWRF correspond with the projected future growth identified in the MIP.

The proposed project is directly and indirectly applicable to the goal and relevant objective, and policies related to infrastructure and public facilities. The proposed project will provide wastewater treatment capacity in a timely manner to support growth that is consistent with the MIP. R-1 recycled water is the primary disposal method for the proposed WWRF, and as a back-up disposal method, a SAT system is proposed, which is a sustainable technology as an alternative to injection wells. By providing R-1 recycled water for nonpotable purposes, the project will indirectly conserve Maui's critical water resources. The project will also incorporate solar PV equipment to generate renewable energy to supplement the energy needs at the proposed WWRF.

The proposed project is indirectly applicable to the goals and relevant objectives and policies related to land use. The proposed project will support the future development of urban communities, infill, and redevelopment of underutilized urban lots within the Central Maui UGB. The proposed project will provide future wastewater treatment capacity in Central Maui which will facilitate future growth and development, which will include, but is not limited to affordable housing projects.

The project is directly applicable to the goal and relevant policies related to urban and small town growth areas. The proposed project is primarily located within the UGB with a portion of the pipeline located in the STB. The proposed project provides future wastewater treatment capacity to service future developments in accordance with the MIP.

F. WAILUKU-KAHULUI COMMUNITY PLAN

Within Maui County, there are nine (9) community plan regions. From a General Plan implementation standpoint, each region is governed by a Community Plan which sets forth desired land use patterns, as well as goals, objectives, policies, and implementing actions for a number of functional areas, including infrastructure-related parameters. The project area is located within the Wailuku-Kahului Community Plan region.

Land use designations are set forth by the Wailuku-Kahului Community Plan Land Use Maps. See **Figure 29**.

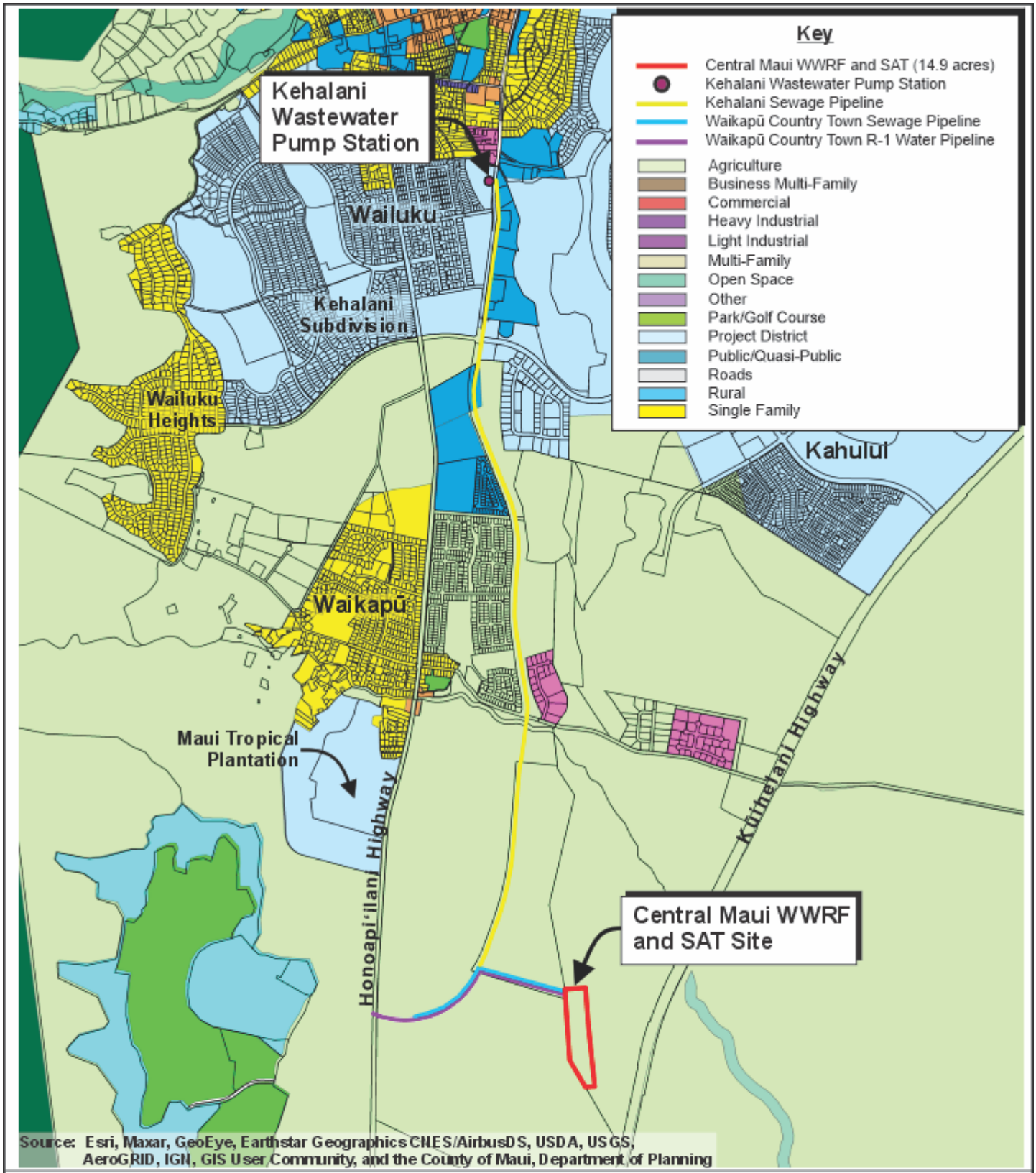


Figure 29 Proposed Central Maui Wastewater Reclamation Facility
Wailuku-Kahului Community Plan Map

0 1250 Feet
625 2500

MUNEKIYO HIRAGA

Prepared for: County of Maui, Department of Environmental Management

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Most of the project area is designated by the Wailuku-Kahului Community Plan for "Agricultural" use with exceptions of portions of the Kehalani Sewage Pipeline located within areas designated for "Public/Quasi-Public" and "Project District" uses, and the Kehalani WWPS located in an area designated for "Project District" use. As the WWRF and SAT site is currently designated "Agricultural", DEM will coordinate with the Department of Planning to request that the appropriate community plan "Public/Quasi-Public" designation be applied to the WWRF and SAT project site as part of the upcoming Central Maui Community Plan update process. Depending on timing of the community plan update process, DEM may seek a Community Plan Amendment from the Maui County Council for a "Public/Quasi-Public" designation. It is anticipated that the Community Plan Amendment (CPA) request would be initiated by the Planning Director.

The proposed project is in conformance with the following goals, objectives, and policies of the Wailuku-Kahului Community Plan:

ECONOMIC ACTIVITY

Goal

A stable and viable economy that provides opportunities for growth and diversification to meet long-term community and regional needs and in a manner that promotes agricultural activity and preserves agricultural lands and open space resources.

Objective and Policy

1. *Support agricultural production so agriculture can continue to provide employment and contribute to the region's economic well-being.*

Response: The primary method of disposing the treated effluent from the proposed Central Maui WWRF will be to distribute R-1 recycled water to surrounding properties in the Central Maui region for nonpotable purposes, including agricultural irrigation. As such, the proposed project supports agricultural production within the Wailuku-Kahului Community Plan region.

ENVIRONMENT

Goal

A clean and attractive physical and natural environment in which man-made developments or alterations to the natural environment relate to sound environmental and ecological practices, and important scenic and open space resources are maintained for public use and enjoyment.

Objectives and Policies

**

2. *Protect nearshore waters by ensuring that discharges from waste disposal meet water quality standards. Continuous monitoring of existing and future waste disposal systems is necessary to ensure their efficient operation.*

**

8. *Minimize noise, water and air pollution from industrial uses, electric power generating facilities and wastewater treatment plants.*

**

13. *Support energy conservation measures, including the use of solar heating and photovoltaic systems, in conjunction with urban uses.*

Response: While the use of R-1 recycled water for nonpotable purposes is the primary method for effluent disposal, Chapter 11-62, HAR and the State of Hawaii, Department of Health (DOH) Recycled Water Guidelines require a backup effluent disposal system for all water reuse applications. The SAT system has been selected as the most viable back-up effluent disposal approach for the Central Maui WWRF, which is considered the more environmentally sustainable alternative to injection wells. Appropriate BMPs, such as sound attenuation treatments and enclosures to trap nuisance odors, will be used to reduce potential nuisance noise and odors to the surrounding community. Solar PV systems will be incorporated into the WWRF facility design to supplement the energy demand at the WWRF.

CULTURAL RESOURCES

Goal

Identification, protection, preservation, enhancement, and where appropriate, use of cultural practices and sites, historic sites and structures, and cultural landscapes and view planes that:

1. *Provide a sense of history and define a sense of place for the Wailuku-Kahului region; and*

2. *Preserve and protect native Hawaiian rights and practices customarily and traditionally exercised for subsistence, cultural and religious purposes in accordance with Article XII, Section 7, of the Hawaii State Constitution, and the Hawaii Supreme Court's PASH opinion, 79 HAW. 425 (1995).*

Objectives and Policies

1. *Preserve the character and integrity of historic sites in the Wailuku-Kahului region.*

2. *Recognize the importance of historically and archaeologically sensitive sites and encourage their preservation through development project review.*

3. *Protect and preserve historic, cultural and archaeological sites and resources through on-going programs to identify and register important sites, and encourage their restoration. This shall include structures and elements that are a significant and functional part of Hawaii's ethnic and cultural heritage.*

4. *Ensure that the proposed projects are compatible with neighboring historic, cultural, and archaeological sites or districts. Such projects should be reviewed by the Cultural Resources Commission, where appropriate.*

5. *Require development projects to identify all cultural resources located within the project area as part of initial project studies. Further, require that all proposed activity include recommendations to mitigate potential adverse impacts on cultural resources.*

Implementing Actions

**

2. *Require development projects to identify all cultural resources located within or adjacent to the project area and consult with individuals knowledgeable about such cultural resources prior to application as part of the County development review process. Further, require that all proposed activity include recommendations to mitigate potential adverse impacts on cultural resources including site avoidance, adequate buffer areas, and interpretation. Particular attention should be directed toward dune areas, known and probable precontact habitation areas, and other sites and areas listed in No. 5 below, with review by the Cultural Resources Commission, where appropriate.*

**

5. *Significant Wailuku-Kahului region sites and areas include the following:*

Wahi Pana (Significant Traditional Places)

a. Na Wai Eha (Waihe'e, Waiehu, Wailuku, Waikapū)

Response: A CIA was conducted as part of this EIS. The CIA identified Waikapū Stream, located in the vicinity of the proposed WWRF, as a culturally significant resource. Refer to **Appendix "O"**. As noted previously, the use of SAT system for an effluent disposal method at the WWRF is a more environmentally viable way when compared with injection wells and will allow for the expansion of sewer service areas to where cesspools or individual septic systems are used. A Hydrogeological Study has been conducted to assess potential impacts to nearby streams. The lateral spread of infiltration liquids and solutes from the SAT system is estimated to extend about 100 feet from the SAT basin perimeters. Since Waikapū stream is approximately 2,000 feet away, modeling indicates that there will be no migration of infiltration flow to the stream. Refer to **Appendix "F"**.

The Hydrogeological Study notes that there is minimal lateral diffusion until the effluent reaches groundwater. To address this, the Facility Report states that where the adjacent existing elevations are below the proposed bottom of the SAT basin, a vertical wall will be built to ensure water does not surface laterally before reaching the groundwater. The wall will extend on the south and east side of the SAT basins. Refer to **Appendix "A"**.

HOUSING

Goal

A sufficient supply and choice of attractive, sanitary and affordable housing accommodations for the broad cross section of residents, including the elderly.

Objectives and Policies

**

6. Coordinate the planning, design and construction of public infrastructure improvements with major residential projects that have an affordable housing component.

7. Plan, design and construct off-site public infrastructure improvements (i.e. water, roads, sewer, drainage, police and fire protection, and solid waste) in anticipation of residential, commercial and industrial developments defined in the Community Plan.

**

Response: The proposed Central Maui WWRF has been envisioned as a long-term plan of action to service the Central Maui Service Area as part of Resolution No. 06-12 that was approved by the Maui County Council in February 2006. There are a number of housing projects (including affordable housing) planned in the Central Maui region to accommodate projected population growth on Maui, and the proposed WWRF is a necessary infrastructure improvement to support future housing development. As such, the proposed project is consistent with the Goal, Objectives and Policies related to housing.

GOVERNMENT

Goal

Government that demonstrates the highest standards of fairness; responsiveness to the needs of the community; fiscal integrity; effectiveness in planning and implementation of programs and projects; a fair and equitable approach to taxation and regulation; and efficient, results-oriented management.

Objective and Policy

5. Ensure that adequate infrastructure is or will be available to accommodate planned development.

Response: As discussed above, the County of Maui has long envisioned a new WWRF to service the Central Maui region and the proposed project is a necessary infrastructure improvement to accommodate planned development in the Central Maui region, including Waikapū Country Town project.

LAND USE

Goal

An attractive, well-planned community with a mixture of compatible land uses in appropriate areas to accommodate the future needs of residents and visitors in a manner that provides for the social and economic well-being of residents and the preservation and enhancement of the region's environmental resources and traditional towns and villages.

Objective and Policy

16. Upon adoption of this plan, allow no further development unless infrastructure, public facilities, and services needed to service new

development are available prior to or concurrent with the impacts of new development.

Response: As discussed above, the County of Maui has long envisioned a new WWRF to service the Central Maui region and the proposed project is a necessary infrastructure improvement to accommodate planned development in the Central Maui region, including the Waikapū Country Town project.

INFRASTRUCTURE

Goal

Timely and environmentally sound planning, development and maintenance of infrastructure systems which serve to protect and preserve the safety and health of the region's residents, commuters and visitors through the provision of clean water, effective waste disposal and drainage systems, and efficient transportation systems which meet the needs of the community.

LIQUID AND SOLID WASTE

Objectives and Policies

Coordinate sewer system improvement plans with future growth requirements, as defined in the Community Plan.

4. Reuse the treated effluent from the County's wastewater treatment system for irrigation and other suitable purposes in a manner that is environmentally sound.

Implementing Actions

**

2. Explore feasibility of extending sewer service to unserviced areas as part of comprehensive sewer system planning.

3. Investigate the feasibility of constructing a wastewater treatment facility for the Central Maui area to service the future needs of population growth. Locations to be investigated include the airport area, the Pu'unene sugar mill area, and other areas east of Kuihelani Highway. Site conditions to be evaluated shall include, but not be limited to, potential odor problems with surrounding neighborhoods, corrosive environments, effluent disposal, groundwater contamination and project costs.

Response: The proposed WWRF is a necessary infrastructure improvement to accommodate projected population growth and planned development in the Central Maui region. R-1 recycled water is proposed to be a primary method of effluent management and will be used for nonpotable use, such as landscaping and agricultural irrigation. The proposed project directly supports Implementing Action No. 3. Various BMPs will be incorporated into the facility design to mitigate potential odors, views, and other environmental impacts. The proposed SAT system is a more environmentally sound effluent management system, when compared with injection wells currently used at the County WWRF facilities, in terms of potential impacts to groundwater and nearshore water environment.

DRAINAGE

Objective and Policy

4. *Ensure that storm water run-off and siltation from proposed development will not adversely affect the marine environment and nearshore and offshore water quality. Minimize the increase in discharge of storm water runoff to coastal waters by preserving flood storage capacity in low-lying areas, and encouraging infiltration of runoff.*

Implementing Actions

2. *Establish a comprehensive program of improvements to the storm drainage system; implement a maintenance program; and ensure that safety, property loss, pollutant removal, and the need for comprehensive planning, are considered. Maintain current drainage ways, swales and spillways.*

Response: During construction, temporary BMPs, such as temporary sedimentation basins, will be utilized to mitigate erosion and the release of sediment and other pollutants to existing storm drains, waterways, and adjacent properties. In the long term, permanent drainage improvements will be incorporated into the project design. Potential drainage improvements include reduction of impervious surfaces, onsite retention ponds, infiltration basins, or vegetated swales.

ENERGY

Objectives and Policies

Promote the use of alternative energy sources, such as biomass, wind and solar.

5. Expand efforts to utilize environmentally and cost effective renewable resources for energy production, such as solar, biomass, and wind energy.

Response: Solar PV systems will be incorporated into the WWRF facility design to utilize more sustainable sources of energy at the facility.

URBAN DESIGN

Goal

An attractive and functionally integrated urban environment that enhances neighborhood character, promotes quality design, defines a unified landscape planting and beautification theme along major public roads and highways, watercourses and at major public facilities, and recognizes the historic importance and traditions of the region.

Objectives and Policies for the Wailuku-Kahului Region in General

7. Buffer public and quasi-public facilities and light-heavy industrial/commercial type facilities from adjacent residential uses with appropriate landscape planting.

**

11. Use native Hawaiian plants for landscape planting in public projects to the extent practicable.

Response: The proposed WWRF and SAT will be set back from public highways and transportation corridors and visually screened by landscaping buffers to ensure that views of the mountains, ocean, and scenic landscapes will continue to be enjoyed by the public. A landscaping plan will be prepared for the project and will utilize native Hawaiian plants to the extent practicable.

G. MAUI COUNTY ZONING

Existing County zoning designations for the project area are set forth in **Figure 30**. A majority of the project area is zoned “Agriculture” with portions of the project within the existing Wai‘ale Road zoned as “Road” and the Kehalani WWPS zoned as “Project District”. Pursuant to Chapter 19.31A, MCC, permitted uses in the “Agricultural” District are limited to agricultural production and related accessory and special uses. As mentioned previously, the offsite infrastructure components for the project in County zoned agricultural lands are anticipated to qualify as minor utilities and, as such, a permitted use within such lands.

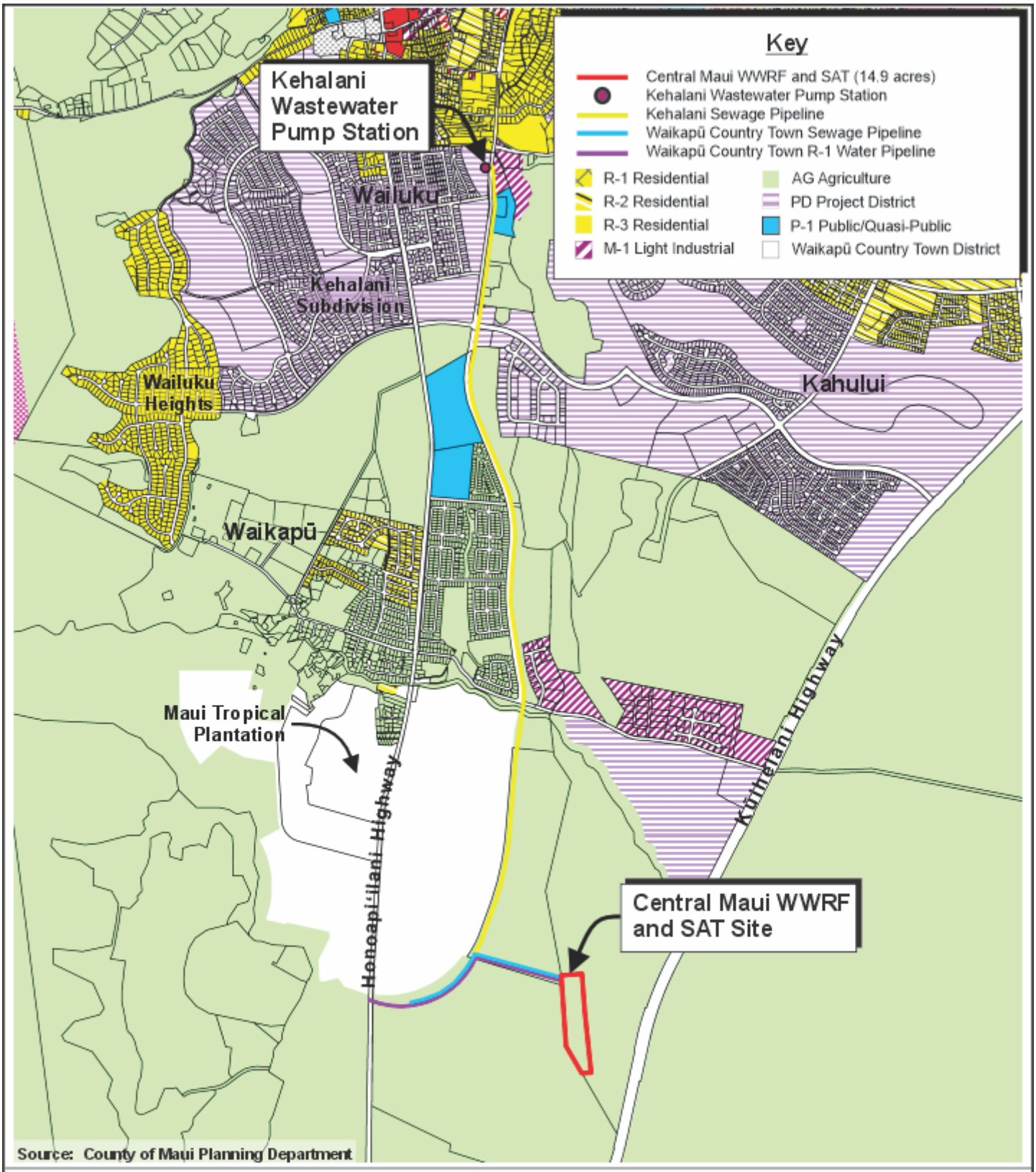

Figure 30 Proposed Central Maui Wastewater Reclamation Facility
Maui County Zoning Map

0 1250 Feet
625 2500

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO HIRAGA

COM/DEM Cmaui WW Infrastructure/Applications/Figures/MC Zoning

The proposed Central Maui WWRF and SAT are not a permitted use within the County "Agricultural" District. To implement the project, a Change of Zoning (COZ) for the 14.9-acre site will be required for the proposed WWRF and SAT from the "Agriculture" District to a more appropriate land use designation. It is anticipated that the appropriate zoning district to be requested is the "Public/Quasi-Public (P-1)" District, which permits wastewater treatment facilities. It is anticipated that the COZ application will be initiated by the Planning Director.

Applicable Project District processing requirements will be complied with for the Kehalani WWPS, which is located within the Kehalani Project District.

MCC, Section 19.510.040 outlines the criteria which a project must meet in order to be granted a COZ approval by the Maui County Council. The proposed project was evaluated with respect to these criteria as discussed below:

1. **The proposed request meets the intent of the general plan and the objectives and policies of the community plans of the county.**

   As previously discussed, the WWRF and SAT site is located within the MIP's UGB. The UGB denotes the areas within which urban-density development requiring a full range of services, such as new multi-user sewer and water infrastructure, is supported in accordance with applicable land use laws.

   In addition to growth boundaries, the MIP classifies Planned Growth Areas and Planned Protected Areas. The proposed WWRF and SAT site is located within the Park Protected Area identified by the MIP Planned Protected Areas Map and designated for "Park" by the MIP Planned Growth Areas Map. Both maps also indicate that the area where the 14.9-acre project site is located for "Regional Park and County Facilities". As a county facility, the proposed WWRF and SAT system are an appropriate use in the Regional Park and County Facilities area. It is noted that a MIP Amendment application will be initiated by the Planning Director to amend the MIP Planned Growth Areas Map, Planned Protected Areas Map, and related narratives to make the MIP fully compatible with the proposed Central Maui WWRF.

   The proposed project will not interfere with the development of park or recreational facilities or uses. It is noted that the County of Maui, Department of Parks and Recreation (DPR) is in the early stages of planning a regional park adjacent to the proposed WWRF and SAT site. The proposed project will incorporate visual, noise, and odor mitigation measures to avoid potential adverse impacts to future adjacent park uses, and as such, the WWRF is considered compatible use with the regional park proposed by the DPR. Refer to Section C.4 of Chapter II. In this context, the proposed project is consistent with the growth and type of development that is envisioned for the area.

As noted previously, an amendment to the Wailuku-Kahului Community Plan will be necessary to support the development of the proposed project. The preferred amendment would be to change the designation of the project area from "Agriculture" to "Public-Quasi Public" to be consistent with the proposed COZ request. As discussed in Section F of this Chapter, with the land use changes noted above, the proposed project will be consistent with the objectives and policies of the Wailuku-Kahului Community Plan.

2. The proposed request is consistent with the applicable community plan land use map of the county.

As previously discussed, to be consistent with the County zoning, an amendment to the Wailuku-Kahului Community Plan will be necessary. It is anticipated that the appropriate Community Plan designation for the Central Maui WWRF and SAT site would be "Public/Quasi-Public". A "Public/Quasi-Public" land use designation would be in alignment with the "Public/Quasi-Public" County zoning designation proposed for the project.

3. The proposed request meets the intent and purpose of the district being requested.

The proposed Central Maui WWRF and SAT is a public utility facility project, as is permissible by the Maui County Zoning Ordinance's "Public/Quasi-Public" zoning designation, which will be sought for the project site. In this regard, the proposed development meets the intent and purpose of the requested "Public/Quasi-Public" zoning district.

4. The application, if granted, would not adversely affect or interfere with public or private schools, parks, playgrounds, water systems, sewage and solid waste disposal, drainage, roadway and transportation systems, or other public requirements, conveniences and improvements.

The COZ request will not adversely affect or interfere with public or private schools, parks, playgrounds as the proposed project is not considered a direct population generator and will not necessitate an expansion of existing services or provision of new social services.

Rather, the proposed project will provide critical infrastructure in the form of wastewater treatment to the Central Maui region, which includes residences, schools, parks, and other public facilities.

5. <u>The application, if granted, would not adversely impact the social, cultural, economic, environmental, and ecological character and quality of the surrounding area.</u>

As previously discussed, the proposed WWRF and SAT are located within the UGB as designated within the MIP. The proposed project would support the development of future planned Growth Areas of Puʻunani, Waiʻale and Waikapū Country Town as described in the MIP. These Growth Areas include planned housing developments that require sewer service. As such, the granting of the request for a COZ for the project would be compatible with the social, cultural, economic, environmental, and ecological character and quality of the surrounding area.

6. <u>If the application change in zoning involves the establishment of an agricultural district with a minimum lot size of two acres, an agricultural feasibility study shall be required and reviewed by the department of agriculture and the United States Soil and Conservation Service.</u>

The COZ does not involve the establishment of an agricultural district. The request is for a change of zoning to "Public/Quasi-Public".

Additionally, Section 19.30A.020, MCC outlines criteria applied to agricultural lands for determining whether those lands should be retained in the agricultural district. If two (2) of the following three (3) criteria are met, the lands are given high priority for retention:

A. Agricultural Lands of Importance to the State of Hawaiʻi (ALISH);

B. Lands not classified by the ALISH system whose agricultural land suitability, based on soil, topographic, and climatic conditions, supports the production of agricultural commodities, including but not limited to coffee, taro, watercress, ginger, orchard and flower crops and nonirrigated pineapple. In addition, these lands shall include lands used for intensive animal husbandry, and lands in agricultural cultivation in five of the ten years immediately preceding the date of approval of this chapter; and

C. Lands which have seventy-five percent or more of their boundaries contiguous to lands within the agricultural district.

Although the lands underlying the proposed project meet both Criteria A and C, the proposed project would support agricultural uses in the vicinity by providing R-1 recycled water for irrigation use. Further, the proposed location is an appropriate location for a WWRF from a land use planning perspective as the surrounding agricultural lands allow for a buffer from nearby residential areas.

7. The Project Site is Not Designated as Important Agricultural Lands (IAL)

As previously mentioned, the lands underlying the proposed Central Maui WWRF and SAT site are not designated as IAL.

8. The Project is Supported by Agriculture Functional Plan

The Agriculture Functional Plan supports a system of standards, criteria, and procedures "*to redesignate parcels of 'important agricultural lands' to 'urban' or 'other use' upon a demonstrated change of economic or social conditions, where the requested redesignation will provide greater benefits to the public than its retention in the IAL district*" (State of Hawai'i, Department of Agriculture, 1991). While the subject land is not designated as IAL, this criterion is deemed appropriate in the context of redesignating agricultural lands to other uses. The proposed WWRF and SAT would provide long-term public benefit in the form of critical infrastructure, which includes the provision of wastewater treatment and R-1 recycled water. As such, the proposed rezoning of land from "Agricultural" to a "Public/Quasi-Public" designation is anticipated to provide greater benefits to the public than retaining the land in an underutilized agricultural designation.

9. The Project is Compatible with Maui Island Plan

The MIP identifies the Central Maui WWRF and SAT site within the UGB, as designated by the MIP. The MIP identifies Planned Growth Areas, which include proposed housing developments that would be served by the proposed Central Maui WWRF and SAT. The Central Maui WWRF will be planned in accordance with the framework outlined in the MIP. In this regard, the proposed rezoning is supported by the MIP.

H. COUNTY OF MAUI'S OPEN SPACE, NATURAL RESOURCES, CULTURAL RESOURCES, AND SCENIC VIEWS PRESERVATION FUND

The proposed Central Maui WWRF and SAT would be located on a 209-acre parcel owned by the County of Maui and identified as TMK (2)3-8-005:023. The Fiscal Year 2013 budget appropriated approximately $5.0 million for the acquisition of the 209-acre parcel from the Open Space, Natural Resources, Cultural Resources, and Scenic Views Preservation Fund, which was established via Chapter 2.88, MCC. Resolution No. 13-97 notes that the property shall be used consistently with the purposes set forth in Section 9-19, Revised Charter of the County of Maui (1983), as amended, and Chapter 3.88, MCC.

Pursuant to Chapter 3.88 MCC, lands purchased with these funds shall be used for the following purposes:

1. *Public outdoor recreation and education;*
2. *Preservation of historic or culturally important land areas,*

3. *Protection of significant habitat or ecosystems, including buffer zones,*
4. *Preserving forests, beaches, coastal areas and agricultural lands;*
5. *Protecting watershed lands to preserve water quality;*
6. *Conserving land for the purpose of reducing erosion, floods, landslides, and runoff; and*
7. *Improving disabled and public access to, and enjoyment of, public land, open space, and recreational facilities.*

The proposed Central Maui WWRF Project is consistent with "*3. Protection of significant habitat or ecosystems, including buffer zones*", "*4. Preserving forests, beaches, coastal areas and agricultural lands*", and "*5. Protecting watershed lands to preserve water quality*" as the proposed project will provide an alternative to cesspools and septic tanks in the Central Maui region by providing additional wastewater treatment capacity, which will help protect natural habitats, ecosystems, and watersheds. The SAT system is proposed as a sustainable alternative to injection wells currently used at four (4) of the County operated WWRFs including the Wailuku-Kahului WWRF. Injection wells have been the subject of concern in recent years regarding potential impacts to near-shore reef environments. A Hydrogeological Study has been prepared for the proposed SAT system and indicated that through denitrification process via SAT basins, the nitrate concentration of the disposed effluent that reaches Māʻalaea Bay will be reduced significantly, compared with the injection wells which inject treated effluent directly into the underground aquifer. The Study also indicated the effluent from the WWRF is not anticipated to impact the streams in the vicinity, including Waikapū Stream. Refer to **Appendix "F".** Further, the proposed WWRF will produce R-1 recycled water available for nonpotable uses which will conserve water resources on Maui.

The County of Maui, DPR provided comment letters dated August 21, 2023 and December 19, 2024 on the project's Environmental Impact Statement Preparation Notice (EISPN). The December 19, 2024 letter noted that the DPR acknowledged that the proposed project complied with regulatory requirements of the subject fund as the project may protect water shed resources in the future by providing an alternative wastewater management system and that the proposed facility will preserve water resources by providing R-1 recycled water.

I. HAWAIʻI COASTAL ZONE MANAGEMENT PROGRAM – OBJECTIVES AND ENFORCEABLE POLICIES

The project area is not within the County of Maui's Special Management Area (SMA). See **Figure 31**. Nevertheless, an assessment of the development plan pursuant to the Hawaiʻi Coastal Zone Management Program (HCZMP) is provided as follows.

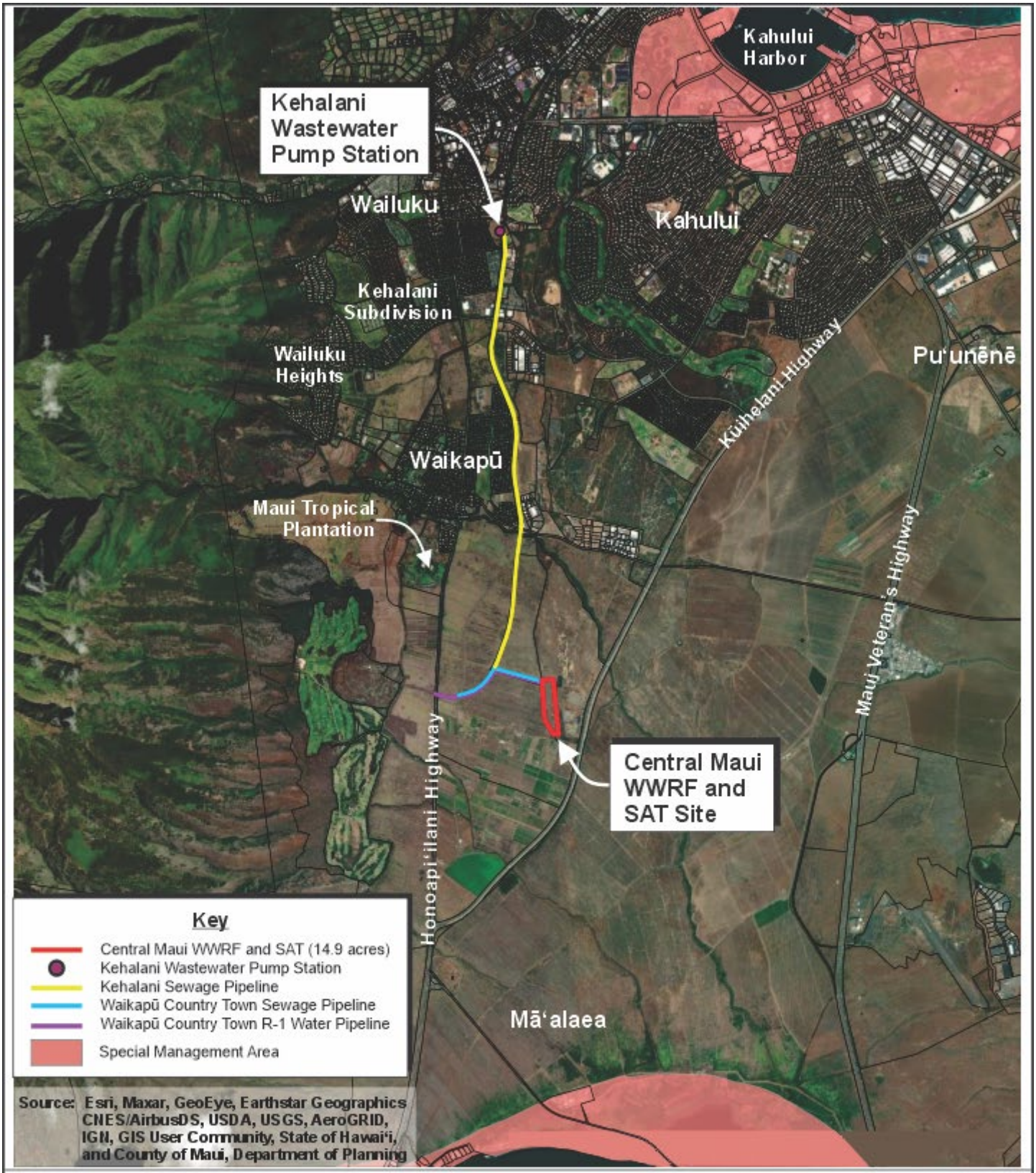

Figure 31 Proposed Central Maui Wastewater Reclamation Facility Special Management Area Map

0 2250 Feet
1125 4500

Prepared for: County of Maui, Department of Environmental Management

MUNEKIYO HIRAGA

COM/DEM Cmaul WW Infrastructure/Applications/Figures/SMA

1. Recreational Resources

Objective:

Provide coastal recreational opportunities accessible to the public.

Policies:

a. Improve coordination and funding of coastal recreational planning and management; and

b. Provide adequate, accessible, and diverse recreational opportunities in the coastal zone management area by:

i. Protecting coastal resources uniquely suited for recreational activities that cannot be provided in other areas;

ii. Requiring replacement of coastal resources having significant recreational value including, but not limited to surfing sites, fishponds, and sand beaches, when such resources will be unavoidably damaged by development; or requiring reasonable monetary compensation to the State for recreation when replacement is not feasible or desirable;

iii. Providing and managing adequate public access, consistent with conservation of natural resources, to and along shorelines with recreational value;

iv. Providing an adequate supply of shoreline parks and other recreational facilities suitable for public recreation;

v. Ensuring public recreational uses of county, state, and federally owned or controlled shoreline lands and waters having recreational value consistent with public safety standards and conservation of natural resources;

vi. Adopting water quality standards and regulating point and nonpoint sources of pollution to protect, and where feasible, restore the recreational value of coastal waters;

vii. Developing new shoreline recreational opportunities, where appropriate, such as artificial lagoons, artificial beaches, and artificial reefs for surfing and fishing; and

viii. Encouraging reasonable dedication of shoreline areas with recreational value for public use as part of discretionary approvals or permits by the land use commission, board of land and natural resources, and county authorities; and crediting such dedication against the requirements of section 46-6.

Response: The subject project is located on the Central Maui isthmus inland of the ocean and is not anticipated to affect existing coastal recreational resources. Access to the shoreline areas will remain unaffected by the proposed project.

2. Historic Resources

Objective:

Protect, preserve, and, where desirable, restore those natural and manmade historic and prehistoric resources in the coastal zone management area that are significant in Hawaiian and American history and culture.

Policies:

a. Identify and analyze significant archaeological resources;

b. Maximize information retention through preservation of remains and artifacts or salvage operations; and

c. Support state goals for protection, restoration, interpretation, and display of historic resources.

Response: Through consultation with the SHPD, an AIS was prepared for the project. Refer to **Appendix "N"**. A total of five (5) historic properties have been identified within the portions of the existing Waiʻale Road and future Waiʻale Road Extension that overlap with the Central Maui WWRF project area. State Inventory of Historic Places (SIHP) #s 50-50-04-05965 and -05966 are previously disturbed human skeletal remains that were discovered during archaeological monitoring within Waiʻale Road for the Kehalani Mauka Subdivision Project. SIHP # 50-50-04-06668 is a post-Contact terrace that was previously documented and reidentified during the AIS for the Waiʻale Road Extension. SIHP # 50-50-04-09167 (water control complex) and SIHP # 50-50-04-09168, a historic refuse disposal deposit (subsurface cultural deposits) also were identified during the AIS for the Waiʻale Road Extension. Of those, two (2) historic properties (SIHP #50-50-04-06668 and #50-50-04-09168) are identified as significant.

Due to the significant historic properties identified and potential for the project to impact these properties, the AIS recommends a project effect determination of "*effect, with proposed mitigation commitments*". Mitigation is proposed in the form of archaeological monitoring. The AIS is currently under review by SHPD and the project will comply with all agreed upon recommendations from SHPD.

3. Scenic and Open Space Resources

Objective:

Protect, preserve, and, where desirable, restore or improve the quality of coastal scenic and open space resources.

Policies:

a. Identify valued scenic resources in the coastal zone management area;

b. Ensure that new developments are compatible with their visual environment by designing and locating such developments to minimize the alteration of natural landforms and existing public views to and along the shoreline;

c. Preserve, maintain, and, where desirable, improve and restore shoreline open space and scenic resources; and

d. Encourage those developments that are not coastal dependent to locate in inland areas.

Response: The project site is located in Maui's central valley with scenic views of Haleakalā and the West Maui Mountains. A View Impact Analysis has been prepared to evaluate the project in the context of the surrounding area. Refer to **Appendix "M"**. The analysis provides renderings of the proposed WWRF and Kehalani WWPS. The Kehalani WWPS will be housed within a building designed to match the visual characteristics of the Kehalani development. In addition, landscaping around the WWRF will be implemented to reduce visual impacts along with the use of earth-tone finishes, minimized structural heights where feasible, and adherence to lighting regulations to reduce glare and visibility at night to visually integrate with the landscape. Similarly, the visual impact of the Kehalani WWPS will be minimized in the form of architectural blending through color selection, low-profile design, and use of existing screening features.

4. Coastal Ecosystems

Objective:

Protect valuable coastal ecosystems, including reefs, from disruption and minimize adverse impacts on all coastal ecosystems.

Policies:

a. Exercise an overall conservation ethic, and practice stewardship in the protection, use, and development of marine and coastal resources;

b. Improve the technical basis for natural resource management;

c. Preserve valuable coastal ecosystems, including reefs, of significant biological or economic importance;

d. Minimize disruption or degradation of coastal water ecosystems by effective regulation of stream diversions, channelization, and similar land and water uses, recognizing competing water needs; and

e. Promote water quantity and quality planning and management practices that reflect the tolerance of fresh water and marine ecosystems and maintain and enhance water quality through the development and implementation of point and nonpoint source water pollution control measures.

Response: The proposed project will provide treatment of wastewater, which if left untreated, may be harmful to coastal ecosystems. The primary effluent disposal method involves conversion to R-1 recycled water, which will primarily be used for irrigation purposes. The Central Maui WWRF will also divert wastewater from the Wailuku-Kahului WWRF, which uses injection wells for wastewater disposal. As a backup effluent disposal method, a SAT system is proposed at the Central Maui WWRF which is considered a sustainable and more environmentally friendly alternative to injection wells. In terms of drainage, the Central Maui WWRF is expected to produce a peak runoff volume of 4.4 cubic feet per second (cfs) while the Kehalani WWPS is expected to produce a peak runoff volume of 2.2 cfs from a 10-year 1-hour storm, once fully constructed. Measures will be implemented to reduce runoff and mitigate potential adverse impact on downstream waters or adjacent properties. Potential mitigation measures include reduction of impervious surfaces, onsite retention ponds, infiltration basins, or vegetated swales. According to the Central Maui WWRF Preliminary Drainage report, a basin of 0.102 acre-feet would be sufficient to reduce post development peak runoff to predevelopment levels and is anticipated to result in no adverse downstream impacts. Offsite runoff flows will be routed through and around the site. Offsite peak runoff flow volumes will not be increased. Offsite flows will be discharged to the same drainage swale, culvert, and drainage canal as in the existing condition. The Kehalani WWPS will result in a net increase of approximately 1.7 cfs. This increase in runoff can be accommodated by the existing Kehalani Makai Detention Basin.

The Hydrogeological Study prepared for the project modeled the nitrate levels through the vadose zone and groundwater to assess potential environmental impacts. To evaluate recycled water chemical migration, the Study used nitrate as a chemical proxy for excess recycled water. Through denitrification and monitoring, the

potential excess effluent will meet regulatory standards set by the Department of Health. Refer to **Appendix "F"**.

5. Economic Uses

Objective:

Provide public or private facilities and improvements important to the State's economy in suitable locations.

Policies:

a. Concentrate coastal dependent development in appropriate areas;

b. Ensure that coastal dependent development such as harbors and ports, and coastal related development such as visitor industry facilities and energy generating facilities, are located, designed, and constructed to minimize adverse social, visual, and environmental impacts in the coastal zone management area; and

c. Direct the location and expansion of coastal dependent developments to areas presently designated and used for such developments and permit reasonable long-term growth at such areas, and permit coastal dependent development outside of presently designated areas when:

i. Use of presently designated locations is not feasible;

ii. Adverse environmental effects are minimized; and

iii. The development is important to the State's economy.

Response: The implementation of the project will support short-term construction related jobs as well as permanent County staff positions involved with operations and maintenance of the facility. The proposed action is not deemed to be coastal-dependent and is in consonance with the MIPs growth boundaries. The project will support planned growth in Central Maui.

6. Coastal Hazards

Objective:

Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, subsidence, and pollution.

Policies:

a. Develop and communicate adequate information about storm wave, tsunami, flood, erosion, subsidence, and point and nonpoint source pollution hazards;

b. Control development in areas subject to storm wave, tsunami, flood, erosion, hurricane, wind, subsidence, and point and nonpoint source pollution hazards;

c. Ensure that developments comply with requirements of the Federal Flood Insurance Program; and

d. Prevent coastal flooding from inland projects.

Response: According to the Flood Insurance Rate Maps, the proposed Central Maui WWRF, SAT, Kehalani WWPS, and pipelines are located primarily on lands are located within Zone "X" (unshaded), which is defined as areas determined to be outside the 0.2 percent annual chance floodplain of minimal flooding. A portion of the Kehalani Sewage Pipeline will cross over the Waikapū Stream, which is in Flood Zone "AE", which is subject to the 1-percent-annual-chance flood event. Refer to **Figure 13**. The pipeline portion in Zone "AE" will be within an elevated bridge which will reduce impacts from potential flooding. The project site is also located outside the Tsunami Evacuation Zone.

7. Managing Development

Objective:

Improve the development review process, communication, and public participation in the management of coastal resources and hazards.

Policies:

a. Use, implement, and enforce existing law effectively to the maximum extent possible in managing present and future coastal zone development;

b. Facilitate timely processing of applications for development permits and resolve overlapping or conflicting permit requirements; and

c. Communicate the potential short and long-term impacts of proposed significant coastal developments early in their life cycle and in terms understandable to the public to facilitate public participation in the planning and review process.

Response: The proposed project shall be reviewed and processed pursuant to Chapter 343, HRS, and through the DBA, CPA, and COZ permitting processes. Public review will be coordinated through these processes. The County of Maui DEM hosted a public scoping meeting during the EISPN comment period and has consulted with the Waikapū Community Association and Waikapū Gardens Homeowners Association. A summary of the public scoping meeting during the EISPN comment period is provided in **Appendix "T"**.

8. Public Participation

Objective:

Stimulate public awareness, education, and participation in coastal management.

Policies:

a. Promote public involvement in coastal zone management processes;

b. Disseminate information on coastal management issues by means of educational materials, published reports, staff contact, and public workshops for persons and organizations concerned with coastal issues, developments, and government activities; and

c. Organize workshops, policy dialogues, and site-specific mediations to respond to coastal issues and conflicts.

Response: As noted above, opportunity for public awareness, education and participation pertaining to significant resource attributes of the coastal zone is provided through Chapter 343, HRS environmental review procedures, and the DBA, CPA, and COZ review processes which provide for public review of the project. A summary of the public scoping meeting during the EISPN comment period is provided in **Appendix "T"**.

9. Beach Protection

Objective:

Protect beaches for public use and recreation.

Policies:

a. Locate new structures inland from the shoreline setback to conserve open space, minimize interference with natural shoreline processes, and minimize loss of improvements due to erosion;

b. Prohibit construction of private erosion-protection structures seaward of the shoreline, except when they result in improved aesthetic and engineering solutions to erosion at the sites and do not interfere with existing recreational and waterline activities;

c. Minimize the construction of public erosion-protection structures seaward of the shoreline;

d. Prohibit private property owners from creating a public nuisance by inducing or cultivating the private property owner's vegetation in a beach transit corridor; and

e. Prohibit private property owners from creating a public nuisance by allowing the private property owner's unmaintained vegetation to interfere or encroach upon a beach transit corridor.

Response: As an inland action, the implementation of the project will not impact shoreline activities and, as such, adverse impact to beach processes are not expected.

10. Marine Resources

Objective:

Promote the protection, use, and development of marine and coastal resources to assure their sustainability.

Policies:

a. Ensure that the use and development of marine and coastal resources are ecologically and environmentally sound and economically beneficial;

b. Coordinate the management of marine and coastal resources and activities to improve effectiveness and efficiency;

c. Assert and articulate the interests of the State as a partner with federal agencies in the sound management of ocean resources within the United States exclusive economic zone;

d. Promote research, study, and understanding of ocean processes, marine life, and other ocean resources to acquire and inventory information necessary to understand how ocean development activities relate to and impact upon ocean and coastal resources; and

e. Encourage research and development of new, innovative technologies for exploring, using, or protecting marine and coastal resources.

Response: Although the proposed WWRF and related infrastructure are located inland away from the shoreline, the proposed SAT system involves an intermittent application of treated effluent at high hydraulic loading rates to basins constructed in highly permeable soils, such as sand or gravel. In order to assess potential impacts to marine resources, a Hydrogeological Study has been prepared for the project to assess potential impacts of the proposed SAT system to nearby wetland and streams as well as nearshore waters. Refer to **Appendix "F"**. The conservative denitrification rate modeling forecast suggests that after 10 years of operation, nitrate migration may reach the shoreline and near the Keālia Pond area at a concentration of 0.29 milligrams per liter (mg/L). Using more rapid denitrification rates, considering enhancements from the

addition of biomass, such as wood chips, in the SAT basins, the projected nitrate concentration is less than 0.05 mg/L and below the State regulatory standard. In comparison, it is noted the baseline nitrate concentration in groundwater in the area is estimated to be approximately 2 mg/L or greater due to past agricultural activities and onsite disposal systems, and the projected discharge is well below the nitrate drinking water standard of 10 mg/L. The Hydrogeological Study's modeling scenario projects that nitrate levels above 0.1 mg/L will not reach the Mā'alaea Bay shoreline and the inland waters of Keālia Pond National Wildlife refuge area within 100 years.

In addition to the foregoing objectives and policies and pursuant to Act 224 (2005):

No special management area use permit or special management area minor permit shall be granted for structures that allow artificial light from floodlights, uplights, or spotlights used for decorative or aesthetic purposes when the light:

(1) Directly illuminates the shoreline and ocean waters; or

(2) Is directed to travel across property boundaries toward the shoreline and ocean waters.

Further, this prohibitation shall not apply to authorized users for government operations, security, public safety, or navigational needs; provided that a government agency or its authorized users shall make reasonable efforts to properly position or shield lights to minimize adverse impacts.

Response: The project area is located inland of the shoreline. The development of the improvements will be designed to ensure that light fixtures will be shielded to comply with the dark sky lighting requirements and not directed across property boundaries.

J. HAWAIʻI CLEAN WATER STATE REVOLVING FUND ENVIRONMENTAL CROSSCUTTERS

The proposed project may be funded in part by the Hawaiʻi Clean Water State Revolving Fund (SRF). Should such funding be utilized, the project will comply with the Environmental Cross-Cutters and Federal Requirements for Clean Water SRF projects, as applicable. **Table 21** below provides a listing of the Environmental Cross-Cutters as well as the documentation related to addressing the requirement criteria.

Table 21. Environmental Cross-Cutters and Project Documentation

No.	Environmental Authority	Procedure	Responsible Agency	Response	Project Documentation
1.	Archaeological and Historical Preservation Act of 1974	Obtain review for all projects.	SHPD	An AIS was prepared for the project and is being submitted to SHPD for review and approval. Section 106 of the National Historic Preservation Act of 1966 (NHPA) consultation will be completed prior to the initiation of the construction, as may be applicable.	See Chapter II, Section A. 15, Archaeological and Historic Resources of this EIS document. Refer to the AIS in **Appendix "N"**.
2.	Bald and Golden Eagle Protection Act	Permit required for taking eagles.	U.S. Department of the Interior	Not applicable. Bald and Golden Eagles do not exist in Hawai'i.	Not applicable.
3.	Clean Air Act	Coordinate to ensure project conforms with State Implementation Plan (SIP).	State Department of Health, Clean Air Branch.	The EISPN was and this Draft EIS is being provided to the Department of Health for review and comment.	See Chapter II, Section A. 11 of this EIS document for discussion of potential air quality impacts and mitigation measures.
4.	Coastal Barrier Resources Act	Obtain review, if project is located on a coastal barrier island.	State Coastal Zone Management Agency.	Not applicable. The project site is not located on a coastal barrier island.	Not applicable.
5.	Coastal Zone Management Act	Obtain review, if project is located in coastal zone.	State Coastal Zone Management Agency.	Pursuant to Chapter 205A-1, HRS, the project site is within the Coastal Zone Management Area, which encompasses all lands of the State. The project site is, however, outside of the SMA. A SMA permit is not required.	See Chapter III, Section I of this EIS document for discussion of the Coastal Zone Management Program review criteria.

No.	Environmental Authority	Procedure	Responsible Agency	Response	Project Documentation
6.	Endangered Species Act, Section 7	Obtain review by U.S. Fish and Wildlife Service for all projects.	U.S. Fish and Wildlife Service (USFWS).	The EISPN was and Draft EIS is being provided to the USFWS for review and comment. Section 7 consultation will be completed prior to the initiation of the construction as may be applicable.	See Chapter XI of this EIS document for the EISPN distribution list.
7.	Environmental Justice	Are low income and minority groups affected?	U.S. Environmental Protection Agency (EPA)	No low-income or minority groups will be adversely affected as a result of the proposed project. The EISPN and Draft EIS is being provided to the EPA for review and comment.	Refer to Chapter XI of this EIS document for the EISPN distribution list. See Chapter II, Section B of this EIS document for a discussion of socioeconomic and demographic parameters and Chapter II, Section A.13 for a discussion of noise impacts.
8.	Floodplain Management	Obtain review, if project is located in or affects 100-year flood plain.	Federal Emergency Management Agency	The majority of the project area is located within Flood Zone X (unshaded), with a portion of the proposed Kehalani Sewage Pipeline crossing Waikapū Stream, which is designated as Flood Zone AE. The Draft EIS is being provided to FEMA for review and comment.	Refer to Chapter XI of this EIS document for the EISPN distribution list. See Chapter II, Section A.7 of this EIS document for a discussion of Flood and Tsunami Hazards.
9.	Protection of Wetlands	Obtain review, if project area contains wetlands.	U.S. Army Corps of Engineers (USACE)	Not applicable. The project site does not contain any wetlands.	See Chapter II Section A.5 of this EIS document for a discussion of Streams and Wetlands.

No.	Environmental Authority	Procedure	Responsible Agency	Response	Project Documentation
10.	Farmland Protection Policy Act	Obtain review, if project area contains prime farmland.	Natural Resources Conservation Service (NRCS)	The proposed WWRF and SAT site has poor soils for farming, however, approximately four (4)-acre of access and utility easement from the future Wai'ale Road extension to the WWRF and SAT site has favorable conditions for farming. An Agricultural Impact Assessment prepared for the project concluded that a standalone farm on the 4-acre easement could be challenging to cultivate due to the long narrow shape of the property. The Draft EIS is being provided to NRCS for review and comment.	Refer to Chapter XI of this EIS document for the EISPN distribution list. See Chapter II Section A.6 of this EIS document for a discussion of agriculture.
11.	Fish and Wildlife Coordination Act	Obtain review for all projects.	USFWS	The EISPN and the Draft EIS is being provided to USFWS for review and comment.	See Chapter II, Section A.9 of this EIS document for discussion of flora and fauna resources.
12.	Marine Mammal Protection Act	Permit required for capturing marine mammals.	USFWS	The project site is located over three (3) miles inland of the nearest coastline. It is noted that a Hydrogeological Assessment was prepared to assess any potential impacts of the SAT system to groundwater and nearshore water quality. The proposed project is not anticipated to affect essential marine mammal's habitats.	See Chapter II, Section A.4 of this EIS document for a discussion of groundwater resources and nearshore water quality and marine environment.

No.	Environmental Authority	Procedure	Responsible Agency	Response	Project Documentation
13.	Migratory Bird Treaty Act	Obtain review, if project impacts breeding bird species.	USFWS	The EISPN was and the Draft EIS is being provided to USFWS for review and comment.	Refer to Chapter XI of this EIS document for the EISPN distribution list. Refer to Chapter II, Section A.9 of this EIS document for discussion of flora and fauna resources.
14.	National Historic Preservation Act	Obtain review for all projects.	SHPD	An AIS was prepared in October 2025. The AIS has been submitted to SHPD for review and approval. Section 106 of the NHPA consultation will be completed prior to the initiation of construction, as may be applicable.	Refer to Chapter II, Section A.15, Archaeological and Historic Resources. Refer to the AIS in **Appendix "N"**.
15.	Rivers and Harbors Act	Obtain review, if project requires construction of any structure in or over a navigable water of the U.S. or if structure or work will affect the course, location, or condition of a water body.	U.S. Army Corps of Engineers (USACE)	A portion of the proposed Kehalani Sewage Pipeline will be installed underground of the future Waiʻale Road Extension. The Waiʻale Road Extension project includes construction of a bridge for crossing over Waikapū Stream, and the utility lines will be installed to the bridge and will cross over Waikapū Stream. No work is anticipated within the Waters of the U.S. The USACE will be consulted to confirm applicability of Department of Army permit requirements.	Refer to Chapter II, Section A.5 of this EIS document for a discussion of streams and wetlands.

No.	Environmental Authority	Procedure	Responsible Agency	Response	Project Documentation
16.	Safe Drinking Water Act	Obtain review, if project could affect sole source aquifer.	State Department of Health, Safe Drinking Water Branch (DOH-SDWB)	The proposed project will not be anticipated to affect a sole source aquifer. A Hydrogeological Assessment was prepared to assess any potential impacts to groundwater resources. The Draft EIS is being provided to the DOH-SDWB for review and comment.	Refer to Chapter XI of this EIS document for the EISPN distribution list. Refer to Chapter II Section A.4 of this EIS document for a discussion of groundwater resources.
17.	Wild and Scenic Rivers Act	Obtain review, if project is located in area with Wild and Scenic Rivers.	National Park Service	Not applicable. The project site is not located in an area with Wild or Scenic Rivers. There are no Wild or Scenic Rivers in the State of Hawai‘i.	Not applicable.
18.	Consultation Process Under the Magnuson- Stevens Fishery Conservation and Management Act	Obtain review, if it will affect essential fish habitat.	National Marine Fisheries Service	The project site is located over three (3) miles inland of the nearest coastline. It is noted that a Hydrogeological Assessment was prepared to assess any potential impacts of the SAT system to groundwater and nearshore water quality. The proposed project is not anticipated to affect essential fish habitats.	Refer to Chapter II, Section A.4 of this EIS document for a discussion of groundwater resources and nearshore water quality, and marine environment.

IV ALTERNATIVES TO THE PROPOSED ACTION

IV. ALTERNATIVES TO THE PROPOSED ACTION

The County of Maui, Department of Environmental Management (DEM) is proposing the development of a new Central Maui Wastewater Reclamation Facility (WWRF) to service the Central Maui region. The project as outlined and discussed in Chapter I represents the preferred alternative. The proposed project is needed to divert existing wastewater flows to alleviate pressure on the Wailuku-Kahului WWRF and by providing adequate wastewater treatment facilities to accommodate increased wastewater flows for planned developments in the region. The following is a description of alternative scenarios considered in the development of the Draft Environmental Impacts Statement (EIS).

A. NO ACTION ALTERNATIVE

With the no action alternative, a new WWRF for Central Maui would not be developed and the County of Maui, DEM would continue to rely on the existing Wailuku-Kahului WWRF to provide sewer service to the communities in the central valley. The existing facility has limited capacity to support planned growth. The no action alternative is not considered a viable scenario in the context of the limitations of the existing Wailuku-Kahului WWRF. The no action alternative is not consistent with the objectives of the proposed action.

B. LOCATION ALTERNATIVES

Various private and County-owned parcels were considered for the WWRF and Soil Aquifer Treatment (SAT) project site, as well as the Kehalani Wastewater Pump Station (WWPS).

Central Maui WWRF and SAT Site

The Preferred Alternative location for the Central Maui WWRF and SAT is on land owned by the County of Maui and identified as Tax Map Key (TMK) (2)3-8-005:023. A predominant consideration during the site selection process for the Central Maui WWRF was the site's abilities to support the Soil Aquifer Treatment (SAT) system for effluent disposal purposes. The SAT system requires highly permeable soils (e.g., sand or gravel) of sufficient depth to allow effluent to be applied at high hydraulic loading rates. Within the Central Maui area, the Jaucas sand (JaC) soil type as shown in **Figure 7** appeared to have favorable characteristics to support the SAT system.

In addition, the State of Hawai'i, Department of Health (DOH), Safe Drinking Water Branch was consulted early in the site selection process to obtain their recommendations to avoid any adverse impacts to drinking water wells. The County provided five (5) alternative sites for the Safe Drinking Water Branch's groundwater modeling. See **Figure 32**. The Safe Drinking Water Branch ultimately recommended that a SAT system be located south of Waikapū Stream to avoid impacts to existing drinking water wells in Kahului.

Source: Brown & Caldwell, Inc.

Figure 32

Proposed Central Maui Wastewater Reclamation Facility

Central Maui WWRF Location Alternatives Map

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

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In addition to the presence of Jaucas sand soil type and the recommendation by the DOH Safe Drinking Water Branch, the following site selection criteria were considered:

1. Parcel ownership: County of Maui owned parcels were preferred over privately owned parcels.
2. Proximity to planned development projects.
3. Distance to roads and proposed developments for visual, noise, and odor buffers.
4. Prevailing wind direction.

Based on the foregoing, the proposed WWRF and SAT site (Preferred Alternative) was selected as the most appropriate location due to the following reasons:

- Jaucas sand soil type is present to support a SAT system.
- The site is a portion of a large parcel (TMK (2)3-8-005:023) that is owned by the County of Maui.
- Locating the SAT system at the site that will not impact existing drinking water wells.
- The proposed site is located on the downwind side of the large parcel (TMK (2)3-8-005:023).
- The proposed site provides large buffers from existing highways and existing and proposed development projects.
- The parcel downwind of the proposed WWRF and SAT site is a designated agricultural preserve that will not be developed with residential housing or other sensitive receptors.

Kehalani WWPS Site

Based on preliminary engineering assessment, the preferred alternative for the Kehalani WWPS is the existing stormwater basin parcel for the master-planned Kehalani community owned by the County of Maui and identified as TMK (2)3-5-020:036. Only a small portion of this parcel (maximum 10,000 square feet) would be utilized for the WWPS. The WWPS would be designed to maintain the existing performance of the basin such that detention capabilities would not be significantly impacted.

The DEM assessed various alternatives for the Kehalani WWPS location, which included a portion of Maui Community Correctional Center parking lot along Waiʻale Road (TMK (2)3-8-046:005 and 006) and a portion of the County of Maui baseyard at TMK (2) 3-4-003:001 and (2)3-4-003:022. See **Figure 33**. These alternative locations were not selected due to their existing uses and the need for those existing uses to be relocated, as well as flood zone considerations.

Figure 33

Proposed Central Maui Wastewater Reclamation Facility

Kehalani Wastewater Pump Station Location Alternatives Map

NOT TO SCALE

Prepared for: County of Maui, Department of Environmental Management

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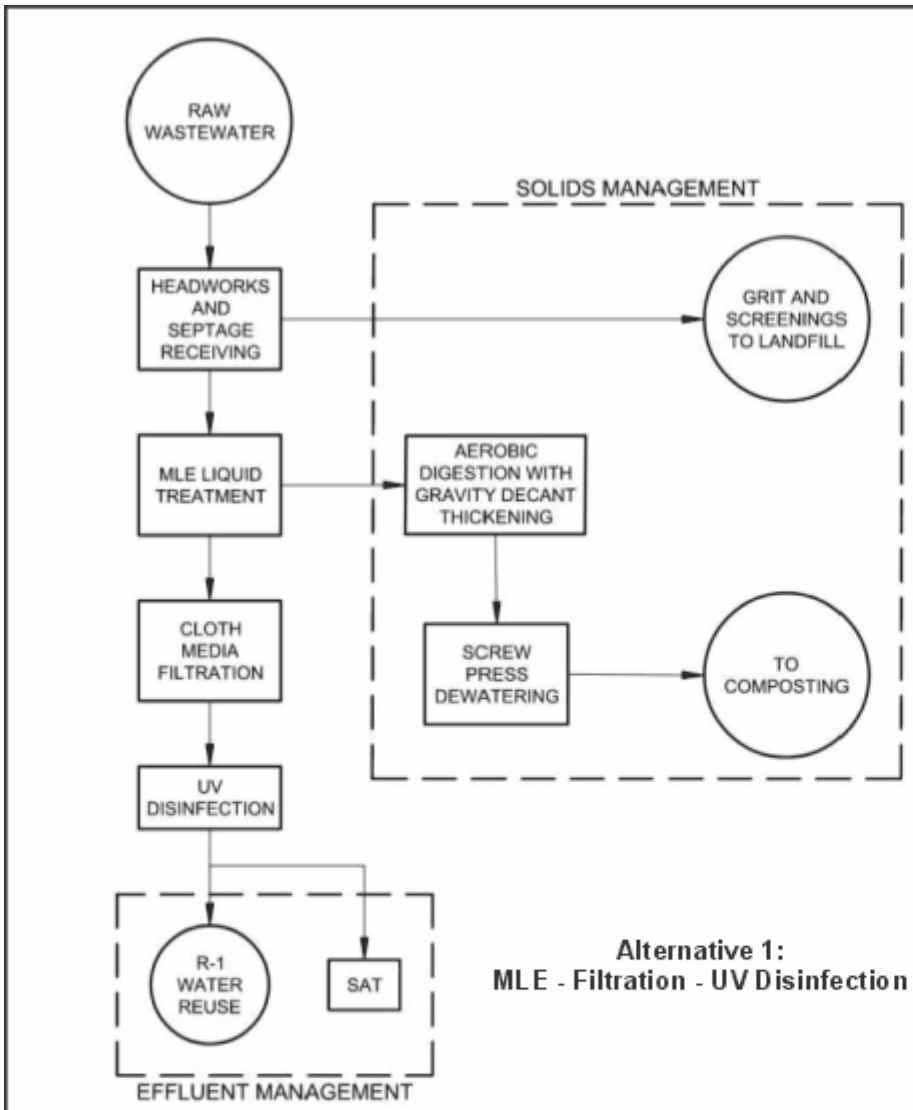
C. SECONDARY LIQUID TREATMENT ALTERNATIVES

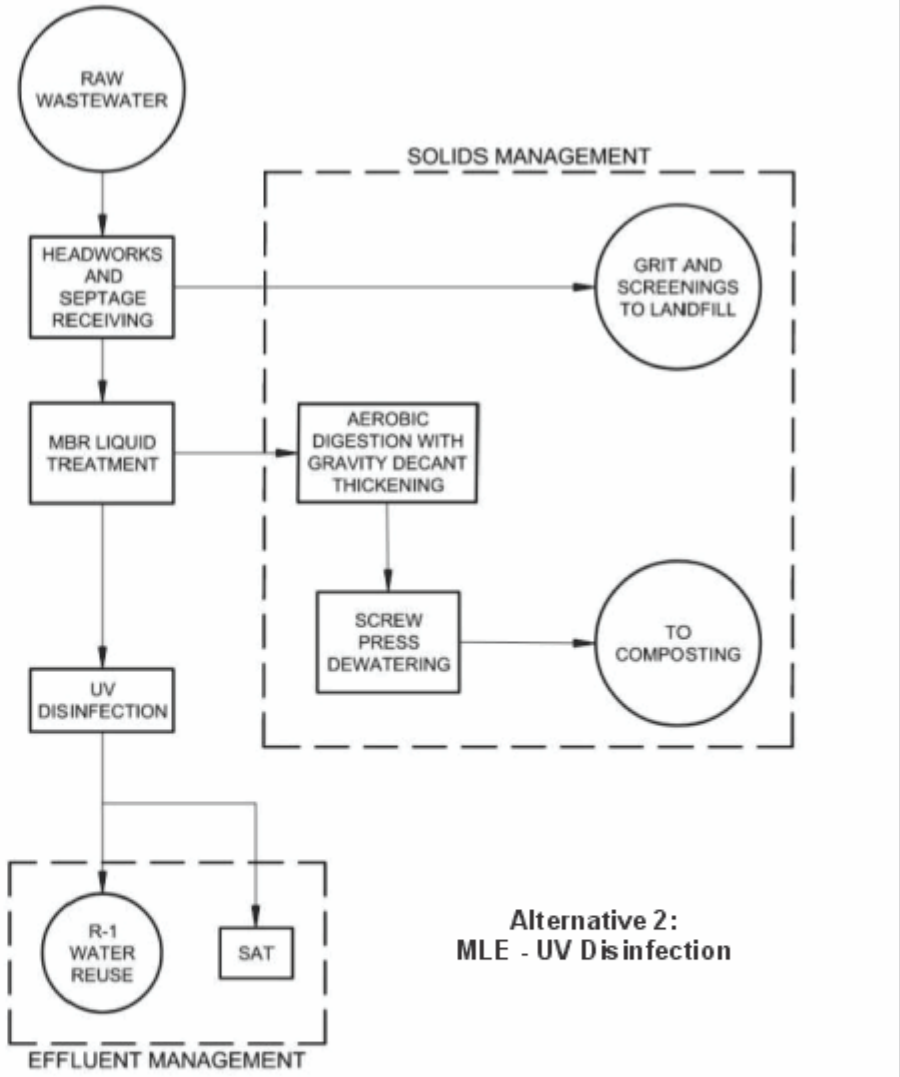
Through the development of the Facility Plan, Brown & Caldwell evaluated multiple liquid and solid treatment options for the proposed WWRF. Refer to **Appendix "A"**. There are two (2) alternative methods being considered for secondary liquid treatment for the proposed WWRF. The first alternative liquid treatment method involves Biological Nutrient Removal (BNR) via Modified Ludack-Ettinger (MLE) Activated Sludge. This is a modification from a conventional activated sludge system with the addition of an internal mixed liquor recycle (IMLR). Nitrification (ammonia removal) occurs in the aerobic zone. The mixed liquor, high in nitrate from nitrification, is recycled to the anoxic zone (by the internal recycle) for denitrification. See **Figure 34** and refer to **Figure 23**.

The second alternative treatment method also uses BNR, however, the BNR is conducted via a Membrane Bioreactor (MBR). A MBR combines aeration with membrane filtration, eliminating the need for additional tertiary treatment if a very high-quality effluent is desired for water reuse purposes for water reuse. Refer to **Figure 34** and **Figure 24**. Although these two (2) alternatives are nearly identical, BNR via MBR leaves a smaller footprint than BNR via MLE. The Central Maui WWRF Facility Plan recommends further evaluation of these methods for secondary liquid treatment, and the preferred alternative will be determined during the design phase of the project.

D. EFFLUENT MANAGEMENT ALTERNATIVES

Three (3) alternatives were considered for effluent management with all alternatives involving water recycling/re-use as the primary disposal method. The preferred alternative involves the use of an onsite SAT for back-up effluent disposal. Due to the soil in the project area, the SAT was determined to be the most suitable land treatment system and offers greater environmental protection when compared to other alternatives. Another alternative would be to use injection wells for effluent management, which is the method currently used at four (4) of the County operated WWRFs including the Wailuku-Kahului WWRF. However, injection wells have been the subject of concerns in recent years regarding potential impacts to near-shore reef environments. Furthermore, state law prohibits the State Department of Health (DOH) from issuing permits for construction of new injection wells if other options are feasible. A final alternative for effluent management involves effluent disposal via ocean outfall, which poses both ecological and human health risks. As such, the SAT has been selected as the most environmentally safe back-up disposal method for effluent management for the proposed WWRF.





Source: Brown & Caldwell, Inc.

Figure 34 Proposed Central Maui Wastewater Reclamation Facility

Secondary Liquid Treatment Alternatives Diagrams

Prepared for: County of Maui, Department of Environmental Management

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V

SUMMARY OF ADVERSE ENVIRONMENTAL EFFECTS THAT CANNOT BE AVOIDED

V. SUMMARY OF ADVERSE ENVIRONMENTAL EFFECTS THAT CANNOT BE AVOIDED

The development of the project may result in certain unavoidable construction-related impacts as outlined in Chapter II.

Potential effects include short-term noise, air and water quality impacts occurring during site preparation and construction phases of the project. These impacts will arise as a direct result of construction activities, such as the generation of noise from construction equipment, the generation of dust and other airborne pollutants, and erosion from wind and stormwater runoff during grading and other construction activity. Appropriate Best Management Practices (BMPs), such as use of sound attenuating construction equipment, will be used, where practicable, to mitigate noise impacts caused by construction. Additionally, installation of dust fences and watering of exposed areas to mitigate air quality impacts, and utilization of stormwater runoff BMPs to address water quality impacts associated with construction will be employed.

An additional unavoidable impact relates to construction traffic effects upon roadways in the vicinity of work undertaken. For example, during construction, heavy equipment and trucks will be traveling along the existing roadways. A Construction Traffic Management Plan has been prepared and will be updated prior to construction with more details to ensure safe and efficient passage of passenger and commercial vehicles, bicycles, and pedestrians during construction. Refer to **Appendix "Q-2"**. Recommended construction traffic management strategies include avoiding large trailer deliveries during peak traffic hours, establishing detours and temporary traffic control zones to facilitate traffic during lane closures, incorporation of the County of Maui BMPs to reduce the tracking of mud and dirt onto public roadways, and notifying the public of the construction status.

The foregoing unavoidable effects are temporary in nature and are associated with project construction. Mitigation measures may include, among others, the BMPs cited above, which are anticipated to provide the necessary environmental protections, and appropriately address public safety and welfare considerations to ensure implementation with the least amount of inconvenience, nuisance, and detriment.

In the long term, unavoidable impacts associated with operation of the Central Maui Wastewater Reclamation Facility (WWRF) include the need for additional infrastructure and resources to support the operation of the WWRF, such as water, electricity, stormwater runoff, and solid waste. In addition, there will be low-to-moderate impacts on existing views from the surrounding roadways in vicinity of the proposed WWRF and Kehalani Wastewater Pump Station (WWPS).

As noted previously, the proposed Central Maui WWRF, will, in the long run, provide an additional wastewater capacity to serve existing population by diverting wastewater flows from the Wailuku-Kahului WWRF as well as projected future population increase on Maui that would happen with or without the project. In addition, the Central Maui WWRF will provide R-1 recycled water for nonpotable and irrigation uses, and include a Soil Aquifer Treatment (SAT) system for disposal of effluent as a backup, which is considered as a more sustainable alternative to injection wells that are currently commonly used in the County WWRFs.

VI

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

VI. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Implementation of the proposed project is expected to result in the irreversible and irretrievable commitment of land and fiscal resources. Other resource commitments include energy, labor, and material resources. However, this commitment of resources is considered appropriate in the context of the project's long-term objectives of providing additional wastewater treatment capacity to the Central Maui region to support future development to accommodate the projected population growth on Maui.

The proposed project includes former agricultural lands that are currently designated for agricultural uses by the State Land Use Commission, Maui County Zoning, and Wailuku-Kahului Community Plan. Implementation of the proposed project will result in removal of the 14.9 acre-Central Maui Wastewater Reclamation Facility (WWRF) site from such agricultural designations. However, the County has long envisioned development of the proposed WWRF as indicated in Resolution No. 06-12 (approved by the Maui County Council on February 2006), recommending implementation of the long-term plan of action to service the Central Maui Service Area, and the proposed project site has been carefully selected to avoid areas with potential impacts from shoreline erosion, tsunami, and flooding.

In addition to fiscal commitments, labor and materials are required during project construction. After construction, operation of the project will require the continued use of resources such as energy and labor for maintenance and operation of the project. Such uses of resources are considered necessary and appropriate to provide critical infrastructure services to residents and businesses on Maui.

VII

RELATIONSHIP BETWEEN THE SHORT-TERM USE OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

VII. RELATIONSHIP BETWEEN THE SHORT-TERM USE OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

This chapter discusses the relationship between the short-term use of environmental resources and the long-term productivity of these resources with respect to the proposed action. It considers environmental parameters and resources which may be temporarily affected during construction and examines their implications for the maintenance and enhancement of long-term environmental productivity, including land use, air and noise quality, drainage and traffic. An assessment of these resources is summarized in **Table 22**.

Table 22. Assessment of the Relationship Between the Short-Term Uses of the Environment and the Maintenance and Enhancement of Long-Term Productivity

Environmental Resource Parameter	Relationship Assessment
Land Use	The proposed action involves the development of former agricultural lands to accommodate a new Wastewater Reclamation Facility (WWRF) and related improvements in Central Maui. Development of the WWRF and Soil Aquifer Treatment (SAT) will require a State Land Use Commission District Boundary Amendment (DBA), Change of Zoning (COZ), and Community Plan Amendment (CPA) approvals to amend the current agricultural designations to the State Urban District and Public/Quasi-Public zoning and community plan designations. While the project will reduce the amount of agricultural lands available on Maui, the Agricultural Impact Assessment prepared for the project indicated that the 14.9-acre WWRF and SAT site has poor soils for farming. Approximately four (4) acres of access and utility easement from the future Waiʻale Road Extension to the WWRF and SAT site has favorable conditions for farming, however, a standalone farm on the four (4)-acre easement could be challenging to cultivate due to the long, narrow shape of the property. The proposed WWRF, SAT, and related infrastructure are long-term use to provide additional wastewater treatment capacity to support future development needs in Central Maui, including affordable housing.
Air and Noise Quality	The construction of the proposed project may result in temporary construction related nuisances to air quality and noise conditions. Best Management Practices (BMPs), such as dust fences, water sprinklers, and equipment maintenance, will be used to ensure that impacts associated with construction are mitigated to the maximum extent practicable. In addition, as warranted, the contractor(s) shall obtain a noise permit in accordance with the Department of Health's Title 11, Administrative Rules, Department of Health (DOH), Chapter 46, Community Noise Control. The proposed Central Maui WWRF will be subject to the DOH regulations regulating noise and air pollution. As such, in the

	long term, the proposed WWRF is not anticipated to be sources of adverse air and noise pollution.
Drainage	Construction may create temporary drainage impacts from stormwater runoff. Erosion control BMPs will be implemented to mitigate erosion and the release of sediment and other pollutants to existing storm drains, waterways, and adjacent properties. In the long term, permanent drainage improvements will be implemented at the WWRF site as well as Kehalani Wastewater Pump Station (WWPS) site to reduce post construction runoff and treat and improve stormwater quality.
Traffic	Construction traffic may create temporary delays on Honoapiʻilani Highway, Waiʻale Road, and the future Waiʻale Road Extension, and connecting regional roadways. A Construction Traffic Management Plan (CTMP) has been prepared which presents potential mitigation measures, such as avoiding large trailer deliveries during peak traffic hours, establishing detours and temporary traffic control zones to facilitate traffic during lane closures, and notifying the public of the construction status, to ensure that public safety and convenience along surrounding roadways/highways are maintained. After construction, there will be a small number of staff onsite to operate the WWRF and septage haulers and large trucks to haul away solid waste will enter and exit the WWRF site during business hours. Similarly, staff and contractors may occasionally travel between the WWRF site and Kehalani WWPS. However, the traffic increase from the operation is not anticipated to significantly change the existing traffic condition.

UNRESOLVED ISSUES

VIII

VIII. UNRESOLVED ISSUES

The following section summarizes issues that remain unresolved at the time of writing the Draft Environmental Impact Statement (EIS) for the Central Maui Wastewater Reclamation Facility (WWRF) Project.

A. PROJECT DESIGN AND LANDSCAPING PLAN

Detailed design of the proposed Central Maui WWRF, Kehalani Wastewater Pump Station (WWPS), and the proposed pipelines will be further developed during the design phase of the project. This will include a landscaping master plan to mitigate potential visual impacts, and appropriate measures to mitigate potential noise impacts.

B. SECONDARY LIQUID TREATMENT METHOD

As discussed in Chapter IV of this EIS, two (2) alternative methods being considered for secondary liquid treatment for the proposed WWRF. The first alternative liquid treatment method involves Biological Nutrient Removal (BNR) via Modified Ludack-Ettinger (MLE) Activated Sludge. This is a modification from a conventional activated sludge system with the addition of an internal mixed liquor recycle (IMLR). Nitrification (ammonia removal) occurs in the aerobic zone. The mixed liquor, high in nitrate from nitrification, is recycled to the anoxic zone (by the internal recycle) for denitrification. Refer to **Figure 23** and **Figure 34**.

The second alternative treatment method also uses BNR, however, the BNR is conducted via a Membrane Bioreactor (MBR). A MBR combines aeration with membrane filtration, eliminating the need for additional tertiary treatment if a very high-quality effluent is desired for water reuse purposes for water reuse. Refer to **Figure 24** and **Figure 34**. Although these two (2) alternatives are nearly identical, BNR via MBR leaves a smaller footprint than BNR via MLE. The Central Maui WWRF Facility Plan recommends further evaluation of these methods for secondary liquid treatment, and the preferred alternative will be determined during the design phase of the project.

C. FUNDING SOURCES

The funding sources for development of the proposed Central Maui WWRF are undetermined at this time and the County will explore various funding options. It is noted that the use of federal funds may be pursued for the proposed project. In such event that said funds are secured and utilized by the County of Maui, the Department of Environmental Management (DEM) will work with the relevant federal agency to comply with the applicable provisions of the National Environmental Policy Act (NEPA) and any related consultation requirements.

D. LAND USE ENTITLEMENTS

The 14.9-acre project site for the Central Maui WWRF and onsite Soil Aquifer Treatment (SAT) is located on lands designated a “Agricultural” by the State Land Use Commission, designated for “Agriculture” use in the Wailuku-Kahului Community Plan, and zoned “Agricultural” district by the County of Maui. In order to proceed with the proposed public/quasi-public land use objective of the project, a District Boundary Amendment (DBA) from the “Agricultural” district to the “Urban” district will be required. For the County of Maui, the Maui County Council is the decision-making authority for DBAs involving land areas of 15 acres or less. Inasmuch as the proposed WWRF and SAT site is less than 15 acres, the DEM will seek a DBA from the Council. Additionally, a Community Plan Amendment (CPA) to amend the “Agriculture” designation of the Wailuku-Kahului Community Plan to “Public/Quasi-Public”, as may be applicable, and a Change of Zoning (COZ) to amend “Agricultural” zoning district to “Public/Quasi-Public (P-1)” will be pursued for the proposed WWRF. The 14.9-acre WWRF and SAT site is designated as “Park” and labeled “Regional Park and County Facilities” by the Maui Island Plan (MIP) Planned Growth Areas Map. The MIP Planned Protected Areas Map also designates the WWRF and SAT site as “Park Protected Area” with the label “Regional Park and County Facilities”. Based on the consultation with the Department of Planning, an amendment to the MIP is anticipated to be required. For the MIP Growth Areas Map, the “Park” designation for the 14.9-acre WWRF and SAT site will be amended to the “Planned Growth Areas” designation. For the MIP Planned Protected Areas map, the “Park” designation will be removed and no Planned Protected Areas will be assigned for the 14.9-acre project site. The narrative of the MIP will also be amended to include a County WWRF as an example of the County Facilities planned in the region. It is noted that these land use applications will be initiated by the Planning Director after the EIS process is completed. It is also noted that a Community Plan update request will be submitted as part of the Central Maui Community Plan update process, and a separate CPA may not be necessary.Conditions of approval for these land use applications will be determined in conjunction with the DBA/MIP Amendment/CPA/COZ application processes.

E. CHAPTER 6E, HAWAIʻI REVISED STATUTES (HRS) COMPLIANCE

An Archaeological Inventory Survey (AIS) and a Cultural Impact Assessment (CIA) have been conducted to assess the project’s potential impacts to the cultural and historic resources within and in the vicinity of the project area. The State Historic Preservation Division (SHPD) is being consulted pursuant to HRS, Chapter 6E, and appropriate mitigation measures requested by the SHPD will be undertaken.

PUBLIC SCOPING MEETING

IX

IX. PUBLIC SCOPING MEETING

A public scoping meeting for the project, as required by Chapter 11-200.1-23, Hawai‘i Administrative Rules for the Department of Health, was held on Wednesday, August 16, 2023, at 6:00 p.m. at the Waikapū Community Center located at 22 East Waiko Road, Waikapū, Hawai‘i, 96793. A summary of the meeting, including comments received and responses, is included herein as **Appendix “T”**.

LIST OF PERMITS AND APPROVALS

X

X. LIST OF PERMITS AND APPROVALS

The following is a preliminary list the permits and approvals that are anticipated to be required for implementation of the proposed project:

Federal:

1. National Environmental Policy Act (NEPA) compliance, as applicable, including related federal consultation requirements **(To be coordinated with applicable federal agency if determined to be required)**

State of Hawai'i:

1. Chapter 343, Hawai'i Revised Statutes (HRS), Environmental Impact Statement **(Final EIS to be prepared and published with the Environmental Review Program)**
2. Chapter 6E, HRS, Historic Preservation Compliance **(SHPD consultation has been initiated and in progress)**
3. National Pollutant Discharge Elimination System (NPDES) Permit **(To be submitted to State DOH following the completion of the EIS process)**
4. Noise Permit, as applicable **(To be coordinated with State DOH following the completion of the EIS process)**
5. Hawai'i Administrative Rules (HAR) 11-62, Wastewater Systems, Approval to Construct **(To be submitted to State DOH following the completion of the EIS process)**
6. HAR 11-62, Wastewater Systems, Approval to Operate **(To be submitted to State DOH following the completion of the EIS process)**

County of Maui:

1. District Boundary Amendment/Maui Island Plan Amendment/Community Plan Amendment (as may be required)/Change of Zoning (for WWRF/SAT site which is less than 15 acres in area) **(To be initiated by the County of Maui, Planning Director following the completion of the EIS process)**
2. Building Permits **(To be submitted to the County of Maui, Department of Public Works (DPW) following the completion of the EIS process)**
3. Other Construction Permits (i.e., grading, electrical, plumbing) **(To be submitted to the County of Maui, DPW following the completion of the EIS process)**

PARTIES CONSULTED DURING THE PREPARATION OF THE DRAFT ENVIRONMENTAL IMPACT STATEMENT; LETTERS RECEIVED AND RESPONSES TO SUBSTANTIVE COMMENTS

XI

XI. PARTIES CONSULTED DURING THE PREPARATION OF THE DRAFT ENVIRONMENTAL IMPACT STATEMENT; LETTERS RECEIVED AND RESPONSES TO SUBSTANTIVE COMMENTS

The Environmental Impact Statement Preparation Notice (EISPN) for the subject action was filed with the Office of Planning and Sustainable Development, Environmental Review Program and published in *The Environmental Notice* on July 23, 2023. The following agencies were sent a copy of the EISPN. Comments on the EISPN were received during the 30-day public comment period. Letters received as well as responses to substantive comments are included in this Chapter. A representative sample of the consultation request letter is included herein as **Appendix "U"**.

	Agency	Date of Comment Letter
FEDERAL AGENCIES		
1	Gerald Gregory, District Conservationist Natural Resources Conservation Service U.S. Department of Agriculture 77 Hoʻokele Street, Suite 202 Kahului, Hawaiʻi 96732	No Response
2	Kay Zukeran NOAA Inouye Regional Center NMFS/PIRO 1845 Wasp Blvd., Building 176 Honolulu, Hawaiʻi 96818	No Response
3	Jen Martin, Interim Chief U.S. Department of the Army U.S. Army Corps of Engineers Honolulu District Regulatory Branch, Building 230 Fort Shafter, Hawaiʻi 96858-5440 Via email: CEPOH-RO@usace.army.mil	No Response
4	U.S. Environmental Protection Agency Region 9 (Pacific Southwest) Pacific Islands Contact Office 300 Ala Moana Blvd., Rm. 5124 Honolulu, Hawaiʻi 96850	No Response
5	Earl Campbell, Project Leader U.S. Fish and Wildlife Service Pacific Islands Fish and Wildlife Office 300 Ala Moana Blvd., Rm. 3-122 Honolulu, Hawaiʻi 96850 Via email: pifwo_admin@gws.gov	08/22/23

	Agency	Date of Comment Letter
STATE AGENCIES		
6	Keith A. Regan, Comptroller Department of Accounting and General Services State of Hawaiʻi 1151 Punchbowl Street, #426 Honolulu, Hawaiʻi 96813	07/28/23
7	Sharon Hurd, Chairperson Department of Agriculture State of Hawaiʻi 1428 South King Street Honolulu, Hawaiʻi 96814-2512	No Response
8	James Kunane Tokioka, Director Department of Business, Economic Development & Tourism (DBEDT) State of Hawaiʻi P.O. Box 2359 Honolulu, Hawaiʻi 96804	No Response
9	Keith Hayashi, Superintendent Department of Education State of Hawaiʻi P.O. Box 2360 Honolulu, Hawaiʻi 96804	08/22/23
10	Department of Education Office of Planning State of Hawaiʻi 3633 Waialae Avenue, Room C-209 Honolulu, Hawaiʻi 96816	No Response

	Agency	Date of Comment Letter
11	Kali Watson, Chair Department of Hawaiian Home Lands State of Hawai'i P.O. Box 1879 Honolulu, Hawai'i 96805	No Response
12	Kenneth S. Fink, MD, MGA, MPH, Director Department of Health State of Hawai'i 1250 Punchbowl St., Rm. 325 Honolulu, Hawai'i 96813	No Response
13	Kathleen Ho, Deputy Director Department of Health, Environmental Health Administration State of Hawai'i 1250 Punchbowl Street Honolulu, Hawai'i 96813	No Response
14	Sina Pruder, P.E., Chief Department of Health Wastewater Branch Environmental Management Division State of Hawai'i Hale Ola Building 2827 Waimano Home Road, Room 207 Pearl City, Hawai'i 96782	08/08/23
15	Alec Wong, P.E., Chief Department of Health Clean Water Branch State of Hawai'i Hale Ola, Room 225 2827 Waimano Home Rd. Pearl City, Hawai'i 96782	No Response

	Agency	Date of Comment Letter
16	Patti Kitkowski, District Environmental Health Program Chief Department of Health Maui Sanitation Branch State of Hawai'i 54 S. High Street, Rm. 301 Wailuku, Hawai'i 96793	No Response
17	Lene Ichinotsubo Department of Health Solid and Hazardous Waste Branch State of Hawai'i 2827 Waimano Road, Ste. 100 Pearl City, Hawai'i 96782-1407	No Response
18	Dawn N. S. Chang, Chairperson Department of Land and Natural Resources State of Hawai'i P.O. Box 621 Honolulu, Hawai'i 96809 Via email: dlnr@hawaii.gov and dlnr.land@hawaii.gov	08/21/23 and 8/24/23
19	M. Kaleo Manuel, Deputy Director Department of Land and Natural Resources Commission on Water Resource Management State of Hawai'i P.O. Box 621 Honolulu, Hawai'i 96809 Via email: dlnr@hawaii.gov and dlnr.land@hawaii.gov	08/23/23
20	Michael Cain, Administrator Department of Land and Natural Resources Office of Conservation and Coastal Lands State of Hawai'i 1151 Punchbowl Street, Rm. 131 Honolulu, Hawai'i 96813 Via email: dlnr@hawaii.gov and dlnr.land@hawaii.gov	No Response

	Agency	Date of Comment Letter
21	Edwin Sniffen, Director Department of Transportation State of Hawai‘i 869 Punchbowl Street, Room 509 Honolulu, Hawai‘i 96813-5097	08/21/23
22	Dean Minakami, Executive Director Hawai‘i Housing Finance and Development Corporation State of Hawai‘i 677 Queen Street Honolulu, Hawai‘i 96813	No Response
23	Colin Kippen, Chief Executive Officer Office of Hawaiian Affairs State of Hawai‘i 560 N. Nimitz Highway, Suite 200 Honolulu, Hawai‘i 96817	No Response
24	Mary Alice Evans, Acting Director Office of Planning and Sustainable Development Environmental Review Program State of Hawai‘i 235 South Beretania St., Rm. 702 Honolulu, Hawai‘i 96804	No Response
25	Dan Orodenker, Executive Officer Land Use Commission, DBEDT State of Hawai‘i P.O. Box 2359 Honolulu, Hawai‘i 96804	No Response
COUNTY OF MAUI AGENCIES		
26	Bradford Ventura, Chief Department of Fire and Public Safety County of Maui 200 Dairy Road Kahului, Hawai‘i 96732	No Response
27	Lori Tsuhako, Director Department of Housing and Human Concerns County of Maui 2200 Main Street, Suite 546 Wailuku, Hawai‘i 96793	07/25/23
28	Patrick McCall, Director Department of Parks and Recreation County of Maui 700 Halia Nakoa St., Unit 2F Wailuku, Hawai‘i 96793	08/21/23 and 12/19/24
29	Kathleen Ross Aoki, Director Department of Planning County of Maui 2200 Main Street, Suite 315 Wailuku, Hawai‘i 96793	08/01/23
30	Jordan Molina, Director Department of Public Works County of Maui 200 South High Street, 4th Floor Wailuku, Hawai‘i 96793	No Response
31	Marc Takamori, Director Department of Transportation County of Maui 110 Ala‘ihi Street, Suite 210 Kahului, Hawai‘i 96732	No Response
32	John Stufflebean, P.E., Director Department of Water Supply County of Maui 200 South High Street, 5th Floor Wailuku, Hawai‘i 96793	08/09/23
33	Maui County Cultural Resources Commission County of Maui 2200 Main Street, Rm. 315 Wailuku, Hawai‘i 96793	No Response
34	Herman Andaya, Administrator Maui Emergency Management Agency County of Maui 200 South High St., 1st Floor Wailuku, Hawai‘i 96793	No Response

	Agency	Date of Comment Letter
35	John Pelletier, Chief Maui Police Department County of Maui 55 Mahalani Street Wailuku, Hawai'i 96793	10/10/23
36	Luana Mahi, Director Office of Economic Development County of Maui 2200 Main Street, Suite 305 Wailuku, Hawai'i 96793	No Response
MAUI COUNTY COUNCIL		
37	Alice Lee, Council Chair County of Maui 200 High Street, 8th Floor Wailuku, Hawai'i 96793	No Response
38	Keani Rawlins-Fernandez, Vice Chair County of Maui 200 High Street, 8th Floor Wailuku, Hawai'i 96793	No Response
39	Shane Sinenci, Councilmember County of Maui 200 High Street, 8th Floor Wailuku, Hawai'i 96793	No Response
40	Tasha Kama, Councilmember County of Maui 200 High Street, 8th Floor Wailuku, Hawai'i 96793	No Response
41	Gabe Johnson, Councilmember County of Maui 200 High Street, 8th Floor Wailuku, Hawai'i 96793	No Response
42	Tom Cook, Councilmember County of Maui 200 High Street, 8th Floor Wailuku, Hawai'i 96793	No Response
43	Nohelani U'u-Hodgins, Councilmember County of Maui 200 High Street, 7th Floor Wailuku, Hawai'i 96793	No Response

	Agency	Date of Comment Letter
44	Yuki Lei Sugimura, Councilmember Maui County Council County of Maui 200 High Street, 8th Floor Wailuku, Hawai'i 96793	No Response
45	Tamara Paltin, Councilmember Maui County Council County of Maui 200 High Street, 8th Floor Wailuku, Hawai'i 96793	No Response
OTHER ORGANIZATIONS		
46	Hawaiian Telcom Plan Review Department Via email: HT-PlanReviews@hawaiiantel.com	No Response
47	Scott Matsuura, President Kehalani Community Association P.O. Box 1530 Wailuku, Hawai'i 96793	No Response
48	Pamela Tumpap, President Maui Chamber of Commerce 62 N. Market Street, #302 Wailuku, Hawai'i 96793	No Response
49	Debbie Cabebe, Chief Executive Officer Maui Economic Opportunity 99 Mahalani Street Wailuku, Hawai'i 96793	07/28/23
50	Michael Grider, Manager, Engineering Maui Electric Company, Ltd. P. O. Box 398 Kahului, Hawai'i 96733	No Response
51	Albert Perez, Executive Director Maui Tomorrow P. O. Box 880390 Pukalani, Hawai'i 96788 Via mail and email: director.mauitomorrow@gmail.com	No Response
52	Sierra Club Maui P.O. Box 791180 Paia, Hawai'i 96779	No Response

	Agency	Date of Comment Letter
53	Spectrum 158 Ma‘a Street Kahului, Hawai‘i 96732	No Response
54	Brad Harger, President Waikapu Community Association Via email: waikapuca@gmail.com	No Response
55	Glenn Adolpho Waikapu Gardens Homeowners Association Via email: gncadolpho@hawaiiantel.net	08/23/23
56	Kristin Holmes, President & Treasurer Wailuku Community Association P.O. Box 1966 Wailuku, Hawai‘i 96793	No Response
AHA MOKU REPRESENTATIVES		
57	Ke‘eaumoku Kapu, CEO ‘Aha Moku O Maui Via email: kapukapuakea@gmail.com	No Response
58	U‘ilani Kapu ‘Aha Moku O Maui Lahaina Moku Via email: uilani.kapu@gmail.com	No Response
59	Kaipo Kekona ‘Aha Moku O Maui Kā‘anapali Moku Via email: kekona83@gmail.com	No Response
60	Clyde Kahalehau ‘Aha Moku O Maui Wailuku Moku Via email: rkkahalehau@gmail.com	No Response
61	Ki‘ai Collier ‘Aha Moku O Maui Hāmākuapoko Moku Via email: kiai.collier@hilt.org	No Response
62	Joyclynn Costa ‘Aha Moku O Maui Hāmākualoa Moku Via email: jkalai.kauihou@gmail.com	No Response
63	Nichole Inouye-Nohara, Interim ‘Aha Moku O Maui Ko‘olau Moku Via email: nic.mkf@gmail.com	No Response
64	Sam Akoi ‘Aha Moku O Maui Hāna Moku Via email: ulupono@gmail.com	No Response
65	Lind ‘Ohana, Interim ‘Aha Moku O Maui Kīpahulu Moku Via email: terrance_lind@yahoo.com	No Response
66	Lyons Cabacungan ‘Aha Moku O Maui Kaupō Moku Via email: ahamokuokaupo@gmail.com	No Response
67	Chad Newman ‘Aha Moku O Maui Kahikinui Moku Via email: kahikinui93@yahoo.com	No Response
68	Ka‘onohi Lee ‘Aha Moku O Maui Honua‘ula Moku Via email: kaonohi66@gmail.com	No Response
69	Timothy Bailey ‘Aha Moku O Maui Kula Mauka Moku Via email: paulokaleioku@hawaiiantel.net	No Response
70	Cody Nemet, Interim ‘Aha Moku O Maui Kula Makai Moku Via email: kokoroots@gmail.com	No Response

While a copy of the EISPN was not directly distributed, comments were also received from the individuals below.

	INDIVIDUALS	**Date of Comment Letter**
71	Tom Board Owner of Ma‘alaea Condominium Via email: tomboard333@gmail.com	07/25/23
72	Eassie M. Miller 22 Lanikeha Place Kahului, Hawai‘i 96732 Via email: millere009@hawaii.rr.com	08/17/23

In addition, the following libraries received a copy of the EISPN for public review.

	LIBRARIES	**Date of Comment Letter**
73	State of Hawai‘i, DOE Hawai‘i State Library Hawai‘i Documents Center 478 South King Street Honolulu, Hawai‘i 96813	Delivered on 07/22/25 for Public Review
74	Wailuku Public Library 251 South High Street Wailuku, Hawaii 96793 (HAND DELIVERED)	Delivered on 07/24/23 for Public Review

From:	Harrington, Carrie
To:	Central Maui WWRF
Cc:	Asman, Lindsy
Subject:	U.S. Fish & Wildlife Service Recommendations for Central Maui WWRF draft EIS
Date:	Tuesday, August 22, 2023 9:43:48 AM
Attachments:	IPaC Info Letter_Species List Instructions_PIFWO_20Apr2022_Final.pdf USFWS Invasive Species Biosecurity Protocols_CentralMauiWWRF_22Aug2023.docx BMPs For Work In or Around Aquatic Environment_2023.doc

Aloha Yukino Uchiyama,

The U.S. Fish and Wildlife Service reviewed your Environmental Impact Statement Preparation Notice (EISPN) and have a few recommendations for your team:

1. Please obtain an Official Species List (OSL) in our relatively new Information for Planning and Consultation (IPaC) online tool. Directions for obtaining an OSL are attached.
2. Under each species on the IPaC generated OSL there will be a link that provides our recommended avoidance and minimization measures, respectively.
3. We concur that conducting biological surveys within the action area is prudent and would have recommended it had it not already been included in your project description.
4. There may be a few listed plants found within the project area; however, the urban landscape combined with low elevation decreases the likelihood. IPaC generates a list of species with ranges that include the project area. It is more likely that listed animals will be in or transit through the project area, including the Hawaiian hoary bat, Hawaiian waterbirds, Hawaiian seabirds, Hawaiian goose, and the Blackburn's sphinx moth (if tree tobacco and/or listed *Nothocestrum* species are present in the project area).
5. We recommend you incorporate a management strategy for managing listed Hawaiian waterbirds that may visit the new WWRF. If you do not wish to have waterbirds frequent the facility, you may want to consider working with us and the state (DOFAW) to develop a way to exclude the birds from the facility without harming them. You could also option to work with us and the State on a biological opinion (if federal nexus) or a HCP (if no federal nexus).
6. Earth moving actions followed by subsequent rain may also provide temporary water pooling that attracts Hawaiian stilts, in particular. We have language in our avoidance and minimization measures under this species on the OSL which we recommend including.
7. While the EISPN provided does not include a naturally occurring body of water within or adjacent to the project action area, please notify our office if this changes. Projects with a federal nexus are required to consult with the USFWS under the Fish and Wildlife Coordination Act (FWCA).
8. Please find our best management practices for working in or adjacent to an aquatic environment and for invasive species biosecurity.

If you have any questions pertaining to our recommendations or accessing IPaC, please contact me.

Best regards,
Carrie Harrington

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawai‘i 96850

Subject: IPaC generated official species list for the Pacific Islands Fish and Wildlife Office

Dear Action Agency or Applicant:

The Pacific Islands Fish and Wildlife Office (PIFWO) is transitioning to the Information for Planning and Consultation (IPaC) online portal, https://ipac.ecosphere.fws.gov/ for federal action agencies and non-federal agencies or individuals to obtain official species lists, including threatened and endangered species, designated critical habitat, and avoidance and minimization measures to consider in your general project design. IPaC has been used by continental USFWS offices to provide official species lists and avoidance and minimization guidance since 2017. Using IPaC expedites the process for species list distribution. Obtaining a species list in IPaC is relatively straightforward and takes minimal time to complete. Step by step instructions are included below.

Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of your species list should be verified after 90 days. New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change the species list. Verification can be completed by visiting the IPaC website at regular intervals during project planning and implementation. An updated list may be requested through the IPaC system by completing the same process used to obtain the initial species list.

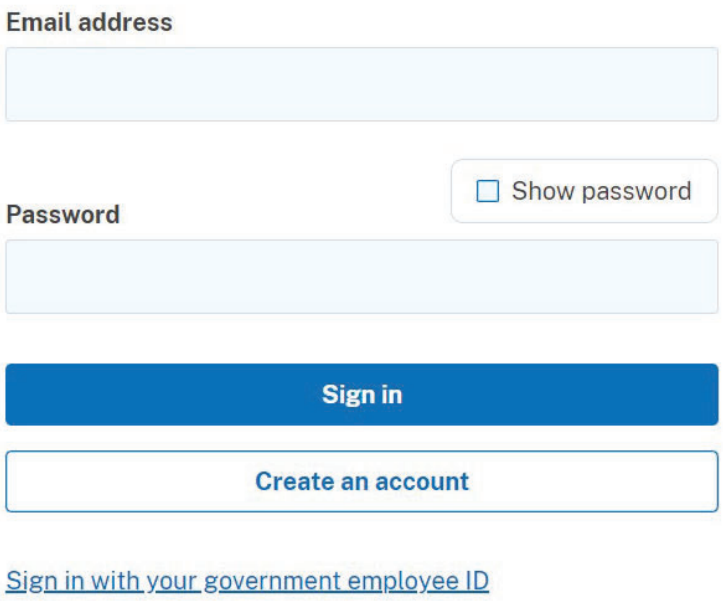
We hope this process provides efficiencies to our partners in obtaining a species list. For federal action agencies, it also opens additional IPaC functionality that the PIFWO office is still working on, such as the use of Determination Keys for informal section 7 programmatic consultations. We will let our agency partners know when that functionality becomes available.

If you have questions about a species list obtained through the IPaC system or need assistance in completing an IPaC species list request, please contact the Service at 808-792-9400 or via email at pifwo_admin@fws.gov. We appreciate your efforts to conserve listed species across the Pacific Islands.

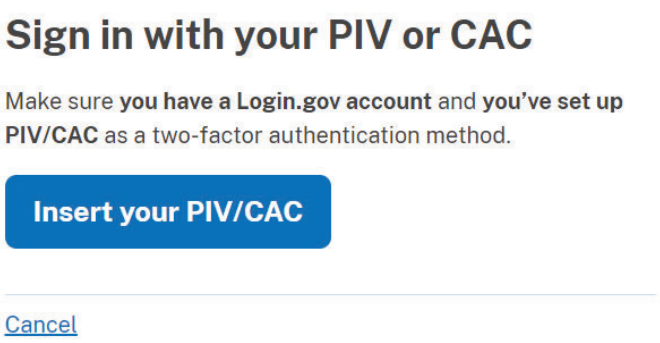
Instructions for Action Agencies and partners to obtain an official species list in IPaC

- Navigate to https://ipac.ecosphere.fws.gov/
- You can get an unofficial species list without logging in. However, if you want an official species list you will need to log in first using your Login.gov account. If you don't have an IPaC account, they are easy to create.

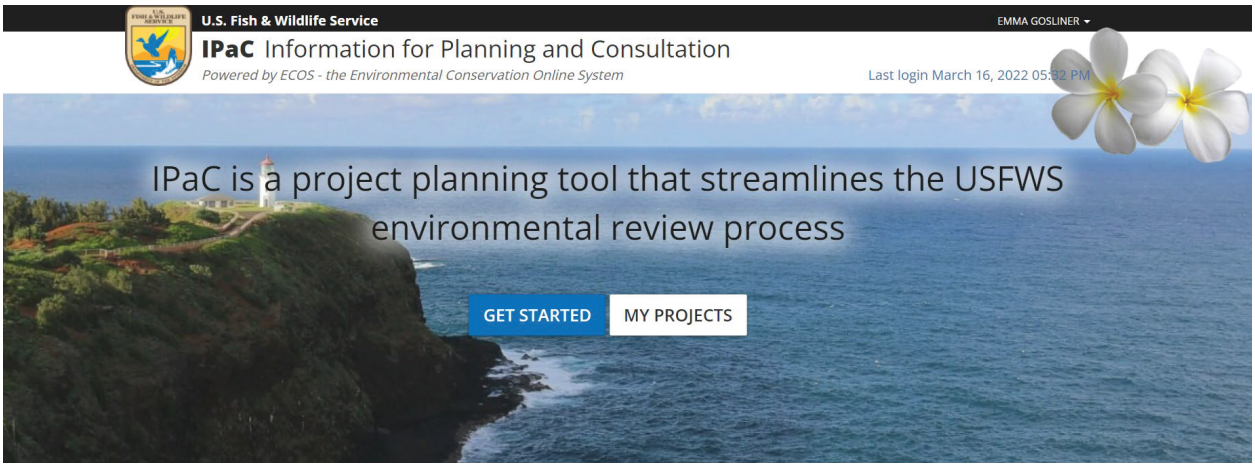
Select Log in with Login.gov and sign in using your email and password.



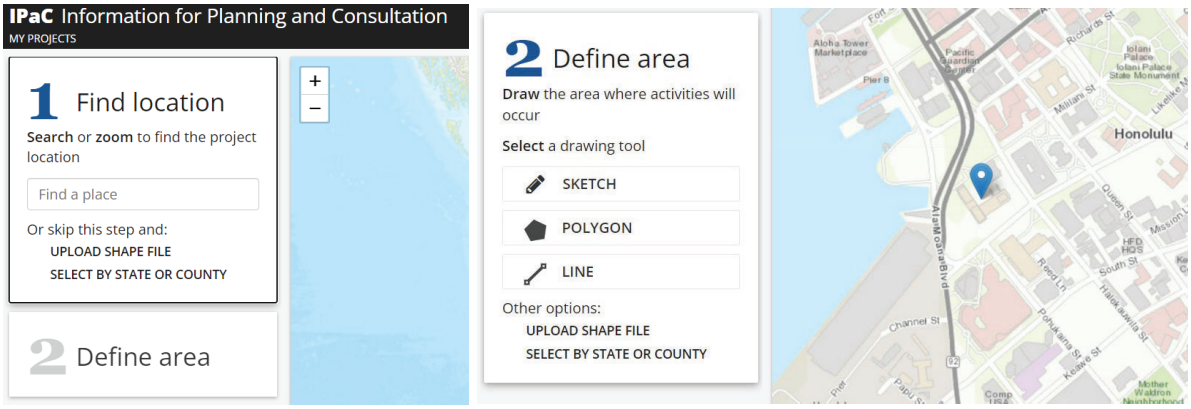
If you have a PIV or CAC card, you can sign in using that method as well.

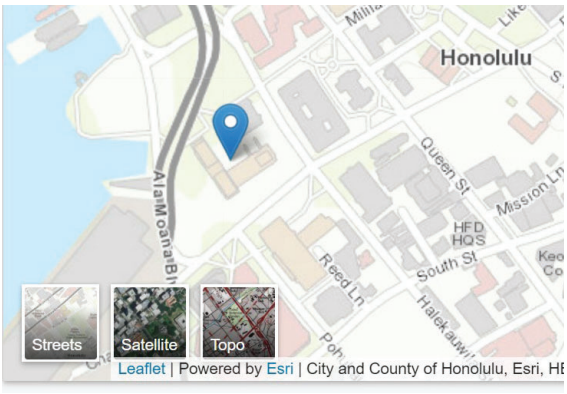


- Once you log in, select "Get Started".

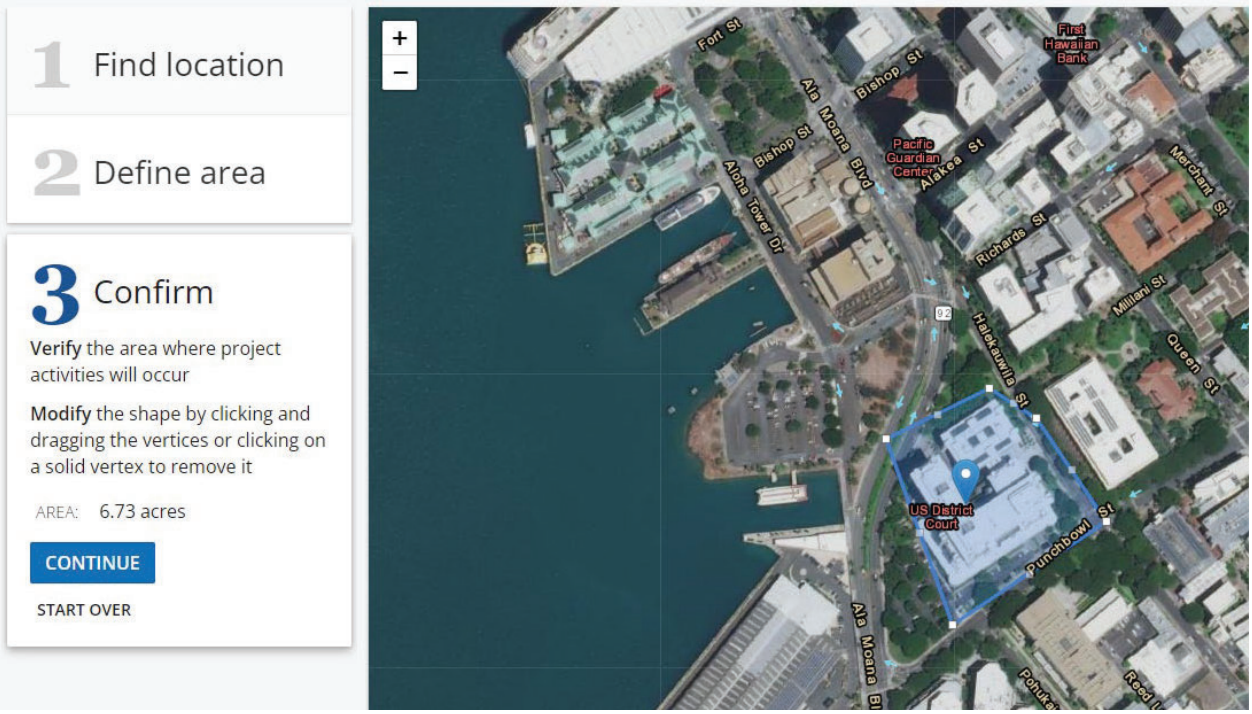


- Define the action area: Identify the location of the proposed action by uploading an existing shapefile or by entering an address or coordinates of the action area. Once identified on the map, you can manually draw the action area using the drawing tools.



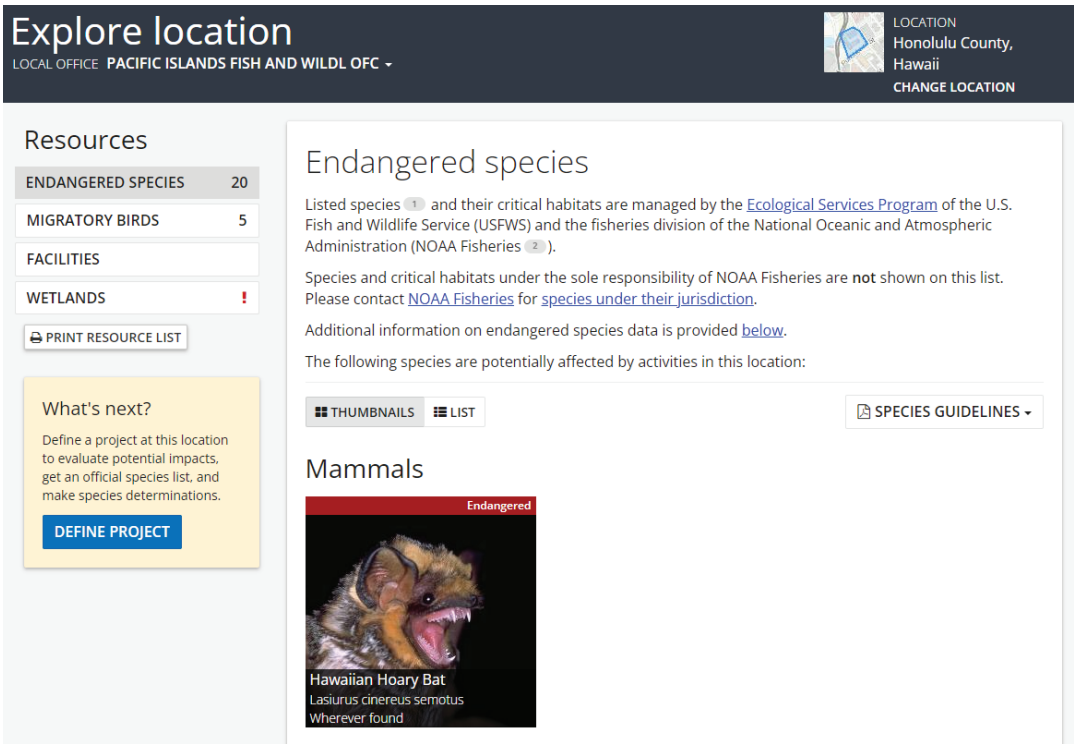


To help identify your action area you can choose between multiple base maps available.

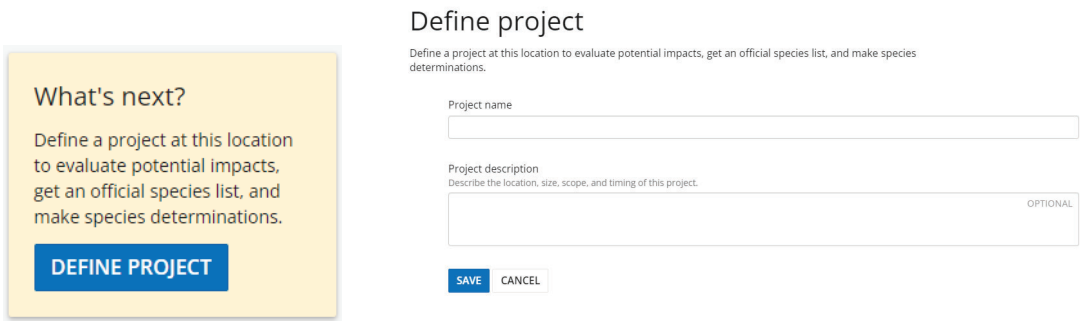


Press continue when you have finished drawing or uploading the action area location.

- The species information on the page that follows is not official. However, it identifies the project County, local Fish and Wildlife Field Office, species covered under NOAA Fisheries as well as Migratory Bird Treaty Act species. The list can be viewed in Thumbnail or List format.
- Once the species list populates you will see images of the species that may occur on, near, or transgress across your project. Click on SPECIES GUIDELINES on your top right to see Avoidance and Minimization measures to incorporate into your General Project Design Guidelines.

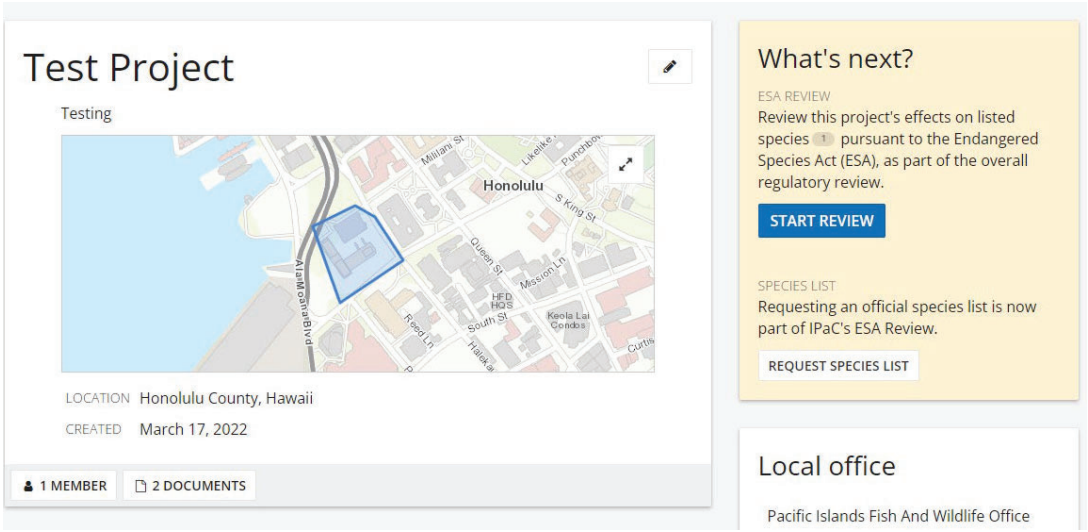


- Continue with the following steps to comply with the requirements of ESA section 7 to obtain an **official species list**.
- Select Define Project

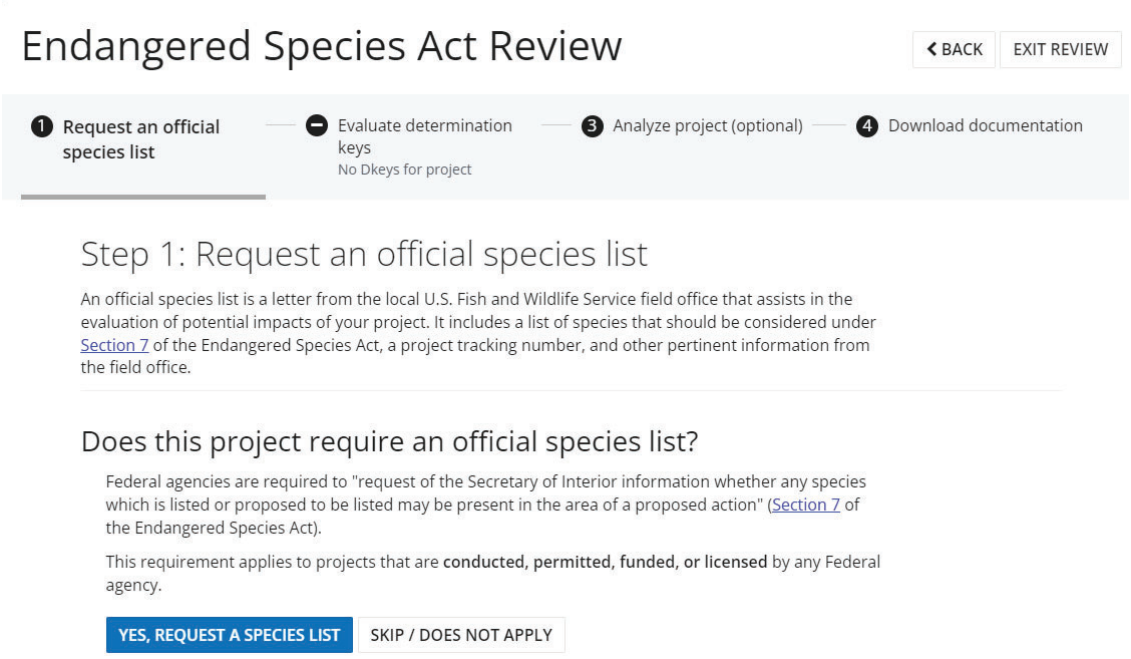


Enter the Project Name and a brief description of the project (a description is not mandatory, but recommended for future coordination with the Service). Click SAVE at bottom of page.

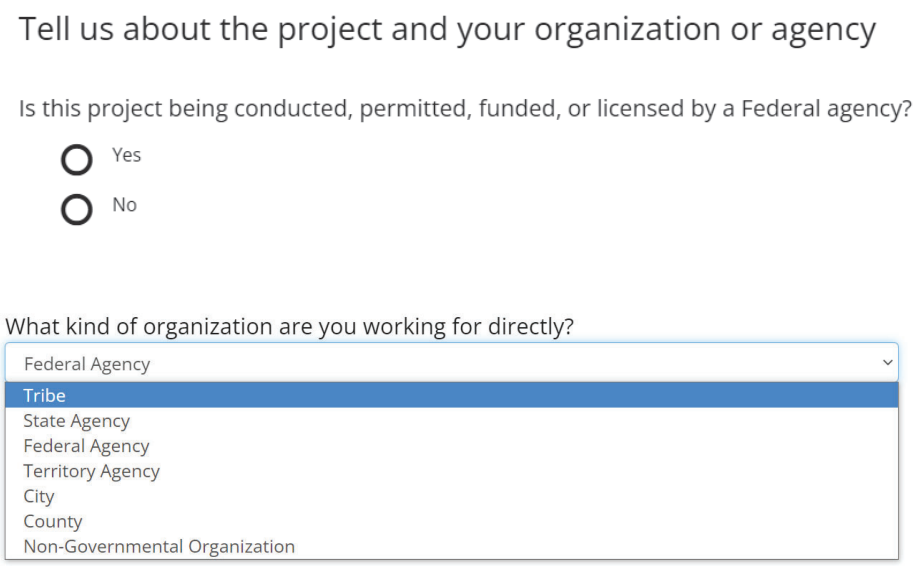
- At the bottom of the What's next box on the right, click Request Species List



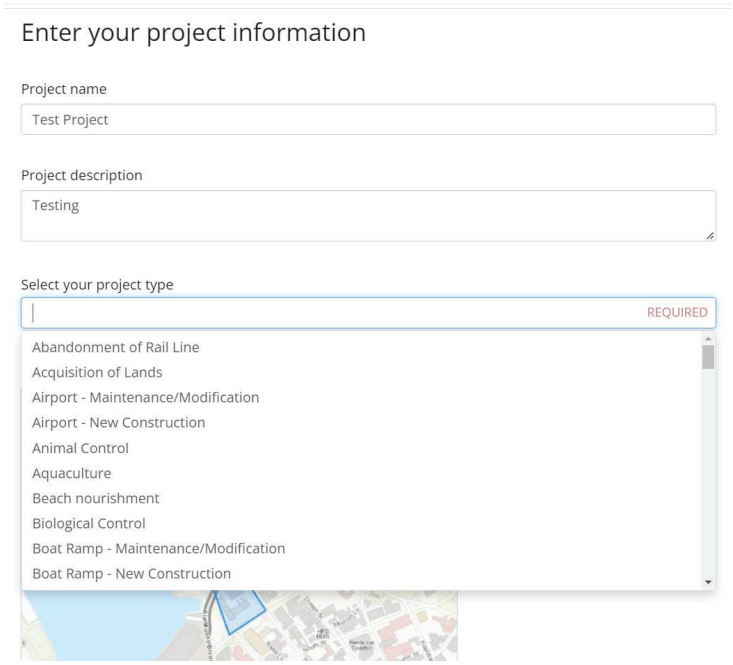
- on the following screen, click Yes, Request Species List



- Fill out the contact information for yourself or your agency. Contractors, state partners, and any other project proponents may request a species list and should be covered using the dropdown menus.



- From the pull-down menu for Classify Type of Project, select the project type that best fits the proposed action.



- Once all required sections are filled out, press SUBMIT OFFICIAL SPECIES LIST REQUEST

PIFWO Invasive Species Biosecurity Protocols
(Updated February 2023)

Project activities may introduce or spread invasive species, causing negative ecological consequences to new areas or islands, resulting in potential impacts to fish, wildlife, and their habitat. For example, seeds of invasive plant species (e.g., *Chromolaena odorata*, *Senecio madagascariensis*, *Cyathea cooperi*, or *Miconia calvescens*) can be inadvertently transported on equipment from a previous work site to a new site where the species are not present. Likewise, equipment used in an area infected with a pathogen or insect pest that can have ecological consequences (e.g., rapid ʻōhiʻa death (*Ceratocystis spp.*), black twig borer (*Xylosandrus compactus*), or naio thrips (*Klambothrips myopori*), if not properly decontaminated, can act as a vector to introduce the pathogen into a new area. Additionally, vehicles must be properly inspected and cleaned to ensure vertebrate or invertebrate pests do not stowaway and spread to other areas. These are just a few examples of how even well-intended project activities may inadvertently introduce or spread invasive species.

To avoid and minimize invasive species potential impacts to fish, wildlife, and their habitat we recommend incorporating the general biosecurity protocols outlined below into your project planning. Additionally, your project occurs in a geographic area and/or involves activities that risk spreading invasive species, such as nonnative grasses (fountain grass, *Cenchrus setaceus*), kiawe (*Prosopis juliflora*), and koa haole (*Leucaena leucocephala*). Therefore, we recommend including additional protocols specific to those invasive species. Since the project area has burned to the ground in most places, establishing a program to prevent the regrowth of such noxious invasive plants would benefit native habitats that support listed plants and animals as well as reduce fire risk. Additional consultation is recommended if project activities involve transportation of materials, equipment, vehicles, etc. between islands or transpacific movement of materials or equipment.

Invasive Species Biosecurity Protocol

The following biosecurity protocol is recommended to be incorporated into planning for your project to avoid or minimize transportation of invasive species with potential to impact to fish, wildlife, and their habitat. Cleaning, treatment, and/or inspection activities are the responsibility of the equipment or vehicle owner and operator. However, it is ultimately the responsibility of the action agency to ensure that all project materials, vehicles, machinery, equipment, and personnel are free of invasive species before entry into a project site. Please refer to the resources listed below for current removal/treatment recommendations that may be relevant to your project.

1. Cleaning and treatment:
   Project applicants should assume that all project materials (i.e., construction materials, or aggregate such as dirt, sand, gravel, etc.), vehicles, machinery, and equipment contain dirt and mud, debris, plant seeds, and other invasive species, and therefore require thorough cleaning. Treatment for specific pests, for example, trapping and poison baiting for rodents, or baiting and fumigation for insects, should be considered when applicable. For effective cleaning we offer the following recommendations prior to entry into a project site:
   a. Project materials, vehicles, machinery, and equipment must be pressure washed thoroughly (preferably with hot water) in a designated cleaning area. Project materials, vehicles, machinery, and equipment should be visibly free of mud/dirt (excluding aggregate), seeds, plant debris, insects, spiders, frogs (including frog eggs), other vertebrate species (e.g., rodents, mongoose, feral cats, reptiles, etc.), and rubbish. Areas of particular concern include bumpers, grills, hood compartments, wheel wells, undercarriage, cabs, and truck beds. Truck beds with accumulated material are prime sites for hitchhiking invasive species.
   b. The interior and exterior of vehicles, machinery, and equipment must be free of rubbish and food, which can attract pests (i.e., rodents and insects). The interiors of vehicles and the cabs of machinery should be vacuumed clean particularly for any plant material or seeds.

2. Inspection:
   a. Following cleaning and/or treatment, project materials, vehicles, machinery, and equipment, must be visually inspected by its user, and be free of mud/dirt (excluding aggregate), debris, and invasive species prior to entry into a project site. For example, careful visual inspection of a vehicle's tires and undercarriage is recommended for any remaining mud that could contain invasive plant seeds.
   b. Any project materials, vehicles, machinery, or equipment found to contain invasive species (e.g., plant seeds, invertebrates, rodents, mongoose, cats, reptiles, etc.) must not enter the project site until those invasive species are properly removed/treated.

3. For all project site personnel:
   a. Prior to entry into the project site, visually inspect and clean your clothes, boots or other footwear, backpack, radio harness, tools and other personal gear and

equipment for insects, seeds, soil, plant parts, or other debris. We recommend the use of a cleaning brush with sturdy bristles. Seeds found on clothing, footwear, backpacks, etc., should be placed in a secure bag or similar container and discarded in the trash rather than being dropped to ground at the project site or elsewhere.

4. Additional considerations:
    a. Consider implementing a Hazard Analysis and Critical Control Point (HACCP) plan (https://www.fws.gov/policy/A1750fw1.html) to improve project planning around reducing the risk of introducing or spreading invasive species.
    b. When applicable, use pest-free or low-risk sources of plants, mulch, wood, animal feed or other materials to be transported to a project site.
    c. For projects involving plants from nurseries (e.g., outplanting activities, etc.), all plants should be inspected, and if necessary, appropriately cleaned or treated for invasive species prior to being transported to the project site.
    d. Avoid unnecessary exposure to invasive species at a particular site (to the extent practical) to reduce contamination and spread. For example, if your project involves people or equipment moving between multiple locations, plan and organize timelines so that work is completed in native habitat prior to working in a disturbed location to reduce the likelihood of introducing a pest into the native habitat.
    e. Maintain good communication about invasive species risks between project managers and personnel working on the project site (e.g., conduct briefings and training about invasive species). Ensure prevention measures are communicated to the entire project team. Also consider adding language on biosecurity into contracts or permitting mechanisms to provide clarity to all involved in the project. Report any species of concern or possible introduction of invasive species to appropriate land managers.

For current removal/treatment recommendations please refer to the following:
Hawaiian Islands:

- Hawai‘i Island – https://www.biisc.org/
- Maui – https://mauiinvasive.org/
- Moloka‘i - https://www.molokaiisc.org/
- Lāna‘i - https://pulamalanai.com/
- O‘ahu – https://www.oahuisc.org/
- Kaua‘i – https://www.kauaiisc.org/

Mariana Islands:

- Guam – https://biosecurity.guam.gov/
- CNMI – http://www.dfwcnmi.com/

Species-Specific Biosecurity Protocols

Table 1. Current distribution of invasive species with specific biosecurity protocols on Maui

Island	Invasive Species with Specific Protocols			
	Rapid ʻŌhiʻa Death	**Little Fire Ant**	**Coconut Rhinoceros Beetle**	**Brown Treesnake**
Maui	not present	incipient	not present	not present

Little Fire Ant (LFA)

The little fire ant (*Wasmannia auropunctata*), or LFA, is an invasive species with a painful sting that can inhabit many different environments. In Hawaiʻi, it often infests agricultural fields and farms, damaging crops and stinging unsuspecting workers. Little fire ants are also highly disruptive to native tropical ecosystems and harmful to wildlife. Slow moving, but tiny and capable of foraging 24 hours a day with multiple queens per colony, LFA is a formidable threat to biodiversity, agriculture, and quality of life on tropical islands in the Pacific.

For more information about LFA including helpful guides and workshops for treating or detecting LFA, please visit www.littlefireants.com.

To reduce the risk of spreading LFA, the following biosecurity protocol is recommended:

Biosecurity Protocol for LFA

1. For projects involving plants from nurseries (e.g., outplanting activities, etc.), all plants should be inspected for little fire ants and other pests prior to being transported to the project site. If plants are found to be infested by ants of any species, plants should be sourced from an alternative nursery and the infested nursery should follow treatment protocols recommended by the Hawaiʻi Ant Lab (https://littlefireants.com/wp-content/uploads/2020-Management-of-Pest-Ants-in-Nurseries-min.pdf).

2. All work vehicles, machinery, and equipment should follow steps 1 and 2 in the "Invasive Species Biosecurity Protocol" for (1) cleaning and treatment and (2) inspection for invasive ants prior to entering a project site.

3. Any machinery, vehicles, equipment, or other supplies found to be infested with ants (or other invasive species) must not enter the project site until it is properly treated (https://littlefireants.com/how-to-treat-for-little-fire-ants-for-homeowners/#recommended-bait-products) and re-tested. Infested vehicles must be treated following recommendations by the Hawaiʻi Ant Lab (https://littlefireants.com/resource-center/) or another ant control expert and in accordance with all State and Federal laws. Treatment is the responsibility of the equipment or vehicle owner. Ultimately however, it is the responsibility of the action agency to ensure that all project materials, vehicles, machinery, and equipment follow the appropriate protocol(s).

4. General Vehicle Ant Hygiene: Even the cleanest vehicle can pick up and spread little fire ant. Place MaxForce Complete Brand Granular Insect Bait (1.0 percent Hydramethylnon; https://labelsds.com/images/user_uploads/Maxforce%20Complete%20Label%201-5-18.pdf) into refillable tamper resistant bait stations. An example of a commercially available refillable tamper resistant bait station is the Ant Café Pro (https://www.antcafe.com/). Place a bait station (or stations) in the vehicle and note that larger vehicles, such as trucks, may require multiple stations. Monitor bait stations frequently (every week at a minimum) and replace bait as needed. If the bait station does not have a sticker to identify the contents, apply a sticker listing contents to the station.

5. Gravel, building materials, or other equipment such as portable buildings should be baited using MaxForce Complete Brand Granular Insect Bait (1.0 percent Hydramethylnon; https://labelsds.com/images/user_uploads/Maxforce%20Complete%20Label%201-5-18.pdf) or AmdroPro (0.73 percent Hydramethylnon; https://connpest.com/labels/AMDROPRO.pdf) following label guidance.

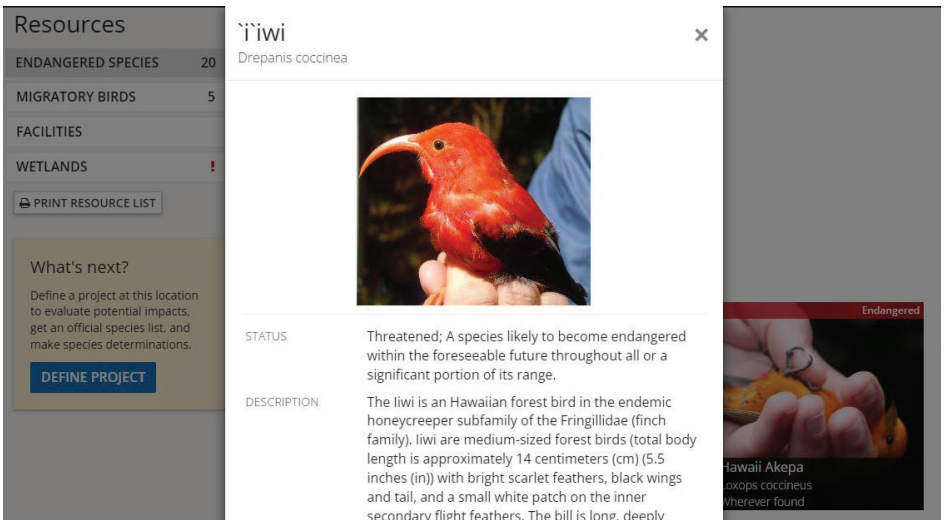
6. Storage areas that hold field tools, especially tents, tarps, and clothing should be baited using MaxForce Complete Brand Granular Insect Bait (1.0 percent Hydramethylnon; https://labelsds.com/images/user_uploads/Maxforce%20Complete%20Label%201-5-18.pdf) or AmdroPro (0.73 percent Hydramethylnon; https://connpest.com/labels/AMDROPRO.pdf) following label guidance.

7. Vehicles that have entered a project site known or thought to overlap with areas infested with LFA should subsequently be tested for LFA with baiting in accordance with protocol recommended by the Hawai‘i Ant Lab (https://littlefireants.com/survey-your-home-for-lfa/).

8. If LFA are detected, please report it to 808-643-PEST (Hawai‘i), 671-475-PEST (Guam), or 684-699-1575 (American Samoa). Please visit https://littlefireants.com/identification-of-little-fire-ants/ for assistance in identifying LFA.

- An Official Species List should be generated and available for download in a couple of seconds.

- If you need additional information on a species, click on their name that is hot-linked to their species information page. A brief overview of the species' status, description and critical habitat will appear as well as a link to their ECOS species profile.



U.S. Fish and Wildlife Service
Recommended Standard Best Management Practices

The U.S. Fish and Wildlife Service (USFWS) recommends the following measures to be incorporated into project planning to avoid or minimize impacts to fish and wildlife resources. Best Management Practices (BMPs) include the incorporation of procedures or materials that may be used to reduce either direct or indirect negative impacts to aquatic habitats that result from project construction-related activities. These BMPs are recommended in addition to, and do not over-ride any terms, conditions, or other recommendations prepared by the USFWS, other federal, state or local agencies. If you have questions concerning these BMPs, please contact the USFWS Aquatic Ecosystems Conservation Program at 808-792-9400.

1. Authorized dredging and filling-related activities that may result in the temporary or permanent loss of aquatic habitats should be designed to avoid indirect, negative impacts to aquatic habitats beyond the planned project area.

2. Dredging/filling in the marine environment should be scheduled to avoid coral spawning and recruitment periods, and sea turtle nesting and hatching periods. Because these periods are variable throughout the Pacific islands, we recommend contacting the relevant local, state, or federal fish and wildlife resource agency for site specific guidance.

3. Turbidity and siltation from project-related work should be minimized and contained within the project area by silt containment devices and curtailing work during flooding or adverse tidal and weather conditions. BMPs should be maintained for the life of the construction period until turbidity and siltation within the project area is stabilized. All project construction-related debris and sediment containment devices should be removed and disposed of at an approved site.

4. All project construction-related materials and equipment (dredges, vessels, backhoes, silt curtains, etc.) to be placed in an aquatic environment should be inspected for pollutants including, but not limited to; marine fouling organisms, grease, oil, etc., and cleaned to remove pollutants prior to use. Project related activities should not result in any debris disposal, non-native species introductions, or attraction of non-native pests to the affected or adjacent aquatic or terrestrial habitats. Implementing both a litter-control plan and a Hazard Analysis and Critical Control Point plan (HACCP – see https://www.fws.gov/policy/A1750fw1.html) can help to prevent attraction and introduction of non-native species.

5. Project construction-related materials (fill, revetment rock, pipe, etc.) should not be stockpiled in, or in close proximity to aquatic habitats and should be protected from erosion (*e.g.*, with filter fabric, etc.), to prevent materials from being carried into waters by wind, rain, or high surf.

6. Fueling of project-related vehicles and equipment should take place away from the aquatic environment and a contingency plan to control petroleum products accidentally spilled during the project should be developed. The plan should be retained on site with the person responsible for compliance with the plan. Absorbent pads and containment booms should be stored on-site to facilitate the clean-up of accidental petroleum releases.

7. All deliberately exposed soil or under-layer materials used in the project near water should be protected from erosion and stabilized as soon as possible with geotextile, filter fabric or native or non-invasive vegetation matting, hydro-seeding, etc.

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Mark Alexander Roy AICP, LEED AP
VICE PRESIDENT
Tessa Munekiyo Ng AICP
VICE PRESIDENT

Michael T. Munekiyo AICP
FOUNDER

October 16, 2025

Via email: pifwo_admin@fws.gov and carrie.harrington@fws.gov

Carrie Harrington
U. S. Department of the Interior
Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office

SUBJECT: Response to Comments Regarding Chapter 343, Hawai'i Revised Statutes, Environmental Impact Statement Preparation Notice for the Proposed County of Maui Central Maui Wastewater Reclamation Facility Project; Maui, Hawai'i

Dear Ms. Harrington:

Thank you for your comment letter dated August 22, 2023 regarding the Environmental Impact Statement Preparation Notice (EISPN) for the subject project. On behalf of the County of Maui, Department of Environmental Management (DEM), we offer the following information in response to the comments received:

Comment No. 1:

Please obtain an Official Species List (OSL) in our relatively new Information for Planning and Consultation (IPaC) online tool. Directions for obtaining an OSL are attached.

Response: An official species list has been generated through the IPaC online tool. This species list will be included in the Draft EIS.

Comment No. 2:

Under each species on the IPaC generated OSL there will be a link that provides our recommended avoidance and minimization measures, respectively.

Response: We confirm that recommended avoidance and minimization measures for each species from the Official Species List (OSL) will be reviewed and incorporated into the project, as applicable.

Comment No. 3:

We concur that conducting biological surveys within the action area is prudent and would have recommended it had it not already been included in your project description.

Response: Thank you for your concurrence on the decision to conduct a biological survey of the project area. The biological resources survey will be included and discussed in the Draft Environmental Impact Statement (EIS).

Comment No. 4:

There may be a few listed plants found within the project area; however, the urban landscape combined with low elevation decreases the likelihood. IPaC generates a list of species with ranges that include the project area. It is more likely that listed animals will be in or transit through the project area, including the Hawaiian hoary bat, Hawaiian waterbirds, Hawaiian seabirds, Hawaiian goose, and the Blackburn's sphinx moth (if tree tobacco and/or listed Nothocestrum species are present in the project area).

Response: We acknowledge that listed plants may be found within the project area, but note that none were identified during the biological resources survey. We also acknowledge that the urban landscape and low elevation of the project area decreases the likelihood of listed plants being present in the project area. Further, we acknowledge that the Hawaiian hoary bat, Hawaiian waterbirds, Hawaiian seabirds, Hawaiian goose, and the Blackburn's sphinx moth may transit through the project area.

Comment No. 5:

We recommend you incorporate a management strategy for managing listed Hawaiian waterbirds that may visit the new WWRF. If you do not wish to have waterbirds frequent the facility, you may want to consider working with us and the state (DOFAW) to develop a way to exclude the birds from the facility without harming them. You could also option to work with us and the State on a biological opinion (if federal nexus) or a HCP (if no federal nexus).

Response: Both U.S. Fish and Wildlife Services (USFWS) and the Division of Forestry and Wildlife (DOFAW) are being consulted as part of the EIS process. In terms of management strategy considerations, a conventional mechanical treatment process is proposed for the WWRF, which will not be attractive to birds. Also, open water ponds that would be attractive to birds are not proposed for the facility. The proposed Soil Aquifer Treatment basins will be dosed with water intermittently, and any surface ponding of water within the basins will be of short duration.

Comment No. 6:

Earth moving actions followed by subsequent rain may also provide temporary water pooling that attracts Hawaiian stilts, in particular. We have language in our avoidance and minimization measures under this species on the OSL which we recommend including.

Response: We confirm that avoidance and minimization measures for the protection of Hawaiian stilts will be discussed in the flora and fauna section of the Draft EIS.

Comment No. 7:

While the EISPN provided does not include a naturally occurring body of water within or adjacent to the project action area, please notify our office if this changes. Projects with a federal nexus are required to consult with the USFWS under the Fish and Wildlife Coordination Act (FWCA).

Response: We note that the proposed action involves a sewage pipeline that will cross over the Waikapū Stream. However, we note that the pipeline will be elevated above the stream and impacts to aquatic resources are not anticipated. We also acknowledge that projects with a federal nexus are required to consult with the USFWS under the Fish and Wildlife Coordination Act (FWCA).

Comment No. 8:

Please find our best management practices for working in or adjacent to an aquatic environment and for invasive species biosecurity.

Response: Thank you for providing best management practices for working in or adjacent to an aquatic environment and for invasive biosecurity. These BMPs will be incorporated into the project, as applicable.

Thank you again for your participation in the Chapter 343, Hawai'i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft EIS that is being prepared for this project. Should you have any questions or require additional information, please feel free to contact me at (808) 983-1233.

Very truly yours,

Yukino Uchiyama, AICP
Manager

YU:ab
cc: Juan Rivera, Department of Environmental Management
Eric Nakagawa, Department of Environmental Management
Scott Rollins, Department of Environmental Management
Craig Lekven, Brown and Caldwell
Irina Constantinescu, Brown and Caldwell
Bradford Wright, Warren S. Unemori Engineering
K:\DATA\COM\DEM CMaui WW Infrastructure\Apps\0EISPN ComResp\EISPN resp ltrs\USFWS.docx

JUL 3 1 2023

JOSH GREEN, M.D.
GOVERNOR
KE KIA'ĀINA

KEITH A. REGAN
COMPTROLLER
KA LUNA HO'OMALU HANA LAULĀ

MEOH-LENG SILLIMAN
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KA HOPE LUNA HO'OMALU HANA LAULĀ

STATE OF HAWAI'I | KA MOKU'ĀINA O HAWAI'I
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES | KA 'OIHANA LOIHELU A LAWELAWE LAULĀ
P.O. BOX 119, HONOLULU, HAWAII 96810-0119

(P)23.116

JUL 2 8 2023

Yukino Uchiyama, AICP
Munekiyo Hiraga
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Uchiyama:

Subject: Environmental Impact Statement Preparation Notice for the Proposed Central Maui Wastewater Reclamation Facility, Maui, Hawaii
TMK: (2)3-5-001:017 (por.) and 120 (por.), (2)3-5-002:014 (por.), (2)3-5-020:036 (por.), (2)3-6-002:003(por.) and 004(por.), and (2)3-8-005:023 (por.), portions of Waikapū Stream, and portions of the existing Waiale Road, Kuikahi Drive, and Waiko Road rights-of-way

Thank you for the opportunity to comment on the subject project. We concur with the project but have no comments to offer at this time. The Department of Accounting and General Services' future Pulehunui development is within the service area, and therefore, we request to be informed of any progress and review of future developments.

If you have any questions, your staff may call Dora Choy of the Planning Branch at (808) 586-0488.

Sincerely,

CHRISTINE L. KINIMAKA
Public Works Administrator

DC:mo
c: Jeff Pearson, DAGS MDO

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Tessa Munekiyo Ng AICP
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Michael T. Munekiyo AICP
FOUNDER

October 16, 2025

Via email: dagspwd@hawaii.gov

Gordon Wood, Public Works Administrator
State of Hawai'i
Department of Accounting
and General Services
P. O. Box 119
Honolulu, Hawai'i 96810-0119

SUBJECT: Response to Comments Regarding Chapter 343, Hawai'i Revised Statutes, Environmental Impact Statement Preparation Notice for the Proposed County of Maui Central Maui Wastewater Reclamation Facility Project; Maui, Hawai'i

Dear Mr. Wood:

Thank you for your department's comment letter dated July 28, 2023 regarding the Environmental Impact Statement Preparation Notice (EISPN) for the subject project. On behalf of the County of Maui, Department of Environmental Management (DEM), we offer the following information in response to the comments received:

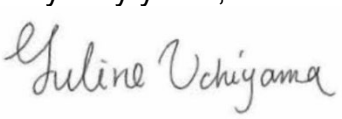
Comment:

The Department of Accounting and General Services' future Pulehunui development is within the service area, and therefore, we request to be informed of any progress and review of future developments.

Response: We acknowledge that the Department of Accounting and General Services' (DAGS) future Pūlehunui development is within the Central Maui WWRF service area. A copy of the Draft Environmental Impact Statement (EIS) will be made available to DAGS for review and comment.

Thank you again for your participation in the Chapter 343, Hawai‘i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft EIS that is being prepared for this project. Should you have any questions or require additional information, please feel free to contact me at (808) 983-1233.

Very truly yours,



Yukino Uchiyama, AICP
Manager

YU:ab
cc: Juan Rivera, Department of Environmental Management
Eric Nakagawa, Department of Environmental Management
Scott Rollins, Department of Environmental Management
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JOSH GREEN, M.D.
GOVERNOR

KEITH T. HAYASHI
SUPERINTENDENT

STATE OF HAWAI`I
DEPARTMENT OF EDUCATION
KA ʻOIHANA HOʻONAʻAUAO
P.O. BOX 2360
HONOLULU, HAWAI`I 96804

OFFICE OF FACILITIES AND OPERATIONS

August 22, 2023

Yukino Uchiyama, AICP
Munekiyo Hiraga
305 High Street, Suite 104
Wailuku, Hawaii 96793

Re: Environmental Impact Statement Preparation Notice for the Proposed Central Maui Wastewater Reclamation Facility; Maui, Hawaii

Dear Ms. Uchiyama:

Thank you for your letter dated July 20, 2023. Based on the information provided, the proposed project will not impact Hawaii State Department of Education Facilities.

Should you have any questions, please contact Cori China of the Facilities Development Branch, Planning Section, at (808) 784-5080 or via email at cori.china@k12.hi.us.

We appreciate the opportunity to comment.

Sincerely,

Roy Ikeda
Interim Public Works Manager
Planning Section

RI:ctc

c: Juan Rivera, P.E., County of Maui, Department of Environmental Management
Wastewater Reclamation Division
Facilities Development Branch

MUNEKIYO HIRAGA
Planning. Project Management. Sustainable Solutions.

Karlynn K. Fukuda
PRESIDENT
Mark Alexander Roy AICP, LEED AP
VICE PRESIDENT
Tessa Munekiyo Ng AICP
VICE PRESIDENT

Michael T. Munekiyo AICP
FOUNDER

October 16, 2025

Keith Hayashi, Superintendent
State of Hawai'i
Department of Education
P. O. Box 2360
Honolulu, Hawai'i 96804

SUBJECT: Response to Comments Regarding Chapter 343, Hawai'i Revised Statutes, Environmental Impact Statement Preparation Notice for the Proposed County of Maui Central Maui Wastewater Reclamation Facility Project; Maui, Hawai'i

Dear Mr. Hayashi:

Thank you for your department's comment letter dated August 22, 2023 regarding the Environmental Impact Statement Preparation Notice (EISPN) for the subject project. On behalf of the County of Maui, Department of Environmental Management (DEM), we acknowledge that the Department of Education has no comments to offer at this time.

Thank you again for your participation in the Chapter 343, Hawai'i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft Environmental Impact Statement (EIS) that is being prepared for this project. Should you have any questions or require additional information, please feel free to contact me at (808) 983-1233.

Very truly yours,

Yukino Uchiyama, AICP
Manager

YU:ab
cc: Juan Rivera, Department of Environmental Management
Cori China, Facilities Development Branch (cori.china@k12.hi.us)
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JOSH GREEN, M.D.
GOVERNOR OF HAWAI'I
KE KIA'ĀINA O KA MOKU'ĀINA 'O HAWAI'I

KENNETH S. FINK, MD, MGA, MPH
DIRECTOR OF HEALTH
KA LUNA HO'OKELE

STATE OF HAWAI'I
DEPARTMENT OF HEALTH
KA 'OIHANA OLAKINO
P. O. BOX 3378
HONOLULU, HI 96801-3378#

In reply, please refer to:
File:

6603 – 2 3 5 001 017 Proposed
Central Maui WWRF Wailuku

August 8, 2023

Ms. Yukino Uchiyama, AICP, Manager
Munekiyo & Hiraga
305 High Street Suite 104
Wailuku, Hawaii 96793
Email: centralmauiWWRF@munekiyohiraga.com

Dear Ms. Uchiyama:

Subject: Environmental Impact Statement (EIS) Preparation Notice for the
Proposed Central Maui Wastewater Reclamation Facility
Waiale Road, Kuikahi Drive and Waiko Road, Wailuku, Maui, 96793
TMKs (2) 3-5-001: 017, 3-5-002: 014, 3-5-020: 036, 3-6-002: 003 & 004, 3-8-005: 023

Thank you for allowing us the opportunity to provide comments for the subject EIS Preparation Notice. Plans and construction of the subject reclamation facility shall conform to applicable provisions of the Hawaii Administrative Rules, Chapter 11-62, "Wastewater Systems."

Please be informed that the proposed wastewater systems for the subject property development may have to include design considerations to address any effects associated with the construction of and/or discharges from the wastewater systems to any public trust, Native Hawaiian resources or the exercise of traditional cultural practices.

Should you have any questions, please call Mr. Mark Tomomitsu of my staff at (808) 586-4294.

Sincerely,

SINA PRUDER, P.E., CHIEF
Wastewater Branch

LM/MST:ct

c: Mr. Roland Tejano, Maui IWS Staff, via email

MUNEKIYO HIRAGA
Planning. Project Management. Sustainable Solutions.

Karlynn K. Fukuda
PRESIDENT
Mark Alexander Roy AICP, LEED AP
VICE PRESIDENT
Tessa Munekiyo Ng AICP
VICE PRESIDENT

Michael T. Munekiyo AICP
FOUNDER

October 16, 2025

Jonathan Nagato, P.E., Chief
State of Hawai'i
Department of Health
Wastewater Branch
P. O. Box 3378
Honolulu, Hawai'i 96801-3378

SUBJECT: Response to Comments Regarding Chapter 343, Hawai'i Revised Statutes, Environmental Impact Statement Preparation Notice for the Proposed County of Maui Central Maui Wastewater Reclamation Facility Project; Maui, Hawai'i; Ref. 6603-235001

Dear Mr. Nagato:

Thank you for your department's comment letter dated August 8, 2023 regarding the Environmental Impact Statement Preparation Notice (EISPN) for the subject project. On behalf of the County of Maui, Department of Environmental Management (DEM), we offer the following information in response to the comments received:

Comment No. 1:

Please be informed that the proposed wastewater systems for the subject property development may have to include design considerations to address any effects associated with the construction of and/or discharges from the wastewater systems to any public trust, Native Hawaiian resources or the exercise of traditional cultural practices.

Response: Thank you for this information. The Draft Environmental Impact statement (EIS) will include a Hydrogeological Study for the project, which will evaluate potential effects to surface and groundwater resources in the area. Potential effects to Native Hawaiian and traditional cultural practices will also be evaluated through preparation of a Cultural Impact Assessment report which will also be included and discussed in the Draft EIS.

Thank you again for your participation in the Chapter 343, Hawai‘i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft EIS that is being prepared for this project. Should you have any questions or require additional information, please feel free to contact me at (808) 983-1233.

Very truly yours,

Yukino Uchiyama, AICP
Manager

YU:ab
cc: Juan Rivera, Department of Environmental Management
Eric Nakagawa, Department of Environmental Management
Scott Rollins, Department of Environmental Management
Craig Lekven, Brown and Caldwell
Irina Constantinescu, Brown and Caldwell
Tehani Baculpo, Cultural Surveys Hawaii
Rich Kraft, Geosyntec
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JOSH GREEN, M.D.
GOVERNOR | KE KIAʻĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIAʻĀINA

DAWN N. S. CHANG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAIʻI | KA MOKUʻĀINA ʻO HAWAIʻI
DEPARTMENT OF LAND AND NATURAL RESOURCES
KA ʻOIHANA KUMUWAIWAI ʻĀINA
LAND DIVISION

P.O. BOX 621
HONOLULU, HAWAII 96809

August 21, 2023

Munekiyo Hiraga
Attention: Ms. Yukino Uchiyama
305 High Street, Suite 104
Wailuku, Hawaii 96793

via email: centralmauiwwrf@munekiyohiraga.com

Dear Ms. Uchiyama:

SUBJECT: Environmental Impact Statement Preparation Notice for the Proposed **Central Maui Wastewater Reclamation Facility** located at Waikapu, Wailuku, Central Maui; Various TMKs on behalf of County Of Maui, Department of Environmental Management

Thank you for the opportunity to review and comment on the subject matter. The Land Division of the Department of Land and Natural Resources (DLNR) distributed or made available a copy of your request pertaining to the subject matter to DLNR's Divisions for their review and comments.

At this time, enclosed are comments from the Engineering Division on the subject matter. Should you have any questions, please feel free to contact Darlene Nakamura at (808) 587-0417 or email: darlene.k.nakamura@hawaii.gov. Thank you.

Sincerely,

Russell Tsuji

Russell Y. Tsuji
Land Administrator

Enclosure
cc: County of Maui
Department of Environmental Management
Attn: Mr. Juan Rivera, P.E. (w/copy, via email: environmental.mgmt@co.maui.hi.us)
Central Files

JOSH GREEN, M.D.
GOVERNOR | KE KIA'ĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIA'ĀINA

DAWN N. S. CHANG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAI'I | KA MOKU'ĀINA 'O HAWAI'I
DEPARTMENT OF LAND AND NATURAL RESOURCES
KA 'OIHANA KUMUWAIWAI 'ĀINA
LAND DIVISION

P.O. BOX 621
HONOLULU, HAWAII 96809

July 24, 2023

MEMORANDUM

FROM: ~~TO:~~ **DLNR Agencies:**
___Div. of Aquatic Resources
___Div. of Boating & Ocean Recreation
_X_ Engineering Division (DLNR.ENGR@hawaii.gov)
_X_ Div. of Forestry & Wildlife (rubyrosa.t.terrago@hawaii.gov)
___Div. of State Parks
_X_ Commission on Water Resource Management (DLNR.CWRM@hawaii.gov)
___Office of Conservation & Coastal Lands
_X_ Land Division – Maui District (daniel.l.ornellas@hawaii.gov)
_X_ Aha Moku Advisory Committee (leimana.k.damate@hawaii.gov)

TO: ~~FROM:~~ Russell Y. Tsuji, Land Administrator Russell Tsu
SUBJECT: Environmental Impact Statement Preparation Notice for the Proposed **Central Maui Wastewater Reclamation Facility**
LOCATION: Waikapu, Wailuku, Central Maui; Various TMKs
APPLICANT: Munekiyo Hiraga on behalf of County Of Maui, Department of Environmental Management

Transmitted for your review and comment is information on the above-referenced subject matter. The EISPN was published on July 24, 2023, by the State Environmental Review Program (formerly the Office of Environmental Quality Control) at the Office of Planning and Sustainable Development in the periodic bulletin, The Environmental Notice, available at the following link:

https://planning.hawaii.gov/erp/environmental-notice/

Please submit any comments by **August 21, 2023**. If no response is received by this date, we will assume your agency has no comments. Should you have any questions, please contact Darlene Nakamura directly via email at darlene.k.nakamura@hawaii.gov. Thank you.

BRIEF COMMENTS:

( ) We have no objections.
( ) We have no comments.
( ) We have no additional comments.
(✓) Comments are included/attached.

Signed: CSC
Print Name: Carty S. Chang, Chief Engineer
Division: Engineering Division
Date: Aug 14, 2023

Attachments

DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

LD/Russell Y. Tsuji

Ref: Environmental Impact Statement Preparation Notice for the Proposed Central Maui Wastewater Reclamation Facility
Location: Waikapu, Wailuku, Central Maui
TMK(s): Numerous
Applicant: Munekiyo Hiraga on behalf of County of Maui, Department of Environmental Management

COMMENTS

The rules and regulations of the National Flood Insurance Program (NFIP), Title 44 of the Code of Federal Regulations (44CFR), are in effect when development falls within a Special Flood Hazard Area (high-risk areas). Be advised that 44CFR, Chapter 1, Subchapter B, Part 60 reflects the minimum standards as set forth by the NFIP. Local community flood ordinances may stipulate higher standards that can be more restrictive and would take precedence over the minimum NFIP standards.

The owner of the project property and/or their representative is responsible to research the Flood Hazard Zone designation for the project. Flood zones subject to NFIP requirements are identified on FEMA's Flood Insurance Rate Maps (FIRM). The official FIRMs can be accessed through FEMA's Map Service Center (msc.fema.gov). Our Flood Hazard Assessment Tool (FHAT) (fhat.hawaii.gov) could also be used to research flood hazard information.

If there are questions regarding the local flood ordinances, please contact the applicable County NFIP coordinating agency below:

- Oahu: City and County of Honolulu, Department of Planning and Permitting (808) 768-8098.
- Hawaii Island: County of Hawaii, Department of Public Works (808) 961-8327.
- Maui/Molokai/Lanai County of Maui, Department of Planning (808) 270-7139.
- Kauai: County of Kauai, Department of Public Works (808) 241-4849.

Signed: _____
CARTY S. CHANG, CHIEF ENGINEER

Date: Aug 14, 2023

MUNEKIYO HIRAGA
Planning. Project Management. Sustainable Solutions.

Karlynn K. Fukuda
PRESIDENT
Mark Alexander Roy AICP, LEED AP
VICE PRESIDENT
Tessa Munekiyo Ng AICP
VICE PRESIDENT

Michael T. Munekiyo AICP
FOUNDER

October 16, 2025

Via email: dlnr@hawaii.gov and dlnr.land@hawaii.gov

Ian Hirokawa, Acting Land Administrator
State of Hawai'i
Department of Land and Natural Resources
Land Division
P. O. Box 621
Honolulu, Hawai'i 96809

SUBJECT: Response to Comments Regarding Chapter 343, Hawai'i Revised Statutes, Environmental Impact Statement Preparation Notice for the Proposed County of Maui Central Maui Wastewater Reclamation Facility Project; Maui, Hawai'i

Dear Mr. Hirokawa:

Thank you for your department's comment letter dated August 21, 2023 regarding the Environmental Impact Statement Preparation Notice (EISPN) for the subject project. On behalf of the County of Maui, Department of Environmental Management (DEM), we offer the following information in response to the comments received from the Engineering Division:

Comment from Engineering Division:

The rules and regulations of the National Flood Insurance Program (NFIP), Title 44 of the Code of Federal Regulations (44CFR), are in effect when development falls within a Special Flood Hazard Area (high-risk areas). Be advised that 44CFR, Chapter 1, Subchapter B, Part 60 reflects the minimum standards as set forth by the NFIP. Local community flood ordinances may stipulate higher standards that can be more restrictive and would take precedence over the minimum NFIP standards.

The owner of the project property and/or their representative is responsible to research the Flood Hazard Zone designation for the project. Flood zones subject to NFIP requirements are identified on FEMA'S Flood Insurance Rate Maps (FIRM). The official FIRMs can be accessed through FEA's Map Service Center (msc.fema.gov). Our Flood Hazard Assessment Tool (FHAT) (fhat.hawaii.gov) could also be used to research flood hazard information.

Response: We acknowledge that NFIP Title 44CFR, Chapter 1, Subchapter B, Part 60 is applicable to any development within a Special Flood Hazard Area. Flood zone information for the project site will be included in the Draft Environmental Impact Statement (EIS).

Thank you again for your participation in the Chapter 343, Hawai‘i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft EIS that is being prepared for this project. Should you have any questions or require additional information, please feel free to contact me at (808) 983-1233.

Very truly yours,

Yukino Uchiyama, AICP
Manager

YU:ab
cc: Juan Rivera, Department of Environmental Management
Eric Nakagawa, Department of Environmental Management
Scott Rollins, Department of Environmental Management
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JOSH GREEN, M.D.
GOVERNOR | KE KIAʻĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIAʻĀINA

DAWN N. S. CHANG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAIʻI | KA MOKUʻĀINA ʻO HAWAIʻI
DEPARTMENT OF LAND AND NATURAL RESOURCES
KA ʻOIHANA KUMUWAIWAI ʻĀINA
LAND DIVISION

P.O. BOX 621
HONOLULU, HAWAII 96809

August 24, 2023

Munekiyo Hiraga
Attention: Ms. Yukino Uchiyama
305 High Street, Suite 104
Wailuku, Hawaii 96793

via email: centralmauiwwrf@munekiyohiraga.com

Dear Ms. Uchiyama:

SUBJECT: Environmental Impact Statement Preparation Notice for the Proposed **Central Maui Wastewater Reclamation Facility** located at Waikapu, Wailuku, Central Maui; Various TMKs on behalf of County Of Maui, Department of Environmental Management

Thank you for the opportunity to review and comment on the subject matter. In addition to our previous comments dated August 21, 2023, enclosed are comments from the Division of Forestry & Wildlife on the subject matter. Should you have any questions, please feel free to contact Darlene Nakamura at (808) 587-0417 or email: darlene.k.nakamura@hawaii.gov. Thank you.

Sincerely,

Russell Tsuji

Russell Y. Tsuji
Land Administrator

Enclosure
cc: County of Maui
Department of Environmental Management
Attn: Mr. Juan Rivera, P.E. (w/copy, via email: environmental.mgmt@co.maui.hi.us)
Central Files

JOSH GREEN, M.D.
GOVERNOR | KE KIA'ĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIA'ĀINA

DAWN N. S. CHANG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAI'I | KA MOKU'ĀINA 'O HAWAI'I
DEPARTMENT OF LAND AND NATURAL RESOURCES
KA 'OIHANA KUMUWAIWAI 'ĀINA
LAND DIVISION

P.O. BOX 621
HONOLULU, HAWAII 96809

July 24, 2023

MEMORANDUM

FROM: **DLNR Agencies:**
___Div. of Aquatic Resources
___Div. of Boating & Ocean Recreation
_X_ Engineering Division (DLNR.ENGR@hawaii.gov)
_X_ Div. of Forestry & Wildlife (rubyrosa.t.terrago@hawaii.gov)
___Div. of State Parks
_X_ Commission on Water Resource Management (DLNR.CWRM@hawaii.gov)
___Office of Conservation & Coastal Lands
_X_ Land Division – Maui District (daniel.l.ornellas@hawaii.gov)
_X_ Aha Moku Advisory Committee (leimana.k.damate@hawaii.gov)

TO: Russell Y. Tsuji, Land Administrator Russell Tsu
SUBJECT: Environmental Impact Statement Preparation Notice for the Proposed **Central Maui Wastewater Reclamation Facility**
LOCATION: Waikapu, Wailuku, Central Maui; Various TMKs
APPLICANT: Munekiyo Hiraga on behalf of County Of Maui, Department of Environmental Management

Transmitted for your review and comment is information on the above-referenced subject matter. The EISPN was published on July 24, 2023, by the State Environmental Review Program (formerly the Office of Environmental Quality Control) at the Office of Planning and Sustainable Development in the periodic bulletin, The Environmental Notice, available at the following link:

https://planning.hawaii.gov/erp/environmental-notice/

Please submit any comments by **August 21, 2023**. If no response is received by this date, we will assume your agency has no comments. Should you have any questions, please contact Darlene Nakamura directly via email at darlene.k.nakamura@hawaii.gov. Thank you.

BRIEF COMMENTS:

( ) We have no objections.
( ) We have no comments.
( ) We have no additional comments.
(☑) Comments are included/attached.

Signed: Kathryn Stanaway
Print Name: KATHRYN STANAWAY, Acting Wildlife Program Mgr.
Division: Division of Forestry and Wildlife
Date: Aug 23, 2023

Attachments

JOSH GREEN, M.D.
GOVERNOR | KE KIAʻĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIAʻĀINA

STATE OF HAWAIʻI | KA MOKUʻĀINA ʻO HAWAIʻI
DEPARTMENT OF LAND AND NATURAL RESOURCES
KA ʻOIHANA KUMUWAIWAI ʻĀINA

DIVISION OF FORESTRY AND WILDLIFE
1151 PUNCHBOWL STREET, ROOM 325
HONOLULU, HAWAII 96813

DAWN N.S. CHANG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

LAURA H.E. KAAKUA
FIRST DEPUTY

M. KALEO MANUEL
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

August 23, 2023

Log no. 4196

MEMORANDUM

TO: RUSSELL Y. TSUJI, Administrator
Land Division

FROM: KATHRYN STANAWAY, Acting Wildlife Program Manager
Division of Forestry and Wildlife

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN) for the Proposed County of Maui Central Maui Wastewater Reclamation Facility on Maui Island

The Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW) has received your request for comments on the Environmental Impact Statement Preparation Notice (EISPN) for the Proposed County of Maui, Department of Environmental Management (DEM), Central Maui Wastewater Reclamation Facility located on the island of Maui. The Proposed Facility is located in Central Maui; (TMKs) (2)3-5-001:017 (por.) and:120 (por.), (2)3-5-002:014 (por.), (2)3-5-020:036 (por.), (2)3-6-002:003(por.) and 004(por.), (2)3-8-005:023 (por.), portions of Waikapu Stream, and portions of the existing Wai'ale Road, Kuikahi Drive, and Waiko Road rights-of-way (ROWs). The County of Maui, Department of Environmental Management (DEM) is proposing to develop a new Central Maui Wastewater Reclamation Facility (WWRF) and onsite Soil Aquifer Treatment (SAT) basin on approximately 14.9 acres of former agricultural lands between Honoapiʻilani Highway and Kuihelani Highway as well as related offsite infrastructure improvements. Offsite improvements will occur on a stormwater detention basin that serves the Kehalani development and will consist of a wastewater pump station (WWPS) near the
existing master-planned Kehalani community, a sewage pipeline from the Kehalani WWPS to the WWRF, portions of sewage pipeline and R-1 recycled water transmission line that connect the WWRF and the future Waikapū Country Town development, and a WWRF access road. The total project area (onsite
and offsite improvements) is approximately 21.5 acres. The proposed WWRF will service existing and planned developments throughout the Waikapū/Wailuku area, as well as State of Hawaiʻi projects in Pūlehunui.

The State listed ʻŌpeʻapeʻa or Hawaiian Hoary Bat (*Lasiurus cinereus semotus*) could potentially occur at or in the vicinity of the project and may roost in nearby trees. Any required site clearing should be timed to avoid disturbance to bats during their birthing and pup rearing season (June 1 through September 15). During this period woody plants greater than 15 feet (4.6 meters) tall should not be disturbed, removed, or trimmed. Barbed wire should also be avoided for any construction because bats can become ensnared and killed by such fencing material during flight.

Artificial lighting can adversely impact seabirds that may pass through the area at night by causing them to become disoriented. This disorientation can result in their collision with manmade structures or the grounding of birds. For nighttime work that might be required, DOFAW recommends that all lights used be fully shielded to minimize the attraction of seabirds. Nighttime work that requires outdoor lighting should be avoided during the seabird fledging season, from September 15 through December 15, when young seabirds make their maiden voyage to sea.

If nighttime construction is required during the seabird fledgling season (September 15 to December 15), we recommend that a qualified biologist be present at the project site to monitor and assess the risk of seabirds being attracted or grounded due to the lighting. If seabirds are seen circling around the area, lights should then be turned off. If a downed seabird is detected, please follow DOFAW's recommended response protocol by visiting https://dlnr.hawaii.gov/wildlife/seabird-fallout-season/#response.

Permanent lighting also poses a risk of seabird attraction, and as such should be minimized or eliminated to protect seabird flyways and preserve the night sky. For illustrations and guidance related to seabird-friendly light styles that also protect seabirds and the dark starry skies of Hawaiʻi please visit https://dlnr.hawaii.gov/wildlife/files/2016/03/DOC439.pdf.

State-listed waterbirds such as the Ae'o or Hawaiian stilt (*Himantopus mexicanus knudseni*), 'Alae ke'oke'o or Hawaiian coot (*Fulica alai*), and Nēnē or Hawaiian Goose (*Branta sandvicensis*) could potentially occur at or in the vicinity of the proposed project site. It is against State law to harm or harass these species. If any of these species are present during construction, all activities within 100 feet (30 meters) should cease and the bird or birds should not be approached. Work may continue after the bird or birds leave the area of their own accord. If a nest is discovered at any point, please contact the Maui Branch DOFAW Office at (808) 984-8100.

The endemic pueo or Hawaiian Short-Eared Owl (*Asio flammeus sandwichensis*) could potentially nest in the project area. Before any potential vegetative alteration, especially ground-based disturbance, we recommend that line transect surveys are conducted during crepuscular hours through the project area. If a pueo nest is discovered, a minimum buffer distance of 100 meters from the nest should be established until chicks are capable of flight.

DOFAW recommends using native plant species for landscaping that are appropriate for the area; i.e., plants for which climate conditions are suitable for them to thrive, plants that historically occurred there, etc. Please do not plant invasive species. DOFAW also recommends referring to www.plantpono.org for guidance on the selection and evaluation of landscaping plants and to determine the potential invasiveness of plants proposed for use in the project.

DOFAW recommends minimizing the movement of plant or soil material between worksites. Soil and plant material may contain detrimental fungal pathogens (e.g., Rapid ʻŌhiʻa Death), vertebrate and invertebrate pests (e.g., Coqui Frogs, Little Fire Ants, etc.), or invasive plant parts (e.g., Miconia, Mullein, etc.) that could harm our native species and ecosystems. We recommend consulting the Maui Invasive Species Committee (MISC) at (808) 573-6472 to help plan, design, and construct the project, learn of any high-risk invasive species in the area, and ways to mitigate their spread. All equipment, materials, and personnel should be cleaned of excess soil and debris to minimize the risk of spreading invasive species.

DOFAW is concerned about the wastewater treatment facility attracting vulnerable birds to areas that may host nonnative predators such as cats, rodents, and mongooses. We therefore recommend taking action to minimize predator presence; i.e., remove cats, place bait stations for rodents and mongoose, and provide covered trash receptacles. Implementing additional mitigation measures is also recommended to avoid avian mortality during project design and during operation for the long term.

Due to the arid climate and risks of wildfire to listed species, we recommend coordinating with the Hawaiʻi Wildfire Management Organization at (808) 850-900 or admin@hawaiiwildfire.org, on how wildfire prevention can be addressed in the project area. When engaging in activities that have a high risk of starting a wildfire (i.e. welding in the grass), it is recommended that you: Wet down the area before starting your task, continuously wet down the area as needed, have a fire extinguisher on hand, and in the event that your vision is impaired, (i.e. welding goggles) have a spotter to watch for fire starts.

We recommend that Best Management Practices are employed during and after construction to contain any soils and sediment with the purpose of preventing damage to near-shore waters and marine ecosystems.

We appreciate your efforts to work with our office for the conservation of our native species. These comments are general guidelines and should not be considered comprehensive for this site or project. It is the responsibility of the applicant to do their own due diligence to avoid any negative environmental impacts. Should the scope of the project change significantly, or should it become apparent that threatened or endangered species may be impacted, please contact our staff as soon as possible. If you have any questions, please contact Myrna N. Girald Pérez, Protected Species Habitat Conservation Planning Coordinator at (808) 265-3276 or myrna.girald-perez@hawaii.gov.

Sincerely,

Kathryn Stanaway

KATHRYN STANAWAY
Acting Wildlife Program Manager

MUNEKIYO HIRAGA
Planning. Project Management. Sustainable Solutions.

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VICE PRESIDENT

Michael T. Munekiyo AICP
FOUNDER

October 16, 2025

Via email: dlnr@hawaii.gov and dlnr.land@hawaii.gov

Ian Hirokawa, Acting Land Administrator
State of Hawai'i
Department of Land and Natural Resources
Land Division
P. O. Box 621
Honolulu, Hawai'i 96809

SUBJECT: Response to Comments Regarding Chapter 343, Hawai'i Revised Statutes, Environmental Impact Statement Preparation Notice for the Proposed County of Maui Central Maui Wastewater Reclamation Facility Project; Maui, Hawai'i

Dear Mr. Hirokawa:

Thank you for your department's comment letter dated August 24, 2023 regarding the Environmental Impact Statement Preparation Notice (EISPN) for the subject project. On behalf of the County of Maui, Department of Environmental Management (DEM), we offer the following information in response to the comments received from the Division of Forestry and Wildlife (DOFAW):

Comment No. 1:

The State listed 'Ōpe'ape'a or Hawaiian Hoary Bat (Lasiurus cinereus semotus) could potentially occur at or in the vicinity of the project and may roost in nearby trees. Any required site clearing should be timed to avoid disturbance to bats during their birthing and pup rearing season (June 1 through September 15). During this period woody plants greater than 15 feet (4.6 meters) tall should not be disturbed, removed, or trimmed. Barbed wire should also be avoided for any construction because bats can become ensnared and killed by such fencing material during flight.

Response: We acknowledge that the Hawaiian Hoary Bat or 'Ōpe'ape'a (*Lasiurus cinereus semotus*) has the potential to occur in the vicinity of the project area and may roost in nearby trees. It is noted that a site-specific Biological Resources Survey prepared for the project did not identify any Hawaiian Hoary Bat in the vicinity of the project areas. Nevertheless, these recommendations have been shared with the project team for evaluation and incorporation into the project, as appropriate.

Comment No. 2:

Artificial lighting can adversely impact seabirds that may pass through the area at night by causing them to become disoriented. This disorientation can result in their collision with manmade structures or the grounding of birds. For nighttime work that might be required, DOFAW recommends that all lights used be fully shielded to minimize the attraction of seabirds. Nighttime work that requires outdoor lighting should be avoided during the seabird fledging season, from September 15 through December 15, when young seabirds make their maiden voyage to sea.

If nighttime construction is required during the seabird fledgling season (September 15 to December 15), we recommend that a qualified biologist be present at the project site to monitor and assess the risk of seabirds being attracted or grounded due to the lighting. If seabirds are seen circling around the area, lights should then be turned off. If a downed seabird is detected, please follow DOFAW's recommended response protocol by visiting https://dlnr.hawaii.gov/wildlife/seabird-fallout-season/#response.

Response: We understand that artificial lighting can adversely impact seabirds that may pass through the area at night by causing disorientation. For nighttime work that might be required, all lights will be fully shielded to minimize impacts. Any use of outdoor lighting will be avoided during the seabird fledging season from September 15 through December 15, to the extent practicable. If seabirds are observed circling the project area, lights will be turned off to the extent practicable. In addition, the recommended protocol for downed seabirds has been reviewed by DEM.

Comment No. 3:

Permanent lighting also poses a risk of seabird attraction, and as such should be minimized or eliminated to protect seabird flyways and preserve the night sky. For illustrations and guidance related to seabird-friendly light styles that also protect seabirds and the dark starry skies of Hawai'i please visit https://dlnr.hawaii.gov/wildlife/files/2016/03/DOC439.pdf.

Response: We acknowledge that permanent lighting can pose a risk of seabird attraction. As such, permanent lighting will be downward facing and designed to be as seabird-friendly as practicable.

Comment No. 4:

State-listed waterbirds such as the Ae'o or Hawaiian stilt (Himantopus mexicanus knudseni), 'Alae ke'ke'o or Hawaiian coot (Fulica alai), and or Hawaiian Goose (Branta sandvicensis) could potentially occur at or in the vicinity of the proposed project site. It is against State law to harm or harass these species. If any of these species are present during construction, all activities within 100 feet (30 meters) should cease and the bird or birds should not be approached. Work may continue after the bird or birds leave the area of their own accord. If a nest is discovered at any point, please contact the Maui Branch DOFAW Office at (808) 984-8100.

Response: We acknowledge that State-listed waterbirds such as the Hawaiian stilt (*Himantopus mexicanus knudseni*), Hawaiian coot (*Fulica alai*), Hawaiian gallinule (*Gallinula chloropus sandvicensis*), Hawaiian Duck (*Anas wyvilliana*), and Hawaiian Goose (*Branta sandvicensis*) could potentially occur at or in the vicinity of the proposed project site. It is noted that the Biological Resources Survey prepared for the project did not identify any Hawaiian seabirds in or in the vicinity of the project areas. Nevertheless, should any of these species be present during construction activities, the bird(s) will not be approached and all activities within 100 feet of these species should cease until the bird(s) leave on their own accord. If a nest is discovered, the Maui DOFAW Branch will be contacted.

Comment No. 5:

The endemic pueo or Hawaiian Short-Eared Owl (Asio flammeus sandwichensis) could potentially nest in the project area. Before any potential vegetative alteration, especially ground-based disturbance, we recommend that line transect surveys are conducted during crepuscular hours through the project area. If a pueo nest is discovered, a minimum buffer distance of 100 meters from the nest should be established until chicks are capable of flight.

Response: We acknowledge that the endemic Short-eared owl or pueo (*Asio flammeus sandwichensis*) could potentially occur in the project vicinity. The pedestrian Biological Resources Survey for the project did not identify pueo within or in the vicinity of the project area. Should a pueo nest be discovered, a minimum 100-meter buffer distance will be established until chicks are able to take flight.

Comment No. 6:

DOFAW recommends using native plant species for landscaping that are appropriate for the area; i.e., plants for which climate conditions are suitable for them to thrive, plants that historically occurred there, etc. Please do not plant invasive species. DOFAW also recommends referring to www.plantpono.org for guidance on the selection and evaluation of landscaping plants and to determine the potential invasiveness of plants proposed for use in the project.

Response: A licensed landscape architect will prepare the WWRF and Kehalani Wastewater Pump Station landscaping plans, which will emphasize native plantings to the extent practicable. Listed invasive species will not be used.

Comment No. 7:

DOFAW recommends minimizing the movement of plant or soil material between worksites. Soil and plant material may contain detrimental fungal pathogens (e.g., Rapid ʻŌhiʻa Death), vertebrate and invertebrate pests (e.g., Coqui Frogs, Little Fire Ants, etc.), or invasive plant parts (e.g., Miconia, Mullein, etc.) that could harm our native species and ecosystems. We recommend consulting the Maui Invasive Species Committee (MISC) at (808) 573-6472 to help plan, design, and construct the project, learn of any high-risk invasive species in the area, and ways to mitigate

their spread. All equipment, materials, and personnel should be cleaned of excess soil and debris to minimize the risk of spreading invasive species.

Response: Thank you for the recommended mitigation measures for minimizing movement of plant or soil material between work sites. This information will be provided to the project contractor for guidance. The Maui Invasive Species Committee will be contacted, as may be needed, as a Best Management Practices plan for the project is formulated by the design team.

Comment No. 8:

DOFAW is concerned about the wastewater treatment facility attracting vulnerable birds to areas that may host nonnative predators such as cats, rodents, and mongooses. We therefore recommend taking action to minimize predator presence; i.e., remove cats, place bait stations for rodents and mongoose, and provide covered trash receptacles. Implementing additional mitigation measures is also recommended to avoid avian mortality during project design and during operation for the long term.

Response: In addition to DOFAW, the U.S. Fish and Wildlife Services is also being consulted as part of the Environmental Impact Statement (EIS) process. A conventional mechanical treatment process is proposed for the WWRF, which will not be attractive to birds. Open water ponds that would be attractive to birds are not proposed for the facility. The proposed Soil Aquifer Treatment basins will be doused with water intermittently, and any surface ponding of water within the basins will be of short duration.

Comment No. 9:

Due to the arid climate and risks of wildfire to listed species, we recommend coordinating with The Hawai'i Wildfire Management Organization at (808) 850-900 or admin@hawaiiwildfire.org, on how wildfire prevention can be addressed in the project area. When engaging in activities that have a high risk of starting a wildfire (i.e. welding in the grass), it is recommended that you: Wet down the area before starting your task, continuously wet down the area as needed, have a fire extinguisher on hand, and in the event that your vision is impaired, (i.e. welding goggles) have a spotter to watch for fire starts.

Response: We acknowledge that the project area is at risk of wildfires. As such, the Hawai'i Wildfire Management Organization will be consulted, and wildfire prevention measures will be discussed in the Draft EIS and incorporated into the project, as applicable.

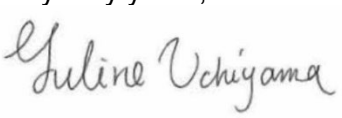
Comment No. 10:

We recommend that Best Management Practices are employed during and after construction to contain any soils and sediment with the purpose of preventing damage to near-shore waters and marine ecosystems.

Response: An National Pollutant Discharge Elimination System (NPDES) construction stormwater permit will be obtained for the construction of the project. The construction documents will include Best Management Practices (BMPs) to contain soils and sediment. The Draft EIS will also include and discuss a preliminary drainage report that discusses permanent BMPs for the WWRF.

Thank you again for your participation in the Chapter 343, Hawai'i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft EIS that is being prepared for this project. Should you have any questions or require additional information, please feel free to contact me at (808) 983-1233.

Very truly yours,



Yukino Uchiyama, AICP
Manager

YU:ab
cc: Juan Rivera, Department of Environmental Management
Eric Nakagawa, Department of Environmental Management
Scott Rollins, Department of Environmental Management
Myrna N. Giral Perez, Protected Species Habitat Conservation Coordinator
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From: Lu, Bonnie
To: Central Maui WWRF
Cc: Roth, Katie C
Subject: CWRM comments - Central Maui Wastewater Reclamation Facility
Date: Wednesday, August 23, 2023 8:35:26 AM
Attachments: RFD 6050.6 (part 1) - signed.pdf

Aloha Yukino,

Please find the attached comments for the Central Maui Wastewater Reclamation Facility. If you have any questions, please feel free to contact us. Mahalo.

Bonnie Lu
Planning Branch Secretary
Department of Land and Natural Resources (DLNR)
Commission on Water Resource Management (CWRM)
1151 Punchbowl Street, Room 227
Honolulu, HI 96813
(808) 587-0216
Website: http://dlnr.hawaii.gov/cwrm

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DEAN D. UYENO
ACTING DEPUTY DIRECTOR

STATE OF HAWAI'I | KA MOKU'ĀINA 'O HAWAI'I
DEPARTMENT OF LAND AND NATURAL RESOURCES | KA 'OIHANA KUMUWAIWAI 'ĀINA
COMMISSION ON WATER RESOURCE MANAGEMENT | KE KAHUWAI PONO
P.O. BOX 621
HONOLULU, HAWAII 96809

Jul 25, 2023

REF: RFD.6050.6

TO: Yukino Uchiyama, AICP
Munekiyo Hiraga

FROM: Dean D. Uyeno, Acting Deputy Director
Commission on Water Resource Management

SUBJECT: Central Maui Wastewater Reclamation Facility

FILE NO.: RFD.6050.6
TMK NO.: (2) 3-5-001:017, (2) 3-5-001:120, (2) 3-5-002:014, (2) 3-5-002:888, (2) 3-5-020:036, (2) 3-6-002:003, (2) 3-6-002:004, (2) 3-6-005:023

Thank you for the opportunity to review the subject document. The Commission on Water Resource Management (CWRM) is the agency responsible for administering the State Water Code (Code). Under the Code, all waters of the State are held in trust for the benefit of the citizens of the State, therefore all water use is subject to legally protected water rights. CWRM strongly promotes the efficient use of Hawaii's water resources through conservation measures and appropriate resource management. For more information, please refer to the State Water Code, Chapter 174C, Hawaii Revised Statutes, and Hawaii Administrative Rules, Chapters 13-167 to 13-171. These documents are available via the Internet at http://dlnr.hawaii.gov/cwrm.

Our comments related to water resources are checked off below.

- [X] 1. We recommend coordination with the county to incorporate this project into the county's Water Use and Development Plan. Please contact the respective Planning Department and/or Department of Water Supply for further information.
- [ ] 2. We recommend coordination with the Engineering Division of the State Department of Land and Natural Resources to incorporate this project into the State Water Projects Plan.
- [ ] 3. We recommend coordination with the Hawaii Department of Agriculture (HDOA) to incorporate the reclassification of agricultural zoned land and the redistribution of agricultural resources into the State's Agricultural Water Use and Development Plan (AWUDP). Please contact the HDOA for more information.
- [X] 4. We recommend that water efficient fixtures be installed and water efficient practices implemented throughout the development to reduce the increased demand on the area's freshwater resources. Reducing the water usage of a home or building may earn credit towards Leadership in Energy and Environmental Design (LEED) certification. More information on LEED certification is available at http://www.usgbc.org/leed. A listing of fixtures certified by the EAP as having high water efficiency can be found at http://www.epa.gov/watersense.
- [X] 5. We recommend the use of best management practices (BMP) for stormwater management to minimize the impact of the project to the existing area's hydrology while maintaining on-site infiltration and preventing polluted runoff from storm events. Stormwater management BMPs may earn credit toward LEED certification. More information on stormwater BMPs can be found at http://planning.hawaii.gov/czm/initiatives/low-impact-development/
- [X] 6. We recommend the use of alternative water sources, wherever practicable.
- [ ] 7. We recommend participating in the Hawaii Green Business Program, that assists and recognizes businesses that strive to operate in an environmentally and socially responsible manner. The program description can be found online at http://energy.hawaii.gov/green-business-program.
- [X] 8. We recommend adopting landscape irrigation conservation best management practices endorsed by the Landscape Industry Council of Hawaii. These practices can be found online at http://www.hawaiiscape.com/wp-content/uploads/2013/04/LICH_Irrigation_Conservation_BMPs.pdf.

[X] 9. There may be the potential for ground or surface water degradation/contamination and recommend that approvals for this project be conditioned upon a review by the State Department of Health and the developer's acceptance of any resulting requirements related to water quality.

[ ] 10. The proposed water supply source for the project is located in a designated water management area, and a Water Use Permit is required prior to use of water. The Water Use Permit may be conditioned on the requirement to use dual line water supply systems for new industrial and commercial developments.

[X] 11. The Hawaii Water Plan is directed toward the achievement of the utilization of reclaimed water for uses other than drinking and for potable water needs in one hundred per cent of State and County facilities by December 31, 2045 (§174C-31(g)(6), Hawaii Revised Statutes). We strongly recommend that this project consider using reclaimed water for its non-potable water needs, such as irrigation. Reclaimed water may include, but is not limited to, recycled wastewater, gray water, and captured rainwater/stormwater. Please contact the Hawai'i Department of Health, Wastewater Branch, for more information on their reuse guidelines and the availability of reclaimed water in the project area.

[X] 12. A Well Construction Permit(s) is (are) are required before the commencement of any well construction work.

[X] 13. A Pump Installation Permit(s) is (are) required before ground water is developed as a source of supply for the project.

[ ] 14. There is (are) well(s) located on or adjacent to this project. If wells are not planned to be used and will be affected by any new construction, they must be properly abandoned and sealed. A permit for well abandonment must be obtained.

[ ] 15. Ground-water withdrawals from this project may affect streamflows, which may require an instream flow standard amendment.

[ ] 16. A Stream Channel Alteration Permit(s) is (are) required before any alteration can be made to the bed and/or banks of a steam channel.

[ ] 17. A Stream Diversion Works Permit(s) is (are) required before any stream diversion works is constructed or altered.

[ ] 18. A Petition to Amend the Interim Instream Flow Standard is required for any new or expanded diversion(s) of surface water.

[ ] 19. The planned source of water for this project has not been identified in this report. Therefore, we cannot determine what permits or petitions are required from our office, or whether there are potential impacts to water resources.

[X] OTHER: Planning -

The proposed water source(s) and projected water demands for the project, both potable and non-potable, should be identified and the calculations used to estimate demands should be provided. A discussion of the potential impacts on water resources and other public trust uses of water should be included, and any proposed mitigation measures described. Water conservation and efficiency measures to be implemented should also be discussed.

The DEA should include a discussion of the Aquifer System Area, its sustainable yield, and how proposed water demands will affect available sustainable yield.

Please consider onsite reclamation and reuse that supports development of a dual water system for the project and the use of nonpotable water to meet nonpotable needs. The Commission strongly encourages the use of xeriscaping or drought-tolerant plantings, the incorporation of low impact design features, and the use of water efficient fixtures throughout the development. We recommend onsite reclamation and reuse where appropriate.

Groundwater -

Impacts to ground water dependent ecosystems are becoming an emerging issue as impacts to these are related to impacts to traditional & customary practices of sustenance from these ecosystems. We recommend consultation with the region's (moku) Aha Moku Council on whether a land use conversion or project that uses water will impact any traditional & customary practices.

If you have any questions, please contact Katie Roth of the Planning Branch at (808) 587-0216 or Ryan Imata of the Regulation Branch (808) 587-0225.

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Mark Alexander Roy AICP, LEED AP
VICE PRESIDENT
Tessa Munekiyo Ng AICP
VICE PRESIDENT

Michael T. Munekiyo AICP
FOUNDER

October 16, 2025

Via email: dlnr@hawaii.gov and dlnr.cwrm@hawaii.gov

Ciara W.K. Kahahane, Deputy Director
State of Hawai'i
Department of Land and Natural Resources
Commission on Water Resource Management

SUBJECT: Response to Comments Regarding Chapter 343, Hawai'i Revised Statutes, Environmental Impact Statement Preparation Notice for the Proposed County of Maui Central Maui Wastewater Reclamation Facility Project; Maui, Hawai'i (REF: RFD.6050.6)

Dear Ms. Kahahane:

Thank you for your department's comment letter emailed on August 23, 2023 regarding the Environmental Impact Statement Preparation Notice (EISPN) for the subject project. On behalf of the County of Maui, Department of Environmental Management (DEM), we offer the following information in response to the comments received:

Comment No. 1:

We recommend coordination with the county to incorporate this project into the county's Water Use and Development Plan. Please contact the respective Planning Department and/or Department of Water Supply for further information.

Response: As a County project, DEM will coordinate with the Maui County Planning Department and Department of Water Supply (DWS) regarding incorporation of the proposed Central Maui WWRF project into the County's Water Use and Development Plan, as may be appropriate.

Comment No. 2:

We recommend that water efficient fixtures be installed and water efficient practices implemented throughout the development to reduce the increased demand on the area's freshwater resources. Reducing the water usage of a home or building may earn credit towards Leadership in Energy and Environmental Design (LEED) certification. More information on LEED certification is available at http://www.usgbc.org/leed. A listing of fixtures certified by the EAP as having high water efficiency can be found at http://www.epa.gov/watersense.

Response: Water efficient fixtures will be installed at the WWRF in accordance with applicable codes and standards. The WWRF effluent will be recycled for non-potable uses, significantly reducing demand for freshwater resources. Recycled water will be used within the WWRF for process needs.

Comment No. 3:

We recommend the use of best management practices (BMP) for stormwater management to minimize the impact of the project to the existing area's hydrology while maintaining on-site infiltration and preventing polluted runoff from storm events. Stormwater management BMPs may earn credit toward LEED certification. More information on stormwater BMPs can be found at http://planning.hawaii.gov/czm/initiatives/low-impact-development/

Response: Best Management Practices (BMP) will be incorporated into the design of this project. The Draft Environmental Impact Statement (EIS) will include a preliminary drainage study that will evaluate drainage-related considerations for the project.

Comment No. 4:

We recommend the use of alternative water sources, wherever practicable.

Response: The proposed project will generate R-1 Recycled Water. Recycled water will be distributed for non-potable (i.e. irrigation) purposes as the primary effluent management disposal method for the treated wastewater as well as used within the Central Maui WWRF for process needs.

Comment No. 5:

We recommend adopting landscape irrigation conservation best management practices endorsed by the Landscape Industry Council of Hawaii. These practices can be found online at http://www.hawaiiscape.com/wp-content/uploads/2013/04/LICH_Irrigation_Conservation_BMPs.pdf.

Response: Thank you for the recommendation to adopt landscape irrigation conservation BMPs. The link to the BMPs does not appear to be working. It is noted that the Central Maui WWRF landscaping will be irrigated with recycled water from the facility.

Comment No. 6:

There may be the potential for ground or surface water degradation/contamination and recommend that approvals for this project be conditioned upon a review by the State Department of Health and the developer's acceptance of any resulting requirements related to water quality.

Response: We acknowledge this recommendation. We confirm that the State Department of Health (DOH) has been and will continue to be consulted during the EIS process and will also review the design plans prior to implementation of the project. DOH will regulate the WWRF and the recycled water program during the operational phase of the project. It is noted that a Hydrogeological Assessment Report has been prepared for the project and will be included and discussed in the Draft EIS.

Comment No. 7:

The Hawaii Water Plan is directed toward the achievement of the utilization of reclaimed water for uses other than drinking and for potable water needs in one hundred per cent of State and County facilities by December 31, 2045 (§174C-31(g)(6), Hawaii Revised Statutes). We strongly recommend that this project consider using reclaimed water for its non-potable water needs, such as irrigation. Reclaimed water may include, but is not limited to, recycled wastewater, gray water, and captured rainwater/stormwater. Please contact the Hawai'i Department of Health, Wastewater Branch, for more information on their reuse guidelines and the availability of reclaimed water in the project area.

Response: As previously noted, the proposed project will generate R-1 recycled water. The recycled water will be distributed for non-potable (i.e. irrigation) purposes as the primary effluent management disposal method for the treated wastewater as well as used within the Central Maui WWRF for process needs. The WWRF and recycled water use areas will be regulated by DOH and will be designed to comply with the reuse guidelines.

Comment No. 8:

A Well Construction Permit(s) is (are) are required before the commencement of any well construction work.

Response: The proposed project does not involve well construction work.

Comment No. 9:

A Pump Installation Permit(s) is (are) required before ground water is developed as a source of supply for the project.

Response: The proposed project does not involve ground water source development.

Comment No. 10:

Planning -

The proposed water source(s) and projected water demands for the project, both potable and nonpotable, should be identified and the calculations used to estimate demands should be provided. A discussion of the potential impacts on water resources and other public trust uses of water should be included, and any

proposed mitigation measures described. Water conservation and efficiency measures to be implemented should also be discussed.

The DEA should include a discussion of the Aquifer System Area, its sustainable yield, and how proposed water demands will affect available sustainable yield.

Please consider onsite reclamation and reuse that supports development of a dual water system for the project and the use of nonpotable water to meet nonpotable needs. The Commission strongly encourages the use of xeriscaping or drought-tolerant plantings, the incorporation of low impact design features, and the use of water efficient fixtures throughout the development. We recommend onsite reclamation and reuse where appropriate.

Response: Thank you for the comment. The Draft EIS will provide discussion of water sources and estimates of demands. A Hydrogeological Assessment report is also being prepared to evaluate the project's potential impacts on groundwater resources in the area. A copy of this report as well as a preliminary drainage analysis of the proposed facility will be included and discussed in the Draft EIS.

Potable water for the pump station and WWRF and will be supplied from the County of Maui, DWS's Central Maui system. Potable water demands within the WWRF will be limited to internal building needs (e.g., drinking fountains, restrooms, showers) and process control laboratory needs (sinks). Potable water will also be used for emergency eyewash and showers for worker safety. As previously mentioned, water efficient fixtures will be installed at the WWRF in accordance with applicable codes and standards. The WWRF treatment process water and onsite irrigation needs will be met with recycled water produced by the facility.

Comment No. 11:

Groundwater -

Impacts to ground water dependent ecosystems are becoming an emerging issue as impacts to these are related to impacts to traditional & customary practices of sustenance from these ecosystems. We recommend consultation with the region's (moku) Aha Moku Council on whether a land use conversion or project that uses water will impact any traditional & customary practices.

Response: We note that potential impacts to ground water dependent ecosystems may be related to potential impacts to traditional and customary practices. We confirm that the Aha Moku o Maui Council has been consulted on the project. A Cultural Impact Assessment (CIA) report has been prepared and will be included and discussed in the Draft EIS.

Thank you again for your participation in the Chapter 343, Hawai‘i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft EIS that is being prepared for this project. Should you have any questions or require additional information, please feel free to contact me at (808) 983-1233.

Very truly yours,

Yukino Uchiyama, AICP
Manager

YU:ab
cc: Juan Rivera, Department of Environmental Management
Eric Nakagawa, Department of Environmental Management
Scott Rollins, Department of Environmental Management
Craig Lekven, Brown and Caldwell
Irina Constantinescu, Brown and Caldwell
Bradford Wright, Warren S. Unemori Engineering
Tehani Baculpo, Cultural Survey Hawaii
Rich Kraft, Geosyntec
Katie Roth, Commission on Water Resource Management
Ryan Imata, Commission on Water Resource Management
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GOVERNOR

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STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:

DIR 0579
STP 8.3647

August 21, 2023

VIA Email: CentralMauiWWRF@munekiyohiraga.com

Ms. Yukino Uchiyama, AICP
Munekiyo Hiraga
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Uchiyama:

Subject: Environmental Impact Statement Preparation Notice for the
Proposed Central Maui Wastewater Reclamation Facility
Wailuku, Maui, Hawaii
Tax Map Keys: (2) 3-5-001: 017 (por), 120 (por); 3-5-002: 014 (por);
3-5-020: 036 (por); 3-6-002: 003 (por) , 004 (por); 3-8-005: 023 (por)

Thank you for your letter dated July 20, 2023, requesting the Hawaii Department of Transportation's (HDOT) review and comment on the proposed Central Maui Wastewater Reclamation Facility (WWRF). HDOT understands that the County of Maui, Department of Environmental Management is proposing to develop the new Central Maui WWRF and Soil Aquifer Treatment basin on approximately 14.9 acres of land between Honoapiilani Highway (State Route 30) and Kuihelani Highway (State Route 380). Other improvements associated with the proposed project include a wastewater pump station, sewage pipelines, an R-1 recycled water transmission line, and an access road to the Central Maui WWRF.

HDOT has the following comments:

1. The proposed project is approximately 2.71 miles from the property boundary of Kahului Airport. All projects within 5 miles of Hawaii State airports are advised to read the Technical Assistance Memorandum (TAM) for guidance with development and activities that may require further review and permits. The TAM can be viewed at this link: http://files.hawaii.gov/dbedt/op/docs/TAM-FAA-DOT-Airports_08-01-2016.pdf.

2. Federal Aviation Administration (FAA) regulation requires the submittal of FAA Form 7460-1 Notice of Proposed Construction or Alteration pursuant to the Code of Federal Regulations, Title 14, Part 77.9, if the construction or alteration is within 20,000 feet of a public use or military airport which exceeds a 100:1 surface from any point on the runway of each airport with its longest runway more than 3,200 feet. Construction equipment and staging area heights, including heights of temporary construction cranes, shall be included in the submittal. The form and criteria for submittal can be found at the

following website: https://oeaaa.faa.gov/oeaaa/external/portal.jsp. Please provide a copy of the FAA response to the Part 77 analysis to the HDOT Airport Planning Section.

3. The proposed project shall not provide landscape, vegetation, and/or operating conditions that will create a wildlife attractant, which can potentially become a hazard to aircraft operations. Please review the FAA Advisory Circular 150/5200-33C, Hazardous Wildlife Attractants On Or Near Airports for guidance. If the project's landscaping or operating conditions create a wildlife attractant, the developer shall immediately mitigate the hazard upon notification by the HDOT and/or FAA.

4. The Traffic Impact Analysis Report that will be included in the Draft Environmental Impact Statement (DEIS) should contain an evaluation to identify whether the proposed daily operations related to typical trip patterns, including number of staff, will have any direct or regional impacts on state highway facilities, and any required mitigation measures.

5. The upcoming DEIS should discuss potential coordination with HDOT on the project construction schedule to minimize possible conflicts with HDOT's scheduled highway and maintenance projects in the area.

6. Before construction plans are approved, the applicant shall consult with the HDOT Highways, Maui District Office, regarding access, safety, and any necessary permit requirements.

Please submit any subsequent land use entitlement-related requests for review or correspondence to the HDOT Land Use Intake email address at DOT.LandUse@hawaii.gov.

If there are any questions, please contact Mr. Blayne Nikaido, Planner, Land Use Section of the HDOT Statewide Transportation Planning Office at (808) 831-7979 or via email at blayne.h.nikaido@hawaii.gov.

Sincerely,

EDWIN H. SNIFFEN
Director of Transportation

c: Juan Rivera, P.E. – County of Maui, Department of Environmental Management,
Wastewater Reclamation Division
(VIA Email: environmental.mgmt@co.maui.hi.us)

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VICE PRESIDENT

Michael T. Munekiyo AICP
FOUNDER

October 16, 2025

Via email: DOT.LandUse@hawaii.gov

Edwin H. Sniffen, Director
State of Hawai'i
Department of Transportation
869 Punchbowl Street
Honolulu, Hawai'i 96813-5097

SUBJECT: Response to Comments Regarding Chapter 343, Hawai'i Revised Statutes, Environmental Impact Statement Preparation Notice for the Proposed County of Maui Central Maui Wastewater Reclamation Facility Project; Maui, Hawai'i; DIR 0579 STP 8.3647

Dear Mr. Sniffen:

Thank you for your comment letter dated August 21, 2023 regarding the Environmental Impact Statement Preparation Notice (EISPN) for the subject project. On behalf of the County of Maui, Department of Environmental Management (DEM), we offer the following information in response to the comments received:

Comment No. 1:

The proposed project is approximately 2.71 miles from the property boundary of Kahului Airport. All projects within 5 miles of Hawaii State airports are advised to read the Technical Assistance Memorandum (TAM) for guidance with development and activities that may require further review and permits. The TAM can be viewed at this link: http://files.hawaii.gov/dbedt/op/docs/TAM-FAA-DOT-Airports_08-01-2016.pdf.

Response: We acknowledge that the proposed WWRF is within five (5) miles from the Kahului Airport boundary. As such, the Technical Assistance Memorandum (TAM) will be reviewed for applicable guidance.

Comment No. 2:

Federal Aviation Administration (FAA) regulation requires the submittal of FAA Form 7460-1 Notice of Proposed Construction or Alteration pursuant to the Code of Federal Regulations, Title 14, Part 77.9, if the construction or alteration is within 20,000 feet of a public use or military airport which exceeds a 100:1 surface from any point on the runway of each airport with its longest runway more than 3,200 feet. Construction equipment and staging area heights, including heights of temporary construction cranes, shall be included in the submittal. The form and criteria for submittal can be found at the following website:

https://oeaaa.faa.gov/oeaaa/external/portal.jsp. Please provide a copy of the FAA response to the Part 77 analysis to the HDOT Airport Planning Section.

Response: A Federal Aviation Administration (FAA) Form 7460-1 Notice of Proposed Construction or Alteration will be submitted, as may be applicable, pursuant to the Code of Federal Regulations, Title 14, Part 77. The proposed WWRF site is over four (4) miles away from Kahului Airport.

Comment No. 3:

The proposed project shall not provide landscape, vegetation, and/or operating conditions that will create a wildlife attractant, which can potentially become a hazard to aircraft operations. Please review the FAA Advisory Circular 150/5200-33C, Hazardous Wildlife Attractants On Or Near Airports for guidance. If the project's landscaping or operating conditions create a wildlife attractant, the developer shall immediately mitigate the hazard upon notification by the HDOT and/or FAA.

Response: FAA Advisory Circular 150/5200-33C, Hazardous Wildlife Attractants On Or Near Airports will be reviewed by DEM for applicable guidance based on the proposed location of the WWRF site from Kahului Airport (over four (4) miles away).

Comment No. 4:

The Traffic Impact Analysis Report that will be included in the Draft Environmental Impact Statement (DEIS) should contain an evaluation to identify whether the proposed daily operations related to typical trip patterns, including number of staff, will have any direct or regional impacts on state highway facilities, and any required mitigation measures.

Response: We confirm that the Traffic Impact Analysis Report (TIAR) has been prepared for the project and will be included in the Draft Environmental Impact Statement (EIS). The TIAR will contain an evaluation of proposed daily operations related to typical trip patterns, including number of staff to identify potential impacts to State highway facilities and mitigation measures, if needed.

Comment No. 5:

The upcoming DEIS should discuss potential coordination with HDOT on the project construction schedule to minimize possible conflicts with HDOT's scheduled highway and maintenance projects in the area.

Response: The Draft EIS will include a discussion regarding DEM's future coordination with the State Department of Transportation (HDOT) regarding the construction schedule to minimize possible conflicts with HDOT highway maintenance projects in the area.

Comment No. 6:

Before construction plans are approved, the applicant shall consult with the HDOT Highways, Maui District Office, regarding access, safety, and any necessary permit requirements.

Response: We confirm that the HDOT Highways, Maui District Office will be consulted prior to construction plan approval regarding access, safety, and any necessary permit requirements.

Thank you again for your participation in the Chapter 343, Hawai'i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft EIS that is being prepared for this project. Should you have any questions or require additional information, please feel free to contact me at (808) 983-1233.

Very truly yours,

Yukino Uchiyama

Yukino Uchiyama, AICP
Manager

YU:ab
cc: Juan Rivera, Department of Environmental Management
Eric Nakagawa, Department of Environmental Management
Scott Rollins, Department of Environmental Management
Kelcee Mira, Austin Tsutsumi & Associates, Inc.
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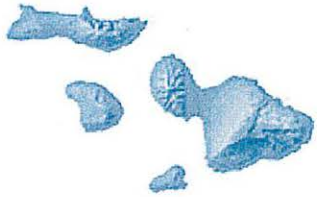
RICHARD T. BISSEN, JR.
Mayor

LORI TSUHAKO
Director

SAUMALU MATA'AFA
Deputy Director



DEPARTMENT OF HOUSING
& HUMAN CONCERNS
COUNTY OF MAUI
2200 MAIN STREET, SUITE 546
WAILUKU, MAUI, HAWAI'I 96793
PHONE: (808) 270-7805

July 25, 2023

Yukino Uchiyama, AICP
Munekiyo Hiraga
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Uchiyama:

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE FOR THE PROPOSED CENTRAL MAUI WASTEWATER RECLAMATION FACILITY; MAUI, HAWAII

The Department has reviewed the information submitted for the above subject project. Based on our review, we have determined that the project is not subject to Chapter 2.96, Maui County Code, and does not require a residential workforce housing agreement. At the present time, the Department has no additional comments to offer.

Please contact Mr. Buddy Almeida, Housing Administrator, at (808) 270-7351 if you have any questions.

Sincerely,

LORI TSUHAKO, LSW, ACSW
Director of Housing and Human Concerns

xc: Buddy Almeida, Housing Administrator
Juan Rivera, Department of Environmental Management, Wastewater Reclamation Division

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Tessa Munekiyo Ng AICP
VICE PRESIDENT

Michael T. Munekiyo AICP
FOUNDER

October 16, 2025

Richard E. Mitchell, Director
County of Maui
Department of Housing
2065 Main Street, Suite 108
Wailuku, Hawai‘i 96793

SUBJECT: Response to Comments Regarding Chapter 343, Hawai‘i Revised Statutes, Environmental Impact Statement Preparation Notice for the Proposed County of Maui Central Maui Wastewater Reclamation Facility Project; Maui, Hawai‘i

Dear Mr. Mitchell:

Thank you for your department’s comment letter dated July 25, 2023 regarding the Environmental Impact Statement Preparation Notice (EISPN) for the subject project. On behalf of the County of Maui, Department of Environmental Management (DEM), we acknowledge that the Department of Housing has no comments to offer at this time.

Thank you again for your participation in the Chapter 343, Hawai‘i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft EIS that is being prepared for this project. Should you have any questions or require additional information, please feel free to contact me at (808) 983-1233.

Very truly yours,

Yukino Uchiyama

Yukino Uchiyama, AICP
Manager

YU:ab
cc: Juan Rivera, Department of Environmental Management
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RICHARD T. BISSEN, JR.
Mayor

KEKUHAUPIO R. AKANA
Managing Director

PATRICK S. MCCALL
Director

SHANE T. DUDOIT
Deputy Director

DEPARTMENT OF PARKS AND RECREATION
COUNTY OF MAUI
700 HALI'A NAKOA STREET, UNIT 2
WAILUKU, MAUI, HAWAI'I 96793
www.mauicounty.gov

August 21, 2023

Yukino Uchiyama, AICP
Munekiyo Hiraga
305 High Street, Suite 104
Wailuku, HI 96793

Dear Ms. Yukino:

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE FOR THE PROPOSED CENTRAL MAUI WASTEWATER RECLAMATION FACILITY; KAHULUI, MAUI, HAWAI'I

Thank you for the opportunity to review and comment on the subject project. The Department of Parks and Recreation (DPR) has the following comments and concerns.

Land purchased with revenue from the open space, natural resources, cultural resources, and scenic views preservation fund. The Fiscal Year 2013 budget appropriated $5 million for the acquisition of the 209-acre site from the open space, natural resources, cultural resources, and scenic views preservation fund. Resolution No. 13-97 identifies the agreed upon purchase price of the property as $5,226,075 plus closing costs of $5,000. Resolution No. 13-97 further notes that the property shall be used consistently with the purposes set forth in Section 9-19, Revised Charter of the County of Maui (1983), as amended, and Chapter 3.88, Maui County Code (MCC). Pursuant to Chapter 3.88 MCC, lands purchased with these funds shall be for the following purposes:

1. Public outdoor recreation and education;
2. Preservation of historic or culturally important land areas;
3. Protection of significant habitat or ecosystems, including buffer zones;
4. Preserving forests, beaches, coastal areas and agricultural lands;
5. Protecting watershed lands to preserve water quality;
6. Conserving land for the purpose of reducing erosion, floods, landslides, and runoff; and
7. Improving disabled and public access to, and enjoyment of, public land, open space, and recreational facilities.

7. Improving disabled and public access to, and enjoyment of, public land, open space, and recreational facilities.

The proposed Central Maui Wastewater Reclamation Facility as described in the EISPN is not consistent with the purposes set forth in Section 9-19, Revised Charter of the County of Maui (1983), as amended, and Chapter 3.88, MCC.

DPR planning for a regional park at the site. The Maui Island Plan (2012) identifies the subject 209-acre site and the adjacent 100-acre County base yard site as the Central Maui Regional Park and County Facility Area. Both sites are designated Park on the Protected Areas Diagram and described in the Directed Growth Plan to be used for parks, open space, recreation, and preservation of the cultural resources in the Central Maui Sand Dune system.

To fulfill the purposes as described in the Maui Island Plan and Resolution No. 13-97, the DPR retained a consultant in 2020 to prepare a master plan and technical studies including an existing site conditions analysis, Preliminary Engineering Report, Traffic Impact Assessment Report (TIAR), and Cultural Impact Assessment (CIA). The CIA is underway and the results of the study will inform the range of potential recreational or cultural uses of the site.

Potential impacts on the proposed park. Regardless of what the specific uses are, the presence of a wastewater facility in proximity to the park will likely have negative impacts due to odors and other operational functions at the facility. As a result, the "usable" area of the site would be limited to areas where odors and other impacts are not experienced. Furthermore, the final footprint of the WWRF site could be larger than what has been shown. Access roads and other ancillary structures for the facility should be displayed, along with any buffer areas that will be provided and are not part of the park.

Historic properties at the proposed facility. As noted earlier, a CIA is now being prepared for the 209-acre site. The DPR starts master plan projects with a CIA before any planning is initiated, as part of its commitment to understanding the cultural importance of lands we steward and identifying and protecting cultural features and historic properties. This approach is part of the department's four pillars for its planning program. Under the Stewardship Pillar, the strategy is to "Respect the historical and cultural legacy of park sites and features during planning and design".

As part of this approach and in addition to the CIA, we consult with Dr. Janet Six, the County of Maui's archaeologist, on projects where her expertise is needed. Dr. Six has provided information on other historic properties in the area and has provided the DPR with the comments below.

Comments from Dr. Six

As DPR has already pointed out, a project such as this is not appropriate for this area

based on vetted criteria, therefore I would like to weigh in on the cultural inappropriateness of constructing such a facility in or adjacent to a known burial ground – the Pu`uone Dune Complex.

Below are my comments and concerns with the proposed Waste Water Reclamation Facility being constructed in this area. If they seem familiar it is because they are. This is some of the same data that I presented to our former Mayor when he wanted to build "Dream City II" in the Wai`ale area leading to the "Wai`ale Acquisition" and the preservation of over 500 acres to the northeast. The only thing that has changed since I presented this data in 2020, is that additional precontact burials have been identified in the immediate area.

The Pu`uone Dune Complex:

The following maps are the result of a collaborative effort in August of 2020, between the Principal Archaeologist for Maui County, Janet Six, PhD, County GIS specialists Michael Napier (Planning) and Daniel Sereno (Management) and the State Historic Preservation Division (SHPD) GIS specialist Michael Wahl. Dr. Susan Lebo, head of the SHPD Archaeology Branch, allowed the County to utilize sensitive SHPD data to create a cultural sensitivity "fishnet" layer to better inform the then-Mayor Michael Victorino's proposed Wai`ale 100% affordable housing project. ***This analysis comes with the following caveat: the following data displayed is what has been digitized by the SHPD at the time of this request and does not represent the entire scope of SHPD data.***

The cultural sensitivity fishnet layer – visible as red for high sensitivity and yellow for medium sensitivity - is based on the intersection of soil type and previously recorded archaeological data. It is displayed as a "fishnet" comprised of 100 meter red or yellow squares. The analysis below is based on the following question: ***Where is the intersection of sand, known burials and burial preserves in relation to the parcels that are proposed for development by the County?***

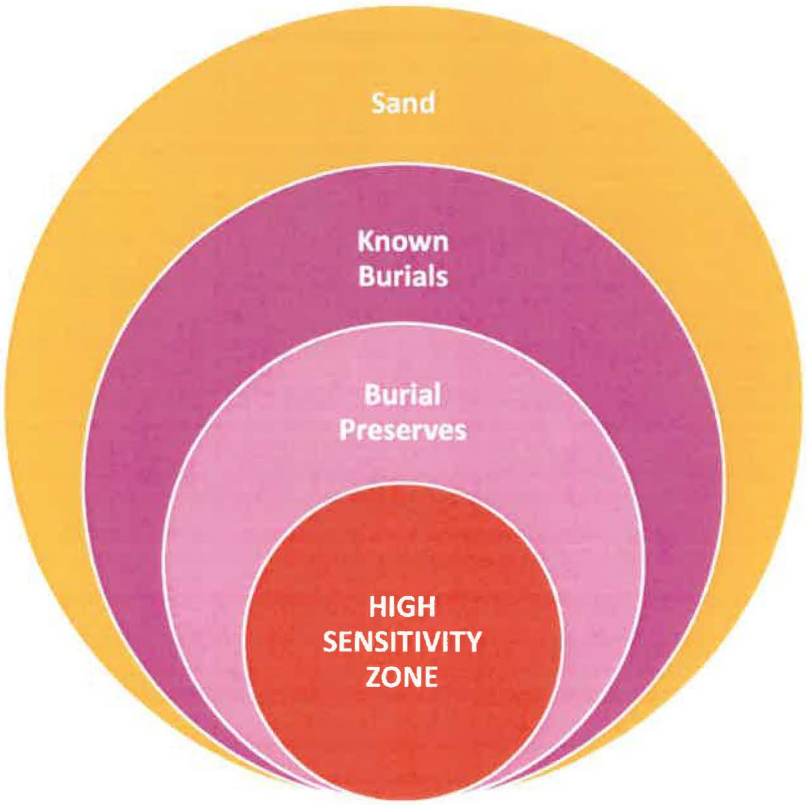


Figure 1: Attributes of HIGH SENSITIVITY areas.
Areas that possess these attributes are displayed on the following map in red or yellow.

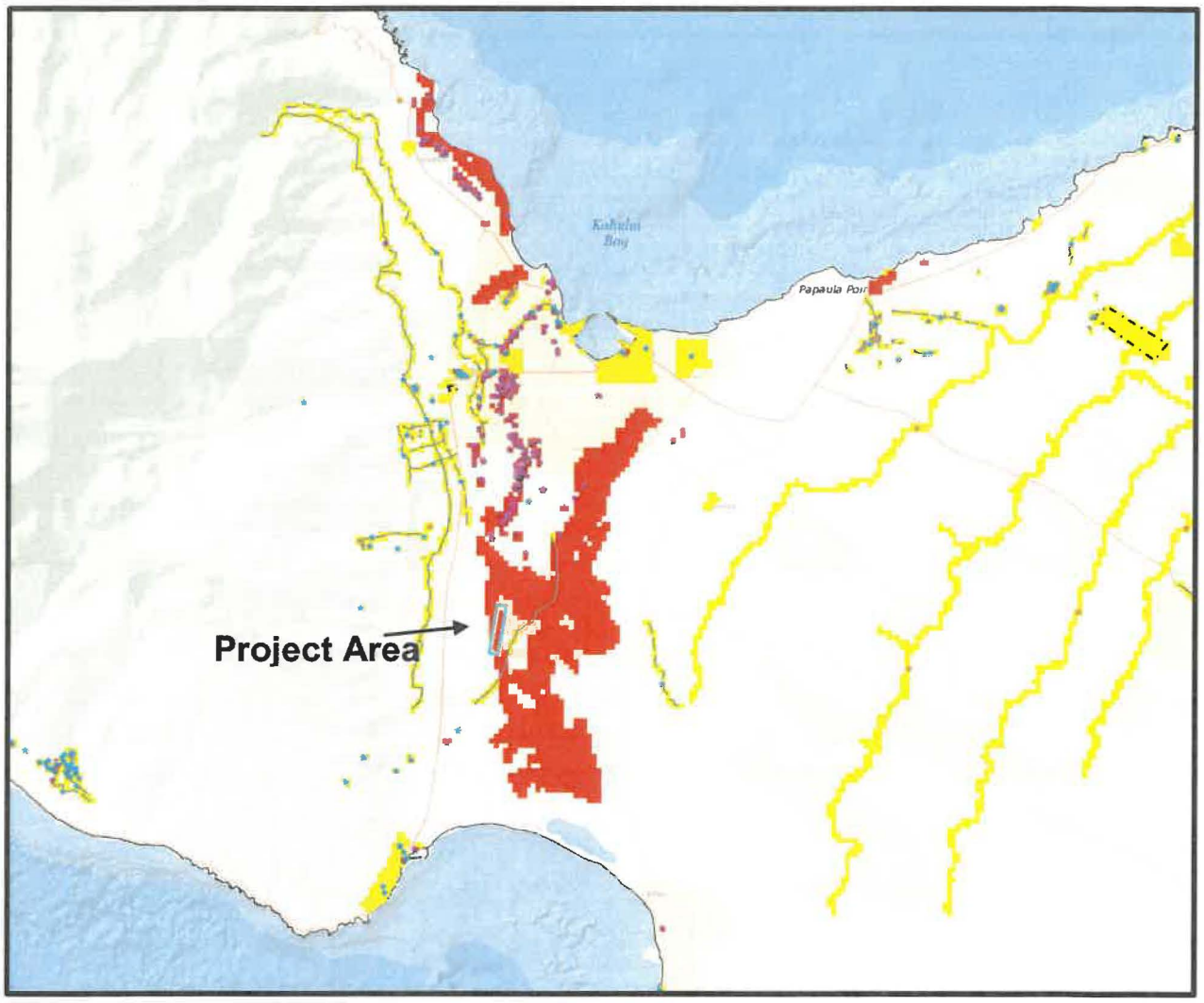


Figure 2: Pu`uone dune complex with the Cultural Sensitivity Fishnet Layer displaying the SHPD data.

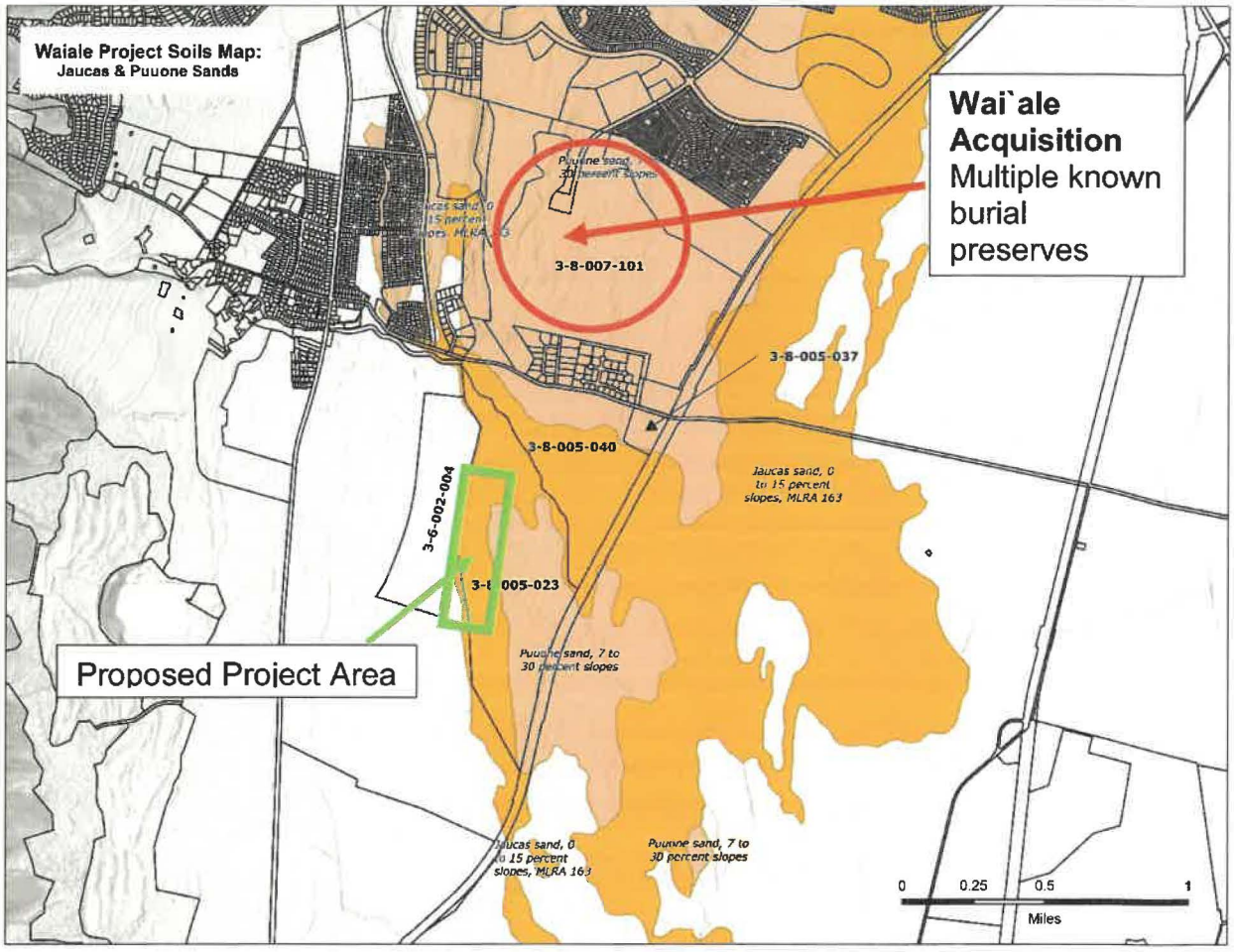


Figure 3: Soils map showing Jaucaus (dark orange) and Pu`uone (light orange) Sands in relation to known burial preserves and the proposed project area.

In an aeolian environment where the wind can shape and shift the dunes over time, "burial depths" could be deeper or shallower than anticipated. At Waiko Light Industrial the ten inadvertent finds are found at three different depths likely indicating various interments over a length of time where surface elevations had likely shifted.

It is well known that people lived in the adjacent valleys such as Waikapu, and not in the dunes so this should not be surprising there is a lack of habitation sites found here. This dune complex is an **Ao Kuewa** - realm of Homeless Spirits.

The following excerpt, taken from a document drafted for the County by then Cultural Advisor to Mayor Victorino, Kumu Hula Pueo Pata. Pata, noted the following about the Pu`uone Dune Complex:

"The expansive region contemporarily known by the superimposed term of "Wailuku Commons" encompasses the low lying plains of Kama'oma'o. Kama'oma'o, also Kulaokama'oma'o, is famed as an **ao kuewa**. Although mentioned in numerous ka'ao, a

concise description about this culturally significant is featured herein. In his 48th installment of his "Ka Moolelo Hawaii" series in the Hawaiian language newspaper, *Ke Au Okoa*, historian Samuel Kamakau wrote:

> *. . . There are three realms spoken of frequently by the very learned people of the olden days here in Hawai'i, and so too thought the prophets, the geologists, the astronomers, and the architects: 1. The realm of homeless spirits; 2 The realm of family gods and guardians; 3 The realm of Milu. Those are the orders also known as 'Owā, Kapōkuakini, Kapōkuamano, and as many other names by the people of old. 1. The realm of homeless spirits, the wandering realm is another name. When a person without blood relatives died, their spirit wandered drifting while blundering amongst the wild weeds, and went aimlessly to Kama'oma'o, and to the wiliwili tree of Kaupe'a, and their spirit could go to Leilono where the 'Uluola'iwalo is. If their spirit is not procured by their own family god or guardian, or one that might help them, then their spirit will leap upon the rotten breadfruit branch and they will fall all the way down into the endless night presided over by Milu . . . There are places spoken of as belonging to wandering spirits, Maui has Kama'oma'o . . ."* (Volume VI, October 6, 1870)"

In Ruling Chiefs of Hawaii, Samuel M. Kamakau writes the following about the Battle of Kakanilua that took place in Sandhills in 1776, between the paramount chief of Hawai`i Island, Kalani'opu'u and Maui's Kahekili.

> *"They slew the Alapa on the sandhills at the southeast of Kalua.* ***There the dead lay in heaps strewn like kukui branches; the corpses lay heaped in death****; they were slain like fish in enclosed in a net. This great slaughter was called Ahulau ka Pi'ipi'i i Kakanilua (Slaughter-of-the-Pi'ipi'i-at-Kaka-nilua)" (1961: 84-87).*

In Elsbeth Sperling's Sites of Maui the following first-hand experience is recorded, describing the Pu`uone Dune Complex as a huge "Golgotha" and also speaks to the scirocco like winds in this region:

WAILUKU 127 BATTLE AND BURIAL SITES

G. W. Bates, *Sandwich Island Notes*, 309.

[Coming from Lahaina.] This mountain-region once passed, the traveler enters on the plain or isthmus of Kula. It is a sandy alluvial, constantly changing the configuration of its surface beneath the action of heavy winds. This neck of land has a gradual elevation from the sea-shore on the southwest, to nearly two hundred feet on the northeast, in the region of Wai-lu-ku. In extent it is seven miles by twelve. During three fourths of the year it forms a fine pasture-land for hundreds of cattle that range over its surface. It is not fit for cultivation.

Leaving Wai-lu-ku, and passing along toward the village Kahului, a distance of three miles, the traveler passes over the old battle-ground named after the village. It is distinctly marked by moving sand-hills, which owe their formation to the action of the northeast trades. Here these winds blow almost with the violence of a sirocco, and clouds of sand are carried across the northern side of the isthmus to a height of several hundred feet. These sand-hills constitute a huge "Golgotha" for thousands of warriors who fell in ancient battles. In places laid bare by the action of the winds, there were human skeletons projecting, as if in the act of struggling for a resurrection from their lurid sepulchres. In many portions of the plain whole cart-loads were exposed in this way. Judging of the numbers of the dead, the contests of the old Hawaiians must have been exceedingly bloody. . . .

Although I could not reconcile my mind to the belief that a removal of any of these remains would be exactly right, I could not resist the inclination to procure a few perfect craniums. This "Golgotha," however, afforded no such specimens. Calling at a store in the village of Kahului, I borrowed a shovel to aid me in my researches. As I rode a short distance to the eastward beyond the village, that shovel, dangling from my saddle-bow, sent forth such sepulchral notes as seemed to chide my resolves. But I rode on. Arriving at the eastern extremity of this old battle-ground, I took off coat and vest, for the weather was intensely warm.

Wailuku 127–132

The openness of the plain caused my operations to be seen by a few natives, who lived the sea-shore, at the distance of a short mile. An ever-restless curiosity brought them to the sc of my excavations, but they manifested not the least concern on account of my sacrilegious a . . . I discovered a few decomposed vertebrae, and some imperfect craniums, which crumble dust by an exposure to the atmosphere.

Conclusion and Expectations:

It is important to consider the data at hand both textual and physical in order to fully comprehend the risks and challenges associated with developing any portion of the Pu`uone dune complex. ***Based solely on the SHPD data, the Cultural Sensitivity Fishnet Layer indicates a high statistical probability of encountering intact and/or previously disturbed burials within portions of the proposed project area.***

Should you have any questions, please feel free to contact me or Samual Marvel, Chief of Planning and Development, at samual.marvel@co.maui.hi.us or (808) 270-6173.

Sincerely,

PATRICK S. MCCALL
Director of Parks and Recreation

c: Juan Rivera, Department of Environmental Management
Janet Six, PhD, County of Maui Principal Archaeologist
David Yamashita, Planner VI
Samual A. Marvel, Chief of Planning and Development

PSM:SAM:csa

From: Samual A. Marvel <Samual.Marvel@co.maui.hi.us>
Sent: Tuesday, October 29, 2024 2:53 PM
To: Juan A. Rivera <Juan.Rivera@co.maui.hi.us>
Subject: Re: Central Maui WWRF and SAT Facilities -- Dept of Parks (Out of Office - Returning 11/4/2024)

I'm currently away from the office and will be returning on Monday, November 4. Please contact Cheryl Akiona at cheryl.akiona@co.maui.hi.us for immediate assistance.

>>> Juan Rivera 10/29/24 14:53 >>>

Samual,

I am reaching out to the Dept of Parks to resolve some questions related to the Environmental Impact Statement Preparation Notice (EISPN) for the new, proposed Central Maui Wastewater Reclamation Facility. On August 21, 2023, the Dept of Parks submitted a letter of comment on the EISPN which enumerated various concerns which the Department of Environmental Management (DEM) wishes to address, clarify and resolve prior to the publication of the Final EIS for this project.

A copy of the letter is attached.

In summary, the concerns and our responses are as follows;

DPR Comment: New WWRF is located on land Purchased with the Open Space, Natural Resources, Cultural Resources, and Scenic Views Preservation Fund

Per DPR's comment, the project needs to be consistent with Chapter 3.88 MCC which states that the lands purchased with this fund need to be used for preservation/recreational purposes etc. Please note that one of the listed land use purposes is "***5. Protecting watershed lands to preserve water quality***". The DEM would like to make the argument that the proposed project is providing an alternative to cesspools and septic tanks, which help protect watersheds. It could also be argued that the project will protect significant habitat/eco systems, forests, beaches, etc. Moreover, the proposed facility will produce R-1 quality recycled water, most of it intended for beneficial agricultural and irrigation use, further saving valuable watershed resources.

Alternatively, the DEM suggests that the 14.9-acre WWRF site could be subdivided so that the WWRF site can be removed from this Chapter 3.88 MCC requirements.

DPR Comment: The Maui Island Plan (MIP)'s designation – See attached, MIP excerpt.

According to the MIP, the Directed Growth Plan map shows the 14.9-acre WWRF site as "Regional Park and County Facilities". It also says "*The Central Maui Regional Park may provide an area for the offices of the County Department of Parks and Recreation, a community center, County baseyards and like County facilities, and a location for the annual County Fair*".

The DEM argues that the MIP does not seem to preclude the WWRF type use from this location. Moreover the Planning Department has not provided any comments opposing the location of the proposed facility.

DPR Comment: Potential Impacts (i.e. odors and views)
The design of the proposed facility provides for Odor control and visual buffers. We are confident that with implementation of these measures, the park type uses and the proposed facility can co-exist. Please note that the DEM no longer uses chlorine gas for wastewater effluent disinfection. There is no possibility of poisonous gas leaks.

DPR Comment: Historic Properties and the Puuone Dune Complex

The project site was selected due to the soil type which is very good for intended effluent disposal systems, and for its resiliency against sea level rise, erosion hazard, and tsunami impacts. We understand that this is a cultural sensitive area; according to Cultural Surveys Hawaii (CSH), the sand dune complex stretches across Central Maui from Waiheʻe to Maʻalaea, so the same historic and environmental considerations will be typical of nearly every other project being built or considered in this region.

At CHS's recommendation we are conducting an Archaeological Inventory Survey (AIS) and we are initiating Section 6E consultation with SHPD. The project will coordinate with SHPD and implement necessary mitigation measures.

Actions:

Please review our responses and feel free to comment. It is the desire of the DEM to obtain a statement of concurrence from the DPR which we can include in our final EIS.

If you have any questions or concerns, please feel free to contact me or our Permit Consultant, Ms. Yukino Uchiyama, AICP, Manager, at Munekiyo Hiraga, Inc. at Yukino@munekiyohiraga.com or by phone at 808-983-1233.

Mahalo

Juan Rivera, PE, CE-VI
Capital Improvements Program Manager
Wastewater Reclamation Division
2200 Main Street, Suite 610
Wailuku, Maui, HI 96793
Office: (808) 270-7268
PLEASE DO NOT CC ME UNLESS YOU NEED MY DIRECT INPUT, THANKS.

RICHARD T. BISSEN, JR.
Mayor

JOSIAH K. NISHITA
Managing Director

PATRICK S. MCCALL
Director

SHANE T. DUDOIT
Deputy Director

DEPARTMENT OF PARKS AND RECREATION
COUNTY OF MAUI
700 HALI'A NAKOA STREET, UNIT 2
WAILUKU, MAUI, HAWAI'I 96793
www.mauicounty.gov

December 19, 2024

Wastewater Reclamation Division
Department of Environmental Management
2200 Main St., Suite 601
Wailuku, HI 96763
Attention Mr. Juan Rivera:

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE FOR THE PROPOSED CENTRAL MAUI WASTEWATER RECLAMATION FACILITY; KAHULUI, MAUI, HAWAI'I

Thank you for your October 29, 2024, e-mail response to our comment letter, dated August 21, 2023, regarding the Environmental Impact Statement Preparation Notice (EISPN) for the proposed Central Maui Wastewater Reclamation Facility (WWRF). The Department of Environmental Management (DEM) seeks a statement of concurrence from the Department of Parks and Recreation (DPR) on several issues and concerns as part of the final EIS.

Criteria set forth in Section 9-19, Revised Charter of the County of Maui (1983), as amended, and Chapter 3.88, Maui County Code (MCC)

On the topic of the proposed WWRF site on land purchased with the Open Space, Natural Resources, Cultural Resources, and Scenic Views Preservation Fund (Preservation Fund), the DEM contends that the proposed project meets the regulatory compliance of the Preservation Fund by protecting watershed resources since the facility will provide an alternative to cesspools and septic tanks and will produce R-1 quality recycled water for agricultural and irrigation use.

The DPR acknowledges the project may protect watershed resources in the future by providing an alternative wastewater management system to reduce dependency on cesspools and septic tanks in preparation of a growing population and future development. Furthermore, DPR agrees that the proposed facility will preserve water by producing recycled water. In consideration of this, we concur that project may be consistent with the goals and objectives of the Preservation Fund.

Although the project may comply with the regulatory requirements on land acquired with the Preservation Fund, it doesn't mean that the proposed use is the best use. The EISPN fails to acknowledge the Preservation Fund and associated criteria. The draft EIS should provide an assessment of the project's compliance with the Preservation Fund, and it should provide an alternatives analysis that weighs the benefits of the proposed project against the alternative use of the project site as part of a regional park.

The Maui Island Plan (MIP) Designation

The MIP states "The Central Maui Regional Park may provide an area for the offices of the County Department of Parks and Recreation, a community center, County base yards and like County facilities, and a location for the annual County Fair." Since other uses are possible on this parcel, the draft EIS should provide an alternatives analysis of other possible uses at the proposed WWRF site.

The DEM argues that the Central Maui Regional Park allows for "County baseyards and like County facilities", and that the proposed WWRF qualifies as a like County facility. While DPR will not dispute that the proposed WWFR is a county facility that complies with other relevant criteria described in the MIP, we do maintain that the primary intended use of the Central Maui Regional Park property is to provide recreation facilities and open space for use as a regional park. We concur that the proposed WWFR could be a reasonable secondary use compliant with the MIP designation if adverse impacts are properly mitigated.

Potential Impacts / Historic Properties

The EISPN does not adequately assess potential impacts and mitigation. For example, under the section assessing potential impacts to recreational facilities, the EISPN only states, "the proposed project is not anticipated to impact recreational facilities in Central Maui." DPR does not concur with this statement in the EISPN. We believe that one of the biggest impacts of the proposed project is that it is taking away lands that were intended for use as a regional park, and that the project may adversely impact the adjacent planned future recreational area. The draft EIS should acknowledge the impact of the proposed project, account for the area of impact beyond the footprint of the facilities and describe the mitigation that will be implemented to promote the full enjoyment of the surrounding planned Central Maui Regional Park. The DPR acknowledges that the design of the proposed facilities will include odor control and visual buffers. Please provide a detailed description of these and other mitigation in your draft EIS.

The DPR recognizes that the culturally sensitive nature of the project area would have similar implications for any proposed development in the Pu'uone dune complex, and that other possible sites for the proposed WWRF would also likely have potential impacts to historic and cultural resources. We also recognize that as part of the EIS, consultation with the State Historic Preservation Division (SHPD) and Office of Hawaiian Affairs (OHA) will be conducted to ensure historic, archaeological, and cultural concerns are addressed and appropriate mitigation measures identified. The draft EIS should provide a comprehensive overview of the project area's history and cultural significance, clarify likely impacts of the proposed project, and describe all mitigation measures that will be implemented to minimize adverse impacts.

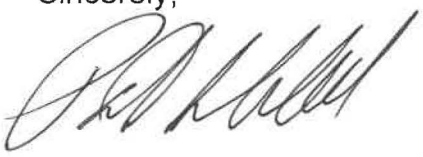
Location Alternatives

In the *Alternatives to the Proposed Action* section of the EISPN that explores alternative locations for the proposed project, please prepare a more thorough analysis describing why the Central Maui Regional Park site is the preferred location. The EISPN simply states, "these alternative locations were not selected due to their existing uses and need for those existing uses to be relocated, as well as flood zone considerations." Given the drawbacks of the Central Maui Regional Park site, DPR would expect DEM to have more compelling reasons to justify the project site.

The draft EIS should mention that one of the main benefits to an alternative siting is that no space would be lost at the future Central Maui Regional Park. That is one clear benefit of an alternative siting of the proposed project and DPR strongly contends this should be mentioned in the draft EIS in order to provide the public with a complete picture of the proposed action and possible alternatives.

Should you have any questions, please feel free to contact me or Samual Marvel, Chief of Planning and Development, at samual.marvel@co.maui.hi.us or (808) 270-6173.

Sincerely,



PATRICK S. MCCALL
Director of Parks and Recreation

c: Samual Marvel, Chief of Planning and Development
Wesley Bradshaw, Planner

PSM:SAM:wcb

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PRESIDENT
Mark Alexander Roy AICP, LEED AP
VICE PRESIDENT
Tessa Munekiyo Ng AICP
VICE PRESIDENT

Michael T. Munekiyo AICP
FOUNDER

October 16, 2025

Patrick S. McCall, Director
Department of Parks and Recreation
County of Maui
P.O. Box 1405
Wailuku, Hawai'i 96793-6405

SUBJECT: Response to Comments Regarding Chapter 343, Hawai'i Revised Statutes, Environmental Impact Statement Preparation Notice for the Proposed County of Maui Central Maui Wastewater Reclamation Facility Project; Maui, Hawai'i

Dear Mr. McCall:

Thank you for your comment letters dated August 21, 2023 and December 19, 2024 regarding the Environmental Impact Statement Preparation Notice (EISPN) for the subject project. Our understanding is that your latest comment letter sets forth your Department's updated comments on the EISPN and the proposed project. As such and on behalf of the County of Maui, Department of Environmental Management (DEM), we offer the following information in response to your updated comments:

Comment No. 1:

Criteria set forth in Section 9-19, Revised Charter of the County of Maul (1983), as amended, and Chapter 3. 88, Maui County Code (MCC)

On the topic of the proposed WWRF site on land purchased with the Open Space, Natural Resources, Cultural Resources, and Scenic Views Preservation Fund (Preservation Fund), the DEM contends that the proposed project meets the regulatory compliance of the Preservation Fund by protecting watershed resources since the facility will provide an alternative to cesspools and septic tanks and will produce R-1 quality recycled water for agricultural and irrigation use.

The DPR acknowledges the project may protect watershed resources in the future by providing an alternative wastewater management system to reduce dependency on cesspools and septic tanks in preparation of a growing population and future development. Furthermore, DPR agrees that the proposed facility will preserve water by producing recycled water. In consideration of this, we concur that project may be consistent with the goals and objectives of the Preservation Fund.

Although the project may comply with the regulatory requirements on land acquired with the Preservation Fund, it doesn't mean that the proposed use is the best use. The EISPN fails to acknowledge the Preservation Fund and associated criteria. The draft EIS should provide an assessment of the project's compliance with the Preservation Fund, and it should provide an alternatives analysis that weighs the benefits of the proposed project against the alternative use of the project site as part of a regional park.

Response: We appreciate your concurrence that implementation of the proposed Central Maui Wastewater Reclamation Facility (WWRF) on the land purchased with the Open Space, Natural Resources, Cultural Resources and Scenic Views Preservation Fund (Preservation Fund) complies with the regulatory requirements of the Preservation Fund as the WWRF will protect watershed by providing alternative wastewater management system and preserve water by providing R-1 recycled water.

Pursuant to your request, the Draft Environmental Impact Statement (EIS) will include a discussion relating to the Preservation Fund, as well as an alternatives analysis chapter that will discuss potential alternative uses for the subject property.

Comment No. 2:

The Maui Island Plan (MIP) Designation

The MIP states "The Central Maui Regional Park may provide an area for the offices of the County Department of Parks and Recreation, a community center, County base yards and like County facilities, and a location for the annual County Fair." Since other uses are possible on this parcel, the draft EIS should provide an alternatives analysis of other possible uses at the proposed WWRF site.

The DEM argues that the Central Maui Regional Park allows for "County baseyards and like County facilities", and that the proposed WWRF qualifies as a like County facility. While DPR will not dispute that the proposed WWFR is a county facility that complies with other relevant criteria described in the MIP, we do maintain that the primary intended use of the Central Maui Regional Park property is to provide recreation facilities and

open space for use as a regional park. We concur that the proposed WWFR could be a reasonable secondary use compliant with the MIP designation if adverse impacts are properly mitigated.

Response: As previously noted, the Draft EIS will include a discussion of alternative uses for the Central Maui WWRF project site. We note your concurrence that the proposed WWRF could be a reasonable use adjacent to a potential future regional park if adverse impacts are properly mitigated. The Draft EIS will include discussions of proposed odor control systems and visual mitigation measures to avoid and minimize potential impacts to an adjacent potential future park use. It is noted that the Planning Department was consulted and it was determined that a MIP amendment is appropriate to amend the MIP Growth Areas Map, Planned Protected Areas Map, and related narratives to make the MIP fully compatible with the proposed Central Maui WWRF.

Comment No. 3:

Potential Impacts to Historic Properties

The EISPN does not adequately assess potential impacts and mitigation. For example, under the section assessing potential impacts to recreational facilities, the EISPN only states, "the proposed project is not anticipated to impact recreational facilities in Central Maui." DPR does not concur with this statement in the EISPN. We believe that one of the biggest impacts of the proposed project is that it is taking away lands that were intended for use as a regional park, and that the project may adversely impact the adjacent planned future recreational area. The draft EIS should acknowledge the impact of the proposed project, account for the area of impact beyond the footprint of the facilities and describe the mitigation that will be implemented to promote the full enjoyment of the surrounding planned Central Maui Regional Park. The DPR acknowledges that the design of the proposed facilities will include odor control and visual buffers. Please provide a detailed description of these and other mitigation in your draft EIS.

The DPR recognizes that the culturally sensitive nature of the project area would have similar implications for any proposed development in the Pu'uone dune complex, and that other possible sites for the proposed WWRF would also likely have potential impacts to historic and cultural resources. We also recognize that as part of the EIS, consultation with the State Historic Preservation Division (SHPD) and Office of Hawaiian Affairs (OHA) will be conducted to ensure historic, archaeological, and cultural concerns are addressed and appropriate mitigation measures identified. The draft EIS should provide a comprehensive overview of the project area's history and cultural significance, clarify likely impacts of the proposed

project, and describe all mitigation measures that will be implemented to minimize adverse impacts.

Response: The purpose of an EISPN is for scoping of potential environmental impacts and to solicit comments from the public and various agencies on the topics to be addressed in the subsequent Draft EIS. Various technical studies have now been completed for the Draft EIS as a result of input received on the EISPN, and the Draft EIS will include technical and in-depth analysis of potential environmental impacts and proposed mitigation measures associated with the project. We note your comment that the proposed project is utilizing a portion of lands that were initially envisioned for potential use as a regional park and that the project could present impacts on an adjacent future recreational area. The Draft EIS will include discussion of the proposed project's potential impacts to surrounding land uses as well as odor control and visual mitigation measures, as appropriate.

We acknowledge the cultural sensitivity of the project area located in the Puʻuone dune complex. An Archaeological Inventory Survey (AIS) and Cultural Impact Assessment (CIA) have been prepared for the project and will be included and discussed in the Draft EIS. The State Historic Preservation Division (SHPD) is being consulted pursuant to Hawaiʻi Revised Statutes (HRS) 6E and agreed upon cultural and archaeological mitigation measures will be implemented as part of the project. The Office of Hawaiian Affairs (OHA) is also being consulted through the Chapter 343, HRS EIS process.

Comment No. 4:

Location Alternatives

In the Alternatives to the Proposed Action section of the EISPN that explores alternative locations for the proposed project, please prepare a more thorough analysis describing why the Central Maui Regional Park site is the preferred location. The EISPN simply states, "these alternative locations were not selected due to their existing uses and need for those existing uses to be relocated, as well as flood zone considerations." Given the drawbacks of the Central Maui Regional Park site, DPR would expect DEM to have more compelling reasons to justify the project site.

The draft EIS should mention that one of the main benefits to an alternative siting is that no space would be lost at the future Central Maui Regional Park. That is one clear benefit of an alternative siting of the proposed project and DPR strongly contends this should be mentioned in the draft EIS in

order to provide the public with a complete picture of the proposed action and possible alternatives.

Response: We appreciate and note your comment regarding location alternatives. The Draft EIS will include information and discussion on alternative location considerations that were evaluated by DEM and its design team in the process of identifying the preferred location for the project.

Thank you again for your participation in the Chapter 343, Hawai‘i Revised Statutes environmental review process. A copy of your letters and this response will be included in the Draft EIS that is being prepared for this project. Should you have any questions or require additional information, please feel free to contact me at (808) 983-1233.

Very truly yours,

Yukino Uchiyama, AICP
Manager

YU:ab
cc: Juan Rivera, Department of Environmental Management
Eric Nakagawa, Department of Environmental Management
Scott Rollins, Department of Environmental Management
Craig Lekven, Brown and Caldwell
Irina Constantinescu, Brown and Caldwell
Trevor Yucha, Cultural Surveys Hawai‘i
Tehani Baculpo, Cultural Surveys Hawai‘i
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RICHARD T. BISSEN JR.
Mayor

KATHLEEN ROSS AOKI
Planning Director

GARRETT E. SMITH
Deputy Director

DEPARTMENT OF PLANNING
COUNTY OF MAUI
ONE MAIN PLAZA
2200 MAIN STREET, SUITE 315
WAILUKU, MAUI, HAWAI'I 96793

August 1, 2023

Ms. Yukino Uchiyama, AICP
Munekiyo Hiraga
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Uchiyama:

SUBJECT: RESPONSE TO CHAPTER 343, HAWAII REVISED STATUTES, ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE FOR THE PROPOSED CENTRAL MAUI WASTEWATER RECLAMATION FACILITY; MAUI (RFC2023-00085)

The Maui County Planning Department (Department) is in receipt of your letter dated July 20, 2023, regarding the proposed Central Maui Wastewater Reclamation Facility.

The Department recognizes the criticality of the Central Maui Wastewater Reclamation Facility not only for projects such as Waikapu Country Town, but for the greater Waikapu and Wailuku regions.

The Department concurs with the planned review process for the project as outlined in the EISPN regarding the District Boundary Amendment, Community Plan Amendment, and Change in Zoning.

We look forward to providing additional comments as more construction details come forward in the draft Environmental Impact Statement documents.

Thank you for your cooperation. If additional clarification is required, please contact Staff Planner Kurt Wollenhaupt at kurt.wollenhaupt@mauicounty.gov or at (808) 270-1789.

Sincerely,

Kathleen Ross Aoki

KATHLEEN ROSS AOKI
Planning Director

MAIN LINE (808) 270-7735 / CURRENT DIVISION (808) 270-8205 / LONG RANGE DIVISION (808) 270-7214 / ZONING DIVISION (808) 270-7253

xc: Jordan E. Hart, Planning Program Administrator (PDF)
Jacky Takakura, Planning Program Administrator (PDF)
Ann Cua, Planning Program Administrator (PDF)
Danny Dias, Land Use Planning Supervisor (PDF)
Kurt Wollenhaupt, Staff Planner (PDF)
Juan Rivera, DEM, County of Maui (PDF)
Eric Nakagawa, DEM, County of Maui (PDF)
Scott Rollins, DEM, County of Maui (PDF)

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Karlynn K. Fukuda
PRESIDENT
Mark Alexander Roy AICP, LEED AP
VICE PRESIDENT
Tessa Munekiyo Ng AICP
VICE PRESIDENT

Michael T. Munekiyo AICP
FOUNDER

October 16, 2025

Kate Blystone, Director
County of Maui
Department of Planning
One Main Plaza
2200 Main Street, Suite 315
Wailuku, Hawai'i 96793

SUBJECT: Response to Comments Regarding Chapter 343, Hawai'i Revised Statutes, Environmental Impact Statement Preparation Notice for the Proposed County of Maui Central Maui Wastewater Reclamation Facility Project; Maui, Hawai'i

Dear Ms. Blystone:

Thank you for your department's letter dated August 1, 2023 regarding the Environmental Impact Statement Preparation Notice (EISPN) for the subject project. On behalf of the County of Maui, Department of Environmental Management (DEM), we offer the following information in response to the comments received:

Comment No. 1:

The Department recognizes the criticality of the Central Maui Wastewater Reclamation Facility not only for projects such as Waikapu Country Town, but for the greater Waikapu and Wailuku regions.

Response: Thank you for acknowledging the importance of the proposed project for the greater Waikapū and Wailuku regions.

Comment No. 2:

The Department concurs with the planned review process for the project as outlined in the EISPN regarding the District Boundary Amendment, Community Plan Amendment, and Change in Zoning.

Response: Thank you for your concurrence with the planned review process for the District Boundary Amendment, Community Plan Amendment, and Change in Zoning. It is noted that following the publication of the EISPN, your department was consulted and it was determined that a Maui Island Plan (MIP) Amendment would be appropriate to amend the MIP Planned Growth Areas Map, Planned Protected Areas Map, and related narratives to make the MIP fully compatible with the proposed Central Maui WWRF.

Thank you again for your participation in the Chapter 343, Hawai'i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft Environmental Impact Statement (EIS) that is being prepared for this project. Should you have any questions or require additional information, please feel free to contact me at (808) 983-1233.

Very truly yours,

Yukino Uchiyama, AICP
Manager

YU:ab
cc: Juan Rivera, Department of Environmental Management
Eric Nakagawa, Department of Environmental Management
Scott Rollins, Department of Environmental Management
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RICHARD T. BISSEN, JR.
Mayor

KEKUHAUPIO R. AKANA
Managing Director

JOHN STUFFLEBEAN, P.E.
Director

JAMES A. LANDGRAF
Deputy Director

DEPARTMENT OF WATER SUPPLY
COUNTY OF MAUI
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAI'I 96793
http://www.mauicounty.gov/water

August 9, 2023

Yukino Uchiyama, AICP
MUNEKIYO HIRAGA
via email: CentralMauiWWRF@munekiyohiraga.com

Juan Rivera, P.E.
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
via email: environmental.mgmt@co.maui.hi.us

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE
Proposed Central Maui Wastewater Reclamation Facility
TMK: (2) 3-5-001:017 (por.) and 120 (por.), 3-5-002:014 (por.), 3-5-020:036 (por.), 3-6-002:003 (por.) and 004 (por.), 3-8-005:023 (por.), portions of Waikapu Stream, and portions of the existing Waiale Road, Kuikahi Drive and Waiko Road

Thank you for the opportunity to review and comment on the proposed Central Maui Wastewater Reclamation Facility project, which also includes an onsite Soil Aquifer Treatment basin and offsite infrastructure improvements (wastewater pump station and pipeline).

Prior to commencement of construction, submit construction plans (24"x36") stamped and signed by a licensed engineer for the Department's review and approval, indicating any water system improvements in accordance with the Department's Water System Standards 2002, as may be amended. Construction plans shall show location of existing waterlines, valves, fire hydrants, water meters, etc. and indicate, but not limited to the following:

- Depth and location of existing waterlines and appurtenances.
- Demolition of existing water valve and water meter manhole concrete collars within the project limits and reconstruction per Department Standard Detail V12 and V23, respectively.
- Replacement of existing valve box riser and cover of all water valves within the project limits.
- Minimum clearance with waterline or service lateral crossing over existing sewerline or service lateral shall be 18-inch minimum.

If water service from the Department of Water Supply is required, the project must meet the criteria outlined in the Administrative Rules (Title 16, Chapter 201). Please be aware there are existing water meters assigned to some of the subject properties, as follows:

- TMK 3-5-001:017: 1-1/2" water meter (WM #200515453) located along Olomea Street
- TMK 3-5-020:036: 1-1/2" water meter (Account #2316931047) located along Olomea Street

As indicated on page 39 of the Environmental Impact Statement Preparation Notice, a Preliminary Engineering and Drainage Report (PEDR) shall be prepared as part of the Draft EIS. We recommend that we are included in the report process to ensure comments are provided prior to completion of the Draft EIS.

If you have any questions, please contact me at (808) 270-7682 or at tammy.yeh@co.maui.hi.us. Engineering Division's main number is (808) 270-7835.

Sincerely,

Tammy Yeh

TAMMY YEH, P.E.
Civil Engineer VI

cc: DWS – Water Resource & Planning (Water.Resources@mauicounty.gov)

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PRESIDENT
Mark Alexander Roy AICP, LEED AP
VICE PRESIDENT
Tessa Munekiyo Ng AICP
VICE PRESIDENT

Michael T. Munekiyo AICP
FOUNDER

October 16, 2025

John Stufflebean, P.E., Director
County of Maui
Department of Water Supply
200 S. High Street, 5th Floor
Wailuku, Hawai'i 96793

SUBJECT: Response to Comments Regarding Chapter 343, Hawai'i Revised Statutes, Environmental Impact Statement Preparation Notice for the Proposed County of Maui Central Maui Wastewater Reclamation Facility Project; Maui, Hawai'i

Dear Mr. Stufflebean:

Thank you for your department's comment letter dated August 9, 2023 regarding the Environmental Impact Statement Preparation Notice (EISPN) for the subject project. On behalf of the County of Maui, Department of Environmental Management (DEM), we offer the following information in response to the comments received:

Comment No. 1:

Prior to commencement of construction, submit construction plans (24"x36") stamped and signed by a licensed engineer for the Department's review and approval, indicating any water system improvements in accordance with the Department's Water System Standards 2002, as may be amended.

Response: We confirm that construction plans for any water system improvements associated with this project will be sent to the Department of Water Supply (DWS) for review in accordance with the current Department's Water System Standards.

Comment No. 2:

Construction plans shall show location of existing waterlines, valves, fire hydrants, water meters, etc. and indicate, but not limited to the following:

- *Depth and location of existing waterlines and appurtenances.*
- *Demolition of existing water valve and water meter manhole concrete collars within the project limits and reconstruction per Department Standard Detail V12 and V23, respectively.*
- *Replacement of existing valve box riser and cover of all water valves within the project limits.*

- *Minimum clearance with waterline or service lateral crossing over existing sewerline or service lateral shall be 18-inch minimum.*

Response: Thank you for this information. The construction plans will include the information listed in your comment so that connection to the public water system can be approved by the DWS.

Comment No. 3:

If water service from the Department of Water Supply is required, the project must meet the criteria outlined in the Administrative Rules (Title 16, Chapter 201). Please be aware there are existing water meters assigned to some of the subject properties, as follows:

- *TMK 3-5-001:017: 1-1/2" water meter (WM #200515453) located along Olomea Street*
- *TMK 3-5-020:036: 1-1/2" water meter (Account #2316931047) located along Olomea Street*

Response: Water service from the DWS system will be required at the Kehalani Wastewater Pump Station (WWPS) and the Central Maui WWRF sites. Associated infrastructure improvements will be designed in accordance with the applicable Administrative Rules and Water System Standards so that the DWS can approve the connection. Thank you for the information regarding the two (2) existing water meters and the project team will look into these existing meters during the design process.

Comment No. 4:

As indicated on page 39 of the Environmental Impact Statement Preparation Notice, a Preliminary Engineering and Drainage Report (PEDR) shall be prepared as part of the Draft EIS. We recommend that we are included in the report process to ensure comments are provided prior to completion of the Draft EIS.

Response: As a follow-up to this comment, the project design engineer (Brown & Caldwell) submitted a letter to DWS dated May 21, 2025 with the project's preliminary water demand calculations and information for DWS' review. See **Attachment "A"**. A technical memorandum with the same preliminary water demand calculations and information will also be included in the Draft Environmental Impact Statement (EIS). When complete, a copy of the Draft EIS will be made available to the DWS for review and comment.

Thank you again for your participation in the Chapter 343, Hawai‘i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft EIS that is being prepared for this project. Should you have any questions or require additional information, please feel free to contact me at (808) 983-1233.

Very truly yours,

Yukino Uchiyama, AICP
Manager

YU:ab
Attachment
cc: Juan Rivera, Department of Environmental Management (w/attachment)
Eric Nakagawa, Department of Environmental Management (w/attachment)
Scott Rollins, Department of Environmental Management (w/attachment)
DWS - Water Resource & Planning (Water.Resources@mauicounty.gov) (w/attachment)
Piyalerg Kongsil, DWS – Engineering Division (w/attachment)
Craig Lekven, Brown and Caldwell (w/attachment)
Irina Constantinescu, Brown and Caldwell (w/attachment)
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2261 Aupuni Street, Suite 201
Wailuku, Maui, HI 96793

T: 808.244.7005

May 21, 2025

Mr. Piyalerg Kongsil, P.E.
County of Maui Department of Water Supply
200 South High Street
Wailuku, HI 96793

158098.161

Subject: Proposed Central Maui Wastewater Reclamation Facility – Potable Water Demands

Dear Mr. Kongsil,

This letter has been prepared in response to Ms. Tammy Yeh's letter dated August 9, 2023, with the subject, "ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE, Proposed Central Maui Wastewater Reclamation Facility, TMK: (2) 3-5-001:017 (por.) and 120 (por.), 3-5-002:014 (por.), 3-5-020:036 (por.), 3-6-002:003 (por.) and 004 (por.), 3-8-005:023 (por.), portions of Waikapu Stream, and portions of the existing Waiale Road, Kuikahi Drive, and Waiko Road".

1. Project Overview

As described in the Environmental Impact Statement Preparation Notice (EISPN), the subject project is being constructed to provide wastewater service to existing and future customers within a defined service area. The two project facilities that will require potable water service are:

- A new Kehalani (Wailuku Waikapu Diversion) Wastewater Pump Station (WWPS), to be located on a portion of parcel TMK 3-5-020:036
- A new Central Maui Wastewater Reclamation Facility (WWRF) to be located on a portion of parcel TMK 3-8-005:023.

Both facilities will be owned and operated by the County of Maui Department of Environmental Management (DEM) and will provide a governmental service for public benefit (wastewater collection, treatment, and disposal) as defined in §19.04.040 of the Maui County Code. As such, §16-201-03 (g) (3) establishes that the projects shall not be considered projects using large quantities of water, provided that the water system has adequate capacity to meet the project's water needs.

2. Potable Water Needs

Potable water needs for the two facilities are summarized below.

2.1 Kehalani WWPS

The Kehalani WWPS will require potable water for hose bibbs (clean up), odor control system makeup water, and worker sanitation. Potable water demands will be similar to other County WWPS facilities. Water bills for the Hawaiian Homes WWPS, located on parcel TMK 3-3-005:003 for the period of January 2021 through June 2024 were evaluated to establish likely water demand at the Kehalani WWPS. The Hawaiian Homes WWPS is similar in size to the proposed Kehalani WWPS and is equipped with a similar odor control system. Table 1 summarizes the projected potable water demand at the Kehalani WWPS.

Table 1. Potable Water Demand Projections for Kehalani WWPS

Demand Description	Peaking Factor	Demand
Average day	1.0	4,000 gpd (2.8 gpm)
Peak day	1.5	6,000 gpd (4.2 gpm)
Peak hour	3.0	8.3 gpm

As noted in your letter, there are two existing meters located along Olomea Street. The WWPS design team will work with DWS during the design process to identify the preferred method for supplying potable water to the new facility. The potable water improvements will be designed in accordance with the Water System Standards and will be submitted for DWS review and approval prior to construction.

2.2 Central Maui WWRF

The Central Maui WWRF will be designed so that the effluent will meet State of Hawaii Department of Health (DOH) R-1 recycled water requirements, and the recycled water will be used extensively within the facility. Table 2 summarizes the anticipated water demands within the facility, and what sources will be used to meet the demands.

Table 2. Central Maui WWRF Water Demands and Sources		
Demand	R-1 Recycled Water	Potable Water
Irrigation	●	
Process water	●	
Hose bibbs	●	
Chemical dilution	●	
Chemical carrier	●	
Pump seal water	●	
Restrooms		●
Showers		●
Sinks		●
Drinking fountains		●
Emergency eyewash		●
Emergency showers		●
Laboratories		●

Potable water demands at the Central Maui WWRF are anticipated to be similar to the existing Kihei WWRF. Kihei WWRF potable water use records from July 2021 through July 2022 were evaluated to establish estimates for the Central Maui WWRF. Table 3 summarizes the potable water use projections for the Central Maui WWRF.

Table 3. Potable Water Demand Projections for Central Maui WWRF		
Demand Description	Peaking Factor	Demand
Average day	1.0	4,500 gpd (3.1 gpm)
Peak day	1.5	6,800 gpd (4.7 gpm)
Peak hour	3.0	9.4 gpm

Fire flows are estimated to be 2,500 gpd for 2 hours, for a total volume of 300,000 gallons per the Water Systems Standards. A separate fire line is proposed to be installed from the Waiale Road extension to the Central Maui WWRF hydrants.

The potable water improvements will be designed in accordance with the Water System Standards and will be submitted for DWS review and approval prior to construction.

Thank you for your comments on the EISPN. DEM looks forward to DWS review of the draft EIS.

Very truly yours,

Brown and Caldwell

Craig C. Lekven, P.E.
Project Director

POLICE DEPARTMENT
COUNTY OF MAUI
55 MAHALANI STREET
WAILUKU, MAUI, HAWAII 96793
TELEPHONE: (808) 244-6400
FAX: (808) 244-6411

RICHARD T. BISSEN, JR.
MAYOR

OUR REFERENCE

YOUR REFERENCE

JOHN PELLETIER
CHIEF OF POLICE

WADE M. MAEDA
DEPUTY CHIEF OF POLICE

October 10, 2023

Ms. Yukino Uchiyama, AICP
Munekiyo Hiraga
305 High Street, Suite 104
Wailuku, Hawaii 96793

Re: Environmental Impact Statement Preparation Notice for the Proposed Central Maui Wastewater Reclamation Facility, Maui, Hawaii

Dear Ms. Uchiyama:

This is in response to your letter dated July 20, 2023 requesting comments on the Environmental Impact Statement Preparation Notice on the proposed Central Maui Wastewater Reclamation Facility project.

In review of the submitted documents, we have no objections to the upcoming construction project if it meets the minimal standards set forth by county codes and state laws. Thank you for giving us the opportunity to comment on this project.

Sincerely,

Assistant Chief Keola Tom
for: JOHN PELLETIER
Chief of Police

MUNEKIYO HIRAGA
Planning. Project Management. Sustainable Solutions.

Karlynn K. Fukuda
PRESIDENT
Mark Alexander Roy AICP, LEED AP
VICE PRESIDENT
Tessa Munekiyo Ng AICP
VICE PRESIDENT

Michael T. Munekiyo AICP
SENIOR ADVISOR

October 16, 2025

John Pelletier, Chief of Police
County of Maui
Police Department
55 Mahalani Street
Wailuku, Hawai'i 96793

SUBJECT: Response to Comments Regarding Chapter 343, Hawai'i Revised Statutes, Environmental Impact Statement Preparation Notice for the Proposed County of Maui Central Maui Wastewater Reclamation Facility Project; Maui, Hawai'i

Dear Chief Pelletier:

Thank you for your comment letter dated October 10, 2023, regarding the Environmental Impact Statement Preparation Notice (EISPN) for the subject project. On behalf of the County of Maui, Department of Environmental Management (DEM), we acknowledge that the Maui Police Department has no comments to offer at this time.

Thank you again for your participation in the Chapter 343, Hawai'i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft Environmental Impact Statement (EIS) that is being prepared for this project. Should you have any questions or require additional information, please feel free to contact me at (808) 983-1233.

Very truly yours,

Yukino Uchiyama

Yukino Uchiyama, AICP
Manager

YU:ab
cc: Juan Rivera, Department of Environmental Management
Eric Nakagawa, Department of Environmental Management
Scott Rollins, Department of Environmental Management
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Maui Economic Opportunity, Inc.

P.O. Box 2122
Kahului, HI 96733
808-249-2990
Fax: 808-249-2991
www.meoinc.org

July 28, 2023

Yukino Uchiyama, AICP
Munekiyo Hiraga
305 High St., Suite 104
Wailuku, HI 96793
Email: CentralMauiWWRF@munekiyohiraga.com

Juan Rivera, P.E.
County of Maui
Department of Environmental Management
Wastewater Reclamation Division
2200 Main St., Suite 610
Wailuku, HI 96793
Email: environmental.mgmt@co.maui.hi.us

Re: Environmental Impact Statement Preparation Notice for the Proposed Central Maui Wastewater Reclamation Facility; Maui, Hawai'i.

To Whom It May Concern:

Maui Economic Opportunity, Inc., offers its support for this much-needed project, which will benefit the community and the environment.

Affordable housing is always at the top of MEO's Community Needs Assessments, and this project will help facilitate the building of homes and rental units.

As a supporter of agriculture and distributor of Maui County microgrants, MEO also applauds the collection of R-1 water for farms and other uses in lieu of injection wells, which could impact the environment.

We just ask that you take into consideration the ability of our Maui Bus paratransit and Human Services vehicles to navigate the work site while developing a traffic control plan during development, especially when building the R-1 line under Honoapiilani Highway.

The 58-year-old MEO offers programs countywide for business development; youths, including workforce preparation, substance abuse prevention; Head Start preschool; senior club coordination; rental and energy assistance; and integration of formerly incarcerated individuals into the community.

Thank you for allowing us to comment on the project.

Sincerely,

Debbie Cabebe, SHRM-SCP
Chief Executive Officer

The Promise of Community Action
Community Action changes people's lives, embodies the spirit of hope, improves communities, and makes America a better place to live. We care about the entire community, and we are dedicated to helping people help themselves and each other.

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Karlynn K. Fukuda
PRESIDENT
Mark Alexander Roy AICP, LEED AP
VICE PRESIDENT
Tessa Munekiyo Ng AICP
VICE PRESIDENT

Michael T. Munekiyo AICP
FOUNDER

October 16, 2025

Debbie Cabebe, SHRM-SCP, Chief Executive Officer
Maui Economic Opportunity, Inc.
P. O. Box 2122
Kahului, Hawai'i 96733

SUBJECT: Response to Comments Regarding Chapter 343, Hawai'i Revised Statutes, Environmental Impact Statement Preparation Notice for the Proposed County of Maui Central Maui Wastewater Reclamation Facility Project; Maui, Hawai'i

Dear Ms. Cabebe:

Thank you for your comment letter dated July 28, 2023 regarding the Environmental Impact Statement Preparation Notice (EISPN) for the subject project. On behalf of the County of Maui, Department of Environmental Management (DEM), we offer the following information in response to the comments received:

Comment No. 1:

Affordable housing is always at the top of MEO's Community Needs Assessments, and this project will help facilitate the building of homes and rental units.

As a supporter of agriculture and distributor of Maui County microgrants, MEO also applauds the collection of R-1 water for farms and other uses in lieu of injection wells, which could impact the environment.

Response: Thank you for your support of the project which would support the development of affordable housing, generate R-1 recycled water, and use a sustainable alternative technology (Soil Aquifer Treatment system) in lieu of injection wells.

Comment No. 2:

We just ask that you take into consideration the ability of our Maui Bus paratransit and Human Services vehicles to navigate the work site while developing a traffic control plan during development, especially when building the R-1 line under Honoapiilani Highway.

Response: A Construction Traffic Management Plan (TMP) has been prepared and implemented during construction to allow for continued vehicular access, including Maui Bus paratransit and Human Service vehicles using the roadways in vicinity of the project site. A copy of the Construction TMP will be included in the Draft Environmental Impact Statement (EIS).

Thank you again for your participation in the Chapter 343, Hawai‘i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft EIS that is being prepared for this project. Should you have any questions or require additional information, please feel free to contact me at (808) 983-1233.

Very truly yours,

Yukino Uchiyama, AICP
Manager

YU:ab
cc: Juan Rivera, Department of Environmental Management
Eric Nakagawa, Department of Environmental Management
Scott Rollins, Department of Environmental Management
Kelcee Mira, Austin Tsutsumi & Associates, Inc.
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From: gncadolpho@hawaiiantel.net
Sent: Wednesday, August 23, 2023 6:16 AM
To: Yukino Uchiyama
Cc: Angie Bayez
Subject: RE: Environmental Impact Statement Preparation Notice (EISPN) for the Proposed Central Maui Wastewater Reclamation Facility

Aloha Ms. Uchiyama,

I was able to attend your EIS Public meeting on Wednesday, 8/16/23 at the Waikapu Community Center. Thank you for the presentation and opportunity to give feedback.

At this time, our Waikapu Gardens Homeowner's Association dose not have any further comments to submit.

Mahalo, and have a wonderful day!

Glenn Adolpho
Waikapu Gardens Homeowners Association

From: Angie Bayez <angie@munekiyohiraga.com>
Sent: Monday, July 24, 2023 7:29 AM
To: gncadolpho@hawaiiantel.net
Cc: Yukino Uchiyama <Yukino@munekiyohiraga.com>
Subject: Environmental Impact Statement Preparation Notice (EISPN) for the Proposed Central Maui Wastewater Reclamation Facility

To: Glenn Adolpho
Waikapu Gardens Homeowners Association

From: Yukino Uchiyama, AICP
Munekiyo Hiraga

Attachment:

Quantity	Date	Description
1	7/24/23	EISPN for the Proposed Central Maui Wastewater Reclamation Facility

Message: We are providing the attached letter for your review. Thank you!

MUNEKIYO HIRAGA

Maui: 305 High Street, Suite 104, Wailuku, Hawaii 96793 **T:** 808.244.2015 **F:** 808.244.8729
Oahu: 735 Bishop Street, Suite 412, Honolulu, Hawaii 96813 **T:** 808.983.1233
Planning. Project Management. Sustainable Solutions. www.munekiyohiraga.com

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Karlynn K. Fukuda
PRESIDENT
Mark Alexander Roy AICP, LEED AP
VICE PRESIDENT
Tessa Munekiyo Ng AICP
VICE PRESIDENT

Michael T. Munekiyo AICP
FOUNDER

October 16, 2025

Via email: gncadolpho@hawaiiantel.net

Glenn Adolpho
Waikapu Gardens Homeowner's Association

SUBJECT: Response to Comments Regarding Chapter 343, Hawai'i Revised Statutes, Environmental Impact Statement Preparation Notice for the Proposed County of Maui Central Maui Wastewater Reclamation Facility Project; Maui, Hawai'i

Dear Mr. Adolpho:

Thank you for participating in the public scoping meeting on August 16, 2023 and providing your email dated August 23, 2023 regarding the Environmental Impact Statement Preparation Notice (EISPN) for the subject project. On behalf of the County of Maui, Department of Environmental Management (DEM), we acknowledge that the Waikapu Gardens Homeowner's Association has no further comments to offer at this time.

Thank you again for your participation in the Chapter 343, Hawai'i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft Environmental Impact Statement (EIS) that is being prepared for this project. Should you have any questions or require additional information, please feel free to contact me at (808) 983-1233.

Very truly yours,

Yukino Uchiyama, AICP
Manager

YU:ab
cc: Juan Rivera, Department of Environmental Management
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From: Tom Board <tomboard333@gmail.com>
Sent: Tuesday, July 25, 2023 7:39 AM
To: Central Maui WWRF
Subject: Central Maui Wastewater Reclamation Facility

Hello. I am an owner of a Maalaea condo. Will the proposed project have any positive effect for treatment of waste water at the condos on Hauoli Street? It would be great if those condos could decommission their private waste treatment plants and injection wells. Thanks for letting me know.

Tom Board

Virus-free.www.avg.com

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Mark Alexander Roy AICP, LEED AP
VICE PRESIDENT
Tessa Munekiyo Ng AICP
VICE PRESIDENT

Michael T. Munekiyo AICP
FOUNDER

October 16, 2025

Via email: tomboard333@gmail.com

Tom Board
Owner of Maʻalaea Condominium

SUBJECT: Response to Comments Regarding Chapter 343, Hawaiʻi Revised Statutes, Environmental Impact Statement Preparation Notice for the Proposed County of Maui Central Maui Wastewater Reclamation Facility Project; Maui, Hawaiʻi

Dear Mr. Board:

Thank you for your email dated July 25, 2023 regarding the Environmental Impact Statement Preparation Notice (EISPN) for the subject project. On behalf of the County of Maui, Department of Environmental Management (DEM), we offer the following information in response to the comments received:

Comment No. 1:

Will the proposed project have any positive effect for treatment of waste water at the condos on Hauoli Street? It would be great if those condos could decommission their private waste treatment plants and injection wells.

Response: The County has initiated a study evaluating wastewater treatment options and opportunities for Māʻalaea. While currently not included in the service area, the proposed Central Maui WWRF will be designed to have additional capacity to accommodate a possible future connection from Māʻalaea.

Thank you again for your participation in the Chapter 343, Hawaiʻi Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft Environmental Impact Statement (EIS) that is being prepared for this project. Should you have any questions or require additional information, please feel free to contact me at (808) 983-1233.

Very truly yours,

Yukino Uchiyama

Yukino Uchiyama, AICP
Manager

YU:ab
cc: Juan Rivera, Department of Environmental Management
Eric Nakagawa, Department of Environmental Management
Scott Rollins, Department of Environmental Management
Craig Lekven, Brown and Caldwell
Irina Constantinescu, Brown and Caldwell
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From: millere009@hawaii.rr.com
To: Central Maui WWRF
Cc: Eassie@MAI-Hawaii.com
Subject: Central Maui WWRF EISPN Scope Comments
Date: Thursday, August 17, 2023 11:18:46 AM
Attachments: CM WWRF EIS Scoping Comments.docx

Aloha Yukino:

Attached are my comments and questions to the subject document. Pls contact me with any questions.

Mahalo…….Eassie

Eassie M. Miller
Morikawa & Associates, LLC
Office: (808) 572-1745
Cell (808)264-6556
Desk (808)466-2968
www.mai-hawaii.com

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Central Maui Wastewater Reclamation Facility EISPN Scoping Comments

1. The County is at a crossroads in developing this project and is expecting to spend more than $100,000,000 to build this system. This project provides the County an opportunity to take a broad assessment of the wastewater needs for the whole Central Maui Region including Maalaea, future phaseout of the Wailuku-Kahului WWRF, development along Maui Veteran's Highway, Paia, Waiehu, Waihee, Waikapu, and fill in development in the existing Wailuku-Kahului Service area.

2. This project is essential to meet the wastewater treatment needs for Central Maui, which should include phaseout of the Maalaea private wastewater systems along the shoreline. Hence, including the Maalaea region in this WWRF is strongly encouraged. Having a separate facility for Maalaea is not practical as the challenges with staffing the facility and economy of scale for construction and operation costs of this separate facility.

3. The proposed location of the WWRF is questionable as its proximity to residential and commercial development. A more appropriate location is at the Puunene sugar mill site. The land is classified as industrial and a WWRF siting is appropriate. I believe there is 800 acres in this area that would be suitable for the new facility. The County needs to be looking forward to the future and make decisions to meet this need. The proposed site is land limited, takes up agricultural lands and lands designated for park and other commercial use. Don't be short sighted and take the easy road to meet today's needs only.

4. Funding for this project needs to be addressed in detail. How will the existing Ratepayers be impacted? Will the project have a connection fee ordinance to cover the debt service cost?

5. The proposed WWPS site will remove designated drainage basin land from its intended purpose. Pls address how this will be resolved.

6. The WWRF process schematic, and processes shared is a concern.
    a. Is a Regional Septage Receiving Station included with this WWRF? If yes then all septage haulers will be directed to this WWRF and not the W-K WWRF.
    b. Impact of hauler traffic needs to be assessed in the traffic study.
    c. It seems the biological process has been selected by the consultant. Pls address in detail the selection process as there is a more appropriate alternative,

Granular Activated Sludge process. This process is more energy efficient, requires less land, and less equipment.

7. It was shared that the proposed SAT effluent disposal system is intended to dispose of all 4 MGD of effluent from the facility. What is the design criteria for this system will it have the capacity to dispose of multiple days of effluent discharge experienced during a major rain/storm event? Pls elaborate on how it is determined that the SAT system will provide further treatment and not negatively impact the groundwater or the adjacent stream.

8. Who will own and manage the R-1 storage facility? If it is WCT, how will non WCT customers be addressed? Does WCT charge these other uses for the recycled water? Pls provide a breakdown of potential recycled water users and quantities. It seems you need ~800 acres to use 4 MGD of recycled water.

9. Although a community meeting is not required for the EIS process, it is strongly encouraged that community outreach be held. This is a major capital project, and it impacts the existing homeowners. Be inclusive…..

10. Pls provide a copy of the Facility Plan as it sets the framework for this project. Is a community meeting scheduled to roll out the Facility Plan? Is there a requirement by law for a community meeting?

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Karlynn K. Fukuda
PRESIDENT
Mark Alexander Roy AICP, LEED AP
VICE PRESIDENT
Tessa Munekiyo Ng AICP
VICE PRESIDENT

Michael T. Munekiyo AICP
FOUNDER

October 16, 2025

Via email: millere009@hawaii.rr.com

Eassie M. Miller
22 Lanikeha Place
Kahului, Hawai'i 96732

SUBJECT: Response to Comments Regarding Chapter 343, Hawai'i Revised Statutes, Environmental Impact Statement Preparation Notice for the Proposed County of Maui Central Maui Wastewater Reclamation Facility Project; Maui, Hawai'i

Dear Mr. Miller:

Thank you for your comments at the Scoping Meeting held on August 16, 2023 and your comments via email on August 17, 2023 regarding the Environmental Impact Statement Preparation Notice (EISPN) for the subject project. On behalf of the County of Maui, Department of Environmental Management (DEM), we offer the following information in response to the email comments received. It is noted that the Draft Environmental Impact Statement (EIS) will include a summary of scoping meetings, including comments received and DEM's responses.

Comment No. 1:

The County is at a crossroads in developing this project and is expecting to spend more than $100,000,000 to build this system. This project provides the County an opportunity to take a broad assessment of the wastewater needs for the whole Central Maui Region including Maalaea, future phaseout of the Wailuku-Kahului WWRF, development along Maui Veteran's Highway, Paia, Waiehu, Waihee, Waikapu, and fill in development in the existing Wailuku-Kahului Service area.

Response: The proposed project is a result of the County' research and assessment of wastewater service needs for the Central Maui region. The County has initiated a study evaluating potential for a sewer connection from Mā'alaea to the Central Maui WWRF. The Central Maui WWRF will be designed to have an additional capacity to accommodate possible connections from other communities such as Mā'alaea, should they be determined to be feasible in the future. The service areas for the Central Maui WWRF also include the State of Hawai'i developments in Pulehunui along Maui Veteran's Highway and the existing and future developments in Waikapū.

The proposed Central Maui WWRF is also designed to accommodate flow diverted from the Wailuku-Kahului WWRF via the Kehalani Wastewater Pump Station and associated sewage pipeline to reduce the burden on the Wailuku-Kahului WWRF. The County is planning another SAT project that will accommodate the remaining treated effluent from the Wailuku-Kahului WWRF, which is separate and unrelated to the Central Maui WWRF project.

Comment No. 2:

This project is essential to meet the wastewater treatment needs for Central Maui, which should include phaseout of the Maalaea private wastewater systems along the shoreline. Hence, including the Maalaea region in this WWRF is strongly encouraged. Having a separate facility for Maalaea is not practical as the challenges with staffing the facility and economy of scale for construction and operation costs of this separate facility.

Response: As noted previously, the County has initiated a study to evaluate the possibility of connecting Mā‘alaea to the Central Maui WWRF. The proposed Central Maui WWRF will have capacity to accommodate wastewater flow from Mā‘alaea, however, a connection to Mā‘alaea is not part of the proposed improvements of this project.

Comment No. 3:

The proposed location of the WWRF is questionable as its proximity to residential and commercial development. A more appropriate location is at the Pu‘unene sugar mill site. The land is classified as industrial and a WWRF siting is appropriate. I believe there is 800 acres in this area that would be suitable for the new facility. The County needs to be looking forward to the future and make decisions to meet this need. The proposed site is land limited, takes up agricultural lands and lands designated for park and other commercial use. Don’t be short sighted and take the easy road to meet today’s needs only.

Response: While the sugar mill site has not been directly evaluated, another site near the sugar mill was evaluated. Both the evaluated site and the sugar mill site do not have soils that are conducive to Soil Aquifer Treatment and would require substantially more land area for secondary effluent disposal purposes.

Comment No. 4:

Funding for this project needs to be addressed in detail. How will the existing Ratepayers be impacted? Will the project have a connection fee ordinance to cover the debt service cost?

Response: A combination of funding sources will likely be used to construct the proposed project. The funding sources may include, but not be limited to State funds, grants, loans, and bonds. Additional discussion on the project funding will be included in the Draft Environmental Impact Statement (EIS), as may be available.

Comment No. 5:

The proposed WWPS site will remove designated drainage basin land from its intended purpose. Pls address how this will be resolved.

Response: The Kehalani drainage basin was built with excess capacity. After the new Kehalani Wastewater Pump Station is constructed, its capacity will still be more than what is required. Additional information on this will be provided in the Draft EIS.

Comment No. 6:

The WWRF process schematic, and processes shared is a concern.

a. *Is a Regional Septage Receiving Station included with this WWRF? If yes then all septage haulers will be directed to this WWRF and not the W-K WWRF.*

b. *Impact of hauler traffic needs to be assessed in the traffic study.*

c. *It seems the biological process has been selected by the consultant. Pls address in detail the selection process as there is a more appropriate alternative, Granular Activated Sludge process. This process is more energy efficient, requires less land, and less equipment.*

Response:

a. The Central Maui WWRF facility plan will include septage receiving provisions.

b. The Traffic Impact Analysis Report (TIAR) for the project will include septage haulers in the analysis.

c. The WWRF facility plan considered the Nereda granular activated sludge process, however the Biological Nutrient Removal (BNR) via Modified Ludzack-Ettinger (MLE) or Membrane Bioreactor (MBR) was deemed more appropriate and desirable for this particular application. It was determined that due to the lack of long-term operational experience in the United States, the Nereda granular activated sludge process is considered not appropriate for the Central Maui WWRF. In addition, the Nereda system is operated by a computer control system and cannot be operated in manual mode, and may require influent and/or effluent equalization (and thus increasing the footprint requirements).

Comment No. 7:

It was shared that the proposed SAT effluent disposal system is intended to dispose of all 4 MGD of effluent from the facility. What is the design criteria for this system will it have the capacity to dispose of multiple days of effluent discharge experienced during a major rain/storm event? Pls elaborate on how it is determined that the SAT system will provide further treatment and not negatively impact the groundwater or the adjacent stream.

Response: The Draft EIS will include and discuss a Hydrogeological Study to address these potential impacts of the SAT system, including major rain/storm events and potential impacts to groundwater and/or nearby streams. It is noted that water recycling will be the primary effluent management system at the WWRF, and the SAT system will be the backup disposal system. Per the Department of Health (DOH) regulations, the backup disposal system will be designed to accommodate all of the WWRF flow, including during major storm events or extended outage where the effluent does not meet R-1 recycled water requirements.

Comment No. 8:

Who will own and manage the R-1 storage facility? If it is WCT, how will non WCT customers be addressed? Does WCT charge these other uses for the recycled water? Pls provide a breakdown of potential recycled water users and quantities. It seems you need ~800 acres to use 4 MGD of recycled water.

Response: Waikapū Country Town will develop the recycled water storage facility and the portion of the wastewater and R-1 recycled water transmission pipelines that are located on their property. Waikapū Country Town will own and operate the storage facility and will be responsible for distributing the recycled water as a Public Utility Commission (PUC) regulated water utility. The WWRF Facility Plan (to be included in the Draft EIS) will include discussion of recycled water users and acreages.

Comment No. 9:

Although a community meeting is not required for the EIS process, it is strongly encouraged that community outreach be held. This is a major capital project, and it impacts the existing homeowners. Be inclusive…..

Response: DEM will consider holding an additional community meeting following the publication of the Draft EIS.

Comment No. 10:

Pls provide a copy of the Facility Plan as it sets the framework for this project. Is a community meeting scheduled to roll out the Facility Plan? Is there a requirement by law for a community meeting?

Response: The Facility Plan will be included in the Draft EIS, which will be shared with you and made available for public comment. There is no community meeting requirement other than the scoping meeting held in August 2023. However, DEM has met with Waikapū Community Association and will consider holding an additional meeting following the publication of the Draft EIS.

Thank you again for your participation in the Chapter 343, Hawai'i Revised Statutes environmental review process. A copy of your letter and this response will be included in the Draft EIS that is being prepared for this project. Should you have any questions or require additional information, please feel free to contact me at (808) 983-1233.

Very truly yours,

Yukino Uchiyama, AICP
Manager

YU:ab
cc: Juan Rivera, Department of Environmental Management
Eric Nakagawa, Department of Environmental Management
Scott Rollins, Department of Environmental Management
Craig Lekven, Brown and Caldwell
Irina Constantinescu, Brown and Caldwell
Bradford Wright, Warren S. Unemori Engineering
Rich Kraft, Geosyntec
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REFERENCES XII

XII. REFERENCES

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CENTRAL MAUI WASTEWATER RECLAMATION FACILITY PLAN

APPENDIX

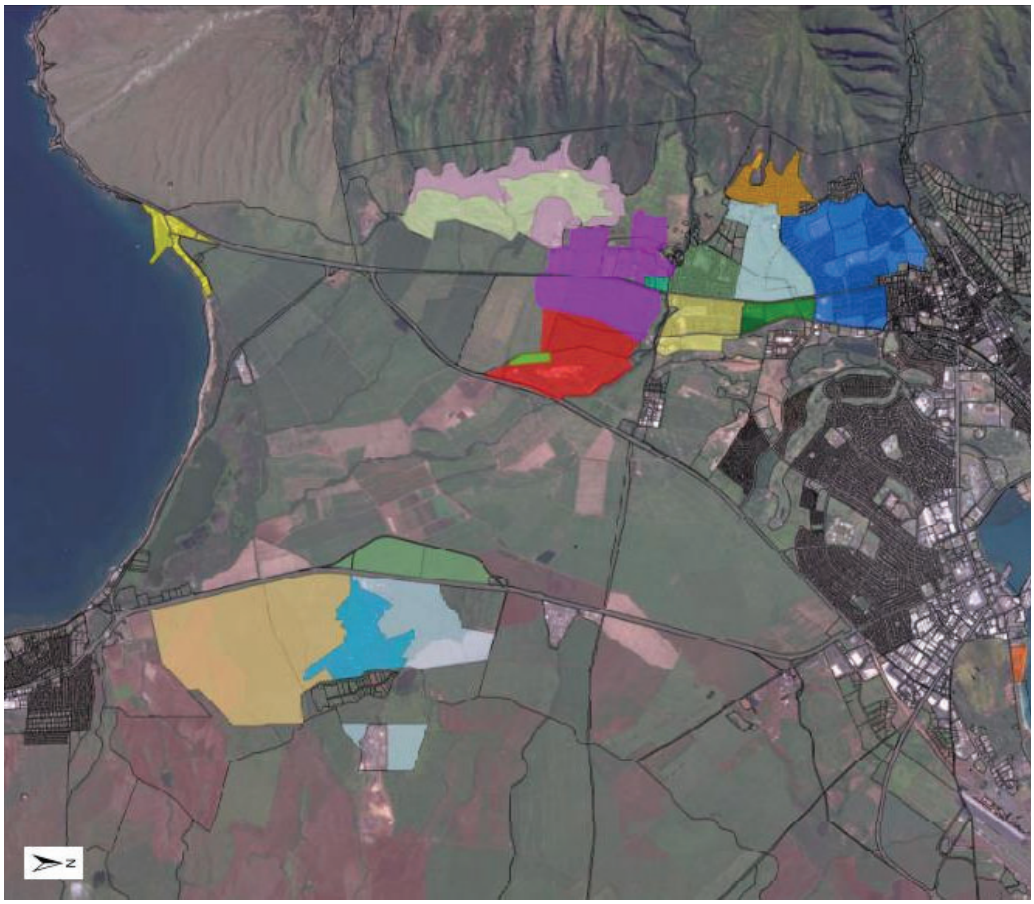
A

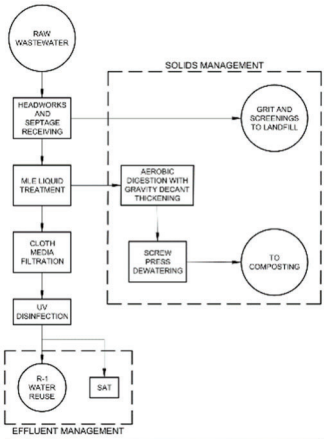
Brown AND Caldwell

FINAL REPORT | Prepared for
County of Maui
Department of Environmental Management
Wastewater Reclamation Division
Wailuku, Maui, Hawaii

Central Maui Wastewater Reclamation Facility Plan

June 2024
Updated for CM WWRF Draft EIS





Central Maui Wastewater Reclamation Facility Plan

Prepared for
County of Maui,
Department of Environmental Management
Wastewater Reclamation Division
June 2024

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

Signature

April 30, 2026
Expiration Date of the License

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List of Abbreviations

ADWF	Average Dry Weather Flow
A/S	air to solids
BFE	base flood elevation
bgs	below ground surface
BOD_5	5-day biochemical oxygen demand
CFR	Code of Federal Regulations
CFU	colony forming units
CNG	compressed natural gas
CO_2	carbon dioxide
COM	County of Maui
DAFT	dissolved air flotation thickening
DBEDT	State of Hawaii Department of Business, Economic Development and Tourism
DHHL	Department of Hawaiian Home Lands
DLNR	Department of Land and Natural Resources
DNA	deoxyribonucleic acid
DOD	Department of Defense
DOH	State of Hawaii Department of Health
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FIRM	flood insurance rate map
FOG	fats, oils, and grease
ft	feet
GAC	granular activated carbon
GBT	gravity belt thickener
GIS	geographic information system
gpd	gallons per day
gph	gallons per hours
gpm	gallons per minute
HAR	Hawaii Administrative Rules
HSDC	Hawaii State Data Center
I/I	infiltration and inflow
IFAS	integrated fixed film activated sludge
kWh	kilowatt hours
lbs.	pounds
lf	linear feet
LOS	level of service
MBR	membrane bioreactor
mg	milligram
mgd	million gallons per day
mg/L	milligrams per liter
MICP	Molokai Island Community Plan
mL	milliliter
MLSS	mixed liquor suspended solids
mm	millimeter
msl	mean sea level
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
OF	overland flow
O&M	operation and maintenance
pH	hydrogen ion concentration
PM	project manager
ppd	pounds per day
ppm	pounds per minute
PWWF	peak wet weather flow
RAS	return activated sludge
RBC	rotating biological contactor
RFP	request for proposal
RNA	ribonucleic acid
SA	service area
SARA	Superfund Amendments and Reauthorization Act of 1986
SAT	soil aquifer treatment
SBR	sequencing batch reactor
SC	solids contact
SES	sand equivalent size
sf	square foot
SR	slow rate
SRT	solids retention time
TDS	total dissolved solids
TRC	total residual chlorine
TF	tricking filter
TSDF	transporter treatment, storage and/or disposal facility
TSS	total suspended solids

UIC	underground injection control
USEPA	United States Environmental Protection Agency
UV	ultraviolet light
W-K	Wailuku-Kahului
WAS	waste activated sludge
WWRD	Wastewater Reclamation Division
WWRF	wastewater reclamation facility
WWPS	wastewater pump station
ZOM	zone of mixing
µm	microns

Executive Summary

The County of Maui Department of Environmental Management (County) is proposing to develop a new wastewater reclamation facility (WWRF) in Central Maui. This facility plan was prepared to establish the initial concept for the Central Maui WWRF. The service areas for the new WWRF are shown in Figure ES-1. The new WWRF will serve two important functions:

- Service new growth in the service areas
- Divert some existing wastewater flow from the existing Wailuku-Kahului (W-K) WWRF, thereby reducing the amount of treated effluent that is disposed via injection wells at the facility.

The Central Maui WWRF is one element of a collection of projects that are needed to provide the intended wastewater service, as shown in Figure ES-2. An environmental impact statement (EIS) is being prepared to cover the WWRF and the associated projects. The associated projects include:

Kehalani (Waikapu Wailuku Diversion) Wastewater Pump Station (WWPS): A new WWPS (constructed by the County) located on Waiale Road, designed to divert flow from the Kehalani area away from the W-K WWRF and instead pump it to the new Central Maui WWRF.

Kehalani (Diversion) Pipelines: A new wastewater forcemain (constructed by the County) designed to deliver flow from the Kehalani WWPS to the Central Maui WWRF.

Central Maui WWRF: The subject of this facility plan report, to be constructed by the County.

Recycled Water Distribution Pipeline: Recycled water will be distributed from the Central Maui WWRF back to the Waikapu Country Town development for non-potable uses. The County and the Waikapu Country Town developer will each construct their respective portions of the pipeline.

Capacity

The Central Maui WWRF is planned to have a capacity to treat average dry weather flows up to 4.0 million gallons per day (mgd), which will be sufficient for the service areas.

Effluent Management

The facility will be designed to create recycled water that meets State of Hawaii Department of Health (DOH) R-1 designation. The recycled water will be used for irrigation and other non-potable uses in the surrounding area. Greater than 90 percent of the WWRF effluent is anticipated to be recycled.

An effluent disposal system is required by DOH regulations. The Central Maui WWRF will include a soil aquifer treatment (SAT) system for disposal of effluent when:

- Effluent does not meet R-1 standards due to process upset of malfunction.
- When recycled water supply exceeds the demand (e.g., during periods of extended wet weather).

Capital Cost

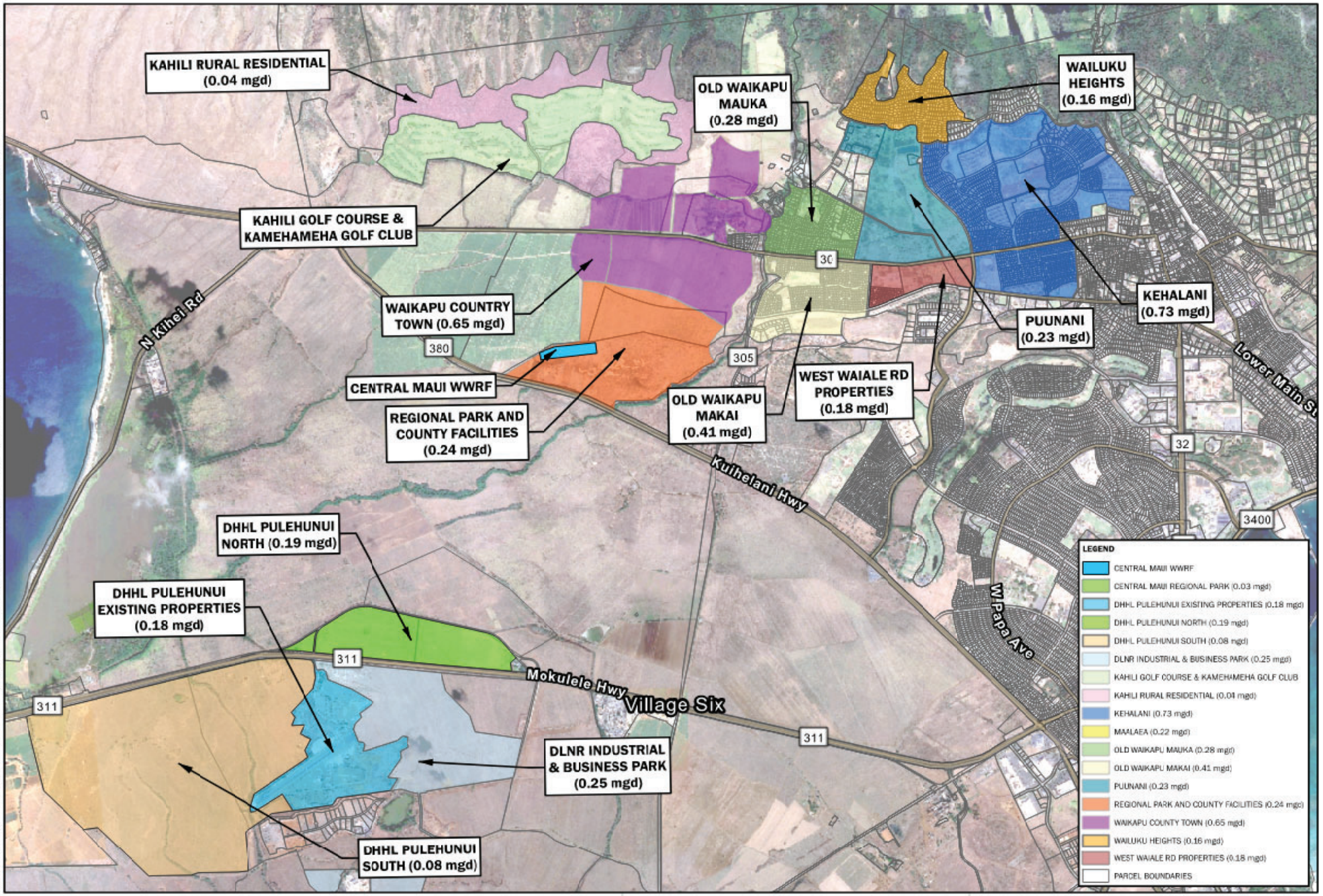
The planning-level estimate to construct the WWRF is $82 million, expressed in current (December 2022) dollars. Hawaii is currently experiencing high construction cost inflation rates, and the cost to construct the facility is expected to escalate to $125 million by the time the construction project is bid in late 2026.

Operation and Maintenance (O&M) Costs

Planning-level O&M costs for the facility total $6.8 million annually, expressed in current (December 2022) dollars. The O&M costs include labor, electricity, chemicals, maintenance materials, and solids disposal.

Implementation

An environmental impact statement (EIS) will be prepared for the WWRF and the associated projects. The WWRF is currently expected to operational in 2028.



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Brown AND Caldwell

COUNTY OF MAUI, HAWAII

CENTRAL MAUI WWRF FACILITY PLAN

DATE: JANUARY 2023
PROJECT: 158098

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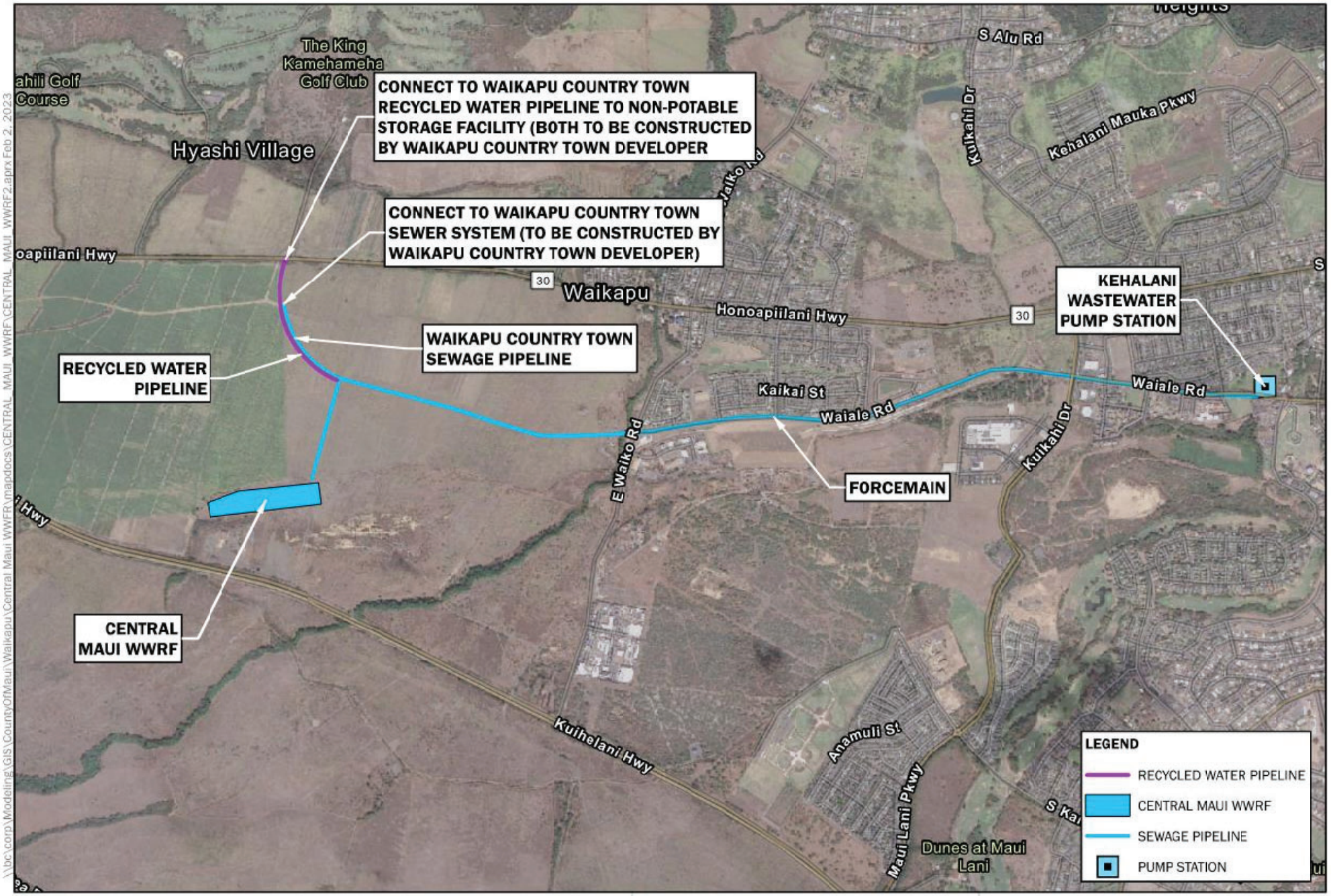
FIGURE ES-1

CENTRAL MAUI WWRF SERVICE AREAS



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Brown AND Caldwell

COUNTY OF MAUI, HAWAII

CENTRAL MAUI WWRF EIS

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PROJECT: 158098

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1. Aerial photo: Google Earth, 2019

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FIGURE ES-2

CENTRAL MAUI WWRF PROJECT ELEMENTS TO BE CONSTRUCTED BY COUNTY OF MAUI

Section 1

Introduction

1.1 Background / Purpose

The Maui Island Plan (MIP) includes a Directed Growth Plan that prescribes and outlines how Maui will grow through the year 2030. Wastewater generated from residents and businesses located in the proposed growth areas will require management. Currently, wastewater generated from existing Central Maui communities (Wailuku, Waikapu, and Kahului) is conveyed to the Wailuku-Kahului (W-K) Wastewater Reclamation Facility (WWRF) for treatment and disposal. However, the W-K WWRF does not have capacity to accommodate flow from all the proposed growth areas, and the County of Maui Department of Environmental Management (County) does not plan on expanding flow capacity due to land limitations at the site. Therefore, alternative wastewater management measures will be required for growth areas.

Establishment of a new Central Maui WWRF will address the capacity concerns at the W-K WWRF. In addition, the new WWRF can treat a portion of existing Wailuku and Waikapu wastewater flows, reducing the effluent disposal needs at the W-K WWRF (currently served by injection wells) while also managing the wastewater generated by the multiple development projects within the growth area.

The Central Maui WWRF Facility Plan establishes design criteria and conceptual design for both treatment and disposal of the Central Maui wastewater flows. The report also establishes potential service area and flow projections for the WWRF.

1.2 WWRF Site

The proposed 14.9-acre site is currently part of a larger property is currently owned by the County of Maui. Figure 1-1 provides the site location.

1.3 Relation to the Larger Project

The Central Maui WWRF is one element of a larger project and its associated environmental impact statement (EIS) designed to accommodate growth in the Central Maui area and reduce wastewater flows to the existing W-K WWRF. The larger project elements are also shown in Figure 1-1 and include:

Kehalani Wastewater Pump Station (WWPS):

A new WWPS located on Waiale Road, designed to divert flow from the Kehalani area away from the W-K WWRF and instead pump it to the new Central Maui WWRF. This element is discussed in a separate report.

Kehalani Forcemain:

A new wastewater forcemain designed to deliver flow from the Kehalani WWPS to the Central Maui WWRF. This element is discussed in a separate report.

Central Maui WWRF:

The subject of this facility plan report.

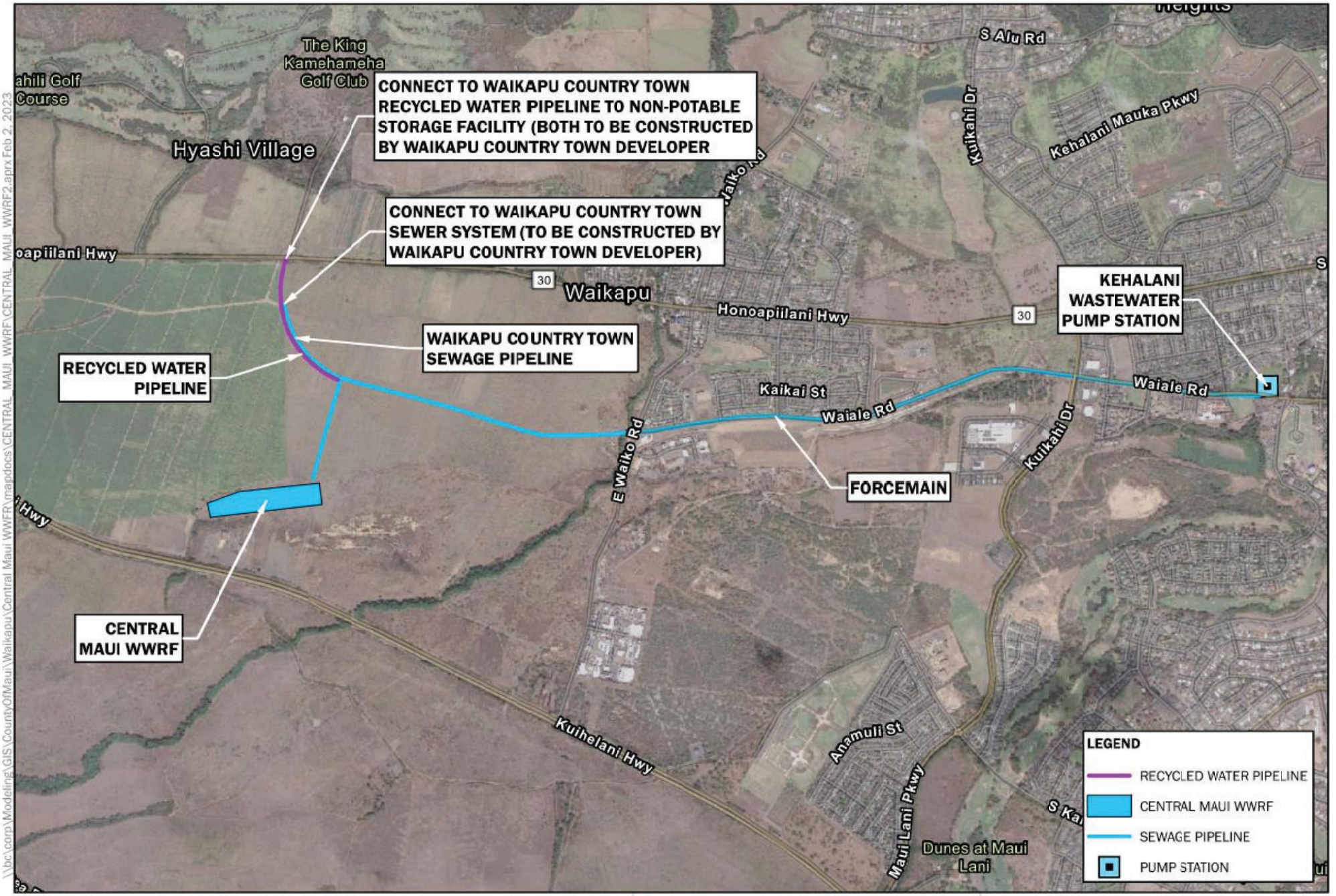
Recycled Water Distribution Pipeline:

Recycled water will be distributed from the Central Maui WWRF back to the Waikapu Country Town development for non-potable uses.

1.4 Report Organization

The report is organized as follows:

- Section 2 – Flow Projections and Characteristics
- Section 3 – Effluent Management and Regulatory Requirements
- Section 4 – Preliminary Treatment Options
- Section 5 – Liquid Treatment: Primary Treatment Options
- Section 6 – Liquid Treatment: Secondary Treatment Options
- Section 7 – Liquid Treatment: Filtration and Disinfection
- Section 8 – Solids Treatment Options
- Section 9 – Auxiliary Systems and Appurtenances
- Section 10 – Water Recycling Systems
- Section 11 – Soil Aquifer Treatment (SAT)
- Section 12 – Alternatives
- Section 13 – Economic Evaluations
- Section 14 – Non-Economic Evaluation
- Section 15 – Recommended Facility



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Brown AND Caldwell

COUNTY OF MAUI, HAWAII

CENTRAL MAUI WWRF EIS

DATE: FEBRUARY 2023
PROJECT: 158098

Notes:
1. Aerial photo: Google Earth, 2019

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FIGURE 1-1

CENTRAL MAUI WWRF PROJECT ELEMENTS TO BE CONSTRUCTED BY COUNTY OF MAUI

Section 2

Flow Projections and Characteristics

2.1 Service Area and Wastewater Flow Projections

Wastewater generated by communities in Central Maui is currently treated at the Wailuku-Kahului Wastewater Reclamation Facility (W-K WWRF) with disposal of the treated effluent via the plant's injection wells system. The service area of the current treatment plant spans as far as Paia to the West, Waihee to the East, and Waikapu to the South. The W-K WWRF is slowly reaching its design capacity of 7.9 million gallons per day (mgd). In order to alleviate some capacity at the existing treatment plant and limit use of the plant's injections wells, a new Central Maui WWRF is proposed. The new plant would treat wastewater generated by new developments in the area in addition to a portion of the W-K WRRF existing wastewater flows.

Divert existing flows. A portion of the Wailuku and Waikapu flows will be diverted to the new WWRF for treatment and disposal. An existing wastewater main along Waiale Road collects wastewater from Wailuku Heights, Kehalani, and Waikapu and conveys it to the W-K WWRF. A new pump station is proposed near the intersection of Waiale Road and Waiinu Road in Wailuku. The pump station will divert flows away from the Wailuku-Kahului WWRF to the new Central Maui WWRF via a new forcemain (FM) along Waiale Road as shown in Figure 1-2. Based on existing zoning, the estimated diverted average dry weather flow will be up to 1.78 mgd. The existing flow estimates are based on the County of Maui's wastewater standards. These standards include inflow and infiltration (I&I) and are conservative especially for newer neighborhoods such as Kehalani, where the pipes are relatively new, above the water table, and there is minimal I&I. More accurate flows can be measured prior to design of the new pump station and pipelines.

New developments. In addition to the diverted flows, the new Central Maui WWRF will service other new and currently unsewered existing developments in the area. Based on existing planning documents, the proposed developments to be serviced will generate a total estimated flow of up to 1.93 mgd.

Total future flows. Table 2-1 lists the expected flows from the service area. Figure 2-1 shows an approximate timeline for projected flows at the new WWRF. The wastewater flows for future developments are based on available planning documents submitted to the County by the various owners and developers. Figure 2-2 shows a map of approximate service areas listed in Table 2-1. The new Central Maui WWRF design average dry weather flow will be 4 mgd, allowing for potential future connections not have been identified at the time of this report,

Table 2-1. Anticipated Buildout Flow from Developments in Service Area			
Development Name	Average Dry Weather Flow (mgd)	New Growth (mgd)	Existing Development Diverted Flow from W-K WWRF
Puunani	0.30	0.30	
Kahili Rural Residential	0.04	0.04	
Waikapu Tropical Plantation Town	0.65	0.65	
Regional Parks and County Facilities	0.24	0.24	
West Waiale Road Properties	0.18		0.18
DHHL Pulehunui North	0.19	0.19	
DHHL Pulehunui South	0.08	0.08	
DHHL Pulehunui - Existing Properties	0.18	0.18	
DLNR Industrial & Business	0.25	0.25	
Wailuku Heights	0.16		0.16
Kehalani	0.73		0.73
Old Waikapu - Makai	0.41		0.41
Old Waikapu - Mauka	0.28		0.28
Waiko Road Subdivision	0.02		0.02
Potential future connections	0.29		
Totals	**4.00**	**1.93**	**1.78**
Percentage of total flow	**100%**	**48%**	**44%**

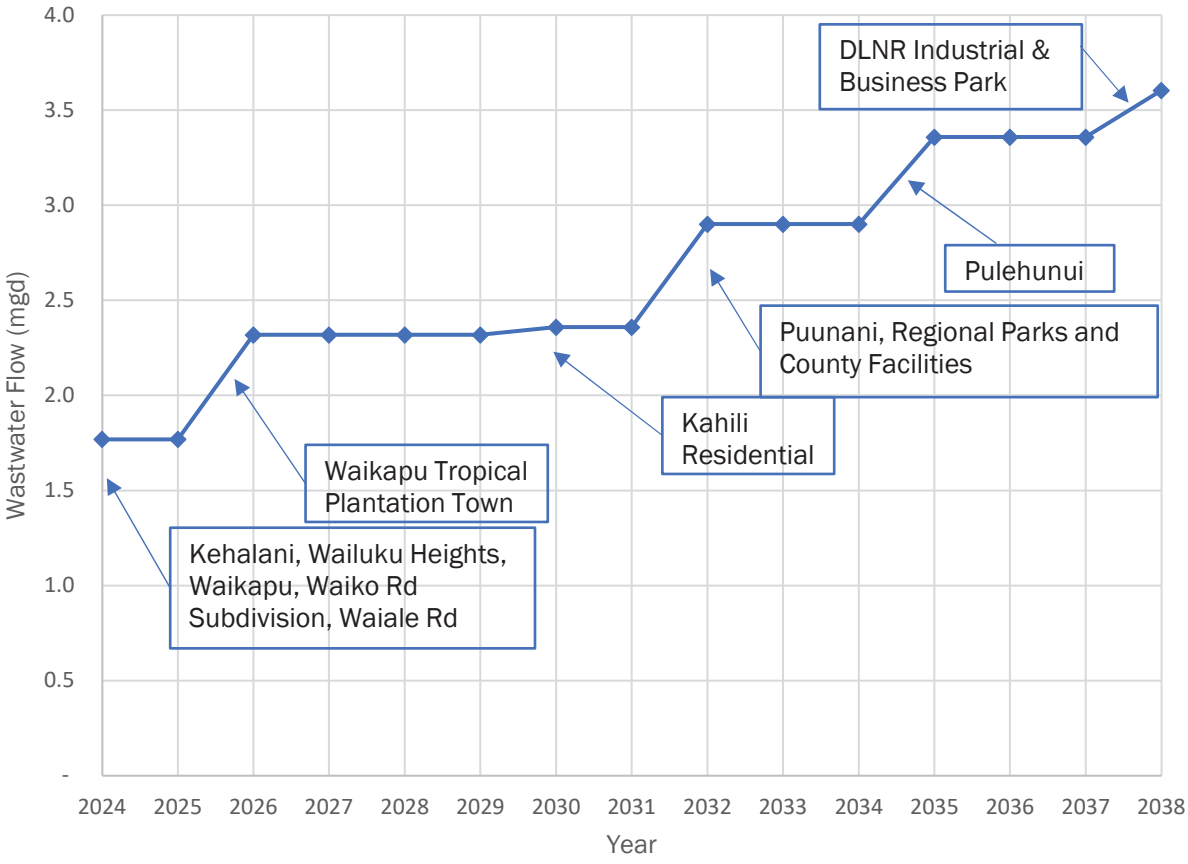
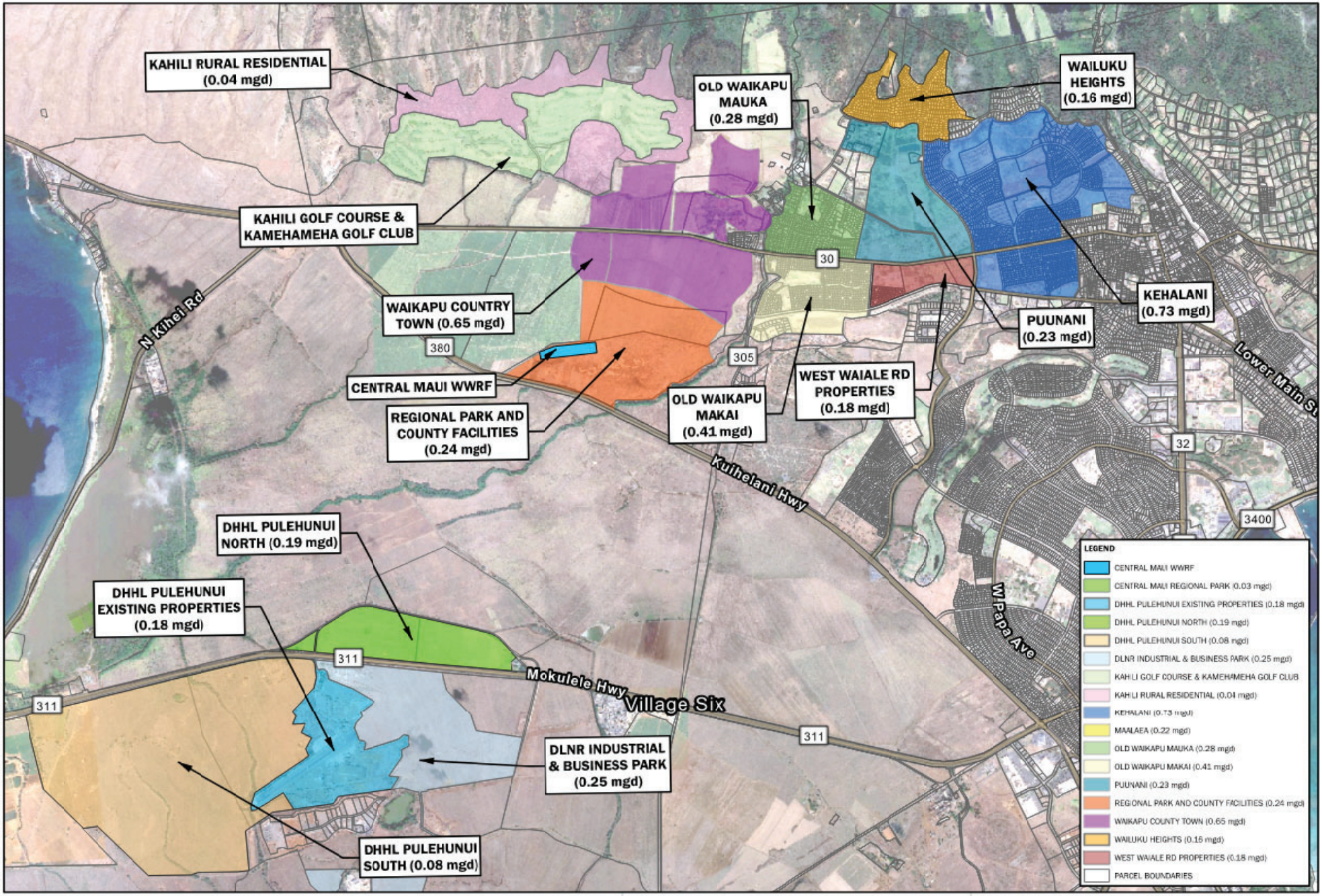


Figure 2-1. Projected Flows Timeline



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Brown AND Caldwell

COUNTY OF MAUI, HAWAII

CENTRAL MAUI WWRF FACILITY PLAN

DATE: JANUARY 2023
PROJECT: 158098

Notes:
1. Aerial photo: Google Earth, 2019

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FIGURE 2-2

CENTRAL MAUI WWRF SERVICE AREAS

2.2 Wastewater Characteristics

2.2.1 Influent Wastewater Characteristics and Loads

In order to gauge the likely influent characteristics at the proposed Central Maui WWRF, influent data collected at the existing W-K WWRF was used. The influent characteristics data, collected and provided by the County, was recorded daily for a one-year timeframe, taken between February 1, 2020, and February 1, 2021. This data included five-day biochemical oxygen demand (BOD_5), total and volatile suspended solids (TSS and VSS) and nitrogen species concentrations. To conservatively select an appropriate design concentration, the maximum value of the calculated 30-day running average was selected for each of these constituents. This selection method errs on the conservative side, while mitigating the influence of any single outlier value. The selected design influent characteristics concentrations that resulted from this analysis are summarized in Table 2-2, below.

A design total phosphorus concentration was also selected using additional sampling data that was collected in a separate W-K WWRF influent characterization study performed by Kennedy Jenks. This study was performed over 14 days, from October 13 through October 26, 2020. The phosphorus value shown in Table 2-2 is the average from the study.

Table 2-2. Wailuku-Kahului WWRF Influent Characteristics

Parameter	Average Concentration (mg/L)
BOD_5	346
TSS	418
VSS	382
Nitrogen, Ammonia	33
Nitrogen, Organic	21
Nitrogen, Total Kjeldahl	55
Phosphorous, Total	6

Wastewater influent has historically increased in strength over time due to the impact of water conservation efforts. Table 2-3 summarizes the influent wastewater characteristics selected for planning purposes and includes a factor to account for increased future strength, along with the corresponding mass loads for BOD_5, TSS, and VSS. The “average day” mass load is the expected loading corresponding to the assumed design concentrations and average dry weather flow conditions (4 mgd). The “peak month” mass load is the expected loading on a day during a peak month and is assumed to be approximately 20 percent greater than average day mass load.

Table 2-3. Design Influent Mass Loading			
Parameter	Design Concentration (mg/L)	Mass Load – Average Day (lbs./day)	Mass Load – Peak Month (lbs./day)
BOD_5	400	13,300	16,000
TSS	450	15,000	18,000
VSS	410	13,700	16,400
Total N	60	2,000	2,400
Total P	8	500	600

2.2.2 Septage Receiving

Septage is very concentrated as compared with wastewater, with typical septage containing approximately 7,000 mg/L of BOD_5, 15,000 mg/L of TSS, 700 mg/L of total Kjeldahl nitrogen (TKN), and 250 mg/L of total phosphorus (TP) (Crites and Tchobanoglous, 1998). Septage generated on Maui Island is treated and disposed at the Wailuku-Kahului WWRF. Haulers currently discharge collected septage into a manhole just upstream of Wailuku Pump Station; there is not currently a way of separately tracking the volume and characteristics of septage that is received. The County has studied septage receiving needs at the Wailuku-Kahului WWRF (HDR, April 2018), and volume and strength projections (Kennedy Jenks, April 14, 2021).

The Central Maui WWRF will become the island's location for septage disposal, and septage will no longer be discharged to Wailuku-Kahului WWRF. The Wailuku-Kahului data used to approximate the influent characteristics for the proposed Central Maui WWRF already included any septage in its characteristic concentrations. However, increased septage quantities are anticipated to occur due to cesspool conversion requirements. Table 2-4 lists septage characteristics, volumes, and loads to be used for design purposes.

Table 2-4. Septage Volumes and Characteristics			
Description	Volume (gpd)	Concentration (mg/L)	Mass Load (lbs./day)
Maximum discharge volume	50,000	--	--
BOD_5	--	7,000	2,900
TSS	--	15,000	6,300
TKN	--	700	300
TP	--	250	100

2.2.3 Influent Mass Loads with Septage

Table 2-5 summarizes the mass loads to the WWRF including septage.

Table 2-5. WWRF Mass Loads with Septage

Parameter	Average Influent Mass Load (lbs./day)	Septage Mass Load (lbs./day)	Total Mass Load (lbs./day)
BOD_5	13,300	2,900	16,200
TSS	15,000	6,300	21,300
VSS	13,700	5,800	19,500
TKN	2,000	300	2,300
TP	500	100	600

2.3 Initial vs. Ultimate Capacity

Table 2-6 lists the proposed initial WWRF capacity based on the flow projections. The initial capacity is expected to be sufficient for at least 15 years.

Table 2-6. Initial Capacity Wastewater Flow Projections

Flow Description	Value	Peaking Factor
Average dry weather	3.0 mgd	1.0
Peak month dry weather	3.6 mgd	1.2
Peak day dry weather	6.6 mgd	2.2
Peak day wet weather	9.9 mgd	3.3
Peak hour wet weather	12.0 mgd (8,333 gpm)	4.0

A WWRF expansion project will be required when flows approach the initial capacity. Table 2-7 lists the ultimate capacity of the facility (after the expansion project).

Table 2-7. Ultimate Capacity Wastewater Flow Projections

Flow Description	Value	Peaking Factor
Average dry weather	4.0 mgd	1.0
Peak month dry weather	4.8 mgd	1.2
Peak day dry weather	8.7 mgd	2.2
Peak day wet weather	13.0 mgd	3.3
Peak hour wet weather	16.1 mgd (11,200 gpm)	4.0

Section 3

Effluent Management and Regulatory Requirements

This section presents the intended effluent management systems and presents the anticipated regulatory requirements. The primary effluent management system for the Central Maui WWRF will be a water recycling program, with soil aquifer treatment as the backup disposal method. The new facility will reduce the County's use of injections wells.

3.1 Water Recycling

A recycled water program is planned to be a major part of the effluent management system at the Central Maui WWRF. The water recycling program will extend Maui's freshwater resources by putting treated effluent to beneficial non-potable use, freeing up valuable potable and raw water resources for other uses. These uses include facilitating growth within the community and enhancing the environment.

Water recycling has been extensively evaluated for the Central Maui WWRF in a previous study (Brown and Caldwell, April 2015). Table 3-1 presents an irrigation demand estimate for the area.

Table 3-1. Irrigation Requirements – Average Precipitation Year

Month	Precipitation [a] (inches)	Pan Evaporation [b] (inches)	Evapotranspiration [c] (inches)	Estimated Irrigation Needs [d]	
				(inches)	(gpd/acre)
Jan	3.74	5.38	5.38	2.2	1,882
Feb	2.36	5.58	5.58	4.2	4,103
Mar	2.35	7.10	7.10	6.2	5,464
Apr	1.75	7.73	7.73	7.9	7,108
May	0.66	8.94	8.94	10.9	9,519
Jun	0.23	9.69	9.69	12.4	11,234
Jul	0.49	10.59	10.59	13.3	11,607
Aug	0.53	10.41	10.41	13.0	11,362
Sep	0.39	9.45	9.45	11.9	10,763
Oct	1.06	8.18	8.18	9.4	8,200
Nov	2.17	6.56	6.56	5.8	5,215
Dec	3.08	5.68	5.68	3.4	2,989
Totals	18.8	95.3	95.3	100.4	--

a. *Source: NOAA, Stations 310.10, 313.30, and 394.10. Period of record 1971-2000.*

b. *Source: Engott and Vana, 2007.*

c. *Assumes pan coefficient = 1.0 and crop coefficient = 1.0 to represent a mixture of landscape and agricultural crops.*

d. *Assumes irrigation efficiency = 80 percent and leaching fraction = 5 percent.*

Figure 3-1 presents the results in graphical form. Irrigation demand is greatest during the summer season when temperatures are higher, and precipitation is minimal. Irrigation demand is lowest during the winter season when temperatures are cooler, and precipitation is more abundant.

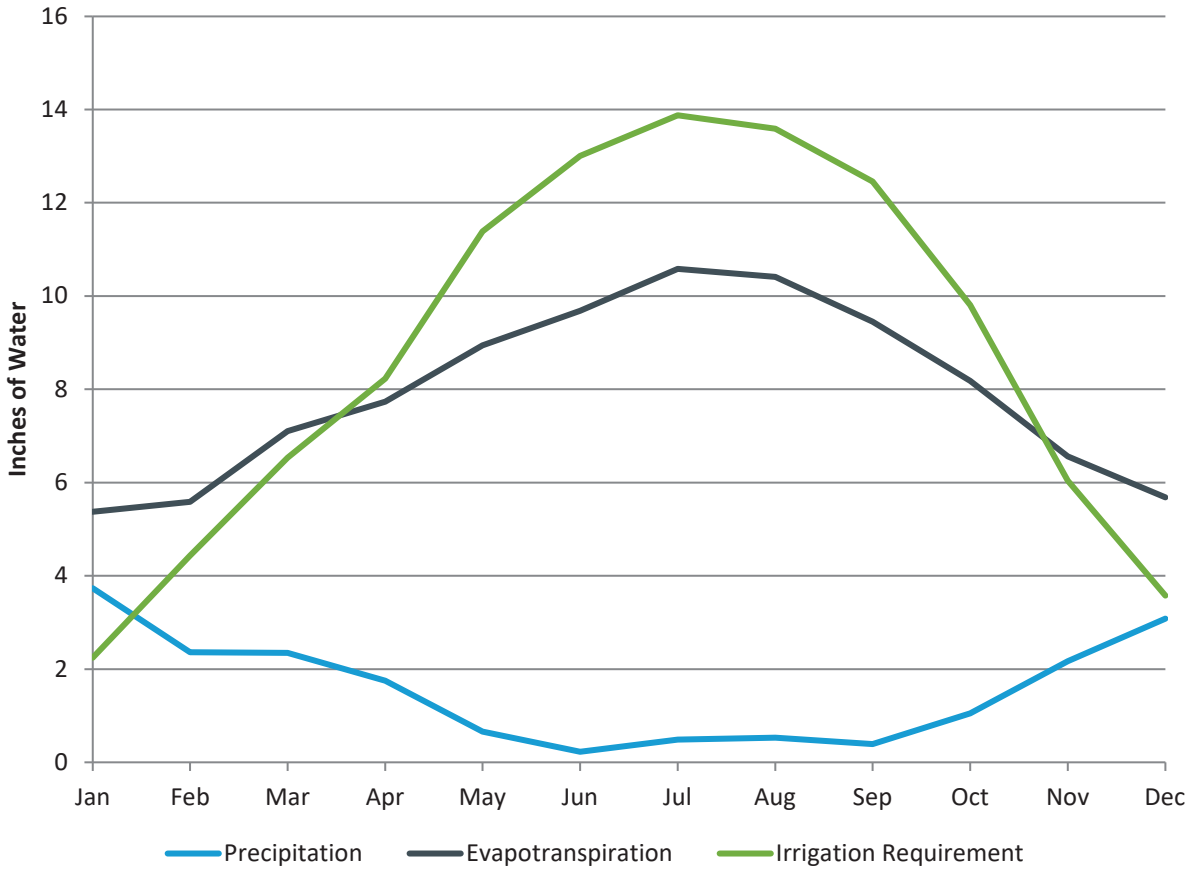


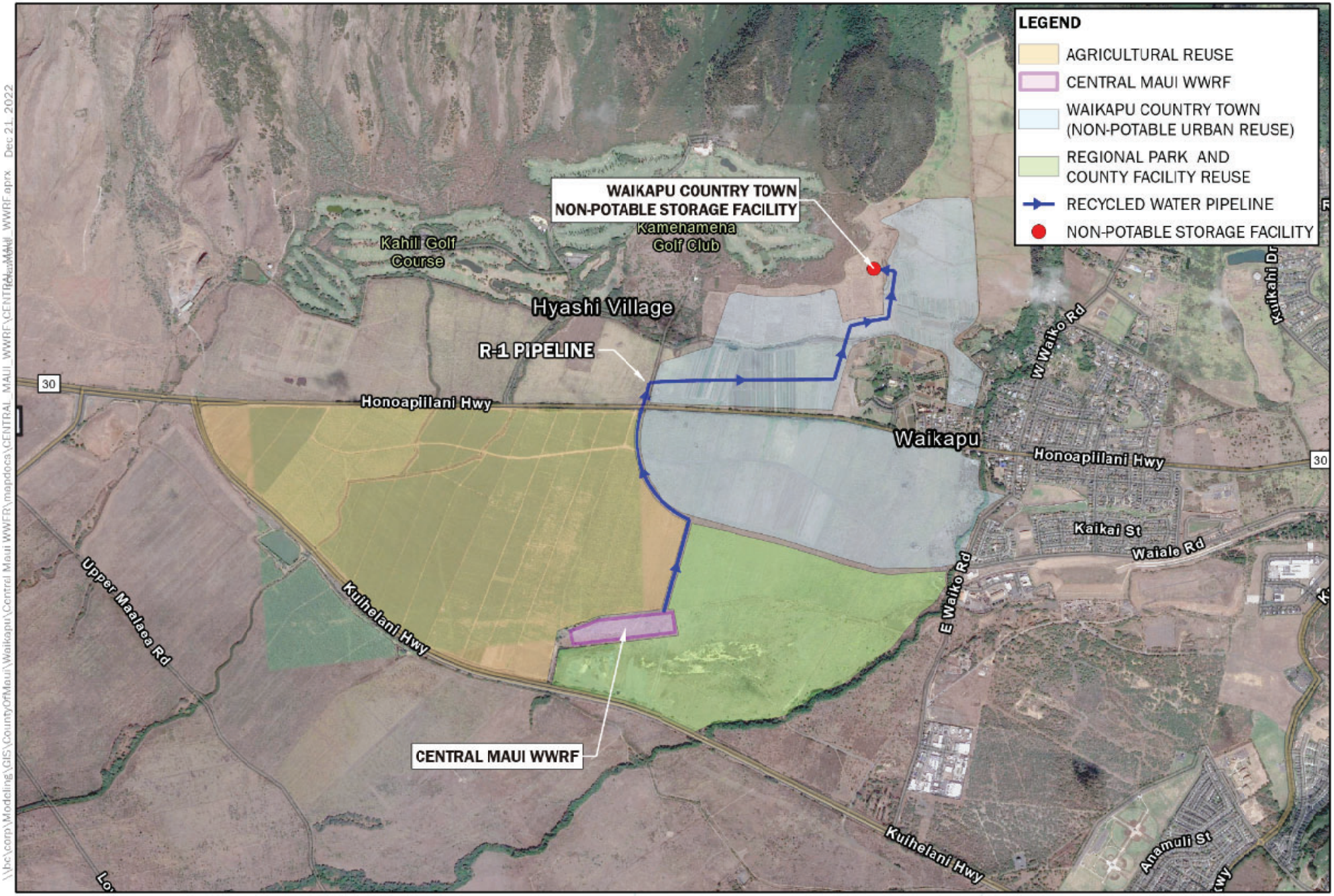
Figure 3-1. Irrigation Requirements at Central Maui WWRF

Recycled water will be used within the proposed Waikapu Country Town development for non-potable irrigation uses. In addition, recycled water will be used to supplement surface (ditch) water supplies to irrigate agricultural land adjacent to the Central Maui WWRF. Figure 3-2 shows the proposed agricultural irrigation area in blue. Table 3-2 lists the estimated irrigated acreages.

Table 3-2. Recycled Water Use Areas – Estimated Acreage

Recycled Water Use Area	Acres
Waikapu Country Town Parks	32 [a]
Waikapu Country Town Greenbelts and Open Space	50 [a]
Agricultural reserve	1,077 [a]
County regional park	100
Total	1,259

[a] *Source: Waikapu Country Town Final Environmental Impact Statement, December 2016.*



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COUNTY OF MAUI, HAWAII

CENTRAL MAUI WWRF EIS

DATE: DECEMBER 2022
PROJECT: 158098

Notes:
1. Aerial photo: Google Earth, 2019.

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FIGURE 3-2

CENTRAL MAUI WWRF RECYCLED WATER USE AREA BOUNDARIES

A water balance was prepared to assess potential recycled water use at the WWRF without implementing a large seasonal storage reservoir. Table 3-3 presents the results of the water balance evaluation, based on the full 4.0 mgd WWRF capacity, and a total of 1,259 acres of land under irrigation.

Table 3-3. Recycled Water Balance at 4.0 mgd Capacity

Month	Irrigation Area Demand (mgal)	R-1 Supply (mgal)	Supplemental Surface Water Demand (mgal)	Excess R-1 Water (mgal)
January	73	124	0	51
February	145	112	33	0
March	213	124	89	0
April	268	120	148	0
May	372	124	248	0
June	424	120	304	0
July	453	124	329	0
August	443	124	319	0
September	407	120	287	0
October	320	124	196	0
November	197	120	77	0
December	117	124	0	7
Totals	3,432	1,460	2,030	58

Figure 3-3 presents the results in graphical format. The purple line shows the amount of recycled water available for use, assuming flows are equal to the full 4.0 mgd WWRF capacity. The green line shows the irrigation water demand for 1,259 acres of land. Note that in all months except January and December the irrigation demand exceeds the recycled water supply, and significant volumes of surface water will be needed to meet the irrigation demand. The orange line shows the excess recycled water (supply – demand). The graph shows no excess recycled water for most of the year, but there will be small volumes in January and December that requires disposal. The graph shows that the large land base will can be expected to use approximately 96 percent of the recycled water produced by the Central Maui WWRF each year, and only 4 percent will need to be disposed.

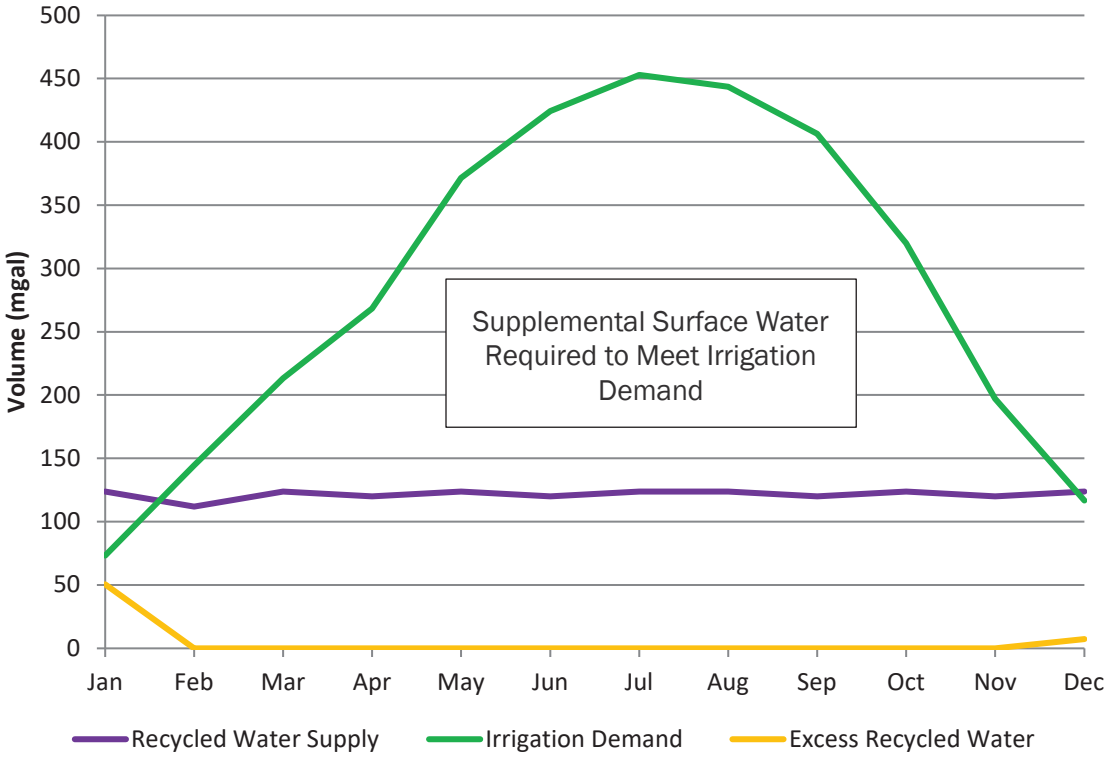

Figure 3-3. Recycled Water Supply and Demand Analysis

3.1.1 Nutrient Balance

Application of recycled water at the rates shown in Table 3-1 and Figure 3-1 will apply 2.73 million gallons of water annually per acre. The R-1 recycled water will contain nitrogen that will provide fertilizer value to the vegetation that is irrigated. The supplemental water may also contain some nitrogen as well, but at significantly lower concentrations than the recycled water. Table 3-4 lists the total nitrogen application per acre at a range of effluent total nitrogen concentrations. An effluent total N concentration of 10 mg/L is readily achievable with biological nutrient removal (BNR) technology in the tropics and will result in a gross N application of 106 lbs. N/acre/year, which is less that the nutrient requirements of most vegetation grown in the tropical climate. Therefore, we recommend an effluent total N concentration of 10 mg/L or less as a goal for the Central Maui WWRF.

Table 3-4. Nitrogen Application at Various Effluent TN Concentrations

Recycled Water Total N Concentration (mg/L)	Gross N Application (lbs. N/acre/year)		
	From Supplemental Water [a]	From Recycled Water	Total
7	13	65	78
10	13	93	106
15	13	139	153
20	13	186	199

[a] *Assumes supplemental water total N = 1 mg/L*

3.1.2 Treatment Requirements

The anticipated recycled water uses include irrigation of parks, school yards, streetscapes, and agricultural crops. The effluent from the Central Maui WWRF will need to meet DOH requirements for R-1 recycled water.

3.2 Disposal System Required per HAR 11-62

A wastewater effluent disposal system is necessary. Hawaii Administrative Rules (HAR) Chapter 11-62 and the DOH's Recycled Water Guidelines require a backup effluent disposal system for all water reuse applications. This backup system ensures effluent can be safely disposed when recycled water supply exceeds the demand or if the recycled water fails to meet the required treatment specifications. The backup disposal system must be designed to allow for disposal of 100 percent of the WWRF average capacity.

3.2.1 Disposal System Needs for Central Maui WWRF

The Central Maui WWRF will need a disposal system that can fulfill the following:

- Operate in all weather conditions, including extended and/or extreme wet weather periods.
- Can accept the full WWRF peak effluent flow. This scenario can occur during periods of extended wet weather when recycled water use is minimal or zero.
- Can accept effluent that does not meet recycled water standards (i.e., off-spec water).
- Protect human health. Provide responsible management of effluent that cannot be recycled, minimizing human exposure.
- Protect the environment. Designed to minimize adverse environmental impacts. May provide additional polishing treatment.
- Comply with applicable federal, state, and local regulations.

3.3 Soil Aquifer Treatment

Soil aquifer treatment (SAT) appears to be a viable effluent disposal approach for the Central Maui WWRF. SAT consists of the intermittent application of effluent at high hydraulic loading rates to basins constructed in highly permeable soils, such as sand or gravel. Treatment in the SAT process is accomplished via biological, chemical, and physical interactions that occur as the water percolates through the soil matrix to groundwater. Treatment benefits can include nitrogen and phosphorus removal, heavy metal and trace organic removal, and removal of endocrine disrupting chemicals. Vegetation may or may not be present and doesn't play a significant role in the treatment that is provided due to the high hydraulic loading rate. Vegetation can also be used as a visual mitigation method.

In a typical SAT system, treated effluent is intermittently dosed to a series of unlined earthen basins, resulting in saturated soil conditions followed by unsaturated (resting) conditions. The application periods are designed for specific treatment objectives and can range from 1 to 12 days depending upon the climate, pretreatment, and treatment goals. Rotating between active and inactive basins also provides redundancy for required maintenance in order to sustain surface permeability.

SAT systems require highly permeable soils to be present in order to achieve a high hydraulic loading rate. Geotechnical evaluations are needed before the design phase to establish the final system size. Safety factors incorporated in the design ensure that the basins can simultaneously handle peak wastewater flows and wet weather events.

Figure 3-4 is a schematic illustration of a soil aquifer treatment system. Figure 3-5 is a photo of SAT basins located in Washington State; the basins were resting when the photo was taken.

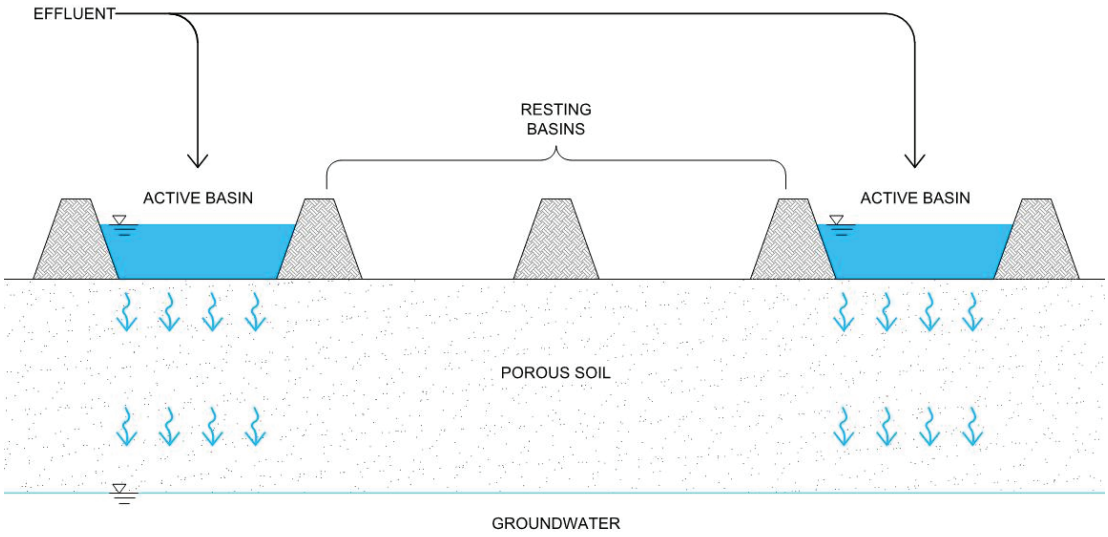

Figure 3-4. Soil Aquifer Treatment System Schematic

Figure 3-5. Soil Aquifer Treatment System Basins in Washington State

3.3.1 Anticipated Treatment Benefits

Soil aquifer treatment is an effective process for BOD_5, TSS, trace organics, endocrine disruptors, and pathogen removal. Removal of phosphorus and metals is excellent. Nitrogen removal can be significant when systems are managed for that objective.

3.3.1.1 BOD_5 and TSS Removal

BOD_5 levels are typically less than 2 mg/L in SAT percolate. Suspended solids are typically 1 to 2 mg/L in the percolate from SAT systems because of filtration through the soil profile.

3.3.1.2 Nitrogen Removal

Nitrification/denitrification is the principal mechanism for removal of ammonia and nitrate from the wastewater in SAT systems. Ammonia adsorption also plays an important role in retaining ammonia in the soil long enough for biological conversion. Nitrification and denitrification are affected by low temperatures and proceed slowly at temperatures of 36 to 41°F (3.6 to 5°C). In addition, denitrification requires an adequate carbon source and the absence of available oxygen. The relatively high average annual temperatures on Maui will support the nitrification process, but the treated effluent that is applied to the SAT will be low in carbon due to the high level of treatment to be provided in the WWRF processes (tertiary treatment to create R-1 recycled water), so denitrification in the SAT is expected to be limited.

3.3.1.3 Phosphorus Removal

Phosphorus removal in SAT is accomplished by adsorption and chemical precipitation. The adsorption occurs quickly and the slower-occurring chemical precipitation replenishes the adsorption capacity of the soil. Typical phosphorus removals for SAT are presented in Table 3-5 including travel distances through the soil.

Table 3-5. Phosphorus Removal for Soil Aquifer Treatment Systems

Location	Applied Phosphorus[3] (mg/L)	Vertical Travel Distance (feet)	Horizontal Travel Distance (feet)	Percolate Concentration (mg/L)	Removal (%)
Boulder, Colorado	6.2	8–10	0	0.2–1.5	40–97
Brookings, South Dakota	3.0[b]	2.6	0	0.45	85
Calumet, Michigan	3.5	10–30	0–400	0.1–0.4	89–97
	3.5	30[c]	5,580[c]	0.03	99
Ft. Devens, Massachusetts	9.0[b]	50	100	0.1	99
Hollister, California	10.5	22	0	7.4	29
Lake George, New York	2.1[b]	10	0	<1	>52
	2.1[b]	10[c]	1,970[c]	0.014	99
Phoenix, Arizona	8–11	30	0	2–5	40–80
	7.9	20	100	0.51	94
Vineland, New Jersey	4.8[b]	6.5–60	0	1.54	68
	4.8[b]	13–52	850–1,700	0.27	94

Source: *USEPA, Process Design Manual for Land Treatment of Municipal Wastewater, EPA 625/1-81-013, U.S. Environmental Protection Agency, Cincinnati, OH, 1981.*

a. Total phosphate measured, except as noted.

b. Soluble phosphate measured.

c. Seepage.

3.3.1.4 Heavy Metals Removal

Heavy metals removal, using the mechanisms of precipitation, adsorption and complexation, will range from 50 to 90 percent for SAT. Metals applied at very low concentrations (below drinking water standards) may not be affected by passage through sand (Crites, 1985a).

Metals removal at a SAT in Boulder, Colorado was studied over a six-week period. The results of the applied influent and the effluent percolate are presented in Table 3-6. The soil was a loamy to clay sand and the depth of the underdrains was 8 to 10 feet (Smith et al., 1979)

At a SAT on Cape Cod the accumulation of metals was measured by depth from the surface down to a depth of 1.7 feet. The distribution of the metals retained is shown in Table 3-7. For all five metals, between 76 and 88 percent of the metals detected were found in the top 1.5 inches (0-0.13 feet). When 33 years of loading was compared to the total metals detected in the top 1.7 feet of the SAT sandy soils, the amounts retained ranged from 49 to 129 percent of the amounts applied over 33 years (US EPA 1981).

Table 3-6. Heavy Metal Removal by SAT at Boulder, Colorado			
Metal	Total Metals		
	Applied, ppb	Percolate, ppb	Removal %
Cadmium	2.47	0.78	68
Copper	54.02	18.75	65
Chromium	25.93	14.60	47
Nickel	13.86	8.94	36
Lead	10.15	1.75	83
Zinc	60.28	7.94	87

Note: Adapted from Smith, et al. (1979)

Table 3-7. Heavy Metal Retention by Depth at SAT on Cape Cod, Massachusetts, %					
Depth, ft	Cadmium	Chromium	Copper	Lead	Zinc
0 – 0.13	84	87	76	88	82
0.13 – 0.19	12	10	23	12	13
0.46 – 0.52	1	0	0.4	0	1
0.79 – 0.85	1	2	0.4	0	2
0.95 – 1.02	1	0	0.1	0	0.8
1.44 – 1.50	0.5	1	0.1	0	1.2
1.64 - 170	0.5	0	0	0	0
TOTAL	100	100	100	100	100
Percent retention of 33-year loading	113	62	85	129	49

Note: Adapted USEPA (1981).

3.3.1.5 Trace Organics

Trace organics are removed in SAT systems by volatilization, sorption, and degradation. Removal levels depend on the constituent, the applied concentration, the loading rate, and the presence of easily degradable organics to serve as a primary substrate (Crites, 1985b). Removals have been studied at Phoenix, AZ; Ft. Devens, MA; and Whittier Narrows, CA; and have ranged from 10 to 96 percent.

3.3.1.6 Endocrine Disruptors

SAT systems have been utilized for the removal of endocrine disrupting chemicals found in municipal wastewaters (Conroy, et al., 2001; Quanrud, et al., 2002). Endocrine disruptors originate from industrial, agricultural, and domestic sources. These include a combination of natural hormones, pharmaceutical products, and industrial chemicals such as polychlorinated biphenyls, organochlorine pesticides, phenoxyacid herbicides, phthalates and triazines. Following conventional secondary treatment, percolation through approximately 120 feet (36 m) of unconsolidated sediments to the local aquifer reduced residual estrogenic activity by greater than 95 percent, as

illustrated in Table 3-8 (Quanrud, et al., 2002). The fate of micropollutants originating from pharmaceuticals and active ingredients in personal care products have been studied at two groundwater recharge facilities in Arizona (Drewes, et al., 2001). Preliminary studies indicate that groundwater recharge offers a high potential to remove acidic drugs such as lipid regulators and analgesics. Other compounds such as antiepileptic drugs and X-ray contrast agents showed no clear indication of removal during travel times of more than 6 years.

Table 3-8. Fractional Attenuation of Estrogenic Activity (Relative to Primary Effluent) During Secondary Treatment and Soil Aquifer Treatment

Sample Location	Fractional Removal
Primary	0.00
Secondary unchlorinated	0.62
Secondary chlorinated	0.65
Secondary dechlorinated	0.65
Storage pond	0.68
0.8 m (2.5 ft)	0.77
3.1 m (10 ft)	0.83
5.2 m (17 ft)	0.83
18.3 m (60 ft)	0.93
36.6 m (120 ft)	0.99

Source: *USEPA, Process Design Manual for Land Treatment of Municipal and Industrial Wastewater. Center for Environmental Research Information (CERI), U.S. Environmental Protection Agency, Cincinnati, OH, 2006.*

Additional studies of long-term SAT at field sites in Mesa, AZ., indicate that substantial removal of effluent organic matter can occur. Identified trace organics were efficiently removed as a function of travel time to very low concentrations or below detection limits. Based on the characterization techniques used, the character of bulk organics that are present in final SAT water resembled the character of natural organic matter present in drinking water (Drewes, et al., 2001).

3.3.1.7 Pathogens

Pathogens are filtered out by the soil and adsorbed onto clay particles and organic matter. Fecal coliform is removed by 2 to 4 orders of magnitude in many SAT systems (U.S.EPA, 1981). At the SAT site in Phoenix, AZ, 99.99 percent virus removal was achieved after travel through 30 feet (10 m) of sand at a loading rate of 300 feet/year (Crites, 1985b). A summary of virus removal through soil at different SAT sites is presented in Table 3-9.

Table 3-9. Virus Removal through Soil at SAT System (USEPA, 1976)			
Location	Sampling distance, m	Virus concentration, PFU/L	
		At source	At sample point
Phoenix, Arizona (Jan-Dec 1974)	3-9	8	0
		27	0
		24	0
		2	0
		75	0
		11	0
Gainesville, Florida (Apr-Sep 1974)	7	0.14 (average over study period)	0.005
		0.14 (average over study period)	0
		0.14 (average over study period)	0
		0.14 (average over study period)	0
		0.14 (average over study period)	0
		0.14 (average over study period)	0
		0.14 (average over study period)	0
Santee, California (1966)	61	Concentrated type 3 polio	0
Ft. Devens, Massachusetts (1974)	17	Indigenous virus, 276 (average) F_2 bacteriophage seed, 2.2×10^5	8.3 (average) 1.3×10^5
Medford, New York (Nov 1976-Oct 1977)	0.75-8.34	Indigenous virus, 1.1-81.0	17 samples negative; 6 positive, at 0.47 average; range 0.14-0.66
	0.75	Polio virus seed, 7×10^4 (6 cm/h infiltration rate)	Range 0-25.5
	0.75	1.84×10^5 (100 cm/h infiltration rate)	Range 0.03×10^4 to 97.5×10^4
Vineland, New Jersey (Aug 1976-May 1977)	0.6-16.8	13 (average over study period)	9 of 10 positive, 1.62 average
		13 (average over study period)	7 of 10 positive
		13 (average over study period)	2 of 10 positive, 1.95 average
		13 (average over study period)	0 of 10 positive, 0.48 average

3.3.2 SAT Discharge Requirements

The DOH considers SAT to be land disposal of effluent. HAR 11-62 requires secondary treatment (BOD_5 and TSS ≤ 30 mg/L) for land disposal. As presented above, an effluent total N concentration of 10 mg/L or less is readily achievable with BNR technology in the tropics and is recommended for the Central Maui WWRF for recycled water use. Reduction of effluent total N to this concentration is

not technically required for SAT discharge, but is recommended to reduce the flux of nitrogen to groundwater from the SAT.

3.4 Other Effluent Management Systems Considered

Other effluent management systems that were considered are described below.

3.4.1 Slow Rate Land Treatment

Slow rate (SR) land treatment is the application of municipal wastewater effluent to a vegetated soil surface. The applied wastewater receives significant treatment as it flows through the plant root/soil matrix. The vegetation uses the nutrients in the effluent as fertilizer and transpires a portion of the applied water. Figure 3-6 illustrates the process. Figure 3-7 is an example image of a slow rate system.

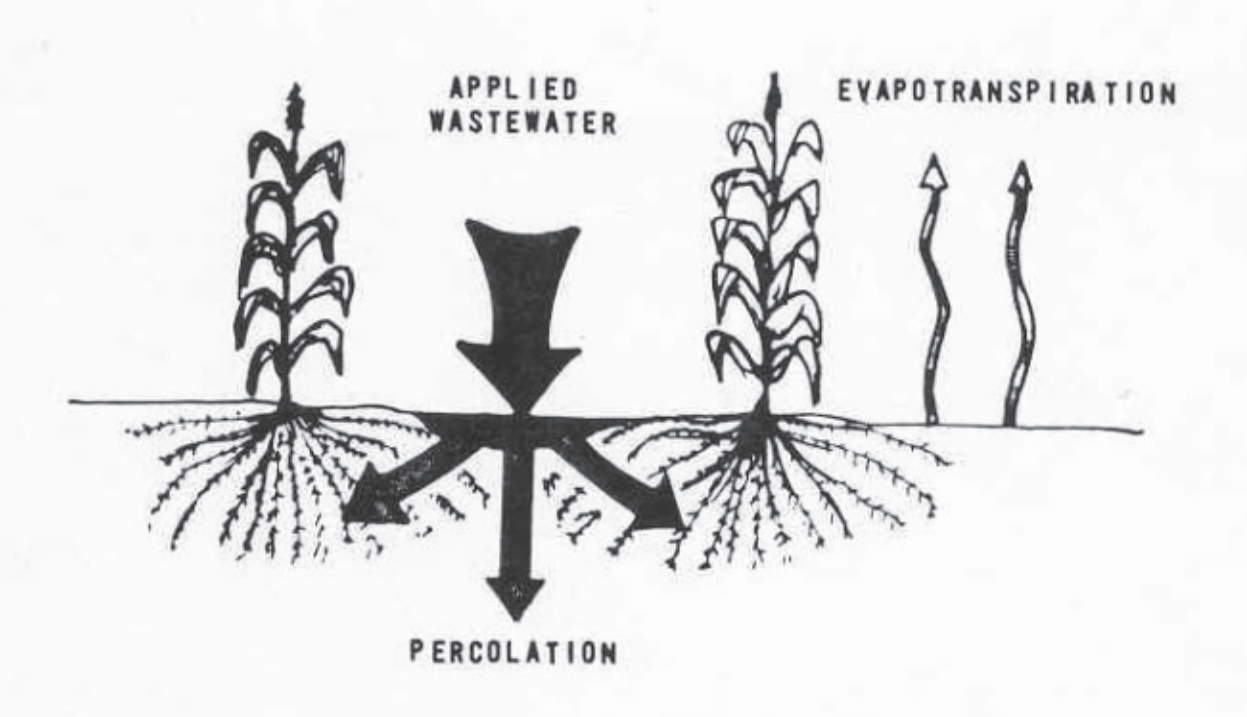

Figure 3-6. SR Land Treatment Process

Figure 3-7. Example of SR System Utilizing Sprinkler Irrigation

There are two types of SR systems:

- **Slow Rate Type 1:** Effluent is applied in excess of the crop's water requirements. This results in a significant percolation component to groundwater. Effluent can be applied via sprinkler irrigation or surface (flood) irrigation. Nutrient uptake by the soils and crop is typically excellent. During rain events, effluent continues to be applied. Runoff is typically collected in a tailwater ditch or pond and recirculated to the application area. Since treated effluent can exist as runoff, the slow rate area is typically fenced to deter public access.
- **Slow Rate Type 2 (Reuse):** Effluent can be beneficially reused in non-potable water recycling initiatives. Non-potable reuse is the beneficial reuse of recycled water in non-potable situations, such as irrigation for landscaping. Effluent is applied to meet the needs of the crop, and percolation to groundwater is limited. Typically, recycled water is treated at a WWRF and sold to recycled water users through a separate distribution system, colored purple to distinguish it from the potable water distribution system. The proposed water recycling program described above fit into this category of SR land treatment.

The sandy soils that are present at the proposed WWRF site are better suited for SAT than SR Type 1 land treatment. SR Type 2 land treatment (i.e., reuse) is included as part of the proposed Central Maui WWRF effluent management system.

3.4.2 Evaporation

Natural and mechanical evaporation was previously evaluated by the County (Brown and Caldwell, April 2015). The climate on Maui results in excessively large area requirements for evaporation ponds. Mechanical evaporation is energy intensive and not practical for municipal WWRF effluent. This option is not a viable alternative for the Central Maui WWRF.

3.4.3 Injection Wells

DOH is prohibited from issuing permits to construct new injection wells for WWRF effluent disposal purposes if other feasible options exist. Therefore, this option is not a viable alternative for the Central Maui WWRF.

3.4.4 Discharge to Waikapu Stream

While stream discharge of treated effluent may be a valid option elsewhere, it was immediately removed from consideration for the Central Maui WWRF. The Hawaii water quality standards for freshwater streams and rivers are very stringent, and treatment to the required levels is currently unachievable using reasonable and economically viable technology.

3.4.5 Ocean Outfall

Ocean outfalls for the existing WWRFs were previously evaluated by the County (Brown and Caldwell, January 21, 2021). Ocean outfalls were determined to be a less-desirable effluent disposal approach than land treatment.

Section 4

Preliminary Treatment Options

Preliminary treatment prepares the raw wastewater for downstream treatment by removing debris.

4.1 Influent Flow Metering and Sampling

Influent flow metering and sampling is needed to monitor the influent flow and characteristics.

4.1.1 Influent Flow Measurement

Influent flow measurement is required to allow assessment of flows and loads to the biological treatment process, and to assess the biological treatment process performance. A Parshall flume or magnetic flow meter is recommended, depending on the hydraulic conditions.

A Parshall flume is recommended upstream of the screening system if the influent wastewater enters the treatment plant via gravity flow. Parshall flumes work well for influent measurement because the flume can operate in an open-channel configuration, can accommodate wide ranges of flows, and is self-cleaning. A straight approach length of at least 20 times the flume throat width is recommended upstream of the flume to provide favorable hydraulic conditions. Proper conditions are also required to ensure a hydraulic jump occurs downstream of the flume throat. Water level in the flume is measured using an ultrasonic or radar level sensor.

A magnetic flow meter is recommended if the influent is pumped. Magnetic flow meters take advantage of Faraday's Law of Electromagnetic Induction to determine flow. The flow meter creates a magnetic field and the water flowing through it, being conductive, creates a voltage which is proportional to the flow. Magnetic flow meters have no parts intruding into the pipe, making them favorable for wastewater applications. Proper meter installation is required for the best measurement performance; at least five pipe diameters upstream and three diameters downstream of straight pipe are recommended for accurate flow measurement.

The influent flow meter should be sized to pass the peak hour wet weather flow rate.

4.1.2 Influent Flow Sampling

An automatic refrigerated composite sampler will be required to allow influent composite samples to be collected. Influent composite samples, when combined with influent flow measurement, can be used to calculate influent mass loading rates to the WWRF to allow assessment of the treatment performance and optimization of aeration rates in the biological treatment process. Periodic influent sampling is also recommended to monitor for changes in the influent characteristics. The sampler should be configured to allow flow-paced sample collection using a signal from the influent flow meter.

4.2 Screening

Screening is recommended to protect the downstream system operations from large objects, debris, and rags that can be present in wastewater. The industry trend is towards finer screening systems that remove greater amounts of debris from the waste stream; screens with 6 millimeters (¼ inch) openings are frequently used for activated sludge treatment systems. Membrane bioreactor

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treatment systems require even finer screening, with screen openings sizes of 2 millimeter (mm) or smaller being common.

Screening options evaluated for the Central Maui WWRF include band screens, step screens, filter screens, and drum screens as described below.

4.2.1 Band Screen

Band screens utilize a continuous band of screening panels and can be likened to an elongated drum screen. It has a rectangular footprint and operates vertically. Clear openings can range from 1 to 6 mm. Influent water enters the band screen at the center of the screen and passes through each side of the screening band. Screened wastewater exits through either side and recollects into a smaller downstream channel. The screening panels retain the debris while lifting lips hold larger screenings. In the cleaning process, the band revolves, carrying the screenings collected on the panels up to deck level. The captured screenings are deposited into the center trough by gravity, and screening panels cleaned with backwash water. The captured screenings and wash wastewater then exit the head section via a sluice trough. The drive mechanism is externally mounted and makes no contact with the wastewater. The main chains that revolve the screening band are supported by two sprockets above deck. Figure 4-1 illustrates how the band screen works.

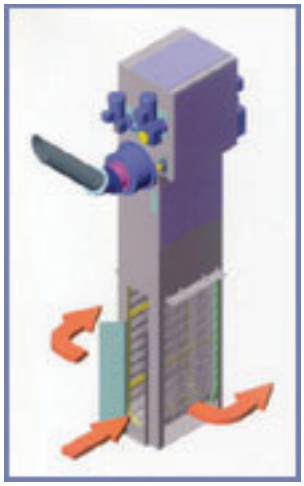


Figure 4-1. Band Screen

Manufacturers of band screens include Brackett Green, Jones and Attwood, and JWC Environmental. Each manufacturer has respective washer/compactors to handle the captured screenings and wash water. A screenings trough or conveyor is typically required to transport the screenings from the screen to the washer. Table 4-1 lists some advantages and disadvantages of band screens.

Table 4-1. Band Screen – Advantages and Disadvantages	
Advantages	Disadvantages
Screens cleaned with backwash water – no raking	Requires separate washer/compactor
Screen area independent of channel width	Two-stage screening (coarse and fine) often required
Effective screenings capture	Cannot pivot screen to service in place; must lift out

4.2.2 Step Screen

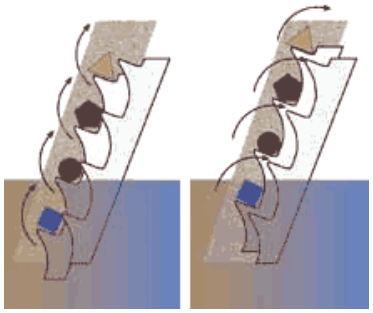
Step screens utilize two sets of inclined stepped plates. One set of plates is fixed while the other set is movable. The movable set lifts the screenings to the next step via a circular movement of the movable plates each time the head loss reaches a designated amount, as shown in Figure 4-2.

The controls can be set to allow a mat to build up on the screening surface, achieving finer screening of the wastewater. Screenings are discharged after they reach the top step. Step screens typically come with clear openings of 3 to 6 mm. The thickness of the screen plates varies among the manufacturers, ranging from 2 to 3 mm. Manufacturers include Huber and Parkson Hycor. Both manufacturers make a compatible screw wash press. A screenings trough or conveyor is required to transport the screenings from the screen to the washer.

A significant feature of the step screen is that all moving parts aside from the screen bars and reciprocating arm are above the water surface and accessible for maintenance. Submerged components can be accessed by pivoting the screen. Other important features include flexible bottom fixed teeth at the channel invert allows debris trapped between the teeth to move up the bar rack and a flexible plate at the invert to prevent debris from packing into the area at the bottom of the screen.

Step 1 - Screenings are retained on the steps and form a screenings carpet.

Step 2 - The screenings carpet is lifted by rotation of the moveable plate.



Step 3 - The screenings carpet is placed on the next steps of the fixed plate. The lowest step is clean and ready for the formation of a new screenings carpet.

Figure 4-2. Step Screen

Table 4-2 lists some advantages and disadvantages of step screens.

Table 4-2. Step Screen – Advantages and Disadvantages

Advantages	Disadvantages
All moving parts above water	Peak flows can cause screenings to fall backward
Can be adjusted to form a mat on the screens for increased solids removal	Vulnerable to damage from large objects, broken glass, rocks, and grit
Self-cleaning mechanism	Rocks and other objects can get stuck in-between the plates

4.2.3 Filter Screen

The filter screen is a self-cleaning belt screening device with a specific configuration of "teeth" or "hooks" mounted horizontally and vertically on a series of parallel shafts to form an endless moving belt. Solids are captured on the filter elements and carried upward on the belt assembly to discharge at the rear of the unit. Two-stage screening achieved with coarse filtration occurring on the forward screen face and fine filtration on the recessed face. As the rake tip of one row of filter elements passes between the shank arm of the lower row, the elements clean themselves automatically. A rotating brush is also provided to provide additional solids removal. The belt is composed of interlocking plastic elements. The nominal screen opening can vary from 1 mm to 30 mm. Figure 4-3 shows a filter screen installation.

Figure 4-3. Filter Screen

The main benefits of this screen are that it has no submerged bearings, has low power consumption, and has a high capture rate. All moving parts can be accessed and serviced on the operating deck. Because of its high angle of inclination (typically 75 degrees), the screen does not require as long a channel as the step screen. The main disadvantage of this screen is that captured screenings that are not completely washed off may carry over to the effluent side of the screen. Manufacturers of filter screens include Parkson and Andritz. Table 4-3 lists some advantages and disadvantages of filter screens.

Table 4-3. Filter Screen– Advantages and Disadvantages

Advantages	Disadvantages
No submerged bearings	Screenings can carry over if not completely washed off
Low power consumption	Plastic teeth are not durable, increasing maintenance requirements
High capture rate	

4.2.4 Drum Screen

A drum screen combines screening, screenings washing, dewatering, compacting, and bagging/disposal within a single unit. The screening portion consists of a rotating inclined screen basket inserted into the wastewater channel. The screening basket can consist of bars, perforated plates or sieves, depending on the application and clear opening required. Water sprays clean the drum as it rotates. Controlled by head loss, a rake arm starts rotating within the screen basket, pushing the screenings off the rake and into a perforated screenings hopper located at the screen's central axis. An auger along the screen axis conveys the screenings from the hopper through an inclined tube, which dewaters and compacts the screenings. The tube includes a perforated dewatering section. The discharged screenings are about 40-percent dry and can be discharged into a bin or directly into a bagging system. Figure 4-4 illustrates the process. Manufacturers include Lakeside and Huber. The key benefit to this system is the integrated screenings washing system, minimizing additional screenings handling and odor potential. However, this style of screen is typically only used for WWTPs that are smaller than the Central Maui WWRF, because the diameter of the drum becomes excessively large to handle high peak flows, or a larger number of units must be installed. For these reasons the style of screen will receive no further consideration.

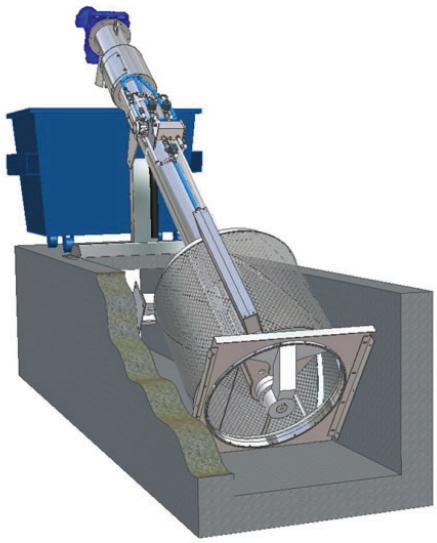


Figure 4-4. Drum Screen

4.2.5 Screening Recommendations

Step screens with ¼" openings are recommended for the Central Maui WWRF. Having all moving parts accessible above water provides ease of maintenance. Quarter-inch openings will provide sufficient screening for the anticipated downstream processes. A minimum of two units is recommended; one active unit capable of screening the peak hour wet weather flow rate, plus one redundant unit, plus a manually-cleaned bar rack in a bypass channel. The bypass channel should include an overflow weir as well as channel isolation gates. The overflow weir will allow passive bypass to the manual bar rack if the on-line screen(s) fail or a blinded by excessive loading. It is recommended that screening equipment only be procured from a manufacturer with proven reliable service and technical support personnel located in Hawaii or the U.S. mainland west coast.

Screenings would be conveyed to a washer/compactor to remove organic matter prior to being deposited into a dumpster. Screenings would be disposed at the Central Maui Landfill.

4.3 Grit Removal

Grit is comprised of particles that are heavier than the organic biodegradable matter in wastewater. Grit particles can consist of sand, gravel, pebbles, silt, cinders, ground bone, eggshells, coffee grounds, and other materials. Grit in the wastewater collection and treatment system causes abrasive wear to mechanical equipment, piping, and appurtenances. Grit can also form deposits in pipelines, channels, and tanks, which reduces hydraulic capacity and can damage equipment. Removal of grit is very important to help prevent wear to downstream equipment, costly service interruptions and repair.

Grit removal systems usually are placed after the screening process. At this point, the largest materials have been removed by the screens and will not interfere with grit handling equipment.

There are several types of grit removal methods, including induced vortex grit removal, aerated grit chambers, and lamella plate settlers. The type of grit removal chosen is mainly dependent on the size of the incoming grit particles and the desired capture rate. Removed grit must be washed, dewatered, and disposed.

4.3.1 Induced Vortex Grit Removal

Historically, vortex grit removal or the circular grit chamber has been the most widely used method for grit removal in the U.S. Vortex grit removal relies on the principle that grit has a greater specific gravity than organic matter.

There are two configurations of vortex grit removal systems: a sloped bottom unit and a flat bottom unit. The sloped bottom unit relies on particle settling to remove grit. Flow enters the grit chamber tangentially to provide the longest flow path around the inside of the circular grit chamber. This longer flow path is designed to achieve a sufficient retention time to allow grit to settle. The sloped bottom funnels the settled grit into a hopper below the basin. A sloped bottom vortex grit unit cross section is shown in Figure 4-5.

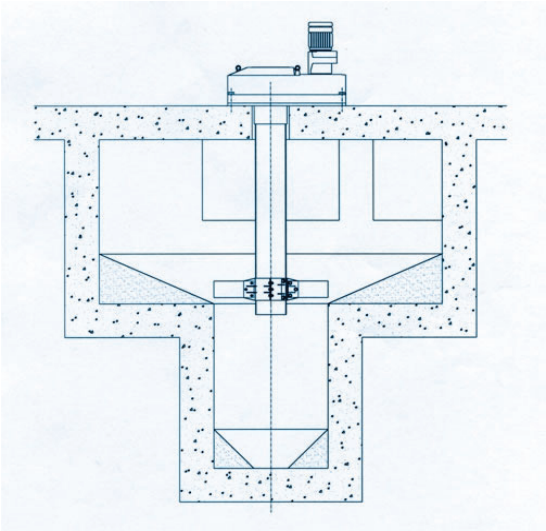


Figure 4-5. Sloped Bottom Vortex Grit Removal Cross Section

The flat bottom vortex system relies on hydraulic removal instead of specific gravity alone to remove grit from the wastewater stream. Flat bottom vortex systems use two paddles within the interior of the grit chamber that induce a toroidal flow pattern to move grit along the bottom towards the center. Once collected at the center of the grit chamber, a propeller forces excess grit down into the hopper. A flat bottom PISTA® Grit unit is shown in Figure 4-6.

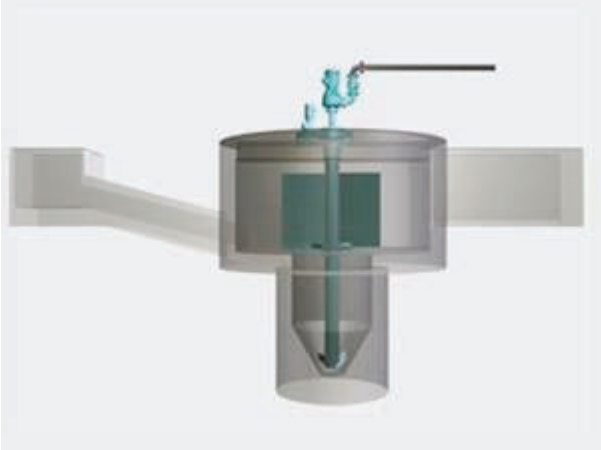


Figure 4-6. Flat Bottom PISTA® Grit Removal

4.3.2 Vortex Grit Removal Capture Rate

In Brown and Caldwell's experience it is necessary to de-rate vortex type grit removal units by a factor of 50 percent of the advertised capacity to achieve satisfactory performance, due to the short detention time in the chamber. At large flow rates, the small-chambered vortex type units tend to re-suspend smaller grit particles which become a problem for downstream processes.

Table 4-4 lists some advantages and disadvantages of the vortex type grit removal.

Table 4-4. Induced Vortex – Advantages and Disadvantages

Advantages	Disadvantages
Low maintenance	Re-suspends/low capture rate of fines
Low head loss	Poor capture efficiency
Small footprint	

4.3.3 Aerated Grit Removal

Aerated grit chambers are tanks that function specifically to remove inorganic solids from the wastewater stream. Aerated grit tanks are designed to induce sufficient vertical velocity in order to separate organic and inorganic solids. In theory, inorganic solids have a higher specific gravity than organic solids, and therefore require higher vertical velocities to keep them in suspension.

Air diffusers placed near one longitudinal tank wall induce a roll in the contents of the grit tank. This roll creates maximum velocities near the walls and lower velocities at the surface and bottom of the

tank. The lower transverse horizontal velocities allow inorganic particles to settle out and be transported to the grit hopper by shear-induced currents.

Aerated grit chamber design is based on providing sufficient hydraulic detention time during peak wet weather flow (PWWF) conditions. In Brown and Caldwell's experience it is necessary to provide at least 10 minutes of detention time to achieve satisfactory grit removal.

Aerated grit tanks can provide excellent grit removal with minimal head loss, but the chambers themselves require a large footprint. Proper operation of aerated grit tanks can be difficult under varying hydraulic loads due to the need to make fine adjustments to the air diffusers.

Figure 4-7 illustrates the particle settling action of an aerated grit chamber.

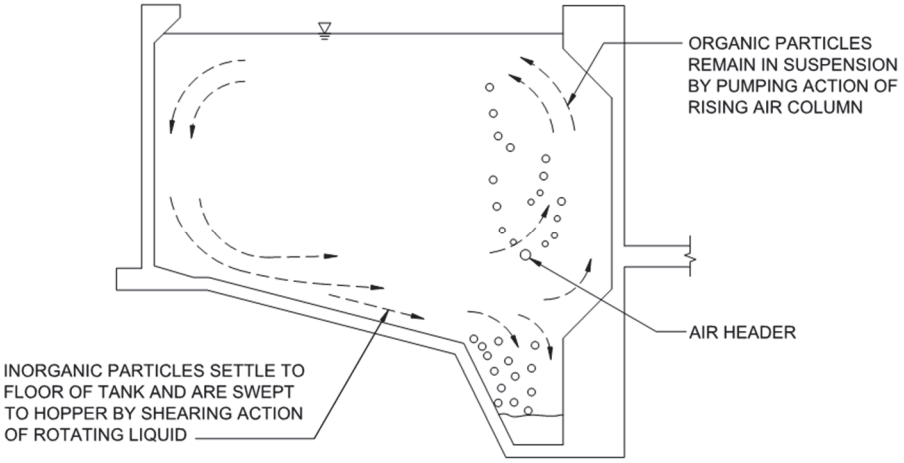


Figure 4-7. Aerated Grit Removal Schematic

Table 4-5 lists some advantages and disadvantages of aerated grit chambers.

Table 4-5. Aerated Grit Removal – Advantages and Disadvantages

Advantages	Disadvantages
Low head loss	Large footprint
Once airflow is dialed in, the maintenance is low	Requires fine tuning diffuser airflow for optimal performance
Effective removal of fines	High capital cost
Provides additional aeration; "freshens" sewage prior to primary clarification. Reduces denitrification in primary clarifiers.	High O&M cost due to blowers

4.3.4 Lamella Grit Removal

This proprietary technology from Eutek, called the HeadCell, consists of sloped trays stacked in deep tanks. Flow enters the tanks tangentially and establishes a vortex flow pattern. Solids settle onto each plate and fall toward an opening at the center of each plate. The grit collects at the cone shaped bottom of the tank where it is pumped to be washed and dewatered. Effluent flows out of the trays, over a weir, and into an effluent trough.

Grit capture is done all hydraulically and there are no moving parts. The head loss through each HeadCell is around one foot. HeadCells can be sized to provide up to 50 mgd of capacity within a single unit.

With the stacked tray design, the HeadCells can achieve a 95 percent capture rate of grit 75 microns and larger. The multiple trays provide a large surface area for settling multiple size particles. The treatment capacity of the HeadCell is greater than other technologies with the same footprint.

Figure 4-8 is an illustration of a section cut through the HeadCell process.

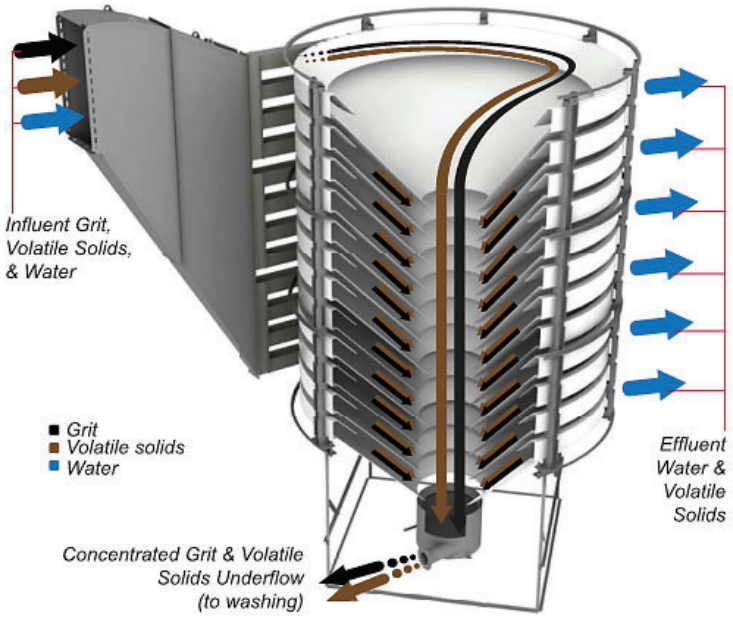


Figure 4-8. Headcell Process Schematic

Table 4-6 lists advantages and disadvantages of the Headcell.

Table 4-6. Lamella Plate Settling/HeadCell – Advantages and Disadvantages

Advantages	Disadvantages
Effective removal of fines	High capital cost
Small footprint	Low history of installations
No moving parts	
Low operating cost	

4.3.5 Grit Particle Size Considerations

Most grit technologies and literature assume that grit is a clean sand or silica particle with a specific gravity of 2.65. In reality, grit particles are often coated with fats, grease, and organic material, which reduce the particle's specific gravity. Grit particles with lower specific gravity have lower settling velocities, behaving like lighter and smaller grit particles.

The sand equivalent size (SES) is the size of a clean sand sphere that exhibits the same settling velocity as the coated grit particles. For example, a grease coated grit particle with a physical size of 200 microns may settle and behave like a clean particle with an SES of 150 microns.

4.3.6 Efficiency comparison

Each of the alternatives claims a minimum particle size and capture rate. These claims are based on the ideal, clean grit particle. As previously discussed, in reality grit particles are coated with fats and grease and do not exhibit the behavior of ideal grit particles. The capture rates have to be de-rated to reflect the SES of the particles. Table 4-7 compares the claimed minimum particle size captured of the alternatives discussed.

Table 4-7. Grit Capture Size Comparison

Alternative	Targeted Particle Size
Induced Vortex	105 µm
Aerated Grit Removal	105 µm
HeadCell	75 µm

The Headcell is able to remove the finest particles, with up to 95 percent removal of particles with a physical size down to 75 microns.

4.3.7 Grit Removal Recommendation

A HeadCell grit removal system is recommended for the Central Maui WWRF. The HeadCell system is the most effective at removing fine particles. It has no moving parts that would be difficult to repair or replace. The City and County of Honolulu has installed a HeadCell grit removal system at the Kailua WWTP with good results. The Headcell(s) would be followed by a Eutek SlurryCup(s) for grit washing and a Eutek Grit Snail(s) for dewatering. Washed and dewatered grit would be disposed at the Central Maui Landfill.

Two HeadCell grit chambers are proposed; one unit would be capable of treating the peak hour wet weather flow, and the second unit would be redundant.

4.4 Preliminary Treatment Recommendations

Our preliminary treatment recommendations are summarized below.

4.4.1 Processes

Table 4-8 is a summary of the preliminary treatment recommendations.

Table 4-8. Preliminary Treatment Recommendations

Process	Description	Value
Influent flow measurement	Type	Parshall flume or magnetic flow meter, depending on hydraulic conditions.
	Minimum capacity	16.1 mgd
Influent sampling	Type	Automatic refrigerated composite sampler
	Sample collection	Flow paced
Screening	Type	Step screens

Table 4-8. Preliminary Treatment Recommendations		
	Number of units	2 (1 redundant) plus bypass channel with manually-cleaned bar rack
	Minimum capacity	16.1 mgd with one unit in operation
Grit removal	Type	HeadCell
	Number of units	2 (1 redundant)
	Minimum capacity	16.1 mgd with one unit in operation
	Number of grit pumps	4 (2 redundant)
	Grit washer type	Eutek SlurryCup
	Number of grit washer units	2
	Grit dewatering type	Eutek Grit Snail
	Number of grit dewatering units	2

The screening process can be odorous; we recommend that foul air be collected from the headworks channels and treated for odor control.

4.5 Septage Receiving Station

Packaged septage receiving systems with integral rock removal and screening represents the current best-in-class septage receiving. These systems may include options such as key card operation for access control and billing purposes, rock trap for gravel removal, screening to remove and clean debris, and a grinder for particle size reduction. The septage receiving tank can be sized to allow the WWRF operator to inspect the load before it is released to the treatment plant. Figure 4-9 is a photo of a typical packaged septage receiving system.

Figure 4-9. Typical Package Septage Receiving Station

(courtesy JWC Environmental)

A packaged septage receiving station is recommended for its ability to address several key septage receiving issues.

1. Rock trap for gravel removal. Septage can contain a significant amount of gravel and debris that are inadvertently picked up during the process of pumping out a cesspool. These can clog up the septage receiving system and/or cause damage to downstream processes if not removed. The ability for a septage receiving system to handle and easily remove gravel is therefore a key feature.
2. Data Collection and Billing. A packaged system with key-card access will allow for control of who is discharging septage into the WWRF and will keep track of and record the volumes that are discharged to facilitate billing and record keeping.
3. Fats, oils, and grease (FOG). If septage receiving is implemented at the front end of the plant, FOG discharged by haulers will need to be managed to avoid negative impacts downstream. Packaged septage receiving systems can include features to accommodate FOG.

Received septage can be sent to the WWRF headworks along with the other wastewater influent to follow through the entire liquid treatment train. Because septage is much more concentrated than wastewater in terms of BOD_5 and solids, an equalization tank with metering pumps is recommended downstream of the septage receiving station to gradually feed the septage to the liquid treatment process to avoid shock loading the system. FOG control is also recommended.

Section 5

Liquid Treatment: Primary Treatment Options

One significant consideration with respect to the design of the liquid treatment train of the proposed Central Maui WWRF is whether or not to include a primary treatment step in the process. In this report, both the options of with and without primary treatment will be considered. This section provides an overview and summarizes the key considerations to be made with respect to primary treatment. This decision will have downstream impacts, therefore, other sections of this report will make reference to the way(s) in which inclusion of primary treatment will influence them, as applicable.

Primary treatment is intended to remove the majority of suspended solids present in wastewater through simple physical settling. While not strictly a necessary part of a wastewater treatment process, the inclusion of a primary treatment step is a low-energy way of achieving a significant reduction in both BOD_5 and TSS. This reduction in contaminant loading early in the liquid treatment train will permit a reduction in the size of the downstream, more energy-intensive, secondary treatment process.

5.1 Primary Clarifiers

Primary clarifiers are used to slow the velocity of the water to a point where inert and organic solids will settle to the bottom of the tank. This primary sludge is collected and sent to the solids handling processes. Primary clarifiers also contain equipment that is used to remove floating solids and grease from the surface. Figure 5-1 is a depiction of a typical rectangular primary clarifier.

Figure 5-1. Rectangular Primary Clarifier

(courtesy Brentwood Industries)

Historically, primary clarifiers have not been included in the Maui County wastewater treatment process, presumably due to the potential for odors to develop in the warm climate and the relatively small size of many of the WWRFs. It should be noted that odor issues may be mitigated by covering the clarifiers and collecting the foul air for treatment by an odor control system.

5.2 High-Rate Primary Filtration

This newer technology utilizes a filter media or screen to physically separate suspended solids from the waste stream. The specific manufacturers considered that have experience with municipal wastewater are as follows:

- Huber Technology, Inc - Drum Screen Liquid® (see Figure 5-2)
- Trojan Technologies – Salsnes Filter® (see Figure 5-2)
- Aqua-Aerobics Systems, Inc – AquaPrime ® systems (see Figure 5-4)

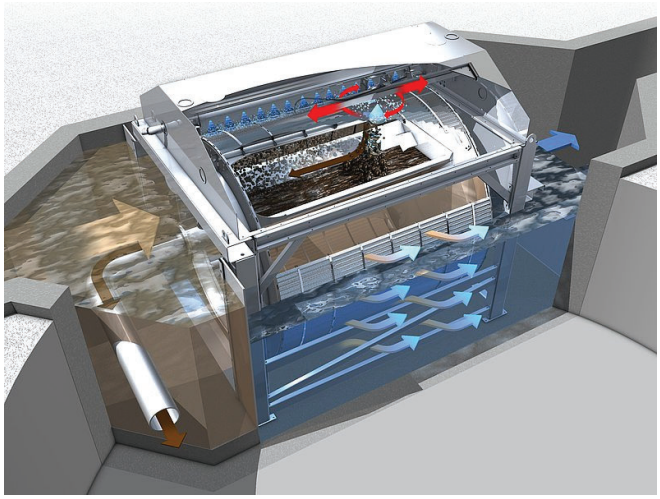


Figure 5-2. Huber Drum Screen Liquid

Figure 5-3. Trojan Technologies Salnes Primary Filter

Figure 5-4. Aqua-Aerobics AquaPrime Disc Filter

The Aqua-Aerobics technology utilizes a cloth pile media while the Huber and Trojan Technologies filters utilize a filter mesh to remove the primary solids. Each of these technologies require cleaning the filter media or mesh with a high-pressure spray system or periodic backwashing. These technologies offer notable site footprint saving over circular or rectangular clarification. Odor control and capture is also anticipated to be easier and less costly for this option compared to primary clarifiers. The units do have more mechanical parts than a primary clarifier; and it is anticipated more units will be required to maintain reliability, likely resulting more labor needed than a primary clarifier system.

Another feature of primary filtration is due to the smaller footprint and generally smaller piping, the units could be placed in a building. The advantages of a building are to provide visual shielding from the public, the ability to fully control odors, and to protect the operations and maintenance staff from the adverse weather. The disadvantage of placing the equipment within a building is general maintenance and upkeep and HVAC costs as building will be subject to NFPA 820 requirements of at least six air changes per hour.

General process performance is as follows:

- TSS/VSS removal: 80% (cloth), 70% (mesh screen)
- BOD/COD removal: 50% (cloth), 40% (mesh screen)
- Solids concentrations: < 0.5% (cloth), 0.5-2.5% (mesh screen)

In general, primary filters utilizing cloth media have higher removals. However, the solids concentrations (from backwashing and any solids settling) could be very low, thus potentially requiring additional thickening and impacting selection of thickening technology. Another consideration is scum removal. The Aqua-Aerobics filters incorporate a trough that allows removal of floatables, while the Huber filters do not include that feature.

5.3 Primary Treatment Link to Solids Treatment

The primary treatment process is directly linked to the solids treatment processes. Sludge from primary treatment process is called primary sludge and is required to operate an anaerobic digestion system. The anaerobic digestion process produces biogas that can be used to produce electricity. Primary sludge can also be digested within an aerobic digestion system, but aerobic digestion is not capable of providing similar energy production benefits. Further discussion is provided in Section 8.

5.4 No Primary Treatment

The Central Maui WWRF can also be designed without a primary treatment process. This option removes the primary treatment odor risk, but the secondary treatment process would need to be larger because there would be no upstream BOD_5 and TSS reduction.

5.5 Conclusions and Recommendation

Table 5-1 provides a comparison of providing a primary treatment process or not.

Table 5-1. Primary Treatment Evaluation

Description	Primary Treatment Process	No Primary Treatment Process
Odor risk	Yes, but mitigatable with foul air collection and treatment	None
Operation complexity	Increases operation complexity by adding additional treatment process	None
Maintenance complexity	Increases maintenance complexity due to additional equipment	None
Upstream grit removal needs	Effective upstream grit removal required	Effective upstream grit removal is not as critical
Supports anaerobic digestion	Yes, with corresponding energy production benefits possible	No
Capital cost impacts	Higher capital cost	Lower capital cost
Secondary treatment impacts	Significant BOD_5 and TSS reduction possible, reducing size of downstream secondary process	Larger secondary treatment process required
Treatment plant size	Common in large WWRFs	Common in small WWRFs

We recommend not including a primary treatment process at the Central Maui WWRF for the following reasons:

- For standardization with the County's other WWRFs, which don't have primary treatment processes.
- As will be discussed in Section 8, the small WWRF size makes anaerobic digestion economically unattractive.
- Operations and maintenance simplification.
- Reduced odor risk.

Section 6

Liquid Treatment: Secondary Treatment Options

Secondary treatment process provides BOD_5 and nutrient removal via biological treatment. This section provides descriptions of various secondary treatment options including their advantages, disadvantages and applicability to the Central Maui WWRF. The treatment options are screened to options that are further evaluated.

6.1 RBCs

Rotating biological contactors (RBCs) employ a series of plastic media discs mounted on a rotating center shaft. Wastewater is contained in a tank which the media rotates through. A biological film is established on the media. The shaft rotates the media through the wastewater and lifts the wastewater to trickle down the media for aeration and further contact with the biological film. The process is similar to a trickling filter. Figure 6-1 is a photo of one of the existing RBC units at the Kaunakakai Wastewater Reclamation Facility (WWRF) with a portion of the fiberglass cover removed.

Figure 6-1. RBC unit at Kaunakakai WWRF

RBCs are an effective and simple technology for BOD_5 reduction and can nitrify if lightly loaded. However, they do not provide a mechanism for denitrification. Tertiary processes, such as denitrification filters (and possibly nitrification filters if additional nitrification is needed), would be required to provide nitrogen removal. For this reason, the RBC process is eliminated from further evaluation.

6.2 Oxidation Ditch

An oxidation ditch is a variation of the complete-mix extended aeration activated-sludge process. The process generally has a long solids residence time (SRT) and high mixed liquor suspended solids (MLSS) concentration, making it resilient to upset by peak organic loads. The typical SRT for oxidation ditches ranges from 15 to 30 days, and the MLSS is generally between 2,000 and 5,000 mg/L. Oxidation ditches are often oval in shape and have been called "racetrack" reactors. The depth of the ditch typically ranges from 4 to 12 feet. Mechanical aerators in the ditch provide aeration and mixing. Strategic placement of the aerators creates aerobic and anoxic zones within the oxidation ditch, for effective nitrification and denitrification. Biological phosphorus removal is also possible.

Oxidation ditches are usually preceded by preliminary treatment, such as screening and grit removal. Primary settling is typically not included upstream of oxidation ditch systems. Return activated sludge (RAS) is pumped from the secondary clarifier back into the ditch.

Figure 6-2 presents a schematic of a typical oxidation ditch. Typically, rotating brush or disc mechanical aerators are used to move mixed liquor around the tank and to provide aeration. The aerators help mix scum into the water column for treatment. The rigorous mixing action of the mechanical aerators can generate off-spray. To mitigate this effect, side walls can be designed higher to provide additional freeboard. However, because of the expected windy conditions at the Waikapu plant site, aerosol generation could be significant. Because of the large footprint requirements and potential significant aerosol generation, the oxidation ditch process is eliminated from further evaluation.

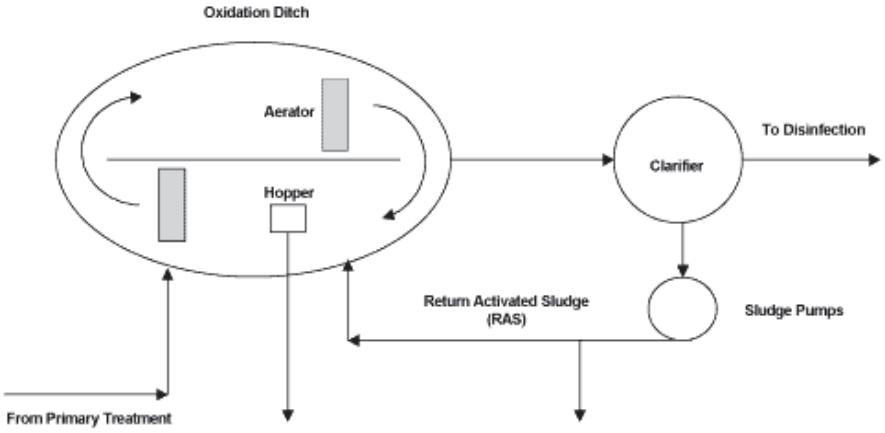


Figure 6-2. Typical Oxidation Ditch Schematic

6.3 Integrated Fixed Film Activated Sludge/Moving Bed Bioreactor

Integrated fixed film activated sludge (IFAS) and moving bed bioreactor systems introduce synthetic media into strategic zones of an aeration basin to increase performance without requiring a larger tank footprint.

The media can be rectangular or cylindrical and can be held fixed in the basin or freely suspended. A biofilm is established on the surface of the media. The biofilm combined with the suspended biomass improves overall performance of the aeration basin.

The capability to increase system performance without increasing volume makes this an attractive option for retrofit applications. For new applications the aeration tank size can potentially be reduced compared to other activated sludge systems.

Figure 6-3 is a photo of IFAS media made by Hazen and Sawyer. Figure 6-4 is an example diagram of an IFAS system. MBBR systems are similar but do not have solids recycle or anoxic zone elements.

Figure 6-3. IFAS Media

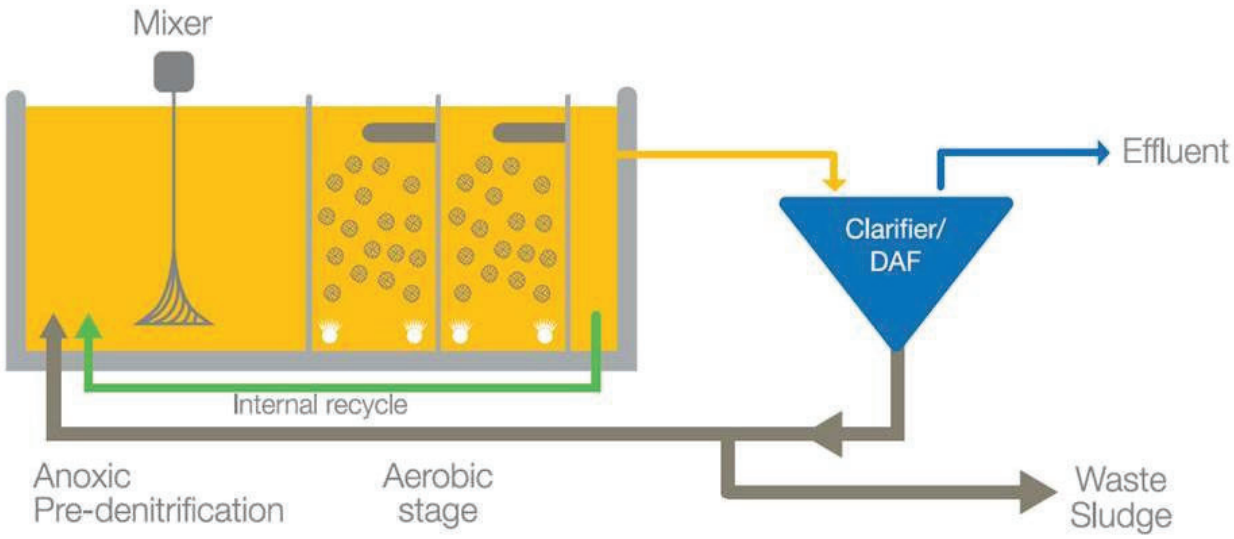


Figure 6-4. IFAS System Process Schematic

IFAS systems are potentially a good option for retrofit applications that are in need of increased capacity or improved nutrient removal (e.g., nitrification) in cold climates. However, in tropical climates where wastewater temperatures are high there is little or no benefit to be achieved by the presence of additional attached growth biomass in the aeration tank. Capital costs are high for the proprietary media without significant reduction in footprint requirements. There is a high risk for filamentous bulking if there is insufficient aeration. For these reasons the IFAS process will receive no further consideration.

MBBRs have been successfully implemented in Hawaii, but do not have nutrient removal capabilities. For this reason, the MBBR process will receive no further consideration.

6.4 Membrane Bioreactor

A membrane bioreactor (MBR) has the smallest footprint of the various biological treatment systems available and provides the highest quality effluent. An MBR basically combines an aeration basin with membrane filtration, eliminating the need for tertiary treatment if a very high-quality effluent is desired for water reuse purposes.

Membranes provide an absolute barrier to large particles; total suspended solids (TSS) concentrations of the effluent (also known as "filtrate") are typically less than 1 mg/L. Effluent from an MBR process can meet stringent water recycling turbidity requirements without an additional filtration process.

The main difference between MBRs and other biological treatment technologies is the method of separating the bacteria from the clean water. MBRs have thin membranes with many thousands of micro-perforations. Depending on the manufacturer, these perforations are 0.04 to 0.2 microns (4 to 20 hundred-thousandths of a millimeter) in diameter, too small for the passage of most microorganisms or other particles present in the wastewater, but large enough to allow the passage of water molecules.

Figure 6-5 is an illustration of an MBR. Figure 6-6 is a photo of submerged MBR membranes in clean water.

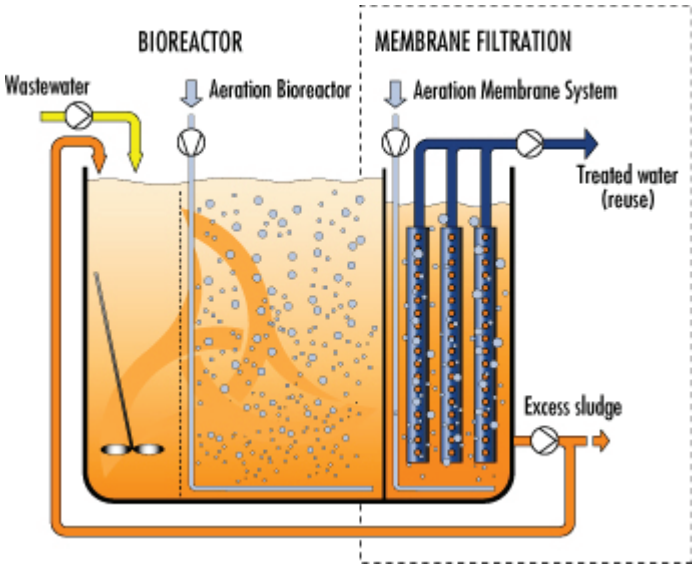


Figure 6-5. Membrane Bioreactor Illustration

Figure 6-6. Membrane Cassettes at Johns Creek Environmental Campus, Fulton County, GA

Important considerations of an MBR system include:

- MBRs can be designed and programmed to achieve nutrient reduction.
- The membranes are expensive and must be replaced every 10 to 15 years.
- Membrane fouling can occur with wastewater with high fats, oils, and grease (FOG) levels
- MBRs require the use of membrane cleaning chemicals, typically sodium hypochlorite and citric acid.
- The process requires a computer control system and is difficult to operate efficiently if the computer malfunctions.
- The process incurs high electrical power costs, relatively high costs for cleaning chemicals, and high overall O&M costs. Highly skilled labor is required for some of the O&M tasks.

The MBR process would produce an effluent that is of high quality and has a small footprint, but has high overall capital, O&M, and lifecycle costs. MBR is retained for further evaluation.

6.5 BioMag

BioMag™ is a proprietary process from Evoqua Water Technologies in which magnetite is added to the biological process to make biological flocs in activated sludge processes settle faster. Magnetite is an inert iron ore, with a specific gravity of 5.2 and a strong affinity for biological flocs. This provides the opportunity to increase the active MLSS concentration, while still maintaining adequate settling in the secondary clarifiers. As a result, the process can increase treatment capacity and nutrient removal. It can be incorporated into new or existing treatment plants.

In the BioMag process, virgin and recovered magnetite are blended with mixed liquor or return activated sludge (RAS) in the magnetite mix tank. The ballasted mixed liquor then flows to the aeration tank, and then on to secondary clarification, where the solids settle and thicken. Some of the settled solids from the clarifier are returned to the bioreactor via the RAS line. The waste activated sludge (WAS) is directed through a shear mill to recover the magnetite for reuse. The excess biological solids, minus the magnetite, are wasted to sludge processing.

Figure 6-7 is a schematic from Evoqua depicting the BioMag process.

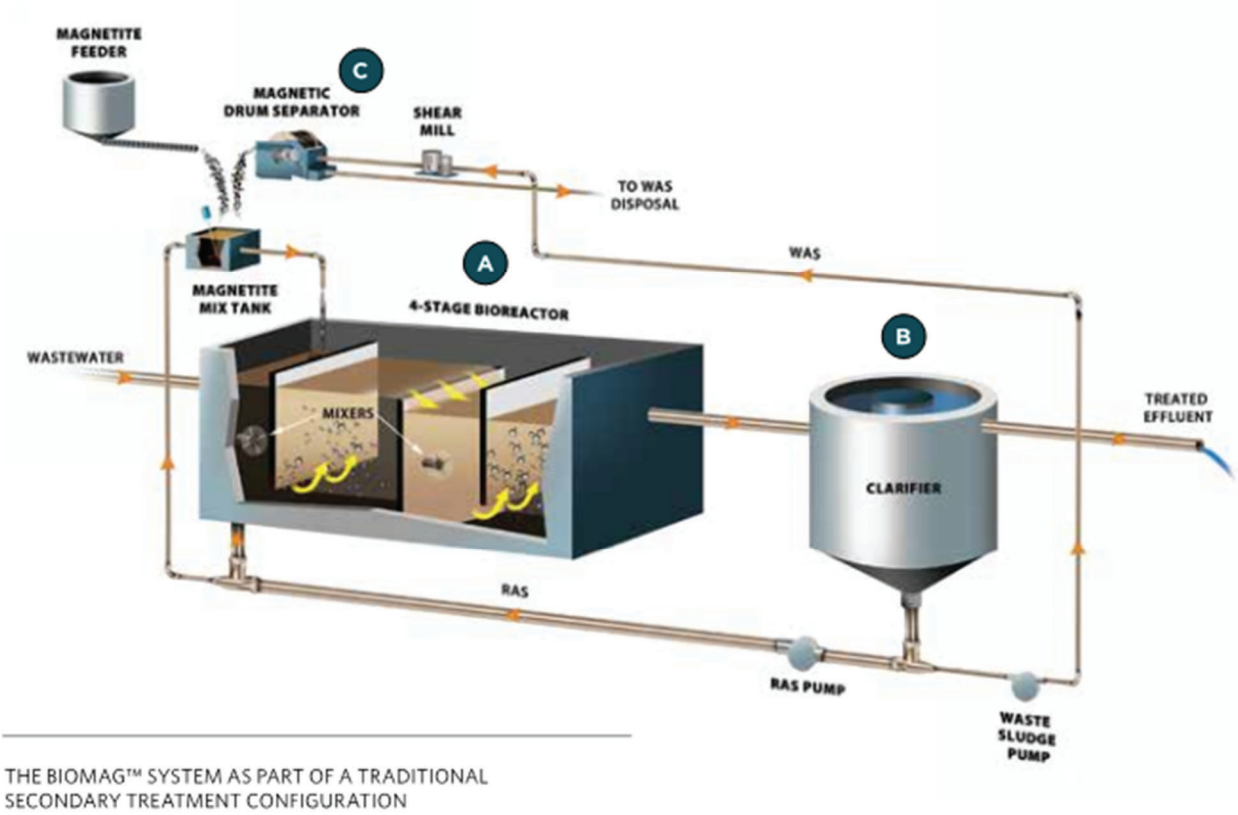


Figure 6-7. BioMag Process Schematic

(Source: Evoqua)

The BioMag process reduces the size requirements for the aeration basins and, to a lesser extent, the secondary clarifiers by significantly increasing sludge settleability. However, the process is dependent on periodic magnetite deliveries making it less attractive than other options for a remote island location. For these reasons the process will receive no further consideration.

6.6 Extended Aeration

Extended aeration is a less-complex system which can operate without primary treatment or anaerobic digestion. The treatment provides a completely mixed process operated at long hydraulic detention times and high sludge age. The process uses larger aeration tanks with extended solids retention times (SRTs) of over 20 days. Careful consideration needs to be given to the capacities of motors, pumps, and compressors in order to ensure the process can handle variations in flow. The basic extended aeration process schematic is shown in Figure 6-8.

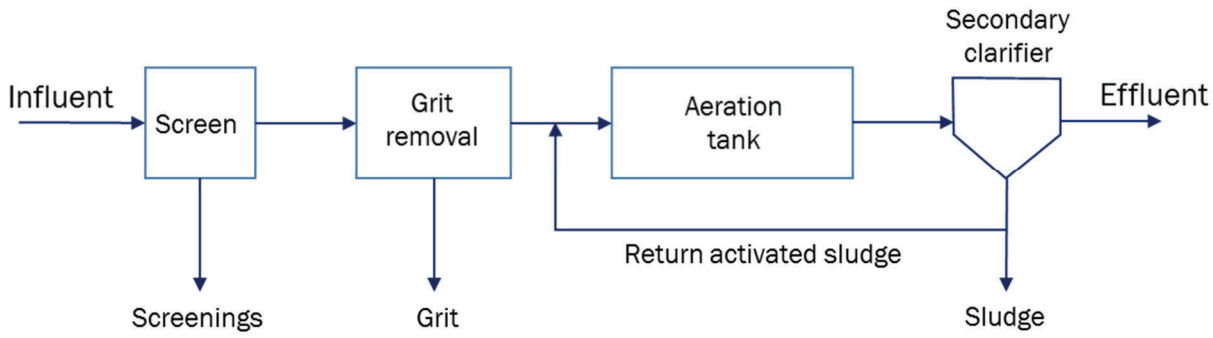


Figure 6-8. Extended Aeration Process Schematic

The process is generally limited to smaller WWRFs and is often used in prefabricated packaged plants. The range of typical SRTs on the mainland is 20 to 40 days, and the process generally operates with MLSSs between 2,000 and 5,000 mg/L. The long SRT and relatively high MLSS makes the process resistant to shock loading and stable but requires somewhat larger tanks and therefore incurs higher aeration costs for a given flow, compared to other forms of activated sludge. The process would provide sufficient nitrification for the Central Maui WWRF application, and an anoxic selector can be incorporated into the process to ensure good sludge settling characteristics and provide denitrification. The process is similar to the oxidation ditch technology previously described but would use diffused aeration rather than mechanical aeration. The process is forgiving and resistant to shock loadings. However, compared to other activated sludge processes described below, the large footprint and high capital cost associated with the large tankage would outweigh these advantages. Therefore, extended aeration is eliminated from further evaluation.

6.7 Activated Sludge with Anoxic Selector

This process is similar to extended aeration but would employ a shorter SRT of less than 10 days and would operate at a MLSS concentration between 1,500 and 4,000 mg/L. Figure 6-9 shows a process schematic for this process. The Kihei WWRF and Wailuku-Kahului WWRFs operate with this process. The anoxic selector is typically sized to have a volume of approximately 10 to 30 percent of the total aeration basin volume. The process would not be as forgiving and resistant to shock loadings compared to the oxidation ditch and extended aeration processes due to the shorter SRT and lower MLSS concentration. This option would incur a smaller footprint than the oxidation ditch and extended aeration processes but would require operation and maintenance of blowers to provide air to the process. The fine bubble diffused aeration system would be more efficient than the mechanical aerators generally used in the oxidation ditch process. This process is retained for further evaluation.

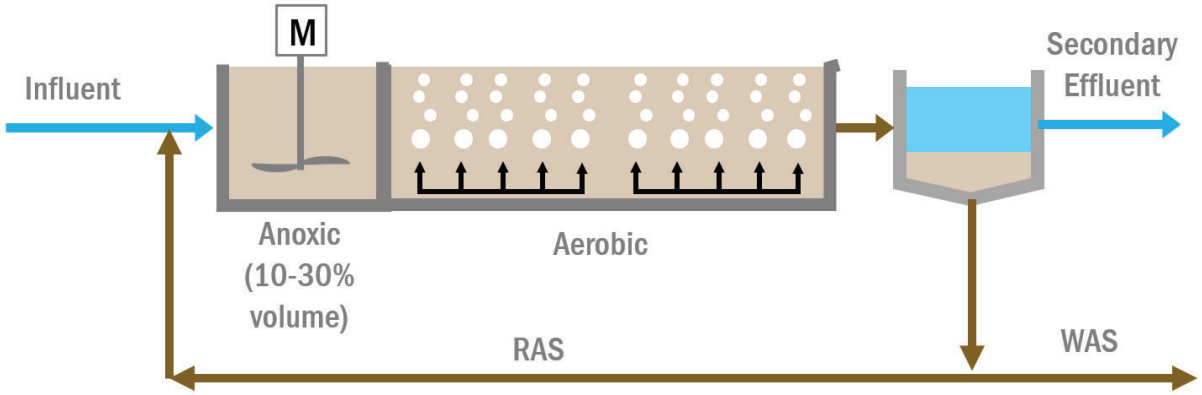


Figure 6-9. Activated Sludge with Anoxic Selector Process Schematic

6.8 Modified Ludzack-Ettinger (MLE) Activated Sludge

This process is similar to activated sludge with anoxic selector but with an internal mixed liquor recycle (IMLR) stream from the aerated zone to the anoxic zone. Figure 6-10 shows a process schematic for this process. The IMLR flow typically ranges from 150 to 400 percent of the influent flow. By incorporating the IMLR, the denitrification capability is increased. This process is retained for further evaluation.

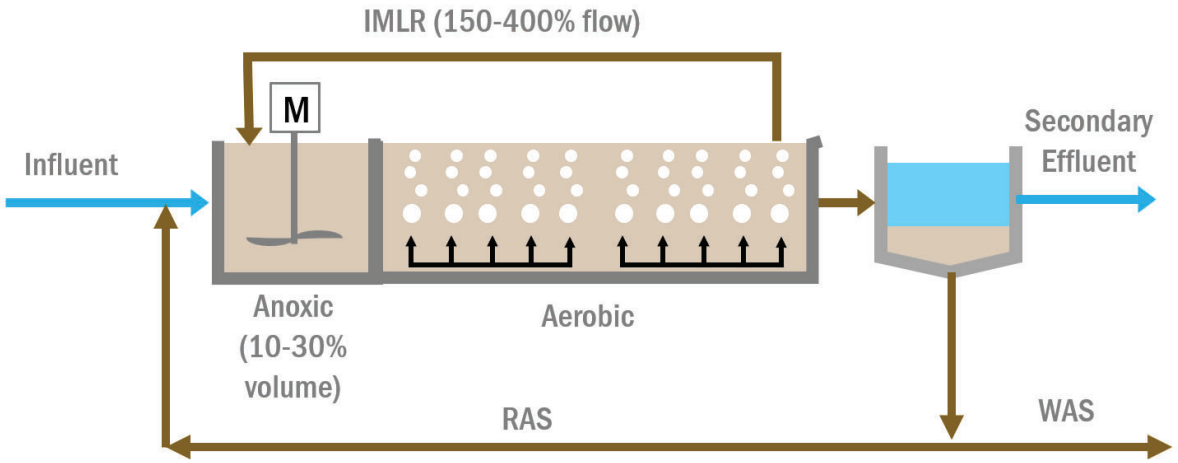


Figure 6-10. MLE Process Schematic

6.9 Anoxic Step-Feed Activated Sludge

A variation of the MLE process is the anoxic step-feed process. This process consists of a configuration similar to the one implemented at the new aeration basin (Step-Feed Aeration Basin) at the Lahaina Wastewater Treatment Facility. Figure 6-11 shows an illustration of this process. Each aeration basin is configured to include 3 or 4 passes. Each pass consists of an anoxic zone followed by an aerobic zone. Influent is split among the passes. The basin can be designed to allow one pass taken out of service. An IMLR pump can be installed in the aerobic zone to return nitrified mixed

liquor to the anoxic zone. The main advantages of the anoxic step-feed process are that it could be very efficient in providing denitrification (even without IMLR) and has built-in operating flexibility by having multiple passes. The main disadvantages are the potential high construction costs for the additional baffle walls and piping and somewhat higher operating complexity than the MLE process.

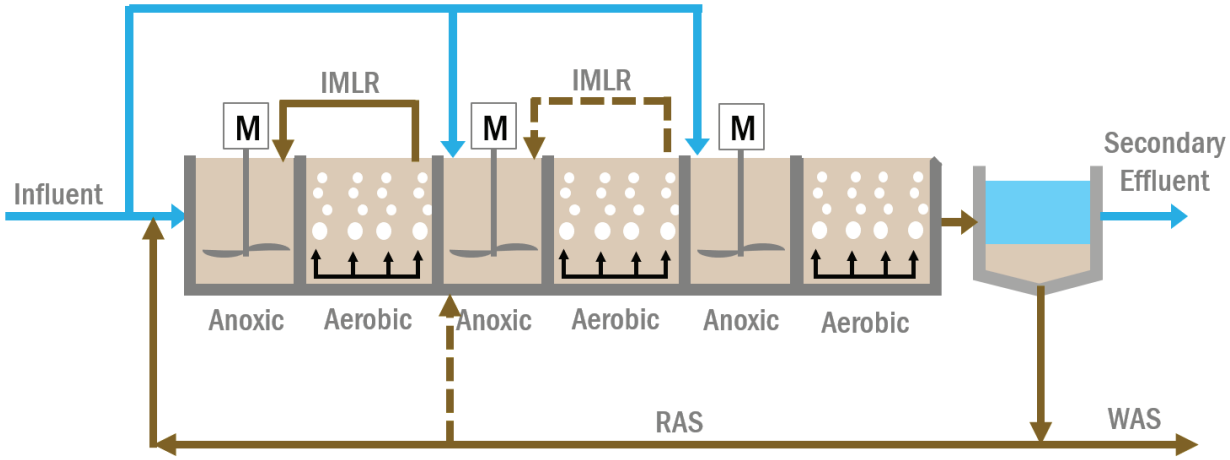


Figure 6-11. Anoxic Step-Feed Process Schematic

For this study, sizing and cost estimating were not performed for the anoxic step-feed process separately, but if the MLE process is selected for further evaluation, an analysis can then be performed for this process.

6.10 Sequencing Batch Reactor

Sequencing batch reactors (SBRs) are fill-and-draw systems that combine the processes of activated sludge in a single reactor. The reactor is filled with wastewater, where aeration, settling, and decanting occurs. By combining these processes, the need for secondary settling is not required. Denitrification can be achieved by incorporating an anoxic fill step in the cycle or a separate anoxic zone. A minimum of two SBR reactors are typically used for the process.

SBRs are capable of producing high quality effluent and are potentially space saving in that separate secondary sedimentation is not needed. However, SBRs are operated by a computer control system, cannot be operated in manual mode, and may require influent and/or effluent equalization (and thus increasing the footprint requirements). Considering these challenges, SBRs will not be considered further.

6.11 Granular Activated Sludge – Nereda

The Nereda technology is a granular activated sludge process that utilizes proprietary granules in an SBR. Features of the process include simultaneous fill and draw, fast settling, and approximately 1/5 the footprint of traditional activated sludge systems. The process was developed in Europe and most current full-scale applications are located in Europe. In the U.S., the process is marketed by Aqua Aerobic Systems, Inc, according to the supplier website, there are currently only two full-scale operating systems treating municipal wastewater in the United States. One is a demonstration facility, and the other is a 3.6 MGD facility in Alabama that began operation in early 2020. Figure 6-12 is a conceptual illustration of the Nereda process.

Due to the challenges listed for an SBR and the lack of long-term operational experience in the United States, the Nereda process is considered not appropriate for the Central Maui WWRF application.

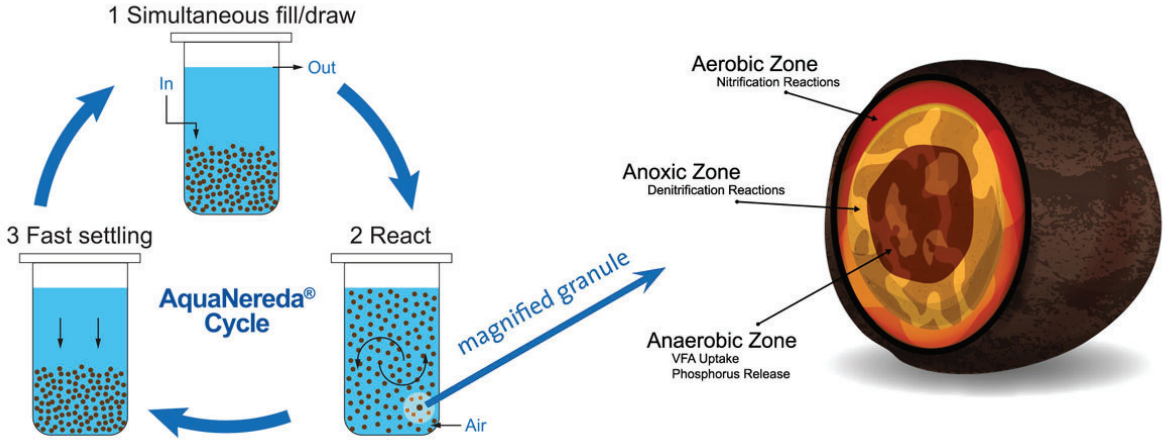


Figure 6-12. Nereda Illustration

Courtesy: Aqua Aerobic Systems

6.12 Fixed Bed Biofilm Activated Sludge– Organica

Organica is a proprietary activated sludge process developed in Europe which combines natural and engineered elements to achieve wastewater treatment. A fixed bed bioreactor is installed typically below ground level, with plants growing on the surface. A biofilm is established on the plant root structure, as well as on the process' patented biofiber media. Using the plant and engineered media, the process claims to be able to achieve an increased amount of treatment in a relatively small footprint. Effluent from the process is routed to a specially designed disc filtration system. Typically, coagulant is added in the process to aid in settling. Figure 6-13 is an illustration of the Organica process.

The aesthetically pleasing appearance of the Organica system could have community acceptance benefits. However, there are currently no installations in the United States, and it is our opinion that a remote island location like Maui is a poor place to implement new technology. The process is considered not appropriate for this application.

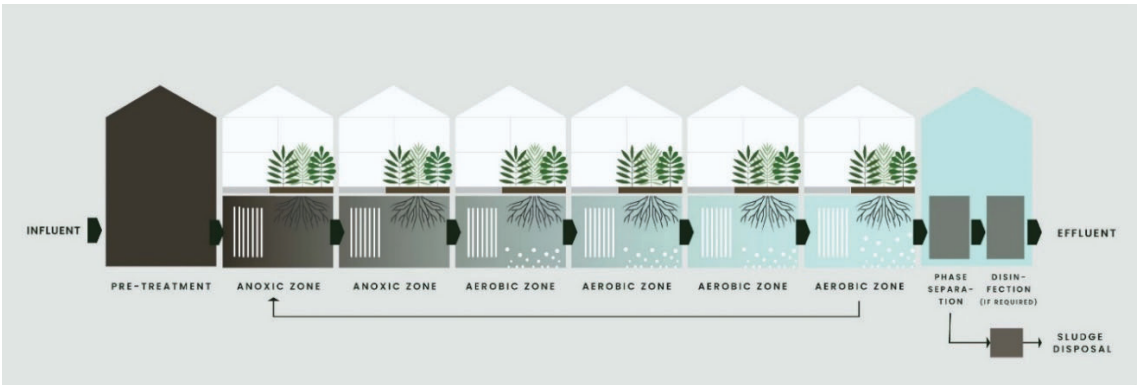


Figure 6-13. Illustration of an Organica treatment facility.

Courtesy: organicawater.com

6.13 Trickling Filter / Solids Contact (TF/SC)

In a TF/SC process, the primary clarifier effluent first flows through a trickling filter, which is a fixed-film process using plastic media and provides soluble BOD_5 removal. Effluent from the trickling filter is then treated in a short detention time solids contact tank (which is essentially the same as an aeration basin), and then into the secondary clarifiers. The solids contact tank, which is aerated, provides the time for solids flocculation, creating heavier flocs for improved settling. The secondary clarifiers often also include flocculating center wells to further enhance flocculation. Figure 6-14 shows a typical TF/SC process schematic.

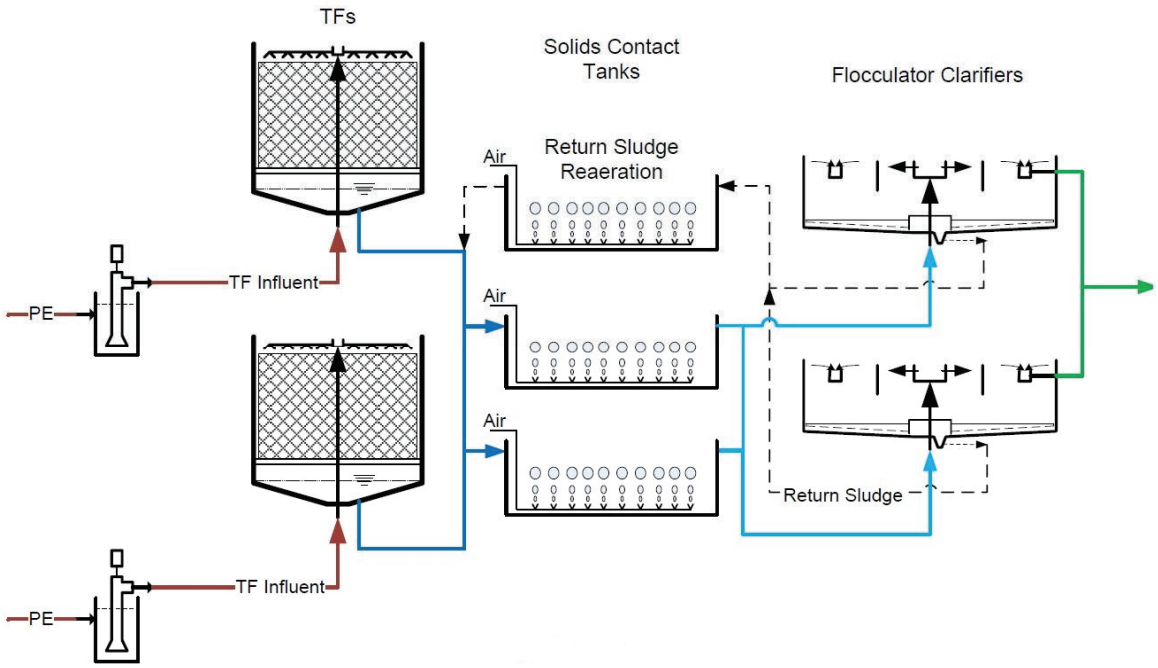


Figure 6-14. TF/SC Example Process Schematic

The TF/SC process incurs significantly lower energy consumption than the activated sludge alternatives presented above, produces a high-quality effluent, is reliable, and easy to operate. However, while the process can provide nitrification at low loading rates, it offers poor flexibility to achieve nitrogen removal. For this reason, the process will receive no further consideration for the Central Maui WWRF.

6.14 Membrane Aerated Biofilm Reactor (MABR)

The MABR process uses a gas permeable membrane to supply oxygen to a biofilm that grows on the membrane surface. Air is introduced through the membrane filaments and oxygen diffuses out through the biofilm. The membranes are typically added to unaerated zones to allow nitrification and denitrification to occur in the same reactor, with anoxic conditions in the suspended biomass and aerobic conditions in the biofilm. Ammonia diffuses into the biofilm and nitrifiers grow on the surface of the membrane media closest to the oxygen source. In addition, the membrane diffusion allows oxygen transfer to the biofilm at high transfer efficiencies (approximately 3–4 times more efficient

than fine bubble diffusers). Vendors currently offering MABR technology include SUEZ (formerly GE Water and Process Technologies), OxyMem, and Fluence. Figure 6-15 shows a schematic of the MABR process.

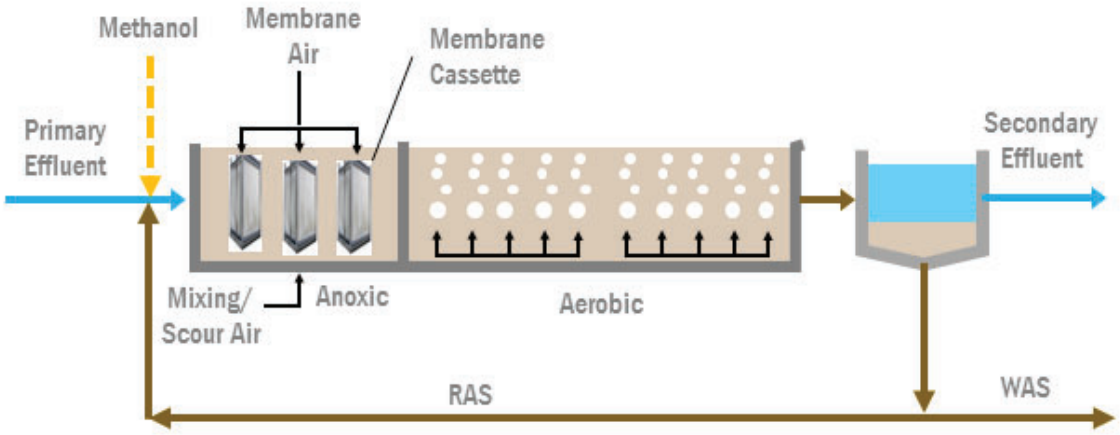


Figure 6-15. MABR Process Schematic

The main advantages of MABR include the potential to operate at lower SRT, thus reducing the basin volume, and lower aeration costs. However, there are currently limited full-scale facilities, and the capital costs are likely high. Therefore, this process is eliminated from further evaluation.

6.15 Biological Aerated Filter (BAF)

The BAF process is a fixed-film process where carrier media (styrene beads or expanded clay, dependent on manufacturer) are used to provide a surface for biofilm growth. The primary advantage of the BAF process is the ability to achieve nitrification in the attached biomass, which can reduce the volume required for treatment. Secondary clarifiers are not required, thus eliminating space requirements for them. A disadvantage of the process is that it requires two-stage treatment for denitrification, with full chemical addition to the second stage denitrifying BAF – similar to a tertiary fixed film process. A more recent possible amendment to this process may allow for simultaneous nitrification and denitrification (SND) within a single stage BAF tower with proprietary controls developed by Veolia for their Biostyr™ system. However, there are currently limited installations operating in SND mode. Figure 6-16 shows a schematic of the Biostyr system.

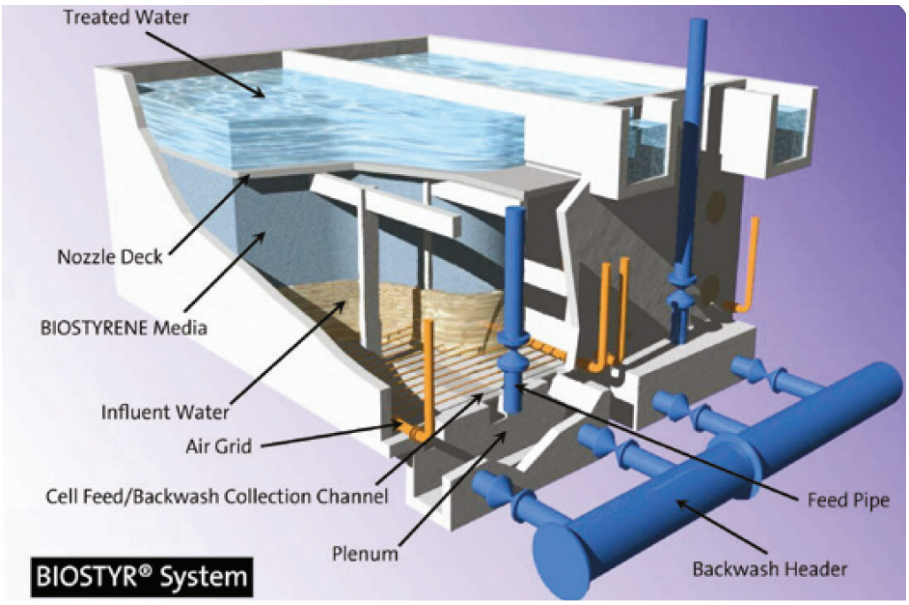


Figure 6-16. BAF Schematic
(Source: Veolia)

The BAF process requires upstream primary clarification and proprietary media, which would increase the capital costs. A second stage BAF may also be needed for denitrification, thus requiring additional pumping. There are currently limited US installations of BAF used for secondary treatment. Because of these disadvantages, BAF is eliminated from further evaluation.

6.16 Ntensify

Ntensify™ is a process developed by Brown and Caldwell that combines advanced aeration controls that allows simultaneous nutrient removal with hydrocyclone-based wasting to select for fast-settling sludge. The process takes place in continuous-flow basins. The hydrocyclones are commercially available from World Water Works (inDense™ process). In a hydrocyclone, the heavier flocs are retained and only the light material is wasted. Over time, this leads to granule formation by continually selecting for heavier and heavier floc materials. Ntensify offers the benefits of Increasing plant capacity, reducing operating costs through energy and chemical savings, increasing process stability, and improving effluent quality. Figure 6-17 shows a schematic for the Ntensify process.

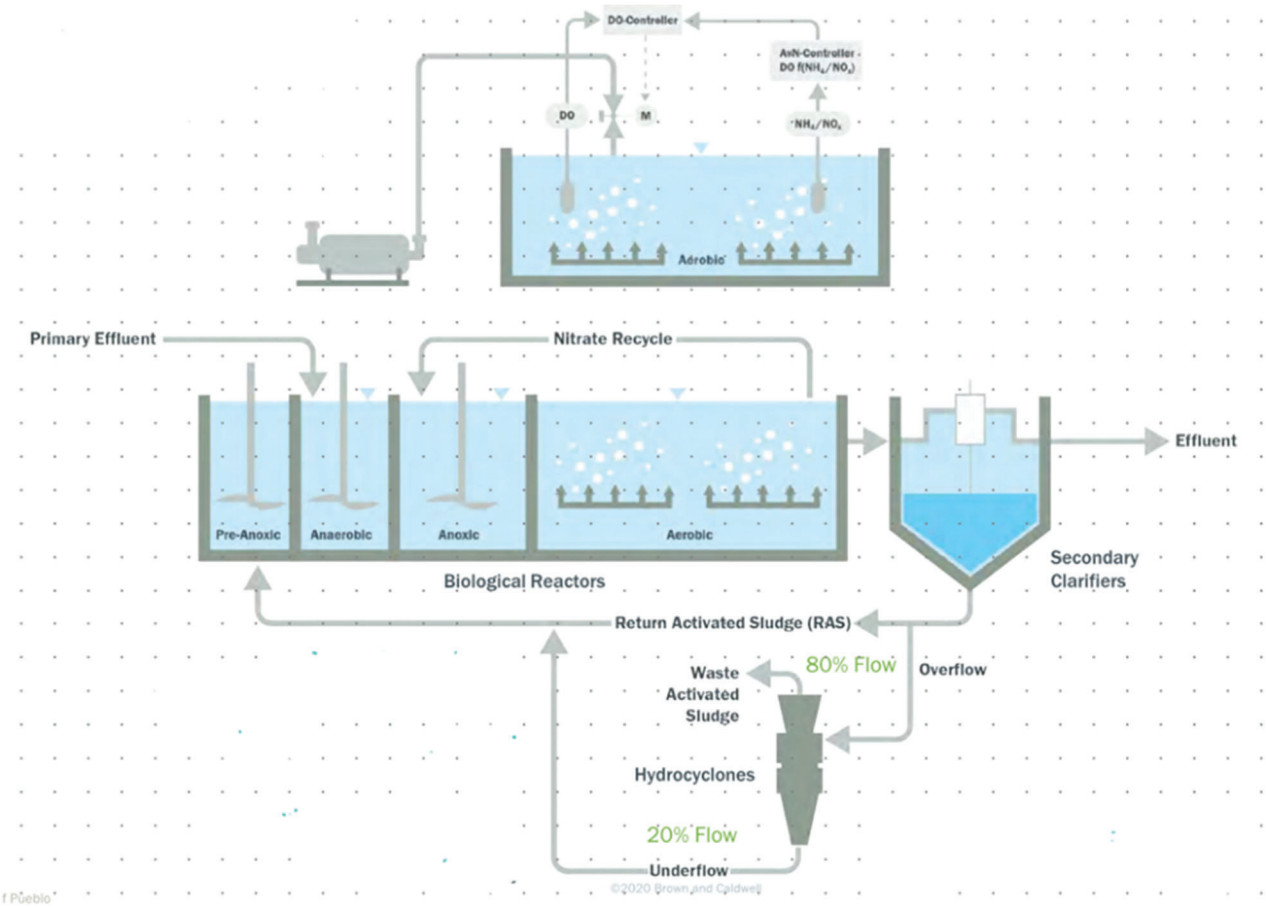


Figure 6-17. Ntensify Process Schematic

Ntensify has mainly been applied in installations that include both biological phosphorus removal and nitrogen removal. A minimum SRT (at least around 5 days of aerobic SRT) is needed to maintain the densified sludge. If the activated sludge with anoxic selector or MLE process is selected, either of those processes can be adapted to include some or all of the elements of an Ntensify process. Further analysis can be performed during preliminary design, if desired.

6.17 Nuvoda MOB

The Nuvoda Mobile Organic Biofilm (MOB™) process is a hybrid fixed-film/ballast process similar to IFAS except that organic media are used to support biofilm growth instead of plastic media. In addition, the media is not retained in the aeration basins but passes through to the secondary clarifiers, where it also acts as a ballast to increase settling rates. The media settles in the secondary clarifiers and is returned to the head of the process via the RAS. A rotary screen on the WAS line is used to recover the organic media and return it to the process. The organic media is a lignocellulosic material that is harvested from kenaf plants. Similar to IFAS, the Nuvoda MOB process has the benefit of potentially reducing SRT for nitrification, although the relative benefit is likely smaller in warm climates. Figure 6-18 shows a schematic of the MOB process.

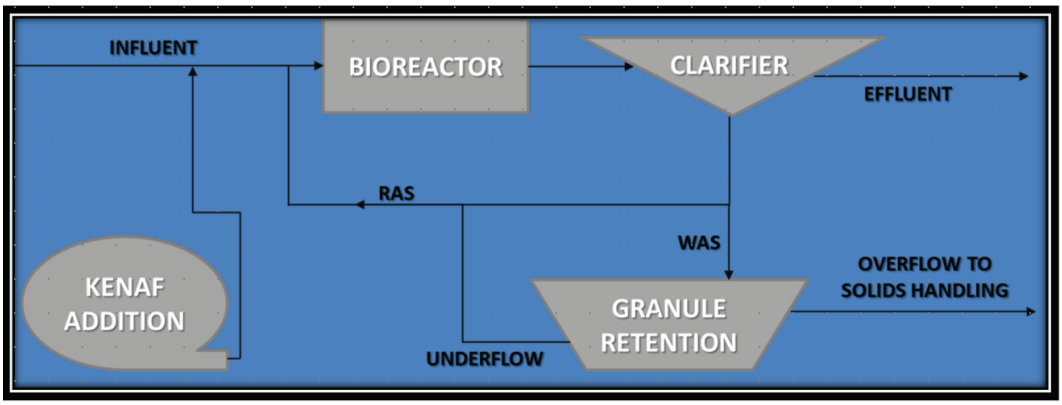


Figure 6-18. Nuvoda MOB Process Schematic

(Source: Nuvoda)

The MOB process is a relatively new process with limited full-scale applications in municipal wastewater treatment plants. It requires periodic addition of the kenaf organic media, which would need to be shipped from South Carolina. For those reasons, this process is eliminated from further evaluation.

6.18 Screening of Secondary Treatment Options

Table 6-1 compares the various secondary treatment options discussed above. As shown in the table, the MLE activated sludge and the MBR processes are the two options that were not eliminated from further consideration. Both would satisfy the project's intended treatment requirements and the County's O&M concerns. The main differences between the two is the footprint and energy requirements (see economic evaluation in Section 13) with the MBR process requiring significantly less space, but an increased O&M cost. Other processes that are not eliminated, including the activated sludge with anoxic selector, anoxic step-feed activated sludge, and Ntensify, are variations of the MLE process or the MLE process can be adapted to include features of those processes. For this study, cost estimates are not prepared for those processes. They can be further evaluated during preliminary design for consideration if the MLE process is selected.

6.19 Conclusions and Recommendations

The following processes are recommended for further evaluation:

- MLE activated sludge
- MBR.

If the MLE activated sludge process is ultimately selected, then the following variations or options can be considered during the preliminary design phase:

- Activated sludge with anoxic selector
- Anoxic step feed activated sludge
- Ntensify.

Table 6-1. Summary of Secondary Treatment Options

Criterion	RBCs	Oxidation Ditch	IFAS	MBBR	MBR	BioMag	Extended Aeration	Activated Sludge with Anoxic Selector	MLE Activated Sludge	Anoxic Step-Feed Activated Sludge	Sequencing Batch Reactor	Granular Activated Sludge - Nereda	Fixed Bed Biofilm Activated Sludge	TF/SC	MABR	BAF	Ntensify	Nuvoda MOB
$BOD_5 \leq 30$ mg/L	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
TSS ≤ 30 mg/L	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Nitrification	Possible	X	X	Possible	X	X	X	X	X	X	X	X	X	Possible	X	X	X	X
TN < 10 mg/L		X	X		X	X	X	Possible	X	X	X	X			X	X	X	X
Anoxic selector		X	X		X	X	X	X	X	X					X		X	X
Appropriate for remote island location	X	X	X	X	X		X	X	X	X	X	X		X	X	X	X	
Appropriate for tropical climate	X	X		X	X	X	X	X	X	X	X	X		X	X	X	X	
Aeration tank size	Moderate	Large	Moderate	Moderate	Small	Moderate	Large	Moderate	Moderate	Moderate	Moderate	Low	Low	Moderate	Moderate	Moderate	Moderate	Moderate
Secondary clarifier size	Large	Largest	Large	Large	None	Small	Largest	Large	Large	Large	None	None	None	Moderate	Moderate	None	Moderate	Small
Energy requirement	Moderate	Moderate	High	High	Highest	Moderate	Higher	Moderate	Moderate	Moderate	Moderate	Low	Moderate	Lowest	Moderate	High	Low	Moderate
Operational complexity	Moderate	Moderate	Moderate	Moderate	High	High	Moderate	Moderate	Moderate	Moderate	High	Moderate	Moderate	Low	High	Moderate	High	Moderate
Process standardization	X							X		X								
Fatal flaw	Not able to provide nitrogen removal	Large footprint	Relatively low tank volume reduction at high costs	No able to provide nitrogen removal		Requires periodic magnetite deliveries	Large footprint				Large footprint if influent/ effluent EQ is needed	Limited full scale installations in U.S.	No U.S. installations	Not able to provide nitrogen removal	Limited full scale installations in U.S.	Limited full scale installations in U.S.		Limited full scale facilities; requires kenaf addition
Removed from further consideration	X	X	X	X		X	X				X	X	X	X	X	X		X

Section 7

Liquid Treatment: Filtration and Disinfection

7.1 R-1 Treatment Requirements

The State of Hawaii Department of Health (DOH) Reuse Guidelines requires that R-1 recycled water be oxidized, filtered, and disinfected. For media (sand, granular, or cloth) filtration the filtration process must produce effluent with turbidity that does not exceed:

- An average of 2 nephelometric turbidity units (NTU) within a 24-hour period.
- 5 NTU, more than 5 percent of the time within a 24-hour period.
- 10 NTU at any time.

For membrane filtration processes the effluent turbidity must not exceed:

- 0.2 NTU more than 5 percent of the time within a 24-hour period.
- 0.5 NTU at any time.

R-1 recycled water must also meet the following fecal coliform standards:

- The median density of shall not exceed 2.2 organisms per 100 mL using the bacteriological results of the last seven days for which analyses have been completed.
- The density shall not exceed 23 organisms/100 mL in more than one sample in any 30-day period.
- No sample shall exceed 200 organisms/100mL.

R-1 recycled water production at the Central Maui WWRF will require (at a minimum) filtration and disinfection processes downstream of the secondary treatment process. Chemical addition and flocculation upstream of the filtration process may also be required. If an MBR is used only a downstream disinfection process will be required.

7.2 Chemical Addition

Addition of chemical coagulants and/or flocculants can be required upstream of media filtration. The chemicals are used to gather small particles together so that they are large enough to be removed by the filters. The systems that are needed to effectively add chemicals are:

- Chemical storage and metering systems.
- High energy rapid mixing to initially add the chemicals to the secondary effluent.
- Low energy mixing in flocculation chambers to create filterable flocs.

The County typically has not had to add chemicals upstream of cloth media filtration systems to meet the R-1 turbidity requirements. At the Central Maui WWRF, physical space will be set aside within the footprint and hydraulic profile for chemical addition systems, but construction of the systems will be deferred until it is determined that they are needed.

7.3 Filtration

The County has standardized on cloth media filtration at the existing WWRFs and has had good results. Cloth disc filters (AquaDisk) are used at the Lahaina, Kihei, and Kaunakakai WWRFs. The original travelling bridge sand filters at the Wailuku-Kahului WWRF were retrofitted with a cloth media retrofit package (AquaDiamond). Cloth media filters have lower hydraulic head loss than sand media filters. The cloth media characteristics reduce the cleaning energy required for removal of filtered solids, resulting in lower backwash water volume than sand media filters.

Several companies make cloth disc filters that are an accepted filtration technology for California Title-22 water recycling applications and would thus be acceptable to the State of Hawaii Department of Health. The maximum allowable hydraulic loading rate for cloth media filters is 6.0 gpm/ft^2. A cutaway view of one cloth disc filter option (Aqua-Aerobic Systems) is shown in Figure 7-1 below. Other CDPH-approved cloth media filter systems are manufactured by Kruger, Nordic Water, Parkson, Siemens, and Five Star Filtration.

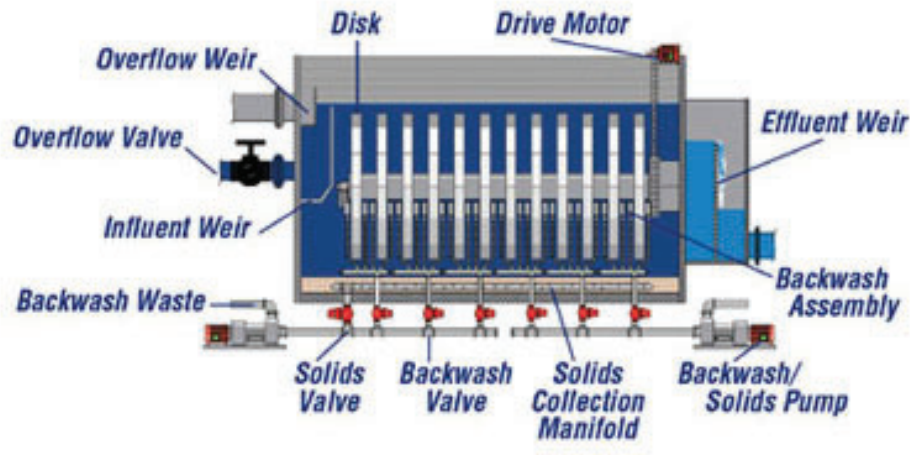


Figure 7-1. Cloth Disc Filter Cutaway View

(Source: Aqua-Aerobic Systems)

Typical cloth disc filter operation is broken down into three stages: filtration, backwash, and solids waste. During filtration, inlet wastewater enters the tank, completely submerging the cloth media. Solids are deposited on the cloth media while the filtered water is collected internally in each disc and conveyed through a central shaft for discharge. A backwash cycle is initiated when solids accumulation on the cloth media increases head loss across the filter. Discs rotate slowly as liquid suction removes solids from both sides of each cloth media disc. Discs are cleaned in pairs while the remaining discs continue to operate. Since heavier solids naturally settle to the tank bottom, a periodic waste cycle pumps accumulated solids from the filter.

7.4 Disinfection

Disinfection will be required for both water recycling and discharge to a land treatment system. Chlorination and ultraviolet light (UV) disinfection options are discussed below.

7.4.1 Chlorination

Chlorine, in various forms, is a commonly used disinfectant in the United States. Chlorination is an effective and cost-efficient method for disinfecting treated wastewater.

Chlorine is available in gas, liquid, and solid forms. Chlorine gas represents the purest and lowest cost form to transport and use, however it presents the highest environmental, and safety concerns and risks. Bulk chlorine gas is currently not available in Hawaii. Bulk liquid sodium hypochlorite incurs higher costs due to the weight of water that must be transported along with the active chemical. In addition, sodium hypochlorite degrades in storage. Sodium hypochlorite can be generated onsite at low concentrations but will require salt deliveries and has higher energy requirements. Solid calcium hypochlorite is typically the most expensive form and is typically only suitable for small discharge flows. However, due to a lack of suppliers providing chlorine gas and high cost of bulk sodium hypochlorite, the County of Maui recently transitioned from using chlorine gas to solid calcium hypochlorite for maintenance chlorination needs at the Kihei and Lahaina WWRFs, and as the primary means of effluent disinfection at the Wailuku-Kahului WWRF. Unfortunately, problems with scale formation at the existing WWRFs has made sodium hypochlorite more attractive for the Central Maui WWRF

The effectiveness of a chlorination system is highly dependent on the characteristics of the wastewater, the initial mixing and contact time, and the chlorine dose used. For secondary effluent, the recommended dose is between 2 and 8 mg/L. The recommended minimum contact time for chlorination prior to effluent disposal is 15 minutes (Ten States Standards Wastewater, Recommended Standards for Wastewater Facilities, 1997, Great Lakes – Upper Mississippi River Board of State and Provincial Public health and Environmental Managers). The required chlorine contact time for R-1 water recycling is 90 minutes based on peak day dry weather flow. The size of the chlorine contact tank will need to accommodate at least a 15-minute contact time for the peak hour wet weather discharge rate, and at least a 90-minute contact time for the peak day dry weather flow, whichever is greater.

7.4.2 Ultraviolet Light (UV)

Disinfection via ultraviolet light (UV) is a common practice throughout the world. Ultraviolet systems destroy microorganisms by affecting their deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) and impeding their ability to reproduce.

A UV disinfection system is comprised of lamps, a reactor, and control panel. Wastewater can flow either parallel or perpendicular to the lamps in the reactor, while the control box provides a starting voltage and maintains the continuous current needed. Currently, most systems are equipped with an automated lamp cleaning system, to maintain lamp efficiency levels.

A UV system's effectiveness is dependent on the characteristics of the wastewater, the intensity of the UV light, and the exposure time. In the case of UV radiation, the most important factor is the UV transmittance at the germicidal wavelength through the water, which has a direct effect on the ability of UV light to penetrate through the liquid and reach microorganisms present at the required intensity. A UV disinfection system requires a much smaller footprint than chlorine, because it is a physical process, and no significant contact time is required. Disinfection occurs as the microorganism is exposed to the UV radiation when the water flows past the UV lamps. The main disadvantage of UV disinfection is the high energy requirements.

The County of Maui currently uses UV disinfection at the Kihei and Lahaina WWRFs for recycled water production.

7.5 Conclusions and Recommendations

Cloth media filtration and UV disinfection are currently used by the County for recycled water production, and so are logical choices for the Central Maui WWRF for operations and maintenance standardization purposes. Chemical addition upstream of the cloth media filtration system will likely

not be needed to achieve R-1 turbidity standards, but physical space and accommodation in the WWRF hydraulic profile are recommended to allow addition of chemical facilities in the future, if needed.

A sodium hypochlorite system is recommended for maintenance chlorination needs.

Section 8

Solids Treatment Options

Solids treatment options are discussed in this section.

8.1 Biosolids and Sludge Terminology

Throughout this document the terms “wastewater solids”, “sewage sludge” and “biosolids” are used. The terms “wastewater solids” and “sewage sludge” are both used to describe the residual material from the wastewater treatment process. Modern wastewater treatment plants serve to remove the waste from wastewater, so that the clean WWRF effluent can be safely discharged to the environment or be used for beneficial purposes. The wastewater treatment process concentrates the waste materials present in sewage, creating wastewater solids or sewage sludge as a residual material.

The term “biosolids” is used to describe wastewater solids or sewage sludge that have undergone sufficient treatment to allow the material to be put to beneficial use. Wastewater solids that comply with the standards developed by the USEPA for beneficial use can be called “biosolids”. The USEPA standards include limitations on heavy metal and pathogen content, and requirements for vector attraction reduction. Note that while all “biosolids” are derived from wastewater solids, not all wastewater solids can be called “biosolids”. The dewatered wastewater solids currently generated at the County’s WWRFs do not meet the USEPA standards for recycling, and therefore cannot be called “biosolids”.

Biosolids are further differentiated by their pathogen content. “Class A” biosolids comply with the USEPA’s most stringent pathogen requirements and are virtually pathogen free. “Class B” biosolids have higher pathogen content but are just as safe to recycle if proper management practices are followed.

8.2 Raw Solids Projections

Projections of the quantities of raw solids produced at the Central Maui WWRF are summarized in Table 8-1. The projections are based on the full WWRF capacity of 4.0 mgd assuming no primary treatment.

Table 8-1. Central Maui WWRF Solids Projections at Full 4.0 mgd Capacity		
Description	Average	Peak Month
Screenings	40 ft^3/day	48 ft^3/day
Grit	20 ft^3/day	24 ft^3/day
Waste activated sludge (dry weight)		
Total solids	12,000 ppd	14,400 ppd
Volatile solids	9,600 ppd	11,500 ppd
Fixed solids	2,400 ppd	2,900 ppd
Tertiary solids (dry weight)	600 ppd	700 ppd

8.3 End Use and Disposal Regulations

This section summarizes regulatory considerations which govern the use and disposal of biosolids and sludge.

8.3.1 Biosolids Use Regulation: 40 CFR 503

The USEPA regulates biosolids use under Chapter 40, Part 503 of the Code of Federal Regulations (CFR), also referred to as 40 CFR 503. The 40 CFR 503 regulations address land application, surface disposal, and incineration of biosolids. The 40 CFR 503 regulations are self-implementing and include monitoring, certification, and reporting requirements. Although a permit application must be submitted, USEPA Region 9 does not typically issue permits. Agencies are required to send an annual report to USEPA Region 9 summarizing and certifying their compliance with the rule.

The 40 CFR 503 regulations establish metal concentration limitations, pathogen density requirements, vector attraction reduction requirements, and site management practices for land application of biosolids. Land application refers to the beneficial use of biosolids for their nutrient and organic matter content. Biosolids land application rates cannot exceed the fertilizer (nitrogen) needs of the vegetation that will be grown. The metal concentration limitations are based on a risk assessment prepared by USEPA. The pathogen density and vector attraction reduction requirements are based on past successful experience. Class B biosolids have significantly reduced pathogen densities (as compared to raw sludge) but require application site management to ensure protection of public health and the environment. Class A biosolids have further reduced pathogen densities and do not require application site management to ensure protection of public health and the environment. Biosolids that meet the pollutant concentration, Class A pathogen, and vector attraction reduction requirements in 40 CFR 503 are often called “Exceptional Quality Biosolids” and can be sold or given away in bulk or bags without additional regulation by USEPA.

The 40 CFR 503 regulations also establish requirements for surface disposal of biosolids. Surface disposal includes monofills, surface impoundments, lagoons used for final disposal as opposed to treatment, waste piles, dedicated disposal sites, and dedicated beneficial use sites. In general, surface disposal of biosolids refers to application at high rates – in excess of crop nutrient requirements, if a crop is grown – as a management practice. The regulation establishes metal concentration limitations, pathogen density reduction requirements, vector attraction reduction requirements, and site management practices.

40 CFR 503 does not regulate disposal of sewage sludge or biosolids to landfills; this is regulated under 40 CFR 258.

8.3.2 Criteria for Municipal Solid Waste Landfills: 40 CFR 258

Disposal of sewage sludge (or biosolids) to municipal solid waste landfills is regulated under 40 CFR 258. Sewage sludge that is disposed in municipal solid waste landfills cannot be classified as hazardous waste as defined by Federal rules. In addition, the sewage sludge cannot contain free liquids and must pass the "Paint Filter Test" (EPA test method 9095B). Testing is often required to demonstrate that the sludge does not qualify as hazardous waste prior to initiation of disposal activities. Sludge or biosolids that are mechanically dewatered generally pass the paint filter test.

8.4 End Use and Disposal Options

Potential end use and disposal options are discussed below.

8.4.1 Central Maui Landfill Disposal

The County of Maui currently disposes grit and screenings from the existing County WWRFs at the Central Maui Landfill. Continued grit and screenings disposal at the landfill is considered to be a viable alternative.

8.4.2 Land Application of Cake

Dewatered biosolids (Class A or Class B) can be spread on farm fields and used as soil amendment and fertilizer. The practice is used extensively on the U.S. mainland. Agencies often contract with service providers who secure users and permits, haul and spread dewatered cake on the farmers' fields, and provide all required monitoring and reporting. The farmer plants, grows, and harvests the crop after the biosolids are applied, and generally pays nothing for the biosolids. The applied biosolids provide macro and micro-nutrients for the crop and increase moisture retention in the soil. Typically, biosolids are applied to land that is used to grow animal feed crops. Figure 8-1 is a photo of a biosolids spreading operation in California.

Figure 8-1. Land Application of Dewatered Cake

Land application rates are a function of the nutrient content of the biosolids and the fertilizer needs of the crop. Typical land application rates are 2 to 5 dry tons per acre. For planning purposes, assuming the Central Maui WWRF produces approximately 5 dry tons per day of biosolids and the biosolids were applied at a rate of 5 dry tons per acre, the County would need access to approximately 365 acres of application area for the annual disposal requirements. The County or its service provider would need to obtain permits for a land application site, because no permitted sites currently exist. The complexity of permitting and operating a land application site makes this option unattractive, and it will receive no further consideration.

8.4.3 Composting

Dewatered sludge or biosolids can be mixed with green waste or other amendments and composted in accordance with USEPA time and temperature criteria to produce a Class A biosolids compost product that can be used as a soil amendment on all types of land, including residential properties. The sludge feedstock does not have to meet 40 CFR 503 requirements prior to composting because a properly designed and operated composting process will produce a Class A biosolids product from dewatered sludge.

Active marketing is required to ensure the product is used, or else it will ultimately end up being disposed in the landfill. Inclusion of sludge or biosolids as a compost feedstock can significantly increase the odor emission from the composting operation, due to the ammonia content of the sludge or biosolids. Therefore, composting operations that use sludge or biosolids as feedstock should have foul air collection and odor control to prevent nuisance odor conditions.

The County has long relied on composting for solids management for the Maui Island WWRFs. Dewatered sludge is composted with green waste to create a Class A biosolids product. The private composting operation, operated by Maui EKO Systems is currently located at the Central Maui Landfill. Composting is considered to be a viable option into the future.

8.4.4 Other Class A Biosolids Processes/Products/Uses

A variety of processes are available to create Class A biosolids products for beneficial use. In general, these processes involve one or more of the following:

- Use of heat to achieve pathogen reduction.
- Use of heat to dry solids.
- Use of heat/and or pressure to enhance digestibility or dewaterability of solids.
- Elevating the pH of the solids using lime or fly ash to achieve Class A requirements.

The markets for these products include:

- Land application as fertilizer and soil amendment on farmland as described above.
- Land application as fertilizer and soil amendment on other types of property, including residential, golf courses, parks, etc.
- Use as landfill daily cover material.
- Combustion.

In general, this class of processes is inappropriate for a remote island location like Maui for the following reasons:

- These complex processes require higher personnel skill levels to operate and maintain.
- High cost of imported fossil fuel energy.
- High cost of imported alkaline amendments (e.g., lime or fly ash).
- Lack of viable markets for end products on a small island.

8.4.5 End Use/Disposal Recommendation

Landfill disposal of grit and screenings is recommended for the Central Maui WWRF. Continued co-composting the dewatered sludge from all of the County's WWRFs (including the Central Maui WWRF) along with the island's green waste is recommended as a centralized sludge management system.

8.5 Processing Options

This section will evaluate digestion, thickening, dewatering, and biogas options for solids processing at the Central Maui WWRF.

8.5.1 Digestion Technologies

Digestion reduces the mass of solids requiring disposal and also renders the end product less offensive. Both anaerobic and aerobic digestion technologies have a long history of use in sludge processing in North America, although anaerobic digestion is much more common at larger wastewater treatment plants greater than 10 mgd due to favorable life-cycle costs.

8.5.1.1 Mesophilic Anaerobic Digestion

Anaerobic digesters are large, covered tanks equipped with mixing, heating, and biogas collection systems. Anaerobic bacteria in the digesters convert organic matter into methane, carbon dioxide, and water; pathogen densities are reduced; and a stabilized sludge is produced. Modern high-rate digesters are typically single-stage reactors. Mesophilic anaerobic digesters are typically operated at temperatures between 35 and 38°C. Mesophilic digestion systems can produce a Class B biosolids product if the solids retention time (SRT) is greater than 15 days.

Two-stage mesophilic anaerobic digestion, where digesters are operated in series, improves process performance. The second-stage anaerobic digester generally has less SRT than the first stage. The advantages of this process configuration are slightly improved volatile solids reduction, a product with reduced pathogen content, and less product odor potential.

The anaerobic digestion process generates biogas that can be used for digester heating and generation of electricity. Biogas management is discussed separately below.

The mesophilic anaerobic digestion process requires primary sludge to operate effectively. Therefore, primary clarifiers are required for an anaerobic digestion process. WWRFs that do not have primary clarifiers must use other digestion technologies.

Anaerobic digestion is generally cost effective only for facilities larger than 5 to 10 mgd. Anaerobic digestion is not considered to be an appropriate technology for a facility the size of the Central Maui WWRF and will not receive further consideration.

8.5.1.2 Aerobic Digestion

Aerobic digestion consists of aerating sludge in a tank for an extended period of time. Volatile solids are oxidized in the process, stabilizing the sludge and reducing the total mass of solids that must be managed by recycling or disposal. Pathogen densities are also reduced. The process does not produce biogas. The aerobic digestion process requires substantial energy input in the form of aeration blowers, and therefore is not typically used at larger (i.e., greater than 10 mgd) WWRFs.

Many small (less than 5 mgd) wastewater treatment plants in the United States use aerobic digestion to stabilize solids, due to its relatively low capital costs, simplicity, and compatibility with the liquid treatment processes.

8.5.1.3 Aerobic Digestion with Gravity Decant Thickening

This two-stage process can be achieved in the same basin. The first stage includes a period of aerobic digestion as described above. In the second stage the blowers are turned off for a period of time to allow sludge to settle and thicken. Supernatant is then decanted off the top. The blowers are turned back on to continue the aerobic digestion process. This process is repeated a few times until the sludge reaches approximately three percent solids. It is then pumped to a sludge holding tank and dewatered.

The County of Maui has operated aerobic digestion with gravity decant thickening at the Wailuku-Kahului Wastewater Reclamation Facility (WWRF) and the Kihei WWRF for several decades.

8.5.2 Thickening Technologies

Thickening operations are used to remove large quantities of water from sludge slurries to reduce the size of downstream processes.

8.5.2.1 Thickening Primary Sludge in a Primary Clarifier

Thickening of primary sludge within the primary clarifier is a common technique at wastewater treatment plants. There are, however, some drawbacks to this option. Odors can be produced in warm climates if the sludge blanket is too thick and becomes septic. Thickening performance varies and often the thickened solids contain less than four percent solids.

8.5.2.2 Gravity Belt Thickener

A gravity belt thickener (GBT) consists of a fabric belt that rotates slowly around a series of rollers driven by electric variable speed motors. The top surface is flat, and slopes gradually upward from the feed end to the discharge end of the machine. A series of "plows" suspended from a frame above the belt gently mix the sludge as it passes to separate water from the flocculated solids.

Water is separated from the solids by gravity drainage and also by the capillary suction forces exerted by the belt pores. Thickened sludge typically discharges to a hopper from where positive displacement pumps convey it downstream to the next process. Polymer must be added to the sludge for the proper operation of a GBT. It can be fed to the sludge in a small mixing chamber directly upstream of the sludge feed point, into the sludge feed box, or at a point in the feed piping upstream of the unit. Having several injection points allows optimization of polymer performance.

Through adjustment of the operating variables such as belt speed, polymer dosing, and sludge feed rate, thickened sludge concentrations of 4 to 7 percent are commonly achievable. Thickening of WAS is very common with GBTs, and co-thickening of primary and WAS on GBTs has been conducted successfully.

8.5.2.3 Dissolved Air Flotation

In dissolved air flotation thickening (DAFT) the solids are floated to the surface of the tank by using air bubbles to alter their specific gravity. In the DAFT process, a source of air for flotation is provided by pressurizing a stream of liquid (process water or DAFT effluent) and saturating the liquid with air. When the pressurization system is discharged into the tank, the pressure is reduced, and turbulence is created. Pressurized air in excess of that required for saturation at atmospheric pressure leaves solution as very small bubbles (the effect is similar to that of removing the cap from a bottle of carbonated water or soda). A key requirement is a depressurizing zone at a location where the bubbles that form upon release of pressure contact the solids entering the DAFT. The bubbles adhere to the suspended particles or become enmeshed in the solids matrix. Since the average density of the solids-air aggregate is less than that of water, the agglomerate floats to the surface and is skimmed off the top.

Polymer is commonly used to enhance the performance of the DAFT. DAFTs typically achieve thickened sludge solids concentrations ranging from 4 to 6 percent, depending upon the characteristics of the sludge, the air to solids (A/S) ratio, polymer dosage, and various design and operating refinements. WAS is commonly thickened in DAFT units, and DAFTs are also effective in co-thickening of primary sludge and WAS.

8.5.2.4 Centrifuge Thickening

Centrifuges are typically used for thickening applications where high capacity is required within a small footprint, or where fully contained thickening is critical for odor control. The machines use more electrical power than other thickening options and usually require more maintenance. Thickened solids of five percent or more can be achieved, and polymer conditioning is required. Centrifuge thickening is used for biological sludges and has also been used by a few agencies to thicken primary solids, and even for co-thickening service.

8.5.2.5 Gravity Thickening

Separate gravity thickeners have been most often used to thicken primary sludge. They are used less often today than historically, mostly because of improved thickening performance of other processes. Gravity thickening for primary sludge can sometimes achieve five percent solids, but the thickening can be variable in performance. It is also an odorous process, as the sludge is retained within the thickener for several hours. Thickening of biological sludge within gravity thickeners is not advisable because thickening performance would deteriorate, and increased odors are likely. A separate gravity thickening process offers little advantage at the Central Maui WWRF and is not considered further.

Gravity thickening can also be conducted as a batch operation within an aerobic digester; this option is presented separately under the digestion stabilization technologies discussion above.

8.5.2.6 Rotary Drum Thickening

Rotary drum thickening, sometimes called rotary screen thickening, has been used primarily at smaller wastewater plants. It functions similar to gravity belt thickening, in that free water from a flocculated sludge is drained through porous media. Polymer use is required, and in general, better performance is achieved on sludges with more fiber content. An advantage is its small footprint requirement. Concerns for the process include odor control, sensitivity to polymer type, and operator attention requirements. The technology is primarily used at WWRF's smaller than 3 mgd but is gaining popularity at larger facilities.

8.5.3 Dewatering Technologies

Dewatering technologies remove water from sludge or biosolids to create materials having about 15 to 30 percent solids content. Dewatered sludge is often called "cake". Four dewatering options are discussed below.

8.5.3.1 Belt Filter Press

Belt filter presses employ moving porous belts to continuously dewater sludge. Belt filter presses are capable of achieving approximately 12 to 18 percent total solids content, which will pass the "paint filter test". Figure 8-2 illustrates the belt filter press process. The process consists of three distinct phases. In the first phase, polymer is mixed with the sludge for conditioning purposes. The second phase consists of gravity drainage on a single belt to a non-fluid consistency. The sludge is then pressed between two belts and rollers in the third stage to produce the dewatered cake. Belt widths of 1.0 and 2.0 meters are generally used, although machines using belts up to 3.0 meters wide are manufactured. High pressure water sprays continuously clean the belts. Required ancillary

equipment includes polymer feed systems, wash water systems, sludge feed pumps, odor containment and control systems, and dewatered cake conveyance systems.

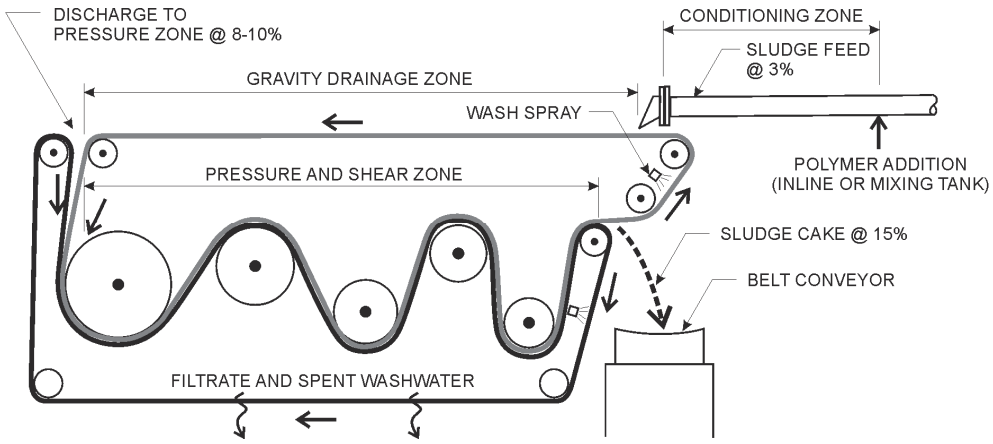


Figure 8-2. Belt Filter Press

8.5.3.2 Centrifuge

Centrifuges are another commonly used dewatering technology. Centrifuges provide the best dewatering performance of the dewatering technologies presented in this report but require the highest energy input to do so. High-solids centrifuge machines typically achieve dewatered cake of approximately 23 to 28 percent total solids content. The process is illustrated in Figure 8-3. Centrifugal force of 500 to 3,000 times the force of gravity is applied to the biosolids within the centrifuge, separating liquid from the solids. The centrifuge has a solid bowl that spins at a high rate. Liquid sludge, conditioned with polymer, is introduced within the rotating bowl. The sludge spins with the bowl, separating into liquid and solid fractions. A screw conveyor mechanism spins within the rotating bowl at a slightly faster or slower speed than the bowl to facilitate moving the solids fraction towards one end of the bowl, where it is discharged. The centrate (removed liquid) is discharged through another port. The process operates continuously. Required ancillary equipment includes sludge feed pumps, polymer feed systems, and sludge cake conveyance systems.

Centrifuges are sized based on hydraulic and solids throughput. Machines are available to dewater sludge flow rates ranging from 25 gpm to 700 gpm. High-solids machines can produce a very well-dewatered material.

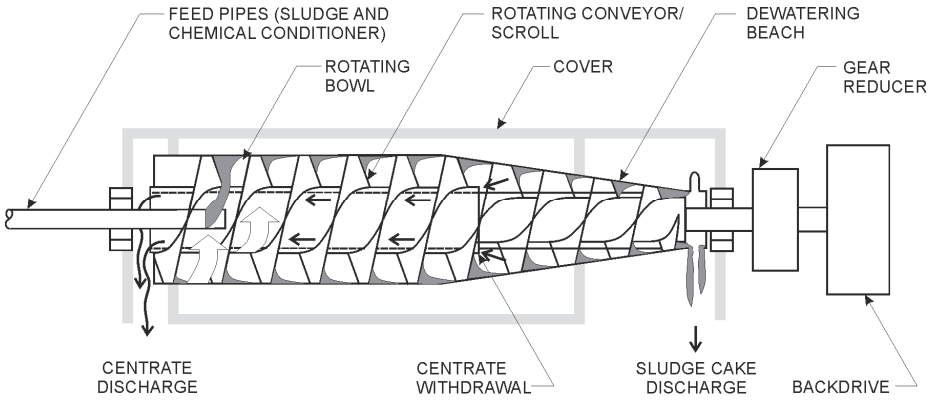


Figure 8-3. Centrifuge

The County currently operates centrifuges at its Lahaina, Kihei, and Wailuku-Kahului WWRFs, and has found that an operator must be present to monitor the machines' operation. The County desires to implement technology that does not require a high level of operator attention. For this reason, centrifuges are eliminated from further consideration.

8.5.3.3 Screw Press

The screw press represents a relatively new technology for dewatering municipal wastewater solids, although the technology has been used successfully in industrial, pulp and paper production, chemical, and food processing applications.

Figure 8-4 is a diagram of a screw press. Thickened sludge, conditioned with polymer, is introduced to the machine in the head box at the inlet end. The mixture is conveyed from the inlet end to the outlet end of the press by the rotating screw. As the material is conveyed along the length of the press it is squeezed between the tapered screw shell and the screen drums. The dewatered solids exit the press at the discharge end and fall down the discharge box. The adjustable pressure cone provides back pressure within the machine, particularly when the machine is initially filled. For municipal wastewater solids applications, the pressure cone is typically not needed after the machine is filled; the dewatered sludge provides sufficient back pressure. The liquid that was forced out through the screens is returned to the liquid treatment process.

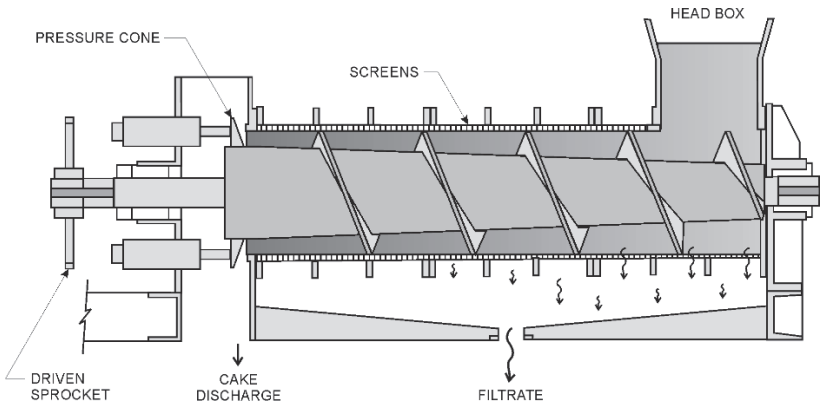


Figure 8-4. Screw Press

Unlike the centrifuge, the screw press operates at a very slow rotational speed. The screw rotation is usually one-half of a revolution per minute or less for municipal wastewater solids. Water is slowly forced from the sludge by squeezing action – similar to a belt filter press – but for much longer periods of time. The solids retention time in a screw press can be on the order of two hours. The simplicity of screw presses makes them practical for small wastewater treatment plants, such as the Central Maui WWRF.

8.5.3.4 Drying Beds

Drying beds are a relatively low-cost and simple to operate option that is commonly used at small wastewater facilities. The general concept involves filling a bed with sludge, draining or decanting the liquid, and leaving a layer of cake to be removed. The typical solids content of the air-dried sludge is 40 percent or greater. Four common types of drying beds are sand, paved, artificial medium, and vacuum assisted. Drawbacks of drying beds are potential odors if the sludge is not anaerobically digested and the required footprint. Figure 8-5 is a photo of a drying bed with dried sludge cracking.

Figure 8-5. Example of a Sludge Drying Bed

Sludge drying beds are removed from further consideration for the Central Maui WWRF due to odor potential and the large footprint required.

8.5.3.5 Dewatering Recommendation

Screw press dewatering is recommended for the Central Maui WWRF due to the O&M simplicity and energy efficiency of the technology.

As with many solids processing systems, solids dewatering can be odorous. The solids processing components should be housed or covered, and foul air collected. An odor control system is recommended.

8.5.4 Anaerobic Digestion Biogas Processing and Use Technologies

With anaerobic digestion of wastewater solids and other organic feedstocks, an energy-rich gas is produced which usually contains between 60 and 70 percent methane. This gas is often called digester gas or biogas, and we refer to it as "biogas" in this report. The biogas is increasingly valuable in today's energy markets and is a renewable fuel which has important implications for sustainability goals. Capturing methane and using it wisely minimizes methane emissions to the atmosphere – a critical greenhouse gas concern.

Biogas can be used wherever natural gas is used; however, required gas characteristics vary depending on the combustion method/device. Characteristics required for stationary biogas applications at a WWRF are much less stringent than required to meet pipeline quality natural gas or vehicle fuel needs. Options for biogas use are presented and discussed here along with technologies for biogas processing and handling.

8.5.4.1 Boiler Use for Heating

The most common use of biogas has been, and continues to be, for heating of sludge in anaerobic digesters. There are several methods used for such digester heating, but the most common method is to use biogas as fuel in a hot water boiler, and the hot water is then used in heat exchangers to heat the sludge/biosolids slurry. Steam boilers are also used at some plants to provide steam for heating (and, through absorption chillers, for cooling uses in buildings). Even if the digestion plant

uses cogeneration or other methods of biogas utilization on a normal basis, the plant will typically need to maintain a boiler system as a backup heating method, so that digestion heating is assured even if mechanical breakdown or other problems arise in the biogas utilization system.

8.5.4.2 On-Site Electric Power Generation and Cogeneration

Electrical power is a highly valued and flexible commodity. Therefore, on-site power generation or cogeneration is popular at wastewater treatment plants when considering options for using the biogas from anaerobic digestion of solids. The heat byproduct from cogeneration facilities is also valuable in heating the digesters and providing heat for buildings, and even for building cooling via absorption chillers. Biogas power generation via internal combustion engines is a mature and well proven technology. Gas turbine technology is also used for electric power production from biogas. Several major reciprocating engine and gas turbine manufacturers have dozens of successful operating projects. Biogas to electricity projects have been more risk-free than some of the other biogas use options, and the power that is created is fully usable. The optional technologies for power generation and cogeneration are:

- Internal combustion engines are the most frequently used technology for biogas cogeneration at wastewater plants. Heat recovery from the engine is almost always implemented, creating a hot water system for heating purposes. Engine development has produced greater efficiency over the years.
- Gas turbines are also used for biogas cogeneration, particularly at larger WWRFs (i.e., significantly larger than the Central Maui WWRF). For combustion gas turbines, slightly less biogas energy goes to electric power production and somewhat more waste heat energy is produced. Turbines are more sensitive to gas moisture content and characteristics such as siloxane. Gas turbines also require higher pressure biogas than most other gas use technologies – often 150 to 250 psi. Therefore, gas pretreatment becomes more critical.
- Fuel cells produce electric power and some waste heat with no moving parts. Fuel cells combine hydrogen (extracted from the biogas) and oxygen (from air) in an electrochemical reaction and represent a very clean technology from the standpoint of air emissions. The technology is now available but is very costly and still undergoing additional development.

8.5.4.3 Clean the Biogas and Use for Vehicle Fuel

An option being used in Europe and gaining some momentum there, is to clean the biogas and compress it to high pressures (2,000 to 3,000 psi) that are required for use in compressed natural gas (CNG) vehicles. Typically, a CNG fleet vehicle organization is required at close proximity to the digestion plant to make this option work. Cleaning the biogas to high quality standards is required for the high-pressure compressors and to protect vehicle engines. This option is inappropriate for a remote island location like Maui due to the process complexity. Also, the economics of this approach have been evaluated by others in the US, and it does not appear favorable for a facility of this size.

8.5.4.4 Biogas Flares

Biogas flares (sometimes referred to as waste gas burners or emergency flares) are required for anaerobic digestion processes as a safety and air emission control measure. If biogas use in boilers, cogeneration, or other methods is not able to handle the quantities of biogas being produced, the flares must be used to combust excess biogas. Flare design in the last couple of decades has achieved improved combustion of the biogas to minimize products of incomplete combustion and NOx emissions. Typically, flares are sized to handle the peak potential biogas production from the facility to account for the emergency situation whereby the biogas may not be able to be sent to any other combustion device.

8.5.4.5 Biogas Cleaning Technologies

8.5.4.5.1 Hydrogen Sulfide Removal

Reduction of hydrogen sulfide gas concentrations within the biogas is becoming very common because of air emission regulatory controls. A common approach has been to add iron salts so that the ferric or ferrous ion precipitates the sulfide within the liquid phase sludge. Agencies using this approach can often reduce hydrogen sulfide concentrations from 1,000 ppm or greater down to 100 ppm or less. However, air pollution control districts sometimes require hydrogen sulfide levels less than 100 ppm. In this case, agencies have used iron oxide/hydroxide technology (iron sponge). Other technologies occasionally used include water or hydroxide scrubbing or activated carbon treatment.

8.5.4.5.2 Moisture Removal

Biogas is saturated with water vapor. At mesophilic temperature (37 °C, or 99 °F), water vapor is about 6 percent by volume. Moisture must be removed prior to combustion and is also removed to minimize condensation within gas piping (potential pipe blockages), to protect instruments, and limit corrosion from low pH liquid conditions. Moisture is removed by cooling the biogas. Condensers are common technology for this purpose. A slight re-heating of the biogas after condensation limits chances for moisture problems downstream.

8.5.4.5.3 Siloxane Removal

Organo-siloxanes and silicones are present in typical municipal wastewater sludge, and these compounds are also contained in the biogas. These compounds cause tough, whitish-colored deposits to form on biogas combustion surfaces in boilers, engines, and other devices. Increasingly, these siloxane-caused deposits cause maintenance problems and equipment downtime, and, therefore, there is a need to minimize the siloxane content in the biogas. Condensation of biogas for moisture removal (cooling to about 4 °C temperature) removes a small portion of the siloxanes from the biogas, but greater removal is often required. The most common current method to bring siloxane levels down to < 1 ppm, is through the use of granular activated carbon. Another method for siloxane removal is to cool the biogas down to very low temperature (-30 °C or colder); however, this approach has not met with high success rate to date. Other removal methods are undergoing research work.

8.5.4.5.4 Carbon Dioxide Removal

Several technologies are available for carbon dioxide removal from biogas. However, water scrubbing/absorption has been used more frequently than other methods in the US because, for WWRFs, there is an abundance of water available to carry off the carbon dioxide. Hydrogen sulfide is also largely removed in this absorption process. The driver for CO_2 removal is normally to create pipeline-quality gas or vehicular fuel. These CO_2 removal technologies can be complicated, and therefore, WWRFs are less inclined to pursue this approach without clear economic advantage. Besides water scrubbing, other methods for CO_2 removal include polyethylene glycol absorption, carbon molecular sieves (pressure swing adsorption), and membrane separation.

8.5.4.6 Biogas Storage

A small amount of biogas storage is normally used at sludge digestion plants as a means of equalizing the gas pressure in the system, and providing consistent feed of biogas to engines, boilers, and other gas use systems. The storage volume provided is often one hour or less of biogas production; however, sometimes several hours of storage time are constructed. Beyond this quantity of storage, the cost typically becomes hard to justify. Most biogas storage at wastewater plants is within low pressure units such as variable volume bladder tanks or within digester covers

that can store biogas directly. Compressing the biogas for medium or high-pressure storage is costlier and is usually done only when the biogas use system requires increased pressure.

8.6 Economic Comparison of Anaerobic and Aerobic Digestion

Anaerobic digestion is generally not cost effective for WWRFs with flows of less than 5 mgd, and aerobic digestion is generally used at small WWRFs similar to the Central Maui WWRF. However, a planning-level economic evaluation was prepared for the Central Maui WWRF in recognition of the high cost of electricity on the island, and whether biogas processing and use would potentially reduce the life-cycle costs of the facility. The capital and differential O&M costs (and benefits) for anaerobic digestion were assessed and are summarized in Table 8-2. As shown in the table, anaerobic digestion with biogas use would incur higher capital costs, but also would have reduced overall annual costs. The life-cycle cost comparison shows that aerobic digestion is a better overall value for the Central Maui WWRF and will have lower overall costs than anaerobic digestion and biogas use.

Table 8-2. Summary of Economic Comparison of Aerobic and Anaerobic Digestion

Description	Aerobic Digestion	Anaerobic Digestion and Biogas Use
Capital cost	$10.9 M	$18 M
Annual O&M costs		
Differential power use cost		-$213,000/year
Differential labor cost		$624,000/year
Differential maintenance cost		$115,000/year
Biogas value as electricity	--	$561,000/year
Net annual benefit	--	$35,000/year
20-year life-cycle cost	$10.9 M	$17.3 M (+59%)

8.7 Conclusions and Recommendations

Recommendations for solids management at the Central Maui WWRF are listed below.

End Use/Disposal: Landfill disposal of grit and screenings in accordance with 40 CFR 258 requirements. The dewatered sludge will be composted with green waste at the off-site facility, currently located at the Central Maui Landfill.

Digestion and Thickening: Aerobic digestion with decant thickening.

Dewatering: Screw press technology with odor control.

Biogas Processing and Use: None, not applicable.

Section 9

Auxiliary Systems and Appurtenances

9.1 Electrical Systems

It is anticipated that a new electrical service from Hawaiian Electric Company (HECO) will need to be brought to the site via aboveground or underground electrical lines from the intersection of Waiale Road and Waiko Road following along the proposed Waiale Road extension or from Honoapiilani Highway. The new service will supply 480V, 3 phase power to the new WWRF. Depending on the final configuration of the WWRF, the total calculated connected electrical loads are anticipated to be approximately 4,200 KVA as shown in Table 9-1. A standby power system will be provided by a diesel generator with an above ground fuel tank and an automatic transfer switch.

The electrical distribution equipment, including the main switchgear, motor control centers, and standby power system will be housed within the WWRF buildings. Auxiliary electrical rooms can also be constructed throughout the plant to place motor starters closer to the end device. All electrical rooms will be climate controlled to reduce the effects of heat and corrosion on the electrical equipment.

Table 9-1. Initial Estimate of Major Electrical Loads				
Process Area	Major Equipment	Total Units	Motor Size (hp)	Total Connected Load (kVA)
Headworks	Automatic screens	2	2	6
	Screenings conveyor	2	2	6
	Grit washers	2	1	3
	Grit pumps	2	5	13
	Foul air fan	1	20	22
	Agitation air blowers	2	30	66
Secondary Treatment	Aeration blowers	5	200	996
	Anoxic mixers	3	25	85
	Clarifier mechanisms	3	5	19
	RAS pumps	2	40	86
	Mixed liquor pumps	2	25	56
	WAS pumps	2	10	23
	Scum pumps	2	20	45
Tertiary Treatment	Rapid mixers	1	5	6
	Flocculators	4	1	7
	Cloth media filters	4	10	47
Disinfection	UV disinfection			540
	Transfer pumps	5	30	166
Effluent Pumping	Disposal pumps	5	50	270
	Recycling pumps	2	150	299
Aerobic Digestion	Digester blowers	4	50	216
	DS pumps	2	10	23
Sludge Dewatering	Screw press feed pumps	3	5	19
	Screw presses	3	10	35
	Cake conveyors	2	5	13
	Foul air fan	1	10	12
Miscellaneous	Stormwater pumps	3	50	448
	Plant water pumps	2	20	45
	Fire pump	2	60	128
	Process drainage return	2	20	45
	HVAC			68
	Miscellaneous loads (lighting, kitchen, etc.)			421
			TOTAL:	***4234***

9.2 Potable Water System (1W)

Potable water will be needed for an employee breakroom, bathrooms, showers, water fountains, etc. Water demands will be developed during preliminary design. Connection to the County water system is the preferred approach. The potable water system at a WWRF is typically designated as "1W".

9.3 Non-Potable Water Systems

Non-potable utility water needs like hose bibbs, water cannons, and foam sprays will be met with R-1 effluent. A pump system will be needed to provide adequate flow and pressure. The pump system will be housed at the effluent pump station, described below. Demands and pressures will be developed during final design. The non-potable water system at a WWRF is typically designated as "3W".

Certain process water needs are best met using potable water rather than recycled water. Examples include chemical dilution water and pump seal water. The water system that supplies water to these uses will be completely isolated from the potable water system by an air gap or a reverse pressure backflow preventer. If an air gap is used there will be a need for a pump system to deliver adequate flow and pressure to the uses. Demands and pressures will be developed during final design. This type of non-potable water system at a WWRF is typically designated as "2W".

9.4 Fire Protection

Fire protection systems will be needed for certain WWRF elements in accordance with applicable codes.

9.5 WWRF Drainage Return System

WWRF drainage includes sanitary waste, filter backwash, aerobic digester supernatant, solids dewatering filtrate, floor drains and provisions to drain process tanks. These flows will be directed to a drainage return pump station that will return the flow to the WWRF headworks for treatment.

9.6 Stormwater System

A stormwater system that is compliant with applicable codes will be required. All stormwater generated on-site will be collected and conveyed to the SAT basins. A stormwater pump station may be required.

9.7 Odor Control Systems

Wastewater treatment plants can be a source of nuisance odors to the surrounding community if not properly designed and/or operated. Not all processes with a wastewater treatment plant generate odors; nuisance odors are most commonly associated with anaerobic (without oxygen) conditions and with residual solids processing.

The headworks is commonly an odorous process area at wastewater treatment plants because incoming raw wastewater can be anaerobic, and the screening and grit removal processes involve solids processing. The Central Maui WWRF headworks will be covered or enclosed to facilitate foul odor collection. The air removed from the process will be treated in an odor control biotrickling filter (or similar process). Biotrickling filters consist of an vessel filled with plastic or ceramic media. Recycled water is distributed over the media using distribution piping. The foul air is treated as it flows through the media. Biotrickling filters are capable of removing hydrogen sulfide (H_2S) and a wide variety of other odorous compounds from the air.

The liquid treatment processes within the wastewater treatment plant will not be a source of nuisance odors because the process tanks will be aerated to maintain dissolved oxygen concentrations at approximately 2.0 mg/L or greater at all times. Waste solids will be pumped to an aerobic digester for stabilization. The dissolved oxygen concentration in the aerobic digester will be maintained at 2.0 mg/L or greater at all times by aeration. The WWTP will include at least one redundant blower for each aeration system to ensure that aeration air can be provided at all times.

The solids dewatering process is another potential source of odors. The dewatering equipment will be enclosed in a room to facilitate foul air collection. The foul air will be routed to a biotrickling filter for treatment.

9.8 Effluent Pumping

An effluent pump station will be required to deliver effluent to the two effluent management systems:

- Water recycling customers.
- Soil aquifer treatment effluent disposal system.

In addition, the effluent pump station will support the non-potable utility water system (3W). A triple-purpose pump station will be needed, because the two effluent management systems and the non-potable utility water system will all have different flow and pressure needs. Therefore, three sets of pumps will be required. The effluent pumping needs are discussed in the following sections for water recycling and the SAT, respectively.

9.9 Landscaping

A landscape buffer will be designed around the perimeter of the site to provide visual mitigation. Although the WWRF is not adjacent to the highway, a County park facility may be developed on the North side of the treatment plant. The landscape perimeter is envisioned to be comprised of native plants and equipped with irrigation piping. Additional landscaping may be required throughout the facility

Section 10

Water Recycling Systems

A water recycling program will be the primary effluent management system at the Central Maui WWRF. The WWRF systems that will support water recycling are discussed in this section.

10.1 Recycled Water Treatment Systems

Filtration and disinfection systems were discussed in Section 7. The filtration and UV systems will be sized and designed to comply with DOH requirements for R-1 recycled water production. Additional details are provided in the following paragraphs.

10.2 Continuous Turbidity Monitoring

Continuous turbidity monitoring will be provided upstream and immediately downstream of the filtration system in accordance with DOH requirements.

10.3 UV Intensity Monitoring

Continuous UV intensity monitoring will be provided in accordance with DOH requirements and the National Water Research Institute (NWRI) Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse, latest edition.

10.4 Other Monitoring

Continuous flowrate and UV transmittance will be provided in accordance with the NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse, latest edition, to allow the UV control system to continuously calculate the operational UV dose. The minimum UV dose provided shall comply with DOH requirements (100 mJ/cm^2 for media filtration, or 80 mJ/cm^2 for membrane filtration).

10.5 UV Bioassay

A UV bioassay will be performed on the constructed system in accordance with the NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse, latest edition.

10.6 Recycled Water Pumping

The recycled water pumping system will be designed to meet the peak recycled water demands. Recycled water will be pumped to a reservoir to be constructed by Waikapu Country Town, as shown in Figure 10-1. The recycled water will be distributed to users from the reservoir. Pressure boosting systems may be required for some higher-elevation users.

10.7 Automatic Diversion System

Automatic diversion will occur if the R-1 water goes “off-spec” with respect to turbidity limits or the operational UV dose. The recycled water pumps will automatically de-energize until the situation is corrected. Off-spec effluent will automatically divert to the SAT system for disposal.

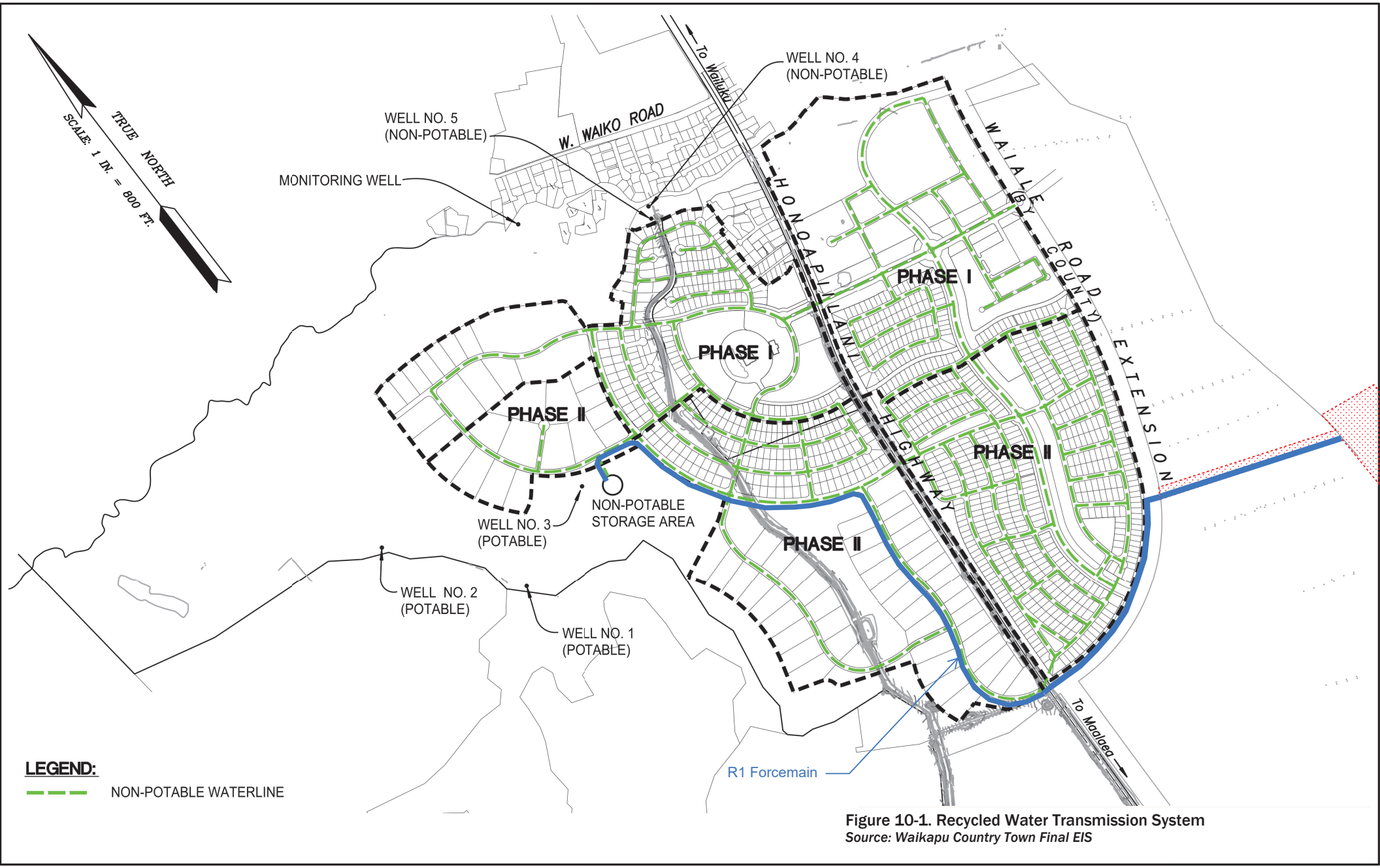


Figure 10-1. Recycled Water Transmission System
Source: Waikapu Country Town Final EIS

Section 11

Soil Aquifer Treatment System

A soil aquifer treatment (SAT) system will serve as the secondary effluent management system at the Central Maui WWRF. The proposed SAT is discussed in this section.

11.1 Function as Secondary Effluent Management System

As mentioned in the previous section, a water recycling program will serve as the primary effluent management system. Therefore, the SAT can be expected to receive effluent under the following conditions:

- When recycled water supply exceeds demand.
- When effluent is "off-spec" and cannot be recycled.

Figure 11-1 shows the water balance for the facility at the full 4.0 mgd capacity, assuming 1,259 acres of land is irrigated. The water balance shows that the irrigation demand will exceed the recycled water supply during ten months of the year. Supplemental surface or groundwater will be needed to meet the irrigation demand during those ten months. The recycled water supply is projected to exceed the irrigation demand during the months of January and December, and the excess recycled water will need to be disposed in the SAT.

All of the WWRF effluent will be directed to the SAT if the effluent does not meet R-1 requirements, until the situation is corrected. This could potentially happen at any time of the year.

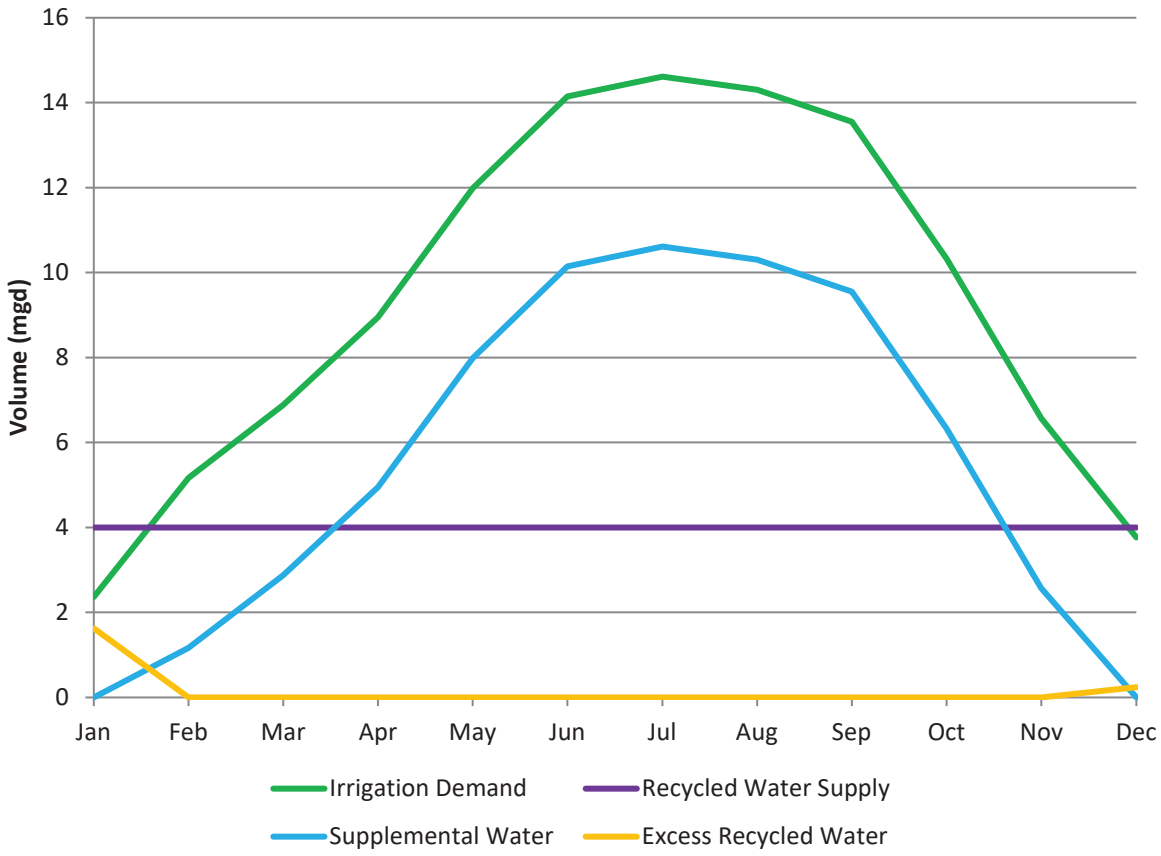


Figure 11-1. Water Balance for Central Maui WWRF Effluent Management Systems.

Table 11-1 lists the estimates of excess recycled water daily flows and monthly volumes at the facility, based on the water balance results. The total effluent volume shown in the table reflects approximately 4 percent of the total effluent volume from the facility.

Table 11-1. Excess R-1 Water Estimate – SAT Disposal Flows and Volumes

Month	Excess R-1 Water to SAT [a]	
	Daily Flow (mgd)	Monthly Volume (mgal)
January	1.6	51
February	0	0
March	0	0
April	0	0
May	0	0
June	0	0
July	0	0
August	0	0
September	0	0
October	0	0
November	0	0
December	0.2	7
Totals	--	58

[a] *Assumes 4.0 mgd effluent flow, 1,259 acres under irrigation, and average precipitation.*

The SAT will also be required to accept all flow from the WWRF when the effluent is "off-spec" and unable to be recycled. Therefore, the SAT design will consider the average dry weather flow, peak day wet weather, and peak hour wet weather flows presented in Section 2.

11.2 Site Soils per Soil Survey

The SAT site soils are classified as Jaucas sand, 0 to 15 percent slopes, by the National Resources Conservation Service Soil Survey. These are excessively drained sands that are greater than 60 inches deep. The depth to restrictive feature is greater than 80 inches, and the capacity of the most limiting layer to transmit water (Ksat) is high to very high (6.00 to 19.98 inches/hour). The frequency of flooding is rare, and frequency of ponding is none.

11.3 Geotechnical Study

A geotechnical study will be performed on the site during the design phase, including borings to confirm the subsurface geological profile. In addition, infiltration testing will be performed to confirm soil permeability.

11.4 Hydrogeological Study

A separate hydrogeological study has been prepared by Geosyntec Consultants, Inc. that addresses treatment benefits within the vadose and saturated zones, time and distance of travel to navigable waters, dilution effects within the groundwater aquifer, and anticipated environmental impacts.

11.5 Basin Configuration and Operation

The SAT system will occupy approximately 8 acres of the WWRF site. Four shallow basins will be constructed, each approximately the same size. The final number of basins and total bottom area

will be determined during final design. A ramp will be designed in each basin for maintenance purposes. The hydrogeologic report notes minimal lateral diffusion until the effluent reaches groundwater. Where the adjacent existing elevations are below the proposed bottom of the SAT basin, a vertical wall will be built to ensure water does not surface laterally before reaching the groundwater. The wall will extend on the South and East side of the SAT basins.

Normal operation will be to have the entire flow go to a single basin at a time. The normal operational cycle will be to change the flow to the basins every two days, so that each basin will receive flow for two days, followed by six days of drying.

During high flow periods, flow will be directed to a second and third basin as needed to ensure the entire effluent flow is safely disposed.

11.6 Hydraulic Loading Rates

Table 11-2 presents a summary of the SAT annual hydraulic loading rates. The primary effluent management system will be the water recycling program, and the SAT will function as a backup disposal system. The annual hydraulic loading rate shown in the table is within the normal ranges for SAT systems (20 to 410 feet/year) (USEPA, September 2006) when the effluent flow reduction offered by the water recycling program is taken into account. Without the water recycling program in place the SAT hydraulic loading rate would be higher than normal ranges for SAT systems. This higher hydraulic loading rate could occur if the effluent goes "off-spec" and cannot be recycled but is expected to be temporary until the effluent quality can be restored to meet R-1 water recycling requirements.

Table 11-2. SAT Annual Hydraulic Loading Rate Summary

Description	Value
Number of basins	4
Bottom area per basin	1.9 acres
Total bottom area	7.5 acres
Design clean water infiltration rate	12.0 inches per hour (to be field verified) 288 inches per day
Land application rate	8% of clean water infiltration rate 23.0 inches per day
With water recycling	
Average flow to SAT	0.16 mgd (On average, 4% of effluent is disposed to the SAT)
Hydraulic loading rate	24 feet/year
Without water recycling	
Average flow	4.0 mgd (WWRF ultimate capacity)
Hydraulic loading rate	600 feet/year

Table 11-3 summarizes the application rates to the basins taking into account the wet/dry cycles described above and the wet weather operational strategy. As shown in the table, the peak day wet weather flow rate application to three basins will be about 8 percent greater than the average flow rate application to a single basin with no water recycling, but this represents only 30 percent of the clean water infiltration rate of the site soils.

Table 11-3. SAT Basin Application Rates			
Description	Average Day Full Flow to SAT	Average Day With Water Recycling	Peak Day Full Flow to SAT
Flow to SAT	4.0 mgd	0.16 mgd	13.0 mgd
Number of active basins	1	1	3
Application rate to active basin(s)	6.6 feet/day	0.3 feet/day	7.1 feet/day

11.7 Nitrogen and BOD_5 Loading Rates

Table 11-4 summarizes the nitrogen and BOD_5 loading rates to the SAT at the full WWRF capacity, taking the water recycling program into account. Due to the high level of treatment provided in the liquid treatment processes the projected BOD_5 (carbon) to nitrogen ratio will be too low to support significant denitrification in the SAT surface soils. Denitrification effects are expected to occur within the deeper vadose zone and the receiving groundwater aquifer, and are evaluated in a separate report by Geosyntec Consultants, Inc.

Table 11-4. Nitrogen and BOD_5 Loading Rate Projections	
Description	Value
Average annual flow to SAT	0.16 mgd
Effluent TN concentration	10 mg/L
TN mass load to SAT	2 lbs./acre/day
Effluent BOD_5 concentration	5 mg/L
BOD_5 mass load to SAT	1 lbs./acre/day
BOD_5: nitrogen ratio	0.5

Geosyntec also recommends the use of biomass, such as wood chips, in the base of the SAT basins to increase available organic carbon that may increase denitrification rates, and thereby further lower nitrate concentrations in the vadose zone, groundwater, and potential discharge at marine and inland waters.

11.8 Water Distribution

Effluent will be distributed to the SAT basins using graded border irrigation techniques. A series of alfalfa valves will be located along the high side of each basin. The basin bottoms will be gently sloped to facilitate water distribution. A control system will open and close automatic valves to distribute the effluent flow to the basins as desired.

Section 12

Alternatives

Project alternatives are developed in this section.

12.1 Alternative 1: MLE – Filtration – UV Disinfection

Figure 12-1 is a schematic diagram for Alternative 1. Liquid treatment will be provided by an MLE process, potentially incorporating step-feed and/or the Intensify process. Cloth media filtration and UV disinfection will be used to create R-1 recycled water for reuse. Effluent that cannot be reused will be disposed in the SAT system. Solids management will consist of aerobic digestion with gravity decant thickening, followed by screw press dewatering. Grit and screenings will be disposed at the landfill, and dewatered solids will be composted off-site.

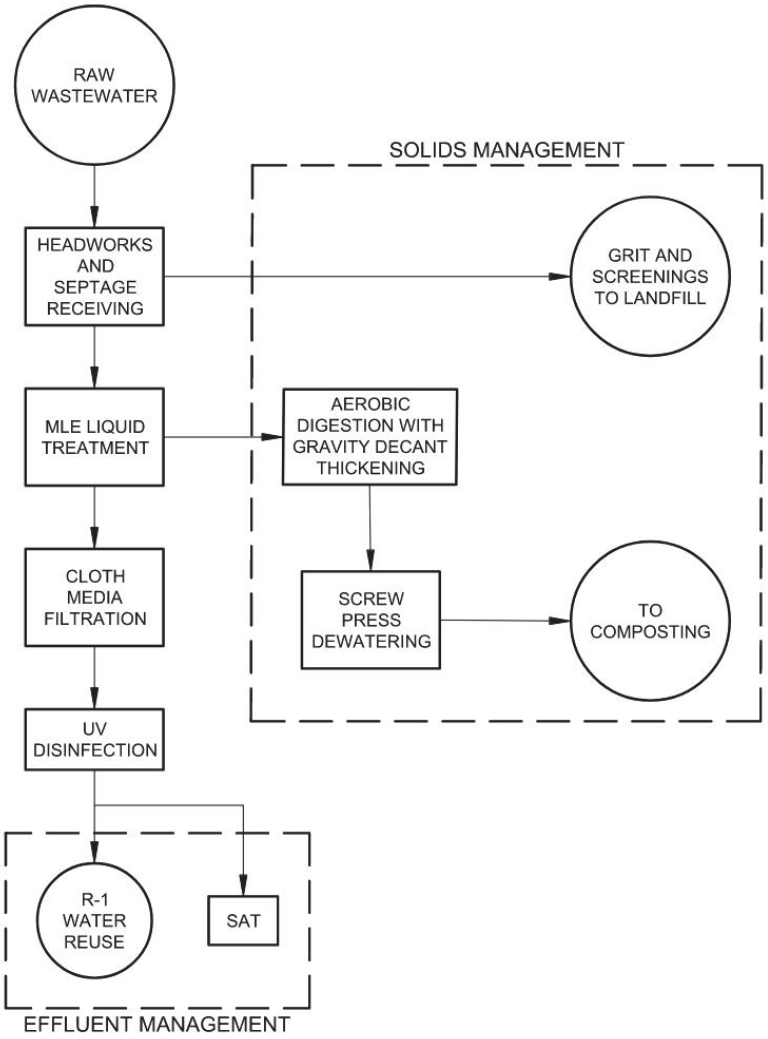


Figure 12-1. Alternative 1

12.2 Alternative 2: MBR – UV Disinfection

Figure 12-2 is a schematic diagram for Alternative 2. Alternative 2 is nearly identical to Alternative 1 but uses MBR technology to provide liquid treatment and filtration within a smaller footprint than Alternative 1.

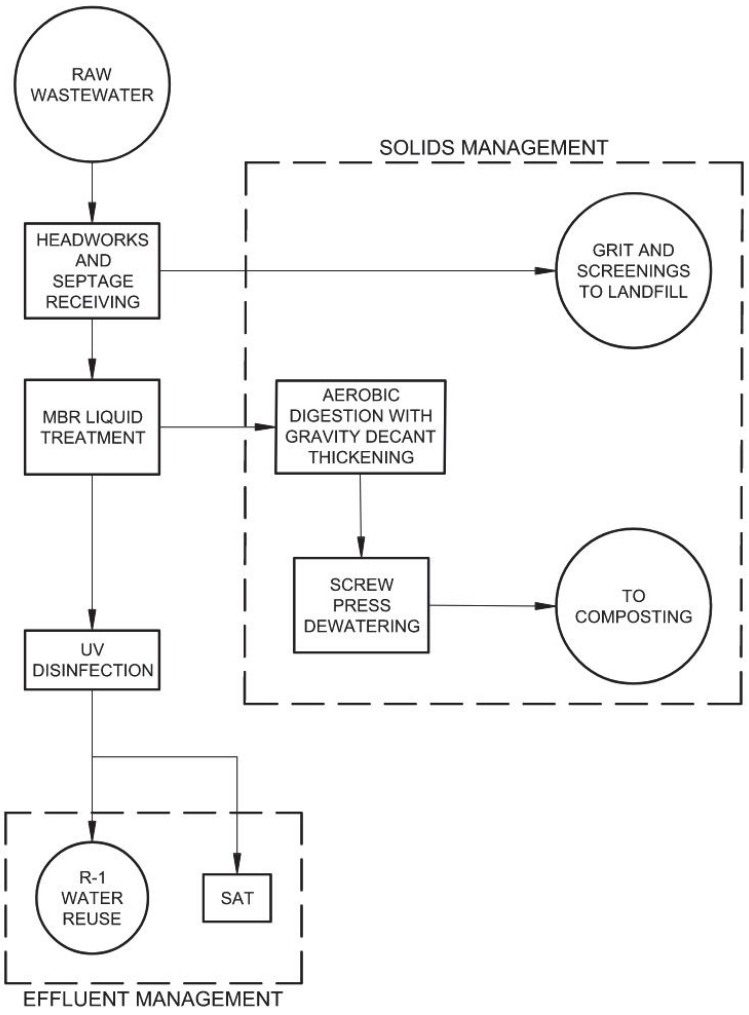


Figure 12-2. Alternative 2

12.3 Alternative 3: No Project

Alternative 3 consists of not constructing the Central Maui WWRF and its associated project elements. If the project is not constructed the following could happen:

- The County would not provide wastewater services to the identified service area. Developers would likely be required to include wastewater treatment and disposal provisions for their housing projects, resulting in several smaller private WWRFs rather than a single, larger facility. Alternatively, the developers would likely lobby the County to be allowed to connect to the Wailuku-Kahului WWRF.
- Flow would not be diverted from the Wailuku-Kahului WWRF, and capacity expansion at the facility would likely be necessary to accommodate the needs of the growing community within the Wailuku-Kahului WWRF service area.

- The Department of Hawaiian Homelands would need to develop another means to provide wastewater services to their planned Pulehunui developments, as well as the adjacent Department of Land and Natural Resources Industrial and Business Park development.

The Maui County Council adopted Resolution No. 06-12 on February 6, 2006. The resolution calls for the County to implement the long-term plan of action to service the Central Maui Service Area. The long-term plan of action includes the development of a Central Maui WWRF to service growth areas within the Central Maui area. The "no project" alternative does not conform to Resolution No. 06-12 and will receive no further discussion in this facility plan report.

Section 13

Economic Evaluations

Capital, operation and maintenance (O&M), and life-cycle cost evaluations are presented in this section.

13.1 Capital Costs

Conceptual cost estimates were developed for the two alternatives. The cost estimates were developed using the construction bids from similar projects, quantity take-offs, vendor quotes, and other sources. The costs were adjusted to account for economies of scale and construction inflation since the bid opening date. Where Hawaii costs were unavailable, U.S. mainland costs were used after adjustment to reflect Maui Island conditions.

In accordance with the Association for the Advancement of Cost Engineering International (AACE) criteria, these are Class 5 estimates. A Class 5 estimate is defined as a Conceptual Level or Project Viability Estimate. Typically, engineering is from 0 to 2 percent complete. Class 5 estimates are used to prepare planning level cost scopes or evaluation of alternative schemes, long range capital outlay planning and can also form the base work for the Class 4 Planning Level or Design Technical Feasibility Estimate.

Expected accuracy for Class 5 estimates typically ranges from -50 to +100 percent, depending on the technological complexity of the project, appropriate reference information and the inclusion of an appropriate contingency determination. In unusual circumstances, ranges could exceed those shown.

Table 13-1 provides a summary of capital cost assumptions used.

Table 13-1. Capital Cost Estimating Assumptions

Description	Value
Estimate date	September 2022
Engineering News Record 20-Cities Average Construction Cost Index	13,175
Contractor general conditions markup	15 percent
Start-up, training, and O&M	2 percent
Construction contingency	50 percent
Area contingency (Hawaii)	30 percent
Builders risk, liability, and auto insurance	2 percent
Performance and payment bonds	1.5 percent
Mid-point of construction date	January 2028
Rate of construction cost escalation	8% per year
Escalation to mid-point of construction	53 percent

Table 13-2 provides a summary of the capital cost estimates, in both current dollars and future dollars. Detailed estimates can be found in Appendix A. Engineering costs were not included in the estimates.

The future dollars costs should be used for capital budgeting purposes because they take cost escalation due to inflation into account to represent likely prices at bid opening.

Table 13-2. Capital Cost Estimates Summary

Description	Future (January 2028) Dollars		Current (December 2022) Dollars	
	Alternative 1: MLE/Filtration	Alternative 2: MBR	Alternative 1: MLE/Filtration	Alternative 2: MBR
Site work	$5.1 M	$5.1 M	$3.3 M	$3.3 M
Headworks	$7.1 M	$7.1 M	$4.6 M	$4.6 M
Aeration tanks	$13.8 M	$16.0 M	$9.0 M	$10.6 M
Secondary clarifiers	$21.0 M	N/A	$13.7 M	N/A
RAS pump station	$1.9 M	N/A	$1.2 M	N/A
R-1 treatment	$21.4 M	N/A	$14.0 M	N/A
MBR equipment building	N/A	$6.0 M	N/A	$4.0 M
Membrane tanks	N/A	$47.0 M	N/A	$30.9 M
Effluent pump station	$6.0 M	$6.0 M	$3.9 M	$3.9 M
Aerobic digesters	$9.2 M	$9.2 M	$6.0 M	$6.0 M
Dewatering building	$5.1 M	$5.1 M	$3.3 M	$3.3 M
Operations building	$4.6 M	$4.6 M	$3.0 M	$3.0 M
Easement piping	$3.8 M	$3.8 M	$2.5 M	$2.5 M
Yard piping	$1.3 M	$1.3 M	$0.8 M	$0.8 M
Electrical and instrumentation	$24.8 M	$24.8 M	$16.2 M	$16.2 M
Totals	**$125 M**	**$137 M**	**$82 M**	**$89 M**

As shown in the table, Alternative 1: MLE/Filtration incurs lower capital costs than Alternative 2: MBR in both future and current dollars.

13.2 O&M Costs

O&M costs estimates were developed for the two alternatives. The O&M cost estimates include estimates of labor, electricity consumption, chemicals, maintenance materials and solids disposal. O&M assumptions are listed in Table 13-3. The O&M estimates are based on flow projections at the mid-point of the planning period.

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Table 13-3. O&M Cost Assumptions	
Description	Value
Average dry weather flow	2 mgd
Electricity cost	$0.40/kWh
Solids disposal cost	$100/wet ton
Maintenance materials	2 percent

The O&M estimates for the alternative WWTP capacity scenarios are summarized in Table 13-4. Detail can be found in Appendix A. As shown in the table, Alternative 2: MBR incurs higher O&M costs, largely due to higher electricity consumption than Alternative 1: MLE/Filtration.

Table 13-4. O&M Cost Estimate Summary		
Description	Annual Cost – Current (2022) Dollars	
	Alternative 1: MLE/Filtration	Alternative 2: MBR
Labor	$910,000	$910,000
Electricity	$4,700,000	$6,390,000
Chemicals	$220,000	$240,000
Maintenance materials	$290,000	$330,000
Solids disposal	$660,000	$660,000
Totals	$6,780,000	$8,530,000

13.3 Life-Cycle Costs

An economic evaluation was prepared to assess the potential life-cycle costs associated with each alternative. The economic evaluation consists of a net present value comparison. The net present value analysis includes and capital, O&M, and equipment replacement costs. An appropriate inflationary factor and discount rate are applied to obtain the net present value over a 30-year planning period. The net present value of an alternative represents the amount of money that would need to be set aside today (at a given interest rate) to pay the costs associated with the alternative over the entire planning period. The alternative with the lowest net present value is considered the most attractive from an economic perspective. The evaluation results are included in Appendix A.

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Table 13-5 summarizes the life-cycle cost evaluation assumptions.

Table 13-5. Life-Cycle Economic Assumptions

Description	Value
Year of analysis	2022
Planning period	30 years
Inflation rate	3.0 percent
Discount rate	5.0 percent
Equipment replacement cycle	20 years
Membrane replacement cycle	10 years

Table 13-6 summarizes the results of the life-cycle cost analysis.

Table 13-6. Life-Cycle Cost Analysis Summary

Description	Alternative 1: MLE/Filtration	Alternative 2: MBR
Current (2022) capital cost	$82 M	$89 M
Annual O&M cost	$6,780,000	$8,530,000
Equipment replacement cost (excluding membranes)	$14.7 M	$8.8 M
Membrane replacement cost	N/A	$7.8 M
Life-cycle cost	$241 M	$295 M
Comparison to lowest cost alternative	0	+$54 M (122%)

As shown in the table, Alternative 1: MLE/Filtration incurs the lowest life-cycle costs and presents significant cost savings over the life cycle when compared to Alternative 2: MBR.

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Section 14

Non-economic Evaluation

A non-economic evaluation was conducted to provide a qualitative comparison between the two alternatives.

14.1 Approach

Non-economic evaluations are generally subjective by necessity. Quantifiable measurements are used when available, but lack of information or difficulty and expense of obtaining information requires subjective assessments.

The project alternatives were scored in relation to one another and according to an evaluation matrix, described below. Each alternative was scored from 1 to 5 (5 = high/desirable, 1 = low/less desirable) for each evaluation criteria. The alternatives were not ranked in the scoring; alternatives could receive the same scores for any given criteria.

The evaluation criteria were weighted to reflect their overall significance for the project. The scores were multiplied by the criteria weights to develop a non-economic score for each alternative.

14.2 Non-Economic Evaluation Criteria

Table 14-1 shows the non-economic criteria chosen for comparing the two alternatives.

Table 14-1. Non-Economic Comparison Criteria

Category	Criteria	Description
Level of Service Measures	Wastewater Effluent Discharges	Compliance with the local, state and federal regulations for effluent discharges
	Potential for Capacity Expansion	Ability of the system to be expanded should additional capacity be required.
	Recycled Water Reliability	Reliability of R-1 water availability for potential customers
	Public perception / community concerns	The community's impression of the project and the perceived support.
Regulatory	Monitoring complexity	The relative difficulty of monitoring tasks required for the option chosen.
	Treatment adjustment potential	The ability to increase treatment to comply with future permit requirements and/or growth.
	Safety regulations complexity	The relative difficulty to comply with safety regulations including staff training, reporting, maintenance procedures.
	Environmental concerns	The extent of the project's potential environmental impacts should failures occur.
O&M Factors	Footprint	The physical space that the processes will occupy (affecting land acquisition, subdivision, and permitting).
	Safe work environment	Lost time accidents and the relative health and safety risk operation of given option will have on the employees; includes equipment access, chemical hazards, confined spaces, dust, etc.; the extent of measures required to ensure the health and safety of the employees.
	Maintenance complexity	The relative intensity of equipment maintenance requirements.
	Operations complexity	The relative intensity of the operations requirements.
Island Factors	Mainland delivery dependence	The relative dependence on regular deliveries of equipment, supplies, or spare parts from mainland sources.
	Mainland servicing dependence	The relative degree to which technology will require special servicing by mainland-based personnel.
	Power dependence	The relative degree to which the treatment processes depend on electrical power for operation.
	Chemical dependence	The relative dependence on chemical supplies, whether locally available or restricted by mainland delivery schedules and requirements.

The categories and criteria were developed using best engineering judgment and our understanding of the project, the County of Maui Department of Environmental Management goals and concerns, as well as EIS needs.

The weighting factors are listed in Table 14-2.

Table 14-2. Non-Economic Comparison Criteria

Category	Criteria
Level of Service Measures (25%)	Wastewater Effluent Discharges (25%)
	Potential for Capacity Expansion (25%)
	Recycled Water Reliability (25%)
	Public perception / community concerns (25%)
	Category Total (100%)
Regulatory (25%)	Monitoring complexity (25%)
	Treatment adjustment potential (25%)
	Safety regulations complexity (25%)
	Environmental concerns (25%)
	Category Total (100%)
Owner Factors (25%)	Footprint (25%)
	Safe work environment (25%)
	Maintenance complexity (25%)
	Operations complexity (25%)
	Category Total (100%)
Island Factors (25%)	Mainland delivery dependence (25%)
	Mainland servicing dependence (25%)
	Power dependence (25%)
	Chemical dependence (25%)
	Category Total (100%)
Overall Total 100%	

14.3 Non-Economic Evaluation Results

A score of 1 through 5 was given for each criterion, with 5 being the most favorable, and 1 representing the least desired option. The complete non-economic evaluation is included as Appendix B. The non-economic evaluation results are summarized in Table 14-3.

Table 14-3. Non-Economic Weighted Scores

Alternative	Score	Rank
Alternative 1: MLE/Filtration	4.00	1
Alternative 2: MBR	3.88	2

As shown in the table, Alternative 1: MLE received a slightly higher non-economic score. The score difference is not significant and the economic evaluation results revealed a more considerable difference.

Section 15

Recommended Facility

Alternative 1: MLE/Filtration is recommended for the Central Maui WWRF due to lower capital, O&M, and life-cycle costs, plus a slightly higher non-economic evaluation score.

The Central Maui WWRF facility recommendations are summarized in this section.

15.1 Preliminary Site Plan

Figure 15-1 is a preliminary site plan for the facility. The site measures ±14.9 acres in total.

15.2 Process Diagram

Figure 15-2 is a preliminary process diagram for the facility.

Brown AND Caldwell

SCALE: 1" = 200'

PROJECT NO. 155381

DATE: Jan 2023

CENTRAL MAUI WWRF FACILITY PLAN

PRELIMINARY SITE PLAN

FIGURE

15-1

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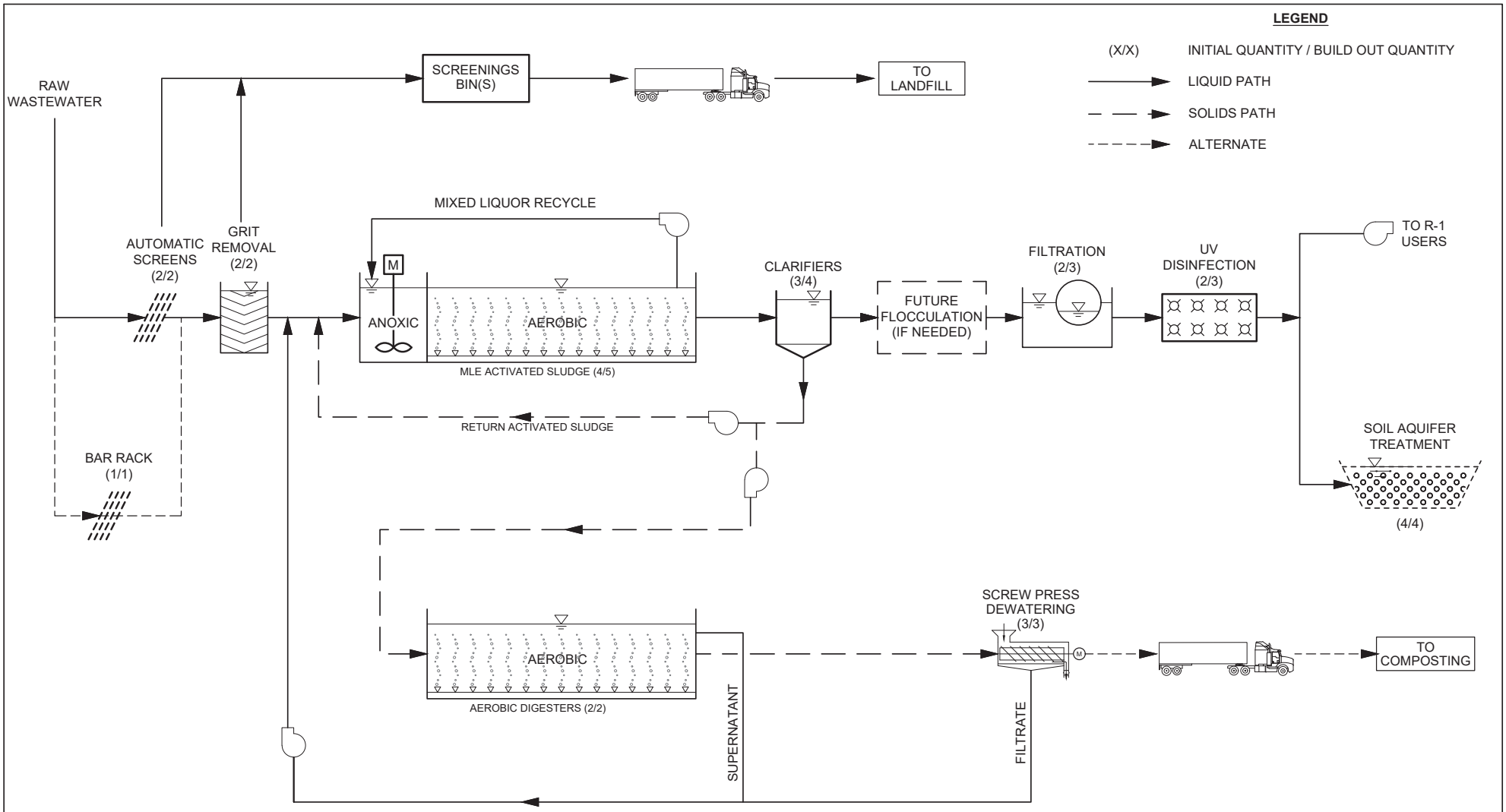

Brown AND Caldwell

SCALE: NONE
PROJECT NO. 155381
DATE: Jan 2023

CENTRAL MAUI WWRF FACILITY PLAN

PRELIMINARY PROCESS FLOW DIAGRAM

FIGURE
15-1

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15.3 Preliminary Design Criteria

Table 15-1 summarizes the preliminary design criteria for the recommended facility

Table 15-1. Central Maui WWRF – Preliminary Design Criteria

Unit Process	Design Parameter	At 3 mgd Flow Capacity	At 4 mgd Flow Capacity
Headworks – influent flow measurement	Type	Parshall flume	
	Number of units	1	
	Flow capacity	16.1 mgd	
Headworks – influent sampling	Type	Automatic refrigerated composite sampler	
	Number of units	1	
Headworks – automatic screens	Number of units	1 active + 1 redundant	
	Flow capacity, each	16.1 mgd	
	Screen opening size	¼ inch	
	Screenings load	Up to 10 cubic feet/mgal	
Headworks – manually cleaned bar rack	Number of units	1	
	Minimum flow capacity	16.1 mgd	
	Opening size	1 inch	
Headworks – grit removal	Type	Lamella (stacked tray)	
	Number of units	1 active + 1 redundant	
	Flow capacity, each	16.1 mgd	
	Number of grit washer and dewatering systems	1 active + 1 redundant	
MLE activated sludge	SRT	6 days	
	Estimated sludge yield	0.9 lbs. TSS/lb. BOD_5	
	MLSS	3,000 mg/L	
	RAS Recycle Ratio	50% - 100%	
	IMLR Ratio	300% - 400%	
	Number of tanks	3+1 redundant	4+1 redundant
	Water depth	20 ft	
	Width, each tank	30 ft	
	Length, each tank	260	
	Anoxic zone, percentage of total	25%	
	Number of blowers	3+1 redundant	4+1 redundant
	Motor size, each blower	200 hp	
Secondary clarifiers	Number of circular clarifiers	3	4
	Clarifier diameter (internal)	70 ft	
	Clarifier depth	20 ft	
R1 treatment	Filter type	Cloth disk	
	Number of filter units	3+1 redundant	

Table 15-1. Central Maui WWRF – Preliminary Design Criteria			
Unit Process	Design Parameter	At 3 mgd Flow Capacity	At 4 mgd Flow Capacity
	Number of UV channels	3	
	Number of UV banks per channel	3	
	UV dose	100 mWatt-sec/cm^2	
Effluent pump station – recycled water pumps	Type	Vertical turbine	
	Number	3	
	Estimated motor size	250 hp	
Effluent pump station – disposal pumps	Type	Vertical turbine	
	Number	3	
	Estimated motor size	40	
Effluent pump station – 3W pumps	Type	Vertical turbine	
	Number	3	
	Estimated motor size	10	
Aerobic digestion with decant thickening	Detention time	16 days	
	Volatile solids reduction	40%	
	Detention time	16 days	
	Number of tanks	2	
	Volatile solids reduction	40%	
	Digester width (internal, each)	40 feet	
	Tank length (internal, each)	80 ft	
	Tank width (internal, each)	40 ft	
	Maximum water depth	20 ft	
	Number of blowers	2+1 redundant	
	Blower motor size, each	100 hp	
Sludge dewatering	Type	Screw press	
	Number of machines	2+1 redundant	
	Capacity per machine	45 gpm	
	Dewatering time	5 hours/day	7 hours/day
Soil aquifer treatment	Number of basins	4	
	Bottom area, each	1.9 acres	
	Dosing schedule	2 days wetting/6 days drying	

15.4 Cost Estimate

A detailed cost estimate is included in Appendix A. Table 15-2 provides a summary; note that costs are provided in both current dollars and future (January 2028) dollars. In addition, the table shows a preliminary estimate should construction be phased and only 3 mgd of capacity be constructed.

Table 15-2. Capital Cost Estimate Summary				
	Future (January 2028) Dollars		Current (December 2022) Dollars	
Description	4.0 mgd capacity	3.0 mgd capacity	4.0 mgd capacity	3.0 mgd capacity
Site work	$5.1 M	$5.1 M	$3.3 M	$3.3 M
Headworks	$7.1 M	$7.1 M	$4.6 M	$4.6 M
Aeration tanks	$13.8 M	$11.0 M	$9.0 M	$7.2 M
Secondary clarifiers	$21.0 M	$15.8 M	$13.7 M	$10.3 M
RAS pump station	$1.9 M	$1.7 M	$1.2 M	$1.1 M
R-1 treatment	$21.4 M	$17.1 M	$14.0 M	$11.2 M
Effluent pump station	$6.0 M	$5.4 M	$3.9 M	$3.5 M
Aerobic digesters	$9.2 M	$9.2 M	$6.0 M	$6.0 M
Dewatering building	$5.1 M	$5.1 M	$3.3 M	$3.3 M
Operations building	$4.6 M	$4.6 M	$3.0 M	$3.0 M
Easement piping	$3.8 M	$3.8 M	$2.5 M	$2.5 M
Yard piping	$1.3 M	$1.3 M	$0.8 M	$0.8 M
Electrical and instrumentation	$24.8 M	$22.3 M	$16.2 M	$16.2 M
Totals	**$125 M**	**$110** M	**$82 M**	**$72** M

In accordance with the Association for the Advancement of Cost Engineering International (AACE) criteria, these are Class 5 estimates. A Class 5 estimate is defined as a Conceptual Level or Project Viability Estimate. Typically, engineering is from 0 to 2 percent complete. Class 5 estimates are used to prepare planning level cost scopes or evaluation of alternative schemes, long range capital outlay planning and can also form the base work for the Class 4 Planning Level or Design Technical Feasibility Estimate.

Expected accuracy for Class 5 estimates typically ranges from -50 to +100 percent, depending on the technological complexity of the project, appropriate reference information and the inclusion of an appropriate contingency determination. In unusual circumstances, ranges could exceed those shown.

15.5 Preliminary Implementation Schedule

Appendix C is a preliminary implementation schedule.

Section 16

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Appendix A: Cost Evaluations

Memorandum

Date: September 2, 2022

To: Irina Constantinescu, Maui

From: Doug Gabbard, Cincinnati

Reviewed by: Bill Agster, Denver

Copy to: Craig, Lekven, Maui

Project No.: 158098.201. ****

Subject: Central Maui WWRF Facility Plan
2-Percent Design Completion
Basis of Estimate of Probable Construction Cost

The Basis of Estimate Report and supporting estimate reports for the subject project are attached. Please call me if you have questions or need additional information.

Enclosures (3):

1. Basis of Estimate Report
2. Summary Estimate
3. Detailed Estimate

Basis of Estimate Report

Central Maui WWRF Facility Plan

Introduction

Brown and Caldwell (BC) is pleased to present this opinion of probable construction cost (estimate) prepared for the County of Maui, Central Maui WWRF Facility Plan, Maui, Hawaii.

Estimated Project Costs

Based on the typical accuracy of a Class 5 estimate, the expected range of costs is:

Upper Range	Estimated Cost	Lower Range
+ 100 %		- 50 %
$ 250,399,474	$ 125,199,737	$ 62,599,869

Summary

This Basis of Estimate contains the following information:

- Scope of work
- Background of this estimate
- Class of estimate
- Estimating methodology
- Direct cost development
- Indirect cost development
- Bidding assumptions
- Estimating assumptions
- Estimating exclusions
- Allowances for known but undefined work
- Contractor and other estimate markups

Scope of Work

This work includes construction of a new Wastewater Recycled Water Facility which include:

1. Site work.
2. Headworks Facility.
3. Activated Sludge Facility
4. Treatment Facility.
5. Three Secondary Clarifiers.
6. RAS Pump Station

7. Saturation Basins.
8. Effluent Pump Station.
9. Aerobic Digester.
10. Operations Building

Background of this Estimate

There have been no previous estimates prepared by the Brown and Caldwell Estimating and Scheduling Group for this project.

The attached estimate of probable construction cost is based on documents dated 8/22/2022, received by the Estimating and Scheduling Group (ESG). These documents are described as 2 percent complete based on the current project progression, additional or updated scope and/or quantities, and ongoing discussions with the project team. Further information can be found in the detailed estimate reports.

Class of Estimate

Class 5: 0 to 2 Percent Conceptual Design Completion

In accordance with the Association for the Advancement of Cost Engineering International (AACE) criteria, this is a Class 5 estimate. A Class 5 estimate is defined as a Conceptual Level or Project Viability Estimate. Typically, engineering is from 0 to 2 percent complete. Class 5 estimates are used to prepare planning level cost scopes or evaluation of alternative schemes, long range capital outlay planning and can also form the base work for the Class 4 Planning Level or Design Technical Feasibility Estimate.

Expected accuracy for Class 5 estimates typically ranges from -50 to +100 percent, depending on the technological complexity of the project, appropriate reference information and the inclusion of an appropriate contingency determination. In unusual circumstances, ranges could exceed those shown.

Estimating Methodology

This estimate was prepared using quantity take-offs, vendor quotes and equipment pricing furnished either by the project team or by the estimator. The estimate includes direct labor costs and anticipated productivity adjustments to labor and equipment. Where possible, estimates for work anticipated to be performed by specialty subcontractors have been identified.

Construction labor crew and equipment hours were calculated from production rates contained in documents and electronic databases published by R.S. Means, Mechanical Contractors Association (MCA), National Electrical Contractors Association (NECA), and Rental Rate Blue Book for Construction Equipment (Blue Book).

This estimate was prepared using BC's estimating system, which consists of Sage Construction and Real Estate 300 estimating software engine (formerly Timberline) using RS Means database, historical project data, the latest vendor and material cost information, and other costs specific to the project location.

Direct Cost Development

Costs associated with the General Provisions and the Special Provisions of the construction documents, which are collectively referred to as Contractor General Conditions (CGC), were based on the estimator's interpretation of the contract documents. The estimates for CGCs are divided into two groups: a time-related group (e.g., field personnel) and non-time-related group (e.g., bonds and insurance). Labor burdens such as

health and welfare, vacation, union benefits, payroll taxes, and worker's compensation insurance are included in the labor rates. No trade discounts were considered.

Indirect Cost Development

Local sales tax has been applied to material and equipment rentals. A percentage allowance for contractor's home office expense has been included in the overall rate markups. The rate is standard for this type of heavy construction and is based on typical percentages outlined in Means Heavy Construction Cost Data.

The contractor's cost for builder's risk, general liability and vehicle insurance has been included in this estimate. Based on historical data, this is typically two to four percent of the overall construction contract amount. These indirect costs have been included in this estimate as a percentage of the gross cost and are added after the net markups have been applied to the appropriate items.

Bidding Assumptions

The following bidding assumptions were considered in the development of this estimate.

1. Bidders must hold a valid, current Contractor's credentials, applicable to the type of project.
2. Bidders will develop estimates with a competitive approach to material pricing and labor productivity, and will not include allowances for changes, extra work, unforeseen conditions or any other unplanned costs.
3. Estimated costs are based on a minimum of four bidders. Actual bid prices may increase for fewer bidders or decrease for a greater number of bidders.
4. Bidders will account for General Provisions and Special Provisions of the contract documents and will perform all work except that which will be performed by traditional specialty subcontractors as identified here:
   - Electrical
   - HVAC systems

Estimating Assumptions

As the design progresses through different completion stages, it is customary for the estimator to make assumptions to account for details that may not be evident from the documents. The following assumptions were used in the development of this estimate.

1. Contractor performs the work during normal daylight hours, nominally 7 a.m. to 5 p.m., Monday through Friday, in an 8-hour shift. No allowance has been made for additional shift work or weekend work.
2. Contractor has complete access for lay-down areas and mobile equipment.
3. Equipment rental rates are based on verifiable pricing from the local project area rental yards, Blue Book rates, and/or rates contained in the estimating database.
4. Contractor markup is based on conventionally accepted values that have been adjusted for project-area economic factors.
5. Major equipment costs are based on vendor supplied price quotes obtained by the project design team and/or estimators and on historical pricing of like equipment.
6. Process equipment vendor training using vendors' standard Operations and Maintenance (O&M) material is included in the purchase price of major equipment items where so stated in that quotation.
7. Bulk material quantities are based on manual quantity take-offs.

8. There is enough electrical power to feed the specified equipment. The local power company will supply power and transformers suitable for this facility.
9. Soils are of adequate nature to support the structures. No piles have been included in this estimate.

Estimating Exclusions

The following estimating exclusions were assumed in the development of this estimate.

1. Rock excavation.
2. Dewatering.
3. Hazardous materials remediation and/or disposal.
4. O&M costs for the project except for the vendor supplied O&M manuals.
5. Utility agency costs for incoming power modifications.
6. Permits beyond those normally needed for the type of project and project conditions.
7. Impacts from COVID-19 including additional labor and management hours required to meet social distancing, personal protection, and cleaning routines, additional costs of protective equipment, supply chain impacts, and material shortages.

Allowances for Known but Undefined Work

The following allowances were made in the development of this estimate.

1. Electrical $6,062,415
2. Headworks building - Interior mechanical and piping $90,000.
3. Activated Sludge building - Interior mechanical and piping $30,000
4. Clarifiers - Interior mechanical and piping $30,000
5. RAS Pump Station - interior mechanical and piping $100,000
6. Pretreatment Building - interior piping allowance $60,000
7. Effluent pump station - interior piping allowance $100,000
8. Aerobic Digester - interior piping allowance $50,000
9. Dewatering and blower building - interior piping allowance $100,000

Contractor and Other Estimate Markups

Contractor markup is based on conventionally accepted values which have been adjusted for project-area economic factors. Estimate markups are shown in Table 1.

Table 1. Estimate Markups

Item	Rate (%)
Net Cost Markups	
Labor markup	15
Materials and process equipment	10
Equipment (construction-related)	10
2022 Diesel Fuel Adjustment	6
Subcontractor	10

Other – Process Equipment	8
Sales Tax (State and local for materials, process equipment and construction equipment rentals, etc.)	4
Material Shipping and Handling	2
Gross Cost Markups	
Contractor General Conditions	15
Start-up, Training and O&M	2
Construction Contingency	50
Aera Contingency (Hawaii)	30
Builders Risk, Liability and Auto Insurance	2
Performance and Payment Bonds	1.5
Escalation to Midpoint of Construction	53

Labor Markup

The labor rates used in the estimate were derived from RS Means latest national average wage rate tables and city cost indexes. These include base rate paid to the laborer plus fringes. A labor burden factor is applied to these such that the final rates include all employer paid taxes. These taxes are FICA (which covers social security plus Medicare), Workers Comp (which varies based on state, employer experience and history) and unemployment insurance. The result is fully loaded labor rates. In addition to the fully loaded labor rate, an overhead and profit markup is applied at the back end of the estimate. This covers payroll and accounting, estimator's wages, home office rent, advertising and owner profit.

Materials and Process Equipment Markup

This markup consists of the additional cost to the contractor beyond the raw dollar amount for material and process equipment. This includes shop drawing preparation, submittal and/or re-submittal cost, purchasing and scheduling materials and equipment, accounting charges including invoicing and payment, inspection of received goods, receiving, storage, overhead and profit.

Equipment (Construction) Markup

This markup consists of the costs associated with operating the construction equipment used in the project. Most GCs will rent rather than own the equipment and then charge each project for its equipment cost. The equipment rental cost does not include fuel, delivery and pick-up charges, additional insurance requirements on rental equipment, accounting costs related to home office receiving invoices and payment. However, the crew rates used in the estimate do account for the equipment rental cost. Occasionally, larger contractors will have some or all the equipment needed for the job, but to recoup their initial purchasing cost they will charge the project an internal rate for equipment use which is like the rental cost of equipment. The GC will apply an overhead and profit percentage to each individual piece of equipment whether rented or owned.

To address the significant increase in fuel pricing from early 2022 to the date of this estimate, a 6% Diesel Fuel Adjustment markup is applied in addition to the standard equipment markup.

Subcontractor Markup

This markup consists of the GC's costs for subcontractors who perform work on the site. This includes costs associated with shop drawings, review of subcontractor's submittals, scheduling of subcontractor work,

inspections, processing of payment requests, home office accounting, and overhead and profit on subcontracts.

Sales Tax (Materials, Process Equipment and Construction Equipment)

This is the tax that the contractor must pay according to state and local tax laws. The percentage is applied to both the material and equipment the GC purchases as well as the cost for rental equipment. The percentage is based on the local rates in place at the time the estimate was prepared.

Contractor Startup, Training, and O&M Manuals

This cost markup is often confused with either vendor startup or owner startup. It is the cost the GC incurs on the project beyond the vendor startup and owner startup costs. The GC generally will have project personnel assigned to facilitate the installation, testing, startup and O&M manual preparation for equipment that is put into operation by either the vendor or owner. These project personnel often include an electrician, pipe fitter or millwright, and/or I&E technician. These personnel are not included in the basic crew makeup to install the equipment but are there to assist and troubleshoot the startup and proper running of the equipment. The GC also incurs a cost for startup for such things as consumables (oil, fuel, filters, etc.), startup drawings and schedules, startup meetings and coordination with the plant personnel in other areas of the plant operation.

Builders Risk, Liability, and Vehicle Insurance

This percentage comprises all three items. There are many factors which make up this percentage, including the contractor's track record for claims in each of the categories. Another factor affecting insurance rates has been a dramatic price increase across the country over the past several years due to domestic and foreign influences. Consequently, in the construction industry we have observed a range of 0.5 to 1 percent for Builders Risk Insurance, 1 to 1.25 percent for General Liability Insurance, and 0.85 to 1 percent for Vehicle Insurance. Many factors affect each area of insurance, including project complexity and contractor's requirements and history. Instead of using numbers from a select few contractors, we believe it is more prudent to use a combined 2 percent to better reflect the general costs across the country. Consequently, the actual cost could be higher or lower based on the bidder, region, insurance climate, and the contractor's insurability at the time the project is bid.

Material Shipping and Handling

This can range from 2 to 6 percent, and is based on the type of project, material makeup of the project, and the region and location of the project. Material shipping and handling covers delivery costs from vendors, unloading costs (and in some instances loading and shipment back to vendors for rebuilt equipment), site paperwork, and inspection of materials prior to unloading at the project site. BC typically adjusts this percentage by the amount of materials and whether vendors have included shipping costs in the quotes that were used to prepare the estimate. This cost also includes the GC's cost to obtain local supplies, e.g., oil, gaskets and bolts that may be missing from the equipment or materials shipped.

Escalation to Midpoint for Labor, Materials and Subcontractors

In addition to contingency, it is customary for projects that will be built over several years to include an escalation to midpoint of anticipated construction to account for the future escalation of labor, material and equipment costs beyond values at the time the estimate is prepared. For this project, the anticipated rate of escalation is 8 percent per annum.

The estimated construction time for this project is 24 months, exclusive of unusual weather or site conditions delays. Construction is anticipated to start 1/1/2027 and be completed by 1/1/2029. The escalation factors used in this estimate are calculated from the date of this estimate to the anticipated midpoint of construction which is approximately 64 months from the date of this estimate.

Undesigned/Undeveloped Contingency

The contingency factor covers unforeseen conditions, area economic factors, and general project complexity. This contingency is used to account for those factors that cannot be addressed in each of the labor and/or material installation costs. Based on industry standards, completeness of the project documents, project complexity, the current design stage and area factors, construction contingency can range from 10 to 50 percent.

Performance and Payment Bonds

Based on historical and industry data, this can range from 0.75 to 3 percent of the project total. There are several contributing factors including such items as size of the project, regional costs, contractor's historical record on similar projects, complexity and current bonding limits. BC uses 1.5 percent for bonds, which we have determined to be reasonable for most heavy construction projects.

Estimate Summary Report

9/2/2022 1:26 PM

BC Project Number: 158098
Estimate Version Number: 1
Estimate Date: 7/9/2022
Lead Estimator: Doug Gabbard

Central Maui WWRF Facility Plan

County of Maui, HI
Central Maui WWRF Facility Plan
Class 5 Estimate

Estimator	Doug Gabbard
BC Project Manager	Irina Constantinescu
BC Office	Maui
Est Version Number	1
QA/QC Reviewer	Bill Agster
QA/QC Review Date	9/8/2022
BC Project Number	158098

Phase	Description	Takeoff Quantity	Grand Total Price	Gross Total Cost with Markups
01 Total				
100 Site work				
31230	Site Clearing & Grubbing for WWRF	16.00 AC	4,806.27 /AC	76,900
31230	Site Clearing - Waste Area	3.37 AC	62,816.92 /AC	211,693
31230	Site Clearing - West Easement Area	4.13 AC	4,806.27 /AC	19,850
31310	Grading - Cut and Fill (Open Site)	699,100.00 sf	4.72 /sf	3,298,950
31999	Finish Grade Saturation Beds	4.00 ea	2,386.54 /ea	9,546
32740	Asphaltic Paving, Roadway (1800' x 25' x 6")	45,000.00 sf	32.18 /sf	1,448,300
	100 Site work		/LS	5,065,240
120 Headworks Building				
03330	Headworks Slabs (On Grade & Mat)	890.56 cy	2,037.20 /cy	1,814,251
03345	Headworks Trench Concrete Walls	54.44 cy	1,871.14 /cy	101,865
04220	Headworks Exterior Masonry Walls (CMU & Brick)	6,691.00 sf	165.47 /sf	1,107,153
07220	Roof Insulation (see also Assembly 03358)	11,450.00 sf	9.63 /sf	110,285
07400	Metal Roofing, Conceptual	11,450.00 sf	71.73 /sf	821,261
23001	HVAC Conceptual	22,500.00 sf	51.75 /sf	1,164,273
31290	Headworks Trench Excavation and Backfill (Sloped Sides)	439.00 cy	151.94 /cy	66,702
33999	Interior Piping Allowance	1.00 LS	373,793.05 /LS	373,793
46999	Process Equipment	1.00 LS	1,590,064.03 /LS	1,590,064
	120 Headworks Building		/LS	7,149,646
160 Activated Sludge Building				
03330	Activated Sludge Slab (On Grade & Mat)	3,712.64 cy	1,330.93 /cy	4,941,246
03335	Columns (2' x 2' x 15' x 32 ea)	32.00 EA	13,010.14 /EA	416,324
03470	Activated Sludge Tilt Up Walls 915' x 15'	13,225.00 sf	97.56 /sf	1,290,241
07220	Roof Insulation (see also Assembly 03358)	47,734.00 sf	9.63 /sf	459,767
07400	Metal Roofing, Conceptual	47,734.00 sf	71.73 /sf	3,423,760
23001	HVAC Conceptual	60,890.00 sf	51.75 /sf	3,150,767
33999	Interior Mechanical and Piping Allowance	4.00 EA	31,149.42 /EA	124,598
	160 Activated Sludge Building		/LS	13,806,703
200 Secondary Clarifiers (72' Dia)				

Phase	Description	Takeoff Quantity	Grand Total Price	Gross Total Cost with Markups
03320	Mechanism Footing	56.89 cy	2,949.52 /cy	167,795
03330	Clarifier Slab (On Grade & Mat) (4298SF x 2' x 4ea)	3.00 EA	993,972.05 /EA	2,981,916
03345	Clarifier Concrete Walls (226' x 25' x 1.5' 4 ea)	3.00 EA	2,369,584.30 /EA	7,108,753
03351	Clarifier Trough (226' x 6' x 6" 4ea)	4.00 EA	144,390.97 /EA	577,564
05999	Railing and Stairs	4.00 ea	99,707.91 /ea	398,832
31290	Excavation and Backfill for Clarifiers (Sloped Sides)	31,152.30 cy	113.47 /cy	3,534,702
33999	Interior Mechanical and Piping Allowance	1.00 LS	830,651.23 /LS	830,651
46999	Mechanical Clarifier Mechanism	1.00 LS	5,365,910.43 /LS	5,365,910
	200 Secondary Clarifiers (72' Dia)		/EA	20,966,124
350 RAS Pump Station Slab (472 sf x 1')				
03330	RAS Pump Station (472 sf x 1')	208.50 cy	105.65 /cy	22,028
03345	Perimeter Concrete Walls at RAS Pump Station (93' x 25' x 1')	2,325.00 cy	92.34 /cy	214,692
06999	Aluminum Grating	1.00 LS	109,984.80 /LS	109,985
31315	Excavation and Backfill for RAS Pump Station	1,390.74 cy	35.73 /cy	49,684
33521	8" Ductile Iron Pipe, buried	48.00 lf	5,555.01 /lf	266,640
33999	Submersible Pump	4.00 EA	181,829.98 /EA	727,320
33999	24" Slide Gates	3.00 EA	38,968.59 /EA	116,906
33999	Interior Mechanical and Piping Allowance	1.00 LS	415,325.61 /LS	415,326
	350 RAS Pump Station Slab (472 sf x 1')		/LS	1,922,582
400 R-1 Treatment Facility				
03320	Column Footing, 8' x 8'x 16" Thick	9.95 cy	77,111.03 /cy	767,486
03330	Upper Slab - 23-6" x 49' x 18" th.	64.00 cy	2,549.65 /cy	163,178
03330	Lower Slab - 65'-2" x 63'-8" x 18" th.	206.50 cy	2,539.97 /cy	524,504
03335	Concrete Columns, 28" x 28" x 31'-10" High	3.00 ea	37,486.01 /ea	112,458
03335	Concrete Columns, 24" x 24" x 38' High	39.41 cy	6,615.39 /cy	260,693
03340	Beams (Spandrel or Frame) & Girders	38.00 cy	21,671.20 /cy	823,506
03340	Canopy Fascia Beams - 8'-10" deep x 2'-8' wide x 62'-6" & 75' long x 2 ea.	109.15 cy	4,154.52 /cy	453,457
03345	Concrete Walls, 12' High x 14" Thick x 296' Long	153.48 cy	4,939.65 /cy	758,142
03345	Concrete Walls, 12' High x 48" Thick x 296' Long	51.56 cy	2,896.39 /cy	149,326
03345	Concrete Walls, 6' High x 14" Thick x 28' Long	7.26 cy	4,939.74 /cy	35,858
03345	Concrete Walls, 7' High x 14" Thick x 25' Long	7.56 cy	4,939.50 /cy	37,353

Phase	Description	Takeoff Quantity	Grand Total Price	Gross Total Cost with Markups
03345	Concrete Walls, 5' High x 48" Thick x 47' Long	34.82 cy	2,896.44 /cy	100,839
03345	Concrete Walls, 8' High x 24" Thick x 270' Long	168.00 cy	3,559.76 /cy	598,039
03350	Elevated Slabs, 12" Thick	39.67 cy	4,151.23 /cy	164,667
03350	Precast Double Tee Roof	4,100.00 sf	69.50 /sf	284,950
03360	Stairs (Cast in Place or Pan Fill)	2.00 ea	34,324.21 /ea	68,648
05999	Metal Grating	1,200.00 sf	483.41 /sf	580,093
05999	Handrails - Treatment Area	1.00 LS	152,962.14 /LS	152,962
05999	Checkered Plate at UV Channels	1.00 LS	274,401.56 /LS	274,402
07999	Roofing System	44.00 sq	1,487.68 /sq	65,458
11999	Bridge Crane	1.00 ea	249,004.74 /ea	249,005
33999	Interior Piping Allowance	1.00 LS	249,190.91 /LS	249,191
40500	3" BW Piping Filtration System 1	120.00 lf	264.59 /lf	31,750
40500	3" BW Piping Filtration System 2	120.00 lf	264.58 /lf	31,750
40500	6" BW Piping to Backwash Return	50.00 lf	327.61 /lf	16,380
40500	1" CLS Piping	100.00 lf	217.02 /lf	21,702
40500	4" PD at Backwash Return Pumps	120.00 lf	348.06 /lf	41,767
46999	Process Equipment	1.00 ls	1,566,245.20 /ls	1,566,245
46999	Rotating Cloth Disk Filters	2.00 EA	2,424,817.02 /EA	4,849,634
46999	UV Disinfection System	2.00 EA	3,292,923.96 /EA	6,585,848
46999	Sluice Gates at UV Channel	1.00 LS	188,865.77 /LS	188,866
46999	Pumps, 250 HP, Turbine	3.00 EA	398,525.95 /EA	1,195,578
	400 R-1 Treatment Facility		/LS	21,403,735
440 Effluent Pump Station				
03330	Effluent Pump Station Slabs (On Grade & Mat)	151.67 cy	1,402.42 /cy	212,706
03345	Effluent Pump Station Concrete Walls	220.27 cy	5,413.83 /cy	1,192,504
03351	Effluent Pump Station Elevated Slabs (Flat)	75.21 cy	3,718.70 /cy	279,683
31290	Effluent Pump Station Excavation and Backfill (Sloped Sides)	4,376.44 cy	109.32 /cy	478,436
33999	Effluent Pumps	3.00 ea	1,136,648.43 /ea	3,409,945
33999	Interior Mechanical and Piping Allowance	1.00 LS	415,318.16 /LS	415,318
	440 Effluent Pump Station		/LS	5,988,592
480 Aerobic Digester				

Phase	Description	Takeoff Quantity	Grand Total Price	Gross Total Cost with Markups
03330	Aerobic Digester Slab (On Grade & Mat) (11,600sf x 2')	11,600.00 cy	170.95 /cy	1,983,009
03345	Aerobic Digester Concrete Walls (516LF x 20' x 18")	10,320.00 cy	314.28 /cy	3,243,344
03345	Aerobic Digester Divider Concrete Walls (58' x 20' x 18")	1,160.00 cy	314.71 /cy	365,066
05520	Handrail and Guardrail	516.00 lf	746.58 /lf	385,237
31290	Aerobic Digster Excavation and Backfill (Sloped Sides)	15,435.41 cy	121.03 /cy	1,868,078
33999	Interior Mechanical and Piping Allowance	1.00 LS	207,659.10 /LS	207,659
46999	Mixer, Digester	1.00 LS	753,834.07 /LS	753,834
46999	Fine Bubble Diffuser	1.00 LS	391,775.16 /LS	391,775
	480 Aerobic Digester		/LS	9,198,002
520	Dewatering & Blower Building			
03330	Dewatering & Blower Building Slab (On Grade & Mat) (5000sf x 2')	5,000.00 cy	173.27 /cy	866,374
04220	Dewatering & Blower Building Exterior Masonry Walls (CMU & Brick)	4,447.00 sf	176.41 /sf	784,480
07220	Roof Insulation (see also Assembly 03358)	5,000.00 sf	9.63 /sf	48,159
07400	Metal Roofing, Conceptual	5,000.00 sf	71.73 /sf	358,629
23001	HVAC Conceptual	16,250.00 sf	51.75 /sf	840,865
33999	Interior Mechanical and Piping Allowance	1.00 LS	415,318.16 /LS	415,318
46999	Blowers	1.00 LS	1,835,487.88 /LS	1,835,488
	520 Dewatering & Blower Building		/LS	5,149,313
540	Operations Building			
03330	Operations Building Slab (On Grade & Mat) (10,585sf x 1')	10,585.00 cy	88.32 /cy	934,843
04220	Operations Building Exterior Masonry Walls (CMU & Brick) (426' x 15')	6,337.00 sf	176.15 /sf	1,116,240
07220	Roof Insulation (see also Assembly 03358)	10,585.00 sf	9.63 /sf	101,953
07400	Metal Roofing, Conceptual	10,585.00 sf	71.73 /sf	759,218
22405	Commercial Plumbing, Conceptual	10,201.00 sf	55.03 /sf	561,352
23001	HVAC Conceptual	21,835.00 sf	51.75 /sf	1,129,858
	540 Operations Building		/LS	4,603,462
600	Piping Included In Easement			
33490	Trench for 8" Potable Water Line (Shored)	1,800.00 lf	152.08 /lf	273,751
33490	Trench for 18" Force Main for Recycled Water (Shored)	1,800.00 lf	208.44 /lf	375,191
33490	Trench for 24" Gravity Sewer Trench (Shored)	1,800.00 lf	351.59 /lf	632,858

Phase	Description	Takeoff Quantity	Grand Total Price	Gross Total Cost with Markups
33521 8" Ductile Iron Pipe, buried		1,800.00 lf	263.74 /lf	474,728
33526 18" HDPE Pipe, Recycled Water		1,800.00 lf	341.29 /lf	614,323
40500 24" PVC Gravity Sewer		1,800.00 lf	774.63 /lf	1,394,335
600 Piping Included In Easement			/LS	3,765,186
620 Yard Piping On-Site				
33490 Trench for 24" Force Main to Saturation Basins (Shored)		1,600.00 lf	245.76 /lf	393,209
33526 24" HDPE Pipe, Forcemain to Saturation Basins		1,600.00 lf	589.42 /lf	943,066
620 Yard Piping On-Site			/LS	1,336,275
950 EI & C Allowance (50% of Contract Total)				
26002 Electrical, Instrumentation, and Controls Subcontract		1.00 ls	24,844,877.85 /ls	24,844,878
950 EI & C Allowance (50% of Contract Total)			/LS	24,844,878
01 Total		1.00 LS	125,199,737.18 /LS	125,199,737

County of Maui, HI
Central Maui WWRF Facility Plan
Class 5 Estimate

Estimator	Doug Gabbard
BC Project Manager	Irina Constantinescu
BC Office	Maui
Est Version Number	1
QA/QC Reviewer	Bill Agster
QA/QC Review Date	9/8/2022

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
01 Total												
10 Site work												
100 Site work												
31230 Site Clearing & Grubbing for WWRF												
31-13-13.10	0550	Selective tree and shrub removal, selective clearing brush, medium clearing, to 4" diameter, with dozer and brush rake, excludes removal offsite	16.0	acre	2,855	-	3,029	-	-	367.77	/acre	5,884
31-14-13.23	0200	Topsoil stripping and stockpiling, topsoil, sandy loam, ideal conditions, 300 HP dozer	12,906.7	cy	4,746	-	7,882	-	-	0.98	/cy	12,628
		Site Clearing & Grubbing for WWRF	**16.0**	**AC**	**7,601**		**10,911**			**1,157.00**	**/AC**	**18,512**
31230 Site Clearing - Waste Area												
31-11-10.10	0200	Clearing & grubbing, medium trees, to 12" diameter, cut and chip	3.4	acre	19,562	-	9,674	-	-	8,675.53	/acre	29,237
31-11-10.10	0250	Clearing & grubbing, trees to 12" diameter, grub stumps and remove	3.4	acre	7,222	-	9,550	-	-	4,976.99	/acre	16,772
31-13-13.10	1040	Selective tree and shrub removal, selective clearing brush mowing, medium density, tractor with rotary mower, excludes removal offsite	3.4	acre	1,749	-	563	-	-	686.15	/acre	2,312
31-14-13.23	0200	Topsoil stripping and stockpiling, topsoil, sandy loam, ideal conditions, 300 HP dozer	2,718.5	cy	1,000	-	1,660	-	-	0.98	/cy	2,660
		Site Clearing - Waste Area	**3.4**	**AC**	**29,533**		**21,448**			**15,127.90**	**/AC**	**50,981**
31230 Site Clearing - West Easement Area												
31-13-13.10	0550	Selective tree and shrub removal, selective clearing brush, medium clearing, to 4" diameter, with dozer and brush rake, excludes removal offsite	4.1	acre	737	-	782	-	-	367.77	/acre	1,519
31-14-13.23	0200	Topsoil stripping and stockpiling, topsoil, sandy loam, ideal conditions, 300 HP dozer	3,331.5	cy	1,225	-	2,034	-	-	0.98	/cy	3,260
		Site Clearing - West Easement Area	**4.1**	**AC**	**1,962**		**2,816**			**1,157.00**	**/AC**	**4,778**
31310 Grading - Cut and Fill (Open Site)												
31-23-16.50	2350	Excavation, bulk, scrapers, bank measure, common earth, 3,000' haul, 21 C.Y. bucket, self propelled scrapers, 1/4 push dozer	78,000.0	bcy	128,487	-	285,935	-	-	5.31	/bcy	414,422
31-23-23.17	0020	Fill, dumped material, spread, by dozer, excludes compaction	78,000.0	lcy	86,280	-	118,449	-	-	2.62	/lcy	204,730
31-23-23.24	0300	Compaction, structural, common fill, 8" lifts, sheepsfoot or wobbly wheel roller	78,000.0	ecy	66,370	-	49,469	-	-	1.49	/ecy	115,838
31-22-16.10	1100	Fine grading, fine grade for slab on grade, machine	11,111.1	sy	15,294	-	9,270	-	-	2.21	/sy	24,564
31-25-13.10	0200	Synthetic erosion control, polypropylene mesh, stapled, 6.5 oz./ S.Y.	5,684.0	sy	4,529	21,599	-	-	-	4.60	/sy	26,128
31-25-13.10	1000	Synthetic erosion control, silt fence, polypropylene, ideal conditions, 3' high	1,400.0	lf	4,407	1,602	638	-	-	4.75	/lf	6,647

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
31310 Grading - Cut and Fill (Open Site)												
01-54-36.50	0700	Mobilization or demobilization, scraper, self-propelled, 24 C.Y. capacity, up to 50 miles	2.0	ea	718	-	1,053	-	-	885.29	/ea	1,771
		Grading - Cut and Fill (Open Site)	**699,100.0**	**sf**	**306,085**	**23,201**	**464,814**			**1.14**	**/sf**	**794,100**
31999 Finish Grade Saturation Beds												
31-22-16.10	0016	Fine grading, laggon bottoms, to be paved with grader	4.0	msf	1,432	-	868	-	-	574.80	/msf	2,299
		Finish Grade Saturation Beds	**4.0**	**ea**	**1,432**		**868**			**574.80**	**/ea**	**2,299**
32740 Asphaltic Paving, Roadway (1800' x 25' x 6")												
31-22-16.10	0100	Fine grading, for roadway, base or leveling course, large area, 6,000 S.Y. or more	5,000.0	sy	3,579	-	2,169	-	-	1.15	/sy	5,748
32-11-23.23	0302	Base course drainage layers,aggregate base course for roadways and large paved areas,crushed stone base,compacted,crushed 1-1/2"stone base,6"deep	5,000.0	sy	6,206	75,490	5,269	-	-	17.39	/sy	86,965
32-11-23.23	8000	Base course drainage layers, prepare and roll sub-base, large areas over 2,500 S.Y.	5,000.0	sy	3,653	-	2,357	-	-	1.20	/sy	6,010
32-11-26.19	0700	Bituminous-stabilized base courses, for roadways and large paved areas, liquid application to gravel base, asphalt emulsion	1,000.0	gal	282	11,163	186	-	-	11.63	/gal	11,631
32-12-16.13	0200	Plant-mix asphalt paving, for highways and large paved areas, binder course, 4" thick, no hauling included	5,000.0	sy	10,592	135,420	4,573	-	-	30.12	/sy	150,585
32-12-16.13	0380	Plant-mix asphalt paving, for highways and large paved areas, wearing course, 2" thick, no hauling included	5,000.0	sy	7,623	75,945	3,331	-	-	17.38	/sy	86,899
10-14-53.20	0600	Signs, guide and directional signs, reflectorized, 12" x 18", excludes posts	4.0	ea	158	150	35	-	-	85.73	/ea	343
10-14-53.20	1500	Signs, 10'-0", add to above for steel posts, galvanized, upright, bolted	4.0	ea	55	130	12	-	-	49.38	/ea	198
		Asphaltic Paving, Roadway (1800' x 25' x 6")	**45,000.0**	**sf**	**32,148**	**298,298**	**17,932**			**7.74**	**/sf**	**348,379**
		100 Site work	**1.0**	**LS**	**378,761**	**321,499**	**518,789**			**1,219,049.02**	**/LS**	**1,219,049**
		10 Site work	**1.0**	**LS**	**378,761**	**321,499**	**518,789**			**1,219,049.02**	**/LS**	**1,219,049**
12 Headworks Building												
120 Headworks Building												
03330 Headworks Slabs (On Grade & Mat)												
31-22-16.10	1100	Fine grading, fine grade for slab on grade, machine	1,272.2	sy	1,751	-	1,061	-	-	2.21	/sy	2,813
03-05-13.25	1050	Aggregate, stone, 3/4" to 1-1/2", prices per C.Y., includes material only	424.1	cy	-	16,115	-	-	-	38.00	/cy	16,115
03-15-13.50	1300	Waterstop, PVC, ribbed type, split, 3/8" thick x 6" wide	451.0	lf	2,896	2,775	-	-	-	12.57	/lf	5,671

Phase	Item	Description	Quantity	Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit	Total Net Amount
03330 Headworks Slabs (On Grade & Mat)										
03-15-13.50	5250	Waterstop, fittings, rubber, flat, dumbbell or center bulb, field union, 3/8" thick x 9" wide	38.0 ea	634	1,407	-	-	-	53.72 /ea	2,041
03-21-10.60	0600	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	42.4 ton	73,413	65,917	-	-	-	3,285.55 /ton	139,330
03-21-10.60	2005	Reinforcing in place, unloading & sorting, add to above - slabs	42.4 ton	2,829	-	1,080	-	-	92.17 /ton	3,909
03-21-10.60	2215	Reinforcing in place, crane cost for handling, add to above, slabs	42.4 ton	3,075	-	1,174	-	-	100.18 /ton	4,248
03-31-05.35	0350	Structural concrete,ready mix,normal weight,4500 psi,includes local aggregate,sand,portland cement and water,excludes all additives and treatments	890.6 cy	-	207,749	-	-	-	233.28 /cy	207,749
03-31-05.70	2950	Structural concrete, placing, foundation mat, pumped, over 20 C.Y., includes vibrating, excludes material	890.6 cy	13,549	-	2,266	-	-	17.76 /cy	15,815
03-35-29.30	0250	Concrete finishing, floors, monolithic, machine trowel finish	11,450.0 sf	15,754	-	728	-	-	1.44 /sf	16,481
03-39-13.50	0300	Curing, sprayed membrane curing compound	114.5 csf	1,749	2,681	-	-	-	38.69 /csf	4,430
03-35-29.30	2350	Concrete finishing, floor, hardener, non-metallic, medium service, 0.75 psf, add	11,450.0 sf	12,472	5,542	-	-	-	1.57 /sf	18,014
		Headworks Slabs (On Grade & Mat)	**890.6 cy**	**128,122**	**302,186**	**6,308**			**490.27 /cy**	**436,617**
03345 Headworks Trench Concrete Walls										
03-21-10.60	0700	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	1.3 ton	1,720	2,015	-	-	-	2,881.61 /ton	3,735
03-21-10.60	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	1.3 ton	86	-	33	-	-	92.17 /ton	119
03-21-10.60	2225	Reinforcing, crane cost for handling, add to above, walls, cols, beams	1.3 ton	94	-	36	-	-	100.19 /ton	130
03-31-05.35	0350	Structural concrete,ready mix,normal weight,4500 psi,includes local aggregate,sand,portland cement and water,excludes all additives and treatments	54.4 cy	-	12,701	-	-	-	233.28 /cy	12,701
03-31-05.70	5350	Structural concrete, placing, walls, pumped, 15" thick, includes vibrating, excludes material	54.4 cy	2,761	-	462	-	-	59.19 /cy	3,223
03-35-29.60	0600	Concrete finishing, walls, float finish, 1/16" thick	1,400.0 sf	3,813	798	-	-	-	3.29 /sf	4,611
		Headworks Trench Concrete Walls	**54.4 cy**	**8,474**	**15,513**	**531**			**450.37 /cy**	**24,518**
04220 Headworks Exterior Masonry Walls (CMU & Brick)										
04-22-10.28	0350	Concrt block,high strngt,hollow,3500 psi,12"8"16",inclds mortar and horzntl joint rnfrcng every other course,excluds scffldn,grout and verticl rnfrcng	6,691.0 sf	124,769	45,278	-	-	-	25.41 /sf	170,047
04-05-19.26	0250	Masonry reinforcing bars, truss type steel joint reinforcing, mill standard galvanized, 12" wide	49.6 clf	2,043	2,374	-	-	-	89.03 /clf	4,417

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
04220 Headworks Exterior Masonry Walls (CMU & Brick)												
04-05-19.26	0020	Masonry reinforcing bars, #5 and #6 reinforcing steel bars, placed horizontally, ASTM A615	2,274.9	lb	2,342	2,648	-	-	-	2.19	/lb	4,990
04-05-19.26	0060	Masonry reinforcing bars, #5 and #6 reinforcing steel bars, placed vertically, ASTM A615	1,672.8	lb	2,119	1,947	-	-	-	2.43	/lb	4,067
04-05-16.30	2000	Grout, for bond beams, lintels and concrete masonry unit (CMU) cores, C476, includes material only	2,810.2	cf	24,530	23,758	1,362	-	-	17.67	/cf	49,650
04-05-16.30	0800	Grout, door frames, 3' x 7' opening, 2.5 C.F. per opening	2.0	opng	102	42	6	-	-	74.89	/opng	150
04-05-16.30	0850	Grout, door frames, 6' x 7' opening, 3.5 C.F. per opening	2.0	opng	136	59	8	-	-	101.33	/opng	203
04-05-19.05	0070	Anchor bolts, hooked type, 3/4" diameter x 12" long, installed fresh grout in cmu bond beam or filled core, includes nut and washer, excludes template	51.0	ea	336	382	-	-	-	14.09	/ea	718
04-05-19.26	X9000	Allow - shoring and bracing at CMU walls (percentage wall area)	6,691.0	sfwa	7,894	3,265	-	-	-	1.67	/sfwa	11,160
04-05-23.13	0180	Control joint, PVC, 12" wall	18.0	lf	62	96	-	-	-	8.74	/lf	157
05-12-23.40	0672	Channel framing, structural steel, field fabricated, C8x11.5, incl cutting & welding	14.0	lf	1,063	183	62	-	-	93.45	/lf	1,308
07-71-26.10	0700	Reglet, zinc and copper alloy, 20 ounce	72.0	lf	259	276	-	-	-	7.43	/lf	535
07-71-26.10	1600	Reglet, counter flashing for zinc and copper alloy, 20 ounce, 12" wide	72.0	lf	491	505	-	-	-	13.83	/lf	995
07-19-19.10	0300	Silicone water repellants, sprayed on CMU, 2 coat	13,382.0	sf	3,994	14,212	-	-	-	1.36	/sf	18,205
07-92-10.10	1800	Caulking & Sealants, butyl based, bulk, in place, 77 LF per gallon, 1/2" x 1/2"	18.0	lf	53	13	-	-	-	3.67	/lf	66
		Headworks Exterior Masonry Walls (CMU & Brick)	**6,691.0**	**sf**	**170,193**	**95,038**	**1,437**			**39.85**	**/sf**	**266,668**
07220 Roof Insulation (see also Assembly 03358)												
07-22-16.10	0460	Roof deck insulation, fiberglass, 1-1/16" thick, R4.17, fastening excluded	11,450.0	sf	7,763	18,778	-	-	-	2.32	/sf	26,541
		Roof Insulation (see also Assembly 03358)	**11,450.0**	**sf**	**7,763**	**18,778**				**2.32**	**/sf**	**26,541**
07400 Metal Roofing, Conceptual												
07-42-13.10	0100	Standing seam roofing, aluminum, kynar finish, including flashings	11,450.0	sf	156,386	41,495	-	-	-	17.28	/sf	197,881
		Metal Roofing, Conceptual	**11,450.0**	**sf**	**156,386**	**41,495**				**17.28**	**/sf**	**197,881**
23001 HVAC Conceptual												
23-01-00.00	0003	Cooling Tons (/sf)	65.2	tons	-	-	-	163,045	-	2,500.00	/tons	163,045
23-01-00.00	0004	Supply CFM (/sf)	27,000.0	cfms	-	-	-	17,550	-	0.65	/cfms	17,550
23-01-00.00	0005	Ductwork (lbs/sf)	9,000.0	lbs	-	-	-	76,500	-	8.50	/lbs	76,500
23-01-00.00	0006	Controls (/sf)	22,500.0	sf	-	-	-	27,000	-	1.20	/sf	27,000
		HVAC Conceptual	**22,500.0**	**sf**				**284,095**		**12.63**	**/sf**	**284,095**

Phase	Item	Description	Quantity	Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit	Total Net Amount
31290 Headworks Trench Excavation and Backfill (Sloped Sides)										
31-23-16.42	4400	Excavating, bulk bank measure, in sheeting or cofferdam, with all other equipment, minimum	439.0 bcy	4,016	-	3,783	-	-	17.77 /bcy	7,799
31-23-23.23	7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	35.3 ecy	115	-	22	-	-	3.89 /ecy	137
31-23-23.16	0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	82.2 lcy	1,121	3,637	203	-	-	60.37 /lcy	4,961
31-23-23.23	7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	70.7 ecy	230	-	45	-	-	3.89 /ecy	275
31-23-23.14	4020	Backfill, structural, common earth, 200 HP dozer, 50' haul, from existing stockpile, excludes compaction	346.9 lcy	174	-	239	-	-	1.19 /lcy	414
31-23-23.23	7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	301.7 ecy	982	-	191	-	-	3.89 /ecy	1,173
31-23-23.19	BC-0011	Loading trucks, 2.5 C.Y. bucket, front end loader, wheel mounted	104.2 bcy	73	-	48	-	-	1.16 /bcy	121
31-23-23.18	0450	Hauling, excavated or borrow material, loose cubic yards, 3 mile round trip , 1.9 loads/hour, 12 C.Y. truck, highway haulers, excludes loading	129.4 lcy	521	-	658	-	-	9.11 /lcy	1,179
		Headworks Trench Excavation and Backfill (Sloped Sides)	**439.0 cy**	**7,231**	**3,637**	**5,190**			**36.58 /cy**	**16,059**
33999 Interior Piping Allowance										
33-99-99.99	MISC	Headworks Interior Piping alowance	1.0 LS	44,330	45,670	-		-	90,000.00 /LS	90,000
		Interior Piping Allowance	**1.0 LS**	**44,330**	**45,670**				**90,000.00 /LS**	**90,000**
46999 Process Equipment										
46-06-00.00	BC-0451	Grit removal, classifier, complete w/ supports	2.0 ea	7,438	64,000	-	-	-	35,718.82 /ea	71,438
46-06-00.00	BC-0261	Bar screen, mechanical, inclined, complete w/ motor,sprays,chute	2.0 ea	33,056	277,998	-	-	-	155,526.92 /ea	311,054
		Process Equipment	**1.0 LS**	**40,494**	**341,998**				**382,491.46 /LS**	**382,491**
		120 Headworks Building	**1.0 LS**	**562,994**	**864,314**	**13,466**	**284,095**		**1,724,869.65 /LS**	**1,724,870**
		12 Headworks Building	**1.0 LS**	**562,994**	**864,314**	**13,466**	**284,095**		**1,724,869.65 /LS**	**1,724,870**
16 Activated Sludge Building										
160 Activated Sludge Building										
03330 Activated Sludge Slab (On Grade & Mat)										
31-22-16.10	1100	Fine grading, fine grade for slab on grade, machine	5,303.8 sy	7,301	-	4,425	-	-	2.21 /sy	11,725

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
03330 Activated Sludge Slab (On Grade & Mat)												
03-05-13.25	1050	Aggregate, stone, 3/4" to 1-1/2", prices per C.Y., includes material only	1,767.9	cy	-	67,183	-	-	-	38.00	/cy	67,183
03-15-13.50	1300	Waterstop, PVC, ribbed type, split, 3/8" thick x 6" wide	915.0	lf	5,875	5,630	-	-	-	12.57	/lf	11,505
03-15-13.50	5250	Waterstop, fittings, rubber, flat, dumbbell or center bulb, field union, 3/8" thick x 9" wide	76.0	ea	1,269	2,814	-	-	-	53.72	/ea	4,083
03-31-05.35	0350	Structural concrete,ready mix,normal weight,4500 psi,includes local aggregate,sand,portland cement and water,excludes all additives and treatments	3,712.6	cy	-	866,086	-	-	-	233.28	/cy	866,086
03-31-05.70	2950	Structural concrete, placing, foundation mat, pumped, over 20 C.Y., includes vibrating, excludes material	3,712.6	cy	56,486	-	9,445	-	-	17.76	/cy	65,931
03-35-29.30	0250	Concrete finishing, floors, monolithic, machine trowel finish	47,734.0	sf	65,675	-	3,033	-	-	1.44	/sf	68,709
03-39-13.50	0300	Curing, sprayed membrane curing compound	477.3	csf	7,292	11,176	-	-	-	38.69	/csf	18,469
03-35-29.30	2350	Concrete finishing, floor, hardener, non-metallic, medium service, 0.75 psf, add	47,734.0	sf	51,997	23,103	-	-	-	1.57	/sf	75,100
		Activated Sludge Slab (On Grade & Mat)	**3,712.6**	**cy**	**195,894**	**975,992**	**16,904**			**320.20**	**/cy**	**1,188,790**
03335 Columns (2' x 2' x 15' x 32 ea)												
03-11-13.25	7750	Cip concret forms,col,square,steel framed plywd,24"x24",based 50 us purchsd forms,4 us bracing lumber,includes erecting,bracing,stripping and cleaning	3,840.0	sfca	28,095	3,636	-	-	-	8.26	/sfca	31,732
03-15-05.12	5400	Chamfer strip, wood, 1" wide	1,920.0	lf	3,112	501	-	-	-	1.88	/lf	3,613
03-15-05.95	3050	Form oil, up to 800 S.F. per gallon, coverage, includes material only	10.2	gal	-	245	-	-	-	23.96	/gal	245
03-21-10.60	0250	Reinforcing steel, in place, columns, #8 to #18, A615, grade 60, incl labor for accessories, excl material for accessories	7.1	ton	12,310	11,053	-	-	-	3,285.55	/ton	23,364
03-21-10.60	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	7.1	ton	474	-	181	-	-	92.17	/ton	655
03-21-10.60	2225	Reinforcing, crane cost for handling, add to above, walls, cols, beams	7.1	ton	516	-	197	-	-	100.18	/ton	712
03-31-05.35	0407	Concrete, ready mix, regular weight, walls/cols/beams, 5000 psi	74.7	cy	-	22,192	-	-	-	297.22	/cy	22,192
03-31-05.70	0850	Structural concrete, placing, column, square or round, with crane and bucket, 24" thick, includes vibrating, excludes material	74.7	cy	7,339	-	3,174	-	-	140.80	/cy	10,513
03-35-29.60	0050	Concrete finishing, walls, burlap rub with grout, includes breaking ties and patching voids	3,840.0	sf	6,971	265	-	-	-	1.88	/sf	7,236
		Columns (2' x 2' x 15' x 32 ea)	**32.0**	**EA**	**58,818**	**37,893**	**3,552**			**3,133.23**	**/EA**	**100,263**
03470 Activated Sludge Tilt Up Walls 915' x 15'												
03-47-13.50	1010	Bond breaker/release agent, coat casting surface, 1 gal per 1 MSF	13.7	gal	-	335	-	-	-	24.40	/gal	335

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
03470 Activated Sludge Tilt Up Walls 915' x 15'												
03-47-13.50	1015	Edge and blockout forms, tilt-up panel, wood, 6" - 12" high, average 3 use	562.5	sfca	5,499	466	-	-	-	10.60	/sfca	5,965
03-47-13.50	1055	Form oil, allow 1000 SF/gallon, edge/blockouts	2.0	gal	-	32	-	-	-	15.85	/gal	32
03-47-13.50	1058	Wall insulation, isocyanurate, foil faced both sides, 3" thick	13,725.0	sf	13,108	50,645	-	-	-	4.65	/sf	63,753
03-47-13.50	1065	Welded wire fabric, sheets, 6 x 6 - W2.9 x W2.9 (6 x 6), 42 lb/CSF	137.3	csf	8,000	4,679	-	-	-	92.38	/csf	12,680
03-47-13.50	1060	Reinforcing in place, A615 Gr 60, tiltup panels, #3 to #7	19.8	ton	29,161	24,136	-	-	-	2,686.62	/ton	53,297
03-47-13.50	1070	Reinforcing in place, unloading & sorting, add to above	22.7	ton	1,287	-	491	-	-	78.26	/ton	1,778
03-45-13.50	X9140	Panel lift inserts w/ oval void former and base	184.0	ea	802	2,400	-	-	-	17.40	/ea	3,202
03-45-13.50	X9160	Wall panel inserts for braces	92.0	ea	665	868	-	-	-	16.67	/ea	1,533
03-45-13.50	X9190	Tilt up pipe brace w/ drill in foot plate anchors, monthly rental	92.0	ea	1,603	11,501	-	-	-	142.44	/ea	13,104
03-45-13.50	X9170	Panel edge weld plates, min. 6"x6"x1/4" thick, w/ anchor embeds	184.0	ea	2,138	3,325	-	-	-	29.69	/ea	5,463
03-47-13.50	1090	Anchor bolts, ledger, incl. nut and washer, to 7/8" diam, to 12" long	184.0	ea	2,138	1,710	-	-	-	20.91	/ea	3,847
03-47-13.50	1230	Placing concrete, tiltup panels, pumped	123.7	cy	4,766	-	797	-	-	44.97	/cy	5,563
03-47-13.50	1280	Concrete, ready mix, regular weight, 5000 psi	123.7	cy	-	28,450	-	-	-	229.96	/cy	28,450
03-47-13.50	1300	Finishing, tiltup panels, machine trowel, 1side	13,225.0	sf	16,171	-	-	-	-	1.22	/sf	16,171
03-39-13.50	1315	Curing, sprayed membrane curing compound	132.3	csf	2,020	3,097	-	-	-	38.69	/csf	5,117
03-45-13.50	X9220	Plastic insert patches, panel and edge insert voids	276.0	ea	385	1,593	-	-	-	7.17	/ea	1,978
03-47-13.50	3010	Finishing walls, panel, special, burlap rub w/ grout	26,450.0	sf	39,521	1,402	-	-	-	1.55	/sf	40,923
03-45-13.50	X9210	Panel bearing shims, allow	12.0	ea	-	76	-	-	-	6.32	/ea	76
03-45-13.50	X9230	Grout mix, panel to footing void, allow .3 cy per panel	0.3	cy	3	55	-	-	-	192.33	/cy	58
03-45-13.50	X9200	Cranage cost: lift, walk and set panel	46.0	hr	2,278	-	3,413	-	-	123.72	/hr	5,691
03-47-13.50	1425	Welding, field, cost per welder, with 1/2 operating engineer	46.0	hr	7,124	290	876	-	-	180.21	/hr	8,290
03-47-13.50	3100	Caulking and sealants, backer rod, polyethylene, 1/2" diameter	27.6	clf	4,172	158	-	-	-	156.86	/clf	4,329
03-47-13.50	3110	Caulking & sealants, polyurethane or elastomeric, 1/2" x 1/4"	2,760.0	lf	13,233	15,793	-	-	-	10.52	/lf	29,026
		Activated Sludge Tilt Up Walls 915' x 15'	**13,225.0**	**sf**	**154,073**	**151,010**	**5,577**			**23.49**	**/sf**	**310,660**
07220 Roof Insulation (see also Assembly 03358)												
07-22-16.10	0460	Roof deck insulation, fiberglass, 1-1/16" thick, R4.17, fastening excluded	47,734.0	sf	32,363	78,284	-	-	-	2.32	/sf	110,647
		Roof Insulation (see also Assembly 03358)	**47,734.0**	**sf**	**32,363**	**78,284**				**2.32**	**/sf**	**110,647**
07400 Metal Roofing, Conceptual												
07-42-13.10	0100	Standing seam roofing, aluminum, kynar finish, including flashings	47,734.0	sf	651,959	172,988	-	-	-	17.28	/sf	824,947

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
		Metal Roofing, Conceptual	**47,734.0**	**sf**	**651,959**	**172,988**				**17.28**	**/sf**	**824,947**
23001 HVAC Conceptual												
23-01-00.00	0003	Cooling Tons (/sf)	176.5	tons	-	-	-	441,233	-	2,500.00	/tons	441,233
23-01-00.00	0004	Supply CFM (/sf)	73,068.0	cfms	-	-	-	47,494	-	0.65	/cfms	47,494
23-01-00.00	0005	Ductwork (lbs/sf)	24,356.0	lbs	-	-	-	207,026	-	8.50	/lbs	207,026
23-01-00.00	0006	Controls (/sf)	60,890.0	sf	-	-	-	73,068	-	1.20	/sf	73,068
		HVAC Conceptual	**60,890.0**	**sf**				**768,821**		**12.63**	**/sf**	**768,821**
33999 Interior Mechanical and Piping Allowance												
33-99-99.99	MISC	Activated Sludge Interior Piping allowance	1.0	LS	14,777	15,223	-		-	30,000.00	/LS	30,000
		Interior Mechanical and Piping Allowance	**4.0**	**EA**	**14,777**	**15,223**				**7,500.00**	**/EA**	**30,000**
		160 Activated Sludge Building	**1.0**	**LS**	**1,107,884**	**1,431,391**	**26,032**	**768,821**		**3,334,128.28**	**/LS**	**3,334,128**
		16 Activated Sludge Building	**1.0**	**LS**	**1,107,884**	**1,431,391**	**26,032**	**768,821**		**3,334,128.28**	**/LS**	**3,334,128**
20 Secondary Clarifiers (72' Dia)												
200 Secondary Clarifiers (72' Dia)												
03320 Mechanism Footing												
31-23-16.16	6050	Structural excavation for minor structures, bank measure, for spread and mat footings, elevator pits, and small building foundations, common earth, 1-1/2 C.Y. bucket, machine excavation, hydraulic backhoe	56.9	bcy	578	-	440	-	-	17.89	/bcy	1,018
03-11-13.45	3050	C.I.P. concrete forms, pile cap, square or rectangular, plywood, 2 use, includes erecting, bracing, stripping and cleaning	768.0	sfca	7,146	2,024	-	-	-	11.94	/sfca	9,169
03-15-05.95	3000	Form oil, up to 1200 S.F. per gallon, coverage, includes material only	2.0	gal	-	30	-	-	-	14.81	/gal	30
03-21-10.60	0500	Reinforcing steel, in place, footings, #4 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	2.8	ton	5,392	4,421	-	-	-	3,450.42	/ton	9,813
03-21-10.60	2000	Reinforcing steel, unload and sort, add to base	2.8	ton	190	-	72	-	-	92.17	/ton	262
03-21-10.60	2210	Reinforcing steel, crane cost for handling, average, add	2.8	ton	206	-	79	-	-	100.18	/ton	285
31-23-16.13	2100	Excavating, trench or continuous footing, common earth, trim sides and bottom for concrete pours, excludes sheeting or dewatering	192.0	sf	255	-	20	-	-	1.43	/sf	275
03-31-05.35	0300	Structural concrete,ready mix,normal weight,4000 psi,includes local aggregate,sand,portland cement and water,excludes all additives and treatments	59.7	cy	-	16,928	-	-	-	283.39	/cy	16,928
03-31-05.70	3900	Structural concrete, placing, pile caps, pumped, 6 C.Y. to 10 C.Y., includes vibrating, excludes material	59.7	cy	1,818	-	304	-	-	35.52	/cy	2,122

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
03320 Mechanism Footing												
31-23-23.18	0400	Hauling, excavated or borrow material, loose cubic yards, 1 mile round trip, 2.2 loads/hour, 12 C.Y. truck, highway haulers, excludes loading	56.9	lcy	216	-	273	-	-	8.60	/lcy	489
		Mechanism Footing	**56.9**	**cy**	**15,801**	**23,403**	**1,188**			**710.00**	**/cy**	**40,391**
03330 Clarifier Slab (On Grade & Mat) (4298SF x 2' x 4ea)												
31-22-16.10	1100	Fine grading, fine grade for slab on grade, machine	1,910.5	sy	2,630	-	1,594	-	-	2.21	/sy	4,224
03-05-13.25	1050	Aggregate, stone, 3/4" to 1-1/2", prices per C.Y., includes material only	636.8	cy	-	24,201	-	-	-	38.00	/cy	24,201
03-11-13.65	4050	C.I.P. concrete forms, slab on grade, slab blockouts, wood, to 24" high, 1 use, includes erecting, bracing, stripping and cleaning	96.0	lf	2,575	169	-	-	-	28.59	/lf	2,745
03-15-13.50	1300	Waterstop, PVC, ribbed type, split, 3/8" thick x 6" wide	904.3	lf	5,807	5,564	-	-	-	12.57	/lf	11,371
03-15-13.50	5250	Waterstop, fittings, rubber, flat, dumbbell or center bulb, field union, 3/8" thick x 9" wide	76.0	ea	1,269	2,814	-	-	-	53.72	/ea	4,083
03-21-10.60	0600	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	79.6	ton	137,808	123,738	-	-	-	3,285.55	/ton	261,546
03-21-10.60	2005	Reinforcing in place, unloading & sorting, add to above - slabs	79.6	ton	5,310	-	2,027	-	-	92.17	/ton	7,337
03-21-10.60	2215	Reinforcing in place, crane cost for handling, add to above, slabs	79.6	ton	5,772	-	2,203	-	-	100.18	/ton	7,975
03-31-05.35	0350	Structural concrete,ready mix,normal weight,4500 psi,includes local aggregate,sand,portland cement and water,excludes all additives and treatments	1,337.4	cy	-	311,980	-	-	-	233.28	/cy	311,980
03-31-05.70	2950	Structural concrete, placing, foundation mat, pumped, over 20 C.Y., includes vibrating, excludes material	1,337.4	cy	20,347	-	3,402	-	-	17.76	/cy	23,750
03-35-29.30	0250	Concrete finishing, floors, monolithic, machine trowel finish	17,194.6	sf	23,657	-	1,093	-	-	1.44	/sf	24,750
03-39-13.50	0300	Curing, sprayed membrane curing compound	171.9	csf	2,627	4,026	-	-	-	38.69	/csf	6,653
03-35-29.30	2350	Concrete finishing, floor, hardener, non-metallic, medium service, 0.75 psf, add	17,194.6	sf	18,730	8,322	-	-	-	1.57	/sf	27,052
		Clarifier Slab (On Grade & Mat) (4298SF x 2' x 4ea)	**3.0**	**EA**	**226,532**	**480,814**	**10,319**			**239,221.67**	**/EA**	**717,665**
03345 Clarifier Concrete Walls (226' x 25' x 1.5' 4 ea)												
03-11-13.85	X9950	Forms in place, wall, steel framed plywood, >16' high, 2 use/month	45,200.0	sfca	512,523	516,862	-	-	-	22.77	/sfca	1,029,385
03-15-05.95	3050	Form oil, up to 800 S.F. per gallon, coverage, includes material only	120.5	gal	-	2,888	-	-	-	23.96	/gal	2,888
03-21-10.60	0700	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	47.1	ton	62,489	73,186	-	-	-	2,881.61	/ton	135,675

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
03345 Clarifier Concrete Walls (226' x 25' x 1.5' 4 ea)												
03-21-10.60	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	47.1	ton	3,141	-	1,199	-	-	92.17	/ton	4,340
03-21-10.60	2225	Reinforcing, crane cost for handling, add to above, walls, cols, beams	47.1	ton	3,414	-	1,303	-	-	100.18	/ton	4,717
03-31-05.35	0350	Structural concrete,ready mix,normal weight,4500 psi,includes local aggregate,sand,portland cement and water,excludes all additives and treatments	1,318.3	cy	-	307,541	-	-	-	233.28	/cy	307,541
03-31-05.70	5350	Structural concrete, placing, walls, pumped, 15" thick, includes vibrating, excludes material	1,318.3	cy	66,859	-	11,180	-	-	59.19	/cy	78,039
03-35-29.60	0600	Concrete finishing, walls, float finish, 1/16" thick	45,200.0	sf	123,090	25,764	-	-	-	3.29	/sf	148,854
		Clarifier Concrete Walls (226' x 25' x 1.5' 4 ea)	**3.0**	**EA**	**771,515**	**926,240**	**13,682**			**570,479.17**	**/EA**	**1,711,438**
03351 Clarifier Trough (226' x 6' x 6" 4ea)												
03-11-13.35	1150	C.I.P. concrete forms, elevated slab, flat plate, plywood, to 15' high, 4 use, includes shoring, erecting, bracing, stripping and cleaning	5,424.0	sf	47,777	11,043	-	-	-	10.84	/sf	58,820
03-11-13.35	7090	C.I.P. concrete forms, elevated slab, edge forms, 7" to 12" high, 3 use, includes shoring, erecting, bracing, stripping and cleaning	452.0	sfca	6,554	399	-	-	-	15.38	/sfca	6,953
03-15-05.70	1550	Shores, reshoring at elevated decks, allow	5,424.0	sf	6,469	3,602	-	-	-	1.86	/sf	10,070
03-21-10.60	0400	Reinforcing steel, in place, elevated slabs, #4 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	5.3	ton	7,240	8,196	-	-	-	2,927.38	/ton	15,436
03-21-10.60	2050	Reinforcing in place, unloading & sorting, add to above - decks	5.3	ton	352	-	134	-	-	92.17	/ton	486
03-21-10.60	2220	Reinforcing steel, crane cost for handling, maximum, add	5.3	ton	1,005	-	384	-	-	263.33	/ton	1,389
03-31-05.35	0350	Structural concrete,ready mix,normal weight,4500 psi,includes local aggregate,sand,portland cement and water,excludes all additives and treatments	105.5	cy	-	24,603	-	-	-	233.28	/cy	24,603
03-31-05.70	1500	Structural concrete, placing, elevated slab, pumped, 6" to 10" thick, includes vibrating, excludes material	105.5	cy	4,012	-	671	-	-	44.40	/cy	4,682
03-35-29.30	0275	Finishing elev slab, manual screed, bull float, machine float & trowel	5,424.0	sf	7,460	-	344	-	-	1.44	/sf	7,805
03-39-13.50	0310	Curing, sprayed membrane curing compound, elevated decks	54.2	csf	829	1,134	-	-	-	36.19	/csf	1,963
03-35-29.30	2300	Concrete finishing, floor, hardener, non-metallic, light service, 0.50 psf, add	5,424.0	sf	5,213	1,687	-	-	-	1.27	/sf	6,900
		Clarifier Trough (226' x 6' x 6" 4ea)	**4.0**	**EA**	**86,910**	**50,664**	**1,533**			**34,776.80**	**/EA**	**139,107**
05999 Railing and Stairs												
05-51-19.50	3440	Spiral steel stairs, stock units, galv., check'd plate tread, 5'-0" di	6.0	flgh	7,770	*315*	-	-	-	1,347.44	/flgh	8,085

Phase	Item	Description	Quantity	Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit	Total Net Amount
05999 Railing and Stairs										
05-52-13.50	0140	Railing, pipe, aluminum, satin finish, 3 rails, 3'-6" high, posts @ 5' OC, 1-1/4" diameter, shop fabricated	904.0 lf	24,459	62,376	1,073	-	-	97.24 /lf	87,908
		Railing and Stairs	**4.0 ea**	**32,228**	**62,691**	**1,073**			**23,998.10 /ea**	**95,992**
31290 Excavation and Backfill for Clarifiers (Sloped Sides)										
31-23-16.42	4400	Excavating, bulk bank measure, in sheeting or cofferdam, with all other equipment, minimum	31,152.3 bcy	284,959	-	268,479	-	-	17.77 /bcy	553,438
31-23-23.23	7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	363.0 ecy	1,181	-	230	-	-	3.89 /ecy	1,411
31-23-23.16	0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	844.1 lcy	11,514	37,360	2,084	-	-	60.37 /lcy	50,957
31-23-23.23	7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	725.9 ecy	2,362	-	460	-	-	3.89 /ecy	2,823
31-23-23.14	4020	Backfill, structural, common earth, 200 HP dozer, 50' haul, from existing stockpile, excludes compaction	19,637.9 lcy	9,874	-	13,556	-	-	1.19 /lcy	23,429
31-23-23.23	7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	17,076.4 ecy	55,566	-	10,830	-	-	3.89 /ecy	66,396
31-23-23.19	BC-0011	Loading trucks, 2.5 C.Y. bucket, front end loader, wheel mounted	12,197.4 bcy	8,568	-	5,609	-	-	1.16 /bcy	14,177
31-23-23.18	0450	Hauling, excavated or borrow material, loose cubic yards, 3 mile round trip , 1.9 loads/hour, 12 C.Y. truck, highway haulers, excludes loading	15,204.1 lcy	61,179	-	77,296	-	-	9.11 /lcy	138,475
		Excavation and Backfill for Clarifiers (Sloped Sides)	**31,152.3 cy**	**435,203**	**37,360**	**378,544**			**27.32 /cy**	**851,106**
33999 Interior Mechanical and Piping Allowance										
33-99-99.99	MISC	Secondary clarifiers Interior Piping allowance	1.0 LS	98,511	101,489	-		-	200,000.00 /LS	200,000
		Interior Mechanical and Piping Allowance	**1.0 LS**	**98,511**	**101,489**				**200,000.00 /LS**	**200,000**
46999 Mechanical Clarifier Mechanism										
46-06-00.00	BC-1031	Mechanical, clarifier mechanism, 72' dia. w/ bridge, cage, launders, weirs	4.0 ea	132,770	1,131,287	26,709	-	-	322,691.42 /ea	1,290,766
		Mechanical Clarifier Mechanism	**1.0 LS**	**132,770**	**1,131,287**	**26,709**			**1,290,765.68 /LS**	**1,290,766**
		200 Secondary Clarifiers (72' Dia)	**4.0 EA**	**1,799,470**	**2,813,947**	**433,048**			**1,261,616.28 /EA**	**5,046,465**
		20 Secondary Clarifiers (72' Dia)	**4.0 EA**	**1,799,470**	**2,813,947**	**433,048**			**1,261,616.28 /EA**	**5,046,465**

35 RAS Pump Station Slab (472 sf x 1')

350 RAS Pump Station Slab (472 sf x 1')

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
03330 RAS Pump Station (472 sf x 1')												
31-22-16.10	1100	Fine grading, fine grade for slab on grade, machine	23.2	sy	32	-	19	-	-	2.21	/sy	51
03-05-13.25	1050	Aggregate, stone, 3/4" to 1-1/2", prices per C.Y., includes material only	7.7	cy	-	293	-	-	-	38.00	/cy	293
03-15-13.50	1300	Waterstop, PVC, ribbed type, split, 3/8" thick x 6" wide	52.2	lf	335	321	-	-	-	12.57	/lf	656
03-15-13.50	5250	Waterstop, fittings, rubber, flat, dumbbell or center bulb, field union, 3/8" thick x 9" wide	4.0	ea	67	148	-	-	-	53.72	/ea	215
03-21-10.60	0600	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	0.4	ton	668	600	-	-	-	3,285.54	/ton	1,268
03-21-10.60	2005	Reinforcing in place, unloading & sorting, add to above - slabs	0.4	ton	26	-	10	-	-	92.18	/ton	36
03-21-10.60	2215	Reinforcing in place, crane cost for handling, add to above, slabs	0.4	ton	28	-	11	-	-	100.18	/ton	39
03-31-05.35	0350	Structural concrete,ready mix,normal weight,4500 psi,includes local aggregate,sand,portland cement and water,excludes all additives and treatments	8.1	cy	-	1,891	-	-	-	233.28	/cy	1,891
03-31-05.70	2950	Structural concrete, placing, foundation mat, pumped, over 20 C.Y., includes vibrating, excludes material	8.1	cy	123	-	21	-	-	17.76	/cy	144
03-35-29.30	0250	Concrete finishing, floors, monolithic, machine trowel finish	208.5	sf	287	-	13	-	-	1.44	/sf	300
03-39-13.50	0300	Curing, sprayed membrane curing compound	2.1	csf	32	49	-	-	-	38.69	/csf	81
03-35-29.30	2350	Concrete finishing, floor, hardener, non-metallic, medium service, 0.75 psf, add	208.5	sf	227	101	-	-	-	1.57	/sf	328
		RAS Pump Station (472 sf x 1')	**208.5**	**cy**	**1,825**	**3,404**	**74**			**25.43**	**/cy**	**5,302**
03345 Perimeter Concrete Walls at RAS Pump Station (93' x 25' x 1')												
03-21-10.60	0700	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	3.2	ton	4,286	5,019	-	-	-	2,881.61	/ton	9,305
03-21-10.60	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	3.2	ton	215	-	82	-	-	92.17	/ton	298
03-21-10.60	2225	Reinforcing, crane cost for handling, add to above, walls, cols, beams	3.2	ton	234	-	89	-	-	100.18	/ton	323
03-31-05.35	0350	Structural concrete,ready mix,normal weight,4500 psi,includes local aggregate,sand,portland cement and water,excludes all additives and treatments	90.4	cy	-	21,092	-	-	-	233.28	/cy	21,092
03-31-05.70	5350	Structural concrete, placing, walls, pumped, 15" thick, includes vibrating, excludes material	90.4	cy	4,585	-	767	-	-	59.20	/cy	5,352
03-35-29.60	0600	Concrete finishing, walls, float finish, 1/16" thick	4,650.0	sf	12,663	2,651	-	-	-	3.29	/sf	15,314
		Perimeter Concrete Walls at RAS Pump Station (93' x 25' x 1')	**2,325.0**	**cy**	**21,984**	**28,762**	**938**			**22.23**	**/cy**	**51,684**

Phase	Item	Description	Quantity	Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit	Total Net Amount
06999 Aluminum Grating										
05-53-13.10	0122	Floor grating, aluminum, 1-1/4" x 3/16" bearing bars @ 1-3/16" OC, cross bars @ 4" OC, up to 300 S.F., field fabricated from panels	742.0 sf	3,667	22,631	161	-	-	35.66 /sf	26,459
		Aluminum Grating	**1.0 LS**	**3,667**	**22,631**	**161**			**26,459.04 /LS**	**26,459**
31315 Excavation and Backfill for RAS Pump Station										
31-23-23.18	0400	Hauling, excavated or borrow material, loose cubic yards, 1 mile round trip, 2.2 loads/hour, 12 C.Y. truck, highway haulers, excludes loading	1,390.7 lcy	5,285	-	6,677	-	-	8.60 /lcy	11,961
		Excavation and Backfill for RAS Pump Station	**1,390.7 cy**	**5,285**		**6,677**			**8.60 /cy**	**11,961**
33521 8" Ductile Iron Pipe, buried										
33-14-13.15	2060	Water supply distribution piping,ductile iron pipe,cement lined,mechanical joint,fittings,18'lengths,8"diameter,class 50,excludes excavation backfill	48.0 lf	998	6,140	77	-	-	150.31 /lf	7,215
33-14-13.15	8040	Water supply distribution piping,fitting,90 degree bend elbow,mechanical joint,ductile iron,cement lined,awwa c110,8"diameter,class 50 water piping	8.0 ea	2,078	5,720	160	-	-	994.79 /ea	7,958
33-14-13.15	8240	Water supply distribution piping, fitting, wye or tee, ductile iron, cement lined, mechanical joint, AWWA C110, 8" diameter, class 50 water piping	4.0 ea	1,559	6,035	120	-	-	1,928.61 /ea	7,714
33-14-13.15	8460	Water supply distribution piping, fitting, reducer, ductile iron, cement lined, mechanical joint, AWWA C110, 8" x 6" diameter, class 50 water piping	1.0 ea	238	525	18	-	-	781.23 /ea	781
33-14-13.15	8730	Water supply distribution piping, joint restraint, ductile iron mechanical joints, 8" diameter	34.0 ea	4,416	2,721	341	-	-	219.95 /ea	7,478
33-00-00.01	BC-0011	Utility pipe testing, nondestructive hydraulic pressure test	1.9 hr	163	-	89	-	-	131.18 /hr	252
22-05-23.80	1480	Valves, steel, cast, check, swing type, flanged, 150 lb., 8"	4.0 ea	4,060	15,492	-	-	-	4,888.18 /ea	19,553
22-05-23.70	7050	Valves, semi-steel, lubricated plug valve, flanged, 200 psi, 8"	4.0 ea	4,060	9,155	-	-	-	3,303.73 /ea	13,215
		8" Ductile Iron Pipe, buried	**48.0 lf**	**17,573**	**45,789**	**805**			**1,336.80 /lf**	**64,167**
33999 Submersible Pump										
46-06-22.00	BC-0121	Submersible pump Local Control Panel-FLYGT-Model-NP 3300 HT3 - 463 - 1750 GPM 150 TDH	4.0 ea	11,116			-	163,824	43,734.93 /ea	174,940
		Submersible Pump	**4.0 EA**	**11,116**				**163,824**	**43,734.93 /EA**	**174,940**
33999 24" Slide Gates										
35-22-73.16	0120	Slide gates, hydraulic structures, steel, self contained, 24" x 24", incl. anchor bolts & grout	3.0 ea	3,290	23,979	853	-	-	9,374.18 /ea	28,123

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
		24" Slide Gates	**3.0**	**EA**	**3,290**	**23,979**	**853**			**9,374.18**	**/EA**	**28,123**
33999 Interior Mechanical and Piping Allowance												
33-99-99.99	MISC	RAS pump station, Interior Piping allowance	1.0	LS	49,256	50,744	-		-	100,000.00	/LS	100,000
		Interior Mechanical and Piping Allowance	**1.0**	**LS**	**49,256**	**50,744**				**100,000.00**	**/LS**	**100,000**
		350 RAS Pump Station Slab (472 sf x 1')	**1.0**	**LS**	**113,995**	**175,309**	**9,508**		**163,824**	**462,635.26**	**/LS**	**462,635**
		35 RAS Pump Station Slab (472 sf x 1')	**1.0**	**LS**	**113,995**	**175,309**	**9,508**		**163,824**	**462,635.26**	**/LS**	**462,635**
40 R-1 Treatment Facility												
400 R-1 Treatment Facility												
03320 Column Footing, 8' x 8'x 16" Thick												
31-23-16.16	6130	Strt excv for minr strt,bank measr,for sprd and mat ftngs,elvtr pits,and small bldng fndtn,clay,till blstd rock,1-1/2 cy buckt,machn excvt,hydrl backh	2,109.9	bcy	21,744	-	16,608	-	-	18.18	/bcy	38,351
03-11-13.45	5000	C.I.P. concrete forms, footing, spread, plywood, 1 use, includes erecting, bracing, stripping and cleaning	128.0	sfca	1,241	307	-	-	-	12.09	/sfca	1,547
03-11-13.45	6100	C.I.P. concrete forms, supports for dowels, plinths or templates, 8' x 8' footing, includes erecting, bracing, stripping and cleaning	6.0	ea	887	144	-	-	-	171.82	/ea	1,031
03-15-05.95	3000	Form oil, up to 1200 S.F. per gallon, coverage, includes material only	0.3	gal	-	5	-	-	-	14.75	/gal	5
03-21-10.60	0500	Reinforcing steel, in place, footings, #4 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	0.9	ton	1,591	955	-	-	-	2,685.42	/ton	2,546
03-21-10.60	2000	Reinforcing steel, unload and sort, add to base	0.9	ton	56	-	7	-	-	66.64	/ton	63
03-21-10.60	2210	Reinforcing steel, crane cost for handling, average, add	0.9	ton	61	-	7	-	-	72.43	/ton	69
31-23-16.13	2100	Excavating, trench or continuous footing, common earth, trim sides and bottom for concrete pours, excludes sheeting or dewatering	2,352.0	sf	2,879	-	72	-	-	1.25	/sf	2,950
03-31-05.35	0400	Structural concrete,ready mix,normal weight,5000 psi,includes local aggregate,sand,portland cement and water,excludes all additives and treatments	10.0	cy	-	2,253	-	-	-	226.37	/cy	2,253
03-31-05.70	2650	Structural concrete, placing, spread footing, pumped, over 5 C.Y., includes vibrating, excludes material	10.0	cy	372	-	75	-	-	44.87	/cy	447
31-05-13.10	0200	Soils for earthwork, common borrow, spread with 200 H.P. dozer, includes load at pit and haul, 2 miles round trip, excludes compaction	2,100.4	cy	7,956	46,780	9,530	-	-	30.60	/cy	64,266
31-23-16.13	3040	Excavating, trench backfill, 1 C.Y. bucket, 100' haul, front end loader, wheel mounted, excludes dewatering	2,100.4	lcy	10,666	-	3,512	-	-	6.75	/lcy	14,178

Phase	Item	Description	Quantity	Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit	Total Net Amount
03320 Column Footing, 8' x 8'x 16" Thick										
31-23-16.13	1900	Excavating, trench continuous footing, common earth, for tamping backfilled trenches, 6" lift, vibrating plate, excludes sheeting or dewatering, add	2,100.4 ecy	21,422	-	533	-	-	10.45 /ecy	21,955
31-23-23.18	1120	Hauling, excavated or borrow material, loose cubic yards, 10 mile round trip, 0.6 load/hour, 16.5 C.Y. dump trailer, highway haulers, excludes loading	2,109.9 lcy	16,659	-	18,459	-	-	16.64 /lcy	35,118
		Column Footing, 8' x 8'x 16" Thick	**10.0 cy**	**85,533**	**50,443**	**48,802**			**18,565.08 /cy**	**184,778**
03330 Upper Slab - 23-6" x 49' x 18" th.										
31-22-16.10	1100	Fine grading, fine grade for slab on grade, machine	128.0 sy	162	-	91	-	-	1.98 /sy	253
03-05-13.25	1050	Aggregate, stone, 3/4" to 1-1/2", prices per C.Y., includes material only	21.3 cy	-	1,147	-	-	-	53.78 /cy	1,147
03-15-13.50	1300	Waterstop, PVC, ribbed type, split, 3/8" thick x 6" wide	145.0 lf	855	709	-	-	-	10.79 /lf	1,564
03-15-13.50	5250	Waterstop, fittings, rubber, flat, dumbbell or center bulb, field union, 3/8" thick x 9" wide	12.0 ea	184	425	-	-	-	50.72 /ea	609
03-21-10.60	0600	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	6.4 ton	9,804	6,449	-	-	-	2,539.53 /ton	16,253
03-21-10.60	2005	Reinforcing in place, unloading & sorting, add to above - slabs	6.4 ton	381	-	45	-	-	66.63 /ton	426
03-31-05.35	0405	Concrete, ready mix, regular weight, slabs/mats, 5000 psi	67.2 cy	-	15,212	-	-	-	226.37 /cy	15,212
03-31-05.70	2950	Structural concrete, placing, foundation mat, pumped, over 20 C.Y., includes vibrating, excludes material	67.2 cy	942	-	189	-	-	16.83 /cy	1,131
03-35-29.30	0100	Concrete finishing, floors, monolithic, screed and bull float(darby) finish	1,152.0 sf	628	-	-	-	-	0.54 /sf	628
03-39-13.50	0300	Curing, sprayed membrane curing compound	11.5 csf	162	253	-	-	-	36.00 /csf	415
03-35-29.30	2350	Concrete finishing, floor, hardener, non-metallic, medium service, 0.75 psf, add	1,152.0 sf	1,161	478	-	-	-	1.42 /sf	1,640
		Upper Slab - 23-6" x 49' x 18" th.	**64.0 cy**	**14,278**	**24,673**	**326**			**613.70 /cy**	**39,277**
03330 Lower Slab - 65'-2" x 63'-8" x 18" th.										
31-22-16.10	1100	Fine grading, fine grade for slab on grade, machine	413.0 sy	522	-	294	-	-	1.98 /sy	816
03-05-13.25	1050	Aggregate, stone, 3/4" to 1-1/2", prices per C.Y., includes material only	68.8 cy	-	3,701	-	-	-	53.78 /cy	3,701
03-15-13.50	1300	Waterstop, PVC, ribbed type, split, 3/8" thick x 6" wide	436.0 lf	2,571	2,132	-	-	-	10.79 /lf	4,703
03-15-13.50	5250	Waterstop, fittings, rubber, flat, dumbbell or center bulb, field union, 3/8" thick x 9" wide	36.0 ea	552	1,274	-	-	-	50.72 /ea	1,826

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
03330 Lower Slab - 65'-2" x 63'-8" x 18" th.												
03-21-10.60	0600	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	20.7	ton	31,633	20,809	-	-	-	2,539.53	/ton	52,441
03-21-10.60	2005	Reinforcing in place, unloading & sorting, add to above - slabs	20.7	ton	1,230	-	146	-	-	66.63	/ton	1,376
03-31-05.35	0405	Concrete, ready mix, regular weight, slabs/mats, 5000 psi	216.8	cy	-	49,082	-	-	-	226.37	/cy	49,082
03-31-05.70	2950	Structural concrete, placing, foundation mat, pumped, over 20 C.Y., includes vibrating, excludes material	216.8	cy	3,038	-	611	-	-	16.83	/cy	3,649
03-35-29.30	0100	Concrete finishing, floors, monolithic, screed and bull float(darby) finish	3,717.0	sf	2,025	-	-	-	-	0.54	/sf	2,025
03-39-13.50	0300	Curing, sprayed membrane curing compound	37.2	csf	522	816	-	-	-	36.00	/csf	1,338
03-35-29.30	2350	Concrete finishing, floor, hardener, non-metallic, medium service, 0.75 psf, add	3,717.0	sf	3,748	1,543	-	-	-	1.42	/sf	5,290
		Lower Slab - 65'-2" x 63'-8" x 18" th.	**206.5**	**cy**	**45,840**	**79,357**	**1,051**			**611.37**	**/cy**	**126,248**
03335 Concrete Columns, 28" x 28" x 31'-10" High												
03-11-13.25	7150	C.I.P. concrete forms, column, square, plywood, 36" x 36", 4 use, includes erecting, bracing, stripping and cleaning	891.2	sfca	10,543	757	-	-	-	12.68	/sfca	11,299
03-15-05.12	5400	Chamfer strip, wood, 1" wide	382.0	lf	568	121	-	-	-	1.80	/lf	689
03-15-05.95	3050	Form oil, up to 800 S.F. per gallon, coverage, includes material only	2.4	gal	-	53	-	-	-	22.33	/gal	53
03-21-10.60	0250	Reinforcing steel, in place, columns, #8 to #18, A615, grade 60, incl labor for accessories, excl material for accessories	1.7	ton	2,581	1,698	-	-	-	2,539.53	/ton	4,279
03-21-10.60	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	1.7	ton	100	-	12	-	-	66.64	/ton	112
03-31-05.35	0407	Concrete, ready mix, regular weight, walls/cols/beams, 5000 psi	20.2	cy	-	8,385	-	-	-	414.72	/cy	8,385
03-31-05.70	1000	Structural concrete, placing, column, square or round, pumped, 36" thick, includes vibrating, excludes material	20.2	cy	809	-	163	-	-	48.08	/cy	972
03-35-29.60	0010	Finishing: break ties & patch voids (walls, cols or beams)	891.2	sf	1,247	46	-	-	-	1.45	/sf	1,294
		Concrete Columns, 28" x 28" x 31'-10" High	**3.0**	**ea**	**15,849**	**11,060**	**175**			**9,027.71**	**/ea**	**27,083**
03335 Concrete Columns, 24" x 24" x 38' High												
03-11-13.25	6650	C.I.P. concrete forms, column, square, plywood, 24" x 24", 4 use, includes erecting, bracing, stripping and cleaning	2,128.0	sfca	26,441	2,039	-	-	-	13.38	/sfca	28,479
03-15-05.12	5400	Chamfer strip, wood, 1" wide	1,064.0	lf	1,583	336	-	-	-	1.80	/lf	1,919
03-15-05.95	3050	Form oil, up to 800 S.F. per gallon, coverage, includes material only	5.7	gal	-	127	-	-	-	22.32	/gal	127

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
03335 Concrete Columns, 24" x 24" x 38' High												
03-21-10.60	0250	Reinforcing steel, in place, columns, #8 to #18, A615, grade 60, incl labor for accessories, excl material for accessories	3.4	ton	5,282	3,474	-	-	-	2,539.53	/ton	8,756
03-21-10.60	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	3.4	ton	205	-	24	-	-	66.63	/ton	230
03-31-05.35	0407	Concrete, ready mix, regular weight, walls/cols/beams, 5000 psi	41.4	cy	-	17,160	-	-	-	414.72	/cy	17,160
03-31-05.70	0800	Structural concrete, placing, column, square or round, pumped, 24" thick, includes vibrating, excludes material	41.4	cy	2,521	-	507	-	-	73.16	/cy	3,027
03-35-29.60	0010	Finishing: break ties & patch voids (walls, cols or beams)	2,128.0	sf	2,978	111	-	-	-	1.45	/sf	3,089
		Concrete Columns, 24" x 24" x 38' High	**39.4**	**cy**	**39,010**	**23,247**	**531**			**1,593.31**	**/cy**	**62,788**
03340 Beams (Spandrel or Frame) & Girders												
03-11-13.20	2650	C.I.P. concrete forms, beams and girders, interior, plywood, 24" wide, 4 use, includes shoring, erecting, bracing, stripping and cleaning	4,617.0	sfca	52,993	4,372	-	-	-	12.42	/sfca	57,366
03-15-05.95	3050	Form oil, up to 800 S.F. per gallon, coverage, includes material only	12.3	gal	-	275	-	-	-	22.33	/gal	275
03-15-05.70	0500	Shores, horizontal members, joists and stringers, aluminum, includes erect and strip by hand	288.0	ea	7,358	-	-	-	-	25.55	/ea	7,358
03-15-05.70	0600	Shores, horizontal members, adjustable beam, steel, includes erect and strip by hand	180.0	ea	6,132	-	-	-	-	34.07	/ea	6,132
03-15-05.70	1050	Shores, vertical members, to 13' high, includes erect and strip by hand	252.0	ea	7,726	-	-	-	-	30.66	/ea	7,726
03-15-05.70	3000	Shores, horizontal, rent for job duration, aluminum joists, @ 2' O.C., per month	513.0	flr	-	229	-	-	-	0.45	/flr	229
03-15-05.70	1500	Shores, reshoring	513.0	sf	562	341	-	-	-	1.76	/sf	902
03-21-10.60	0150	Reinforcing steel, in place, beams and girders, #8 to # 18, A615, grade 60, incl labor for accessories, excl material for accessories	3.3	ton	4,339	3,351	-	-	-	2,312.59	/ton	7,689
03-23-05.50	0300	Prestressing steel, grouted strand in beams, 100' span, 100 kip, post-tensioned in field	10,260.0	lb	39,091	31,016	800	-	-	6.91	/lb	70,907
03-21-10.60	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	8.5	ton	504	-	60	-	-	66.63	/ton	563
03-31-05.35	0407	Concrete, ready mix, regular weight, walls/cols/beams, 5000 psi	39.9	cy	-	16,547	-	-	-	414.72	/cy	16,547
03-31-05.70	0200	Structural concrete, placing, beam, large, elevated, pumped, includes vibrating, excludes material	39.9	cy	2,485	-	499	-	-	74.79	/cy	2,984
03-35-29.60	0700	Concrete finishing, walls, sandblast, light penetration	5,130.0	sf	13,886	4,612	1,192	-	-	3.84	/sf	19,690
		Beams (Spandrel or Frame) & Girders	**38.0**	**cy**	**135,076**	**60,742**	**2,551**			**5,220.25**	**/cy**	**198,369**
03340 Canopy Fascia Beams - 8'-10" deep x 2'-8' wide x 62'-6" & 75' long x 2 ea.												

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
03340 Canopy Fascia Beams - 8'-10" deep x 2'-8' wide x 62'-6" & 75' long x 2 ea.												
03-11-13.20	2550	C.I.P. concrete forms, beams and girders, interior, plywood, 24" wide, 2 use, includes shoring, erecting, bracing, stripping and cleaning	2,541.3	sfca	31,566	4,206	-	-	-	14.08	/sfca	35,772
03-15-05.95	3050	Form oil, up to 800 S.F. per gallon, coverage, includes material only	6.8	gal	-	151	-	-	-	22.32	/gal	151
03-15-05.12	5200	Chamfer strip, wood, 3/4" wide	500.0	lf	730	87	-	-	-	1.63	/lf	817
03-15-05.75	0250	Sleeves and chases, plastic, 12" long x 12" diameter, 1 use	8.0	ea	102	205	-	-	-	38.37	/ea	307
03-15-05.70	0500	Shores, horizontal members, joists and stringers, aluminum, includes erect and strip by hand	36.0	ea	920	-	-	-	-	25.55	/ea	920
03-15-05.70	0600	Shores, horizontal members, adjustable beam, steel, includes erect and strip by hand	20.0	ea	681	-	-	-	-	34.07	/ea	681
03-15-05.70	1050	Shores, vertical members, to 13' high, includes erect and strip by hand	28.0	ea	858	-	-	-	-	30.66	/ea	858
03-15-05.70	3000	Shores, horizontal, rent for job duration, aluminum joists, @ 2' O.C., per month	333.8	flr	-	149	-	-	-	0.45	/flr	149
03-15-05.70	1500	Shores, reshoring	333.8	sf	365	222	-	-	-	1.76	/sf	587
03-21-10.60	0150	Reinforcing steel, in place, beams and girders, #8 to # 18, A615, grade 60, incl labor for accessories, excl material for accessories	9.6	ton	12,462	9,623	-	-	-	2,312.59	/ton	22,085
03-21-10.60	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	9.6	ton	569	-	68	-	-	66.63	/ton	636
03-21-10.60	2225	Reinforcing, crane cost for handling, add to above, walls, cols, beams	9.6	ton	618	-	73	-	-	72.43	/ton	692
03-31-05.35	0407	Concrete, ready mix, regular weight, walls/cols/beams, 5000 psi	114.6	cy	-	25,943	-	-	-	226.37	/cy	25,943
03-31-05.70	0200	Structural concrete, placing, beam, large, elevated, pumped, includes vibrating, excludes material	114.6	cy	7,137	-	1,434	-	-	74.79	/cy	8,571
03-35-29.60	0700	Concrete finishing, walls, sandblast, light penetration	2,875.0	sf	7,782	2,585	668	-	-	3.84	/sf	11,035
		Canopy Fascia Beams - 8'-10" deep x 2'-8' wide x 62'-6" & 75' long x 2 ea.	**109.1**	**cy**	**63,791**	**43,170**	**2,244**			**1,000.52**	**/cy**	**109,205**
03345 Concrete Walls, 12' High x 14" Thick x 296' Long												
03-11-13.85	9260	Cip concret forms,walls,steel framed plywd,over 8'16'hg,based 50 us purchsd forms,4 us bracing lumber,includes erecting,bracing,stripping and cleaning	7,104.0	sfca	71,575	5,570	-	-	-	10.86	/sfca	77,144
03-15-05.95	3050	Form oil, up to 800 S.F. per gallon, coverage, includes material only	18.9	gal	-	423	-	-	-	22.33	/gal	423
03-21-10.60	0700	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	10.7	ton	12,515	10,738	-	-	-	2,182.10	/ton	23,252
03-21-10.60	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	10.7	ton	635	-	75	-	-	66.63	/ton	710

Phase	Item	Description	Quantity	Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit	Total Net Amount
03345 Concrete Walls, 12' High x 14" Thick x 296' Long										
03-31-05.35	0407	Concrete, ready mix, regular weight, walls/cols/beams, 5000 psi	161.2 cy	-	66,835	-	-	-	414.72 /cy	66,835
03-31-05.70	5350	Structural concrete, placing, walls, pumped, 15" thick, includes vibrating, excludes material	161.2 cy	7,527	-	1,513	-	-	56.09 /cy	9,039
03-35-29.60	0010	Finishing: break ties & patch voids (walls, cols or beams)	3,552.0 sf	4,971	185	-	-	-	1.45 /sf	5,155
		Concrete Walls, 12' High x 14" Thick x 296' Long	**153.5 cy**	**97,221**	**83,750**	**1,588**			**1,189.46 /cy**	**182,559**
03345 Concrete Walls, 12' High x 48" Thick x 296' Long										
03-11-13.85	9260	Cip concret forms,walls,steel framed plywd,over 8'16'hg,based 50 us purchsd forms,4 us bracing lumber,includes erecting,bracing,stripping and cleaning	696.0 sfca	7,012	546	-	-	-	10.86 /sfca	7,558
03-15-05.95	3050	Form oil, up to 800 S.F. per gallon, coverage, includes material only	1.9 gal	-	41	-	-	-	22.33 /gal	41
03-21-10.60	0700	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	1.0 ton	1,226	1,052	-	-	-	2,182.11 /ton	2,278
03-21-10.60	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	1.0 ton	62	-	7	-	-	66.64 /ton	70
03-31-05.35	0407	Concrete, ready mix, regular weight, walls/cols/beams, 5000 psi	54.1 cy	-	22,450	-	-	-	414.72 /cy	22,450
03-31-05.70	5350	Structural concrete, placing, walls, pumped, 15" thick, includes vibrating, excludes material	54.1 cy	2,528	-	508	-	-	56.09 /cy	3,036
03-35-29.60	0010	Finishing: break ties & patch voids (walls, cols or beams)	348.0 sf	487	18	-	-	-	1.45 /sf	505
		Concrete Walls, 12' High x 48" Thick x 296' Long	**51.6 cy**	**11,316**	**24,107**	**516**			**697.08 /cy**	**35,939**
03345 Concrete Walls, 6' High x 14" Thick x 28' Long										
03-11-13.85	9260	Cip concret forms,walls,steel framed plywd,over 8'16'hg,based 50 us purchsd forms,4 us bracing lumber,includes erecting,bracing,stripping and cleaning	336.0 sfca	3,385	263	-	-	-	10.86 /sfca	3,649
03-15-05.95	3050	Form oil, up to 800 S.F. per gallon, coverage, includes material only	0.9 gal	-	20	-	-	-	22.32 /gal	20
03-21-10.60	0700	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	0.5 ton	592	508	-	-	-	2,182.10 /ton	1,100
03-21-10.60	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	0.5 ton	30	-	4	-	-	66.65 /ton	34
03-31-05.35	0407	Concrete, ready mix, regular weight, walls/cols/beams, 5000 psi	7.6 cy	-	3,161	-	-	-	414.72 /cy	3,161
03-31-05.70	5350	Structural concrete, placing, walls, pumped, 15" thick, includes vibrating, excludes material	7.6 cy	356	-	72	-	-	56.09 /cy	428
03-35-29.60	0010	Finishing: break ties & patch voids (walls, cols or beams)	168.0 sf	235	9	-	-	-	1.45 /sf	244

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
		Concrete Walls, 6' High x 14" Thick x 28' Long	**7.3**	**cy**	**4,598**	**3,961**	**75**			**1,189.48**	**/cy**	**8,634**
03345 Concrete Walls, 7' High x 14" Thick x 25' Long												
03-11-13.85	9260	Cip concret forms,walls,steel framed plywd,over 8'16'hg,based 50 us purchsd forms,4 us bracing lumber,includes erecting,bracing,stripping and cleaning	350.0	sfca	3,526	274	-	-	-	10.86	/sfca	3,801
03-15-05.95	3050	Form oil, up to 800 S.F. per gallon, coverage, includes material only	0.9	gal	-	21	-	-	-	22.33	/gal	21
03-21-10.60	0700	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	0.5	ton	617	529	-	-	-	2,182.10	/ton	1,146
03-21-10.60	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	0.5	ton	31	-	4	-	-	66.65	/ton	35
03-31-05.35	0407	Concrete, ready mix, regular weight, walls/cols/beams, 5000 psi	7.9	cy	-	3,293	-	-	-	414.72	/cy	3,293
03-31-05.70	5350	Structural concrete, placing, walls, pumped, 15" thick, includes vibrating, excludes material	7.9	cy	371	-	75	-	-	56.09	/cy	445
03-35-29.60	0010	Finishing: break ties & patch voids (walls, cols or beams)	175.0	sf	245	9	-	-	-	1.45	/sf	254
		Concrete Walls, 7' High x 14" Thick x 25' Long	**7.6**	**cy**	**4,790**	**4,126**	**78**			**1,189.42**	**/cy**	**8,994**
03345 Concrete Walls, 5' High x 48" Thick x 47' Long												
03-11-13.85	9260	Cip concret forms,walls,steel framed plywd,over 8'16'hg,based 50 us purchsd forms,4 us bracing lumber,includes erecting,bracing,stripping and cleaning	470.0	sfca	4,735	368	-	-	-	10.86	/sfca	5,104
03-15-05.95	3050	Form oil, up to 800 S.F. per gallon, coverage, includes material only	1.3	gal	-	28	-	-	-	22.32	/gal	28
03-21-10.60	0700	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	0.7	ton	828	710	-	-	-	2,182.10	/ton	1,538
03-21-10.60	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	0.7	ton	42	-	5	-	-	66.64	/ton	47
03-31-05.35	0407	Concrete, ready mix, regular weight, walls/cols/beams, 5000 psi	36.6	cy	-	15,161	-	-	-	414.72	/cy	15,161
03-31-05.70	5350	Structural concrete, placing, walls, pumped, 15" thick, includes vibrating, excludes material	36.6	cy	1,707	-	343	-	-	56.09	/cy	2,050
03-35-29.60	0010	Finishing: break ties & patch voids (walls, cols or beams)	235.0	sf	329	12	-	-	-	1.45	/sf	341
		Concrete Walls, 5' High x 48" Thick x 47' Long	**34.8**	**cy**	**7,641**	**16,280**	**348**			**697.09**	**/cy**	**24,269**
03345 Concrete Walls, 8' High x 24" Thick x 270' Long												
03-11-13.85	9260	Cip concret forms,walls,steel framed plywd,over 8'16'hg,based 50 us purchsd forms,4 us bracing lumber,includes erecting,bracing,stripping and cleaning	4,320.0	sfca	43,525	3,387	-	-	-	10.86	/sfca	46,912

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
03345 Concrete Walls, 8' High x 24" Thick x 270' Long												
03-15-05.95	3050	Form oil, up to 800 S.F. per gallon, coverage, includes material only	11.5	gal	-	257	-	-	-	22.33	/gal	257
03-21-10.60	0700	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	6.5	ton	7,610	6,530	-	-	-	2,182.10	/ton	14,140
03-21-10.60	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	6.5	ton	386	-	46	-	-	66.63	/ton	432
03-31-05.35	0407	Concrete, ready mix, regular weight, walls/cols/beams, 5000 psi	168.0	cy	-	69,673	-	-	-	414.72	/cy	69,673
03-31-05.70	5350	Structural concrete, placing, walls, pumped, 15" thick, includes vibrating, excludes material	168.0	cy	7,846	-	1,577	-	-	56.09	/cy	9,423
03-35-29.60	0010	Finishing: break ties & patch voids (walls, cols or beams)	2,160.0	sf	3,023	112	-	-	-	1.45	/sf	3,135
		Concrete Walls, 8' High x 24" Thick x 270' Long	**168.0**	**cy**	**62,390**	**79,959**	**1,623**			**856.98**	**/cy**	**143,972**
03350 Elevated Slabs, 12" Thick												
03-11-13.35	1150	C.I.P. concrete forms, elevated slab, flat plate, plywood, to 15' high, 4 use, includes shoring, erecting, bracing, stripping and cleaning	1,071.0	sf	8,670	1,388	-	-	-	9.39	/sf	10,058
03-11-13.35	7000	C.I.P. concrete forms, elevated slab, edge forms, to 6" high, 4 use, includes shoring, erecting, bracing, stripping and cleaning	132.0	lf	781	29	-	-	-	6.13	/lf	810
03-15-05.70	1550	Shores, reshoring at elevated decks, allow	214.2	sf	235	142	-	-	-	1.76	/sf	377
03-21-10.60	0400	Reinforcing steel, in place, elevated slabs, #4 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	2.1	ton	2,531	2,099	-	-	-	2,222.60	/ton	4,630
03-23-05.50	2250	Prestressing steel, ungrouted single strand, 100' elevated slab, 35 kip, post-tensioned in field	856.8	lb	2,072	542	22	-	-	3.08	/lb	2,635
03-21-10.60	2050	Reinforcing in place, unloading & sorting, add to above - decks	0.4	ton	27	-	3	-	-	66.64	/ton	30
03-21-10.60	2220	Reinforcing steel, crane cost for handling, maximum, add	0.4	ton	76	-	9	-	-	190.38	/ton	85
03-31-05.35	0402	Concrete, ready mix, regular weight, elevated decks, 5000 psi	41.7	cy	-	17,273	-	-	-	414.72	/cy	17,273
03-31-05.70	1600	Structural concrete, placing, elevated slab, pumped, over 10" thick, includes vibrating, excludes material	41.7	cy	1,297	-	261	-	-	37.39	/cy	1,557
03-35-29.30	0020	Concrete finishing, floors, monolithic, screed finish	1,071.0	sf	486	-	-	-	-	0.45	/sf	486
03-15-05.25	5525	Sawcut control joints, elevated decks	39.0	lf	35	19	14	-	-	1.72	/lf	67
03-39-13.50	0310	Curing, sprayed membrane curing compound, elevated decks	10.7	csf	151	235	-	-	-	36.00	/csf	386
03-35-29.30	2300	Concrete finishing, floor, hardener, non-metallic, light service, 0.50 psf, add	1,071.0	sf	952	296	-	-	-	1.17	/sf	1,248
		Elevated Slabs, 12" Thick	**39.7**	**cy**	**17,312**	**22,022**	**309**			**999.38**	**/cy**	**39,642**
03350 Precast Double Tee Roof												

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
03350 Precast Double Tee Roof												
03-41-33.60	0200	Precast tees, double, floor, 60' span, prestressed	4,100.0	sf	3,474	58,929	1,017	-	-	15.47	/sf	63,420
22-14-26.13	3920	Drain, roof, flat metal deck, cast iron body, 12" cast iron dome, 6" pipe size	4.0	ea	612	2,935	-	-	-	886.63	/ea	3,547
07-71-23.10	0400	Aluminum downspouts, enameled, 6", .024" thick	120.0	lf	853	720	-	-	-	13.11	/lf	1,573
		Precast Double Tee Roof	**4,100.0**	**sf**	**4,939**	**62,584**	**1,017**			**16.72**	**/sf**	**68,539**
03360 Stairs (Cast in Place or Pan Fill)												
03-11-23.75	2000	C.I.P. concrete forms, stairs, cast on sloping ground (length x width), 1 use, includes erecting, bracing, stripping and cleaning	64.0	sf	1,319	159	-	-	-	23.09	/sf	1,478
03-11-23.75	2150	Edge forms, for stair landings on grade, to 6" high, 4 uses	38.0	lf	187	24	-	-	-	5.56	/lf	211
03-15-05.85	0010	Furnish & set stair tread inserts, cast iron, abrasive, 3" wide	64.0	lf	545	533	-	-	-	16.85	/lf	1,078
03-21-10.60	1250	Reinforcing in place, A615 Gr 60, cast in place stairs, #4 to #7	3.2	ton	3,936	3,265	-	-	-	2,222.60	/ton	7,201
03-21-10.60	2025	Reinforcing in place, unloading & sorting, add - stairs	3.2	ton	193	-	23	-	-	66.63	/ton	216
03-31-05.35	0165	Concrete, ready mix, lightweight, 3000 psi	451.5	cf	-	4,759	-	-	-	10.54	/cf	4,759
03-31-05.70	5450	Placing concrete, stairs, (cast in place or pan fill) - pumped	16.7	cy	781	-	157	-	-	56.09	/cy	938
03-35-29.30	4500	Concrete finishing, stairs, fresh concrete, steel trowel	156.0	sf	590	-	-	-	-	3.78	/sf	590
03-39-13.50	0325	Curing, sprayed membrane curing compound, stairs	1.6	csf	22	34	-	-	-	36.01	/csf	56
		Stairs (Cast in Place or Pan Fill)	**2.0**	**ea**	**7,573**	**8,774**	**180**			**8,263.73**	**/ea**	**16,527**
05999 Metal Grating												
05-53-13.10	0134	Floor grating, aluminum, 1-1/2" x 3/16" bearing bars @ 1-3/16" O.C., cross bars @ 4" O.C., over 300 S.F., field fabricated from panels	974.0	sf	3,489	27,759	103	-	-	32.19	/sf	31,351
05-12-05.60	BC-0056	Grating frame ss, for gratings 1" to 1-1/2" deep	521.0	lnft	52,356	38,118	-	-	-	173.65	/lnft	90,474
05-14-23.05	0010	Aluminum, structural shapes, 1" to 10" members, under 1 ton	1,371.0	lb	1,959	5,912	629	-	-	6.20	/lb	8,500
03-82-16.10	0700	Concrete impact drilling, for anchors, to 4" d, 1" dia, in concrete or brick walls and floors, includes bit cost, layout and set up time, excl anchor	112.0	ea	2,136	27	-	-	-	19.31	/ea	2,163
05-05-19.10	1430	Chemical anchor, 3/4" diameter x 9-1/2" L, in concrete, brick or stone, incl layout, drilling, threaded rod & epoxy cartridge	112.0	ea	5,186	1,492	498	-	-	64.06	/ea	7,175
		Metal Grating	**1,200.0**	**sf**	**65,126**	**73,308**	**1,230**			**116.39**	**/sf**	**139,663**
05999 Handrails - Treatment Area												
05-52-13.50	2010	2-line pipe rail with pickets and attached handrail,aluminum,satin finish,1-1/2"pipe,1/2"pickets @ 4-1/2"oc, 42"high,shop fabricated,straight&level	124.0	lf	3,702	32,984	109	-	-	296.73	/lf	36,795

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
		Handrails - Treatment Area	**1.0**	**LS**	**3,702**	**32,984**	**109**			**36,794.73**	**/LS**	**36,795**
05999 Checkered Plate at UV Channels												
05-54-13.20	0300	Floor plate, steel checkered plate, pit or trench cover and frame, 2' to 3' W x 1/4" T, field fabricated	522.0	sf	18,699	5,977	551	-	-	48.33	/sf	25,227
05-54-13.20	0400	Floor plate, steel checkered plate, pit or trench cover and frame, 2' to 3' W x 1/4" T, field fabricated, for galvanized, add	5,325.0	lb	-	1,438	-	-	-	0.27	/lb	1,438
05-12-05.60	BC-0056	Grating frame ss, for gratings 1" to 1-1/2" deep	218.0	lnft	21,907	15,950	-	-	-	173.65	/lnft	37,857
05-14-23.05	0010	Aluminum, structural shapes, 1" to 10" members, under 1 ton	38.0	lb	54	164	17	-	-	6.20	/lb	236
03-82-16.10	0700	Concrete impact drilling, for anchors, to 4" d, 1" dia, in concrete or brick walls and floors, includes bit cost, layout and set up time, excl anchor	16.0	ea	305	4	-	-	-	19.31	/ea	309
05-05-19.10	1430	Chemical anchor, 3/4" diameter x 9-1/2" L, in concrete, brick or stone, incl layout, drilling, threaded rod & epoxy cartridge	16.0	ea	741	213	71	-	-	64.06	/ea	1,025
		Checkered Plate at UV Channels	**1.0**	**LS**	**41,706**	**23,745**	**640**			**66,091.05**	**/LS**	**66,091**
07999 Roofing System												
07-53-29.10	7600	Polyisobutylene roofing, (PIB), 0.57 psf, loose-laid & ballasted with stone/gravel (10 psf), 100 mils	44.0	sq	3,132	12,430	188	-	-	357.94	/sq	15,750
		Roofing System	**44.0**	**sq**	**3,132**	**12,430**	**188**			**357.94**	**/sq**	**15,750**
11999 Bridge Crane												
41-22-13.13	0500	Overhead bridge crane, under hung hoist, electric operating, 2 girder, 2 ton, 50' span	1.0	ea	7,476	52,000	425	-	-	59,901.06	/ea	59,901
		Bridge Crane	**1.0**	**ea**	**7,476**	**52,000**	**425**			**59,901.06**	**/ea**	**59,901**
33999 Interior Piping Allowance												
33-99-99.99	MISC	Pretretreatment Interior Piping allowance	1.0	LS	***30,000***	***30,000***	-		-	60,000.00	/LS	60,000
		Interior Piping Allowance	**1.0**	**LS**	**30,000**	**30,000**				**60,000.00**	**/LS**	**60,000**
40500 3" BW Piping Filtration System 1												
40-05-31.13	A111002 080000	Pipe Plain End-PVC--Sch 40 3 Inch (80mm)	120.0	lf	-	422	-	-	-	3.52	/lf	422
40-05-31.13	A112211 080000	Fitting Socket Weld-PVC-Ell45-Sch 40 3 Inch (80mm)	1.0	ea	-	24	-	-	-	24.10	/ea	24
40-05-31.13	A112212 080000	Fitting Socket Weld-PVC-Ell90-Sch 40 3 Inch (80mm)	9.0	ea	-	215	-	-	-	23.88	/ea	215
40-05-31.13	A112214 080000	Fitting Socket Weld-PVC-Tee-Sch 40 3 Inch (80mm)	5.0	ea	-	155	-	-	-	30.90	/ea	155
40-05-05.00	L1134660 80001	Pipe Erection-Handle Fittings-Plastic-Sch 40 3 Inch (80mm)	15.0	ea	285	-	-	-	-	19.02	/ea	285
40-05-63.00	A116233 616200	Valve Socket Weld-PVC-Ball-Cls 150 (PN20) 3 Inch (80mm)	4.0	ea	-	1,871	-	-	-	467.79	/ea	1,871

Phase	Item	Description	Quantity	Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit	Total Net Amount
40500 3" BW Piping Filtration System 1										
40-05-51.00	L1140620 06201	Pipe Erection-Handle Valves-Plastic-Cls 150 (PN20) 3 Inch (80mm)	4.0 ea	144	-	-	-	-	35.97 /ea	144
40-05-31.13	L1140020 800P1	Pipe Erection-Straight Run-PVC-Sch 40 3 Inch (80mm)	120.0 lf	819	-	-	-	-	6.82 /lf	819
40-05-05.00	L1134610 00000	Pipe Erection-Make Up Cemented Plastic Socket Joint-Non-Specific 3 Inch (80mm)	43.0 ea	2,667	-	-	-	-	62.01 /ea	2,667
40-05-07.00	A116044 000000	Pipe Support 3 Inch (80mm)	5.0 ea	258	89	-	-	-	69.57 /ea	348
40-05-07.00	A116045 000000	Hanger Rod 3 Inch (80mm)	5.0 ea	155	119	-	-	-	54.87 /ea	274
40-05-07.00	A116043 000000	Hilti-Chemical Anchor - Pipe Support Size 3 Inch (80mm)	5.0 ea	103	60	-	-	-	32.60 /ea	163
40-05-05.00	L1190480 00000	Field Testing-Hydrotest-Non-Specific 3 Inch (80mm)	120.0 lf	260	-	-	-	-	2.17 /lf	260
		3" BW Piping Filtration System 1	**120.0 lf**	**4,692**	**2,955**				**63.72 /lf**	**7,647**
40500 3" BW Piping Filtration System 2										
40-05-31.13	A111002 080000	Pipe Plain End-PVC--Sch 40 3 Inch (80mm)	120.0 lf	-	422	-	-	-	3.52 /lf	422
40-05-31.13	A112211 080000	Fitting Socket Weld-PVC-Ell45-Sch 40 3 Inch (80mm)	1.0 ea	-	24	-	-	-	24.10 /ea	24
40-05-31.13	A112212 080000	Fitting Socket Weld-PVC-Ell90-Sch 40 3 Inch (80mm)	9.0 ea	-	215	-	-	-	23.88 /ea	215
40-05-31.13	A112214 080000	Fitting Socket Weld-PVC-Tee-Sch 40 3 Inch (80mm)	5.0 ea	-	155	-	-	-	30.90 /ea	155
40-05-05.00	L1134660 80001	Pipe Erection-Handle Fittings-Plastic-Sch 40 3 Inch (80mm)	15.0 ea	285	-	-	-	-	19.02 /ea	285
40-05-63.00	A116233 616200	Valve Socket Weld-PVC-Ball-Cls 150 (PN20) 3 Inch (80mm)	4.0 ea	-	1,871	-	-	-	467.79 /ea	1,871
40-05-51.00	L1140620 06201	Pipe Erection-Handle Valves-Plastic-Cls 150 (PN20) 3 Inch (80mm)	4.0 ea	144	-	-	-	-	35.97 /ea	144
40-05-31.13	L1140020 800P1	Pipe Erection-Straight Run-PVC-Sch 40 3 Inch (80mm)	120.0 lf	819	-	-	-	-	6.82 /lf	819
40-05-05.00	L1134610 00000	Pipe Erection-Make Up Cemented Plastic Socket Joint-Non-Specific 3 Inch (80mm)	43.0 ea	2,667	-	-	-	-	62.01 /ea	2,667
40-05-07.00	A116044 000000	Pipe Support 3 Inch (80mm)	5.0 ea	258	89	-	-	-	69.57 /ea	348
40-05-07.00	A116045 000000	Hanger Rod 3 Inch (80mm)	5.0 ea	155	119	-	-	-	54.87 /ea	274
40-05-07.00	A116043 000000	Hilti-Chemical Anchor - Pipe Support Size 3 Inch (80mm)	5.0 ea	103	60	-	-	-	32.60 /ea	163
40-05-05.00	L1190480 00000	Field Testing-Hydrotest-Non-Specific 3 Inch (80mm)	120.0 lf	260	-	-	-	-	2.17 /lf	260
		3" BW Piping Filtration System 2	**120.0 lf**	**4,692**	**2,955**				**63.72 /lf**	**7,647**
40500 6" BW Piping to Backwash Return										

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
40500 6" BW Piping to Backwash Return												
40-05-31.13	A151002080000	Pipe Plain End-PVC--Sch 40 6 Inch (150mm)	50.0	lf	-	443	-	-	-	8.86	/lf	443
40-05-31.13	A152212080000	Fitting Socket Weld-PVC-Ell90-Sch 40 6 Inch (150mm)	2.0	ea	-	855	-	-	-	427.67	/ea	855
40-05-31.13	A152216080000	Fitting Socket Weld-PVC-Reducer 1 Dia-Sch 40 6 Inch (150mm)	2.0	ea	-	233	-	-	-	116.60	/ea	233
40-05-31.13	A152214080000	Fitting Socket Weld-PVC-Tee-Sch 40 6 Inch (150mm)	1.0	ea	-	315	-	-	-	315.40	/ea	315
40-05-05.00	L153466080001	Pipe Erection-Handle Fittings-Plastic-Sch 40 6 Inch (150mm)	5.0	ea	168	-	-	-	-	33.69	/ea	168
40-05-31.13	L1540020800P1	Pipe Erection-Straight Run-PVC-Sch 40 6 Inch (150mm)	50.0	lf	434	-	-	-	-	8.68	/lf	434
40-05-05.00	L153461000000	Pipe Erection-Make Up Cemented Plastic Socket Joint-Non-Specific 6 Inch (150mm)	9.0	ea	651	-	-	-	-	72.35	/ea	651
40-05-07.00	A156044000000	Pipe Support 6 Inch (150mm)	2.0	ea	207	36	-	-	-	121.25	/ea	243
40-05-07.00	A156045000000	Hanger Rod 6 Inch (150mm)	2.0	ea	62	179	-	-	-	120.48	/ea	241
40-05-07.00	A156043000000	Hilti-Chemical Anchor - Pipe Support Size 6 Inch (150mm)	2.0	ea	41	60	-	-	-	50.50	/ea	101
40-05-05.00	L159048000000	Field Testing-Hydrotest-Non-Specific 6 Inch (150mm)	50.0	lf	258	-	-	-	-	5.17	/lf	258
		6" BW Piping to Backwash Return	**50.0**	**lf**	**1,822**	**2,122**				**78.87**	**/lf**	**3,944**
40500 1" CLS Piping												
40-05-31.13	A061002080000	Pipe Plain End-PVC--Sch 40 1 Inch (25mm)	97.7	lf	-	84	-	-	-	0.86	/lf	84
40-05-31.13	A062212080000	Fitting Socket Weld-PVC-Ell90-Sch 40 1 Inch (25mm)	12.0	ea	-	13	-	-	-	1.12	/ea	13
40-05-31.13	A062214080000	Fitting Socket Weld-PVC-Tee-Sch 40 1 Inch (25mm)	6.0	ea	-	9	-	-	-	1.57	/ea	9
40-05-05.00	L063466080001	Pipe Erection-Handle Fittings-Plastic-Sch 40 1 Inch (25mm)	18.0	ea	156	-	-	-	-	8.68	/ea	156
40-05-63.00	A066233616200	Valve Socket Weld-PVC-Ball-Cls 150 (PN20) 1 Inch (25mm)	7.0	ea	-	728	-	-	-	103.95	/ea	728
40-05-51.00	L064062006201	Pipe Erection-Handle Valves-Plastic-Cls 150 (PN20) 1 Inch (25mm)	7.0	ea	69	-	-	-	-	9.92	/ea	69
40-05-31.13	L0640020800P1	Pipe Erection-Straight Run-PVC-Sch 40 1 Inch (25mm)	100.0	lf	682	-	-	-	-	6.82	/lf	682
40-05-05.00	L063461000000	Pipe Erection-Make Up Cemented Plastic Socket Joint-Non-Specific 1 Inch (25mm)	56.0	ea	2,894	-	-	-	-	51.68	/ea	2,894
40-05-07.00	A066044000000	Pipe Support 1 Inch (25mm)	4.0	ea	207	57	-	-	-	65.99	/ea	264
40-05-07.00	A066045000000	Hanger Rod 1 Inch (25mm)	4.0	ea	83	57	-	-	-	34.99	/ea	140
40-05-07.00	A066043000000	Hilti-Chemical Anchor - Pipe Support Size 1 Inch (25mm)	4.0	ea	41	24	-	-	-	16.30	/ea	65

Phase	Item	Description	Quantity	Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit	Total Net Amount
40500 1" CLS Piping										
40-05-05.00	L0690480 00000	Field Testing-Hydrotest-Non-Specific 1 Inch (25mm)	100.0 lf	124	-	-	-	-	1.24 /lf	124
		1" CLS Piping	**100.0 lf**	**4,257**	**973**				**52.29 /lf**	**5,229**
40500 4" PD at Backwash Return Pumps										
40-05-31.13	A131002 080000	Pipe Plain End-PVC--Sch 40 4 Inch (100mm)	116.6 lf	-	587	-	-	-	5.03 /lf	587
40-05-31.13	A132211 080000	Fitting Socket Weld-PVC-Ell45-Sch 40 4 Inch (100mm)	1.0 ea	-	49	-	-	-	48.96 /ea	49
40-05-31.13	A132212 080000	Fitting Socket Weld-PVC-Ell90-Sch 40 4 Inch (100mm)	5.0 ea	-	365	-	-	-	73.04 /ea	365
40-05-31.13	A132214 080000	Fitting Socket Weld-PVC-Tee-Sch 40 4 Inch (100mm)	1.0 ea	-	58	-	-	-	57.87 /ea	58
40-05-05.00	L1334660 80001	Pipe Erection-Handle Fittings-Plastic-Sch 40 4 Inch (100mm)	7.0 ea	163	-	-	-	-	23.26 /ea	163
40-05-65.23	A136235 616200	Valve Socket Weld-PVC-Check-Cls 150 (PN20) 4 Inch (100mm)	2.0 ea	-	1,318	-	-	-	659.01 /ea	1,318
40-05-62.00	A136437 026200	Valve Flanged & Bolted-Iron Body-Plug-Cls 150 (PN20) 4 Inch (100mm)	3.0 ea	-	3,057	-	-	-	1,019.06 /ea	3,057
40-05-51.00	L1340620 06201	Pipe Erection-Handle Valves-Plastic-Cls 150 (PN20) 4 Inch (100mm)	5.0 ea	276	-	-	-	-	55.19 /ea	276
40-05-31.13	L1340020 800P1	Pipe Erection-Straight Run-PVC-Sch 40 4 Inch (100mm)	120.0 lf	893	-	-	-	-	7.44 /lf	893
40-05-05.00	L1334610 00000	Pipe Erection-Make Up Cemented Plastic Socket Joint-Non-Specific 4 Inch (100mm)	25.0 ea	1,809	-	-	-	-	72.35 /ea	1,809
40-05-07.00	A136044 000000	Pipe Support 4 Inch (100mm)	5.0 ea	517	89	-	-	-	121.25 /ea	606
40-05-07.00	A136045 000000	Hanger Rod 4 Inch (100mm)	5.0 ea	155	149	-	-	-	60.83 /ea	304
40-05-07.00	A136043 000000	Hilti-Chemical Anchor - Pipe Support Size 4 Inch (100mm)	5.0 ea	103	119	-	-	-	44.53 /ea	223
40-05-05.00	L1390480 00000	Field Testing-Hydrotest-Non-Specific 4 Inch (100mm)	120.0 lf	347	-	-	-	-	2.89 /lf	347
		4" PD at Backwash Return Pumps	**120.0 lf**	**4,263**	**5,792**				**83.79 /lf**	**10,055**
46999 Process Equipment										
46-06-04.00	BC-1340	Flocculation Mixers, 540 lbs, 1 hp	8.0 ea	16,451	12,000	3,932	-	198,128	28,813.81 /ea	230,510
46-06-04.00	BC-1340	Rapid Mixer, 340 lbs, 2 hp	1.0 ea	1,371	350	8	-	21,482	23,210.57 /ea	23,211
46-06-08.00	BC-0146	Slide gate structures, various sizes, aluminum frame and slide, stainless fasteners, self contained, geared handwheel lift	13.0 ea	34,304	6,500	7,347	-	74,919	9,466.94 /ea	123,070
		Process Equipment	**1.0 ls**	**52,125**	**18,850**	**11,287**		**294,529**	**376,791.25 /ls**	**376,791**
46999 Rotating Cloth Disk Filters										
46-06-00.00	BC-0696	Rotating cloth filters w/ backwash pump and flowmeter	2.0 ea	41,127	10,000	9,829	-	1,105,430	583,193.06 /ea	1,166,386

Phase	Item	Description	Quantity	Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit	Total Net Amount
		Rotating Cloth Disk Filters	**2.0 EA**	**41,127**	**10,000**	**9,829**		**1,105,430**	**583,193.06 /EA**	**1,166,386**
46999 UV Disinfection System										
46-06-00.00	BC-1066	Ultraviolet Lamp Array	2.0 ea	164,507	10,000	39,317	-	1,370,400	792,112.22 /ea	1,584,224
		UV Disinfection System	**2.0 EA**	**164,507**	**10,000**	**39,317**		**1,370,400**	**792,112.22 /EA**	**1,584,224**
46999 Sluice Gates at UV Channel										
35-22-26.16	0220	Hydraulic sluice gates, hydraulic structures, cast iron, heavy duty, self contained w/crank operated gate, 102" x 38", AWWA C501	1.0 ea	10,787	250	4,660	-	9,400	25,096.65 /ea	25,097
35-22-26.16	0180	Hydraulic sluice gates, hydraulic structures, cast iron, heavy duty, self contained w/crank operated gate, 60" x 66", AWWA C501	1.0 ea	9,160	250	1,962	-	9,000	20,371.60 /ea	20,372
		Sluice Gates at UV Channel	**1.0 LS**	**19,947**	**500**	**6,622**		**18,400**	**45,468.25 /LS**	**45,468**
46999 Pumps, 250 HP, Turbine										
46-06-20.00	BC-0166	MLPS turbine pump, CI, 12,500 GPM, 250 HP, 20" discharge	3.0 ea	22,313	265,265				95,859.29 /ea	287,578
		Pumps, 250 HP, Turbine	**3.0 EA**	**22,313**	**265,265**				**95,859.29 /EA**	**287,578**
		400 R-1 Treatment Facility	**1.0 LS**	**1,088,043**	**1,142,134**	**131,060**		**2,788,759**	**5,149,995.14 /LS**	**5,149,995**
		40 R-1 Treatment Facility	**1.0 LS**	**1,088,043**	**1,142,134**	**131,060**		**2,788,759**	**5,149,995.14 /LS**	**5,149,995**
44 Effluent Pump Station										
440 Effluent Pump Station										
03330 Effluent Pump Station Slabs (On Grade & Mat)										
31-22-16.10	1100	Fine grading, fine grade for slab on grade, machine	216.7 sy	298	-	181	-	-	2.21 /sy	479
03-05-13.25	1050	Aggregate, stone, 3/4" to 1-1/2", prices per C.Y., includes material only	72.2 cy	-	2,745	-	-	-	38.00 /cy	2,745
03-15-13.50	1300	Waterstop, PVC, ribbed type, split, 3/8" thick x 6" wide	190.0 lf	1,220	1,169	-	-	-	12.57 /lf	2,389
03-15-13.50	5250	Waterstop, fittings, rubber, flat, dumbbell or center bulb, field union, 3/8" thick x 9" wide	16.0 ea	267	592	-	-	-	53.72 /ea	860
03-31-05.35	0350	Structural concrete,ready mix,normal weight,4500 psi,includes local aggregate,sand,portland cement and water,excludes all additives and treatments	151.7 cy	-	35,381	-	-	-	233.28 /cy	35,381
03-31-05.70	2950	Structural concrete, placing, foundation mat, pumped, over 20 C.Y., includes vibrating, excludes material	151.7 cy	2,308	-	386	-	-	17.76 /cy	2,693
03-35-29.30	0250	Concrete finishing, floors, monolithic, machine trowel finish	1,950.0 sf	2,683	-	124	-	-	1.44 /sf	2,807
03-39-13.50	0300	Curing, sprayed membrane curing compound	19.5 csf	298	457	-	-	-	38.69 /csf	754
03-35-29.30	2350	Concrete finishing, floor, hardener, non-metallic, medium service, 0.75 psf, add	1,950.0 sf	2,124	944	-	-	-	1.57 /sf	3,068

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
		Effluent Pump Station Slabs (On Grade & Mat)	**151.7**	**cy**	**9,198**	**41,287**	**691**			**337.41**	**/cy**	**51,176**
03345 Effluent Pump Station Concrete Walls												
03-11-13.85	X9950	Forms in place, wall, steel framed plywood, >16' high, 2 use/month	7,600.0	sfca	86,176	86,906	-	-	-	22.77	/sfca	173,082
03-11-13.85	0150	C.I.P. concrete forms, wall, box out for opening, to 16" thick, over 10 S.F. (use perimeter), includes erecting, bracing, stripping and cleaning	2.5	lf	44	8	-	-	-	20.96	/lf	52
03-15-05.95	3050	Form oil, up to 800 S.F. per gallon, coverage, includes material only	20.3	gal	-	486	-	-	-	23.96	/gal	486
03-21-10.60	0700	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	7.9	ton	10,441	12,228	-	-	-	2,881.61	/ton	22,670
03-21-10.60	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	7.9	ton	525	-	200	-	-	92.17	/ton	725
03-21-10.60	2225	Reinforcing, crane cost for handling, add to above, walls, cols, beams	7.9	ton	570	-	218	-	-	100.18	/ton	788
03-31-05.35	0350	Structural concrete,ready mix,normal weight,4500 psi,includes local aggregate,sand,portland cement and water,excludes all additives and treatments	220.3	cy	-	51,384	-	-	-	233.28	/cy	51,384
03-31-05.70	5350	Structural concrete, placing, walls, pumped, 15" thick, includes vibrating, excludes material	220.3	cy	11,171	-	1,868	-	-	59.19	/cy	13,039
03-35-29.60	0600	Concrete finishing, walls, float finish, 1/16" thick	7,552.0	sf	20,566	4,305	-	-	-	3.29	/sf	24,871
		Effluent Pump Station Concrete Walls	**220.3**	**cy**	**129,493**	**155,317**	**2,286**			**1,303.38**	**/cy**	**287,096**
03351 Effluent Pump Station Elevated Slabs (Flat)												
03-11-13.35	1150	C.I.P. concrete forms, elevated slab, flat plate, plywood, to 15' high, 4 use, includes shoring, erecting, bracing, stripping and cleaning	1,950.0	sf	17,176	3,970	-	-	-	10.84	/sf	21,147
03-11-13.35	7090	C.I.P. concrete forms, elevated slab, edge forms, 7" to 12" high, 3 use, includes shoring, erecting, bracing, stripping and cleaning	190.0	sfca	2,755	168	-	-	-	15.38	/sfca	2,923
03-11-13.35	5550	Cip concrete forms,elevated slab,box-out for shallow slab openings,over 10 sf (use perimeter),includes shoring,erecting,bracing,stripping and cleaning	16.0	lf	132	41	-	-	-	10.80	/lf	173
03-15-05.70	1550	Shores, reshoring at elevated decks, allow	1,950.0	sf	2,326	1,295	-	-	-	1.86	/sf	3,620
03-21-10.60	0400	Reinforcing steel, in place, elevated slabs, #4 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	3.8	ton	5,164	5,846	-	-	-	2,927.38	/ton	11,010
03-21-10.60	2050	Reinforcing in place, unloading & sorting, add to above - decks	3.8	ton	251	-	96	-	-	92.17	/ton	347
03-21-10.60	2220	Reinforcing steel, crane cost for handling, maximum, add	3.8	ton	717	-	274	-	-	263.33	/ton	990

Phase	Item	Description	Quantity	Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit	Total Net Amount
03351 Effluent Pump Station Elevated Slabs (Flat)										
03-31-05.35	0350	Structural concrete,ready mix,normal weight,4500 psi,includes local aggregate,sand,portland cement and water,excludes all additives and treatments	75.2 cy	-	17,545	-	-	-	233.28 /cy	17,545
03-31-05.70	1600	Structural concrete, placing, elevated slab, pumped, over 10" thick, includes vibrating, excludes material	75.2 cy	2,543	-	425	-	-	39.46 /cy	2,968
03-39-13.50	0310	Curing, sprayed membrane curing compound, elevated decks	19.5 csf	298	408	-	-	-	36.19 /csf	706
03-35-29.30	2300	Concrete finishing, floor, hardener, non-metallic, light service, 0.50 psf, add	1,950.0 sf	1,874	606	-	-	-	1.27 /sf	2,481
07-72-33.10	1100	Roof hatch, with curb, 1" fiberglass insulation, aluminum curb & cover, 4' x 4'	1.0 ea	429	3,004	-	-	-	3,432.86 /ea	3,433
		Effluent Pump Station Elevated Slabs (Flat)	**75.2 cy**	**33,664**	**32,883**	**795**			**895.39 /cy**	**67,342**
31290 Effluent Pump Station Excavation and Backfill (Sloped Sides)										
31-23-16.42	4400	Excavating, bulk bank measure, in sheeting or cofferdam, with all other equipment, minimum	4,376.4 bcy	40,033	-	37,717	-	-	17.77 /bcy	77,750
31-23-23.23	7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	47.3 ecy	154	-	30	-	-	3.89 /ecy	184
31-23-23.16	0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	110.1 lcy	1,502	4,872	272	-	-	60.37 /lcy	6,645
31-23-23.23	7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	94.7 ecy	308	-	60	-	-	3.89 /ecy	368
31-23-23.14	4020	Backfill, structural, common earth, 200 HP dozer, 50' haul, from existing stockpile, excludes compaction	3,262.9 lcy	1,641	-	2,252	-	-	1.19 /lcy	3,893
31-23-23.23	7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	2,837.3 ecy	9,232	-	1,800	-	-	3.89 /ecy	11,032
31-23-23.19	BC-0011	Loading trucks, 2.5 C.Y. bucket, front end loader, wheel mounted	1,227.0 bcy	862	-	564	-	-	1.16 /bcy	1,426
31-23-23.18	0450	Hauling, excavated or borrow material, loose cubic yards, 3 mile round trip , 1.9 loads/hour, 12 C.Y. truck, highway haulers, excludes loading	1,526.7 lcy	6,143	-	7,761	-	-	9.11 /lcy	13,904
		Effluent Pump Station Excavation and Backfill (Sloped Sides)	**4,376.4 cy**	**59,874**	**4,872**	**50,457**			**26.32 /cy**	**115,203**
33999 Effluent Pumps										
46-06-18.00	BC-0051	Pumps, gen util, W/mot, mtd on base, sgl stage, 5"d. x 6"s., 40 HP	3.0 ea	23,931	24,113		-	-	16,014.50 /ea	48,043
46-06-20.00	BC-0021	Pumps, gen util, W/mot, sump pump, submersible, 8100 gpm @ 76 TDH incl VFD.250hp	3.0 ea	48,228	708,750		-	-	252,325.89 /ea	756,978

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
33999 Effluent Pumps												
46-06-32.00	BC-0161	Pumps, crcltg, CI, htd/CHW appl, close cpld,end suct, 4",10HP,600GPM	3.0	ea	4,645	10,575		-	-	5,073.46	/ea	15,220
		Effluent Pumps	**3.0**	**ea**	**76,804**	**743,438**				**273,413.85**	**/ea**	**820,242**
33999 Interior Mechanical and Piping Allowance												
33-99-99.99	MISC	Pretretreatment Interior Piping allowance	1.0	LS	*50,000*	*50,000*	-		-	100,000.00	/LS	100,000
		Interior Mechanical and Piping Allowance	**1.0**	**LS**	**50,000**	**50,000**				**100,000.00**	**/LS**	**100,000**
		440 Effluent Pump Station	**1.0**	**LS**	**359,034**	**1,027,797**	**54,228**			**1,441,058.26**	**/LS**	**1,441,058**
		44 Effluent Pump Station	**1.0**	**LS**	**359,034**	**1,027,797**	**54,228**			**1,441,058.26**	**/LS**	**1,441,058**
48 Aerobic Digester												
480 Aerobic Digester												
03330 Aerobic Digester Slab (On Grade & Mat) (11,600sf x 2')												
31-22-16.10	1100	Fine grading, fine grade for slab on grade, machine	1,288.9	sy	1,774	-	1,075	-	-	2.21	/sy	2,849
03-05-13.25	1050	Aggregate, stone, 3/4" to 1-1/2", prices per C.Y., includes material only	429.6	cy	-	16,326	-	-	-	38.00	/cy	16,326
03-15-13.50	1300	Waterstop, PVC, ribbed type, split, 3/8" thick x 6" wide	316.0	lf	2,029	1,944	-	-	-	12.57	/lf	3,973
03-15-13.50	5250	Waterstop, fittings, rubber, flat, dumbbell or center bulb, field union, 3/8" thick x 9" wide	26.0	ea	434	963	-	-	-	53.72	/ea	1,397
03-21-10.60	0600	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	53.7	ton	92,970	83,478	-	-	-	3,285.55	/ton	176,447
03-21-10.60	2005	Reinforcing in place, unloading & sorting, add to above - slabs	53.7	ton	3,582	-	1,367	-	-	92.17	/ton	4,950
03-21-10.60	2215	Reinforcing in place, crane cost for handling, add to above, slabs	53.7	ton	3,894	-	1,486	-	-	100.18	/ton	5,380
03-31-05.35	0350	Structural concrete,ready mix,normal weight,4500 psi,includes local aggregate,sand,portland cement and water,excludes all additives and treatments	902.2	cy	-	210,470	-	-	-	233.28	/cy	210,470
03-31-05.70	2950	Structural concrete, placing, foundation mat, pumped, over 20 C.Y., includes vibrating, excludes material	902.2	cy	13,727	-	2,295	-	-	17.76	/cy	16,022
03-35-29.30	0250	Concrete finishing, floors, monolithic, machine trowel finish	11,600.0	sf	15,960	-	737	-	-	1.44	/sf	16,697
03-39-13.50	0300	Curing, sprayed membrane curing compound	116.0	csf	1,772	2,716	-	-	-	38.69	/csf	4,488
03-35-29.30	2350	Concrete finishing, floor, hardener, non-metallic, medium service, 0.75 psf, add	11,600.0	sf	12,636	5,614	-	-	-	1.57	/sf	18,250
		Aerobic Digester Slab (On Grade & Mat) (11,600sf x 2')	**11,600.0**	**cy**	**148,778**	**321,512**	**6,962**			**41.14**	**/cy**	**477,251**
03345 Aerobic Digester Concrete Walls (516LF x 20' x 18")												

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
03345 Aerobic Digester Concrete Walls (516LF x 20' x 18")												
03-11-13.85	X9950	Forms in place, wall, steel framed plywood, >16' high, 2 use/month	20,640.0	sfca	234,037	236,018	-	-	-	22.77	/sfca	470,055
03-11-13.85	0150	C.I.P. concrete forms, wall, box out for opening, to 16" thick, over 10 S.F. (use perimeter), includes erecting, bracing, stripping and cleaning	2.5	lf	44	8	-	-	-	20.96	/lf	52
03-15-05.95	3050	Form oil, up to 800 S.F. per gallon, coverage, includes material only	55.0	gal	-	1,319	-	-	-	23.96	/gal	1,319
03-21-10.60	0700	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	21.5	ton	28,469	33,342	-	-	-	2,881.61	/ton	61,811
03-21-10.60	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	21.5	ton	1,431	-	546	-	-	92.17	/ton	1,977
03-21-10.60	2225	Reinforcing, crane cost for handling, add to above, walls, cols, beams	21.5	ton	1,555	-	594	-	-	100.18	/ton	2,149
03-31-05.35	0350	Structural concrete,ready mix,normal weight,4500 psi,includes local aggregate,sand,portland cement and water,excludes all additives and treatments	600.6	cy	-	140,108	-	-	-	233.28	/cy	140,108
03-31-05.70	5350	Structural concrete, placing, walls, pumped, 15" thick, includes vibrating, excludes material	600.6	cy	30,459	-	5,093	-	-	59.19	/cy	35,552
03-35-29.60	0600	Concrete finishing, walls, float finish, 1/16" thick	20,592.0	sf	56,077	11,737	-	-	-	3.29	/sf	67,814
		Aerobic Digester Concrete Walls (516LF x 20' x 18")	**10,320.0**	**cy**	**352,072**	**422,533**	**6,233**			**75.66**	**/cy**	**780,838**
03345 Aerobic Digester Divider Concrete Walls (58' x 20' x 18")												
03-11-13.85	X9950	Forms in place, wall, steel framed plywood, >16' high, 2 use/month	2,320.0	sfca	26,306	26,529	-	-	-	22.77	/sfca	52,836
03-11-13.85	0150	C.I.P. concrete forms, wall, box out for opening, to 16" thick, over 10 S.F. (use perimeter), includes erecting, bracing, stripping and cleaning	8.0	lf	141	27	-	-	-	20.96	/lf	168
03-15-05.95	3050	Form oil, up to 800 S.F. per gallon, coverage, includes material only	6.2	gal	-	148	-	-	-	23.96	/gal	148
03-21-10.60	0700	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	2.4	ton	3,196	3,743	-	-	-	2,881.62	/ton	6,939
03-21-10.60	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	2.4	ton	161	-	61	-	-	92.16	/ton	222
03-21-10.60	2225	Reinforcing, crane cost for handling, add to above, walls, cols, beams	2.4	ton	175	-	67	-	-	100.18	/ton	241
03-31-05.35	0350	Structural concrete,ready mix,normal weight,4500 psi,includes local aggregate,sand,portland cement and water,excludes all additives and treatments	67.4	cy	-	15,731	-	-	-	233.28	/cy	15,731
03-31-05.70	5350	Structural concrete, placing, walls, pumped, 15" thick, includes vibrating, excludes material	67.4	cy	3,420	-	572	-	-	59.20	/cy	3,992
03-35-29.60	0600	Concrete finishing, walls, float finish, 1/16" thick	2,312.0	sf	6,296	1,318	-	-	-	3.29	/sf	7,614

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
		Aerobic Digester Divider Concrete Walls (58' x 20' x 18")	**1,160.0**	**cy**	**39,695**	**47,496**	**700**			**75.77**	**/cy**	**87,890**
05520 Handrail and Guardrail												
05-52-13.50	0210	Railing, pipe, aluminum, clear finish, 3 rails, 3'-6" high, posts @ 5' OC, 1-1/2" diameter, shop fabricated	516.0	lf	13,961	47,988	613	-	-	121.24	/lf	62,561
05-53-13.10	0224	Floor grating, aluminum, 1-1/4" x 3/16" bars @ 15/16" OC, cross bars @ 4" OC, over 300 S.F., field fabricated from panels	600.0	sf	2,417	27,600	106	-	-	50.21	/sf	30,123
		Handrail and Guardrail	**516.0**	**lf**	**16,378**	**75,588**	**719**			**179.62**	**/lf**	**92,685**
31290 Aerobic Digster Excavation and Backfill (Sloped Sides)												
31-23-16.42	4400	Excavating, bulk bank measure, in sheeting or cofferdam, with all other equipment, minimum	15,435.4	bcy	141,192	-	133,026	-	-	17.77	/bcy	274,219
31-23-23.23	7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	244.1	ecy	794	-	155	-	-	3.89	/ecy	949
31-23-23.16	0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	567.8	lcy	7,745	25,130	1,402	-	-	60.37	/lcy	34,277
31-23-23.23	7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	488.3	ecy	1,589	-	310	-	-	3.89	/ecy	1,899
31-23-23.14	4020	Backfill, structural, common earth, 200 HP dozer, 50' haul, from existing stockpile, excludes compaction	7,307.7	lcy	3,674	-	5,044	-	-	1.19	/lcy	8,719
31-23-23.23	7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	6,354.5	ecy	20,677	-	4,030	-	-	3.89	/ecy	24,707
31-23-23.19	BC-0011	Loading trucks, 2.5 C.Y. bucket, front end loader, wheel mounted	8,381.9	bcy	5,888	-	3,854	-	-	1.16	/bcy	9,742
31-23-23.18	0450	Hauling, excavated or borrow material, loose cubic yards, 3 mile round trip , 1.9 loads/hour, 12 C.Y. truck, highway haulers, excludes loading	10,461.5	lcy	42,095	-	53,185	-	-	9.11	/lcy	95,280
		Aerobic Digster Excavation and Backfill (Sloped Sides)	**15,435.4**	**cy**	**223,655**	**25,130**	**201,006**			**29.14**	**/cy**	**449,791**
33999 Interior Mechanical and Piping Allowance												
33-99-99.99	MISC	Aerobic digestert Interior Piping allowance	1.0	LS	***25,000***	***25,000***	-		-	50,000.00	/LS	50,000
		Interior Mechanical and Piping Allowance	**1.0**	**LS**	**25,000**	**25,000**				**50,000.00**	**/LS**	**50,000**
46999 Mixer, Digester												
46-06-00.00	BC-0836	Mixer, digester draft tube, roof mounted, 15hp, 36" dia. impeller, draft tube, tenemic coating, steel construction, local panel.	2.0	ea	11,116	170,200	-	-	-	90,658.04	/ea	181,316
		Mixer, Digester	**1.0**	**LS**	**11,116**	**170,200**				**181,316.09**	**/LS**	**181,316**

Phase	Item	Description	Quantity	Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit	Total Net Amount
46999 Fine Bubble Diffuser										
46-06-00.00	BC-0031	Deaeration diffusers, fine bubble, complete with headers	2.0 ea	55,580	38,771	-	-	-	47,175.79 /ea	94,352
		Fine Bubble Diffuser	**1.0 LS**	**55,580**	**38,771**				**94,351.57 /LS**	**94,352**
		480 Aerobic Digester	**1.0 LS**	**872,274**	**1,126,229**	**215,620**			**2,214,122.82 /LS**	**2,214,123**
		48 Aerobic Digester	**1.0 LS**	**872,274**	**1,126,229**	**215,620**			**2,214,122.82 /LS**	**2,214,123**
52 Dewatering & Blower Building										
520 Dewatering & Blower Building										
03330 Dewatering & Blower Building Slab (On Grade & Mat) (5000sf x 2')										
31-22-16.10	1100	Fine grading, fine grade for slab on grade, machine	555.6 sy	765	-	463	-	-	2.21 /sy	1,228
03-05-13.25	1050	Aggregate, stone, 3/4" to 1-1/2", prices per C.Y., includes material only	185.2 cy	-	7,037	-	-	-	38.00 /cy	7,037
03-15-13.50	1300	Waterstop, PVC, ribbed type, split, 3/8" thick x 6" wide	300.0 lf	1,926	1,846	-	-	-	12.57 /lf	3,772
03-15-13.50	5250	Waterstop, fittings, rubber, flat, dumbbell or center bulb, field union, 3/8" thick x 9" wide	25.0 ea	417	926	-	-	-	53.72 /ea	1,343
03-21-10.60	0600	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	23.1 ton	40,073	35,981	-	-	-	3,285.55 /ton	76,054
03-21-10.60	2005	Reinforcing in place, unloading & sorting, add to above - slabs	23.1 ton	1,544	-	589	-	-	92.17 /ton	2,133
03-21-10.60	2215	Reinforcing in place, crane cost for handling, add to above, slabs	23.1 ton	1,678	-	641	-	-	100.18 /ton	2,319
03-31-05.35	0350	Structural concrete,ready mix,normal weight,4500 psi,includes local aggregate,sand,portland cement and water,excludes all additives and treatments	388.9 cy	-	90,720	-	-	-	233.28 /cy	90,720
03-31-05.70	2950	Structural concrete, placing, foundation mat, pumped, over 20 C.Y., includes vibrating, excludes material	388.9 cy	5,917	-	989	-	-	17.76 /cy	6,906
03-35-29.30	0250	Concrete finishing, floors, monolithic, machine trowel finish	5,000.0 sf	6,879	-	318	-	-	1.44 /sf	7,197
03-39-13.50	0300	Curing, sprayed membrane curing compound	50.0 csf	764	1,171	-	-	-	38.69 /csf	1,935
03-35-29.30	2350	Concrete finishing, floor, hardener, non-metallic, medium service, 0.75 psf, add	5,000.0 sf	5,446	2,420	-	-	-	1.57 /sf	7,866
		Dewatering & Blower Building Slab (On Grade & Mat) (5000sf x 2')	**5,000.0 cy**	**65,410**	**140,101**	**3,001**			**41.70 /cy**	**208,511**
04220 Dewatering & Blower Building Exterior Masonry Walls (CMU & Brick)										

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
04220 Dewatering & Blower Building Exterior Masonry Walls (CMU & Brick)												
04-22-10.28	0350	Concrt block,high strngt,hollow,3500 psi,12"8"16",inclds mortar and horzntl joint rnfrcng every other course,excluds scffldn,grout and verticl rnfrcng	4,447.0	sf	82,924	30,093	-	-	-	25.41	/sf	113,017
04-05-19.26	0250	Masonry reinforcing bars, truss type steel joint reinforcing, mill standard galvanized, 12" wide	33.0	clf	1,359	1,579	-	-	-	89.03	/clf	2,938
04-05-19.26	0020	Masonry reinforcing bars, #5 and #6 reinforcing steel bars, placed horizontally, ASTM A615	6,670.5	lb	6,867	7,764	-	-	-	2.19	/lb	14,632
04-05-19.26	0060	Masonry reinforcing bars, #5 and #6 reinforcing steel bars, placed vertically, ASTM A615	3,468.7	lb	4,395	4,038	-	-	-	2.43	/lb	8,433
04-05-16.30	2000	Grout, for bond beams, lintels and concrete masonry unit (CMU) cores, C476, includes material only	1,867.7	cf	16,303	15,790	905	-	-	17.67	/cf	32,999
04-05-16.30	0800	Grout, door frames, 3' x 7' opening, 2.5 C.F. per opening	2.0	opng	102	42	6	-	-	74.89	/opng	150
04-05-16.30	0850	Grout, door frames, 6' x 7' opening, 3.5 C.F. per opening	2.0	opng	136	59	8	-	-	101.33	/opng	203
04-05-19.05	0070	Anchor bolts, hooked type, 3/4" diameter x 12" long, installed fresh grout in cmu bond beam or filled core, includes nut and washer, excludes template	20.0	ea	132	150	-	-	-	14.09	/ea	282
04-05-19.26	X9000	Allow - shoring and bracing at CMU walls (percentage wall area)	2,223.5	sfwa	2,623	1,085	-	-	-	1.67	/sfwa	3,708
04-05-23.13	0180	Control joint, PVC, 12" wall	8.0	lf	27	42	-	-	-	8.74	/lf	70
06-11-10.24	8780	Wood framing, miscellaneous, rough bucks, treated, for doors or windows, 2" x 8"	0.0	mbf	62	23	-	-	-	4,498.40	/mbf	85
07-71-26.10	0700	Reglet, zinc and copper alloy, 20 ounce	14.0	lf	50	54	-	-	-	7.43	/lf	104
07-71-26.10	1600	Reglet, counter flashing for zinc and copper alloy, 20 ounce, 12" wide	14.0	lf	95	98	-	-	-	13.83	/lf	194
07-19-19.10	0300	Silicone water repellants, sprayed on CMU, 2 coat	8,894.0	sf	2,654	9,445	-	-	-	1.36	/sf	12,100
07-92-10.10	1800	Caulking & Sealants, butyl based, bulk, in place, 77 LF per gallon, 1/2" x 1/2"	8.0	lf	24	6	-	-	-	3.67	/lf	29
		Dewatering & Blower Building Exterior Masonry Walls (CMU & Brick)	**4,447.0**	**sf**	**117,755**	**70,269**	**919**			**42.49**	**/sf**	**188,943**
07220 Roof Insulation (see also Assembly 03358)												
07-22-16.10	0460	Roof deck insulation, fiberglass, 1-1/16" thick, R4.17, fastening excluded	5,000.0	sf	3,390	8,200	-	-	-	2.32	/sf	11,590
		Roof Insulation (see also Assembly 03358)	**5,000.0**	**sf**	**3,390**	**8,200**				**2.32**	**/sf**	**11,590**
07400 Metal Roofing, Conceptual												
07-42-13.10	0100	Standing seam roofing, aluminum, kynar finish, including flashings	5,000.0	sf	68,291	18,120	-	-	-	17.28	/sf	86,411
		Metal Roofing, Conceptual	**5,000.0**	**sf**	**68,291**	**18,120**				**17.28**	**/sf**	**86,411**
23001 HVAC Conceptual												

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
23001 HVAC Conceptual												
23-01-00.00	0003	Cooling Tons (/sf)	47.1	tons	-	-	-	117,755	-	2,500.00	/tons	117,755
23-01-00.00	0004	Supply CFM (/sf)	19,500.0	cfms	-	-	-	12,675	-	0.65	/cfms	12,675
23-01-00.00	0005	Ductwork (lbs/sf)	6,500.0	lbs	-	-	-	55,250	-	8.50	/lbs	55,250
23-01-00.00	0006	Controls (/sf)	16,250.0	sf	-	-	-	19,500	-	1.20	/sf	19,500
		HVAC Conceptual	**16,250.0**	**sf**				**205,180**		**12.63**	**/sf**	**205,180**
33999 Interior Mechanical and Piping Allowance												
33-99-99.99	MISC	Aerobic digestert Interior Piping allowance	1.0	LS	***50,000***	***50,000***	-		-	100,000.00	/LS	100,000
		Interior Mechanical and Piping Allowance	**1.0**	**LS**	**50,000**	**50,000**				**100,000.00**	**/LS**	**100,000**
46999 Blowers												
46-06-04.00	BC-1210	Centrifugal Blowers - 475.6 tp 500 HP 460 V - with all Accessories	2.0	ea	13,222			-	423,731	218,476.83	/ea	436,954
01-54-19.50	0600	Crane crew, daily use for small jobs, 100-ton truck-mounted hydraulic crane, portal to portal	1.0	day	1,600	-	2,898	-	-	4,497.99	/day	4,498
		Blowers	**1.0**	**LS**	**14,822**		**2,898**		**423,731**	**441,451.64**	**/LS**	**441,452**
		520 Dewatering & Blower Building	**1.0**	**LS**	**319,668**	**286,690**	**6,817**	**205,180**	**423,731**	**1,242,086.36**	**/LS**	**1,242,086**
		52 Dewatering & Blower Building	**1.0**	**LS**	**319,668**	**286,690**	**6,817**	**205,180**	**423,731**	**1,242,086.36**	**/LS**	**1,242,086**
54 Operations Building												
540 Operations Building												
03330 Operations Building Slab (On Grade & Mat) (10,585sf x 1')												
31-22-16.10	1100	Fine grading, fine grade for slab on grade, machine	1,176.1	sy	1,619	-	981	-	-	2.21	/sy	2,600
03-05-13.25	1050	Aggregate, stone, 3/4" to 1-1/2", prices per C.Y., includes material only	392.0	cy	-	14,898	-	-	-	38.00	/cy	14,898
03-21-10.60	0600	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	19.6	ton	33,934	30,469	-	-	-	3,285.55	/ton	64,403
03-21-10.60	2005	Reinforcing in place, unloading & sorting, add to above - slabs	19.6	ton	1,308	-	499	-	-	92.17	/ton	1,807
03-21-10.60	2215	Reinforcing in place, crane cost for handling, add to above, slabs	19.6	ton	1,421	-	543	-	-	100.18	/ton	1,964
03-31-05.35	0350	Structural concrete,ready mix,normal weight,4500 psi,includes local aggregate,sand,portland cement and water,excludes all additives and treatments	411.6	cy	-	96,027	-	-	-	233.28	/cy	96,027
03-31-05.70	2950	Structural concrete, placing, foundation mat, pumped, over 20 C.Y., includes vibrating, excludes material	411.6	cy	6,263	-	1,047	-	-	17.76	/cy	7,310
03-35-29.30	0250	Concrete finishing, floors, monolithic, machine trowel finish	10,585.0	sf	14,563	-	673	-	-	1.44	/sf	15,236
03-39-13.50	0300	Curing, sprayed membrane curing compound	105.9	csf	1,617	2,478	-	-	-	38.69	/csf	4,095

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
03330 Operations Building Slab (On Grade & Mat) (10,585sf x 1')												
03-35-29.30	2350	Concrete finishing, floor, hardener, non-metallic, medium service, 0.75 psf, add	10,585.0	sf	11,530	5,123	-	-	-	1.57	/sf	16,653
		Operations Building Slab (On Grade & Mat) (10,585sf x 1')	**10,585.0**	**cy**	**72,255**	**148,996**	**3,743**			**21.26**	**/cy**	**224,994**
04220 Operations Building Exterior Masonry Walls (CMU & Brick) (426' x 15')												
04-22-10.28	0350	Concrt block,high strngt,hollow,3500 psi,12"8"16",inclds mortar and horzntl joint rnfrcng every other course,excluds scffldn,grout and verticl rnfrcng	6,337.0	sf	118,168	42,882	-	-	-	25.41	/sf	161,050
04-05-19.26	0250	Masonry reinforcing bars, truss type steel joint reinforcing, mill standard galvanized, 12" wide	46.9	clf	1,930	2,242	-	-	-	89.03	/clf	4,172
04-05-19.26	0020	Masonry reinforcing bars, #5 and #6 reinforcing steel bars, placed horizontally, ASTM A615	9,505.5	lb	9,786	11,064	-	-	-	2.19	/lb	20,850
04-05-19.26	0060	Masonry reinforcing bars, #5 and #6 reinforcing steel bars, placed vertically, ASTM A615	4,942.9	lb	6,263	5,753	-	-	-	2.43	/lb	12,016
04-05-16.30	2000	Grout, for bond beams, lintels and concrete masonry unit (CMU) cores, C476, includes material only	2,661.5	cf	23,233	22,501	1,290	-	-	17.67	/cf	47,023
04-05-16.30	0800	Grout, door frames, 3' x 7' opening, 2.5 C.F. per opening	2.0	opng	102	42	6	-	-	74.89	/opng	150
04-05-16.30	0850	Grout, door frames, 6' x 7' opening, 3.5 C.F. per opening	2.0	opng	136	59	8	-	-	101.33	/opng	203
04-05-19.05	0060	Anchor bolts, hooked type, 3/4" diameter x 8" long, installed fresh grout in cmu bond beam or filled core, includes nut and washer, excludes template	20.0	ea	130	120	-	-	-	12.48	/ea	250
04-05-19.26	X9000	Allow - shoring and bracing at CMU walls (percentage wall area)	3,168.5	sfwa	3,738	1,546	-	-	-	1.67	/sfwa	5,285
04-05-23.13	0180	Control joint, PVC, 12" wall	18.0	lf	62	96	-	-	-	8.74	/lf	157
06-11-10.24	8780	Wood framing, miscellaneous, rough bucks, treated, for doors or windows, 2" x 8"	0.0	mbf	62	23	-	-	-	4,498.40	/mbf	85
07-71-26.10	0700	Reglet, zinc and copper alloy, 20 ounce	14.0	lf	50	54	-	-	-	7.43	/lf	104
07-71-26.10	1600	Reglet, counter flashing for zinc and copper alloy, 20 ounce, 12" wide	14.0	lf	95	98	-	-	-	13.83	/lf	194
07-19-19.10	0300	Silicone water repellants, sprayed on CMU, 2 coat	12,674.0	sf	3,782	13,460	-	-	-	1.36	/sf	17,242
07-92-10.10	1800	Caulking & Sealants, butyl based, bulk, in place, 77 LF per gallon, 1/2" x 1/2"	18.0	lf	53	13	-	-	-	3.67	/lf	66
		Operations Building Exterior Masonry Walls (CMU & Brick) (426' x 15')	**6,337.0**	**sf**	**167,589**	**99,954**	**1,303**			**42.43**	**/sf**	**268,847**
07220 Roof Insulation (see also Assembly 03358)												
07-22-16.10	0460	Roof deck insulation, fiberglass, 1-1/16" thick, R4.17, fastening excluded	10,585.0	sf	7,177	17,359	-	-	-	2.32	/sf	24,536
		Roof Insulation (see also Assembly 03358)	**10,585.0**	**sf**	**7,177**	**17,359**				**2.32**	**/sf**	**24,536**

Phase	Item	Description	Quantity	Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit	Total Net Amount
07400 Metal Roofing, Conceptual										
07-42-13.10	0100	Standing seam roofing, aluminum, kynar finish, including flashings	10,585.0 sf	144,572	38,360	-	-	-	17.28 /sf	182,932
		Metal Roofing, Conceptual	**10,585.0 sf**	**144,572**	**38,360**				**17.28 /sf**	**182,932**
22405 Commercial Plumbing, Conceptual										
933-00-00.00	46-1650-X906	6" PVC perforated pipe, subdrainage system/foundation drain	430.0 lf	2,364	1,501	-	-	-	8.99 /lf	3,864
31-23-23.16	0050	Fill by borrow and utility bedding, for pipe and conduit, crushed or screened bank run gravel, excludes compaction	15.9 lcy	217	1,066	39	-	-	83.04 /lcy	1,322
933-00-00.00	46-1650-X908	Filter fabric separator - subdrainage bedding	21.5 sq	219	341	-	-	-	26.01 /sq	559
22-13-29.14	X9010	Sump pumps, duplex w/ pit, controls and grate	1.0 ea	1,245	2,151	-	-	-	3,395.54 /ea	3,396
22-13-23.10	4220	Interceptor, oil, fabricated steel, 100 GPM, 3" pipe size	1.0 ea	830	22,365	-	-	-	23,195.22 /ea	23,195
22-13-19.13	2420	Drain, floor, heavy duty with sediment bucket, cast iron, 12" diameter loose grate, 2", 3", 4", 5" and 6" pipe size	2.0 ea	369	2,328	-	-	-	1,348.25 /ea	2,697
22-14-26.13	6000	Cast iron heavy duty trench floor drain, 12"x12" top, 2" thru 6" pipe	2.0 ea	415	2,581	-	-	-	1,497.81 /ea	2,996
05-54-13.70	0020	Trench cover, cast iron grating with bar stops and angle frame, to 18" W, field fabricated	1.0 lf	46	315	-	-	-	360.82 /lf	361
22-13-16.20	6000	Trench for buried waste or drain pipe, avg.12" W, up to 24" D	60.0 lf	125	-	36	-	-	2.69 /lf	161
22-13-16.20	6010	Hand clean and trim trench for waste/drain lines	60.0 lf	247	-	-	-	-	4.11 /lf	247
22-13-16.20	6025	Bedding, sand, for waste/drain piping, to 6" deep	1.1 cy	15	20	3	-	-	34.16 /cy	38
22-13-16.20	X9030	6" Cast iron single hub w/ fittings, extra heavy, buried	20.0 lf	730	1,591	-	-	-	116.07 /lf	2,321
22-13-16.20	6015	Backfill and compact piping trench, avg. 12" wide to, 24" deep	60.0 lf	191	-	37	-	-	3.81 /lf	229
22-05-76.20	0240	Cleanout tee, cast iron, B. & S., 4" pipe size, includes countersunk plug	4.0 ea	1,082	1,388	-	-	-	617.68 /ea	2,471
22-11-19.64	1100	Hydrant, wall type, non-freeze, bronze, exposed, 3/4" I.P.S connection, 4" to 9" thick wall	1.0 ea	64	663	-	-	-	727.24 /ea	727
22-11-13.23	X9640	3/4" copper type L w/ fittings & hangers 10' oc, wall hydrants	100.0 lf	1,186	620	-	-	-	18.06 /lf	1,806
22-11-19.38	2640	Water supply meter, domestic/commercial, bronze, compound, flanged, to 320 GPM, 3" diameter	1.0 ea	553	1,771	-	-	-	2,324.35 /ea	2,324
22-11-19.42	5680	Backflow preventer, reduced pressure principle, iron, automatic operation, OS&Y valves, flanged, 3" pipe size, includes valves and four test cocks	1.0 ea	369	3,365	-	-	-	3,733.80 /ea	3,734
22-13-29.14	0770	Pump,sewage ejector,simplex system,plythyl tank,134 gpm,1 hp, 15'head,70 gallon,3"discharge,includes operating and level controls,tank,cover and pump	1.0 ea	830	1,619	-	-	-	2,449.22 /ea	2,449

Phase	Item	Description	Quantity	Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit	Total Net Amount
22405 Commercial Plumbing, Conceptual										
22-13-23.10	1160	Interceptor, grease, fabricated steel, 100 GPM, 200 lb. fat capacity	1.0 ea	830	23,074	-	-	-	23,903.62 /ea	23,904
22-42-39.30	3700	Carriers/supports, lavatory, concealed arm, wall mounted, in stud or masonry, flat slab fixture	2.0 ea	300	1,113	-	-	-	706.83 /ea	1,414
22-41-16.13	2900	Lavatory, vanity top, vitreous china, white, single bowl, 20" x 16", includes trim	2.0 ea	615	502	-	-	-	558.39 /ea	1,117
22-41-16.13	3580	Lavatory, vanity top, rough-in, supply, waste and vent	2.0 ea	1,444	1,194	-	-	-	1,318.84 /ea	2,638
22-41-39.10	2810	Faucets/fittings, lavatory faucet, automatic sensor and operator, with faucet head, residential	2.0 ea	293	1,245	-	-	-	768.94 /ea	1,538
22-42-39.30	6300	Carriers/supports, urinal, wall mounted, plate type system	2.0 ea	300	1,113	-	-	-	706.83 /ea	1,414
22-42-13.16	3100	Urinal, wall hung, vitreous china, with self-closing valve, siphon jet type	2.0 ea	1,107	688	-	-	-	897.43 /ea	1,795
22-42-13.16	3300	Urinal, wall hung, rough-in, supply, waste and vent	2.0 ea	1,173	1,639	-	-	-	1,406.31 /ea	2,813
22-42-39.30	7040	Carriers/supports, water closet, siphon jet, horizontal, adjustable, caulk, single, 4" pipe size	1.0 ea	169	1,543	-	-	-	1,712.41 /ea	1,712
22-41-13.13	3100	Water closet, bowl only, w/ flush valve, seat, wall hung	1.0 ea	286	992	-	-	-	1,277.98 /ea	1,278
22-41-13.13	3200	Rough in water supply, waste & vent for wall hung water closet	2.0 ea	1,297	3,491	-	-	-	2,394.16 /ea	4,788
22-41-39.10	0972	Fcts/f,flush valve,autmtc flush sensor and opertr for urinals wtrclsts	4.0 ea	451	2,348	-	-	-	699.63 /ea	2,799
22-41-39.10	4200	Faucets/fittings, shower thermostatic mixing valve, concealed, with shower head trim kit	1.0 ea	113	380	-	-	-	492.17 /ea	492
22-41-23.20	4000	Shower, stall, polypropylene, with molded stone floor, stall only, 30" x 30", includes drain only, excludes valve control and door/curtain	1.0 ea	830	805	-	-	-	1,634.56 /ea	1,635
22-41-23.20	4200	Shower, stall, rough-in, supply, waste and vent for above shower	1.0 ea	810	633	-	-	-	1,442.28 /ea	1,442
22-13-16.50	2820	Drain, shower, with strainer, uniform diameter trap, bronze top, 4" pipe size	1.0 ea	237	577	-	-	-	813.99 /ea	814
22-41-16.16	3100	Sink, kitchen, counter top style, stainless steel, self rimming, single bowl, 25" x 22", includes faucet and drain	1.0 ea	296	729	-	-	-	1,025.08 /ea	1,025
22-41-16.16	4980	Sink, kitchen, counter top style, rough-in, supply, waste and vent	1.0 ea	776	526	-	-	-	1,301.96 /ea	1,302
22-41-16.16	6650	Service sink, faucet and drain, floor/corner mtd, 28"x28" PE on CI	2.0 ea	755	3,036	-	-	-	1,895.29 /ea	3,791
22-41-16.16	6790	Rough in water supply, waste & vent for floor mtd. service sinks	2.0 ea	2,024	4,099	-	-	-	3,061.53 /ea	6,123
22-42-39.30	0600	Carriers/supports, drinking fountain, wall mounted, plate type with studs, top back plate	2.0 ea	258	148	-	-	-	202.64 /ea	405
22-47-16.10	1040	Water cooler, wall mounted, non-recessed, dual height, 14.3 GPH	2.0 ea	874	4,959	-	-	-	2,916.26 /ea	5,833

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
22405 Commercial Plumbing, Conceptual												
22-11-19.64	0300	Hydrant, wall type, moderate climate, bronze, anti-siphon, encased, 1" I.P.S. connection	1.0	ea	64	2,935	-	-	-	2,999.18	/ea	2,999
22-05-76.10	0120	Cleanout, floor type, round or square, scoriated nickel bronze top, 3" pipe size	4.0	ea	447	1,952	-	-	-	599.54	/ea	2,398
22-33-30.13	4100	Comm'l water heater, 100 deg rise, elec, 5 gal., 3 kW, 12 GPH, 208V	1.0	ea	451	4,250	-	-	-	4,701.07	/ea	4,701
		Commercial Plumbing, Conceptual	**10,201.0**	**sf**	**27,296**	**107,653**	**116**			**13.24**	**/sf**	**135,065**
23001 HVAC Conceptual												
23-01-00.00	0003	Cooling Tons (/sf)	63.3	tons	-	-	-	158,225	-	2,500.00	/tons	158,225
23-01-00.00	0004	Supply CFM (/sf)	26,202.0	cfms	-	-	-	17,031	-	0.65	/cfms	17,031
23-01-00.00	0005	Ductwork (lbs/sf)	8,734.0	lbs	-	-	-	74,239	-	8.50	/lbs	74,239
23-01-00.00	0006	Controls (/sf)	21,835.0	sf	-	-	-	26,202	-	1.20	/sf	26,202
		HVAC Conceptual	**21,835.0**	**sf**				**275,697**		**12.63**	**/sf**	**275,697**
		540 Operations Building	**1.0**	**LS**	**418,889**	**412,323**	**5,162**	**275,697**		**1,112,070.99**	**/LS**	**1,112,071**
		54 Operations Building	**1.0**	**LS**	**418,889**	**412,323**	**5,162**	**275,697**		**1,112,070.99**	**/LS**	**1,112,071**
60 Piping Included In Easement												
600 Piping Included In Easement												
33490 Trench for 8" Potable Water Line (Shored)												
31-23-16.13	0110	Excavating, trench or continuous footing, common earth, 3/4 C.Y. excavator, 4' to 6' deep, excavator, excludes sheeting or dewatering	829.6	bcy	4,047	-	2,722	-	-	8.16	/bcy	6,769
01-54-33.40	7040	Rent trench box, 7200 lbs, 6' x 20'	54.0	day	-	-	6,754	-	-	125.07	/day	6,754
31-23-23.19	BC-0016	Trench box, move and reset	90.0	ea	8,233	-	6,262	-	-	161.05	/ea	14,494
31-23-23.16	0200	Fill by borrow and utility bedding, for pipe and conduit, sand, dead or bank, excludes compaction	532.0	lcy	7,256	15,734	1,313	-	-	45.69	/lcy	24,304
31-23-23.16	0500	Fill by borrow and utility bedding, for pipe and conduit, compacting bedding in trench	450.8	ecy	3,260	-	635	-	-	8.64	/ecy	3,895
33-05-97.10	0400	Utility line signs, markers, and flags, underground tape, detectable, reinforced, aluminum foil core, 2", excludes excavation and backfill	18.0	clf	78	63	-	-	-	7.81	/clf	141
31-23-16.13	3020	Excavating, trench backfill, 1 C.Y. bucket, minimal haul, front end loader, wheel mounted, excludes dewatering	408.9	lcy	1,131	-	372	-	-	3.68	/lcy	1,503
31-23-23.23	7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	355.6	ecy	1,157	-	226	-	-	3.89	/ecy	1,382
31-23-23.19	BC-0011	Loading trucks, 2.5 C.Y. bucket, front end loader, wheel mounted	474.1	bcy	333	-	218	-	-	1.16	/bcy	551

Phase	Item	Description	Quantity	Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit	Total Net Amount
33490 Trench for 8" Potable Water Line (Shored)										
31-23-23.18	0450	Hauling, excavated or borrow material, loose cubic yards, 3 mile round trip , 1.9 loads/hour, 12 C.Y. truck, highway haulers, excludes loading	592.6 lcy	2,385	-	3,013	-	-	9.11 /lcy	5,397
01-54-33.50	5400	Roadway plate, steel, 1" x 8' x 20'	18.0 day	-	-	711	-	-	39.52 /day	711
		Trench for 8" Potable Water Line (Shored)	**1,800.0 lf**	**27,879**	**15,797**	**22,225**			**36.61 /lf**	**65,901**
33490 Trench for 18" Force Main for Recycled Water (Shored)										
31-23-16.13	0110	Excavating, trench or continuous footing, common earth, 3/4 C.Y. excavator, 4' to 6' deep, excavator, excludes sheeting or dewatering	1,283.3 bcy	6,261	-	4,210	-	-	8.16 /bcy	10,471
01-54-33.40	7040	Rent trench box, 7200 lbs, 6' x 20'	54.0 day	-	-	6,754	-	-	125.07 /day	6,754
31-23-23.19	BC-0016	Trench box, move and reset	90.0 ea	8,233	-	6,262	-	-	161.05 /ea	14,494
31-23-23.16	0200	Fill by borrow and utility bedding, for pipe and conduit, sand, dead or bank, excludes compaction	824.7 lcy	11,249	24,394	2,036	-	-	45.69 /lcy	37,679
31-23-23.16	0500	Fill by borrow and utility bedding, for pipe and conduit, compacting bedding in trench	698.9 ecy	5,054	-	985	-	-	8.64 /ecy	6,039
33-05-97.10	0400	Utility line signs, markers, and flags, underground tape, detectable, reinforced, aluminum foil core, 2", excludes excavation and backfill	18.0 clf	78	63	-	-	-	7.81 /clf	141
31-23-16.13	3020	Excavating, trench backfill, 1 C.Y. bucket, minimal haul, front end loader, wheel mounted, excludes dewatering	536.7 lcy	1,484	-	488	-	-	3.68 /lcy	1,972
31-23-23.23	7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	466.7 ecy	1,519	-	296	-	-	3.89 /ecy	1,814
31-23-23.19	BC-0011	Loading trucks, 2.5 C.Y. bucket, front end loader, wheel mounted	816.7 bcy	574	-	376	-	-	1.16 /bcy	949
31-23-23.18	0450	Hauling, excavated or borrow material, loose cubic yards, 3 mile round trip , 1.9 loads/hour, 12 C.Y. truck, highway haulers, excludes loading	1,020.8 lcy	4,108	-	5,190	-	-	9.11 /lcy	9,297
01-54-33.50	5400	Roadway plate, steel, 1" x 8' x 20'	18.0 day	-	-	711	-	-	39.52 /day	711
		Trench for 18" Force Main for Recycled Water (Shored)	**1,800.0 lf**	**38,558**	**24,456**	**27,308**			**50.18 /lf**	**90,322**
33490 Trench for 24" Gravity Sewer Trench (Shored)										
31-23-16.13	1000	Excavating, trench or continuous footing, common earth, 1-1/2 C.Y. excavator, 10' to 14' deep, excludes sheeting or dewatering	3,466.7 bcy	9,396	-	7,147	-	-	4.77 /bcy	16,542
01-54-33.40	7070	Rent trench box 12,000 pounds 10' x 20'	108.0 day	-	-	19,489	-	-	180.46 /day	19,489
31-23-23.19	BC-0016	Trench box, move and reset	180.0 ea	16,465	-	12,524	-	-	161.05 /ea	28,989
31-23-23.16	0200	Fill by borrow and utility bedding, for pipe and conduit, sand, dead or bank, excludes compaction	1,011.7 lcy	13,799	29,923	2,497	-	-	45.69 /lcy	46,219
31-23-23.16	0500	Fill by borrow and utility bedding, for pipe and conduit, compacting bedding in trench	857.3 ecy	6,199	-	1,208	-	-	8.64 /ecy	7,408

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
33490 Trench for 24" Gravity Sewer Trench (Shored)												
33-05-97.10	0400	Utility line signs, markers, and flags, underground tape, detectable, reinforced, aluminum foil core, 2", excludes excavation and backfill	18.0	clf	78	63	-	-	-	7.81	/clf	141
31-23-16.13	3020	Excavating, trench backfill, 1 C.Y. bucket, minimal haul, front end loader, wheel mounted, excludes dewatering	2,760.0	lcy	7,632	-	2,511	-	-	3.68	/lcy	10,144
31-23-23.23	7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	2,400.0	ecy	7,809	-	1,522	-	-	3.89	/ecy	9,332
31-23-23.19	BC-0011	Loading trucks, 2.5 C.Y. bucket, front end loader, wheel mounted	1,066.7	bcy	749	-	491	-	-	1.16	/bcy	1,240
31-23-23.18	0450	Hauling, excavated or borrow material, loose cubic yards, 3 mile round trip , 1.9 loads/hour, 12 C.Y. truck, highway haulers, excludes loading	1,333.3	lcy	5,365	-	6,779	-	-	9.11	/lcy	12,144
01-54-33.50	5400	Roadway plate, steel, 1" x 8' x 20'	18.0	day	-	-	711	-	-	39.52	/day	711
		Trench for 24" Gravity Sewer Trench (Shored)	**1,800.0**	**lf**	**67,494**	**29,985**	**54,879**			**84.64**	**/lf**	**152,358**
33521 8" Ductile Iron Pipe, buried												
33-14-13.15	3040	Water supply distribution piping,ductile iron,cement lined,push-on joint,fittings,18'lengths,8"diameter,class 50,excludes excavation backfill	1,800.0	lf	24,940	77,933	1,924	-	-	58.22	/lf	104,797
33-00-00.01	BC-0011	Utility pipe testing, nondestructive hydraulic pressure test	72.0	hr	6,121	-	3,324	-	-	131.18	/hr	9,445
		8" Ductile Iron Pipe, buried	**1,800.0**	**lf**	**31,061**	**77,933**	**5,248**			**63.47**	**/lf**	**114,242**
33526 18" HDPE Pipe, Recycled Water												
33-14-13.35	0800	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 18" diameter, SDR 21	1,800.0	lf	50,513	59,040	17,089	-	-	70.36	/lf	126,641
33-00-00.01	BC-0011	Utility pipe testing, nondestructive hydraulic pressure test	162.0	hr	13,773	-	7,478	-	-	131.18	/hr	21,251
		18" HDPE Pipe, Recycled Water	**1,800.0**	**lf**	**64,286**	**59,040**	**24,567**			**82.16**	**/lf**	**147,893**
40500 24" PVC Gravity Sewer												
40-05-31.13	A2410020 80000	Pipe Plain End-PVC--Sch 40 24 Inch (600mm)	1,800.0	lf	-	196,448	-	-	-	109.14	/lf	196,448
40-05-31.13	L2440020 800P1	Pipe Erection-Straight Run-PVC-Sch 40 24 Inch (600mm)	1,800.0	lf	114,999	-	-	-	-	63.89	/lf	114,999
40-05-05.00	L2490480 00000	Field Testing-Hydrotest-Non-Specific 24 Inch (600mm)	1,800.0	lf	24,210	-	-	-	-	13.45	/lf	24,210
		24" PVC Gravity Sewer	**1,800.0**	**lf**	**139,210**	**196,448**				**186.48**	**/lf**	**335,658**
		600 Piping Included In Easement	**1.0**	**LS**	**368,488**	**403,660**	**134,227**			**906,374.87**	**/LS**	**906,375**
		60 Piping Included In Easement	**1.0**	**LS**	**368,488**	**403,660**	**134,227**			**906,374.87**	**/LS**	**906,375**

Phase	Item	Description	Quantity		Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit		Total Net Amount
62 Yard Piping On-Site												
620 Yard Piping On-Site												
33490 Trench for 24" Force Main to Saturation Basins (Shored)												
31-23-16.13	0110	Excavating, trench or continuous footing, common earth, 3/4 C.Y. excavator, 4' to 6' deep, excavator, excludes sheeting or dewatering	1,422.2	bcy	6,938	-	4,666	-	-	8.16	/bcy	11,604
01-54-33.40	7040	Rent trench box, 7200 lbs, 6' x 20'	48.0	day	-	-	6,003	-	-	125.07	/day	6,003
31-23-23.19	BC-0016	Trench box, move and reset	80.0	ea	7,318	-	5,566	-	-	161.05	/ea	12,884
31-23-23.16	0200	Fill by borrow and utility bedding, for pipe and conduit, sand, dead or bank, excludes compaction	899.2	lcy	12,266	26,598	2,220	-	-	45.69	/lcy	41,084
31-23-23.16	0500	Fill by borrow and utility bedding, for pipe and conduit, compacting bedding in trench	762.1	ecy	5,511	-	1,074	-	-	8.64	/ecy	6,585
33-05-97.10	0400	Utility line signs, markers, and flags, underground tape, detectable, reinforced, aluminum foil core, 2", excludes excavation and backfill	16.0	clf	69	56	-	-	-	7.81	/clf	125
31-23-16.13	3020	Excavating, trench backfill, 1 C.Y. bucket, minimal haul, front end loader, wheel mounted, excludes dewatering	545.2	lcy	1,508	-	496	-	-	3.68	/lcy	2,004
31-23-23.23	7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	474.1	ecy	1,543	-	301	-	-	3.89	/ecy	1,843
31-23-23.19	BC-0011	Loading trucks, 2.5 C.Y. bucket, front end loader, wheel mounted	948.1	bcy	666	-	436	-	-	1.16	/bcy	1,102
31-23-23.18	0450	Hauling, excavated or borrow material, loose cubic yards, 3 mile round trip , 1.9 loads/hour, 12 C.Y. truck, highway haulers, excludes loading	1,185.2	lcy	4,769	-	6,025	-	-	9.11	/lcy	10,794
01-54-33.50	5400	Roadway plate, steel, 1" x 8' x 20'	16.0	day	-	-	632	-	-	39.52	/day	632
		Trench for 24" Force Main to Saturation Basins (Shored)	**1,600.0**	**lf**	**40,587**	**26,654**	**27,420**			**59.16**	**/lf**	**94,660**
33526 24" HDPE Pipe, Forcemain to Saturation Basins												
33-14-13.35	0900	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 24" diameter, SDR 21	1,600.0	lf	62,860	93,414	21,266	-	-	110.96	/lf	177,541
33-14-13.35	2000	Water supply distribution piping, piping HDPE, butt fusion joints, fittings, elbows, 90 degree, 24" diameter, SDR 21	3.0	ea	3,929	2,913	1,329	-	-	2,723.51	/ea	8,171
33-14-13.35	3000	Water supply distribution piping, piping HDPE, butt fusion joints, fittings, tees, 24" diameter, SDR 21	3.0	ea	5,893	2,303	1,994	-	-	3,396.47	/ea	10,189
33-00-00.01	BC-0011	Utility pipe testing, nondestructive hydraulic pressure test	192.0	hr	16,324	-	8,863	-	-	131.18	/hr	25,187
01-54-33.40	1695	Rent butt fusion machine, tracked, 83 HP diesel, 8"-24" pipe	8.0	day	-	-	5,924	-	-	740.51	/day	5,924

Phase	Item	Description	Quantity	Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit	Total Net Amount
		24" HDPE Pipe, Forcemain to Saturation Basins	**1,600.0 lf**	**89,006**	**98,630**	**39,376**			**141.88 /lf**	**227,012**
		620 Yard Piping On-Site	**1.0 LS**	**129,593**	**125,283**	**66,796**			**321,672.09 /LS**	**321,672**
		62 Yard Piping On-Site	**1.0 LS**	**129,593**	**125,283**	**66,796**			**321,672.09 /LS**	**321,672**
95 EI & C Allowance (50% of Contract Total)										
950 EI & C Allowance (50% of Contract Total)										
26002 Electrical, Instrumentation, and Controls Subcontract										
26-00-00.02	BC-0006	EI&C Subcontract, from electrical estimate report (50% of $12,124,829)	1.0 ls	-	-	-	6,062,415	-	6,062,415.00 /ls	6,062,415
		Electrical, Instrumentation, and Controls Subcontract	**1.0 ls**				**6,062,415**		**6,062,415.00 /ls**	**6,062,415**
		950 EI & C Allowance (50% of Contract Total)	**1.0 LS**				**6,062,415**		**6,062,415.00 /LS**	**6,062,415**
		95 EI & C Allowance (50% of Contract Total)	**1.0 LS**				**6,062,415**		**6,062,415.00 /LS**	**6,062,415**
		01 Total	**1.0 LS**	**7,519,093**	**10,130,576**	**1,614,752**	**7,596,208**	**3,376,314**	**30,236,942.85 /LS**	**30,236,943**

Estimate Totals

Description	Rate	Hours	Amount	Totals
Labor		69,931 hrs	7,519,093	
Material			10,130,576	
Subcontract			7,596,208	
Equipment		20,273 hrs	1,614,752	
Other			3,376,314	
			30,236,943	**30,236,943**
Labor Mark-up	15.00 %		1,127,864	
Material Mark-up	10.00 %		1,013,058	
Subcontractor Mark-up	10.00 %		759,621	
Construction Equipment Mark-up	10.00 %		161,475	
2022 Diesel Fuel Adjustment	6.00 %		96,885	
Other - Process Equip Mark-up	8.00 %		270,105	
			3,429,008	**33,665,951**
Material Shipping & Handling	2.00 %		202,612	
Material Sales Tax	4.00 %		405,223	
Other - Process Eqp Sales Tax	8.00 %		270,105	
Net Markups			**877,940**	**34,543,891**
Contractor General Conditions	15.00 %		5,181,584	
			5,181,584	**39,725,475**
Start-Up, Training, O&M	2.00 %		794,509	
			794,509	**40,519,984**
Undesign/Undevelop Contingency	50.00 %		20,259,992	
			20,259,992	**60,779,976**
"Area" Contingency	30.00 %		18,233,992	
			18,233,992	**79,013,968**
Bldg Risk, Liability Auto Ins	2.00 %		1,580,279	
			1,580,279	**80,594,247**
Payment and Performance Bonds	1.50 %		1,208,914	
			1,208,914	**81,803,161**
Escalation to Midpoint (ALL)	53.05 %		43,396,577	
Gross Markups			**43,396,577**	**125,199,738**
Total				**125,199,738**

Central Maui WWRF Facility Plan
MLE + Filtration
Capital Cost Summary

Construction midpoint factor: 53%

Description	At Construction Mid-Point			Current Dollars	
	4 mgd estimate ($ M)	Project phasing factor	3 mgd estimate ($ M)	4 mgd estimate ($ M)	3 mgd estimate ($ M)
Site work	5.1	100%	5.1	3.3	3.3
Headworks	7.1	100%	7.1	4.6	4.6
Aeration tanks	13.8	80%	11.0	9.0	7.2
Secondary clarifiers	21.0	75%	15.8	13.7	10.3
RAS pump station	1.9	90%	1.7	1.2	1.1
R-1 treatment	21.4	80%	17.1	14.0	11.2
Effluent pump station	6.0	90%	5.4	3.9	3.5
Aerobic digesters	9.2	100%	9.2	6.0	6.0
Dewatering building	5.1	100%	5.1	3.3	3.3
Operations building	4.6	100%	4.6	3.0	3.0
Easement piping	3.8	100%	3.8	2.5	2.5
Yard piping	1.3	100%	1.3	0.8	0.8
Electrical and instrumentation	24.8	90%	22.3	16.2	14.6
Total	125		110	82	71.6

$31 /gpd $20 /gpd

Equipment cost estimate

Gross equipment structures: $90.1 M

Equipment at 25% of gross: $22.5 M $14.7

Central Maui WWRF Facility Plan
MBR
Capital Cost Summary

Construction midpoint factor: 53%

Description	At Construction Midpoint		Current Dollars
	4 mgd Estimate ($ M)	Notes	4 mgd estimate ($ M)
Site work	5.1	Same as MLE	3.3
Headworks	7.1	Same as MLE	4.6
Aeration tanks	16	Per Alderwood	10.6
MBR equipment building	6	20% of Alderwood for MBR equipment	4.0
Membrane tanks	47	Per Alderwood	30.9
Effluent pump station	6	Same as MLE	3.9
Aerobic digesters	9.2	Same as MLE	6.0
Dewatering building	5.1	Same as MLE	3.3
Operations building	4.6	Same as MLE	3.0
Easement piping	3.8	Same as MLE	2.5
Yard piping	1.3	Same as MLE	0.8
Electrical and instrumentation	24.8	Same as MLE	16.2
	$137 M		$89 M
	$34 /gpd		$22 /gpd

Equipment cost estimate

Gross equipment structures:	$101.6 M		
Equipment at 25% of gross:	$25.4 M		$16.6 M

Central Maui WWRF Facility Plan
O&M Cost Estimates

Common Inputs

Electricity	$0.40	/kWh
Sludge disposal	$100	/wet ton
Maintenance materials	2%	of equipment capital/year

Labor

Labor requirements are similar for both alternatives

Position	Count	Monthly Salary	Annual Cost
WWTP Operations Supervisor IV	1	$ 7,138	$ 85,656
Asst WWTP Operations and Maintenance Supervisor IV	1	$ 6,301	$ 75,612
WWTP Operator IV	2	$ 5,942	$ 142,608
Assistant WWTP Operator	6	$ 4,794	$ 345,168
WWTP Worker	1	$ 4,258	$ 51,096
Plant Electrician/Electronics Repairer I	1	$ 5,733	$ 68,796
Electronic Technician I	1	$ 6,400	$ 76,800
WWTP Maintenance Mechanic I	1	$ 5,733	$ 68,796
Total			**$ 910,000**

Electricity

Load	Duty Unit Count	Motor Size (hp)	Use Factor	Equivalent Continuous Load (hp)	Annual Power (kWh)	Alt 1 MLE (kWh)	Alt 2 MBR (kWh)
Headworks							
Screens	2	1	10%	0.2	1,306	1,306	1,306
Screening washer	2	15	10%	3	19,597	19,597	19,597
Screening compactor	1	7.5	10%	0.75	4,899	4,899	4,899
Grit pumps	2	15	10%	3	19,597	19,597	19,597
Grit washer	1	1	10%	0.1	653	653	653
Grit dewatering unit	1	1	10%	0.1	653	653	653
Process Tanks							
Anoxic zone mixer	3	5	100%	15	97,985	97,985	97,985
Mixed liquor recycle	3	25	100%	75	489,925	489,925	489,925
Aeration blowers	3	150	100%	450	2,939,549	2,939,549	2,939,549
RAS/WAS Pumps							
RAS pumps	2	50	100%	100	653,233	653,233	653,233
WAS pumps	2	10	30%	6	39,194	39,194	39,194
Secondary Clarifiers							
Clarifier mechanism	3	2	100%	6	39,194	39,194	N/A
Scum pumps	3	10	20%	6	39,194	39,194	N/A
Tertiary Treatment							
Rapid mixers	1	5	100%	5	32,662	32,662	N/A
Flocculators	3	1	100%	3	19,597	19,597	N/A
Cloth media filters	3	10	100%	30	195,970	195,970	N/A
Membranes							
Membrane blowers	3	200	100%	600	3,919,399	N/A	3,919,399
Permeate pumps	3	30	100%	90	587,910	N/A	587,910
Scum pumps	3	10	20%	6	39,194	N/A	39,194
Disinfection							
UV disinfection	1	724	100%	724	4,729,408	4,729,408	4,729,408
Effluent Pump Station							
R-1 pumps	1	200	96%	192	1,254,208	1,254,208	1,254,208
SAT pumps	2	40	4%	3.2	20,903	20,903	20,903
Plant water pumps	1	20	100%	20	130,647	130,647	130,647
Aerobic Digestion							
Digester blowers	2	75	90%	135	881,865	881,865	881,865

Sludge Dewatering							
Screw press feed pump	1	5	30%	1.5	9,798	9,798	9,798
Screw press	1	2	30%	0.6	3,919	3,919	3,919
Cake Conveyor	1	2	30%	0.6	3,919	3,919	3,919
Miscellaneous							
Drainage return pumps	1	20	50%	10	65,323	65,323	65,323
Fans	4	2	100%	8	52,259	52,259	52,259
Total kWh:						11,745,460	15,965,346
Annual cost:						**$4,700,000**	**$6,390,000**

Chemicals

Description	Alt 1 MLE	Alt 2 MBR
UV cleaning chemicals	$10,000	$10,000
Maintenance hypochlorite	$10,000	$10,000
Membrane cleaning chemicals	N/A	$20,000
Dewatering polymer	$200,000	$200,000
Totals	**$220,000**	**$240,000**

Maintenance Materials

Description	Alt 1 MLE	Alt 2 MBR
Equipment estimate	$14,722,222	$16,600,254
Annual cost	**$290,000**	**$330,000**

Membrane replacement **$7.8M 10 year life**

Sludge Disposal

Both alternatives are similar

Dewatered sludge @ 4 mgd	36	wet tons/d
Dewatered sludge @ 2 mgd	18	wet tons/d
Annual cost @ 2 mgd:	**$660,000**	**/year**

County of Maui DEM
Central Maui WWRF Alternatives
Alternatives Net Present Value Analysis

			Sensitivity Adjustments (%)			Results		
Agency:	County of Maui DEM							
Project/Problem:	Central Maui WWRF	Risk Premium	Benefits	Capital Costs	Other Costs	Capital Cost	30-year NPV	Benefit over Status Quo
Alternative 1	MLE					$82,000,000	($241,269,922)	
Alternative 2	MBR					$89,000,000	($294,525,368)	($53,255,446)
Alternative 3								$241,269,922
Alternative 4								$241,269,922
Alternative 5								$241,269,922
Alternative 6								$241,269,922
Alternative 7								$241,269,922
Alternative 8								$241,269,922
Alternative 9								$241,269,922
Alternative 10								$241,269,922
Alternative 11								$241,269,922
Alternative 12								$241,269,922

Year of analysis:	2022
Escalation rate:	3.00%
Discount rate:	5.00%

Select one
- (●) All entries in dollars
- ( ) All entries in thousands of dollars

Appendix B: Non-Economic Evaluation

Central Maui WWRF Facility Plan
Non-Economic Evaluation

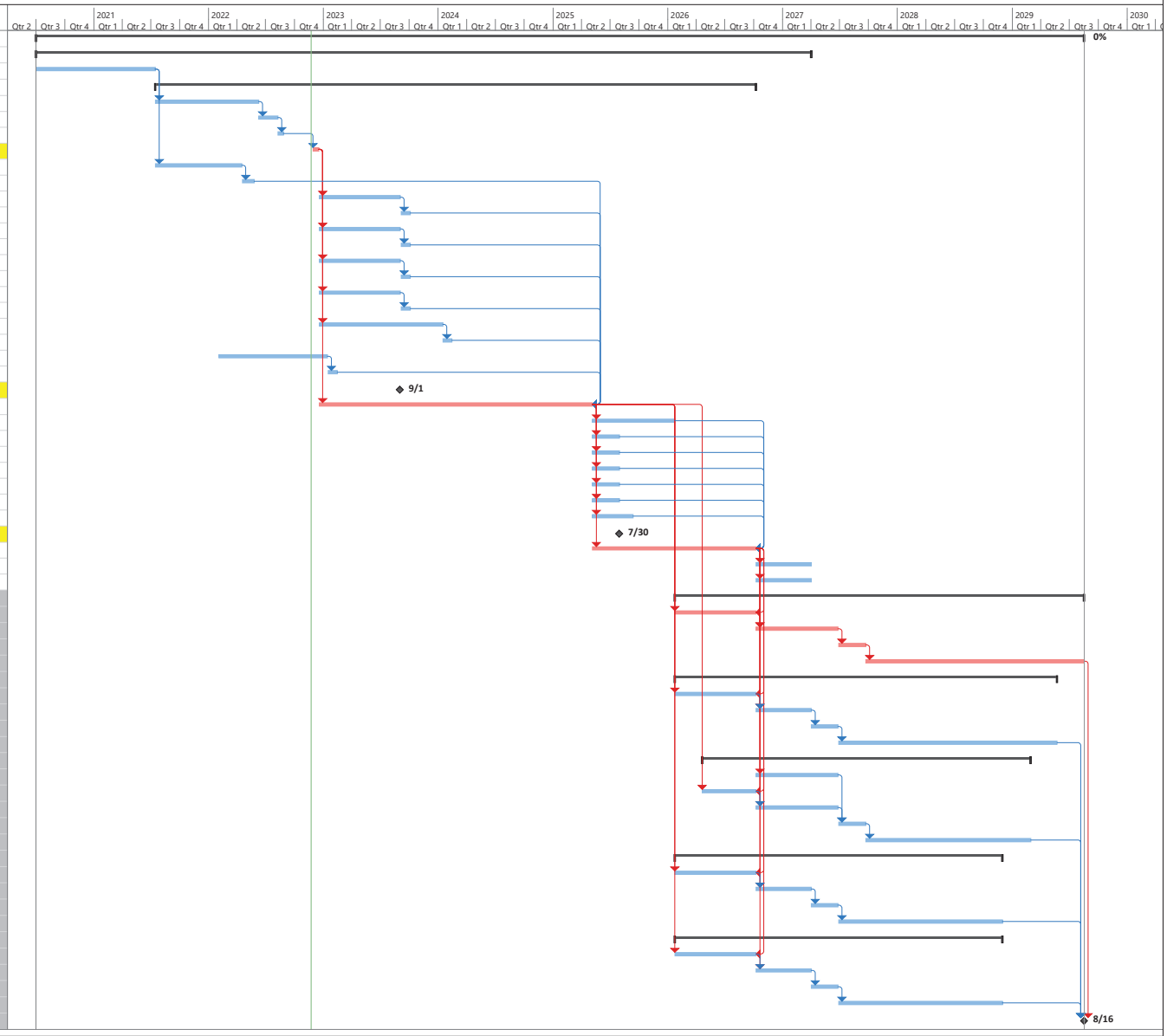
Category	Category Weight	Criteria	Criteria Weight	Raw Scores		Weighted Scores	
				MLE	MBR	MLE	MBR
Level of Service	25%						
		Wastewater Effluent Discharges	25%	4	4	1.00	1.00
		Potential for Capacity Expansion	25%	4	5	1.00	1.25
		Recycled Water Reliability	25%	4	4	1.00	1.00
		Public perception / community concerns	25%	3	4	0.75	1.00
Regulatory	25%						
		Monitoring complexity	25%	4	5	1.00	1.25
		Treatment adjustment potential	25%	5	4	1.25	1.00
		Safety regulations complexity	25%	4	3	1.00	0.75
		Environmental concerns	25%	4	5	1.00	1.25
O&M Factors	25%						
		Footprint	25%	4	5	1.00	1.25
		Safe work environment	25%	4	3	1.00	0.75
		Maintenance complexity	25%	4	3	1.00	0.75
		Operations complexity	25%	4	3	1.00	0.75
Island Factors	25%						
		Mainland delivery dependence	25%	4	4	1.00	1.00
		Mainland servicing dependence	25%	4	4	1.00	1.00
		Power dependence	25%	4	3	1.00	0.75
		Chemical dependence	25%	4	3	1.00	0.75
					Overall Score:	**4.00**	**3.88**

****Note : 5 = high/desirable, 1 = low/not-desirable*

Appendix C: Preliminary Implementation Schedule

CentralMauiWWRF-Schedule20221122

ID	Task Mode	Task Name
1		**Central Maui WWRF Project(s)**
2		**Planning / Environmental Documents**
3		Site Selection
4		EIS for Entire Project (WWRF, Kehalani PS, Kehalani Pipeline, Tropica Plantation Pipelines)
5		Confirm APE (including all project elements)
6		Draft Pre-consultation Package
7		Team Review of Pre-consultation Package
8		Final Pre-consultation Package (EISPN)
9		Draft WWRF Facility Plan
10		County Review of Draft WWRF Facility Plan
11		Draft Kehalani FM PER
12		County Review of Draft Kehalani FM PER
13		Draft Tropical Plantation FM PER
14		County Review of Draft Tropical Plantation FM PER
15		Draft Kehalani PS Feasibility Study
16		County Review of Draft Kehalani PS Feasibility Study
17		Draft Kehalani PS PER
18		County Review of Draft Kehalani PS PER
19		Draft Drainage Report
20		County Review of Draft Drainage Report
21		Draft Hydrogeologic Study
22		County Review of Draft Hydrogeologic Study
23		MH and subs deliverables prior to Draft EIS + WWRD or team reviews?
24		**Draft EIS**
25		Final WWRF PER
26		Final Kehalani FM PER
27		Final Tropical Plantation FM PER
28		Final Kehalani PS Feasibility Study
29		Final Kehalani PS PER
30		Final Drainage Report
31		Final Hydrogeologic Study
32		MH and subs deliverables prior to Final EIS + WWRD or team reviews?
33		**Final EIS**
34		Special Use Permit - County
35		Subdivision
36		**WWRF (with on-site SAT) Design and Construction**
37		50% Design - WWRF (begin at risk before Final EIS)
38		Complete Design and Permitting - WWRF
39		Procurement - WWRF construction contract
40		Construction - WWRF
41		**Kehalani Pipeline**
42		50% Design and permitting - pipeline (begin at risk before Final EIS)
43		Complete Design and Permitting - Kehalani pipeline
44		Procurement - pipeline construction contract
45		Construction - pipeline
46		**Kehalani PS**
47		Land Acquisition
48		50% Design - Kehalani PS (begin at risk before Final EIS)
49		Complete Design and Permitting - Kehalani PS
50		Procurement - PS construction contract
51		Construction - PS
52		**Tropical Plantation Pipeline**
53		Design - Tropicla Plantation Pipeline (begin at risk before Final EIS?)
54		Complete Design and Permitting - Tropical Plantation Pipeline
55		Procurement - Tropical Plantation Pipeline construction contract
56		Construction - Tropical Plantation Pipeline
57		**DHHL Pipelines and PS**
58		Design - DHHL Pipelines and PS (begin at risk before Final EIS?)
59		Complete Design and Permitting - DHHL Pipelines and PS
60		Procurement - DHHL Pipelines and PS construction contract
61		Construction - DHHL Pipelines and PS
62		**WWRF Operational**



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KEHALANI WASTEWATER PUMP STATION FEASIBILITY STUDY AND SITING ANALYSIS

APPENDIX

B

Established 1969

Feasibility Study and Siting Analysis

KEHALANI WASTEWATER PUMP STATION

Wailuku, Maui, Hawaii
TMK: (2) 3-5-020: 036

Prepared For:

Brown and Caldwell
2261 Aupuni Street, Suite 201
Wailuku, Maui, Hawaii 96793

License Expires
April 30, 2026

Signature Date

Warren S. Unemori Engineering, Inc.
Civil and Structural Engineers - Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, Hawaii

Date: August 15, 2025

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Figure 2-1 (2 of 2) Kehalani WWPS Site Plan

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APPENDIX C - Water Demand Calculation

Feasibility Study and Siting Analysis

for

Kehalani Wastewater Pump Station

1. INTRODUCTION

1.1 Purpose

The Maui County Department of Environmental Management Wastewater Reclamation Division (DEM-WWRD) is seeking to build a new wastewater pump station in Wailuku. This report describes the existing infrastructure in the vicinity of the proposed Kehalani Wastewater Pump Station (Kehalani WWPS) site, defines the improvements needed to support the proposed pump station, and identifies the anticipated impacts of the proposed project.

1.2 Project Location

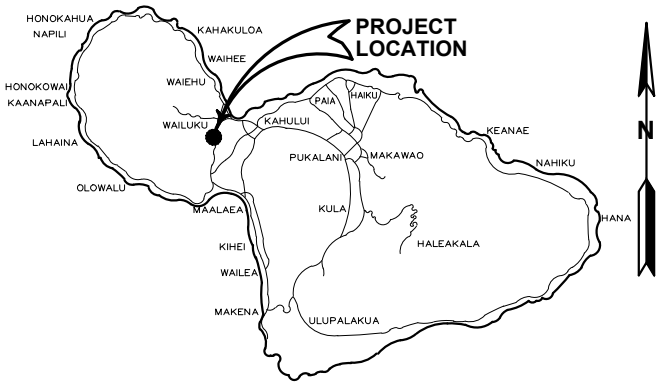
The proposed Kehalani WWPS will be located in Wailuku, Maui on the western (mauka) side of Waiale Road, northern side of Olomea Street, and eastern (makai) side of the existing Halemalu at Kehalani residential subdivision (See Figure 1-1). The project site is approximately 0.4 acres and will be located at the south end of the 7.515 Acre Kehalani Makai Park/Detention Basin parcel at Tax Map Key (2) 3-5-020: 036 which is owned and maintained by the County of Maui.[1] See Figure 2-1 (1 of 2).

[1] The 7.515 acre project site is Lot 36 of the *Wailuku Project District C-5 Subdivision* which was recorded as File Plan 2177.

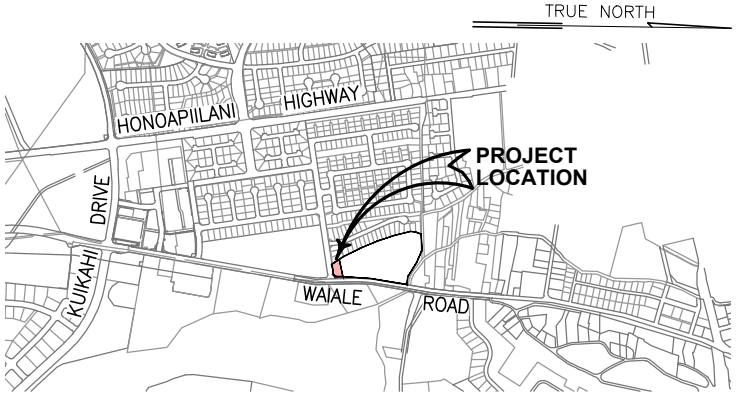
1.3 Project Description

The proposed project involves construction of a new wastewater pump station which will enable DEM-WWRD to divert wastewater from the Kehalani, Wailuku Heights, and Waikapu service areas to a future wastewater reclamation facility in Waikapu, hereinafter referred to as the Central Maui Wastewater Reclamation Facility (Central Maui WWRF). The proposed Kehalani WWPS will be part of the infrastructure appurtenant to the future Central Maui WWRF. The Central Maui WWRF will be part of DEM-WWRD's decentralization plan intended to help maintain adequate capacity at the existing Wailuku-Kahului Wastewater Reclamation Facility (W-K WWRF).

Construction of the new pump station will also consist of associated site improvements including onsite grading and drainage improvements; site utilities; retaining walls; wastewater utilities, equipment and structures; underground water and electrical systems; paved access and parking; landscaping; and a perimeter fence.



ISLAND OF MAUI



PROJECT VICINITY

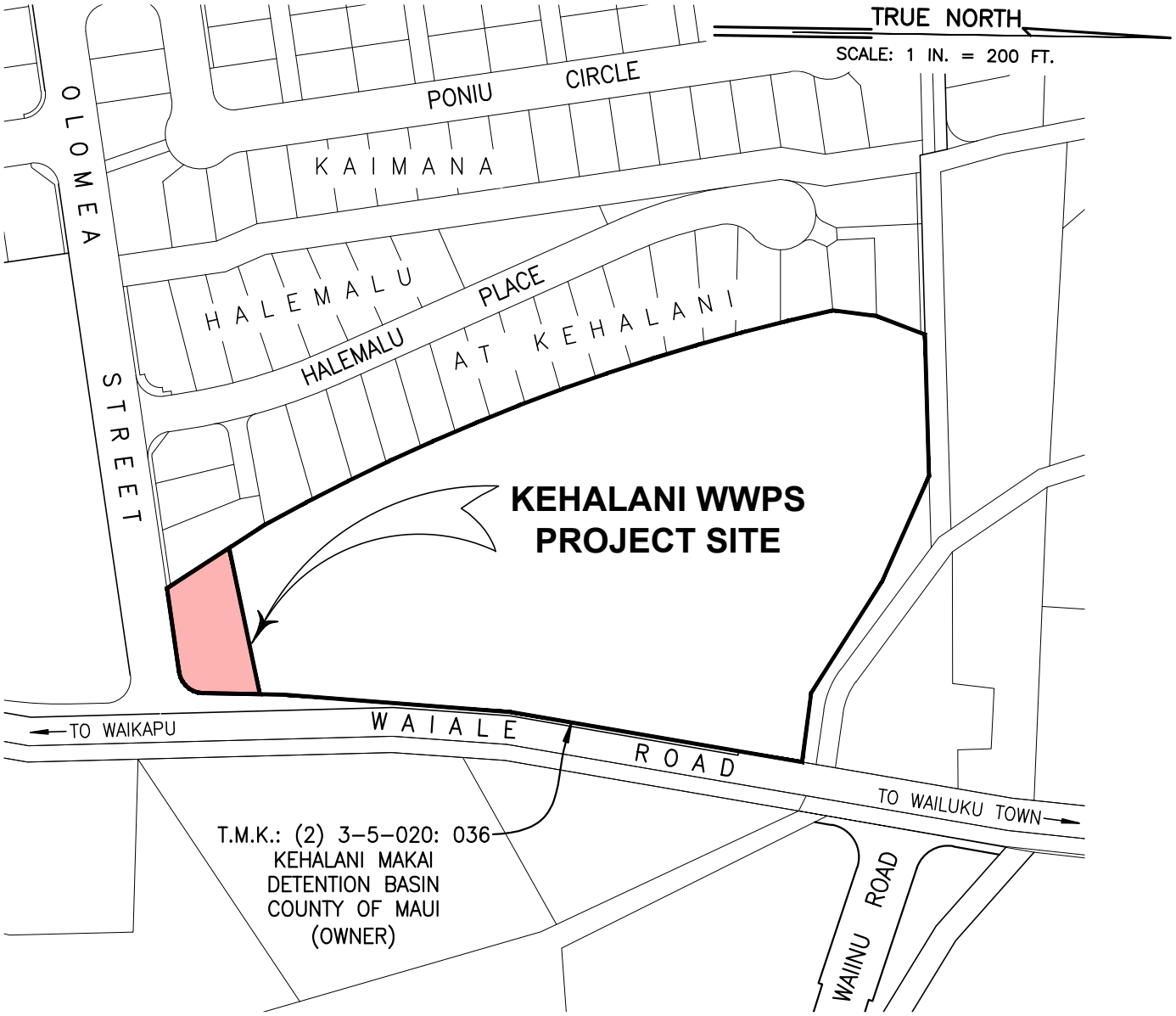


FIGURE 1-1
LOCATION MAP

0 200 400 600 800

SCALE: 1 IN. = 200 FT.

WARREN S. UNEMORI ENGINEERING, INC.
CIVIL & STRUCTURAL ENGINEERS / LAND SURVEYORS

August 15, 2025

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2. WASTEWATER

2.1 Existing Infrastructure

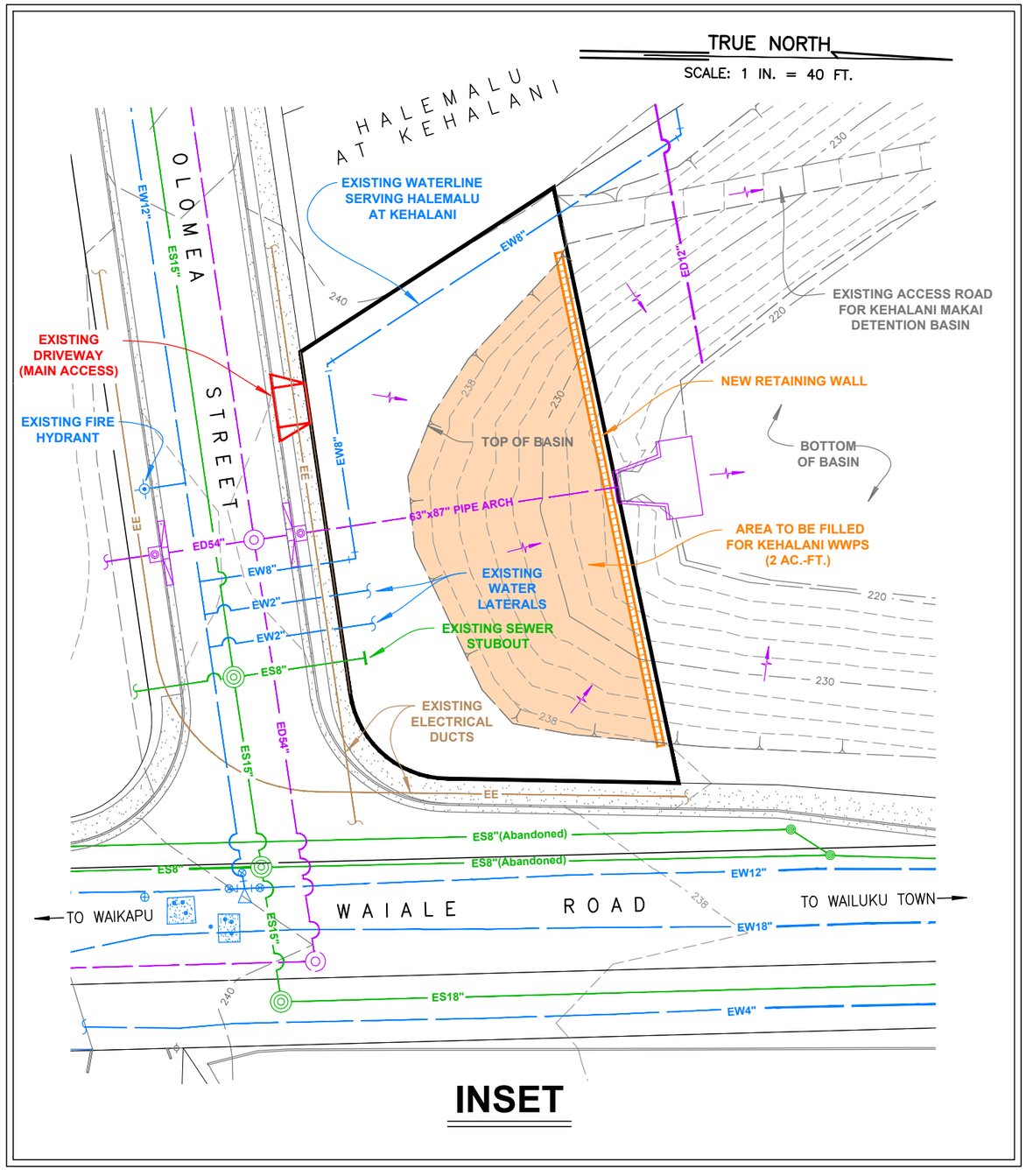
The project site is located near the existing 15-inch and 18-inch gravity sewer mains under Olomea Street and Waiale Road, respectively, which convey wastewater from the Kehalani, Wailuku Heights, and Waikapu service areas to the trunk sewer main under Waiale Road where it continues toward Lower Main Street on its way to the W-K WWRF for treatment and disposal.

2.2 Proposed Improvements

A new wastewater pump station (Kehalani WWPS) is being proposed to divert the wastewater from the Kehalani, Wailuku Heights, and Waikapu service areas presently conveyed to the W-K WWRF to the future Central Maui WWRF (See Figure 2-1). It is our understanding that the new Kehalani WWPS will be designed to divert an estimated flow of approximately 901,900 gallons per day (gpd)[2] toward the future Central Maui WWRF via a proposed 18-inch force main [the ultimate size of all pipelines will be determined; and, the possibility of parallel (dual) piping will be considered, in conjunction with final design stages of the project]. This proposed force main will extend south along Waiale Road, then along a future Waiale Road extension at its intersection with East Waiko Road, eventually diverting in a southeasterly direction towards Central Maui WWRF via a gravity system (separate project). At the two (2) localized high points along the force main, near East Waiko Road and between East Waiko Road and Central Maui WWRF, a combination air-vacuum release

[2] Approximately 330,575 gpd and 571,328 gpd are the estimated projected wastewater flows for the Kehalani and Waikapu areas, respectively. See Appendix A for wastewater flow tabulation.

valve (CARV) will be installed to release air pressure buildup. An oversized gravity force main transition and odor control system will be installed to alleviate any tendency for pump and system instabilities at the highest point of the force main (near East Waiko Road). Considering the intermediate high point between this location and Central Maui WWRF, the oversized gravity force main transition will return to an 18-inch force main, eventually connecting to Central Maui WWRF. The proposed diversion of wastewater to the Kehalani WWPS is expected to help alleviate capacity constraints in the County's downstream gravity sewage systems under Waiale Road and Lower Main Street; therefore, no upgrades to the existing gravity sewage system is expected to be necessary.



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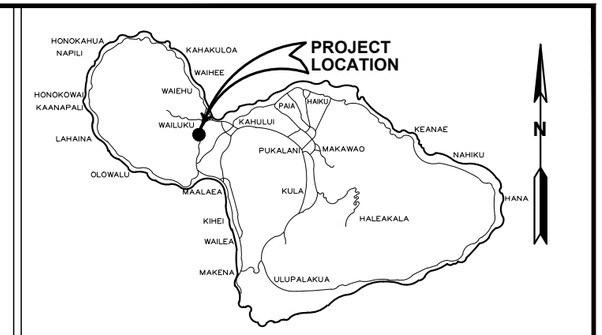

ISLAND OF MAUI

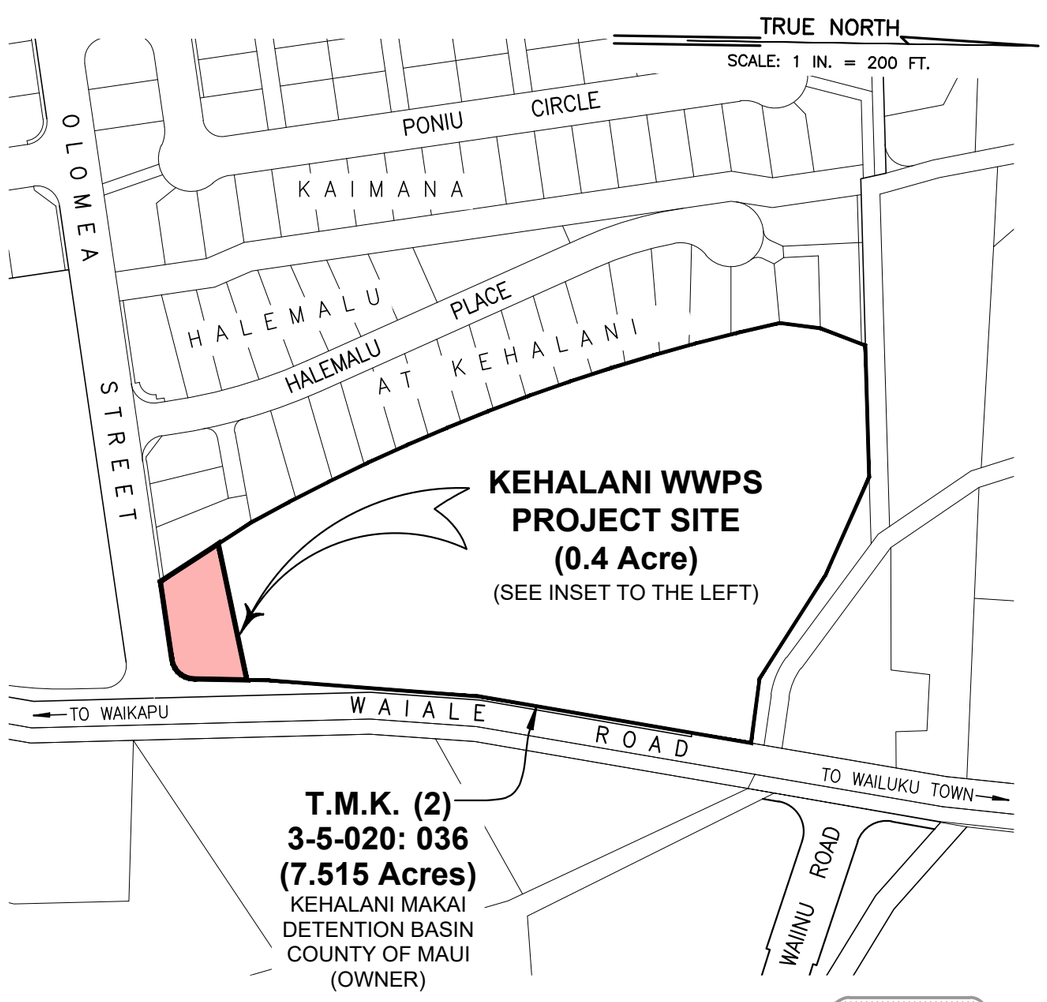

FIGURE 2-1 (1 of 2)
KEHALANI WWPS SITE PLAN

WARREN S. UNEMORI ENGINEERING, INC.
CIVIL & STRUCTURAL ENGINEERS / LAND SURVEYORS

August 15, 2025

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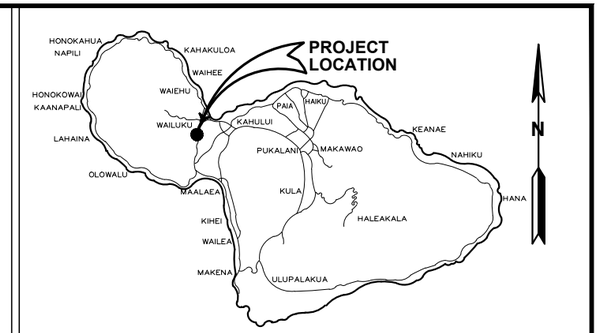
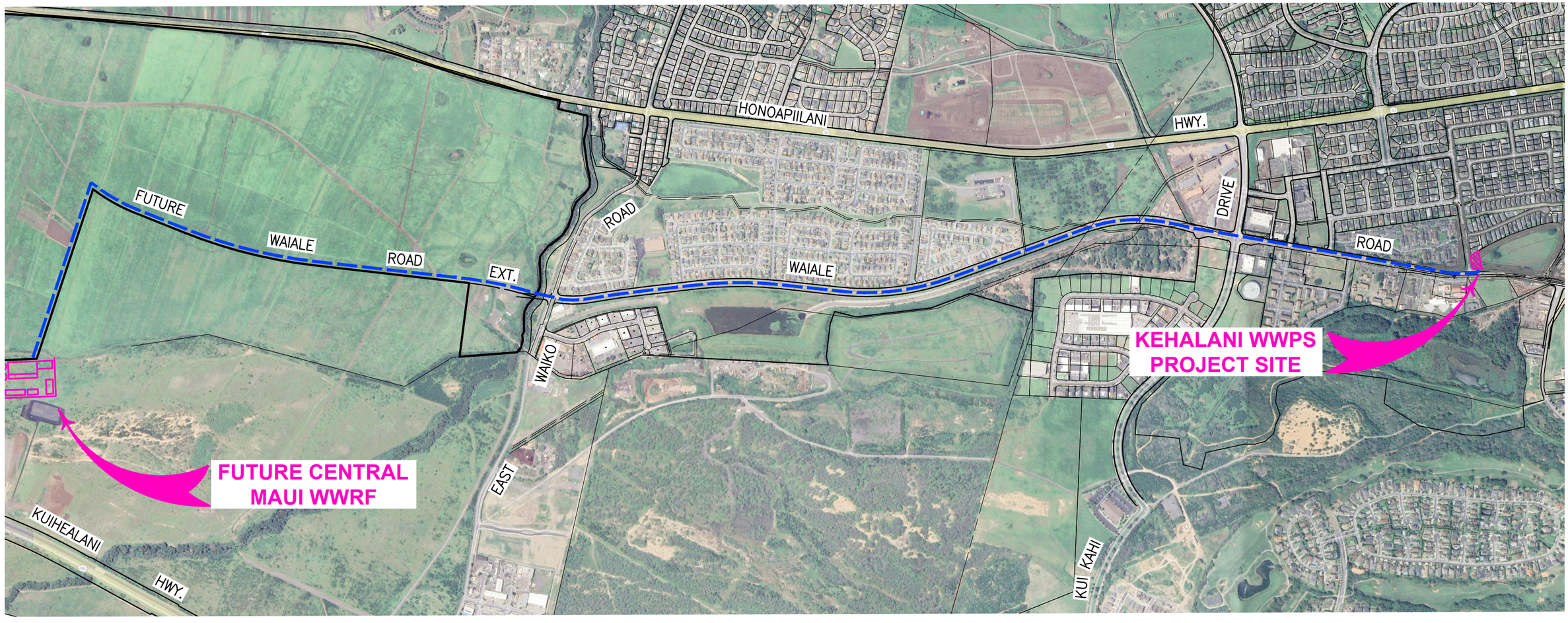


ISLAND OF MAUI



LEGEND:

PROPOSED 18–IN FORCE MAIN [THE ULTIMATE SIZE OF ALL PIPELINES WILL BE DETERMINED; AND, THE POSSIBILITY OF PARALLEL (DUAL) PIPING WILL BE CONSIDERED, IN CONJUNCTION WITH FINAL DESIGN STAGES OF THE PROJECT]

NOTE:

AERIAL IMAGE OBTAINED FROM GOOGLE EARTH
(DATED: FEBRUARY 27, 2024)

FIGURE 2-1 (2 of 2)
KEHALANI WWPS SITE PLAN

WARREN S. UNEMORI ENGINEERING, INC.
CIVIL & STRUCTURAL ENGINEERS / LAND SURVEYORS

August 15, 2025

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3. ROADWAY ACCESS

3.1 Existing Infrastructure

An existing 16-foot wide paved driveway along Olomea Street (See Figure 2-1) currently provides vehicular access to the Kehalani Makai Park/Detention Basin. Olomea Street, which is located along the southern boundary of the project site, is a County-owned and maintained minor collector street which connects to Waiale Road on its eastern end. Waiale Road is controlled by the County of Maui and classified as a limited-access collector street.

3.2 Proposed Improvements

Vehicular access to the Kehalani WWPS will be provided by the same existing driveway on Olomea Street (See Figure 2-1). Access to the new pump station will be infrequent and limited to operations and daily maintenance visits by the DEM-WWRD personnel; therefore, the construction of a new pump station is not expected to require additional access points.

4. DRAINAGE

4.1 Existing Conditions

4.1.1 Topography and Soils

The project site will be located at the south end of an existing park/detention basin built for the Makai Section of the Kehalani Master Planned Community. The existing interior basin slopes are approximately 25 percent (4H:1V). Elevation ranges from 238 feet along the south side of the site, to 224 feet at its north border.

The USDA Natural Resources Conservation Service identifies Iao Silty Clay (IaA) as the predominant soil type found on the project site (See Figure 4-1). These Iao clay soils are reported to produce runoff that is slow and represent a slight erosion hazard.[3]

4.1.2 Flood and Tsunami Zone

FEMA's Flood Insurance Rate Map for Maui County locates the project site within Zone X, outside of both the 500-year floodplain and tsunami zone.[4] Figure 4-2 shows a current DLNR Flood Hazard Assessment Report for the parcel. It is noted, pursuant to Floodplain Management Requirements, A Study Guide and Desk Reference for Local Officials, "basins in new subdivisions typically do not have a measurable effect on the base flood and, therefore, do not warrant a map change." [5]

---

[3] United States Department of Agriculture, Soil Conservation Service, *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii*, August 1972, pp. 46, Map 99.

[4] U.S. Department of Homeland Security, Federal Emergency Management Agency, Flood Insurance Rate Map, Maui County, Hawaii, Community-Panel Numbers 150003 0391E, September 25, 2009.

[5] National Flood Insurance Program (NFIP) Floodplain Management Requirements, A Study Guide and Desk Reference for Local Officials, FEMA 480, February 2005.

4.1.3 Existing Drainage Condition

Surface runoff generated by the undeveloped 0.4-acre project site enters the existing Kehalani Makai Detention Basin for disposal which, in turn, eventually discharges into an existing underground drainage system that terminates at the Wailuku River (formerly known as Iao Stream). The 10-year 1-hour[6] peak flow rate generated by the project site in its current, undeveloped state is estimated to be 0.5 cubic feet per second (cfs).[7]

4.2 Drainage Plan

4.2.1 Post-Development Condition

The Kehalani WWPS is expected to produce a peak runoff volume of 2.2 cfs from a 10-year 1-hour storm once it has been fully constructed[8]. This represents a net increase of approximately 1.7 cfs attributable to development of the project area. A comparative summary of pre-development and post-development runoff is presented in Table 4-1.

---

[6] County of Maui, Department of Public Works and Waste Management, "Rules for the Design of Storm Drainage Facilities in the County of Maui," Title MC-15, Chapter 4, Section 15-04-05(a), November 2, 1995.

[7] Supporting calculations may be found in Appendix B.

[8] Supporting calculations may be found in Appendix B.

TABLE 4-1
Increase in Runoff Attributable to Development
(10 yr. - 1 hr. storm)

Pre-Development Flow	Post-Development Flow Before Mitigation	Net Change
0.5 cfs	2.2 cfs	+1.7 cfs

4.2.2 Detention Basin Storage Capacity

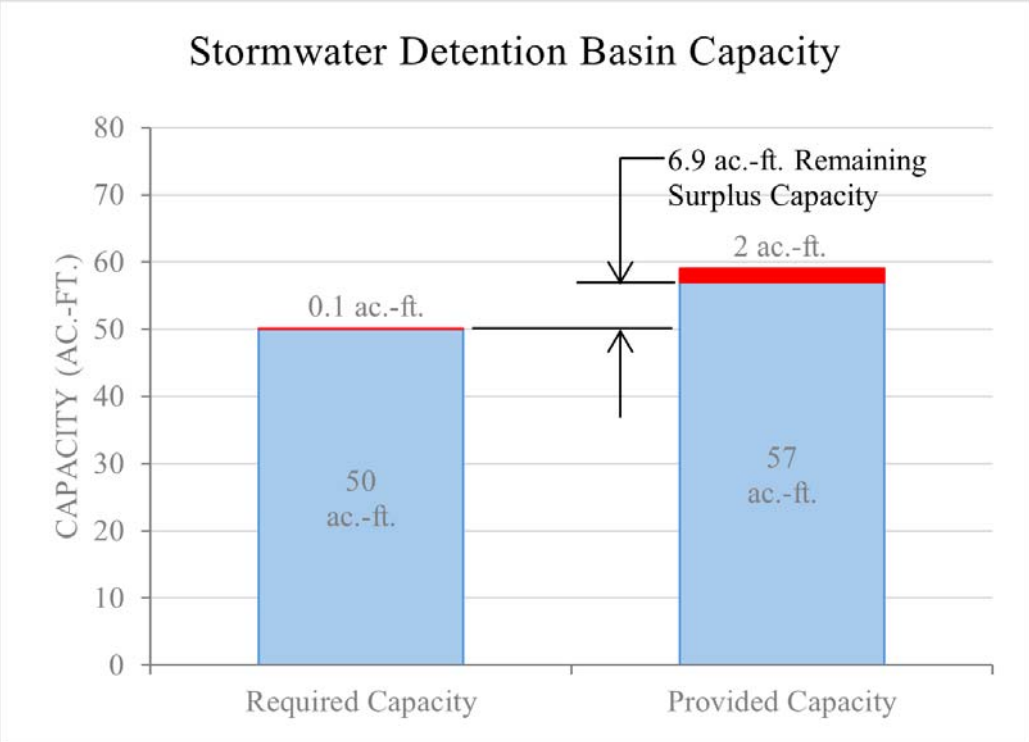
The Kehalani Makai Detention Basin has a required storage capacity of 50 ac.-ft.[9] and an actual storage capacity of 59 ac.-ft. A small portion of the basin will be filled in order to accommodate the pump station which will result in approximately 2 ac.-ft. of embankment. Thus, the basin will have sufficient capacity to accommodate the additional post-development runoff volume of 0.1 ac.-ft.[10] from the project site and pump station embankment as summarized in Table 4-2.

[9] Ref. Warren S. Unemori Engineering, Inc., "Wailuku Project District Drainage Master Plan", February 1998.

[10] Supporting calculations may be found in Appendix B.

TABLE 4-2
Stormwater Detention Basin Capacity

Original Storage Capacity Required	50 ac.-ft.
Additional Storage Capacity Required for WWPS	0.1 ac.-ft.
Total Storage Capacity Required with WWPS	50.1 ac.-ft.
Actual Storage Capacity Provided	59 ac.-ft.
Reduction in Storage Capacity from WWPS Embankment	2 ac.-ft.
Adequacy of Total Storage Capacity Provided with WWPS	57 ac.-ft. > 50.1 ac.-ft. ∴ OK



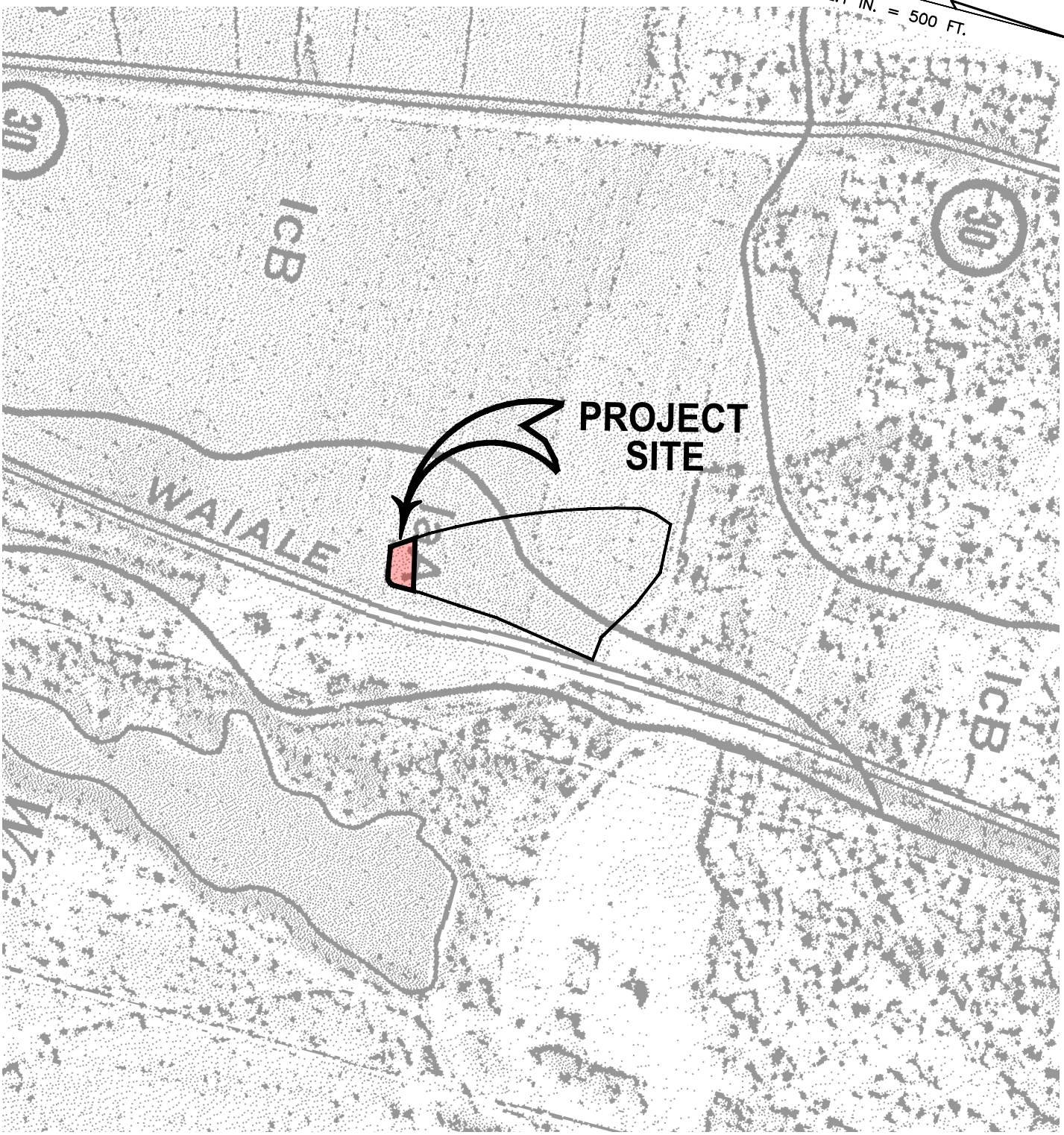


FIGURE 4-1
SOIL SURVEY MAP

Source:
U.S. Department of Agriculture, Soil Conservation Service, "Soil Survey of Island of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii", August 1972, Map 99.

WARREN S. UNEMORI ENGINEERING, INC.
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August 15, 2025

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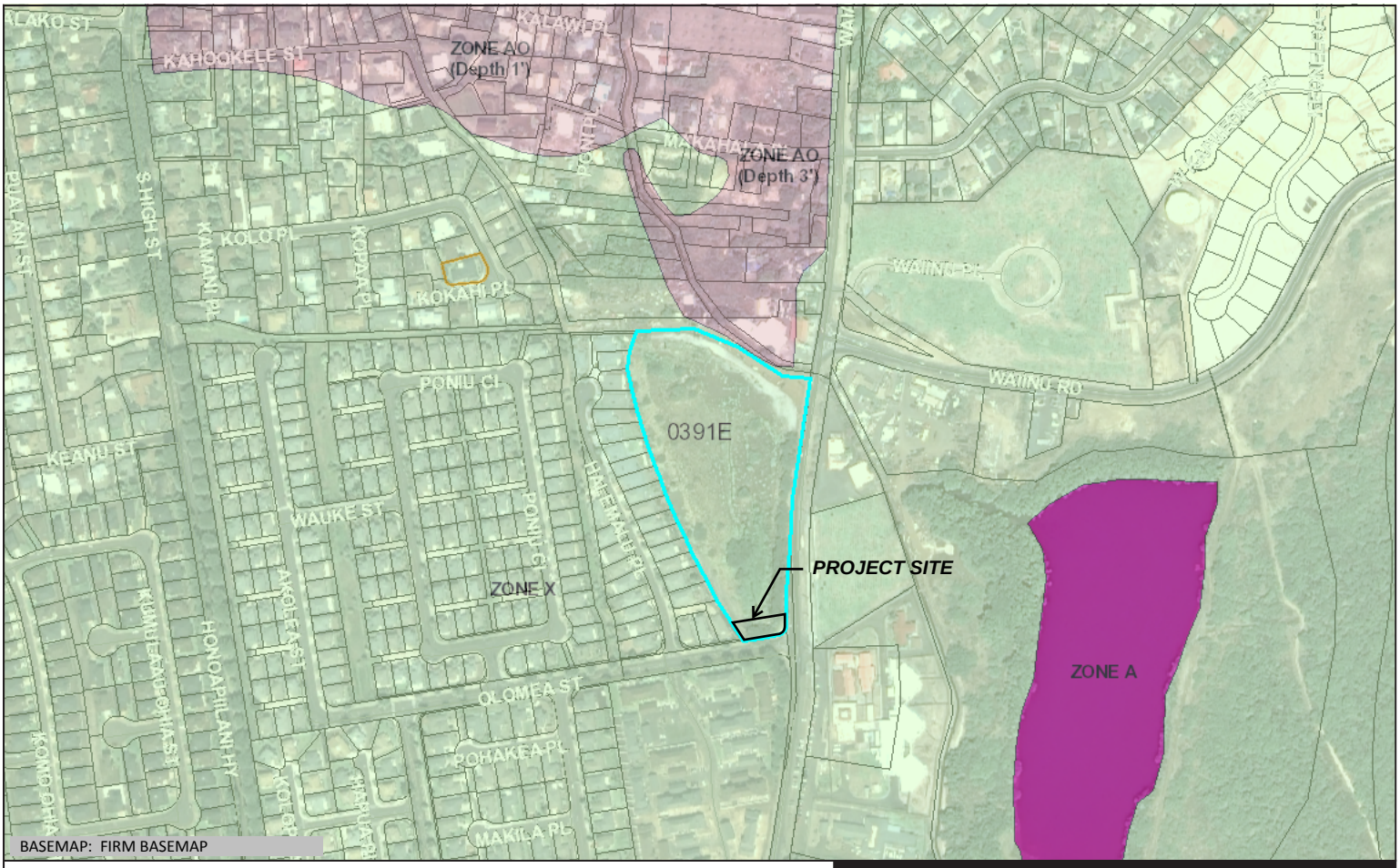
FIGURE 4-2 DLNR FLOOD HAZARD ASSESSMENT REPORT



Flood Hazard Assessment Report

www.hawaiinfip.org

Property Information

COUNTY:	MAUI
TMK NO:	(2) 3-5-020:036
WATERSHED:	IAO
PARCEL ADDRESS:	547 WAIALE RD WAILUKU, HI 96793

Notes:

Flood Hazard Information

FIRM INDEX DATE:	NOVEMBER 04, 2015
LETTER OF MAP CHANGE(S):	NONE
FEMA FIRM PANEL:	1500030391E
PANEL EFFECTIVE DATE:	SEPTEMBER 25, 2009

THIS PROPERTY IS WITHIN A TSUNAMI EVACUTION ZONE: NO
FOR MORE INFO, VISIT: http://www.scd.hawaii.gov/

THIS PROPERTY IS WITHIN A DAM EVACUATION ZONE: NO
FOR MORE INFO, VISIT: http://dlnreng.hawaii.gov/dam/

0 400 800 ft

Disclaimer: The Hawaii Department of Land and Natural Resources (DLNR) assumes no responsibility arising from the use, accuracy, completeness, and timeliness of any information contained in this report. Viewers/Users are responsible for verifying the accuracy of the information and agree to indemnify the DLNR, its officers, and employees from any liability which may arise from its use of its data or information.

If this map has been identified as 'PRELIMINARY', please note that it is being provided for informational purposes and is not to be used for flood insurance rating. Contact your county floodplain manager for flood zone determinations to be used for compliance with local floodplain management regulations.

FLOOD HAZARD ASSESSMENT TOOL LAYER LEGEND
(*Note: legend does not correspond with NFHL)*

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD - The 1% annual chance flood (100-year), also know as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. SFHAs include Zone A, AE, AH, AO, V, and VE. The Base Flood Elevation (BFE) is the water surface elevation of the 1% annual chance flood. Mandatory flood insurance purchase applies in these zones:

	Zone A: No BFE determined.
	Zone AE: BFE determined.
	Zone AH: Flood depths of 1 to 3 feet (usually areas of ponding); BFE determined.
	Zone AO: Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined.
	Zone V: Coastal flood zone with velocity hazard (wave action); no BFE determined.
	Zone VE: Coastal flood zone with velocity hazard (wave action); BFE determined.
	Zone AEF: Floodway areas in Zone AE. The floodway is the channel of stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without increasing the BFE.

NON-SPECIAL FLOOD HAZARD AREA - An area in a low-to-moderate risk flood zone. No mandatory flood insurance purchase requirements apply, but coverage is available in participating communities.

	Zone XS (X shaded): Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
	Zone X: Areas determined to be outside the 0.2% annual chance floodplain.

OTHER FLOOD AREAS

	Zone D: Unstudied areas where flood hazards are undetermined, but flooding is possible. No mandatory flood insurance purchase apply, but coverage is available in participating communities.

5. WATER SYSTEM

5.1 Existing Infrastructure

The Kehalani WWPS is located within the Maui County Department of Water Supply's (DWS) Central Maui water system. Water for the pump station will be supplied from the DWS' distribution system in Wailuku, which uses a groundwater well as its source and distributes water from the existing 3.0 million gallon (MG) capacity storage tank (Iao Tank) located along Alu Road at an elevation of 506 feet.

The site is currently outfitted with two (2) existing 2-inch water laterals supplied by the 12-inch water main under Olomea Street. Department of Water Supply records indicate that one service lateral has a 1.5" meter while the other meter is unknown. Existing fire hydrants are spaced out about 310 feet or less along Olomea Street with the closest fire hydrant located approximately 50 feet from the project's southern border. See Figure 2-1.

5.2 Demand

Water will be required for operations, maintenance and sanitary purposes. The proposed pump station is expected to have a potable water demand of approximately 25 gallons per minute (gpm).[11]

5.3 Proposed Improvements

Water Source and Reservoir Storage Capacity

No water source and storage improvements are proposed with the Kehalani WWPS project. It is our understanding that the project will be processed under the water source provisions for public development projects present in the DWS' Water

[11] See Appendix C for potable water demand calculation.

Service Rules[12] and Maui County Code[13]. The project site will be supplied from the aforementioned 3.0 MG capacity Iao Tank owned by DWS.

Distribution System

One of the two existing water laterals from Olomea Street will be utilized to supply water to the proposed Kehalani WWPS. No new waterline connections to DWS' Central Maui water system are proposed by the project.

Fire Protection

Fire protection will be provided by the existing fire hydrants along Olomea Street. No new fire protection improvements are proposed with the project.

[12] Maui County Administrative Rules, Section 16-201-03(g)(2).

[13] Maui County Code, Section 14.12.030.G.

6. POWER AND TELECOMMUNICATION

6.1 Existing Infrastructure

There are existing underground electric power, telephone, and cable television (CATV) distribution systems along Olomea Street and Waiale Road near the project site.

6.2 Proposed Improvements

Electric power required for the Kehalani WWPS will be extended from the existing underground distribution lines to the new pump station building. Service connections to the telephone and CATV systems will also be available if required by the project. See Figure 2-1.

7. ALTERNATIVE SITES CONSIDERED

7.1 Evaluation of Alternative Sites

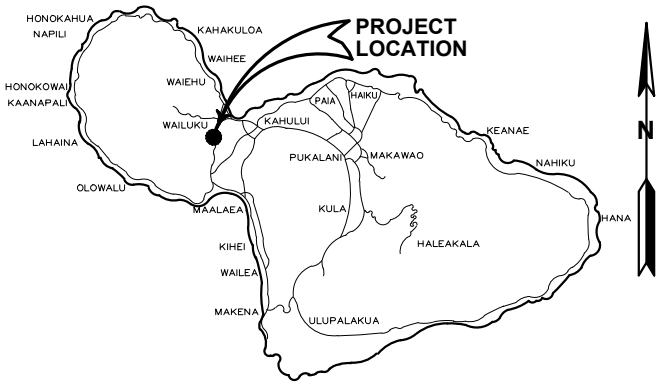
Multiple sites near the Waiale Road / Olomea Street sewer system node were considered for the project. Each site was evaluated based on several criteria including their current ownership and use, location relative to the flood zone, land size, and other potential factors affecting their suitability for the proposed wastewater pump station as summarized in Table 7-1. As a result, Site No. 1 (Kehalani Makai Park/Detention Basin) was deemed by both the Design Consultants Team and the County DEM-WWRD to be the most favorable location for the Kehalani WWPS project. (See Figure 7-1 for alternative site locations).

Prepared by:

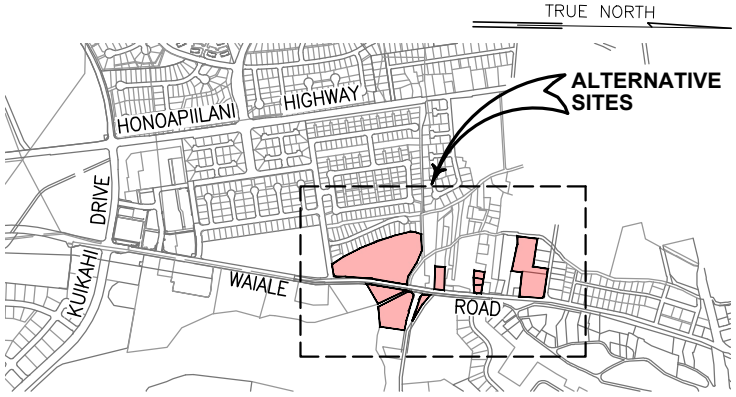
Tehina K. Brito

Reviewed by:

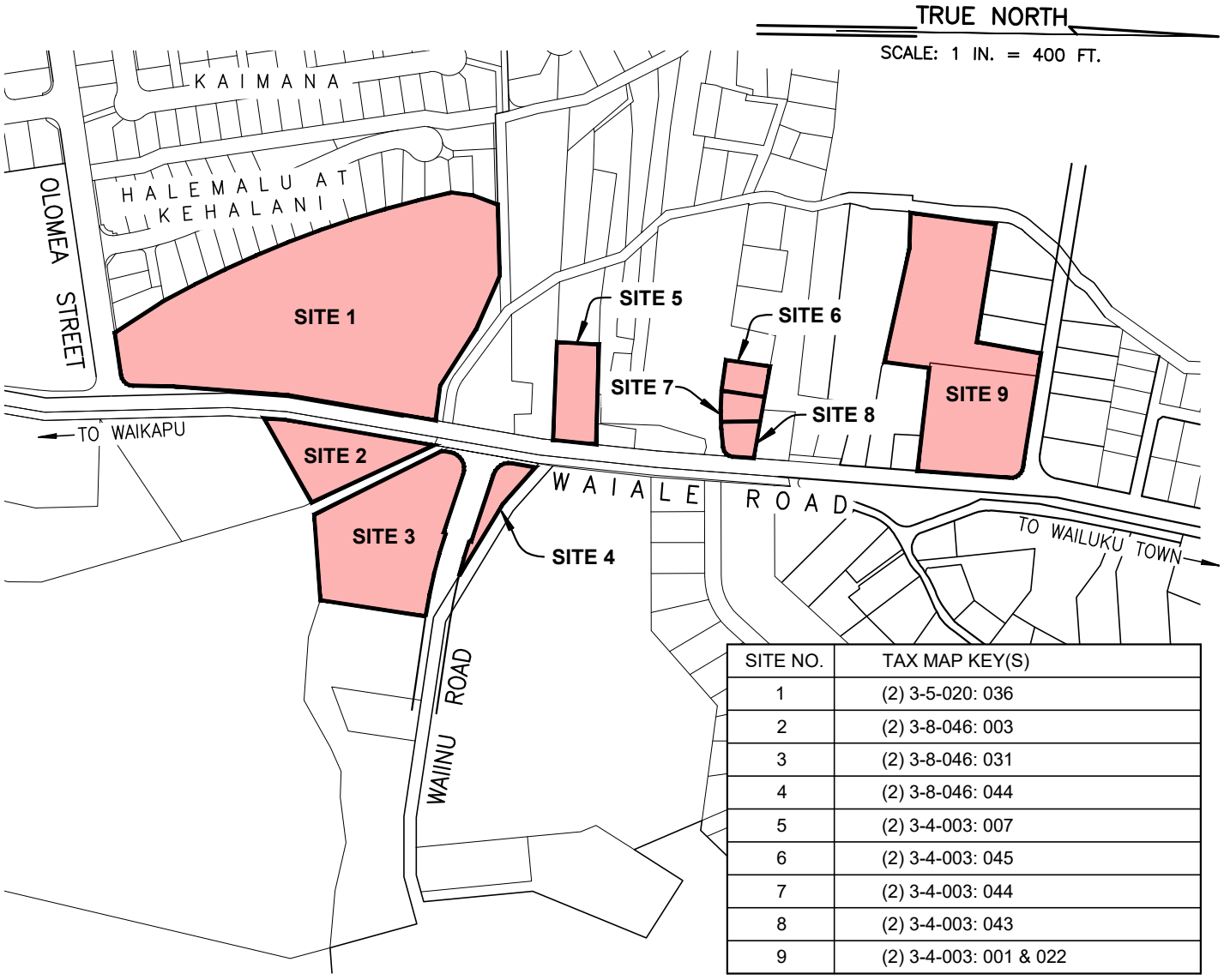
Clifford N. Mukai, P.E.



ISLAND OF MAUI



PROJECT VICINITY



SITE NO.	TAX MAP KEY(S)
1	(2) 3-5-020: 036
2	(2) 3-8-046: 003
3	(2) 3-8-046: 031
4	(2) 3-8-046: 044
5	(2) 3-4-003: 007
6	(2) 3-4-003: 045
7	(2) 3-4-003: 044
8	(2) 3-4-003: 043
9	(2) 3-4-003: 001 & 022

FIGURE 7-1

LOCATION MAP OF ALTERNATIVE SITES

0 400 800 1200 1600

SCALE: 1 IN. = 400 FT.

WARREN S. UNEMORI ENGINEERING, INC.
CIVIL & STRUCTURAL ENGINEERS / LAND SURVEYORS

August 15, 2025

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TABLE 7-1

Sites Considered for Kehalani WWPS

Site No.	T.M.K.	Area	Owner	Zoning	Flood Zone	Distance to Waiale/Olomea Sewer Node	Description	Remarks
1	(2) 3-5-020: 036	7.52 acs.	County of Maui	PD Project District	No	0 feet	Stormwater Detention Basin for Kehalani Makai Area	Lot is maintained by the County of Maui Department of Parks & Recreation.
2	(2) 3-8-046: 003	1.03 acs.	Bacon Finance & Realty Inc.	Commercial Mixed Use - MRA	No	400 feet	Private Baseyard	Owner was not interested in selling their lot.
3	(2) 3-8-046: 031	2.50 acs.	Gomes, Terrance J Trust Gomes, Sandra M Trust	Commercial Mixed Use - MRA	No	850 feet	Private Baseyard	Owner was not interested in selling their lot.
4	(2) 3-8-046: 044	0.26 acs.	Maui Memorial Park, LLC	Commercial Mixed Use - MRA	No	1,000 feet	Private Memorial Park Lot	Owner was not interested in selling their lot. Insufficent lot area.
5	(2) 3-4-003: 007	0.57 acs.	Kaluaahole LLC	R-3 Residential	Yes	1,100 feet	Residential	Owner was not interested in selling their lot. Insufficent lot area.
6	(2) 3-4-003: 045	0.17 acs.	Nu'alolo LLC	R-1 Residential	Yes	1,700 feet	Vacant (Residential)	Owner was not interested in selling their lot. Insufficent lot area.
7	(2) 3-4-003: 044	0.17 acs.	Nu'alolo LLC	R-1 Residential	Yes	1,600 feet	Vacant (Residential)	Owner was not interested in selling their lot. Insufficent lot area.
8	(2) 3-4-003: 043	0.20 acs.	Nu'alolo LLC	R-1 Residential	Yes	1,500 feet	Vacant (Residential)	Owner was not interested in selling their lot. Insufficent lot area.
9	(2) 3-4-003: 001 (2) 3-4-003: 022	3.78 acs.	County of Maui	R-3 Residential	Yes	2,000 feet	County of Maui Baseyard	Relocation of existing County facilities and equipment would be required.

V:\Projdata\21PROJ\21065\Reports\PER\Sources\Table 7-1-00.xlsx

APPENDIX A

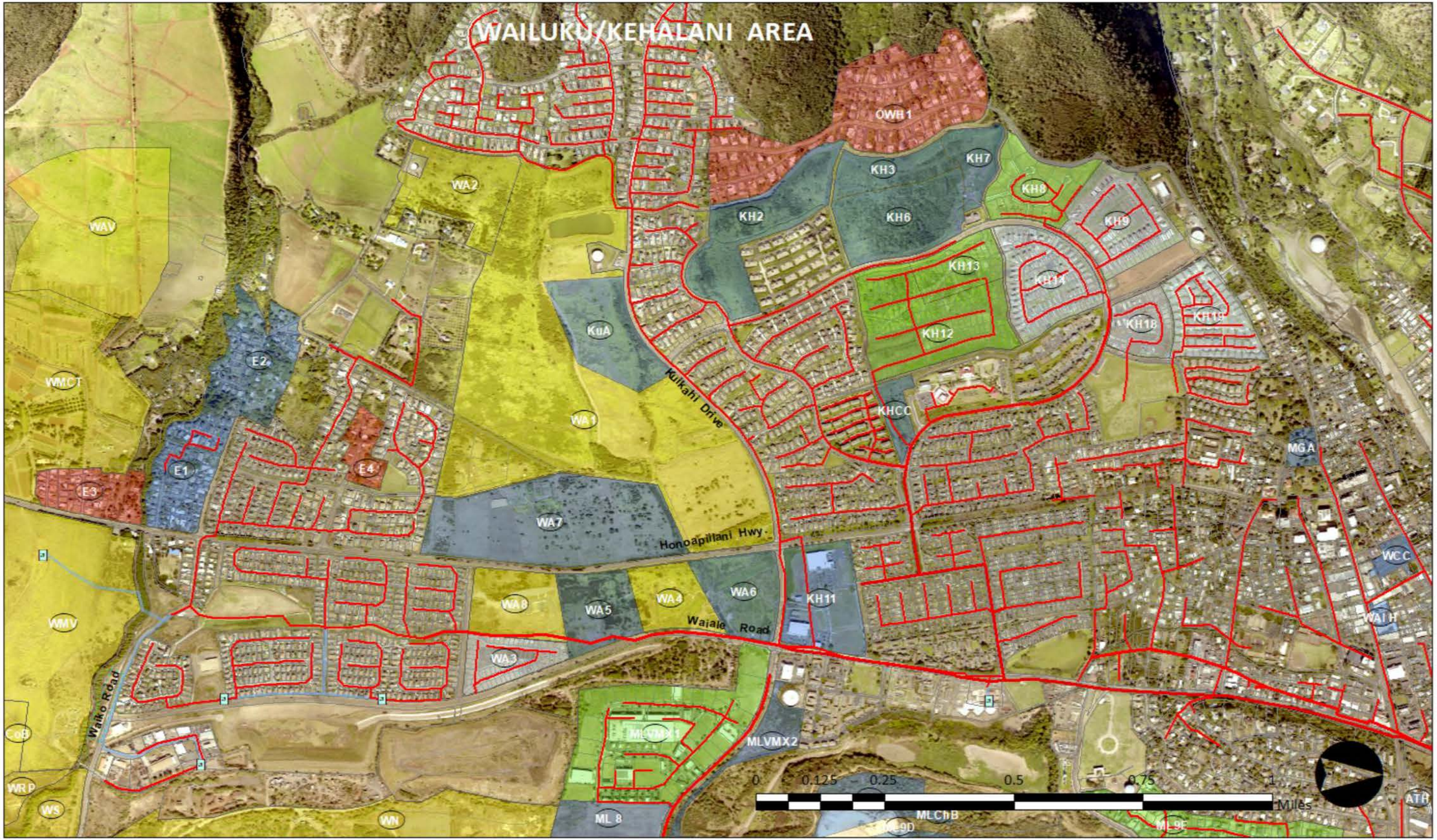
Wastewater Flow Tabulation
(from County of Maui Department of Environmental Management Wastewater Reclamation Division)

Wailuku Diversion

ITEM	PROJECTS	Single Family Units	Single Family % Built	Ohana Units Units	Ohana Units % Built	Multifamily Units	Multifamily % Built	Commercial Acres	Industrial Acres	Quasi-Public Acres	Park Acres	Hotel Rooms	Health Beds	Projected Flow	TMK
KH2	Kehalani Unit 2	60	0%	0	0%	-	0%	-	-	-	-	-	-	21,000 gpd	35001075
KH3	Kehalani Unit 3	27	0%	0	0%	-	0%	-	-	-	-	-	-	9,450 gpd	35001113
KH6	Kehalani Unit 6	100	0%	0	0%	-	0%	-	-	-	-	-	-	35,000 gpd	35001113
KH7	Kehalani Unit 7	25	0%	0	0%	-	0%	-	-	-	-	-	-	8,750 gpd	35001114
KH8	Kehalani Unit 8	25	4%	0	0%	-	0%	-	-	-	-	-	-	8,750 gpd	35001111
KH9	Kehalani Unit 9	95	0%	0	0%	-	0%	-	-	-	-	-	-	33,250 gpd	35001112
KH12	Kehalani Unit 12	144	20%	0	0%	-	0%	-	-	-	-	-	-	50,400 gpd	35001108
KH13	Kehalani Unit 13	71	50%	0	0%		0%	-	-	-	-	-	-	24,850 gpd	35001109
KH14	Kehalani Unit 14	88	100%	0	0%	-	0%	-	-	-	-	-	-	30,800 gpd	35001110
KH18	Kehalani Unit 18	48	100%	0	0%	-	0%	-	-	-	-	-	-	16,800 gpd	35001089
KH19	Kehalani Unit 19	138	100%	0	0%	-	0%	-	-	-	-	-	-	48,300 gpd	35001090
KHCC	Kehalani Community Center (6 ac.)	-	0%	0	0%	-	0%	-	-	5	-	-	-	18,800 gpd	35001103
KH11	Kehalani Commercial	-	35%	0	0%	-	0%	20	-	-	-	-	-	24,425 gpd	35001063
	REMAINING KEHALANI TOTAL	**821**												**330,575 gpd**	945
	Future Projects														
KuA	Kuikahi Affordable	40	0%	-	0%	164	0%	-	-	-	-	-	-	55,820 gpd	35002003
WA1	Puunani Planned Growth Area	400	0%	-	0%	-	0%	20	-	-	-	-	-	165,000 gpd	35002002-003
WA2	Upper Waikapu Subdivision	60	0%	-	0%	-	0%	-	-	-	-	-	-	21,000 gpd	35004022
WA3	Proposed Affordable Housing	70	100%	-	0%	-	0%	-	-	-	-	-	-	24,500 gpd	35002020
WA4	Proposed Affordable Housing	80	0%	-	0%	-	0%	-	-	-	-	-	-	28,000 gpd	35002011
WA5	EML Affordable Housing	80	0%	-	0%	-	0%	-	-	-	-	-	-	28,000 gpd	35002011
WA6	Wailuku Affordable Housing	-	0%	-	0%	324	0%	-	-	-	-	-	-	82,620 gpd	35001064
WA7	Puunani Homestead	161	0%	-	0%	-	0%	-	-	-	-	-	-	56,350 gpd	35002002 (por.)
WA8	Valley Isle Fellowship	-	20%	-	0%	-	0%	15						18,738 gpd	35002012
	FUTURE TOTAL	**891**				**488**		**35**						**480,028 gpd**	1,372
	Existing development - sewer expansion														
E1	Waiko Road Subdivision Sewer System	78	0%	20	0%	-	0%	-	-	-	-	-	-	30,900 gpd	35011XXX
E2	Upper Waiko Road Sewer Extension	39	0%	10	0%	-	0%	-	-	-	-	-	-	15,450 gpd	35012XXX
E4	Waikapu Infill	9	0%	-	0%	-	0%	-	-	-	-	-	-	3,150 gpd	35004XXX
E5	Old Wailuku Heights	104	0%	30	0%	-	0%	-	-	-	-	-	-	41,800 gpd	35006xxx, 35007XXX
	EXPANSION TOTAL													**91,300 gpd**	261

***TOTAL PROJECTED FLOW* = 901,903 GPD**

WAILUKU/KEHALANI AREA



APPENDIX B
Drainage Calculations

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Kehalani Wastewater Pump Station
Project No.: 21065.00
Engineer: Clarissa S. Ong
Date: 03/20/2023

Area

Description: Pre-development surface runoff.

Area (A): 0.4 acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Rolling]	→	0.03
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
	Composite Runoff Coefficient:		0.28

Time of Concentration

Runoff Length:	90	ft.
Start Elevation:	238	ft. M.S.L.
End Elevation:	224	ft. M.S.L.
Average Slope:	15.6	%
Time of Concentration (T_c):	14	minutes

Intensity

Project Location: Wailuku, Maui, Hawaii
Design Storm: 10-year recurrence interval, 1-hour duration
Rainfall Depth: 2.25 in.
Intensity (I): 4.20 in./hr.

Flow Rate

$Q = C \cdot I \cdot A$
$= 0.5$ $ft.^3/sec.$

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Kehalani Wastewater Pump Station
Project No.: 21065.00
Engineer: Clarissa S. Ong
Date: 03/21/2023

Area

Description: Post-development surface runoff.

Area (A): 0.4 acres

Runoff Coefficient

Impervious Runoff Coefficient: 0.95

Time of Concentration

Time of Concentration (T_c): 5 minutes

Intensity

Project Location: Wailuku, Maui, Hawaii
Design Storm: 10-year recurrence interval, 1-hour duration
Rainfall Depth: 2.25 in.
Intensity (I): 5.70 in./hr.

Flow Rate

$Q = C \cdot I \cdot A$
$= 2.2$ $ft.^3/sec.$

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HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Kehalani Wastewater Pump Station
Project No.: 21065.00
Engineer: Clarissa S. Ong
Date: 03/20/2023

Area

Description: Pre-development surface runoff.

Area (A): 0.4 acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Rolling]	→	0.03
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
	Composite Runoff Coefficient:		0.28

Time of Concentration

Runoff Length:	90	ft.
Start Elevation:	238	ft. M.S.L.
End Elevation:	224	ft. M.S.L.
Average Slope:	15.6	%
Time of Concentration (T_c):	14	minutes

Intensity

Project Location: Wailuku, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration
Rainfall Depth: 2.60 in.
Intensity (I): 4.90 in./hr.

Flow Rate

$Q = C \cdot I \cdot A$
$= 0.5$ $ft.^3/sec.$

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Project Name: Kehalani Wastewater Pump Station
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Date: 03/21/2023

Area

Description: Post-development surface runoff.

Area (A): 0.4 acres

Runoff Coefficient

Impervious Runoff Coefficient: 0.95

Time of Concentration

Time of Concentration (T_c): 5 minutes

Intensity

Project Location: Wailuku, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration
Rainfall Depth: 2.60 in.
Intensity (I): 6.30 in./hr.

Flow Rate

$Q = C \cdot I \cdot A$
$= 2.4$ $ft.^3/sec.$

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020 Tuesday, 03 / 21 / 2023

Hyd. No. 1

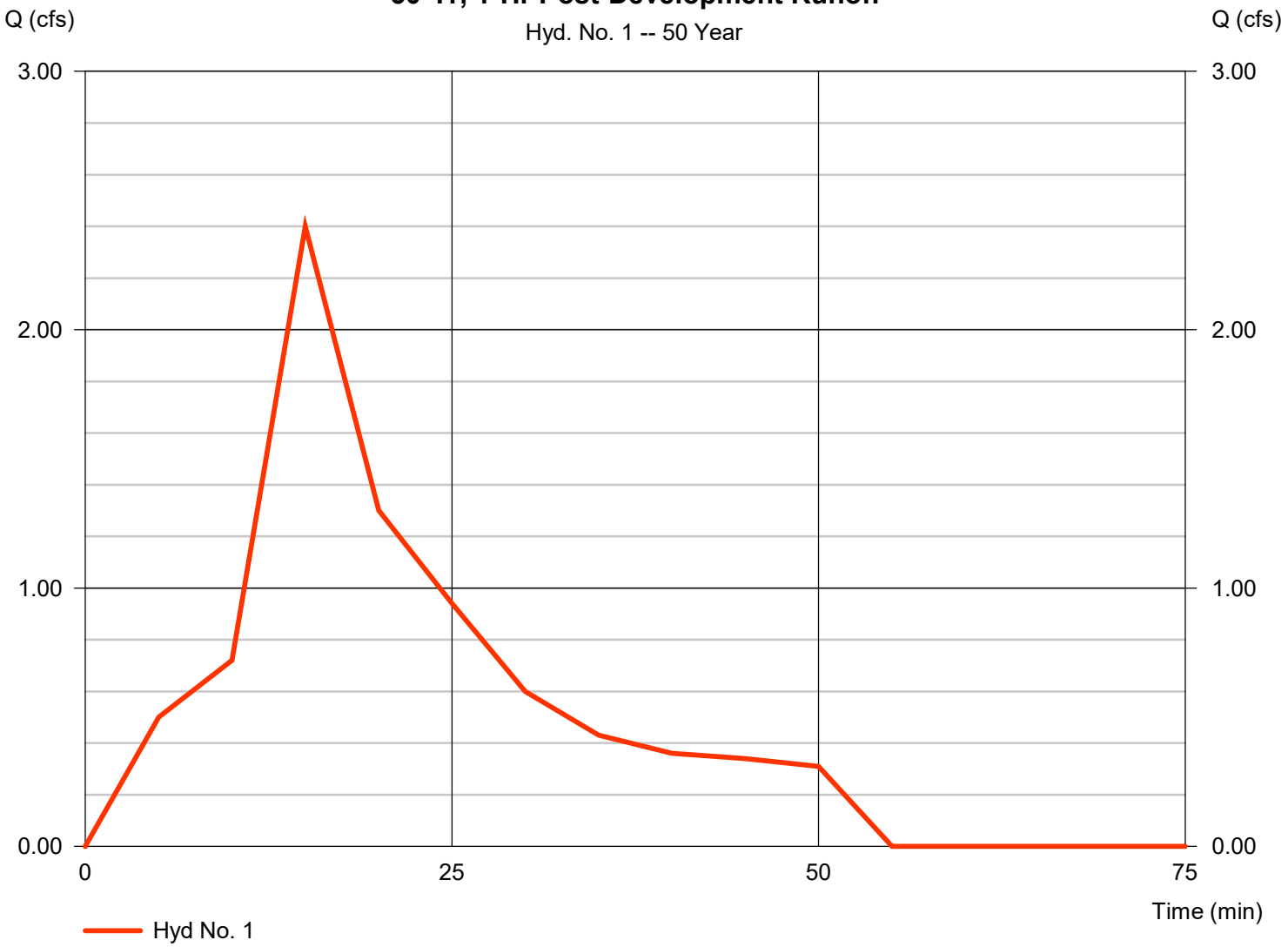
50-Yr, 1-Hr Post-Development Runoff

Hydrograph type	=	Manual	Peak discharge	=	2.400 cfs
Storm frequency	=	50 yrs	Time to peak	=	15 min
Time interval	=	5 min	Hyd. volume	=	0.054 acft **≈0.1 acft**

Universal Rational Hydrograph Parameters for 50-Yr., 1-Hr. Storm

T/Tc	T (hr)	Q/Qp	Q cfs
0	0.00	0.00	0.00
1	0.08	0.21	0.50
2	0.17	0.30	0.72
3	0.25	1.00	2.40
4	0.33	0.54	1.30
5	0.42	0.39	0.94
6	0.50	0.25	0.60
7	0.58	0.18	0.43
8	0.67	0.15	0.36
9	0.75	0.14	0.34
10	0.83	0.13	0.31
11	0.92	0.00	0.00

50-Yr, 1-Hr Post-Development Runoff



Hydrologic Calculations

The following onsite hydrologic calculations are based on the "Rules for the Design of Storm Drainage Facilities in the County of Maui"[13] and the *Rainfall-Frequency Atlas of the Hawaiian Islands*.[14] The design storm for the project site is a 10-year recurrence interval, 1-hour duration storm, and precipitation of 2.25 inches is used in the calculations.[15] The design storm for the proposed detention system is a 50-year recurrence interval, 1-hour duration storm, and precipitation of 2.60 inches is used in the calculations.[16]

Rational Formula used:

$$Q = C \cdot I \cdot A$$

where,

Q = *rate of flow* (cubic feet per second)

C = *runoff coefficient*

I = *rainfall intensity* (inches per hour)

A = *area* (acres)

---

[13] Ref. County of Maui, Department of Public Works and Waste Management, Rules for the Design of Storm Drainage Facilities in the County of Maui, Title MC-15, Chapter 4, Section 15-04-05, November 2, 1995

[14] U.S. Department of Commerce, Weather Bureau, *Rainfall-Frequency Atlas of the Hawaiian Islands*. 1962.

[15] The proposed drainage system will be sized to accommodate surface runoff based on a 10-year recurrence interval, 1-hour duration storm per the *Rules for the Design of Storm Drainage Facilities in the County of Maui*, which recommend the following hydrologic criteria based on the drainage area size:

"*For drainage areas of 100 acres or less, Tm (recurrence interval) = 10 year based on 1 hour storm . . .* "

[Ref. County of Maui, Department of Public Works and Waste Management, Rules for the Design of Storm Drainage Facilities in the County of Maui, Title MC-15, Chapter 4, Section 15-04-05(a), November 2, 1995]

[16] The estimated additional post-development runoff volume generated from the project site was based on a 50-year recurrence interval, 1-hour duration storm per the *Rules for the Design of Storm Drainage Facilities in the County of Maui*, which recommend the following hydrologic criteria:

"*Retention and Detention Basins: Tm (recurrence interval) = 50 year based on 1 hour storm for drainage areas 100 acres or less . . .*"

[Ref. County of Maui, Department of Public Works and Waste Management, Rules for the Design of Storm Drainage Facilities in the County of Maui, Title MC-15, Chapter 4, Section 15-04-05(e), November 2, 1995]

APPENDIX C
Water Demand Calculation

KEHALANI WASTEWATER PUMP STATION

ESTIMATE OF POTABLE WATER DEMAND

Fixture	No.		Fixture Unit Multiplier [1]		Total Fixture Unit Values
Wash Sink	1	x	1.6	==>	1.6
Hose Bib	2	x	3.0	==>	6.0
			Total Domestic Water Demand Fixutre Unit	==>	7.6
			Total Domestic Water Demand Fixture Unit *Converted* to GPM [2]	==>	**25 gpm**

Sources:

[1] Fixture unit values taken from Water Meter Sizing Worksheet - Non-Residential, Department of Water Supply, County of Maui, State of Hawaii, January 10, 2023.

[2] Extrapolated from Water Meter Sizing Worksheet - Non-Residential, Department of Water Supply, County of Maui, State of Hawaii, January 10, 2023, Table 2.

Table 2 - Flow to Fixture Unit Conversions**

Flow GPM	Fixture Units: Flush Tank	Fixture Units: Flush Valve										
1	0	-	**15**	21	-	**29**	51	12	**43**	99	33
2	1	-	**16**	23	-	**30**	53	13	**44**	103	35
3	3	-	**17**	24	-	**31**	56	14	**45**	107	37
4	4	-	**18**	26	-	**32**	58	15	**46**	111	39
5	6	-	**19**	28	-	**33**	60	16	**47**	115	42
6	7	-	**20**	31	-	**34**	63	18	**48**	119	44
7	8	-	**21**	32	-	**35**	66	20	**49**	123	46
8	10	-	**22**	34	5	**36**	69	21	**50**	128	48
9	12	-	**23**	36	6	**37**	74	23	**51**	130	50
10	13	-	**24**	39	7	**38**	78	25	**52**	135	52
11	15	-	**25**	42	8	**39**	83	26	**53**	141	54
12	16	-	**26**	44	9	**40**	86	28			
13	18	-	**27**	46	10	**41**	90	30			
14	20	-	**28**	49	11	**42**	95	31			

KEHALANI WASTEWATER PUMP STATION TECHNICAL MEMORANDUM

APPENDIX C

Brown AND Caldwell

2261 Aupuni Street
Wailuku, HI 96793
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Technical Memorandum

Prepared for: County of Maui, Department of Environmental Management - Wastewater Reclamation Division

Project Title: Central Maui Wastewater Reclamation Facility Study

Project No.: 155381.166

Job No.: WW20-19

Contract No.: C7095

Technical Memorandum

Subject: Kehalani Wastewater Pump Station - Environmental Impact Statement Technical Report

Date: March 2025

To: Munekiyo Hiraga

Limitations:

This is a draft memorandum and is not intended to be a final representation of the work done or recommendations made by Brown and Caldwell. It should not be relied upon; consult the final report.

This document was prepared solely for the County of Maui, Department of Environmental Management, Wastewater Division (County) in accordance with professional standards at the time the services were performed and in accordance with the contract between the County and Brown and Caldwell dated June 30, 2020. This document is governed by the specific scope of work authorized by the County; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by the County and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

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Kehalani WWPS EIS TM v3 EIS

Section 1: Introduction

The purpose of this technical memorandum (TM) is to present a technical overview of the Kehalani (Wailuku-Waikapu Diversion) Wastewater Pump Station (WWPS) that provides a concept-level project framework to evaluate the potential environmental impact of the work. Information presented in this report will be developed further in a subsequent Preliminary Engineering Report (PER) during the design phase of the project.

1.1 Project Background

The Central Maui WWRF will provide wastewater services (treatment and disposal) for both existing and planned communities in the central Maui region. This new WWRF is part of the County's decentralization plan to help maintain adequate capacity at the existing Wailuku-Kahului Wastewater Reclamation Facility (W-K WWRF) and reduce the amount of treated wastewater being disposed via the W-K WWRF's current injection wells. The need for maximizing capacity at the W-K WWRF has become more important in the aftermath of the Lahaina fires as displaced Lahaina residents move into central Maui and increase loading on the treatment plant.

The proposed Kehalani WWPS is considered part of the Central Maui WWRF infrastructure and an integral component of the County's decentralization plan because it will intercept flows from existing and future developments that would otherwise be conveyed to the W-K WWRF.

1.2 Project Overview

A feasibility study and siting analysis was performed for the proposed Kehalani WWPS by Warren S. Unemori Engineering in April 2023. The study evaluated site location alternatives and recommended the new pump station be located at the Kehalani Makai Detention Basin. The pump station will be located on the south end of the lot, mauka of Waiale Road and north of Olomea Street. The detention basin parcel is designated by Tax Map Key (2) 3-5-020:036 and is currently owned and maintained by the County of Maui.

A new gravity sewer pipe will divert flows from an existing 18-inch sewer main that runs along Waiale Road into the pump station. Flows will be conveyed from the pump station through an approximate 3.3-mile-long force main that will be routed along existing Waiale Road and the future Department of Public Works (DPW) Waiale Road Extension project into the Central Maui WWRF for treatment.

Figure 1-1 illustrates the Kehalani WWPS project overview.

1.3 Goals

Construction of the Kehalani WWPS will help the County achieve the following goals:

1. Provide critical infrastructure to support wastewater decentralization in central Maui.
2. Promote wastewater reuse via a new state-of-the-art Central Maui WWRF.
3. Alleviate capacity at the W-K WWRF to provide a more robust and reliable treatment facility.
4. Reduce the use of injection wells for treated wastewater disposal at the W-K WWRF.
5. Provide critical infrastructure to support affordable housing developments in Central Maui, especially as it relates to the aftermath of the Lahaina fires of August 2023.

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Figure 1-1. Kehalani WWPS Project Overview

Section 2: Flow Projections

This section presents a summary of flow projections for the Kehalani WWPS that will be used as the basis for pump station sizing, equipment selection, and design.

2.1 Service Area

The Kehalani WWPS will serve the area on the lower slopes of the West Maui Mountains generally bound by Wailuku town to the north, Waiko Road to the south, and Waiale Road to the east. The service area includes the existing Wailuku Heights, Kehalani, and Waikapu Subdivisions and planned future developments in the vicinity. It is one of several tributaries that will convey wastewater flow to the proposed Central Maui WWRF.

Figure 2-1 illustrates the Kehalani WWPS service area.

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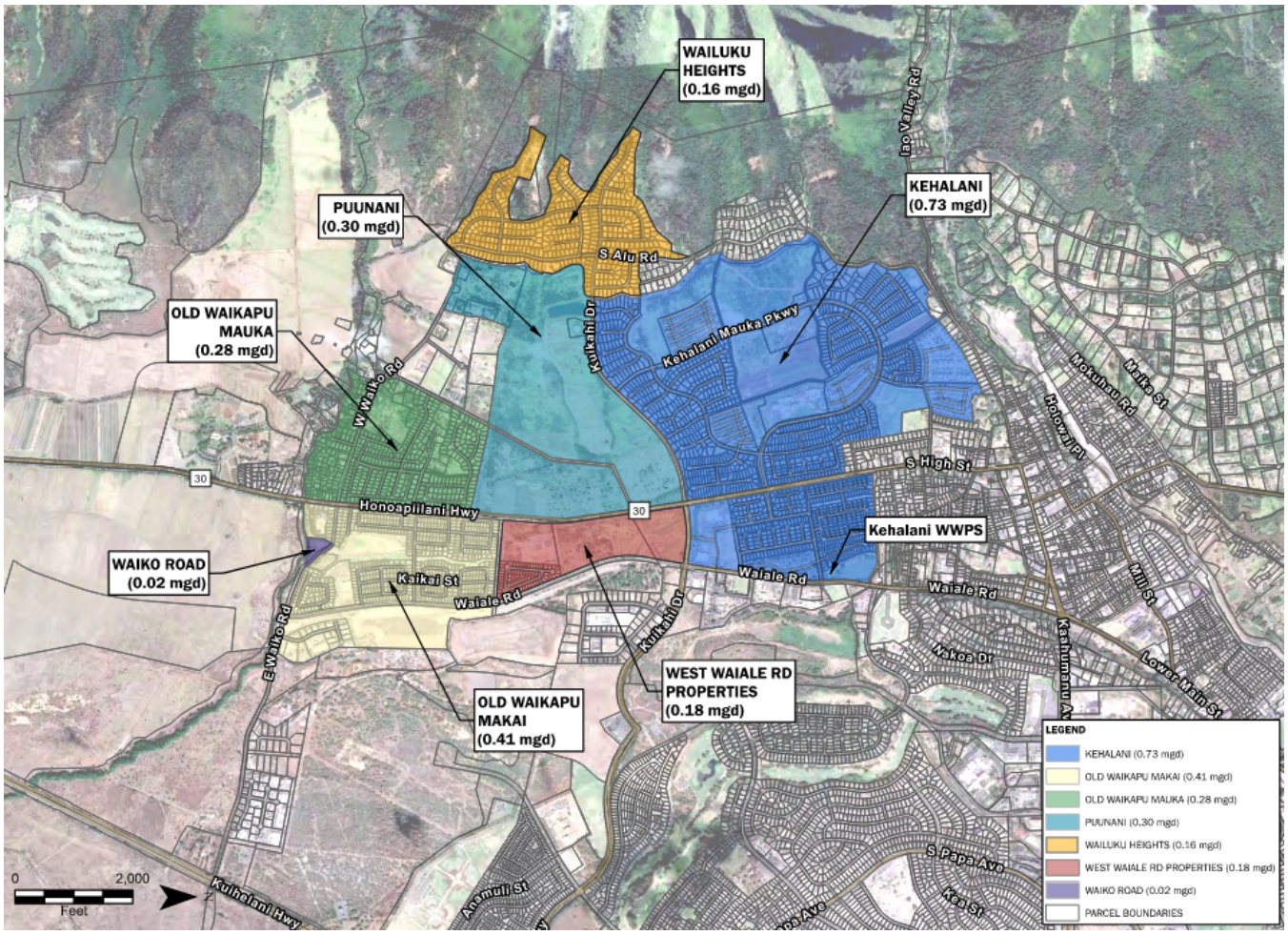

Figure 2-1. Kehalani WWPS Service Area

2.2 Design Flows

Flow projections for the Kehalani WWPS were originally developed in the Facility Plan using County Wastewater Flow Standards. These standards utilize initial flow contributions based on land use and add dry weather inflow and infiltration (I&I) to determine the average dry weather flow (ADWF). Flow factors and wet weather I&I values are applied to the ADWF to determine the peak dry weather flow (PDWF) and peak wet weather flow (PWWF).

The Facility Plan flows have been modified into a two-phase approach for this TM based on a Kehalani WWPS Feasibility Study and Siting Analysis conducted by Warren S. Unemori Engineering (WSUE) in 2024 that shows approximately 0.90 million gallons per day (mgd) of the service area's projected flow is currently undeveloped (0 percent built). Phase 1 (current flows) covers existing flows and partially constructed developments that are anticipated to be complete by the time Kehalani WWPS is constructed in 2028. Phase 2 (buildout flows) adds future developments with a more uncertain construction horizon. For the purpose of this analysis, a 20-year buildout horizon is assumed.

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Table 2-1 and Table 2-2 summarize the base flow projections and subsequent phased design flows.

Table 2-1. Base Flow Projections

Service Area	ADWF Projection (mgd)[1]
Kehalani	0.73
Puunani[2]	0.30
Wailuku Heights	0.16
West Waialae Road Properties	0.18
Old Waikapu Mauka	0.28
Old Waikapu Makai	0.41
Waiko Road	0.02
Total Buildout (Phase 2):	2.08
Future Flows[3]	0.90
Current Buildout (Phase 1):	1.33

1. *Source: Central Maui WWRF Facility Plan (Brown and Caldwell, January 2023).*
2. *Updated from Central Maui WWRF Facility Plan value (0.23 mgd) based on County building permit data.*
3. *Based on data presented in the Feasibility Study and Siting Analysis, Kehalani WWPS (WSUE, April 2024).*

Table 2-2. Design Flows

Flow Condition	Peaking Factor[1]	Phase 1 Flow (mgd)	Phase 2 Flow (mgd)[2]
ADWF	1.0	1.3	2.1
PDWF	2.2	2.9	4.5
PWWF	4.1	5.4	8.4

1. *Source: Central Maui WWRF Facility Plan (Brown and Caldwell, January 2023).*
2. *Assumes a 20-year buildout horizon.*

Flow projections based on assumed I&I are conservative especially for newer neighborhoods such as Kehalani where the pipes are relatively new, above the water table, and typically experience minimal infiltration. As such, a future planning effort has been identified to measure more accurate flows prior to design of the new pump station and pipelines.

These flow projection refinements, any updates to the buildout horizon, and subsequent design flow calculations will be revisited in future project phases as additional data becomes available. However, it is not anticipated that flow refinements or modifications to the buildout phasing will materially change the sizing or environmental impact of the proposed project features presented in this report.

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Section 3: Pumping System

3.1 Pump Type

The wastewater pumps will be non-clog, solids-handling, centrifugal submersible type. This type of pump is reliable, readily available, requires a low capital investment, has low maintenance requirements, and is familiar to County operators. Figure 3-1 shows an illustration of a typical non-clog submersible pump.

Figure 3-1. Typical Non-Clog Submersible Pump

Source: Xylem/Flygt

The pumps will be coupled with energy efficient induction motors. The preliminary estimate is that 125 hp motors will be required to meet Phase 1 design conditions. Maximum pump speed will be 1,800 rpm to mitigate against the potential for long-term vibration issues associated with higher speeds.

3.2 Wet Well Design

The proposed pump station design will include a self-cleaning trench-type wet well. Self-cleaning wet wells provide the following advantages to the Kehalani WWPS.

- Design can accommodate a wide range of flow rates, so capacity can be increased without major structural modifications.
- Can operate to provide a self-cleaning function to flush solids out of the wet well and prevent buildup for easier maintenance.
- Wet well entrance is less turbulent than conventional wet well entrances which minimizes odor release.
- Facility footprint is smaller than pump stations with conventional wet wells.
- Pumps will be below grade and submerged, which will limit the amount of noise produced by the pump station.

The wet well structure will be slightly oversized for Phase 1 conditions to accommodate future expansion during the Phase 2 buildout.

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Access hatches will be provided on the top of the structure to facilitate pump removal. The access hatches will be approximately six feet by eight feet, centered over the pump pairs, and have integrated fall protection grating.

Figure 3-5 shows a typical wet well access hatch configuration.

Figure 3-5. Typical Wet Well Access Hatch

Source: East Jordan Iron Works

3.3 Force Main

The Kehalani WWPS force main will travel south along Waiale Road and then along the future DPW Waiale Road Extension project into the Central Maui WWRF. The proposed force main will be approximately 3.3-miles-long and initial calculations estimate that an 18-inch diameter pipe will be able accommodate both Phase 1 and Phase 2 design flows. A dual pipeline should also be considered depending on the ultimate flow variations. The force main will primarily be constructed of PVC except for in vaults where piping will be ductile iron.

Combination air-vacuum release valves (CARVs) will be located along the force main at locations where localized high points are required to avoid existing utilities. Figure 3-6 illustrates an estimate of the pipeline profiles along Waiale Road. Pipeline configuration details will be determined during the design phase of the Diversion forcemain project.

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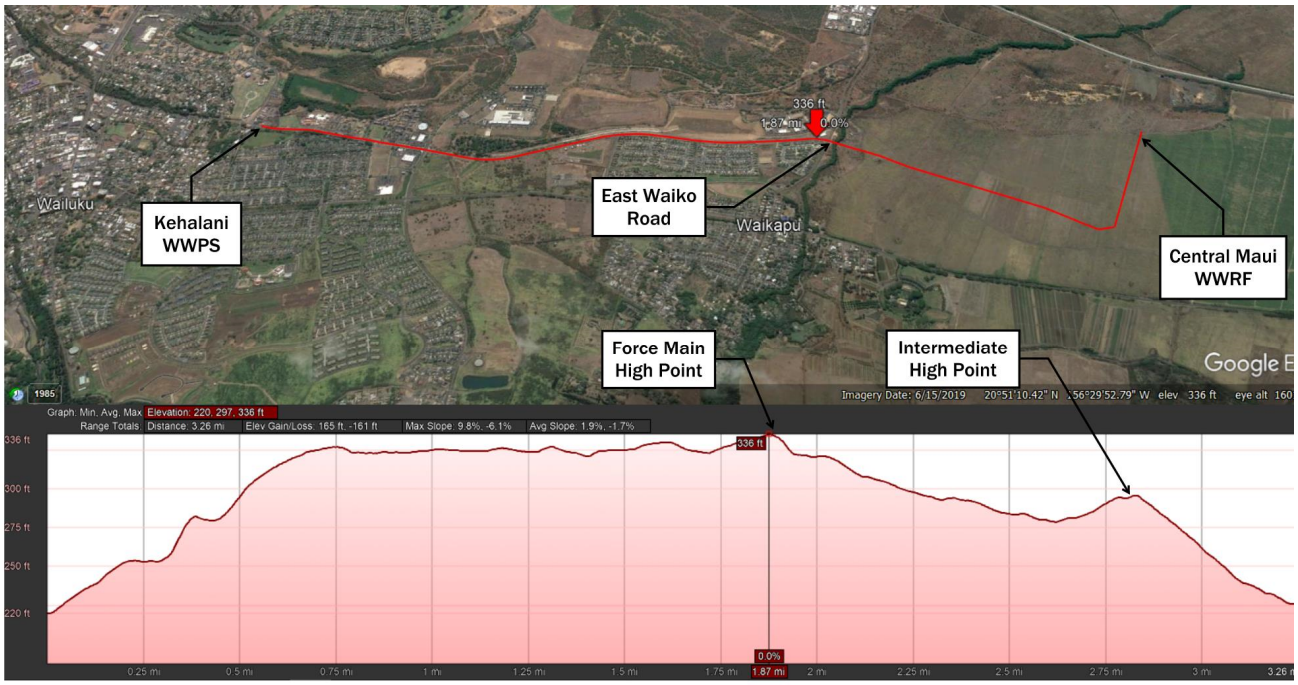

Figure 3-6. Force Main Elevation Profile

Base Image Source: Google Earth

Section 4: Odor Control

This section discusses odor control systems that will be implemented to mitigate against the negative impacts of fugitive odors.

There are many odor producing compounds present in different types of wastewater systems. However, for a typical municipal system like the one in Central Maui, the most common odor-producing compound is hydrogen sulfide gas (H_2S). H_2S is characterized by a rotten egg smell, detectable at concentrations as low as 0.5 parts per billion (ppb), and the most common cause of nuisance odors near wastewater facilities. The odor control systems for the Kehalani WWPS and force main will be designed to minimize formation of and release of H_2S.

4.1 Pump Station

The collection system feeding the Kehalani WWPS is at the upstream end of the tributary area where sewage is still fresh. Resulting sulfide generation and the potential for H_2S release at the pump station where the incoming sewer enters the wet well is anticipated to be low, but odor control will be provided because the Kehalani WWPS is in a sensitive residential area. There are a wide variety of technologies available for odor control, but activated carbon is recommended because it is economical at small scale, has low maintenance requirements, and is suitable for the low anticipated H_2S levels.

A packaged system consisting of a fan, an activated carbon scrubber, and ductwork will be provided. The fan will come with an acoustic enclosure to provide sound attenuation and keep ambient noise levels below maximum permissible sound levels. Preliminary calculations indicate that a system rated at 650 cubic feet per minute (cfm) will be sufficient to capture airflow that enters the wet well through the approach sewer under worst case conditions while maintaining a negative pressure within the wet well headspace.

Figure 4-1 provides an illustration of a typical packaged activated carbon system.

Figure 4-1. Packaged Activated Carbon Odor Control System

4.2 Force Main

The force main from the Kehalani WWPS to the Central Maui WWRF will be approximately 3.3 miles long and the velocity in the pipe will be relatively low, particularly during Phase 1 before the service area is fully built out. Low velocities in long pipelines provide a high residence time for sewage, which results in formation of dissolved sulfides that can be released as highly concentrated H_2S when the force main breaks to gravity. In the Kehalani system, the potential for H_2S release will be present at the CARV vault structure located at the force main high point and at the Central Maui WWRF where the pipeline discharges.

While the force main may break to gravity at the high point, the pipeline will be a sealed system. Air release will only occur at the hydraulic structure through the CARVs when air pressure buildup in the force main is released to atmosphere. Although the potential for high H_2S concentrations will be present in the pipe headspace at this location, the air discharges are anticipated to be non-continuous and short in duration.

Carbon cannisters can be used for odor control at the hydraulic structure because they are suitable for the nature and frequency of discharge. They are also compact and economical for installation in a sub-grade vault.

Figure 4-2 shows a carbon cannister installed on a CARV outlet on the Hawaiian Homes WWPS force main.

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Figure 4-2. Carbon Cannister Installed on CARV Outlet

The Facility Plan recommends the Central Maui WWRF include covered structures to facilitate foul air collection and use of biotrickling filters (or a similar process) for air treatment prior to discharge. Odor control at the Central Maui WWRF is beyond the scope of this TM and will be developed further in separate planning efforts.

Section 5: Electrical and I&C Systems

This section describes electrical and instrumentation and control (I&C) systems that are needed to support reliable pump station operation.

5.1 Electrical Systems

A new electrical service from Hawaiian Electric Company will need to be brought to the site via underground or overhead electrical lines. The new service will supply 480-volt, 3-phase power to the pump station. Electrical distribution equipment will include main switchgear, a motor control center, and a standby power system.

The standby power system will consist of a diesel-driven generator with an aboveground fuel tank and an automatic transfer switch to power the facility in the event of a service disruption. Standby power is essential for critical infrastructure such as wastewater pump stations that need to run during power outages to reduce the likelihood of spills. Preliminary calculations indicate that a 500-kW standby generator is required to meet the demands of this facility during phase 1. It is estimated that a 1,000-kW generator will be required to meet ultimate buildout condition requirements but will be reevaluated as flow projections are refined.

Figure 5-1 shows a photo of a typical standby diesel generator.

Figure 5-1. Typical Standby Diesel Generator

The aboveground fuel tank will provide bulk fuel storage for generator operation. Typical County projects are designed to provide three days of fuel storage at PWWF. Based on the preliminary generator selection, a 3,000-gallon bulk fuel storage tank is required. The fuel tank will be double-walled and equipped with an integral leak detection system. A day tank system will facilitate transfer of fuel from the bulk fuel storage tank to the standby generator.

Figure 5-2 shows a cutaway view of a typical double-walled bulk fuel storage tank.

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Kehalani WWPS EIS TM v3 EIS

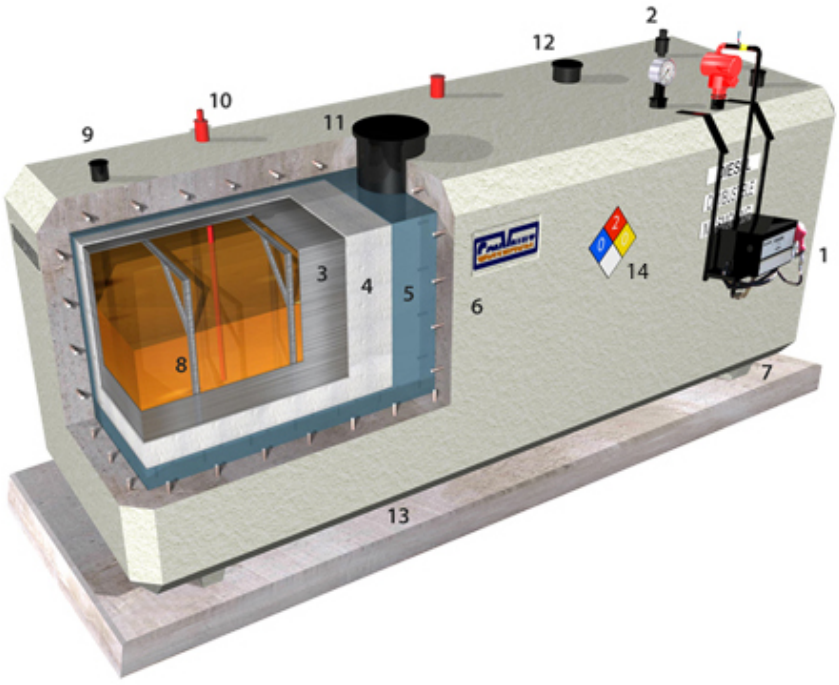

Figure 5-2. Double-Walled Bulk Fuel Storage Tank Cutaway View

A building will be constructed to house the standby generator, electrical equipment, auxiliary systems, and appurtenances. The building will be split into a generator room and an electrical room. The generator room will be mechanically ventilated while the electrical room will be climate controlled to reduce the effects of heat and corrosion on electrical equipment. The building will be architecturally designed to blend in with the surrounding community.

Figure 5-3 illustrates an electrical/generator building conceptual layout.

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Kehalani WWPS EIS TM v3 EIS

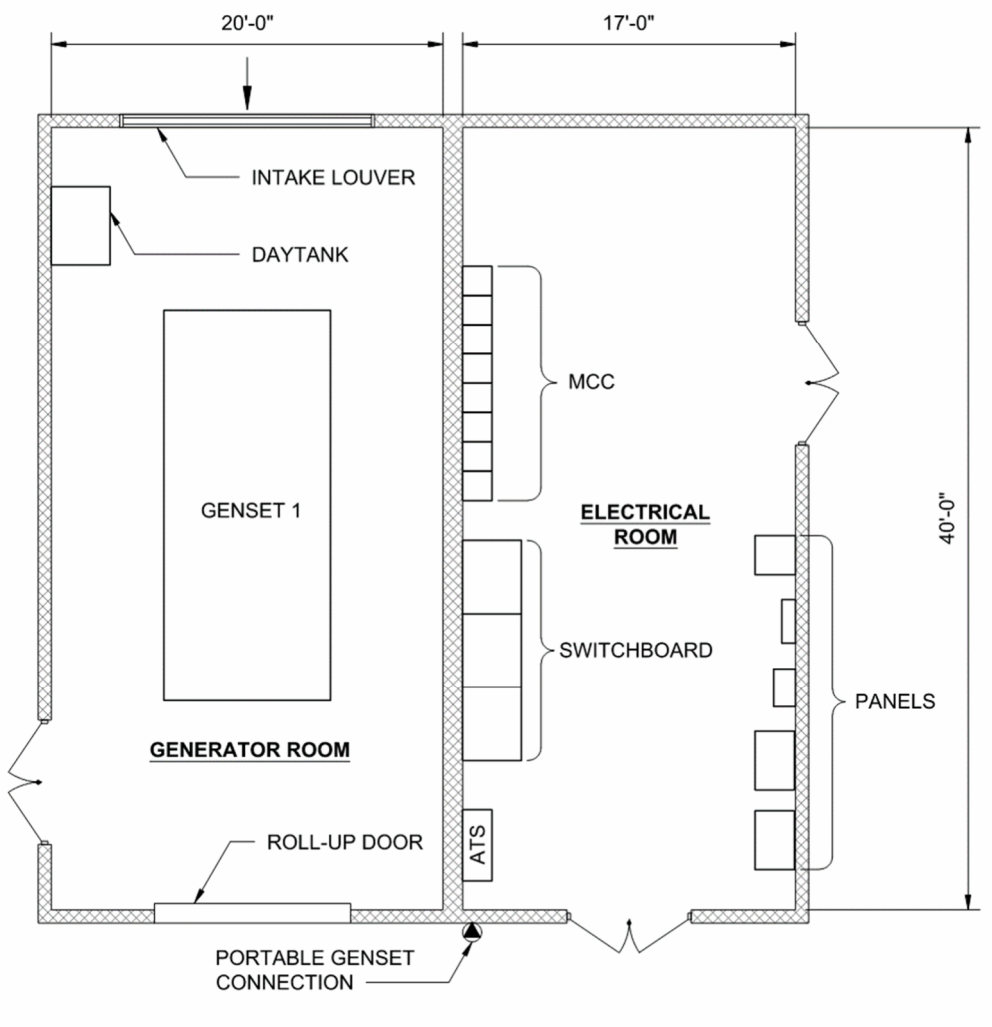

Figure 5-3. Electrical/Generator Building Conceptual Layout

Because of the proximity of the facility to adjacent residences, the generator building will incorporate some or all of the following features to provide sound attenuation:

- Residential muffler on the generator exhaust.
- Acoustic-style air intake and exhaust louvers.
- Sound dampening acoustic panel boards on interior walls.

An acoustic evaluation will be conducted during preliminary design to establish background noise levels and the level of sound mitigation required to meet fence line noise limits.

5.2 I&C Systems

Instrumentation will be installed to monitor wet well levels; pump discharge flow and pressure; generator status; fuel tank levels; and other parameters of interest that will be determined during design.

Buried fiber cables will be routed adjacent to the force main to provide a direct connection between the pump station and the Central Maui WWRF. This will increase reliability of communication between the two facilities and overall critical infrastructure reliability.

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Kehalani WWPS EIS TM v3 EIS

Section 6: Site Layout

The Kehalani WWPS will be located at the Kehalani Makai Detention Basin on a parcel designated by Tax Map Key (2) 3-4-020:036. Refer to feasibility and siting analysis performed for the proposed Kehalani WWPS by WSUE in April 2024 for more information on the site selection.

Figure 6-1 shows the proposed Kehalani WWPS site layout based on the information presented in this report. Additional discussion related to key site layout considerations is given below.

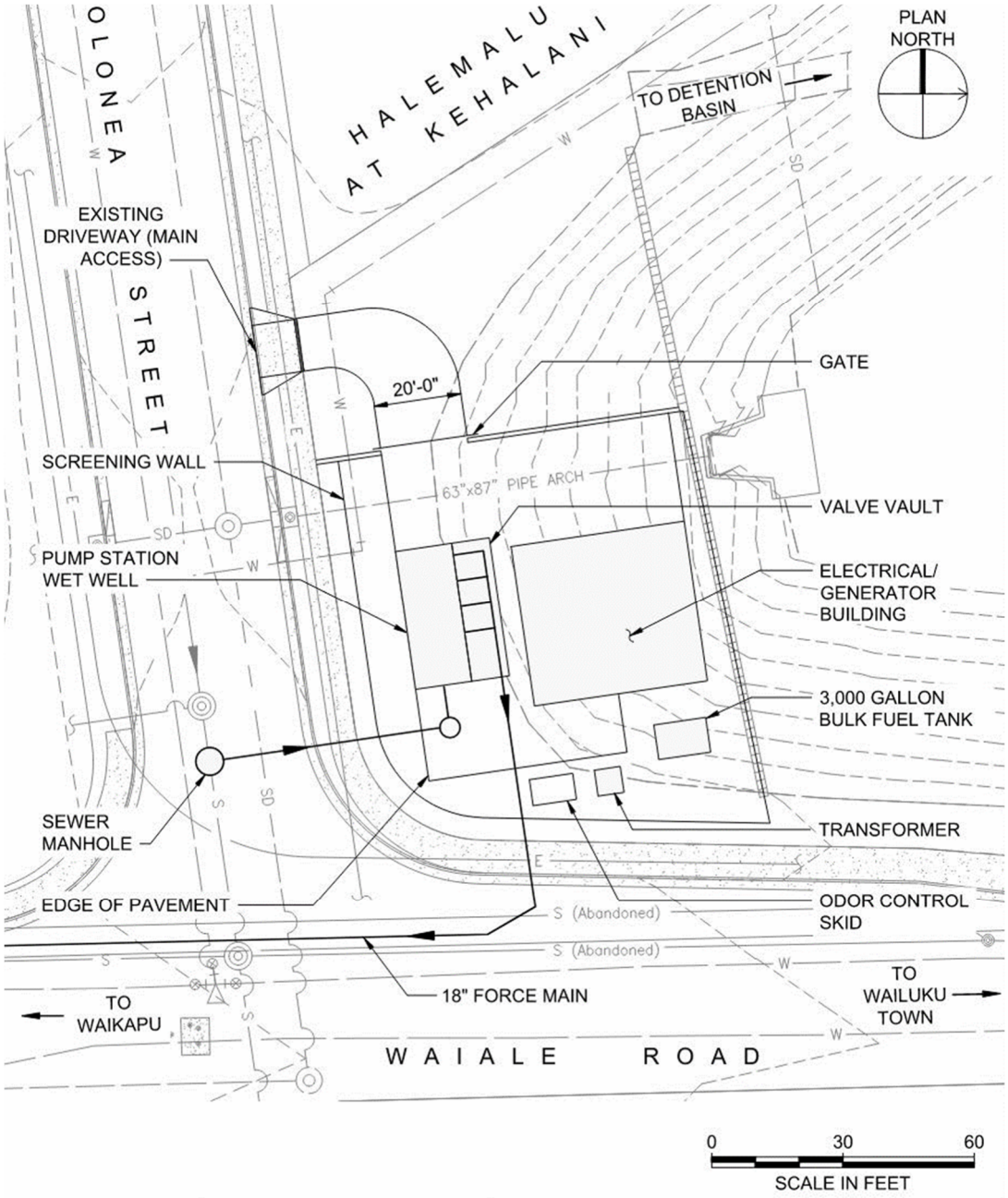

Figure 6-1. Overall Site Layout

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Kehalani WWPS EIS TM v3 EIS

6.1 Site Plan

The Kehalani WWPS site plan is designed to be operator-friendly while minimizing the impact to the environment and surrounding community.

Access to the site will be provided through an existing driveway off Olomea Street. This driveway is used for detention basin access so a separate gate interior to the parcel boundary that is dedicated to the Kehalani WWPS will be required to maintain the necessary separation and security between the two facilities. The dedicated WWPS entrance gate will be located on the west edge of the site. This allows the various facility components, especially noise producing elements such as the generator and odor control fan, to be located on the east end, furthest away from adjacent residences.

The pump station wet well and valve vault will be below-grade site features to minimize the vertical profile of the facility. They can be designed with traffic-rated hatches to maximize working area for operations and maintenance while keeping the overall site area to a minimum.

6.2 Retaining and Screening Walls

Because the proposed site location is located on the berm of an existing detention basin, a retaining wall will be constructed to provide adequate flattened space for the facility. The retaining wall will cut through the southernmost portion of the existing basin and the area south of the retaining wall will be filled and graded to match the surrounding areas.

A screening wall to hide the facility from adjacent properties and mitigate against sound emissions will be constructed around the site. The screening wall will be offset from the sidewalk to allow for landscaping along the south and east edges of the site and will be integrated into the retaining wall to the north. The screening wall will join with the existing fence that surrounds the stormwater basin at the boundaries of the project site. Architectural design of the screening wall will be conducted in the next phase of the project.

6.3 Stormwater Basin Improvements

A small portion of the basin will be filled and a retaining wall will be constructed as part of the pump station layout. The basin will have sufficient capacity to accommodate the additional post-development runoff from the project site and pump station embankment. The basin will be re-landscaped to match the existing conditions.

6.4 Landscaping

Landscaping will be provided around the exterior of the site, outside of the screening wall, to match the surrounding community aesthetic. Native flora and fauna will be prioritized in the landscaping design. Existing mature trees will be protected to the extent feasible during construction. If trees are removed, native trees will be re-planted at a different location on the site.

Section 7: Summary

The Kehalani WWPS is a critical component of the Central Maui WWRF infrastructure and an integral part of the County's decentralization plan that will ensure adequate wastewater treatment capacity for the foreseeable future and promote long-term wastewater reuse.

Project features designed to mitigate environmental impacts include the following:

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Kehalani WWPS EIS TM v3 EIS

- Diversion of wastewater flows away from the W-K WWRF to reduce the use of injection wells for treated wastewater disposal.
- Energy efficient pumping system with built-in redundancy to promote reliable long-term operation.
- Use of submersible pumps (below-grade) to minimize vertical profile of the facility and reduce sound emissions of the pumping system.
- Capture and treatment of fugitive odors at the Kehalani WWPS and at the force main high point.
- Standby power system to ensure facility operation during power outages and mitigate against wastewater spills.
- Architectural design that matches the community aesthetic.
- Efficient site layout to minimize overall footprint and provide maximum separation of noise generating systems from adjacent residences.
- Screening wall around the facility with native landscaping to blend the facility in with the surrounding area and minimize noise emissions from the site.

Although many design details will be refined or developed in future phases of the project, it is not anticipated that changes associated with the design progression will have a material environmental impact beyond what is presented in this TM.

References

Central Maui WWRF Facility Plan, Brown and Caldwell, January 2023.

Feasibility Study and Siting Analysis, Kehalani WWPS, Warren S. Unemori Engineering, April 2024.

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Kehalani WWPS EIS TM v3 EIS

LETTER FROM GOVERNOR DATED JUNE 2, 2023 DESIGNATING COUNTY OF MAUI, DEPARTMENT OF ENVIRONMENTAL MANAGEMENT AS ACCEPTING AUTHORITY

APPENDIX

D

EXECUTIVE CHAMBERS
KE KE‘ENA O KE KIA‘ĀINA

JOSH GREEN, M.D.
GOVERNOR
KE KIA‘ĀINA

June 2, 2023

Shayne Agawa, Director
Department of Environmental Management
County of Maui
200 South High Street
Wailuku, Hawai‘i 96793

SUBJECT: Accepting Authority for the Proposed Central Maui Wastewater Reclamation Facility Project; Waikapū, Maui, Hawai‘i

Aloha Mr. Agawa:

Pursuant to Hawai‘i Revised Statutes § 343-5(d)(1) and Hawai‘i Administrative Rules (HAR) § 11-200.1-7(b), Environmental Impact Statement (EIS) Rules, agency actions involving State and County lands, or State and County funds, or both State and County lands and funds, the Governor or the Governor’s authorized representative shall have the final authority to accept an environmental impact statement.

As the Central Maui Wastewater Reclamation Facility project is a regional wastewater infrastructure action being undertaken by the County of Maui with the assistance of State funds, I hereby designate the County’s Department of Environmental Management as the authorized representative for reviewing, processing, and accepting the EIS for the project.

Mahalo,

Josh Green M.D.

Josh Green, M.D.
Governor, State of Hawai‘i

c: Scott Rollins, County of Maui, Department of Environmental Management
Juan Rivera, County of Maui, Department of Environmental Management
Irina Constantinescu, Brown and Caldwell
Yukino Uchiyama, Munekiyo Hiraga
Emily Murai, Munekiyo Hiraga

LETTER FROM DEPARTMENT OF PLANNING DATED FEBRUARY 10, 2023 REGARDING MAUI COUNTY COUNCIL PROCESSING OF DISTRICT BOUNDARY AMENDMENT

APPENDIX

E

RICHARD T. BISSEN JR.
Mayor

KATHLEEN ROSS AOKI
Acting Planning Director

GARRETT E. SMITH
Deputy Director

DEPARTMENT OF PLANNING
COUNTY OF MAUI
ONE MAIN PLAZA
2200 MAIN STREET, SUITE 315
WAILUKU, MAUI, HAWAI'I 96793

February 10, 2023

Mr. Juan Rivera, P.E.
Capital Improvements Program Manager
Wastewater Reclamation Division
Department of Environmental Management
2200 Main Street, Suite 610
Wailuku, Hawaii 96793

Dear Mr. Rivera:

SUBJECT: CENTRAL MAUI WASTEWATER RECLAMATION FACILITY – AREA DETERMINATION FOR PROCESSING OF DISTRICT BOUNDARY AMENDMENT FOR PROPERTY LOCATED OFF OF KUIHELANI HWY, MAUI, HAWAII; TMK: (2) 3-8-005:023

The Department of Planning (Department) is in receipt of your letter dated February 3, 2023 and email communications requesting a determination for the above-referenced project.

After reviewing the February 3, 2023 letter describing the project scope, transmitted from Irinia Constantinescu, Brown and Caldwell to Ms. Yukino Uchiyama, Munekiyo and Hiraga, it has been determined that the uses and areas as described and depicted would qualify for processing under the approval authority of the Maui County Council pursuant to *HAR 15-15-77 Decision-making criteria for boundary amendments.*

If you require further clarification or discussion, feel free to contact me at (808) 270-7253 or by email at Jordan.Hart@mauicounty.gov.

Sincerely,

JORDAN E. HART
Planning Program Administrator

For KATHLEEN ROSS AOKI
Acting Planning Director

Attachment: February 3, 2023 project scope letter
Kathleen Ross Aoki, Acting Planning Director
Shayne Agawa, P.E., Acting Director, Department of Environmental Management
Jordan Hart, Planning Program Administrator, Zoning Administration and Enforcement Division
Ann Cua, Planning Program Administrator, Current Planning Division
Eric Nakagawa, P.E.,Wastewater Reclamation Division Chief
Carolyn Cortez, Supervising Planner
EG&AX
KRA:JEH:CEC:lt
K:\WP_DOCS\Planning\LTR\2023\238005023_CentralValleyWWRF\Response.docx

2261 Aupuni Street, Suite 201
Wailuku, Maui, HI 96793

T: 808.244.7005

February 3, 2023

Ms. Yukino Uchiyama
Munekiyo Hiraga
735 Bishop Street, Suite 412
Honolulu, HI 96813

158098.305

Subject: Central Maui Wastewater Reclamation Facility - Project Description for Environmental Impact Statement Preparation Notice (EISPN)

Dear Ms. Uchiyama,

The County of Maui Department of Environmental Management (County) proposes to construct a new wastewater recycling facility (WWRF) in the Central Valley of Maui Island. The new Central Maui WWRF will provide a number of benefits to the community:

1. Provide wastewater treatment service to growth areas in the Central Valley area, as established in the Maui Island Plan. Wastewater treatment service is required to construct affordable and market rate housing in the area.
2. Divert a portion of the wastewater flow that is currently treated at the Wailuku-Kahului WWRF, reducing the volume of treated effluent that is currently disposed via injection wells at the facility.
3. Provide recycled water to irrigation users located near the Central Maui WWRF.

Figure 1 provides an overview of the Central Maui WWRF elements to be implemented by the County.

1. Wastewater Service Areas

Figure 2 presents the wastewater service areas that are expected to contribute wastewater to the Central Maui WWRF. Wastewater will be conveyed to the Central Maui WWRF by gravity sewers, pump stations, and pressurized pipelines.

The Central Maui WWRF will produce effluent that complies with State of Hawaii Department of Health (DOH) R-1 recycled water requirements. R-1 water will be available for potential users nearby, including the Waikapu Country Town development, nearby agricultural areas, and County properties.

2. Preliminary Flow Projections

Table 1 provides a summary of the projected average dry weather flow (ADWF) contributions from the wastewater service areas. As shown in the table, approximately half of the flow is expected to originate from areas that currently contribute flow to the Wailuku-Kahului WWRF. Diversion of the flow from the Wailuku-Kahului WWRF to the Central

Maui WWRF will reduce disposal volumes at the current facility. The remaining half of the flow is projected to originate from new and future growth areas within the wastewater service areas. The future potential development shown in the table is not defined at this time but could potentially include the existing Maalaea community if a decision is made to connect it to the Central Maui WWRF.

Table 1. Anticipated Buildout Wastewater Flow from Developments in Service Area

Wastewater Flow Source	Average Dry Weather Flow (mgd)	Percent of Total Buildout Capacity of 4 mgd
Existing Development (Diverted Flow from Wailuku-Kahului WWRF)	1.78	45%
New Anticipated Development Growth	1.93	48%
Future Potential Development	0.29	7%
Total	4.00	100%

Note: mgd = million gallons per day

The Central Maui WWRF will have an average dry weather flow capacity of 4 million gallons per day (mgd). Construction of the WWRF may be phased.

3. Summary of County of Maui Project Elements

The project elements to be implemented by the County of Maui are described in this section.

3.1 New Kehalani Wastewater Pump Station and Forcemain

A new Kehalani Wastewater Pump Station (WWPS) located near Waiale Road, will be designed to divert all of the flow from the existing 18-inch sewer in Waiale Road away from the Wailuku-Kahului WWRF and instead pump it to the new Central Maui WWRF. A new wastewater forcemain will be designed to deliver flow from the new WWPS to the new Central Maui WWRF. Figure 1 shows the route of the forcemain.

The Kehalani WWPS will be constructed on parcel tax map key (TMK) number (2)3-5-020:036. The parcel is a stormwater detention basin that serves the Kehalani development. The new WWPS will be constructed on the edge of the detention basin, and modifications will be made to the detention basin to retain its full function as originally designed. Additional information will be presented in the Draft Environmental Impact Statement.

3.2 Central Maui Wastewater Reclamation Facility

The Central Maui Wastewater Reclamation Facility will provide wastewater treatment and effluent management for the service area.

3.2.1 Site

The Central Maui WWRF will be located on a portion of parcel TMK (2)3-8-005:023, owned by the County of Maui. The 209.04-acre parcel will be subdivided to provide a separate 14.9-acre parcel for the WWRF. Figure 3 shows the proposed WWRF location within the larger parcel. The WWRF location within the larger parcel was chosen to take advantage of the soil conditions present there for effluent disposal purposes, as described below.

The WWRF will be accessed from an extension of Waiale Road to be constructed by the County of Maui. A 100-foot-wide access and utility easement will be developed across parcel TMK (2) 3-6-002:004 for the new WWRF.

3.2.2 Liquid Treatment Processes

The Central Maui WWRF will include:

- **Preliminary treatment:** screening and grit removal to remove coarse debris prior to further treatment.
- **Secondary treatment with biological nutrient removal:** activated sludge process with anoxic zones, intermediate mixed liquor recycling, and clarification: to remove carbon and nitrogen.
- **Tertiary treatment:** filtration to remove suspended solids and turbidity.
- **UV disinfection:** to inactivate bacteria and viruses from the effluent.

Figure 4 includes a conceptual site plan for the facility.

3.2.3 Effluent Quality

The anticipated recycled water uses include irrigation of agricultural fields, parks, school yards, and streetscapes. The effluent from the Central Maui WWRF will comply with DOH requirements for R-1 recycled water. In addition, the effluent total nitrogen concentration will be 10 mg/L or less to ensure that the amount of total nitrogen applied to land with the recycled water does not exceed the needs of the crops that are irrigated with the R-1 water and to minimize the potential environmental impact of the effluent disposal system.

3.2.4 Water Recycling Program

A recycled water program is planned to be a major part of the effluent management system at the Central Maui WWRF. The water recycling program will extend Maui's freshwater resources by putting treated effluent to beneficial non-potable use, freeing up valuable potable and raw water resources for other uses. These uses include facilitating growth within the community and enhancing the environment.

Figure 5 shows the County-constructed portion of the pipeline that will be used to deliver recycled water to a recycled water storage facility to be constructed by Waikapu Country

Town. The portion of the pipeline located within the Waikapu Country Town Development will be constructed by the developer and was included in the Waikapu Country Town Final EIS. The portion of the pipeline located on the Waiale Road Extension will be constructed by the County of Maui.

Recycled water will be used for non-potable purposes at approved sites in accordance with DOH regulations and guidelines. Recycled water will also be used for agricultural irrigation purposes in the area shown in Figure 5.

3.2.5 Effluent Disposal

A wastewater effluent disposal system is necessary for the proposed WWRF. Hawaii Administrative Rules (HAR) Chapter 11-62 and the DOH's Recycled Water Guidelines require a backup effluent disposal system for all water reuse applications. This backup system ensures effluent can be safely disposed when recycled water supply exceeds the demand or if the recycled water fails to meet the required treatment specifications. The backup disposal system must be designed to allow for disposal of 100 percent of the WWRF flow.

Soil aquifer treatment (SAT) appears to be a viable effluent disposal approach for the Central Maui WWRF. SAT consists of the intermittent application of effluent at high hydraulic loading rates to basins constructed in highly permeable soils, such as sand or gravel. Treatment in the SAT process is accomplished via biological, chemical, and physical interactions that occur as the water percolates through the soil matrix to groundwater. Treatment benefits can include nitrogen and phosphorus removal, heavy metal and trace organic removal, and removal of endocrine disrupting chemicals. Vegetation may or may not be present and doesn't play a significant role in the treatment that is provided due to the high hydraulic loading rate. Vegetation can also be used as a visual mitigation method. The draft EIS will include a hydrogeological study of the proposed SAT system.

3.2.6 Solids Management

The proposed liquid treatment processes will create residual solids that will require management:

- **Grit and Screenings:** Grit and screenings will be washed and dewatered prior to disposal at the Central Maui Landfill.
- **Secondary and Tertiary Solids:** Secondary and tertiary will be stabilized using aerobic digestion with decant thickening. The digested solids will be dewatered using screw press technology. The dewatered solids will be managed in accordance with wastewater solids generated by the County's other WWRFs. Currently dewatered solids are composted with green waste at the Central Maui Landfill.

3.2.7 Ancillary Systems

Ancillary systems needed for the WWRF include electrical service, potable water, non-potable water, fire protection, stormwater management, and odor control.

Electrical Systems: It is anticipated that a new electrical service from Hawaiian Electric Company (HECO) will need to be brought to the site via underground or aboveground

electrical lines from the intersection of Waiale Road and Waiko Road following along the proposed Waiale Road extension or from Honoapiilani Highway. An emergency power system will be provided to ensure uninterrupted wastewater treatment in the event of power failure.

Potable Water: Potable water needs will be met by connection to the County water system.

Non-Potable Water: Non-potable utility water needs like hose bibbs, water cannons, and foam sprays will be met with R-1 effluent. A pump system will be needed to provide adequate flow and pressure.

Fire Protection: Fire protection systems will be needed for certain WWRF elements in accordance with applicable codes.

Stormwater Management: A stormwater system that is compliant with applicable codes will be required. A stormwater pump station may be required.

Odor Control: Wastewater treatment plants can be a source of nuisance odors to the surrounding community if not properly designed and/or operated. Not all processes with a wastewater treatment plant generate odors; nuisance odors are most commonly associated with anaerobic (without oxygen) conditions and with residual solids processing. Foul air collection and treatment will be provided for treatment processes that can generate nuisance odors.

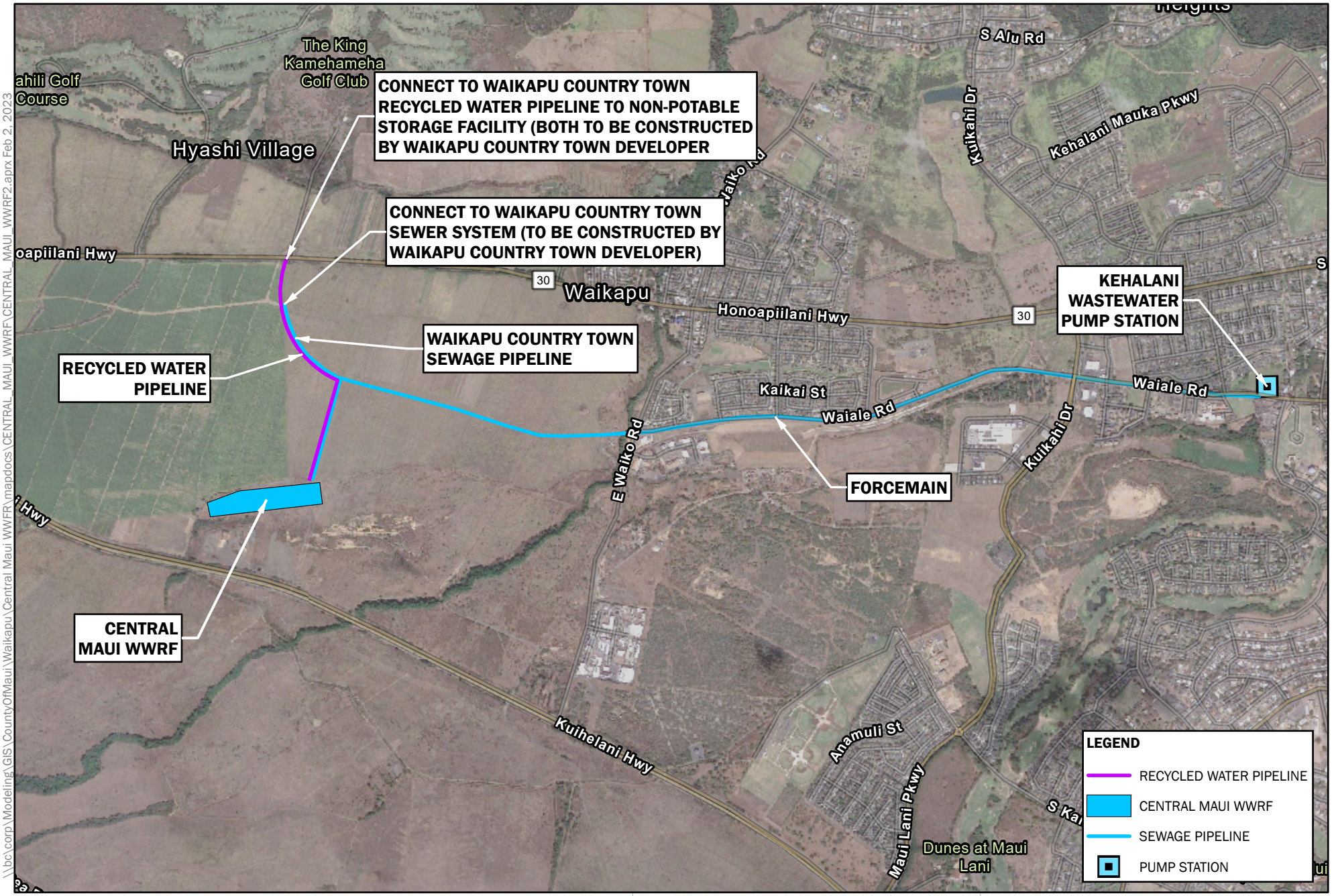
Should you have any questions, please do not hesitate to call Irina Constantinescu at (808) 442-3305, or Craig Lekven at (808) 442-3301.

Very truly yours,

Brown and Caldwell

for

Irina Constantinescu
Project Manager



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Brown AND Caldwell

COUNTY OF MAUI, HAWAII

CENTRAL MAUI WWRF EIS

DATE: FEBRUARY 2023
PROJECT: 158098

Notes:
1. Aerial photo: Google Earth, 2019

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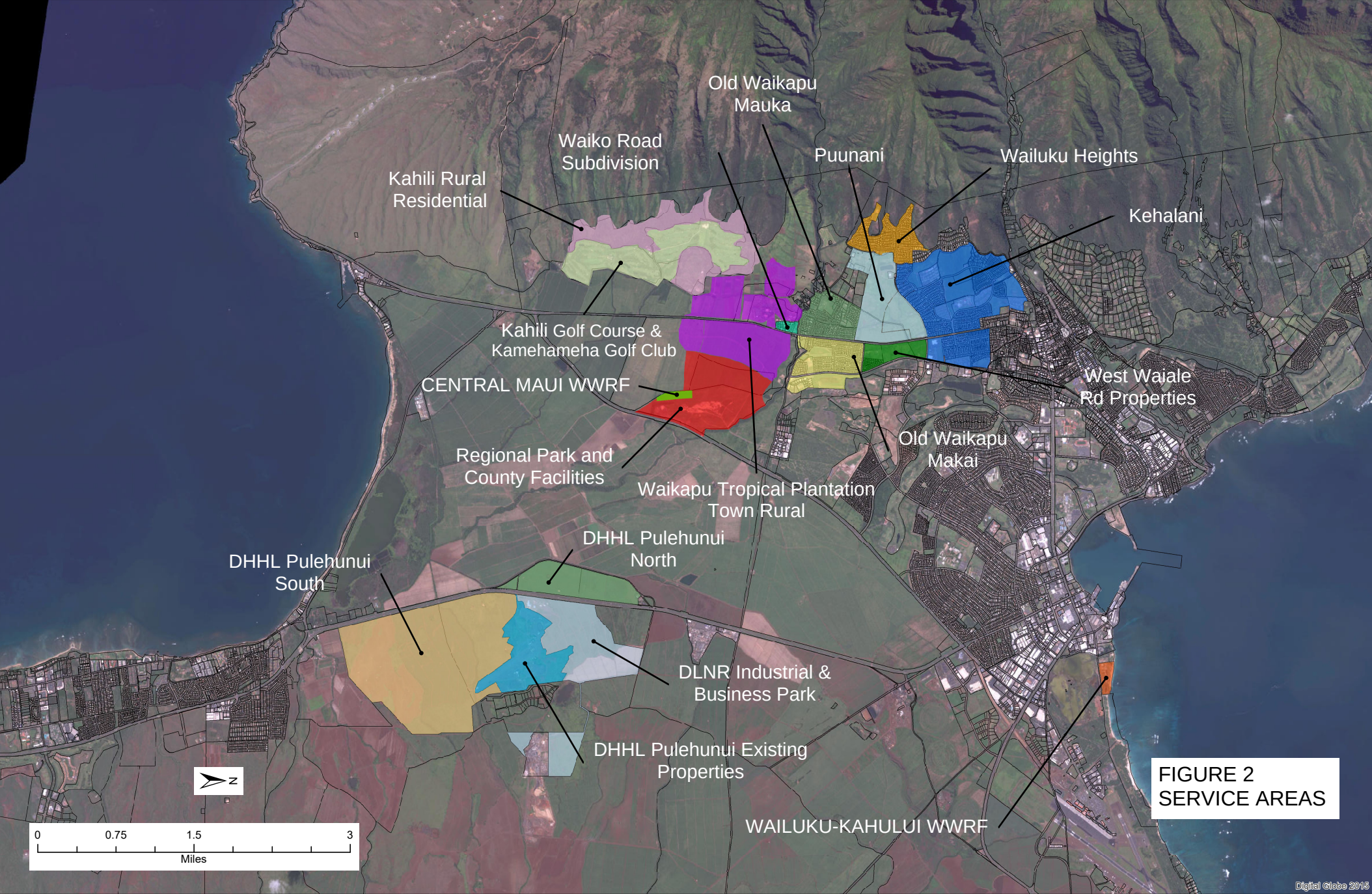
FIGURE 1

CENTRAL MAUI WWRF PROJECT ELEMENTS TO BE CONSTRUCTED BY COUNTY OF MAUI


Old Waikapu
Mauka
Waiko Road
Subdivision
Puunani
Wailuku Heights
Kahili Rural
Residential
Kehalani
Kahili Golf Course &
Kamehameha Golf Club
CENTRAL MAUI WWRF
West Waiale
Rd Properties
Old Waikapu
Makai
Regional Park and
County Facilities
Waikapu Tropical Plantation
Town Rural
DHHL Pulehunui
North
DHHL Pulehunui
South
DLNR Industrial &
Business Park
DHHL Pulehunui Existing
Properties
WAILUKU-KAHULUI WWRF
N
0
0.75
1.5
3
Miles
FIGURE 2
SERVICE AREAS
Digital Globe 2015

Brown AND Caldwell

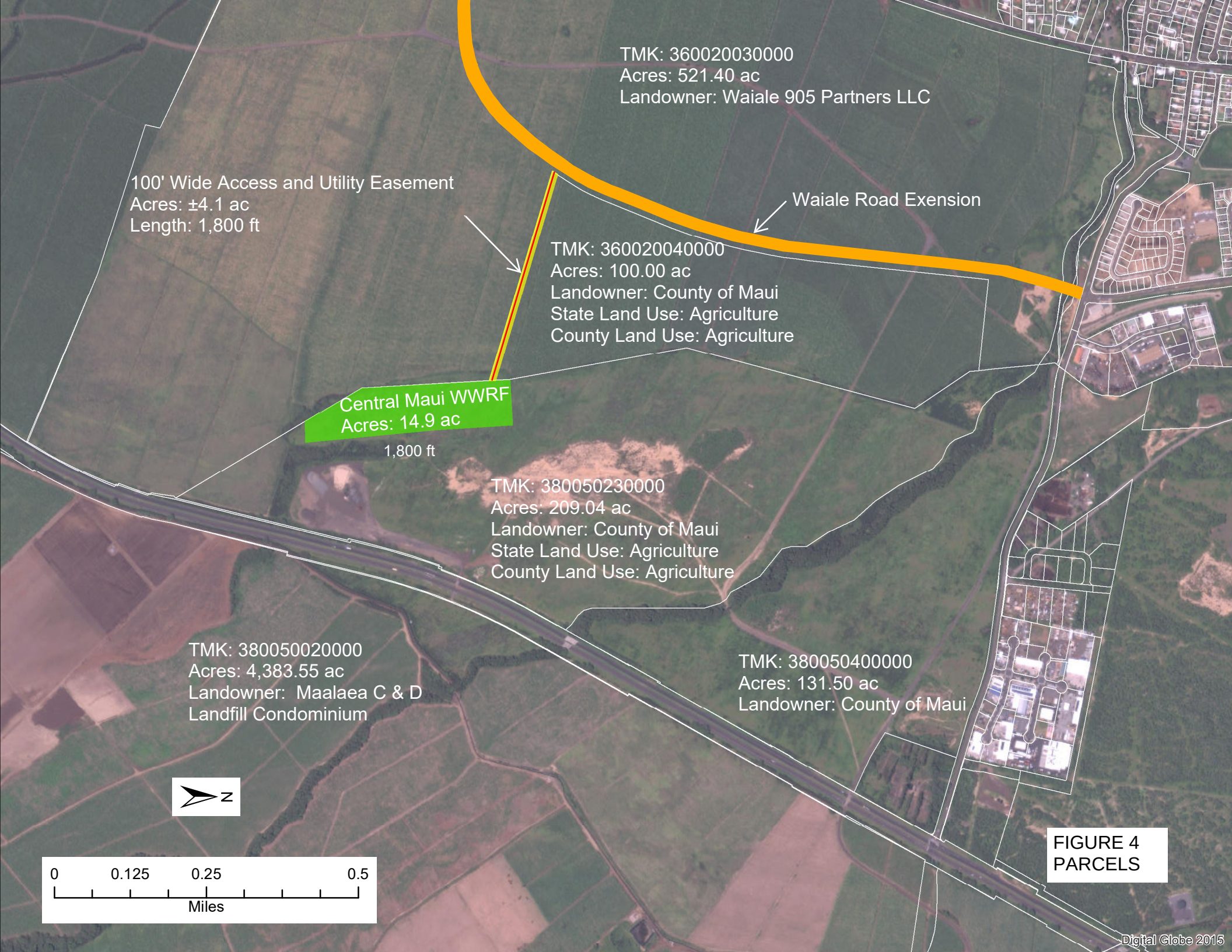
SCALE: 1" = 200'
PROJECT NO. 155381
DATE: 23-May-22

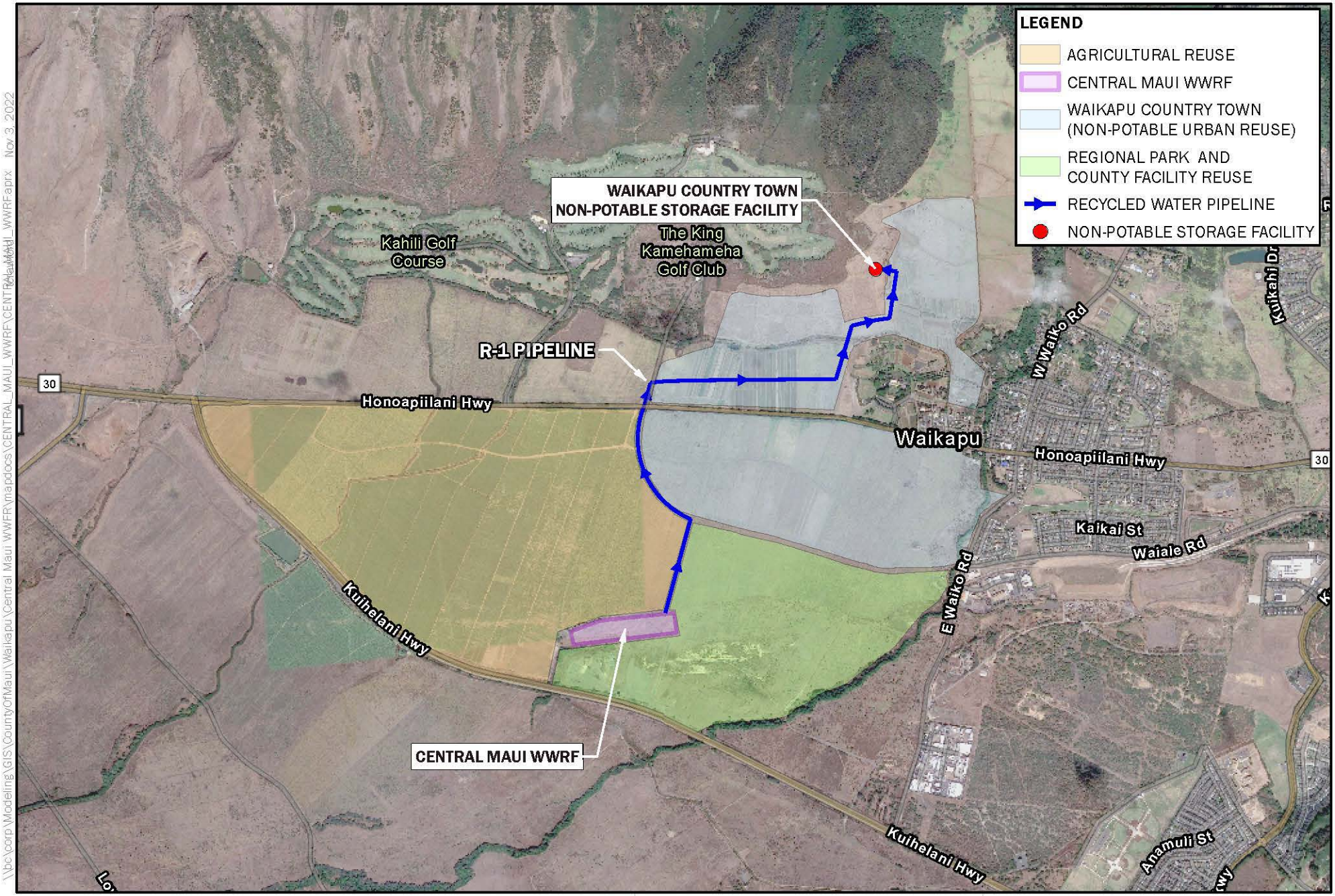
CENTRAL MAUI WWRF FACILITY PLAN

PRELIMINARY SITE PLAN

FIGURE 3

Path: C:\bcpw\d2373836 File Name: 155381-FIG-SITE LAYOUT Plot Date: May 23, 2022 10:55 AM Cadd User: Richard Sellona


TMK: 360020030000
Acres: 521.40 ac
Landowner: Waiale 905 Partners LLC
100' Wide Access and Utility Easement
Acres: ±4.1 ac
Length: 1,800 ft
Waiale Road Exension
TMK: 360020040000
Acres: 100.00 ac
Landowner: County of Maui
State Land Use: Agriculture
County Land Use: Agriculture
Central Maui WWRF
Acres: 14.9 ac
1,800 ft
TMK: 380050230000
Acres: 209.04 ac
Landowner: County of Maui
State Land Use: Agriculture
County Land Use: Agriculture
TMK: 380050020000
Acres: 4,383.55 ac
Landowner: Maalaea C & D
Landfill Condominium
TMK: 380050400000
Acres: 131.50 ac
Landowner: County of Maui
N
0
0.125
0.25
0.5
Miles
FIGURE 4
PARCELS
Digital Globe 2015



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Brown AND Caldwell

COUNTY OF MAUI, HAWAII

CENTRAL MAUI WWRF EIS

DATE: NOVEMBER 2022
PROJECT: 158098

Notes:
1. Aerial photo: Google Earth, 2019.

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FIGURE 5

CENTRAL MAUI WWRF RECYCLED WATER USE AREA BOUNDARIES

APPENDIX

F

HYDROGEOLOGICAL STUDY

Geosyntec consultants

engineers | scientists | innovators

EVALUATION OF RECYCLED WATER INFILTRATION – CENTRAL MAUI WASTEWATER RECLAMATION FACILITY (WWRF) STUDY

County of Maui

Prepared for

Brown and Caldwell
Mr. Craig Lekven, Ms. Irina Constantinescu

Prepared by

Geosyntec Consultants, Inc.
211 East Ocean Boulevard, Suite 300
Long Beach, CA 90802

Project Number: LB1047

February 11, 2025

Evaluation of Recycled Water Infiltration – Central Maui Wastewater Reclamation Facility (WWRF) Study

County of Maui

Prepared for

Brown and Caldwell
Mr. Craig Lekven, Ms. Irina Constantinescu

Prepared by

Geosyntec Consultants, Inc.
211 East Ocean Boulevard, Suite 300
Long Beach, CA 90802

Richard P. Kraft, PG, CEG, CHg. (CA)
Senior Consultant Hydrogeologist

Mark Davidson, Ph.D.
Senior Scientist

Project No: LB1047

February 11, 2025

Geosyntec consultants

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ACRONYMS AND ABBREVIATIONS

µg/L	micrograms per liter
2D	2-dimensional
CEG.	Certified Engineering Geologist
CHg	Certified Hydrogeologist
CMLF	Central Maui Landfill
CO_2	carbon dioxide
County	County of Maui
CSM	Conceptual Site Model
EIS	Environmental Impact Statement
ft	feet/foot
ft/day	feet per day
ft bgs	feet below ground surface
ft bmsl	feet below mean sea level
ft msl	feet above mean sea level
Geosyntec	Geosyntec Consultants
IbB	Iao cobbly silt clay
JaC	Jaucas sands
K_h	horizontal hydraulic conductivity
k_{sat}	saturated permeability
K_v	vertical hydraulic conductivity
KWRF	Kihei Wastewater Reclamation Facility
lb/ft^3	pounds per cubic foot
LWWRF	Lahaina Wastewater Reclamation Facility
MCL	maximum contaminant level
MDL	method reporting limit
mgd	million gallons per day
mgy	million gallons per year
mg/L	milligrams per liter
mgN/L	milligrams of nitrate as N per liter
ML	sandy silt (USCS)
$mmole/m^3$	millimoles per cubic meter
MW	monitoring well
N_2	dinitrogen gas

NH_4^+	ammonia
N_2O	nitrous oxide
NO_2^-	nitrite
NOAA	National Oceanic and Atmospheric Administration
Off-spec	Off-specification excess recycled water
OSDS	On-site sewage disposal system
pcf	pounds per cubic foot
P.G.	Professional Geologist
PPCPs	Pharmaceutical and personal care products
PrB	Pulehu cobbly silt loam
PZUE	Puuone sands
Qa	quaternary alluvium
Qdo	Older dune deposits
Qkul	Kula Volcanics
QTao	Older alluvium
Report	Evaluation of Recycled Water Infiltration Central Maui Wastewater Reclamation Facility
SAT	Soil aquifer treatment
Site	Proposed Central Maui Wastewater Reclamation Facility (WWRF)
SM	silty sand (USCS)
SW	well-graded sands
SWAP	State of Hawaii Source Water Assessment Program
SWPPP	Stormwater Pollution Prevention Plan
TIC	total inorganic carbon
TOC	total organic carbon
USCS	Unified Soil Classification System
USDA	US Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
W-K WWRF	Wailuku-Kahului Wastewater Reclamation Facility
VZM	vadose zone numerical model
WWRF	Wastewater Reclamation Facility
YKE	Yogi Kwong Engineers, LLC

EXECUTIVE SUMMARY

Geosyntec has performed a multi-faceted evaluation of proposed soil aquifer treatment (SAT) basin infiltration of excess recycled water for the proposed Central Maui Wastewater Reclamation Facility (WWRF). The work was performed on behalf of the County of Maui and at the direction of Brown and Caldwell. The objective of this study and report is to provide the community and decision makers with projections of potential future conditions to assess the feasibility of proposed recycled water infiltration, as well as potential impacts to environmental receptors. The analyses focus on the migration and fate of dissolved nitrate, as it is anticipated to be the major chemical constituent of total nitrogen in the recycled water.

The SAT basin treatment method involves infiltrating excess recycled water (i.e., R-1 water) and occasional off-specification (off-spec) effluent into the subsurface. The recycled water infiltrates into the unsaturated (vadose) zone before migrating to, and mixing with, the underlying groundwater aquifer. Residual chemical constituents in the recycled water are anticipated to undergo attenuation processes such as natural degradation, dispersion, and dilution prior to reaching potential environmental receptors. Because nitrate is expected to be the predominant component of recycled R-1 water, it was used as a proxy for the modeled migration of total nitrogen in the subsurface.

The proposed WWRF location is in the central Maui isthmus area, southeast of Waikapu town, with the current surface elevations of the proposed future SAT basin locations ranging from approximately 200 to 224 feet above mean sea level (ft msl). Groundwater is estimated to be encountered beneath the site at an approximate elevation of 2.4 to 4 ft msl. The unsaturated zone beneath the proposed WWRF is approximately 220 feet (ft) thick in the location of the two northerly basins and approximately 196 ft in the south basin. The final constructed SAT basin elevations are not known at this time, thus the vadose zone transport model evaluated current site conditions. Groundwater flow beneath the WWRF and potential mixed excess recycled water chemical transport is expected to be southerly for approximately 2.5 miles toward Maalaea Bay and beneath the western edge of Kealia Ponds National Wildlife Refuge area.

It is important to note that the baseline nitrate concentration in groundwater in the area is estimated to be approximately 2 to 3 milligrams of nitrate as N per liter (mgN/L) (2,000 to 3,000 µgN/L) or greater due to past agricultural activities and the presence of on-site sewage disposal systems (OSDSs). The projected WWRF nitrate discharge is to groundwater is well below the nitrate drinking water standard of 10 mgN/L (10,000 µgN/L).

Geosyntec utilized numerical modeling to simulate the potential future infiltration of excess recycled water as well as the fate and transport of dissolved nitrate in both the vadose zone and the groundwater aquifer. The modeling simulations are projections of potential future conditions and are based on estimates of infiltration rate projections, chemical degradation rates from literature, and approximations of a complex subsurface system. As such, the projections are considered a screening-level analysis, and further refinement may be warranted should additional site-specific data become available.

Vadose zone numerical modeling found that the SAT basins should have the capacity to meet the infiltration needs of both Average Precipitation Year (Scenario 1) and Wet Precipitation Year (Scenario 2) infiltration rates established by Brown and Caldwell (2024). The model results indicate that infiltration is predominantly vertical with limited lateral migration. The simulations did not project lateral migration of infiltrated excess recycled water would reach Waikapu stream, located at least 2,000 ft from the proposed WWRF.

To evaluate potential impacts to environmental receptors, Geosyntec modeled the fate of nitrate through the vadose zone and groundwater. Nitrate concentrations in treated water can be reduced through the natural action of microorganisms, in a process termed denitrification. Denitrification, which combines the removal of nitrate with consumption of organic carbon, has been shown to occur in a wide range of environments, including in groundwater affected by injected wastewater at the Lahaina, Kihei, and Kahului WWRFs. In the vadose zone, Geosyntec simulated both a conservative and enhanced rate (based on the addition of organic carbon via adding wood chips in the bottoms of the SAT basins) of denitrification in migrating soil pore liquids, based on scientific literature values and *in situ* estimates from groundwater studies on Maui. Geosyntec also simulated a conservative and enhanced denitrification rate for dissolved nitrate migration in the groundwater model.

Groundwater modeling projects groundwater flow and chemical transport will be southerly towards Maalaea Bay. Geosyntec utilized both enhanced (high) and conservative (low) denitrification rates in the vadose zone and groundwater models. For the high denitrification rate scenario, the simulated dissolved nitrate concentration of 0.012 mgN/L; or 12 micrograms nitrogen per liter [µgN/L]) was projected to reach steady state at the shoreline at Maalaea Bay in approximately 12 years. This represents a greater than 99% reduction in nitrate from the 8 mgN/L of total nitrogen applied at the SAT basins. For the conservative scenario (slower denitrification), the nitrate concentration at Maalaea Bay shoreline was projected to reach a steady state of approximately 0.29 mgN/L (290 µgN/L) in approximately 25 years. This represents an ~96% reduction in nitrate from the 8 mgN/L of total nitrogen applied at the SAT basins. See report Figures 44, 45 and 46 showing the distribution of dissolved nitrate concentrations in groundwater using both enhanced and conservative denitrification rates. Chemicals in recycled water that are more resistant to degradation, such as personal care or pharmaceutical compounds, are projected to undergo an approximate 93% reduction in concentration from the SAT basins to the shoreline at Maalaea Bay due to natural attenuation processes.

The State of Hawaii categorizes Maalaea Bay as a Class A Marine Water Embayment. Discharge regulations established for this category include various chemical compounds, detection frequencies, and sampling time periods. Geosyntec concludes the geometric mean “Dry” criterion for total nitrogen of 150 µgN/L as the comparative regulatory threshold for the nitrate modeling projections. Nitrate is expected to be the primary form of nitrogen in total nitrogen. Using enhanced denitrification rates that could potentially be achieved with planned operational improvements at the SAT basins via the addition of organic carbon, the modeled additive nitrate outflow concentrations (~12 µgN/L) above the current baseline are projected to be below State of Hawaii regulatory discharge criteria as described above. The projected additive nitrate

concentrations from baseline, applying enhanced denitrification rates, are also below the State of Hawaii discharge criteria for inland waters for total nitrogen (180 µgN/L) using the same geometric mean of "Dry" conditions.

The analyses and modeling projections are based on estimates of current and future conditions. We conclude that the potential use of SAT basins for excess recycled water infiltration is an innovative methodology that can provide improved environmental outcomes as compared with other existing recycled water discharge approaches. We also conclude that the addition of organic carbon, via wood chips, and/or available biomass has the potential to increase denitrification rates such that nitrate concentration outflows at the shoreline can be below State of Hawaii regulatory standards.

Pending WWRF approval and construction, Geosyntec recommends a detailed monitoring program be deployed that includes monitoring recycled water infiltration rates and chemical concentrations, vadose zone monitoring using shallow and deep lysimeters, and groundwater monitoring along the prospective flow path to evaluate actual conditions versus the modeling projections presented in this report. As part of the WWRF subsurface environmental monitoring network installation, Geosyntec recommends bench-scale laboratory column testing of subsurface soils and effluent samples be performed to estimate the potential range of site-specific denitrification rates. The column study rates can be compared with the rates used in this analysis.

1. INTRODUCTION

1.1 Terms of Reference

Geosyntec Consultants (Geosyntec) has prepared the following Evaluation of Recycled Water Infiltration Study for the Proposed Central Maui Wastewater Reclamation Facility (WWRF) Report (Report). The proposed Site is located within the isthmus area of the island of Maui (Figure 1). This Report has been prepared by Geosyntec on behalf of Brown and Caldwell and the County of Maui (County). This Report was prepared by Laura Vezzoli, Luis Martinez, PG, (CA); and Julie Chambon, PE, Ph.D. and was reviewed by Richard Kraft, PG, CHg, CEG (CA) and Mark Davidson, Ph.D., in accordance with Geosyntec's document review policy.

1.2 Project Purpose and Objectives

The County is evaluating the application of the soil aquifer treatment (SAT) method to infiltrate excess recycled water, as described in *Final Report - Central Maui Wastewater Reclamation Facility Plan* (Brown and Caldwell, 2023). This evaluation of recycled water infiltration study combines the following:

- Review of published reports and site-specific data of subsurface material properties, including geologic, geotechnical, geochemical, and hydrogeologic, as well as groundwater flow and geochemistry.
- Development of a Conceptual Site Model (CSM).
- Use of the HYDRUS© modeling software to simulate and evaluate excess recycled R-1 water infiltration flow scenarios into the vadose zone (i.e., unsaturated zone), including fate and transport of dissolved nitrate.
- Use of the MODFLOW© modeling software to simulate nitrate fate and transport in groundwater.
- Provide conclusions and recommendations for the proposed SAT basin infiltration scenarios and provide estimates of potential environmental impacts in comparison to state and federal regulatory standards.

This Report and analyses are expected to be included as a supporting technical document for the proposed WWRF Environmental Impact Statement (EIS).

1.3 Overview of Proposed WWRF

The proposed WWRF is described in the following documents from Brown and Caldwell:

- Brown and Caldwell, 2018, *Countywide WWRF Land Treatment Study*, prepared for County of Maui Department of Environmental Management, May;
- Brown and Caldwell, 2023. *Final Report - Central Maui Wastewater Reclamation Facility Plan*, prepared for Department of Environmental Management, Wastewater Reclamation Facility, Wailuku, Maui, Hawaii; and
- Brown and Caldwell, 2024. *Technical Memorandum - SAT Disposal Flows for Hydrogeological Model*, prepared for County of Maui Department of Environmental Management, Wastewater Reclamation, Wailuku, Maui, Hawaii, September 12.

Figure 2 presents the layout of the proposed WWRF SAT basin configurations. The four SAT basins have a combined bottom surface area of approximately 7.5 acres (Brown and Caldwell, 2023). The basins are designed to infiltrate excess recycled water into the subsurface during times when other discharge options are not available, such as when demand for off-site agriculture irrigation is limited due to extended periods of precipitation during winter months.

1.4 Excess Recycled Water Infiltration Scenarios

The Brown and Caldwell *SAT Disposal Flows for Hydrogeological Model*, dated September 12, 2024, defined two SAT basin infiltration scenarios that were evaluated in this infiltrations analysis and report as follows:

1.4.1 Hydrogeologic Model Scenario 1: Long-Term Pollutant Transport Focus

As described by Brown and Caldwell (2024), the first proposed model scenario considers anticipated average long-term infiltration conditions to establish potential environmental impacts from infiltration of recycled water at the SAT basins. The goals of this scenario include:

- Establish the likely path of water applied to the SAT basins through the vadose zone and saturated zone to the Pacific Ocean; and
- Establish potential environmental impacts from the SAT basin discharge.

Brown and Caldwell further stated for this hydrogeological modeling scenario that it is considered reasonable to model the average precipitation year condition, coupled with intermittent off-spec conditions throughout the year. Table 1A lists the estimated excess recycle water infiltration rates for this scenario. Table 1B lists the combined estimated excess recycle water and off-specification infiltration rates for this scenario.

For Scenario 1, the HYDRUS© vadose zone infiltration and chemical transport modeling was combined with MODFLOW© groundwater flow and chemical transport modeling to evaluate potential dissolved nitrate impacts to groundwater quality and potential concentrations at outflow to the Pacific Ocean.

1.4.2 Hydrogeologic Model Scenario 2: Vadose Zone Focus – Wet Year Conditions

As described by Brown and Caldwell (2024); *The objective of this proposed scenario is to model the vadose zone's capacity to assimilate high flows for an extended period of time. The goals of this scenario are to:*

- *Establish the SAT's ability to dispose of the entire WWRF flow in accordance with Hawaii Administrative Rules 11-62-25 requirements for backup disposal systems.*
- *Evaluate the mounding potential above the restrictive layer in the vadose zone to establish the potential for impacts to nearby streams or other features.*

Table 2A lists the estimated excess recycle water infiltration rates for this scenario. Table 2B lists the combined estimated excess recycle water and off-specification infiltration rates for this scenario.

2. BACKGROUND

2.1 Site Location

The proposed WWRF (Site) is located in the gently sloping isthmus area of central Maui (Figure 1), east of the West Maui Mountains. The shoreline to Maalaea Bay is approximately 2.5 miles south of the southernmost proposed SAT basin. The shoreline of Kahului Harbor is located approximately 4 miles to the northeast of the northernmost proposed SAT basin. Figure 3 provides a 3-dimensional perspective view of the Site vicinity and topography.

2.2 Site Setting

Figure 4 presents the regional topographic setting for the Site vicinity showing the east-southeasterly topographic slope. The ground surface slopes at approximately 2% from the northwest to the southeast following the slope of the alluvial fan emanating from the West Maui Mountains. The Site surface elevation beneath the proposed SAT basins is estimated to range from approximately 200 above mean sea level (ft msl) in the south basin to 224 ft msl in the two northerly basins (Figure 2). The final elevations for the SAT basins following construction are not known at this time.

Waikapu town is located approximately 1-1/4 miles northwest of the Site. The Waikapu stream drainage extends to the north and east of the Site. At its closest point, the Waikapu stream drainage is approximately 2,000 ft east (downslope) of the proposed SAT basin locations.

2.3 Historical Land Use

The Site and surrounding vicinity were historically used for industrial sugar cane production. Production occurred at least since the 1920s (see Figure 2 from Engott and Vana, 2007). Historical aerial photographs of the Site facility boundary suggest that sugar production ended between 2000 and 2011. The Site appears to have been graded since the most recent sugar cane production.

As previously described, the Site is located approximately 1-1/4 miles southeast of the town of Waikapu. Based on a Hawaii Department of Health Study (2018a), dozens of septic systems and/or cesspools (referred to as on-site sewage disposal systems [OSDSs]) have historically been used in this area (see Figure 5). Given the long-term sugar cane production and the past use of fertilizers plus proximity of the historic use of OSDSs, it is anticipated that soil and groundwater have been impacted to some degree from these historical uses. An objective of this investigation is to evaluate the baseline chemical conditions, specifically the presence of fertilizer and domestic disposal system compounds, in Site soils and regional groundwater.

2.4 Surface Soils and Geologic Deposits

As will be described in further detail in Sections 3, 4, and 5, surface soils within the proposed SAT basin footprint consist predominantly of loose dune sands defined as Older Dune deposits (Qdo) and referred to by other sources as Jaucas sands (JaC). Figure 6 presents a map of the surface geology of central and west Maui modified from the Geologic Map of the State of Hawaii (United

States Geological Survey [USGS], 2007) showing the distribution of the Qdo deposits overlying quaternary alluvium (Qa) and older alluvium (QTao) deposits. Figure 7 presents the distribution of soil deposits modified from the US Department of Agriculture (USDA). The USDA defines the surficial soils beneath the proposed SAT basin footprint as JaC dune deposits. In this study, the Qdo and JaC dune deposits are considered to be equivalent materials.

2.5 Area Water Resources

The following section describes local water resources and relies heavily on data and analyses presented in Gingerich, Stephen (2008), *Ground-Water Availability in the Wailuku Area, Maui, Hawaii*, USGS Scientific Investigations Report 2008–5236 and Rotzoll, Kolja et al., 2021, *Long-Term Groundwater Availability in the Waihe'e, 'Īao, and Waikapu Aquifer Systems, Maui, Hawaii*, US Geological Survey, Scientific Investigations Report 2021–5113.

2.5.1 Precipitation and Recharge

Precipitation varies significantly across the island of Maui, based on altitude, location, and the range of years of data collected. The mean annual rainfall estimate for the Site land surface is estimated to be approximately 15 to 20 inches per year based on lines of equal mean annual rainfall and fog zone shown in Figure 3 in Gingerich, 2008. Directly to the west in the West Maui Mountains and the Waikapu Stream watershed, annual rainfall rates exceed 100 inches per year.

Brown and Caldwell (2023) report an average annual precipitation rate of 18.8 inches between 1971 and 2000 based on area National Oceanic and Atmospheric (NOAA) data collections. As shown in Brown and Caldwell, Table B-4, annual pan evaporation and evapotranspiration rates (95.3 inches per year) greatly exceeds the annual precipitation estimates of 18.8 inches per year.

The Rainfall Atlas of Hawaii interactive map (https://www.hawaii.edu/climate-data-portal/rainfall-atlas/) estimates annual rainfall for the Site vicinity as 16.3 inches per year, with a similar monthly precipitation distribution as compared with Brown and Caldwell (2023). Rotzoll et al., 2022 estimates in Appendix 1, Figure 1.8J, that a small amount of aerial groundwater recharge occurs in the central Maui isthmus area, regardless of the local evapotranspiration rates. Geosyntec estimated 2 to 3 inches of annual groundwater recharge for the site vicinity based on inspection of Figure 1.8J (Rotzoll et al., 2022).

2.5.2 Infiltration Along Waikapu Stream

The lower Waikapu stream emanates from the West Maui Mountains and extends into the central Maui isthmus area approximately 4,000 ft north and 2,000 ft east of the Site. The Waikapu stream, which is an incised channel in the site vicinity, is documented in Gingerich (2008) as a losing stream (i.e., the stream flow infiltrates into the subsurface). Figure 8 is modified from Gingerich (2008) and provides quantitative estimates of infiltration rates per length of stream reach. Gingerich estimated a 2.4 million-gallon per day (mgd) infiltration rate for an approximately 5-mile reach of lower Waikapu Stream north and east of the WWRF. Thus, the lower Waikapu Stream is estimated to be a significant source of groundwater recharge in this portion of the central Maui isthmus area. The Rotzoll (2022) report describes stream flow and aquifer recharge has

increased in Waikapu stream since approximately 2010 when stream diversions for irrigation were curtailed and/or eliminated.

Based on the USDA soil map (Figure 7), the stream reach infiltrates into JaC and Puuone sands (PZUE) and less commonly in Pulehu cobbly silt loam (PrB) and Iao cobbly silt clay (IbB). The average estimated stream loss (i.e., infiltration) per foot of channel length was reported by Gingerich (2008) to be 270 gallons per day per foot of channel. Since approximately 2010, when streamflow in the lower Waikapu Stream was restored, new streamflow standards of 2.9 mgd have been established for the Waikapu Stream (Rotzoll et al., 2022). During its field investigation, Geosyntec (2024) inspected the lower Waikapu stream north of the site (see Appendix A for photo documentation) and described an incised channel with approximately 10 feet (ft) of active stream flow bottom width. Conservatively estimating the average width of lower Waikapu stream to be approximately 30 ft, the lower Waikapu stream is estimated to infiltrate over 390,000 gallons of stream-fed water per acre of stream bed. A lower or higher rate of infiltration per acre would be estimated if the average stream bed width estimate is greater or less than the 30 ft estimated here. Thus, the lower Waikapu stream infiltrates significant stream flows into surface soils similar to those found at the Site (i.e., JaC or Qdo and QTao sediments), and therefore provides a qualitative line-of-evidence for robust local soil liquids infiltration potential (including excess recycled water) in the Site vicinity.

2.5.3 Surface Soil Infiltration Properties

Figure 9 is adapted from the *State of Hawaii Soil Altas* (2014) and presents qualitative estimates of water permeability rates in surface materials in the Site vicinity. The Qdo deposits at the Site surface are classified as “Fast” water permeability rates. The QTao deposits that extend from the West Maui mountains west of the Site and dip under the Site are classified as “Moderate” permeability rates. These data provide another qualitative line-of-evidence that the Site vicinity soils are amenable to liquids infiltration.

2.5.4 Groundwater Elevation and Flow

Groundwater is an important resource that is actively produced via drinking water, irrigation, and industrial production wells in the Site vicinity. The Site is located near the western boundary of the Kahului aquifer system of the Central Maui aquifer sector, as defined by the State of Hawaii Commission on Water Resources Management (Gingerich, 2008). Figure 10 shows the locations of wells in the Site vicinity from the State of Hawaii, Hawaii well database. In general, production wells to the north of the Site are used for drinking water supply, whereas at this time wells to the south were more commonly used for agriculture irrigation and industrial supply.

Gingerich (2008) also presents water level gauging from production wells in the central Maui area collected in May 2005. The Gingerich (2008) water levels are provided in Figure 11A. The well closest to the Site (located approximately 1 mile north) had a measured water level elevation of 3.8 ft msl in 2005. In Rotzoll (2022), the simulated groundwater elevation beneath the Site is approximately 2.3 ft msl. With the Site surface elevation ranging from approximately 200 ft msl in the south SAT basin and up to 224 ft msl in the two northerly basins, the estimated depth to

groundwater and thickness of the vadose zone beneath the proposed SAT basins ranges from approximately 195 to 220 feet below ground surface (ft bgs). It is estimated that fresh groundwater beneath the Site will be encountered in fractured volcanic rocks of the Kula Volcanics and Honomanu Basalts. Figure 11B provides estimates of groundwater contours in the Site area based on Gingerich (2008, Figure 26B). As shown in Figure 11B, the proposed Site was located near the north-south groundwater flow divide in 2005. It is noted that recharge into the groundwater system has been modified and has likely increased in the Site vicinity since approximately 2010, as stream flow diversions for agricultural purposes along lower Waikapu stream have been curtailed.

As stated above, fresh groundwater beneath the Site is estimated to be encountered at an elevation of approximately 2.3 to 3.8 ft msl. Production well Waikapu No. 2, which is located approximately 1.75 miles to the northwest of the Site at the base of the West Maui Mountains, is gauged regularly. The hydrograph for Waikapu Well No. 2 is provided in Figure 12 and shows water level elevations ranging from approximately 9 to 15 ft msl at that upgradient location.

Based on the Gingerich (2008) estimates of the distribution of the depth of 50% salinity groundwater, we estimate it will be encountered beneath the Site at between -200 and -300 ft msl (see Gingerich, 2008, Figure 30).

3. SUBSURFACE CONCEPTUAL SITE MODEL (CSM)

The subsurface CSM for the Site provides the framework for vadose zone and groundwater flow model development to support SAT basin infiltration simulations. The CSM was developed from the following data sources:

- Published reports on the nature and distribution of local soils, including water permeability characteristics;
- Published geologic maps and reports from the USGS that describe the deeper subsurface geologic materials (USGS, 2007);
- Shallow soils laboratory testing and infiltration testing performed at the Site (Yogi Kwong Engineers, LLC [YKE], 2024) and in the Site vicinity (Geolabs, 2013);
- A site-specific subsurface investigation performed by Geosyntec (2024) with three soil borings advanced up to 60 ft bgs, with extensive soil sample collection and geotechnical laboratory testing. The investigation also included in-borehole falling head tests to estimate soil infiltration rates. As background information from the above-referenced investigation, Table 3 presents soils geochemical testing results; Tables 4A and 4B present soils laboratory geotechnical testing results; Table 5 presents in-borehole falling head test results; and Table 6 presents a comparison of infiltration rates estimated at the site and in the site vicinity. Appendix A contains boring logs, a subsurface cross-section, investigation photo documentation, and soil grain size testing from that investigation.
- Additional reports from Gingerich (2008), Rotzoll et al. (2021), Izuka et al. (2018), and others on the nature of groundwater flow and aquifers in the central Maui area; and
- The combination of site-specific soil geochemical testing with published reports evaluating baseline water quality conditions (specifically nitrate concentrations) and denitrification rate estimates in the vadose zone and groundwater.

3.1 CSM Development

The CSM provides the framework for future vadose zone numerical model construction. Key aspects of the CSM include:

- The nature and thickness of the various subsurface soils/geologic units found within the vadose zone at the Site; and
- The depth to groundwater at the site, groundwater flow conditions, and aquifer characteristics.

3.2 Vadose Zone

Figure 13 presents a conceptual subsurface profile near the center of the proposed SAT basins. As shown in Figure 13, three main lithologic materials are characterized in the subsurface as follows:

3.2.1 Older dune deposits (Qdo) / Jaucas sand (JaC) - (Holocene and Pleistocene)

Depth: From ground surface to approximately 40 ft bgs.

Geosyntec used data from multiple published sources plus site-specific soil geotechnical testing to characterize this uppermost unit of dune deposits (defined as Qdo and/or JaC) as summarized below.

The Site is situated within the central Maui Inland Sand Deposits, as described in the *Central Maui Sand Resource Quantification Study* (County of Maui, 2018). The central Maui inland sand deposits are described as calcareous wind-blown sands.

An additional soil definition was described in the *Update: Maui Inland Sand Resource Quantification Study* (County of Maui, 2018) in which the USGS, Geologic Map of the State of Hawaii, Sheet 7, Island of Maui identifies Qdo soils within the Island of Maui. The report states: *This soil type is defined as older dune deposits (Holocene and Pleistocene) and are only found in areas within central Maui. In general, Qdo soils consistently overlap with the JaC and PZUE soil locations*. For this study, we will use the USGS Qdo and USDA JaC designations and distribution, as shown in Figure 7.

The USGS (2007) adds, the Qdo is lithified calcareous sand or eolianite and forms dune fields inland of the modern coastline. An extensive dune field mantles the isthmus between West and East Maui, where dune-sand thickness is as great as 10 to 12 meters (m).

In Geosyntec (2024), the Qdo / JaC horizon was identified at ground surface to depths of approximately 40 ft bgs. The upper 20-ft horizon is described primarily as wind-blown, poorly graded, fine to medium sand and silty sand, that is loose and dry. Some rounded to sub-rounded basalt gravels were also intermixed within this upper horizon. Sieve testing classified the soils in this unit as silty sand (SM). From depths of approximately 20 to 40 ft bgs, the Qdo / JaC sand materials consist of sands commonly intermixed with silt materials. The materials in this zone are primarily described as SM and sandy silt (ML) and becoming slightly more consolidated.

The *Soil Survey of the Islands of Kaua'i, O'ahu, Maui, Moloka'i, and Lāna'i, State of Hawaii*, published by the USDA, Soil Conservation Service, describes two soil types in the central valley of Maui, the JaC and the PZUE, both of which consist of calcareous sand (USDA, 1972).

In Brown and Caldwell, 2018, the JaC is reported to be excessively drained with a limiting saturated permeability (k_{sat}) of 6.00 to 19.98 inches per hour. The information source is the USDA web soil survey [Web Soil Survey (usda.gov)]

Percolation rates measured from the three in-borehole falling head tests were rapid, ranging from 7 to 101 inches per hour (Geosyntec, 2024, Table 5). The calculated downward infiltration rates using the Porchet method ranged from 2 to 42 inches per hour (Geosyntec, 2024, Table 5). The incremental infiltration rate (inches per hour) measurements for the double-ring infiltrometer "inner ring" ranged from approximately 2 to 23 inches per hour (YKE, 2024). A Geolabs (2013)

study at the nearby Central Maui Regional Park geotechnical investigation reported sand infiltration rates in test pits to range from 59 inches per hour to too rapid to measure.

In summary, these sediments are commonly loose to partly consolidated well-graded sands (SW) and SM. There are some interbeds that contain silt and gravel materials. As presented in Figure 7, the State of Hawaii Soil Atas (2014) classified the surface Qdo deposits as "Fast" water permeability rates. This investigation used in-borehole falling-head tests that resulted in estimated infiltration rates of 2 to 42 inches per hour. No groundwater was encountered in this zone. The multiple lines of evidence (i.e., soil classification, surface permeability rating, in-borehole falling-head tests, double-ring infiltrometer test (YKE, 2024), plus lower Waikapu Stream infiltration rates) indicate that the approximately upper 40 ft of the subsurface materials (Qdo / JaC) exhibit rapid infiltration and drainage potential.

3.2.2 Older alluvium (QTao)

Depth: From approximately 40 to up to 180 bgs.

In the updated geologic map and pamphlet from the USGS (2007), the QTao unit - Older alluvium (Pleistocene and Pliocene), is described as follows:

> *Consolidated sand and gravel, some of it sufficiently lithified to warrant the designation "conglomerate." Chiefly well rounded and moderately sorted, but includes minor, poorly sorted colluvial deposits. Forms terrace deposits and thick valley fills now being incised by modern drainages.*

In Stearns and MacDonald (1942), the older alluvium materials are described as "Consolidated Earthy Deposits" as follows:

> *Consolidated Earthy Deposits – The alluvium consists of mottled brown to red-brown, deeply weathered, poorly sorted friable conglomerates. The most extensive deposits are near the mouths of streams on the Isthmus. No water has been found in it.*

In Geosyntec (2024), the QTao sediments were encountered at depths ranging from approximately 40 ft bgs to the base of drilling at 60 ft bgs. The sediments were interpreted to be deposited as an alluvial fan emanating from the West Maui mountains along the Waikapu stream valley. The sediments were described in the field as a heterogeneous mixture of silts, sands, gravels, and clays. The material is dry to damp and dense. The gravels were typically subrounded basalt clasts. Based on field thread tests, the clays were described as low to medium plasticity. Sieve testing classified the fine-grained QTao sediments as SM. Hydrometer testing found the fine fraction (i.e., silt and clay size particles) to be approximately 80% silt and 20% clay. Based on review of grain-size distribution plots presented in Scholle and Spearing (1982), the grain-size distribution for QTao sediments at the Ste were interpreted to have been deposited as intermediate between mudflow and water laid deposits. This may suggest that sediments are representative of the mid-fan area. The underlying QTao sediments (i.e., below 60 ft bgs) are estimated to be similar to the materials tested at 40 to 60 ft bgs. However, it is noted that alluvial fan sediments can exhibit both coarsening upwards sequences (prograding fan) and fining-upwards sequences when weathering back from

the mountain front. Additional exploration may help evaluate this potential vertical variation of alluvial fan sediments beneath the site. The base of the QTao unit is estimated from the volcanic bedrock structure contour map provided in Figure 7 in Gingerich (2008), in which the top of the Kula Volcanics / Honomanu Basalt is estimated to be encountered beneath the Site at approximately 40 ft msl. Thus, at the vicinity of the north SAT basins where the surface elevation is up to 224 ft msl, the base of the QTao would be estimated to be at a depth of approximately 180 ft bgs. With the top of the QTao at a depth of approximately 40 ft bgs, the overall thickness of the QTao unit is estimated to be up to approximately 140 ft thick.

As presented in Figure 7, the State of Hawaii Soil Atlas (2014) classified the QTao surface deposits west of the Site with "Moderate" water permeability rates. This investigation used in-borehole falling-head tests that resulted in estimated infiltration rates of 1 to 8 inches per hour in the upper 20 ft of this lithologic unit. No groundwater was encountered in the interval of the QTao investigated. Furthermore, based on Gingerich (2008), the entire section of QTao at the Site is anticipated to be within the vadose zone (i.e., unsaturated zone). The multiple lines of evidence (i.e., soil classification, surface water permeability rating, and in-borehole falling head tests) indicate that the approximately 140 ft of QTao sediments are likely to exhibit "moderate" drainage rates, but somewhat lower than the overlying Qdo / JaC deposits.

Percolation rates measured from the in-borehole falling-head tests were moderate, ranging from 2 to 17 inches per hour (Geosyntec, 2024, Table 5). The calculated downward infiltration rates using the Porchet method ranged from 1 to 8 inches per hour (Table 5). A Geolabs (2013) study at the nearby Central Maui Regional Park geotechnical investigation reported similar infiltration rates for clayey silt materials (estimated to correlate with QTao materials) in test pits that ranged from 1 to 5 inches per hour.

While this study investigated the QTao materials at depths from approximately 40 to 60 ft bgs, it is estimated this unit is on the order of 140 ft thick beneath the Site, and soil properties at depth may vary.

3.2.3 Tertiary Volcanics - Kula Volcanics (Qkul)

Depth: Unsaturated interval from approximately 180 to 220 ft bgs beneath north SAT basins; saturated interval from 222 to over 500 ft bgs.

Underlying the QTao sediments, the subsurface below the Site is underlain by volcanic flows from both the Haleakala volcano to the east and the West Maui volcano to the west.

Several publications have estimated the depth to volcanic bedrock based on evaluation and interpolation of well logs. In Gingerich (2008) and review of the structure contours shown in Figure 7, we estimate the top of the Kula Volcanics (Qkul) / Honomanu Basalt of the Haleakala volcanic sequence to be intercepted at an elevation of approximately 40 ft msl beneath the Site. Based in Figure 6 from Gingerich (2008) we estimate the top of the underlying Wailuku Basalt from the West Maui volcano to be intercepted at about -1,000 ft msl beneath the Site. Others (Rotzoll et al., 2022 and Izuka, et al, 2018) have reported similar estimates, although Rotzoll et al.

(2022) presents structure contour estimates that suggest the top of the Kula Volcanics / Honomanu Basalt may be found at a somewhat lower elevation of between 0 to -25 ft msl beneath the Site.

In the USGS (2007) the Qkul unit is described as Pleistocene aphyric and porphyritic lava flows. They are chiefly aa flows with minor pahoehoe flows. The underlying Honomanu Basalt is Pleistocene in age and described as pahoehoe flows with minor aa flows. Gingerich 2008 reports the thickness of individual lava flows averages about 20 ft near the Haleakala summit and 50 ft near the periphery but flows as much as 200 ft thick are not rare (Stearns and Macdonald, 1942). The usual dip of the flows is about 10 degrees.

No direct geotechnical or infiltration testing of the Tertiary volcanics was performed due to the depths at the Site. However, other studies provide data and interpretations that assist in estimating conditions below the Site as follows:

- The water permeability rates for the surface exposures of the volcanic units are depicted to range from "Slow" to "Fast," as reported in the State of Hawaii Soil Atlas (2104) and shown in Figure 7.
- Figure 8 of Gingerich (2008) presents saturated horizontal hydraulic conductivities (K_h) for wells screened in the Kula Volcanics and Honomanu Basalt in the Site vicinity. The publication reported a range of saturated K_h values of 800 to 1,600 feet per day (ft/day) in the Site vicinity. The updated hydrogeologic analysis and modeling in Rotzoll et. al. (2022), used a K_h of 10,000 ft/day for the dike-free volcanic rocks in the region and beneath the Site.

The available published data suggest high hydraulic conductivity rates, and therefore likely rapid infiltration rates, within the vadose zone section of the Tertiary volcanics underlying the Site.

3.2.4 Vadose Zone Model Development

The vadose zone modeling is described in detail in Appendix B. Figure 14 provides a conceptual illustration of liquid inputs for the model (i.e., excess recycled water, aquifer recharge, precipitation, and evapotranspiration). The figure also lists estimated vertical hydraulic conductivity (K_v) values for the various units (see Appendix B for details on the process used to estimate the K_v values) that are an important property governing vadose zone infiltration flow rates and directions. The flow arrows illustrate estimated potential flow directions. The horizontal flow arrows at the top of the QTao material contact is based on the potential for horizontal flow due to the lower (K_v) value in the QTao material underlying the JaC / Qdo horizon. Also, the potential for horizontal flow may also occur in the Tertiary volcanics due to the anisotropy of the layered volcanics in which K_h is likely considerably greater than K_v. A key objective of the vadose zone modeling will be to estimate potential for lateral flow.

3.3 Saturated Zone

Depth: Tertiary volcanics (Kula Volcanics and Honomanu Basalt) – from approximately 220 ft bgs at the north SAT basin area to over 500 ft bgs

This subsurface investigation was focused on vadose zone characteristics, and no direct physical testing was performed in the Tertiary volcanic aquifer beneath the Site. However, as described above in published studies, such as Gingerich (2008) and Rotzoll et al., 2022), useful information is available regarding depth to fresh and 50% salinity groundwater, groundwater flow directions and gradients, and saturated K_h values in the Site vicinity. As described in Gingerich (2008), the nearest groundwater level elevation recorded from a supply well was 3.8 ft msl in 2005. Water level simulations in Rotzoll (2022), suggests the top of groundwater beneath the Site would be approximately 2.3 ft msl. The estimated elevation of the 50% salinity groundwater is approximately -250 ft msl. Figure 8 of Gingerich (2008) presents saturated horizontal hydraulic conductivities (K_h) for wells screened in the Kula Volcanics and Honomanu Basalt in the Site vicinity. The reported saturated K_h values range from 800 to 1,600 ft/day in the vicinity of the Site. The updated hydrogeologic analysis and modeling in Rotzoll et. al. (2022), used a K_h of 10,000 ft/day for the dike-free volcanic rocks beneath the Site and in the region.

Based on a review of the Rotzoll et al, (2022) SUTRA groundwater flow model, "Baseline Condition" simulations of groundwater flow indicate groundwater flow beneath the Site is estimated to flow to the south-southwest toward Maalaea Bay. However, some future scenarios evaluated in the Rotzoll et al, (2022) groundwater modeling report found groundwater flow to the north could occur under conditions of increased groundwater pumping from wells in the Wailuku area or if recharge from Waikapu Stream was reduced due to diversions or drought. Figure 15 presents a conceptual model of regional SAT basin infiltration and migration.

4. GEOCHEMISTRY EVALUATION

Numerous geochemical studies have focused on the groundwater of Maui, including Fackrell et al., (2016), Bishop (2017), Hunt and Rosa (2009), Hunt (2007), Whittier and El-Kadi (2014), and CH2M (2019), but only limited data exist for the central isthmus in the vicinity of the proposed Site, which presents a data limitation regarding background and baseline groundwater conditions. Nonetheless, data from studies in surrounding areas of Maui can be used as reasonable proxies for the likely groundwater conditions in the central isthmus area.

The fate and transport of dissolved constituents in groundwater are affected by the physical properties of the aquifer matrix, as well as the chemical and biological properties of the constituents. The key processes affecting the fate and transport of groundwater constituents are hydrodynamic, abiotic, and biotic. Hydrodynamic processes that reduce concentrations of constituents in groundwater are non-degradative (no chemical bonds are broken). Processes such as advective flow, diffusion, and dispersion tend to dominate in groundwater systems. Nonreactive constituents can migrate with the groundwater and, if they are mostly unaffected by the materials through which they flow, can sometimes serve as conservative tracers, helping to identify and differentiate different groundwater sources. In contrast, constituents that are reactive may be transformed by either abiotic or biotic processes. Abiotic processes result from interactions between the constituent and the materials through which it migrates. Adsorption, ion exchange, and hydrolysis are some of the most important abiotic processes. Biotic processes reduce concentrations of reactive constituents through the metabolic activity of microorganisms and follow a sequential process that is dependent on the oxidation/reduction (redox) state of the aquifer. The redox state of the aquifer is dependent on the amount of bioavailable organic carbon. Under anaerobic conditions, redox-sensitive constituents are biologically reduced in sequence: dissolved oxygen, nitrate, iron and manganese, sulfate, and carbon dioxide (CO_2).

The fate and transport of constituents in the subsurface, including dissolved nitrate$^-$, are therefore controlled by a combination of the effects of the three processes described above.

The following section provides background on the geochemistry of:

- Compositions of recycled water from the Kahului, Kihei, and Lahaina WWRFs;
- Baseline groundwater quality in the Central Maui and Upcountry areas;
- Baseline soil geochemistry at the WWRF; and
- Use of dissolved nitrate as a surrogate for recycled water transport in the subsurface.

4.1 Compositions of recycled water from the Wailuku-Kahului, Kihei, and Lahaina WWRFs

Groundwater affected by treated wastewater injections is typically characterized by elevated concentrations of dissolved ions and geochemical effects caused by the biochemical oxygen demand exerted by dissolved organic matter in the effluent. This may be observed as the formation of anaerobic conditions in the immediate vicinity of the injections along with changes in

concentration of redox-sensitive constituents due to microbial activity. Bicarbonate alkalinity commonly may be elevated because of the CO_2 produced by microbial respiration, but typically decreases rapidly with distance away from the microbial population producing it.

Treated wastewater presence in Maui has previously been confirmed by multiple "inherent" wastewater tracers, the most conclusive being stable isotopes of nitrate ($\delta^{15}N$ and $\delta^{18}O$), organic waste indicator compounds, and in some cases pharmaceuticals (Hunt and Rosa, 2009). Effluent data from two Maui wastewater treatment plants (Kahului and Kihei) both indicate that nitrate is the predominant nitrogen species (ranging from 77 to 96% of the total nitrogen; Hunt & Rosa, 2009 and Brown and Caldwell, 2018). Nitrate comprises approximately 50% of the Lahaina WWTP effluent total nitrogen (Hunt & Rosa, 2009). Nitrogen and oxygen isotopic composition of dissolved nitrate have been used extensively to identify sources and transformations of nitrate in groundwater and marine systems (Böhlke, 2003; Hastings et al., 2013; Hunt and Rosa, 2009; Kaushal et al., 2011; McMahon and Böhlke, 2006; Singleton et al., 2005; Tobias et al., 2017). The pharmaceuticals carbamazepine and sulfamethoxazole were detected in very low part-per-billion concentrations at both Lahaina and Kihei and appear to be consistently associated with the waste-treatment process on Maui.

The studies summarized below employed a variety of analytical techniques and data analysis methods to trace the evolution of treated wastewater effluent in the groundwater aquifers of Maui. These same methods can be used to trace the impact of treated wastewater effluent applied at the Site.

4.1.1 Wailuku-Kahului Wastewater Reclamation Facility (W-K WWRF)

Prior studies have assessed the impact of treated effluent injection into groundwater from the Wailuku-Kahului Wastewater Reclamation Facility (W-K WWRF) (Bishop et al, 2017) by studying the nitrogen ($\delta^{15}N$) and oxygen ($\delta^{18}O$) isotopic composition of nitrate along the groundwater flow paths. The $\delta^{15}N$ and $\delta^{18}O$ values of dissolved nitrate suggest wastewater effluent is discharging to groundwater and coastal waters at Kahului. The sample of treated effluent collected from W-K WWRF was consistent with values expected for treated sewage and was comparable to effluent values measured at other municipal wastewater treatment facilities on Maui (Hunt, 2007; Hunt and Rosa, 2009; Glenn et al., 2012). The wastewater treatment process used at W-K WWRF includes simultaneous nitrification-denitrification to attenuate N-species concentrations (County of Maui, 1990). This treatment ends after the denitrification phase, which leaves residual nitrate with $\delta^{15}N$ and $\delta^{18}O$ values that reflect the denitrification process. The samples from Kahului coastal groundwater and coastal surface waters had $\delta^{15}N$ values consistent with nitrate that has been partially denitrified. In addition, many of the samples plotted along a theoretical denitrification trend, suggesting that the nitrate in those samples has undergone partial denitrification, a phenomenon not observed in samples from other field areas. Samples with $\delta^{15}N$ values heavier than the effluent sample contain nitrate that is derived from the wastewater injection facility but has continued to denitrify as it flowed through the aquifer after injection. Nitrate concentrations were low relative to other samples from Kahului, further indicating that denitrification was occurring in groundwater. Three end-member mixing triangle analysis

suggested mixing of effluent with low $\delta^{15}N$ background groundwater. The authors concluded that processes that may drive $\delta^{15}N$ and $\delta^{18}O$ towards high values (reflective of denitrification) are uncommon on Maui except in the presence of wastewater effluent. It should be noted that the W-K WWRF effluent injection wells are located ~150 ft from the coastline, in contrast to ~2.5 miles from the proposed Central Maui WWRF SAT basins to the coast.

4.1.2 Kihei Wastewater Reclamation Facility (KWRF)

A study of nearshore wading surveys performed at the Kihei Wastewater Reclamation Facility (KWRF) indicated that there was evidence of denitrification of nitrate occurring within the effluent plumes, but that the plumes constituted large nutrient fluxes to the nearshore environment (Hunt and Rosa, 2009), given their proximity to the shoreline. The KWRF effluent injection wells are located approximately 0.6 miles from the shoreline (vs. ~2.5 miles for the proposed Central Maui WWTP SAT basins).

The authors assessed $\delta^{15}N$ data from algae and water samples to reach their conclusions. Wastewater presence was also confirmed by the detection of the pharmaceutical compounds, carbamazepine and sulfamethoxazole, albeit in very low concentrations (less than 0.15 micrograms per liter [µg/L]). The authors also noted that groundwater beneath fertilized fields in the study area is similarly high in nitrogen (as the effluent is) and that groundwater nitrogen concentrations beneath undeveloped forests are two to three orders of magnitude higher than in low-nutrient seawater.

4.1.3 Lahaina Wastewater Reclamation Facility (LWWRF)

In another wastewater effluent injection study on Maui, at the Lahaina Wastewater Treatment Plant (LWWRF), the authors concluded that denitrification was the primary mechanism of nitrogen loss within the groundwater plume (Fackrell et al, 2016). They based their conclusions on groundwater concentration data, as well stable isotope data ($\delta^{15}N$ of nitrate and $\delta^{13}C$ of dissolved organic carbon). Pharmaceuticals and other waste indicator compounds were not assessed in this study, but were assessed in another study (Hunt & Rosa, 2009) with low level detections of sulfamethoxazole and carbamazepine. A secondary, but important finding was that chlorination for pathogen disinfection suppressed microbial activity responsible for nitrogen loss in the aquifer, resulting in increased coastal ocean nitrogen loading. Chlorination is not proposed for the Central Maui WWRF. It should be noted that the LWWRF effluent injection wells are located approximately 0.6 miles from the coastline (vs. ~2.5 miles for the proposed Central Maui WWRF SAT basins).

4.2 Baseline Groundwater Quality in the Central Maui and Upcountry Area

The following presents an overview of groundwater quality data in the central Maui isthmus area and from other relevant published studies.

4.2.1 Supply Well Testing Data in the Isthmus Area

Water quality testing data were provided by the Consolidated-Waiko Water Association for Consolidated Baseyard Wells 1 and 2 (Table 7). These wells are located approximately 1 to 2 miles north of the proposed WWRF (Consolidated-Waiko Water Association, Inc., 2024). The table below lists the water quality data for water samples collected from the wells. In the Stormwater Pollution Prevention Plan (SWPPP) assessment memorandum (State of Hawaii, 2020), nitrate levels, referred to as "current nitrate" concentrations, were reported for the following wells:

- Consolidated Baseyard Well 1 – 3.3 mgN/L
- Consolidated Baseyard Well 2 – 3.3 mgN/L
- Waiale Wells 1 and 2 – 2.0 mgN/L
- Maui Lani Wells 5, 6 and 7 – 2.8 mgN/L

4.2.2 Groundwater and Leachate Monitoring Plan, Central Maui Landfill (CH2M, 2019)

The Central Maui Landfill (CMLF) is located on the eastern side of the isthmus between West Maui and Haleakala, approximately three miles from the Pacific Ocean coastline at Kahului. Analysis of the upgradient monitoring wells (MW-1 and MW-6) at the CMLF offers insight into the background groundwater quality conditions (i.e., the quality of groundwater resulting from migration from upgradient areas coupled with surface water recharge, if any).

Historical groundwater sampling at MW-1 has resulted in sporadic detections of the trace metals vanadium and zinc, as well as frequent detections of nitrate (99% of samples contained detectable nitrate, with a mean concentration of 18.9 mgN/L). Total organic carbon (TOC) was detectable in 76% of samples at a mean concentration of 8.1 mg/L.

Historical groundwater sampling results at MW-6 are like that of MW-1, with detections of zinc (62% of samples with a mean concentration of 0.018 mg/L), nitrate (98% of samples contained detectable nitrate, with a mean concentration of 4.86 mgN/L), and TOC (77% of samples at a mean concentration of 7.1 mgN/L).

Therefore, it is reasonable to expect that receiving groundwater in the vicinity of the proposed SAT basins will likely exhibit a similar geochemical profile as CMLF wells MW-1 and MW-6, although local hydrological features (stream recharge, etc.) may result in differences.

4.2.3 Upcountry Groundwater Investigation

The State of Hawaii Department of Health (2018a) published the *Upcountry Maui Groundwater Nitrate Investigation Report, Maui, Hawaii*. While the study focuses on the Maui Upcountry Area east of the Site and the Central Maui isthmus area, the report provides useful data and findings. The study compared water quality testing results from wells with historical land use, ranging from natural areas, former sugar cane agriculture, former pineapple agriculture, to OSDSs (i.e., septic systems/cesspool locations), golf courses, and confined animal feed lots. The wells were tested for a broad suite of analytes, including nutrients, nitrogen and oxygen isotopes, and pharmaceutical compounds. Portions of the study area are upgradient of the isthmus area and Site. The study found

no drinking water source appears to be at risk of exceeding the nitrate maximum contaminant level (MCL) of 10 mgN/L. However, several current wells are producing drinking water that has been degraded by OSDSs or other nitrate sources. The study concludes that leachate from the OSDS in Upcountry Maui, in combination with agricultural and natural nitrate sources, are adversely impacting the aquifer. The nitrate concentrations in groundwater in 2017 ranged from 0.3 to 5.8 mgN/L.

In February 2018, the State of Hawaii Department of Health presented its findings to the Upper Kula Community Association in a PowerPoint presentation (State of Hawaii, 2018b). On Slide 17 of the presentation, a map illustrates the distribution of nitrate concentrations in wells and OSDS locations for the State of Hawaii, including the isthmus area (see Figure 5). The map shows two wells in the isthmus area north of the Site with nitrate concentrations ranging from 2.1 to 3.0 mgN/L. It also shows a dense collection of OSDSs in the Waikapu Town area directly west and north of the Site. Thus, the combination of prior and current land use (i.e., former sugar cane agriculture and historic and current use of OSDSs) that are known to have degraded water quality for nitrate in other areas of Maui, with well data north of the Site, suggests that water quality beneath the Site is somewhat degraded, with nitrate in the 2 to 3 mgN/L range. Natural nitrate concentrations in groundwater are reported to be less than 1 mgN/L (Hawaii Department of Health, 2018a). The Upcountry study also detected the pharmaceuticals, sulfamethoxazole and Acesulfame-K, the latter of which the authors attribute to wastewater injection (Hawaii Department of Health, 2018a) and unrelated to livestock.

4.3 Nutrient Outflow at Maalaea Bay Shoreline

Bishop et al. (2017) in *Effect of land use and groundwater flow path on submarine groundwater discharge nutrient flux* also assessed the most likely sources of nutrients to coastal waters at Maalaea Bay, identifying sugar cane fertilizer applications and, to a lesser extent, wastewater injection wells at some of the beachside condominiums. Their data were inconsistent with the presence of wastewater effluent because groundwater and coastal water $\delta^{15}N$ values were low, ammonia (NH_4^+) concentrations were low, and dissolved oxygen concentrations were high. The authors concluded that elevated nitrate concentrations at Maalaea are predominantly from past fertilizers applied to sugar cane, which overlies nearly the entire length of the groundwater flow path from southern central Maui isthmus area.

4.4 Baseline Soil Geochemistry at the Site

Select soil grab samples were collected and submitted for chemical analyses as part of the subsurface investigation (Geosyntec, 2024). The objective of the testing program was to evaluate soil chemical trends that will serve as a baseline for prior to future liquid infiltration from the prospective WWRF. For example, do the soils retain chemical impacts from past sugar cane production?

The three soil borings (G-1, G-2, and G-3) were sampled at three depths each: a shallow depth (between 10 and 23 ft bgs); an intermediate depth (between 38 and 45 ft bgs); and a deep depth (between 52 and 58 ft bgs). The soil chemical results are presented in Table 3. Samples were

analyzed for ammonia, bromide, chloride, fluoride, nitrate, total nitrate-nitrite, dissolved nitrate-nitrite, nitrite-N, orthophosphate (as P), sulfate, total inorganic carbon (TIC), TOC, and total phosphorus (as P).

No samples had detections of nitrate, total nitrate-nitrite, or nitrite at the reported laboratory detection limits. Ammonia was detected in samples G-1 and G-2. G-3 samples did not contain any ammonia detections at the laboratory detection limit. TIC and TOC were detected in samples from these three locations. There does not seem to be a clear depth trend in nitrogen or carbon concentrations across the three samples.

Regarding data quality, TOC was detected in the lab blank for all G-3 samples, but that was the only unusual qualifier. It is also noted that many values are in bold, indicating that the result is above the lab reporting limit, but many of these bold values are also J-flagged, meaning the result is an estimated value, below the lab reporting limit but above the method reporting limit (MDL).

4.5 Rationale for Use of Dissolved Nitrate as a Surrogate for Recycled Water Transport in the Subsurface

The fate of total nitrogen species, such as ammonia, nitrite and nitrate compounds in soil pore liquids and groundwater can be explained by a complex series of interconnected cycles and pathways that may occur independently, at the same time, or not at all, depending on site-specific environmental conditions. Currently, there are no site-specific data available to definitively identify the likely flow of nitrogen species through these cycles and pathways. Nonetheless, it is our professional opinion that, given the presently available information, denitrification (reduction of nitrate) is likely to be the dominant nitrogen attenuating process observed in the vadose zone during SAT basin operation. This assessment is based on our current understanding of the likely influent chemistry that may contain up to 8 mgN/L of total nitrogen, assumed to be predominantly nitrate (based on personal communication and assessment of Kahului and Kihei effluent profiles, see Section 4.1), as well as up to 6 mg/L of dissolved organic carbon (Brown and Caldwell, 2024). Nitrate is a component of total nitrogen analysis (in conjunction with nitrite, ammonia, and organic nitrogen). To simplify the modeling process and provide a conservative, high-end source term, we assumed that the total nitrogen in the Central Maui WWRF effluent is present as nitrate only.

The use of the dissolved nitrate compound to serve as a surrogate for recycled water transport in the subsurface is based on the following criteria:

- It is the major component of treated wastewater;
- Its transport is not readily retarded due to adsorption in the subsurface, and its concentration is affected predominantly by denitrification;
- It has been the focus of much research in other areas of Maui (for comparative purposes); and
- It is possible to use stable isotopic data to track its evolution in the subsurface after infiltration at the Site.

4.6 Fate and Transport of Nitrate

Based on data from other WWRFs on Maui (Lahaina and Kihei) and anticipated effluent chemistry data provided by Brown & Caldwell, the primary constituent of concern in treated wastewater effluent from the proposed Central Maui WWRF is expected to be nitrate. Denitrification is a microbially facilitated process involving the stepwise reduction of nitrate to nitrite (NO_2^-), nitric oxide (NO), nitrous oxide (N_2O), and finally to dinitrogen gas (N_2). Denitrification occurs under anaerobic (lack of oxygen) or microaerophilic (minimal oxygen) conditions, whereby reducing equivalents derived from oxidation of the energy source for growth (often organic carbon) are diverted from the reduction of oxygen. This process is a common metabolic strategy implemented by a wide range of naturally occurring microorganisms in a wide variety of environments.

Given that the Central Maui WWRF is proposed and not operating, there are currently no WWRF effluent geochemistry data available for the central Maui isthmus from which to estimate *in situ* denitrification rates. Therefore, a literature search was performed to estimate potential rates in both the vadose zone and the underlying groundwater. Reported rates of denitrification in natural environments vary widely with streams, rivers, and constructed wetlands generally exhibiting the highest degradation rates (up to 100 per day [d^{-1}]) and groundwater aquifer and lakes systems exhibiting the slowest rates ($3x10^{-7}$ d^{-1}) [See Table 8 for list of references]. As can be seen in Figure 16, there is considerable overlap of denitrification rates across these environments.

Denitrification has been documented to occur in SAT system vadose zones such as the one proposed for Central Maui (see Mienis & Arye, 2018). The SAT described in Mienis & Arye serves as a good proxy for the Central Maui WWRF vadose zone given similar influent nitrate concentrations (ranging from 10 to 30 mgN/L), and similar overall vadose zone thickness (~200 ft). It should be noted that dissolved organic carbon data are not reported in the paper. Nonetheless, one can calculate a conservative first-order denitrification rate for their SAT, using the following equation:

$$C_t = C_0 e^{-kt}$$

where C_t is the concentration of nitrate (mgN/L) or total nitrogen load (ton) after time t, C_0 is the starting concentration of nitrate (mgN/L) or total nitrogen load (ton), k is the denitrification rate constant, and t is time (days). The authors reported an 18-month (~540 days) travel time to the deeper monitoring well based on chloride transport modeling, with a 49% reduction in total nitrate occurring over this timeframe (see "Period 5,6" in Table 2 of Mienis & Ayres). Rearranging the first order equation to solve for k and substituting the observed variables listed above yields a denitrification rate constant of $1.3x10^{-3}$ d^{-1}. This rate is conservative, as the authors showed that 47% of the denitrification occurred in just 90 days and that only a subsequent 2% of reduction occurred over the remaining 450-day travel time. This calculated rate is approximately four orders of magnitude slower than the fastest reported denitrification rates for streams and rivers and approximately four orders of magnitude faster than the slower rates reported for groundwater aquifer systems (see Figure 16).

To check whether the denitrification rate calculated above is appropriate for use in the Central Maui SAT analysis, we performed the same first-order rate calculations for the Lahaina WWRF (using data from Table 7 and a travel time of 427 days; Fackrell, 2016). The calculated denitrification rate constant for Lahaina groundwater is $6.3x10^{-3}$ d^{-1}, which is approximately 5 times faster than the rate calculated from Mienis & Arye. We also calculated a rate constant for Kihei data (Hunt et al, 2007). Using the injection and downgradient well total dissolved nitrogen data (from Table 5 in Hunt et al 2007), along with water levels, k_h, and porosity (from Table 7 in Hunt et al. 2007), we calculated a denitrification rate constant in groundwater of 0.0099 d^{-1}, which is approximately 8 times faster than the rate calculated from Mienis & Arye. Therefore, as shown in the calculations below, we proposed to use a vadose zone denitrification rate constant of $1.3x10^{-3}$ d^{-1}, which is likely conservative based on observed denitrification rates for injected wastewater effluent in the Maui and SAT systems. In the future, the actual denitrification rate for the Central Maui WWRF SAT application will be measured using data from lysimeters (shallow vadose zone), monitoring wells (groundwater), and water supply wells (groundwater).

The geometric mean denitrification rate constant for groundwater in the literature ($3.1x10^{-5}$ d^{-1}) was selected to be used in our groundwater fate and transport analysis.

An additional check was performed by comparing the proposed total nitrogen load estimates to the vadose zone for Hydrogeologic Model Scenarios 1 and 2 with large datasets of denitrification rates for various climate regions, compiled by Li et al. (2022). The authors in this paper calculated an average rate of denitrification for global tropical climates (such as Maui) of 2.9 mgN/kg soil/day based on analysis of data from 85 peer-reviewed scientific papers and reports (Li, 2022).

For Hydrogeologic Model Scenario 1, the calculated daily nitrate loading is $7.0x10^7$ mgN/day (assuming all nitrogen is present as nitrate). If we calculate the soil volume of the upper 1 ft of the proposed WWRF vadose zone, assuming an average soil density of 79 pounds per cubic foot (lb/ft^3) and area of 7.5 acres, we estimate $1.2x10^7$ kg soil to be present. Assuming the average denitrification rates for tropical climates from Li (2022) above, the calculated daily nitrate removal capacity is $3.4x10^7$ mgN/day. This calculated nitrate removal capacity is approximately half of the estimated Hydrogeologic Model Scenario 1 loading rate.

If we increase the calculated thickness to 3 ft to account for the presence of dissolved organic carbon in the WWRF effluent and biomass addition in the base of the WWRF basins, the calculated daily nitrate removal capacity is $1.0x10^8$ mgN/day, which is 1.5 times greater than the estimated Hydrogeologic Model Scenario 1 loading rate.

Therefore, based on global surveys of denitrification rates in tropical climates, the likely denitrification potential of the upper 1 to 3 ft of the proposed WWRF vadose zone is likely sufficient to reduce at least half, but potentially all, of the applied nitrate.

Denitrification Rate Calculations:

Exponential form of the first order degradation equation: $C_t = C_0 e^{-kt}$

Linear form of the first order degradation equation solving for the rate constant:

$$k = (\ln C_t - \ln C_0) / -t$$

1. *Soil Aquifer Treatment from Mienis & Arye (2018) for Period 5,6 (Table 2):*

C_t = 1,615 tons

C_0 = 3192 tons

t = 540 days

Calculated k = 1.3×10^{-3} d^{-1}

Note: this calculation assumes that all nitrogen species are converted to nitrate, for the sake of direct comparison. The actual denitrification rate may be even higher. Nonetheless, this value was used as the conservative denitrification rate for the vadose zone.

2. *Lahaina Groundwater from Fackrell et al (2016) and Glenn et al (2013)*

For the purposes of these calculations, it was assumed that non-degradative processes such as dilution, advection, and sorption of nitrate are negligible, and that all measured nitrate loss in the system was due to denitrification coupled to oxidation of dissolved organic carbon present in the effluent (primary) or trace amounts of natural organic carbon in the aquifer matrix. We applied the mean nitrate numbers from Table 7 in Fackrell (2016), and the 14-month travel time determined by Glenn (2013).

C_t = 17 µM

C_0 = 255 µM

t = 427 days (average 30.5 days x 14 months)

Calculated k = 6.3×10^{-3} d^{-1}

3. *Kihei Groundwater from Hunt et al (2007)*

For the purposes of these calculations, it was assumed that non-degradative processes such as dilution, advection, and sorption of nitrate are negligible and that all measured nitrate loss in the system was due to denitrification coupled to oxidation of dissolved organic carbon present in the effluent (primary) or trace amounts of natural organic carbon in the aquifer matrix. We applied the nitrate data from Table 5 and hydraulic parameters from Table 8 in Hunt (2007).

C_t = 3.49 mgN/L

C_0 = 7.33 mgN/L

t = 75 days

Calculated k = 9.9×10^{-3} d^{-1}

The calculated average denitrification rate for the two Maui groundwater studies is 8×10^{-3} d^{-1}, and this value was used as the enhanced or rapid denitrification rate for the vadose zone, as it best reflects likely *in situ* conditions.

4.7 Enhanced and/or Optimal Denitrification in SAT basins and Vadose Zone

The denitrification rates calculated above reflect scenarios where treated effluent containing elevated levels of dissolved organic carbon along with nitrate was either infiltrated (in the case of the SAT basins) or injected (in the case of Lahaina and Kihei). In most environmental systems, denitrification is limited by the amount of organic carbon present.

While the estimated denitrification rates calculated in the section above indicate that denitrification should occur rapidly in the study area, operational enhancements can be considered that may further accelerate the rates of denitrification. An example of a potential enhancement is the addition of biomass, such as wood chips or other organic matter, to the base of the SAT basins without affecting the physical infiltration rates of the system. Wood chips can serve as a long-term carbon source, adding additional organic carbon to the system as the chips slowly degrade through natural microbial processes, maintaining slightly reducing redox conditions in the bottom of the basins. Enhancements such as this can further accelerate the overall rate of denitrification, with only minor operational impact (replenishment and/or annual tilling/rotation).

The denitrification rate constants applied to the groundwater model (3.1×10^{-5} d^{-1} and 1.5×10^{-4} d^{-1}) are one to two orders of magnitude lower than those applied to the vadose zone (1.3×10^{-3} d^{-1} and 8×10^{-3} d^{-1}, respectively). This is because our assumption is that most or all the dissolved organic carbon in the recycled water applied at the SAT basins will be consumed via aerobic and denitrifying processes in the vadose zone. Therefore, we assumed that denitrification rates in the groundwater aquifer are dependent on the low levels of naturally occurring organic carbon in the groundwater aquifer and thus much slower than the vadose zone. This is considered to be conservative.

Vertical monitoring through the vadose zone via lysimeters and lateral monitoring via monitoring wells in groundwater beneath and downgradient of the SAT basins is recommended to be performed to assess the actual denitrification rate conditions once the proposed WWRF is operational.

5. VADOSE ZONE INFILTRATION MODELING

Vadose zone infiltration modeling is designed to evaluate two infiltration scenarios directed by Brown and Caldwell (2024) as follows:

- Scenario 1 – Long-Term Pollutant Transport Focus (Average Precipitation Year Infiltration Estimate); and
- Scenario 2 – Vadose Zone Transport Focus (Wet Precipitation Year Infiltration Estimate).

See Section 1.4 for a further discussion of the infiltration scenarios.

Geosyntec developed a four-layer, 67 m (220 ft) depth, 2-dimensional (2D) vadose zone model ("VZM"), using the specialized HYDRUS© modeling software, license Version 5 (M. Šejna1, J. Šimůnek, and M. Th. van Genuchten, 2022). Two model alternatives were created to evaluate: a) the performance of a single SAT basin in an east-west direction; and b) the simultaneous performance of four SAT basins in a north-south direction. The model architecture is based on the vadose zone conceptual model presented in Figure 14. Figure 17 shows the locations of the HYDRUS model cross-section, and Figure 18 presents the model dimension, boundary conditions, and material properties. To be conservative for excess recycled water migration potential, the VZM simulates infiltration along the combined north-south dimensions of the SAT basins (1,066 ft [325 m]) as the primary model dimension (Scenarios 1 and 2). For the vadose zone focus (Scenario 2), Geosyntec also created a model that evaluated an east-west cross-section at an interior basin (380 ft [116 m]). For Scenario 1, Geosyntec deployed; a) a conservative denitrification rate ($1.3x10^{-3}$ d^{-1}); and b) a more rapid denitrification rate ($8x10^{-3}$ d^{-1}) that is estimated to be more representative of enhanced conditions using added biomass and estimated local Maui denitrification rates from Kihei and Lahaina WWRFs (Hunt, 2007).

Geosyntec concludes that the VZM simulations provide a useful preliminary assessment of excess recycled water infiltration migration projections into the subsurface that meets relevant professional standards. However, the reader should note the VZM is an approximation of a complex and heterogeneous natural subsurface soil system, and thus the VZM input parameters are considered approximations of this complex system, and the output simulations are approximations and preliminary. Further field investigations and infiltration monitoring are recommended in Section 8, Conclusions and Recommendations. This section focuses on presenting the findings of the vadose zone modeling. Appendix B presents a detailed description of model development, assumptions, input parameters, and additional findings.

5.1 Vadose Zone Thickness Uncertainty

The thickness of the vadose zone is anticipated to vary in time and space. For example, if water levels beneath the site change seasonally or over a long-term period, this could change the subsurface vadose zone thickness. Also, at this time, there is uncertainty regarding the site grading plan (i.e., areas of potential cut and fill) plus the thickness of the SAT basins. Thus, Geosyntec used the approach of setting the vertical thickness of the model to 220 ft (67 m), which is what we

believe would be considered a likely upper bound thickness beneath the two northern SAT basins. However, we understand there is the potential for a reduced vadose zone thickness based on a potential future rise in water levels or a more extensive Site grading plan. Thus, in addition to considering the model Scenario 1 nitrate concentration free drainage outputs (at a depth of 220 ft [67 m]), we will also evaluate simulated nitrate concentrations within the model at a depth of approximately 205 ft (63 m) to evaluate concentration variations that may occur due to potential vadose zone thickness changes. We conclude that the potential vadose zone thickness reduction will likely only affect the vadose zone thickness of the high permeability Layer 4 – Qkul /Kula Volcanics.

5.2 Scenario 1 - Long-Term Pollutant Transport Focus

Scenario 1 simulates the anticipated long-term SAT basin excess recycled water infiltration rate scenario, as described in Brown and Caldwell (2024). As described in detail in Section 1.2, Scenario 1 evaluates SAT basin excess recycled water infiltration based on estimated average annual precipitation conditions and consists of 1.15 mgd in January, and 4.0 mgd for 21 individual days in mid-month periods for the months of February through December. The total excess recycled water infiltration is 120 million gallons per year (mgy). The Geosyntec VZM simulates the annual cyclical SAT basin infiltration of excess recycle water over a 10-year simulation period. The VZM outputs of Scenario 1 are used as an input to the groundwater flow and chemical transport model described in Section 6 of this report and Appendix C. The combined VZM and groundwater transport modeling are used to estimate a forecast of SAT basin solute transport in groundwater towards the Pacific Ocean shoreline.

The VZM model output presented in Appendix B includes the following:

- Images of output for relevant time steps to illustrate the progression of key output parameters (i.e., water content distribution, water head pressure, infiltration velocity, and simulated nitrate concentrations);
- Graphs of output results for distributed observation nodes placed in the model; and
- Output of the final time step showing the mass balance summary, including percent error for water content and solute transport.

5.2.1 Conservative Denitrification Rate Simulation ($1.3x10^{-3}$ d^{-1})

Figures 19 and 20 present the simulated projections of nitrate migration in the vadose zone at six separate time steps over the 10-year period. As shown in Figure 20, low concentrations of nitrate are simulated to reach the base of the model (i.e., the interface with groundwater) in approximately 1 year. In the 5- and 10-year periods, the concentration is estimated to be approximately 340 mmole/m^3 (4.6 mgN/L). Figure 21 provides a graph of nitrate concentrations over time for observation nodes placed in the model. As shown in Figure 21, Node 1, which is located at the base of the simulated SAT basins, records nitrate input concentrations of approximately 570 mmole/m^3 (8 mgN/L). Node 5, which is located at the base of the model (i.e., groundwater interface) records steady-state nitrate concentrations of approximately 330 mmole/m^3 (4.6

mgN/L). Thus, due to attenuation properties in the vadose zone subsurface, including denitrification, the nitrate concentration is reduced from approximately 8 to 4.6 mgN/L at the groundwater interface using a conservative denitrification rate of $1.3x10^{-3}$ d^{-1}.

5.2.2 Enhanced and/or Optimal Denitrification Rate Simulation ($8x10^{-3}$ d^{-1})

Figures 22 and 23 present the simulated projections of nitrate migration in the vadose zone at six separate time steps over the 10-year period using enhanced and/or optimal denitrification rates described Section 4. As shown in the figures, nitrate migration is attenuated in the subsurface due to the effect of robust denitrification. Figure 24 provides a graph of nitrate concentrations over time for observation nodes placed in the model. As shown in Figure 24, Node 5, which is located at the base of the model (i.e., groundwater interface), records steady-state nitrate concentrations of approximately 21 mmole/m^3 (0.3 mgN/L). It is noted the nitrate concentration at the base of the SAT basin (Node 1) is shown as approximately 500 mmole/m^3 (approximately 7 mgN/L). The model infiltration input is 571 mmole/m^3 (8 mgN/L); however, the more rapid denitrification rate simulates a lower nitrate concentration in the shallow subsurface. Thus, due to attenuation properties in the vadose zone subsurface, including denitrification, the nitrate concentration is reduced from approximately 8 to 0.3 mgN/L at the groundwater interface using a more rapid, enhanced, and/or optimal denitrification rate of $8x10^{-3}$ d^{-1}.

5.2.3 Evaluation of Vadose Zone Thickness Variation

The thickness of the vadose zone beneath currently and in the future is subject to some uncertainty and variability as follows:

- The vadose zone thickness may vary due to seasonal and long-term groundwater level fluctuations.
- The current depth to groundwater estimate is projected from available data resources that are spatially and temporarily variable.
- The final elevation of the constructed SAT basin bottoms will be known following site grading and may include cut and fill operations.

Thus, Geosyntec developed a vadose zone model with a thickness of 220 ft (67 m), which was selected as a potential upper bound vadose thickness for the site. The current surface elevation for the western perimeter for the two northerly basins ranges between 222 and 224 ft msl. We then evaluated nitrate concentration variations at the base of the model versus a shallower depth (205 ft [or 62.5 m]) to consider the effect of a potential thinner vadose zone scenario. Using the nitrate concentration output from Scenario 1 for the conservative denitrification rate of $1.3x10^{-3}$ d^{-1}, at the end of the 10-year simulation period, the nitrate concentration varies from 333 to 338.5 mmole/m^3 (4.67 to 4.74 mgN/L) or an approximate ~1.5% variation over the 15-ft (4.5-m) interval (see Figure 25). Using the nitrate concentration output from Scenario 1 with the more robust $8x10^{-3}$ d^{-1} denitrification rate, at the end of the 10-year simulation period, the nitrate concentration varies from 22.8 to 25.1 mmole/m^3 (0.32 to 0.35 mgN/L) or approximately ~9 % variation over the 4.5-m (15-ft) interval Figure 26). The variation in nitrate concentrations is interpreted to be due to

differences in residence time in the vadose zone to promote nitrate denitrification. We do not expect the vadose zone thickness variation to significantly affect the ultimate migration of non-degrading chemicals found in excess recycled water nor for the Scenario 2 simulations that focus on the shallow vadose zone. Also, we used this 15-ft thickness variation as an example, which may or may not be relevant for future SAT basins conditions.

5.3 Scenario 2 - Vadose Zone Focus

Section 1.4 describes the Scenario 2 SAT basin input parameters. This scenario simulates a potential worst-case SAT basin infiltration rate scenario due to a Wet Precipitation year, as described in Brown and Caldwell (2024). The Wet Precipitation Year scenario consists of 3.1 mgd in December, 4.0 mgd in January, 1.0 mgd in February, and 21 individual days of off-spec infiltration in the mid-month period in March through November. The model simulation period is for 1 year and follows the traditional water year cycle from October 1 through September 30.

The objectives include:

- Evaluate SAT basin flow capacity to infiltrate wet year flow rates:
  - Soil saturation – Does the soil at the base of SAT basins remain partially saturated (not saturated) to maintain infiltration void space?
  - Head pressure – Is the soil at the base of SAT basins under negative head pressure to maintain gravity flow? Positive pressure would suggest backup.
- Evaluate extent of lateral flow; and
- Evaluate the potential to impact the Waikapu Stream 2,000 ft to the east.

Geosyntec evaluated two independent model dimensions, including east-west 2D simulation of a single SAT basin (Scenario 2A), and north-south 2D simulation of combined four SAT basins (Scenario 2B).

To evaluate infiltration capacity, Geosyntec tracked soil saturation and hydraulic head pressure at the base of the SAT basins and at approximately 40 ft bgs, where the contact between the overlying JaC unit meets the lower permeability QTao. For the SAT basin to achieve the needed infiltration capacity, it would be necessary to have soils that have water content that is not saturated and head pressures that are negative at the base of the SAT basins. To evaluate lateral liquid migration, we evaluated infiltration flow vectors and nitrate concentration dimensions.

5.3.1 Scenario 2A – East-West Simulation of a Single Basin

In this simulation, we simulated approximately 1/4 of the total infiltration quantities in the east-west dimension of a single SAT basin.

Simulated Water Content Behavior

Water content behavior is shown in Figures 27 and 28. Figure 27 presents the water content distribution at 123 days (i.e., the end of the 31 days of 4.0 mgd in January) and at the end of 1 year. During both periods, the soils beneath the base of the SAT ponds remain partially saturated. Figure 28 presents a graph of water content over time for the soils at the base of the SAT basins (Nodes 1 and 2). The graph shows that water content remains well below the soil saturation level of 0.430. Thus, the shallow JaC soil retains infiltration capacity during the simulation period.

Simulated Head Pressure Behavior

Head pressure behavior is shown in Figures 29 and 30. Figure 29 presents the head pressure distribution at 123 days (i.e., the end of the 31 days of 4.0 mgd in January) and at the end of 1 year. During both periods, the soils beneath the base of the SAT ponds remain under negative head pressures beneath the SAT basins. Figure 30 presents a graph of head pressure over time for the soils at the base of the SAT basins. The graph shows that head pressure remains negative during the simulation period. Thus, the simulations indicate that positive head pressure that would impede infiltration does not occur at the base of the SAT basins.

Simulated Infiltration Flow Vectors

Flow vectors of infiltration advective flow are shown in Figure 31. Flow vectors indicate primarily vertical flow, with some lateral flow along the SAT basin perimeter. The lateral migration distance is approximately ~100 ft (~30 m) at each perimeter.

Simulated Solute (Dissolved Nitrate Concentration) Migration

Figure 31 presents a cross-section of simulated nitrate concentrations at the end of the 1-year period. January (period of 4-mgd infiltration) and the end of October (end of 1-year period). Overall, the advective nitrate migration distribution is similar to the flow vectors, with the lateral migration distance being approximately ~100 ft (~30 m) at each perimeter. We conclude that lateral flow, even under elevated Wet Year infiltration conditions, will not migrate to Waikapu stream, approximately 2,000 ft distant.

The modeling did suggest that there is some potential for very shallow nitrate chemical diffusion to shallow soils. Figure 32 provides a zoom-in for nitrate migration at the end of the 1-year period. As shown, there is a thin sliver of nitrate concentration migration simulated at the shallow surface. We conclude that this is an indication of chemical diffusion and not infiltration advective liquids flow. Chemical diffusion occurs as molecules migrate along concentration gradients as found at the site, with the SAT basins liquids with nitrate at 8 mgN/L and adjacent soils with 0 mgN/L of nitrate. The results suggest that a vertical, perimeter slurry wall may be useful to mitigate the potential chemical diffusion issue.

5.3.2 Scenario 2B – North-West Simulation of Four SAT Basins

Figure 17 presents the location of the Scenario 2B simulations. In this simulation, we simulate the total average infiltration rate evenly distributed along the four SAT basins. To understand behavior

differences along the four SAT basins, we inserted observation nodes beneath each simulated SAT basin (Figure 33).

Simulated Water Content Behavior

Water content behavior is shown in Figures 34, 35, and 36. Figure 34 presents the water content distribution at 123 days (i.e., the end of the 31 days of 4.0 mgd in January). The simulation suggest that saturated conditions may occur in the interior basins, but the north and south basins retain partially saturated conditions to support infiltration. Figure 34 shows that the system recovers rapidly, as uniform, partially saturated conditions exist at the end of February. Figure 36 presents a graph of water content over time for the soils at the base of the SAT basins (nodes 1, 2, 3, and 4). The graph shows that water content remains well below the soil saturation level of 0.430 for the majority of the simulation period. However, it also presents the temporary period when saturated conditions exist beneath the interior basins (Nodes 2 and 3).

Simulated Head Pressure Behavior

Head pressure in the subsurface is shown in Figures 37 and 38. In general, a negative head pressure at the base of the SAT basins would suggest infiltration conditions exist. Figure 37 presents the head pressure distribution at 123 days (i.e., the end of the 31 days of 4.0 mgd in January) and 1 year. The simulations suggest that negative head pressures exist at the SAT basins during these time periods. Figure 38 presents a graph of head pressure over time for the soils at the base of the SAT basins (Nodes 1, 2, 3, and 4). The graph shows that head pressure remains negative for the majority of the simulation period. However, it also presents the temporary period when saturated conditions exist beneath the interior basins (Nodes 2 and 3).

Simulated Infiltration Flow Vectors

Flow vectors of infiltration advective flow are shown in Figure 39. The flow vectors indicate primarily vertical flow, with some lateral flow along the SAT basin perimeter. The lateral migration distance is approximately ~130 ft (~40 m) at the north and south perimeter.

Simulated Solute (Dissolved Nitrate Concentration) Migration

Figure 39 presents the simulated results of nitrate migration at the end of September (end of the 1year period). Overall, the advective nitrate migration distribution is similar to the flow vectors, with the lateral migration distance being approximately ~130 ft (~40 m) at each perimeter.

5.4 Summary of Vadose Zone Modeling Findings

Geosyntec has performed preliminary infiltration modeling for the WWRF using the HYDRUS© software. The following are the initial conclusions:

Scenario 1 – Average Year Infiltration

- Geosyntec simulated the infiltration scenario for the combined four SAT basins over a 10-year period.

- The simulations indicate rapid infiltration rates in the upper 40 ft of Qdo / JaC soils (Layers 1 and 2) and moderate infiltration rates in QTao material in Layer 3.
- During the simulation period, the head pressures remained negative, and the water content remained partially saturated in the subsurface, suggesting the four SAT basins can achieve the required infiltration flows.
- Advective flow in the subsurface was predominantly vertical, with lateral migration estimated to be limited to between 65 to 130 ft (20 to 40 m). A very thin layer of solute concentration migration was projected at land surface due to what we believe is chemical diffusion. Thus, a perimeter vertical slurry wall may be warranted to mitigate this potential issue.
- To evaluate recycled water chemical migration, Geosyntec used nitrate at 8 mgN/L as a chemical proxy for excess recycled water. The simulated nitrate solute transport results are sensitive to applied denitrification rates. Using a conservative denitrification rate of $1.3x10^{-3}$ d^{-1} (see Section 4.10), the nitrate concentration drops from 8 mgN/L input at the SAT basin bottom to an average of approximately 4.6 mgN/L at the interface with groundwater, a reduction of approximately 42%. Using a more rapid denitrification rate of $8x10^{-3}$ d^{-1}, based on the evaluation of data from the Kihei and Lahaina WWRFs and the consideration of enhanced conditions through the addition of organic carbon via biomass in the SAT basins, the nitrate concentration drops from 8 mgN/L input at the SAT basin bottom to an average of approximately 0.3 mgN/L at the interface with groundwater, a reduction of approximately 96%. The projected concentration reductions are due predominantly to denitrification. Geosyntec concludes that deploying methods to enhance denitrification rates, such as adding sources of organic carbon such as biomass, can have a significant beneficial effect of lowering nitrate concentrations and mass in the subsurface.
- Geosyntec has applied what we consider to be a defensible range of solute denitrification rates for vadose zone infiltration transport. It should be noted that the vadose zone nitrate removal rates are directly related to both the denitrification rate and the residence time in the vadose zone. Thus, actual overall nitrate solute degradation can also be increased by a managed program to lower average infiltration velocities.
- Geosyntec applied the liquid and solute flux outputs, using the two denitrification rates, as inputs into the groundwater fate and transport model.

<u>Scenario 2 – Wet Year Precipitation</u>

- The Scenario 2 simulations, using water content and pressure head results, suggest that the SAT basins, as currently planned, have the capacity to infiltrate the Wet Year Precipitation quantities. Overall, the soils beneath the SAT basins remain partially saturated and exhibit negative head pressures to accommodate infiltration flow during the simulation period. It was noted that at the end of the input period of 31 days at 4.0 mgd (end of January), the two interior basins exhibited a temporary period (approximately

6 days) of saturated soils and positive head pressures at the base of these two basins. This would suggest that infiltration in these basins could be impeded for this short period. However, it is important to note that the north and south basins retained capacity during this temporary period. Thus, there may be a temporary need to allocate reduced infiltration rates in the interior basins and increase the rates in the north and south basins for an extended period of 4.0-mgd infiltration.

- Overall, the lateral spread of infiltration liquids and solute is estimated to be approximately 130 ft (40 m) from the SAT basin perimeters. Given that the closest distance to Waikapu stream is approximately 2,000 ft distant, modeling suggests that there will be no infiltration flow migration to the stream. As with Scenario 1, we did note that there is the potential for chemical diffusion that could migrate laterally into near surface soils. A perimeter, vertical slurry wall or similar function improvement is planned to mitigate this issue.

6. GROUNDWATER FLOW AND TRANSPORT MODELING

6.1 Objective

A groundwater flow and transport model has been developed to simulate groundwater flow in the Site vicinity and evaluate the nature and fate of excess recycled water following migration through the vadose zone as it mixes with groundwater and migrates within groundwater over time. The simulations will assist with evaluation of the nature of the discharge as compared with State of Hawaii shoreline discharge criteria.

6.2 Approach

The groundwater fate and transport model development and methodology are described in detail in Appendix C and summarized in this section. The groundwater flow and fate and transport model used for the simulations was developed based on a published USGS model. The USGS model was developed to characterize the long-term effects of seven different withdrawals and recharge scenarios for the Waiheʻe, ʻĪao, and Waikapū aquifer systems and evaluate future groundwater availability in Central Maui using a range of future scenarios (Rotzoll, et. al., 2022). One of those scenarios, the baseline scenario, represents current withdrawals and recharge conditions and is used as the starting point for simulating the influence of the proposed SAT basin on groundwater flow and quality. To facilitate the model simulation, the USGS model was converted to the MODFLOW-NWT model (Niswonger et al., 2011). The USGS SUTRA model is converted to a steady-state MODFLOW-NWT (Niswonger et al., 2011) model to facilitate simulations and perform fate and transport nitrate simulations using MT3D-USGS (Bedekar et al., 2016). This approach is consistent with preliminary modeling evaluation performed by Mr. Whittier in 2020 where the 2008 SUTRA USGS model (Gingerich, 2008) was converted to MODFLOW to perform groundwater flow and nitrate fate and transport simulations (Whittier, 2008).

The modeling approach combines the following:

- Developing a Site-specific groundwater flow model adapted from the recent Maui groundwater modeling developed by the USGS (Rotzoll, et. al., 2022);
- Applying an excess recycled water source term into the model, based on the vadose zone, Scenario 1 simulation output (described in Section 7);
- Simulating the future nature and fate of dissolved nitrate in groundwater as it migrates into the subsurface over time; and
- Simulating the future nature and fate of a non-degrading generic analyte (potentially included in recycled infiltration) dissolved in groundwater as it migrates into the subsurface over time.

6.3 Model Conversion

The conversion of the USGS SUTRA model to MODFLOW is described in Appendix C and is summarized as follow:

- A uniform, 500- by 500-foot grid is used in the MODFLOW model, instead of the heterogeneous mesh used in the USGS SUTRA model.
- The horizontal extent of the MODFLOW model is the same as the USGS SUTRA model.
- The MODFLOW model represents the top 1,000 ft using 11 layers, as follows: Layers 1 through 5 representing the top 100 ft, Layers 6 through 10 representing between 100 and 00 ft below mean sea level (ft bmsl), and Layer 11 representing between 500 and 1,000 ft bmsl. The model domain is presented in Figure 40.
- Due to the changing of grid, the hydraulic conductivity and boundary conditions (specified heads and recharge) used in the USGS model were interpolated with different approaches and applied to the MODFLOW model. In the vicinity of the SAT basin and between the SAT basin and the shoreline, the horizontal hydraulic conductivity is 10,000 ft/day, and the vertical anisotropy (K_h/K_v) is 100.
- Production wells were defined as well boundary conditions with locations, screen intervals, and pumping rates consistent with the USGS SUTRA model.

The comparison between the USGS SUTRA model and the converted MODFLOW model is described in Appendix C and demonstrates that the MODFLOW model has the capability to appropriately simulate shallow local groundwater conditions. For example, a comparison of simulated water levels between the MODFLOW and SUTRA models in presented in Figure 41.

6.4 Model Setup

The results from the VZM were incorporated into MODFLOW and the MT3D-USGS flow and fate and transport model to simulate the influence of the proposed SAT basin. The average infiltration at the water table beneath the SAT basin is simulated over six model cells (approximately 34 acres) with a steady-state rate of 0.032 ft/day (Figure 42). As described in Section 5, the groundwater transport modeling simulated two vadose zone concentration source terms based on two nitrate denitrification rates applied to the vadose zone as follows:

- Conservative vadose zone dentification rate – Based on a conservative rate of $1.3x10^{-3}$ d^{-1}, which is based on a review and evaluation of a broad range of denitrification data, an average steady-state nitrate input concentration into the groundwater model of 4.6 mgN/L is applied into the groundwater model; and
- An enhanced and/or optimal dentification rate – Based on an enhanced rate of $8x10^{-3}$ d^{-1}, which is based on a review and evaluation of data from the Kihei and Lahaina WWRFs and the consideration for adding organic carbon in the form of biomass into the SAT basins, an average steady-state nitrate input concentration of 0.3 mgN/L is applied into the groundwater model.

Figure 42 provides graphs that show the input fluxes into the groundwater model under: a) conservative vadose zone denitrification assumptions; and b) enhanced or optimal vadose zone denitrification assumptions,

Also, the influence of denitrification in groundwater on the simulated nitrate concentrations was evaluated using three scenarios: 1) denitrification of 3.1×10^{-5} 1/day; 2) denitrification of 1.5×10^{-4} 1/day; and 3) no denitrification.

6.5 Model Results

6.5.1 Groundwater Flow

- The infiltration from the SAT basin has negligible impacts on the local groundwater level (Figure C-5 in Appendix C).
- In the horizontal direction, the infiltrated water flows southwards and towards the ocean at Maalaea Bay and near the Kealia Ponds area (see Figure 43). In the vertical direction, the water infiltrates to approximately 120 ft bmsl locally. This southerly flow direction toward Maalaea Bay is very similar to the flow direction estimated by the State of Hawaii Source Water Assessment Program (SWAP) simulations (State of Hawaii Department of Health, 2020 and 2021).

6.5.2 Chemical Transport

Conservative Vadose Zone Denitrification Rate Source Term

- Figure 44 presents simulations of nitrate migration using conservative (i.e., slow) rates for denitrification in both the vadose zone and groundwater. Using these assumptions, nitrate concentrations above 0.1 mgN/L (100 µgN/L) are projected to reach the shoreline in less than 10 years. Steady-state nitrate concentrations of approximately 0.29 and 0.19 mgN/L (290 and 190 µgN/L) are simulated at the shoreline for the low and high denitrification rate in groundwater, respectively (Figure 47). Without denitrification in groundwater, the corresponding concentration is 0.33 mgN/L (330 µgN/L).
- Nitrate concentrations are anticipated to reach steady state at the shoreline after approximately 25 to 30 years.
- For the three groundwater denitrification scenarios, the concentration at the shoreline is slightly higher than the state total nitrogen shoreline regulatory standard (150 µgN/L, Table 9) and much lower than the drinking water standard (10 mgN/L).
- Without degradation, the simulated concentration at the shoreline is approximately 7.5% of the concentration of infiltrating water at the water table.

Enhanced and/or Optimal Vadose Zone Denitrification Rate Source Term

- Figures 45 and 46 presents nitrate migration simulations considering enhanced and/or optimal nitrate denitrification rate in the vadose zone of $8x10^{-3}$ d^{-1}. The enhanced denitrification rate considers the effect of adding organic carbon (i.e., biomass) in the SAT basins to stimulate denitrification rates. Coupling the enhanced and/or optimal nitrate denitrification rate in the vadose zone with low and high denitrification rates in groundwater project that additive nitrate concentrations above baseline of less the 0.02 mgN/L would be discharged at Maalaea Bay and in the vicinity of Kealia Ponds, and well below the State of Hawaii total nitrogen discharge criteria for Class A Marine Water Embayments and inland waters (see Tables 9 and 10).
- The modeling simulations presented in Figures 44 through 47 illustrate the importance of nitrate denitrification in the subsurface, both in the vadose zone and groundwater. It also illustrates that measures to enhance denitrification or increase hydraulic retention time in the vadose zone, such as adding organic carbon via biomass, can have an important role in mitigating nitrate impacts to environmental receptors.

Evaluation of a Generic, Non-Degrading Analyte

Excess recycled water may include chemical compounds other than nitrate that may not degrade in the subsurface. To evaluate that condition, Figure 48 presents a generic analyte migration in groundwater in terms of percent concentration entering groundwater beneath the SAT basins, and Figure 49 presents a graph of the attenuated concentration at the shoreline. For example, if a generic analyte entered groundwater beneath the SAT basins at a concentration of 50 µg/L, through the attenuation processes of dilution and dispersion during the 2.5-mile migration to the shoreline, the concentration at the shoreline is estimated to be approximately 7 percent, or 3.5 µg/L, in this example.

6.6 Comparison to SWAP Nitrate Transport Projections (2020, 2021)

The State of Hawaii SWAP performed multiple initial groundwater flow and chemical transport modeling simulations in *SWAP assessment of the proposed Soil Aquifer Treatment Basins impact on Drinking Water Wells* (Hawaii Department of Health, 2020) and *SWAP re-assessment of the proposed Soil Aquifer Treatment Basins impact on Drinking Water Wells* (Hawaii Department of Health, 2021). The following provides a discussion and comparison of the assumptions, methods, and SWAP model findings with those provided in this study.

In the 2021 memo, *SWAP re-assessment of the proposed Soil Aquifer Treatment Basins impact on Drinking Water Wells* (State of Hawaii, 2021), the model simulation is based on a source at Site No. 4. This example site is southeast of this proposed WWRF. The SWAP simulation found the nitrate transport to the south toward Maalaea Bay. The memo states: *The simulated nitrate plume migrates to south-southwest, well away from any current Public Drinking Water Sources.* While the proposed WWRF is located closer to the groundwater flow divide than example Site No.4, the Geosyntec modeling found a similar nitrate plume transport pathway toward Maalaea Bay and the

vicinity of the Kealia Ponds National Wildlife Refuge (Figures 44, 45, and 46). Also, based on SWAP Figure 4, no current Public Drinking Water Sources are located within the modeled nitrate groundwater plume. The SWAP simulated plume is based on higher nitrate input concentrations (8 mgN/L) as compared to 4.6 and 0.3 mgN/L (conservative and enhanced denitrification rates, respectively) used by Geosyntec based on vadose zone modeling. Furthermore, it is our understanding the SWAP modeling did not include a denitrification degradation term, thus the SWAP-projected discharge concentrations are considerably higher than the Geosyntec discharge projections.

In the 2020 memo, *SWAP assessment of the proposed Soil Aquifer Treatment Basins impact on Drinking Water Wells*, multiple sites and modeling scenarios were evaluated. In our opinion, none of these scenarios are comparable due the different assumptions of location and size of the SAT basins, as well as infiltration rates and influent concentrations. For example, the simulation results shown in Figure 3 and 4 (Hawaii, 2020) have the following key differences in assumptions:

- The SWAP simulation assumes 10 mgd (3,650 mgy) infiltration, whereas the Scenario 1 – Average Year Precipitation used for this study infiltrates 120 mgy, or about 3% of the infiltration quantity. The amount of mounding that would enhance radial flow and chemical migration is significantly less for the proposed WWRF.
- Furthermore, the proposed WWRF is designed with 7.5 acres of basins, whereas the SWAP Figure 3 source area is estimated to be approximately 25 acres. Also, the SWAP source area is located north and east of the proposed WWRF, closer to the groundwater divide.
- The SWAP simulation in Figure 3 used a nitrate source concentration of 8 mgN/L, compared to the 4.6 and 0.3 mgN/L scenarios (conservative and enhanced denitrification rates, respectively) calculated by Geosyntec.

Lastly, a key difference between the SWAP and Geosyntec simulations is that Geosyntec's nitrate plume simulation migrates exclusively south toward Maalaea Bay. Our modeling does not project nitrate migration to the north toward the Consolidated Baseyard, Waiale, and Maui Lani drinking water supply wells. We attribute this difference to two key factors as follows:

- The simulated SAT basin assumptions for source areas (larger area), location (more northerly and closer to groundwater divide), infiltration rate (10 mgd), and nitrate concentration (8 mgN/L) used by SWAP at the time tended to create broader chemical transport and also northerly transport toward Kahului Harbor.
- The Geosyntec model based on Rotzoll (2022) uses updated recharge in the Waikapu stream that was resumed in approximately 2010. This recharge feature enhances the groundwater divide in the central Maui area north of the proposed WWRF. With the proposed SAT basins south and west of Waikapu stream, it makes sense that groundwater flow and chemical transport would be southerly.

In the SWAP modeling (Figure 4), the southern extent of the nitrate plume projection extends to the Maalaea Bay shoreline and the western edge of the Kealia Ponds. The Geosyntec simulations forecast a much lower concentration of nitrate, due to reduced mass input and denitrification in the vadose zone and groundwater, but the location where the chemical transport is projected to reach the shoreline is very close to the same location, suggesting that the two models provide similar groundwater flow projections.

Thus, given the variations in assumptions between the simulations developed by SWAP and the assumptions used by Geosyntec of the proposed WWRF, it is not surprising that different projections are presented.

7. REGULATORY FRAMEWORK

There are currently no direct environmental regulatory standards for recycled water concentrations in the environment. However, there are regulatory standards for chemicals that are known to be primary components of recycled water. For the modeling projections presented in this report, we focused on nitrogen species by modeling the fate and transport of nitrate. Brown and Caldwell (2024) provide a preliminary total nitrogen concentration estimate of 8 mgN/L for the facility recycled water in the SAT basins. This is comparable to other wastewater facilities on Maui, which indicates that nitrate is the predominant nitrogen species (ranging from 77 to 96% of the total nitrogen; see Section 4.1). To simplify the modeling process and provide a conservative, high-end source term, we assumed that the total nitrogen in the Central Maui WWRF effluent is present as nitrate only (see Section 4.5). In this section, we describe our understanding of the current regulatory framework on Maui as it pertains to nitrate, but also with reference to total nitrogen where applicable.

7.1 Marine Class A Embayments §11-54-6

The groundwater flow and chemical transport modeling described in Section 6 forecasts that chemical discharge, if any, will occur in the Maalaea Bay shoreline region, which is categorized as a Class A Marine Embayment (Hawaii Department of Health, 2021). See Table 9 for various discharge criteria. It is our professional opinion that the outflow of groundwater to Maalaea Bay is likely less than one percent of the embayment volume, and therefore the "Dry" criteria are relevant. "Dry" does not reference seasonality in this instance (see notes on Table 9). The discharge criteria for Dry season nitrate plus nitrite nitrogen and total nitrogen are 0.005 and 0.15 mgN/L, respectively. It should be noted that the current standard commercial laboratory reporting limit for nitrate testing in groundwater is 0.1 mgN/L (Stephen Nowak, Eurofins Laboratory, personal communication, February 3, 2025). The 0.1 mgN/L reporting limit is 20 times higher than the Dry season geometric mean criteria for nitrate plus nitrite nitrogen in Table 9 (0.005 mgN/L) and would likely be too low to measure in a facility monitoring program. We therefore conclude that the total nitrogen discharge criteria of 0.15 mgN/L (using Dry season assumptions and with the geometric mean not to exceed that value), which is slightly above the nitrate testing reporting limit of 0.1mgN/L, is a reasonable discharge standard to compare with the preliminary chemical transport modeling projections that use dissolved nitrate as a surrogate for recycled water.

7.2 Inland Water Criteria §11-54-5.2

Inland water criteria established for the State (Hawaii Department of Health, 2021) are generally higher than for marine waters (see Section 7.3, below). The modeling projects the potential for recycled water discharge in the vicinity of the Kealia Ponds. Given that the SAT basins are expected to operate in the winter, the "Wet season" criteria are the relevant comparison. The values for Wet season nitrate plus nitrite nitrogen and total nitrogen are 0.07 and 0.25 mgN/L, respectively (see Table 10 of this report). As noted above, the current standard laboratory reporting limit for nitrate in groundwater is 0.1 mgN/L, which is above the Wet season geometric mean value for

nitrate plus nitrate nitrogen; therefore, comparing modeling projections to total nitrogen in the Wet season (geometric mean not to exceed 0.25 mgN/L) is considered appropriate.

7.3 Maximum Contaminant Level

The MCL for nitrate in groundwater and drinking water is 10 mgN/L. Given that the MCL is higher than the expected Central Maui WWRF effluent nitrate concentration and no drinking water supply wells are located downgradient of the proposed SAT basins, exceedances of the MCL are not anticipated. Under enhanced denitrification conditions, modeled additive nitrate concentrations above baseline reaching groundwater are 0.3 mgN/L. Baseline groundwater nitrate concentrations in the vicinity of the SAT basins are approximately ten times higher than this (2 to 3 mgN/L) because of historical agricultural practices and OSDSs. There is no federal MCL for total nitrogen.

7.4 Other Potential Compounds

Based on the effluent profiles of the Kihei and Lahaina wastewater facilities, low level detections of pharmaceuticals and personal care products (PPCPs) have been observed (Hunt & Rosa, 2009) in addition to the nitrogen species that are the focus of this report. There were detections of carbamazepine, sulfamethoxazole, diphenhydramine, and trimethoprim in the facility effluents, in varying concentrations. Based on Geosyntec's modeling of a generic analyte (see Section 6.5.2), if similar concentrations of these compounds were to reach groundwater beneath the SAT basins, a reduction of 93% would result in levels below the respective reporting limits at Maalaea Bay (i.e., non-detect based on the reporting limits in the paper).

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 Preliminary Conclusions

Geosyntec performed a multi-faceted technical analysis to evaluate future infiltration from SAT basins at the proposed WWRF. Based on the modeling, assuming under enhanced denitrification conditions, nitrate migrating from Central Maui WWRF is forecast to comply with the State's water quality thresholds for total nitrogen (0.15 mgN/L), potentially discharging to a Class A Marine Embayment (i.e., Maalaea Bay) and (0.25 mg/L) for inland waters (i.e., Kealia Ponds). It is anticipated that there will be a monitoring program established to assess baseline conditions and concentrations of individual nitrogen species and other recalcitrant, low-concentration chemicals such as pharmaceutical compounds. The following describes mitigation measures and potential environmental impacts.

8.1.1 Mitigation Measures

The planned facility will incorporate multiple mitigation measures that are designed to reduce or eliminate potential environmental impacts as follows:

- A significant proportion of recycled water will be used for off-site irrigation during 11 months of each average year. Thus, the average year SAT basin recycled water infiltration quantity is reduced and is expected to be limited to the month of January only, with potential intermittent, limited off-spec infiltration in other months.
- The recycled water undergoes secondary, biological nutrient removal and tertiary treatment prior to being applied to the SAT basins and infiltration into the subsurface. For example, the influent recycled water nitrate concentration (8 mgN/L) at the SAT basins is expected to be below the nitrate drinking water MCL of 10 mgN/L.
- The facility plan will include addition of biomass amendments in the SAT basins. This will enhance denitrification rates in the shallow subsurface beneath the SAT basins.
- The facility is sited in an area of materials with "Fast" to "Moderate" infiltration rates and more the 2,000 ft distant from the nearest perennial surface water body, Waikapu Stream.
- The facility basins are anticipated to include vertical slurry walls or other similar-functioning features that will mitigate potential chemical diffusion in the adjacent shallow soils.

8.1.2 Potential Environmental Impacts

As described in Section 8.1.1, the planned facility mitigation measures will reduce potential environmental impacts as follows:

- The technical analysis concludes that the primary component of recycled water (i.e., dissolved nitrate) will undergo significant biological degradation in the vadose zone under the SAT basins via the process known as denitrification.

- Denitrification beneath the SAT basins will be facilitated by the naturally occurring organic carbon present in the soil, as well as organic carbon remaining in the treated effluent, but may also be further accelerated by operational amendments (e.g., addition of biomass to the base of the SAT basins).
- The significant thickness of the vadose zone of up to approximately 220 ft provides an infiltration and residence time to support significant denitrification in the vadose zone prior to reaching groundwater.
- Vadose zone modeling forecasts that SAT basin infiltration will not migrate to Waikapu stream, over 2,000 ft distant from the basins.
- Under enhanced conditions (e.g. biomass addition to SAT basins), the nitrate impact to groundwater directly beneath the basins is projected to be limited (0.3 mgN/L or less) compared with the initial SAT basin concentration of 8 mgN/L (an approximate 96% reduction). This projected concentration is much lower than the existing measured levels of nitrate already in groundwater of 2 to 3 mgN/L that are a result of natural conditions, past agricultural fertilizer practices, and the regional use of domestic OSDSs.
- The projected additive concentration of total nitrogen at the shoreline of Maalaea Bay, following approximately 2.5 miles of travel in the subsurface with attenuation due to denitrification, dispersion and dilution, is projected to be less than 0.02 mgN/L under enhanced conditions. This projection is below State discharge regulatory levels for total nitrogen in a Marine Class A embayment such as Maalaea Bay (0.15 mgN/L) and inland waters (0.25 mg/L) such as Kealia Ponds
- Other residual chemicals that may not be attenuated in the facility prior to SAT basin infiltration and treatment, are modeled to undergo an approximate 93% reduction in concentration following infiltration and migration in groundwater to the shoreline. Residual low-concentrations of chemicals such as pharmaceuticals and personal care products, are forecasted to be below standard laboratory reporting limit levels at potential points of discharge.
- No known drinking water wells are in the projected flow path of the recycled water migration in groundwater.
- A regulatory agency-approved environmental monitoring program will be implemented to evaluate the projections provided herein, and if environmental conditions vary from this evaluation, additional mitigation measures can be deployed, if necessary.

In summary, Geosyntec concludes that under the planned enhanced denitrification operational conditions, additive nitrate from the Central Maui WWRF is forecast to comply with the State's water quality thresholds for total nitrogen (0.15 mgN/L) potentially discharging into a Class A Embayment (i.e., Maalaea Bay) and (0.25 mg/L) for inland water (i.e., Kealia Ponds). It is anticipated there will be a monitoring program established to assess baseline conditions and concentrations of individual nitrogen species and other recalcitrant, low-concentration chemicals such as pharmaceutical compounds.

We underscore that the Central Maui WWRF is not yet constructed and operating, thus there is uncertainty in multiple variables that may affect the modeling scenario projections described in this report. Simplifying assumptions have been incorporated into the modeling analysis that provide a preliminary estimate of the potential environmental impacts that might be expected as compared with regulatory standards. Actual conditions may vary upon construction and operation of the WWRF.

8.2 Recommendations

Geosyntec provides the following recommendations:

- Geosyntec concurs with the recommendations provided in the State of Hawaii (2021) *SWAP re-assessment of the proposed Soil Aquifer Treatment Basins impact on Drinking Water Wells* that is summarized below:
    - Implement a monitoring program to assess the degree of impact on the groundwater quality and potential receptors. The monitoring program should include deep lysimeters and groundwater monitoring wells. The monitoring wells should be installed near the SAT basins to serve as early-warning sentinel wells to identify potential issues and provide time to make operational adjustments if needed.
    - The monitoring program should include nitrate and other potential wastewater indicator compounds such as pharmaceuticals and personal care products. Sampling for nitrate isotopic analysis should also be considered. Samples should be collected at the monitoring wells, deep lysimeters, and Public Drinking Water Wells (if needed).
    - The deep lysimeters will document the chemical composition of the infiltrating recycled water and will inform and support the ongoing management of the SAT basins. Monitoring the infiltrating recycled water and the groundwater beneath the SAT basins will be important to understanding the environmental impact of this treatment system and will allow the Maui Department of Environmental Management to evaluate SAT basin operations and minimize the potential impacts.
- Geosyntec recommends that the facility plan include the use of biomass, such as wood chips, in the base of the SAT basins to increase available organic carbon that may increase denitrification rates, and thereby lower nitrate concentrations in the vadose zone, groundwater, and potential discharge at marine and inland waters. As part of the WWRF subsurface environmental monitoring network installation, Geosyntec recommends bench-scale laboratory column testing of subsurface soils and effluent samples be performed to estimate the potential range of site-specific denitrification rates. The column study rates can be compared with the rates used in this analysis.
- Vadose zone modeling for the Wet Year infiltration rates noted that near the end of the prospective 31-day, 4.0-mgd period in January, a short period of positive head pressure and saturated soil conditions are projected to occur in the two interior SAT basins, while the north and south basins retained negative pressure and infiltration capacity. Thus, during this infiltration scenario, there may be a need to manage infiltration rates such that

the north and south basins temporarily receive a higher relative infiltration volume. The normal SAT basin infiltration conditions (i.e., negative head pressure and partially saturated soils) recover rapidly under lower February infiltration rates.

9. LIMITATIONS

This document was prepared by the staff of Geosyntec under the supervision of persons whose signatures appear hereon. The proposed approach contained in this Report is based solely on the approved scope of work and conditions found at the Site.

No warranty, expressed or implied, is made regarding the professional opinions expressed in this Report or concerning the completeness of the data contained in this evaluation. If actual conditions are found to differ from those described in this Report or if new information regarding the Site is obtained, Geosyntec should be notified and additional conclusions and/or recommendations, if required, will be provided. Geosyntec is not liable for any use of the information contained in this Report by persons other than Brown and Caldwell and the County.

In addition, the findings and/or professional opinions presented in this report are based upon: a) preliminary data, analyses, and interpretations of subsurface conditions; b) approximations of data collected by others; and c) the use of vadose zone and groundwater numerical model simulations to preliminarily estimate and project future SAT basin infiltration performance and conditions. Although we were not able to independently verify data reported by others, we did evaluate it to determine whether it was consistent with other information that we developed in the course of our performance of the scope of services. Subsurface investigations and interpretations are inherently limited to data derived from samples taken or tests performed at selected locations. Due to these inherent limitations, it must be recognized that the actual subsurface conditions may vary from those predicted, despite the use of professional care.

Furthermore, this report includes numerical model simulations of Site conditions and future projections of potential WWRF excess recycled water infiltration. As is typical for numerical models, the numerical models in this evaluation are approximations of the Site subsurface conditions and use forecasts of future WWRF operations and site conditions to simulate projections of potential environmental impacts. Thus, the actual material properties and SAT basin infiltration rates used at the Site during future facility operation may vary from the preliminary interpretations, assumptions, simulations, projections, and concepts presented herein.

Geosyntec's services were performed in accordance with generally accepted professional standards of care applicable to the scope of services authorized by Brown and Caldwell and the County of Maui, and no other warranty is provided in connection therewith. Consistent with applicable professional standards of care, our opinions and recommendations were based in part on data furnished by others.

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TABLES

Table 1A – Scenario 1 - Average Precipitation Year SAT Basin Disposal Estimate

Month	SAT Basin Disposal Estimate (mgd)(1)	SAT Basin Disposal Estimate (mgal)
January	1.15	36
February	0	0
March	0	0
April	0	0
May	0	0
June	0	0
July	0	0
August	0	0
September	0	0
October	0	0
November	0	0
December	0.0	0
Total	**	36

Footnote: 1) Estimate for Excess R-1 from Brown and Caldwell (September 12, 2024)

Table 1B - Scenario 1 - Average Precipitation Year SAT Basin Disposal Estimate Plus Off-Spec Condition Disposal

Description	Volume (mgal/year)(1)
Average precipitation year discharge	36
Off-spec condition discharge (21 days/year at 4.0 mgd))	84
Scenario 1: Total annual discharge to SAT basins	120

Footnote: 1) Estimate for Excess R-1 and Off-Spec disposal events from Brown and Caldwell (September 12, 2024)

Table 2A – Scenario 2: Wet Precipitation Year SAT Basins Disposal Estimate Excess R-1 Disposal

Month	SAT Basin Disposal Estimate [million gallons per day (mgd)][(1)]	SAT Basin Disposal Estimate [million gallons (mgal)]
January	4.0	124
February	1.0	28
March	0	0
April	0	0
May	0	0
June	0	0
July	0	0
August	0	0
September	0	0
October	0	0
November	0	0
December	3.1	96
Total	**	248

Footnote: 1) Excess R-1 disposal estimate from Brown and Caldwell (September 12, 2024)

Table 2B - Scenario 2: Wet Precipitation Year SAT Basin Disposal Estimate – Excess R-1 plus Off-Spec Disposal

Month	SAT Disposal Volume [(1)]	Condition
December	3.1 mgd daily all month (96 mgal)	Excess R-1 Disposal
January	4.0 mgd daily all month (124 mgal)	Excess R-1 Disposal
February	1.0 mgd daily for 28 days, (28 mgal)	Excess R-1 Disposal
March to May	4.0 mgd for three consecutive, 15th day of each; 36 mgal	Off-spec water disposal events
June through November	4.0 mgd for two consecutive, 15th day of each month; 48 mgal	Off-spec water disposal events
Total Scenario 2: 332 million gallons (248 mgal excess R-1 + 84 mgal off-spec)		

Footnote: 1) Excess R-1 and off-spec disposal estimate from Brown and Caldwell (September 12, 2024)

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Table 3
Soil Chemistry Laboratory Tesing Results
Central Maui Waste Water Reclamation Facility
Maui, Hawaii

Sample ID	Depth (ft bgs)	Date Collected	Ammonia (as N)	Bromide	Chloride	Fluoride	Nitrate-N	Nitrate-Nitrite (as N)	Nitrate-Nitrite (as N), Dissolved	Nitrite-N	Orthophosphate as P	Sulfate	Total Inorganic Carbon	Total Organic Carbon [1]	Total Phosphorus as P
Units			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
G-1-10	10	9/12/2023	**72.8J**	**0.43J**	**21**	<1.0	<1.0	<1.0	**0.472J**	<1.0	<1.0	**6.4J**	**1910J**	**2980J**	**227**
G-1-45	45	9/12/2032	**67.2J**	<1.0	**8.8J**	**0.78J**	<1.0	<1.0	**0.644**	<1.0	**0.59J**	<10	**1150J**	**1450J**	**62.6**
G-1-58	58	10/23/2023	**89.6J**	<1.0	<10	**1.0**	<1.0	<1.0	**0.309J**	<1.0	<1.0	**3.9J**	**3860J**	**1220J**	**0.862**
G-2-15	15	10/24/2023	**106**	<0.99	<9.9	**0.73J**	<0.99	<1.0	**1.27**	<0.99	<0.99	**4.8J**	<4000	**4580**	**0.711**
G-2-41.5	41.5	10/25/2023	**78.4J**	<2.0	<20	**1.4J**	<2.0	<1.0	**0.277J**	<2.0	<2.0	<20	**3620J**	**2570J**	**0.984**
G-2-58	58	10/25/2023	**89.6J**	<10	<100	<10	<10	<1.0	**0.191J**	<10	<10	<100	**2890J**	<4000	**2.62**
G-3-23	23	10/27/2023	<100	<1.0	<10	**0.68J**	<1.0	<1.0	**0.205J**	<1.0	**0.63J**	<10	**1470J**	**1700J,B**	**2.45**
G-3-38	38	10/27/2023	<100	<0.99	<9.9	**0.46J**	<2.0	<1.0	**0.729**	<2.0	<2.0	<9.9	<4000	**2580J,B**	**1.34**
G-3-52	52	10/27/2023	<100	<5.0	<50	<5.0	<5.0	<1.0	**0.630**	<5.0	<5.0	<50	**966J**	**974J,B**	**1.41**

Notes:
1 - Result is reported on a dry weight basis
Bold Value indicates dectections above laboratory reporting limit
J: Results is less than the Reporting Limit, but greater than or equal to the Method Detection Limit and the concentration is an approximate value
B: Compund was found in the blank and sample
mg/kg - milligrams per kilogram

Table 4A – Summary of Lab Soil Classification Testing Results

Boring	Sample No.	Depth (ft)	Lab Soil Classification (USCS)(1)	Percent Coarse - Gravel and Sand (1)	Percent Fines - Silt and Clay (1)	Silt / Clay Differentiation w/Hydrometer (1)	Comparison with USDA Soil Texture Triangle(2)(3)
G-1	2	10-11.5	Silty Sand (SM)	59%	41%	**	Sandy Loam
G-1	7	35-36.5	Silty Sand (SM)	50%	50%	**	Loam
G-1	9	45-46.5	Silty Sand (SM)	69%	31%	**	Sandy Loam
G-2	2	10-11.5	Sandy elastic Silt	23%	77%	**	Loam
G-2	8	40-41.5	Sandy elastic Silt	38%	61%	**	Loam
G-2	11	55-56.5	Sandy silt (ML)	49%	51%	41% Silt / 10% Clay	Loam
G-3	3	15-16.5	Silty Sand (SM)	65%	35%	**	Sandy Loam
G-3	8	40-41.5	Sandy silt (ML)	38%	62%	**	Loam
G-3	9	45-46.5	Sandy silt (ML)	40%	60%	52% Silt / 8% Clay	Silt Loam

Notes:

1. See lab testing sheets from YKE Labs in Appendix A (Geosyntec, 2023)
2. The vadose zone infiltration modeling software HYDRUS® uses the USDA Soil Texture Triangle classification which are assigned here.
3. Based on the two hydrometer tests for the observed fine-grained horizon plus field logging, the fines fraction in the sieve analysis was estimated to be 80% silt and 20% clay.
4. ** Indicates test not performed

Abbreviations:

USCS - Unified Soil Classification System

USDA - U.S. Department of Agriculture

Table 4B – Summary of Laboratory Soil Physical Properties Testing Results

Boring	Sample No.	Depth (ft)	Lab Soil Classification (USCS)[1]	Moisture Content (%) [1]	Dry Density (pcf) [1]	Specific Gravity (Unitless) [1]
Older Dune Sand (Qdo) / Jaucas Sand (JaC)						
G-1	2	10-11.5	Silty Sand (SM)	9.1	78.6	2.25
G-2	2	10-11.5	Sandy elastic Silt	19.2	91	2.022
G-3	3	15-16.5	Silty Sand (SM)	20.9	85.4	1.933
Weathered Alluvium (QTao)						
G-1	7	35-36.5	Silty Sand (SM)	27.4	88.5	1.946
G-1	8	40-41.5				
G-1	9	45-46.5	Silty Sand (SM)	22	76.7	1.908
G-2	7	35-36.5				
G-2	8	40-41.5	Sandy elastic Silt	23.4	84.9	1.919
G-2	9	45-46.5				
G-2	11	55-56.5	Sandy Silt (ML)	28.2	70.4	1.865
G-3	8A	40-41.5	Sandy Silt (ML)	30.8	73.3	2.044
G-3	8B	40-41.5				
G-3	9	45-46.5	Sandy Silt (ML)	29.2	77	1.838

Notes:

Abbreviations:

pcf - pounds per cubic feet

psf- pounds per square feet

TABLE 5

Summary of In-Borehole Falling-Head Test Results

Borehole Test	Target 6-inch Saturated Depth Interval (ft bgs)	Soil Type (Field Classification)	Pre-Soak Implemented	Average Percolation Rate at Approximate 6-inch Head Level (minutes/inch)	Average Percolation Rate at Approximate 6-Inch Head Level (Converted to Inches/Hour)	Approximate Infiltration Rate (Inches/Hour) (calculated using Porchet Method)[1]
G-1B SHALLOW	14.08 to 14.58	Poorly graded SAND with Silt (SP-SM)	No	4.2	14	5
G-1 DEEP	58.58 to 59.08	CLAY (CL) with sand	Yes	8.9	7	2
G-2B SHALLOW	11.88 to 12.38	Poorly graded SAND (SP) and Silty SAND (SM)	No	0.6	101	42
G-2 DEEP	58.1 to 58.6	CLAY (CL) *(Lab-Sandy SILT (ML))*	Yes	16.7	4	1
G-3B SHALLOW	13.87 to 14.37	Well graded GRAVEL (GW) with sand	No	8.3	7	2
G-3 DEEP	49.63 to 50.13	GRAVEL (GW) with clay	No	3.5	17	8
G-3 DEEP (adjusted) [2]	43.82 to 43.82	CLAY (CL) and Sand	Yes	33	2	1

Footnotes:

1) Conversion of Percolation Rate to Infiltration Rate using the Porchet Method (see report Section 4.2). Selected falling-head testing interval with starting head nearest to 6-inches as per US EPA protocol.
2) A second deep zone test (designated G-3 DEEP adjusted) was implemented by backfilling the previous bottom with approximately 4 feet of hydrated bentonite chips. The test was to evaluate and compare percolation rate in the gravel zone found at refusal (G-3 DEEP at approximately 52 ft bgs) with a finer grained clay layer found at approximately 44 feet bgs (G-3 DEEP adjusted).

Abbreviations:

Ft Bgs – feet below ground surface

TABLE 6

Comparison of Infiltration Rates from Central Maui WWRF and Waikapu Park Development Testing

Sandy Soils – Older Dune Deposits (Qdo)/Jaucas sand

CMWWRF/ Geosyntec	Borehole No.	Saturated Depth Interval (ft bgs)	Soil Type (Field Classification)	Approximate Infiltration Rate (Inches/Hour) (calculated from Porchet Method)(1)
	G-1B Shallow	14.08 to 14.58	Poorly graded Sand with Silt (SP-SM)	5
	G-2B Shallow	11.88 to 12.38	Poorly graded SAND (SP) and Silty SAND (SM)	42
	G-3B Shallow	13.87 to 14.37	Well graded GRAVEL (GW) with sand	2
Waikapu Park / Geolabs	Test Pit No.	Depth (ft bgs)	Material Tested	Approximate Infiltration Rate (Inches/Hour) (2)
	3	4.0	Sand	59
	8	5.5	Sand	Too rapid to measure

Mixed Clay, Silt, Sand, and Gravel – Older Alluvium (Qtao)

CMWWRF/ Geosyntec	Borehole	Saturated Depth Interval (bgs)	Soil Type (Field Classification)	Approximate Infiltration Rate (Inches/Hour) (calculated from Porchet Method)(1)
	G-1 Deep	58.58 to 59.08	CLAY (CL) with sand	2
	G-2 Deep	58.1 to 58.6	CLAY (CL)	1
	G-3 Deep	49.63 to 50.13	CLAY (CL) with gravel	8
	G-3 Deep (adjusted) (2)	43.82 to 43.82	CLAY (CL) and sand	1
Waikapu Park / Geolabs	Test Pit No.	Depth (ft bgs)	Material Tested	Approximate Infiltration Rate (Inches/Hour) (2)
	1	5.0	Clayey Silt	4
	2	4.3	Clayey Silt	5
	4	4.5	Clayey Silt	1

Footnotes:

1) Conversion of Percolation Rate to Infiltration Rate using the Porchet Method (see report Section 4.2)
2) Geloabs performed double-ring infiltrometer tests in nearby Waikapu Park. Infiltration rates reported in cm/hour at nearby; converted to inches/hour in table above..

Abbreviations:

CMWWRF – Central Maui Wastewater Reclamation Facility

Table 7 – Supply Well Groundwater Testing Data

Well	Date	Chemical	Concentration	Units	MCL (mg/L)
CB Well 1	10/27/2008	Sodium	44	mg/L	NA
CB Well 2	10/27/2008	Sodium	38	mg/L	NA
CB Well 1	10/27/2008	Sulfate	<0.01	mg/L	250*
CB Well 2	10/27/2008	Sulfate	10	mg/L	250*
CB Well 2	6/05/2017	Calcium	20	mg/L	NA
CB Well 1	7/26/2022	Nitrate	2.6	mg/L	10
CB Well 2	7/26/2022	Nitrate	3.3	mg/L	10
CB Well 1	7/26/2022	Nitrate-Nitrite	2.6	mg/L	10
CB Well 2	7/26/2022	Nitrate-Nitrite	3	mg/L	10
CB Well 1	7/26/2022	Nitrite	<0.1	mg/L	1
CB Well 2	7/26/2022	Nitrite	<0.1	mg/L	1
CB Well 1	1/31/2024	Chloride	45	mg/L	250*
CB Well 2	1/31/2024	Chloride	91	mg/L	250*
CB Well 1	4/22/204	Chloride	50	mg/L	250*
CB Well 2	4/22/2024	Chloride	86	mg/L	250*

Abbreviations: MCL – chemical maximum contaminant level (USEPA), NA – not applicable; * - indicates secondary MCL standard, CB Well 1 and 2 – Consolidated Baseyard Well No. 1 and No. 2.

Table 8 – Compilation of representative denitrification rates from peer-reviewed literature by aquatic system.

System	Transport Rate (d^{-1})	Reaction Rate (d^{-1})	Reference
SAT Vadose Zone	1.9E-03	1.3E-03	Mienis & Arye (2018)
SAT Vadose Zone	1.1E-02	7.1E-03	Mienis & Arye (2018)
SAT Vadose Zone	1.9E-03	3.2E-03	Mienis & Arye (2018)
SAT Vadose Zone	1.1E-02	1.1E-02	Mienis & Arye (2018)
SAT Vadose Zone	1.9E-03	1.8E-03	Mienis & Arye (2018)
SAT Vadose Zone	1.1E-02	9.5E-03	Mienis & Arye (2018)
Lahaina Groundwater	2.3E-03	6.3E-03	Fackrell et al (2016)
Kihei Groundwater	1.3E-02	9.9E-03	Hunt et al (2007)
Constructed wetland	6.3E-02	1.0E-02	Jordan et al. (2003)
Constructed wetland	3.3E-02	1.7E-02	Jordan et al. (2003)
Constructed wetland	1.1E-01	5.0E-02	Jordan et al. (2003)
Constructed wetland	5.0E-01	5.9E-02	Jordan et al. (2003)
Constructed wetland	1.4E+00	1.4E-01	Jordan et al. (2003)
Constructed wetland	4.3E-01	2.8E-02	Jordan et al. (2003)
Constructed wetland	5.9E-01	3.6E-01	Reilly et al. (2000)
Constructed wetland	1.4E-01	5.6E-01	Reilly et al. (2000)
Constructed wetland	1.4E-01	9.1E-01	Reilly et al. (2000)
Constructed wetland	5.6E-01	3.2E-01	Reilly et al. (2000)
Constructed wetland	4.3E-01	5.6E-01	Reilly et al. (2000)
Constructed wetland	3.1E-01	1.0E+00	Reilly et al. (2000)
Constructed wetland	1.3E+00	1.1E+00	Reilly et al. (2000)
Constructed wetland	2.5E+00	1.4E+00	Reilly et al. (2000)
Constructed wetland	2.0E+00	3.3E+00	Reilly et al. (2000)
Constructed wetland	2.6E-01	5.3E-01	Reilly et al. (2000)
Constructed wetland	4.0E-01	5.0E-01	Reilly et al. (2000)
Constructed wetland	1.7E+00	1.7E+00	Reilly et al. (2000)
Constructed wetland	7.7E-01	6.7E-01	Reilly et al. (2000)
Estuary	1.4E-04	1.8E-04	Nixon et al. (1996)
Estuary	1.8E-03	1.6E-03	Nixon et al. (1996)
Estuary	4.8E-03	1.4E-03	Nixon et al. (1996)
Estuary	1.0E-02	6.7E-03	Nixon et al. (1996)

System	Transport Rate (d^{-1})	Reaction Rate (d^{-1})	Reference
Estuary	6.5E-03	1.1E-03	Nixon et al. (1996)
Estuary	3.0E-02	5.1E-03	Nixon et al. (1996)
Estuary	3.8E-02	8.5E-03	Nixon et al. (1996)
Estuary	3.3E-01	3.7E-02	Nixon et al. (1996)
Estuary	1.0E-01	1.1E-02	Nixon et al. (1996)
Estuary	1.1E-02	5.7E-03	Nixon et al. (1996)
Lake/Reservoir	3.3E-01	2.2E-01	Tomaszek (2003)
Lake/Reservoir	4.7E-03	1.4E+00	Tomaszek (2003)
Lake/Reservoir	7.6E-03	2.4E-03	David et al. (2006)
Lake/Reservoir	1.4E-02	6.1E-03	Harrison et al. (2009)
Lake/Reservoir	1.2E-03	1.0E-03	Harrison et al. (2009)
Lake/Reservoir	7.1E-04	1.2E-03	Harrison et al. (2009)
Lake/Reservoir	4.7E-04	5.7E-04	Harrison et al. (2009)
Lake/Reservoir	3.3E-04	1.3E-03	Harrison et al. (2009)
Lake/Reservoir	3.1E-04	1.2E-03	Harrison et al. (2009)
Lake/Reservoir	1.1E-04	5.0E-04	Harrison et al. (2009)
Lake/Reservoir	9.1E-03	2.5E-03	Harrison et al. (2009)
Lake/Reservoir	7.4E-04	7.0E-04	Harrison et al. (2009)
Lake/Reservoir	2.7E-03	1.7E-03	Harrison et al. (2009)
Lake/Reservoir	3.0E-03	1.0E-03	Harrison et al. (2009)
Lake/Reservoir	1.7E-04	6.7E-04	Harrison et al. (2009)
Lake/Reservoir	2.8E-05	1.6E-04	Harrison et al. (2009)
Lake/Reservoir	1.1E-02	6.0E-03	Harrison et al. (2009)
Lake/Reservoir	3.0E-02	7.2E-03	Harrison et al. (2009)
Lake/Reservoir	5.0E-02	7.6E-03	Harrison et al. (2009)
Lake/Reservoir	2.0E-02	6.8E-03	Harrison et al. (2009)
Lake/Reservoir	1.1E-02	6.1E-03	Harrison et al. (2009)
Lake/Reservoir	2.3E-02	6.9E-03	Harrison et al. (2009)
Lake/Reservoir	5.1E-04	6.7E-04	Harrison et al. (2009)
Lake/Reservoir	1.4E-03	6.9E-04	Harrison et al. (2009)
Lake/Reservoir	1.7E-03	7.6E-04	Harrison et al. (2009)
Lake/Reservoir	1.5E-03	1.1E-03	Harrison et al. (2009)
Lake/Reservoir	8.8E-04	5.7E-04	Harrison et al. (2009)

System	Transport Rate (d^{-1})	Reaction Rate (d^{-1})	Reference
Lake/Reservoir	7.2E-04	7.6E-04	Harrison et al. (2009)
Lake/Reservoir	1.1E-03	5.7E-04	Harrison et al. (2009)
Lake/Reservoir	7.7E-03	6.2E-03	Harrison et al. (2009)
Lake/Reservoir	7.1E-02	2.3E-02	Harrison et al. (2009)
Lake/Reservoir	5.6E-02	1.4E-02	Harrison et al. (2009)
Lake/Reservoir	1.7E-02	4.5E-03	Harrison et al. (2009)
Lake/Reservoir	2.6E-02	2.0E-02	Harrison et al. (2009)
Lake/Reservoir	9.1E-02	2.5E-02	Harrison et al. (2009)
Lake/Reservoir	6.7E-04	1.0E-03	Harrison et al. (2009)
Lake/Reservoir	1.9E-04	4.0E-04	Harrison et al. (2009)
Lake/Reservoir	1.5E-03	7.7E-04	Harrison et al. (2009)
Lake/Reservoir	3.2E-03	6.4E-04	Harrison et al. (2009)
Lake/Reservoir	5.6E-02	1.4E-02	Harrison et al. (2009)
Lake/Reservoir	3.8E-02	7.8E-03	Harrison et al. (2009)
Lake/Reservoir	3.4E-02	1.0E-02	Harrison et al. (2009)
Lake/Reservoir	2.7E-02	8.3E-03	Harrison et al. (2009)
Lake/Reservoir	2.0E-02	1.6E-02	Harrison et al. (2009)
Lake/Reservoir	5.6E-03	4.7E-03	Harrison et al. (2009)
Lake/Reservoir	5.0E-03	3.2E-03	Harrison et al. (2009)
Lake/Reservoir	4.0E-03	5.1E-03	Harrison et al. (2009)
Lake/Reservoir	1.4E-01	1.6E-02	Harrison et al. (2009)
Lake/Reservoir	6.7E-02	8.8E-03	Harrison et al. (2009)
Lake/Reservoir	6.7E-02	1.4E-02	Harrison et al. (2009)
Lake/Reservoir	5.6E-02	1.3E-02	Harrison et al. (2009)
Lake/Reservoir	3.4E-02	1.6E-02	Harrison et al. (2009)
Lake/Reservoir	1.6E-02	5.5E-03	Harrison et al. (2009)
Lake/Reservoir	1.1E-02	7.4E-03	Harrison et al. (2009)
Lake/Reservoir	2.5E-03	2.1E-03	Harrison et al. (2009)
Lake/Reservoir	1.8E-03	2.9E-03	Harrison et al. (2009)
Lake/Reservoir	3.1E-03	2.4E-03	Harrison et al. (2009)
Lake/Reservoir	2.1E-02	3.8E-03	Harrison et al. (2009)
Lake/Reservoir	1.1E-02	3.6E-03	Harrison et al. (2009)
Lake/Reservoir	5.8E-04	3.0E-04	Harrison et al. (2009)

System	Transport Rate (d^{-1})	Reaction Rate (d^{-1})	Reference
Lake/Reservoir	2.7E-05	3.0E-05	Harrison et al. (2009)
Lake/Reservoir	5.0E-02	3.8E-02	Harrison et al. (2009)
Lake/Reservoir	1.3E-02	7.0E-03	Harrison et al. (2009)
Lake/Reservoir	1.6E-03	8.9E-04	Harrison et al. (2009)
Lake/Reservoir	5.9E-02	4.5E-02	Harrison et al. (2009)
Lake/Reservoir	6.0E-03	4.4E-03	Harrison et al. (2009)
Lake/Reservoir	4.4E-03	3.5E-03	Harrison et al. (2009)
Lake/Reservoir	7.4E-03	2.2E-03	Harrison et al. (2009)
Lake/Reservoir	1.7E-03	8.7E-04	Harrison et al. (2009)
Lake/Reservoir	3.4E-03	5.5E-03	Harrison et al. (2009)
Lake/Reservoir	9.8E-03	5.9E-03	Harrison et al. (2009)
Lake/Reservoir	3.7E-03	4.3E-03	Harrison et al. (2009)
Lake/Reservoir	3.3E-02	1.1E-02	Harrison et al. (2009)
Lake/Reservoir	3.4E-01	8.1E-03	Harrison et al. (2009)
Lake/Reservoir	3.6E-03	2.6E-04	Harrison et al. (2009)
Lake/Reservoir	3.2E-02	1.4E-02	Harrison et al. (2009)
Lake/Reservoir	1.2E-02	7.6E-03	Harrison et al. (2009)
Lake/Reservoir	2.1E-02	2.2E-03	Harrison et al. (2009)
Lake/Reservoir	8.3E-03	1.6E-03	Harrison et al. (2009)
Lake/Reservoir	4.1E-03	4.7E-03	Harrison et al. (2009)
Lake/Reservoir	2.2E-03	1.7E-03	Harrison et al. (2009)
Lake/Reservoir	1.0E-01	1.4E-02	Harrison et al. (2009)
Lake/Reservoir	1.4E-03	3.7E-04	Harrison et al. (2009)
Lake/Reservoir	3.4E-03	9.0E-04	Harrison et al. (2009)
Lake/Reservoir	2.0E-02	8.6E-03	Harrison et al. (2009)
Lake/Reservoir	6.7E-02	1.6E-02	Harrison et al. (2009)
Lake/Reservoir	1.7E-03	3.0E-03	Harrison et al. (2009)
Lake/Reservoir	9.1E-03	1.1E-02	Harrison et al. (2009)
Lake/Reservoir	1.5E-02	7.1E-03	Harrison et al. (2009)
Lake/Reservoir	2.7E-02	7.1E-03	Harrison et al. (2009)
Lake/Reservoir	9.1E-03	2.7E-03	Harrison et al. (2009)
Lake/Reservoir	9.1E-02	1.2E-02	Harrison et al. (2009)
Hillslope	7.1E-01	2.1E-01	Ocampo et al. (2006)

System	Transport Rate (d^{-1})	Reaction Rate (d^{-1})	Reference
Hillslope	1.0E-03	8.0E-03	Ocampo et al. (2006)
Hillslope	9.1E-02	1.8E-01	Ocampo et al. (2006)
Hillslope	1.2E-01	6.7E-02	Ocampo et al. (2006)
Hillslope	1.7E+00	3.4E-01	Ocampo et al. (2006)
Hillslope	2.5E+00	3.4E-01	Ocampo et al. (2006)
Hillslope	1.0E+00	7.1E-01	Ocampo et al. (2006)
Hillslope	1.0E-01	2.9E-01	Ocampo et al. (2006)
Hillslope	9.1E-01	1.0E-01	Ocampo et al. (2006)
Hillslope	1.0E-01	1.5E-01	Ocampo et al. (2006)
Hillslope	4.5E-01	1.2E-01	Ocampo et al. (2006)
Hillslope	1.0E+00	1.2E-01	Ocampo et al. (2006)
Hillslope	2.0E+00	2.0E+00	Ocampo et al. (2006)
Hillslope	9.0E-03	1.5E-02	Ocampo et al. (2006)
Hillslope	1.2E-01	1.7E-01	Ocampo et al. (2006)
Hillslope	1.0E-01	9.1E-02	Ocampo et al. (2006)
Hillslope	2.8E-01	1.3E-01	Ocampo et al. (2006)
Hillslope	4.2E-01	1.3E-01	Ocampo et al. (2006)
Hillslope	2.0E-01	2.0E-02	Ocampo et al. (2006)
Hillslope	2.0E-02	3.4E-02	Ocampo et al. (2006)
Hillslope	3.4E-01	1.8E-05	Kaushal (2008)
Hillslope	3.7E-01	5.3E-03	Kaushal (2008)
Stream/River	8.9E+00	5.6E-01	Mulholland et al. (2008)
Stream/River	2.6E+01	1.1E+00	Mulholland et al. (2008)
Stream/River	7.9E+00	4.0E-01	Mulholland et al. (2008)
Stream/River	2.0E+01	1.7E+00	Mulholland et al. (2008)
Stream/River	1.4E+01	2.7E-01	Mulholland et al. (2008)
Stream/River	6.4E+00	1.9E-01	Mulholland et al. (2008)
Stream/River	3.6E+01	1.3E+00	Mulholland et al. (2008)
Stream/River	1.2E+01	1.3E-01	Mulholland et al. (2008)
Stream/River	1.8E+01	4.0E-01	Mulholland et al. (2008)
Stream/River	9.1E+01	1.1E-01	Mulholland et al. (2008)
Stream/River	4.5E+01	7.5E+00	Mulholland et al. (2008)
Stream/River	2.0E+02	5.0E-01	Mulholland et al. (2008)

System	Transport Rate (d^{-1})	Reaction Rate (d^{-1})	Reference
Stream/River	5.9E+01	2.0E+00	Mulholland et al. (2008)
Stream/River	7.1E+01	1.4E+00	Mulholland et al. (2008)
Stream/River	3.0E+01	8.3E-02	Mulholland et al. (2008)
Stream/River	4.2E+01	4.0E-01	Mulholland et al. (2008)
Stream/River	8.3E+01	1.4E+00	Mulholland et al. (2008)
Stream/River	5.0E+01	7.7E-01	Mulholland et al. (2008)
Stream/River	4.8E+01	1.4E-01	Mulholland et al. (2008)
Stream/River	1.0E+02	6.3E-01	Mulholland et al. (2008)
Stream/River	1.1E+02	2.5E+00	Mulholland et al. (2008)
Stream/River	2.9E+01	3.6E-02	Mulholland et al. (2008)
Stream/River	1.2E+01	3.6E+00	Mulholland et al. (2008)
Stream/River	3.4E+01	1.4E-01	Mulholland et al. (2008)
Stream/River	3.2E+01	5.9E-01	Mulholland et al. (2008)
Stream/River	1.4E+02	4.5E+00	Mulholland et al. (2008)
Stream/River	6.7E+01	7.7E+01	Mulholland et al. (2008)
Stream/River	3.8E+01	1.6E-01	Mulholland et al. (2008)
Stream/River	7.1E+01	1.4E+00	Mulholland et al. (2008)
Stream/River	1.0E+02	3.8E-01	Mulholland et al. (2008)
Stream/River	1.6E+01	4.0E-01	Mulholland et al. (2008)
Stream/River	1.7E+02	8.5E+00	Mulholland et al. (2008)
Stream/River	2.5E+02	2.0E+00	Mulholland et al. (2008)
Stream/River	9.9E+00	1.4E-01	Mulholland et al. (2008)
Stream/River	6.9E+00	7.1E-02	Mulholland et al. (2008)
Stream/River	6.2E+00	1.1E-01	Mulholland et al. (2008)
Stream/River	3.6E+01	4.0E-01	Mulholland et al. (2008)
Stream/River	3.4E+01	9.1E-01	Mulholland et al. (2008)
Stream/River	2.2E+01	1.7E+00	Mulholland et al. (2008)
Stream/River	5.6E+01	4.8E-01	Mulholland et al. (2008)
Stream/River	1.5E+01	5.9E-01	Mulholland et al. (2008)
Stream/River	5.9E+01	1.7E-01	Mulholland et al. (2008)
Stream/River	1.3E+01	9.1E-02	Mulholland et al. (2008)
Stream/River	1.3E+01	2.0E+00	Mulholland et al. (2008)
Stream/River	7.6E+00	6.3E-02	Mulholland et al. (2008)

System	Transport Rate (d^{-1})	Reaction Rate (d^{-1})	Reference
Stream/River	2.7E+01	4.8E-01	Mulholland et al. (2008)
Stream/River	2.3E+01	1.3E+00	Mulholland et al. (2008)
Stream/River	2.5E-02	5.5E-03	Seitzinger et al. (2002)
Stream/River	1.4E+00	9.1E-02	Seitzinger et al. (2002)
Stream/River	1.7E+01	1.7E-01	Seitzinger et al. (2002)
Stream/River	3.0E+01	3.5E+00	Seitzinger et al. (2002)
Stream/River	1.7E+01	2.0E+00	Seitzinger et al. (2002)
Stream/River	7.4E-03	3.2E-03	Seitzinger et al. (2002)
Stream/River	0.0E+00	3.3E+00	Seitzinger et al. (2002)
Stream/River	1.0E+01	3.3E+00	Seitzinger et al. (2002)
Stream/River	3.7E-01	5.9E-02	Seitzinger et al. (2002)
Stream/River	1.3E+00	2.9E-01	Seitzinger et al. (2002)
Groundwater	1.1E-04	4.9E-05	Green et al. (2008)
Groundwater	2.5E-04	4.5E-04	Green et al. (2008)
Groundwater	2.4E-03	1.2E-03	Green et al. (2008)
Groundwater	2.0E-04	1.1E-04	Green et al. (2008)
Groundwater	1.7E-04	1.2E-03	Green et al. (2008)
Groundwater	6.7E-04	2.7E-05	Green et al. (2008)
Groundwater	2.5E-03	1.4E-05	Green et al. (2008)
Groundwater	5.5E-04	5.3E-06	Green et al. (2008)
Groundwater	4.6E-04	3.6E-06	Green et al. (2008)
Groundwater	4.6E-05	3.2E-04	Green et al. (2008)
Groundwater	4.5E-05	3.1E-04	Green et al. (2008)
Groundwater	4.6E-05	1.3E-04	Green et al. (2008)
Groundwater	5.8E-05	4.0E-04	Green et al. (2008)
Groundwater	5.5E-05	3.8E-04	Green et al. (2008)
Groundwater	5.5E-05	1.5E-04	Green et al. (2008)
Groundwater	6.2E-05	8.9E-05	Green et al. (2008)
Groundwater	7.0E-05	7.8E-05	Green et al. (2008)
Groundwater	6.6E-05	7.5E-05	Green et al. (2008)
Groundwater	5.1E-05	2.2E-05	Green et al. (2008)
Groundwater	5.1E-05	7.6E-06	Green et al. (2008)
Groundwater	4.7E-05	3.9E-06	Green et al. (2008)

System	Transport Rate (d^{-1})	Reaction Rate (d^{-1})	Reference
Groundwater	5.4E-05	3.1E-07	Green et al. (2008)
Groundwater	6.5E-05	3.8E-07	Green et al. (2008)
Groundwater	9.3E-05	2.6E-05	Green et al. (2008)
Groundwater	1.1E-04	2.5E-05	Green et al. (2008)
Groundwater	1.1E-04	2.7E-05	Green et al. (2008)
Groundwater	1.3E-04	3.4E-05	Green et al. (2008)
Groundwater	1.6E-04	2.2E-05	Green et al. (2008)
Groundwater	1.8E-04	1.5E-05	Green et al. (2008)
Groundwater	2.5E-04	1.0E-06	Green et al. (2008)
Groundwater	3.1E-04	3.1E-06	Green et al. (2008)
Groundwater	2.8E-04	8.4E-06	Green et al. (2008)
Groundwater	3.5E-04	1.4E-05	Green et al. (2008)
Groundwater	3.0E-04	1.9E-05	Green et al. (2008)

Table 9 – State of Hawaii Department of Health - Marine Waters Class A Shoreline Discharge Criteria

§11-54-6

Waters are listed in Appendix C dated July 1, 2014, entitled "Class A, Marine Waters and Embayments", located at the end of this chapter.

(3) The following criteria are specific for all embayments excluding those described in section 11-54-6(d). (Note that criteria for embayments differ based on fresh water inflow.)

Parameter	Geometric mean not to exceed the given value	Not to exceed the given value more than ten per cent of the time	Not to exceed the given value more than two per cent of the time
Total Nitrogen (ug N/L)	200.00*	350.00*	500.00*
	150.00**	250.00**	350.00**
Nitrate + Nitrite Nitrogen (ug $[NO_3 + NO_2]$-N/L)	8.00*	20.00*	35.00*
	5.00**	14.00**	25.00**
Ammonia Nitrogen (ug NH_4-N/L)	6.00*	13.00*	20.00*
	3.50**	8.50**	15.00**
Total Phosphorus (ug P/L)	25.00*	50.00*	75.00*
	20.00**	40.00**	60.00**
Chlorophyll a (ug/L)	1.50*	4.50*	8.50*
	0.50**	1.50**	3.00**
Turbidity (N.T.U.)	1.5*	3.00*	5.00*
	0.40**	1.00**	1.50**

* "Wet" criteria apply when the average fresh water inflow from the land equals or exceeds one per cent of the embayment volume per day.
** "Dry" criteria apply when the average fresh water inflow from the land is less than one per cent of the embayment volume per day.
Applicable to both "wet" and "dry" conditions:
L = liter.
N.T.U. - Nephelometric Turbidity Units are used to measure changes in the intensity of light scattered by

54-42

Reference: Hawaii Department of Health, 2021. Amendment and Compilation of Chapter 11-54 Hawaii Administrative Rules, October 22.

Table 10 – State of Hawaii Department of Health – Inland Waters Discharge Criteria

Parameter	Geometric mean not to exceed the given value	Not to exceed the given value more than ten per cent of the time	Not to exceed the given value more than two per cent of the time
Total Nitrogen (ug N/L)	250.0* 180.0**	520.0* 380.0**	800.0* 600.0**
Nitrate + Nitrite Nitrogen (ug $[NO_3 + NO_2]$-N/L)	70.0* 30.0**	180.0* 90.0**	300.0* 170.0**
Total Phosphorus (ug P/L)	50.0* 30.0**	100.0* 60.0**	150.0* 80.0**
Total Suspended Solids (mg/L)	20.0* 10.0**	50.0* 30.0**	80.0* 55.0**
Turbidity (N.T.U.)	5.0* 2.0**	15.0* 5.5**	25.0* 10.0**

* Wet season - November 1 through April 30.
** Dry season - May 1 through October 31.
L = liter.
N.T.U. - Nephelometric Turbidity Units are used to measure changes in the intensity of light scattered by

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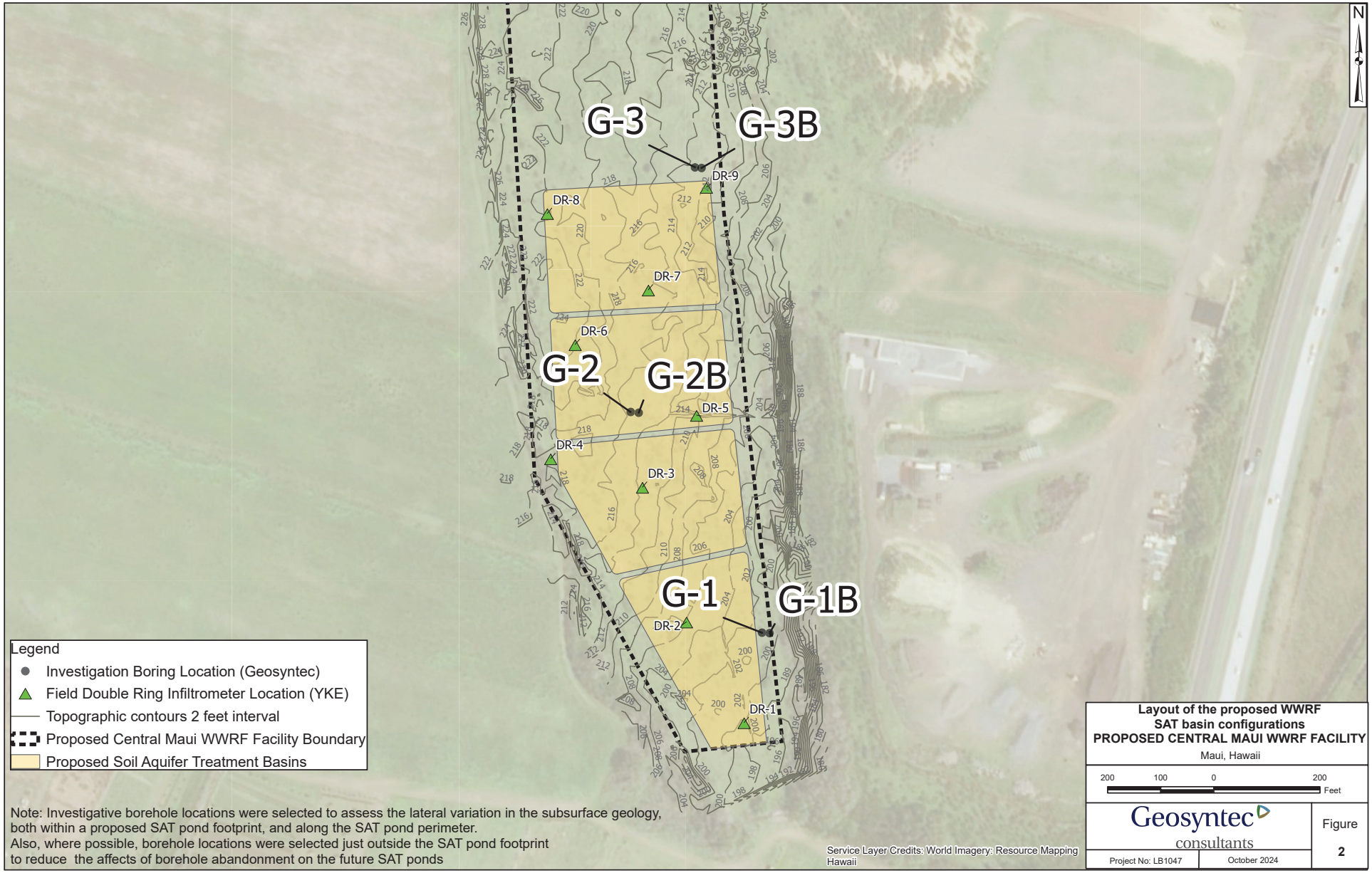
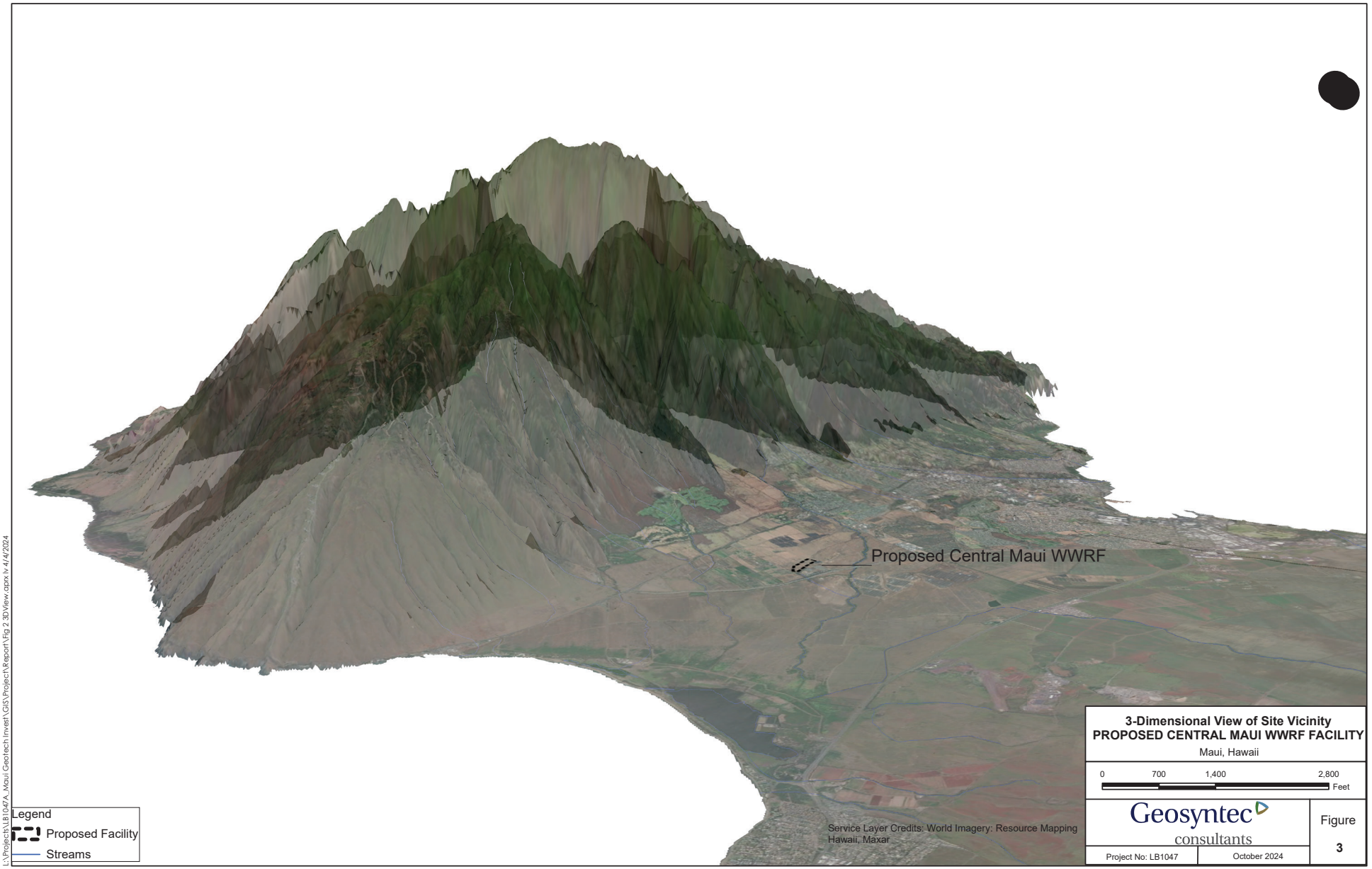
Hawaii Department of Health, 2021. Amendment and Compilation of Chapter 11-54 Hawaii Administrative Rules, October 22.

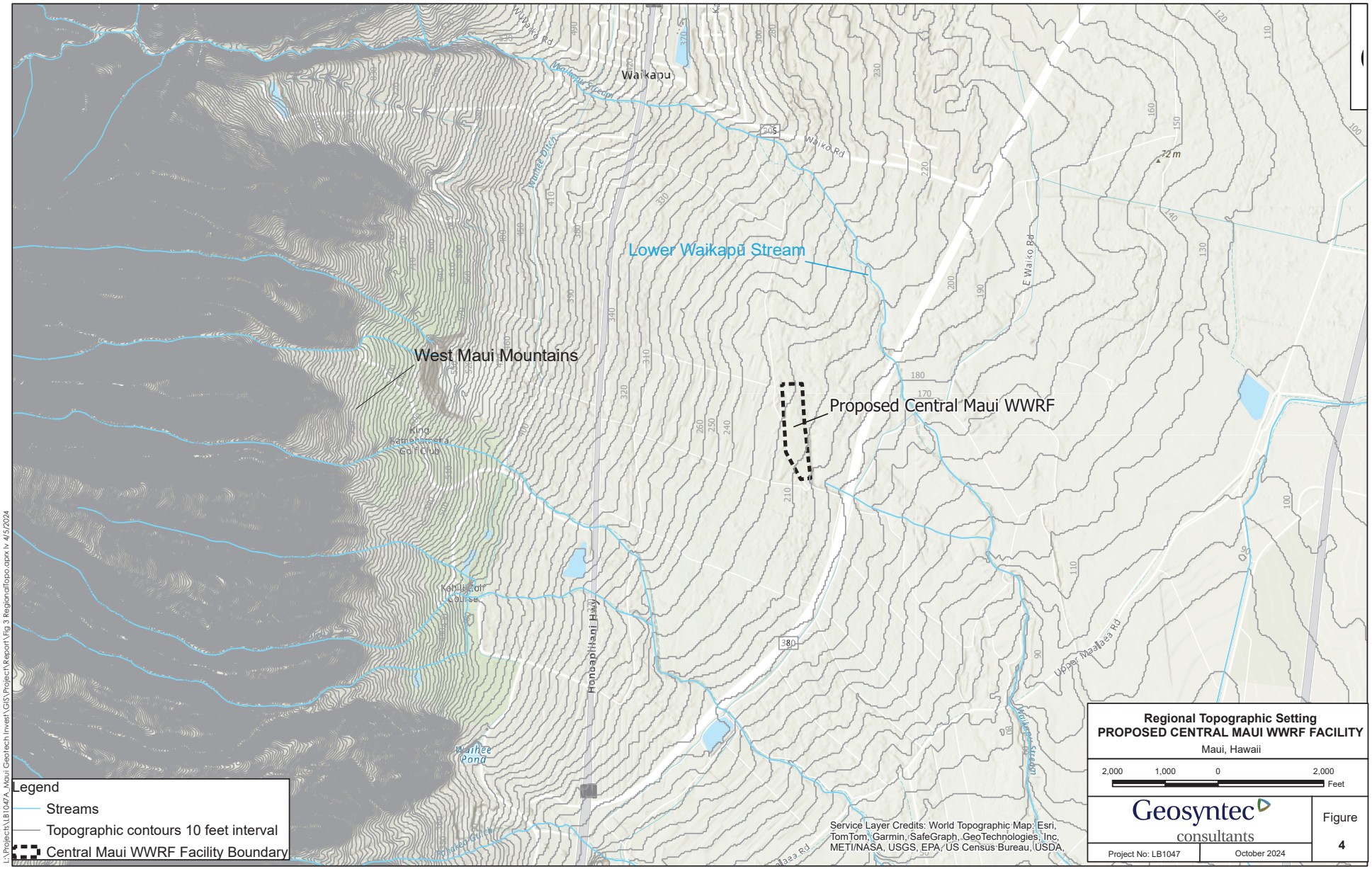
FIGURES

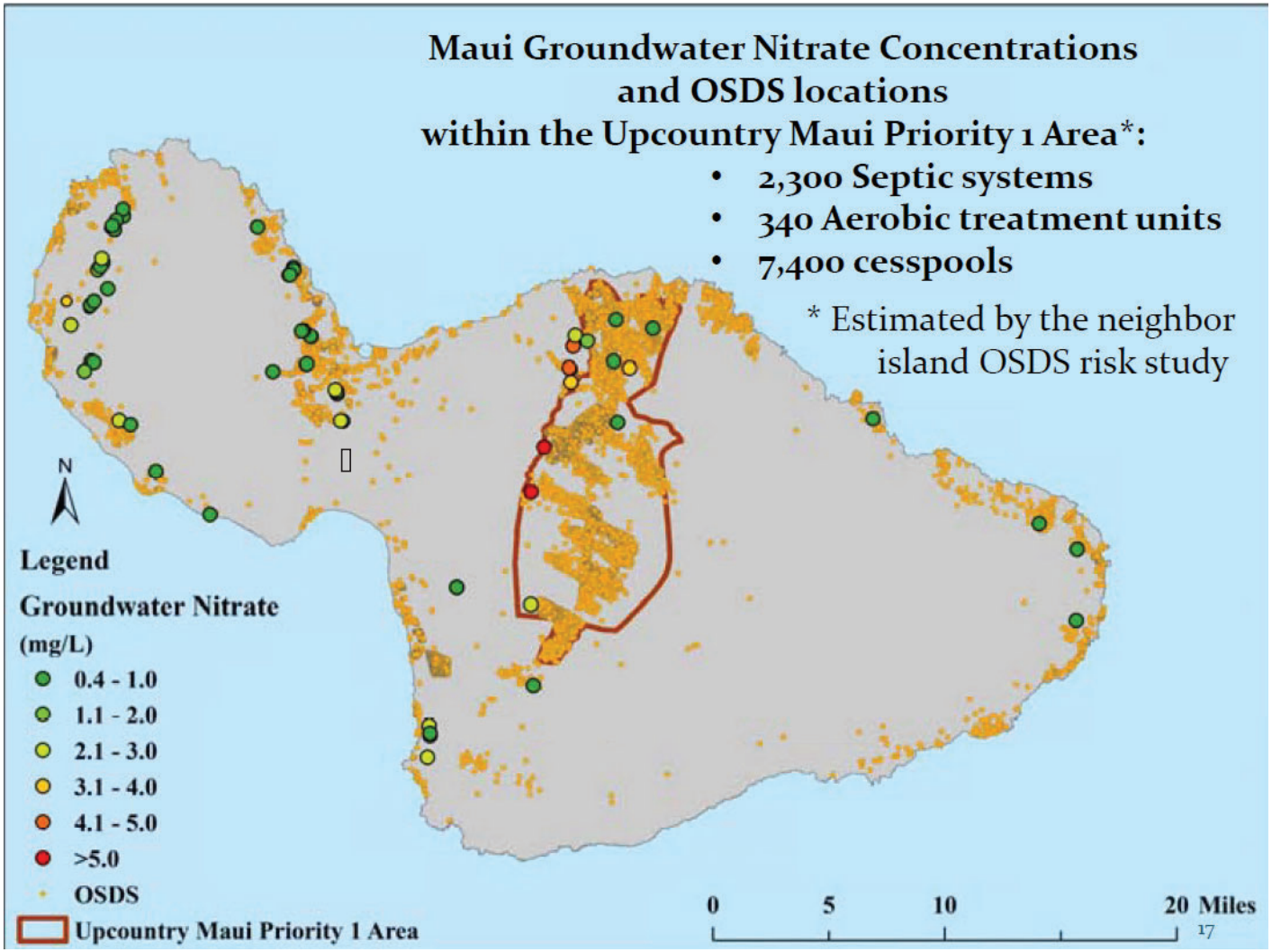
Figures

Honolulu
Kahului
Kihei
Waiehu Camp
Waihee-Waiehu
South Waiehu Stream
Wailuku
Kahului
Maui Country Club
Kahului Airport
Kanaha Pond State Wildlife Sanctuary
Iao Valley State Monument
Iao Valley
The Dunes at Maui Lani Golf Course
Puunene
Waikapu
Waikapu Stream
PROPOSED CENTRAL MAUI WWRF FACILITY
Maalaea
Pulehunui Hawaiian Home Land
Kealia Pond National Wildlife Refuge
Ukumehame Reservoirs
Ukumehame Park
Ukumehame Gulch
Pohakea Gulch
Honokowai Gulch
Kihei
Waihee Ditch
Everett Ditch
Haiku Ditch
Upper Maalaea Rd
Upper Kihei Rd
S Firebreak Rd
N Firebreak Rd
Hansen Rd
Hookele St
Lono Ave
Ani St
Division Rd
Waiale Rd
S Alu Rd
Kuikahi Dr
Lower Main St
Eha St
Maika St
Stable Rd
Pulehu Rd
Pulehu Gulch
Waiakoa Rd
Honokowai Gulch
1615 m
1388 m
99 m
87 m
83 m
N
Site Location Map
PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii
1 0.5 0 1
Miles
Geosyntec consultants
Figure 1
Project No: LB1047
October 2024
Service Layer Credits: World Topographic Map: Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, USDA, USFWS
World Imagery: Earthstar Geographics
World Hillshade: Esri, NASA, NGA, USGS, FEMA
World Street Map: Esri, HERE, Garmin, NGA, USGS
L:\Projects\LB1047_Maui_WWTF\ GIS \Projects \Report\ Fig1_SiteLocation.aprx lv 10/1/2024


G-3
G-3B
DR-9
DR-8
DR-7
DR-6
G-2
G-2B
DR-5
DR-4
DR-3
G-1
G-1B
DR-2
DR-1
N
Legend
Investigation Boring Location (Geosyntec)
Field Double Ring Infiltrometer Location (YKE)
Topographic contours 2 feet interval
Proposed Central Maui WWRF Facility Boundary
Proposed Soil Aquifer Treatment Basins
Note: Investigative borehole locations were selected to assess the lateral variation in the subsurface geology, both within a proposed SAT pond footprint, and along the SAT pond perimeter.
Also, where possible, borehole locations were selected just outside the SAT pond footprint to reduce the affects of borehole abandonment on the future SAT ponds
Service Layer Credits: World Imagery: Resource Mapping Hawaii
Layout of the proposed WWRF SAT basin configurations
PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii
200 100 0 200
Feet
Geosyntec consultants
Figure 2
Project No: LB1047
October 2024
L:\Projects\LB1047_Maui_WWTF\GIS\Projects\Report\Proposed\WWRFSAT_basin.aprx\Lyt 9/23/2024


Proposed Central Maui WWRF
Legend
Proposed Facility
Streams
Service Layer Credits: World Imagery: Resource Mapping Hawaii, Maxar
3-Dimensional View of Site Vicinity
PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii
0
700
1,400
2,800
Feet
Geosyntec consultants
Figure
3
Project No: LB1047
October 2024
L:\Projects\LB1047A_Maui Geotech Invest\GIS\Project\Report\Fig 2 3DView.aprx lv 4/4/2024


Waikapu
Lower Waikapu Stream
West Maui Mountains
Proposed Central Maui WWRF
Honoapiilani Hwy
Waiko Rd
E Waiko Rd
Upper Waiaka Rd
Waihee Pond
Kahili Golf Course
Legend
Streams
Topographic contours 10 feet interval
Central Maui WWRF Facility Boundary
Service Layer Credits: World Topographic Map: Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, US Census Bureau, USDA,
Regional Topographic Setting
PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii
2,000 1,000 0 2,000
Feet
Geosyntec consultants
Figure 4
Project No: LB1047
October 2024
L:\Projects\LB1047A_Maui Geotech Invest\GIS\Project\Report\Fig 3 RegionalTopo.aprx lv 4/5/2024

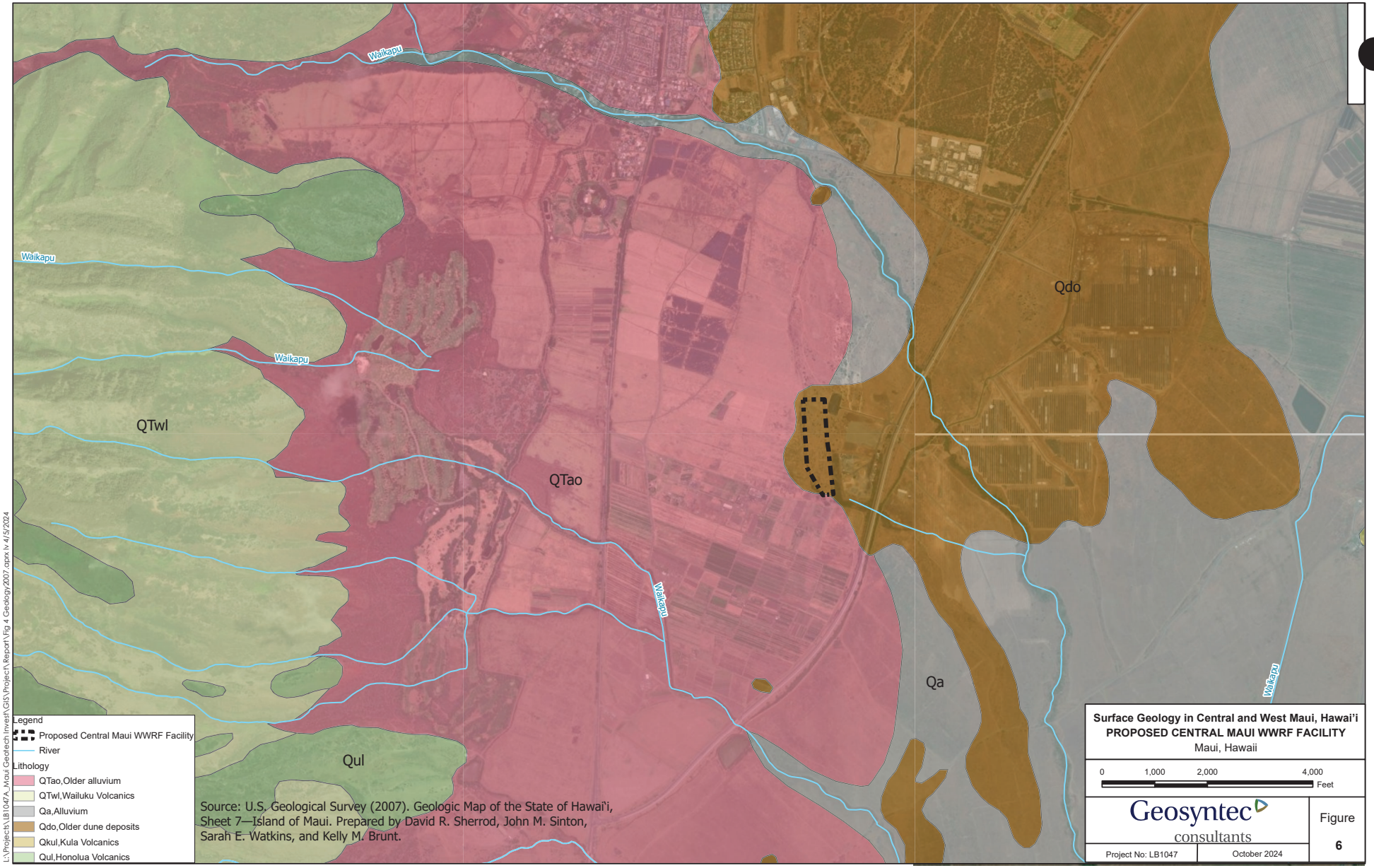


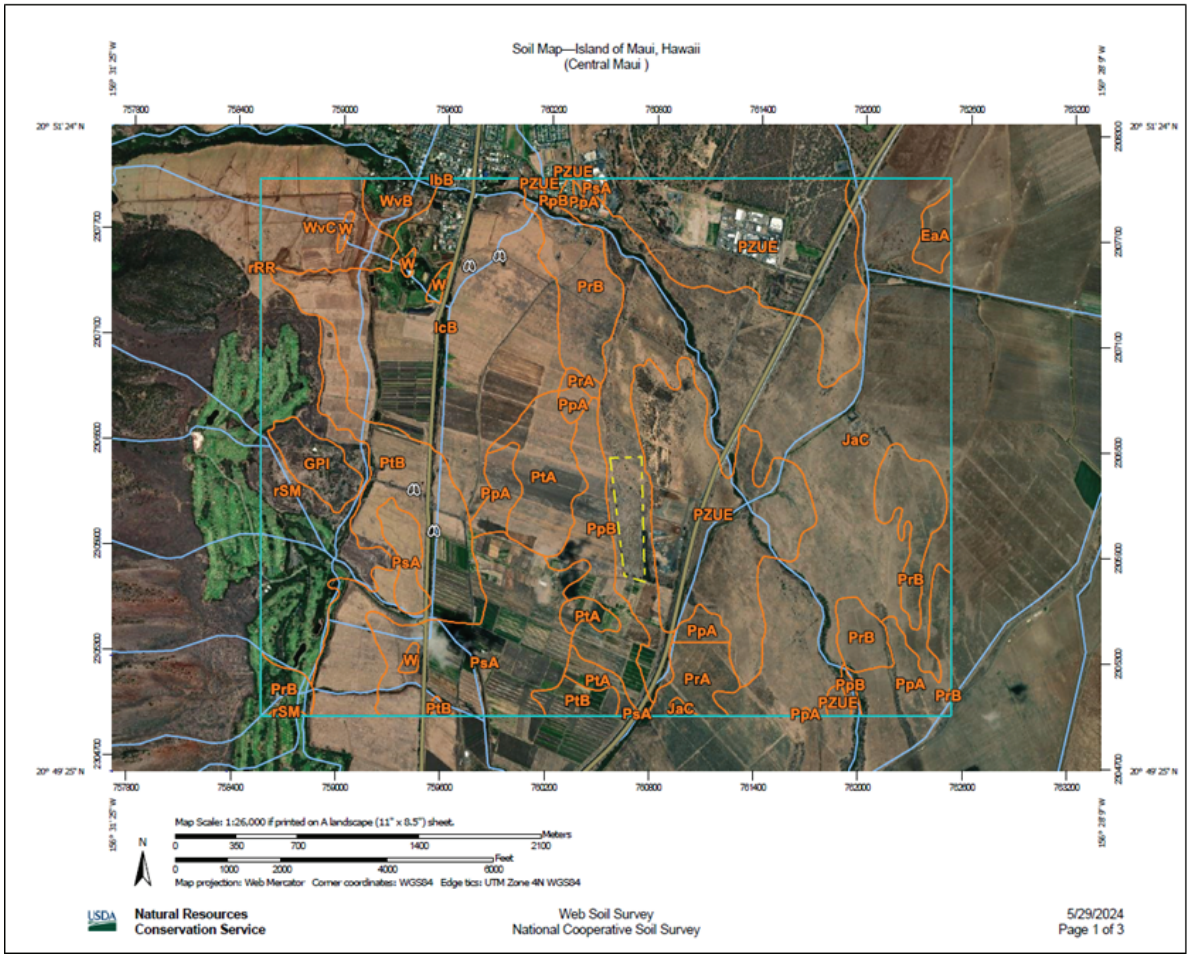
Proposed Central Maui WWRF location (approximate)

Source: Upcountry Maui Nitrate Contamination Investigation Work Plan and Sampling and Analysis Plan- June 2017

N

Groundwater Nitrate Concentrations and OSDS Locations		
PROPOSED CENTRAL MAUI WWRF FACILITY Maui, Hawaii		
Geosyntec consultants		Figure 5
Project No: LB1047	October 2024	


Waikapu
Waikapu
Waikapu
Waikapu
Waikapu
QTwl
QTao
Qdo
Qa
Qul
Legend
Proposed Central Maui WWRF Facility
River
Lithology
QTao,Older alluvium
QTwl,Wailuku Volcanics
Qa,Alluvium
Qdo,Older dune deposits
Qkul,Kula Volcanics
Qul,Honolua Volcanics
Source: U.S. Geological Survey (2007). Geologic Map of the State of Hawai'i, Sheet 7—Island of Maui. Prepared by David R. Sherrod, John M. Sinton, Sarah E. Watkins, and Kelly M. Brunt.
Surface Geology in Central and West Maui, Hawai'i
PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii
0
1,000
2,000
4,000
Feet
Geosyntec consultants
Figure
6
Project No: LB1047
October 2024
L:\Projects\LB1047A_Maui Geotech Invest\GIS\Project Report\Fig 4 Geology2007.qpx lv 4/5/2024



Map Unit Legend

Map Unit Symbol	Map Unit Name
EaA	Ewa silty clay loam, 0 to 3 percent slopes, MLRA 158
GPI	Gravel pits
IbB	Iao cobbly silty clay, 3 to 7 percent slopes
IcB	Iao clay, 3 to 7 percent slopes, MLRA 163
JaC	Jaucas sand, 0 to 15 percent slopes, MLRA 163
PpA	Pulehu silt loam, 0 to 3 percent slopes
PpB	Pulehu silt loam, 3 to 7 percent slopes
PrA	Pulehu cobbly silt loam, 0 to 3 percent slopes
PrB	Pulehu cobbly silt loam, 3 to 7 percent slopes
PsA	Pulehu clay loam, 0 to 3 percent slopes , MLRA 163
PtA	Pulehu cobbly clay loam, 0 to 3 percent slopes
PtB	Pulehu cobbly clay loam, 3 to 7 percent slopes
PZUE	Puuone sand, 7 to 30 percent slopes
rRR	Rough broken land
rSM	Stony alluvial land
W	Water > 40 acres
WvB	Wailuku silty clay, 3 to 7 percent slopes, MLRA 163
WvC	Wailuku silty clay, 7 to 15 percent slopes, MLRA 163

Reference: Natural Resources Conservation Service. Web Soil Survey URL: Coordinate System: Web Mercator (EPSG:3857)

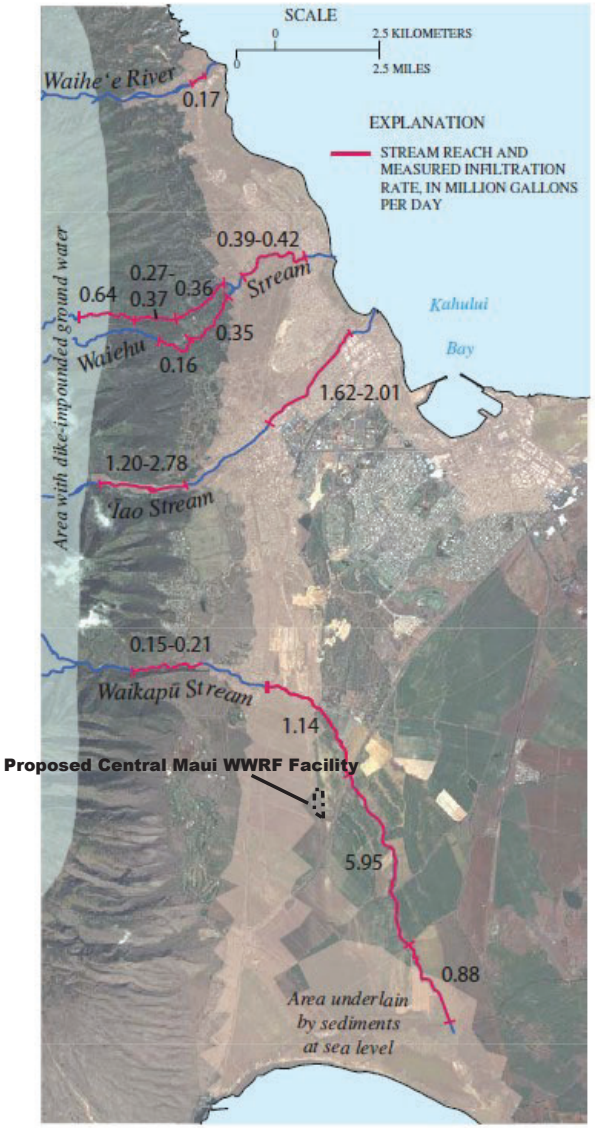
USDA Web Soil Survey Map, Central Maui WWRF Area

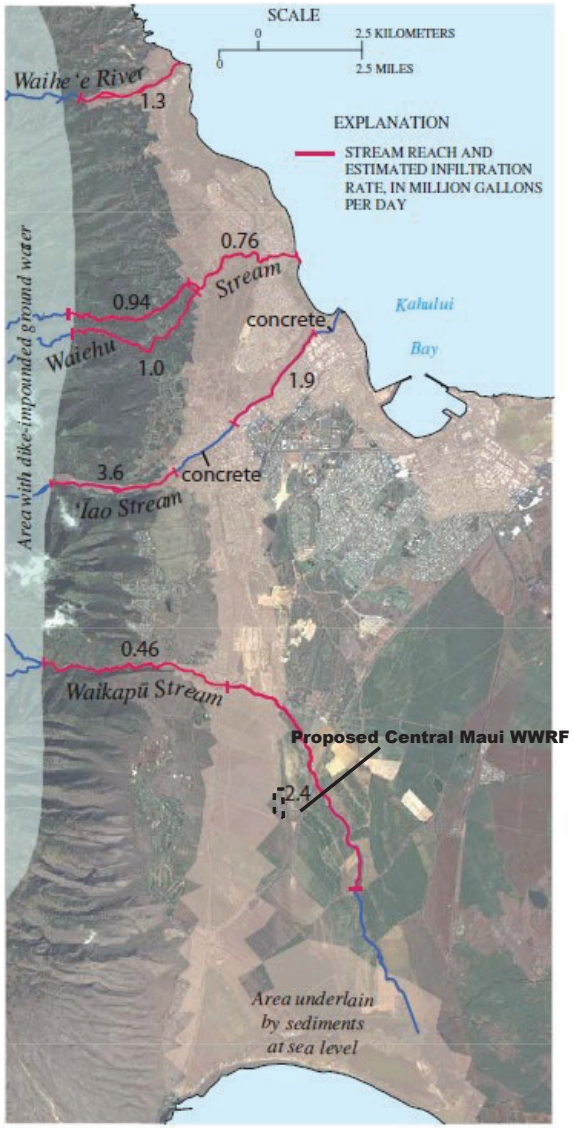
PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii

Geosyntec consultants

Project No: LB1047 | October 2024

Figure 7





Source: Gingerich, Stephen, 2008. Ground-Water Availability in the Wailuku Area, Maui, Hawai'i, Scientific Investigations Report 2008–5236.

Comparison of Measured Versus Estimated Waikapu Stream Reach Infiltration Rates (Million Gallons per Day)

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Maui, Hawaii

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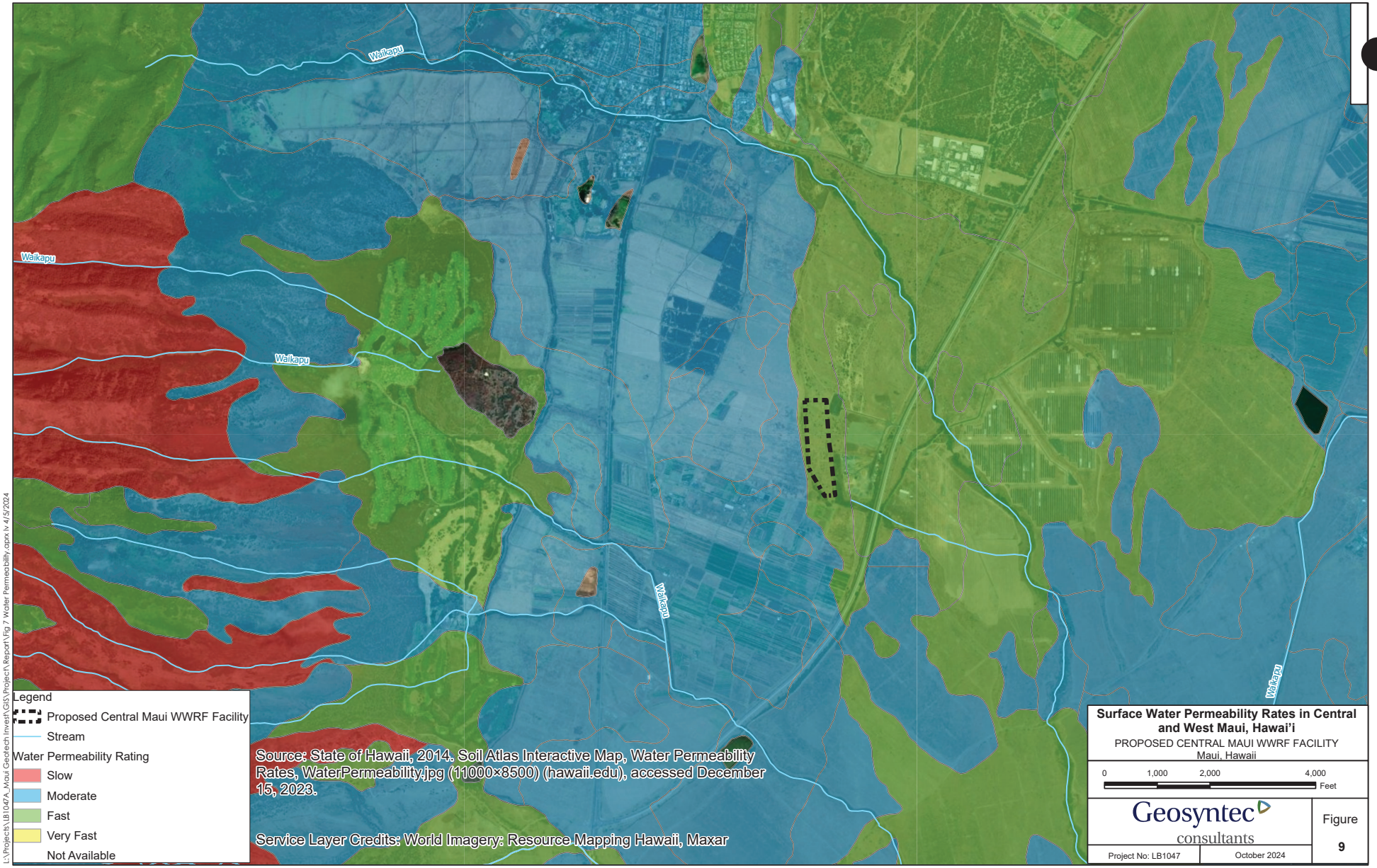
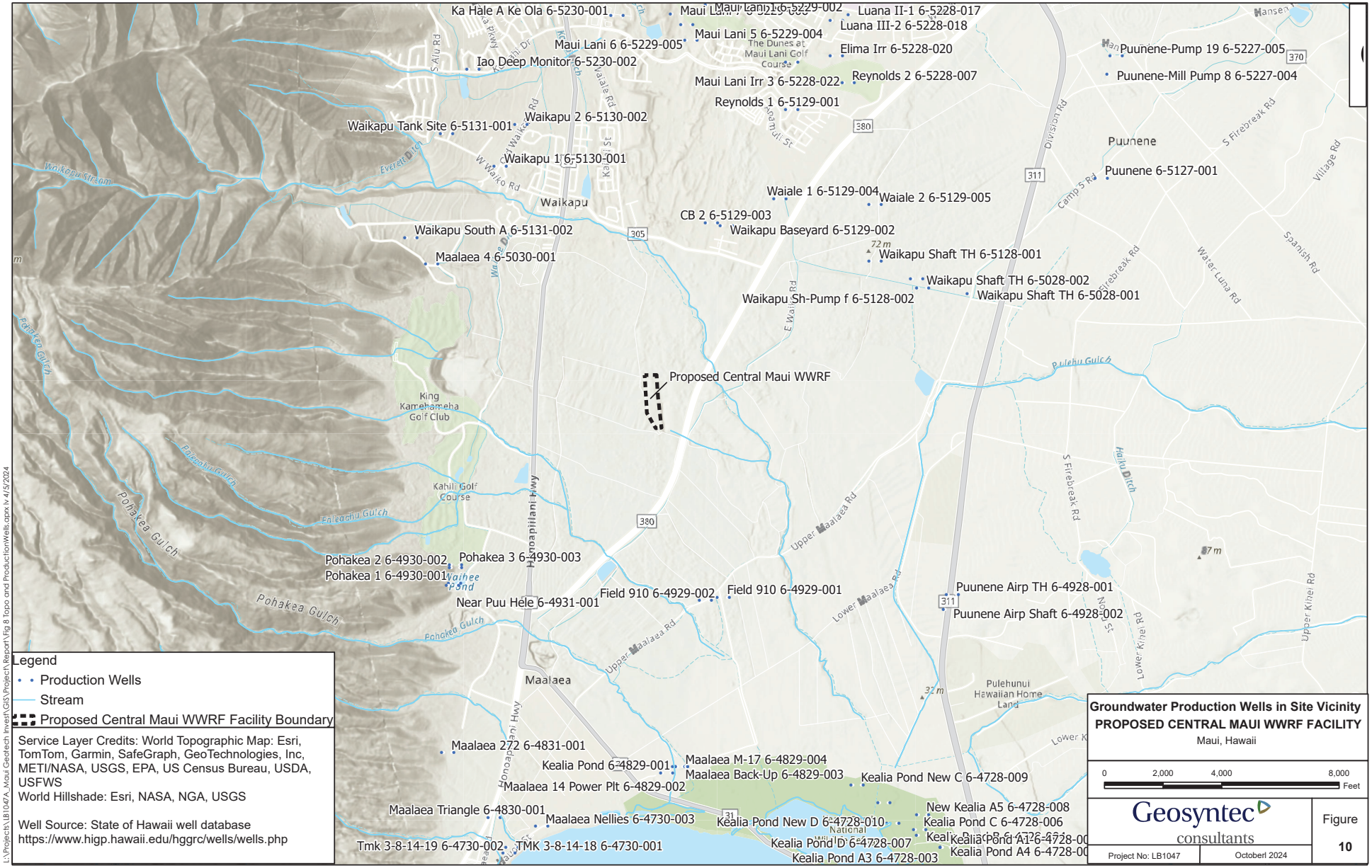
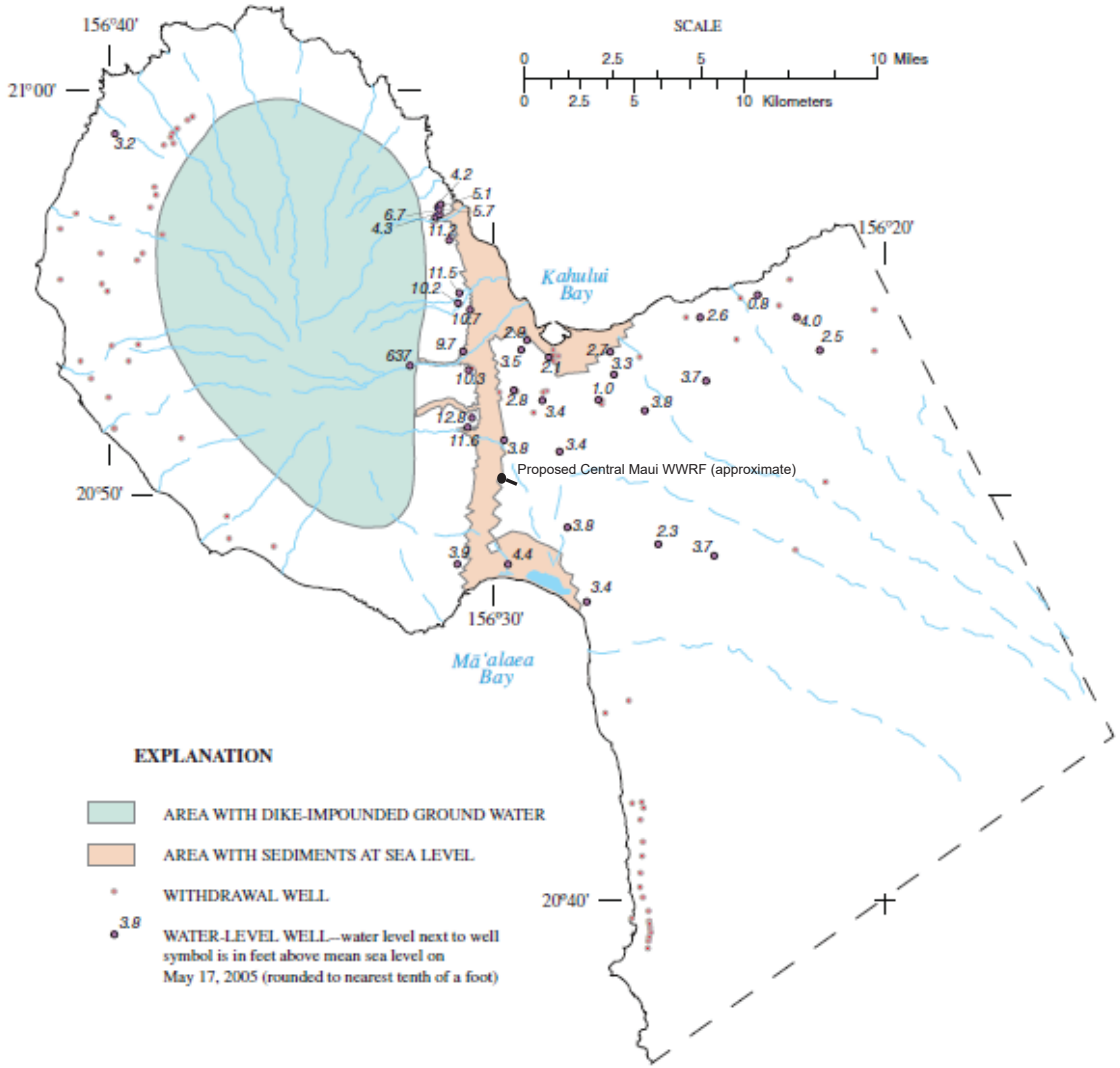
Figure 8


Waikapu
Waikapu
Waikapu
Waikapu
Waikapu
Legend
Proposed Central Maui WWRF Facility
Stream
Water Permeability Rating
Slow
Moderate
Fast
Very Fast
Not Available
Source: State of Hawaii, 2014. Soil Atlas Interactive Map, Water Permeability Rates, WaterPermeability.jpg (11000×8500) (hawaii.edu), accessed December 15, 2023.
Service Layer Credits: World Imagery: Resource Mapping Hawaii, Maxar
Surface Water Permeability Rates in Central and West Maui, Hawai'i
PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii
0
1,000
2,000
4,000
Feet
Geosyntec consultants
Figure
9
Project No: LB1047
October 2024
L:\Projects\LB1047A_Maui Geotech Invest\GIS\Project Report\Fig 7 Water Permeability.qpx lv 4/5/2024


Ka Hale A Ke Ola 6-5230-001
Maui Lani 1 6-5229-002
Luana II-1 6-5228-017
Luana III-2 6-5228-018
Maui Lani 5 6-5229-004
Maui Lani 6 6-5229-005
Elima Irr 6-5228-020
Iao Deep Monitor 6-5230-002
Maui Lani Irr 3 6-5228-022
Reynolds 2 6-5228-007
Reynolds 1 6-5129-001
Puunene-Pump 19 6-5227-005
Puunene-Mill Pump 8 6-5227-004
Waikapu Tank Site 6-5131-001
Waikapu 2 6-5130-002
Waikapu 1 6-5130-001
Puunene
Puunene 6-5127-001
Waiale 1 6-5129-004
Waiale 2 6-5129-005
Waikapu
CB 2 6-5129-003
Waikapu Baseyard 6-5129-002
Waikapu South A 6-5131-002
Maalaea 4 6-5030-001
Waikapu Shaft TH 6-5128-001
Waikapu Shaft TH 6-5028-002
Waikapu Sh-Pump f 6-5128-002
Waikapu Shaft TH 6-5028-001
Proposed Central Maui WWRF
King Kamehameha Golf Club
Kahili Golf Course
Pohakea 2 6-4930-002
Pohakea 3 6-4930-003
Pohakea 1 6-4930-001
Near Puu Hele 6-4931-001
Field 910 6-4929-002
Field 910 6-4929-001
Puunene Airp TH 6-4928-001
Puunene Airp Shaft 6-4928-002
Maalaea
Pulehunui Hawaiian Home Land
Maalaea 272 6-4831-001
Kealia Pond 6-4829-001
Maalaea M-17 6-4829-004
Maalaea Back-Up 6-4829-003
Maalaea 14 Power Plt 6-4829-002
Kealia Pond New C 6-4728-009
Maalaea Triangle 6-4830-001
Maalaea Nellies 6-4730-003
Kealia Pond New D 6-4728-010
New Kealia A5 6-4728-008
Kealia Pond C 6-4728-006
Tmk 3-8-14-19 6-4730-002
TMK 3-8-14-18 6-4730-001
Kealia Pond D 6-4728-007
Kealia Pond A1 6-4728-00
Kealia Pond A4 6-4728-00
Kealia Pond A3 6-4728-003
Legend
Production Wells
Stream
Proposed Central Maui WWRF Facility Boundary
Service Layer Credits: World Topographic Map: Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, US Census Bureau, USDA, USFWS
World Hillshade: Esri, NASA, NGA, USGS
Well Source: State of Hawaii well database https://www.higp.hawaii.edu/hggrc/wells/wells.php
Groundwater Production Wells in Site Vicinity
PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii
0 2,000 4,000 8,000 Feet
Geosyntec consultants
Figure 10
Project No: LB1047
October 2024
L:\Projects\LB1047A_Maui Geotech Invest\GIS\Project Report\Fig 8 Topo and ProductionWells.aprx lv 4/9/2024



N

Source: Gingerich, Stephen, 2008. Ground-Water Availability in the Wailuku Area, Maui, Hawai'i, Scientific Investigations Report 2008–5236. Figure 16B

Regional Groundwater Elevations – 2005

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Maui, Hawaii

Geosyntec consultants

Figure **11A**

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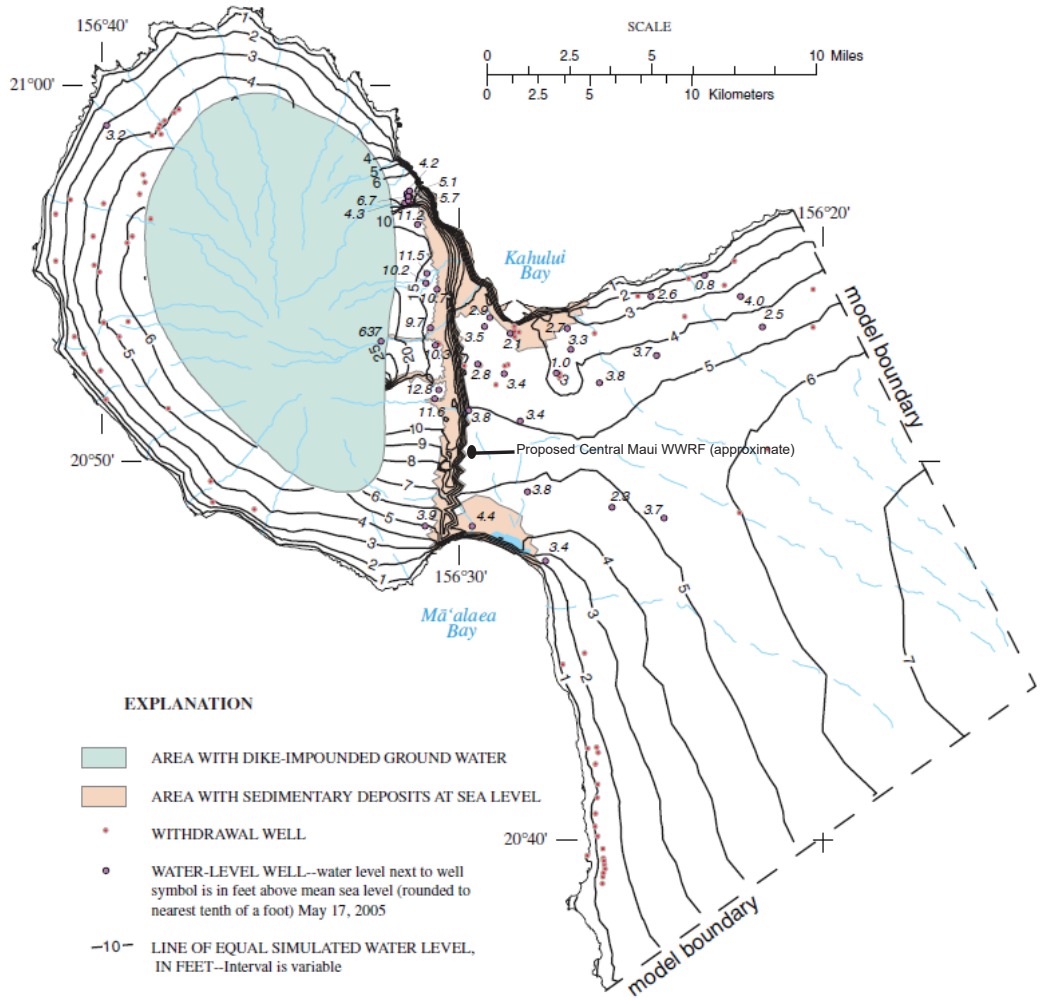
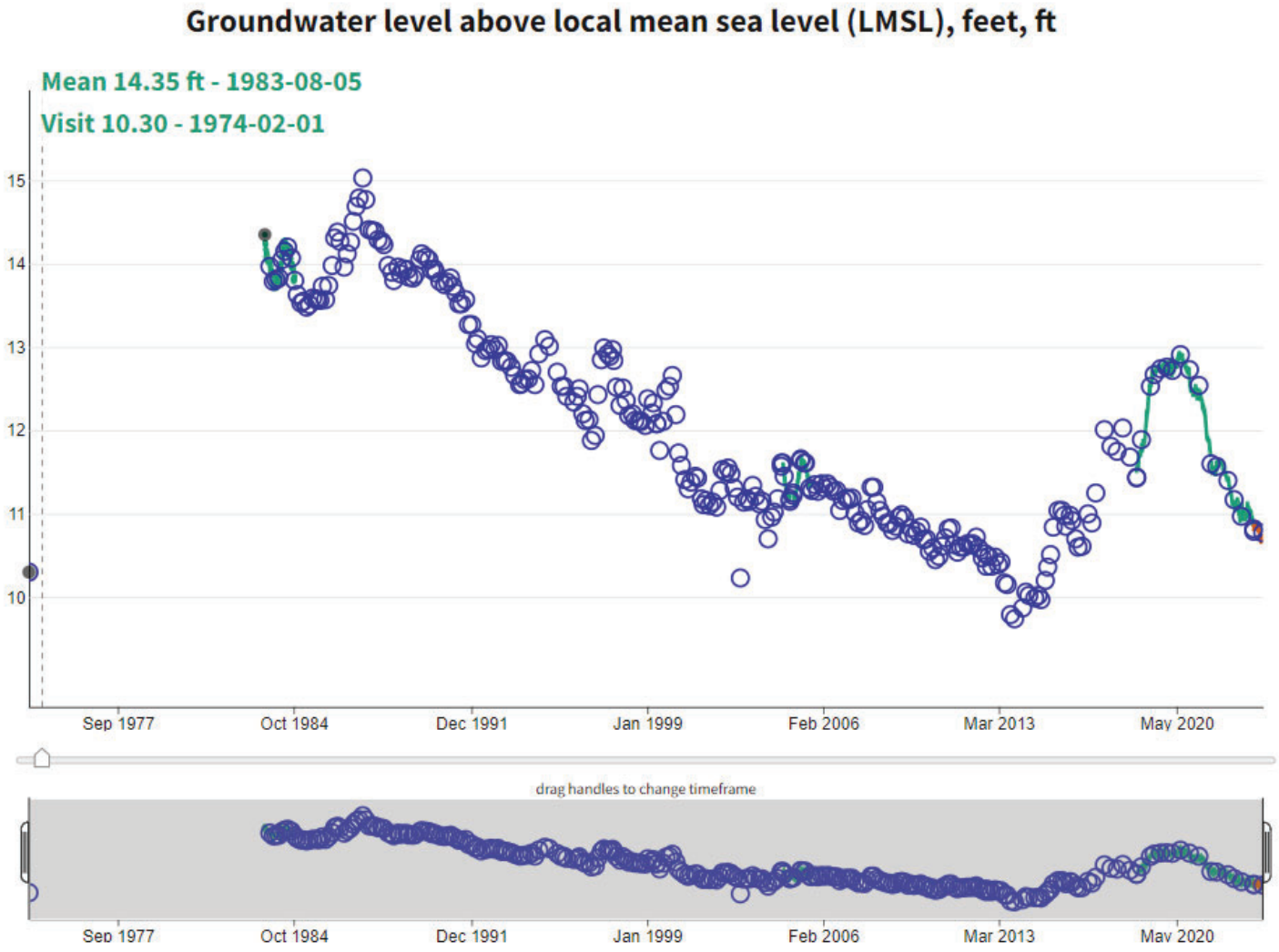
B



Source: Gingerich, Stephen, 2008. Ground-Water Availability in the Wailuku Area, Maui, Hawai'i, Scientific Investigations Report 2008–5236, Figure 26B.

Simulated Groundwater Contours-2005	
PROPOSED CENTRAL MAUI WWRF FACILITY Maui, Hawaii	
Geosyntec consultants	Figure **11B**
Project No: LB1047	October 2024

6-5130-02 Waikapu 2, Maui, HI - 205154156303801



Note: See Figure 8 for Waikapu Well 2 (6-5130-02) location

Source: USGS Water Data for the Nation https://waterdata.usgs.gov/monitoring-location/205154156303801/#parameterCode=72019&period=P1Y&showMedian=true

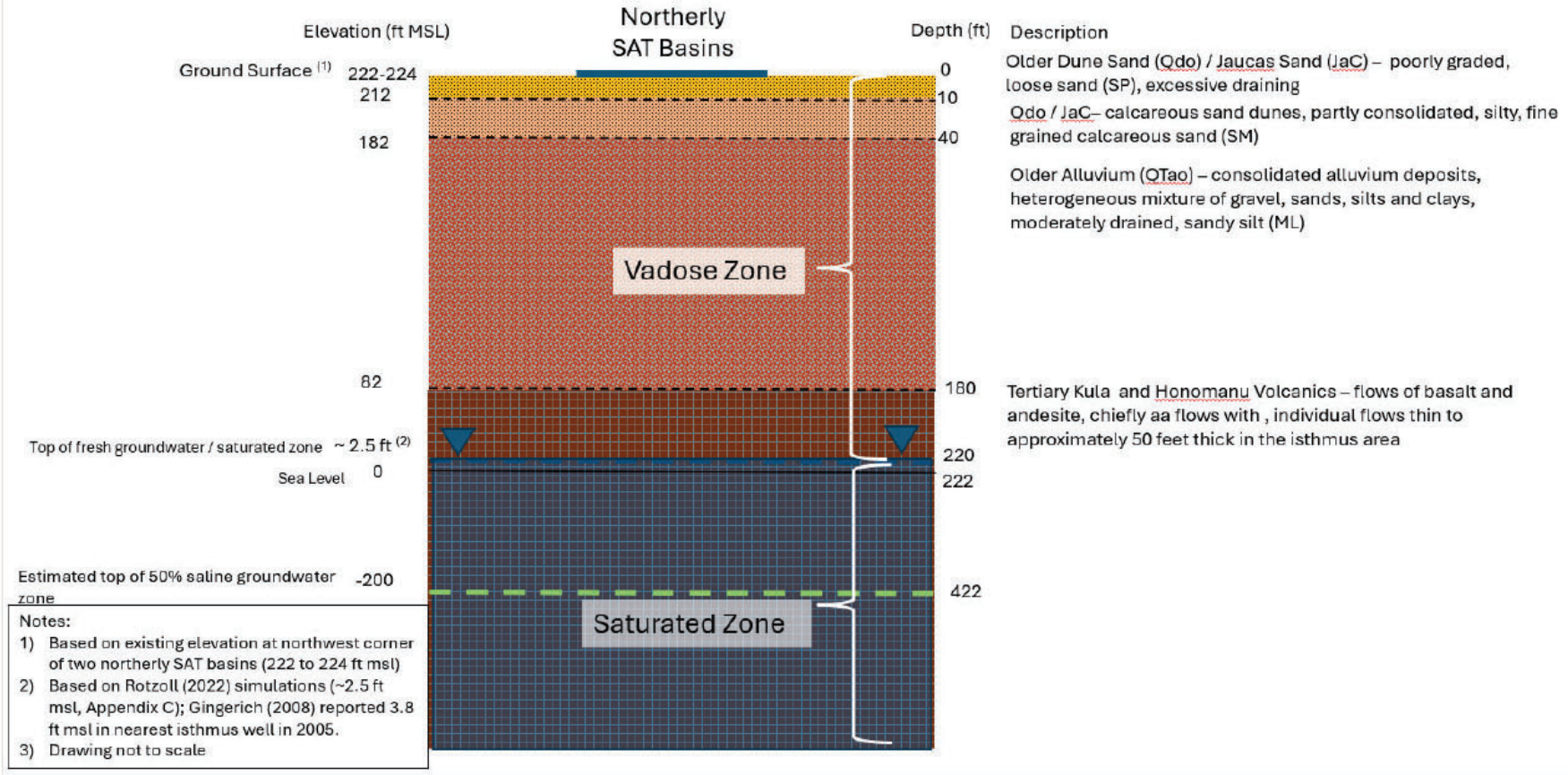
Waikapu Well No 2 Hydrograph

PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii

Geosyntec consultants

Figure **12**

Project No: LB1047 | October 2024



Conceptual Subsurface Profile at the Site

PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii

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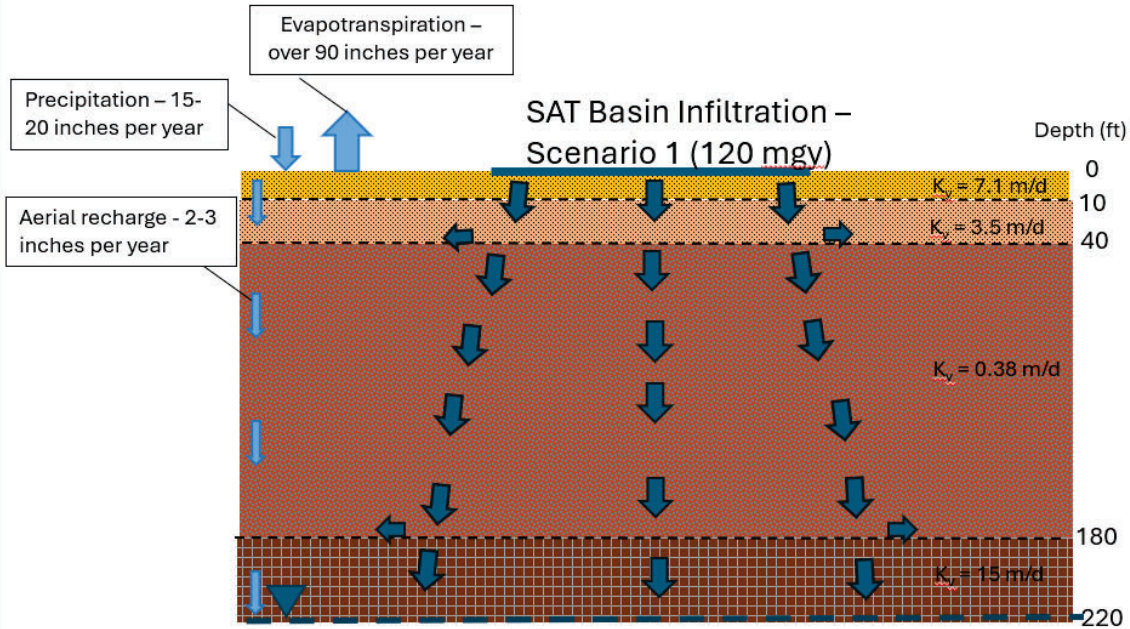
Figure 13



Legend:

Estimated SAT Basin excess recycled water infiltration flow

Estimated precipitation infiltration flow (recharge estimated at 2-3 inches per year from Rotzoll, 2022)

Notes:

1) Based on estimated thicknesses at the northwest corner of northerly basins (222 to 224 ft msl at surface)
2) Based on Rotzoll (2022) simulations (Appendix C; Gingerich (2008) reported 3.8 ft msl in nearest isthmus well in 2005.

Abbreviations:

mgy – million gallons per year (Scenario 1)

K_v – Estimated vertical hydraulic conductivity, m/d – meters per day

Conceptual Model of Vadose Zone Infiltration

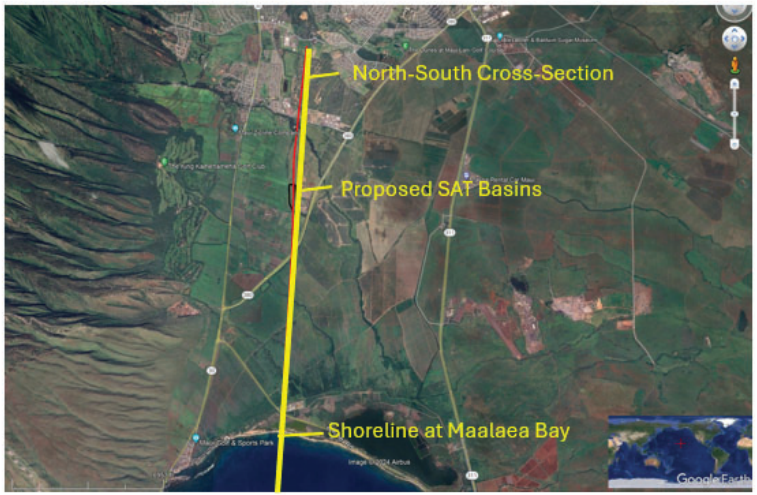
PROPOSED CENTRAL MAUI WWRF FACILITY

Maui, Hawaii

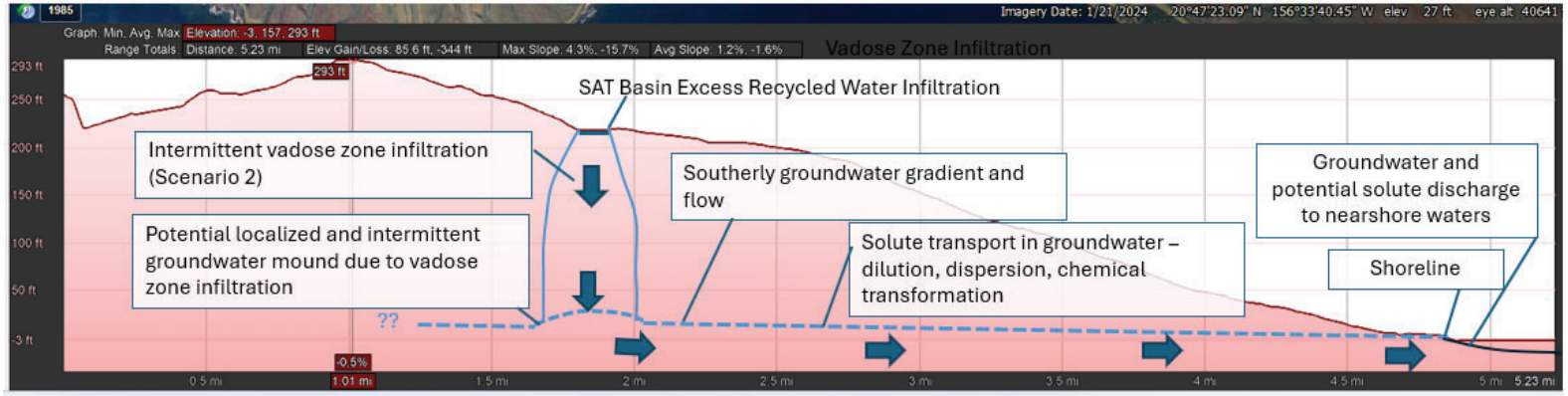
Geosyntec consultants

Project No: LB1047A | October 2024

Figure 14



Vertical Exaggeration ~ 17.5 :1



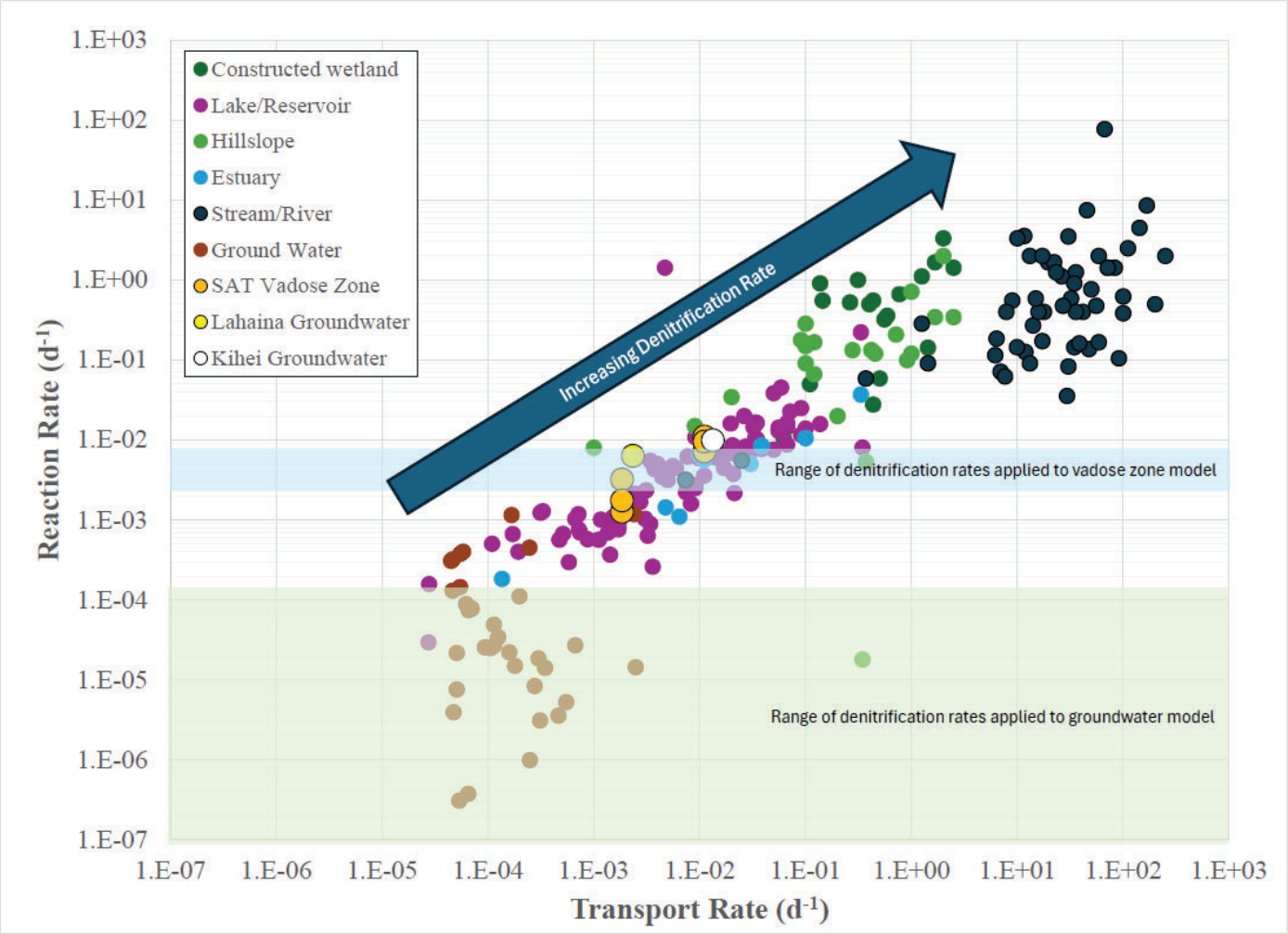
Conceptual Model of Regional SAT Basin Infiltration and Migration

PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii

Geosyntec consultants

Project No: LB1047A | October 2024

Figure **15**



Denitrification rates versus transport rates for various aquatic systems

PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii

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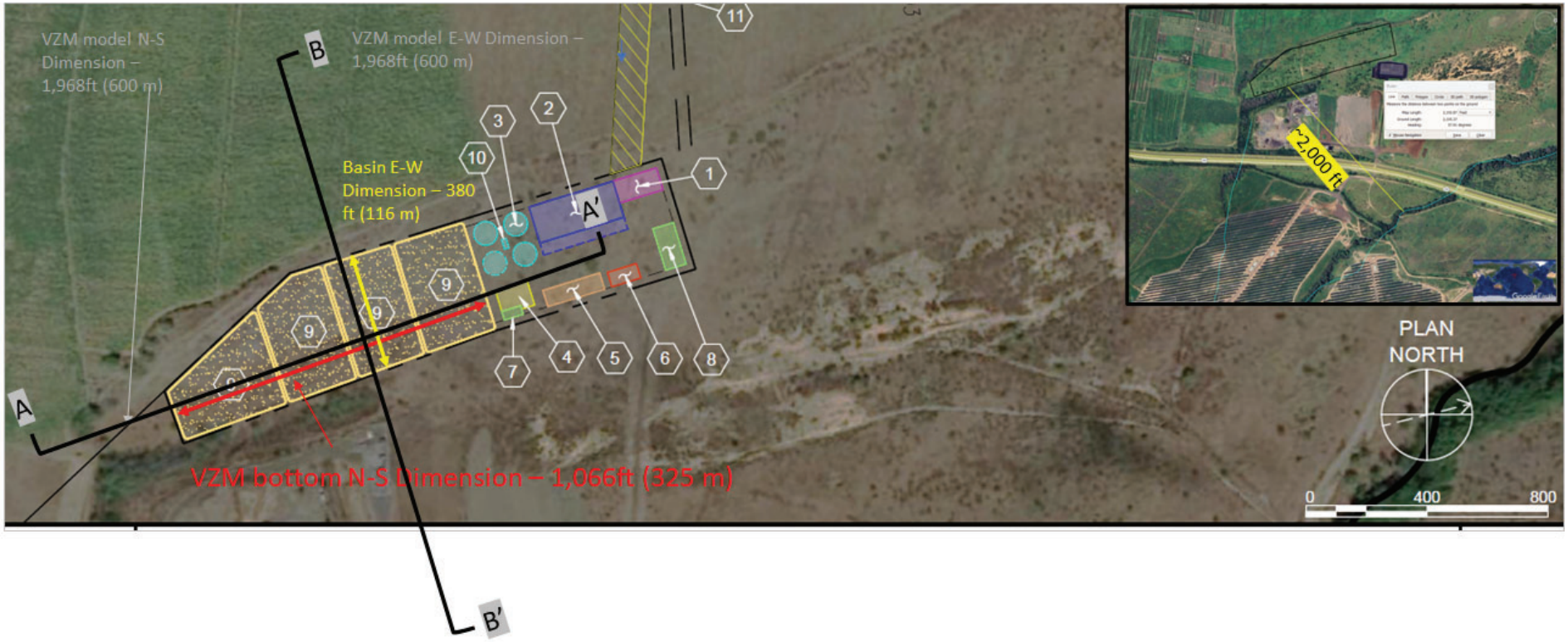
Figure **16**



HYDRUS Vadose Zone Model Cross-Section Locations (A-A' and B-B')

PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii

Geosyntec consultants

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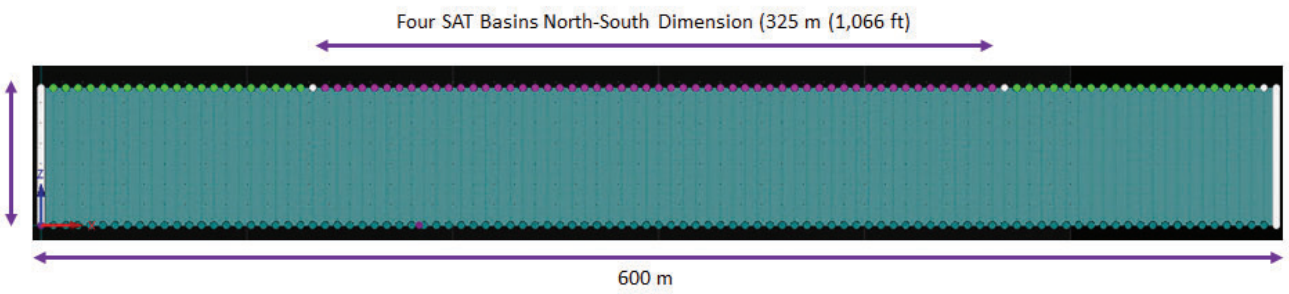
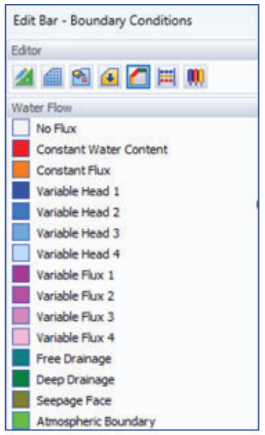
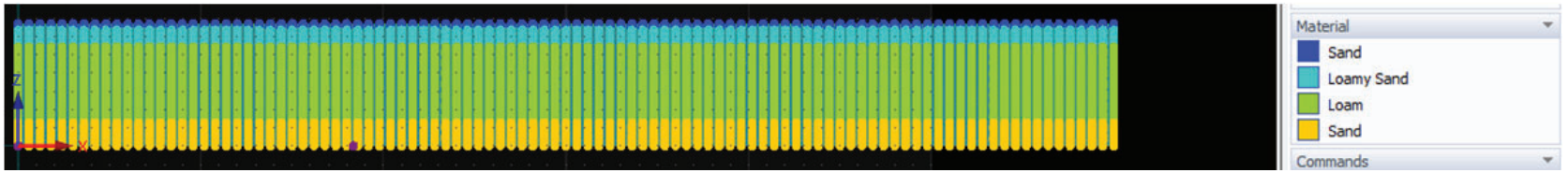
Figure 17

Liquid Flow Boundary Conditions





Material Properties



Scenario 1, Cross-Section A-A" - HYDRUS Vadose Zone North-South Model Dimensions, Boundary Conditions and Material Properties

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Maui, Hawaii

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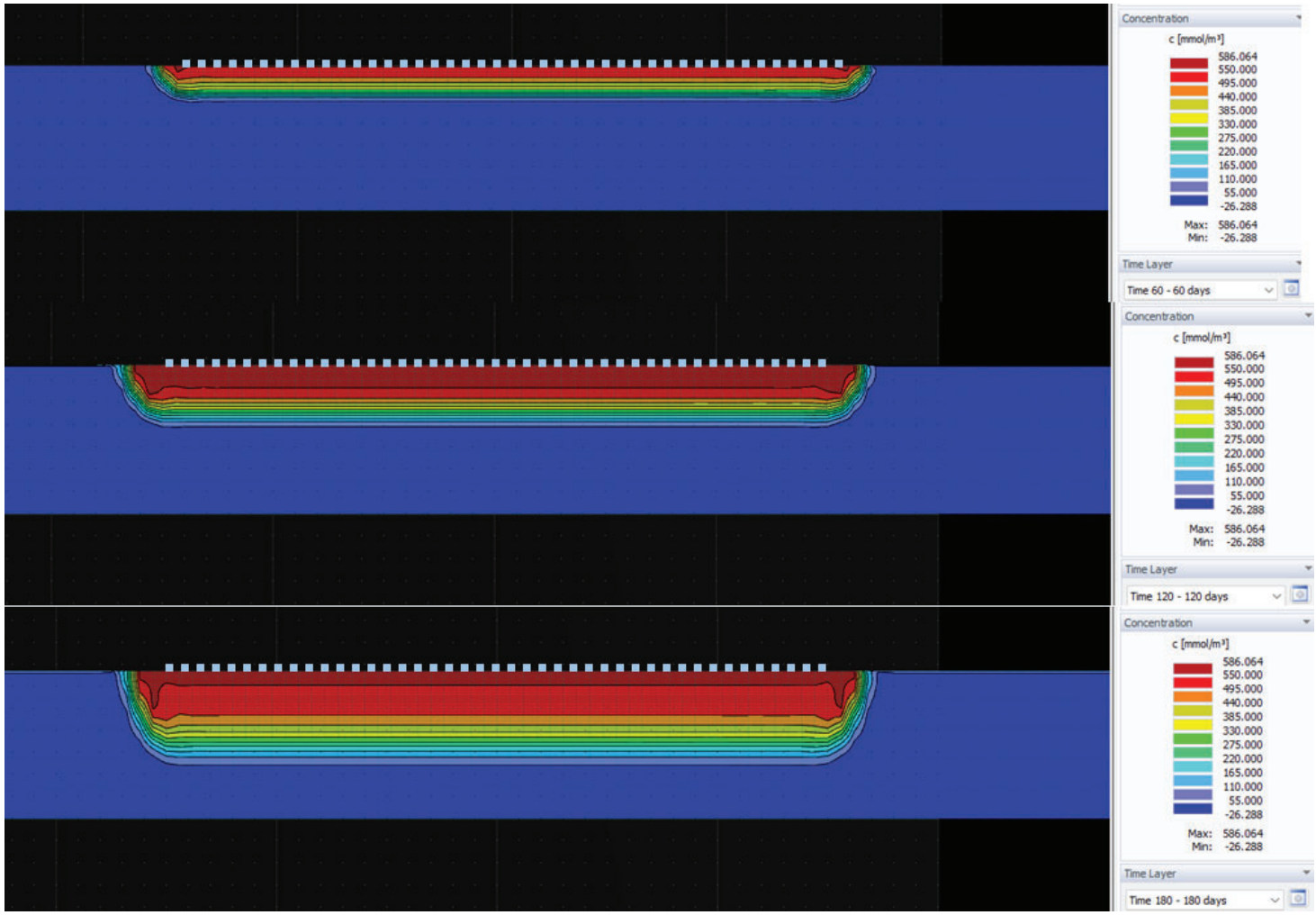
Figure **18**



60 Days

120 Days

180 Days

Notes:

1) $1.3 \times 10^{-3}\ d^{-1}$ denitrification rate applied
2) Dotted line symbolizes model infiltration flux boundary
3) 8 mgN/L = 571 $mmol/m^3$

Scenario 1, Cross-Section A-A'
HYDRUS Vadose Zone Model Nitrate Solute Concentration Migration Over Time

PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii

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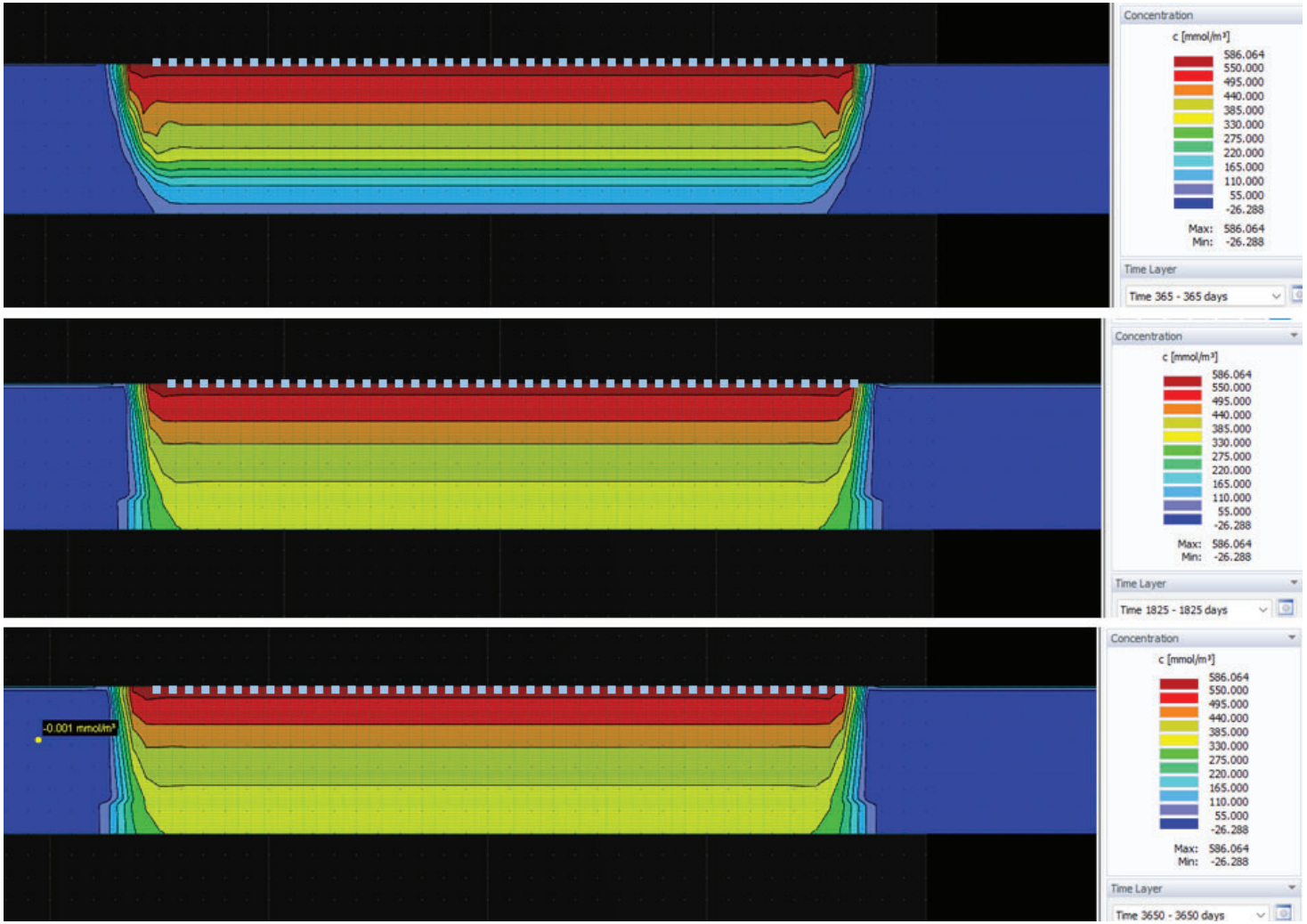
Figure **19**



1 Year

5 Years

10 Years

Notes:

1) $1.3 \times 10^{-3}\ d^{-1}$ denitrification rate applied
2) Dotted line symbolizes model infiltration flux boundary
3) 8 mgN/L = 571 $mmol/m^3$

Scenario 1, Cross-Section A-A' - HYDRUS Vadose Zone Model Nitrate Solute Concentration Migration Over Time

PROPOSED CENTRAL MAUI WWRF FACILITY

Maui, Hawaii

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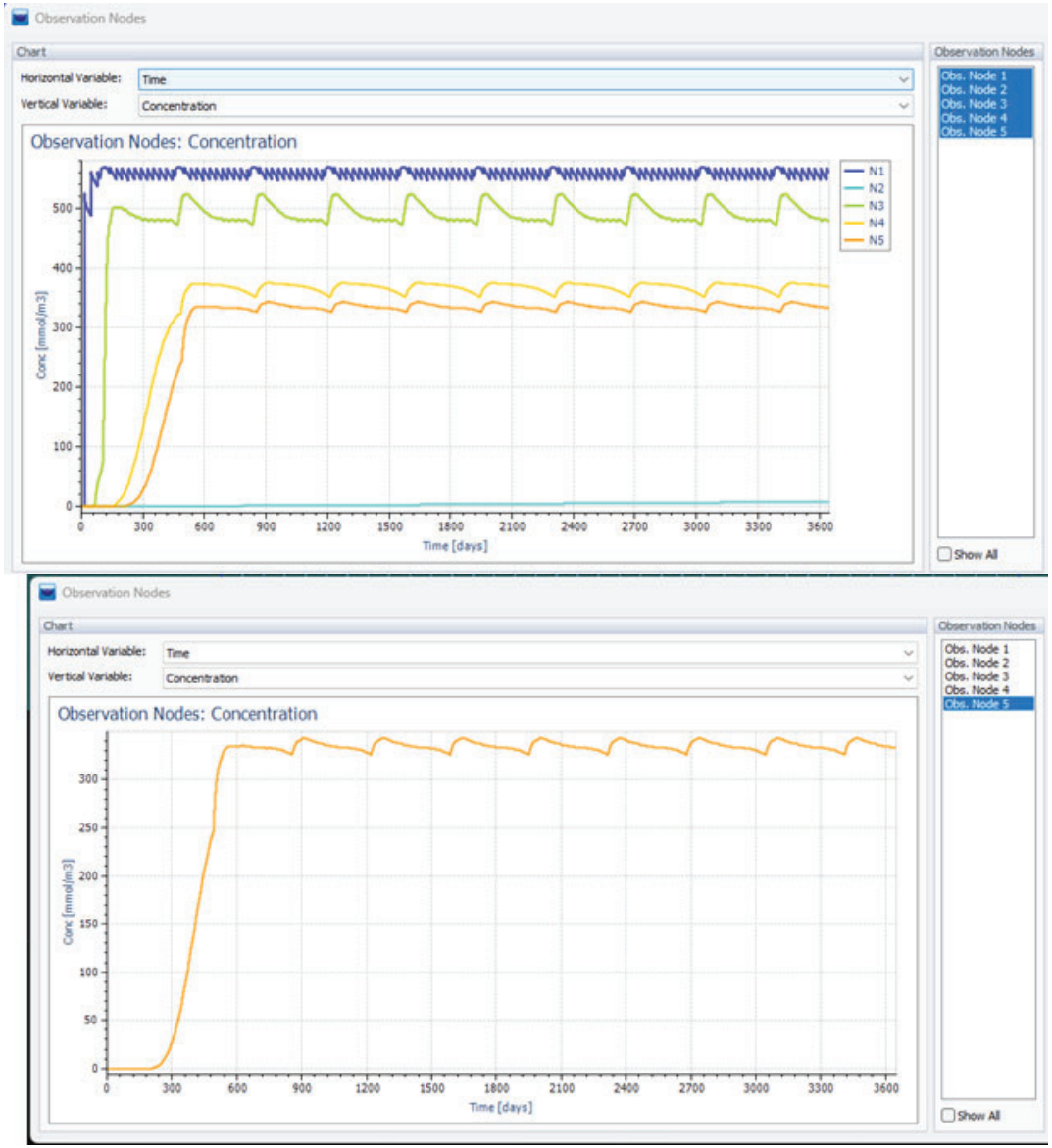
Figure **20**



Legend:
Node 1 – Base of SAT Basin
Node 2 – Ground surface at northern model boundary
Node 3 – At interface of JaC and QTao
Node 4 – At interface of QTao and Kula Volcanics
Node 5- Drainage out of Kula Volcanics at base of the model

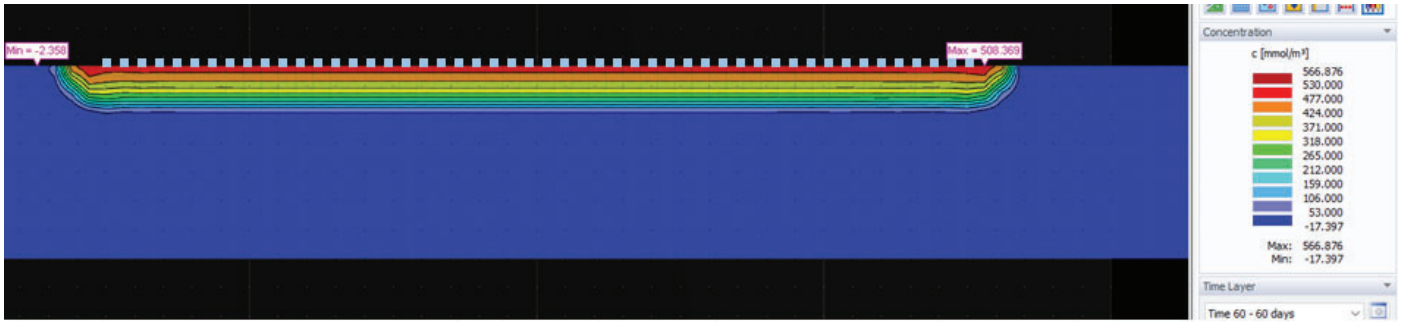
Notes:
1) $1.3 \times 10^{-3}\ d^{-1}$ denitrification rate
2) 8 mgN/L = 571 mmol/m^3

Scenario 1, Cross-Section A-A', HYDRUS Vadose Zone Model Nitrate Solute Concentrations Over Time at Observation Nodes
PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii

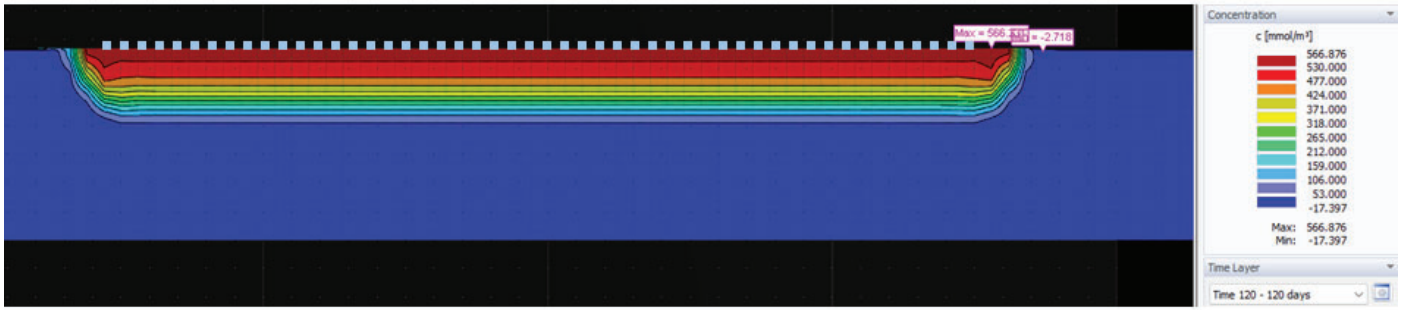
Geosyntec consultants

Project No: LB1047 | October 2024

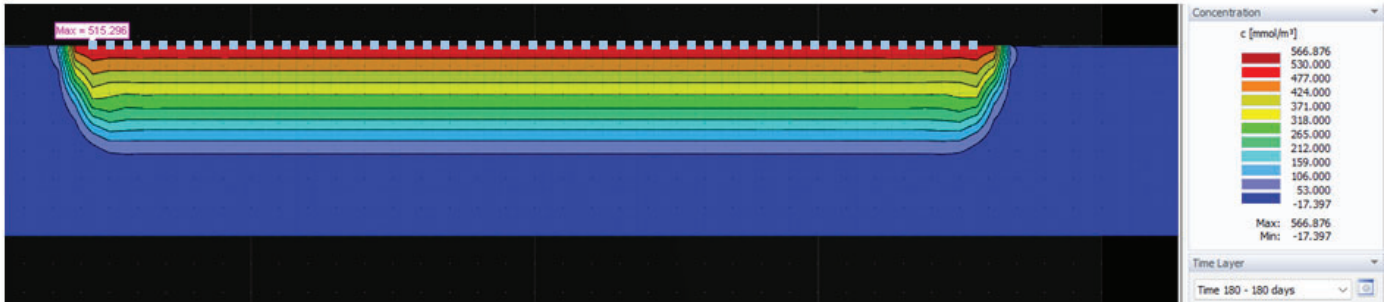
Figure 21



60 Days



120 Days



180 Days

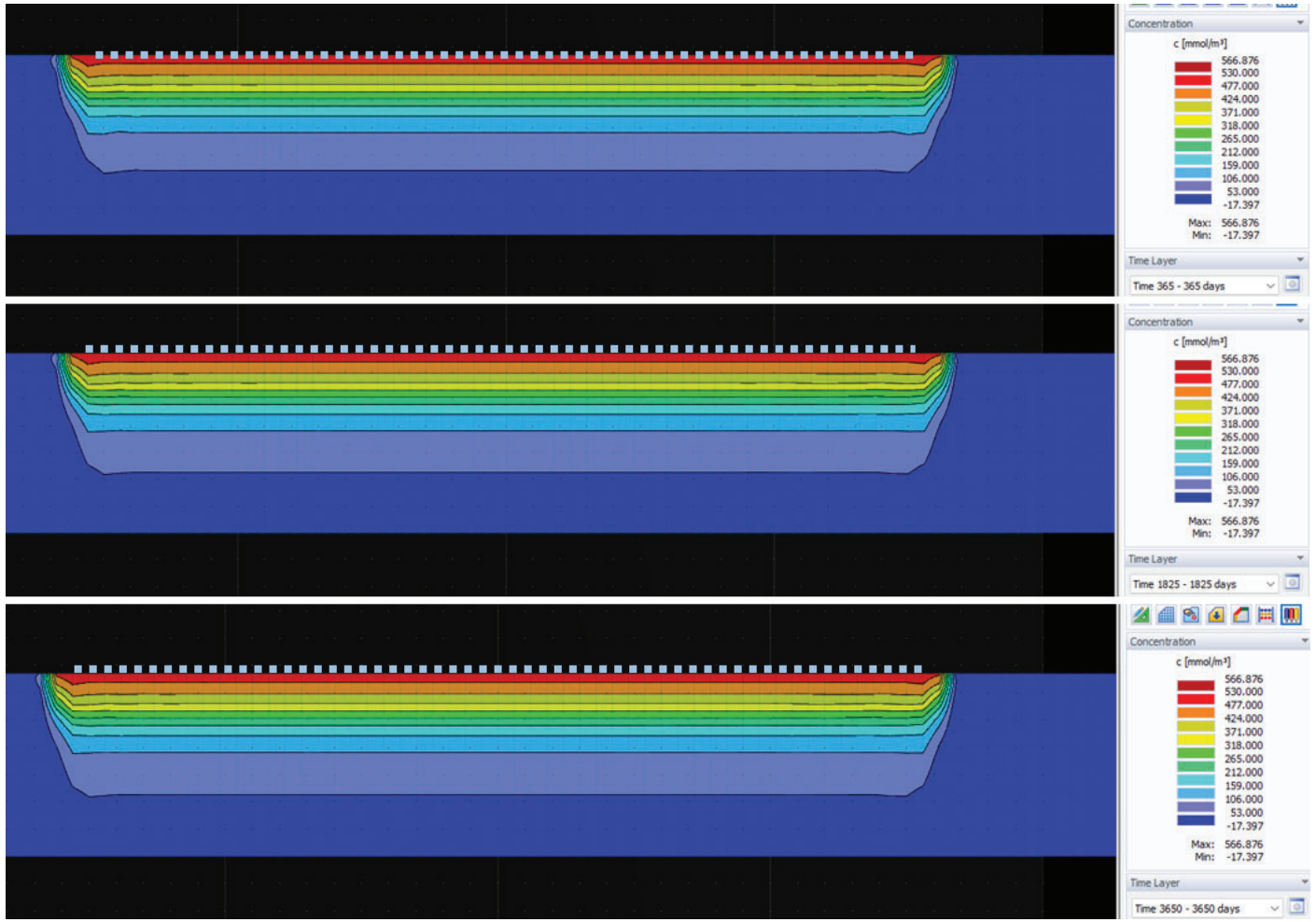
Notes:
1) $8x10^{-3}$ d^{-1} denitrification rate applied
2) Dotted line symbolizes model infiltration flux boundary
3) 8 mgN/L = 571 mmol/m^3

Scenario 1- HYDRUS Vadose Zone Model Nitrate Solute Concentrations Over Time at Observation Nodes ($8x10^{-3}$ d^{-1} denitrification rate)
PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii

Geosyntec consultants

Project No: LB1047 | October 2024

Figure 22



1 Year

5 Years

10 Years

Notes:

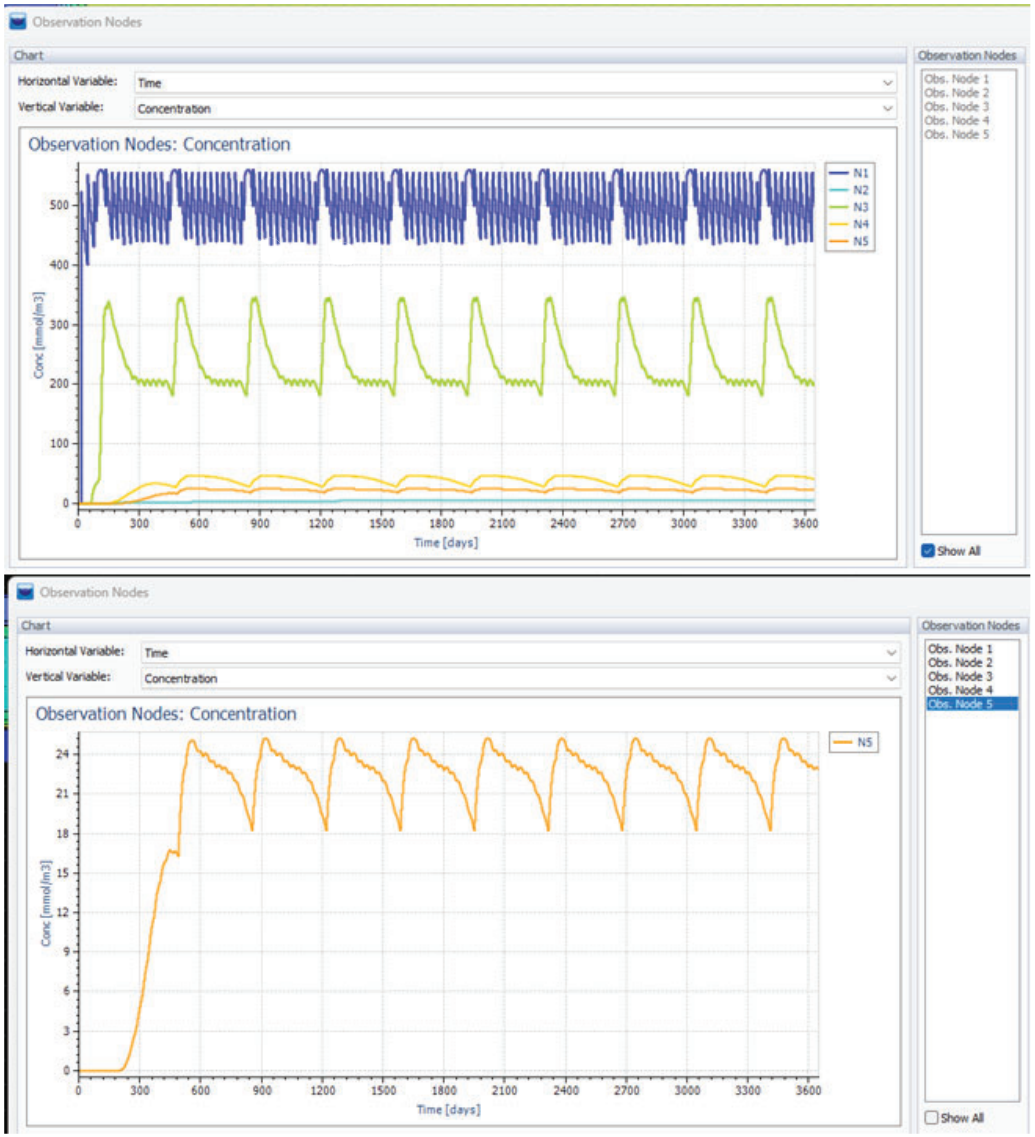
1) $8x10^{-3}$ d^{-1} denitrification rate applied
2) Dotted line symbolizes model infiltration flux boundary
3) 8 mgN/L = 571 $mmol/m^3$

Scenario 1- HYDRUS Vadose Zone Model Nitrate Solute Concentrations Over Time at Observation Nodes ($8x10^{-3}$ d^{-1} denitrification rate)
PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii

Geosyntec consultants

Project No: LB1047 | October 2024

Figure 23



Legend:
Node 1 – Base of SAT Basin
Node 2 – Ground surface at northern model boundary
Node 3 – At interface of JaC and QTao
Node 4 – At interface of QTao and Kula Volcanics
Node 5- Drainage out of Kula Volcanics at base of the model

Notes:
1) $8x10^{-3}$ d^{-1} denitrification rate applied
2) 8 mgN/L = 571 $mmol/m^3$

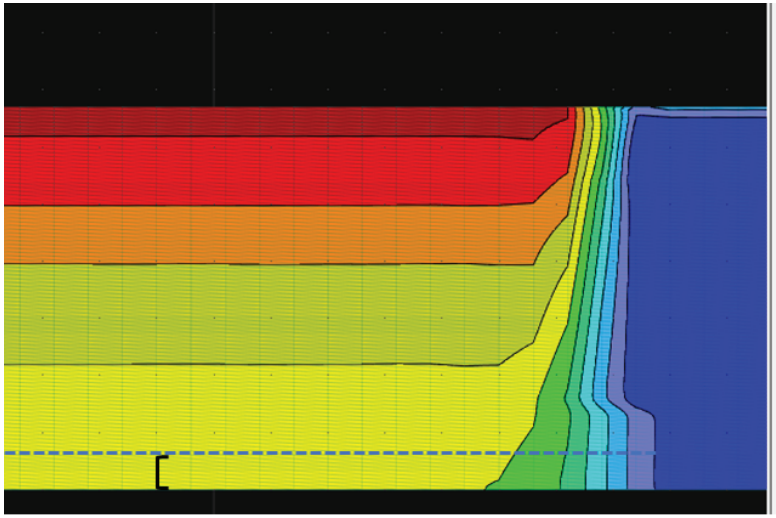
Scenario 1- HYDRUS Vadose Zone Model Nitrate Solute Concentrations Over Time at Nodes ($8x10^{-3}$ d^{-1} denitrification rate)

PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii

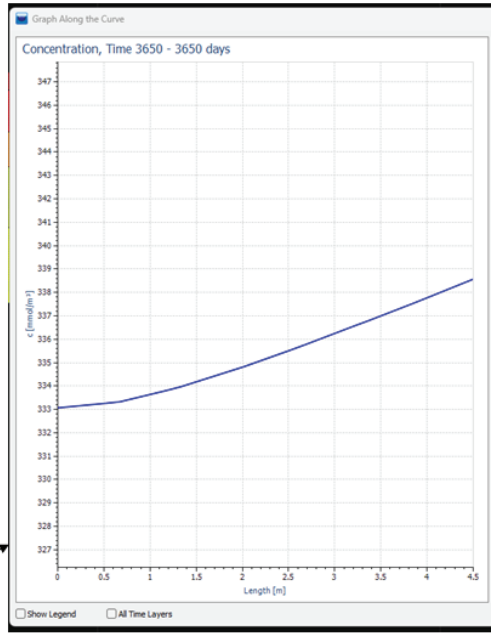
Geosyntec consultants

Project No: LB1047 | October 2024

Figure 24



Location of Concentration Variation Cross-Section Graph for a Thinner Vadose Zone Thickness Scenario



Graph of simulated nitrate concentration gradient at the free drainage base of model (67 m, 220 ft) and at a potential thinner vadose zone thickness at 62.5 m (205 ft). Concentration varies from 333 to 338.5 mmole/m^3 (4.67 to 4.74 mgN/L) or ~1.5% over the 4.5 m (15 ft) interval.

Evaluation of the Affect of Vadose Zone Thickness Variation and Simulated Nitrate Concentration -

Scenario 1, 10 Year Period ($1.3x10^{-3}d^{-1}$ denitrification rate)

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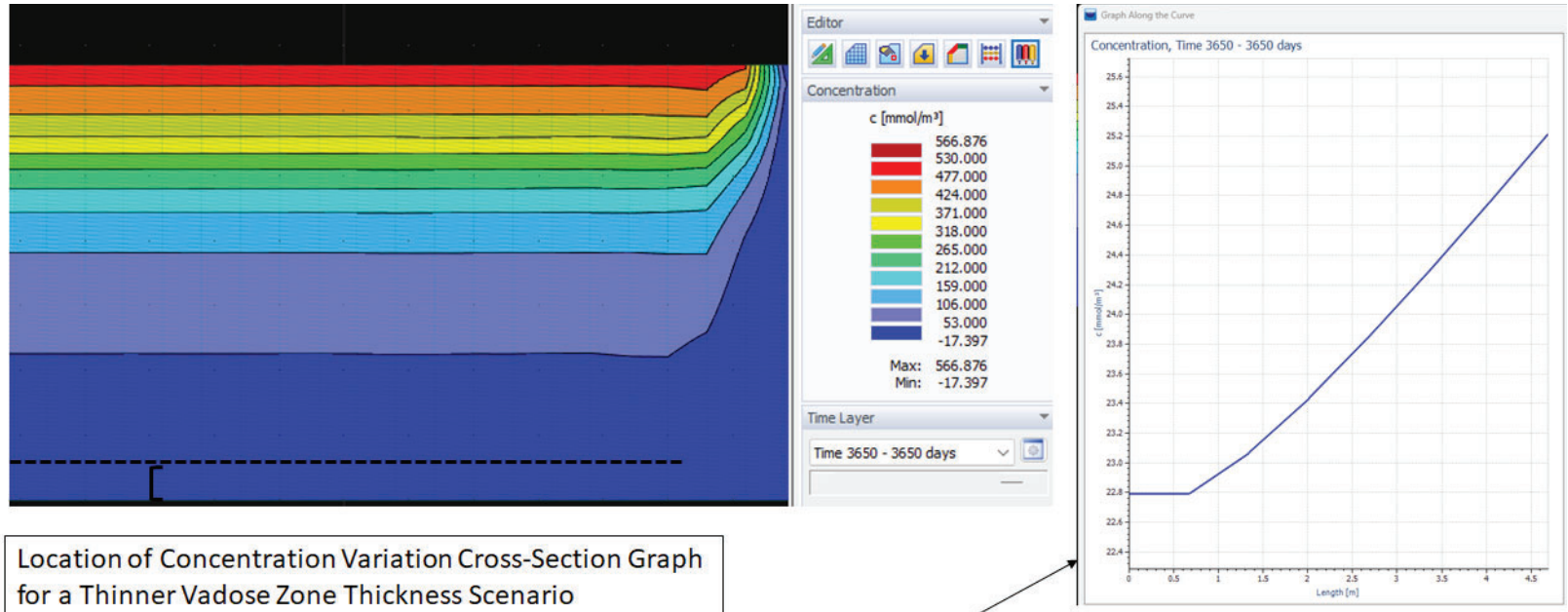
Figure **25**



Location of Concentration Variation Cross-Section Graph for a Thinner Vadose Zone Thickness Scenario

Graph of simulated nitrate concentration gradient at the free drainage base of model (67 m, 220 ft) and at a potential thinner vadose zone thickness at 62.5 m (205 ft). Concentration varies from 22.8 to 25.1 mmole/m^3 (0.32 to 0.35 mgN/L) or ~9 % over the 4.5 m (15 ft) interval.

Evaluation of the Affect of Vadose Zone Thickness Variation and Simulated Nitrate Concentration

Scenario 1, 10 Year Period ($8x10^{-3}d^{-1}$ denitrification rate)

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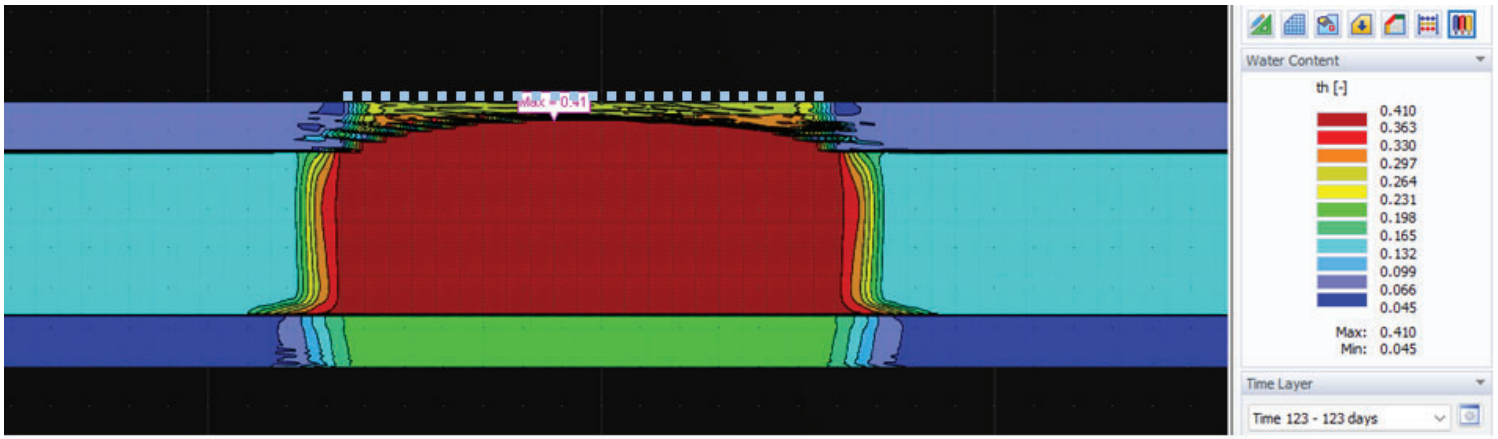
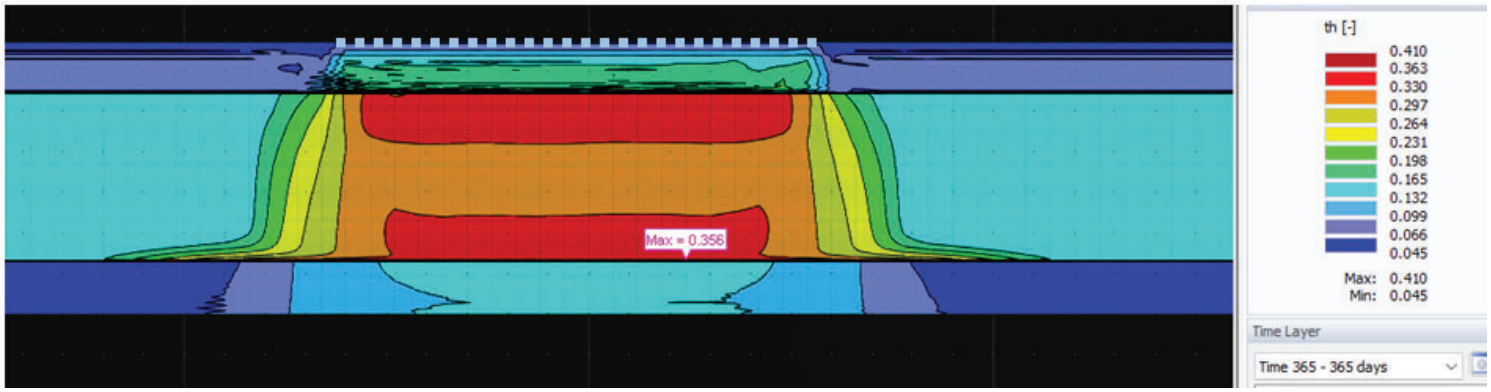
Figure 26



End of January – Soil not saturated at SAT Basin



End of 1-Year Period, September – Soil not saturated at SAT Basin

Notes:

1) $1.3 \times 10^{-3}\ d^{-1}$ denitrification rate applied
2) Dotted line symbolizes model infiltration flux boundary
3) 8 mgN/L = 571 mmol/m^3

Scenario 2A East-West Direction - HYDRUS Vadose Zone Model Water Content Simulations
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Figure 27

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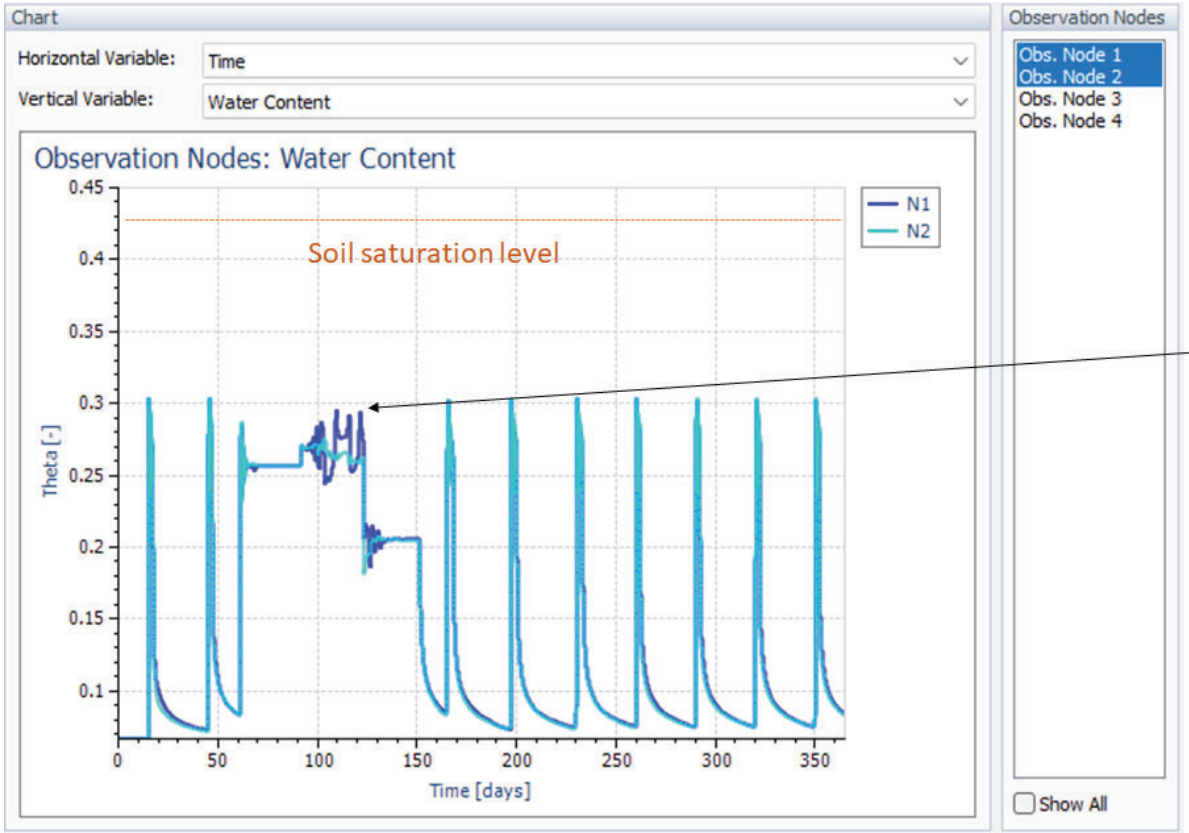

Legend:
Node 1 – Base of SAT Basin
Node 2 – Base of SAT Basin

Soil saturation levels partially saturated over time; remain below saturation level of 0.430. Indicate additional infiltration capacity.

Scenario 2A HYDRUS Vadose Zone Model Water Content Simulation Results Over Time - SAT Basin Nodes 1 and 2
PROPOSED CENTRAL MAUI WWRF FACILITY
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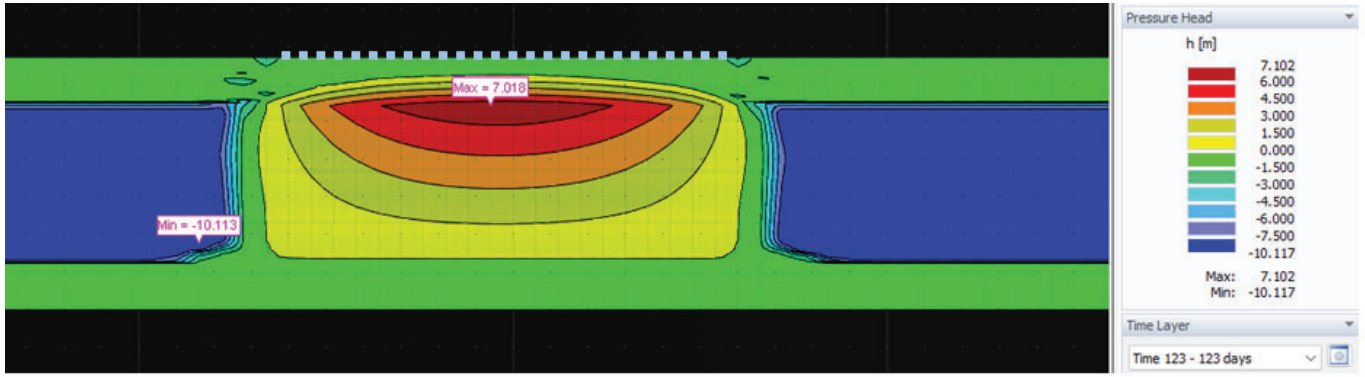
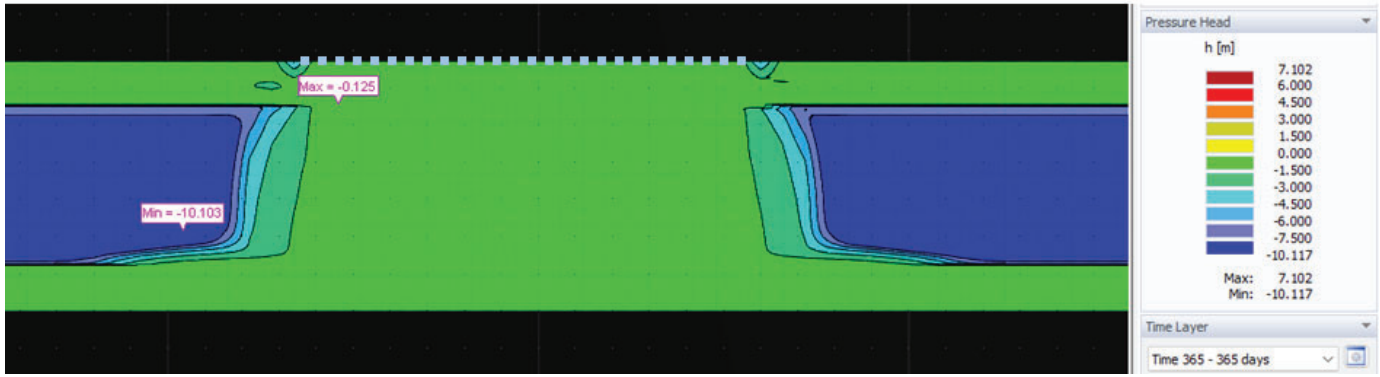
Figure 28



End of January – Negative pressure at base of SAT basin; available infiltration capacity.



End of 1-Year Period (September) – Negative pressure at base of SAT basin; available infiltration capacity.

Scenario 2A East-West Direction - Hydrus Vadose Zone Model Head Pressure
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Figure **29**

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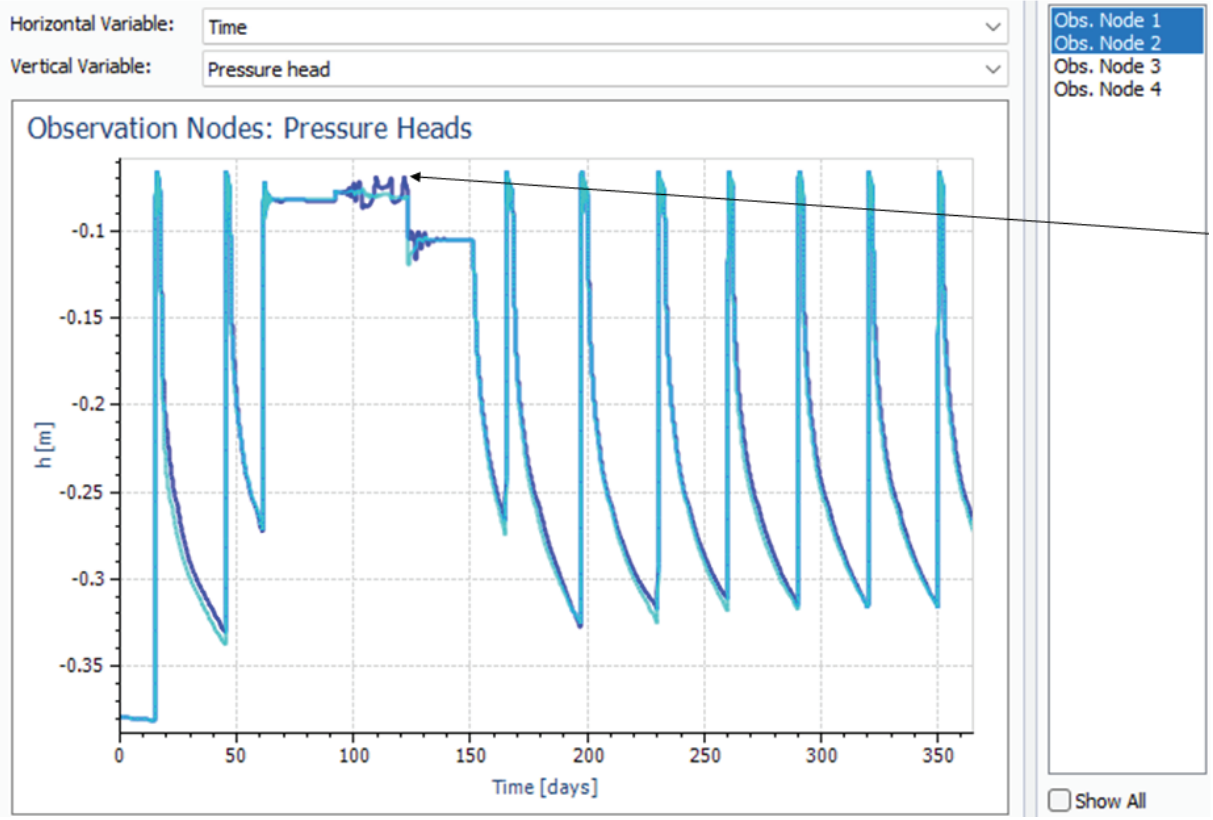

Legend:
Node 1 – Base of SAT Basin
Node 2 – Base of SAT Basin

Pressure heads remain negative during the simulation period; indicate no positive pressure resistance to infiltration.

Scenario 2A HYDRUS Vadose Zone Model Head Pressure Simulation Results Over Time - SAT Basin Nodes 1 and 2
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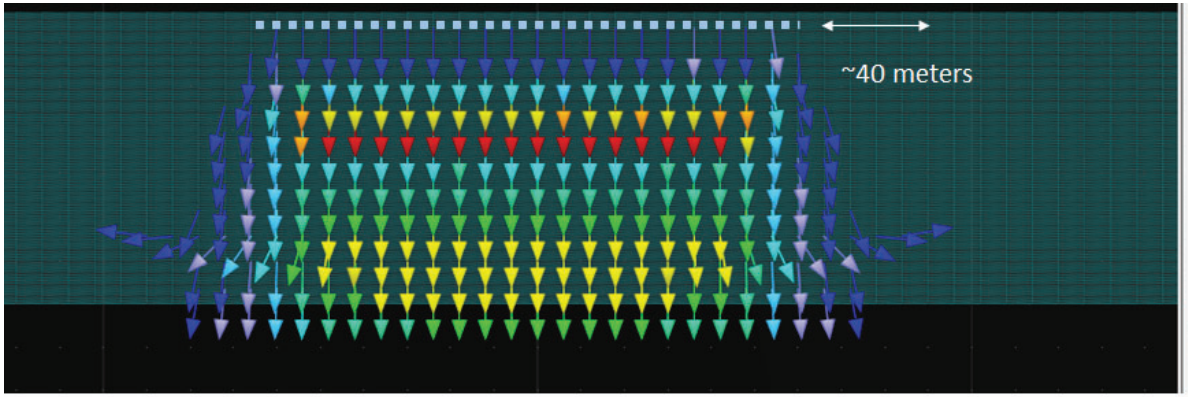
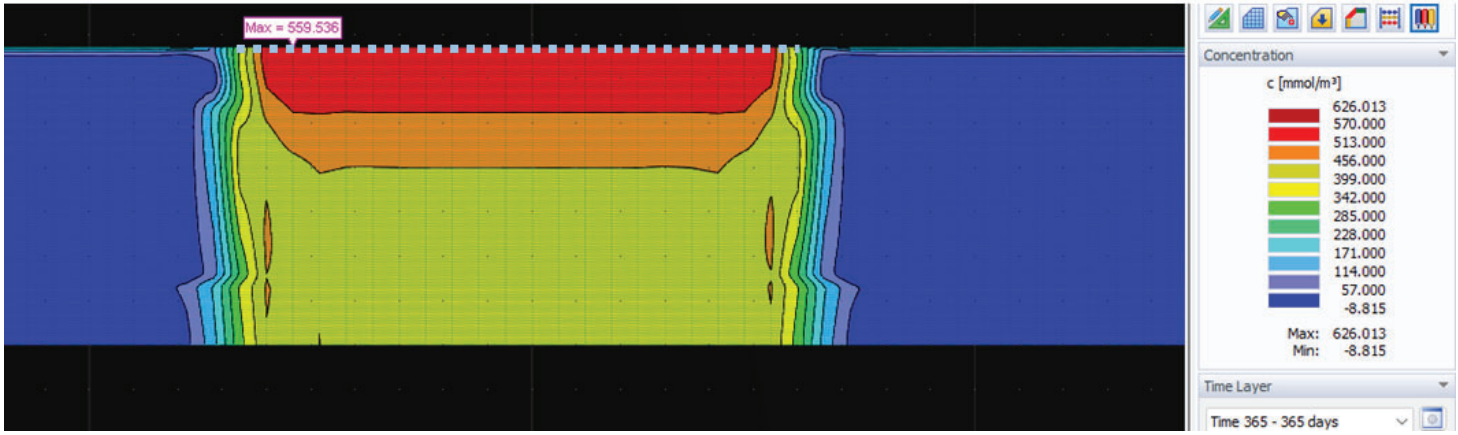
Figure 30



Velocity Vectors (End of 1-Year Period, September)



Nitrate Concentration Migration (End of 1-Year Period, September)

Notes:
1) 1.3×10^{-3} d^{-1} denitrification rate applied
2) Dotted line symbolizes model infiltration flux boundary
3) 8 mgN/L = 571 mmol/m^3

Scenario 2A HYDRUS Vadose Zone Model Infiltration Velocity Vector and Nitrate Concentration Migration Simulations (1-Year
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Figure 31

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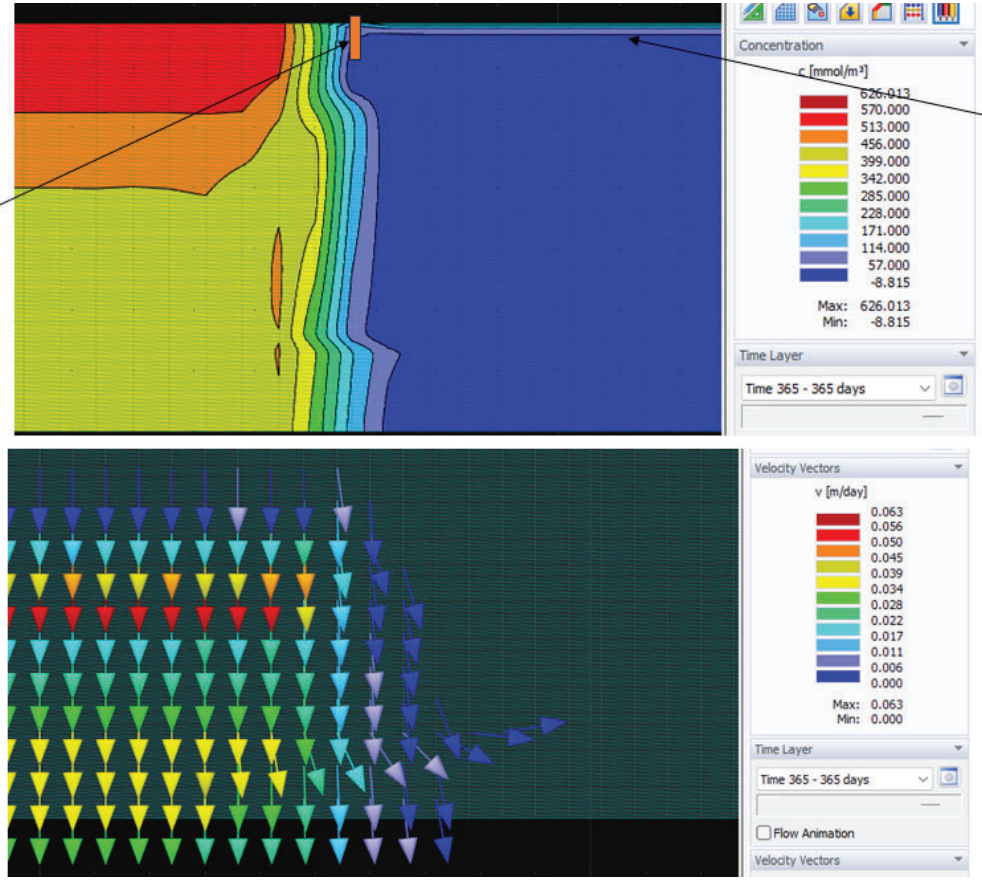
May suggest a subsurface vertical slurry wall would be useful to mitigate chemical diffusion



Model simulations suggests a thin, 1-2 m thick layer of nitrate chemical diffusion may occur in soil pore liquids. Not expected to be due to advective flow. See flow velocity vectors below.

Notes:
1) 1.3×10^{-3} d^{-1} denitrification rate applied
2) 8 mgN/L = 571 mmol/m^3

Scenario 2A HYDRUS Vadose Zone Model Nitrate Concentration and Migration Simulations - Shallow Lateral Migration
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Figure 32

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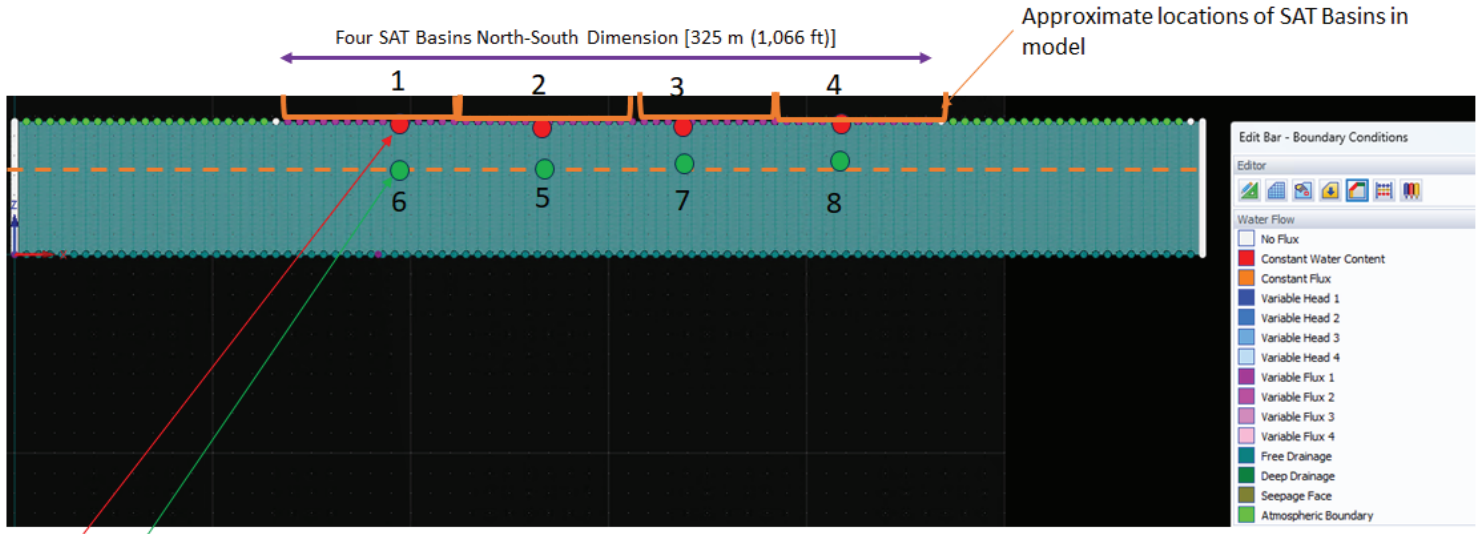

Four evenly spaced observation nodes at the SAT basin surface which are intended to estimate conditions at the approximate center of each individual SAT basins

Four evenly spaced observation nodes at Layer 2/3 interface (top of the lower permeability alluvium layer at about 40 ft) which are intended to estimate conditions in the subsurface at the approximate center of each individual SAT basin

Scenario 2B HYDRUS North-South Direction, Four SAT Basins – HYDRUS© Vadose Zone Model Dimensions, Boundary Conditions and Observation Nodes
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Figure 33

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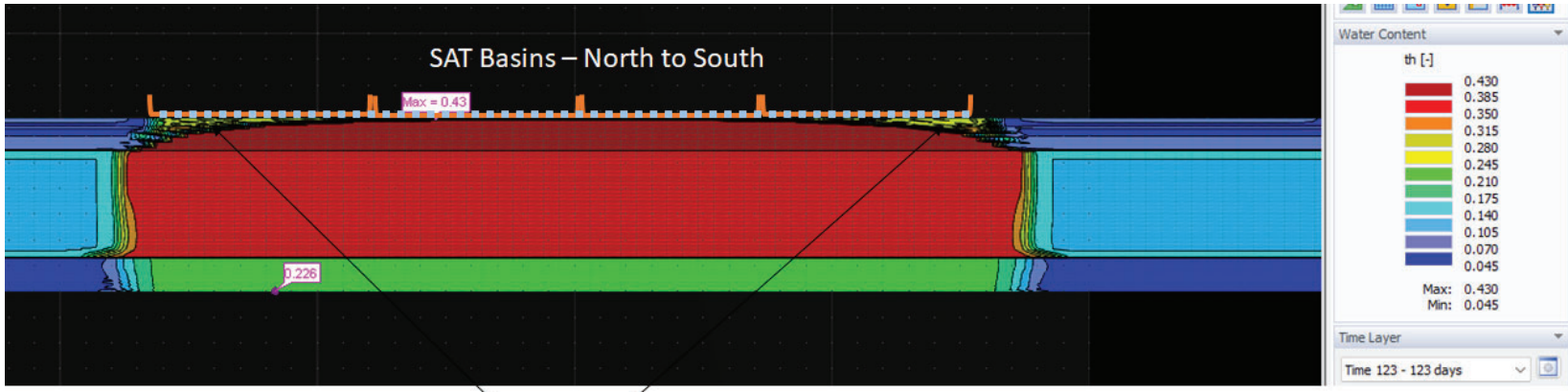

Partially saturated subsurface remains beneath the north and south basins following this stress period. Available infiltration capacity.

Notes:

1) Dotted line symbolizes model infiltration flux boundary for four SAT basins

Scenario 2B North-South Direction - HYDRUS Vadose Zone Model Water Content Simulation- End January
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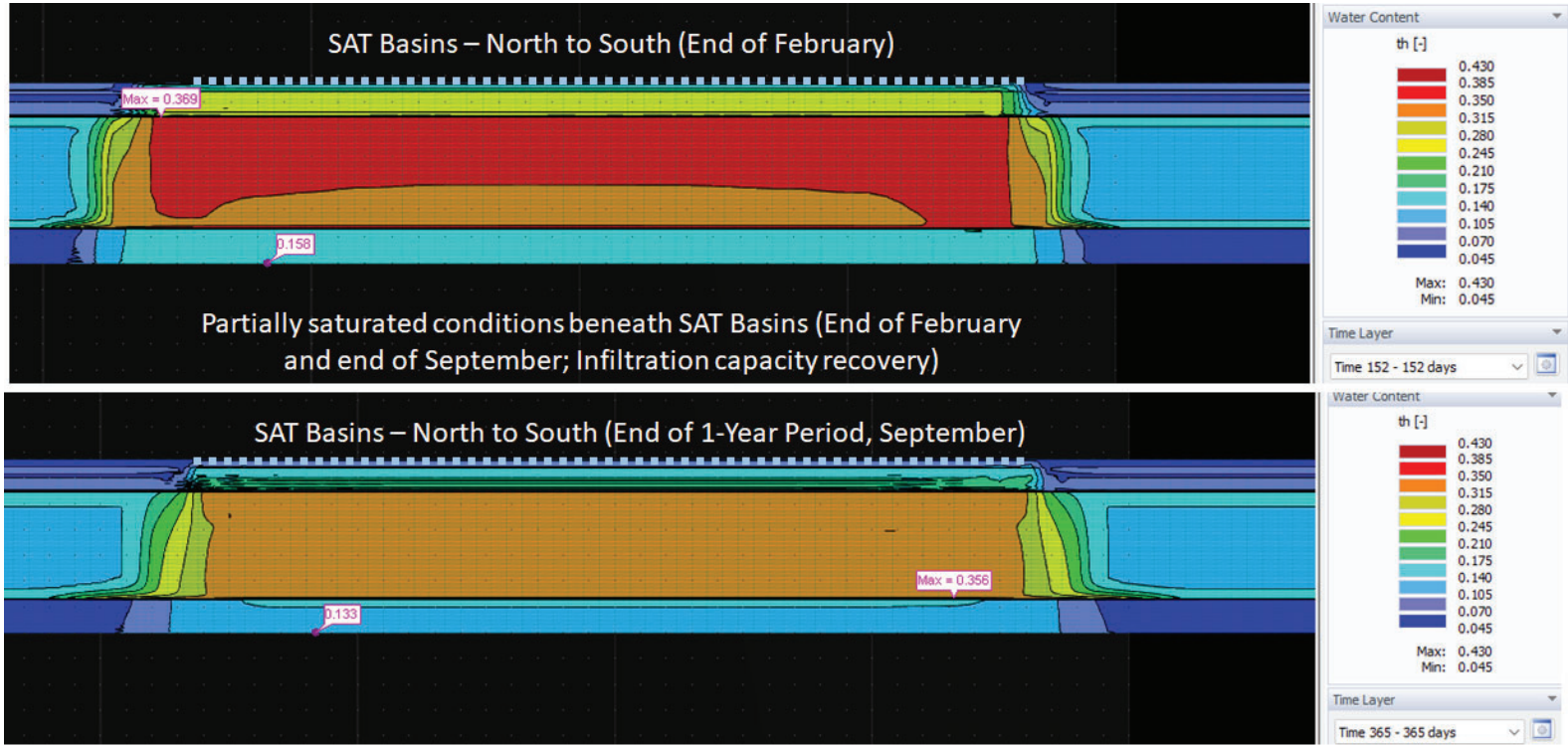
Figure 34



Notes:
1) Dotted line symbolizes model infiltration flux boundary for four SAT basins

Scenario 2B North-South Direction - HYDRUS Vadose Zone Model Water Content Simulation - End February and 1-Year Period PROPOSED CENTRAL MAUI WWRF FACILITY
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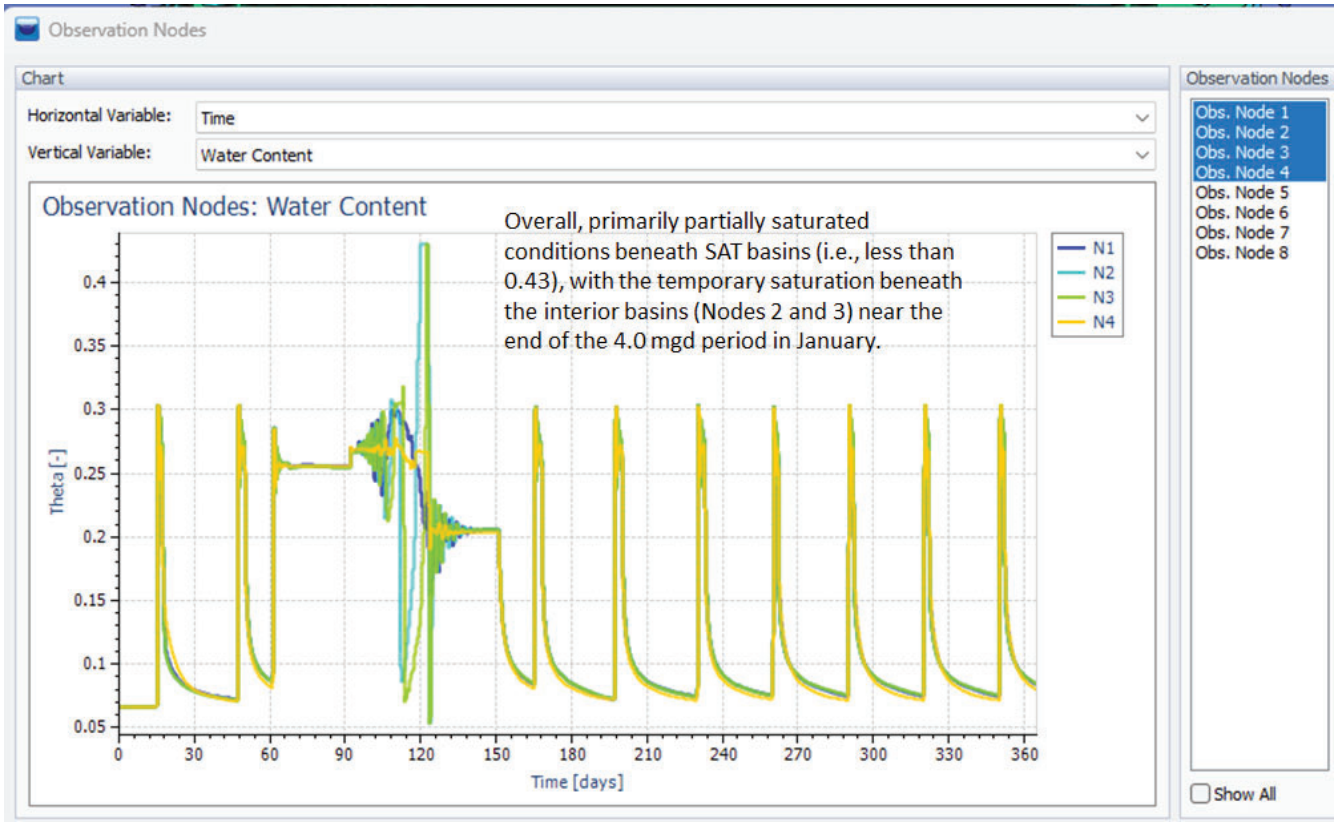
Figure 35



Legend:
Node 1 – Base of North SAT Basin
Node 2 – Base of Interior SAT Basin
Node 3 – Base of Interior Basin
Node 4 – Base of South Basin

Scenario 2B HYDRUS Vadose Zone Model Water Content Simulation Results Over Time - SAT Basin Nodes 1, 2, 3 and 4
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Figure 36

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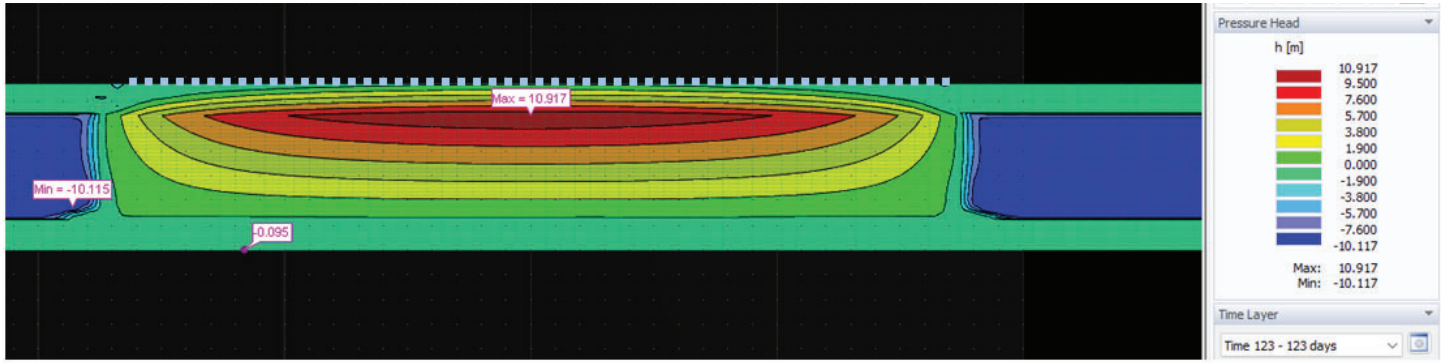
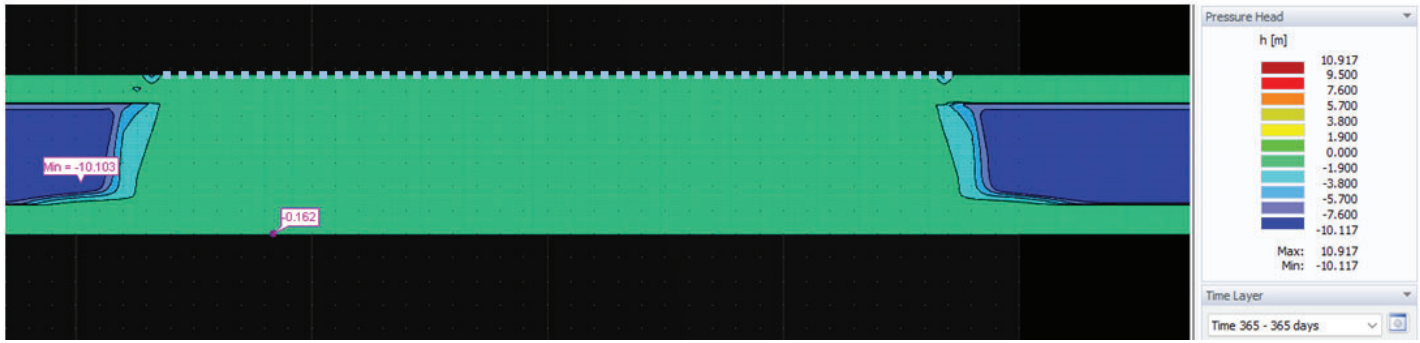
End of January – Negative pressure at base of SAT basin; available infiltration capacity.



End of 1-Year Period (September) – Negative pressure at throughout subsurface; system recovered and available infiltration capacity.



Notes:
1) Dotted line symbolizes model infiltration flux boundary for four SAT basins

Scenario 2B North-South Direction - HYDRUS Vadose Zone Model Pressure Head Simulation
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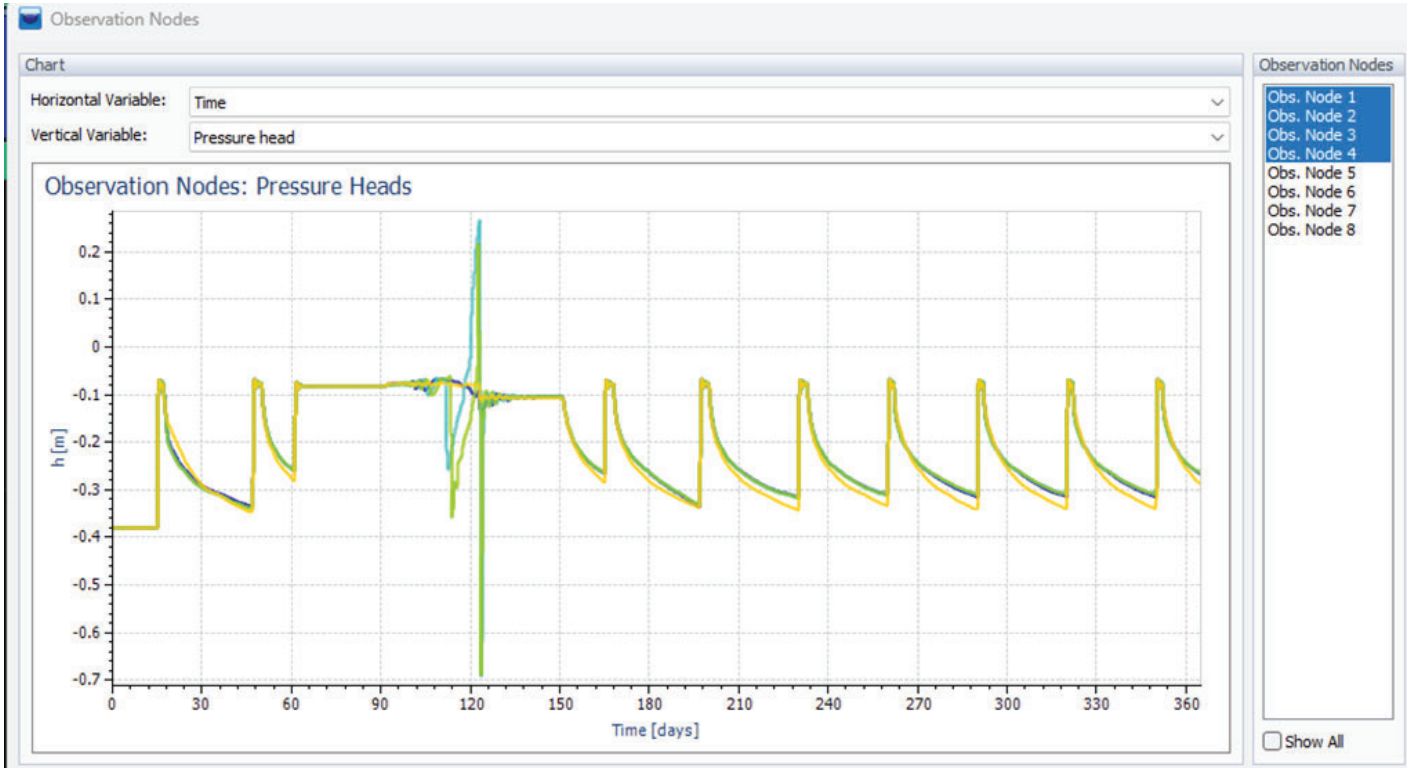
Figure 37



Legend:
Node 1 – Base of North SAT Basin
Node 2 – Base of Interior SAT Basin
Node 3 – Base of Interior Basin
Node 4 – Base of South Basin

Scenario 2B HYDRUS Vadose Zone Model Pressure Head Simulation Results Over Time - SAT Basin Nodes 1, 2, 3 and 4
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Figure 38

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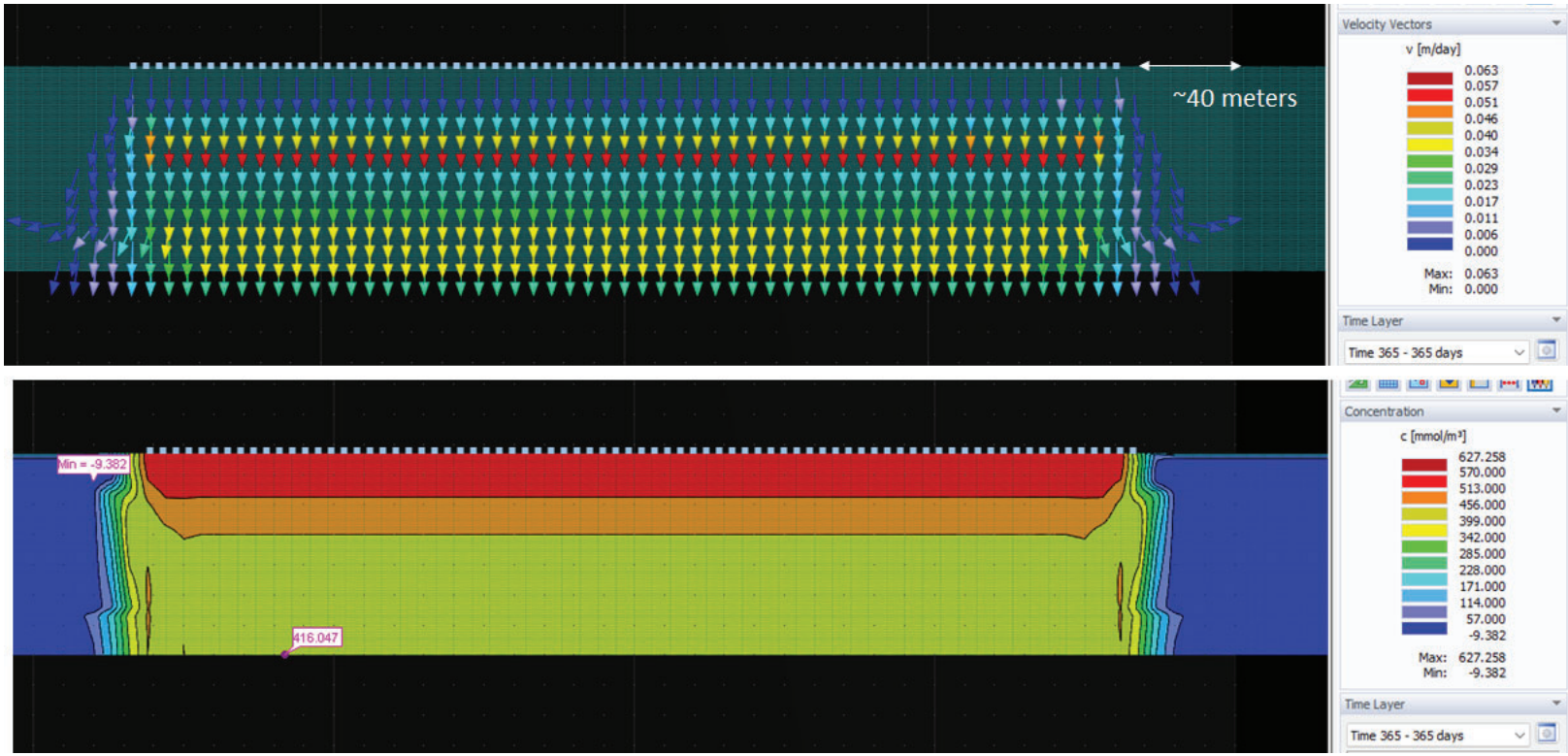
End of 1-Year Period (September)



Notes:
1) $1.3 \times 10^{-3}\ d^{-1}$ denitrification rate applied
2) Dotted line symbolizes model infiltration flux boundary
3) 8 mgN/L = 571 mmol/m³

Scenario 2A HYDRUS Vadose Zone Model Infiltration Velocity Vector and Nitrate Concentration Simulations (1-Year
PROPOSED CENTRAL MAUI WWRF FACILITY
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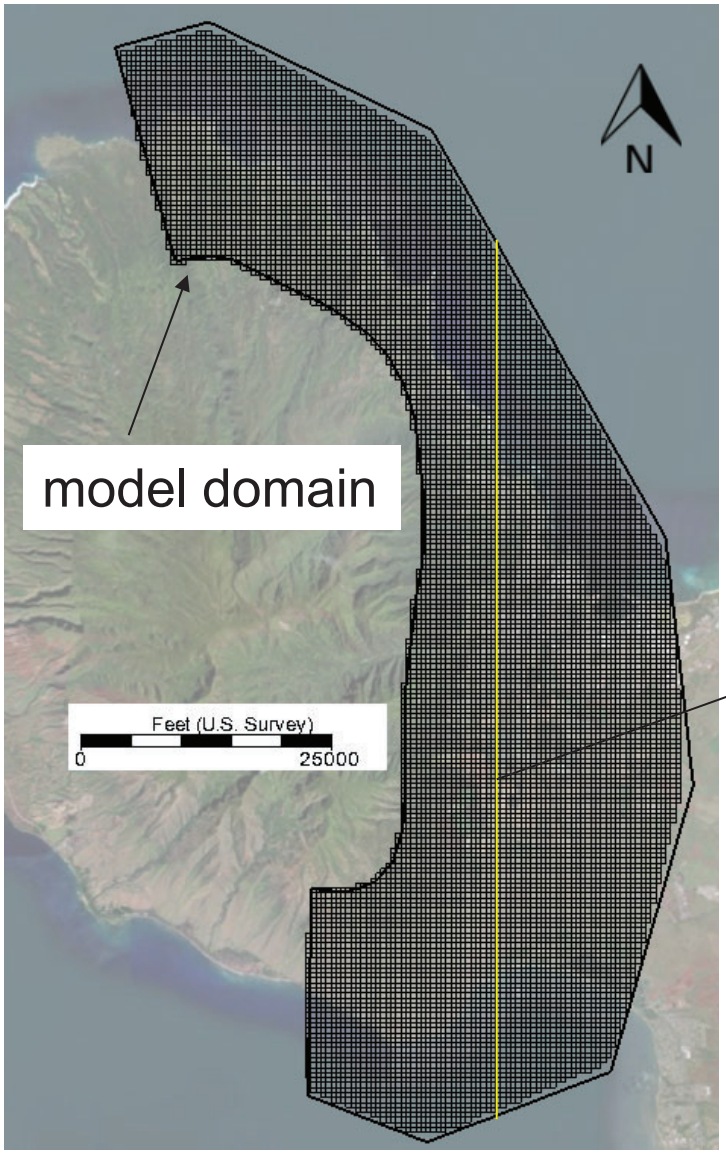
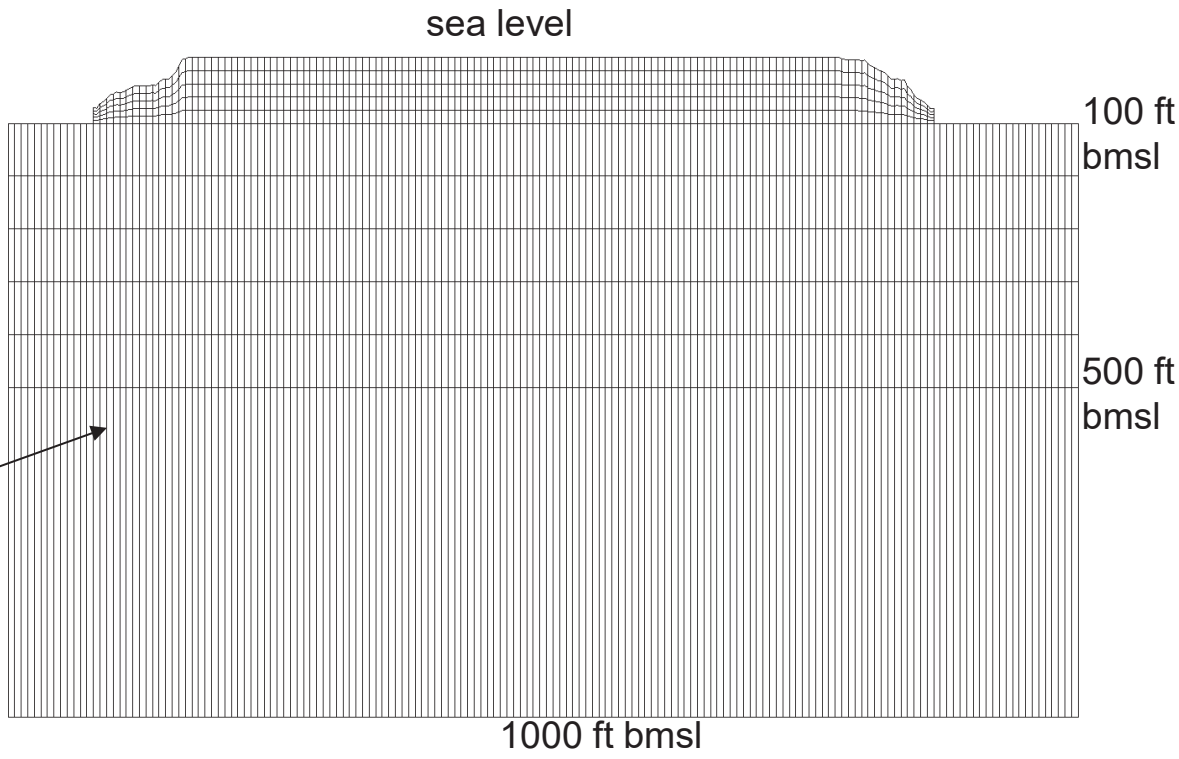
Figure 39





Notes:
bmsl = below mean sea level
ft = feet

Model Domain and Layering

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Figure 40

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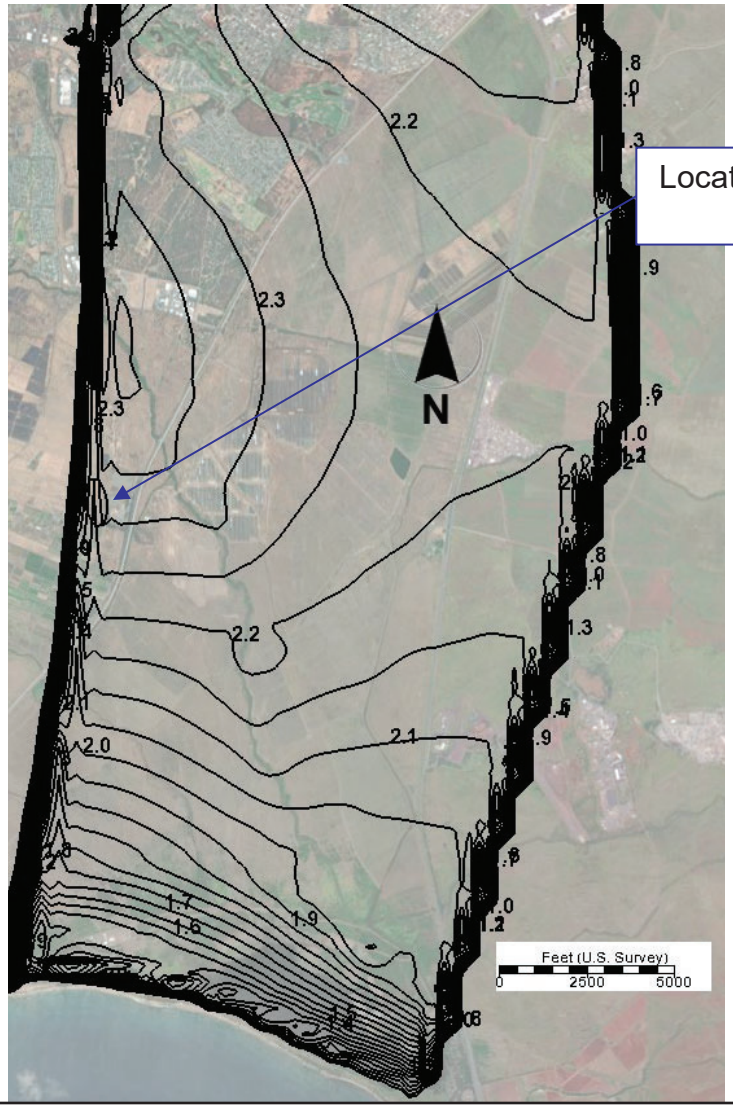
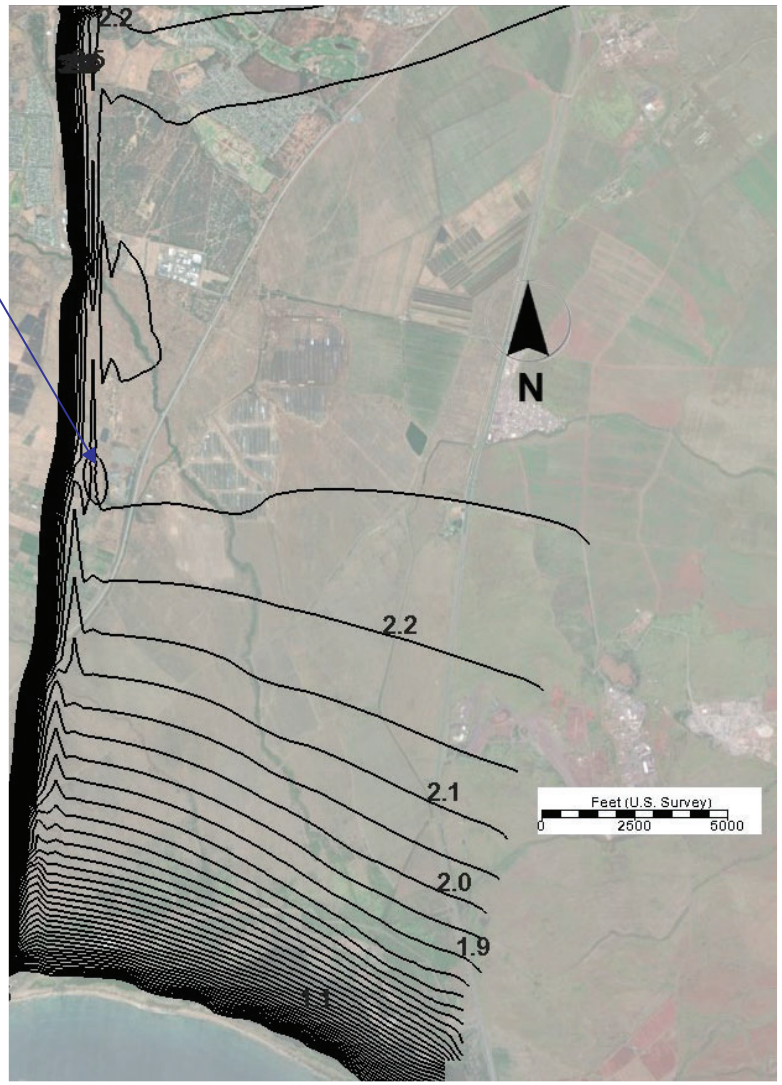
USGS SUTRA Model[1]



MODFLOW Model



Notes:
The contour lines represent simulated water levels (0.05-foot interval).

Reference:
[1]: Rotzoll, K., Oki, D.S., Johnson, A.G., and Souza, W.R., 2022, Long-term groundwater availability in the Waiheʻe, ʻĪao, and Waikapū aquifer systems, Maui, Hawaiʻi: U.S. Geological Survey Scientific Investigations Report 2021–5113, 80 p.

Comparison of Simulated Water Levels in MODFLOW and SUTRA Models
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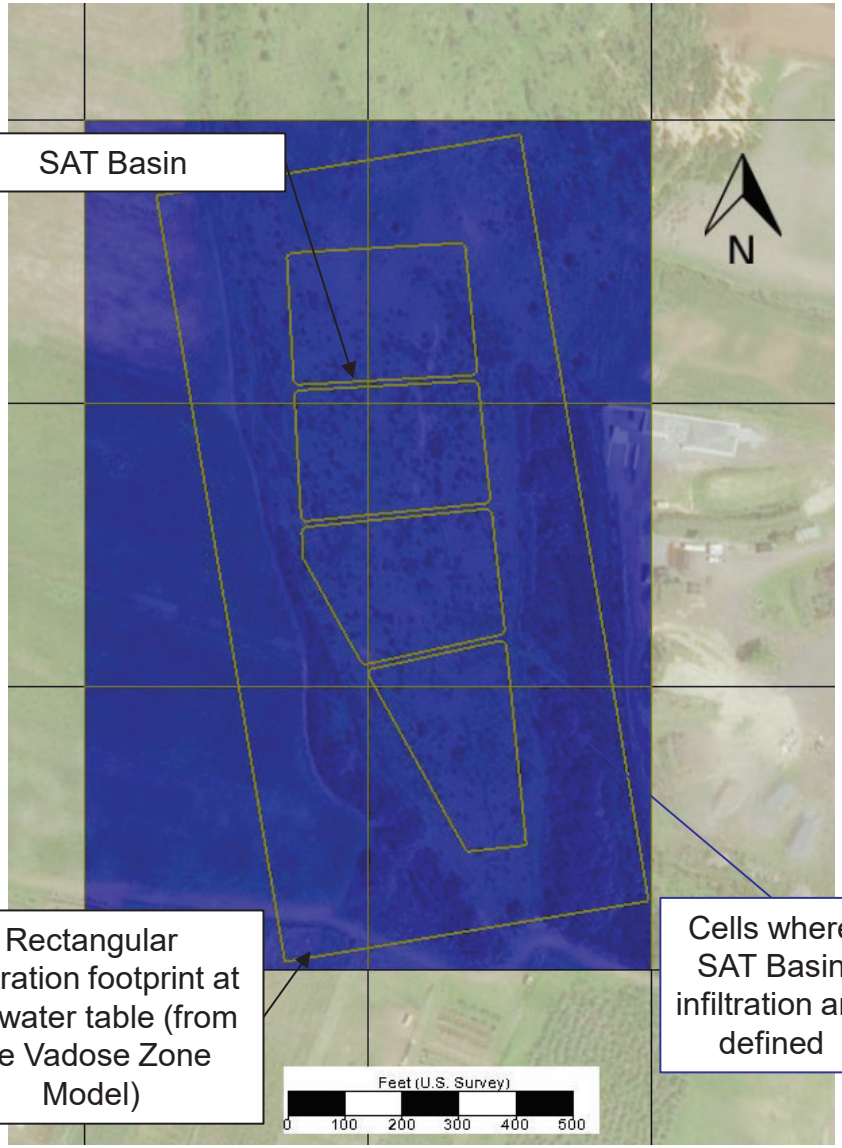
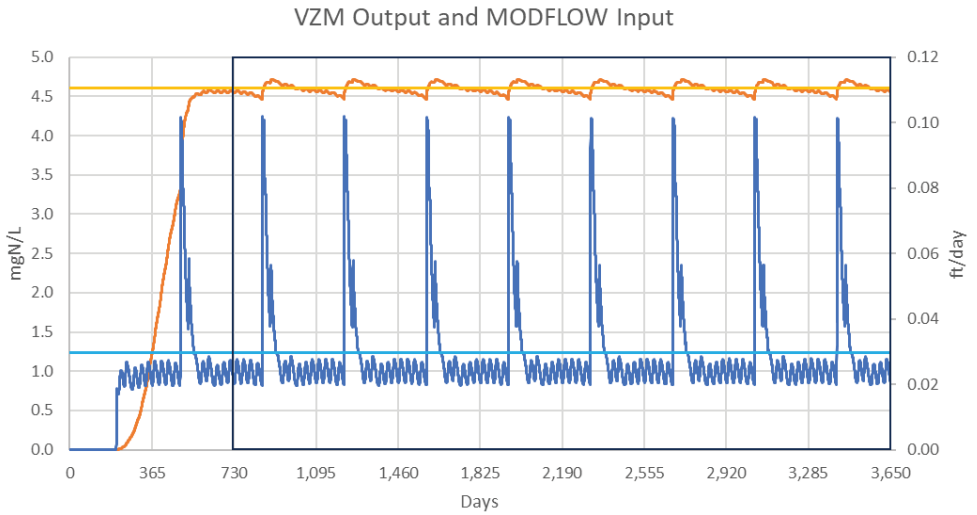
Figure 41

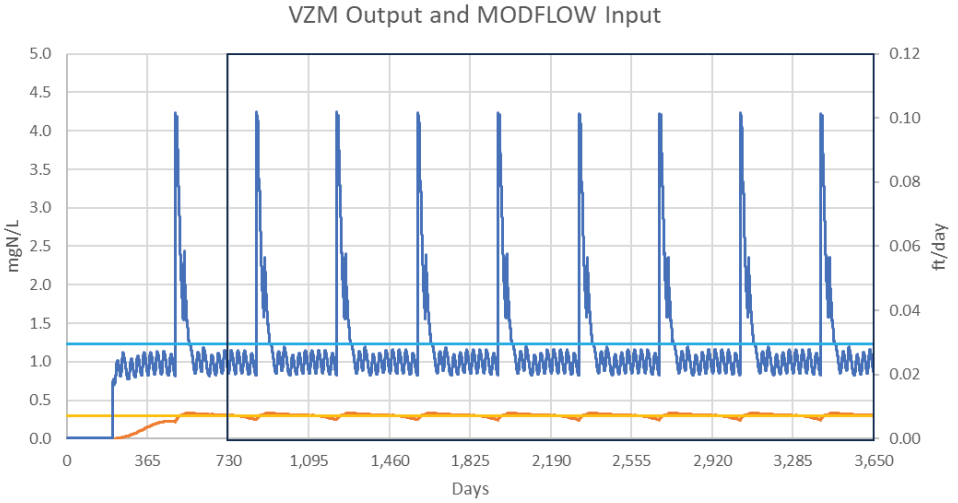
P:\PRJ2003REM\Maui\Model



Assuming conservative vadose zone denitrification rate



Assuming enhanced and/or optimal adose zone denitrification rate



Notes:
ft/day = feet per day
mgN/L = milligrams nitrate per liter

- VZM Simulated Nitrogen Concentration at Water Table (mgN/L)
- Steady-state MODFLOW Nitrogen Concentration (mgN/L)
- VZM Infiltration Rate at Water Table (ft/day)
- Steady-State MODFLOW Infiltration Rate (ft/day)

Model Setup with SAT Basin Input Fluxes
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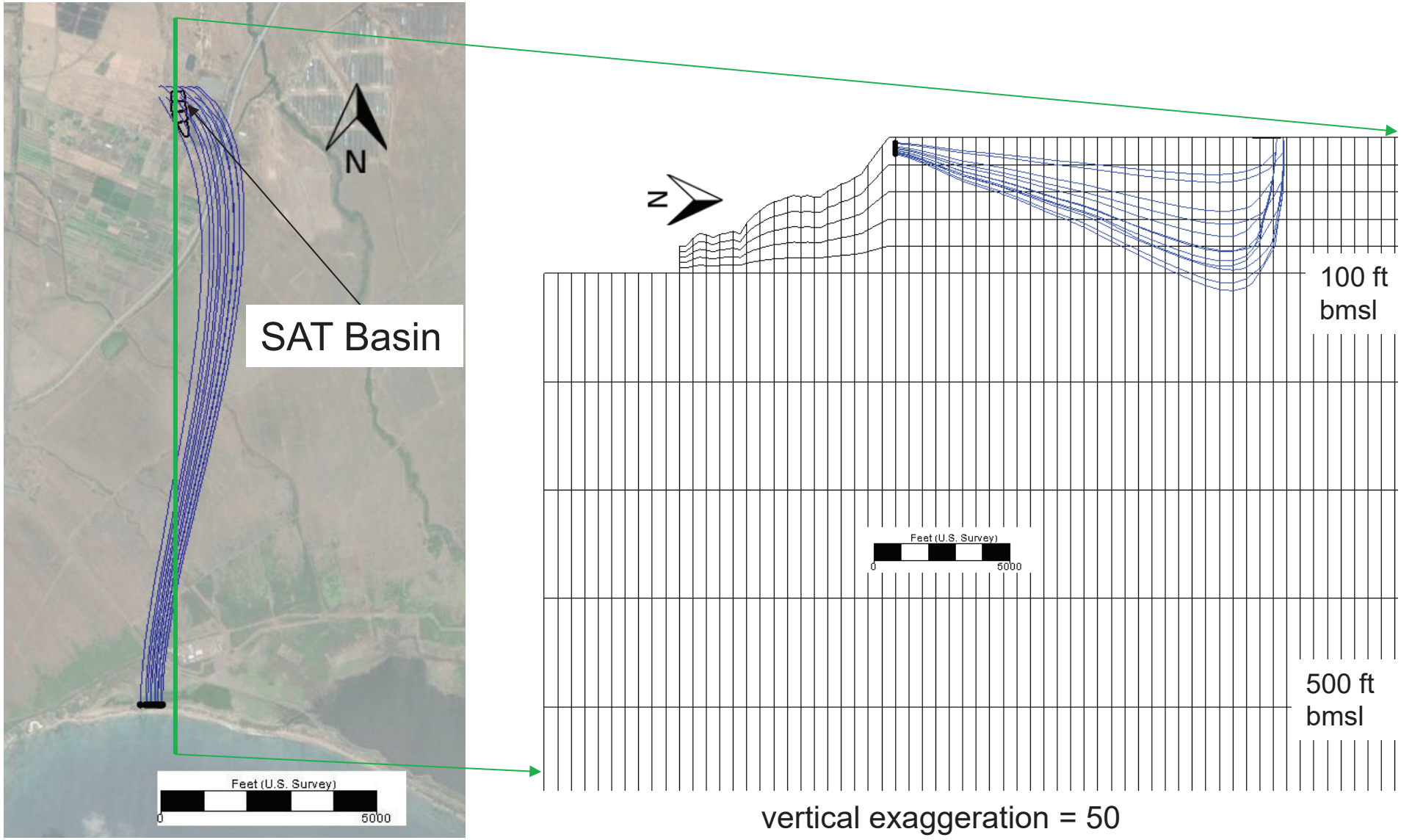
Figure 42

P:\PRJ2003REM\Maui\Model



Notes:
ft bmsl = feet below mean sea level

Simulated Flowpath from the SAT Basins
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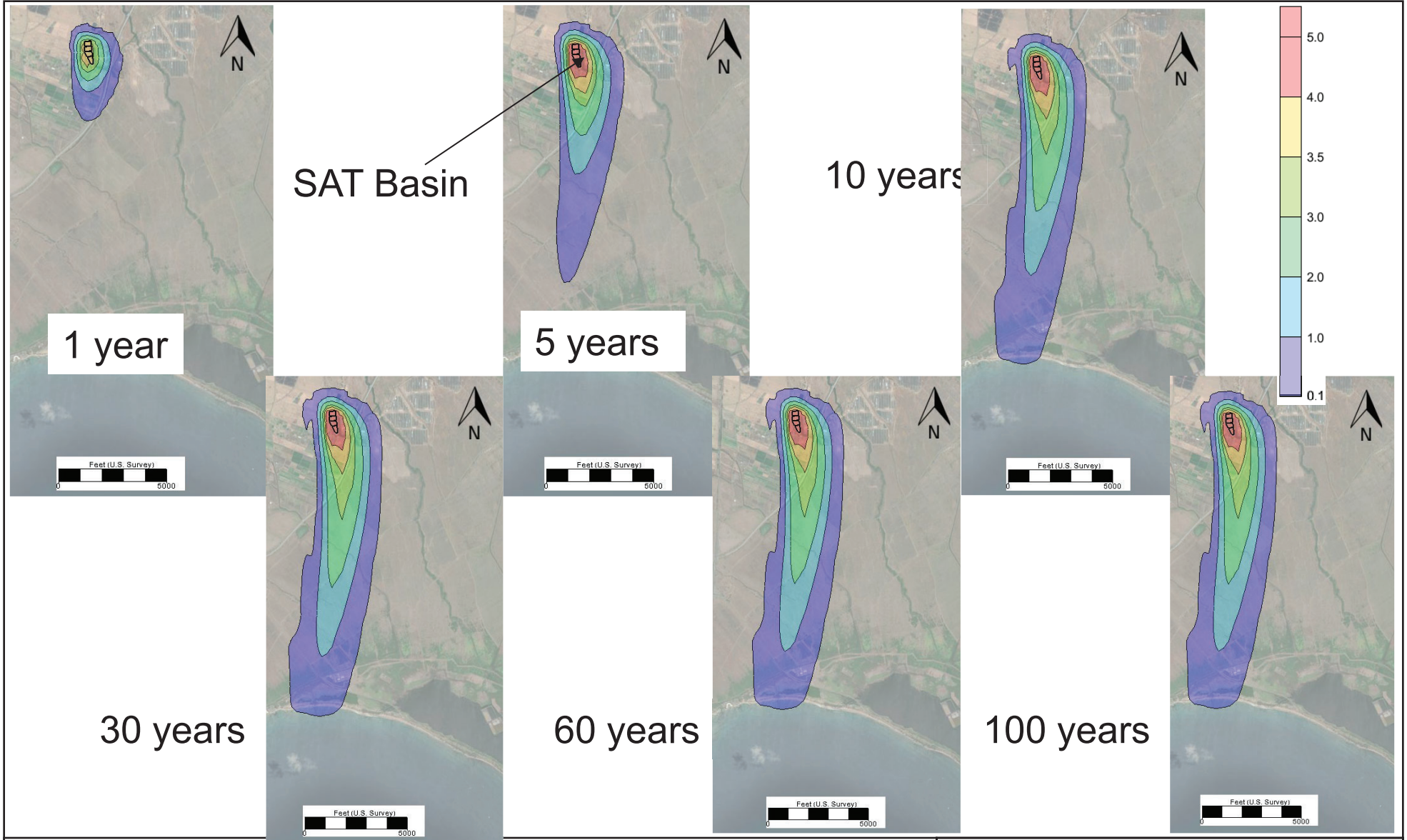
Figure
43

P:\PRJ2003REM\Maui\Model



Notes:
1. The high nitrate concentration input is 4.6 mgN/L and corresponds to simulated concentration in the infiltrating water at the water table based on a conservative denitrification rate in the vadose zone ($1.3x10^{-3}$ d-1)
2. The denitrification rate in groundwater used in the model is 3.1×10^{-5} d^{-1}.
3. Unit of nitrate concentration is mgN/L.

Simulated Nitrate Concentrations over 100 Years – With Low Nitrate Denitrification Rate in Vadose Zone and Groundwater

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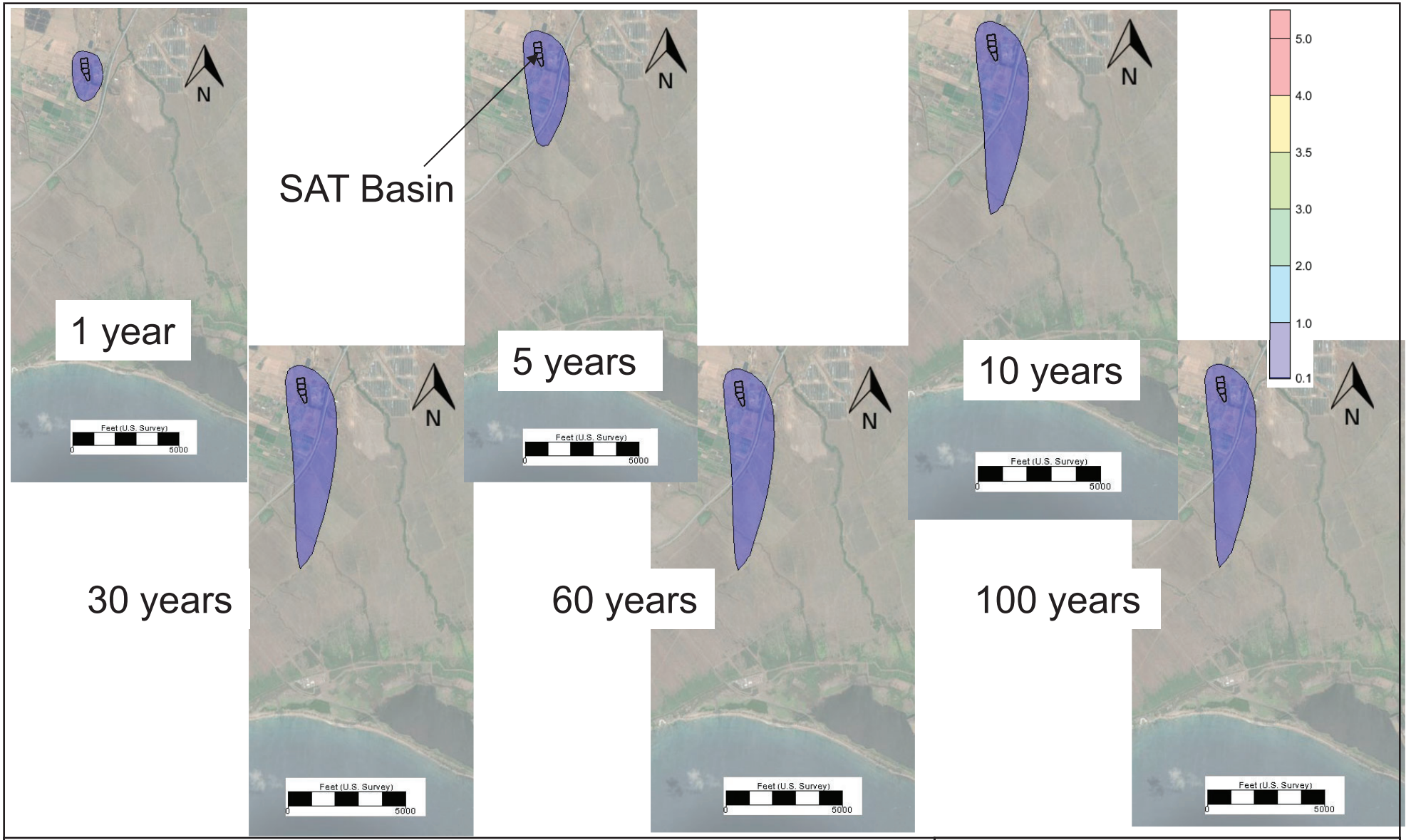
Figure 44

P:\PRJ2003REM\Maui\Model



Notes:
1. The low nitrate concentration input is 0.3 mgN/L and corresponds to simulated concentration in the infiltrating water at the water table based on an enhanced and/or rapid denitrification rate in the vadose zone ($8x10^{-3}d^{-1}$).
2. The denitrification rate in groundwater used in the model is 1.5×10^{-4} 1/day.
3. Unit of nitrate concentration is mgN/L.

Simulated Nitrate Concentrations over 100 Years – With Enhanced/Optimal Nitrate Denitrification Rates in Vadose Zone and Groundwater

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Maui, Hawaii

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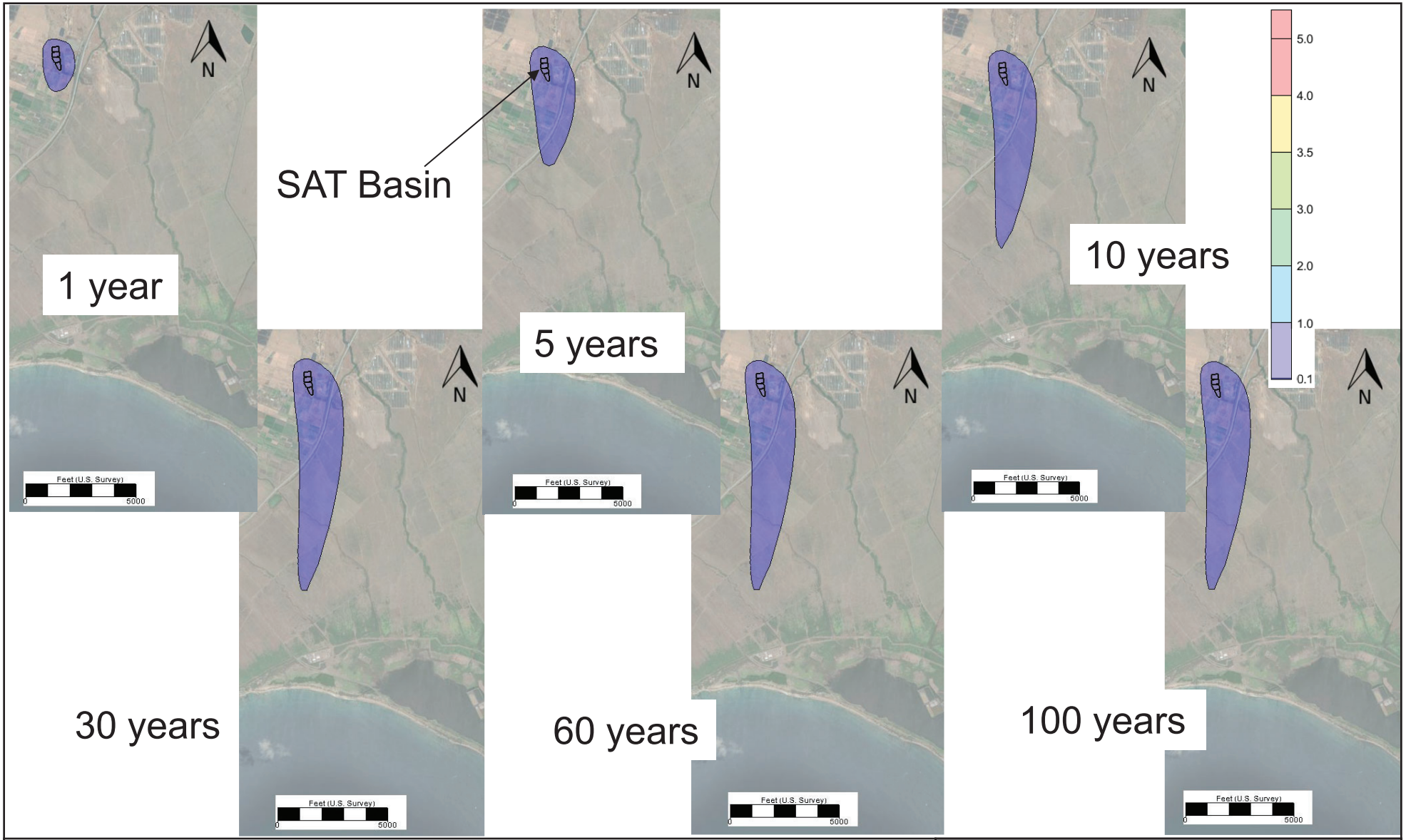
Figure 45

P:\PRJ2003REM\Maui\Model



Notes:
1. The low nitrate concentration input is 0.3 mgN/L and corresponds to simulated concentration in the infiltrating water at the water table based on an enhanced and/or rapid denitrification rate in the vadose zone ($8x10^{-3}$ d^{-1}).
2. The denitrification rate used in groundwater in the model is 3.1×10^{-5} 1/day.
3. Unit of nitrate concentration is mgN/L.

Simulated Nitrate Concentrations over 100 Years – With Enhanced/Optimal Nitrate Denitrification Rates in Vadose Zone and Low Rate in Groundwater

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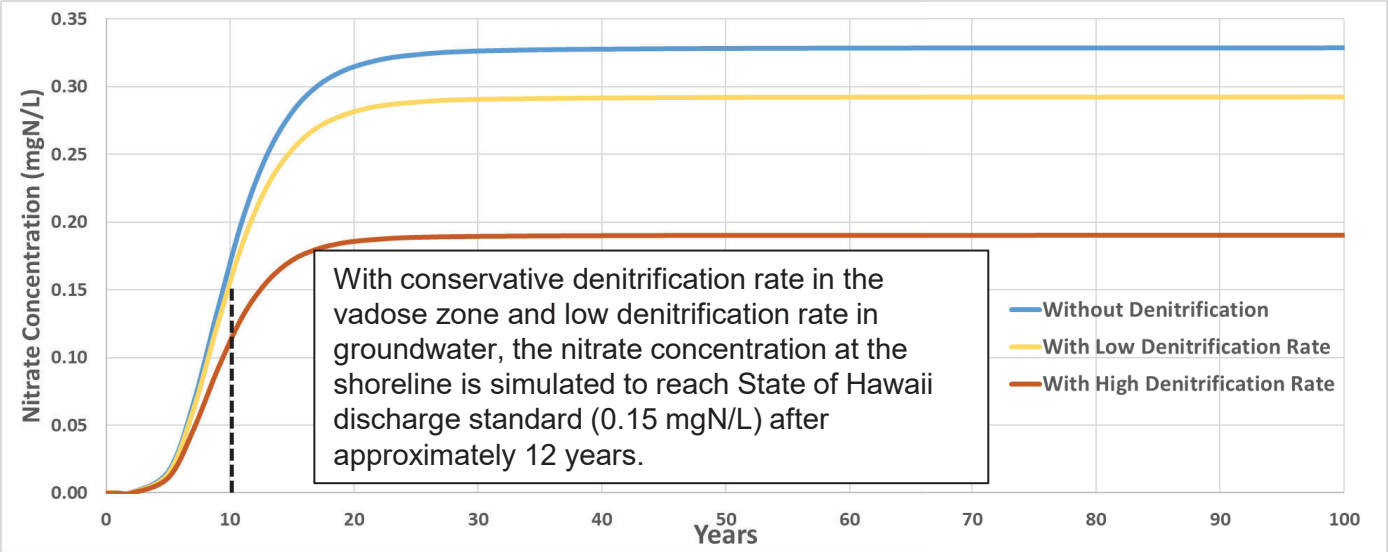
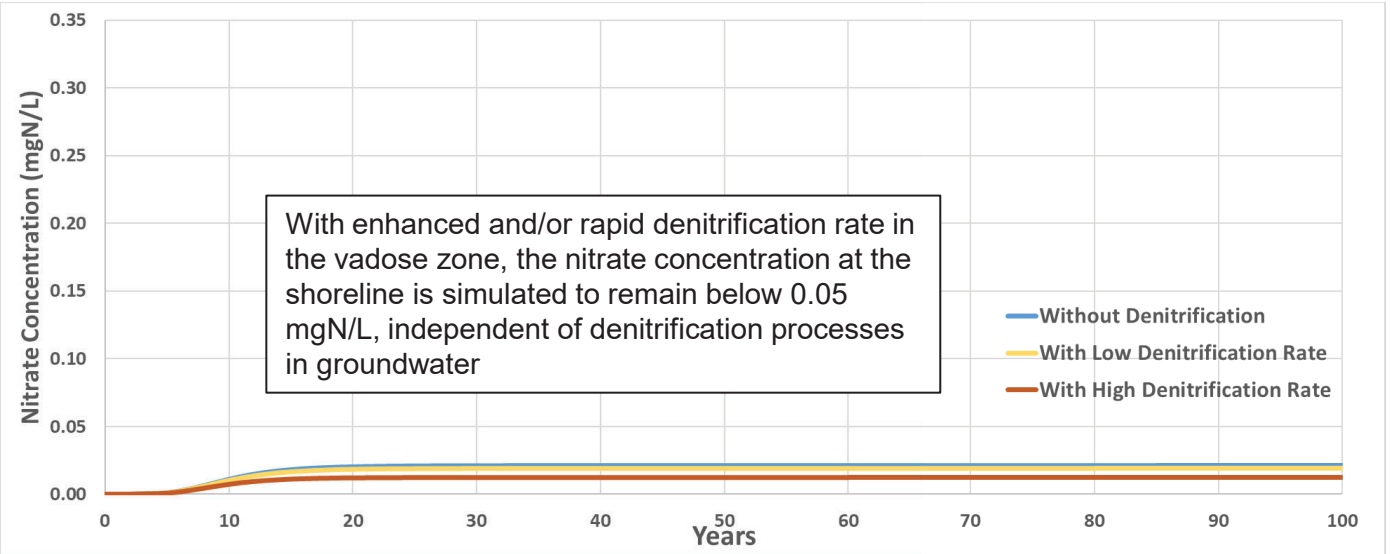
Figure 46

P:\PRJ2003REM\Maui\Model

(a): the nitrate concentration in water infiltrating at the water table is 4.6 mgN/L based on a conservative vadose zone denitrification rate



(b): the nitrate concentration in water infiltrating at the water table is 0.3 mgN/L based on an enhanced and/or optimal vadose zone denitrification rate



Notes:
The low and high denitrification rates in groundwater are 3.1×10^{-5} and 1.5×10^{-4} 1/day, respectively.

Simulated Nitrate Concentrations at the Shoreline
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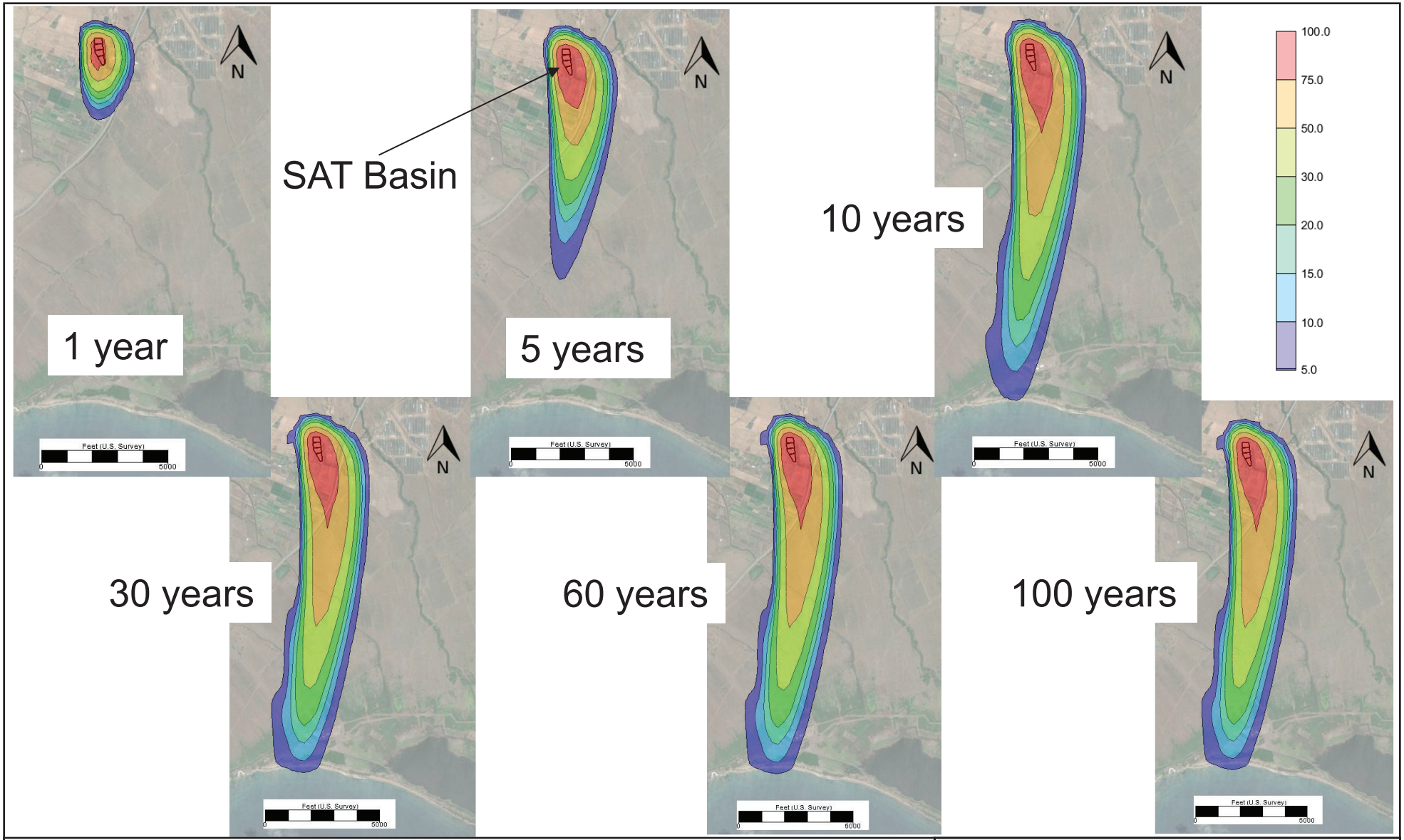
Figure 47

P:\PRJ2003REM\Maui\Model



Notes:
Concentration contours are in percentage of the concentration in infiltrating water at the water table.

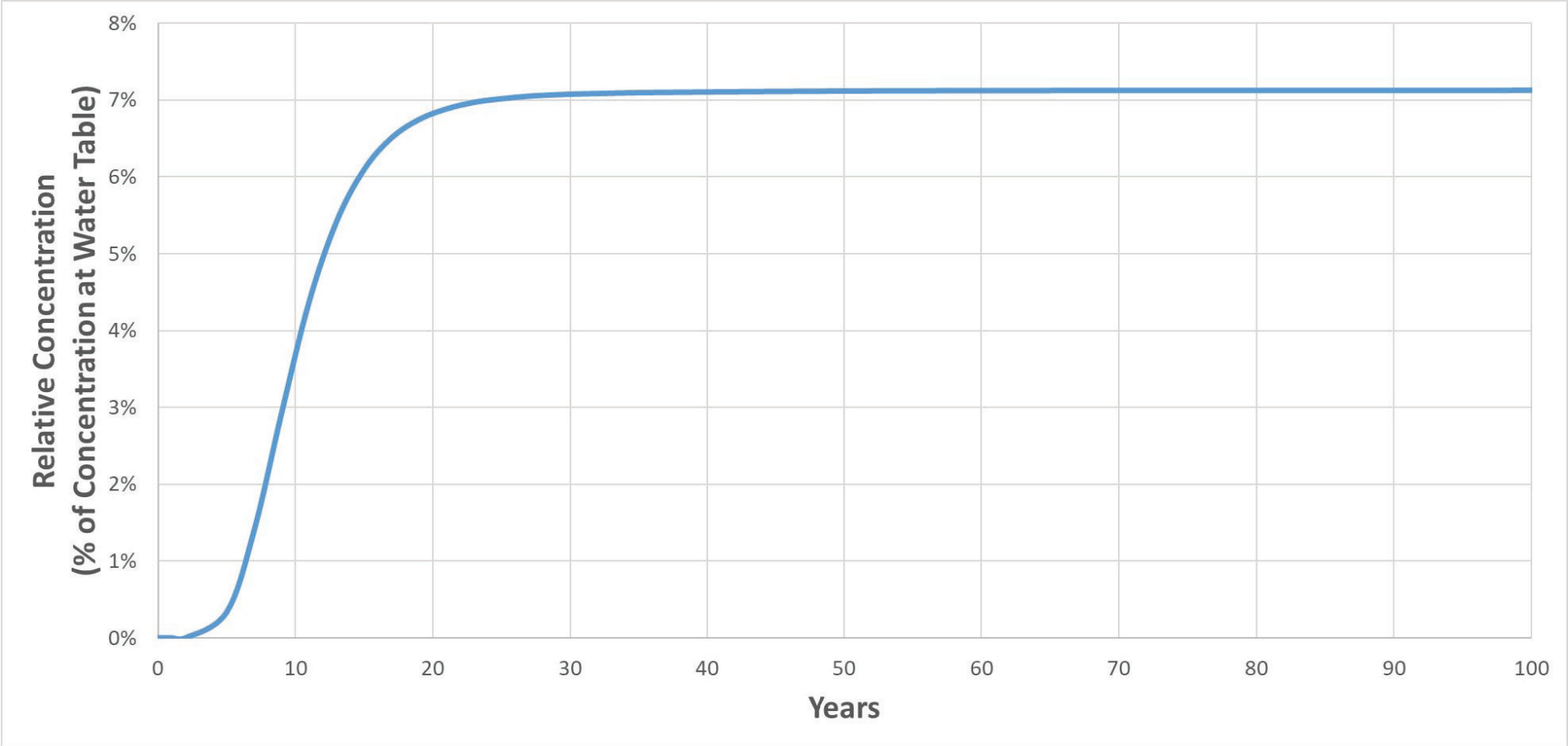
Simulated Plumes without Degradation in Groundwater for a Generic Analyte
PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii

Geosyntec consultants

Project No: LB1047 | October 2024

Figure 48

P:\PRJ2003REM\Maui\Model



Simulated Concentrations at the Shoreline without Degradation in Groundwater for a Generic Analyte

PROPOSED CENTRAL MAUI WWRF FACILITY

Maui, Hawaii

Geosyntec consultants

Figure 49

Project No: LB1047

October 2024

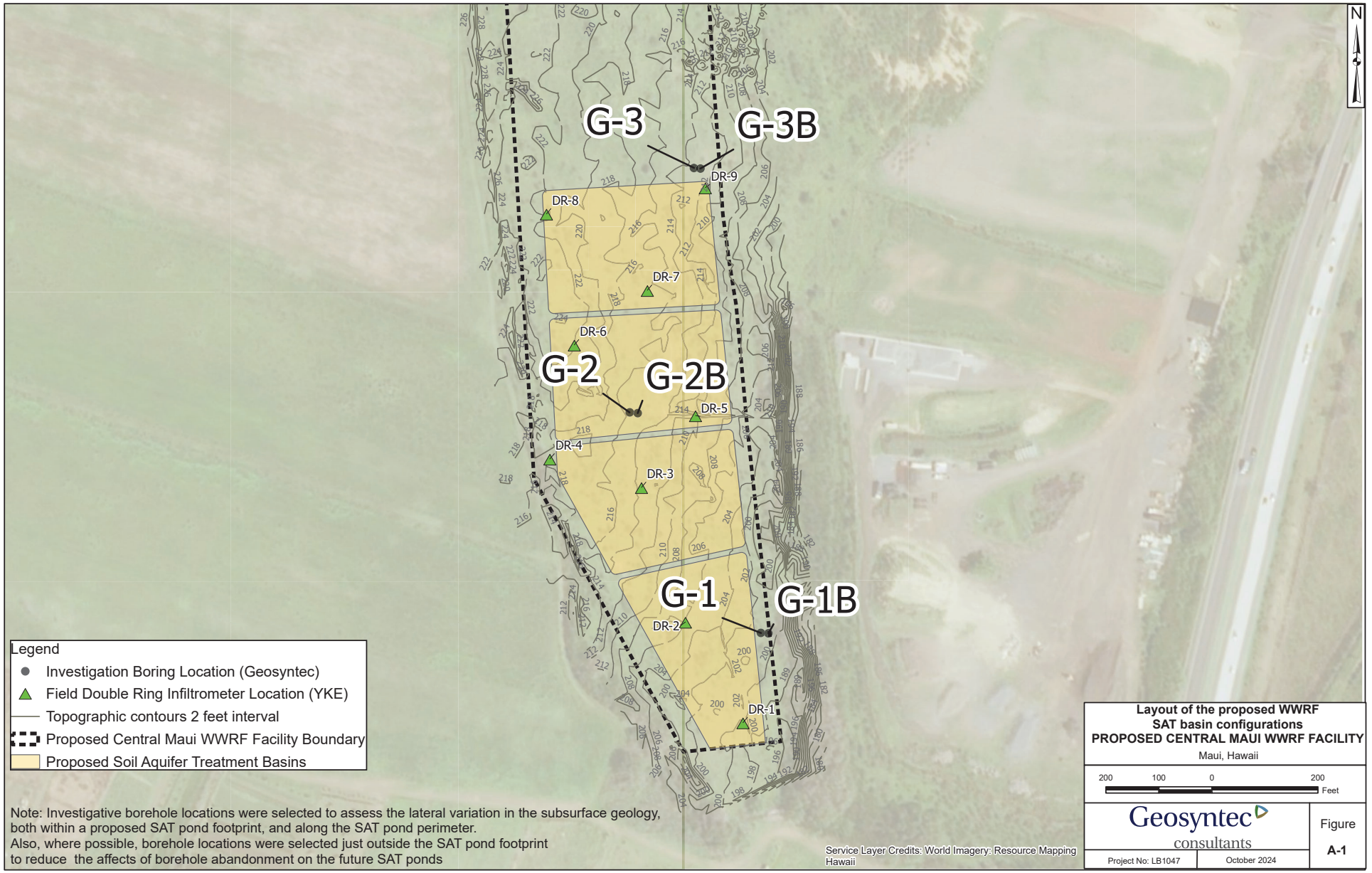
P:\PRJ2003REM\Maui\Model

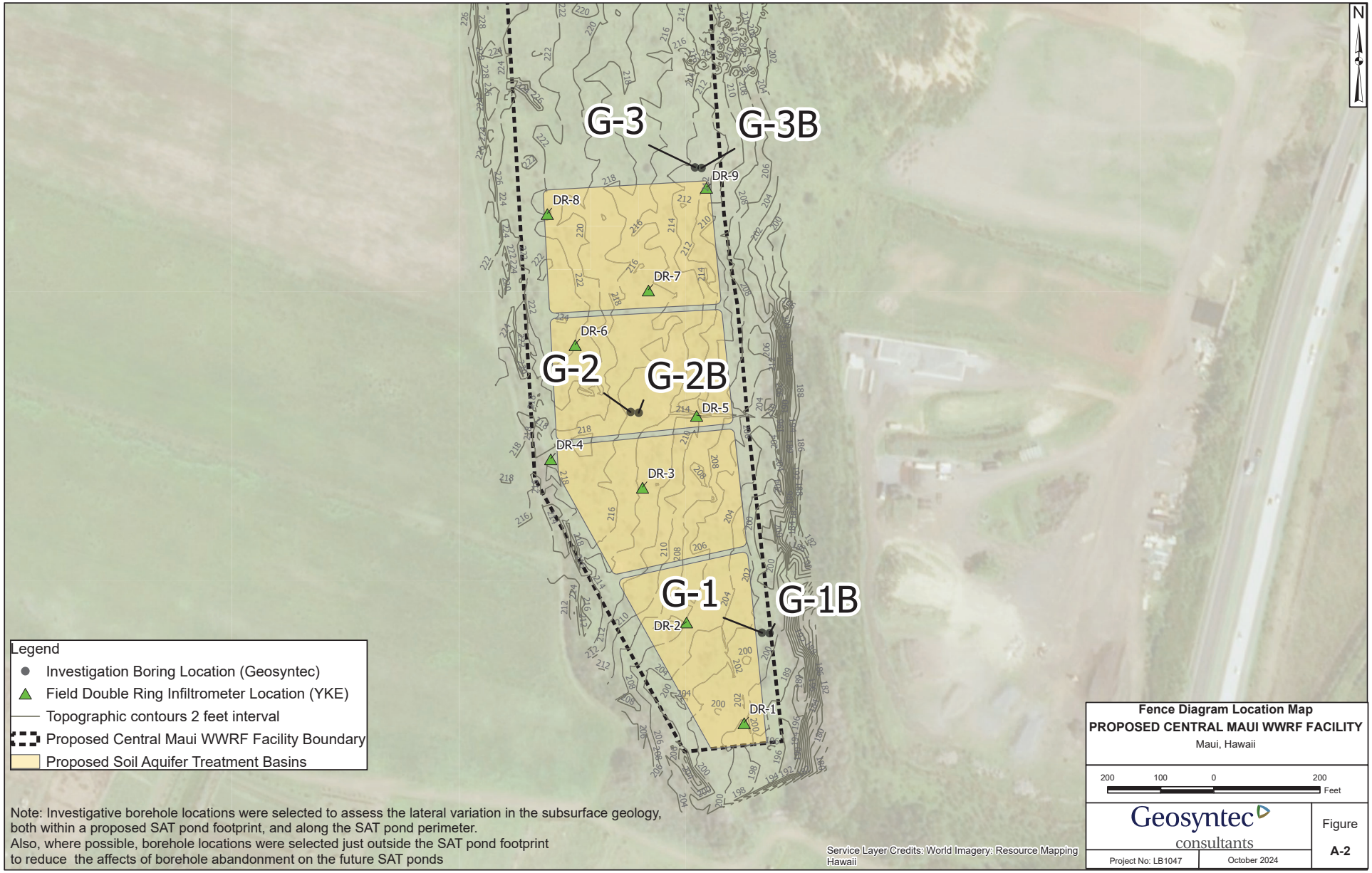
APPENDIX A

Background Subsurface Soil Information

- Figures
- Boring Logs – G-1, G-2, and G-3
- Investigation Photo Documentation
- Soils Grain Size Testing

Appendix A - Figures


G-3
G-3B
DR-9
DR-8
DR-7
DR-6
G-2
G-2B
DR-5
DR-4
DR-3
G-1
G-1B
DR-2
DR-1
N
Legend
Investigation Boring Location (Geosyntec)
Field Double Ring Infiltrometer Location (YKE)
Topographic contours 2 feet interval
Proposed Central Maui WWRF Facility Boundary
Proposed Soil Aquifer Treatment Basins
Note: Investigative borehole locations were selected to assess the lateral variation in the subsurface geology, both within a proposed SAT pond footprint, and along the SAT pond perimeter.
Also, where possible, borehole locations were selected just outside the SAT pond footprint to reduce the affects of borehole abandonment on the future SAT ponds
Service Layer Credits: World Imagery: Resource Mapping Hawaii
Layout of the proposed WWRF
SAT basin configurations
PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii
200 100 0 200
Feet
Geosyntec consultants
Figure
A-1
Project No: LB1047
October 2024
L:\Projects\LB1047_Maui_WWTF\GIS\Projects\Report\Proposed\WWRFSAT_basin.aprx\L 9/23/2024


G-3
G-3B
DR-9
DR-8
DR-7
DR-6
G-2
G-2B
DR-5
DR-4
DR-3
G-1
G-1B
DR-2
DR-1
N
Legend
Investigation Boring Location (Geosyntec)
Field Double Ring Infiltrometer Location (YKE)
Topographic contours 2 feet interval
Proposed Central Maui WWRF Facility Boundary
Proposed Soil Aquifer Treatment Basins
Note: Investigative borehole locations were selected to assess the lateral variation in the subsurface geology, both within a proposed SAT pond footprint, and along the SAT pond perimeter.
Also, where possible, borehole locations were selected just outside the SAT pond footprint to reduce the affects of borehole abandonment on the future SAT ponds
Service Layer Credits: World Imagery: Resource Mapping Hawaii
Fence Diagram Location Map
PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii
200 100 0 200
Feet
Geosyntec consultants
Figure
A-2
Project No: LB1047
October 2024
L:\Projects\LB1047_Maui_WWTF\GIS\Projects\Report\Proposed\WWRFSAT_basin.aprx\L 9/23/2024

Geosyntec consultants

Fence Diagram - View Facing West

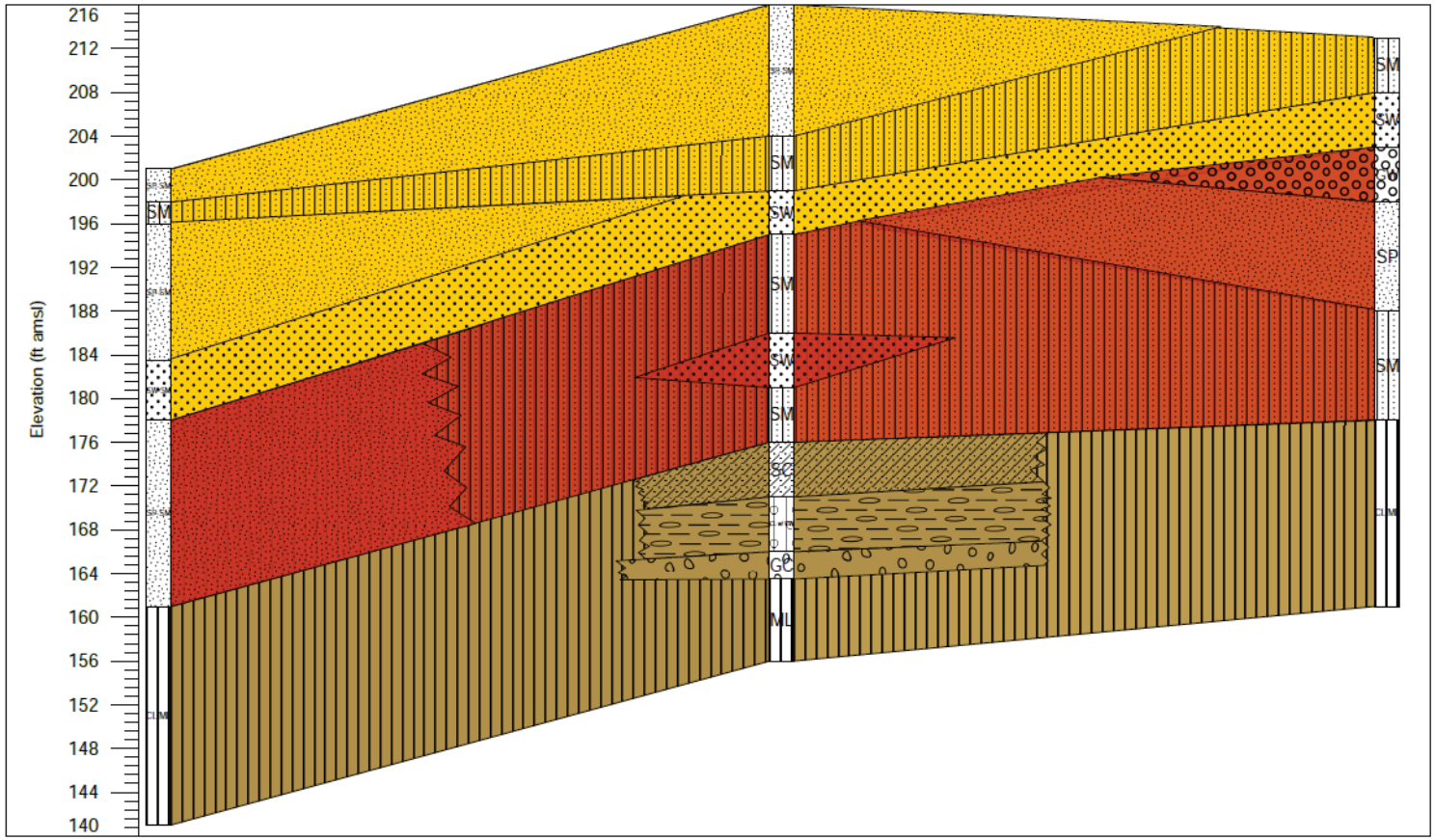
PROJECT: Central Maui WWRF
LOCATION: Maui, Hawaii
JOB NO: LB1047A

LOGGED BY: Luis Martinez, G.I.T
REVIEWED BY: Rich Kraft, P.G., C.E.G., G. Hg.

Lithology

GW	SP	ML
GC	SP-SM	CL/ML
SW	SM	CL w/ GW
SW-SM	SC	

- Older dune deposits (Qdo) /Jaucas sand
- Older dune deposits (Qdo) /Jaucas sand - interbedded and partly consolidated
- Older alluvium (QTao) - consolidated Sandy SILT with clay and gravel



Vertical Exaggeration ~ 10X

Fence Diagram of Subsurface Geology
PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii

Geosyntec consultants

Project No: LB1047A | April 2024

Figure **A-3**

Boring Logs G-1, G-2 and G-3

Geosyntec consultants
211 E. Ocean Blvd
Suite 300
Long Beach, CA 90802
Tel: (562) 257-1401

BORING.: G-1
PROJECT: Support of the Central Maui WWRF
LOCATION: MAUI, HAWAII
JOB NO.: LB1047A

LOGGED BY: Luis Martinez, G.I.T
REVIEWER: Rich Kraft, P.G., C.E.G, C.Hg.
START DRILL DATE: 09/12/2032
FINISH DRILL DATE: 10/23/2023

DEPTH (ft bgs)	DESCRIPTION OF STRATA	LEGEND	COMMENTS	SAMPLES	SPT blows/18in (0, 25, 50, 75, 100)
0	**Older dune deposits (Qdo) / Jaucas sand** - Poorly Graded SAND (SP-SM) with silt; dark brown (7.5YR 2.5/2); dry; fines, fine sand, and gravel (~0.25"); (TR, 95, 5)				
	Silty SAND (SM); dark brown (7.5YR 2.5/2); dry; fines and fine sand; (0, 85, 15)				
5				S1	
	Poorly Graded SAND (SP-SM) with silt; dark brown (7.5YR 2.5/2); dry; fines and fine sand; (0, 90, 10)				
10				S2*; G-1-10	
	Poorly Graded SAND (SP-SM) with silt; dark brown (7.5YR 2.5/2); dry; fines, fine sand, and trace gravel, (TR, 90, 10)				
15				S3	
	Poorly Graded SAND (SP-SM) with silt; brown (10YR 2.4/3); dry; fines, fine sand, and trace gravel, (TR, 90, 10)				
	Poorly Graded SAND (SP-SM) with silt; brown (10YR 2.4/3); dry; fines, fine sand, and trace gravel, (TR, 95, 5)				
20				S4	
	Well Graded SAND (SW-SM) with silt; dark brown (2.5YR 3/2); dry; fines and fine to medium sand; (0, 95, 5)				
	Well Graded SAND (SW-SM) with silt; dark brown (2.5YR 3/2); dry; fines, fine to medium sand, and trace gravel (~0.25"); TR, 95, 5)				
25				S5	

DESCRIPTION OF STRATA
1) Unit/Formation Name
2) USCS Name
3) Color
4) Moisture
5) Grain Size
6) Percent Grain Size (gravel, sand, fines)
7) Plasticity
8)Density/Consistency
9)Structure
10) Other

CONTRACTOR: YK Drilling
EQUIPMENT: SIMCO 2800
DRILL METHOD: Hollow Stem Auger
DIAMETER: 6-inch

NOTES: no groundwater encountered
ft bgs = feet below ground surface
*submitted for geotechnical analysis
See discussion and comparison of field logging and laboratory testing of fine grained soil materials (i.e, silt and clay fractions) in report text.

Geosyntec consultants
211 E. Ocean Blvd
Suite 300
Long Beach, CA 90802
Tel: (562) 257-1401

BORING.: G-1
PROJECT: Support of the Central Maui WWRF
LOCATION: MAUI, HAWAII
JOB NO.: LB1047A

LOGGED BY: Luis Martinez, G.I.T
REVIEWER: Rich Kraft, P.G., C.E.G, C.Hg.
START DRILL DATE: 09/12/2032
FINISH DRILL DATE: 10/23/2023

DEPTH (ft bgs)	DESCRIPTION OF STRATA	LEGEND	COMMENTS	SAMPLES	SPT blows/18in (0, 25, 50, 75, 100)
	Poorly Graded SAND (SP-SM) with silt; dark brown (7.5YR 2.5/2); dry; fines, fine sand, and gravel (~0.25"); (10, 80, 10)				
30	SAME AS ABOVE			S6; G-1-30 (HOLD)	
35	Poorly Graded (SP-SM) with silt; dark brown (7.5YR 2.5/2); dry; fines and fine to medium sand; (0, 95, 5)		Potential transition to earthy, alluvial fan deposits	S7*	
40	***Top of Older alluvium (QTao)*** *NOTE: Interval between 40 to 60 ft bgs redefined from CLAY (CL) to Sandy CLAY (CL) and Sandy SILT (ML) based on laboratory testing of similar materials in G-2 and G-3 in the same interval.* Sandy CLAY (CL); dark brown (7.5 3/2); dry; fines and fine to medium sand; (0, 30, 70)			S8	
45	SAME AS ABOVE			S9*; G-1-45	
50	CLAY (CL) with sand and gravel; dark brown (7.5YR 3/2); dry; fines, fine sand, and gravel (0.25"-1.0"); (15, 20, 65)			S10	

CONTRACTOR: YK Drilling
EQUIPMENT: SIMCO 2800
DRILL METHOD: Hollow Stem Auger
DIAMETER: 6-inch

NOTES: no groundwater encountered
ft bgs = feet below ground surface
*submitted for geotechnical analysis
See discussion and comparison of field logging and laboratory testing of fine grained soil materials (i.e, silt and clay fractions) in report text.

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211 E. Ocean Blvd
Suite 300
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BORING.: G-1
PROJECT: Support of the Central Maui WWRF
LOCATION: MAUI, HAWAII
JOB NO.: LB1047A

LOGGED BY: Luis Martinez, G.I.T
REVIEWER: Rich Kraft, P.G., C.E.G, C.Hg.
START DRILL DATE: 09/12/2032
FINISH DRILL DATE: 10/23/2023

DEPTH (ft bgs)	DESCRIPTION OF STRATA	LEGEND	COMMENTS	SAMPLES	SPT blows/18in (0, 25, 50, 75, 100)
55	CLAY (CL) with sand; very dark brown (7.5YR 2.5/3); dry; fines fine to coarse sand; and gravel (0.25"); (10, 30, 60)			S11	
				G-1-58	
60	Total Depth = 60 ft bgs			S12	

1) Unit/Formation Name
2) USCS Name
3) Color
4) Moisture
5) Grain Size
6) Percent Grain Size (gravel, sand, fines)
7) Plasticity
8)Density/Consistency
9)Structure
10) Other

CONTRACTOR: YK Drilling
EQUIPMENT: SIMCO 2800
DRILL METHOD: Hollow Stem Auger
DIAMETER: 6-inch

NOTES: no groundwater encountered
ft bgs = feet below ground surface
*submitted for geotechnical analysis
See discussion and comparison of field logging and laboratory testing of fine grained soil materials (i.e, silt and clay fractions) in report text.

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Long Beach, CA 90802
Tel: (562) 257-1401

BORING.: G-2
PROJECT: Support of the Central Maui WWRF
LOCATION: MAUI, HAWAII
JOB NO.: LB1047A

LOGGED BY: Luis Martinez, G.I.T
REVIEWER: Rich Kraft, P.G., C.E.G, C.Hg.
START DRILL DATE: 10/24/2023
FINISH DRILL DATE: 10/25/2023

DEPTH (ft bgs)	DESCRIPTION OF STRATA	LEGEND	COMMENTS	SAMPLES	SPT blows/18in
	1) Unit/Formation Name; 2) USCS Name; 3) Color; 4) Moisture; 5) Grain Size; 6) Percent Grain Size (gravel, sand, fines); 7) Plasticity; 8)Density/Consistency; 9)Structure; 10) Other				0, 25, 50, 75, 100
0	**Older dune deposits (Qdo) / Jaucas sand -** Poorly Graded SAND (SP-SM) with silt; brown (10yr 4/3); dry; fines and fine sand; (0, 90, 10)				
5				S1	
	Poorly Graded SAND (SP); olive brown (2.5Y 4/2); dry; fine to medium sand and gravel (~0.25"); (5, 95, 0)				
10				S2	
	Silty SAND (SM); olive brown (2.5Y 4/2); dry, fines, fine sand, and gravel (0.25"-1.0"); (10, 60, 30)				
15				S3*; G-2-15	
	Well Graded SAND (SW) with gravel; dark brown (10YR 3/3); dry; fines, fine-coarse sand, and gravel; (25, 65,10)		One Large piece of basalt gravel, ~3" in diameter		
20				S4	
	Silty SAND (SM); very dark brown (7.5YR 2.5/2); dry; fines and fine sand; (0, 80, 20)				
25				S5	

CONTRACTOR: YK Drilling
EQUIPMENT: SIMCO 2800
DRILL METHOD: Hollow Stem Auger
DIAMETER: 6-inch

NOTES: no groundwater encountered
ft bgs = feet below ground surface
*submitted for geotechnical analysis
See discussion and comparison of field logging and laboratory testing of fine grained soil materials (i.e, silt and clay fractions) in report text.

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211 E. Ocean Blvd
Suite 300
Long Beach, CA 90802
Tel: (562) 257-1401

BORING.: G-2
PROJECT: Support of the Central Maui WWRF
LOCATION: MAUI, HAWAII
JOB NO.: LB1047A

LOGGED BY: Luis Martinez, G.I.T
REVIEWER: Rich Kraft, P.G., C.E.G, C.Hg.
START DRILL DATE: 10/24/2023
FINISH DRILL DATE: 10/25/2023

DEPTH (ft bgs)	DESCRIPTION OF STRATA	LEGEND	COMMENTS	SAMPLES	SPT blows/18in (0, 25, 50, 75, 100)
	Silty SAND (SM); very dark brown (7.5YR 2.5/2); moist; fines, fine sand, and gravel (0.25"); (5, 80, 15)				
30	Well Graded SAND (SW) with gravel and silt; very dark brown (7.5YR 2.5/3); moist; fines, fine-medium sand, subrounded gravel (0.25"-1"); (45, 50, 5); low plasticity			S6	
35	Silty SAND (SM) with gravel; very dark brown (7.5YR 2.5/2); moist; fines, fine-medium sand, and subrounded gravel (0.25"); low plasticity			S7	
40	**Top of Older alluvium (QTao)** Clayey SAND (SC); very dark brown (7.5YR 2.5/1); moist; fines and fine to medium sand; (0, 80, 20)		Potential transition to earthy, alluvial fan deposits	S8* G-2-41.5	
45	Gravelly CLAY (CL); black (7.5YR 2.5Y/1); moist; fines and subangular to subrounded gravel (0.25"-0.5"); (40, 0, 60)		@ 46 ft bgs auger having trouble drilling down, tough material encountered	S9	
50				S10	

CONTRACTOR: YK Drilling
EQUIPMENT: SIMCO 2800
DRILL METHOD: Hollow Stem Auger
DIAMETER: 6-inch

NOTES: no groundwater encountered
ft bgs = feet below ground surface
*submitted for geotechnical analysis
See discussion and comparison of field logging and laboratory testing of fine grained soil materials (i.e, silt and clay fractions) in report text.

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Tel: (562) 257-1401

BORING.: G-2
PROJECT: Support of the Central Maui WWRF
LOCATION: MAUI, HAWAII
JOB NO.: LB1047A

LOGGED BY: Luis Martinez, G.I.T
REVIEWER: Rich Kraft, P.G., C.E.G, C.Hg.
START DRILL DATE: 10/24/2023
FINISH DRILL DATE: 10/25/2023

DEPTH (ft bgs)	DESCRIPTION OF STRATA 1) Unit/Formation Name 2) USCS Name 3) Color 4) Moisture 5) Grain Size 6) Percent Grain Size (gravel, sand, fines) 7) Plasticity 8)Density/Consistency 9)Structure 10) Other	LEGEND	COMMENTS	SAMPLES	SPT blows/18in (0, 25, 50, 75, 100)
	Clayey GRAVEL (GC) with sand; black (10YR 2/1); moist; fines, fine sand, and subrounded to angular gravel (0.25"-1.0");				
	NOTE: Interval between 52.5-60 ft bgs redefined from CLAY (CL) to Sandy SILT (ML) based on laboratory testing at 55-56.5 ft bgs (1% gravel, 48% sand, 41% silt, and 10% clay (Appendix E)).				
55	*CLAY (CL); black (10YR 2/1); moist; fines, fine sand, subrounded gravel (0.25"); (10, 5, 75)* CLAY (CL); very dark brown (10YR 2/2); moist; fines, fine sands, subrounded gravel (0.25"-2.0"); (15, 5, 80)		@56 ft bgs slow down in drilling, tough material encountered	S11* G-2-58	
60	Total Depth = 60 ft bgs				

CONTRACTOR: YK Drilling
EQUIPMENT: SIMCO 2800
DRILL METHOD: Hollow Stem Auger
DIAMETER: 6-inch

NOTES: no groundwater encountered
ft bgs = feet below ground surface
*submitted for geotechnical analysis
See discussion and comparison of field logging and laboratory testing of fine grained soil materials (i.e, silt and clay fractions) in report text.

Geosyntec consultants
211 E. Ocean Blvd
Suite 300
Long Beach, CA 90802
Tel: (562) 257-1401

BORING.: G-3
PROJECT: Support of the Central Maui WWRF
LOCATION: MAUI, HAWAII
JOB NO.: LB1047A

LOGGED BY: Luis Martinez, G.I.T
REVIEWER: Rich Kraft, P.G., C.E.G, C.Hg.
START DRILL DATE: 10/26/2023
FINISH DRILL DATE: 10/27/2023

DESCRIPTION OF STRATA
1) Unit/Formation Name
2) USCS Name
3) Color
4) Moisture
5) Grain Size
6) Percent Grain Size (gravel, sand, fines)
7) Plasticity
8)Density/Consistency
9)Structure
10) Other

DEPTH (ft bgs)	DESCRIPTION OF STRATA	LEGEND	COMMENTS	SAMPLES	SPT blows/18in (0 10 20 30 40 50)
0	**Older dune deposits (Qdo) / Jaucas sand -** Silty SAND (SM); grayish brown (10YR 5/2); dry; fines and fine sand; (0, 85, 15)				
5	Well Graded SAND (SW) with gravel; very dark brown; fines, fine to coarse sand, subrounded gravel (0.25"-0.75"); (30, 60, 10)			S1	
10	Well Graded GRAVEL (GW); with sand; dark brown (10YR 3/2) sand and Grey (GLEY1 6/N) gravel; moist; fines, fine to medium sand, subrounded to angular gravel (0.25" - 3"), (65, 30, 5)		hard rock, drill struggling to dig through	S2	
15	Poorly Graded SAND (SP); dark redish brown (5YR 3/2); moist; fines and fine sand; (0, 98, 2)			S3*	
20	SAME AS ABOVE			S4	
				G-3-23	
25				S5	

CONTRACTOR: YK Drilling
EQUIPMENT: SIMCO 2800
DRILL METHOD: Hollow Stem Auger
DIAMETER: 6-inch

NOTES: no groundwater encountered
ft bgs = feet below ground surface
*submitted for geotechnical analysis
See discussion and comparison of field logging and laboratory testing of fine grained soil materials (i.e, silt and clay fractions) in report text.

Geosyntec consultants
211 E. Ocean Blvd
Suite 300
Long Beach, CA 90802
Tel: (562) 257-1401

BORING.: G-3
PROJECT: Support of the Central Maui WWRF
LOCATION: MAUI, HAWAII
JOB NO.: LB1047A

LOGGED BY: Luis Martinez, G.I.T
REVIEWER: Rich Kraft, P.G., C.E.G, C.Hg.
START DRILL DATE: 10/26/2023
FINISH DRILL DATE: 10/27/2023

DEPTH (ft bgs)	DESCRIPTION OF STRATA	LEGEND	COMMENTS	SAMPLES	SPT blows/18in
	Silty SAND (SM); very dark brown (10YR 2/2); moist; fines and fine sand; (0, 75,5); low plasticity				
30	Silty SAND (SM); dark brown (10YR 2/2); moist; fines, fine sand, subrounded gravel (0.25"); (15, 45, 45)		Potential transition ro earthy alluvial fan deposits	S6	
35	***Top of Older alluvium (QTao)*** *NOTE: Interval between 35-50 ft bgs redefined from CLAY (CL) to Sandy SILT (ML) based on laboratory testing (2% gravel, 38% sand, 49%silt, and 8% clay (Appendix E)).* CLAY (CL) with sand; very dark brown (10YR 2/2); dry; fines and fine sand; (0, 20, 80); low plasticity		@37 ft bgs drill having trouble advancing	S7 G-3-38	
40	CLAY (CL) with sand; black (10YR 2/1); lightly moist; fines and fine sand; (0, 2, 98)			S8*	
45	SAME AS ABOVE			S9*	
	CLAY (CL); black (10YR 2/1); moist; fines and subangular gravel (~1"); (10, 0, 90)				
50				S10	

CONTRACTOR: YK Drilling
EQUIPMENT: SIMCO 2800
DRILL METHOD: Hollow Stem Auger
DIAMETER: 6-inch

NOTES: no groundwater encountered
ft bgs = feet below ground surface
*submitted for geotechnical analysis
See discussion and comparison of field logging and laboratory testing of fine grained soil materials (i.e, silt and clay fractions) in report text.

Geosyntec consultants
211 E. Ocean Blvd
Suite 300
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Tel: (562) 257-1401

BORING.: G-3
PROJECT: Support of the Central Maui WWRF
LOCATION: MAUI, HAWAII
JOB NO.: LB1047A

LOGGED BY: Luis Martinez, G.I.T
REVIEWER: Rich Kraft, P.G., C.E.G, C.Hg.
START DRILL DATE: 10/26/2023
FINISH DRILL DATE: 10/27/2023

DEPTH (ft bgs)	DESCRIPTION OF STRATA	LEGEND	COMMENTS	SAMPLES	SPT blows/18in
	1) Unit/Formation Name; 2) USCS Name; 3) Color; 4) Moisture; 5) Grain Size; 6) Percent Grain Size (gravel, sand, fines); 7) Plasticity; 8)Density/Consistency; 9)Structure; 10) Other				0 10 20 30 40 50
	Hit Refusal; Total Depth = 52 ft bgs		Drill hits tough material	G-3-52	
55					
60					

CONTRACTOR: YK Drilling
EQUIPMENT: SIMCO 2800
DRILL METHOD: Hollow Stem Auger
DIAMETER: 6-inch

NOTES: no groundwater encountered
ft bgs = feet below ground surface
*submitted for geotechnical analysis
See discussion and comparison of field logging and laboratory testing of fine grained soil materials (i.e, silt and clay fractions) in report text.

Field Program Photo Documentation

Photo Field Investigation Log – September 12, 2023

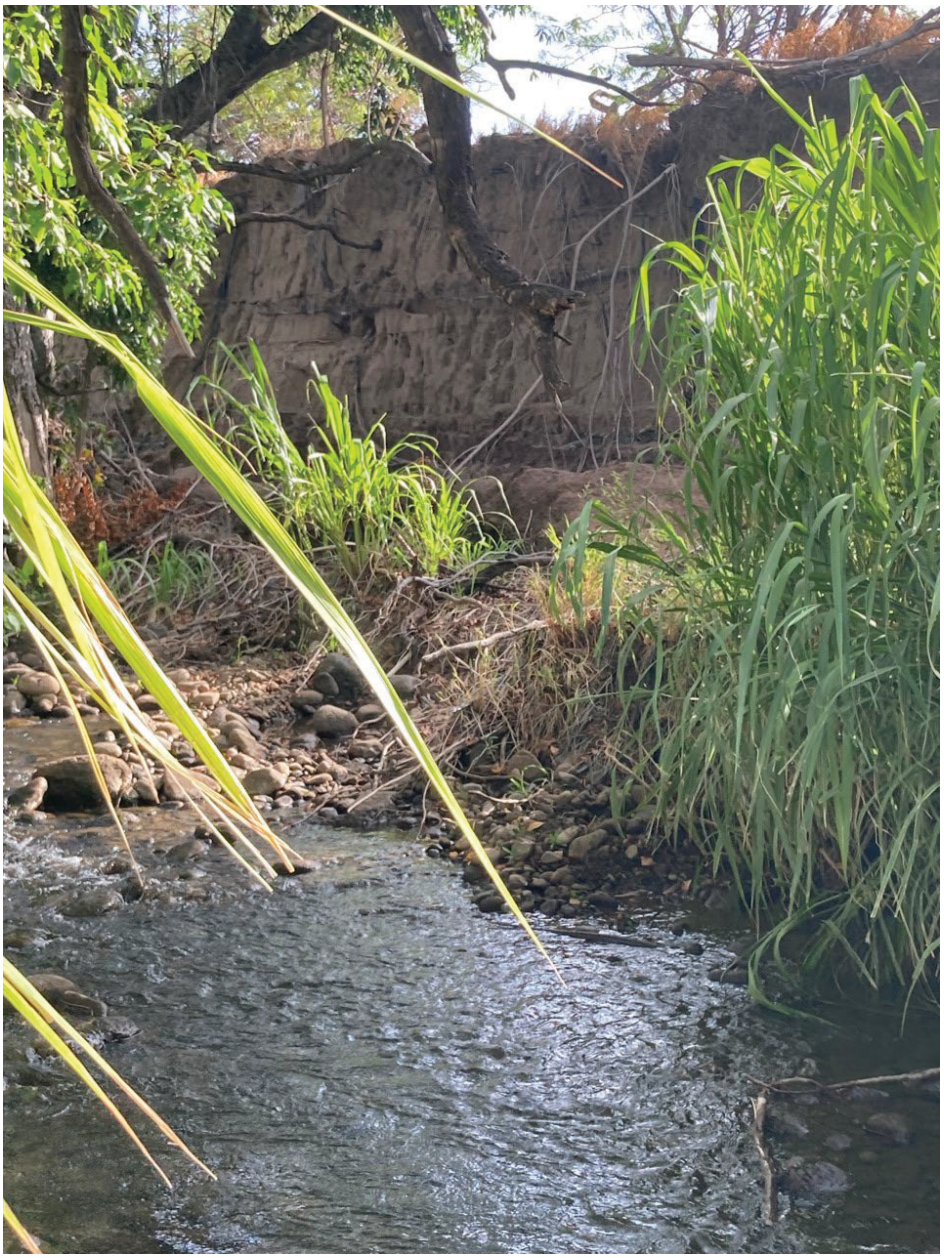
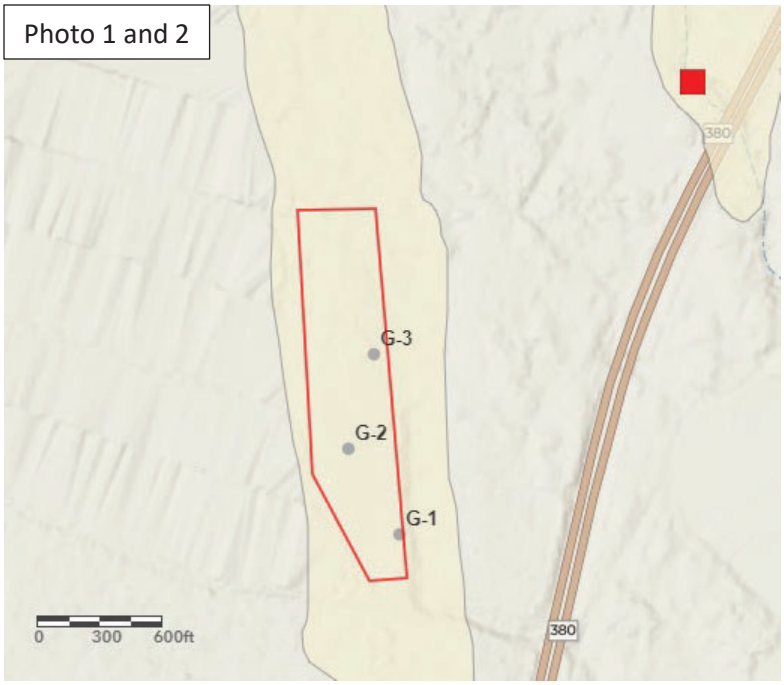


Photo 1 – Waikapu Stream and Stream Bank Outcrop – Older dune sands (Qdo) / Jaucas Sand overlying stream conglomerate, consisting of rounded to semi-rounded gravels to cobbles with sand matrix. Stream is approximately 10 feet wide, average of 0.5 feet deep, estimate of 1 ft per second flow rate (~ 5 cubic feet per second flow).

Photo 2 – Waikapu Stream Bank Outcrop – Older Dune sands (Qdo) / Jaucas sand overlying stream conglomerate, consisting of rounded to semi-rounded gravels to cobbles with sand matrix.



Approximate locations of Photos 1 and 2

Photos 3a and 3b – Outcrop of Older Dune deposits (Qdo) / Jaucas Sand, consists of fine to medium sand, loose, with coral fragments. Coral fragments may be disturbed and not in natural deposit.

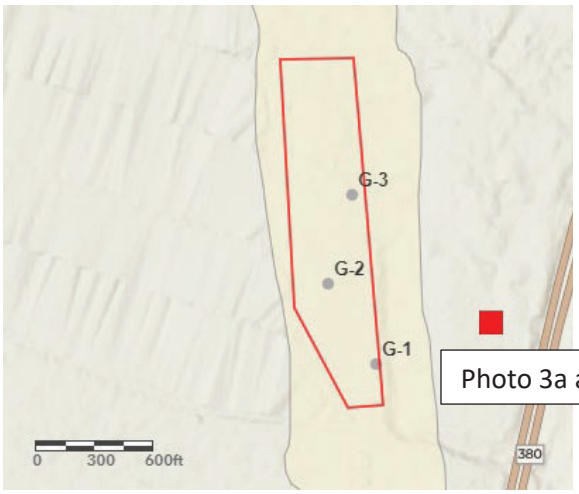

G-3
G-2
G-1
Photo 3a and 3b
0
300
600ft
380

Photo 4 – View looking northwest to West Maui Mountains and Waikapu Canyon. Note older alluvial fan (QTao) deposits emanating from the canyon, that is projected to underly the Older Dune sand deposits (Qdo) found at the Site ground surface.

Photo 6 – Drilling and soil sampling at G-1 (YK Drilling and Geosyntec logging).

Photo 7 – Modified California split-spoon soil sampling tool (YK Drilling).

Photo 8 – Cut-bank of Older Dune sand deposits (Qdo) / Jaucas Sand (approximately 15 feet in height) along ditch near boring G-1.

Photo 9 – Logging soils in boring G-1. Older dune sands (Qdo) / Jaucas Sand from ground surface to approximately 40 feet bgs, transition to earthy alluvial deposits (QTao), consisting of mixed sand, silt, clay and gravels, from 40 to 60 feet bgs.

Photo 10 – Series of soil samples collected in boring G-2. Note change from loose, Older dune sands (Qdo) / Jaucas sand in the

upper sample, to dense silts, sands and clays in the two deeper samples.

23004 CENTRAL MAUI WWRF
10/26/23
BORING G-3
S: 2
DEPTH: 10-11.5 FT
OP
BOTTOM

23004 CENTRAL MAUI WWRF
10/26/23
BORING G-3
S: 7
DEPTH: 35-36.5 FT
TOP
BOTTOM

23004 CENTRAL MAUI WWRF
10/26/23
BORING G-3
S: 10
DEPTH: 50-51.5 FT
BOTTOM

Photo 11 – Series of soil samples collected in boring G-2. Note change from loose, Older dune sands (Qdo) / Jaucas Sand with intermixed gravels in the upper sample, to dense silts, sands and clays in the two deeper samples.

Photo 12 – Collection of water-level measurements using an electronic water-level sounder during the in-borehole falling head tests.

Soil Grain Size Testing

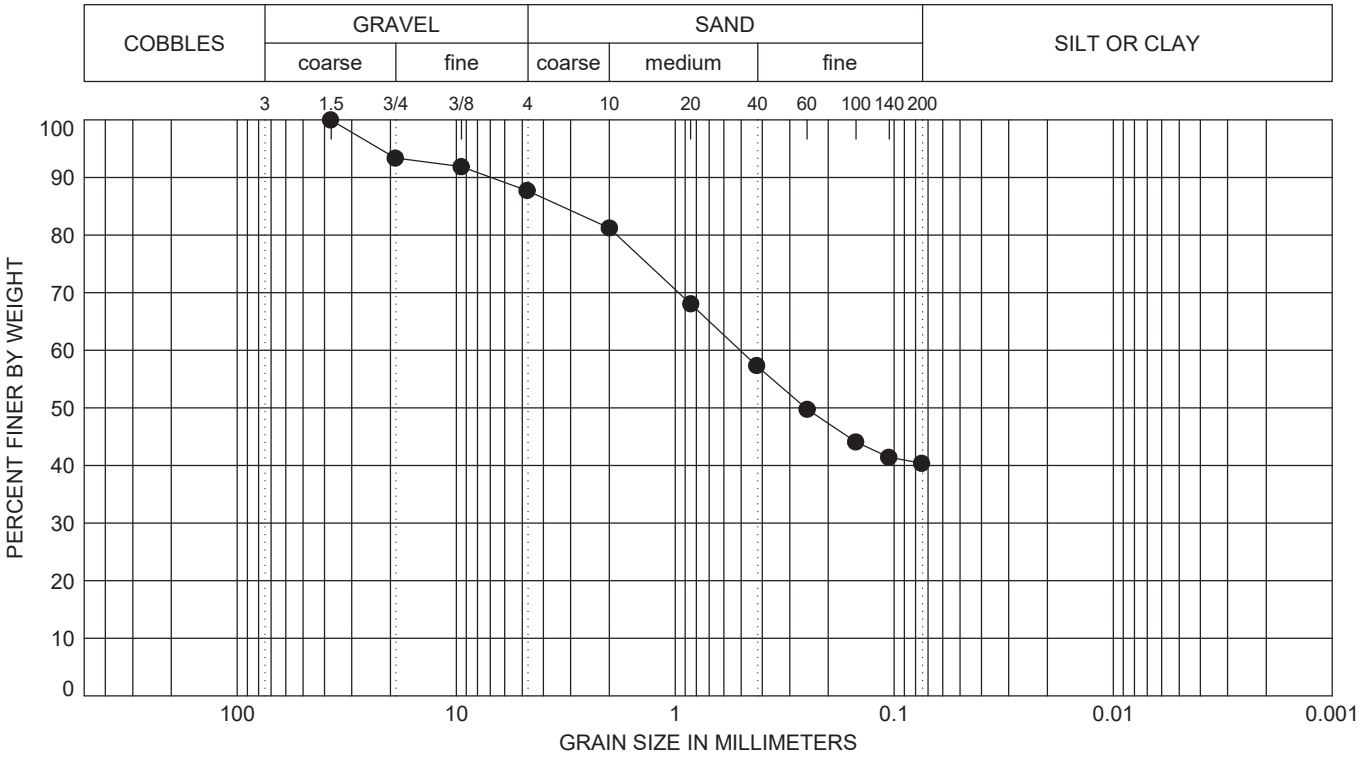
SIEVE ANALYSIS ASTM D6913

PROJECT: Central Maui Wastewater Reclamation Facility

BORING: G-1 SAMPLE NO. 2 DEPTH: 10 PROJECT NO: 23004

SIEVE NO.	SIEVE SIZE	CUMULATIVE WEIGHT RETAINED (GRAMS)	CUMULATIVE PERCENT RETAINED	PERCENT FINER
3 IN.	75			
1.5 IN.	37.5	0.00	0.0	100.0
3/4 IN.	19	29.71	6.6	93.4
3/8 IN.	9.5	36.34	8.1	91.9
NO. 4	4.75	54.86	12.3	87.7
NO. 10	2	83.98	18.8	81.2
NO. 20	0.85	142.95	31.9	68.1
NO. 40	0.425	190.92	42.7	57.3
NO. 60	0.25	224.89	50.2	49.8
NO. 100	0.15	250.27	55.9	44.1
NO. 140	0.106	262.18	58.6	41.4
NO. 200	0.075	266.86	59.6	40.4
	PAN		---	---

MOISTURE CONTENT (%)	9.1
DRY DENSITY (PCF)	78.4
TOTAL WT. OF DRY SOIL (GRAMS)	447.64
WT. OF NO. 200 WASHED OUT (GRAMS)	



GRAVEL	SAND	FINES	D60	D30	D10	Cu	Cc	CLASSIFICATION
12	47	41	0.50					Silty sand (SM)

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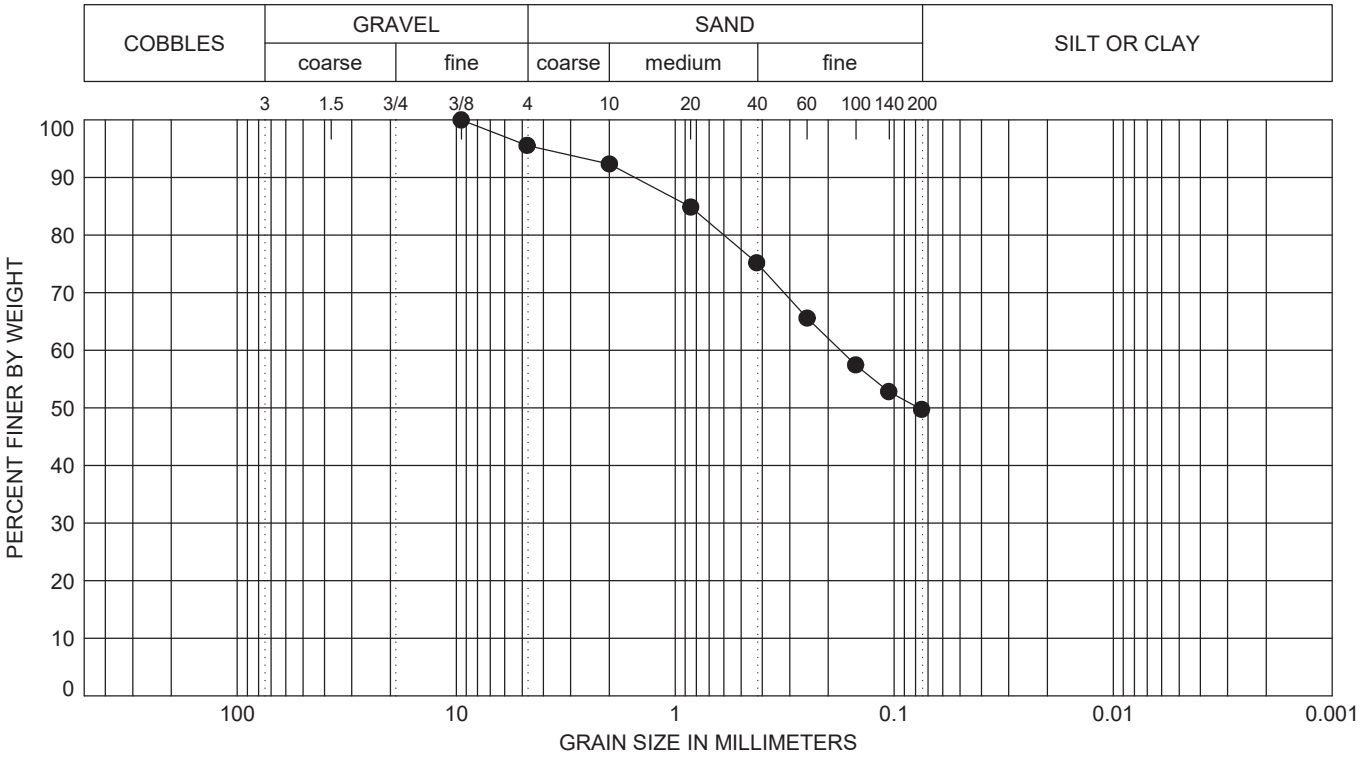
SIEVE ANALYSIS ASTM D6913

PROJECT: Central Maui Wastewater Reclamation Facility

BORING: G-1 SAMPLE NO. 7 DEPTH: 35 PROJECT NO: 23004

SIEVE NO.	SIEVE SIZE	CUMULATIVE WEIGHT RETAINED (GRAMS)	CUMULATIVE PERCENT RETAINED	PERCENT FINER
3 IN.	75			
1.5 IN.	37.5			
3/4 IN.	19			
3/8 IN.	9.5	0.00	0.0	100.0
NO. 4	4.75	10.90	4.4	95.6
NO. 10	2	18.80	7.6	92.4
NO. 20	0.85	37.20	15.1	84.9
NO. 40	0.425	61.00	24.8	75.2
NO. 60	0.25	84.60	34.4	65.6
NO. 100	0.15	104.60	42.5	57.5
NO. 140	0.106	116.00	47.2	52.8
NO. 200	0.075	123.60	50.3	49.7
	PAN		---	---

MOISTURE CONTENT (%)	27.4
DRY DENSITY (PCF)	73.9
TOTAL WT. OF DRY SOIL (GRAMS)	245.93
WT. OF NO. 200 WASHED OUT (GRAMS)	



GRAVEL	SAND	FINES	D60	D30	D10	Cu	Cc	CLASSIFICATION
4	46	50	0.18					Silty sand (SM)

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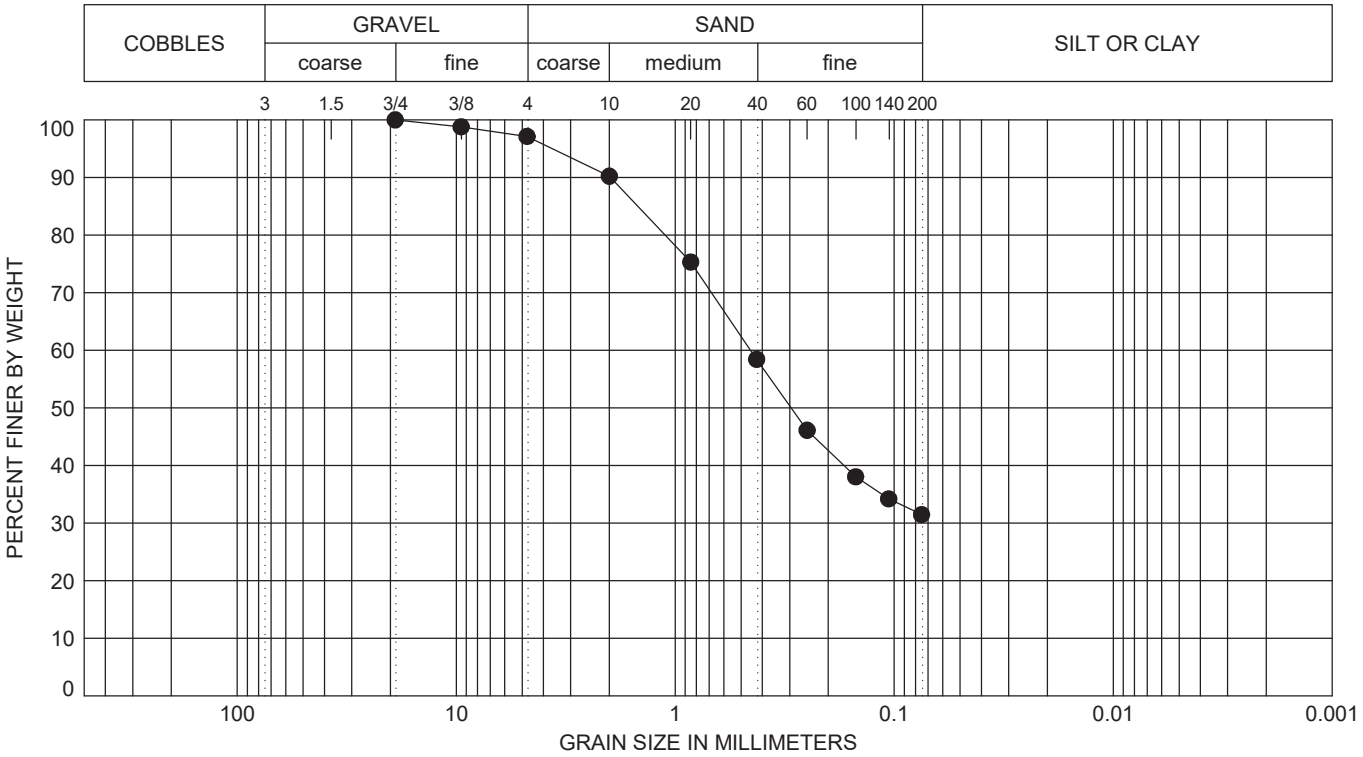
SIEVE ANALYSIS ASTM D6913

PROJECT: Central Maui Wastewater Reclamation Facility

BORING: G-1 SAMPLE NO. 9 DEPTH: 45 PROJECT NO: 23004

SIEVE NO.	SIEVE SIZE	CUMULATIVE WEIGHT RETAINED (GRAMS)	CUMULATIVE PERCENT RETAINED	PERCENT FINER
3 IN.	75			
1.5 IN.	37.5			
3/4 IN.	19	0.00	0.0	100.0
3/8 IN.	9.5	4.00	1.2	98.8
NO. 4	4.75	9.60	2.9	97.1
NO. 10	2	32.60	9.8	90.2
NO. 20	0.85	82.30	24.7	75.3
NO. 40	0.425	138.60	41.6	58.4
NO. 60	0.25	179.70	53.9	46.1
NO. 100	0.15	206.60	62.0	38.0
NO. 140	0.106	219.40	65.8	34.2
NO. 200	0.075	228.50	68.5	31.5
	PAN		---	---

MOISTURE CONTENT (%)	18.6
DRY DENSITY (PCF)	84.5
TOTAL WT. OF DRY SOIL (GRAMS)	333.45
WT. OF NO. 200 WASHED OUT (GRAMS)	



GRAVEL	SAND	FINES	D60	D30	D10	Cu	Cc	CLASSIFICATION
3	66	31	0.45					Silty sand (SM)

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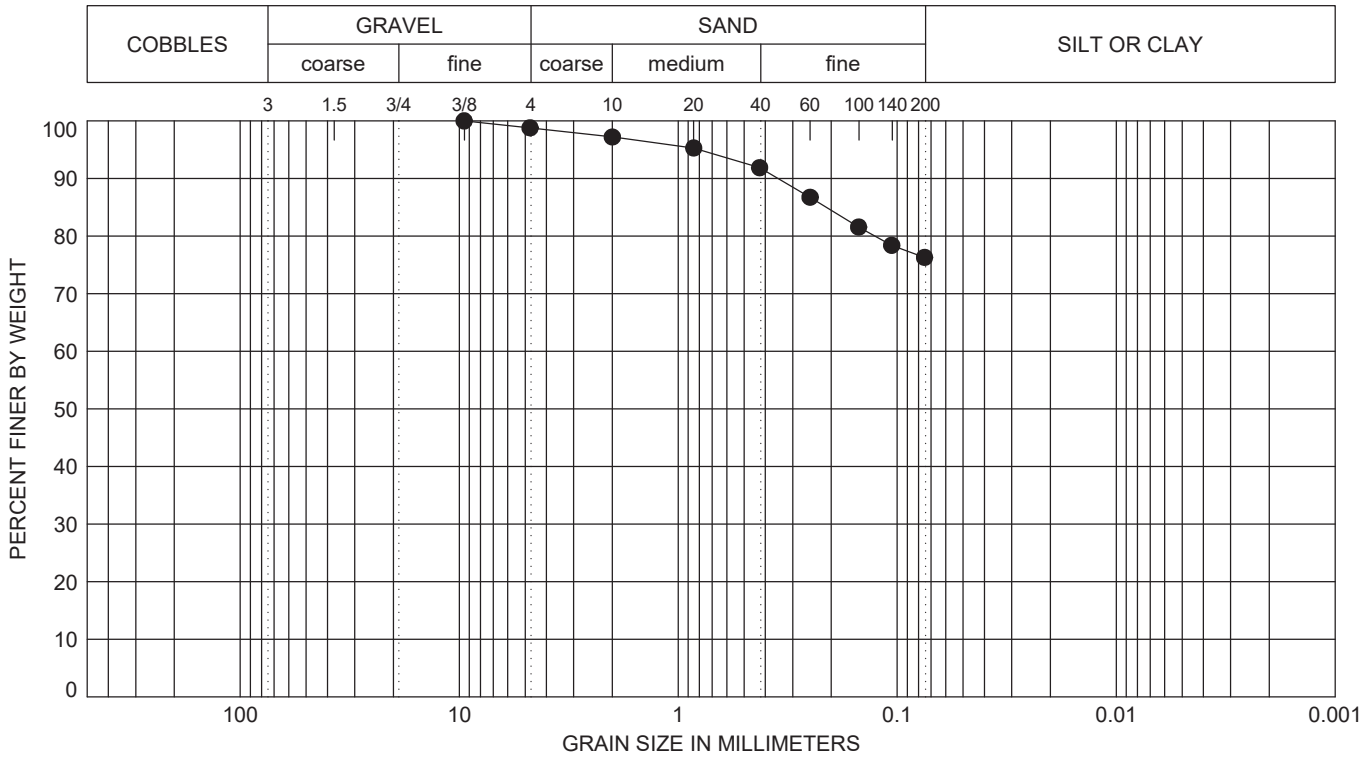
SIEVE ANALYSIS ASTM D6913

PROJECT: Central Maui Wastewater Reclamation Facility

BORING: G-2 SAMPLE NO. 2 DEPTH: 10 PROJECT NO: 23004

SIEVE NO.	SIEVE SIZE	CUMULATIVE WEIGHT RETAINED (GRAMS)	CUMULATIVE PERCENT RETAINED	PERCENT FINER
3 IN.	75			
1.5 IN.	37.5			
3/4 IN.	19			
3/8 IN.	9.5	0.00	0.0	100.0
NO. 4	4.75	2.61	1.2	98.8
NO. 10	2	6.03	2.8	97.2
NO. 20	0.85	10.16	4.7	95.3
NO. 40	0.425	17.53	8.1	91.9
NO. 60	0.25	28.61	13.3	86.7
NO. 100	0.15	39.78	18.4	81.6
NO. 140	0.106	46.62	21.6	78.4
NO. 200	0.075	51.15	23.7	76.3
	PAN	164.65	---	---

MOISTURE CONTENT (%)	19.2
DRY DENSITY (PCF)	91.0
TOTAL WT. OF DRY SOIL (GRAMS)	215.80
WT. OF NO. 200 WASHED OUT (GRAMS)	



GRAVEL	SAND	FINES	D60	D30	D10	Cu	Cc	CLASSIFICATION
1	22	77						Sandy elastic silt

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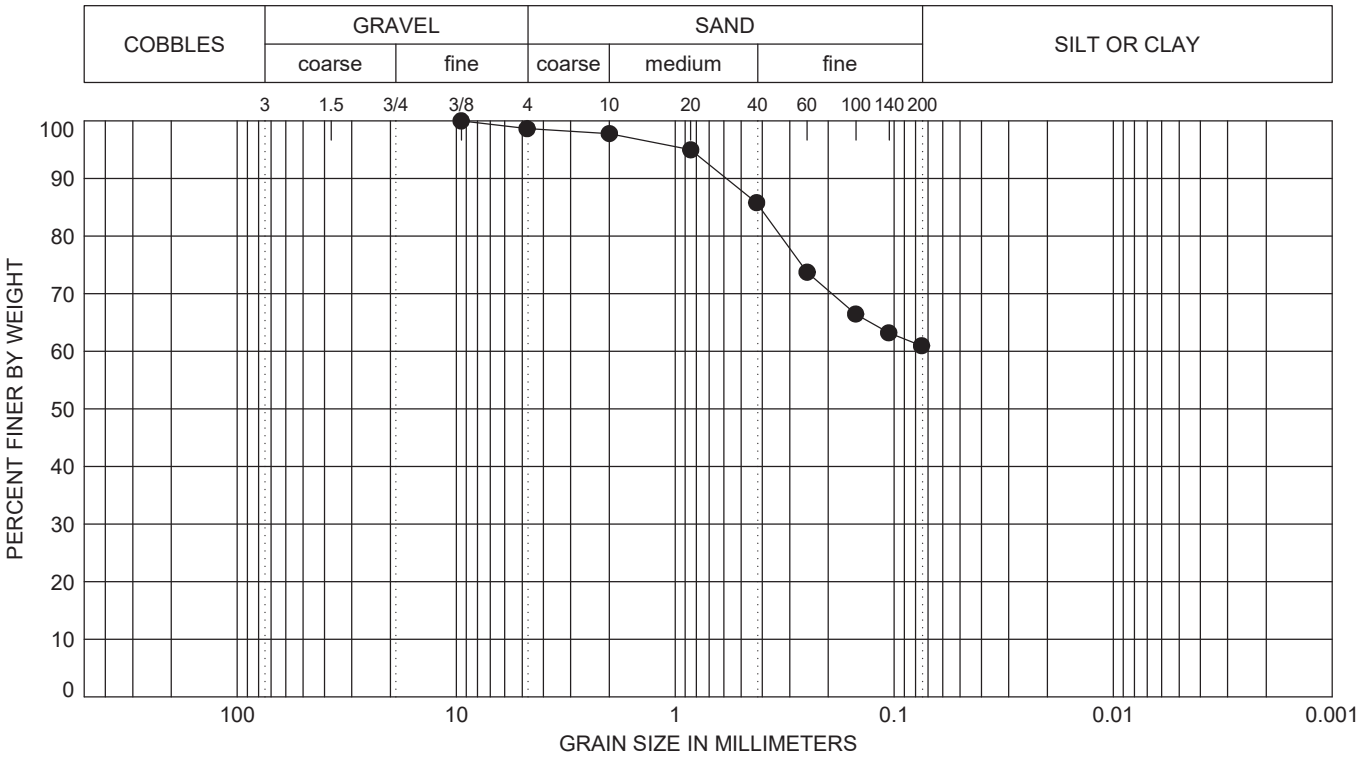
SIEVE ANALYSIS ASTM D6913

PROJECT: Central Maui Wastewater Reclamation Facility

BORING: G-2 SAMPLE NO. 8 DEPTH: 40 PROJECT NO: 23004

SIEVE NO.	SIEVE SIZE	CUMULATIVE WEIGHT RETAINED (GRAMS)	CUMULATIVE PERCENT RETAINED	PERCENT FINER
3 IN.	75			
1.5 IN.	37.5			
3/4 IN.	19			
3/8 IN.	9.5	0.00	0.0	100.0
NO. 4	4.75	2.33	1.3	98.7
NO. 10	2	3.79	2.2	97.8
NO. 20	0.85	8.68	5.0	95.0
NO. 40	0.425	24.51	14.2	85.8
NO. 60	0.25	45.36	26.3	73.7
NO. 100	0.15	57.89	33.5	66.5
NO. 140	0.106	63.53	36.8	63.2
NO. 200	0.075	67.39	39.0	61.0
	PAN	125.27	---	---

MOISTURE CONTENT (%)	23.4
DRY DENSITY (PCF)	
TOTAL WT. OF DRY SOIL (GRAMS)	172.66
WT. OF NO. 200 WASHED OUT (GRAMS)	



GRAVEL	SAND	FINES	D60	D30	D10	Cu	Cc	CLASSIFICATION
1	38	61						Sandy elastic silt

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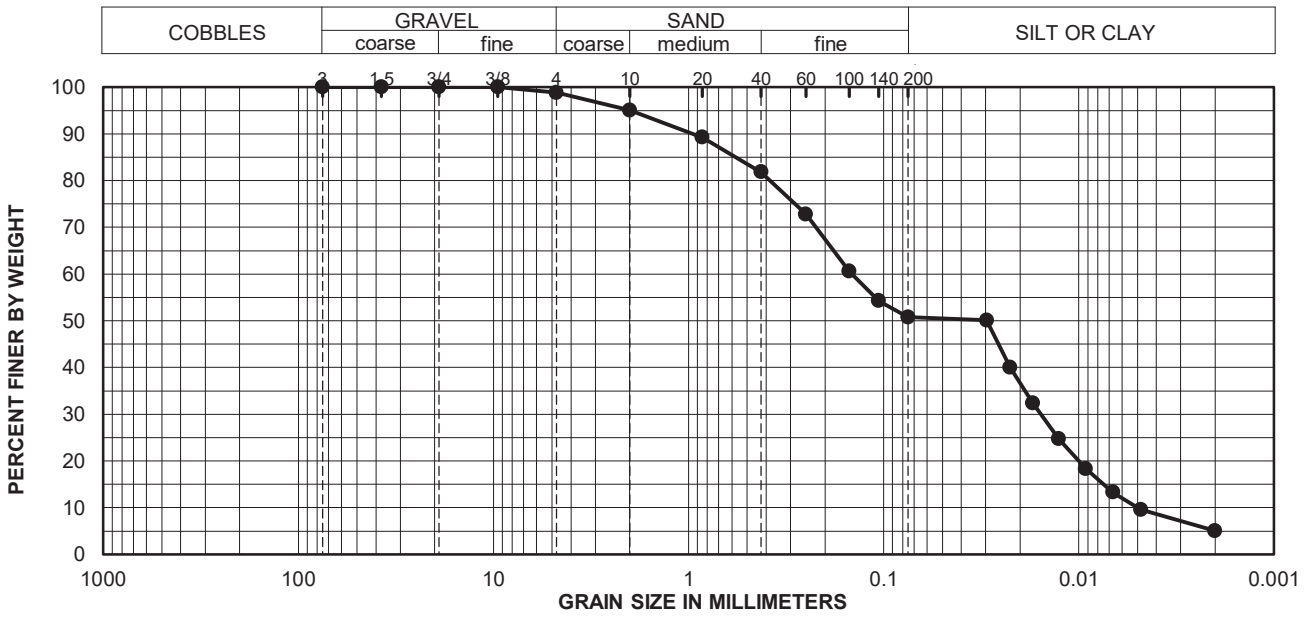
PARTICLE-SIZE DISTRIBUTION OF FINE-GRAINED SOILS USING HYDROMETER ANALYSIS - ASTM D7928-21ε[1]

PROJECT: Central Maui WWRF PROJECT NO.: 23004

BORING: G-2 SAMPLE NO.: 11A DEPTH (FT): 55-56.5

Gradation		
SIEVE NO.	SIEVE SIZE (mm)	CUMULATIVE PCT FINER
3 IN.	75	
1.5 IN.	37.5	
3/4 IN.	19	
3/8 IN.	9.5	100.0
NO. 4	4.75	98.8
NO. 10	2	95.0
NO. 20	0.85	89.2
NO. 40	0.425	81.8
NO. 60	0.25	72.8
NO. 100	0.15	60.6
NO. 140	0.106	54.2
NO. 200	0.075	50.8

Hydrometer	
GRAIN SIZE (mm)	CUMULATIVE PCT FINER
0.02969	50.1
0.02245	40.0
0.01714	32.3
0.01263	24.7
0.00922	18.3
0.00668	13.3
0.00481	9.6
0.00200	5.0



GRAVEL	SAND	FINES	D60	D30	D10	C_u	C_c
1	48	51	0.15				
CLASSIFICATION:		Sandy silt (ML)					

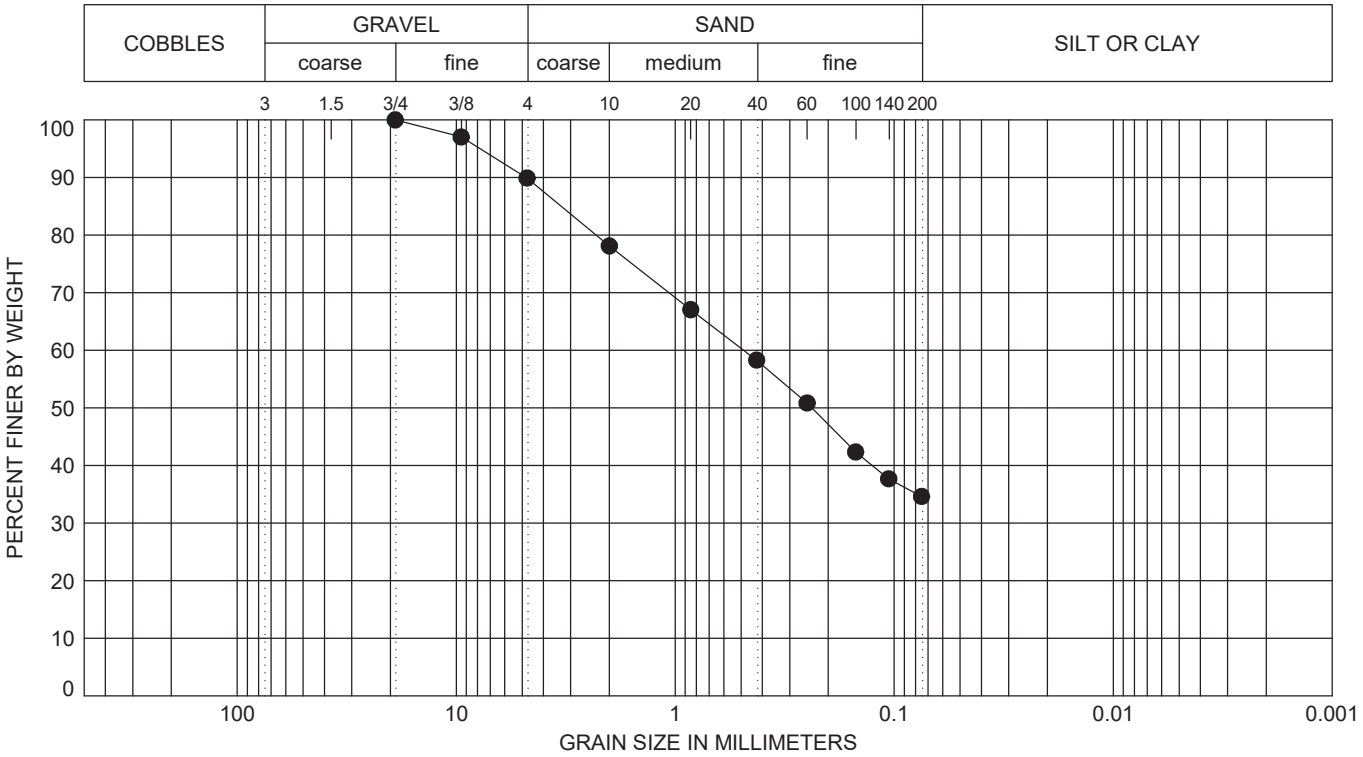
SIEVE ANALYSIS ASTM D6913

PROJECT: Central Maui Wastewater Reclamation Facility

BORING: G-3 SAMPLE NO. 3 DEPTH: 15 PROJECT NO: 23004

SIEVE NO.	SIEVE SIZE	CUMULATIVE WEIGHT RETAINED (GRAMS)	CUMULATIVE PERCENT RETAINED	PERCENT FINER
3 IN.	75			
1.5 IN.	37.5			
3/4 IN.	19	0.00	0.0	100.0
3/8 IN.	9.5	5.10	3.0	97.0
NO. 4	4.75	17.35	10.1	89.9
NO. 10	2	37.62	21.9	78.1
NO. 20	0.85	56.61	32.9	67.1
NO. 40	0.425	71.67	41.7	58.3
NO. 60	0.25	84.47	49.2	50.8
NO. 100	0.15	99.09	57.7	42.3
NO. 140	0.106	107.08	62.3	37.7
NO. 200	0.075	112.35	65.4	34.6
	PAN		---	---

MOISTURE CONTENT (%)	34.9
DRY DENSITY (PCF)	
TOTAL WT. OF DRY SOIL (GRAMS)	171.85
WT. OF NO. 200 WASHED OUT (GRAMS)	



GRAVEL	SAND	FINES	D60	D30	D10	Cu	Cc	CLASSIFICATION
10	55	35	0.49					Silty sand

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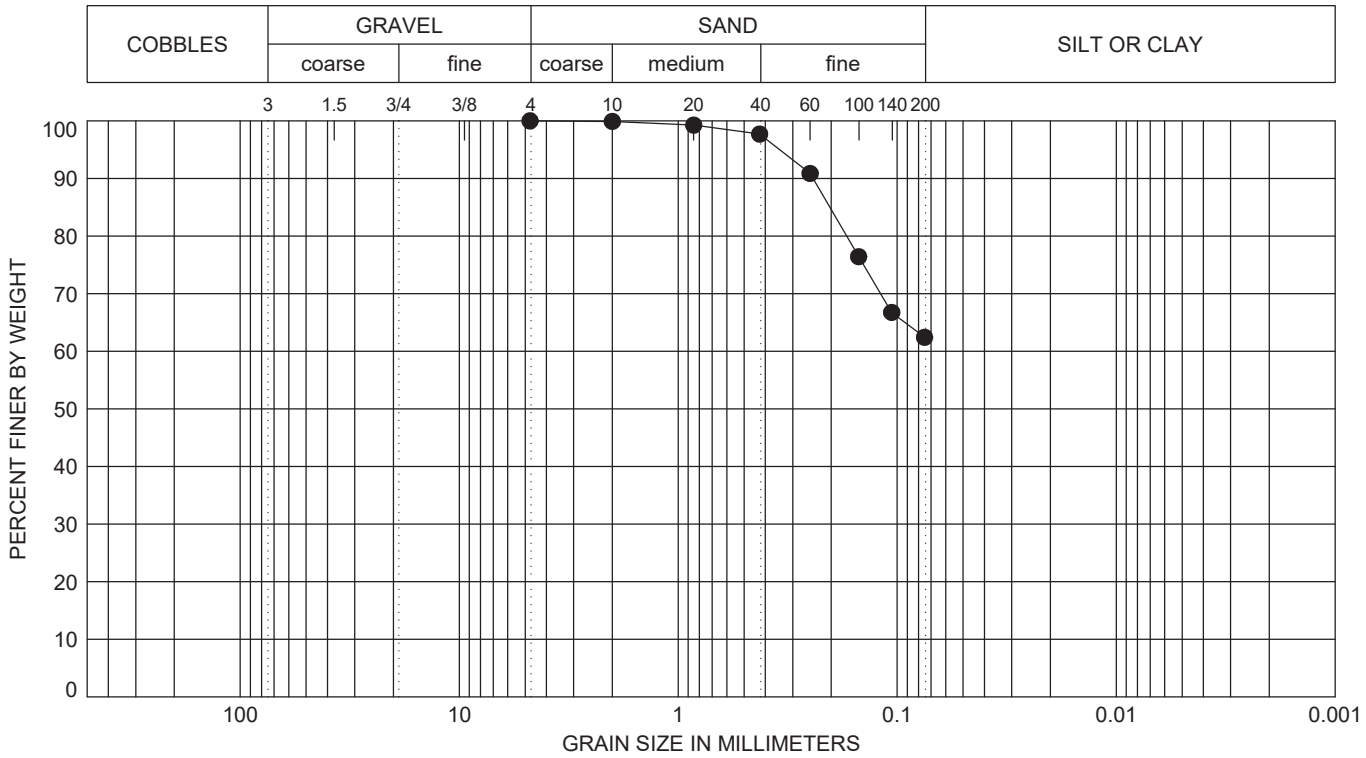
SIEVE ANALYSIS ASTM D6913

PROJECT: Central Maui Wastewater Reclamation Facility

BORING: G-3 SAMPLE NO. 8 DEPTH: 40 PROJECT NO: 23004

SIEVE NO.	SIEVE SIZE	CUMULATIVE WEIGHT RETAINED (GRAMS)	CUMULATIVE PERCENT RETAINED	PERCENT FINER
3 IN.	75			
1.5 IN.	37.5			
3/4 IN.	19			
3/8 IN.	9.5			
NO. 4	4.75	0.00	0.0	100.0
NO. 10	2	0.17	0.1	99.9
NO. 20	0.85	1.25	0.7	99.3
NO. 40	0.425	3.88	2.3	97.7
NO. 60	0.25	15.50	9.1	90.9
NO. 100	0.15	40.01	23.6	76.4
NO. 140	0.106	56.42	33.3	66.7
NO. 200	0.075	63.76	37.6	62.4
	PAN	105.92	---	---

MOISTURE CONTENT (%)	30.8
DRY DENSITY (PCF)	
TOTAL WT. OF DRY SOIL (GRAMS)	169.68
WT. OF NO. 200 WASHED OUT (GRAMS)	



GRAVEL	SAND	FINES	D60	D30	D10	Cu	Cc	CLASSIFICATION
0	38	62						Sandy silt

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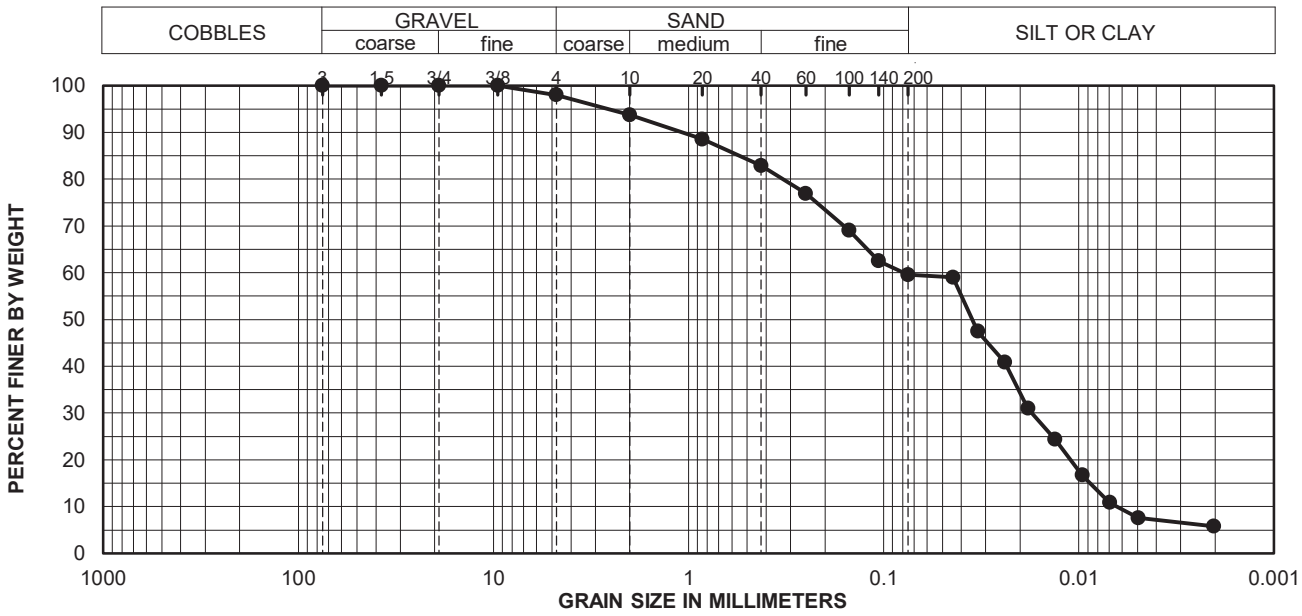
PARTICLE-SIZE DISTRIBUTION OF FINE-GRAINED SOILS USING HYDROMETER ANALYSIS - ASTM D7928-21ε[1]

PROJECT: Central Maui WWRF PROJECT NO.: 23004

BORING: G-3 SAMPLE NO.: 9A DEPTH (FT): 45-46.5

Gradation		
SIEVE NO.	SIEVE SIZE (mm)	CUMULATIVE PCT FINER
3 IN.	75	
1.5 IN.	37.5	
3/4 IN.	19	
3/8 IN.	9.5	100.0
NO. 4	4.75	98.0
NO. 10	2	93.7
NO. 20	0.85	88.5
NO. 40	0.425	82.9
NO. 60	0.25	76.9
NO. 100	0.15	69.0
NO. 140	0.106	62.5
NO. 200	0.075	59.6

Hydrometer	
GRAIN SIZE (mm)	CUMULATIVE PCT FINER
0.04403	59.0
0.03290	47.4
0.02395	40.9
0.01821	31.0
0.01321	24.3
0.00960	16.7
0.00692	10.9
0.00495	7.6
0.00203	5.8



GRAVEL	SAND	FINES	D60	D30	D10	C_u	C_c
2	38	60	0.08				
CLASSIFICATION:		Sandy silt (ML)					

Geosyntec consultants

APPENDIX B

Vadose Zone Modeling Documentation

Geosyntec consultants

engineers | scientists | innovators

APPENDIX B – HYDRUS® VADOSE ZONE MODELING METHODOLOGY

Prepared for

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Prepared by

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Project LB1047

October 30, 2024

Geosyntec consultants

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Attachment B: Scenario 2 - HYDRUS Modeling Documentation

ACRONYMS AND ABBREVIATIONS

µm/sec	micrometers per second
2D	2-dimensional
ASTM	American Society for Testing and Materials
cm/hour	centimeters per hour
CSM	conceptual site model
d	Days
DLL	Dynamically Linked Library
EPA	U.S. Environmental Protection Agency
feet bgs	feet below ground surface
JaC	Jaucas sands
kg/m^3	kilograms per cubic meter
K_v	hydrologic conductivity
M	Meters
m/d	meters per day
m/s	millimeters per second
mgd	million gallons per day
mg/l	milligrams per liter
Mgal	million gallons
ML	sandy silt
mm	Millimeters
$mmole/m^3$	millimole per cubic meter
NO_3^-	Nitrate
pcf	pounds per cubic foot
PpB	Pulehu silt loam
PrB	Pulehu cobbly silt loam
PTF	pedotransfer function
PZUE	Puuone sands
Qdo	Older dune deposits
QTao	Weathered older alluvium
SAT	saturated aquifer treatment
SM	silty sand
SP	Poorly graded sand
USCS	Unified Soil Classification System
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
VZM	vadose zone model

WWRF	Wastewater Reclamation Facility
YKE	Yogi Kwong Engineers

1. INTRODUCTION

The following appendix provides supplemental information pertaining to the HYDRUS® vadose zone modeling (VZM) methodology. VZM results are discussed in Section 5 of the main report. In addition, VZM simulations are presented in Figures 17 through 39 of the report. The VZM approach simulated two saturated aquifer treatment (SAT) basin infiltration scenarios, as requested by Brown and Caldwell in: *Technical Memorandum - SAT Disposal Flows for Hydrogeological Model*, dated September 12, 2024 (Brown and Caldwell, 2024).

It is noted the VZM simulations are based on multiple assumptions and approximations, including but not limited to, a conceptual site model (CSM), an approximation of the heterogeneous subsurface soil conditions, assumptions of nitrate solute denitrification rates, and future recycled water infiltration quantities.

The VZM infiltration scenarios are described below:

1.1 Hydrogeologic Model Scenario 1: Long-Term Pollutant Transport Focus

As described by Brown and Caldwell (2024), the long-term pollutant focus model scenario considers anticipated average long-term precipitation and SAT basin infiltration conditions to estimate potential environmental impacts from the SAT basins. The goals of Scenario 1 are stated as:

- Establish the likely path of recycled water applied to the SAT basins through the vadose zone and saturated zone to the Pacific Ocean;
- Evaluate the discharge with respect to the "functional equivalent" criteria established by the United States Supreme Court in *County of Maui v. Hawai'i Wildlife Fund, et al; and*
- Establish potential environmental impacts from the SAT basin discharge.

For this hydrogeological modeling scenario, it is considered reasonable to model the average precipitation year condition, coupled with intermittent off-spec conditions throughout the year. The tables below summarize the discharge modeling scenario.

Table B-1A – Average Precipitation Year SAT Basin Disposal Estimate (Brown and Caldwell, 2024)

Month	SAT Basin Disposal Estimate (mgd)[(1)]	SAT Basin Disposal Estimate (Mgal)
January	1.15	36
February	0	0
March	0	0
April	0	0
May	0	0
June	0	0
July	0	0
August	0	0
September	0	0
October	0	0
November	0	0
December	0.0	0
Total	**	36

Table B-1B – Scenario 1 – SAT Basin Disposal Estimate (Brown and Caldwell, 2024)

Description	Volume (Mgal/year)
Average precipitation year discharge	36
Off-spec condition discharge (21 days/year at 4.0 mgd))	84
Scenario 1: Total annual discharge to SAT basins	120

Brown and Caldwell (2024) estimate a total nitrogen concentration of 8 milligrams per liter (mg/L) to be representative for excess recycled water. Geosyntec will use dissolved nitrate (at 8 mg/L) as a tracer or proxy to evaluate chemical solute transport resulting from excess recycled water infiltration in the vadose zone. The VZM liquids and dissolved nitrate solute flux for Scenario 1 will be used as an input for groundwater flow and dissolved nitrate solute transport described in Appendix C. For the solute input concentration, the VZM model software uses the units millimole per cubic meter (mmole/m^3). For nitrate, 8 mg/L = 571 mmole/m^3.

1.2 Hydrogeologic Model Scenario 2: Vadose Zone Focus

As described by Brown and Caldwell (2024); *The objective of this proposed scenario is to model the vadose zone's capacity to assimilate high flows for an extended period of time. The goals of this scenario are to:*

- *Establish the SAT's ability to dispose of the entire WWRF flow in accordance with Hawai'i Administrative Rules 11-62-25 requirements for backup disposal systems.*
- *Evaluate the mounding potential above the restrictive layer in the vadose zone, to establish the potential for impacts to nearby streams or other features.*

The infiltration metrics for this scenario are estimated wet year infiltration rates plus consideration for off-spec conditions and are listed below in Tables B-2A and B-2B:

Table B-2A – Wet Precipitation Year SAT Basins Disposal Estimate (Brown and Caldwell, 2024)

Month	SAT Basin Disposal Estimate [million gallons per day (mgd)][(1)]	SAT Basin Disposal Estimate [million gallons (Mgal)]
January	4.0	124
February	1.0	28
March	0	0
April	0	0
May	0	0
June	0	0
July	0	0
August	0	0
September	0	0
October	0	0
November	0	0
December	3.1	96
Total	**	248

Footnote: 1) Excess R-1 disposal estimate from Brown and Caldwell (September 12, 2024)

Table B-2B – Scenario 1 – SAT Basin Disposal Estimate – Wet Year Precipitation plus Off-Spec Infiltration (Brown and Caldwell, 2024)

Month	SAT Disposal Volume [(1)]	Condition
December	3.1 mgd daily all month (96 Mgal)	Excess R-1 Disposal
January	4.0 mgd daily all month (124 Mgal)	Excess R-1 Disposal
February	1.0 mgd daily for 28 days, (28 Mgal)	Excess R-1 Disposal
March to May	4.0 mgd for three consecutive, 15th day of each; 36 Mgal	Off-spec water disposal events
June through November	4.0 mgd for two consecutive, 15th day of each month; 48 Mgal	Off-spec water disposal events
Total Scenario 2: 332 million gallons (248 Mgal excess R-1 + 84 Mgal off-spec)		
Footnote: 1) Excess R-1 and off-spec disposal estimate from Brown and Caldwell (September 12, 2024)		

2. FACILITY BACKGROUND AND LAYOUT

The *Final Report, Central Maui Wastewater Reclamation Facility Plan* (Brown and Caldwell, 2023) describes the prospective facility operational processes. The location of the Wastewater Reclamation Facility (WWRF) is shown in Figure B-1. The proposed layout and dimensions of the WWRF SAT basins are shown in Figure B-2. The four SAT basins combine for a total basin bottom area of approximately 7.5 acres (Table 11-2, Brown and Caldwell, 2023). Figure B-2 also shows the location of the north-south oriented 2-dimensional (2D) VZM profile, which extends through the four basins. An east-west cross-section is also used in an alternative modeling simulation in Scenario 2.

3. VADOSE ZONE MODEL DEVELOPMENT

3.1 Model Software

Geosyntec deployed the specialized and industry standard HYDRUS© modeling software titled: *The HYDRUS Software Package for Simulating the One-, Two-, and Three-Dimensional Movement of Water, Heat, and Multiple Solutes in Variably-Saturated Porous Media* (License Version 5, Šejna et al., 2022). The numerical model is used to simulate SAT basin recycled water infiltration, subsurface soil conditions beneath the SAT basins, and dissolved nitrate solute migration in the subsurface. The potential SAT basin infiltration is anticipated to consist of:

- Potential future excess recycled water conditions (i.e., when volumes of treated recycled water exceed off-site use options); and
- Off-spec water (i.e., potential condition when treated recycled water does not meet off-site chemical discharge concentrations).

The numerical model scenarios evaluate potential future excess recycled water and off-spec water subsurface migration rates and dimensions, including when the migration is estimated to encounter the interface with groundwater (i.e., exits the bottom layer of the model). Also, chemical solute transport was evaluated using dissolved nitrate as a proxy for recycled and off-spec water solute migration and attenuation from the base of the SAT basins to the interface with groundwater, considering both conservative (i.e., slow) and enhanced (i.e., higher rate based on the addition of organic carbon) denitrification rates. See Section 4 of the report for a discussion on proposed denitrification rates.

3.2 Model Dimensions and Geometry

Geosyntec used 2-D, rectangular VZM geometry (i.e., vertical pane) to evaluate SAT basin infiltration behavior. As shown in Figure B-3, the VZM is a 2-D vertical rectangle that extends from north to south across the four SAT basins at the WWRF. The VZM includes north-south extensions to the model side boundaries. The model simulates variable infiltration flow in the four adjacent SAT basin bottoms with a combined north-south dimension of 325 meters (1,066 feet).

The overall length (x) of the VZM domain is 600 meters (approximately 1,968 feet) to provide a wider area to evaluate potential lateral infiltration migration. The depth dimension (Z) of the model is 67 meters (220 feet), consistent with the anticipated upper bound depth to groundwater at the northern basins at the WWRF. Note that for Scenario 2, an east-west, cross-section model was constructed to evaluate the behavior in a single SAT basin (see Figure 17 in the report figures).

3.3 Model Layering

The VZM is developed with four separate model layers to simulate the four subsurface material properties estimated to be encountered beneath the WWRF and described in the CSM in Section 3 of this report and in the Subsurface Investigation Report Geosyntec (2024). Table B-3 below summarizes the geologic units and thicknesses that are simulated in the model.

Table B-3 – Summary of HYDRUS Model Layering

Model Layer Number	Unit Name	Generalized Lithology (Unified Soil Classification System)	Model Layer Simulated Thickness (meters / feet)
1	Older Dune Sands (Qdo)/Jaucas Sand (JaC) (1)	Sand	3 m / 10 feet
2	Older Dune Sands (Qdo)/Jaucas Sand (JaC)	Silty Sand / Sandy Silt	10 m / 33 feet
3	Weathered alluvium (QTao)	Sandy Silt	41 m /135 feet
4	Kula Volcanics and Honomanu Basalt (1)	Volcanic Bedrock (2)	13 m / 43 feet
		Total	67 m / 220 feet

Notes:

1. The uppermost layer beneath the SAT basins is Jaucas Sand (JaC) / Older Dune Sands (Qdo). Infiltration drainage to groundwater occurs at the base of the volcanic bedrock layer.
2. Volcanic bedrock material is not described in the Unified Soil Classification System (USCS).

3.4 Model Boundary Conditions

The model boundary conditions are assigned to simulate the various liquids inputs to support the modeling. As shown in Figure B-3, the model contains the following boundaries:

- The four adjacent SAT basins are assigned a variable flux boundary in the middle of the upper VZM boundary to simulate variations in variable excess recycled water infiltration over time.
- A no-flux node is assigned at the northern and southern SAT basin boundaries to simulate a basin berm.

- The remaining upper boundary surface on both sides of the of the SAT basin berms are assigned an atmospheric boundary to simulate local soil recharge due to precipitation and evaporation.
- The model sides are no-flux boundaries. We do not anticipate horizontal liquid infiltration from off-site sources.
- The model bottom is a free drainage boundary to simulate flow from the vadose zone to groundwater zone.

3.5 Model Initial Soil Moisture Conditions

Prior to simulating SAT basin infiltration, it is necessary to provide an initial moisture content for the simulated soils. The HYDRUS® program provides an option to use soil field capacity values for the various soils. Field capacity refers to the maximum amount of water that a soil can hold after excess water has drained away. Geosyntec applied the HYDRUS® program default field capacity values for the various soil types as the initial soil moisture condition.

3.6 Model Atmospheric Conditions

In the upper model boundary to the north and south of the simulated SAT basins, atmospheric conditions, including precipitation, evaporation, and transpiration, may be simulated. Brown and Caldwell (2023) estimated average annual monthly precipitation, pan evaporation, and transpiration rates in Table B-4 below.

Table B-4 – Projected Irrigation Requirements – Average Precipitation Year (Brown and Caldwell, 2023)

Table 3-1. Irrigation Requirements – Average Precipitation Year

Month	Precipitation [a] (inches)	Pan Evaporation [b] (inches)	Evapotranspiration [c] (inches)	Estimated Irrigation Needs [d]	
				(inches)	(gpd/acre)
Jan	3.74	5.38	5.38	2.2	1,882
Feb	2.36	5.58	5.58	4.2	4,103
Mar	2.35	7.10	7.10	6.2	5,464
Apr	1.75	7.73	7.73	7.9	7,108
May	0.66	8.94	8.94	10.9	9,519
Jun	0.23	9.69	9.69	12.4	11,234
Jul	0.49	10.59	10.59	13.3	11,607
Aug	0.53	10.41	10.41	13.0	11,362
Sep	0.39	9.45	9.45	11.9	10,763
Oct	1.06	8.18	8.18	9.4	8,200
Nov	2.17	6.56	6.56	5.8	5,215
Dec	3.08	5.68	5.68	3.4	2,989
Totals	18.8	95.3	95.3	100.4	--

a. *Source: NOAA, Stations 310.10, 313.30, and 394.10. Period of record 1971-2000.*
b. *Source: Engott and Vana, 2007.*
c. *Assumes pan coefficient = 1.0 and crop coefficient = 1.0 to represent a mixture of landscape and agricultural crops*
d. *Assumes irrigation efficiency = 80 percent and leaching fraction = 5 percent.*

As shown in Brown and Caldwell Table B-4, estimated annual pan evaporation and evaporation rates (95.3 inches per year) greatly exceeds the annual precipitation estimates of 18.8 inches per year. The Rainfall Atlas of Hawai'i interactive map (www.rainfall.geography.edu/interactivemap.html) estimates annual rainfall for the site vicinity as 16.30 inches per year, with a similar monthly distribution as compared with Brown and Caldwell. However, Rotzoll et al., (2022) estimates in Appendix 1, Figure 1.8J that a small amount of aerial groundwater recharge occurs in the Central Maui area, regardless of the local evapotranspiration rates. Geosyntec estimated 2 to 3 inches of annual groundwater recharge for the site vicinity based on inspection of the Figure 1.8J. Furthermore, for the model surface to the north of the SAT basins, facility appurtenances may create a paved or sealed surface. Thus, given the combination of the model issues (i.e., evapotranspiration exceeding precipitation but some aerial groundwater recharge being reported), Geosyntec chose to approximate these conditions by inputting approximately 2.5 inches of precipitation recharge spread evenly over the wettest months of December, January, and February.

3.7 Fate and Transport of Nitrate

The VZM provides the capability to estimate solute dilution, dispersion, and degradation during migration in the vadose zone. Based on data from other WWRFs on Maui (Lahaina and Kihei) and anticipated recycled water chemistry data provided by Brown & Caldwell, the primary constituent of concern in recycled water from the proposed Central Maui WWTP is nitrate (NO_3^-). Section 4 of the main report describes the rationale for using nitrate as a recycled water proxy, denitrification rate data sources, and analyses used to estimate denitrification rates in both the vadose zone and groundwater.

There is currently no geochemistry data available for the Site vicinity in central Maui from which to estimate *in situ* denitrification rates. Therefore, a literature search was performed to calculate and assess potential rates in both the vadose zone and the underlying groundwater. Reported rates of denitrification in natural environments vary widely with streams, rivers, and constructed wetlands generally exhibiting the highest rates (up to 100 d^{-1}) and groundwater aquifer and lakes systems exhibiting the slowest rates ($3x10^{-7}$ d^{-1}). As can be seen in Figure B-4, there is considerable overlap of denitrification rates across these environments. Table B-5 provides a list of supporting denitrification references.

Denitrification has been documented to occur in SAT system vadose zones such as the one proposed for Central Maui [Mienis & Ayres, 2018]. The SAT described in Mienis & Ayres serves as a good proxy for the Central Maui WWTP vadose zone, given similar influent nitrate concentrations (ranging from 10 to 30 mg/L total dissolved nitrogen), and similar overall vadose zone thickness (~200 feet). It should be noted that dissolved organic carbon data are not reported in the paper. Nonetheless, one can calculate a conservative first-order denitrification rate for their SAT, using the following equation:

$$C_t = C_0 e^{-kt}$$

where C_t is the concentration of nitrate (mg/L) or total nitrogen load (ton) after time t, C_0 is the starting concentration of nitrate (mg/L) or total nitrogen load (ton), k is the denitrification rate constant, and t is time (days). The authors reported an 18-month (~540-day) travel time to the deeper monitoring well based on chloride transport modeling, with a 49% reduction in total nitrate occurring over this timeframe (see "Period 5,6" in Table 2 of Mienis & Ayres). Rearranging the first order equation to solve for k and substituting the observed variables listed above yields a vadose zone denitrification rate constant of $1.3x10^{-3}$ d^{-1}. This rate is conservative, as the authors showed that 47% of the denitrification occurred in just 90 days and that only a subsequent 2% of reduction occurred over the remaining 450-day travel time. This calculated rate is approximately four orders of magnitude slower than the fastest reported denitrification rates for streams and rivers and approximately four orders of magnitude faster than the slower rates reported for groundwater aquifer systems (see Figure B-4).

To check whether the denitrification rate calculated above is appropriate for use in the central Maui SAT analysis, we performed the same first-order rate calculations for Lahaina WWTP (using data from Table 7 and a travel time of 427 days; Fackrell, 2016). The calculated denitrification rate

constant for Lahaina groundwater is $6.3x10^{-3}$ d^{-1}, which is approximately 5 times faster than the rate calculated from Mienis & Ayres. We also calculated a rate constant for Kihei data (Hunt et al, 2007). Using the injection and downgradient well total dissolved nitrogen data from Table 5, along with water levels, horizontal hydraulic conductivity, and porosity from Table 9, we calculate a denitrification rate constant of 0.0099 d^{-1}, which is approximately 8 times faster than the rate calculated from Mienis & Ayres.

Therefore, the vadose zone denitrification rate constant of $1.3x10^{-3}$ d^{-1} is considered conservative based on observed denitrification rates for injected wastewater effluent in the Maui and SAT systems. The actual denitrification rate for Central Maui SAT application can be measured in the future using data from the SAT basins, lysimeters (shallow vadose zone), monitoring wells (groundwater), and water supply wells (groundwater).

Geosyntec was asked to also consider a potential enhanced denitrification rate based on adding organic carbon via wood chips or biomass. As described in Section 4.11 of the report, Geosyntec evaluated published data to use a proposed enhanced denitrification rate of $8.0x10^{-3}$ d^{-1} as an alternate analysis for Scenario 1.

3.8 Simulation Time Period

The simulation scenarios include the daily calculation of soil pore head pressure, water content, infiltration velocity, and solute infiltration migration progress and dimensions. For Scenario 1, the overall model simulation period is 10 years. For Scenario 2, the overall simulation period is 1 year. The time steps allow inspection of initial conditions as well as transient conditions of: soil pore head pressure over time; infiltration migration over time; infiltration velocity over time; and chemical solute transport over time. Ten years was found to provide a sufficient simulation time period to simulate steady-state water content and solute transport conditions for Scenario 1.

4. INFILTRATION POTENTIAL OF SURFACE AND SUBSURFACE GEOLOGIC MATERIALS

Geosyntec used multiple data sources and lines-of-evidence to evaluate vadose zone soil conditions in the site vicinity and beneath the WWRF to inform the VZM input parameter selection to evaluate SAT basin infiltration characteristics. As described below, the evaluation included multiple relevant published reports, governmental agency data compilations, and the site-specific subsurface investigations by YKE (2024) and Geosyntec Consultants (Geosyntec, 2024).

Note, throughout the discussion below, the hydrologic conductivity (K) measurements and infiltration measurements are converted to units of meters (m) and days (d) to provide a consistent comparison of results, and also these are the units used in the HYDRUS® numerical model. The following is a summary of the various documents and data that were relied upon to develop the VZM input parameters.

4.1 Hydraulic Property Estimates from Central Maui Regional Studies

The following section describes estimates of saturated hydraulic conductivity (both horizontal K_h and vertical K_v) for materials found in the central Maui area based on regional groundwater studies. These data are provided for information purposes to be considered with other site-specific data.

Sedimentary Caprock

The Older dune sands (Qdo) / Jaucas sands (JaC) and older weathered alluvium (QTao) found at the site surface and subsurface are sedimentary materials that are typically included in the general "caprock" term referred to in central Maui groundwater modeling studies of Gingerich (2008), Rotzoll et al. (2021), and others.

Ginegrich (2008) reports:

- *Although the permeability of the various components of the caprock may vary widely, from low permeability in older alluvium and saprolite to high permeability in buried coral reef deposits and sand dunes, overall the caprock has lower regional permeability than the volcanic-rock aquifers.*
- *Rotzoll and others (2007) show a range of about 30–650 ft/d* (approximately 9–200 m/d) *in hydraulic conductivity (K) estimates from five aquifer tests in sediments of central Maui.*
- *Burnham and others (1977) modeled a clay layer overlying the volcanic-rock aquifer beneath Kahului using a range of vertical hydraulic conductivities between about 1 and 10 ft/d* (0.3 and 3 m/d*). Little information about the anisotropy or vertical hydraulic conductivity of the caprock is available.* It is also stated: *In their analysis, Souza and Voss treated the caprock as a homogeneous and isotropic unit, although significant heterogeneity may exist (Oki and others, 1998.*
- Rotzoll (2021) reported*: Izuka and others (2021) estimated a vertical hydraulic-conductivity value of 1.6 ft/d* (0.5 m/d) *for coastal sedimentary deposits in the west region of Maui aquifer systems of concern for this study. Izuka and others (2021) also estimated isotropic horizontal hydraulic-conductivity values from 17 to 490 ft/d (5 to 150 m/d) for zones used to represent valley-fill barriers in west Maui.*

Kula Volcanics and Honomanu Basalt

Underlying the sedimentary "caprock" materials at the site is dike-free volcanic rocks of the Kula volcanics or Honomanu basalt formations.

Gingerich (2008) reported:

- In Figure B-5, Distribution of aquifer hydraulic conductivity in central and west Maui, Hawai'i (Gingerich, 2008; modified from Rotzoll and others, 2007) presents horizontal K_h values in wells screened in the Kula volcanics or Honomanu basalt in the central Maui area

that range between 800 to 1,600 feet per day (244 to 488 m/d). The median of this K_h range is 1,200 ft/d (366 m/d).

- To estimate the K_v for the future HYDRUS® modeling, Geosyntec considered information in Gingerich (2008), which included the following statements regarding anisotropy (ratio of K_h:K_v) of the volcanic materials:
  - *Horizontal hydraulic conductivity in the lava flows may be anisotropic—several times greater parallel to the lava flows than perpendicular to the flows (Nichols and others, 1996, p. A14).*
  - *In general, the vertical hydraulic conductivity of the dike-free lava flows may be tens to hundreds of times less than the horizontal hydraulic conductivity.*
  - *In the Kahului area, Bowles (1970) suggested that horizontal permeability might be as great as ten times vertical permeability on the basis of aquifer tests on stormwater disposal wells.*
  - *Burnham and others (1977) obtained acceptable results with their numerical model using horizontal hydraulic conductivity 10 to 100 times the vertical hydraulic conductivity near Kahului.*
- In Rotzoll et al. (2022) it is reported; *On the basis of a two-dimensional numerical-model analysis, Izuka and others (2021) estimated the hydraulic conductivity (K_h) of the dike-free volcanic rocks in the main study area to be 1,600 feet per day (ft/d)* (488 m/d).

No site-specific data on the Kula volcanics or Honomanu basalt formations are available due to the estimated depth of ~180 feet bgs. By using the median of the K_h range (1,200 ft/d; 366 m/d) reported in Gingerich (2008) and an anisotropy ratio of K_h:K_v of approximately 25:1, a vertical K_v value of 15 m/d (48 ft/d) is estimated to be a reasonable intermediate representation for the volcanic materials beneath the site. The 25:1 K_h:K_v ratio is within the 10 to 100 times anisotropy range referenced in Gingerich (2008).

4.2 U.S. Department of Agriculture (USDA) Website – Soil Survey Data for Central Maui

Geosyntec accessed the U.S. Department of Agriculture (USDA), Natural Resource Conservation Service Soil Survey website on May 29, 2024 (Web Soil Survey (usda.gov)) to collect and review surface soil data for the central Maui WWRF site vicinity (defined as area of interest in the website). Geosyntec downloaded the following information maps and datasets annotated with the Site boundary.

- Soil Map of Central Maui – includes the mapped boundaries of the Jaucas sand (JaC) that are exposed at the WWRF surface and the adjacent Pulehu silt loam (PpB) that is adjacent to the western site boundary that is interpreted to be the local surface exposure of weathered alluvium (QTao) that underlies the Jaucas sand at the WWRF.

- Drainage Class Map of Central Maui – includes the drainage classification for the Jaucas sand (JaC) as "Excessively Drained" and the adjacent Pulehu silt loam (PpB) that is classified as "Well Drained."
- Percent Sand Map of Central Maui – includes the sand percent for the Jaucas sand (JaC) as "93.9%" and the adjacent Pulehu silt loam (PpB) as "41%."
- Percent Silt Map of Central Maui – includes the silt percent for the Jaucas sand (JaC) as "3.89%" and the adjacent Pulehu silt loam (PpB) as "36.7%."
- Percent Clay Map of Central Maui – includes the clay percent for the Jaucas sand (JaC) as "2.3%" and the adjacent Pulehu silt loam (PpB) as "23%."
- Unified Soil Classification Map of Central Maui - includes the Jaucas sand (JaC) defined as "SP" [typically defined as poorly graded sands and gravelly sands with little or no fines (i.e., clay or silt)] and SM (typically defined as silty sands) and the adjacent Pulehu silt loam (PpB) as ML (typically defined as inorganic silt, very fine sands, silty or clayey fine sands).
- Organic Matter Map of Central Maui - includes the Jaucas sand (JaC) with an organic matter percent of 0.23% and the adjacent Pulehu silt loam (PpB) with an organic matter percent of 0.84%.
- Hydrologic Soil Group Map of Central Maui – The Jaucas sand (JaC) is defined as Hydrologic Soil Group "A." Group A is defined as: *Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands*. The adjacent Pulehu silt loam (PpB) is defined as Hydrologic Soil Group "B." Group B is defined as: *Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.*
- Saturated Hydraulic Conductivity (K_{sat}) – The Jaucas sand (JaC) is estimated to have a vertical K_{sat} of 92 micrometers per second (µm/sec) (converts to 9.2 x 10^{-03} cm/sec and 8.0 m/d) and the Pulehu silt loam (PpB) is estimated to have a K_{sat} of 49.5 µm/sec (4.95 x 10^{-03} cm/sec and 4.3 m/d).

These data are provided as one source of relevant background information and data that rely upon regional studies and surface soil conditions. Further, the Pulehu silt loam (PpB), which is exposed at the surface adjacent to western site boundary, is interpreted to be the surface expression of the alluvium material (QTao) found in the subsurface of the site. However, material properties are known to vary spatially.

4.3 Infiltration Along Waikapū Stream

The lower Waikapū Stream emanates from the West Maui Mountains and extends into the central Maui isthmus area approximately 4,000 feet north and 2,000 feet east of the Site. The Waikapū Stream is documented in Gingerich (2008) as a losing stream (i.e., the stream flow infiltrates into the subsurface). Figure B-6 is adapted from Gingerich (2008) and provides quantitative estimates of infiltration rates per length of stream reach. Gingerich estimated a 2.4 million gallons per day (Mgal/day) infiltration rate for an approximate 5-mile reach of lower Waikapu Stream north and east of the WWRF. Based on the USDA soil map (Attachment A), the reach infiltrates into Jaucas sands (JaC) and Puuone sands (PZUE) and less commonly in Pulehu cobbly silt loam (PrB) and Iao cobbly silt clay (IbB). The average estimated stream loss (i.e., infiltration) per foot of channel length was reported by Gingerich (2008) to be 270 gallons per day per foot of channel. Since approximately 2010, when streamflow in lower Waikapū Stream was restored, new stream-flow standards of 2.9 Mgal/d have been established for the Waikapū Stream (Rotzoll et al., 2022). During the field investigation, Geosyntec inspected lower Waikapu Stream north of the site (see Appendix A) and described an incised channel with approximately 10 feet of active stream flow width. Conservatively estimating the average width of lower Waikapu Stream to be approximately up to 30 feet, the lower Waikapu Stream is estimated to infiltrate over 390,000 gallons of stream-fed water per acre of stream bed. A lower or higher rate of infiltration per acre would be estimated if the average stream bed width estimate is greater or less than the 30 feet estimated here. Thus, the lower Waikapū Stream infiltrates significant stream flows into surface soils similar to those found at the Site (i.e., Jaucas sand (JaC) or Older dune deposits (Qdo) and Older alluvium (QTao) sediments), and therefore provides a line-of-evidence for robust soil infiltration properties in the Site vicinity.

4.4 Double Ring Infiltrometer Testing in the Site Vicinity – Geolabs (2013)

A subsurface geotechnical investigation was performed by Geolabs (2013) in support of the central Maui Regional Park in Waikapū, Maui. The investigation was performed in an area approximately 1.3 miles north of the Site in the isthmus area. The investigation encountered soils similar to those found at the Site, including both shallow sands and alluvial sediments that consisted of variable silts, sands, gravels, and cobbles with some intermixed clay materials. The investigation included logging test pits and infiltration testing using a double-ring infiltrometer method for dune sands and alluvium. The infiltration tests reported rates of a up to 150 centimeters per hour (cm/hour) (59 inches/hour or 36 meters per day) in sand material. Another test in sand reported infiltration rates too rapid to measure. The study also reported an infiltration rate of 3 cm/hour, which converts to 1.2 inches/hour and 0.7 m/d, in clayey silt material, which is estimated to be similar to the weathered alluvium material (QTao). These results are provided for comparison purposes only.

4.5 Site-Specific Soil Testing

Double-Ring Infiltrometer Testing [Yogi Kwong Engineers (YKE)]

YKE performed field double-ring infiltrometer tests at nine locations at the Site. The detailed results will be provided in a separate YKE report, and the preliminary results are summarized here

(YKE, 2024). The nine locations are shown in Figure B-7. The tests were performed at depths ranging from 0.7 to 1.3 feet bgs. The tests were performed in the Older dune deposits (Qdo) / Jaucas sand (JaC) and were described as silty sand (SM). The incremental infiltration rate (inches per hour) measurements for the double-ring infiltrometer "inner ring" ranged from approximately 2 to 23 inches per hour [converts to a range of 1.2 to 14 meters per day (m/d)]. The inner ring rate measurement is typically considered a measurement of vertical migration rates for the tested formation (i.e., infiltration rate).

Subsurface Investigation (Geosyntec, 2024)

Geosyntec performed a multi-faceted subsurface investigation that is reported in the April 2024 *Subsurface Investigation Report in Support of the Central Maui Wastewater Reclamation Facility (WWRF) Study* (Geosyntec, 2024) and is summarized below.

Soils Infiltration Testing

Geosyntec performed a total of seven in-borehole falling-head tests following the procedure described in US Environmental Protection Agency (USEPA) 1980 *Design Manual Onsite Wastewater Treatment and Disposal Systems, EPA 625/1-80-012.* The reference is provided in Geosyntec, 2024, Appendix F. The objective of the in-borehole falling-head tests is to provide semi-quantitative estimates of infiltration rates in the Older dune sands (Qdo) / Jaucas sand (JaC) and the underlying weathered alluvium (QTao) soils. The infiltration rates were reported at approximately 6 inches of head, as per the procedure cited above. Three in-borehole falling head tests were performed in the Odo/JaC soils at depths ranging from approximately 11 to 15 ft bgs. The infiltration rates were calculated to be 2, 5, and 42 inches per hour (converts to 1.2, 3.0, and 25.6 m/d, respectively). Note, the infiltration rates calculated from Geosyntec's in-borehole falling head tests are reasonably comparable to the double-ring (specifically the inner ring) measurements collected by YKE (2024). In addition, four in-borehole falling-head tests were performed in the Older alluvium (QTao) sediments at depths ranging from approximately 43 to 60 ft bgs. The infiltration rates were calculated to be 1, 2 and 8 inches per hour (converts to 0.6, 1.2 and 4.9 m/d, respectively). The field infiltration measurements are generally consistent with the USDA website (2024) classification "Excessively Drained" for the Jaucas sand (JaC) and "Well Drained" classification of the adjacent Pilehu silt loam (PpB) that is interpreted to underlie the Jaucas sand (JaC) as the weathered alluvium unit QTao) at the Site. These infiltration rate data will be used to evaluate the vadose zone numerical model simulated infiltration velocities as a calibration check.

Soils Geotechnical Testing

The Subsurface Investigation (Geosyntec, 2024) report included an extensive borehole logging and soils lab testing program for both Older Dune deposits (Qdo) / Jaucas sand (JaC) and the underlying weathered alluvium (QTao). Given the investigation program was limited to drilling to approximately 60 feet bgs, the soil sampling in the QTao material was limited to the approximately upper 20 feet of that unit, and no volcanic material estimated to be found at approximately 180 feet bgs was directly tested. A detailed description of the testing program is presented in Geosyntec (2024) and summarized here.

4.6 Soil Geotechnical Laboratory Testing Program

Selected ring samples collected during drilling were submitted for laboratory geotechnical testing at the YKE geotechnical laboratory in Honolulu, Hawai`i.

The geotechnical testing suite consisted of:

- Sieve analysis, including two fine-grained samples with hydrometer (American Society for Testing and Materials [ASTM] D6913 and D7928);
- Soil specific gravity (ASTM D854);
- Soil density test (ASTM D7263);
- Soil moisture content (ASTM D2216); and
- Hydraulic conductivity testing (ASTM D5084).

Soil testing results are listed in Tables 4A, 4B, and 5 in the main report.

4.7 Soil Classification Testing

Nine soils samples were submitted for sieve analyses to assess soil classification and particle size distribution. Table 4A in the main report provides a summary of the lab soil classification results and lab test sheets are provided in Appendix A. For the four soil sample tests performed for the Older dune deposits (Qdo) / Jaucas sand (JaC) sediments and within the upper 40 feet bgs of ground surface, the coarse fraction (sand and gravel size particles greater than 0.05 millimeters in diameter) was measured to be 23%, 50%, 59% and 65%, respectively. The fine-grained fraction, consisting of silt and clay particles, were 35%, 41%, 50% and 77%, respectively. Three of the samples were classified as a Silty Sand (SM) in the Unified Soil Classification System (USCS). One sample was classified as Sandy elastic silt.

For the soil samples tested from the underlying Older weathered alluvium (QTao) sediments at depths below 40 feet bgs, the soils were predominantly classified as sandy silt (ML). For two samples in which the fine fraction (i.e., silt and clay size particles) was estimated to exceed 50% in the sample in the field, a hydrometer test was also performed to assess the silt and clay fractions. The silt fraction represents particles that are between 0.005 and 0.05 millimeters (mm), and the clay fraction represents particles between 0.001 and 0.005 mm (Rahm, 1986). The two hydrometer tests found the fine fraction (i.e., clays and silts) to be over 80% silt and less than 20% clay (see Table 4A of the main report).

Following review of the lab testing data, it was noted the field logging appeared to have over-estimated the clay fraction of the fine fraction material (i.e., the silt plus clay fraction) as compared to the lab tests. Geosyntec used the standard method of rolling a moisten soil into a thin thread to estimate a clay fraction in the field. Nevertheless, the final soil classifications in the boring logs were annotated and adjusted to consider interpretation from both field observations and lab classifications.

4.8 Soil Physical Properties Testing

Lab testing for other soil physical properties, including moisture content, specific gravity, soil density, and hydraulic conductivity testing were also performed. The results are provided in Table 4B in the main report. Moisture content ranged from 9.1 to 30.8%, with slightly higher moisture contents in the Older alluvium (QTao) sandy silt (ML) sediments. The bulk dry density of the soil samples ranged from 70.4 to 88.5 pounds per cubic foot (pcf) with an average of 79 pcf. The 79 pcf converts to approximately 1,265 kilograms per cubic meter (kg/m^3). The specific gravity of the soil samples ranged from 1.838 to 2.044. The specific gravity of soil, which is unitless, is defined as the ratio of the mass of solids to the mass of an equivalent volume of water at 4ºC.

The soil lab testing program utilized ASTM method D5084, which is referred to as the Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter. Thirteen samples were tested to estimate the vertical hydraulic conductivity (K_v) of the soil. The lab reported the results as saturated permeability (k_v) in inches per second. For this evaluation, we have used a variety of soil compressive pressures and water input gradients. The graphed k_v measurements over time and for each gradient step are provided in Geosyntec (2024). Following review of the field procedures, Geosyntec concluded that the use of a Modified California Sampler and a 120-pound drive hammer to collect the soil samples with the number of blow counts ranging from 10 to 80 blows per 18-inch sample run created disturbed and compressed soil samples that likely contributed to biased low K_v test results as compared to actual conditions. For the reasons stated above, the k_v testing results were not directly used for the vadose zone model input parameter estimation. Geosyntec recommends soil sample coring in the future if further soil sample hydraulic conductivity testing is performed. Also, borehole permeameters, as described in Reynolds and Elrick (2002), may be a more reliable method to estimate *in situ* saturated hydraulic conductivity below the surface in the unsaturated zone in the future.

4.9 USDA Soil Texture Classification Triangle

The HYDRUS VZM software relies upon the USDA soil texture triangle classification system to estimate soil properties (see Figure B-8). The three sides of the triangle define soil classes based on percent of sand, silt, and clay in soils. The soil classifications are defined as follows:

- Sand
- Loamy Sand
- Sandy Loam
- Loam
- Silt Loam
- Sandy Clay Loam
- Clay Loam
- Silty Clay Loam
- Sandy Clay
- Silty Clay
- Clay

The USDA defines a loam as a balanced mixture of sand, silt and clay, with different subtypes (i.e., Sandy Loam) depending upon the proportions of the three components. Figure B-8 is annotated with the QTao samples that were tested for sand, silt, clay fractions. The samples varied from Loam to Silt Loam composition, with the average composition falling in the Loam category.

4.10 HYDRUS Software Soil Catalog

The HYDRUS software includes a soil catalog of hydraulic functions and parameters for users to consider and select. The van Genuchten parameters reviewed are from the following references. and including in Tables B-6A, -6B, -6C, and -6D:

- Table B-6A - Soil hydraulic parameters for the analytical functions of *van Genuchten* [1980] for 12 textural classes of the USDA soil textural triangle, according to *Carsel and Parrish 1988.* (HYDRUS Table 7)

Table 7. Soil hydraulic parameters for the analytical functions of *van Genuchten* [1980] for twelve textural classes of the USDA soil textural triangle, according to *Carsel and Parrish* [1988].

Textural class	θ_r [L^3L^{-3}]	θ_s [L^3L^{-3}]	α [cm^{-1}]	n [-]	K_s [cm d^{-1}]
Sand	0.045	0.430	0.145	2.68	712.8
Loamy Sand	0.057	0.410	0.124	2.28	350.2
Sandy Loam	0.065	0.410	0.075	1.89	106.1
Loam	0.078	0.430	0.036	1.56	24.96
Silt	0.034	0.460	0.016	1.37	6.00
Silty Loam	0.067	0.450	0.020	1.41	10.80
Sandy Clay Loam	0.100	0.390	0.059	1.48	31.44
Clay Loam	0.095	0.410	0.019	1.31	6.24
Silty Clay Loam	0.089	0.430	0.010	1.23	1.68
Sandy Clay	0.100	0.380	0.027	1.23	2.88
Silty Clay	0.070	0.360	0.005	1.09	0.48
Clay	0.068	0.380	0.008	1.09	4.80

- Table B-6B - Soil hydraulic parameters for the analytical functions of *van Genuchten* [1980] for 12 textural classes of the USDA textural triangle as obtained with the Rosetta Lite program [*Schaap et al.*, 2001] (HYDRUS Table 8)

Table 8. Soil hydraulic parameters for the analytical functions of *van Genuchten* [1980] for twelve textural classes of the USDA textural triangle as obtained with the Rosetta Lite program [*Schaap et al.*, 2001].

Textural class	θ_r [L^3L^{-3}]	θ_s [L^3L^{-3}]	α [cm^{-1}]	n [-]	K_s [cm d^{-1}]
Sand	0.053	0.375	0.035	3.18	643.
Loamy Sand	0.049	0.390	0.035	1.75	105.
Sandy Loam	0.039	0.387	0.027	1.45	38.2
Loam	0.061	0.399	0.011	1.47	12.0
Silt	0.050	0.489	0.007	1.68	43.7
Silty Loam	0.065	0.439	0.005	1.66	18.3
Sandy Clay Loam	0.063	0.384	0.021	1.33	13.2
Clay Loam	0.079	0.442	0.016	1.41	8.18
Silty Clay Loam	0.090	0.482	0.008	1.52	11.1
Sandy Clay	0.117	0.385	0.033	1.21	11.4
Silty Clay	0.111	0.481	0.016	1.32	9.61
Clay	0.098	0.459	0.015	1.25	14.8

- Table B-6C - Soil hydraulic parameters for the analytical functions of *Brooks and Corey* [1964] for 12 textural classes of the USDA soil textural triangle, according to *Rawls et al.* [1982]. (HYDRUS Table 9)

Table 9. Soil hydraulic parameters for the analytical functions of *Brooks and Corey* [1964] for twelve textural classes of the USDA soil textural triangle, according to *Rawls et al.* [1982].

Textural class	θ_r [L^3L^{-3}]	θ_s [L^3L^{-3}]	α [cm^{-1}]	n [-]	K_s [cm d^{-1}]
Sand	0.020	0.417	0.1380	0.592	504.0
Loamy Sand	0.035	0.401	0.1150	0.474	146.6
Sandy Loam	0.041	0.412	0.0682	0.322	62.2
Loam	0.027	0.434	0.0897	0.220	31.7
Silt	0.015	0.486	0.0482	0.211	16.3
Silty Loam	0.015	0.486	0.0482	0.211	16.3
Sandy Clay Loam	0.068	0.330	0.0356	0.250	10.3
Clay Loam	0.075	0.390	0.0386	0.194	5.52
Silty Clay Loam	0.040	0.432	0.0307	0.151	3.60
Sandy Clay	0.109	0.321	0.0343	0.168	2.88
Silty Clay	0.056	0.423	0.0292	0.127	2.16
Clay	0.090	0.385	0.0268	0.131	1.44

- Table B-6D - Soil hydraulic parameters for the analytical functions of *Kosugi* [1996] for 12 textural classes of the USDA soil textural triangle. (HYDRUS Table 10)

Table 10. Soil hydraulic parameters for the analytical functions of *Kosugi* [1996] for twelve textural classes of the USDA soil textural triangle.

Textural class	θ_r [L^3L^{-3}]	θ_s [L^3L^{-3}]	α [cm^{-1}]	n [-]	K_s [cm d^{-1}]
Sand	0.045	0.430	303.7	0.383	712.8
Loamy Sand	0.057	0.410	12.47	0.950	350.2
Sandy Loam	0.065	0.410	27.42	1.26	106.1
Loam	0.078	0.430	101.8	1.80	24.96
Silt	0.034	0.460	510.6	2.48	6.00
Silty Loam	0.067	0.450	325.9	2.30	10.80
Sandy Clay Loam	0.100	0.390	80.89	2.04	31.44
Clay Loam	0.095	0.410	666.3	2.81	6.24
Silty Clay Loam	0.089	0.430	2853.	3.26	1.68
Sandy Clay	0.100	0.380	1129.	3.41	2.88
Silty Clay	0.070	0.360	140538.	4.49	0.48
Clay	0.068	0.380	103815.	4.67	4.80

The HYDRUS model software is also coupled with the Rosetta Lite DLL (Dynamically Linked Library) that was independently developed by Marcel Schaap at the U.S. Salinity Laboratory [*Schaap et al*., 2001]. Rosetta implements pedotransfer functions (PTFs) and provides another tool to predict *van Genuchten*'s [1980] water retention parameters and the saturated hydraulic conductivity (K_s) in a hierarchical manner from the soil textural class, the soil textural distribution, bulk density, and water retention inputs (HYDRUS, 2022). Geosyntec reviewed these various HYDRUS resources in the selection of soil input parameters, as described in Section 5 below.

5. SELECTION OF MODEL SOIL PROPERTIES

Geosyntec evaluated regional K data, site-specific soil data, USDA soil data, measured field infiltration rates, and HYDRUS soil catalog data to select soil properties for each of the four model layers in the VZM. It should be noted, the VZM model uses a single soil property simplification for each layer in the VZM, while it is understood each layer has soil properties that vary in nature. Geosyntec endeavored to select soil properties that were representative of an intermediate of the potential range of soil properties.

This modeling exercise evaluates infiltration through four separate horizontal layers of soil units. In the book reference from Radcliffe and Šimůnek (2010), *Soil Physics with HYDRUS – Modeling and Applications,* it is stated:

- *Most soil, other than Entisols and Inceptisols* (not found at this site)*, have well-developed horizons or layers that have different hydrologic characteristics, including* K_s*,* ….; and

- *Above the water table* (i.e., the unsaturated zone or vadose zone)*, water usually flows vertically, so that flow is perpendicular to these layers. Below the water table, flow can occur parallel to these layers.*

Also, the VZM includes a feature to estimate the effects of subsurface infiltration based on soil K_s and potential anisotropy in soils. Anisotropy is the ratio of horizontal K_h : vertical K_v which reflects the relative ease of flow in the horizontal and vertical directions. As described in Section 4.1, Geosyntec's estimates for anisotropy in the model are as follows:

- Model Layers 1, 2, and 3 – Older dune sands (Qdo) / Jaucas sands (JaC) and weathered alluvium (QTao). These sedimentary materials are typically included in the general "caprock" referral in Maui modeling studies. Ginegrich (2008) reports:
    - *Little information about the anisotropy or vertical hydraulic conductivity of the caprock is available.* It is also stated: *In their analysis, Souza and Voss treated the caprock as a homogeneous and isotropic unit, although significant heterogeneity may exist (Oki and others, 1998).*

Geosyntec found the soils in these units to contain significant percentages of sands and limited clay materials. Furthermore, the weathered alluvium (QTao) is a heterogeneous mixture of gravels, sands, silts and clays resulting from alluvial fan deposition. Based on these references and data described above, Geosyntec concluded that Layers 1, 2, and 3 should be simulated as isotropic (K_h:K_v = 1:1) materials.

- Model Layer 4 - Kula volcanics or Honomanu basalt bedrock. These materials are reported to be anisotropic, with K_h values 10-100 times or more greater than K_v values. Geosyntec used estimates of reported data to implement an anisotropy K_h:K_v of approximately 25:1 in the model.

5.1 Model Layer 1 – Older Dune Deposits (Qdo) / Jaucas sand (JaC)

Ground Surface to 10 feet bgs (~ 3 meters bgs) Sand (USDA Texture)

This model layer simulates Older Dune sand (Qdo) / Jaucas Sand (JaC) properties that are mapped at the surface (State of Hawai'i Soil Survey) and that were visually logged by Geosyntec at the surface in the three investigative borings. While no soils sieve tests were performed at the Site for the surface sands, the State of Hawai'i classifies this unit with 93.9% sand, 3.9% silt, and 2.3% clay. The USDA classification estimates a soil with 85% to 100% sand texture as a Sand and was selected here by Geosyntec. The HYDRUS software provides soil hydraulic parameters for the analytical functions of van Genuchten (1980) for 12 textural classes of the USDA soil texture triangle. The analytical functions include saturated hydraulic conductivity (K_s) plus residual (Q_r) and saturated water (Q_s) contents, and empirical coefficients affecting the shape of the hydraulic functions. Table B-7A lists the range of K_s, residual water content (Q_r), and saturated water content (Q_s) values reported from four sources contained in HYDRUS catalog (Attachment B) for the USDA Sand classification:

Table B-7A – HYDRUS Input Parameters Ranges for Layer 1 – Qdo / JaC

USDA Classification	Residual Water Content (Q_r) Unitless	Saturated Water Content (Q_s) Unitless	Saturated Hydraulic Conductivity (K_s) cm/d	Saturated Hydraulic Conductivity (K_s) m/d	Source
Sand	0.045	0.430	712.8	7.1	Carsel and Parrish, 1988
Sand	0.053	0.375	643	6.4	Schaap et al., 2001
Sand	0.02	0.417	504.0	5.0	Rawls et al., 1982
Sand	0.045	0.430	712.8	7.1	Kosugi, 1996

As described in Section 4.1, for the Jaucas sand (JaC), the USDA Soil Survey estimated a K_s of 92 millimeters per second (m/s) that converts to 8.0 m/d. Geosyntec elected to use the Carsel and Parrish (1988) van Genuchten function parameters that represents an intermediate value as compared to other references (Table B-7A).

5.2 Model Layer 2 – Older Dune sand (Qdo) / Jaucas sand (JaC)

10 feet bgs to 40 feet bgs (~ 3 to 12 meters bgs) Loamy Sand (USDA Texture)

This model layer also simulates Older Dune sand (Qdo) / Jaucas Sand (JaC) properties, but includes sieve soil testing results, logging by Geosyntec in the three investigative borings, and three in-borehole infiltration tests. The sieve analysis samples from this interval were variable, with the sand fraction measured at 23%, 59%, and 65%, respectively. The two samples with 59% and 65% fall into the Sandy Loam USDA texture. Geosyntec logging described silty sand and sandy silt. Geosyntec concludes the Loamy Sand classification is the best fit for this model layer. Table B-7B lists the range of K_s, Q_r, and Q_s values reported from four sources contained in HYDRUS for the USDA Loamy Sand classification:

Table B-7B – HYDRUS Input Parameter Ranges for Layer 2 – Qdo / JaC

USDA Classification	Residual Water Content (Q_r) Unitless	Saturated Water Content (Q_s) Unitless	Saturated Hydraulic Conductivity (K_s) cm/d	Saturated Hydraulic Conductivity (K_s) m/d	Source
Loamy Sand	0.057	0.410	350.2	3.5	Carsel and Parrish, 1988
Loamy Sand	0.049	0.390	105	1.0	Schaap et al., 2001
Loamy Sand	0.035	0.401	146.6	1.5	Rawls et al., 1982
Loamy Sand	0.057	0.410	350.2	3.5	Kosugi, 1996

Geosyntec chose to use the Carsel and Parrish (1988) van Genuchten function parameters for a Loamy Sand for this layer. This layer may represent a transition between the overlying Jaucas sand (JaC) and the underlying weathered alluvium (QTao).

5.3 Model Layer 3 – Weathered Alluvium (QTao)

40 – 180 feet bgs (~ 12 to 41 meters bgs) Loam (USDA Texture)

This model layer simulates the older weathered alluvium (QTao) that underlies the Older Dune sand (Qdo) / Jaucas Sand (JaC) layers. The older weathered alluvium unit contains a heterogeneous mixture of gravel, sand, silt, and clay. Six soil samples were collected in the unit at depths ranging from 40 to 56.5 feet bgs in which sieve testing and other tests were performed. The percent of sand ranged from 38% to 69%. Two samples included both sieve and hydrometer testing evaluating silt and clay fractions. The two samples were classified as follows:

- G-2 (55 to 56.5 feet bgs) – 49% sand, 41% silt, and 10% clay;
- G-3 (45 to 46.5 feet bgs) – 40% sand, 52% silt, and 8% clay; and
- Average – 44.5% sand, 46.5% silt and 9% clay.

Geosyntec interpreted that the average of these two samples would provide a reasonable estimate for the USDA texture for the older alluvium (QTao) layer. As shown in Figure B-8, the average of these two soil compositions fall within the USDA Loam classification. This soil composition compares reasonably with the composition of the Pulehu Silt Loam (41% sand, 36.7% silt, and 20% clay, USDA Soil Map) that is exposed west of the Site and is interpreted to underlie the Jaucas sand (JaC) beneath the WWRF.

Table B-7C lists the range of Ks, Qr, and Qs values reported from four sources contained in HYDRUS for the USDA Loam classification:

Table B-7C – HYDRUS Input Parameters Range for Layer 3 – QTao

USDA Classification	Residual Water Content (Qr) Unitless	Saturated Water Content (Qs) Unitless	Saturated Hydraulic Conductivity (Ks) cm/d	Saturated Hydraulic Conductivity (Ks) m/d	Source
Loam	0.078	0.430	24.96	.25	Carsel and Parrish, 1988
Loam	0.061	0.399	12.0	0.12	Schaap et al., 2001
Loam	0.027	0.434	31.7	0.32	Rawls et al., 1982
Loam	0.078	0.430	24.96	0.25	Kosugi, 1996

Geosyntec also used the PTF in HYDRUS, which uses a direct input of percent sand, silt, and clay, plus bulk density. A relative increase in bulk density produces a relative decrease in K_s. Using the average percent of sand, silt, and clay listed above for samples G-2 and G-3 (44.5% sand, 46.5% silt and 9% clay) plus the various density values listed in the table below, the HYDRUS PTF calculates the K_s value.

Table B-7D – HYDRUS Calculated Relationship Between Dry Density (gr/cm3) and Calculated K_s (m/d) for Weathered Alluvium Samples (QTao)

Density Description	Dry Density (pcf)	Dry Density (gr/cm3)	HYDRUS Pedotransfer (PTF) Calculated K_s (cm/d)	HYDRUS Pedotransfer (PTF) Calculated K_s (m/d)
Minimum Alluvium Density Sample Measured	70.4	1.13	96	0.96
Average Density of G-2 and G-3 Samples	73.7	1.18	77	0.77
Average Density of each of the Alluvium Samples	78.5	1.26	54	0.54
HYDRUS Density Default Value	84.1	1.35	38	0.38
Maximum Density of Alluvium Sample Measured	88.5	1.42	29	0.29

Upon review, the HYDRUS default bulk density of 1.35 gr/cm^3 (approximately 84.1 pcf) is within the upper range of the density values measured for weathered alluvium (QTao) at the site and when used with the HYDRUS PTF function, calculates an intermediate K_s value of 0.38 m/d. Using the soil characteristics listed above, the HYDRUS PTF resulted in the following van Genuchten function values:

Table B-7E – Selected HYDRUS Input Parameters for Layer 3 – QTao

USDA Classification	Residual Water Content (Qr) Unitless	Saturated Water Content (Qs) Unitless	Saturated Hydraulic Conductivity (Ks) cm/d	Saturated Hydraulic Conductivity (Ks) m/d	Source
Loam	0.0415	0.377	37.8	0.38	HYDRUS Pedofunction calculation

Geosyntec chose to use the HYDRUS PTF calculation for the van Genuchten function parameters for a Loam for this layer listed above. It is based on evaluation and comparison of soil data collected at the site plus the HYDRUS PTF. This layer is estimated to be approximately 140 feet thick, based on the upper contact being encountered at approximately 40 feet bgs and the bottom contact with the underlying volcanic unit at a depth of approximately 180 feet bgs. The depth of the basal contact is estimated from Gingerich 2008 (Figure 7) that shows Kula volcanics and Honomanu basalt volcanic bedrock structure contours in the vicinity of the Site. The K_s rate for the Loam layer is approximately 10% of the K_s value for the overlying Loamy Sand layer and is about 5% of the K_s value for the upper Sand horizon. Thus, it is anticipated that this layer will cause impedance of vertical infiltration flow as compared with the overlying layers.

5.4 Model Layer 4 – Fractured Volcanics of the Kula volcanics or Honmanu basalt

180 feet bgs to 220 feet bgs (~ 54 to 67 meters bgs) Sand (USDA Texture)

The HYDRUS van Genuchten function tables are limited to soils classified in the USDA soil texture triangle (Figure B-8) and do not include parameters for volcanic rock, as anticipated here. As a proxy for the volcanic material, Geosyntec classified this unit as a Sand in the model as it contains the highest K_s values in the HYDRUS catalog. This selection is based on a prior study by Gingerich (2008) that reported high horizontal K_s values in wells screened in the Kula volcanics or Honomanu basalt in the central Maui area that range between 800 to 1,600 feet per day (244 to 488 m/d), median of 1,200 ft/d and 366 m/d. As described in Section 4.1, Geosyntec estimated a vertical K_s of 15 m/d for the HYDRUS model. The 25:1 K_h:K_v ratio is within the 10 to 100 times anisotropy range referenced in Gingerich (2008) and others.

Table B-7F – Selected HYDRUS Input Parameters for Layer 4 – Volcanic Bedrock

USDA Classification	Residual Water Content (Q_r) Unitless	Saturated Water Content (Q_s) Unitless	Saturated Hydraulic Conductivity (K_s) cm/d	Saturated Hydraulic Conductivity (K_s) m/d	Source
Sand	0.045	0.430	712.8	7.1	Carsel and Parrish, 1988
Sand (Volcanics Proxy)	0.045	0.430	1500	15	Geosyntec estimate

There is acknowledged uncertainty regarding the depth and nature of the anticipated Kula volcanics or Honmanu basalt material beneath the WWRF. However, Geosyntec concludes there is reasonable information to estimate the model parameters for the purposes of this preliminary and conceptual vadose zone modeling effort.

6. HYDRUS VZM MODEL INPUT SETTINGS

The following lists various HYDRUS® modeling software settings:

- Model domain – Vertical Plane, 2D-Simple
- Dimensions – Length 600 m, Height 67 m, 0-degree slope
- Water flow – HYDRUS® default setting
- Solute transport – HYDRUS® Standard Solute Transport
- Time Information – Days
- Iteration Criteria – Water content tolerance [-] – 0.001; Pressure head tolerance [m] – 0.1
- Soil Hydraulic Model – van Genuchten – Mualem (van Genuchten, 1980)

- Hysteresis – no hysteresis (HYDRUS default setting)
- Solute transport – Crank-Nicholson Scheme (HYDRUS default setting)
- Space weighting – Galerkin Finite Elements (HYDRUS default setting)
- Initial conditions – In Liquid Concentration (HYDRUS default setting)
- For Scenario 1, Alternative A slow denitrification simulated as a sink ($1.3x10^{-3}$ d^{-1}) and Alternative B enhanced denitrification rate of $8.0x10^{-3}$ d^{-1}.
- Initial nitrate concentration of 8 mg/L = 571 mmol/m^3 input in model.
- For Scenario 1, variable flux rates into model, 10-year period – 4.0 mgd for 21 spaced off-spec days plus 1.15 mgd for January. 120 mgal/year for 10-year period.
- For Scenario 2, variable flux rates into the model, 1-year period. 4.0 mgd in January, 1.0 mgd in February, 3.1 mgd in December, plus 21 days of off-spec infiltration at 4 mgd. Total equals 332 mgal.

6.1 Solute Dispersivity

Chemical transport through sedimentary units such as found in the site subsurface cause solutes to undergo both longitudinal (D_L) (downward) dispersion and transverse dispersion (D_T). The longitudinal component of dispersion is larger than the transverse dispersion component and thus the major axis of mixing occurs in the direction of flow (Todd and Mays, 2005). No direct testing for dispersivity was performed at the site. However, a number of relevant studies are available and reviewed to estimate this parameter including:

- Khaleel et al., 2002. Upscaled flow and transport properties for heterogeneous unsaturated media;
- Butters and Jury, 1989. Field Scale Transport of Bromide in an Unsaturated Soil; Dispersion Modeling; and
- CH2MHill Plateau Remediation Company, 2020. *Vadose Zone Flow and Transport Parameters Data Package for the Hanford Site Composite Analysis*

Based on a review of these studies, the numerical value of D_L for the field scale of this study was estimated to be 1.0 m, and D_T was estimated to be 0.1 m.

6.2 Bulk Density

Site-specific soil testing (8 samples) was found to have an average bulk density of 79 pcf. The average value is converted to 1265 kg/m^3 which was used in the model.

7. MODEL SIMULATION DOCUMENTATION

Attachments A and B provide HYDRUS® input and output graphs for the Scenarios 1 and 2 simulations, respectively.

The Attachment A materials include:

Scenario 1, Alternative A, denitrification rate ($1.3x10^{-3}$ d^{-1})

- Time-variable recycled water flux input at the SAT basin surface (as per Brown and Caldwell, 2024) and drainage out at the base of the model over the 10-year model simulation period;
- Cumulative recycled water flux input at the SAT basin surface (as per Brown and Caldwell, 2024) and drainage out at the base of the model over the 10-year simulation period;
- Time-variable recycled water nitrate solute flux input at the SAT basin surface (as per Brown and Caldwell, 2024) and drainage out at the base of the model over the 10-year model simulation period;
- Cumulative recycled water nitrate solute flux input at the SAT basin surface (as per Brown and Caldwell, 2024) and drainage out at the base of the model over the 10-year model simulation period;
- Graph of the model numerical scheme – Courant number; and
- Model mass balance information at 3-year and 10-year time steps.

Scenario 1, Alternative B, denitrification rate ($8x10^{-3}$ d^{-1})

- Time-variable recycled water nitrate solute flux input at the SAT basin surface (as per Brown and Caldwell, 2024) and drainage out at the base of the model over the 10-year model simulation period;
- Cumulative recycled water nitrate solute flux input at the SAT basin surface (as per Brown and Caldwell, 2024) and drainage out at the base of the model over the 10-year model simulation period; and
- Model mass balance information at 3-year and 10-year time steps.

The Attachment B materials include:

Scenario 2, Alternative A, denitrification rate ($1.3x10^{-3}$ d^{-1})

- Time-variable recycled water flux input at the SAT basin surface (as per Brown and Caldwell, 2024) and drainage out at the base of the model over the 1-year model simulation period;

- Cumulative recycled water flux input at the SAT basin surface (as per Brown and Caldwell, 2024) and drainage out at the base of the model over the 1-year simulation period;
- Time-variable recycled water nitrate solute flux input at the SAT basin surface (as per Brown and Caldwell, 2024) and drainage out at the base of the model over the 1-year model simulation period;
- Cumulative recycled water nitrate solute flux input at the SAT basin surface (as per Brown and Caldwell, 2024) and drainage out at the base of the model over the 1-year model simulation period;
- Graph of the model numerical scheme – Courant number;
- Model mass balance information at 1-year time step; and
- Graphs of recycled water flow velocity vectors at 90, 123, and 365 days.

8. VADOSE ZONE MODEL LIMITATIONS AND UNCERTAINTY

Geosyntec's services were performed, and this preliminary vadose zone modeling and evaluation report has been prepared, in accordance with generally accepted professional standards of care applicable to the scope of services authorized by Brown and Caldwell and the County of Maui, and no other warranty is provided in connection therewith. Consistent with applicable professional standards of care, our opinions and recommendations were based in part on data furnished by others. Although we were not able to independently verify such data, we did evaluate it to determine whether it was consistent with other information that we developed in the course of our performance of the scope of services. Subsurface investigations and interpretations are inherently limited to data derived from samples taken or tests performed at selected locations. Due to these inherent limitations, it must be recognized the actual subsurface conditions may vary from those predicted, despite the use of professional care.

This preliminary evaluation document was prepared by the staff of Geosyntec Consultants under the supervision of persons whose signatures appear below. The findings or professional opinions are based upon: a) preliminary data, analyses, and interpretations of subsurface conditions; b) approximations of data collected by others; and c) the use of vadose zone model simulations to preliminarily estimate and project future SAT basin infiltration conditions. Thus, the actual vadose zone materials and SAT basin infiltration rates used at the Project Site during future facility operation may vary from the preliminary interpretations, projections, and concepts presented herein.

No warranty, expressed or implied, is made regarding the professional opinions expressed in this document by Geosyntec or the references cited in this document, or concerning the completeness of the data presented to us. If actual conditions are found to differ from those described in this document or if new information regarding the Project Site is obtained, Geosyntec should be notified and additional analyses or recommendations, if required, will be provided.

9. REFERENCES

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TABLES

FIGURES

Honolulu
Kahului
Kihei
Waiehu Camp
Waihee-Waiehu
South Waiehu Stream
Wailuku
Kahului
Iao Valley State Monument
Iao Valley
Maui Country Club
Kahului Airport
Kanaha Pond State Wildlife Sanctuary
The Dunes at Maui Lani Golf Course
Puunene
Waikapu
Waikapu Stream
PROPOSED CENTRAL MAUI WWRF FACILITY
Maalaea
Pulehunui Hawaiian Home Land
Kealia Pond National Wildlife Refuge
Ukumehame Reservoirs
Ukumehame Park
Ukumehame Gulch
Pohakea Gulch
Honokowai Gulch
Waiko Ditch
Everett Ditch
Haiku Ditch
Upper Maalaea Rd
Upper Kihei Rd
S Firebreak Rd
N Firebreak Rd
Hansen Rd
Hookele St
Lono Ave
Ani St
Kuikahi Dr
S Alu Rd
Waiale Rd
Lower Main St
Eha St
Maika St
Stable Rd
Division Rd
Pulehu Rd
Waiakoa Rd
1615 m
1388 m
99 m
87 m
83 m
Service Layer Credits: World Topographic Map: Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, USDA, USFWS
World Imagery: Earthstar Geographics
World Hillshade: Esri, NASA, NGA, USGS
World Street Map: Esri, HERE, Garmin, NGA, USGS
N
Site Location Map
PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii
1 0.5 0 1
Miles
Geosyntec consultants
Figure B-1
Project No: LB1047
August 2024
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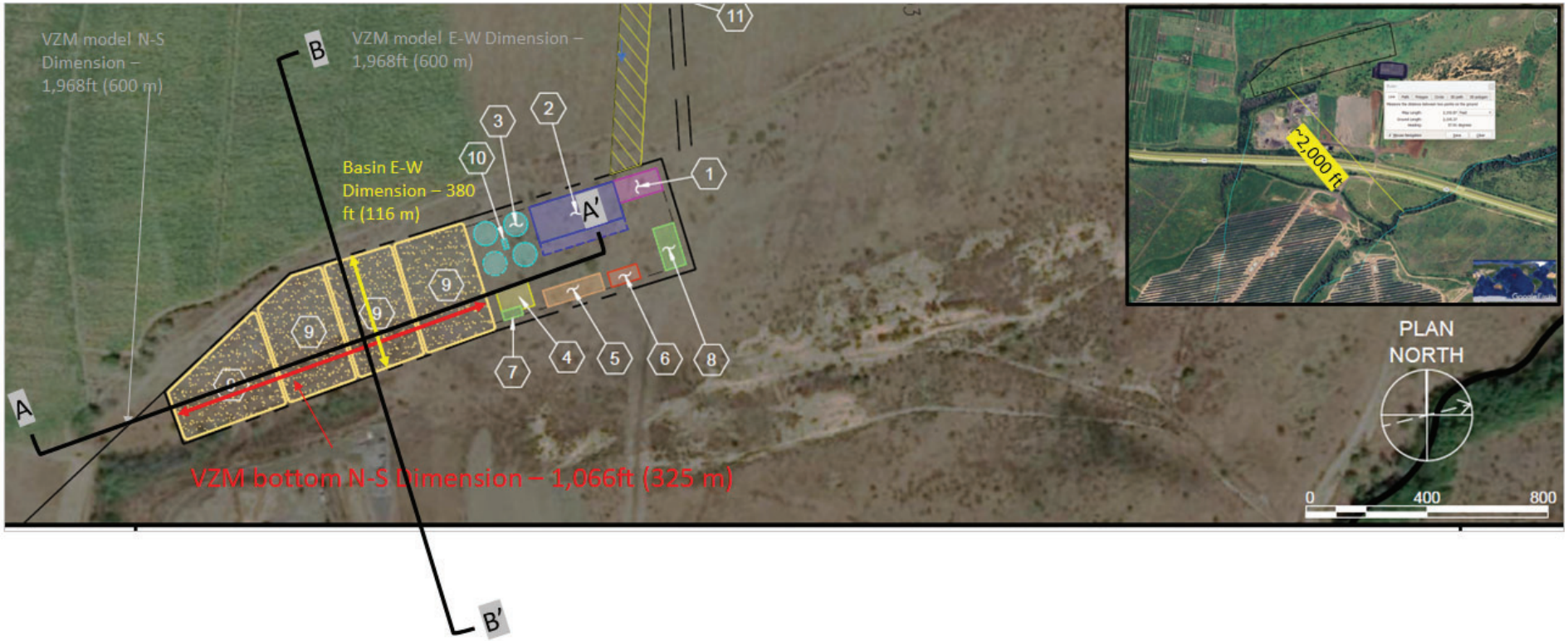


HYDRUS Vadose Zone Model Cross-Section Locations (A-A' and B-B')

PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii

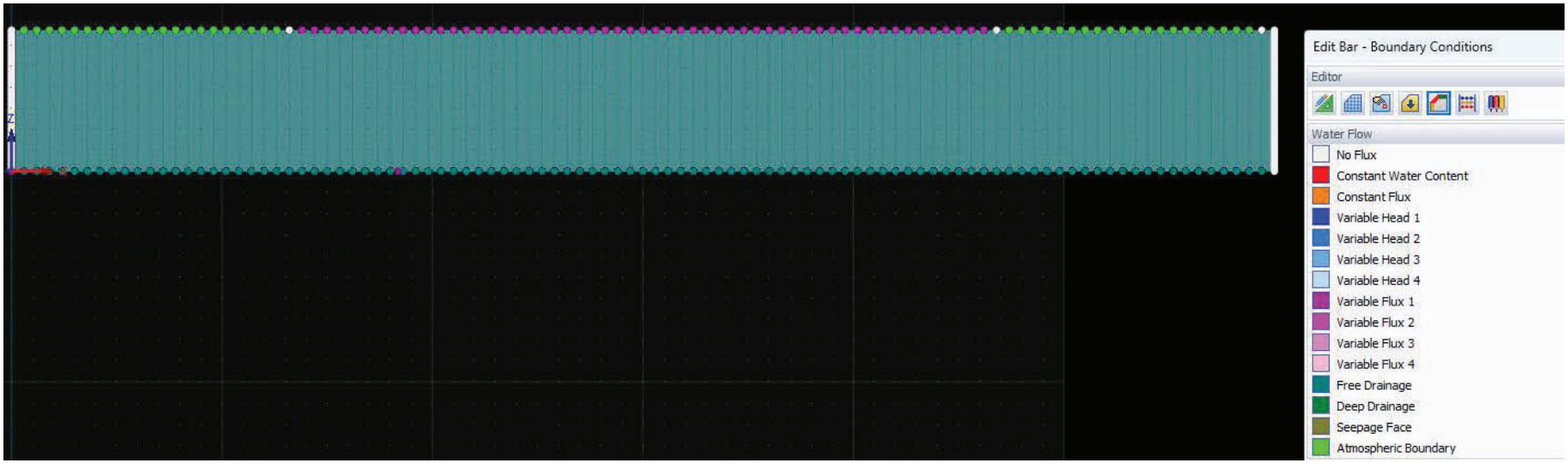
Geosyntec consultants

Project No: LB1047 | October 2024

Figure **B-2**

Water Flow

Four SAT Basins North-South Dimension (325 m (1,066 ft)



Vadose Zone Model Cross-Section and Initial Conditions

PROPOSED CENTRAL MAUI WWRF FACILITY

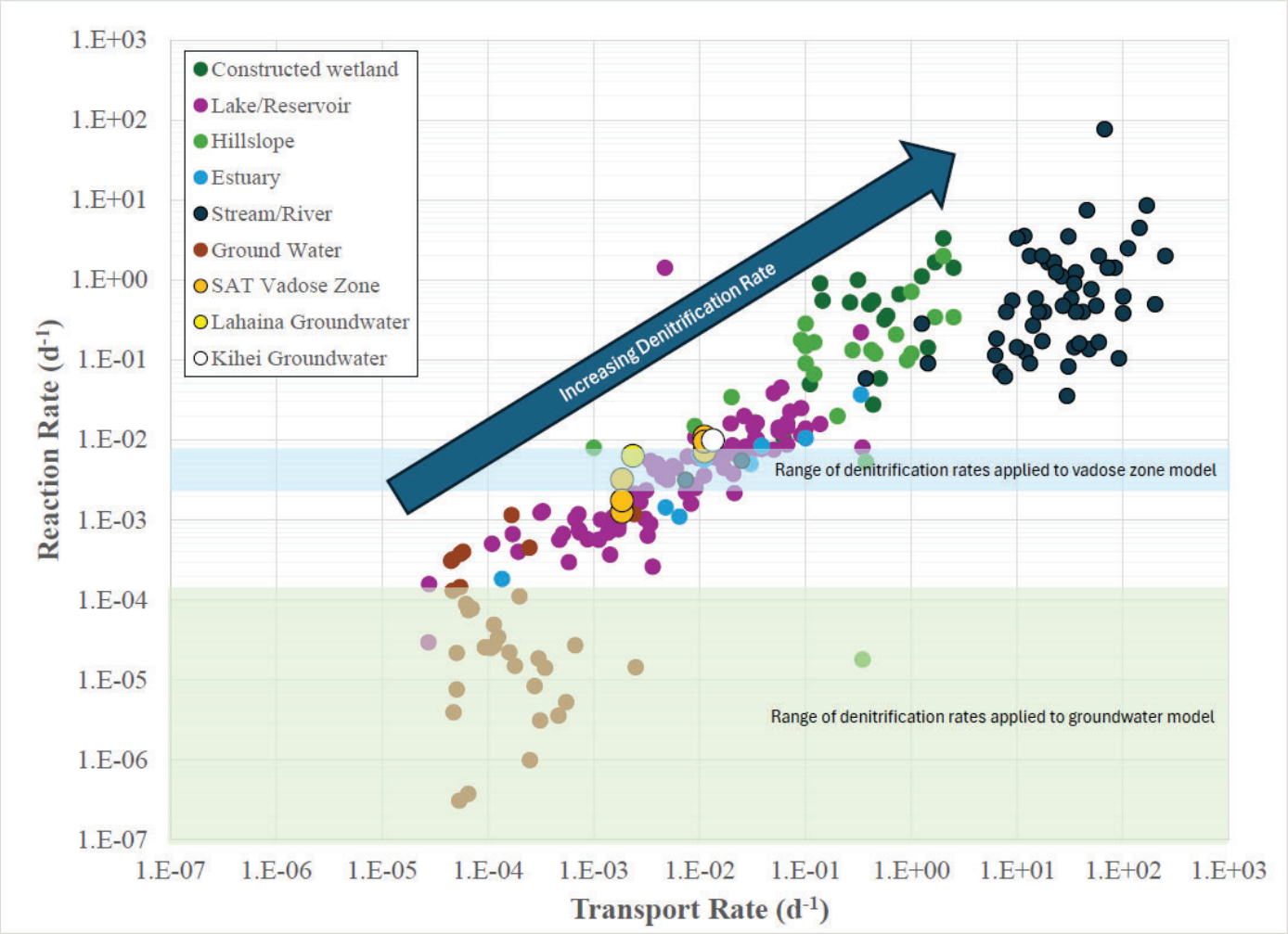
Maui, Hawaii

Geosyntec consultants

Figure **B-3**

Project No: LB1047

October 2024



Dentrification rates versus transport rates for various aquatic systems

PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii

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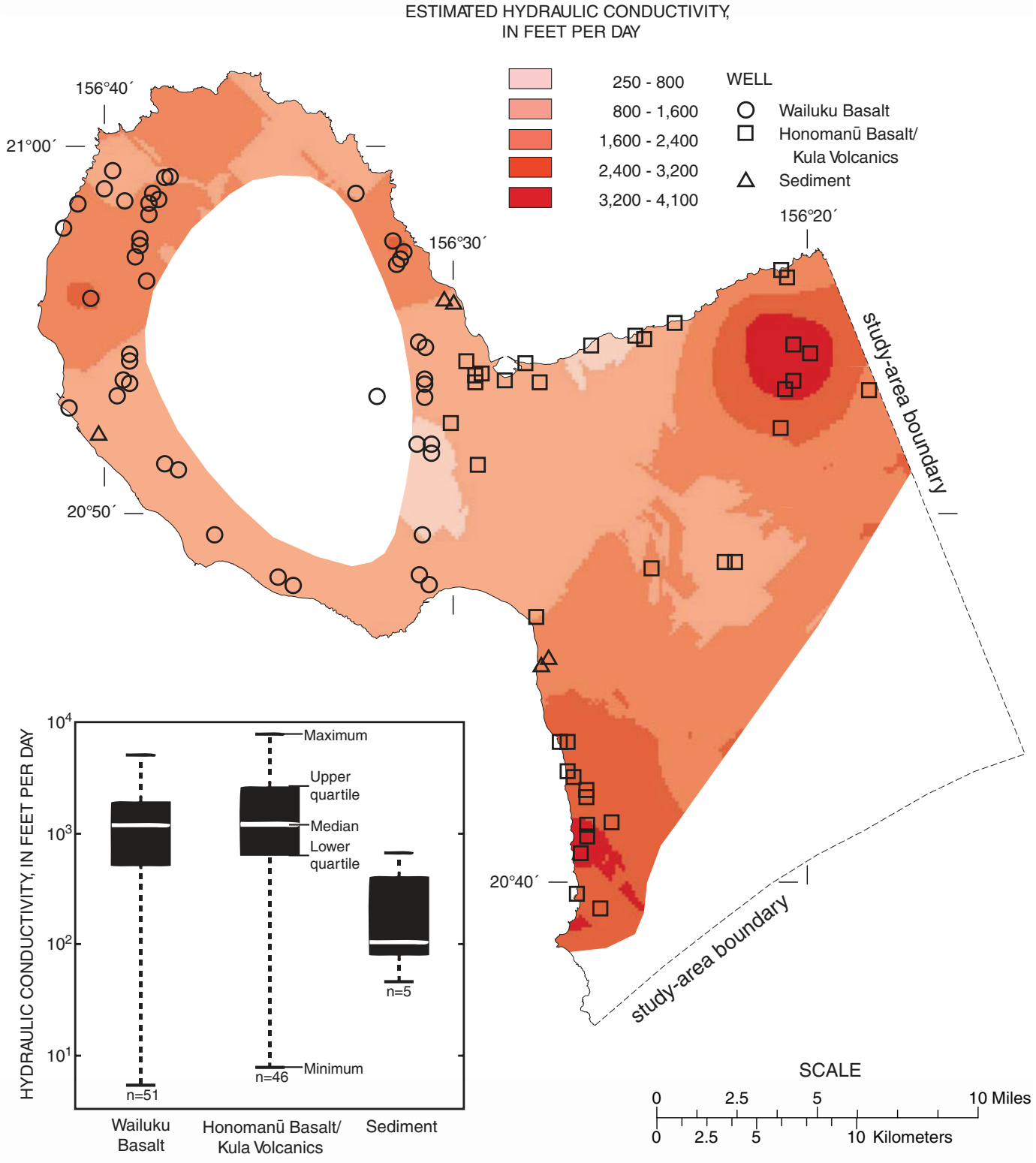
Project No: LB1047 | October 2024

Figure **B-4**



Distribution of aquifer hydraulic conductivity in central and west Maui, Hawaii (adapted from Gingerich, 2008)
PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii

Geosyntec consultants

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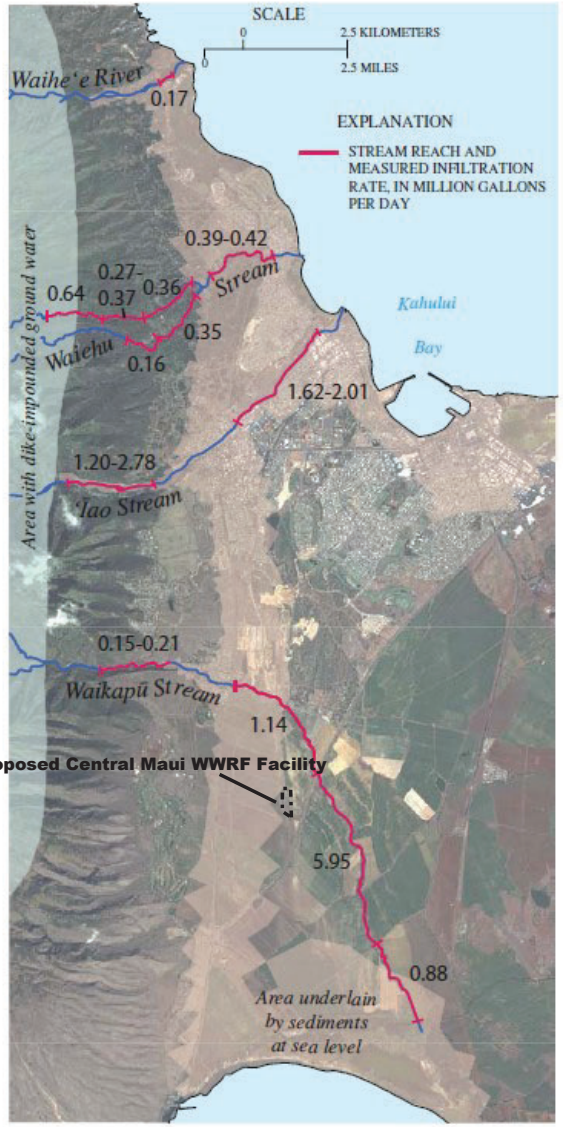
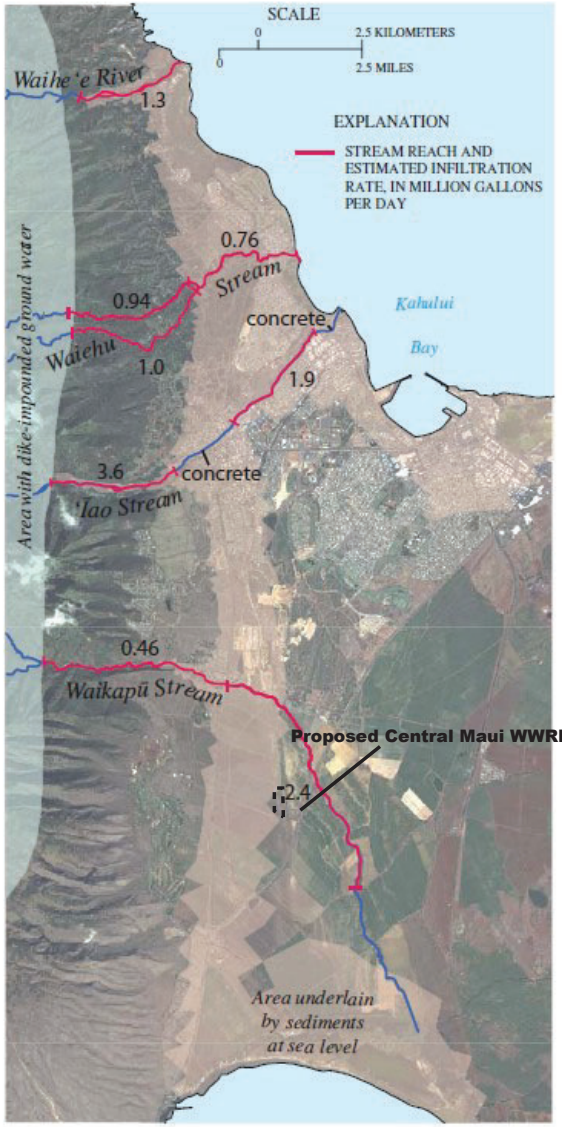
Figure **B-5**





N

Source: Gingerich, Stephen, 2008. Ground-Water Availability in the Wailuku Area, Maui, Hawai'i, Scientific Investigations Report 2008–5236.

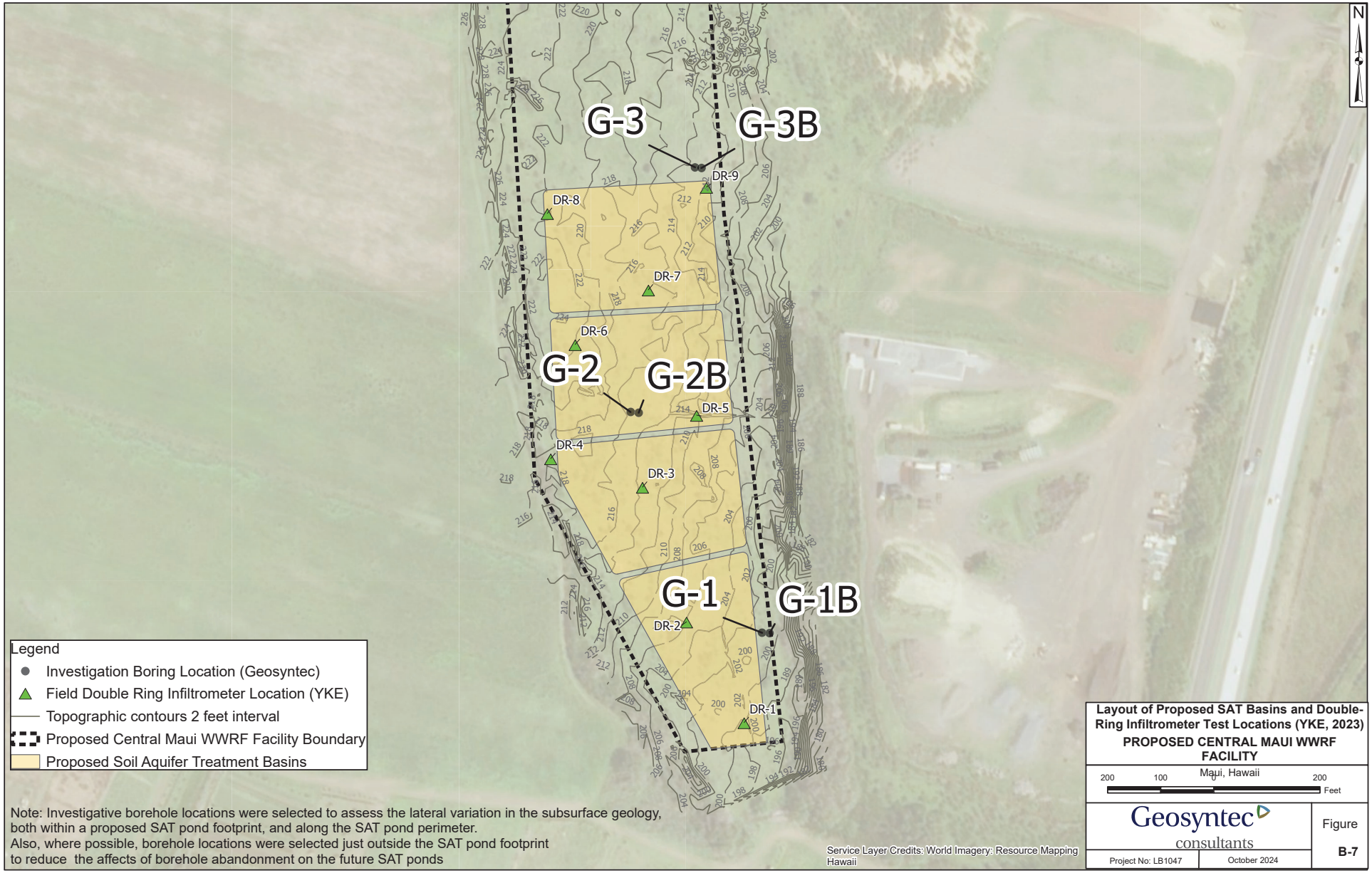
Comparison of Measured Versus Estimated Waikapu Stream Reach Infiltration Rates (Million Gallons per Day)

PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii

Geosyntec consultants

Project No: LB1047 | October 2024

Figure **B-6**


G-3
G-3B
DR-9
DR-8
DR-7
DR-6
G-2
G-2B
DR-5
DR-4
DR-3
G-1
G-1B
DR-2
DR-1
N
Legend
Investigation Boring Location (Geosyntec)
Field Double Ring Infiltrometer Location (YKE)
Topographic contours 2 feet interval
Proposed Central Maui WWRF Facility Boundary
Proposed Soil Aquifer Treatment Basins
Note: Investigative borehole locations were selected to assess the lateral variation in the subsurface geology, both within a proposed SAT pond footprint, and along the SAT pond perimeter.
Also, where possible, borehole locations were selected just outside the SAT pond footprint to reduce the affects of borehole abandonment on the future SAT ponds
Service Layer Credits: World Imagery: Resource Mapping Hawaii
Layout of Proposed SAT Basins and Double-Ring Infiltrometer Test Locations (YKE, 2023)
PROPOSED CENTRAL MAUI WWRF FACILITY
Maui, Hawaii
200 100 0 200
Feet
Geosyntec consultants
Figure
B-7
Project No: LB1047
October 2024
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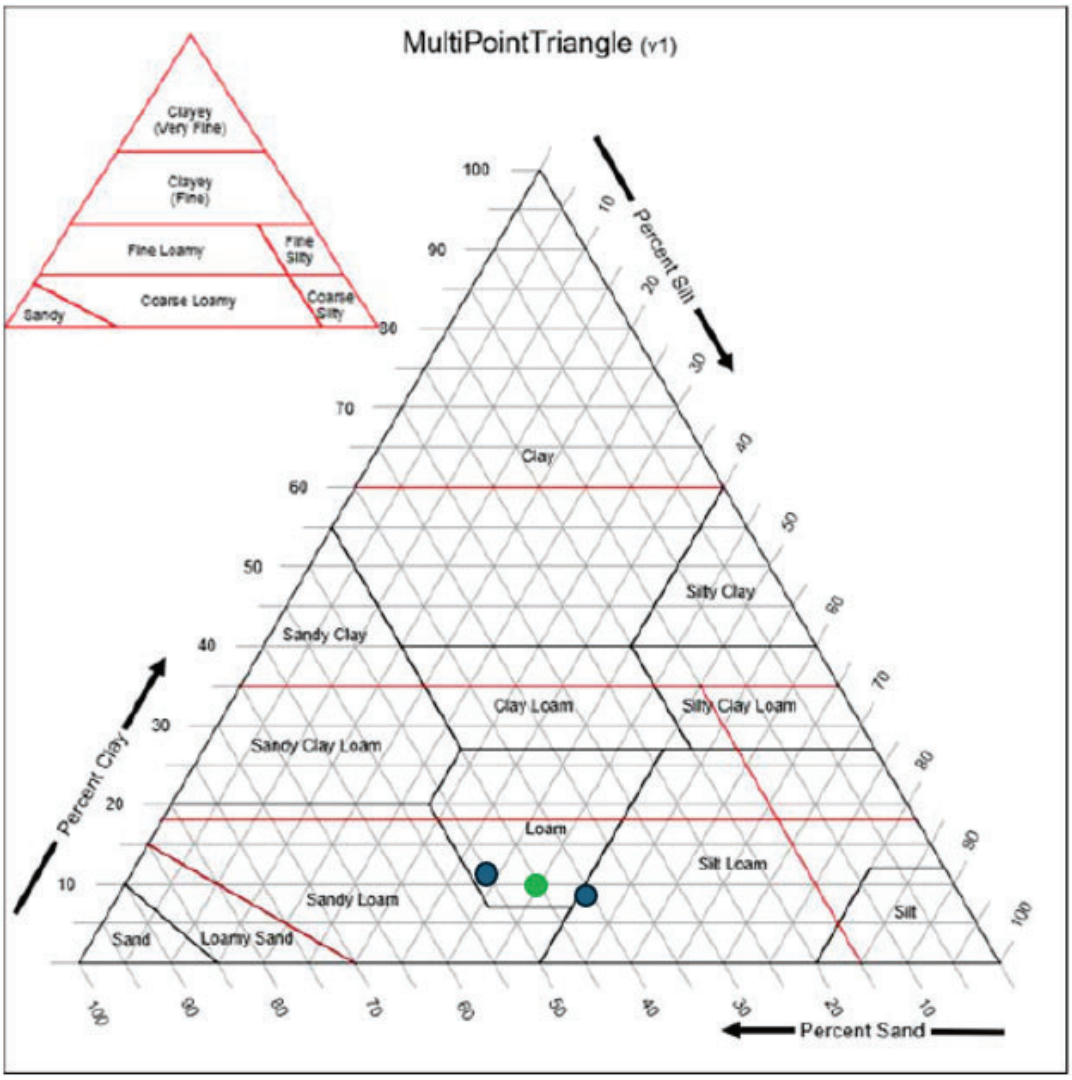

Legend

- QTao Sample Testing
- QTao Average

USDA Soil Classification Triangle– QTao samples

PROPOSED CENTRAL MAUI WWRF FACILITY

Maui, Hawaii

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Project No: LB1047

October 2024

Figure B-8

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ATTACHMENT A: SCENARIO 1 - HYDRUS MODELING DOCUMENTATION

Hydrogeologic Model Scenario 1: Long-Term Pollutant Transport Focus

Objective: estimate infiltration recycled liquid quantities and nitrate solute flux through the vadose zone. Output at base of model to become an input to the groundwater fate and transport model

Infiltration rate input – 120 Mgal/year – consists of 36 Mgal in January plus 4mgd per day for 21 random days for off-spec infiltration.

Infiltration time period – 10 years overall period, with a daily iteration calculation.

Alternative A – applies a conservative denitrification rate of 1.3×10^{-3} d^{-1}. See report text Section 5 for a discussion and calculation of rate.

Alternative B – applies a higher denitrification rate of 8.0×10^{-3} d^{-1} based on the assumption organic carbon will be added via wood chips or biomass. See report text Section 5 for a discussion and calculation of rate.

Scenario 1, Alternative A (denitrification rate of $1.3x10^{-3}$ d^{-1})

HYDRUS File Name: Scenario1_10Y_Sept12Memo

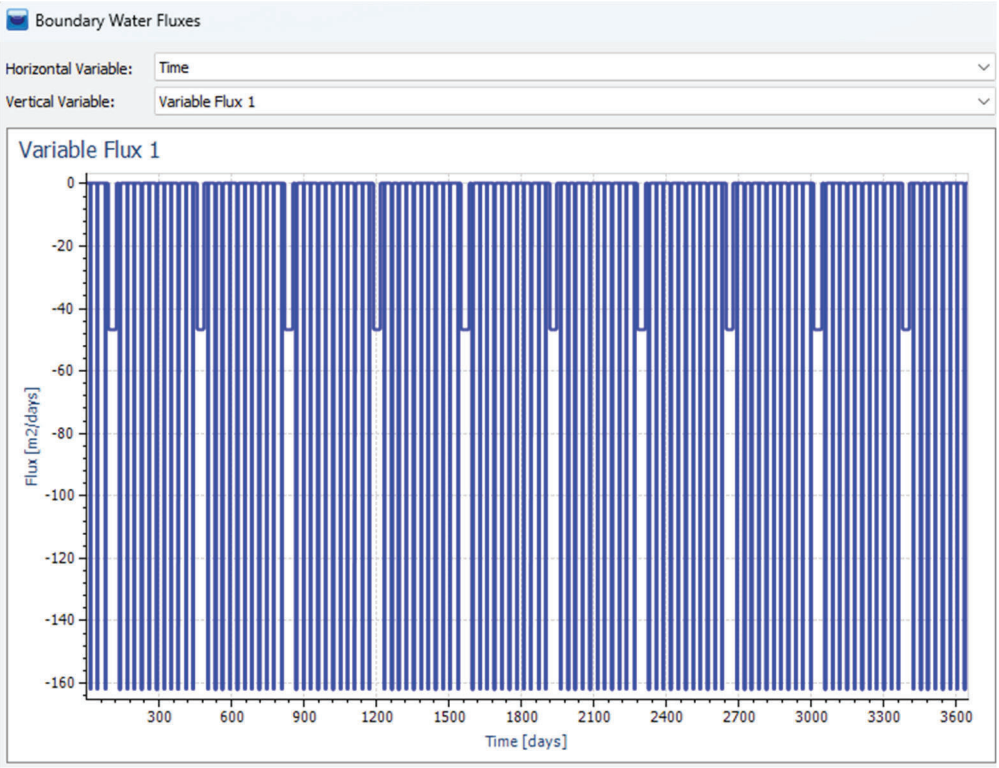
Infiltration Rate Source: Brown and Caldwell, 2024. *SAT Disposal Flows for Hydrogeological Model,* September 12.

Recycled Water Nitrate Concentration: 8 mg/L (Brown and Caldwell, 2024).

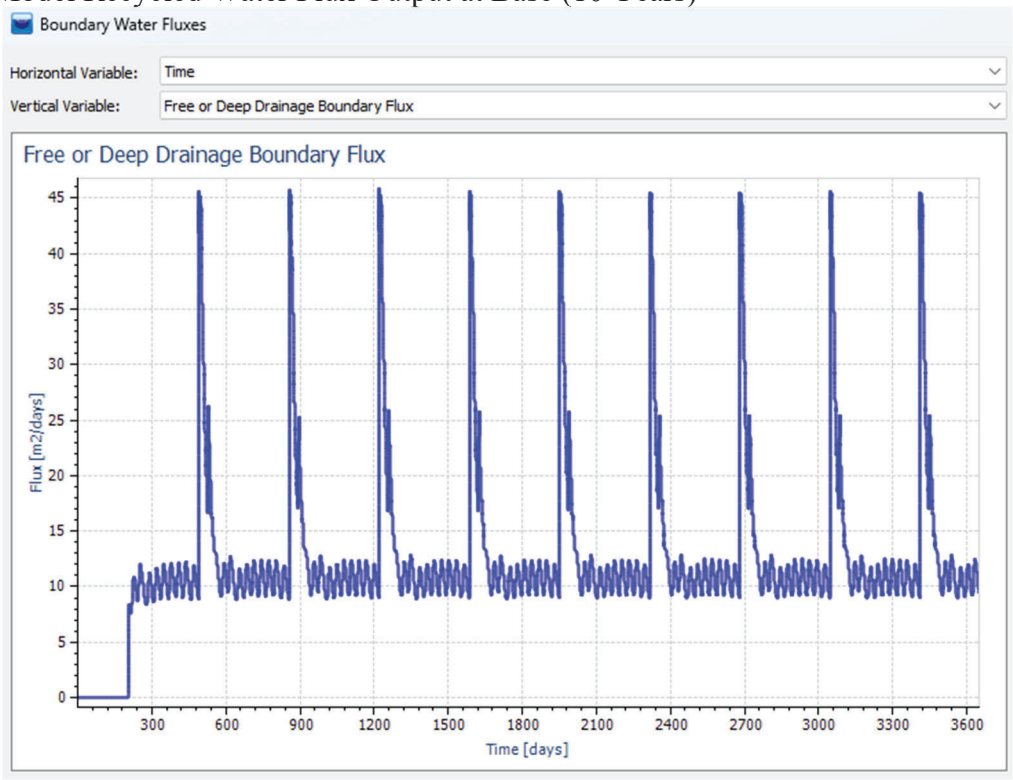
See report figures 19,20, and 21 for selected model solute simulation outputs for Scenario 1, Alternative A.

Model Variable Recycled Water Flux Input at Surface (10 Years)

Note: negative quantity in model indicates added flux

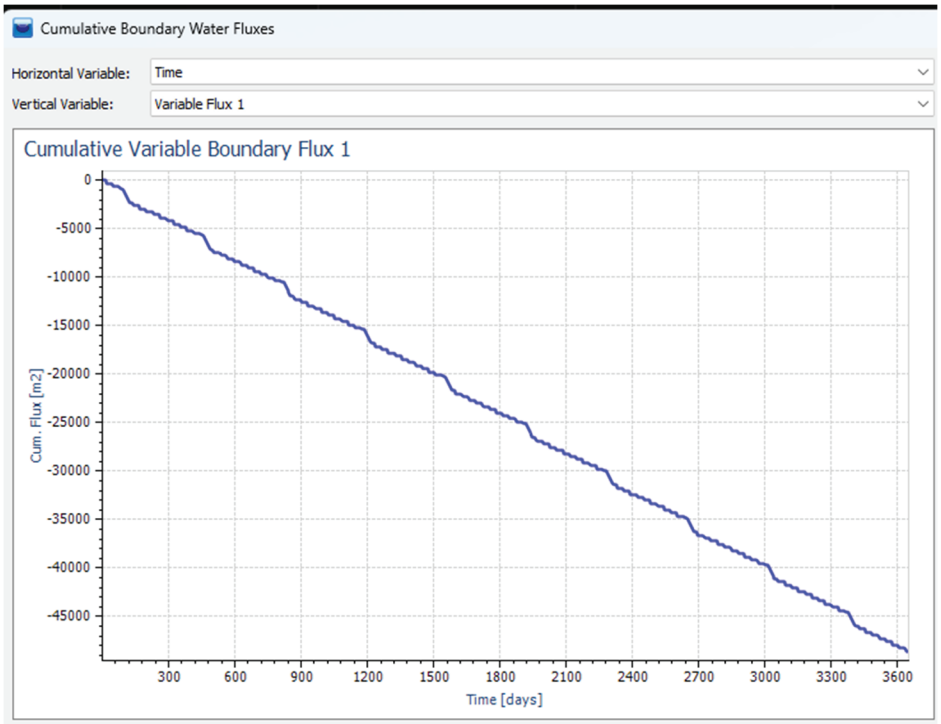


Model Recycled Water Flux Output at Base (10 Years)

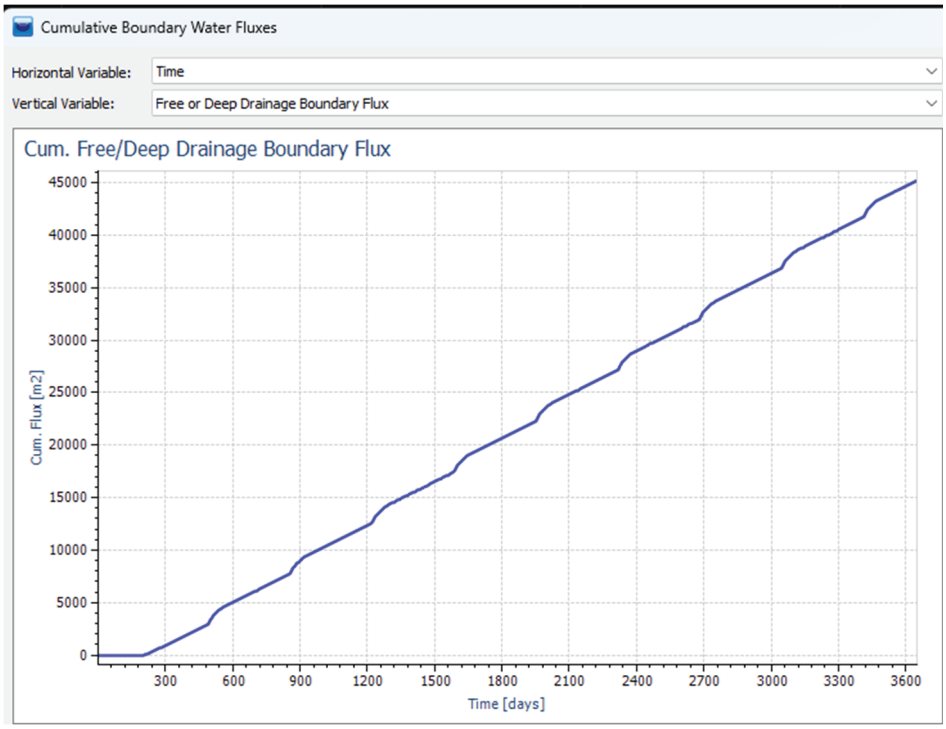


Cumulative Recycled Water Flux Input at Surface (10 Years)

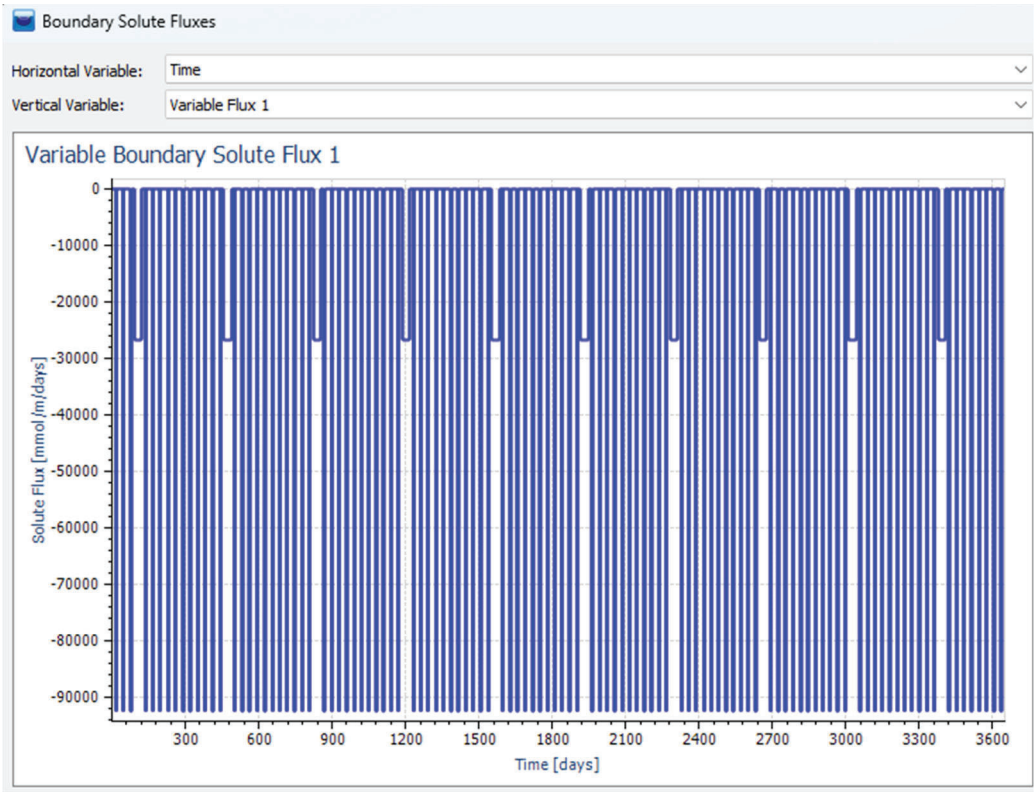
Note: negative quantity in model indicates added flux



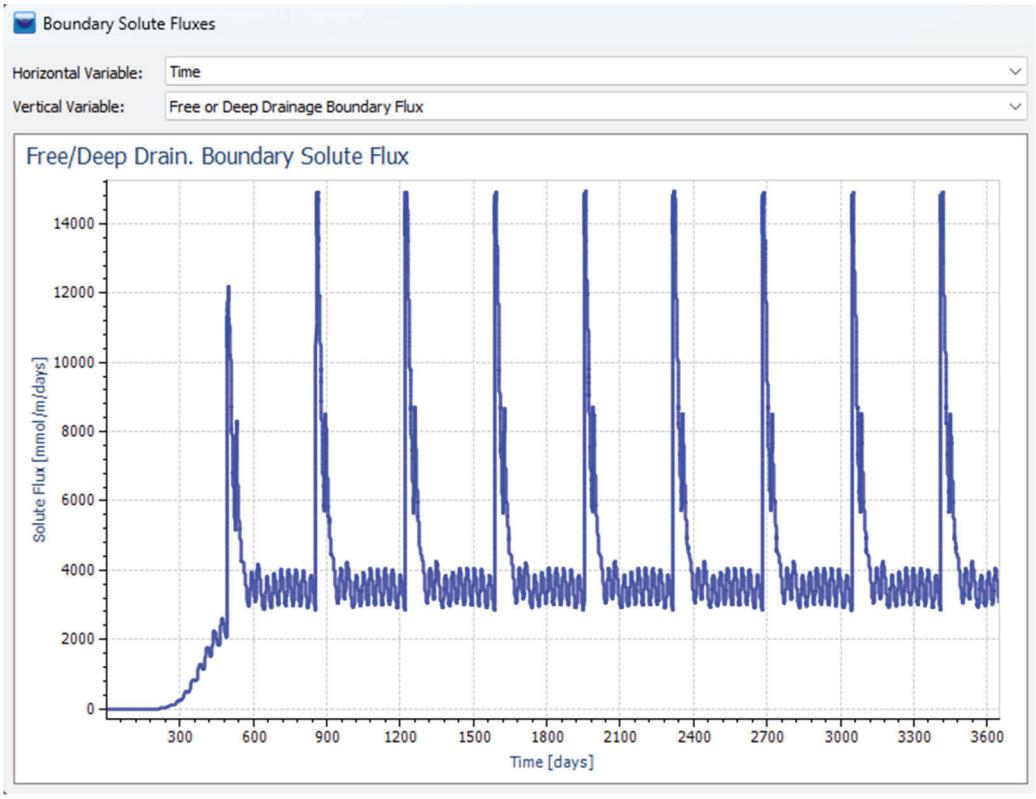
Cumulative Recycled Water Flux Out at Base of Model (10 Years)



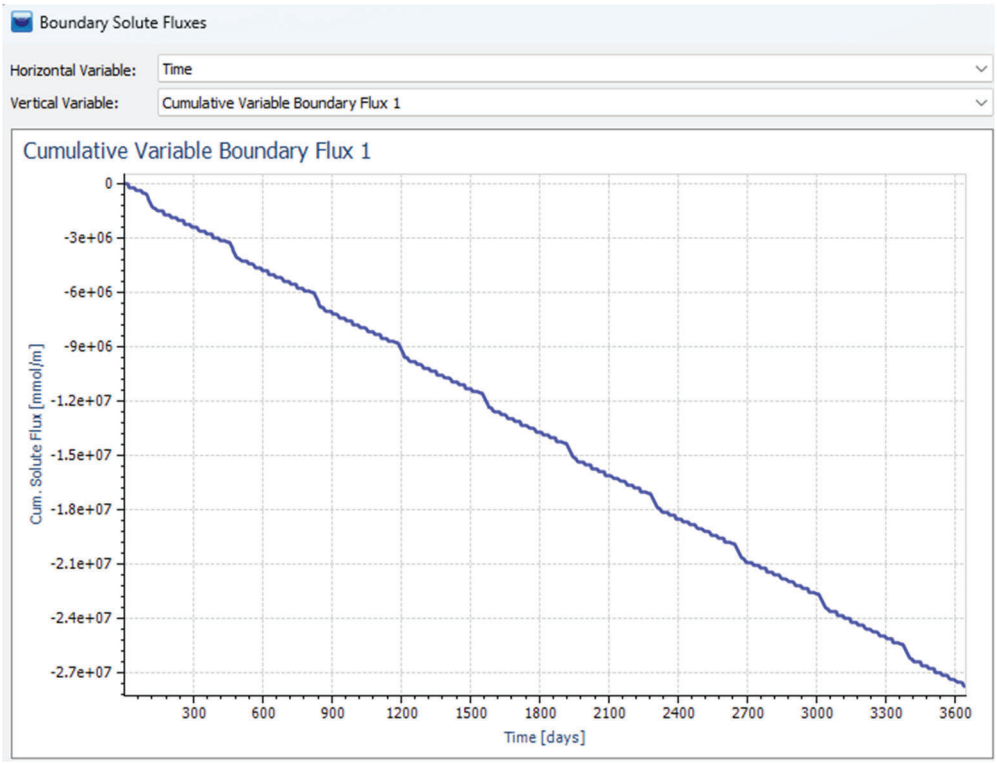
Model Variable Recycled Water Solute Mass (Nitrate) Flux Input at Surface (10 Years)



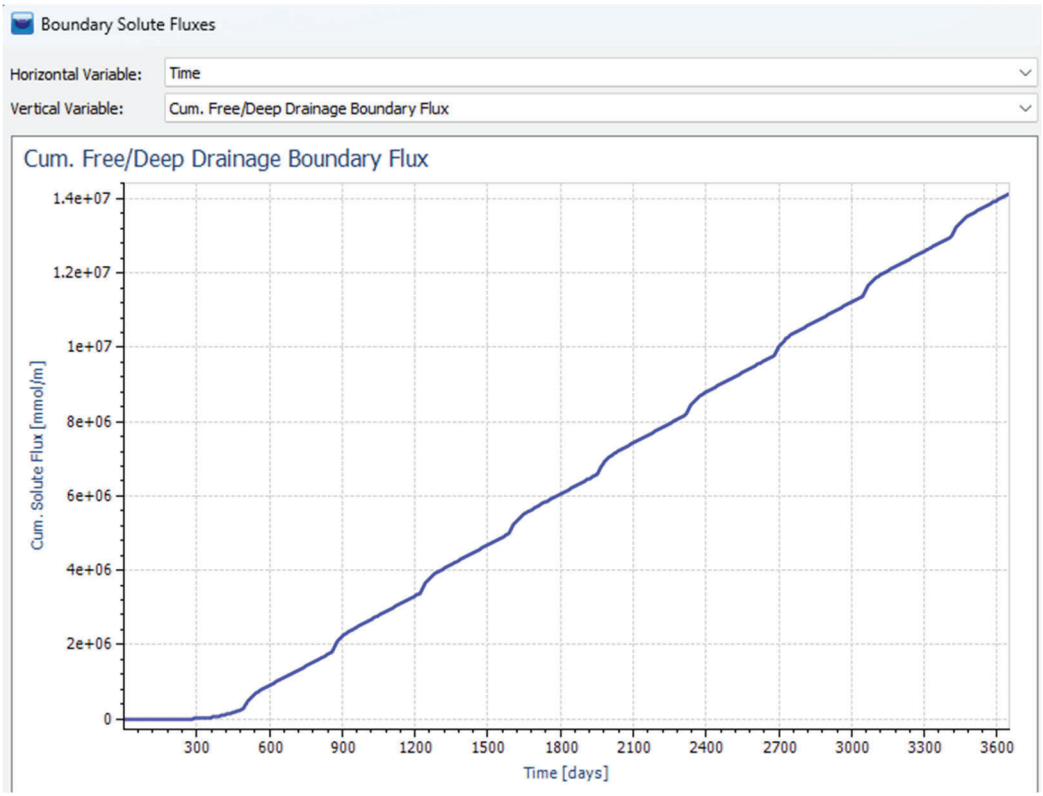
Model Variable Recycled Water Solute (Nitrate) Mass Flux Output at Base of Model (10 Years)



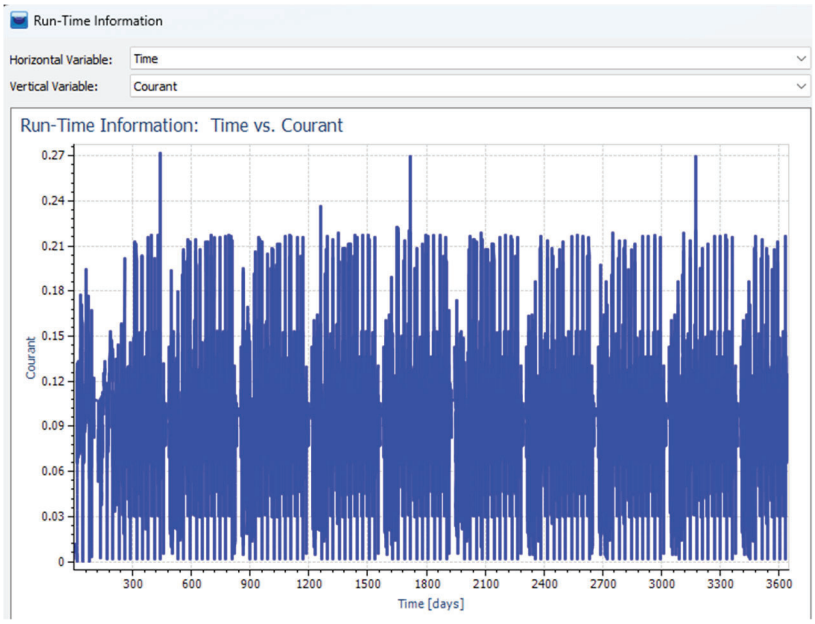
Model Cumulative Recycled Water Solute (Nitrate) Mass Flux Input at Surface (10 Years)



Model Cumulative Recycled Water Solute (Nitrate) Mass Flux Output at Base of Model (10 Years)
Note: reduced solute mass flux at model base due to applied denitrification rate - $1.3x10^{-3}$ d^{-1}



Model Courant Information – a measure of time step requirements and the stability of numerical schemes. The Courant number is well below guidelines suggesting below 0.7 to 1.



Example Mass Balance Information (1,095 days; 3 years) Note; water balance residual percent (WatBalR%) and concentration balance residual (CncBalR%) are well below suggested range of less than 1% residual error for both time periods.

```
------------------------------------------------------------
Time        [T]     1095.0000
------------------------------------------------------------
Sub-region num.                        1            2           3           4
------------------------------------------------------------
Area     [V]          0.40197E+05  0.42210E+04  0.32160E+04  0.24922E+05  0.78387E+04
Volume   [V]          0.79371E+04  0.44700E+03  0.43696E+03  0.62390E+04  0.81411E+03
InFlow   [V/T]       -0.94244E+01 -0.48878E+01 -0.60041E+01 -0.15467E+01  0.30142E+01
hMean    [L]         -0.28322E+01       -0.408       -0.862       -4.260       -0.406
ConcVol  [VM/L3] 1    0.24898E+07  0.17196E+06  0.17567E+06  0.19385E+07  0.20372E+06
cMean    [M/L3]  1    0.24150E+03  0.31989E+03  0.29910E+03  0.23676E+03  0.19076E+03
WatBalT  [V]          0.90709E+01
WatBalR  [%]                0.035
CncBalT  [VM/L3] 1   -0.26044E+05
CncBalR  [%]     1          0.184
------------------------------------------------------------
```

Example Mass Balance Information (3,650 days; 10 years)

```
------------------------------------------------------------
Time        [T]     3650.0000
------------------------------------------------------------
Sub-region num.                        1            2           3           4
------------------------------------------------------------
Area     [V]          0.40197E+05  0.42210E+04  0.32160E+04  0.24922E+05  0.78387E+04
Volume   [V]          0.80228E+04  0.44786E+03  0.44820E+03  0.63138E+04  0.81294E+03
InFlow   [V/T]       -0.94400E+01 -0.48968E+01 -0.60030E+01 -0.16184E+01  0.30782E+01
hMean    [L]         -0.26109E+01       -0.409       -0.743       -3.923       -0.391
ConcVol  [VM/L3] 1    0.24981E+07  0.17297E+06  0.17588E+06  0.19441E+07  0.20517E+06
cMean    [M/L3]  1    0.24280E+03  0.32346E+03  0.29980E+03  0.23763E+03  0.19243E+03
WatBalT  [V]          0.27384E+02
WatBalR  [%]                0.029
CncBalT  [VM/L3] 1   -0.64860E+05
CncBalR  [%]     1          0.122
------------------------------------------------------------
```

Scenario 1, Alternative B (denitrification rate of $8x10^{-3}$ d^{-1})

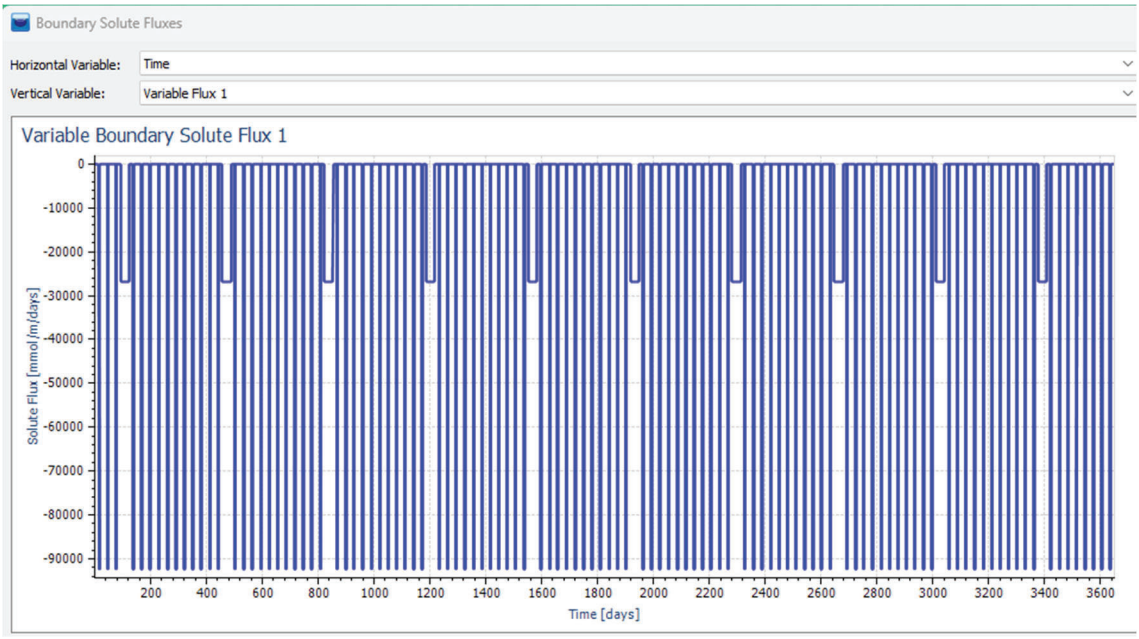
HYDRUS File Name: Scenario1_10Y_high denitrification 0.008

Infiltration Rate Source: Brown and Caldwell, 2024. *SAT Disposal Flows for Hydrogeological Model,* September 12.

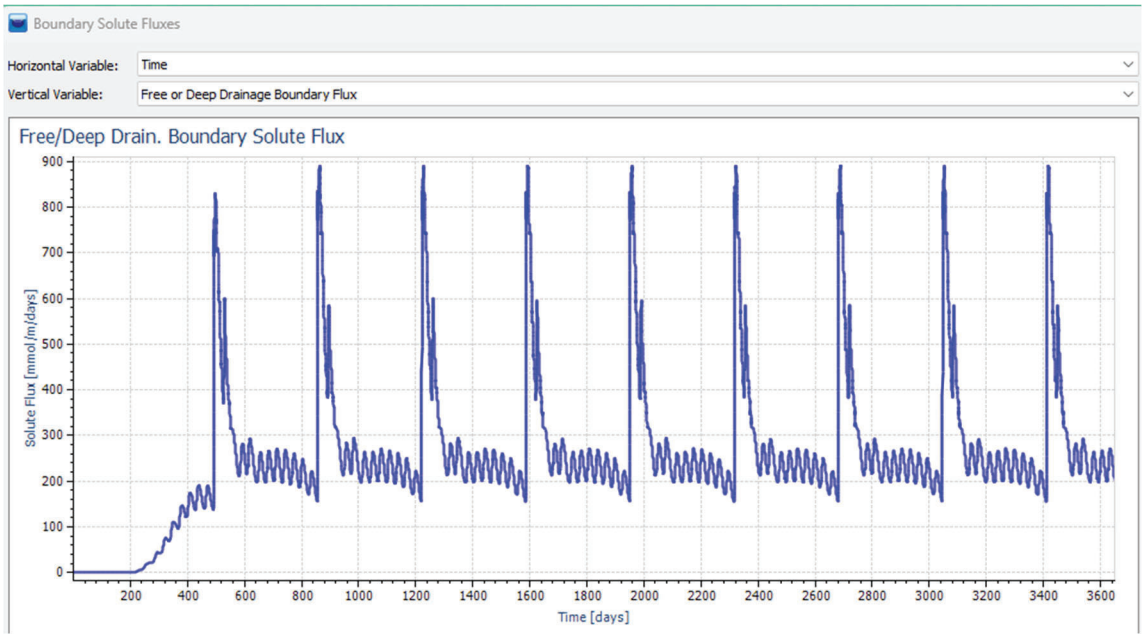
Recycled Water Nitrate Concentration: 8 mg/L (Brown and Caldwell, 2024).

See report figures 22, 23, and 24 for selected modeled solute simulation outputs for Scenario 1, Alternative B.

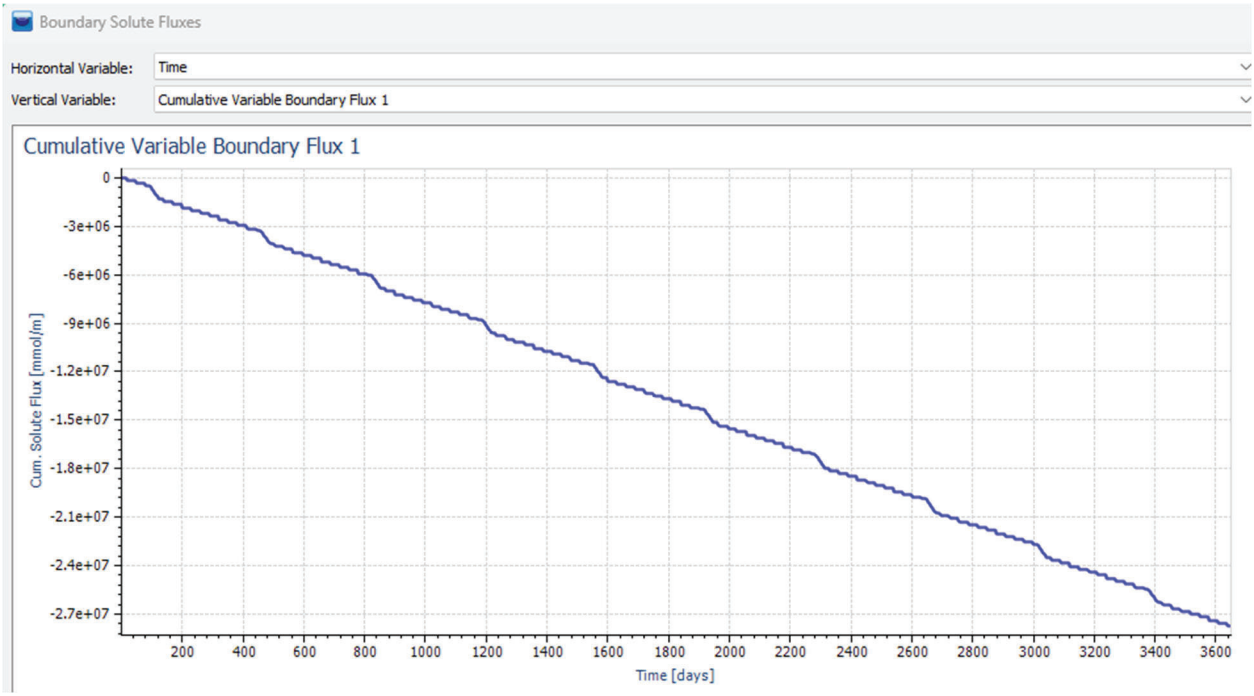
Model Variable Recycled Water Solute Mass (Nitrate) Flux Input at Surface (10 Years). Equivalent to Alternative 1A



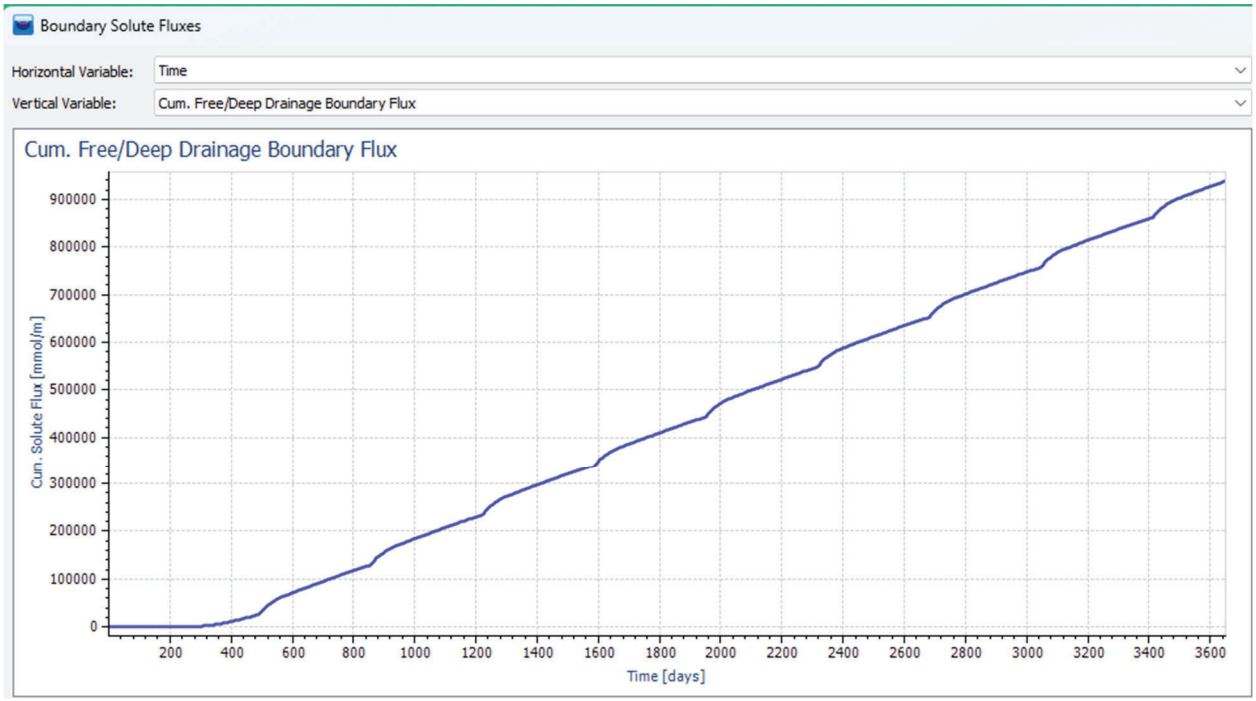
Model Variable Recycled Water Solute Mass (Nitrate) Flux Out Base of Model (10 Years). Applies denitrification rate of $8x10^{-3}$ d^{-1}



Cumulative Recycled Water Solute Mass (Nitrate) Flux Out Base of Model (10 Years).



Cumulative Recycled Water Solute Mass (Nitrate) Flux Out Base of Model (10 Years). Applies denitrification rate of $8x10^{-3}$ d^{-1}. Cumulative solute mass output is approximately 3% of input due to applied denitrification in the vadose zone.



Example Mass Balance Information (1,095 days; 3 years) Note; water balance residual percent (WatBalR%) and concentration balance residual (CncBalR%) are well below suggested range of less than 1% residual error for both time periods.

Time [T]	1095.0000				
Sub-region num.		1	2	3	4
Area [V]		0.40197E+05	0.42210E+04	0.32160E+04	0.24922E+05	0.78387E+04
Volume [V]		0.79371E+04	0.44700E+03	0.43696E+03	0.62390E+04	0.81411E+03
InFlow [V/T]		-0.94244E+01	-0.48878E+01	-0.60041E+01	-0.15467E+01	0.30142E+01
hMean [L]		-0.28322E+01	-0.408	-0.862	-4.260	-0.406
ConcVol [VM/L3]	1	0.80500E+06	0.14154E+06	0.12630E+06	0.52184E+06	0.15332E+05
cMean [M/L3]	1	0.86294E+02	0.25989E+03	0.21351E+03	0.63159E+02	0.14180E+02
WatBalT [V]		0.90709E+01				
WatBalR [%]		0.035				
CncBalT [VM/L3]	1	-0.68661E+05				
CncBalR [%]	1	0.435				

Example Mass Balance Information (3,650 days; 10 years)

Time [T]	3650.0000				
Sub-region num.		1	2	3	4
Area [V]		0.40197E+05	0.42210E+04	0.32160E+04	0.24922E+05	0.78387E+04
Volume [V]		0.80228E+04	0.44786E+03	0.44820E+03	0.63138E+04	0.81294E+03
InFlow [V/T]		-0.94400E+01	-0.48968E+01	-0.60030E+01	-0.16184E+01	0.30782E+01
hMean [L]		-0.26109E+01	-0.409	-0.743	-3.923	-0.391
ConcVol [VM/L3]	1	0.80500E+06	0.14154E+06	0.12630E+06	0.52183E+06	0.15334E+05
cMean [M/L3]	1	0.86294E+02	0.25989E+03	0.21351E+03	0.63160E+02	0.14173E+02
WatBalT [V]		0.27384E+02				
WatBalR [%]		0.029				
CncBalT [VM/L3]	1	-0.21782E+06				
CncBalR [%]	1	0.400				

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ATTACHMENT B: SCENARIO 2 - HYDRUS MODELING DOCUMENTATION

Scenario 2, Alternative B (denitrification rate of $1.3x10^{-3}$ d^{-1})

HYDRUS File Name: Scenario2B_Sept12Memo

Infiltration Rate Source: Brown and Caldwell, 2024. *SAT Disposal Flows for Hydrogeological Model,* September 12.

Recycled Water Nitrate Concentration: 8 mg/L (Brown and Caldwell, 2024).

See report figures 27 through 39 for selected modeled solute simulation outputs for Scenario 2, Alternatives A and B.

Objective: estimate infiltration capacity of four SAT basins during Wet Year conditions.

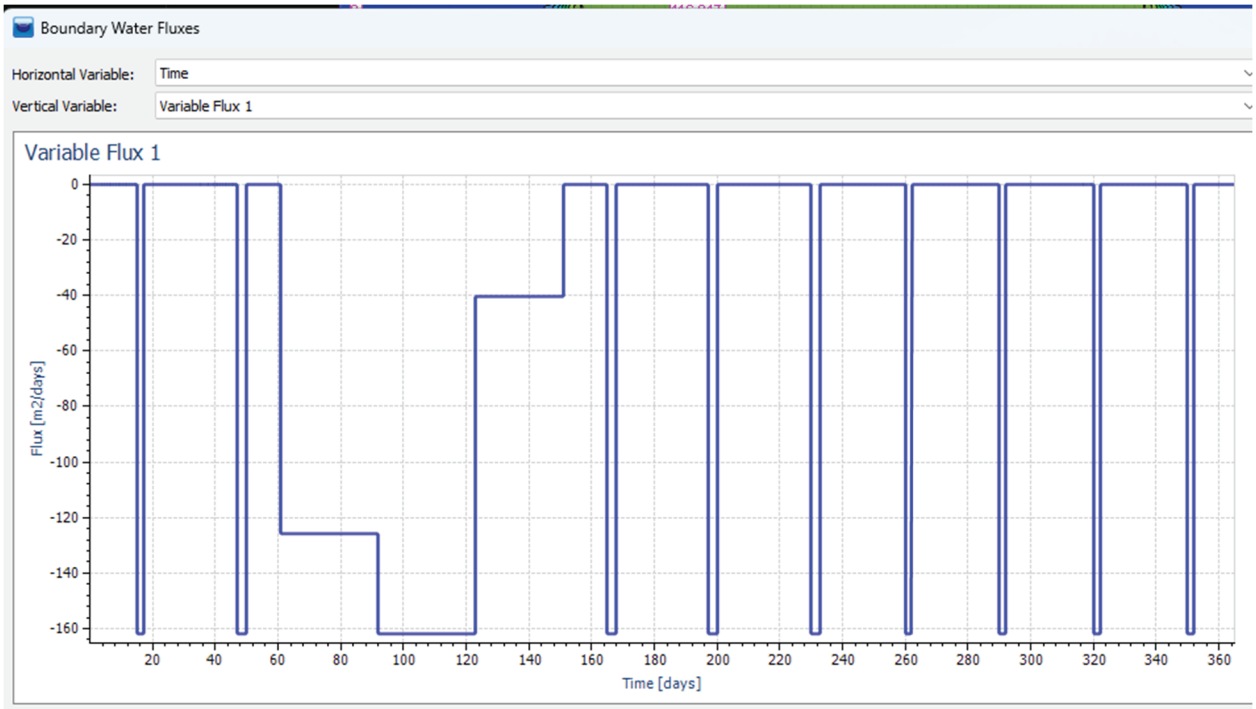
Infiltration time period – 1-year overall period, with a daily iteration calculation. Follows USGS water year starting on October 1.

Alternative A – Evaluates estimated capacity of a single basins. East-west cross-section through SAT basins.

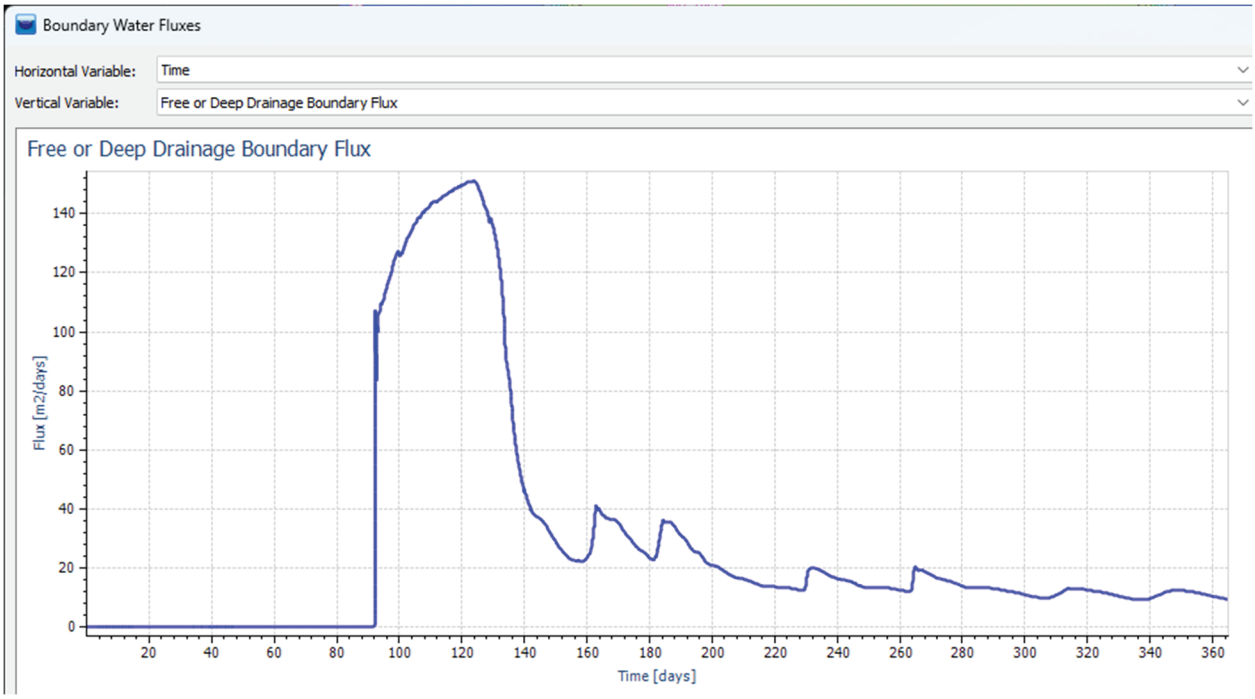
Alternative B – Evaluates estimated capacity of four basins. North-south cross-section through SAT basins.

Model Variable Recycled Water Flux Input at Surface (1 Year)

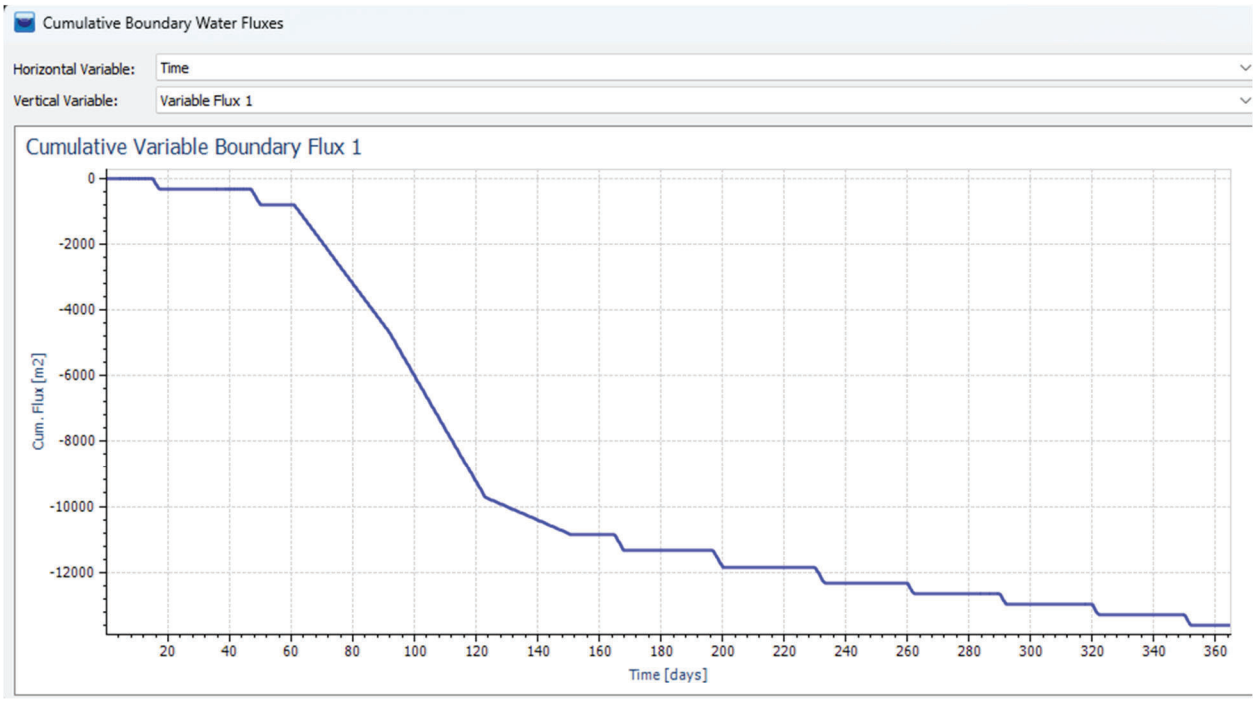
Note: negative quantity in model indicates added flux



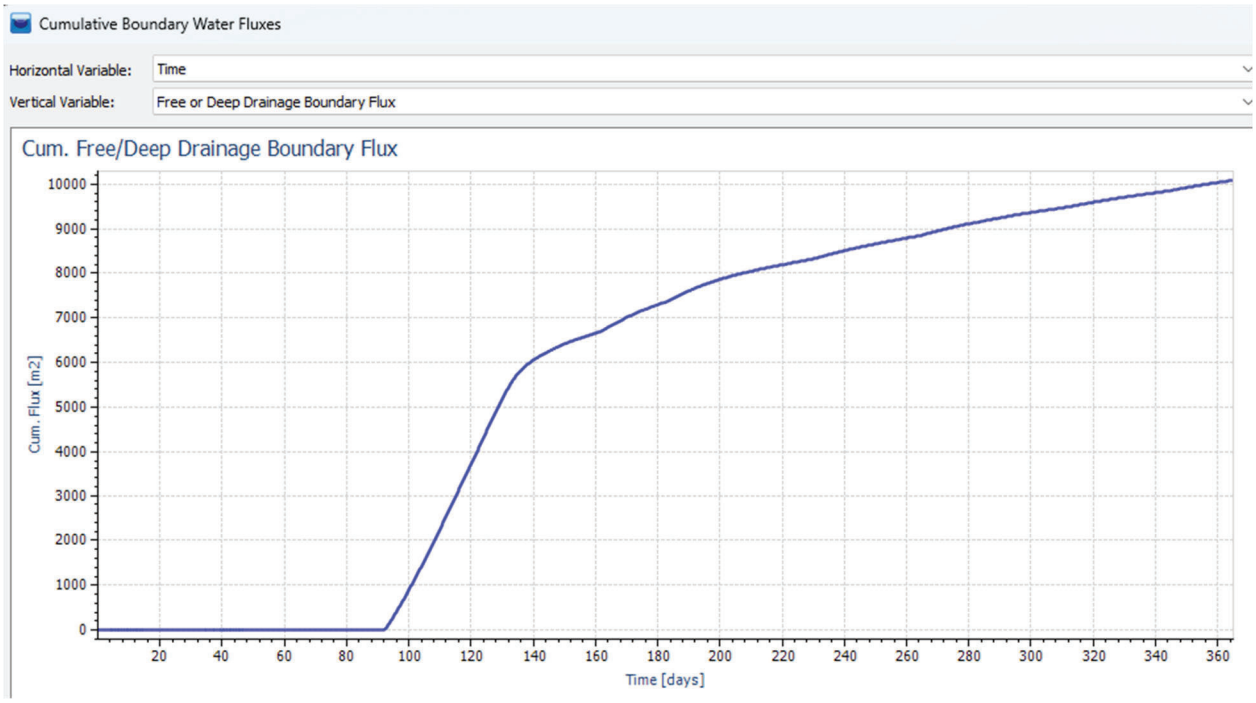
Model Variable Recycled Water Flux Out Base of Model (1 Year)



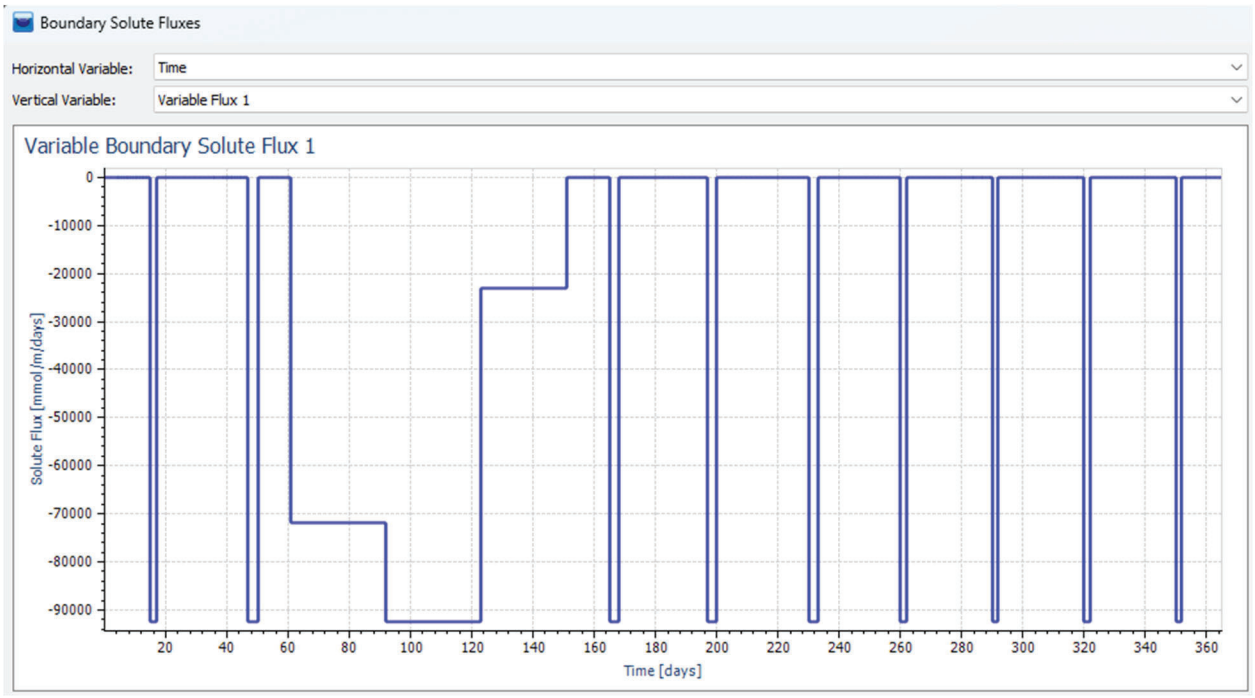
Cumulative Model Recycled Water Flux Input at Surface (1 Year)



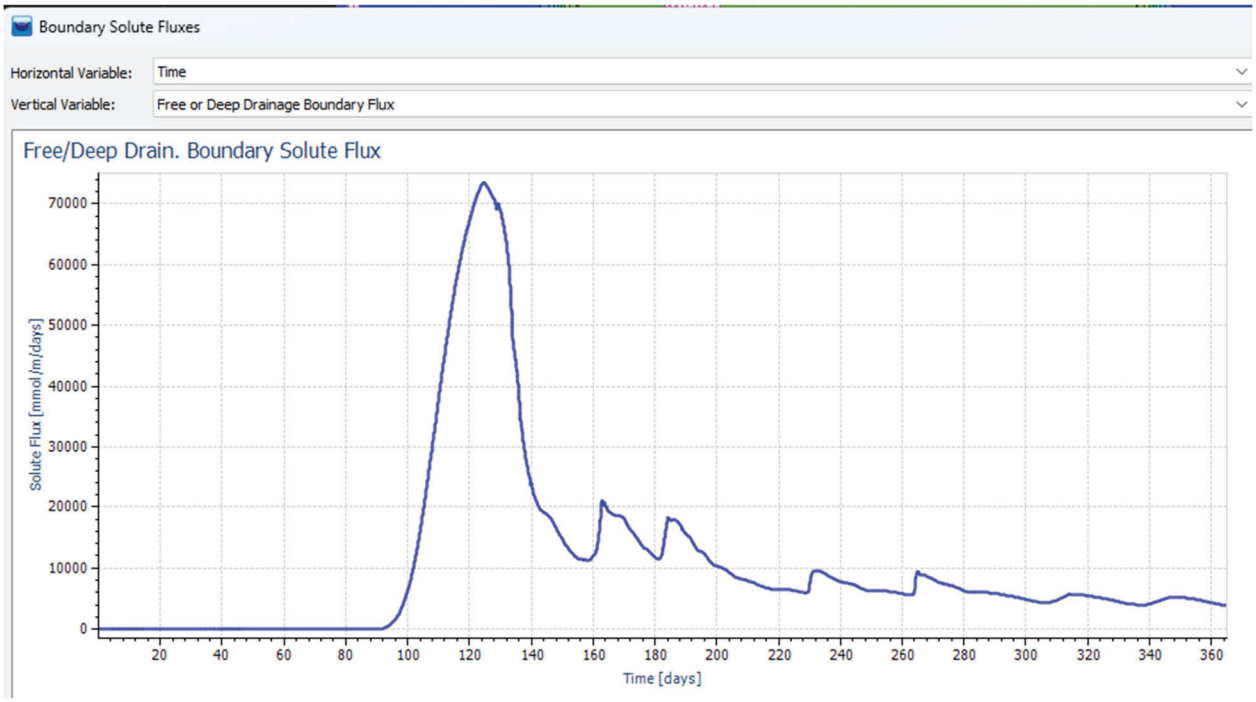
Cumulative Recycled Water Flux Out at Base of Model (1 Year)



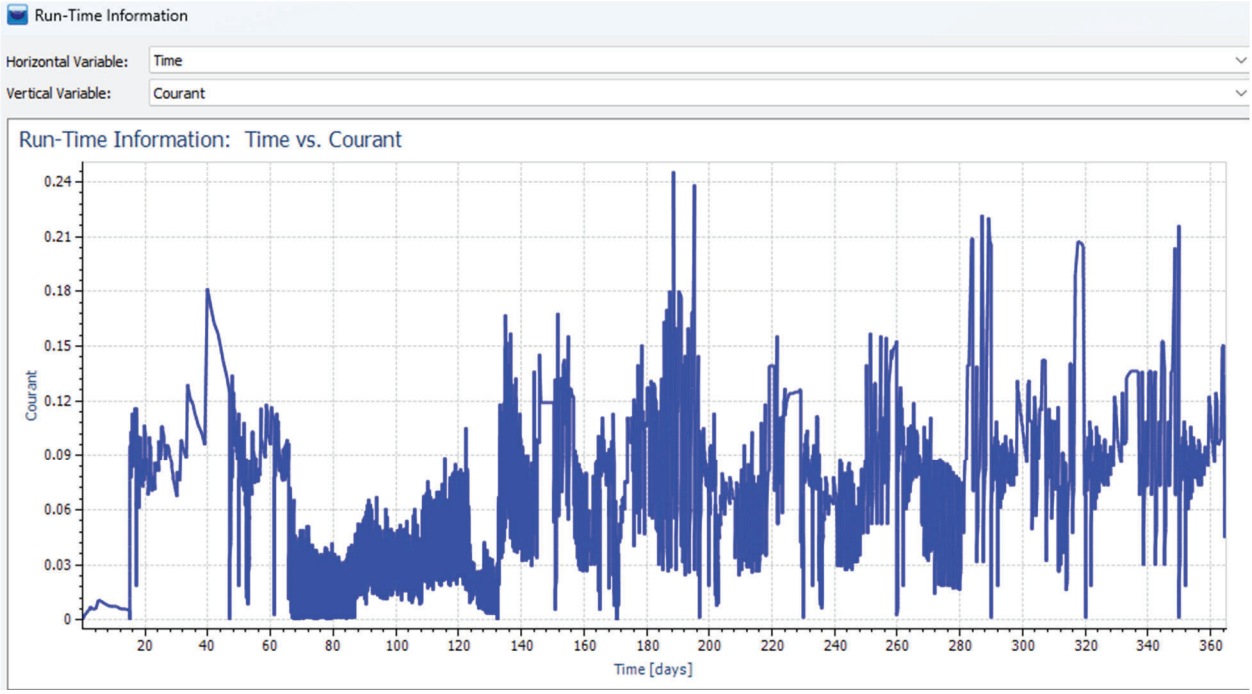
Simulated Recycled Water Nitrate Mass Flux Input at Surface (1 Year)



Simulated Recycled Water Nitrate Mass Flux Out at Base of Model (1 Year) (denitrification rate of $1.3x10^{-3}$ d^{-1})



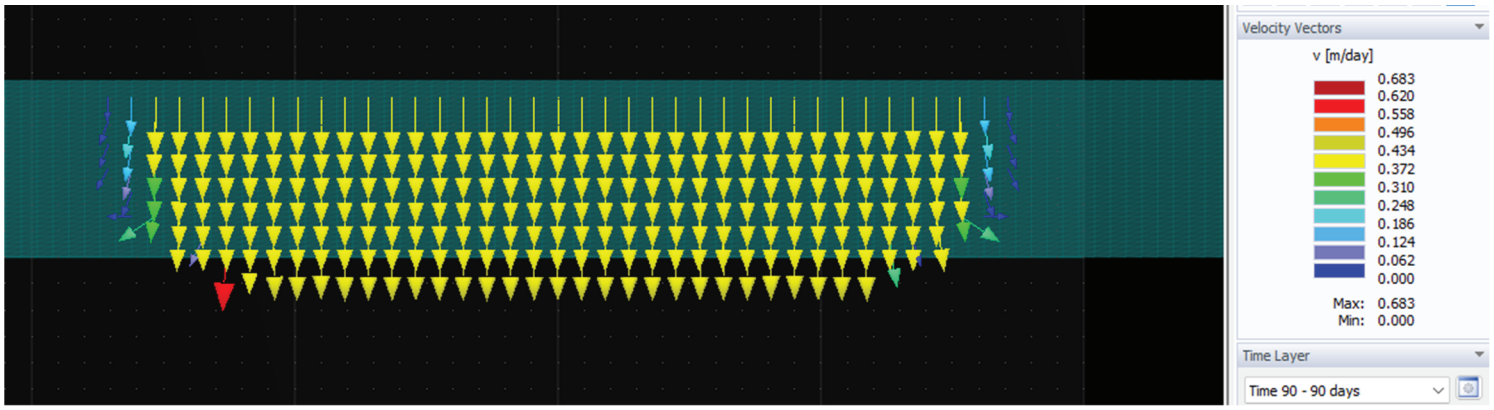
Model Courant Information – a measure of time step requirements and the stability of numerical schemes. The Courant number is well below guidelines suggesting below 0.7 to 1.



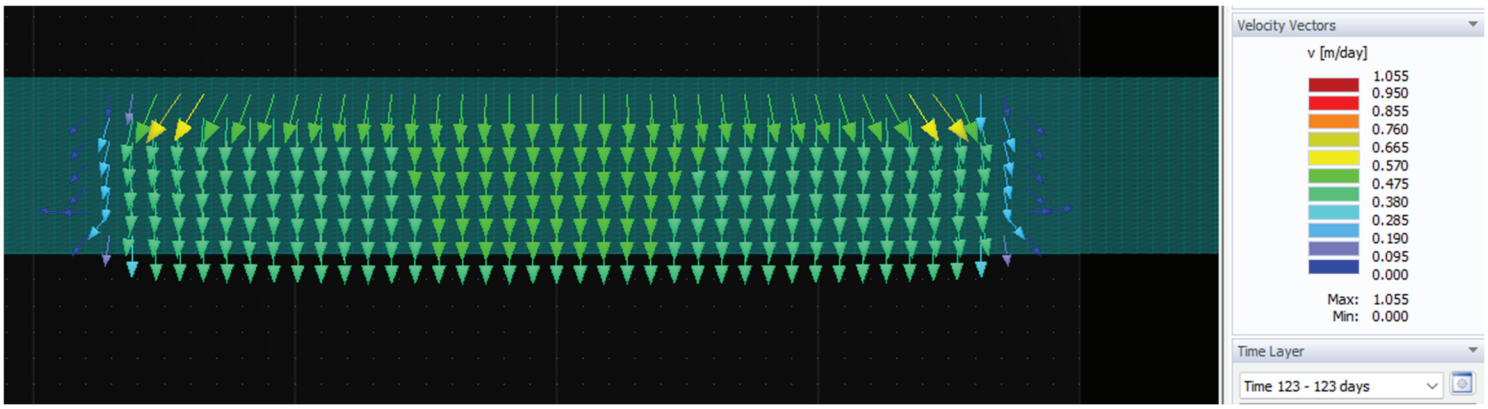
Mass Balance Information (365 days; 1 year). Note; water balance residual percent (WatBalR%) and concentration balance residual (CncBalR%) are well below suggested range of less than 1% residual error at the end of the simulation period.

```
------------------------------------------------------------
Time        [T]      365.0000
------------------------------------------------------------
Sub-region num.                        1           2           3           4
------------------------------------------------------------
Area     [V]          0.40197E+05  0.42210E+04  0.32160E+04  0.24922E+05  0.78387E+04
Volume   [V]          0.79818E+04  0.43943E+03  0.44503E+03  0.62687E+04  0.82867E+03
InFlow   [V/T]       -0.94327E+01 -0.47963E+01 -0.60116E+01 -0.16306E+01  0.30055E+01
hMean    [L]         -0.28062E+01       -0.482       -0.692       -4.234       -0.386
ConcVol  [VM/L3] 1    0.27179E+07  0.17331E+06  0.17651E+06  0.21109E+07  0.25716E+06
cMean    [M/L3]  1    0.26680E+03  0.32576E+03  0.30259E+03  0.25987E+03  0.24242E+03
WatBalT  [V]         -0.11544E+03
WatBalR  [%]               0.487
CncBalT  [VM/L3] 1   -0.48625E+05
CncBalR  [%]     1         0.380
------------------------------------------------------------
```

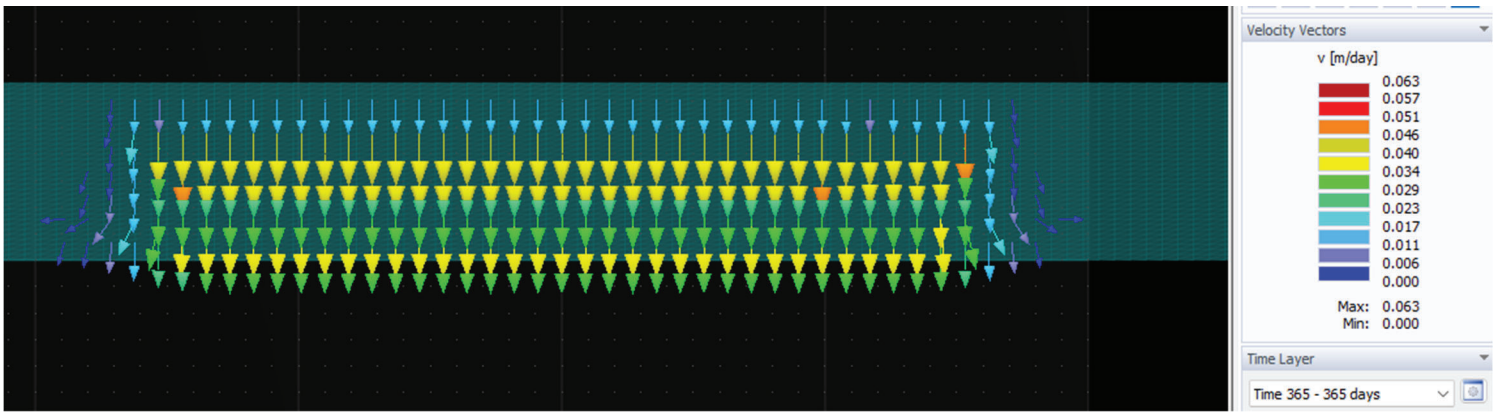
Velocity Vectors (90 days) – Predominantly ~0.4 m/d



Velocity Vectors (123 days, end of 4.0 mgd period) – Predominantly ~0.4 to 0.5 m/d



Velocity Vectors (365 days, end of simulation period) – Predominantly less than 0.1 m/d



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APPENDIX C

Groundwater Flow and Transport Modeling Documentation

Geosyntec consultants

engineers | scientists | innovators

APPENDIX C – SATURATED AQUIFER TREATMENT (SAT) BASIN INFILTRATION EVALUATION

Groundwater Modeling Evaluation

Prepared for

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Prepared by

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Project LB1047

October 30, 2024

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ACRONYMS AND ABBREVIATIONS

bmsl	below mean sea level
CSM	conceptual site model
Geosyntec	Geosyntec Consultants Inc.
ft/d	feet per day
mg/L	milligrams per liter
mgd	million gallons per day
mgy	million gallons per year
mgN/L	milligrams nitrogen per liter
SAT	saturated aquifer treatment
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VZM	vadose zone model
WWRF	Wastewater Reclamation Facility

1. INTRODUCTION

The following appendix describes the groundwater modeling methodology and findings used to evaluate groundwater transport of excess recycled water or off-spec water following infiltration into the underlying vadose zone from the Proposed Central Maui Wastewater Recycling Facility (WWRF) saturated aquifer treatment (SAT) basins. The groundwater modeling approach simulated the long-term scenario evaluated with the vadose zone model (VZM) and outlined by Brown and Caldwell in: *SAT Disposal Flows for Hydrogeological Model*, dated September 12, 2024 (Brown and Caldwell, 2024).

It is noted the preliminary groundwater modeling simulations are based on a conceptual site model (CSM) and an approximation of the heterogeneous subsurface soil conditions.

Geosyntec performed this modeling study to evaluate the potential influence of the proposed SAT basin and infiltrating treated wastewater on groundwater flow and quality. For this evaluation, Geosyntec used a groundwater flow model developed by U.S. Geological Survey (USGS) in SUTRA for characterization of the long-term groundwater availability in the Waihe'e, 'Īao and Waikapū Aquifer Systems, Maui, Hawai'I (Rotzoll et al., 2022) and converted the flow model to MODFLOW to perform fate and transport simulations of nitrate transport[1] from the SAT basin. This memorandum documents the USGS model conversion and the use of groundwater flow and fate and transport model to evaluate the influence of the SAT basin.

2. GROUNDWATER FLOW AND TRANSPORT MODEL

2.1 Overview of USGS SUTRA Model

The USGS developed a three-dimensional groundwater flow and salinity-transport model for Central Maui using SUTRA to simulate density-dependent groundwater flow and salinity transport and improve understanding of hydrologic effects of groundwater withdrawals. The model covers the dike-free volcanic rocks of the Kahakuloa, Waihe'e, 'Īao and Waikapū aquifer systems and parts of the Honokohau, Ukumehame, and Kahului aquifer systems.

Following review of the Rotzoll et al. (2022) and modeling approach, Geosyntec concluded that the USGS SUTRA model was a useful tool to evaluate groundwater flow and chemical transport conditions from the proposed SAT basins in central Maui, including:

- The numerical model was constructed specifically to simulate the flow and salinity of groundwater in central Maui, where the proposed WWRF is located.
- The numerical model incorporates updated water-budget estimates of groundwater recharge from infiltration and direct recharge, seepage in stream channels, and inflow from inland areas.

[1] Dissolved nitrate is used as a surrogate for recycled water transport in the subsurface as further described in Section 4.4 of the main report.

- The numerical model for the USGS study utilizes the latest available hydrologic and geologic information available.
- The numerical groundwater model developed for the USGS study was calibrated to 1926 to 2012 transient water levels.
- The prior existing numerical groundwater model (Gingerich, 2008) was refined and updated for the updated model (Rotzoll et al., 2022) to reflect recent hydrologic changes in the area and hydrologic information not previously available. Relevant changes in hydrologic conditions that are incorporated in the SUTRA model include: 1) restoration of about 25 million gallons per day (mgd) of surface water starting in 2010, which resulted in additional groundwater recharge from streams that lose water; and 2) cessation of sugar cane cultivation in central Maui at the end of 2016, which resulted in reduced irrigation, reduced recharge in areas of cultivation, and reduced groundwater withdrawals.

The USGS model is a finite-element model that includes 1,074,838 nodes and 1,043,685 variably sized elements. In the vertical direction, there are 116 layers onshore and fewer than 116 layers offshore. The top of the model is 0 feet onshore and defined by the ocean floor altitude offshore. The bottom of the model is 6,000 feet below mean sea level (bmsl) and defined as a no-flow boundary. The lateral boundaries are either no flow or specified pressure. There are 15 hydraulic-conductivity zones defined in the model to represent subsurface hydrogeologic features.

To evaluate the long-term groundwater availability under different future conditions, seven different groundwater withdrawals and recharge scenarios were simulated. One scenario, the baseline scenario, used average recharge conditions based on 1980-2010 rainfall, 2017 land cover condition, and average groundwater withdrawals during 2017-2018. This baseline scenario provides a basis for evaluating the long-term effects of existing withdrawals rates in Central Maui. The baseline scenario was used as the starting point to evaluate the potential influence of the proposed SAT basin on groundwater flow and quality.

2.2 USGS SUTRA Model Conversion to MODFLOW-NWT

The USGS SUTRA model is converted to a steady-state MODFLOW-NWT (Niswonger et al., 2011) model to facilitate simulations and perform fate and transport nitrate simulations. This approach is consistent with preliminary modeling evaluation performed by Mr. Whittier in 2020 where the 2008 SUTRA USGS model (Gingerich, 2008) was converted to MODFLOW to perform preliminary groundwater flow and nitrate fate and transport simulations (Whittier, 2020 and 2021). As the MODFLOW model is used to evaluate flow and fate transport from the SAT basin inland, it is anticipated that the impacts from density-dependent flow is negligible and beyond the scope of this modeling exercise. Therefore, density-dependent flow, which is taken into account in SUTRA, is not included in the converted MODFLOW model.

The USGS model input files for baseline scenario are used to setup the MODFLOW model as follows:

- Grid: the model domain is consistent with the USGS SUTRA model (Figure C-1). In the USGS model, the mesh size varied spatially. To simplify the model, a uniform, 500- by 500-foot grid is applied to the entire MODFLOW model domain.
- Layering: it is anticipated that the impacts of proposed SAT basin on the deep aquifer are negligible. Therefore, the bottom of the model is set as 1,000 ft bmsl (Figure C-1). The layering is also simplified as compared to the SUTRA model with layers 1-5 representing the top 100 feet, Layers 6-10 representing between 100 and 500 ft bmsl and Layer 11 representing between 500 and 1,000 ft bmsl (Figure C-1).
- Hydraulic conductivity: in the SUTRA model, the hydraulic conductivities were assigned to each node. Those values were interpolated and assigned to the 11 layers of the MODFLOW model. In the model, the horizontal hydraulic conductivities and vertical anisotropy range between 0.1 and 10,000 feet per day (ft/d) and between 1 and 740, respectively. In the vicinity of the SAT basin and between the SAT basin and the shoreline, the horizontal hydraulic conductivity of the volcanic aquifer is 10,000 ft/day and the vertical anisotropy is 100.
- Boundary conditions
    - Specified heads: the SUTRA model defined specific pressure head at select nodes along the boundary. The specific pressure head values were converted to hydraulic head values and assigned to MODFLOW model cells as specified head boundary conditions (Figure C-2).
    - Production wells: wells defined in the SUTRA model are defined as well boundary conditions and set up based on the top and bottom elevation of well screen (Figure C-2).
    - Recharge: recharge was defined at nodes in the top layer of the SUTRA model. Polygons were created around each SUTRA node, and the SUTRA recharge flow was converted to a recharge rate based on the polygon area. The polygons are used to assign the recharge boundary conditions to the top layer of MODFLOW model.

2.3 Comparison of MODFLOW Model with USGS Model

The water levels simulated with the MODFLOW model are compared to the simulated water level with the SUTRA model in Figure C-3. The water levels simulated with the MODFLOW model are generally consistent with the SUTRA model, including representation of the location of water divide, north of the proposed SAT basin. The horizontal hydraulic gradients simulated in SUTRA and MODFLOW models are as follows:

- 3.6×10^{-5} (SUTRA) and 3.2×10^{-5} (MODFLOW) in the vicinity of the proposed SAT basin;
- 4.3×10^{-4} (SUTRA) and 4.1×10^{-4} (MODFLOW) in the vicinity of the shoreline; and
- 1.6×10^{-5} (SUTRA) and 1.5×10^{-5} (MODFLOW) on average between the proposal SAT basin and the shoreline.

Based on these comparisons, the converted MODFLOW model can be used to evaluate the influence of the SAT basin on local groundwater flow and quality.

2.4 Model Setup with SAT Basin

The outputs from the VZM for Scenario 1 (i.e., scenario representing the average long-term loading conditions) are used as the input to simulate the SAT basin in the MODFLOW model. Scenario 1 is based on an annual cyclical SAT basin infiltration scenario over a 10-year simulation period with an infiltration of 1.15 mgd in January, and 4.0 mgd for 21 individual days in the mid-month periods for the months of February through December for a total of 120 million gallons per year (mgy), with a nitrate concentration of 8 milligrams nitrogen per liter (mgN/L). The VZM simulated nitrate transport with two different denitrification rates: the conservative rate of $1.3x10^{-3}$ d^{-1} and the enhanced and/or rapid rate of $8.0x10^{-3}$ d^{-1} (Appendix B).

The transient infiltration rate and nitrate concentrations simulated at the water table with the VZM are converted to steady-state average values for the inputs into the MODFLOW model (Figure C-4). The infiltration at the SAT basin is simulated over an area represented by six model cells (approximately 34 acres) to account for the infiltration footprint at the water table from the VZM (Figure C-4). The combined SAT basin bottom area is approximately 7.5 acres (Brown and Caldwell, 2024). Thus, the area of infiltration into groundwater in the model (approximately 34 acres) is approximately 4.5 times larger than the combined SAT basins, which approximates lateral infiltration spreading in the vadose zone. The average infiltration rate input into the MODFLOW model is 0.029 ft/d. The average, high-nitrate concentration input is 4.6 mgN/L when the conservative denitrification rate was applied to the VZM. The average, low-nitrate concentration input is 0.3 mgN/L when the enhanced and/or rapid denitrification rate was applied to the VZM. Nitrate transport in groundwater is simulated using MT3D-USGS (Bedekar et al., 2016). See Appendix B for a description of the nitrate concentration attenuation from 8.0 mgN/L in the SAT basins to 4.6 or 0.3 mgN/L at the vadose zone / groundwater interface.

As described in Section 4.6 of the main report, a denitrification rate of 3.1×10^{-5} 1/day, corresponding to a half-life of 61 years, is applied in the model for dissolved nitrate transport in groundwater. Due to the uncertainties in estimating the denitrification rate, a case with higher denitrification rate (1.5×10^{-4} 1/day corresponding to a half-life of 13 years) is also simulated. Nitrate transport is simulated for 100 years. The dispersivity and effective porosity values used in MT3D-USGS are consistent with the SUTRA model. The effective porosity is 0.15, the longitudinal dispersivity is 213 feet, and the horizontal and vertical transverse dispersivity is 0.066 feet.

In addition to the nitrate simulations described above, the model was used to evaluate fate and transport of a generic analyte in groundwater. The same assumptions were used for infiltration and transport parameters, but no degradation was assumed to occur in groundwater.

2.5 Model Results

2.5.1 Water Levels

Based on the simulation, the infiltration at the SAT basin is anticipated to have limited impacts on the groundwater levels. As shown in Figure C-5, water levels are simulated to increase less than 0.01 feet beyond ~1,700 feet from the SAT basin. Particles are released at the SAT basin and tracked with MODPATH (Pollock, 2016) to illustrate the groundwater flow path from the SAT basin. Water infiltrating at the SAT basin flows southwards towards to the ocean and infiltrates to approximately 110 feet bmsl (Figure C-6).

2.5.2 Nitrate Fate and Transport

The simulated nitrate plumes for the simulation with different nitrate concentration inputs and denitrification rates are shown in Figures C-7a, 7b, 8a and 8b. The simulated nitrate concentration at the shoreline is shown in Figure C-9.

- With high nitrate concentration input (4.6 mgN/L) based on conservative denitrification rates in the vadose zone, in-groundwater nitrate concentrations reach steady-state after approximately 30 years with low denitrification in groundwater (3.1×10^{-5} 1/day) at a concentration around 0.29 mgN/L, and reach steady-state after approximately 25 years with high denitrification in groundwater (1.5×10^{-4} 1/day), at a concentration around 0.19 mgN/L (Figure C-9).
- With low nitrate concentration input (0.3 mgN/L) based on enhanced and/or rapid denitrification rates in the vadose zone, nitrate concentrations reach steady-state after approximately 20 years, at concentrations of around 0.018 and 0.012 mgN/L with low and high denitrification in groundwater, respectively.

2.5.3 Generic Analyte Fate and Transport

Figures C-10 and C-11 show the simulated plumes and simulated shoreline concentrations for a generic analyte without degradation, respectively. The simulated concentrations are shown as a percentage of the concentration in infiltrating water at the water table. These figures can be used to evaluate concentrations of other analytes that may be present in the infiltrating water.

For example, due to transport attenuation properties, not including degradation (i.e., transverse, longitudinal, and vertical dispersion and dilution), the concentration of a generic compound that enters groundwater at the vadose zone / groundwater interface beneath the SAT basins would be reduced to a concentration of about 7.1 % or less of its original concentration at the shoreline. There is a chemical transport distance of approximately 2.5 miles from the SAT basins to the shoreline at Maalaea Bay. A chemical that is subject to degradation in groundwater would be expected to have an increased level of concentration decline during transport.

3. GROUNDWATER MODELING CONCLUSIONS

The converted MODFLOW model has the capability to simulate the influence of the proposed SAT basin on groundwater flow and quality in Central Maui. The groundwater modeling evaluation indicates:

- The infiltration from the SAT basin is anticipated to flow southwards towards the ocean at Mā'alaea Bay. The groundwater travel distance is approximately 2.5 miles.
- Nitrate concentrations are anticipated to reach steady state at Mā'alaea Bay after approximately 20 to 30 years.
- Nitrate concentrations at Mā'alaea Bay varies with nitrate concentration inputs and denitrification rates. With the high concentration input based on conservative denitrification in the vadose zone, the simulated nitrate concentration is approximately 0.19 and 0.29 mgN/L with high and low denitrification rate in groundwater, respectively. With the low nitrate concentration input (based on the higher denitrification rates in the vadose zone), the simulated nitrate concentration is approximately 0.012 and 0.018 mgN/L with high and low denitrification rate in groundwater, respectively. Over these simulated cases, the concentration at Mā'alaea Bay is slightly higher than the State of Hawai'i Class A Marine Water Embayment "Dry" discharge criterion (0.15 milligrams per liter [mgN/L]) with high nitrate concentration input, but is much lower than the drinking water standard (10 mg/L) with both high and low nitrate concentration inputs.
- The simulation of dissolved nitrate transport (including the conservative nitrate denitrification estimate of 3.1×10^{-5} 1/day) suggests that nitrate concentrations at the 0.15 mgN/L Class A Marine Water Embayment "Dry" discharge criterion would occur at the shoreline following approximately 12 years of average year SAT basin operation with the conservative denitrification rate in the vadose zone. With the enhanced and/or rapid denitrification rate in the vadose zone, the simulated nitrate concentration at the shoreline is constantly below 0.15 mgN/L and is independent of denitrification process in groundwater.

4. GROUNDWATER AND FATE AND TRANSPORT MODEL LIMITATIONS AND UNCERTAINTY

Geosyntec's services were performed, and this preliminary groundwater modeling and evaluation report has been prepared in accordance with generally accepted professional standards of care applicable to the scope of services authorized by Brown and Caldwell and the County of Maui, and no other warranty is provided in connection therewith. Consistent with applicable professional standards of care, our opinions and recommendations were based in part on data furnished by others. Although we were not able to independently verify such data, we did evaluate it to determine whether it was consistent with other information that we developed in the course of our performance of the scope of services. Subsurface investigations and interpretations are inherently limited to data derived from samples taken or tests performed at selected locations. Due to these

inherent limitations, it must be recognized that the actual subsurface conditions may vary from those predicted, despite the use of professional care.

This preliminary evaluation document was prepared by the staff of Geosyntec Consultants under the supervision of persons whose signatures appear below. The findings or professional opinions are based upon: a) preliminary data, analyses, and interpretations of subsurface conditions; b) approximations of data collected by others; and c) the use of groundwater and fate and transport simulations to preliminarily estimate and project the potential influence of the SAT basin on groundwater flow and water quality. Thus, the actual nitrate concentrations and SAT basin infiltration rates used at the Project Site during future facility operation may vary from the preliminary interpretations, projections, and concepts presented herein.

No warranty, expressed or implied, is made regarding the professional opinions expressed in this document by Geosyntec or the references cited in this document, or concerning the completeness of the data presented to us. If actual conditions are found to differ from those described in this document or if new information regarding the Project Site is obtained, Geosyntec should be notified and additional analyses or recommendations, if required, will be provided.

5. REFERENCES

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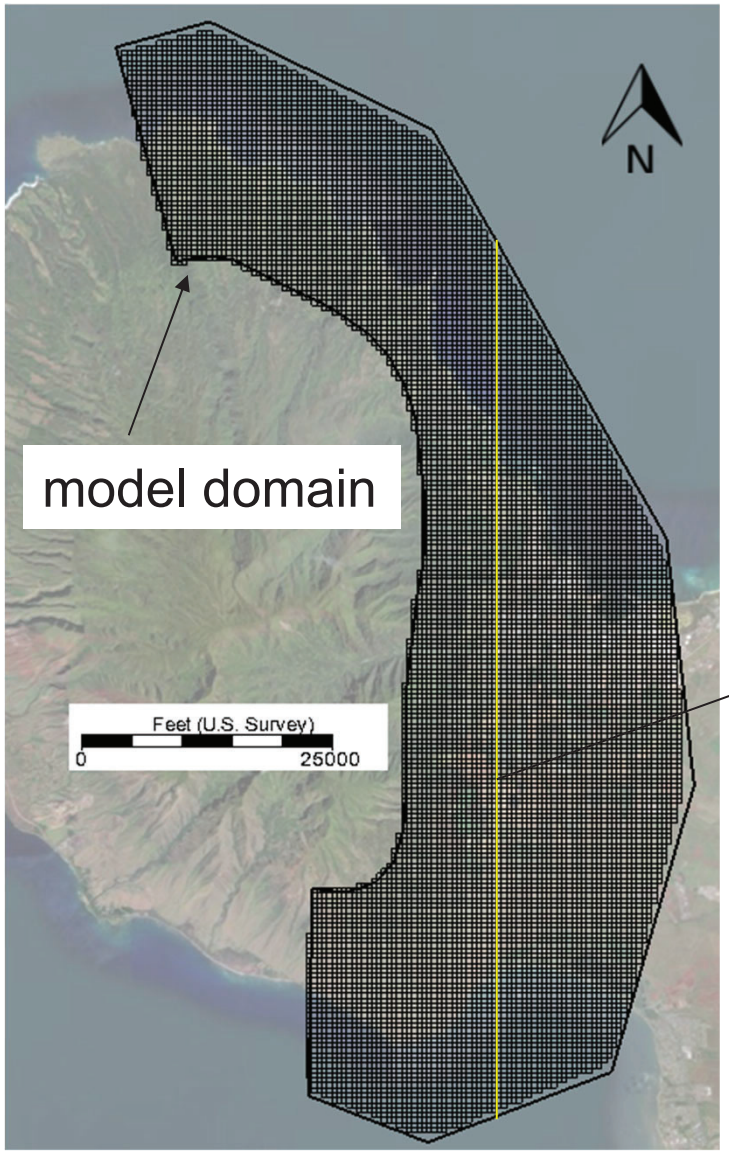
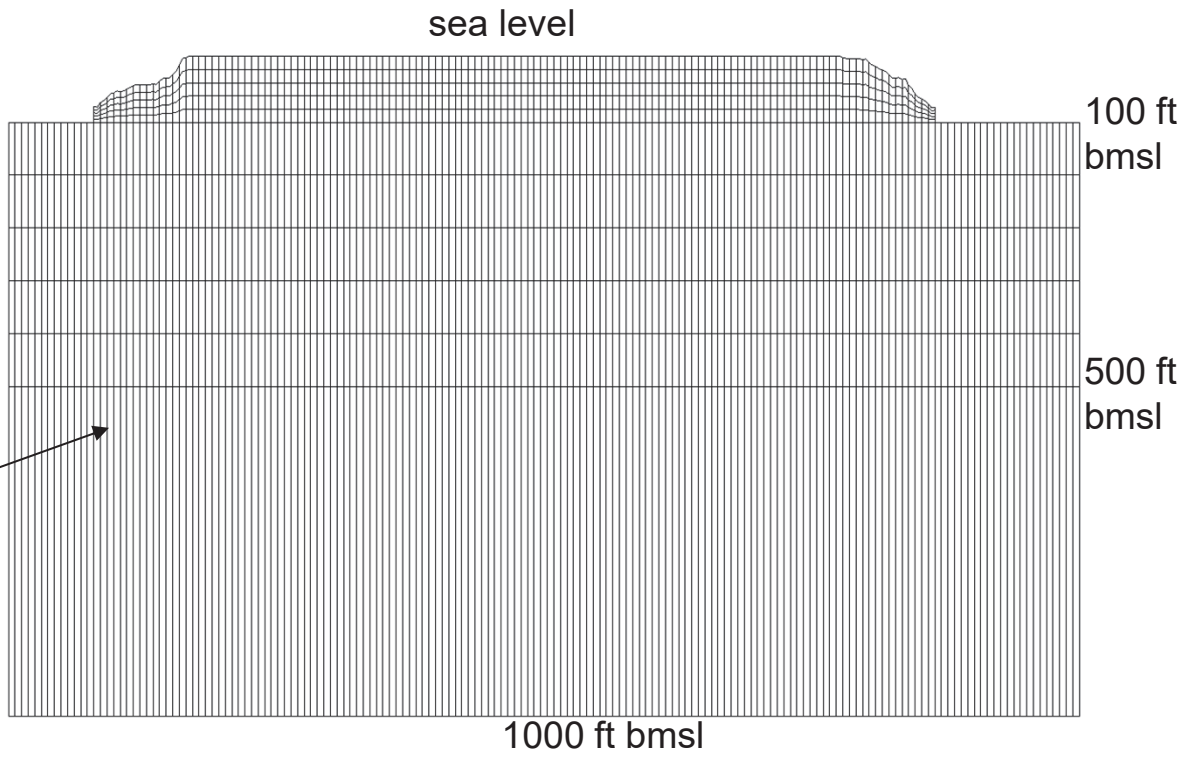
FIGURES





Notes:
bmsl = below mean sea level
ft = feet

Model Domain and Layering

County of Maui
Maui, Hawaii

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Figure C-1

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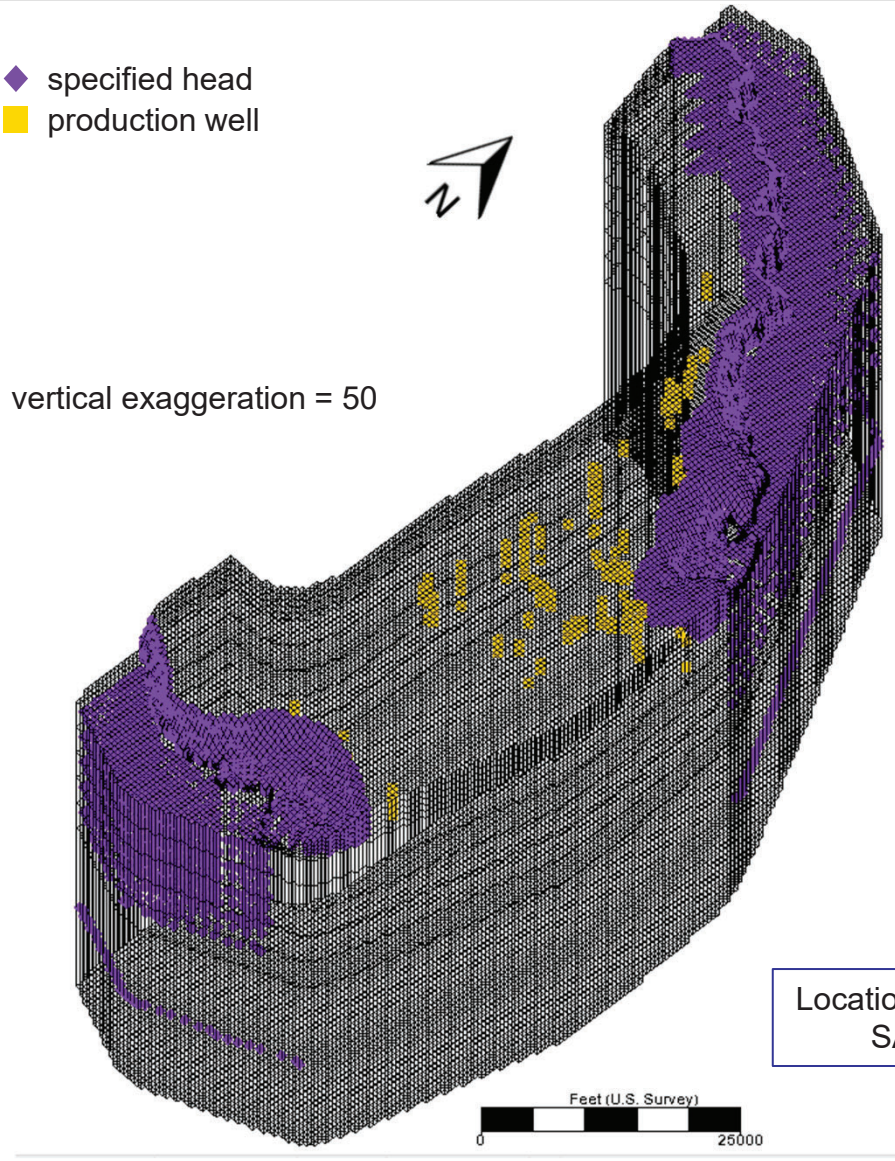

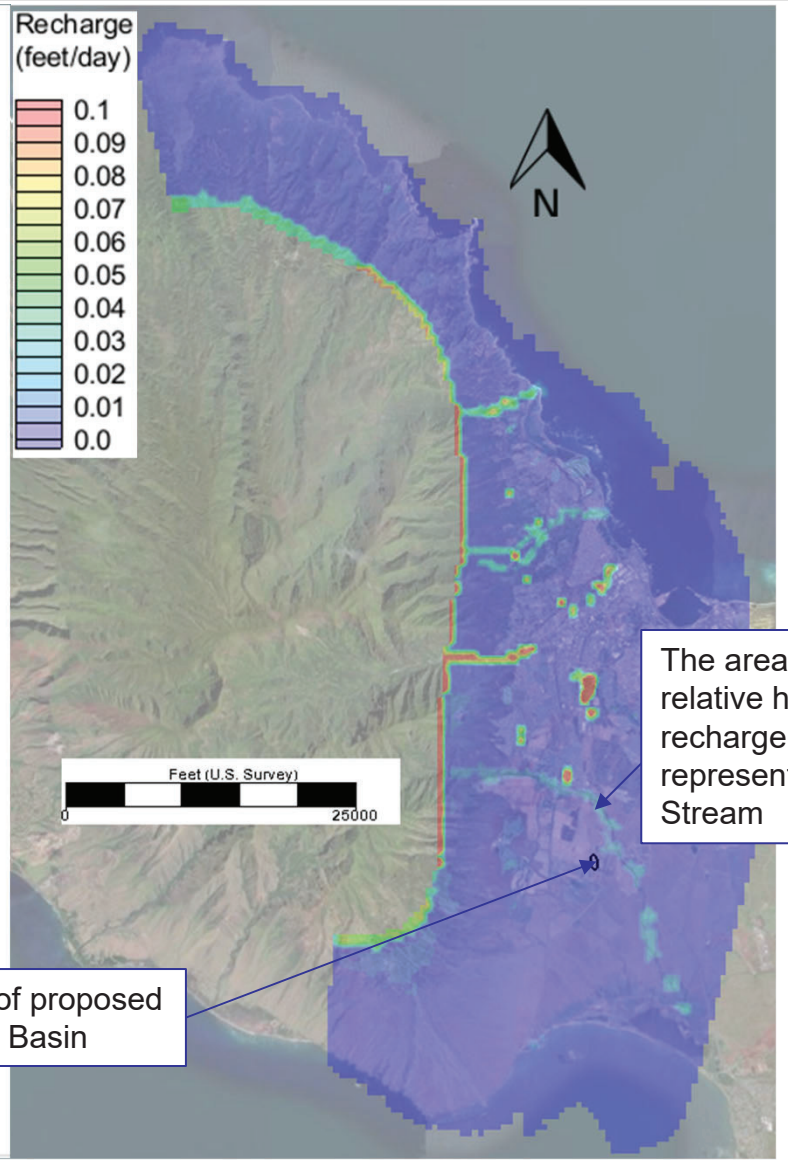

Model Boundary Conditions

County of Maui
Maui, Hawaii

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Figure C-2

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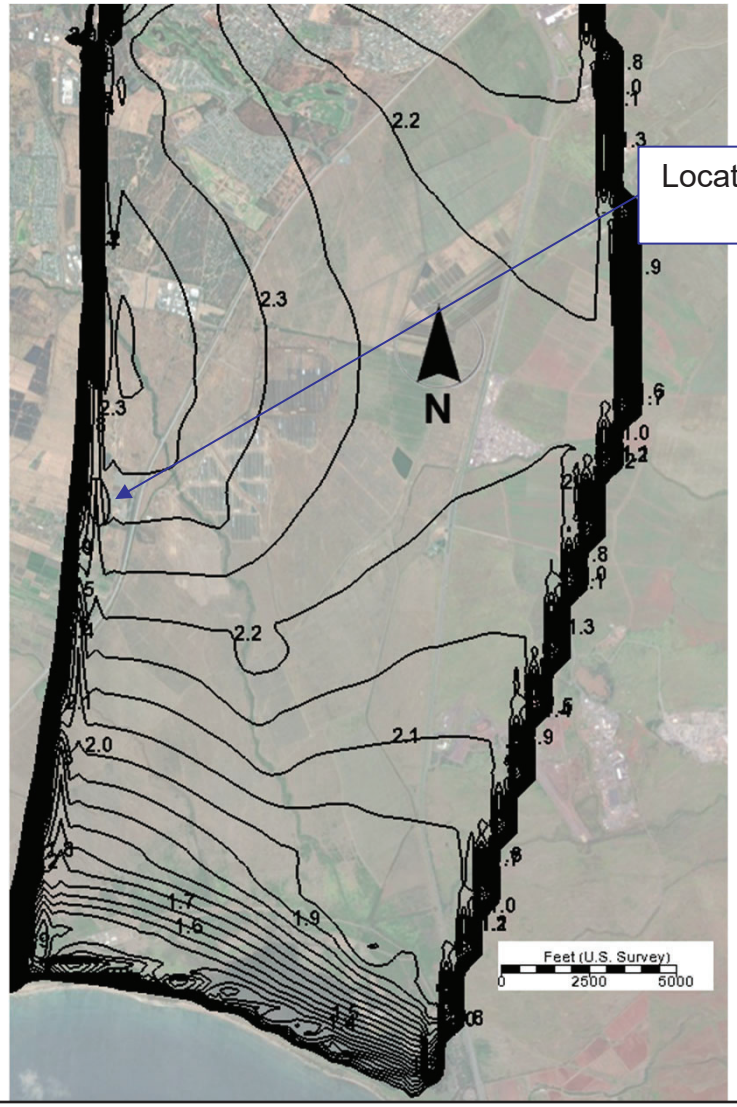
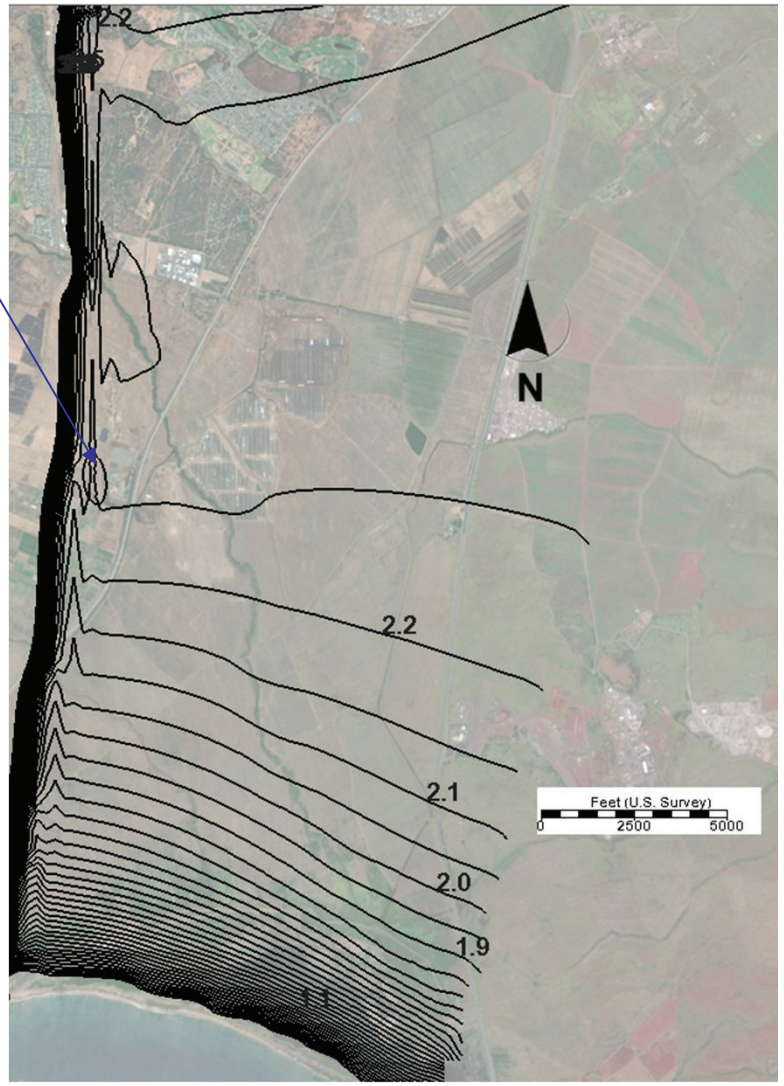
USGS SUTRA Model[1]



MODFLOW Model



Notes:
The contour lines represent simulated water levels (0.05-foot interval).

Reference:
[1]: Rotzoll, K., Oki, D.S., Johnson, A.G., and Souza, W.R., 2022, Long-term groundwater availability in the Waiheʻe, ʻĪao, and Waikapū aquifer systems, Maui, Hawaiʻi: U.S. Geological Survey Scientific Investigations Report 2021–5113, 80 p.

Comparison of Simulated Water Levels in MODFLOW and SUTRA Models
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Maui, Hawaii

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Figure C-3

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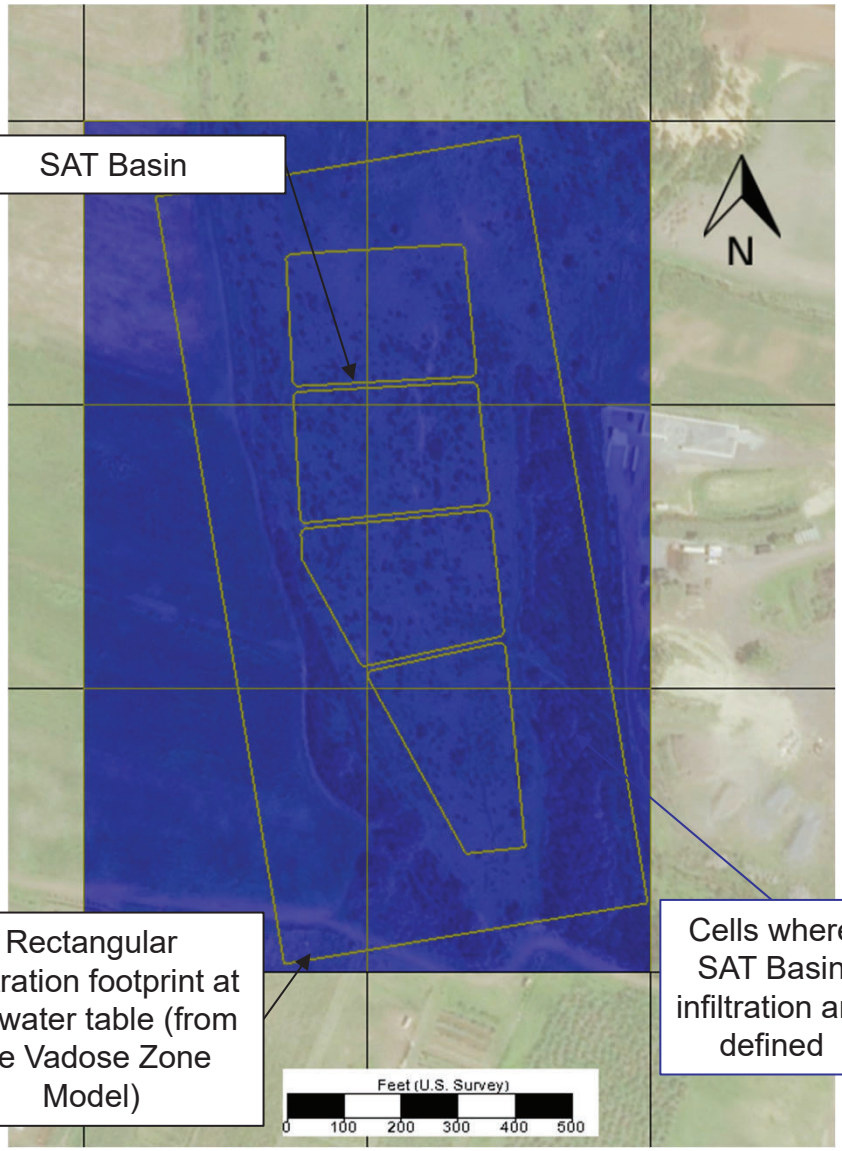
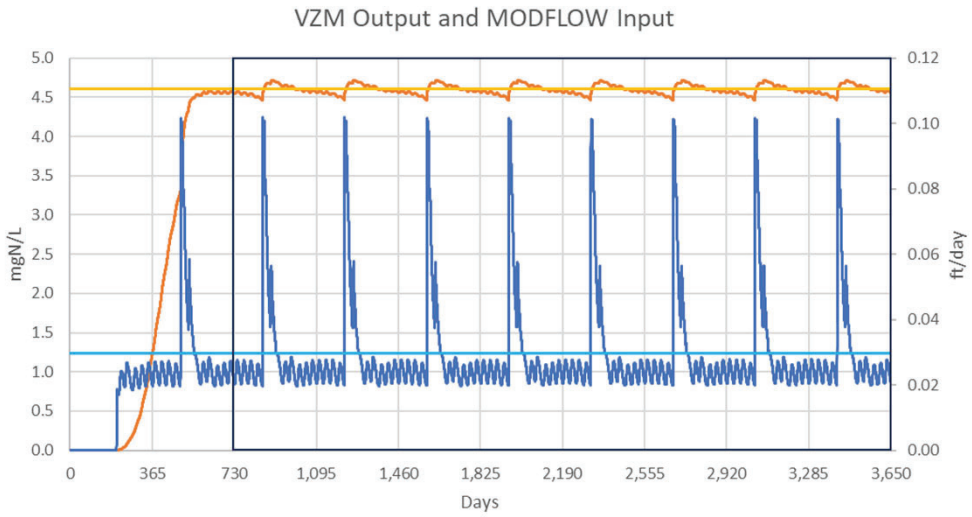
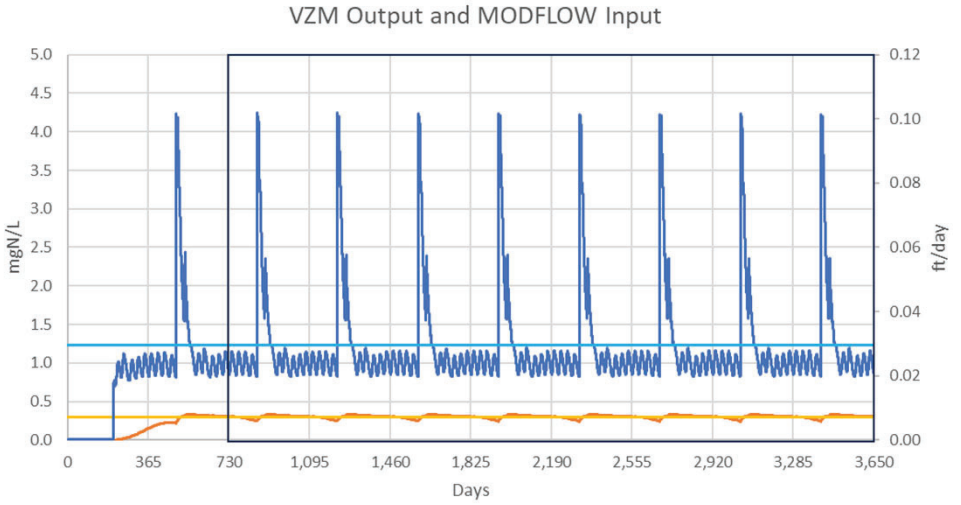


Assuming conservative vadose zone denitrification rate



Assuming enhanced and/or rapid vadose zone denitrification rate



Notes:
ft/day = feet per day
mgN/L = milligrams nitrate per liter

- VZM Simulated Nitrogen Concentration at Water Table (mgN/L)
- Steady-state MODFLOW Nitrogen Concentration (mgN/L)
- VZM Infiltration Rate at Water Table (ft/day)
- Steady-State MODFLOW Infiltration Rate (ft/day)

Model Setup with SAT Basin

County of Maui
Maui, Hawaii

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Figure C-4

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SAT Basin

Notes:
Unit of the contour lines is feet.

Simulated Increase in Groundwater Levels with Proposed SAT Basin
County of Maui
Maui, Hawaii

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Figure C-5

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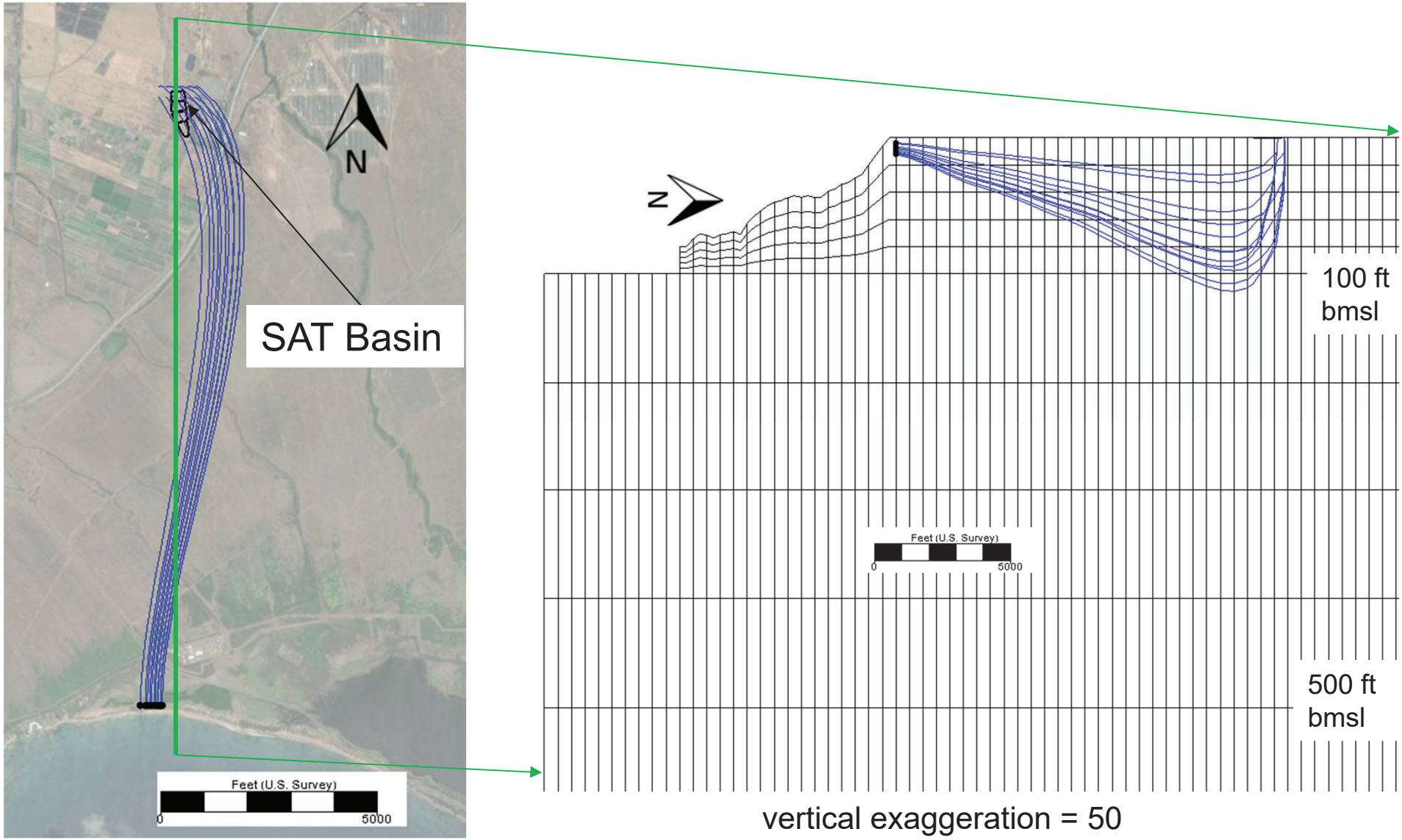

Notes:
ft bmsl = feet below mean sea level

Simulated Flowpath from the SAT Basin

County of Maui
Maui, Hawaii

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Figure C-6

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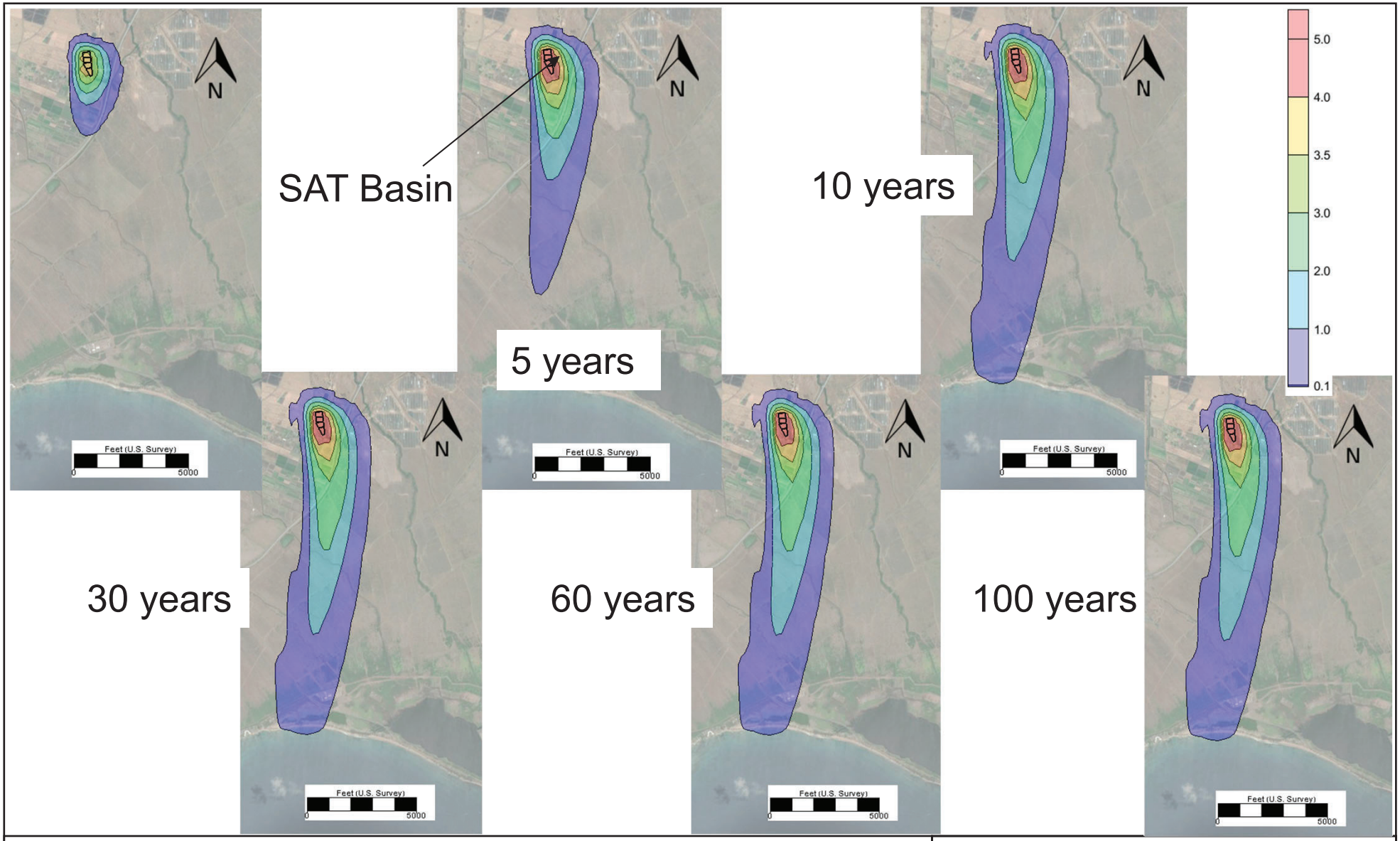

Notes:
1. The high nitrate concentration input is 4.6 mgN/L and corresponds to simulated concentration in the infiltrating water at the water table based on a conservative denitrification rate in the vadose zone.
2. The denitrification rate in groundwater used in the model is 1.5×10^{-4} 1/day.
3. Unit of nitrate concentration is mgN/L.

Simulated Nitrate Concentrations over 100 Years – With High Nitrate Concentration Input and High Denitrification Rate in Groundwater

County of Maui
Maui, Hawaii

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Figure C-7a

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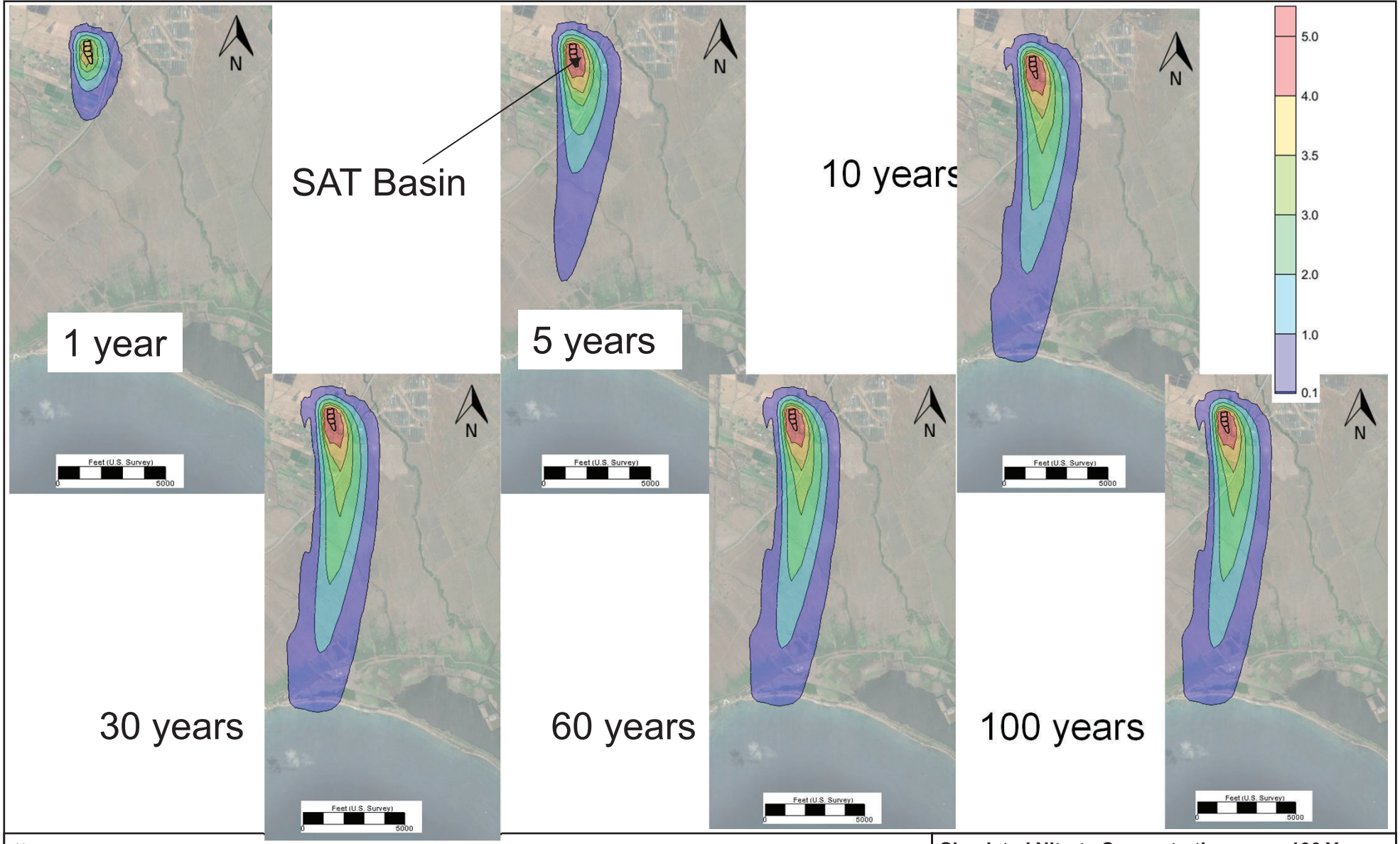

Notes:
1. The high nitrate concentration input is 4.6 mgN/L and corresponds to simulated concentration in the infiltrating water at the water table based on a conservative denitrification rate in the vadose zone.
2. The denitrification rate in groundwater used in the model is 3.1×10^{-5} 1/day.
3. Unit of nitrate concentration is mgN/L.

Simulated Nitrate Concentrations over 100 Years – With High Nitrate Concentration Input and Low Denitrification Rate in Groundwater

County of Maui
Maui, Hawaii

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Figure C-7b

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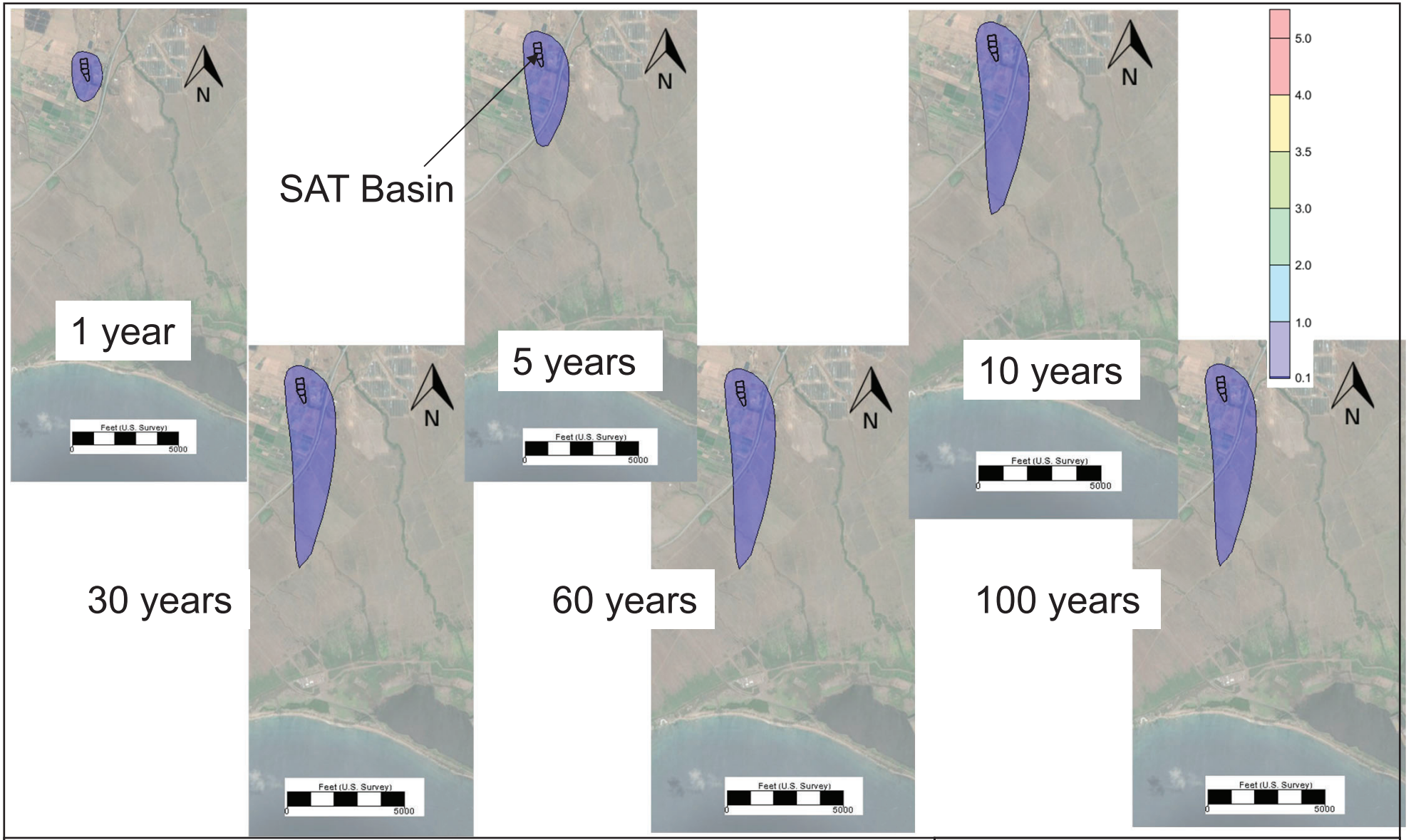

Notes:
1. The low nitrate concentration input is 0.3 mgN/L and corresponds to simulated concentration in the infiltrating water at the water table based on an enhanced and/or rapid denitrification rate in the vadose zone.
2. The denitrification rate in groundwater used in the model is 1.5×10^{-4} 1/day.
3. Unit of nitrate concentration is mgN/L.

Simulated Nitrate Concentrations over 100 Years – With Low Nitrate Concentration Input and High Denitrification Rate in Groundwater

County of Maui
Maui, Hawaii

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Figure C-8a

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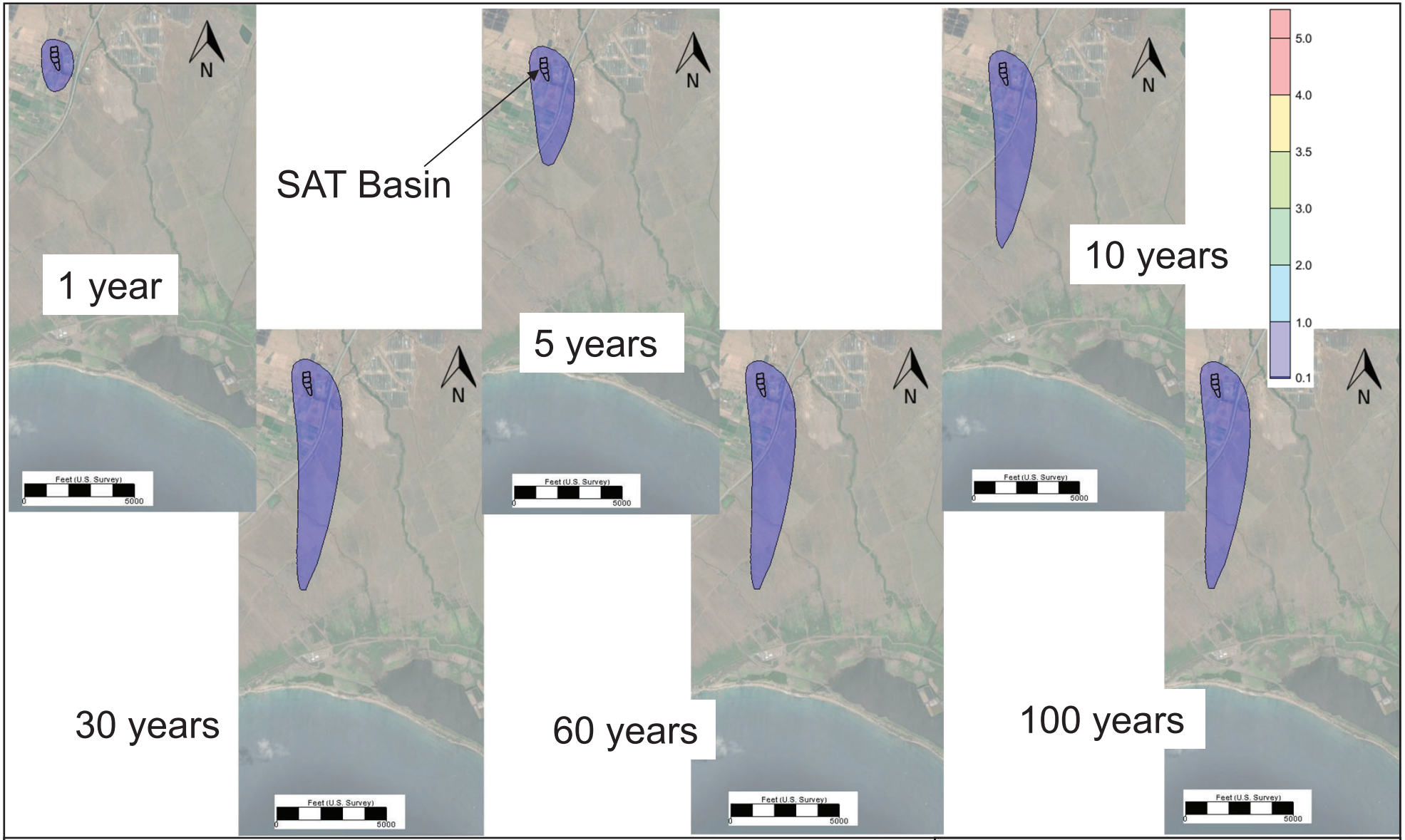

Notes:
1. The low nitrate concentration input is 0.3 mgN/L and corresponds to simulated concentration in the infiltrating water at the water table based on an enhanced and/or rapid denitrification rate in the vadose zone.
2. The denitrification rate in groundwater used in the model is 3.1×10^{-5} 1/day.
3. Unit of nitrate concentration is mgN/L.

Simulated Nitrate Concentrations over 100 Years – With Low Nitrate Concentration Input and Low Denitrification Rate in Groundwater

County of Maui
Maui, Hawaii

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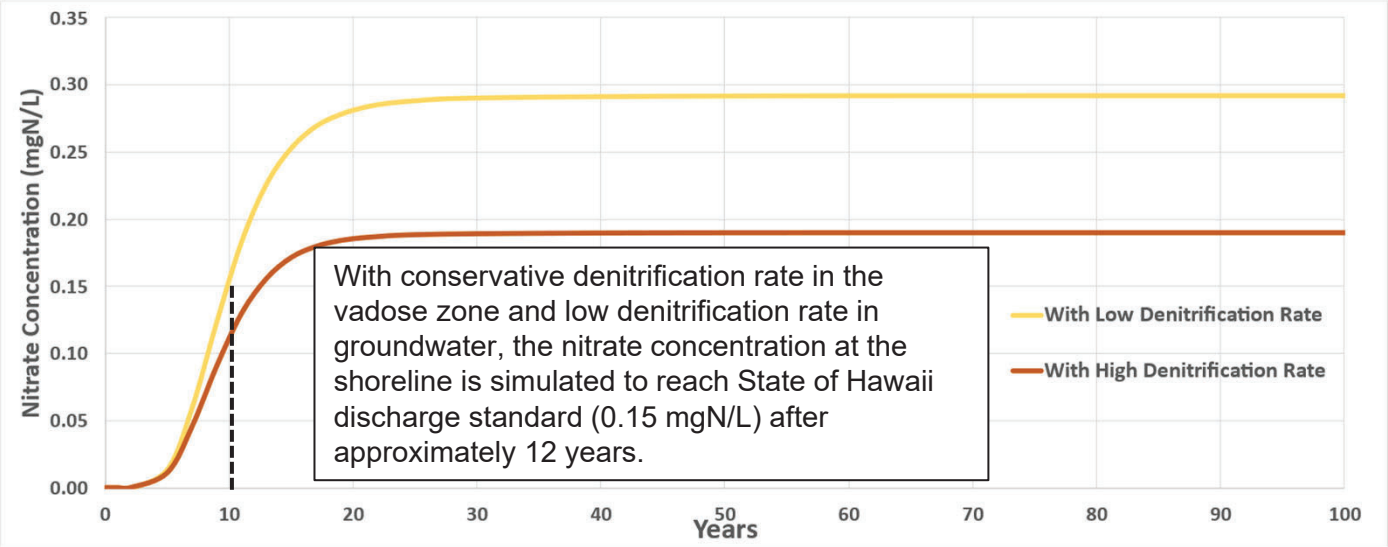
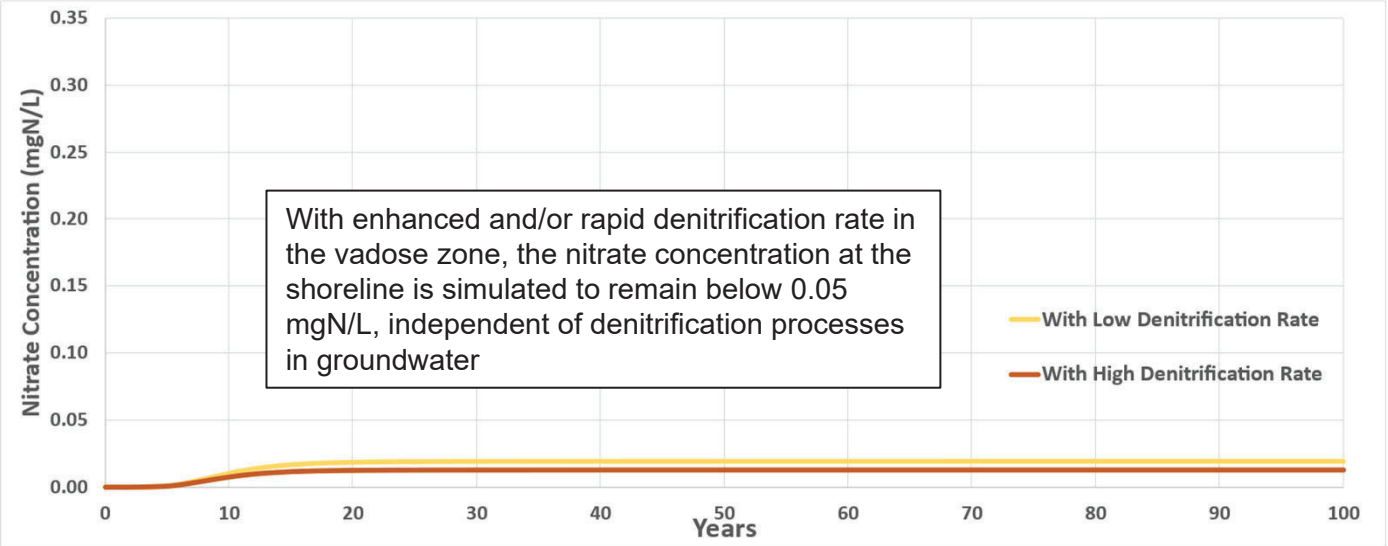
Figure C-8b

P:\PRJ2003REM\Maui\Model

(a): the nitrate concentration in water infiltrating at the water table is 4.6 mgN/L based on a conservative vadose zone denitrification rate



(b): the nitrate concentration in water infiltrating at the water table is 0.3 mgN/L based on an enhanced and/or rapid vadose zone denitrification rate



Notes:
The low and high denitrification rates in groundwater are 3.1×10^{-5} and 1.5×10^{-4} 1/day, respectively.

Simulated Nitrate Concentrations at the Shoreline
County of Maui
Maui, Hawaii

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Figure C-9

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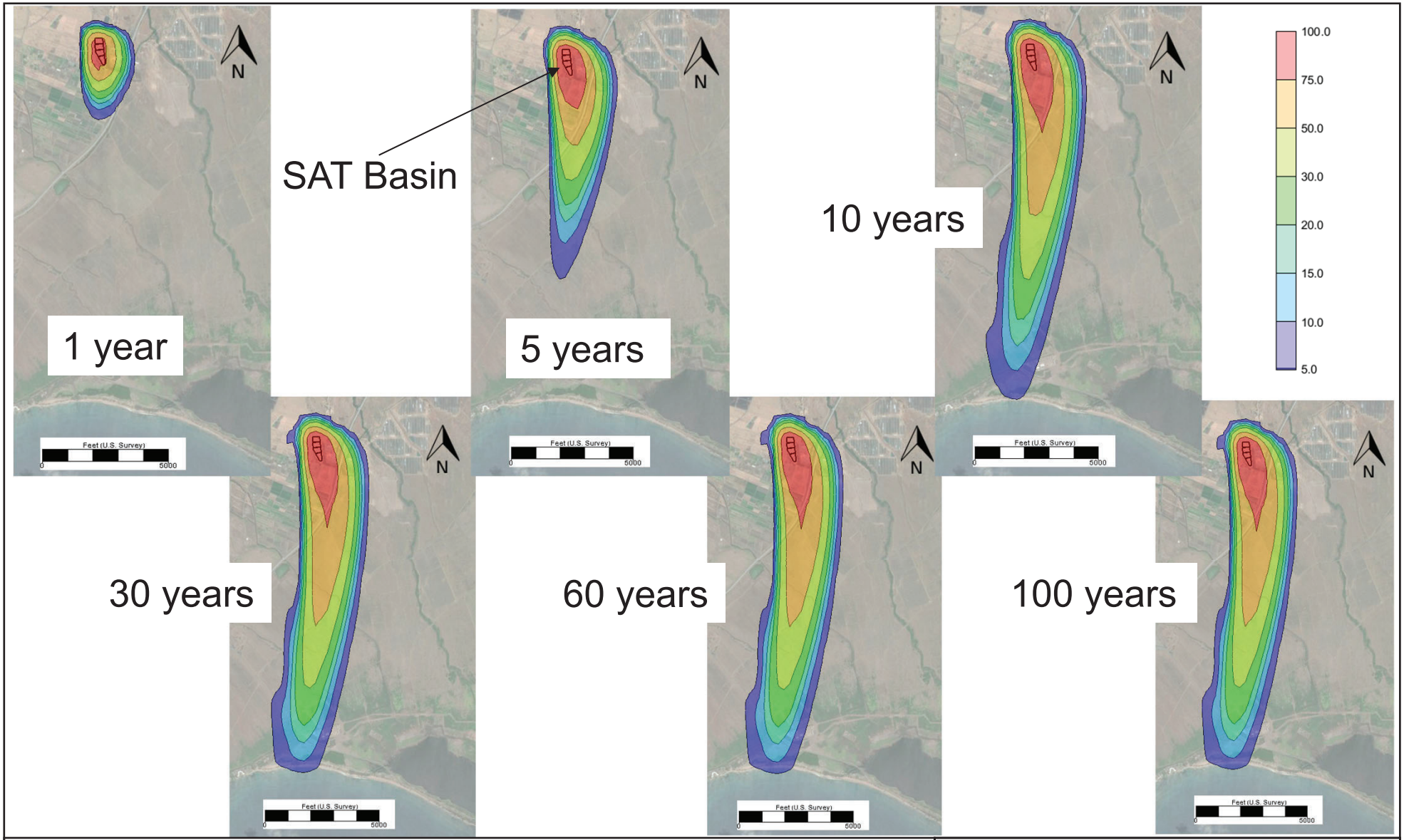

Notes:
Concentration contours are in percentage of the concentration in infiltrating water at the water table.

Simulated Plumes without Degradation in Groundwater for a Generic Analyte

County of Maui
Maui, Hawaii

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Figure C-10

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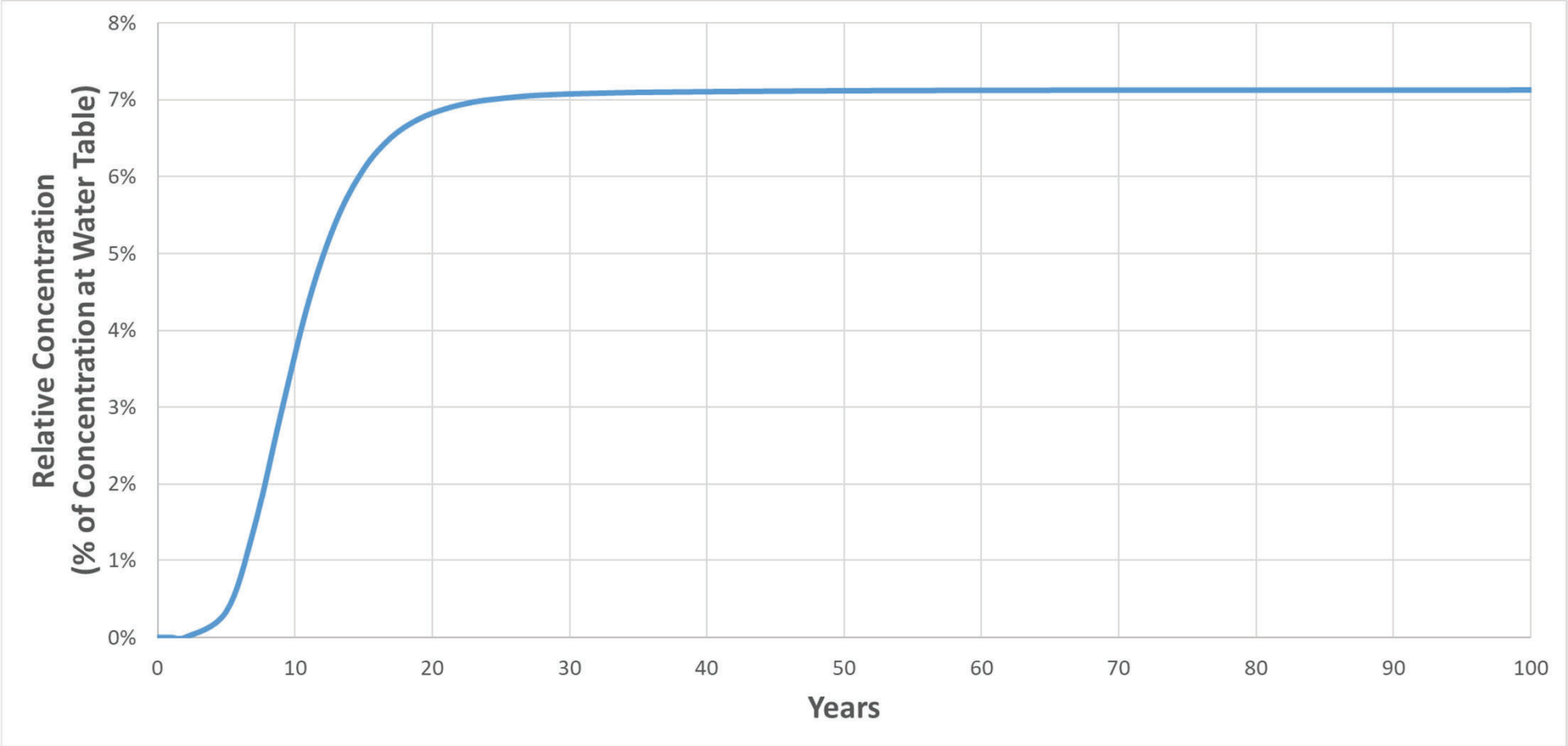

Simulated Concentrations at the Shoreline without Degradation in Groundwater for a Generic Analyte

County of Maui
Maui, Hawaii

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Figure C-11

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P:\PRJ2003REM\Maui\Model

APPENDIX D

Brown & Caldwell Technical Memorandum

2261 Aupuni Street, Suite 201
Wailuku, Maui, HI 96793

T: 808.244.7005

Technical Memorandum

Prepared for: County of Maui Department of Environmental Management, Wastewater Reclamation Division

Project Title: Central Maui WWRF EIS

Project No.: 158098.301

Technical Memorandum

Subject: SAT Disposal Flows for Hydrogeological Model

Date: September 12, 2024

To: Laura Vezzoli, Rich Kraft, Geosyntec

From: Craig Lekven

Prepared by: Craig C. Lekven, Director, HI License PE-13003, Exp. 4/30/26

The primary effluent management system at the Central Maui WWRF will be recycling of the R-1 effluent for irrigation and other purposes. DOH requires a disposal system capable of handling 100 percent of the WWRF flow for when:

- Condition 1: R-1 supply exceeds demand (excess recycled water).
- Condition 2: when the effluent does not meet R-1 requirements (off-spec water).

1.1 Condition 1: R-1 Supply Exceeds Demand

The Central Maui WWRF recycling area is very large in proportion to the anticipated effluent flows, resulting in high levels of reuse under typical conditions. However, R-1 supply could exceed demand during periods of extended wet weather.

Water balances were prepared for an average precipitation year and a wet year (defined as 1 in 10-year annual precipitation or an exceedance probability of 10 percent). Climate change models for Maui indicate a trend of increasing dryness in the Central Maui WWRF area, so the 10 percent exceedance probability assumption is conservative.

1.1.1 Average Precipitation Year

Figure 1 illustrates the average year precipitation condition:

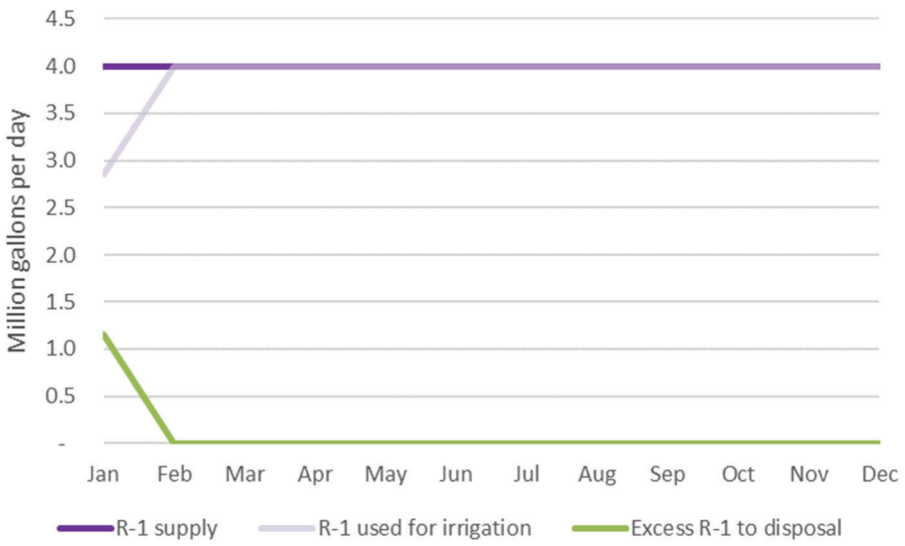

Figure 1. Average Year Water Balance

R-1 demand is anticipated to exceed the supply during all months except January. Peak SAT disposal would occur in January at a rate of 1.1 mgd. From February through December all R-1 water is expected to be used for irrigation or other authorized uses.

1.1.2 Wet Precipitation Year

Figure 2 illustrates the water balance for the wet (1 in 10) year precipitation condition:

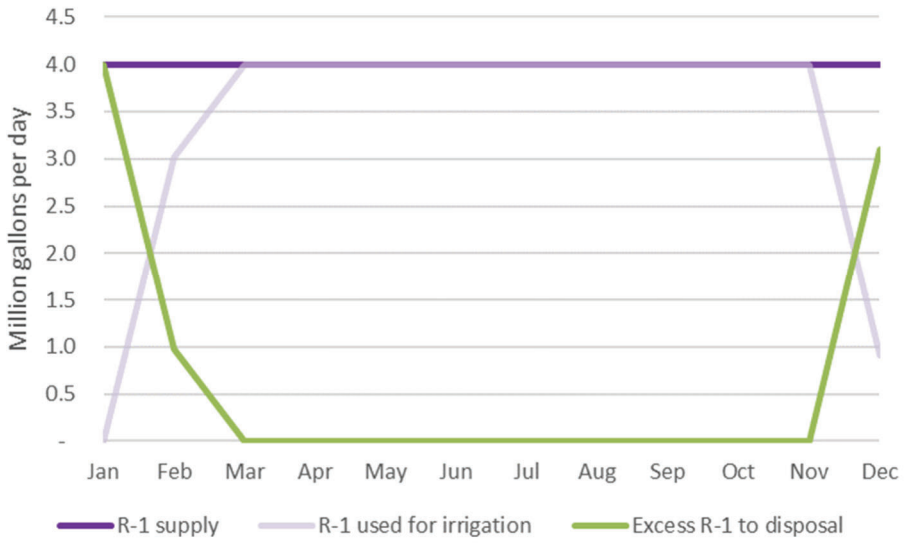

Figure 2. Wet Year Water Balance

Under the wet year scenario, there is no demand for R-1 water during the month January, and reduced R-1 demand in December and February. From March through November all R-1 water is expected to be used for irrigation or other authorized uses.

Table 1 summarizes the two scenarios:

Table 1. SAT Disposal Estimates – Average and Wet Precipitation Year Scenarios

Month	Average Precipitation Year		Wet Precipitation Year	
	(mgd)	(mgal)	(mgd)	(mgal)
Jan	1.1	36	4.0	124
Feb	0	0	1.0	28
Mar	0	0	0	0
Apr	0	0	0	0
May	0	0	0	0
Jun	0	0	0	0
Jul	0	0	0	0
Aug	0	0	0	0
Sep	0	0	0	0
Oct	0	0	0	0
Nov	0	0	0	0
Dec	0	0	3.1	96
Totals	--	36	--	248

1.2 Condition 2: Off-Spec Water Disposal

The WWRF effluent will be continuously monitored for R-1 compliance parameters, and effluent will be automatically diverted to the SAT when the water does not meet R-1 standards. In addition, the County will be required to test daily samples for fecal coliform in the laboratory. Five years of flow and laboratory data from the Kihei WWRF was evaluated to assess the reliability of the R-1 treatment processes. The Kihei WWRF was selected for analysis because the flows and treatment processes are similar to those that will be used at the Central Maui WWRF. Table 2 summarizes the findings of the evaluation:

Table 2. Kihei WWRF R-1 Reliability Assessment

	Number of Occurrences					
Year	R-1 flow less than 0.1 mgd [a]	Effluent turbidity > 2.0 NTU [b]	7-day median fecal coliform > 2.2.MPN/100 mL [b]	Fecal coliform > 23 MPN/100 mL in more than 1 sample during 30-day period [b]	Fecal coliform > 200 MPN/100 mL in any single sample [b]	Total
2019	3	2	7	3	4	19
2020	6	0	0	0	1	7
2021	4	0	0	0	1	5
2022	1	0	5	2	0	8
2023	3	4	4	0	0	11

[a] *Assumed to indicate off-spec conditions.*

[b] *Based on laboratory analysis results.*

As shown in the table, up to 19 individual R-1 exceedance occurrences were experienced annually at Kihei WWRF during the period of evaluation. This corresponds to an off-spec rate of 5.2 percent of the year. The individual exceedance events tend to occur throughout the year and do not necessarily correspond to one another. To be conservative we recommend modelling 21 off-spec days per year, occurring randomly.

1.3 Hydrogeologic Model Scenarios

Two hydrogeologic modeling scenarios are proposed to support the project EIS. The first focuses on long-term pollutant transport under typical conditions. and the second focuses on the vadose zone's ability to assimilate high flows during wet weather conditions.

1.3.1 Hydrogeologic Model Scenario 1: Long Term Pollutant Transport Focus

The first proposed model scenario considers anticipated long-term loading conditions to establish potential environmental impacts from the SAT. The goals of this scenario are:

- Establish the likely path of water applied to the SAT through the vadose zone and saturated zone to the Pacific Ocean.
- Evaluate the discharge with respect to the "functional equivalent" criteria established by the United States Supreme Court in *County of Maui v. Hawaii Wildlife Fund, et.al.*
- Establish potential environmental impacts from the SAT.

For hydrogeological modeling purposes, it will be reasonable to model the average precipitation year condition, coupled with intermittent off-spec conditions throughout the year. Table 3 summarizes the modeling scenario.

Table 3. Central Maui WWRF: Hydrogeological Model Scenario 2: Long Term Pollutant Transport Focus

Description	Volume (mgal/year)
Average precipitation year discharge	36 (occurring in January)
Off-spec condition discharge (21 days/year)	84 (occurring on random days from February through December)
Total discharge to SAT	120

1.3.2 Hydrogeologic Model Scenario 2: Vadose Zone Focus

The intention of this proposed scenario is to model the vadose zone's capacity to assimilate high flows for an extended period of time. The goals of this scenario are to:

- Establish the SAT's ability to dispose of the entire WWRF flow in accordance with Hawaii Administrative Rules 11-62-25 requirements for backup disposal systems.
- Evaluate the mounding potential above the restrictive layer in the vadose zone, to establish the potential for impacts to nearby streams or other features.

For hydrogeological modeling purposes, it would be conservative to model the wet precipitation year condition, with a total of 21 days of off-spec conditions occurring throughout the year Table 4 summarizes the modeling scenario.

Table 4. Central Maui WWRF: Hydrogeological Model Scenario 1: Vadose Zone Focus

Month	SAT Disposal Volume	Condition
December	3.1 mgd daily all month (96 mgal total)	Wet year precipitation
January	4.0 mgd daily all month (124 mgal total)	Wet year precipitation
February	1.0 mgd daily all month (28 mgal total)	Wet year precipitation
March through November	4.0 mgd for total of 21 days, randomly spaced occurrence (84 mgal total)	Off-spec water condition
Total scenario: 4.0 mgd for 99 days straight (396 mgal)		

1.3.3 Effluent Characteristics

Table 5 summarizes the effluent characteristics that we propose to be used in the modeling efforts.

Table 5. Central Maui WWRF: Effluent Characteristics for Hydrogeological Modeling Purposes

Parameter	Concentration
Total nitrogen	8 mg/L
Total phosphorus	8 mg/L
5-day biochemical oxygen demand	10 mg/L
Total organic carbon	6 mg/L [a]

[a] *Estimated to be 60% of BOD_5*

MUNEKIYO HIRAGA

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