COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII

In the Matter of Water Use Permit Applications, Petitions for Interim Instream Flow Standard Amendments, and Petitions for Water Reservations For the Waiahole Ditch Combined Contested Case Hearing:	LEGAL FRAMEWORK, FINDINGS OF FACT, AND DECISION AND ORDER

ON REMAND

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I. INTRODUCTION

This Decision and Order responds to the Supreme Court of the State of Hawai`i's August 22, 2000, decision "In the Matter of the Water Use Permit Applications, Petitions for Interim Instream Flow Standard Amendments, and Petitions for Water Reservations for the Waiahole Ditch Combined Contested Case Hearing." (In re Water Use Permit Applications, 94 Haw. 97; 9 P.3d 409 (2000))

The Commission on Water Resource Management (Commission or CWRM) issued its original decision and order on December 24, 1997. ("In the Matter of Water Use Permit Applications, Petitions for Interim Instream Flow Standard Amendments, and Petitions for Water Reservations for the Waiahole Ditch Combined Contested Case Hearing; Findings of Fact, Conclusions of Law, and Decision and Order;" Case No. CCH-OA95-1)

The Commission: 1) amended the Interim Instream Flow Standards (IIFS) by adding 4 million gallons per day (mgd) to Waiahole Stream and 2 mgd to Waianu Stream (a tributary of Waiahole Stream), whose flows had been diminished by the construction of the Waiahole Ditch and Tunnel System; 2) found that a reasonable duty of water for diversified agriculture was 2,500 gallons per acre per day (gad), and on this basis, allocated 10.64 mgd for approved agricultural water use permits to certain leeward landowners[1] and proposed an agricultural reserve of an additional 1.58 mgd; 3) deferred formal rulemaking action on reservation petitions to a later date; 4) approved leeward non-agricultural use permits for a total of 1.29 mgd; 5) denied certain leeward applications in whole or in part for agricultural or non-agricultural water use permits; and 6) ordered that any portion of water subject to a water use permit or allowed for operational losses which were not being used, as well as the remaining Ditch flows not subject to use permits, be released into windward streams.

The Commission also made allowances for 2.1 mgd in operational losses for Waiahole Irrigation Company (WIC). WIC had requested a water use permit for 2.0 mgd of Ditch water as operational losses. The Commission had denied the request but recognized that operational water losses do occur and hence provided the 2.10 mgd of Kahana Stream surface waters being diverted into the Ditch as an allowance for such losses. The Commission had concluded that it had no permitting authority over Kahana Stream surface waters, because the Kahana watershed was not in a surface water management area. The Commission further stated its intention to initiate the process of designation for the Kahana watershed as a surface water management area and to consider the Kahana surface water diversions for future restoration to Kahana Stream. Because there was no evidence presented concerning any present demand for the use of Kahana surface water and because the water would be wasted if it continued in the Ditch

[1] Where historical actual use was lower than 2500 gad (as in the case of pineapple), the Commission adopted the actual lower number, which was included in the 10.64 mgd approved for agricultural uses.

to the leeward side without a permit, the Commission concluded that it should be used as an allowance for WIC's operational losses.[2]

In light of the integrated nature of the relevant water sources and infrastructure, the Commission also ordered that the Waiahole Ditch system be regulated as a unified water system within the Waipahu-Waiawa Water Management Area and the Koolaupoko and Kahana Water Management Areas.[3]

The Commission also ordered the agricultural parties, with the cooperation and participation of WIC and the Department of Agriculture, to draft an Implementation Plan incorporating the principles of the "Farm Delivery Agreement" to form a cooperative to coordinate and facilitate the delivery of water.

Finally, the Commission proposed to establish technical advisory committees representing a cross-section of interests to address specific areas of concern, most notably, the effects of stream flow restoration, conservation measures, and financing of the technical studies.

In its August 22, 2000, decision, the Hawai`i Supreme Court vacated in part the Commission's decision and remanded for additional findings and conclusions, with further hearings if necessary, the following: 1) the designation of an interim instream flow standard for windward streams based on the best available information, as well as the specific apportionment of any flows allocated or otherwise released to the windward streams; 2) the merits of the petition to amend the interim standard for Waikane Stream; 3) the actual need for 2,500 gallons per acre per day over all acres in diversified agriculture; 4) the actual needs for certain leeward parcels of agricultural lands; 5) the practicability of two leeward parties using alternative ground-water sources; 6) practicable measures to mitigate the impact of variable offstream demand on the streams;

[2] In its decision, the Commission had stated that: "Because there was no evidence presented concerning any present demand for the use of Kahana water, and because water should not be wasted, the Commission temporarily recognizes that 2.1 mgd Kahana surface water corresponds approximately to operational losses." (Decision and Order at 5-6) The Hawai`i Supreme Court's interpretation of this statement was that "most troublesome is the suggestion that retaining water in streams constitutes waste, contrary to the public trust mandate of protection." (94 Haw. 97 at 172; 9 P.3d 409 at 484) However, the Commission was referring to its lack of jurisdiction over Kahana Stream water, 2.1 mgd of which was being diverted into the ditch and transported to the leeward side: "(B)ecause the permitting of Kahana surface water is not under its jurisdiction, the Commission intends to initiate the process of designation for the Kahana watershed as a surface water management area. The Kahana surface water diversions may also be considered for future restoration to Kahana Stream." (Decision and Order at 6) The Hawai`i Supreme Court's decision obviated the need for designating the Kahana watershed as a surface water management area: "(A)part from any water management area designation, the Commission has jurisdiction to hear any dispute regarding water resource protection, water permits, or constitutionally protected water interests, and to investigate and take appropriate action in response to WWCA's allegation that the ditch is wasting water due to deficient operation and upkeep (internal quotes and references omitted)." (94 Haw. 97 at 172; 9 P.3d 409 at 484)

[3] As explained in the preceding footnote, the Hawai`i Supreme Court extended this line of reasoning to include surface water in the Kahana watershed, even though the Commission had not designated the Kahana watershed as a surface water management area.

and 7) the merits of the permit application for ditch “system losses.” All other aspects of the Commission’s decision not otherwise addressed in the opinion were affirmed.

The hearing officer assigned to hear the remand by the Hawai`i Supreme Court concluded that the record of the first hearing provided adequate information without the need for additional hearings to designate IIFS’s for the windward streams, as well as the specific apportionment of any flows allocated or otherwise released to these streams. The other five issues were the subject of additional hearings held on April 4, 2001, with closing arguments held on April 24, 2001.

II. BACKGROUND

Initial construction on the Waiahole Ditch and Tunnel System took place between February 1913 and December 1915 to transport water from windward streams and springs to irrigate sugar cane fields on the drier leeward side. During construction, large amounts of dike-impounded ground water was encountered at the high altitudes (between approximately 700 to 800 feet elevation) at which the transmission tunnels were being bored, and subsequent extensions of the tunnel system during 1925 to 1933 and again in 1964, have resulted in a system which currently collects mostly dike-impounded ground water. However, these dike-impounded waters also previously fed Waiahole (and its tributary Waianu), Waikane and Kahana streams through springs and seeps, resulting in diminished flows in these streams.

On April 19, 1989, the Commission adopted the Interim Instream Flow Standard (IIFS) for all windward Oahu streams as “that amount of water flowing in each stream on the effective date of this standard, and as that flow may naturally vary throughout the year and from year to year without further amounts of water being diverted offstream through new or expanded diversions, and under the stream conditions existing on the effective date of the standard.” (effective May 4, 1992) In essence, the IIFS provides that no additional diversions from the “status quo” shall be made without Commission approval. A restoration of stream flows above the “status quo” may also require Commission approval.

On May 5, 1992, the Commission designated the five aquifer systems of windward Oahu as ground-water management areas. Notice of the action was published on July 15, 1992, the effective date of designation. Under the Water Code, users of ground water must apply for a water use permit within one year of the effective date of designation.

In June 1993, WIC filed a combined water use permit application for all the then-existing water users of the Waiahole Ditch water transported to Central Oahu.

On August 4, 1993, Oahu Sugar Company (OSCO) announced that it would cease its sugar operations by 1995.

On November 4, 1993, the Department of Agriculture (DOA) petitioned the Commission “to preserve the present use flow of the Waiahole Ditch system for agricultural uses…to take effect upon the demise of the Oahu Sugar Company’s operations”. Petitions to reserve water under Haw. Rev. Stat. Sec. 174C-49(d) were later filed by the Office of Hawaiian Affairs (8/31/94); the Kahalu`u Neighborhood Board No. 29, the Hakipu``u `Ohana, and the Waiahole-Waikane Community Association (9/26/94); Kamehameha Schools/Bishop Estate (12/15/94); and the Department of Hawaiian Home Lands (1/25/95).

On December 7, 1993, the Kahaluu Neighborhood Board No. 29, the Hakipu`u `Ohana, and the Waiahole-Waikane Community Association petitioned to amend the interim instream flow standards for windward Oahu streams affected by the Waiahole Ditch. The Office of Hawaiian Affairs also petitioned to amend the IIFS for windward streams on February 28, 1995.

In response to complaints received at its May 18, 1994, meeting, the Commission investigated releases of Waiahole Ditch water into central Oahu gulches. After site visits, public informational meetings and a staff report on these releases, the Commission considered an “Order To Show Cause to Waiahole Irrigation Company Why It Should Not Be Ordered To Cease Wasting Water” at its September 28 and October 19, 1994, meetings. The Commission deferred action on the matter and asked interested groups to enter into expedited mediation of the release issue in lieu of holding a contested case hearing.

Mediation on the Waiahole interim release issue was held on November 21, 1994, with seventeen parties participating.

On December 16, 1994, the Commission adopted a Mediation Agreement, Waiahole Ditch Interim Water Releases, signed by most of the Waiahole Ditch water users, applicants, and petitioners to allow 8 mgd to flow past the North Portal (below the crest of the Ko`olau mountains between the windward and leeward sides) in the Waiahole Tunnel and release the remainder back into the windward streams. (This order was amended in June 1995 to release 2 mgd of the remainder into Waianu Stream.)

On January 25, 1995, the Commission ordered that a combined contested case hearing be held on: 1) all related applications for water use permits, 2) all related petitions to reserve water, and 3) the petitions to amend the interim instream flow standards, and 4) any other matters related to the Waiahole Ditch system.

On April 18, 1995, a public hearing was held to give all interested persons and organizations the opportunity to testify or present information on Waiahole Ditch matters and given the opportunity to request to be an intervening party, orally or in writing, by the end of the public hearing.

On May 17, 1995, the Commission gave all applicants to participate the opportunity to be heard orally and/or in writing, and gave anyone objecting to the standing of any applicant to participate the opportunity to submit such objections in writing and/or orally. The Commission granted standing to twenty-five parties and denied standing to nine parties, as explained in Order Number 1, Order Granting and Denying Applications to Participate in the Combined Contested Case Hearing, issued on May 30, 1995, and Order Granting Ka Lahui's Motion to Reconsider Standing in the Waiahole Combined Contested Case Hearing, issued on July 13, 1995.

From May 22, 1995, to November 8, 1995, there were seventeen meetings, which included six prehearing conferences, a field investigation, four hearings on existing uses, and six hearings on motions.

On November 9, 1995, the parties began their opening statements and presentation of evidence. The hearing continued to August 21, 1996, during which time there were fifty-two days of hearings including four evening sessions. The parties presented written testimony from 161 witnesses, of which 140 testified orally. There were 567 exhibits introduced into evidence. Closing arguments were presented during three days, from September 18 to 20, 1996.

On July 15, 1997, the Commission issued the Proposed Findings of Fact, Conclusions of Law, and Decision and Order.

On August 22, 1997, the Commission heard oral arguments on written exceptions to the Proposed Findings of Fact, Conclusions of Law, and Decision and Order.

On December 24, 1997, the Commission issued the final Findings of Fact, Conclusions of Law, and Decision and Order for the Waiahole Ditch Combined Contested Case Hearing.

On January 22 and 23, 1998, Notices of Appeal to the Supreme Court of the State of Hawai`i from the final Decision and Order of the Commission on Water Resource Management were filed by Waiahole-Waikane Community Association et al.; Hawai`i's Thousand Friends; City & County of Honolulu, Planning Department and Board of Water Supply; and Kamehameha Schools/Bernice Pauahi Bishop Estate.

From February 4 to 6, 1998, Notices of Cross-Appeal were filed by: The Robinson Estate; Pu`u Makakilo, Inc.; State of Hawai`i, Department of Agriculture and Department of Land and Natural Resources; The Estate of James Campbell; Dole Food Company, Inc./Castle & Cooke; Department of Navy; and Land Use Research Foundation.

On December 15, 1999, the Hawai`i Supreme Court heard arguments on certain issues of the Waiahole Ditch Combined Contested Case Hearing.

On August 22, 2000, the Hawai`i Supreme Court issued its decision in the Waiahole Ditch Combined Contested Case Hearing.

On August 31, 2000, Kamehameha Schools filed a motion for reconsideration on the Supreme Court's decision.

On September 27, 2000, the Supreme Court denied Kamehameha Schools' motion for reconsideration.

On October 2, 2000, the Supreme Court filed the Final Judgment, officially remanding the case to the Commission.

On October 3, 2000, the Commission issued an interim order for Commissioners Girald and Richards to participate in the remanded case and for recusal of Commissioner Nishida in the remanded case.

Also on October 3, 2000, the Commission issued an interim order for no changes in water allocations, no issuance of additional water use permits, and no further diversions from windward streams affected by the Waiahole Ditch pending determination of interim instream flow standards for affected windward streams.

On November 9, 2000, legal counsel to the Board of Land and Natural Resources (BLNR) informed the Commission that on October 27, 2000, the BLNR voted to withdraw the Department of Land and Natural Resources from further participation as a party in the remanded case.

On November 15, 2000, the Commission issued an interim order for Chairperson Johns to participate in the remanded case and for recusal of Commissioner Richards in the remanded case.

On November 29, 2000, the Commission delegated the remanded Waiahole Ditch Combined Contested Case Hearing to a hearing officer and appointed Dr. Lawrence Miike as the hearing officer for the remanded Waiahole Ditch Combined Contested Case Hearing.

On January 12, 2001, Hearing Officer Miike issued a notice of a prehearing conference to be held on February 2, 2001.

The prehearing conference was held on February 2, 2001. The date of the start of the hearing was set at April 4, 2001. A schedule was determined for the filing of opening statements, opening briefs, witness lists, witness statements, and exhibits. The parties were limited to five of the seven issues remanded by the Supreme Court: 1) The actual need for 2,500 gallons per acre per day over all acres in diversified agriculture; 2) The actual needs of Field Nos. 146 and 166 (ICI Seeds), and Field Nos. 115, 116, 145, and 161 (Gentry and Cozzens); 3) Practicable measures to mitigate the impact of variable off stream demand on the streams; 4) The practicability of Campbell Estate and Puu Makakilo using alternative ground-water sources; and 5) The merits of the permit application for ditch "system losses."

On March 1, 2001, Hearing Officer Miike issued Minute Order Number 76, stating that no further hearings would be necessary for item 1) the designation of an interim instream flow standard for windward streams based on the best information available, as well the specific apportionment of any flows allocated or otherwise released to the windward streams, and item 2) the merits of the petition to amend the interim standard for Waikane Stream. The Hearing Officer concluded that there was sufficient evidence in the existing record to set an interim instream flow standard without further hearings, and the Commission could at any time modify the interim standard or establish a permanent standard based on the best information available.

On April 4, 2001, prior to the hearing on the five issues, a hearing was held on the motion by petitioners Waiahole-Waikane Community Association, Hakipu`u `Ohana, Kahalu`u Neighborhood Board, and Ka Lahui Hawai`i to strike Kamehameha Schools' opening brief, direct testimony, witness lists and exhibits. The motion was granted, on the basis that the issues raised and evidence offered by Kamehameha Schools were not relevant to the remanded contested case hearing and were instead applicable to Kamehameha Schools' pending Waiawa water use permit application.

On April 4, 2001, following the above motion, the City and County of Honolulu, Planning Department and Board of Water Supply's motion to strike pages 1 through 6 (inclusive) of petitioners Waiahole-Waikane Community Association, Hakipu`u `Ohana, Kahalu`u Neighborhood Board and Ka Lahui Hawai`i's Opening Statement was denied.

On April 4, 2001, following rulings on the two motions, the parties began and concluded their opening statements and presentation of evidence.

On April 18, 2001, the parties filed written closing arguments.

On April 24, 2001, the Hearing Officer heard closing arguments.

On April 26, 2001, the parties filed Proposed Findings of Fact, Conclusions of Law, and Decision and Order for the five remanded issues heard on April 4, 2001.

On August 1, 2001, the Hearing Officer issued the HEARING OFFICER'S PROPOSED LEGAL FRAMEWORK, FINDINGS OF FACT, AND DECISION AND ORDER. The parties were given to noon, Tuesday, September 4, 2001, to submit written exceptions.

On or about September 4, 2001, the following parties filed written exceptions: The Estate of James Campbell; Kamehameha Schools Bernice Pauahi Bishop Estate; Nihonkai Lease Co., Ltd.; State of Hawaii, Agribusiness Development Corporation; Department of the Navy; Land Use Research Foundation; City and County of Honolulu Planning Department and Board of Water Supply; Waiahole-Waikane Community Association, Hakipuu Ohana, Kahaluu Neighborhood Board, and Ka Lahui Hawaii; and Hawaii's Thousand Friends.

On October 1, 2001, Chairperson Gilbert Coloma-Agaran, Director of Health Bruce Anderson, and Commissioners David Nobriga and Robert Girald heard oral arguments on the written exceptions to the Hearing Officer's Proposed Decision and Order. Appearances of counsel included: Alan M. Oshima, for the Estate of James Campbell; Marjorie A. Lau, Haunani Burns, and Junie Hayashi for the State of Hawaii Agribusiness Development Corporation; Paul M. Sullivan and Cheryl L. Connett for the Department of the Navy; Paul Achitoff and Kapua`ala Sproat for the Waiahole-Waikane Community Association, Hakipu`u Ohana, and Ka Lahui Hawaii; Benjamin Kudo and Naomi U. Kuwaye for Kamehameha Schools/Bernice Pauahi Bishop Estate; Reid M. Yamashiro and Rosemary Liu for the City and County of Honolulu; Pamela Bunn for Hawaii's Thousand Friends; David Schulmeister for Land Use Research Foundation of Hawaii; and Jean Campbell for Nihonkai Lease Co., Ltd.

III. SUMMARY OF THE LEGAL FRAMEWORK GOVERNING THE ISSUES ON REMAND FROM THE HAWAI`I SUPREME COURT (CONCLUSIONS OF LAW)

A. STATUTORY BASIS

Under the Hawai`i State Water Code, Instream Uses of Water/Protection of Instream Uses are governed by HRS Chapter 174C, part VI, or HRS section 174C-71, and Regulation of Water Use is governed by HRS Chapter 174C, part IV, or HRS sections 174C-41 to 174C-63 (1993 & Supp. 1999).

While the statute relating to instream use protection operates independently of the procedures for water use regulation (94 Haw. 97 at 148; 9 P.3d 409 at 460), in setting instream flow standards, the Commission must weigh the importance of instream uses with the importance of offstream uses; and applicants for offstream uses must take into account the public interest in instream flows (see following discussion).

1. INSTREAM USES OF WATER/PROTECTION OF INSTREAM USES

"Instream flow standard" is defined in the Code as "a quantity of water or depth of water which is required to be present at a specific location in a stream system at certain specified times of the year to protect fishery, wildlife, recreational, aesthetic, scenic, and other beneficial instream uses." "Instream use" is defined as "beneficial uses of stream water for significant purposes which are located in the stream and which are achieved by leaving the water in the stream. Instream uses include, but are not limited to: (1) Maintenance of fish and wildlife habitats; (2) Outdoor recreational activities; (3) Maintenance of ecosystems such as estuaries, wetlands, and stream vegetation; (4) Aesthetic values such as waterfalls and scenic waterways; (5) Navigation; (6) Instream hydropower generation; (7) Maintenance of water quality; (8) The conveyance of irrigation and domestic water supplies to downstream points of diversion; and (9) the protection of traditional and customary Hawaiian rights." (HRS section 174C-3)

"Interim instream flow standard" is defined as "a temporary instream flow standard of immediate applicability, adopted by the commission without the necessity of a public hearing, and terminating upon the establishment of an instream flow standard." (HRS section 174C-3)

"Each instream flow standard shall describe the flows necessary to protect the public interest in the particular stream. Flows shall be expressed in terms of variable flows of water necessary to protect adequately fishery, wildlife, recreational, aesthetic, scenic, or other beneficial instream uses in the stream in light of existing and potential water developments including the economic impact of restriction of such use." (HRS section 174C-71(1)(C))

The instream flow standard is the surface water corollary to the ground-water "sustainable yield" in that both perform the function of guiding water planning and regulation by prescribing responsible limits to the development and use of public water resources. Therefore, standards must be designated before offstream diversions can be authorized. (94 Haw. 97 at 148; 9 P.3d 409 at 460)

In establishing standards for instream uses, "the Commission must duly consider the significant public interest in continuing reasonable and beneficial existing offstream uses…(but) the Commission's duty to establish proper instream flow standards continues notwithstanding existing diversions." (94 Haw. 97 at 462; 9 P.3d 409 at 150)

"In formulating the proposed standard, the commission shall weigh the importance of the present or potential instream values with the importance of the present or potential uses of water from the stream for noninstream purposes, including the economic impact of restriction of such uses. In order to avoid or minimize the impact on existing uses of preserving, enhancing, or restoring instream values, the commission shall consider physical solutions, including water exchanges, modifications of project operations, changes in points of diversion, changes in time and rate of diversion, uses of water from alternative sources, or any other solution." (HRS section 174C-71(1)(E))

Finally, "the Code contemplates the designation of the standards based not only on scientifically proven facts, but also on future predictions, generalized assumptions, and policy judgments." (94 Haw. 97 at 155; 9 P.3d 409 at 467) And in establishing the standards, reasonable margins of safety should be considered, incorporating allowances for scientific uncertainty into the standards. (94 Haw. 97 at 156; 9 P.3d 409 at 468)

2. REGULATION OF WATER USE

To obtain a water use permit, "the applicant shall establish that the proposed use of water: (1) Can be accommodated with the available water source; (2) Is a reasonable-beneficial use as defined in section 174C-3; (3) Will not interfere with any existing legal use of water; (4) Is consistent with the public interest; (5) Is consistent with state and county general plans and land use designations; (6) Is consistent with county land use plans and policies; and (7) Will not interfere with the rights of the department of

Hawaiian home lands as provided in section 221 of the Hawaiian Homes Commission Act." (HRS section 174C-49(a))

"'Reasonable-beneficial use' means the use of water in such a quantity as is necessary for economic and efficient utilization, for a purpose, and in a manner which is both reasonable and consistent with the state and county land use plans and the public interest." (HRS section 174C-3)

"(T)he 'reasonable-beneficial use' standard and the related criterion of 'consistent with the public interest' demand examination of the proposed use not only standing alone, but also in relation to other public and private uses and the particular water source in question. Hence, permit applicants requesting water diverted from streams must duly take into account the public interest in instream flows." (94 Haw. 97 at 161; 9 P.3d 409 at 473)

"The common law of the State to the contrary notwithstanding, the commission shall allow the holder of a use permit to transport and use surface or ground water beyond overlying land or outside the watershed from which it is taken if the commission determines that such transport and use are consistent with the public interest and the general plans and land use policies of the State and counties." (HRS section 174C-49(c))

Finally, appurtenant rights are preserved, subject to sections 174C-26 (filing of declaration), 174C-27 (issuance of a certificate declaring the use to be reasonable and beneficial), and sections 174C-58 to 174C-62 (revocations and transfers of permits, contested cases, fees, and declarations of water shortages). (HRS section 174C-63)

B. APPURTENANT RIGHTS AND RIPARIAN USES

Appurtenant water rights are incidents of the ownership of land, which, by virtue of their appurtenant nature, may not be transferred or applied to lands other than those to which the rights appertain. They may, however, be extinguished by the grantor of such lands. (65 Haw. 531, at 552 (1982))

When the same parcel of land is being utilized to cultivate traditional products by means approximating those utilized at the time of the Mahele, there is sufficient evidence to give rise to a presumption that the amount of water diverted for such cultivation sufficiently approximates the quantity of appurtenant water rights to which that land is entitled. (65 Haw. 531, at 554)

Riparian landowners are entitled to make reasonable use of the quantity and flow of a natural watercourse. The agricultural activities of taro farmers constitute a reasonable use of such waters if their mode of irrigation approximates that which has been historically utilized for the cultivation of taro. (Reppun v. Board of Water Supply, 65 Haw. 531, at 553-554)

A riparian proprietor has the right to enjoy the benefits of a flow of water, as an incident to his estate, can use the water for irrigation, watering his cattle, and other domestic purposes, provided he does not materially diminish the supply of water or render useless its application by others. (65 Haw. 531, at 552-553)

Water rights attaching to riparian lands by virtue of HRS section 7-1 cannot be severed or extinguished by a riparian landowner's grantor. (65 Haw. 531, at 550)

C. PUBLIC TRUST DOCTRINE

"The Hawai'i Constitution states that 'all public resources are held in trust by the state for the benefit of its people,' Haw. Const. art. XI, section 1, and establishes a public trust obligation 'to protect, control, and regulate the use of Hawaii's water resources for the benefit of its people,' Haw. Const. art. XI, section 7." (94 Haw. 97, at 133; 9 P.3d 409, at 445)

"(T)he state has certain powers and duties which it cannot legislatively abdicate." (94 Haw. 97 at 130-131; 9 P.3d 409 at 442-443) "Even with the enactment and any future development of the Code, the doctrine continues to inform the Code's interpretation, define its permissible 'outer limits,' and justify its existence… (A)lthough…the public trust and Code…shar(e) similar core principles…the Code does not supplant the protections of the public trust doctrine." (94 Haw. 97 at 133; 9 P.3d 409 at 445)

The Hawai`i Supreme Court has recognized that "the extent of the state's trust obligation over all waters of course would not be identical to that which applies to navigable waterways." (<u>Robinson v. Ariyoshi</u>, 65 Haw. 641 at 675; 658 P.2d 287 at 310) "In Hawaii…a distinct public trust encompass(es) all the water resources of the state…(T)he public trust doctrine applies to all water resources without exception or distinction." (94 Haw. 97 at 133; 9 P.3d 409 at 445)

The Hawai`i Supreme Court has held that the state's water resources trust embodies the following fundamental principles: (1) "the state has both the authority and duty to preserve the rights of present and future generations in the waters of the state"; (2) "(t)his authority empowers the state to revisit prior diversions and allocations, even those made with due consideration of their effect on the public trust"; and (3) "(t)he state also bears an affirmative <u>duty</u> to take the public trust into account in the planning and allocation of water resources, and to protect public trust uses whenever feasible" (internal quotes omitted).[4] (94 Haw. 97 at 141; 9 P.3d 409 at 453)

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[4] In a footnote accompanying the word "feasible," the Hawai`i Supreme Court noted that, read narrowly, it could mean "capable of achievement," apart from any balancing of benefits and costs. The Court then noted that it did not use "feasible" in this strict sense. (94 Haw. 97 at 141; 9 P.3d 409 at 453) The Court also noted elsewhere that "(w)e have indicated a preference for accommodating both instream and offstream uses where <u>feasible</u> (emphasis added)." (94 Haw. 97 at 142; 9 P.3d 409 at 454)

"Reason and necessity dictate that the public trust may have to accommodate offstream diversions inconsistent with the mandate of protection, to the unavoidable impairment of public instream uses and values...(A)rticle XI, section 1 (of the Hawaii Constitution) does not preclude offstream use, but merely requires that all uses, offstream or instream, public or private, promote the best economic and social interests of the people of this state." (94 Haw. 97 at 141; 9 P.3d 409 at 453) "The state water resources trust thus embodies a dual mandate of 1) protection and 2) maximum reasonable and beneficial use." (94 Haw. 97 at 139; 9 P.3d 409 at 451) "In short, the object is not maximum consumptive use, but rather the most equitable, reasonable, and beneficial allocation of state water resources, with full recognition that resource protection also constitutes 'use.'" (94 Haw. 97 at 140; 9 P.3d 409 at 452)

The maintenance of waters in their natural state constitutes both resource protection and a distinct use under the water resources trust; and domestic water use and the exercise of Native Hawaiian and traditional and customary rights are also purposes of the state water resources trust. (94 Haw. 97 at 136-137; 9 P.3d 409 at 448-449)

"(W)hile the state water resources trust acknowledges that private use for 'economic development' may produce important public benefits and that such benefits must figure into any balancing of competing interests in water, it stops short of embracing private commercial use as a protected 'trust purpose'…(I)f the public trust is to retain any meaning and effect, it must recognize enduring public rights in trust resources separate from, and superior to, the prevailing private interests in the resources at any given time." (94 Haw. 97 at 138; 9 P.3d 409 at 450)

"Given the diverse and not necessarily complementary range of water uses, even among public trust uses alone, (the Hawai`i Supreme Court) consider(s) it neither feasible nor prudent to designate absolute priorities between broad categories of uses under the water resources trust…(T)he Commission inevitably must weigh competing public and private water uses on a case-by-case basis, according to any appropriate standards provided by law…(A)ny balancing between public and private purposes (must) begin with a presumption in favor of public use, access, and enjoyment…In practical terms, this means that the burden ultimately lies with those seeking or approving such uses to justify them in light of the purposes protected by the trust…(T)he Commission must not relegate itself to the role of a mere umpire passively calling balls and strikes for adversaries appearing before it, but instead must take the initiative in considering, protecting, and advancing public rights in the resource at every stage of the planning and decision making process..(T)he public trust compels the state duly to consider the cumulative impact of existing and proposed diversions on trust purposes and to implement reasonable measures to mitigate this impact, including the use of alternative sources (citations and internal quotes omitted)" (94 Haw. 97 at 142-143; 9 P.3d 409 at 454-455)

IV. INTERIM INSTREAM FLOW STANDARDS FOR WAIAHOLE (AND ITS TRIBUTARY, WAIANU), WAIKANE AND KAHANA STREAMS[5]

A. HISTORY OF THE WAIAHOLE DITCH AND TUNNEL SYSTEM AND ITS EFFECTS ON WINDWARD STREAM FLOWS

1. WAIAHOLE DITCH AND TUNNEL SYSTEM

Summary. The Waiahole Ditch and tunnel system transects dikes containing high-level ground water on the windward side of the Ko`olau mountains between 700 and 800 feet elevation, drawing dike-impounded water from the mountains overlooking Kahana (elevation 790 feet) and Waiahole (elevation 754 feet) Valleys, and transporting the water to leeward O`ahu. Initiated with the intent of transporting windward stream (surface) and spring water, construction revealed the far greater amount of dike-impounded water that was encountered by the tunnels under construction.

Currently, only 2.1 mgd of surface water from the headwaters of Kahana Stream are being diverted, with the remainder of the total on average of 23.3 mgd developed directly from the tunnel system. An additional 3.7 mgd on average (measured between the North Portal crest gauge station and Adit 8, where the waters emerge from underground and flow into the leeward ditch) are developed within the tunnel (the "main bore") transporting these waters to the leeward side.

"Dikes, mostly vertical and parallel or subparallel to the fissure zone, control movement and discharge of ground water because they are less permeable than the rocks they intrude. Dikes impound or partly impound ground water by preventing or retarding its movement toward discharge points. The top of this water, called high-level water in Hawaii, is at an altitude of about 1,000 feet in the north end of windward Oahu and 400 feet near the south end of Waimanalo Valley. It underlies most of the area and extends near or to the surface in poorly permeable rocks in low-lying areas." (United States Geological Survey Water Supply Paper 1894, Exhibit No. N-118, at 1) "As a general rule, the dikes (between Waiahole and Kahana) are vertical or nearly vertical." (United States Geological Survey Water Supply Paper 2217, Exhibit No. M-36D, at 28)

The bed rock on which these dike-impounded waters rest, extends to about 400 feet elevation in the Waiahole-Waikane drainage basin, and acts as a dam for the high level water in the dike compartments. (D. Lum, Tr., 4/24/96 at 44, lines 7-21)

A 1911 report explained the rationale for driving a tunnel at about 750 feet altitude from the windward or east side of the Ko`olau crest to the west or lee side of O`ahu: "There is a pronounced strata of hard and impervious bed rock, which apparently

[5] In sections IV-IX, addressing the seven issues remanded to the Commission by the Supreme Court, the factual bases for the conclusions which are reached are presented.

forms the floor, or bed, of the under-ground reservoir, the top of which appears on the windward side of the range at an elevation of approximately 850 ft in the Waiahole District. This bed rock can be observed continuously from Waiahole through to the Kahana Gulch, it being perhaps 50 ft higher in the Kahana District, and lower in the districts southerly from Waiahole. This bed rock appears to be overlaid with a porous formation, which carries large quantities of water. Practically all of the spring waters, which have been measured at the 750 ft level, on the windward side of the island in connection with these investigations, are fed from the underground reservoir, and issue from the top of this stratum of bed rock." (Exhibit M-36D, at 2)

The Waiahole Ditch and tunnel system consists of dike water development tunnels, surface water intakes, open ditches, gates, flumes, siphons, roads, trails, camps, support shops, etc. The system starts at Kahana Valley in windward O`ahu, collects primarily groundwater and some surface water through a series of development tunnels in the Ko`olau Mountains, and transports the non-potable water to Central and Leeward O`ahu primarily for agricultural purposes. (Hatton, Binder #1, written direct testimony, Exhibit A-1, at 4-5)

The portion of the tunnel from North Portal[6] leeward is known as the Trans-Ko`olau Tunnel or the Waiahole Main Bore. It is 14,500 feet in length, and the elevation is approximately 724 feet at the south portal Adit 8, and 754 feet at the North Portal. (Chuck Tr. 12/14/95 at 71, lines 14-18) The transmission tunnel from Kahana to North Portal is 24,621 feet in length and 790 feet elevation at the Kahana end. ("Geology and Ground-Water Resources of the Island of Oahu, Hawaii," by Stearns and Vaksvik, Division of Hydrography, Department of Public Lands, Territory of Hawai`i, May 1935, at 399; cited in Exhibit N-118, at 12, and by Lum, Tr., 4/24/96, at 27, lines 17-22)

The main tunnel (main bore), the section of the tunnel system that transects the Ko`olau mountains to connect the windward water collection tunnels to the leeward ditches, was constructed between 1913 and 1916. (Hatton, Binder #1, written direct testimony, Exhibit A-1, at 2)

Between 1925 and 1935, the Kahana, Waikane #1, Waikane #2 and the Uwau Main Tunnels were developed to collect dike-impounded water. (Hatton, Binder #8, written rebuttal testimony, at 2-3) As the system collected more dike water, it collected less surface water. Thus, except between 1925 and 1935 when the development tunnels were under construction, the amount of water flowing through the Ditch system has been relatively constant from 1916 through 1994. (Hatton, Binder #8, written rebuttal testimony, Exhibit A-R-1, at 3)

In 1964 the Uwau tunnel was extended by about 220 feet, and about 177 of those feet was past the crest of the Ko`olaus into Waipio lands owned by Castle & Cooke.

[6]The "North Portal" is an opening in the pali face at ditch level on the windward side. The "North Portal gauge" is directly under the crest of the Ko`olau mountains, at the divide between the leeward and windward sides of O`ahu.

(Hatton, Binder #1, written direct testimony, Exhibit A-1, at 2; Tr., 11/29/95, at 46, lines 21-24.)

Until 1982 about 1 to 1.5 mgd of water was pumped from Waiahole Stream at 450 feet elevation into the Waiahole Ditch. This practice was stopped due to pumping costs. (Hatton, Binder #8, written rebuttal testimony, Exhibit A-R-1, at 6)

In 1992 a bulkhead was installed at the Kahana Development Tunnel by the State of Hawai`i. (Hatton, Tr., 11/29/95, at 49, lines 6-8)

Average flows in the Waiahole Tunnels follow. Except for the period when the development tunnels were being built, variability in ditch flow runs roughly between 20 to 30 mgd. (Hatton, Tr., 4/10/96, at 98, lines 11-13) The average flows for the period 1989 to 1993 were selected because the flows were neither extraordinarily high nor were they extraordinarily low, and it was also after pumping from Waiahole Stream into the ditch system had ceased. (Hatton, Tr., 11/29/95, at 48, lines 7-13)

The average amount of water developed from the Kahana Development Tunnel was 2.6 mgd. In addition, there was about an additional 2.1 mgd of Kahana Stream surface water that is also collected, giving the total waters collected from Kahana of about 4.7 mgd. ((Hatton, Tr. 11/29/95 at 48, line 21 to 49, line 20)

Waikane #1 develops approximately 4.2 mgd, and Waikane #2 develops approximately 1.1 mgd. At this point in the system, the total waters developed, including the Kahana waters, were approximately 10 mgd. (Hatton, Tr., 11/29/95 at 49, line 21 to 50, line 6)

The system then enters the lands of Uwau and Waianu. The Uwau Development Tunnel has two components: the original Uwau Tunnel, and its 1964 extension. Approximately 8.7 mgd is developed in the main part of the Uwau Development Tunnel, on the windward side of the Ko`olau crest, and another 4.8 mgd is developed in the Uwau Tunnel extension, on the leeward side of the Koolau crest, for a total of 13.5 mgd. At this point, the total water developed is 23.5 mgd. (Hatton, Binder #1, written direct testimony, Exhibit A-1, at 5, lines 6-8)

The 1964 Uwau extension developed only a net of 2.77 mgd. Before the extension was built, some of the water upstream of the gauge was finding its way into the already existing main Uwau development tunnel. Therefore, about half of the Uwau Tunnel extension water represents a decrease from the main tunnel prior to construction of the extension. (Hatton, Binder #8, written rebuttal testimony, Exhibit A-R-1, at 5, lines 4-12)

The total water developed between the lands of Uwau and Waianu and the North Portal gauge, which is directly underneath the crest of the Ko`olaus, was approximately 1.3 mgd. Therefore, the system to this point for the period of record developed approximately 24.8 mgd. (Hatton, Tr., 11/29/95, at 52, lines 9-22)

During this period of record, 1989 to 1993, the Kahana bulkhead was installed in early 1992. Ditch flows from Kahana tunnel have been reduced by approximately 1.5 mgd to 1.1 mgd from the original flow of 2.6 mgd. Therefore, the system from Kahana to North Portal gate developed approximately 23.3 mgd. (Hatton, Tr., 4/10/96, at 108, lines 8-10; Exhibit A-R-103, attachments 5-26 to 5-30)

Beyond the North Portal, the tunnel then enters into the lands of Waiawa, which are owned by Kamehameha Schools/Bernice Pauahi Bishop Estate ("KSBE"). (Hatton, Tr., 11/29/95 at 53, lines 3-4) (This section between the North Portal and Adit 8 is called the "main bore.")

For the period of record from 1989 to 1993, the total average water developed between the North Portal crest gauge station and the gauging station at the leeward end of the main bore at Adit 8 was 3.7 mgd. (Hatton, Tr., 11/29/95, at 53, lines 4-10; Chuck, Tr., 12/14/95, at 72, lines 15-18). Thus, the total water developed from Kahana to Adit 8 is approximately 27.0 mgd for the period of record.

2. IMPACT ON WINDWARD STREAM FLOWS

Summary. The Waiahole Ditch's tunnel system has affected the flow of Waiahole (and its tributary, Waianu), Waikane, and Kahana Streams, but not the flow of Hakipu`u Stream. While experts agree that the stream flows have been significantly affected by the tunnels, they disagree on whether there is a one-to-one relationship between ditch flows and loss of flows from the streams, although all agree that most, if not all, of the tunnel waters would have flowed into the windward streams.

Streams in Hawai`i are typically very flashy in nature. They can rise up to many times the base flow when a storm occurs, then come right back down. Windward streams are usually short and have steep gradients, are flashy, and can rise and fall several feet in a few hours. The annual maximum discharge usually occurs in the cooler months, October through April.

The base flow is an estimate of the dry-weather or ground-water contribution to a stream's flow. The average flow is an average of all flows, including the base flow and rainfall, runoff and percolating ground waters from the surface. For example, the U.S. Geological Survey estimates that, in the post-ditch period, the long-term average and base flows for Waiahole Stream are 6.9 mgd and 3.9 mgd, respectively.

The only historical data on stream flows prior to construction of the Waiahole Ditch's tunnel system were: 1) for Waiahole Stream: 98 daily measurements taken from September 25 through December 31, 1911; 2) for Waianu Stream: 22 measurements taken at various dates in September to November, 1911; 3) for Waikane Stream: a single measurement taken on October 9, 1911; and 4) for Kahana Stream: a single measurement taken on October 27, 1911. During the

period August 16, 1911, through January 3, 1912, the average daily rainfall in Waiahole Valley was 0.43 inches, clearly not a dry period, even when the period of observation includes more than a month of summer before the actual measurements were taken. Using the lowest measurements for Waiahole and Waianu Streams and the single measurements for Waikane and Kahana Streams, and comparing them to U.S. Geological Survey estimates of post-Waiahole Ditch base flows, the cumulative deficit totals 9 mgd.

Water diverted by the Waiahole Ditch's tunnel system is the maximum amount that could have been diverted from the affected streams. Experts do not disagree that most of the water would have flowed as part of the ground-water contribution to the streams. Their only disagreement is whether or not all of the tunnel water would have entered the streams. Thus, the estimates based on the limited 1911 stream flow measurements likely overestimate the cumulative four-stream deficit by nearly 9 mgd (32.2 mgd minus 23.3 mgd equals 8.9 mgd) or nearly 40 percent (8.9 mgd divided by 23.3 mgd equals 38%).

"Valleys on the windward side penetrate deeply into the mountains and cut into the dike-impounded reservoir, whereas most of the leeward valleys do not. This causes proportionately more dike-impounded water to leak to the windward side from the area underlying the crest. Consequently, the ground-water divide lies (somewhere) to the leeward along most of the crest." (Exhibit M-36D, at 18)

"The flow of Waiahole (and its tributary, Waianu), Waikane, and Kahana Streams have (*sic*) been affected by the Waiahole Ditch tunnel system, which diverts water at an altitude of 800 feet.[7]" (Exhibit N-118, at 74) Thus, the U.S. Geological Survey does not consider Hakipu`u Stream to be affected by the Waiahole tunnels.

Hakipu`u Stream does not go all the way back up to the Ko`olau crest, and a good portion of that stream is below 400-foot elevation (that is, below the top of the bed rock underlying the dike-impounded ground water through which the tunnel system has been dug – Exhibit M-36D, at 2). (Lum, Tr., 4/24/96, at 52, line 15 to 53, line 8)

"Waiahole, Waianu, and Waikane Streams lie down-gradient from Uwau tunnel and Waikane tunnels 1 and 2 and lie entirely in the dike complex. The total base flow of the streams below tunnel level is 5.8 mgd or only about a third of the flow of the upgradient tunnels. In contrast, Kahana Stream, downgradient from Kahana tunnel, lies only partly in the dike complex and mostly in the marginal dike zone. Its base flow below tunnel level is 11.2 mgd, or about three times the flow of the tunnel (before the Kahana bulkhead was installed)." (Exhibit M-36D, at 35)

"Leakage and overflow from the dike-impounded water bodies, not exploited by tunnels, continues (*sic*) to provide flow in all streams at the lower levels. Exceptions are

[7] Note, *supra*, that the actual elevations are 790 feet at Kahana and 754 feet at North Portal.

the lower parts of Hakipuu and Kaaawa Streams, which are somewhat isolated from the main Koolau mass." (Exhibit M-36D, at 35) In other words, the lower reaches of the streams are being fed by dikes that are not cut by the tunnel. (Lum, Tr., 4/24/96, at 42, lines 8-15) Windward streams are gaining streams, although Hakipu`u Stream is a losing stream in much of its reach. Between altitudes of 400 and 250 feet, Waiahole Stream cuts deeper into saturated rock in this reach than streams in the other valleys, resulting in more leakage into the stream. (Exhibit M-36D, at 35)

However, while experts agree that the stream flows have been affected significantly by the tunnels, they disagree on whether there is a one-to-one relationship between ditch flows and loss of flows from the streams. The following statements illustrate these disagreements.

On one hand is the following:

> "The stored dike water discharges where the streams have cut notches in the dikes, and some of the water probably discharges as underflow, through or around the dikes…The tunnels that were constructed to develop the stored water have provided lower points of discharge from the dike reservoirs. The base-flow regimen of the streams is affected, and probably part of the underflow is intercepted. The uncontrolled flow from the tunnels varies with reservoir level similarly to the variations in base flow of the streams. The combined flow from tunnels and streams probably exceeds on average the flow from the streams before the tunnels were added. The additional flow is composed of intercepted underflow and the increase in recharge. Recharge is likely increased because the tunnels drain the stored water faster between storms, thereby providing more space in the reservoir. Storm water that formerly might have run off directly to the streams, when the ground-water reservoir was full, now may infiltrate and enter the dike reservoir." (Exhibit N-118, at 27-28)

In contrast are the following:

> "The reduction in the base stream flow may be considered approximately equal to that quantity that is diverted away from the stream sources after sufficient time has passed so that the diverted flows stabilize." ("Preliminary Engineering Report Covering Water Resources in Waiahole Valley," by Russ Smith for the Hawai`i Housing Authority, State of Hawai`i, Honolulu, January 31, 1980, Exhibit N-117 at 4-5)

> "Q: So your testimony as a hydrologist is there is a one-for-one correlation on measurable Uwau Tunnel production and baseflow in each of those three streams (Waiahole, Waianu, and Waikane),[8] one-for-one correlation?

[8] Earlier in his testimony, Meyer had identified the three streams as Waiahole, and its two tributaries, Waianu and Uwau (which flows into Waianu). (Meyer, Tr., 4/16/96, at 10, lines 3-7). However, he also stated that the combined base flow of these three streams was 5.8 mgd, which is the combined base flow of

A: Our reports have indicated that, for all practical purposes, the water diverted by the tunnels would have entered the stream.[9]
Q: Your testimony – again, your testimony is that if – there is a one-for-one correlation, for each gallon developed in the tunnel?
A: I'm testifying as the head of U.S. Geological Survey for our work."
(Meyer, Tr., 4/16/96, at 12, line 19 to 13, line 7)

Again, on one hand:

"Under natural conditions, all of the water (collected by the Waiahole Tunnel complex) probably drained to Kaneohe Bay, including the 10 mgd or so from the leeward side of the crest." (Excerpts from "Report on the Hydrologic Investigation of Groundwater and Surface Water Conditions in the Windward O`ahu Water Management Area, O`ahu," by George A.L. Yuen and Associates, Inc., for the Commission on Water Resource Management, September 1989, and revised February 1990, Exhibit N-119 at 63)

In contrast are the following:

"Before excavation of the main bore, part of this water probably moved to the windward area, and the rest moved leeward from the ground-water divide. Owing to a lack of detailed information, half the average discharge…and half of the Q90 (of the main bore)…are assigned to the windward side." (Exhibit N-118, at 74)

"(S)hould the Ditch flow be discontinued, the dike-confined water will discharge naturally at the surface in the form of springs feeding windward streamflow, and beneath the surface recharging adjacent windward dike-confined and basal aquifers. In the undeveloped state, the dike compartments now supplying the Waiahole Ditch system undoubtedly also leaked water in the leeward direction, ultimately recharging the aquifers of the Pearl Harbor region." (Meyer, Binder #7, written direct testimony, exhibit H, at 7)

And even the head of the U.S. Geological Survey, who testified that there was a one-for-one correlation to stream flow for each gallon of water developed in the tunnel, *supra*, stated later in the same testimony that "it would seem very, very likely that some of the water being drained by the tunnels that goes into the Ditch on the Windward side is

Waiahole, Waianu, and Waikane Streams. There is no average or base flow data for Uwau Stream (Exhibit N-118, at 40) Furthermore, he was not asked, nor did he explain, why Waikane Stream would have been affected by the Uwau Tunnel, which would have affected streams in the Waiahole watershed. So it is unclear from his testimony whether he was referring to Waiahole Stream and its tributaries, or also including Waikane Stream as being affected by the Uwau Tunnel extension in 1964.

[9] But the opposing statement, *supra*, is taken from a U.S. Geological Survey publication. (Exhibit N-118, at 27-28)

derived from water that would have normally gone into the Leeward streams." (Meyer, Tr., 4/16/96, at 19, lines 19-23)

These contrasting opinions reflect uncertainty in the scientific foundations on which these opinions are based. Thus, at other times, the experts are explicit in stating their limitations:

> "Before excavation of the main bore, part of this water probably moved to the windward area, and the rest moved leeward from the ground-water divide. Owing to a lack of detailed information, half the average discharge…and half of the Q90 (of the main bore)…are assigned to the windward side." (Exhibit N-118, at 74)
>
> "If all tunnels were sealed, eventually, the natural or near natural conditions would return and the base flow of the affected streams would be increased to near natural conditions. USGS cannot, however, estimate the gain to the affected streams at this time…One possible way to estimate the gain of the base flow of the windward streams would be to model the dike-stream flow system." (Meyer, Binder #7, written direct testimony, at 7) On the other hand, "(t)he vast initial storage that has been depleted could not likely be returned to its original state because of disruption to the integrity of the reservoir caused by tunnel construction." (Exhibit M-36D, at 32)

Stream flows are measured in: 1) base flows and 2) average flows, at specified places along the streams' reaches, usually with corresponding altitudes noted. (Exhibit N-118, at 40)

Most of Hawai`i's streams are classified as straight channels. Straightness is determined by the ratio of the valley length to the river length, and in Hawai`i they are about the same. Their steepness has some bearing on this. In steep channels, when you put more flow in, they tend not to spread out and not to deepen very much compared to how they speed up. The water just goes faster, it doesn't get a lot deeper, and it doesn't spread out a whole lot more with increasing flows. (Bovee, Tr., 4/10/96, at 199, lines 7-20) Streams in Hawai`i are typically very flashy in nature. They can rise up to many times the base flow when a storm occurs, then come right back down. (Lum, Tr., 4/24/96, at 59, lines 9-13 and at 70, lines 19-24) Windward streams are usually short and have steep gradients, are flashy, and can rise and fall several feet in a few hours. The annual maximum discharge usually occurs in the cooler months, October through April. (Devick, Binder #2, written direct testimony, Exhibit L-300, at 2.)

The base flow is an estimate of the ground-water contribution to the stream. The Q90 flow is used as an index of the reliability of flow from a water source for water development studies and represents that volume of water that is equaled or exceeded 90 percent of the time over the period of record. The Q90 flow is an estimate of the dry weather flow (base flow) of streams, and, in most cases, the Q90 flow is an estimate of the ground-water contribution to the stream. (Meyer, binder #7, written direct testimony, at 4-5)

The average flow is an average of all flows, including the base flow and rainfall, runoff and percolating ground waters from the surface. Therefore, the base flow is less than the actual amount of water that flowed in the streams during the time periods chosen. (Lum, Tr., 4/24/96, at 55, line 1 to 56, line 4)

The United States Geological Survey (USGS) uses multiple-year data to compute stream flows, and its "inventory of streamflow for all perennial streams in windward Oahu" uses the base period July 1, 1926, to June 30, 1960. (Exhibit N-118, at 33). Estimates of the long-term average and Q90 flows of Waiahole, Waianu, Waikane, and Kahana Streams are as follows:

Waiahole Stream: the point of maximum base flow is at its confluence with Waianu Stream[10], where the long-term average flow is 6.9 mgd[11] and the Q90 flow is 3.9 mgd.

Waianu Stream: the point of maximum base flow is at its confluence with Waiahole Stream, where the long-term average flow is 1.2 mgd and the Q90 flow is 0.5 mgd.

Waikane Stream: the point of maximum base flow is at 75 feet altitude, where the long-term average flow is 4.2 mgd and the Q90 flow is 1.4 mgd.

Kahana Stream: the point of maximum base flow is at 15 feet altitude, where the long-term average flow is 29.5 mgd and the Q90 flow is 11.2 mgd. (Exhibit N-118, at 40, 75, and 88)

Pre-ditch flows for the windward streams are limited to 1911 and 1912 data[12] (Lum, Tr., 4/24/96, at 26, line 9 to 31, line 9), not enough to account for seasonal variations. For example, in 1961, when rainfall was 100 inches measured at the Waiahole Rain Gauging Station at elevation 750 feet, Waiahole Stream averaged 4 mgd; in 1965, when rainfall was 200 inches, Waiahole Stream averaged 10 mgd, two-and-a-half times greater than the 1961 average. (Hatton, Tr., 4/10/96, at 102, line 21 to 103, line 8)

Nevertheless, some experts have expressed opinions on pre- and post-ditch stream flows.

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[10] The elevation at this point is 80 feet. (Lum, Tr., 4/24/96, at 74, line 25 to 75, line 1)

[11] This is the average flow at the point in the stream where the base flow has reached its maximum. Average flows further downstream would be higher, the amount depending on runoff and rain in the part of the watershed which drains into these lower reaches of the stream. In contrast to average flows, contribution of base flow at points lower downstream would not increase and would be the same as its contribution at the elevation where base flow had reached its maximum.

[12] However, as explained, *infra*, all pre-Ditch data introduced into evidence was from 1911 only.

Lum testified on the amounts of water to be released from the ditch into Waiahole, Waianu, Waikane and Kahana Streams, which would result in a continuous flow in the streambeds from ditch level to where the streams first contain water. In these comparisons, he used data from miscellaneous months in 1911 and 1912 for pre-ditch stream flows for Waiahole Stream, data from miscellaneous months in 1911 for Waianu and Waikane Streams, and data from miscellaneous months in 1911 and 1916 for Kahana Streams.[13] (Lum, Tr., 4/24/96, at 23, line 3 to 48, line 21) Lum's rationale for using these periods was that stream flow values recede or diminish to a low point in dry periods, thus representing base flows, (Lum, Tr., 4/24/96, at 24, lines 4-9) and 1911 and 1912 were dry years in the Waiahole area.[14] (Lum, Tr., 4/24/96, at 26, lines 13-16)

Before the Ditch was constructed, at Ditch level (750 feet elevation), Lum made the following estimates:

Waiahole Stream had a flow of 8.1 mgd from three springs. (Lum, Tr., 4/24/96, at 26, lines 21-22, and Exhibit J-94)[15]
Waianu Stream had a flow of 4.2 mgd. (Lum, Tr., 4/24/96, at 28, lines 24-25, and Exhibit J-95)
Waikane Stream had a flow of 2.8 mgd. (Lum, Tr., 4/24/96, at 30, lines 10-15, and Exhibit J-96)
Kahana Stream had a flow of 7.5 mgd. (Lum, Tr., 4/24/96, at 31, lines 1-2, and Exhibit J-97)

Lum's estimates of maximum base flow for these streams were as follows:

Waiahole Stream: 11.5 mgd[16] (Lum, Tr., 4/24/96, at 26, line 23 to 27, line 2, and Exhibit J-94)
Waianu Stream: 7.2 mgd[17] (Lum, Tr., 4/24/96, at 28, line 24 to 29, line 2, and Exhibit J-95)

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[13] Lum used only a few data points for his post-ditch flows: July 1959 for Waiahole Stream, July 1959 and May 10, 1995 for Waianu Stream, July 1959 for Waikane Stream, and 1960 and 1961 for Kahana Streams.
[14] But see discussion, *infra*, on The Russ Smith Corporation's study of 1911 stream data. During the period of these 1911 measurements, which were made in the winter of 1911, the average rainfall in Waiahole Valley was nearly one-half inch per day.
[15] In his testimony, Lum cites "Stearns in bulletin one in which he gives the values for three major streams just below the Ditch system, and the total was 8.1 (mgd), and that corroborates the miscellaneous measurements (emphasis added)." (Lum,Tr., 4/24/96, at 26, lines 17-20) However, either Lum was misquoted in the transcription or he misstated "streams" for "springs." In Bulletin 1 by Stearns and Vaksvik , they describe three springs in Waiahole Valley at altitudes of about 750 feet, discharging 4.7 mgd, 1.0 mgd, and 2.4 mgd, respectively, for a total of 8.1 mgd. (Stearns and Vaksvik, *supra*, at 403) Lum did not provide sources for his estimate for the other three streams.
[16] The source of this estimate is not specified, other than a comment by Lum that it was "a value that I found in the year 1912, and it was a minimum flow condition." (Lum, Tr. 4/24/96, at 26, lines 24-25) In contrast, according to U.S. Geological Survey Water Supply Paper 318, at 183 (Waiahole Stream flow above junction with Waianu), the reference used by The Russ Smith Corporation, Exhibit N-117, *infra*, stream flow was 14.5 mgd on September 10, 1911. And the lowest flow recorded among 98 measurements from September 16 through December 31, 1911, was 14.4 mgd. (see discussion, *infra*)

Waikane Stream: 6.0 mgd[18] (Lum, Tr., 4/24/96, at 30, line 12-19, and Exhibit J-96)
Kahana Stream: 11 mgd[19] (Lum, Tr. 4/24/96, at 31, lines 2-4, and Exhibit J-97)

In a 1980 report on water resources in Waiahole Valley, The Russ Smith Corporation also made estimates on pre-ditch flows for Waiahole and Waianu Streams.[20] (The Russ Smith Corporation, Exhibit N-117)

As the Russ Smith Corporation's focus was on developing more water from the Waiahole Valley watershed, its focus was on average flows, and not on base flows, or the ground-water contribution to stream flows. However, examination of its source of data -- U.S. Geological Survey Water Supply Paper 318, published in 1913 – provides information on the range of stream flows in the short periods Waiahole and Waianu Streams were observed. Whatever the data's shortcomings, the lowest flows recorded during this time are more representative of base flows than the average flows that were the focus of the Russ Smith Corporation's report. However, further illumination on the limitations of this 1911 data is provided by first analyzing the Russ Smith Corporation's presentation of its average flow data.

According to the Russ Smith Corporation's report, the estimates of average stream flow were based on data from 98 daily readings from September 25 through December 31, 1911 for Waiahole Stream and 22 readings in September, October, and November of 1911 for Waianu Stream.[21] (Exhibit N-117, at 7)

The Russ Smith Corporation reported that average flow[22] at the mouth of Waiahole Stream was 30.2 mgd (46.6 ft-sec. or cubic feet per second (cfs)), accompanied by the following statement: "This flow was not caused by heavy rains, low flow during

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[17] Although Lum did not identify his source for this estimate, it matches the data in U.S. Geological Survey Water Supply Paper 318, at 183 (Waianu Stream flow above junction with Waiahole, measured on September 10, 1911), the reference used by The Russ Smith Corporation, Exhibit N-117, *infra.*

[18] Although Lum did not identify his source for this estimate, it matches data in USGS Paper 318, at 178 (Waikane Stream flow above all diversions, about 2 miles from the mouth, measured on October 9, 1911), the reference used by The Russ Smith Corporation, Exhibit N-117, *infra*.

[19] This value reflects 1916 data, which Lum stated was a reasonable and usable number, because the Kahana, Uwau and Waikane development tunnels weren't constructed until after 1925. (Lum, Tr., 4/24/96, at 31, lines 2-8) However, surface water diversions from the headwaters of Kahana Stream into the Waiahole ditch and tunnel system were already occurring. According to data in USGS Paper 318, at 177 (see preceding footnote), on October 27, 1911, Kahana Stream flow was 32.2 cubic feet per second (cfs), or 21.0 mgd.

[20] Because the report was specifically on Waiahole Valley, there was no analysis of pre-ditch data for Waikane and Kahana Streams.

[21] Lum, *supra*, did not specify the months or days in 1911 on which he based his estimates, other than to state that he used "particularly the months of June and July." (Lum, Tr., 4/24/96, at 26, lines 12-13) However, as noted in footnotes accompanying Lum's estimates, *supra*, his data on Waianu and Waikane Streams match those contained in USGS Water Supply Paper 318, which contain measurements from September to December 1911 only.

[22] This is the average flow at the point in the stream where the base flow has reached its maximum. Average flows further downstream would be higher, the amount depending on runoff and rain in the watershed. The contribution of base flow at points lower downstream would not increase and would be the same as its contribution at the elevation where base flow had reached its maximum.

the entire month of November was 44 sec.-ft. (28.7 mgd) while the high flow was 49 sec.-ft. (31.7 mgd)." (Exhibit N-117, at 6)

However, the Russ Smith Corporation was being selective in its reporting. The average flow of 30.2 mgd was based on 98 measurements from September 25 to December 31, 1911, not just on the 30 measurements in the month of November 1911. Among these 98 measurements, the highest was 130 cfs (84.9 mgd) on October 1, 1911, and the lowest were 33 cfs (21.6 mgd) on September 28 and 29, 1911. In September 1911, highest flow was 59 cfs (38.5 mgd) and lowest flow was 33 cfs (21.6 mgd). In October 1911, highest flow was 130 cfs (84.9 mgd) and lowest flow was 39 cfs (25.5 mgd). In November 1911, high and low flows were as reported by the Russ Smith Corporation, *supra*. And in December 1911, highest flow was 61 cfs (39.8 mgd) and lowest flow was 44 cfs (28.7 mgd). (USGS Water Supply Paper 318, at 181, cited in Exhibit N-117 at 6)

Moreover, the Russ Smith Corporation stated that rainfall records for the post-ditch period, 1955 through 1966, were comparable to the September through December 1911 period, stating that the 1911 period averaged 0.43 inches per day, and the 1955 through 1966 period, an average of 0.41 inches per day. However, the Russ Smith Corporation did not compare similar periods. For 1911, the Russ Smith Corporation included rainfall measurements from August 16, 1911, through January 3, 1912 (even though stream flow measurements had been taken from September 25, 1911, through December 31, 1911); while for the 1955 through 1966 period, they included measurements only from October through December.[23] (Exhibit N-117, at 14-15)

These shortcomings aside, what the Russ Smith Corporation's report shows is that, for the 1911 pre-ditch measurement period, rainfall was averaging nearly half-an-inch a day. Note that Lum had commented that 1911 and 1912 were dry years (*supra*, and Lum, Tr., 4/24/96, at 26, lines 13-16), but the rainfall records for the period in which the stream measurements were taken apparently do not support his conclusion, at least for the year 1911.

The Russ Smith Corporation's report focused particularly on October 11, 1911, for a simple reason; the Russ Smith Corporation was attempting to identify total Waiahole Watershed stream flows for the pre-ditch period, and that was the only day in which measurements had also been taken for two tributaries, Halona (a tributary of Waiahole Stream's main channel) and Uwau (a tributary of Waianu Stream, which in turn was the main tributary of Waiahole Stream).

[23] There is no explanation in the report why the rainfall data for 1911 started at August 16. The Waiahole Stream measurements started on September 25 and the Waianu Stream measurements included two on September 9 and 10, but except for one measurement on November 22, the rest of the measurements were performed on consecutive days from September 28 through October 16, 1911. As August is usually a dry month, the average of 0.43 inches per is probably lower than the average for the period September 25 through December 31, 1911.

For the specific day, October 11, 1911, the Russ Smith Corporation reported that, at their confluence, pre-ditch flows were 25.0 cfs (16.2 mgd) for Waiahole Stream and 12.0 cfs (7.7 mgd)[24] for Waianu Stream, and that at the mouth of Waiahole Stream, it was 39 cfs (25.2 mgd). (Exhibit N-117, at 13-14)

The U.S. Geological Survey identifies the confluence of Waiahole and Waianu Streams as the points of maximum base flow for both streams. (See discussion, *supra*, and Exhibit N-118, at 33)

The October 11, 1911, flow for Waiahole Stream of 25.0 cfs (16.2 mgd) was among the 98 measurements taken by the U.S. Geological Survey at this point in Waiahole Stream. The highest measurements among the 98 were 54 cfs (35.3 mgd) on December 9, 1911, and the lowest measurements were 22 cfs (14.4 mgd) on September 28 and 29, 1911. (U.S.G.S. Water Supply Paper 318, at 179, cited in Exhibit N-117)

The October 11, 1911, flow for Waianu Stream of 12.0 cfs (7.7 mgd) was among 22 measurements taken by the U.S. Geological Survey in September – November 1911. The highest measurement was 15 cfs (9.8 mgd) on October 2, 1911, and the lowest measurements were 12 cfs (7.8 mgd) on 13 of the 22 days in which measurements were taken, including the two days in which Waiahole Stream flow was at its lowest, 22 cfs (14.4 mgd). (U.S.G.S. Water Supply Paper 318, at 182, cited in Exhibit N-117)

Base flow is the ground-water contribution to stream flow. (See discussion, *supra*, and Meyer, Binder #7, written direct testimony, at 4-5) The 1911 measurements are few in number and taken over a short time period in September through December 1911.[25] Among these limited data, the flows most representative of base flows would be the lowest flows:

for Waiahole Stream, 14.4 mgd at the point in the stream that the U.S.G.S. has identified as the point of maximum base flow; and

for Waianu Stream, 7.8 mgd at the point in the stream that the U.S.G.S. has identified as the point of maximum base flow.

There are no comparable data for Waikane and Kahana Streams of even these limited measurements for Waiahole and Waianu Streams.

In 1911, parts of Waikane Stream were being diverted into rice and taro fields, and measurements were taken above all diversions and at various points downstream. Only a single measurement, on October 9, 1911, was taken of Waikane Stream above all diversions, where stream flow was 9.3 cfs (6.0 mgd). (U.S.G.S. Water Supply Paper 318, at 178)

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[24] Conversion from cfs results in 7.776 mgd, or 7.8, not 7.7 mgd.
[25] In contrast, the U.S.G.S. long-term average and Q90 flows used 35 years of data. (Exhibit N-118, at 33)

Similarly, only a single measurement, on October 27, 1911, was taken of Kahana Stream "just below intake of upper ditch on north side", where stream flow was 32.2 cfs (21.0 mgd). (U.S.G.S. Water Supply Paper 318, at 177)

To summarize, in 1911, the best available data on base flows, are as follows:

Waiahole Stream: 14.4 mgd (based on the lowest of 98 readings from September 25 through December 31, 1911)

Waianu Stream: 7.8 mgd (based on the lowest of 22 readings in September – November, with 19 of the 22 readings performed from September 28 through October 16, 1911)

Waikane Stream: 6.0 mgd (based on a single reading on October 9, 1911)

Kahana Stream: 21.0 mgd (based on a single reading on October 27, 1911)

In comparison, the U.S. Geological Survey estimates of post-tunnel base flows are as follows (Exhibit N-118, at 40):

Waiahole Stream: 3.9 mgd

Waianu Stream: 0.5 mgd

Waikane Stream: 1.4 mgd

Kahana Stream: 11.2 mgd

The estimated deficits, based on these data, are therefore:

Waiahole Stream:	14.4 mgd minus 3.9 mgd	=	10.5 mgd
Waianu Stream:	7.8 mgd minus 0.5 mgd	=	7.3 mgd
Waikane Stream:	6.0 mgd minus 1.4 mgd	=	4.6 mgd
Kahana Stream:	21.0 mgd minus 11.2 mgd	=	9.8 mgd
	TOTAL:		32.2 mgd

In comparison, current estimated ditch flows are as follows:

Kahana Tunnel and Stream Diversion:[26]	3.2 mgd
Waikane Tunnels #1 and #2:	5.3 mgd
Uwau Tunnels to North Portal Gauge: [27]	14.8 mgd
TOTAL:	23.3 mgd

[26] 1.1 mgd from Kahana Tunnel and 2.1 mgd from Kahana Stream surface water diversion.
[27] 13.5 mgd from the Uwau Tunnels, and 1.3 mgd from Uwau to North Portal Gauge.

Recall from the discussion, *supra*, that at the time of the 1911 measurements, rainfall in Waiahole Valley from August 16, 1911, to January 3, 1912, totaled 60.4 inches, or an average of 0.43 inches per day. (Exhibit N-117, at 14-15) However, these averages include over one month of summer data, prior to the measurements of stream flow that started in the fall of 1911.

Therefore, rainfall may have been even higher in the actual periods of measurements: 1) daily measurements from September 25 to December 31, 1911, for Waiahole Stream; 2) September 9, 10, and 28-30, October 1-16, and November 12, 1911, for Waianu Stream; 3) a single measurement on October 9, 1911, for Waikane Stream; and 4) a single measurement on October 27, 1911, for Kahana Stream. Windward streams are usually short and have steep gradients, are flashy, and stages can rise and fall several feet in a few hours. The annual maximum discharge usually occurs in the cooler months, October through April. (Devick, Binder #2, written direct testimony, Exhibit L-300, at 2.)

Furthermore, using the only available pre-ditch measurements, the computed deficits in base flow for the four streams between current flows and pre-ditch flows are: 10.5 mgd for Waiahole Stream, 7.3 mgd for Waianu Stream, 4.6 mgd for Waikane Stream, and 9.8 mgd for Kahana Stream. The total for these computed deficits, 32.2 mgd, is nearly 9 mgd higher than the current estimate of Waiahole ditch flow from Kahana to the North Portal gauge of 23.3 mgd.

A watershed-by-watershed comparison results in the following findings:

	Ditch Flow[28]	"Deficit" Using 1911 Data[29]	Excess Over Ditch Flow
Waiahole/ Waianu:[30]	14.8 mgd	17.8 mgd	3.0 mgd
Waikane:	5.3 mgd	4.6 mgd	(0.7 mgd)
Kahana:	3.2 mgd	9.8 mgd	6.6 mgd
TOTALS:	23.3 mgd	32.2 mgd	8.9 mgd

[28] Water flowing in Waiahole Ditch from the three watersheds of Kahana Valley, Waikane Valley, and Waiahole Valley.
[29] "Deficit" calculated by subtracting U.S. Geological Survey estimate of current stream base flow from stream base flow using limited 1911 data.
[30] Attempting to separate the watershed contribution to Waiahole Stream from the contribution to Waianu Stream based on the available evidence would result in an anomalous situation. The two Uwau tunnels (Uwau is a tributary of Waianu, which is in turn a tributary of Waiahole) together provide 13.5 mgd, while the tunnel system from Uwau to the North Portal gauge provides only 1.3 mgd. So 13.5 mgd would be attributed to Waianu Stream, and 1.3 mgd to Waiahole Stream. Furthermore, Meyer testified that development of the Uwau Tunnel extension would have affected Waiahole as well as Waianu Streams. (Meyer, Tr., 4/16/96, at 9, line 16 to 13 line 7**)**

Waiahole/Waianu and Kahana Streams' estimated deficit flows account for the excess over ditch flows, and Waikane Stream's estimated deficit flow is somewhat smaller than its counterpart ditch flow.

The prevailing opinion among the experts is that most, if not all, of the waters developed by the Waiahole Ditch and Tunnel system windward of the North Portal gauge would have flowed into the windward streams. Most experts also assume that some amounts flowed leeward. And in one U.S. Geological Survey publication, it even was stated that: "The combined flow from tunnels and streams probably exceeds on average the flow from the streams before the tunnels were added." (see discussion on "Impact on Windward Stream Flows", *supra*, and Exhibit N-118, at 27-28)

In sum, water developed through the Waiahole tunnel system is equal to or perhaps somewhat more than what would have flowed into the affected windward streams from ground-water sources. In other words, the water diverted by the tunnels, according to expert opinion, is the maximum amount that could have been diverted from the affected streams. Thus, the estimates based on the limited 1911 stream flow measurements likely overestimate the cumulative four-stream deficits by nearly 9 mgd (32.2 mgd minus 23.3 mgd) or nearly 40 percent (8.9 mgd divided by 23.3 mgd equals 38%).

If we use the ditch flows in place of the estimated "deficits" from the limited 1911 data – i.e., using a total of 23.3 mgd instead of 32.2 mgd for the amount that would restore base flows to pre-ditch levels -- then pre-ditch flows for the three streams would be current base flows as estimated by the U.S. Geological Survey, plus current ditch flows from each of the three watersheds:

	Current Base Flow		Current Ditch Flow		Estimated Pre-Ditch Flow
Waiahole/ Waianu Stream:	4.4 mgd (3.9+0.5)	+	14.8 mgd	=	19.2 mgd
Waikane Stream:	1.4 mgd	+	5.3 mgd	=	6.7 mgd
Kahana Stream:	11.2 mgd	+	3.2 mgd	=	14.4 mgd

The results are as follows for pre-ditch base flows when comparing estimated pre-ditch groundwater contributions to stream flows: 1) using the limited 1911 stream measurements data, versus 2) using current base flows plus current ditch flows:

	Using Limited 1911 Data	Using Current Base + Ditch Flows
Waiahole Stream:	14.4 mgd	

		19.2 mgd
Waianu Stream:	7.8 mgd	
Waikane Stream:	6.0 mgd	6.7 mgd
Kahana Stream:	21.0 mgd	14.4 mgd

3. IMPACT ON INSTREAM USES

a. STREAM ECOLOGY

Evidence on stream ecology consisted of two types: 1) personal testimonials on stream conditions in the 1960s; and 2) instream studies by scientists following the interim releases into Waiahole Stream in December 1994 and Waianu Stream in June 1995.

i. Personal Testimonials

Summary. According to Hawaiian historians, the area of windward O`ahu from Kane`ohe to Kualoa was the first land planned for creation by the gods Kane, Ku, and Lono.

People in their fifties and sixties from Waiahole, Waikane, Hakipu`u and Kahana recall that Waiahole, Waikane and Hakipu`u Streams had clean, cold, year-round, swiftly flowing streams abundant with native stream life until there was a marked and qualitative decrease in the amount of water in the streams and in the *`auwai* and aqueducts after 1962 and 1963. While all described abundance of stream life, stream flow and in some cases, stream watershed, during their childhood days, none used descriptions of the change that could be characterized as being gradual and imperceptible, and all ascribed the changes to multiple causes. The Hakipu`u witnesses described changes in Hakipu`u Stream and its watershed that were similar to those that had occurred in Waiahole and Waikane Streams and their watersheds, even though Hakipu`u Stream is not hydrologically affected by the tunnel system. One witness also described similar changes in Punalu`u Stream, which also is not affected by the tunnel system.

Opposing opinions were expressed on whether or not the additional 2.8 mgd developed from the Uwau Tunnel extension in 1964 would have been visibly noticeable as reductions in Waiahole and Waianu Streams. The pumping of 1 to 1.5 mgd from Waiahole Stream at 450 feet elevation back up into the tunnel was permanently stopped in 1982, and the increase in flow in Waiahole Stream may or may not have been visible to the naked eye.

Native Hawaiians descend from a tradition and genealogy of nature deities: Wakea, Papa, Ho`ohokukalani, Hina, Kane, Kanaloa, Lono and Pele, the sky, the earth, the stars, the moon, water, the sea, natural phenomena such as the rain and steam and from native plants and animals. Native Hawaiians today, inheritors of these genes and *mana*, are the *kino lau*, or alternate body forms of all their deities. (McGregor, Exhibit M-47, at 7)

In Hawaiian history, the area of Windward O`ahu from Kane`ohe to Kualoa was the first land planned for creation by the gods Kane, Ku and Lono. Kualoa was the land dedicated to Lono, god of fertility and agriculture. Waikane Valley is located in this area, and therefore, restoration of the "Water of Kane," Waikane Stream, is vital to the restoration of the Hawaiians' spiritual and cultural heritage. (Kanahele, Binder #7, written direct testimony, at 3) Kane is the chief deity among Hawaiian gods. The name Kane is the male symbol for the procreative force. (Kanahele, Binder #7, written direct testimony, at 2) Native Hawaiians believe that the gods Kane and Kanaloa especially looked for groundwater on O`ahu in the region of Waikane and Waiahole Valleys in preparation for the coming of man. (Kanahele,Tr., 5/7/96, at 25, lines 18-22) Waikane is also considered a *pu`uhonua* (a place of refuge, asylum, place of peace and safety) for the district of Ko`olaupoko and worked in conjunction with the sacred land of Kualoa. (Kanahele, Binder #7, written direct testimony, at 3)

A variety of traditional and customary practices in Waiahole, Waikane, Hakipu'u, and Kahana are dependent upon adequate streamflow, in addition to taro cultivation. They include the gathering of two species of *`opae* (freshwater shrimp), several species of *`o`opu* (freshwater fish), *hihiwai* (freshwater mollusk), freshwater eel, catfish, and frogs in the stream, as well as aholehole, papio, and mullet (species of saltwater fish) that swam up into the stream, and Samoan crabs and *limu `ele`ele* (a type of seaweed) that were found at the stream mouths. The streams were also used for drinking, bathing, and swimming. (McGregor, Tr., 4/16/96, at 28, lines 13-25; at 30, lines 10-11; at 33, lines 14-24)

Hawaiian people who have a connection to Waiahole believe that the water that was there up through the 1960s was sufficient to provide for their traditional Hawaiian customs and practices. (McGregor, Tr., 4/16/96, at 61, lines 19-24)

McGregor, based on her interviews with informants from the *ahupua`a* of Waiahole, Waikane, Hakipu`u, and Kahana who are in their fifties and sixties, reported the following:

> "(T)he streams, up through World War II, Waiahole, Waikane, and Hakipu`u, each had clean, cold, year-round swiftly flowing streams abundant with native stream life, which were channeled into terraced wetland ponds, or lo`i kalo, through `auwai for taro cultivation and eventually flowed into Kaneohe Bay providing healthy spawning grounds for marine life";
>
> "Informants from Waiahole, Waikane, Hakipu`u, and Kahana who are in their fifties and sixties recall that in their youth the native stream life was abundant and included two species of `opae -- `opae kuahiwi and `opae lolo – different species of o`opu, including the o`opu nakea, some hihiwai, gold and red swordtails, kuna the freshwater eel, catfish, and frogs…It was relatively easy to

catch 15 o`opu at a time, enough for a family meal. Both baby and mature ocean fish also made their way up the streams, including aholehole, papio, and mullet. By the river mouths there used to be Samoan crabs and limu `ele`ele";

"Informants from Waiahole remember the river as being deeper, broader, cooler, and cleaner in their youth. Residents speak of bringing boats up past the poi factory and as far as the Fernandez home." (McGregor, Tr., 4/16/96, at 28, line 6 to 29, line 5)

These informants also reported that there was a marked and qualitative decrease in the amount of water in the stream and in the `auwai and aqueducts after 1962 and 1963, and that the stream life had decreased. (McGregor, Tr., 4/16/96, at 69, lines 16-23) And there used to be sufficient water for fishponds and taro until about 20-30 years ago. (Uyemura, Tr., 3/5/96, at 136, lines 1-11)

McGregor also reported that the decrease in water in Waiahole Stream in the early 1960s was not attributed to anything specific. Only Mr. Paglinawan attributed it to Mr. Kupau's closing off the *`auwai* going through his yard and the City and County dredging or altering the stream by the bridge inappropriately. (McGregor, Tr., 4/16/96, at 70, lines 6 to 71, line 5)

However, in later surrebuttal testimony to rebuttal of her direct testimony, McGregor added the following:

"What is also interesting is that at the time they noticed the change in those characteristics, they did not attribute them to the tunnel system, they being ignorant of anything taking place up mauka. They attributed the changes to weather, the closing of one of the main `auwai by a new valley resident, and the City and County's dredging of the stream in the area of the bridge by the poi factory. Over time, however, they eventually noticed changes in the waterfalls and the condition of the trees and plants in the mauka regions of the valley, and in the springs. They noticed that there was less flow, even during the rainy season. The change in the stream was gradual and almost imperceptible, except over time. Some of the residents are of the opinion that over time the water table has been lowered, causing the springs to dry up and the ground to be less saturated…(T)hey see the problem as being how to rectify the cumulative effect of the diversion of the water over the past 80 years with its resultant lowering of the water table." (McGregor, Binder #10, written surrebuttal testimony, at 4-5)

However, it is unclear whether this interpretation is McGregor's or her informants'. In her written direct testimony, she ascribes these conclusions to her informants rather than recording what they actually said, and she states strong personal opinions on the ditch and tunnel system:

"The following are my findings and conclusions based upon the a (*sic*) review of the land commission documents, maps, and the insights, experiences, and observations shared by the key informants interviewed for this

> study…Apparently, the impacts of the diversion on the river flow were gradual, almost imperceptible, seemingly natural but nevertheless steady and cumulative. Informants noticed changes in different points in their lives. However, all agree that the most noticeable decline in water and in natural resources occurred after 1962-63. After that, the key informants noted that the aquatic and terrestrial natural resources declined in amount and size…None of the informants voiced this concern, however, I observe that, in accordance with traditional Hawaiian spiritual beliefs, fresh water sources are the life force and energy of Kane-I-ka-wai-ola, Hawaiian god/akua of fresh water sources and springs. In a spiritual sense, the tunnels are sucking out the life force of Kane as if it were sucking out blood from a human body. The tunnels are depleting that energy and life source which provides water, rather than allowing that energy to be constantly replenished and to seep and flow out and up to naturally emerge as the springs and streams that sustain the lives of all living things, including humans. The tunnels, over time, have upset the natural balance, harmony or lokahi between nature, humans and the gods (*emphasis added*)." (McGregor, Binder #7, written direct testimony, at 17-19)

Moreover, nothing in her "Summary of Insights and Observations Shared By Key Informants Of The Ahupua`a of Waiahole, Waikane, Hakipu`u, and Kahana" (McGregor, Binder #7, written direct testimony, at 11-17) supports her statement that her informants stated or concluded that "the changes in the streams were gradual and imperceptible". (McGregor, Binder #10, written surrebuttal testimony, at 4) And her informants identified other factors besides the water diversion as possible contributing causes:

> "Changes In The Stream and Ocean Life: In addition to the water diversion, there are other factors which have contributed to the degradation of the natural resources including introduced aggressive species such as Malaysian and Tahitian prawns, and tilapia, chemical pollutants, bulldozing and grading, over gathering by a growing population. However, the fishermen, the fishpond caretaker and the farmers who were interviewed agreed that restoration of the fresh water would help to clean out the pollutants and the mud and increase the streamlife, the marine life, and the flora and fauna on the land." (McGregor, Binder #7, written direct testimony, at 16)

Seven of McGregor's informants personally testified on conditions during their childhood; three on Waiahole Stream (Badiyo, Tr., 4/3/96, at 204, line 12 to 242, line 7; Binder #6A, written direct testimony) (Fernandez, Tr., 4/10/96, at 67, line 7 to 94, line 9; Binder #7, written direct testimony) (Paglinawan, Tr., 4/10/96, at 277, line 8 to 300, line 16; Binder #7, written direct testimony), one on Waikane Stream (Roberts, Tr., 4/4/96, at 42, line 7 to 68, line 20; Binder #6B, written direct testimony), and three on Hakipu`u Stream (Calvin Hoe, Tr., 4/3/96, at 107, line 20 to 164, line 3; Binder #6A, written direct testimony) (George Uyemura, Tr., 3/5/96, at 123, line 16 to 152, line 10; Binder #6B, written direct testimony) (Chester Uyemura, Tr., 4/4/96,at 91, line 9 to 112, line 11; Binder #6B, written direct testimony). While all described abundance of stream life, stream flow and in some cases, stream watershed, during their childhood days, none used descriptions that could be characterized as being gradual and imperceptible, and all ascribed the changes to multiple causes.

And one of McGregor's informants had the following exchange upon questioning:

> "Commissioner Nobriga: Well, you're saying in the sixties had lot of water, but basically they diverted the thing back in 1912.
> The witness: Okay. That's what I can't get in my – through my mind also, because I remember the streams flowing, like I stated, through Waiahole school. And as the years went by, the flow stopped. So if everything was taken in 1912, what happened?
> Commissioner Nobriga: Why would that happen?
> The witness: Right. I don't know why.
> Commissioner Nobriga: That's the question I have in mind too.
> The witness: Yeah, it's beyond me." (Fernandez, Tr., 4/10/96 at 77, lines 11-23)

An additional witness, who was not one of McGregor's informants, testified that water levels in Waikane Stream have dropped severely since 1990, with some areas of the stream dropping from 3-4 feet to less than 6 inches. (Medeiros, Binder #6B, written direct testimony, at 2)

The Hakipu`u witnesses described changes in Hakipu`u Stream and its watershed, similar to those that occurred in Waiahole and Waikane Streams and their watersheds, even though Hakipu`u Stream is not hydrologically affected by the tunnel system. (Exhibit N-118, at 74) (Lum, Tr., 4/24/96, at 52, line 15 to 53, line 8)

Calvin Hoe testified as follows: "When I was a child, the water in Hakipu`u Stream was clean, and good for swimming. Hakipu`u Stream was much deeper and contained more water. Hakipu`u Stream was never dry. I can remember areas near our family house where the water was at least four feet deep; I could paddle our canoe for about 50 yards. About ten to fifteen years ago, the owner of a prawn farm near our family's land built a dam and took most, if not all, of the water. Hakipu`u Stream dried up then. It became more difficult to raise taro because there was now less water in Hakipu`u Stream. Now the prawn farm is not taking water from the stream, but we continue to have an inadequate water supply for our taro." (Calvin Hoe, Binder #6A, written direct testimony, at 3-4)

Hoe had the opinion that the changes he saw in Hakipu`u were attributable to the tunnels:

> "But I think that the major thing is the lack of water, and that occurred by the diversion of the water that took 95 percent of the water to the other side." (C. Hoe, Tr., 4/3/96, at 140, lines 21-23)

> "I think I've heard of new development tunnels in the thirties and then in the sixties. But I think it's kind of a cumulative effect, yeah." (C. Hoe, Tr., 4/3/96, at 152, lines 20-22)
>
> "I think that there's a connection. You know, like I said, I'm not a hydrologist, but I think, you know, because the ditch runs right in the back of Hakipuu, to me, there's a connection. So you know, so that taking the water from over there is going to effect (sic) how much water I get in Hakipu`u." (C. Hoe, Tr., 4/3/96, at 162, lines 21-25)

Chester Uyemura, another Hakipu`u resident, described similar changes. (C. Uyemura, Binder #6B, written direct testimony; Tr., 4/4/96, at 91, line 9 to 112, line 11) George Uyemura, caretaker of Moli`i fishpond, stated that: "On the mauka side of the ponds (northern end), there used to be taro patches and springs which fed the pond up until 20-30 years ago. The springs are now blocked by vegetation and there is no taro there any more." (G. Uyemura, Binder #6B, written direct testimony, at 2) And Fukumitsu, a taro farmer in Hakipu`u who was not one of McGregor's informants, described Hakipu`u Stream as having plenty of water, *`o`opu* and *`opae* until the 1960s and ascribed these changes to the tunnel system. (Fukumitsu, Binder #7, written direct testimony, at 3-5; Tr., 4/4/96, at 136, line 1 to 195, line 25)

Faris, who lived in the Kahalu`u area in the 1950s, testified: 1) that many of the streams and waterfalls that he knew in the area in the 1950s and 1960s are gone; and 2) that Punalu`u Stream had *hihiwai* up to the 1960s, but cold running water doesn't flow there anymore. (Faris, Tr., 3/5/96, at 190, line 8 to 191, line 18)

As noted earlier, Hakipu`u Stream is not affected by the Waiahole ditch tunnel system, (Exhibit N-118, at 74) (Lum, Tr., 4/24/96, at 52, line 15 to 53, line 8) nor is Punalu'u Stream.

Meyer is of the opinion that the extension of the Uwau tunnel in 1964, which developed an additional 2.8 mgd, had a one-for-one effect on Waiahole, Waianu, and Waikane Streams; i.e., decreasing base flow in those streams by the same amount, and that the decrease would have been visible to the naked eye. (Meyer, Tr., 4/16/96, at 9, line 16 to 13, line 7) However, Meyer may have been referring to Waiahole Stream and its two tributaries, Waianu and Uwau, and may not have meant to include Waikane Stream. (See footnote 9, *supra*, and Meyer, Tr., 4/16/96 at 9, line 16 to 13, line 7)

Hatton, to the contrary, was of the opinion that it would have been hard to see the impact, if any, of the extension of Uwau tunnel, because of the variability of rainfall. In 1965, after the tunnel was extended, the rainfall at the Waiahole rain gauging station at elevation 750 feet was 200 inches, almost double the rainfall of 1961, and the stream gage in Waiahole Stream at elevation 250 feet registered an average of 10 mgd in that year (1965). Hatton also believed it would probably have been hard for anyone downstream, given the natural variability due to rainfall, to see the increase in Waiahole Stream after pumping into the Ditch from Waiahole Stream at 450 feet elevation was stopped in 1982. (Hatton, 4/10/96, at 102, line 15 to 103, line 25)

But according to Meyer: “Oh, if you’re pumping from the stream and then you stop pumping, certainly you would notice an increase in flow,” and that it would “be a measurable difference to the naked eye.” (Meyer, Tr., 4/16/96, at 14, line 21 to 15, line 2)

Hatton also stated that the period of stability in Ditch flows started about 1938, with variability in Ditch flows ranging roughly between 20 to 30 mgd. Prior to that, there were much higher flows during the time when the stored waters in the dikes pierced by the tunnel system were being depleted. (Hatton, Tr., 4/10/96, at 98, line 6 to 100, line 15)

According to the U.S. Geological Survey: “Because the tunnel system and the dike-impounded reservoirs are under steady-state conditions, there is no further depletion of ground-water storage in the aquifers.” (Exhibit No. M-36D, at 29)

ii. Instream Post-Release Studies

Summary. In December 1994, water was released from the Waiahole Ditch’s tunnel system into Waiahole Stream, averaging about 14 mgd. In June 1995, 2 mgd of these waters was released into Waianu Stream, with about 12 mgd continuing to be released into Waiahole Stream. Pre-ditch flows at ditch level -- the level at which these releases were added to Waiahole Stream and its tributary, Waianu Stream – have been estimated at 8.1 mgd and 4.2 mgd, respectively. Thus, the 12 mgd release into Waiahole Stream was about 150 percent higher than pre-ditch flow at the headwaters of the stream, and the 2 mgd release into Waianu Stream was about 50 percent of pre-ditch flow at its headwaters.

Instream studies of varying intensity, ranging from one day to monitoring over several months, were conducted by six scientists during the period December 1994 to August 1995.

Font concluded that the water releases had reduced populations of exotic fishes and absolute numbers of fish parasites, and that it appeared likely that in time, abundances of parasites in native gobioid fishes would also decrease. Devick concluded that substantial recruitment of all five native *`o`opu* species, along with the native *`opae,* had occurred. Brasher concluded that the stream had a habitat suitable for native organisms, such as *`o`opu, `opae,* and *hihiwai.* Kido concluded that the stream appeared to be in transition, which should translate into increases in existing biotic components. Hodges concluded that the increased flow would directly address the factors that have limited native macrofaunal abundance. And Englund concluded that the increased flow could improve habitat quality and displace introduced fish that serve as vectors for parasites.

Two of these scientists, Hodges and Brasher, also stated that the added flows were the minimum required to improve the stream, while Englund recommended no further decreases in the releases. However, all three also made statements that directly contradicted these conclusions: 1) Hodges stated that there was no

mathematical relationship yet developed for any stream in Hawai`i between the density and/or abundance of native stream animals and the amount of water flowing through the stream; 2) Brasher stated that her one-day survey was not intended to be a comprehensive study but rather a reconnaissance survey, and that studies of at least two years, and perhaps up to five years, were needed to begin to evaluate the impact of changes in stream flow regimes; and 3) Englund stated that it didn't make biological sense to continue to put all the collected water of three major watersheds down just two separate stream channels, the Waiahole and Waianu, and that flows should be adjusted once hydrologists have determined how much water the Waiahole Stream channel should normally hold during low base flow.

Besides the recommendations for long-term studies, Devick stated that restoration does not need to be an expansive effort to return a natural flow. Stream restoration is likely to be incremental through partial restoration of the original base flow. Restoration can take many forms, such as removal of a drainage pipe, replanting of riparian vegetation, removal of man-mad alterations and the control or eradication of exotic species. Even small flow increases should be viewed as beneficial to the native biota, because those incremental improvements could not only become substantial with time but could also improve the knowledge base during the entire period, if appropriate simultaneous studies were undertaken.

As described in the Background section, *supra*, on December 16, 1994, the Commission adopted a Mediation Agreement, Waiahole Ditch Interim Water Releases, to allow 8 mgd to flow past the North Portal to the leeward side and release the remainder back into the windward streams. The windward streams' releases were initially confined to Waiahole Stream. The order was amended in June 1995 to release 2 mgd of the remainder into Waianu Stream. (Release gates exist for Waiahole and Waianu Streams but not for Waikane Stream, a condition that is presently unchanged.) These orders resulted in releases into Waiahole Stream between the end of December 1994 to June 1995 of over 14 mgd, and after June 1995, of 2 mgd into Waianu Stream and over 12 mgd into Waiahole Stream.[31]

After the initial release in late December 1994, Waiahole Stream above 200 feet consisted of very high velocity riffles. In September 1995, after the release into Waiahole Stream had been decreased by the 2 mgd released into Waianu Stream in June 1995, flow in the upper reaches of Waiahole Stream was still best described as torrential. (Englund, Tr., 12/13/95, at 217, lines 11-16)

[31] Recall from the discussion, *supra*, of pre-ditch stream flows at ditch level, Waiahole Stream had a flow of 8.1 mgd and Waianu Stream may have had a flow of 4.2 mgd. Thus, these releases resulted in a ditch-level flow for Waiahole Stream of about 150 percent of pre-ditch levels (12 mgd vs. 8 mgd). In contrast, Waianu Stream releases resulted in a stream flow at ditch level that may have been equal to about 50 percent of pre-ditch levels (2 vs. 4.2 mgd).

There are ten species of Hawaiian freshwater animals, five fish, three crustaceans and two mollusks. All are amphidromous, migrating from fresh water to the ocean and the reverse during their life cycle, but neither leg of the migration is immediately associated with spawning. All five species of fishes are indigenous (native) and four are endemic (occur only in Hawai'i). One shrimp and one prawn are endemic, and one prawn is introduced. The two mollusks are endemic. (Fitzsimons, Binder #6A, written direct testimony, at 6-7)

The five native Hawaiian freshwater fishes, the gobies or *`o`opu* species, spend their entire lives in fresh water and spawn in fresh water. After the *`o`opu* eggs hatch, the larvae, which are about a millimeter and half in size, are then washed into the ocean. The larvae remain in the ocean between four to six months before moving back up into the streams. (Fitzsimons, Tr., 1/11/96, at 11, line 20 to 12, line 25)

`O`opu are found throughout the world, primarily throughout the tropical areas such as in Costa Rica, Puerto Rico, and Palau. (Englund, Tr., 2/27/96, at 138, line 22 to 139, line 18)

Two of the Hawaiian *`o`opu* species, *`o`opu akupa (eleotris sandwicensis)* and *`o`opu naniha (stenogobius hawaiiensis)*, are usually restricted to the lower parts of the streams and not found farther than the first waterfall. (Fitzsimons, Tr., 1/11/96, at 13, lines 8-25) The *`o`opu nopili (sicyopterus stimpsoni)* and *`o`opu nakea (awaous guamensis)* reside in the middle reaches of the streams. *`O`opu nopili* are found in the swiftest part of the streams where there is a fairly shallow ripple zone and a good strong current coming over the area. *`O`opu nakea* are usually found a little further down the main channel in pockets where there is less current. (Fitzsimons, Tr., 1/11/96, at 16, lines 11-19) *`O`opu alamo (lentipes concolor)* are usually found further inland above the higher waterfalls; it has the ability to climb waterfalls through the use of a fused pelvic fin that forms like a suction disc. (Fitzsimons, Tr., 1/11/96, at 17, line 24 to 18, line 25)

The *`o`opu nakea* is considered a favorite food and a sport fish, and probably the only species that has a somewhat discreet spawning season. Unlike other *`o`opu* which breed all year, judged from its courtship behavior, it breeds most intensively during the summer months of June and July. (Fitzsimons, Tr., 1/11/96, at 15, line 3 to 16, line 9)

Recruitment events of the *`o`opu* from the ocean into the streams are tied very closely to freshets. During a typical Hawaiian rainy season, a repeated series of flash floods appear to impact recruitment by causing the onshore orientation and movement of young fish to enter and move up the streams. (Fitzsimons, Tr., 1/11/96, at 22, line 15 to 23, line 6) Storm events or flash floods appear to attract young fish to the streams because, it is hypothesized, these young fish can detect the odor or taste of the sediment flow or other *`o`opu*. (Fitzsimons, Tr., 1/11/96, at 23, line 20 to 24, line 19)

Native *`o`opu* on Oahu are not distinct from the native *`o`opu* on the other Hawaiian Islands. Because of the offshore larval stage process, larval *`o`opu* can get transported between islands and development of distinctions has not occurred. (Fitzsimons, Tr., 1/11/96, at 82, lines 7-25)

There are streams that are very small naturally that have low flow, but are permanently occupied by *`o`opu*. For example, on Maui, there are streams with low flow that do contain mostly native fishes and a good native fish habitat. (Hodges, Tr., 4/16/96, at 174, lines 13-18)

The two endemic crustaceans or *`opae* are the shrimp *atya bisulcata* (*`opae kala`ole*) and the prawn *macrobrachium grandimanus* (*`opae oeha`a*). The introduced prawn is the Tahitian or Guamanian prawn (*Macrobrachium lar*). The mollusks are *neritina granosa* (*hihiwai*, *wi*, or river *opihi*) and *theodoxus vespertinus* (*hapawai*), which are patelliform (shaped like a knee cap). (Fitzsimons, Binder #6A, written direct testimony, at 6-7)

The flashy nature of Hawaiian windward streams, with their sudden peaks and long troughs in flow rates is an integral component for maintenance of biotic stability in the streams. The peak flows help to flush debris from the streambed and provide triggers for migration and spawning by aquatic organisms. Periodic drying that naturally occurs in the lower reaches of streams may help maintain genetic variability in amphidromous species that would be advantageous for survival over the long term in response to temporal shifts in weather patterns. Native species, particularly amphidromous species, have evolved to fit these conditions. (Devick, Binder #2, written direct testimony, Exhibit L-300, at 4)

Instream studies were conducted by several scientists in the few months between the interim releases and the start of the original contested case hearing in November 1995.

Font, a witness for WWCA: 1) observed stream conditions and fish populations in Waiahole and Waianu Streams on December 17, 1994, a date prior to the restoration of flows to Waiahole Stream, and again on December 20, 1994, the day after flow was restored to Waiahole Stream; 2) collected fish for parasitological examinations for the remainder of December 1994 through January 7, 1995; and 3) made additional observations, collections, and parasitological examinations of Waiahole and Waianu Stream fishes in unspecified days in May and June 1995, although some of the June observations in Waianu were after 2 mgd had been released in Waianu Stream in that month. (Font, Binder #6A, written direct testimony, at 14-16)

Devick, a witness for DLNR/DOA, did a spot survey of *`o`opu* in Waiahole Stream on an unspecified day in November 1994 (Devick, Tr., 2/13/96, at 134, line 22 to 135, line 6) and surveys of *`o`opu* in Waiahole and Waikane Streams on unspecified days in January through August 1995. (Devick, Binder #2, written direct testimony, Exhibit L-300, items 2a – 2i)

Brasher, a witness for OHA, conducted a one-day "reconnaissance" study of Waiahole Stream and its Waianu and `Uwao[32] tributaries on July 6, 1995, of water quality characteristics, discharge measurements, and native and introduced microfauna. (Brasher, Binder #7, written direct testimony, at 3)

Kido, a witness for OHA, conducted a one-day survey on July 6, 1995, of Waiahole Stream to collect benthic data; namely, plant and invertebrate species inhabiting the bottom of the stream. (Kido, Binder #7, written direct testimony, at 2)

Hodges, a witness for OHA, conducted surveys of native aquatic amphidromous macrofauna (i.e., *`o`opu, opae* and *hihiwai*, or freshwater fish, shrimp and mollusks) on: 1) July 6, 7 and 9, 1995, in lower Waiahole, Waikane and Kahana Streams; and 2) July 21 and 22, 1995, in upper Waiahole and Kahana Streams. (Hodges, Binder #7, written direct testimony, Exhibit B)

Englund, a witness for KS/BE and ROR, conducted studies from February to August 1995 of Waiahole, Waianu, Waikane, Hakipu`u, Ka`alaea, Waihe`e, Kahalu`u and He`e`ia drainages on the windward side, and of Waiawa Stream and selected sites along the Waiahole Ditch on the leeward side. The purposes of these studies were to: 1) describe the distribution and abundance of stream biota including native and introduced fish species, introduced amphibians, crustaceans, mollusks, and aquatic insects; 2) determine species composition of native and introduced birds, with an emphasis on threatened and endangered species; 3) evaluate habitat quality for aquatic and avian biota; and 4) evaluate potential biological consequences associated with changes in the distribution of Waiahole Ditch water. (Englund, Binder #2, written direct testimony, at 5-6)

Font conducted studies on exotic fishes and their parasitic infections in Waiahole and Waianu Streams on December 17, 1994 and from December 20, 1994 – the day after the water releases into Waiahole Stream -- through January 7, 1995, and again in May and June 1995, including some days in June after 2 mgd was released into Waianu Stream. He found a dramatic reduction of exotic fish in Waiahole Stream but no reduction in Waianu Stream, which he attributed to weaker stream flow in Waianu Stream.[33] (Font, Binder #6A, written direct testimony, at 14-17)

Font concluded:

> "In natural streams, the only parasite control methods available involve reducing exotic fish populations through human intervention. However, in those streams with man-made diversions, restoration of stream flow has been demonstrated in Waiahole Stream to reduce populations of exotic fishes and

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[32] The name of this tributary is spelled in one of two ways: "Uwao" or "Uwau". Note, *supra*, that the latter spelling is used for the tunnels developing water above this tributary.

[33] However, Waiahole Stream had been receiving water releases for six months by the time of his followup observations in May and June 1995, while Waianu Stream had been receiving water releases only for a few unspecified number of days in June 1995 when Font made his final observations in Waianu Stream.

absolute numbers of fish parasites. Based on these declines, it appears likely that in time, the abundance of parasites in native gobioid fishes will also decrease in streams where flow has been restored." (Font, Binder #6A, written direct testimony, at 17)

Devick testified that, in studies conducted in Waiahole and Waikane Streams from January to June of 1995, substantial recruitment of all five native *`o`opu* species, along with the native shrimp was discovered.[34] The recruitment was substantially higher in Waiahole Stream than in Waikane Stream. (Devick, Tr., 2/13/96, at 120, lines 3-14)

These findings were significant because two of the *`o`opu* species, *lentipes concolor* and *sicyopterus stimpsoni,* had not been found as adults in Waiahole Stream in prior samples; another species, *awaous guamensis,* was only found occasionally as an adult; and all three require suitable upstream habitat conditions for growth and reproduction. (Devick, Tr., 2/13/96, at 120, lines 15-21) *Lentipes concolor* was thought to be extinct on O`ahu, known to exist in only a few streams, and was the subject of a petition for statewide listing as a federal endangered species. (Devick, Tr., 2/13/96, at 120, line 22 to 121, line 1)

Brasher, based on her one-day "reconnaissance" study of Waiahole Stream and its Waianu and `Uwau tributaries on July 6, 1995, of water quality characteristics, discharge measurements, and native and introduced microfauna, reached the following conclusions:

"a. The habitat in Waiahole, `Uwao, and Waianu Streams showed excellent potential for establishment of native populations of *`o`opu, `opae,* and *hihiwai*;

b. The presence of post larval fish, such as the *`o`opu nopili* and *`o`opu nakea,* indicate that fish are recruiting (returning to the stream from the ocean) into areas where water flow has been restored;[35]

c. Water chemistry analysis showed Waiahole Stream to have water quality comparable to neighbor island streams with substantial populations of native *`o`opu, `opae*, and *hihiwai*. Waiahole Stream was cool, clear, and well oxygenated as required by native stream organisms (*citation omitted*);

d. The return of water to Waiahole Stream has created a stream with a habitat suitable for native organisms, such as *`o`opu, `opae*, and *hihiwai*;

e. Further increases in flow level and the return of natural flow regimes, which include periodic flooding events (spates) also would improve habitat quality. Notably, the removal of silt would allow the growth of algae and diatoms which are especially important in the diets of *`o`opu nopili, `opae*, and *hihiwai*."(Brasher, Binder #7, written direct testimony, at 3-4)

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[34] Waikane Stream did not receive any of the flows released from the tunnels in December 1994 and June 1995.

[35] Brasher had no data on pre-release flows, so no conclusions can be reached on whether this is a post-release improvement. And Devick, *supra*, found *`o`opu* in Waikane Stream, which had no added water, while Kido, *infra,* found more *`o`opu* in Waikane Stream than in Waiahole Stream.

Kido, based on his day-long survey on July 6, 1995, of Waiahole Stream to collect benthic data (plant and invertebrate species inhabiting the bottom of the stream), reached the following conclusions:

> "a. In general, Waiahole and its tributaries, \`Uwao and Waianu Streams, appear to be waterways in stages of transition;
>
> b. Loose sediment is moving downstream and slow-water species are being replaced by species adapted to swifter flow;
>
> c. Wettable habitat is increasing, which should translate into increases in existing biotic components. These biotic components are typical of high quality streams, although they appear to be in much lower abundance in Waiahole." (Kido, Binder #7, written direct testimony, at 2)

Kido also testified that, in July 1995, he found more *\`o\`opu* in Waikane Stream than in Waiahole Stream, even though Waikane Stream did not have any additional releases of water from the ditch. (Kido, Tr., 4/17/96, at 52, line 20 to 53, line 2)

Hodges conducted surveys of *\`o\`opu, opae* and *hihiwai* on July 6, 7 and 9, 1995, in lower Waiahole, Waikane and Kahana Streams and on July 21 and 22, 1995, in upper Waiahole and Kahana Streams, and compared his findings with that of data previously recorded by him of Wai\`ohue, Honomanu, and Hanawi Streams, and his observations in numerous other Hawaiian streams. (Hodges, Binder #7, written direct testimony, Exhibit B, at 4) His conclusions were as follows:

> "a. There is a low quality of the native macrofauna communities, such as *\`o\`opu*, *\`opae*, and *hihiwai*, in Waiahole, Waikane, and Kahana Streams;
>
> b. There are several factors which appear to have limited native macrofaunal abundance, or are associated with limited native macrofaunal abundance in Waiahole, Waikane, and Kahana Streams. These factors are all related to reduced stream flow. They include, but are not limited to: (1) reduced water quality (slower flow, higher temperature); (2) reduced habitat quantity (narrower channels, shallower water); (3) a preponderance of smaller bed materials (including silt) and abundant large organic debris; (4) the presence of invasive alien species (including predation and competition for space and food); (5) overshadowed and obstructed channels caused by vegetation and forest encroachment; (6) reduced access for recruits to upper reaches; and (7) reduced recruitment;
>
> c. The restoration of flow to these Windward O\`ahu streams will directly address each of these population limiting factors directly. Increased flow will (1) decrease water temperature; (2) increase current speed; (3) increase habitat area; (4) flush silt and smaller bed materials and large organic debris; (5) flush invasive species; (6) push back vegetative encroachment; (7) increase ease of travel through the stream for recruits; and (8) increase the signal for recruits to come in from the ocean;
>
> d. Despite low faunal abundance, Waiahole, Waikane, and Kahana Streams are of much higher natural quality than the seriously degraded streams

found in other parts of Hawai`i. This is so because Waiahole, Waikane, and Kahana Streams exhibit largely unaltered channels and banks, and drain largely forested watersheds. Also, limited regions of Waiahole, Waikane, and Kahana Streams, particularly the upper reaches, currently exhibit higher natural quality than the seriously degraded streams found in other areas of the State;

e. The unaltered channels and banks, largely forested watersheds, comparatively low levels of human activity within the watersheds, and comparatively clean nearshore marine environment indicate that Waiahole, Waikane, and Kahana Streams are excellent candidates for stream restoration efforts; and

f. Restoration of stream flow in these Windward Oahu streams would dramatically increase the quality and quantity of habitat available to the native macrofauna species, such as *`o`opu*, *`opae*, and *hihiwai*." (Hodges, Binder #7, written direct testimony, at 4-5)

Englund studied the drainages of Waiahole (and Waianu), Waikane, Hakipu`u, Ka`alae`a, Waihe`e, Kahalu`u and He`e`ia on the windward side, and Waiawa Stream and selected sites along the Waiahole Ditch on the leeward side from February to August 1995. His conclusions were as follows:

Leeward impacts. If the water in Waiawa Stream is augmented by the flow from the Waiahole Ditch (i.e., if there is leakage from the ditch into Waiawa Stream),[36] a decreased flow to the leeward side could have negative impacts on: 1) two native damselfly species and *`o`opu nakea* in Waiawa Stream between 700 and 850 feet elevation; and 2) native waterbirds in the Poliwai and possibly Huliwai gulches by depleting wetland habitats on the leeward side.

Windward impacts. 1) increased flow in Waiahole, Waianu or Waikane Streams could improve habitat quality and could benefit *`o`opu* by displacing introduced fish species that serve as vectors for parasites, and by improving habitat quality, and could benefit native *`opae* in all drainages and *hapawai* found in Waiahole Stream; 2) increased flow in upper Waikane Stream could change current habitat conditions and likely result in adverse impacts to the native damselfly, *megalagrion nigrohamatum nigrolineatum*, listed as a candidate level 1 endangered species;[37] 3) increased taro cultivation correlative with an increased flow on the windward side could have detrimental effects on *`o`opu* from increased water temperature and nutrient levels and reduced dissolved oxygen in return flow to the streams;[38] and 4) an increased flow on the windward side could likely

[36] This is a condition for Englund's conclusions on possible leeward impacts, but there was no evidence that significant leakages were occurring into Waiawa Stream from the ditch.

[37] However, this damselfly was found in all drainages except Waiahole and Hakipu`u (Englund, Binder #2, written direct testimony, at 8)

[38]To the contrary, Englund specifically stated that: "My main concern is not – about taro, increased amounts of taro is not over the water quality effect such as increased temperatures and nutrient levels, which – caused by large amounts of taro cultivation, although this still possibly occur…The main problem and our primary concern about taro is that alien fish species flourish in taro fields and they provide a slow water velocity refuge for these alien fish species. And I should point out that we have proposed a removal method for these alien species, and this could potentially mitigate problems associated with an increase in

create additional wetland habitat, including taro fields, which could benefit native waterbirds. (Englund, Binder #2, written direct testimony, at 10-11)

Of these six studies summarized, *supra*, Brasher's, Kido's and Hodges's were only one-day studies of specific streams or parts of streams, while Font's, Devick's and Englund's were longitudinal but of brief duration, two study periods four months apart for Font, for a continuous period of eight months for Devick, and for a continuous period of seven months for Englund.

Englund questioned the validity of Brasher's and Kido's conclusions, based on their one-day studies:

> "The basis for the conclusions made in Ms. Brasher's report (Exhibit "B") is <u>questionable</u>. If the stated purpose of Ms. Brasher's study was, as stated at page 1 of Exhibit "B", to 'provide information necessary for a complete study of the watershed and protocol to be used by the community in future monitoring efforts,' then a one-day field study of Waiahole, Waianu, and Uwau Streams is clearly inadequate to gather enough data to provide a clear picture of this system (emphasis in original)." (Englund, Binder #9, written rebuttal testimony to Brasher, at 10)
>
> "(T)here is little evidence that 'slow-water species are being replaced by species adapted to swifter flow.' Such a statement would need to be based on a number of data points collected over time, not only a day-long survey, as conducted by Mr. Kido…(T)here is no unequivocal evidence that 'slow-water species are being <u>replaced</u> by species adapted to swifter flow' (emphasis added). The abundance of slow-water species has remained relatively <u>constant</u> in Waiahole and Waianu Streams overall. The results of our monthly monitoring of fish, crustaceans and mollusks from February through August 1995 show that the abundance of slow-water species has perhaps even 'rebounded' in some sections of the Waiahole Stream since the initial flow increase (emphasis in original)." (Englund, Binder #9, written rebuttal testimony to Kido, at 5-6)

And contrary to Font's findings on exotic fishes in Waiahole Stream after the releases, which were conducted in late December 1994 to early January 1995 and again in May and June 1995, *supra*, Englund found that, after a dramatic initial decline when the flow was increased, his monthly monitoring of Waiahole Stream showed that the abundance of introduced fish had remained nearly constant since February 1995. (Englund, Binder #9, written rebuttal testimony to Heacock, at 6)

Devick expressed a cautionary note even for data collected at widely separated points: "(S)ampling as frequently as possible is a target because linearity does not exist under natural conditions for either biota or water quality. Because of this it is dangerous

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taro fields." (Englund, Tr., 2/27/96, at 105, lines 8-24) And contrary to Englund's professed concerns, although the water coming from a taro *lo`i* might be a degree or two warmer than it was when it flowed into the *lo`i*, if the stream into which the *lo`i* water flows has a good flow, the *lo`i* water would simply mix in with the stream water and no change in the stream water would be detectable. (Lowe, Tr., 2/29/96, at 140, lines 5-12) to assume that widely separated temporal data points depict trends." (Devick, Binder #2, written direct testimony, Exhibit L-300, at 7, lines 16-20)

On the question of the relationship between stream flow and the abundance of native stream animals, the following opinions were expressed:[39]

> "(R)estoration does not need to be an expansive effort to return a natural flow. Stream restoration is likely to be incremental through partial restoration of the original base flow. Restoration can take many forms, such as removal of a drainage pipe, replanting of riparian vegetation, removal of man-made alterations and the control or eradication of exotic species. Even small flow increases should be viewed as beneficial to the native biota because those incremental improvements could not only become substantial with time but we could also improve our knowledge base during the entire period, if appropriate simultaneous studies were undertaken." (Devick, Binder #2, written direct testimony, Exhibit L-300, at 12)

> "I think that you're probably well aware, as we all are, that there is no mathematical relationship yet developed for any stream in Hawaii between the density and/or abundance of native stream animals and the amount of water flowing through that stream." (Hodges, Tr., 4/16/96, at 202, lines 9-13)

> "(A)ppropriate scientific studies are essential to our understanding of Hawaiian Stream ecosystems. Furthermore, such studies should be conducted over a period of at least two years, and perhaps up to five to begin to evaluate the impact of changes in stream flow regimes. Additionally, before and after studies and the use of 'control' streams in watersheds not impacted by the anticipated change are critical for adequate scientific evaluation." (Brasher, Binder #10, written surrebuttal testimony, Exhibit A, at 1)

Nevertheless, Hodges, Brasher and Englund expressed opinions on the adequacy of the post-release flows in Waiahole Stream, based on the studies they conducted as described, *supra*.

In oral testimony, Hodges, testifying for OHA, stated that: "(I)t's my belief that the amount of flow that was in Waiahole at the time of my survey is probably somewhere near the threshold level that would be required to provide good to excellent habitat in that stream." (Hodges, Tr., 4/16/96, at 201, lines 19-22) Hodges also believed that the flow in Waiahole Stream was four to five times its pre-release flow (Hodges, Tr., 4/16/96, at 200, lines 9-11), and that Waikane Stream flow should be doubled (Hodges, Tr., 4/16/96, at 200, lines 16-21).

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[39] For further findings on the relationships between stream flow restoration and restoration of viable biological populations in the affected streams, see FOF 167 to 181, in the Commission's original, December 24, 1997, Findings of Fact, Conclusions of Law, and Decision and Order.

But when asked why a quadrupling of Waiahole and a doubling of Waikane, Hodges answered: "The difference between a doubling in Waikane and what appears to be a tripling (*sic*) in Waiahole, I can't speak to with any quantitative authority." (Hodges, Tr., 4/16/96, at 204, lines 21-23) And in earlier questioning, when asked what was sufficient flow, Hodges had replied: "Yes. Good Question. I'll charge you a million dollars for that answer. I don't know." (Hodges, Tr., 4/16/96, at 191, lines 21-22) Finally, it was Hodges himself who stated, *supra*: "I think that you're probably well aware, as we all are, that there is no mathematical relationship yet developed for any stream in Hawaii between the density and/or abundance of native stream animals and the amount of water flowing through that stream." (Hodges, Tr., 4/16/96, at 202, lines 9-13)

In oral testimony, Brasher, testifying for OHA, stated that: "It looks to me like the flow that's currently in there is probably the minimum acceptable amount to provide all of the different kinds of habitats that are needed for all the different kind (*sic*) of organisms." (Brasher, Tr., 4/23/96, at 25, line 23 to 26, line 1.) "(W)hat I see now looks adequate. And I would be afraid that if there is any less, it might not be adequate. What we see is adequate."[40] (Brasher, Tr., 4/23/96, at 39, lines 14-16)

However, Brasher admitted to limited experience with Waiahole Stream: "The only experience I have with Waiahole Stream is doing a reconnaissance survey so that I could testify here." (Brasher, Tr., 4/23/96, at 40, lines 22-24) Her written surrebuttal testimony expands on the limitations of her one-day study: "When asked to testify, I made a one day survey of Waiahole Stream to familiarize myself with the area. This was not in any way intended to be a comprehensive study, but rather a reconnaissance survey to allow me to better understand the situation in Waiahole Stream, to provide a basis for any future scientific studies or monitoring projects that might be conducted in the area, and to allow me to better evaluate the stream in comparison to the numerous other streams I am familiar with on O`ahu, Maui, Moloka`i and Kau`ai." (Brasher, Binder #10, written surrebuttal testimony, Exhibit A, page 2) "(A) long-term (minimum of two years) objective scientific study is exactly what I would recommend for Waiahole Stream. I was not hired to design and conduct a study of Waiahole Stream, but like many other scientists with experience in Hawaiian Stream systems I was asked to testify, and simply chose to conduct a brief reconnaissance survey to allow me to apply my knowledge of other Hawaiian stream systems to the situation in Waiahole Stream." (Brasher, Binder #10, written surrebuttal testimony, Exhibit A, page 3)

Englund, testifying for KS/BE and ROR, recommended that: 1) no water be added to Waikane Stream because it would change the present habitat of the damselfly found there (this damselfly was also found in all other areas he studied, except for Waiahole and Hakipu`u); 2) no additional water be added to Waiahole Stream, because the stream above 500 feet was "torrential" and above 200 feet consisted of very high-velocity riffles prior to the reduction of 2 mgd in June 1995 from the Waiahole Stream releases in order to add that amount to Waianu Stream; and 3) predicated these recommendations for no added water to Waiahole and Waikane Streams by "not recommend(ing) a further reduction in Waiahole stream flow," because the reduction in Waiahole by 2 mgd

[40] Brasher's one-day study in July 1995 coincided with the first day of Hodges's six-day study.

“increased the amount of run and pool habitat resulting in a better balance of habitat types.” (Englund, Binder #2, written direct testimony, at 13)

Englund’s recommendation on no further reduction in Waiahole Stream flow is not based on an assessment of the appropriate flow for the stream, but on “a better balance of habitat types” relative to what he described as “very high-velocity riffles” prior to reducing releases in Waiahole Stream by 2 mgd. Yet, at the same time that he described the stream as having “a better balance of habitat types,” he also described the flow as “torrential”: “Prior to the flow decreases in May, much of the stream above 200 feet consisted of very high-velocity riffles. Flow in the upper Waiahole still appeared to exceed natural base flow as of September 1995. However, above 500 feet, the stream could have been best described as torrential. The high discharge has probably been detrimental in the short term to some native insect species and much of the upper reach did not provide good habitat for `o`opu nakea. The flow reduction increased the amount of exposed substrate. A greater amount of lower-velocity habitat has rendered the area more suitable for native fish, and more exposed mid-channel substrate should also benefit native insects.” (Englund, Tr. 12/13/95, at 217, lines 8-21)

Furthermore, immediately following these statements, Englund contradicts his statement that further reductions in Waiahole Stream should not occur:

“True restoration of Windward Oahu streams would involve partitioning the flow among a number of systems, and restoring springs and seeps that feed these streams. This would include all those systems that received groundwater intercepted by the Waiahole Ditch. (Repeated) This would include all those systems that received groundwater intercepted by the Waiahole Ditch. Creating a sluice-way in the upper reaches of Windward streams is not stream restoration. It does not make sense to exceed the natural capacity of the upper Waiahole as appears to have been currently done.” (Englund, Tr., 12/13/95, at 217, line 22 to 218, line 7)

And in later oral testimony, Englund again directly contradicts his own recommendation of no further reduction in Waiahole Stream flow:

> “It should be obvious that starting at the headwaters of Kahana Stream, the Waiahole Ditch intersects both dike water and surface water from Kahana Stream, Waikane Stream, and Waiahole Stream and their numerous tributaries.
>
> “It doesn’t make biological sense to continue to put all the collected water of three major watersheds down just two separate stream channels, the Waiahole and Waianu.
>
> ‘I have recommended that qualified hydrologists from USGS determine if the normal low-base-flow stream channel capacity is being exceeded in the upper Waiahole Stream and in Waianu Stream. Flow should be adjusted in these streams once hydrologists have determined how much water the Waiahole Stream channel should normally hold during low base flow.” (Englund, Tr., 2/27/96, at 130, lines 12-24)

Finally, at the time of the studies conducted by Hodges, Brasher, and Englund, the flow in upper Waiahole Stream was approximately 150 percent of pre-ditch flows. (Footnote 14, *supra*) Englund himself had concluded that these were excessive flows, *supra*.

Furthermore, Devick had the following opinion on these excessive flows:

> "To achieve stream restoration you should never exceed the original base flow. Flow in Waiahole, as well as (in) the other windward streams, resulted in part from spring water lower down the slopes feeding into the stream channels; thus, the water velocity and volume were less than the present restored conditions at high elevation in Waiahole Stream. (Devick, Binder #2, written direct testimony, at 10, line 22 to 11, line 3)

b. IMPACT ON KANE`OHE BAY

As in the case of the Waiahole Ditch and Tunnel System's impact on instream resources, evidence presented at the contest case hearing consisted of personal testimonials and scientific opinions plus limited post-release studies on the impact of windward stream diversions on Kane`ohe Bay.

i. Personal Testimonials

<u>Summary</u>. A general decline of fish in Kan`eohe Bay was noted, beginning in the 1960s, primarily from over fishing and the use of monofilament nets. One witness thought the decline of *limu* at the mouth of Waiahole Stream might be due to reduced stream flow, but Abbott, an expert witness in ethnobotany, attributed it in part to spreading mangrove trees from Hakipu`u Stream and observed that the overall decline of edible seaweed on O`ahu was mostly due to population pressure.

Faris, who was a kid in the 1950s, noticed a change since the 1960s in the amount of big pelagic fish that would come to the outer reef of Kane`ohe Bay to feed, and that there were large schools of akule and opelu in the 1950s. He also remembers first seeing bubble algae in Kane`ohe Bay about 20 years ago and hearing about sewage spills in the Bay at about the same time. In the last ten years, he has seen a general decline in papio, awa, and `awa`awa, and stated that monofilament gillnets started coming in wholesale in the early sixties. These nets are so good that the fish can't see them, and the eye limits of the nets are still too small. (Faris, Tr., 3/5/96, at 190, line 23 to 194, line 9)

G. Uyemura, caretaker of Moli`i fishpond, stated that back in the 1920s, fish were plentiful in the Bay. When he first began to live there, approximately ten fishponds surrounded the Kane`ohe Bay area. (G. Uyemura, Tr., 3/5/96, at 125, lines 1-21) The introduction of exotic predatory saltwater fish – snappers, tuas , tilapia, and gold-spot herrings -- really changed the way the caretakers used to run a pond. (G., Uyemura, Tr., 3/5/96, at 133, lines 16-18; at 144, line 24 to 145, line 24) When monofilament nets came into being, they had a big, big effect because they are nonselective, catching everything. (G. Uyemura, Tr., 3/5/96, at 138, lines 17-24) Poachers also limit the number of fish that would eventually be harvested from the pond. (G. Uyemura, Tr., 3/5/96, at 141, line 22 to 142, line 7)

Fernandez, fifty-years old, remembers an abundance of mullets and awa as a child, as well as *limu` ele`ele* at the mouth of Waiahole Stream. But today, there are no more awa on the reefs, which he attributed to over fishing; and no more *limu*, for reasons he didn't know but tended to think it was because of the decline in normal stream flow. (Fernandez, Tr.,4/10/96, Day Session, at 69, line 10 to 70, line 8; at 72, line 22 to 73, line 20)

Abbott, testifying as an expert witness in ethnobotany, stated that the overall decline of edible seaweed on the island of O`ahu is mostly due to population pressure. (Abbot, Tr., 3/6/96, at 247, lines 3-4) The disappearance of *limu* along Waiahole-Waikane is due in part to the spreading of mangrove that comes from the mouth of Hakipu`u Stream. (Abbott, Tr., 3/6/96, at 247, lines 15-19) There is nothing that distinguishes the availability of edible seaweed in Waiahole-Waikane versus the rest of Kane`ohe Bay or Ewa Beach or wherever else that there has been a decline or disappearance. (Abbott, Tr., 3/6/96, at 248, lines 16-25)

ii. Scientific Opinions and Studies

Summary. There are trends in terms of fish availability in Kane`ohe Bay by species from 1948 through 1993. The trends show that there was a decline from 1948 until about 1960. The trend began increasing up until 1967. Then, the trend began to fluctuate up and down, which is characteristic of over fishing effects. It continued to fluctuate until 1978 and then a steady decline continued until the present.

There are no adequate scientific studies that would refute or support any hypothesis that fishes in Kane`ohe Bay require fresh-water input as a factor to their survival versus other characteristics of the Bay, such as the oceanography, morphology, pollution, introduced exotic predatory species, over-fishing, and habitat destruction.

There are many variables involved when conducting an ecosystem study, including the freshwater system, the deep-sea system, climatic features, water quality analysis, and nutrient loading. Data collected over a period of 8-9 years would be necessary before any valid scientific conclusions could be reached as to how various factors affect the actual productivity and biological organization of Kane`ohe Bay.

From a scientific standpoint, restoring Waiahole and Waikane Streams (which empty into Kane`ohe Bay - Kahana Stream does not) would be particularly

useful to factor out these influences and study the impact of increased flow in relative isolation, because of the relative absence of pollution and urbanization of the watersheds of these two streams.

There are many variables involved when conducting an ecosystem study, including the freshwater system, the deep-sea system, climatic features, water quality analysis, and nutrient loading. (Livingston, Tr., 3/13/96, at 71, lines 14-21)

Livingston estimated that data collected over a period of 8-9 years would be necessary before any valid scientific conclusions could be reached as to how various factors affect the actual productivity and biological organization of Kane`ohe Bay. (Livingston, Tr., 3/14/96, at 8, lines 21-25)

From a scientific standpoint, restoring Waiahole and Waikane Streams (which empty into Kane`ohe Bay) would be particularly useful to factor out these influences and study the impact of increased flow in relative isolation, because of the relative absence of pollution and urbanization of the watersheds of these two streams. (Livingston, Tr., 3/14/96, at 60, lines 14-18)

High base flow of streams is important to the estuary ecosystem. The flows generated during storm events perform a function different from that of base flows. The estuary does not assimilate a great deal of nutrients from flood events, because the water moves through the system so rapidly. Those flows flush out the estuarine system, while the base flow sustains the nutrient levels throughout the year that is essential for estuary productivity. (Livingston, Tr., 7/3/96, at 15, line 20 to 16, line 9)

There are primary and secondary productivity factors that are applicable to the estuary system in Kane`ohe Bay. Primary productivity is the production of green plants and the *detritus*, or dead organic material and microbes, which form the base of the food web. Secondary productivity is essentially the animals that consume the plants and *detritus*. (Leber, Tr., 4/23/96, V. 1, at 159, lines 21 to 160, line 8)

There is also a relationship between higher flows and fisheries. If there is a higher flow, there is going to be a higher delivery rate of leaf material and sediments to the offshore area, which translates into a greater availability of food. (Lowe, Tr., 2/29/96, at 119, line 25 to 120, line 15)

With respect to streams and freshwater input, there is a lot more involved than just looking at the flow rates. You must also look at the number of pools, refugia, plants and the chemistry of the water when the plants dissolve. (Lobel, Tr., 4/11/96, at 114, lines 15-22)

Striped mullet is a valuable indicator of ecosystem responses to changes in productivity in the estuaries. They prefer the low salinity areas in mud flats outside of stream mouths. It feeds directly on plants and *detritus* and is a key link between the lower and upper levels of the food web. It converts plants and *detritus* into a food source – small mullet – that other fishes can use. (Leber, Tr., 4/23/96, V. 1, at 164, line 22 to 165, line 15)

There are trends in terms of fish availability in Kane`ohe Bay by species from 1948 through 1993. The trends show that there was a decline from 1948 until about 1960. (Lowe, Tr., 2/29/96, at 169, lines 2-22) The trend began increasing up until 1967. Then, the trend began to fluctuate up and down, which is characteristic of over fishing effects. It continues to fluctuate until 1978 and then a steady decline continued until the present. (Lowe, Tr., 2/29/96, at 170, lines 8-18)

Factors contributing to the decline are urbanization, over-fishing, poaching, pollution, sediment run-off, dredging, sewage spills, algae blooms, growth of mangrove, development of culverts (cementing the sides of streams), and habitat degradation. (Devick, Tr., 2/14/96, at 43, lines 9-12) (Leber, Tr., 4/23/96, V. 1, at 165, lines 21-24; at 166, lines 19-22; at 168, lines 1-2; at 168, lines 21-22) (Lowe, Tr., 2/29/96, at 144, lines 5-17) (Livingston, Tr., 3/13/96, at 143, lines 23-25) All of these factors are interrelated and as such, efforts are needed to improve these conditions before fishing improves. (Lowe, Tr., 3/5/96, at 41, lines 17-20) The synergism of these factors is worse than the effects of any single factor. (Lobel, Tr. 4/11/96, at 136, line 15 to 138, line 20)

Although the decrease in stream flow may have been a factor affecting fish populations in Kane`ohe Bay, scientists are unable to quantify the correlation between stream flow and increased fish habitat. ((Lowe, Tr., 2/29/96, at 142, lines 1-11; at 144, lines 5-17)

What makes Kane`ohe Bay an important habitat is not so much the salinity factor per se, but involves the morphology and the sheltered areas of the Bay. (Lobel, Tr., 4/11/96, at 127, line 19 to 128, line 5)

Nursery grounds are very important as they are usually in coastal areas. It is clear that those are areas that have a lot of fresh-water input. However, what we do not know is whether or not the physiology of the fish in these areas is dependent on fresh water. (Lobel, Tr., 4/11/96, at 102, lines 9-14)

There are no adequate scientific studies that would refute or support any hypothesis that fishes in Kane`ohe Bay require fresh-water input as a factor to their survival versus other characteristics of the Bay, such as the oceanography, morphology, pollution, introduced exotic predatory species, over-fishing, and habitat destruction. (Lobel, Tr., 4/11/96, at 89, line 11 to 90, line 9)

c. IMPACT OF WATERSHED CHANGES ON THE STREAMS

<u>Summary</u>. Clearing for agricultural practices and lack of water are responsible for the retraction of the forest in the Waikane area. But development, by drying up the slopes below, is probably a more important factor than the Waiahole Ditch itself. Even in undiverted streams, non-native plant species may cause a problem for the ecosystem within that undiverted stream. Vegetation can also have an effect on the amount of water in a stream over a period of time. Today, there is very little, if any, of the original native vegetation left. Almost all of the vegetation is secondary in nature.

Restoration of the forest cover in the lower Waikane watershed, particularly on the slopes of the tributaries that feed Waikane Stream, would not only stop the accelerated erosion, but would also regulate the surface water flow.

The diversion of water by the Ditch along with other changes greatly disturbed the watershed ecosystem of Waiahole-Waikane. (Mueller-Dombois, Tr., 3/7/96, at 65, lines 6-25)

Clearing of the land and lack of water are responsible for the retraction of the forest in the Waikane area. But development, by drying up the slopes below the Ditch, is probably a more important factor than the Ditch itself. (Mueller-Dombois, Tr., 3/17/96, at 87, lines 3-11)

Even in undiverted streams, non-native plant species may cause a problem for the ecosystem within that undiverted stream. (Kido, Tr., 04/17/96, at 62, lines 1-9) Vegetation can also have an effect on the amount of water in a stream over a period of time. (Bovee, Tr., 04/10/96, at 180, lines 15-25)

Today, there is very little, if any, of the original native vegetation left. Almost all of the vegetation is secondary in nature. (Char, Tr., 12/13/95, at 202, lines 1-3)

Fernandez testified that in the 1950s and 1960s, there was less vegetation growing in and around the Waiahole Stream. For example, there were no albezia trees there, and the hau bushes were much less dense before, especially on the property that he maintained. (Fernandez, Tr., 4/10/96, at 85, lines 7-22) This is because the farmers used to maintain the stream banks and even the stream because they used the stream for irrigation purposes. Now, there are fewer farmers maintaining the area, which means increased vegetation along the stream. Therefore, the increase in vegetation may be one of the reasons contributing to the change in stream flow. (Fernandez, Tr., 4/10/96, at 86, line 21 to 87, line 7; at 88, lines 1 to 89, line 20)

The rain forest has diminished in the Waiahole-Waikane Valley by about 1,000 meters up to where the ditch is located. One of the possible causes for the retraction of the rain forest cover in Waikane could be due to the pineapple and sugarcane or other activities in the kula area actively removing trees or vegetation. (Mueller-Dombois, Tr., 3/7/96, at 85, lines 16-22; at 86, lines 17-23)

Broom sedge grass is an alien grass, which may cause some watershed impairment, such as erosion. The grass sod becomes waterlogged, often gets torn off, and begins to move downslope, causing erosion. (Mueller-Dombois, Tr, 9/15/95, at 10, lines 13-17) Broom sedge grass is a problem in the Waiahole-Waikane area, especially in the *kula* portions of the Waikane side of the valley, where it grows in the abandoned fields where pineapple and sugarcane were formerly farmed. (Mueller-Dombois, Tr., 3/7/96, at 77, lines 9-25; at 78, lines 17-25; at 79, lines 1-21; at 80, lines 1-21)

The partially dormant and dried-up cover of broom sedge is capable of recirculating only one-fourth of the incoming rainfall from its root zone in the surface soil. It acts like a mulch overlying the mineral soil. The mulch allows the water to penetrate onto the soil during showers, but it also locks the water into the shallow root mass. Since transpiration is minimal, and since the soil under the broom sedge ground cover appears to be always moister than field capacity, most of the rain water will be diverted as runoff once it reaches the soil surface. (Mueller-Dombois, Binder #6B, written direct testimony, at 15-16)

In contrast, foliated tree crowns are capable of recycling much more water by transpiration, potentially more than twice as much as the amount of February rainfall. The trees act like wicks, transferring soil water back into the atmosphere during sunny and windy periods. The water storage capacity of the soil is restored by the actively transpiring trees soon after any prolonged rain shower. Moreover, the trees can effectively remove water from their deeper reaching root zone, which extends to more than twice the depth of the grass roots in the soils of Waikane Valley. Also, water penetration is facilitated under tree cover because of their deeper root zones, which increases the water storage capacity of the soil. (Mueller-Dombois, Binder #6B, written direct testimony, at 16-17)

Restoration of the forest cover in the lower Waikane watershed, particularly on the slopes of the tributaries that feed Waikane Stream, would not only stop the accelerated erosion, but would also regulate the surface water flow. Without fire, the broom sedge will become reforested naturally on windward O`ahu, and in lower Waikane Valley, natural succession would potentially revert the grass cover back to koa forest and at higher elevation, into `ohi`a forest. (Mueller-Dombois, Binder #6B, written direct testimony, at 17)

4. WINDWARD OFFSTREAM WATER NEEDS

a. WETLAND TARO

i. ACREAGE

__Summary__. While the results of three different researchers on *kuleana* awards at the time of the Mahele in 1850 are conflicting, there were probably in the neighborhood of 100 acres in total awards to small farmers and commoners in Waiahole Valley. Most of the *kuleanas* had two *apana* or parcels. A typical *kuleana* had several *lo`i*, *kula* lands, and a houselot, so only a portion of the total of 100 acres, perhaps half, or 50 acres, must have been in actively cultivated taro *lo`i*.[41] In contrast, there were probably about 300 acres of taro *lo`i* in Waiahole Valley in the pre-Cook era. Apart from a mention of summary data, no information was presented on Waikane, Hakipu`u or Kahana Valleys.

In Waiahole Valley there are currently 13 acres under cultivation in wetland taro, 10 acres in commercial leaf taro, and three acres in *poi* taro for both personal and commercial use. Another farmer would like to farm seven acres of *poi* taro, which he plans to sell. In Waikane Valley, one farmer currently has a quarter acre in wetland taro, which he consumes and sells the remainder, and wants to expand to three-quarter acre. If he can recover land currently covered by a landslide, he would add another three-quarter acre. Another farmer intends to farm one acre of wetland taro.

About ten percent of taro *lo`i* are fallow at any one time, and infrastructure (dikes, roads, paths, etc.) take up another 15 percent. So net acreage actually planted at any time is about 75 percent of the total wetland taro acreage.

Taro yields are estimated at 20,000 (Fukumitsu) to 40,000 (Reppun) pounds per acre per year, and while not all the taro is processed into *poi*, the yield of *poi* is about 80 percent of the taro that is cooked (Reppun). Consumption is about 10 pounds of taro per person weekly (Fukumitsu), which converts into eight pounds of poi per week, or a little more than one pound per person per day. Miyagi estimated pre-Cook taro yields at 12,000 to 20,000 per acre, conversion at one pound of *poi* from two pounds of taro, and consumption at five pounds of *poi* a day for an Hawaiian adult. Using Fukumitsu's and Reppun's current conversion and usage rates, each acre of wetland taro would provide the *poi* needs of about 38 to 77 persons per year. Even with the relatively small acreages on which the Reppuns and Roberts

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[41] Using Miyagi's (Exhibit J-26, at 84-85) estimates – 12,000 to 20,000 pounds of taro per acre per year, a conversion from taro to poi of 2 for 1, and daily consumption of five pounds of poi by a Hawaiian adult at the time of the Mahele – an acre of taro would have provided the poi needs of from 3 to 7 adult Hawaiians. Therefore, of the approximately two acres of *kuleana* that was typically awarded to small farmers or commoners, about one acre must have been in taro *lo`i*. This would mean that, at the time of the Mahele, perhaps 50 acres of the approximately 106 acres among the 53 awards to small farmers or commoners was in taro *lo`i*.

currently farm wetland taro, these amounts of taro production mean that they produce more than needed by their immediate families, which they have affirmed.

The customary and traditional use of wild and cultivated renewable resources is for direct personal or family consumption, not for profit or commercial use. So, if applied to the concept of growing taro in Waiahole Valley, subsistence would not extend to granting water so that people could grow taro for commercial sale. (McGregor, Tr., 2/22/96, at 46, lines 18-25; at 47, lines 4-16)

When a Land Commission award was made, it was only those *lo`i* that were in cultivation that were awarded to the applicant for the *kuleana*.[42] (Kameeleihiwa, Tr., 4/3/96, at 43, lines 9-20.)

A claim for water allotment should be based on the number of acres of land planted in taro at the time of the *Mahele* and not on whether an area is deemed suitable for taro growing based on the Office of State Planning's (OSP) Geographical Information Systems (GIS) baseline information. (Saiki, Binder #9, written rebuttal testimony to Manrique, at 6, lines 2-6) *Kula* lands (which include pasture lands) or lands for other agricultural crops were not given consideration for water allotment based on a given quantity of gallonage per acre per day. (Saiki, Binder #9, written rebuttal testimony to Manrique, at 6, lines 6-9) *Kula* lands generally meant that the area was in banana or dryland taro cultivation. (Kahalewai, Tr., 5/1/96, at 46, lines 22-25)

Miyagi, in his Master of Arts Thesis of June 1963 on "Land Use in Waiahole Valley, Oahu," estimated that there were about 300 acres of land in Waiahole Valley suitable for taro production in the pre-Cook era. (Exhibit J-26, at 85)

By the time of the *Mahele*, the decrease of the Hawaiian population had led to the abandonment of taro lands, and Miyagi found a total of 58 Land Commission awards in Waiahole Valley. Five were larger awards claimed by a foreigner and chiefs. The remaining 53 awards were small *kuleanas* made to farmers or commoners. The average size was 2.02 acres. Most of the *kuleanas* had two *apanas* or parcels, several had three, and one had four. Most of the *apanas* of one kuleana were located near each other, frequently within a thousand feet. All the *apanas* of a single *kuleana* were given the same number on the map to indicate ownership under one title. (Exhibit J-26, at 74-76)

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[42] "For instance, a strong able bodied man who had not only worked himself at the opening of the `auwai, but had also induced others to help as his quota to the konohiki work, but had neglected to claim or utilize the amount of water he was entitled to, using only enough to irrigate the koele, or konohiki patch in his holding and one or two other lo`i for his own use, would, after a while be restricted to the use only of such quantity of water as would irrigate those lo`is which it had become customary for him to cultivate." (Nakuina, Emma, "Ancient Hawaiian Water Rights, and some of the Customs Pertaining to Them," Thrum's Hawaiian Annual, pp. 79-84, at 80-81 (1894), cited by Kame`eleihiwa, Binder #6A, written direct testimony, at 9)

A typical *kuleana* in Waiahole Valley had several *lo`i*, *kula* lands, and a houselot. (Exhibits M-64, M-67, M-68)

The majority of the *kuleanas* or their fragmented *apanas* were located in the lowland in relation to high water table and the possibility of water diversion from streams. Their primary use was for the cultivation of taro, the staple food crop. Some of the holdings were located in *kula* areas, but their number and size were small as compared with the lowland plots. Most of the *kula* parcels of the *kuleanas* were located in Kaneloa, the flat-surfaced old alluvial terrace in the central portion of the valley and were seldom more than one-quarter acre in extent. They were probably utilized for house lots and gardens. (Exhibit J-26, at 76-77)

Only a few *kuleanas* were claimed during the *Mahele* in the northern portion of the coastal plain adjacent to Waikane Valley. Water was not available from Waiahole Stream because of the alluvial terrace between the area and the stream. A small stream[43] crossing the area probably was diverted for taro cultivation, but the supply of water would have been inadequate to bring the entire area under cultivation. The water was probably obtained from Waikane Stream in the next valley, and the land was probably no longer in cultivation at the time of the *Mahele*. Miyagi also speculates that another reason for the few *kuleana* claims in this area of Waiahole might have been that what water rights prevailed, if water was drawn from another valley, was not clear. (Exhibit J-26, at 75-76)

McGregor stated that at the time of the *Mahele* in 1848 to 1850: 1) in Waiahole, 58 of the 62 applicants for land awards, or 94 percent of the applicants claimed land for a total of 455 *lo`i*;[44] 2) in Waikane, 23 of the 28 applicants, or 83 percent, claimed land for a total of 119 *lo`i*; 3) in Hakipu`u, 35 of the 37 applicants, or 95 percent, claimed land for a total of 238 *lo`i*; and 4) in Kahana, 29 of the 32 applicants, or 91 percent, claimed land for a total of 251 *lo`i*. (McGregor, Binder #7, written direct testimony, Exhibit B, page 13; McGregor, Tr., 4/16/96, at 31, line 17 to 32, line 5)

McGregor did not cite her source for this data, but Shimizu testified that, as a law student assigned to the Native Hawaiian Legal Cooperation, he was asked to compile certain data regarding evidence to which taro was being cultivated in Waiahole Valley at the time of the *Mahele*, and was told to contact McGregor, because she had compiled some information previously, foreign testimonies and native register testimonies, describing the land that claimants were <u>applying for</u> to the Land Commission at the time

[43] This stream, unnamed at present, was described by Lowe in her testimony on the influence of fresh water on marine and estuarine organisms in Kaneohe Bay. It apparently is not connected to Waiahole Stream, as Lowe, describing the flows of Waiahole, Waikane and the unnamed streams after the flow in Waiahole had been increased for some time, found that: "And relative flow, you had a higher flow rate in Waiahole Stream, you had a less flow in Waikane Stream, and the unnamed stream was like almost nothing, was really, really low flow." (Lowe, Tr. 2/29/96, at 117, lines 10-13)

[44] McGregor's and Shimizu's (*infra*) testimonies contain an arithmetical error. The tables presented by Shimizu and Blakeslee (also *infra*) contain two "totals," one for 228 *lo`i*, and the other for 207 *lo`i*, which add up to 435 *lo`i*, not 455 *lo`i*. (Shimizu, Binder 6B, written direct testimony, Exhibit A)

of the *Mahele* (*emphasis added*). Shimizu, along with another law student, Blakeslee, put together a chart. (Shimizu, Tr., 4/3/96 at 16, line 15 to 166, line 7)

In addition to Waiahole data, Shimizu mentioned summary data on Waikane Valley of 23 of 28 applicants, or 83 percent, for a total of 119 *lo`i*, in his written direct testimony (Shimizu, Binder 6B, written direct testimony, at 2), but provided no data on Waikane Valley. Blakeslee neither mentioned nor provided any data or summary of data on Waikane Valley. (Blakeslee, Binder #6A, written direct testimony; Tr., 4/10/96, Evening Session, at 265, line 17 to 277, line 4)

Neither Shimizu nor Blakeslee mentioned compiling data on, nor presented any data of, similar information on Hakipu`u and Kahana valleys, (Shimizu, Binder #6B, written testimony; Binder #7, written surrebuttal testimony; Tr., 4/3/96 at 165, line 9 to 202, line 7) (Blakeslee, Binder #6A, written direct testimony; Tr., 4/10/96, Evening Session, at 265, line 17 to 277, line 4)

The object of Shimizu's and Blakeslee's research was to show the extent of taro cultivation at the time of the *Mahele*, regardless of whether the lot was awarded or not. (Shimizu, Tr., 4/3/96, at 174, lines 20-24):

> "(T)he number of *lo`i* came from the application. The acreage figure comes from the index of Land Commission awards which was made after the parcels were awarded.
>
> "(For example,) (b)ecause Kaoa applied for 22 *lo`i* doesn't mean he got all 22 *lo`i*. He might have been awarded only a part of the parcel which he applied for, which might have contained only six. But within his testimony, within his application, he claimed he had 22 *lo`i* in cultivation, so that's why that figure 22 is there." (Shimizu, Tr., 4/3/96, at 176, lines 13-21)

An example of the relevance of the number of *lo`i* contained in the application to the Land Commission compared to the number actually awarded by the Commission was provided by Kahalewai. For Land Commission award 7648,[45] the application was as follows:

> "Number 7648, Kapule. To the Land Commissioners, Greetings to you all. I hereby state my claim to you in the `Ili of Kuakaikoo, in the Ahupua`a of Waiahole, District 6, Division 2, Island of Oahu. There are four taro *lo`i*, seven weed-grown *lo`i*, one *kula*, and one house site. That is my petition on this 31st day of December, A.D. 1847, at Waiahole, Koolau." (Kahalewai, Tr., 5/1/96, at 54, line 21 to 55, line 2)

[45] There is a discrepancy in the acreage of this award between Shimizu, who lists it at 2.25 acres (Shimizu, Binder #6B, written direct testimony, Exhibit A) and Kahalewai, who lists it at 62.50 acres (amended Exhibit M-49).

Shimizu and Blakeslee had listed 11 *lo`i*, while Kahalewai had determined that only two *lo`i* actually had been awarded. (Kahalewai, Tr. 5/1/96, at 53, lines 16 to 54, line 9)

Nor did Shimizu and Blakeslee know the average size of the *lo`i*. (Shimizu, Tr., 4/3/96, at 197, line 12 to 198, line 18)

Moreover, while the acreage of land listed in Shimizu's and Blakeslee's testimony was the amount actually awarded, they did not know the acreage where taro was growing, and there wasn't a relationship between even the number of *lo`i* they listed and the acreage of the award. (Shimizu, Tr., 4/3/96, at 182, line 15 to 183, line 13)

In addition, more than two-thirds of awards with *lo`i* in their application as defined by Shimizu and Blakeslee, also had both *kula* lands and house lots, and about one-fourth were also identified as having *awa* plants or garden plots. (Shimizu, Binder 6B, written direct testimony, Exhibit A)

And for the total of 419.951 acres with 435 *lo`i*,[46] there are two large parcels of 225 acres for which there were no *lo`i*, and 93 acres for which there was a notation of "NL",[47] or more than seventy-five percent of the total acreage. (Shimizu, Binder #6B, written direct testimony, Exhibit A)

Of the remaining 60 Land Commission awards totaling approximately 102 acres, the largest was 5.4 acres, and nearly all were less than 3 acres. This is close to the 53 awards to farmers and commoners, averaging 2.02 acres, that Miyagi found in his research (*supra*).

In marked contrast to Shimizu and Blakeslee, Kahalewai, testifying for OHA, identified only 20 *lo`i* actually awarded in 13 Land Commission awards totaling 223.86 acres in Waiahole agricultural park.[48] (Kahalewai, Tr. 5/1/96, at 59, lines 16-20; Binder #7, written direct testimony, Amended Exhibit A; Exhibit M-49)

Of the 13 awards she identified, two were 0.35 acres and 0.20 acres (with no *lo`i* awarded), respectively, one was 8.35 acres (with no *lo`i* awarded), nine were 16.940 acres each (only six of which had a total of 20 *lo`i* awarded), and one was 62.50 acres (with 2 *lo`i* awarded).

The 62.50 acres may be an error. This award is for Land Commission Award 7648, to Kapule, (*supra*), and for which Shimizu and Blakeslee identified as containing 2.25 acres. (Shimizu, Binder #6B, written direct testimony, Exhibit A.) Therefore, if 60 acres is subtracted from Kahalewai's total acreage of approximately 224, she would have

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[46] The *lo`i* in Shimizu's and Blakeslee's tables totaled 435, not 455. See footnote 44, *supra*.
[47] No explanation was given for this "NL" notation; it may mean "no *lo'i*". Whatever the meaning of "NL", no *lo'i* were ascribed to this 93-acre parcel.
[48] The 223.86 acreage total may be approximately 60 acres less. See footnote 45, *supra*.

identified 20 awarded *lo`i* in approximately 164 acres of Land Commission awards in Waiahole Valley.

But 164 acres is still in marked contrast to the approximately 100 acres of Land Commission awards comprised of small holdings that both Miyagi and Shimizu/Blakeslee identified. Furthermore, notwithstanding the perhaps gross overstatement of Shimizu's and Blakeslee's calculation of *lo`i* in the Land Commission awards, Miyagi had concluded that most of these awarded lands were devoted to taro *lo`i* (*supra*).

Manrique, testifying for OHA, identified lands suitable for taro production and within those lands, lands highly suitable for taro production, according to Office of State Planning (OSP) criteria, in Waiahole watershed and Kahana Valley. (Manrique, Binder #7, written direct testimony.) Approximately 75 acres of lands suitable for taro production were identified in Waiahole, of which approximately 12 acres were identified as highly suitable. (Manrique, Tr., 5/1/96, at 77, lines 3-9; Binder #7, written direct testimony, Exhibit C, table 2)

However, Kobayashi, from OSP, stated that the report which was used by Manrique was for illustrative purposes only and that the information should not be used to make decisions requiring more precision and accuracy on irrigation water requirements, crop suitability and agricultural land use projections. (Kobayashi, Binder #2, written direct testimony, Exhibit L-200 at 10)

Paul Reppun believed there is a potential for 300 to 400 acres of wetland taro in Waiahole, Waikane, Hakipu`u, Kahana, and Ka`a`awa Valleys, and that over the next generation, there will be an increase of 50 to 100 acres and eventually maybe as much as 200 acres. (P. Reppun, Tr., 3/12/96, at 77, line 22 to 78, line 2) He also believed that there were 300 acres in Waiahole Valley at one time. (Reppun, Tr., 3/12/96, at 90, lines 11-12) He later stated that 200 acres was for Waiahole and Waikane Valleys alone (P. Reppun, Tr., 3/12/96, at 90, lines 1-2), and that Waiahole alone had the potential of 50 to 100 acres. (P. Reppun, Tr., 3/12/96, at 108, lines 22-23)

Currently, there are about 13 acres of wetland taro in Waiahole Valley, 10 acres in leaf taro for commercial sale, and about 3 acres of poi taro farmed by the Reppun brothers. (P. Reppun, Tr., 3/12/96, at 98, line 23 to 99, line 7)

The Reppuns' acres are in two patches, one about an acre and three quarters, and the other a little over an acre. (P. Reppun, Tr., 3/12/96, at 139, lines 20-22) Both patches are further divided up into a number of different fields. (P. Reppun, Tr., 3/12/96, at 10-18) The Reppuns also have another farm in Waihe`e, three-quarters planted in taro, and they rotate their plantings a lot.[49] (P. Reppun, Tr., 3/12/96, at 141, lines 5-7)

[49] The Reppuns' planting practices are described in the following section on per acre water requirements of wetland taro.

Their three acres in Waiahole Valley are on an agricultural lot of 30 acres, of which about 15 acres are tillable or cultivable. (P. Reppun, Tr., 3/12/96, at 138, line 22 to 139, line 8) The two taro patches are on the inside of a bend of Waianu Stream. (P. Reppun, Tr., 3/12/96, at 139, lines 14-25.) In addition to taro, "bananas, papayas, sweet potato, corn, breadfruit, all kinds of things" are grown. (P. Reppun, Tr., 3/12/96, at 160, lines 20-21)

The Reppuns make their poi according to what orders they have, and when they have a surplus beyond what would be made into poi, they take the whole corms to the open market or sell it to a lot of different outlets. (P. Reppun, Tr., 3/12/96, at 81, lines 5-14)

Badiyo, who has 10.465 acres in Waiahole Agriculture Park, plans to farm seven acres of wetland taro. The taro from these patches will be sold to Waiahole poi factory for poi, and some patches will be used strictly for the sale of *luau* leaf.[50] (Badiyo, Binder 6A, written direct testimony, at 3-4.) He currently farms ti leaves and cut flowers on the higher acre and a third section of land, which is irrigated from the McCandless pipeline, and he would irrigate the taro patches on the lower eight-plus acres through *`auwai* from the old *lo`i* system. (Badiyo, Tr., 4/3/96, at 210, line 23 to 211, line 15)

Agard, testifying on behalf of the Department of Hawaiian Home Lands for a reservation request for its Waiahole agricultural park parcels, stated that DHHL's request was specifically for water from Waianu Stream, even though there might be as much as one million gallons per day from the water system built expressly for the agricultural park. (Agard, Tr., 5/7/96, at 9, line 18 to 12, line 10)

None of the DHHL parcels are located on the stream, and DHHL had no evidence that their homesteaders use or intend to use those parcels for taro cultivation purposes. For the island of Oahu, only one DHHL lot is being used for taro purposes on the entire island, and it's an experimental hydroponic project actually cultivating snails for escargot. The water drains down to the taro patch. (Agard, Tr. 5/7/96, at 17, lines 3-16)

Medeiros has a 2.63-acre *kuleana* in Waikane Valley on which she farms Vietnamese taro, bananas, and ornamental flowers, utilizing a flood overflow channel that transmits water from Waikane Stream. She also farms bananas and ornamental flowers on this land. She has another *kuleana* in the valley of about an acre, on which she wants to grow wetland taro.[51] (Medeiros, Binder #6B, written direct testimony, at 1-3)

Roberts has a 3.10-acre *kuleana* in Waikane Valley on which he grows taro, ung choy, and ornamental flowers. He currently raises wetland taro on about a quarter acre,

[50] According to Badiyo: "I don't know about this subsistence stuff, yeah. All I know is commercial stuff, because that's all we do is commercially. And as we do it commercially, we take what we need. So I don't know if you guys consider that subsistence." (Badiyo, Tr., 4/3/96, at 210, lines 13-17)

[51] In written testimony, Medeiros had stated that she wanted to use all of her land for wetland taro, but in oral testimony, Medeiros stated that only the lower acre would be used to grow Hawaiian taro. (Medeiros, Tr. 4/4/96, at 79, lines 20-24)

and wants to expand it by another half-acre. If he can restore *lo`i* now covered by a landslide, he could open up another three-quarter acre for taro cultivation, for a total of one-and-a-half acres. And if he can get permission to use more land in Waikane or Waiahole Valleys where there used to be *lo`i*, and the necessary water to support it, he would be willing to grow another 2-3 acres in taro, and up to 5 or more acres if young farmers go into a *hui* with him. (Roberts, Binder #6B, written direct testimony, at 1-3) The poi he grows now is for family and friends and for sale to Waiahole Poi Factory. "So I just farm by what I would use, and if too much, then I would sell." (Roberts, Tr., 4/4/96, at 66, line 4 to 67, line 6)

In Moriarty's study of water needs of taro *lo`i*, on the 33 acres he studied in Hanalei Valley, about 10 percent of the taro fields were dry (fallow), and about 15 percent was roads or dikes. (Moriarty, Tr., 3/14/96, at 206, lines 21-24; at 208, lines 3-6)

Of the Reppuns' three acres in taro, some portions of it are "banks, roadways, and things like that". (P. Reppun, Tr., 3/12/96, at 106, lines 23-25) The Hanalei Valley taro fields probably have less infrastructure type improvements, like roads and that sort of thing, than on taro fields based on steep land, because steeper areas have more banks, so there would be less net *lo`i* in Waiahole Valley. (P. Reppun, Tr., 4/24/96, at 215, lines 11-24)

The Reppuns also like to fallow the ground, to rest their fields for up to six months between crops. (P. Reppun, Tr., 3/12/96, at 145, lines 14-15)

One acre of wetland taro produced from 12,000 to 20,000 pounds annually. Miyagi estimated that two pounds of taro were required to produce a pound of poi (30% solid), and that five pounds of poi per day were necessary to sustain an Hawaiian adult. (Exhibit J-26, at 84-85)

Paul Reppun estimated that his yield today is approximately 40,000 pounds per acre per year, which is complicated to calculate, because taro is a 15-month crop. Not all of his taro is processed into poi, but his yield of poi is approximately 80 percent of the taro that is cooked. (P. Reppun, Tr., 3/12/96, at 106, lines 16 to 107, line 9)

Fukumitsu of Hakipu`u Valley first estimated his yield at approximately 20,000 pounds per acre per year, (Fukumitsu, Tr., 4/4/96, at 156, lines 7-12) and that he had two harvests a year, depending on the variety of taro planted. (Fukumitsu, Tr. 4/4/96, at 193, lines 2-11) But when questioned about his five acres yielding 100,000 pounds a year, which meant that he might have to give away or sell 50,000 pounds of taro a year, Fukumitsu stated that there was no way it could be 20,000 pounds per acre and that he was just giving an average. (Fukumitsu, Tr., 4/4/96, at 193, line 15 to 194, line 23)

Fukumitsu also estimated that his family – he had five children – ate more than one acre's worth or 20,000 pounds a year, and that one person ate maybe ten pounds a week. While it was not clear whether this ten pounds was taro or poi, when asked whether he agreed that ten pounds translated into 520 pounds and 40 people per acre (i.e., taro, not poi), he replied affirmatively. (Fukumitsu, Tr., 4/4/96, at 195, lines 6-21)

Using Reppun's estimate of an 80 percent conversion rate from taro into poi, and Fukumitsu's estimate of his family's consumption of 10 pounds of taro per person per week, weekly consumption would be eight pounds of poi a week, or approximately one pound of poi per day. (Contrast this with Miyagi's estimate that five pounds of poi per day was the consumption rate of Hawaiians at the time of the *Mahele*.)

At a consumption rate of 10 pounds of taro per person per week (or a little more than one pound of poi per day), each person would consume 520 pounds of taro per year. Using Fukumitsu's 20,000 pounds per acre per year and Reppun's 40,000 pounds, each acre of wetland taro would provide the poi and/or taro needs of about 38 to 77 persons per year. Even with the relatively small acreages on which the Reppuns and Roberts currently farm wetland taro, these amounts of taro production mean that they produce more than needed by their immediate families, which they have affirmed, *supra*.

ii. PER ACRE WATER REQUIREMENTS

<u>Summary</u>. According to Watson, the water requirements of taro in any locality at any time depend on many factors, including: 1) the available supply, and therefore whether it is, or is not, necessary to conserve water; 2) whether or not the taro patch "floors" had been well puddled and the banks well tamped to minimize leakage; 3) the stage of the crop or crops; 4) rainfall, elevation, average hours of sunshine, and wind conditions; 5) soil characteristics; and 6) whether or not there is a profit incentive.

Experiments or observations conducted on water requirements have produced results that vary widely according to the specific locations in which the experiments have been conducted. Observations of a taro farm in Hanalei Valley and experiments conducted in Hanapepe Valley on Kaua`i, resulted in good yields at inflow rates of 25,000 gad and 30,000 gad, respectively, with net loss (inflow minus outflow) so minimal that no outflow measurements were taken. In contrast, observations of taro patches in Kahalu`u and Waiahole Valleys found the following: 1) inflow varied widely and at times were at very high rates, even over a million gallons per acre per day (gad); 2) net loss (inflow minus outflow) averaged 30,000 gad in Kahalu`u and in Waiahole, between 50,000 to 60,000 (twice the Kahalu`u rate, but leakage was observed at Waiahole); and 3) for much of the fifteen-month crop cycle, no or very little water was required to enter the patches.

It was concluded that, in Waiahole Valley, representative water use was 15,000 to 40,000 gad, allowing for sufficient outflow to assure good circulation. Since all stages of the crop were included in the study, the recommendation was that 40,000 gad be recognized as the fair requirement for an area of several taro patches in various stages of crop development, including patches requiring maximum irrigation and those requiring none.

Reppun, a Waiahole taro farmer, emphasized the high inflows that he found necessary for good taro corm production, but his emphasis is not incompatible with the estimate of net water loss, which is focused on determining the water requirement of taro in order to ascertain the quantities of water to which owners of taro lands in the area may be entitled.

According to one Hawaiian historian, no more than one-half of a stream's flow was usually diverted for offstream uses. It is unclear, however, whether the limit of half the flow from a stream referred to the original flow of the stream or to the flow where the diversion was taking place. Nor is it clear how it was determined how much of the stream's flow was being diverted.

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Moriarty, testifying as an expert witness, studied water flow on a typical taro farm in Hanalei Valley to estimate the amount of water used to grow wetland taro, in order to construct new ditches into new taro fields. He only measured the amount of water flowing in, and did not take outflow or water temperature measurements. (Moriarty, Binder #9, written rebuttal testimony, at 2-4; Tr., 3/14/96, at 205, lines 17-21) Most of the water flowing in also flowed out. (Moriarty, Binder #9, written rebuttal testimony, at 6)

Moriarty found that just under 25,000 gallons per acre per day (gad) were flowing into the *lo`i*. (Moriarty, Binder #9, written rebuttal testimony, at 4) This was the average per acre on 33 acres in all stages of production, and included roadways, dikes, and portions of land that weren't in taro production. (Moriarty, Binder #9, written surrebuttal testimony, at 5) About 10 percent of the taro fields were dry, and about 15 percent was roads or dikes. (Moriarty, Tr., 3/14/96, at 206, lines 21-24; at 208, lines 3-6)

de la Pena, testifying as an expert witness, conducted experiments in Hanapepe Valley in a commercial taro farmer's field to determine the effects of different rates of water flow and depth of flooding on the yield of wetland taro. Field plots were constructed measuring 20 by 30 feet, and each plot used the same amount of fertilizer and grew the same variety of taro (*lehua maoli*). The only variable in these experiments was the rate of water flowing through each plot. (de la Pena, Binder #8, written rebuttal testimony, at 3)

The flow varied from 30,000 gad to 105,000 gad and the taro was harvested in 15 months. There were no significant differences in yield when water volume was increased from 30,000 gad to 105,000 gad. (de la Pena, Binder #8, written rebuttal testimony, at 3)

Highest yields decreased as depth of flooding increased from 0 cm to 20 cm. Highest yields were obtained from plots where water depth was maintained at 0 cm. Flooding to a depth of 16 to 20 cm drastically reduced marketable corm yields causing a severe drop in total yield. Optimum depth of flooding appeared to be 4 to 8 cm, sufficient to keep weeds under control without causing severe yield losses. (de la Pena, Binder #8, written rebuttal testimony, Exhibit B-3, at 97)

Watson conducted studies in Waiahole and Kahalu`u Valleys from October 1962 to June 1964 on the amounts of water utilized in growing taro (net water loss between inflow and outflow). The purpose of the study was to determine the water requirement of taro at Waiahole, O`ahu; i.e., to ascertain the quantities of water to which owners of taro lands in the area were entitled. (Watson, Exhibit N-207, at 150)

The Waiahole study was conducted on 14 patches totaling 2.2 acres net planted[52] taro area in the lower valley and on 16 patches totaling 2.17 acres net planted area in the upper valley. The Kahalu`u study was conducted on 53 patches totaling 7.10 acres net planted area. Measurements of inflow and outflow were taken. (Watson, Exhibit N-206, Memorandum from J.L. Grance to Leslie J. Watson, June 24, 1964)

Representative use per acre per day (inflow minus outflow) was approximately 30,000 gad at Kahalu`u, ranging from 4,000 to 83,000 gad. At Waiahole, representative use was approximately 60,000 gad for the lower patches, ranging from 19,000 to 160,000 gad; and approximately 50,000 gad for the upper patches, ranging from 14,000 to 116,000 gad. However, some of the water in the Waiahole patches was seeping out through the banks, most noticeably in the lower Waiahole patches.[53] (Watson, Exhibit N-206, Memorandum from J.L Grance to Leslie J. Watson, June 24, 1964)

In the Kahalu`u patches, inflow varied from 277,000 to 1,436,000 gallons for 7.1 net planted acres (total of nine measurements taken between November 1962 and November 1963), with reported average use (inflow minus outflow) of approximately 30,000 gad in days of "not over light rainfall, if any." On a per acre basis, the inflow range would be approximately 39,000 gad to 202,000 gad. On three measurements taken after or during a rainy period, there was actually more water flowing out than flowing in, from 26,000 to 85,000 gad more. (Watson, Exhibit N-206, Memorandum from J.L. Grance to Leslie J. Watson, June 24. 1964, attachment, table labeled "Kahaluu Taro Patches")

In the upper Waiahole patches, inflow varied from 937,000 to 1,794,000 gallons for 2.17 net planted acres (total of four measurements taken between March 1963 and November 1963), with average use of 50,000 gad. On a per acre basis, the range would be approximately 430,000 to 825,000 gad inflow, with net use of 50,000 gad on average. On three measurements taken after or during a rainy period, there was more water

[52] Although Watson used the term "cultivated", he was measuring water needs only of *lo'i* that were planted. To avoid confusion over the terms "cultivated" and "planted" – see the discussion on water needs of diversified agriculture, *infra* -- "planted" is used here instead of "cultivated".

[53] According to P. Reppun, whatever water leaks out of the taro patch ends up back in the stream. (P. Reppun, Tr., 3/12/96, at 113, lines 11-13) However, such leakages affect the measurements of inflow minus outflow and, thus, the estimates of water requirements in Waiahole Valley, or the quantities of water to which owners of taro land in the area are entitled. For example, based on these measurements, the Waiahole water "requirements" would be approximately twice that of Kahaluu's, even though some, or as much as half, would be leaking back into the stream.

flowing out than flowing in, from 28,000 to 90,000 gad more. (Watson, Exhibit N-206, Memorandum from J.L. Grance to Leslie J. Watson, June 24, 1964, attachment, table labeled "Upper Waiahole Taro Patches")

In the lower Waiahole patches, inflow varied from 45,000 to 408,000 for 2.2 net planted acres (total of eleven measurements taken between October 1962 and June 1963), with average use of 58,000 gad (rounded to 60,000). On a per acre basis, the range would be approximately 20,000 to 185,000 gad inflow, with net use of 60,000 gad on average. No rainy day measurements were given. (Watson, Exhibit N-206, Memorandum from J.L. Grance to Leslie J. Watson, June 24, 1964, attachment, table labeled "Lower Waiahole Taro Patches")

These figures were averages when water was flowing into the taro patches. Watson stated that, as a general average throughout Hawaii, no water is required to enter patches approximately 40 to 50 percent of the time. (Watson, Exhibit N-206, Appendix A, page 4)

The rate of flow into the patches also depended on the time in the growing cycle. The following is a typical planting cycle. After planting with the patch "slushy," no irrigation occurs for about two to three months. "Normal irrigation" is then started, described as follows: "Although plenty of water available, flow entering and leaving the patch was so small as to give the impression that water in the patch was not moving at all. From our continued observations we found this typical at all patches and that it indicated near perfection in keeping the patches water level almost absolutely level to give an even spread and water movement although slow." Normal irrigation continues, interspersed with short periods of no irrigation, "half irrigation" -- described as: "portion of patch covered with water of an inch or so depth and remainder with none visible, the idea being to keep the soil near saturation" -- and "full irrigation" -- not described, but presumably at the high end of flows measured, *supra*. The patch is then flooded for harvest. Finally, during the growth cycle of approximately 15 months, there are periods of rain when the patches are flooded naturally. (Watson, Exhibit N-206, "Observations made of irrigation and growth status of patches: Waiahole Patches")

Watson concluded that, in the locality studied (i.e., Waiahole Valley), representative water use was in the range of 15,000 to 40,000 gad, allowing for sufficient outflow to assure good circulation. Since all stages of the crop were included in his study, he recommended that 40,000 gad be recognized as the fair requirement for an area of several taro patches in various stages of crop development, including patches requiring maximum irrigation and those requiring none. (Watson, Exhibit N-207, at 150)

P. Reppun, a Waiahole Valley taro farmer was of the opinion that wetland taro requires 100,000 to 300,000 gallons per acre per day (gad), taking into account that not all the patches will be planted at the same time and not all of them will be in the same stage of production. Some of them may be fertilized, some may be in the process of being harvested. 100,000 might be if you're harvesting a substantial area and fertilizing at the same time and maybe it's the wintertime. 300,000 might be necessary during the summertime, even if you were harvesting and fertilizing. So the figure goes up and down. (Reppun, Tr., 3/12/96, at 69, line 11 to 70, line 23)

Reppun's estimates of requirements are on the amount of water flowing into the *lo`i*, and not on the net loss to the stream source after water is diverted into the *lo`i* and returned into the stream:

> "The earliest studies, actual studies that I've seen are studies done in conjunction with the McBryde Robinson case in Hanapepe Valley…
>
> "…The conclusion of those (early) studies was that taro needs approximately 70,000 gallons per acre per day…
>
> "…And in these studies are contained tables showing the amounts of water used by taro. And what they did was they measured the water flowing in, they measured water flowing out, and they took the difference. And they said that's how much water taro needs….
>
> "…It takes no account of the amount of water flowing through the patch…
>
> "The actual figures of water flowing into taro patches in Hanapepe Valley ranged from about 200,000 gallons per acre per day to over a million gallons per acre per day…In spite of those actual measurements, they came up with the conclusion that taro needs 70,000 gallons per acre per day. But if you look at the tables of their studies, it shows you how they arrived at that figure. What they were actually measuring was the consumption of water." (P. Reppun, Tr., 3/12/96, at 71, line 16 to 72, line 23)

Reppun's opinion is that the flow-through amount of a downstream *lo`i* would have to be twice that of the upstream *lo`i*:

> "Here's why: the minimum amount of water needed is that amount that flows through the lo`i and exits at 77 degrees. This is the temperature that everyone seems to agree is the maximum allowable, above which pythium rot begins to accelerate unacceptably. Water that has absorbed enough heat to rise to this temperature can be said to be "used up." It has no capacity left to keep temperatures below the critical level. If a downstream farmer, irrigating the same acreage as that which has already been irrigated, were to reuse this water, it would need to be mixed with an equal amount of unused water. His water use would therefore be double that of the upstream user, but the amount of new water would be the same. The rate of water use would now be twice that of the upstream farmer, but the capacity of the total amount of water to absorb heat would be the same." (P. Reppun, Binder 6B, written direct testimony, at 4)

> "Q But that 100,000 gallons per acre per day assumes an outflow temperature increase that results in an increased use of water at each lo`i that diverts water from the stream?
>
> "A That's right. If you had 100 acres, the amount of water you need would be exactly 100 times the amount one acre needs. So the guy at the bottom

of the valley might be using 10 million gallons per acre, the guy at the top might be using 100,000." (P. Reppun, Tr., 3/12/96, at 124, line 22 to 125, line 4)

For the second downstream *lo`i*, Reppun's conclusions are predicated on the "used up" water being mixed with an equal amount of "unused" stream water before entering the next *lo`i*, instead of that water returning into the stream and being greatly diluted before being diverted into the downstream *lo`i* (Reppun, Tr., 3/12/96, at 83, lines 9-22) Furthermore, for the third downstream *lo`i*, the water flowing out of the second *lo`i*, which, according to Reppun would be twice the volume flowing out of the first *lo`i*, would have to be mixed with half as much unused stream water. Therefore, by the time of Reppun's 100 acres example, 9,900,000 gallons would be flowing out of the 99th acre at a temperature of 77 degrees, to be mixed with 100,000 of unused stream water before flowing into the 100th *lo`i*.

In his assumption of the need for a minimum of 100,000 gad, Reppun does not specify the temperature of the water flowing into the *lo`i*, nor the temperature of the stream water mixed with the water flowing out of the *lo`i*, numerical values that are needed in order to quantify the amount of water flowing in that would be required for an exit temperature of 77 degrees Fahrenheit.

P. Reppun also agreed that, in Waiahole Valley, water entering and exiting the *lo`i* was not significantly different in temperature, becomes immediately mixed with the ambient stream water, and therefore does not harm the stream life. (P. Reppun, Tr., 4/24/96, at 205, line 5 to 206, line 11)

According to de la Pena, soil temperature is much more important than water temperature. While it is true that warmer water favors some diseases, it is not always true that once you have warm water in the *lo`i*, the taro will start to get sick. What is critical in the taro field is warm, stagnant water, and in his experiments, the water was always flowing. (de la Pena, Tr., 4/23/96, V. I, at 134, line 13 to 137, line 6) As long as the water is flowing, it insulates the soil from the sun so that the soil itself doesn't get too warm, which de la Pena believes is more critical than water temperature. (de la Pena, Tr., 4/23/96, V. I, at 138, lines 5-8)

P. Reppun also stated that, if you're closer to the mountain, you need less water. If you're closer to the ocean, you need more water because stream level, stream temperature rise. If you have a short stream, you need less water; if a long stream, you need more water at the bottom. And, referring to Moriarty's study, *supra*: "So Hanalei and Waiahole are really not very comparable because Hanalei has a very long, big stream and Waiahole has a fairly relatively short stream." (P. Reppun, Tr., 3/12/96 at 65, lines 13-22)

P. Reppun also stated that all of the studies that he had seen about the requirements for growing taro, which resulted in lower estimates than Reppun's, were not measurements of inflow into taro patches, but the difference between inflow and outflow.

The only study that he was not sure of was de la Pena's, because he didn't cite his methodology. He also believed if 30,000 gallons were put into a taro *lo`i*, nothing would come out the other end. The taro would grow, but it would become dryland taro. (P. Reppun, Tr., 3/12/96, at 87, line 23 to 88, line 21)

However, Moriarty's study, *supra*, only measured inflow. (Moriarty, Binder #9, written rebuttal testimony, at 2-4; Tr., 3/14/96, at 205, lines 17-21) de la Pena's study measured the rate of water flowing through each plot (de la Pena, Binder #8, written rebuttal testimony, at 3), and his published report describes the water flow rate in the section on "Materials and Methods." (de la Pena, Binder #8, written rebuttal testimony, Exhibit B-3, at 98) Finally, Watson's study was designed to measure the amounts of water utilized in growing taro (net water loss between inflow and outflow), in order to determine the water requirement of taro at Waiahole, O`ahu; i.e., to ascertain the quantities of water to which owners of taro lands in the area were entitled. (Watson, Exhibit N-207, at 150) Watson's study also included measurements of inflow and outflow. (Watson, Exhibit N-206)

P. Reppun also agreed that, if there are 100,000 to 300,000 gad going into the *lo`i*, whether the net loss is 30,000, 50,000 or 60,000 gad from transpiration, leakage, etc., the studies might be comparable. (P. Reppun, Tr., 4/24/96, at 211, lines 13-18)

According to Watson, the water requirement of taro in any locality at any time depends on many factors, including: 1) the available supply, and therefore whether it is, or is not, necessary to conserve water; 2) whether or not the taro patch "floors" had been well puddled and the banks well tamped; 3) the stage of the crop or crops; 4) rainfall, elevation, average hours of sunshine, and wind conditions; 5) soil characteristics; and 6) whether or not there is a profit incentive. (Watson, Exhibit N-207, at 150)

According to one Hawaiian historian, "no ditch was permitted to divert more than half the flow from a stream." (Handy, E.S.C and Handy, E.G., "Native Planters in Old Hawaii: Their Life, Lore, and Environment, 1972, at 58, cited in Kame'eleihiwa, Binder 6A, written direct testimony, reference listed at page 15; Kame`eleihiwa, Tr., 4/3/96, at 14, lines 4-7) It is unclear, however, whether the limit of half the flow from a stream referred to the original flow of the stream or to the flow where the diversion was taking place. Nor is it clear how it was determined how much of the stream's flow was being diverted.

On the other hand, Watson found that: "In certain areas including Koloa on Kauai and Waimea on Oahu, it is well known that old Hawaiian irrigated taro areas of the 1840s were developed up to, and perhaps somewhat beyond, the available water supply." (Exhibit N-207, at 150) Therefore, while historically noted, it does not appear that it was a uniform rule that no more than ½ of stream flow should be used offstream.

b. MCCANDLESS PIPELINE AND EXISTING ALTERNATIVES

<u>Summary</u>. In constructing the Waiahole tunnels, water rights purchased from McCandless allowed Waiahole Irrigation Company to collect all waters, except 500,000 gallons per day, in Waikane above the 450-foot elevation. The reserved 500,000 gpd is currently delivered from the Ditch to some farmers in Waiahole Valley.

The State of Hawai`i's Housing and Community Development Corporation of Hawai'i[54] built a water system to supply all domestic and agricultural water needs for the Waiahole agricultural subdivision. It has been in operation since 1989 and is sized to meet the water demand at full subdivision build out. It has a capacity to supply 1 million gallons per day.

The water system was intended to replace the McCandless system, and the state, which had acquired rights to the McCandless system, relinquished them in 1989 at the time the water system was put into operation. The intention was that the 500,000 gpd **would remain in Waianu Stream, but some people have continued to take water out of the stream via the McCandless pipeline.**

Compared to the water system's capacity of 1 million gallons per day, actual usage in 1996 was only approximately 76,000 gallons per day by 80 agricultural and residential customers, or about eight percent of capacity.

In constructing the Waiahole tunnels, water rights purchased from McCandless allowed Waiahole Irrigation Company to collect all waters, except 500,000 gallons per day, in Waikane above the 450-foot elevation. The reserved 500,000 gpd is currently delivered from the Ditch to some farmers in Waiahole Valley. (Hatton, Binder #1, written direct testimony, at 3)

This amount of water is diverted into Waianu Stream, where the same quantity is taken out through a surface water intake and into a pipeline system that provides water to a number of users, the exact number of which is not known. (Hatton, Tr., 11/29/95, at 66, line 13 to 67, line 6)

The State of Hawai`i's Housing Finance Development Corporation (HFDC)[55] built a water system to supply all domestic and agricultural water needs for the Waiahole agricultural subdivision. It has been in operation since 1989 and is sized to meet the water demand at full subdivision build out. It has a capacity to supply 1 million gallons per day. All of the subdivision's tenants and former Department of Land and Natural Resources' permittees as well as the privately owned parcels within the agricultural park

[54] Previously known as Housing Finance Development Corporation, or HFDC.
[55] Now known as the Housing and Community Development Corporation of Hawai'i (HCDCH).

boundary are connected to the system. Rates were set in 1989, with a basic charge of $3.00 monthly per meter, and a domestic rate of $0.90 per thousand gallons, and an agriculture rate at the domestic rate for the first 15,000 gallons and a 1995 rate of $0.30 for each additional thousand gallons. The agriculture rate has provision for a 10% annual increase based on the initial 1989 rate of $0.20 per thousand gallons. (McElroy, Binder #9, Exhibit No. L-900, written rebuttal testimony, at 5-6)

The water system was intended to replace the McCandless system, and the state, which had acquired rights to the McCandless system, relinquished them in 1989 at the time the water system was put into operation. The intention was that the 500,000 gpd would remain in Waianu Stream, but some people have continued to take water out of the stream via the McCandless pipeline. (McElroy, Tr., 4/16/96 at 116, lines 2-22)

Compared to the water system's capacity of 1 million gallons per day, actual usage in 1996 was only approximately 76,000 gallons per day by 80 agricultural and residential customers, or about eight percent of capacity. (McElroy, Tr., 4/16/96, at 97, lines 8-17)

Approximately two-thirds of the lots in the agricultural park are occupied. There are three priorities for tenancy: 1) existing tenants who were in place on the land at the time the state acquired it from the landowner, Marks; 2) tenancy granted to those Marks tenants residing elsewhere, outside of the acreage the state acquired, who had been threatened with eviction at the time prior to the state acquiring the Waiahole acreage; and 3) the general public. However, vacant acreage within the park that is left over beyond the second priority, will be transferred to the Department of Hawaiian Home Lands as part of a 1994 settlement agreement. Therefore, the general public will not have an opportunity to gain tenancy. (McElroy, Tr., 4/16/96, at 105, line 19 to 108, line 7)

J. Reppun, a tenant in Waiahole agricultural park on a parcel leased jointly by the Reppuns, Fraiolas and Hoes, and who were among the first priority tenants, stated that the agricultural park's water system carries chlorinated water that cannot be used for taro and agriculture. (J. Reppun, Binder #10, written surrebuttal testimony, at 4) However, he also conceded that the water system had been designed for an agricultural park and, except for wetland taro and possibly organic farming, diversified agriculture could use chlorinated water. (J. Reppun, Tr., 4/24/96, at 121, line 25 to 123, line 19) But Reppun stated that the Housing and Finance Development Corporation did not disturb the McCandless pipeline when building the agricultural park water system and was only interested in not being responsible for maintaining the pipeline. (Reppun, Tr., 4/24/96, at 130, lines 3-20)

Badiyo, who leases in Waiahole agricultural park, testified that his upper acre and a third section of land was watered through the McCandless pipeline, but that he is also a user of the agricultural park's water system for household water, drinking water, and bathing water. With the use of the McCandless system and the taro *lo`i* and an *`auwai* system, he wouldn't use the park's water system too much. (Badiyo, Tr., 4/3/96, at 211, line 3 to 212, line 6)

Agard, testifying on behalf of the Department of Hawaiian Home Lands for a reservation request for its Waiahole agricultural park parcels, stated that DHHL's request was specifically for water from Waianu Stream, even though there might be as much as one million gallons per day from the water system built expressly for the agricultural park. (Agard, Tr., 5/7/96, at 9, line 18 to 12, line 10)

None of the DHHL parcels are located on the stream, and DHHL had no evidence that their homesteaders will or intend to use those parcels for taro cultivation purposes. For the island of O`ahu, only one DHHL lot is being used for taro purposes on the entire island, and it's an experimental hydroponic project actually cultivating snails for escargot. The water drains down to the taro patch. (Agard, Tr. 5/7/96, at 17, lines 3-16)

B. FUTURE STUDIES

The Commission affirms that the instream flow standards that it set out in this decision and order are interim only. The Commission believes strongly that further hydrological and biological studies must be made before the permanent instream flow standards can be set. These interim instream flow standards were set on the best available scientific evidence. Should additional studies or data become available in the future, the Commission will make modifications of the interim standards to best reflect the most current scientific information. The standards set by the Commission should be revisited as new information and studies become available and as appropriate.

V. PRACTICABLE MEASURES TO MITIGATE THE IMPACT OF VARIABLE OFFSTREAM DEMAND ON THE STREAMS

A. 12-MONTH MOVING AVERAGE

Summary. A shorter time period than the 12-MAV would put farmers at a great disadvantage. They need to be able to adjust to actual weather conditions and the limitation for water use needs to be flexible enough to allow for that response.

Month-to-month variability in water usage has not been large in recent years, with movement to peak usage relatively gradual, in steps of about 1 to 1.5 mgd or less for the most part.

The Coop has been operating under the assumption that, no matter what the 12-MAV would allow them, the streams would get their ditch water first. Therefore, even under the 12-MAV, variability in day-to-day diversions of water would not affect a stream's IIFS.

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Farmers need a statistical measurement that smoothes out variations in use over a year. There are seasonal variations, and the 12-MAV at least considers those variations over a period of a year. Farmers would prefer a longer time period. (Whalen, written direct testimony, at 8, lines 11-14)

A shorter time period would put farmers at a great disadvantage if they were constrained by their average water use in the preceding few months. There is usually a certain rainfall pattern associated with the seasons. Farmers need to be able to adjust to actual weather conditions and the limitation for water use needs to be flexible enough to allow for that response. (Whalen, written direct testimony, at 8, line17 to 9, line 8)

Month-to-month variability in water usage has not been large in recent years. Usage starts out low and gradually increases in the springtime, March to April, and normally peaks in May to June, remains somewhat constant, and then starts to decrease in September, going down from there to the end of the year. Month-to-month movement to peak usage is relatively gradual, in steps of about 1 to 1.5 mgd or less for the most part. (Lee, Tr., 4/4/01, at 180, lines 17-24; written direct testimony, at 3, line 6 to 4, line 7; Exhibit L-1100)

The Agribusiness Development Corporation (ADC), as operator of the Waiahole Water System (WWS), believes that, under the 12-MAV, it will provide the requested amount to leeward water use permit holders as long as: 1) it does not threaten the instream flow standard; and 2) the requested amount is within the permittee's allocation amount. (Lee, written direct testimony, at 5, lines 7-9)

ADC's position is that, no matter what, even on a day-to-day basis, a user does not get anything beyond their allotment. (Lee, Tr., 4/4/01, at 183, lines 8-12) Therefore, even under the 12-MAV, variability in day-to-day diversions of water will not affect a stream's IIFS. (Lee, Tr., 4/4/01, at 186, line 25 to 187, line 8)

The Kunia Water Cooperative (Coop) has been operating under the assumption that the first amount of water goes to the streams, and whatever their needs were, no matter what the 12-MAV would allow them, the streams would get theirs first. (Whalen, Tr., 4/4/01, at 222, line 20 to 223, line 5.

ADC routinely releases the required amounts of 2.0 mgd and 4.0 mgd into Waianu and Waiahole Streams, respectively, and insures that those amounts are released to those streams before accommodating leeward requests for water. Any supplemental flows, including unused permitted water, are released to Waiahole Stream through Gate 31. (Lee, written direct testimony, at 4, lines 12-19; Exhibit L-1102)

B. COORDINATING OFFSTREAM USES & USE OF RESERVOIRS

<u>Summary</u>. The Coop farmers could coordinate the time of day when ditch waters will be used, provided that time is during the 12 daylight hours.

Several small reservoirs (1-2 mg capacity), and a medium-sized one (10-15 mg) are already built or being built by individual farming operations. A larger reservoir of 60 – 100 mg capacity might be better suited to collect water during high windward stream flows or when there is low leeward demand, but it would cost between $32 and 40 million and have to be built with public funds on public lands. The implementation of these operational measures would reduce the variability of the amount withdrawn from the Waiahole ditch and tunnel system.

The Coop was directed by the Commission to be formed to coordinate and facilitate delivery of water to leeward farmers. All agricultural producers having a water meter using the ditch waters can become members of the Coop. (Whalen, written direct testimony on remand, at 1)

Although it would not be easy for the Coop's farmers to coordinate times and rates of water usage because they are all growing different crops, the Coop farmers, can, if necessary, coordinate the time of day when ditch waters will be used, provided that time is during the 12 daylight hours. Farmers need to schedule irrigation during daylight hours so they can see if there's a break in a line so they can prevent waste and overwatering and protect the quality of their crops. (Whalen, written direct testimony on remand, at 9, line 20 to 10, line 6)

Additional coordination can utilize reserves of water that would be held in the reservoirs of those who can afford to build them. (Whalen, written direct testimony on remand, at 11, lines 7-8)

However, farmers need more water when rainfall is least. Farmers still need to grow crops year round and need to be consistent suppliers to have a firm foothold in the market and to keep their workers employed. (Whalen, written direct testimony on remand, at 11, lines 8-15)

Small reservoirs of 1 to 3 million gallons for 1 – 4 days' storage, depending on rainfall and the farmer's needs, are feasible if the individual farming operation can justify the cost. However, they will not have much effect during peak demand or when the farmer otherwise needs much more water. (Whalen, written direct testimony on remand, at 7, lines 1-2; at 7, line 20 to 8, line 1)

The existing reservoirs on the ditch system have maximum storage capacities of 9.3 mg for reservoir #225 and 14.5 mg for reservoir #155. (Matsuo, written direct testimony on remand, at 2, line 19 to 3, line 4)

Larry Jefts is building a 10 – 15 mg lined reservoir; Del Monte is planning a 1.5 to 2 mg reservoir; Hawaiian Fertilizer Sales has built a 0.5 mg reservoir; Garst Seed is planning to double the size of their existing 0.5 mg reservoir; and several other reservoir projects are under study. (Whalen, written direct testimony on remand, at 7, lines 5-18)

Matsuo from the Department of Agriculture believes that a reservoir in the range of 60 – 100 mg capacity is better suited than smaller reservoirs to collect water during high windward stream flows or when there is low leeward demand. You would be banking a huge amount of water so that you don't have to have all these small individual reservoirs that the individual farmers would have to still keep filled. (Matsuo, Tr., 4/4/01, at 215, line 22 to 216, line 17)

However, Matsuo also concluded that the cost of developing, installing, operating, and maintaining reservoirs with more than a few days storage capacity and pumping facilities would make it impractical and not cost effective for most farming operations. (Matsuo, written direct testimony on remand, at 2, lines 15-17)

The cost of the Department of Agriculture's 60 mg lined reservoir on the Waimanalo Irrigation System cost $6 million and took 10 years to complete. Matsuo estimates that a 300 mg lined reservoir would cost between $32 to 40 million, including appurtenant structures, if done with public funds on public land. (Matsuo, written direct testimony on remand, at 3, line 18 to 4, line 6)

C. VARIABLE IIFS TO ACCOMMODATE HIGHER OFFSTREAM DEMAND AT CERTAIN TIMES OF THE YEAR

<u>Summary</u>. A variable IIFS that is based on the seasons would not be practicable, because a definite time for higher offstream use cannot be reliably predicted, and higher needs would come at the same time streams might need the most protection.

A standard that locks in farmers' abilities to draw more water at certain times of the year wouldn't be practicable, because nature doesn't work that way. We've had dry winters the last several years so that leeward farmers probably needed more water than is usually the case. The seasons can be atypical and farmers just have to be able to respond to the weather if they are going to produce and market their crops reliably. That's why farmers need the 12-MAV. (Whalen, written direct testimony, at 10, line 16 to 11, line 3)

In the farmers' experiences, a definite time for higher offstream use cannot be reliably predicted because of the occurrence of atypical weather patterns. Weather cannot be reliably predicted nor is it likely that one season will produce the same amount of flow as in a prior year. (Whalen, Tr., 4/4/01, at 225, line 19 to 226, line 10)

With a variable IIFS, offstream needs might come at the same time that the streams might need to sustain their flows. Offstream needs would usually increase in the dry season, but that would be the time that the streams might need the most protection against reduced flows. (Whalen, Tr., 4/4/01, at 236, line 20 to 237, line 5)

VI. ACTUAL NEED FOR 2,500 GALLONS PER ACRE PER DAY OVER ALL ACRES IN DIVERSIFIED AGRICULTURE

A. THE COURT'S FINDINGS OF FACT

Summary. Arable[56] land is land that is able to be cultivated but not necessarily in cultivation. Cultivated land goes through the cycle of being plowed, planted, harvested, plowed under and left to rest (either with or without cover crop), then plowed and planted, etc. Planted means when the plants are actually present. So you may be planted three or four months a year, but you're in cultivation continuously throughout the year. The record from the original hearing is clear that "cultivated" is not the same as "planted" and what the Court was referring to as "cultivated" instead should have been "planted". In other words, large leeward farmers such as Jefts plant only one-third to one-half of their cultivated land at any given time.

Jefts and Sou estimated their average water usage at 3,500 gad. This is an average on land over a period of years, considering fallow land, etc. In contrast, average water usage is about 7,500 gad while plants are in the ground and being irrigated.

On appeal to the Hawai`i Supreme Court, WWCA made a distinction between "acreage actually in cultivation" and "agricultural land, including those lying fallow", apparently leading the Court to equate "cultivated" with "planted". However, the record of the original hearing shows that counsel for WWCA knew that "cultivated" was not the same as "planted".

Jefts's and Sou's testimonies, the cross-examination of Sou by counsel for WWCA on Sou's startup operations on his Nihonkai lands, and the Commission's comparison of the water duty of sugar cane versus diversified agriculture are all consistent with the Commission's conclusion that 2,500 gad for diversified agriculture was a more conservative figure than the 3,500 gad that both Jefts and Sou had recommended.

According to the Hawai'i Supreme Court:

> "The uncontroverted evidence at the hearing establishes that leeward farmers cultivate only one-third to one-half of their land at any given time. This

[56] Also referred to as "tillable".

> evidence includes the testimony of farmers Larry Jefts and Alec Sou, on which the Commission based its determination of the 2,500 gad figure. The Commission observed in its decision that, according to Sou, 'at any one point, the maximum they have in actual crop on ground is one-third (1/3) of their land, while the other two-thirds (2/3) is in various stages of harvest, plow down and arid aeration to disrupt insect buildup (*emphasis added*).'" (94 Haw. 97, at 162; 9 P.3d 409, at 474)

The Court equated "cultivated" with "planted" and therefore had concluded that farmers cultivated their land only one-third to one-half the time. At the remanded hearings, Jefts clarified the distinction between "cultivated" and "planted":

Arable land is land that is able to be cultivated but not necessarily in cultivation. When you begin to work on development, you begin to till, plow, plant; that is land brought into cultivation. Cultivated land goes through the cycle of being plowed, planted, harvested, plowed under and left to rest (either with or without cover crop), then plowed and planted, etc. Planted means when the plants are actually present. So you may be planted three or four months a year, but you're in cultivation continuously throughout the year. (Jefts, written direct testimony for Campbell Estate on remand, Exhibit B-RD-2, at 1, lines 7-11; Tr., 4/4/01, at 54, lines 10-22)

Leeward farmers do not cultivate only one-third to one-half of their land at any given time. That is what may be planted by large farmers such as Jefts. (Jefts, written direct testimony for Campbell Estate on remand, Exhibit B-RD-2, at 1, line 12 to 2, line 2)

Moreover, the record from the original hearing is clear that "cultivated" is not the same as "planted" and what the Court was referring to as "cultivated" instead should have been "planted". In other words, leeward farmers plant only one-third to one-half of their cultivated land at any given time.

At the original hearing, Jefts testified on what he believed were the water needs per acre of cultivated land, making further distinctions of the water needs while crops were growing (e.g., planted) and while the land was between crop cycles:

> "Generally, I would say we need an average of about 3,500 gallons per acre per day. Much water is used while the crops are growing. The first day of planting can perhaps use a peak of as much as 54,000 gallons per acre. From the second day through the day of harvest, the usage may be as much as 10,000 gallons per acre per day. For example, this amount might be used during the 75-90 day crop cycle for watermelons, bell peppers and tomatoes. The amount of water used varies depending on the crop cycle, the weather, and other factors. In between crop cycles, somewhat less water is needed for remaining uses such as cover crop (*emphasis added*)" (Jefts, Binder #1, written direct testimony, at 8, lines 6-17)

At the original hearing, Sou testified as follows on the difference between cultivated and planted:

"Q. Do some of your lands remain fallow?

"A. Yes, at certain times. As a general rule, with the types of crops we plant, about one-third of the usable acres will actually be planted and irrigated (*emphasis added*). The other 2/3 will be in various stages of harvest, plowing and land preparation. This treats the insects naturally, and reduces the need to apply pesticides." (Sou, Binder #1, written direct testimony, at 7, line 21 to 8, line 2)

Sou testified that he produces a wide range of crops, each requiring diverse cultivating processes. Each crop has a different range of water needs and different water delivery systems, influenced by the type of crop, stage of crop development, season, weather, how long a field was fallow, and market factors. He uses drip irrigation as well as overhead irrigation. Overhead irrigation is used for certain crops, even though it utilizes more water than drip irrigation, because overhead irrigation cools plants and therefore encourages growth. In addition, it reduces pests, and keeps dust down, making it unnecessary to wash the produce at harvesting. (Sou, Binder #1, written direct testimony, at 6, line 14 to 7, line 19)

Sou made a clear distinction on water demand between cultivated and planted acreage, stating that he had a water demand for cultivated land of 1,800 to 54,000 gad, a comfortable zone for him to pursue his farming plans being an average of 3,500 gad. This is an average on land over a period of years, considering fallow land, etc. In contrast, average water usage is about 7,500 gad while plants are in the ground and being irrigated. (Sou, Tr., 12/13/95, at 35, line 25 to 37, line 24)

Thus, the "uncontroverted evidence" is not that Sou cultivates his lands only one-third to one-half at any given time, but that he plants and irrigates all of the land for that fraction of time. Even the Court's reference to Sou's testimony quotes "in actual crop on ground," but assumes that "cultivate" is identical to "crop on ground", when the record clearly shows that it is not.

The Hawai`i Supreme Court also referred to the following cross-examination of Sou by counsel for WWCA:

"Q. Now the lease that you signed with Nihonkai says that 2,325 (gad) will be reasonably sufficient for your cultivation purposes; isn't that right?

"A. Yes.

"Q. And the chart attached to your July 18th affidavit shows that you don't intend to have more than 80 acres in cultivation at any one time, correct?

"A. Yes, exceeding that would run into a lot of trouble.

"Q. Okay. So according to my math, 80 acres using 2,325 (gad) would total 185,000 gallons per day. So according to your figures in your affidavit and in your lease, 186,000 gallons per day is reasonably sufficient for your needs; is that right?

"A. This would be sufficient provided that we accounted for every aspect of irrigation, having the best system in line, shutting it off exactly when it's at a peak…(*emphasis added by the Court*)" (94 Haw. 97, at 163; 9 P.3d 409, at 475)

Based on this exchange, the Court noted with disapproval that: "Instead of the .186 mgd that Sou confirmed would be 'sufficient' under efficient use conditions, Sou received 2,500 gad for every one of the 190 acres he leases from Nihonkai, or .48 mgd in total." (94 Haw. 97, at 163; 9 P.3d 409, at 475)

However, there is no inconsistency between Sou's testimony and the Commission's award of 2,500 gad for the 190 acres.[57]

In his cross-examination, counsel for WWCA was referring to Exhibit A of Sou's written direct testimony. Exhibit A was Sou's "Estimated Acres In Croping (*sic*) Schedule", in which he projected how he would be putting the Nihonkai property he was leasing into production. Starting in July '96 with a monthly total of 6 acres, he projected that by January '97 he would have a total of 80 acres on a cropping schedule. He would be using two methods of irrigation, a drip system based on 4 months under crop cycle, and a sprinkler system based on 3 months under crop cycle. (Sou, Binder #1, written direct testimony, Exhibit A)

In other words, Sou was estimating how he intended to put the acreage he was leasing from Nihonkai into initial production; and he intended to put the acreage into production according to his normal farming practices of land under cultivation. Initially, he would have only one crop cycle per acre, either on a 4-month drip system, or a 3-month sprinkle system. So his water needs for the 80 acres was based on the land being planted for only 3-4 months in 1997.

According to Exhibit A, the 80 acres Sou projected he would have in production by January '97 would require 0.224 mgd, or an average of 2,800 gad. This is consistent with his estimate of 3,500[58] gad of cultivated land versus his estimate of 7,500 gad of planted land. Therefore**,** an award of 2,500 gad of cultivated land, for which the 80-acre parcel would have a budget of about 0.186 gad, is entirely consistent with a total award of 0.48 mgd for the entire 190 acres.[59] At the time of his testimony, Sou was providing

[57] Total acreage was 205. The Commission's award was for 190 arable acres.
[58] His estimate of 3,500 gad was based on more than one crop cycle per acre of cultivated land, while 2,750 gad was his estimate at the time of what would be required for only one crop per year.
[59] If the Commission had decided to award permits on the basis of land actually planted at any point in time, it could have used Sou's estimate of 7,500 gad for average use while planted, and approved a water use permit for approximately 80 of the 190 acres, for a total of 0.60 mgd. But the evidence that farming practices involved rotation among fields made it difficult to specify what a particular acreage's water needs were. Thus, the Commission decided that an average water use of acreage under cultivation was the most

information on the water needs of 80 cultivated acres of the total of 190 acres he eventually planned to put into cultivation. His agreement of the estimate of 185,000 gad for the 80 cultivated acres was predicated on approximately one-third of the 80 cultivated acres actually planted at any given time; 7,500 gad per planted acre, or 2,500 gad over all 80 cultivated acres. When he placed all 190 acres into cultivation, his water needs would increase to 0.48 mgd, based on 2,500 gad for 190 cultivated acres.

Finally, the Court stated:

> "(T)he Commission noted that, because of the much lower per-acre water requirements of diversified agriculture, 1,800 to 5,400 gad, as compared to the previously grown sugar, 7,500 to 10,000 gad, water would become available for other purposes 'even if the same acreage was planted.' COLs at 19 (emphasis added). The Commission, nevertheless, assigned 2,500 gallons per day to as much as two or three times the acreage actually planted, resulting in a per-acre duty apparently approaching that of sugar and contradicting the Commission's description of 2,500 gad as a 'more conservative figure.'" (94, Haw. 97, at 163; 9 P.3d 409, at 475)

From the preceding analysis, *supra*, of the difference between "cultivated" and "planted", 2,500 gad is on the basis of acreage cultivated and not on the basis of acreage planted. An award on that basis does not result in a per-acre water duty approaching that of sugar.

The full text of the Commission's COL was as follows:

> "In this case, the conversion of sugar to diversified agriculture with its lower duty per acre water requirements (7,500 to 10,000 gal/acre/day for sugar v. 1,800 to 5,400 gal/acre/day for diversified agriculture on a twelve month moving average) means that even if the same acreage is planted, currently allocated ground water is available for other purposes." (COLs, at 19)

The Commission was making a simple, straightforward comparison. If the sugar lands were converted to diversified agriculture, with water requirements as stated above, the ground water previously allocated for sugar cane, even if the water requirements for diversified agriculture on the same amount of lands were met, left ground water available for other purposes. [60]

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appropriate method to use. The resulting award was 0.48 mgd, significantly less than if the Commission had based the permit on an estimate of land actually planted at any point in time and less than Sou's recommendation that the per-acre-in-cultivation award be 3,500 gad.

[60] Taken in context, the Commission was not using the word "planted" in the specific manner that the Commission and the witnesses used when discussing it in the context of the distinctions between "arable", "cultivated", and "planted". The Commission was using "planted" in its more general sense; namely, in "the conversion of (the same acreage from) sugar to diversified agriculture". Furthermore, this contextual interpretation of "planted" is supported by the comparison the Commission was making; namely 7,500 to 10,000 gad for sugar cane versus 1,800 to 5,400 gad for diversified agriculture, thereby leading to the conclusion that water would become available for other purposes. Only by using the word "planted" out of

Finally, in its opinion, the Hawai`i Supreme Court had noted:

"WWCA does not dispute the reasonableness of the 2,500 gad figure as applied to acreage actually in cultivation…WWCA asserts, however, that the application of this per-acre figure to every acre of agricultural land, including those lying fallow, resulted in a 'gross over-allocation' of water far exceeding actual need." (94 Haw. 97, at 162; 9 P.3d 409, at 474)

In this statement, WWCA makes a distinction between "acreage actually in cultivation" and "agricultural land, including those lying fallow". And this statement immediately preceded the Court's statements analyzed in Part A, *supra*, where the Court equated "cultivated" with "planted".[61]

Yet, counsel for WWCA clearly recognized the distinction between "cultivated" and "planted" at the original hearing, at which the following cross-examination of Jefts took place. It is the counsel for WWCA himself who uses the word "cultivation" without any pre-identification of that word from Mr. Jefts:

"Q. There's been a lot of discussion in this hearing about the water demands of diversified agriculture, and one number that has been mentioned a number of times is the supposed need for 54,000 gallons of water per acre per day at the time of planting, and, in fact in your written surrebuttal you allude to that figure…Just on that subject, <u>that would not be all of your planted acres at one time; would it?</u>

"A. <u>If you're referring to growing acres, that is, all the acres that – we use a little different terminology</u>, we plant, that would be the planted acres, that would be what we would do that day, planting.

"Q. All of your growing acres?

"A. No not over the growing acres.

"Q. So you would never be needing 54,000 gallons per acre per day times the number of acres that you've got <u>in cultivation</u>?

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context of the comparison being made – i.e., using it as specifically meant when compared to "arable" and "cultivated" -- could the conclusion be reached that the Commission was contradicting itself and advocating that diversified agriculture's water needs actually approached that of sugar cane.

If all acres <u>were</u> planted at all times, average water use would be 7,500 gad, which would approach the water duty for sugar cane. But the Commission was not stating that all acres would be planted all the time. The 2,500 gad was an average over all cultivated acres, planted or not, at any particular point in time. The basic error, however, is that a water duty of 2,500 gad did not refer to planted acres but to cultivated acres. The Commission was making a direct comparison of 7,500 to 10,000 gad for sugar cane versus 1,800 to 5,400 gad for diversified agriculture, given their respective irrigation practices.

[61] Therefore, the Commission concludes it was WWCA's argument which persuaded the Court that "cultivated" land and "planted" land were equivalent.

"A. No (*emphasis added*)." (Jefts, Tr., 2/27/96, at 47, line 18 to 49, line 3)

B. ACTUAL NEED FOR 2,500 GALLONS PER ACRE PER DAY FOR DIVERSIFIED AGRICULTURE

<u>**Summary**</u>**. Jefts and Sou have had to prepare the previous sugar cane lands for diversified agriculture and to test which crops will work best on a particular field, a process that will take several years. Sou has found that at times crop yields have been inconsistent and uncertain, especially in the summer when ditch flow was inadequate, which has affected his yields.**

Sou is reluctant to invest in additional irrigation infrastructure and will not risk losing crops because he is not confident that the water will be available when he needs it. He estimates that installing a reservoir to serve Field 280 would cost at least $25,000. Only with more reliable Ditch water would installing additional irrigation infrastructure allow him to make Field 280 more productive and to fully utilize the land and the water.

On his Campbell Estate leases, Jefts currently averages between 1,000 to 1,300 gad for about 1.1 crop cycles on all of the arable acres that he leases. At his projected optimum crop mix of 1.9 crop cycles per year, 1,000 to 1,300 gad should nearly double but not exceed 2,500 gad. His projection to 1.9 crop cycles per year is based on 2,500 gad as the limiting factor in increasing productivity. His total water consumption has increased as follows: 865,196 gallons per day in 1998; 1,022,844 gallons per day in 1999; and 1,508,553 gallons per day in 2000. Usage increased about 17 percent in 1999 over 1998, and by about 48 percent in 2000 over 1999.

Ogasawara's total water consumption is presently approximately 0.722 mgd. In 1997 water use was approximately 2.229 mgd. The decrease in use is due to reduction in the acreage subleased, and to improved efficiencies in the use of water. Of the 0.722 mgd, 0.663 mgd was used on the 176 acres he subleases to small farmers, for an average of 3,767 gad. He currently cultivates about 3/4s of his remaining 40 percent, growing some vegetable crops and long-term crops such as lychee and longan. Across all of his approximately 328 acres in cultivation (all of his tenants' 40 percent and 3/4s of his 40 percent), water usage averages about 2,200 gad. He plans to continue his planting schedule of fruit crops until all his 40 percent are planted.

HARC's current water consumption is about 2,600 gad over 65 cultivated acres of a total of 78 acres. The number of HARC's crop cycles is currently 1.19 and expected to increase to 1.9 crop cycles. They expect their water needs to increase to about 4,000 gad.

From the preceding analysis presented in Part A, *supra*: 1) 2,500 gad was the water requirement that the Commission had concluded was appropriate for diversified agriculture in leeward O`ahu as applied to cultivated lands; 2) cultivated lands are not equivalent to planted lands; 3) the record of the original hearing supports these conclusions; 4) the per-acre water duty for diversified agriculture does not approach the per-acre water duty of sugar; and 5) it is not a contradiction for the Commission to describe 2,500 gad as a "more conservative figure" than the 3,500 gad that Jefts and Sou had identified.[62]

Jefts and Sou originally estimated that 3,500 gad for cultivated land would be the water requirement for diversified agriculture on the leeward side. (Jefts, Binder #1, written direct testimony, at 9, lines 11- 17; Sou, Tr., 12/13/95, at 36, lines 11-14)

In contrast, the Department of Hawaiian Homeland's (DHHL's) water reservation request for its lands in Waiahole Agricultural Park was based on 5,000 gad. Agard, testifying on behalf of the DHHL, based DHHL's request for 0.41 mgd by multiplying the maximum 82 acres available by 5,000 gallons per acre per day (gad). The estimate of 5,000 gad resulted from Agard's discussions with the Honolulu Board of Water Supply on the water requirements for diversified agriculture in the Waiahole area, assuming crops other than taro, and was generally within the range estimated by the Office of State Planning, State of Hawai`i. Agard did not know why the estimate of water use for diversified agricultural use on the wetter, windward side was higher than the estimated average use of 3,500 gad on the leeward side. (Agard, Binder #11, written direct testimony, at 2, paragraph 8, to 3, paragraph 9; Tr., 5/7/96, at 9, lines 8-14)

Jefts's original lease stated that average annual usage was estimated to be 2,500 gad of arable land being cultivated, and that if at least 75 percent of the 2,500 gallons, or 1,875 gallons per acre per day, was not made available, he could terminate the lease. This lower number was not an indication of his water needs, but arrived at through negotiations and was as good as he could do. He didn't know whether he could survive with this amount, but he wouldn't be asked to try at less than that. (Jefts, Tr., 2/27/96, at 52, line 4 to 55, line 2)

Jefts's estimate of 2,500 gad was a calculation of average water use throughout the year on all arable acres being cultivated. In other words, it was a calculation that factored in those days when he soaks the fields and those days when the field receives no water at all and everything in-between. It was just a calculation. It's not like it was the amount of water that is actually applied on any given day. (Jefts, written direct testimony for Campbell Estate on remand, Exhibit B-RD-2, at 2, lines 11-16)

[62] In its Decision and Order, the Commission had concluded: "The Commission is selecting 2,500 gad as a starting point for agricultural uses in this particular situation. 3,500 gad may be a more generous number and may be applicable for general planning purposes. However, because diversified agriculture is just starting and may not reach full production for several years, and because there is a lack of data on actual uses for diversified agriculture, the Commission is using the more conservative 2,500 gad. It is nearer the lower end of the range of estimates but it is an adjustable number and will be evaluated periodically or upon request, based on the best available data and field experience." (D&O, at 6)

In order to convert the land to diversified farming operations, Jefts had to knock down the ratoon cane, till the fields compacted after sugar planting, and adjust the pH component in the soil. The effort to adjust the pH level may take several years, and he hoped that, in three to four years, things will begin to look sustainable. A testing of sort happens with each new area, and variety trial work must be done for each area to determine the particular variety of a crop that will work best on the particular field. (Jefts, Binder #1, written direct testimony, at 2, line 16 to 6, line 13)

At the time of the original hearing, Sou was still learning about the land and the crops. At times crop yields had been inconsistent and uncertain, especially in the summer when ditch flow was inadequate. The low ditch flows affected his yields. Soil make-up in Kunia was different from his past experience in Makaha and led to days of over-watering and under-watering. He was also constantly trying to raise the pH level, which was taking time, and was still working to improve his yields. (Sou, Binder #1, written direct testimony, at 5, lines 5-15)

By the time of the remanded hearings, Sou was farming lands he leased from Nihonkai (Field 280) and the Robinson Estate (Field 231).

On the Nihonkai lands, Sou had sub-leased 114 acres and remained in possession of approximately 76 acres. While he had plans at the time of the original hearings to make more extensive use of his portion, at the time of the remanded hearings, he had done only some experimental planting. A number of factors had led to his change of plans. One very influential factor has been the water supply for his Nihonkai lands versus other lands he farms. He has been unable to get a guaranteed allotment that is sufficient for him to feel comfortable planting many crops there, so he has focused on farming more intensely the other lands on which he has water and irrigation infrastructure that is more readily available and therefore is guaranteed a much larger water supply. Some of the reasons for the inadequate water supply include: 1) the fluctuating water level in the Ditch itself because, without a reservoir to serve the property, he has to pump straight from the Ditch; 2) the irrigation infrastructure currently in operation on the field; and 3) the operation of the Cooperative regulating the use of Waiahole water, which guarantees a minimum water allocation, but will not guarantee any availability above that minimum allocation. Until he is assured that he will be able to get a continuous and adequate supply of water from the Ditch to supply Field 280, he is reluctant to invest in additional irrigation infrastructure and will not risk losing crops because he is not confident that the water will be available when he needs it. He estimates that installing a reservoir to serve Field 280 would cost at least $25,000. Only with more reliable Ditch water would installing additional irrigation infrastructure allow him to make Field 280 more productive and to fully utilize the land and the water. (Sou, written direct testimony for Nihonkai on remand, at 2-3)

Sou’s various tenants on the 114 acres he has sub-leased have farmed their leased lands for various periods starting in June 1996. Their average water use per cultivated acre has ranged from 1,579 gad to 2,662 gad. (Exhibit G-20)

Sou has farmed Field 231 on the Robinson Estate lands since 1995, approximately 155 acres in various stages of cultivation – planting, harvest, plow down or fallow. In 1995 he had testified that he needed an annual average of 3,500 gad for diversified agriculture on Robinson lands, but testified at the remanded hearings that he can live with the 2,500 gad that the Commission awarded until full build out indicates more is needed. His annual average use has been as follows: 1,346 gad in 1998, 1,455 gad in 1999, and 1,204 gad in 2000. The Cooperative has asked the farmers to commit to use a certain amount of water, which they must pay for whether they use it or not. For Field 231, he has committed to 0.25 mgd, or only about 1,600 gad for the 155 acres. But it doesn't mean that he did not expect to use more. He is required to pay for the amount regardless of whether the water is used, and he wanted to protect himself in the event his usage was less. The irrigation infrastructure on Field 231 is not presently developed to maximize productivity. The irrigation infrastructure requires an additional investment of $25,000 to $50,000 or more, and the uncertainty with regard to Waiahole water has caused him to devote his resources first to other lands. With more certainty and reliability of Waiahole water, he will make the additional investment. (Sou, written direct testimony for Robinson Estate on remand, at 2, line 16 to 6, line 14)

By the time of the remanded hearings, Jefts had concluded that the optimum crop mix for him in Kunia was about 1.9 crop cycles per year:

> "As an example, I could have a field planted with vegetable A for 13 weeks, devote the next 18 weeks to harvesting and letting the ground lay fallow, then plant vegetable B, which is a 23-week crop. In that example, that means that within a 52-week period, I've had two crop cycles. I can have fractions of crop cycles within a one-year period; the possible combinations are endless…I came up with 1.9 based on agronomic limitations. It allows for flexibility in mixing of crops and crop cycles while still allowing for planting breaks. For example, I could do two medium-length crops, or one long – one short, three or four short crops, etc. with planting breaks in between. It allows me to optimize my investment in land and infrastructure…Planting breaks are temporal breaks between crops when we give the land a chance to rest, so to speak. Its (*sic*) important for insect control and to control nematodes. Dry waste is managed by being plowed under. On the mainland, planting breaks occur naturally with the seasons. Where land is short, farmers will use chemicals to provide an artificial break. Those farmers may average 3 to 4 crop cycles per year. At an average of 1.9 crop cycles per year, I minimize the amount of chemicals that I use." (Jefts, written direct testimony for Campbell Estate on remand as amended, Exhibit B-RD-2, at 3, line 4 to 4, line 5)

On his Campbell Estate leases, Jefts currently averages between 1,000 to 1,300 gad for about 1.1 crop cycles on all of the arable acres that he leases. At his projected optimum crop mix of 1.9 crop cycles per year, 1,000 to 1,300 gad should nearly double but not exceed 2,500 gad.[63] His projection to 1.9 crop cycles per year is based on 2,500

[63] These are only general estimates: increasing the crop cycle from 1.1 to 1.9 per year may increase water consumption by only 20 percent, or it may be a 200 percent increase, depending on the crop mix. (Jefts,

gad as the limiting factor in increasing productivity. (Jefts, Tr., 4/4/01, at 99, line 16 to 101, line 3)

Based on all of his Robinson leases, approximately 1,093 tillable (arable) acres, his average gallons per acre per day has increased as follows: 792 gad in 1998; 936 gad in 1999; and 1,380 gad in 2000. Jefts now has all 1,093 tillable (arable) acres in cultivation, averaging about one crop cycle per year. His total water consumption has increased as follows: 865,196 gallons per day in 1998; 1,022,844 gallons per day in 1999; and 1,508,553 gallons per day in 2000. Usage increased about 17 percent in 1999 over 1998, and by about 48 percent in 2000 over 1999. (Jefts, written direct testimony for Robinson Estate on remand, at 3, lines 11-24; at 5, lines 11-19)

Jefts's build out plans are event driven. These events are primarily the events that reduce the risk profile that give him the confidence that he can run a successful farming operation. In Kunia, some of the important events did not happen as quickly as he would have liked. These events included the assurance of the availability of water: 1) until the Water Commission's decision came at the end of 1997, it was anybody's guess as to how much water would be available for how long, so even though he began farming, he had to go slow; 2) until the State took over the Ditch in July 1999, he didn't have a comfortable level of assurance that the owner would continue to operate or adequately maintain it; and 3) the Supreme Court's decision in August 2000 has been a definite setback. (Jefts, written direct testimony for Campbell Estate on remand, Exhibit B-RD-2, at 7, lines 11-20)

Ogasawara of Hawaii Fertilizer Sales (formerly Hawaiian Foliage) leases 468 acres from Dole/Castle & Cook. Approximately 40 percent of his lands consist of sub-tenant farmers with acreage varying from 1 acre to 40 acres. Seventy-five percent of his tenants cultivate lots of 2 acres or less; 8 percent, 2-5 acres; 9 percent, 10 acres; and 8 percent 10-40 acres. On another approximately 40 percent, he has initiated planting of vegetable crops, tropical fruit crops and ornamental trees, shrubs and ground covers for the landscape industry. Twenty percent of the land will remain as a buffer zone to separate the farms from the residential areas. (Ogasawara, written direct testimony on remand, at 2)

Ogasawara states that small leeward farmers often have their land planted all year. There is no fallowing when you deal with small acreages like this. It's really intense farming on a very small scale. There's no need to put in large rows, because they don't have large equipment. So planting densities are much greater than the typical farming operation. (Ogasawara, Tr. 4/4/01, at 158, line 25 to 159, line 15)

Ogasawara's total water consumption is presently approximately 0.722 mgd. In 1997 water use was approximately 2.229 mgd. The decrease in use is due to reduction in the acreage subleased, and to improved efficiencies in the use of water – strategically installing pressure sustain valves, dump valves, isolation valves, meters and most

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Tr., 4/4/01, at 68, lines 3-6) Jefts cannot arrive at a specific gad, and it has to be a general range because of the various crops that he could use. (Jefts, Tr., 4/4/01, at 80, line 4 to 81, line 1) importantly, mandating that all individual tenants use only micro-irrigation systems. Farmers who insisted on using wasteful irrigation (flood irrigation) or who were otherwise irresponsible in the way they used water were evicted/terminated. (Ogasawara, written direct testimony on remand, at 5-6)

Of the 0.722 mgd, 0.663 mgd was used on the 176 acres he subleases, for an average of 3,767 gad. (Ogasawara, written direct testimony on remand, at 5) Ogasawara currently cultivates about 3/4s of his remaining 40 percent, growing some vegetable crops and long-term crops such as lychee and longan. (Ogasawara, Tr., 4/4/01, at 157, lines 7-10; at 160, line 23 to 161, line 1). Across all of his approximately 328 acres in cultivation (all of his tenants' 40 percent and 3/4s of his 40 percent), water usage averages about 2,200 gad.[64] (Ogasawara, Tr., 4/4/01, at 164, line 24 to 165, line 12) He plans to continue his planting schedule of fruit crops until all his 40 percent are planted. (Ogasawara, Tr., 4/4/01, at 171, lines 1-9)

Osgood testified on behalf of Hawai`i Agricultural Research Center (HARC), formerly known as Hawaiian Sugar Planters Association (HSPA). HARC cultivates 65 acres of its overall area of about 78 acres.[65] (Osgood, TR., 4/4/01, at 102, lines 20-22) Average water usage has increased as follows: 901 gad in '97; 2,019 gad in '98; 2,619 gad in '99; and 2,558 gad in '00.[66] (HARC Historical Water Usage, submitted April 24, 2001 by the Estate of James Campbell at the request of the hearing officer -- see Tr., 4/4/01, at 116, lines 21-25) The number of HARC's crop cycles is currently 1.19.[67] For the winter, they are pretty much filled up with crops, and perhaps one-third in the summer, although that's changing now and they are also getting more interest in spring cropping. HARC's business is client-driven, and they can go up to 1.9 crop cycles, which is their limit. They expect their water needs to be in the range of about 4,000 gad.[68]

VII. ACTUAL NEEDS FOR ICI SEEDS' AND GENTRY AND COZZENS' FIELDS

<u>Summary</u>. Garst Seeds, formerly ICI Seeds, used 595 gad, based on 344 cultivated acres, for the period July '99 through June 2000, on Fields 146 and 166. As a research station, one of their purposes is to provide isolation for their crops, and since the operation is basically a mono-type crop, they use spatial isolation, which is why approximately two-thirds of their acres are idle at any given time. They are working with their neighbors, Jefts and Hawaiian Agricultural Research Center, to try to utilize the idle acres between their crops to make them more

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[64] Counsel on cross-examination estimated 2,100 gad, but invited someone to divide 0.722 by 328. The answer is 2,200, not 2,100.

[65] In the original D&O, the Commission awarded Campbell Estate 2,500 gad for 78 acres for the HARC lands, for a total of 0.20 mgd.

[66] For the first two months of '01, usage was 3,415 gad and 1,969 gad.

[67] HARC planted about 20 percent more land than they actually physically have because they planted some of that land more than once; hence the crop cycle of 1.19. Stated in acres, they planted "77" acres of the 65 acres they physically have. (Osgood, Tr., 4/4/01, at 111, lines 14-19)

[68] Current usage of 2,600 gad for 1.19 crop cycles, expected to increase to 4,000 gad for 1.9 crop cycles.

productive, looking at different cropping rotations using Jefts' and the Research Center's crops, and working with USDA on conservation-type crops to be used on the idle acres

Gentry and Cozzens originally leased Fields 115,116, and 145 from Campbell Estate and Field 161 from Del Monte to grow hay but are no longer in operation. Campbell has leased its fields to Larry Jefts for diversified agriculture, and Del Monte now grows pineapple on Field 161. One of the Commission's original Findings of Fact was that pineapple crops were estimated to require approximately 2,000 gad. In contrast, Dole /Castle & Cooke requested and was awarded 904 gad for its pineapple fields in the original Decision and Order, and its president testified that pineapple required 40,500 gallons per acre per month, or approximately 1,350 gad, and that it could come from rain or from irrigation. 2,000 gad is for overhead irrigation, while 1,000 gad is for drip irrigation.

The Court vacated and remanded for further proceedings the Commission's allocation to Campbell Estate of 0.86 mgd to Field Numbers 146 and 166 (ICI Seeds) and of 1.19 mgd for Field Numbers 115, 116, 145, and 161 (Gentry and Cozzens). For ICI Seeds, the Court stated that the allocation was nearly three times its stated average demand during its four-month peak season. For Gentry and Cozzens, the Court concluded that there was no information on current and projected use. (94 Haw. 97, at 164; 9 P.3d 409, at 476)

ICI Seeds/Garst Seed Company. ICI Seeds leased 344[69] acres from the Campbell Estate, 149 acres on Field 146 and 195 acres on Field 166. At the time of the original hearings, seed corn was grown, with peak demand in November through February. An average of 80 acres to as much as 100 acres is planted during the peak season. During the peak season, usage is about 5,000 gallons a day per planted acre, with an average of 1,643 gallons a day per planted acre over the course of the year.[70] (Nishii, Tr., 12/12/95, at 191, line 23 to 192, line 3); Binder #1, written direct testimony, at 2)

At the remanded hearings, Stuart, testifying for Garst Seed Company, formerly ICI Seeds, stated that usage had gone up from 80-100 acres in the winter cycle to 100-115 acres, and the summer cycle had gone up from 30 acres to 35-50 acres. The winter cycle runs from October through the end of March and the summer cycle runs from mid-April to early August. Each of those cycles has about a four to four-and-a-half month

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[69] In oral testimony, Nishii said that they leased approximately 350 acres. (Nishii, Tr., 12/12/95 at 183, line 12) At the remanded hearings, Stuart said that they leased 364 acres. (Stuart, Tr. 4/4/01, at 120, lines 16-19)

[70] In his written testimony, Nishii stated that average use throughout the year was 0.13 mgd and peak use was 0.3 mgd. On oral testimony, using the per acre planted usage in the text, above, he changed this to 0.16 mgd and 0.5 mgd.

crop. For the period July '99 through June 2000, average water use was 595 gallons per acre per day for the total farm.[71] (Stuart, Tr., 4/4/01, at 120, line 10, to 131, line 18)

As a research station, one of their purposes is to provide isolation for their crops, and since the operation is basically a mono-type crop, they use spatial isolation, which is why approximately two-thirds[72] of their acres are idle at any given time. They also use mechanical and timing isolation as well to ensure purity of crop and prevent mixing of pollen. They are also working with their neighbors, Jefts and Hawaiian Agricultural Research Center, to try to utilize the idle acres between their crops to make them more productive, looking at different cropping rotations using Jefts' and the Research Center's crops, and working with USDA on conservation-type crops to be used on the idle acres. Garst Seeds is trying to come up with cover crops that would require minimal maintenance, minimal water, and provide a good cover on that ground to cut down on erosion and wind drift and things of that nature. They are also working with HARC on the possibility of putting some of their crops on Garst Seeds' open lands, and with Jefts to swap land (for example, if Jefts were to use 40 acres of Garst's acres, he would allow Garst to use 40 acres of his fallow land). (Stuart, Tr. 4/4/01, at 120, line 23, to 121, line 14; at 126, lines 4-22; at 127, line 25 to 129, line 15) (Osgood, written direct testimony on remand, Exhibit B-RD-3, at 3, lines 18-21)

Gentry and Cozzens (Circle C Ranch & Hay Company) leased 117 acres on Field 115, 70 acres on Field 116, 80 acres on Field 145 from the Campbell Estate, and 208 acres on Field 161 from Del Monte (which leased the land from Campbell Estate). Guinea grass hay was being grown, with plans to expand to other higher protein crops; but Cozzens was unwilling to invest in installing an irrigation system until there was a final allocation decision by the Water Commission. Circle C used water from the Waiahole Ditch to irrigate its crops, using both sprinklers and drip. Current use from the Ditch was about 0.24 mgd, which Cozzens expected to increase as more fields were planted and under irrigation. About 80 acres[73] were then in production, with an expected yield of 1,300 tons per year. Under ideal circumstances, the yield could be as high as 2,900 tons per year. (Cozzens, Binder #1, written direct testimony, at 1-3)

Gentry and Cozzens did not exercise its option to purchase Fields 115, 116, and 145 by the expiration date of November 1999, and in February 2000, these fields were leased to Jefts for diversified agriculture. (Hatton, written direct statement on remand, Exhibit B-RD-1, at 1, lines 13-19; Exhibit B-RD-37) Del Monte terminated the lease for Field 161 and since May 1998, has planted it in pineapple. (Pang, written direct statement on remand, Exhibit B-RD-4, at 1, lines 15-17)

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[71] At approximately 1/3 planted, 595 gallons per acre per day for the total farm would equal about 1,800 gallons per planted acre per day, comparable to the 1,643 gallons per planted acre per day averaged over a year that Nishii estimated at the original hearings, and also near to the 5,000 gallon per planted acre with crop (which is about one-third of the year). Stuart stated that water usage has been on the increase because there has not been much rainfall during the winter months. (Stuart, Tr. 4/4/01, at 125, lines 6-9)

[72] In his testimony, Stuart actually said "a third", but he clearly meant two-thirds.

[73] Average use of 0.24 mgd on 80 acres equals 3,000 gad for planted acreage.

Jefts had begun to clear the land and put in the infrastructure to get water on the former Gentry lands, and had completed 188 acres (of the 267 acres) at the time of the remanded hearing. (Jefts, written direct statement for Campbell Estate on remand, Exhibit B-RD-2, at 4, lines 13-16)

At the original hearings, Del Monte had testified that it was planting potatoes and pumpkins and looking to develop export markets for Hawaiian grown melons, tomatoes and onions. With a change in ownership of Del Monte in 1996, Del Monte has decided at the present time to concentrate their efforts on pineapple, and its representative was not aware of any plans to produce anything other than pineapple. However, just as they changed plans in the mid 1990's from trying to expand into diversified agriculture to focus primarily on pineapple, the reverse could happen again, depending on market conditions, not just here, but worldwide, and on direction from their corporate office. (Pang, written direct statement on remand, Exhibit B-RD-4, at 2-3)

In its original Findings of Fact, Conclusions of Law, and Decision and Order, based on the testimony of the Vice-President and General Manager of Del Monte Fresh Produce Hawai`i, the Commission found that: "It is estimated that pineapple crops require approximately 2,000 gallons of water per day per acre." (D&O, FOF #522)

In contrast, Dole/Castle & Cooke requested and was granted 904 gallons per acre per day for its Dole Fresh Fruit Co. pineapple fields. (D&O, Table 2, at 21) Its president, Vriesenga, testified at the original hearing that pineapple required 40,500 gallons per acre per month, or approximately 1,350 gad, and that it could come from rain or from irrigation. (Vriesenga, Binder #1, written direct testimony, at 5, lines 9-13) Pineapple requires relatively large amounts of water to initiate plant growth and minimally 40,500 gallons per acre per month during the time of vegetative growth and during the first three months of fruit development. After that, water is held off while the fruit matures. (Vriesenga, Tr., 12/13/95, at 106, lines 4-10) Vriesenga was also asked to comment on the use of 2,000 gad and answered that they use closer to 1,000 gad. Dole has invested heavily in drip irrigation systems, which puts the water at the roots; for overhead watering, 2,000 gad is a good number. (Vriesenga, Tr., 12/13/95, at 120, lines 5-16)

VIII. PRACTICABILITY OF ALTERNATIVE GROUND-WATER SOURCES FOR CAMPBELL ESTATE AND PU`U MAKAKILO, INC.

<u>Summary</u>. In its decision, the Hawaii Supreme Court directed the Commission to review the practicability of Campbell Estate and PMI using alternative ground-water sources. The Commission finds that an alternative is practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of the overall project purposes. Practicable is not synonymous with possible, but means feasible, fair and convenient.

In its decision, the Hawai`i Supreme Court referred to the record of the original hearings as revealing that Campbell Estate could supply up to 6.16 mgd of its permitted ground water to certain agricultural fields for as little as $0.39 to $0.45,[74] and that an alternative supply of ground water would cost PMI and various leeward users $0.58 per 1,000 gallons. The lower rate for Campbell Estate was extracted from a single system scenario in which the entire Waiahole Ditch flow were replaced by ground water, for an average cost of $0.62 per 1,000, and testimony was that the pieces which comprised the entire system could not stand alone. Hence, $0.58 per 1,000 gallons applied both to PMI and certain agricultural lands of Campbell Estate as the cost of alternative ground-water sources.

In contrast to Campbell Estate's agricultural use permits at the time of the original hearings, Campbell currently has retained only 0.957 mgd from EP-10 and 7.967 mgd from EP-18, which includes EP-3,4, EP-5,6 and EP- 7,8.

The engineering scenario in which 5.99 mgd of ground water could be delivered to 1,665 acres, including Campbell Estate lands below 520 feet elevation and PMI, and which projected a base cost of $0.58 per 1,000 gallons, assumed that the water would come from EP-15/16. Campbell Estate no longer has this well, which was transferred to the Board of Water Supply.

The two scenarios in which the rest of the Campbell Estate lands would be provided with ground water used WP-2 and WP-30, wells which are on sites that were owned by Oahu Sugar Co. and which Campbell Estate does not and has never owned.

The scenarios also did not include land and easement purchases, delivery to individual fields, taxes and return on investment. It was assumed that ground water would be available for irrigation, that ground water from former Oahu Sugar Co. wells could be applied over Pearl Harbor aquifers regardless of its salinity, and that new ground-water wells could be located anywhere within lands for which Waiahole water had been requested.

The wells that Campbell Estate has retained, EP-10 and the EP-18 battery of wells, have chloride contents exceeding Board of Water standards for irrigation water applied over drinking water aquifers. If Campbell Estate were to drill a new well, it would have to be in the Waipahu-Waiawa aquifer, because allocations in Ewa-Kunia have reached or are close to the sustainable yield. Most of Campbell Estate's Kunia lands overlie the Ewa-Kunia aquifer.

PMI considered three ground-water alternatives. PMI's Conditional Use Permit for the property requires the use of non-potable water having less than 200 ppm of chlorides. The Board of Water Supply standards for irrigation water applied over drinking water aquifers is 160 ppm. Ewa Caprock water has chlorides

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[74] The portion of the record that the Court was referring to actually had a range of $0.39 to $0.48, not $0.45, per 1,000 gallons.

in the 900 to 1,100 ppm range. Desalinating the water to below 200 ppm would cost $6,000,000, with operating costs of $3.00 per 1,000 gallons, exclusive of land and easement acquisitions. An on-site basal well in the Ewa-Kunia aquifer would have 1998 construction costs estimated at $900,000 and operating costs of $0.18 per 1,000 gallons and is economically feasible, but the property has deed restrictions prohibiting an on-site well and allocations from the Ewa-Kunia aquifer are already close to the revised sustainable yield. A basal well in the Waipahu-Waiawa aquifer, using EP-5,6 (owned by Campbell Estate and with a marginally acceptable chloride content of 180 ppm vs. the standard of 160 ppm) would have construction costs of $3,000,000 and estimated operating costs of $0.39 per 1,000 gallons to a delivery point at Farrington Highway, exclusive of the pumping and delivery charge by the well operator to move the water from the well to Farrington Highway. Other factors affecting this alternative are the chloride level of the water, available pumping capacity, a long-term pumping agreement, obtaining an allocation in the Waipahu-Waiawa aquifer, and the ease and cost of obtaining an easement from the Farrington Highway delivery point, under the H-1 Freeway to the golf course property.

There is essentially no balance remaining in the Ewa-Kunia Water Management Area and approximately 21.5 mgd of unallocated water in the Waipahu-Waiawa Water Management Area. The Board of Water Supply has some concerns about their wells if a new well is drilled just mauka of them. The position of the City and County of Honolulu is that Campbell and PMI should not be given water permits merely because there is unallocated permitted ground water available, because of the public's rights in the ground water for domestic use.

If Campbell Estate (and PMI) is required to use alternative sources, reduced flows in the Waiahole Ditch would accelerate deterioration of system components and increase maintenance requirements, and the continued operational viability of the Ditch would be at risk because of the large proportion of total Ditch flows that go to Campbell Estate's lessees.

There are no practicable alternative ground-water sources available for Campbell Estate and PMI to use.

At the original hearings, evidence was presented on an engineering evaluation by Belt Collins Hawaii of alternative water sources to replace all of the Waiahole Ditch water. (Vierra, Binder #1, written direct testimony, at 2, lines 12-17; at 10, lines 4-10; Exhibit A-102, at 3-2 to 3-3) In a follow up report, Belt Collins augmented its original report (Exhibit A-102) with a Four System Alternative, describing four independent systems, each serving approximately one-quarter of the lands for which Waiahole water had been requested. (Exhibit A-204, at 3-4)

All costs were in 1995 dollars and unadjusted for inflation. Estimated costs were for production and transmission costs only and did not include return on investment, taxes, land and easement purchases, nor delivery to individual fields. The actual cost for delivery of water to any elevation or location would be higher. Capital costs were amortized over a 20-year period using an interest rate of 8 percent. It was assumed that land and easements would be available, and their purchase costs were excluded from the analysis. (Exhibit A-204, at 2-3)

To estimate the base cost of providing ground water to agricultural lands *mauka* of the H-1 Freeway, it was assumed that ground water would be available for irrigation, that ground water from former Oahu Sugar Co. wells could be applied over Pearl Harbor aquifers regardless of its salinity, and that new ground-water wells could be located anywhere within lands for which Waiahole water had been requested. (Exhibit A-204, at 3)

Under the Single Groundwater Production and Transmission System alternative, Waiahole water is replaced with ground water extracted from existing Oahu Sugar Co. ground-water pumping stations WP-2 and EP-15/EP-16 plus a new high-elevation well. Existing WP-2 pumps, motors, controls and piping are used while new pumps, motors and controls are placed in station EP-15/EP-16. A new 30-inch ductile iron (DI) transmission main delivers water from WP-2 to lower elevation C&C lands, Robinson lands, the Halekua Agricultural Park, the Royal Oahu Resort, and Nihonkai. Transmission mains ranging in size from 6-inch diameter polyvinyl chloride (PVC) to 30-inch diameter DI deliver water from EP-15/16 to Campbell lands and PMI. A new 16-inch diameter well located adjacent to the ditch and east of the H-2 freeway provides irrigation water for C&C's pineapple operations, the Mililani Cemetery, and the Waiawa Correctional Facility. A booster station is included on the 36-inch transmission line from WP-2 to the Waiahole Ditch.

The average base cost of water delivery to all areas was $0.62+ per 1,000 gallons. Capital costs of improving/building the production and transmission components were $12,120,000,[75] with annual costs of $5,300,000. (Exhibit A-204, Table 1: Base Cost of Production and Transmission – Single System, at 6)

Under the four-independent-systems scenario:

Zone I covered 1,665 acres and included Campbell Estate lands below 520 feet elevation and PMI. To provide an average of 5.99 mgd to this area, new pumps would be installed at EP-15/16 and new transmission lines ranging in size from 15-inch PVC to 24-inch DI would be run from EP-15/16 to areas served. The base cost was projected at

[75] These costs are amortized over 20 years at an annual interest rate of 8 percent, which are included in the annual base costs.

$0.58+ per 1,000 gallons, with annual base costs of $1,280,000.[76] (Exhibit A-204, at 4 and 7)

Zone II covered 1,813 acres and included most Campbell Estate lands above 520 feet elevation as well as the Royal Oahu Golf Course. To provide an average of 6.10 mgd to this area, two of the four existing WP-2 pumps would be used, new booster pumps installed at the WP-30 location, and a new 30-inch DI transmission main laid from WP-2 to Reservoir 255. The base cost was projected at $0.67+ per 1,000 gallons, with annual base costs of $1,500,000. (Exhibit A-204, at 4 and 7)

Zone III covered 1,925 acres, including most Robinson Estate lands, higher-elevation Campbell Estate lands along Kunia Road, Nihonkai, and the Halekua Agricultural Park. To provide an average of 5.60 mgd to this area, two of the four existing WP-2 pumps would be used, WP-30 booster pumps replaced, and a 30-inch DI transmission line laid to Reservoir 225. At Reservoir 225, the 30-inch transmission line would connect to a 16-inch DI line to Robinson fields 270 and 275. The base cost was projected at $0.75+ per 1,000 gallons, with annual base costs of $1,540,000. (Exhibit A-204, at 4 and 7)

Zone IV covered 3,028 acres, including all Castle & Cooke lands, the Waiawa Correctional Facility, and higher-elevation Robinson Estate lands. To provide an average of 5.60 mgd to these lands, two new deep well pumping stations would be installed. Deep well pumping stations would discharge directly to existing Waiahole Ditch infrastructure, precluding the need for new transmission infrastructure. The base cost would be $0.77+ per 1,000 gallons, with annual base costs of $1,580,000. (Exhibit A-204, at 4 and 7)

In its decision, the Hawai`i Supreme Court specifically referred to two parts of these scenarios:

> "The record, in fact, reveals that Campbell Estate could supply up to 6.16 mgd of its permitted ground water to certain agricultural fields for as little as 39 to 45[77] cents per thousand gallons." (94 Haw. 97, at 165; 9 P.3d 409, at 477)

> "(T)he record demonstrates…that an alternative supply of ground water would cost a blended rate of 58 cents per thousand gallons to various leeward users, including PMI, as opposed to the $1.20 per thousand gallons that PMI pays for Waiahole Ditch water." (94 Haw. 97, at 171; 9 P.3d 409, at 483)

Addressing the first quotation, under the Single Groundwater Production and Transmission System alternative, in which the average base cost of water delivery to all areas was $0.62+ per 1,000 gallons, part of one scenario projected that more than 6 mgd

[76] Base delivery costs are calculated as the sum of production, transmission, and operation and maintenance costs. It does not include other factors such as return on investment, cost of easements, land costs, and taxes.

[77] The actual range was $0.39 to $0.48, not $0.45. See following paragraph.

could be delivered to Fields 115, 116,145, 146, HSPA (now "HARC"), "Campbell Low" and PMI at $0.39 to $0.48 per 1,000 gallons. (Exhibit A-102, at page 3-4 and Table 3-7 at page 3-12)

However, under cross-examination, Vierra had testified that the estimate of $0.39 per 1,000 gallons could not be isolated from the context in which it was produced, as it was only part of the whole scenario that led to the estimate of $0.62 per 1,000 gallons for a system that entirely replaced Waiahole Ditch water:

> 'You're referring to pieces of alternative number one…None of these are stand-alone…This alternative one includes a variety of things, you've taken three of (*sic*) pieces out…(A)lternative one was a 23-million-gallon system, and that is a 6-million-gallon piece of a 23-million-gallon system, but it's a big system." (Vierra, Tr., 2/22/96, at 159, line 14, to 160, line 3)

Instead of $0.39 per 1,000 gallons, the scenario for Zone I, which covered Fields 115, 116,145, 146, HSPA (now "HARC"), "Campbell Low" and PMI, projected a rate of $0.58 per 1,000 gallons, *supra*. Thus the second quotation, *supra*, from the Court's opinion, should have applied to its reference to certain Campbell Estate lands as well as to PMI. Under the scenarios developed by Belt Collins Hawaii, base costs for certain of Campbell Estate's fields and for PMI of using ground water instead of Ditch water were projected at $0.58 per 1,000 gallons. This projection was exclusive of other factors such as return on investment, taxes, land and easement purchases, and delivery to individual fields. And it was assumed that ground water would be available for irrigation, that ground water from former Oahu Sugar Co. wells could be applied over Pearl Harbor aquifers regardless of its salinity, and that new ground-water wells could be located anywhere within lands for which Waiahole water had been requested.

Hatton testified at the remanded hearings that from 1997, when the Water Commission issued its decision, until the Supreme Court issued its decision in August 2000, Campbell Estate was assured of Waiahole Ditch water, so they did not conduct a systematic study of alternative water sources. During the past 6 months, there have been some informal and very general discussions about possible scenarios if Ditch water were no longer available. (Hatton, written direct testimony on remand, at 6, lines 1-7)

Hatton also testified that Campbell Estate held agricultural use permits for 34.581 mgd at the time of the original hearings, all for use below the H-1 Freeway, but now has permits for only 8.926 mgd. The Water Commission revoked 13.501 mgd for non-use, and 12.154 mgd was transferred to the Board of Water Supply. Campbell Estate holds two permits for the remaining 8.926 mgd, 0.957 mgd from EP-10 and 7.967 mgd from EP-18, which includes EP-3,4, EP-5,6, and EP-7,8. (Hatton, written direct testimony on remand, Exhibit B-RD-1, at 3, lines 1-11; Exhibit B-RD-40)

The 12.154 mgd transferred to the Board of Water Supply was from EP-15/16.[78] (Exhibit B-RD-40) Waipahu pumps 2, 4 and 7 (WP-2, WP-4, WP-7), the wells used to

[78] This well is the ground-water source in the scenario for Belt Collins Hawaii's Zone I.

partially irrigate the Campbell Estate lands above the H-1 Freeway when Oahu Sugar Co. farmed them, were on sites owned by Oahu Sugar Co. Campbell Estate does not and has never owned these wells.[79] (Hatton, Tr., 4/4/01, at 50, lines 15-25)

Board of Water Supply standards for irrigation water applied over drinking water aquifers is 160 ppm. EP-10 has a chloride content of 460 ppm and some of the water from the battery of wells feeding into the EP-18 pumping station also exceed the standard – EP-3,4 is at 260 ppm, EP-5,6 is at 180 ppm, and EP-7,8 is at 240 ppm. (Hatton, written direct testimony on remand, Exhibit B-RD-1, at 5, lines 9-15)

If Campbell Estate were to drill a new well, it would have to be in the Waipahu-Waiawa aquifer, because allocations in Ewa-Kunia have reached or are close to the sustainable yield. Most of Campbell Estate's Kunia lands overlie the Ewa-Kunia aquifer. (Hatton, written direct testimony on remand, Exhibit B-RD-1, at 6, lines 9-13)

PMI considered three ground-water alternatives to Waiahole Ditch water. A source contemplated in the original golf course plans was the Ewa Caprock aquifer. The application was rejected because the chlorides were in the 900 to 1,100 ppm range and would be used over a potable aquifer. Estimates of desalinating the water to below 200 ppm were $6,000,000, exclusive of land and easement acquisition, with estimated operating costs of $3.00 per 1,000 gallons, which was not considered economically feasible. In addition, the original arrangements for the plant site lease and easements to the golf course were not available to PMI at the time it purchased the property in foreclosure. (Creps, written direct testimony on remand, at 3, line 30 to 4, line 49)

The second alternative was an on-site basal well in the Ewa-Kunia aquifer, with 1998 construction costs estimated at $900,000 and operating costs of $0.18 per 1,000 gallons. This was considered economically feasible, but the property has deed restrictions prohibiting an on-site well, and the likelihood of obtaining an allocation for a basal well in the Ewa-Kunia aquifer is remote. The current sustainable yield is 16 mgd, the existing allocations total 14.5 mgd, applications are pending for an additional 3.1 mgd, and the milestone yield for the aquifer is 14 mgd. (Creps, written direct testimony on remand, at 4, lines 50-64)

The third alternative was a basal well in the Waipahu-Waiawa aquifer, using EP-5,6 (owned by Campbell Estate and with a marginally acceptable chloride content of 180 ppm). Estimated construction costs were $3,000,000 and estimated operating costs were $0.39 per 1,000 gallons to a delivery point at Farrington Highway, exclusive of the pumping and delivery charge by the well operator to move the water from the well to Farrington Highway. PMI considered this alternative marginally feasible. Other factors affecting practicability were the chloride level of the water, available pumping capacity, a long-term pumping agreement, the ease of obtaining an allocation in the Waipahu-Waiawa aquifer, and the ease and cost of obtaining an easement from the Farrington Highway delivery point, under the H-1 Freeway to the golf course property. With the marginally feasible economics and difficulty in obtaining supply agreements and

[79] WP-2 is one of the ground-water sources in the scenarios for Zones II and III.

easements, PMI did not consider this a practicable alternative. (Creps, written direct testimony on remand, at 5, line 65 to 6, line 90)

The sustainable yield for the Ewa-Kunia aquifer was revised downward by the Water Commission from 20 mgd to 16 mgd on March 15, 2000. Permitted use as of 12/8/2000 was 14.492 mgd, leaving a balance of 1.508 mgd. The Board of Water Supply's share of the 14.492 mgd is 9.220 mgd, and it has averaged 7.984 mgd over the five-year period 1996-2000, leaving a balance of 1.236 mgd in permitted use. However, the 1.236 mgd balance is not available as a potable supply, because it consists of 0.954 mgd from the Makakilo Well, which cannot be pumped due to high chlorides of between 250 to 260 ppm, and 0.291 mgd from the Barber's Point nonpotable wells. (Usagawa, written direct testimony on remand, at 2-5)

There is a balance of 21.499 mgd of unallocated permitted use in the Waipahu-Waiawa Water Management Area based on the revised sustainable yield, and a balance of 1.508 mgd in the Ewa-Kunia Water Management Area. The Board of Water Supply has a balance of 23.793 mgd between its already permitted use and the five-year average pumpage in Waipahu-Waiawa. In Ewa-Kunia, the balance is 1.236 mgd, but that balance is brackish and nonpotable. At a water demand growth rate of 1 to 2 mgd per year, the 24 mgd of unused permitted use is expected to last another 12 to 24 years. However, for the last ten years, demand has been basically flat, so the future rate of growth could be significantly less than projected. (Usagawa, Tr., 4/4/01, at 247, line 23 to 248, line 4; at 251, lines 13-19; at 255, line 23 to 258, line 1)

Although the Board of Water Supply has a balance of nearly 24 mgd in permitted use and there is about 21.5 mgd of unallocated water in the Waipahu-Waiawa Water Management Area, BWS still has some concerns about the sustainable yield or quality of the water being affected. If a well is drilled just mauka of one of BWS's sources, then it will intercept some of the water for BWS's wells, affecting its quantity and quality. So where it is makes a big difference. (Usagawa, Tr., 4/4/01, at 277, lines 2-17)

According to the City and County of Honolulu, the public trust doctrine applies to leeward ground-water sources and that Campbell and PMI should not be given water use permits merely because there is unallocated permitted ground water available, and they must justify their use of ground water as against the rights the public has in the ground water for domestic use. If the Commission decides to allocate some of the unallocated ground water for irrigation purposes, it should do so on a conditional basis until recycled water becomes available. If after BWS's three-year soil aquifer treatment study, it is determined that use of recycled water over the underlying aquifer is feasible, the BWS intends to replace or supplement ground-water irrigation sources with recycled water. (City and County of Honolulu, Opening Statement, at 3-4) (Jamile, written direct testimony on remand, at 2-3)

Vierra had also testified at the original hearings that reduced flows in the Waiahole Ditch would accelerate deterioration of system components and increase maintenance requirements. Reduced flows in the transmission ditch cause a drop in the water level, exposing more of the ditch's concrete lining to ambient air. Daily and seasonal variations in air temperature induce concrete expansion and contraction, accelerating cracking of the ditch lining. Additionally, lower flow conditions lead to lower velocities and a more rapid build up of algae. System losses due to leaks are present in any water distribution system. The Waiahole system was designed to carry flows in excess of 40 mgd. In a large-capacity system with reduced flows, losses will become a more significant factor in the overall flow budget. (Vierra, Binder #1, written direct testimony, at 6, lines 1-22)

At the remanded hearings, Hatton also questioned whether or not diversified agriculture in Kunia would survive without Waiahole Ditch water for Campbell Estate. The Kunia Water Coop requires each farmer to make a minimum commitment to ensure the Ditch's continued operational viability. If Campbell Estate's lessees's water budgets are subtracted, survival of the remaining farmers becomes tenuous.[80] (Hatton, written direct testimony on remand, Exhibit B-RD-1, at 6, line 16 to 7, line 2)

IX. MERITS FOR A PERMIT FOR DITCH "SYSTEM LOSSES"

Summary. System losses occur from evaporation from the open ditch, including from the system's two reservoirs; leakage from the lined ditches, siphons, pipelines which distribute water to the edges of the users' fields, and reservoirs; and overflow from the two reservoirs.

A calculation of "system losses" is made by taking the amount of water measured at Adit 8 and subtracting the reported amount of metered usage. Essentially, this calculation of system losses includes any and all flows not actually recorded in the users' meters.

Because of the system's operational limitations, such as evaporation, the inability to shut off flows completely, and meter malfunctioning, some degree of system losses is unavoidable.

System losses have been reduced from 6.27 mgd in July - December 1999, the period immediately following the State of Hawai`i's purchase of the WWS, to 4.62 mgd in July – December 2000, and is projected to be reduced further to 2.02 mgd after the siphons are replaced by June 2001. The 2.02 mgd in losses are projected to consist of: 1) no losses from the siphons; 2) 0.45 mgd overflow at Reservoir 155; 3) 0.07 mgd in evaporation; and 4) 1.50 in the residual category, "unmetered losses".

Much of the 1.50 mgd in continuing unmetered losses is probably due to leakage and seepage. Of the 0.45 mgd in continued overflow at the reservoir at the end of the system, it is hard to say how much further that loss might be reduced. It is at the end of the system, and end-users need an adequate flow of water in the ditch.

[80] At the original hearings, out of the total 11.93 mgd in Ditch water awarded, Campbell Estate received 5.28 mgd, or 44 percent of the total.

The Agribusiness Development Corporation (ADC), as successor in interest to the Waiahole Irrigation Company, Limited, effective July 1999, is the present applicant for a water use permit for system losses occurring in connection with operation of the Waiahole Water System (WWS). (Lee, written direct testimony, at 1, lines 4-6)

Beginning at Adit 8, the point where the ditch exits the Ko`olaus and begins the leeward delivery of water, the delivery portion of the system is approximately 11.5 miles of primarily open irrigation system. This delivery portion consists of open, lined ditches and wooden and metal siphons which carry the water across the gulches. There are also two earthen reservoirs, nine sumps (ponds), and 1000 feet of unlined ditches. (Lee, written direct testimony, at 9, line 20 to 10, line 4)

System losses due to leaks are present in any water distribution system. The Waiahole system was designed to carry flows in excess of 40 mgd. In a large-capacity system with reduced flows, losses will become a more significant factor in the overall flow budget. (Vierra, Binder #1, written direct testimony, at 6, lines 19-22)

WWS system losses occur downstream of Adit 8 in the form of evaporation from the open ditch, including from the system's two reservoirs; of leakage from the lined ditches, siphons, pipelines which distribute water to the edges of the users' fields, and reservoirs; and of overflow from the two reservoirs. (Lee, written direct testimony, at 10, lines 6-9)

A calculation of "system losses" can be made by taking the amount of water measured at Adit 8 and subtracting the reported amount of metered usage. Essentially, this calculation of system losses includes any and all flows not actually recorded in the users' meters. (Lee, written direct testimony, at 8, lines 12-18)

A further breakdown of "system losses" has been made by measuring losses from the three remaining wooden siphons, estimating system evaporation from the surface area of the open ditches and reservoirs, and overflow at Reservoir 155 at the end of the system. The remaining losses are collectively categorized as "unmetered flows." The loss from one of the three siphons is included in the category of unmetered flows, because its losses do not collect in a single location and commingle in a culvert with waters from other sources. (Lee, written direct testimony, at 10, line 19 to 11, line 13; at 15, lines 6-16; Exhibit L-1106)

Malfunctioning meters sometimes result in a lower reading than what was actually drawn. Because of the way system losses are calculated, the difference between the larger amount actually used and the incorrect meter reading is considered a loss and is included in the unmetered flows. In addition, at times, flows into a meter are too low to register on a meter even though a user is actually drawing some flow. (Lee, written direct testimony, at 10, lines 9-18)

Flows through the WWS cannot be shut off entirely, because of the water developed in the “main bore”, or the Waiawa portion of the system between the windward side’s north portal and the leeward side’s Adit 8. If users did not draw flows from the system, the unused Waiawa flows would go into reservoir 155 at the end of the ditch and possibly end up as overflow. (Lee, written direct testimony, at 14, lines 6-13; Exhibit L-1104)

Because of the system’s operational limitations, such as evaporation, the inability to shut off flows completely, and meter malfunctioning, some degree of system losses is unavoidable. (Lee, written direct testimony, at 10, lines 10-15; at 14, lines 7-19; at 15, lines 11-12)

In heavy rains on the leeward side, a lot of rainwater will come into the ditch and become overflow, over which ADC doesn’t have control. And during these times, users will not be irrigating, but there will still be water flowing in the ditch from the Waiawa portion of the system. These overflows would be included in system losses, so a method should be devised to discount these amounts. (Lee, Tr., 4/4/01, at 286, line 19 to 289, line 3)

The three wooden siphons are being replaced, with completion projected in June 2001. Losses from two of the siphons are projected to decrease from 1.63 mgd to 0 mgd. Losses from the third siphon are projected to reduce “unmetered flows” by 0.70 mgd. Overflow from Reservoir 155 at the end of the ditch is projected to decrease from 0.75 mgd to 0.45 mgd: 1) by pumping water from the reservoir back into the ditch to reduce the occurrence of overflow, while, at the same time, making the pumped water available for end-users of the ditch; and 2) using Reservoir 255, further up the ditch, to provide capacity for flows which are anticipated would otherwise go to Reservoir 155 as overflows. The adjustment gate that controls the flow of windward waters to the leeward side is being automated, allowing quicker adjustments of flow. Two large leaks serving the Campbell Estate lands were patched, and two gates were permanently sealed off in an effort to reduce unmetered losses. Recalibration of meters and ditch repairs continue. (Lee, written direct testimony, at 11, lines 18-20; at 12, line 3 to 13, line 17; at 15, lines 2-16; Exhibit L-1103)

System losses have been reduced from 6.27 mgd in July - December 1999, the period immediately following the State of Hawai`i’s purchase of the WWS, to 4.62 mgd in July – December 2000, and is projected to be reduced further to 2.02 mgd after the siphons are replaced by June 2001. The 2.02 mgd in losses are projected to consist of: 1) no losses from the siphons; 2) 0.45 mgd overflow at Reservoir 155; 3) 0.07 mgd in evaporation; and 4) 1.50 in the residual category, “unmetered losses”. (Lee, written direct testimony, at 16, lines 3-5; Exhibit L-1106; Exhibit L-1103)

Much of the 1.50 mgd in continuing unmetered losses is probably due to leakage and seepage. The two reservoirs, 1000 feet of the ditch, and some of the sumps (ponds) are unlined. In addition, there are cracks in the cement lining of the ditch, some of which are not obvious, which are patched as they are discovered. (Lee, Tr., 4/4/01, at 295, line

12 to 299, line 2) ADC does not know what it would cost to line the 1000 feet of ditch or the two reservoirs, as their efforts so far have been focused on replacing the siphons. (Lee, Tr., 4/4/01, at 295, line 17, to 296, at 18)

Of the 0.45 mgd in continued overflow at the reservoir at the end of the system, it is hard to say how much further that loss might be reduced. It is at the end of the system, and end-users need an adequate flow of water in the ditch. Pumping from the reservoir back into the ditch would meet some of these flow needs at the end of the ditch. (Lee, Tr., 4/4/01, at 299, lines 3-25; written direct testimony, at 12, lines 3-6)

X. DECISION AND ORDER

A. INTERIM INSTREAM FLOW STANDARDS[81]

The Hawai`i Supreme Court remanded the Commission's designation of an additional 6 mgd to Waiahole and Waianu Streams as the IIFS, partly based on its conclusion that: "(w)ithout any proper findings as to the actual requirements for instream purposes, or the reasonableness of offstream diversions relative to these requirements, the Commission effectively assigned to windward streams the water remaining <u>after it had approved the bulk of the offstream use permit requests</u> (emphasis added)." (94 Ha. 97, at 153; 9 P.3d 409, at 465)

However, rather than arriving at the 6 mgd as a "remainder",[82] in its Decision and Order, the Commission did the following:

First, amended the IIFS for certain windward streams by restoring 6 mgd to current flows, 4 mgd into Waiahole Stream, and 2 mgd into Waianu Stream;

Second, approved water use permits for 11.93 mgd out of a total request of 31.08 mgd;

Third, proposed an agricultural reserve of 1.58 mgd;

Fourth, temporarily recognized the 2.1 mgd of Kahana surface waters flowing in the ditch (see *supra*, Part I and footnote 2) as corresponding approximately to operational losses;

Fifth, leaving a remainder of 5.39 mgd [83]of non-permitted ground water from the total of 27.0 mgd measured at Adit 8 (which includes the waters developed by the Main Bore as it traversed the leeward lands at Waiawa); and

Sixth, ordering that the nonpermitted ground water, the proposed agricultural reserve, and any of the permitted water not consumed or needed for day-to-day operations for any of the allocated uses or for operational losses, be added to the 4 mgd restored to Waiahole Stream. (Decision and Order, pp.1-13)

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[81] See "Section IV. – Interim Instream Flow Standards For Waiahole (And Its Tributary, Waianu), Waikane And Kahana Streams", *supra*, for documentation of the following discussion.

[82] For example, the Court used this term in its decision: "the Commission's decision to add the <u>remaining</u> 6.0 mgd to the WIIFS…(emphasis added)." (94 Haw. 97, at 155; 9 P.3d 409, at 467)

[83] In order to arrive at 6.00 mgd for stream restoration as a remainder, the Commission would have had to somehow arrive at a nonpermitted ground-water amount precise to one-one hundredth of a mgd. Instead, as shown from the sequence of the Commission's decision, the thirty-nine one-hundredths in the 5.39 mgd of nonpermitted ground water was clearly arrived at as the remainder after all other allocations were made.

The Court particularly focused on what it referred to as “the nonpermitted ground water buffer”, objecting to it as a “formal and distinct category of allocation.” (94 Haw. 97, at 156; 9 P.3d 409, at 468) The Commission, however, never intended nor designated it as a formal and distinct category.[84]

The Court concluded that: “The Commission’s assignment of the buffer flows to the windward streams, on its face, seems to amount to a determination that it is ‘practicable’ to ‘protect, enhance, and reestablish’ instream uses by that quantity, at least for the interim. If so, this would generally meet the definition and purpose of ‘interim’ standards under the Code.” (94 Hawaii 97, at 157; 9 P.3d 409, at 469) However, the Commission’s “assignment” of the nonpermitted flows to the windward streams was in fact not a categorical assignment, but part of its general order that “any water not consumed or needed for day to day operations for any of the allocated uses or for operational losses” shall be released into the windward streams. (Decision and Order, at 4)

The Court also stated that, pending the establishment of permanent standards, it did not bar the Commission from setting the interim standards lower than the combined total of 6.00 mgd for the amended IIFS and 5.39 mgd for the nonpermitted ground water, but that several factors suggested to it “that the interim standard should, at least for the time being, incorporate much of the total present stream flow: 1) the lack of proper studies and adequate information on the streams; 2) the corresponding inability of the Commission presently to fulfill the instream use protection framework; 3) the substantial, largely uncontroverted expert testimony that the present instream flows represent the minimum necessary to sustain an adequate stream habitat; 4) the Commission’s statement that, ‘in general, it is expected that additional flows to the streams would increase the native biota habitat’; and 5) the Commission’s generous provision for immediate and near-term offstream demands under a ‘prima facie’ standard. (94 Haw. 97, at 156-157; 9 P.3d 409, at 468-469)

The Commission agrees that some of these factors are at work, but respectfully disagrees with the Court’s conclusions on the others.

We agree with the Court’s second point that the Commission has not developed permanent instream flow standards, as ultimately required by the Water Code.

And what the Court characterizes in its fifth point as “the Commission’s generous provision for immediate and near-term offstream demands” and its remand to the Commission on some of these provisions, are addressed elsewhere in this revised Decision and Order.

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[84] The “nonpermitted ground-water buffer” that the Court vacated in its Decision (94 Haw. 97, at 156; 9 P.3d 409, at 468) is not in the Commission’s final D&O. It was in the proposed D&O, but it was changed to “nonpermitted ground water” in the final D&O. “Nonpermitted ground-water buffer” was also removed from the Conclusions of Law, although “buffer” inadvertently remained in the COL at page 33, as correctly referenced in the Court’s Decision. (94 Haw. 97, at 156; 9 P.3d 409, at 468) However, it was not a “formal and distinct category of allocation” as the Court concluded.

However:

First, what the Court characterizes as “the lack of proper studies and adequate information on the streams” does not inevitably lead to the conclusion that “the interim standard should, at least for the time being, incorporate much of the present stream flow.” Known information on the streams and on stream restoration techniques in general include: 1) in the upper reaches of Waiahole Stream flow conditions were too swift to provide goby habitat; 2) a more suitable restoration of windward streams would involve the partitioning of flow among a number of stream systems such as Kahana, Waikane, Waianu and Waiahole Streams, from which the flows were originally disrupted; 3) the Division of Aquatic Resources of the Department of Land and Natural Resources recommended that higher flows should be introduced in stages rather than suddenly restoring the total original base flow; 4) flow restoration alone will probably not lead to recovery of native organisms; and 5) restoration can take many forms and even small flow increases can become substantial with time.[85]

Second, the Court referred to “the substantial, largely uncontroverted expert testimony that the present instream flows represent the minimum necessary to sustain an adequate stream habitat”.[86] The Commission respectfully disagrees and believes its position is supported by the record. The three experts who made such statements contradicted themselves not only in their written testimonies but also during the same oral testimonies in which they made the “minimum necessary” claims. Documentation of these self-contradictory statements as well as the opposing opinions of other experts is covered in detail in Part IV-A-3-a-ii –“Instream Post-Release Studies.” In addition, further refutation is contained in the record of the Commission’s original D&O, at FOFs 167 through 181.[87]

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[85] In a footnote, the Court stated: “We are also unconvinced by the Commission’s reasoning that the buffer enables the Commission to study the effect of flow reductions on the streams. The Commission could just as easily accomplish this purpose by alternating flows among the streams, instead of diverting flows for offstream uses.” (94 Haw. 97, at 156; 9 P.3d 409, at 468)

The Court was assuming that studies in one stream would be directly relevant to another, but apart from generalizable conditions, this assumption probably does not hold when the objective is to restore a particular stream to a particular level of biological activity (e.g., enough *`o`opu, `opae, and hihiwai* to revive traditional gathering rights). For example, in the preliminary studies, more *`o`opu* were found in Waikane Stream than in Waiahole Stream, even though no water had been restored into Waikane Stream. (Kido, Tr., 4/17/96, at 52, line 20 to 53, line 2) There are streams that are very small naturally that have low flow, but are permanently occupied by *`o`opu*; for example, on Maui, there are streams with low flow that do contain mostly native fishes and a good native fish habitat. (Hodges, Tr., 4/16/96, at 174, lines 13-18) Restoration of a stream is not only limited to the quantity or the velocity of the water in the stream, but it also involves the vegetation around the stream, the uses around the stream, and, probably, even how the stream water is diverted. (Kido, Tr., 2/21/96, at 146, lines 10-25 and at 149, lines 1-15) Restoration can take many forms, such as removal of a drainage pipe, replanting of riparian vegetation, removal of man-made alterations and the control or eradication of exotic species. (Devick, Binder #2, written direct testimony, at 12)

[86] The Court did not identify the evidence on which its conclusion was based.

[87] Furthermore, contradictory views by the three experts themselves to their “minimum necessary” statements are among these Findings of Fact. (Brasher: FOF 167; Englund: FOF 172; Hodges: FOF 176)

Third, the Commission's statement that, 'in general, it is expected that additional flows to the streams would increase the native biota habitat' does not translate into identifying a particular flow as being the minimum, maximum or any other quantitative valuation between the two. Furthermore, the Commission was referring to the streams in their pre-release state. The six scientists who conducted preliminary studies of some of the windward streams (primarily Waiahole, but also in some cases, Waianu and Waikane), found that increased flows had begun to shift the stream environment toward habitat conditions that would be more favorable to native biota. But that is all those preliminary studies had shown; i.e., a qualitative shift toward a more favorable environment, far short of any quantitative conclusion that the restored flows were minimal, optimal, or anywhere in-between.

Even if the Commission could agree with the Court's conclusion that the interim instream flow standard should incorporate much of the total instream flow, the Commission would be in violation of the Court's disapproval of "without any proper findings as to the actual requirements for instream purposes…assign(ing) to windward streams the water remaining after it had approved the bulk of the offstream use permit requests." (94 Haw. 97, at 153; 9 P.3d 409, at 465) The suggested IIFS would be the sum of the Commission's designation of 6 mgd to be added to Waiahole and Waianu Streams, plus 5.39 mgd in nonpermitted ground water. However, the 5.39 mgd was arrived at after designating 6 mgd for the amended IIFS, 11.9 mgd in water use permits, 1.58 mgd for an agricultural reserve, and 2.1 mgd for system losses. Thus, the suggested IIFS would be arrived at after considering all offstream uses, which the Commission believes is contrary to the mandate of the Court's holding to determine the IIFS first.

The Commission's proposed requirement for requests for water use permits of the nonpermitted ground water in effect would have treated such requests as though they were petitions for amending the IIFS: "(S)cientific studies under the Commission's supervision will be the basis for deciding how much, if any, of the nonpermitted ground water may be used…(T)he permits will be subject to conditions providing for stream restoration if the Commission determines that additional water should be returned to the stream." (D&O, December 24, 1997,at 11) Thus, from the Commission's point of view, there would have been a double-tier of protection for the streams: 1) heightened scrutiny for water permit requests from the nonpermitted ground water, which were not subject to petitions to amend the IIFS; and 2) a floor under the nonpermitted ground water, where requesters would have to petition to amend the IIFS.

Despite greatly reduced flows in the affected streams from the construction of the Waiahole Ditch's windward tunnel system, the evidence has shown that much of the vitality of these streams was maintained until the 1960s.[88] Similar productivity was seen in Kaneohe Bay until the 1960s, but the Bay's changes appear to be coincidental to the changes in the streams and due primarily to overfishing and a multiplicity of factors, only one of which may have been the reduced stream flows.[89]

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[88] See Part IV.A.3.a.i – "Impact on Instream Uses, Stream Ecology, Personal Testimonials".
[89] See Part IV.A.3.b.ii. – "Impact on Kane`ohe Bay, Scientific Opinions and Studies".

Degradation of the streams also appears to have been caused by multiple factors.[90] And such changes similarly occurred in streams which are not hydrologically affected by the Waiahole Ditch's windward tunnel system; namely, Hakipu`u Stream and even Punalu`u Stream.[91]

A minimalist approach to restoring stream flows could look to the period of the 1960s and see what stream-flow-related changes occurred during that time that could have contributed to the decline in stream vitality. One such event did occur – extension of the Uwau Tunnel in 1964, which could have reduced flows in Waianu and Waiahole Streams by 2.8 mgd. But in 1982, pumping from Waiahole Stream up into the tunnel system of 1 to 1.5 mgd per day was discontinued.[92] Therefore, under the minimalist approach, either 2.8 mgd would be added to Waiahole and Waianu Streams, or 1.3 to 1.8 mgd to Waianu Stream (because 1 to 1.5 mgd had been "returned" to Waiahole Stream by the cessation in pumping).

However, the Commission, pursuant to its duties as trustee of all fresh water resources of the state, and in the interest of precaution, has determined that reasonable "margins of safety" should be adopted in establishing the windward IIFSs. (94 Haw. 97 at 156; 9 P.3d 409 at 468). In the Waiahole case, the Hawaii Supreme Court affirmed the Commission's use of the precautionary principle. The Commission stated: "[w]here scientific evidence is preliminary and not yet conclusive regarding the management of fresh water resources which are part of the public trust, it is prudent to adopt "precautionary principles" in protecting the resources…In addition, where uncertainty exists a trustee's duty to protect the resource mitigates in favor of choosing presumptions that protect the resource" Id. at 154. In affirming the Commission's use of the precautionary principle, the Court stated:

> As with any general principle, its meaning must vary according to the situation and can only develop over time. In this case, we believe the Commission describes the principle in its quintessential form: at minimum, the absence of firm scientific proof should not tie the Commission's hands in adopting reasonable measures designed to further the public interest.
>
> So defined, the precautionary principle simply restates the Commission's duties under the constitution and the Code. Indeed, the lack of scientific certainty does not extinguish the presumption in favor of public trust purposes or vitiate the Commission's affirmative duty to protect such purposes wherever feasible. Nor does present inability to fulfill the instream use protection framework render the statute's directives any less mandatory. In requiring the Commission to establish instream flow standards at an early planning stage, the Code contemplates the

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[90] See Part IV.A.3.a.i – "Stream Ecology, Personal Testimonials" and Part IV.A.3.c. – "Impact on Instream Uses, Impact of Watershed Changes on the Streams".
[91] See Part IV.A.3.a.i. – "Stream Ecology, Personal Testimonials".
[92] See Part IV.A.3.a.i. – "Impact on Instream Uses, Stream Ecology, Personal Testimonials".

> designation of the standards based not only on scientifically proven facts, but also on future predictions, generalized presumptions, and policy judgments. Neither the constitution nor Code, therefore, constrains the Commission to wait for full scientific certainty in fulfilling its duty towards the public interest in minimum instream flows.

Id. at 155.

The Commission is concerned that the use of the minimalist approach to restoring streams by looking to the amounts of water that were present in those streams in the 1960s would not satisfy the precautionary principle, especially in light of a lack of scientific data that fully accounts for the qualitative reduction of aquatic life in those streams. Without more studies, the Commission will employ the precautionary principle and will, except for Kahana Stream which is least diverted (22% of estimated pre-ditch flow) by the ditch, restore more water to those streams than was present in the 1960s.

The Commission finds that it is practicable to use increased stream flows to partially compensate for the other factors that have affected the vitality of the streams, as well as to increase the contribution that these stream flows may have on the vitality of Kaneohe Bay. From the preliminary studies conducted in the few months following release of Waiahole Ditch waters into Waiahole and Waianu Streams, while no quantitative conclusions can be reached, the studies have all pointed toward an improvement in stream habitat, conducive to the enhanced recruitment of the amphidromous[93] species (*`o`opu*, *`opae*, and possibly *hihiwai*, or fishes, crustaceans, and mollusks) that are native to the Hawaiian Islands. Furthermore, preliminary studies of the impact of these increased stream flows reveal an improvement in fish recruitment habitat, at least near the mouth of Waiahole Stream, with a potential magnifying effect on a larger area of Kaneohe Bay.[94]

The practicability of using increased stream flows to partially compensate for other factors that have affected the vitality of the streams comes with a word of caution. Such other factors, which are largely if not entirely outside the jurisdiction of the Commission, must be simultaneously addressed. If the focus is solely on restoring stream flows, expectations on the degree of improvements in the streams and their watersheds cannot possibly be met, even if all the waters in the Waiahole Ditch's windward tunnels are added to the streams.

One Hawaiian approach to diversion of stream waters, which has been cited earlier, appears to limit diversions to no more than one-half of a stream's flow, although much more has been diverted on occasion.[95] As historically noted and earlier cited, there

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[93] Migrating from fresh water to the ocean and the reverse during their life cycle, but neither leg of the migration is immediately associated with spawning. (Fitzsimons, Binder #6A, written direct testimony, at 6-7)

[94] See Part IV.A.3.b.ii. – "Impact on Kane`ohe Bay, Scientific Opinions and Studies".

[95] And, as noted *supra*, it is unclear whether this applies to the stream's original flow or only to the stream's flow at the point of diversion.

have been diversions limited to half the flow from a stream or place of diversion, and examples of other diversions taking up to or perhaps somewhat beyond the available water supply. However, it does not appear that there was any specific, quantified amount of water that should remain in the stream or be taken for off stream use. Considering the specific facts of this case, not establishing a standard or generalized policy for future decisions, and in accordance with the precautionary principle, a reasonable and practicable approach would be to restore Waiahole, Waianu, Waikane, and Kahana Streams to one-half their pre-Ditch base flow levels which would also exceed their 1960 levels where testimony established the presence of aquatic biota at a higher level than today. The Commission believes that the IIFSs set at such a level would protect aquatic biota in the streams.

The only recorded flows in these streams in the pre-Ditch era are very limited data from 1911.[96] Ninety-eight daily readings were taken of Waiahole Stream from September 25 through December 31, 1911; of Waianu Stream, 22 readings on various days in September through November 1911; for Waikane Stream, a single reading on October 9, 1911; and for Kahana Stream, a single reading on October 27, 1911.[97] Using the lowest of the readings for Waiahole and Waianu Streams and the single readings for Waikane and Kahana Streams, pre-Ditch base flows would be estimated as: 14.4 mgd for Waiahole Stream; 7.8 mgd for Waianu Stream; 6.0 mgd for Waikane Stream; and 21.0 mgd for Kahana Stream.

These measurements were taken during the winter months, and average rainfall in Waiahole Valley during the period August 16, 1911, to January 3, 1912 was 0.43 inches **per day**. Average rainfall during the actual period of measurement – from late September through December 1911 – was likely higher, as the 0.43 inches per day was the average over a period of measurement that began more than a month earlier in the summer – August 16, 1911.[98] Thus, the observed flows in the winter of 1911 were not likely to represent base flow conditions (i.e., the ground-water contribution to stream flow, which would more typically be reflected in flows after a period of prolonged dry weather).

The maximum amount of water that could be flowing in Waiahole, Waianu, Waikane, and Kahana Streams would be the sum of current stream flows and waters developed in the Waiahole Ditch's tunnel system from Kahana to the North Portal gauge under the crest of the Ko`olau Mountains.[99]

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[96] A stream's average and base flows are typically based on many years of data to "even out" the natural variability that occurs from season-to-season, and from year-to-year. For example, average and base flows for O`ahu streams as estimated by the U.S. Geological Survey are based on 35 years of data. (Exhibit N-118, at 33)

[97] See Part IV.A.2 – "Impact on Windward Stream Flows". Waiahole and Waianu Streams were measured just above their confluence, the points the U.S. Geological Survey have identified as the points of maximum base flows; Waikane Stream was measured at a point above all diversions; and Kahana Stream was measured "just below intake of upper ditch on north side".

[98] See Part IV.A.2 – "Impact on Windward Stream Flows".

[99] Some of the waters developed by the windward tunnels may have flowed leeward, and the tunnels may be developing more water than would have flowed windward because of changes in storage conditions. So

Thus, maximum stream base flows cannot be more than the sum of current estimated base flows, plus the quantity of water developed in the windward tunnels on a watershed-by-watershed basis:

	Current Base Flow		Current Ditch Flow		Estimated Pre-Ditch Flow
Waiahole/ Waianu Stream:	4.4 mgd (3.9+0.5)	+	14.8 mgd	=	19.2 mgd
Waikane Stream:	1.4 mgd	+	5.3 mgd	=	6.7 mgd
Kahana Stream:	11.2 mgd	+	3.2 mgd	=	14.4 mgd
		TOTAL:	23.3 mgd		

Comparing estimated stream flows using the limited 1911 data versus current ditch flows:

	Using Limited 1911 Data	Using Current Base + Ditch Flows
Waiahole Stream:	14.4 mgd	
Waianu Stream:	7.8 mgd	
	22.2 mgd	19.2 mgd
Waikane Stream:	6.0 mgd	6.7 mgd
Kahana Stream:	21.0 mgd	14.4 mgd
TOTALS:	49.2 mgd	40.3 mgd

Thus, the 1911 data result in a cumulative overestimate of flow in the four streams of 8.9 mgd, or 22 percent (8.9 divided by 40.3 equals 22%).

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the water in the windward tunnels is the maximum that would have been added to the windward streams, and may be less. (See Part IV.A.2. – "Impact on Windward Streams")

Subtracting post-Ditch base flows for these streams, results in the following estimated deficits:

	Ditch Flow[100]	"Deficit" Using 1911 Data[101]	Excess Over Ditch Flow
Waiahole/ Waianu:[102]	14.8 mgd	17.8 mgd	3.0 mgd
Waikane:	5.3 mgd	4.6 mgd	(0.7 mgd)
Kahana:	3.2 mgd	9.8 mgd	6.6 mgd
TOTALS:	23.3 mgd	32.2 mgd	8.9 mgd

If the Interim Instream Flow Standards (IIFSs) were to be established at one-half of base stream flows, the results would be as follows:

	Using Limited 1911 Data	Using Current Base + Ditch Flows
Waiahole Stream:	7.2 mgd	9.6 mgd
Waianu Stream:	3.9 mgd	
Waikane Stream:	3.0 mgd	3.4 mgd
Kahana Stream:	10.5 mgd	7.2 mgd

[100] Water flowing in Waiahole Ditch from the three watersheds of Kahana Valley, Waikane Valley, and Waiahole Valley.

[101] "Deficit" calculated by subtracting U.S. Geological Survey estimate of current stream base flow from stream base flow using limited 1911 data. For example, for Waiahole/Waianu Streams, base flow from 1911 data would be 22.2 mgd, while current stream base flow is 4.4 mgd, resulting in a "deficit" of 17.8 mgd. But the most that could be added to Waiahole/Waianu Streams would be the 14.8 mgd developed in the tunnels from the Waiahole/Waianu watershed. Therefore, the 1911 stream flow data results in an overestimate of 3.0 mgd.

[102] Attempting to separate the watershed contribution to Waiahole Stream from the contribution to Waianu Stream based on the available evidence would result in an anomalous situation. The two Uwau tunnels (Uwau is a tributary of Waianu, which is in turn a tributary of Waiahole) together provide 13.5 mgd, while the tunnel system from Uwau to the North Portal gauge provides only 1.3 mgd. So 13.5 mgd would be attributed to Waianu Stream, and 1.3 mgd to Waiahole Stream. Furthermore, Meyer testified that development of the Uwau Tunnel extension would have affected Waiahole as well as Waianu Streams. (Meyer, Tr., 4/16/96, at 9, line 16 to 13 line 7**)**

Additions to current base flows to increase stream flows to one-half historical levels would be as follows:

	Using Limited 1911 Data	Using Current Base + Ditch Flows
Waiahole Stream[103]:	3.3 mgd	
		5.2 mgd
Waianu Stream:[104]	3.4 mgd	
Waikane Stream:[105]	1.6 mgd	2.0 mgd
Kahana Stream:[106]	0.0 mgd	0.0 mg

Compared to current base flows, the percentage increases in stream flow would be as follows:

	Using Limited 1911 Data[107]	Using Current Base + Ditch Flows
Waiahole Stream:	3.3 mgd = 85% 3.9 mgd	
		5.2 mgd = 118% 4.4 mgd
Waianu Stream:	3.4 mgd = 680% 0.5 mgd	
Waikane Stream:	1.6 mgd = 114% 1.4 mgd	2.0 mgd = 143% 1.4 mgd
Kahana Stream:	0.0 mgd	0.0 mgd

The amounts identified as representing one-half of base stream flows would be the minimum available in the streams. There is significantly more water present in the streams most of the time. As currently defined, nearly 90 percent of the time, the actual amount of water in a stream is higher than the base flow.[108]

The Commission has determined that the higher of the two values will be used to amend the Interim Instream Flow Standards, even though using the 1911 data results in additions to the streams that, in total, would exceed the flows in the windward tunnels of

[103] Current base flow of 3.9 mgd.
[104] Current base flow of 0.5 mgd.
[105] Current base flow of 1.4 mgd.
[106] No additional water would be added to Kahana Stream under either scenario. Perhaps this is not surprising, in view of the finding that Kahana Stream, down gradient from Kahana Tunnel, lies geographically only partly in the dike complex and mostly in the marginal dike zone. (Exhibit M-36D, at 35)
[107] The percent increase of Waiahole and Waianu Streams combined would be 152%, compared to 118% using Ditch flows.
[108] Exhibit N-118, at 40.

the Waiahole Ditch. Thus, additions to Waiahole and Waianu Streams will be 6.7 mgd, using the 1911 data; for Waikane Stream, 2.0 mgd, using current base and ditch flows; and for Kahana Stream, no additions under both the 1911 data and current base and ditch flows.

Appurtenant rights and existing uses, as well as the McCandless pipeline, also need to be considered.

Current wetland taro acreage in Waiahole Valley total 13 acres, 10 acres in leaf taro for commercial sale, and 3 acres in corm and *poi* taro for both personal consumption and for sale. Another farmer intends to plant seven acres in wetland taro, a little for personal consumption, but largely for sale. In Waikane Valley, one farmer intends to farm one acre of wetland taro, and another has one-quarter acre in production, plans to add another one-half acre, and would like to add another one and one-quarter acres, but presently that land is covered by a landslide. Thus, near-term farming of wetland taro is as follows:[109]

> Waiahole Valley: 13 acres in production, 10 of which are in commercial leaf taro, with another seven acres intended to be put into commercial production. Only part of the three acres currently in production is or will be used for personal consumption,[110] the rest will be for sale.
>
> Waikane Valley: One-quarter acre in wetland production, with another one and a half acres planned.

About ten percent of *lo`i* are fallow at any one time, and about 15 percent of the land is in infrastructure (banks, paths, roads, etc.).[111]

Current taro production ranges from 20,000 to 40,000 pounds per acre per year, with a conversion factor from taro corms to *poi* of 80 percent. Consumption is estimated at 10 pounds of taro per person per week, or 8 pounds of *poi* per person per week. Thus, an acre of taro can support the *poi* consumption of from 38 to 77 persons per year.[112] Thus, any acreage of more than one acre cannot be claimed as being cultivated for domestic consumption. Seventeen of the acres in production or intended to be put into production are solely for commercial purposes, and only part of the remaining three acres is or will be used for personal consumption. So no more than three acres, and probably no more than one acre, of the 20 acres in Waiahole Valley is for domestic use.

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[109] See Part IV.A.4.a.i. – "Windward Offstream Water Needs, Wetland Taro, Acreage".

[110] The Reppuns, who farm these three acres, also have another three acres in Waihee Valley, and they rotate their plantings among these two areas. (See Part IV.A.4.a.i. – "Windward Offstream Water Needs, Wetland Taro, Acreage".

[111] See Part IV.A.4.a.i. – "Wetland Taro, Acreage". In Waiahole Valley, the Reppuns like to fallow their lo`i for six months after harvesting (P. Reppun, Tr., 3/12/96, at 145, lines 14-15), and land taken up by infrastructure is larger in a mountainous area like Waiahole Valley than in a place such as Hanalei Valley, so there is less net *lo`i* per acre. (P. Reppun, Tr., 3/12/96, at 215, lines 11-24)

[112] See Part IV.A.4.a.i. – "Wetland Taro, Acreage". Eight pounds of *poi* per person per week is 416 pounds per person per year. 20,000 to 40,000 pounds of taro equals 16,000 to 32,000 pounds of *poi*, so an acre supplies 38 to 77 persons per year.

In Watson's studies of water requirements of taro lo`i in Waiahole and Kahalu`u Valleys, he found that Kahalu`u *lo`i* used an average of 30,000 gallons per acre per day (gad), while Waiahole *lo`i* used an average of 50,000 to 60,000 gad, but visibly leaked. He concluded that, as a general average throughout Hawaii, no water is required to enter patches approximately 40 to 50 percent of the time, estimated water requirements in Waiahole Valley as between 15,000 to 40,000 gad (allowing for sufficient outflow to assure good circulation), and recommended that 40,000 gad be recognized as the fair requirement for an area of several taro patches in various stages of crop development, including patches requiring maximum irrigation and those requiring none.[113]

If Watson's recommendations are applied to Waikane Valley as well as to Waiahole Valley,[114] Waiahole Valley's 20 acres would be budgeted 800,000 gad, and Waikane Valley's one and three-quarters acres, 70,000 gad. Reductions by 25 percent of these amounts would be warranted for land lying fallow and for land in non-cultivated infrastructure. Further reductions would be warranted for lack of a showing of appurtenant rights, as no more than one of the 20 acres in Waiahole Valley, and no more than half of the one and three-quarters acres in Waikane Valley, could be consumed by the farmers.[115]

The reduction in acreage because of infrastructure and *lo`i* lying fallow[116] brings the net cultivated acres in Waiahole Valley to 15 acres; and in Waikane Valley, to 1.5 acres (rounded upwards from 1.31 acres). The Commission will not impose further reductions because of the issues related to appurtenant rights. Thus, an additional 0.6 mgd will be added to Waiahole and Waianu Streams, and 0.06 mgd (rounded up to 0.10 mgd) to Waikane Stream.

The Commission also makes the following observations:

Comparing Watson's data on net water loss (inflow minus outflow) of one-half the amount for Kahalu`u as for Waiahole, and his observation that the Waiahole *lo`i* were visibly leaking, the actual water requirements for Waiahole *lo`i* may be as low as 20,000 gad instead of the assigned amount of 40,000 gad. If so, half of the 40,000 will leak back into the stream, for a total of an additional 0.3 mgd in net gain for the stream flow.[117]

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[113] <u>See</u> Part IV.A.4.a.ii. – "Wetland Taro, Per Acre Water Needs".

[114] There was no evidence on the specific water needs for taro *lo`i* in Waikane Valley.

[115] Appurtenant rights can be claimed at any time in the future.

[116] Reductions are made for *lo`i* lying fallow because the studies in Waiahole Valley measured water use for planted fields only. An alternative method of calculating the water budget would have been to reduce acreage by 15 percent for land in infrastructure, and also reducing the per acre water requirements to account for the 10 percent of land not actually planted. The resulting water budgets would be 0.6 mgd and 0.06 mgd with either method. In contrast, leeward diversified-agriculture per-acre water requirements have been calculated on the basis of acres cultivated, not acres planted. But again, the results would be the same. The per cultivated acre water budget of 2,500 gad is equivalent to a per planted acre water budget of 7,500 gad, assuming that about one-third of cultivated acres are planted at any given time.

[117] And although the quantities for Waikane are small, the same principles would apply there. Perhaps half of the 0.06 mgd assigned to Waikane *lo`i* would actually be a net gain to the stream.

Ditch flows proposed to be added to Waiahole and Waianu Streams on the basis of the 1911 data are 1.5 mgd greater than the flows that would have been added based on the contribution of those portions of the tunnels developing water from the watershed of Waiahole Stream and its tributary, Waianu Stream.[118] These additional flows would have more than compensated for the 0.3 to 0.6 mgd net loss to the *lo`i*.

Finally, approximately 0.5 mgd continues to be supplied from the Ditch to the Waiahole watershed through the McCandless Pipeline, while the evidence shows not only that a reasonable, alternative water supply is available, but also that it was expressly constructed to replace the Pipeline.[119]

This diversion from the Ditch to the Waiahole Valley watershed must meet the requirements of a water use permit, as it is a use of surface or ground water in a water management area (HRS section 174C-48). Hence, users of the McCandless pipeline are subject to the same scrutiny as Waiahole Ditch users on the leeward side.

Therefore, the Commission orders that the diversion of 0.5 mgd from the Ditch into Waianu Stream cease. However, as users of the McCandless Pipeline may have appurtenant rights or existing uses to Waianu Stream, the Commission also orders that 0.5 mgd of Ditch water continue to be added into Waianu Stream so that users or proposed users of the Pipeline may file for water use permits under HRS 174C-48 to 51, within 1 year of this order, if they have appurtenant rights or existing uses.[120] If none of the applicants for a water use permit is successful, the Commission may order the addition of 0.5 mgd into Waianu Stream and diversion into the McCandless Pipeline to cease under the proposed IIFS. If applicants are successful in their application for water use permits, such users must assure, to the extent practicable, that the end of the pipeline is being diverted back into Waianu Stream,[121] so that the Pipeline flow can be kept at 0.5 mgd to assure adequate water delivery, but waters not used will not be wasted and instead flow back into the stream.

Therefore, based on all the evidence presented and in compliance with HRS Section 174C-71 and the public trust doctrine, it is hereby ordered that the Interim Instream Flow Standards (IIFSs) for Waiahole, Waianu, Waikane, and Kahana Streams be amended as follows for the needs of the aquatic biota and in accordance with the precautionary principle:

Waiahole and Waianu Streams combined: 1) 6.7 mgd added to current base flow, on the basis of the larger addition from estimates of 50 percent of historical flows derived from limited 1911 stream flow data versus data from actual Ditch windward tunnel flows

[118] 6.7 mgd using the 1911 data, 5.2 mgd using Ditch flow data.
[119] <u>See</u> Part IV.A.4.b. – "Windward Offstream Water Needs, The McCandless Pipeline". Currently, 0.5 mgd is taken from the windward tunnels and diverted into Waianu Stream, and downstream, an intake pipe then diverts an equal amount of water from the stream.
[120] While there will be no physical change in these arrangements if the Pipeline continues to be used, the legal basis for continued use will change from a diversion from one watershed to another, to the exercise of appurtenant or existing uses to Waianu Stream.
[121] There was no evidence in the record describing where or how the McCandless Pipeline ended.

2) 0.6 mgd for appurtenant rights or riparian uses; and 3) 0.5 mgd for additional appurtenant rights or existing uses, contingent on successful petitions for water use permits for the old McCandless Pipeline waters. A total of 7.8 mgd will be added to Waiahole Stream and its tributary, Waianu Stream.

Waikane Stream: 1) 2.0 mgd added to current base flow, on the basis of the larger addition from estimates of 50 percent of historical flows derived from actual Ditch windward tunnel flows versus limited 1911 stream flow data; and 2) 0.06 mgd, rounded upwards to 0.10 mgd, for appurtenant rights or existing uses.

Current Kahana Stream base flow exceeds 50 percent of historical flow under either scenario, so no additions will be made.

The specific apportionments for each stream are as follows, measured at the point in the respective streams where base flow is at its maximum:

For Waiahole Stream: 4.8 mgd added to current base flow of 3.9 mgd = 8.7 mgd, measured at Waiahole Stream's confluence with its tributary, Waianu Stream.

For Waianu Stream: 3.0 mgd added to current base flow of 0.5 mgd = 3.5 mgd, measured at Waianu Stream's confluence with Waiahole Stream.

For Waikane Stream: 2.1 mgd added to current base flow of 1.4 mgd = 3.5 mgd, measured at altitude of 75 feet.

For Kahana Stream: no change in IIFS from the current base flow of 11.2 mgd, measured at altitude of 15 feet.

Percent increases over current base flow are as follows:

Waiahole Stream: 4.8/3.9 mgd = 123%
Waianu Stream: 3.0/0.5 mgd = 600%
Waikane Stream: 2.1/1.4 mgd = 150%
Kahana Stream: 0.0/11.2 mgd = 0%

Amended base flows as percent of historical levels[122] are as follows:

Waiahole & Waianu Streams: (8.7 mgd + 3.5 mgd)/19.2 mgd = 64%
Waikane Stream: 3.5 mgd/6.7 mgd = 52%
Kahana Stream: 11.2 mgd/14.4 mgd = 78%

Any water not consumed or needed for day-to-day operations for any of the allocated uses or for operational losses shall be released into the windward streams in the

[122] Historical levels defined as sum of current base flows of the streams, plus watershed contributions to tunnel flows. Thus, Waiahole and Waianu historical flows are combined, as contribution of Waiahole watershed to these two streams cannot be separated.

following manner: 1) 0.9 mgd into Waikane Stream, and 2) the remainder to be released into Waiahole Stream. As a result, Waikane Stream releases would increase to 3.0 mgd for an increase in base flow to 4.4 mgd, which would be 66% of historical flows.

Currently, gates exist to divert water from the tunnel system into Waiahole and Waianu Streams, but no gate exists for diversion into Waikane Stream. Therefore, the Agribusiness Development Corporation is ordered: 1) to assess how tunnel water could be diverted into Waikane Stream and 2) to develop a plan for accomplishing the diversion. The assessment and plan shall be delivered to the Commission within ninety (90) days of this Decision and Order. The diversion from the tunnel system into Waikane Stream shall be completed within 180 days after the assessment and plan are delivered to the Commission. The Commission may allow additional time upon a showing of a good cause by Agribusiness Development Corporation.

The IIFSs for Waiahole and Waianu Streams are further modified, as described in Section X.B. – "Practicable Measures to Mitigate the Impact of Variable Offstream Demand on the Streams", *infra*, to allow for variability in the IIFS at certain times of the year.

B. PRACTICABLE MEASURES TO MITIGATE THE IMPACT OF VARIABLE OFFSTREAM DEMAND ON THE STREAMS[123]

The Court vacated the use of a 12-month moving average (12-MAV) to measure leeward uses, accompanied by the following directive: "In order to mitigate the impact of variable offstream demand on instream base flows, the Commission shall consider measures such as coordination of the times and rates of offstream uses, construction and use of reservoirs, and use of a shorter time period over which to measure average usage…If necessary, the Commission may designate the WIIFS so as to accommodate higher offstream demand at certain times of the year…" (94 Haw. 97, at 172; 9 P.3d 409, at 484)

The Court also found "apparent differences between stream diversions and uses of water from other sources such as basal aquifers," accompanied by a footnote that stated: "The storage characteristics of basal aquifers allow 'draft rates in excess of the sustainable yield during periods of high demand and low recharge, so long as there is compensation by reducing draft rates less than the sustainable yield during the other periods (reference omitted)'…Even if properly limited to actual need, however, offstream uses may still subject windward streams to extreme and potentially harmful fluctuations in base flow over the course of a year." (94 Haw. 97, at 171; 9 P.3d 409, at 483)

The DOA/ADC has responded by providing data that shows a pattern of increasing use starting around early spring that peaks in May or June, then continues in slightly lower amounts through August or September, and decreases steadily after that to lowest usage in the winter months. These increases and decreases occur gradually in

[123] See "Section V. – Practicable Measures To Mitigate The Impact Of Variable Offstream Demand On The Streams", *supra*, for documentation of the following discussion.

relatively small increments, in steps of one to one-and-a-half mgd or less, over the course of approximately six months.

Under the 12-MAV, ADC has testified that it will provide the amount of water requested by a leeward permittee only if: 1) it does not threaten the instream standard established herein, and 2) the requested amount is within the permittee's allocation. ADC believes that it can deliver **daily** no more than the maximum amount allocated per leeward user. Furthermore, ADC believes that stream base flows must be taken care of first, and on any given day those base flows will not be cut into, even taking into consideration the 12-MAV. If shortfalls exist, leeward users, through the Coop, would have to apportion any shortfall in delivery of water.

The Commission concludes that two opposing conditions are at work here. As DOA/ADC has concluded, the IIFS can be interpreted as not allowing stream flow to be reduced below the designated level(s) even for a single day. But the Court clearly was concerned that use of the 12-MAV had the potential for "extreme and potentially harmful fluctuations in base flow over the course of a year." (94 Haw. 97, at 171; 9 P.3d 409, at 483)

The Commission, of course, could adopt DOA/ADC's approach; i.e., not allow, even for a single day, leeward permittees to exceed their allotted uses. Here, the DOA/ADC position is unclear: does this approach apply to the subleased, specific fields on which water use permits have been based, or does it apply to the actual permit holder (i.e., Robinson Estate, Campbell Estate, etc)? If the DOA/ADC approach applies to the permit holder, then sublessees would have more flexibility, as they would be but one user within a larger, overall cap imposed on the landowner. Or the Commission could adopt an approach DOA/ADC apparently has not considered; i.e., allow individual permittees to exceed their allotted uses when needed, provided that: 1) the total allotment among all permittees is not exceeded, and 2) the individual permittee's 12-MAV-calculated allotment also is not exceeded.

However, under these approaches, as leeward permittees reach maximum usage of their water allotments, what may be only abstract when use is below capacity[124] should become very concrete. Namely, if permittees are not allowed to exceed their allotments even for a day, their allotments in practice would have been capped at that amount, and their average use will be <u>de</u> <u>facto</u> below (and possibly significantly below) what they had been permitted. In effect, the permitted uses would have been capped at the use for any one day.

The Commission would then have been faced with two choices. First, the Commission could pick an "average" use number that in practice would be the maximum amount that the permittee would be allowed on any given day. This would have the

[124] For example, DOA/ADC persisted in focusing on the short-term implications, pointing out that leeward usage of water is not close to using up the total allocations made in the Commission's original decision, and that agricultural users are not anticipated to fully utilize their total allocations for several more years as they have not fully built out their farm operations. (Lee, written direct testimony, at 7, lines 4-11)

effect of reducing water allotments to the point of endangering the viability of the farming operations. Testimony on agricultural uses is replete with descriptions of highly variable amounts of water per acre per day, ranging from none to 54,000 gad, depending on crop preparation and growth cycles. Thus, the Commission necessarily has had to allot water on an average per acre per day basis. Second, the Commission could pick a maximum use number, such as 54,000 gad, but this would lead to greatly underutilized permitted water, at the expense of other equally qualified applicants, and also leave the Commission open to charges that it had made an unreasonable allocation and was wasting water.

ADC's approach may be workable under the presently underutilized water allotments, but: 1) the Commission in this Decision and Order is revising the windward streams' IIFSs to increase the base flows of Waiahole, Waianu and Waikane Streams; 2) ADC itself has noted that water developed from the Ditch's windward tunnel system currently has been nearly 3.00 mgd under the average the Commission has used (23.3 mgd average vs. 20.39 mgd actual flow for 1997 to 2000 from Kahana to North Portal gauge); and 3) leeward farmers continue to scale up their operations, using more and more of their allotments.

Therefore, the Commission concludes that DOA/ADC should not limit the amount of water that it delivers daily to no more than the maximum amount allocated per leeward user and instead place this limit on the 12-MAV. The conditions specified below will make such a restriction unnecessary, because water from the Waiahole Ditch's windward tunnels will be used first to meet the windward streams' amended IIFSs, which will not be encroached upon by the 12-MAV.

The Court's concerns over the use of a 12-MAV were based on the streams potentially being subject to "extreme and potentially harmful fluctuations in base flow over the course of a year," (94 Haw. 97, at 171; 9 P.3d 409, at 483) and suggested that one solution might be to "designate the WIIFS so as to accommodate higher offstream demand at certain times of the year…" (94 Haw. 97, at 172; 9 P.3d 409, at 484) Furthermore, the Court's concerns were based on what it concluded were "apparent differences between stream diversions and uses of water from basal aquifers, (*emphasis added*) (*supra*)," where the Court concluded that drawing water from basal aquifers in excess of the sustainable yield would not be harmful if excess withdrawals were balanced by periods of withdrawals less than the sustainable yield, whereas withdrawals that affect a stream's base flow might be permanently harmful.

However, as noted earlier, the windward streams are steep, short, and flashy; i.e., they can rise and fall several feet in a few hours when a storm occurs, then come right back down. Therefore, high variability in stream flow is characteristic of windward streams.

If the Commission were to "designate the WIIFS so as to accommodate higher offstream demand at certain times of the year…" (94 Haw. 97, at 172; 9 P.3d 409, at

484), on a seasonal basis, the obvious time of need would be the dry summer months. But that would also be the time when stream flows would usually be lowest.

The Commission concludes that the best approach consists of the following elements: 1) continue to use the 12-MAV; 2) designate the IIFS to allow for variability on a limited, monthly basis; and 3) add water to the streams to meet the amended IIFSs before any water can be used by leeward permittees.

The amended IIFSs described in Section X.A. consist of the following:

Waiahole Stream: 4.8 mgd added to current base flow of 3.9 mgd = 8.7 mgd.
Waianu Stream: 3.0 mgd added to current base flow of 0.5 mgd = 3.5 mgd.

The total additions of 7.8 mgd consisted of the following: 1) 6.7 mgd on the basis of the larger addition from estimates of 50 percent of historical flows derived from limited 1911 data versus data from actual Ditch windward tunnel flows; 2) 0.6 mgd for appurtenant or riparian rights; and 3) 0.5 mgd for possible, additional appurtenant rights or existing uses associated with the McCandless Pipeline.

If actual Ditch windward tunnel flows had been used instead of the limited 1911 stream flow data, 5.2 mgd instead of 6.7 mgd would have been added to these streams. And in both allocations of 0.6 mgd and 0.5 mgd for appurtenant rights or riparian uses, the amount of water allocated are likely to be (much) more than will be awarded, because most of the water is being used for commercial purposes. These amounts total 2.6 mgd ((6.7 mgd – 5.2 mgd = 1.5 mgd) + 0.6 mgd + 0.5 mgd = 2.6 mgd).

Therefore, if the combined IIFSs of Waiahole and Waianu Streams are reduced by 2.6 mgd, their base flows will still equal 50 percent of historical flows, as defined by the totals of current base flows and the contribution to the Waiahole Ditch's tunnel flows from the Waiahole Valley watershed.

Seasonally related variable IIFSs are not practicable: 1) as the dry summer months are usually the time when both offstream uses would be high and maintenance of base instream flows would be desirable; and 2) a definite time for higher offstream use cannot be reliably predicted because of the occurrence of atypical weather patterns.

Therefore, the Commission has concluded that variable IIFSs of short duration, spread throughout the year, should be implemented. While additional water available through such a course of action may be insufficient in and of itself for prolonged water shortages, when combined with coordination of water uses and use of reserve water in reservoirs, such an approach should mitigate, if not alleviate, the effects of a water shortage. The variable IIFSs, allowing some additional waters to flow in the Ditch and not be diverted into the streams, would be operational for only a few days each month, and unused days would not carry over into the following month(s).

For Waiahole and Waianu Streams, for five (5) non-consecutive days of each month, their combined IIFSs of 12.2 mgd (8.7 mgd plus 3.5 mgd) are designated at 9.6 mgd, apportioned as follows:

Waiahole Stream: 6.6 mgd (8.7 mgd – 2.1 mgd)[125]

Waianu Stream: 3.0 mgd (3.5 mgd – 0.5 mgd)[126]

For Waikane Stream, the higher of the estimates for 50 percent of historical flow was derived from current Ditch windward tunnel flows, and not from the single measurement taken in 1911. Furthermore, additional water for appurtenant or riparian rights added only 0.1 mgd. Therefore, Waikane Stream's IIFS will remain the same throughout the year and not vary on the limited monthly basis that the IIFSs for Waiahole and Waianu Streams may vary.

Kahana Stream's IIFS remained unchanged under the amended IIFSs, so its IIFS will also not vary.

In sum, the final, amended IIFSs for the four streams are as follows:

Waiahole Stream: 8.7 mgd, reduced to 6.6 mgd no more than five (5) non-consecutive days a month.[127]

Waianu Stream: 3.5 mgd, reduced to 3.0 mgd no more than five (5) non-consecutive days a month.[128]

Waikane Stream: 3.5 mgd.[129]

Kahana Stream: 11.2 mgd.[130]

To account for variable offstream demand, an additional 2.6 mgd will be available but only up to five non-consecutive days a month from Waiahole and Waianu Streams. These amounts are not to be used unless all permitted and unpermitted amounts above the designated IIFSs are being used. Furthermore, regardless of the 12-MAV, the IIFSs must be met before leeward offstream uses are accommodated.

The Agribusiness Development Corporation is to provide to the Commission, on a monthly basis, daily records of the amount of water diverted from the windward tunnels into Waiahole, Waianu and Waikane Streams, as well as the amount of water transported to the leeward side, measured at the North Portal crest gauge station and the gauging station at Adit 8.

[125] As Waiahole Stream's base flow without Ditch water is 3.9 mgd, this means that 2.7 mgd would be added to the stream when the variable IIFS is in operation, compared to an addition of 4.8 mgd when the variable IIFS is not in operation.

[126] As Waianu Stream's base flow without Ditch water is 0.5 mgd, this means that 2.5 mgd would be added to the stream when the variable IIFS is in operation, compared to an addition of 3.0 mgd when the variable IIFS is not in operation.

[127] Amended from current base flow of 3.9 mgd, as measured at confluence with Waianu Stream.

[128] Amended from current base flow of 0.5 mgd, as measured at confluence with Waiahole Stream.

[129] Amended from current base flow of 1.4 mgd, as measured at altitude of 75 feet.

[130] No change from current base flow of 11.2 mgd, as measured at altitude of 15 feet.

Hakipu`u Stream is not subject to this Decision and Order, as it is not affected by the Waiahole Tunnels.

The Court also stated that the Commission should consider measures such as coordination of the times and rates of offstream uses, and construction and use of reservoirs, in addition to the issue of the 12-MAV.

The Kunia Water Cooperative (Coop) coordinates water usage among its members. However, water needs of diversified agriculture fluctuate widely depending on the water needs of a specific crop, what part of a cycle a crop is in, how many crop cycles occur per acre per year, and how much rainfall has occurred.[131]

The Coop can look at direct use during the day, and during that 12-hour period, there is a possibility of coordinating the time of each user's use. But the same crop isn't being grown by everyone, and there are many tenants and many various people growing different things.

Several of the farmers are planning to install reservoirs, ranging from a 10-15 million gallons (mg) capacity reservoir by Larry Jefts, to smaller ones of 0.5 to 1.5 mg capacity. Smaller reservoirs for short-term storage are feasible, but ADC believes that small reservoirs are not capable of collecting flows at periods of excess water and low demand for storage in the event of a prolonged water shortage. The 60 mg reservoir at Waimanalo cost $6 million and took 10 years to build, and a large capacity reservoir of 300 mg would cost between $32 to 40 million.

However, small reservoirs can assist in evening out fluctuations in demand and in the more efficient use of water. For example, the Coop is looking at the possibility of using the Ditch itself for short-term holding through temporarily damming it at certain places, allowing farmers more time to draw water, and water will be pumped out of the reservoir at the end of the ditch back into the ditch to make it easier for end users to draw water.

Matsuo from the Department of Agriculture concluded that a reservoir in the range of 60 – 100 mg capacity is better suited than smaller reservoirs to collect water during high windward stream flows or when there is low leeward demand, because "you're banking a huge amount of water so that you don't have to have all these small individual reservoirs that the individual farmers would have to still keep filled for the time that they would be required."[132] However, private initiatives are already underway to construct nearly 20 mg total in small reservoirs, Jeft's 10-15 mg reservoir being the largest. And the two existing reservoirs on the ditch delivery system together have a capacity exceeding 20 mg. So incrementally, farmers, looking toward their individual

[131] The Coop's members include Garst Seed Company, Aloun Farms, Alec and Mike Sou, Sugarland Farms, Waikele Farms, Larry Jefts, Hawaiian Fertilizer Sales, Huliwai Tropical Planting, Dole Food Company Hawai`i, Del Monte Fresh Produce, Hawai`i Agricultural Operations, and Hawai`i Agricultural Research Center. (Whalen, written direct testimony, at 1, line 8 to 2, line 8)
[132] Matsuo, Tr., 4/4/01, at 216, lines 13-17.

capabilities to ensure a steady source of water, may collectively prove Matsuo wrong. Reservoirs do help reduce the fluctuation of water uses and can minimize the impact on the water resource.

The Commission finds that ADC and the Coop must continue to develop contingency plans not only for possible water shortages, but also to mitigate against large variations in water use in a population of users with the diverse crop needs for water that are inherent in diversified agriculture. Current water use, even with fairly extreme variations in daily use among individual users, does not encroach on the IIFSs even on an occasional day. But as water use increases, the amount of water needed eventually may require use of the 5-non-consecutive-days-per-month variable IIFSs for Waiahole and Waianu Streams. As water uses increase toward these levels, the Commission will expect the ADC and Coop to have already taken reasonable measures to avoid or delay that milestone. And in any eventuality, the Commission has placed an absolute floor on the variable IIFSs. Thus, even when the variable IIFSs for Waiahole and Waianu Streams are in effect, the total amount of extra water for offstream uses would only be 2.6 mgd, and only for a maximum of five non-consecutive days a month, with no carryover allowed from month to month.

These limitations on the continued use of the 12-MAV likely mean that collectively, the actual amount of water used will not reach the total amount of water permitted. The effect of these limitations is to dampen the wide swings in water use that were potentially possible under a 12-MAV without daily limitations and to better protect beneficial instream uses from such harm. On the other hand, the difference between actual and permitted uses should narrow significantly, if measures to make more efficient use of the water that is available on a daily basis are undertaken and improved continually, as the experiences of both the ditch operator, ADC, and the users mature.

C. ACTUAL NEED FOR 2,500 GALLONS PER ACRE PER DAY OVER ALL ACRES IN DIVERSIFIED AGRICULTURE[133]

In vacating the Commission's adoption of the 2,500 gad figure, the Court stated: "A reviewing court must judge the propriety of agency action solely by the grounds invoked by the agency, and that basis must be set forth with such clarity as to be understandable…(W)here the record demonstrates considerable conflict or uncertainty in the evidence, the agency must articulate its factual analysis with reasonable clarity…(*internal quotes omitted*)" (94 Haw. 97, at 163-164; 9 P.3d 409, at 475-476)

As explained in the analysis contained in "Section VI.A – The Court's Finding of Facts", *supra,* the Court was led to believe that cultivated acres were equivalent to planted acres, thereby leading to the Court's rejection of the Commission's adoption of 2,500 gad and the Commission's characterization of 2,500 gad as a "more conservative figure" than the 3,500 gad recommended by both Jefts and Sou.

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[133] See "Part VI. – Actual Needs For 2,500 Gallons Per Acre Per Day Over All Acres In Diversified Agriculture", *supra*, for documentation of the following discussion.

Sou had concluded in the original hearings that 3,500 gad was an average on land over a period of years, considering fallow land, etc. In contrast, he estimated average water usage at about 7,500 gad while plants are in the ground and being irrigated.

Jefts had concluded in the original hearings that generally he needed an average of about 3,500 gad. Much water is used while the crops are growing. The first day of planting can perhaps use a peak of as much as 54,000 gad; from the second day through the day of harvest, the usage may be as much as 10,000 gad. In between crop cycles, somewhat less water is needed for remaining uses such as cover crop.

Cultivated land goes through the cycle of being plowed, planted, harvested, plowed under and left to rest (either with or without cover crop), then plowed and planted, etc. Planted means when the plants are actually present. Large leeward farmers do not cultivate only one-third to one-half of their land at any given time. That is what may be planted. As Sou explained in the original hearings: "As a general rule, with the types of crops we plant, about one-third of the usable acres will actually be planted and irrigated. The other 2/3 will be in various stages of harvest, plowing and land preparation. This treats the insects naturally, and reduces the need to apply pesticides."[134]

Therefore, the record of the original hearing supports the conclusions that cultivated lands are not equivalent to planted lands; 2,500 gad was appropriate for diversified agriculture in leeward O`ahu as applied to cultivated lands; and it was not a contradiction for the Commission to describe 2,500 gad as a "more conservative figure" than the 3,500 gad that Jefts and Sou had recommended.

Evidence introduced at the remanded hearings supports the Commission's original water allocation of 2,500 gad.

Sou testified that he can live with the 2,500 gad until full build out indicates more is needed. His annual average use on the lands he has leased from Robinson Estate has decreased from 1,346 gad in 1998, to 1,455 gad in 1999, and to 1,204 gad in 2000. And he has only had experimental plantings on the land he has leased from Nihonkai; however, his subtenants have averaged water use from 1,579 gad to 2,662 gad. Sou is reluctant to invest in irrigation infrastructure that would allow him to maximize productivity until the uncertainties of Waiahole Ditch water availability are resolved, so he is currently in somewhat of a holding pattern.

Jefts now averages 1,000 to 1,300 gad for about 1.1 crop cycles on all arable acres that he leases from Campbell Estate, and averages 1,380 gad for about one crop cycle on all arable acres he leases from Robinson Estate. He plans to increase to 1.9 crop cycles per year, based on 2,500 gad as the limiting factor in increasing productivity. Some of the important events did not happen as quickly as he would have liked, including the assurance of the availability of water: 1) until the Water Commission's decision came at the end of 1997, it was anybody's guess as to how much water would be available for how long, so even though he began farming, he had to go slow; 2) until the State took

[134] Sou, Binder #1, written direct testimony, at 7, line 21 to 8, line 2.

over the Ditch in July 1999, he didn't have a comfortable level of assurance that the owner would continue to operate or adequately maintain it; and 3) the Supreme Court's decision in August 2000 was a definite setback.

The original hearings took place from November 1995 to August 1996. In the interim, leeward farmers: 1) have had to await the Commission's original Decision and Order, issued in December 1997; 2) deal with uncertainty of the future of the Waiahole Ditch system itself, which was finally resolved by purchase of the Waiahole Water System by the state and transfer of operational responsibility from WIC to ADC in July 1999; 3) wait for the Hawai`i Supreme Court's Decision and Remand in August 2000; and 4) wait for this remanded Decision and Order, which again is subject to appeal.

In the Commission's original Decision and Order, dated December 24, 1997, interim water use permits were issued, with a final determination of the water use quantity to be made within five years.[135] The Commission concludes that the uncertainties to leeward farmers' build-out plans from the events listed above reasonably affected their capacities to carry out the plans they originally espoused in the original 1995-1996 hearings.

The State Water Code's provision on the Revocation of Permits (Section 174C-58) lists one of the reasons for revocation as: "(4) Partial or nonuse, for reasons other than conservation, of the water allowed by the permit for a period of four continuous years or more."

Therefore, the Commission: 1) reaffirms that 2,500 gad for acres under cultivation or planned to be under cultivation is a reasonable water duty for leeward diversified agriculture; and 2) conditions the diversified agriculture water use permits on a showing of actual use, not to exceed 2,500 gad, within four years of the date of this Decision and Order.

Two other parcels of land on which further evidence was presented on remand, Hawaiian Fertilizer Sales (formerly "Hawaiian Foliage") and HARC (formerly "HSPA"), present sufficiently different circumstances from the general category of "diversified agriculture" to warrant separate attention. Use of the land leased by Hawaiian Fertilizer Sales falls in two distinct categories: 1) intensive farming on small, predominantly two-acre plots which are planted nearly all the time; and 2) planting of long-term crops such as fruit trees. And HARC is an agricultural research service organization, developing, for example, new techniques for growing seeds and new ways to service the seed industry.

Ogasawara of Hawaiian Fertilizer Sales, who leases 468 acres from Dole/Castle & Cook, has small tenant farmers on approximately 40 percent of his land, 40 percent retained for his own use, and 20 percent as buffer lands between his operations and residential areas. His small tenant farmers average 3,767 gad, and for the 70 percent of his land now planted (40 percent by his tenants plus 3/4s of his 40 percent), average use is 2,200 gad, which will increase slightly when he is fully planted out.

[135] Decision & Order, Appendix B, at 30.

As the Hawai`i Supreme Court affirmed all other aspects of the Commission's decision not otherwise addressed in the Court's August 22, 2000, decision, specific water requests were affirmed. However, Hawaiian Fertilizer Sales' lease from Dole/Castle & Cooke was awarded its requested 2,200 gad for all 468 acres, or 1.03 mgd, while testimony on remand was that 20 percent was being used as a buffer zone and not being cultivated. As the record does not show whether or not the 2,200 gad request for all 468 acres was meant to be applied to cultivation of 80 percent of those acres, the Commission has decided to base its revised award to Dole/Castle & Cooke for the Hawaiian Fertilizer Sales acres on the basis of 2,500 gad for 375 acres (80 percent of 468 acres), or 0.94 mgd, instead of 2,200 gad for 375 acres, or 0.83 mgd. Hawaiian Fertilizer Sales is currently already averaging 2,200 gad for 70 percent of the 80 percent it intends to cultivate after full build-out. The Commission will condition this water use permit on a showing of actual use, not to exceed 0.94 mgd, within four years of the date of this Decision and Order.

HARC, formerly HSPA, was originally awarded 2,500 gad for 78 acres, for a total of 0.20 mgd. Testimony on remand was that current water consumption is about 2,600 gad over 65 cultivated acres, that the number of crop cycles is currently 1.19 and expected to increase to 1.9 crop cycles, and that expected water needs will increase to about 4,000 gad. HARC, as an agricultural research service organization, clearly has different water needs from diversified agriculture. In comparison, Jefts currently averages between 1,000 to 1,300 gad for about 1.1 crop cycles per year on all the arable lands that he leases, projected to increase to 2,500 gad for 1.9 crop cycles. Therefore, the Commission has decided to base its revised award to Campbell Estate for the HARC acres on the basis of 4,000 gad for 65 cultivated acres, or 0.26 mgd. The Commission will condition this water use permit on a showing of actual use, not to exceed 0.26 mgd, within four years of the date of this decision.

D. THE ACTUAL NEEDS OF CERTAIN FIELDS[136]

Fields 146 and 166, leased from Campbell Estate to Garst Seed Company (formerly "ICI Seeds"), averaged 1,643 gad per planted acre at the time of the original hearings, with approximately one-third planted at any one time, the remaining acreage used for spatial isolation of the mono-type crops. At the remanded hearings, average water use was 595 gad per acre for the total farm, somewhat higher than previously (i.e., about 1,800 versus 1,643 gad per planted acre), attributed to increased crop acreage in both the winter and summer crop cycles, as well as to lower rainfall during the winter months.

Campbell Estate argues that the allocation of water for Fields 146 and 166 should be based on a generic water duty for diversified agriculture, because "a change in user or a change in crop is not a change in use. Consequently, if Garst began cultivating other crops that did not require the isolation that its parent seed and corn research required, or if the lease of Field (*sic*) 146 and 166 was taken on by another diversified farmer, no

[136] See "Section VII – Actual Needs For ICI Seeds' And Gentry And Cozzens' Fields", *supra*, for documentation of the following discussion.

permit modification would be required and there would be sufficient water to allow for such changes." (The Estate of James Campbell, Opening Brief on Remand, at 7)

The Commission does not agree with the Campbell Estate. The record shows that the water requirements of the specialty planting by Garst Seed is significantly different from that of diversified agriculture, and indeed, even from the water requirements of HARC's research plantings. For Garst Seed, planting about one-third of its cultivated acres at any one time, the water requirement over all cultivated acres is approximately 600 gad. For diversified agriculture, planting about one-third of its cultivated acres at any one time, the water requirement over all cultivated acres is approximately 1,000 to 1,300 gad for 1.1 crop cycles, increasing to 2,500 gad for 1.9 crop cycles. For HARC, the water requirement for 1.19 crop cycles is 2,600 gad, increasing to 4,000 gad for 1.9 crop cycles.

However, Garst Seed Company is also exploring ways to utilize the idle acres between its crops (isolation of seed crops can be accomplished not only with unplanted acres but also with other crops in the isolation acres). Garst Seed is in negotiations to better utilize the isolation acres for its mono-type crops: 1) with USDA on conservation-type crops to be used on the idle ground; 2) with HARC to plant on the isolation acres; and 3) with Jefts to do a land "swap", whereby Jefts would plant on some of Garst Seed's land and Garst would plant an equal amount of acreage on Jefts's lands.

Estimating the water requirements of these plans for Garst Seeds' isolation acres would be difficult. Diversified agriculture, cover crops, and HARC's crop mix have very different water requirements. However, these are reasonable and beneficial uses of water, and therefore the Commission revises its award to Campbell Estate for Fields 146 and 166 as follows: 1) 1,800 gad for 115 acres (approximately one-third of the acres),[137] or 0.21 mgd; and 2) 2,500 gad[138] for 229 acres (approximately two-thirds of the acres), or 0.57 mgd, for a total of 0.78 mgd for 344 acres. The Commission will condition this water use permit on a showing of actual use, not to exceed 0.78 mgd, within four years of the date of this Decision and Order.

Fields 115, 116 and 145 are now leased by Campbell Estate to Jefts for diversified agriculture. At the time of the remanded hearings, Jefts had completed clearing the land and putting in the irrigation infrastructure for 188 of the 267 acres.

Del Monte terminated the lease for Field 161 with Gentry and Cozzens and planted it in pineapple. Del Monte, which leases Field 161's 208 acres from the Campbell Estate, also leases another 803 acres (Fields 140, 156 and 172) from the

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[137] Use for mono-type crops over all cultivated acres is about 600 gad, while use over acres planted at any one time (about one-third of cultivated acres) is about 1,800 gad. As the Commission is awarding a separate water budget for the isolation acres, or about two-thirds of the cultivated acres, the water budget for the mono-type crops is for acres planted and is applied to one-third of the cultivated acres.

[138] This would be Jefts's diversified agriculture water requirements, while cover crops would require less water and HARC's crops would require more.

Campbell Estate.[139] At the original hearing, Del Monte was also growing other crops besides pineapple, but has decided at the present time to concentrate their efforts on pineapple. Del Monte's representative at the remanded hearings was not aware of any plans to produce anything other than pineapple.

One of the Commission's original Findings of Fact was that pineapple crops were estimated to require approximately 2,000 gad.[140] In contrast, Dole/Castle & Cooke requested and was awarded 904 gad for its pineapple fields in the original Decision and Order, and its president testified that: 1) pineapple requires 40,500 gallons per acre per month, or approximately 1,350 gad, and that it could come from rain or from irrigation; and 2) 2,000 gad was for overhead irrigation, while 1,000 gad was for drip irrigation.

The Commission is therefore faced with a situation in which Dole/Castle & Cooke had requested and received an existing use permit of approximately 1,000 gad for its pineapple operations, while the Campbell Estate is requesting 2,000 gad for Del Monte's pineapple operations. The Campbell Estate's request for 2,000 gad applies both to Field 161, as well as to Fields 140, 156 and 172, which were awarded water use permits of 2,500 gad for diversified agriculture in the original hearings.[141]

The State Water Code defines "reasonable-beneficial use" in part as "the use of water in such a quantity as is necessary for economic and efficient utilization…" (HRS Section 174C-3) Pineapple can be successfully grown with 2,000 gad.

Therefore, the Commission revises its award to Campbell Estate for Fields 115, 116, 145 and 161 as follows: 1) 2,500 gad for 267 acres in Fields 115, 116 and 145, for a total of 0.66 mgd; and 2) 2,000 gad for 208 acres in Field 161, for a total of 0.42 mgd. Furthermore, the award for the 803 acres in Fields 140, 156 and 172 is revised from 2,500 gad to 2,000 gad, for a total of 1.60 mgd.[142]

E. PRACTICABILITY OF CAMPBELL ESTATE AND PU`U MAKAKILO, INC. USING ALTERNATIVE GROUND-WATER SOURCES[143]

The Hawaii Supreme Court directed the Commission to review the practicablility of Campbell Estate and PMI using alternative ground-water sources. The Commission finds that an alternative source is practicable if it is available and capable of being

[139] See revised Table 2 (For Campbell Estate Lands) in The Estate of James Campbell's Proposed Findings of Fact, Conclusions of Law, and Decision and Order on Remand.
[140] Based on the testimony of Brian Nishida, Vice-President and General Manager of Del Monte Fresh Produce Hawaii.
[141] Campbell Estate, Closing Statement, 4/18/01, at 17; Oshima, Tr., 4/24/01, at 13, lines 6-11.
[142] Although the water use permit for Fields 140, 156 and 172 was not remanded by the Supreme Court, in this hearing, Campbell Estate requested a revision for these fields from 2,500 gad to 2,000 gad, reflecting Del Monte's decision to only grow pineapple.
[143] See "Section VIII – Practicability Of Alternative Ground-Water Sources For Campbell And PMI", *supra*, for documentation of the following discussion.

utilized after taking into consideration cost, existing technology, and logistics in light of the overall water planning process.

Belt Collins Hawaii developed scenarios for the original hearings on ground-water alternatives to Waiahole Ditch water. To provide an average of 5.99 mgd to serve 1,665 acres of Campbell Estate lands below 520 feet elevation and PMI, the base cost was projected at $0.58+ per 1,000 gallons, with annual base costs of $1,280,000. To provide an average of 6.10 mgd to 1,813 acres including Campbell lands above 520 feet elevation and the Royal Oahu Golf Course, the base cost was projected at $0.67+ per 1,000 gallons, with annual base costs of $1,500,000. To provide 5.60 mgd to 1,925 acres, including higher-elevation Campbell Estate lands along Kunia road, most Robinson Estate lands, Nihonkai, and the Halekua Agricultural Park, the base cost was projected at $0.75+ per 1,000 gallons, with annual base costs of $1,540,000.

Only the first scenario is relevant to the issue of practical alternatives for Campbell Estate and PMI, as the other scenarios involve lands held by other parties, and the cost projections were based on water systems serving all the acreages identified in the scenarios.

The practicability of the scenarios was also limited by the assumptions built into them. They did not include land and easement purchases, delivery to individual fields, taxes and return on investment. These factors would increase the cost of the water. They assumed that ground water would be available for irrigation, that ground water from former Oahu Sugar Co. wells could be applied over Pearl Harbor aquifers regardless of its salinity, and that new ground-water wells could be located anywhere within lands for which Waiahole water had been requested. PMI's Conditional Use Permit for the property requires the use of non-potable water having less than 200 ppm of chlorides. PMI's property is also subject to the Board of Water Supply's standard for irrigation water applied over drinking water aquifers which is 160 ppm.

Since the original hearings, Campbell’s agricultural use permits for its Ewa pumps have been markedly reduced. Campbell retains only 0.957 mgd from EP-10 and 7.967 mgd from EP-18, which includes EP-3,4, EP-5,6 and EP-7,8. The 12.154 mgd from EP-15/16 was transferred to the Board of Water Supply. The Waipahu pumps used to partially irrigate the Campbell Estate lands above the H-1 Freeway when Oahu Sugar Co. farmed them, were on sites owned by Oahu Sugar Co. Campbell Estate has not owned and never owned these wells.

The Belt Collins Hawaii scenario in which 1,665 acres of Campbell Estate lands below 520 feet elevation and PMI would be served by ground water at a base cost of $0.58+ per 1,000 gallons, assumed that the water would come from EP-15/16. Campbell Estate no longer has this well, which was transferred to the Board of Water Supply (see discussion below).

The two scenarios in which the rest of the Campbell Estate lands would be provided with ground water used the WP-2 pumps and the WP-30 booster pumps, which are on sites that were owned by Oahu Sugar Co. and which Campbell Estate does not and has never owned.

Thus, the scenarios developed by Belt Collins Hawaii do not provide practical alternative ground-water sources for either Campbell Estate or PMI, because the assumptions in those scenarios are not applicable.

The wells that Campbell Estate has retained, EP-10 and the battery of wells associated with the EP-18 pumping station, have chloride contents exceeding Board of Water standards for irrigation water applied over drinking water aquifers. If Campbell Estate were to drill a new well, it would have to be in the Waipahu-Waiawa aquifer, because allocations in Ewa-Kunia have reached or are close to the sustainable yield. Most of Campbell Estate's Kunia lands overlie the Ewa-Kunia aquifer.

PMI considered three ground-water alternatives. Ewa Caprock water has chlorides in the 900 to 1,100 ppm range. Desalinating the water to below 200 ppm would cost $6,000,000, with operating costs of $3.00 per 1,000 gallons, exclusive of land and easement acquisitions. An on-site basal well in the Ewa-Kunia aquifer would have 1998 construction costs estimated at $900,000 and operating costs of $0.18 per 1,000 gallons and is economically feasible, but the property has deed restrictions prohibiting an on-site well and there is little likelihood of obtaining an allocation for a basal well in the Ewa-Kunia aquifer. A basal well in the Waipahu-Waiawa aquifer, using EP-5,6, owned by Campbell Estate would not be acceptable because of the chloride content of 180 ppm vs. the standard of 160 ppm. Other factors affecting this alternative are available pumping capacity, a long-term pumping agreement, the ease of obtaining an allocation in the Waipahu-Waiawa aquifer, and the ease and cost of obtaining an easement from the Farrington Highway delivery point, under the H-1 Freeway to the golf course property. These factors make the alternative of using Waipahu-Waiawa water not practicable for use by PMI.

There is essentially no balance remaining in the Ewa-Kunia Water Management Area and approximately 21.5 mgd of unallocated water in the Waipahu-Waiawa Water Management Area. The Board of Water Supply has some concerns about their wells if a new well is drilled just mauka of them.

The position of the City and County of Honolulu is that the public trust doctrine applies to leeward ground-water sources and that Campbell and PMI should not be given water use permits merely because there is unallocated ground water available. They must justify their use of ground water against the rights the public has in the ground water for domestic use. If the Commission decides to allocate some of the unallocated ground water for irrigation purposes, the City and County of Honolulu argues, it should do so on a conditional basis until recycled water becomes available. If after BWS's three-year soil aquifer treatment study, it is determined that use of recycled water over the underlying aquifer is feasible, the BWS intends to replace or supplement ground water irrigation sources with recycled water.

Finally if Campbell Estate (and PMI) is required to use alternative sources, reduced flows in the Waiahole Ditch would accelerate the deterioration of system components and increase maintenance requirements, and the continued operational viability of the Ditch would be at risk because of the large proportion of total Ditch flows that go to Campbell Estate's lessees.

The Commission concludes that the physical impact on the Ditch and the economic impact on the continued operational viability of the Ditch if Campbell Estate is required to use ground-water sources make such an alternative to use of Waiahole Ditch water not practical.[144]

For PMI, use of a well in the Waipahu-Waiawa aquifer is contingent on finding a well or well site and obtaining easements. As in the case of Campbell Estate, a ground-water use permit would have to be obtained from the Commission, which may be the subject of objections by the City and County of Honolulu and other parties and is not a practicable alternative to using ground water.

In the original Decision and Order, the Commission conditioned PMI's permit on the availability of treated wastewater if it could be used over the basal aquifer and could be reasonably obtained. (D&O, at 9) And for all permits, the Commission had the following condition:

> "K. Alternative Sources of Water
>
> This Commission believes that Oahu's remaining ground-water resources must be directed to its highest and best use. There must be an increased emphasis on water conservation, water reclamation and reuse, and system efficiency improvements. One way to stretch Oahu's remaining resources is to utilize lower quality water, such as reclaimed water and brackish caprock water, for irrigation purposes, replacing the use of higher quality ground water. Even if reclaimed water is not available currently, this Commission will revisit and, if appropriate, reduce existing ground-water permits if reclaimed water becomes available and is allowable, subject to economic and health considerations (*emphasis added*)." (D&O, at 12)

Thus, the Commission's stated policy is to reserve potable ground water for its highest and best use, domestic use, replacing it when appropriate for irrigation purposes with reclaimed or nonpotable ground water. However, on remand, the Court has directed the Commission to look at leeward ground water, even of potable quality, as an alternative source for Waiahole Ditch water, which even the Court has recognized as being legitimately used for irrigation purposes.

[144] It is the Commission's conclusion that, even if the transfer of the water use permit for EP 15/16 from the Campbell Estate to BWS were to be ultimately reversed by the Hawai`i Supreme Court, the physical and economic impacts on the continued operational viability of the Ditch if Campbell Estate is required to use ground-water sources as an alterative to Ditch water make the ground-water alternative impracticable.

The Hawai`i Supreme Court has stated:

> " The Hawai`i Constitution states that 'all public resources are held in trust by the state for the benefit of its people,' Haw. Const. art. XI, section 1, and establishes a public trust obligation 'to protect, control, and regulate the use of Hawaii`s water resources for the benefit of its people,' Haw. Const. art. XI, section 7. "…For the purposes of this case…we reaffirm that, under article XI, sections 1 and 7 and the sovereign reservation, <u>the public trust doctrine applies to all water resources without exception or distinction</u> (*emphasis added*)." (94 Haw. 97, at 133; 9 P.3d 409, at 445)

The Court has further identified three distinct uses under the water resources trust: 1) maintenance of waters in their natural state; 2) domestic water use; and 3) the exercise of Native Hawaiian and traditional and customary rights. (94 Haw. 97, at 136, 137; 9 P.3d 409, at 448, 449)

The Court has also found that water used for diversified agriculture on land zoned for agriculture is consistent with the public interest, as it fulfills state policies in favor of reasonable and beneficial water use, diversified agriculture, conservation of agricultural lands, and increased self-sufficiency of the state. (94 Haw. 97, at 162: 9 P.3d 409, at 474)

Agriculture, while a constitutionally specified public purpose,[145] is not one of the three public trust uses, and can only be "accommodated" when it "promotes the best economic and social interests of the people of this state." (94 Haw. 97, at 141; 9 P.3d 409, at 453) However, "reason and necessity dictate that the public trust may have to accommodate offstream diversions inconsistent with the mandate of protection, to the unavoidable impairment of public instream uses and values." (94 Haw. 97, at 141; 9 P.3d 409, at 453)

But such offstream diversions are not limited to constitutionally defined purposes. The Court has indicated its preference for accommodating both instream and offstream uses where feasible and "considers it neither feasible nor prudent to designate absolute priorities between broad categories of uses under the water resources trust." The trust does not establish resource protection as a categorical imperative and the precondition to all subsequent considerations, but instead public and private water uses must be weighed on a case-by-case basis. (94 Haw. 97, at 142; 9 P.3d 409, at 454)

The Commission concludes that, if water from the Waipahu-Waiawa Management Area of the Pearl Harbor aquifer were to replace Ditch water for Campbell Estate and PMI, water from windward public trust resources that are available for non-trust purposes after measures have been taken to enhance those windward public trust resources, would be given priority over a leeward public trust resource.

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[145] Article XI, section 3, of the Hawai`i Constitution states in relevant part: "The State shall conserve and protect agricultural lands, promote diversified agriculture, increase agricultural self-sufficiency and assure the availability of agriculturally suitable lands."

<u>WWCA et al. 's Objection to the Transfer of Campbell Estate's Water Use Permit to the Honolulu Board of Water Supply and the Subsequent Change in Use from Agricultural to Domestic Use</u>

On April 25, 2001, the Hawai`i Supreme Court denied a petition for writ of mandamus by Waiahole-Waikane Community Association, Hakipu`u Ohana and Ka Lahui Hawai`i (WWCA *et al.*), asking the Court to order the Commission to vacate its approval and decisions regarding Campbell Estate's transfer of its water use permit for the Ewa Shaft (EP-15/16) to the City and County of Honolulu's Board of Water Supply (BWS). The Court denied the petition "without prejudice to any other agency or judicial remedy and without prejudice to Petitioners raising the issue in the pending Waiahole Ditch contested case hearing."

In its Opening Statement at the remanded hearings, WWCA *et al.* stated that: "Should the Supreme Court decide to leave it to the Commission on remand to decide whether the transfer is illegal, however, the Windward Parties trust that the Commission will conclude that it is, and require Campbell Estate and Pu`u Makakilo to use that alternative instead of draining windward streams." (WWCA *et al.*, Opening Statement, at 8) And in its Closing Argument, WWCA *et al.* again stated that the transfer was illegal and that the Water Code required the Commission to invalidate the transfer and require Campbell Estate to use the wells. (WWCA *et al.*, Closing Argument, at 34-35) However, except for the Opening Statement and Closing Argument, the issue was not brought up during the evidentiary phase of the remanded hearing, WWCA *et al.* was not precluded from doing so.

In its petition, WWCA *et al.*'s position was that: "(T)he Water Code prohibits the transfer of a water use permit that involves a change in a permit condition, such as changing the purpose of a use from agricultural to municipal. H.R.S. section 174C-59. A permittee seeking a modification must submit a new water use permit application, and demonstrate that the permit, with the proposed modifications, complies with the requirements of the Water Code, including all of the requirements of H.R.S. section 174C-49(a)." (WWCA *et al.*'s Petition for Writ of Mandamus to the Commission on Water Resource Management, December 22, 2000, at 4-5)

The Commission's response to the petition was that: "It is not clear why petitioners do not see the remanded <u>In re Water Use Permit Applications</u> case as an avenue of legal redress with respect to the issues which concern them…(T)he chairperson and the deputy determined that sections 174C-57 (c) and 174C-59, HRS, applied so that the permit transfer and use modification did not require commission action, the new permit for Well No. 2202-21 was issued administratively. Although petitioners opposed the administrative action, they at no time petitioned the commission to review it. The relevant law and the commission's rules provide petitioners with accessible and appropriate means of legal review of the administrative action…" (Respondents' Answer to Petition for Writ of Mandamus to the Commission on Water Resource Management, February 2, 2001, at 9)

H.R.S. section 174C-59 reads as follows:

> “**Transfer of permit.** A permit may be transferred, in whole or in part, from the permittee to another, if:
>
> (1) The conditions of use of the permit, including, but not limited to, place, quantity, and purpose of the use, remain the same; and
>
> (2) The commission is informed of the transfer within ninety days.
>
> Failure to inform the department of the transfer invalidates the transfer and constitutes a ground for revocation of the permit. A transfer which involves a change in any condition of the permit, including a change in use covered in section 174C-57, is also invalid and constitutes a ground for revocation.”

H.R.S. section 174C-57 reads in relevant parts:

> “**Modification of permit terms.**
>
> …(b) All permit modification applications shall be treated as initial permit applications…
>
> (c) County agencies are exempt from the requirements of this section except where the modification involves a change in the quantity of water to be used or where the new use would adversely affect the quality of the water or quantity of use of another permittee.”

As early as 1994, BWS had announced its intentions to acquire and develop Ewa Shaft EP 15/16 as a potable water source. (Respondents’ Answer to Petition for Writ of Mandamus to the Commission on Water Resource Management, February 2, 2001, Exhibit 1)

By letter dated August 8, 2000, which the Commission received on August 10, 2000, and pursuant to the notice requirement of H.R.S. section 174C-59, BWS notified the Commission that the Estate of James Campbell had transferred the permit for EP 15/16 to BWS on July 17, 2000. The letter also informed the Commission that BWS intended to change the use of the water from agricultural to urban should BWS be successful in acquiring the EP 15/16 facilities from Campbell Estate through condemnation. (Respondents’ Answer to Petition for Writ of Mandamus to the Commission on Water Resource Management, February 2, 2001, Exhibit 12)

On November 3, 2000, the Chairperson of the Commission informed BWS by letter that: 1) the new water use permit had been transferred to BWS; and 2) the change of use in the permit could be done administratively under H.R.S. section 174C-57 (c). Respondents’ Answer to Petition for Writ of Mandamus to the Commission on Water Resource Management, February 2, 2001, Exhibit 14)

The Commission also finds that the windward parties had full and fair opportunity to present these issues and did present these issues in the context of this contested case hearing based on the evidence presented. The Commission concludes that the transfer was legal because the provisions of the Water Code were met.

Campbell Estate had transferred the permit for EP 15/16 on July 17, 2000, and the Commission was informed by a letter dated August 8, 2000, and received by the Commission on August 10, 2000, of the transfer within the 90-day period required under H.R.S. 174C-59. Included in this letter was the stated intention of BWS to change the use of the water from agricultural to urban. Once the transfer to BWS had been accomplished, modifications to the permit fell under H.R.S. section 174C-57 (c), which exempted BWS from the initial permit application requirements.

F. MERITS OF THE PERMIT APPLICATION FOR DITCH "SYSTEM LOSSES"[146]

"On remand, the Commission shall consider the permit application for 2.0 mgd to cover system losses and determine whether this request is appropriate given the still uncertain public interest in instream flows, and based on actual need and any practicable mitigating measures, including repairs to the ditch system." (94 Haw. 97, at 173; 9 P.3d 409, at 485)

Since acquisition of WWS from the Waiahole Irrigation Company, Limited, by the Agribusiness Development Corporation (ADC) in July 1999, system losses have been reduced from 6.27 mgd in the period July – December 1999, to 4.62 mgd in the period July – December 2000, and is projected to be even further reduced to 2.02 mgd after replacement of the three wooden siphons is completed in June 2001.

The 2.02 mgd in losses are projected to consist of: 1) no further losses from the siphons; 2) 0.45 mgd overflow at Reservoir 155 at the end of the ditch; 3) 0.07 mgd in evaporation; and 4) 1.50 in the residual category, "unmetered losses". (Lee, written direct testimony, at 16, lines 3-5; Exhibit L-1106; Exhibit L-1103)

Much of the 1.50 mgd in continuing unmetered losses is probably due to leakage and seepage. The two reservoirs, 1000 feet of the ditch, and some of the sumps (ponds) are unlined. In addition, there are cracks in the cement lining of the ditch, some of which are not obvious, which are patched as they are discovered.

Of the 0.45 mgd in continued overflow at the reservoir at the end of the system, it is hard to say how much further that loss might be reduced. It is at the end of the system, and end-users need an adequate flow of water in the ditch. Pumping from the reservoir back into the ditch would meet some of these flow needs at the end of the ditch. In addition, flow into the ditch cannot be completely cut off, because of the water developed in the Waiawa portion of the tunnel between the North Portal on the windward side and Adit 8 on the leeward side, where the tunnel emerges from the Ko`olau Mountains. So when it rains, for example, and users do not draw water from the ditch, water will traverse the ditch system and enter and possibly overflow the reservoir at the end of the system.

[146] See "Part IX. – Merits For A Permit For Ditch 'System Losses'", *supra*, for documentation of the following discussion.

Operational losses are a normal component of any water delivery system, and thus the Commission finds it appropriate to issue a use permit to the ADC for operational losses suffered in delivering water to its clients in leeward O`ahu. The remaining issues are the amount of water to be issued under the permit and the permit's conditions.

The principal area for further improvement is the 1.50 mgd in unmetered losses, most of which are likely due to leakage. The leeward delivery system with its concrete-lined ditch was completed in 1913, nearly 90 years ago. Furthermore, both reservoirs, some of the pumping ponds, and 1000 feet of the ditch are unlined. ADC has concentrated on replacing the wooden siphons, which were leaking badly, and has not yet addressed the feasibility and costs of lining the remaining unlined portion of the ditch and/or the two reservoirs.

ADC's permit request for system losses is 2.02 mgd. The Commission awards a water use permit for system losses to ADC for 2.00 mgd. With continued progress in identifying uses that should be metered and incremental repairs on known leaks in the system, ADC should be able to function with a system loss use permit of 2.00 mgd.

Furthermore, the impact of major repairs, such as to the unlined portion of the ditch and to the unlined reservoirs, may lead to further significant reductions to system losses. Thus, as a condition of its permit, ADC is to conduct studies on: 1) the probable contribution to system losses from leakages in the unlined portions of the ditch and in the reservoirs and any other probable, major contributor; 2) depending on the outcome of those studies, to conduct followup studies on the feasibility of addressing those leaks and the costs of such projects; and 3) to take appropriate actions to reduce such leakages.

G. SUMMARY

Windward Interim Instream Flow Standards. Despite greatly reduced flows in the affected streams from the construction of the Waiahole Ditch's windward tunnel system, the evidence has shown that much of the vitality of these streams was maintained until the 1960s. Degradation of the streams appears to have been caused by multiple factors that simultaneously impacted streams which are not hydrologically affected by the Waiahole Ditch's windward tunnel system.

A minimalist approach to restoring stream flows could look to the period of the 1960s and see what stream-flow-related changes occurred during that time which could have contributed to the decline in stream vitality. One such event did occur – extension of the Uwau Tunnel in 1964, which could have reduced flows in Waianu and Waiahole Streams by 2.8 mgd.

However, the Commission, pursuant to its duties as trustee, and in the interest of precaution, has determined that reasonable "margins of safety" should be adopted in establishing the windward IIFSs.

The Commission finds that it is practicable to use increased stream flows to partially compensate for the other factors that have affected the vitality of the streams, as well as to increase the contribution that these stream flows may have on the vitality of Kaneohe Bay.

As historically noted and earlier cited, there have been diversions limited to half the flow from a stream or place of diversion, and examples of other diversions taking up to or perhaps somewhat beyond the available water supply. However, it does not appear that there was any specific, quantified amount of water that should remain in the stream or be taken for off stream use. Considering the specific facts of this case, not establishing a standard or generalized policy for future decisions, and in accordance with the precautionary principle, a reasonable and practicable approach would be to restore Waiahole, Waianu, Waikane, and Kahana Streams to at least one-half their pre-Ditch base flow levels.

The only recorded flows in these streams in the pre-Ditch era are very limited data from 1911, which likely were higher than what pre-Ditch base flows would have been.

The maximum amount of water that could be flowing in Waiahole, Waianu, Waikane and Kahana Streams would be the sum of current stream flows and waters developed in the Waiahole Ditch's tunnel system from Kahana to the North Portal gauge under the crest of the Ko`olau Mountains. The sum of current estimated base flows plus the quantity of water developed in the windward tunnels on a watershed-by-watershed basis is 40.3 mgd for all four streams. In contrast, using the 1911 stream flow data, the total flow for all four streams would be 49.2 mgd. Thus, the 1911 data results in a cumulative overestimate of flow in the four streams of 8.9 mgd, or 22 percent higher.

Nevertheless, in increasing base stream flows to one-half of total base flows for each of the four streams, the Commission has decided to use the higher of the two values for each stream, when comparing the 1911 data against the sum of current stream base flows plus water diverted by the windward tunnels. In the case of Waiahole and Waianu Streams, the 1911 data result in higher additions; for Waikane, the 1911 data is less; and for Kahana, no further additions would be made under either scenario.

The Commission also added water to the streams to account for possible appurtenant rights and existing uses, even though the great majority of the acres in or proposed to be in wetland taro are for commercial purposes.

Finally, the Commission orders that the diversion of 0.5 mgd from the Ditch into Waianu Stream cease, because of the availability of an alternative water supply. However, the Commission also orders that a similar amount, 0.5 mgd, continue to be added to Waianu Stream so that users or proposed users of the Pipeline may file for water use permits if they have appurtenant rights or existing uses to Waianu Stream and need the Pipeline to draw their water.

These precautionary actions are taken to protect and enhance instream values in the windward streams affected by the Waiahole Ditch and Tunnel system. The additional waters are far in excess of the flow in these streams during the 1960s, when witnesses for the windward parties have testified that the vitality of these streams was still in evidence.

The sum of these additions to the windward streams affected by the Waiahole Ditch are as follows:

Waiahole Stream: 4.8 mgd added to current base flow of 3.9 mgd = 8.7 mgd, measured at Waiahole Stream's confluence with its tributary, Waianu Stream.

Waianu Stream: 3.0 mgd added to current base flow of 0.5 mgd = 3.5 mgd, measured at Waianu Stream's confluence with Waiahole Stream.

Waikane Stream: 2.1 mgd added to current base flow of 1.4 mgd = 3.5 mgd, measured at altitude of 75 feet.

Kahana Stream: no change in IIFS from the current base flow of 11.2 mgd, measured at altitude of 15 feet.

Any water not consumed or needed for day-to-day operations for any of the allocated uses or for operational losses shall be released into the windward streams in the following manner: 1) 0.9 mgd into Waikane Stream; and 2) the remainder to be released into Waiahole Stream.

In addition, Waiahole and Waianu Streams will have variable IIFSs, reducing their collective flows by 2.6 mgd for five non-consecutive days in each month, as set forth in the following section.

Currently, gates exist to divert water from the tunnel system into Waiahole and Waianu Streams, but no gate exists for diversion into Waikane Stream. Therefore, the Agribusiness Development Corporation is ordered: 1) to assess how tunnel water could be diverted into Waikane Stream and 2) to develop a plan for accomplishing the diversion. The assessment and plan shall be delivered to the Commission within ninety (90) days of this decision. The diversion from the tunnel system into Waikane Stream shall be completed within 180 days after the assessment and plan are delivered to the Commission.

Practicable Measures To Mitigate The Impact Of Variable Offstream Demands On The Streams. The Court vacated the use of a 12-month moving average (12-MAV) to measure leeward uses, accompanied by the following directive: "In order to mitigate the impact of variable offstream demand on instream base flows, the Commission shall consider measures such as coordination of the times and rates of offstream uses, construction and use of reservoirs, and use of a shorter time period over which to measure average usage…If necessary, the Commission may designate the WIIFS so as to accommodate higher offstream demand at certain times of the year…"

The Commission concludes that the best approach consists of the following elements: 1) continue to use the 12-MAV; 2) designate the IIFS to allow for variability on a limited, monthly basis; and 3) add water from the tunnels to the streams to meet the revised IIFSs before any water can be used by leeward permittees.

If water is allocated first to maintain the amended stream base flows before leeward offstream permitted uses are met, use of a 12-MAV cannot affect these base flows.

Seasonally related variable IIFSs are not practicable: 1) as the dry summer months are usually the time when both offstream uses would be high and maintenance of base instream flows would be desirable; and 2) a definite time for higher offstream use cannot be reliably predicted because of the occurrence of atypical weather patterns. Therefore, the Commission has concluded that variable IIFSs of short duration, spread throughout the year, should be implemented. While additional water available through such a course of action may be insufficient in and of itself for prolonged water shortages, when combined with coordination of water uses and use of reserve water in reservoirs, such an approach should mitigate, if not alleviate, the effects of a water shortage. The variable IIFSs, allowing some additional waters to flow in the Ditch, would be operational for only a few days each month, and unused days would not carry over into the following month(s).

The final amended IIFSs for the four streams are therefore set as follows:

Waiahole Stream: 8.7 mgd, reduced to 6.6 mgd no more than five (5) non-consecutive days a month, measured at its confluence with Waianu Stream.
Waianu Stream: 3.5 mgd, reduced to 3.0 mgd no more than five (5) non-consecutive days a month, measured at its confluence with Waiahole Stream.
Waikane Stream: 3.5 mgd, measured at altitude of 75 feet.
Kahana Stream: 11.2 mgd, measured at altitude of 15 feet.

To account for variable offstream demand, an additional 2.6 mgd will be available but for only up to five non-consecutive days a month from Waiahole and Waianu Streams (The aggregate base flows of Waiahole and Waianu Streams will still equal 50 percent of historic flows if all of the 2.6 mgd is diverted for leeward uses). These amounts are not to be used unless all permitted and unpermitted amounts above the designated IIFSs are being used on any particular day. Furthermore, regardless of the 12-MAV, the IIFSs must be met before leeward offstream uses are accommodated.

The ADC is to provide to the Commission, on a monthly basis, daily records of the amount of water diverted from the windward tunnels into Waiahole, Waianu and Waikane Streams, as well as the amount of water transported to the leeward side, measured at the North Portal crest gauge station and the gauging station at Adit 8.

The ADC and the water Coop must continue to develop contingency plans not only for possible water shortages, but also to mitigate against large variations in water use in a population of users with the diverse crop needs for water that are inherent in diversified agriculture. As water use increases, the amount of water needed eventually may require use of the 5-non-consecutive-days-per-month variable IIFSs for Waiahole and Waianu Streams. As water uses increase toward these levels, the Commission expects the ADC and Coop to have already taken reasonable measures to avoid or delay that milestone. And in any eventuality, the Commission has placed an absolute floor on the variable IIFSs.

Actual Needs For 2,500 Gallons Per Acre Per Day Over All Acres In Diversified Agriculture. In vacating the Commission's adoption of the 2,500 gad figure, the Court stated: "A reviewing court must judge the propriety of agency action solely by the grounds invoked by the agency, and that basis must be set forth with such clarity as to be understandable…(W)here the record demonstrates considerable conflict or uncertainty in the evidence, the agency must articulate its factual analysis with reasonable clarity…"

The Court was led to believe that cultivated acres were equivalent to planted acres, thereby leading to the Court's rejection of the Commission's adoption of 2,500 gad and the Commission's characterization of 2,500 gad as a "more conservative figure" than the 3,500 gad recommended by farmers Jefts and Sou.

The record of the original hearings, as well as testimony introduced at the remanded hearings, support the conclusions that cultivated lands are not equivalent to planted lands (generally, in large diversified farming operations, one-third of cultivated lands are actually planted at any one time); that 2,500 gad was appropriate for diversified agriculture in leeward O`ahu as applied to cultivated lands; and that it was not a contradiction for the Commission to describe 2,500 gad as a "more conservative figure" than the 3,500 gad that farmers Jefts and Sou had recommended.

Therefore, the Commission: 1) reaffirms that 2,500 gad for acres under cultivation or planned to be under cultivation is a reasonable water duty for leeward diversified agriculture; and 2) conditions the diversified agriculture water use permits on a showing of actual use, not to exceed 2,500 gad, within four years of this Decision and Order.

Two other parcels of land on which further evidence was presented on remand, Hawaiian Fertilizer Sales (formerly "Hawaiian Foliage") and HARC (formerly "HSPA"), present sufficiently different circumstances from the general category of "diversified agriculture" to warrant separate attention. Use of the land leased by Hawaiian Fertilizer Sales falls into two distinct categories: 1) intensive farming on small, predominantly two-acre plots which are planted nearly all the time; and 2) planting of long-term crops such as fruit trees. And HARC is an agricultural research service organization, developing, for example, new techniques for growing seeds and new ways to service the seed industry.

The Commission revises its award to Dole/Castle & Cooke for the Hawaiian Fertilizer Sales acres on the basis of 2,500 gad for 375 acres (80 percent of 468 acres), or

0.94 mgd.[147] Although the water duty for Hawaiian Fertilizer Sales' 375 acres is the same as for diversified agriculture, it has been arrived at through the combination of the separate water needs of the two distinct categories identified, *supra*. Furthermore, the acreage of the original award has been reduced by the 20 percent of land that is being used as a buffer between field operations and residential areas.

The Commission also revises its award to Campbell Estate for the HARC acres on the basis of 4,000 gad for 65 cultivated acres, or 0.26 mgd. The Commission will condition this water use permit on a showing of actual use, not to exceed 0.26 mgd, within four years of this Decision and Order. Current water consumption is about 2,600 gad over 65 cultivated acres for 1.19 crop cycles, expected to increase to 4,000 gad for 1.9 crop cycles. In comparison, Jefts, a diversified agriculture farmer, currently averages between 1,000 to 1,300 gad for about 1.1 crop cycles per year on all the arable lands he leases, projected to increase to 2,500 gad for 1.9 crop cycles. Furthermore, HARC was originally awarded a water duty for 78 acres, but cultivates only 65 acres.

The Actual Needs Of Certain Fields. Campbell Estate leases Fields 146 and 166 to Garst Seed Company (formerly "ICI Seeds"). Planting about one-third of its cultivated acres at any one time, the water requirement for the planted acres is about 1,800 gad or over all cultivated acres, approximately 600 gad. Garst Seed is also exploring ways with Jefts, HARC and the U.S. Department of Agriculture (USDA) to utilize the idle acres between its crops (isolation of seed crops can be accomplished not only with unplanted acres but also with other crops in the isolation acres). Diversified agriculture, cover crops and HARC's crop mix have very different water requirements. However, these are reasonable and beneficial uses of water, and therefore the Commission revises its award to Campbell Estate for Fields 146 and 166 as follows: 1) 1,800 gad for 115 acres (approximately one-third of the acres), or 0.21 mgd; and 2) 2,500 gad for 229 acres (approximately two-thirds of the acres), or 0.57 mgd, for a total of 0.78 mgd for 344 acres. The Commission will condition this water use permit on a showing of actual use, not to exceed 0.78 mgd, within four years of this Decision and Order.

Fields 115, 116 and 145 are now leased by Campbell Estate to Jefts for diversified agriculture. At the time of the remanded hearings, Jefts had completed clearing the land and putting in the irrigation infrastructure for 188 of the 267 acres.

The Commission confirms its original award of 2,500 gad for 267 acres for Fields 115, 116, and 145, or a total of 0.66 mgd.

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[147] Although the water use permit of Hawaiian Fertilizer Sales (formerly "Hawaiian Foliage") was not remanded by the Supreme Court, testimony was given on its current water use at the remanded hearing. The original award was for a request of 2,200 gad for 468 acres, or 1.03 mgd. On the basis of testimony at the remanded hearing, which the Commission did not request and which was voluntarily provided, the Commission concludes that a revised water use permit of 2,500 gad for 375 acres is warranted. Had the Commission not taken this action, the water use permit for 468 acres would continue. The Commission believes that, if it has the authority to revise the permit on the basis of this new evidence, then not only can it revise the acreage downwards from 468 to 375, but also that it can revise the per acre water duty from 2,200 to 2,500, based on the evidence introduced at the remanded hearing.

Del Monte terminated the lease for Field 161 with Gentry and Cozzens and planted it in pineapple. At the original hearing, Del Monte was also growing other crops besides pineapple but has decided at the present time to concentrate their efforts on pineapple only.

One of the Commission's original Findings of Fact was that pineapple crops were estimated to require approximately 2,000 gad. In contrast, Dole/Castle & Cooke requested and was awarded 904 gad for its pineapple fields in the original Decision and Order, and its president testified that pineapple requires 40,500 gallons per acre per month, or approximately 1,350 gad, and that it could come from rain or from irrigation. 2,000 gad is for overhead irrigation; 1,000 gad is for drip irrigation.

The Commission revises its award to Campbell Estate for Field 161 to 2,000 gad for 208 acres, or 0.42 mgd. Furthermore, in the original Decision and Order, Campbell Estate was awarded 2,500 gad for 803 acres in Fields 140, 156 and 172. This award is revised to 2,000 gad for 803 acres, or 1.60 mgd.

Practicability Of Campbell Estate And PMI Using Alternative Ground-Water Sources. The scenarios developed by Belt Collins Hawaii on alternative water sources for the original hearing were contingent on several conditions which were either not applicable or no longer apply and therefore do not provide practical alternative ground-water sources for either Campbell Estate or PMI (see discussion Section X.E.).

As there are no practicable alternative sources available, the Commission's decision is that Campbell Estate's and PMI's water use permits will be met through available waters from the Waiahole Ditch and not from the Pearl Harbor aquifer.

Merits Of The Permit Application For Ditch "System Losses". Since acquisition of the Waiahole Water System (WWS) by the Agribusiness Development Corporation (ADC) in July 1999, system losses have been reduced from 6.27 mgd in the period July – December 1999, to 4.62 mgd in the period July – December 2000, and is projected to be even further reduced to 2.02 mgd after replacement of the three wooden siphons is completed in June 2001.

The 2.02 mgd in losses are projected to consist of: 1) no further losses from the siphons; 2) 0.45 mgd overflow at Reservoir 155; 3) 0.07 mgd in evaporation; and 4) 1.50 mgd in the residual category, "unmetered losses". Reservoir 155 is at the end of the system, and it is hard to say how much further that loss might be reduced, as end-users need an adequate flow of water in the ditch. Much of the 1.50 mgd in continuing unmetered losses is probably due to leakage. The two reservoirs, 1000 feet of the ditch, and some of the sumps (ponds) are unlined. In addition, there are cracks in the cement lining of the nearly ninety year-old ditch, some of which are not obvious, which are patched as they are discovered.

Operational losses are a normal component of any water delivery system, and thus the Commission finds it appropriate to issue a use permit to the ADC for operational losses. ADC's permit request for system losses is 2.02 mgd. With continued progress in identifying uses that should be metered and incremental repairs on known leaks in the system, ADC should be able to function with a system-loss use permit of 2.00 mgd. Further, as a condition of its permit, ADC is to conduct studies on: 1) the probable contribution to system losses from leakages in the unlined portions of the ditch and in the reservoirs and any other probable, major contributing source; 2) depending on the outcome of those studies, to conduct follow up studies on the feasibility of addressing those leaks and the costs of such projects; and 3) to take appropriate actions to reduce such leakages.

Summary Of Changes From The Original Decision And Order. In the Commission's original Decision and Order, the IIFSs of the windward streams affected by the Waiahole Ditch's windward tunnel system were amended by adding 4 mgd to Waiahole Stream and 2 mgd to its tributary, Waianu Stream, for a total addition of 6 mgd. On remand, the IIFSs have been amended by adding 4.8 mgd to Waiahole Stream, 3.0 mgd to its tributary, Waianu Stream, 2.1 mgd to Waikane Stream, and no additions to Kahana Stream, for a total addition of 9.9 mgd. In addition, for five non-consecutive days in each month, the additions to Waiahole Stream may be reduced by 2.1 mgd and for Waianu Stream, additions may be reduced by 0.5 mgd.

Changes in the IIFSs[148] for the affected windward streams between the original and remanded Decision and Order are as follows:

Waiahole Stream:
base flow of 3.9 mgd; increased to 7.9 mgd in the original D&O; modified to 8.7 mgd in this D&O, with possible reduction to 6.6 mgd no more than five (5) non-consecutive days a month;

Waianu Stream:
base flow of 0.5 mgd; increased to 2.5 mgd in the original D&O; modified to 3.5 mgd in this D&O, with possible reduction to 3.0 mgd no more than five (5) non-consecutive days a month;

Waikane Stream:
base flow of 1.4 mgd; unchanged in the original D&O, modified to 3.5 mgd in this D&O; and

Kahana Stream:
no change in IIFS of 11.2 mgd.

On any given day, these amended IIFSs must be met before any leeward offstream permitted uses are allocated water by the ditch operator, ADC. Any water not needed for day-to-day operations of the permitted uses and for operational losses shall be

[148] Base flow at the point in the particular stream where base flow reaches its maximum: 1) for Waiahole Stream, at its confluence with Waianu Stream; 2) for Waianu Stream, at its confluence with Waiahole Stream; 3) for Waikane Stream, at altitude of 75 feet; and 4) for Kahana Stream, at altitude of 15 feet.

released into the windward streams in the following manner: 1) 0.9 mgd into Waikane Stream; and 2) the remainder to be released into Waiahole Stream.

Currently, there is no outlet from the tunnel system into Waikane Stream. In order to meet the amended IIFS for Waikane Stream, ADC is ordered to develop an assessment and plan for creating such an outlet and is to deliver it to the Commission within ninety (90) days of this Decision and Order. The diversion from the tunnel system into Waikane Stream shall be completed within 180 days after the assessment and plan are delivered to the Commission. The Commission may grant additional time upon the showing of good cause for such extension.

In the original Decision and Order, a total of 11.93 mgd in water use permits were granted, out of a request for 31.08 mgd. In addition, the Commission had made allowances for 2.1 mgd in operational losses.[149] On remand, the total water use permits granted equal 13.30 mgd, an increase of 1.01 mgd. However, this total includes 2.00 mgd for the water use permit to ADC for system losses, and there has been a net reduction of 0.63 mgd in all other water use permits. So the original offstream water use permits plus the system loss allowance, which totaled 14.03 mgd, have been reduced to 13.30 mgd.

Changes in water use permits between the original and the remanded Decision and Order are as follows:

Dole/Castle & Cooke:

Hawaiian Fertilizer Sales (formerly "Hawaiian Foliage"): decreased from 1.03 mgd to 0.94 mgd.

Campbell Estate:

HARC (formerly "HSPA"): increased from 0.20 mgd to 0.26 mgd;
Fields 146 and 166: decreased from 0.86 mgd to 0.78 mgd;
Fields 115, 116, 145 and 161: decreased from 1.19 mgd to 1.08 mgd; and
Fields 140, 156 and 172: decreased from 2.01 mgd to 1.60 mgd.

Agribusiness Development Corporation:

Operational losses decreased from an allowance of 2.1 mgd to a water use permit of 2.00 mgd.

These changes result in the following net decreases: 1) from 2.22 to 2.13 mgd for the Dole/Castle & Cooke lands; 2) from 5.28 mgd to 4.74 mgd for the Campbell Estate lands; and 3) from 2.1 mgd to the Waiahole Irrigation Company to 2.00 mgd for its successor, the Agribusiness Development Corporation. All other permits not addressed in this remanded D&O remain unchanged.

[149] See footnote 2 and accompanying main text in the Introduction for why the Commission did not make this allowance through the permit process.

The complete list of revised and unchanged water use permits are summarized in Tables 1 – 6 The apportionment of Waiahole Ditch water and the revised IIFSs for the affected windward streams are summarized in Tables 7 and 8 and Figures 1 – 2.[150]

The water use permits issued under the Commission's original Decision and Order and this Decision and Order are subject to the standard water use permit conditions in Appendix A.

Finally, the Commission's "Rulings on the Proposed Findings of Fact Submitted by the Parties" is contained in Appendix B.

[150] In the Commission's original Decision and Order, 1.58 mgd of the unpermitted water was proposed for an agricultural reserve. As this was not an issue for remand, the proposed agriculture reserve of 1.58 mgd remains in place.

Table 1. Waiahole Ditch System Flows (mgd)

Source	WIC 1989-1993 Data	Adjusted Basis
Kahana Tunnel	2.6	* 1.1
Kahana Surface Water	2.1	2.1
Waikane #2	1.1	1.1
Waikane #1	4.2	4.2
Uwau Tunnel	13.5	13.5
Tunnel to N. Portal	1.3	1.3
Main Tunnel: N. Portal to Adit 8	3.7	3.7
TOTALS (Measured at Adit 8)	28.5	27.0

* Adjusted for Kahana Bulkhead constructed in 1992 (2.6 - 1.5 = 1.1)

Table 2. Waiahole Ditch System - Leeward Oahu Agricultural Water Use Permits (mgd)

Landowner	User/Lands	Use	Acreage	Acreage Subtotal	Basis (GAD)	Allocation	Allocation Subtotal
Robinson	Jefts	Div Ag	620		2500	1.55	
	Sou	Div Ag	375	995	2500	0.94	2.49
Nihonkai	Sou	Div Ag	190	190	2500	0.48	0.48
Campbell	156,140,172	Pineapple	803		2000	1.60	
	105,110	Div Ag	409		2500	1.02	
	HARC	Plant Research	65		4000	0.26	
	146,166	Seed crops	115		1800	0.21	
		Div Ag	229		2500	0.57	
	115,116,145	Div Ag	267		2500	0.66	
	161	Pineapple	208	2096	2000	0.42	4.74
Dole/Castle & Cooke	Dole Fresh Fruit Co.	Div Ag	925		904 (requested)	0.84	
	Hawaii Ag Park	Div Ag	97		2500	0.24	
	Pacific Landscape	Div Ag	22		500 (requested)	0.01	
	Hawaiian Fertilizer Sales	Small plots & long-term crops	375		2500	0.94	
(Robinson)	Eiko Nakama	Div Ag	40	1459	2500	0.10	2.13
KSBE	Waiawa Nursery	Div Ag	36		2500	0.09	
	HFP	Div Ag	33	69	2500	0.08	0.17
TOTAL		DIV AG		4809			10.01

Table 3. Waiahole Ditch System - Leeward Oahu Water Use Permits, Other Uses (mgd)

Landowner	Use	Acreage	Tax Map Key	Basis (GAD)	Allocation
State of Hawaii (Waiawa Corr. Fac.)	Dom, Irr	210	9-6-5:011 9-6-5:012	requested @ 714	0.15
Mililani Memorial	Cemetery	67	9-4-6:10p 9-4-33:01	requested @ 2085	0.14
Mililani Golf	Golf Course	165	9-5-01:35	requested @ 1500	0.25
Royal Oahu Resort	Golf Course	163	9-2-4:046	N / A	0.00
Puu Makakilo	Golf Course	230	9-2-3:074	requested @ 3261	0.75
Agribusiness Development Corporation	System losses			requested 2.02	2.00
TOTAL	OTHER USES	835			3.29

Table 4. Waiahole Ditch System - Leeward Oahu Water Use Permits, Agricultural Lands and Allocations (mgd)

Landowner	Use	Tax Map Key	Acreage	Acreage Subtotal	Water Use Permit Allocation
Campbell (current use)	Agriculture	9-2-1:001(por)	1,310		
		9-2-1:011(por)	256		
		9-2-2:001(por)	185	2,096	
		9-2-4:005(por)	292		
		9-3-4:006(por)	53		
Campbell (Red Lands)	Pasture	9-2-4:005(por)	179	500	
		9-2-4:006(por)	321		
	Agriculture	9-2-1:001(por)	153	557	
		9-2-2:001(por)	57		
		9-2-4:005(por)	347		
Campbell (New Use)	Agriculture	9-2-4:001(por)	273		
		9-2-4:003(por)	20		
		9-2-4:005(por)	113	601	
		9-2-4:006(por)	55		
		9-2-5:002(por)	140		
TOTAL CAMPBELL				3,754	4.74
Robinson	Agriculture	9-4-3:001(por)			
		9-4-3:009(por)			
		9-4-4:004(por)			
		9-4-4:010(por)			
		9-4-4:012(por)			
		9-4-4:019(por)		1,443	
	Agriculture	9-4-3:001(por)			
		9-4-4:004(por)			
		9-4-4:007(por)			
		9-4-4:010(por)			
		9-4-4:011(por)		411	
TOTAL ROBINSON				1,854	2.49
Nihonkai	Agriculture	9-4-4:009(por)	190	190	
TOTAL NIHONKAI				190	0.48

Landowner	Use	Tax Map Key	Acreage	Acreage Subtotal	Water Use Permit Allocation
Dole / Castle & Cooke (Dole Fresh Fruit)	Agriculture	9-4-5:074 9-4-6:001 9-5-3:004		925	
Dole / Castle & Cooke (Hawaii Ag Park)	Agriculture	9-4-3:002(por)		97	
Dole / Castle & Cooke (Pacific Landscape)	Agriculture	9-4-3:002(por)		22	
Dole / Castle & Cooke (Hawaiian Foliage)	Agriculture	9-4-3:002(por) 9-4-5:048(por)		375	
Dole / Castle & Cooke (Banana Patch Parcel - Eiko Nakama)	Agriculture	9-4-3:003		40	
TOTAL DOLE / CASTLE & COOKE				1,459	2.13
KSBE (Waiawa Nursery)	Agriculture	9-6-5:003(por)		50	
KSBE (HFP / Waiawa Nursery Farm)	Agriculture	9-6-5:003(por) 9-6-5:001(por)		100	
TOTAL KSBE				**150**	0.17

Table 5. Waiahole Ditch System - Requested and Granted Uses (mgd)

Landowner	Agricultural		Non-Agricultural		TOTAL	
	Existing Use (Requested)	New Use (Requested)	Existing Use (Requested)	New Use (Requested)	Requested	Granted
Campbell	8.26	3.83			12.09 (1)	4.74
Robinson	5.50				5.50 (1)	2.49
Nihonkai	0.50				0.50 (1)	0.48
Dole / Castle & Cooke	2.22				2.22 (2)	2.03
Dole / Castle & Cooke / Robinson * (Banana Patch Parcel - Eiko Nakama)		0.14			0.14 (2)	0.10
KSBE	1.55			2.65	4.20 (3)	0.17
State of Hawaii (Waiawa Corr. Fac.)			0.15		0.15 (1)	0.15
Mililani Memorial			0.14		0.14 (2)	0.14
Mililani Golf			0.25		0.25 (2)	0.25
Royal Oahu Resort				0.75	0.75 (1)	0.00
Puu Makakilo				0.75	0.75 (1)	0.75
Dept. of Agriculture (Halekua)		0.75			0.75 (1)	0.00
Waiahole Irrigation Company (for operational losses)			2.00		2.00 (1)	0.00
West Beach Estates				1.64	1.64 (4)	0.00
Agribusiness Development Corporation				2.02	2.02	2.00
TOTAL	18.03	4.72	2.54	7.81	33.10	13.30

* Water use permit issued to Dole / Castle & Cooke and Robinson as joint applicants because water is supplied through the Dole / Castle & Cooke system and is used on the parcel which is owned by Robinson.
(1) "Clarification Letter" dated October 2, 1995.
(2) Dole / Castle & Cooke Water Use Permit Application dated October 5, 1994.
(3) KSBE Water Use Permit Application dated September 8, 1994.
(4) WBE Water Use Permit Application dated January 13, 1995.

Table 6. Summary of Allocations
Original Decision and Order and Remanded Decision and Order (mgd)

Landowner	Acreage		Allocation per Original D&O	Allocation on Remand
	ORIGINAL	REMAND		
Robinson	995	995	2.49	2.49
Nihonkai	190	190	0.48	0.48
Campbell	2109	2096	5.28	4.74
Dole / Castle & Cooke	1552	1459	2.22	2.13
KSBE	69	69	0.17	0.17
SUB TOTAL	4915	4809	10.64	10.01
OTHER USES	835	835	1.29	1.29
OPERATIONAL LOSS ALLOWANCE	-	-	2.1	-
Water Use Permit For System Losses	-	-	-	2.0
TOTAL	-	-	14.03	13.30

Table 7. Changes In Water Added To Windward Streams

Stream	Added By Original Decision and Order	Added On Remand
Waiahole Stream	4 mgd[1]	4.8 mgd[2]
Waianu Stream	2 mgd[1]	3.0 mgd[3]
Waikane Stream	0 mgd	2.1 mgd
TOTALS	6 mgd	9.9 mgd

Note 1: **In the Original Decision and Order, the Commission ordered "six (6) mgd shall be restored to certain windward Oahu streams on a continuous basis as an amended base flow. In no case shall there be less than six (6) mgd restored to windward Oahu streams. Initially, four (4) shall be restored at Gate 31 and two (2) mgd shall be restored at Gate 30. The quantities restored to individual windward streams shall be subject to modification with Commission approval."**

Note 2: Additions to Waiahole Stream may be reduced by 2.1 mgd for five (5) non-consecutive days in each month.

Note 3: Additions to Waianu Stream may be reduced by 0.5 mgd for five (5) non-consecutive days in each month.

Table 8. Changes In the Interim Instream Flow Standards for Windward Streams

Streams	Post-Ditch Stream Base Flows	Original Decision and Order Stream Base Flows	Remanded Interim Instream Base Flows
Waiahole	3.9 mgd	7.9 mgd	8.7 mgd[1]
Waianu	0.5 mgd	2.5 mgd	3.5 mgd[2]
Waikane	1.4 mgd	1.4 mgd (no change)	3.5 mgd
Kahana	11.2 mgd	11.2 mgd (no change)	11.2 mgd (no change)
TOTALS	17.0 mgd	23.0 mgd	26.9 mgd

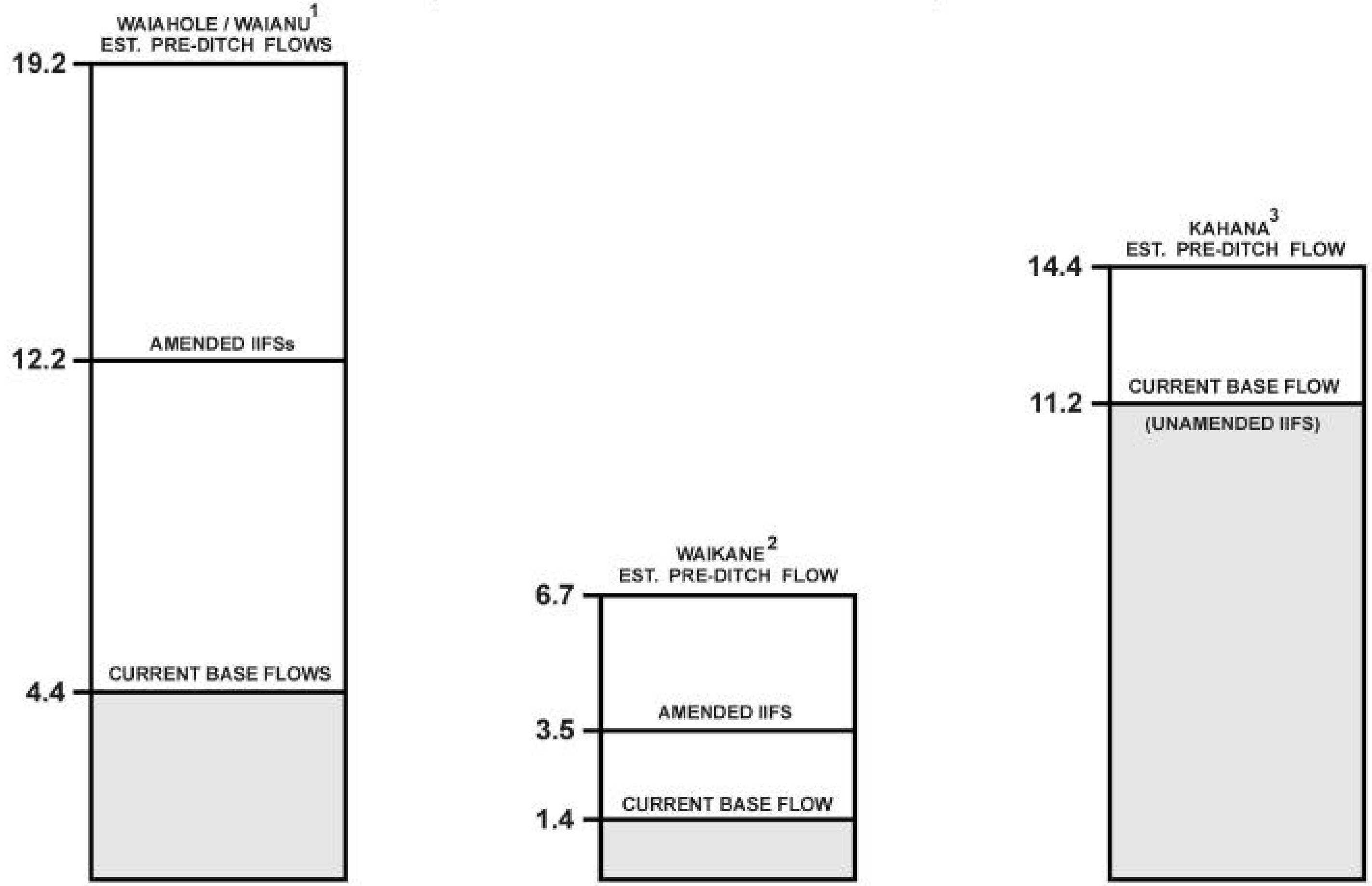
Note 1: Reduced to 6.6 mgd no more than five (5) non-consecutive days a month

Note 2: Reduced to 3.0 mgd no more than five (5) non-consecutive days a month

FIGURE 1

CURRENT BASE FLOWS, AMENDED IIFSs AND ESTIMATED PRE-DITCH FLOWS

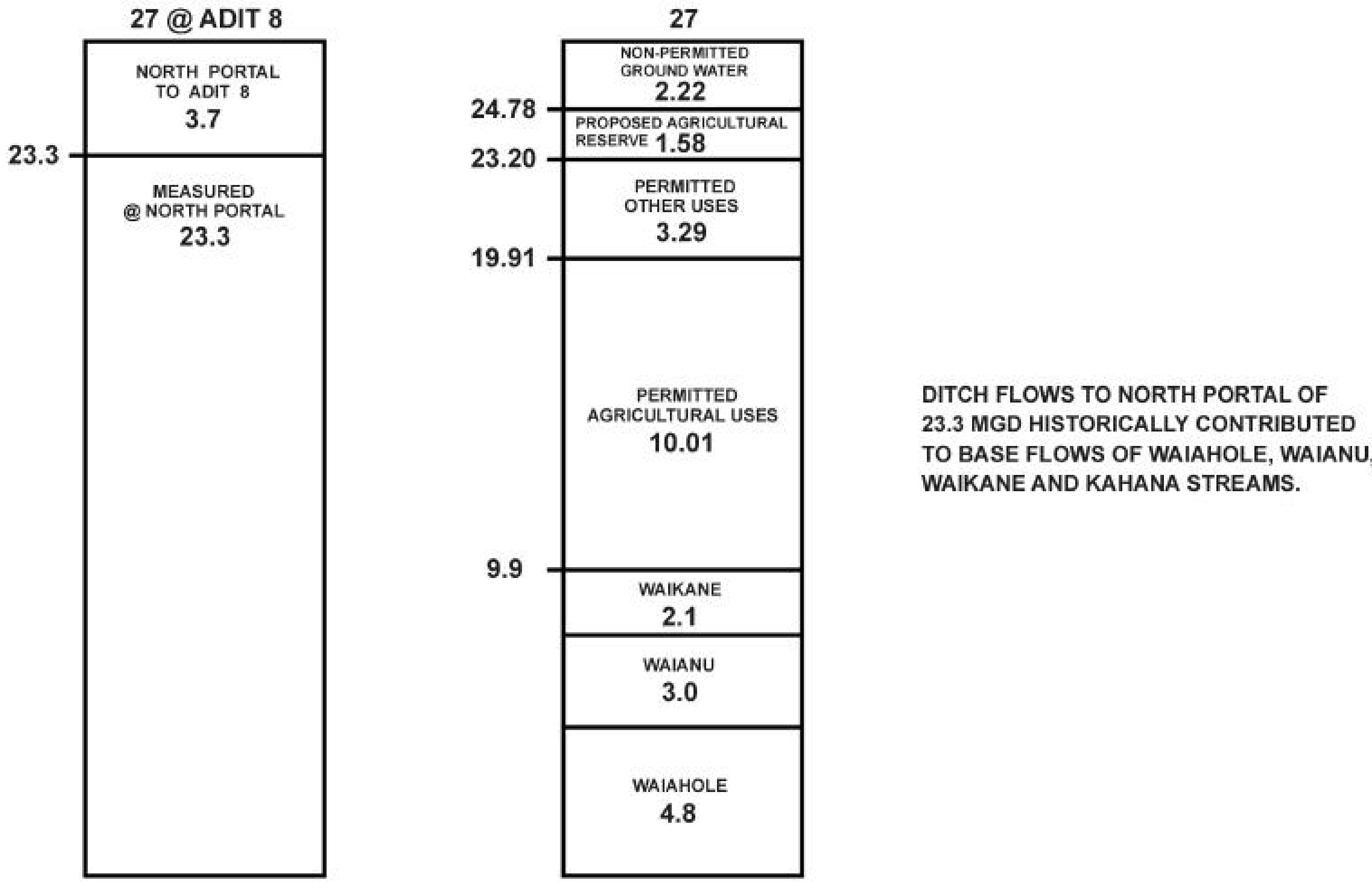
(IN MILLIONS OF GALLONS PER DAY)



[1] Measured at the confluence of Waiahole and Waianu Streams.
[2] Measured at altitude of 75 feet.
[3] Measured at altitude of 15 feet.

FIGURE 2

SUMMARY OF WAIAHOLE DITCH SYSTEM FLOWS
(IN MILLIONS OF GALLONS PER DAY)



Appendix A

Standard Water Use Permit Conditions

1. **The water described in this water use permit may only be taken from the location described and used for the reasonable beneficial use described at the location described in this Decision and Order. Reasonable beneficial uses means "the use of water in such a quantity as is necessary for economic and efficient utilization which is both reasonable and consistent with State and County land use plans and the public interest." (HRS § 174C-3)**

2. The right to use ground water is a shared use right.

3. The water use must at all times meet the requirements set forth in HRS § 174C-49(a), which means that it:

    a. Can be accommodated with the available water source;
    b. Is a reasonable-beneficial use as defined in HRS § 174C-3;
    c. Will not interfere with any existing legal use of water;
    d. Is consistent with the public interest;
    e. Is consistent with State and County general plans and land use designations;
    f. Is consistent with County land use plans and policies; and
    g. Will not interfere with the rights of the Department of Hawaiian Home Lands as provided in section 221 of the Hawaiian Homes Commission Act and HRS § 174C-101(a).

4. The ground-water use here must not interfere with surface or other ground-water rights or reservations.

5. The ground-water use here must not interfere with interim or permanent instream flow standards. If it does, then:

    a. A separate water use permit for surface water must be obtained in the case an area is also designated as a surface water management area;
    b. The interim or permanent instream flow standard, as applicable, must be amended.

6. The water use authorized here is subject to the requirements of the Hawaiian Homes Commission Act, as amended, if applicable.

7. The water use permit application, as amended, approved by the Commission in its December 24, 1997 Decision and Order, are incorporated into this permit by reference.

8. Any modification of the permit terms, conditions, or uses may only be made with the express written consent of the Commission.

9. This permit may be modified by the Commission and the amount of water initially granted to the permittee may be reduced if the Commission determines it is necessary to:

   a. protect the water sources (quantity or quality);
   b. meet other legal obligations including other correlative rights;
   c. insure adequate conservation measures;
   d. require efficiency of water uses;
   e. reserve water for future uses, provided that all legal existing uses of water as of June, 1987 shall be protected;
   f. meet legal obligations to the Department of Hawaiian Home Lands, if applicable; or
   g. carry out such other necessary and proper exercise of the State's and the Commission's police powers under law as may be required.

   Prior to any reduction, the Commission shall give notice of its proposed action to the permittee and provide the permittee an opportunity to be heard.

10. Approved flowmeters must be installed to measure monthly withdrawals and a monthly record of withdrawals must be kept and reported to the Commission on Water Resource Management on a monthly basis.

11. This permit shall be subject to the Commission's periodic review of the Waipahu-Waiawa, Kahana, and Koolaupoko Aquifer System's sustainable yields. The amount of water authorized by this permit may be reduced by the Commission if the sustainable yields of the Waipahu-Waiawa, Kahana, and Koolaupoko Aquifer Systems, or relevant modified aquifer(s), are reduced.

12. A permit may be transferred, in whole or in part, from the permittee to another, if:

   a. The conditions of use of the permit, including, but not limited to, place, quantity, and purpose of the use, remain the same; and
   b. The Commission is informed of the transfer within ninety days.

   Failure to inform the department of the transfer invalidates the transfer and constitutes a ground for revocation of the permit. A transfer which involves a change in any condition of the permit, including a change in use covered in HRS § 174C-57, is also invalid and constitutes a ground for revocation.

13. The use(s) authorized by law and by this permit do not constitute ownership rights.

14. The permittee shall request modification of the permit as necessary to comply with all applicable laws, rules, and ordinances which will affect the permittee's water use.

15. The permittee understands that under HRS § 174C-58(4), that partial or total nonuse, for reasons other than conservation, of the water allowed by this permit for a period of four (4) continuous years or more may result in a permanent revocation as to the amount of water not in use. The Commission and the permittee may enter into a written agreement that, for reasons satisfactory to the Commission, any period of nonuse may not apply towards the four-year period. Any period of nonuse which is caused by a declaration of water shortage pursuant to section HRS § 174C-62 shall not apply towards the four-year period of forfeiture.

16. The permittee shall prepare and submit a water shortage plan within 30 days of the issuance of this permit as required by HAR § 13-171-42(c). The permittee's water shortage plan shall identify what the permittee is willing to do should the Commission declare a water shortage in the Waipahu-Waiawa, Kahana, and Koolaupoko Ground-Water Management Areas.

17. The water use permit shall be subject to the Commission's establishment of instream standards and policies relating to the Stream Protection and Management (SPAM) program, as well as legislative mandates to protect stream resources.

18. The permittee understands that any willful violation of any of the above conditions or any provisions of HRS § 174C or HAR § 13-171 may result in the suspension or revocation of this permit.

Appendix B

RULINGS ON THE PROPOSED FINDINGS OF FACT SUBMITTED BY THE PARTIES

The Commission makes the following rulings on the parties' proposed findings of fact. The findings are placed into two categories.

Category A contains findings that are accepted in their entirety, or accepted with minor modifications or corrections that do not substantially alter the meaning of the original findings.

Category B contains findings that are rejected because they may be: 1) duplicative; 2) not relevant; 3) not material; 4) taken out of context; 5) contrary (in whole or in part) to the found facts; 6) an opinion (in whole or in part); 7) contradicted by other evidence; or 8) contrary to law.

I. CAMPBELL ESTATE

A. ACCEPTED

1-5, 7-37, 37a-b, 38-50

B. REJECTED

6, 51

II. ROBINSON ESTATE

A. ACCEPTED

1-5

B. REJECTED

None

III. DOLE/CASTLE & COOKE

A. ACCEPTED

4-9

B. REJECTED

1-3, 10-11

IV. <u>NIHONKAI</u>

A. ACCEPTED

1-4, 6-7

B. REJECTED

5, 8

V. <u>PU`U MAKAKILO</u>

A. ACCEPTED

1-7, 10-22, 24-42

B. REJECTED

8-9, 23, 43

VI. <u>DEPARTMENT OF AGRICULTURE/AGRIBUSINESS DEVELOPMENT CORPORATION</u>

A. ACCEPTED

14-16, 19, 21-24, 26-29, 32, 34, 36-37, 39, 41-62, 64

B. REJECTED

1-13, 17-18, 20, 25, 30-31, 33, 35, 38, 40, 63, 65

VII. <u>KAMEHAMEHA SCHOOLS</u>

A. ACCEPTED

14-19, 21-25, 27-31, 33-41, 44-47, 51-54, 57-66, 68-69, 72

B. REJECTED

1-13, 20, 26, 32, 42-43, 48-50, 55-56, 67, 70-71, 73

VIII. CITY AND COUNTY OF HONOLULU

A. ACCEPTED

1, 2, 4-15

B. REJECTED

3

IX. WAIAHOLE-WAIKANE COMMUNITY ASSOCIATION/HAKIPU`U OHANA/KAHALU`U NEIGHBORHOOD BOARD/KA LAHUI HAWAI`I

A. ACCEPTED

8-11, 18-19, 25-26, 29, 38-39

B. REJECTED

1-7, 12-17, 20-24, 27-28, 30-37

X. HAWAI`I'S THOUSAND FRIENDS

A. ACCEPTED

None

B. REJECTED

I-IX