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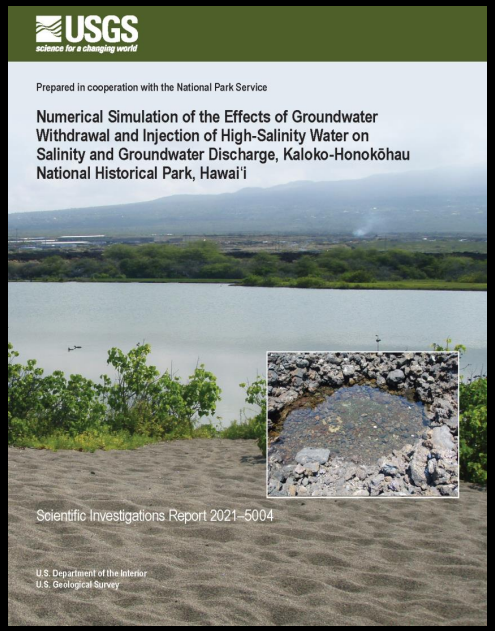
Pacific Islands Water Science Center

Effects of Withdrawal on Groundwater in Kaloko-Honokōhau National Historical Park (KAHO), Hawai‘i

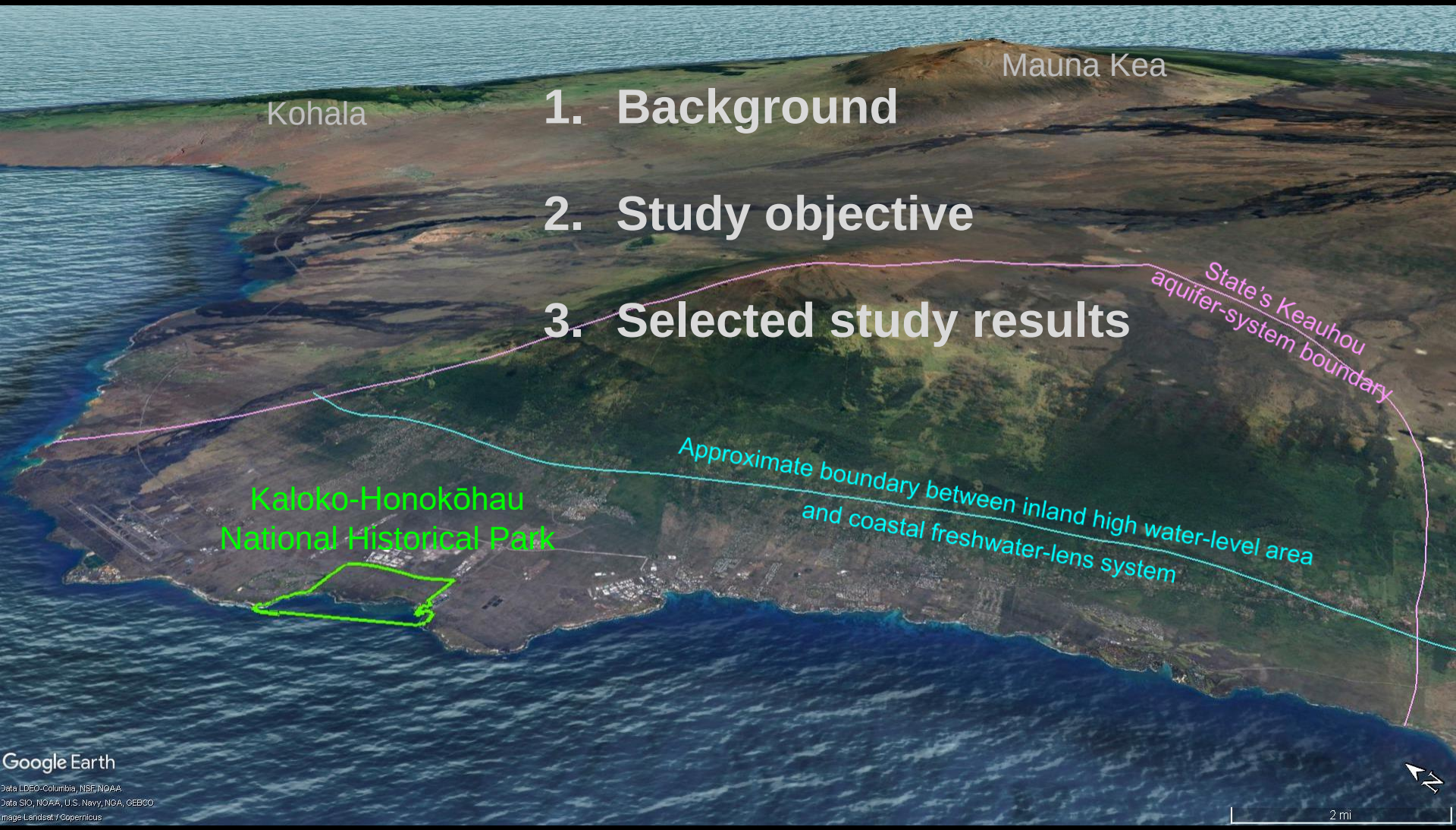
Delwyn S. Oki



Commission on Water Resource Management
April 20, 2021

U.S. Department of the Interior
U.S. Geological Survey

Outline



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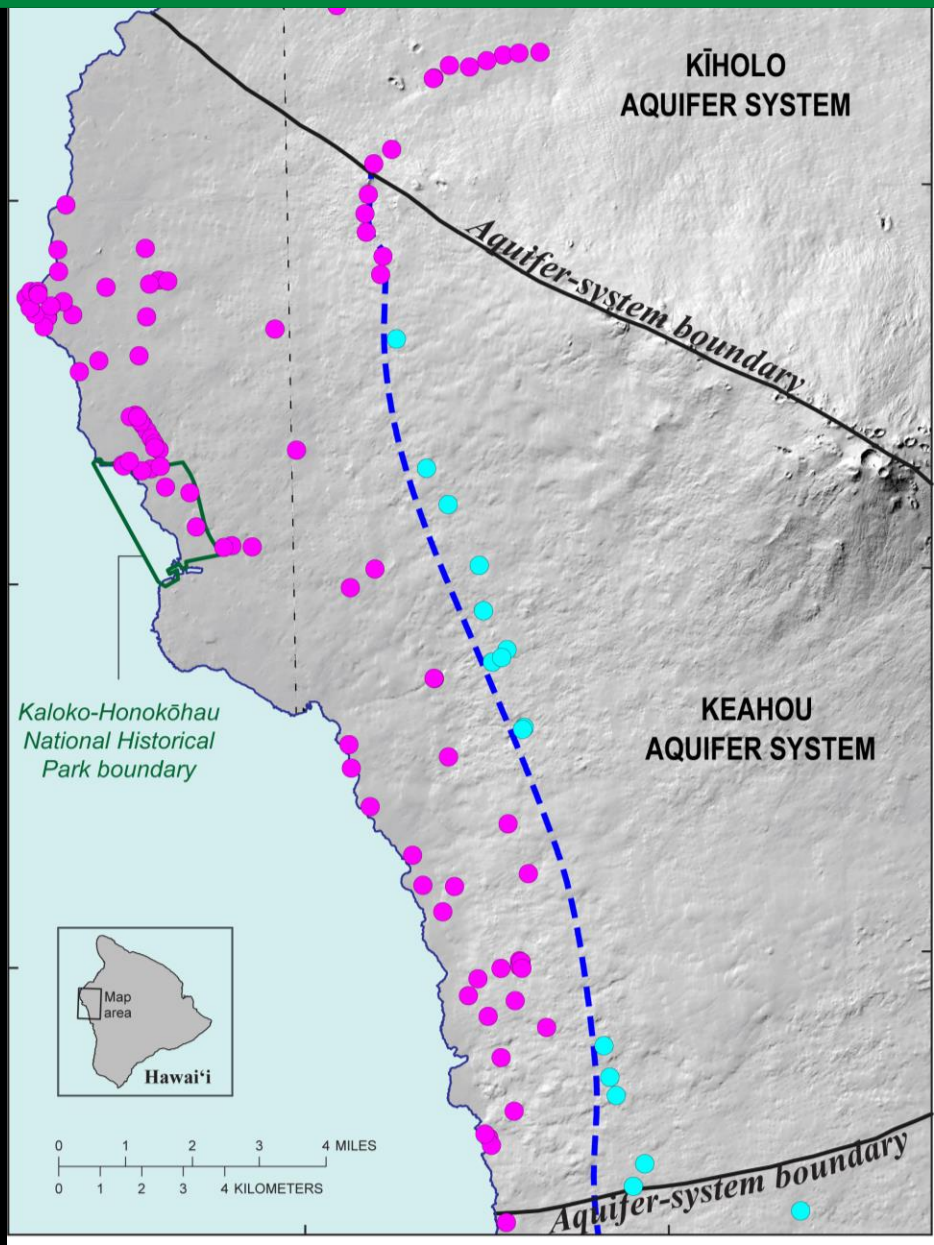
Map of Groundwater Levels

EXPLANATION

- Approximate boundary between inland high water-level area and coastal freshwater-lens system
- Inland well—water level greater than about 40 feet above mean sea level
- Coastal well—water level generally less than about 3 feet above mean sea level



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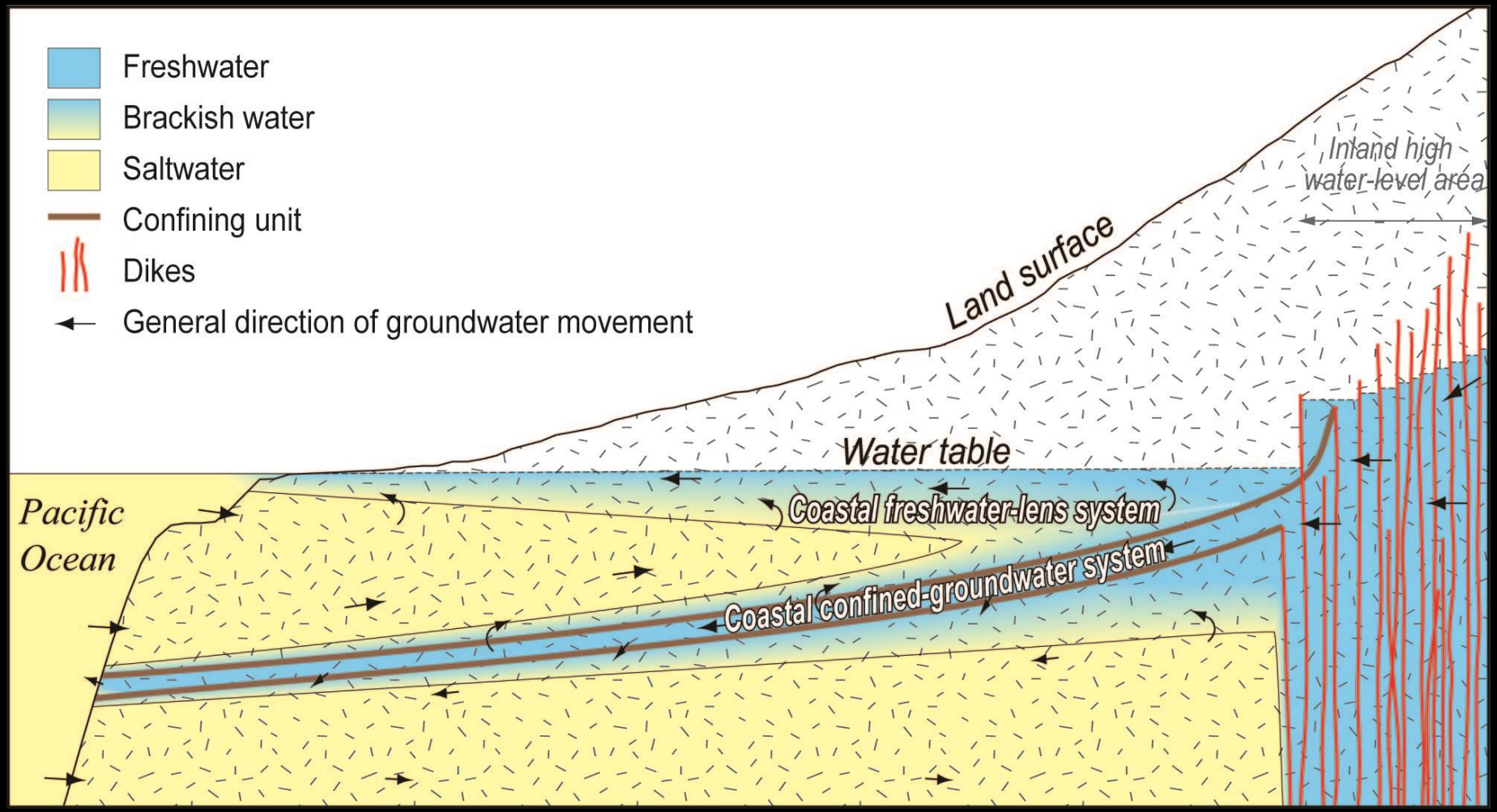
Conceptual Modes of Groundwater Occurrence



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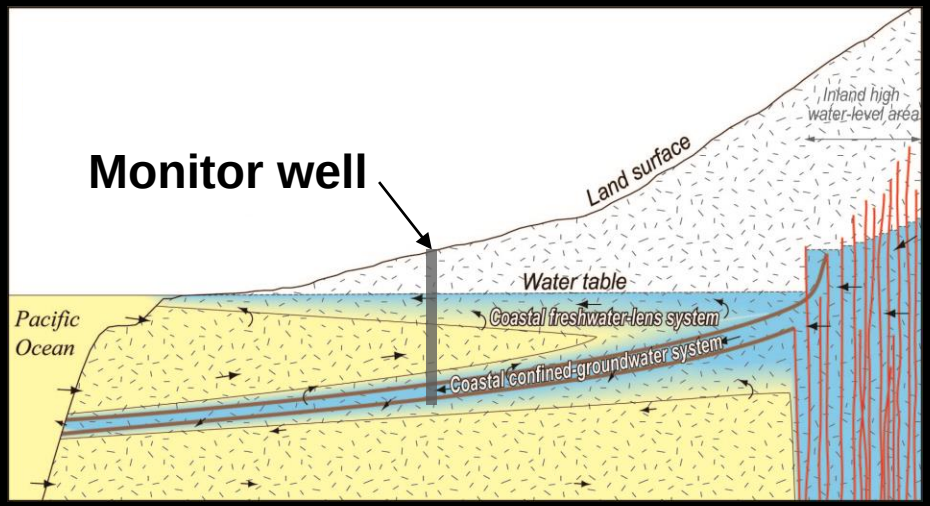
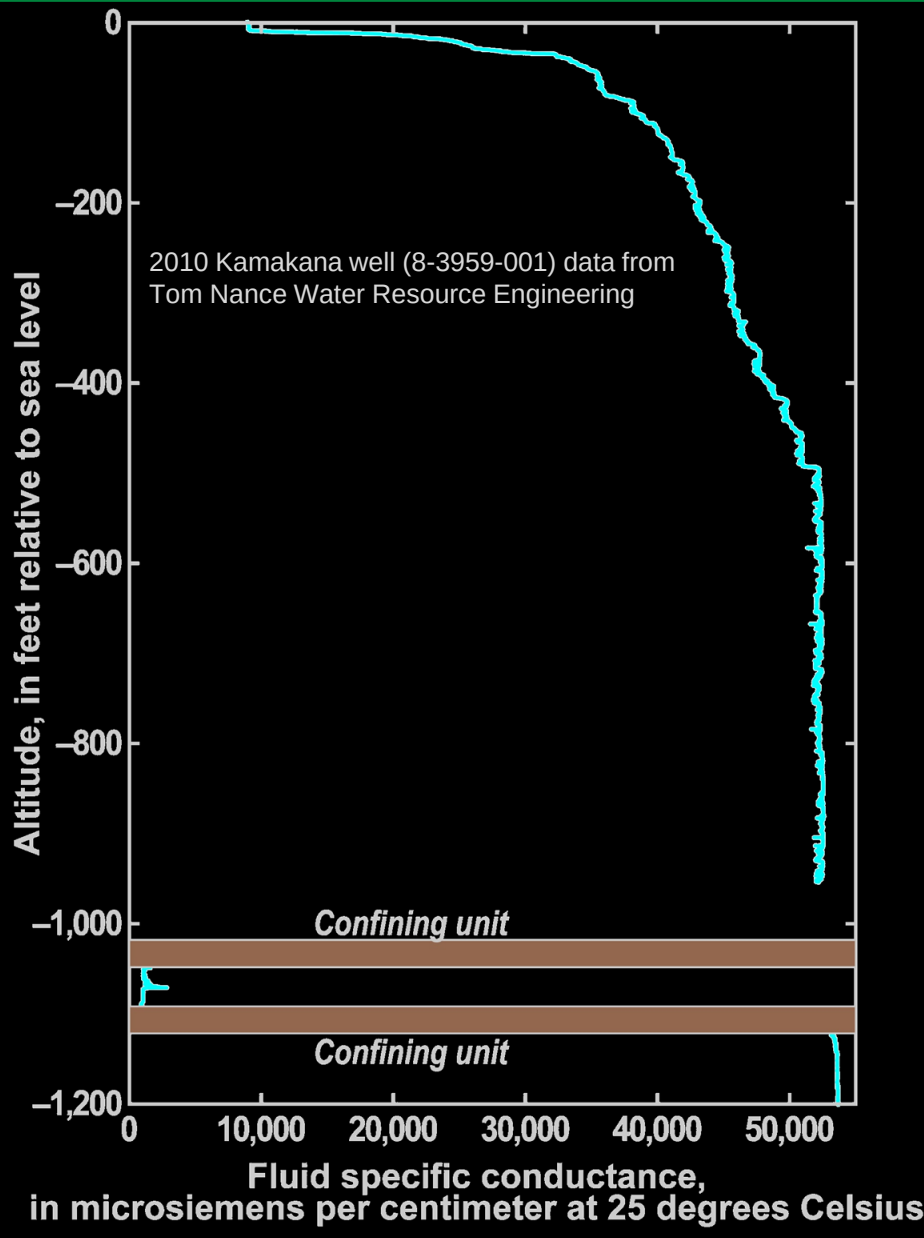
Vertical Salinity Distribution





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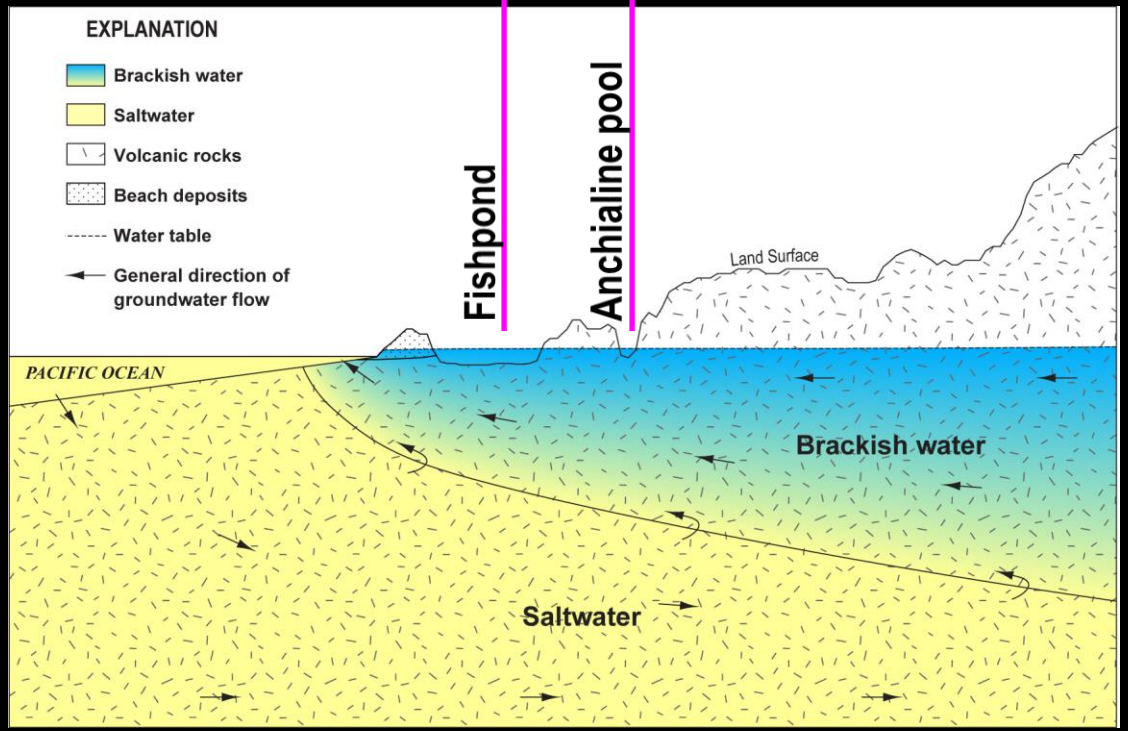
Selected Groundwater-Dependent Ecosystems

Photographs from National Park Service



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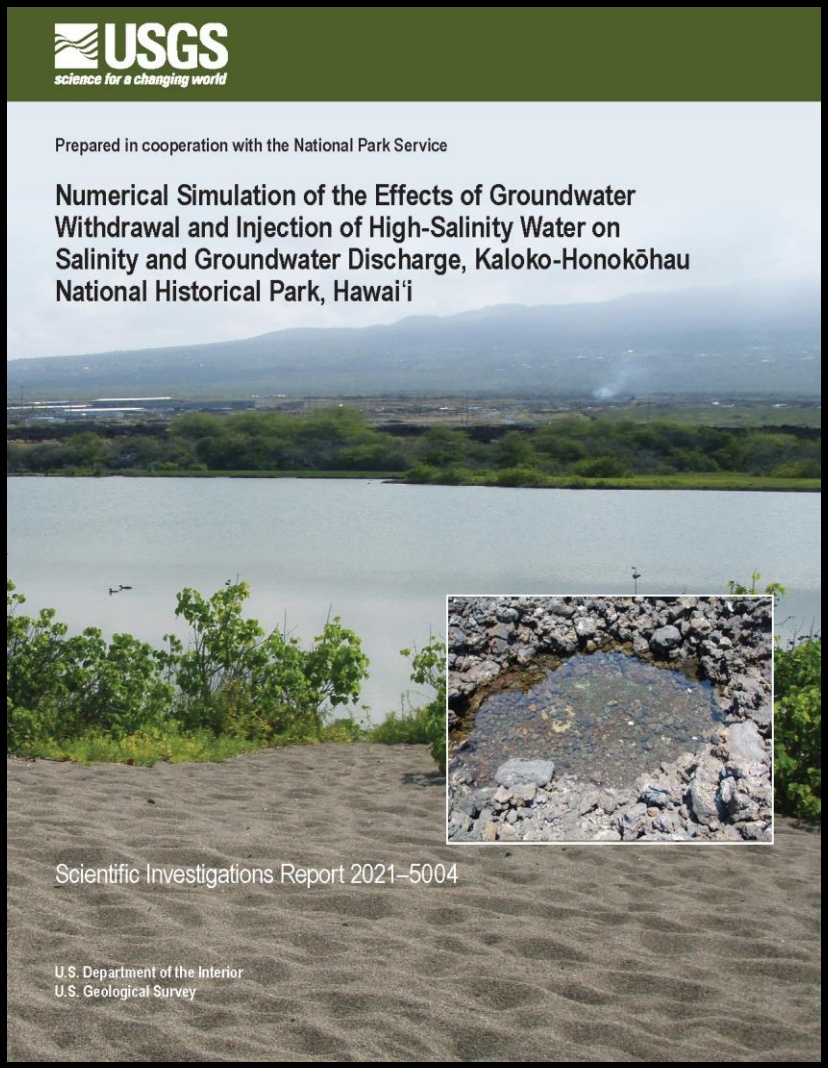
Study Objective

Quantify changes in groundwater discharge and salinity in KAHO for selected scenarios of groundwater withdrawal from and injection of high-salinity water to the coastal-freshwater lens system



https://doi.org/10.3133/sir20215004

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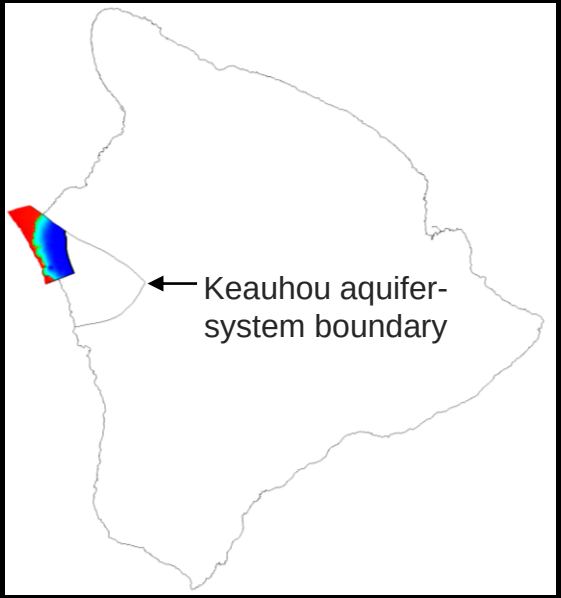
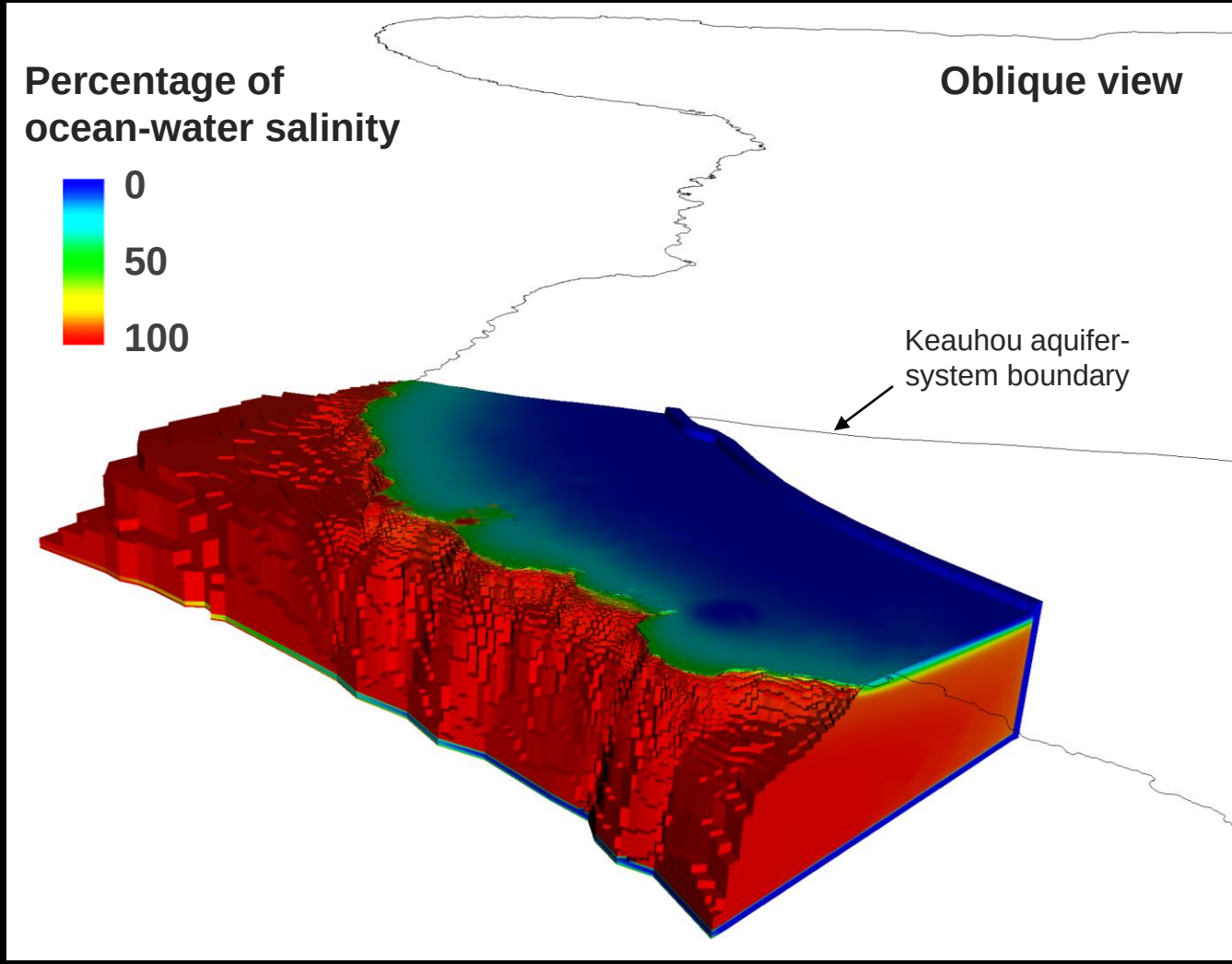
Modeled Area





Vertical exaggeration of model mesh x 10

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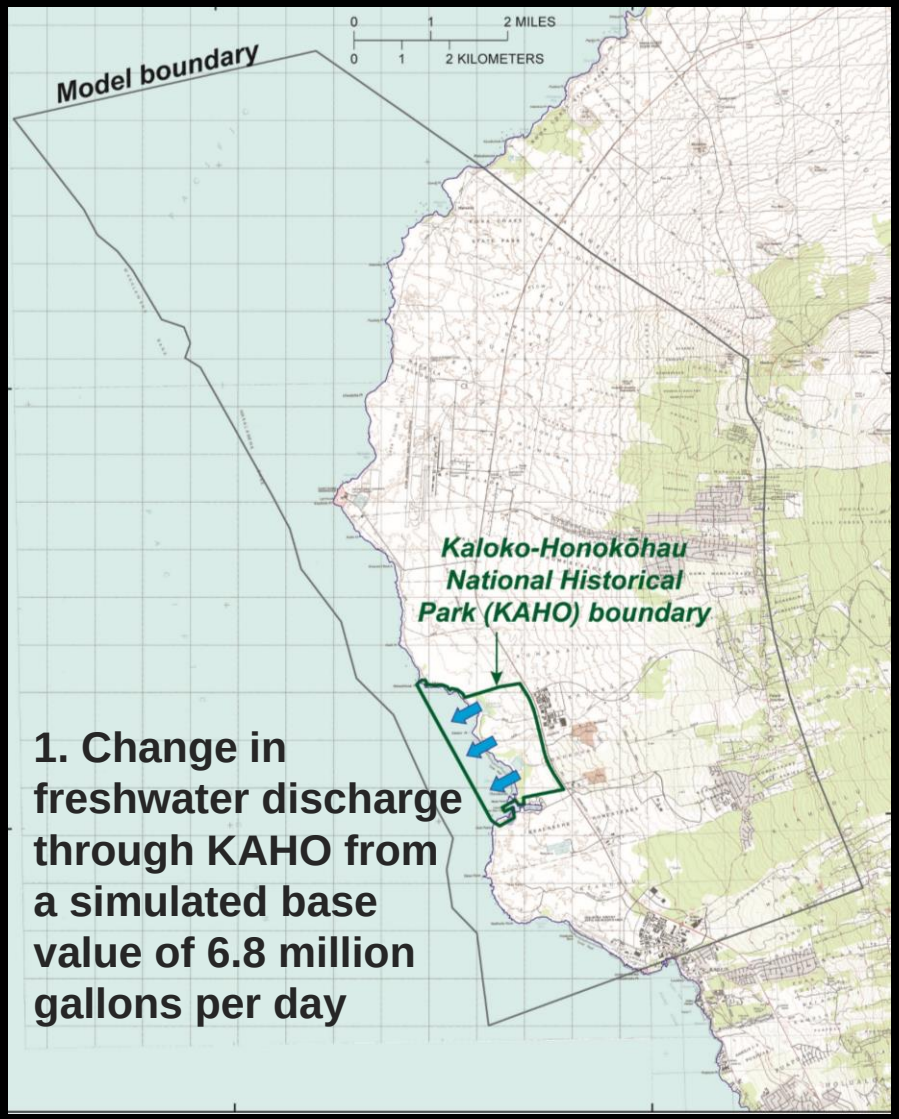
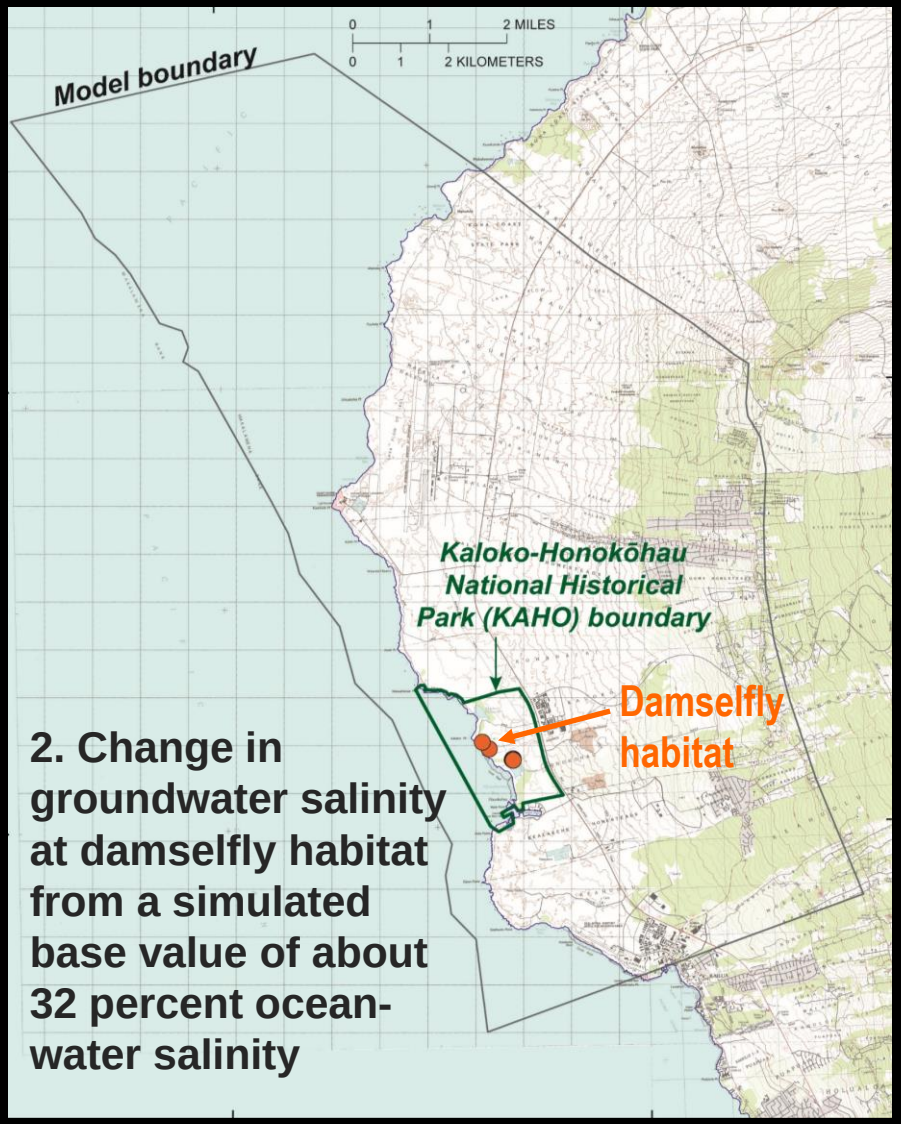
Quantify Changes in Discharge and Salinity



1. Change in freshwater discharge through KAHO from a simulated base value of 6.8 million gallons per day



2. Change in groundwater salinity at damselfly habitat from a simulated base value of about 32 percent ocean-water salinity

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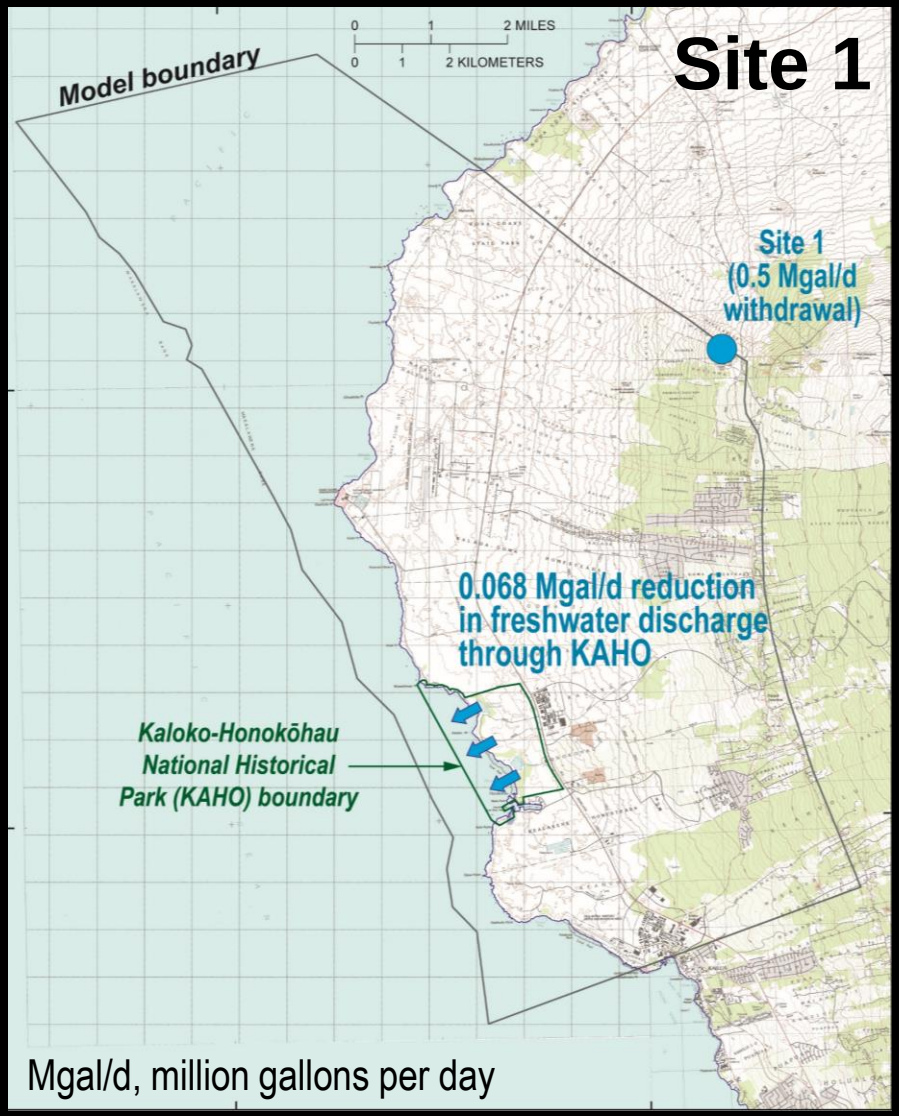
Scenario 1—Simulated Discharge Reduction Caused by 0.5 Mgal/d Withdrawal, Site 1



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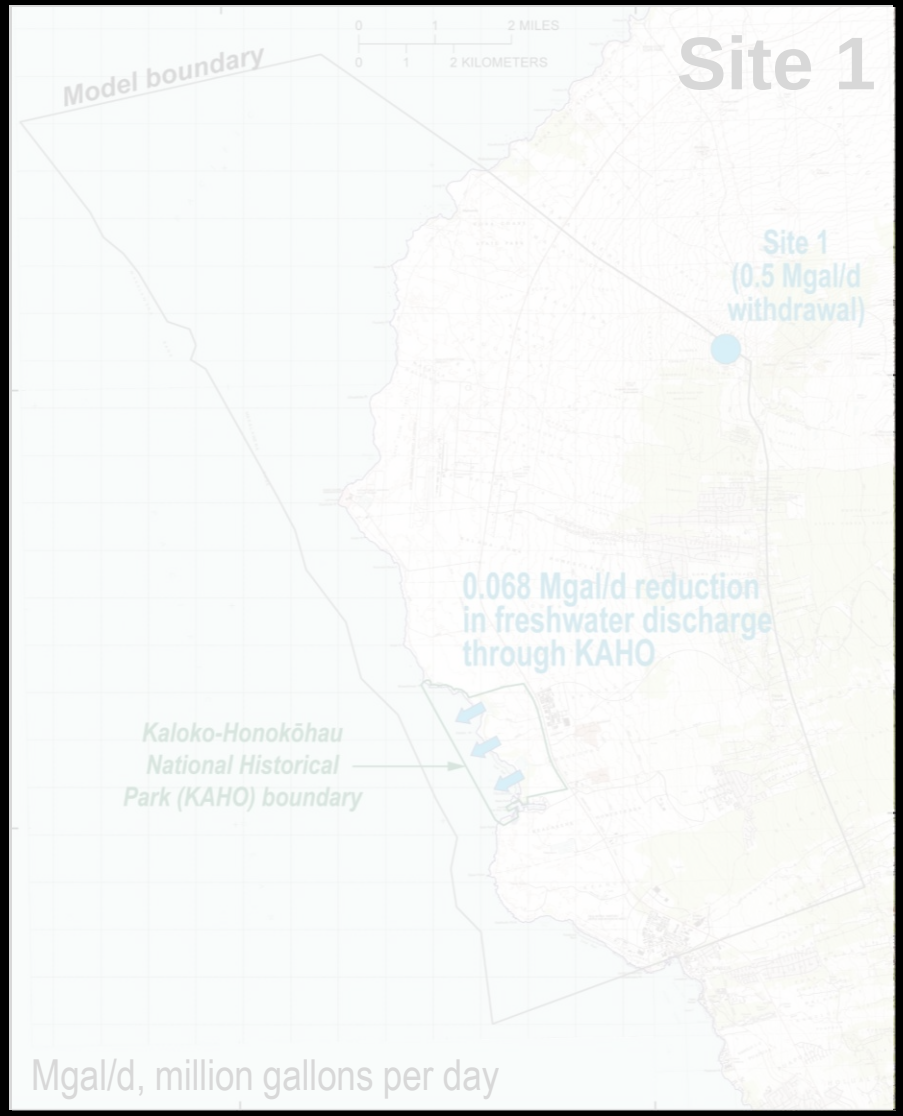
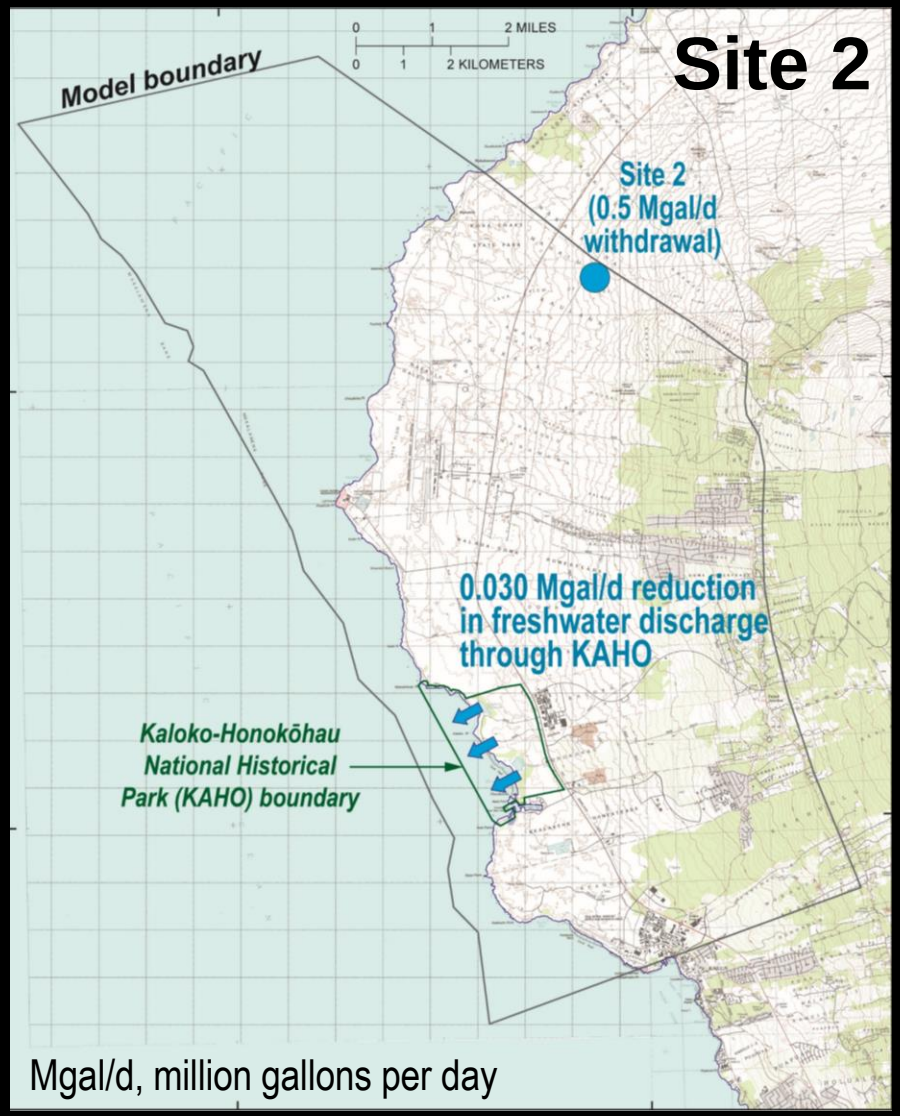
Scenario 1—Simulated Discharge Reduction Caused by 0.5 Mgal/d Withdrawal, Site 2





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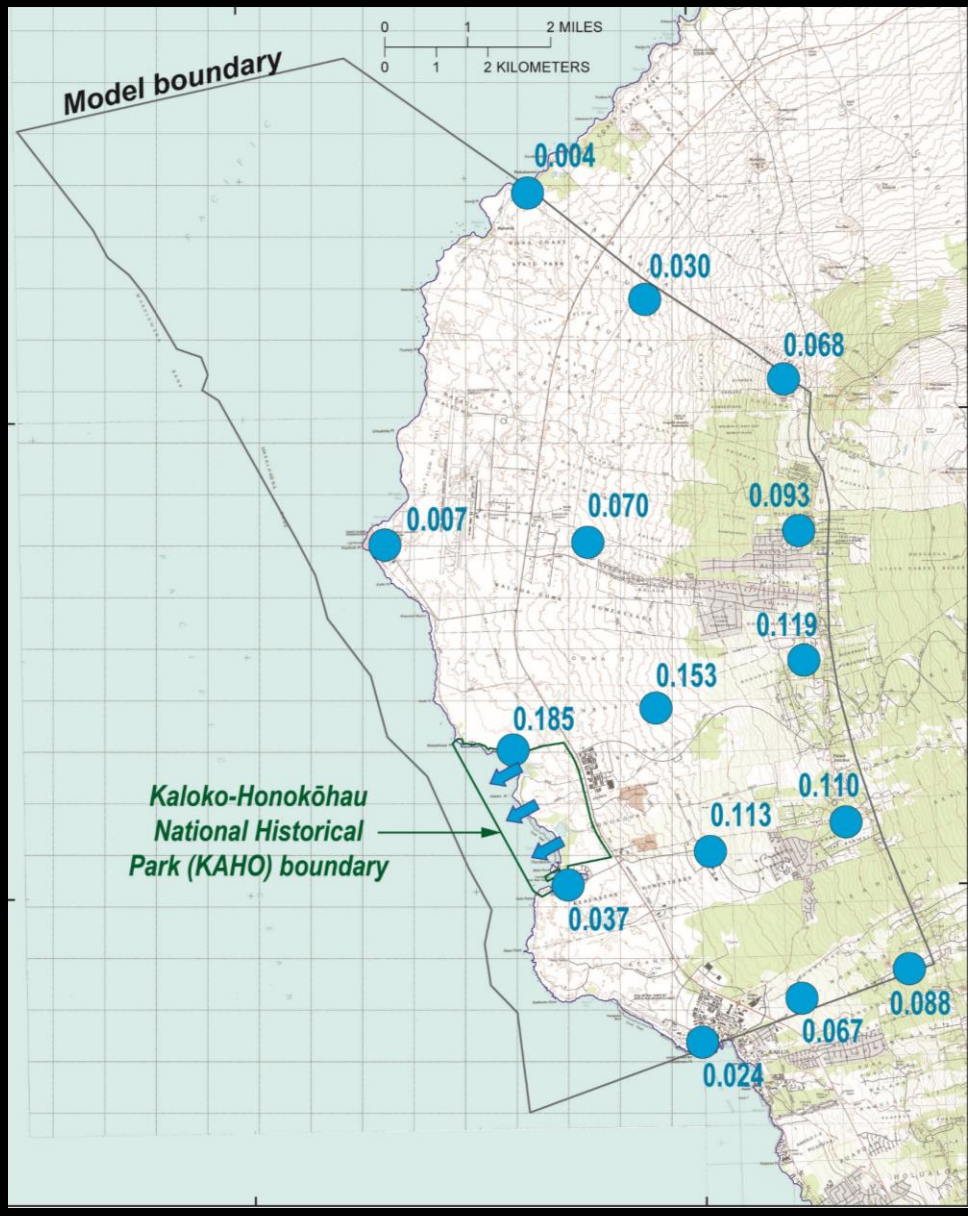
Scenario 1—Simulated Discharge Reduction Caused by Independent 0.5 Mgal/d Withdrawal, Sites 1–15

EXPLANATION

0.153

Hypothetical well site of simulated withdrawal of 0.5 million gallons per day (Mgal/d) and simulated freshwater-discharge reduction in KAHO, in Mgal/d



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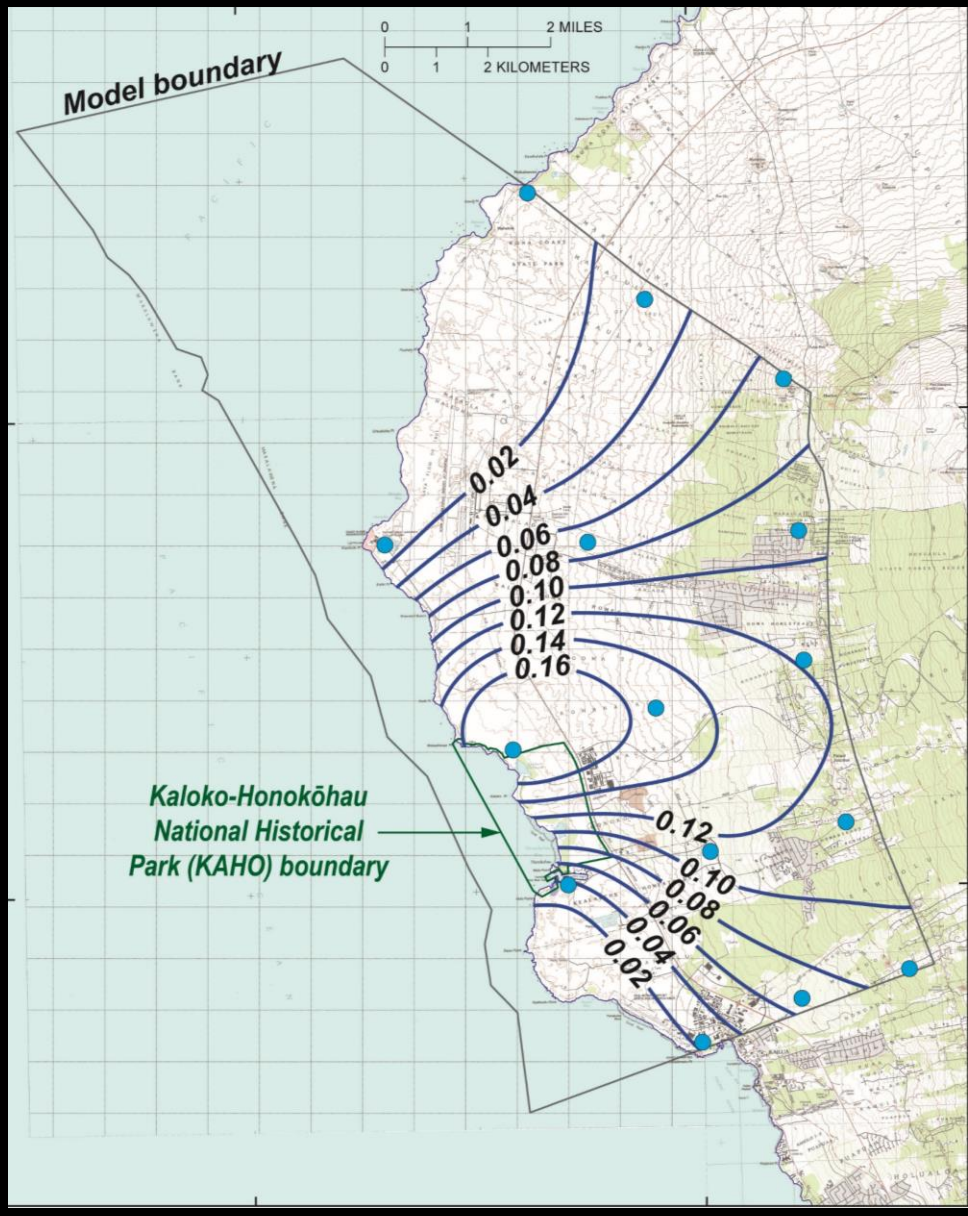
Scenario 1—Simulated Discharge Reduction Caused by 0.5 Mgal/d Withdrawal, Contours

EXPLANATION

0.10 Line of equal simulated freshwater-discharge reduction in KAHO caused by withdrawing 0.5 million gallons per day (Mgal/d) at sites on the line, in Mgal/d

Hypothetical well site of simulated withdrawal of 0.5 Mgal/d



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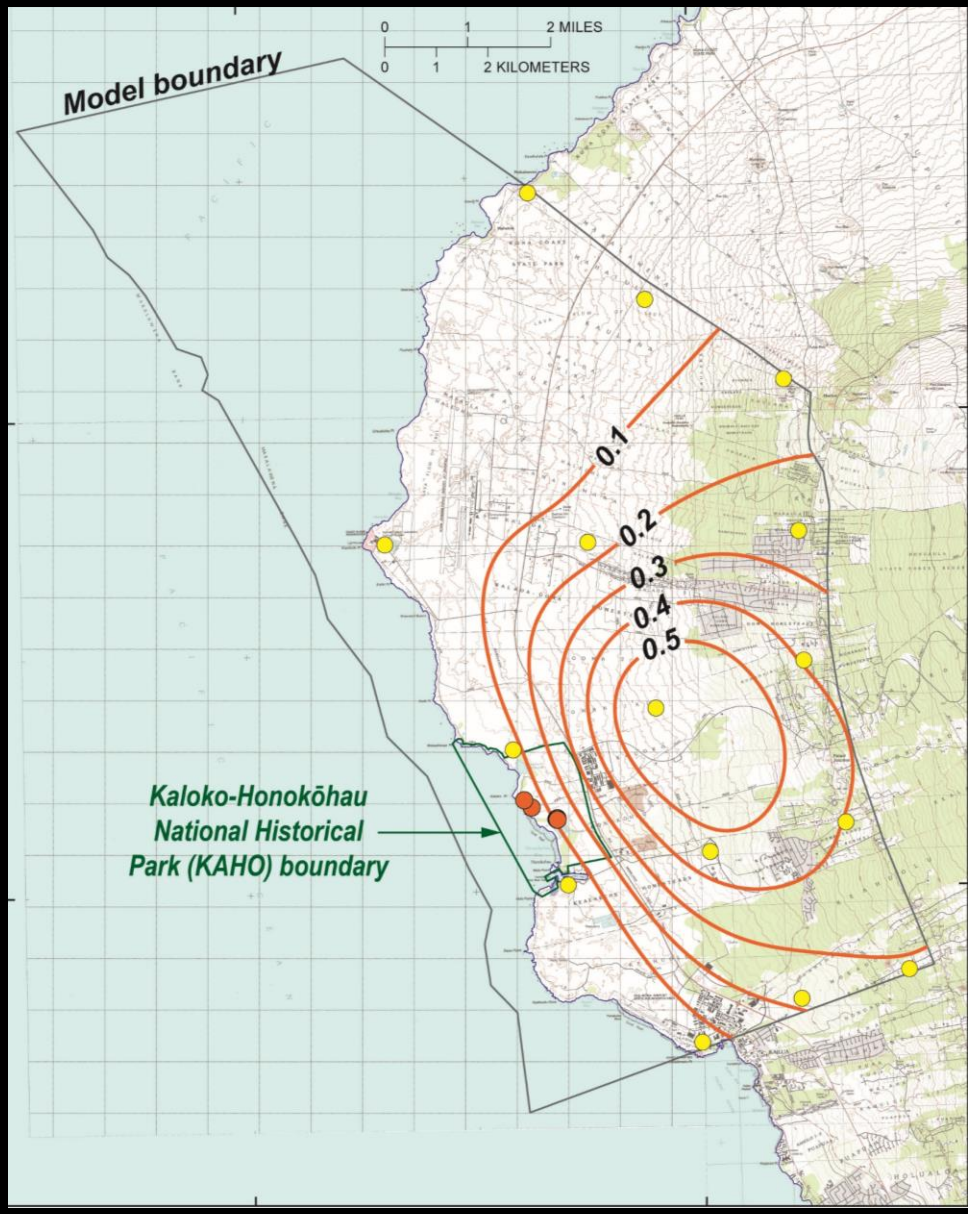
Scenario 1—Simulated Salinity Increase Caused by 0.5 Mgal/d Withdrawal

EXPLANATION

- 0.2 — Line of equal simulated salinity increase at damselfly anchialine-pool habitat caused by withdrawing 0.5 million gallons per day (Mgal/d) at sites on the line, in percent of ocean-water salinity
- Hypothetical well site of simulated withdrawal of 0.5 Mgal/d
- Anchialine-pool habitat for orangeblack Hawaiian damselfly (*Megalagrion xanthomelas*)



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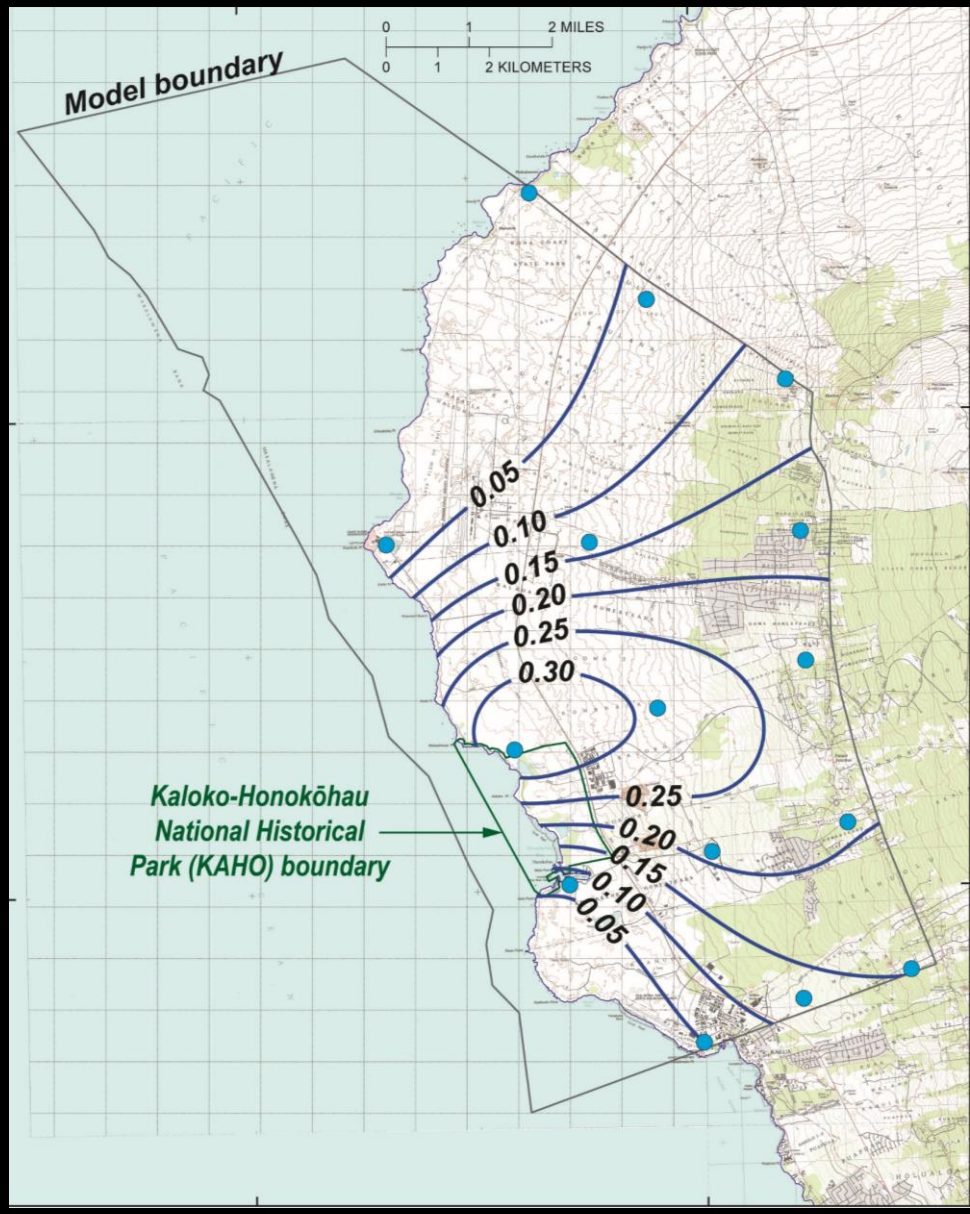
Scenario 2—Simulated Discharge Reduction Caused by 1.0 Mgal/d Withdrawal

EXPLANATION

0.10 Line of equal simulated freshwater-discharge reduction in KAHO caused by withdrawing 1.0 million gallons per day (Mgal/d) at sites on the line, in Mgal/d

Hypothetical well site of simulated withdrawal of 1.0 Mgal/d



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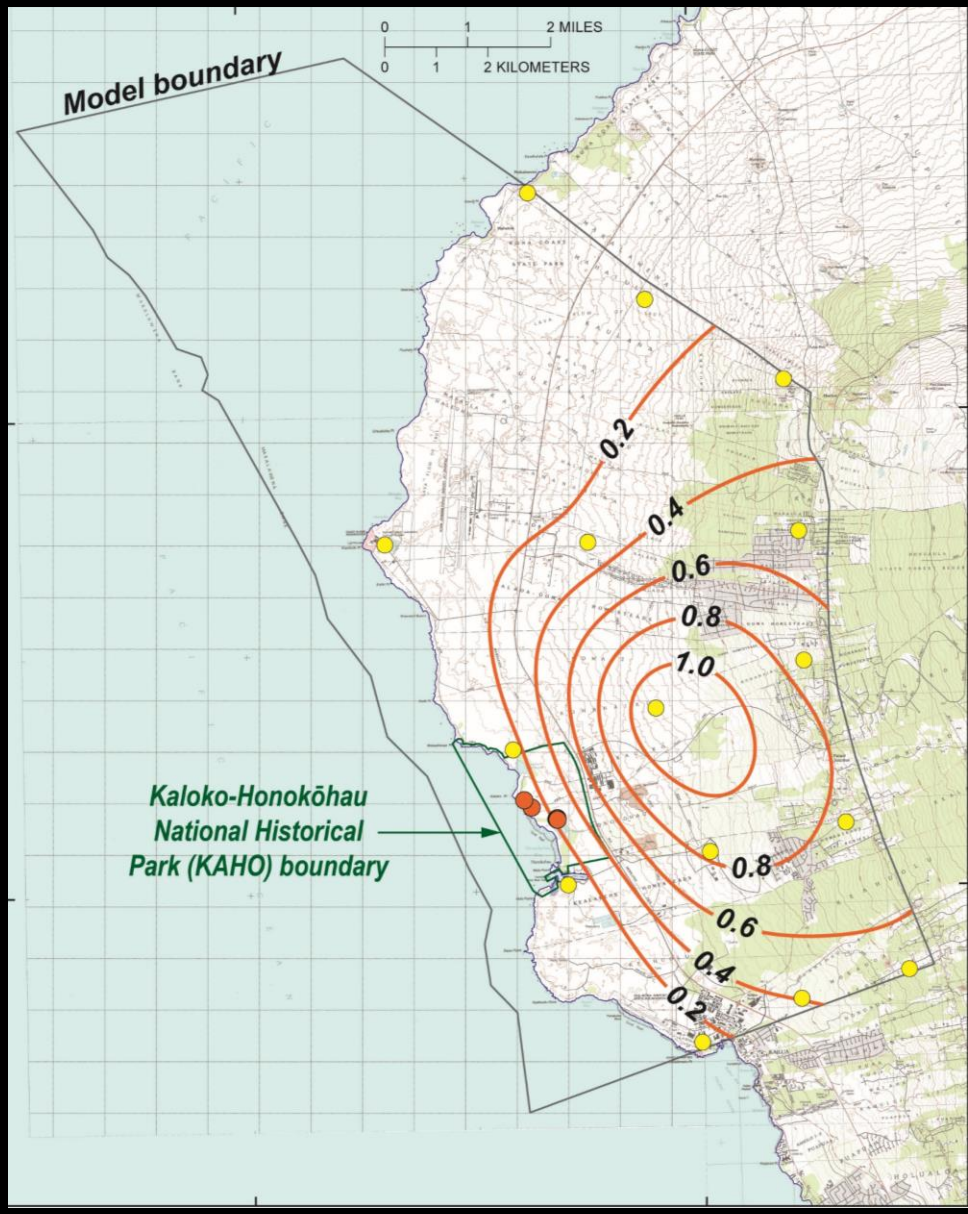
Scenario 2—Simulated Salinity Increase Caused by 1.0 Mgal/d Withdrawal

EXPLANATION

0.2 — Line of equal simulated salinity increase at damselfly anchialine-pool habitat caused by withdrawing 1.0 million gallons per day (Mgal/d) at sites on the line, in percent of ocean-water salinity

Hypothetical well site of simulated withdrawal of 1.0 Mgal/d

Anchialine-pool habitat for orangeblack Hawaiian damselfly (*Megalagrion xanthomelas*)



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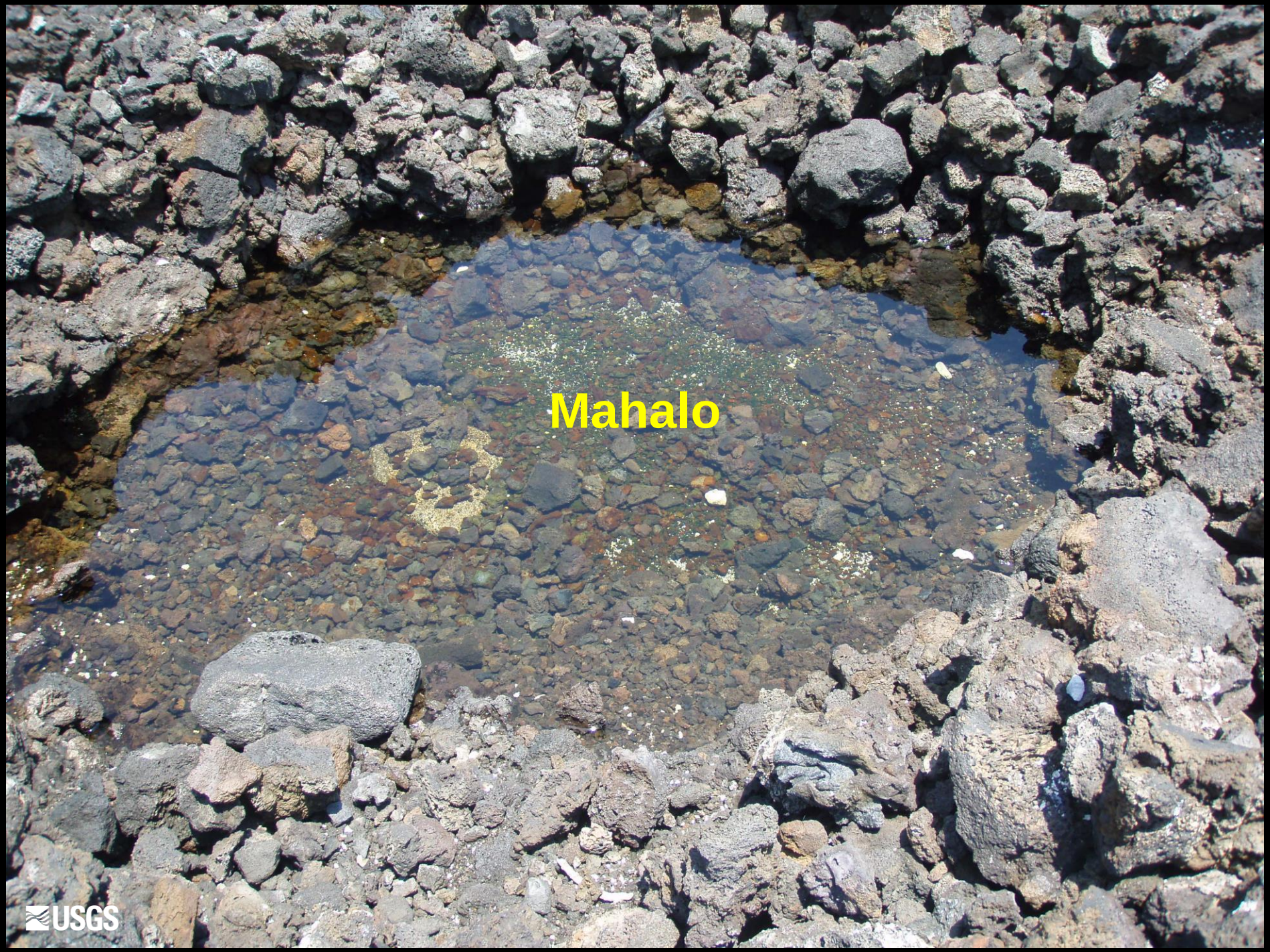
Summary and Conclusions

1. Withdrawal of additional groundwater from the coastal freshwater-lens system will affect the quality and quantity of groundwater discharge in KAHO

2. The magnitude of the hydrologic effect on KAHO caused by withdrawal is rate and site dependent

3. The ecologic effects of changes in the quality and quantity of groundwater in KAHO are uncertain

4. Our conceptual understanding of groundwater occurrence near KAHO will improve as additional information becomes available


Mahalo
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