MICHAEL P. VICTORINO
Mayor

JEFFREY T. PEARSON, P.E.
Director

HELENE KAU
Deputy Director

DEPARTMENT OF WATER SUPPLY
COUNTY OF MAUI
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAI'I 96793
www.mauicounty.gov/water

July 9, 2021

Honorable Michael P. Victorino
Mayor, County of Maui
200 South High Street
Wailuku, Hawaii 96793

APPROVED FOR TRANSMITTAL

Acting Mayor 7/14/21 Date

For Transmittal to:

Honorable Alice L. Lee
Council Chair
Maui County Council
200 South High Street
Wailuku, Hawaii 96793

Dear Chair Lee:

SUBJECT: A BILL FOR AN ORDINANCE AUTHORIZING THE MAYOR OF THE COUNTY OF MAUI TO ENTER INTO AN INTERGOVERNMENTAL AGREEMENT WITH THE U.S. GEOLOGICAL SURVEY, PACIFIC ISLANDS WATER SCIENCE CENTER, UNITED STATES DEPARTMENT OF THE INTERIOR

The Department of Water Supply would like to enter into a joint funding agreement with the U.S. Geological Survey, Pacific Islands Water Science Center, United States Department of the Interior (USGS) to initiate a study to assess groundwater availability under scenario- based recharge changes on the island of Maui during the period of October 1, 2021 to March 31, 2023. This study can help us to better understand how future groundwater demand can be met in the face of climate change and change in land cover.

"By Water All Things Find Life"

Section 2.20.020 of the Maui County Code, requires an ordinance to authorize the Mayor to enter into any intergovernmental agreement which places a financial obligation upon the County or any department or agency. Therefore, we respectfully request approval of the above referenced and furthermore attached proposed legislation.

Sincerely,

JEFFREY T. PEARSON, P.E.
Director

xc: Eva Blumenstein, Planning Program Manager

ORDINANCE NO. _____

BILL NO. _____ (2021)

A BILL FOR AN ORDINANCE AUTHORIZING THE MAYOR OF THE COUNTY OF MAUI TO ENTER INTO AN INTERGOVERNMENTAL AGREEMENT WITH U.S. GEOLOGICAL SURVEY, PACIFIC ISLANDS WATER SCIENCE CENTER, UNITED STATES DEPARTMENT OF THE INTERIOR (STUDY TO ASSESS GROUNDWATER AVAILABILITY UNDER SCENARIO-BASED RECHARGE CHANGES ON THE ISLAND OF MAUI)

BE IT ORDAINED BY THE PEOPLE OF THE COUNTY OF MAUI:

SECTION 1. Purpose. The U.S. Geological Survey, Pacific Islands Water Science Center, United States Department of the Interior ("USGS") desires to enter into a Joint Funding Agreement ("Joint Funding Agreement" or "Agreement") with the County of Maui Department of Water Supply ("MDWS") for a study to assess groundwater availability under scenario-based recharge changes on the island of Maui, during the period of October 1, 2021 to March 31, 2023. The total cost of the Agreement is $224,000 of which $168,000 would be contributed by the MDWS and $56,000 would be contributed by the USGS.

The objective of the study is to characterize optimal withdrawal distributions for local communities and water managers on Maui, subject to appropriate withdrawal-site and saltwater-intrusion constraints, for selected future land-cover and recharge scenarios. The Joint Funding Agreement is attached hereto and incorporated herein as Exhibit "1".

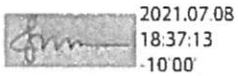
Section 2.20.020, Maui County Code, provides that, unless authorized by ordinance, the Mayor shall not enter into any intergovernmental agreement or any amendment thereto which places a financial obligation upon the County or any department or agency thereof.

SECTION 2. Authorization. The Council of the County of Maui hereby authorizes the Mayor or his authorized representative to execute the Agreement,

all other necessary documents relating to the Agreement, and any amendments thereto.

SECTION 3. Effective date. This ordinance shall take effect upon its approval.

APPROVED AS TO FORM
AND LEGALITY:



JENNIFER M.P.E. OANA
Deputy Corporation Counsel
County of Maui

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Pacific Islands Water Science Center
1845 Wasp Blvd, Bld 176
Honolulu, HI 96818

June 2, 2021

Ms. Eva Blumenstein
Planning Program Manager
County of Maui - Department of Water Supply
200 South High Street
Wailuku, Hawaii 96793-2155

Dear Ms. Blumenstein:

Enclosed is a copy of our standard joint-funding agreement for a study to assess groundwater availability under scenario-based recharge changes on the island of Maui, during the period October 1, 2021 through March 31, 2023 in the amount of $168,000 from your agency. U.S. Geological Survey contributions for this agreement are $56,000 for a combined total of $224,000. Please sign and return one fully-executed original to Bles May Daog at the address above.

Federal law requires that we have a signed agreement before we start or continue work. Please return the signed agreement by October 1, 2021. If, for any reason, the agreement cannot be signed and returned by the date shown above, please contact Stephen Zahniser by phone number (808) 690-9595 or email szahniser@usgs.gov to make alternative arrangements.

This is a fixed cost agreement to be billed quarterly via Down Payment Request (automated Form DI-1040). Please allow 30-days from the end of the billing period for issuance of the bill. If you experience any problems with your invoice(s), please contact Bles May Daog at phone number (808) 690-9601 or email at bdaog@usgs.gov.

The results of all work performed under this agreement will be available for publication by the U.S. Geological Survey. We look forward to continuing this and future cooperative efforts in these mutually beneficial water resources studies.

Sincerely,

John P. Hoffmann

John P. Hoffmann
Center Director

Enclosure
21ZHJFA00000085

EXHIBIT "1"

Form 9-1366
(May 2018)

U.S. Department of the Interior
U.S. Geological Survey
Joint Funding Agreement
FOR
Water Resource Investigations

Customer #: 6000001187
Agreement #: 21ZHJFA00000085
Project #: ZH00U6S
TIN #: 99-6000618

Fixed Cost Agreement YES[X] NO[ ]

THIS AGREEMENT is entered into as of the October 1, 2021, by the U.S. GEOLOGICAL SURVEY, Pacific Islands Water Science Center, UNITED STATES DEPARTMENT OF THE INTERIOR, party of the first part, and the County of Maui - Department of Water Supply party of the second part.

1 The parties hereto agree that subject to the availability of appropriations and in accordance with their respective authorities there shall be maintained in cooperation a study to assess groundwater availability under the scenario-based recharge changes on the island of Maui as described in the attached pre-proposal, herein called the program. The USGS legal authority is 43 USC 36C; 43 USC 50, and 43 USC 50b.

2. The following amounts shall be contributed to cover all of the cost of the necessary field and analytical work directly related to this program. 2(b) include In-Kind-Services in the amount of $0.00

(a) $56,000 by the party of the first part during the period October 1, 2021 to March 31, 2023

(b) $168,000 by the party of the second part during the period October 1, 2021 to March 31, 2023

(c) Contributions are provided by the party of the first part through other USGS regional or national programs, in the amount of $0

Description of the USGS regional/national program

(d) Additional or reduced amounts by each party during the above period or succeeding periods as may be determined by mutual agreement and set forth in an exchange of letters between the parties

(e) The performance period may be changed by mutual agreement and set forth in an exchange of letters between the parties.

3 The costs of this program may be paid by either party in conformity with the laws and regulations respectively governing each party.

4 The field and analytical work pertaining to this program shall be under the direction of or subject to periodic review by an authorized representative of the party of the first part.

5 The areas to be included in the program shall be determined by mutual agreement between the parties hereto or their authorized representatives. The methods employed in the field and office shall be those adopted by the party of the first part to insure the required standards of accuracy subject to modification by mutual agreement.

6 During the course of this program, all field and analytical work of either party pertaining to this program shall be open to the inspection of the other party, and if the work is not being carried on in a mutually satisfactory manner, either party may terminate this agreement upon 60 days written notice to the other party.

7 The original records resulting from this program will be deposited in the office of origin of those records. Upon request, copies of the original records will be provided to the office of the other party.

8 The maps, records or reports resulting from this program shall be made available to the public as promptly as possible. The maps, records or reports normally will be published by the party of the first part. However, the party of the second part reserves the right to publish the results of this program, and if already published by the party of the first part shall, upon request, be furnished by the party of the first part, at cost, impressions suitable for purposes of reproduction similar to that for which the original copy was prepared. The maps, records or reports published by either party shall contain a statement of the cooperative relations between the parties. The Parties acknowledge that scientific information and data developed as a result of the Scope of Work (SOW) are subject to applicable USGS review, approval, and release requirements, which are available on the USGS Fundamental Science Practices website (https://www.usgs.gov/about/organization/science-support/science-quality-and-integrity/fundamental-science-practices)

Form 9-1366
(May 2018)

U.S. Department of the Interior
U.S. Geological Survey
Joint Funding Agreement
FOR
Water Resource Investigations

Customer #: 6000001187
Agreement #: 21ZHJFA00000085
Project #: ZH00U65
TIN #: 99-6000618

9. Billing for this agreement will be rendered quarterly. Invoices not paid within 60 days from the billing date will bear interest, Penalties, and Administrative cost at the annual rate pursuant the Debt Collection Act of 1982, (codified at 31 U.S.C. § 3717) established by the U.S. Treasury.

USGS Technical Point of Contact

Name:	Stephen Zahniser Deputy Center Director
Address	1845 Wasp Blvd Bld 176 Honolulu, HI 96818
Telephone:	(808) 690-9595
Fax:	(808) 690-9599
Email	szahniser@usgs gov

Customer Technical Point of Contact

Name:	Eva Blumenstein Planning Program Manager
Address:	200 South High Street Wailuku, Hawaii 96793-2155
Telephone:	(808) 463-3102
Fax:	
Email:	eva blumenstein@co.maui.hi us

USGS Billing Point of Contact

Name	Bles May Daog Budget Analyst
Address:	1845 Wasp Blvd Bld 176 Honolulu, HI 96818
Telephone:	(808) 690-9601
Fax:	(808) 690-9599
Email	bdaog@usgs.gov

Customer Billing Point of Contact

Name.	Eva Blumenstein Planning Program Manager
Address	200 South High Street Wailuku, Hawaii 96793-2155
Telephone:	(808) 463-3102
Fax:	
Email:	eva.blumenstein@co.maui.hi.us

U.S. Geological Survey
United States
Department of Interior

Signature

By John P. Hoffmann Date: 06/02/21
Name: John P. Hoffmann
Title: Center Director

County of Maui
Department of Water Supply

Signatures

By_____ Date: _____
Name:
Title:

By_____ Date: _____
Name:
Title:

By_____ Date: _____
Name:
Title:

Groundwater Availability under Scenario-Based Recharge Changes, Maui, Hawai'i
U.S. Geological Survey, Pacific Islands Water Science Center
Pre-proposal, May 13, 2021

Introduction

Limited groundwater availability to meet future state needs is a leading concern for water managers in Hawai'i and particularly on the island of Maui. Increasing population, greater demand for groundwater, needs of groundwater-dependent ecosystems, changes in land-cover caused by humans, or invasive species, and climate change have heightened this concern. Reduction of groundwater recharge related to loss of irrigation-return flow, changing vegetation characteristics on the landscape, increased areas with built surfaces, or a drying climate can adversely affect groundwater availability (Engott and Vana, 2007; Engott, 2011; Engott and others, 2017; Izuka and others, 2018; Johnson and others, 2018; Mair and others, 2019; Brewington and others, 2019). Given that demand for groundwater on Maui is likely to increase, understanding how plausible changes in recharge can affect groundwater availability is critical for management of the resource.

A numerical groundwater model is the best available tool for evaluating how changes in groundwater recharge affect groundwater availability. Because pump rate is a variable that can be controlled in a groundwater-flow simulation, it can systematically be varied in the groundwater model to converge on an optimal withdrawal distribution under defined constraints (White and others, 2020). Knowledge about an optimal withdrawal distribution for future recharge scenarios will inform water managers on strategies to meet future demands.

Problem statement

Uncertainty in groundwater availability in a future climate and for future land-cover conditions on Maui leads to a need to better understand how future groundwater demands can be met.

Objectives

The objective of this proposed study is to characterize optimal withdrawal distributions for local communities and water mangers on Maui, subject to appropriate withdrawal-site and saltwater-intrusion constraints, for selected future land-cover and recharge scenarios.

Approach

This proposed study will use published climate and land-cover conditions to create a set of future recharge estimates that will be used as input to an existing island-wide groundwater-flow model. A mid-century "dry" climate scenario for this study will use statistically downscaled rainfall projections for 2041–70 under representative concentration pathway 8.5 (Elison Timm and others, 2015). Future land-cover scenarios were developed by the Pacific Regional Integrated Sciences and Assessments (Pacific RISA) program (Brewington and others, 2017; Brewington, 2018) using a stakeholder-driven process. This process considered forest conservation, agriculture and ranching, urban development, and freshwater use to identify four future land-cover scenarios, which are generally characterized as (1) business-as-usual, (2) conservation, (3) intensive development, and (4) balanced conservation and development. Recharge will be estimated with a water-budget approach that incorporates projected rainfall, and current (2020) and two Pacific RISA future land-cover scenarios: business-as-usual and

balanced conservation and development. The recharge estimates will be used as inputs to the groundwater model to quantify how future withdrawals can be maximized given defined constraints on acceptable effects on groundwater resources and infrastructure, thereby providing water managers with quantitative and direct information on how to meet future water demand.

The groundwater-flow model was constructed using MODFLOW-2005 (Harbaugh, 2005) with the Seawater Intrusion package (Bakker and others, 2013), which allows simulation of freshwater and saltwater in ocean-island aquifers and is calibrated to 2001–10 conditions (Izuka and others, 2021). The pump-optimization simulation will be developed using the PEST++ framework (White and others, 2018; White and others, 2020) under the following constraints:

(1) Sites and depths of existing and proposed new wells (with input from MDWS) are predefined.
(2) Withdrawals at each well cannot exceed a specified rate, possibly a fraction of the pump capacity.
(3) Total withdrawals in each State of Hawaii Commission on Water Resource Management aquifer system (with input from MDWS) are predefined.
(4) The simulated depth of the freshwater/saltwater interface must include a buffer between the well bottoms and interface.

The amount of discharge to streams and ocean in each aquifer system will be quantified for the scenarios. Results of this study will build climate-adaptation capacity by evaluating how groundwater availability may be affected by plausible changes in groundwater recharge and will build upon information and capabilities developed in previous studies. Results will characterize optimal withdrawal distributions for specified constraints and projected mid-century climate conditions.

This study is anticipated to start October 1, 2021 and require 1.5 years to complete at a cost of $168K for MDWS. Additional funding will be provided by Pacific RISA and the USGS will contribute $56K in matching funds. Preliminary results will be shared with cooperators prior to the completion of the study, within the first 12 months. The approach and results of the study will be documented in a U.S. Geological Survey Scientific Investigations Report or a journal article.

Timeline: Groundwater Availability under Scenario-Based Recharge Changes, Maul, Hawai'i

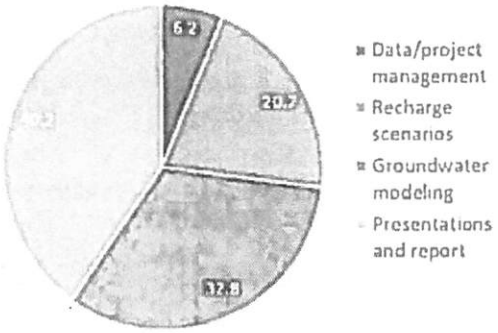
Task	Month																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Groundwater Availability																		
Recharge scenarios																		
Prepare optimization																		
Groundwater modeling																		
Cooperator Meetings																		
Initial, Final																		
Report																		
Report writing																		
Report review and revision																		
Layout																		
Publication																		

Budget

Budget summary in dollars

	Total
Pacific RISA	20,000
USGS	56,000
MDWS	168,000
Total	244,000

Budget distribution by task, in percent



References

Bakker, M., Schaars, F., Hughes, J.D., Langevin, C.D., and Dausman, A.M., 2013, Documentation of the seawater intrusion (SWI2) package for MODFLOW: U.S. Geological Survey Techniques and Methods Book 6, Chap. A46, 47 p., at https://pubs.usgs.gov/tm/6a46/.

Brewington, L., 2018, Maui future land cover scenarios: East-West Center, Honolulu, Hawaii data release version 1.1, accessed September 23, 2020, at https://www.pacificrisa.org/projects/maui-groundwater-project/building-the-scenarios.

Brewington, L., Keener, V., Finucane, M., and Eaton, P., 2017, Participatory scenario planning for climate change adaptation using remote sensing and GIS, *in* Liang, S. and Walsh, S.J. eds., Comprehensive Remote Sensing, Applications for Societal Benefits: Elsevier, Amsterdam, The Netherlands, p. 236–252.

Brewington, L., Keener, V., and Mair, A., 2019, Simulating land cover change impacts on groundwater recharge under selected climate projections, Maui, Hawai'i: Remote Sensing, v. 11, no. 24, p. 3048, at https://doi.org/10.3390/rs11243048.

Elison Timm, O., Giambelluca, T.W., and Diaz, H.D., 2015, Statistical downscaling of rainfall changes in Hawai'i based on the CMIP5 global model projections: Journal of Geophysical Research, v. Atmospheres, no. 120, p. 92–112.

Engott, J.A., 2011, A water-budget model and assessment of groundwater recharge for the Island of Hawai'i: U.S. Geological Survey Scientific Investigations Report 2011–5078, 53 p., at https://doi.org/10.3133/sir20115078.

Engott, J.A., Johnson, A.G., Bassiouni, M., Izuka, S.K., and Rotzoll, K., 2017, Spatially distributed groundwater recharge for 2010 land cover estimated using a water-budget model for the Island of O'ahu, Hawai'i (ver. 2.0, Dec 2017): U.S. Geological Survey Scientific Investigations Report 2015–5010, 49 p., at https://pubs.er.usgs.gov/publication/sir20155010.

Engott, J.A., and Vana, T.T., 2007, Effects of agricultural land-use changes and rainfall on ground-water recharge in central and west Maui, Hawaii, 1926-2004: U.S. Geological Survey Scientific Investigations Report 2007–5103, 56 p.

Harbaugh, A.W., 2005, MODFLOW-2005, the U.S. Geological Survey modular ground-water model - The ground-water flow process: U.S. Geological Survey Techniques and Methods 6-A16, variously p.

Izuka, S.K., Engott, J.A., Rotzoll, K., Bassiouni, M., Johnson, A.G., Miller, L., and Mair, A., 2018, Volcanic aquifers of Hawai'i—Hydrogeology, water budgets, and conceptual models (ver 2.0, Mar 2018): U.S. Geological Survey Scientific Investigations Report 2015–5164, 158 p., at https://doi.org/10.3133/sir20155164.

Izuka, S.K., Rotzoll, K., and Nishikawa, T., 2021, Volcanic aquifers of Hawai'i—Construction and calibration of numerical models for assessing groundwater availability on Kaua'i, O'ahu, and Maui: U.S. Geological Survey Scientific Investigations Report 2020–5126, 63 p., at https://doi.org/10.3133/sir20205126.

Johnson, A.G., Engott, J.A., Bassiouni, M., and Rotzoll, K., 2018, Spatially distributed groundwater recharge estimated using a water-budget model for the Island of Maui, Hawai'i, 1978-2007 (ver. 2.0, February 2018): U.S. Geological Survey Scientific Investigations Report 2014–5168, 53 p., at https://doi.org/10.3133/sir20145168.

Mair, A., Johnson, A.G., Rotzoll, K., and Oki, D.S., 2019, Estimated groundwater recharge from a water-budget model incorporating selected climate projections, Island of Maui, Hawai'i: U.S. Geological Survey Scientific Investigations Report 2019–5064, 46 p., at https://doi.org/10.3133/sir20195064.

White, J.T., Fienen, M.N., Barlow, P.M., and Welter, D.E., 2018, A tool for efficient, model-independent management optimization under uncertainty: Environmental Modelling and Software, v. 100, p. 213–221.

White, J.T., Hunt, R.J., Fienen, M.N., and Doherty, J.E., 2020, Approaches to Highly Parameterized Inversion: PEST++ Version 5, a Software Suite for Parameter Estimation, Uncertainty Analysis, Management Optimization and Sensitivity Analysis: U.S. Geological Survey Techniques and Methods 7C26, 52 p., at https://doi.org/10.3133/ tm7C26.