WR Doc ID: 4341866

DEPARTMENT OF ECOLOGY
State of Washington

STATE OF WASHINGTON
DRAFT
REPORT OF EXAMINATION
FOR WATER RIGHT APPLICATION

PRIORITY DATE	WATER RIGHT APPLICATION NUMBER
March 1, 2007	G1-28489

NAME AND MAILING ADDRESS	SITE ADDRESS (IF DIFFERENT)
Washington Water Service PO Box 336 Gig Harbor WA 98335	13220 Phelps Road NE Bainbridge Island, WA

Total Rate and Quantity Authorized for Withdrawal

WITHDRAWAL RATE (gpm)	ANNUAL QUANTITY (ac-ft/yr)
20*	7.4

gpm = Gallons per Minute; ac-ft/yr = Acre-feet per Year; *G1-28489 and G1-20291C share the same 20 gpm

Attention: The instantaneous rate of withdrawal is *non-additive* with respect to certificate G1-20291C. The annual quantity is *additive*. The total rate and quantity that may be withdrawn under these two rights is 20 gpm and 10.4 ac-ft/yr.

Associated Water Right(s)

DOCUMENT NUMBER	INSTANTANEOUS RATE (gpm)	ANNUAL QUANTITY (ac-ft/yr)	REMARKS
G1-20291C	20	3.0	Currently serving 21 of 26 connections

Purpose(s)

PURPOSE	WITHDRAWAL RATE (gpm)		ANNUAL QUANTITY (ac-ft/yr)		PERIOD OF USE
	ADDITIVE	NON-ADDITIVE	ADDITIVE	NON-ADDITIVE	
Municipal Supply		20	7.4		Jan 1 to Dec 31

IRRIGATED ACRES		PUBLIC WATER SYSTEM INFORMATION	
ADDITIVE	NON-ADDITIVE	WATER SYSTEM NAME and ID	CONNECTIONS
		Phelps Road, ID# 63210W	26

Source Location

COUNTY	WATERBODY	TRIBUTARY TO	WATER RESOURCE INVENTORY AREA
Kitsap	Groundwater	N/A	15-Kitsap

SOURCE NAME	PARCEL	WELL TAG	TOWNSHIP	RANGE	SECTION	QQ Q	LATITUDE	LONGITUDE
Well #1	032502-3-028-2004	AAC 014	25 N	2 E	3	NE SW	47.68308N	122.53475W

SOURCE NAME	PARCEL	WELL TAG	TOWNSHIP	RANGE	SECTION	QQ Q	LATITUDE	LONGITUDE
Well #2	032502-3-028-2004	AAC 013	25 N	2 E	3	NE SW	47.68310N	122. 53466W

QQ Q = Quarter Quarter Datum: NAD83/WGS84

Source Limitations

Total rate of withdrawal shall not exceed 20 gpm and 10.4 ac-ft/yr from all sources.

Place of Use

PARCEL(S)
032502-3-005-2001, 032502-3-036-2004, 032502-3-054-2001, 032502-3-006-2000, 032502-3-007-2009, 032502-3-027-2005, 032502-3-028-2004, 032502-3-008-2008, 032502-3-043-2005, 032502-3-039-2001, 032502-3-041-2007, 032502-3-017-2007, 032502-3-016-2008, 032502-3-035-2005, 032502-3-032-2008, 032502-3-033-2007, 032502-3-058-2007, 032502-3-031-2009, 032502-3-047-2001, 032502-3-057-2008, 032502-3-018-2006, 032502-3-019-2005

LEGAL DESCRIPTION OF THE AUTHORIZED PLACE OF USE
Area served by the Phelps Road Water System as described in the Washington Water Service Umbrella Water System Plan as approved by the Washington Department of Health on April 29, 2021.

Attention: If the criteria in RCW 90.03.386(2) are not met and a Water System Plan/Small Water System Management Program was approved after September 9, 2003, the place of use of this water right is the service area described in that document. If the criteria in RCW 90.03.386(2) are not met and no Water System Plan/Small Water System Management Program has been approved after September 9, 2003, the place of use reverts to the last place of use described by the Department of Ecology in a water right authorization.

Proposed Works

Applicant seeks to utilize existing infrastructure to serve Municipal Supply to 21 current connections and up to 26 connections as approved by DOH.

Development Schedule

BEGIN PROJECT BY THIS DATE	COMPLETE PROJECT BY THIS DATE	PUT WATER TO FULL USE BY THIS DATE
Begun	Completed	March 1, 2027

Attention: These dates represent deadlines that must be met or risk cancellation of this authorization. Submittal of formal documentation for each stage is required. Extensions may be requested.

Measurement of Water Use

HOW OFTEN MUST WATER USE BE MEASURED AND RECORDED?	Bi-weekly
HOW OFTEN MUST WATER USE DATA BE REPORTED TO ECOLOGY?	Annually by January 31
WHAT QUANTITY SHOULD BE REPORTED?	Total annual quantity in acre-feet
WHAT RATE SHOULD BE REPORTED?	Annual peak rate of withdrawal in gpm

Provisions

Measurements, Monitoring, Metering, and Reporting
An approved measuring device must be installed and maintained for each of the sources identified by this water right in accordance with the rule "Requirements for Measuring and Reporting Water Use", chapter 173-173 WAC, which describes the requirements for data accuracy, device installation and operation, and information reporting. It also allows a water user to petition the Department of Ecology (Ecology) for modifications to some of the requirements.

Recorded water use data shall be submitted electronically. To set up an Internet reporting account, contact the Region Office. If you do not have Internet access, you can still submit hard copies by contacting the Region Office for forms to submit your water use data.

Proof of Appropriation
Consistent with the development schedule given in this report (unless extended by Ecology), the water right holder must file a Notice of Proof of Appropriation (PA) of Water with Ecology. The PA documents the project is complete and all the water needed has been put to full beneficial use (perfected). In order to verify the extent of water use under this permit, an inspection of water use is typically required, known as a "proof exam". After filing the PA, the water right holder's next step is to hire a Certified Water Rights Examiner (CWRE) to conduct this proof exam. A list of CWREs is provided to the water right holder upon filing the PA with Ecology. The final water right document, a water right certificate, then may issue based upon the findings of the CWRE. Statutory county and state filing fees may apply prior to certificate issuance.

Schedule and Inspections
Department of Ecology personnel, upon presentation of proper credentials, shall have access at reasonable times, to the project location, and to inspect at reasonable times, records of water use, wells, diversions, measuring devices and associated distribution systems for compliance with water law.

Findings of Fact and Order

Upon reviewing the investigator's report, I find all facts, relevant and material to the subject application, have been thoroughly investigated.

Therefore, I ORDER **APPROVAL** of Application No. G1-28489, subject to existing rights and the provisions specified above.

Your Right To Appeal

You have a right to appeal this Order to the Pollution Control Hearings Board (PCHB) within 30 days of the date of receipt of this Order. The appeal process is governed by chapter 43.21B RCW and chapter 371-08 WAC. "Date of receipt" is defined in RCW 43.21B.001(2).

To appeal, you must do the following within 30 days of the date of receipt of the Order:

- File your appeal and a copy of this Order with the PCHB (see addresses below). Filing means actual receipt by the PCHB during regular business hours.
- Serve a copy of your appeal and this Order to Ecology in paper form - by mail or in person (see addresses below). E-mail is not accepted.

You must also comply with other applicable requirements in chapter 43.21B RCW and chapter 371-08 WAC.

Street Addresses	Mailing Addresses
Department of Ecology Attn: Appeals Processing Desk 300 Desmond Drive SE Lacey, WA 98503 **Pollution Control Hearings Board** 1111 Israel RD SW, Ste 301 Tumwater, WA 98501	**Department of Ecology** Attn: Appeals Processing Desk PO Box 47608 Olympia, WA 98504-7608 **Pollution Control Hearings Board** PO Box 40903 Olympia, WA 98504-0903

For additional information, visit the Environmental Hearings Office Website: http://www.eho.wa.gov. To find laws and agency rules, visit the Washington State Legislature Website: http://www1.leg.wa.gov/CodeReviser.

Authorizing Signature

Signed at Shoreline, Washington, this _____ day of _____, 2022.

_____

Kasey Cykler, Section Manager
Water Resources Program/Northwest Regional Office
Department of Ecology

INVESTIGATOR'S REPORT

Water Right Application No.: G1-28489 (Washington Water Service Company)
Investigator: Douglas H. Wood. MS, P.Geo, LHG

BACKGROUND

This report serves as the written findings of fact concerning Water Right Application Number G1-28489.

The proposed appropriation will add sufficient annual quantity to the Phelps Road Water System water rights portfolio to adequately serve 21 existing and 26 projected connections. No additional instantaneous withdrawal rate is proposed.

The applicant seeks an additional annual quantity (Qa) of 7.4 acre-feet and will share existing Qi of 20 gpm with certificate G1-20291C through up to two wells, one of which already is completed under G1-20291C.

The system currently serves 21 connections under G1-20291C, which authorizes withdrawal of 3.0 ac-ft/yr. This equates to about 100 gallons per day (gpd) per connection, less than ½ of what is likely actually being used based on the location. Current use is more likely to be between 7.3 and 10.2 acre-feet per year based on typical exurban use of between 250 to 350 gallons per day/connection.

Table 1: Summary of Requested Water Right

Applicant Name	Washington Water Service Company
Priority Date	March 1, 2007
County	Kitsap
WRIA	15-Kitsap
Water Source	Groundwater
Place of Use	Service area of the Phelps Road Water System as described in the most recent Water System Plan.

Purpose	Instantaneous Rate (gpm)	Annual Quantity (ac-ft/yr)	Begin Season	End Season
Municipal Supply	20*	7.4	Jan 1	Dec 31

* Non-Additive

Source Name	Parcel	Well Tag	Township	Range	Section	QQ Q	Latitude	Longitude
Well #1	032502-3-028-2004	AAC 014	25 N	2 E	3	NE SW	47.68308N	122.53475W
Well #2	032502-3-028-2004	AAC 013	25 N	2 E	3	NE SW	47.68310N	122. 53466W

WRIA = Water Resource Inventory Area; gpm = Gallons per Minute; ac-ft/yr = Acre-feet per Year; QQ Q = Quarter Quarter Datum: NAD83/WGS84

INVESTIGATION

This investigation included reviews of existing water rights in the area, the hydrogeological setting, and an analysis of technical reports prepared for Washington Water Service by Robinson and Noble, Inc. and USGS hydrogeological reports of Bainbridge Island and the Kitsap Watershed.

Proposed Use and Basis of Water Demand

Site Description

The project site is located in the north central portion of Bainbridge Island. Like much of the Puget Lowland, the topography of the site is of rolling north-south elongated hills created along the base of the Puget Lobe of the Cordilleran Icesheet.

Water System Description

The Phelps Road Water System serves 21 residential connections located in the north central portion of Bainbridge Island, Kitsap County, WA. DOH has approved up to 26 connections.

The existing system includes two wells that are the points of withdrawal proposed for use in this application.

History of Water Use

The Phelps Road Water System was constructed in the early 1970s and was originally intended to serve only four homes utilizing water under certificate G1-20291C. The system subsequently grew to include 21 homes. No information was found in the water right records for certificate G1-20291C that explains the growth of the system from 4 to 21 homes. Note however that the certificate does not reference any limitation to the number of domestic connections.

Proposed Use

The proposal here is to bring the system into compliance with the quantity of water needed to serve 26 connections anticipated at full buildout. The 3.0 acre-feet allocated under G1-20291C is not sufficient to adequately serve more than about 8 homes assuming typical exurban use patterns of about 250 to 350 gallons per day (gpd) per connection. Based on the same water duty, approximately 7.3 to 10.2 acre-feet per year would be needed to provide adequate supply for a 26 connection system.

Other Rights Associated with Project or Place of Use

Groundwater right G1-20291C, based on a priority date of September 22, 1972, allocated 20 gpm and 3.0 acre-feet/yr for group domestic supply. While the application proposed four connections, the certificate, issued in 1974, did not state any limitation on the number of connections.

Hydrogeologic Evaluation

The USGS has extensively studied the project area including surficial geological mapping (Haugerud, 2005) and conceptual and numerical modeling of the Bainbridge Island groundwater system (Frans et al., 2011) and the Kitsap peninsula groundwater system (Welch, et al., 2014; Frans and Olsen, 2016).

The hydrogeological setting of the proposed source is an example of a perched island confined aquifer within the Puget Sound Aquifer System (Jones, 1998).

The Phelps Road wells are completed within the Vashon Advance Aquifer (Qva), which on Bainbridge Island occurs underlying upland areas. Qva is overlain by glacial till (Qvt) where not eroded. In the immediate area of the proposed source, the Qva is partially confined with some areas NW of the well site unconfined where the overlying till has been eroded. East, southeast and south of the Phelps Road wells, Qva is missing, having been either eroded away or not deposited in this area. Groundwater flow within the Qva appears to be northward toward Hidden Cove (Welch et al, 2014).

Conceptual and numerical modeling of the source indicates no hydraulic connection between the source aquifer and streams further south on Bainbridge Island (Becker, 2021; Appendix A). Ecology has thoroughly reviewed the materials submitted in support of this application and finds the analysis and findings to be well-supported and reasonable.

Materials Submitted in Support of Application

Becker (2021): Aquifer Testing, Groundwater Modeling, and Impairment Analysis for Washington Water Service Company Water Right Application G1-28489; Robinson Noble, Inc., 12 pages.

This report discusses the following:

- Aquifer testing to determine pumping rates and sustainability of the proposed withdrawal
- Steady state numerical modeling of the proposed new appropriation
- Conceptual hydrogeological assessment of the proposed new appropriation
- Potential impairment of instream resources

The report concludes that:

- Aquifer testing confirms the appropriation can be sustainably acquired using the proposed source.
- Steady State numerical and conceptual groundwater modeling of the proposed withdrawal show that the proposed withdrawal will not impair instream values in water bodies regulated under chapter 173-515 WAC (Murden Creek).
    - All modeled impacts on Murden Creek are below the error limits of the model.
    - The source aquifer (Qva) is missing in the interval separating the proposed new well and the regulated water body located approximately one mile south of the proposed point of withdrawal.

ANALYSIS

Under Washington State law (RCW 90.03.290), each of the following four criteria must be met for an application for a new water right permit to be approved:

- Water must be available for appropriation.
- Water withdrawal and use must not cause impairment of existing water rights.
- The proposed water use must be beneficial.
- Water use must not be detrimental to the public interest (public welfare).

Water Availability

For any new appropriation, water must be both physically and legally available.

Physical Availability

For water to be physically available for appropriation, water must be present in quantities and quality and on a sufficiently frequent basis to provide a reasonably reliable source for the requested beneficial use or uses. An analysis of physical availability is required for both surface water and groundwater applications.

The system has been serving 21 connections for many years with no indication that water was not available from the aquifer. As such, it is clear that water is physically available for the proposed project.

Legal Availability

To meet the legal availability test, the proposed appropriation may not withdraw and use water that is already "spoken for", such as water from sources that are protected by administrative rule or court order.

The nearest closed stream is the stream that flows into Murden Cove located approximately one mile south of the proposed point of withdrawal (Becker, 2021; Appendix A - Figure 2). As discussed in the hydrogeological analysis section of this report, the aquifer providing water for the proposed withdrawal, the Vashon Aquifer (Qva), is disconnected from the aquifer that is hydraulically connected to the stream draining into Murden Cove (Appendix A, Figure 3b).

Water is therefore legally available from the proposed source aquifer and point of withdrawal.

Impairment

In analyzing impairment, Ecology must make a determination as to whether existing water rights, including adopted instream flows, may be impaired by the withdrawal and proposed use.

Other water rights in the vicinity of the subject wells include 2 certificated rights and 32 claims to vested water rights under chapter 90.14 RCW.

Table 2: Certificated water rights in the vicinity of the proposed withdrawal

Document No.	Person or Organization	Priority Date	Qi (gpm)	Qa (Ac-Ft/Yr)	TRS	QQ	Q
R1-20365C	Green Don A,	11/21/1972		7.0	25N-02E-03	SE	SW
G1-20366C	Green Don A,	11/21/1972	20.0	30.0	25N-02E-03	SE	SW

There are 2 additional certificated water rights located in the vicinity of the proposed project, R1-20356C and G1-20366C, with priority dates of November 21, 1972. The groundwater right (G1-20366C) allocated 20 gpm and 30 acre-feet to serve commercial, domestic and fish rearing. Surface runnoff and possibly groundwater were the sources of 7.0 acre-feet of water stored under the reservoir right (R1-20365C).

Don Green, the original water right holder for these rights, operated a sport fishing manufacturing business approximately 1/4 mile north of the proposed point of withdrawal. The business continues to operate as a sport fishing supply company under the name Sage Manufacturing.

Sage Manufacturing management was contacted by Ecology on January 26, 2022. When asked if their water right has been impaired by the Phelps Road water system's use of their well, they stated that there has been no observable negative impact since they began operations in the 1980s.

Ecology's well database shows there are 3 wells located within the NE 1/4 of the SW 1/4 of Section 3, Township 25N, Range 2E. Two of these wells are the wells of the Phelps Road system and the third is a domestic well located approximately 300 feet NE of the Phelps Road system wells. All three wells are completed in the Qva aquifer. Pumping tests performed at the time of well construction show 10 feet or less of draw down and rapid recovery for all three wells. Available head for all three wells is well in excess of drawdown.

There are no water bodies with minimum instream flows on Bainbridge Island, therefore impairment of minimum flows is not an issue for this application.

There are no indications that the proposed withdrawal will impair existing water rights or instream flows adopted under chapter 173-515 WAC.

Beneficial Use

The proposed appropriation must be for a beneficial use of water.

Municipal Supply is a beneficial use of water as defined in RCW 90.54.020(1).

Public Interest

The withdrawal and associated use must not be detrimental to the public interest. At a minimum, the following is considered when making this assessment.

Notification to the Washington Department of Fish and Wildlife

Per RCW 90.03.280 and 77.57.020, Ecology must give notice to the Washington Department of Fish and Wildlife (WDFW) of applications to divert, withdraw, use, or store water.

WDFW was provided notice of this water right application on January 19, 2022. Ecology received a reply from Steve Boessow, Water Rights Biologist with WDFW on January 20, 2022.

In his letter, Mr. Boessow responded that "Based on impacts to fish and/or wildlife and the habitat they rely on, and pursuant to 77.57.020 RCW, WDFW does not oppose the issuance of this application. While there is a fish bearing stream less than a half mile from the well site, it is upgradient and to the east of the point of withdrawal. The most likely flow of water is to the north into Hidden Cove."

State Environmental Policy Act (SEPA)

Under chapter 197-11 WAC, a water right application is subject to a SEPA threshold determination (i.e., an evaluation of whether there will be significant adverse environmental impacts) if any of the following conditions are met:

- It is a surface water right application for more than 1 cfs, unless that project is for agricultural irrigation, in which case the threshold is increased to 50 cfs, so long as that irrigation project will not receive public subsidies;
- It is a groundwater right application for more than 2,250 gpm;
- It is an application that, in combination with other water right applications for the same project, collectively exceed the amounts above;
- It is a part of a larger proposal that is subject to SEPA for other reasons (e.g., the need to obtain other permits that are not exempt from SEPA);
- It is part of a series of exempt actions that, together, trigger the need to do a threshold determination, as defined under WAC 197-11-305.

Considering that none of the above conditions are met, the application under review is categorically exempt from a SEPA threshold determination.

Public Notice

RCW 90.03.280 requires that notice of a water right application be published once a week, for two consecutive weeks, in a newspaper of general circulation in the county or counties where the water is to be stored, diverted, and used. Notice of this application was published in the *Bainbridge Island Review* on February 18, 2022 and February 25, 2022. An Affidavit of Publication was received electronically on March 4, 2022.

Ecology received no protests to this water right application prior to the publication of this report.

Other Public Interest Concerns

Ecology informed the Suquamish Tribe of the proposed appropriation on January 19, 2022. No comments were received from the Tribe regarding this application.

The Phelps Road Water System is currently serving 21 homes through a water right (G1-20291C) authorized to serve only 3.0 acre-feet per year. Approval of this request for additional Qa of 7.4 acre-feet per year will bring the system into compliance with annual quantity limits necessary for a public water system. This application anticipates five additional connections through development of this application. DOH currently approves up to 26 connections.

Conclusions

I find that:

- Water is physically and legally available.
- The appropriation will not impair existing rights.
- The proposed use for Municipal Supply is a beneficial use.
- Approval of this application will not be detrimental to the public interest.

RECOMMENDATIONS

Based on the above investigation and conclusions, I recommend this request for a water right be **APPROVED** in the amounts and within the limitations listed below and subject to the provisions listed above.

Recommended Quantities, Purpose of Use, and Project Location

The rate and quantity of water recommended are maximum limits. The permit holder may only withdraw water at a rate and quantity within the specified limits that are reasonable and beneficial:

Table 2: Recommended Limits and Location

Maximum Instantaneous Rate (gpm)	20 gallons per minute
Maximum Annual Quantity (ac-ft/yr)	7.4 acre-feet per year
Purpose(s) of Use	Municipal Supply
Points of Withdrawal	NE¼, SW¼, Section 3, Township 25 North, Range 2E, W.M.
Place of Use	See Location Map (Attachment 1)

Douglas H. Wood, M.Sc., P.Geo., LHG *Date*

To request ADA accommodation including materials in a format for the visually impaired, call Ecology Water Resources Program at 360-407-6872. Persons with impaired hearing may call Washington Relay Service at 711. Persons with speech disability may call TTY at 877-833-6341.

References

Becker, Joseph, 2021, Aquifer Testing, Groundwater Modeling, and Impairment Analysis for Washington Water Services Company Water, Right Application G1-28489,

Frans, L.M., Bachmann, M.P., Sumioka, S.S., and Olsen, T.D., 2011, Conceptual model and numerical simulation of the groundwater-flow system of Bainbridge Island, Washington: U.S. Geological Survey Scientific Investigations Report 2011–5021, 96 p.

Frans, LM and Olsen, TD, 2016, Numerical simulation of the groundwater-flow system of the Kitsap Peninsula, west-central Washington; U.S. Geological Survey Scientific Investigations Report 2016-5052, 63 p.

Haugerud, Ralph, 2005, Preliminary geologic map of Bainbridge Island, Washington: U.S. Geological Survey Open-File Report 2005-1387, 1 pl.

Jones, MA, 1998, Geologic Framework for the Puget Sound Aquifer System, Washington and British Columbia; U.S. Geological Survey Professional Paper 1424-C, 31 p.

Welch, WB, Frans, LM, and Olsen, TD, 2014, Hydrogeologic framework, groundwater movement, and water budget of the Kitsap Peninsula, west-central Washington; U.S. Geological Survey Scientific Investigations Report 2014-5106, 44 p.

Appendix A

Appendix A

Aquifer Testing, Groundwater Modeling, and Impairment Analysis for Washington Water Services Company Water Right Application G1-28489

Joseph E. Becker, LHG
Robinson Noble, Inc.

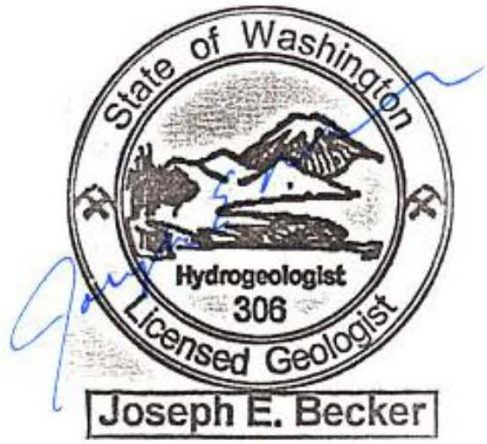
ROBINSON NOBLE

Aquifer Testing, Groundwater Modeling, and Impairment Analysis for Washington Water Services Company Water Right Application G1-28489

December 6, 2021

by

Joseph E. Becker, LHG
Robinson Noble, Inc.



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Aquifer Testing, Groundwater Modeling, and Impairment Analysis for Washington Water Services Company Water Right Application G1-28489

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Appendix

Introduction

Washington Water Services Company (WWSC) has seven water right applications in WRIA 15 that they are seeking to process. Six of these applications are for wells located in south Kitsap County, and the other is for a well on Bainbridge Island. This report addresses the Bainbridge Island water right application, G1-28489. The south Kitsap applications are addressed in a separate report. The subject application is listed below on Table 1.

Table 1: Subject Water Right Application

Application	Priority Date	Qi (gpm)	Qa (afy)	Water System
G1-28489	3/1/2007	0	7.4	Phelps Road

A preliminary permit has been written for the subject application. The permit requires testing of the well, modeling of the proposed production from the application using the USGS Kitsap Groundwater Model (Frans and Olsen, 2016), determination of potential impacts on regulated surface water bodies, a proposed mitigation plan to offset any identified impairments, and a report presenting and describing all data, procedures and analyses. This document forms the report required by the preliminary permit.

The location of the point of withdrawal for the subject application is an existing well. Its location is shown on Figure 1.

Hydrogeologic Setting

Before describing the testing of the wells and the modeling of the proposed well production, it is necessary to place the proposed right into the hydrogeologic setting of northern Bainbridge Island, including both groundwater and surface-water components.

Groundwater Setting

The hydrogeology of the Bainbridge Island Peninsula has been described in a number of previous documents. In 2011, the U.S. Geological Survey (USGS) published a report titled Conceptual Model and Numerical Simulation of the Groundwater-flow System of Bainbridge Island, Washington (Frans and others, 2011). This was following in 2014 and 2016 by the *Hydrogeologic Framework, Groundwater Movement, and Water Budget of the Kitsap Peninsula, West-Central Washington* by Welch, Frans, and Olsen and the *Numerical Simulation of the Groundwater-Flow System of the Kitsap Peninsula, West-Central Washington* by Frans and Olsen. While the focus of these two later studies is the entire Kitsap Peninsula, they both also cover Bainbridge Island. It is the model resultant from this third study that is required for modeling use by the preliminary permit.

Generally, the geology of northern Bainbridge Island involves a complex mixture of glacial and non-glacial sediments, subsequently eroded, deposited on top of bedrock. Four major glaciations and three interglaciations are recognized in the Puget Sound lowland, with deposits from the last major glaciation, the Vashon Stade of the Frasier Glaciation, widely exposed at the surface (Welch and others, 2014).

Typically, three types of sedimentary deposits are associated with the continental glaciations of western Washington: advance outwash, glacial till, and recessional outwash. As the glaciers advanced into the area, meltwater off the glaciers deposited a complex sequence of sediments in front of the glaciers. This advance outwash is typically composed largely of sand or sand and

gravel and generally is quite permeable. When saturated, it forms an aquifer. Glacial till was deposited underneath the glaciers as they further advanced, often on top of the previously deposited advance outwash. Till generally consists of a compact mixture of clay, silt, sand, gravel, and boulders. Its high concentration of fine-grained materials and the compact nature of the unit result in a low permeability, typically making till a confining unit. When the glaciers retreated, they left recessional outwash deposited by meltwaters off the glaciers. Like advance outwash, recessional outwash consists of coarse-grained sediments and is very permeable.

Following each major glaciation, there was an interglacial period similar to the present day where sedimentation generally occurs in marine waters, rivers and streams, lakes, and marshes and bogs. Many of these sediments are fine grained silts and clays, but coarse-grained sands and gravels may also be deposited by rivers. The coarse-grained sediments typically form discontinuous lenses or zones within the lower permeability deposits.

Frans and others (2011) describe eleven hydrostratigraphic units representing a series of aquifers and confining layers on Bainbridge Island. These same units are described by Welch and others (2014) for the entire Kitsap Peninsula. All eleven of these units are present on northern Bainbridge Island. However, only three are important as they relate to the Phelps Road Well. A brief description of these three hydrostratigraphic units, from youngest to oldest, follows.

Vashon till (Qvt) is a confining unit that is present at the surface over much of the northern portion of Bainbridge Island. It consists of a compacted and dense mixture of clay, silt, sand, and gravel. Frans and others (2011) indicate its thickness varies widely, but is generally from 10 to 100 feet thick on the island. Occasionally wells are completed in the Qvt, which can contain small, discontinuous water-bearing zones. While it is present at the Phelps Road site, mapping indicates it is absent through much of the northern island east of Phelps Road (Frans and others, 2011).

Vashon advance outwash (Qva) forms a regional aquifer that is widely used on Bainbridge Island. It typically consists of a well-sorted sand, but can also contain lenses of silt or clay. While it typically underlies the Qvt, it can be exposed at the surface were the Qvt is absent. The Qva aquifer is typically unconfined, however where underlying the Qvt and fully saturated, it can be confined. Frans and others (2011) report the unit has thicknesses commonly between 20 and 200 feet, though most commonly under 100 feet. Widely present elsewhere on Bainbridge Island (outside of the area south of Eagle Harbor), its occurrence on the northern portion of the island is more scattered, and it is absent through an east to west swatch of the island from Murden Cove northwest to Manzanita Bay. While missing from much of the northern island, the subject well is completed in the Qva aquifer.[1]

The *upper confining unit (QC1)* underlies the Qva aquifer. This low permeability unit is thick and laterally extensive across most of Bainbridge Island, being absent only at the bedrock dominated regions around Port Blakely and the coastal areas near Fletcher Bay and Manzanita Bay. Frans and others (2011) state the QC1 is formed by "early Vashon glaciolacustrine silt and clay (Lawton Clay) and underlying interglacial deposits of silt, sand, and gravel with numerous lenses of silt and clay or silty peat." The unit typically ranges from 50 to 300 feet thick (Frans and others, 2011). This unit forms the confining layer beneath the Qva at the Phelps Road site.

[1] As listed in an Excel database of wells created by the USGS as part of Frans and Olsen, 2016 and confirmed by Robinson Noble's interpretation of the well logs.

The deeper units described by both Frans and others (2011) and Welch and others (2014) are not pertinent to the subject application and well.

Recharge to the aquifers of Bainbridge Island occurs primarily from percolation of precipitation and secondarily from septic-system and irrigation return flow (Welch and others, 2014). Using GIS techniques, Welch and others (2014) combined land-cover data, soils data, and precipitation data to calculate the distribution of groundwater recharge. The method invoked regression equations developed by Bidlake and Payne (2001) to relate soil type/surface geology to recharge. Recharge rates from precipitation for most of Bainbridge Island range between 10 and 20 inches per year on average, including in the Phelps Road area. Frans and Olsen (2011) used a similar method and found the recharge rate for the entire Island averaged 15.75 inches, but near Phelps Road it was 20 to 25 inches. Welch and others (2014) report that in 2012, additional recharge from septic and irrigation return flow, on average, added about 3% more recharge. Frans and others (2011) report recharge from septic return flows is generally 1.5 to 3 inches near Phelps Road, about 10 percent more than through precipitation. Therefore, based on Frans and others (2011), the total recharge in the Phelps Road area is about 26.5 to 28 inches annually.

Groundwater is removed from the hydrologic system by well withdrawals, evapotranspiration, discharge to streams, and discharge to marine waters. The method of determining recharge used by both Frans and others (2011) and Welch and others (2014) generally subtracts evapotranspiration from the recharge amounts. Welch and others (2014) estimated discharge to streams based on stream gage records at 14 stations throughout the peninsula, though none were on Bainbridge Island. Welch and others (2014) prepared a groundwater budget for their entire study area for 2012. This budget estimates about 66% of recharge is discharged to streams, 30% leaves the hydrologic system as discharge to other natural features (mostly marine waters), and 4% is withdrawn by wells.

Frans and others (2011) prepared water level altitude and generalized flow direction maps for the aquifer units. For the Qva aquifer, their map generally shows groundwater north and westward from the Phelps Road area.

Surface-water Setting

The point of withdrawal (POW) for the subject application is located Bainbridge Island (Figure 1). The island is drained by a number of small streams. Generally, these streams flow radially off the island. The surface waters of WRIA 15 are regulated under WAC 173-515. The only regulated surface water features near the POW is the unnamed stream that flows into Murden Cove (Figure2, Table 2).

Table 2: Regulated Surface Water Bodies

Creek #	Creek Name	Closure Type	Period of Closure/Instream Flow	Available Gage Data
434	unnamed (Murden Creek)	closed	All year	none

Aquifer/Well Testing

The Phelps Road water system produces from a single well (Table 3) under existing right G1-20291 for 20 gpm and 3 afy. The new application asks for 7.4 afy Qa additive without any additive Qi. Predicted future water demands suggest that a total of 4.3 new additive afy will be needed at full buildout.

Table 3: Phelps Road Well Details

Well Tag Number	AAC013
Kitsap County Parcel Number	03250230282004
Parcel Legal Description	Ptn Of Sw1/4 Ne1/4 Sw1/4 Cnvyd By Aud No.1033328 Desc For Tax Purp Only As Fols, The E 65ft Of S 70ft & The S 30ft Of Fdp, Bat Ne Cor Of Sd Sub Th N89° 01'00w Alg N Ln Thof 157.25ft To Ely Mgn Of Rd Desc In Deed To Kitsap Co Per Aud No.786674 Th S19°37'20w Alg Sd Rd Mgn 410.69ft To Tpob Th S88*49'00e Plw S Ln Of Sd Sub 289.75ft To E Ln Thof Th S0° 48'04w Alg Sd E Ln To Se Cor Of Sd Sub Th N88°49'00w Alg S Ln Of Sd Sub 418ft M/L To E Mgn Of Sd Co Rd Th Nly Alg Sd Rd Mgn To Tpob (Being A Well Site)>>>Except That Portion Conveyed Under Auditor's File No. 1051650, Records Of Kitsap County, Washington.
Latitude	47.683008
Longitude	-122.534746
Top of Casing Elevation (ft, msl)	219
Well Diameter (inches)	6
Depth Drilled (ft)	133
Completion Interval Depth (ft)	128 – 133
Type of Completion	stainless steel well screen
Filter Pack	none
Static Water Level Depth (ft)	104

The Phelps Road well was drilled to a depth of 133 feet in 1989. It is completed with 5 feet of screen between 128 and 133 feet. Welch and others (2014) place the completion zone for the well in the Vashon advance aquifer (Qva). Our review of the well log (attached in Appendix A) confirms the Qva as the completion aquifer. The well log indicates a bailer test was conducted at well construction that resulted in 6 feet of drawdown while producing 25 gpm.

A pumping test was made by Gamble Bay Water Company on June 26, 1991. The well was pumped for a total of 245 minutes. The test record indicates the well was initially pumped at 15 gpm but was increased to 20 gpm after 25 minutes of pumping then increased again to 25.5 gpm after another 10 minutes. The production rate remained at 25.5 gpm for the reminder of the test. Five recovering water levels were measured over a period of one hour following pump shut down. Water levels were measured to the nearest inch.

The lack of precise water level measurement and poor measurement frequency inhibit calculation of aquifer parameters, as does the changing pumping rate during the pumping phase of the test. The data indicates a slight rising water level after the production rate was increased to 25.5 gpm. This indicates either the production rate was slowly decreasing, the well was developing in response to the pumping, or some outside influence (such as changing barometric pressure) was influencing the well. The analysis of the test is described in more detail in Becker (2020). Testing records are attached in Appendix A.

We concluded the results of our analyses indicated the previous testing was not sufficient to determine well and aquifer characteristics. Ecology concurred and required new testing for the application.[2]

A new test was performed earlier this year. This test is described in a report by Colby and Piechowski (2021) and is summarized here. Testing was completed using the existing pump configured to discharge to the water system tank set to allow overflow. Due to space limitations within the small casing, it was not possible to use a submersible pressure transducer for water level measurements. Instead, an acoustic (sonic) sounder was used. Testing of the sonic sounder found highly accurate results under non-pumping conditions, but erratic data during pumping resulting from pumping noise. Consequently, the manual water level measurements were used to identify the main drawdown trend and sonic readings deviating from the trend by more than 10% were eliminated from the data set. Weighted averaging of the remaining sonic data set was used for the hydrogeologic analysis.

The sonic sounder was installed at the well on June 1, and antecedent water levels were measured for one week. Unfortunately, due the well being the sole source for the water system, it was necessary to pump the well during the pre-test monitoring period. There were no observation wells available near the Phelps Road Well, so water levels were only measured in the pumping well itself.

Ignoring the water level changes due to production within the well itself, the pre-test monitoring data appears to show occasional fluctuations in the static water level of about 0.2 feet and a slight declining trend throughout the monitoring period (a total decline of about 0.3 to 0.4 feet). Barometric pressure was downloaded from the monitoring period from the Weather Underground Perennial Vinters (Bainbridge) station (ID #KWABAINB13) located about 3,200 feet east-southeast of the Phelps Road Well site. It appears the fluctuations observed in the well's static levels and the observed overall declining trend are due to barometric response. Analysis of the barometric response indicates the well is approximately 100% barometrically efficient (Colby and Piechowski, 2021).

A step-rate test was conducted on June 7 at rates of 9.7, 14.7, and 16.7 gpm, with each step lasting 30 minutes before starting the next higher rate. A summary of the results is presented on Table 4.

Table 4: Summary of Step-Rate and Constant-Rate Testing at Phelps Road Well

Date	Discharge Rate (gpm)	Elapsed Time (min)	Drawdown from SWLa (feet)	Specific Capacity (gpm/ft)
Step-Rate Testing				
June 7, 2021	9.7	30	0.38	25.8
June 7, 2021	14.7	60	0.70	21.0
June 7, 2021	16.7	90	0.86	19.5
Constant-Rate Testing				
June 9, 2021	16.4	194	0.77	20.9

[a] Static water level of 108.62' below the measuring point prior to step-rate testing and 108.73 ' prior to the constant-rate testing.

[2] Wood, Douglas, "RE: Washington Water – Kitsap Mitigation" email received by Carol Bair and others, October 15, 2020

The decline in specific capacity during the highest pumping rates in the step-rate test indicates that well efficiency declines with pumping rate, at least for the range of rates tested. Indeed, using an empirical equation derived from the Jacob's modified nonequilibrium equation, assigning a transmissivity of 79,000 gpd/ft (the average of the transmissivity values calculated from the test data, see below), and assuming a storage coefficient of 0.1, the calculated efficiency for the three steps and the constant-test rate ranges from 60 to 49%. The calculated efficiency at the end of the constant-rate test is 63%.

On June 9, Robinson Noble began a 24-hour constant rate test with the pump operating at its maximum rate. However, the test had to be aborted after only 194 minutes of pumping because discharge water was directed into the system storage tank which was rigged to allow overflow; however, the overflow arrangement malfunctioned. With the tank full, the test had to be stopped to prevent damage to the tank.

The drawdown data is complicated by the data noise recorded by the acoustic sounder, but it appears the pumping water level was essentially stable after about 15 minutes of pumping, with drawdowns of 0.77, 0.59, 0.68, and 0.75 calculated from the data recorded between 15 and 20 minutes, 60 and 65 minutes, 120 and 125 minutes, and 180 to 185 minutes. The water level returned to its pre-test static water level within 15 minutes after the pump was shut down. Drawdown and recovery results from the constant-rate test are plotted in Appendix A.

The drawdown and recovery data from the test was plotted on semi-log graphs (with the water level on a linear scale and time plotted on a log scale) to help analyze the aquifer properties. Though the data is complicated by the noise in the sonic sounder readings during the pumping phase of the test, by using running averages, we were able to use the Cooper-Jacob straight line method to calculate aquifer transmissivity from the plots. The drawdown data indicates an aquifer transmissivity of about 34,000 gpd/ft (4,545 ft^2/d). The calculated transmissivity from the recovery data is 124,000 gpd/ft (16,580 ft^2/d). The difference between the two values is likely due to an inability to more accurately measure water levels during the test. Regardless, the values do indicate the aquifer is very transmissive.

The thickness of the aquifer was not determined by well drilling. The bottom formations on the well long note:

> Brown gravelly hardpan from 90 to 120 feet
> Brown gravelly hardpan with "seams" of water from 120 to 124 feet
> Brown gravelly hardpan from 124 to 130 feet
> Gravel and water from 130 to 133 feet

The static water level is noted at a depth of 104 feet. We interpret that the "gravelly hardpan" is actually water bearing below the static water level, so that about 30 feet of aquifer was drilled, but clearly the aquifer was not bottomed during drilling. Assuming the transmissivity from the drawdown portion of the test is accurate, a hydraulic conductivity for the aquifer formation is less than 150 ft/d. This is about half of the value used in the USGS Kitsap model, where the cell containing the well has a horizontal hydraulic conductivity of about 343.9 ft/d. However, the USGS Kitsap modeled aquifer thickness at the well location is about 27 feet, which makes the modeled transmissivity as 9,200 ft^2/d, a value about half way between those calculated from the drawdown and recovery portions of the test.

A storage coefficient cannot be calculated due to the fact there is no observation well data. However, as mentioned above, the static water level is at the top of the aquifer or at least very

close above it. Therefore, the aquifer is either unconfined or marginally confined, but unconfined nearby. Indeed, review of well logs indicates the aquifer is definitely unconfined to the northwest (Figure 3).

Using the Theis nonequilbrium equation, the calculated radius of influence for a one-day test at 16.4 gpm is about 125 feet (assuming a storage coefficient of 0.1 and that the radius of influence is defined by a drawdown of 0.1 feet). The nearest regulated stream to the Phelps Road Well is Murden Creek, at a distance of about 5,200 feet. It was not monitored during the test.

Neighboring domestic wells were not surveyed nor monitored for the test. Assuming the nearest well is 100 feet distant, an interference drawdown of much less than one foot would be expected from 24 hours of production at the Qi of 20 gpm.

The four-month typical summer water-use rate for domestic use on the Kitsap Peninsula is about 49% of the annual use (Welch and others, 2014). With the new water right, the Qa for Phelps Road will be 7.3 afy. Consequently, 3.58 af should be produced in the four peak months. If the well is pumped continuously for 120 days, it would need a production rate of 6.8 gpm to produce the required four-month peak acre-feet demand. Using the well and aquifer characteristics from the recent testing, we estimate the 120-day drawdown at 6.8 gpm will be a foot or less.

The recent testing of the Phelps Road Well 3 was able to determine approximate aquifer and well properties. These indicate the well and aquifer can produce the requested Qi under application G1-28489. Therefore, the water requested under the proposed right is physically available.

Groundwater Modeling

If is it not possible to determine whether impairment of regulated surface waters will not occur using a conceptual model, the Phelps Road preliminary permit requires that the proposed water right be modeled with the USGS Kitsap Groundwater Model (Frans and Olsen, 2016) to predict potential impacts to other water rights holders and regulated surface water. It is our opinion that the model, as supplied by the USGS, can be problematic for this type of analysis due to an issue related to the type of model solver used by the USGS. Consequently, we modified the model to help address this issue. Once modified, we investigated the level of model error. We then used the model to look at potential impact to Murden Creek, the only nearby regulated stream.

Model Issues and Modifications

Because of the construction of the Kitsap model, as published by the USGS, well production rates in the model are not necessarily constant between model runs. This makes the unmodified model not well suited for water rights investigations. This issue is caused by the use of the Newton solver, which when the hydraulic head in a model cell containing a well falls below a specified threshold, the well's production rate is automatically ramped downward by the modeling code. During the USGS steady-state simulation, this caused 1,432 wells to lower their production rates from assigned values, including 310 wells which turn completely off. Septic and irrigation return flow is simulated by recharge wells (for corresponding production wells) in non-sewered areas. Yet when modeled production rates are reduced by the Newton solver, the corresponding return flow is not similarly reduced, creating yet another error.

To solve the problem, Robinson Noble made several modifications to the model. All model layers in the published model are simulated as convertible between confined and unconfined conditions. We left the top two layers as convertible, but changed all other layers to confined. This resulted in a large decrease in the number of problem wells. However, when running transient conditions, 131 wells were still experiencing ramped down production. We turned off the production for these wells and their corresponding return-flow injection wells; no further wells had variable production rates. With these changes, however, the degree of calibration, as defined by calibration statistics, was reduced. We forwarded the new model calibration statistics to Lonna Frans, who was the head modeler for the Kitsap model with the USGS. She stated she still considered the model calibrated. We then proceeded to use this modified model for the investigation of impairment. The Phelps Road well was already represented in the model.

Numerical Model Error

Frans and Olsen (2016) discuss model error within the Kitsap model as arising from a combination of three sources: 1) input values being only an approximation of real-world values; 2) limitations of the modeling algorithm not being able to fully represent natural, physical processes; and 3) errors in parameter estimations selected during the calibration process. Together, these can be classified together as imprecision or approximation error, error that result from the imprecise recreation of real-world values into discrete model units.

Two other types of model error occur, one general to all MODFLOW models and one apparently specific to the Kitsap model. Truncation, or iterative, error is common to all MODFLOW models and occurs when models stop running after differing numbers of iterations for differing simulations. The model-specific error discovered by our work with the Kitsap model occasionally causes unrealistic results. Luckily, we did not find any of these model-specific errors for the Phelps Road area.

Truncation Error

MODFLOW provides solutions by checking results against a closure criteria of change in head and change in flux for each active cell in the model, continuing model solution iterations until the results converge to a level below the stated criteria. For each iteration, MODFLOW estimates values in its groundwater flow equation and checks the results against the closure criteria. If the criteria is not met, it estimates new values, hopefully ones that lead to a result closer to the closure criteria. For each specific set of input values, MODFLOW will converge below the closure criteria with slightly different values. While the results should be exactly the same for the exact same inputs, even very tiny changes in input values will obtain different results. Because of this phenomena, MODFLOW can "predict" impacts impossibly far from the area of interest. Such reported impacts are the result of the model converging slightly differently and represent model error and not actual impact. This type of error is called sometimes truncation error. Truncation error is important when using the model for water rights analysis, because it can "predict" impacts that are not real, but simply the result of the program stopping at different points. The error is easily observed by running a steady-state model twice, but using differing starting heads. The results should be exactly the same, but will not be.

Truncation error can be reduced by selecting low closure criteria. However, as the closure criteria are set lower, model run times increase. Thus a balance must be set between the closure criteria used and practical run times. For the model analyses run for these water right applications, closure criteria were set such that run times were in the range of 5 minutes to 1 hour, with most being about 10 to 15 minutes. Further reductions in the closure criteria for the model simulations of the Washington Water applications failed to produce significant reductions in truncation error.

To estimate the level of truncation error, we examined it by several methods in a different project that also used the Kitsap model (our work on the Port Orchard Foster pilot project). First we ran the model using the well production rates input by the USGS to create a dynamic equilibrium condition – one in which there is no change in recharge or stresses year to year. The model was run with 117 stress periods, each representing a year. Recharge and well production were not changed between stress periods. Theoretically, after the model reaches an equilibrium condition, the results should be exactly the same ever year thereafter. However, due to truncation error, that does not occur.

The mass balance results[3] were used to determine the total stream base flow for the area of interest for each stress period. Because conditions in the model are the same for every year, theoretically there should be no change in base flow year-to-year. Yet due to truncation error, there are changes. The base flows for the final 96 years of the model run were averaged. The difference between each year's base flow and the average base flow was calculated. Assuming the average is the correct number, these differences represent truncation error in stream flow for each year. We found the average stream flow model error was about +/- 3 afy and the maximum was +/- 7 afy. However, the area of interest for the Port Orchard Foster pilot project is larger than for the WWSC applications, so the lower limit of +/- 3 afy is probably more applicable.

A second method was used for the Port Orchard Foster pilot project. This method involved running several steady-state simulations using differing sets of initial starting heads, which, as previously explained, should provide the exact same result. The analysis included 19 sets of simulations, each run twice with differing starting heads. It found that impacts on various streams varied up to +/- 5 afy.

Approximation Error

The quality of aquifer and confining layer properties input into the model varies through throughout the model domain based on the amount of data available. Aquifer values may be more precise is some areas of a model and less precise in others, both horizontally and vertically. For example, there is a lot of available data for the Qva aquifer, which is a widely used aquifer on the Kitsap Peninsula, and relatively little data for the QA3.

We made a definition of approximation error for other WWSC water rights work in south Kitsap County (Becker, 2021), but is believed to be valid for the Phelps Road area. The other WWSC study found that modeled impacts below 0.1% of a stream's baseflow should be treated as suspect because of the uncertainty built into the model from approximation error. This is similar to error estimates made by Aspect Consulting (2019) for a water rights project for the Bloedel Reserve on Bainbridge Island. In their analysis, they found the resolution for streamflow in Murden Creek was about 0.2 to 0.4% of baseflow using the Kitsap Model.

Resolution of Model Errors

After correcting/accounting for the model-specific error, the results need to be viewed in light of other model error. Because of truncation error, we suggest the minimum model resolution for stream impact, either positive or negative, of about 5 afy. Results lower than these values

[3] MODFLOW model results report the mass balance results of the entire model. That is, the results report the total inflows of water into the model from each water sources (such as recharge, injection wells, water taken from storage within the sediments, and infiltration from streams, lakes, and saltwater bodies) and the total outflows of water from each water sink (such as wells, evapotranspiration, spring discharge, outflows to streams and saltwater, water placed into storage within the sediments, etc.). Ideally, the sum of all the inflows should equal the sum of all outflows, that is, all inflows should be balanced with all outflows.

should be consider below model error limits. Further, modeled impacts below 0.1% of a stream's baseflow should be treated as suspect because of the uncertainty built into the model from approximation error.

Modeling Analysis

Steady-state modeling of the proposed production from the application was conducted with the USGS Kitsap Groundwater Model. The application was reviewed in relation to projected future water demand to determine if additional Qa was required. The analysis looked at projected demand using conservation. Based on that analysis, it appears at least 4.3 afy of additive Qa is needed for the Phelps Road water system. Consequently, steady-state modeling was accomplished for the new additive Qa. Transient modeling was not conducted.

Modeling was conducted by first running a baseline simulation using existing water rights and then running a predictive simulation with the proposed right. For these simulations, return flow was also applied for all production above the production rates used by the USGS. Return flow as simulated using injection wells in the uppermost active model layer. This is the same method Frans and Olsen (2016) used in the Kitsap model. They applied return flow at 68.5% of the well production rate for domestic wells in non-sewered areas. The same rate was used here. While the Phelps Road water system is within the Bainbridge Island UGA, it is not within either of the two public sewer system service areas on Bainbridge Island, and therefore, is a non-sewered area.

The Phelps Road Well currently operates under right G1-20291, which has a Qi of 20 gpm and a Qa of 3 afy. The new application asks for 7.4 afy Qa additive without any additive Qi. As mentioned, analysis of water demand indicates only 4.3 afy is likely needed. The baseline simulation was run with the well producing the current Qa of 3 afy. Two predictive simulations were conducted, one for the full requested Qa (10.4 afy) and one for the amount needed with conservation (7.3 afy). Return flow beyond what is in the unaltered USGS model was simulated by evenly spreading it using six image wells, one in each model cell covering the water system area.

The predictive simulations were first run with and without return flow as a check of model accuracy since the error analysis discussed above was conducted for the south Kitsap portion of the model, not Bainbridge Island. Conceptually, stream impacts should be less with return flow than without return flow. Runs were also made using two different sets of starting heads. When running steady-state, the starting head configuration should not change results.[4] Results are presented on Table 5.

All modeled impacts on Murden Creek are below the error limits of the model. This is clearly demonstrated by the fact that under the conservation case, runs without return flow are projected to be equal to or greater than those with return flow and that some results with the full requested Qa are smaller than the results under the conservation scenario.

[4] Steady-state results are not dependent on starting heads. Regardless of the starting heads, the model should run until a steady-state solution is reached. Any differences between solutions is a result of model error.

Table 5: Modeled Impact Results

Scenario	Qa added (afy)	Sub-scenario	Impact on Murden Creek (afy)[a]
Full Request	7.4	No return flow 1	-0.04
		No return flow 2	-0.04
		Return flow 1	0.00
		Return flow 2	-0.01
Conserva-tion	4.3	No return flow 1	-0.02
		No return flow 2	-0.03
		Return flow 1	-0.02
		Return flow 2	-0.01

[a] All modeled impacts are below the model error limit

Impairment Analysis

The Phelps Road Well produces water from the Qva aquifer. Conceptually, it is not possible for well production from the well to impair Murden Creek (creek #434), which is the only regulated surface water body near Phelps Road. At its closest, the northern fork of Murden Creek is about 5,200 feet south of the well. However, as shown by Figure 3, the Qva aquifer pinches out between the Phelps Road Well and this northernmost reach of Murden Creek (on Figure 3, the northernmost extent of Murden Creek would project onto the cross section line approximately at well 67566). The absence of the Qva between the well and Murden Creek is confirmed by Frans and others (2011). Their figure 10 shows the extent and thickness of the Qva on Bainbridge Island. The figure indicates the aquifer unit is not present south of Phelps Road through the Murden Creek area.

Steady-state numerical modeling using the Kitsap modeling confirms the lack of impairment determined conceptually. The modeling analysis did not find impacts above the error limits of the model. Based on the conceptual model and the numerical results, neither steady-state nor transient impairment of Murden Creek occurs.

The increase in Qa will also not impair other groundwater rights. The aquifer a Phelps Road has a transmissivity of between 34,000 and 124,000 gpd/ft. At a distance of 100 feet from the well, interference drawdown from pumping the Phelps Road Well will be much less than one foot.

Summary

Washington Water Services Company water right application G1-28489 seeks to add an annual production of 7.4 afy at Phelps Road Well. An analysis of water demand indicates that only 4.3 afy may actually be necessary.

Step-rate and constant-rate pumping tests were made at the well. Although the constant-rate test was cut short, it was possible to determine that the aquifer is physically capable of supplying the additional well production. The testing found the aquifer has an aquifer transmissivity between 34,000 and 124,000 gpd/ft. This transmissivity indicates the aquifer is very productive, and the requested increase in well production in such a highly permeable aquifer will not impair other groundwater uses in the area.

The only nearby regulated surface water body is creek #343, informally known as Murden Creek. An impairment analysis was made to see if the proposed production will impair Murden Creek. Both a conceptual analysis and a numerical modeling analysis made with the USGS

Kitsap Groundwater Model found no impairment at Murden Creek. Consequently, no mitigation is offered.

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Legend

- Point of Withdrawal
- Place of Use

0’ 200’

Sumanee Place Northeast

Fern Creek Ln

Northeast Teem Loop Road

Fairfield Place Northeast

Phelps Road Northeast

Well

Northeast Day Road

ROBINSON NOBLE	Note: Image from Kitsap County GIS 2019 Aerials	PM: JEB November 2021 1360-010A	Kitsap County T 25 N/R 02 E - 03 Scale 1” = 200’	Figure 1 Phelps Road Water System - Well Location Map Washington Water Service: South Kitsap Water Rights

Phelps Road Well

Murden Creek

0’ 2000’

Legend

- Point of Withdrawal
- Regulated Surface Waters Near Points of Withdrawal
- Murden Creek (Watershed Basin)

ROBINSON NOBLE

Note: Basemap from Kitsap County GIS and ESRI ArcGIS

PM: JEB
November 2021
1360-010A

Kitsap County
T 25 N/R 02 E
Scale 1” = 2000’

Figure 2

Regulated Surface Waters near Proposed Water Rights

Washington Water Service: South Kitsap Water Rights

ROBINSON NOBLE	Note: Basemap taken from USGS Suquamish Quadrangle	PM: JEB November 2021 1360-010A	Kitsap County T 25,26 N/R 02 E Scale 1" = 2000'	Figure 3A A-A' Cross Section Location Map Washington Water Service: South Kitsap Water Rights

A
South

A'
North

600'-
500'-
400'-
300'-
200'-
100'-
0'-
-100'-
-200'-
-300'-
-400'-
-500'-
-600'-

- Murden Cove
64389
62923
67568
278119
Phelps Road Well
67293
- Hidden Cove
67176
61112
66190
72221

Qvt
Qva
QC1
QA1
QC2
QA2

CROSS SECTION LEGEND

SYMBOLS

190111 WELL IDENTIFIER

SCREEN

LAND SURFACE

STATIC WATER LEVEL

ROBINSON NOBLE

PM: JEB
November 2021
1360-010A

Kitsap County
T 22,23 N/R 02 E
Horizontal Scale 1" = 2000'

Figure 3B
Cross Section A-A'
Washington Water Service: South Kitsap Water Rights

Appendix A

Phelps Road Well Geologic Log and Testing Data

PHELPS ROAD
(KITSAP COUNTY)
WELL #2 AAC013

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Water Right Pi

(1) OWNER: Name Mr. Mike Knapp/Port Gamble Water Address 23299 Port Gamble Road, Poulsbo 98370

(2) LOCATION OF WELL: County Kitsap NE ¼ SW ¼ Sec. 3 T. 25 N., R. 2E W.M

(2a) STREET ADDDRESS OF WELL (or nearest address) "Phelps Road"

(3) PROPOSED USE: [XX] Domestic [ ] Industrial [ ] Municipal [ ] Irrigation [ ] Test Well [ ] Other [ ] DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one)
Abandoned [ ] New well [XX] Method: Dug [ ] Bored [ ] Deepened [ ] Cable [XX] Driven [ ] Reconditioned [ ] Rotary [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches. Drilled 133 feet. Depth of completed well 133 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from 0 ft. to 128 ft.
Welded [XX] Liner installed [ ] Threaded [ ] " Diam. from ft. to ft.
" Diam. from ft. to ft.

Perforations: Yes [ ] No [XX]
Type of perforator used
SIZE of perforations in by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes [XX] No [ ]
Manufacturer's Name Johnson
Type stainless steel Model No.
Diam. 6 Slot size 20 from 128 ft. to 133 ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes [ ] No [XX] Size of gravel
Gravel placed from ft. to ft.

Surface seal: Yes [XX] No [ ] To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [XX]
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name None
Type H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level 420 ft.
Static level 104 ft. below top of well Date 1/6/89
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [ ] If yes, by whom?
Yield gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test 25 gal./min. with 6 ft. drawdown after 2 hrs.
Airtest gal./min. with stem set at ft. for hrs.
Artesian flow g.p.m. Date
Temperature of water 50 Was a chemical analysis made? Yes [ ] No [XX]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Overburden	0	3
Brown gravelly hardpan	3	20
Grey gravelly hardpan	20	35
Brown gravelly hardpan	35	38
Grey gravelly hardpan	38	55
Brown gravelly hardpan	55	77
Grey hardpan w/clay	77	90
Brown gravelly hardpan	90	120
w/seams H20	120	124
Brown gravelly hardpan	124	130
Gravel & H20	130	133

RECEIVED
FEB 27 1989
DEPARTMENT OF ECOLOGY
NORTHWEST REGION

Work started 1/3/89 19. Completed 1/6/89 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Gresham Well Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address 3105 N.W. Lakeness Rd., Poulsbo 98370

(Signed) (WELL DRILLER) License No 0761

Contractor's Registration No. GRESHWD206NE Date Jan. 11, 1989 19

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) 1329-

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

NAME: GAMBLE BAY WATER

ADDRESS: 23299 PT. GAMBLE RD POULSBO

R & R Pumps
3979 Wagon Wheel Lane
Poulsbo, WA 98370
779-2611 or 842-3744

DATE: 6-26-91

PHELPS ROAD
WELL #2 AAC013

WELL DEPTH: 133'

WELL DIAMETER: 6"

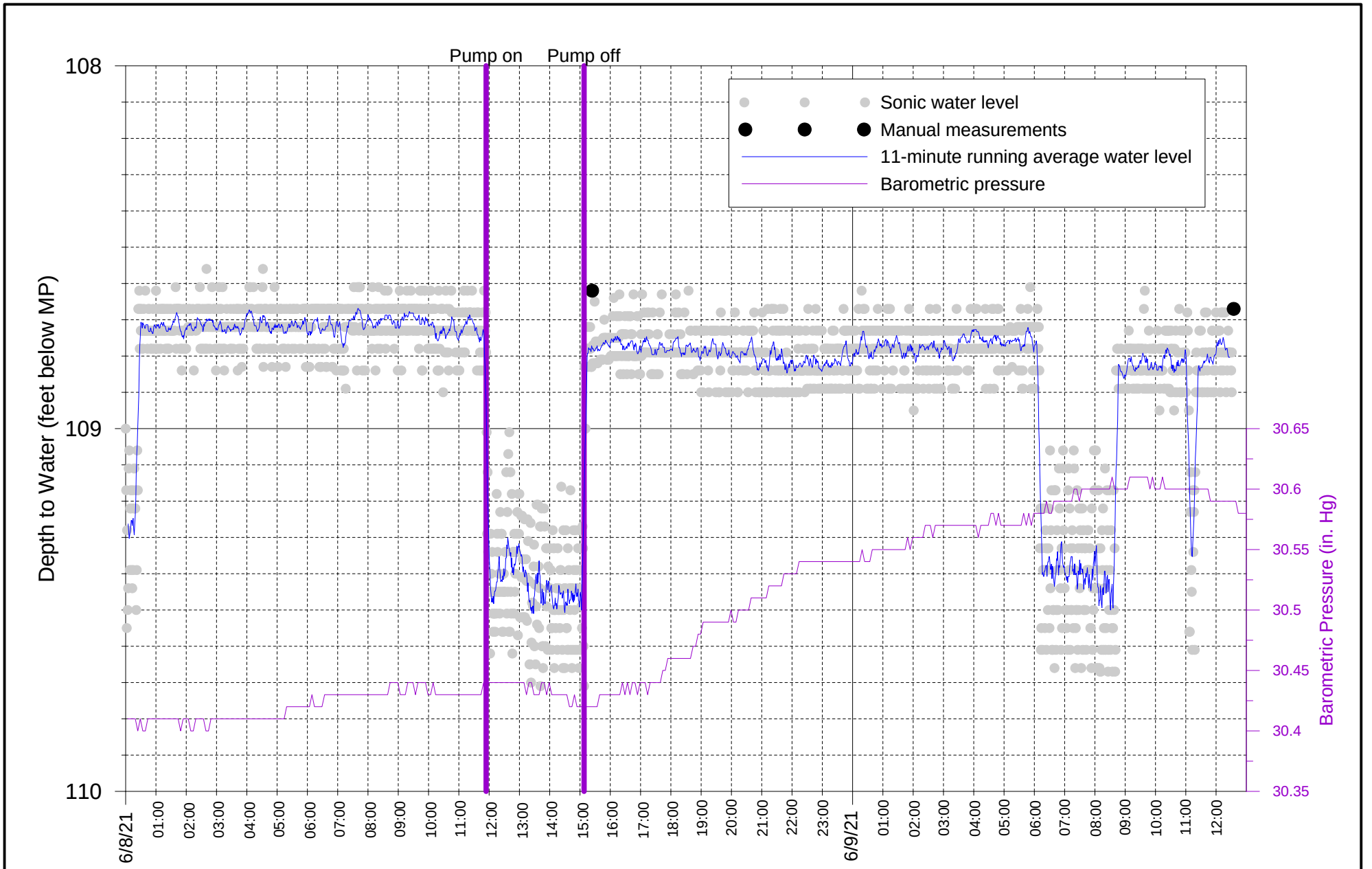
PUMP MAKE: GRUNDFOS

PUMP MODEL:

TANK MAKE:

TANK MODEL:

ate	Time	Llapsed Pumping Time (min)	Depth to Water (1/10 ft.)	Drawdown from Static Water Level (ft.)	Pumping Rate (GPM)	Ren
6/26/91	9:55 AM			100'.2"	15	
	10:00 AM			101'.5"	"	
	10:15			101'.5"	"	
	10:20			103'.2"	20	
	10:25			103'.2"	"	
	10:30			103'.5"	"	
	10:35			105'.5"	25.5	
	10:45			105'.6"	"	
	11:00			105'.2"	"	
	11:15			105'0	"	
	11:30			105'1"	"	
	12:00 AM			104'.8"	"	
	12:30 pm			104'.9"	"	
	1:00 pm			104'.9"	"	
	1:30			104'.8"	25.5	
	2:00 pm			104'.5"	"	
		Pump OFF AT 2:00 pm				
	2:05 pm			104'.3"	OFF	
	2:15			104'	OFF	
	2:30			103.9"	OFF	
	2:45			102.6"	OFF	
6/26/91	3:00 pm			100'.5"	OFF	

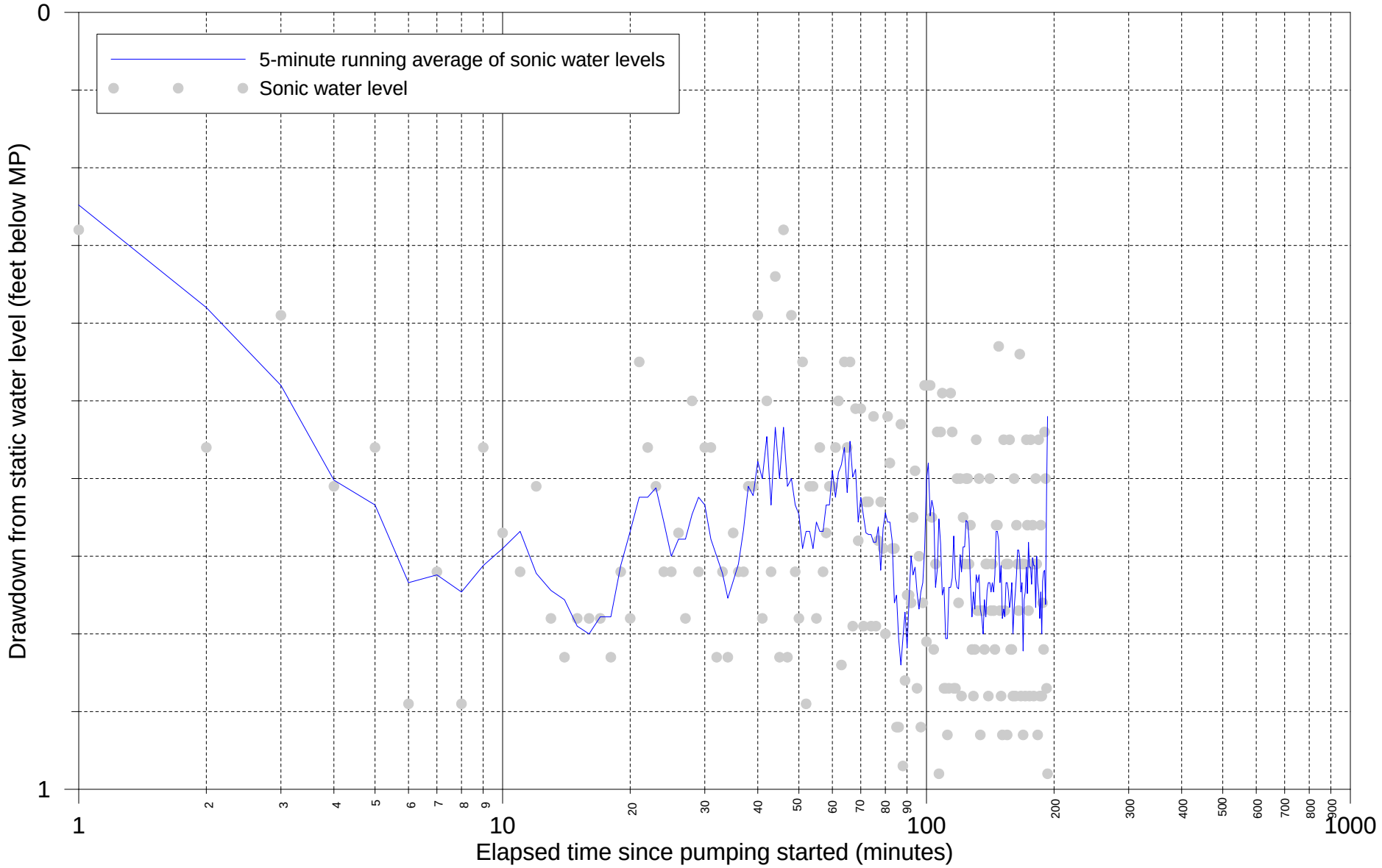


ROBINSON NOBLE

Date: Nov. 2021
Job#: 1360-010B
PM: MFP

June 8 to June 9 Hydrograph
SWL: 108.63' below measuring point
(1.32 feet above land surface)
Barometric pressure from KWABAINB74

Hydrograph with Barometric Pressure
Phelps Road Well
Washington Water Service - South Kitsap Well Testing

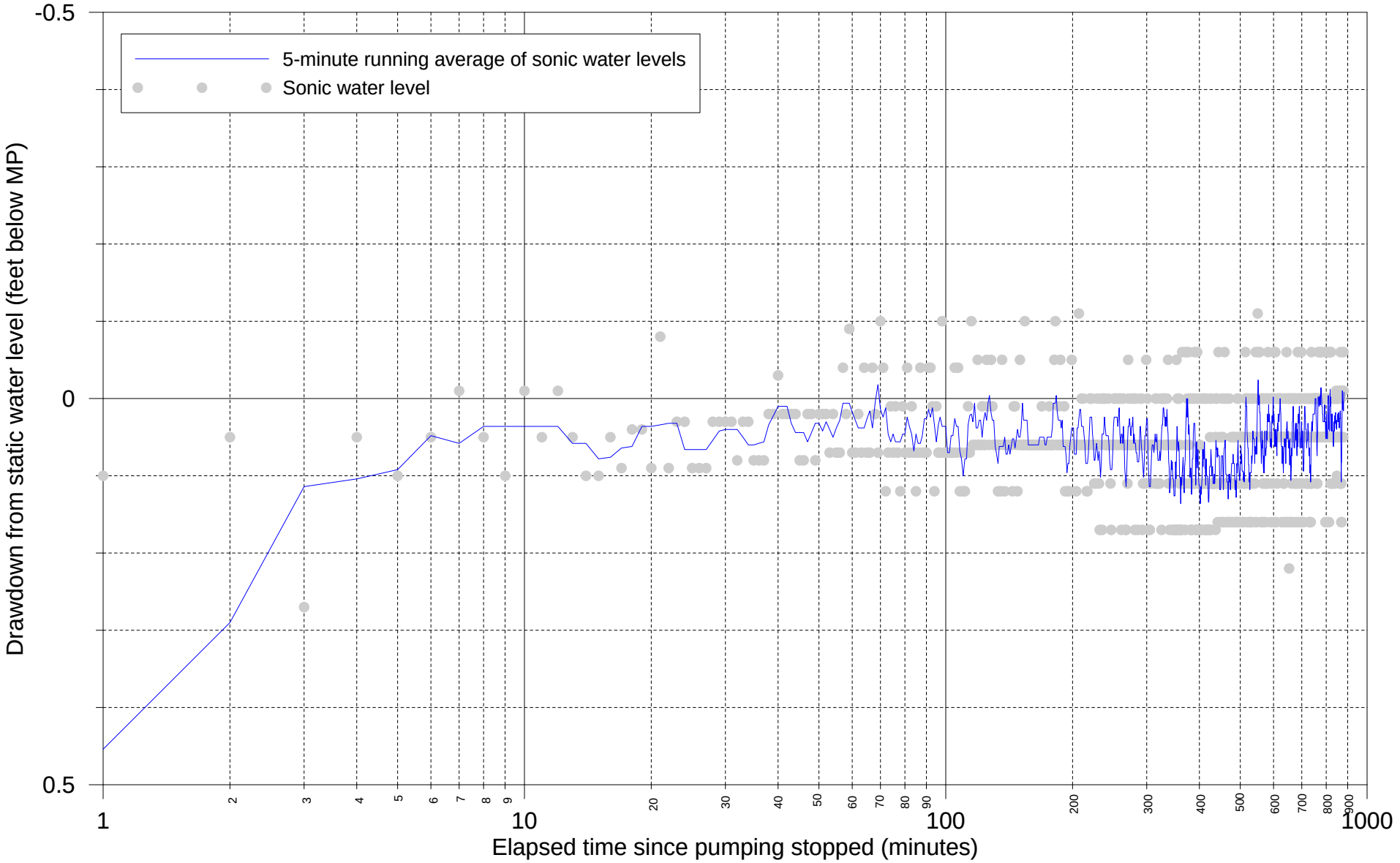


ROBINSON NOBLE

Date: Nov. 2021
Job#: 1360-010B
PM: MFP

Test conducted: June 8, 2021
SWL: 108.73' below measuring point
(1.32 feet above land surface)
Pumping rate is 16 GPM.

Constant-Rate Drawdown
Phelps Road Well
Washington Water Service - South Kitsap Well Testing



ROBINSON NOBLE

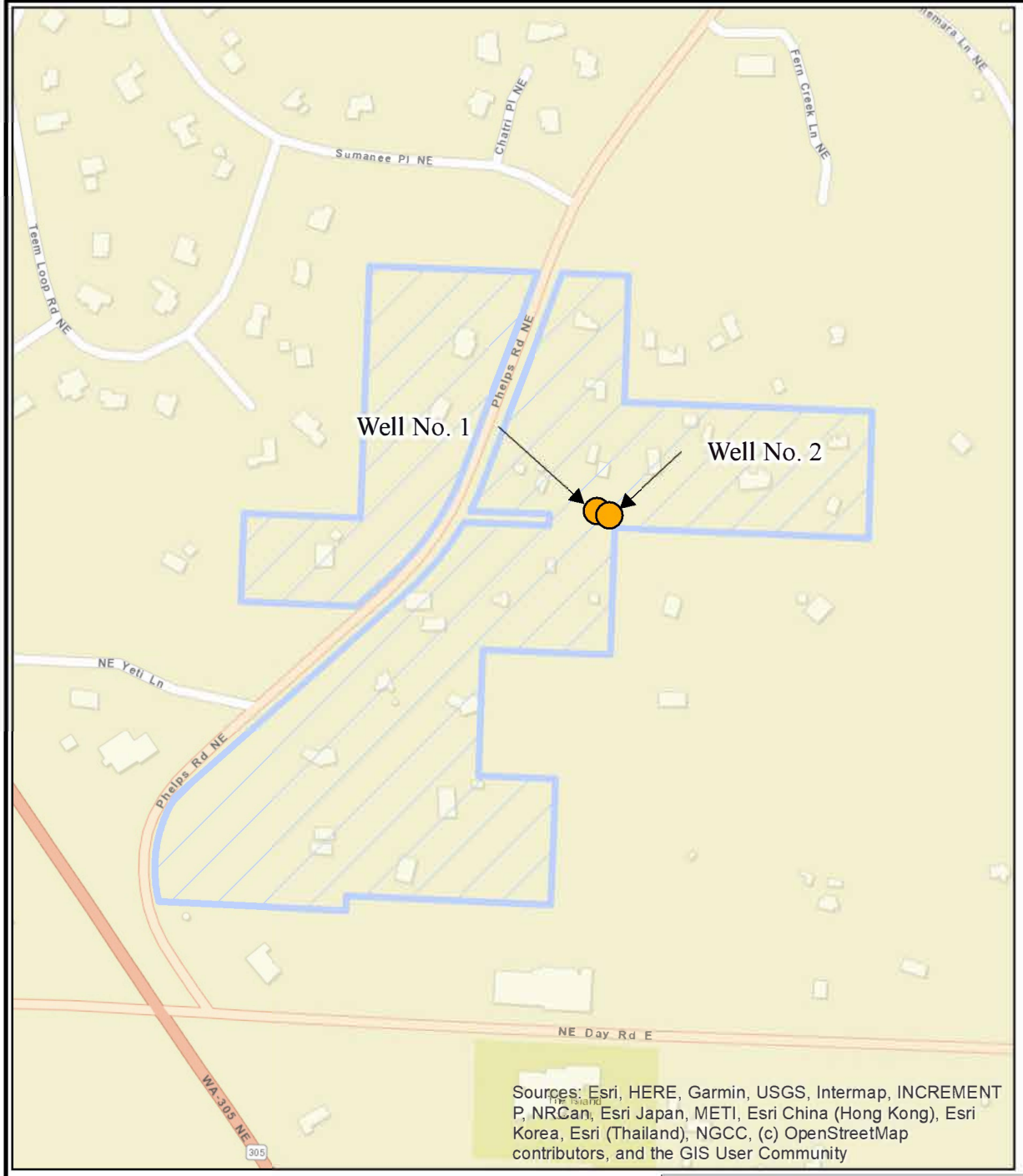
Date: Nov. 2021
Job#: 1360-010B
PM: MFP

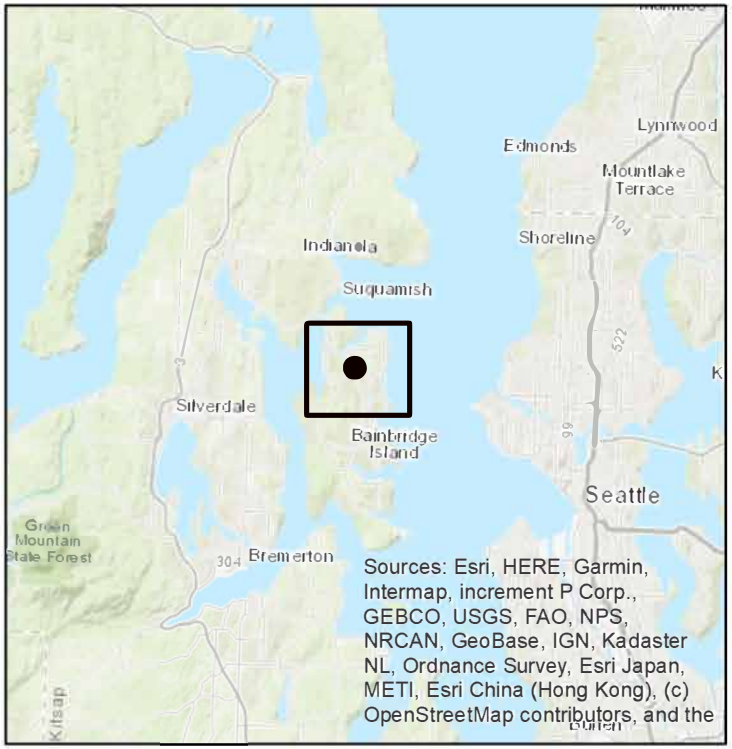
Test conducted: June 8, 2021
SWL: 108.73' below measuring point
(1.32 feet above land surface)
Pumping rate is 16 GPM.

Constant-Rate Recovery
Phelps Road Well
Washington Water Service - South Kitsap Well Testing

Attachment 1: Location Map

Washington Water Service Co.
G1-28489 - Phelps Road Water System
Section 3 - T25N/R02E
WRIA 15 - Kitsap County
Bainbridge Island





Legend

- **Authorized Place of Use**
- **Authorized Point of Withdrawal**
- **Authorized Point of Diversion**

0 190 380 760 1,140 1,520 Feet

DEPARTMENT OF ECOLOGY State of Washington

Map Date: 5/9/2022

Comment:
Place of use and source locations are as defined within the Report of Examination cover sheet for the document identfied in the header above.

ATTACHMENT 1