QUALITY ASSURANCE PROJECT PLAN
LUMMI PENINSULA GROUNDWATER SETTLEMENT AGREEMENT COMPLIANCE MONITORING PROJECT

Version 1.2

Water Resources Division
Natural Resources Department
Lummi Indian Business Council

Prepared for EPA Region 10

July 2021

Lummi Peninsula Groundwater Settlement Agreement Compliance Monitoring Project Quality Assurance Project Plan Approval (A1):

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Recipients identified on this distribution list will be sent updated versions of this document or copies of minor change letters for this document immediately after they are approved. Recipients listed may also obtain the most current copy of the approved Quality Assurance Project Plan (QAPP) by contacting the Water Resources Manager.

REVISION RECORD

Approval	Date	Responsible Person	Description of Change	Location of Change
1	October 2018	Kara Kuhlman	Initial Approval and Release of Version 1.0	N/A
1.1	December 2019	Kara Kuhlman	Staffing updates (new staff) and corrected staff roles	Distribution List, Section 1.2, Figure 1.1
			Remove completed studies	Section 1.1
			Removed two sites to Program	Sections 2.1, 3.1, 6.1, Table 6.1, Figure 3.1
			Reporting frequency increased from annual to every two years	Sections 5.2, 10.2
			Replace sign-out board with informing supervisor	Section 7.3
1.2	July 2021	Kara Kuhlman	Change EPA Tribal Coordinator to Michael Ortiz	Signature page, Distribution List
			Remove ZAPS Technologies LiquID Station Continuous Water Quality Monitoring Study. The study has been completed.	Section 1.1
			Clarify flushing of wells prior to sampling.	Section 7.5.3
			Change STORET to WQX	Section 5.2, 9.1

SIGNATURE PAGE

Document: Lummi Peninsula Groundwater Settlement Agreement Compliance Monitoring Project QAPP

Version 1.2

The following technical staff have read this manual. A copy of this page will be distributed to the employee training record file.

Signature	**Date**
Name (printed)	**Title**

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1. DOCUMENT AND PROJECT ORGANIZATION

1.1 Document Organization

This document is organized following Environmental Protection Agency (EPA) Requirements for Quality Assurance Project Plans (EPA 2001, reissued 2006) with the companion document Guidance for Quality Assurance Project Plans (EPA 2002). Where a letter and number follow a section title (*e.g.,* Distribution List [A3]), they indicate the corresponding section in the EPA Requirements for Quality Assurance Project Plans.

The Lummi Nation Lummi Peninsula Groundwater Settlement Agreement Compliance Monitoring Project is a component of the Lummi Nation Water Quality Monitoring (WQM) Program. The overall quality system for the WQM Program is outlined in a Quality Management Plan (QMP), which serves as the umbrella document for the WQM Program and its component projects. Individual Quality Assurance Project Plans (QAPPs) have been developed for each individual project within the WQM Program. The individual projects include the following:

- Ambient Surface Water Quality Monitoring Project
- Ambient Groundwater Quality and Quantity Monitoring Project
- Continuous Water Temperature Monitoring Project
- First Flush Monitoring Project
- Department of Health Support (National Shellfish Sanitation Program) Project
- Nutrient, Metal, and Hydrocarbon Monitoring Project
- Continuous Water Level Monitoring Project
- Lummi Peninsula Groundwater Settlement Agreement Compliance Monitoring Project (this document)

In addition, Standard Operating Procedures (SOPs) have been developed for each instrument used or parameter measured.

1.2 Project Organization (A4)

The Lummi Peninsula Groundwater Settlement Agreement Compliance Monitoring Project (Settlement Compliance Project) is administered and implemented through the Lummi Water Resources Division (LWRD), a division within the Lummi Natural Resources Department (LNR), contained under the Lummi Indian Business Council (LIBC). An organizational chart of the individuals participating in the Settlement Compliance Project is provided in Figure 1.1. A complete and detailed discussion of the structure of the WQM Program, including organization charts identifying the components of all WQM Program projects and individuals participating in the WQM Program are provided in the QMP (LWRD 2021c).

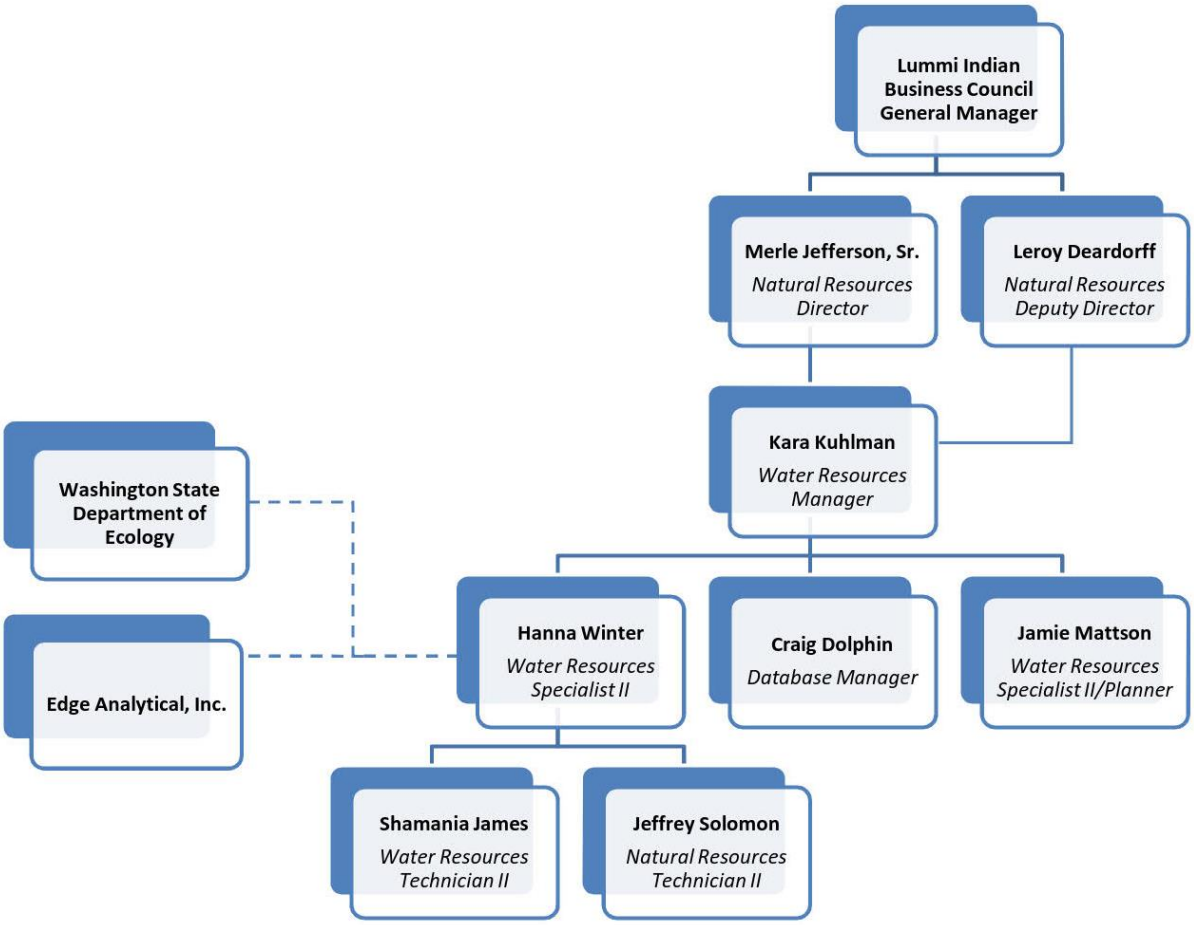

Figure 1.1 Organizational Chart of Individuals and Contracted Laboratories Participating in the Settlement Compliance Project

The Water Resources Specialist II is the primary staff person responsible for Settlement Compliance Project coordination, including maintaining the official, approved QAPP. The Water Resources Specialist II, Water Resources Technician II, and Natural Resources Technician II are responsible for implementing the Settlement Compliance Project. The Water Resources Specialist II supervises the Water Resources Technician II and Natural Resources Technician II and provides approval and oversight of the Settlement Compliance Project, including coordination with the Washington State Department of Ecology and Edge Analytical, Incorporated, an independent contracted laboratory. The Water Resources Manager evaluates compliance with project goals and makes recommendations to the LNR Director and Deputy Director, who make decisions based upon data collected as part of this project. The Database Manager created and maintains the Lummi Well Reporting Database and Water Database and is the primary staff member responsible for database training and documentation.

1.3 Special Training Requirements and Certification (A8)

Details on the roles, contact information, position requirements, and qualifications held by the individuals responsible for managing and implementing the Settlement Compliance Project are listed in detail in the QMP. The QMP also includes details on the required and recommended training and certification for all staff involved in the Project. Supervisors and the Water Resources Manager are responsible for ensuring staff are qualified and trained.

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2. PROBLEM DEFINITION AND BACKGROUND (A5)

2.1 Project Summary

The Settlement Compliance Project provides compliance with the chloride and water use reporting requirements of the Lummi Peninsula Groundwater Settlement Agreement (Settlement Agreement).[1] Chloride samples are collected once per year (in August) for small wells (*i.e.,* wells with three or fewer households connected) and three times per year (in April, August, and December) for large wells (*i.e.,* wells with more than three households connected, including tribal supply wells). Currently, 13 small wells and 7 large wells are sampled for chlorides, and chloride results are evaluated for trends and compared to chloride trigger levels as outlined in the Settlement Agreement. Annual water use for the water year (October 1-September 30) is compared to water use limitations as outlined in the Settlement Agreement. Water use and chloride results are included in well reports completed annually in November as required by the Settlement Agreement.

Chloride samples collected as part of the Settlement Compliance Project supplement the Lummi Nation Ambient Ground Water Quality and Quantity Monitoring (Ground Water Project) Project (LWRD 2021a). Summaries of the Ground Water Project and other WQM Program projects are provided in the QMP.

2.2 Groundwater

As summarized in the QMP, there are numerous threats to Lummi Nation Waters.[2] The QMP provides a detailed description of Lummi Nation Waters and the geographical location of the Reservation. Groundwater resources on the Reservation are vulnerable to groundwater mining and salt water intrusion because the Reservation is located in a coastal area with most of the existing water supply wells within a half-mile of marine waters (LWRD 1997). The majority of residential development has occurred along the marine shoreline placing the most vulnerable portion of aquifers at risk through direct pumping of groundwater near marine shorelines. Currently, groundwater supplies over 95% of the potable water used on the Reservation.

The Settlement Compliance Project Case Area pertains to the potable ground water system located in the southern upland area of the Reservation (Lummi Peninsula) that is completely contained within the Reservation boundaries (LWRD 1997). Another separate potable groundwater system is located in the northern upland area and appears to flow onto the Reservation from the north and drains to the west, south, and east. The floodplain of the Lummi and Nooksack rivers, which contains a surface aquifer that is saline (Cline 1974),

[1] Settlement Agreement Regarding Uses of Groundwater on Lummi Peninsula, *United States and Lummi Nation v. State of Washington, Department of Ecology, et al,* W.D. Wash C01-0047Z, Document 1264-2, November 13, 2007

[2] Pursuant to 17.09.010 of the Lummi Code of Laws, Lummi Nation Water includes all fresh and marine waters that originate or flow in, into, or through the Reservation, or that are stored on the Reservation, whether found on the surface of the earth or underground, and all Lummi Nation tribal reserved water rights.

separates the northern and southern (Lummi Peninsula) potable water systems. A third potable water system may exist on Portage Island, but information on the water quality and the potential yield of this system is limited and inconclusive.

Additional details on groundwater resources and water quality are provided in the QMP.

2.3 Lummi Peninsula Groundwater Settlement Agreement

In January 2001, the United States filed a complaint in United States District Court for the Western District of Washington against the Washington State Department of Ecology, water associations located in the Case Area (*i.e.,* the Lummi Peninsula aquifer), and individual non-tribal land owners using or drawing water from privately owned wells in the Case Area (*United States and Lummi Nation v. State of Washington, Department of Ecology, et al,* W.D. Wash C01-0047Z, Document 1264-2, November 13, 2007). The complaint concerned the priority of federal reserved water rights under the *Winters* doctrine, the threat to the quality of Reservation groundwater due to groundwater mining and saltwater intrusion, and competing jurisdictional claims of the Lummi Nation and the State of Washington over the regulation of groundwater within the Lummi Peninsula aquifer (*i.e.,* the Case Area). As described above, the Lummi Peninsula aquifer is completely contained within the boundaries of the Lummi Reservation. The plaintiffs (Lummi Nation[3] and the United States) sought an injunction against any withdrawals of groundwater that conflict with the Lummi Nation's federal reserved water right.

In November 2007, a settlement was reached in the case with the terms of the settlement outlined in the *Settlement Agreement Regarding Uses of Groundwater on Lummi Peninsula* (Settlement Agreement). The Settlement Agreement assured that every user of water in the Case Area at the time of the settlement was protected in their use of water and allocated to the Lummi Nation control over all groundwater in the Case Area except 120 acre feet of water that were allocated to the Washington State Department of Ecology to distribute among existing users and eligible landowners. The Settlement Agreement also established a uniform set of regulations for groundwater well construction and use, set chloride limits and minimum well spacing requirements, and abolished so-called "exempt" wells. All wells must be authorized through a registration system, must be metered for water use, and may not exceed annual withdrawal or chloride limits. Well owners that overdraw the annual limit must pay back the overage through reduced withdrawals in subsequent years or through purchase of the overage water from the Lummi Water District. A Federal Court-appointed Water Master is employed by the parties to resolve disputes arising as part of the Settlement Agreement and step in and perform the necessary regulatory functions of the parties if either the Washington State Department of Ecology or the Lummi Nation fail to regulate water users in the Case Area as required as part of the Settlement Agreement.

[3] The Lummi Nation intervened in the case as a plaintiff after the initial filing by the United States.

2.4 Project Context

The Settlement Compliance Project is implemented by the LWRD, which has the overall goal of protecting treaty rights to water of sufficient quantity and quality to (a) support the purposes of the Reservation as a permanent economically viable homeland for the Lummi People, and (b) to support a sustainable harvestable surplus of salmon and shellfish sufficient to maintain a moderate living standard.

The Settlement Compliance Project is a component of the Lummi Nation Water Quality Monitoring Program (WQM Program). The goals of the WQM Program are threefold:

1. To establish the baseline conditions of surface and ground waters on and flowing onto the Reservation;
2. To use this information to evaluate regulatory compliance of waters flowing onto the Reservation; and
3. To support the development and implementation of a water quality regulatory program (*e.g.,* Lummi Code of Laws Title 17, Water Quality Standards) on the Reservation.

The WQM Program is an important element of the Comprehensive Water Resources Management Program. Related ground water monitoring projects include the Ground Water Project and the Continuous Aquifer Level Monitoring Project (LWRD 2021b). Additional details on project context and related projects are provided in the QMP.

2.5 Project Justification

An ample supply of good quality groundwater is needed to serve the purposes of the Reservation as a permanent and economically viable homeland for the Lummi People. Chloride and water use monitoring as part of the Settlement Compliance Project is required for compliance with the Settlement Agreement. The Settlement Agreement requires restricted use and careful monitoring of groundwater within the Lummi Peninsula aquifer for two reasons:

1. The potable groundwater is in limited supply, with insufficient potable water available to meet the future needs of every landowner or water claimant within the aquifer.
2. The aquifer is susceptible to contamination through saltwater intrusion if the aquifer is over pumped (groundwater mining) or insufficiently regulated as is bounded on three sides by salt water.

The damaging effects of groundwater mining and saltwater intrusion can be long term and often irreversible. However, groundwater mining and saltwater intrusion can be minimized or controlled through regulation of pumping regimes, withdrawal limits, groundwater well location, well depth, and monitoring, as outlined in the Settlement Agreement.

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3. PROJECT DESCRIPTION (A6)

The Settlement Compliance Project has been ongoing since 2008 after the Settlement Agreement was reached in 2007. The primary objective of the Settlement Compliance Project is to meet the requirements of the Settlement Agreement. The secondary Project objectives support the overall LWRD mission and the WQM Program goals (Section 2.4). Specifically the Settlement Compliance Project objectives are to:

1. Comply with the requirements of the Settlement Agreement (Settlement Agreement Regarding Uses of Groundwater on Lummi Peninsula);
2. Provide high quality data sufficient to establish baseline conditions of Lummi Nation Water;
3. Protect groundwater supplies from groundwater mining and saltwater intrusion; and
4. Support the development of a water quality regulatory program on the Reservation.

3.1 Project Description

The Settlement Compliance Project provides compliance with the chloride and water use reporting required by the Settlement Agreement.

Groundwater wells subject to monitoring as part of the Settlement Agreement are defined as small or large, depending on the number of households connected to the well. Small wells are defined as wells with three or fewer household connections. Large wells are defined as wells with more than three households connected, including tribal supply wells that produce water for the tribal water supply system. Currently, 13 small wells and 7 large wells are subject to the chloride and water use monitoring outlined in the Settlement Agreement. As individual well owners connect to the Lummi Water District water system and no longer use their individual groundwater wells, chloride and water use monitoring as part of the Settlement Compliance Project are no longer required. Figure 3.1 provides a map of the individual well site locations still in use and monitored as part of the Settlement Compliance Project.

Chloride samples are collected once per year (in August) for small wells and three times per year (in April, August, and December) for large wells. Monthly water use for each well is monitored in partnership with the Lummi Water District, which collects water meter data for all wells as part of the Settlement Agreement.

Annual water use for the water year (October 1-September 30) and chloride results are included in well reports completed annually in November as required by the Settlement Agreement. Chloride results are evaluated for trends and compared to chloride trigger levels as outlined in the Settlement Agreement. Water use is averaged by month for each well site and compared to water use limits as outlined in the Settlement Agreement.

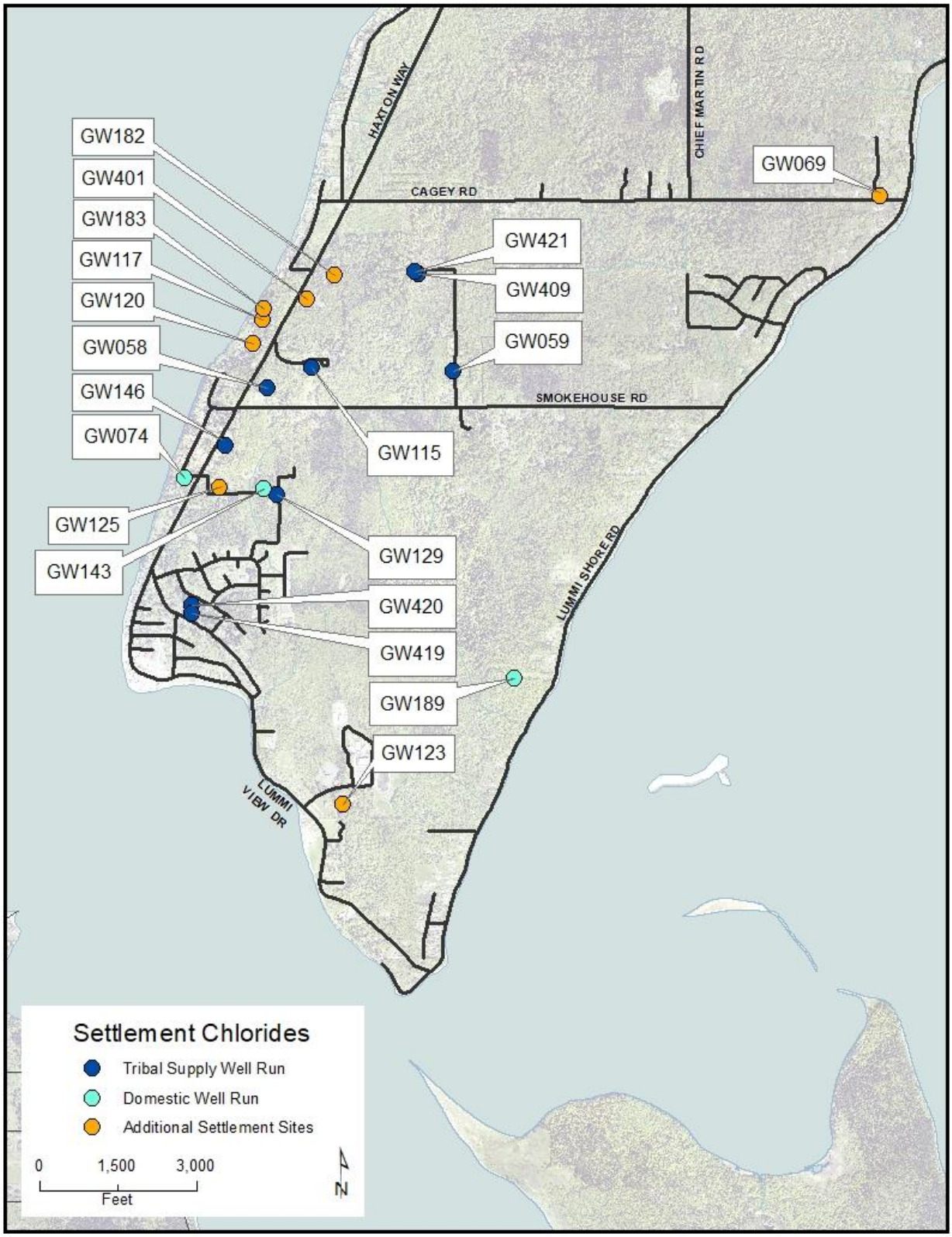

Figure 3.1 Lummi Peninsula Groundwater Settlement Agreement Monitoring Sample Site Locations

4. QUALITY OBJECTIVES AND CRITERIA (A7)

The overall performance standard for the Settlement Compliance Project is the collection of high-quality data sufficient to meet project goals. Data must be of sufficient quality (*i.e.,* known precision, accuracy, bias, traceability, completeness, and representativeness) to support scientifically valid, legally defensible decisions. Data must meet the legal requirements outlined in the Settlement Agreement.

4.1 Project Action Limits

Project action limits include chloride trigger levels and water use limits as outlined in the Settlement Agreement. The chloride trigger level is 140 mg/L except when the chloride base level is greater than 100 mg/L, the chloride trigger level is 40 mg/L higher than the chloride base level, up to a maximum of 250 mg/L. The water allocation for small wells is 350 gallons per day (gpd) per household. If chloride trigger levels or water use allocations are exceeded, the Water Resources Manager is immediately notified by the Water Resources Specialist II. In addition, if chloride levels are increasing for any well, the Water Resources Manager is alerted of the trend. Additional details on project action limits are included in the QMP.

4.2 Precision

Precision is not routinely calculated for the Settlement Compliance Project. See QMP for calculation of summary statistics, including field variability and quality control parameters.

4.3 Accuracy and Bias

Accuracy and bias of chloride results depends on laboratory methods. See Chloride Sample Collection SOP for details (LWRD 2018b). Accuracy and bias are not routinely calculated for water use or meter reading data. Estimated water use values may be calculated to fill in gaps in the data; these estimates are marked as such on Excel spreadsheets.

4.4 Representativeness

Sample sites subject to the Settlement Compliance Project were selected according to the location of active wells on the Lummi Peninsula (*i.e.,* wells included in the Settlement Agreement). Sample sites were not selected to provide spatial representativeness. Temporal representativeness of chloride results is ensured through random sample collection during months selected for sampling. Small wells are sampled for chlorides in August, when groundwater levels are expected to be the lowest and groundwater mining and saltwater intrusion at the highest risk. Large wells are sampled for chlorides in April, August, and December to provide temporal resolution throughout the year. Chloride sample representativeness is ensured by collecting samples prior to drinking water treatment (if applicable) and after the source has been sufficiently flushed.

4.5 Comparability

Only data with known and acceptable accuracy, precision, and traceability will be used for data analysis, reporting, and decision making. Information regarding data quality allows for comparison of data collected at different times over the period of record within the Settlement Compliance Project and with the Ground Water Project, as well as comparison with non-WQM Program sources of data, assuming quality control information is available for non-WQM Program data.

4.6 Completeness

The goal of the Settlement Compliance Project is for chloride samples to be collected annually or three times annually, depending on the well, and for water use data to be collected on a monthly basis. Data are considered complete when all efforts have been taken to collect the data. It is anticipated that chloride samples at all sites will be collected as scheduled. If chloride samples cannot be collected as scheduled, they are collected as soon as possible. Data gaps are addressed on a case-by-case basis. Missing data may be due to water meter malfunction, staff turnover, resource constraints, corrective actions, or logistical problems. Corrective actions, including coordination with the Lummi Water District for collection of water use data, are undertaken to remedy conditions that create missing data to prevent data gaps in the future.

4.7 Range/Sensitivity

The sensitivity and range are determined by the laboratory. See Chloride Sample Collection SOP for details. Deficiencies in sensitivity are evaluated on a case-by-case basis and corrected for future monitoring.

5. DOCUMENTS AND RECORDS (A9)

5.1 Quality Assurance Project Plan Distribution

The Water Resources Specialist II is responsible for ensuring that the people listed on the Distribution List for this QAPP have the most current version of the QAPP. Records are maintained by the Water Resources Specialist II documenting substantial and minor version changes, and the Water Resources Manager is responsible for the distribution of minor change letters and revised QAPPs. Details on documenting QAPP revisions, including version number conventions, are included in the QMP.

5.2 Data Report Package

Chloride and water use data collected as part of the Settlement Compliance Project are included in well reports for the water year (October 1-September 30), which are completed annually in November. Annual well report templates for small and large wells are included as Appendix A. Chloride and water use data are stored in the Lummi Well Reporting Database during completion of annual well reports and transmitted to the Water Master Database as needed.

Chloride data collected at specific sites as part of the Settlement Compliance Project are used to supplement chloride results collected as part of the Ground Water Project and are included in the Water Quality Assessment Report, which summarizes the results of the WQM Program projects implemented by the LWRD. The reports include analysis of chloride data for the two-year reporting period as well as for the period of record. The report is provided to the EPA Project Officer every-other year by March 31 of the year after the two-year reporting period, following approval by the Water Resources Manager and the LNR Deputy Director.

Chloride data for select sites are also transmitted to the EPA via the Water Quality Exchange (WQX) framework upon approval by the Water Resources Manager and the LNR Deputy Director. The select data collected for transmittal are provided to the EPA Project Officer annually by March 31 of the subsequent calendar year.

5.3 Documentation and Storage

The QMP provides detailed requirements for project document storage, including field datasheets and electronic data.

The Water Resources Specialist II is responsible for maintaining and storing all documents and records associated with the Settlement Compliance Project. All chloride and water use data are stored in the Lummi Well Reporting Database, which is saved on LIBC servers that are backed up nightly. Laboratory chloride results are saved in the H:\\DigitalArchive drive, which is also saved on LIBC servers. Hardcopies of chloride results and well reports are saved in folders

maintained and stored by the Water Resources Specialist II. Scanned copies of all file documents are saved on LIBC servers.

Chloride results are also stored in the Water Database, which is saved on secure LIBC servers that are backed up nightly. All site visit observations, notes on issues or concerns, corrective actions, and outcomes are recorded directly into the Water Database in real time using the iPad or are recorded on field datasheets and transcribed into the Water Database. Field data entry quality assurance/quality control (QA/QC) is completed by the Water Resources Technician II and/or Water Resources Specialist II within one week of trip date. All paper records (*e.g.,* field datasheets and QA/QC reports) are stored by the Water Resources Specialist II in the LWRD office. All electronic records are saved in the Water Database and in a data archive folder on secure LIBC servers, which are backed up nightly. Details on QA/QC of data entry into the Water Database are provided in the Water Database User Guide (LWRD 2018a) and QMP.

6. EXPERIMENTAL DESIGN (B1)

As previously described, the Settlement Compliance Project is designed to achieve the following objectives:

- Comply with the requirements of the Settlement Agreement (*Settlement Agreement Regarding Uses of Groundwater on Lummi Peninsula*);
- Provide high quality data sufficient to establish baseline conditions of Lummi Nation Water;
- Protect groundwater supplies from groundwater mining and saltwater intrusion; and
- To support the development of a water quality regulatory program on the Reservation.

The Settlement Compliance Project is ongoing and not intended to prove or disprove a specific hypothesis.

6.1 Project Structure and Sample Sites

The Settlement Compliance Project involves collection of data in compliance with the chloride and water use reporting required by the Settlement Agreement. Thirteen (13) small wells (*i.e.,* wells with three or fewer households connected) and seven (7) large wells (*i.e.,* wells with more than three households connected) are subject to Settlement Agreement compliance monitoring. All seven large wells are tribal supply wells that are routinely sampled as part of the Ground Water Project. Three of the small wells are domestic wells routinely sampled as part of the Ground Water Project (GW074, GW143, GW189). Two of the small wells are tribal supply wells that are not currently (and will not be in the foreseeable future) in production (GW419, GW420). The remaining ten small wells are not sampled as part of any other WQM Program project and are included only in the Settlement Compliance Project.

Table 6.1 Lummi Peninsula Groundwater Settlement Agreement Compliance Monitoring Project Sites

Well Name	Well ID	Service Address(es)
Small Wells (three or fewer connections)		
Berg, Colleen and Kevin; Rogers, Bonnie; Snell, Karen	GW143	3387 and 3391 Southgate Rd
Charles, Kathleen	GW074	3349 Southgate Rd
Curtis, Donald and Lucille; Wales, Richard and Alice	GW125	3395 and 3395 Southgate Rd
Dzyban, Lisa and Morison, David	GW120	2973 and 2977 Haxton Way
Egawa, Marie	GW189	2519 Lummi Shore Rd
Fadden, Rodney and Lea Ann	GW183	3011 Haxton Way
Greene, Dick	GW069	2396 Cagey Rd
Gooseberry Point No. 4 Well	GW420	2596 Mackenzie Road

Table 6.1 Lummi Peninsula Groundwater Settlement Agreement Compliance Monitoring Project Sites

Well Name	Well ID	Service Address(es)
Small Wells (three or fewer connections)		
Gooseberry Point No. 5 Well	GW419	2596 Mackenzie Road
Herrmann, Rob	GW117	3005 Haxton Way
Kinley, Larry	GW123	2304 Lummi View Dr
Robbins, Carolyn and Freeman, William	GW182	3100, 3114 Haxton Way
Summers, Tony	GW401	3060 Haxton Way
Large Wells (more than three connections)		
Balch Well	GW115	3247 Balch Road
Horizon Well	GW058	3249 Smokehouse Road
Kinley Well No. 1	GW059	2950 Kinley Way
Kinley Well No. 2	GW409	3015 Kinley Way
Kinley Well No. 3	GW421	3300 Kinley Way
Mackenzie Well No. 2	GW129	2800 Haxton Way
Westshore Well	GW146	2896 Haxton Way

6.2 Parameters Measured

Chloride samples are collected once per year (in August) for small wells and three times per year (in April, August, and December) for large wells. Chloride samples may be collected at any time during the month during which sample collection is required. Samples may be collected all on the same day, or samples from sites also included as part of the Ground Water Project may be sampled concurrently during sampling for the Ground Water Project. Sampling at Gooseberry #4 (GW420) and Gooseberry #5 (GW419) requires coordination with the Lummi Water District as the inactive wells must be flushed in order to collect representative chloride samples. Chloride samples are analyzed by an independent contracted laboratory, Edge Analytical, Incorporated in Burlington, WA. Chloride results are evaluated for trends and compared to chloride trigger levels as outlined in the Settlement Agreement. Chloride samples collected as part of the Settlement Compliance Project supplement the Ground Water Project (LWRD 2021a). Summaries of the Ground Water Project and other WQM Program projects are provided in the QMP.

Detailed maps, descriptions of sample locations, and driving directions to sample sites are provided to field personnel in the *Lummi Nation Water Quality Monitoring Program Field*

Reference Manual to ensure that sites are sampled on location (LWRD 2019). Sample site access is usually not a problem. If sites are inaccessible, the sample site is returned to at a later time.

Monthly water use data is obtained from the Lummi Water District. Monthly meter readings are reported for large wells and once annual meter readings, as close to September 30 as possible, are reported for small wells. Water use and average daily withdrawal for the water year is calculated from monthly meter readings and entered into the Lummi Well Reporting Database.

All data collection (*i.e.,* chloride and water use data) is critical as complete data collection is required as part of the Settlement Agreement. Well reports are completed annually on November 1, as required by the Settlement Agreement. Reports summarize data collected during the water year (October 1-September 30). Well reports are completed by the Water Resources Specialist II.

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7. DATA COLLECTION (B2)

Sampling methods (B2), sample handling and custody (B3), and analytical methods (B4) for the Settlement Compliance Project are described below. This section also describes safety during data collection activities, equipment required for sample runs, and the site visit sequence.

7.1 Sampling Method Overview

At each site, the well is flushed and a chloride sample is collected using a dedicated groundwater hose. The chloride sample is delivered to the LNR independent contracted laboratory for analysis. Water use data are obtained from the Lummi Water District. Chloride and water use data are recorded in the Lummi Well Reporting Database and included in well reports completed annually in November.

7.2 Sample Handling and Custody (B3)

Details on sample handling and custody, including how samples are physically handled and transported to the laboratory, requirements for chain of custody procedures, and maximum holding times are provided in the Chloride Sample Collection SOP. Information on sample tracking is included in the QMP.

7.3 Safety

All field work is conducted by teams of two or more. All procedures listed in the *Lummi Water Resources Division Health and Safety Plan* (LWRD 2015) are followed while conducting field work outlined in this QAPP. Safety is not addressed in detail in this document; however, no water quality measurement is worth risking injury or death. To ensure that hazards are identified and addressed, field personnel must maintain a general awareness of hazards and possess the ability to respond appropriately. Field personnel must be aware of the environment, use common sense and training, and not exceed their abilities or limits. Field personnel always carry a cell phone and car charger, and notify their supervisor of planned field work, including the time of departure, the time of the scheduled return, and the general location of field work.

7.4 Supplies and Consumables (B8)

Equipment required for implementation of the Settlement Compliance Project is stored in the LNR office, lab, and storage locker. Equipment is kept in good working order and supplies are regularly inventoried and stocked by the Water Resources Specialist II and Water Resources Technician II to ensure availability. Details on supply ordering, stocking levels, and management are provided in the QMP. Details on equipment and supply inspection are listed in the Chloride Sample Collection SOP.

Supplies and consumables used in the Settlement Compliance Project include:

- iPad
- Field notebook and pen/pencil
- Well keys
- Stopwatch (or cell phone)
- 250 ml bottles for chloride sample collection, provided by the independent contracted laboratory
- Garden hose dedicated to groundwater sample collection
- Bucket

7.5 Field Visit Sequence

The field visit sequence varies slightly for domestic and tribal supply wells. Special sampling instructions are provided for inactive supply wells, Gooseberry #4 and #5.

7.5.1 Tribal Supply Wells

Upon arrival at a tribal supply well, the following sequence is followed:

1. Turn pump to Hand.
2. Unplug or turn off any chloride and fluoride treatments, especially if they are added to the supply water prior to sampling location.
3. Locate sampling location and attach dedicated groundwater sampling hose, if possible. Collect sample from as close to the wellhead as possible.
4. Flush the system for 3 minutes through the hose or by filling 2 bucketfuls of water.
    - For supply wells that are not regularly pumped, three casing volumes are flushed prior to sample collection. See Section 7.5.3 for special instructions for sampling inactive supply wells, Gooseberry #4 and #5.
5. Collect chloride sample following instructions provided in the Chloride Sample Collection SOP.
6. Plug in or turn on any chloride and fluoride treatments. Ensure that both treatments are working before changing pump settings.
7. Return pump to setting it was in during arrival (typically Auto).

7.5.2 Domestic Wells

Upon arrival at a domestic well (*i.e.,* wells owned by individuals supplying three or fewer households), the following sequence is followed:

1. Inform the homeowner, if they are home, that a chloride sample will be collected. Verify their name and contact information. Update records as needed.
2. Locate sampling location and attach dedicated groundwater sampling hose. Collect

sample from as close to the wellhead as possible.

3. Flush the system for 3 minutes through the hose.
4. Collect chloride sample following instructions provided in the Chloride Sample Collection SOP.

7.5.3 Gooseberry #4 and #5

Special instructions for sample collection at inactive supply wells Gooseberry #4 (GW420) and Gooseberry #5 (GW419) follow:

1. Contact Lummi Water District one week prior to planned sampling.
2. Wells are flushed for a minimum of four hours (three casing volumes) by Lummi Water District staff.[4]
3. Collect chloride sample following instructions provided in the Chloride Sample Collection SOP.

Wells that become inactive or infrequently used will be flushed prior to sampling as described in footnote 4.

7.6 Water Use Data

Water use data are collected by Lummi Water District staff. Data may be available in electronic format on a monthly basis. If not, hardcopy spreadsheets of meter readings for each well are available at the Lummi Water District offices for data transcription. Note that confidential information may be present on well meter reading summary spreadsheets maintained by the Lummi Water District. All LWRD staff are required to maintain confidentiality. LWRD spreadsheets of water use for each well are updated and maintained by the Water Resources Specialist II. Appendix A provides an example of a water use spreadsheet and summarizes the calculations conducted.

[4] Purge volume calculated as follows: V=0.041*d2*h*3 where, h=depth of water in feet (well depth-water level), d=diameter of the well in inches, and V=volume of water in gallons (EPA R4 2013). The time (in minutes) required to flush three casing volumes can be found by dividing the volume by the flow rate in gallons per minute.

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8. QUALITY CONTROL AND EQUIPMENT USE

This section outlines quality assurance/quality control (QA/QC) activities (B5), equipment testing, inspections, and maintenance (B6) required as part of the Settlement Compliance Project. Quality control activities are integral to data quality as they ensure that measurements have a known accuracy, precision, and traceability.

8.1 Quality Control (B5)

Quality control procedures for the Settlement Compliance Project include appropriate sample collection techniques, observation of laboratory holding times, chain of custody forms, laboratory QA/QC procedures, and data review. No equipment calibrations (B7) are required for data collection as part of the Settlement Compliance Project.

8.1.1 Sample Collection

Chloride samples are collected following the Chloride Sample Collection SOP, instructions from the LNR independent contracted laboratory, and the Settlement Agreement.

8.1.2 Sample Tracking

Every groundwater sample site has a unique numerical identifier. The site identifier is used to track chloride samples collected at the site. The QMP provides details of sample tracking and data recording. Chain of custody forms are provided by the independent contracted laboratory and are used to handle and track samples from field collection to delivery to the laboratory. The number on the chain of custody form will follow the samples through laboratory analysis to final reporting.

8.1.3 Holding Times

Laboratory holding times are observed for all chloride samples collected. See Chloride Sample Collection SOP for details.

8.1.4 Laboratory QA/QC

The independent contracted laboratory is responsible for maintaining data quality for laboratory-analyzed results. Quality assurance samples may include blanks, matrix spikes, laboratory duplicates, and/or standards. The number and frequency of duplicates and matrix spikes are determined by the contracted laboratory according to method requirements and the laboratory QAPP. Quality assurance practices will meet or exceed method and accreditation requirements as outlined in the laboratory QAPP or method SOP. A summary of laboratory QA/QC requirements are provided in the Quality Management Plan (QMP Appendix C).

8.1.5 Data Review

Review of accurate data entry into the Water Database, Lummi Well Reporting Database, and annual well reports is required prior to finalization of annual reports.

8.2 Equipment Maintenance (B6)

The Water Resources Specialist II and the Water Resources Technician II are responsible for ensuring that sampling equipment are ready for use according to SOPs. Chloride sample collection equipment maintenance is described in the Chloride Sample Collection SOP. Specifically, the water sampling hose is kept in working order and unopened bottles provided by the contracted laboratory are inspected before use to ensure that bottles are not damaged or contaminated.

8.3 Acceptance Criteria and Control Limits

Acceptance criteria for laboratory analyses are determined by the independent contracted laboratory. Control limits include chloride trigger levels and maximum annual water use limits set by the Settlement Agreement. The Water Resources Manager is alerted if chloride levels are increasing, chloride trigger levels are exceeded, or maximum annual water use limits are exceeded. The Water Resources Specialist II will notify the Water Resources Manager of exceedances either in person or in writing (via email). Documentation of exceedances will follow requirements outlined in the Lummi Peninsula Groundwater Settlement Agreement. Details on determination and documentation of the effectiveness of control activities are included in the QMP.

8.4 Corrective Actions

The goals of corrective actions are to solve the problem at hand and to eliminate or reduce the occurrence of problems in the future. Problems, corrective actions, and outcomes are recorded in the Water Database as described in the QMP and Water Database User Guide. Problems associated with the analysis of chloride samples at the laboratory are addressed on a case-by-case basis with laboratory personnel. Problems associated with the collection and retrieval of water use data is addressed with Lummi Water District personnel. Typically, corrective actions are only required when data are missing or unavailable to ensure that data can be properly collected in the future.

9. DATA MANAGEMENT (B10)

The Water Resources Specialist II is responsible for management of Settlement Compliance Project data with support and supervision provided by the Water Resources Manager and the Database Manager. Data collected as part of the Settlement Compliance Project are stored in two databases. Chloride and water use data are stored in the Lummi Well Reporting Database. Chloride results are also stored in the Water Database.

9.1 Data Management Summary

As previously described, chloride and water use data are collected for each groundwater well and included in the annual well report (templates attached as Appendix C). Water use data are entered into an Excel spreadsheet (example provided in Appendix A), average daily water use is calculated, and summary data are entered into the Lummi Well Reporting Database (Appendix B). Chloride results are entered into both the Water Database and the Lummi Well Reporting Database.

Chloride data entered into the Water Database are transmitted to EPA via WQX annually upon approval by the Water Resources Manager and the LNR Deputy Director. See Ground Water Project for additional details.

9.2 Water Use Calculation

The Water Resources Specialist II maintains Excel spreadsheets for each well containing meter readings and water use calculations. Meter readings, obtained from the Lummi Water District, are entered into the spreadsheet. From the meter readings, water use per month is calculated. Average daily water use is also calculated from total annual water use and the number of days that year (note leap years). Appendix A contains an example water use spreadsheet and notes on calculations. The water use calculation spreadsheet is printed for inclusion in the well report.

9.3 Chloride Sample Results

Chloride sample results are entered into several locations: the Lummi Well Reports Database, Water Database, spreadsheets for website publication, and the annual well reports.

Chloride sample results are entered into spreadsheets maintained by the Water Resources Specialist II. These spreadsheets are uploaded to the Lummi Natural Resources website upon approval by the Water Resources Manager, and distributed to Department of Ecology personnel involved in Settlement Agreement compliance monitoring.

Section 9.4 provides details on entering chloride data into the Lummi Well Reports Database. The Water Database User Guide provides details on entering chloride data into the Water Database to supplement the Ground Water Project data. Section 9.5 provides details on preparing annual reports.

9.4 Lummi Well Reports Database

Information included in annual well reports is entered into the Lummi Well Reports Database. Detailed instructions for entering data into the Lummi Well Reports Database are provided in Appendix B.

9.5 Report Preparation

Well reports (Appendix C) are completed for each groundwater well by November 1 annually, as required by the Settlement Agreement. Chloride results are transcribed into the table provided in the well report template. Water meter readings are transcribed into a similar table in the well report template; one water meter measurement as close to September 30 as possible is required for small wells and monthly meter readings are required for large wells. Additional information, including number of homes served by the well and any changes in well operation during the water year are recorded in the well reports.

Completed well reports are signed by the report preparer, typically the Water Resources Specialist II. Final laboratory chloride results, a printout of the water use spreadsheet, and a printout of the Lummi Well Reports Database summary report for the well are attached to the well report.

The well report is scanned and saved in an electronic folder maintained by the Water Resources Specialist II on secure LIBC servers that are backed up nightly.

9.6 Non-Direct Measurements (B9)

Water use data are collected by the Lummi Water District following best practices. Other non-direct measurements are not currently routinely used for the Settlement Compliance Project.

9.7 Data Review and Usability (D1, D2, D3)

Data quality is ensured by the following:

- Data collection following methods outlined in this QAPP and the Chloride Sample Collection SOP
- Data entry QA/QC review
- Inclusion of only useable and trustworthy data in annual well reports

The Settlement Compliance Project is ongoing and not designed to prove or disprove specific hypotheses. Uncertainties of the data are documented in this QAPP and in the Chloride Sample Collection SOP. The Water Resources Specialist II is responsible for quantifying or qualifying data quality to data users.

10. OVERSIGHT AND REPORTING

10.1 Assessments and Response Actions (C1)

Section 1 of this QAPP and the QMP list the key personnel and their responsibilities. In summary, the person conducting the monitoring (primarily the Water Resources Specialist II and Water Resources Technician II) is responsible for performing all data collection activities, QA/QC activities, and data management. The Water Resources Specialist II is responsible for ensuring that data are entered in the appropriate databases with support from the Water Resources Technician II and Database Manager. The Water Resources Manager ensures that reporting requirements as outlined in the Settlement Agreement are achieved.

10.2 Reports to Management (C2)

The Water Resources Specialist II is responsible for reporting to the Water Resources Manager regularly and as needed if problems are detected. When problems are detected and not resolved through standard practices or are of a more complex nature than the staff conducting water quality sampling typically address, the Water Resources Specialist II, Water Resources Technician II, and the Water Resources Manager will jointly develop an action plan to remedy the problem with clear roles, responsibilities, and timelines. The Water Resources Manager is immediately alerted if significantly increasing chloride levels are detected or if chloride trigger levels or water use limits are exceeded. Project action limits and assessments are described in the QMP.

The Water Resources Specialist II prepares annual well reports in November of each year and updates chloride result spreadsheets available on the LNR website as results are received.

Chloride data are also included in a Water Quality Assessment Report to supplement data collected as part of the Ground Water Project. These reports are reviewed and approved by the Water Resources Manager and the LNR Deputy Director, and approved reports are transmitted to the EPA every-other year by March 31st of the year following the two-year reporting period. The Water Resources Manager submits bi-annual (twice per year) progress reports to the EPA Project Officer that describe program status, problems, remedies, and schedules.

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11. ACRONYMS AND ABBREVIATIONS

EPA	Environmental Protection Agency
gpd	Gallons per Day
LIBC	Lummi Indian Business Council
LNR	Lummi Natural Resources Department
LWRD	Lummi Water Resources Division
QAPP	Quality Assurance Project Plan
QMP	Quality Management Plan
QA/QC	Quality Assurance/Quality Control
SOP	Standard Operating Procedure
WQM	Lummi Nation Water Quality Monitoring [Project]
WQX	Water Quality Exchange

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12. REFERENCES

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LWRD. 2018a. Water Database User Guide. Prepared for the Lummi Indian Business Council. Lummi Reservation, Washington. October.

LWRD. 2019. Lummi Nation Water Quality Monitoring Program: Field Reference Manual. Internal Document. July.

12.2 QMP, QAPPs, SOPs

LWRD. 2018b. Standard Operating Procedure #006: Chloride Sample Collection. Prepared for the Lummi Indian Business Council. Lummi Reservation, Washington. October.

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LWRD. 2021b. Quality Assurance Project Plan: Lummi Nation Continuous Aquifer Level Monitoring Project. Version 1.1a. Prepared for the Lummi Indian Business Council. Lummi Reservation, Washington. July.

LWRD. 2021c. Quality Management Plan for the Lummi Nation Water Quality Monitoring Program. Version 1.2. Prepared for the Lummi Indian Business Council. Lummi Reservation, Washington. July.

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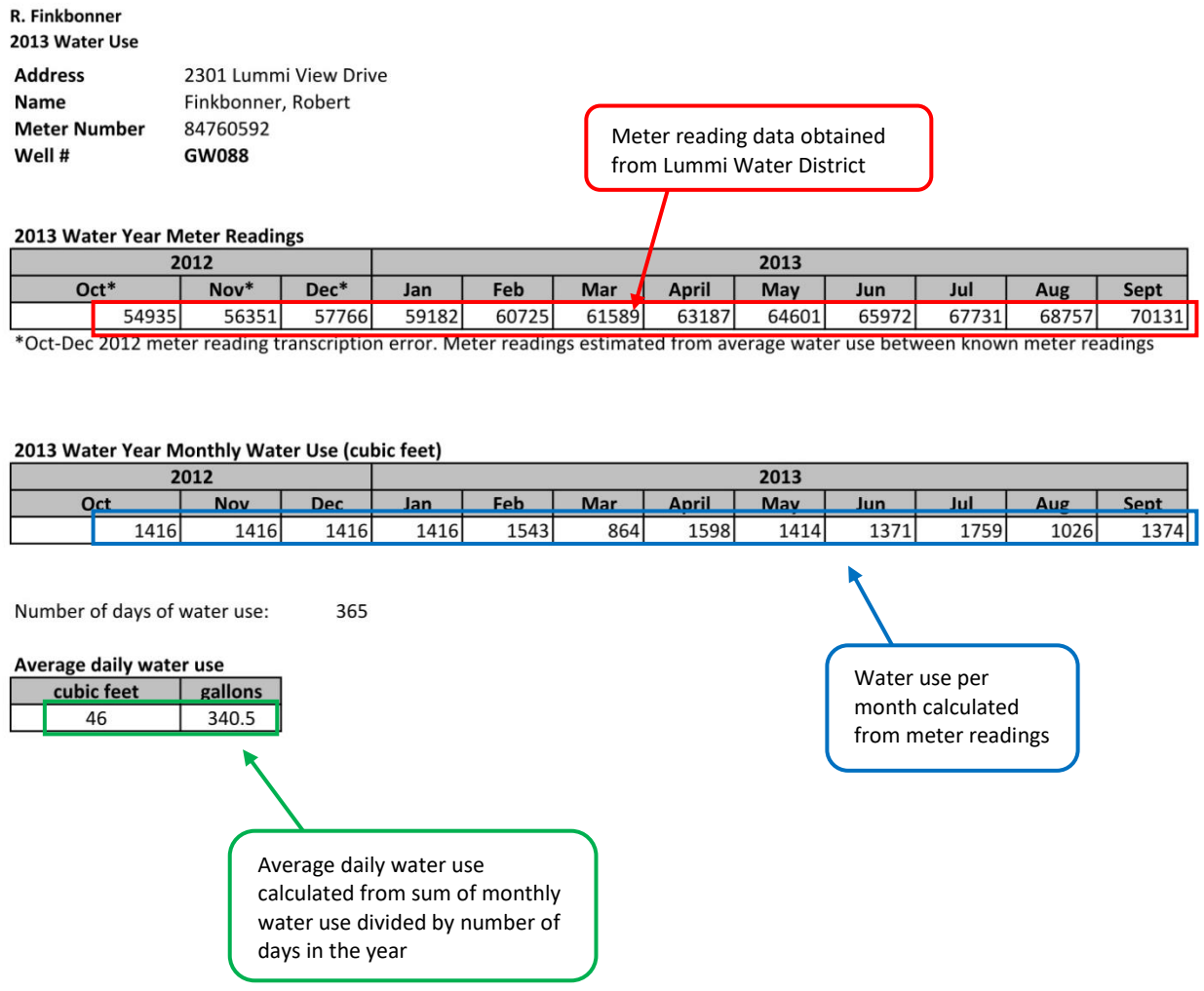
APPENDIX A. WATER USE SPREADSHEET

Figure 12.1 provides an example of a water use spreadsheet for a small well. Meter readings for each month are obtained from the Lummi Water District. For transcription errors or gaps in readings, meter readings can be estimated by interpolating between two known readings. Water use by month is calculated from the monthly meter readings (*e.g.,* water use in January is the January meter reading minus the December meter reading). Average daily water use is calculated by summing the monthly water use values for the water year (October-September) and dividing the annual water use by the number of days in that year (note that leap years have one extra day).



R. Finkbonner
2013 Water Use

Address	2301 Lummi View Drive
Name	Finkbonner, Robert
Meter Number	84760592
Well #	**GW088**

Meter reading data obtained from Lummi Water District

2013 Water Year Meter Readings

2012			2013								
Oct*	Nov*	Dec*	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sept
54935	56351	57766	59182	60725	61589	63187	64601	65972	67731	68757	70131

*Oct-Dec 2012 meter reading transcription error. Meter readings estimated from average water use between known meter readings

2013 Water Year Monthly Water Use (cubic feet)

2012			2013								
Oct	Nov	Dec	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sept
1416	1416	1416	1416	1543	864	1598	1414	1371	1759	1026	1374

Number of days of water use: 365

Average daily water use

cubic feet	gallons
46	340.5

Water use per month calculated from meter readings

Average daily water use calculated from sum of monthly water use divided by number of days in the year

Figure 12.1 Example Water Use Spreadsheet

Figure 12.2 provides an example of a water use spreadsheet for a large well (supplying more than 3 households). Meter readings are obtained from the Lummi Water District. Total gallons used per month are calculated from the meter readings. Annual water use is then calculated and divided by the number of days in that year (note leap years) to calculate average daily water use.

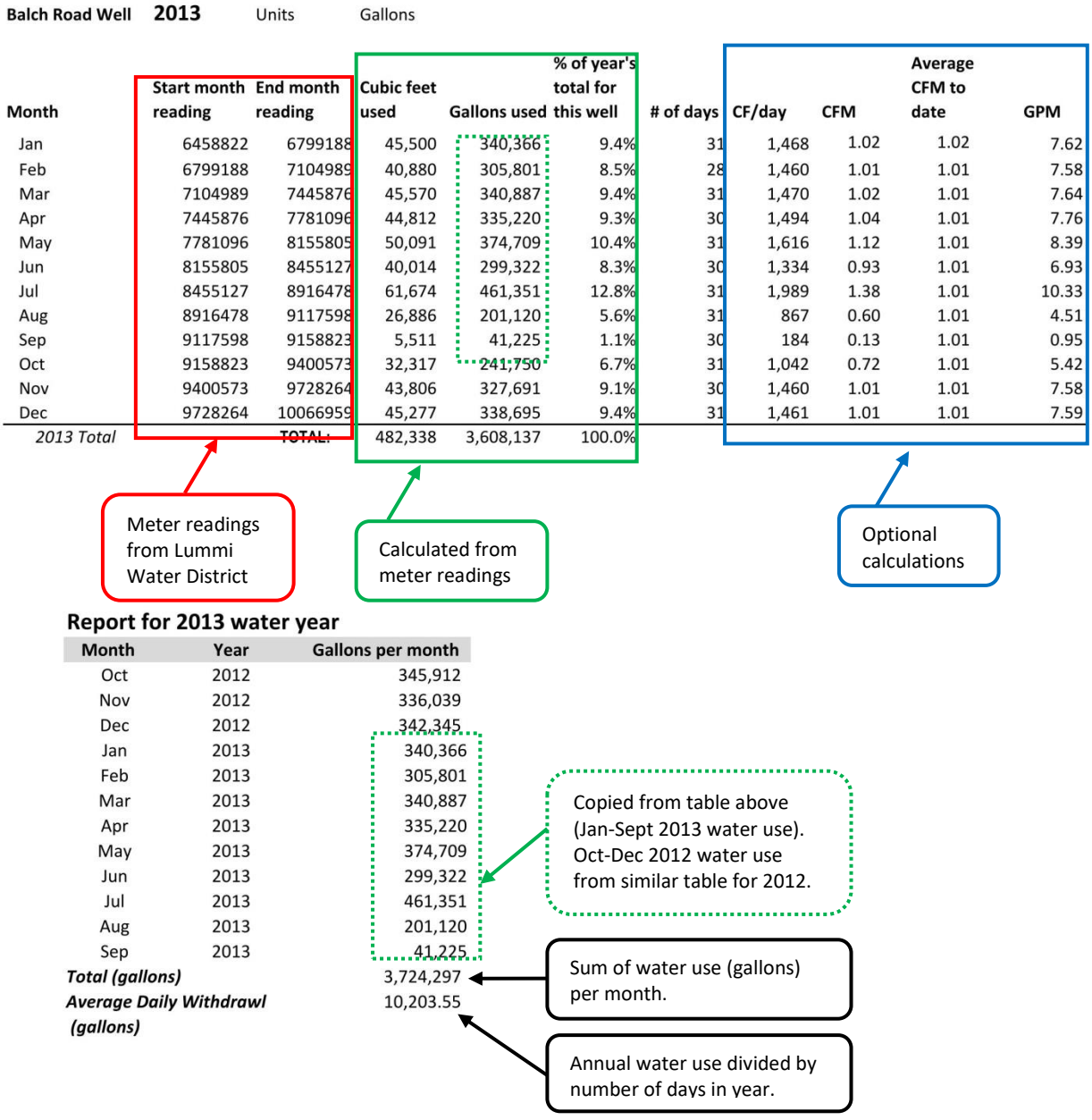


Figure 12.2 Example Water Use Spreadsheet for Large Well (Tribal Supply Well)

APPENDIX B. LUMMI WELL REPORTS DATABASE

The Lummi Well Reports Database is a custom-built Microsoft Access database for storing and organizing data collected as part of the Settlement Compliance Project.

B.1 Open the Database

The Lummi Well Reports Database is saved here:
G:\Natural Resources\Public\DATABASE\WaterMaster\LummiWellReporting0.0

Figure 12.3 provides an image of the database main menu page. To create a new report, click Input New Report on the main menu page. To open and edit a previously created report, click Edit Previous Reports on the main menu page.

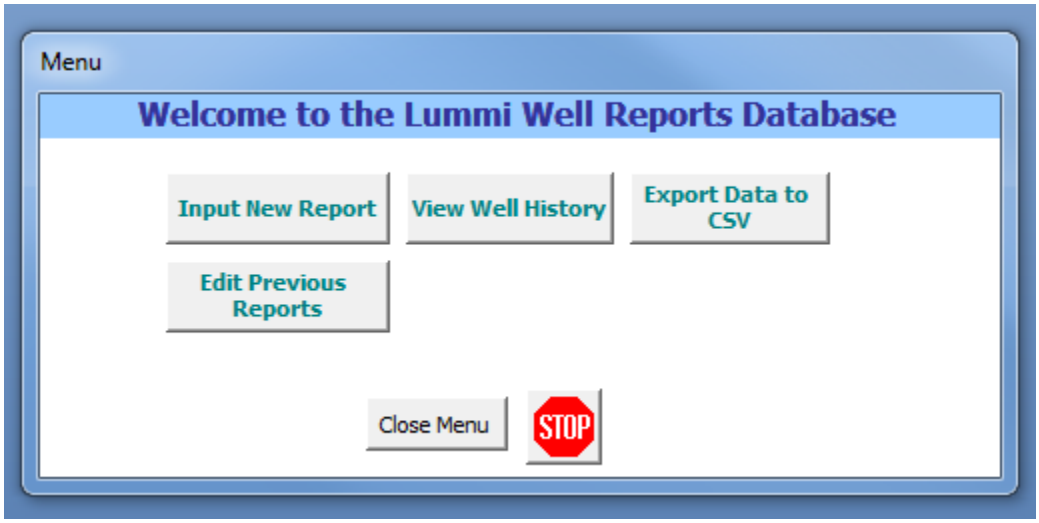


Figure 12.3 Lummi Well Reports Database Main Menu Page

On all pages of the Lummi Well Reports Database is a Return To Menu button, which will return you to the main menu. From the main menu page, click the red STOP sign to exit the database.

B.2 Well Report

Each well report has four tabs: well owners, connection information, chlorides, and meter readings.

B.2.1 Well Owners

On the Well Owners tab (Figure 12.4):

1. Enter the report date at the top of the page.
2. Select the well owner from the drop-down list.

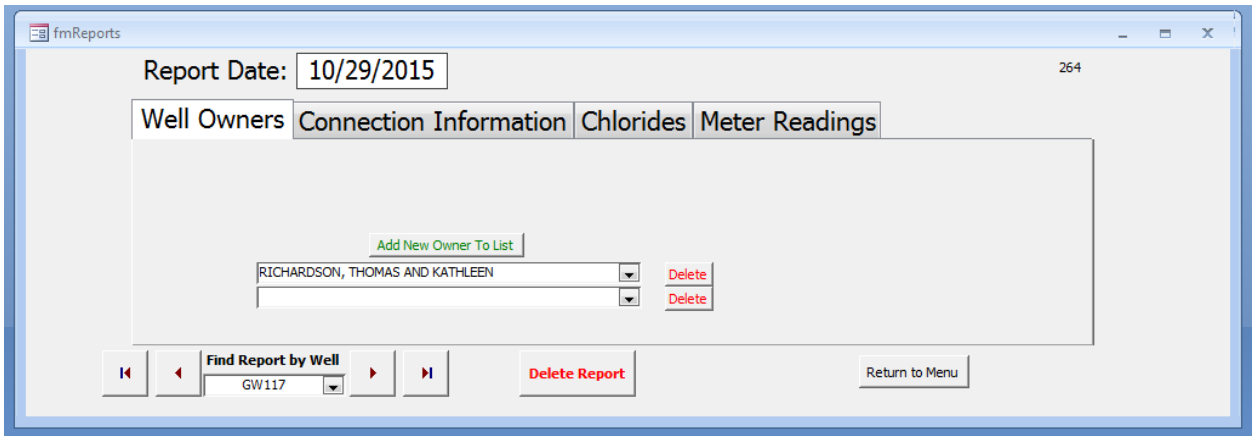


Figure 12.4 Well Report Well Owners Page

B.2.2 Connection Information

On the Connection Information Page (Figure 12.5):

1. Enter the number of households currently supplied by the well, the number of service commitments issued, but not yet supplied, and the number of service commitments anticipated in the coming water year.
    - For supply wells, enter the numbers for the total system and note this in the Other Comments field.
2. Enter the water right number, if known.
3. Add any comments about the well in the WellComments field.
4. Add any comments about the meter, including a new meter installation or rollover event, in the MeterComments field.
5. Add any other comments in the Other Comments field.

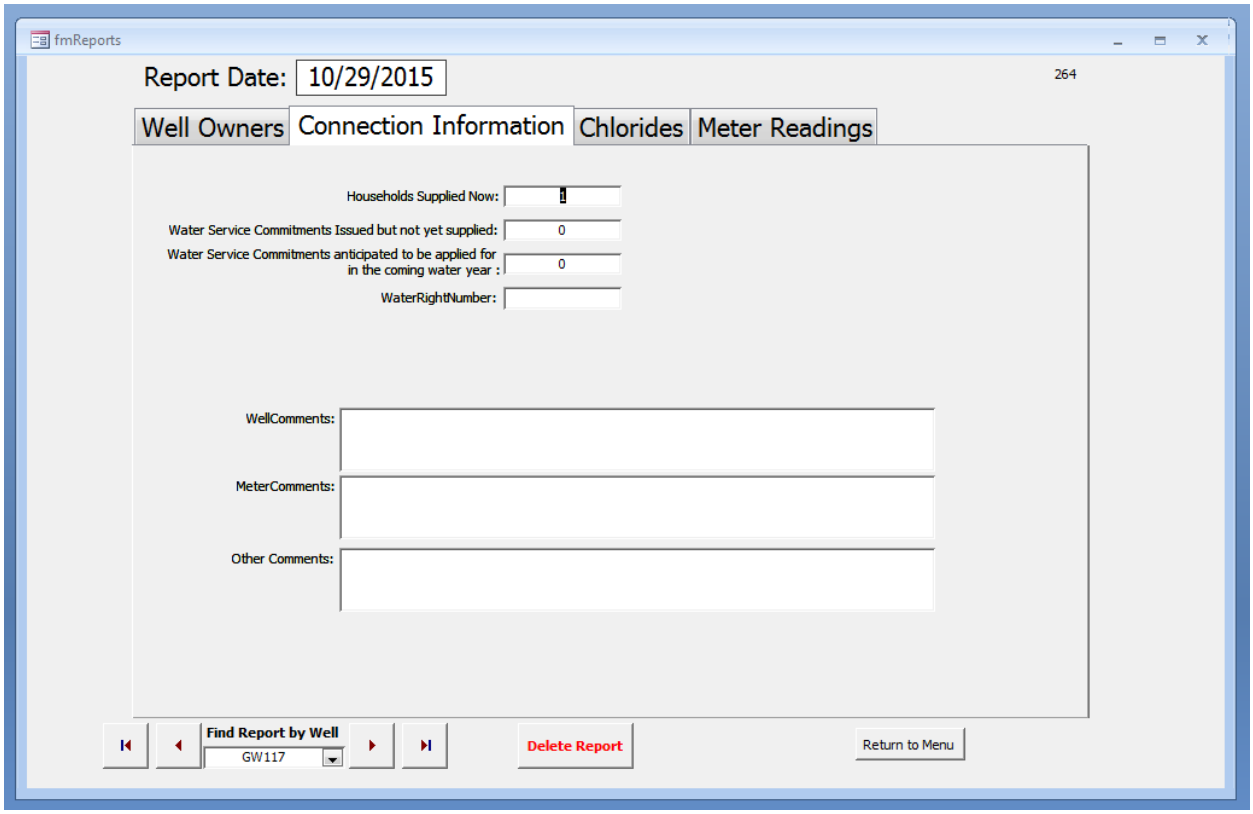


Figure 12.5 Well Report Connection Information Page

B.2.3 Chlorides

On the Chlorides tab, enter information related to the chloride samples collected during that annual reporting period. Note that the reporting period is a water year (Oct 1-Sept 30); chloride samples for a large well in the 2016 water year will include chloride results from Dec 2015, April 2016, and August 2016.

1. Select the Lummi Well Number from the drop down list.
2. Enter the date the sample was collected by clicking in the date field and navigating through the calendar to the appropriate date.
3. Click Lab under Sample Type for chloride samples that were analyzed at an independent contracted laboratory.
4. Type in the Chloride Value.
5. The units will be automatically filled in; ensure that it reads mg/L.

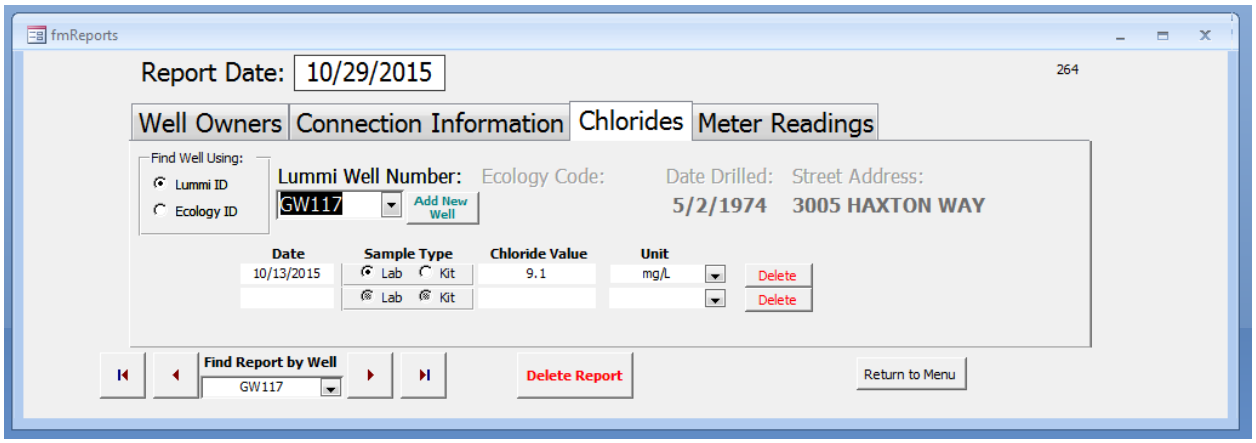


Figure 12.6 Well Report Chlorides Page

B.2.4 Meter Readings

On the Meter Readings tab (Figure 12.7), enter the meter readings for the well.

1. Select the appropriate meter number from the drop down list.
    - Add a new meter by clicking the Add New Meter button and filling in the required information.
2. Enter the average daily withdrawal and select appropriate units.
3. The meter number will automatically generate based on the meter selected in step 1.
    - If two different meter numbers are associated with the report, the meter number can be changed.
4. Select the date by navigating through the calendar to the appropriate date.
5. Enter the meter reading.
6. Ensure that the correct units are selected.
7. To delete a reading, click the red Delete button to the right of the meter reading record.

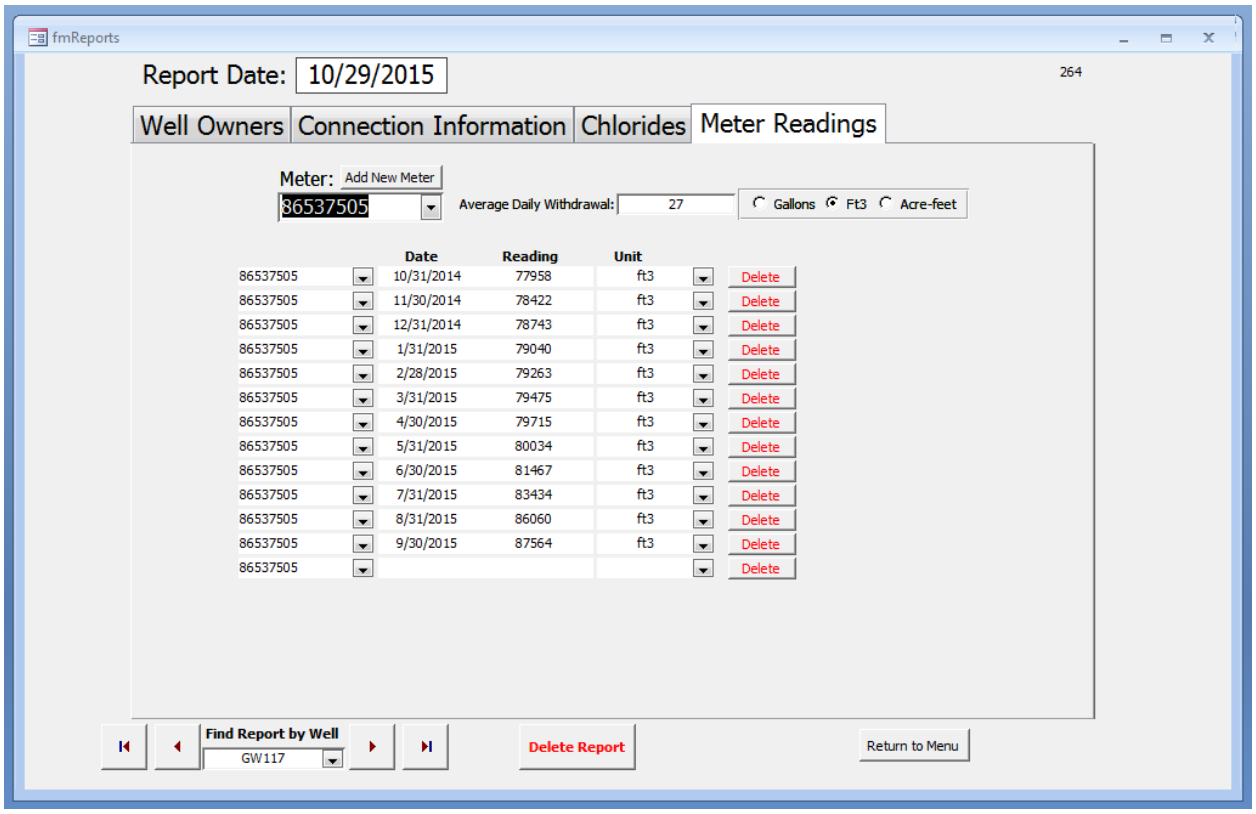


Figure 12.7 Well Report Meter Readings Page

B.3 View Well History

To view the well history, click the View Well History button on the database main page. Select the well number from the drop down list. On the Water Data tab, all chloride, water use, and meter reading data entered into well reports associated with the selected well will be displayed. Note that chloride history data and reported daily use cannot be changed on this page; only meter history can be edited on the Well History page. On the Reporting Owners tab, the reporting owners associated with the well reports and the well report dates are displayed. Click the Print Report for This Well button at the bottom right of the screen to view the print preview of the Summary Report. The summary report is included in the well report.

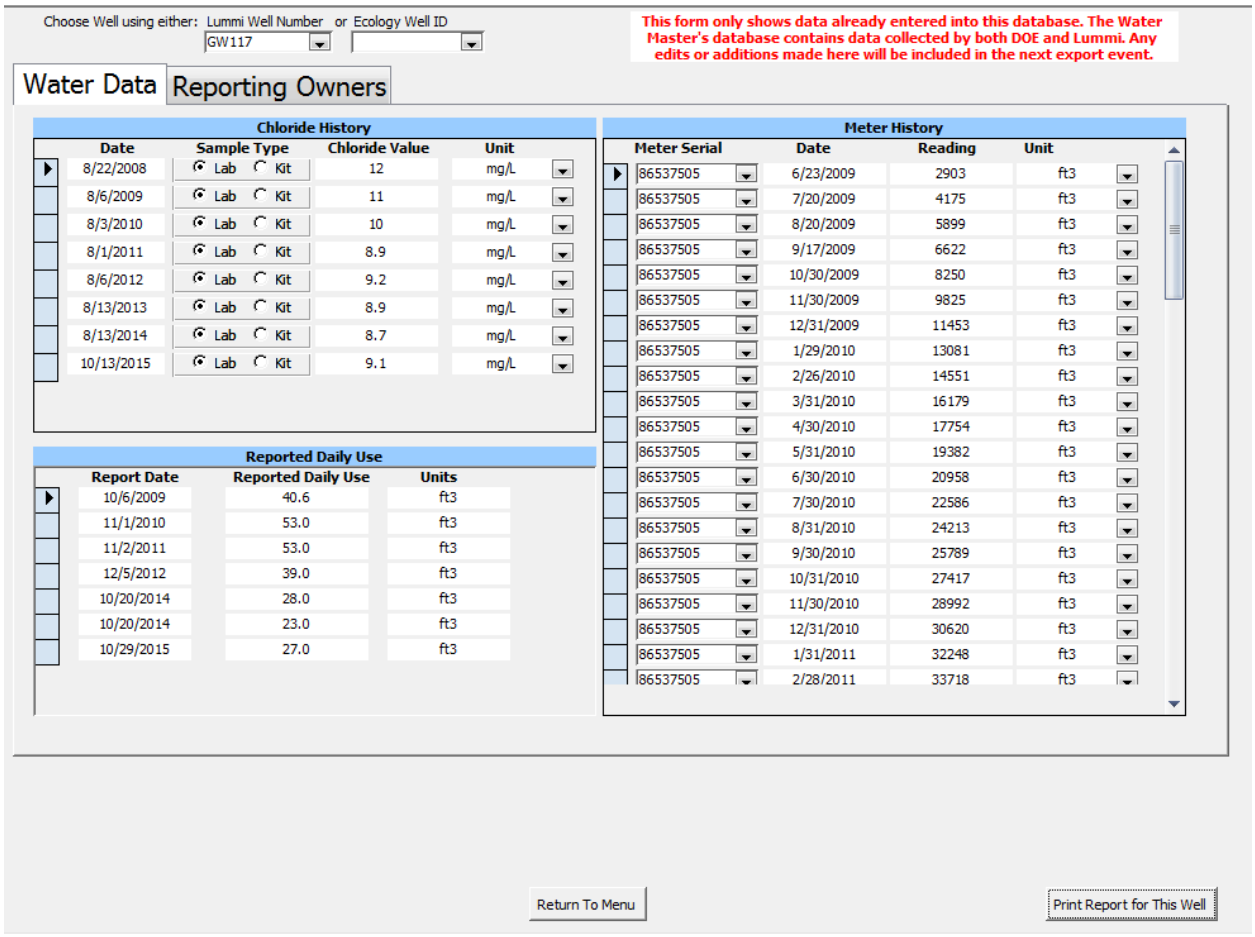


Figure 12.8 Well History for Selected Well

APPENDIX C. ANNUAL WELL REPORT TEMPLATES

This appendix includes templates used for preparation of annual well reports for small wells (3 or fewer connections) and large wells (more than 3 connections).

LUMMI PENINSULA CASE AREA ANNUAL WELL REPORT

FOR SMALL WELLS (3 or fewer connections)

ANNUAL WELL REPORTS ARE DUE NOVEMBER 1st OF THIS YEAR

Well Owner's Name: _____ Date of Report: _____

Address (Where Well is Located): _____ Phone: _____

_____

Parcel Number Well Drilled Within: _____ Date Well Drilled: _____

Lummi Well Number (if applicable): _____ Water Right Number (if applicable): _____

Meter Serial Number: _____ Ecology Unique Well ID (if applicable): _____

Chloride Concentration Measurement*			
Year	Month	Date	Chloride Concentration (mg/L)
	August		

* Please attach a photocopy of the lab report.

Water Meter Measurement (as close to September 30 as possible)				
Year	Month	Date	Meter Reading	Units (gallons or cubic feet)
Meter Replacement During Water Year?		YES	NO	New Serial Number: _____

Number of Homes and/or Approved Uses Served: _____

Names of owners of other homes served: _____

Any changes in well operation during the water year (October 1 through September 30): _____

_____

_____

Any problems with the well or meter during the water year (October 1 through September 30): _____

_____

_____

_____

_____

Other comments: _____

_____

_____

_____

_____

_____

The answers above are true and complete to the best of my knowledge.
Well Owner or Party Responsible for Completing Annual Well Report _____ Date_____

LUMMI PENINSULA CASE AREA ANNUAL WELL REPORT

FOR SUPPLY WELLS (more than 3 connections)

ANNUAL WELL REPORTS ARE DUE NOVEMBER 1st OF THIS YEAR

Well Owner's Name: _____ Date of Report: _____

Address (Where Well is Located): _____ Phone: _____

_____

Parcel Number Well Drilled Within: _____ Date Well Drilled: _____

_____

Lummi Well Number (if applicable): _____ Water Right Number (if applicable): _____

Meter Serial Number: _____ Ecology Unique Well ID (if applicable): _____

The Number of Households or Equivalent Residential Units currently served: _____

The Number of Households or Equivalent Residential Units to which you have issued service commitments but which are not currently supplied with water: _____

The Number of Households or Equivalent Residential Units which you anticipate applying for a service commitment in the coming water year: _____

The Average Daily amount of water withdrawn for delivery per household: _____

Any changes in well operation during the water year (October 1 through September 30): _____

_____

_____

_____

_____

Any problems with the well or meter during the water year: _____

_____

_____

Other comments: _____

_____

_____

_____

Chloride Concentration Measurements*			
Year	Month	Date	Chloride Concentration (mg/L)
	December		
	April		
	August		

* Please attach photocopies of the lab reports.

Water Meter Measurements				
Year	Month	Date	Meter Reading	Units (gallons or cubic feet)
	October			
	November			
	December			
	January			
	February			
	March			
	April			
	May			
	June			
	July			
	August			
	September			

- Each monthly meter reading shall be reported to the responsible regulator by the 15th of the following month.
- Chloride lab analyses for August, December and April shall be submitted to the responsible regulator by the 15th of the following month.

The answers above are true and complete to the best of my knowledge.
Well Owner or Party Responsible for Completing Annual Well Report _____ Date_____