


December 2023
Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

Task 1 Summary Memorandum – Evaluation of Existing Sunlight Beach Water Association Water System

Prepared for:
Sunlight Beach Water Association

Executive Summary

The following memorandum summarizes the results of Task 1 of the Sun Vista/Sunlight Beach Water Consolidation Feasibility Study (Water Consolidation Feasibility Study) completed for the Sunlight Beach Water Association (SBWA) Water System (DOH Water System ID 85270). Task 1 represents the first step toward completing a Water Consolidation Feasibility Study funded through a grant provided by the Washington State Department of Health (DOH). The Task 1 work included an evaluation of the existing SBWA Water System and the Sun Vista/Sunlight Beach Homeowner's Association (SV-SLB HOA) Water System (DOH Water System ID 85160). The purpose of this task was to evaluate the existing water systems and identify improvements that would be needed to maintain adequate water system operations and level of service if the water systems remained in their current configurations with the existing water supply and storage facilities at their present locations.

The following is a summary of some of the key findings and recommendations for the SBWA Water System summarized in this Task 1 Summary Memorandum:

- The existing water system is supplied by one well. There are two wells at the SBWA pump house on the northeast corner of Sunlight Beach Road and Old Henry Lane, but the original source well has been disconnected. The active source well delivers approximately 35 gallons per minute (gpm) of water to the system.
- Water is pumped from the wells directly to the SBWA water storage tanks. There are two water storage tanks with total storage capacity of 34,000 gallons located behind a residence south of Sun Vista Circle and north of the Kohwles property.
- Adequate source and storage capacity are in place to accommodate existing and projected water system demands through the anticipated buildout condition.
- The SBWA Water System does not currently have hydrants or provide fire protection. Properties served by the SBWA Water System currently rely on hydrants supplied by the SV-SLB HOA Water System for fire protection.
- The SBWA Water System currently has enough distribution pipe capacity to convey water from the wells and storage tanks to SBWA members for use while maintaining adequate pressure in the system at all SBWA member water service meters.
- The system currently supplies water that meets DOH water quality standards; however, there is a risk of contamination from nitrates/microbials from anticipated development of septic systems on property upslope of the existing SBWA water supply wells. There is also risk of contamination from seawater intrusion due to surface flooding during high-tide events.
- These risks are sufficiently credible to recommend that affirmative actions be taken to protect the SBWA water supply in the future. A prudent alternative would be to pursue construction of a well or wells at a new location that is upslope of these potential contamination risks.
- A model developed by DOH was used by SBWA to evaluate the potential for nitrate contamination that would result from development of septic systems upslope of the existing

groundwater wells. An independent review of model inputs and methodology was completed by Anchor QEA as part of this task. Some adjustments to input values are recommended, but Anchor QEA believes that these modifications do not appear to warrant a change in the conclusion that the potential development of 10 to15 additional septic systems upslope of the existing wells could increase nitrate levels above allowable levels subject to the potential impact of other factors, such as semi-confining soil conditions and aquifer characteristics, which are largely unknown.

- Anchor QEA agrees that seawater intrusion from long-term increases in seawater levels as well as the potential for upconing appear to be low risks considering the groundwater levels and current levels of chloride. The SBWA wells do have a higher risk of being flooded during extreme high tides (king tides plus low atmospheric pressure plus storm surges). Flooding can damage facilities and would likely require flushing and sanitizing the water system, which would result in disruption of the water supply. A "do-nothing" approach is not advisable.
- It is recommended that a new well(s) be considered in an area with reduced contamination risks, upslope of the Kohwles property. The existing well could continue to be used to provide water in peak demand periods and to mix with water from a new well to reduce water contamination levels.
- Several contributing factors were identified, such as the presence (or consistency) of a semi-confining soil layer, groundwater flow direction, and hydraulic gradient, where the current information available is not adequate to make more definitive assessments of contamination risk levels.
- A second water supply source is recommended to provide reliability. Given that Task 1 is limited to an evaluation of existing SBWA facilities, adding a second source could involve bringing Well 1 back into operation. However, because risks of contamination have been identified for the existing wells and consideration of establishing a new well source at a different location is recommended to address this risk, reconnecting Well 1 for redundancy should be weighed against adding another well at a new well location, as will be evaluated in more detail by Tasks 2 and 3.
- Several components of the SBWA water system are aging and will likely require upgrade or replacement within the next 20 years to ensure that the SBWA can maintain adequate water system operations and level of service into the future.
- Several infrastructure replacement projects are recommended with associated costs over the next 6 to 20 years. The planning level total costs (in 2023 dollars) were estimated at just over $1 million. These include mostly improvements that will address aging infrastructure. They also include a placeholder cost for replacement or relocation of existing wells and related infrastructure to address potential contamination issues.
- A GIS database was generated for existing SBWA facilities that will be invaluable in planning future SBWA system improvements.

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Memorandum

December 4, 2023

To: Carol Russo, Cliff Slabe – Sunlight Beach Water Association

From: David Rice, PE; Bob Montgomery, PE; and Josh Sexton, PE – Anchor QEA, LLC

cc: Ed Sheets, John Lovie - Sun Vista/Sunlight Beach Homeowner's Association

Re: Sun Vista/Sunlight Beach Water Consolidation Feasibility Study
Task 1: Evaluation of Existing Sunlight Beach Water Association Water System

Anchor QEA is pleased to present this memorandum summarizing the results of Task 1 of the Sun Vista/Sunlight Beach Water Consolidation Feasibility Study (Water Consolidation Feasibility Study). Task 1 included an evaluation of the existing Sun Vista/Sunlight Beach Homeowner's Association (SV-SLB HOA) and the Sunlight Beach Water Association (SBWA) water systems. This memorandum summarizes the evaluation of the existing SBWA Water System. A separate memorandum has been prepared to summarize the evaluation of the existing SV-SLB HOA Water System. The Task 1 work was completed under contract with the SV-SLB HOA on behalf of a planning committee comprising representatives of both water systems.

The Washington State Department of Health (DOH) Drinking Water State Revolving Fund (DWSRF) Consolidation Feasibility Grant program was designed to promote consolidation of small Group A water systems into larger entities to improve the management of the water systems and the safety of the drinking water they distribute to the public. The SV-SLB HOA secured a $50,000 grant from the program and entered into an agreement with DOH (Contract CBO27656) for grant funding to complete a feasibility study that will evaluate the potential for consolidating the SV-SLB HOA Water System (DOH Water System ID 85160) with the SBWA Water System (DOH Water System ID 85270). Anchor QEA, LLC, is an engineering and environmental consulting firm based in Seattle, Washington and was selected by SV-SLB HOA to complete the Water Consolidation Feasibility Study.

The DOH grant does not require water systems to consolidate. The grant just funds a study that presents consolidation as a potential alternative. Any decision to relocate wells or other facilities would require an affirmative vote of the membership of the SBWA water system. A decision to consolidate water systems would require an affirmative vote by the members of both the SBWA and the SV-SLB HOA water systems. The study being conducted under the DOH grant will give the two water systems additional information on the options available so that the members of the SBWA and the SV-SLB HOA can make informed decisions about the future of their water systems.

Introduction

Task Scope of Work

Task 1 represents the first step towards completing the Water Consolidation Feasibility Study and included an evaluation of each of the water systems being considered for consolidation. The scope of work for Task 1 included the following:

- Collection and review of pertinent background information on the SBWA Water System, including the *SBWA Small Water System Management Plan* (SBWA 2023a), water production and use records, related analysis and calculations, water system mapping, and other reports.
- Participation in kickoff meetings and a site visit. An initial kickoff call was held in May 2023. That was followed by a meeting and site visit, where Anchor QEA's project manager toured water system facilities with the SBWA/SV-SLB HOA planning committee.
- Creation of a system inventory and maps of existing water system facilities in ArcGIS, a geographic information systems (GIS) software package designed to generate maps with data attached to key map features. The map figures presented in with this memorandum were generated in ArcGIS and represent some of the information incorporated into the GIS-based water system inventory created for the SBWA Water System.
- Evaluation and forecasting of water demands. Well production and metered customer water consumption records were reviewed and evaluated as summarized in this memorandum. The data was then used to quantify existing and future water system demands.
- Evaluation of the existing SBWA Water System. The water system was evaluated as follows:
  - Well source, storage, and pumping capacity were evaluated, according to the guidelines provided in the *DOH Water System Design Manual* (DOH 2020).
  - Hydraulic analysis was performed using a hydraulic model created to simulate hydraulic conditions in the SBWA Water System.
  - Water deficiencies were identified based on the capacity and hydraulic analyses.
  - Water quality data was reviewed.
  - An independent assessment was completed of the analysis outlined in the *Sun Vista/Sunlight Beach HOA Wellhead Protection Area Report* (Golder Associates 2013) and the *Sunlight Beach Water Association Wellhead Protection Plan* (SBWA 2023c).
  - Contamination risks from nitrates/microbials from upslope septic systems and seawater intrusion were assessed based on the background information collected.
  - The potential impact of on-site septic systems proposed for the upslope Kohwles development site was reviewed based on the hydrogeologic information and nitrate transport calculations completed using the DOH Level 1 Nitrate Balance spreadsheet.
  - The County hydrogeologist was contacted to discuss the potential sources of contamination and water quality concerns.

  - An independent assessment was completed of potential changes in treatment that may be required in the future to continue to provide water of adequate quality from existing groundwater wells.
- Based on the deficiencies identified, a planning level (order of magnitude) opinion of probable cost was developed to assess costs associated with improvements that are recommended to maintain the water system in its current configuration with existing water supply and storage facilities at their present locations.
- This work was summarized in this memorandum.

Purpose

The purpose of this study is to evaluate the existing SBWA Water System to identify improvements that would need to be made to maintain adequate water system operations and level of service if the water system remains in its current configuration with existing water supply and storage facilities at their present locations.

Water System Inventory

Task 1 of the Water Consolidation Feasibility Study included creation of an inventory and maps of existing water system facilities in ArcGIS, a geographic information systems (GIS) software package designed to generate maps with data attached to key map features. The map figures presented in with this memorandum were generated in ArcGIS and present some of the information incorporated into the GIS-based water system inventory created for the SBWA Water System. The information presented in the following paragraphs has been attached to the elements of the system inventory map created in ArcGIS. The full water system inventory is also included as Attachment A.

The SBWA Water System is located on Whidbey Island in a rural residential area north and east of Useless Bay. The system serves properties along Sunlight Beach Road, as shown in Figure 1. The water system's service area and infrastructure overlap with the service area and water system infrastructure operated by the SV-SLB HOA. The SBWA Water System is described in detail in the *Sunlight Beach Water Association Water System Facilities Report* (SBWA 2023b). The SBWA Water System comprises the key pieces of infrastructure, as shown in Figure 2:

Wells

The SBWA Water System has two wells, as summarized in Table 1. Well 2 (Source S02) is operational and is the only active source of water supply for the SBWA Water System. Well 1 (Source S01) was disconnected in 2015 at the request of the Washington State Department of Health (DOH). An intertie (S03) with an isolation valve connects the SBWA Water System with the SV-SLB Water System. The intertie is only opened when supply to one of the systems is interrupted.

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Figure 1
Location Map
Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

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Figure 2
Existing Water System – Sunlight Beach Water Association
Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

Table 1
SBWA Wells

Well	Source	Well Number	Well Size (inches)	Well Depth (feet)	Capacity (gpm)	Year Installed	Reported Condition
1	S01	AGA518	10	30	35[1]	1947[2]	Disconnected
2	S02	AGA519	10	50	35[1]	1987[3]	Active, Good

Note:
1. Well capacity is currently estimated at 35 gpm. It was originally estimated at up to 50 gpm.
2. Well 1 was hand dug in 1947 and rebuilt to its current depth in 1994.
3. A new pump and controller were installed at Well 2 in 2020.

Well 1 and associated pipe, fittings, and controls are located in a concrete block pump house building that was constructed in 1991 on 20-foot by 20-foot lot owned by the SBWA at the northeast corner of Sunlight Beach Road and Old Henry Lane. Well 2 is located just outside the pump house building on the same piece of property. The pump and controller for Well 2 were replaced in 2020. A new roof was installed on the pump house in 2020 and the electrical system, monitoring and alarm system, motor starter, and related equipment were all upgraded in 2020-2021.

Storage Tanks

The SBWA Water System includes two partially buried reinforced concrete water storage tanks with a total storage capacity of 34,000 gallons. The tanks are located on a parcel owned by the SBWA south of Sun Vista Circle and northeast of the SBWA wells and pump house. The storage tanks include a 9,000-gallon tank constructed in 1947 and a 25,000-gallon tank constructed in 1982, as summarized in Table 2.

Table 2
SBWA Storage Tanks

Tanks	Shape	Dimensions (feet)	Capacity (gallons)	Bottom Elevation (feet)	Overflow Elevation (feet)	Year Installed	Reported Condition
1	Rectangular	10 X 10	9,000	104[1]	115[2]	1947	Good
2	Octagonal	22.5 X 22.5	25,000	104[1]	115[2]	1982	Good

Note:
1. The bottom elevation is approximate. Approximately 8 feet of each tank is buried.
2. The overflow elevation is approximate. The overall height of each tank is assumed to be approximately 12 feet and the overflow is assumed to be approximately 1 foot below the top of the tank.

The tanks were drained, inspected, and cleaned in 2020 and were found to be in good condition. Both tanks are painted and cracks in the concrete were sealed most recently in 2017. Tank hatch covers were replaced in 2016. A new float switch and check valve were installed on Tank 1 in 2021. The wireless level monitoring system was replaced in June 2023. The tanks are located adjacent to a single-family residence. SBWA has an easement for access to the tanks through the single-family residential lot from Sun Vista Circle.

Pipelines

The water distribution system primarily consists of the following pipelines:

- A 4-inch pipeline conveys water from the wells to the storage tanks and from the storage tanks back to the SBWA water main for distribution. The gasketed, 4-inch-diameter polyvinyl chloride (PVC) pipeline was originally installed in 1968-1969. A portion of the pipeline was then reconstructed and rerouted in 1998 in accordance with an agreement with the property owner (the Kohwles family).
- A 4-inch pipeline conveys water from the pump house to water users along Sunlight Beach Road. The SBWA water main runs along the north edge of the roadway for most of its length, then crosses over to the south side of the roadway between Sunlight Beach Lots 25 and 32, and then crosses back to the north side of the roadway, where it runs to its terminus near Sunlight Beach Lots 37, 38, and 39. This pipeline was installed in 1986-1987 and is also gasketed, 4-inch PVC pipe.
- Customer service meters were installed from 2010 through 2013.

Water Use and Projected Water Demands

As an initial step in evaluating the existing SBWA Water System, Anchor QEA reviewed existing water use and projected water demands for the system. Existing and projected water demands were then used to evaluate the capacity of the system and identify improvements needed to address existing deficiencies and accommodate future growth.

Existing Service Area

Service Area and Land Use

The SBWA serves an area that primarily consists of single-family residences in Island County zoned Rural Residential. Land use planning for the SBWA service area is governed by *Island County Comprehensive Plan* (Island County 2016). The service area includes a total of approximately 48 single-family residential parcels along Sunlight Beach Road. As shown in Figure 2, the SBWA service area and infrastructure overlap with the service area and water system operated by the SV-SLB HOA.

Service Connections

The SBWA currently has 45 active single-family residential service connections and three reserve connections. Each service connection serves one single-family residential parcel.

Existing Water Use and Water Demands

Water Use

Table 3 summarizes water consumption metered by SBWA at customer services from 2018 through 2022. Total annual consumption ranged from 1,907,344 gallons (5.85 acre-feet) in 2022 to 2,419,784 gallons (7.43 acre-feet) in 2021. The average annual consumption over that 5-year period was 2,166,687 gallons (6.65 acre-feet). Annual water consumption numbers from 2018 through 2021 may be skewed due to leaks that were reflected in unusually high customer meter data or incomplete data. SBWA indicated that 2022 was the year with the most complete and representative metered customer water use data.

Table 3
Metered Water Consumption

Year	Total (gallons)	Total (acre-feet)	Average (gpd)
2018	2,287,809	7.02	6,268.0
2019	2,097,407	6.44	5,746.3
2020	2,242,211	6.88	6,126.3
2021	2,419,784	7.43	6,629.5
2022	1,907,344	5.85	5,225.6

Note:
gpd: gallons per day

Water Supply

Table 4 summarizes well production metered by SBWA on the well discharge line from 2019 through 2022. Total annual well production ranged from 1,667,515 gallons (5.12 acre-feet) in 2022 to 2,227,094 gallons (6.83 acre-feet) in 2021. The annual average well production from 2019 through 2022 was 2,022,234 gallons (6.21 acre-feet).

Table 4
Metered Water Production

Year	Total (gallons)	Total (acre-feet)	Average (gpd)
2019	1,968,999	6.04	5,394.5
2020	2,031,017	6.23	5,549.2
2021	2,227,094	6.83	6,101.6
2022	1,667,515	5.12	4,568.5

Note:
gpd: gallons per day

Equivalent Residential Units

DOH recommends evaluating water use and estimating water demand based on Equivalent Residential Units (ERUs). An ERU equates demand for non-single-family residential use to the average demand generated by a single-family residence. For most small systems like SBWA that serve exclusively single-family residential residences, the number of ERUs will be equal to the number of service connections. The SBWA Water System currently has 45 active service connections. Of that total, SBWA estimates that 75% of their members are transient users, meaning that those connections serve residences that are used as secondary residences or vacation homes.

The average metered customer water use for all connections was approximately 132 gpd per ERU from 2018 through 2020. The average metered well production was approximately 120 gpd per ERU.

Distribution System Leakage

The Water Use Efficiency (WUE) Rule, adopted by DOH in 2007, uses the terms "authorized consumption" and "distribution system leakage" (DSL). Authorized consumption includes water use that is billed and/or metered by the water system, as well as other authorized uses such as maintenance flushing, system cleaning, firefighting, etc. as long as the volumes used are tracked. All other water produced by a water system that is not tracked or metered as authorized consumption is considered DSL. DSL typically consists of water lost through system leaks, untracked flushing or hydrant use, and unauthorized use. It can also reflect inconsistencies or inaccuracies in metering between source and customer meters.

Table 5 provides a comparison of annual well production metered on the discharge pipe from the groundwater wells with authorized use measured at customer meters and tracked by SBWA for the period of 2019 through 2022. Figure 3 includes a graph comparing metered water production with metered customer water consumption. The data indicate that for the SBWA Water System, the total annual volume of metered customer water use has exceeded the annual volume of metered well production during each of the last 4 years. That exceedance ranged from 6.5% in 2019 to 14.4% in 2022. Because it is impossible to consume more water than is delivered to the system by the groundwater wells, the results suggest that there is likely a discrepancy between metering of customer water use and well production that will need to be resolved to accurately calculate DSL. The SBWA has indicated that the numbers presented in Table 5 reflect an inaccurate well production meter. That meter was replaced in 2021. SBWA will continue to review metering data to ensure that their well production meter and customer service meters are accurate and read consistently so that DSL can be accurately calculated.

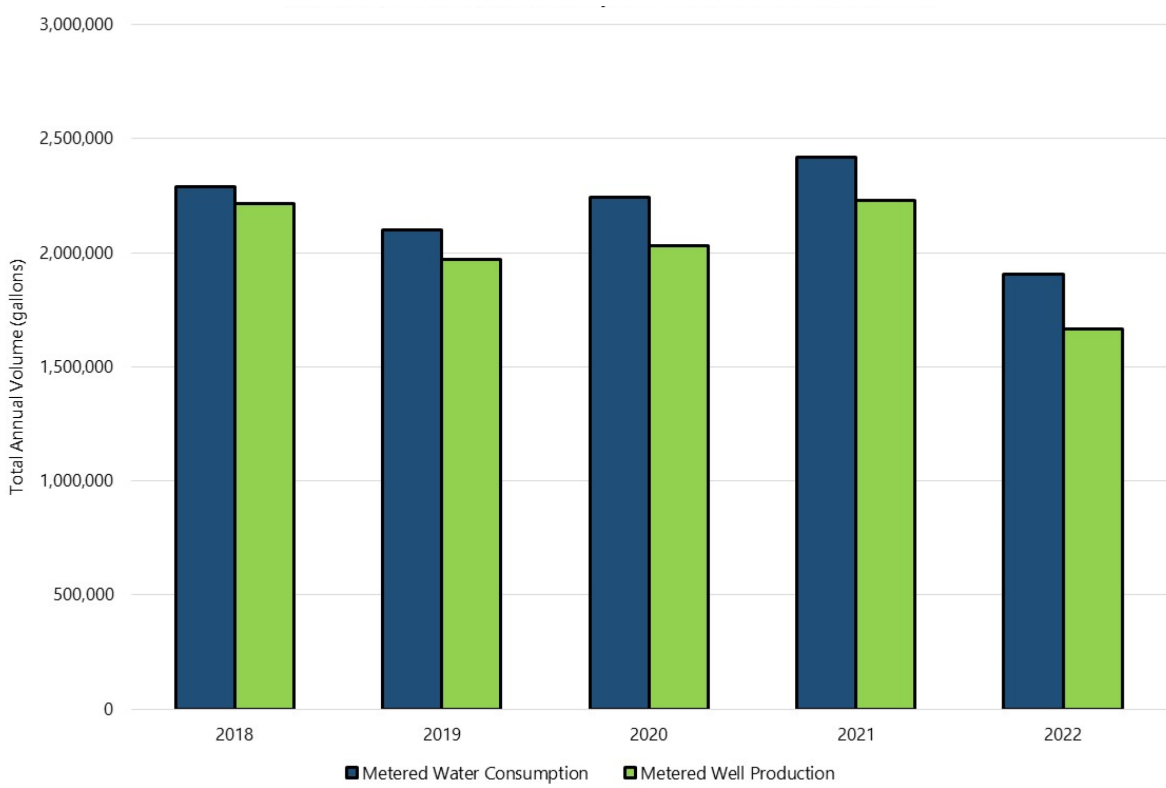
Table 5
SBWA Metered Production, Metered Consumption, and DSL

Year	Water Produced		Metered Consumption (Authorized Use)		DSL[1]	
	gallons	gpd/ERU	gallons	gpd/ERU	gallons	%
2019	1,968,999	119.9	2,097,407	127.7	-128,407.4	-6.5%
2020	2,031,017	123.3	2,242,211	136.1	-211,194.6	-10.4%
2021	2,227,094	135.6	2,419,784	147.3	-192,690.3	-8.7%
2022	1,667,515	101.5	1,907,344	116.1	-239,829.1	-14.4%

Notes:
DSL: Water Supplied - Authorized Use
DSL: Distribution System Leakage
ERU: Equivalent Residential Units
gpd: Gallon per Day

1. A negative DSL number indicates that more water was metered at customer water meters (authorized consumption) that was metered at the groundwater wells. Because it is impossible to consume more water than is supplied to the system by the wells, the results suggest that there is a discrepancy in metering that needs to be resolved.

Figure 3
SBWA Metered Production vs. Metered Consumption



Existing Water Demand

The *DOH Water System Design Manual* provides guidelines for estimating water demands. Where possible, demands are estimated based on actual water use and water supply data. Three levels of water demand are typically used for evaluating water system capacity and planning for future improvements, as follows:

Average Daily Demand

Average daily demand (ADD) represents the average daily water demand generated by the system throughout the year. It is recommended that water demands used for evaluating system capacity be based on water supplied to the system to account for DSL. However, for the SBWA, because the annual metered consumption was higher than the well production, metered consumption was reviewed to estimate the ADD appropriate for evaluating the SBWA Water System. The total metered water consumption ranged from 116.1 gpd per ERU in 2022 to 147.3 gpd per ERU in 2021. To provide a conservative basis for evaluating the SBWA Water System, it is recommended that system demand be estimated based on the following Equation 1:

Equation 1

$$\text{ADD} = 150 \text{ gpd per ERU}$$

where:

ADD	=	average daily demand
ERU	=	equivalent residential unit
gpd	=	gallons per day

Maximum Daily Demand

Maximum daily demand (MDD) represents the water demand on the day of maximum water use during the year. MDD is estimated by multiplying the ADD by a peaking factor, as follows in Equation 2:

Equation 2

$$\text{MDD} = \text{ADD x Peaking Factor}$$

where:

ADD	=	average daily demand
MDD	=	maximum daily demand

The peaking factor, where possible, is selected based on a comparison of daily water production meter records to average annual metered water production. Daily water production records were not provided for the SBWA Water System. However, monthly records (see Table 6) indicate that water production during the month of peak use was 2.0 X the average annual production in 2020 and 2021. The water production during the month of peak use was 2.8 X the average annual production in 2022. Daily production data for the SV-SLB system indicated that an MDD peaking factor of 2.5 was appropriate for that system. Based on the monthly data provided by the SBWA and for consistency in evaluating the two systems, use of an MDD peaking factor of 2.5 is also recommended for the SBWA Water System, as shown in Equation 3:

Equation 3

$$\mathrm{MDD} = 150 \text{ gpd per ERU x } 2.5 = 375 \text{ gpd per ERU}$$

where:
ERU = equivalent residential unit
gpd = gallons per day
MDD = maximum daily demand

Table 6
Maximum Monthly Water Production vs. Average Annual Water Production

Year	Peak Monthly Water Production (gpd)	Average Annual Water Production (gpd)	Peaking Factor
2019	11,511.1	5,394.5	2.1
2020	11,057.4	5,549.2	2.0
2021	12,420.1	6,101.6	2.0
2022	12,850.4	4,568.5	2.8

Note:
gpd: gallons per day

Peak Hourly Demand

Peak hourly demand (PHD) represents the demand during the peak hour of water use during the year. In the absence of data that accurately monitor hourly fluctuations in demand, Equation 5-1 from the *DOH Water System Design Manual* is used to estimate PHD. For a system with less than 50 ERUs, the equation is applied as follows in Equation 4:

Equation 4

$$\text{PHD} = \left(\frac{\text{MDD}}{1{,}440}\right)\left((c)(N) + F\right) + 18$$

where:

C = 3.0

F = 0

MDD = maximum daily demand (in gallons per day per ERU)

N = number of ERUs

PHD = peak hourly demand (in gallons per minute)

Using the value estimated for existing MDD and the estimated number of existing ERUs, Equation 4 results in the following existing PHD in Equation 5:

Equation 5

$$\text{PHD} = \left(\frac{375}{1{,}440}\right)\left((3.0)(45) + 0\right) + 18 = 53.2\ \text{gpm}$$

where:

gpm = gallons per minute

PHD = peak hourly demand

Existing Demand Summary

Table 7 summarizes the existing water demand estimated for the SBWA Water System.

Table 7
Summary of Existing Water Demand

	Existing Water Demand (45 ERUs)		
Demand Level	**gpd/ERU**	**gpd**	**gpm**
ADD	150	6,750	4.7
MDD	375	16,875	11.7
PHD	NA	NA	53.2

Notes
ADD: average daily demand
ERU: equivalent residential units
gpd: gallon per day
NA: not applicable
gpm: gallons per minute
MDD: maximum daily demand
PHD: peak hourly demand

Future Water Service Area

The SBWA Water Service Area is not anticipated to change in the future. The only development that is anticipated to occur is build-out of currently undeveloped parcels. As noted previously, the SBWA currently has 45 active service connections serving 45 residential parcels that represent 45 ERUs. There are approximately three undeveloped parcels that could be served by the SBWA. The SBWA has reported that they are currently approved to serve up to 48 connections. It was assumed that at least two of the vacant parcels would be developed in the next 6 years (by 2029) and the remaining parcel would be built out within the next 20 years (by 2043). Table 8 summarizes the anticipated growth in service connections and ERUs.

Projected Water Demands

A projection of future water demands is needed to evaluate system capacity to determine whether existing water supply, water storage, pumping, and distribution facilities have sufficient capacity to meet future needs. As outlined previously, an ADD of 150 gpd per ERU and an MDD of 375 gpd per ERU were estimated as a basis for projecting demands based on metered water supply delivered to the SBWA Water System. The projected demands are summarized in Table 8.

Table 8
Summary of Existing and Projected Water Demands

		ADD			MDD			PHD
Year	ERUs	gpd/ERU	gpd	gpm	gpd/ERU	gpd	gpm	gpm
2023	45	150	6,750	4.7	375	16,875	11.7	53.2
2029	47	150	7,050	4.9	375	17,625	12.2	54.7
2043	48	150	7,200	5.0	375	18,000	12.5	55.5

Notes
ADD: average daily demand
ERU: equivalent residential units
gpd: gallon per day
gpm: gallons per minute
MDD: maximum daily demand
NA: not applicable
PHD: peak hourly demand

Fire Flow

The SBWA Water System does not include any hydrants and the system is not designed to supply fire flow. The SBWA relies on hydrants connected to the SV-SLB Water System to provide fire flow protection of parcels within the SBWA service area. The hydrants are located within the overlapping area served by the SV-SLB Water System. Fire flow requirements for the SBWA service area are outlined in the *Island County Code (ICC), 13.03A, Water System and Fire Flow Standards* (Island County 1994).

Water System Analysis

The most recent criteria for transmission and distribution, storage, and booster pump facilities are specified in Washington Administrative Code (WAC) 246-290 and summarized in the DOH *Water System Design Manual*. It should be recognized that existing facilities may not meet all current DOH criteria because water systems are required to have greater capacity now than when the existing facilities were installed. The SBWA strives to meet DOH criteria and uses the latest criteria when designing upgrades to the SBWA Water System

System Design Criteria

The criteria listed below are provided for design of new water distribution system facilities. It is recommended that they be designed to maintain the following minimum pressures at all points in the distribution system where service connections are allowed:

- 40 pounds per square inch (psi) during normal demand conditions
- 30 psi during PHD conditions

Compliance with the following criteria is also recommended when sizing new distribution pipelines:

- Pipelines must be sized to limit velocities to 8 feet per second (fps) during PHD conditions. To the extent possible, it is recommended that new pipelines be sized to limit velocities to 5 fps during PHD to limit pressure losses and the potential for high transient pressures.

Design criteria relating to sources of water supply include the following:

- Sources must be able to reliably provide enough water to meet the maximum demand that will be placed on the system.
- Equalizing storage may be provided so that the source water can be stored to supply daily peak demands that exceed the MDD.
- If equalizing storage capacity is not provided, then the source capacity should be sufficient to provide enough water to meet PHD.
- Where storage is provided to supply daily peaking of demand, DOH recommends that source capacity be provided such that the MDD can be supplied within 20 hours of pumping.

System Capacity Analysis

Source Capacity

The SBWA Water System is currently supplied through one active well (Well 2, S02), as noted earlier in this memorandum. Well 2 has an estimated capacity of 35 gpm. The capacity of Well 2 is sufficient to deliver the existing MDD of 16,875 gpd with less than 20 hours of total pumping. The capacity of Well 2 is also sufficient to deliver the projected 20-year (2043) build-out MDD of 18,000 gpd with less than 20 hours of total pumping.

DOH generally recommends that, where possible, water systems be supplied with redundant sources of supply. To achieve redundancy in supply, Well 1 would need to be reconnected to the system, tested, and made operational. However, reconnection of Well 1 should be evaluated against other options to provide redundancy, such as relocating wells, which will be evaluated by Tasks 2 and 3.

Storage Capacity

DOH storage requirements include five components:

1. **Operational Storage**: Allows for normal cycling on and off of well pumps under normal operating conditions.
2. **Equalizing Storage**: Enables the system to meet periodic peaks in demand, when demands on the system exceed the source capacity.
3. **Standby Storage**: Ensures that adequate water supply exists during power failures and pump outages.
4. **Fire Suppression Storage**: Ensures an adequate volume of water to fight fires.
5. **Dead Storage**: Includes storage in a reservoir that is not usable.

Storage requirements for the SBWA Water System were calculated as described in the following paragraphs.

Operational Storage

Operational Storage varies according to pump settings. For the sake of estimating storage requirements, operating storage was assumed to be the top 2 feet of storage in the existing SBWA water storage tanks. The top 2 feet of the active storage tanks were estimated to represent a total storage volume of 6,200 gallons.

Equalizing Storage

Equalizing storage is required when the source pumping capacity cannot meet peak demands on the system. The volume of equalizing storage is normally calculated by the following equation:

Equation 6

$$ES = (PHD - Q_s)(150\,\text{min})$$

where:

ES	=	equalizing storage, in gallons
PHD	=	peak hourly demand, gallons per minute (gpm)
Q_S	=	source capacity, gpm (except emergency sources)
min	=	minutes

The active well pump delivers water directly to the SBWA water storage tanks, as shown in Figure 2. The total source capacity of the active well is approximately 35 gpm. The estimated PHD for the existing SBWA Water System is 53 gpm. The PHD for the SBWA Water System is projected to increase slightly to 55 gpm by 2029 and 56 gpm by 2043. Based on these numbers, the total volume of equalizing storage needed to meet existing demands is estimated at 2,723 gallons. The equalizing storage needed to meet projected 2043 demands is 3,075 gallons.

Standby Storage

Standby storage volumes are typically calculated using the following equation for systems with more than one source of supply:

Equation 7 (for systems with only one source)

$$\mathrm{SB} = 2(\mathrm{ADD})$$

where:

SB	=	standby storage, in gallons
ADD	=	average daily demand, in gallons

The SV-SLB HOA has opted to use the following equation to evaluate standby storage for their water system:

Equation 8 (used for SV-SLB system)

$$\mathrm{SB} = \mathrm{MDD}$$

where:

SB	=	standby storage, in gallons
ADD	=	average daily demand, in gallons

Because the peaking factor used to estimate MDD is greater than 2, the volume estimated using this equation results in a larger volume for standby storage than would be required by DOH. To be conservative and consistent in evaluating standby storage for the SBWA Water System, the same equation was used to evaluate standby storage for the SBWA system as was selected by the SV-SLB Water System. Based on this equation, the SB required for existing demand conditions is estimated at 16,875 gallons. The SB required to meet 2043 demand conditions is 18,000 gallons.

Fire Suppression Storage

As noted previously, the SBWA Water System does not include hydrants and does not include fire suppression storage. Fire protection for parcels served by the SBWA is provided on hydrants connected to the adjacent SV-SLB Water System.

Total Water Storage Required

The total water storage required for the SBWA Water System was calculated as the sum of operating storage, equalizing storage, and standby storage. Table 9 summarizes the overall results of the storage capacity analysis. The existing storage tanks have capacity (34,000 gallons) to meet both existing and projected (2043) water demand conditions.

Table 9
Total Storage Required

Year	Operating Storage (OS) (gallons)	Equalizing Storage (ES) (gallons)	Standby Storage (SB) (gallons)	Fire Suppression Storage (FSS) (gallons)	Total Storage Required (gallons)
2023	6,200	2,723	16,875	0	25,798
2029	6,200	2,958	17,625	0	26,783
2043	6,200	3,075	18,000	0	27,275

Overall Capacity

Overall system capacity was estimated in terms of the number of ERUs that can be served by existing water rights, well supply capacity, and storage capacity, as shown in Table 10. The analysis indicates that the storage tanks have the least additional capacity, in terms of ERUs. However, all components have more than enough capacity to meet existing and projected future demand conditions.

Table 10
Existing System Capacity in Terms of Potential ERUs Served

Component	Component Capacity	Existing ERUs Served	Additional Capacity Available (ERUs)	Total Capacity Available (ERUs)
Source Water Rights, Q_a	100 acre-feet	45	550	595[1]
Source Water Rights, Q_i	100 gpm	45	339	384[2]
Well Supply	35 gpm	45	67	112[3]
Storage	34,000 gallons	45	15	60[4]

Notes:

1. Represents the maximum ERUs that can be served by the annual water right at an ADD of 150 gpd per ERU.
2. Represents the maximum ERUs that can be served by the instantaneous water right limit, assuming that the total flow rate needs to supply existing MDD of 375 gpd per ERU and replenish fire flow storage over 72 hours.
3. Represents the maximum ERUs that can be served with the existing active well capacity, assuming that the well capacity needs to supply MDD within 20 hours of pumping per day and replenish fire flow storage over 72 hours.
4. Represents the maximum ERUs that can be served with the existing storage capacity, assuming existing well capacity and booster pump capacity are unchanged.

ADD: average daily demand
ERU: Equivalent Residential Unit
gpd: gallon per day
gpm: gallons per minute
Q_a: annual withdrawal limit specified by water right
Q_i: instantaneous withdrawal limit specified by water right

Hydraulic Analysis

Hydraulic analysis of the SBWA Water System was performed using WaterCAD hydraulic modeling software from Bentley. WaterCAD is commonly used to model municipal water distribution systems and other pressurized water delivery systems. A WaterCAD model of the SBWA Water System was created to evaluate hydraulic conditions, including system pressures and velocities, to determine whether the criteria set forth earlier in this memorandum can be met for a range of demand and flow conditions. The model was not calibrated. Calibration would require more time and effort than could be supported by the current water consolidation grant. The model does include both the SBWA Water System and the SV-SLB Water System, to facilitate evaluation of the potential consolidation of the two systems, which will be completed as a future task.

Scenarios

Hydraulic analysis was completed using a series of steady state model scenarios. A steady state model scenario simulates hydraulic conditions at a single point in time based on a set of model inputs. The scenarios were set up to simulate pressures, headlosses, and other hydraulic characteristics of system operation under ADD, MDD, and PHD conditions. For systems where fire flow is provided, fire flow availability is typically simulated under MDD conditions. Table 11 summarizes the scenarios that were evaluated for the SBWA Water System. It should be noted that the model was originally set up based on a projected buildout (2043) of 49 ERUs. That number was corrected in the demand and capacity analyses presented in Tables 8, 9, and 10, as requested by the

SBWA, but the model has not been updated. The results would not substantially change with this adjustment. However, the model will be updated as part of Tasks 2 and 3.

Table 11
Hydraulic Analysis Scenarios

Type of Simulation	System	Demands	ERUs Served	Fire Flow	Source of Supply
Steady State	Existing	2023 ADD	45	None	Well 2, 35 gpm
Steady State	Existing	2023 MDD	45	None	Well 2, off
Steady State	Existing	2023 PHD	45	None	Well 2, 35 gpm
Steady State	Existing	2029 ADD	47	None	Well 2, 35 gpm
Steady State	Existing	2029 MDD	47	None	Well 2, off
Steady State	Existing	2029 PHD	47	None	Well 2, 35 gpm
Steady State	Existing	2043 ADD	48	None	Well 2, 35 gpm
Steady State	Existing	2043 MDD	48	None	Well 2, off
Steady State	Existing	2043 PHD	48	None	Well 2, 35 gpm

Results

The capacity analysis and hydraulic analysis results indicate the following:

- The SBWA Water System has adequate source and storage capacity to meet existing and projected water demand conditions.
- The SBWA Water System would require connection, testing, and operation of Well 1 to provide a redundant source of water supply.
- The SBWA Water System, as currently sized and configured, has adequate capacity to meet minimum delivery pressure and velocity criteria that were set forth earlier in this memorandum.
- The SBWA Water System will continue to need to rely on the SV-SLB Water System for fire protection. The system has no hydrants and is not sized to deliver fire flows.

Results from the hydraulic analysis are included as Attachment B to this memorandum.

Water Quality and Groundwater Supply Analysis

The SBWA requested that Anchor QEA perform an independent analysis of their groundwater well supplies to assess potential for contamination and adequacy of water supply as noted earlier in this memorandum. The following summarizes the results of this analysis:

Water Quality Monitoring

The SBWA monitors the water system for potential contaminants as required by DOH. Water is sampled and tested for coliform bacteria, nitrate, lead and copper, disinfection by-products, inorganic chemicals, volatile organic compounds, and synthetic organic compounds on a regular basis, as required by DOH. These samples are collected at the well source or from the distribution system. Table 12 summarizes the results of water quality monitoring from the last 3 years. The SBWA reports that there have been no exceedances of water quality maximum contaminant levels (MCLs) for 20 years, with the exception of one exceedance of manganese in 2016, which was an anomaly. Prior and subsequent samples for manganese have showed no exceedance.

Table 12
Water Quality Monitoring Summary

Year	Date	Type of Test	Exceedance?	Sample No.	Sample Location
2023	02/23/23	Microbial	No	10650	Distribution System
2022	12/19/22	Nitrate	No	41117	S02 (Well 2)
	11/22/22	Microbial	No	75679	Distribution System
	08/23/22	Microbial	No	54880	Distribution System
	07/26/22	Microbial	No	24808	Distribution System
	06/21/22	Microbial	No	20671	Distribution System
	05/24/22	Microbial	No	17557	Distribution System
	02/22/22	Microbial	No	12188	Distribution System
2021	11/22/21	Microbial	No	44637	Distribution System
	08/17/21	Microbial	No	30941	Distribution System
	07/27/21	Microbial	No	27824	Distribution System
	06/15/21	Microbial	No	22249	Distribution System
	05/20/21	Microbial	No	18409	Distribution System
	04/26/21	Nitrate	No	14706	S02 (Well 2)
	02/16/21	Microbial	No	05705	Distribution System
2020	12/01/20	Nitrate	No	42307	S02 (Well 2)
	11/24/20	Microbial	No	42080	S02 (Well 2)
	08/24/20	Microbial	No	29940	S02 (Well 2)
	07/21/20	Microbial	No	24407	S02 (Well 2)
	06/09/20	Microbial	No	18888	S02 (Well 2)
	05/19/20	Microbial	No	16153	S02 (Well 2)
	02/18/20	Microbial	No	05985	S02 (Well 2)

Review of Wellhead Protection Area Reports

An independent review was performed of *Sun Vista/Sunlight Beach HOA Wellhead Protection Area Report* (Golder Associates 2013). The SBWA well is within the mapped Wellhead Protection Zone for the SV-SLB Well 1 analyzed in the report, so this report was reviewed for our analysis of the potential for contamination of the SBWA well. The wells discussed below are SV-SLB wells. Anchor QEA offers the following comments:

- The groundwater flow direction appears to be based a comparison of water levels at well ABD-979 and Sun Vista Well 1. Well ABD-979 is located east of Sun Vista Well 1. Figure 1 of the report shows other wells located north and northeast of Sun Vista Well 1 and it appears they were not included in the assumption of flow direction because their static water level is lower than Well 1, indicating they are completed in a different water-bearing formation. However, the report also states that "The water level elevation at each well was estimated using the depth to water reported on the well log and the land surface elevation estimated from a 10-meter digital elevation model of the area." The potential error in estimating land surface elevations (up to 30 feet) far exceeds the difference in water levels at wells other than ABD-979 shown in Figure 1. This could affect their assumption of groundwater flow direction and the delineation of a WHPA.
- The *Wellhead Protection Plan for Sunlight Beach Water Association* (SBWA 2023a) was also reviewed and presents water level elevations at nearby wells in Figure 2.2 of that report and indicates groundwater flow direction may be in a southwesterly direction and maybe perpendicular to the shoreline. That direction is much different than the assumed westerly flow direction in the Golder report. It is likely the WHPA for Sun Vista Well 1 is wider and extends northeast of the well.
- The analysis assumed a single well withdrawing water at the maximum instantaneous rate (Qi) of 111 gpm (179 acre-feet per year) for the associated water rights for Wells 1 and 2 (Certificate No. 4684; Permit No. 26066). While the maximum combined capacity of Wells 1 and 2 is estimated at 113 gpm, the average combined pumping rate of Wells 1 and 2 is much less than 111 gpm, which would reduce the distance of the times-of-travel and extent of those zones.
- Although the report did not specifically address the potential for additional septic fields immediately east of Well 1 associated with proposed development of single-family residences on the Kohlwes parcel, the parcel was within the mapped zones of the 1- and 5-year travel time. Golder addressed septic fields within those zones by stating "however, surface contamination in these areas could be considered low risk due to the presence of confining material (glacial till) overlying the aquifer east of the wells." The actual extent of glacial till and interface with a more permeable glacial outwash material needs to be confirmed as that would affect the potential for nitrate contamination of downgradient wells.

- The SV-SLB Wellhead Protection Area report states "The WDOH Office of Drinking Water (ODW) Sentry Database indicates nitrate levels remaining relatively constant for the entire period of record, ranging from 1.4 to 2.3 milligrams per liter (mg/L) nitrate-N since 1995; the Safe Drinking Water Act (SDWA) indicates a maximum concentration for nitrate-N of 10 mg/L. No microbiological analyses are available for Well 1 or Well 2 which might identify potential bacterial contamination from septic systems. Aerial photographs dating to 1941 indicate historic cultivation in the fields east of the wells and within the WHPA (Attachment B), indicating the source of low-level nitrate may be from long-term surface application of fertilizers." It is our opinion that nitrate fertilizer applied decades ago would likely have already traveled through the groundwater system. The source of nitrate is probably more recent, perhaps from septic systems upgradient from the wells.
- The analytical methods used to determine the time of travel seem to be reasonable given the amount of data available. However, a range of potential groundwater flow directions should be used to develop a wider potential capture zone. The analysis would also be improved by more accurately measuring water level elevations within the potential capture zone to improve the estimate of flow direction and hydraulic gradient of groundwater flow.
- Aquifer properties listed in the report (Transmissivity, porosity, aquifer thickness) are field measurements or reasonable estimates.
- The report states "Importantly, travel time boundaries do not include vertical travel times, which is additional time required for a contaminant to migrate from ground surface to the aquifer; this additional time provides for more response time if a contaminant is found near ground surface within the WHPA." This is an important point as the mapped zones of travel time are conservatively large.
- The report states "Dry sediment and clay was apparent during construction of Well 2 to a depth of approximately 25 feet below ground surface (bgs), indicating at least semi-confining conditions within the aquifer." This important conclusion is relevant to the discussion of the potential risk of contamination to the both the SBWA and SV-SLB HOA wells.

Assessment of Contamination Risks from Nitrates/Microbials from Upgradient Septic Systems and Seawater Intrusion

As part of an independent assessment of contamination risks, a review of the *Sunlight Beach Water Association Report on the Assessment of Nitrate Contamination Risks* (SBWA 2023d) was performed. The report presents an analysis of potential nitrate contamination from upslope septic fields. The analysis uses the Washington Department of Health (DOH) Level 1 Nitrate Balance for Large On-Site Sewage Systems (LOSS) spreadsheet tool. The SBWA report estimated nitrate levels for input values obtained from the Golder report and estimated based upon a potential configuration of on-site sewage systems on the Kohlwes property. A sensitivity analysis was also performed that applied ranges to the input values to determine selected input values and for a range of potential on-site septic systems (10-15) upgradient from the water supply wells used by SBWA and SV-SLB HOA. Anchor QEA offers the following comments regarding input values to the Level 1 Nitrate Balance worksheet supplied by DOH and used by SBWA:

- The LOSS analysis is used for analysis of large on-site sewage systems and is not directly applicable to analyzing single systems that are spaced apart. Assumptions have to be made for the location of a single system that collectively represent all of the potential single septic drainfields.
- The groundwater recharge rate listed in the report is 24 inches, based upon 35% recharge of an annual precipitation value of 69 inches at Clinton. The average annual precipitation at the site is 29 inches (PRISM 2023). Thirty-five percent of 29 inches is 10 inches. Recharge will be much less than 24 inches. The USGS reported the average recharge rate on Whidbey Island to be about 6 inches (USGS 2003).
- The area of the septic drainfield was estimated to be 385,000 square feet, which is the area of the entire Kohlwes parcel. That, combined with recharge, affects the volume and concentration of flow migrating downgradient. We recommend using a smaller drainfield area approximating the combined size of the potential septic drainfields. To have a conservative analysis, the drainfield area can be assumed to be located between the middle and north end of the Kohlwes parcel, closer to the well.
- The input value used for flow volume of effluent per septic system was 270 gallons per day. That value is a flow rate used for design of large on-site systems intended to ensure an on-site sewage system can handle peak loadings. It is not an average flow volume. The Washington State Department of Ecology recommends a value of 60 gallons per day per person be used to estimate indoor water use, of which 10% is consumptively used and 90% is discharged to a septic system (Ecology 2018). The average household size in the Clinton Census-Designated Place from the 2010 census was 2.1 (OFM 2023). The resulting flow volume would be 113 gallons per day per residence. We recommend using a volume of 135 gallons per day per residence to be conservative. That volume is based upon an average household size of 2.5 using 60 gallons per day per person with 90% of use discharged to a septic system.
- The aquifer thickness used in the analysis is 20 feet, which is the default value from DOH, even if the aquifer may be thicker. The Golder report describes the aquifer as having a saturated thickness in excess of 25 feet. For the purposes of delineating the wellhead capture zones, Golder used an aquifer thickness of 50 feet as a representative thickness of the aquifer. The aquifer thickness may vary with location.

A test of the spreadsheet using adjusted values for recharge, drainfield area for 10 residences, location of the drainfield and volume of effluent was performed. A range of potential drainfield areas were estimated using DOH values for design application rates for Type 3 and Type 5 soils. The input values and results of the analysis are summarized in Table 13.

Table 13
LOSS Spreadsheet Analysis for Ten Residences

Input Values	Factor	Units	Values
Nitrate concentration in precipitation	N_R	mg/l as N	0.24
Total nitrogen concentration in wastewater	N_W	mg/l	60
Soil denitrification	d	unitless	0.1
Aquifer thickness	b	ft	20
Drainfield area	A_D	ft^2	4,500
Distance from drainfield to property boundary	D_{pb}	ft	700
Aquifer width	W_A	ft	200
Aquifer hydraulic conductivity	K	ft/day	400
Hydraulic gradient	i	ft/ft	0.002
Recharge	R	in/yr	6.00
Nitrate concentration of upgradient ground water	N_B	mg/l	2
Wastewater volume	V_W	gpd	1,350
Output Value	**Factor**	**Units**	**Values**
Groundwater nitrate value	NGW	mg/l as N	4.8

The result of the groundwater nitrate analysis for 10 residences is 4.8 mg/l as N, an increase of 2.8 mg/l over background levels. An analysis was performed using 20 residences, which results in a concentration of 7.2 mg/l as N, an increase of 5.2 mg/l over background levels. For 30 residences, an increase of 9.5 mg/l as N was obtained. These levels exceed the 2 mg/l increase that indicates a potential moderate to significant impact to groundwater per DOH. That level is used by Island County in their review of on-site sewage systems and land-use applications. The Island County Environmental Health Department reviews all land-use projects that have the potential to impact the quality or quantity of groundwater. A reduction in the number of residences in a development or more intensive treatment may be required to reduce impacts to groundwater.

Anchor QEA tested the input variables and found that changes in Nitrate concentrations were most sensitive to the values of aquifer properties, especially the hydraulic gradient. If refinements to the calculations are made in the future, we recommend obtaining additional data on groundwater levels to confirm the aquifer hydraulic gradient.

The levels estimated by Anchor QEA are slightly less than estimated in the SBWA report but would not change the conclusions of the SBWA report. The SBWA report states "The sensitivity analysis shows that changes in the values of aquifer characteristics within possible ranges all result in Ni levels that exceed State and Island County allowable limits for 10-15 additional septic systems near-term."

An assumption that is inherent in the conclusions in the SBWA report is the septic effluent will mix with water in the aquifer(s) upgradient of the wells, resulting in an increase in Nitrates in groundwater. The Golder report describes surficial geology at the SV-SLB wells as glacial outwash with glacial till mantling the outwash starting about 800 feet east. The well log for SBWA Well 2 indicates a layer of clay from 1 foot bgs to 16 feet bgs. The well is screened from 16 feet to 21 feet bgs in a gravel formation. The static water level when the well was drilled was slightly above the ground surface, indicating the aquifer Well 1 is developed into is at least semi-confined. The presence of glacial till and a confining layer could restrict the amount of septic effluent entering the aquifer. The wells for SV-SLB HOA appear to also have a confining layer as static water levels are higher in elevation than clay layers indicated on the well log for well AGA 832.

However, the extent of glacial till in upgradient areas is not well known and may not consistently cover the underlying outwash formation. For example, the Olympic Marine View Water Association well (Ecology number BJK759) drilled in 2015 lists silty coarse sand as being encountered from 0 to 50 feet bgs, without mention of clay or till. That well is at about the same elevation and 0.25 mile west of the Kohlwes parcel. Without a better understanding of the surficial geology, aquifer capture area, and the groundwater flow direction, it would be prudent for the SBWA to assume nitrates from on-site sewage systems will increase, either from the Kohlwes parcel or other parcels in the aquifer capture area. The LOSS analysis indicates the increase in Nitrate concentration will exceed levels deemed acceptable by Island County (2 mg/l increase in Nitrate at a point of compliance) with as few as 10 new residences on the Kohlwes parcel. The LOSS analysis indicates Nitrate levels above the State Reporting Level (SRL) of 5 mg/l concentration could occur with more than 10 new residences. The analysis indicates Nitrate levels could approach the Maximum Contaminant Level (MCL) of 10 mg/l with 30 new residences. At that level, babies and people who are pregnant or trying to become pregnant should not drink the water and adults with certain health conditions may be at risk to methemoglobinemia.

In addition to Nitrates, microbial contamination and other chemicals commonly found in residential wastewater could enter the aquifer if adequate treatment through soil layers does not occur because of the proximity of on-site sewage systems to the SBWA well.

Seawater Intrusion Risks

Anchor QEA agrees with the findings about seawater intrusion from long-term increases in saltwater levels and the potential for upconing described in the *Sunlight Beach Water Association Wellhead Protection Plan* (SBWA 2023c). Both appear to be low risks considering the groundwater levels and current levels of chloride. The SV-SLB HOA wells also appear to have a low risk from long-term increases in saltwater levels and low potential for upconing.

The wells do have a higher risk of being flooded during extreme high tides (king tides plus low atmospheric pressures plus storm surges). Well seals and the clay layers above the water-bearing layer may protect the well from contamination by seawater, as long as the top of the well casing is not submerged and is sealed. In addition, the water level elevations in the wells are higher than mean sea level and the direction of flow is either towards the marsh area or towards Puget Sound. Note that SBWA Well No. 2 has a 16-foot-deep seal, and an 18-foot-deep seal is the minimum standard. The condition of the seal is not known and the risk of seawater migrating around the seal if the surface is flooded is also not known. However, seawater entering the ground around the well will likely get flushed out by the positive flow from the aquifer.

Anchor QEA is not advocating a “do-nothing” approach to saltwater contamination from flooding. We recognize that the wells, if flooded, would need to be flushed and sanitized before being put back into operation. In addition, components of the well installation may be damaged by flooding, including wiring, piping, pumping and valves with metallic parts. Loss of pressure in the distribution system may require flushing and sanitizing of the pipe distribution system.

Recommendations For Water Supply Wells

Anchor QEA reviewed existing documents describing the potential for contamination and seawater intrusion. We agree with the assessment of the risk to the SBWA well from Nitrate contamination from upgradient septic systems with as few as 10 new residences on the Kohlwes parcel. However, additional data on soils, geology and aquifer properties would be needed to more definitively assess the potential for nitrate contamination. We agree with assessments on the low potential for seawater intrusion and upconing. We have concluded that it is possible seawater contamination from tidal flooding could occur which would also damage facilities at the well house.

Besides the risks from nitrate and seawater contamination there are other reasons to locate a new well (i.e., “blue” operating permit for SBWA well, lack of space for equipment at well head). A prudent alternative will be to pursue construction of a well or wells at a new location. The existing well could be kept as an emergency backup. If the water quality of the well remains adequate in the future, the well could be used during summer peaking periods or used to strategically mix water supplies to reduce water quality treatment needs. Discussions with DOH will be needed to determine whether and how the existing well can be used.

Water quality treatment in the form of disinfection may be required if microbial contamination occurs from upgradient on-site sewage systems. Chlorination is the most common approach to disinfection. If Nitrate contamination occurs that approaches the MCL, treatment would be cost-prohibitive and securing a new water supply well would be less expensive. Further assessment of changes in treatment that may be required at the existing wells in the future to continue to provide water of adequate quality.

If nitrate contamination occurs that approaches the MCL, treatment would be cost-prohibitive and securing a new water supply well would be less expensive. Further assessment of changes in treatment that may be required at the existing wells in the future to continue to provide water of adequate quality.

In addition to planning for a new water source, in the interim the SBWA can be proactively working with Island County to reduce the potential impact of new residences upgradient. The water systems can request that Island County only approve a development on the Kohlwes parcel that is phased, first with five residences constructed with monitoring of water quality impacts from on-site sewage systems. If, after a period of time, impacts to the SBWA well don't occur, the County could then allow the remaining lots to be developed. The ability to develop can be linked to understanding of the potential impacts to the SBWA and SV-SLB HOA wells.

Recommended Improvements

This following paragraphs provide recommendations for improvements that will be needed to maintain adequate water system operations and level of service if the SBWA Water System remains in its current configuration with existing water supply and storage facilities at their present locations. A prioritized list of recommended improvements was developed to address system deficiencies and includes replacement of facilities that are likely to need replacement due to age and condition within the next 20 years. A planning level opinion of probable costs has also been developed for each of the proposed improvement projects.

Summary of Identified Deficiencies

As noted previously, no capacity-related deficiencies were identified through the capacity analyses and hydraulic analysis. There is adequate source, storage, and distribution system capacity to meet the criteria set forth earlier in this memorandum under existing and projected water demand conditions. However, some of the water system infrastructure is aging and will likely require replacement or upgrade during the next 20 years. The need to replace aging infrastructure has been evaluated and recommended facility upgrades and replacements are included in the prioritized list of improvements recommended below.

The water quality analysis indicated that while the system currently provides water that generally meets water quality standards, the system is at risk of contamination in the future from the following:

- Bacteria, Nitrates
- Seawater Inundation

Recommended Improvements

Table 14 provides a prioritized list of improvements recommended for the SBWA Water System. These improvements are primarily recommended to replace infrastructure and equipment that needs or is anticipated to need replacement due to age and condition within the next 20 years, if the SBWA Water System is maintained in its current configuration with the wells and storage tanks in their current locations. Replacement or relocation of existing wells is also recommended to address the potential risk of contamination from bacterial and nitrates resulting from development of upslope septic systems and sweater intrusion resulting from tidal flooding. Recommended timing of improvements is based on our understanding of the age and condition of the infrastructure and equipment that will need to be replaced.

Table 14
Recommended Improvements

Project ID	Description	Targeted Year for Completion
P-1	Replace the segment of the existing 4-inch PVC pipeline that conveys water from the wells to the storage tanks between the well house and the 90-degree bend where the pipeline runs north through an easement across the Kohwles property. This pipe was not replaced as part of a realignment completed in 1998 that relocated a portion of this pipeline. The pipeline was originally installed in 1968-1969 and will likely require replacement due to age and condition within the next 6 years.	2029
P-2	Replace the segment of the existing 4-inch PVC pipeline that conveys water from the wells to the storage tanks in the easement along the north property boundary of the Kohwles property to the valve cluster located within 66 feet of the storage tanks. A portion of this pipe was not replaced as part of a realignment completed in 1998 that relocated a portion of this pipeline. The pipeline was originally installed in 1968-1969 and will likely require replacement due to age and condition within the next 6 years.	2029
P-3	Replace or relocate existing wells to address risk of bacteria, nitrate, and seawater intrusion contamination. This should be done prior to full development of the Kohwles property. Due to the limited space at the existing well site and location of the well downslope of septic systems that will be installed as part of the development of the Kohwles property, it is recommended that a new well be drilled at a different location, upslope of the Kohwles property and away from the potential risk of seawater intrusion. Relocation of wells will be evaluated in more detail as part of Tasks 2 and 3. A primary and secondary well should be considered for redundancy.	2029
P-4	Replace the existing 1-inch PVC pipeline that extends north from Sunlight Beach Road to serve Sunlight Beach Lots 67-1, 67-2, and 67-3. The age and condition of this pipe is unknown. It is anticipated that it will likely require replacement due to age and condition within the next 20 years.	2043
P-5	Replace the existing 4-inch PVC main pipeline in Sunlight Beach Road. The pipeline was original installed in 1986-1987. The condition of the pipeline should be monitored. It is anticipated that the pipeline may need to be replaced due to age and condition within the next 20 years.	2043

Project ID	Description	Targeted Year for Completion
P-6	Replace the 2-inch storage tank inlet/outlet pipes. The pipes were originally installed in 1982. The condition of these pipes should be monitored. It is anticipated that the pipes may need to be replaced due to age and condition within the next 20 years.	2043
P-7	Replace customer service meters as they fail or become outdated. The customer service meters were installed approximately 10 years ago. It is anticipated that up to one quarter of the meters will need to be replaced in the next 20 years.	2043
P-8	Replace or refurbish Tank 1. This tank was originally installed in 1947. It appears to currently be in good condition but is nearly 80 years old. The condition of the tank should be monitored. It is anticipated that the tank will need to be replaced or refurbished due to age and condition within the next 20 years. Inspection and monitoring may indicate that the life of the tank can be extended by relining and otherwise refurbishing components, rather than replacing the entire tank. Replacement would be challenging due to limited accessibility through an easement across private property.	2043

Opinion of Probable Costs

Planning level opinions of probable costs have been developed for each of the recommended improvement projects shown in Figure 4 and described above. The costs were developed using planning level unit costs and then adding a percentage of the estimated construction cost to account for indirect project costs. Table 15 lists the unit costs and percentages used in developing project costs. Indirect costs include planning and design, project administration, construction services, construction contingency, and taxes. Unit costs for piping projects are intended to include trenching, import and placement of pipe bedding material, furnishing and installing AWWA C900 PVC pipe, placement of backfill, pavement repair, and installation of all equipment appurtenant to the pipe.

Costs for other types of projects not listed in Table 15 were estimated on a case-by-case basis. Construction and indirect costs were added to determine the total project cost. A description of each project, identification of the deficiency or need that is met by the project, and the opinion of probable project implementation costs are summarized in Table 16. These are order-of-magnitude planning level costs. More refined opinions of cost would need to be developed to inform project budgeting and implementation. All opinions of cost are based on our understand of current (2023 dollars) materials and labor costs. Actual costs at the time of implementation will vary based on the cost of materials and labor at the time of construction.

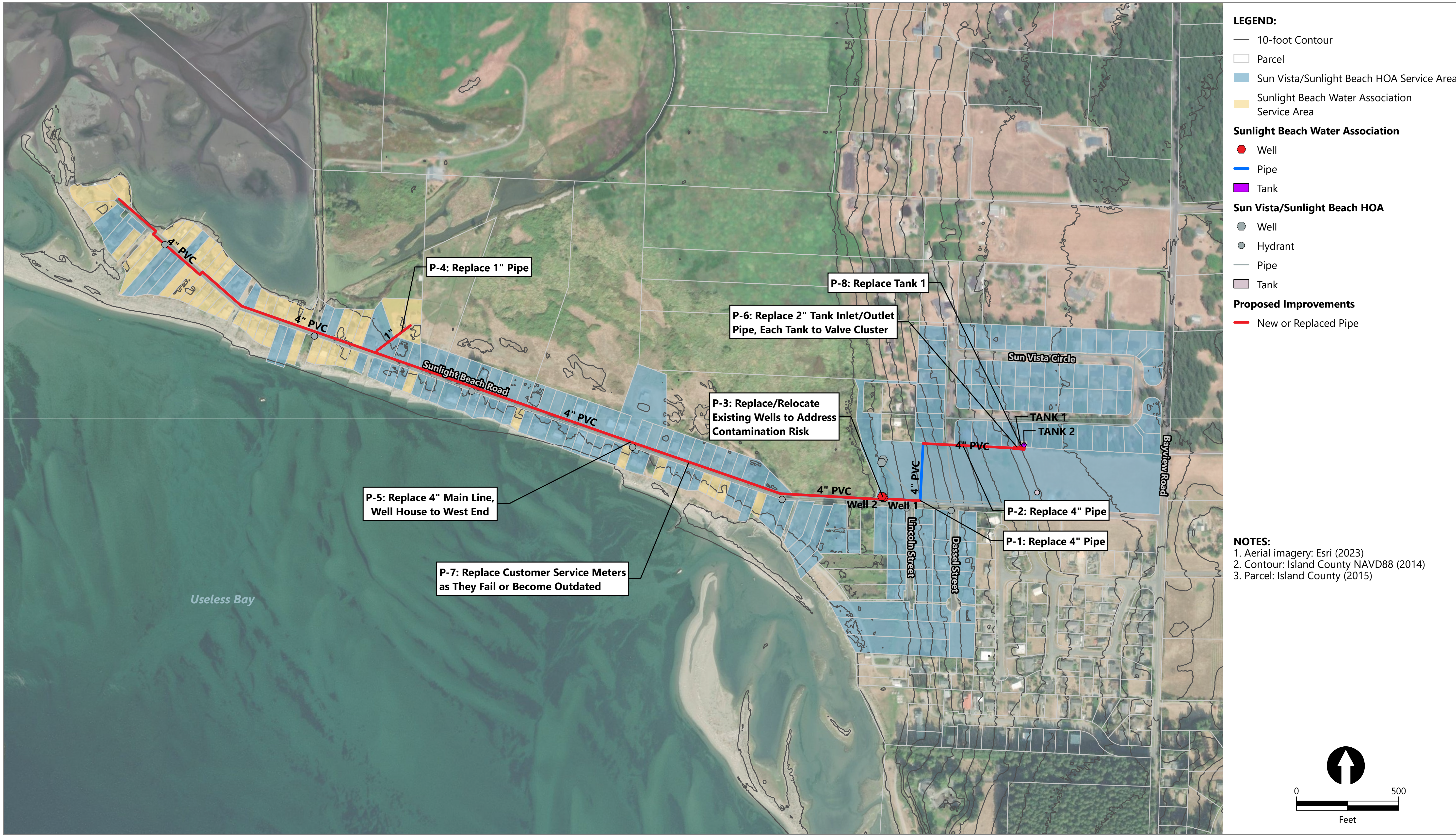


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Figure 4
Proposed Improvements – Sunlight Beach Water Association
Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

Table 15
Distribution System Unit Costs

AWWA C900 PVC Pipe Diameter (Inches)	Unit Cost ($/foot)
1	$25
2	$35
2-1/2	$50
3	$64
4	$76
6	$92
8	$103
New Water Storage Tank	**Unit Cost ($/gallon)**
<50,000 gallons	$6
50,000 to 100,000 gallons	$4
100,000 to 250,000 gallons	$3
New Well	**Unit Cost**
8-inch Well	$200/foot + $5,000 for screen + Pump, Electrical, Controls
10-inch Well	$300/foot + $8,000 for screen + Pump, Electrical, Controls
Well Pump	**Unit Cost ($/each)**
1-horsepower Submersible Well Pump	$3,000
5-horsepower Submersible Well Pump	$9,500
10-horsepower Submersible Well Pump	$15,000
Booster Pump Replacement	**Unit Cost ($/each)**
5-hp End-Suction Centrifugal Pump	$8,000
Indirect Costs (Percentages of Construction Cost)	
Project Administration	5%
Design & Permitting (including survey and geotech)	10% (average) to 20% (complex)
Contractor Mobilization	10%
Construction Contingency	10% (average) to 30% (complex)
State Sales Tax	8.8%

Notes:

1. Construction unit costs include all work needed to complete the project. Construction unit costs also include a 30% contingency, a 10% allowance for mobilization and demobilization, and sales tax.

Table 16
Opinion of Probable Costs

Project ID	Description	Quantity	Unit	Unit Cost	Construction Cost[1]	Non-construction Cost[2]	Total Project Cost[3]	Summary of Deficiency Addressed
P-1	Replace 4-inch Pipe, Well to Tank along Sunlight Beach Road	190	LF	$76	$14,400	$3,600	$18,000	Replace aging pipe.
P-2	Replace 4-inch Pipe, Well to Tank, N Side of Kohwles property	380	LF	$76	$28,900	$7,200	$36,100	Replace aging pipe.
P-3[5]	Replace/Relocate Existing Wells to Address Contamination Risk	1	LS	$350,000	$350,000	$87,500	$437,500	Address risk of contamination.
P-4	Replace 1-inch Pipe to Sunlight Beach Lots 67-1, 67-2, and 67-3	240	LF	$25	$6,000	$1,500	$7,500	Replace aging pipe.
P-5	Replace 4-inch Main Line in Sunlight Beach Rd., Well House to West End	4,480	LF	$76	$340,500	$85,100	$425,600	Replace aging pipe.
P-6	Replace 2-inch Tank Inlet/Outlet Pipe, Each Tank to Valve Cluster	125	LF	$35	$4,400	$1,100	$5,500	Replace aging pipe.
P-7	Replace Customer Service Meters	12	EA	$600	$7,200	$1,800	$9,000	Replace aging meters.
P-8	Replace Storage Tank 1	10,000	Gallon	$6	$60,000	$15,000	$75,000	Replace aging storage tank.
Total – All Projects					**$811,400**	**$202,800**	**$1,014,200**	

Notes:

1. Construction unit costs include all work needed to complete the project, including labor and materials needed to trench, excavate, backfill, install pipe and other equipment, test, disinfect, and repair and restore surfaces. Construction unit costs also include a 30% contingency, a 10% allowance for mobilization and demobilization, and sales tax.
2. Non-construction costs include allowances for engineering design (15% of the construction cost), permitting and administration (5% of the construction cost), and construction management (5% of the construction cost).
3. The total project cost is the total of the construction and non-construction costs. Costs are reported in 2023 dollars. Costs may vary depending on labor and materials costs at the time the project is constructed.
4. Construction, non-construction, and total costs are rounded to the nearest $100.
5. The cost of replacing or relocating existing wells has not been fully evaluated yet. The cost will be further evaluated as part of Tasks 2 and 3, which will consider what the system would need if the wells and other key infrastructure were relocated. The cost included here should be considered a placeholder and will be refined for inclusion in the final Water Consolidation Feasibility Study report.

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Attachment A
Water System Facility Inventory Data

Table A-1
SBWA Well Inventory

ID	System	Source Number	Well Number	Well Size	Well Depth	Well Capacity	Pump HP	Year of Installation	Reported Condition
SBWA Well 1	SBWA	S01	AGA518	10-inch	15 feet	50 gpm max/ 35 gpm current	Unknown	1947 (Rebuilt 1984)	Disconnected
SBWA Well 2	SBWA	S02	AGA519	10-inch	21 feet	50 gpm max/ 35 gpm current	Unknown	1987	Active, Good

Table A-2
SBWA Storage Tank Inventory

ID	System	Dimensions	Capacity	Materials	Year of Installation	Bottom Elevation	Overflow Elevation	Reported Condition
SBWA-Tank 1	SBWA	10' X 10' Rectangular	9,000 gallons	Reinf. Concrete	1947	Approx 104 feet	Approx 115 feet	Good
SBWA-Tank 2	SBWA	22.5' X 22.5' Octagonal	15,000 gallons	Reinf. Concrete	1982	Approx 104 feet	Approx 115 feet	Good

Table A-3
SBWA Pipeline Inventory

ID	Size	Description	Material	Length	Year of Installation	Reported Condition
SBWA-P01	4-inch	Main Line	PVC, Gasketed	901 feet	1986-1987	Good
SBWA-P02	4-inch	Main Line	PVC, Gasketed	754 feet	1986-1987	Good
SBWA-P03	1-inch	Lots 67-1, 67-2, 67-3	Unknown	235 feet	Unknown	Unknown
SBWA-P04	4-inch	Main Line	PVC, Gasketed	2,264 feet	1986-1987	Good
SBWA-P05	4-inch	Main Line	PVC, Gasketed	565 feet	1986-1987	Good
SBWA-P06	4-inch	Intertie	Unknown	27 feet	Unknown	Unknown
SBWA-P07	2-inch	Well 1 Discharge	Steel	26 feet	1987	Good
SBWA-P08	4-inch	Wells to Tanks	PVC, Gasketed	492 feet	1968-1969, 1998	Good
SBWA-P09	4-inch	Wells to Tanks	PVC, Gasketed	482 feet	1968-1969, 1998	Good
SBWA-P10	4-inch	Tank Inlet	PVC, Gasketed	64	1968-1969	Good
SBWA-P11	4-inch	Tank Inlet	PVC, Gasketed	48	1968-1969	Good
SBWA-P12	2-inch	Tank Outlet	Galv. Steel	73	1982	Unknown
SBWA-P13	2-inch	Tank Outlet	Galv. Steel	47	1982	Unknown
SBWA-P14	2-inch	Well 2 Discharge	Steel	2 feet	Unknown	Disconnected
SBWA-P15	2-inch	Well 2 Discharge	Steel	2 feet	Unknown	Disconnected

Attachment B

Hydraulic Analysis Inputs and Results

Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

Sunlight Beach Water Association

WaterCAD Model Inputs - Pipe

Pipe Label	Length (ft)	Nominal Diameter (in)	Material	Hazen-Williams C	Installation Year
SBWA-P01	902	4	PVC	150	1987
SBWA-P02	754	4	PVC	150	1987
SBWA-P03	235	1	Unknown	130	0
SBWA-P04	2,264	4	PVC	150	1987
SBWA-P05	565	4	PVC	150	1987
SBWA-P06	27	4	Unknown	130	0
SBWA-P07A	20	2	Steel	130	1987
SBWA-P07B	6	2	Steel	130	1987
SBWA-P08	492	4	PVC	140	1998
SBWA-P09A	478	4	PVC	140	1998
SBWA-P09B	1	6	Ductile Iron	130	0
SBWA-P09C	2	6	Ductile Iron	130	0
SBWA-P10	66	4	PVC	140	1969
SBWA-P11	47	4	PVC	140	1969
SBWA-P12	75	2	Steel	130	0
SBWA-P13	49	2	STEEL	130	0
SBWA-P14	2	2	Steel	130	0
SBWA-P15	2	2	Steel	130	0

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WaterCAD Model Inputs - Nodes

Node Label	Elevation (ft)	X (ft)	Y (ft)
J-1	12	1,237,714.57	365,781.16
J-2	10	1,237,532.78	365,635.80
J-3	25	1,240,215.72	364,867.53
J-4	25	1,240,215.63	364,865.53
J-6	25	1,240,215.82	364,869.82
J-7	22	1,240,235.27	364,851.34
J-8	25	1,240,235.69	364,860.23
J-10	25	1,240,221.26	364,865.23
J-14	105	1,240,904.46	365,133.53
J-15	25	1,240,220.65	364,872.61
J-17	50	1,240,425.73	365,157.60
J-18	8	1,239,671.30	364,892.13
J-19	11	1,236,821.28	365,884.28
J-20	11	1,236,172.48	366,450.32
J-94	105	1,240,906.43	365,133.44
J-95	105	1,240,903.46	365,133.58
SBWA-Well1	15	1,240,215.89	364,871.78
SBWA-Well2	15	1,240,207.30	364,877.47

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WaterCAD Model Inputs - Storage Tanks

Label	Elevation (Base) (ft)	Elevation (Minimum) (ft)	Elevation (Initial-ADD) (ft)	Elevation (Initial-MDD) (ft)	Elevation (Initial-PHD) (ft)	Elevation (Maximum) (ft)	Capacity (gal)	Area (Average) (ft^2)	Diameter (ft)	Section
SBWA-TANK-1	96	98.00	113.00	112.10	112.10	115	9,000	100	11.28	Non-Circular
SBWA-TANK-2	96	98.00	113.00	112.10	112.10	115	25,000	278.5	18.83	Non-Circular

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WaterCAD Model Results - 1. Existing System 2023 ADD

Label	Demand (gpm)	Pressure (psi)
J-1	0.94	41
J-2	0.94	42
J-3	0	39
J-4	0	39
J-7	0.88	36
J-8	0	35
J-10	0	39
J-14	0	4
J-15	0	35
J-17	0	28
J-18	0.94	43
J-19	0.94	41
J-20	0.94	41
J-94	0	4
J-95	0	4
SBWA-Well1	(N/A)	(N/A)
SBWA-Well2	-35	46

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WaterCAD Model Results - 3. Existing System 2023 PHD

Label	Demand (gpm)	Pressure (psi)
J-1	10.64	28
J-2	10.64	40
J-3	0	38
J-4	0	38
J-7	6.28	36
J-8	0	35
J-10	0	38
J-14	0	3
J-15	0	35
J-17	0	27
J-18	10.64	42
J-19	10.64	39
J-20	10.64	39
J-94	0	3
J-95	0	3
SBWA-Well1	(N/A)	(N/A)
SBWA-Well2	-35	45

Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

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WaterCAD Model Results - 4. Existing System 2029 ADD

Label	Demand (gpm)	Pressure (psi)
J-1	0.98	41
J-2	0.98	42
J-3	0	39
J-4	0	39
J-7	0.92	36
J-8	0	35
J-10	0	39
J-14	0	4
J-15	0	35
J-17	0	28
J-18	0.98	43
J-19	0.98	41
J-20	0.98	41
J-94	0	4
J-95	0	4
SBWA-Well1	(N/A)	(N/A)
SBWA-Well2	-35	46

Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

Sunlight Beach Water Association

WaterCAD Model Results - 6. Existing System 2029 PHD

Label	Demand (gpm)	Pressure (psi)
J-1	10.94	28
J-2	10.94	39
J-3	0	38
J-4	0	38
J-7	6.46	36
J-8	0	35
J-10	0	38
J-14	0	3
J-15	0	35
J-17	0	27
J-18	10.94	42
J-19	10.94	39
J-20	10.94	39
J-94	0	3
J-95	0	3
SBWA-Well1	(N/A)	(N/A)
SBWA-Well2	-35	45

Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

Sunlight Beach Water Association

WaterCAD Model Results - 7. Existing System 2043 ADD

Label	Demand (gpm)	Pressure (psi)
J-1	1.02	41
J-2	1.02	42
J-3	0	39
J-4	0	39
J-7	1.02	36
J-8	0	35
J-10	0	39
J-14	0	4
J-15	0	35
J-17	0	28
J-18	1.02	43
J-19	1.02	41
J-20	1.02	41
J-94	0	4
J-95	0	4
SBWA-Well1	(N/A)	(N/A)
SBWA-Well2	-35	46

Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

Sunlight Beach Water Association

WaterCAD Model Results - 9. Existing System 2043 PHD

Label	Demand (gpm)	Pressure (psi)
J-1	11.26	27
J-2	11.26	39
J-3	0	38
J-4	0	38
J-7	7.01	36
J-8	0	35
J-10	0	38
J-14	0	3
J-15	0	35
J-17	0	27
J-18	11.26	42
J-19	11.26	39
J-20	11.26	39
J-94	0	3
J-95	0	3
SBWA-Well1	(N/A)	(N/A)
SBWA-Well2	-35	45