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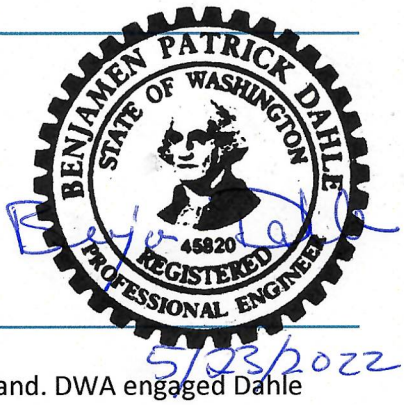
Technical Memo

DATE: May 23, 2022

TO: David Stoltz, Dockton Water Association

FROM: Ben Dahle, MSCE, P.E. BPD

TOPIC: System Capacity Analysis Small Water System Management Plan



5/23/2022

Dockton Water Association (DWA) is a Group A water system on Vashon Island. DWA engaged Dahle Engineering to update their Small Water System Management plan. This memo provides a capacity analysis of the system for that update and to develop 10 and 20-year water right demand projections to address comments from Ecology on the 2013 submittal. To prepare the capacity analysis, basic information about the system was gathered and analyzed. That information includes: a system description, basic planning data, and water demand forecasting. The capacity analysis is comprised of a system inventory, source and storage analysis, and a review of the transmission and distribution network.

Background Information

Planning Document History

Dockton Water Association currently has a Small Water System Management plan (SWSMP) that is pending approval. Before the preparation of the SWSMP, DWA had a Water System Plan approved by the Washington State Department of Health (DOH) in June of 2002 and Amended in 2005. In 2013, the Association submitted a SWSMP to DOH (and Ecology) and has several comments pending. Comment letters and a response letter are in Appendix C of the 2022 SWSMP.

System History

See the 2002 Water System Plan, sections 1.A through 1.E located in Appendix Y of the 2022 SWSMP.

System Description

The current Dockton Water system facilities consist of two active sources, six pressure zones, two twin 155,000-gallon water tanks (total 310,000 gallons), two booster pump stations each with emergency power backup and automatic transfer switches, communications between the storage tanks and

sources, an iron and manganese filtration system, and approximately 12 miles of distribution pipe. These physical assets serve 397 residential connections and 10 non-residential connections with an estimated population of 929. The Department of Health has approved the system to serve up to 485 connections. A copy of the Water Facilities Inventory is included in Appendix C of the 2022 SWSMP.

Water system improvements up to May 2022 include:

- WSP CIP Project No. B-15. Sandy Shores Well Filtration (See Appendix Y). Installed an ATEC filtration system at the Sandy Shores Well site in 2021 to treat for manganese and iron. Improvements include a new treatment building with an ATEC water treatment system with retention pond to hold backflush when filters are automatically cleaned and flushed, a new electrical control system, a new chlorine storage and injection system, and new stainless-steel housing for the well head.
- Installed a back-up generator and automatic transfer switch at the 520-zone booster pump station in 2020.
- Installed perimeter fence around the Sandy Shores Well site.
- Installed a new gate and fence at Dockton Springs.
- WSP CIP Project No. B-13. Replaced approximately 2,100 feet of existing 2-inch pipe along SW 268th St from Hake Rd. SW to 99th Ave SW with 8-inch C900 pipe in the four-year period leading up to 2021.
- WSP CIP Project No. B-8. Replaced approximately 875 feet of existing 2-inch pipe along SW Windmill St from 99th Ave SW to 97th Ave SW in the four-year period leading up to 2021.
- WSP CIP Project No. B-8. Replaced approximately 1,275 feet of existing 4-inch pipe along 97th Ave SW from SW Windmill St to SW 264th St in the four-year period leading up to 2021.
- WSP Amendment CIP Project No. 1 PRV Station Project (See Appendix Z) by 2007.
- WSP Amendment CIP Project No. 2 Dockton Springs BPS Project by 2007.
- WSP Amendment CIP Project No. 3 430 Zone Reservoir Project by 2007.
- WSP CIP Project No. A-1. Rehabilitated wellpoints at Dockton Springs to increase flow 2007.
- Discontinued use of the Hake Springs and associated infrastructure.
- WSP CIP Project No. B-2. Replaced 4-inch distribution pipes along 268th with 8-inch PVC.

Geography and Geology

See the 2002 Water System Plan, sections 1.G in Appendix Y.

Adjacent Water Systems

See the 2002 Water System Plan, sections 1.H in Appendix Y.

Existing Service Area and Characteristics

Service Area

The area served by the Dockton Water system is approximately 1,588 acres of rural unincorporated King County located in the portion of Maury Island, King County, Washington lying within Sections 29, 30, 31, and 32, Range 3 East, Township 22N, W.M. and Sections 5 and 6, Range 3 East, Township 21 N, W. M. See Appendix E of the 2022 SWSMP.

Zoning and Existing Land Use

Zoning and Existing Land Use for DWA's service area was reviewed. There are four zoning designations in the service area. Zoning and existing land use summaries based on King County GIS data are provided below.

Existing Zoning Inventory			
Zoning	**Acreage**	**Percent**	**# parcels**
RA-2.5 • Rural Area (1du/5 acres)	381	24%	444
RA-5 • Rural Area (1du/5 acres)	166	10%	127
RA-10 • Rural Area (1du/10 acres)	1,041	66%	157
NB • Neighborhood Business (n/a)	0.3	0%	2
Total	1,588	100%	730

Existing Land Use	Includes Equations		
Existing Land Use	**Acreage**	**Percentage of Water Service Area**	**Total parcels**
Built Environment			
Residential			
Single Family Residential	778.4	49.0%	443
Total Residential	778.4	49.0%	443
Commercial & Institution			
Commercial	0.6	0.0%	2
Institution	8.6	0.5%	3
Utilities			
Drinking Water Infrustructure	27.9	1.8%	4
Communication	0.1	0.0%	1
Total non-Residential	37.3	2.3%	10
Total Built Environment	815.7	51.4%	453
Unbuilt Environment			
Open Space/Recreation/Parks			
King County Parks	21.5	1.4%	3
King County Natural Areas	319.8	20.1%	45
Farm & Agriculture	0.0	0.0%	0
King County - Other	9.6	0.6%	7
King County Forrest	43.5	2.7%	1
Other Public Land	13.8	0.9%	10
Vacant			
Land Undeveloped	320.1	20.2%	181
Tide Land, HYDR, Tract, Unkn	44.4	2.8%	24
Total Unbuilt Environment	772.6	48.6%	271
Total	**1,588**	**100%**	**724**

Current uses of the properties in the Dockton Water system are primarily single-family residential.

Current Population, Service Connections, Water Use and Equivalent Residential Use

The Dockton Water system has two types of accounts: residential and commercial.

Historic Planning Data

The Dockton Water system's historic number of connections, population, use, and annual production for the past six years are shown below.

Table 2.7.1 - Historical Use Summary

Year	Connection Type	Number of Connec-tions	Metered Use [gpd]	Average Consumption per Connection [gpd]	Equivalent Residential Units - ERUs	Number of Residents /Household	Popu-lation	Total Water Produced [gallons/ year] & DSL	Total Water Produced [acre-feet/ year]
2016	Residential	380	56,042	147	380	2.51	955	23,860,33	73.2
	Comm./Inst	10	1,626	163	11			DSL	
Total		**390**	**57,668**		**391**			14.8%	
2017	Residential	382	53,956	141	382	2.47	944	23,447,20	72.0
	Comm./Inst	10	1,404	140	10			DSL	
Total		**392**	**55,360**		**392**			13.0%	
2018	Residential	384	59,144	154	384	2.43	934	24,160,99	74.1
	Comm./Inst	10	1,564	156	10			DSL	
Total		**394**	**60,708**		**394**			6.9%	
2019	Residential	391	55,856	143	391	2.39	935	23,144,45	71.0
	Comm./Inst	10	1,241	124	8			DSL	
Total		**401**	**57,097**		**399**			7.8%	
2020	Residential	392	57,587	147	392	2.35	921	23,669,98	72.6
	Comm./Inst	10	1,708	171	11			DSL	
Total		**402**	**59,295**		**403**			9.0%	
2021	Residential	397	59,942	151	397	2.34	927	25,465,400	78.2
	Comm./Inst	10	1,265	127	8			DSL	
Total		**407**	**61,207**		**405**			10.9%	
						6- Year Averages:		**23,958,061** **10.3%**	**73.5**

Notes: (1) The Association has 5/8" and 1" meters and reads them monthly. (2) Household Population and growth rates based on PSRC FAZ 6930-Vashon Island. (3) DSL based on annual reports submitted by DWA to DOH. (4) The six year average of daily production per ERU is 156 gpd.

Water Use Data Collection

All sources are metered and read workdays. DWA reads customer meters and invoices every month. Customer account data is processed in DWA's billing software program.

Equivalent Residential Units

The equivalent residential unit (ERU) is the quantity of water consumed by the average full-time single-family customer. An ERU is used to equate non-residential or multi-family residential water usage to a specific number of single-family residences.

The six-year average use for full-time single-family residences and commercial connections in the system are provided in the following table. In 2021, there were 373 full-time single-family residents in the service area.

User Type	Meter Size [1] (inches)	6-Year Average Monthly Use per Connection (gallons)	ERU
Single Family Residences	5/8, 1	4,738	1
KC Parks (74)	5/8	545	0.2
KC Fire#13	5/8	47	0.01
KC parks (108)	5/8	4,551	1
KC parks (128)	5/8	0	0
Century Telephone	5/8	322	0.1
Dockton	5/8	326	0.1
Maple Leaf Lodge	5/8	90	0.02
100% LLC	5/8	4,091	1
De Los Tres	5/8	25,166	5.5
Monastery	5/8	9,497	2

The six-year *average* full-time single-family ERU = 156 gpd was used to populate the table above. It should be noted that the six-year *maximum* full-time single-family ERU_{ADD} = 164 gpd was used to develop demand projections.

Projected Land Use, Future Population, and Water Demand

Projected Land Use

There are several factors that control land use, or development, in an area: location, water availability, wastewater disposal alternatives, and transportation infrastructure. Several factors affect the future service area of a water utility: population growth or development, geography, and resource availability.

Land use and zoning associated with the Dockton Water service area is not expected to change significantly in the foreseeable future. Wastewater in the service area is treated with septic systems. The soil in the area is adequate for this methodology at the current and proposed density with no expected changes to how sewer is treated in the foreseeable future.

Build-out for the service area was developed based on King County GIS zoning and development densities. See the table on following page. Build-out is a function of zoning, maximum density, parcel size, existing connections, and ADUs. Based on these factors, the increase of dwelling units for R2.5, R5, R10 and NB resulted in an additional 261 ERUs. The increase of dwelling units related to ADUs at build-out, (assumed to be 5% of single-family residences) resulted in 35 additional ERUs. The sum of these two values results in a total increase of 296 additional ERUs or dwelling units. Adding this projected growth to the existing number of 407, results in the total projected residential DUs or URUs at buildout to be 703.

Based on data from Health, there are three Group B systems in the service area. This analysis assumes that parcels currently served by private wells or Group B systems will eventually be connected to the system.

DWA - Future Buildout Analysis - No Redevelopment Scenario

Zoning	Density [DU/AC]	BUILDABLE AREA [AC]	Existing Connections	Future Connections	SUM CONN	Future ADUs	Buildout
NB	N/A	0.3	2	0	2	n/a	2.0
RA-10	0.1	633.4	103	50	153	8	161.0
RA-2.5	0.2	325.0	204	183	387	20	407.0
RA-5	0.2	156.0	98	28	126	7	133.0
TOTALS							
Assumptions:		**1114.7**	**407**	**261**	**668**	**35**	**703**

Assume 5% of existing SFR connections will add an ADU.

DU_ZON maximum densities per ac, King County GIS Meta Data

Redevelopment of existing parcels not expected in the foreseeable future.

Excludes public lands including land owned by King County and land controlled by DWA.

Projected Population and Non-Residential Water Needs

Population growth is dependent upon development, which, in turn, is affected by location (proximity to needed services and employment), water availability (water rights and aquifer capacity), wastewater disposal alternatives (wastewater treatment facility or septic system), and transportation infrastructure.

Population growth rates for this analysis were based on the Puget Sound Regional Council projections for FAZ 6930-Vashon Island. The growth rates are 2.24% for years 2021-2030 and 2.23% for years 2031-2040.

There is no anticipated non-residential growth in the foreseeable future.

Projected ERUs and population are shown below.

Projected Connections and Population

Year	Residential ERUs	Non-Residential Connections	Non-Residential ERUs	Total ERUs	Number of Residents/ Household	Population
2021	397	10	8	405	2.34	929
2022	406	10	10	416	2.33	946
2023	416	10	10	426	2.32	965
2024	426	10	10	436	2.31	984
2025	436	10	10	446	2.30	1,002
2026	446	10	10	456	2.30	1,024
2027	457	10	10	467	2.29	1,047
2028	468	10	10	478	2.29	1,071
2029	479	10	10	489	2.29	1,095
2030	490	10	10	500	2.28	1,118
2031	501	10	10	511	2.28	1,142
2036	562	10	10	572	2.25	1,263
2041	630	10	10	640	2.20	1,386

The above table shows buildout of 703 ERUs will not be reached within the 20-year planning horizon.

Projected Demands

Based on the historical production data, demands for the 10- and 20-year planning horizons are shown in the table below. The six-year *maximum* full-time single-family ERU_{ADD} = 164 gpd was used to project residential water demand.

Projected Water Demand

Year	Total ERUs	Water Demand			
		Customer Water Demand (gallons/day)	ADD (gpm)	MDD (gpm)	Total Water Demand (acre-feet /year)
2021	405	74,007	51.4	102.8	82.9
2022	416	75,811	52.6	105.3	84.9
2023	426	77,451	53.8	107.6	86.8
2024	436	79,091	54.9	109.8	88.6
2025	446	80,731	56.1	112.1	90.4
2026	456	82,371	57.2	114.4	92.3
2027	467	84,175	58.5	116.9	94.3
2028	478	85,979	59.7	119.4	96.3
2029	489	87,783	61.0	121.9	98.3
2030	500	89,587	62.2	124.4	100.3
2031	511	91,391	63.5	126.9	102.4
2036	572	101,395	70.4	140.8	113.6
2041	640	112,547	78.2	156.3	126.1

Dockton Water System Analysis

General Design Standards

The Water System is managed by the Dockton Water Association. The system is classified as a Group A Water System and must comply with Washington State requirements for quality, source, treatment, storage, and distribution. In addition, the system must comply with Federal Standards for water quality and County Standards for fire flow.

Except as otherwise superseded in these standards, water system design, installation, modification, and operation are subject to the WAC 246-290 Group A Public Water Systems and King County code Titles 13 and 17.

Water Quality

The following minimum standards apply to quality and treatment of water provided:

1. WAC 246-290 Group A Public Water Systems, Health
2. Safe Drinking Water Act, Public Law 104-182

System Capacities

The following minimum standards apply to water production quantity, storage, and distribution system sizes and pressures:

1. Water System Design Manual, Health, August 2001 December 2009
2. King County code Title 13 & 17

General material Specifications and Construction Standards

DWA has not yet developed system specific design standards to date. Except as provided in approved plans and specifications or in these minimum standards, selection of materials and construction of water system facilities shall conform to the following, in order of hierarchy:

1. Dockton Water Association Resolutions
3. Standard Specifications for Road, Bridge, and Municipal Construction, Washington State Department of Transportation/APWA, latest edition
4. Vashon Island Coordinated Water System Plan (CWSP), Part IV
5. Standards of the American Water Works Association (AWWA)
6. National Fire Protection Association (NFPA) Standards
7. Manufacturer materials and equipment specifications and recommendations

The Association's Engineer will make the final determination of all applicable standards.

Existing Facilities

See the May 2022 SWSMP section 1.2 for a description of the existing facilities.

System Capacity

The existing water system was analyzed to determine adequacy of the available source, storage, and distribution system to supply domestic flows. The available source was reviewed to determine if it was adequate for the existing number of connections and if it could provide adequate source for the future. The storage tanks were evaluated for various numbers of ERUs. The six year maximum full-time single-family ERU_{ADD} = 164 gpd was used in this analysis.

Source Analysis

Total source capacity, as set forth in WAC 246-290-222, shall be sufficient to provide a reliable supply of water equal to or exceeding Maximum Day Demand (MDD). The MDD of a water system is calculated as follows:

MDD = (2)(ADD) (ADD not to exceed 1,000 gpd/ERU)
MDD = 350 gallons/day/ERU (MDD not less than 350 gpd/ERU)

Where: MDD = Maximum Day Demand (gallons/day/ERU)
ADD = Average Day Demand (gallons/day/ERU)
ADD = 164 gallons/day/ERU

Instantaneous Water Rights and Limiting Factors

Per water rights (see Appendix H), sources are permitted to produce an instantaneous flow rate up to 243.6 gpm or 350,784 gpd. The maximum number of ERUs that the sources are capable of supplying is:

$$\frac{\text{Max. Instantaneous Production (gpm)} \times 60 \text{ minutes} \times 24 \text{ hours}}{\text{MDD (gallons/day/ERU)}} = \text{Max ERUs}$$

Dockton Springs:	$\frac{143.6 \text{ gpm} \times 60 \text{ minutes} \times 24 \text{ hours}}{(350 \text{ gallons/day/ERU})}$	=	590.8 ERUs
Sandy Shores:	$\frac{100 \text{ gpm} \times 60 \text{ minutes} \times 24 \text{ hours}}{(350 \text{ gallons/day/ERU})}$	=	411.4 ERUs
	Qi Total Water Rights		**1,002**

Due to limitations of the current system configuration, not all the ERUs calculated above are available. The descriptions below describe system configuration limitations.

Dockton Springs – DWA staff indicate when all wells are maintained they produce over 85 gpm and SO4 produces over 15 gpm for a total of 100 gpm.

$$\frac{100 \text{ gpm} \times 60 \text{ minutes} \times 24 \text{ hours}}{(350 \text{ gallons/day/ERU})} = 411.4 \text{ ERUs}$$

Treatment is provided at Dockton Springs by a chlorine and chlorine contact tank. This analysis assumes the Health approved contact tank can pass 143 gpm from a hydraulic standpoint. Therefore, the contact tank does is not a limiting factor.

Sandy Shores – The Sandy Shores ATEC filtration system limits production to 120,000 gallons (83.3 gpm) of treated water daily as described later in this memo in subsection *Water Treatment*.

$\frac{83.3 \text{ gpm} \times 60 \text{ minutes} \times 24 \text{ hours}}{(350 \text{ gallons/day/ERU})}$	=	342.7 ERUs
Qi System Configuration		**753**

As shown in the analysis above, instantaneous production is limited by the current system configuration to 411.4 ERUs at Dockton Springs and to 342.7 ERUs at Sandy Shores for a total of 753 ERUs. From an instantaneous water rights perspective, the current amount is sufficient when compared to the 20-year projections of 640 ERUs and the buildout projection of 703 ERUs.

Annual Water Rights

Per water rights (see Appendix H), annual volume withdrawal is also a limiting factor. The maximum number of ERUs that can be withdrawn from the sources on an annual basis is:

$$\frac{\text{Max. Annual Production (ac-ft) x 325,851 (gal/ac-ft)}}{\text{ADD (gallons/day/ERU) x 365 days/yr}} = \text{Max ERUs}$$

Dockton Springs right S1-23804C:

$$\frac{\text{(25 Ac-ft/year) x (325,851 gallons/Ac-ft)}}{\text{(164 gallons/day/ERU) x (365 days/year)}} = 136 \text{ ERUs}$$

Dockton Springs right S1*10800C does not have an annual limitation. For this analysis it is assumed Qa is calculated based on Qi over the year:

$$\frac{\text{(71.8 gpm) x 60 minutes x 24 hours}^{(1)}}{\text{(164 gallons/day/ERU)}} = 630 \text{ ERUs}$$

(1) Equivalent of 115.8 ac-ft per year

Sandy Shores right G1-06019C:

$$\frac{\text{(48 Ac-ft/year) x (325,851 gallons/Ac-ft)}}{\text{(164 gallons/day/ERU) x (365 days/year)}} = 261 \text{ ERUs}$$

Qa Total **1,027 ERUs**

As shown in the analysis above, the total combined ERUs from all sources that can be supplied relative to annual water rights is 1,027 ERUs. The current amount is sufficient when compared to the 20-year projections of 640 ERUs and the buildout projection of 703 ERUs.

In summary, based on the source calculations above for instantaneous and annual water rights, the current water rights are sufficient for the projected buildout of the system which is beyond the 20-year planning horizon.

The current system configuration limits the system from exceeding the water rights.

Source Analysis and Peak Hour Demand (PHD)

The system must be able to provide Peak Hour Demand (PHD) at a minimum of 30 psi throughout the distribution system (WAC 246-290-230(5)). The peak hourly demand (PHD) is the maximum rate of water use, excluding fire flow, which can be expected to occur within a defined service area over a continuous sixty-minute time period. The equation to calculate Peak Hour Demand (PHD) production is set forth in the Water System Design Manual, Health, August 2001 December 2009 as:

PHD = (((2)(ADD))/1440)[(C)(N) + F] + 18

Where: PHD = Peak Hourly Demand, (gallons per minute, gpm)
C = Coefficient Associated with Ranges of ERUs
N = Number of Service Connections, ERUs
F = Factor Associated with Ranges of ERUs
ADD = Average Day Demand (gallons/day/ERU)
ADD = 164 gallons/day/ERU

PHD = (((2)(164 gpd/ERU))/1440)[(1.8)(405) + 125] + 18
PHD = 213 gpm

Water Rights available were compared to projected ERUs and projected water demands in the following table.

Summary of Source Analysis & PHD

	Total Projected ERUs	Water Rights Qi (gpm)	Source Analysis			
			ADD (gpm)	MDD (gpm)	PHD (gpm)	PHD Excess or (Deficiency)
2022	416	243.6	52.6	105.3	217.0	26.6
2026	456	243.6	57.2	114.4	233.4	10.2
2031	511	243.6	63.5	126.9	255.5	(11.9)
2036	572	243.6	70.4	140.8	277.7	(34.1)
2041	640	243.6	78.2	156.3	302.5	(58.9)

(1) ADD, MDD, and PHD are based on 164-gal/day/ERU from revenue water data six-year maximum.
(2) PHD demands are met through equalizing storage in the water storage tanks.

Based on the comparison in the table above, the existing source meet demand projections.

The 10-year and 20-year demand projections were compared to the existing water rights in the following table.

10 & 20 Year Forecasted Water Right(s) Status

	Existing Water Rights		Forecasted Water Use From Sources (20-Year Demand)		Forecasted Water Right Status Excess/(Deficiency)	
	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa) [1]	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa) Requested	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)
	GPM	AF/YR	GPM	AF/YR	GPM	AF/YR
10 year (2031)	243.6	188.8	126.9	102.4	116.7	86.4
20 year (2041)	243.6	188.8	156.3	126.1	87.3	62.7

(1) Water Right S1*10800C has no annual limit identified and for this analysis Qa is based on Qi over the year = 115.8 ac-ft per year.

Based on the analysis in this section, the existing water rights meet demand projections.

Water Treatment

WDA is providing chlorination with a 12.5% sodium hypochlorite solution. At Dockton Springs, chlorine is introduced into the raw water supply in the meter box prior to entering the contact basin with a feed pump. At Sandy Shores, chlorine is introduced between the Well (S02) and ATEC filtration system with a feed pump.

The (ATEC) treatment system at the Sandy Shores site consists of a chemical feed pump, a pressure filtration unit, and a backwash system.

- The raw water is injected with sodium hypochlorite between the well and the filtration unit
- The water then passes through the pyrolusite pressure filtration unit (ATEC) to remove arsenic, iron, and manganese. The filtered water is then discharge into the 430 zone.
- The filtration unit back washes after 12 hours run time.

The treatment system is designed to treat 100 gpm. A backwash is scheduled every 12 hours of run time. It is estimated that each backwash takes two hours to complete resulting in approximately 20 hours of production per day providing 120,000 gallons of treated water daily. To meet peak demands, equalizing storage is provided in the water storage tanks.

Storage Analysis

The water system was evaluated for equalizing storage, standby storage, fire suppression storage, operational storage, and dead storage.

Equalizing Storage

Equalizing storage (ES) is based on Peak Hour Demand (PHD) and source production as outlined in the Water System Design Manual, Health, August 2001 December 2009.

ES = (PHD - Qs)(150 min.), but in no case less than zero.

Where: PHD = Peak Hourly Demand, (gallons per minute, gpm)
Qs = Sum of all installed and active source of supply capacities, except emergency sources of supply (gallons per minute, gpm)

PHD = (((2)(164 gpd/ERU))/1440)[(1.8)(405) + 120] + 18
PHD = 213 gpm

Qs = S01 Production Capacity 70 gpm (see source analysis above) = S02 Production Capacity 100 gpm

ES = (213 gpm – 170 gpm)(150 min.), but in no case less than zero.
ES = 6,450 gallons

Standby Storage

The Water System Design Manual, Health, December 2009, recommends that the Standby Storage (SB) volume for systems served by a single source should be based upon the following equation:

SB = (2 days)(ADD)(N)

ADD = Average Daily Demand for the system, in gpd/ERU;
N = Number of ERUs

SB = (2 days)(164 gpd/ERU)(405 ERUs)
SB = 32,040 gallons

However, for this analysis the recommended minimum standby storage shall be 200 gallons/ERU as recommended in the Water System Design Manual, December 2009, and calculated as follows.

$$\frac{\text{Minimum SB}}{\text{Connection}} = \frac{\text{200 Gallons}}{\text{ERU}} \times \text{405 ERUs} = \text{81,000 gallons of minimum standby storage}$$

In addition, a power outage was also considered for his portion of the analysis. For this scenario, the generators will power the Dockton Springs booster pump station and the Sandy Shores well and supply water to the 430 zone (and water storage tanks).

Fire Suppression Storage

King County requires that the water system provides fire flows set forth in Title 17, a copy of which has been included in Appendix S. Based on Health standards, the system is required to provide these fire flows simultaneously with MDD while maintaining a residual pressure of at least 20 psi throughout the system. The minimum fire flow requirements are 1,000 gpm for 2 hours.

Fire suppression storage (FSS) was determined by multiplying the maximum fire flow demand by the appropriate duration. Fire suppression storage was calculated as follows:

FSS = 1,000 gpm x 120 minutes
FSS = 120,000 gallons

Note: Per the Water System Design Manual, December 2009, the State allows nesting of the Standby Storage (SB) storage and the Fire Suppression Storage (FSS) components; whichever volume is smaller, can be excluded from the total storage requirement.

Operational Storage and Dead Storage

Operational storage (OS) means the volume of distribution storage associated with source or booster pump normal cycling times under normal operating conditions and is additive to the equalizing and standby storage components, and to fire flow storage if this storage component exists for any given tank (WAC 246-290-010).

Dead storage (DS) means the volume of stored water not available to all consumers at the minimum design pressure under WAC 246-290-230 (5) and (6). The operational and dead storage for the storage tanks are:

- Operational Storage = 31,774 gallons (4 feet) and
- Dead Storage = 0 gallons (0 feet).

Total Storage

A summary of the 2021 and future storage requirements for the water system are shown below.

Summary of Storage Analysis

Year	DS Dead Storage (gallons)	ES Equalization Storage (gallons)	SB Standby Storage (gallons)	FSS Fire Suppression Storage[(1)] (gallons)	OS Operational Storage (gallons)	Total [(2)] Required Storage (gallons)	Total Available Storage (gallons)	Storage Deficit [(3)] (gallons)
2021	0	6,450	81,000	120,000	31,774	158,224	310,000	0
2022	0	7,055	83,200	120,000	31,774	158,829	310,000	0
2026	0	9,515	91,200	120,000	31,774	161,289	310,000	0
2031	0	12,822	102,200	120,000	31,774	164,596	310,000	0
2036	0	16,157	114,400	120,000	31,774	167,931	310,000	0
2041	0	19,874	128,000	120,000	31,774	179,648	310,000	0

(1) Per the *Water System Design Manual*, December 2009, the State allows nesting of the Standby Storage (SB) storage and the Fire Suppression Storage (FSS) components; whichever volume is smaller, can be excluded from the total storage requirement.
(2) Analysis forecasts build out beyond the 20-year planning horizon.

The table above shows that based on the current analysis, there are not storage needs in the 20-year planning horizon.

Transmission and Distribution System Analysis

Modeling is out of the scope of this capacity analysis. Modeling was performed in the 2002 WSP and the Amendment. In the 2013 SWSMP, there were also looping projects shown on a Figure 2 dated February 2013. A copy of this figure is provided in Appendix K of the 2022 SWSMP.

System Storage Deficiencies

Based on the analysis in this memo, the existing system does not have any storage deficits. However, the storage tanks are concrete tanks that are susceptible to seismic activity. In addition, they need to be cleaned every five years. During cleaning required storage is not available to the whole distribution system. Project ST1 is proposed to improve storage redundancy.

Distribution Deficiencies

Modeling the distribution system is out of scope for this analysis. Therefore, distribution projects were identified in the previous plans and carried forward below.

DWA has hydrants on four-inch pipes and dead-end six-inch pipes in the system. In general, six-inch, or smaller water pipes cannot provide fire flow. These pipes should be upsized or looped as funds become available. These projects are not included in the list of capital projects below.

DWA has AC pipe in their inventory that is at the end of its useful life and should be replaced as funds become available. Not all these projects are included in the list of capital projects below.

System Improvements

Dockton Water system has distribution, storage, and source capacity needs.

Distribution

- D1: 2002 WSP Project No. B-11 Replace Undersized Lines, Lower Sandy – 275th
- D2: Loop. 94th to Pt. Piner Connection
- D3: 2002 WSP Project No. B-3 Replace Undersized Lines, Hake Road
- D4: 2002 WSP Project No. B-10 Replace Undersized Lines, Upper Sandy – 275th
- D5: 2002 WSP Project No. B-9 Replace Undersized Lines, 94th Ave.
- D6: 2002 WSP Project No. B-10 Replace Undersized Lines, Upper Sandy – 274th and 90th
- D7: 2002 WSP Project No. B-12 Eastern Dockton Line [99th] Replacement to 264th
- D8: 2002 WSP Project No. B-4 Replace Undersized Lines, 265th
- D9: 2002 WSP Project No. B-5 Replace Undersized Lines, 263rd
- D10: 2002 WSP Project No. B-6 Replace Undersized Lines, 262nd
- D11: Loop. SW Summerhurst Rd.
- D12: 2013 SWSMP Loop. SW Summerhurst Rd. to Sandy Shores Dr. SW Connection
- D13: 2013 SWSMP Loop. Summerhurst Walk
- D14: 2013 SWSMP Loop. Point Piner to 288th Connection
- D15: Loop. Hake Rd. and Manzanita Connection

Storage

- ST1: New 160,000-gallon Storage Tank. The storage tanks are concrete tanks that are susceptible to seismic activity. In addition, they need to be cleaned every five years. Install a new 160,000 gallon tank to current seismic codes at the reservoir site.

Source

- S1: 2002 WSP Project No. B-14 Replace Deep Well Pump, Sandy Shores.

Wellhead Protection Zones

A Wellhead Protection and Potential Contamination Inventory figure was prepared. A copy is in Appendix M of the SWSMP. Existing source inventory and wellhead protection zone information used to prepare the figure are provided below.

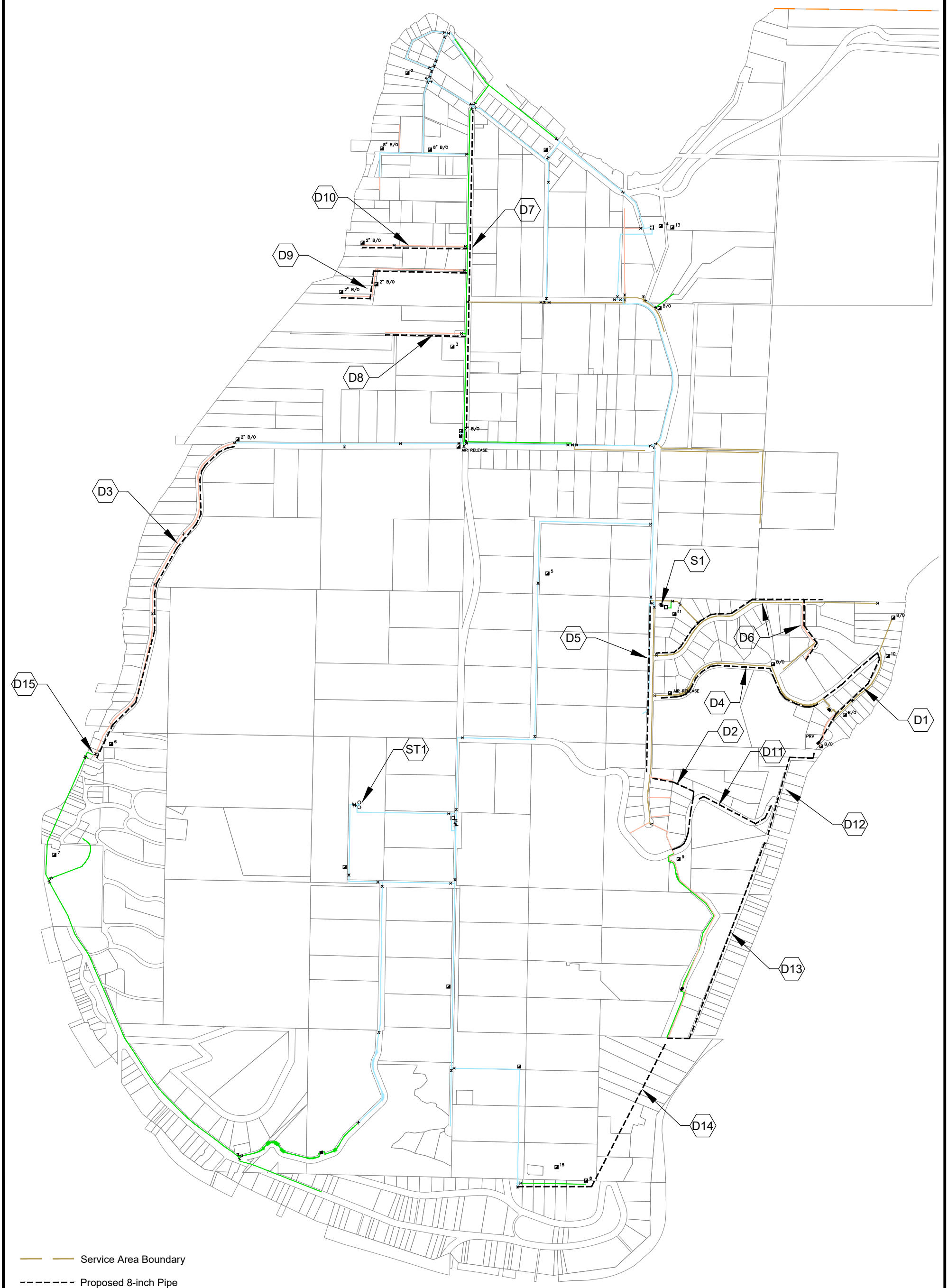
Table 1.5.1: Existing Source Inventory

	Dockton Springs Shallow Wells (S01)		Shandy Shores Well AAB173 (S02)
Water Right	S1-23804C	S1*10800C	G1-06019C
Water Right Maximum Instantaneous Withdrawal	0.16 cfs (71.8 gpm)	0.16 cfs (71.8 gpm)	100 gpm
Water Right Maximum Annual Withdrawal	25 ac-ft		48 ac-ft
Location (Quarter-Section-Township-Range)	SE-NW-29-22N-03E		NE-NW-32-22N-03E
Status	Active		Active
Susceptibility	Moderate to High		Moderate
Production Capacity	Less than 80 gpm		100 gpm
Date Drilled	Varies		Unknown
Casing Diameter	4 inches		12 inches
Total Depth	15 feet		423 feet
Screens	Unknown		Unknown

Table 1.5.2 Fixed Radius Calculated Wellhead Protection Zone

Fixed Radius Method $R = \sqrt{(Q)(t)/(\Pi)(n)(H)}$		Dockton Springs Shallow Wells (S01)	Sandy Shores Well (S02)
Q = pumping rate of well (cu.ft./year)		3,702,600[2]	2,090,880
t = time of travel (years)		0.5, 1, 5, 10	
Π = pi (constant)		3.14	
n = estimated porosity		0.22	
H = length of well screen (feet) [1]		10	
R = calculated radius of protection zone (feet)	6 months	518	389
	1 year	732	550
	5 years	1,637	1,230
	10 years	2,315	1,740

(1) Well log does not indicate screen length, 10 feet used in calculation. (2) Buildout Qa = 85 ac-ft used in calculation.



Parcels: KC GIS System

DAHLE ENGINEERING, LLC
FILE: VWD1901-WSP_FIGURES
DATE: 5/22/2023

N

12-Inch Water Main
10-Inch Water Main
8-Inch Water Main
6-Inch Water Line
4-Inch Water Line
2-Inch Water Line

Dockton Water Association

Capital Improvement Projects #