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MEMORANDUM

TO: LWWSD – Bill Hunter, PE, Rich Munson, and Kristin Hemenway, PE

FROM: Brian Smith, PE and Melanie Mankamyer, PE

SUBJECT: Division 7 Reservoir – Seismic Upgrades and Maintenance vs. Replacement

DATE: February 8, 2018

Introduction

A structural analysis of the Lake Whatcom Water and Sewer District Division 7 water reservoir has found significant deficiencies in its ability to meet existing earthquake code requirements (BHC report, December 2016). The recent Water System Plan also analyzed the capacity of the Division 7 reservoir and found it to be significantly oversized at a volume of one million gallons. The Water System Plan recommended an alternatives analysis for this reservoir to compare the cost of making seismic upgrades and replacing the interior and exterior coatings that are beyond their useful life against the alternative of replacing the Division 7 reservoir with a more appropriate (~half a million gallons) amount of storage volume. This memorandum contains a preliminary analysis of these alternatives.

Alternative 1 – Make Seismic Upgrades and Replace Coatings

Alternative 1 is to make the needed repairs to the Division 7 reservoir and continue to use it for the foreseeable future. There are four major pieces of work that are required to allow the Division 7 reservoir to continue to provide reliable service for the more than 2,000 people that depend on it for their water service:

1. Seismic retrofits as detailed in the December 2016 BHC report.
2. Structural roof support header repair as detailed in the December 13, 2012 Wilson Engineering assessment.
3. Replacement of interior and exterior steel coating systems.
4. Addition of reservoir outlet valve that can respond to earthquake event. This portion of the work would be part of the ShakeAlert Project scope and is not included in the cost estimates in this memo.

Coatings

The existing interior and exterior steel coating systems for the welded steel reservoir are original from its construction in 1971. The Division 7 reservoir had no cathodic protection system from 1971 to 2015. In 2015, a cathodic protection system was installed. In 2014, the coatings were inspected by a qualified professional. The coatings were overall found to be in reasonable condition, although the interior ceiling and roof supports showed visible corrosion and the coatings in that area need to be removed and replaced to prevent further steel corrosion.
It is uncertain if the existing coatings contain lead-based primers. Based on the time of construction (1971), it is possible that they may have lead-based primers. Samples would need to be taken to know for sure, but that has not yet occurred.

The opinion of steel coatings professionals is that the entire interior coating should be removed and replaced. The exterior coating is likely a vinyl coating and is in reasonable condition. With some coatings in reasonable condition, they could be pressure washed and a new coating applied on top of the existing. But vinyl coatings do not work well with standard epoxy overcoats because of the solvent in the epoxy. There are new technologies that may work well with overcoating on top of the vinyl coating, but they are not necessarily time-tested to demonstrate longevity. The District could choose to try a system like this, and there would be substantial initial cost savings, especially if the exterior existing coating was found to contain lead. But because these new technologies have not been time-proven yet and there would be some risk associated with using it, a cost estimate for this option was not included.

Temporary Water Storage

In order to perform the coating work, structural roof repair, and addition of reservoir outlet valve that can respond to an earthquake, the tank would need to be taken out of service and drained. Because there is no alternate storage that could serve this area, temporary storage would need to be installed for the duration of the work. There is no feasible way to temporarily provide the full storage volume. Even to provide a fraction of the full storage volume will be very challenging and expensive. In order to perform the work, the reservoir will likely need to be out of service for a number of months, and this will need to occur in the summer months in order to achieve desirable coating outcomes (hot and dry surfaces). The summer months are also the highest water demand months, which adds to the operational challenge.

One temporary storage solution can be rented from a company called ModuTank. It consists of steel support walls and a water tight, NSF approved liner (with a cover) to contain the water. Based on the design, it is limited to a maximum water height of 4.5 ft. Because of the limited flat space adjacent to the reservoir, the maximum estimated footprint of a temporary storage tank would be approximately 46 ft by 46 ft. Considering that the tank needs 4 ft of framing around the perimeter, this leaves the water tank size at 38 ft by 38 ft for a water volume of 48,600 gallons. Any storage solution to provide more volume than this would likely require a permanent storage solution and would cost significantly more than the temporary tank.

It would be quite challenging to operate the water system with such little water storage at Division 7 (48,600 gallons). An average day demand for the area served by Division 7 (which includes serving Division 30) is approximately 200,000 gallons. If half of the 48,600 gallons was saved for fire suppression / standby storage, this means that there would be 24,000 gallons of operating storage, and it would need to be refilled, on average, every 3 hours. At a fill rate of 700 gpm and with average demand, it would take about 43 minutes to fill the tank. Because the transmission pump is only operated when the treatment plant is running, it makes operation of the whole system challenging, although theoretically possible. Moving forward with this project would require coordination with and approval of the fire department and the Department of Health. It is uncertain if this kind of solution would be acceptable to either of these entities. If it was not, a permanent storage tank would need to be installed next to the Division 7 reservoir that had a more reasonable storage volume, perhaps 100,000 to 200,000 gallons to be able to serve the system temporarily while the Division 7 reservoir is out of service. A permanent storage solution would be significantly more expensive than the temporary tank. A cost estimate for this option was not prepared but may be necessary based on input from the water treatment plant operator, the fire department, and the Department of Health.

Cost Estimate

A cost estimate is shown below for Alternative 1 based on the conservative approach of removing and replacing the exterior as well as the interior coating. As shown, there is an item for containment if the exterior coating is found to contain lead. If it is not, then this item would not be needed. The Alternative 1 cost estimate is shown for the temporary storage of 48,600 gallons. As described above, this may not be adequate. If it is not adequate, the temporary storage item would be much more expensive.

LAKE WHATCOM WATER AND SEWER DISTRICT **2/8/2018**
Division 7 Reservoir Rehabilitation (Alternative 1)
Preliminary Cost Estimates

Prepared by: **Brian Smith, PE and Melanie Mankamyer, PE, Wilson Engineering LLC**

Wilson Job No.: **2018-001**

Preliminary Cost Estimates - Rehabilitate Div 7 (Seismic Retrofits, Re-coatings, Repairs)

Item Description	Quantity	Unit	Unit Price	Amount
CONSTRUCTION				
a. Mobilization (10%)	1	LS	$ 63,210	**$ 63,300**
b. Coating work				
If lead is present on exterior coating, need containment for abrasive blasting	1	LS	$ 90,000	$ 90,000
Remove existing coating from interior and exterior and replace coating	29,385	SF	$ 15	$ 440,800
Subtotal				**$ 530,800**
c. Structural repair of roof support header as detailed in December 13, 2012 assessment	1	LS	$ 15,000	**$ 15,000**
d. Provisions for providing temporary water storage while tank is out of service				
Rental of temporary potable water storage tank assembly (48,600 gallons) for 5 months with freight	1	LS	$ 24,255	$ 24,300
Temporary Erosion and Sediment Control	1	LS	$ 5,000	$ 5,000
Tree removal, clearing and grubbing, and earthwork to provide 46 ft by 46 ft level pad for temporary tank	1	LS	$ 35,000	$ 35,000
Labor to assemble temporary tank, fill, disinfect, and disassemble temporary tank	1	LS	$ 12,000	$ 12,000
Temporary piping to temporary tank (install, test, disinfect appprox 100 ft, 8 inch)	1	LS	$ 10,000	$ 10,000
Subtotal				**$ 86,300**
SUMMARY				
Subtotal				$ 695,400
Contingencies	15%			$ 104,310
Sales Tax	8.5%			$ 67,975
Preliminary Estimated Construction Costs				**$ 868,000**
Complete Estimated Project Costs of Seismic Retrofits from BHC (includes construction, tax, engineering)				$ 721,000
Engineering Design	5%			$ 43,400
Construction Phase Engineering/Inspection	10%			$ 86,800
GRAND TOTAL				**$ 1,720,000**

As described previously, this cost estimate does not include the necessary addition of a reservoir outlet valve that can respond to earthquake event. This portion of the work would be part of the ShakeAlert Project scope.

One piece of information to keep in mind is that the current NSF61 approved interior coating systems have a shorter expected life than previous coating systems because of more stringent requirements for materials in contact with potable water. Current interior coating systems have an expected life of roughly 15 years, at which point they would either need to be coated over or replaced again.

Alternative 2 – Replace Division 7 Reservoir

Alternative 2 entails replacing the existing Division 7 reservoir. The 2016 BHC report performed a quick alternatives analysis of replacing the reservoir instead of retrofitting the existing, but their analysis was based on replacing it with a reservoir of the same size. That analysis also did not account for the need for coatings replacement, structural work, and installation of a new seismic outlet valve, all of which will require the reservoir to be taken out of service and temporary storage put in place.

As the recent Water System Plan points out, the 1,000,000 gallons of storage is roughly twice the storage that is required for build-out. Replacing the Division 7 reservoir with new storage with half the volume is more likely to be a realistic alternative and is analyzed here.

A downside to having an oversupply of treated water storage is that it increases water age and can negatively impact water quality. The American Water Works Association (AWWA) recommends that the hydraulic residence time of water storage reservoirs should not exceed 2.5 days under average demand to maintain water quality. The hydraulic residence time in the existing 1 million gallon Division 7 reservoir under average day demand in a build-out scenario is 4.6 days. Appropriately sized replacement storage for Division 7 would have an average hydraulic residence time within the AWWA recommendation of less than 2.5 days. This lower residence time would help improve water quality in terms of less formation of disinfection by-products and better maintenance of chlorine residual in the distribution system.

One Vs. Two Reservoirs

The Division 7 reservoir could be replaced with one storage reservoir of the appropriate size, or could be replaced with two storage reservoirs that contain an appropriate total volume. Having two reservoirs instead of one offers three major advantages:

1. One reservoir can be taken out of service for maintenance or repairs at any time and the other reservoir is capable of providing sufficient storage for these temporary periods.
2. If one tank happens to have an unexpected leak or failure, the other can be used. If there was only one tank and there was a failure, it would cause a public health emergency until temporary storage was able to be put in place.
3. In a major earthquake, there will likely be both water main breaks that cause major leaks and fires that need fire suppression water. This leads to a situation where if there is only one storage tank it will either be drained quickly by the leaks and fire suppression activities or the outlet valve will be closed to maintain water for the longer-term response but water will not be available for initial fire suppression. With two reservoirs in place, the system can have the best of both because one tank outlet can be left open for immediate fire suppression needs and the other can be closed to maintain a supply of treated water for the days and weeks of response to the emergency.

At the volume being considered (~half a million gallons), the cost of a single reservoir vs two smaller reservoirs will be similar. Because of this and the advantages listed above, this analysis continues with the two reservoir option.

Storage Volume Analysis

The needed storage volume for the Division 7 service area was analyzed in detail. A first step of this was to refine the ERU distribution shown in the Water System Plan to reflect the current status of restricted lots in Sudden Valley and the impact this has on the distribution of ERUs (and subsequent storage needs) throughout the system.

In order to assess ERU distribution throughout the system's water reservoirs, two maps were analyzed. Figure A-1 from the Water System Plan was analyzed to determine the geographic distribution of the service areas of each reservoir. This was cross-referenced with the Sudden Valley Land Use Map (updated August 2015) to determine the number of developed and vacant single-family lots in each of the Division 30 and Division 7 reservoir service areas.

Division 30 serves only single-family lots, so the number of build-out ERUs served by it was easily determined to be 364 ERUs. This is lower than the number of build-out ERUs shown in the Water System Plan (474) because many lots in the Division 30 service area have been converted to SVCA common area and restricted from development.

With the decreased number of ERUs in the Division 30 service area, the Division 30 reservoir can now provide its own standby storage (in the Water System Plan, Div 30 standby storage was provided by Div 7). This change is reflected in Table 1.

The number of ERUs served by Division 7 was determined by counting the number of single-family lots in the service area and adding the numbers of ERUs of the condominiums and commercial areas in the service area from the District's database. The total number of ERUs in the Division 7 service area as defined by Figure A-1 from the Water System plan is 1076 ERUs. This is higher than the number shown in the Water System plan. The total number of build-out ERUs for the water system remains what was shown in the Water System Plan, so the Division 22 ERUs was updated appropriately. An analysis of this distribution of ERUs yielded a required storage volume for the Division 7 service area of 423,000 gallons.

But the service areas shown in Figure A-1 of the water system plan do not fully utilize the existing available storage from Division 22 and Geneva reservoirs. In order to more fully utilize the existing storage of those reservoirs, The Division 22 reservoir could serve a portion (about half) of the lowest pressure zone between Division 22 and Division 7. This would lower the number of ERUs served by Division 7 from 1076 to 654 ERUs. In order for Division 22 to be able to serve this area of the system, the system operation would need to shift so that Geneva reservoir served a portion of the lower pressure zone in Geneva. These shifts in ERU distribution are represented in Table 1 as well as their impact to required storage in each service area. This more efficiently utilizes existing resources and minimizes the required storage volume for the replacement Division 7 reservoirs to about 317,000 gallons.

Note that the Supply Capacity to Division 7 shown in Table 1 is 196 gpm. This is based on the methodology described in the Water System Plan, Appendix A, in that the needed transmission flow rate to Division 7 should be based on the proportional service area and the total needed supply flow. In the Water System Plan, Appendix A, this was 246 gpm, but this was adjusted to 196 based on the updated ERU distribution determined as described above. This means that

the new Division 7 reservoirs are sized based on a supply capacity of 196 gpm so that a future project to replace the transmission pumps can use this design flow rate.

Table 1 shows a reservoir height for the Proposed Division 7 reservoirs of 35 feet, but the intent at this early stage in design is that the top 5 ft will be maintained as freeboard to allow for sloshing in an earthquake event. The amount of freeboard needed will be further refined in a detailed design, but 5 ft should be conservative at this point.

Table 1: Reservoir sizing requirements to meet anticipated build-out based on treatment/pumping capacity appropriate for anticipated build-out - sizing new Div 7 reservoirs - if close valve and have Div 22 serve some of lowest zone instead of Div 7 plus shift some demand from Div 22 to Geneva

					Operating Storage		MDD (gpd/ERU)		ERUs		PHD for Reservoir (gpm)					Equalizing Storage		ADD (gpd/ERU)		Standby Storage		Fire Suppression Storage		Dead Storage	
Reservoir	Base Elevation (ft NAVD88)	Reservoir Height (ft)	Reservoir Diameter (ft)	Reservoir storage per foot (gal/ft)	Storage Volume (gallons)	Level with Storage Depleted (ft)	Geneva	Sudden Valley	Geneva	Sudden Valley	Geneva Contribution	Sudden Valley Contribution	Flow out to other reservoirs (gpm)	Total PHD for Reservoir (gpm)	Supply Capacities (gpm)	Storage Volume (gallons)	Level with Storage Depleted (ft)	Geneva	Sudden Valley	Storage Volume (gallons)	Level with Storage Depleted (ft)	Storage Volume (gallons)	Level with Storage Depleted (ft)	Storage Volume (gallons)	Level with Storage Depleted (ft)
Proposed Division 7A	697	35	30	5,287	42,298	22		250		654		239	165	404	196	31,101	19.06		150	196,200	0.50	45,000	14.80	2,644	0.00
Proposed Division 7B	697	35	30	5,287	42,298	22											19.06				0.50		14.80	2,644	0.00
Division 22	804.65	35	50	14,687	117,496	27	370	250	250	2249	166	682	250	1098	788	46,487	25.60	175	150	762,200	2.58	45,000	24.24	7,343	2.08
Division 22 New	805	35	56	18,423	147,386	27											25.60				2.58		24.24	9,212	2.08
Division 30	1027.98	40	25	3,672	18,359	35		250		364		153	0	153	165	0	35.00		150	109,200	5.26	30,000	26.83	1,836	4.76
Geneva	661.12	32	52	15,885	31,771	30	370		989		482		0	482	250	34,860	27.81	175		346,150	6.02	45,000	24.97	7,943	5.52

Summary:

		Build-out ERUs			
Reservoir	Existing capacity (gallons)	Geneva	Sudden Valley	Sum of required storage (gallons)	
Proposed Division 7A	1,000,000		654	317,186	Two reservoirs, each 30 ft diameter and 35 ft tall, provides this storage with 5 ft freeboard for sloshing
Proposed Division 7B					
Division 22	1,158,859	250	2249	1,090,124	
Division 22 New					
Division 30	146,869		364	129,395	
Geneva	508,333	989		420,724	

Note: Fire Suppression Storage is nested within Standby Storage for all reservoirs

New Reservoir Layout and Elevation

In addition to the existing Division 7 reservoir being vastly oversized for build-out, its base elevation and water elevation do not provide the current required minimum pressure to the residences nearest to the reservoir. The replacement reservoirs can be located at a higher elevation to improve water pressure for these highest residences.

Based on the nearby topography, there is a “bench” further up the ridge to the north with an elevation approximately 25 feet higher than the existing Division 7 reservoir base. Locating the new reservoirs on this bench will provide more pressure to the system served directly from the reservoir but will not increase the pressure so much that there are negative impacts. Increasing the pressure by 25 feet will provide the minimum required pressure to all houses in the service area except for the two highest houses that are adjacent to the existing reservoir. But installing the new reservoirs at a higher location that would provide sufficient pressure to these two houses would increase the maximum pressure in the zone to 130 psi, which is higher than desirable. We propose that installing the new reservoirs on the “bench” with a base elevation of approximately 25 ft higher than the existing Division 7 reservoir is a good balance between improving the pressure for houses at the higher points in the system but not increasing the zone pressure so much that there are detrimental effects. This is a needed balance when modifying an existing system that was not originally designed with this in mind.

Raising the base elevation by about 25 feet will increase the maximum head by about 11 psi. The highest pressure in the area served by the reservoir is at the upstream side of PRV 17-20, which is currently approximately 111 psi. This would increase this pressure to 122 psi. This pressure is slightly higher than desirable, but there are many locations in the water system that have higher pressure because of the topography of the area. The other impact the pressure increase has is on the operating point of the transmission pumps. Based on the existing pump curve and operating pressure, the current transmission pump flow rate is approximately 830 gpm at 405 ft head gain. The increase in system pressure would shift the operating point to approximately 430 ft head gain at a flow rate of 780 gpm. This will not negatively impact operation of the system, as a flow rate of 780 gpm is still well more than what is required. In fact, this flow rate may help ease operation of the system because it is closer to the current treatment plant flow rate of 700 gpm, so it may make it easier to balance the flows.

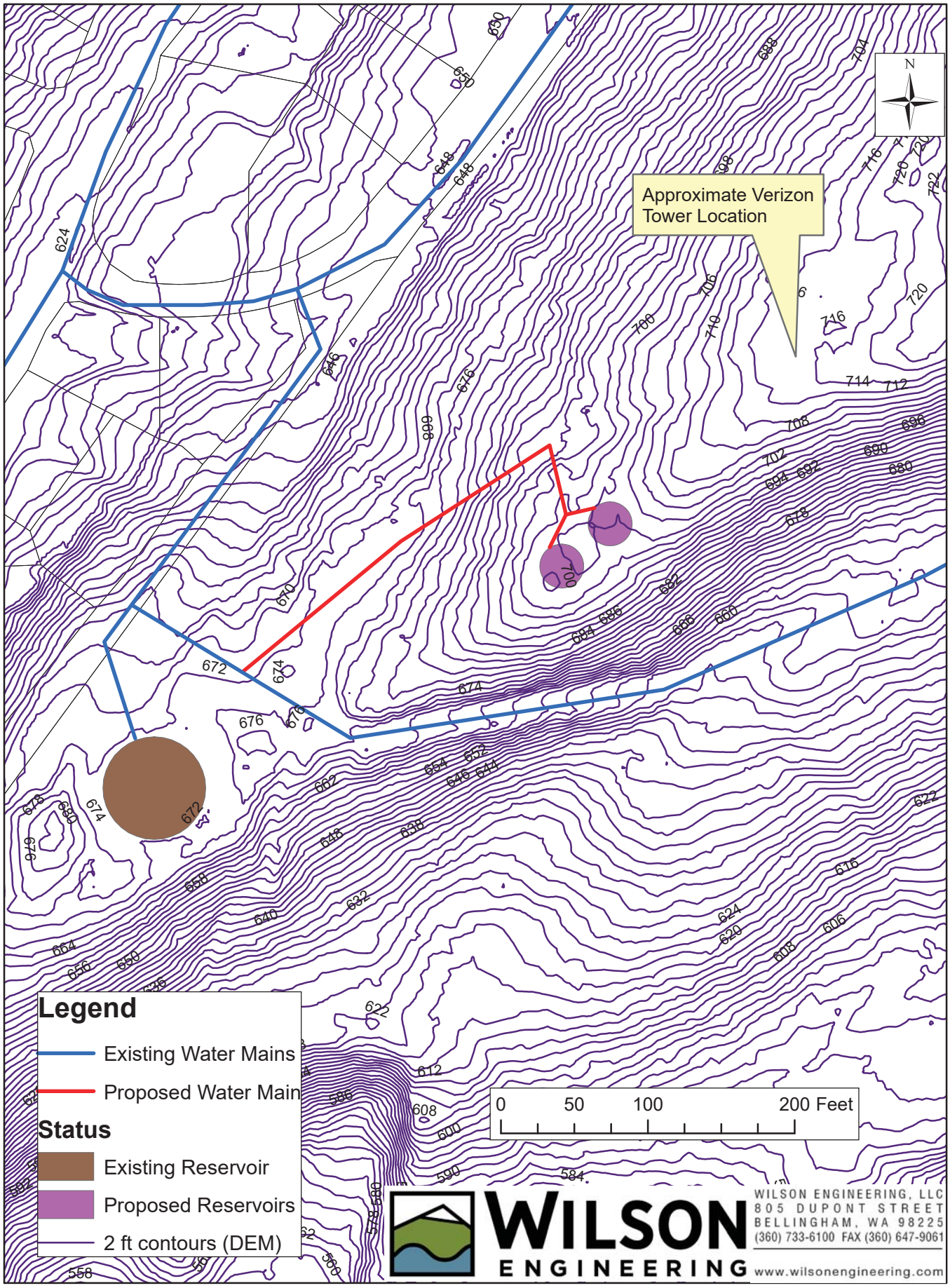
The layout of the proposed location of the new reservoirs is shown in Figure 1. The District has received plans from Verizon for a new cell phone tower in the vicinity of this project. We have confirmed that the proposed reservoir location does not interfere with the Verizon tower.

Cost Estimate

A preliminary cost estimate for Alternative 2 is shown on page 13. Note that demolition of the existing Division 7 reservoir is shown at the bottom. This work could be postponed until a later date depending on funding availability.

As described previously, this cost estimate does not include the necessary addition of a reservoir outlet valve that can respond to earthquake event. This portion of the work would be part of the ShakeAlert Project scope.

Figure 1 - Division 7 Reservoir - Proposed Replacement with 2 Reservoirs



LAKE WHATCOM WATER AND SEWER DISTRICT **2/8/2018**
Division 7 Reservoir Replacement (Alternative 2)
Preliminary Cost Estimates

Prepared by: **Brian Smith, PE and Melanie Mankamyer, PE, Wilson Engineering LLC**

Wilson Job No.: **2018-001**

Preliminary Cost Estimates - Replace Div 7 Reservoir with Two Concrete Reservoirs

Item Description	Quantity	Unit	Unit Price	Amount
CONSTRUCTION				
a. Mobilization (10%)	1	LS	$ 72,200	**$ 73,000**
b. Temporary Erosion and Sediment Control (1%)	1	LS	$ 7,220	**$ 7,300**
c. Storage Improvements				
Concrete storage tank 185,000 Gallon 30 ft dia x 35 ft height (installed by supplier, prevailing wages)	2	EA	$ 171,000	$ 342,000
Reservoir railing	2	EA	$ 10,000	$ 20,000
Tree removal	1	LS	$ 30,000	$ 30,000
Clearing and grubbing	1	LS	$ 10,000	$ 10,000
Site earthwork	1	LS	$ 90,000	$ 90,000
Overflow piping	500	LF	$ 100	$ 50,000
Piping from new tank to existing, 12" diameter	500	LF	$ 100	$ 50,000
Manual valve on one tank outlet (other tank to have seismic valve installed as separate scope of work)	1	EA	$ 2,000	$ 2,000
Surface restoration	1	LS	$ 20,000	$ 20,000
Stormwater management	1	LS	$ 8,000	$ 8,000
Electrical, telemetry and instrumentation	1	LS	$ 100,000	$ 100,000
Subtotal				**$ 722,000**
SUMMARY				
Subtotal				$ 802,300
Contingencies	15%			$ 120,300
Sales Tax	8.5%			$ 78,421
Preliminary Estimated Construction Costs				**$ 1,002,000**
Permit Fees	2.2%			$ 22,000
Easement Acquisition				$ 5,000
Topographic Survey	2%			$ 20,040
Engineering Design	10%			$ 100,200
Construction Phase Engineering/Inspection	10%			$ 100,200
Construction Phase Surveying	1%			$ 10,020
NEW CONSTRUCTION TOTAL PROJECT ESTIMATED COST				**$ 1,260,000**
Demolition of Existing Division 7 Steel Reservoir (including permit fee and sales tax)				$ 167,000
NEW CONSTRUCTION PLUS DEMO TOTAL PROJECT ESTIMATED COST				**$ 1,427,000**

Alternative 3 – Do Nothing

The “do nothing” alternative in this case would be to leave the Division 7 reservoir as-is and in operation and not perform the seismic retrofits. This would leave the water system quite vulnerable to significant and perhaps catastrophic damage if/when a large earthquake occurs. The expected failure modes are described in the BHC December 2016 report.

A “do nothing” alternative in terms of maintenance would mean that the coatings and structural roof support header that needs repair are left as-is. Leaving the roof support unrepaired will lead to further corrosion of the structural steel and eventual roof failure under a snow load, as detailed in the December 2012 assessment. This would leave the system very vulnerable to contamination until repairs were able to be made. This would likely require the tank to be taken out of service, which would put the entire area served by the Division 7 and Division 30 reservoirs out of water until either repairs were made or temporary water storage was put in place.

Leaving the coatings as-is leaves the reservoir vulnerable to corrosion. The frequency of needed inspections and potentially spot repairs would increase. If corrosion was not caught early, it could lead to damage to the structural steel and the need to replace portions of the reservoir. This would require the reservoir to be taken out of service and a temporary tank installed. At this point, it would be an emergency situation and the costs for the expedited delivery and assembly of a temporary tank would increase significantly. More importantly, depending on the severity of the damage/failure, the portion of the water system served by the Division 7 reservoir may not have any storage and would therefore not be able to operate until storage was in-place. This would be a major public health emergency.

Summary and Conclusions

The Do Nothing, Alternative 3 is not recommended because it leaves the entire portion of the water system served by the Division 7 reservoir very vulnerable to both seismic risks as well as the inevitable damage caused by corrosion of structural steel. The Division 7 reservoir is an essential piece of the water system, and it cannot function without the reservoir in service.

There are many advantages Alternative 2 (replace reservoir) has over Alternative 1 (rehabilitate reservoir):

1. Capital Cost – the estimated capital cost of Alternative 2 is significantly lower than Alternative 1.
2. Water Quality – The existing Division 7 reservoir is significantly oversized and results in an excessive average water age of 4.6 days. The hydraulic residence time in the reservoirs proposed in Alternative 2 would be 2.1 days under average day demand in a build-out scenario. This would be within the AWWA recommendation of less than 2.5 days average hydraulic residence time and would help improve water quality in terms of less formation of disinfection by-products and better maintenance of chlorine residual in the distribution system.
3. Improved Water Pressure – Installing new storage 25 feet higher than the existing reservoir will improve water pressure for those houses immediately adjacent to the reservoir. The increased pressure will not negatively impact the system in terms of over pressurizing or decreasing pumped flow excessively.
4. Resiliency – Having two parallel water storage reservoirs provides substantially improved system resiliency in case of emergency (earthquake or unexpected failure of one tank) or typical maintenance. Having the ability to keep one reservoir in service while taking the other out of service will improve the District's ability to serve their customers efficiently.
5. Maintenance – Replacing a steel reservoir with concrete reservoirs decreases maintenance efforts and costs. The corrosion protection systems (interior and exterior coatings, cathodic protection) that are required for steel reservoirs are not needed for concrete reservoirs. Current interior coatings for a steel reservoir need to be replaced/refurbished at least every 15 years. This requires the tank to be taken out of service for the work, and this is significantly challenging with only one tank.
6. Construction/Operation Feasibility – Alternative 1 would require temporary storage during construction that would either be prohibitively expensive or would make operation of the system during construction very challenging. It is unknown if the limited temporary storage proposed as part of this alternative would be acceptable to the water system operator, the fire department, or the Department of Health. Alternative 2 allows the existing tank to remain in service during construction and does not impose the operational challenges of Alternative 1.

Alternative 2 has these six significant advantages over Alternative 1. There are no meaningful advantages Alternative 1 has over Alternative 2. Based on this, we recommend Alternative 2 (replacing Division 7 reservoir with two reservoirs) as the preferred alternative.