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TECHNICAL MEMORANDUM

TO: Greg Johnson, PE
Metropolitan Council Environmental Services

FROM: Christopher Larson, PE

DATE: September 10th, 2026

RE: Amendment - WBL Augmentation Alternatives
SEH No. 191435 14.00

The purpose of this memorandum is to supplement information provided in Study 7B report *Augmentation of White Bear Lake with Surface Water*. This memorandum summarizes the infrastructure and costs for several additional alternatives and scenarios.

1. Infrastructure and costs to purchase partially treated water from the Saint Paul Regional Water Services (SPRWS) McCarrons Water Treatment Plant (WTP) and pump to White Bear Lake for augmentation, with process treatment and pumping capacity of 1 billion gallons per year (BGY), with the ability for future pumping capacity expansion to 2 BGY.
2. Infrastructure and costs for a lake augmentation system described in Study 7B, with process treatment capacity of 1 billion gallons per year (BGY), with ability for future expansion to 2 BGY.
3. Infrastructure and costs for a lake augmentation system described in Study 7B, with treatment consisting of screening and total suspended solids treatment only in lieu of additional dissolved or organic treatment. The system shall have a process treatment capacity of 1 billion gallons per year (BGY), with ability for future expansion to 2 BGY.

Projected Flows

The pumping rates assumed for the augmentation scenarios were 1 BGY and 2 BGY. These rates were assumed over a roughly eight-month open water period, resulting in a treatment and pumping rate of approximately 3,000 GPM (4.3 MGD) and 6,000 GPM (8.6 MGD), respectively.

1. Augmentation with McCarrons WTP

Water Quality

The McCarrons WTP is a conventional lime softening plant for surface water, with solids contact clarifiers, recarbonation and ozonation, filtration with biologically active carbon media, and disinfection. Major upgrades to the plant were last completed in 2025, with the construction of four new solids contact clarifiers.

The McCarrons WTP generally provides all the necessary water quality parameters for augmentation, as described in Barr Engineering's Study 7A – Surface Water Quality Analysis. As the McCarrons WTP targets at least 30% of total organic carbon (TOC) removal required by the EPA for drinking water, the

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effluent is usually below the 4.0 ppm recommended level of treatment for WBL augmentation. While total suspended solids are not measured by drinking water systems, it is expected to be extremely low based on drinking water requirements for turbidity. To meet the water quality requirements, water for augmentation cannot be potable water directly taken from the finished/distribution water. The water would need to be drawn after the filters, prior to the finished water tank where chlorine and ammonia (disinfection), caustic (pH adjustment), and phosphate (for corrosion control) are fed. However, pulling water from this location would contain fluoride, which is added upstream at the recarbonation basins, in accordance with the Minnesota Department of Health for dental health. While Study 7A does not mention targeted treatment for fluoride, it does not address any potential impacts of elevated levels of fluoride. If this augmentation approach is selected, it is recommended that SPRWS relocate the fluoride feed location to the finished water/chlorine contact tank unless further studies indicate no negative impacts. Figure 2 in the Appendix provides a depiction of the current process treatment at McCarrons WTP along with proposed augmentation connection point and pumping.

System Capacity

The plant currently has a total peak hydraulic capacity of 112 MGD, with a firm capacity of 84 MGD with one of the clarifiers out of service. The plant was designed with the ability to expand to 126 MGD total capacity, with a future firm capacity of 112 MGD by constructing a fifth lime softening clarifier and a fourth recarbonation/ozone basin. The table below from Study 2 summarizes SPRWS's current and projected future demands. While the McCarrons WTP has adequate total capacity, the addition of augmentation flow would exceed the plant's current firm capacity of 84 MGD before 2050.

Table 1 – SPRWS Current and Projected Future Demands

Community/Entity	2023 Average Day Demand (MGD)	2023 Max Day Demand (MGD)	2050 Max Day Demand (MGD)	Ultimate Max Day Demand (MGD)
SPRWS	43.72	76.94	84.5	88.7

Source: Study 2 – Surface Water Supply Alternative (Table 6 – SPRWS Water Demands)

As SPRWS is a large regional provider of drinking water, it is recommended that the firm capacity is expanded with an additional clarifier and recarbonation/ozone basin if augmentation water was added, to ensure critical redundancy and reliable operation at the McCarrons WTP. As lake augmentation may be viewed as a lower priority than providing drinking water, there is potential that an expansion is not required, as the WTP has adequate total capacity. If lake augmentation could be temporarily halted during max peak days and if capacity is reduced due to maintenance and repairs, this option may be viable.

Transmission Line Routing and Pumping

A new 24-inch transmission line starting at McCarrons WTP would need to be constructed to supply water to White Bear Lake, as the finished distribution water cannot be utilized. While several alternatives appear feasible, the recommended route is comprised of a combination of alignments determined from both Study 2 and Study 7B, as shown in Figure 3. This route is generally described as departing from McCarrons WTP and heading east 6,500 linear feet to Roselawn/Edgerton Street, with an I-35E overpass crossing. The pipe would then continue north approximately 16,700 feet to the southeast corner of East Vadnais Lake, with major crossings at Hwy 36 and I-35E. This routing is identical to that in Approach 1 in Study 2. The pipe would then follow the alignment described in Study 7B, running approximately 21,250 linear feet along Centerville Road and Goose Lake Road (County Road 14) toward Goose Lake and White Bear Lake. The total transmission line is approximately 44,450 linear feet. The geology, soil

conditions, as well as an inventory of contaminated sites was not evaluated for the section of piping from McCarrons WTP to Vadnais Lake as part of this memo.

One potential alternative would be to route the transmission line along Highway 61. This alignment is the most direct path but involves a water crossing between Keller Lake and Round Lake, which significantly increases environmental and permitting risks.

Additional pumping equipment would be located at McCarrons WTP to supply treated water to White Bear Lake. The equipment would consist of at least two high-capacity pumps, each sized for 3,000 gpm for the 1 BGY scenario. An additional pump would be added to increase the firm capacity to 6,000 gpm for the 2 BGY scenario. An analysis of the power requirements and pipe sizing was completed as noted in Study 7B Appendix A, with results provided in Table 2 below.

Table 2 – Hydraulic Analysis - McCarrons WTP to White Bear Lake

Pumping Rate (gpm)	Est. Total Head (ft)	Est. Horsepower (bhp)
3000	160	152
6000	177	335

Capital Cost Estimate

Table 3 includes the estimated costs for a lake augmentation system supplying partially treated water from the SPRWS McCarrons WTP to White Bear Lake. The overall project costs include expanding McCarrons WTP with an additional clarifier and recarbonation/ozonation basin, a new booster station, augmentation pipeline, and outfall.

Table 3 – Estimated Capital Costs for Lake Augmentation from McCarrons WTP

Item	1 BGY Cost	2 BGY Future Pumping Expansion Cost
Booster Station and Piping Modifications	\$7,500,000	\$650,000
Augmentation Pipeline - McCarrons WTP to East Vadnais Lake	\$69,576,000	-
<i>McCarrons WTP Expansion - Clarifier & Recarb/Ozone Basin*</i>	<i>\$33,156,000</i>	-
Outfall	\$2,000,000	-
Land Acquisition	\$2,500,000	-
Subtotal	\$112,232,000	\$650,000
Contingency (20%)	\$22,446,000	\$130,000
Construction Total	\$134,678,000	\$780,000
Engineering, Legal, Admin (20%)	\$26,936,000	\$156,000
Permitting	\$1,200,000	-
Total	\$162,814,000	\$936,000
Combined Total	\$163,750,000	
<i>*Total without McCarrons WTP Expansion</i>	<i>\$115,069,000</i>	<i>\$936,000</i>
<i>*Combined Total without WTP Expansion</i>	<i>\$116,005,000</i>	

Changes from the Study 7B East Vadnais Lake Alternative include McCarrons WTP expansion, a booster station, and increased pipeline costs. A detailed summary of the pipeline costs is included as an appendix to this memo. As noted in the earlier section, costs could be reduced if McCarrons WTP is not expanded, provided augmentation could be halted during max peak demands to prioritize drinking water supply.

Operating Cost Estimate

Cost of SPRWS Water

The cost to purchase water from SPRWS was approximated using the cost of wholesale water provided to the City of Roseville. Roseville is charged a Water Service Base Fee and a Water Volume Charge based on 60% of the retail charge. The current 2026 published rates are a monthly base cost of \$77,700 and \$2.67 per 100 cubic foot (\$3.57/kgal).

SPRWS noted total chemical expenditure costs in 2024 of \$5.11 million. Based on an average of 40 million gallons of drinking water production, the chemical cost is approximately \$350/MG or \$0.35 per 1,000 gallons. Water for augmentation would avoid the finished water chemicals (chlorine, ammonia, caustic, and phosphate), which can be a significant portion of the chemical budget. As Study 7A noted, SPRWS likely needs to increase coagulant doses to improve water quality parameters. For this estimate, a conservative assumption of 30% chemical savings can be applied, resulting in an estimated savings of \$0.105/kgal, or a cost of \$3.465/kgal.

As the City of Roseville purchases approximately 1.7-1.9 BGY, it is assumed that a similar monthly base rate of \$77,700 could be applied for lake augmentation water to support distribution maintenance costs. The table below provides a summary of the estimated cost of purchasing partially treated water from SPRWS.

Table 4 – Estimated Costs for Purchasing Partially Treated SPRWS Water (Non-Potable)

Annual Treatment	Cost per 1,000 Gal	Monthly Base Fee	Total Annual Cost of Water Purchase
1 BGY	\$3.465	\$77,700	\$4,397,400
2 BGY	\$3.465	\$77,700	\$7,862,400

Note: Future 2 BGY costs provided in 2026 dollars

Pumping Cost

A similar hydraulic analysis was performed as noted in Appendix A of Study 7B to provide a preliminary estimate of pumping needs and associated electrical costs, shown below in Table 5.

Table 5 – Pumping Energy and Costs from McCarrons WTP to White Bear Lake

Pumping Rate (gpm)	Energy Cost/Hour	Annual Energy Cost
3000	\$19.3	\$112,700
6000	\$42.5	\$278,200

Total Operating Cost

The total annual operating cost associated with this scenario is presented in Table 6 below.

Table 6 – Annual O&M costs for Augmentation from McCarrons WTP to White Bear Lake

Annual Treatment	Water Purchase Cost	Pumping Cost	Annual Maintenance Costs	Total Annual Operating Cost
1 BGY	\$4,397,400	\$112,700	\$50,000	\$4,560,100
2 BGY	\$7,862,400	\$278,200	\$100,000	\$8,240,600

2. Augmentation from East Vadnais Lake – 1 BGY Option

Study 7B presents capital costs and operating costs for a lake augmentation system from East Vadnais Lake sized for 2 BGY. An alternative to this approach would be to construct the system with hydraulic conveyance infrastructure to handle 2 BGY, while initially designing for 1 BGY with the ability to expand up to 2 BGY with additional pumping and treatment infrastructure. The capital cost for a 1 BGY option is summarized in the Table below, along with the costs for future expansion to 2 BGY. This approach assumes all permanent infrastructure (intakes, pipelines, building footprint) is constructed initially for 1 BGY capacity. It should be noted that this approach is estimated to be slightly higher in total expansion costs than those presented in Study 7B due to adjusting treatment capacity to maintain redundancy during Phase 1 (1 BGY).

Table 7 – Estimated Capital Costs for Lake Augmentation from East Vadnais Lake, Phased Construction

Cost Item	1 BGY Cost	2 BGY Future Expansion Cost
Lake Intake	\$9,000,000	-
Treatment Plant	\$56,410,000	\$18,060,000
Raw Water Pump/Lift Station	\$1,000,000	-
Augmentation Pipeline	\$36,870,000	-
Outfall	\$2,000,000	-
Land Acquisition	\$2,500,000	-
Subtotal	\$107,780,000	\$18,060,000
Contingency (20%)	\$21,556,000	\$3,612,000
Construction Total	\$129,336,000	\$21,672,000
Engineering, Legal, Admin (20%)	\$25,867,000	\$4,334,000
Permitting	\$1,200,000	-
Total	\$156,403,000	\$26,006,000
Combined Total	\$182,409,000	

Note: Expansion costs provided in 2026 dollars

In addition to capital costs, the augmentation treatment and pumping facilities would incur annual O&M costs, including labor, electricity, membrane replacement, chemicals, natural gas, equipment repair, and purchasing raw water from SPRWS. The concept-level O&M costs for 1 BGY are presented below, along with the 2 BGY costs from Study 7B.

Table 8 – Estimated O&M Costs for Lake Augmentation from East Vadnais Lake

Item	1 BGY Annual O&M Cost	2 BGY Annual O&M Cost
Labor (2 FTE)	\$300,000	\$300,000
Electricity	\$125,000	\$250,000
Membrane Replacement	\$105,000	\$175,000
Chemicals	\$125,000	\$250,000
Natural Gas	\$100,000	\$100,000
Equipment Repair	\$125,000	\$200,000
Purchase of Raw Water from SPRWS ¹	\$610,000	\$1,220,000
Total Annual O&M	\$1,490,000	\$2,495,000

1. Based on \$0.61 per 1,000 gallons pumped and augmenting White Bear Lake with up to 1 billion gallons per year when augmentation is needed. Augmentation costs could be significantly lower in some years or not required when White Bear Lake water elevations are above elevation 922.0 feet.

3. Augmentation from East Vadnais Lake with Screening Only

The augmentation system described in Study 7B included extensive treatment with chemical additions for nutrient, manganese, and TOC removal, along with clarification and filtration prior to being pumped to the outfall at White Bear Lake. An alternative requested was to provide screening and filtration only, to prevent the spread of invasive species. No treatment would be provided to address any dissolved organic or inorganic constituents.

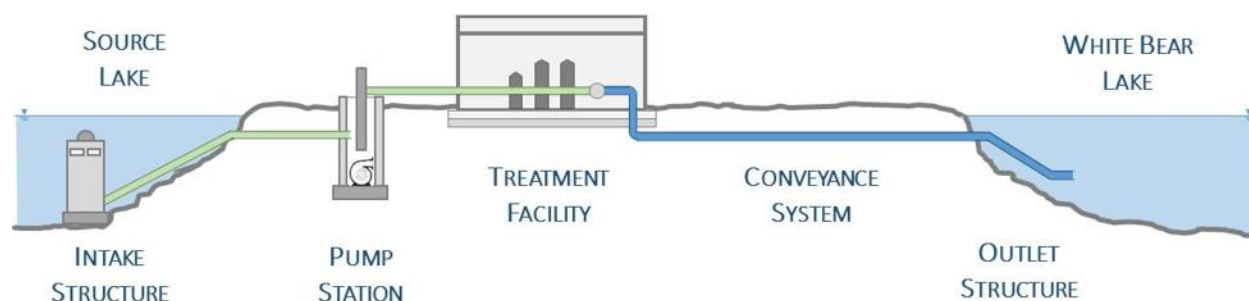
Study 7A recommends that treatment targets filtration down to at least ≤ 35 microns and maintains a total suspended solids (TSS) level of < 1 mg/L. In the absence of data on particle sizes, this evaluation assumes that a combination of mechanical screening and SPRWS modifications to the current ferric chloride dosing can achieve the TSS target. Table 4-1 in Study 7A shows that watershed runoff modelling estimates the TSS concentration in East Vadnais Lake to be approximately 1/3 that of White Bear Lake.

An augmentation system with quality goals of invasive aquatic species and suspended solids would consist of the following components:

1. East Vadnais Lake Intake
2. Raw Water Pump Station
3. Treatment Facility – Screening/Filtration
4. Augmentation Pipeline
5. Outfall into White Bear Lake

A plant schematic for the proposed treatment process is included as Figure 1 below:

Figure 1 – Filtration Only Augmentation Schematic



Filtration Treatment Facility

The filtration system would consist of self-cleaning screen filters providing filtration down to 25 microns or less to remove organic suspended solids. This level of fine filtration prevents the introduction of invasive zebra mussel larvae, while minimizing maintenance. It is assumed that the filter system design includes a primary coarse screening stage followed by a 25-micron final stage, similar to the filter system at Snail Lake, which similarly uses the Mississippi River and chain of lakes for augmentation supply. Each strainer would independently backwash on differential pressure and/or programable timer, returning wash water to the source (East Vadnais Lake). The filtration system would include redundancy to allow for planned maintenance and be designed with an initial capacity of 3,000 GPM with expansion to 6,000 GPM. In addition to the filtering system, the facility would include a flow meter and overhead service crane, along with a maintenance/storage area and control room. The estimated capital cost of the filtration only augmentation scenario is listed in Table 9 below, with estimated operating costs noted in Table 10.

Table 9 – Estimated Capital Costs for Augmentation from East Vadnais Lake with Filtration Only for Aquatic Invasive Species Control

Cost Item	1 BGY Cost	2 BGY Future Expansion Cost
Lake Intake	\$9,000,000	-
Raw Water Pump/Lift Station	\$1,000,000	-
Filtration Facility	\$8,500,000	\$1,250,000
Augmentation Pipeline	\$36,870,000	-
Outfall	\$2,000,000	-
Land Acquisition	\$2,500,000	-
Subtotal	\$59,870,000	\$1,250,000
Contingency (20%)	\$11,974,000	\$250,000
Construction Total	\$71,844,000	\$1,500,000
Engineering, Legal, Admin (20%)	\$14,369,000	\$300,000
Permitting	\$1,200,000	-
Total	\$87,413,000	\$1,800,000
Combined Total	\$89,213,000	

Table 10 – Estimated O&M Costs for Augmentation from East Vadnais Lake with Filtration Only for Aquatic Invasive Species Control

Item	1 BGY Cost	2 BGY Future Expansion Cost
Labor (1 FTE)	\$150,000	\$150,000
Electricity	\$95,000	\$195,000
Maintenance & Repairs	\$70,000	\$105,000
Purchase of Raw Water from SPRWS ¹	\$610,000	\$1,220,000
Total	\$925,000	\$1,670,000

1. Based on \$0.61 per 1,000 gallons pumped and augmenting White Bear Lake with up to 2 billion gallons per year when augmentation is needed. Augmentation costs could be significantly lower in some years or not required when White Bear Lake water elevations are above elevation 922.0 feet.

SUMMARY

Tables 11 and 12 provide overall summary of the estimated capital and O&M costs for the various alternatives for the 1 BGY and 2 BGY scenarios. Augmentation of White Bear Lake from Vadnais Lake with treatment for aquatic invasive species only has the lowest capital and operational costs identified. This option would carry risk in the event that significantly higher concentrations of phosphorus, nitrogen, total organic carbon, total suspended solids, and manganese are detected for extended periods of time in East Vadnais Lake in the future which could impact the water quality in White Bear Lake and the aquifers that supply groundwater for public drinking water systems in the White Bear Lake area. In addition, a lesser 1 billion gallon per year pumping and treatment capacity for any of the options evaluated in this memorandum would carry additional risk in the event that this capacity is not adequate to maintain White Bear Lake at or above elevation 922.0 ft (protective lake elevation) for all future development conditions and associated water demands. However, having the facilities designed initially to be expanded in the future, if needed, should help reduce this risk in which only additional funding would need to be obtained to implement the future expansion of the facility.

Table 11 – Summary Capital Costs for Augmentation Alternatives

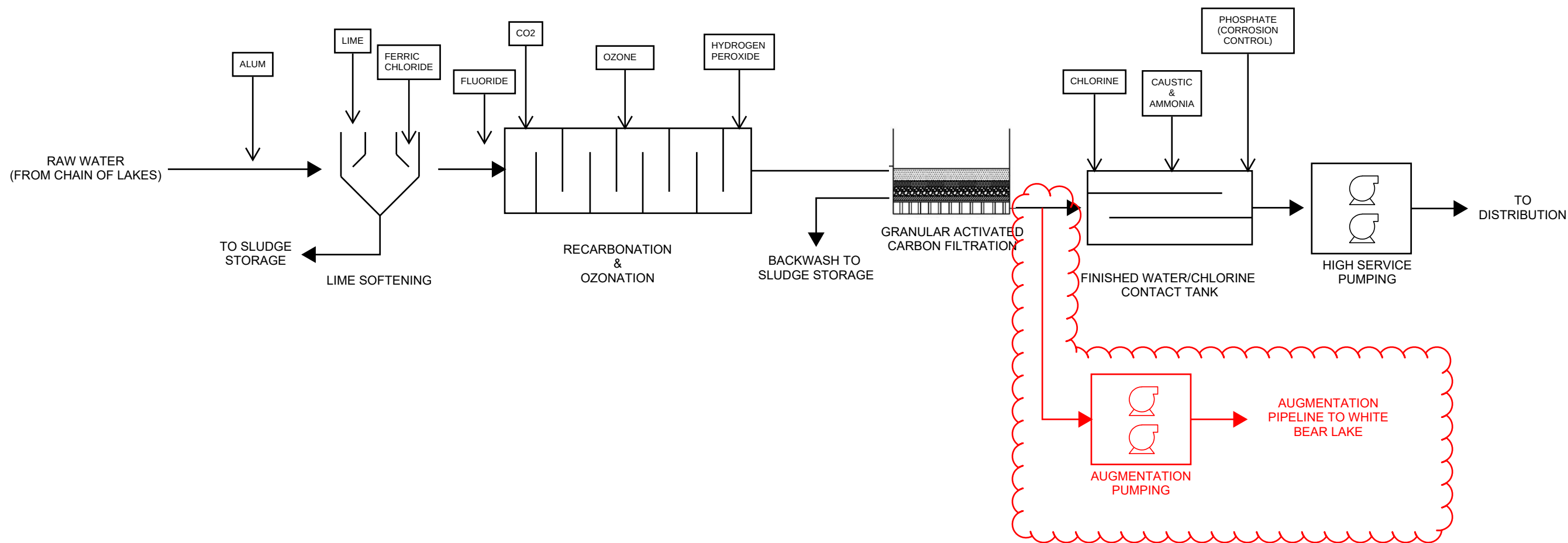
Scenario	Capital Cost		
	Phase 1 (1 BGY)	Phase 2 (Expansion to 2 BGY)	Total
Augmentation with McCarrons WTP	\$162,814,000	\$936,000	\$163,750,000
<i>Augmentation with McCarrons WTP, without Plant Expansion</i>	<i>\$115,069,000</i>	<i>\$936,000</i>	<i>\$116,005,000</i>
Vadnais Lake Augmentation	\$156,403,000	\$26,006,000	\$182,409,000
Vadnais Lake Augmentation - Filtration Only	\$85,973,000	\$1,800,000	\$87,773,000

Table 12 – Summary O&M Costs for Augmentation Alternatives

Scenario	Annual O&M Costs	
	Phase 1 (1 BGY)	Phase 2 (2 BGY)
Augmentation with McCarrons WTP	\$4,560,100	\$8,240,600
Vadnais Lake Augmentation	\$1,490,000	\$2,495,000
Vadnais Lake Augmentation - Filtration Only	\$925,000	\$1,670,000

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McCarrons WTP - Augmentation

Process Flow Diagram

White Bear Lake Comprehensive Study

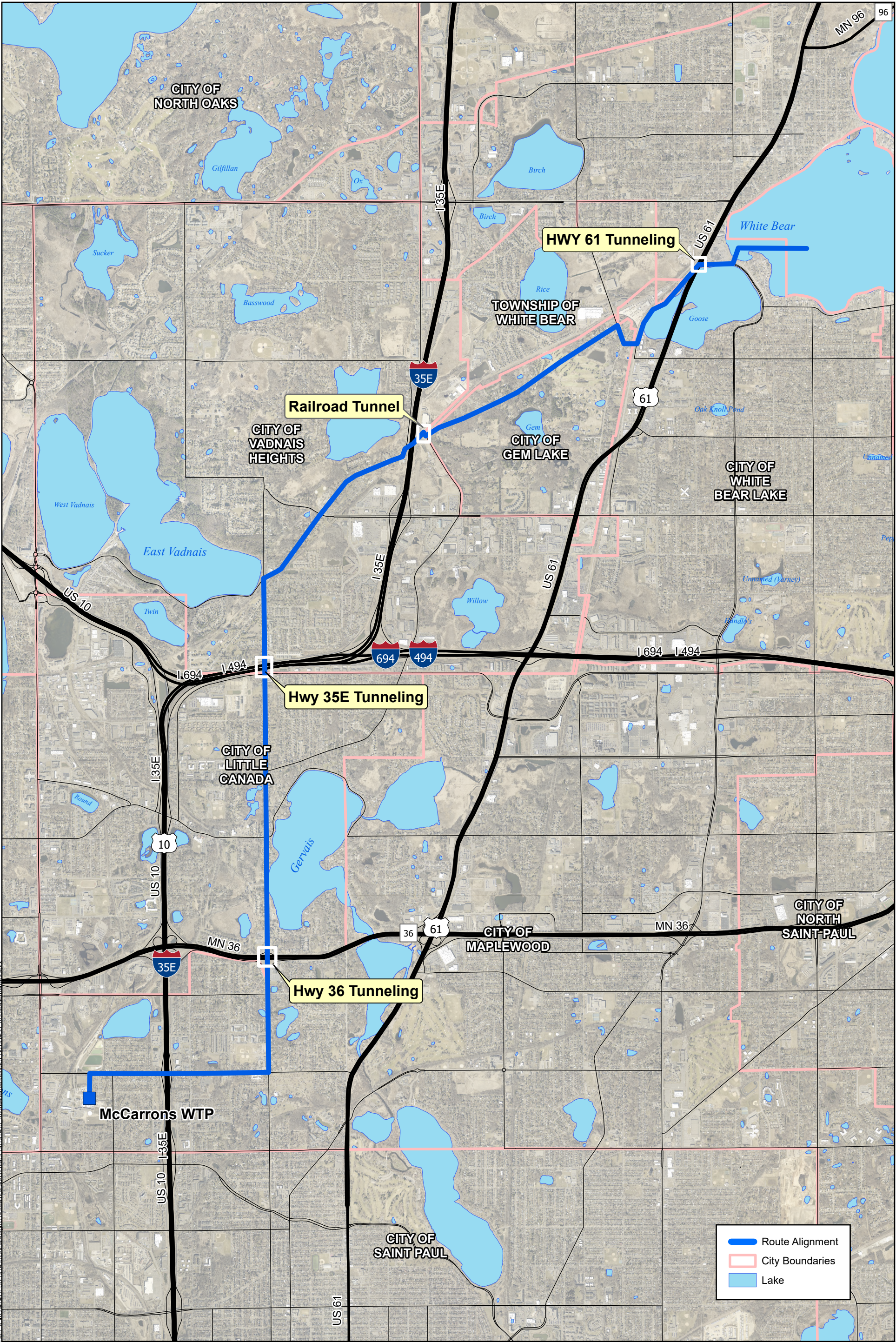
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McCarrons WTP to WBL Alignment

Capital Costs for Concept Level Surface Water Augmentation

8/3/2026

Code	Item	Unit	QTY	Unit Price	Total Price	Uncertainty	Basis of Cost
Sitework							
S1	Mobilization	LS	1	2,024,000	2,024,000		3% construction \$
S2	Traffic Control: Barricades and Lights	LS	1	1,000,000	1,000,000	low	\$250k/yr
S3	Erosion Control	LF	44,500	5	223,000	low	Plugged in footage for downstream (low) side of trench or edge of easement/ROW.
S4	Tree Removal and Replacement	Tree	75	1,600	120,000	low	Estimated from Google Street view of potential trees encountered along route.
S5	Comon Excavation Removal of unsuitable/excess material (includes trucking)	CY	185,500	35	6,493,000	high	Removal of unsuitable/excess material. 3.3 CY/LF - 10'D x 15'W trench width. assumed 40% useable material for backfill based on Ramsey County Geological Atlas and no soil borings. Assumes trench excavation for forcemain is included in forcemain items. Includes removal of: 4" reclaimed material (bit roads), 8" class 5 (conc roads), 3" class 5 (bit trail), 4" class 5 (conc walk)
S6	Bituminous Trail Replacement	SY	1,500	33	50,000	low	Bituminous walk section assumed based on visual site drive through - no pavement cores \$110/Ton*113lb/sy/in*3in= \$19/SY Bit+ \$1.6/SY Reclaim + \$35/CuYd*4in=\$4/SY Class 5.
S7	Concrete Sidewalk and Median	SY	750	94	71,000	low	4" Walk at intersections for sidewalk ADA Access. Includes 4" Class 5 \$10/sf walk = \$90/SY + \$4/SY Class 5
S8	Bituminous Pavement 2 -2" Lifts (4" total bit)+ 4" Reused Reclaim+4" CL5 Residential Roads	SY	2,000	32	64,000	high	Road section assumed based on visual site drive through - no pavement cores \$110/Ton*113lb/sy/in*4in= \$25/SY Bit+ \$3/SY Reclaim + \$35/CuYd*4in=\$4/SY Class 5. Includes Driveway Tie Ins
S9	Bituminous Pavement 4 -2" Lifts (8" total bit)+ 4" Reused Reclaim+8" CL5 County/Arterial Roads	SY	166,700	61	10,169,000	high	County/Arterial Road section assumed based on visual - no pavement cores - 40' wide - Centerville Rd, 34' Wide - Goose Lake Rd, 38' Wide Otter Lake Rd and Hoffman Rd \$110/Ton*113lb/sy/in*8in= \$50/SY Bit+ \$3/SY Reclaim + \$35/CuYd*8in=\$8/SY Class 5. Includes Driveway Tie Ins
S10	Concrete Pavement	SY	5,300	133	705,000	low	White Bear Avenue Assumed 8" with 8" Class 5 - Includes Removal \$110/SY 8" Concrete + \$35/CuYd*8in=\$8/SY Class 5 + \$15/SY Removal
S11	Concrete Curb and Gutter B424	LF	4,200	35	147,000		White Bear Ave Curb (North side) + Centerville Rd Medians Primarily rural road with limited curb and no storm sewer.
S12	Dewatering (Wells/Well Points)	LS	1	600,000	600,000	high	Install local segment system w/Frac tank settling treatment prior to discharge to surface waters or sanitary system. If contaminated. Geotechnical investigations including well pump testing to establish potential drawdown rates necessary.
S14	Trucking to Waste (contaminated)	CY	15,810	120	1,898,000	high	Assumed quantity based on Contaminated Site Inventory. Phase 1 investigations and potential for Phase 2 needed. Geotechnical investigations including well pump testing to establish potential drawdown rates necessary.
S15	Site Grading	SY	75,000	4	300,000	low	Assumed limited disturbance (15') beyond rural road shoulder for segments along pipe installed in roadway. Include site demolition.
S16	CLSM Backfill	CY	2,400	150	360,000	low	Casing backfill and potential utility crossing backfill.
S17	Select Fill	CY	149,000	30	4,470,000	medium	Assumed quantity based on Ramsey Sub -geological Atlas - no borings. Used in areas where existing pipe trench will be backfilled with existing materials encountered. See Geotechnical TM for general locations and descriptions of potential for sands, gravels and glacial deposits. Assumes 60% of material is hauled away. 3.3 CY/LF - 60% x 10'D x 15'W trench

[illegible]

M1	Edgerton and Centerville Rd. Screenhouse	LS	1	2,500,000	2,500,000	high	Temporary disruption and permanent easements.
M2	WBL Outlet Easement	LS	1	40,000	40,000	medium	Temporary disruption and permanent easements.
M3	Temporary Easements	SF	20,000	10	200,000	medium	Temporary disruption and permanent easements.
	Subtotal				\$2,740,000		

Total Construction Costs	\$69,576,000
Contingency @ 20%	\$13,916,000
Total Construction Costs with Contingency @ 20%	\$83,492,000