

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
MISSOURI CLEAN WATER COMMISSION



CONSTRUCTION PERMIT

The Missouri Department of Natural Resources hereby issues a permit to:

City of Salem
Salem WWTF
0.25 miles northwest of Adelman Ln and Hwy 19 intersection
Salem, MO 65560

for the construction of (described facilities):

See attached.

Permit Conditions:

See attached.

Construction of such proposed facilities shall be in accordance with the provisions of the Missouri Clean Water Law, Chapter 644, RSMo., and regulation promulgated thereunder, or this permit may be revoked by the Department of Natural Resources.

As the department does not examine structural features of design or the efficiency of mechanical equipment, the issuance of this permit does not include approval of these features.

A representative of the department may inspect the work covered by this permit during construction. Issuance of a permit to operate by the department will be contingent on the work substantially adhering to the approved plans and specifications.

This permit applies only to the construction of water pollution control components; it does not apply to other environmentally regulated areas.

July 21, 2026
Effective Date

July 20, 2028
Expiration Date

Heather S. Peters, Director, Water Protection Program

CONSTRUCTION PERMIT

I. CONSTRUCTION DESCRIPTION

The proposed construction to the Salem Wastewater Treatment Facility (WWTF) includes a new surface filtration system in a concrete building, new non-potable water pump station, fabric building over the existing dewatering system, new submersible pumps for the existing influent pump station, and selective repair of the three existing secondary clarifiers mechanisms. The improvements will restore the facility to its design capacity and enhance treatment capabilities to meet effluent limitations derived from 2020 TMDL modeling.

This project will also include general site work appropriate to the scope and purpose of the project; removal and disposal of the existing submersible pumps and secondary clarifier mechanisms; and all necessary appurtenances to make a complete and usable WWTF.

II. COST ANALYSIS FOR COMPLIANCE

Pursuant to Section 644.145, RSMo., when issuing permits under this chapter that incorporate a new requirement for discharges from publicly owned treatment works, the Department of Natural Resources shall make a “finding of affordability” on the costs to be incurred and the impact of any rate changes on ratepayers upon which to base such permits and decisions, to the extent allowable under this chapter and the Federal Water Pollution Control Act. This process is completed through a cost analysis for compliance. Permits that do not include new requirements may be deemed affordable.

The department is not required to determine cost analysis for compliance because the permit contains no new conditions or requirements that convey a new cost to the facility.

III. CONSTRUCTION PERMIT CONDITIONS

The permittee is authorized to construct subject to the following conditions:

1. This construction permit does not authorize discharge.
2. All construction shall be in accordance with the plans and specifications submitted by Archer-Elgin Engineering, Surveying & Architecture on April 2, 2025, and signed and sealed by Kenneth A. Campbell, P.E. and Steven L. Stack, P.E., on March 28, 2025, and approved by the department on July 21, 2026.
3. Regulation 10 CSR 20-4.040(18)(B)1 requires that projects be publicly advertised, allowing sufficient time for bids to be prepared and submitted. Projects should be advertised at least 30 days prior to bid opening.

4. The department must be contacted in writing prior to making any changes to the approved plans and specifications that would directly or indirectly have an impact on the capacity, flow, system layout, or reliability of the proposed wastewater treatment facilities or any design parameter that is addressed by 10 CSR 20-8, in accordance with 10 CSR 20-8.110(11).
5. As per 10 CSR 20-4.040, all changes in contract price or time within the approved scope of work must be by change order in accordance with Section 19 of this rule.
6. State and federal law does not permit bypassing of raw wastewater; therefore, steps must be taken to ensure that raw wastewater does not discharge during construction. If a sanitary sewer overflow or bypass occurs, report the appropriate information to the department's electronic Sanitary Sewer Overflow/Bypass Reporting system at <https://dnr.mo.gov/mogem/> or Southeast Regional Office per 10 CSR 20-7.015(9)(G).
7. In addition to the requirements for a construction permit, 10 CSR 20-6.200 requires land disturbance activities of 1 acre or more to obtain a Missouri State Operating Permit to discharge stormwater. The permit requires best management practices sufficient to control runoff and sedimentation to protect waters of the state. Land disturbance permits will only be obtained by means of the department's ePermitting system available online at <https://dnr.mo.gov/data-e-services/missouri-gateway-environmental-management-mogem>. See <https://dnr.mo.gov/data-e-services/water/electronic-permitting-epermitting> for more information.
8. A United States Army Corps of Engineers (USACE) Section 404 Department of Army permit (§404) along with the department's Section 401 Water Quality Certification or waiver (§401) may be required for the activities described in this permit. This permit is not valid until these requirements are satisfied. If construction activity will disturb any land below the ordinary high water mark of jurisdictional waters of the U.S., then a §404/§401 will likely be required. Since the USACE makes determinations on what is jurisdictional, you must contact the USACE to determine permitting requirements. See <https://dnr.mo.gov/water/business-industry-other-entities/permits-certification-engineering-fees/section-401-water-quality> for more information or you may contact the department's Water Protection Program at 573-522-4502 or wpssc401cert@dnr.mo.gov.
9. All construction must adhere to applicable 10 CSR 20-8 (Chapter 8) requirements.
10. Upon completion of construction:
 - A. The City of Salem will become the continuing authority for operation and maintenance of these facilities;
 - B. Submit an electronic copy of the as-builts if the project was not constructed in accordance with previously submitted plans and specifications; and

- C. Submit the Statement of Work Completed form (<https://dnr.mo.gov/document-search/wastewater-construction-statement-work-completed-mo-780-2155>) to the department in accordance with 10 CSR 20-6.010(5)(N) and request the operating permit modification be issued. When the facility applies for their next operating permit renewal, they will be expected to include an updated facility description on their application.

IV. REVIEW SUMMARY

1. CONSTRUCTION PURPOSE

The project includes modifications to the existing WWTF which will restore existing processes to their originally intended design capacity and enhance treatment capabilities to better meet the total daily maximum load (TMDL) study-driven operating permit. The upgrades to the influent pump station will improve operation of the processes at the WWTF. The installation of a new surface filtration process and repairs to the secondary clarifier mechanisms will enable the WWTF to achieve low levels of effluent BOD₅, TSS, and TP. Improvements to the non-potable water pump station will accommodate peak and fireflow demands at the tertiary filtration building and washdown operations at the peak flow storage basin.

2. FACILITY DESCRIPTION

The existing WWTF has an influent lift station, peak flow basin, mechanical screen, emergency bar screen, oxidation ditch, three final clarifiers, UV disinfection, two aerobic sludge digester, eight sludge reed beds, and one sludge drying bed. Improvements to the wastewater treatment process include a new surface filtration, new non-potable water pump station, fabric building over the existing dewatering system, new submersible pumps for the existing influent pump station, and selective repair of the three existing secondary clarifiers mechanisms. The upgrades will help meet 2020 TMDL modeling effluent limitations, replace equipment past its useful life, and restore the WWTF to its design capacity.

The Salem WWTF is located 0.25 miles northwest of Adelman Lane and Hwy 19 intersection, Salem, Missouri, in Dent County. The facility has a design average flow of 1.25 million gallons per day and serves a hydraulic population equivalent of approximately 1000 people.

3. COMPLIANCE PARAMETERS

The proposed construction improvements will not result in any change to the Salem WWTF operating permit's effluent limits and will enhance the plant's treatment capabilities.

4. REVIEW OF MAJOR TREATMENT DESIGN CRITERIA

New Components:

- Influent Pump Station – Construction of a quadruplex influent pump station with each 15 HP submersible pump capable of operating at 1,000 gpm at 25 feet of TDH.
- Non-Potable Pump Station – Construction of a triplex non-potable pump station with one 11 HP submersible pump capable of operating at 100 gpm at 147 feet of TDH and two 25 HP submersible pump capable of operating at 500 gpm at 116 feet of TDH. This pump station will replace the existing component which is utilized for wash-down of the peak flow storage basin
- Cloth Disk Tertiary Filtration – Installation of two surface filtration units. Each unit is capable of treating an average design flow of 1.25 MGD. With one unit out-of-service, the disk filters are capable of treating a peak flow of 7 MGD at a maximum flux rate of 6.5 gpm/ft². Each unit has 14 cloth disk assemblies with a total filtration area of 925 ft². The media is constructed with a maximum pore size of 30 µm. Each disk filter unit shall be supplied with a backwash system. Each backwash system shall consist of duplicate pumps capable of pumping 117 gpm with a 15 HP motor. Backwash of the disk filter unit is based upon vacuum instead of pressure. Disk filtration shall follow clarification prior to disinfection.
- Secondary Clarifiers Mechanisms – Replacement of existing scraper squeegees, turnbuckles, tie rods, steady shaft, journal bearing, skirt, attachment hardware, drive motor, primary gear reducer, and telescoping valve.

5. OPERATING PERMIT

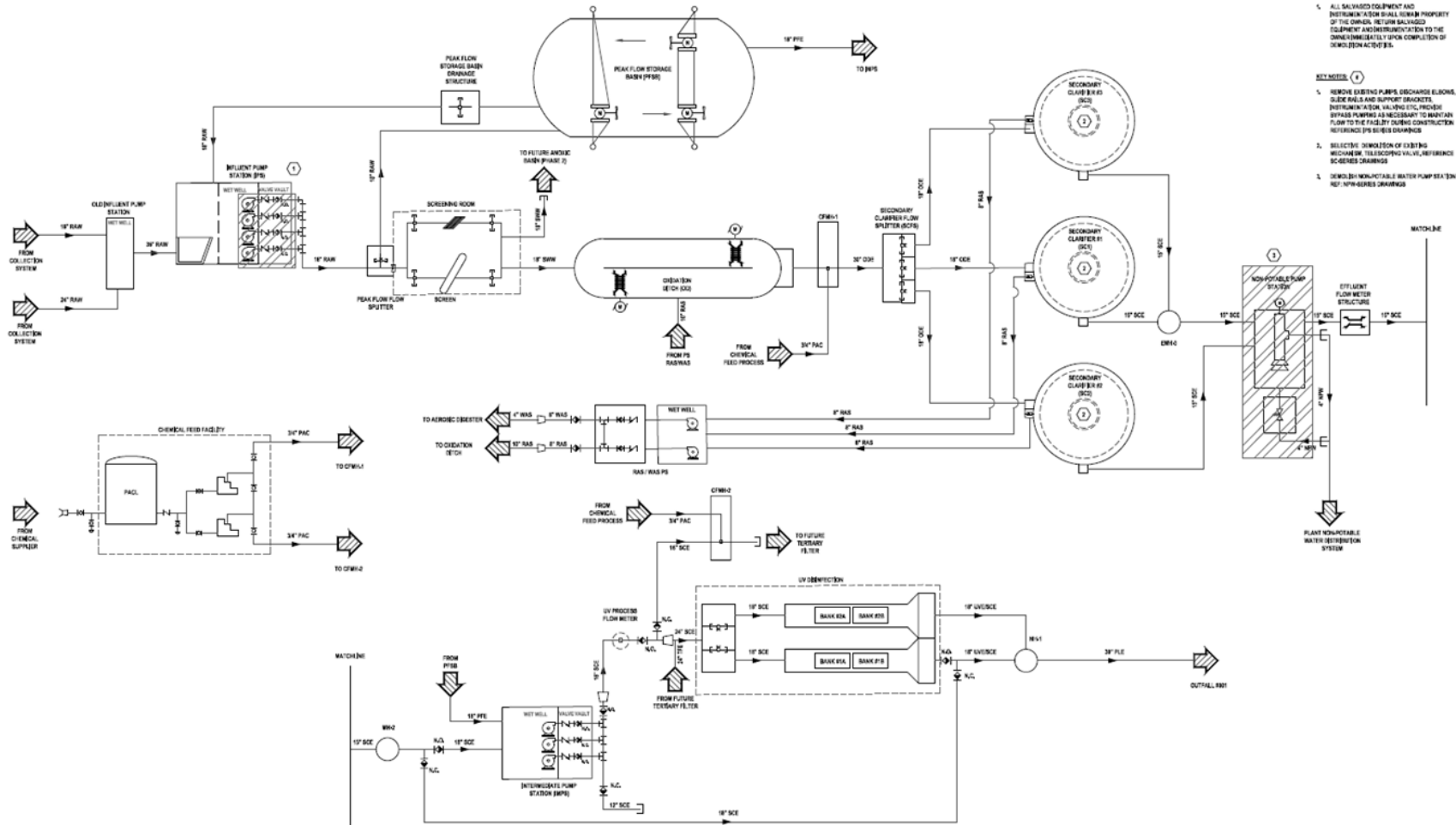
Missouri State Operating Permit No. MO-0021768 will require a modification to reflect the construction activities. The modified operating permit was successfully public noticed from March 6 to April 6, 2026, with no comments received. Submit the Statement of Work Completed to the department in accordance with 10 CSR 20-6.010(5)(N) and request the operating permit modification be issued.

Angie Garcia, P.E.
Financial Assistance Center
angie.garcia@dnr.mo.gov

APPENDICES

- Process Flow Diagram
- Summary of Design

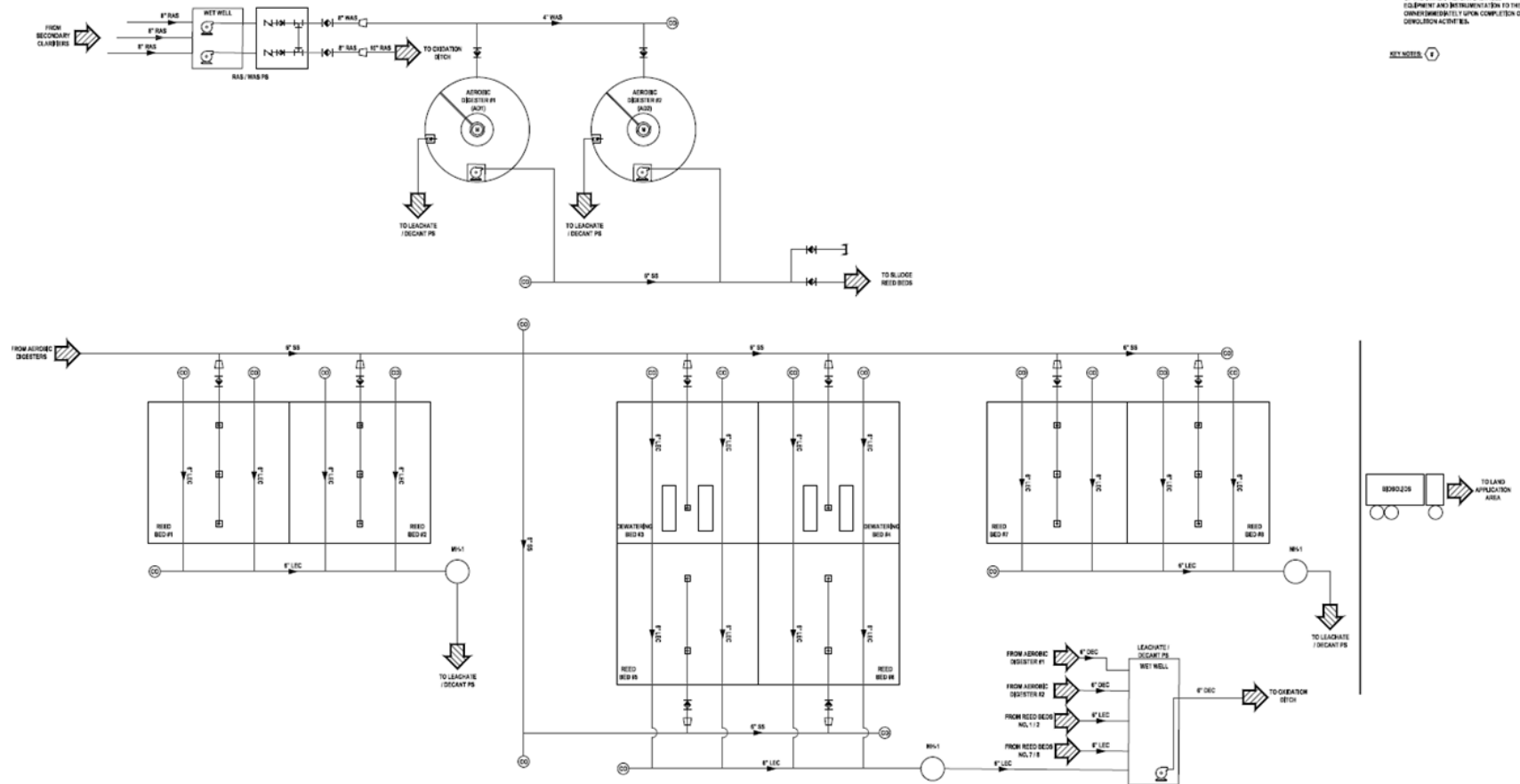
APPENDIX A - PROCESS FLOW DIAGRAM



GENERAL NOTES:

1. ALL BALANCED EQUIPMENT AND INSTRUMENTATION SHALL REMAIN PROPERTY OF THE OWNER. RETURN BALANCED EQUIPMENT AND INSTRUMENTATION TO THE OWNER IMMEDIATELY UPON COMPLETION OF CONSTRUCTION ACTIVITIES.

KEY NOTES: (1)



APPENDIX B – SUMMARY OF DESIGN



City of Salem

Wastewater Treatment Facility Phase 2B Improvements

Summary of Design

March 28, 2025



03-28-25



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1 Introduction

1.1 Purpose

The purpose of this report is to summarize the design of the Salem WWTF Phase 2B improvements required to meet the criteria established in the Salem WWTF Phase 2 Improvements Facility Plan issued on July 11, 2022, by Archer-Elgin Engineering and Surveying. The focus of the design is the restoration of existing processes to their originally intended design capacity. Furthermore, these improvements shall enhance treatment capabilities at the facility to better meet the total daily maximum load (TMDL) study driven operating permit limits recently established for the facility.



2 Design Flow and Loadings

Flow and loading projections over the 20-year planning period, 2022 – 2042, were completed in the Facility Plan. The 2042 projections are shown in the table below.

Table 2-1. 2042 Projected Flow and Loading

	Average Day	Max Month	Max Day	Peak Hour
Flow:	1.25	--	2.36	7.0
BOD (mg/L):	96	162	169	
BOD (lb./d):	1,001	1,689	1,762	
TSS (mg/L):	106	195	238	
TSS (lb./d):	1,105	2,033	2,481	
TKN (mg/L):				
TKN (lb/d):				
NH3-N (mg/L):	15	--	47	
NH3-N (lb/d):	156	--	490	
TP-P(mg/L):	2.1	4.0	--	
TP-P (lb/d):	21	39	--	

Treatment needs were established based upon the effluent limitations listed in the currently effective Missouri State Operating Permit (MO-0021768). The effluent limitations reflect modeling associated with the 2020 Total Daily Maximum Load study performed by the MDNR to address receiving stream impairments. A copy of the operating permit is located in Appendix A.

Table 2-2. Final Effluent Requirements – Effective through 03-31-2034

Effluent Requirements	
<i>BOD₅ Concentration</i> [†]	
Monthly Avg (mg/L)	10
Weekly Avg (mg/L)	15
<i>TSS Concentration</i> [†]	
Monthly Avg (mg/L)	10
Weekly Avg (mg/L)	15
<i>Ammonia Concentration</i>	
Monthly Avg (mg/L) – Summer *	0.4
Daily Max (mg/L) – Summer *	0.8
Monthly Avg (mg/L) – Winter ‡	2.6



Daily Max (mg/L) - Winter ‡	5.2
E. coli	
Monthly Avg (CFU/100 ml) **	206
Weekly Avg (CFU/100 ml) **	1,030
Oil and Grease (mg/L)	
Monthly Avg (mg/L)	10
Daily Max (mg/L)	15
Cadmium, Total Recoverable	
Monthly Avg (µg/L)	0.6
Daily Max (µg/L)	2.0
Copper, Total Recoverable	
Monthly Avg (µg/L)	11.4
Daily Max (µg/L)	23.5
Lead, Total Recoverable	
Monthly Avg (µg/L)	4.0
Daily Max (µg/L)	12.4
Dissolved Oxygen	
Monthly Average (mg/L)	5.0

(†) The facility must meet a removal efficiency of 85% or greater.

(*) Daily maximum and monthly average ammonia nitrogen effluent concentrations limits occurring annually between April 1 and September 30

(‡) Daily maximum and monthly average ammonia nitrogen effluent concentrations limits occurring annually between (October 1 and March 31).

(**) E. coli testing expressed as a geometric mean.

Sampling for effluent total phosphorus and total nitrogen shall be performed during the aforementioned time period. This testing shall afford an assessment of the treatment technology and its ability to remove total nitrogen and total phosphorus from the waste stream. Both effluent total phosphorus and effluent total nitrogen shall be tested once per week. Monthly average effluent mass loads shall be calculated as an average of weekly measurements obtained during the month divided by the total volumetric flow for the month. A performance optimization plan (POP) shall be submitted to the MDNR by 2027 which affords monitoring of dissolved oxygen within the biological unit process and its impacts on total nitrogen removal, with an eye toward reducing the effluent mass load to the maximum extent possible.



3 Process Flow Diagram

The purpose of the Process Flow Diagram is to display the various WWTF liquid and solid treatment train unit processes improvements necessary to remove contaminants and to meet NPDES permit discharge requirements. The proposed liquid and solids handling process schematics are shown in G-series drawings. A summary of all unit processes is listed below. Design details of the proposed improvements are presented in subsequent sections.

Table 3-1. Unit Processes – PH2B Improvements & Modifications

Unit Process Description	Existing	Modification/ Improvement	New
Influent Pump Station		X	
Influent Flow Measurement	X		
Headworks – Peak Flow Splitter	X		
Headworks – Screen & Washer- Compactor	X		
Oxidation Ditch	X		
Secondary Clarifier(s)		X	
Effluent Flow Measurement	X		
Intermediate Pump Station	X		
UV Disinfection – Dry Weather	X		
UV Disinfection – Wet Weather	X		
Chemical P Removal	X		
Aerobic Digester / Sludge Storage	X		
Sludge Dewatering	X		
Peak Flow Storage Basin	X	X	
Electrical Secondary Improvements	X	X	
Tertiary Filter			X
Miscellaneous Site Improvements			X



4 Hydraulic Profiles

The purpose of the Hydraulic Profile is to depict the selected design control elevations for each of the WWTF's unit processes commencing at the Influent Pump Station and ceasing at the plant outfall structure. Design calculations are based upon applicable average and peak flow design capacities of each unit process and reflect accepted practices for water surface freeboard levels. The dry weather and wet weather hydraulic profiles are shown in Appendix B.



5 Wastewater Treatment Plant Improvements

5.1 Influent Pump Station

The Influent Pump Station is located at the southeastern end of the WWTF site and receives all flow from the Salem wastewater collection system. The station is configured as a quadruplex submersible pump station, with two average day flow (ADF) pumps and two peak flow (PF) pumps. The two existing ADF pumps were installed in 2020 as an emergency replacement of two failed pumps. The new pumps were Fairbanks-Nijius Model 8" D5434SMV 10 Hp pumps rated for 950 GPM at 19.3 FT TDH. The remaining two PF pumps are Fairbanks-Morse Model D5434SMV 20Hp pumps rated for 2000 gpm at 21 FT TDH at 900 RPM and are original to the pump station.

Within the scope of this improvements project, all existing pumps shall be removed from service. Four (4) new submersible chopper pumps. New chopper pumps shall be: Vaughan SE8N, 15 HP, 580 RPM, 480VAC, 3-phase, 60 Hz units having a 16 IN impeller and rated for 1,000 GPM at 25 FT TDH; Hayward Gordon CHOPX8L-B, 15 HP, 1200 RPM, 480VAC, 3-phase 60 Hz unit having a 11.13 IN impeller and rated for 1,000 GPM at 32 FT TDH; or approved equal. The pump station shall have a quadruplex configuration, operating in a lead, lag1, lag2, lag3 configuration. With three (3) pumps operating simultaneously in parallel, the pumps station shall have the capacity to convey the design peak influent flow of 7.0 MGD.

All valve vault process piping shall be replaced, with the exception of existing wall pipes. New valves, to include cushioned swing check and excentric plug valves shall be installed.

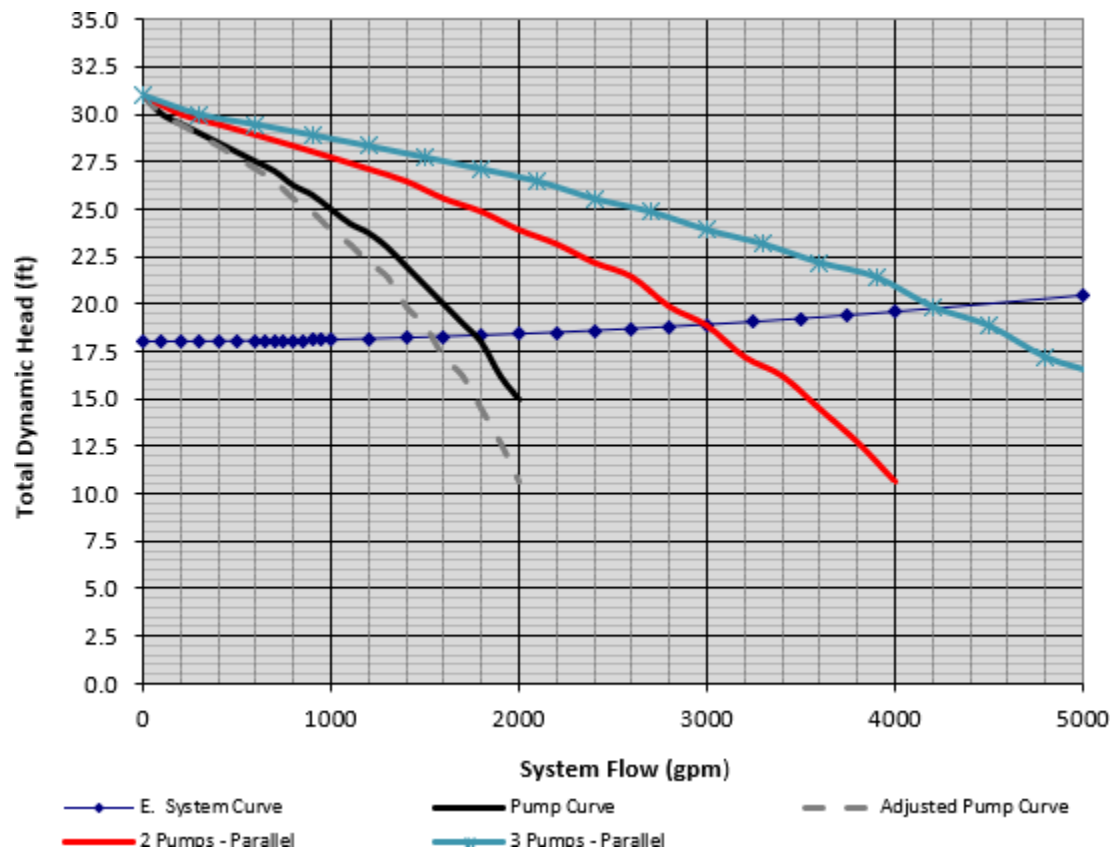
A new control and instrumentation package shall be provided for the facility. The existing control building shall be demolished and a new control building having a larger footprint shall be constructed. The new control building shall house four (4) free-standing VFD enclosures and shall be air conditioned to prevent overheating of the VFDs during warm weather. The IPS control panel (IPSCP) primary control system (PCS) shall interface with each VFD enclosure and operate the pumps in lead, lag1, lag2, lag3 load sharing configuration based on feedback from a wetwell mounted pressure transducer. A proportional-integral-differential (PID) control loop shall be established with the process maintaining a constant water surface elevation within the wetwell. Lead pump assignments shall be alternated based on an operator adjustable timer to balance pump runtimes across all pumps. In the event of a failure of the PCS, the IPSCP shall transition to a secondary control system (SCS) which will operated based on float switch control. The SCS will operate the pump at constant speed. The VFDs shall be provided with bypass contactors, providing the operator with additional redundancies should the VFDs fail. The operator can manually select the bypass contactor operation at the VFD enclosure. The VFD enclosures shall provide operator access to both the VFD and bypass contactor programming for local operation of the equipment should the IPSCP fail.

Two (2) existing jib cranes shall be demolished and new crane equipment shall be provided. A new jib crane shall be installed at the east end of the station to afford the removal of the macerator-grinder unit from the wetwell via the guiderail system. A second crane shall be installed at the west edge of the station to allow the removal of the pump equipment from the wetwell.

The IPS is presented in IPS-series drawings. Design parameters are provided in the table below.

**Table 5-1. Influent Pump Station Design Parameters**

Flow	
Required Pumping Capacity @ ADF (MGD)	1.25
Required Pumping Capacity @ PHF (MGD)	7.00
Proposed Equipment Summary	
Pumps in Service	3 Duty
Pumps in Storage	1 Spare
Single Pump Capacity @ 25 FT TDH (GPM)	1,000
Two Pumps Operating in Parallel @ 15.9 FT TDH (GPM)	2,825
Three Pumps Operating in Parallel @ 13.0 FT TDH (GPM)	4,875
Pump Size, Max (HP)	15.0

**Figure 5.1-1 IPS System Curve at WSE = Pump OFF (1108.00), $C_h = 120$**

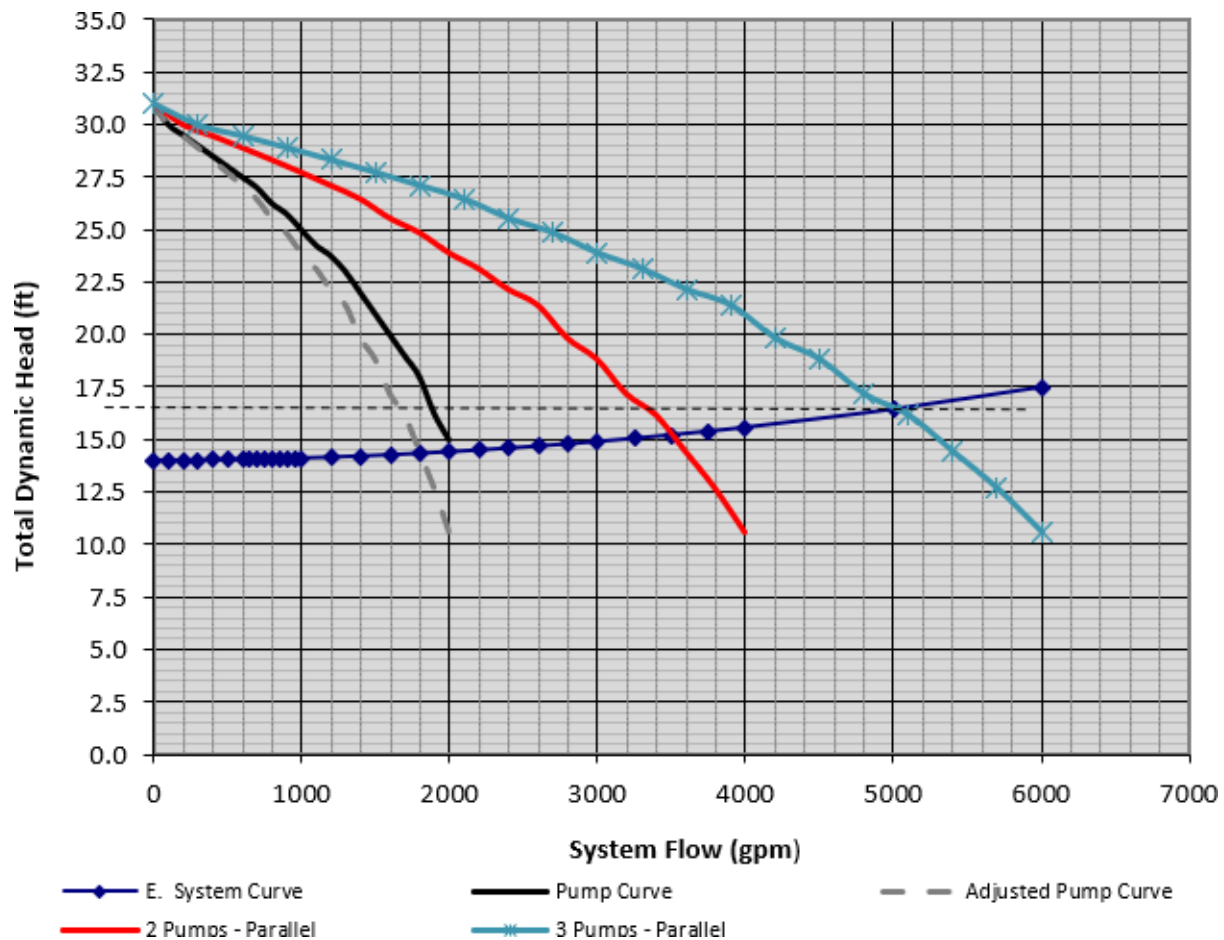


Figure 5.1-2 IPS System Curve at WSE = 1112.00 FT, $C_h = 120$

5.1.1 Calculations

Process calculations are provided below.

Volume for Pump Start

$$\text{Volume (gal)} = \text{Area} \times (\text{Pump On} - \text{Pump Off}) \times 7.4805$$

$$\text{Volume (gal)} = 186.67 \times \text{SF} \times (1110.75 - 1107.75) \times 7.4805 = 4,189$$

Cycle Time

$$\text{Cycle Time (min)} = (4 \times \text{Volume for Pump Start}) / (\text{Pump Capacity})$$

$$(\text{min}) = (4 \times 4,189.6 \text{ gal}) / 1,050 \text{ gpm} = 16.0$$

Pump Starts per Hour

$$\text{Pump Starts per Hour} = 60 \text{ min} / \text{Cycle Time}$$

$$\text{per Hour} = 60 \text{ min} / 16.0 \text{ min} = 3.75$$

$$\text{Pump Starts per Hour per Pump} = 3.75 / 4 \text{ pumps} = 0.9375$$



5.2 Secondary Clarifiers

The Salem WWTF Phase 2 Improvements projects shall require the selective demolition and repair of Secondary Clarifier mechanisms, and telescoping valve. These include but are not limited to:

- replacement of existing scraper squeegees;
- replacement of turnbuckles and tie rods;
- replacement of steady shaft and journal bearing;
- replacement of skirt and attachment hardware;
- replacement of drive motor and primary gear reducer;
- replacement of existing 8" telescoping valve,

Within the scope of the scheduled improvements, the existing mechanisms, to include the bridges, shall receive a new coating system. New scum baffles shall be added to the exterior face of the secondary clarifier launder trough to reduce transfer of floatable solids to the downstream tertiary filtration process. New torque based controls shall be installed with the new clarifier drive units.

Under slab RAS piping shall be modified to afford greater operator control of settle mixed liquor thickening. The existing underslab piping is configured as an 8 IN diameter line, which under certain flow conditions causes plugging of the line due to low flow velocities. This limits the turn-down of the telescoping valve and results in numerous issues in the solids handling process downstream. The existing under slab piping shall be slip lined to afford a nominal diameter of 6 IN. New 6 IN telescoping valves shall be installed.

Table 5-2. Secondary Clarifier Design Parameters

Flow	
Average Dail Flow (MGD)	1.25
Peak Flow (MGD)	3.62
Min RAS Withdrawal Rate (% of ADF)	50
Max RAS Withdrawal Rate (% of ADF)	150
Proposed Equipment Summary	
6 IN RAS Piping Velocity at 0.5 x ADF (FPS)	1.61
6 IN RAS Piping Velocity at 1.5 x ADF (FPS)	4.82
6 IN Telescoping Valve Travel (IN)	48



5.2.1 Calculations

Process calculations are provided below.

Sludge Withdraw at 0.50 x ADF

Velocity (FPS) = ADF / Pipe Area

$$\text{Velocity (FPS)} = [0.5 * (1.25 \text{ MGD} / 3 \text{ clarifiers} * 1.5473)] / [(6.05 \text{ IN} / 12)^2 / 4 * \pi] = 1.61$$

Sludge Withdraw at 1.50 x ADF

Velocity (FPS) = ADF / Pipe Area

$$\text{Velocity (FPS)} = [1.5 * (1.25 \text{ MGD} / 3 \text{ clarifiers} * 1.5473)] / [(6.05 \text{ IN} / 12)^2 / 4 * \pi] = 4.82$$

Preferred minimum velocity in RAS piping = 2.0 FPS. Note that minimum pipe size for gravity withdraw is 6 IN.

5.3 Tertiary Filter

The Salem WWTF Phase 2 Improvements project shall require the installation of a new tertiary filtration process to afford low levels of effluent BOD, TSS and TP. Cloth media surface filters shall be installed immediately downstream of the secondary clarifiers and immediately upstream of the UV Disinfection process. Flow to the process shall be from two discrete sources: secondary clarifier effluent (SCE); peak flow storage basin effluent (PFSB). The PFSB and SCE shall be conveyed to and pumped by the existing Intermediate Pump Station up to the filtration process. Flow shall be by gravity through the filtration and UV disinfection process to the plant outfall.

The design of the wastewater treatment system includes comprehensive specifications for effluent filtration, ensuring effective flow distribution, media protection, and operational efficiency. Each filter unit will have adequate freeboard above the media and an influent baffle system to prevent media displacement. The design accounts for cold climate conditions by providing filter enclosures, covers, and emergency power to maintain operations during outages. Filter units will have a drain line for tank drainage, and backwash liquids will be returned to the aeration basin for treatment. Maintenance access is provided for all components, and HVAC systems will regulate humidity in enclosed spaces, which are rated Class 1, Division 2 per NFPA 820. The filtration media will be cloth or disc with a maximum pore size of 30 microns, chemically resistant to filtration chemicals. Hydraulically, the system will provide variable flow rates, with a filtration area based on submerged media and a maximum filtration rate of 6.5 GPM/FT² at peak flow. Automatic controls, including manual override and headloss monitoring, will be implemented for each unit. Additionally, the facility will be designed to accommodate chemical application for phosphorus removal and ensure fire protection measures according to NFPA standards.

**Table 5-3. Tertiary Filter Design Parameters**

Flow	
Average Dail Flow (MGD)	1.25
Peak Flow (MGD)	7.0
Process Influent TSS (mg / L)	30
Target Effluent TSS (mg / L)	5
Max Surface Loading Rate (GPM FT ²)	5.0 (ADF) 6.5 (PF)
Proposed Equipment Summary	
No. Units	2
Total Filter Area Per Unit (FT ²)	925
Total Submerged Filter Area Per Unit (FT ²)	604
No. of Discs Per Unit	14
Media Pore Size, μm	10
Backwash flowrate, GPM	117
Backwash Pump Size, HP	15

5.3.1 Calculations

Media Surface Area at ADF, A_{ADF}

$$A_{ADF} = (1.25 \text{ MGD})(1,000,000 \text{ GAL/MG}) / (1440 \text{ MIN/D}) / (5.0 \text{ GPM/FT}^2) = 173.61 \text{ FT}^2$$

Note: supplied submerged filter unit media area is 604 FT².

Media Surface Area at PF, A_{PF}

$$A_{ADF} = (7.0 \text{ MGD})(1,000,000 \text{ GAL/MG}) / (1440 \text{ MIN/D}) / (6.5 \text{ GPM/FT}^2) = 747.86 \text{ FT}^2$$

Note: supplied submerged media filter area provided is 1,208 FT².

Backwash Water Required

$$VBW = (1.25 \text{ mgd})(1,000,000 \text{ GAL/MG})(5\%) = 62,500 \text{ GAL}$$



5.4 Non-potable Water Pumping Station

The Non-potable Water Pump Station (NPWPS) shall be located south of the Garage structure. The NPWPS is presented in NPWPS-series drawings. Design parameters are provided in the table below.

The NPWPS shall be designed to accommodate peak/fireflow demands at the Tertiary Filtration Building and washdown operations at the Peak Flow Storage Basin. The NPWPS shall also accommodate for pressure fluctuations in the nonpotable water piping system which occur as a result of daily demands associated with normal washdown operations. The pumps submersible, non-clog centrifugal-style pumps rated for installation within a clearwell. One 11 HP, 480VAC, 3-ph, 60 Hz jockey pump rated for 100 GPM at 147 FT TDH shall operate at variable speed to maintain a system static pressure of 60 PSI for normal daily demands. Two new 25 HP, 480VAC, 3-phase, 60 Hz peak flow pumps rated for 500 GPM at 116 FT TDH shall be operated at constant speed to meet the applicable peak/fireflow demands. The peak flow pumps shall operated in a lead-standby configuration with automatic alternation between each successive call to run.

Secondary clarifier effluent shall be diverted from the main process flow, downstream of the effluent flow meter. The secondary clarifier effluent shall flow by gravity to fill a new 10 FT diameter clearwell having adequate volume to provide the NFPA 820 required 500 GPM for 6 MIN.

Table 5-4. Non-potable Water Pump Station Design Parameters

Flow	
Required Max Jockey Pump Capacity (GPM)	0-100
Required Max Peak Demand Pump	500 GPM 6 MIN
Proposed Equipment Summary	
Jockey Pumps in Service	1 Duty
Peak Demand Pumps in Service	1 Duty 1 Standby
Jockey Pump Operating Duty Point:	100 GPM, 147 FT TDH
Jockey Pump Size (HP)	11.0
Peak Demand Pump Operating Duty Point:	500 GPM, 116 FT TDH
Pump Size, Max (HP)	25.0
Clear Well Diameter (FT)	10
Min Clearwell Storage Volume (GAL)	3,000
Min Clearwell Recharge Rate (GPM)	277 (Min Day) 743 (Ave Day)

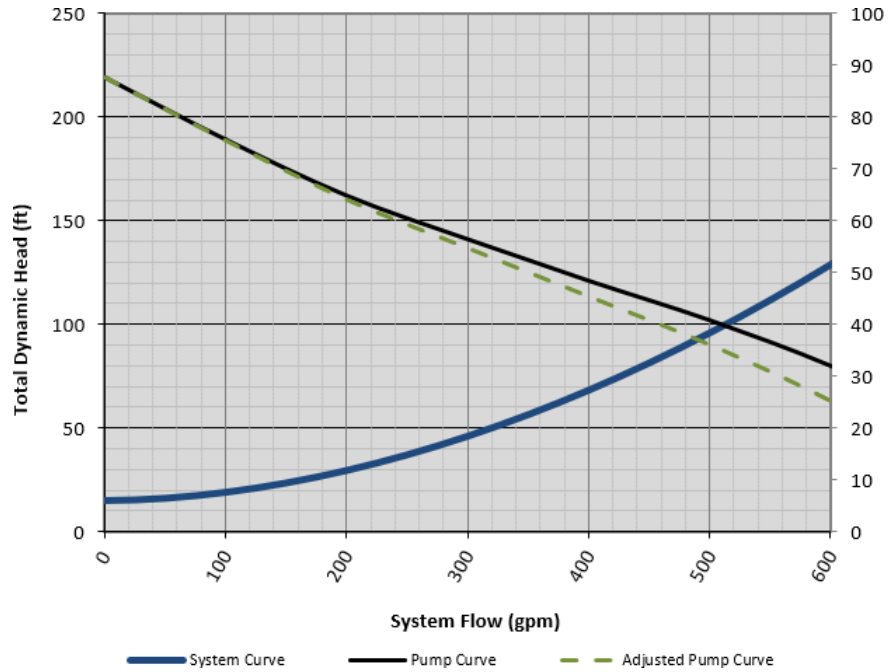


Figure 5.1-1 NPWPS Peak Demand Pump Operation at Min Clearwell Operating WSE, C_h = 120

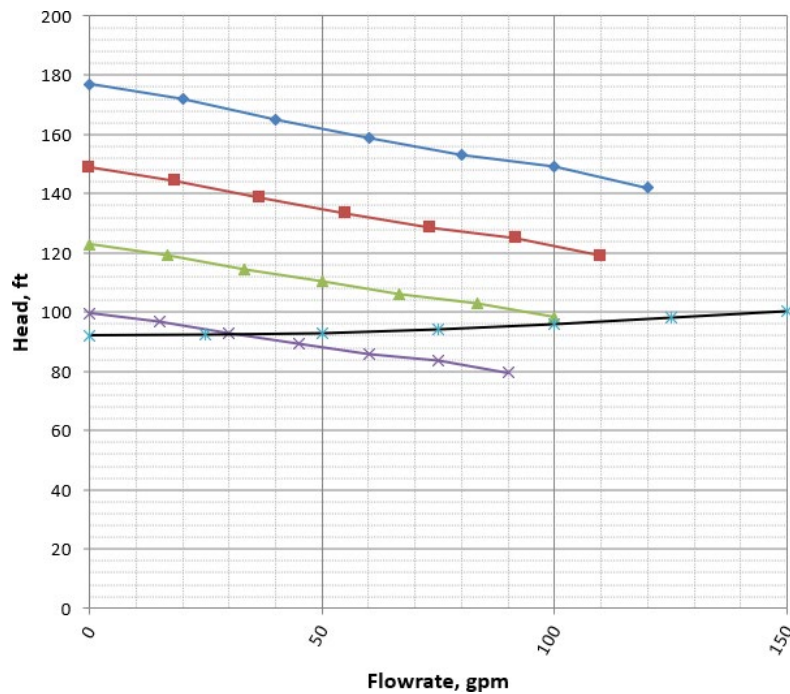


Figure 5.1-2 NPWPS Jockey Pump VFD Operation (45 Hz to 60 Hz) at Minimum System Pressure, C_h = 120



6 Instrumentation

Instrumentation selection will be based on reliability and maintenance considerations. Analog instruments will communicate via 4-20mA signals and digital signals to provide the operator local indication of process status.

The following is a representative list of the type of instruments proposed for specific applications:

- Wetwell / Liquid Level:
 - sealed PVC coated mercury-free weighted float level switches will also be utilized. Float switches are a proven industry standard reliable backup technology. Float switches also enable hardwire interlocks with motor control circuits for failsafe operation.
 - pressure transducer. Foaming and floatables are expected to be present within the wetwell. To minimize inaccurate level readings, a pressure transducer installed within a PVC stilling well shall be used.
 - Conductive level probe / switch. Probes with multiple switches installed at fixed distances, providing set point indication, for installation in wetwells with turbulence or potential for foaming. Discrete conductive switches for indication of process liquid level.
- Pressure and Differential Pressure: Electronic pressure transmitters and/or switches.
- In-Line Pressure Indication: standard pressure gauge. For pressure gauges in liquid sludge applications, a diaphragm will be placed between the liquid and the gauge.
- Combustible gas detector: Multi-gas, multi-sensor with analog level and digital alarm indications. Required by NFPA 820 for classified areas.
- Air Flow: Air flow switch for combustible gas detection thermal-dispersion type.



APPENDIX A – NPDES PERMIT



APPENDIX B – PROCESS SCHEMATIC & HYDRAULIC PROFILE



MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM
**APPLICATION FOR CONSTRUCTION PERMIT –
WASTEWATER TREATMENT FACILITY**

FOR DEPARTMENT USE ONLY

APP NO.	CP NO.
FEE RECEIVED	CHECK NO.
DATE RECEIVED	

APPLICATION OVERVIEW

The Application for Construction Permit – Wastewater Treatment Facility form has been developed in a modular format and consists of Part A and B. **All applicants must complete Part A.** Part B should be completed for applicants who currently land-apply wastewater or propose land application for wastewater treatment. **Please read the accompanying instructions before completing this form. Submittal of an incomplete application may result in the application being returned.**

PART A – BASIC INFORMATION

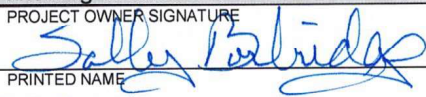
1.0 APPLICATION INFORMATION (Note – If any of the questions in this section are answered NO, this application may be considered incomplete and returned.)

- 1.1 Is this a Federal/State funded project? ☒ YES ☐ N/A Funding Agency: SRF&CDBG Project #: C295924-01
2023-WW-04-ST
- 1.2 Has the Missouri Department of Natural Resources approved the proposed project's antidegradation review?
☐ YES Date of Approval: _____ ☒ N/A
- 1.3 Has the department approved the proposed project's facility plan*?
☒ YES Date of Approval: 03/2023 ☐ NO (If No, complete No. 1.4.)
- 1.4 [Complete only if answered No on No. 1.3.] Is a copy of the facility plan* for wastewater treatment facilities included with this application?
☐ YES ☐ NO ☐ Exempt because _____
- 1.5 Is a copy of the appropriate plans* and specifications* included with this application?
☒ YES Denote which form is submitted: ☐ Hard copy ☒ Electronic copy (See instructions.) ☐ NO
- 1.6 Is a summary of design* included with this application? ☒ YES ☐ NO
- 1.7 Has the appropriate operating permit application (A, B, or B2) been submitted to the department?
☐ YES Date of submittal: _____
☒ Enclosed is the appropriate operating permit application and fee submittal. Denote which form: ☐ A ☐ B ☒ B2
☐ N/A: However, In the event the department believes that my operating permit requires revision to permit limitation such as changing equivalent to secondary limits to secondary limits or adding total residual chlorine limits, please share a draft copy prior to public notice? ☐ YES ☐ NO
- 1.8 Is the facility currently under enforcement with the department or the Environmental Protection Agency? ☒ YES ☐ NO
- 1.9 Is the appropriate fee or JetPay confirmation included with this application? ☐ YES ☒ NO
See Section 7.0

* Must be affixed with a Missouri registered professional engineer's seal, signature and date.

2.0 PROJECT INFORMATION

2.1 NAME OF PROJECT Salem WWTF PH2B Improvements	2.2 ESTIMATED PROJECT CONSTRUCTION COST \$ 4,801,900
2.3 PROJECT DESCRIPTION Upgrades to existing Influent pump station, Secondary Clarifiers, Non-potable water pump station, Construction of new Tertiary Filter.	
2.4 SLUDGE HANDLING, USE AND DISPOSAL DESCRIPTION Accumulated biomass is stabilized via aerobic digestion and dewatered utilizing sludge reed beds/sludge bag dewatering system. Dewatering biosolids are land applied as a solid.	
2.5 DESIGN INFORMATION A. Current population: _____; Design population: _____ B. Actual Flow: _____ gpd; Design Average Flow: _____ gpd; Actual Peak Daily Flow: _____ gpd; Design Maximum Daily Flow: _____ gpd; Design Wet Weather Event: _____	
2.6 ADDITIONAL INFORMATION A. Is a topographic map attached? ☒ YES ☐ NO B. Is a process flow diagram attached? ☒ YES ☐ NO	

3.0 WASTEWATER TREATMENT FACILITY				
NAME Salem WWTF		TELEPHONE NUMBER WITH AREA CODE 573-729-6308		E-MAIL ADDRESS wwtp@salemмо.com
ADDRESS (PHYSICAL) 1/4 MI NW intersection Adelmanн & Hwy 19	CITY Salem	STATE MO	ZIP CODE 65560	COUNTY Dent
Wastewater Treatment Facility: Mo- (Outfall Of)				
3.1 Legal Description: _____ 1/4, _____ 1/4, _____ 1/4, Sec. 12, T 43, R 6W (Use additional pages if construction of more than one outfall is proposed.)				
3.2 UTM Coordinates Easting (X): 628874 Northing (Y): 4168633 For Universal Transverse Mercator (UTM), Zone 15 North referenced to North American Datum 1983 (NAD83)				
3.3 Name of receiving streams: Spring Creek				
4.0 PROJECT OWNER				
NAME City of Salem		TELEPHONE NUMBER WITH AREA CODE 573-729-4811		E-MAIL ADDRESS cityadministrator@salemмо.com
ADDRESS 400 N Iron St	CITY Salem	STATE MO	ZIP CODE 65560	
5.0 CONTINUING AUTHORITY: A continuing authority is a company, business, entity or person(s) that will be operating the facility and/or ensuring compliance with the permit requirements.				
NAME City of Salem		TELEPHONE NUMBER WITH AREA CODE 573-729-4811		E-MAIL ADDRESS cityadministrator@salemмо.com
ADDRESS 400 N Iron St	CITY Salem	STATE MO	ZIP CODE 65560	
5.1 A letter from the continuing authority, if different than the owner, is included with this application. ☐ YES ☐ NO ☒ N/A				
5.2 COMPLETE THE FOLLOWING IF THE CONTINUING AUTHORITY IS A MISSOURI PUBLIC SERVICE COMMISSION REGULATED ENTITY.				
A. Is a copy of the certificate of convenience and necessity included with this application? ☐ YES ☐ NO				
5.3 COMPLETE THE FOLLOWING IF THE CONTINUING AUTHORITY IS A PROPERTY OWNERS ASSOCIATION.				
A. Is a copy of the as-filed restrictions and covenants included with this application? ☐ YES ☐ NO				
B. Is a copy of the as-filed warranty deed, quitclaim deed or other legal instrument which transfers ownership of the land for the wastewater treatment facility to the association included with this application? ☐ YES ☐ NO				
C. Is a copy of the as-filed legal instrument (typically the plat) that provides the association with valid easements for all sewers included with this application? ☐ YES ☐ NO				
D. Is a copy of the Missouri Secretary of State's nonprofit corporation certificate included with this application? ☐ YES ☐ NO				
6.0 ENGINEER				
ENGINEER NAME / COMPANY NAME Kenneth Campbell / Archer-Elgin		TELEPHONE NUMBER WITH AREA CODE 573-364-6362		E-MAIL ADDRESS kcampbell@cmarcher.com
ADDRESS 310 E 6th St	CITY Rolla	STATE MO	ZIP CODE 65401	
7.0 APPLICATION FEE				
☐ CHECK NUMBER ☐ JETPAY CONFIRMATION NUMBER				
8.0 PROJECT OWNER: I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.				
PROJECT OWNER SIGNATURE 				
PRINTED NAME Sally Burbridge			DATE April 1, 2025	
TITLE OR CORPORATE POSITION City Administrator		TELEPHONE NUMBER WITH AREA CODE 573-729-4811		E-MAIL ADDRESS cityadministrator@salemмо.com
Mail completed copy to: MISSOURI DEPARTMENT OF NATURAL RESOURCES WATER PROTECTION PROGRAM P.O. BOX 176 JEFFERSON CITY, MO 65102-0176				
END OF PART A. REFER TO THE APPLICATION OVERVIEW TO DETERMINE WHETHER PART B NEEDS TO BE COMPLETE.				

PART B – LAND APPLICATION ONLY

(Submit only if the proposed construction project includes land application of wastewater.)

8.0 FACILITY INFORMATION

8.1 Type of wastewater to be irrigated: ☐ Domestic ☐ State/National Park ☐ Seasonal business
☐ Municipal ☐ Municipal with a pretreatment program or significant industrial users
☐ Other (explain) _____

8.2 Months when the business or enterprise will operate or generate wastewater:
☐ 12 months per year ☐ Part of the year (list months): _____

8.3 This system is designed for:
☐ No-discharge.
☐ Partial irrigation when feasible and discharge rest of time.
☐ Irrigation during recreational season, April – October, and discharge during November – March.
☐ Other (explain) _____.

9.0 STORAGE BASINS

9.1 Number of storage basins: _____ (Use additional pages if greater than three basins.)

9.2 Type of basins: ☐ Steel ☐ Concrete ☐ Fiberglass ☐ Earthen ☐ Earthen with membrane liner

9.3 Storage basin dimensions at inside top of berm (feet). Report freeboard as feet from top of berm to emergency spillway or overflow pipe.

Basin #1: Length _____	Width _____	Depth _____	Freeboard _____	Depth _____	Safety _____	% Slope _____
Basin #2: Length _____	Width _____	Depth _____	Freeboard _____	Depth _____	Safety _____	% Slope _____
Basin #3: Length _____	Width _____	Depth _____	Freeboard _____	Depth _____	Safety _____	% Slope _____

9.4 Storage Basin operating levels (report as feet below emergency overflow level).

Basin #1: Maximum operating water level _____ ft	Minimum operating water level _____ ft
Basin #2: Maximum operating water level _____ ft	Minimum operating water level _____ ft
Basin #3: Maximum operating water level _____ ft	Minimum operating water level _____ ft

9.5 Design depth of sludge in storage basins.
 Basin #1: _____ ft Basin #2: _____ ft Basin #3: _____ ft

9.6 Existing sludge depth, if the basins are currently in operation.
 Basin #1: _____ ft Basin #2: _____ ft Basin #3: _____ ft

9.7 Total design sludge storage: _____ dry tons and _____ cubic feet

10.0 LAND APPLICATION SYSTEM

10.1 Number of irrigation sites _____ Total Acres _____ Maximum % field slopes _____

Location: _____ 1/4, _____ 1/4, _____ 1/4, _____ 1/4	Sec. _____ T _____ R _____	County _____	Acres _____
Location: _____ 1/4, _____ 1/4, _____ 1/4, _____ 1/4	Sec. _____ T _____ R _____	County _____	Acres _____
Location: _____ 1/4, _____ 1/4, _____ 1/4, _____ 1/4	Sec. _____ T _____ R _____	County _____	Acres _____

(Use additional pages if greater than three irrigation sites.)

10.2 Type of vegetation: ☐ Grass hay ☐ Pasture ☐ Timber ☐ Row crops
☐ Other (describe) _____

10.3 Wastewater flow (dry weather) gallons per day: Average annual _____ Seasonal _____ Off-season _____

10.4 Land application rate (design flow including 1-in-10 year storm water flows):
 Design: _____ inches/year _____ inches/hour _____ inches/day _____ inches/week
 Actual: _____ inches/year _____ inches/hour _____ inches/day _____ inches/week

10.5 Total irrigation per year (gallons): Design: _____ gal Actual: _____ gal

10.6 Actual months used for irrigation (check all that apply):
☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec

10.7 Land application rate is based on:
☐ Hydraulic Loading ☐ Other (describe) _____
☐ Nutrient Management Plan (N&P) If N&P is selected, is the plan included? ☐ YES ☐ NO

Part A, Section 2.0

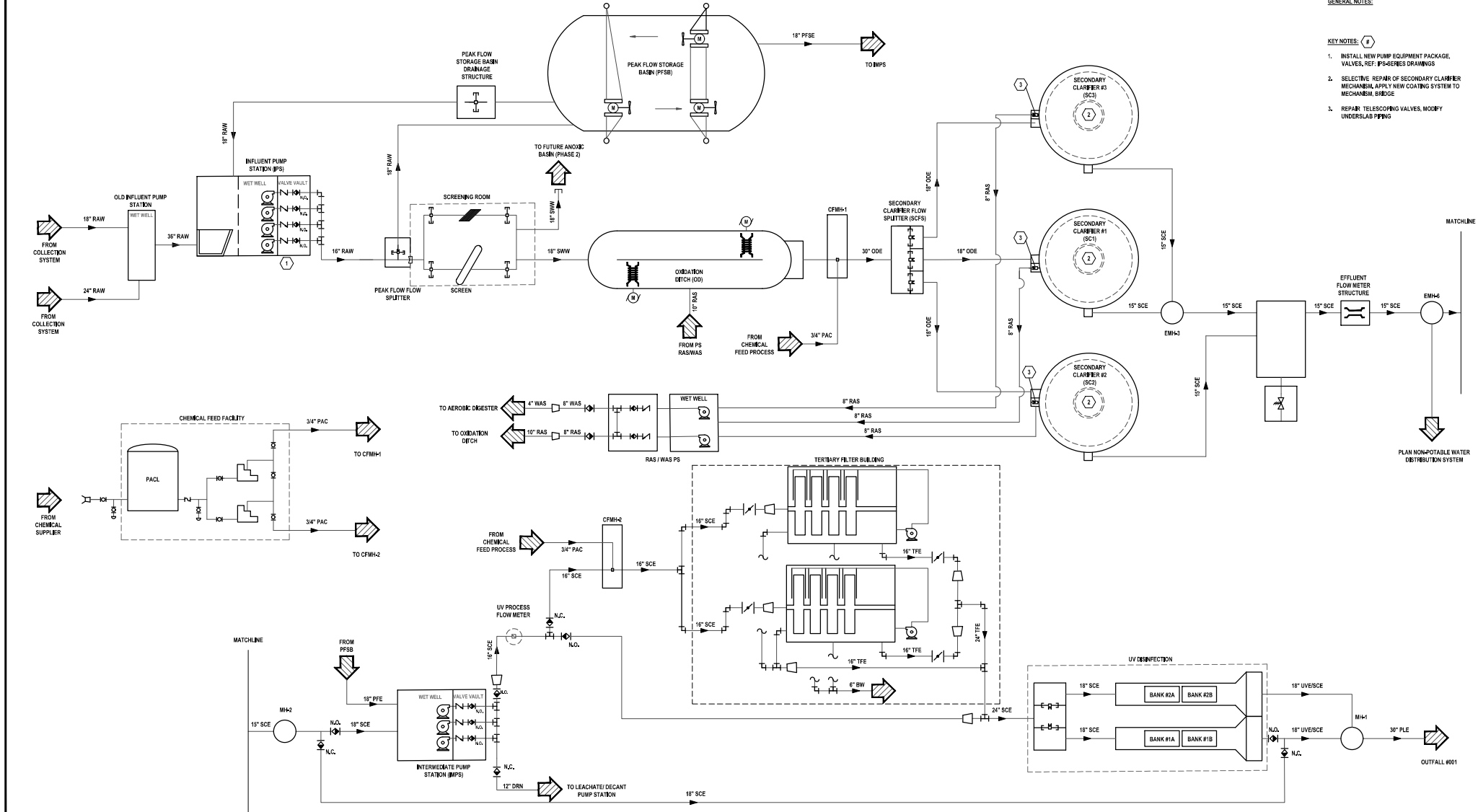
Section 2.5B: Design Information

Actual Flow	1.055	MGD
Design Average Flow	1.25	MGD
Actual Peak Daily Flow	7.0	MGD
Design Maximum Daily Flow	N/A	MGD
Design Wet Weather Event	7.0	MGD

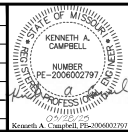
GENERAL NOTES:

KEY NOTES: #

1. INSTALL NEW PUMP EQUIPMENT PACKAGE, VALVES, REF: PS-SERIES DRAWINGS
2. SELECTIVE REPAIR OF SECONDARY CLARIFIER MECHANICAL, APPLY NEW COATING SYSTEM TO MECHANICAL, DRUDGE
3. REPAIR, TELESCOPING VALVES, MODIFY UNDERSLAB PIPING



☒ - Preliminary, not for construction, recording purposes or implementation																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							</
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CM Archer Group, P.C., dba:

ARCHER-ELGIN

ENGINEERING | SURVEYING | ARCHITECTURE

Corporate Authority:

CM Archer Group, P.C., E: 2005023812-0, LS: 2004017977-0, A-2016017179

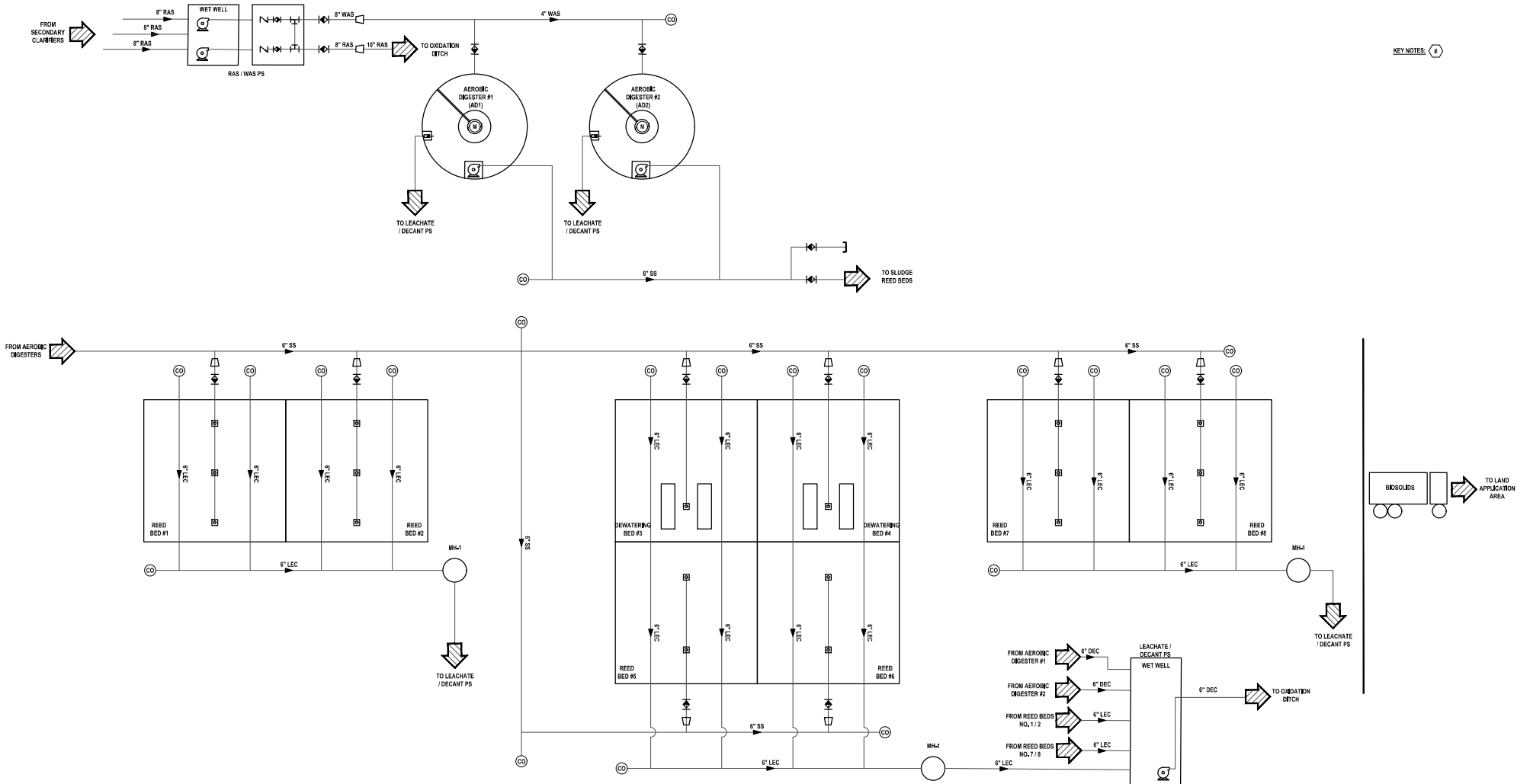
310 East 10th Street, St. Louis, Missouri 63101 • Phone: 572-884-0102 • Fax: 572-884-4702 • info@archer-elgin.com

Salem WWTF Phase 2B Improvements Salem, Missouri		PROJECT NO. 19072111-15
Proposed Facility Flow Diagram Liquid Treatment Train		DRAWING NO. C-300

GENERAL NOTES:

1.

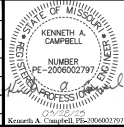
KEY NOTES: 1



☒ - Preliminary, not for construction, recording purposes or implementation

☐ - This is a reduced copy, not for construction, recording purposes or implementation

DESIGNED / DRAWN BY:	DATE:	No.	DATE	BY	ISSUED TO THE MDNR
KAC/WT	03/28/25	1	03-28-25	KAC	REVISION BLOCK



Corporate Authority:
CM Archer Group, P.C., E. 2003023812-0, LS. 2004017577-0, A-2016017175
310 East 18th Street, Suite 1500, St. Louis, Missouri 63103 • Phone: 314-464-4362 • Fax: 314-464-4702 • www.archer-elgin.com

Salem WWTF Phase 2B Improvements
Salem, Missouri

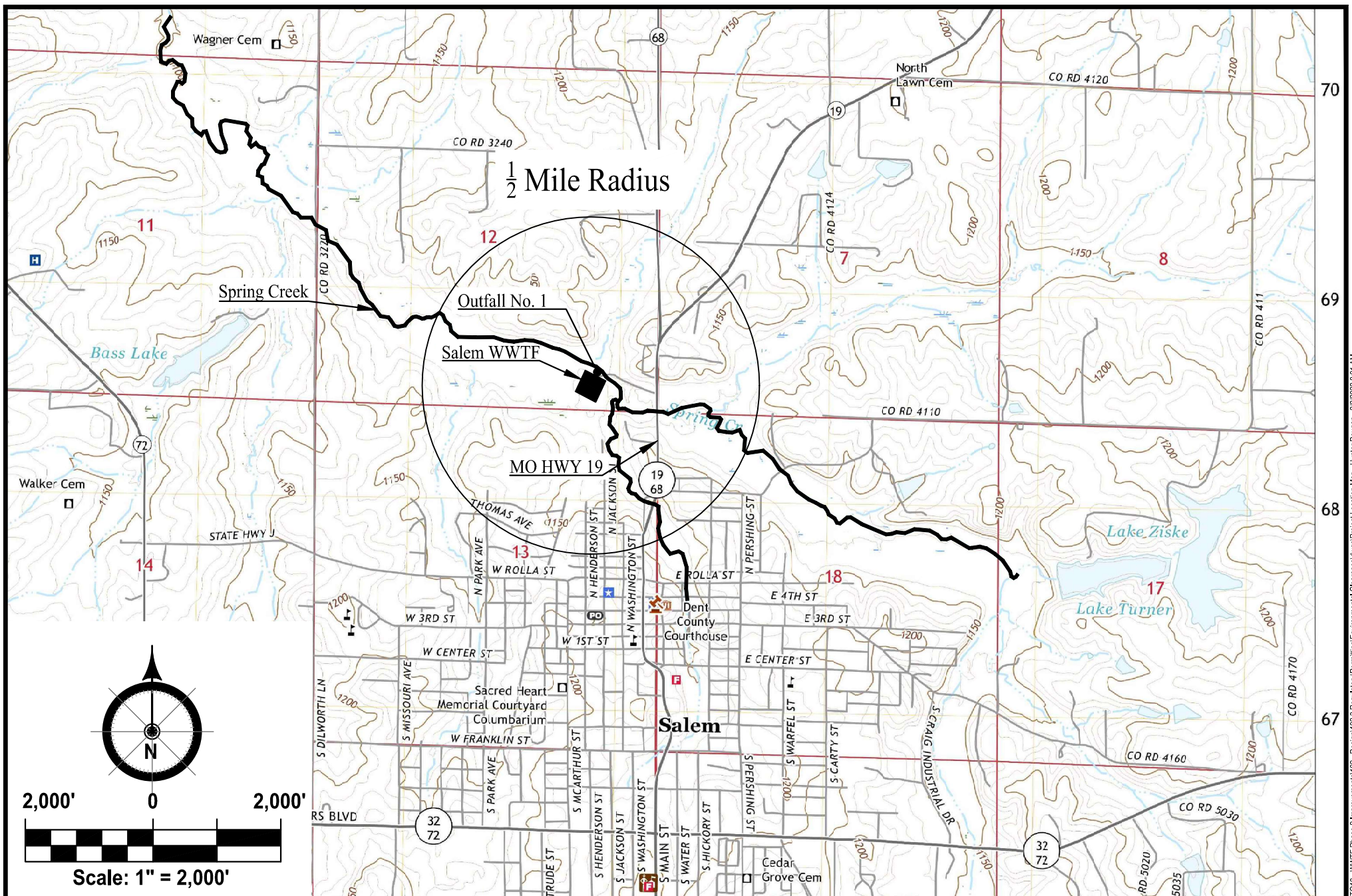
Proposed Facility Flow Diagram
Solids Treatment Train

PROJECT NO.

19072111-15

DRAWING NO.

G-301



DATE: 02/02/22	PRELIMINARY DRAWING FOR REVIEW AND APPROVAL PURPOSES ONLY. FINAL PLANS WILL BE SIGNED, SEALED, & ISSUED UPON RECEIPT OF ALL PLAN REVIEW COMMENTS AND APPROVALS FROM LOCAL, STATE, AND FEDERAL REGULATORY AGENCIES.	Corporate Authority: CM Archer Group, P.C.: E: 2003023612, LS: 2004017577-D Archer-Elgin Surveying & Engineering, LLC: E: 2011024038, LS: 2011025471, A-2012014618	CM Archer Group, P.C. dba: ARCHER-ELGIN engineering surveying architecture Office Location: 310 East Sixth Street Rolla, Mo. 65401 573-364-6362 • Fax 573-364-4782 www.archer-elgin.com	Salem WWTF Salem, Missouri	PROJECT NO. 1907211-10
DESIGNED BY: HPD					DRAWING NO. 1
DRAWN BY: HPD				Project Location Map SE 1/4, SE 1/4, Sec 12, T34N, R6W	