

FINAL

SALINA WASTEWATER TREATMENT PLANT IMPROVEMENT PROJECT

Basis of Design Report

CITY OF SALINA PROJECT NO. 20028
B&V PROJECT NO. 407340
B&V FILE NO. 50.0100

PREPARED FOR



City of Salina, Kansas

11 MAY 2021



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1.0 General

1.1 Project Background and Drivers

The City of Salina retained Black & Veatch (BV) for Phase 1A of the Salina Wastewater Treatment Plant (WWTP) Improvement project. The scope for Phase 1A includes four different alternative evaluations to help define the project, a condition assessment of the existing facilities to further understand what can be reused and what needs to be replaced and drafting this Basis of Design Report (BDR). The purpose of this BDR is to communicate scope, objectives and design criteria to the City of Salina and the Kansas Department of Health and Environment (KDHE).

The Salina WWTP was first constructed in 1926 and has been modified numerous times, with the last major upgrade occurring in 1994. The primary driver for the project is requirements to improve the nutrient removal capabilities to meet new effluent permit goals for total nitrogen (TN), and total phosphorus (TP). It is expected that these improvements will be in accordance with the KDHE Schedule of Compliance. A secondary driver for this project is to replace the aging infrastructure. With the last major upgrade over 25 years ago, many of the components are reaching the end of their useful life.

The 1994 plant upgrade provided the current activated sludge treatment process and decommissioned some of the original treatment facilities. Since then, portions of various treatment process like blowers and intermediate pumping have been upgraded, but for the most part the 1994 project was the most recent major improvement. The current plant consists of the following treatment facilities.

- Preliminary Treatment consists of a Headworks Building with two mechanical fine screens. The grit removal utilizes two rectangular aerated grit basins with two classifiers to handle the settled grit.
- Primary Treatment includes four circular primary clarifiers. There are also two different primary sludge pump stations each associated with a set of two clarifiers.
- Intermediate Pumping sends primary effluent and Return Activated Sludge (RAS) to the head of the aeration basins. There are four pumps installed, two submersibles installed in 2011 and two screw pumps installed in 1994.
- Secondary Treatment includes three 905,080 gallon completely mixed aeration basins. The basins get air from the nearby Blower Building which houses four aeration blowers. Following the aeration basins, there are three circular clarifiers.
- UV Disinfection and Post Aeration
- Polymer and potassium hydroxide chemical feed systems
- Biosolids facilities
 - Gravity Belt Thickening
 - Two-stage Anaerobic Digestion
 - Belt Filter Press Dewatering
 - Associated pumping, heating, and blower facilities

1.2 Project Description

As part of this project described in this BDR, the Salina WWTP will be designed to treat an Annual Average (AA) flow of 6.4 million gallons per day (mgd) of wastewater through full secondary treatment with chemically enhanced primary treatment (CEPT). A general description of the current recommended improvements to the WWTP is as follows and has been organized into three prioritization categories.

- Essential for meeting NPDES effluent nitrogen and phosphorus goals/limits:
 - Retrofit the existing three aeration basins to incorporate biological nutrient removal (BNR). The original basins were constructed as part of the 1994 expansion. The exterior basin walls and slabs will be reused as the aeration basins are modified into BNR Basins. The BNR Basin improvements will include adding interior baffle walls, mixers, piping, diffusers, valves, pumps, and walkways.
 - Install new chemical feed systems for ferric chloride and polymer. The ferric chloride system will be an outdoor bulk storage system with feed pumps located in the lower level of the existing Gravity Belt Thickener Building. The polymer system will utilize tote storage with feeder blenders located in the lower level of the Gravity Belt Thickener Building.
- Essential for NPDES permit compliance:
 - The existing Salina WWTP includes three 80-foot diameter Final Clarifiers. During the 1994 expansion, a future addition of a fourth final clarifier was planned. As such, this project will include a new 80-foot diameter Final Clarifier 4 that matches the three existing final clarifiers. This Final Clarifier will be located south of the existing Final Clarifier 3.
- Essential for plant operations:
 - Miscellaneous Digestion and Sludge Gas Building improvements. Covers on Primary Digesters 1 and 2 will be replaced with radial beam covers with top mounted linear motion mixers. In the existing Digester Control Building, all electrically powered equipment and instruments will be rated for a classified space. The existing Sludge Gas Building improvements will include adding a foam separator and replacing the existing candlestick flare.
 - Construct a new Digester Boiler Building that will house boilers, primary heating water pumps, and the compressed air system associated with the Digester Complex. The Digester Boiler Building will be located north of the existing digester complex.
 - Miscellaneous equipment rehabilitation around the WWTP. Rehab work is expected at the Blower Building, Final Clarifiers, Digester Complex, and Sludge Gas Building to support the project improvements described above.

A discussion of the phasing plan for future facility improvements is included in Section 1.11.

1.2.1 Current Project Cost Model

Table 1-1 summarizes the BDR cost model for the current project scope that is the basis of this BDR.

Table 1-1 Current Project Scope Cost Model

Description	BDR Cost Model
Total Home Office CM Services	\$ 1,478,914
General Conditions - Preconstruction	\$ 56,198
General Conditions – Construction	\$ 2,997,338
General Conditions – Startup and Commissioning	\$ 138,444
Sitework	\$ 170,480
Yard Piping	\$ 30,865
Site Electrical	\$ 116,037
Electrical Substation 1	\$ 1,041,526
Electrical Substation 2	\$ 642,271
Site Instrumentation and Control	\$ 192,385
BNR Basins	\$ 559,533
BNR Basin 1	\$ 2,335,626
BNR Basin 2	\$ 2,367,287
BNR Basin 3	\$ 2,310,699
Blower Building	\$ 497,764
Final Clarifier 1	\$ 690,960
Final Clarifier 2	\$ 690,960
Final Clarifier 3	\$ 690,960
New Final Clarifier 4	\$ 2,776,353
New CEPT Chemical Systems	\$ 1,026,643
Primary Digester 1	\$ 1,458,099
Primary Digester 2	\$ 1,458,099
Digester Control Building	\$ 1,964,289
New Digester Boiler Building	\$ 2,185,017
Sludge Gas Building	\$ 242,656
Total Construction Costs	\$ 28,119,403
Engineering (19%)	\$ 5,342,687
Total Project Cost	\$ 33,462,090
General Notes:	
<ol style="list-style-type: none"> 1. Current project cost to be funded by SRF. If additional funds are required, it will be funded by City’s O&M budget. 2. Costs are based on 2022 dollars. 	

Table 1-2 summarizes the preliminary cost model for projects to be implemented outside of the current project scope. The projects summarized in Table 1-2 are divided into the following categories: permit driven, city maintenance, and growth. The permit driven project could include supplemental carbon feed if the City’s effluent TN limits change. City maintenance projects are driven by the need to address rehabilitation or replacement of aged infrastructure. Growth projects are required to support future flow and/or loading increases to the WWTP.

Table 1-2 Future Project Scope Cost Model

Description	Future Project Cost Model
<u>Permit Driven Project</u>	
New Supplemental Carbon Feed System	\$ 1,224,882
Subtotal Construction Cost	\$ 1,224,882
<u>City Maintenance Project</u>	
New Effluent Outfall	\$ 534,847
Control Structure 1 (Primary Clarifiers)	\$ 218,079
Control Structure 2 (BNR)	\$ 218,079
Control Structure 3 (Final Clarifiers)	\$ 218,079
Headworks Building	\$ 846,423
Raw Sludge Building	\$ 93,364
Monitoring/Raw Sludge Building	\$ 93,364
Intermediate Pump Station	\$ 450,637
UV Disinfection Building and Effluent Meter	\$ 1,094,294
Gravity Belt Thickener Building	\$ 647,887
Secondary Digester 1	\$ 756,357
Secondary Digester 2	\$ 419,589
Sludge Pump Building	\$ 66,780
Pump Station 1 (Offsite)	\$ 145,885
Pump Station 2 (Offsite)	\$ 121,348
Odor Control	\$ 749,223
Blower Building	\$ 460,957
Subtotal Construction Costs	\$ 7,135,192
<u>Growth Project</u>	
New BNR Basin 4	\$ 4,720,056
Primary Clarifier 3	\$ 531,520

Primary Clarifier 4	\$ 531,520
Primary Digester 3	\$ 1,551,019
Primary Digester 4	\$ 1,551,019
Subtotal Construction Costs	\$ 8,885,134
Total Construction Costs	\$ 17,245,208
General Notes:	
<ol style="list-style-type: none"> 1. Improvements to be funded by City's O&M budget. 2. General Conditions and engineering are not included in the costs. 3. Costs are based on 2022 dollars. 	

1.3 Applicable Codes, Regulations, and Standards

1.3.1 Applicable Design Codes and Standards

Final design will comply with federal, state, and city laws or ordinances, as well as applicable codes, standard, and regulatory requirements. A partial listing of applicable requirements and standards are listed below:

- Kansas Department of Health and Environment (KDHE), Minimum Standards of Design for Water Pollution Control Facilities, 1978
- International Building Code, 2018 Edition
- Uniform Plumbing Code, 2018 Edition
- Uniform Mechanical Code, 2018 Edition
- International Fire Code, 2018 Edition
- National Electric Code, 2020 Edition
- International Energy Conservation Code, 2018 Edition
- National Fire Protection Association, Fire Protection in Wastewater Treatment Facilities (NFPA820), 2020 Edition
- Hydraulic Institute Standards

Standards and codes of the following organizations will also govern, where applicable:

- American National Standards Institute (ANSI)
- International Society of Automation (ISA)
- National Electrical Manufacturers Association (NEMA)
- Institute of Electrical and Electronic Engineers (IEEE)
- Insulated Cable Engineers Association (ICEA)
- Occupational Safety and Health Act (OSHA)

- American Society for Testing and Materials (ASTM)
- Underwriters Laboratory (UL)
- Recommended Standards for Sewage Works - Great Lakes – Upper Mississippi River Board of Sanitary Engineers (10 State Standards)
- American Society of Plumbing Engineers (ASPE)
- American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
- American Concrete Institute (ACI)
- American Institute of Steel Construction (AISC)
- American Society of Civil Engineers (ASCE)
- American Welding Society (AWS)
- American Wire Gauge (AWG)
- National Electrical Safety Code (NEC)
- Illuminating Engineering Society of North America (IESNA)
- National Electrical Installation Standards (NEIS)

Additional discipline specific codes and standards are presented in the individual discipline sections.

1.3.2 Anticipated Permits

The following permits governing the WWTP effluent quality, the construction process, and ongoing site utilization will be required:

- National Pollutant Discharge Elimination System (NPDES) Permit regulating the quality of the WWTP discharge.
- Permits required by the City of Salina including but not limited to a Commercial Building Permit.
- KDHE Construction Permit

1.4 List of Terms, Acronyms, and Abbreviations

ABBREVIATION	MEANING
AA	Annual Average
ACPH	Air Changes Per Hour
ADF	Adjustable Frequency Drive
BDR	Basis of Design Report
BNR	Biological Nutrient Removal
BOD	Biochemical Oxygen Demand
CBOD5	Carbonaceous BOD, 5-day
CEPT	Chemically Enhanced Primary Treatment
CFD	Computational Fluid Dynamics
CFM	Cubic Feet per Minute

ABBREVIATION	MEANING
COD	Chemical Oxygen Demand
DO	Dissolved Oxygen
EBPR	Enhanced Biological Phosphorus Removal
EDI	Energy Dissipation Inlet
FeCl ₃	Ferric Chloride
FRP	Fiberglass Reinforced Plastic
ft	Feet
GBT	Gravity Belt Thickener
GMP	Guaranteed Maximum Price
GPD or gpd	Gallons per Day
GPH or gph	Gallons per Hour
GPM or gpm	Gallons per Minute
HRT	High Rate Treatment
KDHE	Kansas Department Health and Environment
MG	Million Gallons
MGD or mgd	Million Gallons per Day
mg/L	Milligrams per Liter
MLSS	Mixed Liquor Suspended Solids
MM	Maximum Monthly Average
MOP	Manual Of Practice
NH ₃ -N	Ammonia Nitrogen
NO ₂ -N	Nitrite Nitrogen
NO ₃ -N	Nitrate Nitrogen
NO _x -N	Nitrite + Nitrate Nitrogen
O&M	Operation & Maintenance
OP	Ortho-phosphorus
ORP	Oxidation-Reduction Potential
PAO	Phosphorus Accumulating Organisms
PD	Peak Day
PS	Primary Sludge
RAS	Return Activated Sludge
SCFM	Standard Cubic Feet per Minute
SLR	Solids Loading Rate
SND	Simultaneous Nitrification and Denitrification
SOR	Surface Overflow Rate

ABBREVIATION	MEANING
sq ft or sf or ft ²	Square Feet
SRT	Solids Retention Time
SWD	Side Water Depth
TBD	To Be Determined
TKN	Total Kjeldahl Nitrogen
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
TWAS	Thickened Waste Activated Sludge
UV	Ultraviolet light
VFA	Volatile Fatty Acids
VFD	Variable Frequency Drive
WAS	Waste Activated Sludge
WEF	Water Environmental Federation
WWTP	Wastewater Treatment Plant

1.5 Project Schedule

The following is a summary of key project dates:

Table 1-3 Milestone Schedule

Task	Date
Notice to Proceed	December 15, 2020
BDR to KDHE (Phase 1A)	May 11, 2021
30% Design (Phase 1B)	Mid-September 2021
60% Plans & Specs (Phase 1B)	December 2021
Final GMP	March 2022
Construction Start (Phase 2)	April 2022
100% Plans & Specs (Phase 2)	June 2022
Substantial Completion	April 30, 2024
2020 NPDES Permit Compliance ¹	December 31, 2024
¹ Milestone corresponds with the compliance schedule in Salina’s 2020 NPDES Permit	

1.6 Site Description

The Salina WWTP is located at 596 N. Marymount Road, Salina, Kansas 67401. Refer to Drawing 000-C-103 for an overall site plan, located in Appendix C.

Elevations used on project drawings and in calculations will be based on USGS (NAVD88) datum. A minimum of one benchmark will be established on the project site for vertical control. Horizontal control will be tied to the Kansas state plane coordinate system.

The WWTP is located in the Smoky Hill River Watershed. Initial evaluation of Flood Insurance Rate Mapping (FIRM) indicates that the 100-year flood elevation on the plant site is 1213 ft, while the 100-year flood elevation at the existing plant outfall is 1212 ft (as shown on the hydraulic profile, Drawing 000-C-506 in Appendix C). From the last major plant expansion, the 100-year flood elevation has increased nearly 5 feet. Most of the plant site is still above this 100-year flood elevation, however the existing plant outfall is not. Section 1.11 provides discussion on phasing of future projects to address peak flow capacity.

Some areas of the plant site, primarily to the north and east, are below the 500-year flood elevation of 1216 ft. The only facility that will be constructed as part of this project is the Digester Boiler Building. This building will be a slab on grade, where the slab is above the 500-year flood elevation. The 100-year and 500-year flood elevations will be verified by a licensed surveyor and provided in the final design documents.

1.7 Geotechnical and Survey Information

1.7.1 Geotechnical

BV is in the process of retaining the services of a subconsultant to gather subsurface information in the vicinity of the facility. The final geotechnical report interpreting data collected will be incorporated into the final design.

1.7.2 Survey Information

BV is in the process of retaining the services of a subconsultant to provide a survey of the site to determine topographical features, existing structure locations and elevations, and weir elevations. The survey will be used as the basis of the design for site facilities. Existing record drawings, showing site piping and utilities, will serve as the basis for identifying buried assets.

1.8 Standards and Documents

1.8.1 Drawings and Specifications

Drawings will be produced using BV drafting standards. Drawings for new structures, and existing BNR Basins, will be prepared from a three-dimensional computer-generated Building Information Model (BIM). The BIM will be produced using Revit 2018 and deliverables will be isometric, plan, and section drawings. Drawings for existing facilities and structures will be prepared using two-dimensional AutoCAD 2021 software.

Electronic review submittals at each detailed design milestone will be issued on standard (22-inch x 34-inch) "B" full size sheets with Black & Veatch standard project border modified with project specific

requirements. Upon project completion, all final CAD drawings will be submitted on standard 22-inch by 34-inch sheets.

BV standard technical specifications will be used and modified as required to suit the project.

1.9 Equipment Identification

All new equipment and all existing equipment with control changes will be assigned an equipment tag as detailed on the P&ID legend sheets. The tagging scheme that will be incorporated is BV's standard.

The purpose of the tagging convention is to fully identify equipment purpose, type, and physical location to help facilitate coordination between all design disciplines, contractors, and startup personnel. Additionally, these equipment tags are used to label equipment and instrumentation in the field as well as on the operator interface terminal (OIT) screens.

The standard designator is comprised of four parts: AREA CODE, PROCESS CODE, EQUIPMENT PREFIX, and SEQUENCE NUMBER. An example of this system is shown on Drawing 000-I-001.

- AREA CODE is comprised of three numbers that denotes the facility location of the instrument or piece of equipment. The area number is also how the drawing set will be organized.
- PROCESS CODE is comprised of 2 to 4 letters that describes the associated process. The P&ID Legend will be updated during final design to incorporate existing facility function codes.
- EQUIPMENT PREFIX defines the equipment type within the specific process.
- SEQUENCE NUMBER ensures that each instrument and piece of equipment gets its own unique identifier.

1.10 References

This BDR has been developed in coordination with various documents including the following:

- Salina WWTP Final Draft Feasibility Study, HDR, 2017.
- Salina Sewage Disposal Works, Wilson & Company Engineers, 1948
- Salina Sewage Treatment Plant Improvements, Wilson & Company Engineers, 1961
- Salina Wastewater Treatment Plant 1 Advanced Treatment, Wilson & Company, 1994

1.11 Phasing Plan

This section provides discussion of the phasing plan for future facility improvements beyond those included within the current project. These projects will be implemented by Salina in the future, outside of the scope of this BDR. In addition to the Secondary Treatment Capacity Phasing and Peak Capacity Phasing plans shown below, refer to Table 1-2 for future maintenance improvements.

1.11.1 Secondary Treatment Capacity Phasing

As indicated in Section 1.2 the design AA flow for this project is 6.4 mgd; the AA permitted treatment capacity for the WWTP is 7.25 mgd. Salina anticipates growth in the future to the 7.25 mgd AA capacity, but desires to utilize a phased approach for implementation of the secondary treatment capacity. This

approach will also allow for rehabilitation of aging critical solids infrastructure within the current project budget.

CEPT will be included in the current project to provide the ability to reduce the organic load to the secondary treatment process. Without utilizing CEPT, the design AA flow of the current project is 4.8 mgd. CEPT can be utilized during wet weather periods as needed, or on occasions when the AA flow exceeds 4.8 mgd to maximize the secondary treatment capacity up to 6.4 mgd AA. Based on the historical flow data presented in Section 2.2, the current AA flow to the Salina WWTP is 3.6 mgd. Therefore, the AA design criteria for the current project (6.4 mgd) allows for adequate future growth in the watershed. As flows increase toward the AA limits of the facilities implemented within the current project, a future BNR expansion will include construction of an additional BNR basin, allowing for treatment of the permitted 7.25 mgd AA utilizing CEPT. The secondary treatment capacity phasing plan is summarized as shown below.

Current Project - The project design flow capacities are as follows with 3 BNR basins and 4 final clarifiers in service:

- Annual Average without CEPT: 4.8 mgd
- Annual Average with CEPT: 6.4 mgd
- Peak Flow: 15 mgd (same as existing)

BNR Expansion – The design flows after the future construction of the 4th BNR basin are as follows:

- Annual Average without CEPT: 5.4 mgd
- Annual Average with CEPT: 7.25 mgd
- Peak Flow: 15 mgd (same as existing)

1.11.2 Peak Capacity Phasing

As implemented in 1994, the current peak flow treatment capacity at the plant is 15 mgd. Increasing the plant treatment peak capacity effectively reduces the need for on-site or collection system storage. As such, the existing facilities were evaluated for hydraulic and process capacity to determine a peak flow throughput for future wet weather planning purposes as well as to identify limitations within the existing facilities.

With four final clarifiers in service, the clarifier maximum solids loading rate (SLR) is limited to 18 mgd assuming 50% RAS (27 mgd total). Similarly, the Intermediate Pump Station which delivers flow to the BNR basins has a total rated capacity of 27 mgd (four 6.75-mgd pumps). Based on these limits, it is reasonable to plan for a future 18 mgd peak treatment capacity through the WWTP. The UV system, reaeration and outfall pipe at the revised 100-year elevation are (discussed in Section 1.6) limited to the current peak capacity of 15 mgd. It is also recommended that collection system modeling be undertaken to better define peak influent flows from the collection system. The proposed peak flow treatment capacity phasing plan is summarized as shown below.

Wet Weather Expansion – Plant improvements required to increase the peak flow treatment capacity to 18 mgd include:

- UV disinfection

- Reaeration Equipment
- Larger diameter outfall pipe (increase from 36 in to 42 or 48 inches)

2.0 Process Design Criteria

2.1 Effluent Discharge Permit Limits

KDHE authorized an NPDES permit for City of Salina’s WWTP. This permit, summarized in Table 2-1, is effective January 1, 2020 and expires December 31, 2024.

The permit recommends to consider operational and construction improvements to the facility to incorporate nutrient removal to achieve the total nitrogen and total phosphorus goal suggested in the table below.

Table 2-1 Key Effluent Limitations for Process Analysis

Final Effluent Limitations ¹						
Parameter	Units	Annual Average	Monthly Average	Weekly Average	Daily Maximum	Comments
Flow	mgd	7.25				
Total Suspended Solids (TSS)	mg/L		30	45		Sample twice weekly
Carbonaceous Biological Oxygen Demand (5-Day) (CBOD ₅)						Sample twice weekly
October-May	mg/L		25	40		
June-September	mg/L		20	35		
Ammonia (as N)						Sample twice weekly
December-February	mg/L		3.9		9.9	
March	mg/L		3.6		9.9	
April	mg/L		2.5		7.7	
May	mg/L		1.8		5.3	
June	mg/L		1.3		3.4	
July	mg/L		1.0		2.7	
August	mg/L		1.0		2.8	
September	mg/L		1.5		4.2	
October	mg/L		2.5		7.7	
November	mg/L		3.5		9.9	
Total Nitrogen (as N) ⁽²⁾	mg/L lb/day	10 606	Monitor			Annual average goal Annual average limit
Total Phosphorus (as P) ⁽²⁾	mg/L lb/day	1 60.6	Monitor			Annual average goal Annual average limit

⁽¹⁾ Measurement at outfall 001A1

⁽²⁾ Target concentrations are not effluent limits for this permit. However, the mass loadings are enforceable limits as imposed by the Schedule of Compliance for this permit. The AA limits are for a rolling 12-month time period calculated on a monthly basis.

2.2 Design Wastewater Flows

Historical average daily plant influent flow data between January 2007 and December 2020 was analyzed to develop the design flows for the Salina WWTP. Although 14-years of data is available, it is typically sufficient to use the most recent 5-year dataset to understand the current flows. As such, Figure 2-1 below presents influent flow data at the Salina WWTP from January 2015 – December 2020.

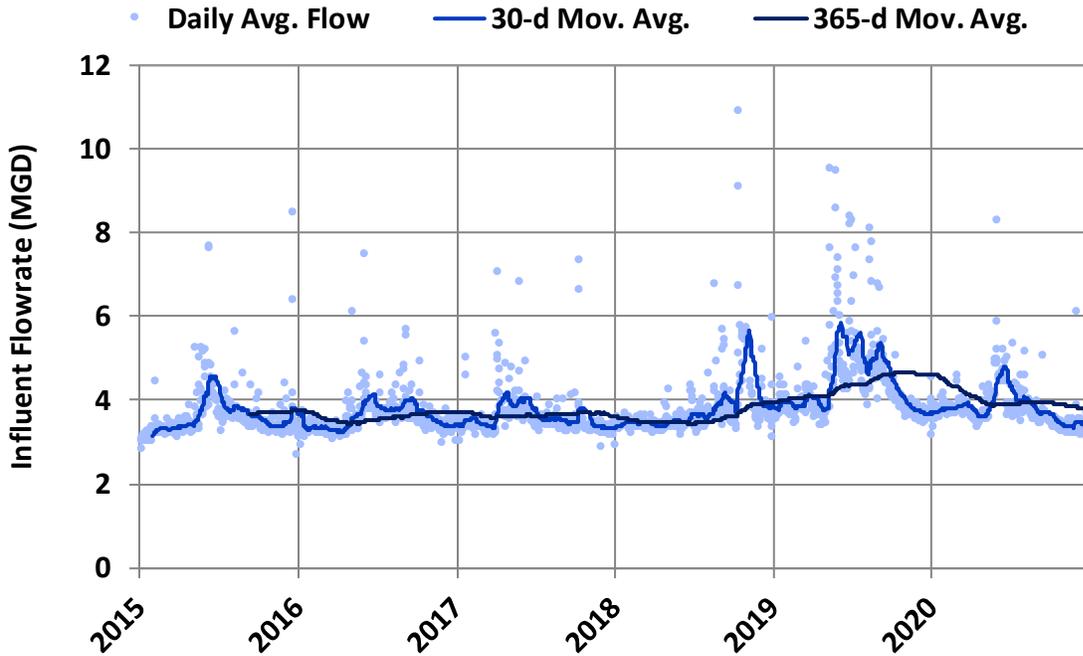


Figure 2-1 Daily Average Influent Flowrate to Salina WWTP

Over this period, the daily average influent flow to the facility fluctuated between 2.7 and 11 mgd, with an average of approximately 3.8 mgd. If data back to January of 2007 is included the daily average influent flow to the facility fluctuated between 2.6 mgd and 16.1 mgd, with an average of approximately 3.9 mgd. The data showed seasonal peaks during Spring and early Summer, which coincides with the wet weather pattern in the Midwest. Year 2019 exhibited extended wet weather season that lasted through early Fall. As a result, the annual average flow rate for 2019 increased from 3.8 mgd during the other years to 4.4 mgd. Based on this historical information flows to the Salina WWTP are relatively steady, with annual variance associated with the precipitation over the year. Although historical flows appear to be relatively steady, future growth is possible and should be accounted for. As such, a summary of the design flows is presented in Table 2-2.

Table 2-2 Influent Wastewater Design Flows

Design Parameter	Total Flow
Current AA, mgd	3.6
Design AA (no CEPT), mgd	4.8
Design AA (w/ CEPT), mgd	6.4
Design MM (no CEPT), mgd	6.2
Design MM (w/ CEPT), mgd	8.2
Design Peak Day, mgd	15
Future AA ¹ (no CEPT), mgd	5.4
Future AA ¹ (w/ CEPT), mgd	7.25
Future MM ¹ (no CEPT), mgd	7.0
Future MM ¹ (w/ CEPT), mgd	9.4
Future Peak Day ¹ , mgd	18
⁽¹⁾ Future conditions require future improvements as described in Section 1.11 outside of the project scope covered by this BDR.	

2.2.1 Chemically Enhanced Primary Treatment (CEPT)

To maximize the available treatment through the BNR Basins, it is recommended to utilize CEPT when needed, as it can reduce the organic loading to the activated sludge process. Utilizing CEPT can increase the AA design capacity of 3 BNR Basins from 4.8 mgd to 6.4 mgd. Similarly, utilizing CEPT increases the MM design capacity of 3 BNR Basins from 6.2 to 8.2 mgd.

As indicated in Section 1.11, it is anticipated that a fourth BNR Basin will be added in the future as part of a phased implementation approach to increase secondary treatment capacity. As such, Table 2-2 also summarizes the future flow conditions after the fourth BNR Basin and other wet weather improvements as indicated in Section 1.11 are completed. Once this future basin is constructed, the AA design flow will be 5.4 mgd without utilizing CEPT, and 7.25 when CEPT is used. This future design AA condition of 7.25 mgd matches the permitted AA capacity.

The design peak day condition is 15 mgd. Over the 14-year dataset, there was one average daily flow that exceeded 15 mgd. Since CEPT facilities will be installed as part of this project, CEPT is also recommended as a wet weather treatment process to reduce the organic and solids loading to the secondary treatment processes. The secondary treatment processes will be designed to handle peak day flows, so anytime influent flows exceed 15 mgd, CEPT will be utilized. Future wet weather capacity improvements to increase future peak day flows to 18 mgd are summarized in Section 1.11 and are not part of the project scope covered by this BDR.

2.3 Design Wastewater Loadings

In addition to the historical flow data that was discussed in Section 2.2, historical plant data between January 2015 and December 2020 was analyzed to develop the wastewater concentrations for the analysis. Figure 2-2 through Figure 2-7 summarizes the daily average concentrations and loads to the WWTP.

The main observations from these plots include:

- **Influent Pollutant Concentration:** The influent TSS concentration at the facility typically ranged between 200 mg/L and 400 mg/L, with a long-term average around 325 mg/L. The 30-day and 365-day moving average BOD concentration has steadily decreased from 300 mg/L in 2015 to around 250 mg/L in 2019, with an average around 280 mg/L. The daily average and long-term average values dipped during the years 2018 and 2019, which can potentially be the dilution effect from the extended wet weather season.
- **Influent Pollutant Load:** The current 365-days moving average BOD and TSS load to the facility is around 9,000 lb/day and 10,000 lb/day respectively. The corresponding ammonia load to the facility is around 1,100 lb/day. Although the concentration values dipped during late 2018 and 2019, the pollutant loads stayed fairly steady.

Based on this historical data, the activated sludge process will be designed to handle peak flows of more than two times the annual average flow. As previously discussed in Section 1.11, the current project includes 3 BNR Basins, and in the future a fourth BNR Basin will be constructed. Although the design flow rate for the current project is less than the fourth BNR Basin design flow rate, it is important that the future design AA is understood. By using the historical average influent concentration at 7.25 mgd, the influent pollutant load is estimated to be around two times the current load to the treatment plant.

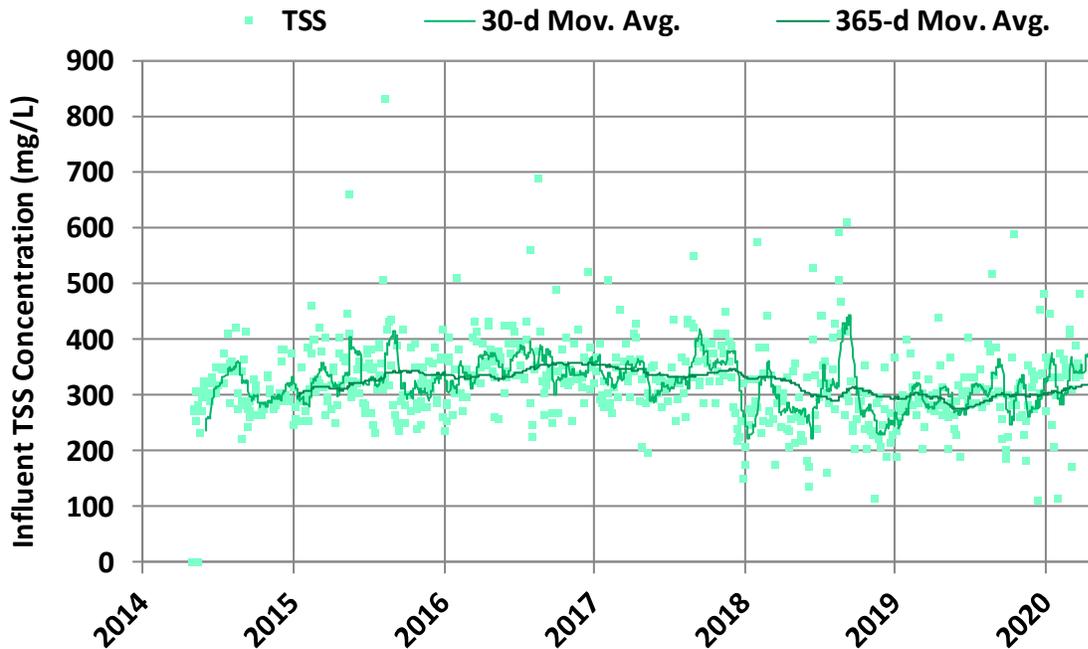


Figure 2-2 Daily Average Influent TSS Concentration to Salina WWTP

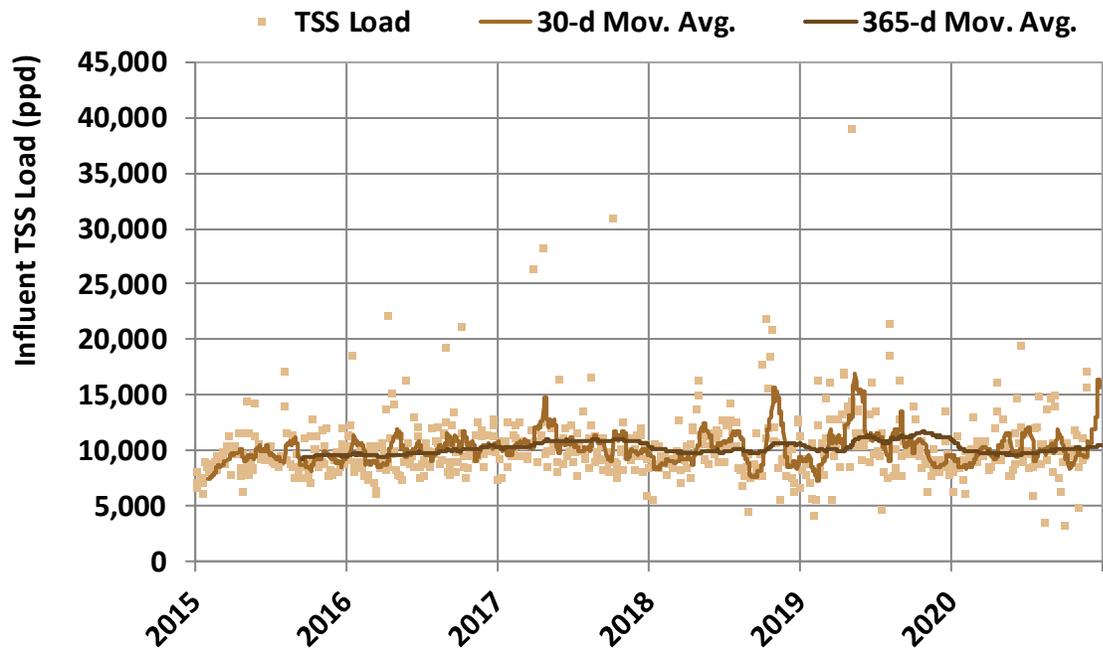


Figure 2-3 Daily Average Inflow TSS Load to Salina WWTP

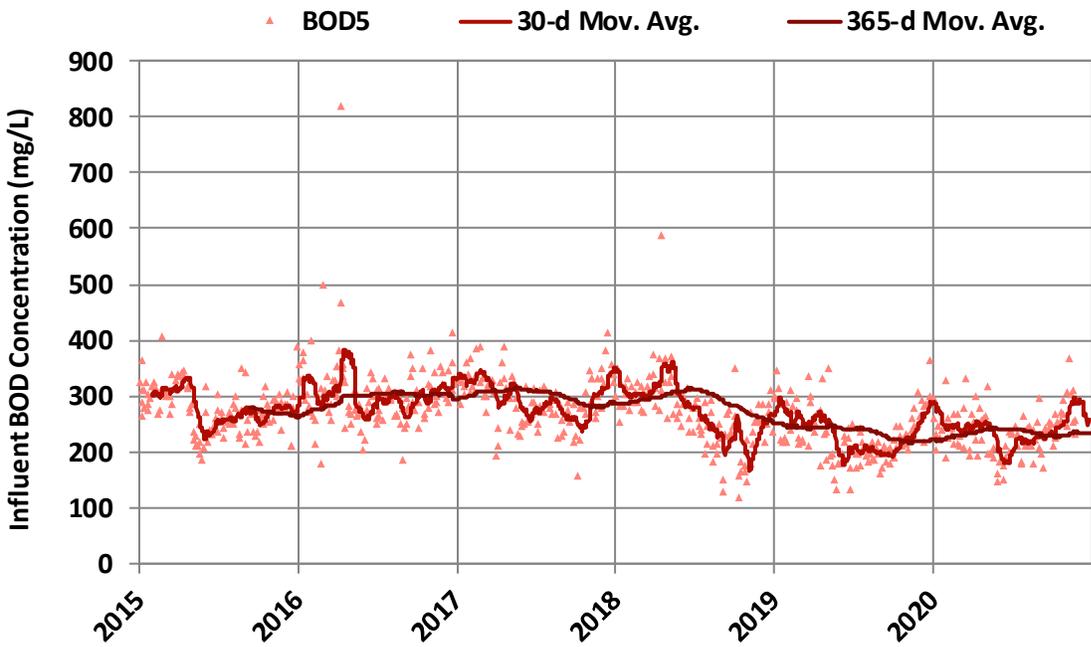


Figure 2-4 Daily Average Inflow BOD5 Concentration to Salina WWTP

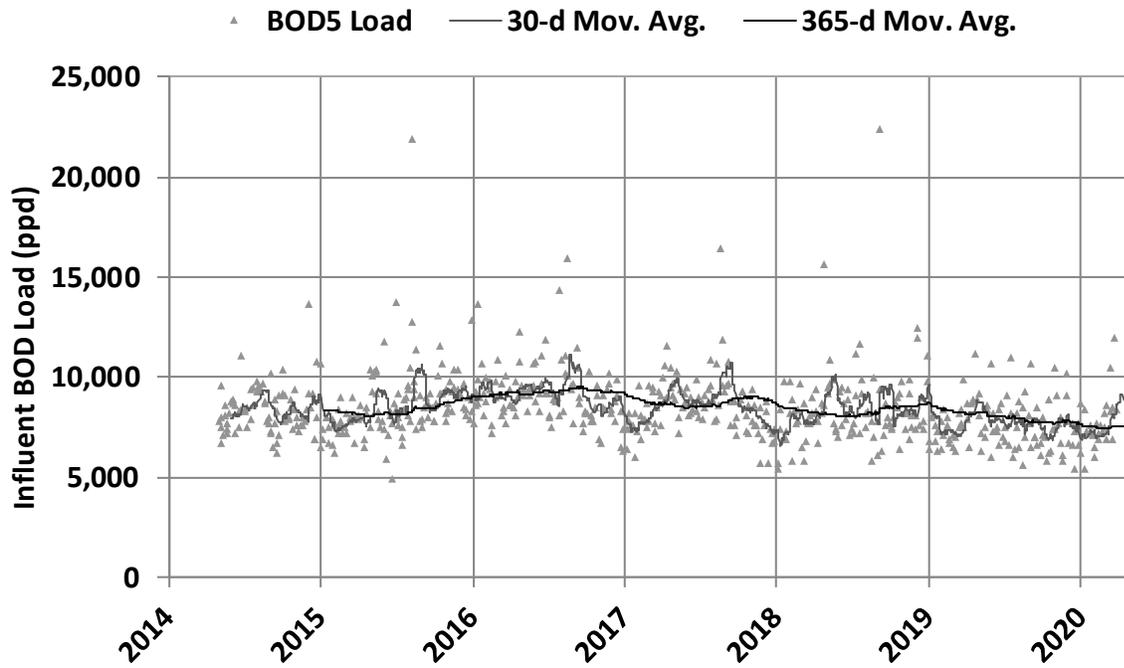


Figure 2-5 Daily Average Influent BOD5 Load to Salina WWTP

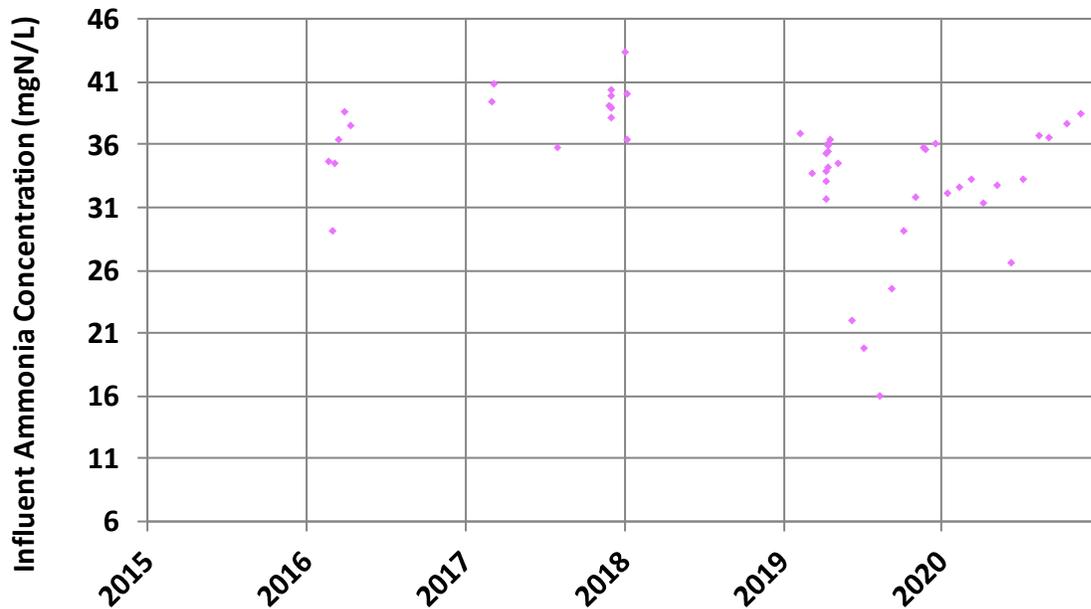


Figure 2-6 Daily Average Influent Ammonia Concentration to Salina WWTP

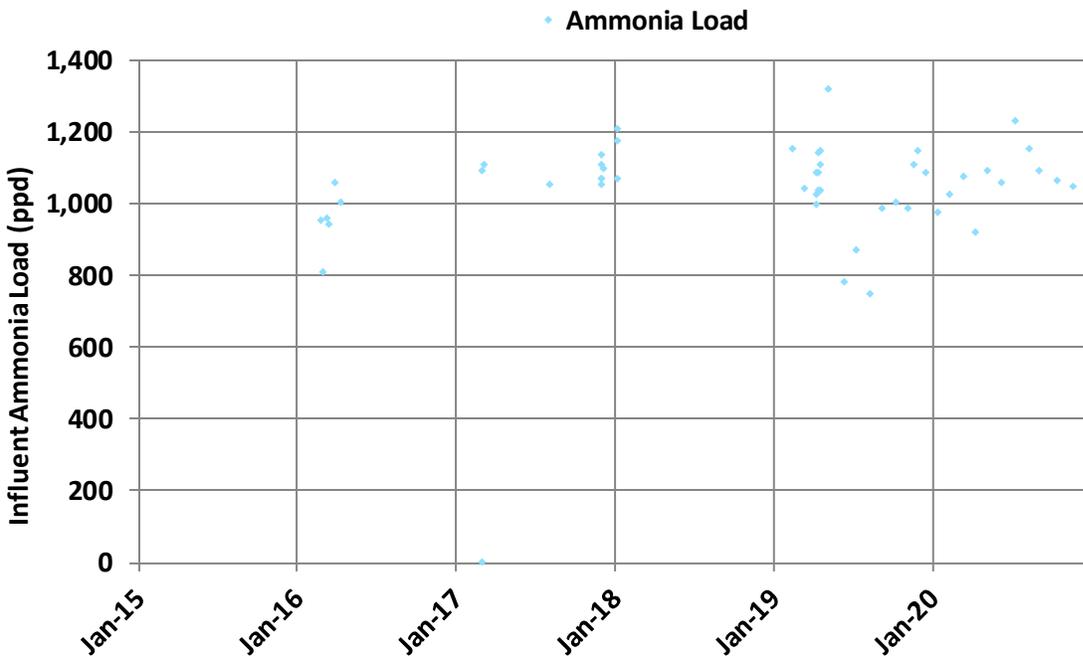


Figure 2-7 Daily Average Influent Ammonia Load to Salina WWTP

The long-term average Biochemical Oxygen Demand (BOD) load to the facility has been steadily decreasing after 2017, while the ammonia load shows an increase until 2018 and then decreasing by around ten percent. Influent ammonia data from 2015 and 2018 was not available for the BDR. The TSS load to the facility has stayed steady throughout the analysis period. Figure 2-8 through Figure 2-10 present the trends in the annual average, maximum monthly average and peak day values for these loadings. Table 2-3 and Table 2-4 present the current and future design wastewater loading rates. It should be noted that the loading rates in Table 2-3 are used for sizing the 3-Train arrangement while the loading rates in Table 2-4 are to be used to size the 4-Train arrangement. Accurately identifying design concentration and loads to the facility is a critical step to optimally size the process. To collect more representative data throughout various processes at the facility, a special sampling campaign was recommended. Salina is currently collecting spring targeted sampling data over a two-week period. A larger sampling program is planned this summer to support a more holistic view of seasonal loading impacts to the WWTP to inform final design. The targeted special sampling plan is included in Appendix D.

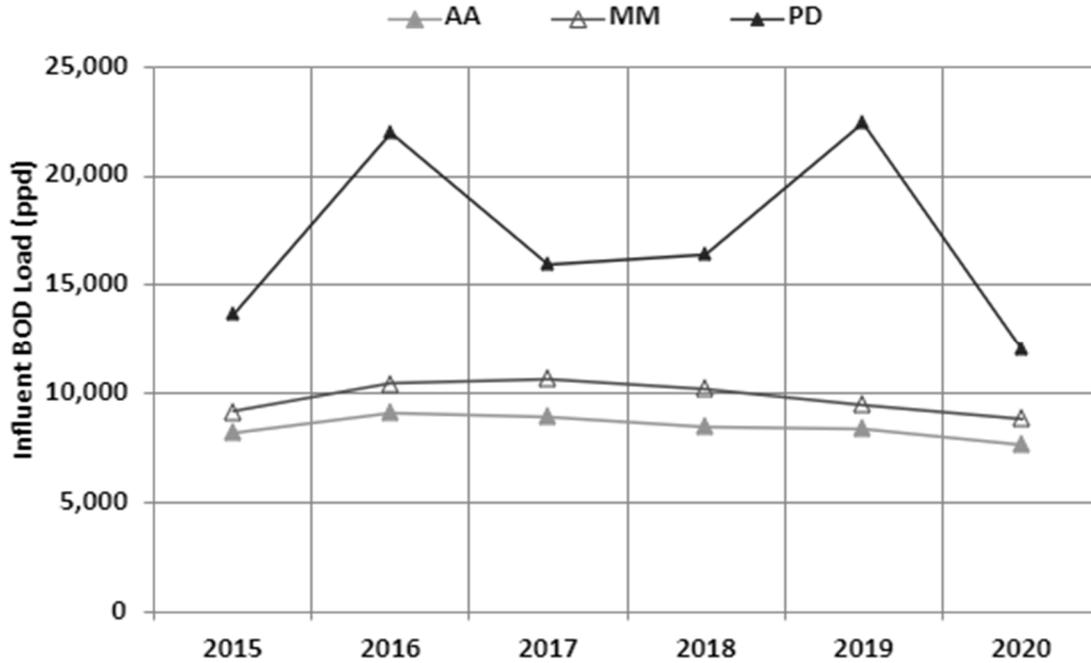


Figure 2-8 Yearly Trends in Influent BOD Load to Salina WWTP

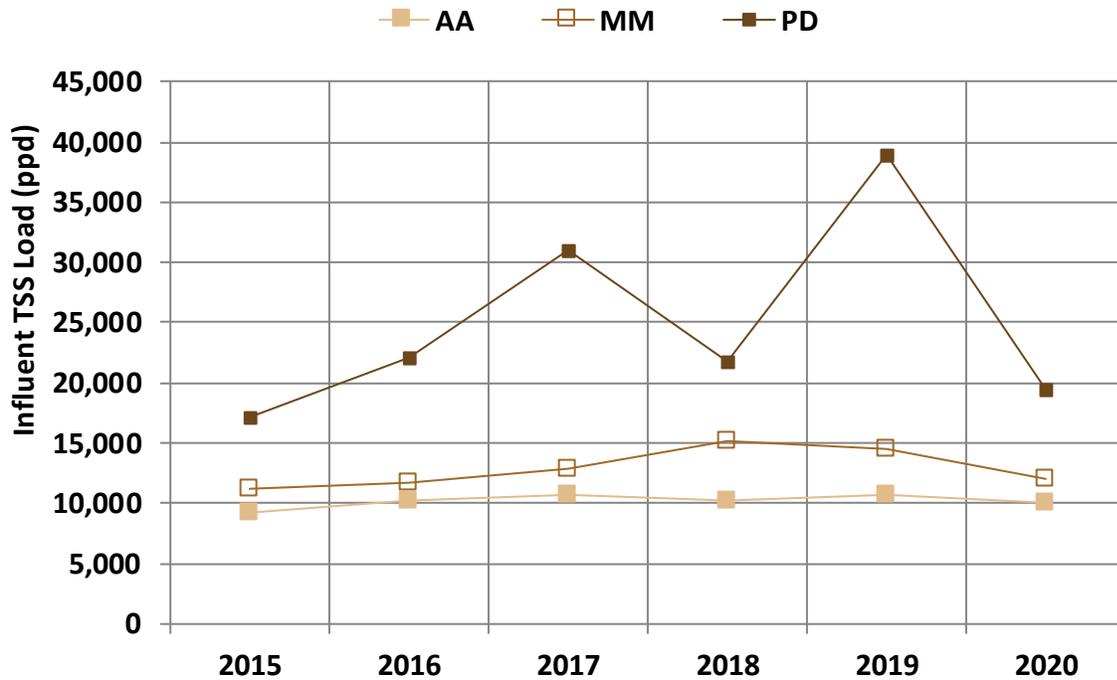


Figure 2-9 Yearly Trends in Influent TSS Load to Salina WWTP

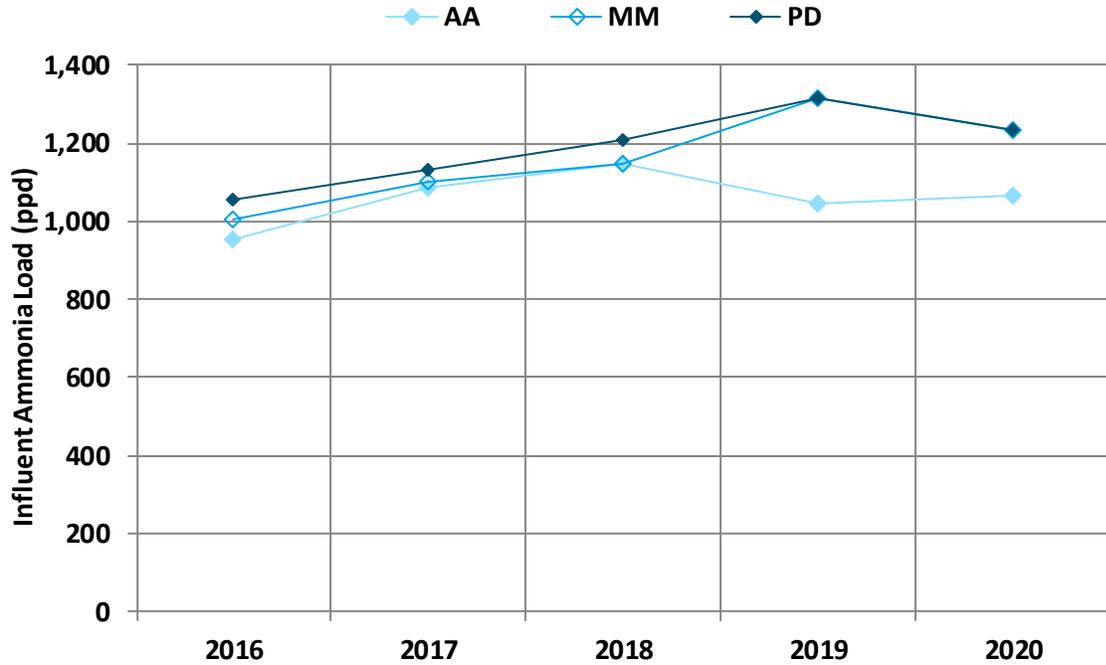


Figure 2-10 Yearly Trends in Influent Ammonia Load to Salina WWTP

Table 2-3 Design Wastewater Loading of Current Project Scope (3 BNR Basins)

	ANNUAL AVERAGE ¹		MAXIMUM MONTHLY AVERAGE ²		PEAK DAY ³	
	Load (lb/d)	Concentration (mg/L)	Load (lb/d)	Concentration (mg/L)	Load (lb/d)	Concentration (mg/L)
BOD	14,950	280	19,630	287	26,380	211
TSS	17,300	324	27,220	398	32,054	256
Ammonia	1,870	35	2,050	30	2,310	18.5
TKN	2,775	52	3,965	58	4,355	35
Total Phosphorus	340	6.4	440	6.4	450	3.6

⁽¹⁾ Based on 6.4 mgd (with CEPT)

⁽²⁾ Based on 8.2 mgd (with CEPT)

⁽³⁾ Based on 15 mgd

Table 2-4 Future Design Wastewater Loading (4 BNR Basins, not included in this BDR scope)

	ANNUAL AVERAGE ¹		MAXIMUM MONTHLY AVERAGE ²		PEAK DAY ³	
	Load (lb/d)	Concentration (mg/L)	Load (lb/d)	Concentration (mg/L)	Load (lb/d)	Concentration (mg/L)
BOD	16,930	280	22,500	287	26,380	211
TSS	19,590	324	31,200	398	32,054	256
Ammonia	2,115	35	2,350	30	2,310	18.5
TKN	3,145	52	4,545	58	4,355	35
Total Phosphorus	390	6.4	500	6.4	450	3.6

(¹) Based on 7.25 mgd (with CEPT)
 (²) Based on 9.4 mgd (with CEPT)
 (³) Based on 15 mgd

2.4 Hydraulics

A preliminary hydraulic profile has been developed for the design flows through the liquid treatment train. The resultant water elevations were used to ensure hydraulic structures were not being overtopped and weirs were not being submerged due to downstream treatment changes. The hydraulic profile will also assist in developing a control strategy for the Intermediate Pump Station that feeds the BNR basins. The elevations presented have been developed using preliminary site piping layouts and calculated headloss through each of the WWTP’s liquid treatment train facilities. These elevations are preliminary and will be refined during final design.

The liquid treatment unit processes and associated interconnecting piping are sized to convey the current and future design flows presented in Table 2-2 from Section 2.2. Refer to Section 1.11 for the phasing plan for increasing future plant treatment capacity.

Refer to Appendix C, Drawing 000-C-506 for the preliminary hydraulic profile for the liquid treatment train. The hydraulic profile depicts the downstream water elevation with the future outlet pipe under the 100-year flood condition (1212.00 ft).

3.0 Facility Design Criteria

The following sections outline the recommended improvements including liquid treatment facilities, solids treatment facilities, support facilities, and civil sitework.

3.1 Liquid Treatment Facilities

Wastewater from five offsite pump stations is delivered to the influent box of the WWTP located at the Headworks Building. The existing liquid treatment consists of fine screening, aerated grit removal, primary clarification, aeration basins, final clarification, UV disinfection, and re-aeration. Following re-aeration, water discharges to the Smoky Hill River. Refer to Appendix C, Drawing 000-C-504 for the Liquids Process Flow Diagram.

The following sections details the liquid treatment improvements for this project:

- Intermediate Pumps Station (by others)
- BNR Basins 1-3
- Blower Building No. 11
- Final Clarifiers 1-4

3.1.1 Intermediate Pump Station

The Intermediate Pump Station, formerly known as the Screw Pump Station, conveys primary clarifier effluent and RAS to the BNR basins. Replacement of the existing two screw pumps with two submersible pumps is not the scope of this BDR. The design criteria (Table 3-1) and pump station controls (Drawing 310-I-501) are provided to ensure proper control scheme is established for maintaining acceptable plant hydraulics and secondary treatment flow.

Table 3-1 Intermediate Pump Station Summary

	DESIGN CRITERIA
Number of Pumps	4 Duty
Designation	IPS-PMP-001 ⁽¹⁾ , IPS-PMP-002, IPS-PMP-003, IPS-PMP-004 ⁽¹⁾
Drive Type	VFD
Total Capacity, gpm	14,100
Individual Capacity, gpm	4,700
Total Dynamic Head, ft	20
Horsepower, ea	30
Discharge Diameter, in	12
⁽¹⁾ Existing pumps	

Figure 3-1 illustrates that the existing ABS submersible pumps are appropriate for the application in the Intermediate Pump Station. Two (2) duty pumps will be required to meet the approximate future design annual average flow (7.25 mgd) plus 100% RAS (14.5 mgd). By replacing the existing screw pumps with submersible pumps of the same capacity, the pump station will be able to meet the future flow of 18 mgd forward flow with 50% RAS as outlined in Section 1.11 with all four pumps in service.

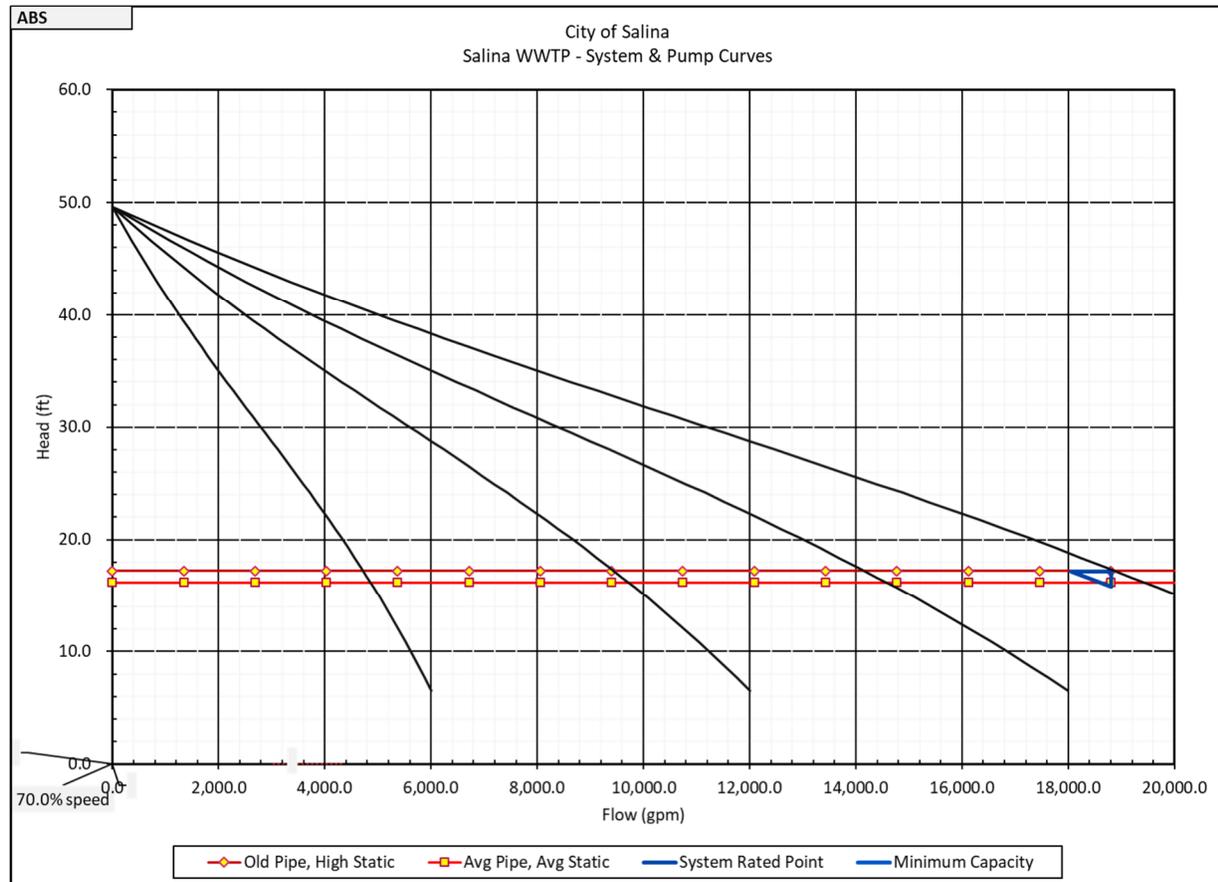


Figure 3-1 System/Pump Head Curve

3.1.2 BNR Basins

The existing three completely mixed aeration basins will be retrofitted into a four-stage simultaneous nitrification-denitrification (SND) arrangement that utilize chemical phosphorus removal. The three parallel basins will provide nitrification and denitrification.

The retrofit will include demolition of the existing air piping and supports located within the basin, demolition and modification of the concrete effluent trough, demolition of the influent pipe, and construction of interior concrete baffle walls to separate the various zones. Each of the interior baffle walls will have a six-foot concrete footing that is poured on top of the existing floor slab. The footing will be dowelled into the existing floor slab on two sides.

All basins will be constructed to have the same water surface elevation and be equipped in the same manner. Each basin may be isolated and taken offline without interrupting operation of the other basins. Drawings 320-M-101 and 320-M-901 show the overall plan and perspective of all the BNR Basins and Drawing 324-M-101 shows the plan for the existing basin improvements.

Chemical phosphorus removal will be achieved by feeding ferric chloride ahead of the Primary Clarifiers. Ferric Chloride will be able to be fed in two different locations. The primary feed point is in the aerated grit chamber, ahead of the Primary Clarifiers, which will provide adequate mixing and contact time. A secondary ferric chloride feed point is Control Structure 3, which is located between the BNR Basins and Final Clarifiers. The secondary feed point will be used as needed for polishing. A more detailed discussion of the chemical systems is included in Section 3.3.1.

The mechanical system including mixers and aeration grids of the BNR Basins are presented below in Table 3-2. The upgraded BNR Basins will be configured to provide four-stages of treatment as follows:

Anoxic Zone – In the first anoxic zone, flow from the Intermediate Pump Station is combined with mixed liquor recycle flow in the mixing chimney. This recycle flow transports nitrates to the anoxic zone for removal using denitrification to nitrogen gas. Flow in this zone is mixed with a low horsepower submersible mixer before it flows into the oxic zone over the effluent weir. The weir is necessary to prevent undesirable back flow of aeration into the anoxic zone.

SND (Oxic) Zone – SND relies on creating a dissolved oxygen (DO) gradient within a single reactor where both nitrification and denitrification can occur. The DO gradient can be created through careful DO control by creating a racetrack-like flow pattern akin to an oxidation ditch. By recirculating mixed liquor through alternating phases of high and low DO, periods of nitrification and denitrification will occur. The oxic zone will be equipped with fine bubble diffuser grids covering portions of the floor. Two submersible banana blade mixers will impart forward velocity and provide mixing. The mixers will be provided with VFDs to allow for some adjustment to power input and flow velocity. An axial flow pump will be used for sending Mixed Liquor Suspended Solids (MLSS) recycle back to the anoxic zone mixing chimney. Flow will leave the oxic zone by flowing over another weir, into the Post Anoxic zone. Near this SND effluent weir a surface baffle will be installed to help promote scum removal from the SND zone.

Post Anoxic Zone – The post anoxic zone is needed to remove additional nitrates required to meet the 10 mg/l TN goal. Similar to the first anoxic zone, mechanical mixing will be provided to maintain suspension of solids. Prior to flow exiting the Post Anoxic Zone it will pass by the Surface Wasting Rotating Weir. This weir will typically be out of the flow path, with the ability to rotate down into the flow path as needed based on operational setpoints. Surface wasting is used to control the settleability of the MLSS by wasting fine dispersed particles and foam forming bacteria from the system while the good settling sludge is retained. When the weir is in the flow path, it will collect flow off the surface which will then flow into the surface wasting collection box. From there, surface wasting from each BNR Basin will combine into a common pipe, then flow by gravity to the Waste Activated Sludge (WAS) storage basin. After passing the Surface Wasting Rotating Weir, effluent will leave the post anoxic zone by flowing over a submerged weir that provides a minimum of 3-inch water surface drop at the AA design flow. The weir is necessary to prevent undesirable back flow of aeration into the anoxic zone.

Post Oxidation Zone – The post oxidization zone is needed to add DO into the BNR effluent ahead of the final clarifiers to prevent denitrification in the clarifiers. The post oxidization zone will be equipped with a coarse bubble diffuser grid covering the entire zone floor. Effluent will leave the post oxidization zone by flowing over a weir into a modified concrete effluent trough. The trough will be lowered from its current elevation, but the existing effluent piping will be reused to convey effluent from each basin to Control Structure 3.

Table 3-2 Biological Nutrient Removal (BNR) Basins Summary

PARAMETER	DESIGN CRITERIA
Number of Basins	3
Total Solids Retention Time, days	10
Anoxic Zone	
Volume, cu ft, each basin	18,000
Total Hydraulic Detention Time, hours	
3 BNR Basin AA (6.4 mgd)	1.50
Future AA (7.25 mgd)	1.78
Mixers per zone	1
Mixer designation	BNR-MXR-104, 204, 304
Mixer type	Submersible
Motor rating each, hp	2.0
SND (Oxic) Zone	
Volume, cu ft, each basin	77,000
Total Hydraulic Detention Time, hours	
3 BNR Basin AA (6.4 mgd)	6.50
Future AA (7.25 mgd)	7.63
Diffuser Type	Fine bubble
Mixer per zone	2
Mixer designation	BNR-MXR-101, 102, 201, 202, 301, 302
Mixer type	Banana Blade
Motor rating each, hp	20
Mixer Motor Speed Adjustment	VFD
MLSS Recycle Pumps per basin	1
Type	Horizontal, Submersible Propeller Pump
Pump designation	MLSS-MLRP-101, 201, 301
Capacity at rated head, mgd	7.25

PARAMETER	DESIGN CRITERIA
Minimum capacity, mgd	3.60
Rated Total Head, ft	3.5
Motor, hp, each	15
Post Anoxic Zone	
Volume, cu ft, each basin	18,000
Total Hydraulic Detention Time, hours	
3 BNR Basin AA (6.4 mgd)	1.50
Future AA (7.25 mgd)	1.78
Mixers per zone	1
Mixer designation	BNR-MXR-103, 203, 303
Mixer type	Submersible
Motor rating each, hp	2.0
Post Oxidation Zone	
Volume, cu ft	2,880
Total Hydraulic Detention Time, hours	
3 BNR Basin AA (6.4 mgd)	0.24
Future AA (7.25 mgd)	0.29
Diffuser type	Coarse bubble

Although the Salina WWTP does not currently experience excessive scum and foam, previous experience with oxidation ditches like this racetrack configuration suggest that scum will accumulate in the SND zone. As such, a surface baffle has been added near the SND effluent weir to help promote scum removal from the SND zone. In the post anoxic zone, scum can be removed via the surface wasting rotating weir or it could flow over the effluent weirs. By continually allowing scum to move through and out of the SND zone, in combination with surface wasting, foam-forming bacteria and scum will be effectively controlled.

The instrumentation for the BNR Basins as shown on Drawing 324-I-501, includes three DO probes per basin (one per aeration grid), three air flow meters per basin (one per aeration grid), and one each ammonia and nitrate probe. The ammonia and nitrate probes will be located at the end of the oxic zone, just before the effluent removal pipe. There will also be a TSS probe located in Control Structure 3 that will measure the MLSS concentration and the concentration of the waste sludge. The TSS measurements are used to adjust the waste flow to maintain the desired SRT for stable and reliable performance.

It should be noted that the layout configurations shown in the drawings are preliminary. During the detailed design phase, special sampling and computational fluid dynamics (CFD) modeling is recommended to confirm the layout and design.

3.1.3 Blower Building No. 11

The Salina WWTP has four existing blowers that are used to supply air to the aeration basins. The blowers are located in Blower Building. Two of the existing blowers are multi-stage and two are turbo blowers, as indicated in Table 3-3. As part of this project, a master control panel will be provided by the system integrator to control the existing blowers along with the new control valves at the basins.

Table 3-3 Aeration Blower Criteria

PARAMETER	EXISTING MULTISTAGE BLOWERS	EXISTING TURBO BLOWERS
Number of Units	2	2
Designation	LPSA-BLR-003, LPSA-BLR-004	LPSA-BLR-001, LPSA-BLR-002
Blower Type	Multistage	Turbo-compressor
Rated Capacity, scfm	1,905	1,800
Rated pressure, psi	9.5	9.5
Drive horsepower, hp	125	125

Additional upgrades to the Blower Building include ducting the intakes for the existing turbo blowers outside on the west side of the building. A concrete pad will be provided around the filters for maintenance. Filters will be accessible from grade. The cross-connection piping in the building will be modified to a header arrangement to help with the air distribution to the basins. These proposed improvements are shown on Drawing 350-M-101.

Each BNR Basin will have two different sets of fine bubble diffuser aeration grids in the SND zone and one coarse bubble diffuser aeration grid in the post oxic zone. The fine bubble grids will consist of membrane disc diffusers. In each basin, each aeration grid will have an individual drop leg which will have independent airflow control through thermal dispersion flow meters and airflow control valves. The control valve can also be used as a shut off valve when a grid is not in use. The airflow to these control zones will have positive feedback control to maintain DO setpoints at the DO probes in the BNR Basins. A blower master control panel will automatically control the aeration supply system. The aeration piping from the Blower Building to the basins is currently buried. The size of the piping is adequate for future use, so the buried carbon steel sections of air piping will be reused. At the BNR Basins aeration stainless steel piping will be elevated above the walkways along the top of the basins. Piping will be insulated where human contact is possible with the pipe to prevent burns. All valves and appurtenances will be rated for temperatures of 250 °F or higher.

For the purposes of air piping design, the peak airflow for each zone was developed by running the maximum loading condition at a variety of temperatures, SRTs, and DO control conditions. These different operational parameters will affect how the oxygen demand associated with maximum loading

is distributed throughout the basin. The maximum for each of these was taken as the peak airflow for each zone as shown in Table 3-4. The peak airflows are used for sizing the common air distribution headers and the individual drop legs to each grid.

Table 3-4 BNR Basins Diffusers Design Criteria

AERATION GRID	MAXIMUM AIRFLOW (SCFM)	APPROXIMATE NUMBER OF DIFFUSERS
Oxic Grid 1	790	225
Oxic Grid 2	640	175
Post Oxic Grid	87	25

3.1.4 Final Clarifiers

From the BNR Basins, wastewater flows to Control Structure 3 where it is currently split in three directions to the existing final clarifiers. Control Structure 3 was originally constructed for a four-way split, with some piping already installed. As such, this project will include the construction of a fourth final clarifier. Final Clarifier 4 will match the dimensions of the existing clarifiers. The clarifier design criteria is presented in Table 3-5.

Table 3-5 Final Clarifier Design Criteria

PARAMETER	VALUE
Number of Units	4 (3 existing, 1 new)
Type	Circular, Spiral Scraper with EDI (hydraulic sludge removal)
Diameter, ft	80
Side Water Depth, ft	12
Bottom Slope, V:H	0.25-inch: 1ft
Surface Overflow Rate, gpd/sf	
Annual Average	424 (3 units in service)
Maximum Month	544 (3 units in service)
Peak Day	995 (3 units in service)
Solids Loading Rate ¹ , ppd/sf	
Annual Average	13 (3 units in service 2,400 mg/L MLSS)
Maximum Month	22 (3 units in service, 3,200 mg/L MLSS)
Peak Day	40 (3 units in service, 3,200 mg/L MLSS)
⁽¹⁾ Based on 50% RAS rate	

Effluent from each Final Clarifier flows over a single v-notch weir into the launder. The existing launders are not covered and are cleaned with an algae sweep mechanism that rotates around the clarifier and physically brushes the downstream side of the weir to keep it free from algae. The existing algae sweep

mechanism will be replaced with fiberglass reinforced plastic (FRP) covers to inhibit algae growth. Final Clarifier No. 4 will also be equipped with FRP launder covers.

The existing clarifiers rely on hydraulics to remove solids from the bottom of the clarifier. Each of the rake arms are equipped with four six-inch PVC sludge withdrawal lines that bring solids into the sight well box where it then flows by gravity to Control Structure 4. The rate of sludge removal is dependent on the water level in the clarifier and the sight well box control gates. The biggest challenge with this type of system is clogging in the sludge withdrawal lines and gate operation in the sight well box. It is recommended that to improve these current challenges, the existing final clarifiers should be retrofitted with spiral scraper rake arms with a two vertical 10-inch sludge withdrawal pipes supported off a new sludge collection box which is supported from the existing walkway. The spiral scraper arms will bring the sludge to the center of the clarifier where it is hydraulically suctioned to the new sludge collection box. Both new 10-inch sludge withdrawal pipes will be equipped with a rotating valve that changes the width of the opening to adjust the sludge removal rate, in lieu of a control gate. In addition to these improvements, it is also recommended to replace the center cage and install an Energy Dissipating Inlet (EDI) on the existing final clarifiers. Adding an EDI will improve clarifier performance by increasing the settleability. All other existing clarifier equipment will be reused. Final Clarifier 4 will match the style of the retrofitted existing clarifiers.

Currently Final Clarifier 1 and Final Clarifier 3 have piped connections to the Final Clarifier 2 scum box. There a scum pump in the Final Clarifier 2 scum box that pumps scum into the Waste Activated Sludge (WAS) storage wetwell. From there, it is processed with the WAS and then pumped to the digesters. It is recommended that an 8-inch pipe is installed from the Final Clarifier 4 scum box to the 8-inch Final Clarifier 3 scum discharge piping. This pipe will allow scum from Final Clarifier 4 to flow by gravity to the Final Clarifier 2 scum box for scum processing similar to the existing clarifiers.

3.2 Solids Treatment Facilities

The Salina WWTP currently utilizes a two-stage anaerobic digestion process to stabilize primary sludge and waste activated sludge (WAS). WAS is thickened to approximately 4% by gravity belt thickening. Next, primary sludge and thickened waste active sludge (TWAS) are combined, heated and mixed in the primary anaerobic digesters for volatile solids reduction and production of gas. The secondary anaerobic digesters provide additional digestion for gas production, solids separation, and storage. Liquid sludge is withdrawn from the secondary anaerobic digester for land application. In lieu of liquid land application, a belt filter press exists for dewatering, although this is rarely used.

The following sections detail solids the treatment improvements for this project:

- Primary Sludge (no new work)
- Primary Digesters 1-2
- Primary Digester Heating System
- Heating Water System and Digester Boiler Building
- Digester Drain Pump
- Sludge Grinder
- Sludge Gas Building No. 13

3.2.1 Digestion

There are four existing primary and two secondary anaerobic digesters. Primary digesters are used to reduce the amount of volatile solids which results in the production of digester gas. One secondary digester has a floating cover for digester gas control. The Digester Control Building is located between the four primary digesters and is a classified space, as defined by NFPA 820. The Digester Control Building will continue to house the components of the primary digester heating system, including heat exchanges and pumps. Electrically powered equipment and instruments along with all electrical components including lighting remaining in the Digester Control Building will be rated for the classified space. The boilers, primary heating water pumps, and compressed air system will be located in the new Digester Boiler Building. If possible, the existing compressed air system located in the Digester Control Building will be reused. The new Digester Boiler Building will be an unclassified one-story building located to the north of the primary anaerobic digesters. Equipment and boiler tube removal will be provided through two overhead doors; one located in front of each boiler.

3.2.1.1 Primary Sludge

There are two existing primary sludge and scum pumps in the Raw Sludge Pump Building and two existing primary sludge and scum pumps in the Monitoring/Raw Sludge Pump Building that service Primary Clarifiers 1-4. Primary sludge and scum is pumped to the Primary Digesters. Table 3-6 presents the primary sludge projections.

Table 3-6 Primary Sludge Projections

PARAMETER	CURRENT AVERAGE ANNUAL, 3.6 MGD	DESIGN ANNUAL AVERAGE, 6.4 MGD	DESIGN MAXIMUM MONTH, 8.2 MGD
Primary Sludge			
TSS, mg/L	10,000	10,000	10,000
Quantity, lbs/day	5,920	13,920	22,770
Flow, gpm ⁽¹⁾	49	116	190
⁽¹⁾ Assumes 1.0% solids concentration			

3.2.1.2 Primary Digesters

Two primary digesters are required to meet current flow. Two of the four primary digester covers will be replaced with fixed radial beam covers as part of this project. Covers will be provided with new level instruments, pressure vacuum relief valves, sample ports and emergency reliefs. In the center of each digester new cover will be one top mounted linear motion mixer.

Table 3-7 Primary Digester Covers Design Criteria

PARAMETER	VALUE
Number of Units	4
Designations	DS-DGE-001 (new) DS-DGE-002 (new)

PARAMETER	VALUE
	DS-DGE-003 (existing) DS-DGE-004 (existing)
Digester Cover Type	Fixed Steel, Radial Beam
Operating Temperature, °F	98
Digester Cover Insulation R-Value	R12
Minimum Sludge Feed Flow, gpm	20
Design Sludge Feed Flow, gpm	78
Nominal Volume, gallons each	428,326
Diameter, feet	45
Side Water Depth, feet	30
Operating Gas Pressure, in w.c.	12
Design Gas Pressure, in w.c.	16
Design Vacuum Gas, in w.c.	-4
Mixer Type	Linear Motion
Number of Units	1 per digester
Designations	DS-MXR-001 (new) DS-MXR-002 (new)
Mixer Motor Size, hp	7.5

3.2.1.3 Digester Heating System

Each digester will be heated by hot water from the boilers through a heat exchanger to maintain the temperature of the biosolids in the digesters. Each digester has a loop piping system that recirculates sludge back to the digester after it has been through the heat exchanger. Sludge recirculation pumps pull from the side and bottom of the digesters. The sludge is pumped through the sludge recirculation pumps to the heat exchangers. Digester sludge piping and valves will be reused when possible. The heat exchanger and recirculation sludge pumps will be replaced in kind. The sludge is combined with raw PS and TWAS before returning to the digester. The heat water system mixes heating water return at 135 F from the digester heating water system with 200 F heating water supplied from the boiler to maintain 150 F water to the heat exchangers. New duty standby digester heating water pumps are provided to supply heating water to all four sludge heat exchangers. Equipment associated with the digester heating system will be located in the Digester Control Building and have the design parameters listed in Table 3-8.

Table 3-8 Digester Heating System Design Criteria

PARAMETER	VALUE
Sludge Heat Exchanger	
Number of Units	4, 1 per digester
Designations	DS-HEX-001 DS-HEX-002 DS-HEX-003 DS-HEX-004
Type	Spiral
Minimum Heat Transfer, Btu/hr	600,000
Pressure Rating, psi	50
Sludge Side	
Flow Rate, gpm	240
Inlet Temperature, °F	97
Outlet Temperature, °F	102
Max Pressure Drop, psi	5
Water Side	
Flow Rate, gpm	80
Inlet Temperature, °F	150
Outlet Temperature, °F	135
Max Pressure Drop, psi	5
Sludge Recirculation Pumps	
Number of Units	4
Designation	DS-PMP-001 DS-PMP-002 DS-PMP-003 DS-PMP-004
Pump Type	Horizontal end-suction centrifugal, chopper
Unit Capacity, gpm	240
Max Sludge Concentration, % solids	4
Sludge Temperature, °F	95 to 98
Rated Head (approximate), ft	17
Motor Size, each, hp	2
Motor Speed, rpm	875
Digester Heating Water Pumps	
Number of Units	2 (Duty/Standby)
Designation	HWS-PHW-001 HWS-PHW-002
Pump Type	End-suction centrifugal

PARAMETER	VALUE
Unit Capacity, gpm	320
Heating Water Supply Temperature, °F	150
Rated Head (approximate), feet	30
Motor Size, each, hp	7.5
Motor Speed, rpm	1,180
Drive Type	Direct

3.2.1.4 Heating Water System and Digester Boiler Building

The new Digester Boiler Building will contain the new boilers, primary heating water pumps and compressed air system. The compressor air system will be evaluated during detail design. If the existing compressed air system has sufficient capacity, it will be relocated from the Digester Control Building. There are two boilers that can operate on digester gas or natural gas. There is only enough digester gas at startup to heat 3 digesters during the winter months. If the fourth digester is utilized as a primary digester before the sludge production increases, the second boiler will need to be run on natural gas. Each boiler will be sized to heat the four digesters during the winter and will be equipped with a digester and natural gas train. Circulating heating water pumps will be located next to the boilers and will supply the digester heating loop and the sludge gas building heat. The boiler system will be designed with the criteria shown in Table 3-9.

Table 3-9 Heating Water System Design Criteria

PARAMETER	VALUE
Heating Water Boilers	
Number of Units	2 (Duty/Standby)
Designation	HWS-BLR-001 HWS-BLR-002
Type	Firebox
Output Capacity, Btuh	2,678,000
Nominal Boiler Size, boiler hp	80
Operating Temperature, °F	200
Return Water Temperature, °F	180
Fuel Source	Primary: Digester Gas Secondary/Pilot: Natural Gas
Digester Gas Usage, max, scfm	5,600
Natural Gas Usage, max, scfh	3,360
Burner Motor Size, hp	3
Primary Heating Water Pumps	
Number of Units	2 (Duty/Standby)

PARAMETER	VALUE
Designation	HWS-PHW-003 HWS-PHW-004
Type	Horizontal End Suction Centrifugal
Flow Rate, gpm	270
Rated Head, feet	30
Motor Size, hp	3

3.2.1.5 Drain Pumps

The drain pump is located in the basement of the digester control building. The pump operation is to drain any one of the digesters and send the digested sludge to either of the Secondary digesters. The drain pump is to be replaced in-kind as shown in Table 3-10.

Table 3-10 Digester Drain Pump Criteria

PARAMETER	VALUE
Number of Units	1
Designation	DS-PPC-001
Type	Progressive Cavity
Flow Rate, gpm	300
Rated Discharge Pressure, psi	12
Motor Size, hp	5
Motor Speed, rpm	1,200

3.2.1.6 Sludge Grinder

The grinder reduces the size of debris/solids in the primary sludge before being blended with the digested sludge. The existing sludge grinder will be replaced in kind. The sludge grinder has a bypass for maintenance and is located in the basement of the digester control building.

Table 3-11 Sludge Grinder Criteria

PARAMETER	VALUE
Number of Units	1
Designation	PS-GRD-001
Type	Grinder
Type	In-line
Minimum flow rate, gpm	280

Motor size, hp	2
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3.2.2 Sludge Gas Building No. 13

Digester gas from the four primary digesters and the two secondary digesters is collected for use in the boilers and the surplus gas is flared. The condensate from existing buried secondary digester gas piping is collection in a vault near the Sludge Gas Building with a drip trap before connecting with gas from the primary digesters. The buried gas piping will not be modified. The new elevated digester gas piping from the primary digesters will have a condensate accumulator for condensate collection before the foam separator. The foam separator will be a water spray to remove any entrained foam or solids materials from the digester gas. The foam separator will be sized to handle 100% capacity of the digester gas flow. The layout of the foam separator will be configured to include a bypass line, with means of isolation, for maintenance of the separator.

The existing candlestick flare is to be replaced including associated gas piping and valves. The gas control valve will remain in the building and the waste gas burner will be location to the south of the Sludge Gas Building as it in currently. The capacity of the digester gas system including piping, valves and equipment from the digester through the waste gas burner will be based on the peak flow, one digester having a foaming event and the others operating at annual average conditions.

Table 3-12 Sludge Gas Equipment Design Criteria

PARAMETER	VALUE
Foam Separator	
Number of Units	1
Designation	DG-FMSP-001
Flow Rate, scfm	132
Waste Gas Burner	
Number of Units	1
Designation	DG-GF-001
Type	Candlestick
Ignition System	Automatic
Digester gas flow rate, scfh	7,920
Digester gas flow rate, scfm	132
Pilot Fuel	Natural gas

3.3 Support Facilities

3.3.1 Chemical Feed Systems

Several chemicals will be utilized to support the Salina WWTP treatment processes.

Table 3-13 summarizes the various chemical systems.

Table 3-13 Process Chemicals Summary

PARAMETER	DESCRIPTION / VALUE
Ferric Chloride, 37%	
Process purpose(s)	Chemical phosphorus removal Chemically enhanced primary treatment (CEPT) Final Clarifier polishing
Feed point(s)	Head of aerated grit basins Control Structure 3
Chemical Feed Flow	Startup – On an as needed basis for flow events exceeding 15 mgd Design AA (6.4 mgd) – 506 gpd with a concentration of 40 mg/L Future AA (7.25 mgd) – 634 gpd with a concentration of 33 mg/L Future MM (9.4 mgd) – 822 gpd with a concentration of 33 mg/L
Tank Storage	Quantity – 2 Usable volume – 8,700 gallons Tank Material - Polyethylene Tank Diameter – 12 feet Straight shell height – 12.25 feet Tanks will be provided with insulation and heating
Storage Design Basis	Future AA – 27 days Future MM – 21 days
Feed Pumps	Quantity – 2 Type – Motor driven peristaltic metering pump Flow Range, gph – 0.5 – 75.0
Polymer, Superfloc C-1598	
Process purpose(s)	WAS Thickening (existing)
Feed point(s)	GBT Building (existing)
Chemical Feed Flow, gpd	Design AA – 3.0 Future AA – 3.4 Future MM – 5.6
Storage, gal	275-gallon tote (existing)
Storage Design Basis	Future AA – 50 days Future MM - 31 days
Feed Pumps	Quantity – 2 (1 duty, 1 shared swing) Type – Skid mounted feeder/blender Flow Range, gph – 0.1 – 5.0
Polymer (CEPT), 35% neat emulsion	
Process purpose(s)	CEPT
Feed point(s)	Back end of aerated grit basins

PARAMETER	DESCRIPTION / VALUE
Chemical Feed Flow, gpd	Startup – On an as needed basis for flow events exceeding 15 mgd Design AA (6.4 mgd) – 5.4 Future AA (7.25 mgd) – 6.1 Future MM (9.4 mgd) – 7.9
Storage, gal	275-gallon tote
Storage Design Basis	Future AA – 45 days Future MM - 34 days
Feed Pumps	Quantity – 2 (1 duty, 1 shared swing) Type – Skid mounted feeder/blender Flow Range, gph – 0.1 – 5.0

The ferric chloride and polymer feed systems will be located in the GBT Building. Both polymer totes will be located on the main level as shown on Drawing 510-M-101. The polymer feeder blenders for these totes are located on the lower level. Polymer feed piping will be routed down to the feeder blenders, from each of the respective storage totes. The piping will be oriented such that one of the feeder blenders is dedicated to the thickening polymer system, one feeder blender will be dedicated to the CEPT polymer system, and one feeder blender will be a swing standby unit. Each feeder blender will also be provided with a non-potable water connection to be used for dilution water. The polymer containment around the feeder blenders is sized to handle both polymer totes completely draining into the lower level. The polymer containment area will also have an emergency eyewash.

The ferric chloride bulk storage tanks will be located outside to the east of the GBT Building. The tanks will be set up to take bulk truck deliveries. From the storage tanks, ferric chloride will flow by gravity down to the GBT lower level in double contained chemical piping. The lower-level ferric chloride chemical area will have two peristaltic metering pumps installed with a shelf spare. One pump is for CEPT and one pump is for the Final Clarifier polishing. The CEPT ferric chloride discharge piping will be routed to the head of the aerated grit basins, and the Final Clarifier polishing will be routed to Control Structure 3. Since the feed pumps are at a lower elevation than the bulk storage tanks, it will be important to add the full containment curb that is shown around the ferric chloride pump area on Drawing 510-M-102. The containment is sized to handle both the bulk storage tanks completely draining into the lower level. In addition, the ferric chloride containment area has been provided with an emergency shower and eyewash. It is also recommended that the ferric chloride feed system is provided with an alarm and emergency shutoff valve.

3.4 Civil Site Work

Civil site work will include excavation, shoring, and backfill associated with new structures such as the Boiler Building and Final Clarifier 4. Once these structures have been constructed the construction areas will be graded and paved to match the existing topography.

3.4.1 Grading and Drainage

New structure perimeters and any site areas affected by construction will be graded to maintain positive drainage away from structures. No storm sewers are anticipated as part of this project. Consideration will be given to existing infrastructure as much as possible to minimize overall impacts. Site drainage and grading design will be finalized once the site survey has been completed.

3.4.2 Paving

Portions of plant roadways will require demolition, removal and replacement to accommodate the construction of new facilities. Any roadways demolished during construction activities will be replaced and will match existing construction, elevations, and alignments. In addition, heavy construction traffic often damages pavement, which will be replaced with new surface course asphalt pavement.

Construction of the new Boiler Building will require new roadway and sidewalks in that area. New roadway pavement sections will consist of a 6-inch aggregate base.

3.4.3 Fencing

No new fencing will be provided. If construction activities require removal of existing fencing, the fencing will be replaced to match existing. If any fencing is removed during construction, temporary fencing will be installed to ensure site security during construction.

3.4.4 Yard Piping

Plant yard piping work will be limited to areas around Final Clarifier 4. Every attempt will be made to prevent interferences with existing plant piping by both new yard piping and new plant structures. Piping under structures will be avoided; however, if required any piping under structures will be concrete encased. All yard piping will be ductile iron pipe unless otherwise specified. Yard piping will be designed and specified during detail design the preliminary major process piping plan is shown on Drawing 000-C-103 in Appendix C. Yard piping installed as part of this project will be sized to handle the future conditions presented in Section 1.11.

3.4.5 Water Systems

The plant has both potable and non-potable water available on-site. Potable water is provided potable to the Administration / Lab Building, Maintenance Buildings, and the Monitoring / Raw Sludge Building. The non-potable system, or potable water downstream of a backflow preventer, is provided throughout the site. The water is serviced from City of Salina and comes into the Administration / Lab Building through an 8-inch main. As previously mentioned in Section 3.3.1, locating chemicals in the lower level of the GBT Building will require an emergency eyewash and shower. This will require adding a potable water connection at the GBT Building.

3.4.6 Natural Gas

Natural gas is currently available on site and feeds nearly all of the existing buildings except the Blower Building and electrical substations. The new Boiler Building will be included in the natural gas loop, but otherwise, no other extensions are expected. Kansas Gas Service is the existing natural gas provider for the plant.

4.0 Architectural Design Criteria

This section describes the basis of architectural design for the new buildings, repairs, and renovation work at Salina WWTP.

4.1 General

The architectural design for the new Digester Boiler Building at Salina WWTP will use masonry insulated cavity wall construction to provide consistent service life and durability, and to blend aesthetically with the existing buildings at the site. New masonry work will match the overall appearance and style of the existing. All new architectural building components utilize durable and low-maintenance construction materials. Building materials and systems are further described in the Building Systems section.

4.2 Applicable Codes and Standards

The architectural design for new buildings, repairs, or renovation work to existing buildings will conform to the following codes:

- 2018 International Building Code (IBC)
- 2018 International Fire Code (IFC)
- 2018 International Energy Conservation Code (IECC)

Table 4-1 identifies the building code requirements based on occupancy classification for all new buildings.

Table 4-1 Occupancy Classification Requirements

DIGESTER BOILER BUILDING (NEW STRUCTURE)	
Occupancy	F-1
Type of Construction	II-B
Allowable Area & Height	15,500 SF/Story, 2 Stories (55 ft)
Actual Area & Height	1,500 SF, 1 Story (17 ft)
Design Occupant Load	300 SF/person (electrical and mechanical areas)
Fire Separation	1-Hour fire barrier between Boiler Room and Electrical Room
Fire Sprinklers	Not Required

4.3 Building Descriptions

4.3.1 New Facilities

The new Digester Boiler Building will be a single-story masonry building, located north of the existing Digester Control Building, which will house the boilers and an electrical room. Roof structure will be metal joists and deck. Rainwater will be managed through scuppers and downspouts. Interior building surfaces will be epoxy coated for durability. Translucent high windows will provide filtered natural light into the boiler area.

4.3.2 Existing Building Repairs / Renovations

The existing Digester Control Building was constructed in 1962. The Electrical Substation Nos. 1 and 2 were constructed in 1995. Buildings are predominantly single-story masonry load-bearing structures.

Proposed repairs to existing buildings described below, include repair of damaged windowsill units, joint sealant replacement, and minor brick replacement and tuckpointing.

4.3.2.1 Digester Control Building

The Digester Control Building was constructed in 1962 and includes Primary Digesters 1, 2 and 3. An addition including Digester 4 was constructed in 1995.

The Digester Control Building currently consists of a single-story concrete framed masonry veneer building between Digesters 1, 2, 3 and 4. The first floor level has the digester control room. The basement level contains pump rooms.

- Repair and repaint interior wall, floor and ceiling surfaces.
- The existing roof system will be replaced with a new light colored insulated single-ply roof system, sloped to drain. New roof insulation will be R-30ci to comply with the 2018 IECC.
- Repair damaged concrete wall cap at Digester 2.
- The southeast face of Digester 2 is exhibiting brick cracking. Selective brick replacement, and tuckpointing will be required.
- The exterior faces of Digesters are exhibiting staining. Brick cleaning will be required.

4.3.2.2 Electrical Substation No. 1

- Substation will be expanded to allow for switchgear installation. Existing switchgear will be demolished and replaced with and replaced with additional BNR MCC and PLC.
- Repair interior painted finishes where electrical equipment removed.

4.3.2.3 Electrical Substation No. 2

- Repair interior painted finishes where electrical equipment removed.

4.4 Building Systems

4.4.1 Structure

The new Digester Boiler Building will consist of face brick masonry veneer with insulated cavity over load-bearing unit masonry walls. Load bearing walls with bar joist roof structure and metal roof deck will be used.

4.4.2 Roofs

Roof for new Digester Boiler Building will be light colored single-ply membrane roofing over a cover board, insulation, and structural decking. New structural decking will be flat with tapered insulation sloped to drain. Rainwater drainage will be managed by scuppers and downspouts for the new building.

4.4.3 Doors and Windows

Exterior windows will be flush aluminum. Rolling doors will be insulated, anodized aluminum. Exterior windows on the new building will be translucent glazing where used for natural lighting. Interior and exterior doors and frames will be aluminum. Exterior windows will be high UV reflective glazing in the new building to reduce heat gain to the boiler area.

5.0 Structural

5.1 General

This structural design criterion establishes the minimum design requirements for buildings, environmental and liquid containing structures, yard structures, miscellaneous equipment foundations, non-structural components, piping supports, and other miscellaneous items requiring structural design.

5.2 Applicable Codes, Standards, and References

The codes, standards, and references listed below will serve as the basis for structural design.

- International Building Code (IBC), 2018 Edition.
- ASCE 7-16: Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- Geotechnical Investigation Report (future).
- ACI 318-14: Building Code Requirements for Structural Concrete.
- ACI 350-06: Code Requirements for Environmental Engineering Concrete Structures and Commentary ACI 350R-06.
- ACI 350.3-06: Seismic Design of Liquid Containing Structures and Commentary ACI 350.3R-06.
- TMS 402/602-16: Building Code Requirements and Specification for Masonry Structures.
- Aluminum Design Manual, 2015 Edition.
- AISC Manual of Steel Construction, 15th Edition.
- AISC 360: Specification for Structural Steel Buildings, 2016.
- PCI MNL 120-17: PCI Design Handbook, Precast and Prestressed Concrete, 8th Edition.

5.3 Specified Material Properties

5.3.1 Concrete

- Cast-In-Place Structural Concrete
 - Flatwork, Mortar Puddle, And Drilled Piers: $F'_c = 4,000 \text{ Psi}$
 - Environmental Structures: $F'_c = 4,500 \text{ Psi}$
 - Other Structures: $F'_c = 4,500 \text{ Psi}$
- Prestressed/Precast Structural Concrete: $F'_c = 5,000 \text{ Psi}$
- Nonstructural Concrete (Concrete Fill, Duct Banks,
 - Pipe Blocking, Pipe Encasement): $F'_c = 3,000 \text{ Psi}$

5.3.2 Concrete and Masonry Reinforcement

- Reinforcing Bars (ASTM A615 or ASTM A706): $f_y = 60,000 \text{ psi}$
- Welded Wire Mesh (ASTM A1064): $f_y = 70,000 \text{ psi}$

5.3.3 Masonry

- Masonry unit assembly: $f'_m = 2,500$ psi

5.3.4 Structural Steel

- W and WT shapes (ASTM A992, Grade 50): $f_y = 50,000$ psi
- M, S, C and MC shapes (ASTM A36): $f_y = 36,000$ psi
- Angles, bars, plates, and other structural shapes (ASTM A36): $f_y = 36,000$ psi
 - HP shapes (ASTM A572, Grade 50): $f_y = 50,000$ psi
 - Pipe sections (ASTM A53, Type E or S, Grade B): $f_y = 35,000$ psi
 - Round Structural Tube sections (ASTM A500, Grade C): $f_y = 46,000$ psi
- Square and Rectangular Tube sections (ASTM A500, Grade C): $f_y = 50,000$ psi
- Weld materials (ANSI/AWS D1.1, Table 3.1), using
 - E70XX filler metal with minimum tensile strength: $F_w = 70$ ksi
- High strength bolts (ASTM F3125, Grade A325,
 - Type 1 or Grade F1852 Twist-Off/TC, Type 1) tensile strength: $F_u = 120$ ksi

5.3.5 Aluminum

- Aluminum Association standard shapes (ASTM B308, Alloy 6061-T6)
- Sheet and Plate (ASTM B209, Alloy 6061-T6)
- Material strengths for all aluminum materials:
 - Tensile yield strength: $F_{ty} = 35,000$ psi
 - Compressive yield strength: $F_{cy} = 35,000$ psi
 - Shear yield strength: $F_{sy} = 20,000$ psi

5.4 Loading Criteria

5.4.1 Dead Loads

Dead load will include the weight of all permanent construction including roofs, walls, floors, partitions, interior finishes, fixed equipment, tanks and bins including contents, equipment bases, pipes, HVAC ducting, and electrical lighting. Dead load criteria are indicated in Table 5-1.

Table 5-1 Dead Load Criteria

DEAD LOAD CRITERIA	
Equipment, tanks, silos, etc.	Actual weights
Pipe, 12 inch diameter and smaller	25 psf over full member length
Pipe, 14 inch diameter and larger	Actual weights
Phantom load	2 kips on primary beams, 1 kip on secondary beams, 300 lbs on steel joists
Concrete (normal weight)	150 pcf
Roofing and rigid insulation board	Actual, 15 psf (minimum)
HVAC ductwork (general)	5 psf
Lighting (general)	3 psf

5.4.2 Live Loads (Floor and Roof)

A minimum floor live load of 150 psf will be applicable to all operating floors. For large equipment areas, the combined weight of equipment and concrete pad plus an additional live load of 50 psf over the base area may be used as the live load. The equipment weight may be assumed distributed over an area 3'-0" all around beyond the concrete pad perimeter. Additional live load criteria are indicated in Table 5-2.

Table 5-2 Live Load Criteria

LIVE LOAD CRITERIA	
Operating floors	150 psf
Walkways, stairs and landings	100 psf
Elevated equipment platforms (non-egress)	60 psf
Storage, general	250 psf
Electrical and Control room floors	250 psf
Ordinary roof live load	20 psf minimum (no reduction taken)

5.4.3 Snow Loads

Snow loads will be determined in accordance with IBC Section 1608 in conjunction with ASCE 7, Chapter 7. Drifting snow, unbalanced snow and rain-on-snow surcharge will be considered. Basic snow load parameters are given in Table 5-3.

Table 5-3 Snow Load Criteria

SNOW LOAD CRITERIA	
Minimum Ground Snow Load	20 psf
Surface Roughness Category	C
Importance Factor	1.1
Exposure Factor, C_e	1.0
Thermal Factor, C_t	1.1

5.4.4 Wind Loads

Wind loads will be determined for primary frames and components of structures in accordance with IBC Section 1609 in conjunction with ASCE 7, Chapter 26. ASCE7, Chapter 28 (Wind Loads on Buildings – MWFRS) will be used for low-rise buildings meeting the scope requirements of Section 28.1.1. For other structures, ASCE 7, Chapter 29 (Wind Loads on Other Structures and Building Appurtenances – MWFRS) will apply. ASCE 7, Chapter 30 will be applied to components and cladding. Basic wind load parameters are given in Table 5-4.

Table 5-4 Wind Load Criteria

WIND LOAD CRITERIA	
Risk Category	III
Basic (Ultimate) Design Wind Speed	119 mph
Ground Elevation Factor, K_e	1.0
Exposure Category	Exposure C

5.4.5 Seismic Loads

Seismic loads will be determined for primary frames and components of building structures in accordance with IBC Section 1613 in conjunction with ASCE 7, Chapter 11. ASCE 7, Chapter 12 will be the basis of design for buildings and similar structures. Non-structural components will be designed for the seismic loads indicated in ASCE 7, Chapter 13. Non-building structures will be designed for the seismic loads indicated in ASCE 7, Chapter 15. Liquid-containing concrete structures will be designed for the seismic loads indicated in ACI 350.3. Interior walls and partitions will be designed for a minimum of 10 psf lateral pressure (strength-level). Basic seismic load parameters are given in Table 5-5.

Table 5-5 Seismic Load Criteria

SEISMIC LOAD CRITERIA	
Short period spectral acceleration, (S_s)	0.076
One second period spectral acceleration, (S_1)	0.048
Risk Category	III

SEISMIC LOAD CRITERIA	
Seismic Design Category	B
Structural System Response Coefficient	ASCE 7, Chapter 12
Total Seismic Dead Loads, W	Actual
Site Soil Classification	D, assumed – to be confirmed with geotechnical report.

5.4.6 Soil and Backfill Loads

Lateral backfill loadings on walls and below grade structures will be based upon the recommendations of the geotechnical report. Geotechnical load criteria are indicated in Table 5-6.

Table 5-6 Geotechnical Load Criteria

GEOTECHNICAL LOAD CRITERIA	
Lateral earth pressures	
Active earth pressure (drained)	Per Geotechnical Report
Active earth pressure (undrained)	Per Geotechnical Report
At-rest (drained)	Per Geotechnical Report
At-rest (undrained)	Per Geotechnical Report

A compaction load will be applied at the top of grade for buried walls to account for extra compaction stresses resulting from using mechanical compaction equipment. The compaction loading will be additive to the lateral earth pressure and will be a constant 400 psf decreasing linearly at the rate of the lateral earth pressure until the lateral earth pressure exceeds 400 psf.

Where vehicular truck traffic can come within a horizontal distance from the top of the structure equal to one-half its exposed height, the design shall include a live load surcharge pressure equal to 2-feet of earth for an equivalent H2O truck loading. This surcharge is not to be applied concurrently with the compaction load above.

5.4.7 Equipment and Piping Loads

Piping thrust loads will be considered live loads and will be located and sized prior to structural design.

5.4.8 Impact Loads

Structural systems will be designed for impact loads from machinery and other moving items. Impact loads will be determined in accordance with ACI 350.4R and IBC Section 1607.9 for machinery. Weight of machinery and moving loads will be increased as indicated in Table 5-7.

Table 5-7 Machinery and Moving Load Percentage Increase

MACHINERY AND MOVING LOAD PERCENTAGE INCREASE	
Elevator loads, and machinery	100%
Light Machinery, Shaft or Motor Driven	20%
Reciprocating Machinery or Power Driven Units	50%
Hangers for Floors and Balconies	33%

5.4.9 Bridge Crane and Monorail Loads

Bridge crane runway beams and monorail beams will be designed for 125 percent of the rated load for each hoist whether powered or manual hoists are used. Lateral and longitudinal forces shall follow ASCE 7, Sections 4.9.4 and 4.9.5 respectively.

5.4.10 Load Combinations

Building structures, components, and cladding will be designed in accordance with the load combinations contained in IBC, Section 1605 or ASCE 7. Reinforced concrete for non-environmental structures will be designed using the load combinations in ACI 318, Section 5.3. Reinforced concrete for environmental structures will be designed using load combinations in ACI 350, Section 9.2.

5.5 Design Procedures

5.5.1 Reinforced Concrete Design

Liquid-containing structures, below grade structures in contact with groundwater in normal conditions, and chemical storage structures will be designed in accordance with ACI 350. Other concrete structures will be designed in accordance with IBC Chapter 19 and ACI 318. Concrete will be designed for 4,000 psi strength even when 4,500 psi strength is specified.

5.5.2 Reinforced Masonry Design

Concrete masonry will be designed in accordance with IBC Chapter 21 and TMS 402.

5.5.3 Structural Steel Design

Structural steel will be designed in accordance with IBC Chapter 22, AISC Manual of Steel Construction, and AISC 360.

5.5.4 Aluminum Design

Aluminum will be designed in accordance with IBC Chapter 20, and the Aluminum Design Manual.

5.5.5 Geotechnical Design

Geotechnical design will be in accordance with the criteria indicated in Table 5-8, which is obtained from the recommendations of the geotechnical report. Minimum frost depth for soil bearing foundations will be verified with the Geotechnical Report.

Table 5-8 Geotechnical Design Criteria

GEOTECHNICAL DESIGN CRITERIA	
Net-allowable soil bearing pressures	Per Geotechnical Report
Modulus of subgrade reaction, slabs-on-grade	Per Geotechnical Report
Allowable passive earth pressure	Per Geotechnical Report
Soil/concrete coefficient of friction	Per Geotechnical Report
Normal groundwater level elevation	Per Geotechnical Report

5.5.6 Flotation

Structures will be designed to resist flotation based on the weight of the structure including weights of fixed equipment and soil above the top surface of the structure. Safety factors will be as indicated in Table 5-9.

Table 5-9 Flotation Safety Factors

FLOTATION SAFETY FACTORS	
Normal Operating Condition	1.25
Extreme Maintenance or Flood Condition	1.1

Water retaining basins will be designed for uplift conditions when drained for maintenance. Uplift may be due to flood, groundwater, or perched groundwater (as determined by the geotechnical report) due to surface runoff or basin leakage. Uplift resistance may be obtained by weight of the structure and/or a pumped underdrain system. The uplift resistance system will be designed in conjunction with the geotechnical engineer.

5.5.7 Impact and Vibration Design

Structures supporting large equipment such as pumps, blowers, and generators will be investigated for the effects of impact and vibration.

5.5.8 Bridge Crane and Monorail Runway Beam Design

The maximum allowed vertical deflection will be L/800 for bridge crane runway beams and L/450 for monorail runway beams.

5.5.9 Non-Structural Component Design

Non-structural components (architectural, electrical, and mechanical) and their anchorage will be designed by the manufacturer for the seismic requirements specified in ASCE 7, Chapter 13, and shop drawings will be required to be sealed by a registered professional engineer when applicable. Components that are exempted from such requirements, per ASCE 7 criteria, will not require a seismic design or any special submittal requirements. Components located outdoors will also be subject to wind, snow, and ice loading requirements as applicable.

5.5.10 Guardrail, Handrail, Ladder, and Stair Designs

Guardrails, handrails, ladders, and metal stair systems will be performance specified and will be designed by the fabricator. Rail, ladder, and stair material to be aluminum. Design will comply with the most stringent requirements of the applicable building code, OSHA 29 CFR Part 1926 Subpart R, and all other pertinent OSHA regulations and local safety regulations. Shop drawings, including calculations, will be required to be sealed by a registered professional engineer.

5.6 Concrete Repair

5.6.1 Concrete Crack Repair

Concrete cracks, identified for repair, will be repaired using pressure-injected epoxy or pressure-injected foam resin. Non-moving (structural) cracks will be repaired using pressure-injected epoxy resin with injection ports at spacings recommended by the material manufacturer. Moving and/or cracks with substantial water movement will be repaired using pressure-injected foam resin with offset injection holes at spacings recommended by the material manufacturer.

5.6.2 Concrete Surface Repair

Concrete surfaces, identified for repair, will be repaired using materials specified for the thickness and location of the application. Surfaces will be prepared per manufacturer requirement with all edges square cut to avoid feathered edges. As required, surfaces will be prepared mechanically to remove all deteriorated, loose, and unsound concrete and to provide the required surface profile per International Concrete Repair Institute (ICRI) Guideline 310.1R "Guide for Surface Preparation".

5.7 Special Inspection Requirements

The authority having jurisdiction (AHJ) is the local building official and the special inspections during construction are to comply with the applicable building code. The Code Required Special Inspections and Procedures specification will be provided to facilitate the special inspections program.

6.0 Mechanical Building Systems Design Criteria

6.1 General

This section presents the criteria and basis of mechanical design associated with the plumbing; heating, ventilating, and air conditioning (HVAC); and fire protection systems. The intent of this section is to define the design criteria, establish the minimum design requirements, and describe the mechanical systems. The selection of the systems will be based on operating performance, system efficiency, life safety considerations, long-term durability, redundancy, local representation/service, ease of operation as well as site and specific requirements identified by the project team as described herein.

6.2 Applicable Codes and Standards

In addition to the applicable building codes and standards previously identified, the system designs will also be based on but not limited to the following publications and standards:

- American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Handbooks and Standards.
- Sheet Metal and Air Conditioning Contractor National Association (SMACNA) Handbooks.
- National Fire Protection Association Recommended Practices (NFPA) and Manuals.
- Recommended Standards for Water Works - Great Lakes - Upper Mississippi River Board of Sanitary Engineers (10 States Standards).
- Occupational Safety and Health Act (OSHA) Standards Manual.
- Applicable State of Kansas Regulations, latest editions
- NFPA 72 National Fire Alarm and Signaling Code
- Other applicable NFPA standards
- 2018 Uniform Mechanical Code (UMC)

6.3 Design Guidelines

6.3.1 Location and Meteorological Design Criteria

Table 6-1 Location and Meteorological Design Criteria

Parameter	Value
Site Elevation, Above sea level, ft.	1269
Site Location ¹	
Station Name	Salina Municipal, KS USA
Station Number, WMO#	724586
North Latitude, degrees	38.800
West Longitude, degrees	97.650

Parameter	Value
Ambient Design Temperatures ²	
Winter, design dry bulb, F	4.3
Summer, design dry bulb, F	101.9
Summer, design wet bulb, F	73.5
Dehumidification, design dew point, F	73.1
Climate Zone	
County	Saline
Climate Zone Designation	4A
Rainfall Intensity ³	
Actual, inches/hour	3.7
Design, inches/hour	4.0
<p>⁽¹⁾ The site location is for determining representative weather data for the project site but is not necessarily the specific project location.</p> <p>⁽²⁾ The winter and summer design temperatures are based on the ASHRAE frequency levels 99.6 percent and 0.4 percent, respectively.</p> <p>⁽³⁾ The actual rainfall intensity rate is based on a 60 minute duration and 100 year return period.</p>	

6.3.2 Materials

Materials will be selected giving preference to those materials that require the least maintenance and have the longest life.

Table 6-2 System Materials of Construction

System	Materials
Sanitary Drainage Systems	Cast Iron
Water Systems	Copper ¹ , PVC/CPVC
Ductwork	Galvanized steel ¹ , Aluminum
Heating water	Carbon steel
<p>⁽¹⁾ Alternate corrosion resistant materials will be used in corrosive locations where indicated on the drawings.</p>	

6.3.3 Seismic

The seismic design will comply with the “Seismic Design Requirements for Nonstructural Components” of the latest edition of American Society of Civil Engineers Standard ASCE/SEI 7, “Minimum Design Loads for Buildings and Other Structures”.

6.4 Plumbing Design

6.4.1 Storm Drainage Systems

Roof drainage systems for the Digester Boiler Building will consist of gutters and downspouts for new structures provided under the architectural design. Existing buildings will retain their current roof drainage systems.

6.4.2 Sanitary Drainage Systems

General floor drainage will be provided in the Digester Boiler Building, and funnel receptors will be located near equipment with equipment drains. In existing buildings, the sanitary drainage systems will be modified to accommodate new process equipment to the greatest extent possible.

All floor drains, funnel receptors, and plumbing fixtures connected to the sanitary drainage system will be provided with traps and vents. Where individual vents cannot be provided for each trap due to physical constraints, a combination waste and vent system will be utilized for floor drains and funnel receptors. All other drains will be individually vented. Piping materials will be cast iron soil pipe with hubless or bell and spigot joints.

All plumbing fixtures and floor drains located on the floor at or above grade will discharge by gravity to the plant sanitary sewer.

6.4.3 Water Piping Systems

In all existing buildings, potable hot and cold water and non-potable water will be maintained to existing fixtures, emergency fixtures, and equipment. For replaced equipment, new connections will be made as required by each piece of equipment. In the Digester Boiler Building, non-potable water will be connected to the heating water makeup and non-potable hose faucets will be provided for washdown. Piping materials will consist of soft annealed copper tubing with flared fittings for buried sizes 2 inch and smaller and type K hard drawn copper tubing with solder joint fittings for above grade piping. At the Gravity Belt Thickener Building, a new potable water service will serve new emergency fixtures provided for the polymer and ferric chemicals. One natural gas storage type water heater will serve all fixtures, and each fixture will be provided with its own mixing valve. A through-wall combination unit will serve the outdoor ferric area, an indoor combination unit will be located in the basement near the pumps, and an eyewash will be located near the polymer system. A new emergency eyewash will be provided at the blower building with an instantaneous electric heater to provide tepid water. It is assumed that available water pressure is acceptable and pressure boosting systems are not required.

All materials in contact with the potable water will comply with the Safe Drinking Water Act of 1986 as amended by the Reduction of Lead in Drinking Water Act of 2011. All plumbing fittings and fixtures intended to convey or dispense water for human consumption will comply with the requirements of NSF/ANSI 61 and NSF/ANSI 372 for low lead.

6.4.4 Natural Gas piping Systems

The new Digester Boiler Building will have natural gas extended to it to serve the boilers and space heating needs in the boiler room. A gas pressure regulator will be provided at the service entrance to the building. Gas service is already provided at existing buildings and will be utilized and modified as needed. Piping materials will consist of polyethylene pipe with butt fusion joints for buried sizes 3 inch and larger and socket fusion joints for buried sizes 2 inch and smaller. For above grade and interior locations, pipe will consist of schedule 40 black steel with butt welding fittings for 2-1/2 inch and larger and socket welding or malleable iron fittings for 2 inch and smaller.

6.5 Heating, Ventilation, and Air Conditioning

6.5.1 HVAC General Requirements

Existing buildings will retain their current HVAC equipment and controls.

6.5.2 Indoor Design Conditions

The following Table describes the indoor design conditions and ventilation rates for each room within the buildings.

Table 6-3 Indoor Design Conditions

Area	Design Temperatures (F) (1)			Ventilation Requirements	Ventilation Notes
	Summer	Winter			
	Design	Design	Setpoint		
Digester Boiler Building					
Electrical Room	85	60	55	Air Conditioned	2
Boiler Room	112	60	55	6 AC/hr (I)	1

(1) Indoor conditions reflect operating temperatures for personnel comfort, code/standard recommendations, or equipment protection.
 AC/HR - designates air changes per hour.
 (C) - designates the ventilation system operates continuously.
 (I) - designates the ventilation system operates intermittently.

Ventilation Notes:

- The ventilation system will be sized on the more restrictive of the AC/HR listed or the airflow required to maintain the indoor design temperature based on the summer outside design temperature.
- The ventilation rate will be based on the exhaust requirements or as required by ASHRAE 62, whichever is more stringent.

6.5.2.1 Intakes

Outdoor air intakes will be designed to manage rain entrainment in accordance with the latest ASHRAE standards. Louvers will be selected to limit water penetration to a maximum of 0.01 oz/ft² (3 g/m²) of

louver free area at the maximum intake velocity. Corrosion resistant screens will cover the openings with openings of 1/2 inch.

6.5.2.2 Air Filtration

Outdoor air will be filtered for air-conditioned areas. Filtration will consist of 2-inch disposable pleated media filters with a minimum efficiency reporting value (MERV) based on ASHRAE 52.2 guidelines of at least 6.

6.5.2.3 Internal Load Factors

Heating and cooling loads will be calculated in accordance with ASHRAE Standards. Internal heat gains will be included in the calculations based on the following:

- Lighting: 1.3 watts/sq ft (unless otherwise indicated)
- Equipment: Equipment heat loss from equipment anticipated to operate simultaneously.

6.5.2.4 Ductwork

Ductwork will be sized for 0.08-inch water column per 100 feet for a friction loss. Ductwork will be insulated for air conditioning systems, outside air, and heating systems. Insulation will consist of duct liner tested to be resistant to mold growth and erosion under a standardized test method. Insulated plenums will be externally insulated and include drain provisions for removal of any moisture that may carryover through the outside air louver.

6.5.3 Heating Systems

In the Digester Boiler Building, space heating will be provided by individual natural gas unit heaters in the boiler room. The electrical room will be provided with electric unit heaters. The heaters will be located to provide uniform space heating of the area served. In some cases, process equipment and piping will not allow ideal heater placement. Some temperature variation can be experienced. Each unit heater will be controlled by an adjustable wall mounted digital thermostat.

In the blower building, electric unit heaters will be added to provide space heating. Each unit heater will be controlled by an adjustable wall mounted digital thermostat.

6.5.4 Ventilation Systems

Ventilation rates are typically based on NFPA 820. While reviewing the existing odor control fan near the Gravity Belt Thickener Building, it was noticed that the system will need to be rebalanced. While it is anticipated that the existing fan can be retained, the system will require opening the existing dampers more to allow more air to flow to the fan. The preliminary calculations, shown below in Table 6-4 are based on 12 ACPH. This results in an increase to approximately 10,600-cfm versus the 9,500-cfm original design.

Table 6-4 New HW/WAS/Belt Thickener Odor Control Fan

PARAMETER	ORIGINAL DESIGN (CFM)	CALCULATED NEW VALUE (CFM)	EXISTING DAMPER
Headworks/Influent Channel	3,000	4,000	AD-152
Grit/Pre-aeration	1,000/basin (2,000 total)	500/basin (1,000 total)	AD-150/AD-151
WAS Storage Tank	500	500	AD-153
GBT Room (Lower Level)	2,800	5,020	AD-154
Thickener/WAS Well	1,200	40	AD-155
Total	9,500	10,600	

Additionally, in the Gravity Belt Thickener Building, a ventilation rate of 6 ACPH is required to keep the building unclassified, per NFPA 820. A preliminary review shows that the existing ventilation system is slightly undersized, so the roof mounted makeup air unit (MAU) may need to be replaced to increase the airflow. This will be further investigated during detailed design, as well as confirming that the building is equipped with the code required combustible gas detection and alarming appurtenances.

In the Digester Boiler Building, the ventilation systems will consist of an intermittent system. The system will consist of exhaust propeller fans, intake and exhaust wall mounted louvers and control dampers. The ventilation system will be designed to promote air movement from all portions of the ventilated space. Control dampers will be used to isolate the space from ambient conditions upon system shutdown. Each fan system will be controlled by a local "ON-OFF-AUTO" selector switch. When the switch is in the "AUTO" position, control will be from a local space thermostat. A MAU will supply tempered air to the space and will exhaust through the louvers. The unit heaters will be sized to account for the additional load.

In the blower building, the existing ventilation systems will remain in service. Since the blowers will now draw air from outside the building, the controls sequence will be modified to ensure efficient operation.

6.5.5 Air Conditioning Systems

The air conditioning system for the Digester Boiler Building electrical room will consist of a single zone, variable air volume, packaged grade mounted air conditioner. Each unit will be controlled by a remote wall mounted thermostat to maintain the desired space temperature.

6.5.6 Building Control Systems

The HVAC controls will consist of automatic industrial grade electromechanical and electronic controls. Control component enclosures will be selected based on the environment where they are installed. Typical controls will consist of the following:

- Differential pressure gauge and differential pressure switch with alarm across air filters.
- Electric thermostats for control of intermittent ventilation systems to start and stop equipment operation.
- Programmable electric thermostats for control of packaged air conditioning systems.

6.6 Fire Protection Design

6.6.1 Applicable Codes and Standards

The fire protection system design will conform to the latest editions of the following applicable standards and codes:

- International Building Code (with local jurisdiction amendments)
- International Fire Code (with local jurisdiction amendments)
- National Fire Protection Association (NFPA)
- Standard for Fire Protection in Wastewater Treatment and Collection Facilities, 2020 Edition (NFPA 820)
- Standard for the Installation of Private Fire Service Mains and Their Appurtenances (NFPA 24)
- Life Safety Code (NFPA 101)
- Fire Alarm Signaling (NFPA 72)

6.6.2 Fire Protection

No modifications or additions to existing fire protection systems are anticipated.

7.0 Electrical Design Criteria

This section presents the criteria for the design of the electrical system which are to be provided as a part of the Salina Wastewater Treatment Plant Improvement Project at Salina, KS.

7.1 General

This section presents the general electrical design criteria for the electrical power system for the project. The intent is to provide a safe and reliable means of delivering and distributing power while maintaining ease of maintenance as much as possible. The following criteria also address a number of other electrical requirements that are not specifically related to power delivery.

Followings are the new electrical equipment that will be provided under the project.

- Two, 480V, 2000-A bus switchboards
- Two 480V, 800-A bus switchboards
- One 480V, 500A MCC with integrated VFD's
- Three 480V, 400A MCC with integrated VFD's

Followings are new lighting system that will be provided under the project.

- New Digester Boiler Building
- Remodeled Digester Control Building.
- Remodeled Sludge Gas Building.

7.2 Applicable Codes and Standards

The electrical design will conform to the latest versions of the following codes and standards unless otherwise specified:

- National Electrical Code (NEC-NFPA 70)
- National Electrical Safety Code (NESC)
- Life Safety Code (NFPA-101-AB)
- Standard for Fire Protection in Wastewater Treatment and Collection Facilities (NFPA 820)

The Standards and codes of the following organizations will also govern, were applicable:

- American National Standards Institute (ANSI)
- Illuminating Engineers Society (IES)
- Instrumentation Society of Automation (ISA)
- National Electrical Manufacturers Association (NEMA)
- National Fire Protection Association (NFPA)
- Institute of Electrical and Electronic Engineers (IEEE)
- Insulated Cable Engineers Association (ICEA)

- Occupational Safety and Health Act (OSHA)
- American Society for Testing and Materials (ASTM)
- Underwriters Laboratory (UL)

Applicable federal and local codes and UL listing requirements shall be followed. Exit signs, emergency egress lighting and emergency lighting power supply will conform to the requirements of the local code authority.

7.3 Power Distribution Design

The design of the power distribution system for the project will follow the current design guidelines recognized by the IEEE and current industry standards.

7.3.1 Existing Plant Electrical Distribution System

The Salina WWTP is located at Salina, KS and the electrical service for this project is provided by Evergy.

The existing electrical service from Evergy consists of a 12.47KV service from the North Street Substation and another 12.47KV service from the Mulberry Creek Substation. Both 12.47KV services are connected to an off-site automatic transfer switch (ATS) owned by the utility company. Two utility 12.47KV power feeds are fed from the ATS to two high-speed grounding switches (HSGA & HSGB). Each HSG is equipped from 2 fused disconnects (80E and 40E). The 80E fused disconnects from both HSGA & HSGB are connected to Substation 1 two transformers (1500KA, 12.47KV:277/480V), while the 40E fused disconnects from both HSGA & HSGB are connected to Substation 2 two transformers (500KVA, 12.47:277/480V). The 12.KV underground lines are routed around the WWTP from the HSG switches to the substation transformers. All the electrical components described in this paragraphed will be reused and will have no modification to them.

In Substation 1, there are two 2,000A-bus switchgears which will be replaced with new switchboards with the same bus size. The new switchboards will be housed in a new substation building. In Substation 2, there are two 800A-bus switchboards which will be replaced with new switchboards with the same bus size. The new switchboards will be housed in a new electrical room located in a new Digester Boiler Building.

The 480V underground circuits are routed throughout the WWTP from the substation switchboards to various motor control centers (MCC's), transformers, and 480V power panels located in different buildings. New 480V power feeds will be provided from the new switchboards to any re-used existing MCC's and to the new MCC's. All circuits to and from existing Substation 2 will be rerouted to the new Boiler Building electrical room in a new ductbank.

7.4 Distribution and Utilization Voltages

The following distribution and equipment utilization voltages and ratings will generally be used. Depending on the specific equipment requirements determined in design, there could be some exceptions,

- | | |
|---------------------------|-------------------------|
| ■ Facility Distribution | 480 volts, three-phase |
| ■ Motors, ½ hp and larger | 480 volts, three-phase |
| ■ Motors, less than ½ hp | 120 volts, single-phase |

■	Motor control	120 volts, single-phase
■	Lighting	120 volts, single-phase
■	Convenience outlets	120 volts, single-phase
■	Instrumentation and Control	120 volts, single-phase

7.5 Electrical Equipment Design Criteria

7.5.1 480 Volt Switchboard

Indoor, NEMA 1 rated switchboard will be used for the project. Control cabling will be insulated and rated for 600V.

Circuit powering the switchboard will be 480 V, three-phase. All equipment will be rated to handle short circuit currents equal to or greater than the available fault current. The switchboard will have power main and tie breakers with solid-state trip units with long-time (L), short-time (S), instantaneous (I) and ground-fault (G) protection functions. Downstream distribution breakers will be molded case type with solid-state adjustable trip or thermal magnetic trip units depended on the breaker size to improve coordination and downstream arc flash characteristics. Surge protection devices (SPDs) will be provided.

Customer power quality monitoring equipment will be included in the switchboard to connect metering data to the Plant Control System through network data link. This connection will be hard-wired to SCADA.

7.5.2 480 Volt Motor Control Center and Starters

Indoor, NEMA 1 rated MCC will be used for the project. Internal and external monitoring and control of MCC devices such as motor starters and VFD's will be via hardwiring. Control cabling installed within the MCC will be insulated and rated for 600V.

Feeder circuit powering the MCC originating from the switchboard feeder breaker will be 480 volt, three-phase, three-wire. The MCC will have a tin-plated copper phase bus and a copper ground bus. MCC will be a single bus configuration and will be rated to handle short circuit currents equal to or in excess of the available fault current. The MCC main breaker will be molded case type with solid-state trip units with LSI protection functions. The MCC main breaker will also be provided with ground-fault protection when required by the NEC. Distribution breakers on the MCC will be molded case type with solid state or thermal-magnetic trip units. Some spares and spaces will be allotted. Surge protection devices (SPDs) will be provided integral to the assembly.

Except for packaged equipment and HVAC equipment, motor starters will generally be located within the MCC. Starters will include a RED indicated lamp for RUNNING (ON), a GREEN indicating lamp for OFF, and an AMBER indicating lamp for trouble or FAILURE (where applicable). All pilot lamps will be push-to-test type. Only full sized NEMA contactors will be used for all systems. IEC contactors will not be acceptable.

7.5.3 Motors

Motors will be specified with "NEMA Premium" high efficiency ratings. Motor enclosures will be suitable for the environment in which they are installed. All motors driven from variable frequency drives (VFDs) will be inverter-duty rated and will be rated for such applications. The heaters will be designed to operate on 120-volt ac power from the associated motor starter or VFD.

7.5.4 Variable Frequency Drives (VFD's)

For motors rated below 100 horsepower, will be 6-pulse drives, of the pulse-width modulated type and shall consist of a full-wave diode or gated-open SCR bridge. For motors rated 100 horsepower and above, the respective VFD will be eighteen-pulse or active front end type, using an 18 pulse, full-wave diode or gated open SCR bridge. VFDs will be considered when the motor operates close to its efficiency point the majority of the time (75% or greater). For motors greater than 100 horsepower, active harmonic mitigation will be provided.

7.5.5 Power Transformers

Transformers that supply 208Y/120 volts or 240/120 volts for lighting requirements will be dry type with copper windings and suitable for the area in which they are to be located. Transformers will be industry standard sizes.

7.5.6 Panelboards

Power distribution panelboards or power centers, if required, will be 480, three-phase, three-wire type, with a copper bus and a main circuit breaker.

Lighting panelboards will be either 208Y/120 volts, three-phase, four wire type or 240/120 volts, single phase, three-wire type, with a copper bus and a main circuit breaker sized to match the lighting transformer capacity.

Each panelboard will have a minimum of 20 percent of its capacity reserved for spare breakers with spaces, bus work, and terminations to complete the standard sized panelboard. SPDs will be provided integral to each panel assembly.

7.5.7 Raceways and Cables

Specific types of raceway will be chosen for use in various locations in the facility based on moisture, temperature, and exposure to damage, corrosion, voltage, and cost. The following general guidelines will be used for raceway sizing, selection, and installation:

- Conduit will be sized based on XHHW-2 insulation for all conductors 600 volts and below.
- The minimum diameter of exposed conduit in all areas will be 3/4-inch.
- Raceways in duct banks will generally not be smaller than 2-inches.
- Raceways in walls and ceilings of control rooms, offices, and all areas with finished interiors will be concealed.
- The number of conduit bends will be limited to an equivalent of 270 degrees on long runs.
- Exterior, exposed conduit will be PVC-Coated galvanized rigid metallic conduit coming out of the ground 6 inches above final grade (AFG) and then galvanized rigid metallic conduit above 6 inches AFG.
- Interior, exposed conduit in non-corrosive areas will be rigid galvanized metal.
- Interior and exterior, exposed conduit in corrosive areas will be Schedule 80 PVC.
- Exterior, underground, direct buried and concrete-encased conduit will be of the PVC Schedule 40.

- Aluminum cable tray of uncovered, open rung type with 9 inch spacing will be used indoor cable management system when routing significant numbers and sizes of power and control circuits.

All power, and control wiring rated 600 volts and below will use stranded copper conductors with XHHW-2 insulation. All lighting wiring rated 600 volts and below will use stranded copper conductors with THHN or XHHW-2 insulation. Individual No. 14 AWG conductors will be used for discrete control circuits, unless it is practical to use multi conductor cables to group control circuits. Cables will have 600V insulation.

Twisted shielded pair control cable with 16 AWG individual stranded copper conductors, PVC insulation, and an aluminum mylar tape shield around the pair will be used for analog signals. Multi pair cables will be used where grouping of circuits is practical. Cables will have 600V insulation.

All power tray cable to equipment controlled by a VFD operating at 600 volts will be 2000 volts multiconductor shielded power cable. Cables will use stranded copper conductors with cross-linked polyethylene insulation.

7.5.8 Receptacles and Switches

Convenience receptacles for general service will be located on walls or columns. Provisions for receptacles at all air conditioning units and air handling units will be made as required by the NEC. Convenience receptacles will generally be mounted 18 inches above finished floors. Weatherproof in-use receptacles installed outdoors and wet areas will be provided with ground fault circuit interrupting capability.

7.5.9 Grounding

The electrical system and equipment will be grounded in compliance with the NFPA National Electrical Code (NEC). Electrical equipment, devices, panelboards, and metallic raceways that do not carry current will be connected to the ground conductors.

A ground wire will be installed in all raceways that contain power conductors at any voltage.

7.6 Lighting Design Criteria

LED lighting systems will be used for all new areas, the digester control building, and sludge gas building. Illumination levels will be provided following the recommended levels suggested in the Illuminating Engineering Society (IES) handbook for the space and tasks being performed. Lighting fixture types are to be suitable for the environments where installed and will be located (serviceable and accessible) for routine maintenance.

Indoor Locations: Means of egress lighting fixtures will be incorporated in the normal lighting layout / scheme to ensure that all passages and exits remain illuminated in the event of a power failure. These fixtures will be switched and will include an emergency battery pack integral with the fixture.

Where otherwise required by the authority having jurisdiction, means of egress and emergency lighting systems will be provided in conformance with NFPA 101 (Life Safety Code)

Exit Signs: Provide LED type and placed inside the facilities per the latest requirements of NFPA 101 (Life Safety Code).

In general, the following suggested foot candle levels will be used for preliminary design. Actual levels provided will be further evaluated during detailed design.

Table 7-1 Suggested Foot Candle Loads

Area	Foot Candle
Electrical rooms	35
General site	1
Maintenance areas	50
Office	70
Process, inside	30
Process, outside	5
Storage, inside	15
Walkway	5

7.7 Hazardous Areas

NFPA 820 will be utilized to determine the area classification, as shown in Code Classification Table in Appendix B. The design will include specification for the components and installation to meet these requirements, including but not limited to seal off fittings, junction boxes, disconnects, light fixtures, combustible gas detectors (CGD), audible and visual alarms, ventilation systems and control stations.

The selection of type and location of CGD units shall be performed by a qualified person as described by NFPA 70. The units shall be placed in accordance to the appropriate table in NFPA 820. The items selected shall be set to 10% of lower explosive limit (LEL) unless otherwise directed by local AHJ and connected to the alarm signaling system and SCADA system as required by code.

Ventilation audible and visual alarms shall be installed both within the space and be tied to the plant control system.

7.8 Fire Alarm System Design

Fire alarm systems will be upgraded and modified as required in new and existing buildings undergoing renovations to meet current code requirements. Where required, smoke detectors, sprinkler flow switches, ventilation flow switches, combustible gas detectors, heat detectors, audible and visual alarms, and manual fire stations will be connected to a central fire alarm control panel, as required. Design of the fire protection system will adhere to the 2020 Edition of NFPA 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities. Final design of fire alarm system will be via a performance specification in the contract. The system will be provided through a local fire alarm system supplier who will be responsible for determining all local fire code requirements and submitting a complete design with complies with those requirements.

7.9 Calculation and Analysis Requirements

The following calculations and analyses will be performed during detail design or during the construction of the facility as indicated below.

7.9.1 Load Analysis

A load analysis will be prepared during detail design to help plan the power distribution system. Major loads, including the estimated values of connected loads and peak running loads will be calculated. Redundant and standby units will be excluded from the total connected load to establish the critical running load requirements.

7.9.2 Short-Circuit Analysis and Coordination Study

A preliminary short circuit analysis will be prepared during the detail design phase to properly specify the equipment in the power distribution system. Short-circuit and protective device coordination studies will be specified to be performed and submitted by the electrical subcontractor during the construction phase. Protective device settings will be finalized and set by the electrical subcontractor prior to electrical equipment start-up.

7.9.3 Arc Flash Analysis

During the construction phase of the Project, an arc flash hazard analysis will be specified to be commissioned by the electrical subcontractor. The analysis will cover all pieces of electrical equipment in accordance with OSHA 29 CFR Part 1910, NEC, NFPA 70E, and IEEE 1584. The arc flash analysis will be performed in coordination with the short circuit and coordination studies. Arc flash study results will be used to properly label all electrical equipment as to the severity of the arc flash hazard and the minimum personal protective equipment (PPE) required to perform work on each piece of energized equipment.

8.0 Instrumentation and Controls Design Criteria

8.1 General

This section represents the I&C design criteria for the project. The intent of this section is to define the design criterion, establish the minimum design requirements, and describe the I&C systems. The following describes design features that will be implemented or considered during final design.

New PLCs and new instruments will be provided for new process systems and existing process systems undergoing renovations while existing PLC and existing instruments will be reused for any existing process systems that are not undergoing renovations.

8.2 Control System Design Standards

The project design will comply with the standards and codes:

- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- Institute of Electrical and Electronic Engineers (IEEE)
- International Society of Automation (ISA)
- Information Technology – Generic Cabling for Customer Premises (ISO/IEC 11801)
- National Electrical Manufacturers Association (NEMA)
- National Electrical Code (NFPA 70)
- Fire Alarm Signaling (NFPA 72)
- Life Safety Code (NFPA 101)
- Standard for Fire Protection in Wastewater Treatment and Collection Facilities (NFPA 820)
- Uniform Building Code (UBC)
- Uniform Fire Code (UFC)
- Underwriter’s Laboratory (UL)

8.3 Control and Monitoring System

The existing plant control system will be reused and upgraded as required to accommodate the additional new process systems.

New Programmable Logic Controllers (PLCs) will be Allen-Bradley CompactLogix. New PLCs will be provided for the new BNR process and for the new digester process equipment. The new PLC will be connected to the existing plant control system through Ethernet based datalink. Existing PLC programs will be modified as required for any existing equipment undergoing replacement or modification.

The existing plant control system network topology will not be modified. New multimode fiber will be installed to the new buildings, and existing fiber will be kept to all existing SCADA hardware.

No new SCADA servers, network equipment, radio equipment, workstations, or software will be provided. The existing SCADA servers and HMI screens will be reused and modified for the new process systems.

8.4 P&ID's

Process and Instrumentation Drawings (P&IDs) will be provided for the new process systems and existing systems/equipment undergoing renovations in the detail design phase. No new P&ID's will be provided for any existing systems / equipment that are not undergoing any renovations.

8.5 Instrumentation

The new instrumentation for the new process systems will be incorporated into the new PLC while the new instrumentation for the existing systems/equipment undergoing renovations will be either incorporated into a new PLC or in the existing control system for remote monitoring and control.

Unless otherwise noted, instrumentation shall be as follows:

- Level Transmitters – Radar, Pressure-sensing
- Level Switches – Float type, Pressure-sensing
- Flow Meters – Magnetic for liquid application, Thermal Dispersion for gas application
- Temperature Elements - RTD

All significant electrical and mechanical equipment and process status signals will be connected to the control system via hardwired controls to support safe, reliable, remote-controlled operation.

Analog field instrumentation will utilize 4-20 mA DC type signals to/from the PLCs. Four-wire type instruments will be powered by 120 volts AC. Discrete input and output signals will utilize 120 volt AC type signals to and from the PLC.

Indicating lights and HMI statuses will be colored as per the existing plant control system color scheme. If there is no existing plant control system color scheme, then the following table will be used unless indicated otherwise on the Drawings, in other specification sections, or in the instrument device schedule.

Table 8-1 Indicating Light Color Codes

COLOR	MEANING
Red	Associated equipment or device is “running,” “open,” or is in an “unsafe” state or position
Green	Associated equipment or device is “stopped,” “closed,” or is in a “safe” state or position
Yellow or Amber	Associated equipment or device has “failed” or a process alarm condition is present or imminent.
White	All other conditions not defined above.

Panel instruments and control devices will be arranged in a logical configuration for the plant operators. Control switches will be within 6 feet and 2'-6" above the base of the panel. Indicators may be located within 2'-6" and 6'-6" above the base of the panels.

8.6 Control Modes and Control Basis

In general, all process equipment will be operated in one or more of the following control modes:

- **Local Manual.** The equipment is manually controlled from a local control station or from the MCC (if no local control station exists).
- **Local Automatic.** The equipment is automatically controlled locally by the packaged equipment PLC or through hardwired interlocking scheme.
- **Remote Manual.** The equipment is controlled manually through the PLC based upon commands issued from a HMI workstation. Such commands are received by the local PLC and converted into physical outputs to the field devices.
- **Remote Automatic.** The equipment is controlled automatically through the PLC based upon measured process parameters, or calculated values received from field devices, or remote PLCs and upon commands and set points issued from the HMI. Such commands, set points, and process values are received by the local PLC. The local PLC will adjust the equipment accordingly, through physical outputs, to meet the process set point. Some equipment may have more than one remote automatic mode of control.

The control mode will be selectable where applicable based on local/off/remote and hand/off/remote switches located at the devices, MCC, and device control panels. Selector switch position feedback will be wired to the PLC, allowing an operator to know whether a device is available for remote control from the HMI.

The specific equipment controls for each process area will be developed into process control software block descriptions and will be provided as part of the design documents.

All equipment safety interlocks and permissives will be monitored by and programmed in the plant PLC and the PLC will have soft-wired interlocks to discontinue the control output to equipment in case of any active equipment safety occurrence. Examples include low-water cutoff, pump high discharge pressure, etc.

8.7 Process Control Strategy

The following are general equipment and instrumentation control concepts that will be incorporated into this project for the new process systems/equipment and existing process systems/equipment undergoing renovations:

Table 8-2 Process Control Scheme

Process/Equipment	Local Control	Remote Control	Control Scheme
Intermediate Pump Station Submersible Pumps 2 & 3 – Existing and Replace (310-I-501)	Start/Stop; : by local control station	Start/Stop/Speed; Manual/Auto;	Pumps will be controlled based on wetwell level.

Process/Equipment	Local Control	Remote Control	Control Scheme
BNR 1, 2, 3 Submersible Mixers – New (328-I-501)	Start/Stop; : by local control station	Start/Stop; Manual/Auto;	Mixer runs automatically and continuously when the associated BNR train is on-line.
BNR 1, 2, 3 Banana Blade Mixers – New (328-I-501)	Start/Stop; : by local control station Start/Stop/Speed : by VFD	Start/Stop/Speed; Manual/Auto;	Mixer runs automatically when the associated BNR train is on-line Mixer speed varies based on operator setpoint.
BNR 1, 2, 3 MLR Pumps – New (328-I-501)	Start/Stop; : by local control station Start/Stop/Speed : by VFD	Start/Stop/Speed; Manual/Auto;	Pump runs automatically when the associated BNR train is on-line Pumps speed varies based upon the BNR flow.
BNR Surface Wasting Rotating Weirs 1, 2, 3 – New (328-I-501)	Open/Stop/Close; : by local control station	Open/Stop/Close; Manual / Auto;	Weir position varies based on the operator selected position, or time cycle mode for automatic operation.
BNR Air Blowers 1-4 – Reuse (350-I-501)	Start/Stop/Speed; : by local blower control panel	Start/Stop/Speed; Manual/Auto; Lead/lag/Lag2/Lag3	Blowers runs automatically when any BNR train is on-line # of blowers to be on-line automatically based on the air header pressure requirement. The existing multistage blowers are constant speed and air flow is set by manually adjusting the air valve. The existing turbo blowers speed varies to maintain the air header pressure which will be varied based on the process. Individual BNR Control valves will be modulating to maintain DO level in each BNR basin.
Final Clarifier 4 – New	Start/Stop; : by local control station	Start/Stop; Manual only	

Process/Equipment	Local Control	Remote Control	Control Scheme
(368-I-501)			
WAS Thickening Polymer Feeders/Blenders – Existing and Replace for 1&2	Start/Stop; : by local Polymer Feeders/Blenders control panel	Start/Stop/Speed; Manual/Auto; Duty/Swing	Feeder/Blender runs automatically when the Gravity Belt Thickener is running Feeders speed varies based on GBT influent flow and dosage setpoint.
CEPT Polymer Feeders/Blenders – New	Start/Stop; : by local Polymer Feeders/Blenders control panel	Start/Stop/Speed; Manual/Auto; Duty/Swing	Feeder/Blender runs automatically Feeders speed varies based on CEPT influent flow and dosage setpoint.
Ferric Chloride Metering Pumps 1 & 2 – New	Start/Stop/Speed; : by local feed pump control panel	Start/Stop/Speed; Manual/Auto; Duty/Standby	Feed pump runs automatically when the Gravity Belt Thickener is running Pump speed varies based on GBT influent flow and dosage setpoint.
Primary Digester 1 & 2 Linear Motion Mixers – New (530-I-501)	Start/Stop; : by local control panel	Start/Stop; Manual/Auto;	Mixer runs automatically when associated digester is on-line.
Primary Digester Sludge Recirculating Pump 1, 2, 3, 4 – Existing and Replace (530-I-501)	N/A	Start/Stop; Manual;	Sludge Recirculation pump runs automatically when associated digester is on-line.
Boiler Water Circulating Pumps 1 & 2 – Existing and Replace (540-I-501)	Start/Stop; : by local control panel	Start/Stop; Manual/Auto;	Pump runs automatically when associated Boiler is in service.
Boiler Room Air Compressor – Existing and Relocated	Start/Stop; Manual/Auto - Automatically maintain the compressed air header pressure : by local air compressor control panel	N/A	N/A
Heat Exchanger Water Circulating Pumps 1 & 2 – Existing and Replace	Start/Stop; : by local control panel	Start/Stop; Manual/Auto;	Pump runs automatically when any of the Digester is on-line.

Process/Equipment	Local Control	Remote Control	Control Scheme
(530-I-505)			
Digester Drain Pump – Existing and Replace	Start/Stop; : by local control panel	Start/Stop; Manual	Pump runs manually per the operator’s command.
Heating Water Boilers 1, 2 – Existing and Replace (540-I-501)	Start/Stop; : by local control panel	Start/Stop; Manual	Boiler runs manually per the operator’s command.
Sludge Grinder – Existing and Replace	Per existing control	Per existing control	Per existing control
Digester Gas Scrubber System – Existing and Replace (570-I-501)	Start/Stop; : by local scrubber control panel	Start/Stop; Manual;	Scrubber runs manually per the operator’s command and runs continuously.
Waste Gas Flare – Existing and Replace (570-I-501)	Start/Stop; : by local waste gas flare control panel The flare runs automatically to maintain the gas pressure within the digesters.	Start/Stop; Manual;	Waste gas flare runs manually per the operator’s command and runs continuously.

* Local Emergency Stop will be provided for selected critical equipment which will be determined during the detail design phase.

Appendix A. NPDES PERMIT

Division of Environment
Curtis State Office Building
1000 SW Jackson St., Suite 400
Topeka, KS 66612-1367



RECEIVED
12-30-19

Phone: 785-296-1535
Fax: 785-559-4264
www.kdheks.gov

Lee A. Norman, M.D., Secretary

Laura Kelly, Governor

December 26, 2019

Salina, City of
Martha Tasker
PO Box 736
Salina, KS 67402-0736

RE: Kansas Water Pollution Control
Permit No. M-SH33-IO01
Salina Wastewater Treatment Facility

Dear Permittee:

You have fulfilled all the filing requirements for a Kansas Water Pollution Control Permit and Authorization to Discharge under the National Pollutant Discharge Elimination System (NPDES). We are pleased to forward your new permit. While it is permissible to make as many copies as needed for monitoring and reporting purposes, you need to retain the original permit for your files.

We suggest you carefully read the terms and conditions of your permit and understand these terms and conditions are enforceable under both State and Federal law.

Please note the reporting paragraph on page 2 of your permit. If required, all discharge monitoring reports are to be processed by the eDMR software program. If KDHE has not contacted you concerning the use of the eDMR software program, please contact Debbie Mendenhall at 785.296.5561 or Deborah.Mendenhall@ks.gov. If this requirement applies to your facility, please share this permit with your certified operator and laboratory.

Any additional reports shall be submitted to the Kansas Department of Health and Environment, Bureau of Water-TSS, 1000 SW Jackson St., Suite 420, Topeka, Kansas 66612-1367.

If you have any questions concerning this permit, contact Michael Beezhold at (785) 296-5513.

Sincerely,

A handwritten signature in cursive script that reads "Thomas C Stiles".

Thomas C Stiles
Director, Bureau of Water

pc: NC - District
RE- Permit File

KANSAS WATER POLLUTION CONTROL PERMIT AND
AUTHORIZATION TO DISCHARGE UNDER
THE NATIONAL POLLUTANT DISCHARGE
ELIMINATION SYSTEM

Pursuant to the Provisions of Kansas Statutes Annotated 65-164 and 65-165, the Federal Water Pollution Control Act as amended, (33 U.S.C. 1251 et seq; the "Act"),

Owner: Salina, City of

Owner's Address: 300 West Ash St.
P.O. Box 736
Salina, KS 67402-0736

Facility Name: Salina Wastewater Treatment Facility
596 N. Marymount Road, Salina, KS 67401

Facility Location: SE $\frac{1}{4}$, NE $\frac{1}{4}$, NW $\frac{1}{4}$, Section 8, Township 14S, Range 2W
Saline County, Kansas
Latitude: 38.85369 Longitude: -97.56844

Outfall: Latitude: 38.85400 Longitude: -97.56502

Receiving Stream & Basin: Smoky Hill River
Smoky Hill River Basin

is authorized to discharge from the wastewater treatment facility described herein, in accordance with effluent limits and monitoring requirements as set forth herein.

This permit is effective January 1, 2020, supersedes the previously issued water pollution control permit M-SH33-IO01, and expires December 31, 2024.

EXISTING FACILITY DESCRIPTION:

- | | |
|---|--|
| 1. Screening and Grit Removal | 7. UV Disinfection |
| 2. Four Primary Clarifiers | 8. Reaeration |
| 3. Four Single Stage Trickling Filters (Not in service) | 9. Gravity Belt Sludge Thickening |
| 4. Four Intermediate Clarifiers (Not in service) | 10. Two Stage Anaerobic Sludge Digestion |
| 5. Three Activated Sludge Nitrification Basins | 11. Sludge Drying Beds |
| 6. Three Final Clarifiers | 12. Liquid Sludge Loadout |
| | 13. Belt Filter Press |
| | 14. Design Flow = 7.25 MGD |



Secretary, Kansas Department of Health and Environment

December 27, 2019

Date

A. EFFLUENT LIMITS AND MONITORING REQUIREMENTS

The permittee is authorized to discharge from outfall(s) with serial number(s) as specified in this permit. The effluent limits shall become effective on the dates specified herein. Such discharges shall be controlled, limited, and monitored by the permittee as specified. There shall be no discharge of floating solids or visible foam in other than trace amounts.

Monitoring reports shall be submitted on or before the 28th day of the following month. In the event no discharge occurs, written notification is still required.

<u>Parameter</u>	<u>Final Limits</u>	<u>Measurement Frequency</u>	<u>Sample Type</u>
<u>Monitoring Location 001AG (EDMR code: INFO01AG) - Influent to Treatment Plant</u>			
Biochemical Oxygen Demand (5-Day)-mg/l	Monitor	Twice Weekly	24 Hour Composite
Total Suspended Solids-mg/l	Monitor	Twice Weekly	24 Hour Composite
Total Phosphorus (as P)-mg/l	Monitor	Once Monthly	24 Hour Composite
Total Kjeldahl Nitrogen (as N)-mg/l	Monitor	Once Monthly	24 Hour Composite
<u>Outfall 001A1 (EDMR code: EFF001A1) - Effluent at Effluent Sampling Point</u>			
Carbonaceous Biochemical Oxygen Demand (5-Day) ¹		Twice Weekly	24 Hour Composite
January - May and October - December			
Weekly Average - mg/l	40		
Monthly Average - mg/l	25		
June, July, August, and September			
Weekly Average - mg/l	35		
Monthly Average - mg/l	20		
Total Suspended Solids ¹		Twice Weekly	24 Hour Composite
Weekly Average - mg/l	45		
Monthly Average - mg/l	30		
Ammonia (as N) - mg/l		Twice Weekly	24 Hour Composite
January, February, and December			
Daily Maximum	9.9		
Monthly Average	3.9		
March			
Daily Maximum	9.9		
Monthly Average	3.6		
April			
Daily Maximum	7.7		
Monthly Average	2.5		

A. EFFLUENT LIMITS AND MONITORING REQUIREMENTS (continued)

Ammonia (as N) - mg/l (continued)		Twice Weekly	24 Hour Composite
May			
Daily Maximum	5.3		
Monthly Average	1.8		
June			
Daily Maximum	3.4		
Monthly Average	1.3		
July			
Daily Maximum	2.7		
Monthly Average	1.0		
August			
Daily Maximum	2.8		
Monthly Average	1.0		
September			
Daily Maximum	4.2		
Monthly Average	1.5		
October			
Daily Maximum	7.7		
Monthly Average	2.5		
November			
Daily Maximum	9.9		
Monthly Average	3.5		
E. coli - colonies/100 ml			
April through October			
Monthly Geometric Mean	262		
Weekly Geometric Mean	4348		
November through March			
Monthly Geometric Mean	2358		
pH - Standard Units	6.0-9.0	Twice Weekly	Grab
Dissolved Oxygen - mg/l (weekly minimum)	6.0	Weekdays	Grab
Total Phosphorus (as P) ⁴	Monitor	Once Monthly	24 Hour Composite
Monthly Average Concentration - mg/l			Composite
Monthly Average Load - lbs/day			Calculated ³
Nitrate (NO ₃) + Nitrite (NO ₂) (as N) - mg/l ^{2,4}	Monitor	Once Monthly	24 Hour Composite
Total Kjeldahl Nitrogen (as N) - mg/l ²	Monitor	Once Monthly	24 Hour Composite
Total Nitrogen (as N) (TKN + NO ₃ + NO ₂) ^{2,4}	Monitor	Once Monthly	Calculated ³
Monthly Average Concentration - mg/l			
Monthly Average Load - lbs/day			

A. EFFLUENT LIMITS AND MONITORING REQUIREMENTS (continued)

Chlorides - mg/l	Monitor	Once Monthly	24 Hour Composite
Sulfates - mg/l	Monitor	Once Monthly	24 Hour Composite
Arsenic (Total Recoverable) - µg/l ⁵	Monitor	Once Monthly	Grab
Selenium (Total Recoverable) - µg/l ⁵	Monitor	Once Monthly	Grab
Whole Effluent Toxicity Testing	See Biomonitoring and Priority Pollutants H.1		
Priority Pollutant Scan	See Biomonitoring and Priority Pollutants H.2		
Flow - MGD	Monitor	Daily	Meter

Annual Rolling Average 001TT (EDMR code: 001TT) - Annual Rolling Average Calculations at Effluent

Parameter	Interim Limits	Final Limits	Measurement Frequency	Sample Type
Total Phosphorus (as P) ⁴			Once Monthly	Calculated ³
Annual Avg. Concentration - mg/l	Monitor	Monitor		
Annual Avg. Load - lbs/day	Monitor	60.6 ⁶		
Total Nitrogen (as N) ⁴			Once Monthly	Calculated ³
Annual Avg. Concentration - mg/l	Monitor	Monitor		
Annual Avg. Load - lbs/day	Monitor	Monitor		
Nitrate (NO ₃) + Nitrite (NO ₂)(as N) ⁴			Once Monthly	Calculated ³
Annual Avg. Concentration - mg/l	Monitor	Monitor		
Annual Avg. Load - lbs/day	Monitor	606.0 ⁶		

- 1 Minimum removal of 85% required for Total Suspended Solids and Biochemical Oxygen Demand (5-Day).
- 2 Permittee shall sample for these tests on the same day. The Minimum Reportable Limit (MRL) for TKN is 1 mg/l and for nitrate + nitrite is 0.1 mg/l. Values less than the MRL shall be reported using the less than sign (<) with the MRL value but for purposes of calculating and reporting the total nitrogen result, less than values shall be defaulted to zero.
- 3 The values for parameters shown as "Calculated" will be calculated by the on-line eDMR program. The values cannot be entered into the on-line eDMR program by the permittee. In addition to these calculated values, for parameters with Annual Daily Mass reporting requirements, the permittee will see monthly average values calculated by the eDMR program and displayed in the raw data tables. The monthly average parameter short name and (parameter code) for total phosphorus is T-P MA (KS665) and for total nitrogen is T.N2 MA (KS600) in mg/l and lbs/day. The monthly averages are required intermediary calculated values used for purposes of calculating the annual averages and are shown for purposes of checking those calculations. The annual average calculations are for a rolling 12-month time period calculated on a monthly basis.

A. EFFLUENT LIMITS AND MONITORING REQUIREMENTS (continued)

4 See Supplemental Conditions.

5 Minimum Reporting Limit (MRL) for arsenic and selenium shall be 10 µg/l and 5 µg/l, respectively.

6 See Schedule of Compliance.

B. STANDARD CONDITIONS

In addition to the specified conditions stated herein, the permittee shall comply with the attached Standard Conditions dated March 1, 2018.

C. SLUDGE DISPOSAL

Sludge disposal shall be in accordance with the 40 CFR Part 503 sludge regulations.

D. SCHEDULE OF COMPLIANCE

Permittee shall upgrade the treatment facility as necessary to achieve compliance with the final effluent limitations for Total Phosphorus Average Annual Load and Nitrate + Nitrite Average Annual load, and with the intent of meeting the effluent Total Nitrogen goals as presented in Part G Supplemental Conditions of this permit, in accordance with the following schedule:

1. The permittee shall submit a Basis of Design Report/Design Memorandum to KDHE by December 31, 2020.
2. Submit 60% Design Plans and Specifications for KDHE review and approval by October 31, 2021.
3. Construction to upgrade the facility for nutrient removal necessary to meet effluent limits shall start by January 1, 2022
4. Substantial completion of construction improvements shall be completed by December 31, 2023
5. The permittee shall achieve compliance with the final limits as presented in Part A "Annual Rolling Average 001TT - Annual Rolling Average Calculations at Effluent" for Total Phosphorus mass load and Nitrate + Nitrite mass load calculations by December 31, 2024.

E. PRETREATMENT PROGRAM

The permittee shall implement and administer the pretreatment program as approved by the Kansas Department of Health & Environment or the Environmental Protection Agency, in accordance with the General Pretreatment Regulations, 40 CFR Part 403.

F. ADDITIONAL INFORMATION

EPA has promulgated a final rule requiring regulated entities to report DMR data electronically. Also, KAR 28-16-63 requires permittees to report NPDES data in a form required by KDHE. KDHE has developed electronic reporting tools to assist permittees in complying with the EPA electronic reporting rule and KAR 28-61-63. Unless a waiver has been approved by KDHE, permittees are required to submit reports electronically

G. SUPPLEMENTAL CONDITIONS

Nutrient Removal: Although this wastewater treatment facility is not designed for nutrient removal, the permittee should consider changes in operations and/ or construction improvements to maximize the level of nutrient removal with the intent of achieving the following goals as annual average target effluent levels:

- | | | |
|---------------------------------------|---------|----------------------------|
| a. Total Nitrogen (as N) - mg/l | ≤ 10.0 | as an annual average goal |
| b. Total Nitrogen (as N) - lbs/day | ≤ 606.0 | as an annual average goal |
| c. Nitrate + Nitrite (as N) - mg/l | ≤ 10.0 | as an annual average goal |
| d. Nitrate + Nitrite (as N) - lbs/day | ≤ 606.0 | as an annual average limit |
| e. Total Phosphorus (as P) - mg/l | ≤ 1.0 | as an annual average goal |
| f. Total Phosphorus (as P) - lbs/day | ≤ 60.6 | as an annual average limit |

These target concentrations (mg/l) are not to be considered as effluent limits for this permit. However, the Nitrate + Nitrite and Total Phosphorus mass loadings (lbs/day) are enforceable limits as imposed by the Schedule of Compliance of this permit. The annual average limits are for a rolling 12-month time period calculated on a monthly basis.

KDHE reserves the right to re-open this permit to impose limits for nutrients pursuant to Kansas law after such criteria or a TMDL limiting nutrients is adopted in the Kansas Surface Water Quality Standards.

H. BIOMONITORING AND PRIORITY POLLUTANTS1. Whole Effluent Toxicity:

- a. Chronic Whole Effluent Toxicity (WET) testing on a 24-hour composite sample shall be conducted once in calendar year 2021 and once in calendar year 2023. The 25% Inhibition Concentration, IC25, shall be equal to or greater than 47% effluent. Test results less than 47% are violations of this permit. The test procedures shall use the seven day static renewal test method in accordance with the EPA document, Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, fourth edition, October 2002 using test organisms *Pimephales promelas* (fathead minnow) and *Ceriodaphnia dubia* (water flea) within a dilution series containing 0%, 25%, 47%, 60%, 80%, and 100% effluent. KDHE reserves the right to increase or decrease testing frequency based upon compliance history and toxicity testing results.
- a. If the WET test results indicate the IC25 is equal to or greater than 47% effluent, the effluent has passed the toxicity test. Samples results shall be submitted to kdhe.dmr4kdhe@ks.gov within 30 days of receipt of the results.
- b. If the WET test results indicate the IC25 is less than 47% effluent, the effluent has failed the toxicity test and the permittee shall immediately notify KDHE by telephone at (785) 296-5517 and submit to KDHE a copy of the test report within five days of receipt of the information. KDHE reserves the right to require the permittee to take such actions as are reasonable to identify and remedy any identified or predicted toxic conditions in the receiving stream outside of the mixing zone which is caused by the permittee's effluent.

H. BIOMONITORING AND PRIORITY POLLUTANTS (continued)

d. Permittee shall also test a portion of one of same effluent samples used for the WET test for the following parameters (required minimum reportable detection levels are in parenthesis):

Antimony (10 µg/l)*	Nickel (10 µg/l)*
Arsenic (10 µg/l)*	Selenium (5 µg/l)*
Beryllium (5 µg/l)*	Silver (2 µg/l)*
Cadmium (2 µg/l)*	Thallium (10 µg/l)*
Chromium (10 µg/l)*	Zinc (20 µg/l)*
Copper (10 µg/l)*	Total Hardness as CaCO ₃ (mg/l)
Lead (5 µg/l)*	Ammonia as N (mg/l)
Mercury (0.2 µg/l-Cold Vapor Method)	

* Parameter shall be tested and reported as "total recoverable" metals.

e. The permittee shall coordinate sampling for this test with other requirements of this permit. The permittee shall use a laboratory approved by KDHE for Whole Effluent Toxicity testing.

2. Priority Pollutants:

Permittee shall conduct a Priority Pollutant Scan on the effluent for the parameters listed in Table I, Priority Pollutant Scan, on the following pages. The Priority Pollutant Scan shall be conducted once in calendar year 2020, once in calendar year 2022, and once in calendar year 2024. Samples results shall be submitted to kdhe.dmr4kdhe@ks.gov within 30 days of receipt of the results.

Sample type shall be 24-hour composite except for Volatiles which shall be a grab sample.

See Biomonitoring and Priority Pollutants H.1.d. for minimum detection limits for certain metals in the Priority Pollutant Scan.

Table I - Priority Pollutant Scan*

<u>Metals (µg/l)</u>	<u>Base/Neutral (µg/l)</u>	<u>Acid Compounds (µg/l)</u>
Total Antimony	Acenaphthene	2-chlorophenol Total Arsenic
Total Arsenic	Acenaphthylene	2,4-dichlorophenol
Total Beryllium	Anthracene	2,4-dimethylphenol
Total Cadmium	Benzidine	2,4-dinitrophenol
Total Chromium	Benzo(a) anthracene	2-nitrophenol
Total Copper	Benzo(a)pyrene	4-nitrophenol
Total Lead	Benzo(k)fluoranthene	Parachlorometa cresol
Total Mercury	Benzo (ghi) perylene	Pentachlorophenol
Total Nickel	Benzo (b) fluoranthene	Phenol
Total Selenium	Bis(2-chloroethoxy)methane	4,6-dinitro-o-cresol
Total Silver	Bis(2-chloroethyl)ether	2,4,6-trichlorophenol
Total Thallium	Bis(2-ethylhexyl)phthalate	
Total Zinc	Bis(2-chloroisopropyl) ether	
	1,2-diphenylhydrazine	<u>Volatiles (µg/l)</u>
<u>Pesticides (µg/l)</u>	Fluoranthene	Acrolein
Aldrin	Fluorene	Acrylonitrile
Alpha-BHC**	Nitrobenzene	Benzene
Beta-BHC**	N-nitrosodimethylamine	Bromoform
Gamma-BHC**	N-nitrosodi-n-propylamine	Carbon Tetrachloride
Delta-BHC**	N-nitrosodiphenylamine	Chlorobenzene
Chlordane	Phenanthrene	Chlorodibromomethane
4,4-DDT	Pyrene	Chloroethane
4,4-DDD	1,2,4-trichlorobenzene	2-chloroethylvinyl ether
4,4-DDE	4-bromophenyl phenyl ether	Chloroform
Dieldrin	Butyl benzyl phthalate	Dichlorobromomethane
Alpha-endosulfan	2-chloronaphthalene	1,1-dichloroethane
Beta-endosulfan	4-chlorophenyl phenyl ether	1,2-dichloroethane
Endosulfan sulfate	Chrysene	1,1-dichloroethylene
Endrin	Dibenzo(a,h) anthracene	1,2-dichloropropane
Endrin aldehyde	1,2-dichlorobenzene	1,3-dichloropropylene
Heptachlor	1,3-dichlorobenzene	Ethylbenzene
Heptachlor epoxide	1,4-dichlorobenzene	Methyl bromide
Toxaphene	3,3-dichlorobenzidine	Methyl chloride
	Dimethyl phthalate	Methylene chloride
<u>Polychlorinated Biphenyls (µg/l)</u>	Diethyl phthalate	1,1,2,2-tetrachloroethane
PCB-1242	Di-n-butyl phthalate	Tetrachloroethylene
PCB-1254	2,4-dinitrotoluene	Toluene
PCB-1221	2,6-dinitrotoluene	1,2 trans-dichloroethylene
PCB-1232	Di-n-octyl phthalate	1,1,1-trichloroethane
PCB-1248	Hexachlorobenzene	1,1,2-trichloroethane
PCB-1260	Hexachlorobutadiene	Trichloroethylene
PCB-1016	Hexachlorocyclopentadiene	Vinyl chloride
	Hexachloroethane	<u>Miscellaneous</u>
	Indeno (1,2,3-cd) pyrene	Total Cyanide (mg/l)***
	Naphthalene	Asbestos (ent/l)
	Isophorone	2,3,7,8-TCDD (Dioxin) (µg/l)

* Testing not required for pollutants with a strike-through.

** Scientific name is hexachlorocyclohexane

*** The total cyanide analysis must include preliminary treatment of the sample to avoid NO₂⁻ interference. See Standard Methods for the Examination of Water and Wastewater, 22nd Edition, 4500-CN B. Preliminary Treatment of Samples.

STANDARD CONDITIONS FOR
KANSAS WATER POLLUTION CONTROL AND
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMITS

1. Representative Sampling and Discharge Monitoring Report Submittals:
- A. Samples and measurements taken as required herein shall be representative of the quality and quantity of the monitored discharge. Test results shall be recorded for the day the samples were taken. If sampling for a parameter was conducted across more than one calendar day, the test results may be recorded for the day sampling was started or ended. All samples shall be taken at the locations designated in this permit, and unless specified, at the outfall/monitoring location(s) before the wastewater joins or is diluted by any other water or substance.
- B. Monitoring results shall be recorded and reported on forms acceptable to the Division and submitted no later than the 28th day of the month following the completed reporting period. Signed and certified copies of other reports, required herein, prepared in accordance with KAR 28-16-59, may be faxed to 785.559.4257, e-mailed as scanned attachments to kdhe.dmr4kdhe@ks.gov, or sent by U.S. mail to:

Kansas Department of Health & Environment
Bureau of Water-Technical Services Section
1000 SW Jackson Street, Suite 420
Topeka, KS 66612-1367

2. Definitions:
- A. Unless otherwise specifically defined in this permit, the following definitions apply:
1. The "Daily Maximum" is the total discharge by weight or average concentration, measurement taken, or value calculated during a 24-hour period. The parameter, pH, is limited as a range between and including the values shown.
 2. The "Weekly Average" is the arithmetic mean of the value of test results from samples collected, measurements taken, or values calculated during four monitoring periods in each month consisting of calendar days 1-7, 8-14, 15-21 and 22 through the end of the month.
 3. The "Monthly Average", other than for E. coli bacteria, is the arithmetic mean of the value of test results from samples collected, measurements taken, or values calculated during a calendar month. The monthly average is determined by the summation of all calculated values or measured test results divided by the number of calculated values or test results reported for that parameter during the calendar month. The monthly average for E. coli bacteria is the geometric average of the value of the test results from samples collected in a calendar month. The geometric average can be calculated by using a scientific calculator to multiply all the E. coli test results together and then taking the nth root of the product where n is the number of test results. Non-detect values shall be reported using the less than symbol (<) and the minimum detection or reportable value. To calculate average values, non-detects shall be defaulted to zero (or one for geometric averages). Greater than values shall be reported using the greater than symbol (>) and the reported value. To calculate average values, the greater than reported value shall be used in the averaging calculation.
- B. A "grab sample" is an individual sample collected in less than 15 minutes. A "composite sample" is a combination of individual samples in which the volume of each individual sample is proportional to the flow, or the sample frequency is proportioned to the flow rate over the sample period, or the sample frequency is proportional to time.
- C. The terms "Director", "Division", and "Department" refer to the Director, Division of Environment, Kansas Department of Health, and Environment, respectively.
- D. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of an in-plant diversion. Severe property damage does not mean economic loss caused by delays in production.
- E. "Bypass" means the intentional diversion of waste streams from any portion of the treatment facility.

3. **Schedule of Compliance:** No later than 14 calendar days following each date identified in the "Schedule of Compliance," the permittee shall submit via mail, e-mail or fax per paragraph 1.B above, either a report of progress or, in the case of specific action being required by identified dates, a written notice of compliance or noncompliance. In the latter case, the notice shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirements, or, if there are no more scheduled requirements, when such noncompliance will be corrected.
4. **Test Procedures:** All analyses required by this permit shall conform to the requirements of 40 CFR Part 136, unless otherwise specified, and shall be conducted in a laboratory accredited by the Department. For each measurement or sample, the permittee shall record the exact place, date, and time of measuring/sampling; the date and time of the analyses, the analytical techniques or methods used, minimum detection or reportable level, and the individual(s) who performed the measuring/sampling and analysis and, the results. If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved procedures, the results shall be included in the Discharge Monitoring Report form required in 1.B. above. Such increased frequencies shall also be indicated.
5. **Change in Discharge:** All discharges authorized herein shall be consistent with the permit requirements. The discharge of any pollutant not authorized by this permit or of any pollutant identified in this permit more frequently than or at a level in excess of that authorized shall constitute a violation of this permit. Any anticipated facility expansions, production or flow increases, or production or wastewater treatment system modifications which result in a new, different, or increased discharge of pollutants shall be reported to the Division at least one hundred eighty (180) days before such change.
6. **Facilities Operation:** The permittee shall always properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the requirements of this permit and Kansas and Federal law. Proper operation and maintenance also include adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the requirements of this permit. The permittee shall take all necessary steps to minimize or prevent any adverse impact to human health or the environment resulting from noncompliance with any effluent limits specified in this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge. When necessary to maintain compliance with the permit requirements, the permittee shall halt or reduce those activities under its control which generate wastewater routed to this facility.
7. **Incidents:**

"Collection System Diversion" means the diversion of wastewater from any portion of the collection system.

"In-Plant Diversion" means routing the wastewater around any treatment unit in the treatment facility through which it would normally flow.

"In-Plant Flow Through" means an incident in which the wastewater continues to be routed through the equipment even though full treatment is not being accomplished because of equipment failure for any reason.

"Spill" means any discharge of wastewater, sludge or other materials from the treatment facility other than effluent or as more specifically described by other "Incidents" terms.

"Upset" means an exceptional incident in which there is unintentional and temporary noncompliance or anticipated noncompliance with permit effluent limits because of factors beyond the reasonable control of the permittee, as described by 40 C.F.R. 122.41(n).
8. **Diversions not Exceeding Limits:** The permittee may allow any diversion to occur which does not cause effluent limits to be exceeded, but only if it also is for essential maintenance to assure efficient operation. Such diversions are not subject to the Incident Reporting requirements shown below.
9. **Prohibition of an In-Plant Diversion:** Any in-plant diversion from facilities necessary to maintain compliance with this permit is prohibited, except: (a) where the in-plant diversion was unavoidable to prevent loss of life, personal injury, or severe property damage; (b) where there were no feasible alternatives to the in-plant diversion, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime and (c) the permittee submitted a notice as required in the Incident Reporting paragraph below. The Director may approve an anticipated in-plant diversion, after considering its adverse effects, if the Director determines that it will meet the three conditions listed above.

10. **Incident Reporting:** The permittee shall report any unanticipated collection system diversion, in-plant diversion, in-plant flow through occurrences, spill, upset, or any violation of a permitted daily maximum limit within 24 hours from the time the permittee became aware of the incident. A written submission shall be provided within 5 days of the time the permittee became aware of the incident. The written submission shall contain a description of the noncompliance and its cause, the period of noncompliance, including exact dates and times; and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance. An Incident Report form is available at www.kdheks.gov/water/tech.html.

For an anticipated incident or any planned changes or activities in the permitted facility that may result in noncompliance with the permit requirements, the permittee shall submit written notice, if possible, at least ten days before the date of the event.

For other noncompliance, the above information shall be provided with the next Discharge Monitoring Report.

11. **Removed Substances:** Solids, sludges, filter backwash, or other pollutants removed in the course of treatment of water shall be utilized or disposed of in a manner acceptable to the Division.
12. **Power Failures:** The permittee shall provide an alternative power source sufficient to operate the wastewater control facilities or otherwise control pollution and all discharges upon the loss of the primary source of power to the wastewater control facilities.
13. **Right of Entry:** The permittee shall allow authorized representatives of the Division of Environment or the Environmental Protection Agency upon the presentation of credentials, to enter upon the permittee's premises where an effluent source is located, or in which are located any records required by this permit, and at reasonable times, to have access to and copy any records required by this permit, to inspect any facilities, monitoring equipment or monitoring method required in this permit, and to sample any influents to, discharges from or materials in the wastewater facilities.
14. **Transfer of Ownership:** The permittee shall notify the succeeding owner or controlling person of the existence of this permit by certified letter, a copy of which shall be forwarded to the Division. The succeeding owner shall secure a new permit. This permit is not transferable to any person except after notice and approval by the Director. The Director may require modification or revocation and reissuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary.
15. **Records Retention:** Unless otherwise specified, all records and information resulting from the monitoring activities required by this permit, including all records of analyses and calibration and maintenance of instruments and recordings from continuous monitoring instruments, shall be retained for a minimum of 3 years, or longer if requested by the Division. Biosolids/sludge records and information are required to be kept for a minimum of 5 years, or longer if requested by the Division. Groundwater monitoring data, including background samples results, shall be kept for the life of the facility regardless of ownership.
16. **Availability of Records:** Except for data determined to be confidential under 33 USC Section 1318, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Department. Effluent data shall not be considered confidential. Knowingly making any false statement on any such report or tampering with equipment to falsify data may result in the imposition of criminal penalties as provided for in 33 USC Section 1319 and KSA 65-170c.
17. **Permit Modifications and Terminations:** As provided by KAR 28-16-62, after notice and opportunity for a hearing, this permit may be modified, suspended or revoked or terminated in whole or in part during its term for cause as provided, but not limited to those set forth in KAR 28-16-62 and KAR 28-16-28b through g. The permittee shall furnish to the Director, within a reasonable amount of time, any information which the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The permittee shall also furnish upon request, copies of all records required to be kept by this permit. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.
18. **Toxic Pollutants:** Notwithstanding paragraph 17 above, if a toxic effluent standard or prohibition (including any schedule of compliance specified at such effluent standards) is established under 33 USC Section 1317(a) for a toxic pollutant which is present in the discharge and such standard or prohibition is more stringent than any limitation for such pollutant in this permit, this permit shall be revised or modified in accordance with the toxic effluent standard or prohibition. Nothing in this permit relieves the permittee from complying with federal toxic effluent standards as promulgated pursuant to 33 USC Section 1317.
19. **Administrative, Civil and Criminal Liability:** The permittee shall comply with all requirements of this permit. Except as authorized in paragraph 9 above, nothing in this permit shall be construed to relieve the permittee from administrative, civil or criminal penalties for noncompliance as provided for in KSA 65-161 et seq., and 33 USC Section 1319.

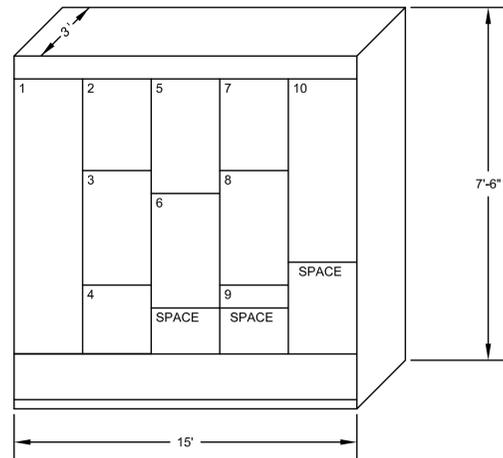
20. **Oil and Hazardous Substance Liability:** Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities or penalties to which the permittee is or may be subject to under 33 USC Section 1321 or KSA 65-164 et seq. A municipal permittee shall promptly notify the Division by telephone upon discovering crude oil or any petroleum derivative in its sewer system or wastewater treatment facilities.
21. **Industrial Users:** A municipal permittee shall require any industrial user of the treatment works to comply with 33 USC Section 1317, 1318 and any industrial user of storm sewers to comply with 33 USC Section 1308.
22. **Property Rights:** The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights nor any infringements of or violation of federal, state, or local laws or regulations.
23. **Operator Certification:** The permittee shall, if required, ensure the wastewater facilities are under the supervision of an operator certified by the Department. If the permittee does not have a certified operator or loses its certified operator, appropriate steps shall be taken to obtain a certified operator as required by KAR 28-16-30 et seq.
24. **Severability:** The provisions of this permit are severable. If any provision of this permit or any circumstance is held invalid, the application of such provision to other circumstances and the remainder of the permit shall not be affected thereby.
25. **Removal from Service:** The permittee shall inform the Division at least three months before a pumping station, treatment unit, or any other part of the treatment facility permitted by this permit is to be removed from service and shall make arrangements acceptable to the Division to decommission the facility or part of the facility being removed from service such that the public health and waters of the state are protected.
26. **Duty to Reapply:** A permit holder wishing to continue any activity regulated by this permit after the expiration date, must apply for a new permit at least 180 days prior to expiration of the permit.
27. **Publicly owned treatment works (POTWs):** All POTWs shall provide adequate notice to the Director of the following per 40 CFR 122.42(b):
 - A. Any new introduction of pollutants into the POTW from a non-domestic source which would be subject to section 301 or 306 of the CWA ; and
 - B. Any substantial change in the volume or character of pollutants being introduced into a POTW by a non-domestic source.
 - C. For purposes of this paragraph, adequate notice shall mean within 30 days of the POTW being aware of the introduction of pollutants and shall include information on the quality and quantity of influent introduced into the POTW, and any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.
28. **POTW regulated pretreatment program requirements:** For POTWs with an approved pretreatment program, the POTW shall:
 - A. Identify, in terms of character and volume of pollutants, any Significant Industrial Users discharging into the POTW subject to Pretreatment Standards under section 307(b) of CWA and 40 CFR part 403.
 - B. Provide to KDHE and EPA a written technical evaluation of the need to develop new local limits or revise existing local limits under 40 CFR 403.5(c)(1).
29. This permit may be reopened and modified if KDHE and/or EPA determines the permittee shall develop and approved pretreatment program that complies with 40 CFR, Part 403.

Appendix B. CODE CLASSIFICATION TABLE

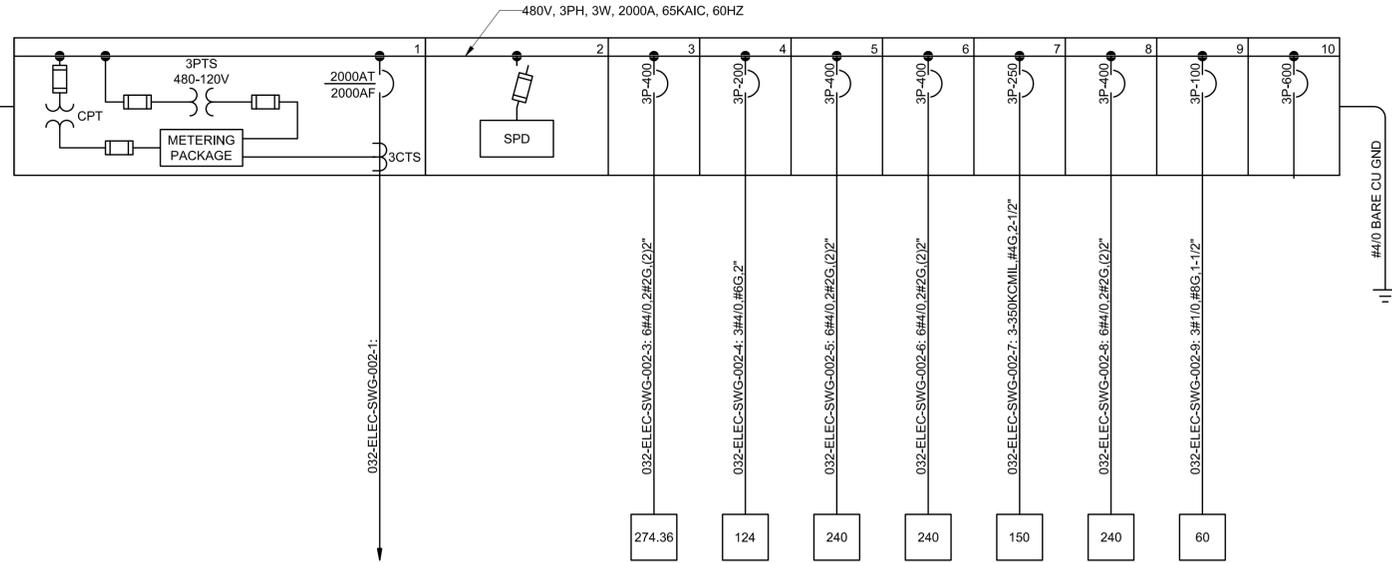
Appendix C. BDR DRAWINGS

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GROUND



FRONT ELEVATION
 NO SCALE



HSCA FUSE

SURGE PROTECTION DEVICE

032-ELEC-MCC-002

EXISTING MCC-A

EXISTING MCC-K

EXISTING MCC-E & F

EXISTING PANEL HD -
 ADMIN / LAB BUILDING

EXISTING MCC-L THR. ATS

LIME RECOVERY SYSTEM

SPARE SPACE

GROUND

SUB 1A - SWB 2
ONE-LINE DIAGRAM
 NO SCALE

NOTE:

1. SEE DRAWINGS 000-E-001 AND 000-E-002 FOR ELECTRICAL LEGEND, ABBREVIATIONS AND NOTES.

CITY OF SALINA, KANSAS
SALINA WASTEWATER TREATMENT PLANT
IMPROVEMENT PROJECT NO. 20028

SUB 1A - SWG 2
 ELECTRICAL
 ONE-LINE DIAGRAM

DESIGNED:
 DETAILED:
 CHECKED:
 APPROVED:
 DATE: 4/9/2021



PROJECT NO.
 407340

032-E-502
 SHEET
 OF

BLACK & VEATCH

Black & Veatch Corporation
 Kansas City, Missouri

DATE

REVISIONS AND RECORD OF USE

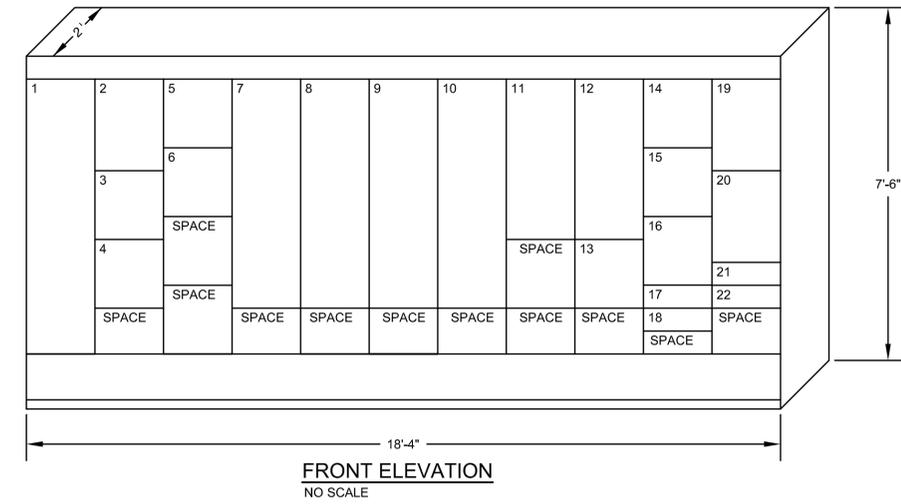
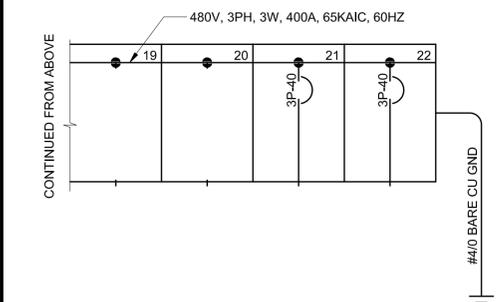
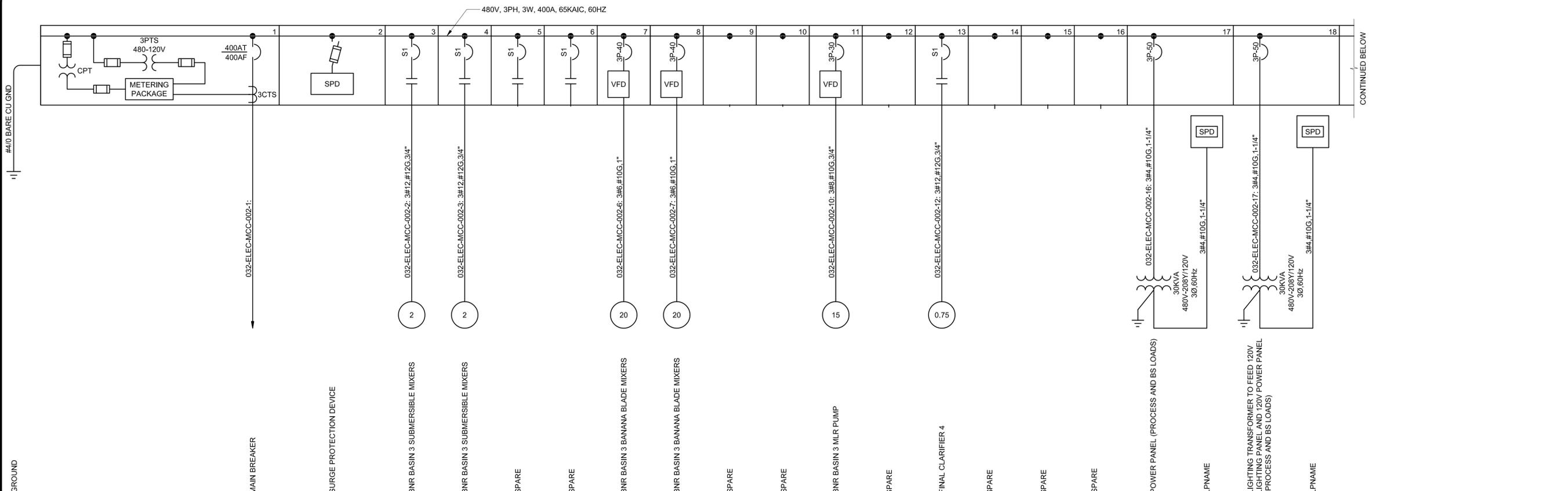
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BY

CHK/APP

PRELIMINARY - NOT FOR CONSTRUCTION

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SUB 1A - MCC 2
ONE-LINE DIAGRAM
 NO SCALE

SPARE
 SPARE
 SPARE
 SPARE
 GROUND

SUB 1A - MCC 2
ONE-LINE DIAGRAM
 NO SCALE

NOTE:
 1. SEE DRAWINGS 000-E-001 AND 000-E-002 FOR ELECTRICAL LEGEND, ABBREVIATIONS AND NOTES.

PRELIMINARY - NOT FOR CONSTRUCTION

<p>BLACK & VEATCH Black & Veatch Corporation Kansas City, Missouri</p>	
<p>CITY OF SALINA, KANSAS SALINA WASTEWATER TREATMENT PLANT IMPROVEMENT PROJECT NO. 20028</p>	
<p>SUB 1A - MCC 2 ELECTRICAL ONE-LINE DIAGRAM</p>	
<p>DESIGNED: DETAILED: CHECKED: APPROVED: DATE: 4/9/2021</p>	<p>NO. BY REVISIONS AND RECORD OF USE DATE</p>
<p>PROJECT NO. 407340</p>	
<p>032-E-504 SHEET OF</p>	

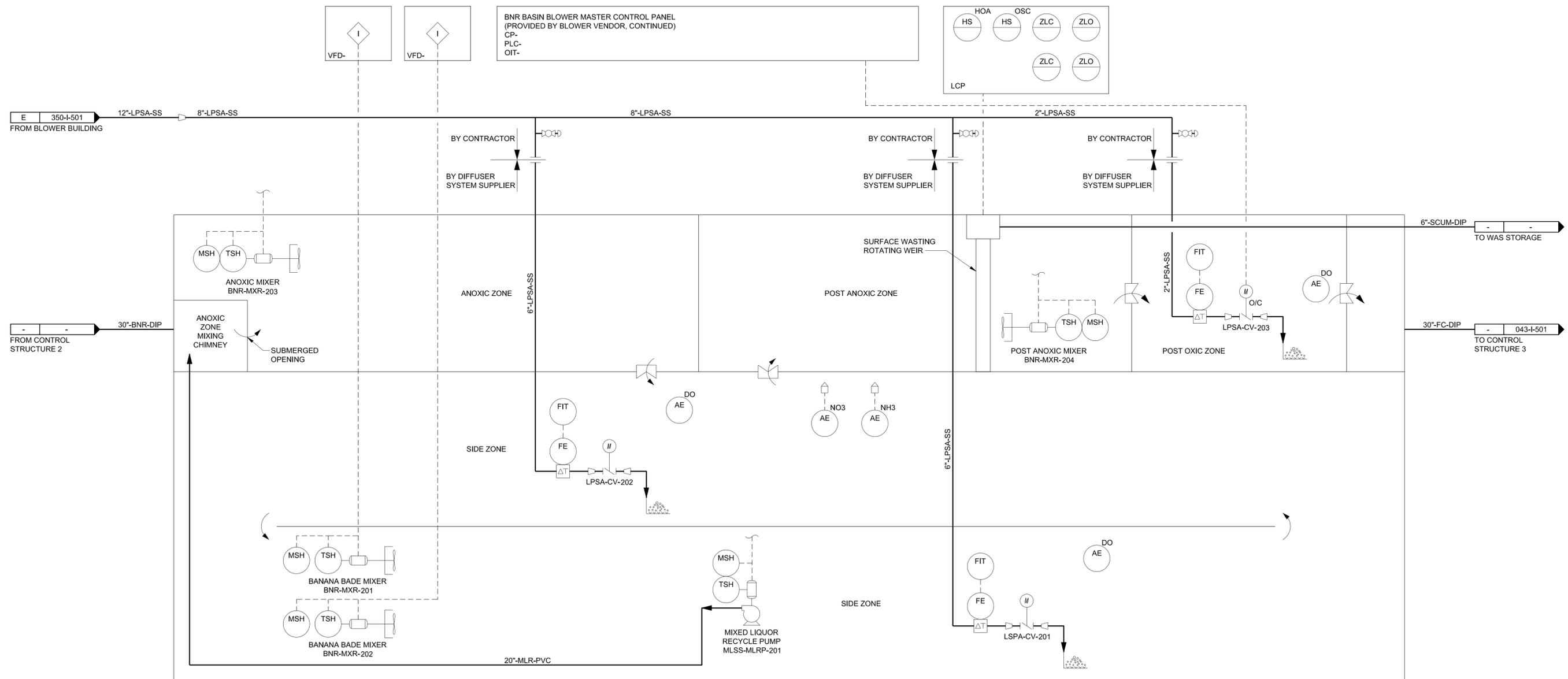
SCADA HMI

PLC-XXX

SCADA HMI

PLC-XXX

NO. BY CHK/APP
REVISIONS AND RECORD OF USE
DATE

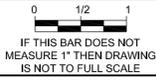


- NOTES:
- SEE LEGEND AND ABBREVIATIONS ON DRAWING 000-I-001, 000-I-002 AND 000-I-003.
 - AREA CODE IS 328 UNLESS OTHERWISE NOTED. SYSTEM CODE IS BNR UNLESS OTHERWISE NOTED.
 - LOCAL CONTROL DEVICES SUCH AS INDICATING LIGHTS AND SWITCHES, LOCATED IN MCC'S OR AT DRIVEN EQUIPMENT MAY NOT INDICATED ON THIS P&ID.
 - FOR DRAWING CLARITY, VALVE TAG NUMBER ONLY SHOW THE SEQUENCE NUMBER UNLESS OTHERWISE NOTED.



CITY OF SALINA, KANSAS
SALINA WASTEWATER TREATMENT PLANT
IMPROVEMENT PROJECT NO. 20028
 BNR BASIN 2
 INSTRUMENTATION & CONTROLS
 P&ID BNR BASIN 2

DESIGNED:
 DETAILED: AD
 CHECKED:
 APPROVED:
 DATE: 4/9/2021



PROJECT NO.
 407340

324-I-501
 SHEET
 OF

PRELIMINARY - NOT FOR CONSTRUCTION

D:\10000

Appendix D. SPECIAL SAMPLING PLAN

TARGETED WINTER SAMPLING PLAN FOR WASTEWATER CHARACTERIZATION

Salina WWTP Improvement Project

B&V PROJECT NO. 407340

PREPARED FOR



City of Salina

4 MARCH 2021



Table of Contents

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1. Background and Purpose

The Salina Wastewater Treatment Plant (WWTP) is currently involved in a major design effort to upgrade their facility to meet nutrient removal requirements. To that end, a special sampling program is recommended to characterize the wastewater constituents, which will ultimately improve process modeling and design accuracy. The primary objectives of this influent characterization program are to elucidate three aspects related to wastewater quality, as outlined below.

- Measure the concentration of pollutants relevant to design of Salina WWTP unit operations;
- Elucidate the fractionation of chemical oxygen demand (COD), nitrogenous, and phosphorus pollutants; and
- Evaluate specific trends, variability, and correlation between these wastewater constituents.

This document describes the requirements and procedures for a targeted sampling campaign in early March, when the plant experiences winter/spring conditions. A future summer campaign will be used to evaluate additional parameters as well as seasonal variation. The resulting data will supplement typical monitoring data.

2. Study Participants

2.1 PARTICIPANT ROLES

Black & Veatch (BV) will provide instructions and training to sampling personnel as needed, oversight of the sampling program, and evaluation of sample results.

The City of Salina will provide sampling and laboratory analytical services as described herein. The City will arrange for testing and analysis by qualified inhouse staff and by qualified outside laboratories.

2.2 CONTACT INFORMATION

Black & Veatch		City of Salina	
Primary Contact	Secondary Contact	Primary Contact	Secondary Contact
Anjana Kadava 913-458-3467 KadavaA@bv.com	Mark Steichen 913-458-3633 SteichenMT@bv.com	Cathy Rider 785-826-7416 ext. 3 cathy.rider@salina.org	Jacob Coy 785-826-7417 ext. 17 jacob.coy@salina.org

3. Sampling Program

3.1 SAMPLE COLLECTION LOCATIONS

Flow-weighted composite samples are to be collected at the sampling points described below:

1. Raw Influent – Sample collection point shall be representative of the plant influent.
2. Primary Effluent - Sample collection point shall be representative of the effluent from all primary clarifiers in service.

3. Final Effluent - Sample collection point shall be representative of the effluent from all final clarifiers in service.

3.2 SAMPLE COLLECTION TYPE

- Time weighted composites shall be collected at the Raw Influent, Primary Effluent, and Final Effluent sampling locations.
- Temperature, pH, and dissolved oxygen (DO) shall be measured in the field.
- Sample collection is to be in accordance with general guidelines in *Standard Methods*¹. All sample containers need to be clean, sealed, and free of contaminants. The sample containers should be labeled with the sample ID, date, and time of collection. The sample bottles require storage at $\leq 6^{\circ}\text{C}$ in the dark (cooler with ice or refrigerator) during the sampling event and prior to laboratory analysis.

3.3 FLOW RATE MEASUREMENTS

The daily average flowrate is requested for the sample locations during the sampling period. It is understood that flow measurements are unavailable for some of the streams.

3.4 MONITORING SCHEDULE

The targeted Winter Sampling Program requires a minimum of 6 sampling days collected over two weeks. Sampling is required over a period of typical dry-weather conditions while the WWTP is operating normally. If a wet-weather event occurs, the sampling campaign should be suspended and resumed after normal flow patterns resume.

An example sampling schedule is provided in Table 3-1. The example extends the sampling duration to 2 weeks, with each week having 3 sampling days. The schedule indicates the streams to be sampled and the sample collection type. As the analytical laboratory (i.e., Pace Analytical) is closed on the weekends, the samples should be collected on the weekdays to ensure timely sample preservation. Long storage times without preservation may lead to degradation of the analytes and inaccurate results. Sample delivery time requires coordination with Pace Analytical to ensure filtration and acidification steps occur as soon as possible after sample collection. Pace Salina requests the samples are delivered by 12:00 pm to allow for time for preservation prior to shipment to Lenexa.

Table 3-2 specifies the analytes to be measured in each sample stream and the laboratory where each sample will be measured (i.e., Salina WWTP or Pace Analytical).

Table 3-1. Example Sampling Schedule

SAMPLING SCHEDULE							
Week	Su	M	T	W	Th	F	Sa
1		Raw Infl.-C, Pri. Effl.-C, Final Effl.-C	Raw Infl.-C, Pri. Effl.-C, Final Effl.-C	Raw Infl.-C, Pri. Effl.-C, Final Effl.-C			
2				Raw Infl.-C, Pri. Effl.-C, Final Effl.-C	Raw Infl.-C, Pri. Effl.-C, Final Effl.-C	Raw Infl.-C, Pri. Effl.-C, Final Effl.-C	

Note: C- Time Weighted Composite

Table 3-2. Analytes to be Measured

	Raw Infl.	Pri. Effl.	Final Effl.
Flowrate	X	X	
Temperature	X		
pH	X		
Total suspended solids (TSS)	X	X	
Volatile suspended solids (VSS)	X		
Chemical oxygen demand (COD)	X	X	
Filtered COD (fCOD) (1.2 µm filter)	X		
Flocculated and filtered COD (ffCOD) (0.45 µm filter)	X		X
Volatile Fatty Acids		X	
Biochemical oxygen demand (BOD)	X	X	
Total phosphorus (TP)	X	X	
Soluble Orthophosphate (PO ₄ -P) (0.45 µm micron filter)	X	X	
DO		X	
To be analyzed by Salina			
To be analyzed by Pace			

3.5 ANALYTICAL METHODS

Analytical methods for this study shall be equivalent to those summarized in Table 3-3.

Table 3-3. Summary of Analytical Methods

ANALYTE	METHOD	PRESERVA-TION (NOTE 1)	MAXIMUM SAMPLE HOLD TIME	COMMENT
pH	SM 4500-H+ B	-	15 minutes	Grab sample or online meter
Temperature	-	-	-	Online meter
DO				Online meter
Total suspended solids (TSS)	SM 2540 D	C	7 days	
Volatile suspended solids (VSS)	SM 2540 E	C	7 days	
Biochemical oxygen demand (BOD)	SM 5210 B	C	48 hours	
Chemical oxygen demand (COD)	SM 5220 D	C, A	28 days with acid	Acidification to be performed at Pace Salina, as soon as samples are received.
Filtered COD (1.2 µm filter)	SM 5220D	C, F, A	28 days with acid	Filtration and acidification to be performed at Pace Salina, as soon as samples are received.
Flocculated and filtered COD (0.45 µm filter)	Mamais et al (1993)	C, F, A	28 days with acid	Note 2; See Section 3.5.1 Filter flocculation to be performed at Pace Salina, as soon as samples are received.
Volatile fatty acids (0.45 µm filter)	SM 5560 D	C, F, H	<7 days at 4°C	Pace will send vial with preservative.
Total phosphorus (TP)	SM 4500-P B followed by SM 4500-P E or F	C, A	48 hours or 28 days with acidification	
Orthophosphate (PO ₄ -P) (0.45 µm filter)	SM 4500-P E or F	C, F	48 hours	Filtration to be performed at Pace Salina, as soon as samples are received.

Sample Preservation Key:

C – Store sample in fridge or cooler at <4° C; A – Acidify to pH<2 with sulfuric acid, F – Filter asap; H – Store sample free of headspace

Notes:

1. Preserve sample immediately upon collection unless sample will be analyzed immediately.
2. Samples analyzed for ffCOD shall not be acidified prior to the flocculation and filter step. After flocculation and filtration, the filtrate may be acidified (H₂SO₄ to pH<2) and held for up to 28 days prior to completing the remainder of the ffCOD test.

3.5.1 Flocculated and Filtered COD (ffCOD)

Filter flocculated COD is recommended for determination of readily biodegradable COD. Mamais et al. (1993) developed a direct method for estimating the influent readily biodegradable COD concentration as an alternative to the more time-consuming biological assay methods. This method is based on a physical separation which involves pre-flocculation of the sample followed by filtration (referred to as the flocCODsol test or “ffCOD”). It is assumed that the flocculation step will remove the colloidal material, resulting in a filtrate that contains only truly soluble material. This method has been shown to give comparable results to the bioassay methods.

The procedure is briefly outlined as follows:

- Add 1 mL of 100 g/L zinc sulfate solution to 100 mL of wastewater.
- Mix the sample vigorously for approximately 1 minute.
- Adjust the sample pH to approximately 10.5 using 6 M sodium hydroxide solution.
- Allow the sample to settle, and then withdraw the supernatant.
- Filter the supernatant using a 0.45 µm membrane filter.
- Analyze the filtrate for COD with the Standard Method normally used.

The unbiodegradable soluble COD must be subtracted to obtain the influent readily biodegradable COD (S_s), i.e. S_s is estimated by determining the ffCOD of the influent and subtracting from it the ffCOD of the effluent. Note that zinc sulfate is used as the coagulant because Narkis et al. (1980) found it to adsorb less organic substrate than lime or ferric chloride that removed approximately 20% of S_s from raw wastewater.

3.6 REPORTING

Laboratory results will be emailed to BV as soon as they become available for each analyte instead of waiting until the completion of all sampling. BV will review the preliminary results as they become available to determine if any sample collection or analytical procedures should be adjusted.

In addition to the special sampling results, plant data normally collected for process monitoring and permit compliance reporting, will be sent to BV for the special sampling periods.

4. References

1. *Standard Methods for the Examination of Water and Wastewater*, 23rd edition, American Public Health Association, American Water Works Association, Water Environment Federation, 2017.
2. D. Mamais, D. Jenkins and P. Pitt, “A Rapid Physical-Chemical Method for the Determination of Readily Biodegradable Soluble COD in Municipal Wastewater,” *Water Research*, Volume 27, Number 1, 1993, pp. 195-197.
3. WERF (2003), *Methods for Wastewater Characterization in Activated Sludge Modeling*, Report from Project 99-WWF-3.