Permit No. CP0002471

STATE OF MISSOURI

DEPARTMENT OF NATURAL RESOURCES

MISSOURI CLEAN WATER COMMISSION

CONSTRUCTION PERMIT

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

City of Unionville
Unionville South Wastewater Treatment Facility
1/3 mile east of Garfield and 8th St Intersection
Unionville, MO 63565

for the construction of (described facilities):

See attached.

Permit Conditions:

See attached.

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

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

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

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

September 26, 2024
Effective Date

September 25, 2026
Expiration Date

John Hoke, Director, Water Protection Program

CONSTRUCTION PERMIT

I. CONSTRUCTION DESCRIPTION

The proposed improvements will include sludge removal from the lagoon cells, installation of a new mechanical screen, demolition and stabilization of earthen lagoon berms, addition of aeration equipment in the lagoons, a moving bed biofilm reactor (MBBR) in between lagoon cells one and two for ammonia removal, a new blower building with blowers for the MBBR to provide aeration to the lagoons, a UV disinfection system, effluent flow measurement, replacement of the pump for wastewater irrigation at the nearby golf course, and the addition of an emergency backup generator and transfer switch. The project will also be removing outfalls #001 and #002 because the facility will be decommissioning the overland flow fields. Treated effluent will instead flow through outfall #005 to the Unnamed Tributary to South Blackbird Creek. The design flow of the facility will remain at 132,000 gallons per day (gpd).

A closure plan will need to be submitted to the Northeast Regional Office for review and approval prior to any closure activities.

This project will also include general site work appropriate to the scope and purpose of the project and all necessary appurtenances to make a complete and usable wastewater treatment facility.

II. COST ANALYSIS FOR COMPLIANCE

Pursuant to Section 644.145, RSMo, when issuing permits under this chapter that incorporate a new requirement for discharges from publicly owned combined or separate sanitary or storm sewer systems or publicly owned treatment works, or when enforcing provisions of this chapter or the Federal Water Pollution Control Act, 33 U.S.C. 1251 et seq., pertaining to any portion of a publicly owned combined or separate sanitary or storm sewer system or [publicly owned] treatment works, the Department of Natural Resources shall make a "finding of affordability" on the costs to be incurred and the impact of any rate changes on ratepayers upon which to base such permits and decisions, to the extent allowable under this chapter and the Federal Water Pollution Control Act. This process is completed through a cost analysis for compliance. Permits that do not include new requirements may be deemed affordable.

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

III. CONSTRUCTION PERMIT CONDITIONS

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

1. This construction permit does not authorize discharge.

2. All construction shall be consistent with plans and specifications signed and sealed by C. Cameron D. Jones, P.E. with Benton & Associates, Inc. and as described in this permit.

3. The department must be contacted in writing prior to making any changes to the plans and specifications that would directly or indirectly have an impact on the capacity, flow, system layout, or reliability of the proposed wastewater treatment facilities or any design parameter that is addressed by 10 CSR 20-8, in accordance with 10 CSR 20-8.110(11).

4. State and federal law does not permit bypassing of raw wastewater, therefore steps must be taken to ensure that raw wastewater does not discharge during construction. If a sanitary sewer overflow or bypass occurs, report the appropriate information to the department's Northeast Regional Office per 10 CSR 20-7.015(9)(G).

5. In addition to the requirements for a construction permit, 10 CSR 20-6.200 requires land disturbance activities of one acre or more to obtain a Missouri state operating permit to discharge stormwater. The permit requires best management practices sufficient to control runoff and sedimentation to protect waters of the state. Land disturbance permits will only be obtained by means of the department's ePermitting system available online at https://dnr.mo.gov/data-e-services/missouri-gateway-environmental-management-mogem. See https://dnr.mo.gov/data-e-services/water/electronic-permitting-epermitting for more information.

6. A United States Army Corps of Engineers (USACE) Clean Water Act Section 404 Department of the Army permit and a Section 401 Water Quality Certification issued by the department may be required for the activities described in this permit. This permit is not valid until these requirements are satisfied or notification is provided that no Section 404 permit is required by the USACE. You must contact your local USACE district since they determine what waters are jurisdictional and which permitting requirements may apply. You may call the department's Water Protection Program, Operating Permits Section at 573-522-4502 for more information. See https://dnr.mo.gov/water/business-industry-other-entities/permits-certification-engineering-fees/section-401-water-quality for more information.

7. All construction must adhere to applicable 10 CSR 20-8 (Chapter 8) requirements listed below.

- Flood protection shall apply to new construction and to existing facilities undergoing major modification. The wastewater facility structures, electrical equipment, and mechanical equipment shall be protected from physical damage by not less than the 100- year flood elevation. 10 CSR 20-8.140(2)(B).
- Unless another distance is determined by the Missouri Geological Survey or by the department's Public Drinking Water Branch, the minimum distance between wastewater treatment facilities and all potable water sources shall be at least 300 feet. 10 CSR 20-8.140(2)(C)1.
- Facilities shall be readily accessible by authorized personnel from a public right–of-way at all times. 10 CSR 20-8.140(2)(D).
- The outfall shall be so constructed and protected against the effects of flood water, ice, or other hazards as to reasonably ensure its structural stability and freedom from stoppage. 10 CSR 20-8.140(6)(A).
- All sampling points shall be designed so that a representative and discrete 24-hour automatic composite sample or grab sample of the effluent discharge can be obtained at a point after the final treatment process and before discharge to or mixing with the receiving waters. 10 CSR 20-8.140(6)(B).

- All outfalls shall be posted with a permanent sign indicating the outfall number (i.e., Outfall #001). 10 CSR 20-8.140(6)(C).
- All wastewater treatment facilities shall be provided with an alternate source of electric power or pumping capability to allow continuity of operation during power failures. 10 CSR 20-8.140(7)(A)1.
- Disinfection and dechlorination, when used, shall be provided during all power outages. 10 CSR 20-8.140(7)(A)2.
- An audiovisual alarm or a more advanced alert system, with a self-contained power supply, capable of monitoring the condition of equipment whose failure could result in a violation of the operating permit, shall be provided for all wastewater treatment facilities. 10 CSR 20-8.140(7)(C).
- A means of flow measurement shall be provided at all wastewater treatment facilities. 10 CSR 20-8.140(7)(E).
- Effluent 24-hour composite automatic sampling equipment shall be provided at all mechanical wastewater treatment facilities and at other facilities where necessary under provisions of the operating permit. 10 CSR 20-8.140(7)(F).
- Adequate provisions shall be made to effectively protect facility personnel and visitors from hazards. The following shall be provided to fulfill the particular needs of each wastewater treatment facility:
    - Gratings over appropriate areas of treatment units where access for maintenance is necessary; 10 CSR 20-8.140(8)(B).
    - First aid equipment; 10 CSR 20-8.140(8)(C).
    - Posted “No Smoking” signs in hazardous areas; 10 CSR 20-8.140(8)(D).
    - Appropriate personal protective equipment (PPE); 10 CSR 20-8.140(8)(E).
    - Portable blower and hose sufficient to ventilate accessed confined spaces; 10 CSR 20-8.140(8)(F).
    - Appropriately-placed warning signs for slippery areas, non-potable water fixtures (see subparagraph (7)(D)3.B. of this rule), low head clearance areas, open service manholes, hazardous chemical storage areas, flammable fuel storage areas, high noise areas, etc.; 10 CSR 20-8.140(8)(I).
    - Provisions for local lockout/tagout on stop motor controls and other devices; 10 CSR 20-8.140(8)(L).
- All wastewater treatment facilities must have a screening device, comminutor, or septic tank for the purpose of removing debris and nuisance materials from the influent wastewater. 10 CSR 20-8.150(2).
- All screening devices and screening storage areas shall be protected from freezing. 10 CSR 20-8.150(4)(A)1.
- Provisions shall be made for isolating or removing screening devices from their location for servicing. 10 CSR 20-8.150(4)(A)2.
- Mechanically cleaned screen channels shall be protected by guard railings and deck gratings. 10 CSR 20-8.150(4)(A)3.A.(II)
- Mechanical screening equipment shall have adequate removal enclosures to protect facility personnel against accidental contact with moving parts and to prevent dripping in multi-level installations. 10 CSR 20-8.150(4)(A)3.B.(I)
- A positive means of locking out each mechanical screening device shall be provided. 10 CSR 20-8.150(4)(A)3.B.(II)
- An emergency stop button with an automatic reverse function shall be located in close proximity to the mechanical screening device. 10 CSR 20-8.150(4)(A)3.B.(III)

- The specifications require that the manufacturer of the ultraviolet (UV) disinfection equipment furnishes a complete in-line pipe flanged, low pressure high intensity ultraviolet non-contact disinfection system to provide the required disinfection prior to discharge. Department regulations pertaining to UV disinfection are split into "open channel" and "closed vessel" systems classifications, and non-contact UV systems do not technically fall under either of these terms. Regulations pertaining to both open channel and closed vessel UV disinfection systems are therefore included below. Though addressing either open channel or closed vessel systems, these requirements below are determined to be applicable for the non-contact UV disinfection system.
- The UV dosage shall be based on the design peak hourly flow, maximum rate of pumpage, or peak batch flow. 10 CSR 20-8.190(5)(A)1.
- If no flow equalization is provided for a batch discharger, the UV dosage shall be based on the peak batch flow. 10 CSR 20-8.190(5)(A)2.
- The UV system shall deliver the target dosage based on equipment derating factors and, if needed, have the UV equipment manufacturer verify that the scale up or scale down factor utilized in the design is appropriate for the specific application under consideration. 10 CSR 20-8.190(5)(A)3.
- The UV system shall deliver a minimum UV dosage of 30,000 microwatt seconds per centimeters squared ($\mu W \bullet s/cm^2$). 10 CSR 20-8.190(5)(A)4.
- Open channel UV systems. The combination of the total number of banks shall be capable of treating the design peak hourly flow, maximum rate of pumpage, or peak batch flow. 10 CSR 20-8.190(5)(B)1.
- Closed vessel UV systems. The combination of the total number of closed vessels shall be capable of treating the design peak hourly flow, maximum rate of pumpage, or peak batch flow. 10 CSR 20-8.190(5)(B)2.
- Closed vessel UV systems utilizing medium-pressure lamps shall be provided with an automatic cleaning system in order to prevent algae growth. 10 CSR 20-8.190(5)(B)3.
- The UV system must continuously monitor and display at the UV system control panel the following minimum conditions:
    - The relative intensity of each bank or closed vessel system; 10 CSR 20-8.190(5)(C)1.A.
    - The operational status and condition of each bank or closed vessel system; 10 CSR 20-8.190(5)(C)1.B.
    - The ON/OFF status of each lamp in the system; 10 CSR 20-8.190(5)(C)1.C. and
    - The total number of operating hours of each bank or each closed vessel system. 10 CSR 20-8.190(5)(C)1.D.
- The UV system shall include an alarm system. Alarm systems shall comply with 10 CSR 20-8.140(7)(C). 10 CSR 20-8.190(5)(C)2.
- Lagoon berms shall be constructed of relatively impervious material and compacted to at least 95 percent maximum dry density test method to form a stable structure. 10 CSR 20-8.200(4)(A)1.
- The minimum berm width shall be eight feet to permit access of maintenance vehicles. 10 CSR 20-8.200(4)(A)2.
- Minimum freeboard shall be two feet. 10 CSR 20-8.200(4)(A)3.
- An emergency spillway shall be provided that—
    - Prevents the overtopping and cutting of berms; 10 CSR 20-8.200(4)(A)4.A.
    - Is compacted and vegetated or otherwise constructed to prevent erosion; 10 CSR 20-8.200(4)(A)4.B. and

  - Has the ability for a representative sample to be collected, if discharging. 10 CSR 20-8.200(4)(A)4.C.
- The soil of the lagoon bottom shall be compacted with the moisture content between 2 percent below and 4 percent above the optimum water content and compacted to at least 95 percent maximum dry density test method. 10 CSR 20-8.200(4)(B).
- The lagoon shall be sealed to ensure that seepage loss is as low as possible and has a design permeability not exceeding 1.0 x 10-7 cm/sec. 10 CSR 20-8.200(4)(C)1.
- Seep collars shall be provided on drainpipes where they pass through the lagoon seal. 10 CSR 20-8.200(4)(C)4.
- Unlined corrugated metal pipe shall not be used for influent lines due to corrosion problems. 10 CSR 20-8.200(4)(D)1.
- A manhole shall be installed with its invert at least six inches above the maximum operating level of the lagoon, prior to the entrance into the primary cell, and provide sufficient hydraulic head without surcharging the manhole. 10 CSR 20-8.200(4)(D)2.
- The influent line(s) shall be located along the bottom of the lagoon so that the top of the pipe is just below the average elevation of the lagoon seal; however, there shall be an adequate seal below the pipe. 10 CSR 20-8.200(4)(D)3.

8. Upon completion of construction:

   A. The City of Unionville will become the continuing authority for operation and maintenance of these facilities;

   B. Submit an electronic copy of the as builts if the project was not constructed in accordance with previously submitted plans and specifications;

   C. Submit the Statement of Work Completed form to the department in accordance with 10 CSR 20-6.010(5)(N) (https://dnr.mo.gov/document-search/wastewater-construction-statement-work-completed-mo-780-2155) and request the operating permit modification public noticed on July 26, 2024, be issued. The operating permit fee has been waived because this project is receiving funding through the American Rescue Plan Act (ARPA).

IV. REVIEW SUMMARY

1. CONSTRUCTION PURPOSE

The Unionville South WWTF was issued an operating permit on August 1, 2013, which included new effluent limitations for ammonia and *E. coli* and a ten-year schedule to attain compliance with those limitations. These limits are currently in effect for the facility. Historic data obtained from discharge monitoring report indicates the facility is not currently equipped to maintain compliance with the new limitations. The proposed construction will allow the Unionville South WWTF to provide treatment to enable compliance.

2. FACILITY DESCRIPTION

The current Unionville South WWTF includes a two-cell lagoon and two overland flow fields, with sludge stored in the lagoon. The proposed construction will add a mechanical screen preceding the lagoon cells, aeration equipment in both lagoon cells, an MBBR in between lagoon cells one and two, blowers housed within a new blower building, and new UV disinfection system.

The Unionville South WWTF is located approximately 0.4 miles east of 8th Street and 180th Street intersection, Unionville, in Putnam County, Missouri. The facility has a design average flow of 132,000 gpd and serves a hydraulic population equivalent of approximately 1320 people.

3. COMPLIANCE PARAMETERS

The proposed project is required to meet final effluent limits as established in Operating Permit MO-0026646.

The limits following the completion of construction will be applicable to the facility:

Parameter	Units	Monthly average limit
Biochemical Oxygen Demand$_5$	mg/L	30
Total Suspended Solids	mg/L	30
Ammonia as N – January	mg/L	3.1
Ammonia as N – February	mg/L	2.7
Ammonia as N – March	mg/L	2.7
Ammonia as N – April	mg/L	2.3
Ammonia as N – May	mg/L	1.9
Ammonia as N – June	mg/L	1.5
Ammonia as N – July	mg/L	1.1
Ammonia as N – August	mg/L	1.3
Ammonia as N – September	mg/L	1.7
Ammonia as N – October	mg/L	2.6
Ammonia as N – November	mg/L	3.1
Ammonia as N – December	mg/L	2.7
pH	SU	6.5-9.0
E. coli	#/100mL	206

4. REVIEW of MAJOR TREATMENT DESIGN CRITERIA

Existing major components that will remain in use include the following:

- Lagoon Cell No. 1 is currently non-aerated and has a surface area of 3.87 acres with a total volume of 9,164,415 gallons and a wastewater volume of 6,643,061 gallons. This cell provides side and end slopes of 3:1, has 2 ft of freeboard and 6 ft of operating depth. This provides approximately 50 days of retention at the proposed design flow. The proposed construction will involve the construction of an aeration piping system with distribution lines and diffusers in the lagoon. Cell 1 will have 16 fine bubble diffusers attached 6 to 12 inches above the lagoon floor. Aeration to be provided by two Aerzen Generation 5 Delta Blower Model GM25S DN125 with F3 sound enclosure or equivalent capable of supplying 675 scfm with 15 HP motors.

- Lagoon Cell No. 2 is currently non-aerated and has a surface area of 1.72 acres with a total volume of 3,933,437 gallons and a wastewater volume of 2,810,042 gallons. This cell provides side and end slopes of 3:1, has 2 ft of freeboard and 6 ft of operating depth. This provides approximately 21 days of retention at the proposed design flow. The proposed construction will involve the construction of an aeration piping system with distribution lines and diffusers in the lagoon. Cell 2 will have 3 fine bubble diffusers attached 6 to 12 inches above the lagoon floor. Aeration to be provided by two Aerzen Generation 5 Delta Blower Model GM25S DN125 with F3 sound enclosure or equivalent capable of supplying 675 scfm with 15 HP motors.

- Land Application Pump Station – Following UV disinfection, treated wastewater may either be directed to the new outfall #005, or the existing outfall #004. Outfall #004 is for wastewater irrigation at the nearby golf course. Outfall #004 is rarely used during dry summer periods to keep the irrigation pond at the land application site full. A simplex pump station to transfer treated wastewater following UV disinfection to the land application site with one 3.8 HP submersible Flygt Model MP 3069 HT pump capable of operating at 60 gpm at approximately 79.6 feet of TDH.

- Land Application Site – The land application site is at the neighboring Unionville Country Club golf course.

Construction will cover the following items:

- Flow Measurement – Installation of accurate flow measurement devices will give the treatment facility a means of improved data analysis.
  - Parshall Flume – A 12-inch throat effluent Parshall flume with ultrasonic flow sensor shall measure the secondary treated and disinfected wastewater prior to discharge at Outfall No. 005.

- Screening – Installation of screening devices removes nuisance inorganic materials from raw wastewater.
  - Vertical Dual Auger Lift Station Screen – One double helix dual auger screen for removing floating, particulate, and fibrous material from influent wastewater stream and for conveying, dewatering, and compacting the screenings. The screening device shall be capable of treating a design average flow of 1.0 MGD and a peak flow of 3.0 MGD for 10 minutes. Bar thickness of 0.375 inches. Powered by 0.5 HP motor with normal operating speed of 1.5 to 6.0 RPM.

- Triplepoint Water Technologies, LLC NitrOx^{TM} – Following the primary treatment lagoon cell, the effluent will flow by gravity to the NitrOx^{TM} system. The NitrOx^{TM} system is capable of treating a design average flow of 242,000 gpd and peak hourly flow rate of 1,196,000 gpd. The system is composed of two tanks with each approximately 16 ft x 16 ft x 18 ft with a sidewater depth of 15 ft. Total volume of the two tanks is 45,957 gallons. The average flow hydraulic retention time is 4.6 hours, and the peak flow hydraulic retention time is 1.8 hours. A floating insulating cover shall be installed in each tank. An immersion tank heater will be installed to maintain a minimum wastewater temperature of 5°C. The engineer elected to benchmark the media with performance standards as outlined in Specification 46 53 34-3 1.05 rather than specifying a particular media fill percentage. This specification requires that the system shall be designed to treat influent concentrations of: Soluble $BOD_5 \leq 30$ mg/L, Total Suspended Solids ≤ 30 mg/L, Ammonia (NH_4-N) ≤ 53.4 mg/L, Water Temperature > 2.5 Deg-C, pH = 7-8, and Bicarbonate Alkalinity per 1 mg/L Ammonia to be treated = 8 mg/L. The system shall be required to meet effluent concentrations of 45 mg/L for Soluble BOD_5, 0.5 mg/L for Ammonia, >5 Deg-C water temperature, and a dissolved oxygen of at least 5 mg/L. Aeration by means of two tri-lobe positive displacement blowers each capable of supplying 249 scfm with 13.1 HP motors. The effluent from the NitrOx^{TM} will flow by gravity to Lagoon Cell No. 2 prior to disinfection and discharge.

- Disinfection – Disinfection is the process of removal, deactivation, or killing of pathogenic microorganisms.
  - Non-Contact Ultraviolet (UV) – A gravity flow, low pressure high intensity UV non-contact disinfection system capable of treating a peak flow of 1.4 MGD while delivering a minimum UV intensity of 30 mJ/cm^2 with an expected ultraviolet transmissivity of 55 percent or greater. The UV system consists of 1 reactor with 2 banks. There will be 8 lamp racks in the reactor with 8 lamps per lamp rack, for a total of 64 lamps. The disinfected effluent will either be pumped to be irrigated at the golf course (Outfall No. 004) or discharged through Outfall No. 005 following flow measurement through the Parshall flume.

- Emergency Power – A 125 kW standby diesel generator and automatic transfer switch will be provided to operate the treatment facility in event of power failure.

5. OPERATING PERMIT

Operating permit MO-0026646 will require a modification to reflect the construction activities. The modified Unionville South WWTF, MO-0026646, was successfully public noticed from July 26, 2024, to August 26, 2024, with no comments received. Submit the Statement of Work Completed to the department in accordance with 10 CSR 20-6.010(5)(N) and request the operating permit modification be issued. The operating permit fee has been waived because this project is receiving funding through the American Rescue Plan Act (ARPA).

V. NOTICE OF RIGHT TO APPEAL

If you were adversely affected by this decision, you may be entitled to an appeal before the Administrative Hearing Commission (AHC) pursuant to Section 621.250 RSMo. To appeal, you must file a petition with the AHC within 30 days after the date this decision was mailed or the date it was delivered, whichever date was earlier. If any such petition is sent by registered mail or certified mail, it will be deemed filed on the date it is mailed; if it is sent by any method other than registered mail or certified mail, it will be deemed filed on the date it is received by the AHC. Any appeal should be directed to:

Administrative Hearing Commission
U.S. Post Office Building, Third Floor
131 West High Street, P.O. Box 1557
Jefferson City, MO 65102-1557
Phone: 573-751-2422
Fax: 573-751-5018
Website: https://ahc.mo.gov

Thomas Silkwood
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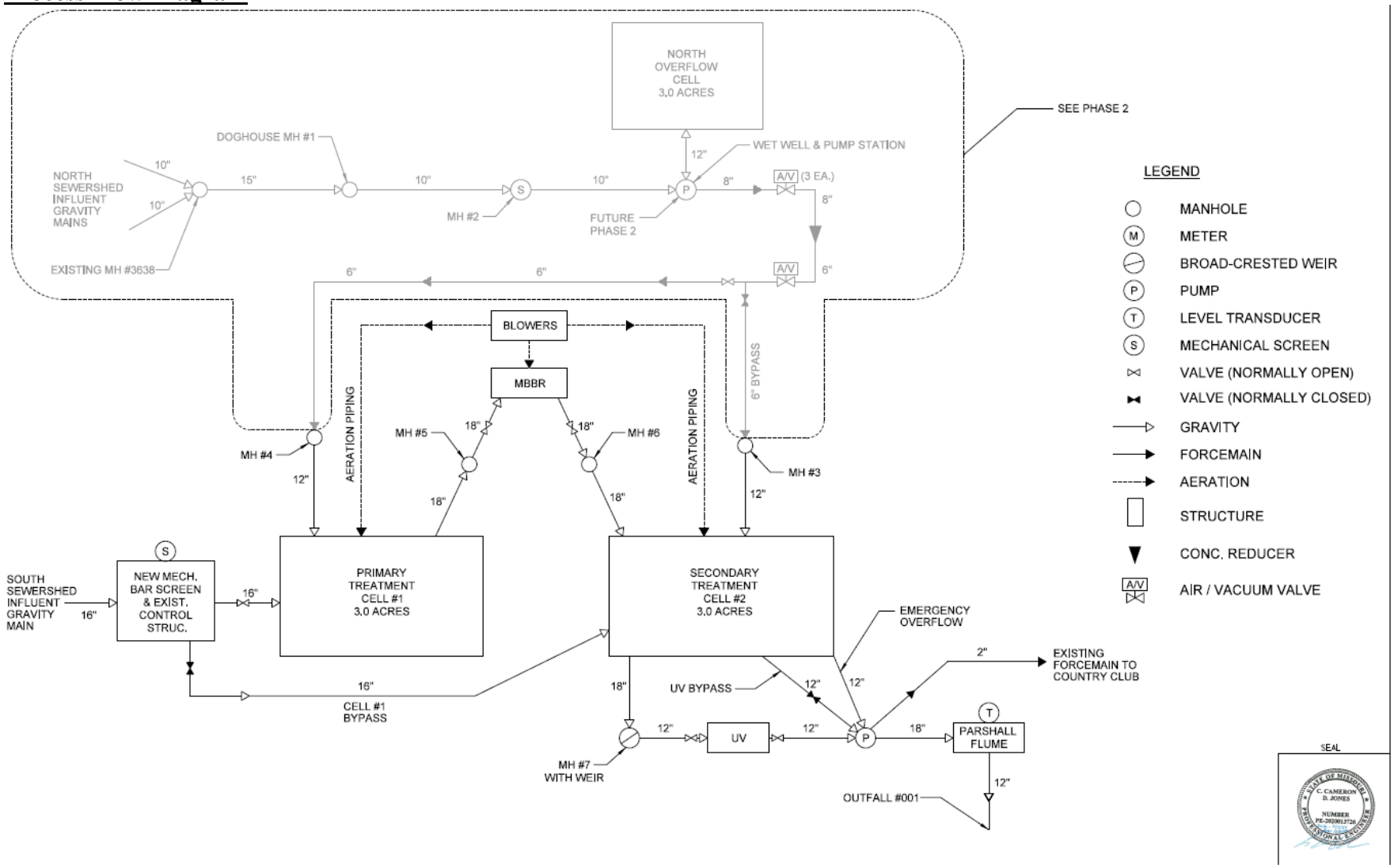
APPENDICES

- **Process Flow Diagram**
- **Summary of Design**
- **Antidegradation**

Process Flow Diagram



Summary of Design

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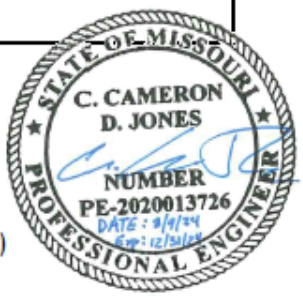
MEMO



To: Missouri Department of Natural Resources
From: Cameron Jones, P.E., PLS
Josh Stewart, P.E.
Subject: Design Basis – Unionville, MO
Phase 1 - Wastewater Treatment System Improvements - **(Revision 2)**
Date: August 8, 2024

This technical memo is provided to supplement the City of Unionville's May 2022 Wastewater Facility Plan ("FP") and May 2024 Construction Permit application. The goal of the memo is to provide additional technical and basis of design information to review the City's plans for construction permit approval. Additional sheets can be provided for your consideration and review upon request.

The approved facility plan identified the City's best path toward regulatory compliance is a project to include two phases, to be funded separately and constructed in rapid succession.

Phase 1 (funded by DNR-ARPA):

- Sludge will be removed from both the South Treatment Facility.
- A Mechanical screen will be added to the gravity influent at the South Treatment Facility.
- Lagoon aeration will be added to the Unionville South Wastewater Treatment Facility.
- Ammonia removal treatment will be added to the Unionville South Wastewater Treatment Facility using a Moving Bed Bio Reactor (MBBR).
- Ultra-violet disinfection will be added to the Unionville South Wastewater Treatment Facility.
- Effluent flow measurement will be added to the Unionville South Wastewater Treatment Facility.
- Overland flow fields will be decommissioned at the North Wastewater Treatment Facility.
- Replacement of pump for wastewater irrigation at golf course existing Outfall #004. See ***Exhibit 5***.
- Associated pipes, valves, and structures will be installed and or decommissioned as needed.

Phase 2 (Funded by SRF): Permitted Separately due to funding.

- Sludge will be removed from the North Treatment Facility.
- A Mechanical screen will be added to the gravity influent at the North Treatment Facility.
- Wastewater flows will be diverted from the existing Unionville North Wastewater Treatment Facility (MO-0054569) to the existing Unionville South Wastewater Treatment Facility (MO-0026646) with the addition of a proposed Lift Station and corresponding forcemain. The secondary lagoon at the north facility will be converted into emergency storage and flow equalization for the proposed lift station and an emergency overflow outfall will be retained.
- Overland flow fields will be decommissioned at the North Wastewater Treatment Facility.
- Associated pipes, valves, and structures will be installed and or decommissioned as needed.

North Flow Characteristics and NPDES Requirements

The following tables contain a summary of the City's NPDES limits and describes the anticipated design flows into the North Wastewater Treatment Facility (WWTF).

Design Parameter	Unit	Design Influent	Current Average	Effluent Limit			Current Daily Average Effluent
				Daily Maximum	Weekly Average	Monthly Average	
Flow (DAF) [DMF]	MGD	0.110	0.106			0.110	0.106 [1.2]
CBODs	mg/L (ppd)				65	45	
BODs	mg/L (ppd)	300(275)	235(208)				13
TSS	mg/L (ppd)	320(294)	230(203)		110	70	16
E. Coli	#/100mL				1030	206	
Oil & Grease	mg/L			15		10	4.7
Ammonia Nitrogen (as N)	mg/L (ppd)	50(46)					5
April-September	mg/L (ppd)			4.9		1.3	
October-March	mg/L (ppd)			8.4		2.9	
TKN	mg/L (ppd)	76(70)					
Dissolved Oxygen	mg/L						
pH	S.U.	7		6.5 Min.			7

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Table 1: North Wastewater Treatment Facility

A peaking factor of 3.63 was used for the North WWTF based on population, as outlined in 10 CSR 20-8.110(3)(B)1. B. Using the Design Average Flow (DAF) of 0.110 MDG, shown above in Table 1, the peak design hourly flow rate for the North WWTF is 0.399 MGD. Historical flow measurements have been recorded at as high as 1.2 MGD, therefore the Peak Hydraulic Flow (PHF) of 1.2 MGD will be used to determine pipe sizes and high-level emergency overflows.

South Flow Characteristics and NPDES Requirements

The following tables contain a summary of the City's NPDES limits and describes the anticipated design flows into the South WWTF.

Design Parameter	Unit	Design Influent	Current Average	Effluent Limit			Current Daily Average Effluent
				Daily Maximum	Weekly Average	Monthly Average	
Flow (DAF) [DMF]	MGD	0.132	0.190				0.190 [0.95]
CBODs	mg/L (ppd)				65	45	
BODs	mg/L (ppd)	200(220)	105(166)				7.8
TSS	mg/L (ppd)	270(297)	124(197)		110	70	90
E. Coli	#/100mL				1030	206	
Oil & Grease	mg/L			15		10	
Ammonia Nitrogen (as N)	mg/L (ppd)	30(33)					4.2
April-September	mg/L (ppd)			4.4		1.4	
October-March	mg/L (ppd)			9.1		2.8	
TKN	mg/L (ppd)	50(55)					
Dissolved Oxygen	mg/L						
pH	S.U.	7.1		6.5 Min.			7.2

K:\Active Projects\20E3430\Documents\Reports\[South Lagoon Combined DMR Data_12-10-2021.xlsx]Summary Tables

Table 2: South Wastewater Treatment Facility

A peaking factor of 3.63 was also used for the South WWTF using 10 CSR 20-8.110(3)(B)1. B. When considering a DAF of 0.132 MDG, shown above in Table 2, the peak design hourly flow rate for the South WWTF is 0.479 MGD. Historical flow measurements have been recorded at as high as 0.95 MGD, therefore a Peak Hydraulic Flow (PHF) of 0.95 MGD will be used to determine pipe sizing high level emergency overflows.

Combined Flow Characteristics and NPDES Requirements

The following tables contain a summary of the City's anticipated NPDES limits and design flows into the south WWTF facility under a combined flow scenario.

Design Parameter	Unit	Design Influent	Effluent Limit		
			Daily Maximum	Weekly Average	Monthly Average
Flow - DAF (DMF) [PHF]	MGD	0.242 (0.878) [1.67]			
CBODs	mg/L (ppd)			65	45
BODs	mg/L (ppd)	245(495)			
TSS	mg/L (ppd)	292(591)		110	70
E. Coli	#/100mL			1030	206
Oil & Grease	mg/L		15		10
Ammonia Nitrogen (as N)	mg/L (ppd)	40(80)			
April-September	mg/L (ppd)		4.4*		1.4*
October-March	mg/L (ppd)		9.1*		2.8*
TKN	mg/L (ppd)	62(125)			
Dissolved Oxygen	mg/L				
pH	S.U.	7.1	6.5 Min.		

*Subject to MDNR Review

P:\20E3430\Documents\Reports\[South Lagoon Combined DMR Data_12-10-2021.xlsx]Combined Summary Table

Table 3: Combined Wastewater Treatment Facility

Influent Pump Stations

As stated within the City's FP, the City's wastewater collection system is divided into north and south sewer sheds. Each subsection directs wastewater to the corresponding lagoon treatment plant via gravity. In the FP's selected alternative, flow from the North Sewer Shed would be conveyed to the centralized treatment at the existing South WWTF via a lift station and associated forcemain.

The North Master Lift Station is proposed to be outfitted with two 340 gpm submersible pumps to meet the existing peak and design flows. Please see ***Exhibit 1*** for pump calculations. Flows above the rated capacity of the pumps will be stored in the existing Unionville North WWTF and eventually pumped to the Unionville South WWTF for treatment. The lift station pumps will be utilized in lead, lag, and alternate fashion where the lead pump will turn on until the wetwell has drained and the lead pump will alternate with each cycle. In the case of high flows, the lead pump will be out paced by influent flows until the "lag" pump set point is reached. In this case, the lag pump set point will be set within the operating range of the excess flow lagoon to effectively utilize the flow equalization lagoon. In practice, only one pump will operate at a time, except on

very rare occasions of peak flows of nearly 4.4 days.

Considering a PHF to the North WWTF of 1.2 MGD and a firm capacity of 0.5 MGD at the Master Lift Station. There is a potential for flows up to 0.7 MGD into the proposed excess flow lagoon. The excess flow lagoon has a capacity of approximately 3.76 million gallons. Therefore, the excess flow lagoon has enough volume to comfortably handle over 5.4 days of peak hydraulic flows with one pump out of service. Once the peak flow event is over, the lagoons will drain by gravity back into the wetwell to be pumped to the South WWTF for treatment. During the event of a power outage, 10 CSR 20-8.130(7) requires 2 hours of retention of peak hourly flow when receiving WWTF > 100,000 gpd. Based on the calculations above, we have much greater retention time than required by statute. Please see ***Exhibit 2*** for Equalization Lagoon Calculations.

Treatment Design

The existing South WWTF will be modified to accept flows from the entire City. The treatment scheme will be modified from two separate facultative lagoon facilities followed by overland flow, to a single treatment facility utilizing a two-cell aerated lagoon system with a moving bed bioreactor (MBBR) between the cells for ammonia removal and UV disinfection for E.coli control. Construction of the aerated lagoon involves installation of approximately 19 aeration diffusers throughout the lagoons. The new aerated lagoon cells will help increase wastewater treatment effluent quality. Please see ***Exhibit 3*** and the attached plans for the proposed equipment layout.

B&A has performed a preliminary design analysis in consultation with MDNR's "Recommended Standards" to determine if the two cells are adequately sized to meet BOD_5 , ammonia, and fecal coliform treatment requirements, and the calculations are detailed on the following pages.

Aeration Design

Minimum design standards utilized for the design of the aerated lagoon are as follows:

1.4 lbs of oxygen per lb of BOD_5 removed
4.6 lbs of oxygen per lb of NH_3 removed

Considering the City's design population of 2,420 people, design removal values for BOD and NH_3 are as follows:

BOD_5	=	245 mg/L or 495 ppd
NH_3	=	40 mg/L or 80 ppd

Therefore, the minimum pounds of oxygen required for daily treatment is as follows:

BOD_5:	495 PPD BOD_5	x	1.4 PPD O_2	=	693 PPD O_2
NH_3:	80 PPD NH_3	x	4.6 PPD O_2	=	368 PPD O_2
			TOTAL	=	**1,061 PPD O_2**

Aeration Design includes: (Calculations Shown Below)

Lagoon Aeration AOR	Cell 1	=	650 PPD O_2
	Cell 2	=	103 PPD O_2
MBBR Aeration AOR	Stage 1	=	285 PPD O_2
	Stage 2	=	292 PPD O_2
	TOTAL	**=**	**1,330 PPD O_2 > 1,061 PPD OK!**

Biological Treatment

The following design assumptions were utilized based on standard treatment conditions generally accepted within the wastewater treatment industry based on common waste characteristics, load variation, and maximum temperature.

K_e	=	0.130	at minimum temperature conditions of 0.5°C
K_e	=	0.280	at maximum temperature conditions of 20°C

Alpha and Beta factors consistent with domestic waste where:

Alpha	=	0.60	
Beta	=	0.95	
Theta	=	1.02	
pH	=	6.5	minimum
pH	=	9.0	maximum
DO	=	2.0 mg/l	minimum
Site Elevation	=	987 ft.	

Considering the lagoon geometry and preceding assumptions, the aeration design calculations are as follows. Note that the aeration system upon which the lagoon has been preliminarily designed is Triplepoint Ares Aeration & Nitrox Nitrification using equations 1-3 below to determine proposed effluent water quality.

SUMMARY - General Design Parameters			
	Design Scenario Name	Units	Combined N & S
1	Influent Flowrate	MGD	0.242
2	Influent Concentration	mg/L	245
3	Effluent Concentration (Winter)	mg/L	6.7
4	Effluent Concentration (Summer)	mg/L	19.5
5	Actual Oxygen Supplied	lb/day	752.5
6	Air included for nitrification?		No
7	Number of Aerators		19
8	Estimated Tubing Length	ft	3000
9	Standard Airflow	SCFM	675.35
10	Inlet Airflow	ICFM	799
11	Design Pressure (w/cushion)	psig	5
12	Projected Brake Hp	bhp	15.09
13	Estimated Design Hp	hp	25

1. $FTE = \alpha\ (SOTE)\ \theta^{(T-20)}\ (\beta\ C^*_{wT} - DO) \div C^*_{w20}$ *field transfer efficiency*

   Where,

α	contaminant factor {contaminants, depth, bubble size} (range: 0.40–0.70)
β	TDS factor {total dissolved solids} (range: 0.90–1.00)
$\theta = 1.024$	temperature factor
DO	target dissolved oxygen level (mg/L)
C^*_{wT}	saturation oxygen concentration at site—adjusted for water depth
C^*_{w20}	sat. oxygen concentration at STP conditions—adjusted for water depth
T	water temperature (Celsius)

2. $Airflow = AOR / (25.056 * FTE)$
3. $E = 2.3 * k * t / (1 + 2.3 * k * t)$ *biological treatment efficiency*

   Where,

k = varies	kinetic coefficient {related to temperature} (range: 0.06 to 0.12)
t = time	treatment time in days

Table 4: Aerated Lagoon Calculations

SUMMARY - Biological Treatment Calculations				
	Item	Description	Units	Combined N & S
	1	Number of Treatment Cells		2
	2	Flow Regime		Series
	3	Site Elevation - HWL	ft	987
Cell 1				
	4	Wastewater Flowrate	MGD	0.242
	5	Treatment Volume	M-Gal	6.2
	6	Treatment Time	days	25.5
	7	Treatment Type		Partial Mix
	8	Std Reaction Rate, K_{20}	$Days^{-1}$	0.28
Summer	9	Design Water Temp	°C	20
	10	Design Reaction Rate, K_T	$Days^{-1}$	0.122
	11	Biological Treatment Eff.	%	87.7%
	12	Influent BOD Loading	lb/day	494
	13	Influent BOD Concentration	mg/L	245
	14	BOD Removed	lb/day	433
	15	Effluent BOD Loading	lb/day	61
	16	Effluent BOD Concentration	mg/L	30.1
Winter	17	Design Water Temp	°C	0.5
	18	Biological Treatment Eff.	%	78.2%
	19	BOD Removed	lb/day	386.1
	20	Effluent BOD Concentration	mg/L	53.5
	N1	Influent NBOD Loading	lb/day	125
	N2	Influent NBOD Concentration	mg/L	61.9
	N3	Assumed NBOD Removed	lb/day	0
	N4	Effluent NBOD Loading*	lb/day	125
	N5	Assumed Eff. NBOD Conc.	mg/L	62
SUMMARY - Biological Treatment Calculations - Cell 2				
	Item	Description	Units	Combined N & S
	21	Wastewater Flowrate	MGD	0.2
	22	Treatment Volume	M-Gal	3
	23	Treatment Time	days	12.4
	24	Treatment Type		Partial Mix
	25	Std Reaction Rate, K_{20}	$Days^{-1}$	0.28
Summer	26	Design Water Temp	°C	20
	27	Design Reaction Rate, K_T	$Days^{-1}$	0.122
	28	Biological Treatment Eff.	%	77.6%
	29	Influent BOD Loading	lb/day	61
	30	Influent BOD Concentration	mg/L	30.1
	31	BOD Removed	lb/day	47
	32	Effluent BOD Loading	lb/day	14
	33	Effluent BOD Concentration	mg/L	6.7
Winter	34	Design Water Temp	°C	0.5
	35	Biological Treatment Eff.	%	63.5%
	36	BOD Removed	lb/day	68.5
	37	Effluent BOD Concentration	mg/L	19.5
	N6	Influent NBOD Loading	lb/day	125
	N7	Influent NBOD Concentration	mg/L	61.9
	N8	Assumed NBOD Removed	lb/day	0
	N9	Effluent NBOD Loading*	lb/day	125
	N10	Assumed Eff. NBOD Conc.	mg/L	62

Table 5: Biological Treatment Calculations

SUMMARY - Aeration Calculations				
	Item	Description	Units	Combined N & S
	1	Site Elevation	ft	987
	2	O_2 Loading Factor (BOD_5)	O_2/BOD	1.5
	3	Alpha-value, ♋		0.60
	4	Beta-value, ♌		0.95
	5	Theta-value, ❑		1.02
SUMMARY - Aeration Calculations Cells 1 & 2				
	Item	**Description**	**Units**	**Combined N & S**
Cell 1				
	6	Lagoon Side Water Depth	ft	6.00
	7	Air Release Depth	ft	5.25
	8	AOR - Total	lb/day	650
	9	SOTE/ft	%/ft	2.10%
	10	SOTE/ft	%	11.03%
	11	Design DO Concentration	mg/L	2.00
	12	FTE		4.44%
	13	Air Requirement	scfm	585
	14	Airflow per Aeration Unit	scfm	36.5
	15	Aerator Type		750T
	16	Number of Aeration Units	Units	16
	17	Water Pressure	psig	2.27
	18	Aerator Pressure Loss	psig	0.55
	19	Header / Feeder P Loss	psig	1.17
	20	Total Operating Pressure	psig	4.00
	21	Design Motor Pressure	psig	5.00
Cell 2				
	6	Lagoon Side Water Depth	ft	6.00
	7	Air Release Depth	ft	5.25
	8	AOR - Total	lb/day	103
	9	SOTE/ft	%/ft	2.14%
	10	SOTE/ft	%	11.24%
	11	Design DO Concentration	mg/L	2.00
	12	FTE		4.52%
	13	Air Requirement	scfm	91
	14	Airflow per Aeration Unit	scfm	30.2
	15	Aerator Type		750T
	16	Number of Aeration Units	Units	3
	17	Water Pressure	psig	2.27
	18	Aerator Pressure Loss	psig	0.55
	19	Header / Feeder P Loss	psig	1.03
	20	Total Operating Pressure	psig	3.85
	21	Design Motor Pressure	psig	4.85

Table 6: Aeration Calculations

SUMMARY - Design Input Values			
Plant	Influent Characteristics	Units	Values
1	Annual Average Daily Flow	gpd	242,000
2	Maximum Monthly Average Daily Flow	gpd	242,000
3	Peak Daily Flow	gpd	878,000
4	Peak Hourly Flow	gpd	878,000
5	Influent BOD	mg/L	245
6	Influent BOD	lb/day	494.5
7	Influent TSS	mg/L	292
8	Influent TSS	lb/day	589.3
9	Tnfluent NH3-N	mg/L	40
10	Tnfluent NH3-N	lb/day	80.7
11	Influent TKN	mg/L	62
12	Influent TKN	lb/day	125.1
A1	Influent Nox-N	mg/L	0
A2	Influent Nox-N	lb/day	0
13	Influent pH		7
14	Water Temperature	deg-C	12
NitrOx	Influent Characteristics	Units	Values
15	Annual Average Daily Flow	gpd	242,000
16	Maximum Monthly Average Daily Flow	gpd	242,000
17	Peak Daily Flow	gpd	484,000
18	Peak Hourly Flow	gpd	605,000
19	Influent BOD	mg/L	30
20	Influent TSS	mg/L	30
21	Influent NH3-N	mg/L	53.4
22	Influent TKN	mg/L	53.4
23	Design Influent TKN	mg/L	53.4
A3	Design Influent Nox-N	mg/L	0
A4	Alkalinity Required as CaCO3 (Minimum)	mg/L	477
24	Influent pH		7
25	NitrOx Water Temperature	deg-C	5

Table 7: Nitrification Equipment Calculations

SUMMARY - General Design Parameters			
Item	NitrOx Tank Sizing Summary	Units	Values
26	Number of Treatment Trains Proposed		1
27	Number of Tanks Per Train		2
28	Total Number of Tanks		2
29	Length of Each	ft	16
30	Width of Each	ft	16
31	Side Water Depth of Each	ft	15
32	Tank Height of Each	ft	18
33	Volume of Each	gallons	28,723
34	Volume Total	gallons	57,446
35	Hydraulic Retention Time at Max Month Flow	hours	5.7
36	Hydraulic Retention Time at Peak Hourly Flow	hours	2.3
40	Number of Ares Units per Tank		4
41	Total Number of Ares Units		8
	NitrOx Air Requirement (Per Treatment Train)	**Stage 1**	**Stage 2**
42	AOR (lbs/day)	285	292
43	Assumed Diffuser Subm. at AWL (ft)	14.25	14.25
44	Elevation (ft)	1063	1063
45	Alpha-value, α	0.7	0.7
46	Beta-value, β	0.95	95.0%
47	Target DO Residual (MBBR Process) (mg/L)	5	5
48	SOR (lbs/day)	868	891
49	Target Diffuser Efficiency/ft Submergence	2	2
50	**Airflow (scfm)**	**123**	**126**
	NitrOx Blower Requirement Summary	**Units**	**Values**
51	No. of Blowers (Includes one redundant)		2
52	Airflow Requirement per Blower	scfm	249
53	Airflow per 1,000 scfm	scfm/1k cf	32
54	Water Pressure at Air Release Depth	psig	6.17
55	Piping and Diffuser Losses	psig	1.5
57	Maximum Design Discharge Pressure	psig	7.67
58	Assumed Overall Efficiency		0.62
59	Approximate BHP Requirement/Blower	bhp	13.1
60	Approximate BHP Requirement Total	bhp	13.1
61	Estimated Nameplate Hp/Blower	hp	20
62	Blower Type		Tri-Lobe PD
SUMMARY - Calculated Output Values			
	NitrOx Effluent Parameters	**Units**	**Values**
63	Effluent SCBOD	mg/L	7.5
64	Effluent SCBOD	lbs/day	15.1
65	Effluent NH3-N in Winter (Monthly Average)	mg/L	0.5
66	Effluent NH3-N in Winter (Monthly Average)	lbs/day	1
67	Effluent NH3-N in Summer (Monthly Average)	mg/L	0.5
68	Effluent NH3-N in Summer (Monthly Average)	lbs/day	1

Table 7: Nitrification Equipment Calculations Continued

Ultraviolet Disinfection

UV Disinfection system selection included manufacturer proposals, cost comparisons, and owner input on operational considerations. A manufacturer was designated as the Basis of Design and multiple manufacturers will be considered for construction bids on a performance basis. Manufacturers will need to meet or exceed design parameters listed below in the basis of design based around equipment manufactured by Enaqua.

UV dosage is based on Average Daily Flow, where peak hour flows will be equalized by a combination of upstream lagoon surface area and hydraulics between the lagoons, UV Disinfection, flow and level control structure, and outfall piping. Hydraulic modeling using Visual Hydraulics confirms that the MDF of 0.88 MGD can be maintained through the UV channel while maintaining freeboard on the lagoons.

As a facility with seasonal bacterial effluent limits, one (1) stored spare module for maintenance will be provided.
The details of the UV design criteria, process configuration, and UV reactor are provided in the following tables.

Average Flow Rate	0.242/ 168	MGD/GPM
Peak Design Flow Rate (Peak Disinfection Flow Rate)	1.45/1,007	MGD/GPM
UV Transmittance	55.0	% UVT (Minimum)
Total Suspended Solids*	<30.0	mg/l (30-day average)
BOD*	<30.0	mg/l (30-day average)
Target Indicator Organism	E. Coli/ Fecal Coliform	
Permit Criteria	206/1030	(CFU/100 ml) monthly geomean/ 7-day geomean
UV Dose (manufacturer calculated)	30.0	Minimum UV dose of 30.0 mJ/cm^2. After applying certified Lamp End of Lamp Life (EOLL) of .87, Fouling Factor of .89.
Plant Process	Lagoon with NITROX Process	
Particle Size*	30.0	Microns
Total Iron*	0.3	mg/l
Turbidity*	5	NTU
Equipment Redundancy	Two UV channels, each with a two-bank reactor capable of treating 50% of the PHWWF.	

*Note: Industry standard parameters used for this proposal.

Reactor model number	C2t.06032
Reactor type	In-Pipe
Installation notes	Indoor/ Outdoor – Covered Installation
Process connection	12.00" ⌀ CL 150 Flange
Reactor configuration	Standard
UV Lamps - Enaqua part #: 001.0617045 XUV60L	145-Watt LPHO Non-Amalgam Smart Lamps
UV Lamp output at 253.7 nm (Nominal Watts)	55.00 Watts
Ballasts - Enaqua part #: 502.5V2427M	145-Watt Enlight High Efficiency Ballast
Non-Contact Reactor Material	C-Series AFP 840 Tube
Material of Construction	304 SS
UV REACTOR(S)	
# of proposed UV reactors	1
# of banks per reactor	2
# of AFP tubes per reactor	18
# of lamp racks per bank	4
# of lamps per lamp rack	8
Total # of lamps per bank	32
Total # of ballasts per bank	32
Total #of lamps per reactor	64
Total # of lamps in system	64
REACTOR THERMAL CONTROL MECHANISM	
Air to air heat exchangers	2 (One per bank)

Lagoon Hydraulics

The "freeboard" height for the lagoons is 2 feet, which is the standard minimum.

It should be noted that the lagoon depths for both aeration cells are controlled via an effluent control structure featuring a five foot (5') broad crested weir for treatment volume retention during low-average flows and low head loss during peak flows. The weir will also include an operator control valve which can be used during

periods of high flows during storm events, when having significant freeboard is most important. The operator will have the ability to lower the pond depths to allow more room for flow fluctuation and treatment capacity. Additionally, the South Cell #1 will act as Flow Equalization for storm flows across the 3.9 acres of surface area. Hydraulic calculations performed for the Hydraulic Profile shown on Sheet G-004 of the plans were performed at steady state flows, however, peak flows would have to continue for multiple days to reach elevations shown on G-004. Please see ***Exhibit 4*** for lagoon volume calculations.

Summary

As is shown in these design basis calculations, the proposed aerated lagoon, MBBR, and UV Disinfection can adequately meet and exceed NPDES permit limits. Preceding discussions within this memo and the Unionville FP also demonstrate that this proposed treatment plant will provide operational efficiencies and be able to be modified efficiently to meet anticipated future effluent goals if required.

Exhibit 1

North Lagoon Transfer Pump Calculations

North Lagoon Transfer Pump Station
Unionville, MO
5/8/2024

Low Water Level = 952
High Water Level = 962 (Lag Pump Set Point)
Invert at outlet = 986.5
8" to 6" force main
C = 120

System Head - 1 pump

Flow (gpm)	Low Head (feet)	High Head (feet)
0	71.0	88.0
50	71.5	88.5
100	72.7	89.7
150	74.6	91.6
200	77.2	94.2
250	80.4	97.4
300	84.3	101.3
350	90.8	107.8
400	99.5	116.5
450	109.2	126.2
500	122.6	139.6

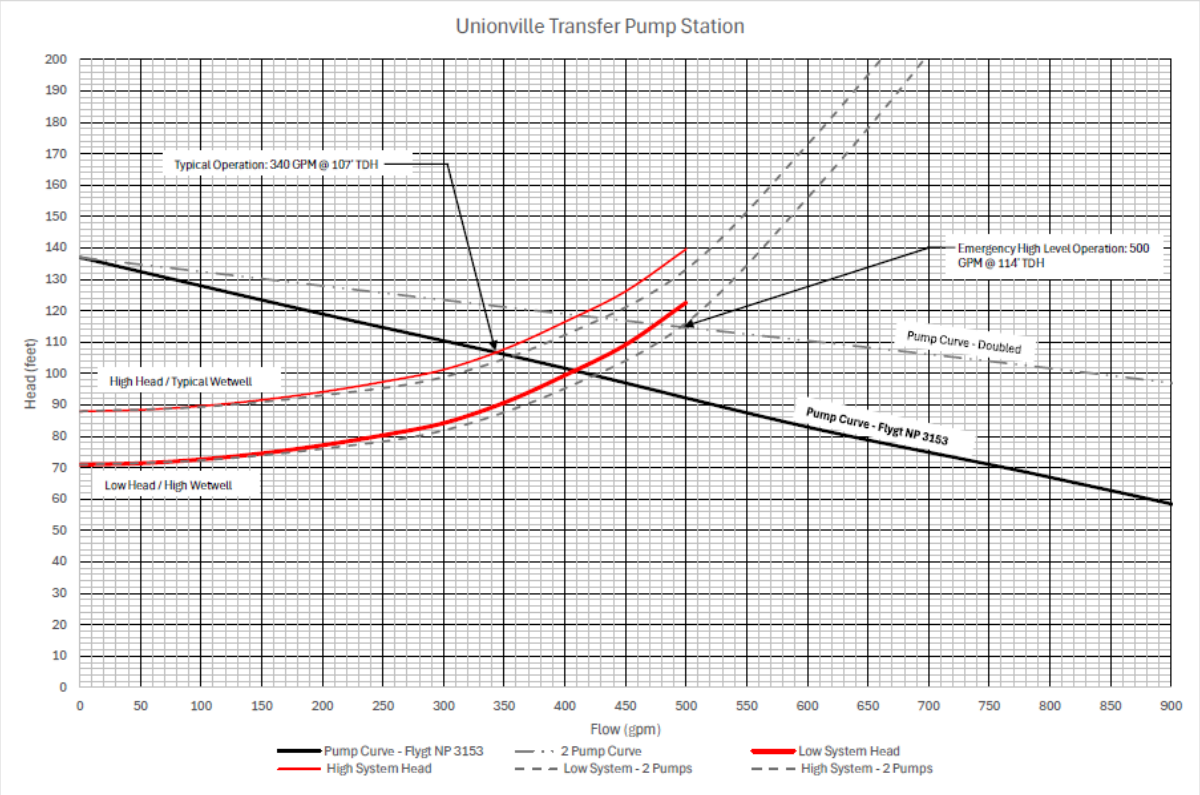
System Head - 2 pumps

Flow (gpm)	Low Head (feet)	High Head (feet)
0	71.0	88.0
100	72.4	89.4
200	76.1	93.1
300	81.9	98.9
400	95.3	112.3
500	116.2	133.2
600	155.9	172.9
700	201.9	218.9
800	253.8	270.8

Pump Curve

Flow (gpm)	Head (feet)	2 Pump Flow (gpm)
0	137	0
200	119	400
386	103	772
600	83	1,200
800	67	1,600
1,000	49	2,000
1,160	28	2,320

P:\20E3430\Design\Design\Hydraulics\Force Main\[Force Main Hydraulics - Unionville.xlsx]Curves BOD


Unionville Transfer Pump Station
Typical Operation: 340 GPM @ 107' TDH
Emergency High Level Operation: 500 GPM @ 114' TDH
Pump Curve - Doubled
Pump Curve - Flygt NP 3153
High Head / Typical Wetwell
Low Head / High Wetwell
Head (feet)
Flow (gpm)
Pump Curve - Flygt NP 3153
2 Pump Curve
Low System Head
High System Head
Low System - 2 Pumps
High System - 2 Pumps

LIFT STATION DESIGN CALCULATIONS

I. Project Details

Project:	Unionville MO
Project Number:	20e3430
Pump Station:	-
Date:	4/24/2024
Doc Number:	N/A
File Designation:	P:\20E3430\Design\Design\Hydraulics\[TDH - Pump HP - System Head Curve - LS Design.xlsx]Wetwell Calculations 340 gpm

II. Design Capacity

A. Average Daily Flow (A.D.F.)

	# of Units	Demand Rate	Demand
SF Units Gravity to LS	315	350 gpd/unit*	110250 gpd
		gpd/unit*	0 gpd
		gpd/unit*	0 gpd
Future Flows		0 gpd/unit*	0 gpd
			gpd
			gpm

Notes: *100gal/day/cap with an average of 3.5 cap/unit

Total A.D.F. = 110,250 gpd
76.56 gpm (24 hr day)

B. Peak Hour Flow

Peak factor per utility technical manual:

Population in Thousands (P) = 1.1025 or 1103 P.E.

$$\frac{Q_{Peak\ Hourly}}{Q_{Design\ Average}} = \frac{18+SQRT(P)}{4+SQRT(P)}$$

Peaking Factor = 3.8

$$\frac{A.D.F. \times Peak\ Factor}{1440}$$

Total P.H.F. = 288.8 gpm
Total GPD 415,894 gallons per day

C. Design Minimum Flow

$$\frac{A.D.F. \times 0.20}{1440}$$

Design min flow = 15.3 gpm

D. Minimum Required Pump Capacity

288.8 gpm

E. Required Flow to Meet Minimum Velocity in Force Main

Diameter of Main (d)	8 in		
Minimum Velocity Required (v)	2 ft/s		
Required flow to meet minimum velocity	313.3 gpm	or	451,183 GPD

$$Q = \frac{v*60*7.48*3.14d^2}{4}$$

F. Required Flow to Meet Historical Flows

Historical Maximum Day Flow = 1,200,000 GPD
Average Hour = 50,000 gallons
833 gpm
Design Peak Hour na GPD

LIFT STATION DESIGN CALCULATIONS

Project: Unionville MO
Project Number: 20e3430

#VALUE! gpm

III. Wet well Design (Duplex System)

A. Design Criteria:

1. Maximum pump motor cycle rate = 10 Starts Per Hour
2. Maximum detention time at average flow = 30 minutes

B. Pump Control Level Settings:

1. Pump cycling rates are at a maximum when inflow equals one-half the design pumping rate of: 340.0 gpm

2. Wet well volume required between lead pump start and pump shut off level:

If S (inflow) = Half the design pumping rate and cycle period selected

$$V = \frac{T * Q}{4} = 850.0 \text{ gallons}$$

where: T= cycle period= 10 min. (2 - 50 HP), 15 min. (51 - 75 HP), 30 min. (76- 250 HP)

Q=pump rate= 340.0 gpm

Starts per pump per hour:

$$\frac{60 \text{ min/hour}}{2 \text{ pumps} * 10.00 \text{ min.}} = 3.0$$

If S (inflow) = Typical Minimum Flow:
Q = Pump Rate

Pump Starts Every (T) Minutes:

$$T = \frac{V}{Q-S} + \frac{V}{S}$$

$$T = \frac{850.00 \text{ gal}}{(340.00 - 15.31) \text{ gpm}} + \frac{850.00 \text{ gal}}{15.31 \text{ gpm}} = 58.13 \text{ min.}$$

Starts per pump per hour:

$$\frac{60 \text{ min/hour}}{2 \text{ pumps} * 58.13 \text{ min.}} = 0.5$$

LIFT STATION DESIGN CALCULATIONS

Project: Unionville MO
Project Number: 20e3430

Adjusted Volume: 423 gallons

If S (inflow) = half the design pumping rate
Q = Pump Rate

Pump Starts Every (T) Minutes:

$$T = \frac{V}{Q-S} + \frac{V}{S}$$

$$T = \frac{423.00 \text{ gal}}{(340.00 - 170.00) \text{ gpm}} + \frac{423.00 \text{ gal}}{170.00 \text{ gpm}} = 4.98 \text{ min.}$$

Starts per pump per hour:

$$\frac{60 \text{ min/hour}}{2 \text{ pumps} * 4.98 \text{ min.}} = 6.0 \text{ min.}$$

If S (inflow) = Typical Minimum Flow:
Q = Pump Rate

Pump Starts Every (T) Minutes:

$$T = \frac{V}{Q-S} + \frac{V}{S}$$

$$T = \frac{423.00 \text{ gal}}{(340.00 - 15.31) \text{ gpm}} + \frac{423.00 \text{ gal}}{15.31 \text{ gpm}} = 28.93 \text{ min.}$$

Starts per pump per hour:

$$\frac{60 \text{ min/hour}}{2 \text{ pumps} * 28.93 \text{ min.}} = 1.0$$

If S (inflow) = Average Daily Flow:
Q = Pump Rate

Pump Starts Every (T) Minutes:

$$T = \frac{V}{Q-S} + \frac{V}{S}$$

$$T = \frac{423.00 \text{ gal}}{(340.00 - 76.56) \text{ gpm}} + \frac{423.00 \text{ gal}}{76.56 \text{ gpm}} = 7.13 \text{ min.}$$

Starts per pump per hour:

$$\frac{60 \text{ min/hour}}{2 \text{ pumps} * 7.13 \text{ min.}} = 4.2$$

LIFT STATION DESIGN CALCULATIONS

Project: Unionville MO
Project Number: 20e3430

If S (inflow) = Peak Hour Flow:
Q = Pump Rate

Pump Starts Every (T) Minutes:

$$T = \frac{V}{Q-S} + \frac{V}{S}$$

$$T = \frac{423.00 \text{ gal}}{(340.00 - 288.81) \text{ gpm}} + \frac{423.00 \text{ gal}}{288.81 \text{ gpm}} = 9.73 \text{ min.}$$

Starts per pump per hour:

$$\frac{60 \text{ min/hour}}{2 \text{ pumps} * 9.73 \text{ min.}} = 3.1$$

3. Wet well Diameter (D) = 6 ft
Wet well Volume (Vw)

Vw= Aw*7.48 211 gal/ft of depth approx 6.25' square

where: Aw=area of wet well (ft^2)
$Aw=3.14(D^2)/4$

4. Wet well level change between pump stop and lead pump start

$$= \frac{\text{pump shut off level}}{\text{wet well volume}} =$$

2.00 ft
24.00 in
Therefore use: 2.00 ft
Wet well volume = 423

5. Control Elevations

High Point of F.M. = 986.50 at receiving manhole
Top of wet well elev. = 968.00
Top of slab elev. = 968.50

	Elev.	Depth measured from bottom (ft)			
Top of Wet Well=	968.00	18.00			
Influent Invert=	956.00	6.00			
High Water Alarm=	956.00	6.00			
Lag Pump On=	955.00	5.00		423	
Lead Pump On (H.W.L.)=	954.00	4.00	-	423	gals. Provided Pump Cycle Volume
Pump off (L.W.L.)=	952.00	2.00			
Bottom of Wet Well=	950.00				

Is Provided Volume greater than Required Volume = Yes
Is Provided Volume cycle less than 30 min at ADF = Yes
Is Provided Volume cycle less than 10 starts per hour at Half Pump Design Flow = Yes
*Allow enough depth between bottom of wet well and pump off elevation to completely submerge pump.

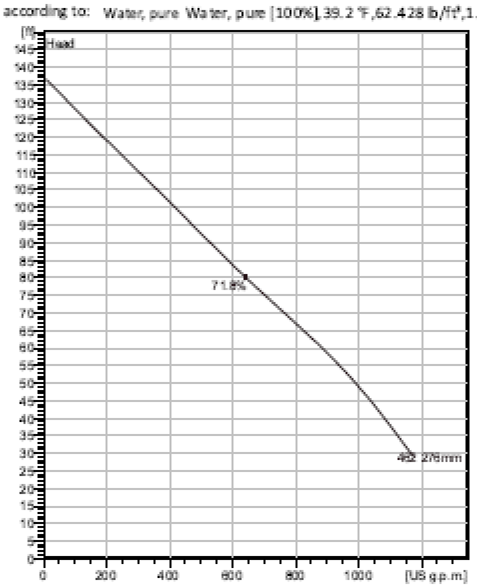
NP 3153 HT 3~ 462

Patented self cleaning semi-open channel impeller, ideal for pumping in waste water applications. Modular based design with high adaptation grade.

FLYGT a xylem brand

Technical specification

Curves according to: Water, pure Water, pure [100%], 39.2 °F, 62.428 lb/ft³, 1.6889E-5 ft²/s



Nominal (mean) data shown. Under- and overperformance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

Configuration

Motor number
N3153.185 21-18-4AA-W
20hp

Impeller diameter
276 mm

Installation type
P - Semi permanent, Wet

Discharge diameter
4 inch

Pump information

Impeller diameter
276 mm

Discharge diameter
4 inch

Inlet diameter
150 mm

Maximum operating speed
1755 rpm

Number of blades
2

Max. fluid temperature
40 °C

Material

Impeller
Hard-Iron ™

Project	Xylect-22174160	Created by			
Block	0	Created on	4/19/2024	Last update	4/19/2024

NP 3153 HT 3~ 462

Technical specification

Motor - General

Motor number N3153.185 21-18-4AA-W 20hp	**Phases** 3~	**Rated speed** 1755 rpm	**Rated power** 20 hp
ATEX approved No	**Number of poles** 4	**Rated current** 26 A	**Stator variant** 3
Frequency 60 Hz	**Rated voltage** 440 V	**Insulation class** H	**Type of Duty** S1
Version code 185			

Motor - Technical

Power factor - 1/1 Load 0.85	**Motor efficiency - 1/1 Load** 87.5 %	**Total moment of inertia** 2.38 lb ft²	**Starts per hour max.** 30
Power factor - 3/4 Load 0.80	**Motor efficiency - 3/4 Load** 89.0 %	**Starting current, direct starting** 158 A	
Power factor - 1/2 Load 0.70	**Motor efficiency - 1/2 Load** 89.0 %	**Starting current, star-delta** 52.7 A	

Project	Xylect-22174160	**Created by**			
Block	0	**Created on**	4/19/2024	**Last update**	4/19/2024

Permit No. CP0002471

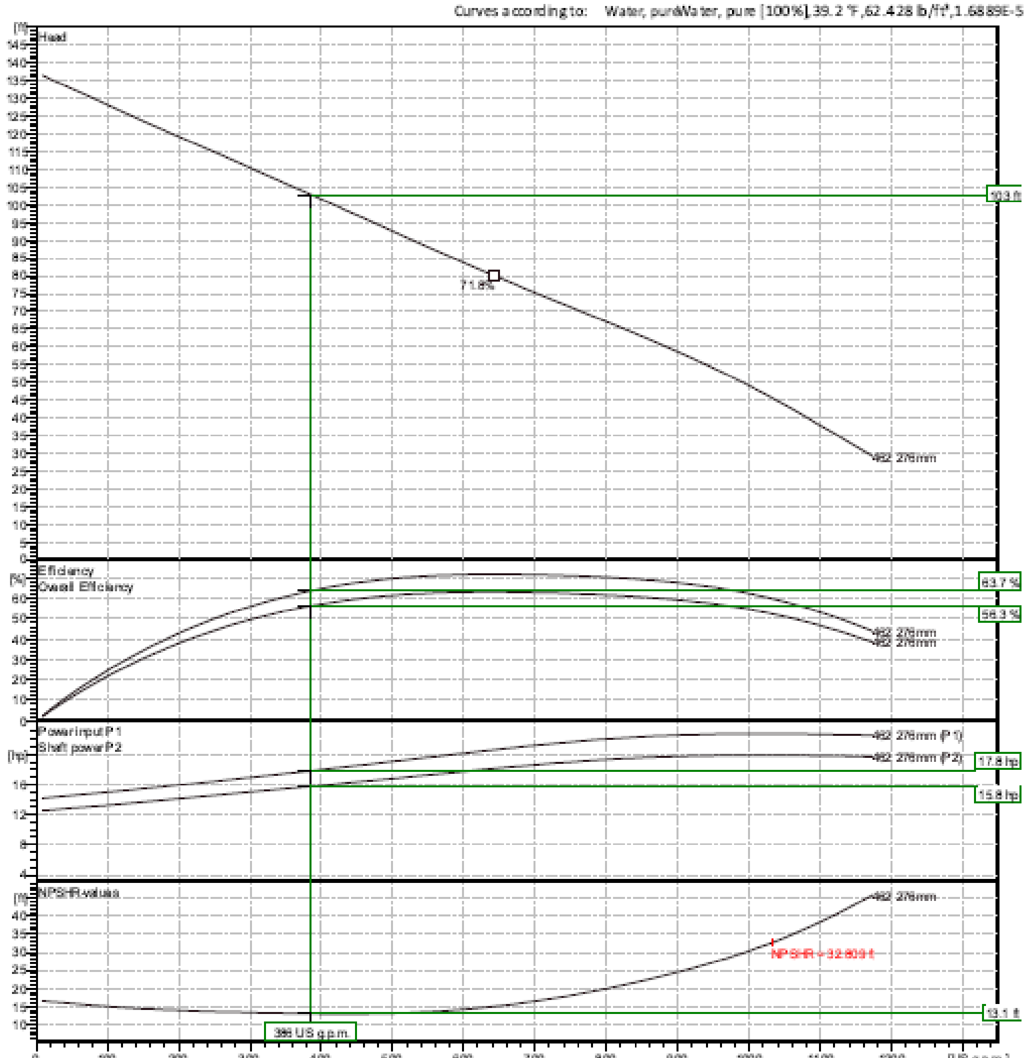
NP 3153 HT 3~ 462

Performance curve

Duty point

Flow	Head
386 US g.p.m.	103 ft

Curves according to: Water, pureWater, pure [100%],39.2 °F,62.428 lb/ft³,1.6889E-5 ft²/s



Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

Curve: ISO 9906

Xylect-22174160

0 | Created on 4/19/2024 | Last update 4/19/2024

Program version | Data version | User group(s)

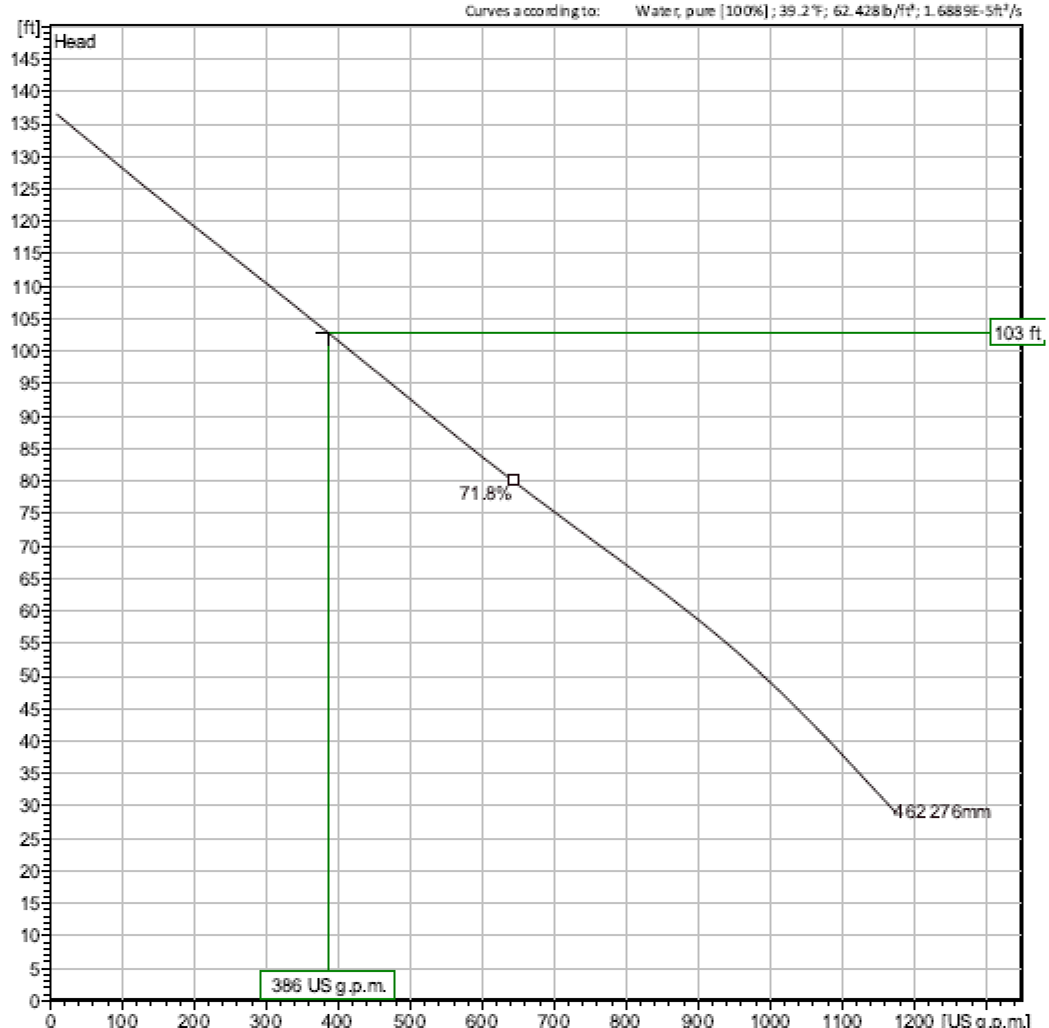
Permit No. CP0002471

NP 3153 HT 3~ 462

Duty Analysis

FLYGT
a xylem brand

Curves according to: Water, pure [100%] ; 39.2 °F; 62.428lb/ft³; 1.6889E-5ft²/s



Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

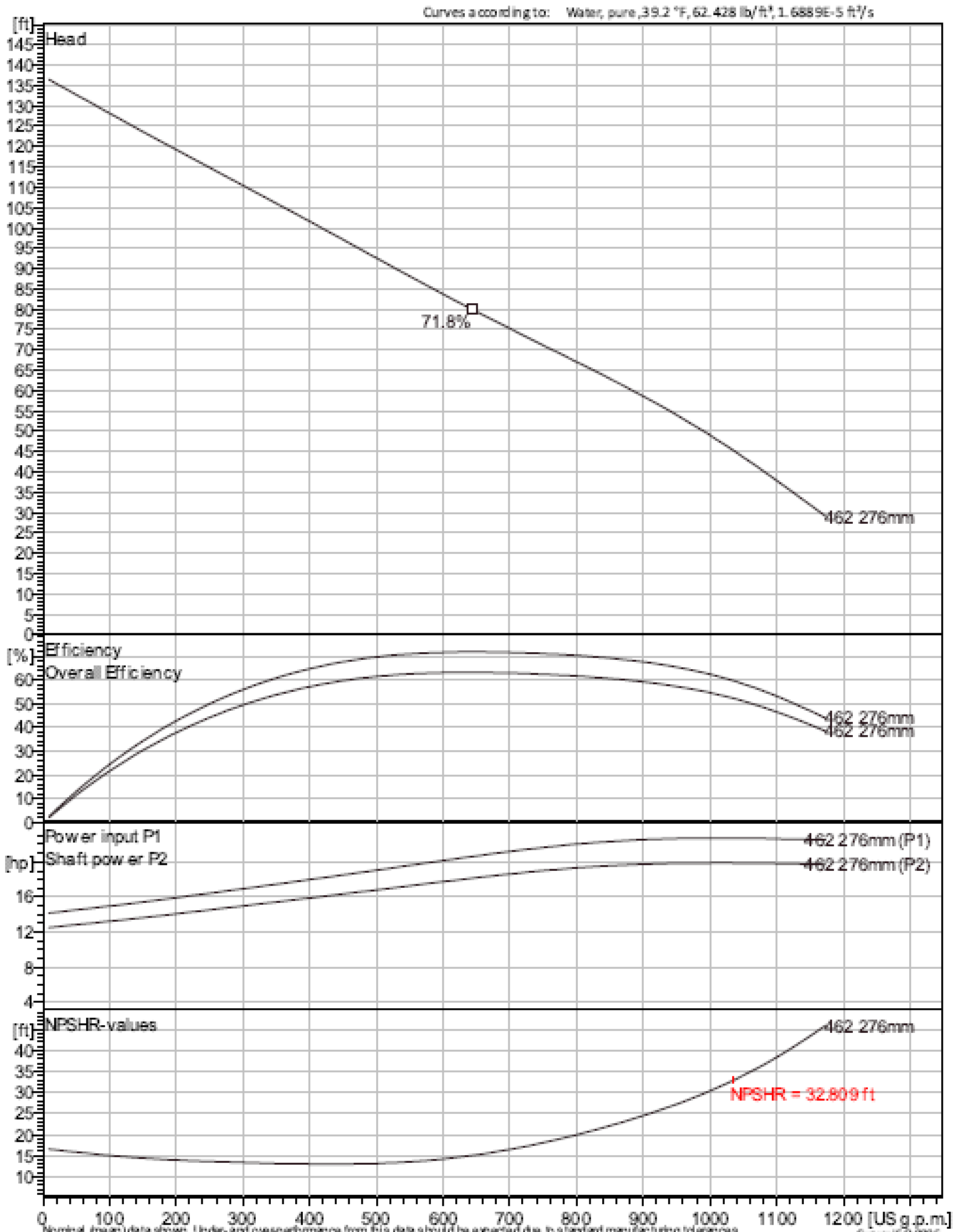
Operating characteristics

Pumps / Systems	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Spec. Energy	NPSHre
	US g.p.m.	ft	hp	US g.p.m.	ft	hp		kWh/US MG	ft
1	386	103	15.8	386	103	15.8	63.7 %	574	13.1

Project		Created by			
Block	Xylect-22174160	Created on	4/19/2024	Last update	4/19/2024

NP 3153 HT 3~ 462

VFD Curve



Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

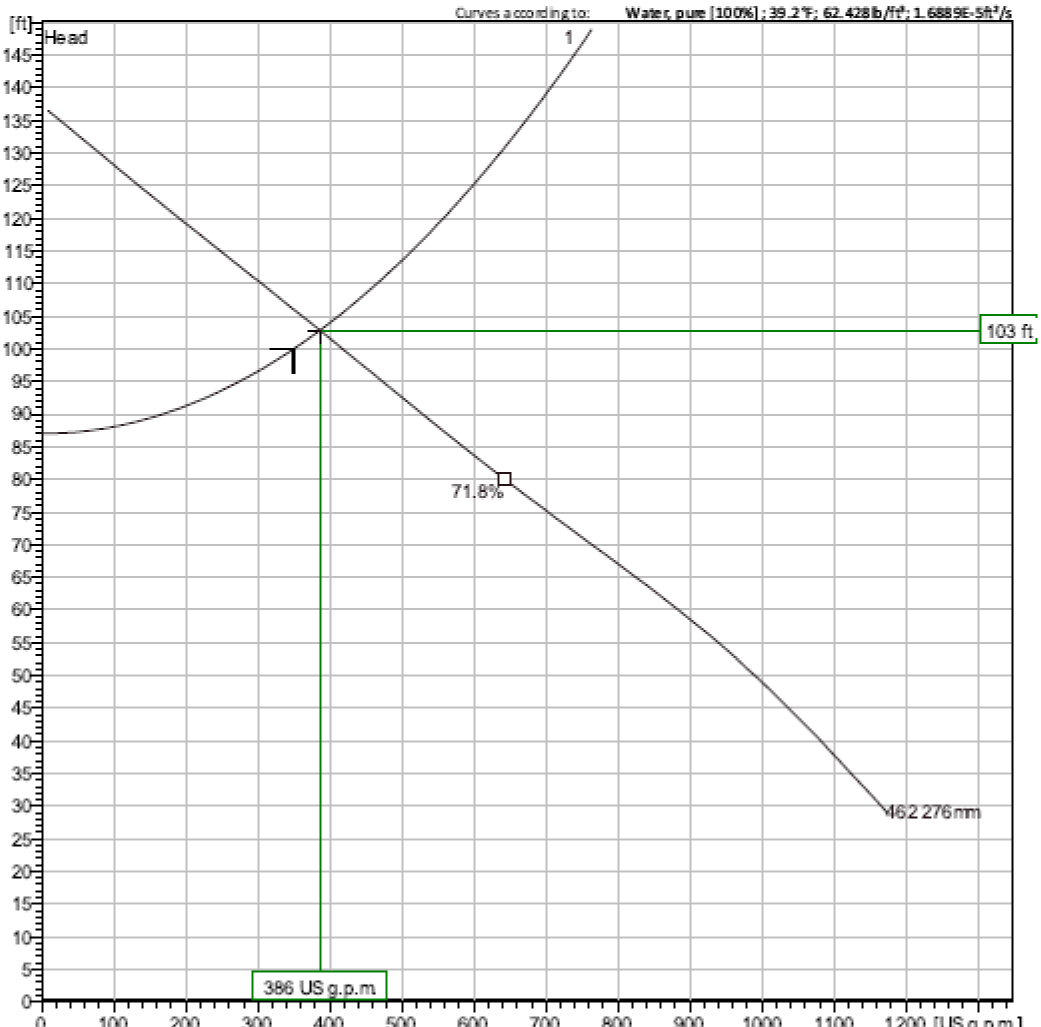
Curve: ISO 9906

Project	Xylect-22174160	Created by			
Block	0	Created on	4/19/2024	Last update	4/19/2024

NP 3153 HT 3~ 462

VFD Analysis

FLYGT
a xylem brand



Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

Operating Characteristics

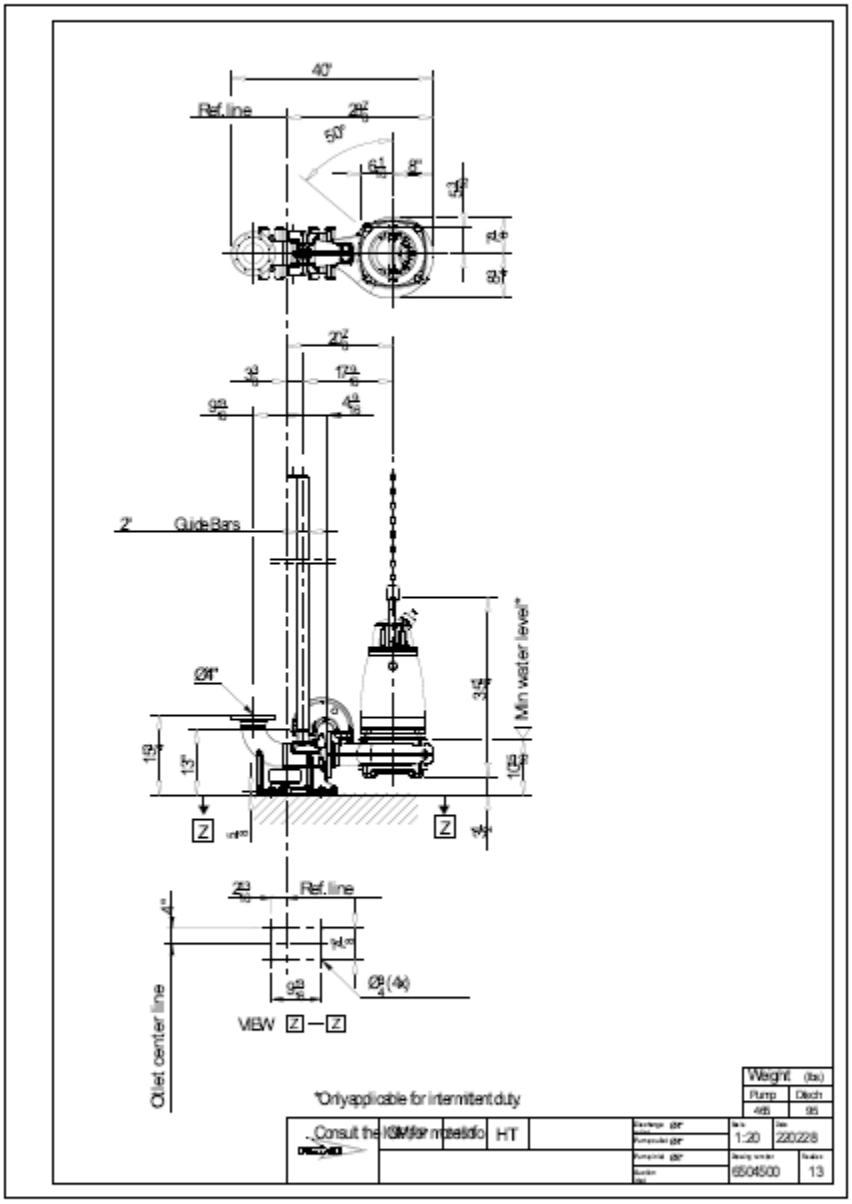
Pumps / Systems	Frequency	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Specific energy	NPSHre
		US g.p.m.	ft	hp	US g.p.m.	ft	hp		kWh/US MG	ft
1	58.5 Hz	386	103	15.8	386	103	15.8	63.7 %	574	13.1

Project	Xylect-22174160	Created by			
Block	0	Created on	4/19/2024	Last update	4/19/2024

Program version | Data version | User group(s)

NP 3153 HT 3~ 462

Dimensional drawing



Project	Xylect-22174160	Created by			
Block	0	Created on	4/19/2024	Last update	4/19/2024

Exhibit 2

Equalization Lagoon Calculations

Basis of Design
Unionville North - Cell #2
Basis of Design - Lagoon Volume Calculator
May 2024

Existing Cell No. 2 - Full Capacity - Flow Equilization Lagoon

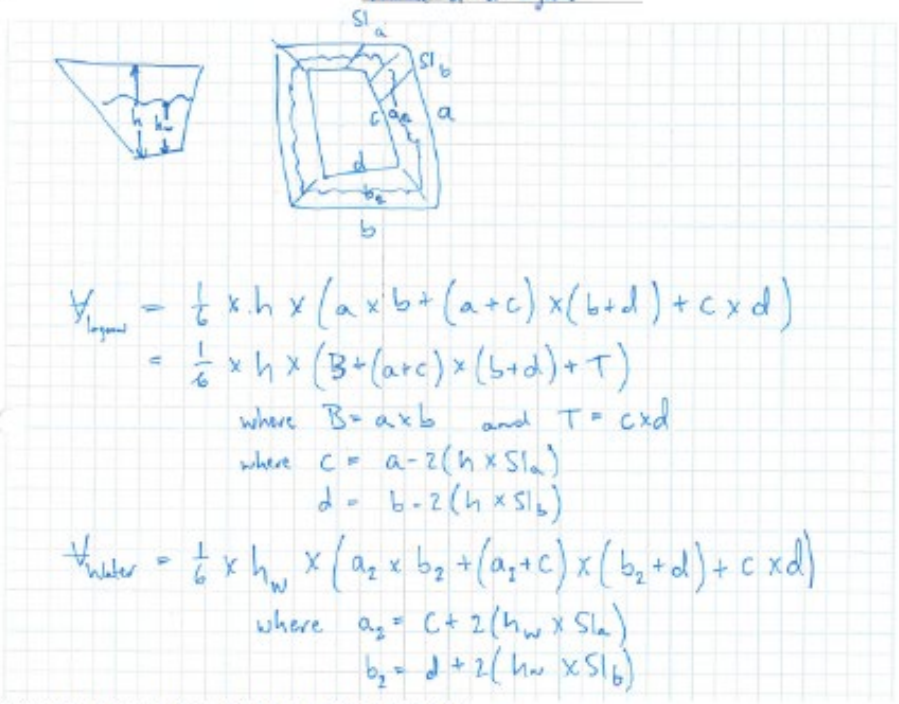
Lagoon Geometries	In Feet		Volume of Lagoon	Volume of Water	Dimension
Length (a)	580		6,084,939	3,764,976	Gallons
Width (b)	190		813,438	503,304	Ft^3
Depth of Lagoon (h)	9		18.67	11.55	acre-feet
Depth of Water (h_w)	6		30,127	18,640.89	CY
Side Slope (run/rise) (Sl_b)	3				
End Slope (run/rise) (Sl_a)	3				
Baffle Wall includes (%)	100%				
				cross check	813,438
					813,438
(c)	526				
(d)	136			Water Surface Acreage	2.37
(a_2)	562				
(b_2)	172				100% of the first cell

BY ELD DATE 12/16
CHKD BY _____ DATE _____

BENTON AND ASSOCIATES, INC.
CONSULTING ENGINEERS / LAND SURVEYORS
JACKSONVILLE, ILLINOIS

SHEET NO. _____ OF _____
JOB NO. _____

Volume of a lagoon



$$V_{lagoon} = \frac{1}{6} \times h \times \left(a \times b + (a+c) \times (b+d) + c \times d\right)$$

$$= \frac{1}{6} \times h \times \left(B + (a+c) \times (b+d) + T\right)$$

where $B = a \times b$ and $T = c \times d$

where $c = a - 2(h \times Sl_a)$

$d = b - 2(h \times Sl_b)$

$$V_{water} = \frac{1}{6} \times h_w \times \left(a_2 \times b_2 + (a_2+c) \times (b_2+d) + c \times d\right)$$

where $a_2 = c + 2(h_w \times Sl_a)$

$b_2 = d + 2(h_w \times Sl_b)$

P:\20E3430\Design\Design\[Unionville Design Calculations 4-21-22.xlsx]North Cell #2

Exhibit 3

South WWTF Site Plan

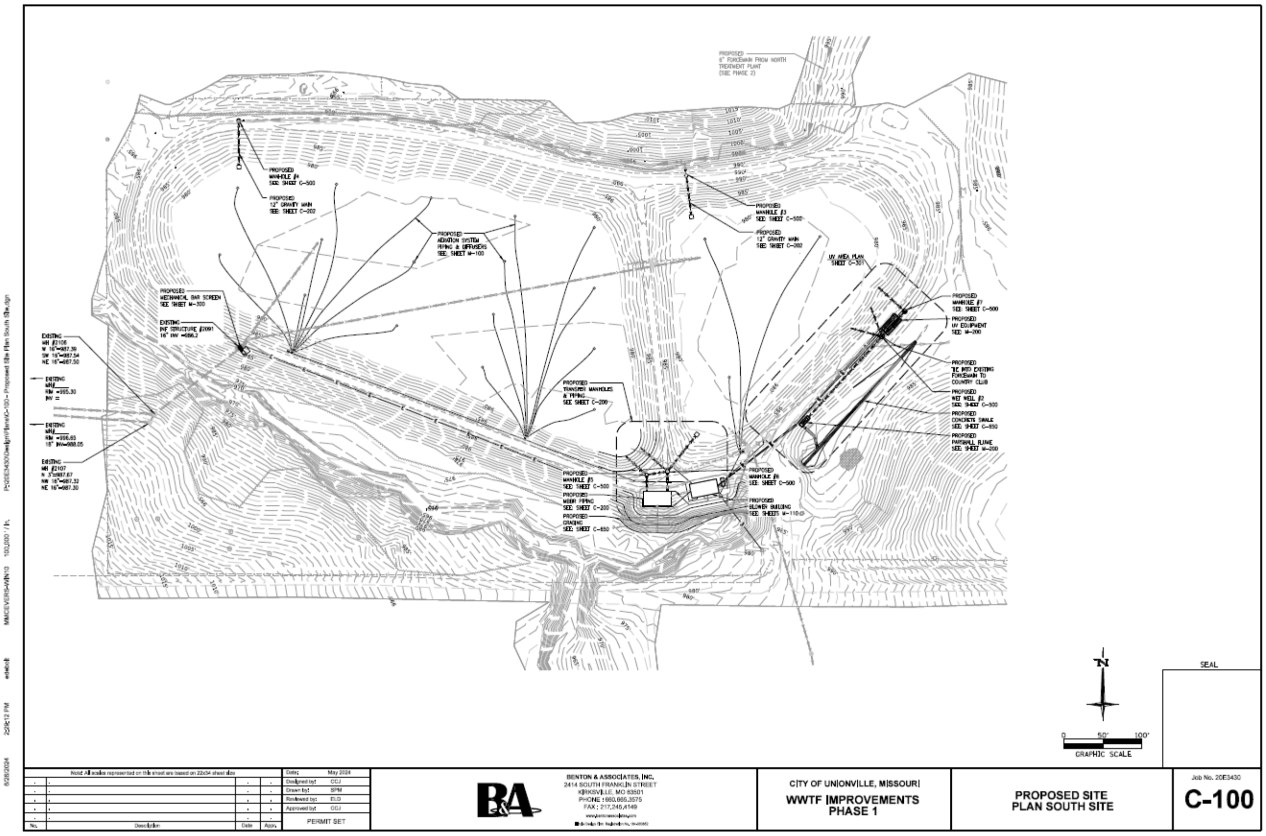

SEAL
0 50' 100'
GRAPHIC SCALE
Note: All scales represented on this sheet are based on 22x34 sheet size
No. Description Date Appr.
Date: May 2024
Designed by: CCJ
Drawn by: SPM
Reviewed by: ELO
Approved by: CCJ
PERMIT SET
BENTON & ASSOCIATES, INC.
2414 SOUTH FRANKLIN STREET
KIRKSVILLE, MO 63501
PHONE : 660.665.3575
FAX : 217.245.4149
CITY OF UNIONVILLE, MISSOURI
WWTF IMPROVEMENTS
PHASE 1
PROPOSED SITE
PLAN SOUTH SITE
Job No. 20E3430
C-100

Exhibit 4

Lagoon Volume Calculations

Basis of Design
Unionville South - Cell #1
Basis of Design - Lagoon Volume Calculator
May 2024

Existing Cell No. 1

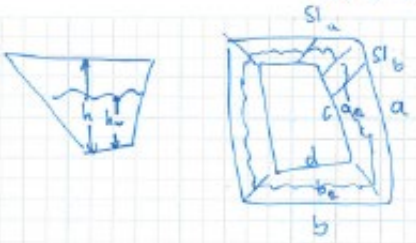
Lagoon Geometries	In Feet		Volume of Lagoon	Volume of Water	Dimension
Length (a)	610		9,164,415	6,643,061	Gallons
Width (b)	285		1,225,104	888,048	Ft^3
Depth of Lagoon (h)	8		28.12	20.39	acre-feet
Depth of Water (h_w)	6		45,374	32,890.67	CY
Side Slope (run/rise) (Sl_b)	3				
End Slope (run/rise) (Sl_a)	3				
Baffle Wall includes (%)	100%				
				cross check	1,225,104
					1,225,104
(c)	562				
(d)	237			Water Surface Acreage	3.87
(a_2)	598				
(b_2)	273				100% of the first cell

BY ECD DATE 12/16
CHKD BY _____ DATE _____

BENTON AND ASSOCIATES, INC.
CONSULTING ENGINEERS / LAND SURVEYORS
JACKSONVILLE, ILLINOIS

SHEET NO. _____ OF _____
JOB NO. _____

Volume of a Lagoon



$$\forall_{lagoon} = \frac{1}{6} \times h \times \left(a \times b + (a+c) \times (b+d) + c \times d\right)$$

$$= \frac{1}{6} \times h \times \left(B + (a+c) \times (b+d) + T\right)$$

where $B = a \times b$ and $T = c \times d$

where $c = a - 2(h \times Sl_a)$

$d = b - 2(h \times Sl_b)$

$$\forall_{water} = \frac{1}{6} \times h_w \times \left(a_2 \times b_2 + (a_1+c) \times (b_2+d) + c \times d\right)$$

where $a_2 = c + 2(h_w \times Sl_a)$

$b_2 = d + 2(h_w \times Sl_b)$

P:\20E3430\Design\Design\[Unionville Design Calculations 4-21-22.xlsx]South Cell #1

Basis of Design
Unionville South WWTP - Cell #2
Basis of Design - Lagoon Volume Calculator
May 2024

Existing Cell No. 2

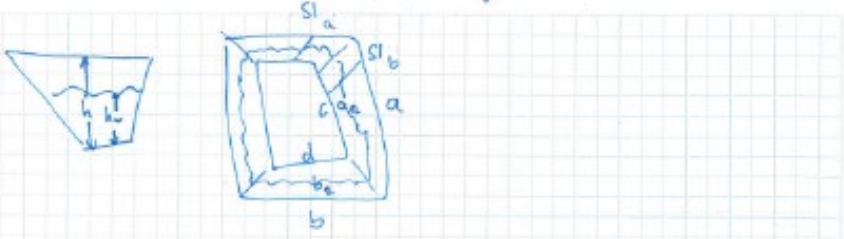
Lagoon Geometries	In Feet		Volume of Lagoon	Volume of Water	Dimension
Length (a)	280		3,933,437	2,810,042	Gallons
Width (b)	280		525,824	375,648	Ft^3
Depth of Lagoon (h)	8		12.07	8.62	acre-feet
Depth of Water (h_w)	6		19,475	13,912.89	CY
Side Slope (run/rise) (Sl_b)	3				
End Slope (run/rise) (Sl_a)	3				
Baffle Wall includes (%)	100%				
				cross check	525,824
					525,824
(c)	232				
(d)	232			Water Surface Acreage	1.72
(a_2)	268				
(b_2)	268				100% of the first cell

BY ECD DATE 12/16
CHKD BY _____ DATE _____

BENTON AND ASSOCIATES, INC.
CONSULTING ENGINEERS / LAND SURVEYORS
JACKSONVILLE, ILLINOIS

SHEET NO. _____ OF _____
JOB NO. _____

Volume of a Lagoon



$$\forall_{lagoon} = \frac{1}{6} \times h \times \left(a \times b + (a+c) \times (b+d) + c \times d\right)$$

$$= \frac{1}{6} \times h \times \left(B + (a+c) \times (b+d) + T\right)$$

where $B = a \times b$ and $T = c \times d$

where $c = a - 2(h \times Sl_a)$

$d = b - 2(h \times Sl_b)$

$$\forall_{water} = \frac{1}{6} \times h_w \times \left(a_2 \times b_2 + (a_2+c) \times (b_2+d) + c \times d\right)$$

where $a_2 = c + 2(h_w \times Sl_a)$

$b_2 = d + 2(h_w \times Sl_b)$

P:\20E3430\Design\Design\[Unionville Design Calculations 4-21-22.xlsx]South Cell #2

Exhibit 5

Golf Course Irrigation Pump Calculations

Computation of Total Dynamic Head for irrigation pond influent sump pump

		Flowrate	=	60 gpm	
		Diameter of Suction Piping	=	2.047 in.	
		Diameter of Effluent Piping	=	2.047 in.	
		Friction Coefficient (inside wet well) "C"	=	130	
		Friction Coefficient (force main) "C"	=	130	
A.		Static Suction Lift	=	1 ft.	
B.		Friction, Suction			
	1.	Pipe Total Length	=	1 ft.	
	2.	Fittings in Eq. Length of Pipe			
		a. 2" 90 degree elbows	=	4 ft.	1 @ at 4' each
		b. 2" check valve	=	13.4 ft.	1 @ at 13.4' each
		c.	=	ft.	
	3.	Total Pipe Equivalent	=	18.4 ft.	
	4.	Total Friction Loss	=	1.40 ft.	
C.		Total Dynamic Suction Lift	=	2.40 ft.	
		Use (rounded up)	=	**3.00 ft.**	
D.		Static Discharge Head	=	25 ft.	
E.		Friction, Discharge or Force Main Line			
	1.	Pipe Total Length	=	850 ft.	
	2.	Fittings in Eq. Length of Pipe			
		a. 2" 90 degree elbows	=	36 ft.	9 @ at 4' each
		b. 2" meter	=	3 ft.	
		c. 2" 45 degree elbow	=	4 ft.	2 @ 2' each
		d. 2" ball valve	=	3 ft.	2 @ 1.5' each
	3.	Total Pipe Equivalent	=	896 ft.	
	4.	Total Friction Loss	=	**68.16 ft.**	
F.		Total Dynamic Discharge Head	=	93.16 ft.	
		Use (rounded up)	=	**94.00 ft.**	
G.		**Total Dynamic Head (TDH)**	=	**97 ft.**	

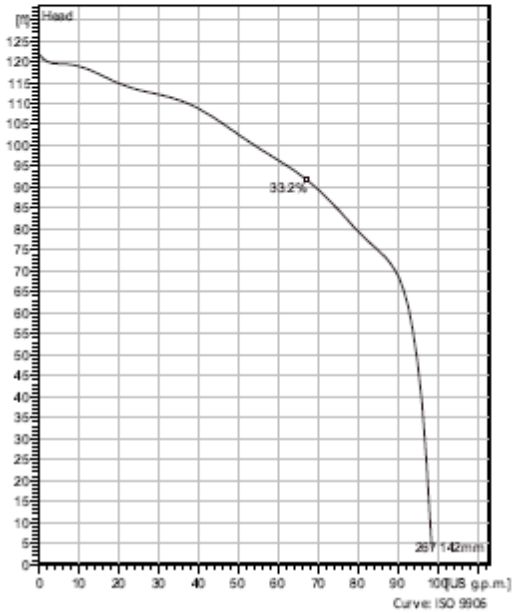
MP 3102 HT 3~ 267

Semi-open multi-channel impellers with integral grinder cutter in single volute casing for liquids containing solids and fibres.

FLYGT
a xylem brand

Technical specification

Curves according to: Water, pure Water, pure [100%],39.2 °F,62.42 lb/ft³,1.6891E-5 ft²/s



Curve: ISO 9906

Nominal (mean) data shown. Under- and overperformance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

Configuration

Motor number
M3102.170 18-10-2AL-W 6hp

Installation type
P - Semi permanent, Wet

Impeller diameter
142 mm

Discharge diameter
1 1/2 inch

Pump information

Impeller diameter
142 mm

Discharge diameter
1 1/2 inch

Inlet diameter
40 mm

Maximum operating speed
3455 rpm

Number of blades
6

Max. fluid temperature
40 °C

Material

Impeller
Grey cast iron

Stator housing material
Grey cast iron

Project	Xylect-2224895	**Created by**	Tyler Menzel		
Block		**Created on**	4/30/2024	**Last update**	4/30/2024

MP 3102 HT 3~ 267

Technical specification

FLYGT a xylem brand

Motor - General

Motor number M3102.170 18-10-2AL-W 6hp	**Phases** 3~	**Rated speed** 3455 rpm	**Rated power** 5 hp
ATEX approved No	**Number of poles** 2	**Rated current** 7.5 A	**Stator variant** 12
Frequency 60 Hz	**Rated voltage** 460 V	**Insulation class** H	**Type of Duty** S1
Version code 170			

Motor - Technical

Power factor - 1/1 Load 0.94	**Motor efficiency - 1/1 Load** 79.6 %	**Total moment of inertia** 0.332 lb ft²	**Starts per hour max.** 30
Power factor - 3/4 Load 0.93	**Motor efficiency - 3/4 Load** 80.6 %	**Starting current, direct starting** 56 A	
Power factor - 1/2 Load 0.91	**Motor efficiency - 1/2 Load** 79.0 %	**Starting current, star-delta** 18.7 A	

Project	Xylect-2224895	**Created by**	Tyler Menzel		
Block		**Created on**	4/30/2024	**Last update**	4/30/2024

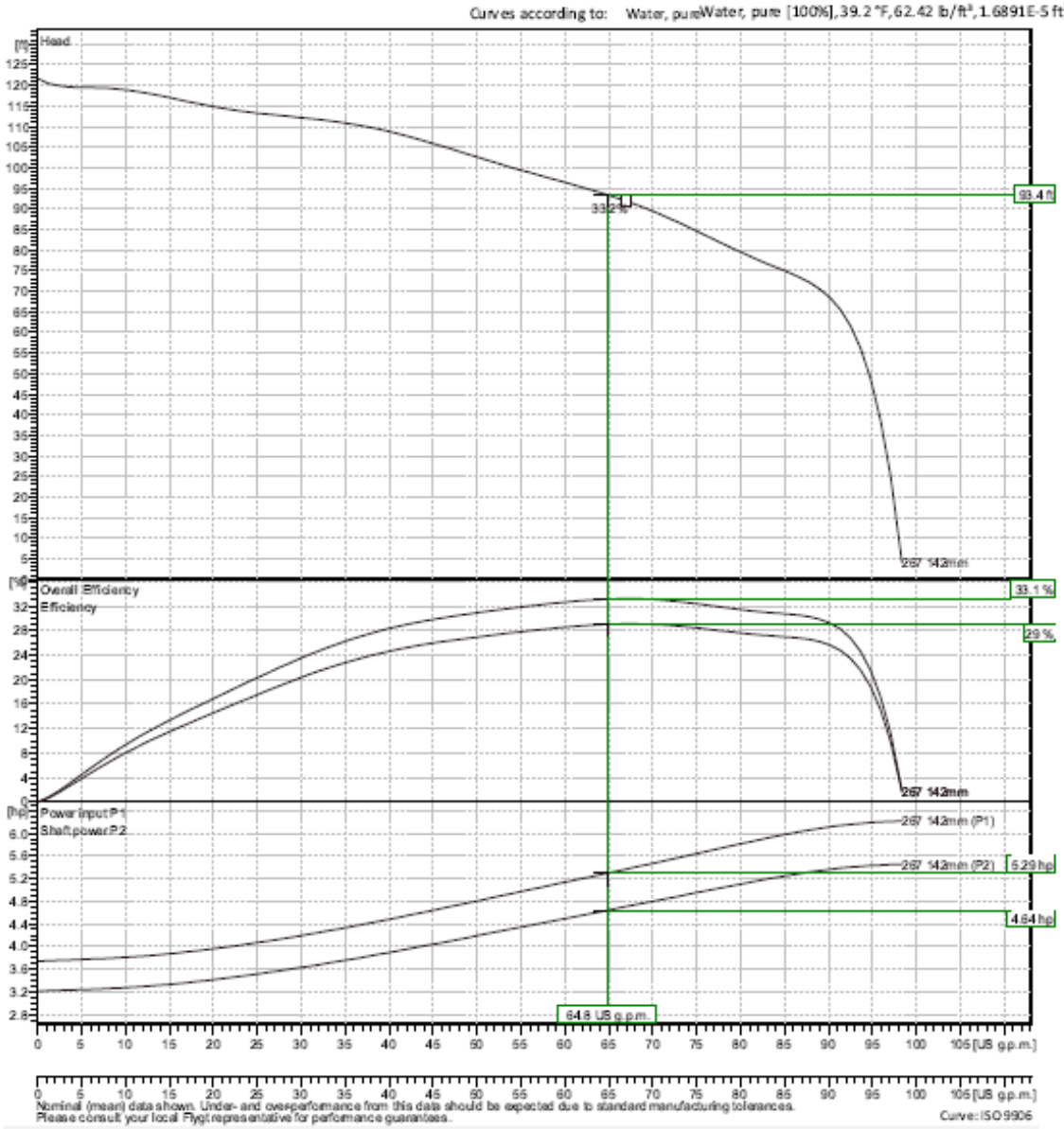
MP 3102 HT 3~ 267

Performance curve

Duty point

Flow	Head
64.8 US g.p.m.	93.4 ft

Curves according to: Water, pureWater, pure [100%], 39.2 °F, 62.42 lb/ft³, 1.6891E-5 ft²/s



Nominal (mean) data shown. Under- and overperformance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

Curve: ISO 9906

Xylect-2224895

Tyler Menzel

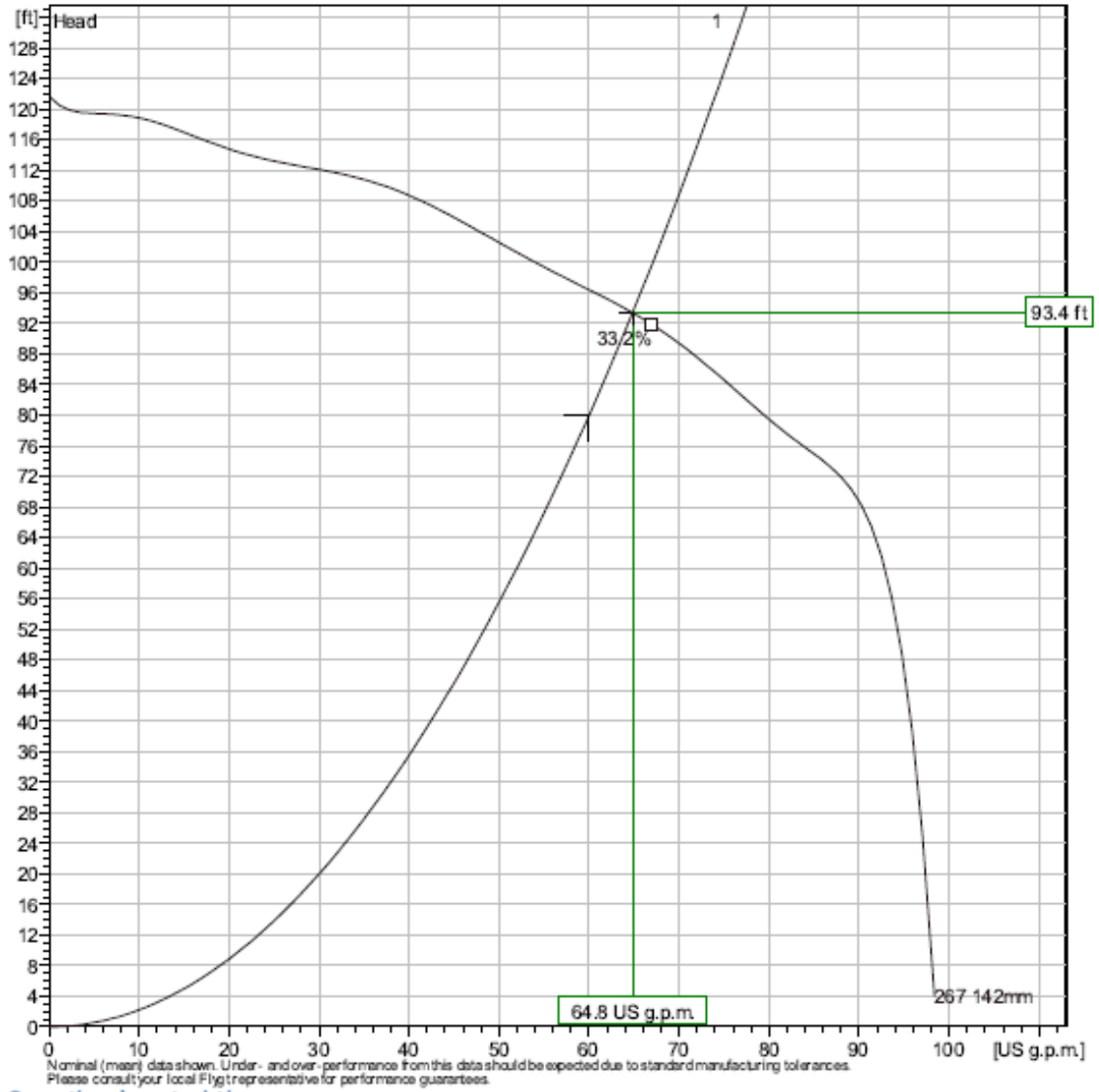
Created on 4/30/2024 **Last update** 4/30/2024

MP 3102 HT 3~ 267

Duty Analysis

FLYGT a xylem brand

Curves according to: Water, pure [100%] ; 39.2°F; 62.42lb/ft³; 1.6891E-5ft²/s



Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

Operating characteristics

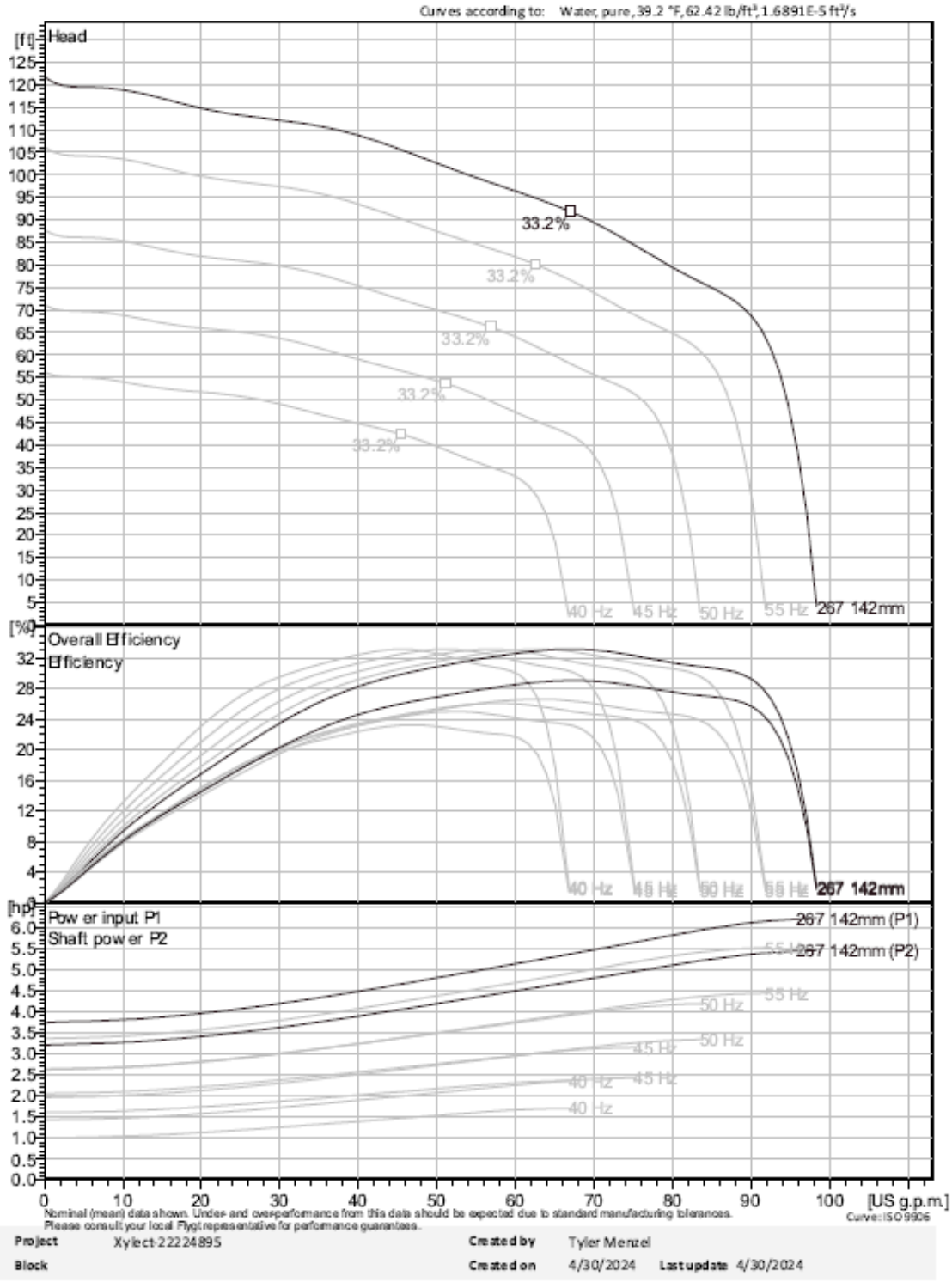
Pumps / Systems	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Spec. Energy	NPSHre
	US g.p.m.	ft	hp	US g.p.m.	ft	hp		kWh/US MG	ft
1	64.8	93.4	4.64	64.8	93.4	4.64	33.1 %	1010	

Project		Created by	Tyler Menzel		
Block	Xylect-2222495	Created on	4/30/2024	Last update	4/30/2024

MP 3102 HT 3~ 267

VFD Curve

FLYGT
a xylem brand



Nominal (mean) data shown. Under- and overperformance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

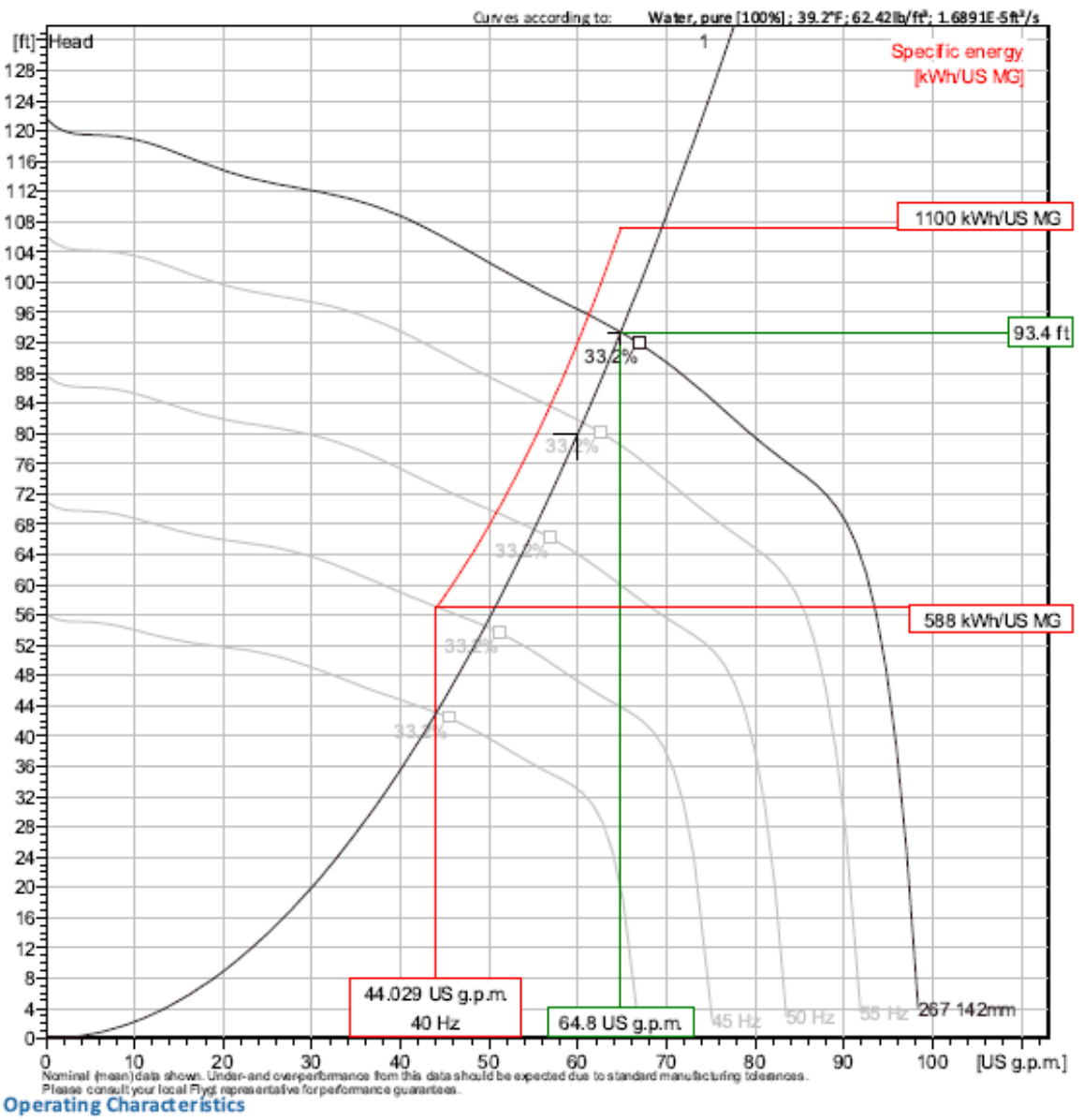
Curve: ISO 9906

Project	Xylect 2224895	Created by	Tyler Menzel
Block		Created on	4/30/2024 Last update 4/30/2024

MP 3102 HT 3~ 267

VFD Analysis

FLYGT
a xylem brand



Nominal (mean) data shown. Under- and overperformance from this data should be expected due to standard manufacturing tolerances. Please consult your local Flygt representative for performance guarantees.

Operating Characteristics

Pumps / Systems	Frequency	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Specific energy	NPSHre
		US g.p.m.	ft	hp	US g.p.m.	ft	hp		kWh/US MG	ft
1	58.9 Hz	64.8	93.4	4.64	64.8	93.4	4.64	33.1 %	1010	
1	55 Hz	60.5	81.5	3.78	60.5	81.5	3.78	33.1 %	966	
1	50 Hz	55	67.3	2.84	55	67.3	2.84	33.1 %	815	
1	45 Hz	49.5	54.5	2.07	49.5	54.5	2.07	33.1 %	690	

Project	Xylect-22224895	Created by	Tyler Menzel		
Block		Created on	4/30/2024	Last update	4/30/2024

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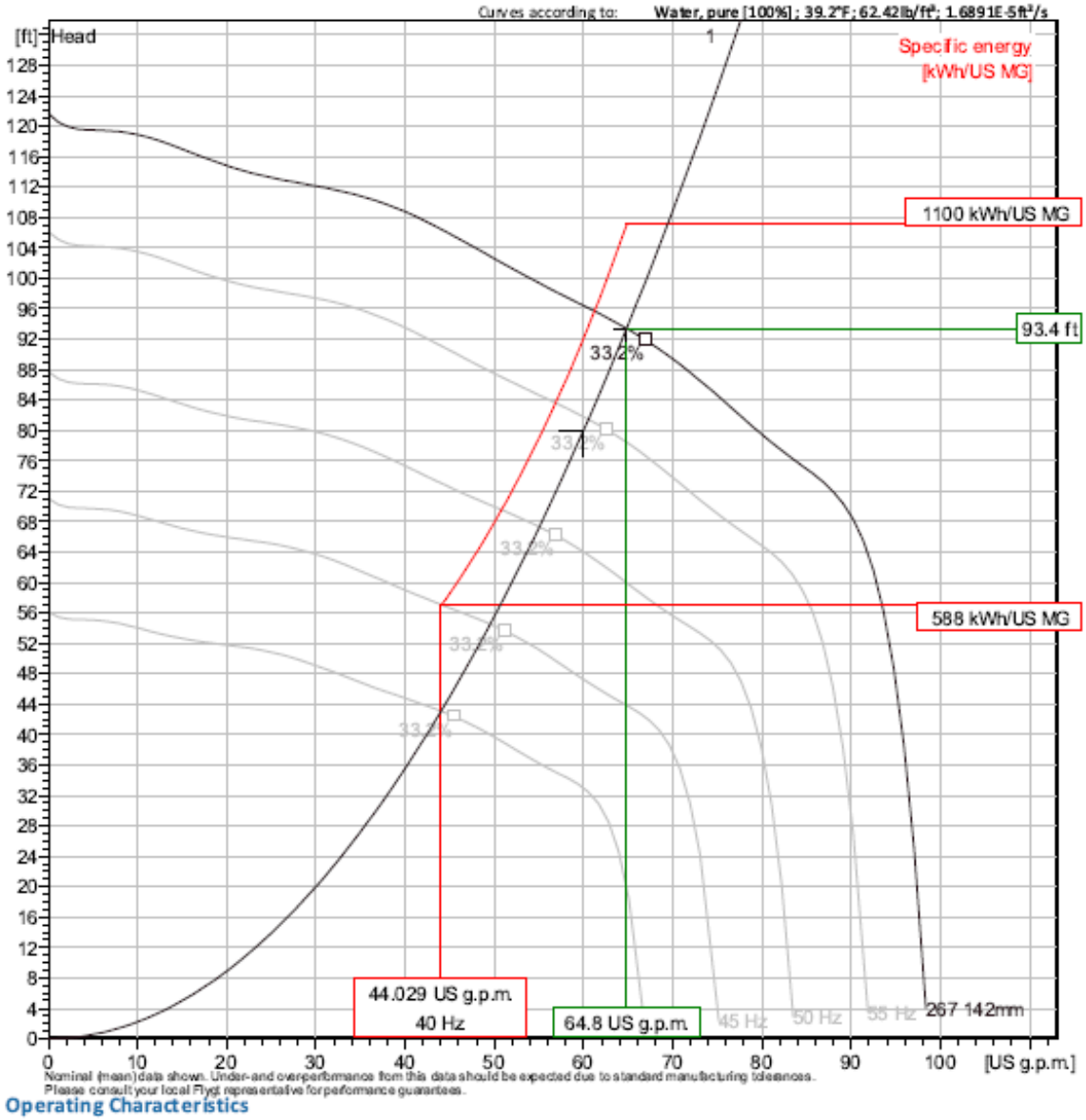
VFD Analysis

FLYGT
a xylem brand



Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

Operating Characteristics

Pumps / Systems	Frequency	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Specific energy	NPSHre
		US g.p.m	ft	hp	US g.p.m.	ft	hp		kWh/US MG	ft
1	40 Hz	44	43.1	1.45	44	43.1	1.45	33.1 %	588	

Project	Xylect-2222495	Created by	Tyler Menzel		
Block		Created on	4/30/2024	Last update	4/30/2024

MP 3102 HT 3~ 267

Dimensional drawing

FLYGT
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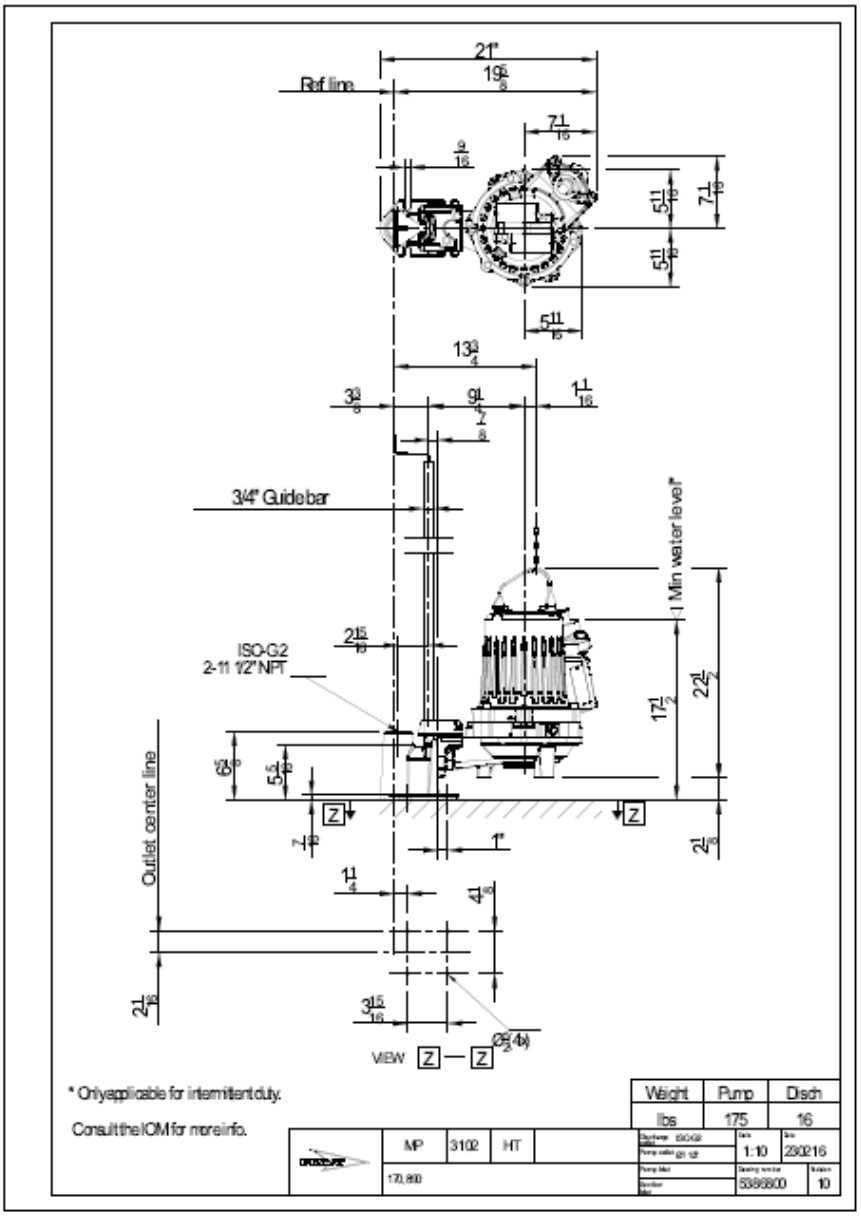


Project	Xylect-22224895	Created by	Tyler Menzel
Block		Created on	4/30/2024 Last update 4/30/2024

Antidegradation

Water Quality and Antidegradation Review

For the Protection of Water Quality
and Determination of Effluent Limits for Discharge to

The Unnamed Tributary to South Blackbird Creek
by
The City of Unionville
Unionville South Wastewater Treatment Facility Expansion

October 2022

Table of Contents

1. PERMIT LIMITS AND MONITORING INFORMATION

Proposed Monitoring Parameters and Effluent Limits

PARAMETER	Unit	Basis for Limits	Daily Maximum	Weekly Average	Monthly Average	Previous Permit Limit	Sampling Frequency	Reporting Frequency	Sample Type
Flow	MGD	FSR	*		*	*/*	once/ month	once/ month	24 hr. estimate
BOD_5	mg/L	FSR		45	30	65/45	once/ month	once/ month	grab
TSS	mg/L	FSR		45	30	110/70	once/ month	once/ month	grab
Escherichia coli	#/100mL	FSR		1,030	206	1,030/206	once/week	once/ month	grab
Ammonia as N									
(January)			12.1		3.1	9.1/2.8			
(February)			10.1		2.7	9.1/2.8			
(March)			10.1		2.7	9.1/2.8			
(April)			10.1		2.3	4.4/1.4			
(May)			12.1		1.9	4.4/1.4	once/ month	once/ month	grab
(June)	mg/L	WQBEL	12.1		1.5	4.4/1.4			
(July)			10.1		1.1	4.4/1.4			
(August)			12.1		1.3	4.4/1.4			
(September)			12.1		1.7	4.4/1.4			
(October)			12.1		2.6	9.1/2.8			
(November)			12.1		3.1	9.1/2.8			
(December)			10.1		2.7	9.1/2.8			
Oil & Grease	mg/L	FSR	15		10	15/10	once/ quarter	once/ quarter	grab
Total Phosphorus	mg/L	FSR	*		*	*/*	once/ quarter	once/ quarter	grab
Total Kjeldahl Nitrogen	mg/L	FSR	*		*	**	once/ quarter	once/ quarter	grab
Nitrite + Nitrate	mg/L	FSR	*		*	**	once/ quarter	once/ quarter	grab

PARAMETER	Unit	Basis for Limits	Minimum		Maximum	Previous Permit Limit	Sampling Frequency	Reporting Frequency	Sample Type
pH	SU	FSR	6.5			≥6.5	once/ month	once/ month	grab

PARAMETER	Unit	Basis for Limits	Daily Minimum		Monthly Avg. Min	Previous Permit Limit	Sampling Frequency	Reporting Frequency	Sample Type
BOD_5 Percent Removal	%	FSR			85	65	once/ month	once/ month	calculated
TSS Percent Removal	%	FSR			85	65	once/ month	once/ month	calculated

* - Monitoring requirement only

** - Parameter not previously established in previous state operating permit.

Basis for Limitations Codes:

MDEL – Minimally Degrading Effluent Limit
NDEL – Non-Degrading Effluent Limit
PEL – Preferred Effluent Limit
TBEL – Technology-Based Effluent Limit
WQBEL – Water Quality-Based Effluent Limit
FSR – Federal or State Regulation

2. PURPOSE OF ANTIDEGRADATION REVIEW REPORT

The Unionville South Wastewater Treatment Facility (WWTF) is a 132,000 gallon per day (gpd) facility receiving actual flows of about 210,000 gpd based on Discharge Monitoring Report (DMR) data from the past five years of operation. The facility currently includes a two-cell lagoon and two overland flow fields. Sludge is stored in the lagoon and pumped out as necessary. Benton & Associates, Inc. prepared, on behalf of the City of Unionville, the *City of Unionville Antidegradation Review Report,* which outlines the proposed expansion to the facility. As a result of the expansion, the design flow will be increased to 242,000 gpd. Six alternatives were analyzed, including regionalization, land application, and four discharging alternatives. The preferred alternative involves shutting down the Unionville North WWTF and consolidating flows to the Unionville South WWTF. Upgrades would then be provided at the South facility, including the addition of aeration in the lagoon, construction of a moving bed biofilm reactor (MBBR), and addition of UV disinfection to the treatment system.

The applicant elected to assume that all pollutants of concern (POC) significantly degrade the receiving stream in the absence of existing water quality. An alternatives analysis was conducted to fulfill the requirements of the Antidegradation Implementation Policy (AIP).

3. FACILITY INFORMATION

Facility Name:	Unionville South WWTF
Address:	180th Street 0.4 miles east of 8th Street, Unionville, MO 63565
Permit #:	MO-0026646
County:	Putnam
Facility Type:	POTW
Owner:	The City of Unionville
Continuing Authority:	Same as Owner
UTM Coordinates:	X = 501471 ; Y = 4480092
Legal Description:	NE ¼, NW ¼, Sec. 1, T65N, R19W
Ecological Drainage Unit:	Central Plains/Grant/Chariton

4. FACILITY HISTORY

The facility was last inspected on January 9, 2018, by Leland Maize, and it was determined that at the time of the inspection, the facility was out of compliance with the Missouri Clean Water Law and MSOP MO-0026646. The following violations were listed in the inspection report, not including effluent limitation exceedances, which are discussed in the *Facility Performance History* section:

- Failure to submit an eDMR Permit Holder and Certifier Registration Form, as required by Special Condition #1 of the operating permit.
- Failure to develop and implement a program for maintenance and repair of the collection system, as required by Special Condition #10 of the operating permit.
- Failure to maintain an Operation and Maintenance Manual, as required by Special Condition #15 of the operating permit.
- Failure to provide a lagoon level gauge that clearly marks the minimum freeboard level in each lagoon cell, as required by Special Condition #18 of the operating permit.

A. FACILITY PERFORMANCE HISTORY:

A review of the past five years of Discharge Monitoring Report data shows that the facility generally performs well but has recorded exceedances in the following parameters: TSS (03/2019), TSS Percent Removal (09/2019), and pH (09/2019). The facility is currently under a schedule of compliance for effluent limitations for ammonia and *E. coli*, which states the facility shall attain compliance with the new limitations no later than August 1, 2023.

B. RECEIVING WATERBODY INFORMATION

OUTFALL(S) TABLE:

OUTFALL	DESIGN FLOW (CFS)	TREATMENT LEVEL	EFFLUENT TYPE
001	0.38	Secondary	Domestic

RECEIVING STREAM(S) TABLE:

WATER-BODY NAME	CLASS	WBID	DESIGNATED USES*	12-DIGIT HUC	DISTANCE TO CLASSIFIED SEGMENT (MI)
100K Extent-Remaining Streams	C	3960	AQL, WBC-B, SCR, HHP, IRR, LWW	10280201-0503	Direct Discharge

* Protection of Warm Water Aquatic Life (AQL), Cold Water Fishery (CDF), Cool Water Fishery (CLF), Whole Body Contact Recreation – Category A (WBC-A), Whole Body Contact Recreation – Category B (WBC-B), Secondary Contact Recreation (SCR), Human Health Protection (HHP), Irrigation (IRR), Livestock & Wildlife Watering (LWW), Drinking Water Supply (DWS), Industrial (IND), Groundwater (GRW).

RECEIVING STREAM(S) LOW-FLOW VALUES:

RECEIVING STREAM	LOW-FLOW VALUES (CFS)		
	1Q10	7Q10	30Q10
100K Extent-Remaining Stream	0.0	0.0	0.0

Receiving Water Body Segment Outfall #1:		
Upper end segment* UTM coordinates:	X = 501468 ; Y = 4480091	outfall
Lower end segment* UTM coordinates:	X = 502051 ; Y = 4476428	downstream confluence

*Segment is the portion of the stream where discharge occurs. Segment is used to track changes in assimilative capacity and is bound at a minimum by existing sources and confluences with other significant water bodies.

A Geohydrologic Evaluation was submitted with the request and the receiving stream is gaining for discharge purposes (see Appendix B).

C. EXISTING WATER QUALITY

No existing water quality data was submitted, and all pollutants of concern are assumed to be Tier 2. The facility discharges to a tributary to South Blackbird Creek. South Blackbird Creek is on the 303(d) list for total ammonia, but well downstream of the outfall.

D. MIXING CONSIDERATIONS

MIXING CONSIDERATIONS
Mixing Zone: Not Allowed [10 CSR 20-7.031(5)(A)4.B.(I)(a)].
Zone of Initial Dilution: Not Allowed [10 CSR 20-7.031(5)(A)4.B.(I)(b)].

5. RECEIVING WATER MONITORING REQUIREMENTS

No receiving water monitoring requirements recommended at this time.

6. ANTIDEGRADATION REVIEW INFORMATION

In accordance with Missouri's Water Quality Standard [10 CSR 20-7.031(3)] and federal antidegradation policy at Title 40 Code of Federal Regulation (CFR) Section 131.12 (a), the department developed a statewide antidegradation policy and corresponding procedures to implement the policy. A proposed discharge to a water body will be required to undergo a level of Antidegradation Review, which documents that the use of a water body's available assimilative capacity is justified. Effective August 30, 2008, and revised July 13, 2016, a facility is required to use Missouri's AIP for new and expanded wastewater discharges.

The AIP specifies that if the proposed activity results in significant degradation then a demonstration of necessity (i.e., alternatives analysis) and a determination of social and economic importance are required.

The following is a review of the *City of Unionville Antidegradation Review Report* dated August 10, 2022.

A. TIER DETERMINATION
Waterbodies are assigned Tier 1, 2, or 3 protection levels.

Tier 1 protection is applied to a waterbody on a pollutant by pollutant basis for pollutants may cause or contribute to the impairment of a beneficial use or violation of Water Quality Criteria (WQC); and prohibit further degradation of Existing Water Quality (EWQ) where additional pollutants of concern (POCs) would result in the water being included on the 303(d) List.

Tier 2 level protection is assigned to the waterbody on a pollutant by pollutant basis that prohibits the degradation of water quality of a surface water unless a review of reasonable alternatives and social and economic considerations justifies the degradation in accordance with the methods presented in the AIP.

Tier 3 protection prohibits any degradation of water quality of Outstanding National Resource Waters and Outstanding State Resource Waters as identified in Tables D and E of the Water Quality Standards (WQS). Temporary degradation of water receiving Tier 3 protection may be allowed by the Department on a case-by-case basis as explained in Section VI of the AIP.

Below is a list of POCs reasonably expected and identified by the permittee in their application to be in the discharge. Pollutants of concern are defined as those pollutants "proposed for discharge that affect beneficial use(s) in waters of the state." They include pollutants that "create conditions unfavorable to beneficial uses in the water body receiving the discharge or proposed to receive the discharge" (AIP, Page 6).

Pollutants of Concern and Tier Determination

Pollutants of Concern	Tier*	Degradation	Comment
Biological Oxygen Demand (BOD_5)/DO	2	Significant	
Total Suspended Solids (TSS)	**	Significant	
Escherichia coli (E. coli)	2	N/A	Schedule of Compliance
Ammonia as N	2	Significant	Schedule of Compliance
Oil & Grease	2	N/A	Permit Limits Applied
Phosphorus, Total	2	N/A	Permit Limits Applied
Nitrogen, Total	2	N/A	Permit Limits Applied
pH	***	N/A	Permit Limits Applied

* Tier assumed.
** Tier determination not possible: No in-stream standards for these parameters.
*** Standards for these parameters are ranges.

Tier 1 Review

South Blackbird Creek was added to the EPA's Approved Section 303(d) Listed Waters in 2006. The creek is considered impaired with respect to total ammonia due to unknown sources, and a total maximum daily load (TMDL) has not yet been developed. However, this impairment occurs over 4 miles downstream of the discharge.

According to the AIP, the waters may receive the POCs that are causing impairments if 1) the discharge would not cause or contribute to a violation of the WQS, 2) all other conditions of the state permitting requirements are met (i.e., no discharge options are explored and technology based requirements (including ELGs) are met); and 3) the permit is issued with the highest statutory and regulatory requirements.

B. NECESSITY OF DEGRADATION

The AIP specifies that if the proposed activity does result in significant degradation then a demonstration of necessity (i.e., alternatives analysis) and a determination of social and economic importance are required. Part of that analysis as shown below is the evaluation of non-degrading alternatives, such as regionalization or no discharge systems.

The applicant has the option of assuming discharge will be significant and proceeding directly to the alternatives analysis, thereby avoiding the determination of the assimilative capacity of the receiving water. The applicant has elected this option.

i. Regionalization
Regionalization eliminates the need for a discharge permit by sending flows to a capable regional facility. The nearest facilities capable of accepting the flows are approximately 20 miles away, making this alternative economically inefficient and impracticable. The engineer's opinion of the probable costs is approximately $12.7 million, which is considerably more expensive than discharging alternatives. The applicant also cites the extensive need for easements, crossing of rivers and highways, and concerns of wastewater becoming septic in the pipes as disadvantages of the regionalization alternative.

ii. No Discharge Evaluation
Land application was evaluated by the applicant as a no-discharge alternative. The large amount of land area needed (approximately 325 acres), the fact that soil near the site is not ideal for application, concerns with maintaining proper setback distances, and the need to construct storage for winter months were all cited as reasons making land application impracticable.

iii. Alternatives to No discharge
Four discharging alternatives were evaluated and are discussed below.

Alternative 1 – Aerated Lagoon and MBBR (Combined North + South Facilities) [Base Case]
For the first discharging alternative, the Unionville North WWTF would be abandoned, and flows would be diverted to the expanded Unionville South WWTF. This alternative, which serves as the base case, involves the addition of aeration in the lagoon, an MBBR following the first lagoon cell and prior to the second, and UV disinfection to the treatment system. This alternative was selected as the preferred alternative due to its economic efficiency, practicability, as well as the reliability and low upset potential that is expected.

Alternative 2 – Facultative Lagoons and MBBR (Separate North + South Facilities)
The second discharging alternative would provide an MBBR and UV disinfection for both the North and South facilities, which would maintain independent operations. The lagoons would remain as facultative lagoons. While considered practicable, this alternative is not preferred.

Alternative 3 – Aerated Lagoons and MBBR (Separate North + South Facilities)
The third discharging alternative would involve the same improvements as the first alternative, but the North and South facilities would remain in operation as independent facilities. While considered practicable, this alternative is not preferred.

Alternative 4 – Activated Sludge Plant (Combined North + South Facilities)
For the fourth discharging alternative, the Unionville North WWTF would be abandoned, and flows would be diverted to the Unionville South WWTF, which would convert the existing lagoon treatment system with an activated sludge system. While this alternative is capable of improved effluent quality compared to other discharging alternatives, it is not considered economically efficient and is not preferred.

Alternatives Analysis Comparison

Pollutant	Alternative 1 (Base Case) Aerated Lagoon and MBBR [Combined Facilities]	Alternative 2 Facultative Lagoons and MBBR [Separate Facilities]	Alternative 3 Aerated Lagoons and MBBR [Separate Facilities]	Alternative 4 Activated Sludge Plant [Combined Facilities]
BOD_5	≤ 30 mg/l	≤ 30 mg/l	≤ 30 mg/l	≤ 10 mg/l
TSS	≤ 30 mg/l	≤ 30 mg/l	≤ 30 mg/l	≤ 15 mg/l
Escherichia coli	≤ 206 CFU/100ml	≤ 206 CFU/100ml	≤ 206 CFU/100ml	≤ 206 CFU/100ml
Ammonia as N	≤ 1.1 mg/l	≤ 1.1 mg/l	≤ 1.1 mg/l	≤ 0.5 mg/l
Oil & Grease	≤ 10 mg/l	≤ 10 mg/l	≤ 10 mg/l	≤ 10 mg/l
Total Phosphorus	*	*	*	*
Total Nitrogen	*	*	*	*
pH	≥ 6.5 SU	≥ 6.5 SU	≥ 6.5 SU	≥ 6.5 SU
Construction Cost	$6,856,000	$6,946,000	$7,830,000	$7,761,000
Annual Operating Cost	$127,000	$140,000	$167,000	$280,000
Present Worth**	$8,835,803	$9,128,460	$10,433,363	$12,125,920
Ratio	100%	103%	118%	137%
Economically Efficient?	Y	Y	Y	N
Practicable?	Y	Y	Y	Y
Preferred Alternative?	Y	N	N	N

* monitoring requirement
**Present worth at 20 year design life and 2.5 percent interest

C. SOCIAL AND ECONOMIC IMPORTANCE

The affected community consists of the residents of the City of Unionville. The project proposes to shut down the Unionville North facility and send flows to the South facility, thereby removing a discharger from the watershed of the North Blackbird Creek. This will also lower operation and maintenance costs for the city by consolidating resources into one facility. With the proposed upgrades to the lagoon, the project will also provide a greater level of pollutant reduction.

D. NATURAL HERITAGE REVIEW

A Missouri Department of Conservation Natural Heritage Review was obtained by the applicant. Two species of bats, Indiana and Northern Long-Eared, may be present in the project area. The following recommendations were made for construction activities:

- Revegetate disturbed areas to minimize erosion using native plant species compatible with the local landscape and wildlife needs.
- Manage construction to minimize sedimentation and run-off to nearby streams.
- Where possible leave snags standing and preserve mature forest canopy.
- Do not enter caves known to harbor Indiana bats or Northern long-eared bats.
- At stream and drainage crossings, avoid erosion, silt introduction, petroleum or chemical pollution, and disruption or realignment of stream banks and beds.
- If any trees need to be removed for the project, contact the U.S. Fish and Wildlife Service for coordination under the Endangered Species Act.
- Remove any mud, soil, trash, plants or animals from equipment before leaving any water body or work area.
- Drain water from boats and machinery that have operated in water, checking any water reservoirs
- When possible, wash and rinse equipment thoroughly with hard spray or hot water and dry in the hot sun before using again.

7. DERIVATION AND DISCUSSION OF PARAMETERS AND LIMITS

Wasteload allocations and limits were calculated using two methods:

A. **Water quality-based** – Using water quality criteria or water quality model results and the dilution equation below:

$$C = \frac{(C_s \times Q_s) + (C_e \times Q_e)}{(Q_e + Q_s)}$$ (EPA/505/2-90-001, Section 4.5.5)

Where C = downstream concentration
C_s = upstream concentration
Q_s = upstream flow
C_e = effluent concentration
Q_e = effluent flow

Chronic wasteload allocations were determined using applicable chronic water quality criteria (CCC: criteria continuous concentration) and stream volume of flow at the edge of the mixing zone (MZ). Acute wasteload allocations were determined using applicable water quality criteria (CMC: criteria maximum concentration) and stream volume of flow at the edge of the zone of initial dilution (ZID).

Water quality-based maximum daily and average monthly effluent limitations were calculated using methods and procedures outlined in USEPA's "Technical Support Document For Water Quality-based Toxics Control" (EPA/505/2-90-001).

B. **Alternative Analysis-based** – Using the preferred alternative's treatment capacity for conventional pollutants such as BOD_5 and TSS that are provided by the consultant as the WLA, the significantly-degrading effluent average monthly and average weekly limits are determined by applying the WLA as the average monthly (AML) and multiplying the AML by 1.5 to derive the average weekly limit (AWL).

Note: Significantly-degrading effluent limits have been based on the authority included in Section I.A. of the AIP. Also under 40 CFR 133.105, permitting authorities shall require more stringent limitations than equivalent to secondary treatment limitations for 1) existing facilities if the permitting authority determines that the 30-day average and 7-day average BOD_5 and TSS effluent values could be achievable through proper operation and maintenance of the treatment works, and 2) new facilities if the permitting authority determines that the 30-day average and 7-day average BOD_5 and TSS effluent values could be achievable through proper operation and maintenance of the treatment works, considering the design capability of the treatment process.

Outfall #001 **– Main Facility Outfall**

- **Flow.** Though not limited itself, the volume of effluent discharged from each outfall is needed to assure compliance with permitted effluent limitations [40 CFR Part 122.44(i)(1)(ii)]. If the permittee is unable to obtain effluent flow, then it is the responsibility of the permittee to inform the department, which may require the submittal of an operating permit modification. Influent monitoring has been and will be required for this facility in its Missouri State Operating Permit.

- **Biochemical Oxygen Demand (BOD_5).** Effluent limits of 30 mg/L average monthly and 45 mg/L average weekly were established as a result of the facility upgrading to secondary treatment per 10 CSR 20-7.015(8)(A)1.

  Dissolved Oxygen Modeling
  MDNR developed a Streeter-Phelps DO model using water quality parameters for the Tributary to South Blackbird Creek. The model included in Appendix E used inputs of temperature at 26 ºC, initial DO of 5 mg/L, effluent BOD_5 of 30 mg/L, and effluent $NBOD_5$ of 41.6 mg/L. Staff also assumed 5 mg/L of DO in the effluent. No input parameter scenario resulted in an instream DO concentration less

than or equal to 5 mg/L. Due to the results of this model, a WQBEL BOD_5 effluent limitation will not be imposed.

Modeling provided in Appendix E demonstrated that BOD effluent is protective of water quality standards for DO. Streeter Phelps modeling indicated that conservative inputs outlined in Appendix E resulted in a reaeration dominant discharge. Staff considers the BOD_5 effluent limitations of 45 mg/L as the average weekly and 30 mg/L as the monthly average protective of aquatic life.

- **Total Suspended Solids (TSS).** Effluent limits of 30 mg/L average monthly and 45 mg/L average weekly were established as a result of the facility upgrading to secondary treatment per 10 CSR 20-7.015(8)(A)1.

- ***Escherichia coli (E. coli).*** Final effluent limits have been retained from the previous permit because the schedule of compliance is anticipated to be continued in the modified operating permit. Monthly average of 206 per 100 mL as a geometric mean and weekly average of 1,030 per 100 mL as a geometric mean during the recreational season (April 1 – October 31), to protect Whole Body Contact Recreation (B) designated use of the first classified stream, as per 10 CSR 20-7.031(5)(C). An effluent limit for both monthly average and weekly average is required by 40 CFR 122.45(d). The geometric mean is calculated by multiplying all of the data points and then taking the nth root of this product, where n = # of samples collected. For example: Five *E. coli* samples were collected with results of 1, 4, 6, 10, and 5 (#/100mL). Geometric mean = 5^{th} root of (1)(4)(6)(10)(5) = 5^{th} root of 1,200 = 4.1 #/100mL.

- **Total Ammonia Nitrogen.** Early Life Stages Present Total Ammonia Nitrogen criteria apply [10 CSR 20-7.031(5)(B)7.C. & Table B3]. Background total ammonia nitrogen = 0.01 mg/L

Month	Temp (°C)*	pH (SU)*	Total Ammonia Nitrogen CCC (mg N/L)	Total Ammonia Nitrogen CMC (mg N/L)
January	2.8	7.8	3.1	12.1
February	4.0	7.9	2.7	10.1
March	10.6	7.9	2.7	10.1
April	17.0	7.9	2.3	10.1
May	22.0	7.8	1.9	12.1
June	26.0	7.8	1.5	12.1
July	28.9	7.9	1.1	10.1
August	28.0	7.8	1.3	12.1
September	24.1	7.8	1.7	12.1
October	17.5	7.8	2.6	12.1
November	11.6	7.8	3.1	12.1
December	4.9	7.9	2.7	10.1

* Ecoregion Data (Central Irregular Plains)

WBQEL equation
$C_e = (((Q_e+Q_s)*C) - (Q_s*C_s))/Q_e$

January
Chronic WLA: Ce = ((0.38 + 0.0)3.1 – (0.0 * 0.01)) / 0.38 Ce = 3.1
Acute WLA: Ce = ((0.38 + 0.0)12.1 – (0.0 * 0.01)) / 0.38 Ce = 12.1
AML = WLAc = 3.1 mg/L
MDL = WLAa = 12.1 mg/L

February
Chronic WLA: Ce = ((0.38 + 0.0)2.7 – (0.0 * 0.01)) / 0.38 Ce = 2.7
Acute WLA: Ce = ((0.38 + 0.0)10.1 – (0.0 * 0.01)) / 0.38 Ce = 10.1

AML = WLAc = 2.7 mg/L
MDL = WLAa = 12.1 mg/L

March
Chronic WLA: Ce = ((0.38 + 0.0)2.7 – (0.0 * 0.01)) / 0.38 Ce = 2.7
Acute WLA: Ce = ((0.38 + 0.0)10.1 – (0.0 * 0.01)) / 0.38 Ce = 10.1
AML = WLAc = 2.7 mg/L
MDL = WLAa = 10.1 mg/L

April
Chronic WLA: Ce = ((0.38 + 0.0)2.3 – (0.0 * 0.01)) / 0.38 Ce = 2.3
Acute WLA: Ce = ((0.38 + 0.0)10.1 – (0.0 * 0.01)) / 0.38 Ce = 10.1
AML = WLAc = 2.3 mg/L
MDL = WLAa = 10.1 mg/L

May
Chronic WLA: Ce = ((0.38 + 0.0)1.9 – (0.0 * 0.01)) / 0.38 Ce = 1.9
Acute WLA: Ce = ((0.38 + 0.0)12.1 – (0.0 * 0.01)) / 0.38 Ce = 12.1
AML = WLAc = 1.9 mg/L
MDL = WLAa = 12.1 mg/L

June
Chronic WLA: Ce = ((0.38 + 0.0)1.5 – (0.0 * 0.01)) / 0.38 Ce = 1.5
Acute WLA: Ce = ((0.38 + 0.0)12.1 – (0.0 * 0.01)) / 0.38 Ce = 12.1
AML = WLAc = 1.5 mg/L
MDL = WLAa = 12.1 mg/L

July
Chronic WLA: Ce = ((0.38 + 0.0)1.1 – (0.0 * 0.01)) / 0.38 Ce = 1.1
Acute WLA: Ce = ((0.38 + 0.0)10.1 – (0.0 * 0.01)) / 0.38 Ce = 10.1
AML = WLAc = 1.1 mg/L
MDL = WLAa = 10.1 mg/L

August
Chronic WLA: Ce = ((0.38 + 0.0)1.3 – (0.0 * 0.01)) / 0.38 Ce = 1.3
Acute WLA: Ce = ((0.38 + 0.0)12.1 – (0.0 * 0.01)) / 0.38 Ce = 12.1
AML = WLAc = 1.3 mg/L
MDL = WLAa = 12.1 mg/L

September
Chronic WLA: Ce = ((0.38 + 0.0)1.7 – (0.0 * 0.01)) / 0.38 Ce = 1.7
Acute WLA: Ce = ((0.38 + 0.0)12.1 – (0.0 * 0.01)) / 0.38 Ce = 12.1
AML = WLAc = 1.7 mg/L
MDL = WLAa = 12.1 mg/L

October
Chronic WLA: Ce = ((0.38 + 0.0)2.6 – (0.0 * 0.01)) / 0.38 Ce = 2.6
Acute WLA: Ce = ((0.38 + 0.0)12.1 – (0.0 * 0.01)) / 0.38 Ce = 12.1
AML = WLAc = 2.6 mg/L
MDL = WLAa = 12.1 mg/L

November
Chronic WLA: Ce = ((0.38 + 0.0)3.1 – (0.0 * 0.01)) / 0.38 Ce = 3.1
Acute WLA: Ce = ((0.38 + 0.0)12.1 – (0.0 * 0.01)) / 0.38 Ce = 12.1
AML = WLAc = 3.1 mg/L
MDL = WLAa = 12.1 mg/L

December

Chronic WLA: Ce = ((0.38 + 0.0)2.7 – (0.0 * 0.01)) / 0.38 Ce = 2.7
Acute WLA: Ce = ((0.38 + 0.0)10.1 – (0.0 * 0.01)) / 0.38 Ce = 10.1
AML = WLAc = 2.7 mg/L
MDL = WLAa = 10.1 mg/L

- **Oil & Grease.** Conventional pollutant, [10 CSR 20-7.031(4)(B)]. Waters shall be free from oil, scum, and floating debris in sufficient amounts to be unsightly or prevent full maintenance of designated uses.

- **Total Phosphorus and Total Nitrogen (Speciated).** Effluent monitoring for total phosphorus, total Kjeldahl nitrogen, and nitrite + nitrate are required per 10 CSR 20-7.015(9)(D)8.

- **pH.** ≥6.5 SU. pH limitations of 6.0-9.0 SU [10 CSR 20-7.015] are not protective of the in-stream Water Quality Standard, which states that water contaminants shall not cause pH to be outside the range of 6.5-9.0 SU. 10 CSR 20-7.015 allows pH for lagoons to be maintained above 6.0 SU. With no mixing zone, the water quality standard, ≥6.5 SU, must be met at the outfall.

- **Biochemical Oxygen Demand (BOD5) Percent Removal.** In accordance with 40 CFR Part 133, removal efficiency is a method by which the Federal Regulations define Secondary Treatment and Equivalent to Secondary Treatment, which applies to BOD_5 and TSS for Publicly Owned Treatment Works (POTWs)/municipals. This facility is required to meet 85 percent removal efficiency for BOD_5.

- **Total Suspended Solids (TSS) Percent Removal.** In accordance with 40 CFR Part 133, removal efficiency is a method by which the Federal Regulations define Secondary Treatment and Equivalent to Secondary Treatment, which applies to BOD5 and TSS for Publicly Owned Treatment Works (POTWs)/municipals. This facility is required to meet 85 percent removal efficiency for TSS.

8. GENERAL ASSUMPTIONS OF THE WATER QUALITY AND ANTIDEGRADATION REVIEW

A. A Water Quality and Antidegradation Review (WQAR) assumes that [10 CSR 20-6.010(2) Continuing Authorities and 10 CSR 20-6.010(4)(A)5.B., consideration for no discharge] has been or will be addressed in a Missouri State Operating Permit or Construction Permit Application.
B. A WQAR does not indicate approval or disapproval of alternative analysis as per [10 CSR 20-7.015(4) Losing Streams], and/or any section of the effluent regulations.
C. Changes to Federal and State Regulations (FSR) made after the drafting of this WQAR may alter Water Quality Based Effluent Limits (WQBEL).
D. Effluent limitations derived from FSR may be WQBEL or Effluent Limit Guidelines (ELG).
E. WQBEL supersede ELG only when they are more stringent. Mass limits derived from technology based limits are still appropriate.
F. A WQAR does not allow discharges to waters of the State, and shall not be construed as a National Pollution Discharge Elimination System (NPDES) or Missouri State Operating Permit to discharge or a permit to construct, modify, or upgrade.
G. Limitations and other requirements in a WQAR may change as Water Quality Standards (WQS), Methodology, and Implementation procedures change.
H. Nothing in this WQAR removes any obligations to comply with county or other local ordinances or restrictions.
I. The operating permit may contain additional requirements to evaluate the effectiveness of the technology once the facility is in operation. This Antidegradation Review is based on the information provided by the facility and is not a comprehensive review of the proposed treatment technology. If the review engineer determines the proposed technology will not consistently meet proposed effluent limits, the permittee will be required to revise their Antidegradation Report.

9. ANTIDEGRADATION REVIEW PRELIMINARY DETERMINATION

The proposed facility expansion and upgrades will result in significant degradation of the unnamed tributary to South Blackbird Creek. Per the requirements of the AIP, the effluent limits in this review were developed to be protective of beneficial uses and to attain the highest statutory and regulatory requirements. The Department has determined that the submitted review is sufficient and meets the requirements of the AIP. No further analysis is needed for this discharge.

Reviewer: Thomas Silkwood
Date: October 2022
Section Chief: Cindy LePage, P.E.

10. Appendix A: Map of Discharge Location

Approximate location of outfall marked by red "X"

11. Appendix B: Geohydrologic Evaluation

MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

Michael L. Parson
Governor

Dru Buntin
Director

LWE22125
Putnam County

August 08, 2022

Charles Jones
1970 W. Lafayette Ave
Jacksonville, IL 62650

RE: Unionville Wastewater Treatment Facility Improvements

Dear Charles Jones:

On June 27, 2022, the Missouri Geological Survey received a request to perform a geohydrologic evaluation for the above referenced project located in Putnam County. Included with this letter is a report that details the geologic and hydrologic conditions at the site and the potential for groundwater contamination in the event of wastewater treatment failure.

Thank you for the evaluation request. If you are in need of further assistance or have questions regarding the report, please contact our office at P.O Box 250, Rolla, Mo 65402-0250, by telephone at 573-368-2100 or gspeg@dnr.mo.gov.

Sincerely,

MISSOURI GEOLOGICAL SURVEY

Molly A. Starkey

Molly Starkey
Geologist
Environmental Geology Section

c: Charley Pittman
WPP
Northeast Regional Office

08/08/2022

Missouri Department Of Natural Resources
Missouri Geological Survey
Geological Survey Program
Environmental Geology Section

Project ID Number
LWE22125
County
Putnam County

Request Details

Project: Unionville Wastewater Treatment Facility Improvements

Legal Description: 36 T66N R19W

Quadrangle: UNIONVILLE EAST
Latitude: 40 28 22.22
Longitude: -92 58 58.71

Organization Official
Name: Charley Pittman
Address: 1611 Grant Street
City: Unionville
State: MO Zip: 63565
Phone: 660-947-2437
Email:

Preparer
Name: Charles Jones
Address: 1970 W. Lafayette Ave
City: Jacksonville
State: IL Zip: 62650
Phone: 217-245-4146
Email: cjones@bentonassociates.com

Project Details

Report Date: 08/08/2022
Date of Field Visit: 08/03/2022

Previous Reports: Not Applicable

Facility Type
- [ ] Mechanical treatment plant
- [ ] Recirculating filter bed
- [ ] Land application
- [X] Lagoon or storage basin
- [ ] Subsurface soil absorption system
- [ ] Lagoon or storage basin W/Land App
- [ ] Lagoon or storage basin W/SSAS
- [ ] Other type of facility

Type of Waste
- [ ] Animal
- [X] Human
- [ ] Process or industrial
- [ ] Leachate
- [ ] Other waste type

Funding Source
- [X] IWT
- [ ] WWL-SRF

Additional Information
- [ ] Plans were submitted
- [ ] Site was investigated by NRCS
- [ ] Soil or geotechnical data were submitted

Geologic Stream Classification: [X] Gaining [ ] Losing [ ] No discharge

Overall Geologic Limitations
- [ ] Slight
- [X] Moderate
- [ ] Severe

Collapse Potential
- [ ] Not applicable
- [ ] Slight
- [X] Moderate
- [ ] Severe

Topography
- [ ] <4%
- [X] 4% to 8%
- [ ] 8% to 15%
- [ ] >15%

Landscape Position
- [X] Broad uplands
- [ ] Floodplain
- [ ] Ridgetop
- [ ] Alluvial plain
- [X] Hillslope
- [ ] Terrace
- [ ] Narrow ravine
- [ ] Sinkhole

Bedrock: Pennsylvanian-age Marmaton Group

Surficial Materials: Dark brown to reddish brown silt loam and loess

Missouri Department Of Natural Resources
Missouri Geological Survey
Geological Survey Program
Environmental Geology Section

Project ID Number
LWE22125
County
Putnam County

Recommended Construction Procedures for Earthen Facility	Determine Overburden Properties	Determine Hydrologic Conditions
	☐ Particle size analysis	☐ Groundwater elevation
☒ Installation of clay pad and Compaction	☐ Atterberg limits	☐ Direction of groundwater flow
☐ Diversion of subsurface flow	☐ 95% Max. dry density test method	☐ 25-Year flood level
☐ Artificial sealing	☐ Overburden thickness	☐ 100-Year flood level
☐ Rock excavation	☐ Permeability coefficient-undisturbed	
☐ Limit excavation depth	☒ Permeability coefficient-remolded	

Remarks:

On August 3, 2022, a geologist with the Missouri Geological Survey conducted a geohydrologic evaluation for upgrades to the existing earthen lagoons at the Unionville wastewater treatment facility (WWTF). The existing facility will reportedly have aeration and a moving bed biofilm reactor added to the current treatment and will begin receiving wastewater from another facility in the city. The purpose of the site visit was to observe the geologic and hydrologic characteristics of the site and to determine potential impacts in the event of wastewater treatment failure. The site is located on the east side of Unionville on a hillslope in a broad upland, with surface water runoff to the south into an unnamed tributary to South Blackbird Creek.

A soil sample was taken with a handheld auger and surficial materials were observed in situ in the banks of the receiving stream. Surficial materials were a dark brown, organic rich silt loam and reddish brown clay loam. These materials have low overall permeability and are glacially-derived sediments. Local well logs indicate that the surficial materials in this area range from 130 to 145 feet in thickness. The upper 90 to 105 feet are low permeability clay above fine sand with moderate permeability. The sand has the potential to act as an aquifer with approximately 1 to 5 gallons of water per minute. Thick deposits of low permeability materials separate the WWTF from this aquifer.

Bedrock was not encountered at this site or in the surrounding area. Geologic mapping indicates that the uppermost bedrock unit at this site is the Pennsylvanian-age Marmaton Group. Due to the thickness and character of the surficial material, bedrock is not a factor considered at this site. There are no known sinkholes or springs within 3 miles of the site. The receiving stream has previously been classified as a gaining stream. Observations made during this evaluation support that conclusion. The receiving stream had one, well defined flow path with no in-channel vegetation. Flow was consistent and increasing downstream of the site.

This site receives a moderate collapse potential rating and moderate overall geologic limitations rating, as a result of the size of the lagoon. In the event of treatment failure, the surface water of the unnamed tributary to South Blackbird Creek may be adversely impacted.

12. Appendix C: Natural Heritage Review

Missouri Department of Conservation

Missouri Department of Conservation's Mission is to protect and manage the forest, fish, and wildlife resources of the state and to facilitate and provide opportunities for all citizens to use, enjoy and learn about these resources.

Natural Heritage Review Level Three Report: Species Listed Under the Federal Endangered Species Act

There are records of species listed under the Federal Endangered Species Act, and possibly also records for species listed Endangered by the state, or Missouri Species and/or Natural Communities of Conservation Concern within or near the the defined Project Area. Please contact the U.S. Fish and Wildlife Service and the Missouri Department of Conservation for further coordination.

Foreword: Thank you for accessing the Missouri Natural Heritage Review Website developed by the Missouri Department of Conservation with assistance from the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, Missouri Department of Transportation and NatureServe. The purpose of this website is to provide information to federal, state and local agencies, organizations, municipalities, corporations and consultants regarding sensitive fish, wildlife, plants, natural communities and habitats to assist in planning, designing and permitting stages of projects.

PROJECT INFORMATION

Project Name and ID Number: Unionville South WWTF #11383
Project Description: UTM: X = 501471, Y = 4480092 Discharge to tributary to South Blackbird Creek Putnam County
Project Type: Waste Transfer, Treatment, and Disposal, Liquid waste/Effluent, Wastewater treatment plant, Construction or expansion
Contact Person: Thomas Silkwood
Contact Information: thomas.silkwood@dnr.mo.gov or 573-751-3443

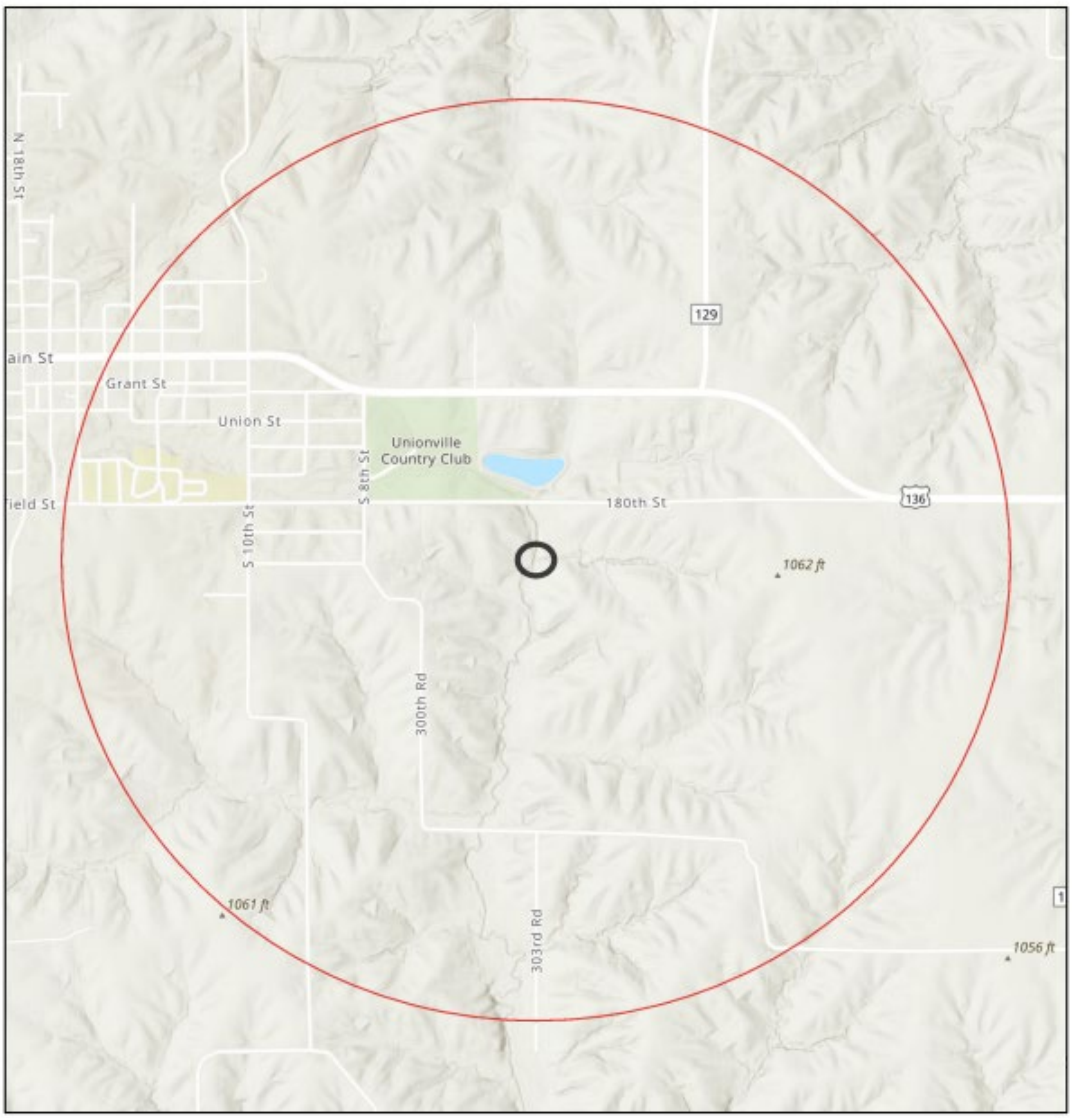
Disclaimer: The NATURAL HERITAGE REVIEW REPORT produced by this website identifies if a species tracked by the Natural Heritage Program is known to occur within or near the area submitted for your project, and shares suggested recommendations on ways to avoid or minimize project impacts to sensitive species or special habitats. If an occurrence record is present, or the proposed project might affect federally listed species, the user must contact the Department of Conservation or U.S. Fish and Wildlife Service for more information. The Natural Heritage Program tracks occurrences of sensitive species and natural communities where the species or natural community has been found. Lack of an occurrence record does not mean that a sensitive plant, animal or natural community is not present on or near the project area. Depending on the project, current habitat conditions, and geographic location in the state, surveys may be necessary. Additionally, because land use conditions change and animals move, the existence of an occurrence record does not mean the species/habitat is still present. Therefore, Reports include information about records near but not necessarily on the project site.

The Natural Heritage Report is not a site clearance letter for the project. It provides an indication of whether or not public lands and sensitive resources are known to be (or are likely to be) located close to the proposed project. Incorporating information from the Natural Heritage Program into project plans is an important step that can help reduce unnecessary impacts to Missouri's sensitive fish, forest and wildlife resources. However, the Natural Heritage Program is only one reference that should be used to evaluate potential adverse project impacts. Other types of information, such as wetland and soils maps and on-site inspections or surveys, should be considered. Reviewing current landscape and habitat information, and species' biological characteristics would additionally ensure that Missouri Species of Conservation Concern are appropriately identified and addressed in planning efforts.

U.S. Fish and Wildlife Service – Endangered Species Act (ESA) Coordination: Lack of a Natural Heritage Program occurrence record for federally listed species in your project area does not mean the species is not present, as the area may never have been surveyed. Presence of a Natural Heritage Program occurrence record does not mean the project will result in negative impacts. The information within this report is not intended to replace Endangered Species Act consultation with the U.S. Fish and Wildlife Service (USFWS) for listed species. Direct contact with the USFWS may be necessary to complete consultation and it is required for actions with a federal connection, such as federal funding or a federal permit; direct contact is also required if ESA concurrence is necessary. Visit the USFWS Information for Planning and Conservation (IPaC) website at https://ecos.fws.gov/ipac/ for further information. This site was developed to help streamline the USFWS environmental review process and is a first step in ESA coordination. The Columbia Missouri Ecological Field Services Office may be reached at 573-234-2132, or by mail at 101 Park Deville Drive, Suite A, Columbia, MO 65203.

Transportation Projects: If the project involves the use of Federal Highway Administration transportation funds, these recommendations may not fulfill all contract requirements. Please contact the Missouri Department of Transportation at 573-526-4778 or visit https://www.modot.org/ for additional information on recommendations.

Unionville South WWTF



August 26, 2022

Buffered Project Boundary

Project Boundary

1:19,675

0 0.15 0.3 0.6 mi

0 0.28 0.55 1.1 km

Iowa DNR, Missouri Dept. of Conservation, Missouri DNR, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, Esri, NASA, NGA, USGS, FEMA

Species or Communities of Conservation Concern within the Area:

There are records of species listed under the Federal Endangered Species Act, and possibly also records for species listed Endangered by the state, or Missouri Species and/or Natural Communities of Conservation Concern within or near the defined Project Area. Please contact the U.S. Fish and Wildlife Service and the Missouri Department of Conservation for further coordination.

Email (preferred): NaturalHeritageReview@mdc.mo.gov
MDC Natural Heritage Review
Science Branch
P.O. Box 180
Jefferson City, MO
65102-0180
Phone: 573-522-4115 ext. 3182

U.S. Fish and Wildlife Service
Ecological Service
101 Park Deville Drive
Suite A
Columbia, MO
65203-0007
Phone: 573-234-2132

Other Special Search Results:

No results have been identified for this project location.

Project Type Recommendations:
Waste Transfer, Treatment and Disposal -Wastewater treatment plant: New or Maintenance; Clean Water Act permits issued by other agencies regulate both construction and operation of wastewater systems, and provide many important protections for fish and wildlife resources throughout the project area and at some distance downstream. Fish and wildlife almost always benefit when unnatural pollutants are removed from water, and concerns are minimal if construction is managed to minimize erosion and sedimentation/runoff to nearby streams and lakes, including adherence to any "Clean Water Permit" conditions.
Revegetate disturbed areas to minimize erosion using native plant species compatible with the local landscape and wildlife needs. Annual ryegrass may be combined with native perennials for quicker green-up. Avoid aggressive exotic perennials such as crownvetch and Sericea lespedeza. Management Recommendations for Construction Projects Affecting Missouri Rivers and Streams is available at https://mdc.mo.gov/sites/default/files/2020-06/Streams.pdf

Project Location and/or Species Recommendations:

Endangered Species Act Coordination - Indiana bats *(Myotis sodalis*, federal- and state-listed endangered) and **Northern long-eared bats** (*Myotis septentrionalis,* federal-listed threatened) may occur near the project area. Both of these species of bats hibernate during winter months in caves and mines. During the summer months, they roost and raise young under the bark of trees in wooded areas, often riparian forests and upland forests near perennial streams. During project activities, avoid degrading stream quality and where possible leave snags standing and preserve mature forest canopy. Do not enter caves known to harbor Indiana bats or Northern long-eared bats, especially from September to April. **If any trees need to be removed for your project, please contact the U.S. Fish and Wildlife Service (Ecological Services, 101 Park Deville Drive, Suite A, Columbia, Missouri 65203-0007; Phone 573-234-2132 ext. 100 for Ecological Services) for further coordination under the Endangered Species Act.**

Invasive exotic species are a significant issue for fish, wildlife and agriculture in Missouri. Seeds, eggs, and larvae may be moved to new sites on boats or construction equipment. Please inspect and clean equipment thoroughly before moving between project sites. See https://mdc.mo.gov/community-conservation/managing-invasive-species-your-community for more information.

- Remove any mud, soil, trash, plants or animals from equipment before leaving any water body or work area.
- Drain water from boats and machinery that have operated in water, checking motor cavities, live-well, bilge and transom wells, tracks, buckets, and any other water reservoirs.
- When possible, wash and rinse equipment thoroughly with hard spray or HOT water (>140° F, typically available at do-it-yourself car wash sites), and dry in the hot sun before using again.

Streams and Wetlands – Clean Water Act Permits: Streams and wetlands in the project area should be protected from activities that degrade habitat conditions. For example, soil erosion, water pollution, placement of fill, dredging, in-stream activities, and riparian corridor removal, can modify or diminish aquatic habitats. Streams and wetlands may be protected under the Clean Water Act and require a permit for any activities that result in fill or other modifications to the site. Conditions provided within the U.S. Army Corps of Engineers (USACE) Clean Water Act Section 404 permit (http://www.nwk.usace.army.mil/Missions/RegulatoryBranch.aspx) and the Missouri Department of Natural Resources (DNR) issued Clean Water Act Section 401 Water Quality Certification (http://dnr.mo.gov/env/wpp/401/index.html), if required, should help minimize impacts to the aquatic organisms and aquatic habitat within the area. Depending on your project type, additional permits may be required by the Missouri Department of Natural Resources, such as permits for stormwater, wastewater treatment facilities, and confined animal feeding operations. Visit http://dnr.mo.gov/env/wpp/permits/index.html for more information on DNR permits. Visit both the USACE and DNR for more information on Clean Water Act permitting.

For further coordination with the Missouri Department of Conservation and the U.S. Fish and Wildlife Services, please see the contact information below:

Email (preferred): NaturalHeritageReview@mdc.mo.gov
MDC Natural Heritage Review
Science Branch
P.O. Box 180
Jefferson City, MO
65102-0180
Phone: 573-522-4115 ext. 3182

U.S. Fish and Wildlife Service
Ecological Service
101 Park Deville Drive
Suite A
Columbia, MO
65203-0007
Phone: 573-234-2132

Miscellaneous Information
FEDERAL Concerns are species/habitats protected under the Federal Endangered Species Act and that have been known near enough to the project site to warrant consideration. For these, project managers must contact the U.S. Fish and Wildlife Service Ecological Services (101 Park Deville Drive Suite A, Columbia, Missouri 65203-0007; Phone 573-234-2132; Fax 573-234-2181) for consultation.
STATE Concerns are species/habitats known to exist near enough to the project site to warrant concern and that are protected under the Wildlife Code of Missouri (RSMo 3 CSR 1 0). "State Endangered Status" is determined by the Missouri Conservation Commission under constitutional authority, with requirements expressed in the Missouri Wildlife Code, rule 3CSR 1 0-4.111. Species tracked by the Natural Heritage Program have a "State Rank" which is a numeric rank of relative rarity. Species tracked by this program and all native Missouri wildlife are protected under rule 3CSR 10-4.110 General Provisions of the Wildlife Code.

See Missouri Species and Communities of Conservation Concern Checklist (mo.gov) for a complete list of species and communities of conservation concern. Detailed information about the animals and some plants mentioned may be accessed at Mofwis Search Results. Please contact the Missouri Department of Conservation to request printed copies of any materials linked in this document.

13. Appendix D: Antidegradation Review Summary Attachments

Antidegradation Review Summary / Request

MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM, WATER POLLUTION CONTROL BRANCH
ANTIDEGRADATION REVIEW SUMMARY / REQUEST

FOR DEPARTMENT USE ONLY	
APP NO.	
FEE RECEIVED	CHECK NO.
DATE RECEIVED	

1. FACILITY

NAME			COUNTY
Unionville South WWTF			Putnam
ADDRESS (PHYSICAL)	CITY	STATE	ZIP CODE
180th Street. 0.4 miles east of 8th Street	Unionville	IL	63565
PERMIT NUMBER	PROPOSED DESIGN FLOW	SIC / NAICS CODE	
MO-0026646	0.242 MGD	4952	

2. OWNER

NAME			
City of Unionville			
ADDRESS	CITY	STATE	ZIP CODE
1611 Grant Street	Unionville	IL	63565
EMAIL ADDRESS		TELEPHONE NUMBER WITH AREA CODE	
ahomann@nemr.net		(660) 947-2437	

3. CONTINUING AUTHORITY The regulatory requirement regarding continuing authority is found in 10 CSR 20-6.010(2).

NAME	SECRETARY OF STATE CHARTER NUMBER		
City of Unionville			
ADDRESS	CITY	STATE	ZIP CODE
1611 Grant Street	Unionville	IL	63565
EMAIL ADDRESS		TELEPHONE NUMBER WITH AREA CODE	
ahomann@nemr.net		(660) 947-2437	

4. CONSULTANT

PREPARER NAME	COMPANY NAME		
C. Cameron Jones, P.E.	Benton and Associates, Inc.		
ADDRESS	CITY	STATE	ZIP CODE
1970 West Lafayette Avenue	Jacksonville	IL	62650
EMAIL ADDRESS		TELEPHONE NUMBER WITH AREA CODE	
cjones@bentonassociates.com		(217) 245-4146	

5. RECEIVING WATER BODY SEGMENT #1

NAME: Tributary to South Blackbird Creek

5.1 Upper end of segment – Location of discharge
UTM: X= _____, Y= _____ OR Lat 40.472392, Long -92.983146

5.2 Lower end of segment –
UTM: X= _____, Y= _____ OR Lat 40.464041, Long -92.984128

Per the Missouri Antidegradation Implementation Procedure (AIP), the definition of a segment, "a segment is a section of water that is bound, at a minimum, by significant existing sources and confluences with other significant water bodies."

6. WATER BODY SEGMENT #2 (IF APPLICABLE, Use another form if a third segment is needed)

NAME:

6.1 Upper end of segment – End of Segment #1
UTM: X= _____, Y= _____ OR Lat _____, Long _____

6.2 Lower end of segment –
UTM: X= _____, Y= _____ OR Lat _____, Long _____

7. DECHLORINATION

If chlorination and dechlorination is the existing or proposed method of disinfection treatment, will the effluent discharged be equal to or less than the Water Quality Standards for Total Residual Chlorine stated in Table A1 of 10 CSR 20-7.031?

☐ Yes ☑ No – What is the proposed method of disinfection? Ultraviolet Disinfection

Based on the disinfection treatment system being designed for total removal of Total Residual Chlorine, minimal degradation for Total Residual Chlorine is assumed and the facility will be required to meet the water quality based effluent limits. These compliance limits for Total Residual Chlorine are much less than the method detection limit of 0.13 mg/L.

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8. SUMMARIZE THE FEASIBILITY OF CONSTRUCTING A NO-DISCHARGE TREATMENT WASTEWATER FACILITY

According to the Antidegradation Implementation Procedure Sections I.B. and II.B.1., the feasibility of no-discharge alternatives must be considered. No-discharge alternatives may include connection to a regional treatment facility, surface land application, subsurface land application, and recycle or reuse.

The nearest WWTP large enough to consider accepting Unionville's wastewater is approximately 20 miles away in Centerville, IA. This significant distance provides cost, easement, and coordination concerns. In addition to estimated costs totaling over $12 million, hundreds of easements would need to be signed by land owners between the two cities. These land owners would not benefit from the project, adding additional difficulty to getting signatures. Regionalization would also require significant coordination efforts with City officials and regulatory agencies from IA and MO. In summary, regionalizing the two existing treatment plants with each other is a better fit for Unionville. As an alternative to regionalization, surface land application was considered. This alternative would require approximately 325 acres of land to be obtained by the City. Obtaining this acreage will likely be difficult and costly, with estimates at $7.7 million. In addition to financial considerations, the topography near Unionville is not ideally suited for surface application. Many of the soils in the region have low infiltration rates and there are many bodies of water nearby that must be avoided. These factors limit usable land area. Additionally, the northern location of Unionville makes it prone to frozen ground for a large portion of the year. This means significant additional storage will need to be added to the lagoons. For these reasons, surface application is not practical.

9. ADDITIONAL REQUIREMENTS

Complete and submit the following with this submittal:

- ☑ Copy of the Geohydrologic Evaluation – Submit request through the Missouri Geological Survey website
- ☑ Copy of the Missouri Natural Heritage from the Missouri Department of Conservation website
- ☑ Attach your Antidegradation Review Report and all supporting documentation as these forms are only a summary.
- ☐ If applicable, submit a copy of any Existing Water Quality data used in this process. Include the date range of the data, source(s) of the data, and location of data collection relative to the outfall. If using your own collected water quality data, submit a copy of the Quality Assurance Project Plan (QAPP) approved by the department's Watershed Protection Section. For more detailed information, see the Missouri Antidegradation Implementation Procedure (AIP), Section II.A.1.

10. PATH / TIER REVIEW ATTACHMENTS ENCLOSED

Path A: Tier 2 – Non-Degradation Mass Balance	☐ Yes	☑ No
Path B: Tier 2 – Minimal Degradation	☐ Yes	☑ No
Path C: Tier 2 – Significant Degradation	☑ Yes	☐ No
Path D: Tier 1 – Preliminary Review Request	☐ Yes	☑ No
Path E: Temporary Degradation	☐ Yes	☑ No

11. APPLICANT PROPOSED ANTIDEGRADATION REVIEW EFFLUENT LIMITS

Preliminary effluent limits for the proposed project are dependent upon the path selected:

Applicable Pollutants of Concern	Concentration*		Path / Tier Review Attachment Used for POC Evaluation	Average Monthly Limit	Daily Maximum Limit or Average Weekly Limit
	mg/L	µg/L			
BOD_5	X		Path C - Tier 2	45	65 (Weekly)
TSS	X		Path C - Tier 2	80	120 (Weekly)
Ammonia (Summer)	X		Path C - Tier 2	1.6	11.4
Ammonia (Winter)	X		Path C - Tier 2	2.8	11.1
Total Phosphorus	X		Path C - Tier 2	Monitor	Monitor
E. Coli (CFU/100 mL)	X		Path C - Tier 2	206	1,134 (Weekly)
Total Nitrogen	X		Path C - Tier 2	Monitor	Monitor

* Place an X in appropriate box for the concentration units for each Pollutant of Concern.

12. PROPOSED PROJECT SUMMARY

The City of Unionville currently has two WWTP's with two facilitative treatment lagoons at each site. The existing lagoons provide pretreatment of wastewater and primary treatment comes from overland flow field at each treatment plant. The proposed project is to improve the South WWTP in Unionville to accept untreated flow from the North WWTP and discontinue the use of overland flow fields at both treatment plants. This would eliminate discharge from the North WWTP and consolidate the City's resources. The project is discussed in more detail in the following paragraphs.

The project plan includes the abandonment of the North Treatment Plant so that all flow from Unionville can be treated by a singular plant, the South Treatment Plant. Flow from the North Collection System would be conveyed to centralized treatment via a lift station and associated force main. The North WWTP will not discharge effluent following the proposed improvements, thus the two treatment plants will be regionalized into one primary plant.

The South Treatment Plant will be improved with aeration technology, a moving bed bioreactor (MBBR), and UV disinfection. This will provide significant improvement to the existing treatment process including ammonia removal and disinfection capabilities. The plant will be designed around the combined average flow of the two existing facilities, 0.242 MGD. Effluent will discharge into an unnamed tributary to South Blackbird Creek.

In summary, with the proposed project the City of Unionville will combine treatment plants, eliminate a source of pollution to North Blackbird Creek, and improve wastewater treatment with ammonia removal and UV disinfection.

Applicants choosing to use a new wastewater technology that are considered an "unproven technology" in Missouri must comply with the requirements set forth in the *New Technology Definitions and Requirements fact sheet.*

13. CONTINUING AUTHORITY WAIVER (For New Discharges)

In accordance with 10 CSR 20-6.010(2)(C), applicants proposing use of a lower preference continuing authority, when the higher level authority is available, must submit a waiver from the existing higher authority one or other documentation for the department's review, provided it does not conflict with any area-wide management plan approved under section 208 of the Federal Clean Water Act or by the Missouri Clean Water Commission. Is the waiver necessary? ☐ Yes ☑ No
If yes, provide a copy.

14. APPLICATION FEE

☑ CHECK NUMBER ☐ JETPAY CONFIRMATION NUMBER

15. SIGNATURE

I am authorized and hereby certify that I am familiar with the information contained in this document and to the best of my knowledge and belief such information is true, complete and accurate.

SIGNATURE	DATE
	8/10/22
PRINT NAME: C. Cameron Jones	TITLE: Engineer

PLEASE IDENTIFY YOUR STATUS FOR THIS PROJECT: ☐ OWNER ☐ CONTINUING AUTHORITY ☑ CONSULTANT

Antidegradation Regionalization and No-Discharge Evaluation

MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM, WATER POLLUTION CONTROL BRANCH

ANTIDEGRADATION: REGIONALIZATION AND NO-DISCHARGE EVALUATION

REGIONALIZATION AND NO-DISCHARGE EVALUATION

According to the Antidegradation Implementation Procedure Sections I.B. and II.B.1., the feasibility of no-discharge alternatives must be considered. No-discharge alternatives may include connection to a regional treatment facility, surface land application, subsurface land application, and recycle or reuse.

Please refer to the *No-Discharge Alternative Evaluation* fact sheet for examples of information to provide to justify common reasons for not pursuing regionalization or no-discharge land application. If sufficient information is not provided on this form to demonstrate that these alternatives are not feasible, a more detailed evaluation of no-discharge options may have to be submitted.

Additional pages may be attached if more room is needed.

1. FACILITY:

NAME	COUNTY
Unionville South WWTF	Putnam

2. EVALUATION OF REGIONALIZATION (Complete all applicable reasons why regionalization was not pursued)

2.1 Regionalization Feasibility:

A. What is the distance to connect to the closest municipality's line or other facility's line? Approximately 20 miles (Centerville, IA).

B. List facilities contacted about possible regionalization. None.

C. Is there any planning or zoning in the area regarding development and services? Not at this time.

D. Who would have the responsibility to maintain the sewer connection line? Unionville would maintain the sewer connection line.

E. What is the estimated cost for piping and pumps to regionalize? Engineer's Opinion of Probable Costs are at approx. $12.7M.

F. Explain any engineering challenges with the regionalization connection – topography, rivers, highways, or other issues.
Crossing Highway 5 and state lines, 200+ ft of elevation change, Wastewater becoming septic and ruining pipes

G. Does a regional facility have the capacity to treat the additional effluent from this project? Unknown.

H. Were land owners contacted for rights to an easement? ☐ Yes ☑ No

I. Describe the easement issues:
The number of easements needed to transport wastewater would be high. This will make getting easements expensive, time consuming, and logistically difficult. This is particularly true since most of the homeowners from which easements are needed will not benefit from the project.

2.2 Summarize why regionalization was not a practicable or economically efficient alternative

Regionalization to another City is not a practical alternative for Unionville for several reasons. For one, Unionville is the largest municipality in Putnam County and is not located near facilities large enough to accept the City's wastewater. The nearest facility to Unionville large enough to consider regionalizing is in Centerville, Iowa. Centerville is approximately 20 miles from Unionville and has struggled with regulatory compliance in the recent past. Transporting wastewater this significant distance can cause several issues with cost and coordination. Further, there are significant topography changes and elevation differences between the two Cities.

Preliminary Engineer's Opinion of Probable Costs to run nearly 20 miles of force main and install multiple lift stations is approximately $12.7 million. Additional costs for regionalizing include trenching, road replacement, traffic control, fertilizing and seeding, construction engineering, legal fees, and various other project components and supplies. The force main and lift stations will also need to be lined to prevent pipe decay from septic sewage. Additionally, Centerville may require WWTP upgrades prior to accepting waste from Unionville. This cost would be the responsibility of Unionville. The significant cost required to regionalize to Centerville, Iowa, is much greater that the cost of other evaluated alternatives and is beyond the means of Unionville.

Project coordination is another concern when considering regionalization to another municipality. In addition to coordinating with Centerville to accept the wastewater, Unionville will also need to coordinate with agencies from two states and numerous homeowners. Since wastewater would be transported across state lines, regulatory agencies from both Missouri and Iowa will need to be involved. Unionville will also need to get signed easements for the 20 miles of the wastewater force main. This will include coordination with hundred of land owners, most of whom will not benefit from the project. Due to these factors, regionalization is not feasible for the City of Unionville. Instead, the City will regionalize by combining the two existing treatment plants.

3. EVALUATION OF NO-DISCHARGE LAND APPLICATION

Check all applicable reasons why no-discharge land application was not pursued:

☑ **3.1 Land Availability and Cost:**

A. Is land available for land application? ☑ Yes ☐ No

If not, explain:

If yes, answer the following:

B. How many acres are required for land application of the effluent? Approximately 325 acres.

C. Provide a breakdown of the capital cost for any necessary additional land, piping, pumps, and irrigation equipment?

See attached Engineer's Estimate of Probable Cost.

D. Were long-term costs evaluated and compared for upgrading to a mechanical plant with future Water Quality Standards changes (i.e. mussel ammonia, bacteria, TP, TN) versus cost for a land application system? ☐ Yes ☑ No

E. Were land owners contacted for rights to an easement? ☐ Yes ☑ No

F. Describe the easement issues:

Due to the significant land area required for surface application, it is infeasible for the City to purchase and own the land needed. A cooperative agreement with multiple farmers in the area may be feasible if the farmers are interested, but this will require coordination efforts and legal agreements. It would likely be difficult to obtain the acreage land required for surface application, even through a lease agreement.

☐ **3.2 Zoning or Suitability of Site in Proximity to Neighboring Sites or Waterbodies:**

A. Was drip or subsurface irrigation evaluated as opposed to surface application? ☐ Yes ☐ No

B. Does the county ordinance specifically restrict land application, surface and subsurface? ☐ Yes ☐ No

C. Can a vegetated buffer be installed to reduce necessary buffer distances? ☐ Yes ☐ No

D. Are there other steps or considerations that can be made?

☑ **3.3 Unsuitability of Geology or Soils**

A. Is a geohydrologic evaluation, county soils survey map, or other resource showing suitability and application rates included with this application? ☑ Yes ☐ No

B. Is it cost-effective to bring in additional soils? ☐ Yes ☑ No

C. Can the application rate be decreased to a suitable rate? ☐ Yes ☑ No

D. Were subsurface application alternatives (e.g. low pressure pipe, drip) considered? ☐ Yes ☑ No

E. If collapse potential is a concern, was using a liner or alternative site evaluated? ☐ Yes ☑ No

3.4 Summarize why no-discharge land application was not a practicable or economically efficient alternative

No-discharge land application of treated wastewater is not a practical alternative for the City of Unionville for several reasons. For one, approximately 325 acres of agricultural land are needed to land apply wastewater. Due to the large acreage needed and other necessary improvements, the costs of this alternative are above the means of the City at an estimated $7.7 million. This cost is greater than the cost of several other considered alternatives. Additionally, although Unionville is located near agricultural land, the soil is not ideally suited for land application. The land near Unionville is primarily composed of clay loams and loam derivatives. Several of the primary soil types have low infiltration rates, which will greatly limit how often these areas can be used for land application without overloading the soil. Further, the area has many ponds, lakes, and streams. Since land application must occur a distance from these bodies of water, finding suitable land could be challenging. Unionville's northern location is also not ideal for land application. For design purposes, the ground was assumed to be frozen 5 months of the year. Since wastewater cannot be applied to frozen ground, significant storage will need to be added to the lagoons to hold wastewater during the winter months. In summary, no-discharge land application is not a feasible alternative due to the significant cost, land acreage required, soil types, weather conditions, and storage demands. Each of these factors contributes to no-discharge being impractical for Unionville.

4. DOCUMENTATION

4.1 Is any other written correspondence or documentation included with this application to provide further justification for not pursuing a no-discharge option or regionalization?

- ☐ No
- ☑ Yes:
  - ☐ A letter from an existing higher preference continuing authority waiving preferential status where service is not available in accordance with 10 CSR 20-6.0 10 (2) or if capacity is not available.
  - ☐ A letter from the existing higher preference continuing authority stating that the regional facility has no interest in taking flow from the new or expanded facility.
  - ☐ A letter from the regional municipality stating that the project area is outside city limits and annexation would be required.
  - ☐ Council meeting minutes.
  - ☐ Correspondence with land owners regarding easement rights.
  - ☐ Correspondence with land owners regarding land for sale or lease.
  - ☐ Letters from the community or a consulting engineer regarding availability, proximity, and location of suitable land and the reasonable cost of such land.
  - ☑ Documentation of recent land sales or appraisals.
  - ☑ Calculations for sizing a land application system.
  - ☑ Detailed cost estimates for a land application system or regionalization including lift stations, piping, easements, liners, and/or connection costs.
  - ☑ Geohydrologic evaluation or other soils report.
  - ☐ Copy of a county or city ordinance.
  - ☐ Verification of funding from State Revolving Fund, which does not fund projects outside city limits.
  - ☐ Other:

Antidegradation Review Summary Path C: Tier 2 – Significant Degradation

MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM, WATER POLLUTION CONTROL BRANCH

ANTIDEGRADATION REVIEW SUMMARY
PATH C: TIER 2 – SIGNIFICANT DEGRADATION

1. FACILITY

NAME	COUNTY
Unionville South WWTF	Putnam

2. SUMMARY OF THE POLLUTANTS OF CONCERN

Pollutants of Concern to be considered include those pollutants reasonably expected to be present in the discharge per the Antidegradation Implementation Procedure Section II.A. and assumed or demonstrated to cause significant degradation. The tier protection levels are specified and defined in rule at 10 CSR 20-7.031(2).

What are the proposed pollutants of concern and their respective effluent limits that the selected treatment option will comply with:

Pollutants of Concern*	Concentration*		Base Case Limit	Basis (WQS, WLA, ELG, Other)**
	mg/L	µg/L		
BOD_5	X		45 (65)	WQS (10 CSR 20-7.015)
TSS	X		80 (120)	WQS (10 CSR 20-7.015)
Ammonia (Summer)	X		1.6 (11.4) (Daily)	TAN WQBEL AML - See attached
Ammonia (Winter)	X		2.8 (11.1) (Daily)	TAN WQBEL AML - See attached
Total Nitrogen	X		Monitor	WQS (10 CSR 20-7.015)
Total Phosphorus	X		Monitor	WQS (10 CSR 20-7.015)
E. Coli (cfu/100mL)	X		206 (1,134)	WQS (10 CSR 20-7.031)
Monthly (Weekly)				

* Place an X in appropriate box for the concentration units for each Pollutant of Concern

** Provide the Basis for the Base Case Limit: WQS – Water Quality Standard, WLA – Wasteload Allocation, ELG – Effluent Limit Guideline, or describe other.

3. IDENTIFYING ALTERNATIVES

Supply a summary of the non-discharging alternatives considered. "For Discharges likely to cause significant degradation, an analysis of non-degrading and less-degrading alternatives must be provided," as stated in the Antidegradation Implementation Procedure Section II.B.1. These alternatives include no-discharge. Attach all supportive documentation in the Antidegradation Review report.

Feasibility of non-discharging alternatives (regionalization, land application, subsurface irrigation, and recycling or reuse):

The nearest WWTP large enough to consider accepting Unionville's wastewater is approximately 20 miles away in Centerville, IA. This significant distance provides cost, easement, and coordination concerns. In addition to estimated costs totaling approximately $12.7 million, hundreds of easements would need to be signed by land owners between the two cities. These land owners would not benefit from the project, adding additional difficulty to getting signatures. Regionalization would also requires significant coordination efforts with City officials and regulatory agencies from IA and MO. In summary, regionalization is not feasible, primarily due to the exorbitant costs. As an alternative to regionalization, surface land application was considered. This alternative would require approximately 325 acres of land to be obtained by the City. Obtaining this acreage will likely be difficult and costly, with estimates at over $7.7 million. In addition to financial considerations, the topography near Unionville is not ideally suited for surface application. Many of the soils in the region have low infiltration rates and there are many bodies of water nearby that must be avoided. These factors limit usable land area. Additionally, the northern location of Unionville makes it prone to frozen ground for a large portion of the year. This means significant additional storage will need to be added to the lagoons. For these reasons, surface application is not practical.

As an additional alternative for no-discharge, Unionville considered Alternative 3. This alternative will combine the two existing treatment plants in the City and eliminate a point source discharge.

Minimum of three (preferably five or more) discharging alternatives* ranging from less-degrading to degrading including Preferred Alternative (All treatment levels for POCs must at a minimum meet water quality standards):

Discharging Alternative #	Treatment Type	Description
1	Surface Land Application	Land application of wastewater on agricultural land
2	Regionalization	Wastewater would be transported to Centerville, Iowa for treatment
3	Aerated Lagoons and MBBR	Combined WWTP with aeration and MBBR for ammonia removal
4	Aerated Lagoons and MBBRs	Separate WWTPs with aeration and MBBRs for ammonia removal
5	Facultative Lagoons and MBBRs	Separate facilitative WWTPs with MBBRs for ammonia removal
6		

* Same technology may be multiple alternatives as you have the base unit and add to it with more capacity to provide additional treatment.

4. DETERMINATION OF THE REASONABLE ALTERNATIVE

Per the Antidegradation Implementation Procedure Section II.B.2, "a reasonable alternative is one that is practicable, economically efficient and affordable." Provide basis and supporting documentation in the Antidegradation Review report. **Please do not write "See Report" for any box below.**

Practicability Summary:

"The practicability of an alternative is considered by evaluating the effectiveness, reliability, and potential environmental impacts," according to the Antidegradation Implementation Procedure Section II.B.2.a. Examples of factors to consider, including secondary environmental impacts, are given in the Antidegradation Implementation Procedure Section II.B.2.a.

The five alternatives discussed above were evaluated for various factors to address effectiveness, reliability, and environmental impacts. The quantitatively make a comparison of the alternatives, ten criteria were scored on a scale of 1 (poor) to 5 (excellent) with no weighting applied. This allows for a maximum score of 50 points. The point summary for the alternatives are as follows: Surface Land Application - 31 points, Regionalization - 28 points, Aerated Lagoons and MBBR (Combined) - 43 points, Aerated Lagoons and MBBRs (Separate) - 37 points, Facilitative Lagoons and MBBRs (Separate) - 36 points. The analysis also determined that regionalization and land application are not feasible alternatives for the City of Unionville. A more complete analysis is included in the supplemental report.

Economic Efficiency Basis:

What is the design life cycle for the comparison? 20 years

What interest rate was used in the present worth calculations? 2.5%

Economic Efficiency Summary:

Alternatives that are deemed practicable must undergo a direct cost comparison in order to determine economic efficiency. Means to determine economic efficiency are provided in the Antidegradation Implementation Procedure Section II.B.2.b.

Alternative 3 (Aerated Lagoons and MBBR – Combined) has the lowest capital cost and total present worth cost of the alternatives. Therefore, the most economically efficient alternative is Alternative 3 (Aerated Lagoons and MBBR – Combined). This alternative can also serve as the base case of pollution control as it is the most affordable treatment option that can meet NPDES permit requirements. By setting Alternative 3 as the base case, the economic efficiency of the other two alternatives can also be determined. Alternative 4 (Aerated Lagoons and MBBRs – Separate) is approximately 117% of the base case and Alternative 5 (Facultative Lagoons and MBBRs – Separate) is approximately 101% of the base case. Based on this analysis, each of the presented feasible alternatives is economically feasible for the City of Unionville as they are less than 120% of the base case. Further analysis is included in the supplemental report.

TABLE OF THE ALTERNATIVES EVALUATION (Attach additional page if necessary)						
PARAMETERS	Alternatives #					
	1	2	3	4	5	6
BOD_5 – mg/L						
TSS – mg/L						
Ammonia (Summer) – mg/L						
Ammonia (Winter) – mg/L						
E. Coli – #/100 mL						
Total Nitrogen – mg/L						
Total Phosphorus – mg/L						
Construction Cost – $			$6,856,000	$7,830,000	$6,946,000	
Operating Cost – $			$127,000	$167,000	$140,000	
Present Worth – $			$6,937,000	$8,104,000	$7,000,000	
Ratio present worth to base case			1	1.17	1.01	

Affordability Summary:

Alternatives identified as most practicable and economically efficient are considered affordable if the applicant does not supply an affordability analysis. An affordability analysis per the Antidegradation Implementation Procedure Section II.B.2.c, "may be used to determine if the alternative is too expensive to reasonably implement."

The City of Unionville intends to implement the most practical and economically efficient alternative: Alternative 3 (Aerated Lagoons and MBBR – Combined). To make the cost of the needed improvements feasible for City residents, Unionville plans to use several funding sources including an IEPA SRF loan with an affordability grant, American Rescue Plan Act (ARPA) grant funds, and Community Development Block Grant (CDBG) funds for gap financing. See supplemental report for additional information.

Justification for Preferred Alternative:

The selected alternative (Alternative 3) is preferred for a variety of cost and non-cost factors. For one, the proposed project will meet NPDES permit effluent requirements for ammonia, E. coli, and other pollutants with the additional treatment processes proposed. Regulatory compliance is the primary goal of the improvements. By combining the two existing treatment plants into one treatment plant, this alternative also eliminates a point source discharge into a local waterway. This is beneficial for the environment. A singular plant also simplifies the maintenance, operation, and labor requirements of wastewater treatment in Unionville. In addition to these benefits, the proposed improvements have the lowest capital, operating, and present worth costs. The improved treatment will allow Unionville to comply with regulatory requirements and accept additional waste loads from the community. In summary, Alternative 3 will reliably meet the needs of Unionville in terms of treatment, operations, and cost considerations and thus is recommended for implementation.

Reasons for Rejecting the other Evaluated Alternatives:

As shown by this supplemental report and accompanying forms, regionalization and surface land application are not feasible alternatives for the City of Unionville. Two other alternatives (Alternative 4 and Alternative 5) were considered practical and were evaluated for a variety of non-cost and cost factors. This analysis concluded that the alternatives have higher capital, operating, and present worth costs. Additionally, these alternatives would require the operation of two distinct treatment plants within City limits. This is not beneficial from a resource management or environmental protection viewpoint. Based on the cost and non-cost factors discussed in the supplemental report, Alternative 4 and Alternative 5 are not recommended for Unionville.

Comments/Discussion:

N/A

5. SOCIAL AND ECONOMIC IMPORTANCE OF THE PREFERRED ALTERNATIVE

If the preferred alternative will result in significant degradation, then it must be demonstrated that it will allow important economic and social development in accordance to the Antidegradation Implementation Procedure Section II.E. Social and Economic Importance is defined as the social and economic benefits to the community that will occur from any activity involving a new or expanding discharge.

Identify the affected community:

The affected community is defined in 10 CSR 20-7.031(2)(B) as the community "in the geographical area in which the waters are located. Per the Antidegradation Implementation Procedure Section II.E.1, "the affected community should include those living near the site of the proposed project as well as those in the community that are expected to directly or indirectly benefit from the project."

The affected community is the residents of the City of Unionville. This community lives in the area of the two existing wastewater treatment plants and their discharge streams, and thus in the project area. The community of Unionville will also be served by the proposed treatment plant improvements. As a whole, the project will benefit the City of Unionville.

Identify relevant factors that characterize the social and economic conditions of the affected community:

Examples of social and economic factors are provided in the Antidegradation Implementation Procedure Section II.E.1., but specific community examples are encouraged.

The proposed project will impact several important social and economic factors in Unionville. Currently, the City operates two separate wastewater treatment plants within the City of Unionville. Each treatment plant requires individualized labor efforts and operating costs. Further, the two treatment plants discharge into two separate creek tributaries and neither treatment plant is equipped with ammonia treatment or disinfection units.

Describe the important social and economic development associated with the project:

Determining benefits for the community and the environment should be site specific and in accordance with the Antidegradation Implementation Procedure Section II.E.1.

These improvements are beneficial for several reasons. For one, the City can consolidate resources by eliminating the use of one treatment plant. This will lower operation and maintenance costs of the wastewater system and allow for a more appropriate distribution of resources. The proposed treatment improvements will also have benefits for local waterways. By adding additional treatment units, effluent will be treated with ammonia removal and disinfection prior to discharge. In addition, the North Treatment Plant will no longer discharge. As such, the existing receiving stream of the North Treatment Plan will benefit from the proposed project.

The improvements to the wastewater treatment plants will provide necessary infrastructure for community sewage collection and treatment, help protect the environment though better treated effluent discharge, eliminate a point source discharge into North Blackbird Creek, and combine the resources of the two existing treatment plants into one primary wastewater treatment site.

PROPOSED PROJECT SUMMARY:

The City of Unionville currently has two WWTP's with treatment lagoons. The proposed project is to improve the South WWTP in Unionville to accept untreated flow from the North WWTP. This would eliminate discharge from the North WWTP and consolidate the City's resources. The project is discussed in more detail in the following paragraphs.

The project plan includes the abandonment of the North Treatment Plant so that all flow from Unionville can be treated by a singular plant, the South Treatment Plant. Flow from the North Collection System would be conveyed to centralized treatment via a lift station and associated forcemain. The North WWTP will not discharge effluent following the proposed improvements.

The South Treatment Plant will be improved with aeration technology, a moving bed bioreactor (MBBR), and UV disinfection. This will provide significant improvement to the existing treatment process including ammonia removal and disinfection capabilities. The plant will be designed around the combined average flow of the two existing facilities, 0.242 MGD. Effluent will discharge into an unnamed tributary to South Blackbird Creek.

In summary, with the proposed project the City of Unionville will combine treatment plants, eliminate a source of pollution to North Blackbird Creek, and improve wastewater treatment with an MBBR for ammonia removal and UV disinfection.

Attach the Antidegradation Review report and all supporting documentation. This is a technical document, which must be signed, sealed and dated by a registered professional engineer of Missouri.

14. Appendix E: Dissolved Oxygen Modeling

INPUT

1. EFFLUENT CHARACTERISTICS	
Discharge (cfs):	0.3751
CBOD5 (mg/L):	71.587
Ammonia as Nitrogen (mg/L):	9.1
NBOD (mg/L):	41.587
Dissolved Oxygen (mg/L):	5
Temperature (deg C):	26
2. RECEIVING WATER CHARACTERISTICS	
Upstream Discharge (cfs):	0
Upstream CBOD5 (mg/L):	2.0
Upstream NBOD (mg/L):	2
Upstream Dissolved Oxygen (mg/L):	5
Upstream Temperature (deg C):	26
Elevation (ft NGVD):	600
Downstream Average Channel Slope (ft/ft):	0.0002
Downstream Average Channel Depth (ft):	0.3
Downstream Average Channel Velocity (fps):	1.053710771
3. REAERATION RATE (Base e) AT 20 deg C (day^-1): **Applicable value below here:**	207.49

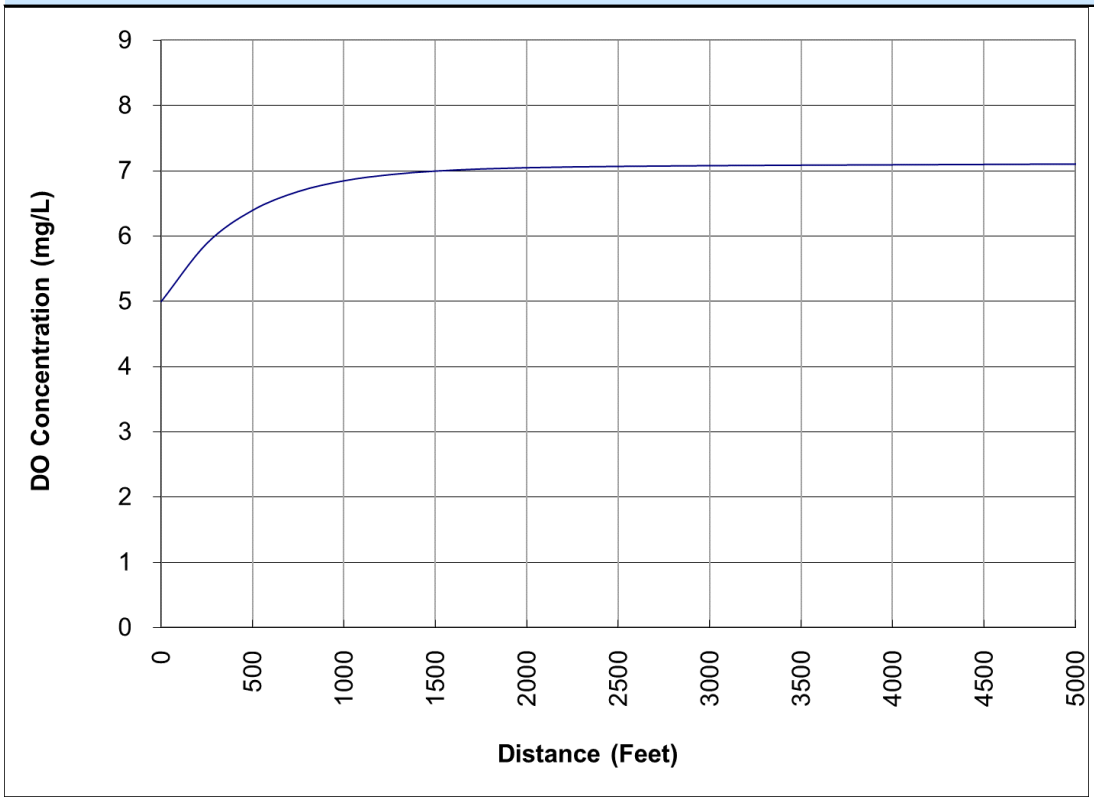
Reference	Applic. Vel (fps)	Applic. Dep (ft)	Suggested Values
Churchill	1.5 - 6	2 - 50	91.46
O'Connor and Dobbins	.1 - 1.5	2 - 50	80.96
Owens	.1 - 6	1 - 2	207.49
Tsivoglou-Wallace	.1 - 6	.1 - 2	1.46

4. BOD DECAY RATE (Base e) AT 20 deg C (day^-1):	1.25

Reference	Suggested Value
Wright and McDonnell, 1979	1.25

OUTPUT

1. INITIAL MIXED RIVER CONDITION	
CBOD5 (mg/L):	71.6
NBOD (mg/L):	41.6
Dissolved Oxygen (mg/L):	5.0
Temperature (deg C):	26.0
2. TEMPERATURE ADJUSTED RATE CONSTANTS (Base e)	
Reaeration (day^-1):	239.22
BOD Decay (day^-1):	1.65
3. CALCULATED INITIAL ULTIMATE CBODU AND TOTAL BODU	
Initial Mixed CBODU (mg/L):	105.3
Initial Mixed Total BODU (CBODU + NBOD, mg/L):	146.9
4. INITIAL DISSOLVED OXYGEN DEFICIT	
Saturation Dissolved Oxygen (mg/L):	7.941
Initial Deficit (mg/L):	2.94
5. TRAVEL TIME TO CRITICAL DO CONCENTRATION (days):	0.000000
6. DISTANCE TO CRITICAL DO CONCENTRATION (feet):	0.00
7. CRITICAL DO DEFICIT (mg/L):	2.94
8. CRITICAL DO CONCENTRATION (mg/L):	5.00



MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM

APPLICATION FOR CONSTRUCTION PERMIT – WASTEWATER TREATMENT FACILITY

FOR DEPARTMENT USE ONLY	
APP NO.	CP NO.
FEE RECEIVED	CHECK NO.
DATE RECEIVED	

APPLICATION OVERVIEW

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

PART A – BASIC INFORMATION

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

1.1 Is this a Federal/State funded project? ☑ YES ☐ N/A Funding Agency: DNR-ARPA Project #: DNR-WW-AE89A7A29A83

1.2 Has the Missouri Department of Natural Resources approved the proposed project's antidegradation review?
☑ YES Date of Approval: 100722 ☐ N/A

1.3 Has the department approved the proposed project's facility plan*?
☑ YES Date of Approval: 081522 ☐ NO (If No, complete No. 1.4.)

1.4 [Complete only if answered No on No. 1.3.] Is a copy of the facility plan* for wastewater treatment facilities included with this application?
☐ YES ☐ NO ☐ Exempt because _____

1.5 Is a copy of the appropriate plans* and specifications* included with this application?
☑ YES Denote which form is submitted: ☐ Hard copy ☑ Electronic copy (See instructions.) ☐ NO

1.6 Is a summary of design* included with this application? ☑ YES ☐ NO

The permit applications, summary of design, plans, and specifications have all been emailed to the agency with this application. Hard copies are available upon request.

1.7 Has the appropriate operating permit application (A, B, or B2) been submitted to the department?
☐ YES Date of submittal: _____
☑ Enclosed is the appropriate operating permit application and fee submittal. Denote which form: ☐ A ☐ B ☑ B2
☐ N/A: However, In the event the department believes that my operating permit requires revision to permit limitation such as changing equivalent to secondary limits to secondary limits or adding total residual chlorine limits, please share a draft copy prior to public notice? ☐ YES ☐ NO

1.8 Is the facility currently under enforcement with the department or the Environmental Protection Agency? ☐ YES ☑ NO

1.9 Is the appropriate fee or JetPay confirmation included with this application? ☑ YES ☐ NO See Section 7.0

The city has mailed the construction and operating permit fees separately to the agency on one check.

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

2.0 PROJECT INFORMATION

2.1 NAME OF PROJECT
Phase I - Wastewater Treatment System Improvements

2.2 ESTIMATED PROJECT CONSTRUCTION COST
$ 1,595,003

2.3 PROJECT DESCRIPTION
Phase I includes the installation a master lift station will be constructed to collect flow currently being received by the North Treatment Plant. From the lift station, a corresponding forcemain will convey flow to the South Treatment Plant.

2.4 SLUDGE HANDLING, USE AND DISPOSAL DESCRIPTION
The contractor will be handling sludge removal and perform all permitting necessary.

2.5 DESIGN INFORMATION

A. Current population: 1865 ; Design population: 2420

B. Actual Flow: _____ gpd; Design Average Flow: 242,000 gpd;
Actual Peak Daily Flow: _____ gpd; Design Maximum Daily Flow: 2,150,000 gpd; Design Wet Weather Event: _____

2.6 ADDITIONAL INFORMATION

A. Is a topographic map attached? ☑ YES ☐ NO

B. Is a process flow diagram attached? ☑ YES ☐ NO

3.0 WASTEWATER TREATMENT FACILITY

NAME	TELEPHONE NUMBER WITH AREA CODE	E-MAIL ADDRESS
Unionville South Wastewater Treatment Facility	660-947-2437	unionwtr@nemr.net

ADDRESS (PHYSICAL)	CITY	STATE	ZIP CODE	COUNTY
1/3 mile east of Garfield and 8th St. Int.	Unionville	MO	63565	Putnam

Wastewater Treatment Facility: Mo- 0026646 (Outfall Of)

3.1 Legal Description: SE ¼, SW ¼, SE ¼, Sec. 36, T 66N, R 19W
(Use additional pages if construction of more than one outfall is proposed.)

3.2 UTM Coordinates Easting (X): 500872 Northing (Y): 4481733
For Universal Transverse Mercator (UTM), Zone 15 North referenced to North American Datum 1983 (NAD83)

3.3 Name of receiving streams: Unnamed tributary to South Blackbird Creek

4.0 PROJECT OWNER

NAME	TELEPHONE NUMBER WITH AREA CODE	E-MAIL ADDRESS
City of Unionville	660-947-2437	unionwtr@nemr.net

ADDRESS	CITY	STATE	ZIP CODE
1611 Grant Street	Unionville	MO	63565

5.0 CONTINUING AUTHORITY: A continuing authority is a company, business, entity or person(s) that will be operating the facility and/or ensuring compliance with the permit requirements.

NAME	TELEPHONE NUMBER WITH AREA CODE	E-MAIL ADDRESS
City of Unionville	660-947-2437	unionwtr@nemr.net

ADDRESS	CITY	STATE	ZIP CODE
1611 Grant Street	Unionville	Mo	63565

5.1 A letter from the continuing authority, if different than the owner, is included with this application. ☐ YES ☐ NO ☑ N/A

5.2 COMPLETE THE FOLLOWING IF THE CONTINUING AUTHORITY IS A MISSOURI PUBLIC SERVICE COMMISSION REGULATED ENTITY.

A. Is a copy of the certificate of convenience and necessity included with this application? ☐ YES ☐ NO

5.3 COMPLETE THE FOLLOWING IF THE CONTINUING AUTHORITY IS A PROPERTY OWNERS ASSOCIATION.

A. Is a copy of the as-filed restrictions and covenants included with this application? ☐ YES ☐ NO

B. Is a copy of the as-filed warranty deed, quitclaim deed or other legal instrument which transfers ownership of the land for the wastewater treatment facility to the association included with this application? ☐ YES ☐ NO

C. Is a copy of the as-filed legal instrument (typically the plat) that provides the association with valid easements for all sewers included with this application? ☐ YES ☐ NO

D. Is a copy of the Missouri Secretary of State's nonprofit corporation certificate included with this application? ☐ YES ☐ NO

6.0 ENGINEER

ENGINEER NAME / COMPANY NAME	TELEPHONE NUMBER WITH AREA CODE	E-MAIL ADDRESS
C. Cameron Jones, PE - Benton & Associates, Inc.	217-245-4146	cjones@bentonassociates.com

ADDRESS	CITY	STATE	ZIP CODE
1970 W. Lafayette Ave	Jacksonville	IL	62650

7.0 APPLICATION FEE

☑ CHECK NUMBER ☐ JETPAY CONFIRMATION NUMBER

8.0 PROJECT OWNER: I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

PROJECT OWNER SIGNATURE

PRINTED NAME	DATE
Charley Bill Pittman	5/2/2024

TITLE OR CORPORATE POSITION	TELEPHONE NUMBER WITH AREA CODE	E-MAIL ADDRESS
Mayor	660-947-2437	lcaley@nemr.net

Mail completed copy to: MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM
P.O. BOX 176
JEFFERSON CITY, MO 65102-0176

END OF PART A.
REFER TO THE APPLICATION OVERVIEW TO DETERMINE WHETHER PART B NEEDS TO BE COMPLETE.