Dewberry

TECHNICAL MEMORANDUM 2

Date: April 17, 2020

To: City of Louisville, Brue Baukol

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Subject: City of Louisville and Redtail Ridge Wastewater Pumping and Treatment Infrastructure – Subject to Revision

INTRODUCTION

Redtail Ridge, a proposed development in southeastern Louisville, will produce a projected 631,550 gallons per day (annual average) at a projected peak hour flow of 2 million gallons per day at completion of their four phase buildout plan. A breakdown of the projected flows and loads by Phase is provided in the "City of Louisville and Redtail Ridge Development Flows and Loads" Technical Memorandum 1.

The intent of this technical memorandum (TM) is to identify the pumping and treatment infrastructure needed for the Redtail Ridge development to (1) lift the wastewater produced in the development into the City's collection system and (2) the treatment infrastructure needed at the City's Wastewater Treatment Plant (WWTP) to treat the developments wastewater. This TM includes the following:

- Capacity evaluation of existing WWTP
- Proposed list of wastewater pumping and infrastructure needs
- Preliminary opinion of probable construction costs
- List of regulatory requirements including duration of effort
- Preliminary project design and construction schedule (including regulatory requirements)

WWTP Capacity

The City of Louisville recently upgraded their WWTP to a biological nutrient removal (BNR) facility that is rated for 2.53 million gallons per day (mgd) and 5,515 pounds per day (ppd) of BOD_5. The improvements at the WWTP included several items to improve resiliency at the WWTP by providing redundancy for key pieces of process equipment. This allows Plant Operations staff the flexibility to address maintenance needs while still providing full treatment and allows the Staff to perform proactive preventative maintenance to reduce the potential of emergency repairs.

The WWTP consists of a headworks, secondary treatment, tertiary (reuse) filtration, ultraviolet (UV) disinfection, and solids handling. The headworks includes mechanical and manual bar screens, grit removal, grit washing, and influent flow measurement. After the headworks, the wastewater enters the influent lift station that pumps the wastewater up into the secondary process. The secondary process includes Johannesburg treatment trains, a pump station [with return activated sludge (RAS), waste activated sludge (WAS), internal mixed liquor return (IMLR), and scum pumps), blowers, secondary clarifiers, and a backup alum system. Solids handling processes consist of a rotary drum thickener (for

WAS thickening), aerobic digestion, and centrifuge dewatering. A process flow diagram for the WWTP is provided in **Figure 1**.

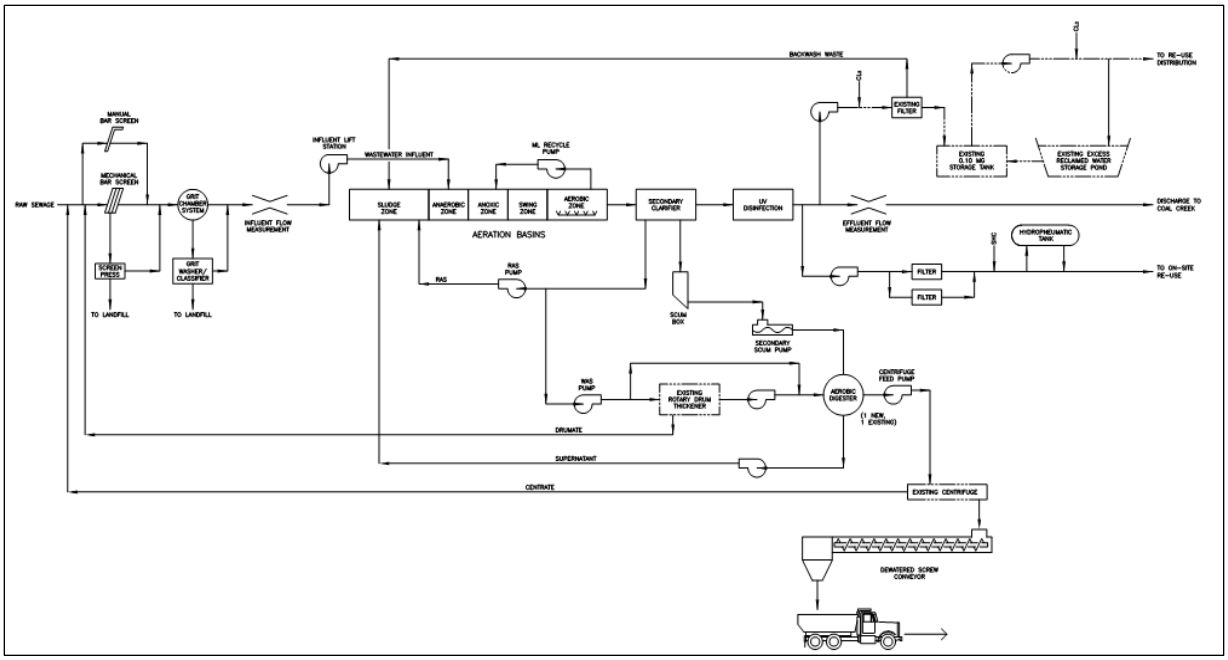

Figure 1 - City of Louisville WWTP Process Flow Diagram

The results of the capacity analysis are provided in the attached **Table 1**. **Table 1** is broken down into the various unit processes at the WWTP: headworks, influent lift station, secondary process, disinfection, solids handling, and reuse. A brief summary of the information in **Table 1** by unit process is in the bullet list below.

- **Headworks.** The headworks consists of screens, grit removal and handling, and influent flow measurement. All installed equipment has sufficient capacity to handle the projected flows and additional flows and loads from the Redtail Ridge development.
- **Influent Lift Station.** The influent lift station was designed to accommodate only the projected flows and loads listed in the 2014 Facility Plan. The additional flows from the Redtail Ridge development exceed the projected flows and loads for all future City development and will require construction of a new lift station.
- **Secondary Process.** This unit process consists of Johannesburg treatment process, secondary clarifier, and process equipment. The existing facility was designed to require the operation of all three treatment trains at the projected City of Louisville buildout conditions (2014 WWTP Facility Plan). The projected additional flows and loads from Redtail Ridge will exceed the current capacity of the secondary process and City's desired level of redundancy.

- **Disinfection.** The WWTP currently utilizes ultraviolet (UV) disinfection. This unit process currently has double redundancy; it has redundancy in each channel (one redundant module per channel) and a redundant channel. If this desired level of redundancy is desired to be maintained, the system will need to be upgraded.
- **Solids Handling.** Solids handling includes WAS thickening with a rotary drum thickener (RDT), aerobic digestion, and biosolids dewatering via centrifuge. The current thickening and dewatering processes do not utilize all of their respective capacity but have no redundancy. With the additional flows and loads from Redtail Ridge, additional burden will be placed on operations staff due to the lack of redundancy and these processes should be expanded to improve redundancy. The aerobic digester only has capacity for the current projected buildout flows; the sludge storage tank provides additional biosolids storage prior to dewatering. The additional wastewater flow and load from Redtail Ridge exceed the projected flows and loads for all future City development and would require construction of additional digester space.
- **Reuse.** The reuse system consists of feed pumps, filters, and distribution pumps. The current system is maxed out during the summer irrigation season and will require additional pumping and filtration infrastructure if Redtail Ridge desires to reuse water for irrigation.

Wastewater Pumping and Treatment Infrastructure Needs

The following wastewater pumping and treatment infrastructure will be needed to pump and treat the projected wastewater flows and loads from Redtail Ridge into the City's collection system and WWTP.

- Lift station at the development capable of pumping a peak hour capacity of 2 mgd.
- Lift station at the WWTP (downstream of the headworks and upstream of secondary process) with a peak hour capacity of 6.6 mgd (existing peak hour flow of 4.58 mgd + 2 mgd from Redtail Ridge)
- Johannesburg process basin matching existing to be located adjacent to train 3.
- Secondary clarifier matching existing.
- Process equipment including one RAS pump, one WAS pump, scum pumps, one IMLR pump, diffusers, and instrumentation to match existing. No additional structures will be needed; all equipment will be in existing structures or in the new process basin.
- Aerobic digester to match existing. New digester will provide capacity and storage to match the current operations of digestion and storage. Projected flows and loads from Redtail Ridge will account for approximately 1/3 of the volume of the new digester. The remaining volume will serve as "storage volume" or as additional capacity.

The following infrastructure is needed to address redundancy concerns that arise of the additional wastewater flow and load from the proposed Redtail Ridge development.

- **UV Disinfection.** The existing system has double redundancy (modules and channels). If the regulatory required redundancy is followed (redundant channel), no upgrades are required. If the

current level of redundancy is desired, channel modifications and new UV equipment will be required. Per discussion on February 5, 2020, the regulatory redundancy requirement is sufficient and the City will not require the double redundancy requirement on UV disinfection.

- **WAS Thickening.** The increase in flows and loads will place increased demands on operations staff and will increase the need for redundancy in WAS thickening. WAS thickening is required to minimize aerobic digester size, e.g. lower concentration of WAS solids requires an increased digester volume. To address this need, it is recommended a redundant RDT and TWAS pump be installed at the WWTP. Alternatively, the digester contents could be thickened in the digester via settling and decanting off the supernatant. Infrastructure for settling and decanting will require less capital cost, but would be significantly more costly to operate due to the additional man power required.
- **Biosolids Dewatering**. Like WAS thickening, the WWTP lacks redundancy in the dewatering process. With an increased load coming into the WWTP from Redtail Ridge, there will be an increased burden on Plant Staff to maintain the current level of operations which will reduce the maintenance opportunities. Due to the importance of this process on plant operations, it is recommended that a redundant dewatering unit be installed at the WWTP. This will require a new structure. The new structure would contain two new centrifuges, outdoor truck discharge, and conveyor system. This dewatering will be similar to the City's existing dewatering process.
- **Reuse.** The existing Reuse system (pumping and filtration) is maxed out at the City's current projected reuse demands. If Redtail Ridge desires to utilize reuse water for irrigation, the current reuse pumping and filtration systems will need to be upgraded as well as the extension of the system to Redtail Ridge (reuse distribution is beyond the scope of this memo). Redtail Ridge will not be utilizing reuse water for irrigation and no infrastructure improvements will be required as a result of the Redtail Ridge development.

Preliminary Opinion of Probable Construction Costs

Table 2 below presents planning level preliminary opinion of probable construction cost for the improvements listed in the previous section. Our construction cost opinions are based on the quantities of raw materials, construction labor, major equipment, supplies, excavation, and contractor's markup for overhead and profit. Dewberry developed opinions of probable construction from recently completed projects, published literature, and equipment manufacturer's quotations.

The itemized opinion of probable construction cost contain contingencies to allow for unknown or uncertain conditions. At present, many project components and details cannot be determined. The contingency factor accounts for hidden or unknown physical conditions such as conflicting utilities and construction details which cannot be identified, predicted, or accurately estimated but are likely to occur based on experience with similar projects. Contingencies vary with the level of detail associated with the planning, budgeting, or design process. As a project becomes more defined, unknowns are identified and contingency factors decrease. The construction cost estimates represent Class IV estimate as defined by the American Association of Cost Engineers (AACE) with a relative accuracy of minus 30 percent to plus 50 percent. The level of accuracy will improve as the project progresses from planning into design.

Based on the current level of uncertainty associated with this project, a contingency factor of 25 percent of estimated construction costs has been assumed. Cost factors given in **Table 2** have been added to the materials and equipment costs to develop total project costs for each alternative.

Table 2 Cost Factors Used to Develop Preliminary Opinion of Probable Construction Cost

Cost Factor	Percent of Construction	Description
Mobilization/ demobilization	3	Contractor cost
Contractor overhead & profit	15	Markup on subcontracts, materials, & labor
Bonding and insurance	2	Contractor cost
Contingencies	25	Unknown conditions & conflicting utilities
Planning, Engineering, and Administration	18	Planning, design, survey, geotechnical investigation, construction observation, training, O&M manual, startup services

A summary of preliminary estimate of probable construction costs by unit process is provided in **Table 3**. As shown in **Table 3**, the preliminary estimate of probable construction costs for all the infrastructure improvements listed in this TM is $20.1 million while the estimated total project cost is $23.8 million. Total project costs include planning, design engineering, geotechnical, regulatory review costs, construction oversight and engineering services, startup, training, and operation and maintenance manual preparation.

Table 3 Preliminary Opinion of Probable Construction Cost and Total Project Costs

Item	Preliminary Opinion of Probable Construction Cost	Total Project Cost
Required Infrastructure		
Offsite Lift Station	$3,083,000	$3,638,000
WWTP - Lift Station	$1,978,000	$2,334,000
WWTP - Johannesburg Process	$3,965,000	$4,679,000
WWTP - SPPS	$679,000	$801,000
WWTP - Secondary Clarifier	$1,979,000	$2,335,000
WWTP - Aerobic Digester	$3,370,000	$3,997,000
Subtotal	**$15,054,000**	**$17,764,000**
Infrastructure That Addresses Redundancy Or Other Needs		
WWTP - RDT	$795,000	$938,000
WWTP - Dewatering	$4,288,000	$5,060,000
Subtotal	**$5,083,000**	**$5,998,000**
Infrastructure Required WWTP Infrastructure	**$20,137,000**	**$23,762,000**

Table 3 Clarifications and Notes

Table 3 lists planning level construction and total project costs for the offsite lift station (no conveyance costs included) and additional treatment infrastructure required at the WWTP to accommodate the projected wastewater flows and loads from Redtail Ridge (see TM1). Below are additional notes to clarify the infrastructure improvements.

- The required improvements in Table 3 will increase the capacity of the WWTP to 3.53 mgd and 8,968 ppd (5,515 ppd current, 1,211 ppd from train 3 currently not included in permitted capacity, and 2,242 ppd from new train 4 for Redtail Ridge) of BOD_5. Final permitted capacity may vary slightly and will be determined prior to submission of the site application.
- BOD_5 capacity is based upon information presented in the Process Design Report for the original improvements. New data (influent and operational) will be incorporated into the process model during design to determine if BOD_5 capacity per train can be increased.
- With the improvements, the WWTP would have approximately 0.2 mgd and 365 ppd BOD_5 in excess capacity in the secondary process (aeration basins, secondary clarifiers, and SPPS equipment) that will go unused by Redtail Ridge. Under max month conditions, the Redtail Ridge development is projected to produce 0.8 mgd and 1,877 ppd BOD_5 while the capacity of a secondary treatment train is 1 mgd and 2,242 ppd BOD_5.
- The new digester will match size and dimensions of the existing for ease of operations. The size of the new aerobic digester will exceed the volume required to accommodate projected Redtail Ridge flow and loads. The additional volume will replace the existing sludge storage tank volume (0.56 million gallons) and will provide an additional volume (e.g. excess capacity) of 0.3 million gallons.
- The UV system currently has double redundancy; it has redundancy in the number of modules per channel and the number of channels. Even with the projected flows from Redtail Ridge, no expansion or modification of this system would be required to meet regulatory redundancy requirements.
- WAS Thickening with RDTs is recommended for inclusion. Incorporation of an RDT has a higher capital cost than manual digester decanting, but significantly lower operation and maintenance cost.
- The proposed dewatering system includes two new centrifuges, polymer system, conveyors, and an outdoor truck bay. If an indoor truck back for loading biosolids is desire, the construction cost will increase by $1 million.

List of Regulatory Requirements Including Duration of Effort

The infrastructure improvements will require two separate regulatory review processes: (1) for the offsite lift station and force main, and (2) for the WWTP improvements. The offsite lift station and WWTP improvements have similar regulatory review processes with a couple of minor differences. The two differences are that (1) the WWTP will require a preliminary effluent limit (PEL) request prior to submitting the site application and (2) the WWTP requires a process design report (PDR) while the lift station will required a basis of design (BDR) report. The WWTP site application (with the PEL request) can be a

long duration item and can impact the project schedule. **Table 4** provides a summary of preparation and review time for each regulatory submittal.

Table 4 Regulatory Review Periods for Offsite Lift Station and the WWTP Improvements

Item	Preparation Time, days	Regulatory Review, days	Total Estimated Time, months
Request Preliminary Effluent Limits	7	60	2.5
Site Application (22.5 for WWTP and 22.7 for Lift Station)	21	60 - local agency review 67 - CDPHE	5
Basis of Design Report (Offsite Lift Station)	30	60	3
Process Design Report (WWTP Improvements)	60	60	4

Note: Dewberry will either perform a streamlined review of the final design documents or will self-certify the design. This steps eliminates a 60 day regulatory review period of the final design documents.

Preliminary Project Design and Construction Schedule

A preliminary project schedule is summarized in **Table 5**. As shown in **Table 5**, the total project duration for the offsite lift station is 25 months while the total project duration for the WWTP improvements is four years (48 months). This project duration could be reduced if alternative delivery is incorporated.

Table 5 Preliminary Project Schedule

Item	Duration, Months
Offsite Lift Station	
Site Application (prep and CDPHE review)	(5) Five Months
30 Percent Design	(2) Two Months
Basis of Design Report	(3) Three Months
Remainder of Design	(6) Six Months
Total Design (Site App, Design, BDR)	(10) Ten Months (requires sequencing of regulatory deliverables)
Bidding	(3) Three Months
Construction	(12) Twelve Months
Total Project Duration	(25) Twenty Five Months
WWTP Infrastructure	
PEL	(2.5) Two and one-half months
Site Application	(5) Five Months
30 Percent Design	(4) Four Months
PDR (prep and regulatory review)	(4) Four Months

Remainder of Design	(12) Twelve Months
Total Design (PEL, Site App, PDR, Design)	(20) Twenty Months (requires sequencing of regulatory deliverables)
Bidding	(4) Four Months
Construction	(24) Twenty Four Months
Total Project Duration	(48) Forty Eight Months

The offsite lift station will need to be the first new piece of infrastructure constructed. It will need to be constructed and operational prior to completion of any occupied structures in Redtail Ridge.

The Redtail Ridge development currently includes four phases. The development for each phase was recently revised and it impacted the flow and load projections (see Tables 6 and 7 of TM1). The revised development plan increased the projected flows in Phase 1 to 0.38 mgd (up from 0.17 mgd). The projected wastewater flow from Phase 1 would result push the WWTP to operating near capacity. Therefore, it is recommended that the improvements at the WWTP be designed and constructed concurrently with the Redtail Ridge Phase 1 development improvements.

Summary

Dewberry has provided this memorandum to inform the City and the Developer about the existing capacity of the City's WWTP and its ability to accommodate future wastewater flow and loads from the proposed Redtail Ridge development. This memorandum covered the following topics:

- Capacity evaluation of existing WWTP
- Proposed list of wastewater pumping and infrastructure needs
- Preliminary opinion of probable construction and total project costs
- List of regulatory requirements including duration of effort
- Preliminary project design and construction schedule (including regulatory requirements)
- All WWTP improvements will need to be designed and constructed concurrently with the Redtail Ridge Phase 1 development improvements.
- Additional input is needed in regards to the desired dewatering improvements.

The total time of regulatory reviews is nearly 14.5 months and reviews are sequenced in the order of completion. The estimated construction cost for a new lift station and for additional infrastructure required is approximately $23.8 million dollars. The schedule includes 25 months for the offsite lift station and 48 months for the WWTP expansion.

Table 1 City of Louisville WWTP Capacity Analysis by Unit Process

Unit Process	Total No. of Units	Units in Operation	Capacity per Unit	Firm Capacity	City Desired Redundancy	Regulatory Required Redundancy	Total Capacity	Units	Permitted Capacity	Current Average Use (see Units)	Percent Permitted Capacity Currently Utilized	At Buildout, percent permitted capacity utilized	Comments
HEADWORKS													
Screens													
Mechanical Screens	2	1	4.6	9.20	4.6		9.2	MGD					
Manual Bar Screen	1	1	10	10			10	MGD					Manual bar screen is the redundancy for the mechanical bar screen
Screens Total	3	1	see above	9.2	9.2	4.6	9.2	MGD	4.58	1.8	42%	50%	Screens are sized based upon peak hour flows.
Grit System	2	1	4.6	4.6	4.6	N/A	9.2	MGD	4.58	1.8	42%	50%	Not required by CDPHE, but recommended.
Flow Measurement - Flume	1	1	10.41	10.41	0	Effluent Flume	10.41	MGD	4.58	1.8	38%	44%	Flow measurement is sized based upon peak hour flows
INFLUENT LIFT STATION													
Sewage Lift Pumps	5	4	795	3,180	795		3,975	gpm		1.8	85%	100%	Peak hour flow
SECONDARY PROCESS													
Aeration Basins	3	2	1.27	2.54	1.27		2.53	MGD	2.53	0	0%	100%	
	3	2	2,242	5,515	1,211		5,515	ppd BOD	5,515	4,502	82%	100%	
Secondary Clarifiers	3	2	1.27	2.54	1.27		2.53	MGD	2.53	1.8	71%	100%	
Alum System	3	3	2.28	4.56	2.28	Bio P removal	6.84	MGD	4.58	3.91	86%	67%	
DISINFECTION													
Modules	3	2	2.3	4.6	2.3	4.56	6.9	MGD	4.56	3.91	86%	100%	Peak hour flow
Channels	2	1	6.9	6.9	6.9	4.56	6.9	MGD	4.56	3.91	86%	100%	Peak hour flow
UV Total	2 channels	1	6.9	6.9	6.9	4.56	6.9	MGD	4.56	3.91	86%	100%	Peak hour flow
Flow Measurement - Flume	1	1	10.41	10.41	0	Influent flume	10.41	MGD	4.56	1.8	38%	44%	Peak hour flow
SOLIDS HANDLING													
Aeration Digester													
Aerobic Digester 1 (Flow Equivalent)	1	1	2.53	2.53	1.2	Dewater and landfill	2.53	MGD	2.53	1.8	71%	100%	Flow equivalent basis. Current Digester has capacity to handle current permitted capacity.
Sludge Holding Basin (Aerobic Digester 2 Flow Equivalent)	1	1	1.2		SHB is digester City Desired Digester Redundancy		1.2	MGD	1.2	1.8			Flow equivalent basis.
Thickening and Dewatering													
Rotary Drum Thickener	1	1	200	0	200	Not Required	200	gpm	200	50	25%	50%	Units are gpm. There is no backup unit. City desires redundancy
Centrifuge	1	1	100	0	110	Not Required	110	gpm	110	110	50%	75%	Units are hours per day. Currently dewater 3 days per week. There is no backup unit. City desires redundancy.
REUSE													
Filter	1	1	1,400	0	200	Not. Required	1	gpm	1,400	700	50%	100%	Operating capacity of filter is truly only about 1 MGD.
Pumps	2	2	1,400	700	700	Not. Required	110	gpm	700	700	100%	100%	

Note: Buildout as defined in the 2014 Facility Plan.

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