SECTION 6
WASTEWATER TREATMENT ASSETS

6.01 INTRODUCTION

Shepherdsville wastewater treatment plant (WWTP) has a design flow capacity of 5.04 million gallons per day (mgd). The Shepherdsville WWTP is currently operating at approximately 40 percent of the design flow capacity, treating wastewater from domestic, commercial, and industrial sources. In order to maintain compliance with regulatory requirements, the Shepherdsville WWTP must evaluate their current facilities to ensure it is operating within the designed capacity and capable of reliably meeting effluent limitations. If the facility reaches 90 percent of the design capacity, the Kentucky Division of Water (KDOW) will require the Shepherdsville WWTP to begin facilities planning for expansion. A Facilities Plan is currently not required for Shepherdsville WWTP. KDOW also requires communities who have not updated their Facilities Plan for 10 years to develop an Asset Inventory. Shepherdsville elected to prepare an Asset Inventory for submittal to KDOW. This report is one part of a more comprehensive Asset Management Plan.

This report section will provide an overview of the Shepherdsville WWTP. Regulatory permits and compliance with those permits will be discussed. A review of operations at Shepherdsville WWTP will be documented with specific recommendations. Shepherdsville WWTP flows and loadings will be reviewed relative to the 90 percent threshold that requires facilities planning. In a similar way, the flow and loadings from Shepherdsville's largest industrial customer, Jim Beam Distillery (Beam) will be reviewed. The details of the WWTP asset condition assessment will be summarized. Lastly, the needs identified over the next 10 years will be documented.

6.02 EXISTING TREATMENT PLANT

The existing Shepherdsville WWTP is located on the southwest edge of Shepherdsville, along the south bank of the Salt River. The Shepherdsville WWTP has been located on this site since the 1970s. Major upgrades to the Shepherdsville WWTP have been constructed in 1984, 2004, and 2013. The 1984 project added a new circular steel package treatment plant to supplement the existing aeration tanks and final clarifier. The 2004 additions converted the existing aeration tanks into sludge storage tanks and added a new headworks building with mechanical screening, a single oxidation ditch, two final clarifiers, UV disinfection, post aeration and a new larger outfall sewer. The capacity of the facility following this upgrade was reportedly 2.2 mgd average daily flow and 5.74 mgd peak hourly flow. The 2013 project included a biological system expansion using an Integrated Fixed-film Activated Sludge process (IFAS). The 2013 expansion also included a new final clarifier, a second RAS pumping station and new dewatering facilities. The capacity of the plant following this project was listed as 5.04 mgd average daily flow and approximately 12 mgd peak hourly flow. Provisions were planned for a future upgrade to increase the peak hourly flow to 22.705 mgd when additional final clarifiers are constructed.

An aerial site plan of the Shepherdsville WWTP can be seen on Figure 6.02-1. Shepherdsville property limits are shown on the site plan. A schematic of the unit processes is shown in Figure 6.02-2 and a site plan is provided in Figure 6.02-3. Overall Shepherdsville WWTP design criteria are presented in Table 6.02-1 and unit process design criteria are listed in Table 6.02-2.

TABLE 6.02-1 EXISTING WWTP DESIGN CRITERIA

Design Influent Flows

	Domestic (mgd)	Industrial (mgd)	TOTAL (mgd)
Average Daily Flow	4.78	0.26	5.04
Peak Hourly Flow	11.74	0.26	12.0

Design Influent Loadings

	Domestic		Industrial		TOTAL LOADING (lb/d)
	Concentration (mg/L)	Loading (lbs/d)	Concentration (mg/L)	Loading (lbs/d)	
BOD_5	280	11,160	2,600	5,640	16,800
TSS	250	9,970	190	410	10,380
NH_3-N	19	760	2	4	764
TKN	36	1,435	4	9	1,444
P	3	120	11	24	144

TABLE 6.02-2 EXISTING WWTP–UNIT PROCESS DESIGN CRITERIA

Influent Flow Measurement

Influent Flow Meter	1
Type of Meter	Mag Meter
Size	30 inch
Velocity at Design Average Flow	1.6 feet per second (ft/s)
Capacity	114.0 mgd

Influent Screening

Number of Channels	2
Number of Mechanically Cleaned Screens	1
Design Capacity	18.0 mgd
Screen Opening	1/4 inch
Number of Manually Cleaned Screens	1
Design Capacity	18.0 mgd
Screen Opening	1 inch

Biological Treatment Process

Oxidation Ditch	1
Total Effective Aeration Volume	1.8 million gallons (mil gal)
Number of Aerators	2
Aerator Horsepower	150 hp each
Design Influent Loadings	30 percent
BOD Loadings	21.0 pounds per 1,000 cubic feet (lbs/1,000 ft^3)
Hydraulic Detention Time	28.6 hours at average daily flow (hrs @ ADF)

IFAS System	1
Total Effective Aeration Volume	1.8 mil gal
Aeration Diffuser Type	Fine Bubble
Design Influent Loadings	70 percent
BOD Loadings	49.0 lbs/1,000 ft^3
Hydraulic Detention Time	12.2 hrs @ ADF

Secondary Clarifiers

Number of Units	3 (2 existing small + 1 existing large)
Clarifier Diameter	88 feet per large clarifier 62 feet per small clarifier
Total Surface Area	12,120 square foot (ft^2)
Surface Loading Rate	416 gallons per day per square foot at ADF (gpd/ft^2 @ ADF) 990 gallons per day per square foot at peak hourly flow (PHF) (gpd/ft^2 @ PHF)
Solids Loading Rate (at 3,000 milligrams per liter mixed liquor suspended solids [mg/L MLSS])	
@ 5.0 mgd + 5.0 mgd RAS	20.6 lbs per day per square foot (lbs/d/ft^2)
@ 12.0 mgd + 5.6 mgd RAS	36.3 lbs/d/ft^2

RAS Pump Station No.1

Type of Pump	Submersible
Number of Pumps	3
Design Capacity	975 gallons per minute (gpm) each
Firm Capacity	2.8 mgd (with 2 pumps in operation)
RAS Capacity	111 percent of ADF (with Clarifiers 1 and 2 treating 50 percent of forward flow)

RAS Pump Station No.2

Type of Pump	Submersible
Number of Pumps	2
Design Capacity	1,950 gpm each
Firm Capacity	2.8 mgd (with 1 pump in operation)
RAS Capacity	111 percent of ADF (with Clarifier 3 treating 50 percent of forward flow)

UV Disinfection

Number of Channels	2
Number of UV Disinfection Units	4 (2 banks per channel)
UV Transmittance	65 percent
Design Capacity, each Channel	11.5 mgd
Total Capacity	23.0 mgd

Effluent Flow Measurement

Effluent Flow Meter	1
Type of Meter	Mag Meter
Size	36 inch
Velocity at Design Average Flow	1.1 ft/s
Capacity	166.0 mgd

Post Aeration System

Total Post Aeration Volume	80,000 gal
Aeration Diffuser Type	Fine Bubble
Hydraulic Detention Time	23 minutes @ ADF

Post Aeration Air Supply

Number of Blowers	2
Blower Capacity (ea.)	320 standard cubic feet per minute (scfm)
Design Aeration Rate	30 scfm/1,000 ft^3
Drive Type	Constant Speed

Biosolids Holding

Number of Tanks	4 (1 for hauled waste and scum, 3 for waste sludge)
Volume of Each Tank	87,000 gallons
Total Volume	348,000 gallons
Type of Aeration	Coarse Bubble Diffusion
Design Mixing	30 scfm/1,000 ft^3

Sludge Dewatering

Type	Belt Filter Press
Number	2 (existing)
Size	2.0 meter belt
Solids Capacity	5,000 pounds per hour (lbs/hr) per each press
Liquid Capacity	300 gpm per each press

Sludge Feed Pumps

Number	2 (1 per each press)
Type	Centrifugal
Size	300 gpm each pump
Control	Variable Speed Drive

6.03 PERMITS

A. KPDES Permit

The current KPDES permit for the Shepherdsville WWTP became effective October 1, 2018 and will remain effective until September 30, 2023. A listing of effluent limits for conventional pollutants are provided in Table 6.03-1.

Table 6.03-1 KPDES Permit Limits (KY00207359)

Parameter	Units	Loadings (lbs/day)		Concentrations (Units)	
		Monthly Average	Weekly Average	Monthly Average	Weekly Average
pH	SU	NA	NA	6 to 9	
CBOD	mg/L	1,050	1,575	25	37.5
TSS	mg/L	1,260	1,890	30	45
NH3-N	mg/L	NA	NA	10	15
DO	mg/L	NA	NA	>7.0	
E. coli	#/100 mL	NA	NA	130	240
Chronic WET	TUc	NA	NA	<1.00	

#/100 mL=number per 100 milliliters
CBOD=carbonaceous biochemical oxygen demand
TSS=total suspended solids
NH3-N=ammonia nitrogrn
DO=dissolved oxygen
WET=whole effluent toxicity
SU=standard unit
TUc=Toxicity unit (chronic)
NA=not available

B. Permit Compliance Review

The WWTP permit compliance is summarized in Table 6.03-2. The WWTP had some compliance concerns over the past 3 years. The majority of these concerns are due to TSS and *E.coli*. The violations for *E. coli* result from inadequate disinfection by the current UV disinfection equipment. Effluent TSS violations are the result of inadequate final clarification. These limitations should be addressed within this Asset Management Plan. The Shepherdsville WWTP has remained compliant with their whole effluent toxicity (WET) testing since the Shepherdsville WWTP was expanded. Its testing is comprised of two different species (*Ceriodaphnia dubia* and *Pimephales promelas*) used to analyze effluent toxicity. *Pimephales promelas*, or fathead minnow as it is commonly referred to, is the more sensitive species and is tested quarterly and consistently remained below the permit limit.

Table 6.03-2 Compliance History (January 2018 to June 2020)

Permit Parameter	Units	KPDES Permit Limit		Violations		Percent of Time in Compliance	
		Weekly	Monthly	Weekly	Monthly	Weekly	Monthly
pH	SU	6 to 9	6 to 9	0	0	100	100
CBOD	mg/L	25	37.5	1	0	99	100
TSS	mg/L	30	45	2	0	98	100
NH3-N	mg/L	10	15	0	0	100	100
DO	mg/L	>7.0	>7.0	0	0	100	100
E. coli	#/100 mL	130	240	6	3	95	90
Chronic WET	TUc	<1.0*	<1.0*	0	0	100	100

***Data from March 2013 to November 2020**

C. <u>Sludge to Landfill</u>

Shepherdsville WWTP hauls its dewatered sludge to the Clark Floyd landfill in Indiana for disposal. The plant currently does not have any written agreement to dispose of its sludge in the landfill, but submits a waste characterization form with Toxicity Characterization Leach Procedure (TCLP) results every three years. Landfills usually require material to be dry enough to a pass a paint filter test and proven to not exceed toxicity thresholds.

Shepherdsville WWTP sludge in recent years has been dry enough to pass a paint filter test and the last TCLP scan from 2018 showed no toxicity. Based on the 2018 TCLP report, mercury, metals, VOCs, and SVOCs almost all reported as nondetectable. Barium was the only constituent to have a conclusive result but is still below the toxicity threshold. Sludge sampling results are located in Appendix X.

It is recommended that the WWTP have a more formal written arrangement with the landfill.

6.04 OPERATIONS REVIEW

An operations review was conducted through video conference and review of available Shepherdsville WWTP data. The following comments are based on observations during this exercise with contributions from Strand's wastewater operations team.

- The influent sampling is substantially impacted by internal side stream flows to the point that influent loadings cannot be estimated. This makes it difficult to control the biological system and understand how much of the system capacity is being used. A proper influent sample location would not include any flows other than the influent wastewater and samples would come from a well-mixed location.

- Influent screening is a difficult application because the screens are constantly in contact with raw wastewater and they are in continuous service. Upgrading these units is inevitable, and updated versions of these screens can be selected for improved debris capture. This facility has sieves downstream of the influent screening that depend on debris removal, making this a critical process.

- Recycled flows and loads are returned to the influent flow upstream of the influent sample location and, therefore, they are included within the samples as discussed previously. This creates a situation where the operators do not know how much of the loading is generated internally versus received from the system users. A discrete sampling location should be considered to allow spot-checking of internal recycle flows and loads. In addition, when a treatment tank is drained, Final Clarifier Nos. 1 and 2 have surcharged weirs resulting from interconnection of the plant drain and RAS Pump Station No. 1 wells.

- Hydraulics associated with the newest clarifier limits the overall system clarification capacity. This results in operation strategies that place more hydraulic pressure on the older clarifiers. The additional stress on these clarifiers also creates a solids loading imbalance that has limited the ability of the existing RAS pumps to transfer enough solids from the older clarifiers to maintain proper solids blankets in the clarifiers. This is especially challenging during wet weather events.

- RAS pumping does not adequately manage the clarifier solids blanket during certain flow conditions. The hydraulic conditions previously mentioned and an increase in RAS pumping capacities, should be considered to properly manage the solids inventories. Failure to maintain the solids balance associated with a clarifier can result in significant loss of solids to the effluent and effluent violations.

- UV disinfection equipment has become antiquated and is not as efficient or effective as newer technology. Replacement parts are more difficult to source and will become more difficult in the future.

- Scum cannot be isolated for separation and ultimately for disposal. This leaves the biological system vulnerable to potential excessive growth of unwanted foaming filamentous organisms. These organisms can impact the settling characteristics of the biological solids and, therefore, the effluent quality. Opportunities to separate foaming filaments should be explored to reduce risk of severe bulking and foaming events. In addition, excess clear water is created when the scum troughs are flushed continuously.

- Metering limitations related to influent, RAS and waste activated sludge (WAS) handicaps the operation staff's ability to finesse these key operation parameters and maintain balance in the biological systems.

- Biosolids holding tank limitations were discussed. Limitations to biosolids removal can limit the management of the biological treatment systems leading to efficiency losses and, potentially, failure. The inability to get sludge out of the plant results in stress on the biological process and clarification process since sludge cannot be wasted. Wasting challenges can result in filamentous organism growth and higher solids loadings on clarifiers that will eventually result in failure if not corrected.

- SCADA upgrades should be considered as part of regular budget cycles. Hardware associated with SCADA systems is critical to ongoing process automation and should be considered a wear item like any other machinery. Software is constantly improving and, therefore, systems can become incompatible and obsolete with time if not managed through preventive maintenance and strategic upgrades. SCADA systems can extend beyond typical control tasks through use of historians and graphing functions to organize data into manageable formats, information sharing, and analysis.

- Data management does not result in a continuous set of data that can be analyzed as information in the form of graphs, be used in calculations, or shared with others. Improvements in data management can be as simple as select information included in a process spreadsheet or as a more comprehensive operations database or SCADA integration.

- Aerator and blower turndown were discussed but the impact is not clearly understood because the amount and distribution of the influent loading is unclear as discussed previously. In general, the wastewater industry has adopted increasingly more aggressive aeration strategies designed to optimize energy, but this depends on good instrumentation and available aerator or blower turndown.

Previously in this section a number of factors have been mentioned that impact the collection and management of data as well as some control limitations and hydraulic details worthy of improvement. Resolving the concerns mentioned previously would allow the facility to be managed in a more data-driven control strategy. Benefits of operating with data-driven decisions include:

- Reduced risk of effluent violations.
- Optimized costs associated with energy, chemicals and supplies, and sludge production.
- Demonstration of institutional control.
- Improved communication between staff members.
- Better understanding of the available capacity and process bottlenecks.

Some specific operations improvements that can be considered with the initiatives above would include:

- Improved balancing of the two similar but different biological processes. The balance would be realized through influent load distribution and the management of the quantities of biological solids within the two systems. Improvements in the information and control as described previously would lead to control of conditions that promote the growth of filamentous organisms that, in high quantities, compromise settling in the clarifiers and increase the potential for effluent violations. With data collection and management, wasting strategies can be developed to manage the sludge age of the system to allow more assertive control of the type of organisms present in the system.

- With good data, simple but effective tools can be incorporated to manage the solids balance within a clarifier through potentially variable flow and health of the biological system. Developed in spreadsheets, these tools organize the settling rates, loading rates, and withdrawal rates to review and predict clarifier performance. Data used is commonly collected at WWTPs if flow metering is trustworthy. A simple tool and guidance can be developed if data is available to provide necessary information to optimize clarifier performance. This is especially critical during wet weather events.

6.05 CURRENT AND FUTURE LOADINGS

Two sources of data are available to analyze current conditions; Jim Beam Distillery (Beam) daily flow and loading data and the Shepherdsville WWTP influent flow and loading data. The influent flow data from the WWTP and the flow and loading data from Beam are deemed reliable and can be used. The WWTP influent sampling data cannot be relied on since the sampler location has been moved several times and often includes the RAS discharges upstream of the sample collection location. The introduction of RAS causes very wide fluctuations in the influent pollutant concentrations. The influent loadings will be "constructed" using data from Beam, WWTP flow data, and assumed concentrations for nonindustrial discharges.

Two low-flow (dry weather) months were selected for review (July and September 2019). The known daily flow from Beam was subtracted from the known daily WWTP flow to arrive at the "domestic" flow from all customers other than Beam. Routine "domestic strength" concentrations were assumed as follows:

- BOD 225 mg/L
- TSS 250 mg/L
- TKN 40 mg/L
- NH3-N 25 mg/L
- P 6 mg/L

These typical concentrations were multiplied by the daily influent domestic flow to compute the daily domestic loadings. These daily loadings were then averaged from the two dry months to get the typical daily average domestic loadings:

- BOD 2,221 lb/day
- TSS 2,485 lb/day
- TKN 398 lb/day
- NH3-N 248 lb/day
- P 60 lb/day

These average daily loadings were then assumed to represent the nonindustrial loadings for each day. The known daily loadings from Beam were then added to arrive at the total "constructed" daily influent loading. Historic Shepherdsville WWTP flow and constructed loadings are presented in Figure 6.05-1.

A. Wastewater Treatment Current WWTP Flow

The Shepherdsville WWTP is currently operating well below the 90 percent design flow, which allows the WWTP to forgo any planning for expansion from regulatory agencies. A few peaks in flow during the wet weather period in the late fall to early winter months exceed the 90 percent capacity. However, the rolling average has stayed approximately 3.0 mgd for the past three years. Shepherdsville is actively working on reduction of infiltration and inflow (I/I), which will reduce the significant wet weather monthly flows.

B. WWTP Current Loadings

The average monthly constructed BOD loadings are consistently under the WWTP design loading capacity except for a few months when loadings from Beam were very high. The average BOD loading is approximately 10,000 lb/d, or approximately 60 percent of the WWTP design capacity. Current constructed BOD loadings are not a concern.

The average monthly constructed TSS loadings are consistently under the design loading capacity except for a few months when loadings from Beam were very high. The average TSS loading is approximately 4,000 lb/d, or approximately 40 percent of the WWTP design capacity. Current constructed TSS loadings are not a concern.

Figure 6.05-1 shows the constructed TKN, NH3-N, and P loadings relative to the WWTP design capacity. Pollutant loadings for these three parameters are well below the WWTP design capacity.

Slug loadings from Beam may warrant closer control to prevent overloading the WWTP.

C. Beam Flow

The Shepherdsville WWTP receives flow from Beam. When the Shepherdsville WWTP was last upgraded in 2013, a Beam flow of 0.21 mgd was anticipated in the design. Figure 6.05-2 shows the average flow is about 0.4 mgd, or twice what was anticipated. Flows from Beam do fluctuate from month to month, but the Shepherdsville WWTP has been able to accept and treat these flows.

D. Beam Loadings

During design of the Shepherdsville WWTP in 2009, Shepherdsville worked with Beam to estimate the total contributions from the distillery. Table 6.05-1 lists the pollutant concentrations and loadings that were anticipated at the time of the WWTP design.

Table 6.05-1 Anticipated Pollutant Loadings from Beam

Parameter	Concentration (mg/L)	Loading (lb/d)
CBOD	1,545	2,706
TSS	186	326
NH3-N	1.7	3

Based on a flow of 0.21 mgd.

1. BOD Loadings

The current planned BOD loading from Beam is 2,706 lb/day. The overall influent loadings of BOD from Beam are two to three times higher than what was planned. Similar to the flow, Figure 6.05-2 shows monthly average data are consistently higher than the WWTP was anticipating. Occasional spikes in BOD loadings can impact the Shepherdsville WWTP.

2. TSS Loadings

Beam's current TSS loadings have consistently been more than the anticipated capacity for the past three years with a large spike in the wet weather period of 2018 to 2019. The TSS loadings from Beam are not much of a concern long-term because Shepherdsville WWTP is currently treating influent with TSS loadings well below the design capacity.

3. NH3-N Loadings

The NH3-N levels from Beam are trending higher than the planned capacity for the past two years. Despite the higher NH3-N loading from Beam, the WWTP has remained well below the design capacity and, therefore, is not a present concern for the treatment plant. The NH3-N loadings from Beam are relatively low.

E. Projections of WWTP Flow and Loadings

Projections of flows and loadings were made to anticipate capacity concerns that might arise over the next 10 years. The projections assumed the current WWTP flows and constructed loadings were valid and then known or anticipated growth was added. Known growth includes:

- Leachate from the Bullitt County landfill in the amount of 3,000 gallons per day (gpd) will be pumped to the Highway (Hwy) 245 Pump Station in 2021.
- A microbrewery is under development and could contribute approximately 50,000 gpd of wastewater assumed to be equivalent to the composition of Beam wastewater. The new source of wastewater was assumed to be operational in 2022.
- A new distillery may also be constructed and was assumed to have a contribution of 50,000 gpd and be equivalent to the composition of Beam wastewater. This contribution was assumed to begin discharge in 2023.
- A new residential development is in the works bear Hwy 245 and Hwy 61. This will add 99 new homes. While this subdivision is anticipated, the contributions from this were included in the general future residential growth allocation.

The 2008 Facilities Plan assumed a fairly high rate of growth that has not been realized over the past 12 years. As Shepherdsville has seen modest growth, the additional flow from development has been offset by a reduction of I/I. Looking forward, the same rate of growth assumed in the 2008 Facilities Plan will be applied to the current flow and loadings. The rate of growth assumes approximately 350 new residential home equivalents will be constructed each year.

Table 6.05-2 includes the projected annual flows for the next decade.

Table 6.05-2 Flow Projections

Year	Average Monthly Flow (mgd)	Average Monthly Domestic Flow (mgd)	Leachate (mgd)	Microbrewery Waste (mgd)	New Distillery Waste (mgd)	Additional Residential Growth (mgd)	Total Projected Influent Flow (mgd)
2017	2.55	2.15					2.55
2018	3.06	2.56					3.06
2019	2.86	2.44					2.86
2020	2.79*	2.37*				0.03	2.61
2021			0.003			0.11	2.51
2022			0.003	0.050		0.22	2.65
2023			0.003	0.050	0.050	0.33	2.81
2024			0.003	0.050	0.050	0.44	2.94
2025			0.003	0.050	0.050	0.55	3.05
2026			0.003	0.050	0.050	0.66	3.16
2027			0.003	0.050	0.050	0.77	3.27
2028			0.003	0.050	0.050	0.88	3.38
2029			0.003	0.050	0.050	0.99	3.49
2030			0.003	0.050	0.050	1.09	3.60

*Data is from January to June 2020.

Figure 6.05-3 illustrates the projected flow and loadings versus the design capacity of the WWTP. The only design loading that is anticipated to exceed the WWTP design capacity (or 90% of the design capacity) over the next decade is phosphorus. Exceeding the design phosphorus criteria is not a concern since the facility is currently not regulated for phosphorus. If these projections hold true, the City will not have to add capacity to the WWTP within the next decade. The City should reconsider influent loadings after the WWTP begins to collect representative influent pollutant concentrations to replace the constructed loadings used in this plan. For planning purposes, the City may anticipate planning for an expansion that should begin in 2030.

6.06 CONDITION ASSESSMENT

A site visit on August 22, 2020, allowed for a condition assessment of WWTP equipment. In the assessment of equipment, the rating system shown in Table 6.06-1 was used. The rating included a review of the condition, failure rating, and renewal and maintenance strategy. The individual equipment ratings are included in Appendix X. The equipment can be ranked in terms of criticality based on the sum of the average assessment score, the average failure ratings, and the average renewal and maintenance strategy score. Table 6.06-2 lists the scale used to assess criticality. This scale differs slightly from the KDOW Asset Inventory Scale.

Assessment Ratings	Rating
Condition	
New or excellent	5
Minor defects	4
Moderate deterioration	3
Significant deterioration	2
Beyond Useful life	1
Performance	
Meets all performance targets	5
Minor performance deficiencies	4
Considerable performance deficiencies	3
Major performance deficiencies	2
Fails to meet performance targets	1
Reliability	
New	5
Seldom breakdown	4
Occasional breakdown	3
Periodic breakdown	2
Continuous breakdowns	1
Failure Ratings	
Consequence	
Minor component failure (25 - 50%)	5
Major component failure (50 - 100%)	4
Minor facility failure (25 – 50%)	3
Major facility failure (50 – 100%)	2
Minor WWTP failure (0 – 10%)	1
Major WWTP failure (10 – 100%)	0
Probability	
Minor (10%)	5
Mid minor (25%)	4
Medium (50%)	3
Mid major (75%)	2
Significant (100%)	1
Redundancy	
No back up	0
50% backup	1
100% backup	3
200% backup	5
Renewal and Maintenance	
Renewal Strategy	
Status Quo	5
Repair	4
Refurbish	3
Replace with similar	2
Replace with improved	1
Maintenance Strategy	
Preventive	5
Condition based	4
Usage Based	3
Run to failure	2
Corrective	1

Table 6.06-1 Condition Assessment Scoring Criteria

	Scale
Critical	< 40
Semi-critical	40-60
Non-critical	> 60

Table 6.06-2 Criticality Scale

Table 6.06-3 reviews the most critical equipment based on the assessment. A strategy is outlined for the anticipated needs of these assets. Many assets can be renewed within the current annual repair and replacement budget. Some larger efforts are grouped into capital projects when City forces might not be able to complete identified improvements. Many critical needs can be addressed in-house.

Table 6.06-3 Critical Assets

Process	Equipment	Criticality Score	Strategy: Annual budget	Strategy: Capital Project	Time Horizon (years)
RAS and WAS Pumping	RAS Pump Station No. 1 Sludge Blanket Analyzer	2			Remove
Control Building	Network Rack	2		X	0 to 2
RAS and WAS Pumping	RAS Doppler Flow Meter No. 1	3		X	0 to 2
RAS and WAS Pumping	WAS Doppler Flow Meter No. 2	3		X	0 to 2
Headworks Electrical	Strainer Control Panel	9		X	0 to 2
Headworks Electrical	Chemical Metering Pump No. 1 Control Panel	10			Remove
Headworks Electrical	Chemical Metering Pump No. 2 Control Panel	10			Remove
Headworks Electrical	Chemical Tank Leak Alarm Panel	10			Remove
Headworks Electrical	Remote Terminal Unit (RTU) Panel	10		X	0 to 2
Biological Treatment	IFAS Media Screen Nos. 2 to 11	12		X	0 to 2
Effluent Disinfection	UV Disinfection System No. 1	12		X	0 to 2
Effluent Disinfection	UV Disinfection System No. 2	12		X	0 to 2
Control Building	Old Generator	12			Remove
Headworks	Headworks Sampler	14	X		3 to 5
Effluent Sampling	Effluent Sampler	14		X	0 to 2
Process Water Pumping	Process Water Pressure Tank No. 1	15		X	0 to 2
Process Water Pumping	Process Water Pressure Tank No. 2	15		X	0 to 2
Control Building	Motor Control Center (MCC)-EM0	17		X	0 to 2
Headworks	Manually Cleaned Bar Screen	18		X	3 to 5
Headworks	Mechanically Cleaned Bar Screen	18		X	3 to 5
Biological Treatment	IFAS Aeration Basin Fine Bubble Diffusers	20	X		3 to 5
Effluent Disinfection	Level Control Gate No. 1	20		X	0 to 2
Effluent Disinfection	Level Control Gate No. 2	22		X	0 to 2
Control Building	ATS	22		X	Remove
Biological Treatment	IFAS Media Basin Medium Bubble Diffusers	27	X		3 to 5
Biological Treatment	IFAS Recirculation Pump Motor Operated Gates	27	X		3 to 5
RAS/WAS Pumping	RAS Flow Meter No. 2	28		X	0 to 2
Biological Treatment	IFAS Anoxic Submersible Mixer No. 4	32	X		3 to 5
Effluent Disinfection	Channel Isolation Gates with Motor Actuators	33		X	6 to 10
Biological Treatment	IFAS Fixed Film Media	34	X		6 to 10
RAS/WAS Pumping	RAS No. 2 Motor Operated Valve	35	X		6 to 10
RAS/WAS Pumping	WAS No. 2 Motor Operated Valve	35	X		6 to 10
Biological Treatment	IFAS Recirculation Pump No. 1	37	X		6 to 10
Biological Treatment	IFAS Recirculation Pump No. 2	37	X		6 to 10
Sludge Transfer Pump Station Building	Decant Pump No.2	37		X	0 to 2
Biological Treatment	IFAS Anoxic Submersible Mixer No. 1	38	X		6 to 10
Biological Treatment	IFAS Anoxic Submersible Mixer No. 2	38	X		6 to 10
Biological Treatment	IFAS Anoxic Submersible Mixer No. 3	38	X		6 to 10
Biological Treatment	IFAS Anoxic Submersible Mixer No. 5	38	X		6 to 10
Solids Processing Building	Polymer Feed System No. 1	38	X		6 to 10
Solids Processing Building	Polymer Feed System No. 2	38	X		6 to 10

A review of semi-critical assets is included in Table 6.06-4. A renewal or replacement strategy for these assets are identified with the anticipated time horizon. Many assets will require continual assessment to monitor asset status and better predict the timing of replacement. Most are not expected to require attention within the next 10 years.

Table 6.06-4 Semi-Critical Assets

Process	Equipment	Criticality Score	Strategy		Time Horizon (years)
			Annual Budget	Capital Project	
Biological Treatment	IFAS Aeration Basin Non-Media Zone Blower No. 5	40		X	10 to 20
RAS/WAS Pumping	RAS/WAS Pump No. 4	40	X		10 to 20
Biological Treatment	Oxidation Ditch Aerator No.1	43		X	10 to 20
Biological Treatment	IFAS Media Zone Blower No. 1	43		X	10 to 20
Biological Treatment	IFAS Aeration Basin Non-Media Zone Blower No. 4	43		X	10 to 20
RAS/WAS Pumping	RAS/WAS Pump No. 5	43	X		10 to 20
Effluent Disinfection	UV Disinfection System Control Panel	44		X	0 to 2
Effluent Disinfection	UV Disinfection System Hydraulic System Center	44		X	0 to 2
Headworks	Channel Flow Control Gates (4)	47	X		10 to 20
Biological Treatment	Oxidation Ditch Aerator No. 2	47		X	10 to 20
Biological Treatment	IFAS Basin Gates	47	X		10 to 20
Post Aeration	Post-Aeration Blower No. 1 Control Panel	47	X		10 to 20
Post Aeration	Post-Aeration Blower No. 2 Control Panel	47	X		10 to 20
Clarification	Clarifier No. 3	48	X		10 to 20
Effluent Disinfection	UV Disinfection System No. 1 Power Distribution Center (PDC) A	50		X	0 to 2
Effluent Disinfection	UV Disinfection System No. 1 PDC B	50		X	0 to 2
Effluent Disinfection	UV Disinfection System No. 2 PDC A	50		X	0 to 2
Effluent Disinfection	UV Disinfection System No. 2 PDC B	50		X	0 to 2
Control Building	Main Switchboard	50	X		10 to 20
Biological Treatment	IFAS Recirculation Pump Gate Motor Operators	51	X		10 to 20
Sludge Holding Tanks	Sludge Holding Tank No. 1 Diffusers	51	X		10 to 20
Sludge Holding Tanks	Sludge Holding Tank No. 2 Diffusers	51	X		10 to 20
Sludge Holding Tanks	Sludge Holding Tank No. 3 Diffusers	51	X		10 to 20
Sludge Holding Tanks	Sludge Holding Tank No. 4 Diffusers	51	X		10 to 20
Biological Treatment	IFAS Media Zone Blower No. 2	52		X	10 to 20
RAS/WAS Pumping	RAS/WAS Pump No. 1	52	X		10 to 20
RAS/WAS Pumping	RAS/WAS Pump No. 2	52	X		10 to 20
RAS/WAS Pumping	RAS/WAS Pump No. 3	52	X		10 to 20
Solids Processing Building	Sludge Conveyor No. 1	52	X		10 to 20
Solids Processing Building	Sludge Conveyor No. 2	52	X		10 to 20
Biological Treatment	IFAS Media Zone Blower No. 3	56		X	10 to 20
Process Water Pumping	Process Water Pump No. 1	56		X	0 to 2
Process Water Pumping	Process Water Pump No. 2	56		X	0 to 2
Headworks Electrical	Hydrogen Sulfide Gas Detection	58	X		3 to 5
Headworks Electrical	Methane Gas Detection	58	X		3 to 5
Headworks Electrical	Oxygen Gas Detection	58	X		3 to 5
Control Building	New Generator	58		X	10 to 20
Control Building	CCC MTU Control Panel	58		X	10 to 20
Post Aeration	Post Aeration Blower No.1	59		X	10 to 20
Post Aeration	Post Aeration Blower No.2	59		X	10 to 20
Post Aeration	Post Aeration Diffusers	59		X	10 to 20

The remaining non-critical WWTP assets are reviewed in Table 6.06-5. The renewal of these assets within the 10-year planning horizon is not anticipated.

Table 6.06-5 Non-Critical Assets

Process	Equipment	Criticality Score	Strategy		Time Horizon (years)
			Annual Budget	Capital Project	
Biological Treatment	Blower Building No. 2 Panelboard LP-BLWR2 Transformer	62	X		>20
Clarification	Clarifier No.3 Rake Control Panel	62	X		>20
RAS and WAS Pumping	Panelboard EM2 Transformer	62	X		>20
RAS and WAS Pumping	Panelboard LP-RAS2 Transformer	62	X		>20
Sludge Transfer pump Station Building	Transformer SXMR-STB	62	X		>20
Solids Processing Building	Panelboard LP-SPB Transformer	62	X		>20
Power Distribution Building	Main Generator	62		X	>20
Power Distribution Building	Panelboard LP-PDB Transformer	62	X		>20
Process Water Pumping	Process Water Pump Control Panel	64	X		>20
Sludge Transfer Pump Station Building	Sludge Transfer Pump No. 1	64	X		>20
Sludge Transfer Pump Station Building	Sludge Transfer Pump No. 2	64	X		>20
Sludge Transfer Pump Station Building	Sludge Grinder No.1	64	X		>20
Sludge Transfer Pump Station Building	Sludge Grinder No.1	64	X		>20
Biological Treatment	Blower Building No. 2 MCC-BLWR2	67		X	10-20
Biological Treatment	Blower Building No. 2 Panelboard PP-BLWR2	67	X		>20
Biological Treatment	Blower Building No. 2 Panelboard LP-BLWR2	67	X		>20
Biological Treatment	Blower Building No. 2 PLC Control Panel DCC-BLWR2	67	X		>20
RAS and WAS Pumping	Motor Control Center MCC-EM1	67		X	>20
RAS and WAS Pumping	Motor Control Center MCC-N2	67		X	>20
RAS and WAS Pumping	Panelboard EM2	67	X		>20
RAS and WAS Pumping	RAS Pump Station No. 1 PLC Control Panel DCC-RAS1	67	X		>20
RAS and WAS Pumping	RAS Pump Station No. 1 Heat Trace Panel	67	X		>20
RAS and WAS Pumping	RAS Pump Station No. 2 PLC Control Panel DCC-RAS2	67	X		>20
RAS and WAS Pumping	RAS Pump Station No. 2 RAS and WAS Control Panel #2	67	X		>20
Sludge Transfer Pump Station Building	Surge Suppressor Panel TC-STB	67	X		>20
Control Building	Automatic Transfer Switch for MCC-EM1	67		X	>20
Control Building	MCC-N1	67		X	>20
Control Building	Fused Switch for MCC-EM1	67	X		>20
Power Distribution Building	Main Switchboard No. 1	67	X		>20
Power Distribution Building	Electrical Harmonic Filter	67	X		>20
RAS/WAS Pumping	RAS Pump Control Field Terminal Enclosure	68	X		>20
Headworks Electrical	Screen and Conveyor Control Panel	75	X		>20
Headworks Electrical	Gas Detection Controller	75	X		>20
RAS and WAS Pumping	Motor Control Center MCC-RAS2	75		X	10-20
RAS and WAS Pumping	Panelboard LP-RAS2	75	X		>20

Process	Equipment	Criticality Score	Strategy		Time Horizon (years)
			Annual Budget	Capital Project	
RAS and WAS Pumping	RAS Pump Station No. 2 EF-RAS2 Motor Starter	75	X		>20
Sludge Transfer Pump Station Building	Sludge Grinder Control Panel	75	X		>20
Sludge Transfer Pump Station Building	Utility Pump Motor Control Panel	75	X		>20
Sludge Transfer Pump Station Building	Exhaust Fan Motor Starter	75	X		>20
Sludge Transfer Pump Station Building	Panelboard PP-STB	75	X		>20
Sludge Transfer Pump Station Building	Panelboard LP-STB	75	X		>20
Solids Processing Building	Conveyors and Sludge Gate Control Panel	75	X		>20
Solids Processing Building	Belt Filter Press No. 1 Motor Control Panel BFP-CP1	75		X	10-20
Solids Processing Building	Belt Filter Press No. 2 Motor Control Panel BFP-CP1	75		X	10-20
Solids Processing Building	Exhaust Fan EF-SPB1 Motor Starter	75	X		>20
Solids Processing Building	Exhaust Fan EF-SPB2 Motor Starter	75	X		>20
Solids Processing Building	Exhaust Fan EF-SPB3 Control Enclosure	75	X		>20
Solids Processing Building	Exhaust Fan EF-SPB4 Motor Starter	75	X		>20
Solids Processing Building	Exhaust Fan EF-SPB4 Control Enclosure	75	X		>20
Solids Processing Building	Telephone Cabinet TC-SPB	75	X		>20
Power Distribution Building	Lighting Contactor Enclosure	75	X		>20
Solids Processing Building	Panelboard PP-SPB	75	X		>20
Solids Processing Building	Panelboard LP-SPB	75	X		>20
Power Distribution Building	Panelboard LP-PDB	75	X		>20
Clarification	Clarifier No. 1	78		X	10-20
Solids Processing Building	Belt Filter Press No. 1	78		X	10-20
Solids Processing Building	Belt Filter Press No. 2	78		X	10-20
Power Distribution Building	Power Distribution PLC Control Panel DCC-PDB	83	X		>20
RAS and WAS Pumping	RAS No. 2 Motor Operated Valve Control Panel	84	X		>20
RAS and WAS Pumping	WAS No. 2 Motor Operated Valve Control Panel	84	X		>20
Clarification	Clarifier No. 2	85		X	10-20
Solids Processing Building	BFP Wastewater Booster Pumps	85	X		>20
Solids Processing Building	BFP Hydraulic Pumps (2)	85		X	10-20
Influent Flow Measurement	Flow Meter (mag meter)	86	X		>20
Effluent Flow Measurement	Flow Meter	86		X	0-2
Sludge Transfer Pump Station Building	Sludge Grinder No. 1 Control Panel	92	X		>20
Sludge Transfer Pump Station Building	Sludge Grinder No. 2 Control Panel	92	X		>20
Sludge Transfer Pump Station Building	Sludge Pump No. 1 Variable Frequency Device (VFD)	92	X		>20
RAS and WAS Pumping	RAS Pump Station No. 1 Wet Well Level Control Panel	98	X		>20

Asset condition assessment should be revisited every 5 years to help address renewal priorities before asset failures occur.

6.07 SUMMARY OF NEEDS

Through Strand's review of compliance, flow and load evaluation, operational review, condition assessments and discussions with City personnel, several needs have been identified. Table 6.07-1 summarizes the identified needs, their justification and priority.

Table 6.07-1 WWTP Needs and Priority

	Need	Justification	Priority
1	Influent Sampling–Revise to collect a representative sample of the influent.	Operations, Regulatory	High
2	Recycle Flow Management–Add a plant recycle pump station and WWTP sewer system to deliver in-plant recycle flows downstream of influent metering and sampling. Include mag meter for recycle flows.	Operations, Regulatory	High
3	Sludge Holding Tanks–Requires additional capacity.	Operations	High
4	Final Clarification–Additional capacity is required for wet weather and solids loading. Requires upgrade to RAS PS 2 and new flow splitting as well.	Operations, Permit Compliance	High
5	Hydraulic Profile–Address higher 100-year floodplain elevation and backup in Final Clarifier No. 3. Revisit post aeration and nonpotable water (NPW) pumping based on lower operating level. Effluent pumping will be required at flood stage. Address oversized effluent flow meter.	Operations, Regulatory	High
6	UV Disinfection–Replace aged equipment with newer technology.	Operations, Regulatory, Energy Savings	High
7	IFAS Media Zone Overflows–Replace remaining media sieves to address current blinding that cause overflows.	Regulatory	High
8	Scum Management–Add scum pumping to remove scum from the final clarifiers to a dedicated sludge holding tank.	Operations	High
9	Headworks Building Ventilation–Replace existing equipment to provide 12 air changes per hour (continuous).	Regulatory, Condition Assessment	High
10	Headworks electrical–Bring existing gear to Class I Division 2 standard.	Regulatory, Risk Reduction	High
11	Operational Enhancements–Make a series of "no capital" improvements to daily operations.	Operations	High
12	RAS Pump Station No. 1–Increase capacity of existing RAS pumps and add new magmeter to replace failed Doppler meters.	Operations, Condition Assessment	High
13	WAS metering and control–Add dedicated WAS flow meter and automate WAS control.	Operations	High
14	Influent Flow Metering–Replace with properly sized mag meter.	Operations, Regulatory	Medium to High
15	SCADA System–Upgrade aged assets, covert to situational graphics.	Operations, Condition Assessment	Medium to High
16	Influent Screening–Improve screening to remove more debris from plant and renew aged asset.	Operations, Condition Assessment	Medium
17	Control Building Motor Gear–Replace aged asset.	Condition Assessment, Risk Reduction.	Medium
18	Headworks Odor Control–Reduce off-site odors.	Community	Medium
19	IFAS Blower–Upgrade for more energy efficient blowers with better turndown. A return on investment calculation indicated the blowers should not be replaced until they are near failure.	Operations, Energy Savings	Low

	Need	Justification	Priority
20	Oxidation Ditch Aerators–Replace aerators to allow improved control and energy efficiency. A return on investment calculation indicated the aerators should not be replaced until they are near failure.	Operations, Energy Savings	Low
21	Biological Process Expansion.	Capacity	Low

The recommendations for resolving these needs will be discussed in Section 7.

SECTION 7
WWTP RECOMMENDATION

7.01 INTRODUCTION

The anticipated needs for the Shepherdsville WWTP over the next 10 years were identified in Section 6. This report section will recommend improvements to address the needs, recommend cost opinions for the improvements, prioritize the improvements with City input, and summarize the recommended projects, costs, and schedule. These recommended improvements will be further prioritized among the collection system needs in Section 8–Capital Improvement Plan, to complete the Asset Management Plan.

7.02 RECOMMENDED IMPROVEMENTS

Each High and Medium-High Priority need identified in Section 6 will be discussed in the following. Needs are discussed using the number designated in Section 6.07.

1. Influent Sampling

   - Tap into the existing force main after the influent magnetic flow meter and construct an influent sample pipe to the relocated influent sampler outside the Control Building.
   - Install a valve after the tap to allow adjustment of flow.
   - Allow influent wastewater to flow through this sample pipe continuously and drain to the WWTP sewer system and flow to the Plant Recycle Pump Station (see Recommended Improvement No. 2).
   - Relocate the existing influent sampler to the new location.

2. Recycle Flow Management

   - Construct a new submersible Plant Recycle Pump Station to collect the filtrate from belt filter presses, decant from the sludge storage tanks, building drains, and tank drainage. The pump station will be sized for 3,750 gpm (firm) with two submersible pumps.
   - Construct a valve vault for isolation of each pump and prevention of backflow.
   - Install an 8-inch magnetic flow meter within a meter vault to measure the WWTP recycle flow.
   - Construct a 14-inch force main from the Plant Recycle Pump Station to tie into the existing RAS force main with a valved option of directing pumped flows to the clarifier splitter box when draining biological treatment tanks.
   - Construct approximately 260 feet of 12-inch sanitary sewers with two additional manholes. to collect in-plant recycle flow and tank drainage to the Plant Recycle Pump Station.
   - Provide related site work including paved access to the new pump station.
   - Construct related power distribution, instrumentation, and controls for the new pump station.

3. Sludge Holding Tanks

   - Demolish the building and tankage to the west of the existing sludge holding tanks.
   - Construct two new Sludge Holding Tanks adjacent to the existing Sludge Holding Tanks. The tanks will be identical to the existing with coarse bubble diffusers and telescoping valves for decanting.

- Use the existing air supply from the media blowers to supply up to 700 cubic feet per minute (cfm) of air to the new Sludge Holding Tanks.
- Construct piping connections for WAS pipe inlet, decant pipe outlet, and enable sludge pumping from the new sludge tanks.
- Construct a tank drain from the new tanks with mud valves.
- Add level monitoring for the new tanks.
- Revise site features to include revised pavement limits and pipe bollards.

4. Final Clarification

- Construct two new final clarifiers (Nos. 4 and 5) to match Clarifier No. 3. Clarifiers will employ either tow-bro or spiral blade collectors. The tank depth and diameter will match Clarifier No. 3. Provide Stamford baffles to prevent short circuiting. Install full radius skimming with a brush-type scum wiper. The hydraulic profile through the final clarifiers will be lowered as noted in Need No. 5.
- Construct a new splitter box in the space of the former Dewatering Building. The new splitter box will divide the flow by weir split to the three existing final clarifiers and will rely on a hydraulic split of flow to the new final clarifiers based on space available for yard piping. The splitter box will allow any existing clarifier to be taken out of service by lowering a slide gate. The new clarifiers will be taken out of service by closing a buried valve.
- Construct related yard piping including mixed liquor to the splitter box and effluent from the final clarifiers. Install new RAS piping to the existing RAS Pump Station No. 2. Extend scum piping to a new scum pump station (see Need No. 8).
- Add two new RAS pumps and related piping, valves, and controls to the RAS Pump Station No. 2, as planned for in the last construction project.
- Provide site improvements including access and grading.
- Add related electrical power distribution.

5. Hydraulic Profile

- Construct a new Effluent Structure housing UV disinfection, post aeration, effluent flow measurement, and effluent pumps. This structure will address the final effluent water surface backup into existing Final Clarifier No. 3 by lowering the operating elevation of the UV system.
- Construct a building to house the UV equipment, electrical gear, and related process equipment.
- Install an improved UV system with better dose-pacing and control. Maintain the UV level using fixed weirs.
- Construct post aeration including new or relocated blowers and diffusers.
- Construct a new 24-inch Parshall flume for effluent flow measurement.
- Construct an effluent pump station to lift effluent to the outfall sewer when the Salt River is at flood stage. Include an isolation gate that will be closed to employ the effluent pumping system.
- Install new or relocated effluent water pumps and hydropneumatics tanks.
- Construct related site piping to and from the new structure.
- Provide site improvements including access and grading.
- Add related electrical power distribution, instrumentation, and controls.

- Confirm the adequacy of emergency power to serve the new UV and effluent pumping equipment.

6. UV Disinfection

New UV disinfection equipment with a fixed effluent weir will be provided in the new Effluent Structure. See discussion within Recommended Improvement No. 5.

7. IFAS Media Zone Overflows

- Replace ten of the 11 existing media sieves with new sieves to match the one recently installed.
- Inspect the new sieve placed into service in 2020 for any buildup on the new perforated openings.

8. Scum Management

- Construct a new Scum Pump Station with pumps. The pump station will be sized for 300 gpm (firm) with two submersible pumps.
- Construct a valve vault for isolation of each pump and prevention of backflow.
- Construct a 6-inch force main from the Scum Pump Station to the Sludge Holding Tank No. 1.
- Construct 8-inch gravity sewers with manholes to collect scum from each final clarifier and deliver it to the Scum Pump Station.
- Provide related site work including paved access to the new pump station.
- Construct related power distribution, instrumentation, and controls for the new pump station.

9. Headworks Building Ventilation

- Replace the existing ventilation system with one capable of providing 12 air changes per hour continuously to the Headworks Building for both levels because the building is interconnected by the screening chute.
- Revise heating to prevent freezing when ventilating on a cold day and provide related thermostat controls.
- Reduce the NEC electrical rating for the space to Class I, Division 2.
- Revise or replace motor-operated dampers.
- Provide related electrical power supply upgrades for the new equipment.

10. Headworks Building Electrical

Revise the motors, disconnects, controls, and electrical conduits to meet NEC criteria for Class I, Division 2 locations. These upgrades assume the ventilation is improved as discussed in Recommended Improvement No. 9.

11. Operational Enhancements

- Manage data using the improved SCADA system and operations spreadsheet or database to allow trending and analysis.
- Build a history of new influent loading information once the sampling is corrected.
- Monitor the biology in each process and begin trending operational indices like SLR, SVI, F:M, SRT, and Organic Loading Rates. Employ data trending to improve operational decision-making including the proportion of loading to be treated by each biological process.
- Monitor the health of the plant biology through regular microscopic evaluation and correlate observations with operations activities including, but not limited to, the flow and load splits between the biological systems.

12. RAS Pump Station No. 1

- Replace existing RAS pumps in RAS Pump Station No.1 with larger RAS pumps. New RAS pumps will be equipped with VFDs to control the RAS flow rates.
- Add a magnetic flow meter to measure the RAS flow.
- Disconnect the waste sludge connection to allow all wasting from RAS Pump Station No. 2.
- Revise related electrical power distribution, instrumentation, and controls.
- Confirm the adequacy of emergency power to serve the larger RAS pumping equipment.

13. WAS Metering and Control

- Construct a new magnetic flow meter to existing WAS pipe to monitor the daily WAS volume. Install the new flow meter in a precast vault to improve access.
- Provide programming within a PLC to automatically control the WAS flow to the Sludge Holding Tanks using the existing motor operated WAS valve and new flow meter.
- Provide related electrical power distribution, instrumentation, and controls.

14. Influent Flow Metering

- Replace the existing mag meter bypass pipe with a new 16-inch influent magnetic flow meter to provide proper velocities for solids flushing.
- Construct a precast vault to house the new magnetic flow meter. Include valving to isolate the new mag meter.
- Abandon the existing 30-inch flow meter in place and employ the piping as a bypass for the new influent meter.
- Revise related electrical power distribution, instrumentation, and controls.

15. SCADA System Upgrade

- SCADA systems are critical to WWTP operation and when properly configured can significantly improve WWTP operability and provide tools historical analytics and troubleshooting. A majority of the equipment in the Control Building network rack is several years beyond its expected service life and is at risk of failure. Restoring failed SCADA system computers and servers is typically a cumbersome process because the software needs to be reinstalled, licensed, and backups of the site-specific applications need to be located from backup storage locations and loaded onto the new hardware.

- An immediate evaluation of how the existing SCADA system computers and servers are being backed up should be performed to determine whether applications will be able to be reliably restored should any equipment fail. If the equipment is not currently being backed up, that should be addressed immediately.
- In addition to upgrading hardware and, if needed, improving backup and recovery procedures, the existing SCADA Human Machine Interface (HMI) graphics would benefit from a transition to high-performance, situational graphics. These improvements would focus on simplifying graphics and reserving the use of color for meaningful, dynamic status of equipment and alarms to improve the ability for operators to determine the current operation status of the Shepherdsville WWTP and quickly identify alarm conditions.
- Additional improvements including historical analytics and trending tools, as well as off-site monitoring should also be evaluated to determine whether those improvements would be beneficial to Shepherdsville.

Several needs are not critical enough to warrant their construction in the recommended capital project. These needs may be addressed by subsequent projects over the next 10 years. Each need will be discussed with an initial strategy for implementation. The strategy should be revisited before detailed design of these additional improvements.

1. Influent Screening Expansion

Replace the existing manual screen with a mechanically cleaned screen. The new mechanically cleaned screen will be identical to the existing mechanically cleaned screen. A new screen conveyor will be provided to convey screening material from new screen to existing discharge location.

2. Control Building MCC

- The existing MCC in the Control Building is beyond its expected service life and should be scheduled for replacement. It appears that it is only being used for power distribution and could be replaced with a 120/240-volt or 120/208-volt panelboard and a 480-volt panelboard. A new panelboard for the 120/2##-volt panel would also be required.
- The primary concern with aging equipment is an increased risk for arc flash hazards. Replacing aging equipment that may have deteriorating insulators with new equipment and selecting the proper circuit breaker coordination will reduce the potential for an arc-flash event and the arc flash incident energy available at the equipment.

3. Headworks Odor Control

The City should anticipate the potential for citizen odor complaints. The primary source of odor complaints would likely be the Headworks Building where conveyed wastewater leaves a closed pipe and enters an open atmosphere. The ventilation improvements installed in Need No. 9 could be plumbed to discharge into a bioscrubber, a biological odor control process. The investment in this improvement can be deferred until citizen odor complaints are received.

4. IFAS Blower

The blowers are new enough and generally reliable enough to avoid replacement in the proposed improvement project. The City should consider alternate blower technology when the current blowers exhibit operation or maintenance problems. Modern turbo compressors offer improved efficiency for energy savings and better turndown for improvement process control. WWTPs that have upgraded older blower technology have realized a 20 to 40 percent reduction in energy use. An evaluation was considered to see whether blower replacement could be considered now, but the anticipated payback exceeded 20 years. The blower upgrade is not justified until blower replacement becomes necessary.

5. Oxidation Ditch Aerators.

The oxidation ditch aerator equipment is still in good working order and capable of meeting process demands for the foreseeable future. The current two-speed aerators could be replaced with variable speed aerators when they are replaced. The variable speed upgrade should be coupled with monitoring for DO and oxidation reduction potential (ORP) to optimize the energy employed in the oxidation ditch extended aeration process. Controls can be installed to vary the speed of the aerators to meet dynamic process demands. WWTPs that have upgraded their aerators may realize a 10 to 20 percent reduction in power use and realize more stability of their extended aeration process. The timing of the upgrade should be deferred until the aerator equipment begins exhibiting operation or maintenance problems.

6. Biological Treatment Expansion

- The existing biological treatment system can handle the projected flows and loading to the year 2030 as discussed in Section 6. Additional capacity should be anticipated after 2030.
- An Orbal-style oxidation ditch system can be considered to the west of the current WWTP when expanding the biological treatment system. The economics of this expansion could be weighed against other means of expansion, like conversion of the Carousel-style oxidation ditch to a second IFAS basin. The selection of additional biological capacity will be the subject of a preliminary design report completed at the time of the design. This will enable Shepherdsville more time to assess the IFAS operation after the sieves are replaced.

7.03 PRIORITIZATION OF IMPROVEMENTS

A prioritization for the recommended improvements was prepared based on a review of the current Shepherdsville WWTP, condition assessment, operational needs, and permit compliance. Engineering judgment was then employed to divide the improvements into high, medium, and low priorities. The engineering prioritization was then reviewed with City personnel to arrive at a consensus prioritization. Table 7.03-1 summarizes the prioritization of needs.

Table 7.03-1 Prioritization of WWTP Needs

	Need	Justification	Initial Engineering Priority	Consensus Priority
1	Influent Sampling–Revise to collect a representative sample of the influent.	Operations, Regulatory	High	
2	Recycle Flow Management–Add a recycle flow pump station and plant sewer system to deliver in plant recycle flows downstream of influent metering and sampling. Include mag meter for recycle flows.	Operations, Regulatory	High	
3	Sludge Holding Tanks–Requires additional capacity.	Operations	High	
4	Final Clarification–Requires additional capacity for wet weather and solids loading. Requires upgrade to RAS PS 2 and new flow splitting as well.	Operations, Permit Compliance	High	
5	Hydraulic Profile–address higher 100-year floodplain elevation and backup in Final Clarifier No. 3. Revisit post aeration and NPW pumping based on lower operating level. Effluent pumping will be required at flood stage.	Operations, Regulatory	High	
6	UV Disinfection–Replace aged equipment with newer technology.	Operations, Regulatory, Energy Savings	High	
7	IFAS Media Zone Overflows–Replace remaining media sieves to address current blinding that causes overflows.	Regulatory	High	
8	Scum Management–Add scum pumping to remove scum from the final clarifiers to a dedicated sludge holding tank.	Operations	High	
9	Headworks Building Ventilation–Replace existing equipment to provide 12 air changes per hour (continuous).	Regulatory, Condition Assessment	High	
10	Headworks Electrical–Bring existing gear to Class I, Division 2 standard.	Regulatory, Risk Reduction	High	
11	Operational Enhancements–Make a series of “no capital” improvements to daily operations.	Operations	High	
12	RAS Pump Station No. 1–Increase capacity of existing RAS pumps and add new magmeter to replace failed Doppler meters.	Operations, Condition Assessment	High	
13	WAS Metering and Control–Add dedicated WAS flow meter and automate WAS control.	Operations	High	
14	Influent Flow Metering–Replace with properly sized mag meter.	Operations, Regulatory	Medium to High	
15	SCADA System–Upgrade aged assets, covert to situational graphics.	Operations, Condition Assessment	Medium to High	
16	Influent Screening–Improve screening to remove more debris from plant and renew aged asset.	Operations, Condition Assessment	Medium	
17	Control Building Motor Gear–Replace aged asset.	Condition Assessment, Risk Reduction.	Medium	
18	Headworks Odor Control–Reduce off-site odors.	Community	Medium	
19	IFAS Blower–Upgrade for more energy efficient blowers with better turndown.	Operations, Energy Savings	Low	
20	Oxidation Ditch Aerators–Replace aerators to allow improved control and energy efficiency.	Operations, Energy Savings	Low	
21	Biological Process Expansion.	Capacity	Low	

7.04 RECOMMENDED PROJECTS AND SCHEDULE

This section will define the recommended projects and summarize their cost opinions and proposed schedule.

The highest priority projects are all recommended to be addressed in a single capital project. The details of the proposed capital project are included in the recommended design criteria listed in Table 7.04-1. Table 7.04-3 show the proposed unit process design criteria for proposed Shepherdsville WWTP upgrade. The improvements will address the performance and hydraulic limitations as well as operational and aging asset concerns. A schematic of the upgraded WWTP that highlights the recommended improvements is included in Figure 7.04-1. Figure 7.04-2 shows the proposed improvements on a site plan.

The Shepherdsville WWTP should handle the projected wastewater flows and loadings within the Shepherdsville City Planning Area to the year 2030. Table 7.04-2 show the proposed design criteria for the upgraded Shepherdsville WWTP.

TABLE 7.04-1 WWTP PROPOSED DESIGN CRITERIA

Influent Flows

	Plant Design Influent Flows (mgd)	Projected Influent Flows at Year 2030 (mgd)
ADF	5.04	3.6
PHF	22.71	18.0

Influent Loadings

	Plant Design Loadings (lb/d)	Projected Loadings at Year 2030 (lb/d)
BOD_5	16,800	13,640
TSS	10,380	6,600
NH_3-N	760	480
TKN	1,420	765
P	120	130

TABLE 7.04-2 WWTP–PROPOSED UNIT PROCESS DESIGN CRITERIA

Influent Flow Measurement (New)

Influent Flow Meter	1
Type of Meter	Mag Meter
Size	16 inch
Capacity	28.6 mgd

Influent Screening (Existing)

Number of Channels	2
Number of Mechanically Cleaned Screen	1
Design Capacity	18.0 mgd
Screen Opening	1/4 inch
Number of Manually Cleaned Screen	1
Design Capacity	18.0 mgd

Biological Treatment Process to year 2030 (Existing)

Oxidation Ditch	1
Total Effective Aeration Volume	1.8 mil gal
Number of Aerators	2
Aerator Horsepower	150 hp each
Design Influent Loadings	30 percent
BOD Loadings	17.0 lbs/1,000 ft^3
Hydraulic Detention Time	40.0 hrs @ 3.6 mgd ADF
IFAS System	1
Total Effective Aeration Volume	1.8 mil gal
Aeration Diffuser Type	Fine Bubble
Design Influent Loadings	70 percent
BOD Loadings	41.0 lbs/1,000 ft^3
Hydraulic Detention Time	17.1 hrs @ 3.6 mgd ADF

Secondary Clarifiers (Existing and New)

Number of Units	5 (2 existing small + 1 existing large+ 2 new large)
Clarifier Diameter	88 feet per larger clarifier
	62 feet per small clarifier
Total Surface Area	24,280 ft^2
Surface Loading Rate	208 gpd/ft^2 @ ADF
	935 gpd/ft^2 @ PHF
Solids Loading Rate (3,000 mg/L MLSS)	
@ 5.04 mgd + 5.04 mgd RAS	10.4 lbs/d/ft^2
@ 22.71 mgd + 11.23 mgd RAS	35.0 lbs/d/ft^2

RAS Pump Station No.1

Type of Pump	Submersible
Number of Pumps	3 new pumps
Design Capacity	1,200 gpm each
Firm Capacity	3.46 mgd (with 2 pumps in operation)
RAS Capacity	275 percent of ADF
Control	Variable Speed Drive

RAS Pump Station No.2

Type of Pump	Submersible
Number of Pumps	4 (Add 2 new pumps)
Design Capacity	1,950 gpm each
Firm Capacity	8.42 mgd (with 3 pumps in operation)
RAS Capacity	223 percent of ADF
Control	Variable Speed Drive

Scum Pump Station (New)

Type of Pump	Submersible
Number of Pumps	2
Size	180 gpm
Control	Constant Speed Drive

UV Disinfection (New)

Number of Channels	2 (new UV system)
Number of UV Disinfection Units	4 (2 banks per channel)
UV Transmission	65 percent
Level control	Fixed Weir
Design Capacity, each Channel	11.5 mgd
Total Capacity	23.0 mgd

Post Aeration System (New)

Total Post Aeration Volume	80,000-gallon new tank
Aeration Diffuser Type	Fine Bubble
Hydraulic Detention Time	23 minutes @ 5.04 mgd flow

Post Aeration Air Supply (New)

Number of Blowers	2
Blower Type	Positive Displacement
Blower Capacity (each)	500 scfm
Design Air	45 scfm/1,000 ft^3
Drive Type	Constant Speed

Effluent Flow Measurement (New)

Influent Flow Meter	1
Type of Meter	Parshall Flume
Size	24 inch
Capacity	21.4 mgd

Effluent Flow Pump Station (New)

Number of Pump	3 (2 + 1 standby)
Type	Submersible
Design Capacity	7,900 gpm each
Firm Capacity	22.71 mgd (with 2 pumps in operation)
Control	Variable Speed Drive

Biosolids Holding (Existing and New)

Number of Tanks	6 (1 for hauled waste and scum, 5 for waste sludge)
Volume of Each Tank	87,000 gallons
Total Volume	522,000 gallons
Type of Aeration	Coarse Bubble Diffusion
Air Supply	700 scfm from Media Zone Blowers
Design Mixing	30 scfm/1,000 ft^3

Sludge Dewatering (Existing)

Type	Belt Filter Press
Number	2 (existing)
Size	2.0 meter belt
Solids Capacity	5,000 lbs/hr per each press
Liquid Capacity	300 gpm per each press

Sludge Feed Pumps (Existing)

Number	3 (1 per each press and 1 standby)
Type	Centrifugal
Size	300 gpm each pump
Control	Variable Speed Drive

Plant Recycle Pump Station (New)

Number of Pump	2
Type	Submersible
Size	3,750 gpm
Control	Constant Speed Drive
Magnetic Flow Meter	8 inch

The recommend capital project will address needs 1 through 15. A capital cost opinion for the project is shown in Table 7.04-3. A planning-level contingency is included in the cost opinion.

Table 7.04-3 Recommended Capital Project Cost Opinion

Item	Cost
Site Work, Yard Piping and Miscellaneous Improvements	$1,719,000
Improvements to Influent Sampling and Recycle Flow Management	$1,040,000
Sludge Holding Tank Expansion	$389,000
Clarifier Splitter Box, Final Clarification Expansion, RAS, and Scum Pumping	$3,010,000
New Effluent Structure (UV, Post Aeration, Flume, Effluent Pumping)	$3,046,000
IFAS Screen Replacement	$210,000
Headworks Building Improvements	$235,000
SCADA System Upgrades	$108,000
Subtotal Construction Cost Opinion	$9,757,000
Contractor's General Conditions (8%)	$976,000
Subtotal	$10,733,000
Contingencies, Engineering Design, Engineering During Construction, and Construction Observation (40%)	$4,293,000
Total Project Cost	**$15,026,000**

Note: All costs are in 1st quarter 2021 dollars.

There are several additional needs that can be excluded from the initial capital project but should be anticipated within the next 10 years. Needs 16 through 21 should be budgeted for this. Table 7.04-4 includes cost opinions for these upgrades.

Table 7.04-4 Additional Projects Planned for 2021 to 2030

	Need	Driver for Implementation	Cost Opinion
16	Influent Screening–Improve screening to remove more debris from plant and renew aged asset.	Condition of existing screen or continued IFAS media zone screen blinding.	$591,000
17	Control Building Motor Gear–Replace aged asset.	Safety.	$83,000
18	Headworks Odor Control–Reduce off-site odors.	Odor complaints.	$1,463,000
19	IFAS Blower–Upgrade for more energy efficient blowers with better turndown.	Problems with existing blowers.	$944,000
20	Oxidation Ditch Aerators–Replace aerators to allow improved control and energy efficiency.	Problems with existing aerators.	$1,690,000
21	Biological Process Expansion.	Increased loadings or performance challenges with the IFAS or oxidation ditch.	$24,588,000

Table 7.04-5 lists the projects, costs and proposed start dates, and project durations.

Table 7.04-5 Recommended Projects Over the Next 10 Years

	Need	Cost Opinion	Start Date	Project Duration (years)
1 to 15	Initial Capital Project to address the following needs: ▪ Influent Sampling ▪ Recycle Flow Management ▪ Sludge Holding Tanks ▪ Final Clarification ▪ Hydraulic Profile ▪ UV Disinfection ▪ IFAS Media Zone Overflows ▪ Scum Management ▪ Headworks Building Ventilation ▪ Headworks Electrical ▪ Operational Enhancements ▪ RAS Pump Station No. 1 ▪ WAS Metering and Control ▪ Influent Flow Metering ▪ SCADA System	$15,026,000	2021	3.5
16	Influent Screening	$591,000	2026 to 2030	1.5
17	Control Building Motor Gear	$83,000	2026 to 2030	0.5
18	Headworks Odor Control	$1,463,000	2026 to 2030	1.5
19	IFAS Blower	$944,000	2026 to 2030	1.5
20	Oxidation Ditch Aerators	$1,690,000	2026 to 2030	1.5
21	Biological Process Expansion	$24,588,000	2030	3.5

In addition to the needs stated in Table 7.04-5, Shepherdsville should anticipate funding needs to address the equipment replacement costs for aging equipment. These smaller improvements are anticipated to be addressed by direct replacement outside of a capital project. Table 7.04-6 includes the likely asset replacement needs over the next 10 years. Shepherdsville should budget $213,000 annually from year 3 through 10 to anticipate replacement of these assets with any unused budget added to an equipment replacement fund for future use.

Table 7.04-6 Critical Assets

Process	Equipment	Time Horizon (years)	Budget
Headworks	Headworks Sampler	3 to 5	$5,000
Biological Treatment	IFAS Aeration Basin Fine Bubble Diffusers	3 to 5	$65,000
Biological Treatment	IFAS Recirculation Pump Motor Operated Gates	3 to 5	$25,000
Biological Treatment	IFAS Anoxic Submersible Mixer No.4	3 to 5	$38,700
Biological Treatment	IFAS Media Basin Medium Bubble Diffusers	3 to 5	12,400
Biological Treatment	IFAS Fixed Film Media	6 to 10	$1,245,600
RAS and WAS Pumping	RAS #2 Motor Operated Valve	6 to 10	$12,000
RAS and WAS Pumping	WAS #2 Motor Operated Valve	6 to 10	$12,000
Biological Treatment	IFAS Recirculation Pump No. 1	6 to 10	$15,500
Biological Treatment	IFAS Recirculation Pump No. 2	6 to 10	$15,500
Biological Treatment	IFAS Anoxic Submersible Mixer No. 1	6 to 10	$38,700
Biological Treatment	IFAS Anoxic Submersible Mixer No. 2	6 to 10	$38,700
Biological Treatment	IFAS Anoxic Submersible Mixer No. 3	6 to 10	$38,700
Biological Treatment	IFAS Anoxic Submersible Mixer No. 5	6 to 10	$38,700
Solids Processing Building	Polymer Feed System No. 1	6 to 10	$48,000
Solids Processing Building	Polymer Feed System No. 2	6 to 10	$48,000
		Total	**$1,697,500**