Winston-Salem • Forsyth County
City/County Utilities
Water • Sewer • Solid Waste Disposal

WASTEWATER FACILITIES MASTER PLAN

JANUARY 2011

CDM

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# Winston-Salem/Forsyth County Utility Commission

# Wastewater Facilities Master Plan

**February 2011**

Camp Dresser & McKee
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# Section 1
# Introduction

This section provides an introduction to the Wastewater Facilities Master Plan for the Archie Elledge and Muddy Creek Wastewater Treatment Plants and Wastewater Lift Stations. The objective, scope, and an outline of this report are described below.

## 1.1 General

The City of Winston-Salem/Forsyth County Utilities Commission (CCUC) recognized the need to update its current Wastewater Facilities Master Plan (2003) to provide long-term guidance and planning for future capital improvement projects at the Archie Elledge and Muddy Creek Wastewater Treatment Plants and 15 wastewater lift stations within its collection system. In April 2009, CCUC retained Camp Dresser & McKee (CDM) to prepare this Facilities Master Plan.

Through this study, the current Facilities Master Plan was updated to a new 20-year facility planning horizon ending in year 2030. Improvements needed at the treatment facilities and lift stations were identified and prioritized to comply with existing and future regulatory requirements, maintain facility reliability throughout the planning period, and accommodate growth within the service area.

## 1.2 Scope of Work

The objectives of the Wastewater Facilities Master Plan were accomplished through completion of the following scope of work:

- ***Task 200 – Data Collection and Review.*** For both Archie Elledge and Muddy Creek WWTPs, Task 200 provided an overview of the existing facility equipment and processes, National Pollutant Discharge Elimination System (NPDES) permit effluent limits, current and projected influent flows and loads, and parameters developed for input into the process model.

- ***Task 300 – Regulatory Review and Coordination.*** CDM met with EPA and the North Carolina Division of Water Quality (DWQ) officials to discuss potential future effluent nutrient limits for the Archie Elledge and Muddy Creek WWTPs associated with the ongoing Total Maximum Daily Load (TMDL) study on High Rock Lake. Based on these discussions and meetings, CDM worked with CCUC to develop three effluent limit scenarios to establish a basis of design over the 20-year planning period for each WWTP. The target effluent limits were used to help guide the review and evaluation of alternative wastewater treatment process improvement options, and development of the implementation plan.

- ***Task 400 – Develop Alternative Wastewater Treatment Process Options.*** Task 400 identified process alternative options potentially suited to the nutrient effluent limits of each of the three effluent limit scenarios developed under Task 300. A preliminary screening of process alternative options was performed by using a list of cost- and non-cost based evaluation criteria with a decision matrix approach.

CDM then worked with CCUC to short-list two wastewater treatment process options for two permit scenarios for each WWTP for further evaluation under subsequent tasks.

- ***Task 500 – Process Modeling.*** Using existing plant data, the wastewater process simulation model was developed and calibrated for both the Archie Elledge and Muddy Creek WWTPs to simulate process performance under future design conditions. The model was used to verify that the WWTPs can perform as required to meet or exceed the target nutrient effluent limits developed under Task 300 over the planning period.

- ***Task 600 – WWTPs Facility and Equipment Condition Assessment and Recommended Improvements.*** A physical condition assessment of the two WWTPs was performed under Task 600 to document the general condition of mechanical equipment, structures, and electrical equipment, provide an estimated remaining service life of major equipment, and provide information to prioritize rehabilitation or replacement needs. Based upon the results of the condition assessment, capital improvements were identified to maintain the facilities and equipment reliability at each WWTP over the 20-year Capital Improvements Planning (CIP) period including planning level cost estimates.

- ***Task 700 – Evaluate Wastewater Treatment Improvement Alternatives.*** Two flow management options for dealing with projected wastewater flows within CCUC's service area were developed in order to maximize the use of the existing treatment plant facilities over the 20-year planning period. These flow options were evaluated in combination with the two permit scenarios for developing four improvement alternatives to meet existing and future treatment facility requirements at both WWTPs. For each alternative, the following were developed: 1) Process flow diagrams and descriptions including a summary of required modifications/additions to the existing facility; 2) a basis of design and preliminary process sizing at the design flows, including conceptual site plans using the existing facility plan as a base plan; and 3) estimated capital and operational/life cycle costs.

- ***Task 800 – Develop Alternative Selection Criteria.*** By using a decision matrix approach, the four wastewater treatment improvement alternatives developed under Task 700 were ranked against each other with respect to non-cost criteria in order to select the most favorable alternative for planning purposes. The non-cost criteria included the following: constructability, permitability, operability, environmental impacts, and community impacts.

- ***Task 900 – Recommended Wastewater Treatment Improvements Including Implementation and Prioritization.*** Based upon the results of the cost and non-cost factor alternative evaluations (Tasks 700 and 800), the physical condition assessments (Task 600) and discussions with CCUC staff, a recommended

improvements plan was developed for both the Archie Elledge WWTP and Muddy Creek WWTP that will meet anticipated future effluent limits and handle projected flows and loads. The recommended improvements plan prioritized improvements by phases -- Phase I (5-year), Phase II (10-year), and Phase III (20-year). The improvements plan identified and described the proposed location, size, and cost of all recommended WWTP facility improvements. A conceptual site plan showing the location and layout of existing treatment facilities and recommended phased improvements was also developed for both WWTPs. More detailed project descriptions and cost estimates of recommended projects for the initial 5-year period were developed for use in establishing the capital improvements plan budget.

- ***Task 1000 - Lift Stations Facility and Equipment Condition Assessment and Recommended Improvements.*** A physical condition assessment was conducted at 15 pump stations selected by CCUC to document the general condition of mechanical equipment, structures, and electrical equipment and provide information used to prioritize rehabilitation or replacement needs or additional operation and maintenance needs for each pump station. Based upon the results of the condition assessment and discussions with CCUC staff, a recommended improvements plan was developed for the 15 pump stations to maintain facility/equipment reliability. The recommended improvements plan prioritized improvements by phases -- Phase I (5-year), Phase II (10-year), and Phase III (20-year). The improvements plan identified and described the proposed improvements and planning level costs. More detailed project descriptions and cost estimates of required projects for the initial 5-year period were developed for use in establishing the capital improvements plan budget.

## 1.3 Report Organization

This report is organized as below:

- Section 1: Introduction: provides an introduction to the Facilities Master Plan study.
- Section 2: Overview of Existing Facilities: provides an overview of the existing facility equipment/ processes, permit limits, influent flows and loads, etc.
- Section 3: Wastewater Flow Projections: presents the findings from the adapted 2008 flow projection study that were used as the basis for this 2009 Master Plan study.
- Section 4: Wastewater Treatment Process Options: summarizes the development, evaluation, and screening of the process options which short-listed up to two process options for each WWTP for further evaluation.

- Section 5: Process Modeling: summarizes the process modeling performed to evaluate nutrient removal at the Muddy Creek and Archie Elledge WWTPs.
- Section 6: Wastewater Treatment Improvement Alternatives: describes the development and evaluation of the wastewater treatment improvement alternatives.
- Section 7: WWTP Condition Assessments: documents the general conditions of mechanical equipment, structures, and electrical equipment and provides information used to prioritize rehabilitation or replacement needs or additional operation and maintenance needs for each WWTP.
- Section 8: Pump Station Condition Assessment: documents the general conditions of mechanical equipment, structures, and electrical equipment and provides information used to prioritize rehabilitation or replacement needs or additional operation and maintenance needs for the 15 pump stations analyzed.
- Section 9: Recommended Capital Improvements Plan: provides a recommended Capital Improvements Plan (CIP) based on the findings of the Facilities Master Plan study.
- Appendices: Includes supporting calculations, tables, data, etc.

# Section 2
# Overview of Existing Facilities

Information including design drawings, reports from construction and facility upgrades, O&M manuals, DMRs, etc. for both WWTPs were provided by CCUC upon CDM's request. This section provides a summary of the existing facilities based on a review of these documents.

## 2.1 Archie Elledge WWTP

### 2.1.1 Physical Facilities

The Archie Elledge WWTP was constructed in 1956 and has undergone significant upgrades to achieve the existing permitted capacity of 30 MGD. Currently, the facility includes the following processes:

- Preliminary treatment including mechanical screening and grit removal
- Primary clarification
- Activated sludge
- Secondary clarification
- Chlorination and dechlorination
- Gravity belt thickening
- Anaerobic digestion
- Centrifuge dewatering
- Solids drying

The AEWWTP process flow diagram (PFD) is shown in **Figure 2-1**. This PFD was prepared based on the AEWWTP O&M Manual (Hazen and Sawyer, 1996) and updated to include facilities constructed since then including the biosolids dewatering facility (Black & Veatch, 1998) and drying facility (Black & Veatch, 2006). Although new influent pump station, preliminary treatment, and primary clarifier facilities are currently under construction (Black & Veatch, 2008) and will increase the capacity of these processes, they will replace existing facilities to be demolished so the PFD will not substantially change.

Three 6-inch diameter pipes were installed between the AEWWTP and MCWWTP; one for conveying digested solids from the MCWWTP to AEWWTP, one for transferring centrate from AEWWTP to MCWWTP, and one that can be used for either purpose. These transfers are included on the process flow diagram.

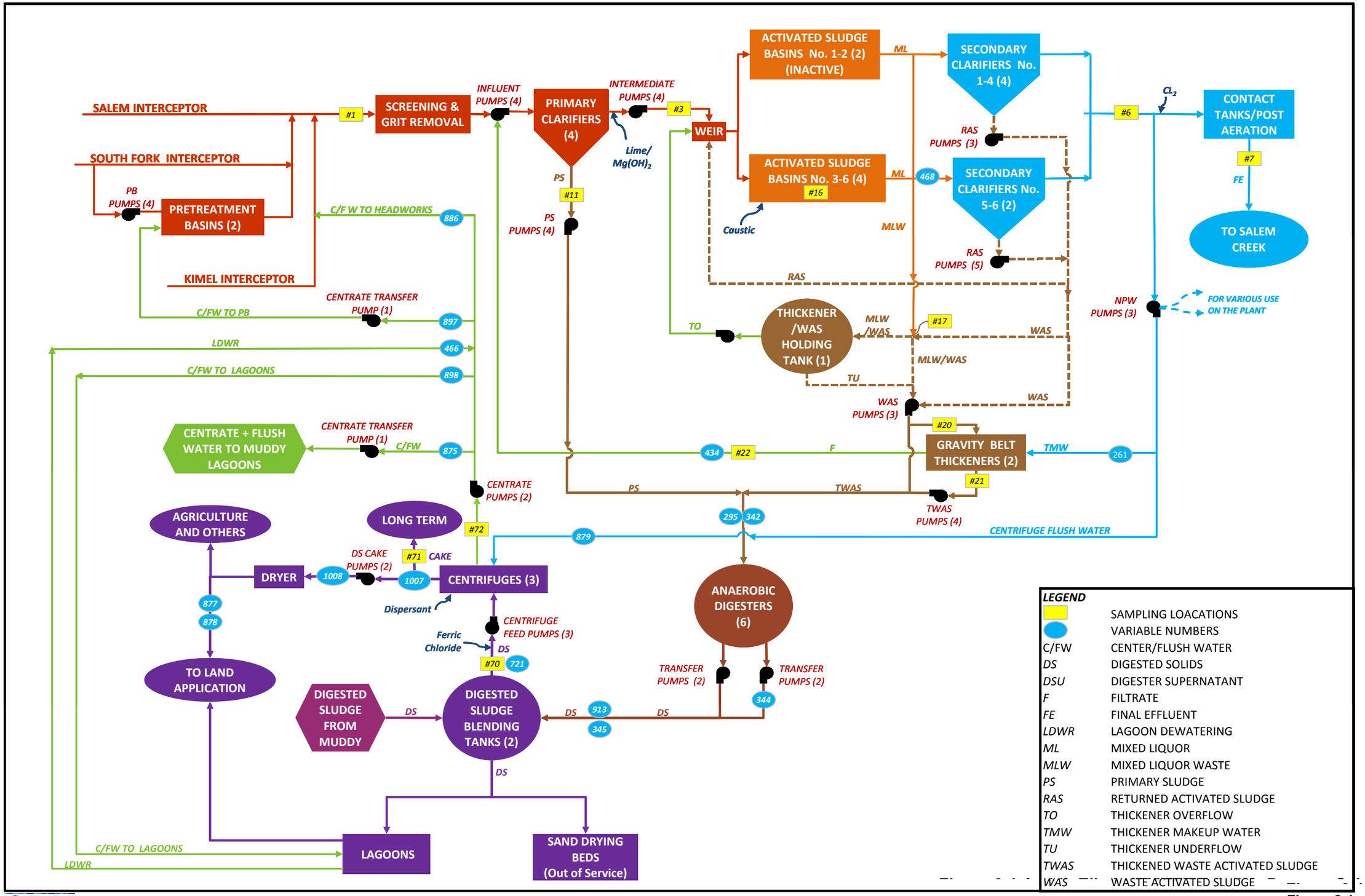


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**Figure 2-1**
**Archie Elledge WWTP Existing Process Schematic**

The PFD also includes indication of sample collection locations (with SCADA identifier) and flow metering locations with SCADA variable number. These are provided for reference in coordination with the influent, effluent, and operating data summaries included in Section 2.3.

An equipment and process summary for the AEWWTP is included as **Table 2-1** below:

**Table 2-1**

**Archie Elledge WWTP Existing Liquid and Solids Treatment Equipment and Process Summary**

| Parameter and Units | Design Criteria | |
|---|---|---|
| **Pretreatment Facilities** | | |
| Number of pumps | 4 | |
| Type | Vertical, non-clog centrifugal | |
| Max. capacity, each (MGD) | 4 | |
| TDH (ft) | 45 | |
| Firm Capacity (MGD) | 12 | |
| Motor horsepower, each | 50 | |
| Number of pretreatment basins | 2 | |
| | No. 1 | No. 2 |
| Volume of basin, each (MG) | 2.2 | 1.33 |
| Number of aerators | 9 | 5 |
| Motor horsepower, each | 60 | 75 |
| **Headworks (to be decommissioned)** | | |
| Number of bar screens | 3 | |
| Clear opening between bars (in) | 1/4" | |
| Capacity, each (MGD) | 30 | |
| Number of grit collectors | 3 | |
| Capacity, each (MGD) | 30 | |
| **Headworks (under construction)** | | |
| Number of bar screens | 3 | |
| Clear opening between bars (in) | 3/8" | |
| Capacity, each (MGD) | 50 | |
| Number of vortex grit removal basins | 2 | |
| Capacity, each (MGD) | 50 | |
| Number of grit pumps | 4 (2 per basin) | |
| Type | Recessed impeller centrifugal | |
| Capacity, each (gpm) | 500 | |
| TDH (ft) | 71 | |
| Motor horsepower, each | 40 | |
| **Influent Pump Station (to be decommissioned)** | | |
| Number of pumps | 4 | |
| Type of pumps | Vertical propeller | |
| Max. capacity, each (MGD) | 25 | |
| Firm capacity (MGD) | 75 | |
| Motor horsepower, each | 125 | |

**Table 2-1**

**Archie Elledge WWTP Existing Liquid and Solids Treatment Equipment and Process Summary**

| Parameter and Units | Design Criteria | |
|---|---|---|
| | | |
| **Influent Pump Station (under construction)** | | |
| Number of pumps | 2 | 4 |
| Type of pumps | Vertical, non-clog | dry pit submersible |
| Capacity (MGD) | 12.5 | 25 |
| Firm capacity (MGD) | 100 | |
| Rated head (ft) | 86 | 85 |
| Secondary capacity (MGD) | 12.5 | 25 |
| Secondary head (ft) | 57 | 55 |
| Max. nominal pump speed (rpm) | 900 | 900 |
| Motor horsepower, each | 300 | 600 |
| **Primary Settling Tanks (to be decommissioned)** | | |
| Number | 4 | |
| Length (ft) | 140 | |
| Width (ft) | 83 | |
| Sidewater depth (ft) | 10 | |
| Surface area, each ($ft^2$) | 11,620 | |
| Total surface area ($ft^2$) | 46,480 | |
| Volume, each (MG) | 0.87 | |
| Total volume (MG) | 3.48 | |
| Detention time at design flow (hrs) | 2.8 | |
| **Primary Clarifiers (under construction)** | | |
| Number | 4 | |
| Diameter (ft) | 120 | |
| Side water depth (ft) | 12 | |
| Surface area ($ft^2$) | 11,310 | |
| Volume, each (MG) | 1.02 | |
| Total volume (MG) | 4.08 | |
| Peak flow per primary clarifier (MGD) | 25 | |
| Peak overflow rate per clarifier (gpd/sf) | 2,210 | |
| **Primary Sludge Pumps (to be decommissioned)** | | |
| Number | 4 | |
| Type | Progressing cavity | |
| Max. capacity (gpm) | 200 | |
| TDH (psi) | 70 | |
| Motor Horsepower, each | 20 | |
| **Primary Sludge Pumps (under construction)** | | |
| Number | 5 | |
| Type | Progressing cavity | |
| TDH (psi) | 55 | |

**Table 2-1**

**Archie Elledge WWTP Existing Liquid and Solids Treatment Equipment and Process Summary**

| Parameter and Units | Design Criteria | |
|---|---|---|
| Capacity at design TDH (gpm) | 180 | |
| Firm capacity (gpm) | 720 | |
| Speed (rpm) | 300 | |
| **Intermediate Pump Station (to be decommissioned)** | | |
| Number of pumps | 4 | |
| Type | Vertical, centrifugal | |
| Capacity, each (MGD) | 25 | |
| TDH (ft) | 24 | |
| Firm capacity (MGD) | 75 | |
| Speed (rpm) | 700 | |
| Motor horsepower | 200 | |
| **Aeration Basins** | | |
| | No. 1&2 | No. 3-6 |
| Number | 2 | 4 |
| Length of each basin at water surface | 525 | 583.33 |
| Length of jet mix zone (ft) | - | 26 |
| Length of diffused air zone (ft) | - | 227.33 |
| Width of each basin at water surface (ft) | 105 | 57.67 |
| Water Depth (ft) | 14.5 | 20 |
| Volume, each (MG) | 5.625 | 5.03 |
| Total volume (MG) | 31.38 | |
| Design flow per basin (MGD) | 5.29 | 4.85 |
| Total flow capacity (MGD) | 30 | |
| Detention time at design flow, hrs | 25.5 | 24.9 |
| **Blowers** | | |
| Number | 4 | |
| Airflow range (scfm) | 8,100-18,000 | |
| Motor horsepower | 1,000 | |
| **Secondary Clarifiers** | | |
| | No. 1-4 | No. 5 & 6 |
| Number | 4 | 2 |
| Diameter (ft) | 120 | 170 |
| Sidewater depth (ft) | 11 | 16 |
| Surface area, each ($ft^2$) | 11,310 | 22,700 |
| Volume, each (MG) | 0.93 | 2.72 |
| Flow per clarifier @ design flow (MGD) | 3.75 | 7.5 |
| Detention time @ design flow (hr) | 6 | 8.7 |
| Drive motor horsepower, each | 1 | |
| **RAS Pump Stations** | | |
| | No. 1 | No. 2 |
| Number of pumps | 3 | 5 |
| Design capacity (MGD) | 1@6, 1@12, | 4@3.9, 1@2.9 (for |

**Table 2-1**

**Archie Elledge WWTP Existing Liquid and Solids Treatment Equipment and Process Summary**

| Parameter and Units | Design Criteria | |
|---|---|---|
| | 1@18 | clarifier dewatering) |
| Firm capacity (MGD) | 18 | 7.8 |
| Horsepower, each | 1@20, 1@40, 1@50 | 15 |
| **WAS Pump Station** | | |
| Number of pumps | 3 | |
| Capacity, each (gpm) | 750 | |
| Firm capacity (gpm) | 1,500 | |
| TDH (ft) | 74 | |
| Horsepower | 25 | |
| **Flood Control Pump Station** | | |
| Number of pumps | 3 | |
| Type | Single stage, axial flow | |
| Capacity, each (MGD) | 20 | |
| Total capacity (MGD) | 60 | |
| Speed (rpm) | 720 | |
| Horsepower | 125 | |
| **Gravity Belt Thickeners** | | |
| Number | 2 | |
| Max. feed rate, each (gpm) | 750 | |
| **Thickened WAS Sludge Pumps** | | |
| Number | 2 | |
| Max. capacity, each (gpm) | 250 | |
| TDH (psig) | 100 | |
| Horsepower | 50 | |
| **Anaerobic Digesters** | | |
| Number | 6 | |
| | No. 1 to 4 | No. 5 to 8 |
| Diameter (ft) | 90 | 100 |
| Max. sidewater depth (ft) | 21.5 | |
| Volume, each ($ft^3$) | 153,000 | 200,000 |
| Total primary volume ($ft^3$) | 1,012,000 | |
| Total secondary volume ($ft^3$) | 400,000 | |
| Total volume ($ft^3$) | 1,412,000 | |
| Hydraulic retention time at annual average conditions (4% solids) (days) | 27 | |

**Table 2-1**

**Archie Elledge WWTP Existing Liquid and Solids Treatment Equipment and Process Summary**

| Parameter and Units | Design Criteria |
|---|---|
| **Digested Sludge Blending Tanks (Re-commissioned Digesters No 6 and No 7, since 2008)** | |
| Number | 2 |
| Effective capacity, each (gal) | 763,000 |
| **Digested Sludge Pumps** | |
| Number | 4 (1 upgraded in 2008) |
| Capacity range (gpm) | 3@150-300, 1@395 |
| Motor horsepower | 3@30, 1@25 |
| **Centrifuges** | |
| Number | 3 (1 added in 2008) |
| Design solids loading rate (dry tons/hr/unit) | 1.3 |
| Max connected horsepower | 2@ 300 (main drive), 100 (backdrive), 1@250-300(main drive), 50-75(backdrive) |
| **Centrate Transfer Pumps** | |
| Number | 2 |
| Rated total head (ft) | 90 |
| Capacity at rated head (gpm) | 700 |
| Operating head range (ft) | 70-115 |
| Max. nominal pump operating speed at rated head (rpm) | 1,800 |
| Motor horsepower | 40 |
| **Muddy Creek Centrate Transfer Pumps (Since 2008)** | |
| Number | 2 |
| Type | Rotary lobe positive displacement |
| Rated total head (ft) | 90 |
| Rated differential pressure (psig) | 125 |
| Capacity at rated differential pressure (gpm) | 275 |
| Normal operating differential pressure (psig) | 25-80 |
| Max. pump operating speed (rpm) | 250 |
| Max. nominal motor operating speed (rpm) | 1,800 |
| Motor horsepower | 36 |
| **Dewatered Sludge Cake Pumps (Since 2008)** | |
| Number | 2 |
| Type | Progressing cavity |
| Operation | |
| Hrs/day | 24 |
| Days/week | 5 |
| Rated differential pressure (psi) | 200 |
| Capacity at rated differential pressure (21% solids) (gpm) | 60 |
| Sludge percent solids range | 19-28 |
| Max. pump speed (rpm) | 85 |

**Table 2-1**

**Archie Elledge WWTP Existing Liquid and Solids Treatment Equipment and Process Summary**

| Parameter and Units | Design Criteria |
|---|---|
| Motor horsepower | 40 |
| **Solids Storage Lagoons for Digested Solids** | |
| Number | 3 |
| Volume, each (MG) | 1@14.3, 1@10.8, 1@7.5 |
| Total volume (MG) | 32.6 |
| **Sand Drying Beds** | |
| Number | 24 |
| Length (ft) | 100 |
| Width (ft) | 100 |
| Total area ($ft^2$) | 240,000 |
| **Dryer System (Since 2008)** | |
| Number of drying trains | 1 |
| Type | Direct hot air contact triple pass rotary drum |
| Operation (hrs/day) | 24 |
| Evaporative capacity (lbs of water per hour) | up to 13,200 |
| Dewatered cake to dryer (%TS) | |
| Average | 21 |
| Range | 19 to 24 |
| Dried product (%TS) | 92 to 96 |
| Granule diameter (mm) | 1 to 4 |
| Solids drying capacity (dtpd at 21% TS) | 43 |
| Fuel requirements (BTU/lb water evaporated) at design throughput) | 1,600 |
| Fuel used: | |
| Primary | Digester gas |
| Secondary | Natural gas |
| Total installed motor horsepower | 900 |
| **Gas Storage Tank** | |
| Number | 1 |
| Type | Spherical |
| Volume ($ft^3$) | 250,000 |
| Maximum working pressure (psi) | 50 |
| **Chlorine Contact Tanks** | |
| Number | 2 |
| Volume, each (gal) | 1@ 634,490, 1@ 669,100 |
| Volume of approx. 800 ft of 60” pipe to the chlorine contact tanks (gal) | 117,500 |
| Total volume (gal) | 1,421,090 |
| Detention time at design flow (min) | 68.2 |

**Table 2-1**

**Archie Elledge WWTP Existing Liquid and Solids Treatment Equipment and Process Summary**

| Parameter and Units | Design Criteria |
|---|---|
| **Post Aeration** | |
| Type | Coarse bubble diffused air |
| Number of diffusers | 200 |
| Blowers | |
| Number | 3 |
| Capacity, each (icfm) | 2@1,000, 1@500 |
| Firm capacity, each (icfm) | 1,500 |
| Horsepower | 2@40, 1@20 |

## 2.1.2 NPDES Permit

The Archie Elledge WWTP discharges into Salem Creek, which is classified as Class C waters in the Yadkin Pee Dee River Basin. **Table 2-2** summarizes the National Pollutant Discharge Elimination System (NPDES) permit effluent limits for the Archie Elledge WWTP issued in July 2009. The temperature and conductivity do not have discharge limitations but are required to be monitored on a daily and monthly basis, respectively. Characteristics including total nitrogen (TN) and total phosphorous (TP) do not have discharge limitations, but are required to be monitored on a weekly basis.

**Table 2-2**

**Archie Elledge WWTP NPDES Permit Effluent Limits (Permit No. NC0037834) for Key Parameters**

| Effluent Characteristics | Discharge Limitations | | | Monitoring Requirements | | |
|---|---|---|---|---|---|---|
| | Monthly Average | Weekly Average | Daily Average | Measurement Frequency | Sample Type | Sample Location |
| Flow (MGD) | 30.0 | | | Continuous | Recording | I or E |
| BOD, 5-Day, 20°C (April 1-October 31) | 21.0 mg/L | 31.5 mg/L | | Daily | Composite | I, E, U, D |
| BOD, 5-Day, 20°C (November 1-March 31) | 30.0 mg/L | 45.0 mg/L | | Daily | Composite | I, E, U, D |
| Total Suspended Solids | 30.0 mg/L | 45.0 mg/L | | Daily | Composite | I, E |
| $NH_3$ as N (April 1 - October 31) | 1.2 mg/L | 3.6 mg/L | | Daily | Composite | E, U, D |
| $NH_3$ as N (November 1 - March 31) | 9.0 mg/L | 27.0 mg/L | | Daily | Composite | E, U, D |
| Dissolved Oxygen | | | $\geq$ 6.5 mg/L | Daily | Grab | E, U, D |
| Fecal Coliform (geometric mean) | 200/100 mL | 400/100 mL | | Daily | Grab | E, U, D |
| Total Residual Chlorine | | | 22.5 µg/L | Daily | Grab | E |
| Temperature | | | | Daily | Grab | E, U, D |
| Conductivity | | | | Monthly | Grab | E, U, D |

**Table 2-2**

**Archie Elledge WWTP NPDES Permit Effluent Limits (Permit No. NC0037834) for Key Parameters**

| Effluent Characteristics | Discharge Limitations | | | Monitoring Requirements | | |
|---|---|---|---|---|---|---|
| | Monthly Average | Weekly Average | Daily Average | Measurement Frequency | Sample Type | Sample Location |
| Total Phosphorus | | | | Weekly | Composite | E |
| Total Nitrogen ($NO_2$+$NO_3$+TKN) | | | | Weekly | Composite | E |
| pH | ≥ 6.0 and ≤ 9.0 standard units | | | Daily | Grab | E |
| Total Cadmium | | | | Quarterly | Composite | E |
| Cyanide | | | | Quarterly | Grab | E |
| Total Zinc | | | | 2/Month | Composite | E |
| Total Copper | | | | 2/Month | Composite | E |
| Chronic Toxicity | | | | Quarterly | Composite | E |
| Total Mercury | 16 ng/L | | | 2/Month | Grab | E |
| Fluoride | | 2,381 µg/L | | Weekly | Composite | E |
| Pollutant Scan | | | | Annually | | E |

# 2.2 Muddy Creek WWTP

## 2.2.1 Physical Facilities

The Muddy Creek WWTP was initially placed in service in 1986 with a permitted capacity of 15 MGD and was expanded in 1997 to a permitted flow of 21 MGD. Wastewater is conveyed to the plant through the 66-inch and 36-inch interceptors from the Lower Muddy Creek and South Fork service areas, respectively. Plant effluent is discharged to the Yadkin River outfall through a 66-inch interceptor.

Currently, the facility consists of the following processing components:

- Preliminary treatment including mechanical screening and grit removal
- Primary clarification
- Activated Sludge
- Secondary clarification
- Anaerobic digestion
- Gravity thickening
- Sludge storage and decanting lagoons

- Belt filter press dewatering (with polymer feed)
- Solids blending tanks prior to land application
- Chlorination and dechlorination

The MCWWTP process flow diagram (PFD) is shown in **Figure 2-2**. This PFD was prepared based on the Muddy Creek WWTP 21 MGD Expansion and Upgrade Drawings (Hazen and Sawyer, 1997). The piping for transferring digested solids from MCWWTP to AEWWTP and for transferring centrate from the AEWWTP to the MCWWTP is included on the process flow diagram. The belt filter presses are only used as a backup since all solids are currently sent to the AEWWTP.

The PFD also includes indication of sample collection locations (with SCADA identifier) and flow metering locations with SCADA variable number. These are provided for reference in coordination with the influent, effluent, and operating data summaries included in Section 2.3.

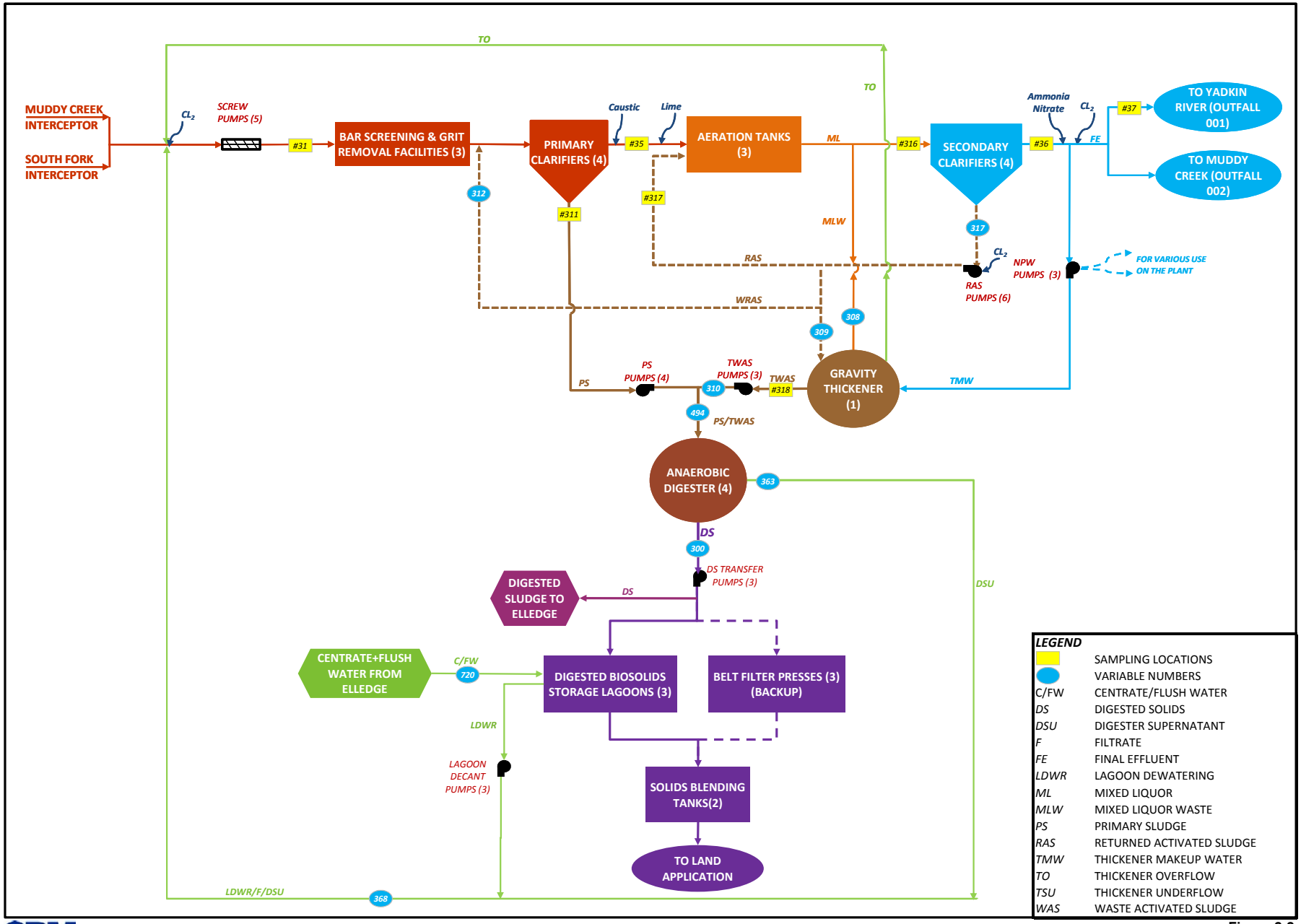


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**Figure 2-2**
**Muddy Creek WWTP Existing Process Schematic**

An equipment and process summary for the MCWWTP is included as **Table 2-3** below:

**Table 2-3**

**Muddy Creek WWTP**
**Existing Liquid and Solids Treatment Equipment and Process Summary**

| Parameter and Units | Design Criteria |
|---|---|
| **Influent Pump Station** | |
| Number of pumps | 5 |
| Type | Spiral screw, enclosed |
| Max. capacity, each (MGD) | 3@11.7, 2@21.6 |
| TDH (ft) | 45 |
| Firm Capacity (MGD) | 56.7 |
| Horsepower | 3@150, 2@200 |
| Total lift | 45.25ft |
| **Bar Screens** | |
| Number | 3 |
| Type | Climber (mechanical) |
| Clear space between bars (in) | 0.25 |
| Max. capacity, each (MGD) | 26.2 |
| Firm capacity (MGD) | 52.4 |
| **Grit Channels** | |
| Number | 3 |
| Length (ft) | 55 |
| Width (ft) | 9 |
| Max. capacity, each (MGD) | 13 |
| Firm capacity (MGD) | 26 |
| **Primary Clarifiers** | |
| Number | 4 |
| Length (ft) | 158 |
| Width (ft) | 46 |
| Sidewater depth (ft) | 11.93 |
| Surface area, each ($ft^2$) | 7,270 |
| Total surface area ($ft^2$) | 29,070 |
| Volume, each (MG) | 0.648 |
| Total volume (MG) | 2.59 |
| Weir length per clarifier (ft) | 311 |
| **Primary Solids Pumps** | |
| Number | 4 |
| Type | Dual valve plunger, duplex |
| Capacity, each (gpm) | 170 |
| Firm capacity (MGD) | 0.73 |
| TDH (ft) | 110 |
| Motor Horsepower, each | 10 |

**Table 2-3**

**Muddy Creek WWTP**
**Existing Liquid and Solids Treatment Equipment and Process Summary**

| Parameter and Units | Design Criteria |
|---|---|
| **Primary Scum Pumps** | |
| Number | 2 |
| Type | horizontal, end suction, centrifugal |
| Capacity, each (gpm) | 150 |
| Firm capacity (gpm) | 150 |
| TDH (ft) | 44 |
| Motor Horsepower, each | 7.5 |
| **Aeration Basins** | |
| Number | 3 |
| Length (ft) | 204 |
| Width (ft) | 68 |
| Sidewater depth (ft) | 24.83 |
| Volume, each (MG) | 2.58 |
| Total volume (MG) | 7.73 |
| Detention time (at 21 mgd) (hr) | 8.83 |
| **Aeration System** | |
| Type of aeration system | Fine bubble |
| Type of diffusers | Sanitaire Silver Series II |
| Numbers of diffusers per tank | 10,575 |
| **Blowers** | |
| Number of blowers | 3 |
| Type of blowers | Single stage centrifugal |
| Capacity range of each blower (scfm) | 11,400 |
| Firm capacity of blower (scfm) | 22,800 |
| Operating pressure range (psig) | 13.5 (discharge) |
| Motor horsepower | 800 |
| **Secondary Clarifiers** | |
| Number | 4 |
| Diameter (ft) | 110 |
| Sidewater depth (ft) | 14 |
| Surface area, each ($ft^2$) | 9,500 |
| Total surface area, each ($ft^2$) | 38,010 |
| Volume, each (MG) | 1 |
| Weir length per clarifier (ft) | 594 |
| **RAS Pumps** | |
| Number | 6 (2 Standby) |
| Type | Horizontal, end suction, centrifugal |
| Design capacity (gpm) | 2,400 (each) |

**Table 2-3**

**Muddy Creek WWTP**
**Existing Liquid and Solids Treatment Equipment and Process Summary**

| Parameter and Units | Design Criteria |
|---|---|
| Firm capacity (MGD) | 13 |
| TDH (ft) | 45 |
| Speed, each (rpm) | 1,150 |
| Horsepower, each | 40 |
| **Gravity Thickener** | |
| Number | 1 |
| Diameter (ft) | 105 |
| Sidewater depth (ft) | 13.66 |
| Volume (MG) | 0.896 |
| **Thickened Solids Pumps** | |
| Number | 3 |
| Capacity, each (gpm) | 170 |
| Firm capacity (MGD) | 0.49 |
| TDH (ft) | 110 |
| Horsepower | 10 |
| **Anaerobic Digesters** | |
| Number | 4 |
| Diameter (ft) | 100 |
| Sidewater depth (ft) | 30.83 |
| Maximum volume, each ($ft^3$) | 268,320 |
| Total volume ($ft^3$) | 1,073,270 |
| Total horsepower per digester | 75 |
| Total mixing capacity per digester (gpm) | 75,000 |
| Recirculation pumps | |
| Number | 6 (2 standby) |
| Type | Horizontal, centrifugal |
| Capacity, each (gpm) | 250 |
| TDH (ft) | 55 |
| Horsepower | 7.5 |
| Transfer pumps | |
| Number | 6(2 standby) |
| Type | Horizontal, centrifugal |
| Capacity, each (gpm) | 350 |
| TDH (ft) | 54 |
| Horsepower | 10 |
| Dewatering and transfer pumps | |
| Number | 2 |
| Type | Horizontal, centrifugal |
| TDH (ft) | 51 |
| Horsepower | 40 |
| Digested sludge transfer pumps (Since 2008) | |
| Number | 3 |
| Type | Progressing cavity |
| Rated differential pressure (psi) | 100 |
| Capacity range (gpm) | 50-260 |
| Max. pump sped (rpm) | 300 |
| Motor horsepower | 40 |

**Table 2-3**

**Muddy Creek WWTP**
**Existing Liquid and Solids Treatment Equipment and Process Summary**

| Parameter and Units | Design Criteria |
|---|---|
| **Gas Holder** | |
| Number | 1 |
| Type | Sphere |
| Diameter (ft) | 40 |
| Volume ($ft^3$) | 33,510 |
| **Belt Filter Presses (Out of Service Since 2008)** | |
| Number | 3 |
| Belt width (ft) | 3 |
| **Digested Biosolids Storage Lagoons** | |
| Number | 3 |
| Total volume (MG) | 13 |
| **Digested Biosolids Blending Tanks** | |
| Number | 3 |
| **Solids Disposal (Used as backup)** | |
| Method | Land application |
| Land available for disposal (acres) | 3501.5 |
| Weight permitted for disposal (DT) | 9300 |
| **Chlorination Facilities** | |
| NaOCl feed at 10% $Cl_2$ content | |
| Number of pumps | 3 |
| Capacity, each (gph) | 118 |
| Chlorine contact | |
| Method | Effluent outfall |
| Volume of outfall used for contact (approximately 1 mile to Frye Bridge Road) (MG) | 0.94 |
| Detention time at 15 mgd (min) | 90 |

## 2.2.2 NPDES Permit

The MCWWTP discharges into the Yadkin River (Outfall 001) and Muddy Creek (Outfall 002). Both streams are currently classified WS-IV waters in the Yadkin Pee Dee River Basin. **Table 2-4** summarizes the National Pollutant Discharge Elimination System (NPDES) permit effluent limitations for the MCWWTP issued in July 2009.

Outfall 002 is only used for overflows during wet weather events and the permit limits are the same as for Outfall 001.

**Table 2-4**

**Muddy Creek WWTP NPDES Permit Effluent Limits (Permit No. NC0050342) for Key Parameters**

| Effluent Characteristics | Discharge Limitations | | | Monitoring Requirements | | |
|---|---|---|---|---|---|---|
| | Monthly Average | Weekly Average | Daily Average | Measurement Frequency | Sample Type | Sample Location |
| Flow (MGD) | 21.0 | | | Continuous | Recording | I or E |
| CBOD, 5-Day, 20°C | 25.0 mg/L | 40.0 mg/L | | Daily | Composite | I & E |
| CBOD, 5-Day, 20°C | | | | Variable | Grab | U & D |
| Total Suspended Solids | 30.0 mg/L | 45.0 mg/L | | Daily | Composite | I & E |
| $NH_3$ -N (April 1 - October 31) | 14.0 mg/L | 35.0 mg/L | | Daily | Composite | E |
| $NH_3$ -N (November 1 - March 31) | | | | Daily | Composite | E |
| $NH_3$ -N | | | | Variable | Grab | U & D |
| Dissolved Oxygen | | | $\geq$ 5.0 mg/L | Daily | Grab | E |
| Dissolved Oxygen | | | | Variable | Grab | U & D |
| Fecal Coliform (geometric mean) | 200/100 mL | 400/100 mL | | Daily | Grab | E |
| Fecal Coliform (geometric mean) | | | | Variable | Grab | U & D |
| Total Residue Chlorine | | | 28 µg/L | Daily | Grab | E |
| Total Nitrogen ($NO_2$+$NO_3$+TKN) | | | | Weekly | Composite | E |
| Total Phosphorus | | | | Weekly | Composite | Et |
| Temperature, °C | | | | Daily | Grab | E |
| Temperature, °C | | | | Variable | Grab | U & D |
| Conductivity | | | | Daily | Grab | E |
| Conductivity | | | | Variable | Grab | U & D |
| Chronic Toxicity | | | | Quarterly | Composite | E |
| pH | $\geq$ 6.0 and $\leq$ 9.0 standard units | | | Daily | Grab | E |
| Total Mercury | 0.2162 µg/L | | | 2/Month | Grab | E |
| Annual Pollutant Scan | | | | Annually | | E |

Other effluent characteristics including $NH_3$-N in winter, temperature, and conductivity do not have discharge limitations but are required to be monitored on a daily basis. Effluent characteristics including total nitrogen (TN) and total

phosphorous (TP) do not have discharge limitations but are required to be monitored on a weekly basis.

## 2.3 Historical Plant Data Analysis

Statistical analysis of the AEWWTP and MCWWTP operational data from April 1, 2004 to March 31, 2009 was gathered in order to estimate the wastewater characteristics for each facility. The data used in this analysis were from instantaneous grab or composite samples. The sample frequency varied depending on the NPDES permit requirements. Frequent samples (daily or five days per week) include: TSS, VSS, COD, BOD and $NH_3$-N. Infrequent samples (less than five days per week) include: TKN, TP, and $NO_2$+$NO_3$.

### 2.3.1 Data Screening

Upon review, two major changes in operational practices were evident:

- In mid-2005, the Solids Retention Time (SRT) at the AEWWTP was significantly reduced from an average of over 29 days through the end of 2005 to an average of 11 days beginning in 2006. For this reason CDM chose to analyze data from January 1, 2006 to current although data from the longer SRT period prior to January 2006 may be used for model validation if necessary.

- In August 2008, the transfer of digested solids from the MCWWTP to the AEWWTP for dewatering and drying began along with the transfer of centrate from the AEWWTP to the MCWWTP. These transfers can affect influent characteristics, plant performance, and effluent quality at both plants. For this reason, CDM chose to separate the data from the period prior to digested solids transfer from the data after the solids transfer and analyze the two data sets separately.

As a result of the preliminary screening, the available operating data was divided into two periods:

- Period One – 1/1/2006 to 7/31/2008 (pre-solids transfer)
- Period Two – 9/1/2008 to 3/31/2009 (post-solids transfer)

August 2008 was not included in the analysis because the plants were transitioning to the new solids handling facilities during this time.

### 2.3.2 Effluent Characteristics

Effluent characteristics from each WWTP (summarized in **Tables 2-5** and **2-6**) were evaluated for later use in the BioWin model calibration with a special focus on parameters that are important for assessing nutrient removal capabilities of various

processes. Using the data provided, both concentration and loading values for effluent total nitrogen (TN) and total phosphorus (TP) were calculated.

Two additional calculated parameters were also developed: Dissolved Organic Nitrogen (DON) and Un-Reactive Phosphorus (URP). Effluent DON is calculated as the difference between the effluent concentrations of soluble Total Kjeldahl Nitrogen (TKN) and ammonia nitrogen ($NH_3$-N). The DON in the effluent is an approximation of the nitrogen that is resistant to nitrification and is sometimes referred to as recalcitrant DON or rDON. The rDON cannot be removed by biological processes. This is important because it is also a component of the effluent TN for which limits may be set in the future.

Effluent URP is calculated as the difference between the TP and the ortho-P (more accurately termed reactive phosphorus). The URP will not be removed by either conventional biological or chemical processes. This is important because URP is a component of the effluent TP for which limits may be set in the future. Note that because in this case the URP is calculated from unfiltered TP, it includes both soluble URP and P that are incorporated into particulates that exist in the effluent. Because filtration can capture much of the URP that is in the particulate form, the soluble fraction of the URP is the most critical to achieving future TP limits.

### 2.3.3 Influent Characteristics

Influent characteristics from the AEWWTP and MCWWTP were analyzed to develop a set of characteristics that will be used in coordination with flow projections to project future plant loadings based on the following flow conditions that are important to plant performance:

- Annual average day (year)
- Average day during the maximum month (max month)
- Maximum day (max day)
- Minimum day (min day)

Analysis of historical daily plant influent characteristics were performed for flow, total suspended solids (TSS), volatile suspended solids (VSS), chemical oxygen demand (COD), TKN, $NH_3$-N, nitrite and nitrate ($NO_2$+$NO_3$) and total phosphorus (TP). For the AEWWTP, the data also includes biochemical oxygen demand (BOD), while for the MCWWTP the data includes carbonaceous BOD (cBOD). In addition to the raw data, ratios of VSS:TSS, BOD (or cBOD):COD, and $NH_3$-N:TKN were developed. These ratios are useful for characterization of the influent for modeling purposes.

**Table 2-5**
**Archie Elledge WWTP Effluent Characteristics**

| ***Parameter*** | | ***Variable Number*** | ***Sample Count*** | ***Annual Average*** | ***Maximum 30 day-Moving Average*** | ***Maximum 7 day-Moving Average*** | ***95th Percentile*** | ***5th Percentile*** |
|---|---|---|---|---|---|---|---|---|
| ***Modeling Period One: 1/1/2006 - 7/31/2008 (943 days)*** | | | | | | | | |
| *Flow* | mgd | *303* | 943 | 17.76 | | | 21.29 | 14.59 |
| *TSS* | mg/L | *59* | 935 | 5.37 | 11.90 | 14.86 | 10.00 | 2.00 |
| *TKN* | mg/l | *151* | 139 | 2.30 | | | 3.41 | 1.60 |
| *COD* | mg/l | *95* | 925 | 59.35 | | | 87.8 | 33.0 |
| *BOD* | mg/l | *216* | 650 | 4.21 | 7.11 | 14.80 | 7.00 | 2.00 |
| *$NO_3$-N* | mg/l | *124* | 910 | 9.75 | | | 13.80 | 5.45 |
| *$NH_3$-N* | mg/l | *83* | 924 | 0.51 | 0.70 | 0.99 | 0.50 | 0.50 |
| *DON** | mg/l | *860/83* | 9 | 1.50 | | | 1.92 | 1.14 |
| *URP*** | mg/l | *176/148* | 26 | 0.33 | | | 0.85 | 0.06 |
| *TN* | mg/l | *151/124* | 139 | 11.47 | | | 16.17 | 6.60 |
| | lb/day | | | 1,749 | | | 2354 | 1057 |
| *TP* | mg/l | *176* | 140 | 3.73 | | | 6.55 | 0.50 |
| | lb/day | | | 568 | | | 1030 | 73 |
| ***Modeling Period Two: 9/1/2008 - 3/31/2009 (212 days)*** | | | | | | | | |
| *Flow* | mgd | *303* | 212 | 17.41 | | | 22.42 | 14.83 |
| *TSS* | mg/l | *59* | 204 | 7.86 | 18.00 | 19.00 | 13.00 | 4.00 |
| *TKN* | mg/l | *151* | 32 | 2.87 | | | 3.60 | 1.66 |
| *COD* | mg/l | *95* | 204 | 48.29 | | | 66.70 | 33.00 |
| *BOD* | mg/l | *216* | 145 | 5.01 | 6.44 | 8.00 | 7.80 | 3.00 |
| *$NO_3$-N* | mg/l | *124* | 190 | 12.67 | | | 19.56 | 7.14 |
| *$NH_3$-N* | mg/l | *83* | 20 | 0.60 | 1.11 | 2.54 | 0.70 | 0.50 |
| *DON** | mg/l | *860/83* | 0 | | | | | |
| *URP*** | mg/l | *176/148* | 6 | 0.34 | | | 0.80 | 0.03 |
| *TN* | mg/l | *151/124* | 32 | 15.39 | | | 21.25 | 8.78 |
| | lb/day | | | 2340 | | | 3383 | 1281 |
| *TP* | mg/l | *176* | 33 | 3.35 | | | 5.51 | 0.95 |
| | lb/day | | | 508 | | | 776 | 142 |

* DON = dissolved organic nitrogen (= soluble TKN - ammonia as N)
** URP = Unreactive P (= TP - ortho P)

**Table 2-6**

**Muddy Creek WWTP Effluent Characteristics**

| *Parameter* | | *Variable Number* | *Sample Count* | *Annual Average* | *Maximum 30 day-Moving Average* | *Maximum 7 day-Moving Average* | *95th Percentile* | *5th Percentile* |
|---|---|---|---|---|---|---|---|---|
| ***Modeling Period One: 1/1/2006 - 7/31/2008 (943 days)*** | | | | | | | | |
| *Flow* | mgd | *303* | 943 | 14.93 | | | 18.30 | 12.77 |
| *TSS* | mg/L | *38* | 930 | 12.08 | 22.11 | 40.00 | 24.00 | 6.00 |
| *TKN* | mg/l | *112* | 138 | 2.66 | | | 4.30 | 1.79 |
| *COD* | mg/l | *68* | 923 | 71.28 | | | 109.9 | 41.0 |
| *CBOD* | mg/l | *156* | 650 | 9.64 | 15.16 | 23.60 | 15.0 | 6.00 |
| *$NO_3$-N* | mg/l | *81* | 908 | 19.22 | | | 23.9 | 13.74 |
| *$NH_3$-N* | mg/l | *55* | 925 | 0.66 | 2.82 | 13.13 | 1.30 | 0.50 |
| *DON** | mg/l | *706/55* | 9 | 1.23 | | | 1.96 | 0.78 |
| *URP*** | mg/l | *129/128* | 26 | 0.68 | | | 1.02 | 0.19 |
| *TN* | mg/l | *112/81* | 135 | 21.98 | | | 27.13 | 17.10 |
| | lb/day | | | 2737 | | | 3347 | 2117 |
| *TP* | mg/l | *129* | 140 | 3.52 | | | 4.38 | 2.29 |
| | lb/day | | | 433 | | | 556 | 288 |
| ***Modeling Period Two: 9/1/2008 - 3/31/2009 (212 days)*** | | | | | | | | |
| *Flow* | mgd | *303* | 212 | 14.64 | | | 18.60 | 12.90 |
| *TSS* | mg/l | *38* | 204 | 8.48 | 12.23 | 15.54 | 14.90 | 5.00 |
| *TKN* | mg/l | *112* | 32 | 2.80 | | | 4.47 | 0.97 |
| *COD* | mg/l | *68* | 204 | 54.65 | | | 83.0 | 35.0 |
| *CBOD* | mg/l | *156* | 145 | 8.87 | 13.07 | 17.04 | 13.0 | 6.00 |
| *$NO_3$-N* | mg/l | *81* | 191 | 20.92 | | | 25.0 | 14.80 |
| *$NH_3$-N* | mg/l | *55* | 203 | 0.52 | 0.66 | 1.1 | 0.5 | 0.5 |
| *DON** | mg/l | *112/55* | 0 | | | | | |
| *URP*** | mg/l | *129/128* | 6 | 0.41 | | | 0.74 | 0.15 |
| *TN* | mg/l | *112/81* | 31 | 22.95 | | | 27.30 | 19.55 |
| | lb/day | | | 2,882 | | | 3793 | 2303 |
| *TP* | mg/l | *129* | 33 | 3.50 | | | 4.40 | 2.40 |
| | lb/day | | | 439 | | | 623 | 311 |

* DON = dissolved organic nitrogen (= soluble TKN - ammonia as N)
** URP = Unreactive P (= TP - ortho P)

Because many plant processes are sensitive to loadings as well as concentrations and because concentrations tend to change during peak flow periods, key steps in influent characteristic analysis include developing loadings and loading peaking factors for each constituent. The loading peaking factors are then applied along with flow peaking factors to develop design concentrations for each constituent at each flow condition. For modeling purposes, it is also important to take the additional step and develop design concentrations for each parameter at each flow condition.

The data analysis procedure developed by CDM, documented in Section 2 of the *CDM Activated Sludge Guideline Version 2.1* (2008), and used to evaluate the data from AEWWTP and MCWWTP is described below.

- **Determine daily mass loads**
  The daily mass loads for the influent parameters listed were calculated using the following equation:

$$T = Q \times C \times 8.34$$

  where:

  T = mass load (lbs/day)
  Q = Flow (mgd)
  C = Concentration (mg/l)

- **Determine historical average mass loads, flow and concentrations**
  The flow and mass loads was averaged over the two time periods selected. Using the average flow and mass loads, the design concentrations was calculated by rearranging the above equation.

- **Determine 30-day moving averages for mass loads**
  The 30-day moving averages were calculated for mass load of each frequent sample. The 30-day moving averages were used to calculate the maximum month loading peaking factors for frequent samples. For infrequent samples, the daily data was used.

- **Determine average day maximum month loading peaking factors**
  For frequent samples (TSS, VSS, COD, BOD and $NH_3$-N): The 95$^{th}$ percentile of the 30-day mass loads moving averages was divided by the average mass load of the data set to determine the average day maximum month loading peaking factor.

  For infrequent samples (TKN, TP and $NO_2$+$NO_3$): The 95$^{th}$ percentile mass load was divided by the average mass load of the data set to determine the average day maximum month loading peaking factor.

- **Determine minimum day loading peaking factors**
  The 5th percentile mass load of the daily load data was divided by the average mass load of the data set to determine the minimum day loading peaking factor.

- **Determine maximum day loading peaking factors**
  The 95th percentile mass load was divided by the average mass load to determine the maximum day loading peaking factor.

- **Calculate design annual average daily loads**
  Using average design flow rate along with the average concentrations found previously, the average day mass loads were determined at the design condition being evaluated.

- **Calculate design maximum month, maximum day, and minimum day concentrations**
  Using the design average daily mass loads along with the mass loading peaking factors developed previously, the average day maximum month, maximum and minimum day concentrations were developed by dividing the mass loading at each flow condition by the historical flow at that condition. This provides a concentration that may be used with projected flows at each condition to project future loadings.

The influent characteristics, peaking factors, and ratios for the AEWWTP are summarized for the two data periods in **Tables 2-7** and **2-8**. The data for the MC WWTP is summarized in **Tables 2-9** and **2-10**.

**Table 2-7**
**Archie Elledge WWTP Influent Characteristics (Period One 1/1/2006 - 7/31/2008)**

| *Parameter* | | *Variable Number* | *Sample Count* | *Annual Average (year)* | *95th Percentile of 30 day Avg (max month)* | *95th Percentile (max day)* | *5th Percentile (min day)* |
|---|---|---|---|---|---|---|---|
| ***Modeling Period One: 1/1/2006 - 7/31/2008*** | | | | | | | |
| *Flow* | MGD | 303 | 943 | 17.76 | 19.88 | 21.29 | 14.59 |
| | | | | 1.00 | 1.12 | 1.20 | 0.82 |
| *TSS* | mg/l | 49 | 925 | 284 | 289 | 341 | 216 |
| | lb/day | | | 42,060 | 47,891 | 60,468 | 26,249 |
| | Load PF | | | 1.00 | 1.14 | 1.44 | 0.62 |
| *TKN* | mg/l | 149 | 28 | 48.0 | | 47.0 | 51.0 |
| | lb/day | | | 7,050 | | 8,290 | 6,210 |
| | Load PF | | | 1.00 | | 1.18 | 0.88 |
| *COD* | mg/l | 92 | 924 | 841 | 827 | 951 | 655 |
| | lb/day | | | 124,663 | 137,056 | 168,837 | 79,659 |
| | Load PF | | | 1.00 | 1.10 | 1.35 | 0.64 |
| *BOD* | mg/l | 213 | 649 | 368 | 371 | 400 | 322 |
| | lb/day | | | 54,606 | 61,502 | 70,944 | 39,237 |
| | Load PF | | | 1.00 | 1.13 | 1.30 | 0.72 |
| $NO_3$+$NO_2$ | mg/l | 846 | 6 | 0.83 | | 1.14 | 0.11 |
| | lb/day | | | 123 | | 203 | 13.5 |
| | Load PF | | | 1.00 | | 1.65 | 0.11 |
| $NH_3$-N | mg/l | 78 | 925 | 26.1 | 27.38 | 29.02 | 23.22 |
| | lb/day | | | 3,863 | 4,539 | 5,152 | 2,825 |
| | Load PF | | | 1.00 | 12.50 | 14.19 | 7.78 |
| *TP* | mg/l | 661 | 7 | 10.8 | | 11.0 | 10.0 |
| | lb/day | | | 1,592 | | 1,924 | 1,249 |
| | Load PF | | | 1.00 | | 1.21 | 0.78 |
| *VSS:TSS* | % | 49/50 | 92 | 83 | | 94.00 | 70 |
| *cBOD:COD* | % | 213/92 | 649 | 41 | | 47 | 35 |
| $NH_3$-N:TKN | % | 78/149 | 28 | 61 | | 72 | 53 |

**Table 2-8**
**Archie Elledge WWTP Influent Characteristics (Period Two 9/1/2008 - 3/31/2009)**

| *Parameter* | | *Variable Number* | *Sample Count* | *Annual Average (year)* | *95th Percentile of 30 day Avg (max month)* | *95th Percentile (max day)* | *5th Percentile (min day)* |
|---|---|---|---|---|---|---|---|
| ***Modeling Period Two: 9/1/2008 - 3/31/2009*** | | | | | | | |
| *Flow* | MGD | 303 | 212 | 17.41 | 18.25 | 22.42 | 14.83 |
| | | | | 1.00 | 1.05 | 1.29 | 0.85 |
| *TSS* | mg/l | 49 | 204 | 259 | 254 | 317 | 194 |
| | lb/day | | | 37,688 | 42,065 | 56,344 | 23,582 |
| | Load PF | | | 1.00 | 1.12 | 1.50 | 0.63 |
| *TKN* | mg/l | 149 | 14 | 47.0 | | 49.0 | 41.0 |
| | lb/day | | | 6871 | | 8753 | 4948 |
| | Load PF | | | 1.00 | | 1.27 | 0.72 |
| *COD* | mg/l | 92 | 204 | 791 | 723 | 859 | 639 |
| | lb/day | | | 114,877 | 119,858 | 152,476 | 77,748 |
| | Load PF | | | 1.00 | 1.04 | 1.33 | 0.68 |
| *BOD* | mg/l | 213 | 145 | 339 | 318 | 357 | 297 |
| | lb/day | | | 49,297 | 52,779 | 63,417 | 36,100 |
| | Load PF | | | 1.00 | 1.07 | 1.29 | 0.73 |
| $NO_3$+$NO_2$ | mg/l | 846 | 0 | | | | |
| | lb/day | | | | | | |
| | Load PF | | | | | | |
| $NH_3$-N | mg/l | 78 | 194 | 30.0 | 29.0 | 34.0 | 24.0 |
| | lb/day | | | 4,364 | 4,755 | 5,969 | 2,975 |
| | Load PF | | | 1.00 | 1.09 | 1.37 | 0.68 |
| *TP* | mg/l | 661 | 2 | 10.6 | | 10.0 | 11.0 |
| | lb/day | | | 1,536 | | 1,699 | 1,373 |
| | Load PF | | | 1.00 | | 1.11 | 0.89 |
| *VSS:TSS* | % | 49/50 | 204 | 86 | | 92 | 78 |
| *cBOD:COD* | % | 213/92 | 145 | 41 | | 46 | 36 |
| $NH_3$-N:TKN | % | 78/149 | 14 | 66 | | 75 | 54 |

**Table 2-9**
**Muddy Creek WWTP Influent Characteristics (Period One 1/1/2006 - 7/31/2008)**

| *Parameter* | | *Variable Number* | *Sample Count* | *Annual Average (year)* | *95th Percentile of 30 day Avg (max month)* | *95th Percentile (max day)* | *5th Percentile (min day)* |
|---|---|---|---|---|---|---|---|
| ***Modeling Period One: 1/1/2006 - 7/31/2008*** | | | | | | | |
| *Flow* | MGD | 303 | 943 | 14.93 | 17.72 | 18.32 | 12.77 |
| | PF | | | 1.00 | 1.19 | 1.23 | 0.86 |
| *TSS* | mg/l | 34 | 924 | 256 | 281 | 313 | 190 |
| | lb/day | | | 31,901 | 41,573 | 47,852 | 20,278 |
| | Load PF | | | 1.00 | 1.30 | 1.50 | 0.64 |
| *TKN* | mg/l | 110 | 30 | 34.6 | | 40.0 | 29.0 |
| | lb/day | | | 4305 | | 6095 | 3050 |
| | Load PF | | | 1.00 | | 1.42 | 0.71 |
| *COD* | mg/l | 65 | 924 | 559 | 575 | 648 | 429 |
| | lb/day | | | 69,690 | 84,931 | 99,068 | 45,698 |
| | Load PF | | | 1.00 | 1.22 | 1.42 | 0.66 |
| *CBOD* | mg/l | 156 | 650 | 155 | 156 | 179 | 128 |
| | lb/day | | | 19,321 | 23,113 | 27,411 | 13,616 |
| | Load PF | | | 1.00 | 1.20 | 1.42 | 0.70 |
| $NO_3$+$NO_2$ | mg/l | 700 | 11 | 1.29 | | 2.00 | 1.00 |
| | lb/day | | | 161 | | 247 | 100 |
| | Load PF | | | 1.00 | | 1.53 | 0.62 |
| $NH_3$-N | mg/l | 53 | 924 | 19.9 | 20.0 | 22.0 | 15.0 |
| | lb/day | | | 2,479 | 3,020 | 3,390 | 1,603 |
| | Load PF | | | 1.00 | 1.22 | 1.37 | 0.65 |
| *TP* | mg/l | 10 | 11 | 5.9 | | 6.00 | 5.00 |
| | lb/day | | | 735 | | 889 | 569 |
| | Load PF | | | 1.00 | | 1.21 | 0.77 |
| *VSS:TSS* | % | 35/34 | 923 | 88 | | 97 | 80 |
| *cBOD:COD* | % | 156/65 | 650 | 28 | | 34 | 22 |
| $NH_3$-N:TKN | % | 53/110 | 30 | 54 | | 64 | 42 |

**Table 2-10**
**Muddy Creek WWTP Influent Characteristics (Period Two 9/1/2008 - 3/31/2009)**

| *Parameter* | | *Variable Number* | *Sample Count* | *Annual Average (year)* | *95th Percentile of 30 day Avg (max month)* | *95th Percentile (max day)* | *5th Percentile (min day)* |
|---|---|---|---|---|---|---|---|
| ***Modeling Period Two: 9/1/2008 - 3/31/2009*** | | | | | | | |
| *Flow* | MGD | 303 | 212 | 14.64 | 17.65 | 18.61 | 12.9 |
| | | | | 1.00 | 1.21 | 1.27 | 0.88 |
| *TSS* | mg/l | 49 | 204 | 236 | 209 | 305 | 169 |
| | lb/day | | | 28,866 | 30,896 | 46,554 | 17,953 |
| | Load PF | | | 1.00 | 1.07 | 1.61 | 0.62 |
| *TKN* | mg/l | 11 | 14 | 36.1 | | 43.0 | 31.0 |
| | lb/day | | | 4406 | | 6523 | 3284 |
| | Load PF | | | 1.00 | | 1.48 | 0.75 |
| *COD* | mg/l | 65 | 204 | 540 | 481 | 673 | 400 |
| | lb/day | | | 65,971 | 71,068 | 102,808 | 42,621 |
| | Load PF | | | 1.00 | 1.08 | 1.56 | 0.65 |
| *CBOD* | mg/l | 156 | 145 | 147 | 149 | 169 | 127 |
| | lb/day | | | 18,026 | 21,982 | 25,754 | 13,485 |
| | Load PF | | | 1.00 | 1.22 | 1.43 | 0.75 |
| *$NO_3$+$NO_2$* | mg/l | 700 | 3 | 0.98 | | 1.00 | 1.00 |
| | lb/day | | | 119 | | 152 | 87 |
| | Load PF | | | 1.00 | | 1.28 | 0.73 |
| *$NH_3$-N* | mg/l | 53 | 196 | 20.4 | 18.0 | 20.0 | 19.0 |
| | lb/day | | | 2498 | 2716 | 3102 | 1982 |
| | Load PF | | | 1.00 | 1.09 | 1.24 | 0.79 |
| *TP* | mg/l | 10 | 3 | 7.93 | | 9.00 | 7.00 |
| | lb/day | | | 969 | | 1361 | 733 |
| | Load PF | | | 1.00 | | 1.40 | 0.76 |
| *VSS:TSS* | % | 35/34 | 202 | 88 | | 94 | 82 |
| *cBOD:COD* | % | 156/65 | 145 | 28 | | 34 | 22 |
| *$NH_3$-N:TKN* | % | 53/110 | 14 | 59 | | 73 | 44 |

# Section 3
# Wastewater Flow Projections

Wastewater flow projections for the AEWWTP and MCWWTP service areas were developed by CDM and presented in the *February 2011 Wastewater Flow Projections Technical Memorandum*.

**Figure 3-1** illustrates the major interceptors of the sewer collection system and the location of the three major sewer basins that contribute flow to the AEWWTP and the MCWWTP. Basin 1 consists of the service area in the western portion of the county, and currently all wastewater from this basin is conveyed to the MCWWTP through the Muddy Creek Interceptor. Basin 2 contains the central portion of the county, and all wastewater flows from this basin are conveyed to the AEWWTP. Basin 3 makes up the eastern portion of the county. All wastewater flow from Basin 3 enters the South Fork Pump Station (SFPS), where flow is pumped to the AEWWTP; however, flow can be diverted to the MCWWTP if the flow capacity of the SFPS is exceeded or if SFPS pump failure occurs.

The flow projections through 2030 have been summarized for all basins combined and are shown in **Table 3-1**. Flow projections for each individual basin are tabulated in **Tables 3-2**, **3-3**, and **3-4.** Because flow is transferred out of the South Fork Basin to the AEWWTP, the flow actually arriving at each of the WWTPs depends on the quantity of inter-basin transfer. The flow at AEWWTP is increased by the amount of flow transferred while the flow at MCWWTP is reduced. Based on the current SFPS firm capacity of 14.4 MGD, the flows projected to arrive at each WWTP with the SFPS operating at firm capacity are shown in **Tables 3-5** through **3-8** for annual average, maximum month, maximum day and maximum hour flows respectively.

Currently flow transfer is by means of the SFPS only, although other pump stations have been proposed including the Little Creek Pump Station to transfer flow from the Muddy Creek Basin to the AEWWTP. **Table 3-6** indicates that the maximum month flow in the Muddy Creek Basin (Basin 1) will exceed the current 21.0 mgd capacity rating of the MCWWTP by approximately 2016. **Figure 3-2** graphically shows the flow projections for each WWTP in relation to the plant capacities. Construction of a pumping station in the Muddy Creek Basin (Basin 1) could relieve the situation by transferring flow from the Muddy Creek Basin to the AEWWTP. Alternatively, the MCWWTP could be expanded to a greater capacity. With inter-basin transfer, many flow/treatment scenarios are possible. The capability to transfer flow between basins will be considered when developing and evaluating treatment scenarios to meet future limits.

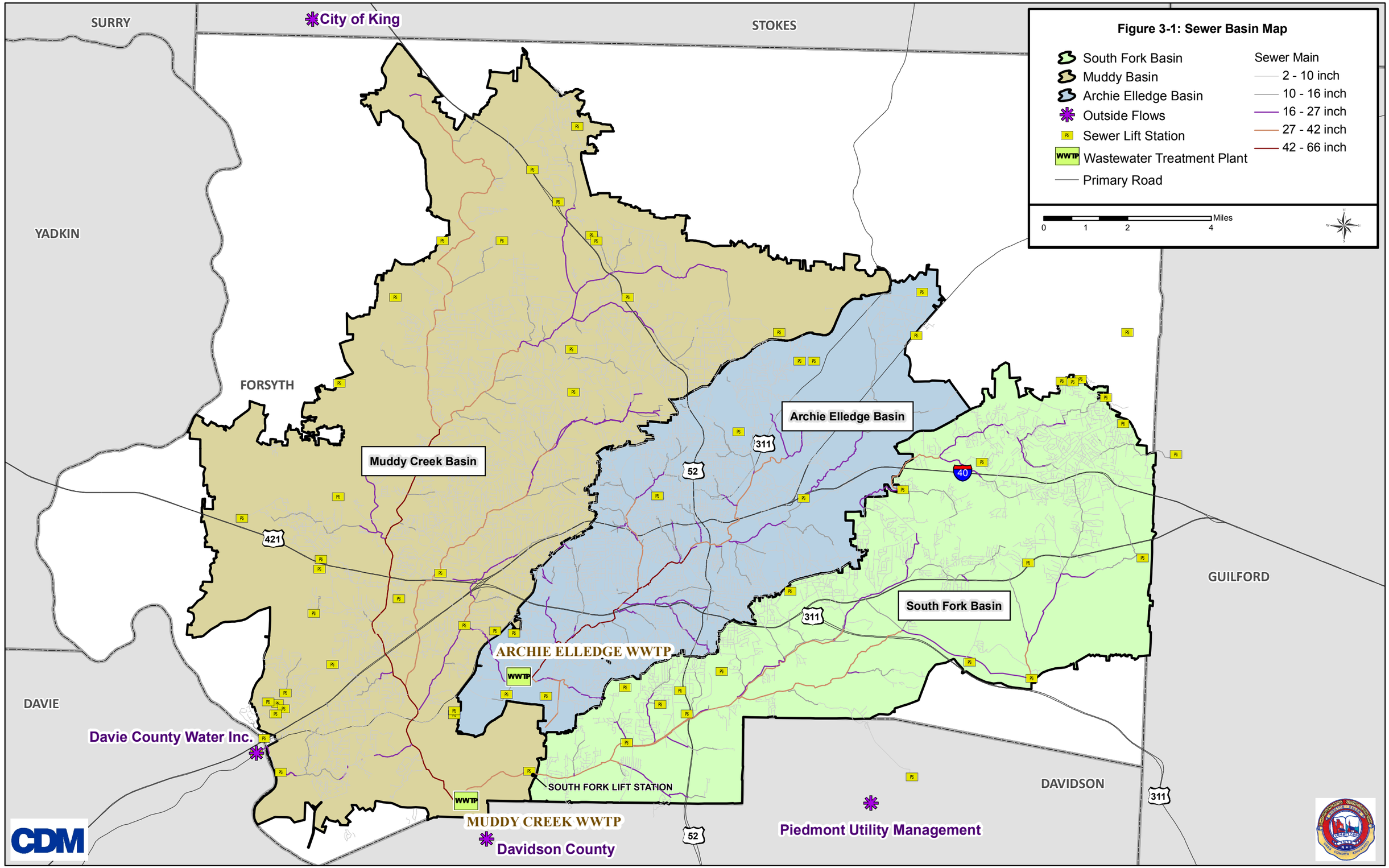
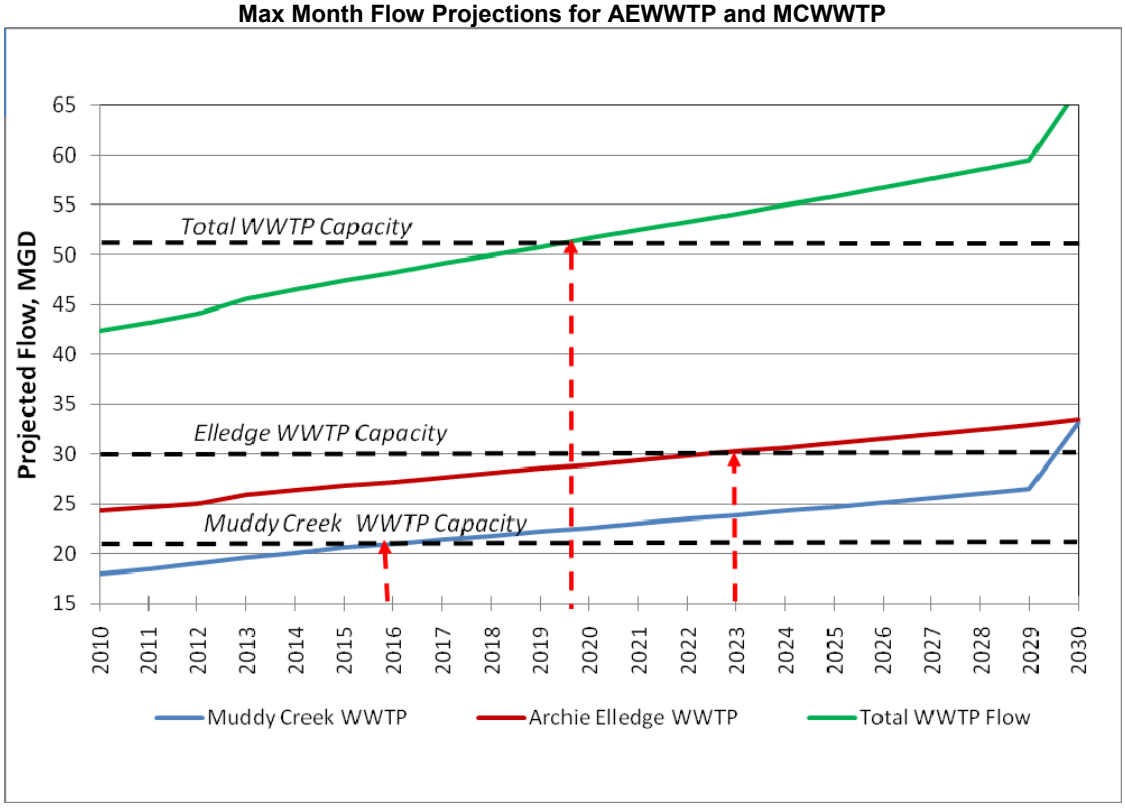


Figure 3-1: Sewer Basin Map
South Fork Basin
Muddy Basin
Archie Elledge Basin
Outside Flows
Sewer Lift Station
Wastewater Treatment Plant
Primary Road
Sewer Main
2 - 10 inch
10 - 16 inch
16 - 27 inch
27 - 42 inch
42 - 66 inch
0
1
2
4
Miles
SURRY
STOKES
YADKIN
FORSYTH
GUILFORD
DAVIE
DAVIDSON
City of King
Muddy Creek Basin
Archie Elledge Basin
South Fork Basin
ARCHIE ELLEDGE WWTP
MUDDY CREEK WWTP
SOUTH FORK LIFT STATION
Davie County Water Inc.
Davidson County
Piedmont Utility Management
WWTP
421
52
311
40
CDM

**Figure 3-2**
**Max Month Flow Projections for AEWWTP and MCWWTP**




Note: Archie Elledge WWTP flow projections include 14.4 mgd for the South Fork PS flows.

**Table 3-1**
**Flow Projections All Basins**

| Year | Annual Average Flow (MGD) | Maximum Month Flow (MGD) | Maximum Day Flow (MGD) | Maximum Hour Flow (MGD) |
|---|---|---|---|---|
| 2010 | 34.0 | 42.3 | 95.7 | 115.6 |
| 2011 | 34.7 | 43.2 | 97.7 | 118.0 |
| 2012 | 35.4 | 44.1 | 99.7 | 120.4 |
| 2013 | 36.6 | 45.5 | 102.9 | 124.4 |
| 2014 | 37.3 | 46.5 | 105.1 | 127.0 |
| 2015 | 38.1 | 47.4 | 107.2 | 129.6 |
| 2016 | 38.8 | 48.3 | 109.1 | 131.9 |
| 2017 | 39.4 | 49.1 | 111.0 | 134.2 |
| 2018 | 40.1 | 49.9 | 112.9 | 136.5 |
| 2019 | 40.8 | 50.8 | 114.8 | 138.8 |
| 2020 | 41.4 | 51.6 | 116.7 | 141.1 |
| 2021 | 42.1 | 52.5 | 118.6 | 143.4 |
| 2022 | 42.8 | 53.3 | 120.5 | 145.7 |
| 2023 | 43.5 | 54.1 | 122.4 | 148.0 |
| 2024 | 44.1 | 55.0 | 124.3 | 150.3 |
| 2025 | 44.8 | 55.8 | 126.2 | 152.6 |
| 2026 | 45.5 | 56.7 | 128.3 | 155.1 |
| 2027 | 46.3 | 57.6 | 130.4 | 157.5 |
| 2028 | 47.0 | 58.6 | 132.4 | 160.0 |
| 2029 | 47.7 | 59.5 | 134.5 | 162.5 |
| 2030 | 53.4 | 66.7 | 151.6 | 182.7 |

**Table 3-2**
**Muddy Creek Basin (Basin 1) Flow Projections**

| Year | Annual Average Flow (MGD) | Maximum Month Flow (MGD) | Maximum Day Flow (MGD) | Maximum Hour Flow (MGD) |
|---|---|---|---|---|
| 2010 | 14.3 | 18.0 | 43.0 | 50.6 |
| 2011 | 14.7 | 18.5 | 44.3 | 52.0 |
| 2012 | 15.1 | 19.1 | 45.5 | 53.5 |
| 2013 | 15.6 | 19.6 | 46.8 | 55.0 |
| 2014 | 16.0 | 20.1 | 48.0 | 56.4 |
| 2015 | 16.4 | 20.6 | 49.3 | 57.9 |
| 2016 | 16.7 | 21.0 | 50.3 | 59.1 |
| 2017 | 17.0 | 21.4 | 51.2 | 60.2 |
| 2018 | 17.4 | 21.8 | 52.2 | 61.4 |
| 2019 | 17.7 | 22.3 | 53.2 | 62.5 |
| 2020 | 18.0 | 22.7 | 54.2 | 63.6 |
| 2021 | 18.3 | 23.1 | 55.2 | 64.8 |
| 2022 | 18.7 | 23.5 | 56.1 | 65.9 |
| 2023 | 19.0 | 23.9 | 57.1 | 67.1 |
| 2024 | 19.3 | 24.3 | 58.1 | 68.2 |
| 2025 | 19.6 | 24.7 | 59.1 | 69.4 |
| 2026 | 20.0 | 25.1 | 60.1 | 70.6 |
| 2027 | 20.3 | 25.6 | 61.2 | 71.9 |
| 2028 | 20.7 | 26.0 | 62.2 | 73.1 |
| 2029 | 21.0 | 26.5 | 63.3 | 74.3 |
| 2030 | 26.4 | 33.2 | 79.4 | 93.3 |

**Table 3-3**
**Elledge Basin (Basin 2) Flow Projections**

| Year | Annual Average Flow (MGD) | Maximum Month Flow (MGD) | Maximum Day Flow (MGD) | Maximum Hour Flow (MGD) |
|---|---|---|---|---|
| 2010 | 13.6 | 16.6 | 36.3 | 44.4 |
| 2011 | 13.7 | 16.8 | 36.6 | 44.8 |
| 2012 | 13.8 | 16.9 | 36.9 | 45.2 |
| 2013 | 14.0 | 17.1 | 37.3 | 45.6 |
| 2014 | 14.1 | 17.2 | 37.6 | 46.0 |
| 2015 | 14.2 | 17.4 | 37.9 | 46.4 |
| 2016 | 14.3 | 17.5 | 38.3 | 46.8 |
| 2017 | 14.5 | 17.7 | 38.6 | 47.3 |
| 2018 | 14.6 | 17.9 | 39.0 | 47.7 |
| 2019 | 14.7 | 18.0 | 39.4 | 48.1 |
| 2020 | 14.9 | 18.2 | 39.7 | 48.6 |
| 2021 | 15.0 | 18.3 | 40.1 | 49.0 |
| 2022 | 15.1 | 18.5 | 40.4 | 49.4 |
| 2023 | 15.3 | 18.7 | 40.8 | 49.9 |
| 2024 | 15.4 | 18.8 | 41.1 | 50.3 |
| 2025 | 15.5 | 19.0 | 41.5 | 50.8 |
| 2026 | 15.7 | 19.2 | 41.9 | 51.2 |
| 2027 | 15.8 | 19.3 | 42.2 | 51.7 |
| 2028 | 16.0 | 19.5 | 42.6 | 52.1 |
| 2029 | 16.1 | 19.7 | 43.0 | 52.6 |
| 2030 | 16.2 | 19.8 | 43.4 | 53.0 |

**Table 3-4**
**South Fork Basin (Basin 3) Flow Projections**

| Year | Annual Average Flow (MGD) | Maximum Month Flow (MGD) | Maximum Day Flow (MGD) | Maximum Hour Flow (MGD) |
|---|---|---|---|---|
| 2010 | 6.1 | 7.7 | 16.4 | 20.7 |
| 2011 | 6.3 | 7.9 | 16.8 | 21.2 |
| 2012 | 6.5 | 8.1 | 17.3 | 21.8 |
| 2013 | 7.1 | 8.9 | 18.9 | 23.8 |
| 2014 | 7.3 | 9.2 | 19.5 | 24.6 |
| 2015 | 7.5 | 9.5 | 20.0 | 25.3 |
| 2016 | 7.7 | 9.7 | 20.6 | 26.0 |
| 2017 | 7.9 | 10.0 | 21.2 | 26.7 |
| 2018 | 8.1 | 10.3 | 21.7 | 27.4 |
| 2019 | 8.4 | 10.5 | 22.3 | 28.1 |
| 2020 | 8.6 | 10.8 | 22.9 | 28.8 |
| 2021 | 8.8 | 11.1 | 23.4 | 29.6 |
| 2022 | 9.0 | 11.3 | 24.0 | 30.3 |
| 2023 | 9.2 | 11.6 | 24.6 | 31.0 |
| 2024 | 9.4 | 11.9 | 25.1 | 31.7 |
| 2025 | 9.6 | 12.1 | 25.7 | 32.4 |
| 2026 | 9.9 | 12.4 | 26.3 | 33.2 |
| 2027 | 10.1 | 12.7 | 27.0 | 34.0 |
| 2028 | 10.3 | 13.0 | 27.6 | 34.8 |
| 2029 | 10.6 | 13.3 | 28.2 | 35.6 |
| 2030 | 10.8 | 13.6 | 28.9 | 36.4 |

**Table 3-5**
**Annual Average Flow Projections including SFPS Inter-basin Transfer Pumping**

| Year | South Fork Basin (MGD) | SFPS to AEWWTP (MGD) | South Fork Basin to MCWWTP (MGD) | Muddy Creek Basin (MGD) | Total to MCWWTP (MGD) | Elledge Basin (MGD) | Total to AEWWTP (MGD) | Total Both WWTPs (MGD) |
|---|---|---|---|---|---|---|---|---|
| 2010 | 6.1 | 6.1 | 0.0 | 14.3 | 14.3 | 13.6 | 19.7 | 34.0 |
| 2011 | 6.3 | 6.3 | 0.0 | 14.7 | 14.7 | 13.7 | 20.0 | 34.7 |
| 2012 | 6.5 | 6.5 | 0.0 | 15.1 | 15.1 | 13.8 | 20.3 | 35.4 |
| 2013 | 7.1 | 7.1 | 0.0 | 15.6 | 15.6 | 14.0 | 21.0 | 36.6 |
| 2014 | 7.3 | 7.3 | 0.0 | 16.0 | 16.0 | 14.1 | 21.4 | 37.3 |
| 2015 | 7.5 | 7.5 | 0.0 | 16.4 | 16.4 | 14.2 | 21.7 | 38.1 |
| 2016 | 7.7 | 7.7 | 0.0 | 16.7 | 16.7 | 14.3 | 22.1 | 38.8 |
| 2017 | 7.9 | 7.9 | 0.0 | 17.0 | 17.0 | 14.5 | 22.4 | 39.4 |
| 2018 | 8.1 | 8.1 | 0.0 | 17.4 | 17.4 | 14.6 | 22.7 | 40.1 |
| 2019 | 8.4 | 8.4 | 0.0 | 17.7 | 17.7 | 14.7 | 23.1 | 40.8 |
| 2020 | 8.6 | 8.6 | 0.0 | 18.0 | 18.0 | 14.9 | 23.4 | 41.4 |
| 2021 | 8.8 | 8.8 | 0.0 | 18.3 | 18.3 | 15.0 | 23.8 | 42.1 |
| 2022 | 9.0 | 9.0 | 0.0 | 18.7 | 18.7 | 15.1 | 24.1 | 42.8 |
| 2023 | 9.2 | 9.2 | 0.0 | 19.0 | 19.0 | 15.3 | 24.5 | 43.5 |
| 2024 | 9.4 | 9.4 | 0.0 | 19.3 | 19.3 | 15.4 | 24.8 | 44.1 |
| 2025 | 9.6 | 9.6 | 0.0 | 19.6 | 19.6 | 15.5 | 25.2 | 44.8 |
| 2026 | 9.9 | 9.9 | 0.0 | 20.0 | 20.0 | 15.7 | 25.5 | 45.5 |
| 2027 | 10.1 | 10.1 | 0.0 | 20.3 | 20.3 | 15.8 | 25.9 | 46.3 |
| 2028 | 10.3 | 10.3 | 0.0 | 20.7 | 20.7 | 16.0 | 26.3 | 47.0 |
| 2029 | 10.6 | 10.6 | 0.0 | 21.0 | 21.0 | 16.1 | 26.7 | 47.7 |
| 2030 | 10.8 | 10.8 | 0.0 | 26.4 | 26.4 | 16.2 | 27.1 | 53.4 |

**Table 3-6**
**Maximum Month Flow Projections including SFPS Inter-basin Transfer Pumping**

| Year | South Fork Basin (MGD) | SFPS to AEWWTP (MGD) | South Fork Basin to MCWWTP (MGD) | Muddy Creek Basin (MGD) | Total to MCWWTP (MGD) | Elledge Basin (MGD) | Total to AEWWTP (MGD) | Total Both WWTPs (MGD) |
|---|---|---|---|---|---|---|---|---|
| 2010 | 7.7 | 7.7 | 0.0 | 18.0 | 18.0 | 16.6 | 24.3 | 42.3 |
| 2011 | 7.9 | 7.9 | 0.0 | 18.5 | 18.5 | 16.8 | 24.7 | 43.2 |
| 2012 | 8.1 | 8.1 | 0.0 | 19.1 | 19.1 | 16.9 | 25.0 | 44.1 |
| 2013 | 8.9 | 8.9 | 0.0 | 19.6 | 19.6 | 17.1 | 26.0 | 45.5 |
| 2014 | 9.2 | 9.2 | 0.0 | 20.1 | 20.1 | 17.2 | 26.4 | 46.5 |
| 2015 | 9.5 | 9.5 | 0.0 | 20.6 | 20.6 | 17.4 | 26.8 | 47.4 |
| 2016 | 9.7 | 9.7 | 0.0 | 21.0 | 21.0* | 17.5 | 27.2 | 48.3 |
| 2017 | 10.0 | 10.0 | 0.0 | 21.4 | 21.4 | 17.7 | 27.7 | 49.1 |
| 2018 | 10.3 | 10.3 | 0.0 | 21.8 | 21.8 | 17.9 | 28.1 | 49.9 |
| 2019 | 10.5 | 10.5 | 0.0 | 22.3 | 22.3 | 18.0 | 28.5 | 50.8 |
| 2020 | 10.8 | 10.8 | 0.0 | 22.7 | 22.7 | 18.2 | 29.0 | 51.6 |
| 2021 | 11.1 | 11.1 | 0.0 | 23.1 | 23.1 | 18.3 | 29.4 | 52.5 |
| 2022 | 11.3 | 11.3 | 0.0 | 23.5 | 23.5 | 18.5 | 29.8 | 53.3 |
| 2023 | 11.6 | 11.6 | 0.0 | 23.9 | 23.9 | 18.7 | 30.3 | 54.1 |
| 2024 | 11.9 | 11.9 | 0.0 | 24.3 | 24.3 | 18.8 | 30.7 | 55.0 |
| 2025 | 12.1 | 12.1 | 0.0 | 24.7 | 24.7 | 19.0 | 31.1 | 55.8 |
| 2026 | 12.4 | 12.4 | 0.0 | 25.1 | 25.1 | 19.2 | 31.6 | 56.7 |
| 2027 | 12.7 | 12.7 | 0.0 | 25.6 | 25.6 | 19.3 | 32.1 | 57.6 |
| 2028 | 13.0 | 13.0 | 0.0 | 26.0 | 26.0 | 19.5 | 32.5 | 58.6 |
| 2029 | 13.3 | 13.3 | 0.0 | 26.5 | 26.5 | 19.7 | 33.0 | 59.5 |
| 2030 | 13.6 | 13.6 | 0.0 | 33.2 | 33.2 | 19.8 | 33.5 | 66.7 |

*Muddy Creek WWTP capacity of 21.0 MGD exceeded.

**Table 3-7**
**Maximum Day Flow Projections including SFPS Inter-basin Transfer Pumping**

| Year | South Fork Basin (MGD) | SFPS to AEWWTP (MGD) | South Fork Basin to MCWWTP (MGD) | Muddy Creek Basin (MGD) | Total to MCWWTP (MGD) | Elledge Basin (MGD) | Total to AEWWTP (MGD) | Total Both WWTPs (MGD) |
|---|---|---|---|---|---|---|---|---|
| 2010 | 16.4 | 14.4 | 2.0 | 43.0 | 45.0 | 36.3 | 50.7 | 95.7 |
| 2011 | 16.8 | 14.4 | 2.4 | 44.3 | 46.7 | 36.6 | 51.0 | 97.7 |
| 2012 | 17.3 | 14.4 | 2.9 | 45.5 | 48.4 | 36.9 | 51.3 | 99.7 |
| 2013 | 18.9 | 14.4 | 4.5 | 46.8 | 51.3 | 37.3 | 51.7 | 102.9 |
| 2014 | 19.5 | 14.4 | 5.1 | 48.0 | 53.1 | 37.6 | 52.0 | 105.1 |
| 2015 | 20.0 | 14.4 | 5.6 | 49.3 | 54.9 | 37.9 | 52.3 | 107.2 |
| 2016 | 20.6 | 14.4 | 6.2 | 50.3 | 56.5 | 38.3 | 52.7 | 109.1 |
| 2017 | 21.2 | 14.4 | 6.8 | 51.2 | 58.0 | 38.6 | 53.0 | 111.0 |
| 2018 | 21.7 | 14.4 | 7.3 | 52.2 | 59.5 | 39.0 | 53.4 | 112.9 |
| 2019 | 22.3 | 14.4 | 7.9 | 53.2 | 61.1 | 39.4 | 53.8 | 114.8 |
| 2020 | 22.9 | 14.4 | 8.5 | 54.2 | 62.6 | 39.7 | 54.1 | 116.7 |
| 2021 | 23.4 | 14.4 | 9.0 | 55.2 | 64.2 | 40.1 | 54.5 | 118.6 |
| 2022 | 24.0 | 14.4 | 9.6 | 56.1 | 65.7 | 40.4 | 54.8 | 120.5 |
| 2023 | 24.6 | 14.4 | 10.2 | 57.1 | 67.3 | 40.8 | 55.2 | 122.4 |
| 2024 | 25.1 | 14.4 | 10.7 | 58.1 | 68.8 | 41.1 | 55.5 | 124.3 |
| 2025 | 25.7 | 14.4 | 11.3 | 59.1 | 70.3 | 41.5 | 55.9 | 126.2 |
| 2026 | 26.3 | 14.4 | 11.9 | 60.1 | 72.0 | 41.9 | 56.3 | 128.3 |
| 2027 | 27.0 | 14.4 | 12.6 | 61.2 | 73.7 | 42.2 | 56.6 | 130.4 |
| 2028 | 27.6 | 14.4 | 13.2 | 62.2 | 75.4 | 42.6 | 57.0 | 132.4 |
| 2029 | 28.2 | 14.4 | 13.8 | 63.3 | 77.1 | 43.0 | 57.4 | 134.5 |
| 2030 | 28.9 | 14.4 | 14.5 | 79.4 | 93.8 | 43.4 | 57.8 | 151.6 |

**Table 3-8**
**Maximum Hour Flow Projections including SFPS Inter-basin Transfer Pumping**

| Year | South Fork Basin (MGD) | SFPS to AEWWTP (MGD) | South Fork Basin to MCWWTP (MGD) | Muddy Creek Basin (MGD) | Total to MCWWTP (MGD) | Elledge Basin (MGD) | Total to AEWWTP (MGD) | Total Both WWTPs (MGD) |
|---|---|---|---|---|---|---|---|---|
| 2010 | 20.7 | 14.4 | 6.3 | 50.6 | 56.8 | 44.4 | 58.8 | 115.6 |
| 2011 | 21.2 | 14.4 | 6.8 | 52.0 | 58.9 | 44.8 | 59.2 | 118.0 |
| 2012 | 21.8 | 14.4 | 7.4 | 53.5 | 60.9 | 45.2 | 59.6 | 120.4 |
| 2013 | 23.8 | 14.4 | 9.4 | 55.0 | 64.4 | 45.6 | 60.0 | 124.4 |
| 2014 | 24.6 | 14.4 | 10.2 | 56.4 | 66.6 | 46.0 | 60.4 | 127.0 |
| 2015 | 25.3 | 14.4 | 10.9 | 57.9 | 68.8 | 46.4 | 60.8 | 129.6 |
| 2016 | 26.0 | 14.4 | 11.6 | 59.1 | 70.6 | 46.8 | 61.2 | 131.9 |
| 2017 | 26.7 | 14.4 | 12.3 | 60.2 | 72.5 | 47.3 | 61.7 | 134.2 |
| 2018 | 27.4 | 14.4 | 13.0 | 61.4 | 74.4 | 47.7 | 62.1 | 136.5 |
| 2019 | 28.1 | 14.4 | 13.7 | 62.5 | 76.2 | 48.1 | 62.5 | 138.8 |
| 2020 | 28.8 | 14.4 | 14.4 | 63.6 | 78.1 | 48.6 | 63.0 | 141.1 |
| 2021 | 29.6 | 14.4 | 15.2 | 64.8 | 80.0 | 49.0 | 63.4 | 143.4 |
| 2022 | 30.3 | 14.4 | 15.9 | 65.9 | 81.8 | 49.4 | 63.8 | 145.7 |
| 2023 | 31.0 | 14.4 | 16.6 | 67.1 | 83.7 | 49.9 | 64.3 | 148.0 |
| 2024 | 31.7 | 14.4 | 17.3 | 68.2 | 85.5 | 50.3 | 64.7 | 150.2 |
| 2025 | 32.4 | 14.4 | 18.0 | 69.4 | 87.4 | 50.8 | 65.2 | 152.6 |
| 2026 | 33.2 | 14.4 | 18.8 | 70.6 | 89.4 | 51.2 | 65.6 | 155.1 |
| 2027 | 34.0 | 14.4 | 19.6 | 71.9 | 91.5 | 51.7 | 66.1 | 157.5 |
| 2028 | 34.8 | 14.4 | 20.4 | 73.1 | 93.5 | 52.1 | 66.5 | 160.0 |
| 2029 | 35.6 | 14.4 | 21.2 | 74.3 | 95.6 | 52.6 | 67.0 | 162.5 |
| 2030 | 36.4 | 14.4 | 22.0 | 93.3 | 115.3 | 53.0 | 67.4 | 182.7 |

# Section 4
# Wastewater Treatment Process Options

## 4.1 General

### 4.1.1 Background

The Archie Elledge WWTP (AEWWTP) and the Muddy Creek WWTP (MCWWTP) are not currently required to remove nitrogen or phosphorus. However, the ongoing study of the High Rock Lake by North Carolina Department of Environment and Natural Resources Division of Water Quality (NCDENR DWQ) will set Total Maximum Daily Loads (TMDLs) for those nutrients in the near future. Much work remains for DWQ to establish specific values for the Total Nitrogen (TN) and Total Phosphorus (TP) TMDLs and then to allocate portions of each to the point sources.

Since TN and TP effluent limits are imminent for each WWTP, the purpose of this section is to develop, screen, and short-list nutrient removal process options for each WWTP for further evaluation. In this section, the potential nutrient removal process options are discussed and a decision matrix evaluation is used to determine the best process option for each WWTP.

### 4.1.2 Effluent Limit Scenarios

Technical Memo 300, included in **Appendix A**, summarizes discussions held between CDM, CCUC, DWQ and EPA regarding potential future effluent nutrient limits for the AEWWTP and MCWWTP. Based on these discussions, three permit limit scenarios were developed that may result from the ongoing High Rock Lake TMDL process (expected to be complete for the 2014 permit cycle):

- Permit Scenario 1: 3 mg/L TN; 0.5 mg/L TP
- Permit Scenario 2: 5 mg/L TN; 0.5 mg/L TP
- Permit Scenario 3: no TN limit; 0.2 mg/L TP

## 4.2 Nutrient Removal Options

Given the above treatment requirements, several potential treatment process options were developed for the two facilities and discussed. As summarized in Section 2, each of the existing WWTPs uses primary treatment followed by the activated sludge biological process. The options considered were those judged most appropriate for integration into the existing treatment process train at each facility.

### 4.2.1 Nutrient Removal Basics

Although many processes can be used to remove nutrients, biological processes have proven most practical for TN removal. Moderate levels of effluent TN (7-9 mg/L) can be achieved by single stage denitrification processes while multistage denitrification

is necessary to achieve effluent TN concentrations approaching the limit of biological technology (LOT). Although the exact effluent TN value that can be achieved biologically depends on several factors, LOT for TN is often assumed to be 3 mg/L. To reduce nitrogen to that level requires a significant second denitrification stage and/or external carbon feed.

Phosphorus can be practically removed using either biological or chemical approaches. The biological approach is a bit less reliable and is rarely implemented without chemical phosphorus removal as a backup and supplement. TP taken up using biological means is also subject to release during anaerobic digestion and much of it would be returned to the liquid process with the centrate if not further treated chemically. Therefore, biological phosphorus removal should be considered as a means to concentrate the TP into the centrate stream where chemical treatment may be more efficient. However, TP must ultimately be removed by chemical means. Also, biological phosphorus removal is rarely used without nitrogen removal because it is so inefficient when significant nitrate is present. Therefore, most of the biological processes considered for phosphorus removal are combined TN/TP removal processes.

### 4.2.2 Options and Performance

The options available for nutrient removal are extensive. **Table 4-1** lists the most widely-used processes and their typical effluent TN and TP concentrations.

Because effluent solids contain both nitrogen and phosphorus, the solids concentration leaving the WWTP must be very low to achieve low nutrient effluent limits. Therefore, enhanced solids removal is necessary as a component of any nutrient removal approach. Effluent filtration is the most common approach. Filtration is inherent in the denitrification filter option, while standard media filters or cloth disk filters would be considered for any of the other process options.

Although it can provide a very low level of effluent solids, using a membrane bioreactor (MBR) in combination with any of the biological processes discussed is best justified by the need to increase the mixed liquor solids concentration beyond what is practical with secondary clarifiers. An alternative approach to increasing biomass in any process is to use an Integrated Fixed-film Activated Sludge (IFAS) technology. Both IFAS and MBR are best considered as process enhancements rather than process options (along with enhanced solids removal) and will be considered after the most appropriate treatment process for each permit scenario is identified.

**Table 4-1**
**Process Options/Performance for Screening**

| Process | Nitrogen Removal | Phosphorus Removal |
|---|---|---|
| LE (Ludzack Ettinger) | Poor (15-18 mg/L TN) | N/A |
| MLE (Modified Ludzack Ettinger) | Good (7-9 mg/L TN) | N/A |
| Step Feed Denitrification | Good (7-9 mg/L TN) | N/A |
| AO (Anoxic/Oxic) | N/A | Moderate (< 2 mg/L TP) |
| $A^2O$ (Anaerobic/Anoxic/Oxic) | Good (7-9 mg/L TN) | Good (< 1 TP) |
| Step Feed Denitrification and Bio-P | Good (7-9 mg/L TN) | Good (< 1 TP) |
| 4 Stage Bardenpho | Excellent (3-6 mg/L TN) | N/A |
| 5 Stage Bardenpho | Excellent (3-6 mg/L TN) | Good (< 1 TP) |
| Denitrification Filter w/ Carbon Feed (DN Filters) | Excellent (3-4 mg/L TN) | N/A |
| Chemical Precipitation (Chem P) | N/A | Excellent (< 0.5 mg/L TP) |
| Advanced Processes | Excellent (1 mg/L TN) | Excellent (< 0.1 mg/L TP) |

Based on discussion with CCUC staff, the list of process options were narrowed to those considered most appropriate for each treatment scenario and most compatible with the existing facilities at each WWTP. The list used in the decision matrix is shown in **Table 4-2** for the Muddy Creek WWTP (MCWWTP) and in **Table 4-3** for the Archie Elledge WWTP (AEWWTP).

**Table 4-2**
**Decision Matrix Process Options for MCWWTP by Scenario**

| Facility | Permit Scenario | Process Option |
|---|---|---|
| MCWWTP | 1: TN 3 mg/L, TP 0.5 mg/L | 1: MLE/DN Filters/Chem P |
| | | 2: Step Feed/DN Filters/Chem P |
| | | 3: 4 Stage Bardenpho/Chem P |
| | | 4: 5 Stage Bardenpho/Chem P |
| | 2: TN 5 mg/L, TP 0.5 mg/L | 1: MLE/Chem P |
| | | 2: Step Feed/Chem P |
| | | 3: $A^2O$/Chem P |
| | 3: TN N/A, TP 0.2 mg/L | 1: Chem P |
| | | 2: $A^2O$/Chem P |

**Table 4-3**
**Decision Matrix Process Options for AEWWTP by Scenario**

| Facility | Permit Scenario | Process Option |
|---|---|---|
| AEWWTP | 1: TN 3 mg/L, TP 0.5 mg/L | 1: MLE/DN Filters/Chem P |
| | | 2: Step Feed/DN Filters/Chem P |
| | | 3: 4 Stage Bardenpho/Chem P |
| | | 4: 5 Stage Bardenpho/Chem P |
| | 2: TN 5 mg/L, TP 0.5 mg/L | 1: MLE/Chem P |
| | | 2: Step Feed/Chem P |
| | | 3: $A^2O$/Chem P |
| | | 4: 5 Stage Bardenpho/Chem P |
| | 3: TN N/A, TP 0.2 mg/L | 1: Chem P |
| | | 2: $A^2O$/Chem P |

## 4.2.3 Process Descriptions

### 4.2.3.1 MLE

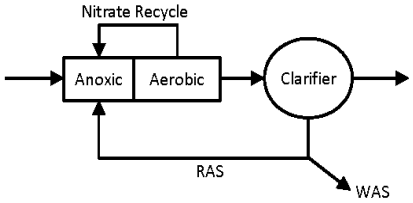
The MLE Process is a two-step nitrification/denitrification process with an anoxic zone followed by an aerobic zone. BOD from the influent wastewater serves as a source of organic material for denitrification in the anoxic zone. A recycle from the aerobic zone brings nitrate to the anoxic zone. Nitrification occurs in the aerobic zone along with the removal of most of the remaining BOD. Below is a summary of the pros and cons of this process:

Pros: Simple process
Many installations worldwide
No interaction with other processes
Less mixed liquor tankage than step feed or Bardenpho processes

Cons: TN removal only
Requires DN filters to achieve low TN level
More sludge production than Bardenpho processes

A simplified schematic of the MLE process is shown in **Figure 4-1**.

**Figure 4-1**
**MLE Process Schematic**




### 4.2.3.2 Step Feed

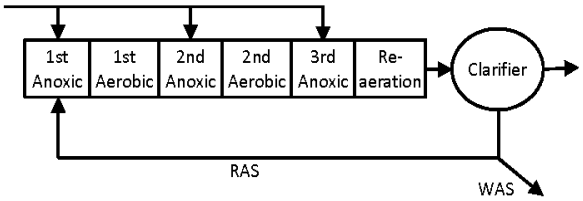
The Step Feed nutrient removal process splits the influent flow and directs a portion of it to each of several anoxic zones for denitrification, with the highest proportion going to the first zone and steadily decreasing until the last anoxic zone. By feeding the influent in steps, this process is able to achieve much of the denitrification of the MLE process without the recycle pumping the MLE process requires. Step feed also reduces the impacts of flow and load variations. A version that performs biological phosphorus removal includes an anaerobic zone upstream of each anoxic zone with recycle from each anoxic zone to the upstream anaerobic zone. Below is a summary of the pros and cons of this process:

Pros: No recycle pumping for TN removal
AEWWTP tankage well suited to multi-stage process
Minimal chemical feed

Cons: Requires many stages so can be complicated to operate
Many recycle streams if used for bio-P removal
Less effective than Bardenpho for TN and TP removal unless many stages used
Complicated process interactions
Most tankage required for mixed liquor
Bio-P release in anaerobic digesters

A simplified schematic of the step feed process is shown in **Figure 4-2**. This figure does not show the biological phosphorus removal option.

**Figure 4-2**
**Step-Feed Process Schematic**




### 4.2.3.3 Bardenpho

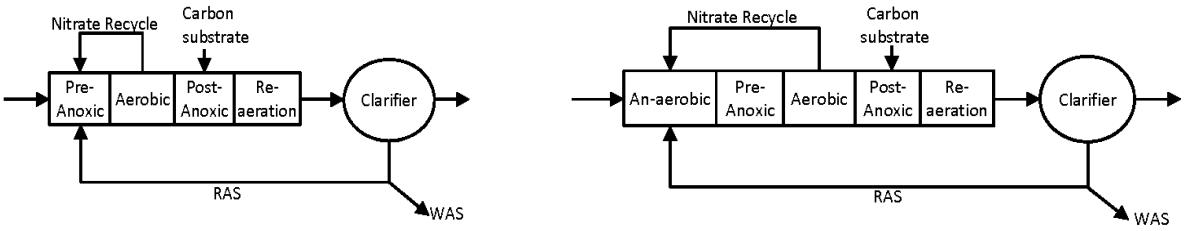
The Bardenpho process builds on the MLE process, with the first two stages being identical to the MLE process. The addition of a post-anoxic zone further removes nitrate. The re-aeration zone strips any nitrogen gas and aerates the wastewater before clarification. Depending on the level of denitrification required, carbon substrate can be added to the post anoxic zone. With the pre-anoxic, aerobic, post-anoxic, and re-aeration zones, this nitrogen removal process is often called the 4 Stage Bardenpho process. When configured with an additional anaerobic stage (the 5 Stage or modified Bardenpho process), the process will promote biological phosphorus removal as well. Below is a summary of the pros and cons of this process:

Pros: Minimizes chemical addition requirements
5 stage has less sludge production than Chem P
Both have less sludge production than process requiring DN filters and carbon addition

Cons: Large amount of mixed liquor tankage required
May still need carbon feed to post-anoxic tank to achieve very low TN
Complicated processes to operate, bio-P released in anaerobic digesters

A simplified schematic of the Bardenpho process is shown in **Figure 4-3**.

**Figure 4-3**
**Bardenpho Process Schematics**




**4 Stage Bardenpho** **5 Stage Bardenpho**

### 4.2.3.4 A²O Process

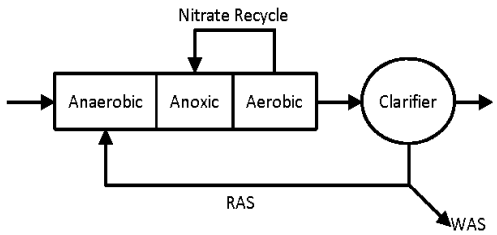
This process is similar to the 5 Stage Bardenpho process in that it includes anaerobic, anoxic and aerobic zones but it does not include the post-anoxic and reaeration zones. Without the post-anoxic zone, nitrogen removal performance is only moderate (similar to MLE and step feed processes). In the anaerobic zone, PAOs release phosphorus, which is subsequently taken up in the aerobic zone. Phosphorus removal will be adversely impacted if nitrate is present in the anaerobic zone. Phosphorus is removed from the system via waste activated sludge. As with other biological phosphorus removal processes, chemical phosphorus trim is typically provided to remove any soluble phosphate that is not taken up biologically. Below is a summary of the pros and cons of this process:

Pros: Removes both TN and TP
Less tankage than 5 stage Bardenpho
Less sludge production than Chem P

Cons: Bio-P process is less reliable (need Chem P backup)
Performance complicated by interaction between TN and TP processes
Does not remove TN to same degree as Bardenpho or DN filters
Bio-P released in anaerobic digesters

A simplified schematic of the A²O process is shown in **Figure 4-4**.

**Figure 4-4**
**$A^2O$ Process Schematic**




### 4.2.3.5 Denitrification Filters

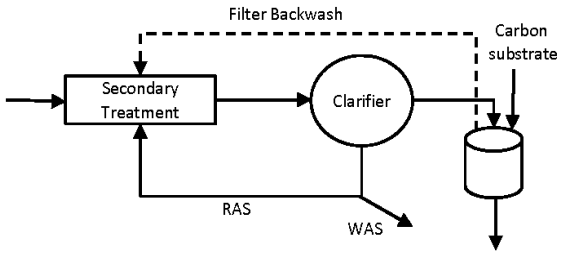
Denitrification filters are usually placed after the secondary treatment process for providing nitrogen removal (with addition of an organic carbon source) as well as acting as an effluent filter. Without carbon feed, the process functions as a non-biological filter to reduce solids. With carbon feed, the filter generates an attached biomass that removes nitrate very effectively. Two carbon sources that are widely used include methanol and glycerol (a byproduct of biodiesel production). The key factor in carbon source selection is that it include very little TN or TP. Below is a summary of the pros and cons of this process:

Pros: Very low levels of TN achievable
TN level controllable with carbon feed rate
Does not require tankage that could be used for mixed liquor

Cons: TN removal only
Carbon feed required
Few vendors
Deep bed filters require pumping from secondary clarifiers

A simplified schematic of the denitrification filter process is shown in **Figure 4-5**.

**Figure 4-5**
**Denitrification Filters Process Schematic**




### 4.2.3.6 Chemical Phosphorus Removal Process

To achieve phosphorus removal, various metal salts such as aluminum sulfate or ferric chloride can be added to wastewater where they react with soluble phosphates to form precipitates. The precipitates are then removed with the waste activated sludge and at the effluent filters. Chemical phosphorus removal (Chem P) may use one or more feed points depending on the effluent TP limit required. Storage facilities are needed for the metal salts along with chemical metering pumps to feed to one or more points in the process. Feed to aeration basins, secondary clarifier influent, and filter influent is common. Below is a summary of the pros and cons of this process:

Pros: Simple to operate
Reliable
Only chemical storage volume and metering pumps required

Cons: Chemical purchase
Increased sludge production

## 4.3 Decision Matrix Approach

By using a decision matrix approach, these process options were evaluated according to a list of criteria to identify the most feasible alternative for each effluent limit scenario. Weighting factors to establish the relative importance of each criterion were developed by CCUC, and the weighting factor for each criterion is the average of all values provided.

The evaluation approach is outlined below:

- Prioritize evaluation criteria based on their relative importance to the project. Assign a relative weighting factor (WF) for each criterion based on a scale of 1 to 5, with 1 being the least important and 5 being the most important.

- Assign a rating, ranging from 1 through 5, with 1 being the worst and 5 being the best to indicate how well each alternative satisfies each criterion.
- Multiply the WF by the rating to determine the score for each option and criterion. Determine the total score for each alternative and then rank the alternatives based on the total score. This allows the alternative that best satisfies the evaluation criteria to be ranked number 1 and selected for implementation.

### 4.3.1 Evaluation Criteria

The alternative treatment technologies were evaluated based on the developed criteria shown in **Table 4-4**. The evaluation criteria can be grouped into four categories:

1. Technology
2. Capital/Construction
3. O&M
4. Community Impact

The weighting factors (WFs) for each criterion are also presented in Table 4-4. These values represent the opinions of CUCC staff as to the relative importance of each criterion.

Technology factors were used to evaluate the capability of a process to meet the objectives of this project on a consistent basis over the long term. Capital/construction factors included those for one-time construction and engineering cost, construction complexity, and land area requirement. O&M factors include ease of operation and maintenance, energy requirements, chemical requirements, residuals quantity, and impact on pellets produced/end user's needs. Community impact criteria include those items of most concern to the public such as odor, traffic, noise, air emissions, dust, water quality, wetland infringement and other impacts during construction and when the facilities are placed in operation.

### 4.3.2 Process Scoring Rationale

Process scoring was done on a 5 point scale with 5 being the best score and 1 the worst score. Processes were compared against one another within a single WWTP scenario. For example, an option requiring little or no chemical feed would receive a top score of 5 on the "Chemical Requirements" criteria. A process requiring a larger quantity of the same chemical would receive a lower score. A process requiring a more dangerous chemical, a significantly larger quantity of chemical or an additional chemical would have additional points removed to arrive at a score. Energy requirements, dependability and the other criteria were scored similarly.

A summary of the rationale used in assigning each score is included in **Appendix B**.

**Table 4-4**
**Process Options Selection Criteria with Weighting Factors**

| Selection Criteria | WFs |
|---|---|
| **1. Technology Factors** | |
| Dependable compliance | **5.0** |
| Phasing potential | **2.6** |
| Process flexibility | **3.2** |
| Compatibility with existing facilities | **3.0** |
| Feasibility | **4.2** |
| Full-scale operation history | **1.4** |
| **2. Capital/Construction Factors** | |
| Construction & engineering cost | **4.2** |
| Construction complexity | **2.4** |
| Land area requirements | **1.4** |
| **3. O&M Factors** | |
| Ease of operation & maintenance | **3.6** |
| Energy requirements | **2.4** |
| Chemical requirements | **2.4** |
| Residuals quantity | **2.4** |
| Impact on pellets produced/end user's needs | **2.2** |
| **4. Community Impact Factors** | |
| Community impacts | **4.2** |

### 4.3.3 Process Scoring Matrix

The process scoring matrix for the three scenarios for the AEWWTP and MCWWTP is included in **Table 4-5**. The total weighted score and rank of each process within each scenario are shown in the last two columns on the far right of the matrix. The larger the difference in weighted scores, the greater the difference in the ability of those two processes to meet the decision criteria for that scenario.

## 4.4 Recommended Options

Based on the weighted scores, the following processes ranked the highest for each effluent limit permit scenario:

Permit Scenario 1: MCWWTP - 4 stage Bardenpho w/ Chemical Phosphorus Removal
AEWWTP – 4 stage Bardenpho w/ Chemical Phosphorus Removal

| | |
|---|---|
| Permit Scenario 2: | MCWWTP – MLE w/ Chemical Phosphorus Removal<br>AEWWTP – 4 stage Bardenpho w/ Chemical Phosphorus Removal |
| Permit Scenario 3: | MCWWTP – Chemical Phosphorus Removal<br>AEWWTP – Chemical Phosphorus Removal |

A common theme among these highly rated processes is that none of them include biological phosphorous removal. This is a consequence of the greater number and weighting of criteria on which chemical phosphorus removal was positively rated as compared to biological phosphorus removal. Although slightly different criteria or weighting may be justifiable, two important factors will tend to work against biological phosphorus removal (bio-P):

- Chem P facilities must be included on the mainstream of any bio-P process for reliability and to assure compliance with low phosphorus limits

- Anaerobic digestion requires that Chem P facilities must be included on the centrate stream as the ultimate form of phosphorus removal

Permit Scenario 2 was developed to consider the possibility that limit of technology treatment (LOT) would not be required at both WWTPs. However, because LOT is approximately 3 mg/L TN, and the processes for moderate denitrification (including the MLE process considered for the MCWWTP in Scenario 2) achieve approximately 8 mg/L TN, the combined 5 mg/L TN required under Scenario 2 can only be achieved if less than 40% of the combined flow is treated at the MCWWTP. The annual average flow currently treated at MCWWTP is approximately 46% of the total. Because the Muddy Creek influent already exceeds the 40% level and because the flow to the MCWWTP is growing at a faster rate than the total flow, further consideration of Scenario 2 is impractical.

**Table 4-5**
**Process Scoring Matrix**

| WWTP | Scenarios* | CRITERIA | Capital costs | Dependable compliance | Feasibility | Full-scale operation history | Phasing potential | Process flexibility | Ease of O&M | Compatibility with existing facilities | Energy requirements | Residuals quantity | Impact on pellets produced/end user's needs | Community impacts | Chemical requirements | Construction complexity | Land area requirements | Total Score | Rank Within Each Scenario |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **WEIGHING FACTORS** | **4.20** | **5.00** | **4.20** | **1.40** | **2.60** | **3.20** | **3.60** | **3.00** | **4.00** | **2.40** | **2.20** | **4.20** | **4.00** | **2.40** | **1.40** | | |
| **Muddy Creek** | **1** | **Alt. 1:** MLE / DN Filters / Chem P | 3 | 5 | 5 | 4 | 4 | 3 | 3 | 3 | 1 | 2 | 2 | 3 | 2 | 4 | 3 | 151.60 | 3 |
| | | **Alt. 2:** Step Feed / DN Filters / Chem P | 2 | 2 | 2 | 2 | 4 | 5 | 2 | 1 | 2 | 3 | 4 | 2 | 3 | 2 | 2 | 118.20 | 4 |
| | | **Alt. 3:** 4-stage Bardenpho / Chem P | 5 | 4 | 4 | 3 | 2 | 2 | 5 | 4 | 3 | 3 | 2 | 5 | 4 | 5 | 5 | 183.20 | 1 |
| | | **Alt. 4:** 5-stage Bardenpho / Chem P | 4 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 161.60 | 2 |
| | **2** | **Alt.1:** MLE / Chem P | 5 | 5 | 5 | 5 | 2 | 3 | 5 | 4 | 4 | 2 | 2 | 3 | 2 | 4 | 5 | 181.20 | 1 |
| | | **Alt. 2:** Step Feed / Chem P | 2 | 3 | 3 | 2 | 2 | 4 | 2 | 2 | 2 | 4 | 4 | 2 | 4 | 2 | 3 | 129.80 | 3 |
| | | **Alt. 3:** $A^2O$ / Chem P | 4 | 3 | 4 | 3 | 2 | 2 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 3 | 4 | 160.20 | 2 |
| | **3** | **Alt. 1:** Chem P | 5 | 5 | 5 | 5 | 2 | 5 | 5 | 4 | 2 | 2 | 2 | 3 | 2 | 5 | 4 | 180.60 | 1 |
| | | **Alt. 2:** $A^2O$ / Chem P | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 4 | 4 | 3 | 4 | 2 | 2 | 127.60 | 2 |
| **Archie Elledge** | **1** | **Alt. 1:** MLE / DN Filters / Chem P | 3 | 5 | 5 | 4 | 4 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 4 | 3 | 155.60 | 3 |
| | | **Alt. 2:** Step Feed / DN Filters / Chem P | 2 | 2 | 4 | 2 | 4 | 5 | 2 | 1 | 2 | 3 | 4 | 2 | 3 | 2 | 2 | 126.60 | 4 |
| | | **Alt. 3:** 4-stage Bardenpho / Chem P | 5 | 4 | 4 | 3 | 2 | 2 | 5 | 4 | 4 | 3 | 2 | 4 | 4 | 5 | 5 | 183.00 | 1 |
| | | **Alt. 4:** 5-stage Bardenpho / Chem P | 4 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 4 | 4 | 4 | 5 | 5 | 4 | 4 | 165.80 | 2 |
| | **2** | **Alt. 1:** MLE / DN Filters / Chem P | 3 | 5 | 5 | 4 | 4 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 4 | 3 | 155.60 | 3 |
| | | **Alt. 2:** Step Feed / DN Filters / Chem P | 2 | 2 | 4 | 2 | 4 | 5 | 2 | 1 | 2 | 3 | 4 | 2 | 3 | 2 | 2 | 126.60 | 4 |
| | | **Alt. 3:** 4-stage Bardenpho / Chem P | 5 | 4 | 4 | 3 | 2 | 2 | 5 | 4 | 4 | 3 | 2 | 5 | 4 | 5 | 5 | 187.20 | 1 |
| | | **Alt. 4:** 5-stage Bardenpho / Chem P | 4 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 161.60 | 2 |
| | **3** | **Alt. 1:** Chem P | 5 | 5 | 5 | 5 | 2 | 5 | 5 | 4 | 2 | 2 | 2 | 2 | 2 | 5 | 4 | 176.40 | 1 |
| | | **Alt. 2:** $A^2O$ / Chem P | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 4 | 4 | 3 | 4 | 2 | 2 | 131.60 | 2 |

**Note:**
* Scenario 1: TN=3.0 mg/L; TP=0.5 mg/L
Scenario 2: TN=5.0 mg/L; TP=0.5 mg/L
Scenario 3: TN=n/a; TP=0.2 mg/L

# Section 5
# Process Modeling

Wastewater simulation process modeling was performed to assist in the evaluation of the MCWWTP and AEWWTP. BioWin™, a proprietary software modeling program developed by EnviroSim Inc, was used in the evaluation. Calibration was performed to a level appropriate to assess the capacity of existing facilities and for a planning level comparison of new process options. A higher level of model calibration should be used when the preliminary and final design of each facility is undertaken.

## 5.1 Characterization of Facility Influent Streams

Data for both the MCWWTP and AEWWTP were screened to develop characteristics for a chemical oxygen demand (COD) based model input. The primary effluent was used as the starting point of the modeling exercise due to the abundance of COD data (as opposed to the primary influent which had less data) and because primary effluent is the wastewater that enters the biological process that is the main focus of BioWin™ modeling. Both facilities measure total and soluble COD, as well as volatile fatty acid (VFA), biochemical oxygen demand (BOD), soluble BOD, total suspended solids (TSS), and ammonia in the primary effluent. Final effluent COD values are also measured.

### 5.1.1 Primary Effluent Characterization

Data from September 2008 through March 2009 was evaluated. EnviroSim's Influent Specifier program was used to develop the COD characterization of the primary effluent waste stream. The filtered flocculated COD concentration is not measured at either facility, therefore a reasonable value was assumed in the evaluation.

BioWin™ was also run to determine the performance of each facility during the time period above. Simulation results for parameters such as mixed liquor suspended solids (MLSS) and waste activated sludge (WAS) quantities were developed and compared to actual facility data.

**Table 5-1** summarizes the comparison of results. Evaluation of the results indicates very good correlation among most of the parameters. Modeled primary effluent and final effluent BOD appear to be the largest detractors from actual facility data. Further evaluation of this discrepancy should be done when the facilities move into preliminary and final design. Effluent concentrations appeared skewed due to the low concentrations in the effluent. The primary effluent values are within 30% and, for the purposes of this Master Plan, are within the source of error for a planning-level study and can be used moving forward with the evaluation.

**Table 5-1**

**Comparison of Biological Process Actual and Simulation Data**

| | | MCWWTP | | AEWWTP | |
|---|---|---|---|---|---|
| **Component[1]** | **Units** | **Plant Average** | **Model Prediction** | **Plant Average** | **Model Prediction** |
| PE COD | mg/L | 298 | 298 | 533 | 533 |
| PE BOD | mg/L | 116[3] | 136 | 240 | 304 |
| PE TSS | mg/L | 78 | 80 | 82 | 85 |
| PE VSS | mg/L | --- | 67 | 69 | 72 |
| PE TKN | mg/L | 29 | 29 | 40.3 | 40.3 |
| MLSS | mg/L | 1,410 | 1,280 | 1,388 | 1,263 |
| WAS | mgd | 0.47 | 0.47 | 1.12 | 1.12 |
| | lb/d | 11,000 | 10,600 | 22,200 | 20,000 |
| RAS | mgd | 12.78 | 12.68 | 22.28 | 22.21 |
| Effluent COD | mg/L | 55 | 55 | 48 | 48 |
| Effluent BOD | mg/L | 8.8 | 4.5 | 5.0 | 3.2 |
| Effluent TSS | mg/L | 8.5 | 9.6 | 7.9 | 6.1 |
| Effluent NH4 | mg/L | 0.52 | 0.48 | 0.6 | 0.4 |
| Effluent NO3 | mg/L | 20.9 | 19.6 | 12.7 | 14.7 |
| Effluent TP | mg/L | 3.5 | 3.4 | 3.4 | 0.9 |

[1] PE = primary effluent
[2] Measured from 9/2008 to 3/2009
[3] Lab measures cBOD by adding nitrification inhibitor to the test. Uninhibited cBOD is assumed to be 19% higher. Value in table is true or uninhibited BOD.

**Table 5-2** summarizes the primary effluent wastewater characterization based on the data provided at each facility. It should be noted that the VFA concentration at MCWWTP and the readily biodegradable COD fraction at AEWWTP are both higher than the default. The VFA value at the AEWWTP will affect biological phosphorus removal and the readily biodegradable COD value will affect denitrification.

**Table 5-2**

**Primary Effluent Wastewater Characterization**

| Name | Default | MCWWTP Value | AEWWTP Value |
|---|---|---|---|
| Fbs - Readily biodegradable (including Acetate) | 0.27 | 0.20 | 0.568 |
| Fac - Acetate | 0.15 | 1.00 | 0.335 |
| Fxsp - Non-colloidal slowly biodegradable | 0.50 | 0.50 | 0.6 |
| Fus - Unbiodegradable soluble | 0.08 | 0.136 | 0.07 |
| Fup - Unbiodegradable particulate | 0.13 | 0.15 | 0.08 |
| Fna - Ammonia | 0.75 | 0.713 | 0.72 |
| Fnox - Particulate organic nitrogen | 0.50 | 0.25 | 0.25 |
| Fnus - Soluble unbiodegradable TKN | 0.02 | 0.02 | 0.02 |
| FupN - N:COD ratio for unbiodegradable part. COD | 0.035 | 0.035 | 0.035 |
| Fpo4 - Phosphate | 0.75 | 0.654 | 0.778 |
| FupP - P:COD ratio for influent unbiodegradable part. COD | 0.011 | 0.011 | 0.011 |

### 5.1.2 Primary Influent Characterization

Due to the lack of COD data in the primary influent, a correlation between the primary effluent and primary influent was needed so that the primary influent characterization could be developed. It was assumed that the soluble COD and BOD species in the primary influent would pass through the primary clarifiers and remain constant. The soluble COD and BOD species, along with the facility data for the primary influent which was given (COD, BOD, TSS, and VSS), was used to characterize the primary influent waste stream.

After characterization, a BioWin™ model comprised solely of primary influent, a primary clarifier, and primary effluent and primary sludge, was developed. The model used the average TSS removal from September 2008 through March 2009 and was used to compare the modeled primary effluent to both the plant measured and Influent Specifier primary effluent shown in Table 5-1.

**Table 5-3** summarizes the results for the MCWWTP. The simulated primary influent and effluent values appear to match favorably to the measured primary influent values. Again, BOD values measured at the plant are lower than those predicted by the model. A full calibration of the model may shed light on this discrepancy. For the purposes of a planning level document, the variability is acceptable.

**Table 5-3**

**Comparison of Actual and Simulated Primary Influent and Primary Effluent for MCWWTP**

| Component | Units | Measured at Plant[1] | | Model Predicted | | |
|---|---|---|---|---|---|---|
| | | Primary Influent | Primary Effluent | Primary Influent | Primary Effluent[2] | Primary Effluent[3] |
| COD | mg/L | 540 | 298 | 540 | 294 | 298 |
| Filtered COD | mg/L | --- | --- | 169 | 169 | 177 |
| Particulate COD | mg/L | --- | --- | 371 | 124 | 121 |
| VFAs | mg/L | --- | --- | 59 | 59 | 60 |
| Slowly bio. COD (colloidal) | mg/L | --- | --- | 69 | 69 | 76 |
| Slowly bio. COD (particulate) | mg/L | --- | --- | 209 | 70 | 76 |
| Soluble inert COD | mg/L | --- | --- | 41 | 41 | 41 |
| Particulate inert COD | mg/L | --- | --- | 161 | 54 | 45 |
| BOD | mg/L | 175[4] | 116[4] | 202 | 128 | 136 |
| Soluble BOD | mg/L | --- | 82[4] | 91 | 91 | 96 |
| TSS | mg/L | 236 | 78 | 232 | 78 | 80 |
| VSS | mg/L | --- | --- | 204 | 68 | 67 |

[1] Measured from 9/2008 to 3/2009
[2] Predicted modeled primary influent and TSS removal from 9/2008 to 3/2009
[3] From Influent Specifier (see Table 5-1)
[4] Lab measures cBOD. Uninhibited BOD assumed to be 19% higher. Value in table is true or uninhibited BOD.

**Table 5-4** summarizes the results for the AEWWTP. The simulated primary influent values appear to match favorably to the measured primary influent values although BOD values measured in the primary influent are lower than the model simulation. This could be explained by the unreported use of AEWWTP a nitrification inhibitor for the influent BOD test. In the event a nitrification inhibitor is used, the uninhibited BOD would be greater and would better correlate with the simulation. Further investigation into this anomaly should be investigated during preliminary design or design. For the purposes of planning, however, the values are less than 15% different which is acceptable for a planning level study.

**Table 5-4**

**Comparison of Actual and Simulated Primary Influent and Primary Effluent for AEWWTP**

| Component | Units | Measured at Plant[1] | | Model Predicted | | |
|---|---|---|---|---|---|---|
| | | Primary Influent | Primary Effluent | Primary Influent | Primary Effluent[2] | Primary Effluent[3] |
| COD | mg/L | 791 | 533 | 791 | 525 | 533 |
| Filtered COD | mg/L | --- | --- | 402 | 402 | 400 |
| Particulate COD | mg/L | --- | --- | 389 | 123 | 133 |
| VFAs | mg/L | --- | --- | 101 | 101 | 101 |
| Slowly bio. COD (colloidal) | mg/L | --- | --- | 62 | 62 | 60 |
| Slowly bio. COD (particulate) | mg/L | --- | --- | 234 | 74 | 90 |
| Soluble inert COD | mg/L | --- | --- | 37 | 37 | 37 |
| Particulate inert COD | mg/L | --- | --- | 154 | 49 | 43 |
| BOD | mg/L | 339 | 240 | 382 | 297 | 304 |
| Soluble BOD | mg/L | --- | --- | 258 | 258 | 256 |
| TSS | mg/L | 259 | 82 | 245 | 78 | 85 |
| VSS | mg/L | --- | 69 | 209 | 66 | 72 |

[1] Measured from 9/2008 to 3/2009
[2] Predicted modeled primary influent and TSS removal from 9/2008 to 3/2009
[3] From Influent Specifier (see Table 5-1)

**Table 5-5** summarizes the primary influent wastewater characterization based on the methodology and evaluation presented above. Again, it should be noted that the VFA concentration at MCWWTP and the readily biodegradable COD fraction at both facilities is higher than the default.

**Table 5-5**

**Primary Influent Wastewater Characterization**

| Name | Default | MCWWTP Value | AEWWTP Value |
|---|---|---|---|
| Fbs - Readily biodegradable (including Acetate) | 0.16 | 0.11 | 0.383 |
| Fac - Acetate | 0.15 | 1.00 | 0.335 |
| Fxsp - Non-colloidal slowly biodegradable | 0.75 | 0.75 | 0.79 |
| Fus - Unbiodegradable soluble | 0.05 | 0.075 | 0.047 |
| Fup - Unbiodegradable particulate | 0.13 | 0.299 | 0.195 |
| Fna - Ammonia | 0.66 | 0.56 | 0.725 |
| Fnox - Particulate organic nitrogen | 0.50 | 0.5 | 0.50 |
| Fnus - Soluble unbiodegradable TKN | 0.02 | 0.02 | 0.02 |
| FupN - N:COD ratio for unbiodegradable part. COD | 0.035 | 0.035 | 0.035 |
| Fpo4 - Phosphate | 0.50 | 0.50 | 0.625 |
| FupP - P:COD ratio for influent unbiodegradable part. COD | 0.011 | 0.011 | 0.011 |

### 5.1.3 Raw Influent Characterization

Both the MCWWTP and AEWWTP sample the primary influent after recycle sidestreams are introduced at the plant. Recycle sidestreams, especially those with facilities that utilize anaerobic digestion, can provide a significant nitrogen and phosphorus load back into the liquids treatment process. In order to determine the mass loads and, ultimately, the characterization of the raw influent, a mass balance was performed by subtracting the centrate sidestream from the primary influent.

Characteristics of the centrate sidestream were developed using a BioWin simulation of solids processing at the two facilities. The simulation was developed to include anaerobic digestion at each facility with digested sludge transferred from MCWWTP to AEWWTP where it is blended and dewatered using the existing centrifuges. The simulation also included centrate being returned to each facility in proportion to the sludge generated at each facility. Centrate flow was simulated as being sent to both the existing lagoons at the AEWWTP as well as being pumped back to MCWWTP and stored in the existing lagoons. The full volume of each lagoon system at each plant was utilized for the simulation. A constant dissolved oxygen (DO) concentration of 0.35 mg/L was assumed in each lagoon. The characteristics of the waste stream after lagoon treatment were ascertained and mass loads developed based on flow. For each WWTP, the mass loads from the lagoon were subtracted from the primary influent mass loads to generate values for the raw influent mass loads. Using flow data, the raw influent mass loads generated by this simulation procedure were then converted to raw influent concentrations of the wastewater at each facility. **Table 5-6** summarizes simulated raw influent concentrations from September 2008 through March 2009 for each facility. **Table 5-7** summarizes the wastewater characterization for each facility.

**Table 5-6**

**Simulated Raw Influent Concentrations from September 2008 through March 2009**

| Component | Units | MCWWTP | | AEWWTP | |
|---|---|---|---|---|---|
| | | Raw Influent | Primary Influent | Raw Influent | Primary Influent |
| COD | mg/L | 527 | 540 | 785 | 791 |
| Filtered COD | mg/L | 166 | 169 | 401 | 402 |
| Particulate COD | mg/L | 361 | 371 | 384 | 389 |
| BOD | mg/L | 201 | 202 | 384 | 382 |
| Soluble BOD | mg/L | 92 | 91 | 259 | 258 |
| TSS | mg/L | 219 | 232 | 239 | 245 |
| VSS | mg/L | 197 | 204 | 205 | 209 |

The raw influent wastewater characterization developed was used for full-scale plant simulations at each facility. The subsequent sections will disclose the results of the analysis.

**Table 5-7**

**Raw Influent Wastewater Characterization**

| Name | Default | MCWWTP Value | AEWWTP Value |
|---|---|---|---|
| Fbs - Readily biodegradable (including Acetate) | 0.16 | 0.117 | 0.390 |
| Fac - Acetate | 0.15 | 0.163 | 0.331 |
| Fxsp - Non-colloidal slowly biodegradable | 0.75 | 0.750 | 0.790 |
| Fus - Unbiodegradable soluble | 0.05 | 0.065 | 0.041 |
| Fup - Unbiodegradable particulate | 0.13 | 0.290 | 0.195 |
| Fna - Ammonia | 0.66 | 0.545 | 0.622 |
| Fnox - Particulate organic nitrogen | 0.50 | 0.500 | 0.500 |
| Fnus - Soluble unbiodegradable TKN | 0.02 | 0.020 | 0.020 |
| FupN - N:COD ratio for unbiodegradable part. COD | 0.035 | 0.035 | 0.035 |
| Fpo4 - Phosphate | 0.50 | 0.321 | 0.362 |
| FupP - P:COD ratio for influent unbiodegradable part. COD | 0.011 | 0.011 | 0.011 |

## 5.2 Nutrient Removal Capability of Existing WWTPs

The 4-stage Bardenpho process with chemical phosphorus removal was selected in Section 4 as the nutrient removal process recommended to meet an effluent permit condition of 3 mg/L total nitrogen (TN) and 0.5 mg/L total phosphorus (TP). Both WWTPs were evaluated to determine capacity using their current primary and secondary treatment tankage reconfigured into a 4-stage Bardenpho process with chemical phosphorus removal. **Table 5-8** lists the evaluation criteria for each unit process.

**Table 5-8**

**Evaluation Criteria for Unit Processes**

| Unit Process | Evaluation Criteria |
|---|---|
| Primary clarifiers | Peak hour flow |
| Anoxic reactors | Maximum month nitrogen mass load |
| Aeration tanks | Maximum month $BOD_5$ mass load |
| Aeration system | Maximum day oxygen demand |
| Secondary settling tanks | Max day flow at design MLSS at RAS flow of 100% of ADF / Peak hour flow at RAS flow of 100% of ADF |

### 5.2.1 MCWWTP

The MCWWTP is presently permitted for up to 21 million gallons per day (mgd) on a maximum month basis. The facility uses the following process components:

- Four rectangular primary clarifiers at 158 feet by 46 feet each.
- Three aeration basins at 204 feet by 68 feet by 24.8 feet deep for a total volume of 7.73 million gallons (MG).
- Three single stage centrifugal blowers each rated at a maximum flow of 11,400 scfm.
- Four secondary clarifiers with a diameter of 110 ft each by 14 feet deep.

The MCWWTP was evaluated using the primary influent concentrations and mass load peaking factors shown in Section 2 as a basis for the evaluation. Primary clarifier BOD5 and TSS removal efficiencies were approximated using empirical formula relating removal efficiency and hydraulic loading rate to the primary clarifier. **Table 5-9** lists a summary of the concentrations and mass load peaking factors.

**Table 5-10** lists the design parameters used in evaluating the capacity of the MCWWTP reconfigured as a 4-stage Bardenpho process with chemical phosphorus removal. Net yields were calculated using industry-standard empirical relationships.

**Table 5-9**

**MCWWTP Design Criteria for Nutrient Removal Capacity Evaluation**

| Constituent | Primary Influent Concentration (mg/L) | Mass Load Peaking Factor | | |
|---|---|---|---|---|
| | | ADF | ADMM | MD |
| BOD | 175 | 1.0 | 1.2 | 1.4 |
| TSS | 236 | 1.0 | 1.1 | 1.6 |
| TKN | 36 | 1.0 | 1.2 | 1.5 |
| TP | 7.9 | 1.0 | 1.2 | 1.4 |

After evaluation of the facilities at the MCWWTP, it was determined that the reconfigured secondary treatment process could treat up to 17.5 mgd on a maximum month flow basin (14.5 mgd on an annual average daily flow basis) utilizing the existing tankage on site.

**Table 5-10**

**Design Parameters for MCWWTP**

| Parameter | Unit | Value |
|---|---|---|
| Temperature | ºC | 15 |
| Reliability | N/A | US EPA Class I |
| Primary Clarifier BOD Removal | % | 36 at max month<br>35 at max day |
| Primary Clarifier TSS Removal | % | 64 at max month<br>63 at max day |
| Aerobic solids retention time | days | 8 |
| Net yield (includes chemical sludge) | mg TSS/mg BOD | 1.08 |
| Internal recycle ratio | N/A | 500% plant influent flow |
| MLSS | mg/L | 4,200 |
| Return activated sludge (RAS) flow | % ADF | 100 |
| Alpha | N/A | 0.60 |

Chemical feed facilities such as alum or ferric would need to be added for chemical phosphorus removal. A supplemental carbon source, such as methanol or acetate, would also need to be added to the second anoxic zone in order to meet permit limits. Upgrades to RAS pumping and new internal recycle pumps would also need to be added. **Table 5-11** lists the volumetric requirements.

**Table 5-11**

**MCWWTP 4-Stage Bardenpho Bioreactor Sizing Requirements**

| Component | Unit | Value |
|---|---|---|
| First Anoxic Zone, Cell 1 | MG | 0.16 |
| First Anoxic Zone, Cell 2 | MG | 0.15 |
| First Anoxic Zone, Cell 3 | MG | 1.43 |
| Aerobic/Anoxic Swing Zone | MG | 0.39 |
| Aeration Zone | MG | 3.92 |
| Second Anoxic Zone | MG | 1.47 |
| Reaeration Zone | MG | 0.18 |
| **TOTAL** | **MG** | **7.7** |

### 5.2.1.1 Primary Clarification

Primary clarification is used on a regular basis in many municipal wastewater applications for removal of BOD and TSS prior to secondary treatment. This process generally removes 20 to 35 percent of the influent $BOD_5$ and 40 to 65 percent of the influent TSS. Primary clarification does not remove significant amounts of nitrogen from the wastewater. Small

amounts of particulate nitrogen can be removed but ammonia and soluble organic nitrogen pass through the process. There are four primary clarifiers at 7,270 sq ft each. At a peak overflow rate of 2,000 gpd/sq ft, each primary has a peak flow capacity of 14.5 mgd. With all four clarifiers in service the peak capacity is 58.2 mgd. However, the bridge-type clarifier scraper mechanisms operate in pairs so that a shutdown for maintenance or any other reason removes two of the four clarifiers from service. With a mechanism shutdown taking two units out of service, the peak capacity would drop to 29.1 mgd. This firm peak capacity is too low for the 21 mgd plant rating and needs to be corrected by replacing the existing scrapers with independently operated units for each clarifier. With independent scrapers, the firm peak capacity will increase to 43.6 mgd.

#### 5.2.1.2 First Anoxic

The size requirement of the first anoxic zone is a function of the mass of nitrate to be removed, the soluble substrate concentration, MLSS concentration, dissolved oxygen concentration and the temperature of the mixed liquor. In order to maximize the denitrification capabilities of the first anoxic zones, the basins are staged in three zones in a series to maximize selector effects and denitrification rates by simulating plug flow. This process configuration should have the capability to remove 2,250 lb/day of nitrate at 15°C at maximum month conditions.

#### 5.2.1.3 Aeration

Biological nitrification takes place in the aeration tank in conjunction with the oxidation of the carbonaceous $BOD_5$. The biomass in the aeration tank oxidizes most of the carbonaceous $BOD_5$ and ammonia, converting organic carbon to carbon dioxide ($CO_2$) and water, and the nitrogen to nitrate. The ability of the microorganisms to consume the carbonaceous $BOD_5$ and oxidize the ammonia is a function of the bacteria growth rates, solids yield, pH, available oxygen, temperature, and SRT. Nitrification, once the reaction starts, is typically carried through to completion, if adequate oxygen and alkalinity are available and no toxic chemicals are present.

The required system aerobic SRT for nitrification is a function of the nitrifier growth rate which is affected by mixed liquor temperature, pH, and DO concentration. The process evaluation focused on winter temperatures since they result in lower nitrification rates. A wastewater temperature of 15°C is used. The actual nitrification capacity of the aeration tank will vary with seasonal changes in wastewater temperature. At a MLSS concentration of 4,200 mg/L (limiting concentration to secondary clarifiers), roughly 3.9 million gallons of operating aeration volume tankage is required.

Sufficient oxygen must be provided to meet the oxygen demand exerted by the oxidation of both BOD and ammonia nitrogen at maximum day loads while maintaining a DO concentration of 2.0 mg/L in the aeration tanks. Based on the plant loadings, the existing blowers have sufficient capacity for the design condition. The proposed configuration of the 4-stage Bardenpho process differs significantly from the existing process configuration. The size and orientation of the first and second

anoxic zones will overlap the existing diffuser grids requiring that the existing diffuser grids be removed and replaced, or reconfigured and additional diffusers be added in the aerated zones. **Table 5-12** summarizes the important design factors and results of the aeration system capacity evaluation.

### 5.2.1.4 Second Anoxic

The biological process upstream of the second anoxic zone will remove essentially all of the organic carbon and the bulk of the nitrogen in the wastewater. The 4-stage Bardenpho process is designed to remove the nitrate nitrogen remaining after the aeration tank using the carbon released to the wastewater as a result of endogenous respiration in the second anoxic tank (anoxic zone after the aeration tank).

**Table 5-12**

**MCWWTP 4-Stage Bardenpho Aeration System Components**

| Parameter | Unit | Value |
|---|---|---|
| DO in basin | mg/L | 2.0 |
| Alpha | --- | 0.60 |
| Beta | --- | 0.95 |
| Carbonaceous oxygen demand | lb/d | 19,900 |
| Nitrogenous oxygen demand | lb/d | 17,000 |
| Denitrification credit | lb/d | 10,900 |
| Oxygen required (field) | lb/d | 26,000 |
| Maximum day air requirement | scfm | 5,300 |
| Firm capacity of existing blowers | scfm | 22,800 |
| Blowers required (operating/standby) | --- | 1/2 |

When endogenous carbon is insufficient to accomplish the required denitrification, an external carbon source is required to supplement the native carbon. Supplemental carbon can be provided by a commercial chemical, typically methanol, or by the use of carbon in the primary sludge. When a supplemental carbon source is required, addition of the chemical after the main aeration tank is the most efficient location. The use of methanol provides two benefits: a carbon source for the wastewater and a readily available substrate that will increase the denitrification rate in the reactor.

In order to be conservative, however, the second anoxic zone was sized using the EPA Nitrogen Control Manual equation which relates denitrification rate to solids retention time. This equation does not consider the use of a supplemental carbon source. Process simulation of the facility, however, indicated that 900 gallons per day of methanol was required at maximum month loading conditions.

#### 5.2.1.5 Reaeration

The main purpose of the reaeration tanks is to remove nitrogen gas from the biological flocs so they will settle easily. Reaeration also reduces the potential for anaerobic conditions in the final clarifiers which could result in phosphorus release in biological phosphorus removal processes. Reaeration can be accomplished with a short detention time tank or channel with high aeration intensity. A design reaeration tank hydraulic detention time of 15 minutes at maximum month flow was chosen. This results in a total reaeration tank volume of 0.18 MG.

#### 5.2.1.6 Secondary Clarification

For this task, the secondary clarifiers were rated using state-point analysis assuming a sludge volume index (SVI) of 125 mL/g as is typical for activated sludge systems when anoxic selectors have been added. As stated in Table 5-8, the clarifiers are evaluated at maximum day and peak hour flow conditions to confirm the sludge blanket will be retained at both conditions. The criteria used to evaluate the clarifiers are shown below:

- Maximum day flow conditions (peaking factor of 1.27 x ADF) with all units in service at design MLSS of 4,200 mg/L, RAS flow of 13 mgd (100% of ADF producing an underflow concentration of 8,400 mg/L), SVI of 125 mL/g, and a 1.3 settleability safety factor.
- Class I Reliability flow conditions (assumed peaking factor of 3.0 x ADF) at 75% of peak hour flow with largest unit out of service at a peak hour flow MLSS of 2,900 mg/L, RAS flow of 13 mgd, underflow concentration of 8,900 mg/L, SVI of 125 mL/g, and a 1.0 settleability safety factor. This approach uses a mass balance to calculate the MLSS. During peak hour flows, the MLSS in the Bardenpho process should decrease due to transfer of solids out of the Bardenpho process and into the final clarifiers in the sludge blanket. It should be noted that the curve shown in **Figure 5-1** normalizes the peak hour MLSS to the average day MLSS concentration.

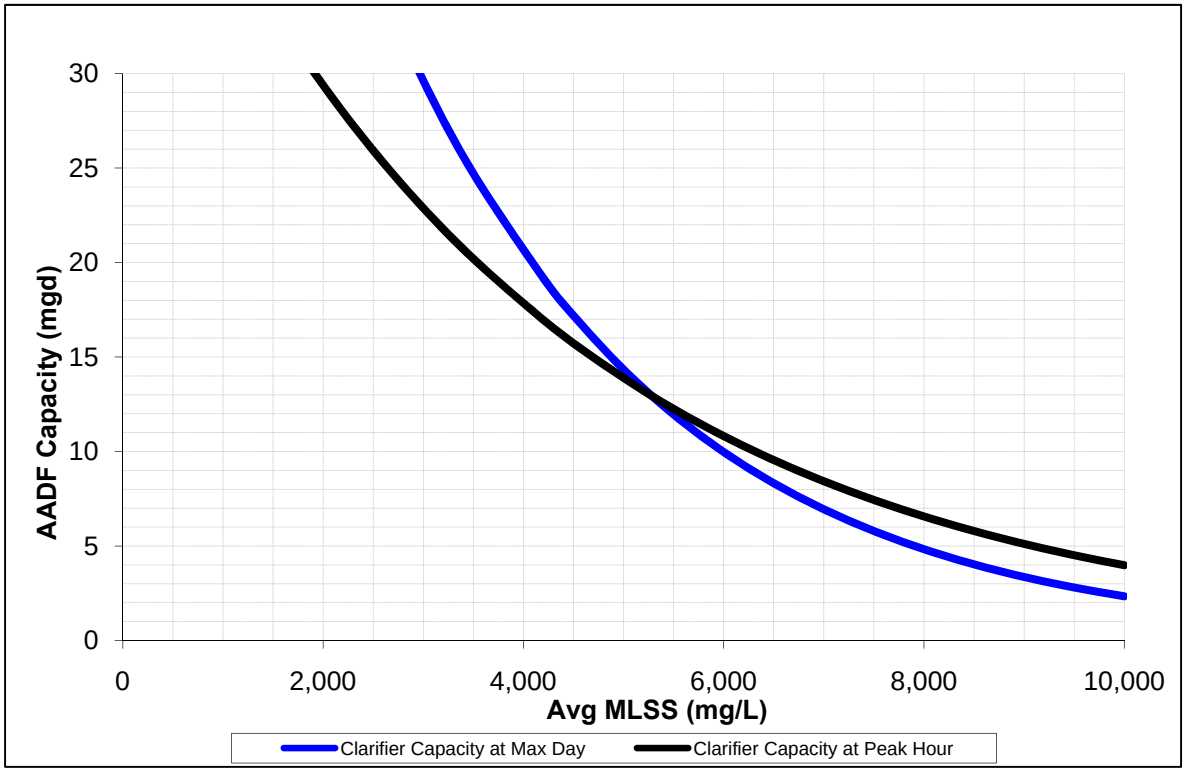
**Figure 5-1** plots the average day flow clarifier capacity versus the average day MLSS concentration and shows the results of the secondary clarifier analysis. As seen in this figure, the peak hour condition is limiting. At the design average day MLSS concentration of 4,200 mg/L, the facility has secondary clarifier capacity of over 15 mgd on an average daily flow basis.

#### 5.2.1.7 Process Modeling Results

The primary effluent loadings, proposed process configuration and tank geometries, and the design assumptions were input into the BioWin™ process modeling simulation program to estimate plant nitrogen removal performance at the design

**Figure 5-1**

**Secondary Clarifier Capacity**




condition. The primary effluent wastewater characterization that was developed in Section 5.1 was used. Secondary clarifiers were simulated using the "model clarifier" process element. The simulation indicated that the facility will meet an effluent total nitrogen concentration of 3 mg/L at the maximum month loading design condition at a flow of 17.5 mgd. Total phosphorus was predicted at 0.44 mg/L with 250 lb/d of alum (as $Al^{3+}$) being added.

## 5.2.2 AEWWTP

The AEWWTP is presently permitted for up to 30 million gallons per day (mgd) on a maximum monthly basis. The facility uses the following primary and secondary processing components:

- Four circular primary clarifiers at 120 foot diameter each by 12 feet deep.
- Aeration Basins 1 and 2 with a total volume of 11.25 MG. Basins 1 and 2 are currently not used and will not be used in this evaluation.
- Aeration Basins 3 through 6 with a total volume of 20.1 MG.
- Four blowers each rated at a maximum air flow of 8,100 to 18,000 scfm each.

- Four 120 ft diameter by 11 foot deep and two 170 foot diameter by 16 foot deep secondary clarifiers. All clarifiers were used in the evaluation.

The AEWWTP was evaluated using the primary influent concentrations and mass load peaking factors developed in Section 2 as a basis for the evaluation. Primary clarifier BOD5 and TSS removal efficiencies were approximated using an empirical formula relating removal efficiency and hydraulic loading rate to the primary clarifier. **Table 5-13** lists a summary of the concentrations and mass load peaking factors.

**Table 5-13**

**AEWWTP Design Criteria for Present Day Nutrient Removal Capacity Evaluation**

| Constituent | Primary Influent Concentration (mg/L) | Mass Load Peaking Factor | | |
|---|---|---|---|---|
| | | ADF | ADMM | MD |
| BOD | 339 | 1.0 | 1.1 | 1.3 |
| TSS | 259 | 1.0 | 1.1 | 1.5 |
| TKN | 47 | 1.0 | 1.2 | 1.3 |
| TP | 10.6 | 1.0 | 1.1 | 1.1 |

**Table 5-14** lists the design parameters used in evaluating the capacity of the AEWWTP reconfigured as a 4- stage Bardenpho process with chemical phosphorous removal. Net yields were calculated using industry-standard empirical relationships.

After evaluation of the facilities at the AEWWTP, it was determined that the existing secondary treatment process could treat up to 33.6 mgd on a maximum month flow basin (32 mgd on an annual average daily flow basis) utilizing the existing primary clarifiers (primary clarifiers being constructed in the current plant expansion), Aeration Basins 3 through 6, and the six secondary clarifiers.

Chemical feed facilities such as alum or ferric would need to be added for chemical phosphorus removal. A supplemental carbon source, such as methanol or acetate, would also need to be added to the second anoxic zone in order to meet permit limits. Upgrades to RAS pumping and new internal recycle pumps would also need to be added. **Table 5-15** lists the volumetric requirements.

**Table 5-14**

**Design Parameters for AEWWTP**

| Parameter | Unit | Value |
|---|---|---|
| Temperature | ºC | 15 |
| Reliability | N/A | US EPA Class I |
| Primary Clarifier BOD Removal | % | 33 at max month<br>31 at max day |
| Primary Clarifier TSS Removal | % | 60 at max month<br>55 at max day |
| Aerobic solids retention time | days | 8 |
| Net yield (includes chemical sludge) | mg TSS/mg BOD | 0.86 |
| Internal recycle ratio | N/A | 500% plant influent flow |
| MLSS | mg/L | 4,800 |
| Return activated sludge (RAS) flow | mgd | 32 (max) |
| Alpha | N/A | 0.60 |

**Table 5-15**

**AEWWTP 4-Stage Bardenpho Bioreactor Sizing Requirements**

| Component | Unit | Value |
|---|---|---|
| First Anoxic Zone, Cell 1 | MG | 0.54 |
| First Anoxic Zone, Cell 2 | MG | 0.51 |
| First Anoxic Zone, Cell 3 | MG | 3.26 |
| Aerobic/Anoxic Swing Zone | MG | 1.09 |
| Aeration Zone | MG | 10.90 |
| Second Anoxic Zone | MG | 3.47 |
| Reaeration Zone | MG | 0.35 |
| **TOTAL** | **MG** | **20.1** |

### 5.2.2.1 Primary Clarification

When the current primary clarifier addition is completed, there will be four new 120 ft diameter primaries providing 11,310 sq ft of settling area each. At a peak overflow rate of 2000 gpd/sq ft, each primary clarifier has a peak flow capacity of 22.6 mgd. With all four clarifiers in service the peak capacity is 90.48 mgd. With one unit out of service, the peak capacity would drop to 67.86 mgd. At the 30 mgd permit capacity that will provide firm capacity for a maximum peaking factor of 2.26.

Higher overflow rates can be applied to primary clarifiers but BOD and solids removal performance tends to decrease at greater overflow rates thereby increasing loadings on the secondary process.

#### 5.2.2.2 First Anoxic

The size requirement of the first anoxic zone is a function of the mass of nitrate to be removed, the soluble substrate concentration, MLSS concentration, DO concentration and the temperature of the mixed liquor. In order to maximize the denitrification capabilities of the first anoxic zones, the basins are staged in three zones in series to maximize selector effects and denitrification rates by simulating plug flow. This proposed process configuration should have the capability to remove 7,200 lb/day of nitrate at 15 degrees Celsius at maximum month conditions.

#### 5.2.2.3 Aeration

Biological nitrification takes place in the aeration tank in conjunction with the oxidation of the carbonaceous $BOD_5$. The biomass in the aeration tank oxidizes most of the carbonaceous $BOD_5$ and ammonia, converting organic carbon to carbon dioxide ($CO_2$) and water, and the nitrogen to nitrate. The ability of the microorganisms to consume the carbonaceous $BOD_5$ and oxidize the ammonia is a function of the bacteria growth rates, solids yield, pH, available oxygen, temperature, and SRT. Nitrification, once the reaction starts, is typically carried through to completion, if adequate oxygen and alkalinity are available and no toxic chemicals are present.

The required system aerobic SRT for nitrification is a function of the nitrifier growth rate which is affected by mixed liquor temperature, pH, and DO concentration. The process evaluation focused on winter temperatures since they result in the lowest nitrification rates. A wastewater temperature of 15°C is used. The actual nitrification capacity of the aeration tank will vary with seasonal changes in wastewater temperature. At a MLSS concentration of 4,800 mg/L (limiting concentration to secondary clarifiers), roughly 10.9 million gallons of operating aeration volume tankage is required.

Sufficient oxygen must be provided to meet the oxygen demand exerted by the oxidation of both BOD and ammonia nitrogen at maximum day loads while maintaining a DO concentration of 2.0 mg/L in the aeration tanks. Based on the plant loadings the existing blowers have sufficient capacity for the design condition. The proposed configuration of the 4-stage Bardenpho process differs significantly from the existing process configuration. The size and orientation of the first and second anoxic zones will overlap the existing diffuser grids requiring that the existing diffuser grids be removed and replaced, or reconfigured and additional diffusers be added in the aerated zones. **Table 5-16** summarizes the important design factors and results of the aeration system capacity evaluation.

#### 5.2.2.4 Second Anoxic

The biological process upstream of the second anoxic zone will remove essentially all of the organic carbon and the bulk of the nitrogen in the wastewater. The 4- stage Bardenpho process is designed to remove the nitrate nitrogen remaining after the

aeration tank using carbon released to the wastewater as a result of endogenous respiration in the second anoxic tank (anoxic zone after the aeration tank).

**Table 5-16**

**AEWWTP 4-Stage Bardenpho Aeration System Components**

| Parameter | Unit | Value |
|---|---|---|
| DO in basin | mg/L | 2.0 |
| Alpha | --- | 0.60 |
| Beta | --- | 0.95 |
| Carbonaceous oxygen demand | lb/d | 82,200 |
| Nitrogenous oxygen demand | lb/d | 40,100 |
| Denitrification credit | lb/d | 26,100 |
| Oxygen required (field) | lb/d | 96,200 |
| Maximum day air requirement | scfm | 12,400 |
| Firm capacity of existing blowers | scfm | 72,000 |
| Blowers required (operating/standby) | --- | 1/4 |

When endogenous carbon is insufficient to accomplish the required denitrification, an external carbon source is required to supplement the native carbon. Supplemental carbon can be provided by a commercial chemical, typically methanol, or by the use of carbon in the primary sludge. When a supplemental carbon source is required, addition of the chemical after the main aeration tank is the most efficient location. The use of methanol provides two benefits: a carbon source for the wastewater and a readily available substrate that will increase the denitrification rate in the reactor.

In order to be conservative, however, the second anoxic zone was sized using the EPA Nitrogen Control Manual equation which relates denitrification rate to solids retention time. This equation does not consider the use of a supplemental carbon source. Process simulation of the facility, however, indicated that 2,000 gallons per day of methanol was required at maximum month loading conditions.

### 5.2.2.5 Reaeration

The main purpose of the reaeration tanks is to remove nitrogen gas from the biological flocs so they will settle easily. Reaeration also reduces the potential for anaerobic conditions in the final clarifiers which could result in phosphorus release in biological phosphorus removal processes. Reaeration can be accomplished with a short detention time tank or channel with high aeration intensity. A design reaeration tank hydraulic detention time of 15 minutes at maximum month flow was chosen. This results in a total reaeration tank volume of 0.35MG.

### 5.2.2.6 Secondary Clarification

For this task, the secondary clarifiers were rated using state-point analysis assuming a sludge volume index (SVI) of 125 mL/g as is typical for activated sludge systems when anoxic selectors have been added. The clarifiers were evaluated using two criteria:

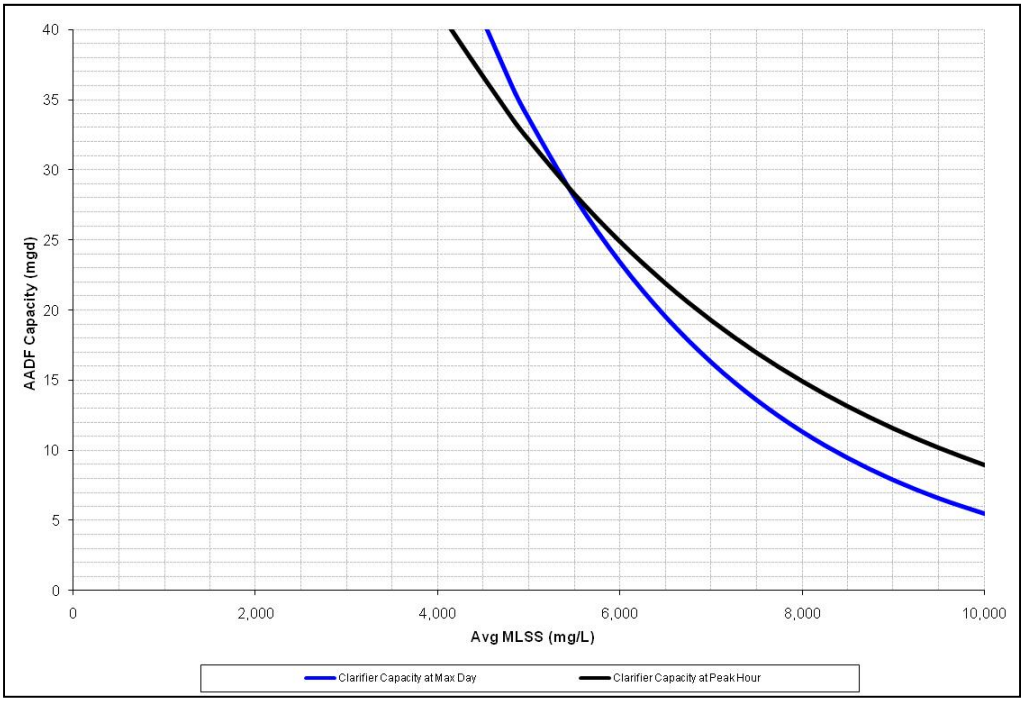
- Maximum day flow conditions (peaking factor of 1.29 x ADF) with all units in service at design MLSS of 4,800 mg/L, RAS flow of 32 mgd, producing an underflow concentration of 9,600 mg/L, SVI of 125 mL/g, and a 1.3 settleability safety factor.

- Class I Reliability flow conditions (assumed peaking factor of 3.0 x ADF) at 75% of peak hour flow with largest unit out of service at a peak hour MLSS of 3,400 mg/L, RAS flow of 32 mgd, underflow concentration of 9,600 mg/L, SVI of 125 mL/g, and a 1.0 settleability safety factor. This approach uses a mass balance to calculate the MLSS. During peak hour flows, the MLSS in the Bardenpho process should decrease due to transfer of solids out of the Bardenpho process and into the final clarifiers in the sludge blanket. It should be noted that the curve developed in **Figure 5-2** normalizes the peak hour MLSS to the average day MLSS concentration.

**Figure 5-2** plots the average day flow clarifier capacity versus the average day MLSS concentration and shows the results. As seen in this figure, the peak hour condition is limiting. At the design average day MLSS concentration of 4,800 mg/L, the facility has secondary clarifier capacity of over 33 mgd on an average daily flow basis.

**Figure 5-2**

**AEWWTP Secondary Clarifier Capacity**




### 5.2.2.7 Process Modeling Results

The primary effluent loadings, proposed process configuration and tank geometries, and the design assumptions were input into the BioWin™ process modeling simulation program to estimate plant nitrogen removal performance at the design condition. The primary effluent wastewater characterization that was developed in Section 5.1 was used. Secondary clarifiers were simulated using the "model clarifier" element.

The simulation indicated that the facility will meet an effluent total nitrogen concentration of 3 mg/L at the maximum month loading design condition at a flow of 33.6 mgd. Due to the higher than normal readily biodegradable COD in the primary effluent, the model is predicting biological phosphorus removal to achieve removal to under 0.5 mg/L. Although the facility data suggests high VFA content, CDM would recommend installing a chemical feed system to trim excess phosphorus in the event that VFA content is not as high as it appears.

# Section 6
# Wastewater Treatment Improvement Alternatives

## 6.1 General

Based on the recommendations from the wastewater process options evaluation in Section 4, the 4 Stage Bardenpho process with chemical phosphorus removal was chosen in order to meet the NDPES Permit Limits established under Permit Scenario 1 (3 mg/L Total Nitrogen and 0.5 mg/L Total Phosphorus). Chemical phosphorus removal was selected to meet the effluent limits established for Permit Scenario 3 (0.2 mg/L Total Phosphorus). Both of these processes will be evaluated for the Archie Elledge WWTP (AEWWTP) and the Muddy Creek WWTP (MCWWTP). Since it was decided to not further evaluate Permit Scenario 2, Permit Scenario 3 will now be called Permit Scenario 2 for the remainder of the report for simplicity. Section 5 explains how the BioWin model was used to simulate the existing WWTP processes and how the proposed nutrient removal processes can be integrated into the existing WWTPs.

In addition, there are several options for dealing with projected wastewater flows within CCUC's service area in order to maximize the use of the existing treatment plant facilities. These flow management options are discussed in Section 6.2 below and were evaluated in combination with the two Permit Scenarios to develop wastewater treatment improvement alternatives at the AEWWTP and MCWWTP.

## 6.2 Wastewater Flow Management Options

In Section 3, the flow projections for the Muddy Creek basin (Basin 1), Elledge basin (Basin 2) and the South Fork basin (Basin 3) were presented through the year 2030. Based on these projections, the maximum month flow in the Muddy Creek basin will exceed the MCWWTP 21 mgd capacity by 2016. For this reason, flows must be transferred from this basin to the AEWWTP so that the existing capacity of the MCWWTP is not exceeded, or the MCWWTP must be expanded to a greater capacity. As a result, two flow management options were developed to be evaluated in combination with the two permit scenarios.

### 6.2.1 Flow Option 1

The first flow option is to maintain the MCWWTP at its current 21 mgd capacity throughout the 20-year planning period by transferring any excess flows to the AEWWTP. The projected 2030 wastewater flows for the three basins within the CCUC service area are shown in **Table 6-1.**

**Table 6-1**
**2030 Projected Wastewater Flows by Basin**

| | Muddy Creek (Basin 1) | Elledge (Basin 2) | South Fork (Basin 3) | Total Flow |
|---|---|---|---|---|
| Max Month (mgd) | 33.2 | 19.8 | 13.6 | 66.7 |
| Max Day (mgd) | 79.4 | 43.4 | 28.9 | 151.6 |
| Max Hour (mgd) | 93.3 | 53.0 | 36.4 | 182.7 |

In order to maintain a max month flow at the MCWWTP of 21 mgd, 12.2 mgd must be transferred from Basin 1 to the AEWWTP, and all flow from Basin 3 must be transferred to the AEWWTP. Currently, the South Fork Pump Station (SFPS) can pump all average day and max month flow from Basin 3 to the AEWWTP, however, it cannot always accommodate peak day and peak hour flows because its firm pumping capacity is limited to 14.4 mgd. In addition, the existing pump station structure is not designed to be easily expanded; therefore, a new pump station would likely have to be constructed in order to increase the capacity. **Table 6-2** shows how the flows would be distributed between the two existing WWTPs under this option.

**Table 6-2**
**Flow Option 1 – WWTP Design Flows**

| | MCWWTP | AEWWTP | Total Flow |
|---|---|---|---|
| Max Month (mgd) | 21.0 | 45.7 | 66.7 |
| Max Day (mgd) | 37.6 | 114.0 | 151.6 |
| Max Hour (mgd) | 59.6 | 123.1 | 182.7 |

For Flow Option 1, one pump station is proposed to pump the combined excess Basin 1 and Basin 3 flows to the AEWWTP. It is recommended that this pump station be located at the MCWWTP in order for the flows from both basins to be combined. Based on the projected 2030 peak hour flows, the proposed size of this pump station is 60 mgd. **Table 6-3** explains how this capacity was determined.

**Table 6-3**
**Flow Option 1 – Proposed Pump Station Capacity**

| Basin 1 Max Hour Flow (mgd) | MCWWTP Max Hour Flow (mgd) | New PS (mgd) |
|---|---|---|
| 93.3 | - 59.6 = | 33.7 |
| Basin 3 MH (mgd) | SFPS MH (mgd) | |
| 36.4 | - 14.4 = | + 22.0 |
| | | **55.7** |

## 6.2.2 Flow Option 2

The second flow option is to maintain the current peak flow hydraulic capacity of 100 mgd at the AEWWTP and convey the remaining flows to the MCWWTP for

treatment. Under this option, the MCWWTP would need to be expanded to 30 mgd, and the AEWWTP would need a capacity of 36.7 mgd. **Table 6-4** shows how the flows would be distributed between the two existing WWTPs.

**Table 6-4**
**Flow Option 2 – WWTP Design Flows**

| | MCWWTP | AEWWTP | Total Flow |
|---|---|---|---|
| Max Month (mgd) | 30.0 | 36.7 | 66.7 |
| Max Day (mgd) | 70.6 | 81.0 | 151.6 |
| Max Hour (mgd) | 82.7 | 100 | 182.7 |

For this flow option, one pump station is proposed to pump the combined excess Basin 1 and Basin 3 flows to the AEWWTP. It is recommended that this pump station be located at the MCWWTP in order for the flows from both basins to be combined. As a result, a new 33 mgd Transfer Pump Station is proposed (in addition to the existing 14.4 mgd South Fork pump station). **Table 6-5** explains how this capacity was determined.

**Table 6-5**
**Flow Option 2 – Proposed Pump Station Capacity**

| Basin 1 Peak Hour (mgd) | | MCWWTP Peak Hour (mgd) | | Additional MCWWTP Capacity (mgd) | Basin 3 Peak Hour (mgd) | SFPS Peak Hour (mgd) | | New PS Capacity (mgd) |
|---|---|---|---|---|---|---|---|---|
| 93.3 | - | 82.7 | = | 10.7 | + 36.4 | - 14.4 | = | **32.6** |

## 6.3 Wastewater Treatment Improvement Alternatives

Four wastewater treatment improvement alternatives were developed for each WWTP based on the two permit scenarios and two flow options discussed above. The treatment improvement alternatives are summarized in **Table 6-6.**

**Table 6-6**
**Summary of WWTP Improvement Alternatives**

| Alternative | Archie Elledge WWTP | Muddy Creek WWTP |
|---|---|---|
| 1 | Permit Scenario 1<br>Flow Option 1 (45.7 mgd) | Permit Scenario 1<br>Flow Option 1 (21 mgd) |
| 2 | Permit Scenario 1<br>Flow Option 2 (36.7 mgd) | Permit Scenario 1<br>Flow Option 2 (30 mgd) |
| 3 | Permit Scenario 2<br>Flow Option 1 (45.7 mgd) | Permit Scenario 2<br>Flow Option 1 (21 mgd) |
| 4 | Permit Scenario 2<br>Flow Option 2 (36.7 mgd) | Permit Scenario 2<br>Flow Option 2 (30 mgd) |

### 6.3.1 Wastewater Treatment Improvement Alternative 1

Alternative 1 for the AEWWTP and MCWWTP incorporates Permit Scenario 1 and Flow Option 1. This alternative provides nutrient removal to meet an effluent permit limit of 3 mg/L Total Nitrogen (TN) and 0.5 mg/L Total Phosphorus (TP) at both

plants. The 4-Stage Bardenpho process with methanol addition is recommended to achieve the TN limit of 3 mg/L whereas chemical phosphorus removal using a metal salt (alum was used for estimating O&M costs) is recommended to achieve a TP of 0.5 mg/L. A summary of the projected influent loading characteristics, reactor sizing, air requirements, chemical phosphorus requirements, effluent summary, and solids handling capacity for both WWTPs is included in **Appendix C**.

#### 6.3.1.1 Archie Elledge WWTP

As described above, the existing 21 mgd capacity of the MCWWTP is maintained under Flow Option 1; therefore, the AEWWTP would have to be expanded to meet a max month flow of 45.7 mgd (114 mgd max day, 123.1 mgd peak hour). Based on the results of the BioWin model simulations and desktop calculations, the following plant improvements are recommended for this alternative:

- Existing Headworks Expansion (including one new mechanical bar screen, screw conveyor, vortex grit removal basin, grit classifier, two grit pumps and primary building expansion)
- Existing Influent Pump Station Upgrade (including replacing two and retrofitting four influent pumps)
- Two New Equalization (EQ) Basins
- New Primary Clarifier No. 5
- New Primary Sludge Pump Station No. 2 (including two new primary sludge pumps and one new macerator)
- Existing Aeration Basins No. 1 and 2 Modification (including diffusers, mixers, mixed liquor recycle pumps and piping)
- Existing Aeration Basins No. 3 through 6 Modification (including diffusers, mixers, mixed liquor recycle pumps and piping)
- New Methanol and Alum Storage and Feed Facilities
- New Secondary Clarifier No. 7
- Existing RAS Pump Station No. 1 Upgrade (including replacing one RAS pump)
- Existing RAS Pump Station No. 2 Upgrade (including replacing four RAS pumps)
- New RAS Pump Station No. 3 (including two new RAS pumps)
- Existing Flood Control Pump Station Upgrade (including replacing four effluent pumps)
- New Tertiary Filtration

- Existing WAS Thickening Building Upgrade (including one new gravity belt thickener and one new TWAS Pump)
- Existing Dewatering Building Upgrade (including replacing two centrifuges)
- New Dryer Building No. 2 (including one new dryer)

A process flow diagram of the proposed improvements incorporated with the existing WWTP facilities is shown in **Figure 6-1**. In addition, a proposed layout of the improvements is shown on an aerial site plan of the site in **Figure 6-2.**

The opinion of probable construction and engineering cost of each plant improvement was determined and is shown in **Table 6-7**. The total capital cost for Alternative 1 for the AEWWTP is $105.2 million. A detailed cost breakdown of the components of each plant improvement is included in **Appendix D**. In addition, the estimated operation and maintenance costs associated with the annual chemical and power usages for the operation of the WWTP including the new facilities are detailed in **Table 6-8.**

**Table 6-7**
**Summary of Alternative 1 AEWWTP Capital Costs**

| Process | Capital Cost |
|---|---|
| Headworks | $1,941,000 |
| Grit Removal | $1,502,400 |
| Influent Pumping | $2,295,000 |
| Flow Equalization | $1,500,000 |
| Primary Clarification | $1,051,600 |
| Biological Nutrient Removal | $4,342,800 |
| Secondary Clarification | $2,654,500 |
| Filtration | $10,388,250 |
| Chemical Feed Systems | $1,482,000 |
| Solids Processing | $16,699,500 |
| **Subtotal** | **$43,857,000** |
| Electrical/Instrumentation (23%) | $10,087,000 |
| Piping and Appurtenances (12%) | $5,263,000 |
| **Subtotal** | **$59,207,000** |
| Insurance and Bonds (2.5%) | $1,480,000 |
| Permits (0.50%) | $306,000 |
| General Conditions (6.0%) | $3,660,000 |
| Indirect OH&P (8.0%) | $5,172,000 |
| **Subtotal** | **$69,825,000** |
| Contingency (25%) | $17,456,000 |
| Allowance for Cost Escalation (6%) | $4,190,000 |
| **CONSTRUCTION TOTAL** | **$91,500,000** |
| Design and Construction Services Fee (15%) | $13,725,000 |
| **GRAND TOTAL** | **$105,225,000** |

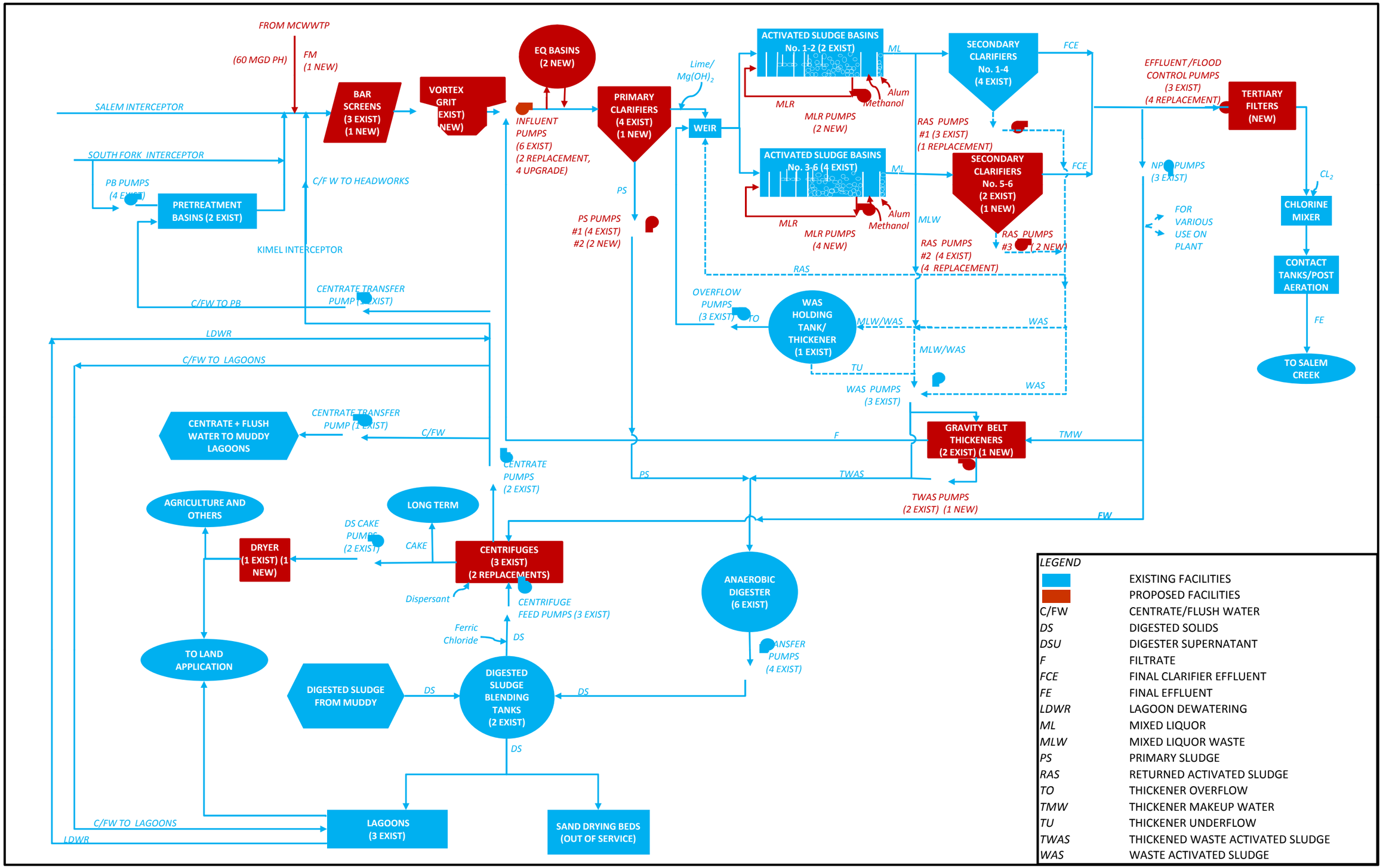



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**Figure 6-1**
**AEWWTP IMPROVEMENT ALTERNATIVE 1 PROCESS SCHEMATIC**
**- Flow Option 1, Permitting Scenario 1 (45.7 MGD)**

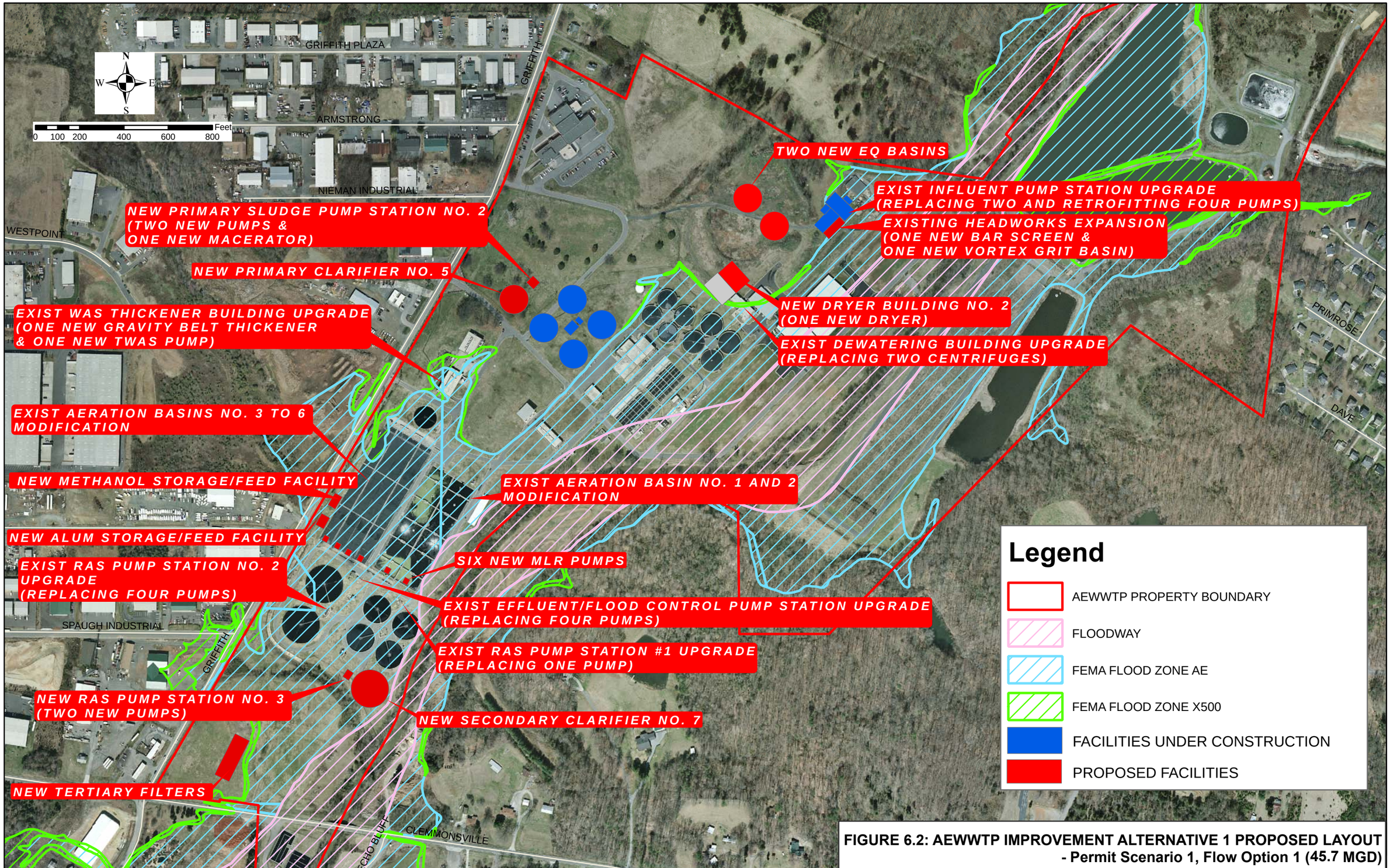


**FIGURE 6.2: AEWWTP IMPROVEMENT ALTERNATIVE 1 PROPOSED LAYOUT - Permit Scenario 1, Flow Option 1 (45.7 MGD)**

**Table 6-8**
**Summary of Alternative 1 AEWWTP O&M Costs**

| POWER COSTS | |
|---|---|
| Influent Pumping | $300,777 |
| Headworks | $28,928 |
| Primary Clarification | $4,030 |
| Secondary Treatment | $974,952 |
| Filters/Disinfection | $30,646 |
| RAS/WAS/IR Pumping | $285,822 |
| Thickening | $7,441 |
| Digestion | $129,996 |
| Centrifuges | $256,642 |
| Dryer | $322,594 |
| **SUBTOTAL** | **$2,341,829** |
| | |
| **CHEMICAL COSTS** | |
| Aluminum Sulfate | $3,545,043 |
| Ferric Chloride | $9,024 |
| Polymer | $577,840 |
| Methanol | $403,249 |
| Sodium Hypochlorite | $444,274 |
| Sodium Bisulfite | $93,944 |
| Lime/Magnesium Slurry | $343,696 |
| **SUBTOTAL** | **$5,417,070** |
| ***ALTERNATIVE 1 TOTAL*** | ***$7,759,000*** |

### 6.3.1.2 Muddy Creek WWTP

The existing 21 mgd capacity of the MCWWTP is maintained under Flow Option 1, but in order to shave peak hour flows that are treated by the plant, 8 million gallons of equalization storage is recommended. The peak flow and load surges that currently challenge treatment performance and hydraulic capacity will be buffered to provide steadier flow and loading into the treatment process. Equalization facilities will reduce the need for additional treatment facilities, add operational flexibility, and improve effluent quality. With this amount of storage, the peak hour flow through the plant is reduced from 59.6 mgd to the 37.6 mgd, which is the max day flow. Therefore, all treatment facilities downstream of the EQ pump station were sized for a peak hour flow of 37.6 mgd.

As described in Section 6.2.1 above, a 60 mgd pump station is needed to pump excess flows to the AEWWTP. Based on the results of the BioWin model simulations and desktop calculations, the plant improvements needed under this alternative include the following:

- New 60 mgd Muddy Creek Transfer Pump Station
- New 30-inch diameter, 23,000 linear foot (LF) force main (initially) and 48-inch diameter, 23,000 linear foot (LF) force main (future) between MCWWTP and AEWWTP (including easement)
- Conversion of Existing Sludge Lagoons to 8 MG EQ Basins
- New 22-mgd EQ Pump Station
- New 36-inch diameter, 1,000 linear foot (LF) gravity sewer from New EQ Basin to Existing Primaries
- New 36-inch diameter, 1,000 linear foot (LF) force main from New EQ Pump Station to EQ Basins
- Existing Grit Removal Facility Expansion (including two new grit removal basins, grit pumps and grit classifiers)
- Existing Aeration Basins No. 1 - 3 Modifications (including diffusers, mixers, mixed liquor recycle pumps and piping)
- Addition of IFAS media to Aeration Basins No. 1 – 3
- New Methanol and Alum Storage and Feed Facilities
- New Secondary Clarifier No. 5
- Existing RAS pumps Upgrade (including two new RAS pumps)
- New Tertiary Filtration

A process flow diagram of the proposed improvements incorporated with the existing WWTP facilities is shown in **Figure 6-3**. In addition, a proposed layout of the improvements is shown on an aerial site plan of the site in **Figure 6-4.**

The opinion of probable construction and engineering cost for each plant improvement was determined and is shown in **Table 6-9**. The total capital cost for Alternative 1 for the MCWWTP is $98 million. A detailed cost breakdown of the components of each plant improvement is included in Appendix D. In addition, the estimated operation and maintenance costs associated with the annual chemical and power usages are detailed in **Table 6-10.**

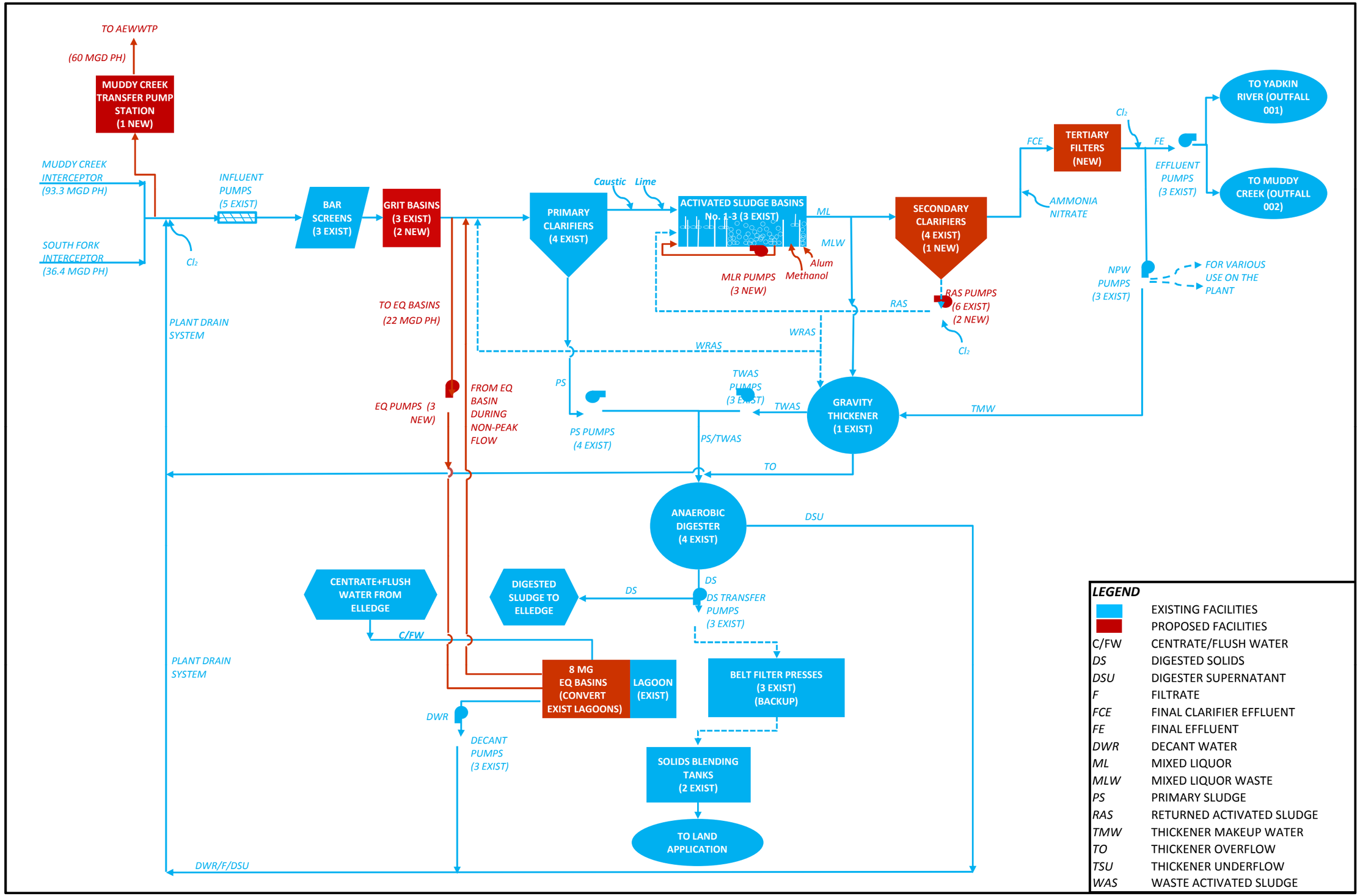


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**Figure 6-3**
**MCWWTP IMPROVEMENT ALTERNATIVE 1 PROCESS SCHEMATIC**

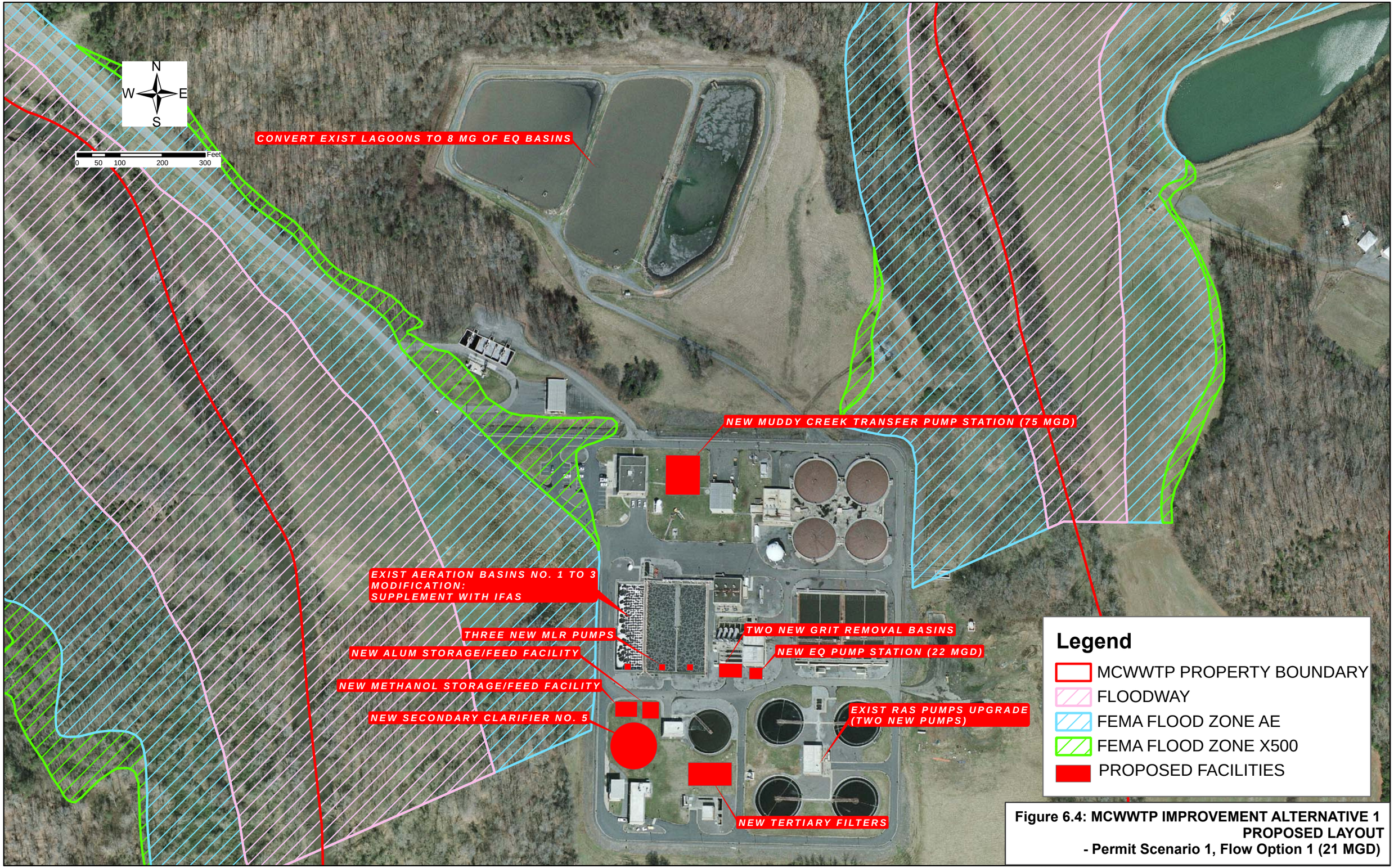


**Figure 6.4: MCWWTP IMPROVEMENT ALTERNATIVE 1 PROPOSED LAYOUT**
**- Permit Scenario 1, Flow Option 1 (21 MGD)**

**Table 6-9**
**Summary of Alternative 1 MCWWTP Capital Costs**

| Process | Capital Cost |
|---|---|
| Headworks | $0 |
| Grit Removal | $1,902,400 |
| Influent Pumping | $0 |
| Primary Clarification | $0 |
| Flow Equalization | $1,500,000 |
| Biological Nutrient Removal | $3,284,650 |
| Secondary Clarification | $1,160,700 |
| Filtration | $3,462,750 |
| Chemical Feed Systems | $782,000 |
| Solids Processing | $0 |
| **Subtotal** | **$12,093,000** |
| Electrical/Instrumentation (23%) | $2,781,000 |
| Piping and Appurtenances (12%) | $1,451,000 |
| **Subtotal** | **$16,325,000** |
| Muddy Creek Transfer PS/FM | $33,190,000 |
| EQ PS/Gravity Sewer/FM | $5,630,000 |
| **Subtotal** | **$55,145,000** |
| Insurance and Bonds (2.5%) | $1,379,000 |
| Permits (0.50%) | $285,000 |
| General Conditions (6.0%) | $3,409,000 |
| Indirect OH&P (8.0%) | $4,817,000 |
| **Subtotal** | **$65,035,000** |
| Contingency (25%) | $16,259,000 |
| Allowance for Cost Escalation (6%) | $3,902,000 |
| **CONSTRUCTION TOTAL** | **$85,200,000** |
| Design and Construction Services Fee (15%) | $12,780,000 |
| **GRAND TOTAL** | **$97,980,000** |

**Table 6-10**
**Summary of Alternative 1 MCWWTP O&M Costs**

| POWER COSTS | |
|---|---|
| Influent Pumping | $72,737 |
| EQ/Elledge Pumping | $73,661 |
| Headworks | $5,117 |
| Primary Clarification | $4,359 |
| Secondary Treatment | $376,360 |
| Filters/Disinfection | $16,130 |
| RAS/WAS/IR Pumping | $130,402 |
| Thickening | $0 |
| Digestion | $23,282 |
| **SUBTOTAL** | **$702,047** |
| | |
| **CHEMICAL COSTS** | |
| Aluminum Sulfate | $803,965 |
| Ferric Chloride | $0 |
| Polymer | $0 |
| Methanol | $216,026 |
| Sodium Hypochlorite | $202,940 |
| Sodium Bisulfite | $42,913 |
| Lime | $0 |
| **SUBTOTAL** | **$1,265,844** |
| ***ALTERNATIVE 1 TOTAL*** | ***$1,968,000*** |

## 6.3.2 Wastewater Treatment Improvement Alternative 2

Alternative 2 for the AEWWTP and MCWWTP incorporates Permit Scenario 1 and Flow Option 2. This alternative provides nutrient removal to meet an effluent permit limit of 3 mg/L TN and 0.5 mg/L TP. As mentioned above, the 4-Stage Bardenpho process with methanol addition is recommended to achieve the TN limit of 3 mg/L whereas chemical phosphorus removal using alum is recommended to achieve a TP of 0.5 mg/L. A summary of the projected influent loading characteristics, reactor sizing, air requirements, chemical phosphorus requirements, effluent summary, and solids handling capacity for both plants is included in **Appendix C**.

### 6.3.2.1 Archie Elledge WWTP

As described in Section 6.2.2, a peak flow of 100 mgd to the AEWWTP is maintained and the remainder of the flow is conveyed to the MCWWTP. This peak flow translates to a 36.7 mgd max month flow to the AEWWTP. Based on the results of the BioWin model simulations and desktop calculations, the plant improvements needed under this alternative include the following:

- Two New EQ Basins
- Existing Aeration Basins No. 1 and 2 Modification (including diffusers, mixers, mixed liquor recycle pumps and piping)
- Existing Aeration Basins No. 3 through 6 Modification (including diffusers, mixers, mixed liquor recycle pumps and piping)
- Existing RAS Pump Station No. 2 Upgrade (including replacing four RAS pumps)
- Existing Effluent/ Flood Control Pump Station Upgrade (including replacing five effluent pumps)
- New Tertiary Filtration
- New Methanol and Alum Storage and Feed Facilities
- Existing WAS Thickening Building Upgrade (including one new gravity belt thickener and one new TWAS pump)
- Existing Dewatering Building Upgrade (including replacing two centrifuges)
- New Dryer Building No. 2 (including one new dryer)

A process flow diagram of the proposed improvements incorporated with the existing WWTP facilities is shown in **Figure 6-5**. In addition, a proposed layout of the improvements is shown on an aerial site plan of the site in **Figure 6-6.**

The opinion of probable construction and engineering cost for each plant improvement was determined and is shown in **Table 6-11**. The total capital cost for Alternative 2 for the AEWWTP is $78.9 million. A detailed cost breakdown of the components of each plant improvement is included in Appendix D. In addition, the estimated operation and maintenance costs associated with the annual chemical and power usages are detailed in **Table 6-12.**

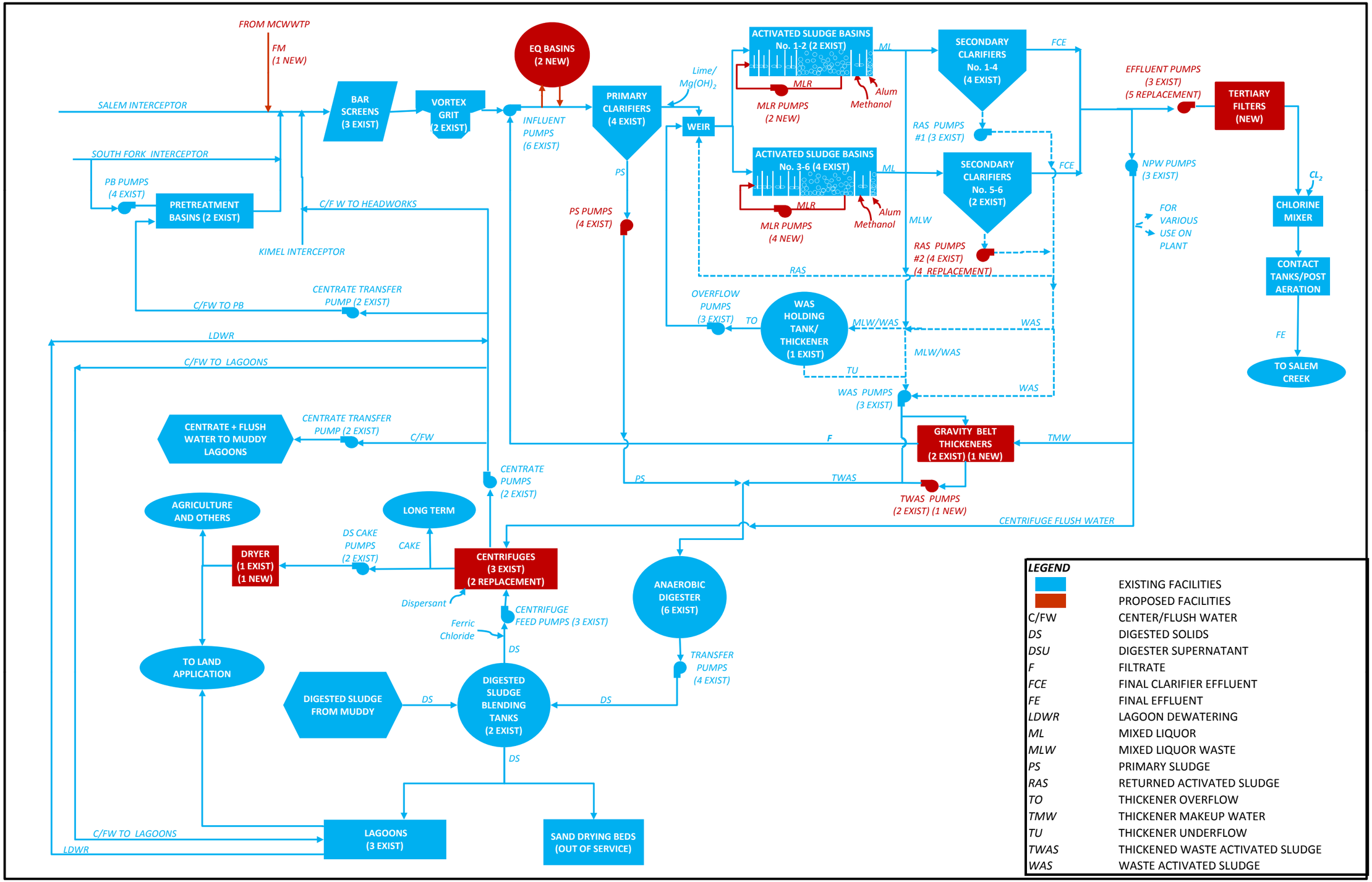


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**Figure 6-5**
**AEWWTP IMPROVEMENT ALTERNATIVE 2 PROCESS SCHEMATIC**

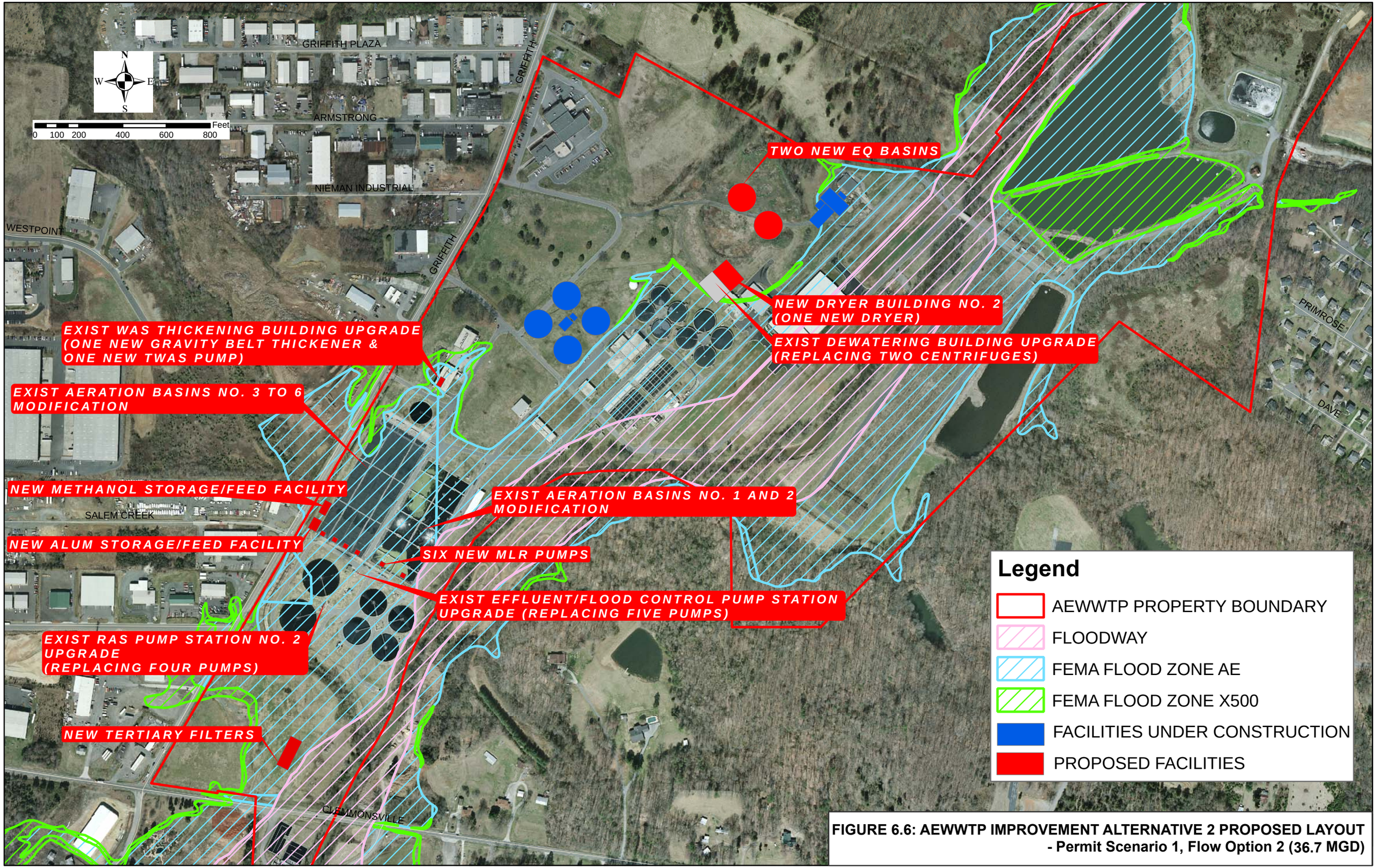


**FIGURE 6.6: AEWWTP IMPROVEMENT ALTERNATIVE 2 PROPOSED LAYOUT - Permit Scenario 1, Flow Option 2 (36.7 MGD)**

**Table 6-11**
**Summary of Alternative 2 AEWWTP Capital Costs**

| Process | Capital Cost |
|---|---|
| Headworks | $0 |
| Grit Removal | $0 |
| Influent Pumping | $0 |
| Flow Equalization | $1,500,000 |
| Primary Clarification | $0 |
| Biological Nutrient Removal | $4,260,675 |
| Secondary Clarification | $945,000 |
| Filtration | $8,079,750 |
| Chemical Feed Systems | $11,514,000 |
| Solids Processing | $16,699,500 |
| **Subtotal** | **$32,872,000** |
| Electrical/Instrumentation (23%) | $7,561,000 |
| Piping and Appurtenances (12%) | $3,945,000 |
| **Subtotal** | **$44,378,000** |
| Insurance and Bonds (2.5%) | $1,109,000 |
| Permits (0.50%) | $230,000 |
| General Conditions (6.0%) | $2,743,000 |
| Indirect OH&P (8.0%) | $3,877,000 |
| **Subtotal** | **$52,337,000** |
| Contingency (25%) | $13,084,000 |
| Allowance for Cost Escalation (6%) | $3,140,000 |
| **CONSTRUCTION TOTAL** | **$68,600,000** |
| Design and Construction Services Fee (15%) | $10,290,000 |
| **GRAND TOTAL** | **$78,890,000** |

**Table 6-12**
**Summary of Alternative 2 AEWWTP O&M Costs**

| POWER COSTS | |
|---|---|
| Influent Pumping | $233,195 |
| Headworks | $19,285 |
| Primary Clarification | $3,257 |
| Secondary Treatment | $974,952 |
| Filters/Disinfection | $24,195 |
| RAS/WAS/IR Pumping | $221,460 |
| Thickening | $5,140 |
| Digestion | $128,191 |
| Centrifuges | $256,642 |
| Dryer | $322,594 |
| New South Fork PS | $27,691 |
| **SUBTOTAL** | **$2,216,602** |
| | |
| **CHEMICAL COSTS** | |
| Aluminum Sulfate | $2,722,087 |
| Ferric Chloride | $9,130 |
| Polymer | $521,708 |
| Methanol | $345,642 |
| Sodium Hypochlorite | $344,449 |
| Sodium Bisulfite | $72,836 |
| Lime/Magnesium Slurry | $324,964 |
| **SUBTOTAL** | **$4,340,815** |
| ***ALTERNATIVE 2 TOTAL*** | ***$6,557,500*** |

### 6.3.2.2 Muddy Creek WWTP

The max month flow is 30 mgd under Flow Option 2; therefore, a significant plant expansion is required. The projected peak hour flow to the plant is 82.7 mgd, while the max day flow is 70.6 mgd. In order to reduce peak hour flows to minimize the treatment process expansions, 12 million gallons of equalization storage is recommended. With this amount of storage, the peak hour flow that has to be treated by the plant is reduced from 82.7 mgd to the 56.4 mgd. Therefore, all treatment facilities were sized for a peak hour flow of 56.4 mgd.

Since the amount of space for new construction is limited at the MCWWTP, the proposed location of the new facilities is adjacent to the existing sludge lagoons. Since this area is at a higher elevation than the existing plant, a new pump station is needed to pump wastewater to the new facilities. Pumping capacity of 30 mgd is required to send flow to the equalization basin. The remaining peak flow, 56.4 mgd, will be treated by the existing plant and the new facilities. Half of this flow (28.2 mgd) will be conveyed to the existing plant and the other half (28.2 mgd) will be pumped to the new facilities; therefore, a 60 mgd pump station is recommended. In addition, a 33 mgd pump station to convey additional Muddy Creek and South Fork basin flows to the AEWWTP is recommended at the MCWWTP to provide flow management flexibility.

Based on the results of the BioWin model simulations and desktop calculations, the plant improvements needed under this alternative include the following:

- New 60 mgd Influent/EQ Pump Station (30 mgd to EQ basins and 28 mgd to new facilities)
- New 48-inch Diameter, 800 linear foot (LF) Force Main (from new Influent/EQ Pump Station to new Headworks)
- New 33 mgd Muddy Creek Transfer Pump Station (to transfer excess flows to AEWWTP)
- New 48-inch Diameter, 23,000 linear foot (LF) Force Main (between MCWWTP and AEWWTP)
- Conversion of Existing Sludge Lagoons to 12 MG EQ Basins
- Three New Mechanical Bar Screens
- Two New Grit Removal Basins (including two new grit classifiers and grit pumps)
- Four New Primary Clarifiers
- New Primary Sludge Pump Station (including four new primary sludge pumps)
- Three New Aeration Basins (including diffusers, mixers, mixed liquor recycle pumps and piping)
- Existing Aeration Basins No. 1 - 3 Modifications (including diffusers, mixers, mixed liquor recycle pumps and piping)
- Four New Secondary Clarifiers
- Existing RAS Pump Station Upgrade (including replacing one RAS pump)
- New RAS Pump Station (including five new RAS pumps and three new WAS pumps)
- New Tertiary Filtration
- New Methanol and Alum Storage and Feed Facilities
- One New Thickened Sludge Pump
- New Gravity Belt Thickener Building (including one gravity belt thickener and TWAS pumps)

A process flow diagram of the proposed improvements incorporated with the existing WWTP facilities is shown in **Figure 6-7**. In addition, a proposed layout of the improvements is shown on an aerial site plan of the site in **Figure 6-8.**

The opinion of probable construction and engineering cost for each plant improvement was determined and is shown in **Table 6-13**. The total capital cost for Alternative 2 for the MCWWTP is $135.4 million. A detailed cost breakdown of the

components of each plant improvement is included in Appendix D. In addition, the estimated operation and maintenance costs associated with the annual chemical and power usages are detailed in **Table 6-14.**

**Table 6-13**
**Summary of Alternative 2 MCWWTP Capital Costs**

| Process | Capital Cost |
|---|---|
| Headworks | $1,417,500 |
| Grit Removal | $1,902,400 |
| Influent Pumping | $0 |
| Primary Clarification | $3,870,500 |
| Biological Nutrient Removal | $7,171,650 |
| Secondary Clarification | $4,704,550 |
| Filtration | $5,001,750 |
| Flow Equalization | $2,250,000 |
| Chemical Feed Systems | $892,000 |
| Solids Processing | $636,500 |
| **Subtotal** | **$27,847,000** |
| Electrical/Instrumentation (23%) | $6,405,000 |
| Piping and Appurtenances (12%) | $3,342,000 |
| Site Work (5%) | $1,392,000 |
| **Subtotal** | **$38,986,000** |
| Influent/EQ PS /FM | $14,665,000 |
| Muddy Creek Transfer PS | $22,538,000 |
| **Subtotal** | **$76,189,000** |
| Insurance and Bonds (2.5%) | $1,905,000 |
| Permits (0.50%) | $394,000 |
| General Conditions (6.0%) | $4,709,000 |
| Indirect OH&P (8.0%) | $6,656,000 |
| **Subtotal** | **$89,853,000** |
| Contingency (25%) | $22,463,000 |
| Allowance for Cost Escalation (6%) | $5,391,000 |
| **CONSTRUCTION TOTAL** | **$117,700,000** |
| Design and Construction Services Fee (15%) | $17,655,000 |
| **GRAND TOTAL** | **$135,355,000** |

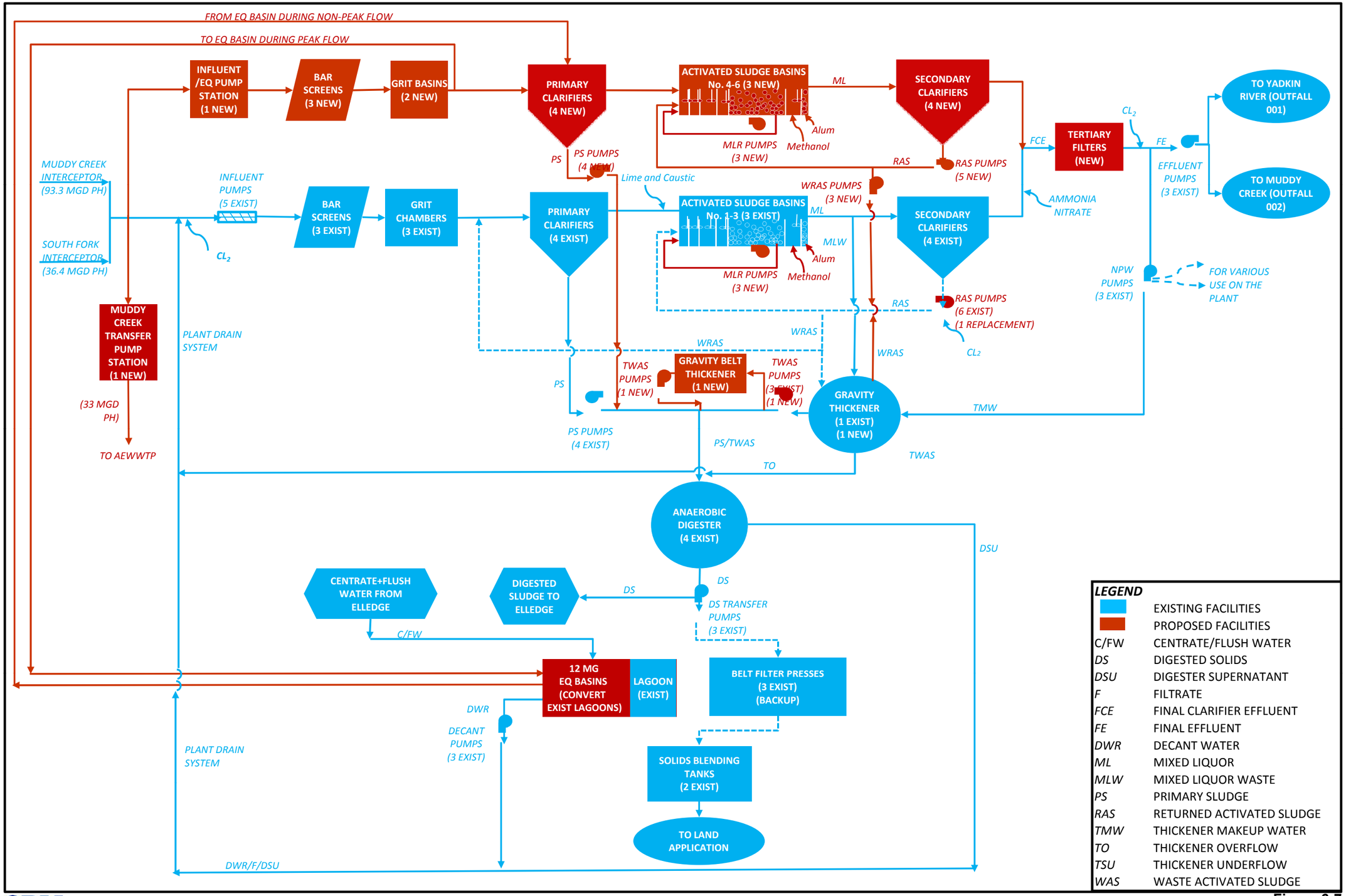


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**Figure 6-7**
**MCWWTP IMPROVEMENT ALTERNATIVE 2 PROCESS SCHEMATIC**
**- Permit Scenario 1, Flow Option 2, (30 MGD)**

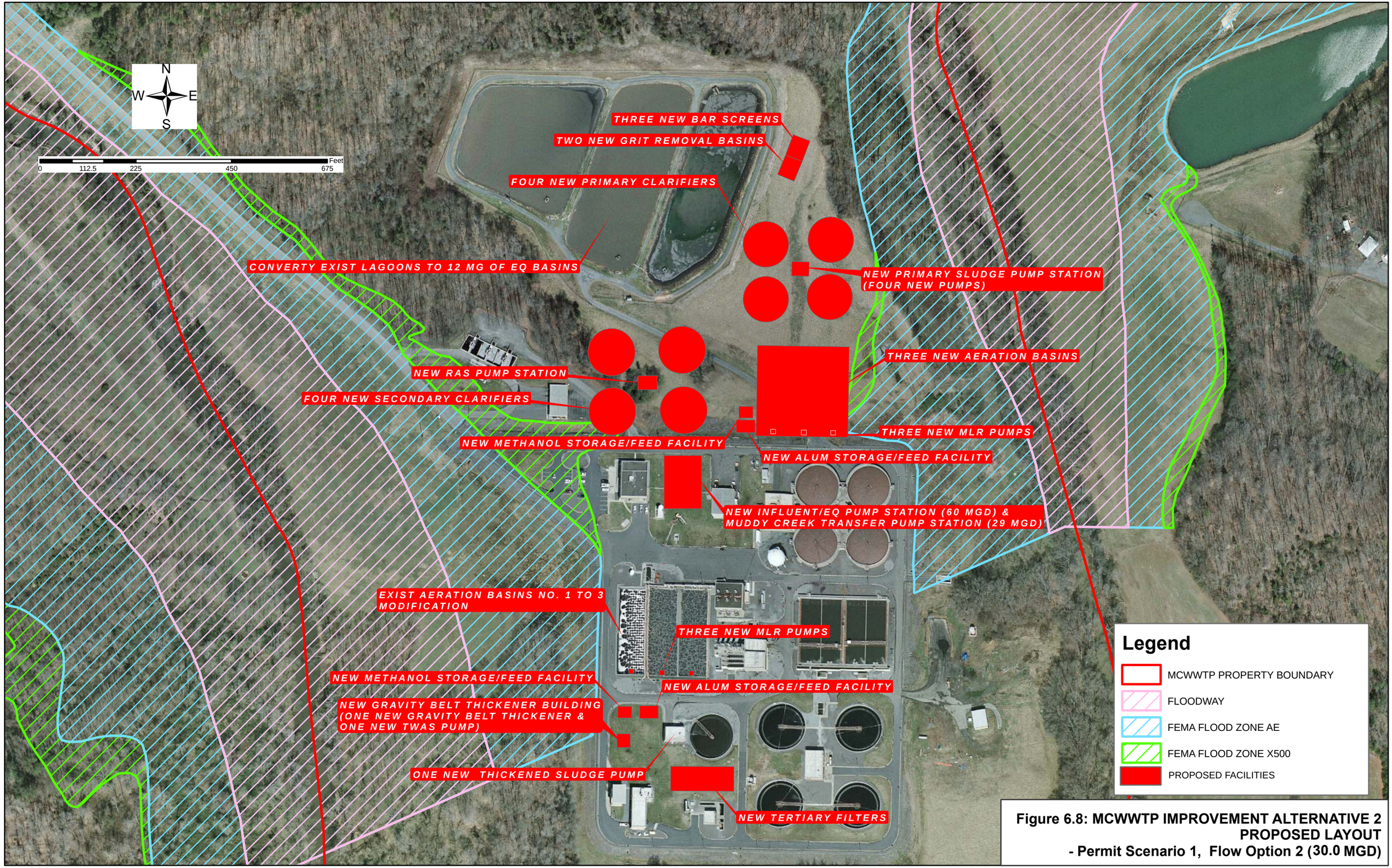


**Figure 6.8: MCWWTP IMPROVEMENT ALTERNATIVE 2 PROPOSED LAYOUT**
**- Permit Scenario 1, Flow Option 2 (30.0 MGD)**

**Table 6-14**
**Summary of Alternative 2 MCWWTP O&M Costs**

| POWER COSTS | |
|---|---|
| Influent Pumping | $110,875 |
| Headworks | $5,834 |
| Primary Clarification | $7,954 |
| Secondary Treatment | $719,027 |
| Filters/Disinfection | $22,582 |
| RAS/WAS/IR Pumping | $197,845 |
| Thickening | $3,068 |
| Digestion | $24,735 |
| **SUBTOTAL** | **$1,091,919** |
| | |
| **CHEMICAL COSTS** | |
| Aluminum Sulfate | $1,373,704 |
| Ferric Chloride | $0 |
| Polymer | $0 |
| Methanol | $216,026 |
| Sodium Hypochlorite | $309,346 |
| Sodium Bisulfite | $65,413 |
| Lime | $0 |
| **SUBTOTAL** | **$1,964,489** |
| ***ALTERNATIVE 2 TOTAL*** | ***$3,056,400*** |

## 6.3.3 Wastewater Treatment Improvement Alternative 3

Alternative 3 for the AEWWTP and MCWWTP incorporates Permit Scenario 2 and Flow Option 1. This alternative provides nutrient removal to meet an effluent permit limit of 0.2 mg/L TP at both plants. Chemical phosphorus removal using alum was used in the analysis to meet this permit limit. A summary of the projected influent loading characteristics, reactor sizing, air requirements, chemical phosphorus requirements, effluent summary, and solids handling capacity for both WWTPs is included in **Appendix C**.

### 6.3.3.1 Archie Elledge WWTP

As described above, the AEWWTP would have to be expanded to meet a max month flow of 45.7 mgd (114 mgd max day, 123.1 mgd peak hour). Based on the results of the BioWin model simulations and desktop calculations, the following plant improvements are recommended for this alternative:

- Existing Headworks Expansion (including one new mechanical bar screen, screw conveyor, vortex grit removal basin, grit classifier, two grit pumps and primary building expansion)
- Existing Influent Pump Station Upgrade (including replacing two and retrofitting four influent pumps)
- New Primary Clarifier No. 5

- Two New EQ Basins
- New Primary Sludge Pump Station No. 2 (including two new primary sludge pumps and one new macerator)
- Existing Aeration Basins No. 1 and 2 Modification (including diffusers)
- Existing RAS Pump Station No. 1 Upgrade (including replacing one RAS pump)
- Existing RAS Pump Station No. 2 Upgrade (including replacing four RAS pumps)
- New RAS Pump Station No. 3 (including two new RAS pumps)
- Existing Effluent/ Flood Control Pump Station Upgrade (including replacing four effluent pumps)
- New Tertiary Filtration
- New Alum Storage and Feed Facility
- Existing WAS Thickening Building Upgrade (including one new gravity belt thickener and one new TWAS pump)
- Existing Dewatering Building Upgrade (including replacing two centrifuges)
- New Dryer Building No. 2 (including one new dryer)

A process flow diagram of the proposed improvements incorporated with the existing WWTP facilities is shown in **Figure 6-9**. In addition, a proposed layout of the improvements is shown on an aerial site plan of the site in **Figure 6-10.**

The opinion of probable construction and engineering cost for each plant improvement was determined and is shown in **Table 6-15**. The total capital cost for Alternative 3 for the AEWWTP is $90.7 million. A detailed cost breakdown of the components of each plant improvement is included in Appendix D. In addition, the estimated operation and maintenance costs associated with the annual chemical and power usages are detailed in **Table 6-16.**

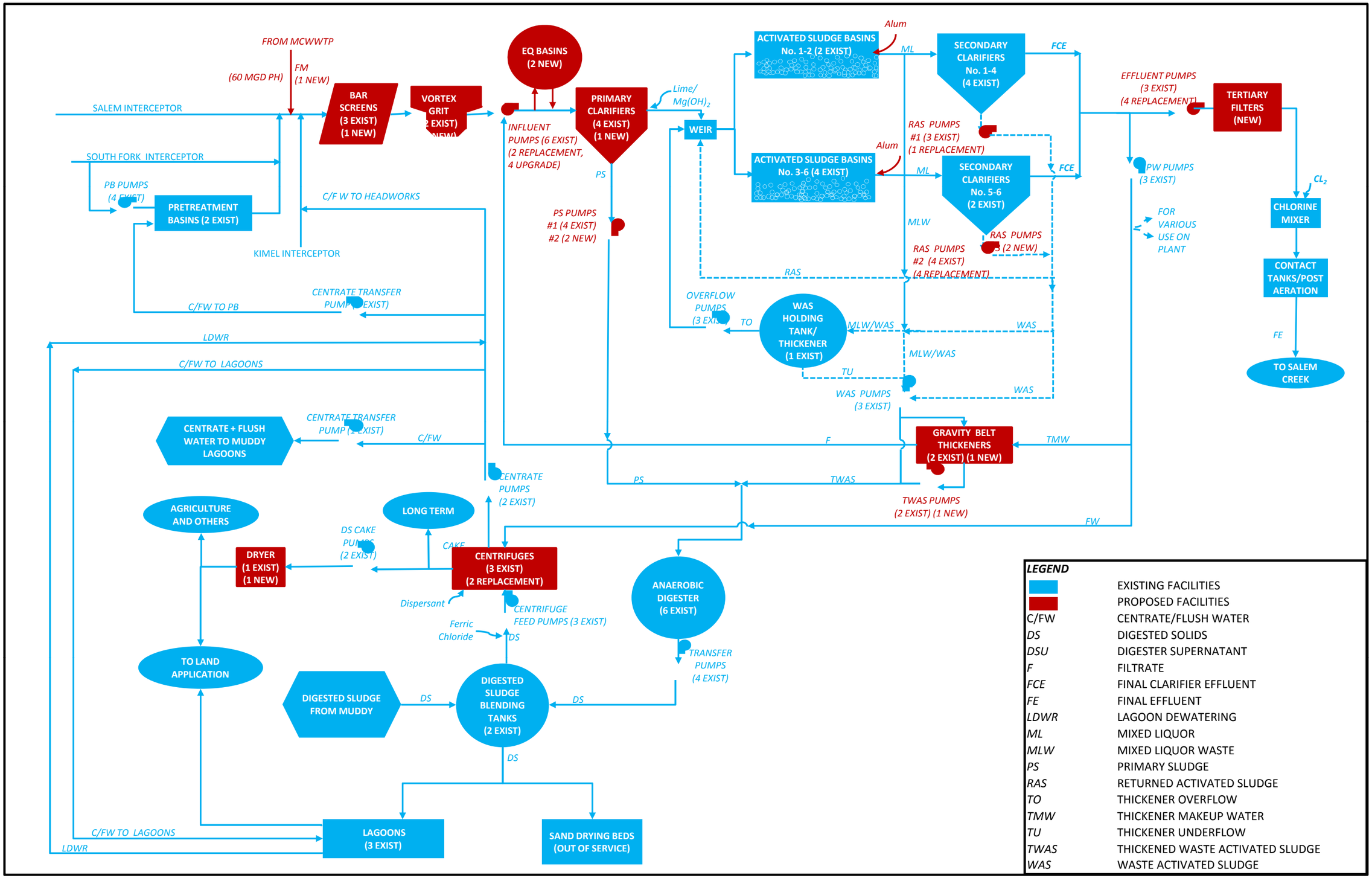


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**Figure 6-9**
**AEWWTP IMPROVEMENT ALTERNATIVE 3 PROCESS SCHEMATIC**
**- Permit Scenario 2, Flow Option 1 (45.7 MGD)**

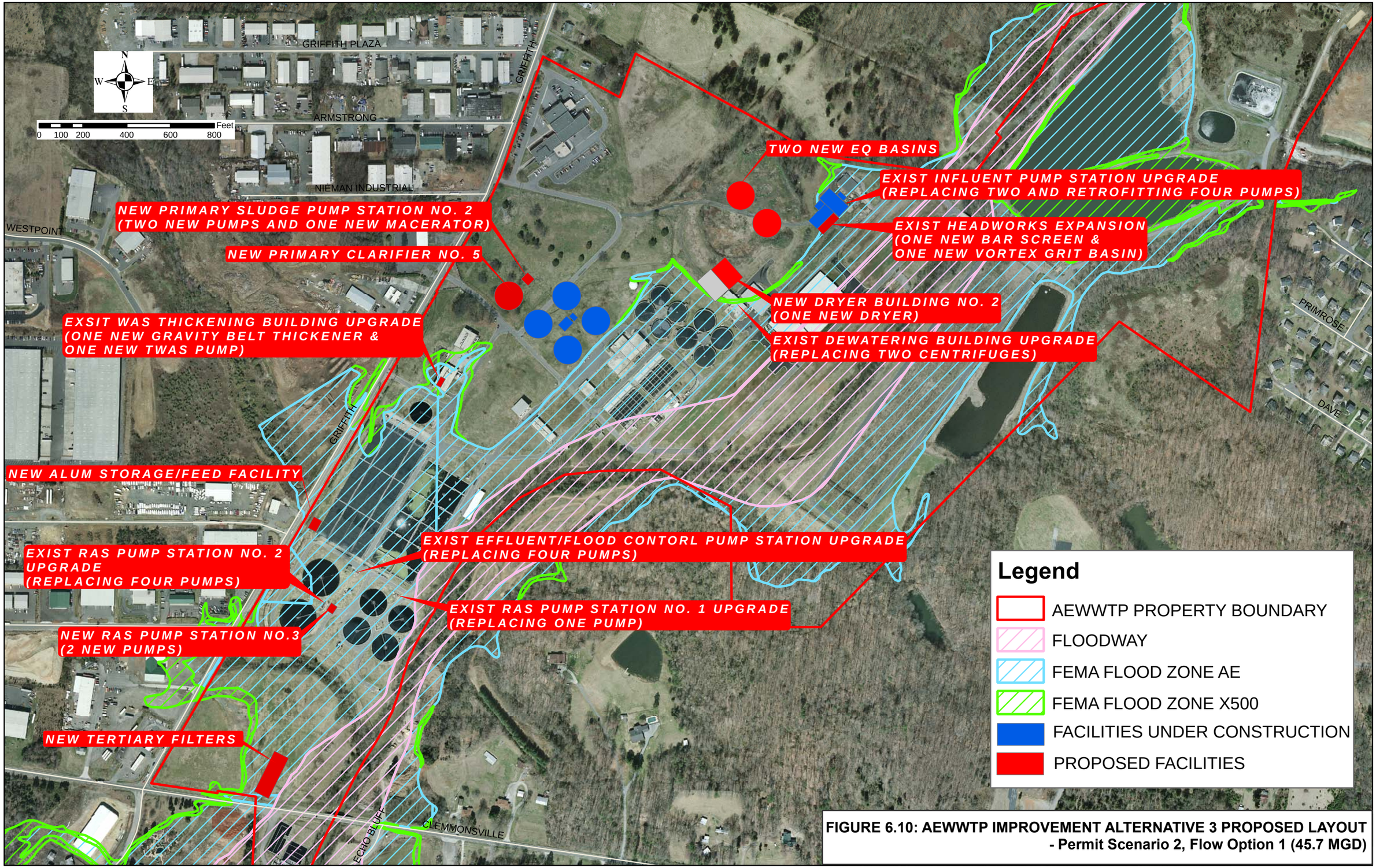


**FIGURE 6.10: AEWWTP IMPROVEMENT ALTERNATIVE 3 PROPOSED LAYOUT - Permit Scenario 2, Flow Option 1 (45.7 MGD)**

**Table 6-15**
**Summary of Alternative 3 AEWWTP Capital Costs**

| Process | Capital Cost |
|---|---|
| Headworks | $1,941,000 |
| Grit Removal | $1,502,400 |
| Influent Pumping | $2,138,400 |
| Flow Equalization | $1,500,000 |
| Primary Clarification | $1,051,600 |
| Biological Nutrient Removal | $955,000 |
| Secondary Clarification | $1,072,000 |
| Filtration | $10,388,250 |
| Chemical Feed Systems | $588,000 |
| Solids Processing | $16,699,500 |
| **Subtotal** | **$37,836,000** |
| Electrical/Instrumentation (23%) | $8,702,000 |
| Piping and Appurtenances (12%) | $4,540,000 |
| **Subtotal** | **$51,078,000** |
| Insurance and Bonds (2.5%) | $1,277,000 |
| Permits (0.50%) | $264,000 |
| General Conditions (6.0%) | $3,157,000 |
| Indirect OH&P (8.0%) | $4,462,000 |
| **Subtotal** | **$60,238,000** |
| Contingency (25%) | $15,060,000 |
| Allowance for Cost Escalation (6%) | $3,614,000 |
| **CONSTRUCTION TOTAL** | **$78,900,000** |
| Design and Construction Services Fee (15%) | $11,835,000 |
| **GRAND TOTAL** | **$90,735,000** |

**Table 6-16**
**Summary of Alternative 3 AEWWTP O&M Costs**

| POWER COSTS | |
|---|---|
| Influent Pumping | $300,777 |
| Headworks | $28,928 |
| Primary Clarification | $4,022 |
| Secondary Treatment | $716,876 |
| Filters/Disinfection | $30,646 |
| RAS/WAS/IR Pumping | $144,837 |
| Thickening | $7,669 |
| Digestion | $130,210 |
| Centrifuges | $256,642 |
| Dryer | $322,594 |
| **SUBTOTAL** | **$1,943,202** |
| | |
| **CHEMICAL COSTS** | |
| Aluminum Sulfate | $4,583,235 |
| Ferric Chloride | $9,330 |
| Polymer | $603,559 |
| Methanol | $0 |
| Sodium Hypochlorite | $444,274 |
| Sodium Bisulfite | $93,944 |
| Lime/Magnesium Slurry | $1,282,574 |
| **SUBTOTAL** | **$7,016,916** |
| ***ALTERNATIVE 3 TOTAL*** | ***$8,960,200*** |

### 6.3.3.2 Muddy Creek WWTP

As discussed in Section 6.3.1.2, the existing 21 mgd capacity of the MCWWTP is maintained under Flow Option 1, but 8 million gallons of equalization storage is recommended. The peak hour flow through the plant is reduced from 59.6 mgd to the 37.6 mgd; therefore, all treatment facilities were sized for a peak hour flow of 37.6 mgd.

A 60 mgd pump station is needed to pump excess flows to the AEWWTP. Based on the results of the BioWin model simulations and desktop calculations, the plant improvements needed under this alternative include the following:

- New 60 mgd Muddy Creek Transfer Pump Station to Transfer Flow to AEWWTP
- New 30-inch Diameter, 23,000 linear foot (LF) force main (initially) and 48-inch diameter 23,000 LF force main (future) between MCWWTP and AEWWTP

- New 22-mgd EQ Pump Station to Transfer Flow from Existing Headworks to EQ Basins
- New 36-inch Diameter, 1,000 linear foot (LF) Gravity Sewer from New EQ Basin to Existing Primaries
- New 36-inch Diameter, 1,000 linear foot (LF) Force Main from New EQ Pump Station to EQ Basins
- Conversion of Existing Sludge Lagoons to 8 MG EQ Basins
- Two Grit Removal Basins (including two new grit classifiers and grit pumps)
- Existing RAS Pump Station Upgrade (including two new RAS pumps)
- New Tertiary Filtration
- New Alum Storage and Feed Facility

A process flow diagram of the proposed improvements incorporated with the existing WWTP facilities is shown in **Figure 6-11**. In addition, a proposed layout of the improvements is shown on an aerial site plan of the site in **Figure 6-12.**

The opinion of probable construction and engineering cost for each plant improvement was determined and is shown in **Table 6-17**. The total capital cost for Alternative 3 for the MCWWTP is $86.3 million. A detailed cost breakdown of the components of each plant improvement is included in Appendix D. In addition, the estimated operation and maintenance costs associated with the annual chemical and power usages are detailed in **Table 6-18.**

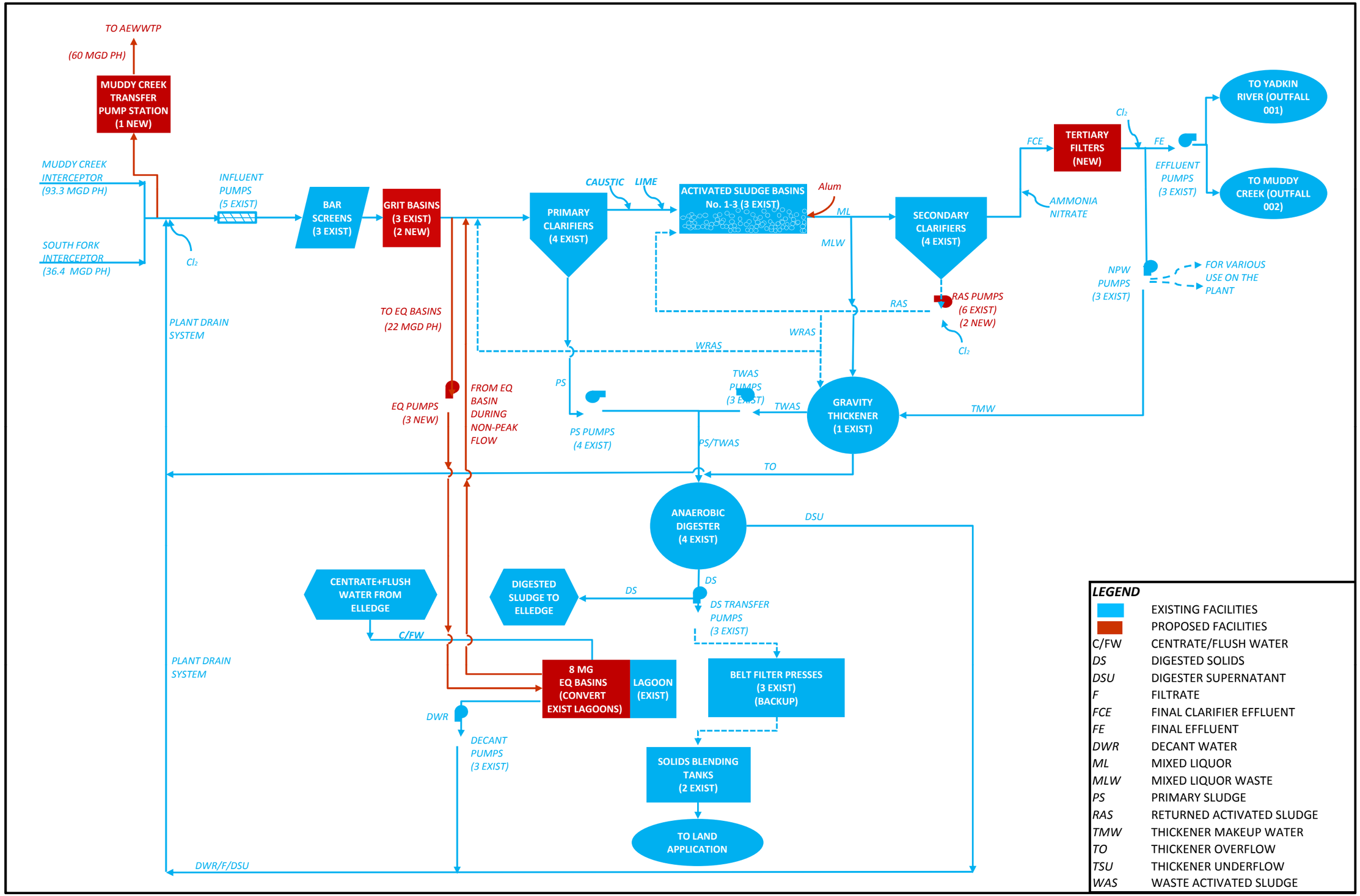


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**Figure 6-11**
**MCWWTP IMPROVEMENT ALTERNATIVE 3 PROCESS SCHEMATIC**
**- Permit Scenario 2, Flow Option 1 (21 MGD)**

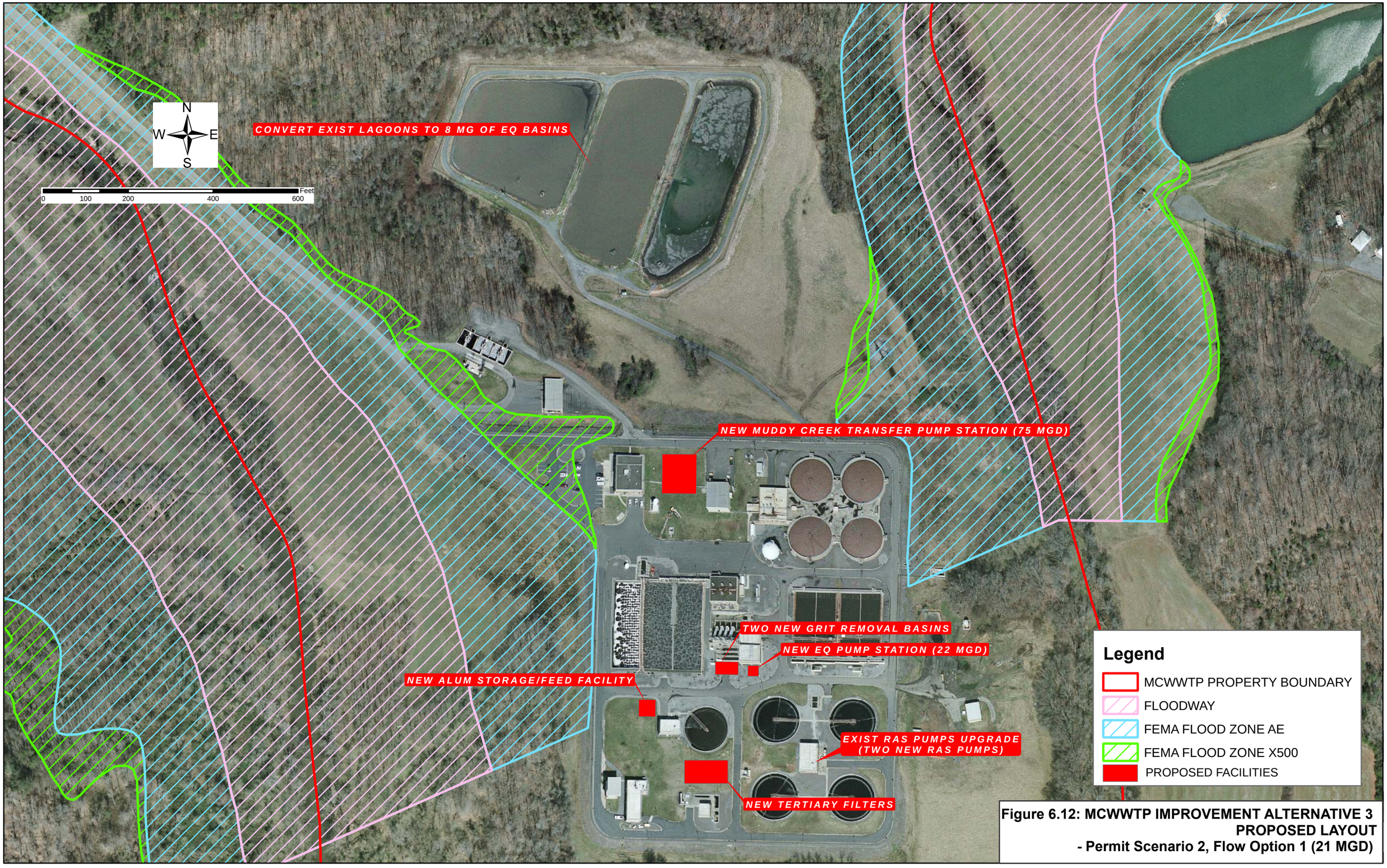


**Figure 6.12: MCWWTP IMPROVEMENT ALTERNATIVE 3 PROPOSED LAYOUT**
**- Permit Scenario 2, Flow Option 1 (21 MGD)**

**Table 6-17**
**Summary of Alternative 3 MCWWTP Capital Costs**

| Process | Capital Cost |
|---|---|
| Headworks | $0 |
| Grit Removal | $1,902,400 |
| Influent Pumping | $0 |
| Primary Clarification | $0 |
| Biological Nutrient Removal | $0 |
| Flow Equalization | $1,500,000 |
| Secondary Clarification | $135,000 |
| Filtration | $3,462,750 |
| Chemical Feed Systems | $226,000 |
| Solids Processing | $0 |
| **Subtotal** | **$7,226,000** |
| Electrical/Instrumentation (23%) | $1,662,000 |
| Piping and Appurtenances (12%) | $867,000 |
| **Subtotal** | **$9,755,000** |
| Muddy Creek Transfer PS/FM | $33,190,000 |
| EQ PS/Gravity Sewer/FM | $5,630,000 |
| **Subtotal** | **$48,575,000** |
| Insurance and Bonds (2.5%) | $1,214,000 |
| Permits (0.50%) | $251,000 |
| General Conditions (6.0%) | $3,002,000 |
| Indirect OH&P (8.0%) | $4,243,000 |
| **Subtotal** | **$57,285,000** |
| Contingency (25%) | $14,321,000 |
| Allowance for Cost Escalation (6%) | $3,437,000 |
| **CONSTRUCTION TOTAL** | **$75,000,000** |
| Design and Construction Services Fee (15%) | $11,250,000 |
| **GRAND TOTAL** | **$86,250,000** |

**Table 6-18**
**Summary of Alternative 3 MCWWTP O&M Costs**

| POWER COSTS | |
|---|---|
| Influent Pumping | $72,737 |
| Elledge Pumping | $73,661 |
| Headworks | $5,117 |
| Primary Clarification | $4,396 |
| Secondary Treatment | $289,618 |
| Filters/Disinfection | $16,130 |
| RAS/WAS/IR Pumping | $65,973 |
| Thickening | $0 |
| Digestion | $23,590 |
| **SUBTOTAL** | **$551,221** |
| | |
| **CHEMICAL COSTS** | |
| Aluminum Sulfate | $1,057,183 |
| Ferric Chloride | $0 |
| Polymer | $0 |
| Methanol | $0 |
| Sodium Hypochlorite | $202,940 |
| Sodium Bisulfite | $42,913 |
| Lime | $183,901 |
| **SUBTOTAL** | **$1,486,936** |
| ***ALTERNATIVE 3 TOTAL*** | ***$2,038,200*** |

## 6.3.4 Wastewater Treatment Improvement Alternative 4

Alternative 4 for the AEWWTP and MCWWTP incorporates Permit Scenario 2 and Flow Option 2. This alternative provides nutrient removal to meet an effluent permit limit of 0.2 mg/L TP at both plants. Chemical phosphorus removal using alum was used in the analysis to meet this permit limit. A summary of the projected influent loading characteristics, reactor sizing, air requirements, chemical phosphorus requirements, effluent summary, and solids handling capacity for both WWTPs is included in **Appendix C**.

### 6.3.4.1 Archie Elledge WWTP

As described above, a peak flow of 100 mgd to the AEWWTP is maintained and the remainder of the flow is conveyed to the MCWWTP. This peak flow translates to a 36.7 mgd max month flow to the AEWWTP. Based on the results of the BioWin model simulations and desktop calculations, the plant improvements needed under this alternative include the following:

- Two New EQ Basins
- Existing RAS Pump Station No. 2 Upgrade (including replacing four RAS pumps)
- Existing Effluent/ Flood Control Pumps Upgrade (including replacing five effluent pumps)
- New Tertiary Filtration

- New Alum Storage and Feed Facility
- Existing WAS Thickening Building Upgrade (including one new gravity belt thickener and one new TWAS pump)
- Existing Dewatering Building Upgrade (including replacing two centrifuges)
- New Dryer Building No. 2 (including one new dryer)

For this alternative, existing Aeration Basins No. 1 and 2 are not needed to treat the 36.7 mgd max month flow. The RAS pumping capacity still needs to be increased because 100% recycle (36.7 mgd) is recommended. A process flow diagram of the proposed improvements incorporated with the existing WWTP facilities is shown in **Figure 6-13**. In addition, a proposed layout of the improvements is shown on an aerial site plan of the site in **Figure 6-14.**

The opinion of probable construction and engineering cost for each plant improvement was determined and is shown in **Table 6-19**. The total capital cost for Alternative 4 for the AEWWTP is $66.5 million. A detailed cost breakdown of the components of each plant improvement is included in Appendix D. In addition, the estimated operation and maintenance costs associated with the annual chemical and power usages are detailed in **Table 6-20.**

**Table 6-19**
**Summary of Alternative 4 AEWWTP Capital Costs**

| Process | Capital Cost |
|---|---|
| Headworks | $0 |
| Grit Removal | $0 |
| Influent Pumping | $0 |
| Flow Equalization | $1,500,000 |
| Primary Clarification | $0 |
| Biological Nutrient Removal | $0 |
| Secondary Clarification | $945,000 |
| Filtration | $8,079,750 |
| Chemical Feed Systems | $484,000 |
| Solids Processing | $16,699,500 |
| **Subtotal** | **$27,708,000** |
| Electrical/Instrumentation (23%) | $6,373,000 |
| Piping and Appurtenances (12%) | $3,325,000 |
| **Subtotal** | **$37,406,000** |
| Insurance and Bonds (2.5%) | $935,000 |
| Permits (0.50%) | $194,000 |
| General Conditions (6.0%) | $2,312,000 |
| Indirect OH&P (8.0%) | $3,268,000 |
| **Subtotal** | **$44,115,000** |
| Contingency (25%) | $11,029,000 |
| Allowance for Cost Escalation (6%) | $2,647,000 |
| **CONSTRUCTION TOTAL** | **$57,800,000** |
| Design and Construction Services Fee (15%) | $8,670,000 |
| **GRAND TOTAL** | **$66,470,000** |

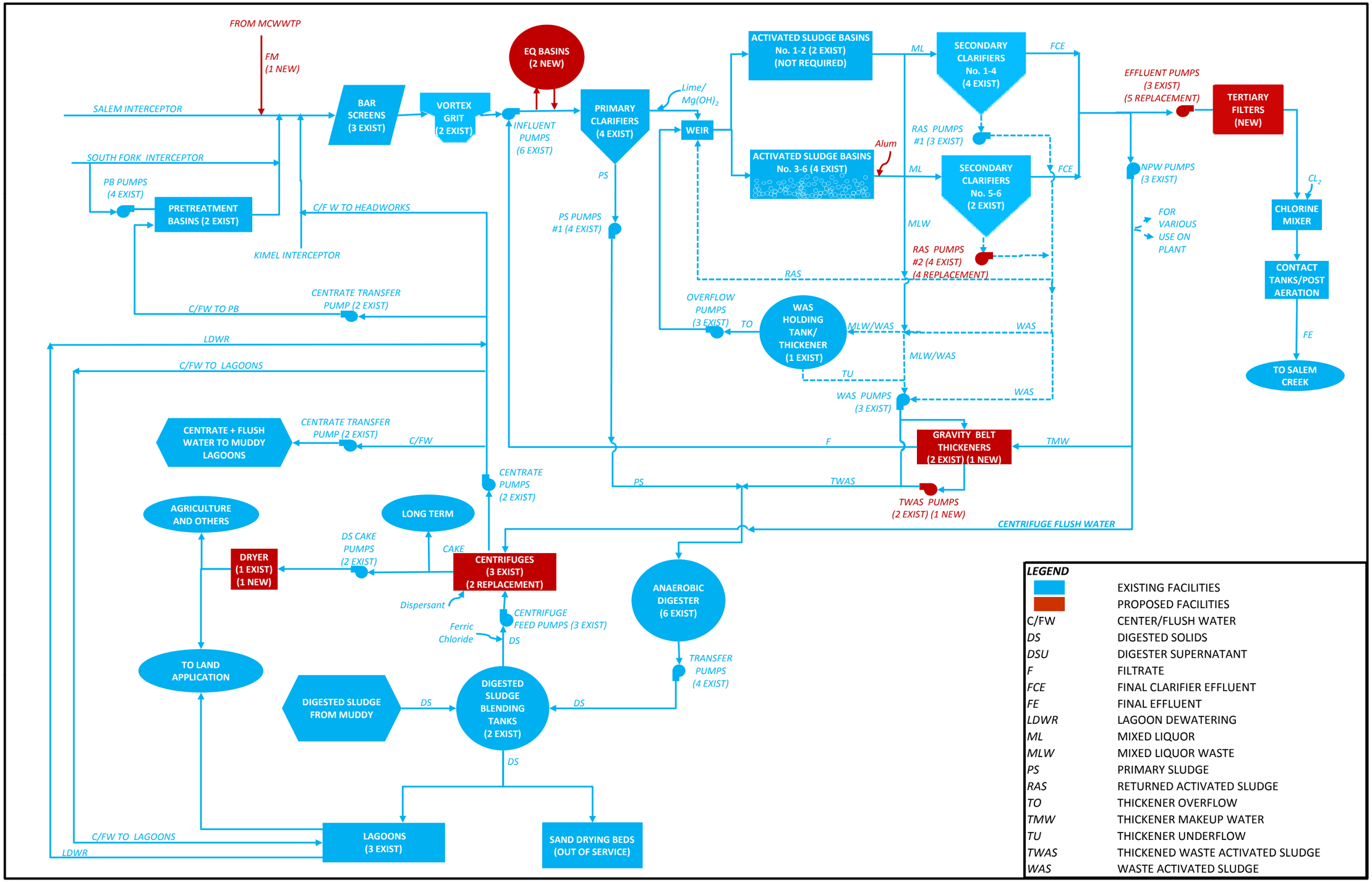


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**Figure 6-13**
**AEWWTP IMPROVEMENT ALTERNATIVE 4 PROCESS SCHEMATIC**

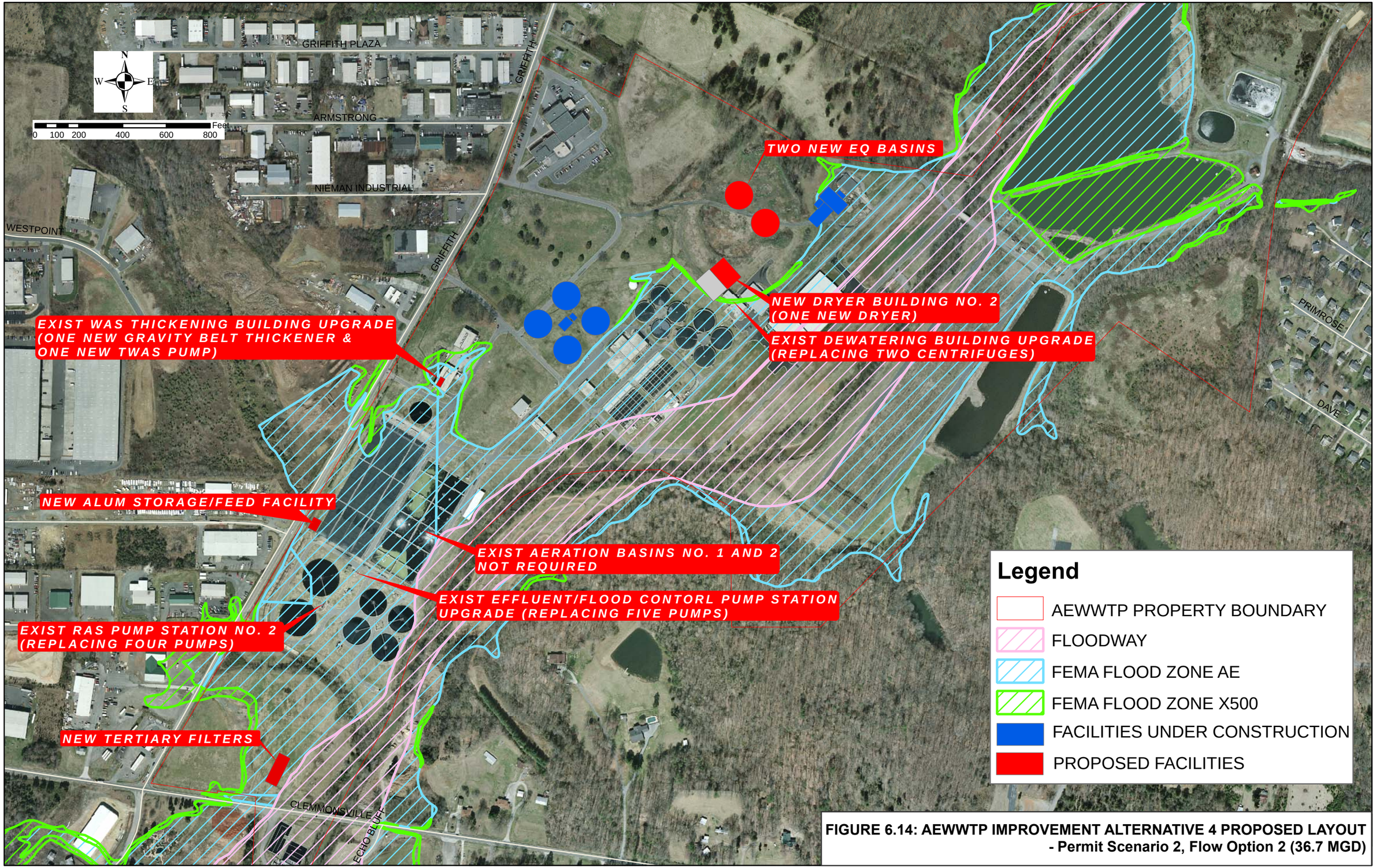


**FIGURE 6.14: AEWWTP IMPROVEMENT ALTERNATIVE 4 PROPOSED LAYOUT - Permit Scenario 2, Flow Option 2 (36.7 MGD)**

**Table 6-20**
**Summary of Alternative 4 AEWWTP O&M Costs**

| POWER COSTS | |
|---|---|
| Influent Pumping | $233,195 |
| Headworks | $19,285 |
| Primary Clarification | $3,251 |
| Secondary Treatment | $716,876 |
| Filters/Disinfection | $24,195 |
| RAS/WAS/IR Pumping | $112,153 |
| Thickening | $6,661 |
| Digestion | $128,366 |
| Centrifuges | $256,642 |
| Dryer | $322,594 |
| New South Fork PS | $27,691 |
| **SUBTOTAL** | **$1,850,909** |
| | |
| **CHEMICAL COSTS** | |
| Aluminum Sulfate | $3,481,739 |
| Ferric Chloride | $9,431 |
| Polymer | $544,017 |
| Methanol | $0 |
| Sodium Hypochlorite | $344,449 |
| Sodium Bisulfite | $72,836 |
| Lime/Magnesium Slurry | $1,091,880 |
| **SUBTOTAL** | **$5,544,352** |
| ***ALTERNATIVE 4 TOTAL*** | ***$7,395,300*** |

### 6.3.4.2 Muddy Creek WWTP

As mentioned above, the max month flow to the MCWWTP is increased to 30 mgd under Flow Option 2; therefore, a significant plant expansion is required. The projected peak hour flow to the plant is 82.7 mgd, while the max day flow is 70.6 mgd. In order to reduce peak hour flows to minimize the treatment process expansions, 12 million gallons of equalization storage is recommended. With this amount of storage, the peak hour flow that has to be treated by the plant is reduced from 82.7 mgd to the 56.4 mgd. As a result, a 30 mgd pump station is required to pump flow to the equalization basin. In addition, 28.2 mgd will be pumped to the new facilities; therefore, a 60 mgd pump station is recommended. In addition, a 33 mgd pump station to convey additional Muddy Creek and South Fork basin flows to the AEWWTP is recommended at the MCWWTP to provide flow management flexibility.

Based on the results of the BioWin model simulations and desktop calculations, the plant improvements needed under this alternative include the following:

- New 60 mgd Influent/EQ Pump Station (30 mgd to EQ basins and 28 mgd to new facilities)
- New 48-inch Diameter, 800 Linear Feet (LF) Force Main from New Influent/EQ Pump Station to New Headworks

- New 33-mgd Muddy Creek Transfer Pump Station to Excess Flows from MCWWTP to AEWWTP
- New 48-inch Diameter, 23,000 Linear Feet (LF) Force Main from MCWWTP to AEWWTP
- Three New Mechanical Bar Screens
- Two New Grit Removal Basins (including two new grit classifiers and grit pumps)
- Conversion of existing Sludge Lagoons to 12 MG EQ Basins
- Four New Primary Clarifiers
- New Primary Sludge Pump Station No. 2 (including four new primary sludge pumps)
- Three New Aeration Basins (including diffusers, mixers, mixed liquor recycle pumps and piping)
- Four New Secondary Clarifiers
- Existing RAS Pump Station Upgrade (including replacing one RAS pump)
- New RAS Pump Station (including five new RAS pumps and three new WAS pumps)
- New Tertiary Filtration
- New Alum Storage and Feed Facility
- One New Thickened Sludge Pump
- New Gravity Belt Thickener Building (including one new gravity belt thickener and TWAS pumps)

A process flow diagram of the proposed improvements incorporated with the existing WWTP facilities is shown in **Figure 6-15**. In addition, a proposed layout of the improvements is shown on an aerial site plan of the site in **Figure 6-16.**

The opinion of probable construction and engineering cost for each plant improvement was determined and is shown in **Table 6-21**. The total capital cost for Alternative 4 for the MCWWTP is $125.1 million. A detailed cost breakdown of the components of each plant improvement is included in Appendix D. In addition, the estimated operation and maintenance costs associated with the annual chemical and power usages are detailed in **Table 6-22.**

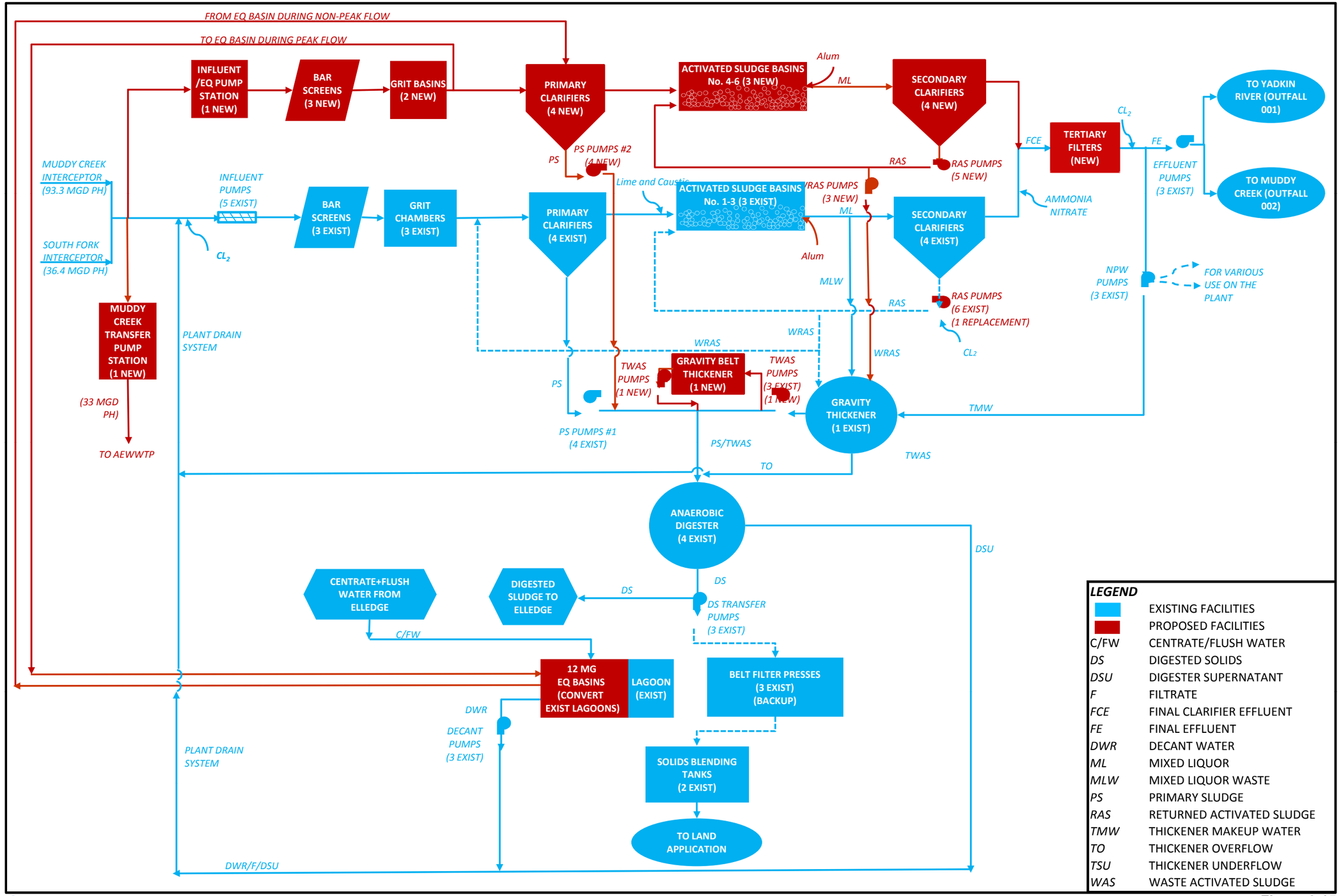


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**Figure 6-15**
**MCWWTP IMPROVEMENT ALTERNATIVE 4 PROCESS SCHEMATIC**
**- Permit Scenario 2, Flow Option 2 (30 MGD)**

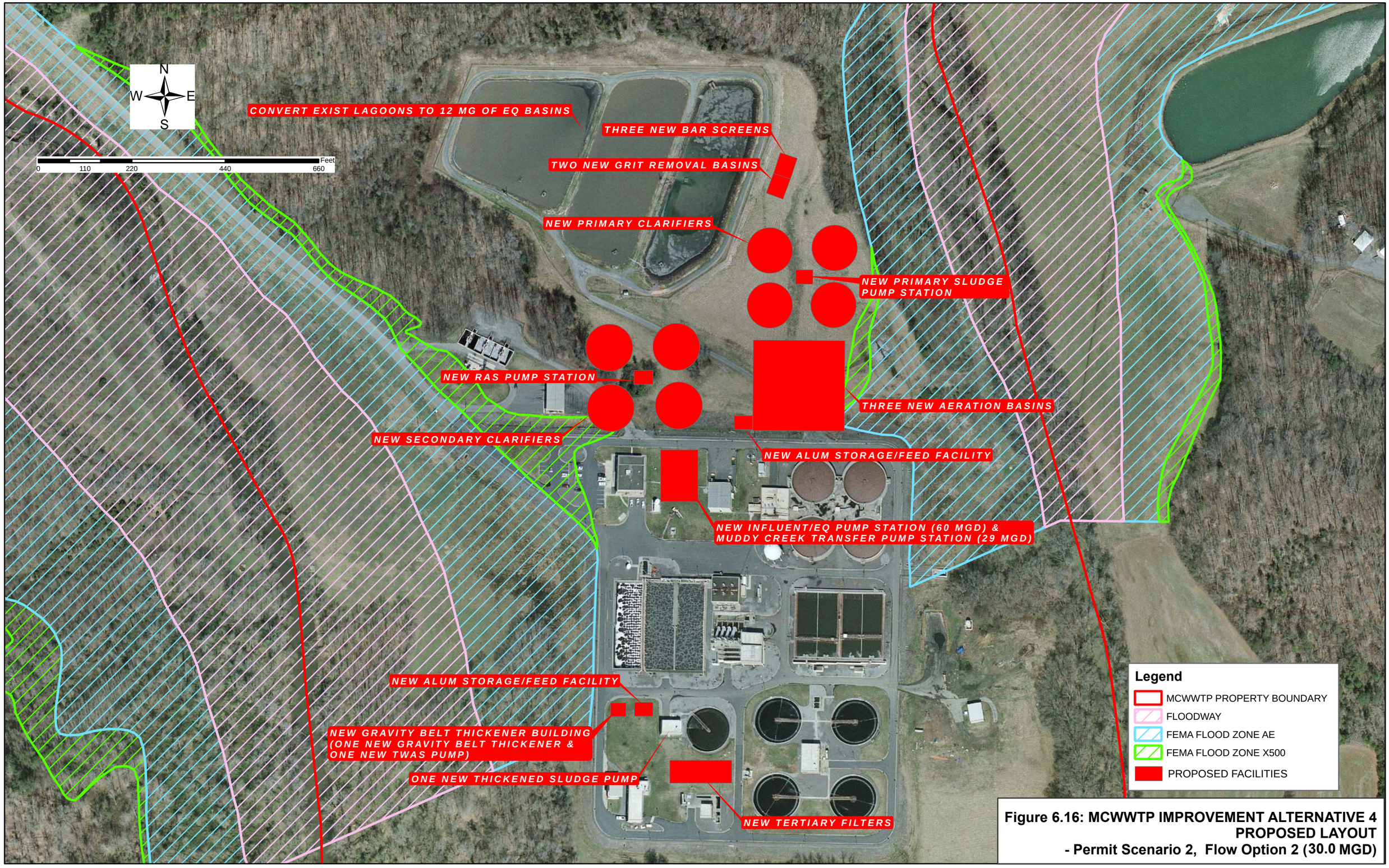



**Figure 6.16: MCWWTP IMPROVEMENT ALTERNATIVE 4 PROPOSED LAYOUT - Permit Scenario 2, Flow Option 2 (30.0 MGD)**

**Table 6-21**
**Summary of Alternative 4 MCWWTP Capital Costs**

| Process | Capital Cost |
|---|---|
| Headworks | $1,417,500 |
| Grit Removal | $1,902,400 |
| Influent Pumping | $0 |
| Primary Clarification | $3,870,500 |
| Biological Nutrient Removal | $3,571,310 |
| Secondary Clarification | $4,704,550 |
| Filtration | $5,001,750 |
| Flow Equalization | $2,250,000 |
| Chemical Feed Systems | $351,000 |
| Solids Processing | $636,500 |
| **Subtotal** | **$23,706,000** |
| Electrical/Instrumentation (23%) | $5,452,000 |
| Piping and Appurtenances (12%) | $2,845,000 |
| Site Work (5%) | $1,185,000 |
| **Subtotal** | **$33,188,000** |
| Influent/EQ PS /FM | $14,665,000 |
| Muddy Creek Transfer PS/FM | $22,538,000 |
| **Subtotal** | **$70,391,000** |
| Insurance and Bonds (2.5%) | $1,760,000 |
| Permits (0.50%) | $364,000 |
| General Conditions (6.0%) | $4,351,000 |
| Indirect OH&P (8.0%) | $6,149,000 |
| **Subtotal** | **$83,015,000** |
| Contingency (25%) | $20,754,000 |
| Allowance for Cost Escalation (6%) | $4,981,000 |
| **CONSTRUCTION TOTAL** | **$108,800,000** |
| Design and Construction Services Fee (15%) | $16,320,000 |
| **GRAND TOTAL** | **$125,120,000** |

**Table 6-22**
**Summary of Alternative 4 MCWWTP O&M Costs**

| POWER COSTS | |
|---|---|
| Influent Pumping | $110,875 |
| Headworks | $5,834 |
| Primary Clarification | $8,000 |
| Secondary Treatment | $577,802 |
| Filters/Disinfection | $16,130 |
| RAS/WAS/IR Pumping | $99,616 |
| Thickening | $3,146 |
| Digestion | $25,021 |
| **SUBTOTAL** | **$846,423** |
| | |
| **CHEMICAL COSTS** | |
| Aluminum Sulfate | $1,835,826 |
| Ferric Chloride | $0 |
| Polymer | $0 |
| Methanol | $0 |
| Sodium Hypochlorite | $309,346 |
| Sodium Bisulfite | $65,413 |
| Lime | $256,568 |
| **SUBTOTAL** | **$2,467,153** |
| ***ALTERNATIVE 4 TOTAL*** | ***$3,313,600*** |

## 6.4 Summary of Wastewater Treatment Improvement Alternatives

The capital and O&M costs for each alternative were combined to determine the 20-year present worth costs. This 20-year present worth analysis is included in **Appendix E.** The present worth analysis assumes 3-percent inflation each year. A summary of the capital costs, annual O&M costs and 20-year life-cycle costs for each of the four wastewater treatment improvement alternatives is shown in **Tables 6-23** and **6-24.**

**Table 6-23**
**Summary of Wastewater Treatment Improvement Alternatives (TN and TP removal)**

| Alternative | Capital Cost (Million) | Annual O&M Cost (Million) | 20-year Present Worth Value |
|---|---|---|---|
| 1 | $203.2 | $9.7 | $377.5 |
| 2 | $214.3 | $9.6 | $386.5 |

**Table 6-24**
**Summary of Wastewater Treatment Improvement Alternatives (TP removal)**

| Alternative | Capital Cost | Annual O&M Cost | 20-year Present Worth Value |
|---|---|---|---|
| 3 | $177.0 | $11.0 | $374.0 |
| 4 | $191.6 | $10.7 | $383.5 |

## 6.5 Decision Matrix Approach

### 6.5.1 General

There are also non-cost factors that may affect the ability to implement and construct the above wastewater treatment improvement alternatives. By using a decision matrix approach, the four wastewater treatment improvement alternatives were ranked with respect to these non-cost factors to select the most favorable alternative for planning purposes.

The selection approach is outlined below:

- Prioritize evaluation criteria based on their relative importance to the project. Assign a relative weighting factor (WF) for each criterion based on a scale of 1 to 5, with 1 being the least important and 5 being the most important.

- Assign a rating, ranging from 1 through 5, with 1 being the worst and 5 being the best to indicate how well each alternative satisfies each criterion.

- Multiply the WF by the rating to determine the score for each option and criterion. Determine the total score for each alternative and then rank the alternatives based on the total score. This allows the alternative that best satisfies the evaluation criteria to be ranked number 1 and selected for implementation.

### 6.5.2 Selection Criteria

The four alternatives were evaluated based on the developed criteria shown in **Table 6-25**. The following non-cost factors being considered include the following:

1. Constructability – the ease of construction with respect to physical conditions and impacts to existing facilities.

2. Permitability – the ease of obtaining local, state, and federal permits required to construct and operate the facility.

3. Operability – the ease of operation of the facilities related to process control, chemical addition and mechanical capabilities.

4. Environmental Impacts – the level of impact of the facility on the surrounding ecology and sensitive habitats.

5. Community Impacts – the impact of the facility's construction and operations to the public; considering traffic impacts, odor concerns, visual impacts, interruption of sewer service, etc.

The weighting factors (WFs) for each criterion are also presented in **Table 6-25**.

**Table 6-25**
**Improvement Alternatives Selection Criteria with Weighting Factors**

| Selection Criteria | WFs |
|---|---|
| Constructability | 4.0 |
| Permitability | 5.0 |
| Operability | 5.0 |
| Environmental Impacts | 4.0 |
| Community Impacts | 3.5 |

## 6.5.3 Scoring Matrix

Alternative scoring was done on a 4 point scale with 4 being the best score and 1 the worst score. Alternatives were compared against one another. For example, an alternative requiring the least site expansion would receive a higher score on the environmental impacts criteria. An alternative requiring a larger site expansion would receive a higher score on the same criteria.

The scoring matrix for the four improvement alternatives is included in **Tables 6-26** and **6-27**. The total weighted scores and ranks of each alternative are shown in the matrix. Alternatives 1 and 2 were compared against each other since both are related to the same permitting scenario (TN and TP removal) and then Alternatives 3 and 4 (TP removal only) were compared against each other. A summary of the rationale used in assigning each score is included in **Appendix F.**

## 6.5.4 Recommended Wastewater Treatment Alternative

Based on the results of the scoring matrix shown in Table 6-26, Alternative 1 is recommended over Alternative 2. Alternative 2 essentially involves the construction of a new plant at the Muddy Creek site which creates more significant impacts and therefore ranks lower than Alternative 1. In addition, the estimated capital cost for Alternative 1 is approximately 5 percent less than Alternative 2. The present worth value for Alternative 1 is about 2.3 percent less than Alternative 2, but for a planning level estimate, these values can be considered equal.

Based on the results of the scoring matrix shown in Table 6-27, Alternative 3 is recommended over Alternative 4. Alternative 3 also involves the construction of a new plant at the Muddy Creek site which creates more significant impacts and therefore ranks lower than Alternative 4. The estimated capital cost for Alternative 3 is approximately 7.5 percent less than Alternative 4, and the present worth value for Alternative 3 is about 2.5 percent less than Alternative 4.

The reason the capital cost for Alternative 1 is about 15 percent higher than Alternative 3 is that Alternative 1 requires facilities for the removal of TN and TP whereas Alternative 3 only requires facilities for TP removal. The present worth value, however, is approximately the same ($377.5M vs. $374M) for both options due

to the higher annual O&M cost associated with chemical phosphorus removal under Alternative 3.

It is therefore recommended that Alternative 1 be used for developing the 20-Year Improvements Plan since the capital cost represents a more conservative planning approach and the "worst case" permitting scenario.

**Table 6-26**
**Alternatives 1 & 2 Scoring Matrix for Non-cost Criteria**

| Permit | Criteria | Constructability | Permitability | Operability | Environmental Impacts | Community Impacts | Total Score | Rank | Capital Cost | 20-Year PW Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| | Weighting | 4.0 | 5.0 | 5.0 | 4.0 | 3.5 | | | $ M | $ M |
| TN 3/ TP 0.5 | Alt. 1 | 4 | 4 | 4 | 2 | 3 | 74.50 | 1 | $203.2 | $377.5 |
| TN 3/ TP 0.5 | Alt. 2 | 2 | 3 | 2 | 3 | 4 | 59.00 | 2 | $214.3 | $386.5 |

**Table 6-27**
**Alternatives 3 and 4 Scoring Matrix for Non-cost Criteria**

| Permit | Criteria | Constructability | Permitability | Operability | Environmental Impacts | Community Impacts | Total Score | Rank | Capital Cost | 20-Year PW Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| | Weighting | 4.0 | 5.0 | 5.0 | 4.0 | 3.5 | | | $ M | $ M |
| TP 0.2 | Alt. 3 | 4 | 4 | 5 | 2 | 2 | 76.00 | 1 | $177.0 | $374.0 |
| TP 0.2 | Alt. 4 | 2 | 3 | 3 | 3 | 3 | 60.50 | 2 | $191.6 | $383.5 |

# Section 7
# Wastewater Treatment Plant Condition Assessment

CDM conducted a physical condition assessment of the Muddy Creek and Archie Elledge Wastewater Treatment Plants (WWTPs) to identify the physical and operable condition and reliability of its equipment and facilities, identify whether the condition requires upgrading or replacement, and identify projects required to maintain the facilities and equipment over the 20-year planning period;. The results and recommendations of the condition assessment will be incorporated into the overall recommended wastewater treatment improvements plan.

This section provides an overview of the established procedures used for the assessments; reviews the observations and findings of the assessments; documents and summarizes the conditional ratings of the assets; and provides prioritization of need based on the assessment.

## 7.1 Condition Assessment

The physical condition assessment is intended to document the general condition of mechanical equipment, structures, and electrical equipment; provide an estimated remaining service life of major mechanical equipment; and provide information to prioritize rehabilitation or replacement needs.

### 7.1.1 Physical Condition Assessments

Assessments were performed through visual observations of equipment, interviews with staff and review of pertinent plant and equipment documentation. Using CDM's standard evaluation forms, these findings were documented and conditional response ratings were assigned to up to eight subcomponents of each asset:

1. Mechanical Equipment
2. Electrical Motor or Driver
3. Electrical Components
4. Control Panels and Controls
5. Gates and Valves or other mechanical appurtenances
6. Piping
7. Structural Integrity and Coatings
8. Operability of the asset

Conditional responses for the eight subcomponents were averaged to provide an overall asset conditional response rating ($C_A$) for the asset. The conditional response ratings were further weighted according to the equipment's criticality in maintaining firm capacity and/or permit compliance by the plant. Using criticality ratings ($C_R$) enables the prioritization of need and prevents the analysis from skewing toward little used or out of service assets not important to the treatment plant's mission. The combination of the $C_A$

and the $C_R$ derives an Asset Risk Index (ARI). The higher the ARI rating, the greater the likely need of that asset.

For the assessment of equipment condition, the following conditional response ratings and criticality ratings were utilized in the determination of an asset's risk index.

#### 7.1.1.1 Conditional Response Ratings

Conditional responses are used to establish baseline information for determining process equipment mechanical condition. Conditional responses are rated on a five point scale, 1, 2, 3, 4, and 5. "1" is the highest or best condition, while "5" is the lowest or worst condition. Descriptions of the conditional responses are presented below.

1 This conditional response is appropriate when no apparent problems exist. When assigning this value to an inspected item, the item is characterized by some or one of the following:

a. Coatings and/or finishes appear to be new or nearly new.
b. Item does not leak, drip, spill or discharge lubricants or process fluids excessively except as designed.
c. Item appears to fit the application to which it is applied.
d. Item does not need repair of replacement.

2 This conditional response is appropriate when the inspected item fails one or more of the criteria outlined in the "1" conditional response. While a piece of equipment may be working properly, it may show signs of corrosion or may be improperly sized. The "2" conditional response should be assigned when the inspected item is characterized by some or one of the following:

a. All "1" conditional response criteria are not met.
b. Item is generally within the first quartile of its Remaining Useful Life.

3 This conditional response is appropriate when the inspected item is generally within the second quartile of its Remaining Useful Life and is characterized by some or one of the following:

a. Item does not leak, drip, spill or discharge lubricants or process fluids excessively, except as designed.
b. Item is capable of remaining in useful service, without requiring repair or replacement, for at least five years
c. Item shows signs of corrosion.

4 This conditional response is appropriate when the inspected item appears to be near the end of its useful life cycle and is characterized by some or one of the following:

a. Generally, within the third quartile of its Remaining Useful Life
b. The item requires excessive maintenance or repair to remain in service.
c. The item is recommended for repair and/or replacement in not less than one year but not more than 5 years.

5 This conditional response is appropriate when the inspected item is not capable or remaining in service for more than one-year and/or is currently out of service. The item should be considered as a "5" if it is characterized by some or one of the following:

a. The item needs immediate replacement (i.e., 1 year or less).
b. The item presents a danger to human health and safety.
c. The item is being used in an improper application.
d. The item is not capable of performing its intended function.

### 7.1.1.2 Criticality Ratings

The following scoring system will be used to weigh each major equipment item's Asset Risk numerically based on its Conditional Response rating times a factor that is related to its degree of importance (Criticality) in the system.

The criteria determined through Condition Assessment workshops with the City/County Utilities Commission (CCUC) that were used for ranking asset Criticality are as follows:

Each major equipment item's criticality will be ranked on a scale of 1 = LOW, 2=MEDIUM, 3=HIGH and 4-HIGH-HIGH. The criteria for these ratings are described below.

1 LOW in importance meets **any** of the following criteria:

a. The equipment is not required for firm capacity.
b. The equipment is not required for continued uninterrupted treatment.
c. The equipment is support or ancillary and is not required to meet permit effluent limits.
d. The repair of equipment is not time sensitive.

2 MEDIUM in importance meets **any** of the following criteria:

a. The equipment is required as back-up to firm capacity and is not required to meet permit effluent limits.
b. The equipment is required for continued uninterrupted treatment.

c. The equipment is support or ancillary and is required for continued uninterrupted treatment.
d. The repair of equipment must be addressed within one month.

3 HIGH in importance meets **any** of the following criteria:
a. The equipment is required to meet permit effluent limits.
b. The equipment is not required to meet firm capacity.
c. The repair of equipment must be addressed within one week.

4 HIGH-HIGH in importance meets **any** of the following criteria:
a. The equipment is required for firm capacity.
b. The equipment is required to meet permit effluent limits.
c. The repair of equipment must be addressed within 24 hours.
d. The equipment contains a health and safety deficiency.

### 7.1.1.3 Asset Risk Index

Asset Risk Index (ARI) is the weighting of an asset's condition against its level of importance to the CCUC's mission of delivering safe and reliable wastewater treatment services. **Table 7-1** demonstrates the possible combinations of condition and criticality ratings and the Resulting ARI Scores.

For instance, a primary sludge pump's condition is assessed as 3 and its criticality is 2 (Medium), the ARI would be as follows:

Where:

$C_A$ = Conditional Response Rating (1 through 5) through assessments
$C_R$ = Criticality designation (1 through 3) through workshop
ARI = Conditional Response x Criticality Rating
= $C_A$ (3) x $C_R$ (2)
= 6

**Table 7-1**

**ARI for Combinations of Condition and Criticality**

| | Conditional Responses | | | | |
|---|---|---|---|---|---|
| Criticality | 1 (Best) | 2 | 3 | 4 | 5 (Worse) |
| 1 (Low) | 1 | 2 | 3 | 4 | 5 |
| 2 (Med) | 2 | 4 | 6 | 8 | 10 |
| 3 (High) | 3 | 6 | 9 | 12 | 15 |
| 4 (Hi-Hi) | 4 | 8 | 12 | 16 | 20 |

An asset risk rating system results whereby a rating of 1 equates to best condition, low criticality, and a rating of 20 equates to worse condition, very high (High-High)

criticality. All assets at the Muddy Creek and Archie Elledge WWTPs were analyzed in this manner.

#### 7.1.1.4 Prioritizing Need

Conditional Responses provide baseline information maintenance information; Criticality determines the degree of importance that the asset has in the system and Asset Risk Index weights an asset's condition against its level of importance to the CCUC's mission of delivering safe and reliable wastewater treatment services. To determine an asset's overall Risk Factor (RF), elements of the U.S. EPA Asset Management best practices were applied to derive an approximation of the asset's remaining useful life, the likelihood of its failure and a prioritization of its replacement.

***Remaining Useful Life (RUL)***

Using standard industrial estimated useful life (EUL) tables, an asset's EUL in years was assigned to each asset. Based on the original installation date (disregarding whether major modifications or repairs have been performed), the estimated remaining useful life (ERUL) was estimated based on the Estimated Useful Life value and the installation year. Finally, the asset's Remaining Useful Life (RUL) was calculated from the ERUL and weighted by the average Conditional Response ($C_a$) rating.

Finally, the replacement year, the year that the asset should theoretically be replaced was determined. The replacement year may be impacted by the equipment's O&M Conditional Response factor, which is an asset's maintenance needs and operational reliability. The Replacement Year adds the RUL (weighted by an O&M Conditional Response factor) to the Current Year.

***Probability of Failure***

The probability that an asset will no longer perform its intended function is a function of whether it's achieved its expected useful life, how well it's been maintained, its operational requirements, environmental conditions and its current condition relative to its age. High probability of failure values represents the greatest chance that an asset will experience a significant failure given the appropriate conditions.

***Risk Factor***

Finally, the Risk Factor (RF) weighs the proportionality of the assets criticality rating to its probability of failure. A high Risk Factor rating is characteristic of an asset that is critical to the CCUC mission and demonstrates a high chance of failure. These assets require a high priority given their need for timely repairs or replacement. Ranking assets by their Risk Factor permits a better assessment and prioritization of need to be established over the 20 year planning period.

# 7.2 Muddy Creek Wastewater Treatment Plant

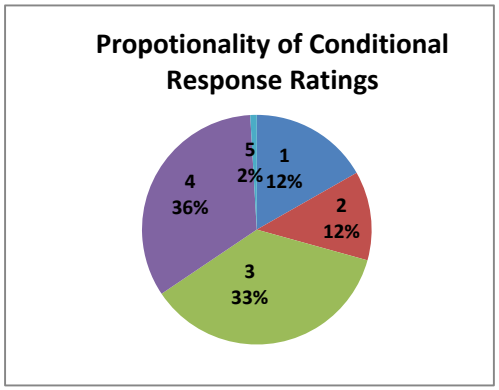
## 7.2.1 Condition Assessments

### 7.2.1.1 Physical Facilities

The Muddy Creek WWTP was constructed in 1986, expanded in 1997 and has undergone several equipment modifications and enhancements since its original construction. The current permitted capacity is 21 mgd. No major construction or plant projects are currently underway.

The condition assessments categorize the facility into the following principal process areas:

- Headworks
- Preliminary Treatment
- Primary Treatment
- Secondary Treatment
- Final Treatment
- Solids Thickening
- Solids Digestion
- Solids Dewatering
- Solids Storage
- Chemical Systems




### 7.2.1.2 Conditional Responses

Within these principal process areas, greater than 200 assets were examined and conditional assessments made. Examining the conditional response ($C_a$) ratings of the equipment observed, the greatest proportionality (approximately 69%) of the equipment was assigned conditional response ratings of 3 and 4. These conditional response ratings are generally appropriate when the inspected- item appears to be within its second quartile of its remaining useful life, a conditional response rating of 3; or when the inspected item appears to be near the end of its useful life cycle, a conditional response rating of 4.

### 7.2.1.3 Criticality Ratings

Each asset was then assigned a Criticality Rating ($C_r$) based on its impact to plant operations, ability to maintain firm capacity, ability to ensure permit compliance and considerations for health and safety. The majority of the assets were assigned criticality ($C_r$) ratings of LOW (1) and MEDIUM (2); 28% and 39% respectfully. Assets considered to have the greatest impact to plant operations, firm capacity, permit compliance and health and safety were rated HIGH-HIGH (4); 12% of all assets were assigned the highest rating. **Table 7-2** is a listing of those assets receiving the highest criticality rating.

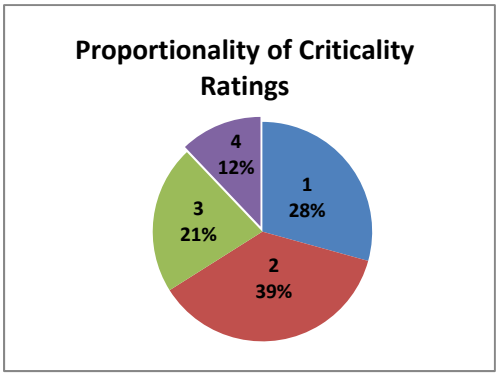



**Table 7-2**

**Assets Receiving Highest Criticality Ratings (HIGH-HIGH)**

| Process Area | Equipment |
|---|---|
| Electrical | Primary MCC |
| Electrical | Blower Bld MCC |
| Electrical | Hypo System MCC |
| Secondary Treatment | SC No. 1 |
| Secondary Treatment | SC No. 2 |
| Secondary Treatment | SC No. 3 |
| Secondary Treatment | SC No. 4 |
| Preliminary Treatment | Bar Screen/Scum Conveyor |
| Preliminary Treatment | Grit Belt Conveyor |
| Preliminary Treatment | Grit Collection Screw Conveyor |
| Primary Treatment | Primary Clarifier - Traveling Bridge No. 1 |
| Primary Treatment | Primary Clarifier - Traveling Bridge No. 2 |
| Electrical | Dual 480 V Main Plant Transformer |
| Electrical | NPW PS MCC |
| Electrical | 1340 kW Gen Radiator |
| Final Treatment | Effluent Channel Parshall Flume |
| Secondary Treatment | ASB Blower PLC 3A |
| Secondary Treatment | ASB Blower PLC 3B |
| Secondary Treatment | ASB Blower PLC 3C |
| Secondary Treatment | Blower Bld PLC-3 |
| Electrical | Russel Electric |
| Electrical | Effluent PS MCC |
| Secondary Treatment | ASB Blower 3A (Diesel) |
| Secondary Treatment | ASB Blower 3B |

**Table 7-2**

**Assets Receiving Highest Criticality Ratings (HIGH-HIGH)**

| Process Area | Equipment |
|---|---|
| Secondary Treatment | ASB Blower 3C |
| Secondary Treatment | Secondary Clarifier Splitter Box |
| Secondary Treatment | ASB No. 1 |
| Secondary Treatment | ASB No. 2 |
| Secondary Treatment | ASB No. 3 |
| Secondary Treatment | ASB Splitter Box |
| Electrical | Backup Power Generator (1340 KW) |
| Electrical | Backup Power Generator (2000 KW) |
| Electrical | Sludge Thickening |
| Preliminary Treatment | Screenings/Grit/Scum Discharge Chute |

### 7.2.1.4 Asset Risk Index

The asset risk index (ARI) is the weighting of an asset's condition (Conditional Response, $C_a$) against its level of importance (Criticality, $C_r$) to the plant's objective of delivering safe and reliable wastewater treatment services. Relating the $C_a$ rating to the $C_r$ rating derived the risk (ARI) for each asset.

Assets receiving the highest criticality rating may result in the assignment of a high Asset Risk Index value. However, if an asset receives an excellent conditional response rating ($C_a$=1) and the highest criticality rating ($C_r$=4), the assets resulting ARI would be low (ARI=4). Conversely, an asset receiving the worst conditional response rating ($C_a$=5) and the lowest criticality rating ($C_r$=1) would result in a corresponding low level of risk (ARI=5). Equipment receiving such low criticality and high conditional response ratings was limited to the Influent Channel Nos. 1 and 2 gates and equipment. Although this equipment received a low risk rating, their condition is rated in the "worst" category.

**Table 7-3** is a matrix of the quantity of assets assigned to each ARI rating category, one through twenty (reference **Table 7-1**).

**Table 7-3**

**Asset Risk Index (ARI), Muddy Creek WWTP**

| | *Conditional Responses, $C_a$* | | | | |
|---|---|---|---|---|---|
| *Criticality, Cr* | 1 (Best) | 2 | 3 | 4 | 5 (Worse) |
| 1 (Low) | 6 | 7 | 22 | 26 | 2 |
| 2 (Med) | 11 | 18 | 32 | 18 | 0 |
| 3 (High) | 11 | 0 | 20 | 16 | 0 |
| 4 (Hi-Hi) | 8 | 2 | 4 | 12 | 0 |

Equipment receiving the highest asset risk index assigned values (ARI=16) were those receiving $C_r$ of 4 and $C_a$ of 4. The next highest risk rating (ARI=12) included equipment receiving a $C_r$ of 3 and a $C_a$ of 4 and those equipment receiving a $C_r$ of 4 and a $C_a$ of 3. **Table 7-4** identifies the equipment that received the highest risk ratings.

**Table 7-4**

**Equipment with Highest Rated Asset Risk Index (ARI)**

| Process | Equipment | $C_a$ | $C_r$ | ARI |
|---|---|---|---|---|
| Preliminary Treatment | Screenings/Grit/Scum Discharge Chute | 5 | 4 | 16 |
| Secondary Treatment | SC No. 1 | 4 | 4 | 16 |
| Secondary Treatment | SC No. 2 | 4 | 4 | 16 |
| Secondary Treatment | SC No. 3 | 4 | 4 | 16 |
| Secondary Treatment | SC No. 4 | 4 | 4 | 16 |
| Preliminary Treatment | Bar Screen/Scum Conveyor | 4 | 4 | 16 |
| Preliminary Treatment | Grit Belt Conveyor | 4 | 4 | 16 |
| Preliminary Treatment | Grit Collection Screw Conveyor | 4 | 4 | 16 |
| Primary Treatment | Primary Clarifier - Traveling Bridge No. 1 | 4 | 4 | 16 |
| Primary Treatment | Primary Clarifier - Traveling Bridge No. 2 | 4 | 4 | 16 |
| Secondary Treatment | ASB Blower 3A (Diesel) | 4 | 4 | 16 |
| Secondary Treatment | ASB Blower 3B | 4 | 4 | 16 |
| Secondary Treatment | ASB Blower 3C | 4 | 4 | 16 |
| Preliminary Treatment | Bar Screen No. 1 | 4 | 4 | 16 |
| Preliminary Treatment | Bar Screen No. 2 | 4 | 4 | 16 |
| Preliminary Treatment | Bar Screen No. 3 | 4 | 4 | 16 |
| Primary Treatment | PC Screw Collector No. 1 | 4 | 4 | 16 |
| Primary Treatment | PC Screw Collector No. 2 | 4 | 4 | 16 |
| Primary Treatment | PC Screw Collector No. 3 | 4 | 4 | 16 |
| Primary Treatment | PC Screw Collector No. 4 | 4 | 4 | 16 |
| Secondary Treatment | ASB No. 1 | 4 | 4 | 16 |
| Secondary Treatment | ASB No. 2 | 4 | 4 | 16 |
| Secondary Treatment | ASB No. 3 | 4 | 4 | 16 |
| Electrical | Blower Bld MCC | 5 | 3 | 15 |
| Electrical | 1340 kw Gen Radiator | 3 | 4 | 12 |
| Secondary Treatment | ASB Splitter Box | 3 | 4 | 12 |
| Electrical | Primary MCC | 4 | 3 | 12 |
| Electrical | Hypo System MCC | 4 | 3 | 12 |
| Solids Digestion | Digester Gas Accessories Val/Press Relief Val on Covers | 4 | 3 | 12 |
| Preliminary Treatment | Grit Collection Chamber No. 1 | 4 | 3 | 12 |
| Preliminary Treatment | Grit Collection Chamber No. 2 | 4 | 3 | 12 |
| Preliminary Treatment | Grit Collection Chamber No. 3 | 4 | 3 | 12 |
| Solids Digestion | Digester Covers #1 | 4 | 3 | 12 |
| Solids Digestion | Digester Covers #2 | 4 | 3 | 12 |
| Solids Digestion | Digester Covers #3 | 4 | 3 | 12 |

**Table 7-4**

**Equipment with Highest Rated Asset Risk Index (ARI)**

| Process | Equipment | $C_a$ | $C_r$ | ARI |
|---|---|---|---|---|
| Solids Digestion | Digester Covers #4 | 4 | 3 | 12 |
| Final Treatment | NPW Pump No. 1 | 4 | 3 | 12 |
| Final Treatment | NPW Pump No. 2 | 4 | 3 | 12 |
| Final Treatment | NPW Pump No. 3 | 4 | 3 | 12 |
| Solids Digestion | Boilers 5050 mgd; 150.8 hp #1 | 4 | 3 | 12 |
| Solids Digestion | Boilers x 3, 5050 mgd; 150.8 hp #2 | 4 | 3 | 12 |
| Solids Digestion | Boilers, 5050 mgd; 150.8 hp #3 | 4 | 3 | 12 |

Additional equipment that rated medium in criticality ($C_r$=3) and average in condition ($C_a$=3) resulted in a medium-high risk index (ARI-9). **Table 7-5** includes the next level of assets with a medium to high level of risk.

**Table 7-5**

**Equipment with a Medium-High Asset Risk Index (ARI)**

| Process | Equipment | $C_a$ | $C_r$ | ARI |
|---|---|---|---|---|
| Electrical | Dual 480 V Main Plant Transformer | 3 | 3 | 9 |
| Solids Digestion | Digester AHU | 3 | 3 | 9 |
| Secondary Treatment | Secondary Clarifier Splitter Box | 3 | 3 | 9 |
| Headworks | Influent Screw Pump No. 4 | 3 | 3 | 9 |
| Headworks | Influent Screw Pump No. 5 | 3 | 3 | 9 |
| Headworks | Influent Screw Pump No. 1 | 3 | 3 | 9 |
| Headworks | Influent Screw Pump No. 2 | 3 | 3 | 9 |
| Headworks | Influent Screw Pump No. 3 | 3 | 3 | 9 |
| Final Treatment | Hypo Feed Pump No. 1 | 3 | 3 | 9 |
| Final Treatment | Hypo Feed Pump No. 2 | 3 | 3 | 9 |
| Final Treatment | Hypo Feed Pump No. 3 | 3 | 3 | 9 |

∗ The influent screw pumps received an average rating due in part to their redundancy in firm capacity.

### 7.2.1.5 Prioritization of Need

The asset risk index (ARI) is the weighting of an asset's condition (conditional response, $C_a$) against its level of importance (criticality, $C_r$). It is an effective means of prioritizing need based on visual observations of the asset. To determine an asset's overall Accumulative Risk Factor, further investigations into the asset's remaining useful life, the degree by which it requires maintenance and upkeep to maintain a serviceable condition, and its operational abilities and constraints provide insights into the asset's likely potential for failure. Given its remaining useful life, operational and maintenance needs, and likely potential for failure, the asset's priority for replacement can be estimated. Prioritization of Need specifically examined the following criteria:

- Remaining Useful Life (RUL): The estimated remaining useful life weighted by the asset's condition and its O&M requirements.

- Probability of Failure (PoF)*:* The probability that an asset will no longer perform its intended function.
    - The greatest PoF value observed and highest probability was 11; values of 5 were considered of medium probability.

- Risk Factor (RF): The proportionality of the assets criticality to its probability of failure.
    - A high RF rating is characteristic of an asset that is critical to the plant and demonstrates a high chance of failure. These assets require a high priority given their need for urgent repairs or replacement.

**Table 7-6 – Prioritization of Need** summarizes the ranking of assets with the greatest priority of need, rank from the greatest need to the least. Only those assets that received an ARI of 9 (medium-high) or higher; received a Probability of Failure rating greater than 4 and a Risk Factor greater than 15 are included. Some assets may have received higher Probability of Failure scores but very low Asset Risk Index scores; these assets had average conditional response ratings but very low criticality ratings. For example, the Caustic Bulk Tank received a conditional response of 3, an O&M conditional response of 3 but a criticality of 1. The resulting PoF was 10 and the RF 10; therefore, it did not warrant a rating placing it on the prioritization of need list (the highest most immediate need).

Based on the prioritization of need table (Table 7-6), the process areas requiring the greatest attention include (by flow path) the Headworks (influent pumping); Preliminary Treatment (screening and grit removal facilities); Primary Treatment; Secondary Treatment (Aeration Basin air system and blowers); and Sludge Treatment (Anaerobic Digestion covers and gas system).

**Table 7-6**

**Asset of Greatest Priority of Need**

| Process | Equipment | ARI | PoF | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|
| Preliminary Treatment | Screenings/Grit/Scum Discharge Chute | 16 | 11.9 | 1986 | 2002 | 47.6 |
| Preliminary Treatment | Bar Screen/Scum Conveyor | 16 | 11 | 1986 | 2000 | 43.9 |
| Preliminary Treatment | Grit Belt Conveyor | 16 | 11 | 1986 | 2000 | 42.0 |
| Preliminary Treatment | Grit Collection Screw Conveyor | 16 | 11 | 1986 | 2005 | 42.0 |
| Primary Treatment | Primary Clarifier - Traveling Bridge No. 1 | 16 | 11 | 1986 | 2005 | 42.0 |

**Table 7-6**

**Asset of Greatest Priority of Need**

| Process | Equipment | ARI | PoF | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|
| Primary Treatment | Primary Clarifier - Traveling Bridge No. 2 | 16 | 11 | 1986 | 2005 | 42.0 |
| Electrical | 1340 kw Gen Radiator | 12 | 10 | 1999 | 2025 | 38.0 |
| Electrical | Blower Bld MCC | 15 | 11.9 | 1986 | 2006 | 35.7 |
| Electrical | Primary MCC | 12 | 11.0 | 1986 | 2009 | 32.9 |
| Electrical | Hypo System MCC | 12 | 11.0 | 1996 | 2019 | 32.9 |
| Solids Digestion | Digester Gas Accessories Val/Press Relief Val on Covers | 12 | 11 | 1986 | 2000 | 32.9 |
| Preliminary Treatment | Grit Collection Chamber No. 1 | 12 | 11.0 | 1986 | 2004 | 32.9 |
| Preliminary Treatment | Grit Collection Chamber No. 2 | 12 | 11.0 | 1986 | 2004 | 32.9 |
| Preliminary Treatment | Grit Collection Chamber No. 3 | 12 | 11.0 | 1986 | 2004 | 32.9 |
| Solids Digestion | Digester Covers #1 | 12 | 10.5 | 1986 | 2003 | 31.5 |
| Solids Digestion | Digester Covers #2 | 12 | 10.5 | 1986 | 2003 | 31.5 |
| Solids Digestion | Digester Covers #3 | 12 | 10.5 | 1986 | 2003 | 31.5 |
| Solids Digestion | Digester Covers #4 | 12 | 10.5 | 1986 | 2003 | 31.5 |
| Electrical | Dual 480 V Main Plant Transformer | 9 | 10 | 1986 | 2011 | 30.0 |
| Secondary Treatment | SC No. 1 | 16 | 7.1 | 1986 | 2004 | 28.4 |
| Secondary Treatment | SC No. 2 | 16 | 7.1 | 1986 | 2004 | 28.4 |
| Secondary Treatment | SC No. 3 | 16 | 7.1 | 1986 | 2004 | 28.4 |
| Secondary Treatment | SC No. 4 | 16 | 7.1 | 1986 | 2004 | 28.4 |
| Solids Digestion | Digester AHU | 9 | 9 | 1986 | 2008 | 27.0 |
| Secondary Treatment | ASB Blower 3A (Diesel) | 16 | 5.5 | 1986 | 2009 | 22.0 |

**Table 7-6**

**Asset of Greatest Priority of Need**

| Process | Equipment | ARI | PoF | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|
| Secondary Treatment | ASB Blower 3B | 16 | 5.5 | 1986 | 2009 | 22.0 |
| Secondary Treatment | ASB Blower 3C | 16 | 5.5 | 1986 | 2009 | 22.0 |
| Preliminary Treatment | Bar Screen No. 1 | 16 | 5.5 | 1986 | 2004 | 22.0 |
| Preliminary Treatment | Bar Screen No. 2 | 16 | 5.5 | 1986 | 2004 | 22.0 |
| Preliminary Treatment | Bar Screen No. 3 | 16 | 5.5 | 1986 | 2004 | 22.0 |
| Primary Treatment | PC Screw Collector No. 1 | 16 | 5.5 | 1986 | 2000 | 22.0 |
| Primary Treatment | PC Screw Collector No. 2 | 16 | 5.5 | 1986 | 2000 | 22.0 |
| Primary Treatment | PC Screw Collector No. 3 | 16 | 5.5 | 1986 | 2000 | 22.0 |
| Primary Treatment | PC Screw Collector No. 4 | 16 | 5.5 | 1986 | 2000 | 22.0 |
| Secondary Treatment | ASB No. 1 | 16 | 5.3 | 1986 | 2005 | 21.0 |
| Secondary Treatment | ASB No. 2 | 16 | 5.3 | 1986 | 2005 | 21.0 |
| Secondary Treatment | ASB No. 3 | 16 | 5.3 | 1986 | 2005 | 21.0 |
| Secondary Treatment | ASB Splitter Box | 12 | 5 | 1986 | 2026 | 20.0 |
| Electrical | Automatic Transfer Switch | 4 | 8.5 | 1999 | 2028 | 16.9 |
| Electrical | Emergency Generator Set 4BT 3.9 - GH | 4 | 8.5 | 1999 | 2028 | 16.9 |
| Final Treatment | NPW Pump No. 1 | 12 | 5.5 | 1986 | 2009 | 16.5 |
| Final Treatment | NPW Pump No. 2 | 12 | 5.5 | 1986 | 2009 | 16.5 |
| Final Treatment | NPW Pump No. 3 | 12 | 5.5 | 1986 | 2009 | 16.5 |
| Secondary Treatment | Secondary Clarifier Splitter Box | 9 | 5 | 1986 | 2026 | 15.0 |
| Headworks | Influent Screw Pump No. 4 | 9 | 5.0 | 1986 | 2006 | 15.0 |
| Headworks | Influent Screw Pump No. 5 | 9 | 5.0 | 1986 | 2006 | 15.0 |

**Table 7-6**

**Asset of Greatest Priority of Need**

| Process | Equipment | ARI | PoF | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|
| Headworks | Influent Screw Pump No. 1 | 9 | 5.0 | 1986 | 2006 | 15.0 |
| Headworks | Influent Screw Pump No. 2 | 9 | 5.0 | 1986 | 2006 | 15.0 |
| Headworks | Influent Screw Pump No. 3 | 9 | 5.0 | 1986 | 2006 | 15.0 |

## 7.2.2 Condition Observations

The following conditional assessment observations were made during the equipment assessments and subsequent staff interviews.

### 7.2.2.1 Headworks

The Headworks facilities for the Muddy Creek WWTP consist of two influent sewers, the Muddy Creek interceptor and the South Fork interceptor, and two influent channels adjacent to the screw pumps. The South Fork interceptor contains an odor control system. Five spiral screw influent pumps convey raw wastewater to the screening and grit removal facilities. The influent screw pumps Nos. 1 through 3 (72-inches) are in fair to good condition and Nos. 4 and 5 (84-inches) are in fair to poor condition. Pumps were overhauled between 1999 and 2005.

***South Fork Influent Structure***

- The South Fork influent structure is in good overall condition with concrete showing only minimal surface cracks.
- The bypass gate valve is stuck in place and should be repaired/replaced.
- Moderate corrosion is present on the surface of night light metals with severe corrosion under base-plate of light.
- Signal conduit for old pH meter in corner of structure is in very bad condition with cover missing and wiring exposed.
- There is standing water and algae present on the northeast corner of the structure.
- Surface rust is present on the odor control system motor.
- The tubing for the odor control system's magnehelic gauge has deteriorated and should be replaced.

- The mounting of the main disconnect panel for the odor control system is unstable.
- The tape used to seal odor control piping is failing, causing leaks within the system.

***Influent Channels***

- The inlet isolation gate frame is bent on channel No. 1. Operators are uncertain if the gate can be closed to isolate flow.
- Severe corrosion is present on some of the channel grating and should be replaced immediately.
- The exterior light at the channel is not operable and should be replaced. The conduit leading to the light is corroded. There is a heavy buildup of rags on conduit.
- Isolation chains between guardrails at each channel are corroded and should be replaced.
- Severe corrosion is present on two electrical outlets and associated conduit between influent channels and screw pumps. Outlets are not usable.

***Influent Pumps***

- Lubricant leakage/spillage is present around gear boxes for pumps No. 4 and 5.
- The bottom belt guard bracket is either severely corrode or missing on pump Nos. 1 thru 3.
- The inlet gates for each screw pump are stuck in place or very difficult to operate. The operations staff believes all gates leak to some degree. Gates and actuators should be repaired/replaced to facilitate operation. Gate/valve exercise programs should be implemented.
- There is minor rust on gear box base plate and paint chipping. Oil lines have paint chipping and surface corrosion.
- Concrete cracks are present between the influent structure exterior wall and the stairs located on the west wall. The stairs have pulled away from the wall.

### 7.2.2.2 Preliminary Treatment

The screenings removal system consists of three climber screens and a belt conveyor. All screenings removed discharge to a belt conveyor that transports screenings and concentrated scum/grease to a collection hopper.

Two roto strainers, located adjacent to the mechanical bar screens, concentrate scum/grease removed from the primary clarifiers. Concentrated scum is discharged on the screenings/scum belt conveyor.

The chain and bucket grit removal system removes grit for screened wastewater flowing through the grit channels. Grit removed is discharged onto a screw conveyor which discharges to a belt conveyor. The belt conveyor transports removed grit to a storage hopper.

***Bar Screens***

- The bar screens are aged (installed in 1986 and upgraded in 1999) and should be considered for replacement.
- For all bar screens, some of the bottom teeth are missing on rake assembly and multiple teeth are bent on main rake.
- There is leakage or lubricant spillage present on all gear boxes. Excess lubricant is present on pin rack and sprocket.
- The proximity switches are corroded on each unit. The top proximity switch on bar screen No. 3 is in very bad condition.
- There is moderate corrosion present on conduit hubs around each unit.
- The differential level meters (HydroRanger) for each screen don't function properly. The bar screens are operated in Timer mode in lieu of differential level.
- The local controls for all screens are faded or unreadable.

***Screenings/Scum Belt Conveyor***

- The screenings/scum conveyors are aged with parts replaced in 2007. The units are very dirty, contain moderate corrosion and should be budgeted for replacement.
- The discharge scraper doesn't work properly contributing to significant debris (screenings and grease) being present on the drip pan. Frequent wash-down is needed to maintain clean working area.
- The conveyor belt is worn and should be replaced.
- The belt guide rollers are worn and roller brackets have severe corrosion.
- Local controls for the conveyor are faded and control box has surface corrosion.

***Roto Strainers***

- The motor and gear box need to be replaced on unit No. 1. Corrosion is present on motor, gearbox, and electrical motor junction box. The motor and gearbox have been replaced on unit No. 2.
- The water line valves to each unit are stuck in current position.
- The covers for pushbutton controls are missing or cracked.
- Conduit to overhead lights in scum concentration area is corroded with failed coatings.

***Grit Chambers and Collection Equipment***

- The operations staff is concerned about grit removal system capacity. During high flow events, retention time is too low in the collection chambers allowing grit to pass through and settle in the primary clarifiers, adversely impacting the primary sludge conveyance systems.
- The local controls are faded and unreadable. Rubber covers for pushbutton are cracked or missing.
- The MCC is original equipment and reportedly have experienced main disconnect switches breaking in the past.
- Teflon strips within grit channel are breaking loose, migrating to the primary clarifiers.
- The local motor overload alarms are disconnected from each unit but overload alarms are displayed through the SCADA system
- There is moderate to severe corrosion present on channel metals. Chain guide brackets and gate shaft support brackets have significant deterioration.
- Multiple isolation gates leak or are stuck in place.
- Corrosion is present on conduit hubs. Supports are missing causing conduit to sag in channel No. 3.

***Grit Screw Conveyor***

- The screw conveyor is circa 1986 and should be considered for replacement. Multiple areas of the trough have been repaired due to bad bearing allowing screw to wear through trough.
- Moderate corrosion is present at unit discharge. Internal surfaces should be evaluated for corrosion.

- The motor and gearbox are aged and should be considered for replacement.
- The limit switch (motion sensor) attached at drive belt guard is not functioning.

*Grit Belt Conveyor*

- The screw conveyor appears to be aged and should be considered for replacement. Operations staff is concerned about excess debris build-up on drip pan. Frequent wash-down is required to maintain clean work area. The discharge scraper should be adjusted or replaced.
- The belt roller brackets have moderate corrosion.
- The local controls are faded and control box has surface corrosion. Normally, the conveyors are controlled remotely through SCADA.
- Grit/screening/scum is discharged through a chute prior to being stored in hoppers. Metals on the discharge chute have significant corrosion and the rubber chute contains significant deterioration. Replacement of the discharge chute is recommended.

#### 7.2.2.3 Primary Treatment

There are four primary clarifiers containing two traveling bridges and associated collection and pumping equipment. Each primary clarifier is equipped with dual screw collection devices at the clarifier's influent area. Four duplex, plunger pumps are used for conveying raw sludge (primary sludge) to the digesters.

*Primary Clarifiers and Traveling Bridges*

- The traveling bridges are aged but have been maintained in good working order. Surface corrosion was present on each unit's drive shaft and at the top portion of the rake frame. Plant staff is concerned about corrosion in the internal framework, especially at the air to water interface. Further investigation is needed to evaluate the internal degradation of the traveling bridge frame work.
- Traveling bridge no. 1 was taken out of service for repair during the assessment period. Observations of sludge collection and associated equipment below the water level appear to be in fair condition. Corrosion and paint chipping was present at the top portion of the rake frame just below the air to water surface.
- Plant staff are concerned that two primary clarifiers must be taken out of service when repair or maintenance is completed on one traveling bridge. This reduces primary clarification capacity by 50 percent, which could adversely impact plant performance, especially during high flow events.

- The primary clarification tanks are in good overall condition. Minor surface cracking was observed.

- The primary clarifier weirs are degrading with weir coating failing. Recoating and/or weir replacement should be considered.

***Primary Sludge/Scum Collection and Pumping***

- The sludge collection screws observed in primary clarifier's No. 1 and 2 were in good condition. Screw collectors in primary clarifier Nos. 3 and 4 were not visible, contained below the water surface.

- The drive units for the screw collectors have some visible wear with the motor previously replaced on screw collector No. 3. Motor replacement for the other units should be budgeted.

- Covering for the pushbutton controls to start/stop the collectors is worn or missing. The pushbuttons should be replaced.

- Some of the conduits for the screw collectors contain corrosion at elbows with cracks visible on electrical flex conduit. The conduit for screw collector drive No. 4 has been pinched resulting in a break in the conduit.

- The metal framing supports for conduit runs and junction boxes contain moderate to heavy corrosion. The limit switch arm for collector No. 3 drive unit is missing and should be replaced.

- The operations staff is currently unable to measure the sludge blanket level using the blanket detectors installed. The sludge blanket detectors should be evaluated for replacement. The traveling bridges will break shear pins if alignment becomes and issue due to high sludge blankets or other obstruction. All raw sludge pumps have major oil leakage in and around the pumping area. Absorbent strips have been positioned around the pumps in an effort to prevent oil from spilling on the floor. It appears the motors have been replaced on pump Nos. 3 and 4. Motor replacement should be considered for pump Nos. 1 and 2.

- The scum collection troughs have moderate corrosion on the trough and associated handles. Previous repairs have been made to the trough handles used to manually remove scum. Automating trough operation should be considered. While scum and grease within the primary clarifiers is at a minimum, accumulated grease was observed in the primary clarifier influent area.

- The scum pumps are aged containing worn shaft sleeves with packing leaking excessively. Seal water drainage from the pumping area is poor.

- Suction and discharge gauges are missing on the scum pumps. The seal water system does not contain pressure gauges and should be considered. Gauges have clogged with grease in the past. Gauges with diaphragms suitable for sludge and grease applications should be considered.

- The controls for the scum pumps are dirty and not labeled well.

- Pump support frames and piping to and from the scum pumps contain moderate corrosion.

- Current plant automation does not prevent scum pumping when issues occur at the roto strainer, causing clogging within the pipe and potential damage to the strainers. Improvements to the scum collection and pumping system should be considered to prevent pumping when the roto strainers are in alarm or piping is clogged.

#### 7.2.2.4 Secondary Treatment

An aeration basin splitter box divides the primary effluent flow between three activated sludge basins (ASB). Three centrifugal blowers, powered by methane gas, diesel fuel, or electrical utility, provide oxygen to the fine bubble diffuser grid in the ASBs. Return activated sludge (RAS) is returned the ASBs, discharging at the head of each basin. The perimeter of the ASBs is piped with a foam suppression system to reduce basin foaming. The ASBs are setup to allow for step feed if necessary.

Four secondary clarifiers are provided for final clarification. A four-way splitter box divides ASB effluent between the clarifiers. Clarified effluent is discharged from weirs located along each tank's perimeter. Solids, settled in the clarifier, are raked to the center and removed using progressing cavity pumps that discharge to the gravity thickener or upstream of the primary clarifiers.

***Activated Sludge Basins***

- The ASB splitter box is in good working condition. The caustic feed pipe at the splitter box inlet contains surface corrosion. Handrail is needed on the top level of the splitter box where an old ladder was removed.

- Various valves and gates around the aeration basin are either stuck in position or not functional. Hand-wheels on multiple actuators are missing or severely corroded. Support brackets for gates/valves/piping are severely corroded. Repair/replacement of valves and gates should be budgeted, and a valve exercise program should be implemented.

- The foam suppression system contains severe corrosion and is currently unusable. Areas of piping are missing and valves are not functional. The entire piping, valve and nozzle system should be replaced immediately if needed for treatment.

- The Unistrut support system for conduits and junction boxes is severely corroded in areas. The Unistrut supports should be replaced with stainless steel or FRP to prevent future corrosion. Various areas of handrail have surface corrosion.

- The air piping, constructed of FRP and stainless steel, contains leaks at expansion joints. Multiple areas of the air piping within the blower building contain insulation that is falling off or missing.

- The basin structures appear to be in fair/poor condition. Some minor to moderate concrete cracking is present. Multiple areas around the basins contain expansion joints that are either missing or deteriorated. Various metals within the basins have severe corrosion.

- A persistent wet area is located near the RAS flowmeter display containing algae making concrete very slick.

- Excess noise is noted within the blower building. Additional noise reduction devices should be considered.

- The engines powering the blowers have been repaired over the years but still contain significant oil leakage. Shaft realignment following repairs is extremely difficult. The operations staff is concerned that bearings made for the Toshiba motors are no longer available.

***Secondary Clarification and RAS Pumping***

- The secondary clarifier splitter box is in fair working order. Weir gates within the splitter box are difficult to operate. Trees observed within the splitter box should be removed. The operations staff did mention flows weren't divided evenly during high flow events, with more flow going to clarifier's No. 2 and 4.

- The rake/scum arm drives for the secondary clarifiers are aged and should be budgeted for replacement. Oil leakage or buildup was observed on each unit with excessive leakage observed on unit No. 4.

- The controls for clarifier drive operation are faded with pushbutton rubber coating missing or torn. The Unistrut type supports for conduit and junction boxes contain moderate to severe corrosion.

- No issues were noted with the rake and scum arms. An improved spray system should be considered to encourage scum to migrate to the scum collection trough.

- The weirs for all secondary clarifiers are in good condition. Sodium hypochlorite can be used periodically to keep the weirs clean. The piping

delivering sodium hypochlorite to the clarifiers is need of replacement due to leakage and breaks. Tar coated metal boxes located on the clarifier launder prevent excess use of sodium hypochlorite.

- The drain valve for clarifier No. 2 does not function and should be replaced. The clarifier must be pumped out using a portable pump.
- New centrifugal RAS pumps were installed in 2000. The pumping system is in excellent shape with no issues observed. The operations staff did mention that some check valves leak. The automatic wasting valve does not function properly. Wasting is currently controlled manually.
- Weir controllers for the RAS return box have surface corrosion on the tandem shaft hubs and other metals. The actuator and motor for boxes No. 3 and 4 are aged and should be considered for replacement. Replacement parts for EIM controller are obsolete or very difficult to locate. Replacing RAS control actuators is recommended.
- The secondary clarifier polymer system dry feeder has surface corrosion on the feeder base. Operations staff noted that some alarm and controls do no function properly.
- The vertical shaft mixer is missing on polymer storage tank No. 1.
- Polymer feed pumps have lubricant leakage around motors and gearboxes.
- Electrical actuators are missing on two valves between polymer storage tanks and feed pumps.
- The sump pump station appears to be in fair working condition. The isolation valves are stuck in their current position.

#### 7.2.2.5 Final Treatment

Effluent flow is measured by a Parshall Flume and ultrasonic level indicator. Three non-potable water pumps are installed adjacent to the old chlorine contact chamber, providing plant water to the treatment plant site. The effluent pump station includes three submersible pumps for pumping treated effluent to the remote discharge location.

***Parshall Flume***

- The Parshall Flume is in good overall condition. No significant issues were noted.

*Non-potable Water Pumps*

- The non-potable water pumps are in poor overall condition. The pumps contain high vibration and excessive wear on rotating surfaces.
- The non-potable water system contains a strainer/filter system. Strainers are worn and should be replaced. Minor corrosion is present on the strainer housing.
- The AHU in the non-potable pumping area is oversized with some corrosion present. Installing properly sized air handler should be considered.
- Non-potable water discharge piping coating is deteriorated in various areas.

*Effluent Pump Station*

- Effluent pumps are in very good condition. The level indicator in the high head well does not work properly due to scum buildup, preventing complete operation of pumps in Auto. The pumps will start in Auto but must be shutdown manually through SCADA. The level indicator should be replaced with operable unit or a scum removal system should be installed.

### 7.2.2.6 Solids Thickening

The solids thickening facilities consist of a gravity thickener, polymer system, and thickened solids transfer pumps. The gravity thickener receives WAS settled from the secondary clarifiers. The dry polymer feed system is only used when needed to enhance thickening in the gravity thickener. Thickened solids transfer pumps are used to feed the primary digesters. Gravity thickener make-up water pumps are used to add water as needed to prevent septicity and subsequent odor.

*Gravity Thickener*

- The drive for the thickener is aged and should be considered for replacement. Evidence of lubricant leakage is present at the gearbox. The coating on the drive unit is beginning to fail with bolt heads containing surface corrosion.
- During gravity thickener assessment, an oily sheen was present on the water surface.
- Effluent overflowing thickener weirs was uneven. Overall, the weirs were in good condition.
- The conduit brackets and supports in the thickener area contain moderate corrosion.

*Thickener Polymer System*

- The dry feeder is aged with corrosion present on feeder housing. The rotameter at the feeder contains a black build-up preventing view of flow measurement.
- The polymer transfer and feed pumps are aged with lubricant leakage around each pump. Some surface corrosion is present.
- The polymer ageing and feed tanks are in good/fair condition.

*Thickened Solids Transfer Pumps (Digester Feed Pumps)*

- Major lubricant leakage is present around all pumps with No. 1in worst condition. Absorbent strips have been placed around each unit in an effort to prevent spillage onto the floor.
- The automated timer to feed thickened sludge to the digester is not functional. Operators currently manually activate pumps to feed solids to the digester.
- The motor has been replaced on pump No. 3. Motor replacement should be budgeted for pump Nos. 1 and 2.

*Gravity Thickener Make-up Water Pump*

- The make-up water pumps were installed during the plant's original construction, but remain in good working order.
- Surface corrosion is present on electrical hub connections.

### 7.2.2.7 Solids Digestion

The digestion system includes four digesters (3 primary and 1 secondary) and the associated mixing equipment. Three pumping systems are used to facilitate proper digestion. The sludge recirculation pumps circulate digester sludge to maintain the proper temperature. Sludge transfer pumps are used to transfer between digesters, typically to digester No. 4. The digested sludge transfer pumps are used to transport digested sludge to the dryer facility at the Archie Elledge WWTP. In addition to the digesters and pumping systems, the digester heating system is used to maintain proper digester temperature, while the gas storage and conveyance system is used to store digester gas to power other equipment at the plant or burn at the waste gas burners.

*Digesters/Mixers*

- The covers for the digesters have been recoated within the last three years. There is corrosion present at the water line for the skirts. Evaluation of the interior of the digester tanks is recommended.

- The digester mixers appear to be in poor condition. During the assessment, two of the twenty mixers were out of service. It appears that two motors have been recently replaced. Budgeting for other motor replacement as well as repair/replacing a portion of mixers each year is prudent. During discussion with the plant's maintenance staff, the digester mixers were of major concern with bearing failures occurring more frequently. Vibration is present on some mixers due to bearing failures or rags present on mixer impellers. Impellers for mixers are pitted and may contribute to a rotational imbalance and shaft deflection.

- Pin holes and moderate corrosion is present on various mixer draft tubes. Repair and/or replacement of draft tubes are recommended.

- The electrical conduit was broken at the hub adjacent to mixer 3-2.

- Assessment of the digester tanks and associated building reveal several areas where the expansion joints have failed and are now out of place or missing. Leaks were observed at expansion joint breaks during a rain event. Repairs are needed to prevent further structural degradation.

***Sludge Recirculation Pumps***

- The sludge recirculation pumps were installed during original plant construction and are nearing the end of their service life. The pumps are now aged with repair and maintenance events occurring more frequently. During discussion with the plant's maintenance staff, the recirculation pumps were of major concern.

- Various valves on the pumping system show corrosion and are very difficult to operate.

- All discharge pressure switches for the pumps have been disconnected. Proper pressure switches should be replaced to ensure safety protection is adequate.

- Seal water isolation valves and strainers contain moderate to severe corrosion.

***Sludge Transfer Pumps***

- The sludge transfer pumps were installed during original plant construction and are nearing the end of their service life. The pumps are now aged with repair and maintenance events occurring more frequently. During discussion with the plant's maintenance staff, the transfer pumps were of major concern.

- Various valves on the pumping system show corrosion and are very difficult to operate.

- Seal water isolation valves and strainers contain moderate to severe corrosion.

- Two original digester transfer pumps No. 1 and 2 were evaluated. Both pumps appear to have been out of service for some time and are in very poor condition. Removal of pumps is recommended.

***Digested Sludge Transfer Pumps***

- Three new digested sludge transfer pumps were installed to transport digested sludge to the Archie Elledge dryer facility. The pumping systems are in excellent condition.

***Heating System***

- Both large heat exchangers used to heat digester feed sludge are in fair condition. Minor scaling around piping is visible. Some isolation valves to instruments are stuck in current position. Multiple valves have been replaced on piping adjacent to the heat exchanger.

- Valves on small heat exchangers are leaking in multiple areas. Valves for heat exchanger No. 5 have been replaced recently.

- Significant scaling is present on piping and associated valves for small heat exchangers. The plant's maintenance staff is concerned that small heat exchangers may begin to fail in the near future.

- The boilers used to provide digester and building heat have been in service for twenty years and will need to be slated for replacement in the future. Piping leaks are present on each boiler. Boilers are in fair condition.

- The hot water booster pumps are aged and should be budgeted for replacement. The motor on pump No. 2 has been replaced. Heavy scale is present around piping and valves. Insulation is falling from associated piping and valves. Corrosion is present on base-plates of pumps.

- The two hot water booster pumps used for building heat are aged and appear to be in poor condition. Discussion with plant staff revealed that pump operation is acceptable.

- Pneumatic valve operators, controlling heat exchanger water valves, were installed during original plant construction. Valve operators are aged with replacement parts difficult to locate. The associated piping is aged and deteriorated. Valve operators and piping should be replaced during future digester heating system upgrades.

*Gas Storage and Conveyance*

- The waste gas burners are in very poor condition. Severe corrosion is present on both units. Replacement of the waste gas burner should be budgeted immediately.
- The automatic ignition system for the waste gas burners is inoperable. Operators must manually light the burner using flame on end of pole which is a significant safety concern.
- Gas piping at the waste gas burner is deteriorated and should be replaced.
- The gas storage sphere is in good overall condition. Pressure relief valves on the top of the sphere contain moderate corrosion. The bottom flange on inlet/outlet gas pipe at sphere has moderate corrosion.
- Moderate corrosion is present on various digester gas accessories, including pressure relief valve bolts and adjacent piping.
- The gas compressors are located in a highly corrosive environment. Compressors should be inspected internally for degradation. Oil leaks are present around compressors.
- The gas piping is in poor condition. Significant corrosion is present on some moisture drain lines with some being replaced with PVC. Numerous sections of the gas piping system have been replaced. Internal inspection of gas piping is warranted to confirm extent of degridadtion.
- The low pressure gas receiver has been replaced due to severe corrosion and deterioration.

### 7.2.2.8 Solids Dewatering

The solids dewatering facilities consist of three belt filter presses (BFP) and conveyors, washwater pumps, and polymer system. The dewatering facility is moth balled and has been out of service since the dryer facility was commissioned at the Archie Elledge WWTP.

- Significant cracks are present on the concrete floor of the BFP building.
- The space heater above the BFPs is in extremely poor condition. Severe corrosion is present on heater metals and threaded rod support hangers.

*Belt Filter Presses*

- The BFPs have been out of service for two years and remain in fair condition. BFP No. 2 was shutdown with sludge remaining in unit.

- The metal coating on the BFPs is beginning to fail with chipped paint present around each unit.
- Conduit brackets and supports are severely corroded or missing in various areas.

***Polymer System***

- The polymer feed area is very dirty with polymer on floor surface.
- The control panel contains surface corrosion. Some analog instruments on the panel indicate values when system is off. Severe corrosion is present on alarm panel horn.
- Dry polymer feeder is covered in polymer slime with heavy corrosion present.
- The piping to polymer feeder is in poor condition.
- The coating is failing on polymer tank metals and associated mixers.
- Polymer feed pumps No. 2 and 3 are in poor condition. Polymer feed pump No. 1 has been removed.

***Belt Conveyors***

- Minor surface corrosion is present on the belt conveyors.
- Dewatered sludge remains in and around the conveyors.

#### 7.2.2.9 Solids Storage

Solids storage consists of three lagoons which are now primarily used for centrate storage. Each lagoon contains one or more submersible pump to remove centrate. Solids stored in the lagoons and/or digester can be transferred to the blended sludge storage tanks. Each tank contains a dual screw conveyor and mechanical mixer. Solids removed from the storage tank are delivered to a tanker truck from the truck loading station via the truck loading pumps.

***Sludge/Centrate Storage Lagoons***

- The operations staff is concerned with Struvite buildup in the centrate piping. Currently caustic is used to break up Struvite which could potentially deteriorate the piping.
- The lagoons are in fair overall condition.
- Moderate to severe corrosion is present on control boxes, selector switches, and disconnects with selector switches and associated labeling faded.

- Supports for controls are inadequate leaving enclosures unstable. Mounting bolts are pulling through on enclosures and some run time meters for lagoon pumps are not functioning.

***Sludge Blend Storage, Tank Mixer and Screw Feeders***

- The sludge blend storage tanks are in good condition with only minor surface cracks present.
- The blend tank mixers are in good condition. Some surface corrosion is present on the gear boxes.
- The dual screw conveyors have been out of service for approximately two years. The screws have significant corrosion and deterioration preventing future use.
- Significant corrosion is present on electrical supports and Unistrut at mixer and screw conveyors.
- Discharge piping within the screw feeder pit is severely corroded.

***Truck Loading Station and Pumps***

- The truck loading station and associated pumps are in good condition. No significant issues were noted.

#### 7.2.2.10 Chemical Systems

Various chemical systems are used at the Muddy Creek WWTP to assist in facility operation. In general, the chemical feed systems consist of a storage tank or silo and chemical feed pumps to conveyor chemical to the application zone. One exception is the lime feed system, which delivers lime slurry by gravity into the primary clarifier effluent.

***Caustic (Sodium Hydroxide)***

- Caustic pumps are aged and should be budgeted for replacement in the future.
- Multiple leaks are present on caustic feed system piping.
- Bulk tank overflow pipe in very bad condition.
- The insulation is beginning to fail on the bulk storage tank.
- Moderate corrosion present on caustic discharge pipe at plant influent splitter box.

***Lime (Calcium Hydroxide)***

- Temporary dust shielding is being used to protect the slurry mixer shaft protection and prevent lime dust mitigation to the surrounding area. Slurry tank mixer shaft guard should be replaced.
- Lime feed system trips from time to time and will not consistently operate in Auto.
- There is moderate lime dust build-up in lime feed area.
- Lime silo appears to be in good overall condition.

***Ferric Chloride***

- Minor leakage stains are present on bottom manway on bulk storage tank.
- The bulk storage tank contains surface cracking.
- Ferric chemical leakage stains are present in feed pump area.
- The coating on the containment area is cracked and peeling.
- The access ladder is mounted very close to the tank preventing safe access.

***Dispersant***

- Leakage is visible around chemical feed pumps.

***Ammonium Nitrate Feed System***

- Heat tracing is exposed in various areas.
- Temporary insulation box positioned over feed pump has deteriorated. Permanent insulation box should be considered.
- Cinderblock containment area is in fair condition with minor paint chipping. The operations staff noted that the containment walls leak.

***Sodium Hypochlorite***

- Corrosion is present on feed pump No. 1 back pressure valves.
- Feed Pump Nos. 2 and 3 have oil leaks.
- Feed pump flow meter appears to have reached its service life and operations staff are concerned they are unable to read meter at low flows.
- Leaks are present on quick connects on offloading station.

- Sodium Hypochlorite recirculation pump Nos. 1 and 2 has been replaced.

***Sodium Bisulfite***

- Piping and valve leaks are present on the bisulfite feed pump piping.
- The building housing the sodium bisulfite feed system is on very good condition. Minor parapet/flashing cracking is present.
- The carry water pump has severe corrosion on back pressure valves.

***Electrical and Backup Power Facilities***

- Electrical utility to the plant is supplied by Duke Power. The single feed is brought in at 17800 volts and stepped down at the main plant transformer to 4160V. The power pole support located at the main plant transformer is leaning with wood deteriorated and corrosion present on metals. Additional support or replacement of the power pole is recommended.
- The 4160 volt switchgear, located in the blower building, is aged with replacement parts difficult to locate or obsolete. Moderate corrosion is present on switchgear. Replacement of switchgear during future upgrades is recommended.
- Two 480 volt transformers are located adjacent to the blower building. The transformers are aged with moderate to severe corrosion present on transformer housing and internal supports. Budgeting for replacing transformers in the future is recommended.
- Backup power generators at the plant are in good overall condition. Diesel fuel storage facilities are in good condition. Minor to moderate corrosion is present on the 1340 kW generator radiator metals and supply/return piping and insulation jacketing.
- Moderate to severe corrosion is present on small transformers located at MCCs in electrical rooms at primary clarifiers, blower building, non-potable water pumps, sodium hypochlorite feed area and at the blended sludge facilities. Parts for transformers are difficult to locate or obsolete. Replacement up transformers during future electrical upgrades is recommended.
- Various MCCs at the plant contain plastic breaker handles. Multiple handles have either cracked or broken in the past. The plant's electrical staff is currently replacing a portion of the plastic handles with metal handles.

- Various electrical vaults around the treatment plant collect rain water and must be pumped out with sump pump periodically. Installing permanent sump pumps should be considered.

## 7.3 Muddy Creek WWTP Recommended Improvements Plan

Based on the results of the condition assessment, CDM has identified $22,054,000 in equipment capital improvements needed to maintain the Muddy Creek wastewater treatment plant over the 20-year planning period. Equipment is ranked by Risk Value, Asset Risk Index, Probability of Failure and Remaining Useful Life. Replacement costs are for planning level approximations only and include equipment and installation cost estimated in 2009 dollars; a more definitive cost estimation should be developed independent of this Master Planning document for specific asset replacement and renewals.

### 7.3.1 Planning Period – Years One through Five

**Table 7-7** represents equipment that should be prioritized during the first 5 years of the 20 year Capital Improvements Planning (CIP) period. Assets are prioritized based on Risk Value ranging from 20 to 47.6, ARI 9 and higher and Probability of Failure 5 and higher. The total estimated cost for the first 5 years of the 20 year CIP is $10,975,000.

**Table 7-7**

**Cost Estimates for Years 1 thru 5 of the 20 Year Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Preliminary Treatment | Screenings/Grit/Scum Discharge Chute | 20 | 11.9 | $ 20,000 | 1986 | 2002 | 47.6 |
| Solids Digestion | Waste Gas Burner | 20 | 8 | $ 80,000 | 1986 | 2003 | 45.8 |
| Preliminary Treatment | Bar Screen/Scum Conveyor | 16 | 11 | $ 75,000 | 1986 | 2000 | 43.9 |
| Preliminary Treatment | Grit Belt Conveyor | 16 | 11 | $ 60,000 | 1986 | 2000 | 42.0 |
| Preliminary Treatment | Grit Collection Screw Conveyor | 16 | 11 | $ 65,000 | 1986 | 2005 | 42.0 |
| Primary Treatment | Primary Clarifier - Traveling Bridge No. 1 | 16 | 11 | $ 700,000 | 1986 | 2005 | 2.0 |
| Primary Treatment | Primary Clarifier - Traveling Bridge No. 2 | 16 | 11 | $ 700,000 | 1986 | 2005 | 42.0 |
| Electrical | Blower Bld MCC | 15 | 11.9 | $ 50,000 | 1986 | 2006 | 35.7 |
| Secondary Treatment | SC No. 1 | 20 | 7.1 | $ 472,500 | 1986 | 2004 | 35.5 |

**Table 7-7**

**Cost Estimates for Years 1 thru 5 of the 20 Year Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Secondary Treatment | SC No. 2 | 20 | 7.1 | $ 472,500 | 1986 | 2004 | 35.5 |
| Secondary Treatment | SC No. 3 | 20 | 7.1 | $ 472,500 | 1986 | 2004 | 35.5 |
| Secondary Treatment | SC No. 4 | 20 | 7.1 | $ 472,500 | 1986 | 2004 | 35.5 |
| Electrical | Primary MCC | 12 | 11.0 | $ 50,000 | 1986 | 2009 | 32.9 |
| Electrical | Hypo System MCC | 12 | 11.0 | $ 50,000 | 1996 | 2019 | 32.9 |
| Solids Digestion | Digester Gas Accessories Val/Press Relief Val on Covers | 12 | 11 | $ 250,000 | 1986 | 2000 | 32.9 |
| Preliminary Treatment | Grit Collection Chamber No. 1 | 12 | 11.0 | $ 65,000 | 1986 | 2004 | 32.9 |
| Preliminary Treatment | Grit Collection Chamber No. 2 | 12 | 11.0 | $ 65,000 | 1986 | 2004 | 32.9 |
| Preliminary Treatment | Grit Collection Chamber No. 3 | 12 | 11.0 | $ 65,000 | 1986 | 2004 | 32.9 |
| Solids Digestion | Digester Covers #1 | 12 | 10.5 | $ 325,000 | 1986 | 2003 | 31.5 |
| Solids Digestion | Digester Covers #2 | 12 | 10.5 | $ 325,000 | 1986 | 2003 | 31.5 |
| Solids Digestion | Digester Covers #3 | 12 | 10.5 | $ 325,000 | 1986 | 2003 | 31.5 |
| Solids Digestion | Digester Covers #4 | 12 | 10.5 | $ 325,000 | 1986 | 2003 | 31.5 |
| Solids Digestion | Digester AHU | 9 | 9 | $ 10,000 | 1986 | 2008 | 27.0 |
| Secondary Treatment | ASB Blower 3A (Diesel) | 16 | 5.5 | $ 890,000 | 1986 | 2009 | 22.0 |
| Secondary Treatment | ASB Blower 3B | 16 | 5.5 | $ 890,000 | 1986 | 2009 | 22.0 |
| Secondary Treatment | ASB Blower 3C | 16 | 5.5 | $ 890,000 | 1986 | 2009 | 22.0 |
| Preliminary Treatment | Bar Screen No. 1 | 16 | 5.5 | $ 190,000 | 1986 | 2004 | 22.0 |
| Preliminary Treatment | Bar Screen No. 2 | 16 | 5.5 | $ 190,000 | 1986 | 2004 | 22.0 |
| Preliminary Treatment | Bar Screen No. 3 | 16 | 5.5 | $ 190,000 | 1986 | 2004 | 22.0 |

**Table 7-7**

**Cost Estimates for Years 1 thru 5 of the 20 Year Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Primary Treatment | PC Screw Collector No. 1 | 16 | 5.5 | $ 75,000 | 1986 | 2000 | 22.0 |
| Primary Treatment | PC Screw Collector No. 2 | 16 | 5.5 | $ 75,000 | 1986 | 2000 | 22.0 |
| Primary Treatment | PC Screw Collector No. 3 | 16 | 5.5 | $ 75,000 | 1986 | 2000 | 22.0 |
| Primary Treatment | PC Screw Collector No. 4 | 16 | 5.5 | $ 75,000 | 1986 | 2000 | 22.0 |
| Secondary Treatment | RAS Return Box No. 2 Weir Controllers | 8 | 11 | $ 20,000 | 1986 | 2000 | 21.0 |
| Primary Treatment | PC effluent troughs #1 | 8 | 11 | $ 40,000 | 1986 | 2003 | 21.0 |
| Primary Treatment | PC effluent troughs #2 | 8 | 11 | $ 40,000 | 1986 | 2003 | 21.0 |
| Secondary Treatment | ASB No. 1 | 16 | 5.3 | $ 500,000 | 1986 | 2005 | 21.0 |
| Secondary Treatment | ASB No. 2 | 16 | 5.3 | $ 500,000 | 1986 | 2005 | 21.0 |
| Secondary Treatment | ASB No. 3 | 16 | 5.3 | $ 500,000 | 1986 | 2005 | 21.0 |
| Solids Digestion | Digester Mixers (all center mixers-4) | 9 | 5.0 | $ 340,000 | 1986 | 2001 | 20.0 |
| **Year 1 through 5 Total Estimated Cost** | | | | **$10,975,000.00** | | | |

## 7.3.2 Planning Period – Years Six through Ten

**Table 7-8** represents equipment that should be prioritized between years 6 and 10 of the 20 year Capital Improvements Planning (CIP) period. Assets are prioritized based on Risk Value and range from 7 to 20. The total estimated cost for the second 5 years of the 20 year CIP is $6,265,000.

**Table 7-8**

**Cost Estimates for Years 6 thru 10 of the 20 Year Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Electrical | NPW PS MCC | 6 | 10 | $ 20,000 | 1986 | 2011 | 20.0 |
| Secondary Treatment | ASB Splitter Box | 12 | 5 | $ 75,000 | 1986 | 2026 | 20.0 |
| Final | NPW PS Backwash | 6 | 10 | $ 25,000 | 1986 | 2001 | 20.0 |

**Table 7-8**

**Cost Estimates for Years 6 thru 10 of the 20 Year Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Treatment | System | | | | | | |
| Secondary Treatment | RAS Return Box No. 1 Weir Controllers | 6 | 10 | $ 25,000 | 1986 | 2001 | 20.0 |
| Secondary Treatment | Blower Bld AHU | 6 | 10 | $ 10,000 | 1986 | 2006 | 20.0 |
| Electrical | 1340 kW Gen Radiator | 12 | 10 | $ 25,000 | 1999 | 2025 | 19.0 |
| Solids Thickening | Gravity Thickener | 6 | 10 | $ 135,000 | 1986 | 2039 | 19.0 |
| Electrical | Dual 480 V Main Plant Transformer | 9 | 10 | $ 100,000 | 1986 | 2011 | 19.0 |
| Solids Digestion | Digester Mixers (all peripheral mixers) | 6 | 1.0 | $ 1,360,000 | 1986 | 2002 | 19.0 |
| Solids Digestion | Gas Sphere | 6 | 9 | $ 250,000 | 1986 | 2006 | 18.0 |
| Solids Digestion | Low Pressure Receiver | 6 | 9 | $ 50,000 | 1986 | 2006 | 18.0 |
| Electrical | Digester MCC | 6 | 9 | $ 20,000 | 1986 | 2014 | 18.0 |
| Final Treatment | Hypo Storage Area | 6 | 9 | $ 25,000 | 1999 | 2016 | 18.0 |
| Primary Treatment | Lime Feed System | 4 | 9 | $ 135,000 | 1986 | 2003 | 18.0 |
| Electrical | Fuel Oil Storage Tank | 4 | 9.0 | $ 35,000 | 1999 | 2019 | 18.0 |
| Final Treatment | Effluent Channel Parshall Flume | 4 | 8.5 | $ 50,000 | 1986 | 2032 | 16.9 |
| Headworks | South Fork Influent Structure | 4 | 8 | $ 75,000 | 2006 | 2052 | 16.9 |
| Final Treatment | Carrier Water Pump | 4 | 8.5 | $ 20,000 | 1999 | 2022 | 16.9 |
| Electrical | Automatic Transfer Switch | 4 | 8.5 | $ 25,000 | 1999 | 2028 | 16.9 |
| Electrical | Emergency Generator Set 4BT 3.9 - GH | 4 | 8.5 | $ 85,000 | 1999 | 2028 | 16.9 |
| Final Treatment | NPW Pump No. 1 | 12 | 5.5 | $ 25,000 | 1986 | 2009 | 16.5 |
| Final Treatment | NPW Pump No. 2 | 12 | 5.5 | $ 25,000 | 1986 | 2009 | 16.5 |
| Final Treatment | NPW Pump No. 3 | 12 | 5.5 | $ 25,000 | 1986 | 2009 | 16.5 |

**Table 7-8**

**Cost Estimates for Years 6 thru 10 of the 20 Year Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Solids Digestion | Ferric Chloride Tank | 2 | 7.9 | $ 25,000 | 2005 | 2023 | 15.8 |
| Mechanical | Effluent PS ACCU /AHU | 2 | 7.9 | $ 10,000 | 2008 | 2032 | 15.8 |
| Electrical | Russel Switchgear | 2 | 7.9 | $ 40,000 | 1999 | 2029 | 15.8 |
| Electrical | Effluent PS MCC | 2 | 7.9 | $ 20,000 | 2008 | 2038 | 15.8 |
| Final Treatment | Effluent Bld Switchgear | 2 | 7.9 | $ 20,000 | 2008 | 2038 | 15.8 |
| Electrical | Backup Power Generator (1340 KW) | 4 | 4.0 | $ 300,000 | 1999 | 2029 | 15.8 |
| Electrical | Backup Power Generator (8000 KW) | 4 | 4.0 | $ 425,000 | 2007 | 2037 | 15.8 |
| Secondary Treatment | Secondary Clarifier Splitter Box | 9 | 5 | $ 75,000 | 1986 | 2026 | 15.0 |
| Headworks | Influent Screw Pump No. 4 | 9 | 5.0 | $ 225,000 | 1986 | 2006 | 15.0 |
| Headworks | Influent Screw Pump No. 5 | 9 | 5.0 | $ 225,000 | 1986 | 2006 | 15.0 |
| Headworks | Influent Screw Pump No. 1 | 9 | 5.0 | $ 225,000 | 1986 | 2006 | 15.0 |
| Headworks | Influent Screw Pump No. 2 | 9 | 5.0 | $ 225,000 | 1986 | 2006 | 15.0 |
| Headworks | Influent Screw Pump No. 3 | 9 | 5.0 | $ 225,000 | 1986 | 2006 | 15.0 |
| Solids Digestion | Hi Press Gas Compression #1 | 8 | 5.7 | $ 75,000 | 1986 | 1999 | 11.5 |
| Solids Digestion | Hi Press Gas Compression #2 | 8 | 5.7 | $ 75,000 | 1986 | 1999 | 11.5 |
| Solids Thickening | Polymer Transfer Pump | 4 | 11 | $ 15,000 | 1986 | 1996 | 10.5 |
| Primary Treatment | Raw Sludge Pump No. 1 | 8 | 5.3 | $ 20,000 | 1986 | 1996 | 10.5 |
| Primary Treatment | Raw Sludge Pump No. 2 | 8 | 5.3 | $ 20,000 | 1986 | 1996 | 10.5 |
| Solids Thickening | Thickener Polymer System Dry Feeder | 4 | 11 | $ 30,000 | 1986 | 2000 | 10.5 |
| Secondary Treatment | RAS Polymer Dry Feeder | 3 | 11 | $ 30,000 | 1986 | 2000 | 10.5 |
| Solids Digestion | Hot Water Booster Pump No. 3 | 8 | 5.3 | $ 10,000 | 1986 | 2005 | 10.5 |

**Table 7-8**

**Cost Estimates for Years 6 thru 10 of the 20 Year Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Electrical | Blended Sludge MCC | 3 | 10.0 | $ 50,000 | 1986 | 2011 | 10.0 |
| Secondary Treatment | Caustic Bulk Tank | 3 | 10 | $ 20,000 | 1988 | 2003 | 10.0 |
| Mechanical | Building Heat Pump HV No. 1 | 6 | 5.0 | $ 10,000 | 1983 | 2003 | 10.0 |
| Mechanical | Building Heat Pump HV NO. 2 | 6 | 5.0 | $ 10,000 | 1983 | 2003 | 10.0 |
| Mechanical | AHU NPW PS Bld | 3 | 10 | $ 10,000 | 1986 | 2006 | 10.0 |
| Solids Thickening | Polymer Aging Tank | 3 | 10 | $ 15,000 | 1986 | 2006 | 10.0 |
| Solids Thickening | Polymer Feed Tank | 3 | 10 | $ 15,000 | 1986 | 2006 | 10.0 |
| Mechanical | Hot Water Booster Pump No. 1 | 6 | 5.0 | $ 10,000 | 1986 | 2006 | 10.0 |
| Mechanical | Hot Water Booster Pump No. 2 | 6 | 5.0 | $ 10,000 | 1986 | 2006 | 10.0 |
| Solids Digestion | Main Heat Exchanger No. 1 | 6 | 5.0 | $ 280,000 | 1986 | 2006 | 10.0 |
| Preliminary Treatment | Scum Concentrator No. 1 | 6 | 5.0 | $ 100,000 | 1998 | 2013 | 10.0 |
| Preliminary Treatment | Scum Concentrator No. 2 | 6 | 5.0 | $ 100,000 | 1998 | 2013 | 10.0 |
| Final Treatment | Sodium Bisulfite Pump 2 | 6 | 5.0 | $ 10,000 | 1999 | 2014 | 10.0 |
| Final Treatment | Sodium Bisulfite Pumps 1 | 6 | 5.0 | $ 10,000 | 1999 | 2014 | 10.0 |
| Headworks | South Fork Odor Control System | 3 | 10 | $ 75,000 | 2006 | 2026 | 10.0 |
| Secondary Treatment | RAS Return Box No. 1 | 6 | 5.0 | $ 50,000 | 1986 | 2026 | 10.0 |
| Secondary Treatment | RAS Return Box No. 2 | 6 | 5.0 | $ 50,000 | 1986 | 2026 | 10.0 |
| Solids Digestion | Main Heat Exchanger No. 2 | 6 | 5.0 | $ 280,000 | 1986 | 2006 | 10.0 |
| Solids Thickening | Digester Feed Pump No. 1 | 8 | 4.8 | $ 15,000 | 1986 | 1996 | 9.6 |
| Solids Thickening | Digester Feed Pump No. 2 | 8 | 4.8 | $ 15,000 | 1986 | 1996 | 9.6 |
| Final Treatment | Fecal Sample Station and Pump | 3 | 10 | $ 10,000 | 1999 | 2015 | 9.5 |

**Table 7-8**

**Cost Estimates for Years 6 thru 10 of the 20 Year Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Primary Treatment | PC Scum Pump 1 | 6 | 4.5 | $ 15,000 | 1986 | 2003 | 9.0 |
| Primary Treatment | PC Scum Pump 2 | 6 | 4.5 | $ 15,000 | 1986 | 2003 | 9.0 |
| Secondary Treatment | RAS AHU | 3 | 9 | $ 10,000 | 1986 | 2008 | 9.0 |
| Final Treatment | Hypo Recirc. Pump No. 2 | 4 | 4.5 | $ 10,000 | 1999 | 2010 | 9.0 |
| Final Treatment | Hypo Recirc. Pump No. 1 | 4 | 4.5 | $ 10,000 | 2008 | 2030 | 9.0 |
| Final Treatment | Hypo Bulk Tank No. 1 | 4 | 4.5 | $ 25,000 | 2008 | 2025 | 9.0 |
| Final Treatment | Hypo Bulk Tank No. 2 | 4 | 4.5 | $ 25,000 | 2008 | 2025 | 9.0 |
| Final Treatment | Ammonium Nitrate Feed System | 2 | 9.0 | $ 75,000 | 2005 | 2025 | 9.0 |
| **Year 6 through 10 Total Estimated Cost** | | | | **$6,265,000.00** | | | |

## 7.3.3 Planning Period – Years Eleven through Twenty

**Table 7-9** represents equipment that should be prioritized between years 11 and 20 of the 20 year Capital Improvements Planning (CIP) period. Assets are prioritized based on Risk Value and range from 0.2 to 8.5. The total estimated cost for the last 10 years of the 20 year CIP is $4,814,000.

It is important to note that during the final 10 years of the 20 year planning period, assets replaced, renewed and rebuilt in the preceding 10 years (year one through ten) will have aged and achieved their remaining useful life. These assets will increase the estimated planning level cost defined for this period.

**Table 7-9**

**Cost Estimates for Years 11 thru 20 of the Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Final Treatment | Mixer (SO2) | 2 | 8 | $ 15,000 | 2002 | 2018 | 8.5 |
| Final Treatment | Sodium Bisulfite Tank 3000 gal. | 2 | 8.5 | $ 20,000 | 1999 | 2015 | 8.5 |
| Solids Digestion | Dispersant Tank | 1 | 7.9 | $ 15,000 | 2005 | 2027 | 7.9 |

**Table 7-9**

**Cost Estimates for Years 11 thru 20 of the Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Headworks | Old Influent Channel No. 1 | 5 | 6.0 | $ 75,000 | 1986 | 2022 | 6.0 |
| Headworks | Old Influent Channel No. 2 | 5 | 6.0 | $ 75,000 | 1986 | 2022 | 6.0 |
| Solids Digestion | Digester Transfer Pump #1 | 4 | 5.7 | $ 20,000 | 1986 | 1996 | 5.7 |
| Solids Digestion | Digester Transfer Pump #2 | 4 | 5.7 | $ 20,000 | 1986 | 1996 | 5.7 |
| Solids Digestion | Instrument Air Compressors | 4 | 5.3 | $ 10,000 | 1986 | 2000 | 5.3 |
| Solids Thickening | Polymer Feed Pump No. 1 | 4 | 5.3 | $ 10,000 | 1986 | 2000 | 5.3 |
| Solids Thickening | Polymer Feed Pump No. 2 | 4 | 5.3 | $ 10,000 | 1986 | 2000 | 5.3 |
| Secondary Treatment | Poly Feed Pump No. 1 | 3 | 5.3 | $ 10,000 | 1986 | 2001 | 5.3 |
| Secondary Treatment | Caustic FB No. 2 | 4 | 5.3 | $ 10,000 | 1988 | 2002 | 5.3 |
| Secondary Treatment | Caustic FP No. 1 | 4 | 5.3 | $ 10,000 | 1988 | 2002 | 5.3 |
| Secondary Treatment | Poly Feed Tank No. 1 | 3 | 5.3 | $ 10,000 | 1986 | 2006 | 5.3 |
| Final Treatment | NPW PS Sump Pumps | 3 | 5.0 | $ 10,000 | 1986 | 2001 | 5.0 |
| Secondary Treatment | Poly Feed Pump No. 2 | 3 | 5.0 | $ 10,000 | 1986 | 2001 | 5.0 |
| Secondary Treatment | RAS Sump Pumps | 3 | 5.0 | $ 10,000 | 1986 | 2001 | 5.0 |
| Solids Digestion | Pneumatic Dual Head Compressor #2 | 3 | 5.0 | $ 10,000 | 1986 | 2001 | 5.0 |
| Solids Digestion | Pneumatic Dual Head Compressors #1 | 3 | 5.0 | $ 10,000 | 1986 | 2001 | 5.0 |
| Secondary Treatment | Poly Feed Tank No. 2 | 3 | 5.0 | $ 25,000 | 1986 | 2006 | 5.0 |
| Solids Thickening | GT Make-up Water Pump No. 1 | 3 | 5.0 | $ 15,000 | 1986 | 2006 | 5.0 |
| Solids Thickening | GT Make-up Water Pump No. 2 | 3 | 5.0 | $ 15,000 | 1986 | 2006 | 5.0 |
| Solids Thickening | Thickener Basement Sump Pump Station | 3 | 4.5 | $ 10,000 | 1986 | 2001 | 4.5 |

**Table 7-9**

**Cost Estimates for Years 11 thru 20 of the Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Solids Storage | Truck Loading Pump No. 1 | 2 | 4.2 | $ 48,000 | 1986 | 1997 | 4.2 |
| Solids Storage | Truck Loading Pump No. 2 | 2 | 4.2 | $ 48,000 | 1986 | 1997 | 4.2 |
| Solids Digestion | Dispersant DMP Pump No. 1 | 1 | 4.0 | $ 10,000 | 2005 | 2022 | 4.0 |
| Solids Digestion | Dispersant DMP Pump No. 2 | 1 | 4.0 | $ 10,000 | 2005 | 2022 | 4.0 |
| Solids Digestion | Boilers 5050 mgd; 150.8 hp #1 | 12 | 1.1 | $ 200,000 | 1999 | 2013 | 3.3 |
| Solids Digestion | Boilers x 3, 5050 mgd; 150.8 hp #2 | 12 | 1.1 | $ 200,000 | 1999 | 2013 | 3.3 |
| Solids Digestion | Boilers, 5050 mgd; 150.8 hp #3 | 12 | 1.1 | $ 200,000 | 1999 | 2013 | 3.3 |
| Final Treatment | Hypo Feed Pump No. 1 | 9 | 1.1 | $ 10,000 | 1999 | 2014 | 3.3 |
| Final Treatment | Hypo Feed Pump No. 2 | 9 | 1.0 | $ 10,000 | 1999 | 2014 | 3.0 |
| Final Treatment | Hypo Feed Pump No. 3 | 9 | 1.0 | $ 10,000 | 1999 | 2014 | 3.0 |
| Final Treatment | Effluent Pump No. 1 | 3 | 0.8 | $ 75,000 | 2008 | 2030 | 2.5 |
| Final Treatment | Effluent Pump No. 2 | 3 | 0.8 | $ 75,000 | 2008 | 2030 | 2.5 |
| Final Treatment | Effluent Pump No. 3 | 3 | 0.8 | $ 75,000 | 2008 | 2030 | 2.5 |
| Solids Digestion | Hot Water Lube Pump No. 1 | 8 | 1.1 | $ 25,000 | 1986 | 2005 | 2.2 |
| Solids Digestion | Hot Water Lube Pump No. 2 | 8 | 1.1 | $ 25,000 | 1986 | 2005 | 2.2 |
| Solids Digestion | Hot Water Lube Pump No. 3 | 8 | 1.1 | $ 25,000 | 1986 | 2005 | 2.2 |
| Solids Storage | Lagoon Pump No. 1 | 8 | 1.1 | $ 20,000 | 1986 | 1996 | 2.1 |
| Solids Storage | Lagoon Pump No. 2 | 8 | 1.1 | $ 20,000 | 1986 | 1996 | 2.1 |
| Solids Storage | Lagoon Pump No. 3 | 8 | 1.1 | $ 20,000 | 1986 | 1996 | 2.1 |
| Solids Digestion | Secondary Heat Exchanger No. 1 | 6 | 1.0 | $ 175,000 | 1986 | 2006 | 2.0 |
| Solids | Secondary Heat | 6 | 1.0 | $ 175,000 | 1986 | 2006 | 2.0 |

**Table 7-9**

**Cost Estimates for Years 11 thru 20 of the Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Digestion | Exchanger No. 2 | | | | | | |
| Solids Digestion | Secondary Heat Exchanger No. 3 | 6 | 1.0 | $ 175,000 | 1986 | 2006 | 2.0 |
| Solids Digestion | Secondary Heat Exchanger No. 4 | 6 | 1.0 | $ 175,000 | 1986 | 2006 | 2.0 |
| Solids Digestion | Secondary Heat Exchanger No. 5 | 6 | 1.0 | $ 175,000 | 1986 | 2006 | 2.0 |
| Solids Digestion | Secondary Heat Exchanger No. 6 | 6 | 1.0 | $ 175,000 | 1986 | 2006 | 2.0 |
| Primary Treatment | Raw Sludge Pump No. 3 | 6 | 1.0 | $ 20,000 | 1986 | 1996 | 2.0 |
| Primary Treatment | Raw Sludge Pump No. 4 | 6 | 1.0 | $ 20,000 | 1986 | 1996 | 2.0 |
| Solids Thickening | Digester Feed Pump No. 3 | 6 | 0.9 | $ 20,000 | 1986 | 1996 | 1.8 |
| Solids Dewatering | Dewatering System Poly Feed Pump #1 | 4 | 1.1 | $ 10,000 | 1986 | 2000 | 1.1 |
| Solids Dewatering | Dewatering System Poly Feed Pump #2 | 4 | 1.1 | $ 10,000 | 1986 | 2000 | 1.1 |
| Solids Dewatering | Dewatered Cake Conveyor North | 4 | 1.1 | $ 55,000 | 1986 | 2000 | 1.1 |
| Solids Dewatering | Dewatered Cake Conveyor South | 4 | 1.1 | $ 55,000 | 1986 | 2000 | 1.1 |
| Solids Storage | Sludge Dual Screw Conveyor No. 1 | 4 | 1.0 | $ 80,000 | 1986 | 2000 | 1.0 |
| Solids Storage | Sludge Dual Screw Conveyor No. 2 | 4 | 1.0 | $ 80,000 | 1986 | 2000 | 1.0 |
| Solids Storage | Sludge Dual Screw Conveyor No. 3 | 4 | 1.0 | $ 80,000 | 1986 | 2000 | 1.0 |
| Solids Storage | Sludge Blend Tank Mixer No. 1 | 2 | 0.9 | $ 35,000 | 1986 | 2002 | 0.9 |
| Solids Storage | Sludge Blend Tank Mixer No. 2 | 2 | 0.9 | $ 35,000 | 1986 | 2002 | 0.9 |
| Solids Storage | Sludge Blend Tank Mixer No. 3 | 2 | 0.9 | $ 35,000 | 1986 | 2002 | 0.9 |
| Solids Digestion | Ferric Feed Pump No. 2 | 1 | 0.8 | $ 10,000 | 2005 | 2022 | 0.8 |
| Solids Digestion | Ferric Feed Pump No. 3 | 1 | 0.8 | $ 10,000 | 2005 | 2022 | 0.8 |

**Table 7-9**

**Cost Estimates for Years 11 thru 20 of the Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Solids Digestion | Ferric Feed Pump No.1 | 1 | 0.8 | $ 10,000 | 2005 | 2022 | 0.8 |
| Solids Digestion | Sludge Recirculation Pump No. 1 | 6 | 0.2 | $ 20,000 | 1986 | 2006 | 0.4 |
| Solids Digestion | Sludge Recirculation Pump No. 2 | 6 | 0.2 | $ 20,000 | 1986 | 2006 | 0.4 |
| Solids Digestion | Sludge Recirculation Pump No. 3 | 6 | 0.2 | $ 20,000 | 1986 | 2006 | 0.4 |
| Solids Digestion | Sludge Recirculation Pump No. 4 | 6 | 0.2 | $ 20,000 | 1986 | 2006 | 0.4 |
| Solids Digestion | Sludge Recirculation Pump No. 5 | 6 | 0.2 | $ 20,000 | 1986 | 2006 | 0.4 |
| Solids Digestion | Sludge Recirculation Pump No. 6 | 6 | 0.2 | $ 20,000 | 1986 | 2006 | 0.4 |
| Secondary Treatment | RAS Pump No. 1 | 4 | 0.2 | $ 48,000 | 2000 | 2021 | 0.3 |
| Secondary Treatment | RAS Pump No. 2 | 4 | 0.2 | $ 48,000 | 2000 | 2021 | 0.3 |
| Secondary Treatment | RAS Pump No. 3 | 4 | 0.2 | $ 48,000 | 2000 | 2021 | 0.3 |
| Secondary Treatment | RAS Pump No. 4 | 4 | 0.2 | $ 48,000 | 2000 | 2021 | 0.3 |
| Secondary Treatment | RAS Pump No. 5 | 4 | 0.2 | $ 48,000 | 2000 | 2021 | 0.3 |
| Secondary Treatment | RAS Pump No. 6 | 4 | 0.2 | $ 48,000 | 2000 | 2021 | 0.3 |
| Solids Digestion | DSTP No. 7 | 2 | 0.2 | $ 25,000 | 2005 | 2016 | 0.3 |
| Solids Digestion | DSTP No. 8 | 2 | 0.2 | $ 25,000 | 2005 | 2016 | 0.3 |
| Solids Digestion | DSTP No. 9 | 2 | 0.2 | $ 25,000 | 2005 | 2016 | 0.3 |
| Solids Digestion | Digested Sludge Recirculation Pump No. 1 | 2 | 0.2 | $ 15,000 | 2005 | 2027 | 0.3 |
| Solids Digestion | Digested Sludge Recirculation Pump No. 2 | 2 | 0.2 | $ 15,000 | 2005 | 2027 | 0.3 |
| Solids Digestion | Digested Sludge Recirculation Pump No. 3 | 2 | 0.2 | $ 15,000 | 2005 | 2027 | 0.3 |

**Table 7-9**

**Cost Estimates for Years 11 thru 20 of the Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Solids Digestion | Digested Sludge Recirculation Pump No. 4 | 2 | 0.2 | $ 15,000 | 2005 | 2027 | 0.3 |
| Solids Digestion | Digested Sludge Recirculation Pump No. 5 | 2 | 0.2 | $ 15,000 | 2005 | 2027 | 0.3 |
| Solids Digestion | Digested Sludge Recirculation Pump No. 6 | 2 | 0.2 | $ 15,000 | 2005 | 2027 | 0.3 |
| Solids Digestion | Sludge Transfer Pump No. 1 | 4 | 0.2 | $ 15,000 | 1986 | 1996 | 0.2 |
| Solids Digestion | Sludge Transfer Pump No. 2 | 4 | 0.2 | $ 15,000 | 1986 | 1996 | 0.2 |
| Solids Digestion | Sludge Transfer Pump No. 3 | 4 | 0.2 | $ 15,000 | 1986 | 1996 | 0.2 |
| Solids Digestion | Sludge Transfer Pump No. 4 | 4 | 0.2 | $ 15,000 | 1986 | 1996 | 0.2 |
| Solids Digestion | Sludge Transfer Pump No. 5 | 4 | 0.2 | $ 15,000 | 1986 | 1996 | 0.2 |
| Solids Digestion | Sludge Transfer Pump No. 6 | 4 | 0.2 | $ 15,000 | 1986 | 1996 | 0.2 |
| Solids Dewatering | Belt Filter Press (BFP) #1 | 4 | 0.2 | $ 335,000 | 1986 | 2005 | 0.2 |
| Solids Dewatering | Belt Filter Press (BFP) #2 | 4 | 0.2 | $ 335,000 | 1986 | 2005 | 0.2 |
| Solids Dewatering | Belt Filter Press (BFP) #3 | 4 | 0.2 | $ 335,000 | 1986 | 2005 | 0.2 |
| **Year 11 through 20 Total Estimated Cost** | | | | **$4,814,000.00** | | | |

# 7.4 Archie Elledge Wastewater Treatment Plant

## 7.4.1 Condition Assessments

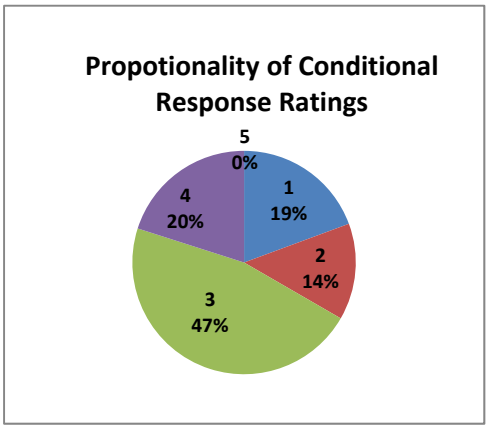
### 7.4.1.1 Physical Facilities

The Archie Elledge WWTP was constructed in 1956 and has undergone significant upgrades to achieve the existing permitted capacity of 30 mgd. The treatment plant is currently under construction to replace the headworks, preliminary and primary treatment facilities.

The condition assessments categorize the facility into the following principal process areas:

- Headworks/ Pretreatment/Lagoons
- Preliminary Treatment
- Primary Treatment
- Secondary Treatment
- Final Treatment
- Solids Thickening
- Solids Digestion and Storage
- Solids Dewatering
- Solids Drying
- Chemical Systems
- Electrical

### 7.4.1.2 Conditional Responses




Within these principal process areas, greater than 300 assets were examined and conditional assessments made. Examining the conditional response ($C_a$) ratings of the equipment observed, the greatest proportionality (approximately 67%) of the equipment was assigned conditional response ratings of 3 and 4. These conditional response ratings are generally appropriate when the inspected item appears to be within its second quartile of its remaining useful life (conditional response rating of 3), or when the inspected item appears to be near the end of its useful life cycle (conditional response rating of 4).

### 7.4.1.3 Criticality Ratings

Each asset was then assigned a Criticality Rating ($C_r$) based on its impact to plant operations, ability to maintain firm capacity, ability to ensure permit compliance and considerations for health and safety. The majority (53%) of the assets were assigned criticality ($C_r$) ratings of MEDIUM (2). Assets considered to have the greatest impact to plant operations, firm capacity, permit compliance and health and safety were rated HIGH-HIGH (4); 29% of all assets were assigned the highest rating. **Table 7-10** is a listing of those assets receiving the highest criticality rating.

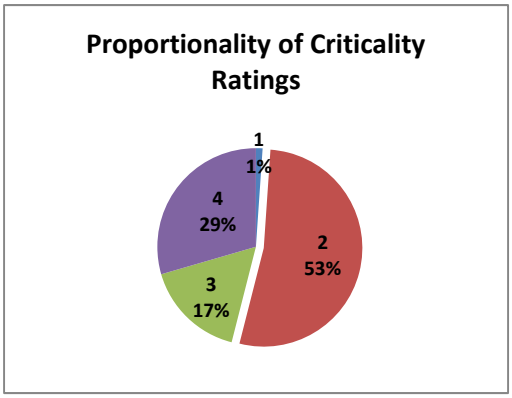



**Table 7-10**

**Assets Receiving Highest Criticality Ratings (HIGH-HIGH)**

| Process Area | Equipment |
|---|---|
| Headworks | Influent Pump No. 1 |
| Headworks | Influent Pump No. 2 |
| Headworks | Influent Pump No. 3 |
| Headworks | Influent Pump No. 4 |
| Secondary Treatment | Aeration Basin Blower No. 1 |
| Secondary Treatment | Aeration Basin Blower No. 2 |
| Secondary Treatment | Aeration Basin Blower No. 3 |
| Secondary Treatment | Aeration Basin Blower No. 4 |
| Secondary Treatment | Electrical Feeds to Basin, Transformer, Transfer Switch |
| Chemical Systems | Sodium Hypo Tank No. 1 |
| Chemical Systems | Sodium Hypo Tank No. 2 |
| Chemical Systems | Sodium Hypo Tank No. 3 |
| Chemical Systems | Sodium Bisulfite Tank No. 1 |
| Chemical Systems | Sodium Bisulfite Tank No. 2 |
| Solids Dewatering/Drying | Polymer Inversion (2) System PSP 1-2 |
| Solids Dewatering/Drying | Polymer Make Down Tank PAT-1 |
| Solids Dewatering/Drying | Polymer Make Down Tank PAT-2 |
| Solids Dewatering/Drying | Wet Cake Transfer Pump Water Injection Pump No. 1 |
| Solids Dewatering/Drying | Wet Cake Transfer Pump Water Injection Pump No. 2 |
| Solids Dewatering/Drying | Off Plant Cake Transfer Pump |
| Solids Dewatering/Drying | Biosolids Cake Conveyor BC-1 Horiz. |
| Solids Dewatering/Drying | Inclined Cake Conveyor To Either BC-1 Cross Conveyor or Cake Bay |
| Solids Dewatering/Drying | Pelletizer |
| Solids Dewatering/Drying | Fire Box |
| Solids Dewatering/Drying | Polymer Storage Tanks (2) |

**Table 7-10**

**Assets Receiving Highest Criticality Ratings (HIGH-HIGH)**

| Process Area | Equipment |
|---|---|
| Solids Dewatering/Drying | Ferric Solution Strainer |
| Solids Dewatering/Drying | Centrifuge #1 |
| Solids Dewatering/Drying | Centrifuge #2 |
| Solids Dewatering/Drying | Centrifuge #3 |
| Solids Dewatering/Drying | DSP (Dig. S1 Pump) |
| Solids Dewatering/Drying | DSM Grinder No. 1 |
| Solids Dewatering/Drying | DSM Grinder No. 2 |
| Solids Dewatering/Drying | DSM Grinder No. 3 |
| Solids Dewatering/Drying | DSM Grinder No. 4 |
| Solids Dewatering/Drying | Centrate To Muddy Pump No. 1 |
| Solids Dewatering/Drying | Centrate To Muddy Pump No. 2 |
| Solids  Dewatering/Drying | HVAC |
| Solids Dewatering/Drying | Pneumatic Pellet Ejector (Final) |
| Solids Dewatering/Drying | Pellet Bin Vibrator (Top Ejector) |
| Solids Dewatering/Drying | Pellet Roller/Crusher |
| Solids Dewatering/Drying | Pneumatic Air Receiver Tank |
| Solids Dewatering/Drying | Induced Draft Fan |
| Solids Dewatering/Drying | Scrubber Drain Pumps |
| Solids Dewatering/Drying | Sludge Cake Pump |
| Solids Dewatering/Drying | Twin Screw Bottom Hopper Cake Screws |
| Solids Dewatering/Drying | Wet Bin Live Bottom Screws |
| Solids Dewatering/Drying | Exhaust Fan Off GC Scrubber |
| Solids Dewatering/Drying | Cake Pug Mixer |
| Solids Dewatering/Drying | Incline Screw To Mixer (Pellets) & Bypass |
| Solids Dewatering/Drying | Pneumatic Ejector Silo (Recycle) |
| Solids Dewatering/Drying | Shaker Roto-Shaker (Pellet Separator) |
| Solids Dewatering/Drying | Pellet Cooler (Finish To Ejector) |
| Solids Dewatering/Drying | Pellet Rotary Air Locks (Pellet Silo) |
| Solids Dewatering/Drying | Pellet Rotary Air Local (Silo Screw) |
| Solids Dewatering/Drying | Pellet Conveyor (Pellet Silo) Horiz. |
| Solids Dewatering/Drying | Pellet Vertical Conveyor To Silo |
| Solids Dewatering/Drying | Pellet Vertical Conveyor To Recycle Bin |
| Solids Dewatering/Drying | Pellet Rotary Air Lock Recycle Bin |
| Solids Dewatering/Drying | Nitrogen Tank |
| Solids Dewatering/Drying | Nitrogen Liquid Gas Exchanger |
| Solids Dewatering/Drying | Silos (2) |
| Solids Dewatering/Drying | Silo Unloaders |
| Final Treatment | Chlorine Contact Basin Blower 1 |

**Table 7-10**

**Assets Receiving Highest Criticality Ratings (HIGH-HIGH)**

| Process Area | Equipment |
|---|---|
| Final Treatment | Chlorine Contact Basin Blower 2 |
| Final Treatment | Chlorine Contact Basin Blower 3 |
| Electrical | Backup Power Generator Engine 4 |
| Electrical | Backup Power Generator Engine 5 |
| Electrical | Generator Radiators |
| Electrical | Generator Day Tank 4 And 5 And Transfer Pump |
| Electrical | Generator Switchgear |
| Solids Digestion | Boiler No. 1 |
| Solids Digestion | Boiler No. 2 |
| Solids Digestion | Boiler No. 3 |
| Solids Digestion | Recirculation Pump For Boiler 1 |
| Solids Digestion | Recirculation Pump For Boiler 2 |
| Solids Digestion | Recirculation Pump For Boiler 3 |
| Solids Digestion | Drainage Tank Low Level In Control Bldg |
| Solids Digestion | Heat Exchanger (In Control Bldg Next To Air Compressor) |
| Primary Treatment | Intermediate Pump No. 1 |
| Primary Treatment | Intermediate Pump No. 4 |
| Primary Treatment | Intermediate Pump No. 4 |
| Primary Treatment | Intermediate Pump No. 4 |
| Solids Storage | Sludge Blend Tanks 1 And 2 |

### 7.4.1.4 Asset Risk Index

The asset risk index (ARI) is the weighting of an asset's condition (Conditional Response, $C_a$) against its level of importance (Criticality, $C_r$) to the plant's objective of delivering safe and reliable wastewater treatment services. Relating the $C_a$ rating to the $C_r$ rating derived the risk (ARI) for each asset.

Assets receiving the highest criticality rating may result in the assignment of a high Asset Risk Index value. However, if an asset receives an excellent conditional response rating ($C_a$=1) and the highest criticality rating ($C_r$=4), the assets resulting ARI would be low (ARI=4). Conversely, an asset receiving the worst conditional response rating ($C_a$=5) and the lowest criticality rating ($C_r$=1) would result in a corresponding low level of risk (ARI=5). **Table 7-11** is a matrix of the quantity of assets assigned to each ARI rating category, one through twenty (reference **Table 7-1**).

**Table 7-11**

**Asset Risk Index (ARI), Archie Elledge WWTP**

| | *Conditional Responses, $C_a$* | | | | |
|---|---|---|---|---|---|
| *Criticality, Cr* | 1 (Best) | 2 | 3 | 4 | 5 (Worse) |
| 1 (Low) | 0 | 0 | 4 | 2 | 0 |
| 2 (Med) | 8 | 15 | 91 | 46 | 0 |
| 3 (High) | 12 | 6 | 55 | 5 | 0 |
| 4 (Hi-Hi) | 35 | 23 | 18 | 7 | 0 |

Equipment receiving the highest asset risk index assigned values (ARI=16) were those receiving $C_r$ of 4 and $C_a$ of 4. The next highest risk rating (ARI=12) included equipment receiving a $C_r$ of 3 and a $C_a$ of 4 and those equipment receiving a $C_r$ of 4 and a $C_a$ of 3. **Table 7-12** identifies the equipment that received the highest risk ratings.

**Table 7-12**

**Equipment with Highest Rated Asset Risk Index (ARI)**

| **Process** | **Equipment** | **$C_a$** | **$C_r$** | **ARI** |
|---|---|---|---|---|
| Secondary Treatment | Electrical Feeds to Basin, Transformer, Transfer Switch | 4 | 4 | 16.0 |
| Final Treatment | Chlorine Contact Basin Blowers 1 | 4 | 4 | 16.0 |
| Final Treatment | Chlorine Contact Basin Blowers 3 | 4 | 4 | 16.0 |
| Primary Treatment | Intermediate Pump No. 1 | 4 | 4 | 16.0 |
| Primary Treatment | Intermediate Pump No. 4 | 4 | 4 | 16.0 |
| Primary Treatment | Intermediate Pump No. 4 | 4 | 4 | 16.0 |
| Primary Treatment | Intermediate Pump No. 4 | 4 | 4 | 16.0 |
| Headworks | Influent Pump No. 1 | 3 | 4 | 12.0 |
| Headworks | Influent Pump No. 2 | 3 | 4 | 12.0 |
| Headworks | Influent Pump No. 3 | 3 | 4 | 12.0 |
| Headworks | Influent Pump No. 4 | 3 | 4 | 12.0 |
| Final Treatment | Chlorine Contact Basin Blowers 2 | 3 | 4 | 12.0 |
| Electrical | Backup Power Generator Engine 4 | 3 | 4 | 12.0 |
| Electrical | Backup Power Generator Engine 5 | 3 | 4 | 12.0 |
| Electrical | Generator Radiators | 3 | 4 | 12.0 |
| Electrical | Generator Day Tanks 4 & 5 and Transfer Pump | 3 | 4 | 12.0 |
| Electrical | Generator Switchgear | 3 | 4 | 12.0 |
| Solids Digestion | Boiler No. 1 | 3 | 4 | 12.0 |
| Solids Digestion | Boiler No. 2 | 3 | 4 | 12.0 |
| Solids Digestion | Boiler No. 3 | 3 | 4 | 12.0 |
| Solids Digestion | Recirculation Pump for Boiler 1 | 3 | 4 | 12.0 |
| Solids Digestion | Recirculation Pump for Boiler 3 | 3 | 4 | 12.0 |

**Table 7-12**

**Equipment with Highest Rated Asset Risk Index (ARI)**

| Process | Equipment | $C_a$ | $C_r$ | ARI |
|---|---|---|---|---|
| Solids Digestion | Drainage Tank Low Level In Control Bldg | 3 | 4 | 12.0 |
| Solids Digestion | Heat Exchanger (in Control bldg Next to Air Compressor) | 3 | 4 | 12.0 |
| Solids Storage | Sludge Blend Tanks 1 and 2 | 3 | 4 | 12.0 |
| Preliminary Treatment | Grit Collector No. 1 | 4 | 3 | 12.0 |
| Preliminary Treatment | Grit Collector No. 2 | 4 | 3 | 12.0 |
| Preliminary Treatment | Grit Collector No. 3 | 4 | 3 | 12.0 |
| Preliminary Treatment | Grit Screw Conveyor | 4 | 3 | 12.0 |
| Secondary Treatment | Aeration Basin Effluent Structures | 4 | 3 | 12.0 |

Additional equipment that rated medium in criticality ($C_r$=3) and average in condition ($C_a$=3) resulted in a medium-high risk index (ARI-9). **Table 7-13** includes the next level of assets with a medium to high level of risk.

**Table 7-13**

**Equipment with a Medium-High Asset Risk Index (ARI)**

| Process | Equipment | $C_a$ | $C_r$ | ARI |
|---|---|---|---|---|
| Preliminary Treatment | Bar Screen No. 1 | 3 | 3 | 9.0 |
| Preliminary Treatment | Bar Screen No. 2 | 3 | 3 | 9.0 |
| Preliminary Treatment | Bar Screen No. 3 | 3 | 3 | 9.0 |
| Preliminary Treatment | Bar Screen/Scum Belt Conveyor | 3 | 3 | 9.0 |
| Preliminary Treatment | Scum Strainer | 3 | 3 | 9.0 |
| Primary Treatment | Primary Clarifiers No. 1 - 4 | 3 | 3 | 9.0 |
| Primary Treatment | Primary Sludge Pump No. 1 | 3 | 3 | 9.0 |
| Primary Treatment | Primary Sludge Pump No. 2 | 3 | 3 | 9.0 |
| Primary Treatment | Primary Sludge Pump No. 3 | 3 | 3 | 9.0 |
| Primary Treatment | Primary Sludge Pump No. 4 | 3 | 3 | 9.0 |
| Final Treatment | NPW Pump No. 1 | 3 | 3 | 9.0 |
| Final Treatment | NPW Pump No. 2 | 3 | 3 | 9.0 |
| Final Treatment | NPW Pump No. 3 | 3 | 3 | 9.0 |
| Solids Dewatering/Drying | Intake Screens | 3 | 3 | 9.0 |
| Solids Dewatering/Drying | Inclined Conveyor | 3 | 3 | 9.0 |
| Solids Dewatering/Drying | SC-7 Horizontal Conveyor | 3 | 3 | 9.0 |
| Solids Dewatering/Drying | SC-6 Horizontal Conveyor | 3 | 3 | 9.0 |
| Solids Thickening | TWAS Pumps #1 | 3 | 3 | 9.0 |
| Solids Thickening | TWAS Pumps #2 | 3 | 3 | 9.0 |
| Solids Thickening | TWAS Pumps #3 | 3 | 3 | 9.0 |
| Solids Thickening | TWAS Station Sump Pumps (2) | 3 | 3 | 9.0 |

**Table 7-13**

**Equipment with a Medium-High Asset Risk Index (ARI)**

| Process | Equipment | $C_a$ | $C_r$ | ARI |
|---|---|---|---|---|
| Final Treatment | Chlorine Contact Chamber Mixer | 3 | 3 | 9.0 |
| Solids Digestion | Sludge Preheater Recirculation Pump 1 And 2 | 3 | 3 | 9.0 |
| Solids Digestion | Small Fuel Pumps In Recirculation Pump Area | 3 | 3 | 9.0 |
| Electrical | Transfer Pump For Small Fuel Tanks | 3 | 3 | 9.0 |
| Mechanical | Exhaust Fans In Control Bldg Nos. 1-5 | 3 | 3 | 9.0 |
| Solids Digestion | Sludge Recirculation Pump No. 1 | 3 | 3 | 9.0 |
| Solids Digestion | Sludge Recirculation Pump No. 2 | 3 | 3 | 9.0 |
| Solids Digestion | Sludge Recirculation Pump No. 3 | 3 | 3 | 9.0 |
| Solids Digestion | Sludge Recirculation Pump No. 4 | 3 | 3 | 9.0 |
| Solids Digestion | Heat Exchanger No. 1 | 3 | 3 | 9.0 |
| Solids Digestion | Heat Exchanger No. 2 | 3 | 3 | 9.0 |
| Solids Digestion | Heat Exchanger No. 3 | 3 | 3 | 9.0 |
| Solids Digestion | Heat Exchanger No. 4 | 3 | 3 | 9.0 |
| Solids Digestion | Gas Compressor No. 1 | 3 | 3 | 9.0 |
| Solids Digestion | Gas Compressor No. 2 | 3 | 3 | 9.0 |
| Solids Digestion | Sludge Transfer Pump No. 1 | 3 | 3 | 9.0 |
| Solids Digestion | Sludge Transfer Pump No. 2 | 3 | 3 | 9.0 |
| Solids Digestion | Sludge Recirculation Pump No. 4 | 3 | 3 | 9.0 |
| Solids Digestion | Sludge Recirculation Pump No. 5 | 3 | 3 | 9.0 |
| Solids Digestion | Sludge Recirculation Pump No. 8 | 3 | 3 | 9.0 |
| Solids Digestion | Heat Exchanger | 3 | 3 | 9.0 |
| Solids Digestion | Gas Compressor No. 3 | 3 | 3 | 9.0 |
| Solids Digestion | Gas Compressor No. 4 | 3 | 3 | 9.0 |
| Solids Digestion | Gas Compressor No. 5 | 3 | 3 | 9.0 |
| Pretreatment/Lagoon Area | Large Concrete Lagoons | 3 | 3 | 9.0 |
| Pretreatment/Lagoon Area | Small Concrete Lagoon | 3 | 3 | 9.0 |
| Pretreatment/Lagoon Area | Un-lined Lagoons (3) | 3 | 3 | 9.0 |
| Pretreatment/Lagoon Area | No. 1 Floating Aerator Large Concrete Lagoon | 3 | 3 | 9.0 |
| Pretreatment/Lagoon Area | No. 2 Floating Aerators Large Concrete Lagoon | 3 | 3 | 9.0 |
| Pretreatment/Lagoon Area | No. 3 Floating Aerator Large Concrete Lagoon | 3 | 3 | 9.0 |
| Pretreatment/Lagoon Area | No. 1 Floating Aerator Small Concrete Lagoon | 3 | 3 | 9.0 |
| Pretreatment/Lagoon Area | No. 2 Floating Aerator Small Concrete Lagoon | 3 | 3 | 9.0 |

**Table 7-13**

**Equipment with a Medium-High Asset Risk Index (ARI)**

| Process | Equipment | $C_a$ | $C_r$ | ARI |
|---|---|---|---|---|
| Pretreatment/Lagoon Area | Influent Parshall Flume | 3 | 3 | 9.0 |
| Pretreatment/Lagoon Area | Outdoor MCC | 3 | 3 | 9.0 |

### 7.4.1.5 Prioritization of Need

The asset risk index (ARI) is the weighting of an asset's condition (conditional response, $C_a$) against its level of importance (criticality, $C_r$). It is an effective means of prioritizing need based on visual observations of the asset. To determine an asset's overall Accumulative Risk Factor, further investigations into the asset's remaining useful life, the degree by which it requires maintenance and upkeep to maintain a serviceable condition, and its operational abilities and constraints provide insights into the asset's likely potential for failure. Given its remaining useful life, operational and maintenance needs, and likely potential for failure, the asset's priority for replacement can be estimated. Prioritization of Need specifically examined the following criteria:

- Remaining Useful Life (RUL): The estimated remaining useful life weighted by the asset's condition and its O&M requirements.

- Probability of Failure (PoF)***:*** The probability that an asset will no longer perform its intended function.
    - The greatest PoF value observed and highest probability was 11; values of 5 were considered of medium probability.

- Risk Factor (RF): The proportionality of the assets criticality to its probability of failure.
    - A high RF rating is characteristic of an asset that is critical to the plant and demonstrates a high chance of failure. These assets require a high priority given their need for urgent repairs or replacement.

**Table 7-14 Prioritization of Need** summarizes the ranking of assets with the greatest priority of need, rank from the greatest need to the least. Only those assets that received an ARI of 9 (medium-high) or higher; received a Probability of Failure rating greater than 4 and a Risk Factor greater than 15 are included.

Based on the prioritization of need table (Table 7-14**)** the process areas requiring the greatest attention include (by flow path) Headworks (influent pumping); Preliminary Treatment (screening and grit removal facilities); Primary Treatment to include Intermediate Pumping;); and Sludge Treatment (conveyors and pumping).

**Table 7-14**

**Asset of Greatest Priority of Need**

| Process | Equipment | ARI | PoF | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|
| Solids Digestion | Drainage Tank Low Level in Control Bldg | 12.0 | 10 | 1980 | 2000 | 40.0 |
| Electrical | Backup Power Generator Engine 4 | 12.0 | 10 | 1992 | 2018 | 38.0 |
| Electrical | Backup Power Generator Engine 5 | 12.0 | 10 | 1992 | 2018 | 38.0 |
| Electrical | Generator Radiators | 12.0 | 10 | 1992 | 2008 | 38.0 |
| Electrical | Generator Switchgear | 12.0 | 10 | 1992 | 2018 | 38.0 |
| Solids Digestion | Recirc Pump for Boiler 1 | 12.0 | 10 | 1980 | 2001 | 38.0 |
| Solids Digestion | Recirc Pump for Boiler 3 | 12.0 | 10 | 1980 | 2001 | 38.0 |
| Preliminary Treatment | Grit Screw Conveyor | 12.0 | 11 | 1992 | 2006 | 31.5 |
| Preliminary Treatment | Bar Screen/Scum Belt Conveyor | 9.0 | 10 | 1992 | 2007 | 30.0 |
| Preliminary Treatment | Scum Strainer | 9.0 | 10 | 1992 | 2000 | 30.0 |
| Solids Dewatering/Drying | Inclined Conveyor | 9.0 | 10 | 2005 | 2020 | 30.0 |
| Final Treatment | Chlorine Contact Chamber Mixer | 9.0 | 10 | 1992 | 2007 | 30.0 |
| Mechanical | Exhaust Fans in Control Bldg Nos. 1-5 | 9.0 | 10 | 1992 | 2012 | 30.0 |
| Primary Treatment | Primary Clarifiers No. 1 through 4 | 9.0 | 10 | 1975 | 1996 | 28.5 |
| Solids Dewatering/Drying | SC-7 Horizontal Conveyor | 9.0 | 10 | 2005 | 2021 | 28.5 |
| Solids Dewatering/Drying | SC-6 Horizontal Conveyor | 9.0 | 10 | 2005 | 2021 | 28.5 |
| Pretreatment/Lagoon Area | Influent Parshall Flume | 9.0 | 10 | 1975 | 2017 | 28.5 |
| Primary Treatment | Intermediate Pump No. 1 | 16.0 | 5 | 1956 | 1974 | 22.0 |
| Primary Treatment | Intermediate Pump No. 4 | 16.0 | 5 | 1956 | 1974 | 22.0 |
| Primary Treatment | Intermediate Pump No. 4 | 16.0 | 5 | 1956 | 1974 | 22.0 |
| Primary Treatment | Intermediate Pump No. 4 | 16.0 | 5 | 1956 | 1974 | 22.0 |
| Secondary Treatment | Electrical Feeds to Basin, Transformer, Transfer Switch | 16.0 | 5 | 1980 | 1994 | 21.0 |
| Headworks | Influent Pump No. 1 | 12.0 | 5 | 1975 | 1983 | 19.0 |

**Table 7-14**

**Asset of Greatest Priority of Need**

| Process | Equipment | ARI | PoF | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|
| Headworks | Influent Pump No. 2 | 12.0 | 5 | 1975 | 1983 | 19.0 |
| Headworks | Influent Pump No. 3 | 12.0 | 5 | 1975 | 1996 | 19.0 |
| Headworks | Influent Pump No. 4 | 12.0 | 5 | 1975 | 1996 | 19.0 |
| Electrical | Generator Day Tank 4 & 5 and Transfer Pump | 12.0 | 5 | 1992 | 2018 | 19.0 |
| Solids Digestion | Boiler No. 1 | 12.0 | 5 | 1980 | 1996 | 19.0 |
| Solids Digestion | Boiler No. 2 | 12.0 | 5 | 1980 | 1996 | 19.0 |
| Solids Digestion | Boiler No. 3 | 12.0 | 5 | 1980 | 1996 | 19.0 |
| Solids Digestion | Heat Exchanger (in Control Bldg Next to air compressor) | 12.0 | 5 | 1980 | 2001 | 19.0 |
| Solids Storage | Sludge Blend Tanks 1 and 2 | 12.0 | 5 | 2008 | 2061 | 19.0 |
| Preliminary Treatment | Grit Collector No. 1 | 12.0 | 5 | 1992 | 2010 | 16.5 |
| Preliminary Treatment | Grit Collector No. 2 | 12.0 | 5 | 1992 | 2011 | 15.8 |
| Preliminary Treatment | Grit Collector No. 3 | 12.0 | 5 | 1992 | 2011 | 15.8 |
| Secondary Treatment | Aeration Basin Effluent Structures | 12.0 | 5 | 1980 | 2018 | 15.8 |
| Preliminary Treatment | Bar Screen No. 1 | 9.0 | 5 | 1992 | 2007 | 15.0 |
| Preliminary Treatment | Bar Screen No. 2 | 9.0 | 5 | 2002 | 2017 | 15.0 |
| Preliminary Treatment | Bar Screen No. 3 | 9.0 | 5 | 2002 | 2017 | 15.0 |
| Primary Treatment | Primary Sludge Pump No. 1 | 9.0 | 5 | 1992 | 2002 | 15.0 |
| Primary Treatment | Primary Sludge Pump No. 2 | 9.0 | 5 | 1992 | 2002 | 15.0 |
| Primary Treatment | Primary Sludge Pump No. 3 | 9.0 | 5 | 1992 | 2002 | 15.0 |
| Primary Treatment | Primary Sludge Pump No. 4 | 9.0 | 5 | 1992 | 2002 | 15.0 |
| Solids Thickening | TWAS Pumps #1 | 9.0 | 5 | 1992 | 2012 | 15.0 |
| Solids Thickening | TWAS Pumps #2 | 9.0 | 5 | 1992 | 2012 | 15.0 |
| Solids Thickening | TWAS Pumps #3 | 9.0 | 5 | 1992 | 2012 | 15.0 |

**Table 7-14**

**Asset of Greatest Priority of Need**

| Process | Equipment | ARI | PoF | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|
| Solids Thickening | TWAS Station Sump Pumps (2) | 9.0 | 5 | 1992 | 2012 | 15.0 |
| Solids Digestion | Small Fuel Pumps in Recirc Pump Area | 9.0 | 5 | 1980 | 1995 | 15.0 |
| Electrical | Transfer Pump for Small Fuel Tanks | 9.0 | 5 | 1980 | 2000 | 15.0 |
| Pretreatment/Lagoon Area | No. 1 Floating Aerator Large Concrete Lagoon | 9.0 | 5 | 1976 | 1996 | 15.0 |
| Pretreatment/Lagoon Area | No. 2 Floating Aerators Large Concrete Lagoon | 9.0 | 5 | 1976 | 1996 | 15.0 |
| Pretreatment/Lagoon Area | No. 3 Floating Aerator Large Concrete Lagoon | 9.0 | 5 | 1976 | 1996 | 15.0 |
| Pretreatment/Lagoon Area | No. 1 Floating Aerator Small Concrete Lagoon | 9.0 | 5 | 1975 | 1995 | 15.0 |
| Pretreatment/Lagoon Area | No. 2 Floating Aerator Small Concrete Lagoon | 9.0 | 5 | 1975 | 1995 | 15.0 |

Section 5 of this Technical Memorandum contains a complete Matrix of equipment assessed for the Archie Elledge WWTP.

## 7.4.2 Condition Observations

The following conditional assessment observations were made during the equipment assessments and subsequent staff interviews.

### 7.4.2.1 Headworks/Pretreatment/Lagoons

Influent flow to the treatment plant flows through the influent channel and Parshall Flume. Chemical odor control and air stripping is provided.

Two pretreatment basins and three earth lined lagoons are used to store centrate produced while thickening and dewatering solids. The pretreatment basins contain a mix of floating aerators and submersible pumps while the lagoons contain only submersible pumps. Four centrifugal influent pumps are used to convey raw wastewater to the treatment plant for treatment. Odor control is provided for the pretreatment basins.

*Influent Channel*

- Minor structural cracking is present on the influent channel concrete.

- Moderate surface corrosion is present on the iron support for Parshall Flume level indicator.
- Excess rag build-up is present on Parshall Flume cross braces.

***Odor Control System***

- The odor control system has been out of service for some time. Various components of the system have been removed.
- The odor control fan enclosure is beginning to collapse with moderate to severe corrosion present at the enclosure base.
- Lubricant leakage is present on the positive displacement blower. Surface corrosion is present on blower supports.

***Pretreatment Basins, Aerators, and Pumps***

- The pretreatment basins are in good overall condition.
- The aerators for the pretreatment basins are in fair condition. Moderate surface corrosion is present on the motors for aerators.
- Outdoor motor control centers (MCC) are provided for aeration and pumping equipment for the pretreatment basins. The MCCs are aged and weathered. Replacement MCCs and adequate coverage /enclosures should be considered if equipment is needed for long term use.
- The pretreatment basin pumps are in good condition. The coating on pumps and associated piping is beginning to chip in various areas. Minor corrosion is present on pump motor bolts and shaft guard metals.

***Lagoons and Pumps***

- The lagoons are in good overall condition.
- The area around each lagoon is overgrown with weeds that prevent clear access to the control panels.
- Fencing is provided in some areas around the perimeter of the lagoons at points of entry. Complete fencing around the entire lagoons should be considered.

***Influent Pumping***

- While the influent pumps are in poor condition, operation of the pumping system appears to be adequate until new pumping facilities are installed.

- Excessive lubricant and debris buildup is present around all pumps with pump No. 1 being the most severe. Removal of build-up is recommended.

- Moderate vibration is present when pumps are in operation.

#### 7.4.2.2 Preliminary Treatment

The screenings removal system consists of one climber screen and two step screens. Scum removed from the primary clarifiers is pumped to a scum strainer. All collected screenings and concentrated scum are transported by a belt conveyor to a collection hopper. The grit removal system consists of three chain and bucket collectors and a grit screw conveyor. Grit removed from the influent stream is transported on a screw conveyor to a collection hopper.

All equipment associated within the preliminary treatment processes is slated for replacement during the current construction. Although no significant issues were noted that should preclude equipment currently installed from maintaining operation through construction completion, items below do identify areas of concern that may require attention to ensure consistent operation.

***Screenings Removal Facilities***

- Surface corrosion is present on the main frame for screen No. 1 and the housing for screens No. 2 and 3.

- The control panels for all units are in good condition but dirty.

- Various screening teeth are bent on all units.

- Cable hanging on bar screen No. 1 was mentioned by the operations staff as being a chronic issue, especially during high flow events.

- The motor on the screenings/scum conveyor is aged. Motor replacement may be necessary prior to installation of new screenings/scum conveyance.

- The end scraper on the screenings/scum conveyor does not function. Replacement of scraper is recommended to improve screening removal from the belt and prevent excessive screenings build-up on the drip pan.

- The control panels for the screenings removal system equipment are extremely dirty. Cleaning of control panels and adjacent area is recommended.

***Grit Chambers and Collection Equipment***

- Significant corrosion is present on tensioner bar shaft. Evidence of lubricant spillage is present on all drive units. Unit No. 3 is in the worst condition.

- The grit screw conveyor is aged and slated for replacement. Evidence of lubricant leakage is present at gear box.
- The drip pan drain for the grit conveyor is plugged preventing proper drainage. Unclogging drip pan drain is recommended.
- The control panels for the grit removal system equipment are extremely dirty. Cleaning of control panels and adjacent area is recommended.

***Scum Strainer***

- The scum strainer area is extremely dirty and unit appears to clog frequently. Cleaning of strainer and addressing clogging issue is recommended.
- The control panels for the grit removal system equipment are extremely dirty. Cleaning of control panels and adjacent area is recommended.

#### 7.4.2.3 Primary Treatment

There are four rectangular primary clarifiers at the Archie Elledge WWTP. Each primary clarifier is equipped with dual chain and flight collectors and screw conveyors for removing primary sludge from the clarifiers. Four primary sludge pumps and associated grinders are used to conveyor primary sludge to the digestion process. Chemical odor control is provided for the primary clarifiers. Four intermediate pumps lift primary clarifier effluent to the aeration basins. A scum pump transports scum removed from the primary clarifiers to the roto strainers in screening area.

All equipment associated within the primary treatment process is slated for replacement during the current construction. Although no significant issues were noted that should preclude primary clarification equipment from maintaining operation until construction completion, items below do identify areas of concern that may require attention to ensure consistent operation.

***Primary Clarifiers***

- Minor structural degradation and cracking is present. Surface corrosion is present on handrail metals.
- The outlet weirs for the clarifiers are in fair condition.

***Primary Sludge/Scum Collection and Pumping***

- The controls for the chain and flight collector drives are not labeled. Labeling unit controls is recommended.

- The drives for the chain/flight collectors and screw conveyors are aged and could fail prior to construction completion. Appropriate funds should be allocated to maintain the drives.

- The primary sludge pumps are slated for replacement and are in fair to poor condition. The operations staff states that maintenance and repair on pumping system is infrequent.

- The grinders upstream of the primary sludge pumps are in fair condition. The operations staff state that the grinders clog and fail on occasion.

- The scum pump and associated motor are aged but appear to be operating adequately.

- The hatch door and frame for accessing the scum pump dry pit is corroded. The recycle valve on scum pump discharge is corroded and very difficult to turn. Pipe hangers within pump station are severely corroded.

***Intermediate Pumps***

- The intermediate pumps are aged and slated for replacement. Severe pump leakage is present.

- The paint coating is failing on all pumps and associated piping. Corrosion is present on shaft guards.

- Significant structural degradation is present around the intermediate pumps and associated wetwell. Currently, a portion of the area contains yellow tape to prevent access. Extreme caution should be taken when working in this area.

***Odor Control System***

- The odor control system will be replaced during current plant construction. The odor control system for the primary clarifiers was not operating during asset evaluation and appears to be out of service. The system will need attention if required for continuous service prior to construction completion.

- Pipe heat tracing and insulation is failing on odor control system piping.

- The magnehelic gauge housing is severely corroded and requires replacement if needed for operation.

- Recirculation pump No. 1 was removed and should be replaced. Recirculation pump No. 2 and associated piping is in poor condition. Recirculation pump piping is in poor condition.

- Moderate corrosion is present on the odor control fan housing.

### 7.4.2.4 Secondary Treatment

Primary effluent is pumped by the intermediate pumps to the aeration basin splitter box, dividing the flow between the activated sludge basins (ASB) No. 1 thru 6. Fixed and floating surface aerators and diffused air provide dissolved oxygen for the activated sludge process. Typically, basins with diffused air are placed in service for treatment. Six secondary clarifiers are provided for final clarification. Clarified effluent is discharged from weirs located on each tank's parameter. Seven return activated sludge (RAS) pumps remove solids settled in the clarifier and discharge to the ASBs or the gravity thickener.

***Activated Sludge Basins, Aerators, and Blowers***

- The ASB blowers are in good overall condition. Minor lubricant spillage or leakage is present around the blowers.
- Selector switch labeling is missing or faded in various areas for blowers. Some labeling is hand written with a black marker.
- The inlet filters for blowers are in fair condition. The room housing the inlet filters is dirty with significant dust and spider webs present. Inlet filters are extremely dirty and should be cleaned/replaced.
- Severe corrosion is present on various floating aerator motors. The motors are aged with many years of service.
- Concrete cracking is present at fixed surface aerators. Aerators are in good to fair condition.
- Floating aerator No. 9 appears to have been out of service for an extended period. Floating aerator No. 13 is out of service with motor removed and impeller damaged.
- Lubricant leakage is present from gearbox on S-3 surface aerator.
- The starters for the floating and fixed aerators are aged and should be considered for replacement if needed for long term use.

***Final Clarification***

- The coating is failing on the catwalk handrails for final clarifiers No. 1 thru 4. Minor surface corrosion is present on skimming arms and threaded rods. Final clarifiers No. 5 and 6 are in better condition than clarifiers No. 1 thru 4.
- Lubricant leakage is present on drives for final clarifiers No. 2, 4, and 5. The drive and gearbox for clarifier No. 1 has been replaced.

- The top perimeter handrail for clarifier No. 3 is broken just left of the catwalk entrance.
- Moderate corrosion is present on the weir baffle at the air/water interface for clarifiers No. 4 and 5. The weirs for all clarifiers are in good to fair condition.
- Severe corrosion is present on the control valves for the blanket detector for clarifiers No. 5 and 6.

***Return Activated Sludge (RAS) Pumping***

- The RAS pumps are aged and are in poor condition. The pump housing for RAS pump No. 1 has been rebuilt. Lubricant leakage is present on the lower motor bearings for RAS pumps No. 1, 2, and 5. RAS pump No. 3 has a crack in the top motor housing.
- The shaft seal has been replaced on RAS pump No. 5. Significant vibration was present on RAS pump No. 5.
- A new motor and shaft seal has been installed on RAS pump No.6.
- The controls for the RAS pumps are dirty. The controls for RAS pumps No. 1, 2 and 3 are not labeled.
- RAS wetwell level transponders are aged and weathered.
- The RAS sodium hypochlorite feed system's metering pump is in poor condition and ready for replacement.
- The RAS wetwell for clarifier No. 1 thru 4 contains weeds.

### 7.4.2.5 Final Treatment

Treated secondary effluent is disinfected through the application of sodium hypochlorite and dechlorinated using sodium bisulfite. Final effluent is aerated prior to discharge. In the event that wet weather events prevent gravity flow of the treated effluent, Flood Control Pumps provide the lift necessary to permit flow through of the facility.

- The chlorine contact chamber mixer has moderate corrosion. Lubricant leakage is present on the mixer.
- The chlorine contact chamber blowers are in fair to poor condition. The back bearing for blower No. 1 is rattling. Blower No. 3 appears to have been out of service for some time. Lubricant leakage is present on all blowers.

- Sluice gates A thru D for the chlorine contact chamber are in fair to poor condition. Gate A and D are in the worst condition. Slide gate E is newer and is in good condition.

***Non-potable Water Pumps***

- The non-potable water pumps (NPW) are in good condition. Excessive leakage from the packing gland is present with No. 2 being the worst.
- Pump pads are cracked with No. 3 being in the worst condition.
- The pressure gauge for pump No. 2 does not function.
- A heavy build-up *of* algae is present on grating adjacent to pumps.
- Strainers for the NPW pumps leak excessively with downstream pressure at 65 psi.

***Flood Control Pumps***

- The flood control pumps are used infrequently. The lower motor bearing leaks on pump No. 1.
- The motor oil for all pumps appears milky.

### 7.4.2.6 Solids Thickening

The solids thickening facilities consist of a gravity thickener, gravity belt thickener and associated pumping systems. Waste activate sludge (WAS) is pumped to the gravity thickener for thickening. Thickened waste activated sludge (TWAS) pumps transfer thickened sludge to the gravity belt thickener while the effluent is pumped by the gravity thickener effluent pumps. A polymer batching system supplies polymer to the gravity belt thickener. Thickened solids transfer pumps convey thickened sludge to the digesters. Washwater pumps are used for cleaning the gravity belt thickener. A packed tower odor control system is used to remove odor from the thickening process.

***Gravity Thickener***

- The gravity thickener and associated drive unit is aged. Evidence of lubricant leakage is present at the gearbox. The coating on the drive unit is beginning to fail with bolt heads containing surface corrosion.
- Control panel labeling is faded or unreadable. The rubber cover for the "Reset" pushbutton is missing.
- Moderate corrosion is present on conduit hardware.

- Effluent flow over thickener weirs is uneven. Overall, the weirs are in good condition.
- An old hypochlorite pipe around the thickener perimeter is degraded and should be replaced.
- Moderate corrosion is present on all pumps, base plates, and piping. Excessive leakage is present at packing gland for pump No. 1.
- The control panel is not labeled for sump pumps in thickener pumping area.

***Thickened WAS Transfer Pumps***

- The TWAS pumping system is aged with the coating chipping on pumps. Moderate corrosion is present on pump base anchor bolts and piping.
- The pressure gauge was not working for TWAS pump No. 3. Pressure gauges are missing from TWAS pumps No. 1 and 2.
- Various isolation valves have been replaced on the pumping system. Replacement of the remaining original valves should be implemented as needed.
- The control panels for the pumps are in good condition but are dirty.
- TWAS pumps No. 1 and 2 have been replaced in the past.
- The electrical cables for TWAS pump No. 3 are not secured. The cables reside on the floor and present a tripping hazard.

***Gravity Thickener Effluent Pumps***

- The packing for pump No. 1 is leaking excessively. A wet area around the pumps is very slick.
- The pumps, base plates, and associated piping contain moderate corrosion.
- The control panel for the effluent pumps is not labeled.

***Gravity Belt Thickener and Thickened Sludge Transfer Pumps***

- The gravity belt thickeners are in fair overall condition.
- The motors for pumped lubricant supply systems are aged with lubricant spillage around each unit.

- Surface corrosion is present on the belt thickener frame below the belt drive unit.

- Moderate to severe corrosion is present on the thickened sludge transfer pumps housing. The pressure switch assembly is corroded on pump No. 1, and the switch has been replaced on pump No. 2.

- Drive units located at each thickener's discharge are aged with moderate corrosion. It appears that the drive for thickener No.2 has been replaced in the past.

***Washwater Pumps***

- The washwater pumps are aged with severe corrosion on pump base plates. Excess lubrication is visible at each pump.

- Solenoid valves on pumping system contain moderate corrosion.

- Washwater pump No. 3 has been removed with motor remaining in position.

***Gravity Belt Thickener Polymer System***

- Neat polymer pump No. 1 is in fair condition. Surface corrosion is present on neat polymer pump No. 2. Neat polymer is leaking from piping.

- Minor surface corrosion is present on polymer batching system housing. Polymer is leaking from some piping joints at dilution area.

- The dilution water rotameter is not visible for all feed pumps. Feed pump No. 3 has been removed. Feed pump piping is constructed of stainless steel or PVC.

- Minor surface corrosion is present on feed pump control panels.

- The bulk polymer recirculation pump is aged and should be replaced. Major leakage of polymer is present at pump seals.

***Gravity Thickener Scum Pump Station***

- The scum pumps are not visible. Guiderail system appears to be in good working order.

- The control panel for the scum pumps is not labeled.

*Odor Control System*

- The odor control system tower is in good condition. Dampers on tower are stuck in place.
- Chains used for damper adjustment are heavily corroded and should be replaced. Magnehelic gauge does not work with water inside gauge.
- Minor corrosion is present on odor control fan base plate.
- Odor control tower recirculation pumps are in fair condition. Seal water contains moderate corrosion. Loose cinderblocks are used for steps to access pumps.

### 7.4.2.7 Solids Digestion and Sludge Holding

The digestion system includes six primary digesters and two blended sludge storage tanks. Three pumping systems are used to facilitate proper digestion. Digester feed is delivered by the gravity belt thickener's thickened sludge transfer pumps (discussed in previous section). The sludge recirculation pumps circulate digester sludge to maintain the proper temperature while the digested sludge transfer pumps transfer digested solids to the blended sludge holding tank.

Draft tube mixers are installed in each digester to facilitate proper mixing. Submersible mixers are included in the blended sludge holding tanks.

Boilers, heat exchangers, gas compressors and associated pumping and conveyance systems make up the heating system for the digesters. Digester gas is stored in a gas storage sphere with excess gas burned at the waste gas burners.

*Digesters/Mixers*

- The digester tanks and covers are in good condition.
- The digester mixers operate intermittently and appear to be in fair condition. Lower bearing failures have occurred on mixers in the past.
- Minor surface corrosion is present on exhaust fan base and housing for the digester buildings.

*Sludge Recirculation Pumps*

- The sludge recirculation pumps are aged and in fair condition. The pumping systems and adjacent piping are dirty.
- Minor corrosion is present on pump base plates.

- Various valves on the pumping system show corrosion and are very difficult to operate.
- The motor has been replaced on sludge recirculation pump No. 3.

***Sludge Transfer Pumps***

- The transfer pumps are aged and in fair condition.
- Evidence of leakage is present on transfer pumps No. 1 and 2, and the area is very dirty.
- The coating for the pumps is chipping in various areas.
- The motor has been replaced for pump No 3.

***Blended Sludge Holding Tank and Submersible Mixers***

- The blended sludge holding tanks (No. 1 and 2) were converted from existing digesters and are in good overall condition.
- Submersible mixers within the tank are in good condition.
- Excess rags and debris are wrapped around the cable for the hoist on tank No. 1.

***Heating System***

- The heat exchangers used for digesters No. 1 thru 4 are in good overall condition. Minor scaling around heat exchanger tubes is visible. Piping leading to/from the heat exchangers is in good condition.
- The heat exchanger in building for digesters No. 5 thru 8 is in fair condition. There is evidence of water leakage from the unit and the coating is beginning to fail in various areas.
- The boilers used to provide digester and building heat are in fair condition. Evidence of water leakage is present on all boilers. Minor corrosion is present on uncoated metals. Boiler No. 1 is in the worst condition.
- The boiler recirculation pumps are in fair condition. Excessive scale buildup is present around pumps and associated piping with pump No. 2 being in the worst condition. Labeling is missing or faded on pumps No. 1 and 3.

*Gas Storage and Conveyance*

- The gas storage sphere is in good condition. The insulation on piping is beginning to fail exposing the heat tracing. Heat tracing is not permanently terminated and is plugged into a receptacle.
- The waste gas burners are in excellent condition.

### 7.4.2.8 Solids Dewatering/Drying

The solids dewatering facilities consist of three centrifuges and associated pumping and polymer systems. Digested sludge transfer pumps and macerators are used to grind and transfer solids contained within the digested blended sludge storage tanks to the centrifuges.

Centrate from the solids dewatering process is pumped to the pretreatment basins and earth lined lagoons or transferred to the Muddy Creek WWTP via the centrate transfer pumps. A dewatered sludge screw conveyor and subsequent belt conveyor are used to transport dewatered solids from the centrifuges to the cake pump feed hopper.

Dewatered sludge cake pumps are used to convey sludge cake to the dryer facilities dryer's wet cake bin. Dried solids are transported to the dried solids storage silos. An odor control system is used to scrub odors from exhaust gas generated by the dryer operation.

- The centrifuges are in good overall condition. Lubricant leaks are present on the back drive of centrifuge No. 2. Centrifuge No. 3 has been in service since the dryer facility was commissioned.
- Polymer leaks are present on polymer system No.2.
- The dryer facility was placed into service in 2007. All components associated with the dryer system are in good condition.
- Slight oil leakage is present on the cake feed bin next to loader SC8-1. Minor corrosion is present on cake bin.

### 7.4.2.9 Chemical Systems

Various chemical systems are used at the Archie Elledge WWTP to assist in facility operation. In general, the chemical feed systems consist of a storage tank and chemical feed pumps to convey chemical to the application zone.

*Caustic (Sodium Hydroxide) for Primary Clarifier Odor Control System*

- Caustic pumps No. 1 and 2 are aged with evidence of leakage at pump head. Pump No. 3 has been replaced with controller and is in very good condition.

- Evidence of significant leakage is present on caustic feed system piping. The majority of leaks are at safety devices back pressure valves (BPV), pressure relief valves (PRV) and pulsation dampeners.

- Minor corrosion is present on bulk tank ladder brackets and level indicator conduit supports and hubs.

***Caustic (Sodium Hydroxide) for Odor Control System next to Gravity Belt Thickeners***

- Caustic feed pump No.1 is aged with significant corrosion present on pump head. Caustic feed pump No. 2 has been removed.

- Covers for "Reset" pushbuttons are missing.

- The caustic bulk storage tank is in good overall condition. Evidence of leakage is present on the tank outlet connection.

***Liquid Lime-Magnesium Hydroxide Blend***

- The liquid lime feed system is in good working order. Electrical supply to mixers and feed pumps is temporary. The system is mounted on pallets.

- Discharge piping is not secured or anchored. Insulation for discharge piping does not cover all pipe with some areas exposed.

- A new feed system, located at the primary effluent junction box, will be installed during current plant upgrades.

***Ferric Chloride***

- Minor leak stains are present on the bulk storage tank with past evidence of overflow.

- Ferric chemical leakage stains are present in feed pump area with ferric splash around all feed pumps.

***Dispersant***

- The dispersant chemical feed system is in very good condition.

- Minor leakage is present on the head of feed pump No. 2.

***Nitrogen (Located at plant effluent)***

- The feed pumps and motors are in fair condition with associating piping and appurtenances in very poor condition. Lubricant leaks are present on pumps.

- The nitrogen storage tank is in good condition. However, the containment area has shown recent signs of prolonged flooding.

***Nitrogen (Located at plant influent adjacent to lagoons)***

- The system appears to be out of service.
- The containment area is in good condition.
- The bulk storage tank is in good overall condition. Piping cracks and breaks are present on the outlet piping.
- The chemical feed pumps are aged. Coating is chipping from both pumps.

***Sodium Hypochlorite***

- The offloading station is in very poor condition. Multiple valve handles are missing. All metals are severely corroded, including quick connects, BPVs, and flowmeters. Instruments at offloading station should be replaced.
- Labeling is torn or missing from all hypochlorite storage tanks.
- The bottom man-way is leaking on bulk storage tank No. 1.
- The outlet valve handle is cracked on bulk tank No. 2. The valve handle on the recirculation pipe for tank No. 1 is missing.
- The electrically actuated valve is disconnected from bulk tank No. 3.
- A tree is growing in front of the tank level display.
- Pump number and indicator lamps are not labeled for recirculation pump control panels. Recirculation pump No. 2 was not present during asset evaluation.
- Lubricant leakage is present on feed pump No. 1 and 2. Chemical leakage is present on pump head of feed pump No. 2.
- Multiple leaks on the hypochlorite discharge piping have occurred in the past. Replacement of the discharge piping with proper material is recommended.
- Discussions with the plant staff indicate that the hypochlorite tanks will be replaced.

***Sodium Bisulfite***

- Labeling is missing from bulk storage tank No. 1

- Aluminum insulation jacketing for drain valve for bulk storage tank No. 1 has been removed.
- Metal conduit and junction boxes for tank level displays contain moderate corrosion.
- Low level switches for tanks are not terminated.
- Control panel indicator lamps are not labeled on recirculation pump No. 1.
- Significant chemical buildup is present on recirculation pump No. 2.
- Evidence of chemical leakage is present on sodium bisulfite feed pumps, pulsation dampener, BPVs, and PRVs.
- Minor lubricant leakage is present on both chemical feed pumps.

#### 7.4.2.10 Electrical and Backup Power Facilities

- The backup power generators and associated switchgear will be replaced during the current project construction. Current generator capacity prevents operation of a portion of the plant during utility power outages. New generators installed will allow all major equipment to operate during a utility power outage with the exception of the effluent structure and associated equipment.
- Backup power generators No. 4 and 5 appear in good overall condition. Minor corrosion is present on some metal surfaces. The coating is failing in areas on the generator housing and associated piping. The fuel line isolation valve is stuck in the open position on generator No. 4. Evidence of lubricant spillage is present on both units.
- The generator switchgear is aged with minor corrosion present on external surfaces.
- Hydrogen sulfide has caused corrosion of equipment and its associated electrical gear within the Control Building. While the generator and associated switchgear appear to be in good condition with respect to corrosion, assessment of the internal components should be completed.
- Moderate to severe corrosion is present on each generator radiator fan motor, valves, flanges and bolts. Valves contain severe corrosion are difficult to operate or stuck in place.
- The generator day tanks are in good overall condition. Evidence of fuel overflow is present on transfer pump and tank No. 4.

- Original starters are installed on the aeration equipment in the two original aeration basins. Replacement starters for this equipment should be considered.

- Outdoor motor control centers (MCCs) are provided for aeration and pumping equipment for the pretreatment basins. The MCCs are aged and weathered. Replacement NEMA 3R MCCs and adequate coverage /enclosures should be considered.

- Currently the treatment plant does not have back up power capability for the effluent structure and associated equipment.

- Various MCCs at the plant contain plastic breaker handles. Multiple handles have either cracked or broken in the past. The plant's electrical staff is currently replacing a portion of the plastic handles with metal handles.

## 7.5 Archie Elledge WWTP Recommended Improvements Plan

Based on the results of the condition assessment, CDM has identified $23,484,000 in equipment capital improvements needed to maintain the Archie Elledge wastewater treatment plant over the 20-year planning period. For the purposes of this planning level estimation, the assets that will be demolished as part of the current upgrade project (2008-2010) have been excluded from the planning level estimates. These process areas and associated equipment include the headworks, preliminary treatment and primary treatment processes.

Equipment is ranked by Risk Value, Asset Risk Index, Probability of Failure and Remaining Useful Life. Replacement costs are for planning level approximations only and include equipment and installation cost estimated in 2009 dollars; a more definitive cost estimation should be developed independent of this Master Planning document for specific asset replacement and renewals. Equipment currently being replaced was excluded from 20-year CIP planning.

### 7.5.1 Planning Period – Years One through Five

**Table 7-15** represents equipment that should be prioritized during the first 5 years of the 20-year Capital Improvements Planning (CIP) period. Assets are prioritized based on Risk Value ranging from 40 to 15, ARI 8 and higher and Probability of Failure 5 and higher. The total estimated cost for the first 5 years of the 20 year CIP is $2,351,000.

**Table 7-15**

**Cost Estimates for Years 1 thru 5 of the 20 Year Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Solids Digestion | Drainage tank low level in control bld. | 12.0 | 10 | $ 10,000 | 1980 | 20 | 40.0 |
| Solids Digestion | Recirc Pump for Boiler 1 | 12.0 | 10 | $ 30,000 | 1980 | 20 | 38.0 |
| Solids Digestion | Recirc Pump for Boiler 3 | 12.0 | 10 | $ 30,000 | 1980 | 20 | 38.0 |
| Solids Digestion | Recirc Pump for Boiler 2 | 8.0 | 9 | $ 30,000 | 1980 | 21 | 35.9 |
| Final Treatment | Chlorine Contact Chamber Mixer | 9.0 | 10 | $ 25,000 | 1992 | 15 | 30.0 |
| Solids Thickening | Bulk Polymer Transfer Pump | 8.0 | 11 | $ 25,000 | 1994 | 19 | 22.0 |
| Secondary Treatment | Electrical feeds to basin, Transformer, Transfer Switch | 16.0 | 5 | $ 250,000 | 1980 | 14 | 21.0 |
| Chemical Systems | Sodium Hypo Tanks No. 1 | 8.0 | 5 | $ 65,000 | 1994 | 16 | 20.1 |
| Chemical Systems | Sodium Hypo Tanks No. 2 | 8.0 | 5 | $ 65,000 | 1994 | 16 | 20.1 |
| Chemical Systems | Sodium Hypo Tanks No. 3 | 8.0 | 5 | $ 65,000 | 1994 | 16 | 20.1 |
| Chemical Systems | Nitrogen Storage Tank and containment area | 8.0 | 10 | $ 85,000 | 1994 | 17 | 20.1 |
| Electrical | Generator day tank 4 and 5 and transfer pump | 12.0 | 5 | $ 75,000 | 1992 | 25 | 19.0 |
| Solids Digestion | Boiler No. 1 | 12.0 | 5 | $ 387,000 | 1980 | 15 | 19.0 |
| Solids Digestion | Boiler No. 2 | 12.0 | 5 | $ 387,000 | 1980 | 15 | 19.0 |
| Solids Digestion | Boiler No. 3 | 12.0 | 5 | $ 387,000 | 1980 | 15 | 19.0 |
| Solids Digestion | Heat Exchanger (in Control bld. Next to air compressor) | 12.0 | 5 | $ 200,000 | 1980 | 20 | 19.0 |
| Electrical | Transfer pump for small fuel tanks | 9.0 | 5 | $ 10,000 | 1980 | 20 | 15.0 |
| Pretreatment/Lagoon Area | No. 1 floating aerator in large concrete lagoon | 9.0 | 5 | $ 15,000 | 1976 | 20 | 15.0 |
| Pretreatment/ Lagoon Area | No. 2 floating aerators for large concrete lagoon | 9.0 | 5 | $ 15,000 | 1976 | 20 | 15.0 |

**Table 7-15**

**Cost Estimates for Years 1 thru 5 of the 20 Year Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Pretreatment/ Lagoon Area | No. 3 floating aerator for large concrete lagoon | 9.0 | 5 | $ 15,000 | 1976 | 20 | 15.0 |
| Pretreatment/ Lagoon Area | No. 1 floating aerator in small concrete lagoon | 9.0 | 5 | $ 15,000 | 1975 | 20 | 15.0 |
| Pretreatment/ Lagoon Area | No. 2 floating aerator in small concrete lagoon | 9.0 | 5 | $ 15,000 | 1975 | 20 | 15.0 |
| Solids Digestion | Small fuel pumps in recirc pump area | 9.0 | 5 | $ 10,000 | 1980 | 15 | 15.0 |
| Solids Thickening | TWAS Pumps #1 | 9.0 | 5 | $ 40,000 | 1992 | 20 | 15.0 |
| Solids Thickening | TWAS Pumps #2 | 9.0 | 5 | $ 40,000 | 1992 | 20 | 15.0 |
| Solids Thickening | TWAS Pumps #3 | 9.0 | 5 | $ 40,000 | 1992 | 20 | 15.0 |
| Solids Thickening | TWAS Station Sump Pumps (2) | 9.0 | 5 | $ 20,000 | 1992 | 20 | 15.0 |
| **Year 1 through 5 Total Estimated Cost** | | | | **$2,351,000.00** | | | |

## 7.5.2 Planning Period – Years Six through Ten

**Table 7-16** represents equipment that should be prioritized between years 6 and 10 of the 20 year Capital Improvements Planning (CIP) period. Assets are prioritized based on Risk Value ARI, and probability of failure. The total estimated cost for the second 5 years of the 20 year CIP is $5,803,000.

**Table 7-16**

**Cost Estimates for Years 6 thru 10 of the 20 Year Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Mechanical | Exhaust fans in control bld. Nos. 1-5 | 9.0 | 10 | $ 10,000 | 1992 | 2012 | 30.0 |
| Pretreatment/Lagoon Area | Influent Parshall Flume | 9.0 | 10 | $ 50,000 | 1975 | 2015 | 28.5 |
| Secondary Treatment | RAS Wetwell Flowmeter | 8.0 | 11 | $ 10,000 | 1992 | 2003 | 22.0 |

**Table 7-16**

**Cost Estimates for Years 6 thru 10 of the 20 Year Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Secondary Treatment | RAS Wetwell Hypo System | 8.0 | 11 | $ 50,000 | 1992 | 2006 | 22.0 |
| Final Treatment | Chlorine Contact Basin Sluice Gates A | 8.0 | 11 | $ 15,000 | 1992 | 2016 | 21.0 |
| Final Treatment | Chlorine Contact Basin Sluice Gates D | 8.0 | 11 | $ 15,000 | 1992 | 2016 | 21.0 |
| Solids Thickening | Odor Control Tower | 4.0 | 10 | $ 225,000 | 1994 | 2015 | 19.0 |
| Electrical | Diesel Fuel Storage System/Tank (Control Bld.) | 4.0 | 10 | $ 35,000 | 1992 | 2011 | 19.0 |
| Solids Digestion | Gas Dome - Sphere | 4.0 | 10 | $ 250,000 | 1992 | 2011 | 19.0 |
| Chemical Systems | Caustic Bulk Storage | 4.0 | 9 | $ 25,000 | 1994 | 2010 | 18.0 |
| Chemical Systems | Caustic FP No. 3 | 2.0 | 8 | $ 10,000 | 1994 | 2011 | 16.9 |
| Chemical Systems | Caustic Transfer Pump | 2.0 | 8 | $ 15,000 | 1994 | 2011 | 16.9 |
| Solids Dewatering/Drying | Pellet Rotary Air Locks (Pellet Silo) | 4.0 | 4 | $ 20,000 | 2005 | 2025 | 15.8 |
| Solids Dewatering/Drying | Nitrogen Tank | 4.0 | 4 | $ 10,000 | 2005 | 2025 | 15.8 |
| Solids Dewatering/Drying | Pneumatic Air Receiver Tank | 4.0 | 4 | $ 10,000 | 2008 | 2028 | 15.8 |
| Solids Dewatering/Drying | Nitrogen Liquid Gas Exchanger | 4.0 | 4 | $ 85,000 | 2005 | 2025 | 15.8 |
| Solids Dewatering/Drying | Silos (2) | 4.0 | 4 | $ 400,000 | 2005 | 2025 | 15.8 |
| Solids Dewatering/Drying | Pellet Rotary Air Local (Silo Screw) | 4.0 | 4 | $ 20,000 | 2005 | 2022 | 15.8 |
| Solids Dewatering/Drying | Pneumatic Ejector Silo (Recycle) | 4.0 | 4 | $ 20,000 | 2005 | 2022 | 15.8 |
| Solids Dewatering/Drying | Pneumatic Pellet Ejector (Final) | 4.0 | 4 | $ 25,000 | 2008 | 2025 | 15.8 |
| Solids Dewatering/Drying | Scrubber Drain Pumps | 4.0 | 4 | $ 25,000 | 2008 | 2030 | 15.8 |
| Solids Dewatering/Drying | Exhaust Fan off of GC Scrubber. | 4.0 | 4 | $ 150,000 | 2005 | 2022 | 15.8 |

**Table 7-16**

**Cost Estimates for Years 6 thru 10 of the 20 Year Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Solids Dewatering/Drying | Induced Draft Fan | 4.0 | 4 | $ 225,000 | 2008 | 2025 | 15.8 |
| Solids Dewatering/Drying | Shaker Roto-Shaker (pellet separator) | 4.0 | 4 | $ 175,000 | 2005 | 2022 | 15.8 |
| Solids Dewatering/Drying | Sludge Cake Pump | 4.0 | 4 | $ 50,000 | 2008 | 2019 | 15.8 |
| Solids Dewatering/Drying | Polymer Storage Tanks (2) | 4.0 | 4 | $ 35,000 | 2000 | 2017 | 15.8 |
| Solids Dewatering/Drying | Pellet Conveyor (pellet Silo) Horz. | 4.0 | 4 | $ 45,000 | 2005 | 2022 | 15.8 |
| Solids Dewatering/Drying | Inclined Cake Conveyor to either BC-1 Cross Conveyor or Cake Bay | 4.0 | 4 | $ 125,000 | 2000 | 2017 | 15.8 |
| Solids Dewatering/Drying | Pelletizer | 4.0 | 4 | $ 300,000 | 2000 | 2017 | 15.8 |
| Solids Dewatering/Drying | Fire Box | 4.0 | 4 | $ 200,000 | 2000 | 2017 | 15.8 |
| Solids Dewatering/Drying | Pellet Bin Vibrater (top ejector) | 4.0 | 4 | $ 20,000 | 2008 | 2025 | 15.8 |
| Solids Dewatering/Drying | Cake Pug Mixer | 4.0 | 4 | $ 200,000 | 2005 | 2022 | 15.8 |
| Solids Dewatering/Drying | Incline Screw to Mixer (Pellets) & Bypass | 4.0 | 4 | $ 45,000 | 2005 | 2022 | 15.8 |
| Solids Dewatering/Drying | Ferric Solution Strainer | 4.0 | 4 | $ 10,000 | 2000 | 2017 | 15.8 |
| Solids Dewatering/Drying | HVAC | 4.0 | 4 | $ 10,000 | 2008 | 2030 | 15.8 |
| Solids Dewatering/Drying | Twin Screw Bottom Hopper Cake Screws | 4.0 | 4 | $ 55,000 | 2005 | 2022 | 15.8 |
| Solids Dewatering/Drying | "Wet Bin Live Bottom Screws" | 4.0 | 4 | $ 45,000 | 2005 | 2022 | 15.8 |
| Solids Dewatering/Drying | Ventilation Fans | 2.0 | 8 | $ 10,000 | 2008 | 2030 | 15.8 |
| Solids Digestion | Waste Gas Burner No. 1 | 2.0 | 8 | $ 30,000 | 2000 | 2017 | 15.8 |

**Table 7-16**

**Cost Estimates for Years 6 thru 10 of the 20 Year Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Solids Digestion | Waste Gas Burner No. 2 | 2.0 | 8 | $ 30,000 | 2000 | 2017 | 15.8 |
| Solids Dewatering/Drying | Cake Feed Bin (by loader) SC8-1 | 3.0 | 4 | $ 125,000 | 2000 | 2017 | 11.9 |
| Solids Dewatering/Drying | Dust Collector Pulse Air | 3.0 | 4 | $ 80,000 | 2005 | 2027 | 11.9 |
| Solids Dewatering/Drying | Bridge Crane | 3.0 | 4 | $ 75,000 | 2008 | 2036 | 11.9 |
| Chemical Systems | Caustic Feed Pump No. 2 | 8.0 | 6 | $ 10,000 | 1994 | 2008 | 11.5 |
| Chemical Systems | Nitrogen feed pump No. 1 | 8.0 | 5 | $ 20,000 | 1994 | 2008 | 11.0 |
| Chemical Systems | Nitrogen feed pump No. . 2 | 8.0 | 5 | $ 20,000 | 1994 | 2008 | 11.0 |
| Chemical Systems | NH3 Pump | 8.0 | 5 | $ 15,000 | 1992 | 2006 | 11.0 |
| Chemical Systems | Hypo Offloading Station | 8.0 | 5 | $ 30,000 | 1994 | 2013 | 11.0 |
| Chemical Systems | Caustic storage tank and containment area | 4.0 | 11 | $ 35,000 | 1994 | 2008 | 11.0 |
| Pretreatment/Lagoon Area | Odor control Scrubber | 4.0 | 11 | $ 325,000 | 1994 | 2013 | 11.0 |
| Secondary Treatment | O/A Surface Floating Aerator | 8.0 | 5 | $ 15,000 | 1980 | 1999 | 10.5 |
| Secondary Treatment | No. 2 Floating Aerator | 8.0 | 5 | $ 15,000 | 1980 | 1999 | 10.5 |
| Secondary Treatment | No. 9 Floating Aerator | 8.0 | 5 | $ 15,000 | 1980 | 1999 | 10.5 |
| Secondary Treatment | No. 12 Floating Aerator | 8.0 | 5 | $ 15,000 | 1980 | 1999 | 10.5 |
| Secondary Treatment | No. 13 Floating Aerator | 8.0 | 5 | $ 15,000 | 1980 | 1999 | 10.5 |
| Secondary Treatment | No. 3 Floating Aerator | 8.0 | 5 | $ 15,000 | 1980 | 1999 | 10.5 |
| Secondary Treatment | No. 5 Floating Aerator | 8.0 | 5 | $ 15,000 | 1980 | 1999 | 10.5 |
| Secondary Treatment | S-4 Surface Aerator | 8.0 | 5 | $ 30,000 | 1970 | 1989 | 10.5 |
| Secondary Treatment | S-9 Surface Aerator | 8.0 | 5 | $ 30,000 | 1970 | 1989 | 10.5 |

**Table 7-16**

**Cost Estimates for Years 6 thru 10 of the 20 Year Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Secondary Treatment | RAS Wetwell | 8.0 | 5 | $ 100,000 | 1970 | 2008 | 10.5 |
| Solids Thickening | GT Effluent Pump No. 1 | 8.0 | 5 | $ 25,000 | 1980 | 1999 | 10.5 |
| Solids Thickening | GT Effluent Pump No. 2 | 8.0 | 5 | $ 25,000 | 1980 | 1999 | 10.5 |
| Solids Thickening | Polymer FP No. 3 | 8.0 | 5 | $ 10,000 | 1994 | 2008 | 10.5 |
| Chemical Systems | Temporary Liquid Lime-Mag system 2 Tanks - 2 Mixers - 1 Hose Pump (Eccentric) | 6.0 | 5 | $ 75,000 | 2008 | 2023 | 10.5 |
| Pretreatment/Lagoon Area | Truck Loading Station | 3.0 | 11 | $ 50,000 | 1992 | 2007 | 10.5 |
| Chemical Systems | Hypo Recirc Pump No. 2 | 6.0 | 5 | $ 25,000 | 1994 | 2014 | 10.0 |
| Chemical Systems | Caustic FP No. 1 | 6.0 | 5 | $ 10,000 | 1994 | 2009 | 10.0 |
| Chemical Systems | Caustic FP No. 2 | 6.0 | 5 | $ 10,000 | 1994 | 2009 | 10.0 |
| Chemical Systems | Sodium Bisulfite FP No. 1 | 6.0 | 5 | $ 15,000 | 1994 | 2009 | 10.0 |
| Chemical Systems | Sodium Bisulfite FP No. 2 | 6.0 | 5 | $ 15,000 | 1994 | 2009 | 10.0 |
| Chemical Systems | Caustic Feed Pump No. 1 | 6.0 | 5 | $ 10,000 | 1994 | 2009 | 10.0 |
| Secondary Treatment | RAS Pump No. 1 | 6.0 | 5 | $ 75,000 | 1992 | 2012 | 10.0 |
| Secondary Treatment | RAS Pump No. 2 | 6.0 | 5 | $ 75,000 | 1992 | 2012 | 10.0 |
| Secondary Treatment | RAS Pump No. ? Pony | 6.0 | 5 | $ 65,000 | 1992 | 2012 | 10.0 |
| Solids Thickening | GT Effluent Pump No. 3 | 6.0 | 5 | $ 25,000 | 1980 | 2000 | 10.0 |
| Solids Thickening | Washwater Pump No. 1 | 6.0 | 5 | $ 15,000 | 1994 | 2014 | 10.0 |
| Solids Thickening | Washwater Pump No. 2 | 6.0 | 5 | $ 15,000 | 1994 | 2014 | 10.0 |
| Solids Thickening | Washwater Pump No. 3 | 6.0 | 5 | $ 15,000 | 1994 | 2014 | 10.0 |
| Solids Thickening | Recirc Pump No. 1 | 6.0 | 5 | $ 25,000 | 1994 | 2014 | 10.0 |

**Table 7-16**

**Cost Estimates for Years 6 thru 10 of the 20 Year Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Solids Thickening | Recirc Pump No. 2 | 6.0 | 5 | $ 25,000 | 1994 | 2014 | 10.0 |
| Solids Thickening | Polymer FP No. 1 | 6.0 | 5 | $ 10,000 | 1994 | 2009 | 10.0 |
| Solids Thickening | Polymer FP No. 2 | 6.0 | 5 | $ 10,000 | 1994 | 2009 | 10.0 |
| Solids Thickening | Polymer FP No. 4 | 6.0 | 5 | $ 10,000 | 1994 | 2009 | 10.0 |
| Final Treatment | NPW Strainers | 6.0 | 5 | $ 125,000 | 1992 | 2007 | 9.5 |
| Pretreatment/Lagoon Area | Sump PS in pretreatment pump room | 6.0 | 5 | $ 10,000 | 1992 | 2012 | 9.5 |
| Solids Digestion | Air compressors 1 and 2 | 6.0 | 5 | $ 50,000 | 1980 | 1995 | 9.5 |
| Chemical Systems | Hypo Recirc Pump No. 1 | 4.0 | 5 | $ 25,000 | 1994 | 2015 | 9.5 |
| Chemical Systems | Sodium Bisulfite Recirc Pump No. 1 | 4.0 | 5 | $ 25,000 | 1994 | 2015 | 9.5 |
| Chemical Systems | Sodium Bisulfite Recirc Pump No. 2 | 4.0 | 5 | $ 25,000 | 1994 | 2015 | 9.5 |
| Chemical Systems | Hypo FP No. 1 | 4.0 | 5 | $ 15,000 | 1994 | 2010 | 9.5 |
| Chemical Systems | Hypo FP No. 2 | 4.0 | 5 | $ 15,000 | 1994 | 2010 | 9.5 |
| Chemical Systems | Hypo FP No. 3 | 4.0 | 5 | $ 15,000 | 1994 | 2010 | 9.5 |
| Chemical Systems | Caustic Feed Tank | 4.0 | 4 | $ 25,000 | 1994 | 2010 | 9.0 |
| Solids Storage | Sludge Blend Mixer 1.1 | 4.0 | 4 | $ 35,000 | 2008 | 2024 | 9.0 |
| Solids Storage | Sludge Blend Mixer 1.2 | 4.0 | 4 | $ 35,000 | 2008 | 2024 | 9.0 |
| Solids Storage | Sludge Blend Mixer 2.1 | 4.0 | 4 | $ 35,000 | 2008 | 2024 | 9.0 |
| Solids Storage | Sludge Blend Mixer 2.2 | 4.0 | 4 | $ 35,000 | 2008 | 2024 | 9.0 |
| Pretreatment/Lagoon Area | Blower at pretreatment area channel | 2.0 | 9 | $ 25,000 | 1994 | 2010 | 9.0 |
| Solids Dewatering/Drying | Mineral Oil Tank "Coating Oil" | 2.0 | 4 | $ 55,000 | 2005 | 2025 | 7.9 |
| Solids Dewatering/Drying | Polymer Neat Recirculation Pump | 2.0 | 4 | $ 20,000 | 2000 | 2011 | 7.9 |
| Solids Dewatering/Drying | Mineral Oil Pumps | 2.0 | 4 | $ 15,000 | 2005 | 2022 | 7.9 |

**Table 7-16**

**Cost Estimates for Years 6 thru 10 of the 20 Year Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Secondary Treatment | No. 4 (Missing) | 4.0 | 5 | $ 15,000 | 1980 | 1999 | 5.5 |
| Solids Dewatering/Drying | Biosolids Unloading Belt Conveyors BC3 | 3.0 | 5 | $ 45,000 | 2005 | 2020 | 5.0 |
| Solids Dewatering/Drying | Biosolids Unloading Belt Conveyors BC4 | 3.0 | 5 | $ 45,000 | 2005 | 2020 | 5.0 |
| Solids Dewatering/Drying | Slide Gates CsG-5&6 | 3.0 | 5 | $ 10,000 | 2005 | 2020 | 5.0 |
| Final Treatment | Chlorine Contact Basin Blowers 1 | 16.0 | 1 | $ 20,000 | 1992 | 2006 | 4.2 |
| Final Treatment | Chlorine Contact Basin Blowers 3 | 16.0 | 1 | $ 20,000 | 1992 | 2006 | 4.0 |
| Final Treatment | Chlorine Contact Basin Blowers 2 | 12.0 | 1 | $ 20,000 | 1992 | 2007 | 4.0 |
| Solids Dewatering/Drying | Wet Cake Transfer Pump Water Injection Pumps No. 1 | 8.0 | 1 | $ 15,000 | 2000 | 2011 | 3.6 |
| Solids Dewatering/Drying | Wet Cake Transfer Pump Water Injection Pumps No. 2 | 8.0 | 1 | $ 15,000 | 2000 | 2011 | 3.6 |
| Solids Dewatering/Drying | DSP (Dig. S1 Pump) | 8.0 | 1 | $ 45,000 | 2000 | 2011 | 3.4 |
| Solids Dewatering/Drying | Poly Make down Tanks PAT1 | 4.0 | 1 | $ 25,000 | 2000 | 2020 | 3.2 |
| Solids Dewatering/Drying | Poly Make down Tanks PAT-2 | 4.0 | 1 | $ 25,000 | 2000 | 2020 | 3.2 |
| Solids Dewatering/Drying | Centrate to Muddy Pumps No. 1 | 4.0 | 1 | $ 20,000 | 2008 | 2025 | 3.2 |
| Solids Dewatering/Drying | Centrate to Muddy Pumps No. 2 | 4.0 | 1 | $ 20,000 | 2008 | 2025 | 3.2 |
| Solids Dewatering/Drying | Poly Inversion (2) System PSP 1-2 | 4.0 | 1 | $ 10,000 | 2000 | 2017 | 3.2 |
| Solids Dewatering/Drying | DSM Grinders No. 1 | 4.0 | 1 | $ 27,000 | 2000 | 2017 | 3.2 |

**Table 7-16**

**Cost Estimates for Years 6 thru 10 of the 20 Year Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Solids Dewatering/Drying | DSM Grinders No. 2 | 4.0 | 1 | $ 27,000 | 2000 | 2017 | 3.2 |
| Solids Dewatering/Drying | DSM Grinders No. 3 | 4.0 | 1 | $ 27,000 | 2000 | 2017 | 3.2 |
| Solids Dewatering/Drying | DSM Grinders No. 4 | 4.0 | 1 | $ 27,000 | 2000 | 2017 | 3.2 |
| Solids Dewatering/Drying | Polymer Pumps PM PS-1 | 3.0 | 1 | $ 10,000 | 2000 | 2011 | 2.4 |
| Solids Dewatering/Drying | Polymer Pumps PM PS-2 | 3.0 | 1 | $ 10,000 | 2000 | 2011 | 2.4 |
| Solids Dewatering/Drying | Polymer Pumps PM PS-3 | 3.0 | 1 | $ 10,000 | 2000 | 2011 | 2.4 |
| Solids Dewatering/Drying | Polymer Pumps PM PS-4 | 3.0 | 1 | $ 10,000 | 2000 | 2011 | 2.4 |
| Pretreatment/Lagoon Area | Pretreatment basin pumps Nos. 1 | 6.0 | 1 | $ 25,000 | 1992 | 2012 | 1.9 |
| Pretreatment/Lagoon Area | Pretreatment basin pumps Nos. 2 | 6.0 | 1 | $ 25,000 | 1992 | 2012 | 1.9 |
| Pretreatment/Lagoon Area | Pretreatment basin pumps Nos. 3 | 6.0 | 1 | $ 25,000 | 1992 | 2012 | 1.9 |
| Pretreatment/Lagoon Area | Pretreatment basin pumps Nos. 4 | 6.0 | 1 | $ 25,000 | 1992 | 2012 | 1.9 |
| Solids Dewatering/Drying | Dispersant Metering Pumps DMP No. 1 | 3.0 | 0 | $ 10,000 | 2008 | 2025 | 0.5 |
| Solids Dewatering/Drying | Dispersant Metering Pumps DMP No. 2 | 3.0 | 0 | $ 10,000 | 2005 | 2022 | 0.5 |
| Solids Dewatering/Drying | Dispersant Metering Pumps DMP No. 3 | 3.0 | 0 | $ 10,000 | 2005 | 2022 | 0.5 |
| Solids Dewatering/Drying | Dispersant Metering Pumps DMP No. 4 | 3.0 | 0 | $ 10,000 | 2005 | 2022 | 0.5 |
| Solids Dewatering/Drying | Dispersant Metering Pumps DMP No. 5 | 3.0 | 0 | $ 10,000 | 2005 | 2022 | 0.5 |
| **Year 6 through 10 Total Estimated Cost** | | | | **$ 5,803,000.00** | | | |

### 7.5.3 Planning Period – Years Eleven through Twenty

**Table 7-17** represents equipment that should be prioritized between years 10 and 20 of the 20 year Capital Improvements Planning (CIP) period. Assets not included in Tables 7-15 and 7-16 are included. The total estimated cost for the last 10 years of the 20 year CIP is $14,875,000.

It is important to note that during the final 10 years of the 20 year planning period, assets replaced, renewed and rebuilt in the preceding 10 years (year one through ten) will have aged and achieved their remaining useful life. These assets will increase the estimated planning level cost defined for this period.

**Table 7-17**

**Cost Estimates for Years 11 thru 20 of the Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Solids Dewatering/Drying | Ferric Storage Tank | 6.0 | 8 | $ 35,000 | 2000 | 2017 | 25.4 |
| Secondary Treatment | Electrical feeds to basin, Transformer, Transfer Switch | 16.0 | 5 | $ 250,000 | 1980 | 1994 | 21.0 |
| Chemical Systems | Nitrogen Pump and Appurtences | 6.0 | 11 | $ 25,000 | 1992 | 2006 | 21.0 |
| Chemical Systems | Nitrogen Tank | 6.0 | 10 | $ 35,000 | 1992 | 2010 | 20.0 |
| Secondary Treatment | RAS Wetwell Level Transponder | 6.0 | 10 | $ 10,000 | 1992 | 2012 | 20.0 |
| Solids Digestion | Digester Mixers - Digester No. 1 | 6.0 | 10 | $ 65,000 | 1994 | 2009 | 20.0 |
| Solids Digestion | Digester Mixers - Digester No. 2 | 6.0 | 10 | $ 65,000 | 1994 | 2009 | 20.0 |
| Solids Digestion | Digester Mixers - Digester No. 3 | 6.0 | 10 | $ 65,000 | 1994 | 2009 | 20.0 |
| Solids Digestion | Digester Mixers - Digester No. 4 | 6.0 | 10 | $ 65,000 | 1994 | 2009 | 20.0 |
| Solids Digestion | Digester Mixers - Digester No. 5 | 6.0 | 10 | $ 65,000 | 1994 | 2009 | 20.0 |
| Solids Digestion | Digester Mixers - Digester No. 8 | 6.0 | 10 | $ 65,000 | 1994 | 2009 | 20.0 |
| Solids Digestion | Digester Cover No. 1 | 6.0 | 10 | $ 350,000 | 1994 | 2009 | 20.0 |
| Solids Digestion | Digester Cover No. 2 | 6.0 | 10 | $ 350,000 | 1994 | 2009 | 20.0 |

**Table 7-17**

**Cost Estimates for Years 11 thru 20 of the Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Solids Digestion | Digester Cover No. 3 | 6.0 | 10 | $ 350,000 | 1994 | 2009 | 20.0 |
| Solids Digestion | Digester Cover No. 4 | 6.0 | 10 | $ 350,000 | 1994 | 2009 | 20.0 |
| Solids Digestion | Digester Cover No. 5 | 6.0 | 10 | $ 350,000 | 1994 | 2009 | 20.0 |
| Solids Digestion | Digester Cover No. 8 | 6.0 | 10 | $ 350,000 | 1994 | 2009 | 20.0 |
| Solids Thickening | GBT 1 | 6.0 | 10 | $ 325,000 | 1994 | 2014 | 20.0 |
| Solids Thickening | GBT 2 | 6.0 | 10 | $ 325,000 | 1994 | 2014 | 20.0 |
| Solids Thickening | Thickened Sludge Pump No. 1 | 6.0 | 10 | $ 30,000 | 1994 | 2004 | 20.0 |
| Solids Thickening | Thickened Sludge Pump No. 2 | 6.0 | 10 | $ 30,000 | 1994 | 2004 | 20.0 |
| Solids Thickening | Odor Control Fan | 6.0 | 10 | $ 75,000 | 1994 | 2014 | 20.0 |
| Solids Thickening | Polymer Dilution/Batching System | 6.0 | 10 | $ 35,000 | 1994 | 2009 | 20.0 |
| Solids Thickening | Neat Polymer Pump No. 1 for GBT | 6.0 | 10 | $ 15,000 | 1994 | 2009 | 20.0 |
| Solids Thickening | Neat Polymer Pump No. 2 for GBT | 6.0 | 10 | $ 15,000 | 1994 | 2009 | 20.0 |
| Solids Thickening | GT Scum PS | 6.0 | 10 | $ 20,000 | 1992 | 2012 | 20.0 |
| Solids Thickening | Bulk Polymer Tank | 6.0 | 10 | $ 40,000 | 1994 | 2014 | 20.0 |
| Solids Storage | Sludge Blend Tanks 1 and 2 | 12.0 | 5 | $ 225,000 | 2008 | 2061 | 19.0 |
| Final Treatment | Slide Gate E | 6.0 | 10 | $ 15,000 | 1992 | 2018 | 19.0 |
| Final Treatment | Chlorine Contact Basin Sluice Gates B | 6.0 | 10 | $ 15,000 | 1992 | 2018 | 19.0 |
| Final Treatment | Chlorine Contact Basin Sluice Gates C | 6.0 | 10 | $ 15,000 | 1992 | 2018 | 19.0 |

**Table 7-17**

**Cost Estimates for Years 11 thru 20 of the Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Secondary Treatment | Final Clarifier 1 | 6.0 | 10 | $ 350,000 | 1970 | 1991 | 19.0 |
| Secondary Treatment | Final Clarifier 2 | 6.0 | 10 | $ 350,000 | 1970 | 1991 | 19.0 |
| Secondary Treatment | Final Clarifier 3 | 6.0 | 10 | $ 350,000 | 1970 | 1991 | 19.0 |
| Secondary Treatment | Final Clarifier 4 | 6.0 | 10 | $ 350,000 | 1970 | 1991 | 19.0 |
| Secondary Treatment | Final Clarifier 5 | 6.0 | 10 | $ 350,000 | 1992 | 2013 | 19.0 |
| Secondary Treatment | Final Clarifier 6 | 6.0 | 10 | $ 350,000 | 1992 | 2013 | 19.0 |
| Secondary Treatment | Old Return Pump Dumping Station | 6.0 | 10 | $ 100,000 | 1992 | 2034 | 19.0 |
| Solids Thickening | WAS Gravity Thickener | 6.0 | 10 | $ 200,000 | 1980 | 2001 | 19.0 |
| Secondary Treatment | Aeration Basin Blower No. 1 | 8.0 | 4 | $ 300,000 | 1992 | 2009 | 18.0 |
| Secondary Treatment | Aeration Basin Blower No. 2 | 8.0 | 4 | $ 300,000 | 1992 | 2009 | 18.0 |
| Secondary Treatment | Aeration Basin Blower No. 3 | 8.0 | 4 | $ 300,000 | 1992 | 2009 | 18.0 |
| Secondary Treatment | Aeration Basin Blower No. 4 | 8.0 | 4 | $ 300,000 | 1992 | 2009 | 18.0 |
| Solids Dewatering/Drying | Biosolids Cake Conveyor BC-1 Horiz. | 8.0 | 4 | $ 125,000 | 2000 | 2017 | 18.0 |
| Solids Dewatering/Drying | Silo Unloaders | 8.0 | 4 | $ 50,000 | 2005 | 2022 | 18.0 |
| Solids Dewatering/Drying | Pellet Roller/Crusher | 8.0 | 4 | $ 25,000 | 2008 | 2025 | 16.9 |
| Solids Dewatering/Drying | Off Plant Cake Transfer Pump | 8.0 | 4 | $ 325,000 | 2000 | 2012 | 16.9 |
| Solids Dewatering/Drying | Pellet Vertical Conveyor to Silo | 8.0 | 4 | $ 45,000 | 2005 | 2022 | 16.9 |
| Solids Dewatering/Drying | Pellet Vertical Conveyor to Recycle Bin | 8.0 | 4 | $ 45,000 | 2005 | 2022 | 16.9 |
| Solids Dewatering/Drying | Pellet Cooler (Finish to Ejector) | 8.0 | 4 | $ 125,000 | 2005 | 2022 | 16.9 |
| Solids Dewatering/Drying | Pellet Rotary Air Lock Recycle Bin | 8.0 | 4 | $ 20,000 | 2005 | 2022 | 16.9 |

**Table 7-17**

**Cost Estimates for Years 11 thru 20 of the Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Secondary Treatment | Aeration Basin Effluent Structures | 12.0 | 5 | $ 200,000 | 1980 | 2018 | 15.8 |
| Solids Dewatering/Drying | Inclined Conveyor | 9.0 | 5 | $ 65,000 | 2005 | 2020 | 15.0 |
| Pretreatment/Lagoon Area | Large concrete lagoons | 9.0 | 5 | $ 500,000 | 1975 | 2054 | 14.3 |
| Pretreatment/Lagoon Area | Small concrete lagoon | 9.0 | 5 | $ 325,000 | 1975 | 2054 | 14.3 |
| Pretreatment/Lagoon Area | Outdoor MCC | 9.0 | 5 | $ 25,000 | 2008 | 2034 | 14.3 |
| Solids Dewatering/Drying | Intake Screens | 9.0 | 5 | $ 20,000 | 2005 | 2021 | 14.3 |
| Solids Dewatering/Drying | SC-7 Horizontal Conveyor | 9.0 | 5 | $ 65,000 | 2005 | 2021 | 14.3 |
| Solids Dewatering/Drying | SC-6 Horizontal Conveyor | 9.0 | 5 | $ 65,000 | 2005 | 2021 | 14.3 |
| Solids Digestion | Gas compressor No. 3 | 9.0 | 5 | $ 55,000 | 1992 | 2008 | 14.3 |
| Solids Digestion | Sludge recirculation pump No. 4 | 9.0 | 5 | $ 35,000 | 1992 | 2013 | 14.3 |
| Solids Digestion | Gas Compressor No. 1 | 9.0 | 5 | $ 55,000 | 1992 | 2008 | 14.3 |
| Solids Digestion | Gas Compressor No. 2 | 9.0 | 5 | $ 55,000 | 1992 | 2008 | 14.3 |
| Solids Digestion | Sludge Recirculation Pump No. 4 | 9.0 | 5 | $ 35,000 | 1992 | 2013 | 14.3 |
| Solids Digestion | Sludge Recirculation Pump No. 5 | 9.0 | 5 | $ 35,000 | 1992 | 2013 | 14.3 |
| Solids Digestion | Sludge Recirculation Pump No. 8 | 9.0 | 5 | $ 35,000 | 1992 | 2013 | 14.3 |
| Solids Digestion | Gas compressor No. 4 | 9.0 | 5 | $ 55,000 | 1992 | 2008 | 14.3 |
| Solids Digestion | Sludge recirculation pump No. 1 | 9.0 | 5 | $ 35,000 | 1992 | 2013 | 14.3 |
| Solids Digestion | Sludge recirculation | 9.0 | 5 | $ 35,000 | 1992 | 2013 | 14.3 |

**Table 7-17**

**Cost Estimates for Years 11 thru 20 of the Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| | pump No. 2 | | | | | | |
| Solids Digestion | Sludge recirculation pump No. 3 | 9.0 | 5 | $ 35,000 | 1992 | 2013 | 14.3 |
| Solids Digestion | Gas compressor No. 5 | 9.0 | 5 | $ 55,000 | 1992 | 2008 | 14.3 |
| Solids Digestion | Heat Exchanger No. 4 | 9.0 | 5 | $ 175,000 | 1992 | 2013 | 14.3 |
| Solids Digestion | Heat Exchanger | 9.0 | 5 | $ 175,000 | 1992 | 2013 | 14.3 |
| Solids Digestion | Heat Exchanger No. 1 | 9.0 | 5 | $ 175,000 | 1992 | 2013 | 14.3 |
| Solids Digestion | Heat Exchanger No. 2 | 9.0 | 5 | $ 175,000 | 1992 | 2013 | 14.3 |
| Solids Digestion | Heat Exchanger No. 3 | 9.0 | 5 | $ 175,000 | 1992 | 2013 | 14.3 |
| Solids Digestion | Sludge preheater recirculation pump 1 and 2 | 9.0 | 5 | $ 25,000 | 1980 | 2001 | 14.3 |
| Solids Digestion | Sludge Transfer Pump No. 1 | 9.0 | 5 | $ 40,000 | 1992 | 2003 | 14.3 |
| Solids Digestion | Sludge Transfer pump No. 2 | 9.0 | 5 | $ 40,000 | 1992 | 2003 | 14.3 |
| Final Treatment | NPW Pump No. 1 | 9.0 | 5 | $ 85,000 | 1992 | 2014 | 13.5 |
| Final Treatment | NPW Pump No. 2 | 9.0 | 5 | $ 85,000 | 1992 | 2014 | 13.5 |
| Final Treatment | NPW Pump No. 3 | 9.0 | 5 | $ 85,000 | 1992 | 2014 | 13.5 |
| Solids Digestion | Sludge Recirculation Pump No. 3 | 6.0 | 4 | $ 35,000 | 1992 | 2014 | 13.5 |
| Chemical System | Ferric Feed Pump No. 1 | 6.0 | 4 | $ 10,000 | 2008 | 2025 | 12.7 |
| Chemical System | Ferric Feed Pump No. 2 | 6.0 | 4 | $ 10,000 | 2008 | 2025 | 12.7 |
| Solids Dewatering/Drying | Incline conveyor to BC-1 from SC8 | 6.0 | 4 | $ 125,000 | 2000 | 2017 | 12.7 |
| Solids Dewatering/Drying | Silo Dust Collector Bioners | 6.0 | 4 | $ 20,000 | 2005 | 2022 | 12.7 |
| Secondary Treatment | S-10 Surface Aerator | 8.0 | 5 | $ 30,000 | 1970 | 1988 | 11.0 |

**Table 7-17**

**Cost Estimates for Years 11 thru 20 of the Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Secondary Treatment | No. 14 Floating Aerator | 8.0 | 5 | $ 15,000 | 1980 | 1998 | 11.0 |
| Secondary Treatment | RAS Wetwell | 8.0 | 5 | $ 100,000 | 1970 | 2008 | 10.5 |
| Solids Dewatering/Drying | Centrifuge #1 | 8.0 | 1 | $ 675,000 | 2000 | 2017 | 3.6 |
| Solids Dewatering/Drying | Centrifuge #2 | 8.0 | 1 | $ 675,000 | 2000 | 2017 | 3.6 |
| Solids Dewatering/Drying | Centrifuge #3 | 4.0 | 1 | $ 675,000 | 2000 | 2018 | 3.2 |
| *Secondary Treatment | 5-3 Surface Aerator (100 Hp) | 6.0 | 5 | $ 30,000 | 1970 | 1990 | 10.0 |
| *Secondary Treatment | No. 10 Floating Aerator | 6.0 | 5 | $ 15,000 | 1980 | 2000 | 10.0 |
| *Secondary Treatment | No. 11 Floating Aerator | 6.0 | 5 | $ 15,000 | 1980 | 2000 | 10.0 |
| *Secondary Treatment | S-8 Surface Aerator (!00 HP) | 6.0 | 5 | $ 30,000 | 1970 | 1990 | 10.0 |
| *Secondary Treatment | No. 14 Floating Aerator | 6.0 | 5 | $ 15,000 | 1980 | 2000 | 10.0 |
| *Secondary Treatment | S-2 Surface Aerator | 6.0 | 5 | $ 30,000 | 1970 | 1990 | 10.0 |
| *Secondary Treatment | S-3 Surface Aerator | 6.0 | 5 | $ 30,000 | 1970 | 1990 | 10.0 |
| *Secondary Treatment | No. 6 Floating Aerator | 6.0 | 5 | $ 15,000 | 1980 | 2000 | 10.0 |
| *Secondary Treatment | No.8 Floating Aerator | 6.0 | 5 | $ 15,000 | 1980 | 1982 | 10.0 |
| *Secondary Treatment | No. 15 Floating Aerator | 6.0 | 5 | $ 15,000 | 1980 | 2000 | 10.0 |
| *Secondary Treatment | RAS Pump No. 3 (smaller pump) | 6.0 | 5 | $ 65,000 | 1992 | 2012 | 10.0 |
| *Secondary Treatment | RAS Pump No. 5 | 6.0 | 5 | $ 75,000 | 1992 | 2012 | 10.0 |
| *Secondary Treatment | RAS Pump No. 6 | 6.0 | 5 | $ 75,000 | 1992 | 2012 | 10.0 |
| *Secondary Treatment | RAS Pump No. 7 | 6.0 | 5 | $ 75,000 | 1992 | 2012 | 10.0 |
| *Secondary Treatment | RAS Pump Well Drain | 6.0 | 5 | $ 75,000 | 1992 | 2012 | 10.0 |

**Table 7-17**

**Cost Estimates for Years 11 thru 20 of the Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| *Final Treatment | Flood Control Pump Nos. 1 | 6.0 | 5 | $ 175,000 | 1980 | 1996 | 9.5 |
| *Final Treatment | Flood Control Pump Nos. 2 | 6.0 | 5 | $ 175,000 | 1980 | 1996 | 9.5 |
| *Final Treatment | Flood Control Pump Nos. 3 | 6.0 | 5 | $ 175,000 | 1980 | 1996 | 9.5 |
| **Year 11 through 20 Total Estimated Cost** | | | | **$ 14,875,000.00** | | | |

* Equipment replacement cost not included in total estimated cost. Equipment is part of other CIP projects.

# Section 8
# Pump Station Condition Assessment

CDM conducted a physical condition assessment of fifteen wastewater pump stations located throughout CCUC's collection system in order to identify the physical and operable condition and reliability of equipment and facilities, identify whether the condition requires upgrading or replacement, and identify projects required to maintain the facilities and equipment over the 20-year planning period.

This section provides an overview of the established procedures used for the assessments; reviews the observations and findings of the assessments; documents and summarizes the conditional ratings of the assets; and provides prioritization of need based on the assessment.

## 8.1 Condition Assessment

The physical condition assessment is intended to document the general condition of mechanical equipment, structures, and electrical equipment; provide an estimated remaining service life of major mechanical equipment; and provide information to prioritize rehabilitation or replacement needs. Condition assessments were performed on the following wastewater pump stations:

- Clemmons No. 2
- Clemmons No. 3
- Clemmons No. 4
- Fair Oaks
- Tanglewood
- Village Club
- Fernbrook
- Wexford
- Linville Springs
- Reedy Fork
- North Lake
- Allison Avenue
- Machine Street
- Kerners Mill
- New South Fork

## 8.1.1 Physical Condition Assessments

Assessments were performed through visual observations of equipment, interviews with staff and review of pertinent equipment documentation. Using CDM's standard evaluation forms, these findings were documented and conditional response ratings were assigned to up to eight subcomponents of each asset:

1. Mechanical Equipment
2. Electrical Motor or Drive
3. Electrical Components
4. Control Panels and Controls
5. Gates and Valves or other mechanical appurtenances
6. Piping
7. Structural Integrity and Coatings
8. Operability of the asset

Conditional responses for the eight subcomponents were averaged to provide an overall asset conditional response rating ($C_A$) for the asset. The conditional response ratings were further weighted according to the equipment's criticality in maintaining firm capacity. Using criticality ratings ($C_R$) enables the prioritization of need and prevents the analysis from skewing toward little used or out of service assets not important to the pump station's operation. The combination of the $C_A$ and the $C_R$ derives an Asset Risk Index (ARI). The higher the ARI rating, the greater the likely need of that asset.

### 8.1.1.1 Conditional Response Ratings

Conditional responses are used to establish baseline information for determining equipment mechanical condition. Conditional responses are rated on a five point scale, 1, 2, 3, 4, and 5. "1" is the highest or best condition, while "5" is the lowest or worst condition. Descriptions of the conditional responses are presented below.

1 This conditional response is appropriate when no apparent problems exist. When assigning this value to an inspected item, the item is characterized by some or one of the following:

   a. Coatings and/or finishes appear to be new or nearly new.
   b. Item does not leak, drip, spill or discharge lubricants or process fluids excessively except as designed.
   c. Item appears to fit the application to which it is applied.
   d. Item does not need repair of replacement.

2 This conditional response is appropriate when the inspected item fails one or more of the criteria outlined in the "1" conditional response. While a piece of equipment may be working properly, it may show signs of corrosion or may be improperly sized. The "2" conditional response should be assigned when the inspected item is characterized by some or one of the following:

a. All "1" conditional response criteria are not met.
b. Item is generally within the first quartile of its Remaining Useful Life.

3 This conditional response is appropriate when the inspected item is generally within the second quartile of its Remaining Useful Life and is characterized by some or one of the following:

a. Item does not leak, drip, spill or discharge lubricants or process fluids excessively, except as designed.
b. Item is capable of remaining in useful service, without requiring repair or replacement, for at least five years
c. Item shows signs of corrosion.

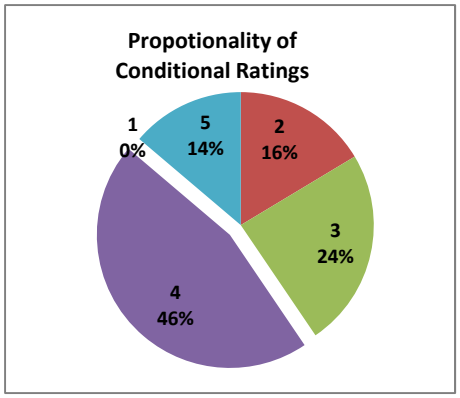
4 This conditional response is appropriate when the inspected item appears to be near the end of its useful life cycle and is characterized by some or one of the following:

a. Generally, within the third quartile of its Remaining Useful Life
b. The item requires excessive maintenance or repair to remain in service.
c. The item is recommended for repair and/or replacement in not less than one year but not more than 5 years.

5 This conditional response is appropriate when the inspected item is not capable or remaining in service for more than one-year and/or is currently out of service. The item should be considered as a "5" if it is characterized by some or one of the following:

a. The item needs immediate replacement (i.e., 1 year or less).
b. The item presents a danger to human health and safety.
c. The item is being used in an improper application.
d. The item is not capable of performing its intended function.

Greater than 120 assets were examined and conditional assessments made. Examining the conditional response ($C_a$) ratings of the equipment observed, the greatest proportionality (approximately 46%) of the equipment was assigned conditional response ratings of 4. These conditional response ratings are generally appropriate when the inspected item appears to be near the end of its useful life cycle (conditional response rating of 4).



### 8.1.1.2 Criticality Ratings

The following scoring system was used to weigh each major equipment item's Asset Risk numerically based on its Conditional Response rating times a factor that is related to its degree of importance (Criticality) in the system.

Each major equipment item's criticality was ranked on a scale of 1 = LOW, 2=MEDIUM, 3=HIGH and 4-HIGH-HIGH. The criteria for these ratings are described below.

1 LOW in importance meets **any** of the following criteria:
   a. The equipment is not required for firm capacity.
   b. The equipment is not required for continued uninterrupted operation.
   c. The equipment is support or ancillary.
   d. The repair of equipment is not time sensitive.

2 MEDIUM in importance meets **any** of the following criteria:
   a. The equipment is required as back-up to firm capacity.
   b. The equipment is required for continued uninterrupted operation.
   c. The equipment is support or ancillary and is required for continued uninterrupted operation.
   d. The repair of equipment must be addressed within one month.

3 HIGH in importance meets **any** of the following criteria:
   a. The equipment is not required to meet firm capacity.
   b. The repair of equipment must be addressed within one week.

4 HIGH-HIGH in importance meets **any** of the following criteria:
   a. The equipment is required for firm capacity.
   b. The repair of equipment must be addressed within 24 hours.
   c. The equipment contains a health and safety deficiency.

Each asset was then assigned a Criticality Rating ($C_r$) based on its impact to pump station operations, ability to maintain firm capacity, and considerations for health and safety. The majority (68%) of the assets were assigned criticality ($C_r$) ratings of HIGH-HIGH (4); assets considered to have the greatest impact to pump station operation, firm capacity, and health and safety. **Table 8-1** is a listing of those assets receiving the highest criticality rating.

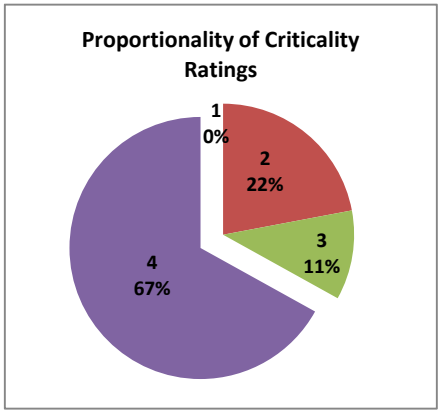


**Table 8-1**

**Assets Receiving Highest Criticality Ratings (HIGH-HIGH)**

| Pump Station | Equipment |
|---|---|
| Clemmons No. 2 | Pump No. 1 |
| Clemmons No. 2 | Pump No. 2 |
| Clemmons No. 2 | Wetwell |
| Clemmons No. 2 | Backup Power Generator |
| Clemmons No. 2 | Station |
| Clemmons No. 3 | Pump No. 1 |
| Clemmons No. 3 | Pump No. 2 |
| Clemmons No. 3 | Wetwell |
| Clemmons No. 3 | PLC |
| Clemmons No. 3 | Station |
| Clemmons No. 4 | Pump No. 1 |
| Clemmons No. 4 | Pump No. 2 |
| Clemmons No. 4 | Wetwell |
| Clemmons No. 4 | PLC |
| Clemmons No. 4 | Station |
| Fair Oaks | Backup Power Generator |
| Fair Oaks | Fuel Storage Tank |
| Fair Oaks | Electrical Switchgear |
| Fair Oaks | PLC |
| Fair Oaks | Station |
| Tanglewood | Backup Power Generator |
| Tanglewood | Fuel Storage Tank |
| Tanglewood | Electrical Switchgear |
| Tanglewood | PLC |
| Village Club | Pump No. 1 |
| Village Club | Pump No. 2 |
| Village Club | Wetwell |
| Village Club | PLC |
| Fernbrook | Pump No. 1 |
| Fernbrook | Pump No. 2 |
| Fernbrook | Wetwell |
| Fernbrook | Backup Power Generator |
| Fernbrook | Electrical Switchgear |
| Fernbrook | PLC |
| Fernbrook | Station |
| Linville Springs | Pump No. 1 |
| Linville Springs | Pump No. 2 |
| Linville Springs | Wetwell |

**Table 8-1**

**Assets Receiving Highest Criticality Ratings (HIGH-HIGH)**

| Pump Station | Equipment |
|---|---|
| Linville Springs | Backup Power Generator |
| Linville Springs | Electrical Switchgear |
| Linville Springs | PLC |
| Linville Springs | Station |
| Wexford | Pump No. 1 |
| Wexford | Pump No. 2 |
| Wexford | Wetwell |
| Wexford | PLC |
| Wexford | PLC |
| Reedy Fork | Pump No. 1 |
| Reedy Fork | Pump No. 2 |
| Reedy Fork | PLC |
| Reedy Fork | Bioxide Tank |
| Reedy Fork | Chemical Containment |
| Reedy Fork | Bar Screen |
| Reedy Fork | Hoist/Crane |
| Reedy Fork | Station |
| North Lake | Pump No. 1 |
| North Lake | Pump No. 2 |
| North Lake | Wetwell |
| North Lake | Backup Power Generator |
| North Lake | Propane Tank |
| North Lake | Electrical Switchgear |
| North Lake | PLC |
| North Lake | Hoist |
| North Lake | Station |
| Allison Avenue | Pump No. 1 |
| Allison Avenue | Pump No. 2 |
| Allison Avenue | Backup Power Generator |
| Allison Avenue | Roto-Phase |
| Allison Avenue | Station |
| Kerners Mill | Pump No. 1 |
| Kerners Mill | Pump No. 2 |
| Kerners Mill | PLC |
| Kerners Mill | Backup Power Generator |
| Kerners Mill | Fuel Storage Tank |
| Kerners Mill | Switchgear |
| New South Fork | Flow Diversion Structure |

**Table 8-1**

**Assets Receiving Highest Criticality Ratings (HIGH-HIGH)**

| Pump Station | Equipment |
|---|---|
| New South Fork | Throttling valve |
| New South Fork | Station |

### 8.1.1.3 Asset Risk Index

The Asset Risk Index (ARI) is the weighting of an asset's condition against its level of importance to the pump station's operation. Relating the $C_a$ rating to the $C_r$ rating derived the risk (ARI) for each asset. For instance, a pump's condition is assessed as 3 and its criticality is 2 (Medium), the ARI would be as follows:

Where:

$C_A$ = Conditional Response Rating (1 through 5) through assessments
$C_R$ = Criticality designation (1 through 3)
ARI = Conditional Response x Criticality Rating
= $C_A$ (3) x $C_R$ (2)
= 6

**Table 8-2** demonstrates the possible combinations of condition and criticality ratings and the resulting ARI scores.

**Table 8-2**

**ARI for Combinations of Condition and Criticality**

| | Conditional Responses | | | | |
|---|---|---|---|---|---|
| Criticality | 1 (Best) | 2 | 3 | 4 | 5 (Worse) |
| 1 (Low) | 1 | 2 | 3 | 4 | 5 |
| 2 (Med) | 2 | 4 | 6 | 8 | 10 |
| 3 (High) | 3 | 6 | 9 | 12 | 15 |
| 4 (Hi-Hi) | 4 | 8 | 12 | 16 | 20 |

An asset risk rating system results whereby a rating of 1 equates to best condition, low criticality, and a rating of 20 equates to worse condition, very high (High-High) criticality. Assets receiving the highest criticality rating may result in the assignment of a high Asset Risk Index value. However, if an asset receives an excellent conditional response rating ($C_a$=1) and the highest criticality rating ($C_r$=4), the assets resulting ARI would be low (ARI=4). Conversely, an asset receiving the worst conditional response rating ($C_a$=5) and the lowest criticality rating ($C_r$=1) would result in a corresponding low level of risk (ARI=5). All assets at the 15 pump stations were analyzed in this manner. **Table 8-3** is a matrix of the quantity of assets for all pump

stations assigned to each ARI rating category, one through twenty (reference Table 8-2). **Table 8-4** identifies the equipment that received the highest risk ratings.

**Table 8-3**

**Asset Risk Index (ARI)**

| | *Conditional Responses, $C_a$* | | | | |
|---|---|---|---|---|---|
| *Criticality, Cr* | 1 (Best) | 2 | 3 | 4 | 5 (Worse) |
| 1 (Low) | 0 | 0 | 0 | 0 | 0 |
| 2 (Med) | 0 | 11 | 7 | 8 | 1 |
| 3 (High) | 0 | 1 | 3 | 6 | 0 |
| 4 (Hi-Hi) | 0 | 6 | 16 | 23 | 0 |

**Table 8-4**

**Equipment with Highest Rated Asset Risk Index (ARI)**

| **Process** | **Equipment** | **$C_a$** | **$C_r$** | **ARI** |
|---|---|---|---|---|
| Fernbrook | Pump No. 1 | 5 | 4 | 20.0 |
| Fernbrook | Pump No. 2 | 5 | 4 | 20.0 |
| Fernbrook | Wetwell | 5 | 4 | 20.0 |
| Kerners Mill | PLC | 5 | 4 | 20.0 |
| Reedy Fork | PLC | 5 | 4 | 20.0 |
| Reedy Fork | Chemical Containment | 5 | 4 | 20.0 |
| Allison Avenue | Pump No. 1 | 4 | 4 | 16.0 |
| Allison Avenue | Pump No. 2 | 4 | 4 | 16.0 |
| Allison Avenue | Roto-Phase | 4 | 4 | 16.0 |
| Clemmons No. 2 | Wetwell | 4 | 4 | 16.0 |
| Clemmons No. 3 | Wetwell | 4 | 4 | 16.0 |
| Clemmons No. 4 | Wetwell | 4 | 4 | 16.0 |
| Fair Oaks | Backup Power Generator | 4 | 4 | 16.0 |
| Fair Oaks | Fuel Storage Tank | 4 | 4 | 16.0 |
| Fair Oaks | PLC | 4 | 4 | 16.0 |
| Fernbrook | Backup Power Generator | 4 | 4 | 16.0 |
| Fernbrook | Electrical Switchgear | 4 | 4 | 16.0 |
| Kerners Mill | Pump No. 1 | 4 | 4 | 16.0 |
| Kerners Mill | Pump No. 2 | 4 | 4 | 16.0 |
| Kerners Mill | Backup Power Generator | 4 | 4 | 16.0 |
| Kerners Mill | Switchgear | 4 | 4 | 16.0 |
| Linville Springs | Pump No. 1 | 4 | 4 | 16.0 |
| Linville Springs | Pump No. 2 | 4 | 4 | 16.0 |
| Linville Springs | PLC | 4 | 4 | 16.0 |
| New South Fork | Flow Diversion Structure | 4 | 4 | 16.0 |

**Table 8-4**

**Equipment with Highest Rated Asset Risk Index (ARI)**

| Process | Equipment | $C_a$ | $C_r$ | ARI |
|---|---|---|---|---|
| New South Fork | Throttling valve | 4 | 4 | 16.0 |
| North Lake | Wetwell | 4 | 4 | 16.0 |
| North Lake | Backup Power Generator | 4 | 4 | 16.0 |
| North Lake | Propane Tank | 4 | 4 | 16.0 |
| North Lake | PLC | 4 | 4 | 16.0 |
| North Lake | Pump No. 1 | 4 | 4 | 16.0 |
| North Lake | Pump No. 2 | 4 | 4 | 16.0 |
| Reedy Fork | Pump No. 1 | 4 | 4 | 16.0 |
| Reedy Fork | Pump No. 2 | 4 | 4 | 16.0 |
| Reedy Fork | Bioxide Tank | 4 | 4 | 16.0 |
| Reedy Fork | Bar Screen | 4 | 4 | 16.0 |
| Reedy Fork | Hoist/Crane | 4 | 4 | 16.0 |
| Tanglewood | Fuel Storage Tank | 4 | 4 | 16.0 |
| Tanglewood | Electrical Switchgear | 4 | 4 | 16.0 |
| Village Club | Wetwell | 4 | 4 | 16.0 |
| Wexford | Wetwell | 4 | 4 | 16.0 |
| Wexford | PLC | 4 | 4 | 16.0 |
| Wexford | Pump No. 1 | 4 | 4 | 16.0 |
| Wexford | Pump No. 2 | 4 | 4 | 16.0 |
| Clemmons No. 2 | Pump No. 1 | 3 | 4 | 12.0 |
| Clemmons No. 2 | Pump No. 2 | 3 | 4 | 12.0 |
| Clemmons No. 3 | Pump No. 1 | 3 | 4 | 12.0 |
| Clemmons No. 3 | Pump No. 2 | 3 | 4 | 12.0 |
| Clemmons No. 4 | Pump No. 1 | 3 | 4 | 12.0 |
| Clemmons No. 4 | Pump No. 2 | 3 | 4 | 12.0 |
| Fair Oaks | Electrical Switchgear | 3 | 4 | 12.0 |
| Fernbrook | PLC | 3 | 4 | 12.0 |
| Kerners Mill | Fuel Storage Tank | 3 | 4 | 12.0 |
| Kerners Mill | Wetwell | 4 | 3 | 12.0 |
| Kerners Mill | Sump Pumps | 4 | 3 | 12.0 |
| Linville Springs | Wetwell | 3 | 4 | 12.0 |
| Machine Street | Pump No. 1 | 4 | 3 | 12.0 |
| Machine Street | Pump No. 2 | 4 | 3 | 12.0 |
| Machine Street | Wetwell | 4 | 3 | 12.0 |
| Machine Street | Exhaust Fan | 4 | 3 | 12.0 |
| North Lake | Electrical Switchgear | 3 | 4 | 12.0 |
| Tanglewood | Backup Power Generator | 3 | 4 | 12.0 |
| Tanglewood | PLC | 3 | 4 | 12.0 |

**Table 8-4**

**Equipment with Highest Rated Asset Risk Index (ARI)**

| Process | Equipment | $C_a$ | $C_r$ | ARI |
|---|---|---|---|---|
| Village Club | Pump No. 1 | 3 | 4 | 12.0 |
| Village Club | Pump No. 2 | 3 | 4 | 12.0 |
| Village Club | PLC | 3 | 4 | 12.0 |

Additional equipment that rated medium in criticality ($C_r$=3) and average in condition ($C_a$=3) resulted in a medium-high risk index (ARI-9). **Table 8-5** includes the next level of assets with a medium to high level of risk.

**Table 8-5**

**Equipment with a Medium-High Asset Risk Index (ARI)**

| Process | Equipment | $C_a$ | $C_r$ | ARI |
|---|---|---|---|---|
| Allison Avenue | Wetwell | 3 | 3 | 9.0 |
| Allison Avenue | Electrical Switchgear | 3 | 3 | 9.0 |
| Fair Oaks | Wetwell | 3 | 3 | 9.0 |
| Wexford | Backup Power Generator | 3 | 3 | 9.0 |
| Wexford | Electrical Switchgear | 3 | 3 | 9.0 |

The pumping stations that rated the highest asset risk index are shown in **Table 8-6**.

**Table 8-6**

**Pump Stations with Highest Asset Risk Index (ARI)**

| Process | ARI |
|---|---|
| Allison Avenue | 20 |
| Clemmons No. 2 | 20 |
| Clemmons No. 3 | 18 |
| Clemmons No. 4 | 16 |
| Fair Oaks | 16 |
| Fernbrook | 16 |
| Kerners Mill | 16 |

### 8.1.1.4 Prioritization of Need

To determine an asset's overall Risk Factor (RF), elements of the U.S. EPA Asset Management best practices were applied to derive an approximation of the asset's remaining useful life, the likelihood of its failure and a prioritization of its replacement.

***Remaining Useful Life (RUL)***
Using standard industrial estimated useful life (EUL) tables, an asset's EUL in years was assigned to each asset. Based on the original installation date (disregarding whether major modifications or repairs have been performed), the estimated remaining useful life (ERUL) was estimated based on the Estimated Useful Life value and the installation year. Finally, the asset's Remaining Useful Life (RUL) was calculated from the ERUL and weighted by the average Conditional Response ($C_a$) rating.

Finally, the replacement year, the year that the asset should theoretically be replaced, was determined. The replacement year may be impacted by the equipment's O&M Conditional Response factor, which is an asset's maintenance needs and operational reliability. The Replacement Year adds the RUL (weighted by an O&M Conditional Response factor) to the Current Year.

***Probability of Failure (PoF)***
The probability that an asset will no longer perform its intended function is a function of whether it's achieved its expected useful life, how well it's been maintained, its operational requirements, environmental conditions and its current condition relative to its age. High probability of failure values represents the greatest chance that an asset will experience a significant failure given the appropriate conditions.

The probability that an asset will no longer perform its intended function is a function of its estimated useful life relative to its remaining useful life weighed by the equipment's redundancy. High values derived for the probability of failure represents the greatest probability of failure. The formula used is as follows:

Probability of Failure (PoF) = ((Estimated Useful Life – Remaining Useful Life) / Estimated Useful Life) x (1 – Redundancy) x 10

***Redundancy***
Equipment with high redundancy ratings are those that have the greatest ability to continue to perform a function due to appropriate equipment backup components or another asset is capable of performing in a similar capacity. If an asset has limited or no redundancy, a resulting higher probability of failure may result (i.e., a pump station's incoming service has limited or no backup power).

***Risk Factor***
Finally, the Risk Factor (RF) weighs the proportionality of the assets criticality rating to its probability of failure (Risk Factor = PoF x Cr). A high Risk Factor rating is characteristic of an asset that is critical and demonstrates a high chance of failure. These assets require a high priority given their need for timely repairs or replacement. Ranking assets by their Risk Factor permits a better assessment and prioritization of need to be established over the 20 year planning period.

**Table 8-7** summarizes the ranking of assets with the greatest priority of need. The table ranks assets found to have the greatest Risk Value (greater than 25 first); possess a high probability of failure indicator (10 or greater) secondarily; and demonstrates a medium-high asset risk index (9 or greater) lastly. Based on this table, the pump stations requiring the greatest attention include.

**Table 8-7**

**Asset of Greatest Priority of Need**

| Process | Equipment | ARI | PoF | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|
| Fernbrook | Pump No. 1 | 20.0 | 12 | 1997 | 2013 | 47.6 |
| Fernbrook | Pump No. 2 | 20.0 | 12 | 1997 | 2013 | 47.6 |
| Fernbrook | Wetwell | 20.0 | 12 | 1997 | 2029 | 47.6 |
| Clemmons No. 2 | Wetwell | 16.0 | 11 | 1994 | 2028 | 45.8 |
| Clemmons No. 3 | Wetwell | 16.0 | 11 | 1991 | 2025 | 45.8 |
| Clemmons No. 4 | Wetwell | 16.0 | 11 | 1993 | 2027 | 45.8 |
| Kerners Mill | Switchgear | 16.0 | 11 | 1981 | 2002 | 45.8 |
| North Lake | Wetwell | 16.0 | 11 | 1999 | 2033 | 45.8 |
| Reedy Fork | Pump No. 1 | 16.0 | 11 | 1980 | 1997 | 45.8 |
| Reedy Fork | Pump No. 2 | 16.0 | 11 | 1980 | 1997 | 45.8 |
| Wexford | Wetwell | 16.0 | 11 | 1986 | 2020 | 45.8 |
| Allison Avenue | Station | 16 | 11 | 1997 | 2040 | 45.8 |
| Allison Avenue | Pump No. 1 | 16.0 | 11 | 1997 | 2015 | 43.9 |
| Allison Avenue | Pump No. 2 | 16.0 | 11 | 1997 | 2015 | 43.9 |
| Fernbrook | Electrical Switchgear | 16.0 | 11 | 1997 | 2020 | 43.9 |
| Linville Springs | Pump No. 2 | 16.0 | 11 | 1992 | 2010 | 43.9 |
| North Lake | Pump No. 1 | 16.0 | 11 | 1999 | 2017 | 43.9 |
| North Lake | Pump No. 2 | 16.0 | 11 | 1999 | 2017 | 43.9 |
| Tanglewood | Electrical Switchgear | 16.0 | 11 | 1987 | 2010 | 43.9 |
| Village Club | Wetwell | 16.0 | 11 | 1995 | 2031 | 43.9 |
| Wexford | Pump No. 1 | 16.0 | 11 | 1986 | 2004 | 43.9 |

**Table 8-7**

**Asset of Greatest Priority of Need**

| Process | Equipment | ARI | PoF | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|
| Wexford | Pump No. 2 | 16.0 | 11 | 1986 | 2004 | 43.9 |
| Clemmons No. 2 | Pump No. 1 | 12.0 | 11 | 1994 | 2013 | 42.0 |
| Clemmons No. 2 | Pump No. 2 | 12.0 | 11 | 1994 | 2013 | 42.0 |
| Clemmons No. 3 | Pump No. 1 | 12.0 | 11 | 1991 | 2010 | 42.0 |
| Clemmons No. 3 | Pump No. 2 | 12.0 | 11 | 1991 | 2010 | 42.0 |
| Clemmons No. 4 | Pump No. 1 | 12.0 | 11 | 1993 | 2012 | 42.0 |
| Clemmons No. 4 | Pump No. 2 | 12.0 | 11 | 1993 | 2012 | 42.0 |
| Fair Oaks | Electrical Switchgear | 12.0 | 11 | 1991 | 2015 | 42.0 |
| Kerners Mill | Pump No. 1 | 16.0 | 11 | 1981 | 2000 | 42.0 |
| Kerners Mill | Pump No. 2 | 16.0 | 11 | 1981 | 2000 | 42.0 |
| Linville Springs | Pump No. 1 | 16.0 | 11 | 1992 | 2011 | 42.0 |
| New South Fork | Flow Diversion Structure | 16.0 | 11 | 2006 | 2044 | 42.0 |
| New South Fork | Throttling valve | 16.0 | 11 | 2006 | 2030 | 42.0 |
| New South Fork | Station | 16 | 10.5 | 2006 | 2054 | 42.0 |
| North Lake | Electrical Switchgear | 12.0 | 11 | 1999 | 2023 | 42.0 |
| Village Club | Pump No. 1 | 12.0 | 11 | 1995 | 2014 | 42.0 |
| Village Club | Pump No. 2 | 12.0 | 11 | 1995 | 2014 | 42.0 |
| Linville Springs | Wetwell | 12.0 | 10 | 1992 | 2032 | 40.0 |
| North Lake | Station | 14 | 10 | 1999 | 2049 | 40.0 |
| Reedy Fork | Station | 14 | 10 | 1980 | 2030 | 40.0 |
| Machine Street | Pump No. 1 | 12.0 | 11 | 1960 | 1977 | 34.4 |
| Machine Street | Pump No. 2 | 12.0 | 11 | 1960 | 1977 | 34.4 |
| Machine Street | Wetwell | 12.0 | 11 | 1960 | 1994 | 34.4 |
| Kerners Mill | Wetwell | 12.0 | 11 | 1981 | 2017 | 32.9 |

**Table 8-7**

**Asset of Greatest Priority of Need**

| Process | Equipment | ARI | PoF | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|
| Machine Street | Exhaust Fan | 12.0 | 11 | 1960 | 1978 | 32.9 |
| Allison Avenue | Wetwell | 9.0 | 11 | 1997 | 2035 | 31.5 |
| Fernbrook | Station | 12 | 11 | 1997 | 2045 | 31.5 |
| Fair Oaks | Wetwell | 9.0 | 10 | 1991 | 2031 | 30.0 |
| Wexford | Electrical Switchgear | 9.0 | 10 | 1986 | 2011 | 30.0 |
| Linville Springs | Station | 11 | 11 | 1992 | 2040 | 31.5 |
| Fair Oaks | Station | 11 | 11 | 1991 | 2039 | 31.5 |
| Kerners Mill | Station | 11 | 11 | 1981 | 2031 | 32.7 |
| Allison Avenue | Electrical Switchgear | 9.0 | 10 | 1997 | 2023 | 28.5 |

## 8.1.2 Condition Observations

The following observations were made during the equipment assessments and subsequent staff interviews.

***Kerners Mill Pump Station***

The Kerners Mill Pump Station was commissioned in August of 1981. The pump station contains two wetwells and two centrifugal pumps with individual capacities of 4,400 gpm. Pumps discharge to a forcemain 6,400 feet in length. A biological odor control system removes odors from raw wastewater entering the station. Backup power is supplied by a 500 kW generator. Wastewater overflows from the pump station will enter Winston Salem Lake.

- The Kerners Mill pump station is in the worst overall condition with respect to pump stations assessed by CDM. The pump station contains equipment that is aged with some having parts that are either obsolete or extremely difficult to acquire. A complete rebuild or replacement of the pump station equipment is recommended.

- Large amounts of sand and grit have been removed from the Kerners Mill pump station. Sand and grit entering the pump station is a sign of significant inflow/infiltration and causes excessive wear and tear on pumps, valves, and piping. Discussion with lift station staff indicates pump impellers contain significant wear. Recent air release valve failures on pump discharge piping

due to sand scouring further illustrate the need for immediate attention. Investigation into sources of inflow/infiltration should be identified to minimized flow and sand/grit accumulation.

- The Kerners Mill pump station does not have pump and haul capabilities. Due to the age and the inability to repair/replace portions of equipment, pump station overflow is a major concern. Wastewater overflow at the pump station will drain to Salem Lake, the drinking water source for Winston Salem.

- The packing glands for both pumps leak excessively, leaving a wet and slick surface around the pumps. Potable seal water is not available for the packing glands. Due to leaking, excessive housekeeping is required by the pump station staff to maintain a safe working environment.

- The coating for the pumps and associated piping and valves is beginning to peel in various areas. Moderate corrosion is present on isolation valves and pump base plates.

- The pump station utilizes an aged bubbler system for pump control. Upgrading the pump control system with admittance probes is recommended.

- The wetwell for the pump station is in fair condition with surface cracking of concrete in multiple areas.

- High levels in the wetwell allow raw sewage to enter the pump station by backflow into the floor drain piping. Check valves or other means of preventing backflow should be installed.

- The odor control system is in good condition. Media for the system is replaced every four years.

- Moderate corrosion is present on the inlet channel sluice gate.

- The electrical gear for the pump station is aged and faded. Acquiring replacement parts for gear is extremely difficult. Replacement of the electrical gear is required.

- The backup power generator and associated switchgear is aged and undersized. Locating replacement parts for the switchgear is extremely difficult as some parts are obsolete. Generator capacity prevents operation of both pumps during a utility power outage, contributing to possible overflow. Surface corrosion is present on the exhaust system for the generator. Replacement of generator and switch gear is recommended.

- Currently, the pump station equipment and wetwell level cannot be monitored remotely through the SCADA system. The pump station is not monitored by the remote SCADA system and utilizes a call out system. It is recommended that this pump station be added to the current SCADA System.

- The PLC for the pump station is aged and in need of replacement.

- The exhaust fan located over the main entrance to the electrical room does not have a guard for protection. Installation of a guard is recommended.

- The sump pumps are aged and should be considered for replacement. Moderate corrosion is present on the cover plate of the sump pit.

***Clemmons No. 2 Pump Station***

The Clemmons No. 2 Pump Station was commissioned in March of 1981. The pump station contains one wetwell and two grinder pumps, each having a capacity of 55 gpm. Pumps discharge to a forcemain 1,200 feet in length. Backup power is supplied by a 20 kW generator. Wastewater overflows from the pump station will enter Blanket Creek.

- The grinder pumps clog with grease frequently. Significant effort by the pump station inspection and maintenance staff is necessary to remove grease and maintain pumps. A septic tank hauler is used periodically to remove grease for the wetwell. The cost benefit of purchasing a tanker truck to remove grease and assist on pumping down wetwells when needed should be evaluated (for all pump stations).

- Flow entering the pump station increases dramatically during heavy rain events. The pumps operate continuously and are unable to keep the wetwell pumped down. A septic tank hauler is used as needed to prevent wetwell overflow. The station does not have bypass pumping capability. The sources of inflow/infiltration should be identified to minimize flow during rain events and wear and tear on equipment.

- The pumps are currently controlled by wetwell floats which hang on debris and grease. Utilizing admittance probes for pump control is recommended.

- Discussion with pump station staff reveals that the force main is undersized at 2-inches. An evaluation to determine the appropriate force main size is recommended.

- The wetwell is sized at 4 feet in diameter and 10 feet in depth. Increasing the wetwell diameter to provide adequate space for inspection and maintenance for pumps and level monitoring equipment is recommended. Adequate space

is not available for pulling/repairing pumps when septic tank hauler is pumping down wetwell. The pump station does not have by pass pumping capabilities.

- The guide rail and support brackets contain moderate to severe corrosion.
- The backup power generator is in good overall condition and sized at 20 kW. Increasing pump station capacity may result in the need for a larger generator/switchgear.
- Insufficient starter capacity has caused pump failures in the past. Starter capacity should be evaluated when upgrading pump station.
- Pump station staff recommends upgrading the Clemmons No. 2 pump station similar to the Clemmons No. 5 pump station.
- Access for parking and working in vicinity of pump station is not available. Adequate space for parking at and working on pump station components should be considered when upgrading/expanding station in the future.
- There are no means (hoist) for removing pumps for repair/maintenance. Permanent pump removal equipment should be considered.
- Currently, wetwell level cannot be monitored remotely. Remote wetwell level monitoring is recommended to assist in the prevention of pump station overflows.
- The valve vault for the pump station is not contained within the pump station fencing. Fencing all pump station components is recommended.

***Wexford Pump Station***

The Wexford Pump Station was commissioned in August of 1986. The pump station contains one wetwell and two grinder pumps, each having a capacity of 63 gpm. Pumps discharge to a forcemain 3,600 feet in length. Backup power is supplied by a 20 kW generator. Wastewater overflows from the pump station will enter as tributary to Fiddlers Creek.

- The grinder pumps clog with grease frequently. Significant effort by the pump station inspection and maintenance staff is necessary to remove grease and maintain pumps. A septic tank hauler is used periodically to remove grease for the wetwell.
- Flow entering the pump station increases dramatically during heavy rain events. The pumps operate continuously and are unable to keep the wetwell

pumped down. A septic tank hauler is used as needed to prevent wetwell overflow. The station does not have bypass pumping capability. The sources of inflow/infiltration should be identified to minimize flow during rain events and wear and tear on equipment.

- The pumps are currently controlled by wetwell floats which hang on debris and grease. Utilizing admittance probes for pump control is recommended.

- Discussion with pump station staff reveals that the force main is undersized at 2-inches. An evaluation to determine the appropriate force main size is recommended.

- The wetwell is sized at 5 feet in diameter and 13 feet in depth. Adequate space is not available for pulling/repairing pumps when septic tank hauler is pumping down wetwell. The pump station is not equipped with bypass pumping capabilities. Increasing the wetwell diameter to provide adequate space for inspection and maintenance for pumps and level monitoring equipment is recommended.

- Severe corrosion is present on wetwell metals' including the brackets/supports for the guiderails and floats as well as the anchor bolts for the wetwell hatch door. Concrete cracking is severe in areas with loose pieces falling into the wetwell.

- The backup power generator is in good overall condition and sized at 20 kW. Increasing pump station capacity may result in the need for a larger generator/switchgear.

- Pump station staff recommends upgrading the Wexford pump station similar to the Clemmons No. 5 pump station.

- There are no means (hoist) for removing pumps for repair/maintenance. Permanent pump removal equipment should be considered. The pump's guide rail system for pulling pumps is too short, requiring lift station staff to enter the top of the wet-well to access pump guide rail system.

- Currently, wetwell level cannot be monitored remotely. Remote wetwell level monitoring is recommended to assist in the prevention of pump station overflows.

***Allison Avenue Pump Station***

The Allison Avenue Pump Station was commissioned in 1997. The pump station contains one wetwell and two grinder pumps, each having a capacity of 67 gpm. Pumps discharge to a forcemain 450 feet in length. Backup power is supplied by a 150

kW generator. Wastewater overflows from the pump station will enter an adjacent stream approximately 40 feet from the station.

- The grinder pumps clog with grease frequently. Significant effort by the pump station inspection and maintenance staff is necessary to remove grease and maintain pumps. A septic tank hauler is used periodically to remove grease for the wetwell.

- Flow entering the pump station increases dramatically during heavy rain events. The pumps operate continuously and are unable to keep the wetwell pumped down. A septic tank hauler is used as needed to prevent wetwell overflow. The sources of inflow/infiltration should be identified to minimize flow during rain events and wear and tear on equipment.

- Insufficient power provided by the electrical utility supplier mandates the use of a roto-phase for pump operation. Upgrading the pump station to include adequate electrical utility service to operate pumps should be considered.

- The pumps are currently controlled by wetwell floats which hang on debris and grease. Utilizing admittance probes for pump control is recommended.

- Pump station staff recommends upgrading the Allison Avenue pump station similar to the Clemmons No. 5 pump station.

- Surface corrosion is present on the mounting brackets for the main disconnect.

- Moderate corrosion is present on exposed discharging piping in wetwell and dry well. Moderate corrosion is also present on float and pump chain support brackets.

- There are no means (hoist) for removing pumps for repair/maintenance. Permanent pump removal equipment should be considered.

- Currently, wetwell level cannot be monitored remotely. Remote wetwell level monitoring is recommended to assist in the prevention of pump station overflows.

***North Lake Pump Station***

The North Lake Pump Station contains one wetwell and two grinder pumps, each having a capacity of 77 gpm. Pumps discharge to a forcemain 2,800 feet in length. Backup power is supplied by a 20 kW generator. Wastewater overflows from the pump station will enter Blanket Creek.

- The grinder pumps clog with grease frequently. Significant effort by the pump station inspection and maintenance staff is necessary to remove grease and maintain pumps. A septic tank hauler is used periodically to remove grease for the wetwell.

- Flow entering the pump station increases dramatically during heavy rain events. The pumps operate continuously and are unable to keep the wetwell pumped down. A septic tank hauler is used as needed to prevent wetwell overflow. The sources of inflow/infiltration should be identified to minimize flow during rain events and wear and tear on equipment.

- Pump station staff recommends upgrading the North Lake pump station similar to the Clemmons No. 5 pump station.

- Moderate corrosion is present on guiderail support brackets.

- Discussion with pump station staff reveals that the force main is undersized at 2-inches. An evaluation to determine the appropriate force main size is recommended.

- Surface corrosion is present on the exhaust piping and the lower portion of the access door for the backup power generator.

- The propane tank used to fuel the backup power generator contains minor surface corrosion.

- The LCD readout for tank level is a displaying a negative value. Currently, wetwell level cannot be monitored remotely. Remote wetwell level monitoring is recommended to assist in the prevention of pump station overflows.

***Reedy Fork Pump Station***

The Reedy Fork Pump Station was commissioned in the early 1980's. The pump station contains one wetwell and a drywell containing two centrifugal pumps, each having a capacity of 1,325 gpm. Pumps discharge to a forcemain 19,400 feet in length. Backup power is supplied by a 230 kW generator. Wastewater overflows from the pump station will enter Reedy Fork Creek.

- A complete replacement of the pump station should be considered. The inability to safely maintain pump station equipment and insufficient capacity to pump flow received during rain events make the Reedy Fork pump station a significant liability to the City.

- The drywell for the pump station is a permitted confined space. Accessing the pumps and associate drive units require the use of a tripod. Currently, the maintenance for the pump station equipment is contracted to a private firm.

- The Reedy Fork pump station is housed in a can style dry well. The pumps are not installed directly below the can opening, requiring side load on crane cables when pulling pumps or drive units. This poses a safety hazard and is against OSHA safety guidelines. The ladder providing access to the pumps must be removed to allow for enough space to retrieve pumps. The pump station dry well does not have proper ventilation to allow for inspection and maintenance station equipment. Safety personnel for the City have directed pump station staff not to enter the dry well. A means of safely removing pump and drive units should be developed.

- Large amounts of sand and grit have been removed from the Reedy Fork pump station. Sand and grit entering the pump station is a sign of significant inflow/infiltration and causes excessive wear and tear on pumps, valves, and piping. During heavy rains and high flows, the pumps operate continuously and are unable to keep the wetwell pumped down. A septic tank hauler is used as needed to prevent wetwell overflow. Investigation into sources of inflow/infiltration should be identified to minimized flow and sand/grit accumulation during rain events.

- A portable diesel pump and associated discharge piping is stored at the pump station at all times due to the unreliability of the pump station equipment and to handle extra flow during rain events. Raw water pumped by the diesel pumps is stored in old basins at the decommissioned treatment plant. The old basins do not have hand rails causing a potential safety issue.

- The pumps are currently controlled by wetwell floats which hang on debris and grease. Utilizing admittance probes for pump control is recommended.

- The coating on the main disconnect and adjacent electrical panels is beginning to fade with surface corrosion present on the Unistrut supports for the local control panel and PLC.
- Currently, wetwell level cannot be monitored remotely. Remote wetwell level monitoring is recommended to assist in the prevention of pump station overflows.

- Surface corrosion is present on the crane adjacent to the pump dry well.

- Bioxide chemical can be fed to the wetwell at the pump station. The tubing for feeding chemical is deteriorated and should be considered for replacement. Bioxide has not been fed at the pump station for some time.

- Multiple valves were replaced on the pumping system in 2006. However, leaks around valves coupled with safety issues to gain access to pump station equipment prevent pulling of pumps or repairing leaks on valves.

***Clemmons No. 3 Pump Station***

The Clemmons No. 3 Pump Station was commissioned in July of 1991. The pump station contains one wetwell and two grinder pumps, each having a capacity of 23 gpm. Pumps discharge to a forcemain 575 feet in length. Backup power is supplied by a 20 kW generator. Wastewater overflows from the pump station will enter Blanket Creek.

- The grinder pumps clog with grease frequently. Significant effort by the pump station inspection and maintenance staff is necessary to remove grease and maintain pumps. A septic tank hauler is used periodically to remove grease for the wetwell.

- Flow entering the pump station increases dramatically during heavy rain events. The pumps operate continuously and are unable to keep the wetwell pumped down. A septic tank hauler is used as needed to prevent wetwell overflow. The sources of inflow/infiltration should be identified to minimize flow during rain events and wear and tear on equipment.

- The pumps are currently controlled by wetwell floats which hang on debris and grease. Utilizing admittance probes for pump control is recommended.

- Discussion with pump station staff reveals that the force main is undersized at 2-inches. An evaluation to determine the appropriate force main size is recommended.

- The wetwell is sized at 4 feet in diameter and 10 feet in depth. Increasing the wetwell diameter to provide adequate space for inspection and maintenance for pumps and level monitoring equipment is recommended. Adequate space is not available for pulling/repairing pumps when septic tank hauler is pumping down wetwell. The pump station does not have by pass pumping capabilities.

- Guide rail and support brackets contain moderate to severe corrosion.

- The backup power generator is in good overall condition and sized at 20 kW. Increasing pump station capacity may result in the need for a larger generator/switchgear.

- Insufficient starter capacity has caused pump failures in the past. Started capacity should be evaluated when upgrading pump station.

- Pump station staff recommends upgrading the Clemmons No. 3 pump station similar to the Clemmons No. 5 pump station.

- Access for parking and working in vicinity of pump station is not available. Adequate space for parking at and working on pump station components should be considered when upgrading/expanding station in the future.

- There are no means (hoist) for removing pumps for repair/maintenance. Permanent pump removal equipment should be considered.

- Currently, wetwell level cannot be monitored remotely. Remote wetwell level monitoring is recommended to assist in the prevention of pump station overflows.

***Linville Springs Pump Station***

The Linville Springs Pump Station was commissioned in 1992. The pump station contains one wetwell and two grinder pumps, each having a capacity of 85 gpm. Pumps discharge to a forcemain 3,200 feet in length. Backup power is supplied by a 60 kW generator. Wastewater overflows from the pump station will enter Belews Creek.

- The grinder pumps clog with grease frequently. Significant effort by the pump station inspection and maintenance staff is necessary to remove grease and maintain pumps. A septic tank hauler is used periodically to remove grease for the wetwell.

- Flow entering the pump station increases dramatically during heavy rain events. The pumps operate continuously and are unable to keep the wetwell pumped down. A septic tank hauler is used as needed to prevent wetwell overflow. The sources of inflow/infiltration should be identified to minimize flow during rain events and wear and tear on equipment.

- The pumps are currently controlled by wetwell floats which hang on debris and grease. Utilizing admittance probes for pump control is recommended.

- Discussion with pump station staff reveals that the force main is undersized at 2-inches. An evaluation to determine the appropriate force main size is recommended.

- The wetwell is sized at 5 feet in diameter and 12 feet in depth. Adequate space is not available for pulling/repairing pumps when septic tank hauler is pumping down wetwell. The pump station does not have by pass pumping capabilities.

- Increasing the wetwell diameter to provide adequate space for inspection and maintenance for pumps and level monitoring equipment is recommended.

- The guide rail support brackets contain moderate to severe corrosion.
- Pump station staff recommends upgrading the Linville Springs pump station similar to the Clemmons No. 5 pump station.

- Access for parking and working in vicinity of pump station is not available. Adequate space for parking at and working on pump station components should be considered when upgrading/expanding station in the future.

- There are no means (hoist) for removing pumps for repair/maintenance. Permanent pump removal equipment should be considered.

- The wetwell level display located on the PLC cabinet is not functioning with the display cover missing. Currently, wetwell level cannot be monitored remotely. Remote wetwell level monitoring is recommended to assist in the prevention of pump station overflows.

***Clemmons No. 4 Pump Station***
The Clemmons No. 4 Pump Station was commissioned in January of 1993. The pump station contains one wetwell and two grinder pumps, each having a capacity of 23 gpm. Pumps discharge to a forcemain 2,200 feet in length. Backup power is supplied by a 20 kW generator. Wastewater overflows from the pump station will enter Blanket Creek.

- The grinder pumps clog with grease frequently. Significant effort by the pump station inspection and maintenance staff is necessary to remove grease and maintain pumps. A septic tank hauler is used periodically to remove grease for the wetwell.

- Flow entering the pump station increases dramatically during heavy rain events. The pumps operate continuously and are unable to keep the wetwell pumped down. A septic tank hauler is used as needed to prevent wetwell overflow. The sources of inflow/infiltration should be identified to minimize flow during rain events and wear and tear on equipment.

- The pumps are currently controlled by wetwell floats which hang on debris and grease. Utilizing admittance probes for pump control is recommended.

- Discussion with pump station staff reveals that the force main is undersized at 2-inches. An evaluation to determine the appropriate force main size is recommended.

- The wetwell is sized at 4 feet in diameter and 10 feet in depth. Adequate space is not available for pulling/repairing pumps when septic tank hauler is pumping down wetwell. The pump station does not have by pass pumping capabilities.
  Increasing the wetwell diameter to provide adequate space for inspection and maintenance for pumps and level monitoring equipment is recommended.

- Guide rail and brackets contain moderate to severe corrosion.

- The backup power generator is in good overall condition and sized at 20 kW. Increasing pump station capacity may result in the need for a larger generator/switchgear.

- Insufficient starter capacity has caused pump failures in the past. Started capacity should be evaluated when upgrading pump station.

- Pump station staff recommends upgrading the Clemmons No. 4 pump station similar to the Clemmons No. 5 pump station.

- Access for parking and working in vicinity of pump station is not available. Adequate space for parking at and working on pump station components should be considered when upgrading/expanding station in the future.

- There are no means (hoist) for removing pumps for repair/maintenance. Permanent pump removal equipment should be considered.

- Currently, wetwell level cannot be monitored remotely. Remote wetwell level monitoring is recommended to assist in the prevention of pump station overflows.

***Tanglewood Pump Station***
The Tanglewood Pump Station was commissioned in 1987. The pump station contains one wetwell and two centrifugal pumps, each having a capacity of 2,700 gpm. Pumps discharge to a forcemain 15,068 feet in length. Backup power is supplied by a 275 kW generator. Wastewater overflows from the pump station will enter wet-weather ditch leading to the Yadkin River.

- Utility electrical service to the pump station will allow only one pump to operate at a time. Upgrading utility electrical service to allow both pumps to operate is highly recommended.

- During periods of heavy flow, a septic tank hauler is used as needed to prevent wetwell overflow. Pump and haul capability is not available if pumps

are out of service due to volume of incoming flow. The pump station does have bypass pumping capabilities. A pump must be rented for bypass pumping with a minimum waiting period of 45 minutes prior to pump arrival. Purchasing a bypass pump for the Tanglewood and Fair Oaks pump stations is recommended.

- The switchgear and associated backup power generator will only power one pump. Upgrading the backup power facilities to operate both pumps is recommended.
- The switchgear is aged with painted coating beginning to fade.
- The wetwell for the pump station is sealed to prevent rising water during flood conditions from charging the wetwell.
- The guiderails for pump removal have been replaced.
- Bioxide chemical treatment is available at the pump station for odor control. The chemical system has been out of service for some time with no odors present during asset evaluation.
- Wetwell level LCD display is not functioning. Wetwell level is provided inside control panel door. Currently, wetwell level cannot be monitored remotely. Remote wetwell level monitoring is recommended to assist in the prevention of pump station overflows.
- Surface corrosion is present on the generator exhaust piping.
- Surface corrosion is present on the wetwell hatch access chains.

***Fair Oaks Pump Station***

The Fair Oaks Pump Station was commissioned in July 1991. The pump station contains one wetwell and two submersible pumps, each having a capacity of 750 gpm. Pumps discharge to a forcemain 5,121 feet in length. Backup power is supplied by a 50 kW generator. Wastewater overflows from the pump station will enter the Yadkin River.

- The pump station does not currently have sufficient capacity during high flow events. Utility electrical service to the pump station will allow only one pump to operate at a time. Upgrading utility electrical service to allow both pumps to operate is highly recommended.
- Consideration is being given to replace current pump impellers to increase pumping capacity. Due to the age of pumps installed and electrical utility

preventing two pumps from operating simultaneously, a complete upgrade/replacement is recommended.

- The transfer switch is aged with paint coating chipped and faded in various areas.

- A broken conduit is located next to the switchgear that is no longer used for service. Sealing or removing the conduit is recommended.

- Flow entering the pump station increases dramatically during heavy rain events. A septic tank hauler is used as needed to prevent wetwell overflow. The sources of inflow/infiltration should be identified to minimize flow during rain events and wear and tear on equipment. Pump and haul capability is not available if pumps are out of service due to volume of incoming flow. The pump station does have bypass pumping capabilities. A pump must be rented for bypass pumping with a minimum waiting period of 45 minutes prior to pump arrival. Purchasing a bypass pump for the Tanglewood and Fair Oaks pump stations is recommended.

- A cinder block containment structure is located within the pump station fencing but no longer used. Coating for the containment structure is beginning to peel.

- Wetwell overflows can easily reach the Yadkin River adjacent to the pump station. A berm or other stream protection device between the wetwell and river should be considered.

- Rain protection and lighting is not provided over electrical components. Proper shelter and lighting are recommended.

- The generator housing contains moderate corrosion with the paint coating beginning to fail. The paint coating for the associated fuel storage tank is peeling on the support legs.
- Permanent support is recommended for alternate pump hookup. The support used at Tanglewood pump station is adequate.

- Currently, wetwell level cannot be monitored remotely. Remote wetwell level monitoring is recommended to assist in the prevention of pump station overflows.

***Fernbrook Pump Station***

The Fernbrook Pump Station was commissioned in September of 1997. The pump station contains one wetwell and two grinder pumps, each having a capacity of 200 gpm. Pumps discharge to a forcemain 1,200 feet in length. Backup power is supplied

by a 25 kW generator. Wastewater overflows from the pump station will enter creek adjacent to the station.

- The grinder pumps installed are aged with replacement parts unavailable. Significant effort by the pump station inspection and maintenance staff is necessary to maintain pumps. Replacing both pumps is recommended.
- A septic tank hauler is used periodically to remove grease for the wetwell.
- Moderate to severe corrosion is present on the wetwell hatch door and frame.
- The pumps are currently controlled by wetwell floats which hang on debris and grease. Utilizing admittance probes for pump control is recommended.
- The wetwell is sized at 5 feet in diameter and 12 feet in depth. Increasing the wetwell diameter to provide adequate space for inspection and maintenance for pumps and level monitoring equipment is recommended.
- Guide rail and float support brackets contain moderate to severe corrosion.
- The wetwell has significant structural deterioration with possible leakage and should be considered for replacement.
- There are no means (hoist) for removing pumps for repair/maintenance. Permanent pump removal equipment should be considered.
- Currently, wetwell level cannot be monitored remotely. Remote wetwell level monitoring is recommended to assist in the prevention of pump station overflows.
- The valve vault for the pump station contains surface corrosion on piping and valves with buildup of rust on vault floor.

***Machine Street Pump Station***

The Machine Street Pump Station was commissioned in January of 1960. The pump station contains one wetwell and two centrifugal pumps, each having a capacity of 75 gpm. Pumps discharge to a forcemain 600 feet in length. The pump station does not have permanent backup generation with portable unit used to operate station during utility power outage. Wastewater overflows from the pump station will enter Blanket Creek.

- The pump station was commissioned in 1962 with minimal upgrades since original installation. The pumps and associated drive units are aged and in need of replacement.

- The pumps are located 30 feet below the drive units with access to the pumps difficult. Discussion with the lift station staff reveals the need to replace the pumps with dry pit submersibles to improve operability and lower maintenance cost.

- Excess leakage from the packing gland for both pumps is present. Leakage allows accumulation of raw wastewater on the floor in the lower level.

- Severe corrosion is present on the hatch frame providing access to the wetwell. The hatch door is not present. Safety railing is not present around the hatch opening and is highly recommended.

- The electrical gear is aged and in fair condition.

- Currently, wetwell level cannot be monitored remotely. Remote wetwell level monitoring is recommended to assist in the prevention of pump station overflows.

- The pump station does not have bypass pumping capabilities.

***Village Club Pump Station***

The Village Club Pump Station was commissioned in September of 1995. The pump station contains one wetwell and two grinder pumps, each having a capacity of 36 gpm. Pumps discharge to a forcemain 611 feet in length. Backup power is supplied by a 35 kW generator. Wastewater overflows from the pump station will enter a tributary for Blanket Creek and a small lake approximately 200 yards from the station.

- The grinder pumps clog with grease periodically. Significant effort by the pump station inspection and maintenance staff is necessary to remove grease and maintain pumps. A septic tank hauler is used periodically to remove grease for the wetwell.

- Flow entering the pump station increases dramatically during heavy rain events. The pumps operate continuously and are unable to keep the wetwell pumped down. A septic tank hauler is used as needed to prevent wetwell overflow. Limited space at the station makes pump and haul operation difficult. The sources of inflow/infiltration should be identified to minimize flow during rain events and wear and tear on equipment. The pump station does not have bypass pumping capabilities.

- The pumps are currently controlled by wetwell floats which hang on debris and grease. Utilizing admittance probes for pump control is recommended.

- Discussion with pump station staff reveals that the force main is undersized at 2-inches. An evaluation to determine the appropriate force main size is recommended.

- The wetwell is sized at 5 feet in diameter and 10 feet in depth. Increasing the wetwell diameter to provide adequate space for inspection and maintenance for pumps and level monitoring equipment is recommended.

- The guide rail and brackets contain moderate to severe corrosion.

- Pump station staff recommends upgrading the Village Club pump station similar to the Clemmons No. 5 pump station.

- There are no means (hoist) for removing pumps for repair/maintenance. Permanent pump removal equipment should be considered.

- Currently, wetwell level cannot be monitored remotely. Remote wetwell level monitoring is recommended to assist in the prevention of pump station overflows.

- Piping and valves within the valve vault contain surface corrosion.

***New South Fork Pump Station Diversion Structure***

- The New South Fork pump station is a regional pump station that receives flow by diverting a portion of raw wastewater to the pump station via a diversion structure. Due to the small size of the diversion opening and high velocity of wastewater within the pipeline, insufficient flow is diverted to the New South Fork pump station. In an effort to force more flow to the pump station and less flow to the Muddy Creek WWTP, a throttling valve has been installed to back up the flow traveling to the Muddy Creek WWTP. The throttling valve leaks excessively and the actuator is not secure on the diversion structure. Replacing the throttling valve with a new valve is recommended.

- Severe corrosion is present on the diversion structure manhole and hand rail due to high levels of hydrogen sulfide (H2S). A means of lowering the H2S concentration and replacement of the manhole metals and handrail is recommended.

## 8.2 Pumping Stations Recommended Improvements Plan

Based on the results of the condition assessment, $7,972,000 in equipment capital improvements were identified in order to maintain the wastewater pumping stations over the 20-year planning period.

Equipment is ranked by Risk Value, Asset Risk Index, Probability of Failure and Remaining Useful Life. Replacement costs are for planning level approximations only and include equipment and installation cost estimated in 2009 dollars; a more definitive cost estimation should be developed independent of this Master Planning document for specific asset replacement and renewals. Equipment currently being replaced was excluded from 20-year CIP planning.

### 8.2.1 Planning Period – Years One through Five

**Table 8-8** represents equipment that should be prioritized during the first 5 years of the 20-year Capital Improvements Planning (CIP) period. The table ranks assets found to have the greatest Risk Value (greater than 32) first; possess a high probability of failure indicator (10 or greater) next; and demonstrates a high asset risk index (12 or greater) lastly. The total estimated cost for the first 5 years of the 20 year CIP is $3,109,000.

**Table 8-8**

**Cost Estimates for Years 1 thru 5 of the 20 Year Planning Period**

| Pump Station | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Fernbrook | Pump No. 1 | 20.0 | 12 | $15,000 | 1997 | 2013 | 47.6 |
| Fernbrook | Pump No. 2 | 20.0 | 12 | $15,000 | 1997 | 2013 | 47.6 |
| Fernbrook | Wetwell | 20.0 | 12 | $100,000 | 1997 | 2029 | 47.6 |
| Clemmons No. 2 | Wetwell | 16.0 | 11 | $80,000 | 1994 | 2028 | 45.8 |
| Clemmons No. 3 | Wetwell | 16.0 | 11 | $80,000 | 1991 | 2025 | 45.8 |
| Clemmons No. 4 | Wetwell | 16.0 | 11 | $80,000 | 1993 | 2027 | 45.8 |
| Kerners Mill | Switchgear | 16.0 | 11 | $60,000 | 1981 | 2002 | 45.8 |
| North Lake | Wetwell | 16.0 | 11 | $80,000 | 1999 | 2033 | 45.8 |
| Reedy Fork | Pump No. 1 | 16.0 | 11 | $95,000 | 1980 | 1997 | 45.8 |

**Table 8-8**

**Cost Estimates for Years 1 thru 5 of the 20 Year Planning Period**

| Pump Station | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Reedy Fork | Pump No. 2 | 16.0 | 11 | $95,000 | 1980 | 1997 | 45.8 |
| Wexford | Wetwell | 16.0 | 11 | $130,000 | 1986 | 2020 | 45.8 |
| Allison Avenue | Pump No. 1 | 16.0 | 11 | $25,000 | 1997 | 2015 | 43.9 |
| Allison Avenue | Pump No. 2 | 16.0 | 11 | $25,000 | 1997 | 2015 | 43.9 |
| Fernbrook | Electrical Switchgear | 16.0 | 11 | $10,000 | 1997 | 2020 | 43.9 |
| Linville Springs | Pump No. 2 | 16.0 | 11 | $20,000 | 1992 | 2010 | 43.9 |
| North Lake | Pump No. 1 | 16.0 | 11 | $20,000 | 1999 | 2017 | 43.9 |
| North Lake | Pump No. 2 | 16.0 | 11 | $20,000 | 1999 | 2017 | 43.9 |
| Tanglewood | Electrical Switchgear | 16.0 | 11 | $50,000 | 1987 | 2010 | 43.9 |
| Village Club | Wetwell | 16.0 | 11 | $100,000 | 1995 | 2031 | 43.9 |
| Wexford | Pump No. 1 | 16.0 | 11 | $25,000 | 1986 | 2004 | 43.9 |
| Wexford | Pump No. 2 | 16.0 | 11 | $25,000 | 1986 | 2004 | 43.9 |
| Clemmons No. 2 | Pump No. 1 | 12.0 | 11 | $25,000 | 1994 | 2013 | 42.0 |
| Clemmons No. 2 | Pump No. 2 | 12.0 | 11 | $25,000 | 1994 | 2013 | 42.0 |
| Clemmons No. 3 | Pump No. 1 | 12.0 | 11 | $20,000 | 1991 | 2010 | 42.0 |
| Clemmons No. 3 | Pump No. 2 | 12.0 | 11 | $20,000 | 1991 | 2010 | 42.0 |
| Clemmons No. 4 | Pump No. 1 | 12.0 | 11 | $20,000 | 1993 | 2012 | 42.0 |
| Clemmons No. 4 | Pump No. 2 | 12.0 | 11 | $20,000 | 1993 | 2012 | 42.0 |
| Fair Oaks | Electrical Switchgear | 12.0 | 11 | $25,000 | 1991 | 2015 | 42.0 |

**Table 8-8**

**Cost Estimates for Years 1 thru 5 of the 20 Year Planning Period**

| Pump Station | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Kerners Mill | Pump No. 1 | 16.0 | 11 | $150,000 | 1981 | 2000 | 42.0 |
| Kerners Mill | Pump No. 2 | 16.0 | 11 | $150,000 | 1981 | 2000 | 42.0 |
| Linville Springs | Pump No. 1 | 16.0 | 11 | $20,000 | 1992 | 2011 | 42.0 |
| New South Fork | Flow Diversion Structure | 16.0 | 11 | $100,000 | 2006 | 2044 | 42.0 |
| New South Fork | Throttling valve | 16.0 | 11 | $50,000 | 2006 | 2030 | 42.0 |
| North Lake | Electrical Switchgear | 12.0 | 11 | $10,000 | 1999 | 2023 | 42.0 |
| Village Club | Pump No. 1 | 12.0 | 11 | $15,000 | 1995 | 2014 | 42.0 |
| Village Club | Pump No. 2 | 12.0 | 11 | $15,000 | 1995 | 2014 | 42.0 |
| Linville Springs | Wetwell | 12.0 | 10 | $168,000 | 1992 | 2032 | 40.0 |
| Machine Street | Pump No. 1 | 12.0 | 11 | $25,000 | 1960 | 1977 | 34.4 |
| Machine Street | Pump No. 2 | 12.0 | 11 | $25,000 | 1960 | 1977 | 34.4 |
| Machine Street | Wetwell | 12.0 | 11 | $66,000 | 1960 | 1994 | 34.4 |
| Kerners Mill | Wetwell | 12.0 | 11 | $1,000,000 | 1981 | 2017 | 32.9 |
| Machine Street | Exhaust Fan | 12.0 | 11 | $10,000 | 1960 | 1978 | 32.9 |

## 8.2.2 Planning Period – Years Six through Ten

**Table 8-9** represents equipment that should be prioritized between years 6 and 10 of the 20 year Capital Improvements Planning (CIP) period. The table ranks assets found to have the Risk Values between 32 and 15; possess a high probability of failure indicator (5 or greater) secondarily; and demonstrates an asset risk index 6 or greater. The total estimated cost for the second 5 years of the 20 year CIP is $3,098,000.

**Table 8-9**

**Cost Estimates for Years 6 thru 10 of the 20 Year Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Allison Avenue | Wetwell | 9.0 | 11 | $156,000 | 1997 | 2035 | 31.5 |
| Fair Oaks | Wetwell | 9.0 | 10 | $560,000 | 1991 | 2031 | 30.0 |
| Wexford | Electrical Switchgear | 9.0 | 10 | $10,000 | 1986 | 2011 | 30.0 |
| Allison Avenue | Electrical Switchgear | 9.0 | 10 | $30,000 | 1997 | 2023 | 28.5 |
| Clemmons No. 2 | Electrical Switchgear | 6.0 | 9 | $10,000 | 1994 | 2022 | 26.9 |
| Kerners Mill | PLC | 20.0 | 6 | $10,000 | 1981 | 1987 | 23.8 |
| Reedy Fork | PLC | 20.0 | 6 | $10,000 | 1980 | 1986 | 23.8 |
| Reedy Fork | Chemical Containment | 20.0 | 6 | $20,000 | 1980 | 2012 | 23.8 |
| Allison Avenue | Roto-Phase | 16.0 | 6 | $10,000 | 1997 | 2012 | 22.9 |
| Reedy Fork | Hoist/Crane | 16.0 | 6 | $25,000 | 1980 | 1995 | 22.9 |
| Fair Oaks | Backup Power Generator | 16.0 | 6 | $50,000 | 1991 | 2012 | 22.9 |
| Fair Oaks | Fuel Storage Tank | 16.0 | 6 | $10,000 | 1991 | 2006 | 22.9 |
| Linville Springs | PLC | 16.0 | 6 | $10,000 | 1992 | 1999 | 22.9 |
| North Lake | Backup Power Generator | 16.0 | 6 | $20,000 | 1999 | 2020 | 22.9 |
| North Lake | Propane Tank | 16.0 | 6 | $10,000 | 1999 | 2014 | 22.9 |
| North Lake | PLC | 16.0 | 6 | $10,000 | 1999 | 2006 | 22.9 |
| Reedy Fork | Bioxide Tank | 16.0 | 6 | $20,000 | 1980 | 1997 | 22.9 |
| Reedy Fork | Bar Screen | 16.0 | 6 | $100,000 | 1980 | 1997 | 22.9 |
| Wexford | PLC | 16.0 | 6 | $10,000 | 1986 | 1993 | |

**Table 8-9**

**Cost Estimates for Years 6 thru 10 of the 20 Year Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| | | | | | | | 22.9 |
| Fair Oaks | PLC | 16.0 | 5 | $10,000 | 1991 | 1998 | 22.0 |
| Tanglewood | Fuel Storage Tank | 16.0 | 5 | $50,000 | 1987 | 2003 | 22.0 |
| Fernbrook | Backup Power Generator | 16.0 | 5 | $20,000 | 1997 | 2020 | 22.0 |
| Kerners Mill | Backup Power Generator | 16.0 | 5 | $425,000 | 1981 | 2004 | 22.0 |
| Fernbrook | PLC | 12.0 | 5 | $10,000 | 1997 | 2005 | 21.0 |
| Tanglewood | Backup Power Generator | 12.0 | 5 | $225,000 | 1987 | 2011 | 21.0 |
| Tanglewood | PLC | 12.0 | 5 | $10,000 | 1987 | 1995 | 21.0 |
| Village Club | PLC | 12.0 | 5 | $10,000 | 1995 | 2003 | 21.0 |
| Clemmons No. 3 | PLC | 8.0 | 5 | $10,000 | 1991 | 1999 | 20.1 |
| Clemmons No. 4 | PLC | 8.0 | 5 | $10,000 | 1993 | 2001 | 20.1 |
| Kerners Mill | Fuel Storage Tank | 12.0 | 5 | $ 25,000 | 1981 | 1999 | 20.0 |
| Fair Oaks | Pump No. 1 | 6.0 | 10 | $120,000 | 1991 | 2012 | 19.0 |
| Fair Oaks | Pump No. 2 | 6.0 | 10 | $120,000 | 1991 | 2012 | 19.0 |
| Tanglewood | Pump No. 1 | 6.0 | 10 | $150,000 | 1987 | 2008 | 19.0 |
| Tanglewood | Pump No. 2 | 6.0 | 10 | $150,000 | 1987 | 2008 | 19.0 |
| Tanglewood | Wetwell | 6.0 | 10 | $672,000 | 1987 | 2029 | 19.0 |

### 8.2.3 Planning Period – Years Eleven through Twenty

**Table 8-10** represents equipment that should be prioritized between years 10 and 20 of the 20 year Capital Improvements Planning (CIP) period. Assets not included in Tables 8-8 and 8-9 are included. The total estimated cost for the last 10 years of the 20 year CIP is $1,765,000. It should be noted that based on the number of assets with high risk values and given the 68% of assets ranking "HIGH-HIGH" in criticality, CDM recommends the a more proactive approach to systems upgrades be provided in years 0-5 and 6-10.

It is important to note that during the final 10 years of the 20 year planning period, assets replaced, renewed and rebuilt in the preceding 10 years (year one through ten) will have aged and achieved their remaining useful life. These assets will increase the estimated planning level cost defined for this period.

**Table 8-10**

**Cost Estimates for Years 11 thru 20 of the Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| Allison Avenue | Backup Power Generator | 8.0 | 4 | $125,000 | 1997 | 2025 | 18.0 |
| Clemmons No. 2 | Backup Power Generator | 8.0 | 4 | $20,000 | 1994 | 2022 | 18.0 |
| Clemmons No. 3 | Electrical Switchgear | 4.0 | 9 | $10,000 | 1991 | 2019 | 18.0 |
| Clemmons No. 4 | Electrical Switchgear | 4.0 | 9 | $10,000 | 1993 | 2021 | 18.0 |
| Linville Springs | Backup Power Generator | 8.0 | 4 | $60,000 | 1992 | 2020 | 18.0 |
| Reedy Fork | Wetwell | 4.0 | 9 | $975,000 | 1980 | 2024 | 18.0 |
| Reedy Fork | Electrical Switchgear | 4.0 | 9 | $50,000 | 1980 | 2008 | 18.0 |
| Village Club | Electrical Switchgear | 4.0 | 9 | $10,000 | 1995 | 2023 | 18.0 |
| North Lake | Hoist | 8.0 | 4 | $10,000 | 1999 | 2018 | 18.0 |
| Kerners Mill | Sump Pumps | 12.0 | 5 | $10,000 | 1981 | 1999 | 16.5 |
| Wexford | Backup Power Generator | 9.0 | 5 | $20,000 | 1986 | 2011 | 15.0 |
| Kerners Mill | Jib Crane | 8.0 | 6 | $10,000 | 1981 | 1996 | |

**Table 8-10**

**Cost Estimates for Years 11 thru 20 of the Planning Period**

| Process | Equipment | ARI | PoF | Replacement Cost | Original Install | RUL | Risk Value |
|---|---|---|---|---|---|---|---|
| | | | | | | | 11.5 |
| Allison Avenue | PLC | 8.0 | 6 | $10,000 | 1997 | 2004 | 11.5 |
| Machine Street | Sump Pump | 8.0 | 6 | $10,000 | 1960 | 1977 | 11.5 |
| Kerners Mill | Crane - Downstairs | 8.0 | 5 | $10,000 | 1981 | 1996 | 11.0 |
| Machine Street | PLC | 8.0 | 5 | $10,000 | 1992 | 1999 | 11.0 |
| Kerners Mill | Zabox Odor Scrubber | 6.0 | 5 | $60,000 | 1981 | 2000 | 10.5 |
| Clemmons No. 2 | PLC | 4.0 | 5 | $10,000 | 1994 | 2002 | 10.0 |
| Tanglewood | Chemical Containment | 6.0 | 5 | $20,000 | 1987 | 2029 | 9.5 |
| Clemmons No. 3 | Backup Power Generator | 4.0 | 4 | $20,000 | 1991 | 2019 | 9.0 |
| Clemmons No. 4 | Backup Power Generator | 4.0 | 4 | $20,000 | 1993 | 2021 | 9.0 |
| Reedy Fork | Backup Power Generator | 4.0 | 4 | $200,000 | 1980 | 2008 | 9.0 |
| Tanglewood | Bioxide Chemical Tank | 4.0 | 4 | $20,000 | 1987 | 2009 | 9.0 |
| Village Club | Backup Power Generator | 4.0 | 4 | $35,000 | 1995 | 2023 | 9.0 |
| Kerners Mill | Exhaust Fan No. 1 | 8.0 | 1 | $10,000 | 1981 | 1999 | 2.2 |
| Kerners Mill | Exhaust Fan No. 2 | 8.0 | 1 | $10,000 | 1981 | 1999 | 2.2 |
| Kerners Mill | Exhaust Fan No. 3 | 8.0 | 1 | $10,000 | 1981 | 1999 | 2.2 |

## 8.2.4 Pump Station Prioritization

The following provides a prioritized list of pump stations based on the overall rating and age of major pieces of equipment, available pumping capacity, utility and backup power deficiencies, bypass pumping capability, and impacts of potential overflows. Pump stations are listed in order of greatest need with Kerners Mill pump station requiring the

most attention and Village Club pump station requiring the least. This list in conjunction with individual equipment assessments provided above should be considered when planning future CIP projects.

- Kerners Mill
- Reedy Fork
- Wexford
- Clemmons No. 2
- Allison Avenue
- Tanglewood
- North Lake
- Clemmons No. 4
- Machine Street
- Clemmons No. 3
- Fair Oaks
- Linville Springs
- Fernbrook
- Village Club

# Section 9
# Recommended Capital Improvements Plan

## 9.1 General

This section presents the recommended Capital Improvements Plan (CIP) based on the findings of the Wastewater Facilities Master Plan. The recommended CIP has two main objectives:

1) identify a listing of capital projects for rehabilitation, upgrades, and improvements at CCUC's treatment facilities and lift stations to address a full range of planning issues, including facility reliability, maintenance, existing and projected capacity constraints, and potential future regulatory compliance over the 20-year planning horizon;

2) prioritize recommended capital projects and provide a phased implementation schedule with associated planning level cost estimates to provide a clear, comprehensive basis for CCUC to plan, schedule, finance, and implement required capital improvements to meet its short-term and long-term facilities needs.

The CIP outlined herein reflects the combined efforts of the CDM team and CCUC staff and is comprised of:

- a listing of the recommended capital improvements projects and their associated planning level opinion of probable costs for the Archie Elledge and Muddy Creek WWTPs and 15 pump stations;
- detailed project descriptions;
- a timeline for the completion of the recommended projects with capital expenditures to be incurred each year along with a phasing schedule;
- a conceptual site plan showing the location and layout of existing treatment facilities and recommended phased improvements for the AEWWTP and MCWWTP.

## 9.2 Development of the Recommended CIP

The CIP consists of two improvement categories: 1) improvements needed to comply with potential future regulatory limits (Effluent Total Nitrogen 3.0 mg/L and Effluent Total Phosphorus of 0.5 mg/L) and accommodate future growth; and 2) rehabilitation and upgrades identified by the physical condition assessments in order to maintain the facilities and equipment reliability over the 20-year planning period.

As discussed in Section 6, the wastewater treatment improvement alternative recommended in order to comply with future regulatory limits and accommodate future growth was Alternative 1; therefore, the facilities and improvements

recommended under this alternative were used for developing the capital improvements plan. Alternative 1 involves maintaining the MCWWTP at its current 21 mgd max month capacity and expanding the AEWWTP to 46 mgd to meet effluent limits of 3 mg/L TN and 0.5 mg/L TP. **Figures 9-1** and **9-2** at the end of this section contain conceptual site plans showing the proposed facilities at the AEWWTP and MCWWTP in order to achieve nutrient removal and accommodate future growth.

The facility condition assessments are summarized in Sections 7 and 8. The recommendations from these assessments were combined with the recommendations from Alternative 1 to form the CIP.

The construction capital costs along with O&M costs are based on CDM's recent experience in the design, bidding, and construction of wastewater treatment facilities improvements; quotations from suppliers and contractors; and a review of recent CDM and CCUC bid tabulations. Engineering services are estimated at 15 percent of the construction cost. A contingency is also included which is 5 percent of the estimated construction cost. The cost estimates are based on 2009 dollars.

## 9.3 Recommended CIP Summary

Planning level costs were determined for all the recommended improvements which were subsequently grouped into eight different capital projects based on the nature, urgency, and duration of the related work. The highlighted CIP projects include:

- Project 1: AEWWTP rehabilitation & upgrades -$19,126,000
- Project 2: MCWWTP rehabilitation & upgrades - $20,937,000
- Project 3: MCWWTP clarifier improvements - $8,750,000
- Project 4: MCWWTP transfer pump station and force main - $59,012,000
- Project 5: AE/MCWWTP nutrient removal - $93,104,000
- Project 6: AEWWTP solids handling expansion - $38,880,000
- Project 7: AEWWTP expansion - $17,280,000
- Project 8: Pump station replacement and improvement – $7,651,000

The opinion of probable cost for the recommended 20-year CIP is $264,741,000. **Figure 9-3** provides a graphic view of the distribution of recommended 20-year CIP expenditures.

A description of each project is presented below along with the recommended implementation schedule and planning level cost estimate. Most projects are comprised of several subprojects, which are also shown below. **Table 9-1** provides a

detailed summary of all recommended CIP projects by fiscal year along with the engineering and construction costs.

## *Project 1: AEWWTP Rehabilitation and Upgrades*

It is critical to maintain facility reliability throughout the planning years to ensure the capital facilities do not deteriorate to the point where costly maintenance is required. The facility condition assessment for the AEWWTP yielded a listing of equipment to assist CCUC in prioritizing and budgeting facilities maintenance needs over the 20-year planning period. After discussions with CCUC staff, the following subprojects are recommended for Project 1.

The total estimated cost for this project is $19,126,000. **Table 9-2** provides a detailed summary for this project with the proposed schedule and cost breakdown for each subproject.

### Subproject 1: Digester Heating Equipment Replacement

During the current upgrade at the AEWWTP, the majority of the digester facility equipment/components are being replaced with the exception of the digester heating equipment. The heating equipment replacement project will include the replacement of three boilers and associated hot water recirculation pumps and fuel pumps. The heat exchanger located in the control building will also be replaced. This equipment provides heat for the digesters and digester building.

The total estimated cost for this subproject is $1,740,000. The recommended implementation schedule is FY 2010 to FY 2012.

### Subproject 2: Gravity Thickener and TWAS System Upgrades

The gravity thickener and associated thickened WAS transfer pumps are at or nearing the end of their useful service life. The gravity thickener and TWAS system upgrades project will include a replacement drive and collection system for the gravity thickener and three new TWAS pumps to transfer thickener solids from the gravity thickener to the gravity belt thickener.

The total estimated cost for this subproject is: $797,000. The recommended implementation schedule is FY 2014.

### Subproject 3: General Plant Rehabilitation & Upgrades

All other rehabilitation and upgrade projects that are not required within the 5-year (Phase I) planning period are included in this subproject. A detailed listing of these projects is provided in Section 7 and will not be repeated in this section.

**TABLE 9-1**
**WASTEWATER TREATMENT**
**2010-2029 CIP SUMMARY**

| PROJECT DESCRIPTION | ESTIMATED TOTAL COST | FY2010 | | | | FY2011 | | | | FY2012 | | | | FY2013 | | | | FY2014 | | | | FY2015 | | | | FY2016 | | | | FY2017 | | | | FY2018 | | | | FY2019 | | | | FY 2020-2029 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1st QTR | 2nd QTR | 3rd QTR | 4th QTR | 1st QTR | 2nd QTR | 3rd QTR | 4th QTR | 1st QTR | 2nd QTR | 3rd QTR | 4th QTR | 1st QTR | 2nd QTR | 3rd QTR | 4th QTR | 1st QTR | 2nd QTR | 3rd QTR | 4th QTR | 1st QTR | 2nd QTR | 3rd QTR | 4th QTR | 1st QTR | 2nd QTR | 3rd QTR | 4th QTR | 1st QTR | 2nd QTR | 3rd QTR | 4th QTR | 1st QTR | 2nd QTR | 3rd QTR | 4th QTR | 1st QTR | 2nd QTR | 3rd QTR | 4th QTR | |
| **AEWWTP REHAB & UPGRADES:** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 2,390,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 16,736,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **TOTAL PROJECT COST** | ***$ 19,126,000*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **MCWWTP REHAB & UPGRADES:** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 2,616,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 18,321,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **TOTAL PROJECT COST** | ***$ 20,937,000*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **MCWWTP CLARIFIER IMPROVEMENTS:** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 1,190,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 7,560,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **TOTAL PROJECT COST** | ***$ 8,750,000*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **MCWWTP TRANSFER PS/FORCE MAIN:** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 7,351,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 51,661,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **TOTAL PROJECT COST** | ***$ 59,012,000*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **AE/MCWWTPS NUTRIENT REMOVAL:** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ***AE/MCWWTPS NUTRIENT REMOVAL FACILITIES:*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 8,280,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 57,957,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **TOTAL PROJECT COST** | ***$ 66,237,000*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ***MCWWTP HEADWORKS/EQ:*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 3,128,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 20,498,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **TOTAL PROJECT COST** | ***$ 23,626,000*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ***AEWWTP EQ:*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 405,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 2,836,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **TOTAL PROJECT COST** | ***$ 3,241,000*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **AEWWTP SOLIDS HANDLING EXPANSION:** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 4,860,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 34,020,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **TOTAL PROJECT COST** | ***$ 38,880,000*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **AEWWTP EXPANSION:** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 2,160,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 15,120,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **TOTAL PROJECT COST** | ***$ 17,280,000*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **PS REPLACEMENT/IMPROVEMENTS:** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 959,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 6,692,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **TOTAL PROJECT COST** | ***$ 7,651,000*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **ENGINEERING SERVICES** | **$ 33,339,000** | **$ 240,000** | | | | **$ 365,000** | | | | **$ 1,025,000** | | | | **$ 4,395,000** | | | | **$ 5,908,000** | | | | **$ 3,690,000** | | | | **$ 2,832,000** | | | | **$ 1,743,000** | | | | **$ 1,443,000** | | | | **$ 2,616,000** | | | | **$ 9,082,000** |
| **CONSTRUCTION** | **$ 231,401,000** | **$ 1,680,000** | | | | **$ 840,000** | | | | **$ 2,921,000** | | | | **$ 8,153,000** | | | | **$ 18,071,000** | | | | **$ 48,760,000** | | | | **$ 36,915,000** | | | | **$ 21,862,000** | | | | **$ 2,543,000** | | | | **$ 12,698,000** | | | | **$ 76,958,000** |
| **TOTAL CIP EXPENDITURES** | **$ 264,740,000** | **$ 1,920,000** | | | | **$ 1,205,000** | | | | **$ 3,946,000** | | | | **$ 12,548,000** | | | | **$ 23,979,000** | | | | **$ 52,450,000** | | | | **$ 39,747,000** | | | | **$ 23,605,000** | | | | **$ 3,986,000** | | | | **$ 15,314,000** | | | | **$ 86,040,000** |

***NOTES:***
*ALL COSTS ARE IN 2009 DOLLARS*
*1st QTR: JULY - SEPTEMBER*
*2nd QTR: OCTOBER - DECEMBER*
*3rd QTR: JANUARY - MARCH*
*4th QTR: APRIL - JUNE*

**TABLE 9-2**
**AEWWTP REHABILITATION & UPGRADES**
**2010-2029 PROJECT SUMMARY**

| SUBPROJECT DESCRIPTION | ESTIMATED TOTAL COST | FY 2010 | | | | FY 2011 | | | | FY 2012 | | | | FY 2013 | | | | FY 2014 | | | | FY 2015 | | | | FY 2016 | | | | FY 2017 | | | | FY 2018 | | | | FY 2019 | | | | FY 2020-2029 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | |
| **DIGESTER HEATING EQUIPMENT REPLACEMENT** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 218,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 1,523,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Total Subproject Cost** | **$ 1,741,000** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **GRAVITY THICKENER & TWAS SYSTEM UPGRADES** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 100,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 697,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Total Subproject Cost** | **$ 797,000** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **GENERAL PLANT REHAB & UPGRADES** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 2,072,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 14,516,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Total Subproject Cost** | **$ 16,588,000** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **PROJECT SUMMARY:** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Engineering Services** | **$ 2,390,000** | **$** | | | **60,000** | **$** | | | **60,000** | **$** | | | **98,000** | | | | | **$** | | | **100,000** | **$** | | | **179,000** | **$** | | | **179,000** | **$** | | | **179,000** | **$** | | | **179,000** | **$** | | | **179,000** | **$ 1,177,000** |
| **Construction** | **$ 16,736,000** | **$** | | | **420,000** | **$** | | | **420,000** | **$** | | | **683,000** | | | | | **$** | | | **697,000** | **$** | | | **1,256,000** | **$** | | | **1,256,000** | **$** | | | **1,256,000** | **$** | | | **1,256,000** | **$** | | | **1,256,000** | **$ 8,236,000** |
| **Total Project Cost** | **$ 19,126,000** | **$** | | | **480,000** | **$** | | | **480,000** | **$** | | | **781,000** | | | | | **$** | | | **797,000** | **$** | | | **1,435,000** | **$** | | | **1,435,000** | **$** | | | **1,435,000** | **$** | | | **1,435,000** | **$** | | | **1,435,000** | **$ 9,413,000** |

**NOTES:**

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*3rd QTR: JANUARY - MARCH*
*4th QTR: APRIL - JUNE*

The total estimated cost for general plant maintenance is $16,588,000. The recommended implementation schedule is FY 2015 to FY 2029.

## *Project 2: MCWWTP Rehabilitation and Upgrades*

The facility condition assessment for the MCWWTP yielded a listing of equipment to assist CCUC in prioritizing and budgeting facilities maintenance needs over the 20-year planning period. After discussions with CCUC staff, the following subprojects are recommended for Project 2.

**Table 9-3** provides a detailed summary for this project with the proposed schedule and cost breakdown for each subproject. The total estimated cost for this project is $20,937,000.

### Subproject 1: Influent Pump Improvements

This subproject includes the replacement of one 84-inch screw pump in the influent pump station.

The total estimated cost for this project is $360,000. The recommended implementation schedule is FY 2010.

### Subproject 2: Digester Cover Improvements

The anaerobic digester covers at the MCWWTP have been recoated in the past to extend the service life of the digester facilities. The digester covers are now nearing the end of their useful service life and will be replaced in this project. The digester gas accessories are also in need of replacement due to their age and corrosion damage. The center mixer for each digester will also be replaced as a part of these improvements since each one is connected to the digester cover. This subproject will provide new digester covers for the four anaerobic digesters, replacement of the center mixer in each digester, replacement of necessary digester gas accessories on the covers, and cleanout of the existing digesters.

The total estimated cost is $4,320,000. The recommended implementation schedule is from FY 2012 to FY 2014.

### Subproject 3: Aeration Basin Blower Replacement

The blowers providing air to the aeration basins are at the end of their useful life. Three new blowers are included within this project. An assessment of the engines driving the blowers should be included in this project.

The total estimated cost is $3,210,000. The recommended implementation schedule is FY 2014.

**TABLE 9-3**
**MCWWTP REHABILITATION & UPGRADES**
**2010-2029 PROJECT SUMMARY**

| SUBPROJECT DESCRIPTION | ESTIMATED TOTAL COST | FY 2010 | | | | FY 2011 | | | | FY 2012 | | | | FY 2013 | | | | FY 2014 | | | | FY 2015 | | | | FY 2016 | | | | FY 2017 | | | | FY 2018 | | | | FY 2019-2020 | | | | FY 2020-2029 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | |
| **INFLUENT PUMP IMPROVEMENTS** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 45,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 315,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Total Subproject Cost** | **$ 360,000** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **DIGESTER COVER IMPROVEMENT** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 540,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 3,780,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Total Subproject Cost** | **$ 4,320,000** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **MCWWTP ASB BLOWER REPLACEMENT** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 401,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 2,809,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Total Subproject Cost** | **$ 3,210,000** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **GENERAL PLANT REHAB & UPGRADES** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 1,630,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 11,417,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Total Subproject Cost** | **$ 13,047,000** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **PROJECT SUMMARY:** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Engineering Services** | **$ 2,616,000** | **$ 45,000** | | | | | | | | **$ 135,000** | | | | **$ 270,000** | | | | **$ 536,000** | | | | **$ 156,000** | | | | **$ 156,000** | | | | **$ 156,000** | | | | **$ 156,000** | | | | **$ 156,000** | | | | **$ 850,000** |
| **Construction** | **$ 18,321,000** | **$ 315,000** | | | | | | | | | | | | **$ 1,890,000** | | | | **$ 4,699,000** | | | | **$ 1,093,000** | | | | **$ 1,093,000** | | | | **$ 1,093,000** | | | | **$ 1,093,000** | | | | **$ 1,093,000** | | | | **$ 5,952,000** |
| **Total Project Cost** | **$ 20,937,000** | **$ 360,000** | | | | | | | | **$ 135,000** | | | | **$ 2,160,000** | | | | **$ 5,235,000** | | | | **$ 1,249,000** | | | | **$ 1,249,000** | | | | **$ 1,249,000** | | | | **$ 1,249,000** | | | | **$ 1,249,000** | | | | **$ 6,802,000** |

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**Subproject 4: General Plant Rehabilitation & Upgrades**

All other rehabilitation and upgrade projects that are not required within the 5-year (Phase I) planning period are included under this subproject. A detailed listing of projects is provided in Section 7 and will not be repeated in this section.

The total estimated cost for plant general maintenance is $13,047,000. The implementation schedule is FY 2015 to FY 2029.

## *Project 3: Muddy Creek Clarifier Improvements*

This project involves the following improvements:

**Replacement of the sludge scraper equipment in existing primary clarifiers:** The existing sludge scraper equipment needs to be replaced with scrapers that can be operated independently for each clarifier unit. Although there are four separate clarifier units, the bridge-type scrapers operate in pairs so that a shutdown for maintenance or any other reason removes two of the four clarifiers from service. This negatively affects the loading and performance of downstream processes and the overall reliability of the entire WWTP. The upgraded units would allow greater reliability within the existing tankage.

**Secondary clarifier evaluation study**: It is necessary to evaluate the performance of the existing secondary clarifiers and RAS pumping system. The existing secondary clarifiers show marked performance issues as flow increases even when flow is well within normal loading guidelines. Dye testing and velocity measurements can identify the specific issues that may be correctable with the installation of baffles within each clarifier. Also, the RAS pumps currently cannot pump the designed pumping capacity. The shortfall is suspected to be caused by excessive suction side headloss, which will be investigated during the clarifier study.

**New secondary clarifier:** A new secondary clarifier needs to be constructed for improving the overall secondary clarification performance. The new secondary clarifier will include new mechanisms and RAS pumps.

**Modification of existing secondary clarifiers:** Includes addition of baffles and new mechanisms in the four secondary existing clarifiers and additional RAS pumping.

Also included in this project is an update of the wastewater flow projections that were developed in 2008. All future wastewater treatment plant upgrades and expansions are based on these projections; however, growth within CCUC's service area has not increased as expected. The timing and scope of these projects might change if the flow projections decrease.

The total estimated cost for this project is $8,750,000. The recommended implementation schedule is late FY 2011 to FY 2013.

## *Project 4: MCWWTP Transfer Pump Station/Force Main*

A transfer pump station is proposed at the MCWWTP to transfer wastewater flows from the MCWWTP to the AEWWTP. This pump station is needed to prevent the MCWWTP from exceeding its permitted flow capacity and also to transfer excess wet weather flows to the AEWWTP.

**MCWWTP Transfer Pump Station:** It is recommended that the pump station structure be built to accommodate an ultimate capacity of 60 mgd, and pumps can be added in the future as flows to the Muddy Creek plant increase. Initially, the pump station would have a capacity of 20 mgd with 3 pumps. As flows increase, two pumps will be added to bring the capacity to 40 mgd, and then eventually two more pumps can be added to bring the total capacity to 60 mgd.

**Force Main:** A 30-inch diameter force main is proposed between the MCWWTP and AEWWTP to convey these flows in the short term, however, as flows increase a parallel 48-inch diameter force main will need to be installed. The force mains will parallel the existing 6-inch centrate/solids transfer piping; however, additional easement will be needed for the construction of the force mains.

The total estimated cost for this project is $59,012,000. The recommended implementation schedule is from FY 2014 to FY 2016 for the transfer pump station and 30-inch diameter force main; FY 2019 to FY 2021 for adding 20 mgd capacity to the pump station and building the 48-inch diameter force main; and FY 2029 for adding another 20 mgd capacity to the pump station.

## *Project 5: Archie Elledge/MCWWTP Nutrient Removal*

This project includes the facilities necessary at both wastewater treatment plants to meet effluent nutrient limits of 3.0 mg/L TN and 0.5 mg/L TP. In order for the nutrient removal processes to perform as designed, other improvements are also needed. These improvements include improving the headworks and converting the existing sludge lagoons into EQ basins at the MCWWTP and adding two EQ tanks at the AEWWTP.

**Subproject 1: Nutrient Removal Facilities:** The following improvements are needed at the AEWWTP in order to perform nutrient removal:

- Modification of Existing Aeration Basins No. 1 and 2 (including diffusers, mixers, mixed liquor recycle pumps and piping)
- Modification of Existing Aeration Basins No. 3 through 6 (including diffusers, mixers, mixed liquor recycle pumps and piping)
- One new Secondary Clarifier
- Upgrade of RAS Pump Station

- Flood Control/Filter Pump Station Upgrade
- New Tertiary Filtration
- New Methanol and Alum Storage and Feed Facilities

The following improvements are needed at the MCWWTP (improvements to RAS pumping and clarifiers are included under Muddy Creek Clarifier Improvements Project) in order to perform nutrient removal:

- Modification of Existing Aeration Basins No. 1 through 3 (including addition of IFAS media, diffusers, mixers, mixed liquor recycle pumps and piping)
- New Tertiary Filtration
- New Methanol and Alum Storage and Feed Facilities

The total cost estimate is: $66,237,000. The recommended implementation schedule is to begin planning and design in FY 2013 with construction taking place from FY 2015 to FY 2017.

**Subproject 2:**
**MCWWTP Headworks:** These improvements are necessary in order for the nutrient removal processes to perform as designed. The existing grit removal basins are sized for 39 mgd which is less than the current peak hour flow to the wastewater treatment facility. As a result, during high flow events, grit passes through the basins and settles in the primary clarifiers, which adversely impacts the primary sludge conveyance. In addition, the existing grit removal equipment is deteriorating due to corrosion. This subproject includes the replacement of the existing grit removal system with a new 60 mgd grit removal system, which will accommodate peak hour flows to the plant. Budgeted in this subproject is also three new mechanical bar screens and upgrade of the existing influent pump station. A study is also included in FY 2012 to evaluate the necessary capacity of the grit removal and screening facilities to determine if these operations should be performed prior to pumping flow to the Archie Elledge WWTP.

**MCWWTP EQ**: 8 million gallons of EQ capacity is recommended for the MCWWTP to operate smoothly during peak hour flows. Flow and load surges that currently challenge treatment performance and hydraulic capacity can be buffered by equalization to provide steadier flow and loading into the treatment process. Hydraulic loading is particularly important to the performance of the clarifiers and to the filters that are recommended to be added as a part of the nutrient removal upgrades. The new EQ basins will reduce the need for additional treatment facilities, add operational flexibility, and improve effluent quality. It is proposed to convert the existing sludge lagoons into two EQ basins to provide storage for peak flows, which involves cleanout of the lagoons and installation of a concrete lining. A pumping station and force main are included to transfer flow from the headworks to EQ thereby reducing the loading into the primary clarifiers and the other downstream facilities.

The total estimated cost for this project is $23,626,000. The recommended implementation schedule for this project is FY 2012 through FY 2015.

**Subproject 3: AEWWTP EQ:** This includes the addition of two 1.5 million gallon pre-stressed concrete tanks at the AEWWTP for equalization of daily flows. The influent pump station currently under construction has been configured so that influent flows can be pumped directly to the future EQ tanks. Flow would return from EQ tanks by gravity to the primary clarifiers. Equalization facilities will add operational flexibility and improve effluent quality since flow and load surges that can challenge treatment performance can be buffered to provide steadier flow and loading into the treatment process.

The total estimated cost for this project is $3,241,000. The recommended implementation schedule for this project is FY 2013 to FY 2015.

## *Project 6: AEWWTP Solids Handling Expansion*

As wastewater flows increase within CCUC's system, additional solids handling facilities will be needed in the future in order to continue producing Class A Biosolids. The proposed improvements include replacing two centrifuges in the existing dewatering building and adding a new dryer, which requires a new dryer building.

The total estimated cost for this project is: $38,880,000. This expansion isn't needed until between FY 2020 to FY 2029, depending on the actual increase in wastewater flows.

## *Project 7: AEWWTP Expansion*

This project is for the planning, design, and construction services associated with a 16 mgd for expansion at the AEWWTP to a total capacity of 46 mgd max month flow.

The proposed improvements include the following:

- Existing Headworks Expansion (including one new mechanical bar screen, screw conveyor, vortex grit removal basin, grit classifier, two grit pumps and primary building expansion)
- Existing Influent Pump Station Upgrade (including replacing two and retrofitting four influent pumps)
- New Primary Clarifier No. 5
- New Primary Sludge Pump Station No. 2 (including two new primary sludge pumps and two new macerators)
- Existing WAS Thickening Building Upgrade (including one new gravity belt thickener and one new TWAS Pump)

The total estimated cost is: $17,280,000.The recommended implementation schedule for this project is to begin design in FY 2018 with construction being completed by the end of FY 2020.

## *Project 8: Pump Station Replacement/Improvements*

This project is for upgrades and replacements at 15 pump stations located within CCUC's sewer collection system that are aging or out of capacity. The project breakdown per fiscal year is as follows (descriptions for 2010-2014 improvements only). Improvements for the remainder of planning years are identified in the condition assessments and summarized in Section 8. **Table 9-4** provides a detailed summary for these projects.

### Subproject 1: Kerner's Mill Pump Station Equipment Replacement

Due to age, condition and capacity limitations, replacement of all major equipment at the Kerner's Mill pump station is proposed. This includes replacement of both pumps and associated electrical equipment, the PLC and the standby generator.

The total estimated cost for this subproject is: $1,080,000. The recommended implementation schedule is FY 2010.

### Subproject 2: Wexford Pump Station Total Replacement and South Fork Pump Station Diversion Structure Improvements

Total replacement of the Wexford pump station ($300,000) is proposed due to capacity limitations and maintenance difficulties. Improvements to the South Fork pump station diversion structure including replacement of corroded metals and a new throttling valve is also proposed ($180,000).

The total estimated cost for this subproject is $480,000. The recommended implementation schedule is FY 2011.

### Subproject 3: Allison Avenue Pump Station Total Replacement and Tanglewood Pump Station Upgrades

Total replacement of the Allison Avenue pump station is proposed due to maintenance difficulties and inadequate electrical service ($300,000). Upgrade of electrical gear and PLC for Tanglewood pump station is also proposed ($100,000).

The total estimated cost for this subproject is $400,000. The recommended implementation schedule is FY 2012.

**TABLE 9-4**
**PUMP STATION REPLACEMENT/IMPROVEMENTS**
**2010-2029 PROJECT SUMMARY**

| SUBPROJECT DESCRIPTION | ESTIMATED TOTAL COST | FY 2010 | | | | FY 2011 | | | | FY 2012 | | | | FY 2013 | | | | FY 2014 | | | | FY 2015 | | | | FY 2016 | | | | FY 2017 | | | | FY 2018 | | | | FY 2019 | | | | FY 2020-2029 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | |
| **KERNER'S MILL PS EQUIPMENT REPLACEMENT** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 135,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 945,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Total Subproject Cost** | **$ 1,080,000** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **WEXFORD PS TOTAL REPLACEMENT** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 38,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 262,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Total Subproject Cost** | **$ 300,000** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **SOUTH FORK PS DIVERSION STRUCTURE** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 22,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 158,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Total Subproject Cost** | **$ 180,000** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **ALLISON AVE PS TOTAL REPLACEMENT** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 38,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 262,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Total Subproject Cost** | **$ 300,000** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **TANGLEWOOD PS ELEC. UPGRADE** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 14,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 86,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Total Subproject Cost** | **$ 100,000** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **NORTH LAKE PS TOTAL REPLACEMENT** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 55,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 383,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Total Subproject Cost** | **$ 438,000** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **CLEMMONS NO. 4 PS TOTAL REPLACEMENT** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 30,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 210,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Total Subproject Cost** | **$ 240,000** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **FERNBROOK PS TOTAL REPLACEMENT** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 89,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 625,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Total Subproject Cost** | **$ 714,000** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **MACHINE STREET PS TOTAL REPLACEMENT** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 55,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 383,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Total Subproject Cost** | **$ 438,000** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **GENERAL PS REHAB & UPGRADES** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Services | $ 483,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Construction | $ 3,378,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Total Subproject Cost** | **$ 3,861,000** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **PROJECT SUMMARY:** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Engineering Services** | **$ 959,000** | **$ 135,000** | | | | **$ 60,000** | | | | **$ 52,000** | | | | **$ 85,000** | | | | **$ 144,000** | | | | **$ 81,000** | | | | **$ 56,000** | | | | **$ 28,000** | | | | **$ 28,000** | | | | **$ 38,000** | | | | **$ 252,000** |
| **Construction** | **$ 6,692,000** | **$ 945,000** | | | | **$ 420,000** | | | | **$ 348,000** | | | | **$ 593,000** | | | | **$ 1,008,000** | | | | **$ 567,000** | | | | **$ 389,000** | | | | **$ 194,000** | | | | **$ 194,000** | | | | **$ 269,000** | | | | **$ 1,765,000** |
| **Total Project Cost** | **$ 7,651,000** | **$ 1,080,000** | | | | **$ 480,000** | | | | **$ 400,000** | | | | **$ 678,000** | | | | **$ 1,152,000** | | | | **$ 648,000** | | | | **$ 445,000** | | | | **$ 222,000** | | | | **$ 222,000** | | | | **$ 307,000** | | | | **$ 2,017,000** |

***NOTES:***
*ALL COSTS ARE IN 2009 DOLLARS*
*1st QTR: JULY - SEPTEMBER*
*2nd QTR: OCTOBER - DECEMBER*
*3rd QTR: JANUARY - MARCH*
*4th QTR: APRIL - JUNE*

**Subproject 4: North Lake and Clemmons No. 4 Pump Stations Total Replacements**

Total replacements of North Lake ($438,000) and Clemmons No. 4 ($240,000) pump stations are proposed due to age of the facilities, condition and capacity limitations.

The total estimated cost for this subproject is $678,000. The recommended implementation schedule is FY 2013.

**Subproject 5: Fernbrook and Machine Street Pump Stations Total Replacements**

Total replacements of Fernbrook ($714,000) and Machine Street ($438,000) pump stations are proposed due to the age and condition of equipment and appurtenances.

The total estimated cost for this subproject is $1,152,000. The recommended implementation schedule is during FY 2014.

## 9.4 Phasing Schedule

To enable CCUC to tie potential revenue sources to its short-term and long-term improvement needs, the CIP prioritizes all above mentioned capital improvement projects by phases over the 20-year planning period. The recommended capital projects to be scheduled in each Phase are listed below. Table 9-1 provides a summary of the phased capital projects and **Table 9-5** shows the cost per fiscal year for each project.

### *Phase I (5-year) - Fiscal Year (FY) 2010 to FY 2014:*

Phase I of the CIP focuses on capital projects that reflect the highest priority of CCUC's capital improvement needs for the next five years and includes the following projects per fiscal year.

**FY2010**

1) Archie Elledge WWTP rehabilitation and upgrades:

   1a) Digester Heating Equipment Replacement – replacement of one boiler in Digester Building and associated hot water recirculation and fuel pumps.

   **Total Cost: $480,000**

2) Muddy Creek WWTP rehabilitation and upgrades:

   2a) Influent Pump Improvements - replacement of one 84-inch screw pump in the influent pump station.

   **Total Cost: $360,000**

3) Pump Station Replacements/Improvements:

**TABLE 9-5**
**WASTEWATER TREATMENT**
**2010-2029 DETAILED CIP PER FISCAL YEAR**

| PROJECT DESCRIPTION | FY2010 | FY2011 | FY2012 | FY2013 | FY2014 | FY2015 | FY2016 | FY2017 | FY2018 | FY2019 | FY2020-2029 | TOTAL COST |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Archie Elledge WWTP Rehab and Upgrades** | | | | | | | | | | | | |
| Planning/Design | $ 60,000 | $ 60,000 | $ 98,000 | | $ 100,000 | $ 179,000 | $ 179,000 | $ 179,000 | $ 179,000 | $ 179,000 | $ 1,177,000 | $ 2,390,000 |
| Construction | $ 400,000 | $ 400,000 | $ 650,000 | | $ 664,000 | $ 1,196,000 | $ 1,196,000 | $ 1,196,000 | $ 1,196,000 | $ 1,196,000 | $ 7,844,000 | $ 15,938,000 |
| Contingency | $ 20,000 | $ 20,000 | $ 33,000 | | $ 33,000 | $ 60,000 | $ 60,000 | $ 60,000 | $ 60,000 | $ 60,000 | $ 392,000 | $ 798,000 |
| **TOTAL** | **$ 480,000** | **$ 480,000** | **$ 781,000** | | **$ 797,000** | **$ 1,435,000** | **$ 1,435,000** | **$ 1,435,000** | **$ 1,435,000** | **$ 1,435,000** | **$ 9,413,000** | ***$ 19,126,000*** |
| **Muddy Creek WWTP Rehab and Upgrades** | | | | | | | | | | | | |
| Planning/Design | $ 45,000 | | $ 135,000 | $ 270,000 | $ 536,000 | $ 156,000 | $ 156,000 | $ 156,000 | $ 156,000 | $ 156,000 | $ 850,000 | $ 2,616,000 |
| Construction | $ 300,000 | | | $ 1,800,000 | $ 4,475,000 | $ 1,041,000 | $ 1,041,000 | $ 1,041,000 | $ 1,041,000 | $ 1,041,000 | $ 5,669,000 | $ 17,449,000 |
| Contingency | $ 15,000 | | | $ 90,000 | $ 224,000 | $ 52,000 | $ 52,000 | $ 52,000 | $ 52,000 | $ 52,000 | $ 283,000 | $ 872,000 |
| **TOTAL** | **$ 360,000** | | **$ 135,000** | **$ 2,160,000** | **$ 5,235,000** | **$ 1,249,000** | **$ 1,249,000** | **$ 1,249,000** | **$ 1,249,000** | **$ 1,249,000** | **$ 6,802,000** | ***$ 20,937,000*** |
| **Muddy Creek WWTP Clarifier Improvements** | | | | | | | | | | | | |
| Planning/Design | | $ 245,000 | $ 540,000 | $ 405,000 | | | | | | | | $ 1,190,000 |
| Construction | | | $ 1,800,000 | $ 5,400,000 | | | | | | | | $ 7,200,000 |
| Equipment/Furnishings | | $ - | $ - | $ - | | | | | | | | $ - |
| Contingency | | $ - | $ 90,000 | $ 270,000 | | | | | | | | $ 360,000 |
| **TOTAL** | | **$ 245,000** | **$ 2,430,000** | **$ 6,075,000** | | | | | | | | ***$ 8,750,000*** |
| **Muddy Creek WWTP Transfer Pump Station/Force Main** | | | | | | | | | | | | |
| Planning/Design | | | | | $ 2,123,000 | $ 1,061,000 | $ 1,061,000 | | | $ 1,523,000 | $ 1,583,000 | $ 7,351,000 |
| Construction | | | | | | $ 14,150,000 | $ 14,150,000 | | | | $ 20,900,000 | $ 49,200,000 |
| Equipment/Furnishings | | | | | $ - | $ - | $ - | | | $ - | $ - | $ - |
| Contingency | | | | | | $ 708,000 | $ 708,000 | | | $ - | $ 1,045,000 | $ 2,461,000 |
| **TOTAL** | | | | | **$ 2,123,000** | **$ 15,919,000** | **$ 15,919,000** | | | **$ 1,523,000** | **$ 23,528,000** | ***$ 59,012,000*** |
| **Archie Elledge/Muddy Creek WWTP Nutrient Removal** | | | | | | | | | | | | |
| Planning/Design | | | | $ 2,070,000 | $ 2,070,000 | $ 1,380,000 | $ 1,380,000 | $ 1,380,000 | | | | $ 8,280,000 |
| Construction | | | | | | $ 18,399,000 | $ 18,399,000 | $ 18,399,000 | | | | $ 55,197,000 |
| Equipment/Furnishings | | | | $ - | $ - | | $ - | $ - | | | | $ - |
| Contingency | | | | $ - | | $ 920,000 | $ 920,000 | $ 920,000 | | | | $ 2,760,000 |
| **TOTAL** | | | | **$ 2,070,000** | **$ 2,070,000** | **$ 20,699,000** | **$ 20,699,000** | **$ 20,699,000** | | | | ***$ 66,237,000*** |
| **MCWWTP Headworks/EQ** | | | | | | | | | | | | |
| Planning/Design | | | $ 200,000 | $ 1,464,000 | $ 732,000 | $ 732,000 | | | | | | $ 3,128,000 |
| Construction | | | | | $ 9,761,000 | $ 9,761,000 | | | | | | $ 19,522,000 |
| Equipment/Furnishings | | | | | | | | | | | | $ - |
| Contingency | | | | | $ 488,000 | $ 488,000 | | | | | | $ 976,000 |
| **TOTAL** | | | **$ 200,000** | **$ 1,464,000** | **$ 10,981,000** | **$ 10,981,000** | | | | | | ***$ 23,626,000*** |
| **AEWWTP EQ** | | | | | | | | | | | | |
| Planning/Design | | | | $ 101,000 | $ 203,000 | $ 101,000 | | | | | | $ 405,000 |
| Construction | | | | | $ 1,350,000 | $ 1,350,000 | | | | | | $ 2,700,000 |
| Equipment/Furnishings | | | | | | | | | | | | $ - |
| Contingency | | | | | $ 68,000 | $ 68,000 | | | | | | $ 136,000 |
| **TOTAL** | | | | **$ 101,000** | **$ 1,621,000** | **$ 1,519,000** | | | | | | ***$ 3,241,000*** |
| **Archie Elledge WWTP Solids Handling Expansion** | | | | | | | | | | | | |
| Planning/Design | | | | | | | | | | | $ 4,860,000 | $ 4,860,000 |
| Construction | | | | | | | | | | | $ 32,400,000 | $ 32,400,000 |
| Equipment/Furnishings | | | | | | | | | | | $ - | $ - |
| Contingency | | | | | | | | | | | $ 1,620,000 | $ 1,620,000 |
| **TOTAL** | | | | | | | | | | | **$ 38,880,000** | ***$ 38,880,000*** |
| **Archie Elledge WWTP Expansion** | | | | | | | | | | | | |
| Planning/Design | | | | | | | | | $ 1,080,000 | $ 720,000 | $ 360,000 | $ 2,160,000 |
| Construction | | | | | | | | | | $ 9,600,000 | $ 4,800,000 | $ 14,400,000 |
| Equipment/Furnishings | | | | | | | | | $ - | | | $ - |
| Contingency | | | | | | | | | $ - | $ 480,000 | $ 240,000 | $ 720,000 |
| **TOTAL** | | | | | | | | | **$ 1,080,000** | **$ 10,800,000** | **$ 5,400,000** | ***$ 17,280,000*** |
| **Pump Station Replacement/Improvements** | | | | | | | | | | | | |
| Planning/Design | $ 135,000 | $ 60,000 | $ 52,000 | $ 85,000 | $ 144,000 | $ 81,000 | $ 56,000 | $ 28,000 | $ 28,000 | $ 38,000 | $ 252,000 | $ 959,000 |
| Construction | $ 900,000 | $ 400,000 | $ 332,000 | $ 565,000 | $ 960,000 | $ 540,000 | $ 370,000 | $ 185,000 | $ 185,000 | $ 256,000 | $ 1,681,000 | $ 6,374,000 |
| Equipment/Furnishings | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Contingency | $ 45,000 | $ 20,000 | $ 16,000 | $ 28,000 | $ 48,000 | $ 27,000 | $ 19,000 | $ 9,000 | $ 9,000 | $ 13,000 | $ 84,000 | $ 318,000 |
| **TOTAL** | **$ 1,080,000** | **$ 480,000** | **$ 400,000** | **$ 678,000** | **$ 1,152,000** | **$ 648,000** | **$ 445,000** | **$ 222,000** | **$ 222,000** | **$ 307,000** | **$ 2,017,000** | ***$ 7,651,000*** |
| **ANNUAL CIP EXPENDITURES** | **$ 1,920,000** | **$ 1,205,000** | **$ 3,946,000** | **$ 12,548,000** | **$ 23,979,000** | **$ 52,450,000** | **$ 39,747,000** | **$ 23,605,000** | **$ 3,986,000** | **$ 15,314,000** | **$ 86,040,000** | **$ 264,740,000** |
| **ENGINEERING SERVICES** | $ 240,000 | $ 365,000 | $ 1,025,000 | $ 4,395,000 | $ 5,908,000 | $ 3,690,000 | $ 2,832,000 | $ 1,743,000 | $ 1,443,000 | $ 2,616,000 | $ 9,082,000 | |
| **CONSTRUCTION** | $ 1,680,000 | $ 840,000 | $ 2,921,000 | $ 8,153,000 | $ 18,071,000 | $ 48,760,000 | $ 36,915,000 | $ 21,862,000 | $ 2,543,000 | $ 12,698,000 | $ 76,958,000 | |

Note: All costs are in 2009 dollars.

3a) Kerner's Mill Pump Station Equipment Replacement - replacement of both pumps and associated electrical equipment, the PLC and the standby generator.

**Total Cost: $1,080,000**

**TOTAL FY2010 EXPENDITURES: $1,920,000**

**FY2011**

1) Archie Elledge WWTP rehabilitation and upgrades:

1a) Digester Heating Equipment Replacement – replacement of one boiler in Digester Building and associated hot water recirculation and fuel pumps.

**Total Cost: $480,000**

2) Muddy Creek WWTP Clarifier Improvements:

In the 4th quarter of FY2011, the secondary clarifier evaluation begins along with design of new primary clarifier mechanisms, secondary clarifier modifications, and new secondary clarifier.

**Total Cost: $245,000**

3) Pump Station Replacements/Improvements:

3a) Wexford Pump Station Total Replacement - replacement of pump station.

**Total Cost: $300,000**

3b) South Fork Pump Station Diversion Structure Improvements - replacement of corroded metals and a new throttling valve.

**Total Cost: $180,000**

**TOTAL FY2011 EXPENDITURES: $1,205,000**

**FY2012**

1) Archie Elledge WWTP rehabilitation and upgrades:

1a) Digester Heating Equipment Replacement – replacement of one boiler in Digester Building and associated hot water recirculation and fuel pump and replacement of heat exchanger in Digester Control Building.

**Total Cost: $781,000**

2) Muddy Creek WWTP rehabilitation and upgrades:

2a) Digester Cover Replacement – In the 3rd quarter of FY2012, design begins of new digester covers for the four anaerobic digesters, replacement of the center mixer in each digester, replacement of necessary digester gas accessories on the covers, and cleanout of the existing digesters.

**Total Cost: $135,000**

3) Muddy Creek WWTP Clarifier Improvements:

Design of the new primary clarifier mechanisms, secondary clarifier modifications, and new secondary clarifier continues and construction begins in the 4th quarter.

**Total Cost: $2,430,000**

4) Muddy Creek WWTP Headworks/Equalization:

In the 3rd quarter of FY2012, study begins to evaluate the necessary capacity of the grit removal and screening facilities at the Muddy Creek WWTP and to determine if these operations should be performed prior to pumping flow to the Archie Elledge WWTP.

**Total Cost: $200,000**

5) Pump Station Replacements/Improvements:

5a) Allison Avenue Pump Station Total Replacement - replacement of pump station.

**Total Cost: $300,000**

5b) Tanglewood Pump Station Improvements - replacement of electrical gear and PLC.

**Total Cost: $100,000**

**TOTAL FY2012 EXPENDITURES: $3,946,000**

**FY2013**

1) Muddy Creek WWTP rehabilitation and upgrades:

1a) Digester Cover Replacement – Construction begins for new digester covers for the four anaerobic digesters, replacement of the center mixer in each digester, replacement of necessary digester gas accessories on the covers, and cleanout of the existing digesters.

**Total Cost: $2,160,000**

2) Muddy Creek WWTP Clarifier Improvements:

Construction of the new primary clarifier mechanisms, secondary clarifier modifications, and new secondary clarifier continues.

**Total Cost: $6,075,000**

3) Archie Elledge/Muddy Creek Nutrient Removal:

Design of plant improvements at the Archie Elledge and Muddy Creek WWTPs to perform nitrogen and phosphorus removal begins.

**Total Cost: $2,070,000**

4) Muddy Creek WWTP Headworks/Equalization:

Design of grit removal and screening facilities, the conversion of the existing sludge lagoons into two EQ basins (including cleanout of the lagoons and installation of a concrete lining) and an EQ pump station and force main.

**Total Cost: $1,464,000**

5) Archie Elledge WWTP Equalization:

Design of two new equalization basins begins.

**Total Cost: $101,000**

6) Pump Station Replacements/Improvements:

6a) North Lake Pump Station Total Replacement - replacement of pump station.

**Total Cost: $438,000**

6b) Clemmons No. 4 Pump Station Replacement - replacement of pump station.

**Total Cost: $240,000**

**TOTAL FY2013 EXPENDITURES: $12,548,000**

**FY2014**

1) Archie Elledge WWTP rehabilitation and upgrades:

   1a) Gravity Thickener and TWAS System upgrades – replacement drive and collection system for the gravity thickener and three new TWAS pumps.

   **Total Cost: $797,000**

2) Muddy Creek WWTP rehabilitation and upgrades:

   2a) Digester Cover Replacement – Construction continues for digester cover replacement for the four anaerobic digesters, replacement of the center mixer in each digester, replacement of necessary digester gas accessories on the covers, and cleanout of the existing digesters.

   **Total Cost: $2,025,000**

   2b) Aeration Basin Blower Replacement – Replacement of the three aeration basin blowers and an assessment of the blower engines.

   **Total Cost: $3,210,000**

3) Muddy Creek WWTP Transfer Pump Station and Force Main:

   Design of 60 MGD transfer pump station and force main to convey excess flows to the Archie Elledge WWTP begins.

   **Total Cost: $2,123,000**

4) Archie Elledge/Muddy Creek Nutrient Removal:

   Design of plant improvements at the Archie Elledge and Muddy Creek WWTPs to perform nitrogen and phosphorus removal continues.

   **Total Cost: $2,070,000**

5) Muddy Creek WWTP Headworks/Equalization:

   Construction of grit removal and screening facilities, the conversion of the existing sludge lagoons into two EQ basins (including cleanout of the lagoons and installation of a concrete lining) and an EQ pump station and force main.

   **Total Cost: $10,981,000**

6) Archie Elledge WWTP Equalization:

   Design continues and construction of two new equalization basins begins in the 3rd quarter.

   **Total Cost: $1,621,000**

7) Pump Station Replacements/Improvements:

   7a) Fernbrook Pump Station Total Replacement - replacement of pump station.

   **Total Cost: $714,000**

   7b) Machine Street Pump Station Replacement - replacement of pump station.

   **Total Cost: $438,000**

**TOTAL FY2014 EXPENDITURES: $23,979,000**

Total recommended Phase I CIP expenditure is $43,598,000, constituting approximately 16.5 percent of the 20-year CIP.

## *Phase II (10-year) - Fiscal Year (FY) 2015 to FY 2019:*

Phase II of the CIP includes the following projects per fiscal year.

**FY2015**

1) Archie Elledge WWTP rehabilitation and upgrades - includes funds for general plant maintenance and rehabilitation projects and the following specific projects:

   1a) RAS System Improvements – evaluation of RAS wetwell, flowmeter, RAS hypochlorite system, RAS pumps No. 1 and 2 and RAS pony pump and replacement as needed.

   **Total Cost: $500,000**

   1b) Influent Parshall Flume – replacement of South Fork Parshall flume.

   **Total Cost: $150,000**

   1c) Hypochlorite Facilities Improvements – evaluation of truck offloading facility and hypochlorite feed and recirculation pumps and replacement as necessary.

   **Total Cost: $200,000**

1d) General Plant Maintenance and Rehabilitation – replacement of aging equipment as needed.

**Total Cost: $585,000**

2) Muddy Creek WWTP rehabilitation and upgrades - includes funds for general plant maintenance and rehabilitation projects and the following specific projects:

2a) Electrical Improvements – evaluation of existing switchgear, MCCs, backup generators etc. and replacements as necessary.

**Total Cost: $500,000**

2b) Thickening Facilities Upgrades – replacement of gravity thickener drive and mechanism, and polymer feed system and pumping as necessary.

**Total Cost: $300,000**

2c) Caustic Tank – replacement of caustic bulk tank.

**Total Cost: $70,000**

2d) General Plant Maintenance and Rehabilitation – replacement of aging equipment as needed.

**Total Cost: $380,000**

3) Muddy Creek WWTP Transfer Pump Station and Force Main:

Construction of 60 MGD transfer pump station structure and force main to convey excess flows to the Archie Elledge WWTP begins.

**Total Cost: $15,919,000**

4) Archie Elledge/Muddy Creek Nutrient Removal:

Construction of plant improvements at the Archie Elledge and Muddy Creek WWTPs to perform nitrogen and phosphorus removal begins.

**Total Cost: $20,699,000**

5) Muddy Creek WWTP Headworks/Equalization:

Construction of grit removal and screening facilities, the conversion of the existing sludge lagoons into two EQ basins (including cleanout of the lagoons and installation of a concrete lining) and an EQ pump station and force main.

**Total Cost: $10,981,000**

6) Archie Elledge WWTP Equalization:

Construction of two new equalization basins continues.

**Total Cost: $1,519,000**

7) Pump Station Replacements/Improvements:

7a) Linville Springs Pump Station Replacement - replacement of pump station.

**Total Cost: $440,000**

7b) Village Club Pump Station Replacement - replacement of pump station.

**Total Cost: $208,000**

**TOTAL FY2015 EXPENDITURES: $52,450,000**

**FY2016**

1) Archie Elledge WWTP rehabilitation and upgrades:

1a) Thickening Facilities Improvements – evaluation of odor control tower, gravity thickener effluent pumps (3), polymer feed pumps (4), washwater pumps (3), and recirculation pumps (2) and replacement as needed.

**Total Cost: $600,000**

1b) General Plant Maintenance and Rehabilitation – replacement of aging equipment as needed.

**Total Cost: $835,000**

2) Muddy Creek WWTP rehabilitation and upgrades:

2a) Digester Facilities Upgrades – evaluation and replacement as necessary of all digester peripheral mixers, gas compressors, hot water booster pumps and heat exchangers.

**Total Cost: $1,249,000**

3) Muddy Creek WWTP Transfer Pump Station and Force Main:

   Construction of 60 MGD transfer pump station structure and force main to convey excess flows to the Archie Elledge WWTP continues.

   **Total Cost: $15,919,000**

4) Archie Elledge/Muddy Creek Nutrient Removal:

   Construction of plant improvements at the Archie Elledge and Muddy Creek WWTPs to perform nitrogen and phosphorus removal continues.

   **Total Cost: $20,699,000**

5) Pump Station Replacements/Improvements:

   5a) Fair Oaks Pump Station Total Improvements - replacement of pumps, electrical switchgear, PLC, and standby generator.

   **Total Cost: $445,000**

**TOTAL FY2016 EXPENDITURES: $39,747,000**

**FY2017**

1) Archie Elledge WWTP rehabilitation and upgrades:

   1a) General Plant Maintenance and Rehabilitation – replacement of aging equipment as needed.

   **Total Cost: $1,435,000**

2) Muddy Creek WWTP rehabilitation and upgrades:

   2a) Digester Facilities Upgrades – evaluation and replacement as necessary of all digester peripheral mixers, gas compressors, hot water booster pumps and heat exchangers.

   **Total Cost: $1,249,000**

3) Archie Elledge/Muddy Creek Nutrient Removal:

   Construction of plant improvements at the Archie Elledge and Muddy Creek WWTPs to perform nitrogen and phosphorus removal continues.

   **Total Cost: $20,699,000**

4) Pump Station Replacements/Improvements:

Miscellaneous pump station maintenance and rehabilitation projects.

**Total Cost: $222,000**

**TOTAL FY2017 EXPENDITURES: $23,605,000**

**FY2018**

1) Archie Elledge WWTP rehabilitation and upgrades:

1a) Solids Mixing Improvements – evaluation of sludge blending mixing and digester mixing equipment and replacement as needed.

**Total Cost: $700,000**

1b) Solids Conveyance Improvements – evaluation of all solids conveyance systems and grinders and replacement as needed.

**Total Cost: $400,000**

1c) General Plant Maintenance and Rehabilitation – replacement of aging equipment as needed.

**Total Cost: $335,000**

2) Muddy Creek WWTP rehabilitation and upgrades:

2a) Replacement of Non-Potable Water Pumps

**Total Cost: $100,000**

2b) Replacement of Effluent Parshall Flume

**Total Cost: $100,000**

2c) Chemical Feed Facilities Assessment and Upgrades – evaluation of sodium bisulfite and sodium hypochlorite storage and feed facilities and replacement as necessary.

**Total Cost: $300,000**

2d) General Plant Maintenance and Rehabilitation – replacement of aging equipment as needed.

**Total Cost: $750,000**

3) Archie Elledge Expansion:

Design of a 16 mgd expansion at the AEWWTP to achieve a total capacity of 46 mgd begins.

**Total Cost: $1,080,000**

4) Pump Station Replacements/Improvements:

Miscellaneous pump station maintenance and rehabilitation projects.

**Total Cost: $222,000**

**TOTAL FY2018 EXPENDITURES: $3,986,000**

**FY2019**

1) Archie Elledge WWTP rehabilitation and upgrades:

1a) Chemical Facilities Improvements – evaluation of caustic storage tanks, feed pumps and transfer pumps, nitrogen feed pumps, sodium bisulfite feed and recirculation pumps and replacement as needed.

**Total Cost: $300,000**

1b) Final Treatment Improvements – replacement of chlorine contact basin sluice gates and blowers, and non-potable water strainers.

**Total Cost: $300,000**

1c) General Plant Maintenance and Rehabilitation – replacement of aging equipment as needed.

**Total Cost: $835,000**

2) Muddy Creek WWTP rehabilitation and upgrades:

2a) Plant HVAC evaluation

**Total Cost: $80,000**

2b) Raw Sludge Pump No. 1 and 2 Replacement

**Total Cost: $50,000**

2c) General Plant Maintenance and Rehabilitation – replacement of aging equipment as needed.

**Total Cost: $1,120,000**

3) Muddy Creek WWTP Transfer Pump Station and Force Main:

Design begins of parallel 48-inch diameter force main and addition of two pumps to achieve a firm pumping capacity of 40 mgd.

**Total Cost: $1,523,000**

4) Archie Elledge Expansion:

Construction of 16 mgd expansion at the AEWWTP to achieve a total capacity of 46 mgd continues.

**Total Cost: $10,800,000**

5) Pump Station Replacements/Improvements:

Miscellaneous pump station maintenance and rehabilitation projects.

**Total Cost: $307,000**

**TOTAL FY2019 EXPENDITURES: $15,314,000**

Total recommended Phase II CIP expenditure is $135,102,000, constituting approximately 51 percent of the 20-year CIP.

## *Phase III - FY 2020 to FY 2029:*

Phase III of the CIP mainly focused on the continued investment in maintaining both treatment facilities and pump stations except for the two specific projects described below.

**FY2020**

1) Muddy Creek WWTP Transfer Pump Station and Force Main:

Construction begins of parallel 48-inch diameter force main and addition of two pumps to achieve a firm pumping capacity of 40 mgd.

**Total Cost: $11,419,000**

2) Archie Elledge Expansion:

Construction of 16 mgd expansion at the AEWWTP to achieve a total capacity of 46 mgd max month flow continues.

**Total Cost: $5,400,000**

**FY2021**

1) Muddy Creek WWTP Transfer Pump Station and Force Main:

   Construction continues of parallel 48-inch diameter force main and addition of two pumps to achieve a firm pumping capacity of 40 mgd.

   **Total Cost: $11,419,000**

**FY2029**

1) Muddy Creek WWTP Transfer Pump Station and Force Main:

   Addition of two pumps to achieve a final firm pumping capacity of 60 mgd.

   **Total Cost: $690,000**

Total recommended Phase III CIP expenditure is $86,040,000, constituting approximately 32.5 percent of the 20-year CIP.

## 9.5 Other Considerations

It should be noted that the recommended improvements are perceived as a statement of needs that are necessary to maintain existing facilities, and for CCUC to continue providing a high level of service over the next 20 years. The required capacity and timing of each recommended project is provided for budgeting and financial projection purposes only. The actual design parameters should be evaluated at the design phase of each project using updated population and flow data if available.

It should be noted that the scope of this Master Plan was to evaluate the two existing wastewater treatment facilities only. Another reasonable option that should be considered is the construction of a regional wastewater treatment facility. This option would eliminate the need for a future AEWWTP expansion, and the transfer pump station proposed at the MCWWTP can be used to convey flows to a new regional WWTP. Planning and coordination with other municipalities/utilities must begin as soon as possible in order for this option to be most beneficial.

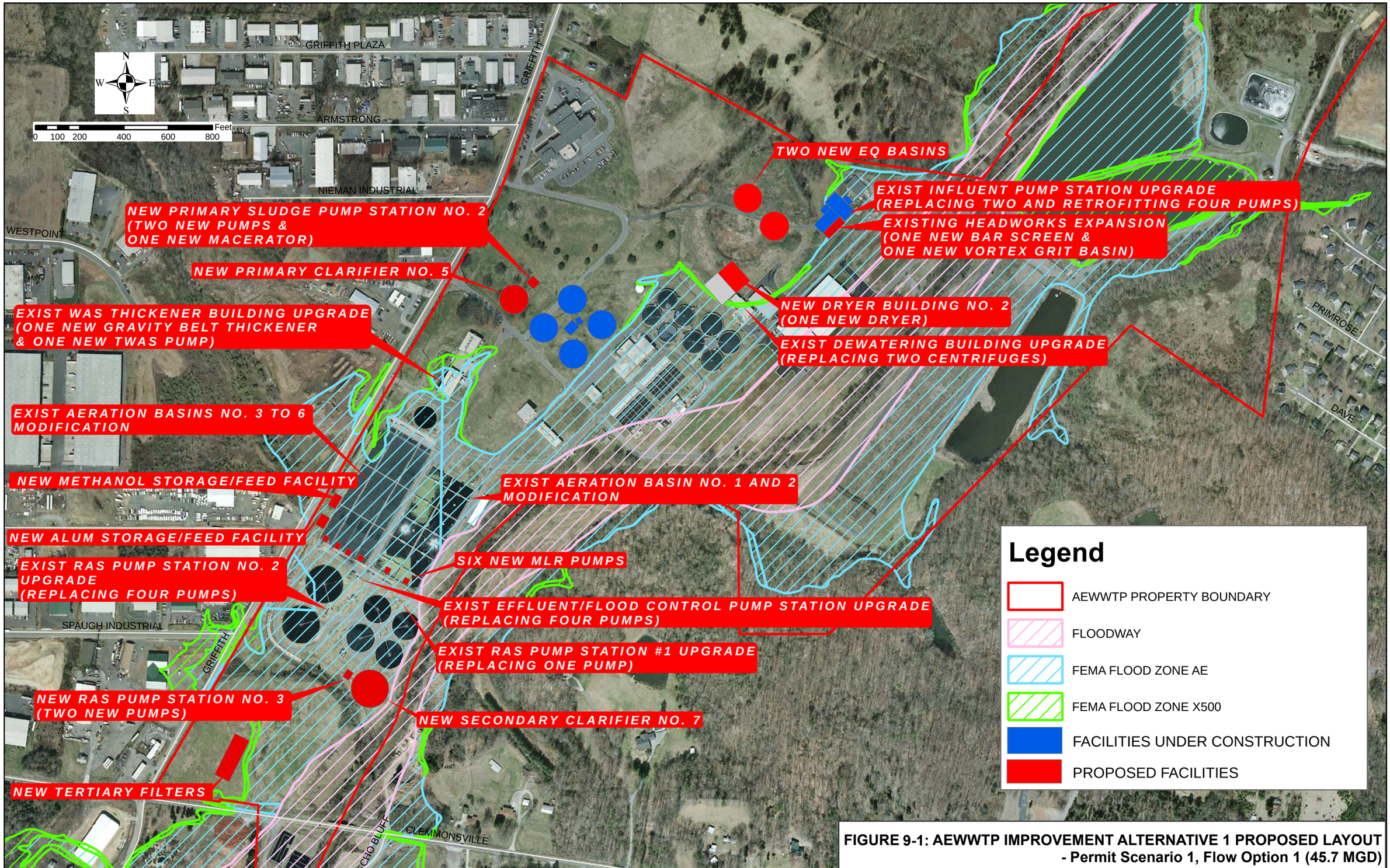


**FIGURE 9-1: AEWWTP IMPROVEMENT ALTERNATIVE 1 PROPOSED LAYOUT - Permit Scenario 1, Flow Option 1 (45.7 MGD)**

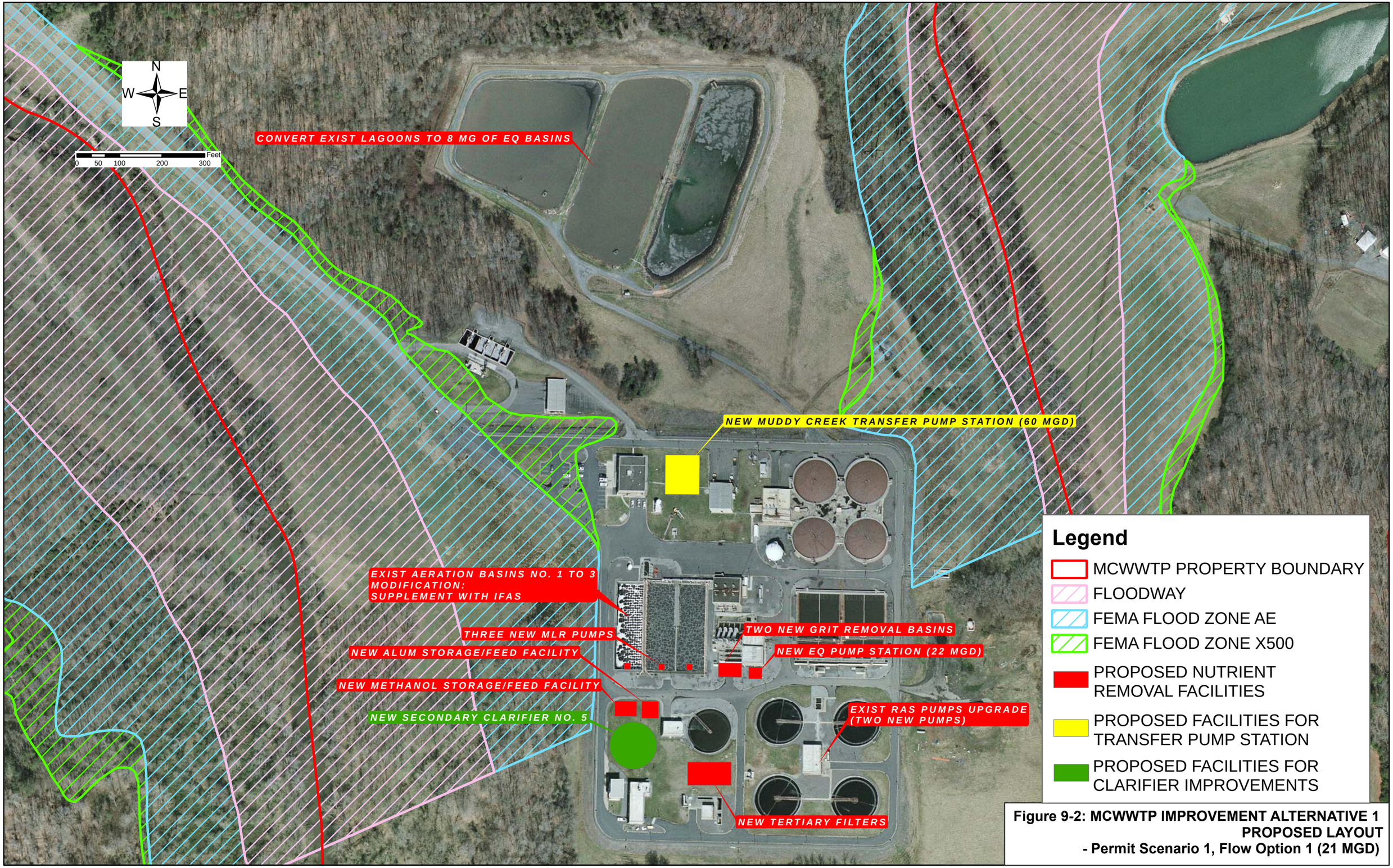


**Figure 9-2: MCWWTP IMPROVEMENT ALTERNATIVE 1 PROPOSED LAYOUT**
**- Permit Scenario 1, Flow Option 1 (21 MGD)**

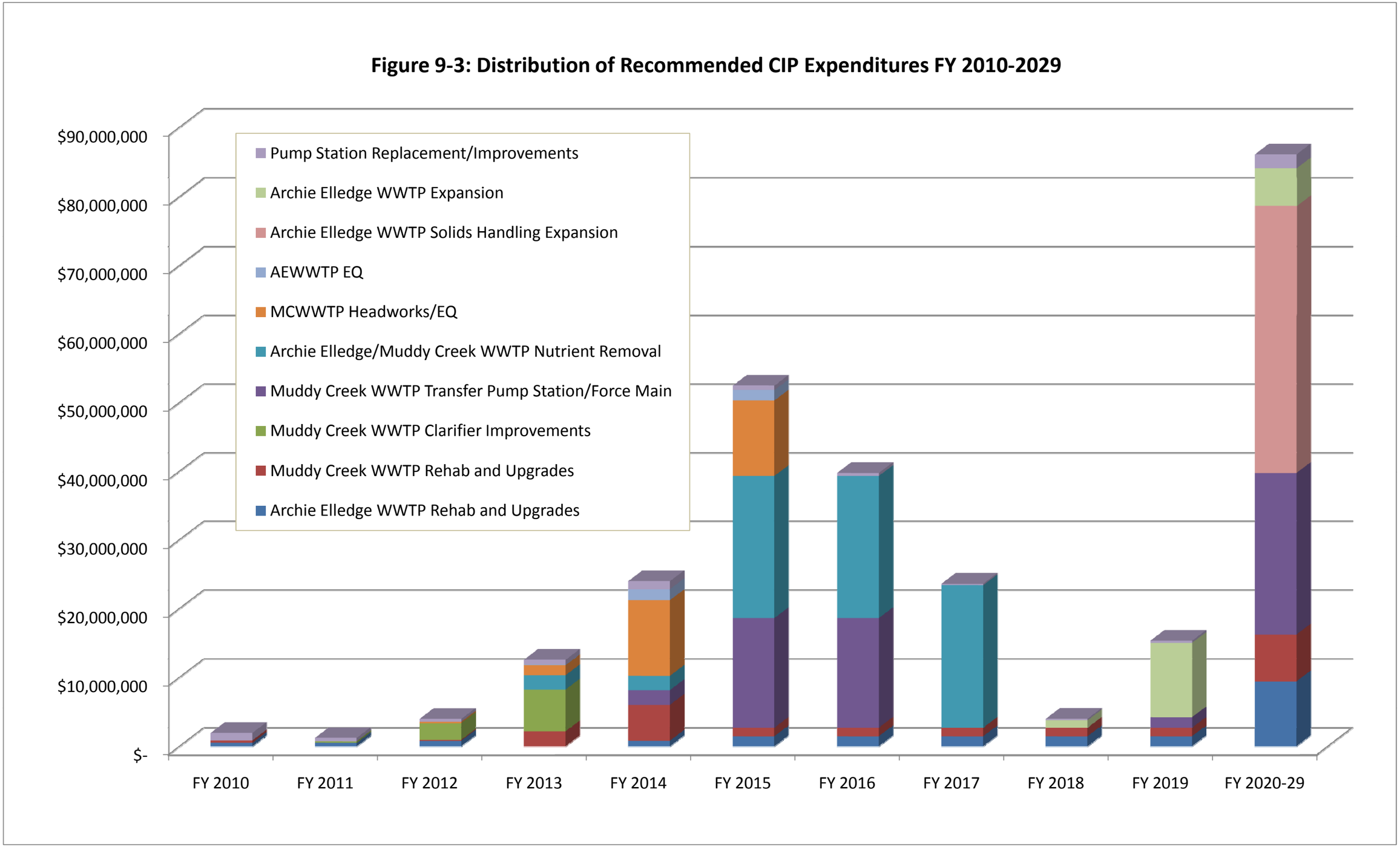
Figure 9-3: Distribution of Recommended CIP Expenditures FY 2010-2029
$90,000,000
$80,000,000
$70,000,000
$60,000,000
$50,000,000
$40,000,000
$30,000,000
$20,000,000
$10,000,000
$-
Pump Station Replacement/Improvements
Archie Elledge WWTP Expansion
Archie Elledge WWTP Solids Handling Expansion
AEWWTP EQ
MCWWTP Headworks/EQ
Archie Elledge/Muddy Creek WWTP Nutrient Removal
Muddy Creek WWTP Transfer Pump Station/Force Main
Muddy Creek WWTP Clarifier Improvements
Muddy Creek WWTP Rehab and Upgrades
Archie Elledge WWTP Rehab and Upgrades
FY 2010
FY 2011
FY 2012
FY 2013
FY 2014
FY 2015
FY 2016
FY 2017
FY 2018
FY 2019
FY 2020-29

# Appendix A
# Technical Memorandum 300,
# Regulatory Review and Coordination

# Memorandum

*To:* *Scott W. Angell, P.E.*
*Project Manager*

*From:* *Jeff Payne, P.E., BCEE, CDM*

*Date:* *June 15, 2009*

*Subject:* *City/County Utilities Commission*
*Facilities Master Plan for the Archie Elledge and Muddy Creek Wastewater Treatment Plants and Wastewater Lift Stations*
*Task 300 - Regulatory Review and Coordination*

The purpose of this Technical Memorandum is to summarize discussions held with EPA and the North Carolina Division of Water Quality (DWQ) for estimating potential future effluent nutrient limits for the Archie Elledge and Muddy Creek Wastewater Treatment Plants (WWTPs). Based on these conversations, CDM and CCUC developed target effluent limits to establish a basis of design over the 20-year planning period for each WWTP.

Particular emphasis has been on determining the future nutrient effluent limitations associated with the ongoing Total Maximum Daily Load (TMDL) study on High Rock Lake. High Rock Lake is on the DWQ list of waters that are not meeting water quality standards for several pollutants including nutrients. Waters on that list, which is developed under the requirements of Section 303(d) of the Federal Clean Water Act, must have pollutant loads limited to a level which will maintain water quality standards. A TMDL is the sum of all the point sources (wasteload allocation) and the non-point sources (load allocation) which contribute to the total pollutant load and will allow meeting water quality standards. The TMDL study has two basic parts: development of a water quality model which relates all pollutant loads to the level of pollutants in the subject water, and a process of limiting and allocating all pollutant loads to a level which will insure that water quality standards are met.

## Meetings with EPA

For High Rock Lake, DWQ, EPA, and a Basin Stakeholders Group have been working together to gather the information needed to develop a water quality model and will also jointly participate in the allocation of pollutants upon completion of the TMDL. The water quality models for the High Rock Basin are currently being developed by Tetra Tech under a contract administered by EPA and co-managed by DWQ.

CDM met with Tim Wool of EPA on May 26, 2009 in Atlanta to gather information about the models being used to develop the TMDL. The three basic models being used are as follows:

1. HSPF Watershed Model to provide for fate and transport of pollutants from their discharge locations to High Rock Lake.

2. EFDC Model to simulate the movement of water in High Rock Lake. This is a three dimensional model and will divide the lake into a grid of volume components.

3. WASP Model to simulate the quality of each of the lake volume components for various pollutants including nutrients and Chlorophyll a.

These models have been peer reviewed and serve as the basis of EPA and State TMDL regulatory decisions nationwide. EPA and DWQ do not intend to have a peer review performed on the actual application of these models to High Rock Lake, but the models will be reviewed by EPA and DWQ technical staff. In addition, EPA and DWQ will allow the Basin Stakeholders Group and any other members of the public to perform a peer review if requested. It is expected that the High Rock models will be calibrated, verified, and ready for allocation scenario use by May of 2010. The final TMDL and associated allocations could be completed as early as 2012 and are expected to be reflected in the NPDES permits that are due to be issued in 2014.

Determining future effluent limits at this time is complicated by the fact that the models and the TMDL have not been completed. Development of the future limits has depended largely on an examination of other similar modeled basins and from insights gained from both EPA and DWQ staff involved in those basins as well as the High Rock Lake Study. Tim Wool's insights seem particularly relevant since he has been involved in all the work on High Rock Lake to date and is considered a National EPA expert on Water Quality Modeling. Below is a summary of the insights obtained from Mr. Wool:

1. Based on the model work and water quality data collected to date, he expects there will need to be a 30-40% reduction in nitrogen and phosphorus from High Rock Lake in order for water quality standards to be met. This does not translate to 30-40% reduction of each source, since consideration must be given to many factors including computing delivered versus generated loads and the final baseline for making allocations.

2. Lake managers for decades have used the technique of limiting phosphorus in fresh water lakes to obtain the desired algae levels. He agreed that the calibrated models can be used to examine this scenario and that it will be evaluated. In regards to why the

trend in recent years has been to limit nitrogen and phosphorus in fresh water lakes, it was implied that EPA has concerns that uncontrolled nitrogen may be a problem at some point farther downstream than the subject lake. This is not particularly convincing considering the cost of nitrogen removal and since nitrogen is naturally removed by biological/physical processes in fresh water systems without adverse consequences. The fact that coastal estuaries and marine systems are often controlled by nitrogen seems to be the focus of this policy; however, High Rock Lake is far removed from coastal waters.

3. The BOD load to High Rock Lake might need to be reduced to avoid causing dissolved oxygen violations. This issue also generates uncertainty into the future effluent limits for BOD, $NH_3$-N, and DO. His recommendation at this point is to start performing long-term BOD testing in the stream and effluents upstream of the lake. The type of long-term BOD testing recommended includes measuring nitrogen series at various points in time from the BOD samples. This would be an issue for the Stakeholders Group to discuss with EPA and DWQ. No specific effluent BOD and $NH_3$-N limits for the future were concluded from this discussion; however, it was recommended that both WWTPs have a well nitrified effluent and potential for high level BOD removal.

## Meetings with DWQ

In the course of this study, two meetings were held with DWQ and considerable other communications concerning various aspects of potential future effluent limits. The first meeting was held on May 7, 2009 with Steve Tedder of the Winston Salem DWQ office along with representatives of CCUC and CDM. Steve provided insights into the staff in the Raleigh DWQ office that will be involved in future effluent nutrient limit decisions and the general process that will be followed to render these decisions. There was also a discussion that a phosphorus only limit option should be considered in the modeling scenarios as part of the TMDL development.

As a follow up to the meeting held with the Winston Salem DWQ office, a second meeting was held with DWQ in Raleigh on May 8, 2009. Present at the meeting for DWQ were Chuck Wakild (Deputy Director), Alan Clark (Planning Section Chief), Kathy Stecker (Modeling and TMDL Unit), Tom Belnick (Western NPDES Program) and Jeffrey Poupart (Point Source Branch) along with representatives of CCUC and CDM. DWQ confirmed the expected date for the High Rock water quality models to be completed is 2010, and the TMDL and allocations could be finalized as early as 2012 for inclusion in the round of NPDES permits that are due to be issued in 2014 . Based on information available at the time as well as completed and ongoing models and TMDL development in other similar basins in North Carolina, DWQ speculated that future effluent limits for CCUC could be as low as 3.0 mg/L TN and 0.5 mg/L TP. There was also discussion that a future phosphorus only limit scenario

should be considered for the modeling and TMDL development for High Rock Lake, and DWQ agreed that this would be appropriate.

DWQ also stated that the Chlorophyll a standards, that are the basis for nutrient limits in lakes, are under consideration for change. DWQ interprets the 40 ug/l Chlorophyll a standard applicable to High Rock Lake as a not to exceed at any time or any place standard. It was pointed out by CDM representative Mike McGhee, who was involved in the development and adoption process of that standard in the late 1970's, that this was not the technical intent or derivation of the standard by those involved in its development. At the request of DWQ, Mr. McGhee forwarded a copy of a paper he presented in 1982 at a technical conference which documented that the standard was intended to be a growing season average for the lake, and not an any time/any place value. It is unclear at this time if this document will affect the future use of the Chlorophyll a standard or how EPA will relate the model outputs to the water quality standard.

Another discussion that began at the meeting in Raleigh and concluded after further email correspondence with DWQ related to how DWQ would allocate loads to point sources. There was concern that facilities that were already achieving some level of nutrient removal may not get credit for this removal with future allocations. After evaluating several different methods of allocating loads, email correspondence received from DWQ on May 26, 2009 stated that the baseline for making allocations would be based on using full permitted flows at each facility. This would provide credit for facilities which achieved reductions early. In essence, all large municipal facilities would have the same concentration allocation at full permitted flows. These concentration allocations will need to be converted into mass loading limitations for the permits so that a bubble permit limit can be developed. A bubble permit limit would provide for the total mass nutrient allocations to be met under an umbrella for the sum of the Archie Elledge and Muddy Creek WWTPs. DWQ indicated their willingness to handle the limits in this manner.

## Target Effluent Limits

Considering all the above discussions, CCUC and CDM concluded that three target nutrient limit scenarios should be used for development of process options and wastewater management alternatives. These three scenarios are shown in Table 1.

**Table 1 – WWTP Effluent Nutrient Limit Scenarios**

| Scenario | TN (mg/L) | TP (mg/L) |
|---|---|---|
| 1 | 3.0 | 0.5 |
| 2 | 5.0 | 0.5 |
| 3 | 0 | 0.2 |

These concentrations would apply at the current permitted flows and can be adjusted for each facility as long as the mass of the nutrients for the sum of both facilities is maintained. Also, the mass limits will remain the same if the WWTP permitted flows are increased.

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Jon Southern, CCUC
Mike McGhee, CDM
Sean Scuras, CDM
Laurin Kennedy, CDM

# Appendix B
# Process Options Scoring Rationale

# Muddy Creek WWTP
# Scenario 1: TN 3.0 mg/L, TP 0.5 mg/L

| Capital Cost | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 3 | Requires new DN filters, less aeration basin mods/new tankage |
| 2: Step Feed/DN Filters/Chem P | 2 | Requires new DN filters, more aeration basin mods/new tankage |
| 3: 4 Stage Bardenpho/Chem P | 5 | Requires less aeration basin mods/new tankage, nonbio filters |
| 4: 5 Stage Bardenpho/Chem P | 4 | Requires moderate aeration basin mods/new tankage, nonbio filters |

| Dependable Compliance | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 5 | Simplest bio process, stable need for carbon feed |
| 2: Step Feed/DN Filters/Chem P | 2 | Most complex bioprocess, stable need for carbon feed |
| 3: 4 Stage Bardenpho/Chem P | 4 | Need for carbon feed varies w/ endogenous denitrification performance |
| 4: 5 Stage Bardenpho/Chem P | 2 | Need for carbon feed varies w/ endogenous denitrification performance, least reliable on TP because of bio P aspect |

| Feasibility | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 5 | Most feasible |
| 2: Step Feed/DN Filters/Chem P | 2 | Least feasible |
| 3: 4 Stage Bardenpho/Chem P | 4 | Moderately feasible |
| 4: 5 Stage Bardenpho/Chem P | 3 | Less moderately feasible |

| Full Scale Operation History | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 4 | MLE is most common process, DN filter moderately common |
| 2: Step Feed/DN Filters/Chem P | 2 | Step feed is least common process |
| 3: 4 Stage Bardenpho/Chem P | 3 | Bardenpho process is moderately common |
| 4: 5 Stage Bardenpho/Chem P | 3 | Bardenpho process is moderately common |

| Phasing Potential | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 4 | DN filters allow phasing up to highest level of N removal |
| 2: Step Feed/DN Filters/Chem P | 4 | DN filters allow phasing up to highest level of N removal |
| 3: 4 Stage Bardenpho/Chem P | 2 | Little phasing opportunity |
| 4: 5 Stage Bardenpho/Chem P | 2 | Little phasing opportunity |

| Process Flexibility | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 3 | Moderate flexibility on N |
| 2: Step Feed/DN Filters/Chem P | 5 | Greatest flexibility on N and P |
| 3: 4 Stage Bardenpho/Chem P | 2 | Little flexibility on N removal |
| 4: 5 Stage Bardenpho/Chem P | 3 | Most flexibility with P removal, little flexibility on N removal |

| Ease of O&M | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 3 | Multi bioprocess, moderate control decisions |
| 2: Step Feed/DN Filters/Chem P | 2 | Multi bioprocess, bio P adds complexity, most control decisions |
| 3: 4 Stage Bardenpho/Chem P | 5 | Single bio process, fewest control decisions |
| 4: 5 Stage Bardenpho/Chem P | 3 | Single bioprocess, bio P adds complexity, moderate control decisions |

| Compatibility with Existing Facilities | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 3 | Minor mods to existing plus DN filters |
| 2: Step Feed/DN Filters/Chem P | 1 | Most mods to existing plus DN filters |
| 3: 4 Stage Bardenpho/Chem P | 4 | Minor mods to existing plus filters |
| 4: 5 Stage Bardenpho/Chem P | 2 | Moderate mods to existing plus filters |

| Energy Requirements | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 1 | Pumping onto DN filters, greatest increase in solids pumping |
| 2: Step Feed/DN Filters/Chem P | 2 | Pumping onto DN filters, moderate increase in solids pumping |
| 3: 4 Stage Bardenpho/Chem P | 3 | More infl BOD removed with nitrate (avoided oxygen), moderate increase in solids pumping |
| 4: 5 Stage Bardenpho/Chem P | 4 | More infl BOD removed with nitrate (avoided oxygen), least increase in solids pumping |

| Residuals Quantity | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 2 | All chem P, moderate carbon feed adds BOD |
| 2: Step Feed/DN Filters/Chem P | 3 | Little chem. P, moderate carbon feed |
| 3: 4 Stage Bardenpho/Chem P | 3 | All chem. P, little carbon feed |
| 4: 5 Stage Bardenpho/Chem P | 4 | Little chem P, little carbon feed |

| Impact on Pellets | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 2 | Most metal addition to pellets |
| 2: Step Feed/DN Filters/Chem P | 4 | Little metal addition to pellets |
| 3: 4 Stage Bardenpho/Chem P | 2 | Most metal addition to pellets |
| 4: 5 Stage Bardenpho/Chem P | 4 | Little metal addition to pellets |

| Community Impacts | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 3 | Second most construction, most chemical delivery traffic |
| 2: Step Feed/DN Filters/Chem P | 2 | Most construction, second most chemical delivery traffic |
| 3: 4 Stage Bardenpho/Chem P | 5 | Least construction, second least chemical delivery traffic |
| 4: 5 Stage Bardenpho/Chem P | 4 | Second least construction, least chemical delivery traffic |

| Chemical Requirements | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 2 | Most chemical required |
| 2: Step Feed/DN Filters/Chem P | 3 | Second most chemical required |
| 3: 4 Stage Bardenpho/Chem P | 4 | Second least chemical required |
| 4: 5 Stage Bardenpho/Chem P | 5 | Least chemical required |

| Construction Complexity | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 4 | Fewest recycles/baffling, DN filters |
| 2: Step Feed/DN Filters/Chem P | 2 | Multi recycles, DN filters |
| 3: 4 Stage Bardenpho/Chem P | 5 | Fewest recycles/baffling, simple filters |
| 4: 5 Stage Bardenpho/Chem P | 4 | Moderate recycles/baffling, simple filters |

| Land Area Requirements | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 3 | Second most additional tankage required |
| 2: Step Feed/DN Filters/Chem P | 2 | Most additional tankage required |
| 3: 4 Stage Bardenpho/Chem P | 5 | Least additional tankage required |
| 4: 5 Stage Bardenpho/Chem P | 4 | Second least additional tankage required |

# Muddy Creek WWTP
# Scenario 2: TN 5.0 mg/L (Muddy 8.0 mg/L), TP 0.5 mg/L

| Capital Cost | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/Chem P | 5 | Less aeration basin mods/new tankage, nonbio filters |
| 2: Step Feed/Chem P | 2 | Most aeration basin mods/new tankage, nonbio filters |
| 3: $A^2O$/Chem P | 4 | Moderate aeration basin mods/new tankage, nonbio filters |

| Dependable Compliance | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/Chem P | 5 | Simplest bio process |
| 2: Step Feed/Chem P | 3 | Moderately complex bioprocess |
| 3: $A^2O$/Chem P | 3 | Moderately complex bioprocess |

| Feasibility | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/Chem P | 5 | Most feasible |
| 2: Step Feed/Chem P | 3 | Least feasible |
| 3: $A^2O$/Chem P | 4 | Moderately feasible |

| Full Scale Operation History | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/Chem P | 5 | MLE is most common process |
| 2: Step Feed/Chem P | 2 | Step feed is least common process |
| 3: $A^2O$/Chem P | 3 | $A^2O$ process is moderately common |

| Phasing Potential | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/Chem P | 2 | Little phasing potential |
| 2: Step Feed/Chem P | 2 | Little phasing potential |
| 3: $A^2O$/Chem P | 2 | Little phasing potential |

| Process Flexibility | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/Chem P | 3 | Moderate flexibility on N |
| 2: Step Feed/Chem P | 4 | Greatest flexibility on N |
| 3: $A^2O$/Chem P | 2 | Least flexibility on N and P |

| Ease of O&M | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/Chem P | 5 | Single bioprocess, few control decisions |
| 2: Step Feed/Chem P | 2 | Multistage bioprocess, bio P adds complexity, most control decisions |
| 3: $A^2O$/Chem P | 3 | Multistage bioprocess, bio P adds complexity, many control decisions |

| Compatibility with Existing Facilities | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/Chem P | 4 | Few mods to existing plus filters |
| 2: Step Feed/Chem P | 2 | Extensive mods to existing plus filters |
| 3: $A^2O$/Chem P | 3 | Moderate mods to existing plus filters |

| Energy Requirements | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/Chem P | 4 | Some recycle pumping |
| 2: Step Feed/Chem P | 2 | Most pumping w/ bioP |
| 3: $A^2O$/Chem P | 3 | More recycle pumping |

| Residuals Quantity | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/Chem P | 2 | All chem P |
| 2: Step Feed/Chem P | 4 | Little chem. P |
| 3: $A^2O$/Chem P | 4 | Little chem. P |

| Impact on Pellets | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/Chem P | 2 | Most metal addition to pellets |
| 2: Step Feed/Chem P | 4 | Little metal addition to pellets |
| 3: $A^2O$/Chem P | 4 | Little metal addition to pellets |

| Community Impacts | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/Chem P | 3 | Least construction, most chemical delivery traffic |
| 2: Step Feed/Chem P | 2 | Most construction, little chemical delivery traffic |
| 3: $A^2O$/Chem P | 4 | Moderate construction, little chemical delivery traffic |

| Chemical Requirements | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/Chem P | 2 | Most chemical required |
| 2: Step Feed/Chem P | 4 | Little chemical required |
| 3: $A^2O$/Chem P | 4 | Little chemical required |

| Construction Complexity | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/Chem P | 4 | Fewest recycles/baffling |
| 2: Step Feed/Chem P | 2 | Multi recycles/baffling |
| 3: $A^2O$/Chem P | 3 | Moderate recycles/baffling |

| Land Area Requirements | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/Chem P | 5 | Least additional tankage required |
| 2: Step Feed/Chem P | 3 | Most additional tankage required |
| 3: $A^2O$/Chem P | 4 | Moderate additional tankage required |

# Muddy Creek WWTP
# Scenario 3: TN n/a, TP 0.2 mg/L

| Capital Cost | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: Chem P | 5 | No aeration basin mods, nonbio filters |
| 2: $A^2O$/Chem P | 3 | Moderate aeration basin mods/new tankage, nonbio filters |

| Dependable Compliance | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: Chem P | 5 | Very simple |
| 2: $A^2O$/Chem P | 3 | Moderately complex bioprocess |

| Feasibility | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: Chem P | 5 | Most feasible |
| 2: $A^2O$/Chem P | 2 | DN necessary just to facilitate bioP |

| Full Scale Operation History | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: Chem P | 5 | Very common |
| 2: $A^2O$/Chem P | 3 | Much less common |

| Phasing Potential | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: Chem P | 2 | Little phasing potential |
| 2: $A^2O$/Chem P | 2 | Little phasing potential |

| Process Flexibility | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: Chem P | 5 | Great flexibility |
| 2: $A^2O$/Chem P | 2 | Little flexibility |

| Ease of O&M | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: Chem P | 5 | Easy to operate |
| 2: $A^2O$/Chem P | 2 | Multistage bioprocess, bio P adds complexity, many control decisions |

| Compatibility with Existing Facilities | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: Chem P | 4 | Few mods to existing plus filters |
| 2: $A^2O$/Chem P | 2 | Moderate mods to existing plus filters |

| Energy Requirements | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: Chem P | 2 | Increased sludge transfer pumping |
| 2: $A^2O$/Chem P | 2 | Recycle pumping |

| Residuals Quantity | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: Chem P | 2 | All chem P |
| 2: $A^2O$/Chem P | 4 | Little chem. P |

| Impact on Pellets | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: Chem P | 2 | Most metal addition to pellets |
| 2: $A^2O$/Chem P | 4 | Little metal addition to pellets |

| Community Impacts | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: Chem P | 3 | Least construction, most chemical delivery traffic |
| 2: $A^2O$/Chem P | 3 | Moderate construction, little chemical delivery traffic |

| Chemical Requirements | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: Chem P | 2 | Most chemical required |
| 2: $A^2O$/Chem P | 4 | Little chemical required |

| Construction Complexity | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: Chem P | 5 | Separate process |
| 2: $A^2O$/Chem P | 2 | Moderate recycles/baffling, mods to existing aeration basins |

| Land Area Requirements | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: Chem P | 4 | Filters required |
| 2: $A^2O$/Chem P | 2 | Filters required, tankage required for anoxic/anaerobic |

# Elledge WWTP
# Scenario 1: TN 3.0 mg/L, TP 0.5 mg/L
# Scenario 2: TN 5.0 mg/L (Elledge 3.0 mg/L), TP 0.5 mg/L

| Capital Cost | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 3 | Requires new DN filters, less aeration basin mods/new tankage |
| 2: Step Feed/DN Filters/Chem P | 2 | Requires new DN filters, moderate aeration basin mods/new tankage |
| 3: 4 Stage Bardenpho/Chem P | 5 | Requires less aeration basin mods/new tankage, nonbio filters |
| 4: 5 Stage Bardenpho/Chem P | 4 | Requires moderate aeration basin mods/new tankage, nonbio filters |

| Dependable Compliance | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 5 | Simplest bio process, stable need for carbon feed |
| 2: Step Feed/DN Filters/Chem P | 2 | Most complex bioprocess, stable need for carbon feed |
| 3: 4 Stage Bardenpho/Chem P | 4 | Need for carbon feed varies w/ endogenous denitrification performance |
| 4: 5 Stage Bardenpho/Chem P | 2 | Need for carbon feed varies w/ endogenous denitrification performance, least reliable on TP because of bio P aspect |

| Feasibility | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 5 | Most feasible |
| 2: Step Feed/DN Filters/Chem P | 4 | Moderately feasible |
| 3: 4 Stage Bardenpho/Chem P | 4 | Moderately feasible |
| 4: 5 Stage Bardenpho/Chem P | 3 | Least feasible |

| Full Scale Operation History | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 4 | MLE is most common process, DN filter moderately common |
| 2: Step Feed/DN Filters/Chem P | 2 | Step feed is least common process |
| 3: 4 Stage Bardenpho/Chem P | 3 | Bardenpho process is moderately common |
| 4: 5 Stage Bardenpho/Chem P | 3 | Bardenpho process is moderately common |

| Phasing Potential | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 4 | DN filters allow phasing up to highest level of N removal |
| 2: Step Feed/DN Filters/Chem P | 4 | DN filters allow phasing up to highest level of N removal |
| 3: 4 Stage Bardenpho/Chem P | 2 | Little phasing opportunity |
| 4: 5 Stage Bardenpho/Chem P | 2 | Little phasing opportunity |

| Process Flexibility | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 3 | Moderate flexibility on N |
| 2: Step Feed/DN Filters/Chem P | 5 | Greatest flexibility on N and P |
| 3: 4 Stage Bardenpho/Chem P | 2 | Little flexibility on N removal |
| 4: 5 Stage Bardenpho/Chem P | 3 | Most flexibility with P removal, little flexibility on N removal |

| Ease of O&M | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 3 | Multi bioprocess, moderate control decisions |
| 2: Step Feed/DN Filters/Chem P | 2 | Multi bioprocess, bio P adds complexity, most control decisions |
| 3: 4 Stage Bardenpho/Chem P | 5 | Single bio process, fewest control decisions |
| 4: 5 Stage Bardenpho/Chem P | 3 | Single bioprocess, bio P adds complexity, moderate control |

| | | |
|---|---|---|
| | | decisions |

| Compatibility with Existing Facilities | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 3 | Minor mods to existing plus DN filters |
| 2: Step Feed/DN Filters/Chem P | 1 | Moderate mods to existing plus DN filters |
| 3: 4 Stage Bardenpho/Chem P | 4 | Minor mods to existing plus filters |
| 4: 5 Stage Bardenpho/Chem P | 2 | Moderate mods to existing plus filters |

| Energy Requirements | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 2 | Pumping onto DN filters |
| 2: Step Feed/DN Filters/Chem P | 2 | Pumping onto DN filters |
| 3: 4 Stage Bardenpho/Chem P | 4 | More infl BOD removed with nitrate (avoided oxygen) |
| 4: 5 Stage Bardenpho/Chem P | 4 | More infl BOD removed with nitrate (avoided oxygen) |

| Residuals Quantity | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 2 | All chem P, moderate carbon feed adds BOD |
| 2: Step Feed/DN Filters/Chem P | 3 | Little chem. P, moderate carbon feed |
| 3: 4 Stage Bardenpho/Chem P | 3 | All chem. P, little carbon feed |
| 4: 5 Stage Bardenpho/Chem P | 4 | Little chem P, little carbon feed |

| Impact on Pellets | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 2 | Most metal addition to pellets |
| 2: Step Feed/DN Filters/Chem P | 4 | Little metal addition to pellets |
| 3: 4 Stage Bardenpho/Chem P | 2 | Most metal addition to pellets |
| 4: 5 Stage Bardenpho/Chem P | 4 | Little metal addition to pellets |

| Community Impacts | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 3 | Second most construction, most chemical delivery traffic, most additional solids hauling |
| 2: Step Feed/DN Filters/Chem P | 2 | Most construction, second most chemical delivery traffic, moderate increase in solids hauling |
| 3: 4 Stage Bardenpho/Chem P | 5 | Least construction, second least chemical delivery traffic, moderate increase in solids hauling |
| 4: 5 Stage Bardenpho/Chem P | 4 | Second least construction, least chemical delivery traffic, least increase in solids hauling |

| Chemical Requirements | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 2 | Most chemical required |
| 2: Step Feed/DN Filters/Chem P | 3 | Second most chemical required |
| 3: 4 Stage Bardenpho/Chem P | 4 | Second least chemical required |
| 4: 5 Stage Bardenpho/Chem P | 5 | Least chemical required |

| Construction Complexity | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 4 | Fewest recycles/baffling, DN filters |
| 2: Step Feed/DN Filters/Chem P | 2 | Multi recycles, DN filters |
| 3: 4 Stage Bardenpho/Chem P | 5 | Fewest recycles/baffling, simple filters |
| 4: 5 Stage Bardenpho/Chem P | 4 | Moderate recycles/baffling, simple filters |

| Land Area Requirements | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: MLE/DN Filters/Chem P | 3 | Second most additional tankage required |
| 2: Step Feed/DN Filters/Chem P | 2 | Most additional tankage required |

| | | |
|---|---|---|
| *3: 4 Stage Bardenpho/Chem P* | *5* | *Least additional tankage required* |
| *4: 5 Stage Bardenpho/Chem P* | *4* | *Second least additional tankage required* |

# Elledge WWTP
# Scenario 3: TN n/a, TP 0.2 mg/L

| ***Capital Cost*** | | |
|---|---|---|
| ***Alternative*** | ***Score*** | ***Basis*** |
| *1: Chem P* | *5* | *No aeration basin mods, nonbio filters* |
| *2: $A^2O$/Chem P* | *3* | *Moderate aeration basin mods/new tankage, nonbio filters* |

| ***Dependable Compliance*** | | |
|---|---|---|
| ***Alternative*** | ***Score*** | ***Basis*** |
| *1: Chem P* | *5* | *Very simple* |
| *2: $A^2O$/Chem P* | *3* | *Moderately complex bioprocess* |

| ***Feasibility*** | | |
|---|---|---|
| ***Alternative*** | ***Score*** | ***Basis*** |
| *1: Chem P* | *5* | *Most feasible* |
| *2: $A^2O$/Chem P* | *2* | *DN necessary just to facilitate bioP* |

| ***Full Scale Operation History*** | | |
|---|---|---|
| ***Alternative*** | ***Score*** | ***Basis*** |
| *1: Chem P* | *5* | *Very common* |
| *2: $A^2O$/Chem P* | *3* | *Much less common* |

| ***Phasing Potential*** | | |
|---|---|---|
| ***Alternative*** | ***Score*** | ***Basis*** |
| *1: Chem P* | *2* | *Little phasing potential* |
| *2: $A^2O$/Chem P* | *2* | *Little phasing potential* |

| ***Process Flexibility*** | | |
|---|---|---|
| ***Alternative*** | ***Score*** | ***Basis*** |
| *1: Chem P* | *5* | *Great flexibility* |
| *2: $A^2O$/Chem P* | *2* | *Little flexibility* |

| ***Ease of O&M*** | | |
|---|---|---|
| ***Alternative*** | ***Score*** | ***Basis*** |
| *1: Chem P* | *5* | *Easy to operate* |
| *2: $A^2O$/Chem P* | *2* | *Multistage bioprocess, bio P adds complexity, many control decisions* |

| ***Compatibility with Existing Facilities*** | | |
|---|---|---|
| ***Alternative*** | ***Score*** | ***Basis*** |
| *1: Chem P* | *4* | *Few mods to existing plus filters* |
| *2: $A^2O$/Chem P* | *2* | *Moderate mods to existing plus filters* |

| ***Energy Requirements*** | | |
|---|---|---|
| ***Alternative*** | ***Score*** | ***Basis*** |
| *1: Chem P* | *2* | *Increased sludge dewatering/drying* |
| *2: $A^2O$/Chem P* | *3* | *Recycle pumping* |

| ***Residuals Quantity*** | | |
|---|---|---|
| ***Alternative*** | ***Score*** | ***Basis*** |
| *1: Chem P* | *2* | *All chem P* |
| *2: $A^2O$/Chem P* | *4* | *Little chem. P* |

| Impact on Pellets | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: Chem P | 2 | Most metal addition to pellets |
| 2: $A^2O$/Chem P | 4 | Little metal addition to pellets |

| Community Impacts | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: Chem P | 2 | Least construction, most chemical delivery traffic, more sludge hauling |
| 2: $A^2O$/Chem P | 3 | Moderate construction, little chemical delivery traffic |

| Chemical Requirements | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: Chem P | 2 | Most chemical required |
| 2: $A^2O$/Chem P | 4 | Little chemical required |

| Construction Complexity | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: Chem P | 5 | Separate process |
| 2: $A^2O$/Chem P | 2 | Moderate recycles/baffling, mods to existing aeration basins |

| Land Area Requirements | | |
|---|---|---|
| **Alternative** | **Score** | **Basis** |
| 1: Chem P | 4 | Filters required |
| 2: $A^2O$/Chem P | 2 | Filters required, tankage required for anoxic/anaerobic |

# Appendix C
# Wastewater Treatment Alternatives Process Summaries

**Alternative 1 – AEWWTP**

a. 2030 conditions -45.8 mgd ADMM

i. Influent Loading Comparison

| | Units | From Spreadsheet Per Capita Calcs | Blended Influent from Biowin |
|---|---|---|---|
| BOD5 | lb/d | 123,300 | 126,900 |
| TSS | lb/d | 95,000 | 92,200 |
| TKN | lb/d | 16,500 | 17,100 |
| TP | lb/d | 3,100 | 3,800 |

ii. Permit scenario 1 – 3 mg/L TN and 0.5 mg/L TP

1. Reactor sizing – Based on 3,800 mg/L MLSS and aerobic SRT of 8 days.

| | Units | Basins 1-2 | Basins 3-6 |
|---|---|---|---|
| 1st Anoxic Zone A | MG | 0.32 | 0.57 |
| 1st Anoxic Zone B | MG | 0.24 | 0.43 |
| 1st Anoxic Zone C | MG | 1.01 | 1.80 |
| Swing Zone | MG | 0.68 | 1.22 |
| Aeration | MG | 6.84 | 12.21 |
| 2nd Anoxic | MG | 2.00 | 3.57 |
| Reaeration | MG | 0.17 | 0.31 |
| Total | MG | 11.26 | 20.11 |

2. Effluent Summary at 15C, 8 day aerobic SRT

| | Units | Conc |
|---|---|---|
| BOD5 | mg/L | 2.3 |
| TSS | mg/L | 3.8 |
| TN | mg/L | 2.9 |
| TP | mg/L | 0.32 |

3. One new primary clarifier (overflow rate at PHF approaching 3000 gpd/sf)

4. Air systems (assumes a 35/65% split):

| | Units | Basins 1 and 2 | Basins 3-6 |
|---|---|---|---|
| Diffuser depth | ft | 13.5 | 19 |
| Alpha | --- | 0.60 | 0.60 |

| | | | |
|---|---|---|---|
| AOR | lb/d | 45,800 | 84,900 |
| AOR/SOR | --- | 0.43 | 0.44 |
| SOR | lb/d | 108,000 | 194,200 |
| Scfm req | cfm | 16,800 | 21,500 |
| Acfm req | cfm | 20,100 | 24,000 |
| Firm bhp req | bhp | 910 | 1,220 |

5. Increase RAS pumping capacity to 46 mgd ADF.

6. Internal recycle of 400% to 500% of ADMM capacity.

7. Tertiary filters.

8. Chemical feed systems (methanol and alum).

9. 7th secondary clarifier.

10. Chemical phosphorus removal requirements

| | Units | |
|---|---|---|
| Phosphorus removed | lb/d | 2,600 |
| Molar ratio (Al:P) | --- | 2.4 |
| Alum ion dose | lb/d | 5,600 |
| Alum dose | lb/d | 61,000 |
| Alum solution req (48%) | gpd | 11,500 |

11. Verification of solids handling capacity –

    a. Model predicting 48,000 lb/d of primary sludge @ 2.5% and 58,000 lb/d of WAS (all biological sludge) @ 0.61%.

    b. Spreadsheet predicting 49,800 lb/d of primary sludge and 77,000 lb/d (56,200 lb/d of biological sludge and 20,800 lb/d of chemical sludge).

**Alternative 2 – AEWWTP**

a. 2030 conditions -35.2 mgd ADMM

    i. Influent Loading Comparison

| | Units | From Spreadsheet Per Capita Calcs | Blended Influent from Biowin |
|---|---|---|---|
| BOD5 | lb/d | 104,200 | 106,500 |
| TSS | lb/d | 74,500 | 70,000 |
| TKN | lb/d | 13,500 | 13,500 |
| TP | lb/d | 3,400 | 3,100 |

ii. Permit scenario 1 – 3 mg/L TN and 0.5 mg/L TP

1. Reactor sizing – Basins 1-6 required along based on 3,000 mg/L MLSS and aerobic SRT of 8 days.

| | Units | Basins 1-2 | Basins 1-2 |
|---|---|---|---|
| 1st Anoxic Zone A | MG | 0.32 | 0.57 |
| 1st Anoxic Zone B | MG | 0.30 | 0.54 |
| 1st Anoxic Zone C | MG | 1.21 | 2.13 |
| Swing Zone | MG | 0.65 | 1.17 |
| Aeration | MG | 6.53 | 11.68 |
| 2nd Anoxic | MG | 2.12 | 3.77 |
| Reaeration | MG | -0.13 | 0.23 |
| Total | MG | 11.25 | 20.1 |

2. Effluent Summary at 15C, 8 day aerobic SRT

| | Units | Conc |
|---|---|---|
| BOD5 | mg/L | 2.2 |
| TSS | mg/L | 3.1 |
| TN | mg/L | 3.0 |
| TP | mg/L | 0.34 |

3. Air systems

| | Units | Basins 1 and 2 | Basins 3-6 |
|---|---|---|---|
| Diffuser depth | ft | 13.5 | 19 |
| Alpha | --- | 0.60 | 0.60 |
| AOR | lb/d | 36,600 | 67,900 |
| AOR/SOR | --- | 0.43 | 0.44 |
| SOR | lb/d | 85,600 | 156,000 |
| Scfm req | cfm | 13,300 | 17,300 |
| Acfm req | cfm | 16,000 | 19,200 |
| Firm bhp req | bhp | 721 | 980 |

4. Increase RAS pumping capacity to 35 mgd ADF.

5. Internal recycle of 400% to 500% of ADMM capacity.

6. Tertiary filters.

7. Chemical feed systems (methanol and alum).

8. Chemical phosphorus removal requirements

| | Units | |
|---|---|---|
| Phosphorus removed | lb/d | 2,100 |
| Molar ratio (Al:P) | --- | 2.4 |
| Alum ion dose | lb/d | 4,300 |
| Alum dose | lb/d | 47,700 |
| Alum solution req (48%) | gpd | 9,000 |

9. Verification of solids handling capacity *(note model is predicting bio-P and no chemical use, hence the decrease in sludge from the model)* –

    c. Model predicting 41,300 lb/d of primary sludge @ 2.2% and 44,200 lb/d of WAS (all biological sludge) @ 0.67%.

    d. Spreadsheet predicting 43,000 lb/d of primary sludge and 57,500 lb/d (42,000 lb/d of biological sludge and 15,500 lb/d of chemical sludge).

**Alternative 3 – AEWWTP**

i. Permit Scenario II –0.2 mg/L TP

1. Modeling not used. Assumed 8 day SRT @ 2500 mg/L MLSS, 15C. Aerobic volume required is 30.4 MG. Basins 1-6 could be used along with the existing secondary clarifiers.

2. One new primary clarifier needed (overflow rate at PHF approaching 3000 gpd/sf)

3. Air systems (assumes a 35/65% split)

| | Units | Basins 1 and 2 | Basins 3-6 |
|---|---|---|---|
| Diffuser depth | ft | 13.5 | 19 |
| Alpha | --- | 0.60 | 0.60 |
| AOR | lb/d | 54,400 | 101,000 |
| AOR/SOR | --- | 0.43 | 0.44 |
| SOR | lb/d | 128,500 | 231,100 |

| | | | |
|---|---|---|---|
| Scfm req | cfm | 20,000 | 25,600 |
| Acfm req | cfm | 24,000 | 28,500 |
| Firm bhp req | bhp | 1,100 | 1,451 |

4. Increase capacity of RAS pumps (46 mgd firm capacity, recommend 100% recycle)

5. Chemical phosphorus removal requirements

| | Units | |
|---|---|---|
| Phosphorus removed | lb/d | 2,770 |
| Molar ratio (Al:P) | --- | 3.0 |
| Alum ion dose | lb/d | 7,240 |
| Alum dose | lb/d | 79,600 |
| Alum solution req (48%) | gpd | 15,000 |

6. Verification of solids handling capacity –

    a. Model predicting mostly removal is through bio-P, therefore not used.

    b. Spreadsheet predicting 48,000 lb/d of primary sludge and 81,000 lb/d (56,200 lb/d of biological sludge and 24,800 lb/d of chemical sludge).

**Alternative 4 – Elledge WWTP**

i. Permit Scenario II –0.2 mg/L TP

1. Modeling not used. Assumed 8 day SRT @ 2900 mg/L MLSS, 15C. Aerobic volume required is 20.10 MG. Basins 3-6 could be used along with the existing secondary clarifiers.

2. Air systems:

| | Units | Basins 1 and 2 | Basins 3-6 |
|---|---|---|---|
| Diffuser depth | ft | --- | 19 |
| Alpha | --- | --- | 0.60 |
| AOR | lb/d | --- | 125,600 |
| AOR/SOR | --- | --- | 0.44 |
| SOR | lb/d | --- | 288,500 |
| Scfm req | cfm | --- | 31,900 |
| Acfm req | cfm | --- | 35,600 |
| Firm bhp req | bhp | --- | 1,811 |

3. Increase capacity of RAS pumps (35 mgd firm capacity, recommend 100% recycle)

4. Chemical phosphorus removal requirements

| | Units | |
|---|---|---|
| Phosphorus removed | lb/d | 2,100 |
| Molar ratio (Al:P) | --- | 3.0 |
| Alum ion dose | lb/d | 5,500 |
| Alum dose | lb/d | 60,900 |
| Alum solution req (48%) | gpd | 11,400 |

5. Verification of solids handling capacity –

    a. Model predicting mostly removal is through bio-P, therefore not used.

    b. Spreadsheet predicting 43,000 lb/d of primary sludge and 61,000 lb/d (42,000 lb/d of biological sludge and 19,000 lb/d of chemical sludge).

**Alternative 1 - MCWWTP**

a. 2030 conditions -21 mgd ADMM

i. Permit scenario 1 – 3 mg/L TN and 0.5 mg/L TP

1. Reactor sizing – Based on 8 day aerobic SRT at MLSS of 3500 mg/L, 15C. Construct an additional 3.03 MG of tankage and convert system to 4-stage Bardenpho with the following volumes:

| | Units | Volume |
|---|---|---|
| 1st Anoxic Zone A | MG | 0.29 |
| 1st Anoxic Zone B | MG | 0.27 |
| 1st Anoxic Zone C | MG | 1.40 |
| Swing Zone | MG | 0.59 |
| Aeration | MG | 5.85 |
| 2nd Anoxic | MG | 2.13 |
| Reaeration | MG | 0.22 |
| Total | MG | 9.97 |

2. Influent loading comparison

| | Units | From Spreadsheet Per Capita Calcs | Blended Influent from Biowin |
|---|---|---|---|
| BOD5 | lb/d | 35,500 | 34,500 |
| TSS | lb/d | 38,300 | 38,900 |
| TKN | lb/d | 6,200 | 6,300 |
| TP | lb/d | 980 | 920 |

3. Effluent Summary at 15C, 8 day aerobic SRT at MLSS 3,500 mg/L

| | Units | Conc |
|---|---|---|
| BOD5 | mg/L | 3.4 |
| TSS | mg/L | 3.3 |
| TN | mg/L | 2.8 |
| TP | mg/L | 0.12 |

4. Add internal recycle flow capabilities of 400% to 500% of max month flow.

5. Increase capacity of RAS pumps (21 mgd firm capacity, recommend 100% recycle)

6. Add tertiary filters

7. Add chemical facilities (ferric/alum and supplemental carbon feed)

8. Air systems

| | Units | All basins |
|---|---|---|
| Diffuser depth | ft | 23.5 |
| Alpha | --- | 0.60 |
| AOR | lb/d | 41,700 |
| AOR/SOR | --- | 0.44 |
| SOR | lb/d | 94,500 |
| Scfm req | cfm | 8,500 |
| Acfm req | cfm | 10,100 |
| Firm bhp req | bhp | 686 |

9. Add 5th secondary clarifier at 110 ft diameter.

10. Chemical phosphorus removal requirements

| | Units | |
|---|---|---|
| Phosphorus removed | lb/d | 550 |
| Molar ratio (Al:P) | --- | 2.4 |
| Alum ion dose | lb/d | 1,270 |
| Alum dose | lb/d | 13,900 |
| Alum solution req (48%) | gpd | 2,600 |

11. Verification of solids handling capacity –

    a. Model predicting 23,300 lb/d of primary sludge @ 2.2% and 19,500 lb/d of WAS @ 0.60%.

    b. Spreadsheet predicting 22,100 lb/d of primary sludge and 22,100 lb/d of WAS.

**Alternative 2 - MCWWTP**

1. 31.6 mgd ADMM of capacity

   i. Permit scenario 1 – 3 mg/L TN and 0.5 mg/L TP

      1. Reactor sizing – Based on 8 day aerobic SRT at MLSS of 3700 mg/L, 15C. Construct 4 new 100' diameter primary clarifiers, 4 new secondary clarifiers @ 110' diameter and install a parallel biological process train

at 7.73 MG. Convert system to 4-stage Bardenpho with the following overall volumes:

| | Units | Volume |
|---|---|---|
| 1st Anoxic Zone A | MG | 0.44 |
| 1st Anoxic Zone B | MG | 0.42 |
| 1st Anoxic Zone C | MG | 0.90 |
| Swing Zone | MG | 0.95 |
| Aeration | MG | 9.47 |
| 2nd Anoxic | MG | 2.96 |
| Reaeration | MG | 0.33 |
| Total | MG | 15.47 |

2. Influent loading comparison

| | Units | From Spreadsheet Per Capita Calcs | Blended Influent from Biowin |
|---|---|---|---|
| BOD5 | lb/d | 53,600 | 51,800 |
| TSS | lb/d | 56,800 | 58,400 |
| TKN | lb/d | 8,300 | 8,300 |
| TP | lb/d | 1,700 | 1,700 |

3. Effluent Summary at 15C, 8 day aerobic SRT at MLSS 3,500 mg/L

| | Units | Conc |
|---|---|---|
| BOD5 | mg/L | 3.3 |
| TSS | mg/L | 3.1 |
| TN | mg/L | 2.6 |
| TP | mg/L | 0.12 |

4. Add internal recycle flow capabilities of 400% to 500% of max month flow.
5. Increase RAS pumping capacity to 31.6 mgd.
6. Add tertiary filters
7. Add chemical facilities (ferric/alum and supplemental carbon feed)
8. Air systems:

| | Units | All basins |
|---|---|---|
| Diffuser depth | ft | 23.5 |
| Alpha | --- | 0.60 |
| AOR | lb/d | 96,900 |
| AOR/SOR | --- | 0.44 |
| SOR | lb/d | 219,500 |
| Scfm req | cfm | 19,600 |
| Acfm req | cfm | 23,500 |
| Firm bhp req | bhp | 1,594 |

9. Chemical phosphorus removal requirements

| | Units | |
|---|---|---|
| Phosphorus removed | lb/d | 1,040 |
| Molar ratio (Al:P) | --- | 2.4 |
| Alum ion dose | lb/d | 2,170 |
| Alum dose | lb/d | 23,800 |
| Alum solution req (48%) | gpd | 4,500 |

10. Verification of solids handling capacity –

    a. Model predicting 29,200 lb/d of primary sludge @ 2.2% and 35,400 lb/d of WAS @ 0.67%.

    b. Spreadsheet predicting 27,200 lb/d of primary sludge and 38,500 lb/d of WAS which includes 7,700 lb/d of alum sludge

**Alternative 3 - MCWWTP (21 mgd ADMM)**

i. Permit Scenario II –0.2 mg/L TP

1. Modeling not used. Assumed 8 day SRT @ 2850 mg/L MLSS, 15C. Aerobic volume required is 7.7 MG. Existing secondary clarifiers are at capacity. Recommend stress testing clarifiers to determine if 5$^{th}$ unit is needed.

2. Air systems:

| | Units | Basins 1 and 2 |
|---|---|---|
| Diffuser depth | ft | 23.5 |
| Alpha | --- | 0.60 |
| AOR | lb/d | 53,300 |
| AOR/SOR | --- | 0.44 |
| SOR | lb/d | 120,800 |

| | | |
|---|---|---|
| Scfm req | cfm | 10,800 |
| Acfm req | cfm | 12,900 |
| Firm bhp req | bhp | 877 |

3. Increase capacity of RAS pumps (21 mgd firm capacity, recommend 100% recycle)

4. Chemical phosphorus removal requirements

| | Units | |
|---|---|---|
| Phosphorus removed | lb/d | 640 |
| Molar ratio (Al:P) | --- | 3.0 |
| Alum ion dose | lb/d | 1,670 |
| Alum dose | lb/d | 18,400 |
| Alum solution req (48%) | gpd | 3,400 |

5. Verification of solids handling capacity –

   a. Spreadsheet predicting 22,100 lb/d of primary sludge and 23,600 lb/d of WAS.

**Alternative 4 - MCWWTP**

i. Permit Scenario II –0.2 mg/L TP

1. Modeling not used. Assumed 8 day SRT @ 2,400 mg/L MLSS, 15C. Construct 4 new 100' diameter primary clarifiers, 4 new secondary clarifiers @ 110' diameter and install a parallel biological process train at 7.73 MG.

2. Air systems:

| | Units | Basins 1 and 2 |
|---|---|---|
| Diffuser depth | ft | 23.5 |
| Alpha | --- | 0.60 |
| AOR | lb/d | 110,200 |
| AOR/SOR | --- | 0.44 |
| SOR | lb/d | 249,700 |
| Scfm req | cfm | 22,300 |
| Acfm req | cfm | 26,700 |
| Firm bhp req | bhp | 1,813 |

3. Increase RAS pumping capacity to 31.6 mgd.

4. Chemical phosphorus removal requirements

| | Units | |
|---|---|---|
| Phosphorus removed | lb/d | 1,100 |
| Molar ratio (Al:P) | --- | 3.0 |
| Alum ion dose | lb/d | 2,900 |
| Alum dose | lb/d | 31,400 |
| Alum solution req (48%) | gpd | 5,900 |

5. Verification of solids handling capacity –

   a. Spreadsheet predicting 27,200 lb/d of primary sludge and 40,600 lb/d of WAS of which 9800 lb/d is alum sludge.

# Appendix D
# Wastewater Treatment Alternatives Cost Opinions and Improvement Summaries

## ARCHIE ELLEDGE WWTP IMPROVEMENT ALTERNATIVE 3 SUMMARY

***Flow Option 1: 45.7 ADMM***
***Permit Scenario 2 - N/A TN and 0.2 mg/L TP***

***Major Improvement Needs:***

*Place aeration basins 1 and 2 in service;*
*Air requirement for all basins is 45,600 scfm;*
*Increase capacity of RAS pumps to 46 mgd (ADMM) firm capacity;*
*Add equalization;*
*Add tertiary filters;*
*Add chemical facilities;*
*Add one Primary Clarifier at 120 ft diameter;*
*Add GBT and TWAS pumping*
*Add Dryer and two Centrifuges*

Installation Cost 35%

### HEADWORKS

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Bar Screen | 3 | 50 mgd ea; 100 mgd firm; 3/8" spacing | 1 New | Match existing | 1 | EA | $400,000 | $540,000 |
| Screw Conveyor /Compactor | 3 | Shaftless screw; 304 ss; 14" auger; 5hp | 1 New | Match existing | 1 | EA | $260,000 | $351,000 |
| Primary Bldg | 1 | | 1 New | New 30' x 70' bldg (for headworks, grit removal and influent pumps) | 2,100 | SF | $500 | $1,050,000 |

### GRIT REMOVAL

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Grit Removal Units | 2 | Vortex; 20' diameter; 50 mgd each | 1 New | Match existing (Grit Equipment) | 1 | EA | $60,000 | $81,000 |
| | 2 | Vortex; 20' diameter; 50 mgd each | 1 New | Match existing (Concrete) | 1,500 | CY | $800 | $1,200,000 |
| Grit Pumps | 4 | Recessed impeller centrifugal; 500 gpm, 71 TDH, 40 hp | 2 New | Match existing | 2 | EA | $30,000 | $81,000 |
| Grit Classifier | 2 | 500 gpm | 1 New | Match existing | 1 | EA | $104,000 | $140,400 |

### INFLUENT PUMPING

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Influent Pumps | 6 | Vertical non-clog dry pit submersible; 2 @ 8,700 gpm, 86 ft TDH, 300 hp; 4 @17,400 gpm, 85 ft TDH, 600 hp | 2 New | Replace (2) exist. 12.5 mgd w/ 26 mgd | 2 | EA | $650,000 | $1,755,000 |
| | | | 4 Upgrade | Upgrade (4) exist. from 25 mgd to 26 mgd; 600 hp to 750 hp | 4 | EA | $71,000 | $383,400 |

## FLOW EQUALIZATION

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Daily EQ Basins | - | - | 2 New | Two new 1.5 million gallon prestressed concrete storage tanks. | 2 | EA | $750,000 | $1,500,000 |

## PRIMARY CLARIFICATION

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Primary Clarifier | 4 | 120 ft in diameter; 12 ft SWD; 25 mgd peak flow each. | 1 New | Match existing (Concrete) | 488 | CY | $600 | $292,800 |
| Primary Clarifier Mechanism | 4 | Center-feed; truss bridge walkway; rotating arms; solids collector; scum collection, etc. | 1 New | Match existing | 1 | EA | $400,000 | $540,000 |
| Scum Pumps | 4 | Chopper; Constant speed; 80 gpm, 21 TDH, 5 hp | 1 New | Match existing | 1 | EA | $18,000 | $24,300 |
| Primary Sludge Pumps | 6 | Progressing cavity w/ VFD; 180 gpm; 55 TDH, 20 hp. | 2 New | Match existing | 2 | EA | $20,000 | $54,000 |
| Primary Sludge Macerators | 4 | 180 gpm (600 max); 1,800 rpm, 3 hp; 6" suction and discharge | 1 New | Match existing | 1 | EA | $30,000 | $40,500 |
| PS Pump Station | 1 | Holds (6) PS pumps and (4) Macerators | 1 New | 20' x 20' building to house 2 PS pumps and 2 macerators with the control room | 400 | SF | $250 | $100,000 |

## AERATION BASIN

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Aeration Basins No. 1& 2 | 2 | 105' x 525', 14.5' SWD; 5.6 MG each. | 2 Modification | Tank modification and repair; Remove existing mechanical aerators; Add new headers and diffuser holders. | 1 | LS | $100,000 | $100,000 |
| Diffusers | 0 | - | 10000 New | New 10,000 diffusers for two basins in order to get 2.0 scfm each. | 10,000 | EA | $50 | $675,000 |
| Blowers | 0 | - | 0 | Existing blower capacity sufficient. | 0 | EA | $0 | $0 |
| Air Piping | 0 | - | 1 New | New 750 ft 30" air pipe; including: Control Valve and DO Control System | 750 | LF | $240 | $180,000 |
| Aeration Basins No. 3-6 | 4 | 58' x 584', 20' SWD, 5.0 MG each. | 0 | No improvements needed. | 0 | CY | $0 | $0 |
| Diffusers | 22680 | 5010 ceramic discs aerobic zones per basin (installed in 1991); 660 fine bubble membrane diffusers in anoxic zones per basin (installed in 2000) | 0 | 3201 diffusers required per basin in order to get 2.0 scfm each - no new diffusers needed. | 0 | EA | $50 | $0 |
| Blowers | 4 | 18,000 scfm each, 54,000 scfm firm. | 0 | No improvements needed. | 0 | EA | $0 | $0 |

## SECONDARY CLARIFICATION

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Secondary Clarifier No. 1, 2, 3 & 4 | 4 | 120 ft in diameter; 11 ft SWD; 0.93 MG each. | 0 | - | 0 | EA | $0 | $0 |
| Secondary Clarifier No. 5 & 6 | 2 | 170 ft in diameter; 16 ft SWD | 0 | - | 0 | CY | 0 | $0 |
| Secondary Clarifier Mechanism | 2 | Center-feed; truss bridge walkway; rotating arms; solids collector; scum collection, etc. | 0 | - | 0 | EA | $0 | $0 |
| RAS Pumps (Station No. 1) | 3 | Propeller, Mixed Flow pumps, 1 @ 6 mgd, 1 @ 12 mgd, and 1 @ 18 mgd; Firm: 18 mgd. | 1 New | 46 mgd total recycle flow; 23 mgd total RAS from SC # 1-4; Replace 6 mgd pump with 12 mgd, 40 hp pump. | 1 | EA | $30,000 | $40,500 |
| RAS Pumps (Station No. 2) | 5 | Propeller, Mixed Flow pumps, 4 @ 3.9 mgd (15 hp); 1@ 2.9 mgd (for dewatering); Firm: 7.8 mgd. | 4 New | 46 mgd total recycle flow; 11.5 mgd ea from SC # 5 & 6; Replace 4 exist. @ 3.9 mgd with 5.75 mgd, 20 hp pumps. | 4 | EA | $15,000 | $81,000 |
| RAS Pump Station No. 3 | 0 | - | 2 New | Two new RAS pumps @ 5.75 mgd, 20 hp ea. | 2 | EA | $15,000 | $40,500 |
| | 0 | - | 1 New | 20' x 20' building to house 2 new RAS pumps. | 400 | SF | $250 | $100,000 |
| Effluent/Flood Control Pumps | 3 | Single stage, axial flow; 20 mgd each; Constant speed | 4 | Replace existing pumps with four 45 mgd pumps. | 4 | EA | $150,000 | $810,000 |
| WAS Pumps | 3 | 750 gpm ea.; 1,500 gpm firm; 74 ft TDH; 25 hp ea. | 0 | Design Requirement: 1230 gpm ADF; 1349 gpm ADMM; 1845 gpm MD; No Improvement Needs | 0 | EA | $0 | $0 |

## TERTIARY FILTERS

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Cloth Disk Filters | 0 | - | 27 | 2.5 mgd ADF each, 5.0 mgd PH each | 27 | EA | $285,000 | $10,388,250 |

## SOLIDS HANDLING

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Thickener/WAS Holding Tank | 1 | 105 ft in diameter; Capacity: 1.2 mgd (830 gpm); Unthickened WAS loading: 790 gpm | 0 | Unthickened WAS flow: 1.39 mgd. No improvements required. | 0 | CY | $0 | 0 |
| Gravity Belt Thickening | 2 | 3 m belt width, feed @ 750 gpm each. | 1 | Adequate at 16 hrs/day, 7 days/wk. Recommend 1 additional gravity belt thickener for redundancy and less operating frequency. | 1 | EA | $250,000 | $337,500 |
| Thickened WAS pumps | 2 | each: 250 gpm, 100 TDH, 50 hp | 1 | Add one pump for additional GBT. | 1 | EA | $40,000 | $54,000 |
| Digesters No. 1-4 | 4 | 153,000 cuft = 1.144 MG ea; PS: 0.17mgd, WAS: 0.2 mgd | 0 | 25 days SRT. No improvements required. | 0 | | $0 | $0 |

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Digesters No. 5-8 | 4 | 200,000 cuft = 1.496 MG each | 0 | | 0 | | $0 | $0 |
| Digested sludge pumps | 5 | 4@300 gpm, 30 hp; 1 @ 395 gpm, 25 hp | 0 | Adequate at 8 hrs/day, 7 days/wk. | 0 | | $0 | $0 |
| Centrifuge Dewatering | 3 | feed @ 2600 lb/hr each, 36,400 lb/d each, 300 hp each | 2 replaced | Adequate if operated at 22 hrs/day, 7 days/wk. | 2 | EA | $775,000 | $2,092,500 |
| Dewatered Sludge Cake pumps | 2 | each: 60 gpm, 40 hp | 0 | Adequate if operated at 17 hrs/day, 7 days/wk. | 0 | | $0 | $0 |
| Dryer | 1 | 43 dtpd, 500 hp total | 1 new | Dryer design information indicates intent to operate 24 hrs/day at 6 days/wk thru 2018. New dryer needed to meet future flows. Includes building and all dryer system equipment. | 1 | LS | $10,530,000 | $14,215,500 |
| Centrate Transfer pumps (all centrate) | 2 | each: 700 gpm AT 100' TDH, 40 hp each | | Adequate at 13 hrs/day, 7 days/wk. | 0 | | $0 | $0 |
| Centrate Transfer pumps (centrate to Muddy) | 2 | each: 275 gpm AT 90' TDH, 40 hp each | | Adequate at 9 hrs/day, 7 days/wk. | 0 | | $0 | $0 |

**CHLORINE DISINFECTION**

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Chlorine Contact Basin | 2 | Disinfection Volume 1.42 MG; 15.7 min at PH flow of 130 mgd. | 0 | No improvements needed. | 0 | | $0 | $0 |

**CHEMICAL FEED SYSTEMS**

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Methanol | - | - | 1 | Required dosage 1,400 gpd: | 0 | LS | $0 | $0 |
| Alum | - | - | 1 | Required dosage 15,000 gpd: 5 - 125 gph feed pumps and 6 - 37,500 gal FRP storage tanks (15 days storage) | 1 | LS | $588,000 | $588,000 |

| | |
|---|---|
| **Subtotal** | **$37,836,000** |
| Electrical/Instrumentation (23%) | $8,702,000 |
| Piping and Appurtenances (12%) | $4,540,000 |
| **Subtotal** | **$51,078,000** |
| Insurance and Bonds (2.5%) | $1,277,000 |
| Permits (0.50%) | $264,000 |
| General Conditions (6.0%) | $3,157,000 |
| Indirect OH&P (8.0%) | $4,462,000 |
| **Subtotal** | **$60,238,000** |
| Contingency (25%) | $15,060,000 |
| Allowance for Cost Escalation (6%) | $3,614,000 |
| **CONSTRUCTION TOTAL** | **$78,900,000** |
| Design and Construction Services Fee (15%) | $11,835,000 |
| **GRAND TOTAL** | **$90,735,000** |

# ARCHIE ELLEDGE WWTP IMPROVEMENT ALTERNATIVE 2 SUMMARY

***Flow Option 2 -36.7 ADMM***
***Permit Scenario 1 - 3 mg/L TN and 0.5 mg/L TP***

***Major Improvement Needs:***

*Convert system to 4-stage Bardenpho (Basins 1-6 required);*
*Air requirement for all basins is 30,600 scfm;*
*Add internal recycle flow capabilities of 400% of ADMM flow;*
*Increase capacity of RAS pumps to 36.7 mgd (ADMM) firm capacity;*
*Add equalization;*
*Add tertiary filters;*
*Add chemical facilities;*
*No new Primary Clarifiers;*
*No new Secondary Clarifiers.*
*Add GBT and TWAS pumping*
*Add Dryer and two Centrifuges*

Installation Cost 35%

## HEADWORKS

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Bar Screen | 3 | 50 mgd ea; 100 mgd firm; 3/8" spacing | 0 | No Improvement Needs | 0 | EA | $0 | $0 |
| Screw Conveyor /Compactor | 3 | Shaftless screw; 304 ss; 14" auger; 5hp | 0 | No Improvement Needs | 0 | EA | $0 | $0 |
| Primary Bldg | 1 | | 0 | No Improvement Needs | 0 | SF | $0 | $0 |

## GRIT REMOVAL

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Grit Removal Units | 2 | Vortex; 20' diameter; 50 mgd each | 0 | No Improvement Needs | 0 | EA | $0 | $0 |
| | 2 | Vortex; 20' diameter; 50 mgd each | 0 | No Improvement Needs | 0 | CY | $0 | $0 |
| Grit Pumps | 4 | Recessed impeller centrifugal; 500 gpm, 71 TDH, 40 hp | 0 | No Improvement Needs | 0 | EA | $0 | $0 |
| Grit Classifier | 2 | 500 gpm | 0 | No Improvement Needs | 0 | EA | $0 | $0 |

## INFLUENT PUMPING

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Influent Pumps | 6 | Vertical non-clog dry pit submersible; 2 @ 8,700 gpm, 86 ft TDH, 300 hp; 4 @17,400 gpm, 85 ft TDH, 600 hp | 0 | No Improvement Needs | 0 | EA | $0 | $0 |

## FLOW EQUALIZATION

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Daily EQ Basins | - | - | 2 New | Two new 1.5 million gallon prestressed concrete storage tanks. | 2 | EA | $750,000 | $1,500,000 |

## PRIMARY CLARIFICATION

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Primary Clarifier | 4 | 120 ft in diameter; 12 ft SWD; 25 mgd peak flow each. | 0 | No Improvement Needs | 0 | CY | $0 | $0 |
| Primary Clarifier Mechanism | 4 | Center-feed; truss bridge walkway; rotating arms; solids collector; scum collection, etc. | 0 | No Improvement Needs | 0 | EA | $0 | $0 |
| Scum Pumps | 4 | Chopper; Constant speed; 80 gpm, 21 TDH, 5 hp | 0 | No Improvement Needs | 0 | EA | $0 | $0 |
| Primary Sludge Pumps | 6 | Progressing cavity w/ VFD; 180 gpm; 55 TDH, 20 hp. | 0 | No Improvement Needs | 0 | EA | $0 | $0 |
| Primary Sludge Macerators | 4 | 180 gpm (600 max); 1,800 rpm, 3 hp; 6" suction and discharge | 0 | No Improvement Needs | 0 | EA | $0 | $0 |
| PS Pump Station | 1 | Holds (6) PS pumps and (4) Macerators | 0 | No Improvement Needs | 0 | SF | $0 | $0 |

## AERATION BASIN

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Aeration Basins No. 1& 2 | 2 | 105' x 525', 14.5' SWD; 5.6 MG each. | 2 Modification | Tank modification and repair; Divide into 7 zones; Remove existing mechanical aerators; Add new headers and diffuser holders. | 1,010 | CY | $600 | $606,000 |
| Diffusers | 0 | - | 6650 New | New 6650 diffusers for two basins in order to get 2.0 scfm each (13,300 scfm total needed) | 6,650 | EA | $50 | $448,875 |
| Mixers | 0 | - | 48 New | New 5 hp each, 50 hp per MG design basis | 48 | EA | $10,000 | $648,000 |
| Blowers | 0 | - | 0 | Existing blower capacity sufficient | 0 | EA | $0 | $0 |
| Air Piping | 0 | - | 1 New | New 750 ft 30" air pipe; including control valve and DO control system | 750 | LF | $240 | $243,000 |
| MLR Pumps | 0 | - | 2 New | 23,000 gpm, 100 hp, @10' TDH | 2 | EA | $90,000 | $243,000 |
| Aeration Basins No. 3-6 | 4 | 58' x 584', 20' SWD, 5.0 MG each. | 4 Modification | Tank modification and repair; Divide cell No. 1 into 1A and 1B, and cell No. 20 into 20A and 20B; Remove 4000 ft of exist. 30" ML pipes and jet mixing system. | 528 | CY | $600 | $316,800 |
| Diffusers | 22680 | 5010 ceramic discs aerobic zones per basin (installed in 1991); 660 fine bubble membrane diffusers in anoxic zones per basin (installed in 2000) | 0 | 2,163 diffusers required per basin in order to get 2.0 scfm each - no new diffusers needed. | 0 | EA | $50 | $0 |
| Mixers | 0 | - | 96 | Mixers for anoxic zones: 5 hp each (used 50 hp per MG as the design basis) | 96 | EA | $10,000 | $1,296,000 |
| Blowers | 4 | 18,000 scfm each, 54,000 scfm firm. | 0 | No improvements needed. | 0 | EA | $0 | $0 |
| MLR Pumps | 0 | - | 4 | New 15,700 gpm, 75 hp @10 TDH. | 4 | EA | $85,000 | $459,000 |

## SECONDARY CLARIFICATION

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Secondary Clarifier No. 1, 2, 3 & 4 | 4 | 120 ft in diameter; 11 ft SWD; 0.93 MG each. | 0 | - | 0 | EA | $0 | $0 |
| Secondary Clarifier No. 5 & 6 | 2 | 170 ft in diameter; 16 ft SWD | 0 | - | 0 | CY | 600 | $0 |
| Secondary Clarifier Mechanism | 2 | Center-feed; truss bridge walkway; rotating arms; solids collector; scum collection, etc. | 0 | - | 0 | EA | $550,000 | $0 |
| RAS Pumps (Station No. 1) | 3 | Pumping capacity: 1 @ 6 mgd, 1 @ 12, and 1 @ 18; Firm: 18 mgd. | 0 | 35 mgd total recycle flow. 17.5 mgd RAS from SCs # 1 -4; No Improvement Needs. | 0 | EA | $0 | $0 |
| RAS Pumps (Station No. 2) | 4 | Pumping capacity: 4 @ 3.9 mgd; Firm: 7.8 mgd. | 4 New | 35 mgd total recycle flow; 17.5 mgd RAS from SC 5 & 6; Replace exist. 3.9 mgd pumps with 8.75 mgd pumps. | 4 | EA | $50,000 | $270,000 |
| Effluent/Flood Control Pumps | 3 | Single stage, axial flow; 20 mgd each; Constant speed | 5 New | Replace exist. w/ five 25 mgd pumps. | 5 | EA | $100,000 | $675,000 |
| WAS Pumps | 3 | 750 gpm ea.; 1,500 gpm firm; 74 ft TDH; 25 hp ea. | 0 | Design Requirement: 471 gpm ADF; 515 gpm ADMM; 700 gpm MD; No Improvement Needs. | 0 | EA | $0 | $0 |

**TERTIARY FILTERS**

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Cloth Disk Filters | 0 | - | 21 | 2.5 mgd ADF each, 5.0 mgd PH each | 21 | EA | $285,000 | $8,079,750 |

**SOLIDS HANDLING**

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Thickener/WAS Holding Tank | 1 | 105 ft in diameter; Capacity: 1.2 mgd (830 gpm); Unthickened WAS loading: 790 gpm | 0 | Unthickened WAS flow: 0.98 mgd. No improvements needed. | 0 | CY | $0 | 0 |
| Gravity Belt Thickening | 2 | 3 m belt width, feed @ 750 gpm each. | 1 | Adequate at 11 hrs/day, 7 days/wk with both operating. Recommend 1 additional gravity belt thickener for redundancy and less operating frequency. | 1 | EA | $250,000 | $337,500 |
| Thickened WAS pumps | 2 | each: 250 gpm, 100 TDH, 50 hp | 1 | Add one pump for additional GBT. | 1 | EA | $40,000 | $54,000 |
| Digesters No. 1-4 | 4 | 153,000 cuft = 1.144 MG ea; PS: 0.17mgd, WAS: 0.2 mgd | 0 | 31 days SRT. No improvements required. | 0 | | $0 | $0 |
| Digesters No. 5-8 | 4 | 200,000 cuft = 1.496 MG each | 0 | | 0 | | $0 | $0 |
| Digested sludge pumps | 5 | 4@300 gpm, 30 hp; 1 @ 395 gpm, 25 hp | 0 | Adequate at 7 hrs/day, 7 days/wk. | 0 | | $0 | $0 |
| Centrifuge Dewatering | 3 | feed @ 2600 lb/hr each, 36,400 lb/d each, 300 hp each | 2 replaced | Adequate if operated at 22 hrs/day, 7 days/wk. | 2 | EA | $775,000 | $2,092,500 |
| **PROCESS COMPONENTS** | **EXIST UNITS** | **EXIST. COMPONENTS DESIGN CRITERIA** | **PROPOSED UNITS** | **IMPROVEMENT DESCRIPTION/ WORK INVOLVED** | **QUANTITY** | **UNIT** | **$/UNIT** | **INSTALLED COST** |
| Dewatered Sludge Cake pumps | 2 | each: 60 gpm, 40 hp | 0 | Adequate if operated at 17 hrs/day, 7 days/wk. | 0 | | $0 | $0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Dryer | 1 | 43 dtpd, 500 hp total | 1 new | Dryer design information indicates intent to operate 24 hrs/day at 6 days/wk thru 2018. New dryer needed to meet future flows. Includes building and all dryer system equipment. | 1 | LS | $10,530,000 | $14,215,500 |
| Centrate Transfer pumps (all centrate) | 2 | each: 700 gpm AT 100' TDH, 40 hp each | | Adequate at 13 hrs/day, 7 days/wk. | 0 | | $0 | $0 |
| Centrate Transfer pumps (centrate to Muddy) | 2 | each: 275 gpm AT 90' TDH, 40 hp each | | Adequate at 14 hrs/day, 7 days/wk. | 0 | | $0 | $0 |

**CHLORINE DISINFECTION**

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Chlorine Contact Basin | 2 | Disinfection Volume 1.42 MG; 20.5 min at PH flow of 130 mgd. | 0 | No improvements needed. | 0 | | $0 | $0 |

**CHEMICAL FEED SYSTEMS**

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Methanol | - | - | 1 | Required dosage 1,200 gpd: | 1 | LS | $930,000 | $930,000 |
| Alum | - | - | 1 | Required dosage 9,000 gpd: 7 - 54 gph feed pumps and 3 - 45,000 gal FRP storage tanks (15 days storage) | 1 | LS | $457,000 | $457,000 |

| | |
|---|---|
| **Subtotal** | **$32,872,000** |
| Electrical/Instrumentation (23%) | $7,561,000 |
| Piping and Appurtenances (12%) | $3,945,000 |
| **Subtotal** | **$44,378,000** |
| Insurance and Bonds (2.5%) | $1,109,000 |
| Permits (0.50%) | $230,000 |
| General Conditions (6.0%) | $2,743,000 |
| Indirect OH&P (8.0%) | $3,877,000 |
| **Subtotal** | **$52,337,000** |
| Contingency (25%) | $13,084,000 |
| Allowance for Cost Escalation (6%) | $3,140,000 |
| **CONSTRUCTION TOTAL** | **$68,600,000** |
| Design and Construction Services Fee (15%) | $10,290,000 |
| **GRAND TOTAL** | **$78,890,000** |

# ARCHIE ELLEDGE WWTP IMPROVEMENT ALTERNATIVE 4 SUMMARY

***Flow Option 2 - 36.7 mgd ADMM***

.

***Major Improvement Needs:***

*Air requirement for all basins is 31,900 scfm;*
*Increase capacity of RAS pumps to 36.7 mgd (ADMM) firm capacity;*
*Add equalization;*
*Add tertiary filters;*
*Add chemical facilities;*
*No new Primary Clarifiers;*
*No new Secondary Clarifiers.*
*Add GBT and TWAS pumping*
*Add Dryer and two Centrifuges*

Installation Cost 35%

## HEADWORKS

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Bar Screen | 3 | 50 mgd ea; 100 mgd firm; 3/8" spacing | 0 | No Improvement Needs | 0 | EA | $0 | $0 |
| Screw Conveyor /Compactor | 3 | Shaftless screw; 304 ss; 14" auger; 5hp | 0 | No Improvement Needs | 0 | EA | $0 | $0 |
| Primary Bldg | 1 | - | 0 | No Improvement Needs | 0 | SF | $0 | $0 |

## GRIT REMOVAL

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Grit Removal Units | 2 | Vortex; 20' diameter; 50 mgd each | 0 | No Improvement Needs | 0 | EA | $0 | $0 |
| | 2 | Vortex; 20' diameter; 50 mgd each | 0 | No Improvement Needs | 0 | CY | $0 | $0 |
| Grit Pumps | 4 | Recessed impeller centrifugal; 500 gpm, 71 TDH, 40 hp | 0 | No Improvement Needs | 0 | EA | $0 | $0 |
| Grit Classifier | 2 | 500 gpm | 0 | No Improvement Needs | 0 | EA | $0 | $0 |

## FLOW EQUALIZATION

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Daily EQ Basins | - | - | 2 New | Two new 1.5 million gallon prestressed concrete storage tanks. | 2 | EA | $750,000 | $1,500,000 |

## INFLUENT PUMPING

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Influent Pumps | 6 | Vertical non-clog dry pit submersible; 2 @ 8,700 gpm, 86 ft TDH, 300 hp; 4 @17,400 gpm, 85 ft TDH, 600 hp | 0 | No Improvement Needs | 0 | EA | $0 | $0 |

## PRIMARY CLARIFICATION

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Primary Clarifier | 4 | 120 ft in diameter; 12 ft SWD; 25 mgd peak flow each. | 0 | No Improvement Needs | 0 | CY | $0 | $0 |
| Primary Clarifier Mechanism | 4 | Center-feed; truss bridge walkway; rotating arms; solids collector; scum collection, etc. | 0 | No Improvement Needs | 0 | EA | $0 | $0 |
| Scum Pumps | 4 | Chopper; Constant speed; 80 gpm, 21 TDH, 5 hp | 0 | No Improvement Needs | 0 | EA | $0 | $0 |
| Primary Sludge Pumps | 6 | Progressing cavity w/ VFD; 180 gpm; 55 TDH, 20 hp. | 0 | No Improvement Needs | 0 | EA | $0 | $0 |
| Primary Sludge Macerators | 4 | 180 gpm (600 max); 1,800 rpm, 3 hp; 6" suction and discharge | 0 | No Improvement Needs | 0 | EA | $0 | $0 |
| PS Pump Station | 1 | Holds (6) PS pumps and (4) Macerators | 0 | No Improvement Needs | 0 | SF | $0 | $0 |

## AERATION BASIN

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Aeration Basins No. 1& 2 | 2 | 105' x 525', 14.5' SWD; 5.6 MG each. | 0 | Basins No. 1 & 2 are not required | 0 | LS | $0 | $0 |
| Aeration Basins No. 3-6 | 4 | 58' x 584', 20' SWD, 5.0 MG each. | 0 | No improvements needed. | 0 | CY | $0 | $0 |
| Diffusers | 22680 | 5010 ceramic discs aerobic zones per basin (installed in 1991); 660 fine bubble membrane diffusers in anoxic zones per basin (installed in 2000) | 0 | 3988 diffusers required per basin in order to get 2.0 scfm each - no new diffusers needed. | 0 | EA | $0 | $0 |
| Blowers | 4 | 18,000 scfm each, 54,000 scfm firm. | 0 | No improvements needed. | 0 | EA | $0 | $0 |

## SECONDARY CLARIFICATION

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Secondary Clarifier No. 1, 2, 3 & 4 | 4 | 120 ft in diameter; 11 ft SWD; 0.93 MG each. | 0 | - | 0 | EA | $0 | $0 |
| Secondary Clarifier No. 5 & 6 | 2 | 170 ft in diameter; 16 ft SWD | 0 | - | 0 | CY | 0 | $0 |
| Secondary Clarifier Mechanism | 2 | Center-feed; truss bridge walkway; rotating arms; solids collector; scum collection, etc. | 0 | - | 0 | EA | $0 | $0 |
| RAS Pumps (Station No. 1) | 3 | Pumping capacity: 1 @ 6 mgd, 1 @ 12, and 1 @ 18; Firm: 18 mgd. | 0 | 35 mgd total recycle flow. 17.5 mgd RAS from SCs # 1 -4; No Improvement Needs. | 0 | EA | $0 | $0 |
| RAS Pumps (Station No. 2) | 4 | Pumping capacity: 4 @ 3.9 mgd; Firm: 7.8 mgd. | 4 New | 35 mgd total recycle; 17.5 mgd RAS from SC 5 & 6; Replace exist. 3.9 mgd pumps with 8.75 mgd pumps. | 4 | EA | $50,000 | $270,000 |
| Effluent/Flood Control Pumps | 3 | Single stage, axial flow; 20 mgd each; Constant speed | 5 New | Replace exist. w/ five 25 mgd pumps. | 5 | EA | $100,000 | $675,000 |
| WAS Pumps | 3 | 750 gpm ea.; 1,500 gpm firm; 74 ft TDH; 25 hp ea. | 0 | No Improvement Needs | 0 | EA | $0 | $0 |

## TERTIARY FILTERS

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Cloth Disk Filters | 0 | - | 21 | 2.5 mgd ADF each, 5.0 mgd PH each | 21 | EA | $285,000 | $8,079,750 |

## SOLIDS HANDLING

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Thickener/WAS Holding Tank | 1 | 105 ft in diameter; Capacity: 1.2 mgd (830 gpm); Unthickened WAS loading: 790 gpm | 0 | Unthickened WAS flow: 1.04 mgd. No improvements needed. | 0 | CY | $0 | 0 |
| Gravity Belt Thickening | 2 | 3 m belt width, feed @ 750 gpm each. | 1 | Adequate at 12 hrs/day, 7 days/wk with both operating. Recommend 1 additional gravity belt thickener for redundancy and less operating frequency. | 1 | EA | $250,000 | $337,500 |
| Thickened WAS pumps | 2 | each: 250 gpm, 100 TDH, 50 hp | 1 | Add one pump for additional GBT. | 1 | EA | $40,000 | $54,000 |
| Digesters No. 1-4 | 4 | 153,000 cuft = 1.144 MG ea; PS: 0.17mgd, WAS: 0.2 mgd | 0 | 31 days SRT. No improvements required. | 0 | | $0 | $0 |
| Digesters No. 5-8 | 4 | 200,000 cuft = 1.496 MG each | 0 | | 0 | | $0 | $0 |
| Digested sludge pumps | 5 | 4@300 gpm, 30 hp; 1 @ 395 gpm, 25 hp | 0 | Adequate at 7 hrs/day, 7 days/wk. | 0 | | $0 | $0 |
| Centrifuge Dewatering | 3 | feed @ 2600 lb/hr each, 36,400 lb/d each, 300 hp each | 2 replaced | Adequate if operated at 22 hrs/day, 7 days/wk. | 2 | EA | $775,000 | $2,092,500 |
| Dewatered Sludge Cake pumps | 2 | each: 60 gpm, 40 hp | 0 | Adequate if operated at 17 hrs/day, 7 days/wk. | 0 | | $0 | $0 |
| Dryer | 1 | 43 dtpd, 500 hp total | 1 new | Dryer design information indicates intent to operate 24 hrs/day at 6 days/wk thru 2018. New dryer needed to meet future flows. Includes building and all dryer system equipment. | 1 | LS | $10,530,000 | $14,215,500 |
| Centrate Transfer pumps (all centrate) | 2 | each: 700 gpm AT 100' TDH, 40 hp each | | Adequate at 14 hrs/day, 7 days/wk. | 0 | | $0 | $0 |
| Centrate Transfer pumps (centrate to Muddy) | 2 | each: 275 gpm AT 90' TDH, 40 hp each | | Adequate at 14 hrs/day, 7 days/wk. | 0 | | $0 | $0 |

## CHLORINE DISINFECTION

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Chlorine Contact Basin | 2 | Disinfection Volume 1.42 MG; 20.5 min at PH flow of 130 mgd. | 0 | No improvements needed. | 0 | | $0 | $0 |

## CHEMICAL FEED SYSTEMS

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Methanol | - | - | 1 | Required dosage 1,200 gpd: | 0 | LS | $0 | $0 |
| Alum | - | - | 1 | Required dosage 11,400 gpd: 5 - 95 gph feed pumps and 6 - 28,500 gal FRP storage tanks (15 days storage) | 1 | LS | $484,000 | $484,000 |

| | |
|---|---|
| **Subtotal** | **$27,708,000** |
| Electrical/Instrumentation (23%) | $6,373,000 |
| Piping and Appurtenances (12%) | $3,325,000 |
| **Subtotal** | **$37,406,000** |
| Insurance and Bonds (2.5%) | $935,000 |
| Permits (0.50%) | $194,000 |
| General Conditions (6.0%) | $2,312,000 |
| Indirect OH&P (8.0%) | $3,268,000 |
| **Subtotal** | **$44,115,000** |
| Contingency (25%) | $11,029,000 |
| Allowance for Cost Escalation (6%) | $2,647,000 |
| **CONSTRUCTION TOTAL** | **$57,800,000** |
| Design and Construction Services Fee (15%) | $8,670,000 |
| **GRAND TOTAL** | **$66,470,000** |

# MUDDY CREEK WWTP IMPROVEMENT ALTERNATIVE 1 SUMMARY

***Flow Option 1 - 21 ADMM; 37.7 MD; 59.6 PH (37.7 PH with EQ)***
***Permit Scenario 1 - 3 mg/L TN and 0.5 mg/L TP***

***Major Improvement Needs:***

*Convert existing aeration basins to 4-stage Bardenpho and add IFAS media;*
*Air requirement for all basins is 8,500 scfm;*
*Add internal recycle flow capabilities of 400% of ADMM flow;*
*Increase capacity of RAS pumps to 21 mgd (ADMM) firm capacity;*
*Add tertiary filters;*
*Add chemical facilities;*
*Add 5th Secondary Clarifier at 110 ft diameter;*
*Add 8 MG of storage volume (EQ basin).*

Installation Cost 35%

## INFLUENT PUMPING

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Influent Pumps | 5 | Spiral Screw; Max. Capacity: 3@11.7 mgd, 2@21.6 mgd, 45 ft TDH, Firm Capacity: 56.7 mgd, 3@150 hp, 2@200 hp. | 0 | No Improvement needs | 0 | EA | $0 | $0 |

## HEADWORKS

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Bar Screens | 3 | Max. capacity: 26.2 mgd ea. Firm capacity: 52.4 mgd, 0.25" opening | 0 | No improvement needs | 0 | EA | $0 | $0 |

## GRIT REMOVAL

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Grit Removal Units | 3 | Max. capacity: 13 mgd ea. | 0 | 39 mgd capacity with all basins in service. | 0 | EA | $0 | $0 |
| | | | 2 New | 60 mgd total vortex grit removal capacity: 2 - 30 mgd basins | 2 | EA | $40,000 | $108,000 |
| | | - | 2 New | Concrete for grit basins | 2,000 | CY | $800 | $1,600,000 |
| Grit Pumps | | - | 2 New | Recessed impeller centrifugal; 250 gpm | 2 | EA | $12,000 | $32,400 |
| Grit Classifier | | - | 2 New | 250 gpm grit classifiers | 2 | EA | $60,000 | $162,000 |

## PRIMARY CLARIFICATION

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Primary Clarifier | 4 | 158' X 46'; 2.59 MG total. | 0 | No Improvement needs | 0 | EA | $0 | $0 |
| Scum Pumps | 2 | Firm Capacity: 150 gpm, 44' TDH, 7.5 hp. | 0 | No Improvement needs | 0 | EA | $0 | $0 |
| Primary Sludge Pumps | 4 | Firm Capacity: 170 gpm ea, 110' TDH, 10 hp; 500 gpm Firm Capacity. | 0 | Adequate if pumped at 6hrs/day or more. | 0 | EA | $0 | $0 |

## AERATION BASINS

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Aeration Basins | 3 | 204'x68', SWD: 24.83'; Volume: 2.58 MG ea. | 3 Modification | Tank modification and repair; Divide each basin into 7 zones; Add new headers and diffuser holders. | 1,599 | CY | $600 | $959,400 |
| Aeration Basins | | - | 3 Modification | Addition of IFAS media | 1 | LS | $1,333,000 | $1,333,000 |
| Diffusers | 11,133 | 3,711 diffusers with 1,463 blank per basin. | 1063 | 4250 diffusers required for all basins in order to get 2.0 scfm ea. Use exist. diffuser holders and rearrange diffusers. No new diffusers needed. | 0 | EA | $50 | $0 |
| Blowers | 3 | Capacity: 11,400 scfm ea. Firm Capacity: 22,800 scfm. | 0 | No improvements needed; 8,500 scfm for all basins required. | 0 | EA | $0 | $0 |
| Mixers | 0 | - | 64 New | Mixers for anoxic zones: 5 hp each (used 50 hp per MG as the design basis) | 48 | EA | $10,000 | $648,000 |
| MLR Pumps | 0 | - | 3 New | One for each basin @ 14,600 gpm (21 mgd) and 70 hp. | 3 | EA | $85,000 | $344,250 |

## SECONDARY CLARIFICATION

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Secondary Clarifier | 4 | 110 ft in diameter; 14 ft SWD; 1 MG ea. | 1 New | Match Existing (Concrete) | 922 | CY | $600 | $553,200 |
| Secondary Clarifier Mechanism | 4 | Center-feed; truss bridge walkway; rotating arms; solids collector; scum collection, etc. | 1 New | Match existing | 1 | EA | $350,000 | $472,500 |
| RAS Pumps | 6 | 4 duty, 2 standby; Capacity: 1@ 2500, 1@3800, 1@4500, 1@5300 gpm; Firm capacity: 13 mgd; 100 hp | 2 New | Required Firm Capacity: 21 mgd. Add two new pumps at 2780 gpm (4 mgd) and 100 hp. | 2 | EA | $50,000 | $135,000 |
| WAS Pumps | 0 | Pipe size: 18 in; Max. WAS flow rate: 2.5 mgd | 0 | Design Requirement: 277 gpm (0.40 mgd) ADF; 345 gpm (0.50 mgd) ADMM; 456 gpm (0.66 mgd) MD; No improvement needs. | 0 | EA | $0 | $0 |

## EQUALIZATION

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| EQ Basin | - | - | 1 Modified | Modify Existing Sludge Lagoons - clean lagoons and install liner to create 8 MG EQ basin. | 1 | LS | $1,500,000 | $1,500,000 |

**TERTIARY FILTERS**

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Cloth Disk Filters | 0 | - | 9 | 2.5 mgd ADF each, 5.0 mgd PH each | 9 | EA | $285,000 | $3,462,750 |

**SOLIDS HANDLING**

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Gravity Thickener | 1 | 105 ft dia, polymer | 0 | Assuming cothickening in the Primary Clarifier | 0 | | $0 | $0 |
| Thickened Solids Pumps | 3 | 170 gpm each, 110 ft TDH, 10 hp each | 0 | Assuming cothickening in the Primary Clarifier | 0 | | $0 | $0 |
| Digesters | 4 | 0.268 cuft each, 1.07 cuft total | 0 | 45 days SRT - No improvements needed. | 0 | | $0 | $0 |
| Dig sludge transfer pumps | 3 | 260 gpm ea., 40 hp | 0 | Adequate if pumped at 6 hrs/day or more. | 0 | | $0 | $0 |

**CHLORINE DISINFECTION**

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Chlorine Contact Basin | 2 | Disinfection Volume 0.94 MG; 22.7 min at PH flow of 59.6 mgd. | 0 | No improvements needed. | 0 | | $0 | $0 |

**CHEMICAL FEED SYSTEM**

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Methanol | - | - | 1 | Required dosage 750 gpd. | 1 | LS | $582,000 | $582,000 |
| Alum | - | - | 1 | Required dosage 2,600 gpd: 4 - 27 gph feed pumps and 3 - 13,000 gal FRP storage tanks (15 days storage) | 1 | LS | $200,000 | $200,000 |
| | | | | | | **Subtotal** | | **$12,093,000** |
| | | | | | | Electrical/Instrumentation (23%) | | $2,781,000 |
| | | | | | | Piping and Appurtenances (12%) | | $1,451,000 |
| | | | | | | **Subtotal** | | **$16,325,000** |

**PIPING AND PUMPING**

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Muddy Creek Transfer Pump Station | - | - | - | New 60 mgd to Elledge WWTP | 1 | LS | $14,100,000 | $14,100,000 |
| Force Main between MCWWTP & AEWWTP | - | - | - | 30" diameter force main initially | 23,000 | LF | $240 | $5,520,000 |
| Force Main between MCWWTP & AEWWTP | | | | 48" diameter force main in future | 23,000 | LF | $575 | $13,225,000 |
| Force Main between MCWWTP & AEWWTP | | | | Easement for force mains | 23,000 | LF | $15 | $345,000 |
| EQ Pump Station | - | - | - | New 22 mgd pump station to pump from headworks to EQ basin | 1 | LS | $5,000,000 | $5,000,000 |
| Gravity Sewer | - | - | - | 36" DIP gravity sewer from EQ basin to existing primaries | 1,000 | LF | $315 | $315,000 |
| Force Main | - | - | - | 36" DIP Force Main, 1000 LF from proposed EQ PS to EQ | 1,000 | LF | $315 | $315,000 |
| | | | | | | | **Subtotal** | **$55,145,000** |
| | | | | | | | Insurance and Bonds (2.5%) | $1,379,000 |
| | | | | | | | Permits (0.50%) | $285,000 |
| | | | | | | | General Conditions (6.0%) | $3,409,000 |
| | | | | | | | Indirect OH&P (8.0%) | $4,817,000 |
| | | | | | | | **Subtotal** | **$65,035,000** |
| | | | | | | | Contingency (25%) | $16,259,000 |
| | | | | | | | Allowance for Cost Escalation (6%) | $3,902,000 |
| | | | | | | | **CONSTRUCTION TOTAL** | **$85,200,000** |
| | | | | | | | Design and Construction Services Fee (15%) | $12,780,000 |
| | | | | | | | **GRAND TOTAL** | **$97,980,000** |

# MUDDY CREEK WWTP IMPROVEMENT ALTERNATIVE 3 SUMMARY

***Flow Option 1 - 21 ADMM; 37.7 MD; 59.6 PH (37.7 PH with EQ)***
***Permit Scenario 2 - N/A TN and 0.2 mg/L TP***

***Major Improvement Needs:***

*No additional Aeration Basin tankage needed;*
*Air requirement for all basins is 10,800 scfm;*
*Increase capacity of RAS pumps to 21 mgd (ADMM) firm capacity;*
*Add tertiary filters;*
*Add chemical facilities;*
*No additional Secondary Clarifier needed.*
*Add 8 MG of storage volume (EQ basin).*

Installation Cost 35%

## HEADWORKS

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Bar Screens | 3 | Max. capacity: 26.2 mgd ea. Firm capacity: 52.4 mgd, 0.25" opening | 0 | No improvement needs | 0 | EA | $0 | $0 |

## GRIT REMOVAL

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Grit Removal Units | 3 | Max. capacity: 13 mgd ea. | 0 | 39 mgd capacity with all basins in service. | 0 | EA | $0 | $0 |
| | | | 2 New | 60 mgd total vortex grit removal capacity: 2 - 30 mgd basins | 2 | EA | $40,000 | $108,000 |
| | | - | 2 New | Concrete for grit basins | 2,000 | CY | $800 | $1,600,000 |
| Grit Pumps | | - | 2 New | Recessed impeller centrifugal; 250 gpm | 2 | EA | $12,000 | $32,400 |
| Grit Classifier | | - | 2 New | 250 gpm grit classifiers | 2 | EA | $60,000 | $162,000 |

## INFLUENT PUMPING

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Influent Pumps | 5 | Spiral Screw; Max. Capacity: 3@11.7 mgd, 2@21.6 mgd, 45 ft TDH, Firm Capacity: 56.7 mgd, 3@150 hp, 2@200 hp. | 0 | No Improvement needs | 0 | EA | $0 | $0 |

## PRIMARY CLARIFICATION

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Primary Clarifier | 4 | 158' X 46'; 2.59 MG total. | 0 | No Improvement needs | 0 | EA | $0 | $0 |
| Scum Pumps | 2 | Firm Capacity: 150 gpm, 44' TDH, 7.5 hp. | 0 | No Improvement needs | 0 | EA | $0 | $0 |
| Primary Sludge Pumps | 4 | Firm Capacity: 170 gpm ea, 110' TDH, 10 hp; 500 gpm Firm Capacity. | 0 | Adequate if pumped at 6hrs/day or more. | 0 | EA | $0 | $0 |

## AERATION BASINS

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Aeration Basins | 3 | 204'x68', SWD: 24.83'; Volume: 2.58 MG ea. | 0 | No improvements needed. | 0 | CY | $0 | $0 |
| Diffusers | 11,133 | 3,711 diffusers with 1,463 blank per basin, | 0 | Required: 5400 diffusers for all basins in order to get 2.0 scfm ea.; Use exist. diffuser holders; Rearrange diffusers. | 0 | EA | $0 | $0 |
| Blowers | 3 | Capacity: 11,400 scfm ea. Firm Capacity: 22,800 scfm. | 0 | No Improvement needs; 10,800 scfm for all basins required. | 0 | EA | $0 | $0 |

## SECONDARY CLARIFICATION

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Secondary Clarifier | 4 | 110 ft in diameter; 14 ft SWD; 1 MG ea. | 0 | No Improvement Needs | 0 | CY | $0 | $0 |
| Secondary Clarifier Mechanism | 4 | Center-feed; truss bridge walkway; rotating arms; solids collector; scum collection, etc. | 0 | No Improvement Needs | 0 | EA | $0 | $0 |
| RAS Pumps | 6 | 4 duty, 2 standby; Capacity: 1@ 2500, 1@3800, 1@4500, 1@5300 gpm; Firm capacity: 13 mgd; 100 hp | 2 New | Required Firm Capacity: 21 mgd. Add two new pumps at 2780 gpm (4 mgd) and 100 hp. | 2 | EA | $50,000 | $135,000 |
| WAS Pumps | 0 | Pipe size: 18 in; Max. WAS flow rate: 2.5 mgd | 0 | Design Requirement: 277 gpm (0.40 mgd) ADF; 345 gpm (0.50 mgd) ADMM; 456 gpm (0.66 mgd) MD; No improvements needed. | 0 | EA | $0 | $0 |

## EQUALIZATION

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| EQ Basin | - | - | 1 Modified | Modify Existing Sludge Lagoons - clean lagoons and install liner to create 8 MG EQ basin. | 1 | LS | $1,500,000 | $1,500,000 |

## TERTIARY FILTERS

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Cloth Disk Filters | 0 | - | 9 | 2.5 mgd ADF each, 5.0 mgd PH each | 9 | EA | $285,000 | $3,462,750 |

## SOLIDS HANDLING

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Gravity Thickener | 1 | 105 ft dia, polymer | 0 | Assuming cothickening in the Primary Clarifier | 0 | | $0 | $0 |
| Thickened Solids Pumps | 3 | 170 gpm each, 110 ft TDH, 10 hp each | 0 | Assuming cothickening in the Primary Clarifier | 0 | | $0 | $0 |
| Digesters | 4 | 0.268 cuft each, 1.07 cuft total | 0 | 44 days SRT - No improvements needed. | 0 | | $0 | $0 |
| Dig sludge transfer pumps | 3 | 260 gpm ea, 40 hp | 0 | Adequate if pumped at 6 hrs/day or more. | 0 | | $0 | $0 |

## CHLORINE DISINFECTION

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Chlorine Contact Basin | 2 | Disinfection Volume 0.94 MG; 22.7 min at PH flow of 59.6 mgd. | 0 | No improvements needed. | 0 | | $0 | $0 |

## CHEMICAL FEED SYSTEM

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Methanol | - | - | 1 | Required dosage 750 gpd: | 0 | LS | $0 | $0 |
| Alum | - | - | 1 | Required dosage 3,400 gpd: 4 - 35.5 gph feed pumps and 3 - 17,000 gal FRP storage tanks (15 days storage) | 1 | LS | $226,000 | $226,000 |

| | |
|---|---|
| **Subtotal** | **$7,226,000** |
| Electrical/Instrumentation (23%) | $1,662,000 |
| Piping and Appurtenances (12%) | $867,000 |
| **Subtotal** | **$9,755,000** |

**PIPING AND PUMPING**

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Muddy Creek Transfer Pump Station | - | - | - | New 60 mgd to Elledge WWTP | 1 | LS | $14,100,000 | $14,100,000 |
| Force Main between MCWWTP & AEWWTP | - | - | - | 30" diameter force main initially | 23,000 | LF | $240 | $5,520,000 |
| Force Main between MCWWTP & AEWWTP | | | | 48" diameter force main in future | 23,000 | LF | $575 | $13,225,000 |
| Force Main between MCWWTP & AEWWTP | | | | Easement for force mains | 23,000 | LF | $15 | $345,000 |
| EQ Pump Station | - | - | - | New 22 mgd pump station to pump from headworks to EQ basin | 1 | LS | $5,000,000 | $5,000,000 |
| Gravity Sewer | - | - | - | 36" DIP gravity sewer from EQ basin to existing primaries | 1,000 | LF | $315 | $315,000 |
| Force Main | - | - | - | 36" DIP Force Main, 1000 LF from proposed EQ PS to EQ | 1,000 | LF | $315 | $315,000 |
| | | | | | | **Subtotal** | | **$48,575,000** |
| | | | | | | Insurance and Bonds (2.5%) | | $1,214,000 |
| | | | | | | Permits (0.50%) | | $251,000 |
| | | | | | | General Conditions (6.0%) | | $3,002,000 |
| | | | | | | Indirect OH&P (8.0%) | | $4,243,000 |
| | | | | | | **Subtotal** | | **$57,285,000** |
| | | | | | | Contingency (25%) | | $14,321,000 |
| | | | | | | Allowance for Cost Escalation (6%) | | $3,437,000 |
| | | | | | | **CONSTRUCTION TOTAL** | | **$75,000,000** |
| | | | | | | Design and Construction Services Fee (15%) | | $11,250,000 |
| | | | | | | **GRAND TOTAL** | | **$86,250,000** |

## MUDDY CREEK WWTP IMPROVEMENT ALTERNATIVE 2 SUMMARY

***Flow Option 2 - 30 ADMM; 56.4 MD; 89.6 PH (56.7 PH with EQ)***
***Permit Scenario 1 - 3 mg/L TN and 0.5 mg/L TP***

***Major Improvement Needs:***

*Construct a parallel biological process train at 7.73 MG and convert system to 4-stage Bardenpho;*
*Air requirement for all basins is 19,600 scfm;*
*Add internal recycle flow capabilities of 400% of ADMM flow;*
*Increase capacity of RAS pumps to 30 mgd (ADMM) firm capacity;*
*Add four new primary clarifiers at 100 ft diameter*
*Add tertiary filters;*
*Add chemical facilities;*
*Add four new Secondary Clarifiers at 110 ft diameter;*
*Add 12 MG of storage volume (EQ basin);*
*Add GBT, pumping and building*

Installation Cost 35%

### HEADWORKS

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Bar Screens | 3 | Max. capacity: 26.2 mgd ea. Firm capacity: 52.4 mgd, 0.25" opening | 3 New | 3 - 30 mgd climber bar screens. | 3 | EA | $350,000 | $1,417,500 |

### GRIT REMOVAL

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Grit Removal Units | 3 | Max. capacity: 13 mgd ea. | 2 New | 60 mgd total vortex grit removal capacity: 2 - 30 mgd basins | 2 | EA | $40,000 | $108,000 |
| | | - | 2 New | Concrete for grit basins | 2,000 | CY | $800 | $1,600,000 |
| Grit Pumps | | - | 2 New | Recessed impeller centrifugal; 250 gpm | 2 | EA | $12,000 | $32,400 |
| Grit Classifier | | - | 2 New | 250 gpm grit classifiers | 2 | EA | $60,000 | $162,000 |

### INFLUENT PUMPING

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Influent Pumps | 5 | Spiral Screw; Max. Capacity: 3@11.7 mgd, 2@21.6 mgd, 45 ft TDH, Firm Capacity: 56.7 mgd, 3@150 hp, 2@200 hp. | 0 | No Improvement needs | 0 | EA | $0 | 0 |

| PRIMARY CLARIFICATION | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
| Primary Clarifiers | 4 | 158' X 46'; 2.59 MG total. | 4 New | 100' dia, 12' SWD tanks | 2,800 | CY | $600 | $1,680,000 |
| Primary Clarifier Mechanisms | 4 | 158' X 46'; 2.59 MG total. | 4 New | Primary Clarifier Mechanisms for 100' dia tanks | 4 | EA | $350,000 | $1,890,000 |
| Scum Pumps | 2 | Firm Capacity: 150 gpm, 44' TDH, 7.5 hp. | 2 New | New 150 gpm pumps for new facilities | 2 | EA | $25,000 | $67,500 |
| Primary Sludge Pumps | 4 | Firm Capacity: 170 gpm ea, 110' TDH, 10 hp; 500 gpm Firm Capacity. | 4 New | New pumps for new facilities | 4 | EA | $20,000 | $108,000 |
| PS Pump Building | | | 1 New | New 20' x 25' building to house 4 new pumps | 500 | SF | $250 | $125,000 |

| AERATION BASINS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
| Aeration Basins | 3 | 204'x68', SWD: 24.83'; Volume: 2.58 MG ea. | 3 Modification | Tank modification and repair; Divide each basin into 7 zones; Add new headers and diffuser holders. | 1,599 | CY | $600 | $959,400 |
| Aeration Basins | | - | 3 New | Add (3) new basins with 7 zones: 204'x68', SWD: 29.05', 3.02 MG | 6,900 | CY | $600 | $4,140,000 |
| Diffusers | 11133 | 3,711 diffusers with 1,463 blank per basin, | 4,900 New | Required: 4900 diffusers for 3 existing basins and 3 new basins in order to get 2.0 scfm ea. | 4,900 | EA | $50 | $330,750 |
| Blowers | 3 | Capacity: 11,400 scfm ea. Firm Capacity: 22,800 scfm. | 0 | No improvements needed; 19,600 scfm for all basins required. | 0 | EA | $0 | $0 |
| Mixers | 0 | - | 78 New | Mixers for anoxic zones: 5 hp each (used 50 hp per MG as the design basis) | 78 | EA | $10,000 | $1,053,000 |
| MLR Pumps | 0 | - | 6 New | One for each basin @ 14,630 gpm (21.1 mgd) and 70 hp. | 6 | EA | $85,000 | $688,500 |

## SECONDARY CLARIFICATION

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Secondary Clarifier | 4 | 110 ft in diameter; 14 ft SWD; 1 MG ea. | 4 New | Match Existing: 110 ft in diameter; Concrete quantity (each): 24,914 cf=922 cy | 3,688 | CY | $600 | $2,212,800 |
| Secondary Clarifier Mechanism | 4 | Center-feed; truss bridge walkway; rotating arms; solids collector; scum collection, etc. | 4 New | Match existing | 4 | EA | $350,000 | $1,890,000 |
| RAS Pumps (Station No. 1) | 6 | 4 duty, 2 standby; Capacity: 1@ 2500, 1@3800, 1@4500, 1@5300 gpm; Firm capacity: 13 mgd; 100 hp | 1 New | Required Firm Capacity: 15.8 mgd. Replace 2500 gpm pump with 2800 gpm (4.00 mgd), 100 hp pump. | 1 | EA | $50,000 | $67,500 |
| RAS Pumps (Station No. 2) | 0 | - | 5 New | Required Firm Capacity: 15.8 mgd. 5 new pumps (4 duty, 1 standby) at 2800 gpm (4.00 mgd), 100 hp ea. | 5 | EA | $50,000 | $337,500 |
| | 0 | - | 1 New PS | New 25' x 25' RAS pump station to house 5 new pumps. | 625 | SF | $250 | $156,250 |
| WAS Pumps | 0 | - | 3 New | Add three - 175 gpm, 5 hp horizontal centrifugal pumps | 3 | EA | $10,000 | $40,500 |

## EQUALIZATION

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| EQ Basin | 0 | - | 1 New | Modify Existing Sludge Lagoons -clean and install liner to create 12 MG of EQ | 1 | LS | $2,250,000 | $2,250,000 |

## TERTIARY FILTERS

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Cloth Disk Filters | 0 | - | 13 | 2.5 mgd ADF each, 5.0 mgd PH each | 13 | EA | $285,000 | $5,001,750 |

## SOLIDS HANDLING

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Gravity Thickener | 1 | 105 ft dia, polymer | 0 | Assuming cothickening in the Primary Clarifier - recommend GBT. | 0 | | $0 | $0 |
| Thickened Solids Pumps | 3 | 170 gpm each, 110 ft TDH, 10 hp each | 1 | Add 1 progressing cavity pump at 170 gpm, 10 hp. | 1 | 1 | $20,000 | $20,000 |
| Gravity Belt Thickener | 0 | - | 1 | 3 m belt width. Run 15 hrs/day, 7 days/wk. | 1 | EA | $250,000 | $337,500 |
| TWAS Pump | - | - | 1 | 250 gpm, 100 TDH, 50 hp progressing cavity pump | 1 | EA | $40,000 | $54,000 |
| GBT Building | - | - | 1 | New 30' x 30' bldg for GBT, polymer system and TWAS pump | 900 | SF | $250 | $225,000 |
| Digesters | 4 | 0.268 cuft each, 1.07 cuft total | 0 | 30 days SRT - no improvements needed. | 0 | | $0 | $0 |
| Dig sludge transfer pumps | 3 | 260 gpm ea, 40 hp | 0 | Adequate if pumped at 9 hrs/day or more. | 0 | | $0 | $0 |

## CHLORINE DISINFECTION

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Chlorine Contact Basin | 2 | Disinfection Volume 0.94 MG; 23.9 min at PH flow of 56.7 mgd. | 0 | No improvements needed. | 0 | | $0 | $0 |

## CHEMICAL FEED SYSTEM

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Methanol | - | - | 1 | Required dosage 750 gpd: | 1 | LS | $582,000 | $582,000 |
| Alum | - | - | 1 | Required dosage 4,500 gpd: 7 - 27 gph feed pumps and 3 - 22,500 gal FRP storage tanks (15 days storage) | 1 | LS | $310,000 | $310,000 |
| | | | | | | **Subtotal** | | **$27,847,000** |
| | | | | | | Electrical/Instrumentation (23%) | | $6,405,000 |
| | | | | | | Piping and Appurtenances (12%) | | $3,342,000 |
| | | | | | | Site Work (5%) | | $1,392,000 |
| | | | | | | **Subtotal** | | **$38,986,000** |

## PIPING AND PUMPING

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Influent/EQ Pump Station | - | - | 1 New | New 60 mgd pump station: 32 mgd to EQ and 28 to new WWTP facilities. | 1 | LS | $14,100,000 | $14,100,000 |
| Force Main | - | - | 1 New | 48" DIP Force Main from proposed Infl/EQ PS to new headworks | 800 | LF | $706 | $565,000 |
| Muddy Creek Transfer PS | - | - | 1 New | New 29 mgd firm capacity pump station at MCWWTP to transfer all South Fork basin flows to the AEWWTP | 1 | LS | $6,300,000 | $6,300,000 |
| 48" Dia Force Main | - | - | 1 New | 48" diameter force main from MCWWTP to AEWWTP | 23,000 | LF | $706 | $16,238,000 |
| | | | | | | **Subtotal** | | **$76,189,000** |
| | | | | | | Insurance and Bonds (2.5%) | | $1,905,000 |
| | | | | | | Permits (0.50%) | | $394,000 |
| | | | | | | General Conditions (6.0%) | | $4,709,000 |
| | | | | | | Indirect OH&P (8.0%) | | $6,656,000 |
| | | | | | | **Subtotal** | | **$89,853,000** |
| | | | | | | Contingency (25%) | | $22,463,000 |
| | | | | | | Allowance for Cost Escalation (6%) | | $5,391,000 |
| | | | | | | **CONSTRUCTION TOTAL** | | **$117,700,000** |
| | | | | | | Design and Construction Services Fee (15%) | | $17,655,000 |
| | | | | | | **GRAND TOTAL** | | **$135,355,000** |

# MUDDY CREEK WWTP IMPROVEMENT ALTERNATIVE 4 SUMMARY

***Flow Option 2 - 30 ADMM; 56.4 MD; 89.6 PH (56.7 PH with EQ)***
***Permit Scenario 2 - N/A TN and 0.2 mg/L TP***

***Major Improvement Needs:***

*Construct a parallel biological process train at 7.73 MG ;*
*Air requirement for all basins is 22,300 scfm;*
*Increase capacity of RAS pumps to 30 mgd (ADMM) firm capacity;*
*Add tertiary filters;*
*Add chemical facilities;*
*Add four new primary clarifiers at 100 ft diameter*
*Add four new Secondary Clarifiers at 110 ft diameter;*
*Add 12 MG of storage volume (EQ basin);*
*Add GBT, pumping and building*

Installation Cost 35%

## HEADWORKS

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Bar Screens | 3 | Max. capacity: 26.2 mgd ea. Firm capacity: 52.4 mgd, 0.25" opening | 3 New | 3 - 30 mgd climber bar screens. | 3 | EA | $350,000 | $1,417,500 |

## GRIT REMOVAL

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Grit Removal Units | 3 | Max. capacity: 13 mgd ea. | 2 New | 60 mgd total vortex grit removal capacity: 2 - 30 mgd basins | 2 | EA | $40,000 | $108,000 |
| | | - | 2 New | Concrete for grit basins | 2,000 | CY | $800 | $1,600,000 |
| Grit Pumps | | - | 2 New | Recessed impeller centrifugal; 250 gpm | 2 | EA | $12,000 | $32,400 |
| Grit Classifier | | - | 2 New | 250 gpm grit classifiers | 2 | EA | $60,000 | $162,000 |

## INFLUENT PUMPING

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Influent Pumps | 5 | Spiral Screw; Max. Capacity: 3@11.7 mgd, 2@21.6 mgd, 45 ft TDH, Firm Capacity: 56.7 mgd, 3@150 hp, 2@200 hp. | 0 | No Improvement needs | 0 | EA | 0 | 0 |

## PRIMARY CLARIFICATION

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Primary Clarifiers | 4 | 158' X 46'; 2.59 MG total. | 4 New | 100' dia, 12' SWD tanks | 2,800 | CY | $600 | $1,680,000 |
| Primary Clarifier Mechanisms | 4 | 158' X 46'; 2.59 MG total. | 4 New | Primary Clarifier Mechanisms for 100' dia tanks | 4 | EA | $350,000 | $1,890,000 |
| Scum Pumps | 2 | Firm Capacity: 150 gpm, 44' TDH, 7.5 hp. | 2 New | New 150 gpm pumps for new facilities | 2 | EA | $25,000 | $67,500 |
| Primary Sludge Pumps | 4 | Firm Capacity: 170 gpm ea, 110' TDH, 10 hp; 500 gpm Firm Capacity. | 4 New | New pumps for new facilities | 4 | EA | $20,000 | $108,000 |
| PS Pump Building | 1 | - | 1 New | New 20' x 25' building to house 4 new pumps | 500 | SF | $250 | $125,000 |

## AERATION BASINS

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Aeration Basins | 3 | 204'x68', SWD: 24.83'; Volume: 2.58 MG ea. | 3 New | Add (3) new basins: 204'x68', SWD: 29.05', 3.02 MG | 5,325 | CY | $600 | $3,195,000 |
| Diffusers | 11133 | 3,711 diffusers with 1,463 blank per basin, | 5575 | Required: 5575 diffusers for 3 existing basins and 3 new basins in order to get 2.0 scfm ea. | 5,575 | EA | $50 | $376,313 |
| Blowers | 3 | Capacity: 11,400 scfm ea. Firm Capacity: 22,800 scfm. | 0 | No improvements needed; 22,300 scfm for all basins required. | 0 | EA | $0 | $0 |

## SECONDARY CLARIFICATION

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Secondary Clarifier | 4 | 110 ft in diameter; 14 ft SWD; 1 MG ea. | 4 New | Match Existing: 110 ft in diameter; Concrete quantity (each): 24,914 cf=922 cy | 3,688 | CY | $600 | $2,212,800 |
| Secondary Clarifier Mechanism | 4 | Center-feed; truss bridge walkway; rotating arms; solids collector; scum collection, etc. | 4 New | Match existing | 4 | EA | $350,000 | $1,890,000 |
| RAS Pumps (Station No. 1) | 6 | 4 duty, 2 standby; Capacity: 1@ 2500, 1@3800, 1@4500, 1@5300 gpm; Firm capacity: 13 mgd; 100 hp | 1 New | Required Firm Capacity: 15.8 mgd. Replace 2500 gpm pump with 2800 gpm (4.00 mgd), 100 hp pump. | 1 | EA | $50,000 | $67,500 |
| RAS Pumps (Station No. 2) | 0 | - | 5 New | Required Firm Capacity: 15.8 mgd. 5 new pumps (4 duty, 1 standby) at 2800 gpm (4.00 mgd), 100 hp ea. | 5 | EA | $50,000 | $337,500 |
| | 0 | - | 1 New PS | New 25' x 25' RAS pump station to house 5 new pumps. | 625 | SF | $250 | $156,250 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| WAS Pumps | 0 | - | 3 New | Add three - 175 gpm, 5 hp horizontal centrifugal pumps | 3 | EA | $10,000 | $40,500 |

**EQUALIZATION**

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| EQ Basin | 0 | - | 1 New | Modify Existing Sludge Lagoons -clean and install liner to create 12 MG of EQ | 1 | LS | $2,250,000 | $2,250,000 |

**TERTIARY FILTERS**

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Cloth Disk Filters | 0 | - | 13 | 2.5 mgd ADF each, 5.0 mgd PH each | 13 | EA | $285,000 | $5,001,750 |

**SOLIDS HANDLING**

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Gravity Thickener | 1 | 105 ft dia, polymer | 0 | Assuming cothickening in the Primary Clarifier | 0 | | $0 | $0 |
| Thickened Solids Pumps | 3 | 170 gpm each, 110 ft TDH, 10 hp each | 1 | Add 1 progressing cavity pump at 170 gpm, 10 hp. | 1 | 1 | $20,000 | $20,000 |
| Gravity Belt Thickener | 0 | - | 1 | 3 m belt width. Run 15 hrs/day, 7 days/wk. | 1 | EA | $250,000 | $337,500 |
| TWAS Pump | - | - | 1 | 250 gpm, 100 TDH, 50 hp progressing cavity pump | 1 | EA | $40,000 | $54,000 |
| GBT Building | - | - | 1 | New 30' x 30' bldg for GBT, polymer system and TWAS pump | 900 | SF | $250 | $225,000 |
| Digesters | 4 | 0.268 cuft each, 1.07 cuft total | 0 | 30 days SRT - no improvements needed. | 0 | | $0 | $0 |
| Dig sludge transfer pumps | 3 | 260 gpm ea, 40 hp | 0 | Adequate if pumped at 9 hrs/day or more. | 0 | | $0 | $0 |

**CHLORINE DISINFECTION**

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Chlorine Contact Basin | 2 | Disinfection Volume 0.94 MG; 23.9 min at PH flow of 56.7 mgd. | 0 | No improvements needed. | 0 | | $0 | $0 |

**CHEMICAL FEED SYSTEM**

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Methanol | - | - | 1 | Required dosage 750 gpd: | 0 | LS | $0 | $0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Alum | - | - | 1 | Required dosage 5,900 gpd: 7 - 35 gph feed pumps and 3 - 29,500 gal FRP storage tanks (15 days storage) | 1 | LS | $351,000 | $351,000 |

| | |
|---|---|
| **Subtotal** | **$23,706,000** |
| Electrical/Instrumentation (23%) | $5,452,000 |
| Piping and Appurtenances (12%) | $2,845,000 |
| Site Work (5%) | $1,185,000 |
| **Subtotal** | **$33,188,000** |

**PIPING AND PUMPING**

| PROCESS COMPONENTS | EXIST UNITS | EXIST. COMPONENTS DESIGN CRITERIA | PROPOSED UNITS | IMPROVEMENT DESCRIPTION/ WORK INVOLVED | QUANTITY | UNIT | $/UNIT | INSTALLED COST |
|---|---|---|---|---|---|---|---|---|
| Influent/EQ Pump Station | - | - | 1 New | New 60 mgd pump station: 32 mgd to EQ and 28 to new WWTP facilities. | 1 | LS | $14,100,000 | $14,100,000 |
| Force Main | - | - | 1 New | 48" DIP Force Main from proposed Infl/EQ PS to new headworks | 800 | LF | $706 | $565,000 |
| Muddy Creek Transfer PS | - | - | 1 New | New 29 mgd firm capacity pump station at MCWWTP to transfer all South Fork basin flows to the AEWWTP | 1 | LS | $6,300,000 | $6,300,000 |
| 48" Dia Force Main | - | - | 1 New | 48" diameter force main from MCWWTP to AEWWTP | 23,000 | LF | $706 | $16,238,000 |

| | |
|---|---|
| **Subtotal** | **$70,391,000** |
| Insurance and Bonds (2.5%) | $1,760,000 |
| Permits (0.50%) | $364,000 |
| General Conditions (6.0%) | $4,351,000 |
| Indirect OH&P (8.0%) | $6,149,000 |
| **Subtotal** | **$83,015,000** |
| Contingency (25%) | $20,754,000 |
| Allowance for Cost Escalation (6%) | $4,981,000 |
| **CONSTRUCTION TOTAL** | **$108,800,000** |
| Design and Construction Services Fee (15%) | $16,320,000 |
| **GRAND TOTAL** | **$125,120,000** |

# Appendix E
# Wastewater Treatment Alternatives Present Worth Analyses

**20-YEAR PRESENT WORTH ANALYSIS**
**Alternative 1**

**Cost Analysis**

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Capital Costs (AEWWTP and MCWWTP) | $203,205,000 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | |
| Annual Power Costs* | $3,043,876 | $3,135,192 | $3,229,248 | $3,326,125 | $3,425,909 | $3,528,687 | $3,634,547 | $3,743,584 | $3,855,891 | $3,971,568 | $4,090,715 | $4,213,436 | $4,339,839 | $4,470,035 | $4,604,136 | $4,742,260 | $4,884,527 | $5,031,063 | $5,181,995 | $5,337,455 | $5,497,579 | |
| Annual Chemical Costs* | $6,682,914 | $6,883,401 | $7,089,903 | $7,302,601 | $7,521,679 | $7,747,329 | $7,979,749 | $8,219,141 | $8,465,716 | $8,719,687 | $8,981,278 | $9,250,716 | $9,528,237 | $9,814,085 | $10,108,507 | $10,411,762 | $10,724,115 | $11,045,839 | $11,377,214 | $11,718,530 | $12,070,086 | |

**Present Worth Analysis**

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0.9551 | 0.9122 | 0.8713 | 0.8322 | 0.7948 | 0.7591 | 0.7251 | 0.6925 | 0.6614 | 0.6317 | 0.6034 | 0.5763 | 0.5504 | 0.5257 | 0.5021 | 0.4796 | 0.4580 | 0.4375 | 0.4178 | 0.3991 | |
| Yearly Present Worth of Capital Costs | $203,205,000 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | **$203,205,000** |
| Yearly Present Worth of Power Costs | $3,043,876 | $2,994,453 | $2,945,832 | $2,898,001 | $2,850,947 | $2,804,656 | $2,759,118 | $2,714,318 | $2,670,246 | $2,626,890 | $2,584,237 | $2,542,277 | $2,500,999 | $2,460,390 | $2,420,441 | $2,381,141 | $2,342,479 | $2,304,444 | $2,267,027 | $2,230,218 | $2,194,006 | **$54,535,998** |
| Yearly Present Worth of Chemical Costs | $6,682,914 | $6,574,404 | $6,467,657 | $6,362,642 | $6,259,333 | $6,157,701 | $6,057,719 | $5,959,361 | $5,862,599 | $5,767,409 | $5,673,764 | $5,581,640 | $5,491,012 | $5,401,855 | $5,314,146 | $5,227,861 | $5,142,977 | $5,059,471 | $4,977,321 | $4,896,505 | $4,817,001 | **$119,735,292** |
| **Total Costs** | **$212,931,790** | **$9,568,857** | **$9,413,489** | **$9,260,644** | **$9,110,280** | **$8,962,357** | **$8,816,837** | **$8,673,679** | **$8,532,846** | **$8,394,299** | **$8,258,002** | **$8,123,918** | **$7,992,011** | **$7,862,245** | **$7,734,587** | **$7,609,002** | **$7,485,455** | **$7,363,915** | **$7,244,348** | **$7,126,723** | **$7,011,007** | **$377,476,290** |

**20-year Total Present Worth for Wastewater Treatment Improvement Alternative 1**

**$377,476,290**

*Based on inflation increase of 3% per year.

0.047 EPA Discount Rate

**20-YEAR PRESENT WORTH ANALYSIS**
**Alternative 2**

**Cost Analysis**

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Capital Costs (AEWWTP and MCWWTP) | $214,245,000 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | |
| Annual Power Costs* | $3,308,521 | $3,407,777 | $3,510,010 | $3,615,310 | $3,723,770 | $3,835,483 | $3,950,547 | $4,069,064 | $4,191,135 | $4,316,869 | $4,446,376 | $4,579,767 | $4,717,160 | $4,858,675 | $5,004,435 | $5,154,568 | $5,309,205 | $5,468,481 | $5,632,536 | $5,801,512 | $5,975,557 | |
| Annual Chemical Costs* | $6,305,304 | $6,494,463 | $6,689,297 | $6,889,976 | $7,096,675 | $7,309,575 | $7,528,863 | $7,754,729 | $7,987,370 | $8,226,992 | $8,473,801 | $8,728,015 | $8,989,856 | $9,259,551 | $9,537,338 | $9,823,458 | $10,118,162 | $10,421,707 | $10,734,358 | $11,056,389 | $11,388,080 | |
| **Present Worth Analysis** | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | |
| | | 0.9551 | 0.9122 | 0.8713 | 0.8322 | 0.7948 | 0.7591 | 0.7251 | 0.6925 | 0.6614 | 0.6317 | 0.6034 | 0.5763 | 0.5504 | 0.5257 | 0.5021 | 0.4796 | 0.4580 | 0.4375 | 0.4178 | 0.3991 | |
| Yearly Present Worth of Capital Costs | $214,245,000 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | **$214,245,000** |
| Yearly Present Worth of Power Costs | $3,308,521 | $3,254,801 | $3,201,953 | $3,149,964 | $3,098,818 | $3,048,503 | $2,999,005 | $2,950,310 | $2,902,407 | $2,855,281 | $2,808,920 | $2,763,312 | $2,718,444 | $2,674,305 | $2,630,883 | $2,588,165 | $2,546,142 | $2,504,800 | $2,464,130 | $2,424,121 | $2,384,760 | **$59,277,544** |
| Yearly Present Worth of Chemical Costs | $6,305,304 | $6,202,926 | $6,102,210 | $6,003,129 | $5,905,657 | $5,809,767 | $5,715,435 | $5,622,634 | $5,531,340 | $5,441,529 | $5,353,175 | $5,266,256 | $5,180,749 | $5,096,630 | $5,013,877 | $4,932,467 | $4,852,379 | $4,773,592 | $4,696,083 | $4,619,834 | $4,544,822 | **$112,969,794** |
| **Total Costs** | **$223,858,825** | **$9,457,727** | **$9,304,163** | **$9,153,092** | **$9,004,475** | **$8,858,270** | **$8,714,440** | **$8,572,945** | **$8,433,747** | **$8,296,809** | **$8,162,095** | **$8,029,568** | **$7,899,193** | **$7,770,935** | **$7,644,759** | **$7,520,632** | **$7,398,521** | **$7,278,392** | **$7,160,214** | **$7,043,954** | **$6,929,583** | **$386,492,338** |

**20-year Total Present Worth for Wastewater Treatment Improvement Alternative 2**

**$386,492,338**

*Based on inflation increase of 3% per year.

0.047 EPA Discount Rate

**20-YEAR PRESENT WORTH ANALYSIS**
**Alternative 3**

**Cost Analysis**

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Capital Costs (AEWWTP and MCWWTP) | $176,985,000 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | |
| Annual Power Costs* | $2,494,423 | $2,569,256 | $2,646,333 | $2,725,723 | $2,807,495 | $2,891,720 | $2,978,472 | $3,067,826 | $3,159,860 | $3,254,656 | $3,352,296 | $3,452,865 | $3,556,451 | $3,663,144 | $3,773,039 | $3,886,230 | $4,002,817 | $4,122,901 | $4,246,588 | $4,373,986 | $4,505,205 | |
| Annual Chemical Costs* | $8,503,852 | $8,758,968 | $9,021,737 | $9,292,389 | $9,571,160 | $9,858,295 | $10,154,044 | $10,458,665 | $10,772,425 | $11,095,598 | $11,428,466 | $11,771,320 | $12,124,460 | $12,488,193 | $12,862,839 | $13,248,724 | $13,646,186 | $14,055,572 | $14,477,239 | $14,911,556 | $15,358,903 | |
| **Present Worth Analysis** | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | |
| | | 0.9551 | 0.9122 | 0.8713 | 0.8322 | 0.7948 | 0.7591 | 0.7251 | 0.6925 | 0.6614 | 0.6317 | 0.6034 | 0.5763 | 0.5504 | 0.5257 | 0.5021 | 0.4796 | 0.4580 | 0.4375 | 0.4178 | 0.3991 | |
| Yearly Present Worth of Capital Costs | $176,985,000 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | **$176,985,000** |
| Yearly Present Worth of Power Costs | $2,494,423 | $2,453,921 | $2,414,077 | $2,374,880 | $2,336,320 | $2,298,385 | $2,261,067 | $2,224,354 | $2,188,237 | $2,152,707 | $2,117,754 | $2,083,368 | $2,049,541 | $2,016,263 | $1,983,525 | $1,951,319 | $1,919,636 | $1,888,467 | $1,857,804 | $1,827,639 | $1,797,964 | **$44,691,652** |
| Yearly Present Worth of Chemical Costs | $8,503,852 | $8,365,776 | $8,229,942 | $8,096,314 | $7,964,855 | $7,835,531 | $7,708,306 | $7,583,147 | $7,460,021 | $7,338,893 | $7,219,733 | $7,102,507 | $6,987,184 | $6,873,734 | $6,762,127 | $6,652,331 | $6,544,318 | $6,438,059 | $6,333,525 | $6,230,688 | $6,129,521 | **$152,360,363** |
| **Total Costs** | **$187,983,275** | **$10,819,697** | **$10,644,019** | **$10,471,194** | **$10,301,175** | **$10,133,916** | **$9,969,373** | **$9,807,501** | **$9,648,258** | **$9,491,601** | **$9,337,487** | **$9,185,875** | **$9,036,726** | **$8,889,997** | **$8,745,652** | **$8,603,650** | **$8,463,953** | **$8,326,525** | **$8,191,329** | **$8,058,327** | **$7,927,485** | **$374,037,015** |

**20-year Total Present Worth for Wastewater Treatment Improvement Alternative 3**

**$374,037,015**

*Based on inflation increase of 3% per year.

0.047 EPA Discount Rate

**20-YEAR PRESENT WORTH ANALYSIS**
**Alternative 4**

**Cost Analysis**

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Capital Costs (AEWWTP and MCWWTP) | $191,590,000 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | |
| Annual Power Costs* | $2,697,332 | $2,778,252 | $2,861,600 | $2,947,448 | $3,035,871 | $3,126,947 | $3,220,755 | $3,317,378 | $3,416,899 | $3,519,406 | $3,624,989 | $3,733,738 | $3,845,750 | $3,961,123 | $4,079,957 | $4,202,355 | $4,328,426 | $4,458,279 | $4,592,027 | $4,729,788 | $4,871,682 | |
| Annual Chemical Costs* | $8,011,505 | $8,251,850 | $8,499,406 | $8,754,388 | $9,017,019 | $9,287,530 | $9,566,156 | $9,853,141 | $10,148,735 | $10,453,197 | $10,766,793 | $11,089,797 | $11,422,490 | $11,765,165 | $12,118,120 | $12,481,664 | $12,856,114 | $13,241,797 | $13,639,051 | $14,048,223 | $14,469,669 | |

**Present Worth Analysis**

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0.9551 | 0.9122 | 0.8713 | 0.8322 | 0.7948 | 0.7591 | 0.7251 | 0.6925 | 0.6614 | 0.6317 | 0.6034 | 0.5763 | 0.5504 | 0.5257 | 0.5021 | 0.4796 | 0.4580 | 0.4375 | 0.4178 | 0.3991 | |
| Yearly Present Worth of Capital Costs | $191,590,000 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | **$191,590,000** |
| Yearly Present Worth of Power Costs | $2,697,332 | $2,653,536 | $2,610,451 | $2,568,065 | $2,526,368 | $2,485,347 | $2,444,993 | $2,405,294 | $2,366,240 | $2,327,819 | $2,290,023 | $2,252,840 | $2,216,261 | $2,180,276 | $2,144,875 | $2,110,049 | $2,075,788 | $2,042,084 | $2,008,927 | $1,976,308 | $1,944,219 | **$48,327,097** |
| Yearly Present Worth of Chemical Costs | $8,011,505 | $7,881,423 | $7,753,454 | $7,627,562 | $7,503,714 | $7,381,877 | $7,262,019 | $7,144,106 | $7,028,108 | $6,913,994 | $6,801,732 | $6,691,294 | $6,582,648 | $6,475,766 | $6,370,620 | $6,267,181 | $6,165,422 | $6,065,315 | $5,966,833 | $5,869,950 | $5,774,641 | **$143,539,165** |
| **Total Costs** | **$202,298,837** | **$10,534,959** | **$10,363,904** | **$10,195,627** | **$10,030,082** | **$9,867,225** | **$9,707,012** | **$9,549,401** | **$9,394,348** | **$9,241,813** | **$9,091,755** | **$8,944,134** | **$8,798,909** | **$8,656,042** | **$8,515,495** | **$8,377,230** | **$8,241,210** | **$8,107,399** | **$7,975,760** | **$7,846,259** | **$7,718,860** | **$383,456,262** |

**20-year Total Present Worth for Wastewater Treatment Improvement Alternative 4**

**$383,456,262**

*Based on inflation increase of 3% per year.

0.047 EPA Discount Rate

# Appendix F
# Wastewater Treatment Alternatives Process Options Scoring Rationale

**Alternative Scoring Rationale**

| ***Constructability*** | | |
|---|---|---|
| ***Alternative*** | ***Score*** | ***Basis*** |
| *1* | *4* | *Moderate construction for preliminary and secondary treatments at both plants, modification on aeration basins, larger force main* |
| *2* | *2* | *Significant construction at MCWWTP, modification on aeration basins, new site for pump station, smaller force main* |
| *3* | *4* | *Moderate construction for preliminary treatment at both plants, larger force main* |
| *4* | *2* | *No construction on AEWWTP, significant construction on MCWWTP, new site for pump station, smaller force main* |

| ***Permitability*** | | |
|---|---|---|
| ***Alternative*** | ***Score*** | ***Basis*** |
| *1* | *4* | *Complex bioprocess, needs carbon feed* |
| *2* | *3* | *Complex process, needs carbon feed, more secondary clarifiers to operate at MCWWTP* |
| *3* | *4* | *Simplest process* |
| *4* | *3* | *Simple process, more secondary clarifiers to operate at MCWWTP* |

| ***Operability*** | | |
|---|---|---|
| ***Alternative*** | ***Score*** | ***Basis*** |
| *1* | *4* | *Most feasible for future expansion* |
| *2* | *2* | *Least feasible for future expansion* |
| *3* | *5* | *Second most feasible for future expansion* |
| *4* | *3* | *Second least feasible for future expansion* |

| ***Environmental Impacts*** | | |
|---|---|---|
| ***Alternative*** | ***Score*** | ***Basis*** |
| *1* | *2* | *Least disturbed areas, second most power consumption* |
| *2* | *3* | *Most disturbed areas, most power consumption* |
| *3* | *2* | *Second least disturbed areas, least power consumption* |
| *4* | *3* | *Second most disturbed areas, second least power consumption* |

| ***Community Impacts*** | | |
|---|---|---|
| ***Alternative*** | ***Score*** | ***Basis*** |
| *1* | *3* | *On site work, second least chemical delivery traffic, less sludge hauling, less odor impact to surroundings* |
| *2* | *4* | *Most site expansion, least chemical delivery traffic, less sludge hauling, more odor impact to surroundings* |
| *3* | *2* | *Modest site expansion, most chemical delivery traffic, more sludge hauling; less odor impact to surroundings* |
| *4* | *3* | *Second most site expansion, second most chemical delivery traffic, more sludge hauling, more odor impact* |