

Hall County, Georgia

Preliminary Engineering Report Update

Mulberry Creek PS, Reunion PS, & Force Main

December 2021

Prepared By:

CEC

CIVIL ENGINEERING CONSULTANTS, INC.

Civil & Environmental Engineering

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#### **BACKGROUND**

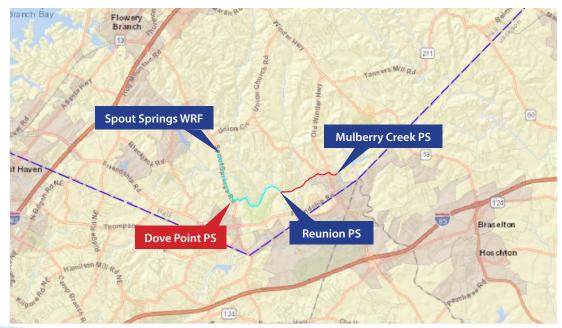
A Preliminary Engineering Report for the Mulberry Regional facilities was prepared and submitted November 2015 by Tetra Tech, Inc. Currently, the wastewater flows entering the Mulberry Creek Pump Station (PS) are discharged to the Crystal Farms Lift Station to be re-pumped to the City of Gainesville for treatment. The wastewater flow discharged from the Reunion PS is treated at the Spout Springs Water Reclamation Facility (SSWRF). The 2015 Tetra Tech report provided recommendations to redirect the Mulberry Creek PS flows to the Spout Springs WRF.

This report serves as an update to the Tetra Tech 2015 report and includes:

- 1. Revised flow projections.
- 2. Re-evaluates pump back options to convey wastewater flows from Mulberry Creek PS to Reunion PS to SSWRF and pumping directly from Mulberry Creek PS to SSWRF directly and bypassing the Reunion PS.
- 3. Mitigation options and recommendations to address solids build up at the Mulberry Creek PS wet well.
- 4. Addresses surge mitigation for the various pump back options in this report. The surge analysis is included in Appendix C.
- 5. Screening the influent flows at the Mulberry Creek PS
- 6. Discussion on mitigating long detention times in the force main between Mulberry Creek and Crystal Farms pump station.

#### **Figure 1: Location Map**

Figure 1 depicts the overall location of the pump stations. The Mulberry Creek and Reunion pump stations are existing. The Dove Point PS is a proposed pump station considered in pump back option C and will be discussed in detail later in this report.



As part of each pump back option, Hall County must relocate the existing 14-inch force main along Spout Springs Road to accommodate the highway widening. Construction of approximately 6,400 linear feet of 16-inch or 18-inch DIPS HDPE force main was included in the analysis for the three pump back options below. The total estimated construction cost is \$1,280,000. The 16-inch pipe was selected to convey the anticipated 1,980gpm flows. The maximum future capacity of the 16-inch force main is approximately 2,800gpm. Alternatively, an 18-inch force main could be constructed for \$1,467,000. A detailed opinion of probable construction cost for the force main is included in Appendix A. The maximum future capacity of the 18-inch force main is approximately 3,100gpm. The capacity is limited mostly due to the 156ft of static head. A 160hp Flygt pump was selected as the largest pump size considered for this station. Larger pumps provide a minimum increase in flow due to the relatively high static head the pumps must overcome.

### **Basis of Design Update – Future Flows**

The County provided the following flow data in Table 1. The average flow at Crystal Farms Lift Station which should also be the average flow for Mulberry Creek from July 20-June 21 was 182,362 gallon per day according to the Gainesville meter report. Also, the flows for SSWRF from July 20-June 21 were 306,058 gallon per day according to the effluent meter reading.

	Current	2015 Opinion <sup>1</sup>	2020 Master Plan Update <sup>2</sup>		date²
	ADF-mgd	ADF-mgd	ADF-mgd	MMF-mgd	PHF-mgd
Mulberry River	0	0.537	0.683	0.854	1.707
Mulberry Creek	0.182	0.152	0.340	0.424	0.849
Mulberry PS Total	0.182	0.689	1.023	1.278	2.556
Reunion	Unknown	0.255	0.119	0.149	0.298

**Table 1: Wastewater Flows** 

#### Source:

1 Tetra Tech 2015 Mulberry Creek PS, Reunion PS, Force Main, and Spouts Springs WWTP Preliminary Engineering Report.

During workshop meetings with the County and Civil Engineering Consultants (CEC), consensus was reached to use updated Master Plan flows shown in Table 1 for pump back option(s) re-evaluation. In cases where flows may seem excessive, it was agreed upon to use sound engineering judgement to avoid over estimating flow conditions. The tables shown in the following page came from the AECOM 2020 Master Plan Update and serve as back-up information in this report.

<sup>2</sup> AECOM Sewer Master Plan and Rate Study: 2020 Update, Table 3-7, 3-8

# **Projected Build-Out Wastewater Flows – South Hall Service Areas**

Dyninago Pasin	Build-Out Wastewater Flow					
Drainage Basin	ADF- mgd MMF-mgd		PHF-mgd			
Caney Fork Creek	0.634	0.792	1.585			
Cooper Creek	0.843	1.054	2.108			
Deaton Creek	0.872	1.090	2.179			
Lollis Creek	0.295	0.369	0.738			
Lott Creek	0.136	0.171	0.341			
Mitchell Creek	0.751	0.939	1.878			
Mulberry Creek	0.340	0.424	0.849			
Mulberry River	0.683	0.854	1.707			
Reunion	0.119	0.149	0.298			
Sherwood Creek	0.056	0.070	0.140			
Total	4.729	5.912	11.823			

1 source: AECOM Table 3-7 Sewer Master Plan: 2020 Update

# Projected Build-Out Wastewater Flows by Type – South Hall Service Area

	Build-Out Wastewater Flows (ADF-mgd)						
Drainage Basin	Residential	Commercial/ Industrial	Institutional/ Public	Mixed Use Transitional	Septic to Sewer Conversion	Total	
Caney Fork Creek	0.475	0.048	0.057	0.000	0.053	0.634	
Cooper Creek	0.087	0.385	0.000	0.368	0.004	0.843	
Deaton Creek	0.662	0.019	0.082	0.093	0.015	0.872	
Lollis Creek	0.269	0.000	0.026	0.000	0.000	0.295	
Lott Creek	0.126	0.000	0.001	0.000	0.009	0.136	
Mitchell Creek	0.441	0.157	0.043	0.111	0.000	0.751	
Mulberry Creek	0.156	0.009	0.164	0.000	0.011	0.340	
Mulberry River	0.035	0.280	0.021	0.343	0.004	0.683	
Reunion	0.092	0.028	0.000	0.000	0.000	0.119	

2 source: AECOM Table 3-8 Sewer Master Plan: 2020 Update

# **Summary of Initial and Future Flow Conditions**

Location	Initial Flows before Transfer to Mulberry Creek Pump Station (MGD)	Initial Flows after Transfer to Mulberry Creek Pump Station (MGD)	Future Buildout Flows (MGD)				
To Mulberry Creek PS							
From Medical Park	0.000	0.015	0.015				
From Village of Deaton Creek	0.000	0.100	0.137				
From SR 211 Basin	0.000	0.000	0.537				
Total to Mulberry Creek PS	0.000	0.115	0.689				
To Reunion PS							
From Medical Park	0.015	0.000	0.000 (to Mulberry Creek Pump Station)				
From Village of Deaton Creek	0.100	0.000	0.000 (to Mulberry Creek Pump Station)				
From Reunion Subdivision	0.157	0.157	0.255				
Total From Mulberry Creek PS	0.000	0.115	0.689				
Total to Reunion PS	0.272	0.272	0.944				
To Spout Springs Wastewater Treatment Plant							
Total From Reunion PS	0.272	0.272	0.944				
Total to Spout Springs Wastewater Treatment Plant	0.272	0.272	0.944				

Source: Flows as shown in Table were provided to Tetra Tech by Hall County

#### PUMP BACK OPTIONS CONSIDERED

### Option A: Flow from Mulberry Creek PS to Reunion PS to Spout Springs WRF

Option A involves modifying the Mulberry Creek existing wet well and installing new pump equipment to send wastewater flows to the Reunion PS. The modification requires installation of three (3) 45 horsepower dry pit submersible pumps in the existing Mulberry Creek PS to pump nearly 1,775 gpm, as peak hourly flow (PHF) to the Reunion Pump Station. The existing pumps will remain in service as an installed emergency backup to send wastewater to the city of Gainesville's collection system in case the dry pit submersible pumps fail. To complement the installation of new dry pit submersible pumps, a new 16-inch HDPE force main is needed between Mulberry Creek Pump Station to the Reunion PS. A 16-inch HDPE line was selected to handle the updated projected flows. The proposed force main length is approximately 9300 feet.

The existing Reunion PS requires significant upgrades to handle the increase in flows. The installation of a new 10-foot diameter wet well is required to convey both the existing Reunion PS flows along with the proposed flows from the Mulberry Creek PS. Three (3) 160 horsepower submersible pumps will be installed in the two wet wells to pump 1,980 gpm PHF to the Spout Springs WRF. All new electrical and switch gear components will be required to handle the proposed electrical loads. The station will also require a permanent by-pass pump to operate in case the submersible pumps are out of order. A surge relief valve should be installed on both the force mains to the Reunion and Crystal Farms pump stations as well as the existing force main to the Spout Springs WRF.

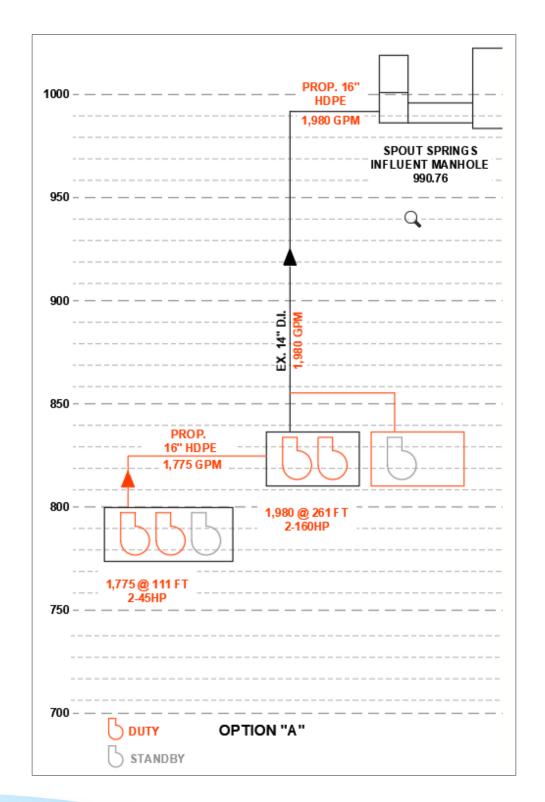
Option A eliminates the need for series pumping at Mulberry Creek PS except in the case of dry pit submersible pump failure. This options also provides new pumps and maintains the ability to pump to Gainesville. Modifications to the existing Reunion PS site will be challenging because the site is relatively small and will require difficult excavation measures to construct the new wet well, access to the proposed site and pumps is limited and may be difficult to maintain, the wet well cost is higher than other options, different size pumps at the Reunion and Mulberry Creek pump stations, and a by-pass pump is required at the Reunion PS. The existing 14-inch ductile iron force main from Reunion to SSWRF will continue to remain in service and with nearly 20 years in service, rehabilitation or replacement is anticipated in the future and is not included in the cost estimate. Approximately 6,400 linear feet of this force main will be replaced with 16-inch HDPE pipe due to the widening of Spout Springs Road.

An overall plan of the proposed project is shown below, additionally preliminary layouts for the improvements to the Mulberry Creek pump stations are included below. A detailed opinion of probable construction cost is included in Appendix A, a summary of the cost is shown below.

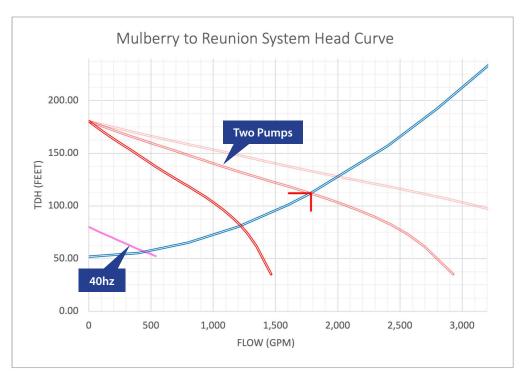
**Table 2: Option A Probable Cost Summary** 

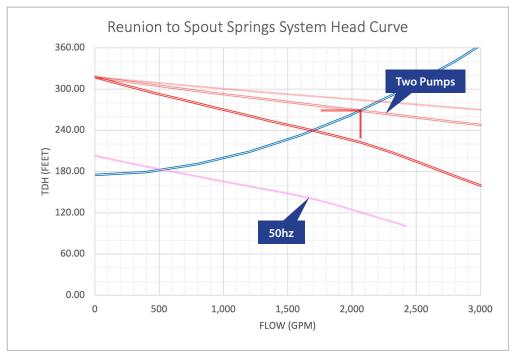
Item	Cost
Modifications to the Mulberry PS	\$815,000
Modifications to the Reunion PS	\$2,670,000
Proposed 9,300 LF 16-inch HDPE DR11 Force Main	\$1,640,000
Total Project	\$5,125,000

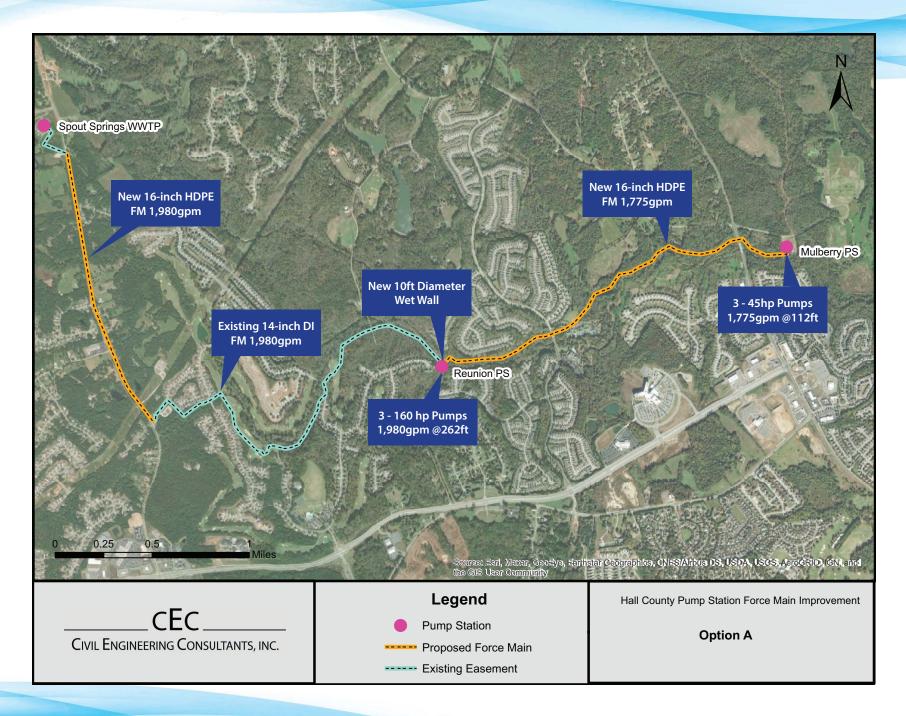
**Figure 2: Option A System Profile** 



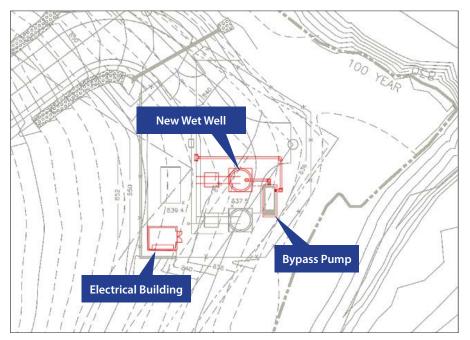
**Figure 3: Option A Pump Curves** 

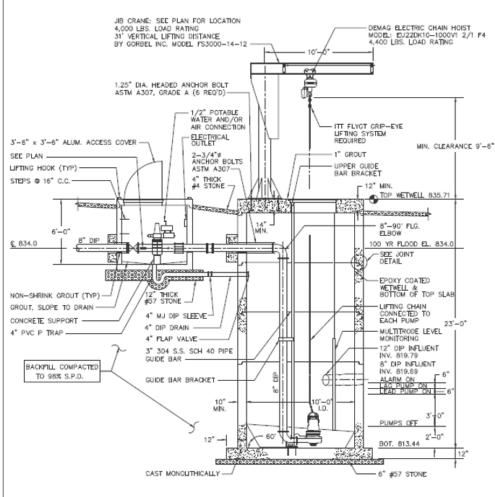




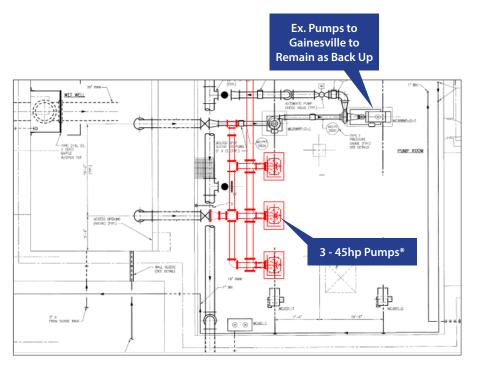


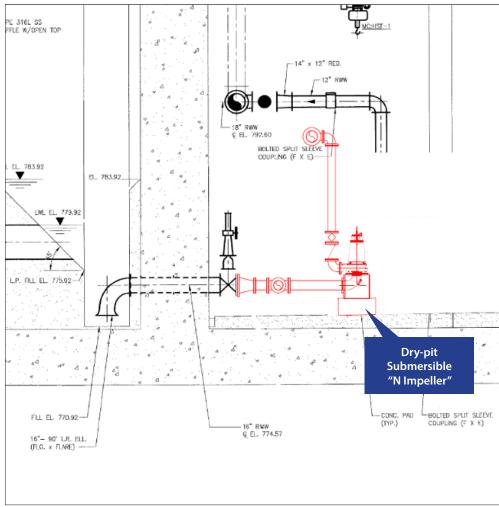
**Figure 4: Preliminary Reunion Pump Station Layout** 





**Figure 5: Preliminary Mulberry Pump Station Layout** 





### **Option B: Flow from Mulberry PS directly to Spout Springs WRF**

Option B consists of modifying the existing Mulberry Creek PS wet well and installing new pumping equipment to send flow directly to the Spout Springs WRF. Refer to Figure 8 for a layout of the proposed pump arrangement. Two 335 horsepower dry pit submersible pumps will be installed in the existing Mulberry Creek PS to pump nearly 1,600 gpm to the Spout Springs WRF. Alternately, three 250 horsepower pumps could be installed in a triplex arrangement. The existing pumps will remain in service as an installed backup the new pumps to send flow to the Gainesville system in an emergency. A new 16-inch force main from the Mulberry Creek PS is required and would connect to the existing 14-inch ductile iron force main at the Reunion PS. The 16-inch HDPE line was selected to handle the updated 2020 Master Plan projected flows of 1,980 gpm. The existing Mulberry Creek PS electrical and switch gear components will be modified to accommodate the proposed electrical loads. The existing Reunion PS will be abandoned. CEC recommends removal of the existing surge tank at Mulberry Creek PS, which is currently not operational. CEC suggests a surge relief valve be installed on both the force mains to the Crystal Farms pump station as well as the 16- inch force main to the Spout Springs WRF.

This option also provides new pumps and maintains the ability to pump to Gainesville. The main advantage of this option is the County can abandon the Reunion PS and eliminates the need to construct a new wet well on the Reunion PS site. Flows from Reunion will be re-directed into an existing gravity sewer and ultimately entering the Mulberry Creek PS wet well.

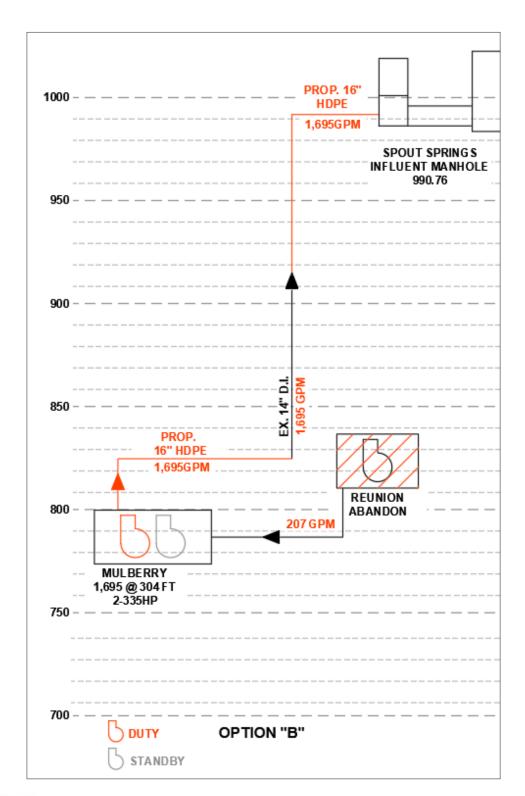
The disadvantage of this option is the proposed 335 horsepower pumps at Mulberry Creek can only provide approximately 1,695gpm of the ultimate 1,980gpm design peak flow. Any flow over 1,695gpm needs to be pumped to Gainesville using the existing series pumps. The long force main from Mulberry Creek PS to SSWRF will create odor and corrosion issues at the SSWRF headworks. The existing liquid chemical feed system is not in use at the Mulberry creek PS. If this option is selected, CEC recommends the chemical system be updated or replaced with a force main air injection, peroxide, or hypochlorite feed system to address corrosion/ odor control concerns. This option utilizes the existing Reunion to SSWRF 14-inch ductile iron force main. This pipeline is nearly 20 years old and will require removal, replacement in a future CIP project. Approximately 6,400 linear feet of this force main will be replaced with 16-inch HDPE pipe due to the widening of Spout Springs Road.

An overall plan of the proposed project is shown below, additionally preliminary layouts for the improvements to the Mulberry Creek pump stations are included below. A detailed opinion of probable construction cost is included in Appendix A, a summary of the cost is shown below.

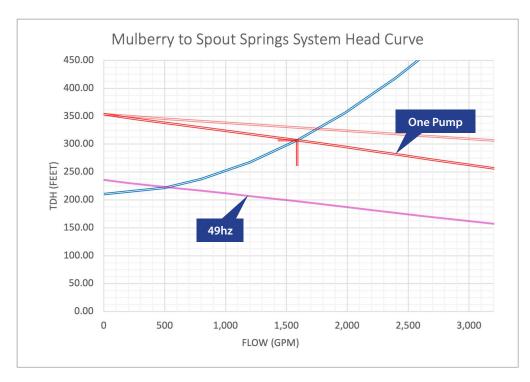
**Table 3: Option B Probable Cost Summary** 

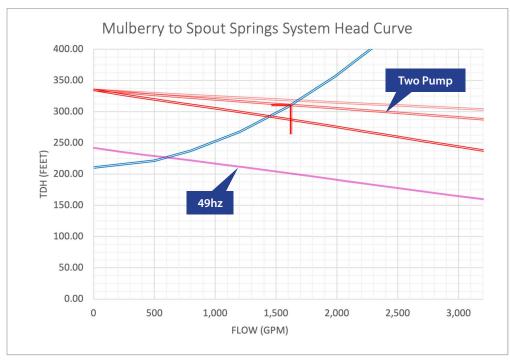
Item	Cost
Modifications to the Mulberry Creek PS	\$1,235,000
Abandon the Reunion PS	\$75,000
Proposed 9,300 LF 16-inch HDPE DR11 Force Main	\$1,640,000
Total Project	\$2,950,000

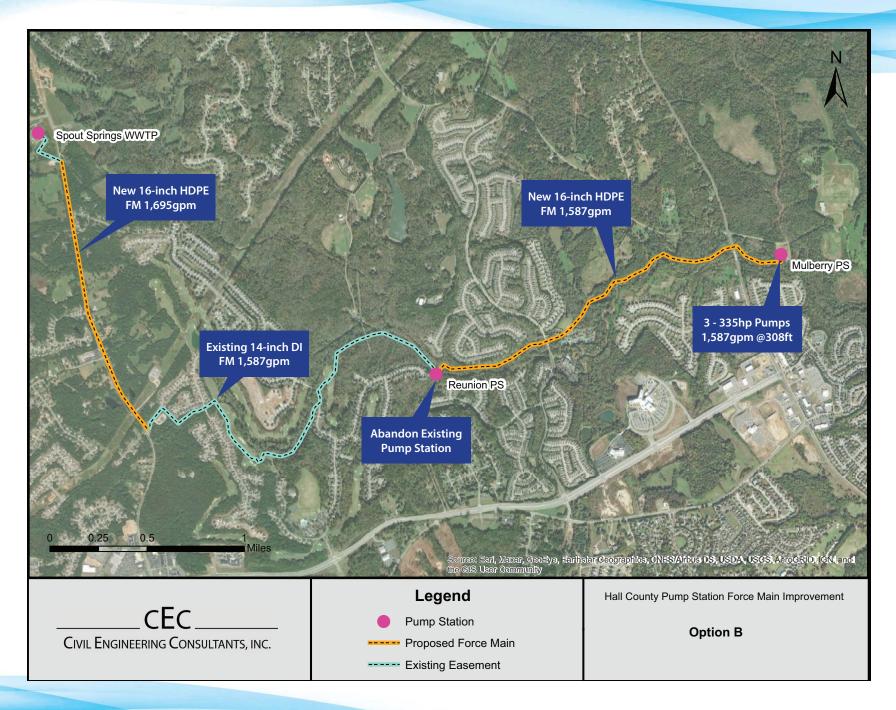
**Figure 6: Option B System Profile** 



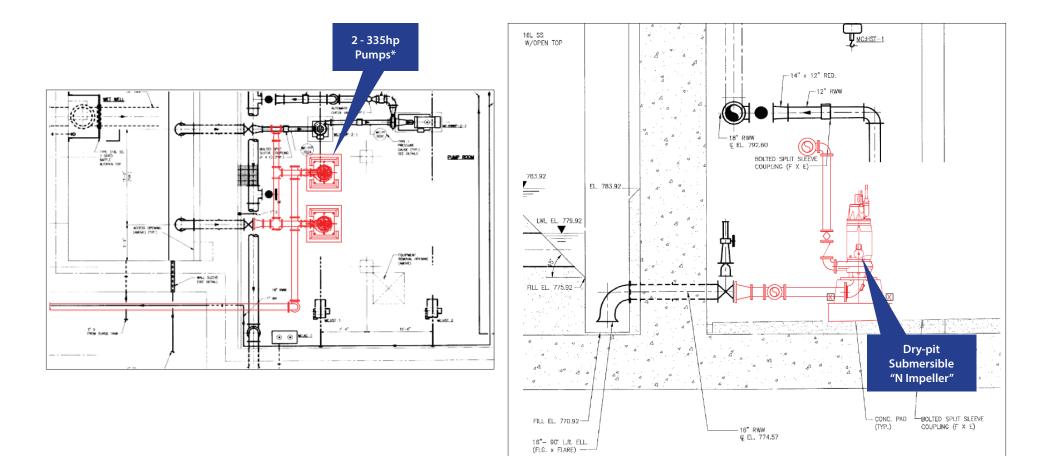
**Figure 7: Option B Pump Curves** 







**Figure 8: Preliminary Mulberry Creek Pump Station Layout** 



### Option C: Flow from Mulberry Creek PS to New Dove Point PS to Spout Springs WF

Option C consists of modifying the existing Mulberry Creek PS wet well and installing new pumps to send flow to a proposed pump station on Dove Point Lane. Proposed pumps at Mulberry Creek, refer to Figure 12, are dry pit submersible pumps sized to pump approximately 1,980 gpm PHF to the Dove Point PS. As with Option B, the existing Mulberry Creek pumps, will remain available as an installed backup to the new and send flow to Gainesville system if necessary. A new 16 -inch HDPE force main will be required to direct the flow from the Mulberry Creek PS and tie onto the existing 14-inch ductile iron Reunion PS force main. A 16-inch HDPE line was selected to handle the updated projected flows.

The Dove Point PS proposed will be a triplex submersible pump station with a cast in place wet well approximately 14 feet by 15 feet. CEC evaluated using self-priming pumps, but the pumps were ruled out due to the wet well depth being over 30 feet. The Dove Point station will also have a permanent by-pass pump to operate the station in case the submersible pumps are out of order. A surge relief valve is proposed for both the Dove Point and Mulberry Creek PSs. Additionally, the existing inoperable surge tank at the Mulberry Creek PS should be replaced with a surge relief valve.

Like the other options considered, this option eliminates the need for series pumping at Mulberry Creek PS except in the case new pumping equipment failures. This options also provides new pumps and maintains the ability to pump to Gainesville. One advantage of constructing the new Dove Creek PS is that the new Mulberry and Dove Point pumps can be the same size. Additionally, there is potential for an increase in service area adjacent to the new Dove Point PS. Other advantages of this option include, abandon the Reunion PS, elimination of the existing grinder pump at the adjacent fire station with flow by gravity to the Dove Point wet well.

Potential disadvantages include the wet well cost is higher than other options, odor control may be required, an intermittent stream on site may complicate construction, and a by-pass pump is required at the Dove Point PS. As discussed in Option B above, the chemical feed system at the Mulberry PS will need to be updated to mitigate the odor control concerns. This option reuses the existing 14-inch ductile iron force main at Reunion. This pipeline is nearly 20 years old and may require rehabilitation in the future. Approximately 6,400 linear feet of this force main will be replaced with 16-inch HDPE pipe due to the widening of Spout Springs Road.

An overall plan of the proposed project is shown below, additionally preliminary layouts for the improvements to both the Mulberry Creek and Dove Point pump stations are included below. A detailed opinion of probable construction cost is included in the Appendix, a summary of the cost is shown below.

**Table 4: Option C Probable Cost Summary** 

Item	Cost
Modifications to the Mulberry PS	\$1,290,000
Dove Point Pump Station	\$2,495,000
Proposed 9,300 LF 16-inch HDPE DR11 Force Main	\$1,640,000
Total Project	\$5,425,000

PROP. 16" **HDPE** 1,980 GPM SPOUT SPRINGS INFLUENT MANHOLE 990.76 900 **DOVE POINT PS** 1,980 @ 200.5 FT 2-105HP 850 16" HDPE 1,980 G PM REUNION 800 -ABANDON 207 GPM

OPTION "C"

MULBERRY 1,980 @ 202.5 FT 2-105HP

DUTY

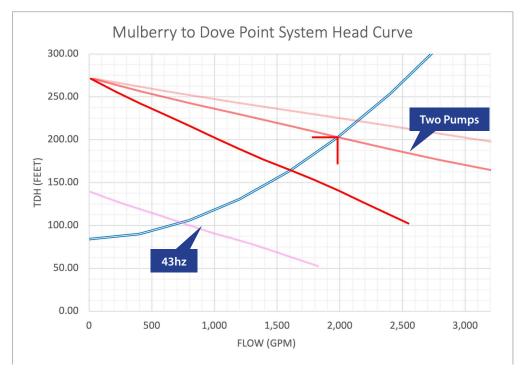
STANDBY

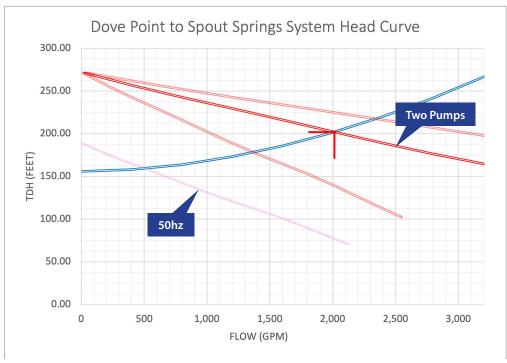
750

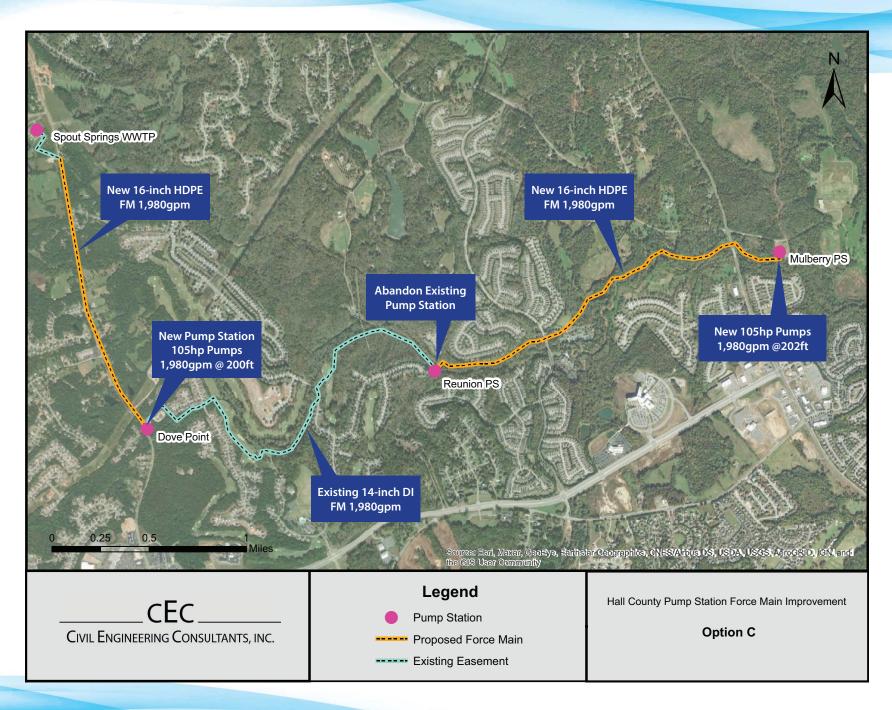
700 -

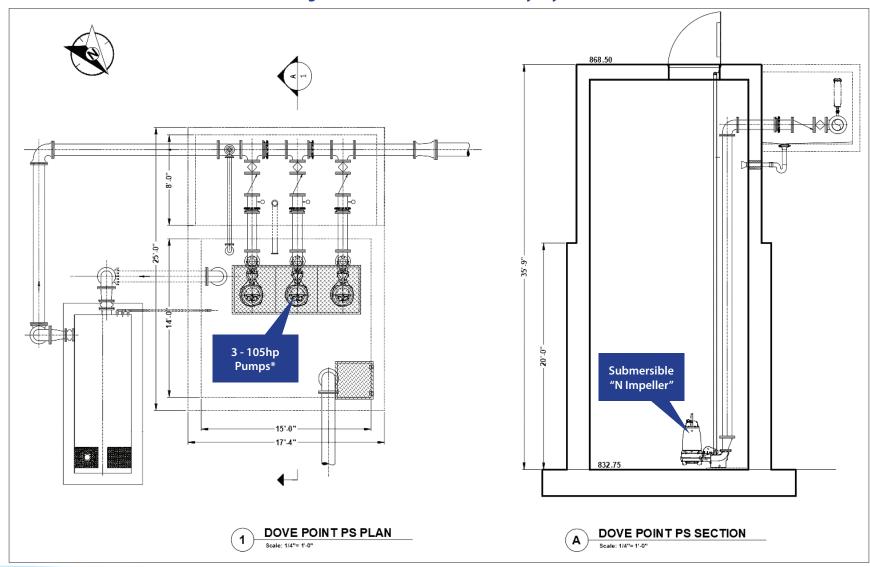
**Figure 9: Option C System Profile** 

**Figure 10: Option C Pump Curves** 





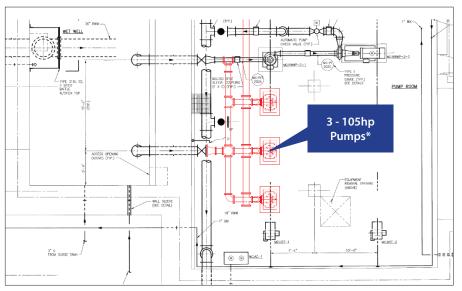


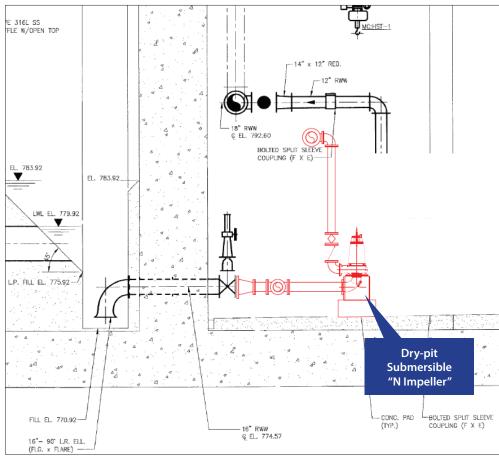


**Figure 11: Dove Point PS Preliminary Layout** 



**Figure 12: Mulberry Creek PS Preliminary Layout** 





### **Wet Well Mixing**

CEC identified five (5) options for mixing and /or aerating the existing Mulberry Creek pump station wet well. The installation of a mixing/aeration system is intended to mitigate both entry into a confined space and manual maintenance requirements of cleaning the wet well of rags, grit, and floatable materials that accumulate over time.

CEC reached out to the following vendors and obtain proposal information.

- ► Phi Pulsed Hydraulics
- Flygt
- Vaughn
- Red Valve
- EnviroMix

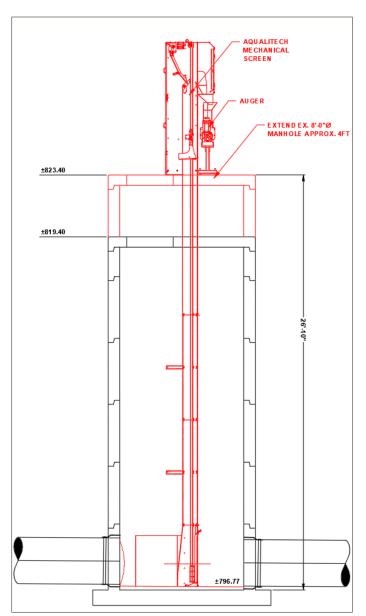
Using the information provided by the vendors, CEC prepared a Technical Memo on Wet Well Mixing describing the advantages, disadvantages, and mixing methodology. The Technical Memo is included in the Appendix of this report. During a meeting with the County, a consensus was reached on the following:

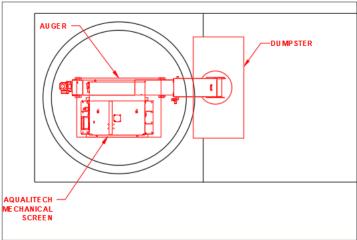
- 1. Air mixing is preferred over mechanical or pump mixing.
- 2. Install a high pressure spray bar with nozzles in the wet well to flush debris off of the sloped filet. This would reduce the need for personnel entry into the wet well to perform cleaning.
- 3. Estimated cost for a Red Valve air mixing system is \$75,000.

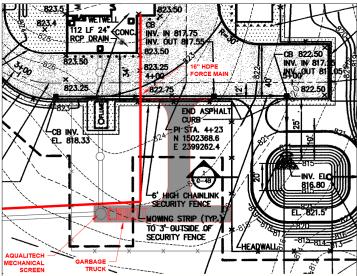
# **Mulberry Creek PS Screening**

The County also requested CEC evaluate screening options at the Mulberry Creek PS. CEC considered two options for screening at the station. Two manufacturers were identified that could provide screening equipment for this installation. The Aqualitec screen is a 90° vertical bar screen with a belt operated rake. The JWC Environmental screen uses an auger to lift screenings out of a perforated plate screen. A sketch of the various options is shown below. Screening Option A, install a screen in the exiting pump station wet well. The screen would be installed on the existing influent pipe approximately, 29′-4 inches below the pump station top wall. Figure 13 depicts the Aqualitec Screen installed in the existing wet well. Figure 14 shows the JWC Environmental Screen installed in the existing wetwell. Option B, shown on Figure 15, involves installing the Aqualitec vertical rake screen in a manhole upstream of the wet well. Option B is preferred because you don't have to modify the existing wet well slab and it would be easier to access the screenings dumpster. The estimate construction cost for the screen improvements is \$500,000. A detailed cost breakdown is included in the Appendix.

Figure 13: Mulberry Creek PS Wetwell Screen - Aqualitec







## **Force Main Detention Time Mitigation**

Each pump back option includes maintaining the existing Mulberry Creek high- head pumps and force main to Crystal Farms lift station for use as an emergency alternative. Under current operating conditions, the hydraulic retention in the force main to Crystal Farms is over seven (7) days. Incorporation of any proposed pump back option, the probability of using the existing pumping equipment is low, thus escalating the retention times in the force main. The following suggestions are recommended to mitigate the long detention times.

This requires modification of the discharge piping located at the Mulberry Creek PS. This modification will allow wastewater to either bleed back or be pumped from the Crystal Farms force main into the existing Mulberry Creek wet well for transfer to Spout Springs using the proposed dry pit submersible pumps. Pumping flow from the Crystal Farms PS back to the Mulberry Creek station will require pump station modifications, like the ones proposed at the Mulberry Creek PS. Dry pit submersible pumps would be installed at Crystal Farms to reverse the flow.

CEC envisions the use of an electric or pneumatically controlled modulating ball or plug valve on the force main drainage piping with an in-line meter to measure flow. The combination of the modulating valve and meter works to provide a drainage control device. Incorporating a set point controller or PLC programming enables the valve to modulate to obtain the desired flow of sewage draining into the existing wet well. In using a drain or pump back system, significant volumes of hydrogen sulfide are anticipated to be released from the sewage draining from the force main back into the Mulberry Creek wet well. Installation of an odor control system to mitigate odors is anticipated. Secondly, the bleed back may need to be controlled or chemicals may need to be added to prevent excessive amounts of anaerobic wastewater from entering the Spouts Springs wastewater plant.

The Crystal Springs force main profile may not allow all wastewater to be drained from the pipeline. Before moving forward, the force main profile needs to be analyzed to determine the quantity of wastewater that could be drained and the amount that would remain. If significant pockets of wastewater remain in the pipeline, the cost/benefit of draining a portion may not be warranted. A review of air/vacuum valves is also suggested to determine adequacy.

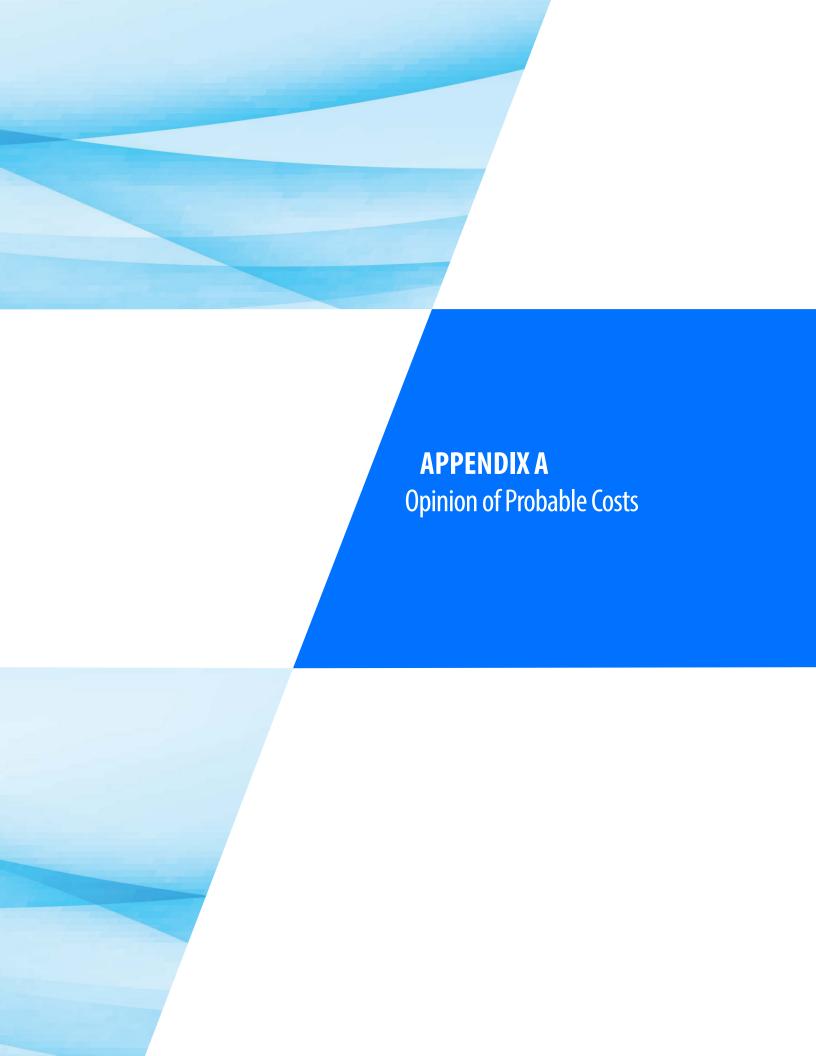
Pump performance is another issue to evaluate. Subsequent to draining the force main, an analysis needs to be performed to determine what the impact will be on the high-head pump performance at "start-up" when discharging into an empty or partially empty pipeline. Control logic and pump control check valves may require modifications.

### **Summary, Conclusions and Recommendations**

CEC recommends Option C: Pumping wastewater from the Mulberry Creek PS to New Dove Point PS to Spout Springs WRF. In summary below are advantages, conclusion, recommendations CEC has identified with executing this option.

- Use of existing space in the Mulberry Creek PS dry well to install dry pit submersible pumps.
   Use of existing piping connections between the wet well and the new pumps can reduce the construction costs.
- 2. The proposed Mulberry Creek dry pit pump selection can meet the predicted peak flow demand of 1,980 gpm allowing all flow to be treated at Spouts Springs.
- 3. CEC recommends the installation of a 16-inch DIPS HDPE force main from Mulberry Creek to provide a pipeline with long service life.
- 4. Install surge valve at Mulberry Creek PS instead of replacing/ repairing the existing surge tank. The failure of the surge tank is believed to be associated with not having grit or screenings removal ahead of the wet well. The proposed surge valve will require maintenance, with easy accessibility for repairs.
- 5. Maintaining the Mulberry Creek PS series pumps provides emergency back-up pumping to Gainesville.
- 6. Dove Point and Mulberry Creek Pumps will be the same size. Spare parts and pumps can be shared.
- 7. Dove point PS offers an expanded service area allowing the County to increase revenues from new customer base. This is a major advantage the other options cannot provide.
- 8. Use of existing County property to locate the Dove Point PS reduces construction capital costs.
- 9. Elimination of a fire station grinder pump station with gravity flow to the Dove Point PS.
- 10. Abandonment of Reunion PS. This is a major benefit shared by other options as well.
- 11. An air based mixing system should be provided in the Mulberry Creek wet well.
- 12. A bar screen should be installed at the Mulberry Creek pump station to remove trash from the flow prior to entering the wet well.

The location of the proposed wet well at Dove Point PS requires a field survey to determine the required pump station depth. Also, an intermittent stream and the flood plain on the site needs to be located.



	Spout Springs Road Forc	e Main Rel	ocation - 16-i	nch HDPE	
ITEM	DESCRIPTION	UNIT	QTY	PRICE	AMOUNT
1	6-inch HDPE DR11 Sewer Force Main	LF	6,850	\$ 110.00	\$ 753,500.00
2	16-inch HDPE DR11 Sewer Force Main, Directional Drill	LF	400	\$ 150.00	\$ 60,000.00
3	24" O.D., 0.22" Wall Thickness Steel Casing, Jack & Bore	LF	260	\$ 825.00	\$ 214,500.00
4	2" Combination Air Vacuum Valve (A&V) w/ MH Assembly	EA	2	\$ 8,000.00	\$ 16,000.00
5	Concrete Blocking	CY	20	\$ 300.00	\$ 6,000.00
6	Stone Stabilization	TN	200	\$ 30.00	\$ 6,000.00
7	Silt Fence Type "C"	LF	11,142	\$ 3.00	\$ 33,426.00
8	Force Main Marker	EA	15	\$ 250.00	\$ 3,750.00
9	Silt Fence Removal	LF	11,142	\$ 1.00	\$ 11,142.00
10	Construction Exit	EA	2	\$ 2,500.00	\$ 5,000.00
11	Erosion Control Monitoring	LS	1	\$ 7,500.00	\$ 7,500.00
12	Permanent Grassing	LF	6,850	\$ 2.00	\$ 13,700.00
13	Contingency	LS	1	\$ 150,000.00	\$ 150,000.00
	TOTAL CONSTRUCT	ION COST			\$1,280,51800

	Spout Springs Road Force Main Relocation - 18-inch HDPE							
ITEM	DESCRIPTION	UNIT	QTY	PRICE	AMOUNT			
1	18-inch HDPE DR11 Sewer Force Main	LF	6,850	\$ 135.00	\$ 924,750.00			
2	18-inch HDPE DR11 Sewer Force Main, Directional Drill	LF	400	\$ 175.00	\$ 70,000.00			
3	30" O.D., 0.22" Wall Thickness Steel Casing, Jack & Bore	LF	260	\$ 750.00	\$ 195,000.00			
4	2" Combination Air Vacuum Valve (A&V) w/ MH Assembly	EA	2	\$ 8,000.00	\$ 16,000.00			
5	Concrete Blocking	CY	20	\$ 300.00	\$ 6,000.00			
6	Stone Stabilization	TN	200	\$ 30.00	\$ 6,000.00			
7	Silt Fence Type "C"	LF	11,142	\$ 3.00	\$ 33,426.00			
8	Force Main Marker	EA	15	\$ 250.00	\$ 3,750.00			
9	Silt Fence Removal	LF	11,142	\$ 1.00	\$ 11,142.00			
10	Construction Exit	EA	2	\$ 2,500.00	\$ 5,000.00			
11	Erosion Control Monitoring	LS	1	\$ 7,500.00	\$ 7,500.00			
12	Permanent Grassing	LF	6,850	\$ 2.00	\$ 13,700.00			
13	Contingency	LS	1	\$ 175,000.00	\$ 175,000.00			
	TOTAL CONSTRUCT	ION COST			\$1,467,268.00			

	Mulberry Creek Pump Station Option A						
ITEM	DESCRIPTION	UNIT	QTY	PRICE	AMOUNT		
1	Mobilization and Administration	LS	1	\$75,000.00	\$75,000.00		
2	Demolition and Removal of Ex. Equipment/Structure	LS	1	\$25,000.00	\$25,000.00		
3	Mulberry Creek Pumping Equipment	LS	1	\$211,000.00	\$211,000.00		
4	Install Equipment (@30%)	LS	1	\$63,000.00	\$63,000.00		
5	Piping and Valves	LS	1	\$50,000.00	\$50,000.00		
6	Surge Valves	LS	1	\$55,000.00	\$55,000.00		
7	Wet Well Mixing	LS	1	\$75,000.00	\$75,000.00		
8	Electrical	LS	1	\$125,000.00	\$125,000.00		
9	Instrumentation	LS	1	\$ 25,000.00	\$25,000.00		
10	Owner Contingency	LS	1	\$110,000.00	\$110,000.00		
	TOTAL CONSTRUC	TION COST			\$814,000.00		

	Reunion Pump Station Option A						
ITEM	DESCRIPTION	UNIT	QTY	PRICE	AMOUNT		
1	Mobilization and Administration	LS	1	\$75,000.00	\$75,000.00		
2	Demolition and Removal of Ex. Equipment/Structure	LS	1	\$25,000.00	\$25,000.00		
3	Existing Wet well Refurbishment	LS	1	\$15,000.00	\$15,000.00		
4	Reunion PS Pumping Equipment	LS	1	\$728,000.00	\$728,000.00		
5	Install Equipment (@20%)	LS	1	\$137,000.00	\$137,000.00		
6	Install Wet Well, Manholes and Vaults	LS	1	\$300,000.00	\$300,000.00		
7	Shoring Wet Well & Dewatering	LS	1	\$150,000.00	\$150,000.00		
8	Painting & Coating	LS	1	\$50,000.00	\$50,000.00		
9	Piping and Valves	LS	1	\$335,000.00	\$335,000.00		
10	Surge Valve	LS	1	\$45,000.00	\$45,000.00		
11	Jib Crane	LS	1	\$25,000.00	\$25,000.00		
12	Concrete Pads and Sidewalk	LS	1	\$25,000.00	\$25,000.00		
13	Painting and Coating	LS	1	\$50,000.00	\$50,000.00		
14	Asphalt Paving	LS	1	\$25,000.00	\$25,000.00		
15	Site Work	LS	1	\$50,000.00	\$50,000.00		
16	Fencing	LS	1	\$5,000.00	\$5,000.00		
17	Lanscaping and Site Restoration	LS	1	\$10,000.00	\$10,000.00		
18	Maintain Existing Pump Station	LS	1	\$15,000.00	\$15,000.00		
19	Erosion Control	LS	1	\$15,000.00	\$15,000.00		
20	Electrical (@10%)	LS	1	\$205,00.00	\$205,00.00		
21	Instrumentation	LS	1	\$35,000.00	\$35,000.00		
22	Owner Contingency	LS	1	\$350,000.00	\$350,000.00		
	TOTAL CONSTRUC	TION COST			\$2,670,00.00		

Mulberry Creek Pump Station Option B					
ITEM	DESCRIPTION	UNIT	QTY	PRICE	AMOUNT
1	Mobilization and Administration	LS	1	\$75,000.00	\$75,000.00
2	Demolition and Removal of Ex. Equipment/Structure	LS	1	\$25,000.00	\$25,000.00
3	Mulberry Creek Pumping Equipment	LS	1	\$400,000.00	\$400,000.00
4	Install Equipment (@30%)	LS	1	\$120,000.00	\$120,000.00
5	Piping and Valves	LS	1	\$50,000.00	\$50,000.00
6	Surge Valves	LS	1	\$55,000.00	\$55,000.00
7	Wet Well Mixing	LS	1	\$75,000.00	\$75,000.00
8	Electrical	LS	1	\$250,000.00	\$250,000.00
9	Instrumentation	LS	1	\$25,000.00	\$25,000.00
10	Owner Contingency	LS	1	\$160,000.00	\$160,000.00
TOTAL CONSTRUCTION COST					\$1,235,000.00

Mulberry Creek Pump Station Option C						
ITEM	DESCRIPTION	UNIT	QTY	PRICE	AMOUNT	
1	Mobilization and Administration	LS	1	\$75,000.00	\$75,000.00	
2	Demolition and Removal of Ex. Equipment/Structure	LS	1	\$25,000.00	\$25,000.00	
3	Mulberry Creek Pumping Equipment	LS	1	\$440,000.00	\$440,000.00	
4	Install Equipment (@30%)	LS	1	\$132,000.00	\$132,000.00	
5	Piping and Valves	LS	1	\$50,000.00	\$50,000.00	
6	Surge Valves	LS	1	\$55,000.00	\$55,000.00	
7	Wet Well Mixing	LS	1	\$75,000.00	\$75,000.00	
8	Electrical	LS	1	\$250,000.00	\$250,000.00	
9	Instrumentation	LS	1	\$25,000.00	\$25,000.00	
10	Owner Contingency	LS	1	\$165,000.00	\$165,000.00	
TOTAL CONSTRUCTION COST					\$1,292,000.00	

Dove Point Pump Station Option C						
ITEM	DESCRIPTION	UNIT	QTY	PRICE	AMOUNT	
1	Mobilization and Administration	LS	1	\$75,000.00	\$75,000.00	
2	Reunion PS Pumping Equipment	LS	1	\$652,000.00	\$652,000.00	
3	Install Equipment (@20%)	LS	1	\$123,000.00	\$123,000.00	
4	Install Wet Well, Manholes and Vaults	LS	1	\$350,000.00	\$350,000.00	
5	Shoring Wet Well & Dewatering	LS	1	\$75,000.00	\$75,000.00	
6	Painting & Coating	LS	1	\$50,000.00	\$50,000.00	
7	Piping and Valves	LS	1	\$335,000.00	\$335,000.00	
8	Surge Valve	LS	1	\$15,000.00	\$15,000.00	
9	Jib Crane	LS	1	\$25,000.00	\$25,000.00	
10	Concrete Pads and Sidewalk	LS	1	\$25,000.00	\$25,000.00	
11	Painting and Coating	LS	1	\$50,000.00	\$50,000.00	
12	Asphalt Paving	LS	1	\$25,000.00	\$25,000.00	
13	Site Work	LS	1	\$100,000.00	\$100,000.00	
14	Fencing	LS	1	\$15,000.00	\$15,000.00	
15	Lanscaping and Site Restoration	LS	1	\$10,000.00	\$10,000.00	
16	Erosion Control	LS	1	\$15,000.00	\$15,000.00	
17	Electrical (@10%)	LS	1	\$192,500.00	\$192,500.00	
18	Instrumentation	LS	1	\$35,000.00	\$35,000.00	
19	Owner Contingency	LS	1	\$325,000.00	\$325,000.00	
TOTAL CONSTRUCTION COST					\$2,492,500.00	

Mulberry Creek Force Main						
ITEM	DESCRIPTION	UNIT	QTY	PRICE	AMOUNT	
1	16-inch HDPE DR11 Sewer Force Main	LF	8100	\$110.00	\$891,000.00	
2	16-inch HDPE DR11 Sewer Force Main, Directional Drill	LF	1200	\$150.00	\$180,000.00	
3	24" O.D., 0.22" Wall Thickness Steel Casing, Jack & Bore	LF	200	\$750.00	\$150,000.00	
4	24-inch HDPE Casing, Direction Drill	TN	450	\$225.00	\$101,250.00	
5	2" Combination Air Vacuum Valve (A&V) w/ MH Assembly	EA	2	\$8,000.00	\$16,000.00	
6	Concrete Blocking	CY	20	\$300.00	\$6,000.00	
7	Stone Stabilization	TN	200	\$30.00	\$6,000.00	
8	Silt Fence Type "C"	LF	11,250	\$3.00	\$33,750.00	
9	Force Main Marker	EA	15	\$250.00	\$3,750.00	
10	Silt Fence Removal	LF	11,250	\$1.00	\$11,250.00	
11	Construction Exit	EA	2	\$2,500.00	\$5,000.00	
12	Erosion Control Monitoring	LS	1	\$7,500.00	\$7,500.00	
13	Permanent Grassing	LF	8,100	\$2.00	\$16,200.00	
14	Contingency	LS	1	\$214,000.00	\$214,000.00	
TOTAL CONSTRUCTION COST					\$1,641,700.00	

Mulberry Creek Pump Station Mechanical Screen					
ITEM	DESCRIPTION	UNIT	QTY	PRICE	AMOUNT
1	Mobilization and Administration	LS	1	\$35,000.00	\$35,000.00
2	Modify Existing Manhole Top	LS	1	\$10,000.00	\$10,000.00
3	Mulberry Creek Screen Equipment	LS	1	\$267,500.00	\$267,500.00
4	Install Equipment (@30%)	LS	1	\$80,250.00	\$80,250.00
5	Asphalt Paving	LS	1	\$50,000.00	\$50,000.00
6	Electrical	LS	1	\$10,000.00	\$10,000.00
7	Instrumentation	LS	1	\$2,000.00	\$2,000.00
8	Owner Contingency	LS	1	\$40,000.00	\$40,000.00
TOTAL CONSTRUCTION COST					\$494,750.00



#### 1. Introduction

Under task 5 of the project scope, CEC identified five (5) options for mixing and /or aerating the existing pump station wet well. The installation of a mixing/aeration system is intended to mitigate both entry into a confined space and manual maintenance requirements of cleaning the wet well of rags, grit, and floatable materials that accumulate over time. Figure 1 is an elevation of the existing pump station with a wet well and dry pit pumps.

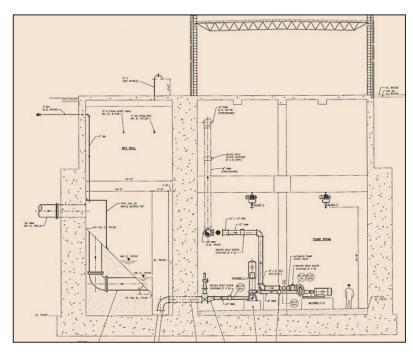


Figure 1- Elevation view of existing pump station

CEC reached out to the following vendors for proposals.

- 1. Phi Pulsed Hydraulics
- 2. Flygt
- 3. Vaughn
- 4. Red Valve
- 5. EnviroMix

The following discussion provides details regarding each mix/aerating product or system CEC investigated. A summary table of the advantages and disadvantages of each mixing/aerating technology is provided at the end of this report.

### 2. Mixing Technology Descriptions

Phi Pulsed Hydraulics – utilizes a combination of floor mounted 316 stainless steel bubble forming plates each connected to an air hose and common air compressor system. Periodically, air is released from the compressor and discharged from the forming plates to produce a large bubble resulting in intense mixing of the entire wet well contents. The advantage of this system is there are no moving parts below the water surface to maintain, thus lower operational and maintenance costs. The system is scalable and works in a variety of wet well configurations. The large bubble rises from the bottom of the wet well at 4 feet per second to the surface and as the bubble rises the contents of the wet well are dragged to the surface and then horizontally and return to the bottom of the wet well creating a mixing wave. Pulsing or release of air to the wet well is adjustable with a typical 2-4 times per minute. Figure 2 illustrates the Phi Pulsed Hydraulic system.

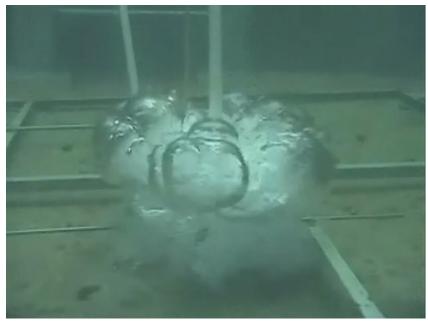
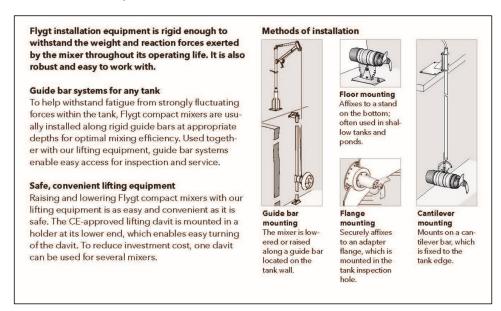


Figure 2- Pulsed Air Release

**Flygt** – Consider the use of a compact mechanical mixer (mixer on a stick). The mixer can be mounted in various configurations. In a shallow mixing configuration like Mulberry Creek, the installation of a vortex shield over the mixer is suggested to improve performance. The mixer propeller is manufactured of cast iron. Designs include the leakage sensors, explosion proof designs, and various mounting configurations. Figure 3 illustrates various compact mixer installations.



**Figure 3- Flygt Mixer Mounting Arrangements** 

Below is an example of the versatility of installing a Flygt compact mixer vertically, which is a different option than shown in Figure 3. The mixer unit was lowered into a tank using a portable hoist and sits on the tank floor in a cage.





**Figure 4- Flygt Compact Mixer** 



**Vaughn** – utilizes a conditioning submersible chopper pump fitted with a high velocity discharge nozzle to recirculate and mix the entire contents of the wet well to create a homogenous mixture. See Figure 5 and 6. The chopping action of the pump reduces rag and debris size, thus potentially reducing clogging of the dry pit pumps. With the high velocity discharge nozzle solids accumulation on the floor is resuspended. Because the pump is mounted on a stand and has no discharge piping, the pump can be relocated in the wet well. The installation of multiple pump stands allows a single conditioning pump to be moved to multiple locations adding flexibility to the mixing system.

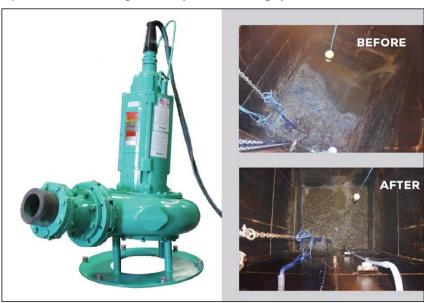


Figure 5 - Example of Vaughn mixer and performance

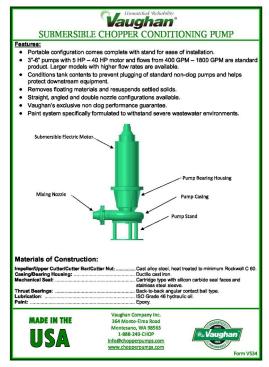


Figure 6 - Vaughn Conditioning Pump

**Red Valve**- utilizes a diffused air mixing system with duckbill check valves strategically located. The diffuser system is connected via manifold to an air compressor. The system is designed to provide intermittent aeration/mixing. An air compressor with control panel is required to operate the system. Figure 7 is a generic layout of the Red Valve System Components.

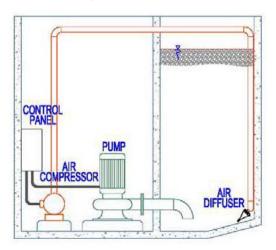
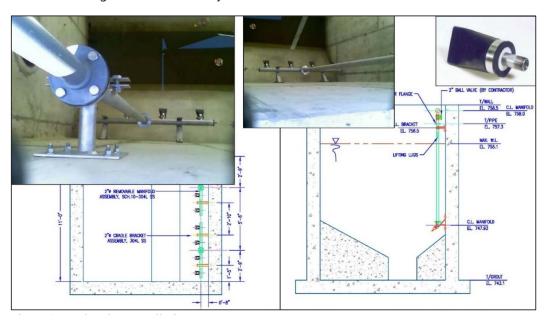


Figure 7- Red Valve Mixing System

The system is designed to provide coarse bubble aeration and with the duckbill diffusers located near the bottom of the wet well. Release of air from the nozzles induces a high level of agitation to resuspend and mix the wet well contents under storage. Figure 8 illustrates a Red Valve mixing system installed in a wet well similar to the configuration of Mulberry Creek.



**Figure 8- Red Valve Installation** 

According to Red Valve, installation of four (4) diffusers in the wet well is a preliminary estimate. Locate each diffuser in the trench area and equally spaced between each pump suction bell fitting would be appropriate. Red Valve estimates operating rate of 5 cfm/diffuser for a total of 20 cfm for the system.

Red Valve recommends use of their TFA-1.50 diffuser installed on 3/4" SS drop pipes, vertically with the diffuser tip about 4 inches from the sump floor.

**EnviroMix** – utilizes a big bubble mixing system in which short bursts of compressed air is released through engineered nozzles located at the floor of the wet well. The system can be programmed to operate automatically or manually. The system components include an air compressor, receiver tank and controls. A drop pipe is installed in the wet well to connect the air receiver to the nozzles. Appendix A of this report provides a preliminary design for this mixing system. A budgetary price for this system equipment is \$66,000 including start-up. Figure 9 illustrates typical components of the EnviroMix system.

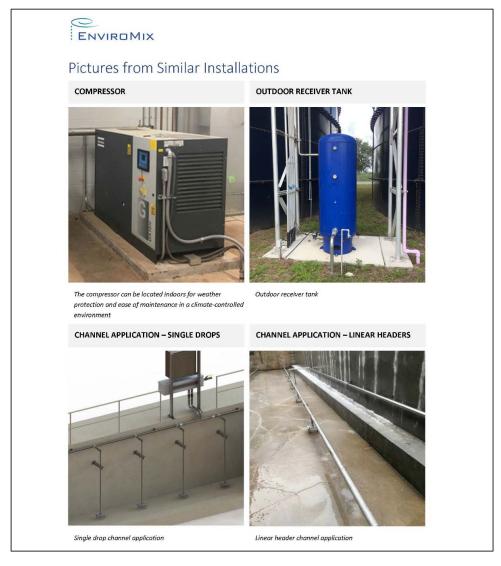


Figure 9- EnviroMix Photos

# 3. Summary Table

In Table 1, the advantages/disadvantages of each wet well mixing system is presented.

System	Advantages	Disadvantages
Phi Pulsed Hydraulics	Air mixing is more efficient than mechanical mixers  No electrical components in the wet well  Variable mixing intensity, unlimited turn-down  Bottom up mixing with aeration as a plus  Big bubble mix with single drop pipe	Compressor maintenance
Flygt	Compact design  Mounting flexibility  Mixes and \homogenizes contents	Mechanical device with electrical components in wet well Requires lifting hoist for maintenance Potential for mixer clogging if rags are present Hatch required in wet well deck to install
Vaughn	Chops and mixes  Portable with stand (s) allowing relocation in wet well  Homogenizes floating mats of grease	Requires lifting hoist for maintenance Pump mixing with high velocity nozzle Electrical in wet well Does not aerate Hatch required in wet well deck to install
Red Valve	No electrical in wet well Variable mixing and aerating Duckbill diffuser system Single drop pipe to wet well All maintenance above water level	Compressor maintenance
EnviroMix	50% more efficient than mechanical mixers No electrical components in the wet well Variable mixing intensity, unlimited turn-down Bottom up mixing with aeration Big bubble mix with single drop pipe	Compressor maintenance

Table 1- Summary of mixing /aerating systems



#### 4. Other Considerations

Even with the best mixing and aeration system installed in the Mulberry Creek wet well, the grout filleted area above normal water level will accumulate debris over time and washdown will be required. To address this maintenance issue and mitigate the need to enter the wet well, CEC suggests the addition of strategically positioned high pressure water spray nozzles in the wet well to the wash down the grout fillet. Periodic manual operation of a single valve located outside the wet well is suggested.

If this project moves into design, we recommend a CFD model be performed of the selected mixing/ aerating technology to optimize performance. Equipment vendors typically offer modeling to support their equipment and to meet the project performance specifications.

#### **EnviroMix Proposal**



ENERGY EFFICIENCY



BioMix<sup>™</sup>
Compressed Gas Mixing System



STRAIGHTFORWARD OPERATION

Mulberry Creek PS - Hall County, GA - Wet Well Application

**Preliminary Proposal** 



PROCESS OPTIMIZATION

EnviroMix Proposal Number: OM-21-125210

Engineering Firm:

CEC

EnviroMix Representative:

The TDH Company

Date:

9/9/21

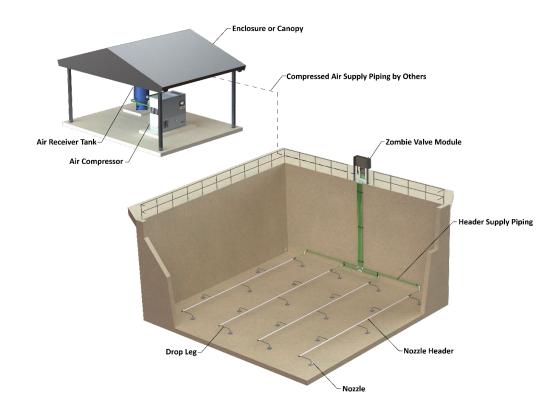


701 East Bay St. Suite 502 • Charleston, SC 29403 T: 843-573-7510 • enviro-mix.com



# **Product Description**

BioMix™ Compressed Gas Mixing System provides uniform mixing of tank contents by firing programmed, short-duration bursts of compressed air through patented, engineered nozzles located near the tank floor. The mixing parameters may be adjusted to optimize mixing and power utilization, either through operator input or automated process feedback. The small surface area of the large gas volumes and their rapid upward velocity enable BioMix to provide efficient mixing.





# System Benefits

#### ROBUST EQUIPMENT DESIGN WITHOUT SACRIFICING ENERGY EFFICIENCY OR FLEXIBILITY



ENERGY EFFICIENCY

- Energy savings of 50% or greater over mechanical mixing or diffused aeration
- Unequaled mixing efficiency of less than 0.54 hp / 1000 ft<sup>3</sup>
- Unlimited turn-down capability



STRAIGHTFORWARD OPERATION

- Zero in-tank maintenance
- No mechanical or electrical components in the wastewater
- Minimal maintenance items located in accessible locations



PROCESS OPTIMIZATION

- Guaranteed uniform mixing with onsite performance testing
- Operator-adjustable firing parameters that enable ideal mixed conditions without deposition and minimum energy input
- Bottom-up mixing to develop a homogeneous mixture as opposed to simply stirring



UNPARALLELED
FLEXIBILITY

- Variable mixing intensity based on process parameters
- Compatible with any tank geometry, configuration, or depth
- Eliminates the need for multi-technology redundancy

#### **APPLICATION HIGHLIGHTS:**

The following pages highlight application-specific benefits related to the proposed BioMix system.





## upstream aerobic zones ▶ HOW DOES EXCESSIVE AERATION IMPACT A TREATMENT PLANT?

• Oxygen demand that is diminished by

- Residual dissolved oxygen in RAS and mixed liquor return that inhibit biological nutrient removal (BNR)
- Poor settling
- Excess treatment chemicals in post-anoxic zones
- Wasted energy

#### enviro-mix.com

701 East Bay Street, Suite 502, Charleston, SC 29403 P: 843.573.7510 · F: 843.573.7531 · E: sales@enviro-mix.com

#### WHY IS BIOMIX THE RIGHT SOLUTION?

Decoupling oxygen demand from mixing requirements provides the operational flexibility to reduce the airflow rate to meet the air required for plant loading. BioMix compressed gas mixing system can be interlaced with diffused aeration grids, allowing simultaneous operation at a wide range of airflow rates. This results in:

- Promotion of anoxic and anaerobic conditions to enable BNR
- . Conditions that promote good settling
- Stable dissolved oxygen profile throughout the aeration tank
- · Significant energy savings

#### Contact sales@enviro-mix.com

TO DISCUSS HOW BIOMIX CAN OPTIMIZE YOUR MIXING LIMITED SOLUTIONS.



## **Design Summary**

Site Conditions	Elevation	Max Ambient Temp
Mulberry Creek PS, Hall	404 FASL	95 °F
County GA		

Designation		Wet Well
Quantity of Tanks		1
Length	ft	48.0
Width	ft	4.0
Side Water Depth	ft	20.3
Design Solids Conc.	%	0.5
BioMix Configuration		
Header Layout		Straight
Headers per Tank		1
Nozzles per Header		6
Nozzles per Tank		6
Nozzle Density	ft²/nozzle	32.0
Pipe Diameter	in	1.5

Total Project Nozzle Count

6

## **TIMER-BASED 1-VALVE CONTROLLER**

Tank(s)	No. Valves
Wet Well	1

## **POWER REQUIREMENTS**

Item	No Operating	Hours of Operation	ВНР	Total kWh/d
BioMix Compressor	1	24	2.10	38



# Scope of Supply

#### **EQUIPMENT SUMMARY**

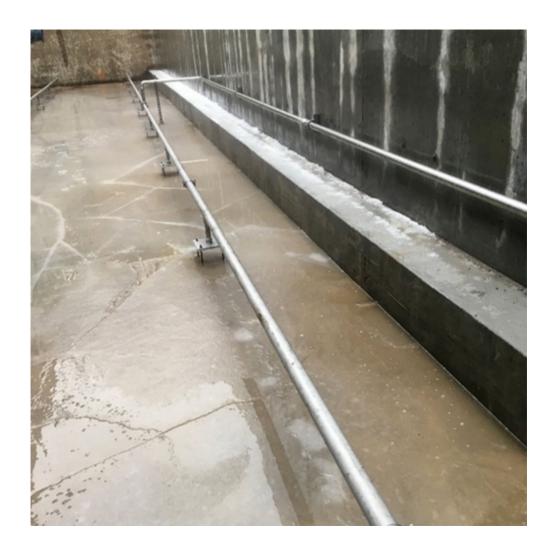
Item	Quantity	Description
Timer-Based 1-Vavle Controller	1	Timer-Based Controller
BioMix Nozzles	6	Type 304 SS engineered nozzles to be threaded onto header piping
Headers	1	Type 304 SS prefabricated headers with radial offsets or drop legs
Header Supply Piping	1 lot	Type 304 SS Sch 5 press-technology from VMs to BioMix Headers includes fittings, 304 SS wall/pipe supports and anchors
Compressor	1	3 HP Rotary Screw Compressor(s) capacity 13 CFM at 104 PSIG, each with: - Inlet filter - Refrigerated dryer - Particulate and oil coalescing filter
Receiver Tanks	1	Vertical Receiver(s) with auto drain valve: Qty 1 @ 120-gallons

#### **CLARIFICATIONS**

- Electrical connection to each compressor (460/3/60) and VM/receiver auto-drain valve (120/1/60) by others
- Interconnecting piping between each compressor, receiver and VM by others
- Control wiring (if required) between each VM and compressor by others
- compressors, and receivers to be installed in a building or under canopy



# Preliminary BioMix Configuration





# Pictures from Similar Installations

#### **COMPRESSOR**



The compressor can be located indoors for weather protection and ease of maintenance in a climate-controlled environment

## **OUTDOOR RECEIVER TANK**



Outdoor receiver tank

#### **CHANNEL APPLICATION – SINGLE DROPS**



Single drop channel application

#### **CHANNEL APPLICATION – LINEAR HEADERS**



Linear header channel application



## Service

The services of a qualified representative are included for two (2) trips with two (2) days per trip onsite to inspect installation, oversee testing and start-up and provide operations and maintenance training. Additional EnviroMix field service is available at a cost of \$1,500.00 per day plus travel and living expenses.

# Pricing

This estimate does not include equipment installation, electrical wiring, conduit, or taxes, if applicable. The preliminary price for the EnviroMix equipment and service outlined in this proposal, FOB jobsite is \$66,000.00.

#### **Patents**

The proposed Compressed Gas Mixing System for this project, including the specific layout of header piping, nozzles, air distribution and its operation is covered by US Patents 8,323,498 / 8,505,881 / 8,702,070 / 9,416,037 / 9,567,245 and any pending patent applications. EnviroMix reserves all rights and remedies for any unauthorized and infringing activity covered by any of its patents and those subsequently issued that are currently pending with the USPTO.

## Contact

Upon acceptance of this Preliminary Proposal, the EnviroMix Team would be pleased to assist in the development of a more detailed design package including drawings and specifications. We appreciate your consideration of BioMix Compressed Gas Mixing System for this application and look forward to the opportunity of working further with you.

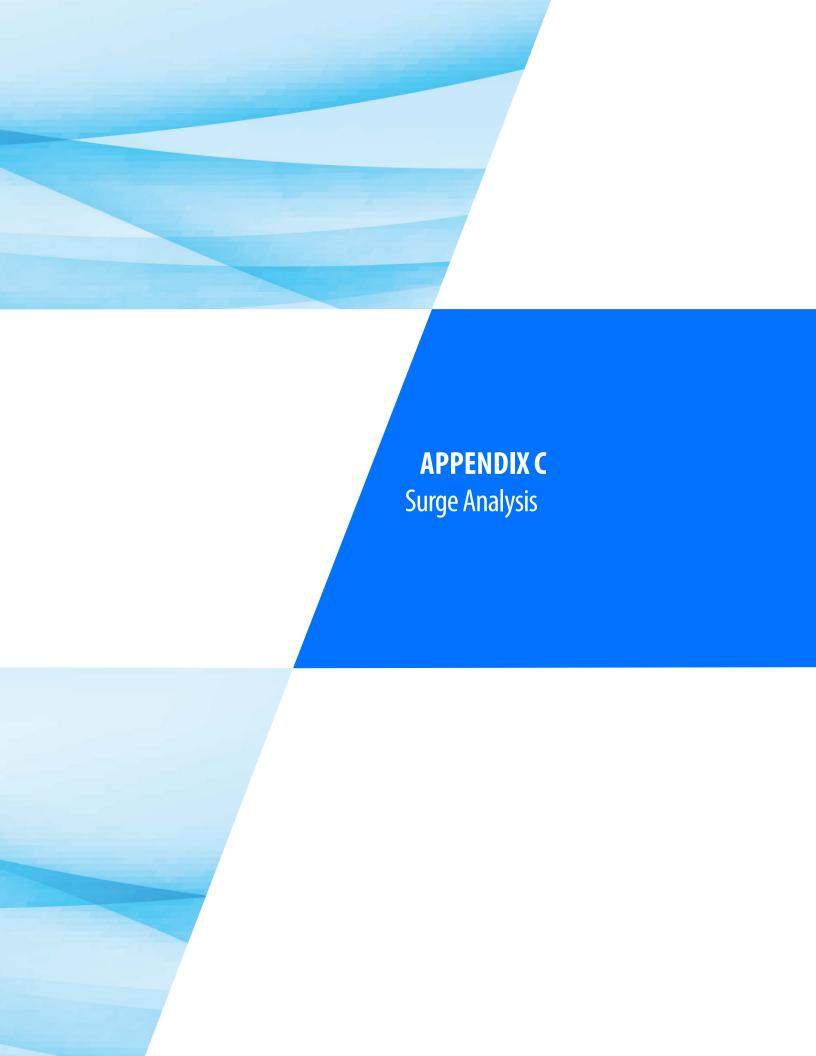
#### **EnviroMix Contact:**

Freddy Kade, P.E., M.S. Director of Regional Sales fkade@enviro-mix.com (414) 949-6361

#### **EnviroMix Representative Contact:**

Clint Curl The TDH Company C 678.983.6795





Under Task 4, the Consultant will prepare a hydraulic model, including the existing surge tank at the Mulberry PS, to evaluate surge along the force main for both Options A and B. Results of the surge analysis will be used to determine if the existing surge tank can be eliminated for either Option A and B, and/or if other measures are required or can be provided to handle surges along the force main.

We recommend replacing the surge tank with an appropriately size surge relief valve. In coordination with appropriately designed pump check valves and air release valves, a surge relief valve will protect the force main and be easier to maintain. A summary of the surge valve sizing and model results are shown below.

The models considered a pump trip, with the pump trip the check valve closure could generate a pressure spike. The worst-case pressure spike shown in the model was due to ARV slam. A properly sized and designed air valve would reduce this spike. The spike generated should be considered to approximate a malfunctioning air valve.

The pressure rise due to pressure surge is calculated in the following formula,  $\Delta H = {}^{4}\!/_{9} \Delta V$ , where the total surge reported in the table below includes both the static pressure on the check valve plus pressure rise due to surge or  $\Delta H + static$  head. Calculated surge values are based on the wave speed and pipe velocity of the pump station valve piping and are more conservative than what is calculated in the surge models. All the table values are based on ductile iron piping which is far more conservative than HDPE. All the options are withing the operating limits of both ductile iron and HDPE DR11 pipe, by incorporating a surge valve at each pump station

		Approximate Peak Surge Pressure (psi)		
Option	Pump Station	Calculated	Modeled	with Surge Valve
Α	Mulberry Creek	270	175	80
Α	Reunion	371	150	150
В	Mulberry Creek	367	250	160
C	Mulberry Creek	337	175	140
C	Dove Point	329	210	175
Existing	Mulberry Creek	400		

**Table 1 - Surge Pressures** 

The pressure rise can also be approximated using the graph below. The  $\Delta H$  is roughly 300psi at 5fps velocity.

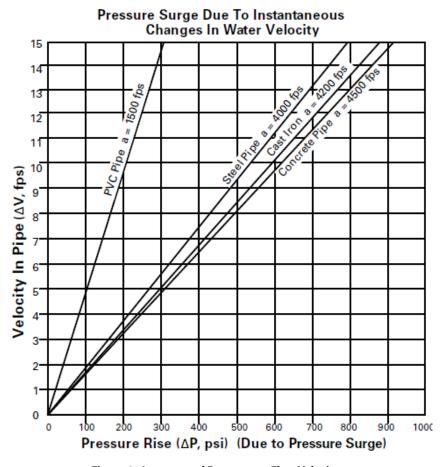


Figure 1 - Incremental Pressure vs. Flow Velocity

The sizing graph for the surge relief valve is shown below.

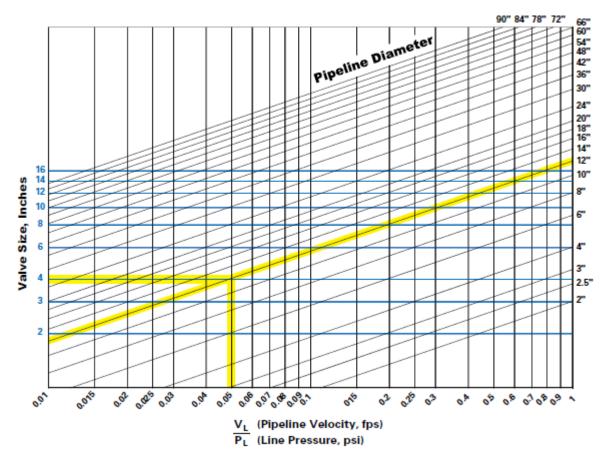


Figure 2 - Surge Relief Valve Sizing Graph

Option	Pump Station	V <sub>L</sub> /P <sub>L</sub>	Pipeline Diameter (ID nominal)	Surge Valve Size
Α	Mulberry Creek	0.09	12"	6"
Α	Reunion	0.03	14"	4"
В	Mulberry Creek	0.03	12"	4"
C	Mulberry Creek	0.06	12"	6"
C	Dove Point	0.04	14"	4"
-	Crystal Farms	0.01	18"	4"

**Table 2 - Surge Valve Sizing** 



Figure 3 - Option A Mulberry Creek Pump to Reunion Model

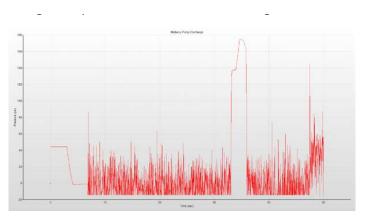


Figure 4 - Option A Model Results without Surge Protection

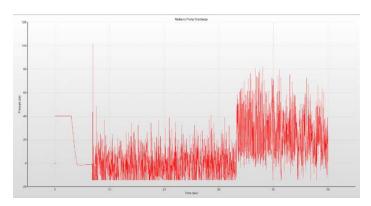


Figure 5 - Option A Model Results with Surge Valve





Figure 6 - Option A Reunion to Spout Springs Model

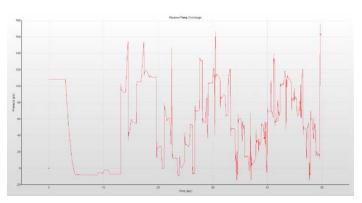


Figure 7 - Option A Model Results without Surge Protection

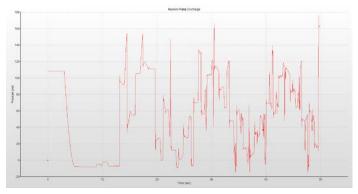


Figure 8 - Option A Model Results with Surge Valve

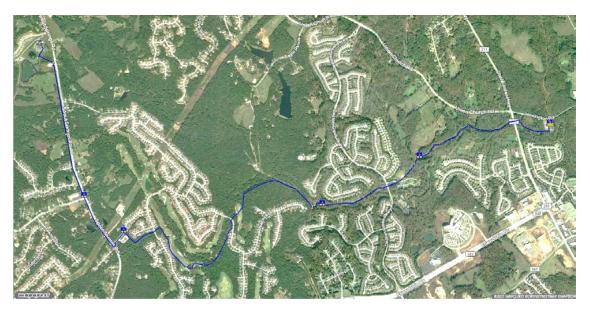


Figure 9 - Option B Mulberry Creek to Spout Springs Model

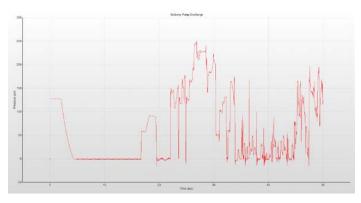


Figure 10 - Option B Model Results without Surge Protection

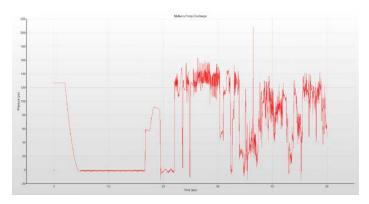


Figure 11 - Option B Model Results with Surge Valve





Figure 12 - Option C Mulberry Creek to Dove Point

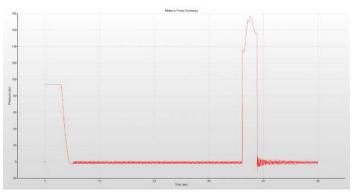


Figure 13 - Option C Model Results without Surge Protection

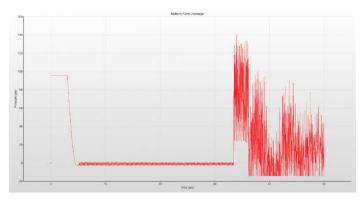


Figure 14 - Option C Model Results with Surge Valve





Figure 15 - Option C Dove Point to Spout Springs

rigure 10 Option C ivioaei kesuits without surge Protection



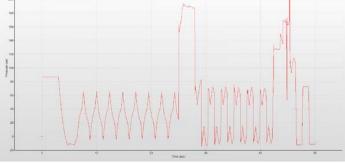


Figure 16 - Option C Model Results without Surge Protection

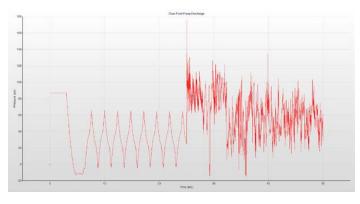


Figure 17 - Option C Model Results with Surge Valve



## References

Air valve operation videos

Αρςο

https://www.youtube.com/watch?v=w -Z-cwOr8k

Vent-tech

https://www.youtube.com/watch?v=aWGYn5fnlmM

















