Facility Plan Report

Centertown Wastewater System Improvements

Project No. 19492.000

Prepared for

Village of Centertown, Cole County, Missouri

Isaac Crabtree, P.E.

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Bartlett &West, Inc
Missouri Certificate of Authority No. 000167
1719 Southridge Drive, Suite 100
Jefferson City, MO 65109-4000
Phone: 573-634-3181
Fax: 573-634-7904

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Abbreviations and Acronyms

- BOD – Biochemical Oxygen Demand
- gpcd – Gallons per Capita per Day
- gpd – Gallons per Day
- gph – Gallons per Hour
- gpm – Gallons per Minute
- LPSS – Low Pressure Sewer System
- MDNR – Missouri Department of Natural Resources
- MHI – Median Household Income
- SDGS – Small Diameter Gravity Sewer
- SS – Suspended Solids
- TKN – Total Kjeldahl Nitrogen

I. Introduction

The Village of Centertown is located in northwestern Cole County, Missouri. The Village has 284 residents and multiple businesses. The Village owns and operates a water distribution system within the Village boundary. A central wastewater collection and treatment system does not exist with residences and businesses operating individual septic systems or lagoons.

In late 2008, the village hired a consultant to review the feasibility of constructing a centralized wastewater collection and treatment system for the residents and businesses within the village limits. At the time, the wastewater project was cancelled by the board because it was determined that constructing a centralized wastewater collection and treatment system was not feasible due to the financial burden it would place on the community.

This Facility Plan is a continuation of the efforts that were begun over 10 years ago, and it examines the possibility of adding a municipal wastewater collection system and either a dedicated treatment system or pump station to convey sewage to Jefferson City for treatment.

A. Purpose and Scope

The Purpose of this Facility Plan is to:

1. identify and evaluate the need for a wastewater collection and treatment system,
2. assemble basic information,
3. present design criteria and assumptions,
4. examine alternate collection and treatment systems, with conceptual layouts and cost estimates,
5. describe financing methods and anticipated user charge,
6. review organizational and staffing requirements,
7. offer a recommendation of proposed improvements for consideration.

II. Planning and Service Area

A. Location

The service area of the proposed wastewater collection system includes the entire area within the Village limits of 0.95 square miles. Locations for potential wastewater treatment facilities are shown in Appendices B and F.

B. Environmental Considerations

The overall impact of constructing a new wastewater treatment system will be positive. A new system will correct problems arising from aging and undersized on-site systems. A full independent environmental assessment will need to be conducted to determine any potential impacts resulting from the construction of the proposed project. The Village will need to procure these services as they are not included in the scope of this study.

1. Floodplain Boundary

Only a small portion of land along an unnamed tributary to North Moreau Creek on the southern boundary of the Village lies within the 100-year flood plain boundaries. Floodplain boundary maps are provided in Appendix A. All wastewater treatment facilities shall be protected from damage during a 100-year flood (1% annual Chance Flood) as required by 10 CSR 20-8.140(3)(A).

2. Geotechnical

According to the USDA Web Soil Survey, the depth to bedrock throughout Centertown is thought to range from 0 to 10 feet which may make construction of wastewater treatment lagoons challenging in some locations. A geotechnical investigation will be conducted during design of the facilities.

3. Agency Coordination

After the selected alternative and funding strategy are approved by the Missouri Department of Natural Resources (MDNR), an environmental review process will begin. The environmental review for the proposed improvements will include environmental clearances from the following agencies:

- MDNR State Historic Preservation
- Missouri Federal Assistance Clearinghouse
- MDNR Division of State Parks
- Missouri Geological Survey
- Missouri Department of Conservation
- U.S. Fish and Wildlife Service
- Corps of Engineers district Office

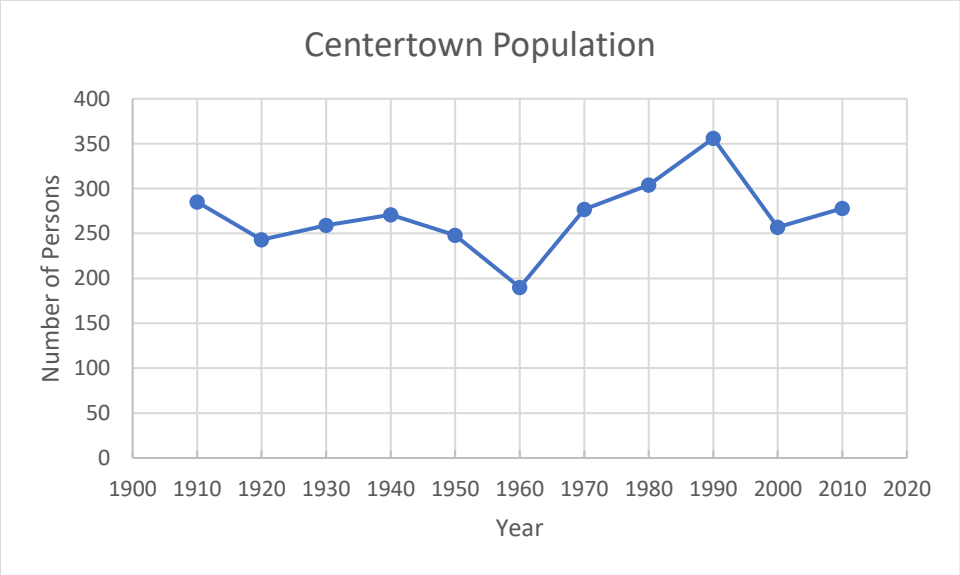
III. Population Projection and Planning Period

Table 1 below shows the population data for Centertown for the hundred-year period between 1910 and 2010. The average annual growth over the hundred-year period between 1910 and 2010 is approximately 0.2%, or essentially zero growth. Centertown reached a maximum population of 356 in 1990. Because of the wide variation, the population data over this period do not provide a clear trend for projecting future growth for Centertown.

Table 1: Centertown Population Data

Year	Population	Average Annual Increase for Preceding Decade
1910	285	n/a
1920	243	-1.47%
1930	259	0.66%
1940	271	0.46%
1950	248	-0.85%
1960	190	-2.34%
1970	277	4.58%
1980	304	0.97%
1990	356	1.71%
2000	257	-2.78%
2010	278	0.82%

Source: Missouri State Census Data Center, available at http://mcdc.missouri.edu/trends/tables/cities1900-1990.pdf

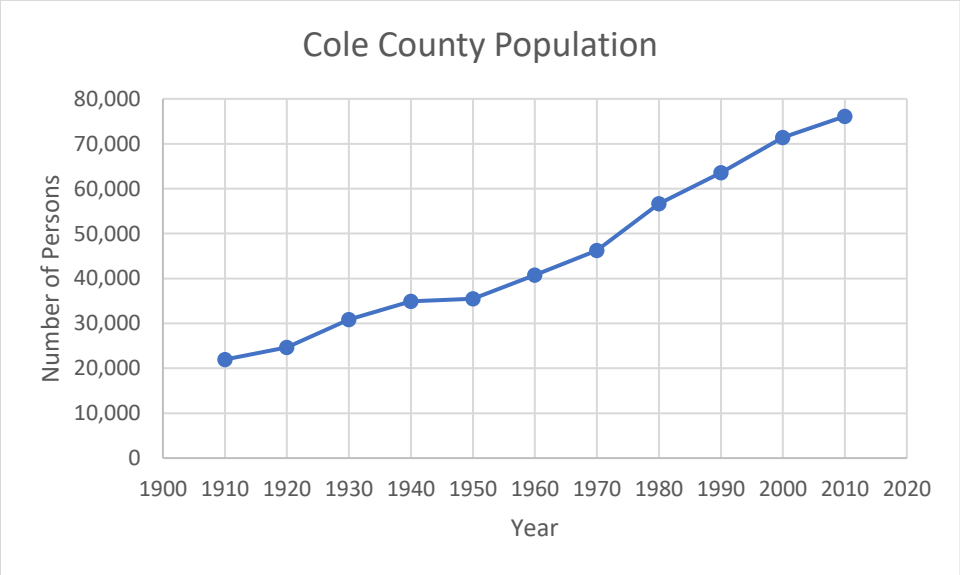


Accordingly, the population for Cole County over a hundred-year period has been more consistent than Centertown's growth. It may provide a better basis than the historical Centertown data for estimating the population growth in Centertown following the completion of the proposed wastewater system improvements. Table 2 below indicates the average annual population increase in Cole County. The average annual population increase over the hundred-year period between 1910 and 2010 is approximately 1.3%.

Table 2: Cole County, Missouri Population Data

Year	Population	Average Annual Increase for Preceding Decade
1910	21,957	n/a
1920	24,680	1.24%
1930	30,848	2.50%
1940	34,912	1.32%
1950	35,464	0.16%
1960	40,761	1.49%
1970	46,228	1.34%
1980	56,663	2.26%
1990	63,579	1.22%
2000	71,397	1.23%
2010	76,116	0.66%

Source: Missouri State Census Data Center, available at http://mcdc2.missouri.edu/webrepts/poptrends/mo/Cole http://mcdc.missouri.edu/trends/tables/historical_indicators/moco_totpop_1900_2000.pdf



Under Missouri regulatory guidelines the design of wastewater treatment facilities must provide sufficient capacity to serve estimated population and flows projected twenty years into the future. 10 CSR 20-8.110(4). Although a planning period of thirty years may reduce the likelihood of the Village being required to expand the treatment capacity before retiring the loan or bond obligation, it may not be cost-effective for the Village to design that far into future, based upon rough population and wastewater flow projections. Overbuilding the treatment system could also be problematic in that it may not function properly if loaded too lightly during the first years of its use.

Although US Census Bureau Population Estimates Program for 2016 indicates approximately 285 residents for Centertown, a continued increase in population from the last census, the proposed wastewater system improvements will likely create a consistent growth trend for the near future. For planning purposes, this study estimates the population of Centertown to be 295 residents in 2019 when it is anticipated that the wastewater system improvements will be completed. Moreover, during the twenty-year period between 2019 and 2039, the population of the Village may increase to roughly 377 residents as available land and infrastructure improvement attract development to the area. This equates to an annual population growth rate of approximately 1.3 percent. For the purposes of this study, the twenty-year planning period will utilize a projected population of 380 residents to perform design and capacity calculations.

The following is a list of businesses and institutions currently operating within the limits of Centertown:

1. Centertown Leisure Village
2. Tammy's Restaurant
3. BO-9 Junction LLC (Gas Station)
4. Longfellows Garden Center
5. Senter's Heating & Cooling
6. Fleugel Equipment Co
7. Centertown Baptist Church
8. U.S. Post Office

IV. Existing Facilities

Located along on a ridge, west of Jefferson City along Old Highway 50 (now called Lookout Trail), the Village of Centertown straddles two separate drainage basins that flow into unnamed tributaries of Rock Creek and the North Moreau River. Both Rock Creek and the North Moreau River ultimately flow to the Missouri River. Because Centertown does not contain a centralized wastewater treatment facility, residences and business within the Village of Centertown utilize individual wastewater treatment methods such as septic tanks. Centertown Leisure Village, a retirement home, operates a small lagoon system permitted by MDNR. Any wastewater overflows from Centertown would eventually flow into either the Moreau River or the Missouri River via Rock Creek.

Although the Village does not have an existing wastewater system, it does have a water distribution system. Currently, the Village owns and operates a water system that services approximately 118 residences and 9 businesses, but these numbers vary somewhat from year to year. This information and water usage records help provide the basis for developing an appropriate design for the Village's new wastewater system.

A. Description of Need

The age and condition of many of the septic tanks within the Village poses the threat that wastewater overflows may run into local drainage ditches that discharge into tributaries of nearby rivers. Specifically, many of the septic tanks may provide only limited treatment

capacity, limited by wall collapse, buildup of solids, and inadequate size. As a result of limited capacity, untreated effluent from the on-site systems may discharge directly into ditches, creating unsightly conditions that pose significant health threats to people who are directly exposed to the untreated waste. Thus, children in this community possess a heightened vulnerability because of their natural attraction to water.

Even indirect exposure may cause health and safety concerns. Vectors, such as flies and mosquitoes, breed in the stagnant wastewater and may transmit pathogens from the untreated wastewater to the surrounding human population. Also, although it may not pose a significant health issue, stagnant wastewater forms sulfides, which produce very offensive odors during summer months. The direct and indirect health hazards posed by the deteriorating septic tanks illustrate the need to provide the citizens of Centertown with a long-term solution to their wastewater treatment problems.

V. Design Parameters

A. Hydraulic Capacity

The design average daily flow and the design peak hourly flow are two parameters used to design a wastewater collection and treatment system. The design average daily flow is the average of the daily volumes to be received for continuous twelve-month period expressed as a volume per unit time. The peak hourly flow is the largest volume of flow to be received during a one-hour period expressed as a volume per unit time.

The Village of Centertown does not have an existing wastewater collection and treatment system, therefore there are no records for existing average day and peak day flows. To determine the value of these parameters typical hydraulic loading factors set forth by 10 CSR or historical water use data must be used. Table 3 below shows annual water meter data during the past three years for the Village, providing a reasonable means to determine the existing average daily wastewater flows.

Table 3: Existing Water System Meter Data for Centertown

Year	Water Pumped	
	(gal/year)	(gpd)
2014	6,152,700	16,857
2015	6,059,100	16,600
2016	6,370,700	17,454
Average	6,194,167	16,970

The historical water use data from the Village indicates an average water usage of 16,970 gpd (gallons per day). This equates to a design average day flow of 60 gpcd (gallons per capita per day) based on a population of 284 persons. 60 gpcd does include all users in Centertown including commercial users. However, the value used for capacity should be increased to

account for future Infiltration and Inflow (I&I) into the sewer collection system as it ages. 10 CSR 20-8.110 requires that new collection and treatment systems be based on an average day use of 100 gpcd in addition to major institutional and commercial flows.

Table 4: Centertown Major Commercial Water Flows

Business	Average Daily Water Use in Gallons
Centertown Leisure Village	820
Longfellows Garden Center	200
Tammy's Restaurant	190
BO-9 Junction LLC	380
Total	**1590**

Major commercial flows in Centertown includes Centertown Leisure Village Retirement Community, Tammy's Restaurant, BO-9 Junction LLC, and Longfellow's Garden Center. Table 4 above shows the average water usage by these business for 2017. The total daily water usage for these business is approximately 1590 gallons. It is reasonable to assume that commercial water use will increase with population growth. If water usage rates increased by 1.3% every year (similar to population growth), commercial water use would account for 2110 gallons of water per day. A design commercial wastewater flow rate of 2200 gpd will be used to perform design and capacity calculations

State regulations require designers of sanitary sewers to provide capacity for peak flows, which may be estimated by using the following equation to calculate the ratio of peak to average daily flow (peak flow factor). In Equation 1 below, a projected 20-year population of 380 people is used. Note that the ratio of peak hourly to design average flow is 4.03.

Equation 1: Ratio of Peak Hourly to Design Average Flow

$$PF = \frac{18 + \sqrt{\frac{population}{1{,}000}}}{4 + \sqrt{\frac{population}{1{,}000}}} = \frac{18 + \sqrt{\frac{380}{1{,}000}}}{4 + \sqrt{\frac{380}{1{,}000}}} = 4.032$$

B. Organic Capacity

Biochemical oxygen demand (BOD) and suspended solids (SS) are two organic loading parameters needed for sizing wastewater treatment system components. BOD is the amount of oxygen required to stabilize biodegradable organic matter under aerobic conditions within a five-day period. SS are solid particles that float to the surface of, or are suspended in the wastewater. Minimum values for determining organic loading for a new wastewater facility design are 0.17 pounds (0.08 kg) of biochemical oxygen demand per capita per day and 0.20 pounds (0.09 kg) of suspended solids per capita per day (10 CSR 20-8.110). Values of 0.22 pounds BOD per day and 0.25 pounds SS per day were used as loading factors to account for the possible use of garbage disposals in households in the project area. Total Kjeldahl nitrogen (TKN)

is the total nitrogen consisting of nitrogen and ammonium. TKN is also an important factor in sizing wastewater treatment systems. Typical loadings for wastewater are 50 mg/L.

Table 5 below summarizes the 20-year design parameters of average daily flow, peak hourly flow, biochemical oxygen demand, and total suspended solids. Missouri regulations (10 CSR 20-8.110(4)), provided the basis for developing these design parameters. The design parameters for peak hourly flow, BOD, SS, and TKN provided the basis for developing alternatives for the new wastewater treatment facility and collection system. These alternatives are described in the following section.

Table 5: Design Parameters for Projected System

Scenario	Average Daily Flow (gpd)	Peak Hourly Factor	Peak Hourly Flow (gph)	BOD (lbs/day)	Suspended Solids (lbs/day)	TKN (lbs/day)
20-year Projection	40,200	4.03	6,750	88.2	100.5	17

C. Anticipated Effluent Limits

Per MDNR, the anticipated effluent limits for discharge are as follows:

1. BOD and TSS
    a. 45 mg/L weekly average
    b. 30 mg/L monthly average
2. E. coli
    a. 1030 Colonies/100 mL weekly average (geometric mean)
    b. 206 Colonies/100 mL monthly average (geometric mean)
3. Oil and Grease
    a. 15 mg/L daily maximum
    b. 10 mg/L monthly average
4. pH between 6.5 and 9
5. Ammonia
    a. 0.6 mg/L summer monthly average

These limits were considered in the treatment system alternatives described in the next section.

VI. Alternatives Considered

A. Collection System Alternatives

The following three alternatives have been developed as possible collection systems:

1. Traditional Gravity System
2. Small Diameter Gravity System
3. Low Pressure Sewer System

The three alternatives are discussed below.

1. Traditional Gravity System

Conventional wastewater collection systems are the most common method to collect and convey wastewater. Pipes are installed on a slope, allowing wastewater to flow by gravity from a system user to the treatment facility or pumping station for transfer to the treatment facility. Pipes are sized and designed with straight alignment and uniform gradients to maintain self-cleansing velocities. Manholes are installed between straight runs of pipe to ensure that blockages can be readily accessed. Pipes are generally eight inches in diameter or larger and are typically installed at a minimum depth of three feet and a maximum depth of 25 feet. Manholes are located no more than 400 feet apart and at changes of direction or slope.

The highest elevation within the Village is about 870 feet and the lowest elevation is approximately 700 feet. The surface drainage for the Village of Centertown flows either north of south. Runoff to the north flows into Rock Creek. Runoff to the south flows into North Moreau Creek. A gravity sewer collection system is a feasible alternative if some lift stations and force mains are included to pump sewage to a central point. The collection point and layout of the system is dependent on the wastewater treatment option. A preliminary layout of the system includes 28,570 feet of gravity main, 128 standard manholes, 7790 feet of force main, 5 pumps stations and 1 grinder pump.

The engineer's opinion of probable total project cost is $5,540,000 The total annual O&M costs for the collection system is $19,000. The O&M costs include electrical power, pump station checks and flow record keeping, quarterly cleaning and miscellaneous equipment replacement including pumps every 7 years. Appendix G shows a detailed breakdown of the project costs and O&M costs. The estimated total present worth of this system is $5,840,000 based on a present worth analysis of 20 years at 2.5%.

2. Small Diameter Gravity System

In locations where a conventional gravity collection system is not feasible or economical, a small diameter gravity collection system is another alternative. Small diameter gravity sewers (SDGS) convey effluent by gravity from a septic tank to a centralized treatment location or pump station for transfer to a treatment facility. Most suspended solids are removed from the wastewater by septic tanks, reducing the potential for clogging to occur and allowing for small diameter piping both downstream of the septic tank in the lateral and in the sewer main. Cleanouts are used to provide access for flushing. Manholes are rarely used in this type of system. Air release risers are required slightly downstream of summits in the sewer profile. Odor control is important at all access points since the SDGS carries odorous septic tank effluent.

Due to the removal of biological solids in the septic tank, the small diameter gravity collection systems are not compatible with most mechanical treatment systems. Because of the small diameters and flexible slope and alignment of the SDGS, excavation depths and volumes are typically much smaller than conventional sewers. Minimum pipe diameters can be 4 inches.

Plastic pipe is typically used because it is economical in small sizes and resists corrosion. This option would be a deviation from the MDNR and would require approval. A preliminary layout of the system includes 28,570 feet of gravity main, 7790 feet of force main, 50 manholes, 78 cleanouts, 5 pumps stations and 1 grinder pump.

The engineer's opinion of probable total project cost is $4,870,000. The total annual O&M costs for the collection system is $84,000. The O&M costs include electrical power, pump station checks and flow record keeping, quarterly cleaning and miscellaneous equipment replacement including pumps every 7 years. Appendix G shows a detailed breakdown of the project costs and O&M costs. The estimated total present worth of this system is $6,180,00 based on a present worth analysis of 20 years at 2.5%.

3. Low Pressure Sewer System

Another alternative to a conventional gravity collection system is a low pressure sewer system (LPSS). A pressure collection system conveys wastewater from users to a centralized treatment location using grinder pumps. Unlike the small diameter gravity collection system which uses septic tanks, the pressure system uses a grinder pump to break down the solids to reduce the potential for clogging to occur which allows for small diameter piping to be used. Grinder pumps with control panels are required for each user. Isolation valves are used to isolate mains and service lines for repairs. Cleanouts are required approximately every 400 to 500 feet and at major changes of direction and where one collector main joins another main.

Air release valves are located in high spots within the system to release trapped air. Because of the small diameters and flexible vertical and horizontal alignment of LPSS, excavation depths and volumes are much smaller than conventional sewers. Minimum pipe diameters can be 2 inches. Plastic pipe is typically used because it is economical in small sizes and resists corrosion. The preliminary system design consists of 20,770 feet of force main, approximately 20 air/vacuum Release Valves, 30 force main cleanouts, and 131 grinder pumps.

The engineer's opinion of probable total project cost is $4,790,000. The total annual O&M costs for the collection system is $130,000. The O&M costs include electrical power, pump station checks and flow record keeping, quarterly cleaning and miscellaneous equipment replacement including pumps every 7 years. Appendix G shows a detailed breakdown of the project costs and O&M costs. The estimated total present worth of this system is $6,820,000 based on a present worth analysis of 20 years at 2.5%.

B. Treatment Alternatives

These five alternatives have been developed as possible alternatives for treatment:

1. Pump to Jefferson City
2. Lagoons with Irrigation
3. Lagoons with Discharge
4. Moving Bed Biofilm Reactor

5. Packed Bed Media Filter

The five alternatives are discussed below.

1. Pump to Jefferson City

This alternative is to pump wastewater from Centertown to Jefferson City for treatment. A pump station would be located to the south of the baseball field. The land for the pump station would need to be purchased. Alternatively, if the required land cannot be purchased the pump station could be located to the north of the baseball field on land currently owned by the Village of Centertown. Locating the pump station to the north of the baseball field would require more clearing of trees and vegetation. Approximately 28,000 feet of force sewer main would need to be constructed to tie in with the Grays Creek inceptor sewer of the Jefferson City collection system located near the intersection of Highway T and Henwick Lane north of the community of St. Martins, Missouri. Jefferson City has indicated an appropriate connection point for the anticipated peak flow rate into their system of 80 gpm.

Jefferson City has indicated that the yearly charge for connecting to their system would be a flat fee of $25,125. This rate would be subject to an agreement between Centertown and Jefferson City and formal approval by the Jefferson City Council. The agreement would also be contingent upon the Village of Centertown adopting City of Jefferson Sewer Use Code Chapter 29, Articles I through IV. A flow meter would need to be installed and maintained by the Village with access available to Jefferson City. Maintenance of the pump station and pipeline would be the responsibility of the Village.

Wastewater collection system costs will be similar for all of the treatment options except that it would be desirable to locate a main lift station so the length of the force main can be minimized. A drawing showing the proposed locations for the pump station, pipeline and connection the the Jefferson City wastewater collection system is included in Appendix B.

The engineer's opinion of probable total project cost is $2,630,000. The total annual O&M costs for the collection system is $36,000. The O&M costs include electrical power, pump station checks, miscellaneous equipment replacement including pumps every 7 years, and Jefferson City connection charge. Appendix E shows a detailed breakdown of the project costs and O&M costs. The estimated total present worth of this system is $3,190,000 based on a present worth analysis of 20 years at 2.5%.

2. Lagoons with Irrigation

The use of lagoons for wastewater treatment and storage prior to irrigation has the advantage of reducing concern regarding the uncertainty of future effluent limit changes. There is a tract of land south of the new Highway 50 that could be used for lagoons and irrigation. It appears that it would be feasible to construct about a 2.75-acre primary lagoon cell and a 4-acre storage cell on this site as shown on the site layout included in Appendix B. Southwest of the lagoon site is

property that should be suitable for irrigation. The approximate location of the lagoons and the outline of the area for irrigation are shown.

The primary cell must have at least one acre of surface area per 34 pounds of BOD load, or 2.59 acres. It is recommended that the primary cell surface area be at least 2.75 acres if possible. The minimum detention time for the primary cell in land application system is 60 days. This amounts to a minimum of 2.412 million gallons of storage. The minimum operational depth required for a 2.75-acre primary pond will be 2.7 feet. A 3-foot deep pond would have a total storage capacity of 2.69 million gallons.

For preliminary planning purposes, the amount of storage needed is based on providing enough storage so the system can store during the winter and other times of the year when it is not feasible to irrigate. In addition, the amount of rainfall that exceeds evaporation that falls on the lagoon will need to be accounted for. Average rainfall in the Centertown Region was determined to be 38.9 inches per year based on data from the National Weather Service. The wettest year in 10 is approximately 54 inches of rain according to the Missouri Climatic Atlas for Design of Land Application Systems. Also, according to the Climatic Atlas, evaporation in the Centertown Region averages at 36.5 inches per year.

Taking the wettest year in ten minus the average evaporation results in 17.5 inches of water that need to be accounted for in the lagoons water storage. Calculations for the size of the storage cell are found below in Equation 2. A storage period of 180 days would require a storage volume of 7.24 million gallons. The proposed storage cell is 4 acres and 8 feet deep (if feasible) for a total storage of 10.43 million gallons.

Equation 2: Storage Cell Size Requirements

$$180\ days * 40{,}200\ \frac{gallons}{day} = 7.24\ million\ gallons$$

$$\frac{17.5\ inches}{12\frac{inches}{foot}} * 6.75\ acres * 43560\frac{feet^2}{acre} * 7.48\frac{gallons}{feet^3} = 3.21\ million\ gallons$$

$$7.24\ million\ gallons + 3.21\ million\ galllons = 10.45\ million\ gallons$$

Preliminary estimates of the irrigation area are based on an application rate of 2 feet per year. Actual allowed wastewater application rates will be dependent on soil characteristics. Using a total annual flow of 14.67 million gallons plus an additional 3.21 million gallons for rainfall in wet years gives a total of 17.88 million gallons, or 54.9 acre-feet of water to be irrigated. This would require 27.5 acres of irrigated area at an application rate of 2 feet per year. An area available for irrigation is identified on the site map shown in Appendix B. This delineated area should provide enough land for irrigation even when the required setbacks from property lines and water bodies are applied. The irrigation system will consist of water lines and fixed sprinkler heads.

There are no locations with the limits of Centertown that would be suitable for this treatment alternative. The best location for the lagoon and irrigation system would be located about a half mile south of Centertown. The site is located next to a small stream which may be prone to flooding during heavy precipitation. See Appendix B for location map.

One important factor regarding the use of this alternative is the shallow soils in this area. While it is anticipated that soils suitable for lagoon construction can be obtained at or near the lagoons site, recent highway construction in the area indicates that bedrock is near the surface, and that soils are thin. It will be difficult to obtain an accurate cost of lagoon construction for this alternative until on site borings and a geotechnical report are completed.

The engineer's opinion of probable total project cost is $3,180,000. The total annual O&M costs for the collection system is $24,000. The O&M costs includes electrical power for irrigation pumps, pump station checks, miscellaneous equipment replacement including pumps every 7 years, and lagoon mowing. Appendix E shows a detailed breakdown of the project costs and O&M costs. The estimated total present worth of this system is $3,550,000 based on a present worth analysis of 20 years at 2.5%.

3. Lagoons with Discharge

This alternative is similar to Alternative 2. Lagoons would be used for facultative wastewater treatment prior to treated effluent being discharged into an unnamed tributary to North Moreau Creek. The lagoons would be located south of the new Highway 50 and would consist of 4-cell pond design with a 2.5-acre primary lagoon cell, a 0.75-acre secondary cell, and two 0.75-acre storage cells. See Appendix B for the location map.

For the primary cell the maximum BOD loading rate is 34 lbs per acre per day resulting in a minimum lagoon size of 2.59 acres. It is recommended that the size be increased to 2.75 acres. The secondary cell has an area 0.3 times the size of the primary cell and is 1 acre. The primary and secondary cells shall have a maximum depth of 5 feet. The two storage cells must have a minimum of 120 days of detention time between them above the minimum pond depth of 2 feet. If it is feasible to make the pond the maximum depth of 8 feet the ponds can each be 0.75 acres. This option may not reliably meet effluent limitations set by the Missouri Department of Natural Resources without additional treatment and disinfection.

The engineer's opinion of probable total project cost is $2,4270,000. The total annual O&M costs for the collection system is $22,000. The O&M costs includes miscellaneous equipment replacement and lagoon mowing. Appendix E shows a detailed breakdown of the project costs and O&M costs. The estimated total present worth of this system is $2,800,000 based on a present worth analysis of 20 years at 2.5%.

4. Moving Bed Biofilm Reactor

Moving Bed Biofilm Reactors (MBBR) have been accepted by MDNR as a viable treatment technology for wastewater treatment in Missouri and recently a couple of these systems have

been installed at nearby municipalities. They have reasonable construction costs and require minimal electrical power. The system would begin with a septic tank with two 20,000-gallon compartments and a total detention time of 36 hours or more. Septic tank effluent would flow into an equalization tank that pumps the flow into MBBR Reactor.

The MBBR Reactor is filled with a plastic media for a biofilm to develop. The media is designed to have approximately the same density of water. The effluent from the MBBR Reactor would flow into a biological filter. The biological treatment system would have two sections, which allows for temporary operation if maintenance work is required. Recycle lines from the biological filters would gravity flow back to the beginning of the system in the septic tank. Prior to discharge, wastewater would pass through UV disinfection.

The proposed location of a mechanical treatment site is shown in Appendix B. The proposed location is located to the east of the baseball field. The mechanical treatment systems could also be located further to the north.

The engineer's opinion of probable total project cost is $2,790,000. The total annual O&M costs for the collection system is $63,000. The O&M costs includes electrical power for the MBBR blower and UV disinfection, miscellaneous equipment including the UV lamps and the cost of lab testing. Appendix E shows a detailed breakdown of the project costs and O&M costs. The estimated total present worth of this system is $3,770,000 based on a present worth analysis of 20 years at 2.5%.

5. Packed Bed Media Filter

A packed bed media filter can be used to treat septic tank effluent. If used in conjunction with a gravity collection system a packed bed filter would be preceded by two 40,000 gallons septic tanks. The effluent from the septic tanks would flow into a dosing tank. The dosing tank would pump wastewater into an Aerocell Treatment Module. In the Aerocell module water trickles in from nozzles at the top of the tank and travels through a media to flow out at the bottom of the tank. The 40,000-gallon 8-foot by 16-foot packed bed media filter would use either open cell foam Aerocell or natural bio-coir as a media.

The proposed location of a mechanical treatment site is shown in Appendix B. The proposed location is located to the east of the baseball field. The mechanical treatment systems could also be located further to the north.

The engineer's opinion of probable total project cost is $2,750,000. The total annual O&M costs for the collection system is $47,000. The O&M costs includes electrical power for dosing pumps, UV disinfection, miscellaneous equipment including the UV lamps and the cost of lab testing. Appendix E shows a detailed breakdown of the project costs and O&M costs. The estimated total present worth of this system is $3,480,000 based on a present worth analysis of 20 years at 2.5%.

VII. Selection of an Alternative

A. Life Cycle Cost Analysis

Alternative 1 – Conventional Gravity Collection System has the lowest total present worth of $5,840,000, as shown in Table 6. Of the five treatment options presented, Alternative 3 – Lagoons with Discharge has the lowest total present worth of $2,690,000. Table 8 shows the total estimated combined costs of the collection and treatment system. The lowest possible total project cost combining the collection system and treatment alternatives is $8,530,000.

Table 6: Collection Systems Life Cycle Costs

Cost Description	Alternative 1 Conventional Gravity System	Alternative 2 Small Dia. Gravity System	Alternative 3 Low Pressure Sewer System
Total Project Cost	$5,540,000	$4,870,000	$4,790,000
Present Worth O&M Cost (@ 2.5%, 20 years)	$300,000	$1,280,000	$1,450,000
Total Present Worth	**$5,840,000**	**$6,150,000**	**$6,240,000**

Table 7: Treatment Systems Life Cycle Costs

Cost Description	Alternative 1 Pump to Jefferson City	Alternative 2 Lagoons with Irrigation	Alternative 3 Lagoons with Discharge	Alternative 4 Moving Bed Media Filter	Alternative 5 Packed Bed Media Filter
Total Project Cost	$2,630,000	$3,180,000	$2,270,000	$2,790,000	$2,750,000
Present Worth O&M Cost (@ 2.5%, 20 years)	$560,000	$370,000	$420,000	$860,000	$730,000
Total Present Worth	**$3,190,000**	**$3,550,000**	**$2,690,000**	**$3,650,000**	**$3,480,000**

Table 8: Collection & Treatment System Combined Life Cycle Costs

	Alternative 1 Conventional Gravity System	Alternative 2 Small Dia. Gravity System	Alternative 3 Low Pressure Sewer System
Alternative 1 Pump to Jefferson City	$9,030,000	$9,340,000	$9,430,000
Alternative 2 Lagoons with Irrigation	$9,390,000	$9,700,000	$9,790,000
Alternative 3 Lagoons with Discharge	$8,530,000	$8,840,000	$9,930,000
Alternative 4 Moving Bed Biofilm Reactor	$9,490,000	Not Compatible	$9,890,000
Alternative 5 Packed Bed Media Filter	$9,320,000	Not Compatible	$9,720,000

B. Non-Monetary Factors

There are other factors besides cost that should be considered in the comparison as well as cost and these are provided in Table 9 and Table 10, for the collection system and treatment system, respectively. These other factors are environmental and impacts to the public.

Table 9: Collection Systems Non-Monetary Factors

Factors	Collection Alternatives		
	Alt. 1	**Alt. 2**	**Alt. 3**
Cost-Effectiveness	3	2	2
Meets State Requirements	3	1	3
Downstream Water Quality	3	3	3
Land Disturbance	1	2	3
Use of Resources – Power, Fuel	2	2	1
O&M Costs	3	2	1
Short Term Public Inconvenience	1	2	2
Maintenance Requirements	3	2	1
Aesthetic Considerations	3	1	1
Constructability	1	2	2
Total	**23**	**19**	**19**

Higher scores are considered best.

Table 10: Treatment Systems Non-Monetary Factors

Factors	Treatment Alternatives				
	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Cost-Effectiveness	3	1	5	3	3
Meets Regulatory Requirements	5	3	1	4	4
Downstream Water Quality	5	2	1	4	4
Land Disturbance	3	1	2	4	4
Use of Resources – Power, Fuel	3	3	5	3	3
Permitting	5	2	1	3	3
O&M Costs	4	5	5	2	3
Expandable	4	1	1	4	4
Maintenance Requirements	4	2	3	3	3
Aesthetic Considerations	5	1	1	4	4
Land Requirements	3	1	1	4	4
Constructability	3	1	2	5	5
Total	**47**	**23**	**28**	**43**	**44**

Higher scores are considered best.

C. Normalized Benefit Ratios

Table 11 and Table 12 show the normalized benefit ratios and the life cycle costs divided by the normalized benefit ratios for each alternative. The normalized benefit ratios combine the non-monetary factors for collection and treatment systems for each possible alternative. The combined scores are then divided by the largest number (the preferred option). The preferred option has a ratio of one. Dividing the life cycle costs by these ratios increases the costs of less preferred options. Options can then be compared based on a monetary value.

Table 11: Normalized Benefit Ratio

	Alternative 1 Conventional Gravity System	Alternative 2 Small Dia. Gravity System	Alternative 3 Low Pressure Sewer System
Alternative 1 Pump to Jefferson City	1.00	0.94	0.94
Alternative 2 Lagoons with Irrigation	0.66	0.60	0.60
Alternative 3 Lagoons with Discharge	0.73	0.67	0.67
Alternative 4 Moving Bed Biofilm Reactor	0.94	0.89	0.89
Alternative 5 Packed Bed Media Filter	0.96	0.90	0.90

Table 12: Life Cycle Costs/Normalized Score

	Alternative 1 Conventional Gravity System	Alternative 2 Small Dia. Gravity System	Alternative 3 Low Pressure Sewer System
Alternative 1 Pump to Jefferson City	$9,030,000	$9,906,060	$10,001,515
Alternative 2 Lagoons with Irrigation	$14,289,130	$16,166,666	$16,316,666
Alternative 3 Lagoons with Discharge	$11,749,019	$13,210,638	$13,344,680
Alternative 4 Moving Bed Biofilm Reactor	$10,065,151	N/A	$11,166,129
Alternative 5 Packed Bed Media Filter	$9,737,313.43	N/A	$10,800,000

VIII. Proposed Project/Recommended Project

The recommended collection alternative is Alternative 1 – Conventional Gravity System and the recommended treatment alternative is Alternative 1 – Pump to Jefferson City. This recommendation based on the cost of proposed systems and non-monetary factors. A Conventional Gravity System is recommended due to being the lowest cost alternative and scoring the highest on non-monetary factors. Pumping wastewater to Jefferson City was not the lowest cost option but is recommended due to non-monetary factors outweighing the cost difference between this alternative and Alternative 3 – Lagoons with Discharge.

A conventional gravity collection system has a lower total present worth value than a SDGS system or low pressure sewer system. In addition, a conventional system has fewer maintenance considerations and is compatible with more treatment options making it a better long-term choice for sewage collection. SDGS and low pressure sewer systems also have much higher maintenance costs than conventional systems due to the necessity of pumping septic tanks on the system or the additional maintenance and power requirements of grinder pumps. In addition, as mentioned previously, a SDGS system would require an approved deviation from MDNR standards. Finally, discharges from septic tanks in a SDGS system are odorous and smells may be noticeable near manholes and cleanouts.

A lagoon system with discharge had the lowest total present worth. However, pumping wastewater to Jefferson City is recommended due to its reliability in meeting MDNR regulations and minimal land requirements. Facultative lagoons will not likely be able to reliably meet permit requirements, particularly the latest ammonia limits, and are not easily adaptable to meet stricter limitations in the future. The land area required for a facultative lagoon would be much larger than the area required for a pump station to pump wastewater to Jefferson City. The larger area would diminish aesthetic qualities of the area surrounding the lagoon system considerably. The feasibility of constructing a lagoon system is also of concern due to shallow depths to bedrock throughout much of the area of Centertown.

A. Proposed Project Design Description

The recommended project is to construct a new conventional gravity collection system throughout Centertown and pump wastewater to Jefferson City by constructing a pump station south of the baseball field. The pump station would be capable of pumping 80 gallons per minute with sufficient storage to handle additional peak flows. The pipeline from Centertown would consist of approximately 28,000 feet of 4-inch PVC pressure line. The pressure line would connect with Jefferson City's sewer system near the intersection of Highway T and Henwick Lane north of the community of St. Martins, Missouri. A flow meter would be installed and maintained by the Village of Centertown to measure flows into the Jefferson City sewer system.

The wastewater from the collection system would flow into a wet well at the pump station. Because the wastewater has a comparatively long distance to travel for treatment, calcium nitrite solution (BIOXIDE or equal) would be dosed into the wet well for odor control. Once wet well reaches a specified wastewater depth the pump station will turn on and pump wastewater through 28,000 feet of PVC pipe to the Jefferson City sewer system. The pump will turn off when wastewater in the wet well drops below a specified depth.

B. Total Project Cost Estimate

The total estimated project cost is $8,170,000. The total present worth for the recommended option is $9,030,000. See Appendices E and G for details of project costs.

C. Annual Operating Budget

The combined annual estimated operation and maintenance for the proposed system is $55,000. For a total of 131 users, this amounts to an average monthly bill of $34.99 to cover maintenance costs. Note that this does not include payments for capital debt service. See Appendices E and G for details on O&M costs for the collection and treatment systems. Administration and Billings costs are expected to remain about the same as they currently are for water distribution. Billing for water and wastewater can be sent to users in one invoice. A capital reserve account will likely have to be set up as required by funding agencies.

D. Financing

The project will be financed using several sources. Options for financing includes low interest loans and grant funds through governmental agencies, private financing, and capital from the Village of Centertown. Government funded programs are the Missouri Department of Natural Resources State Revolving loan program (SRF), the U.S. Department of Agriculture (USDA) Rural Development loan program, the Community Development Block Grant Program (CDBG), and Missouri Department of Natural Resources Rural Sewer Grants. Lease Purchase would be a private financing option.

The SRF program offers low-interest fixed rates 20-year loans for water and wastewater projects. Interest rates are typically lower than 2 percent, but are subject to change. If the loan

from the SRF does not cover the total project cost, Centertown may be eligible for 40 Percent State Construction Grants available to unsewered communities with population under 1,000. The grant may cover up to 40 percent of eligible project costs. Note that the 40 Percent State Construction Grant is not currently available, but may be available in the future. Also available from the SRF program is an Additional Subsidization Affordability Grant. The maximum funding amount from this grant is 50% of project cost. up to a maximum grant amount of $2 million.

The USDA Water & Waste Disposal Loan and Grant Program is available to assist small communities with providing reliable sanitary sewage disposal. The USDA awards most of their funding to small communities with low median household incomes (MHI). The Village of Centertown has an MHI of $28,542 based on the 2006-2010 American Community Survey 5-Year Estimates. This is 62.82% of the nonmetropolitan MHI of Missouri of $45,438.

Water & Waste Disposal Loans from USDA are available to towns with a population less than 10,000, and priority is given to communities with a population of less than 5,500. The length of the loan can be up to 35 years. Since Centertown's MHI is lower than 80% of the nonmetropolitan MHI the poverty interest rate would apply. Currently this rate is 2.125%. For communities with an MHI of less than 80% of the nonmetropolitan MHI, if the debt service is above 0.5% of the MHI, grants may be awarded. Grants will not be awarded for more than 75% of eligible project costs. The monthly rate equal to 0.5% of Centertown's MHI is $11.89.

The CDBG Grant is administered through the Missouri Department of Economic Development. The maximum application amount for water and wastewater projects is $500,000 and at least 51% of the population of the town must be low to moderate income to qualify for this grant. Based on the 2006-2010 American Community Survey 56.67% of Centertown qualifies as low or moderate income.

Rural Sewer Grants are sewer grants provided to projects providing centralized sewers to unsewered areas or funding the additional costs of meeting more stringent requirements for wastewater treatment. The grant can cover up to 50 percent of eligible costs up to a maximum of $500,000 or $1,400 per connection. For Centertown, the current number of connections of 127 results in a maximum funding level of $177,800. A primary funding source must be in place before applying for the Rural Sewer Grant.

Investment banking options are traditionally 20-year loans with interest rates averaging 4-5 percent. These loans are secured with collateral in the form of existing utility assets and are referred to as lease/purchase agreements. A bond issue is not required for these loans.

A comparison of funding options is shown in Table 13.

Table 13: Funding Sources

Source	Type	Terms/Funding
State Revolving Fund	Loan	2%/20 years
40% Construction Grant	Grant	40% max
SRF Additional Subsidization Grant	Grant	$2 million max
USDA Waste Disposal	Loan	2.125%/35 years
USDA Waste Disposal	Grant	75% max/30% Avg.
CDBG	Grant	$500,000 max
Rural Sewer Grants	Grant	$177,800 max
Lease/Purchase	Loan	4%/20 years

There are many possible scenarios for funding the total project cost of $8,170,000. Several options are explored in Table 14 below to estimate the Total Monthly Payment, which will affect projected monthly user rates. The table assumes a total of 131 users to calculate monthly sewer rate.

Table 14: Funding Sources and Projected Rates

Centertown Wastewater System (with DNR Rural Sewer Grant applied to all options)				
Total Project Cost:			$8,172,946	
Total Project Cost Less DNR Rural Sewer Grant?			$7,989,546	
Sources	Type	Financed Percentage	Financed Amount	Average Monthly Rate*
USDA Loan	Loan	100%	$7,989,546	$228.05
USDA Loan & Grant	Loan/Grant	70%	$5,592,682	$159.63
USDA Loan Only/CDBG	Loan/Grant	94%**	$7,489,546	$213.77
USDA Loan & Grant/CDBG***	Loan/Grants	21%**	$1,666,765	$47.57
USDA Loan & Grant/CDBG****	Loan/Grants	44%**	$3,494,773	$99.75
SRF Loan Only	Loan	100%	$7,989,546	$341.91
SRF Loan & Additional Subsidization Grant	Loan/Grant	75%	$5,989,546	$256.32
SRF Loan Only/CDBG	Loan/Grant	94%**	$7,489,546	$320.51
SRF Loan & Additional Subsidization Grant /CDBG	Loan/Grants	69%**	$5,489,546	$234.92
Lease/Purchase	Loan	100%	$7,989,546	$411.37
Lease/Purchase/CDBG	Loan/Grant	94%**	$7,489,546	$385.63

**Includes 10% increase for debt service reserve*

***The loan/grant ratios are calculated based on the assumption of a $500,000 CDBG Grant*

****75% USDA Grant*

*****50% USDA Grant*

The lowest cost option is a USDA loan with a 75% USDA grant combined with both CDBG and Rural Sewer Grants. Note that this option has the maximum potential grant awards. The average monthly rate per user to cover financed project costs would be $47.57 for this option. As noted previously, the average user monthly rate to cover Operations and Maintenance costs is $34.99. The expected total average user charge is $82.56, if the lowest cost option shown in Table 14 is attained.

Based on the information presented on the previous page, constructing a new sewer collection system and pumping wastewater to Jefferson City would not be an affordable option for the Village of Centertown unless more grants can be obtained than what is typical for a wastewater project. It is recommended that the Village of Centertown submit to the Missouri Water and Wastewater Review Committee (MWWRC) for review and comment. The MWWRC meets monthly and is made up of members from the USDA-Rural Development, Missouri Department of Natural Resources, and CDBG. After a response is received from the MWWRC, the financial information can be re-examined to determine if proceeding with the project is financially feasible.

E. Environmental Review

A full independent environmental assessment will need to be conducted to determine if any potential impact will result from the construction of the proposed project. The Village will need to procure these services.

IX. Conclusions

The conclusion from the evaluation provided in this Report is to construct and operate a new conventional gravity sewer system and a pump station to convey wastewater to Jefferson City for treatment. Although this is not the lowest cost option, it is best suited to meeting the wastewater needs of the Village of Centertown in the future. The Village needs to pursue significant grant funding to make this project affordable. All required funding must be secured before proceeding with the project.

A. Community Engagement

If the Village decides to move forward with the recommended alternative and financing for the project is secured, a public meeting will be held regarding the recommended project after the completion of this report. An electronic copy of the report will also be uploaded to the City's website.

X. Antidegradation Analysis Implementation

All waters of the state are subject to the antidegradation implementation procedure. While the antidegradation analysis has not been completed, it is anticipated that the recommended alternative will improve the waters of the state by replacing individual failed septic systems that flow into tributaries around Centertown. A full antidegradation study will be completed if the Village moves forward with a project requiring discharge to a water body.

Appendix A

NFIP Flood Insurance Rate Maps

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NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Missouri State Plane coordinate system, Central Zone (FIPSZONE 2402), Transverse Mercator projection. **Horizontal datum** was NAD 83, GRS1980 spheroid. Differences in datum, spheroid or projection used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov/.

Base map information shown on this map was provided in digital format by the U.S. Farm Service Agency, National Agricultural Imagery Program (NAIP), published in 2010 at a scale of 1:12000.

Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

The "**profilebase lines**" depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the "profile base line" in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

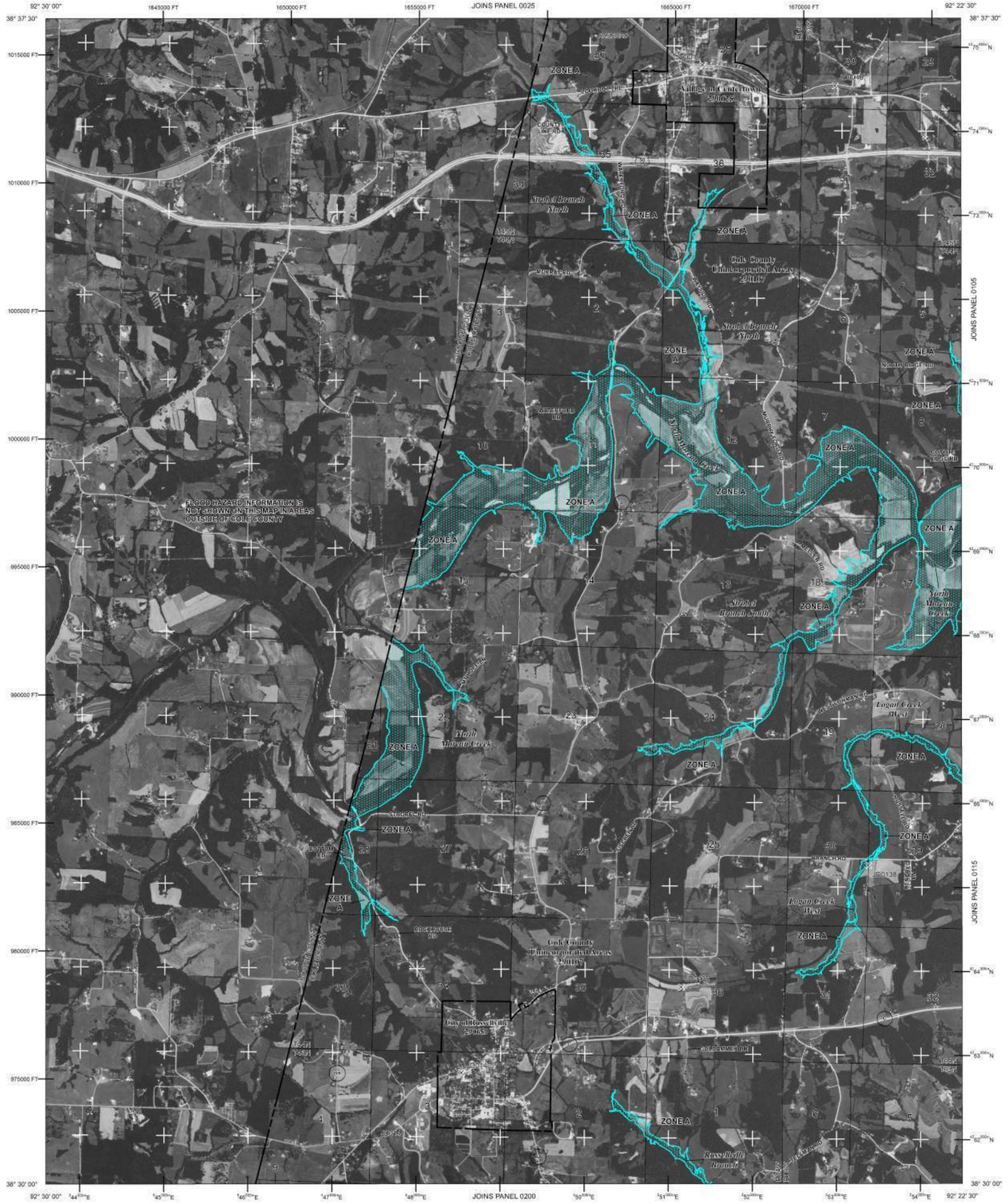
Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA MAP** (1-877-336-2627) for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and /or digital versions of this map. The FEMA Map Information eXchange may also be reached by Fax at 1-800-358-9620 and its website at http://msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

COLE COUNTY, MISSOURI FIRM PANEL LOCATOR DIAGRAM

*PANEL NOT PRINTED



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAS)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% annual chance floodplain boundary
- 0.2% annual chance floodplain boundary
- Floodway boundary
- Zone D boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
- CBRS and OPA boundary
- International, State, or County boundary
- Corporate, Extraterritorial Jurisdiction, or Urban Growth boundary
- Area Not Included boundary
- Military Reservation, Native American Lands boundary
- 513 Base Flood Elevation line and value; elevation in feet*
- (EL 987) Base Flood Elevation value where uniform within zone; elevation in feet*
- * Referenced to the North American Vertical Datum of 1988
- A — A Cross section line
- 23 — 23 Transect line
- 87°07'45", 32°22'30" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 4276000mE 1000-meter Universal Transverse Mercator grid values, zone 15
- 600000 FT 5000-foot grid ticks: Missouri State Plane coordinate system, central zone (FIPSZONE 2402), Transverse Mercator projection
- DX5510 × Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 River Mile
- Aqueduct, Culvert, Flume, Penstock, or Storm Sewer
- Road or Railroad Bridge

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
DECEMBER 2, 2005

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
November 2, 2012 – to update corporate limits, to change Base Flood Elevations, to add Base Flood Elevations, to add Special Flood Hazard Areas, to change Special Flood Hazard Areas, to change zone designations, to add roads and road names, to reflect updated topographic information

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 2000'
1000 0 2000 4000 FEET
600 0 600 1200 METERS

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0100E

FIRM
FLOOD INSURANCE RATE MAP

COLE COUNTY, MISSOURI AND INCORPORATED AREAS

PANEL 100 OF 350
(SEE LOCATOR DIAGRAM OR MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CENTERTOWN, VILLAGE OF	290625	0100	E
COLE COUNTY	290107	0100	E
RUSSELLVILLE, CITY OF	290659	0100	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER 29051C0100E

MAP REVISED NOVEMBER 2, 2012

Federal Emergency Management Agency

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To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Missouri State Plane coordinate system, Central Zone (FIPSZONE 2402), Transverse Mercator projection. **Horizontal datum** was NAD 83, GRS1980 spheroid. Differences in datum, spheroid or projection used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov/.

Base map information shown on this map was provided in digital format by the U.S. Farm Service Agency, National Agricultural Imagery Program (NAIP), published in 2010 at a scale of 1:12000.

Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

The "**profilebase lines**" depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the "profile base line" in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

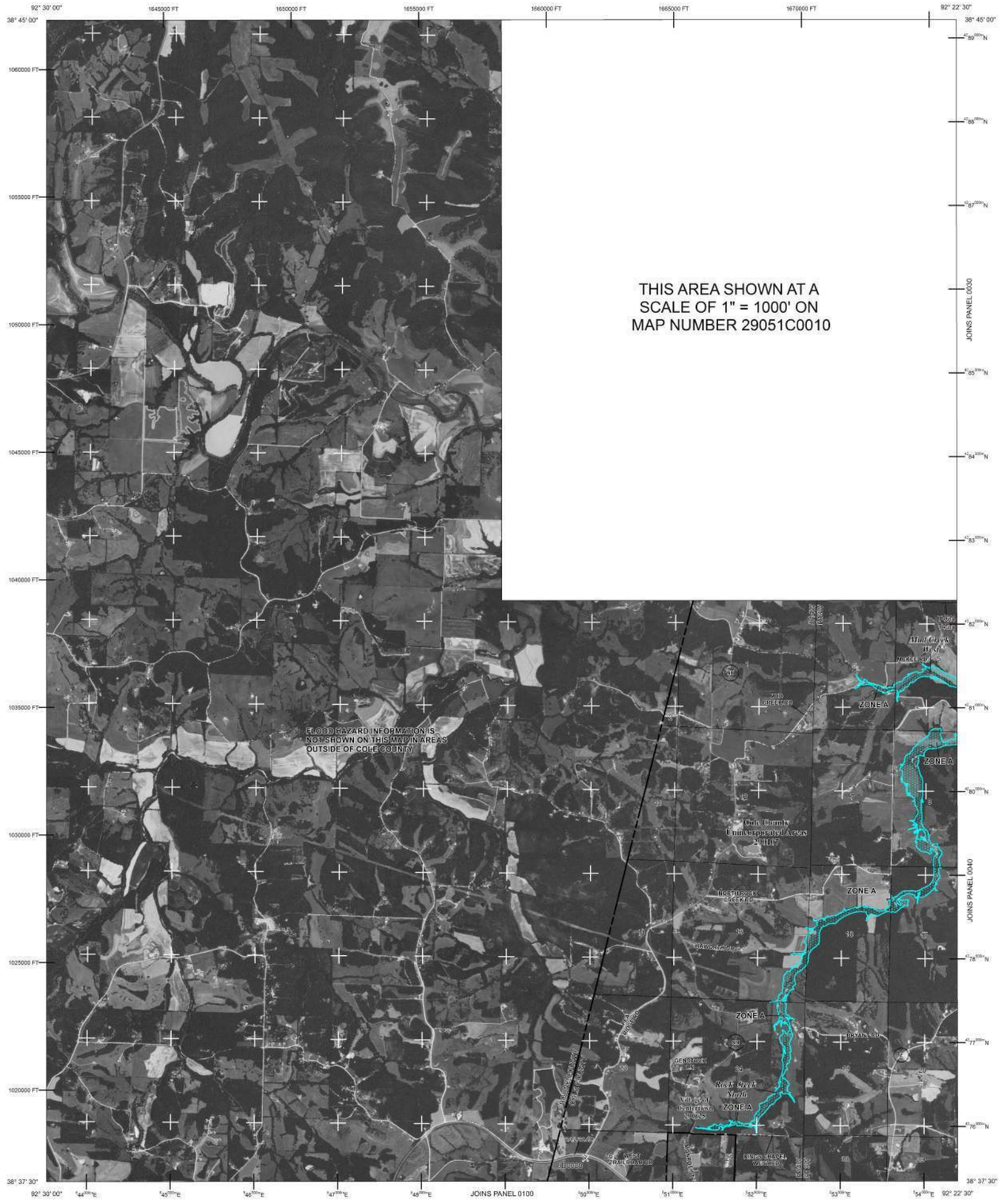
Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA MAP** (1-877-336-2627) for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and /or digital versions of this map. The FEMA Map Information eXchange may also be reached by Fax at 1-800-358-9620 and its website at http://msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

COLE COUNTY, MISSOURI FIRM PANEL LOCATOR DIAGRAM



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% annual chance floodplain boundary
- 0.2% annual chance floodplain boundary
- Floodway boundary
- Zone D boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
- CBRS and OPA boundary
- International, State, or County boundary
- Corporate, Extraterritorial Jurisdiction, or Urban Growth boundary
- Area Not Included boundary
- Military Reservation, Native American Lands boundary
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet* * Referenced to the North American Vertical Datum of 1988
- A — A — Cross section line
- 23 — 23 — Transect line
- 87°07'45", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 4276 000m E — 1000-meter Universal Transverse Mercator grid values, zone 15
- 600000 FT — 5000-foot grid ticks: Missouri State Plane coordinate system, central zone (FIPSZONE 2402), Transverse Mercator projection
- DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile
- Aqueduct, Culvert, Flume, Penstock, or Storm Sewer
- Road or Railroad Bridge

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
DECEMBER 2, 2005

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
November 2, 2012 – to update corporate limits, to change Base Flood Elevations, to add Base Flood Elevations, to add Special Flood Hazard Areas, to change Special Flood Hazard Areas, to change zone designations, to add roads and road names, to reflect updated topographic information

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 2000'
1000 0 2000 4000 FEET
600 0 600 1200 METERS

NFIP

PANEL 0025E

FIRM
FLOOD INSURANCE RATE MAP

COLE COUNTY, MISSOURI AND INCORPORATED AREAS

PANEL 25 OF 350
(SEE LOCATOR DIAGRAM OR MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CENTERTOWN, VILLAGE OF	290625	0025	E
COLE COUNTY	290107	0025	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER 29051C0025E

MAP REVISED NOVEMBER 2, 2012

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

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Appendix B

Treatment System Exhibits

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Last edit on: Mar 19, 2018 by: KAK00402 Drawing Name: \\nt00cfs01\production\Proj\19000\19492\19492.000\AutoCad\Exhibits\19492000_Exhibits.dwg Layout Name: Alt. 1 - JC FM Plotted By: KAK00402 Plotted on: 3/20/2018 8:36:05 AM

TREATMENT SYSTEM ALTERNATE NO. 1
PUMP TO JEFFERSON CITY

CENTERTOWN WASTEWATER FACILITY PLAN
VILLAGE OF CENTERTOWN, MISSOURI

DRAFT DRAFT

Bartlett&West
1719 SOUTHRIDGE DR., SUITE 100 - JEFFERSON CITY, MO 65109.4000
PHONE 573.634.3181 - FAX 573.634.7904
MISSOURI CERTIFICATE OF AUTHORITY NO. 000167 - ENGINEERING
www.bartwest.com

SHEET NO.	DRAWING NO.	DATE	DESIGN PROJ.	DRAWN BY:	APPROVED BY:	DESIGNED BY:	SCALED DATE:
1 of 1		MARCH 2018	19492.000	GWD	KAK	KMT	= = = =

#	DATE	DESCRIPTION	BY

BAR IS ONE INCH ON OFFICIAL DRAWINGS 0 1" IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY

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Bartlett & West

Driving Community and Industry Forward, Together.

BAR IS ONE INCH ON OFFICIAL DRAWINGS. 0 1" IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

#	DATE	DESCRIPTION	BY

Bartlett & West

1719 SOUTHRIDGE DR., SUITE 100 - JEFFERSON CITY, MO 65109.4000
PHONE 573.634.3181 - FAX 573.634.7904
MISSOURI CERTIFICATE OF AUTHORITY NO. 000167 - ENGINEERING
www.bartwest.com

TREATMENT SYSTEM ALTERNATE NO. 2 LAGOONS WITH IRRIGATION

CENTERTOWN WASTEWATER FACILITY PLAN
VILLAGE OF CENTERTOWN, MISSOURI

DRAFT DRAFT

SEALED DATE:	====
DESIGNED BY:	KMT
DRAWN BY:	KAK
APPROVED BY:	GWD
DESIGN PROJ:	19492.000
DATE:	MARCH 2018
DRAWING NO:	
SHEET NO:	1 of 1

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Bartlett & West

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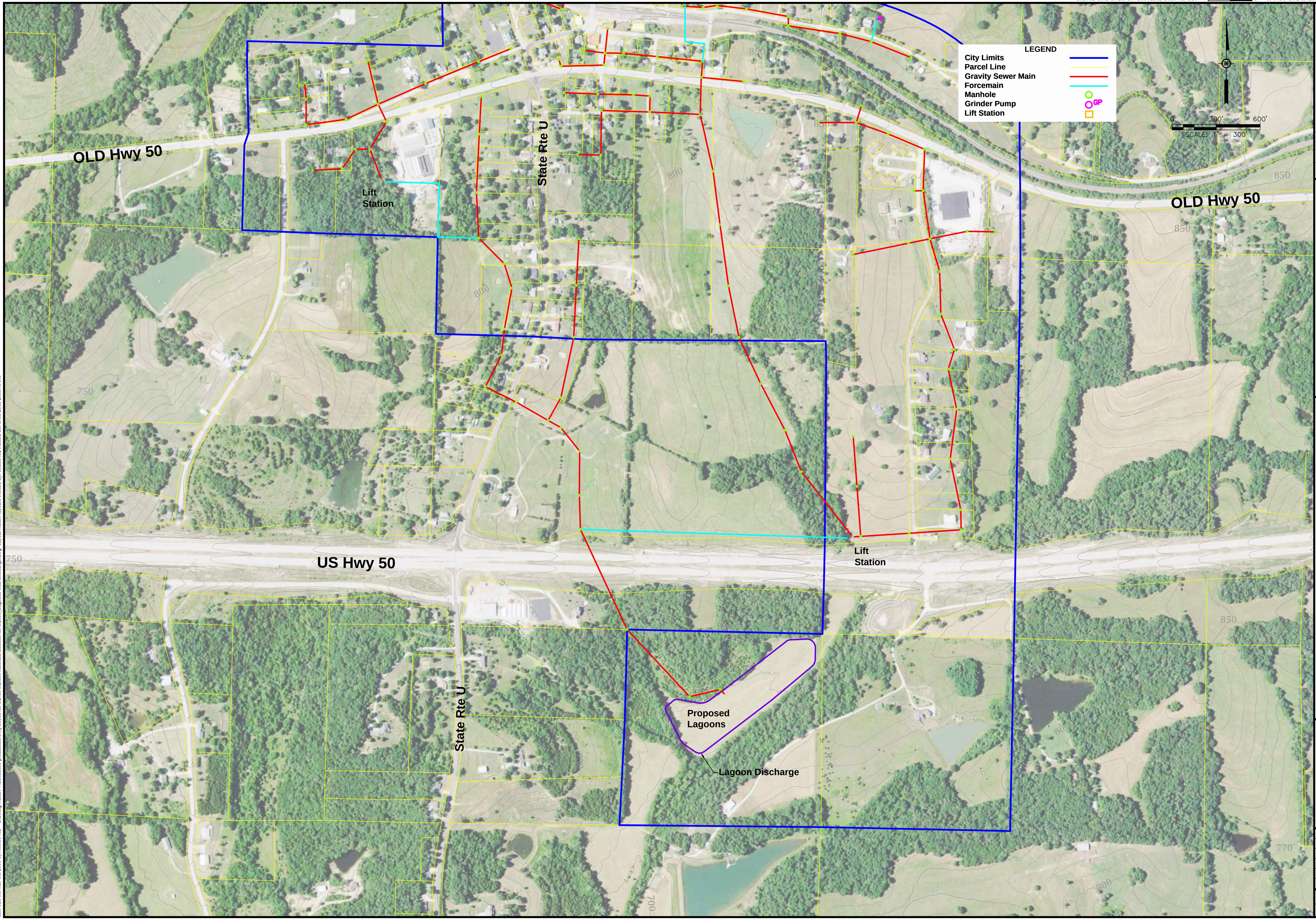
BAR IS ONE INCH ON OFFICIAL DRAWINGS. 0 1" IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.



TREATMENT SYSTEM ALTERNATE NO. 3
LAGOONS WITH DISCHANRGE

CENTERTOWN WASTEWATER FACILITY PLAN
VILLAGE OF CENTERTOWN, MISSOURI

Bartlett & West

1719 SOUTHRIDGE DR., SUITE 100 - JEFFERSON CITY, MO 65109.4000
PHONE 573.634.3181 - FAX 573.634.7904
MISSOURI CERTIFICATE OF AUTHORITY NO. 000167 - ENGINEERING
www.bartwest.com

DRAFT DRAFT

SEALED DATE:	====
DESIGNED BY:	KMT
DRAWN BY:	KAK
APPROVED BY:	GWD
DESIGN PROJ:	19492.000
DATE:	MARCH 2018
DRAWING NO:	
SHEET NO:	1 of 1

#	DATE	DESCRIPTION	BY

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Bartlett & West

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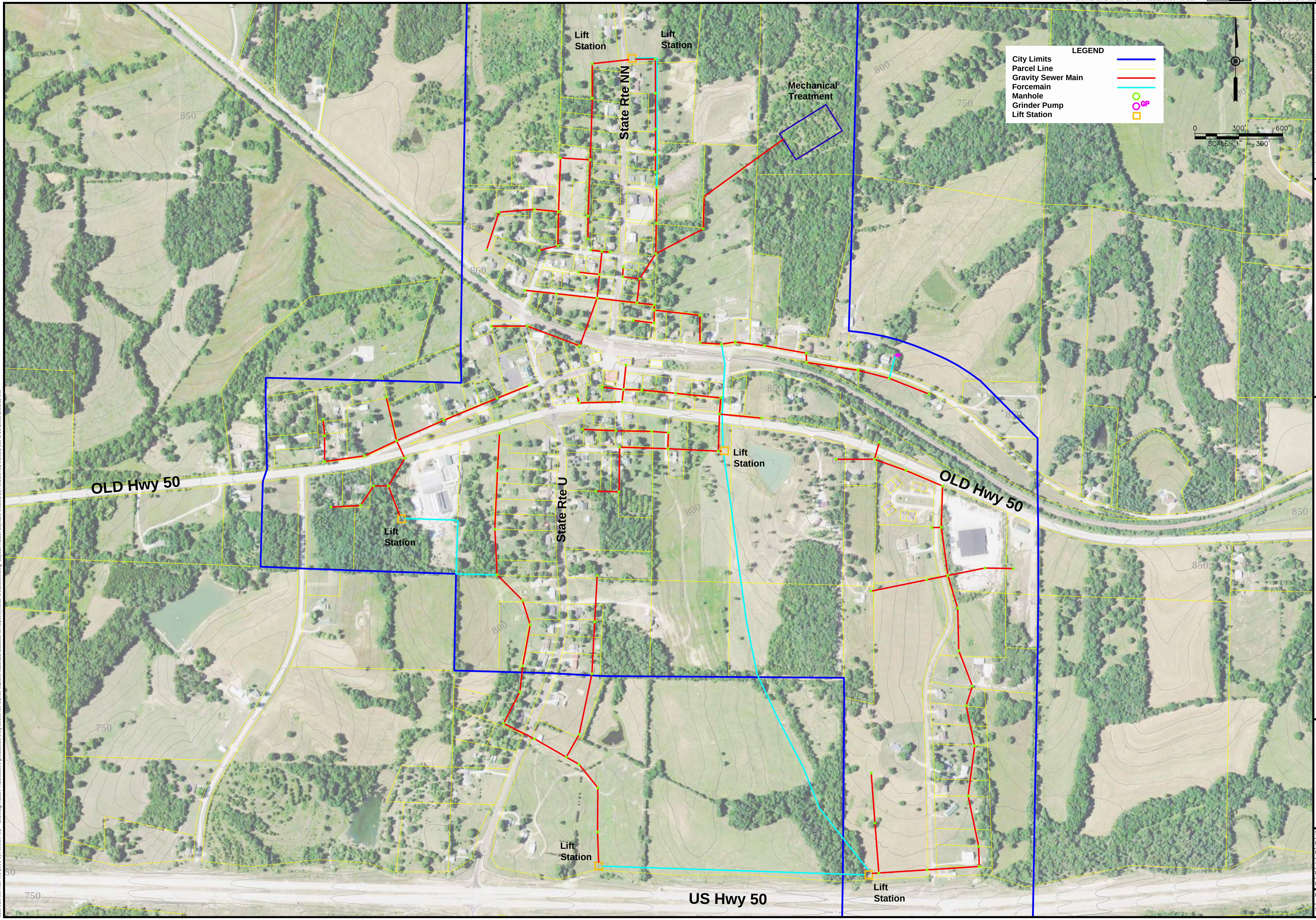
BAR IS ONE INCH ON OFFICIAL DRAWINGS. 0 1" IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.



BY	DESCRIPTION	DATE	#

Bartlett & West

1719 SOUTHRIDGE DR., SUITE 100 - JEFFERSON CITY, MO 65109.4000
PHONE 573.634.3181 - FAX 573.634.7904
MISSOURI CERTIFICATE OF AUTHORITY NO. 000167 - ENGINEERING
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TREATMENT SYSTEM ALTERNATE NO. 4 AND 5 MECHANICAL TREATMENT

CENTERTOWN WASTEWATER FACILITY PLAN
VILLAGE OF CENTERTOWN, MISSOURI

DRAFT DRAFT

SEALED DATE:	====
DESIGNED BY:	KMT
DRAWN BY:	KAK
APPROVED BY:	GWD
DESIGN PROJ:	19492.000
DATE:	MARCH 2018
DRAWING NO:	
SHEET NO:	1 of 1

Last edit on: Mar 19, 2018 by: KAK00402 Drawing Name: \\nt00clfs01\production\Proj\19000\19492\19492.000\AutoCad\Exhibits\19492000_Mech Treatment.dwg Layout Name: Layout1 Plotted By: KAK00402 Plotted on: 3/19/2018 2:06:09 PM

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Appendix C

Moving Bed Biofilm Reactor

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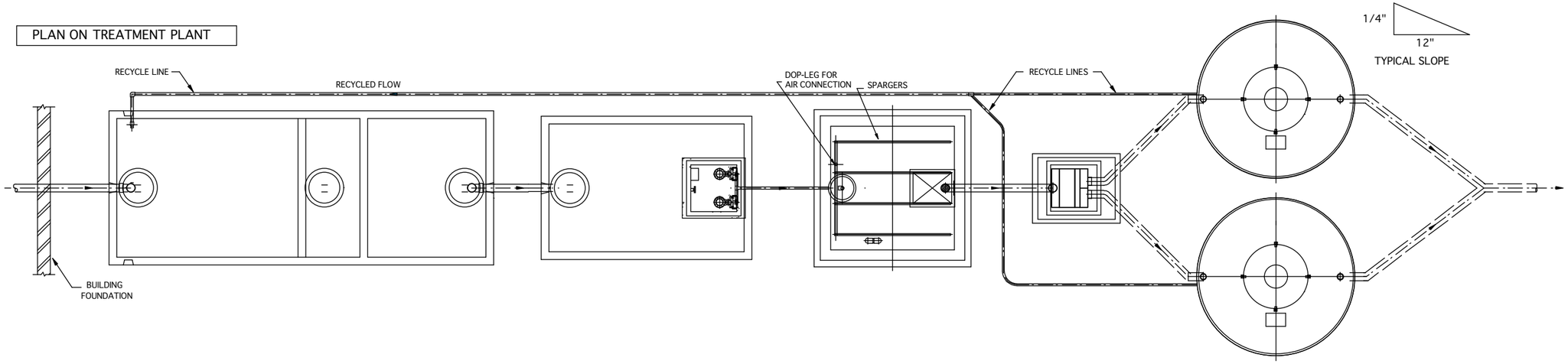
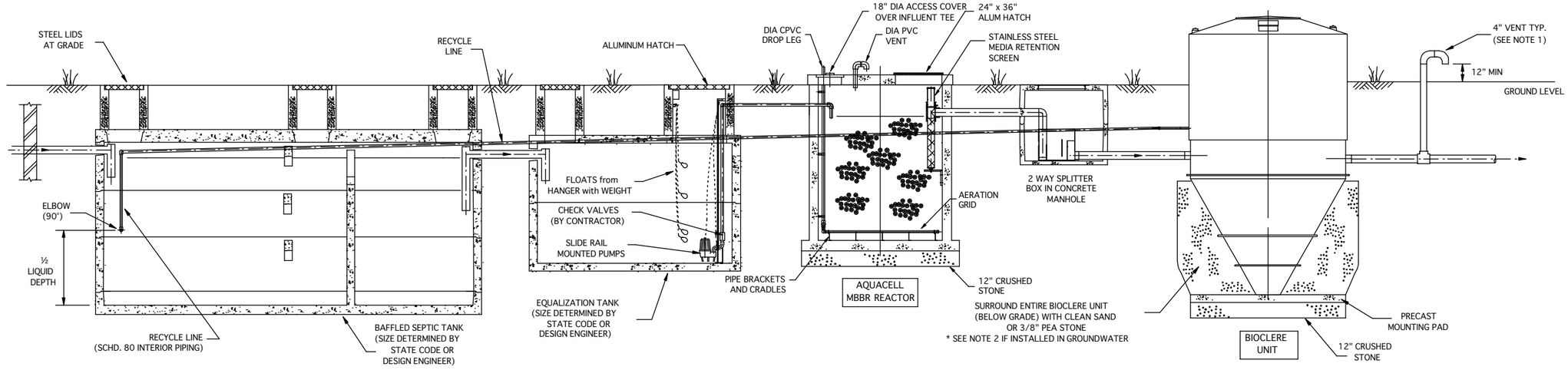
PLAN ON TREATMENT PLANT





SECTION/ELEVATION OF TREATMENT PLANT

AquaPoint
Performance Based Wastewater Treatment Systems
259A SAMUEL BARNET BLVD.
NEW BEDFORD, MA 02745
(508) 998-7577 FAX (508) 998-7177

TITLE:	GEN._EQ_MBBR_PARALLEL BIOCLERE
DRAWING NO.:	MT-1001
REVISION:	A
DATE:	2/23/10
DWN BY:	MRT
SCALE:	NTS
SIZE:	
SHEET #:	1 of 1

NOTES: UNLESS OTHERWISE SPECIFIED:

1. BIOCLERE VENTS MAY BE RUN UP TO THE ROOF OF THE BUILDING.
2. IF INSTALLED IN GROUND WATER CONTACT SITE ENGINEER FOR ANCHORING REQUIREMENTS.
3. CONTRACTOR IS TO SUPPLY ALL CONCRETE STRUCTURES AND PERFORM INSTALLATION.
4. SURROUND ENTIRE BIOCLERE UNITS (BELOW GRADE) WITH CLEAN SAND OR 3/8" PEA STONE.
5. BIOCLERE AND OTHER PLANT, ELECTRICAL CABLES, NOT SHOWN FOR CLARITY.
6. AQUACELL MBBR INTERNALS BY AQUAPOINT

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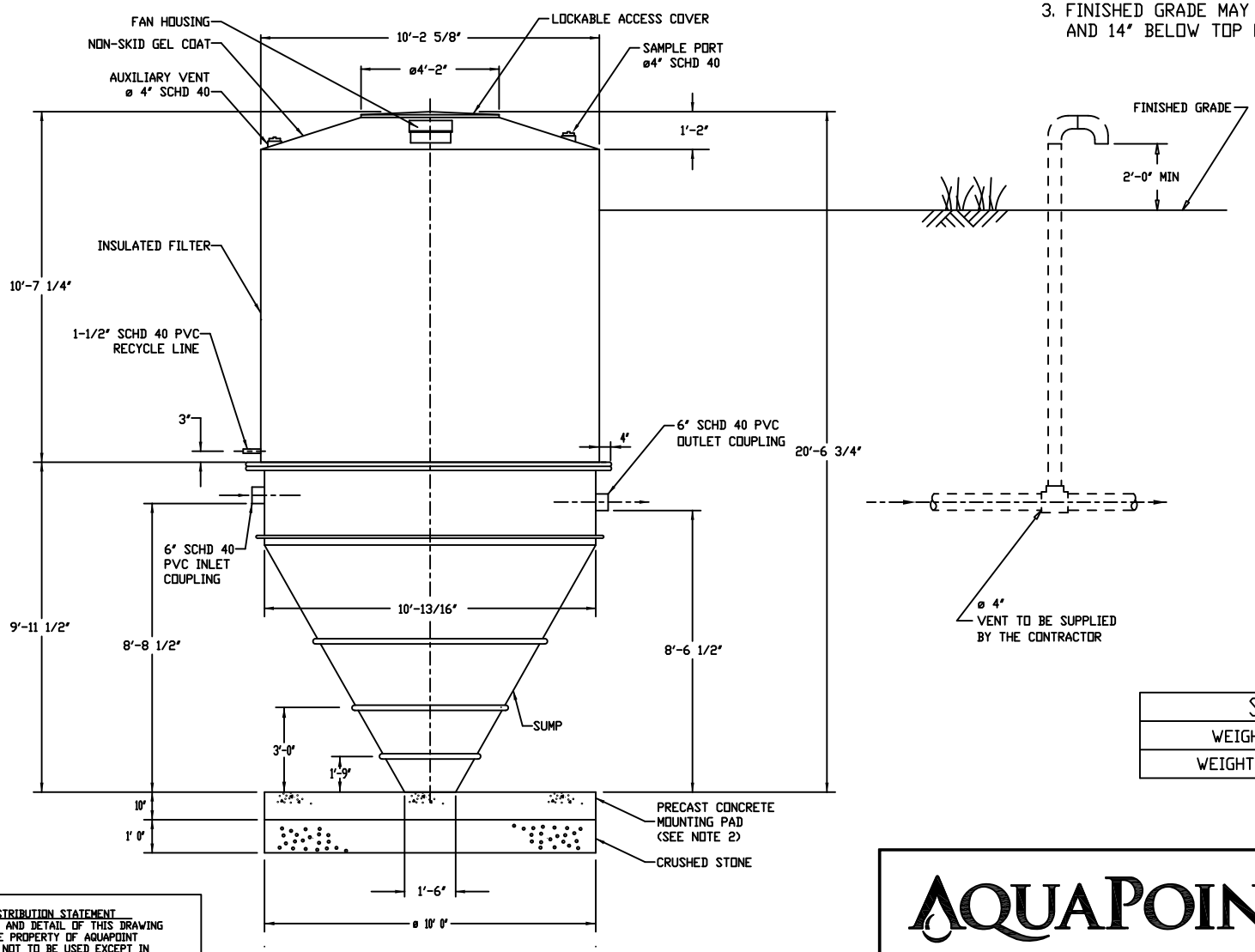
NOTES:
1. VENT MAY BE RUN UP THE SIDE OF BUILDING.
2. SEE DRAWING 1244-9 FOR MOUNTING PAD CONSTRUCTION DETAILS.
3. FINISHED GRADE MAY BE BETWEEN 18" ABOVE RECYCLE LINE AND 14" BELOW TOP OF UNIT.



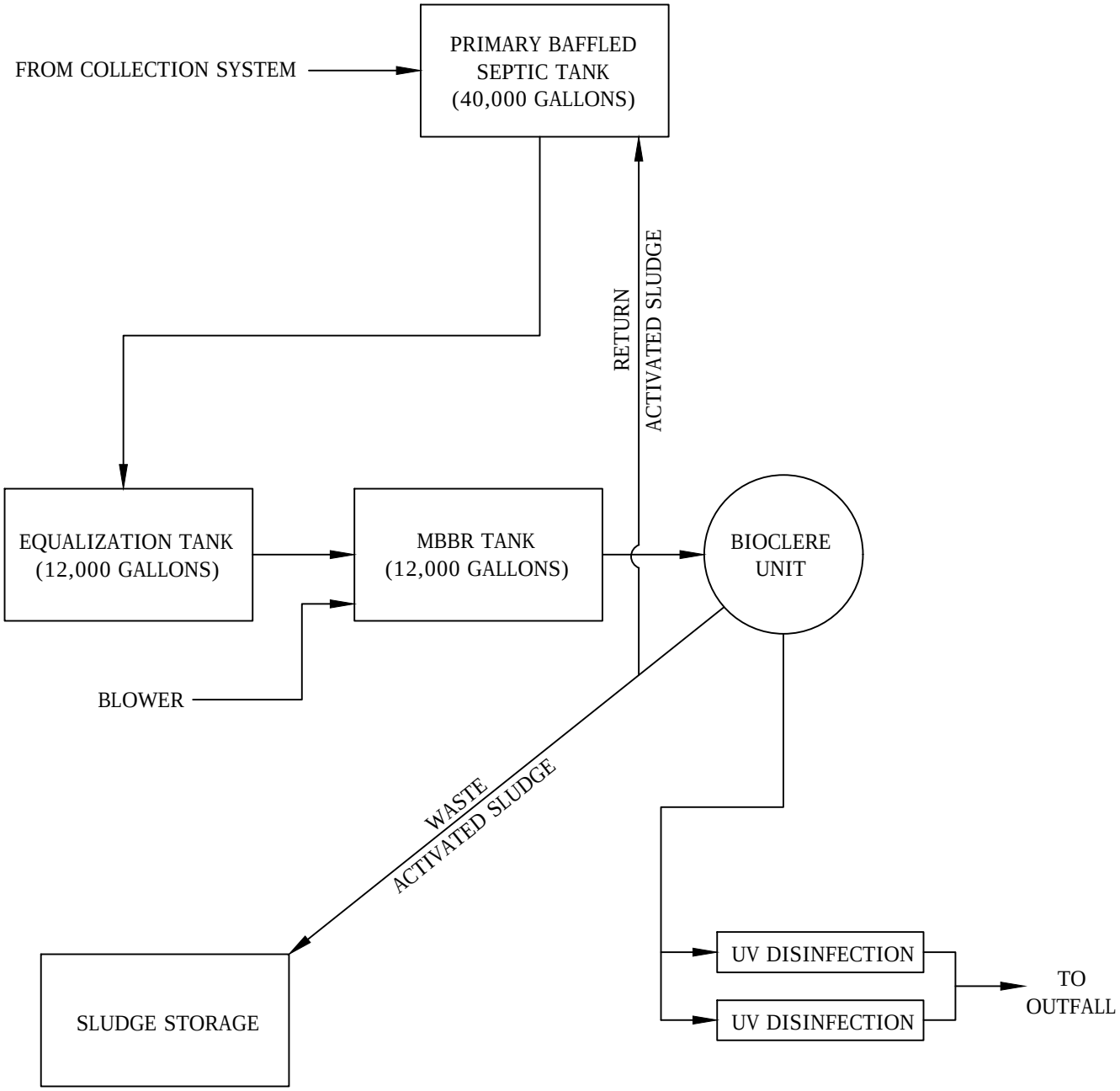
MODEL 30/32 BIOCLERE

SHIPPING WEIGHTS
WEIGHT DRY WITH MEDIA = 5200 lbs
WEIGHT DRY WITH NO MEDIA = 3400 lbs

30-32 GA.dwg

AQUAPOINT
39 TARKILN PLACE
NEW BEDFORD, MA 02745
(508) 985-9050 FAX (508) 985-9072

TITLE:	BIOCLERE 30/32 GENERAL ARRANGEMENT
DRAWING NO:	UK.1262-5
REVISION:	C
DATE:	May 9 2008
DWN BY:	P.Willey
SCALE:	1 : 40 SIZE: B
SHEET #:	1 of 1



Bartlett&West
www.bartlettwest.com

MBBR FLOW SCHEMATIC

VILLAGE OF CENTERTOWN

PROJ NO: 19492.000

DATE: MARCH 2018

SHEET NUMBER 1 OF 1

Appendix D

Packed Bed Media Filter

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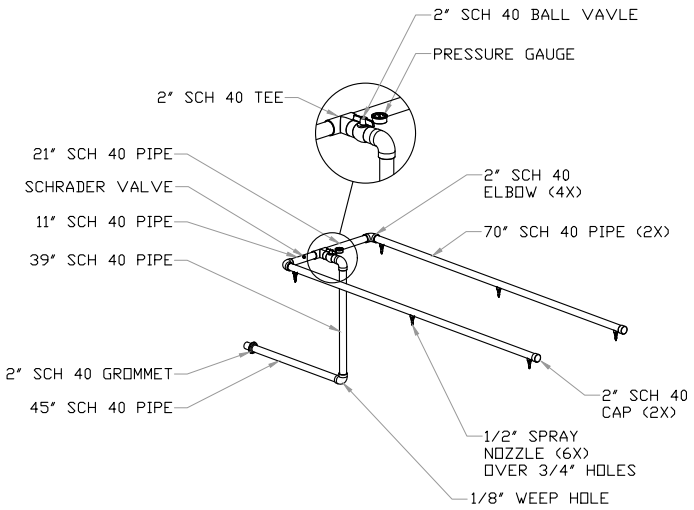
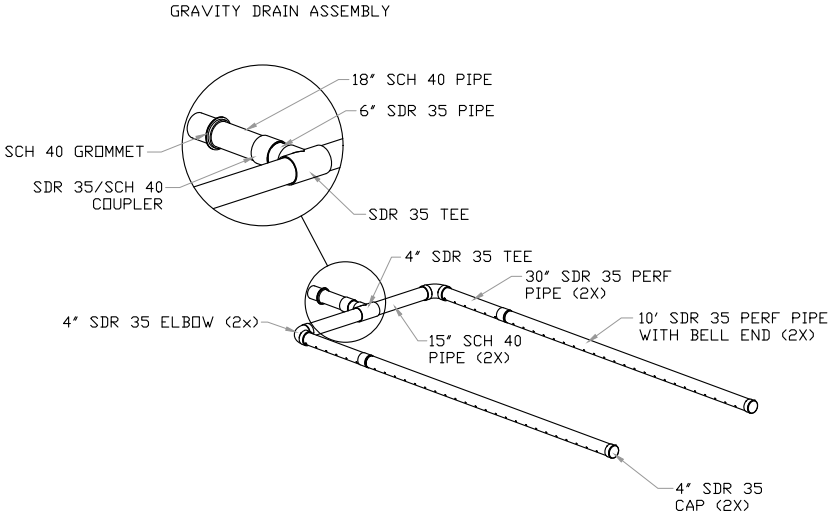
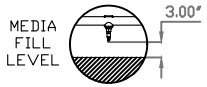
DRAWING - ATS-16-AC/BC PIPING ASSEMBLY
8'x16' ATS TREATMENT MODULE

PRESSURE PIPING ASSEMBLY

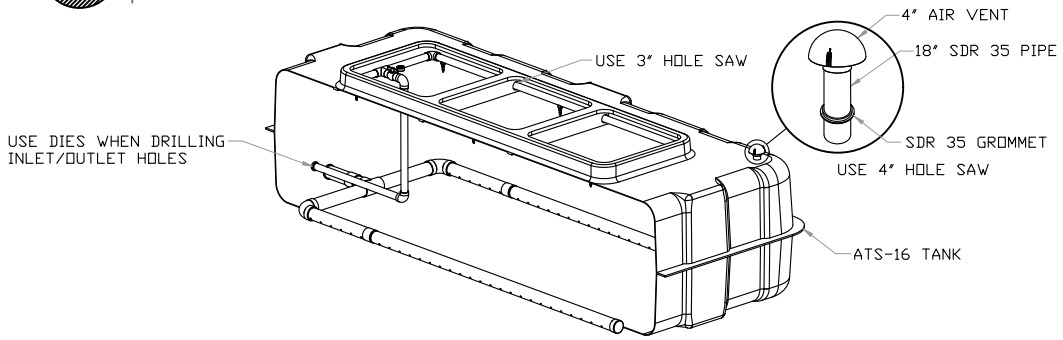


GRAVITY DRAIN ASSEMBLY





ASSEMBLED



TREATMENT MEDIA: OPEN CELL FOAM AEROCELL OR NATURAL BIO-COIR. FILLED TO 3" BELOW NOZZLES.

PARTS LIST
PIPE FITTINGS
2" SCH 40
4 - 90° DEGREE ELBOWS
1 - TEE
1 - BALL VALVE
2 - CAP
1 - SCH 40/SDR 35 COUPLER
1 - GROMMET
6 - 1/2" NOZZLES
4" SDR 35
1 - TEE
2 - 90° ELBOWS
1 - GROMMET
2 - CAPS
PIPING
2" SCH 40
2 - 3'
1 - 11'
1 - 21'
1 - 39'
1 - 45'
2 - 70'
4" SDR 35
1 - 6'
2 - 15'
1 - 18'
2 - 30' PERFORATED
2 - 120' PERFORATED
4" SCH 40
1 - 18'
OTHER PARTS
1 - 4" CARBON FILTER AIR VENT
1 - PRESSURE GAUGE

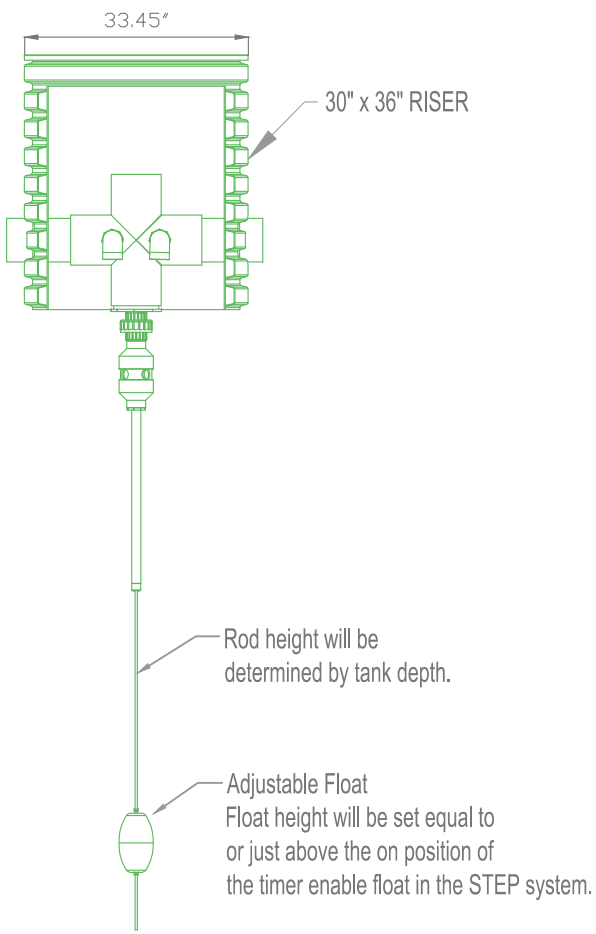
Quanics Contacts - Technical		AutoCad Drawings
Brian Borders, R.S. 502-992-8214 Bborders@quanics.net	Tom Petty, P.G., R.E.H.S 615-289-4399 Tpetty@quanics.net	Tom Jenkins 502-992-8216 Tjenkins @quanics.net

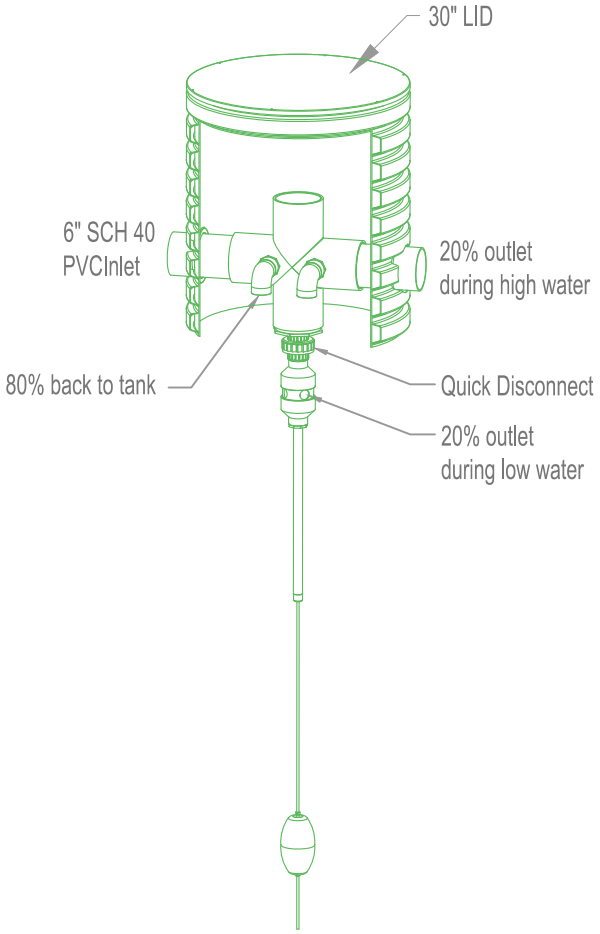
SCALE		NAME	DATE
	Drawn By	TNJ	02-07-06
GPD	Technical Approval	BB	02-07-06
N/A	Engineer Approval	SG	02-08-06

QUANICS INCORPORATED
P.O. Box 1520 Crestwood KY 40014
877-QUANICS
www.quanics.net

NOTE: FLOW NOT TO EXCEED 110 GPM

DRAWING NAME - 6" 100/80/20 RECIRCULATION DEVICE
QUANICS PART # - ATS-GRD-100/80/20-6





- GRAVITY LINES
- PRESSURE LINES
- QUANICS COMPONENTS
- NON-QUANICS COMPONENTS
- SYSTEM FOOTPRINT

Quanics Contacts - Technical

Brian Borders, R.S.
502-992-8214
Bborders@quanics.net

Eric Shields
502-992-8235
Eshields@quanics.net

Tom Petty, P.G., R.E.H.S.
502-992-8236
Tpetty@quanics.net

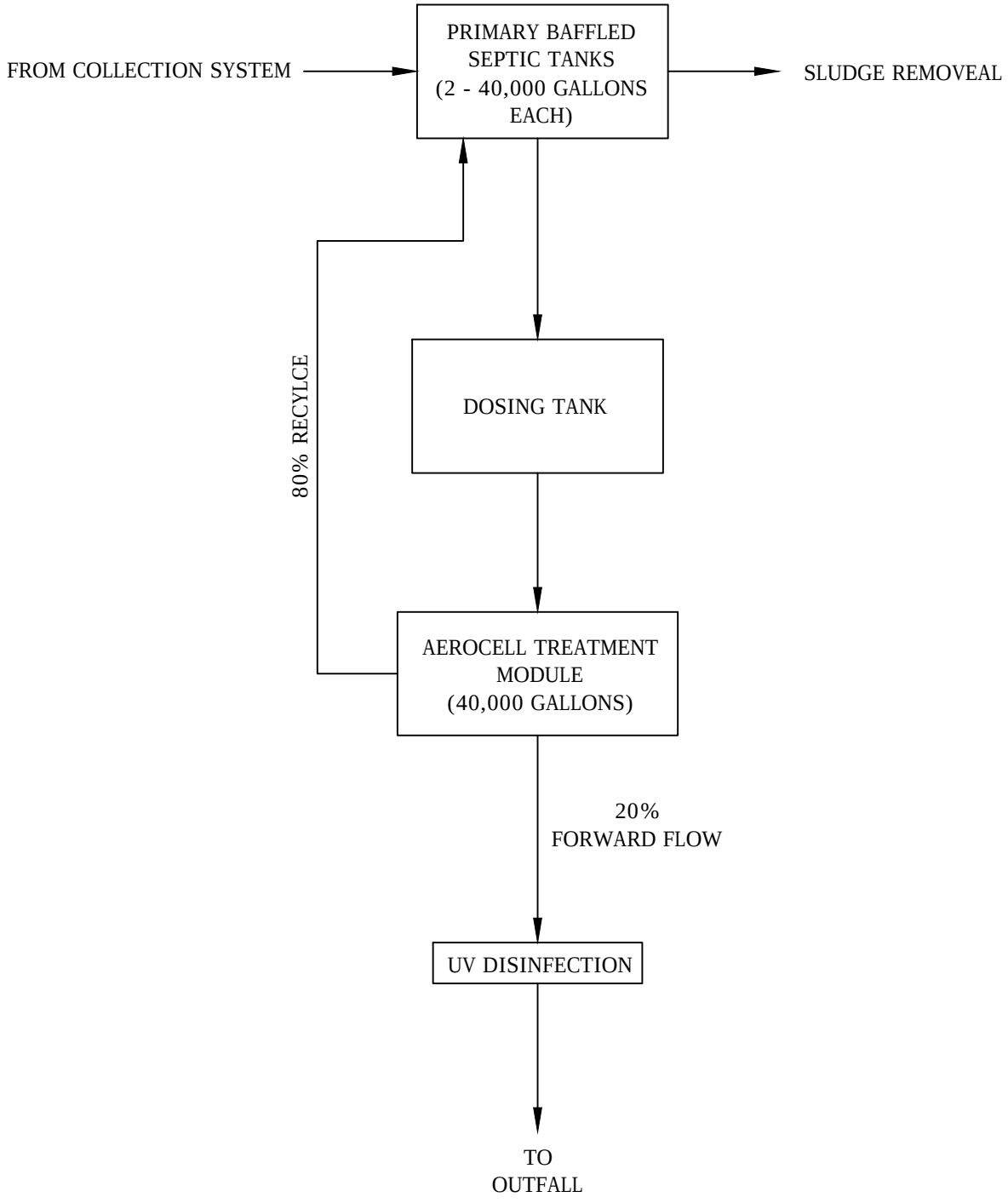
Kevin Sherman, P.E., Ph.D.
502-751-7298
Ksherman@quanics.net

AutoCad Drawings

Tom Jenkins
502-992-8216
Tjenkins@quanics.net

SCALE		NAME	DATE
GPD	Drawn By	TNJ	05-07-09
	Technical Approval	SG	05-07-09
	Engineer Approval		

Quanics Engineering Water Solutions
P.O. Box 1520
Crestwood KY 40014
877-QUANICS
www.quanics.net



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PACKED BED MEDIA FILTER FLOW SCHEMATIC VILLAGE OF CENTERTOWN

PROJ NO: 19492.000

DATE: MARCH 2018

SHEET NUMBER 1 OF 1

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Driving Community and Industry Forward, Together.

Appendix E

Treatment Systems Opinion of Probable Costs and Anticipated O&M Costs

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Driving Community and Industry Forward, Together.

Preliminary Engineer's Opinion of Probable Cost

Village of Centertown, MO

Transport to Jefferson City

March 2018

B&W Project No. 19492.000

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization	1	LS	$120,000	$120,000
2	Duplex Lift Station (80 gpm)	1	LS	$150,000	$150,000
3	4" PVC Force Main	28,000	FT	$40	$1,120,000
4	Air Release Valve & Vault	13	EA	$10,000	$130,000
5	Connection to Existing System	1	LS	$1,000	$1,000
8	Cleanup, Final Grading, Seed, Mulch & Fertilize	1	LS	$112,000	$112,000
9	Railroad Crossing	1	LS	$60,000	$60,000
				Construction Subtotal:	$1,693,000
				10% Contingency:	$169,300
				Total Estimated Construction Cost:	**$1,862,300**
	Non-Construction Costs (35%)				$651,805
	Land Purchase (12 acres @ $10,000/acre)				$120,000
				Total Project Costs	**$2,634,105**

Preliminary Engineer's Opinion of Probable Cost

Village of Centertown, MO

Lagoons with Irrigation

March 2018

B&W Project No. 19492.000

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization	1	LS	$130,000	$130,000
2	Irrigation Sprinkler System	1	LS	$150,000	$150,000
3	Land Clearing and Grubbing	35	AC	$1,800	$63,000
4	Extend 3 phase power	1	LS	$120,000	$120,000
5	4" Pressure Main	4,140	LF	$40	$165,600
6	8" SDR 35 PVC Sewer Main	2,190	LF	$56	$122,640
7	Standard Manholes	8	EA	$4,750	$38,000
8	Bore Under US Hwy 50	1	LS	$160,000	$160,000
9	Primary Lagoon	1	LS	$250,000	$250,000
10	Storage Lagoon	1	LS	$300,000	$300,000
11	Lagoon Effluent Filter	1	LS	$25,000	$25,000
12	Inner Lagoon Control Piping	1	LS	$25,000	$25,000
13	Irrigation Pump Station	1	LS	$100,000	$100,000
14	Rip Rap	1	LS	$50,000	$50,000
15	Fence & Warning Signs	8,400	LF	$15	$126,000
16	Seeding, Grading, Mulch and Fertilizer	1	LS	$50,000	$50,000
				Construction Subtotal:	$1,875,240
				10% Contingency:	$187,524
				Total Estimated Construction Cost:	**$2,062,764**
	Non-Construction Costs (35%)				$721,967
	Land Purchase (40 acres @ $10,000/acre)				$400,000
				Total Project Costs	**$3,184,731**

Preliminary Engineer's Opinion of Probable Cost

Village of Centertown, MO

Lagoons with Discharge

March 2018

B&W Project No. 19492.000

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization	1	LS	$100,000	$100,000
2	Discharge	1	LS	$150,000	$150,000
3	Extend 3 phase power	1	LS	$120,000	$120,000
4	Bore Under US Hwy 50	1	LS	$160,000	$160,000
5	8" SDR 35 PVC Sewer Main	3,850	LF	$45	$173,250
6	Standard Manholes	8	EA	$4,750	$38,000
7	Primary and Secondary Lagoons	1	LS	$325,000	$325,000
8	Storage Lagoons	1	LS	$150,000	$150,000
9	Lagoon Effluent Filter	1	LS	$25,000	$25,000
10	UV System	1	LS	$50,000	$50,000
11	Inner Lagoon Control Piping	1	LS	$25,000	$25,000
12	Fence & Warning Signs	2,900	LF	$15	$43,500
13	Rip Rap	1	LS	$50,000	$50,000
14	Seeding, Grading, Mulch and Fertilizer	1	LS	$50,000	$50,000
				Construction Subtotal:	$1,459,750
				10% Contingency:	$145,975
				Total Estimated Construction Cost:	**$1,605,725**
	Non-Construction (35%)				$562,004
	Land Purchase (10 acres @ $10,000/acre)				$100,000
				Total Project Costs	**$2,267,729**

Preliminary Engineer's Opinion of Probable Cost

Village of Centertown, MO

Moving Bed Media Filter

March 2018

B&W Project No. 19492.000

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization	1	LS	$130,000	$130,000
2	Concrete Pad - MBBR Equipment (Installed)	12	CY	$650	$7,800
3	MBBR Equipment Costs	1	LS	$650,000	$650,000
4	MBBR Equipment Installation	1	LS	$650,000	$650,000
5	WWTF effluent gravity pipe	200	LF	$100	$20,000
6	Influent Pump Station and EQ Basin	1	LS	$180,000	$180,000
7	Fence & Warning Signs	1,200	LF	$15	$18,000
8	Extend 3 Phase Power	1	LS	$120,000	$120,000
9	Grading and Site Gravel Pavement and Drive	1	LS	$50,000	$50,000
10	Seeding, Grading, Mulch and Fertilizer	1	LS	$10,000	$10,000
11	Miscellaneous Piping	1	LS	$10,000	$10,000
				Construction Subtotal:	$1,845,800
				10% Contingency:	$184,580
				Total Estimated Construction Cost:	**$2,030,380**
	Non-Construction Costs (35%)				$710,633
	Land Purchase (5 acres @ 10,000/acre)				$50,000
				Total Project Costs	**$2,791,013**

Preliminary Engineer's Opinion of Probable Cost

Village of Centertown, MO

Packed Media Bed Filter

March 2018

B&W Project No. 19492.000

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization	1	LS	$120,000	$120,000
2	Equipment Costs	1	LS	$550,000	$550,000
3	Equipment Installation	1	LS	$550,000	$550,000
4	40,000 Gallon Septic Tank	2	EA	$95,000	$190,000
5	WWTF effluent gravity pipe	200	LF	$100	$20,000
6	Fence & Warning Signs	1,200	LF	$15	$18,000
7	Extend 3 Phase Power	1	LS	$120,000	$120,000
8	Grading and Site Gravel Pavement and Drive	1	LS	$50,000	$50,000
9	Seeding, Grading, Mulch and Fertilizer	1	LS	$10,000	$10,000
10	Miscellaneous Piping	1	LS	$10,000	$10,000
11	Influent Pump Station and EQ Basin	1	LS	$180,000	$180,000
				Construction Subtotal:	$1,818,000
				10% Contingency:	$181,800
				Total Estimated Construction Cost:	**$1,999,800**
	Non-Construction Cost (35%)				$699,930.00
	Land Purchase (5 acres @ $10,000/acre)				$50,000.00
				Total Project Costs	**$2,749,730**

TREATMENT ALTERNATIVES

ENGINEER'S OPINION OF PROBABLE O&M COSTS

Pump to Jefferson City

20 YEAR AVERAGE DAY (GAL)	40,200
NET ANNUAL (GAL)	14,673,000
ELECTRICAL COST ($/KW-HR)	$0.12

DESCRIPTION	FACTORS	CURRENT ANNUAL $
PUMP STATION POWER		$2,034
PUMPING HEAD (FT)	220	
OVERALL PUMPING EFFICIENCY	0.6	
KW-HR PER YEAR	16,947	
PUMP REPLACEMENT (PUMP STATION)		$4,815
ESTIMATED PUMP DESIGN LIFE (YR)	7	
COST OF PUMP ($)	15000	
INTEREST RATE	0.03	
ANNUAL/PRESENT FACTOR (A/P)	0.16	
EQUIVALENT UNIFORM ANNUAL COST ($)	2408	
NUMBER OF PUMPS (1 duty + 1 standby)	2	
Check Pump Station Weekly		$1,560
Unit hours per week	1	
Annual hours	52	
Hourly wage	30	
Check Pump Station Quarterly		480
Unit hours per quarterly check	4	
Annual hours	16	
Hourly wage	30	
SUPPLIES & MISC. MAINTENANCE ITEMS		$4,000
COST PER YEAR	4000	
JEFFERSON CITY CHARGE		
Monthly Connection Charge	2093.75	$25,125
TOTAL ESTIMATED ANNUAL O&M COST (ROUNDED)		**$36,000**

Lagoons with Irrigation

20 YEAR AVERAGE DAY (GAL)	40,200
NET ANNUAL (GAL)	14,673,000
ELECTRICAL COST ($/KW-HR)	$0.12

DESCRIPTION	FACTORS	CURRENT ANNUAL $
OPERATOR WAGES		$12,775
AVERAGE HOURS PER DAY	1	
WAGE PER HOUR	35	
LAGOON MOWING		$2,400
# OF MOWINGS PER YEAR	12	
COST OF MOWING ($/MOW)	200	
PUMP REPLACEMENT (IRRIGATION)		$2,568
ESTIMATED PUMP DESIGN LIFE (YR)	7	
COST OF PUMP ($)	8000	
INTEREST RATE	0.03	
ANNUAL/PRESENT FACTOR (A/P)	0.16	
EQUIVALENT UNIFORM ANNUAL COST ($)	1284	
NUMBER OF PUMPS (1 duty + 1 standby)	2	
IRRIGATION POWER		$693
PUMPING HEAD (FT)	75	
OVERALL PUMPING EFFICIENCY	0.6	
KW-HR PER YEAR	5777.49375	
SUPPLIES & MISC. MAINTENANCE ITEMS		$4,000
COST PER YEAR	4000	
INSURANCE		$1,000
ANNUAL COST	1000	
TOTAL ESTIMATED ANNUAL O&M COST (ROUNDED)		**$24,000**

Lagoons with Discharge

20 YEAR AVERAGE DAY (GAL)	40,200
NET ANNUAL (GAL)	14,673,000
ELECTRICAL COST ($/KW-HR)	$0.12

DESCRIPTION	FACTORS	CURRENT ANNUAL $
OPERATOR WAGES		$12,775
AVERAGE HOURS PER DAY	1	
WAGE PER HOUR	35	
LAGOON MOWING		$1,800
# OF MOWINGS PER YEAR	12	
COST OF MOWING ($/MOW)	150	
SUPPLIES & MISC. MAINTENANCE ITEMS		$4,000
COST PER YEAR	4000	
INSURANCE		$1,000
ANNUAL COST	1000	
LAB TESTING & SHIPPING SAMPLES		$7,280
SAMPLES PER WEEK	8	
COST PER SAMPLE	15	
NUMBER OF WEEKS PER YEAR	52	
COST FOR SHIPPING OF SAMPLES	20	
ANNUAL SAMPLING COST	6240	
ANNUAL SHIPPING COST OF SAMPLES	1040.00	
TOTAL ESTIMATED ANNUAL O&M COST (ROUNDED)		**$27,000**

TREATMENT ALTERNATIVES

ENGINEER'S OPINION OF PROBABLE O&M COSTS

Moving Bed Biofilm Reactor		
20 YEAR AVERAGE DAY (GAL)	40,200	
NET ANNUAL (GAL)	14,673,000	
ELECTRICAL COST ($/KW-HR)	$0.12	
DESCRIPTION	FACTORS	CURRENT ANNUAL $
OPERATOR		$25,550
AVERAGE HOURS PER DAY	2	
WAGE PER HOUR	35	
MBBR BLOWER POWER		$7,841.95
HORSEPOWER	20	
HOURS OF OPERATION PER DAY	12	
KW-HR PER YEAR	65349.6	
UV DISINFECTION POWER		$420.48
POWER DRAW(KW)	0.4	
HOURS OF OPERATION PER DAY	24	
KW-HR PER YEAR	3504	
LAMP REPLACEMENT		$1,200
NUMBER OF LAMPS PER YEAR	4	
COST OF LAMP ($)	300	
SLUDGE DISPOSAL		$6,000
COST PER YEAR	6000	
SUPPLIES & MISC. MAINTENANCE ITEMS		$5,000
COST PER YEAR	5000	
LAB TESTING & SHIPPING SAMPLES		$7,280
SAMPLES PER WEEK	8	
COST PER SAMPLE	15	
NUMBER OF WEEKS PER YEAR	52	
COST FOR SHIPPING OF SAMPLES	20	
ANNUAL SAMPLING COST	6240	
ANNUAL SHIPPING COST OF SAMPLES	1040.00	
INSURANCE		$1,000
ANNUAL COST	1000	
TOTAL ESTIMATED ANNUAL O&M COST (ROUNDED)		**$55,000**

Packed Bed Media Filter		
20 YEAR AVERAGE DAY (GAL)	40,200	
NET ANNUAL (GAL)	14,673,000	
ELECTRICAL COST ($/KW-HR)	$0.12	
DESCRIPTION	FACTORS	CURRENT ANNUAL $
OPERATOR		$25,550
AVERAGE HOURS PER DAY	2	
WAGE PER HOUR	35	
UV DISINFECTION POWER		$420.48
POWER DRAW(KW)	0.4	
HOURS OF OPERATION PER DAY	24	
KW-HR PER YEAR	3504	
LAMP REPLACEMENT		$1,200
NUMBER OF LAMPS PER YEAR	4	
COST OF LAMP ($)	300	
SLUDGE DISPOSAL		$6,000
COST PER YEAR	6000	
SUPPLIES & MISC. MAINTENANCE ITEMS		$5,000
COST PER YEAR	5000	
LAB TESTING & SHIPPING SAMPLES		$7,280
SAMPLES PER WEEK	8	
COST PER SAMPLE	15	
NUMBER OF WEEKS PER YEAR	52	
COST FOR SHIPPING OF SAMPLES	20	
ANNUAL SAMPLING COST	6240	
ANNUAL SHIPPING COST OF SAMPLES	1040.00	
INSURANCE		$1,000
ANNUAL COST	1000	
DOSING PUMP POWER		$185
PUMPING HEAD (FT)	20	
OVERALL PUMPING EFFICIENCY	0.6	
KW-HR PER YEAR	1540.665	
TOTAL ESTIMATED ANNUAL O&M COST (ROUNDED)		**$47,000**

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Appendix F

Collection System Exhibits

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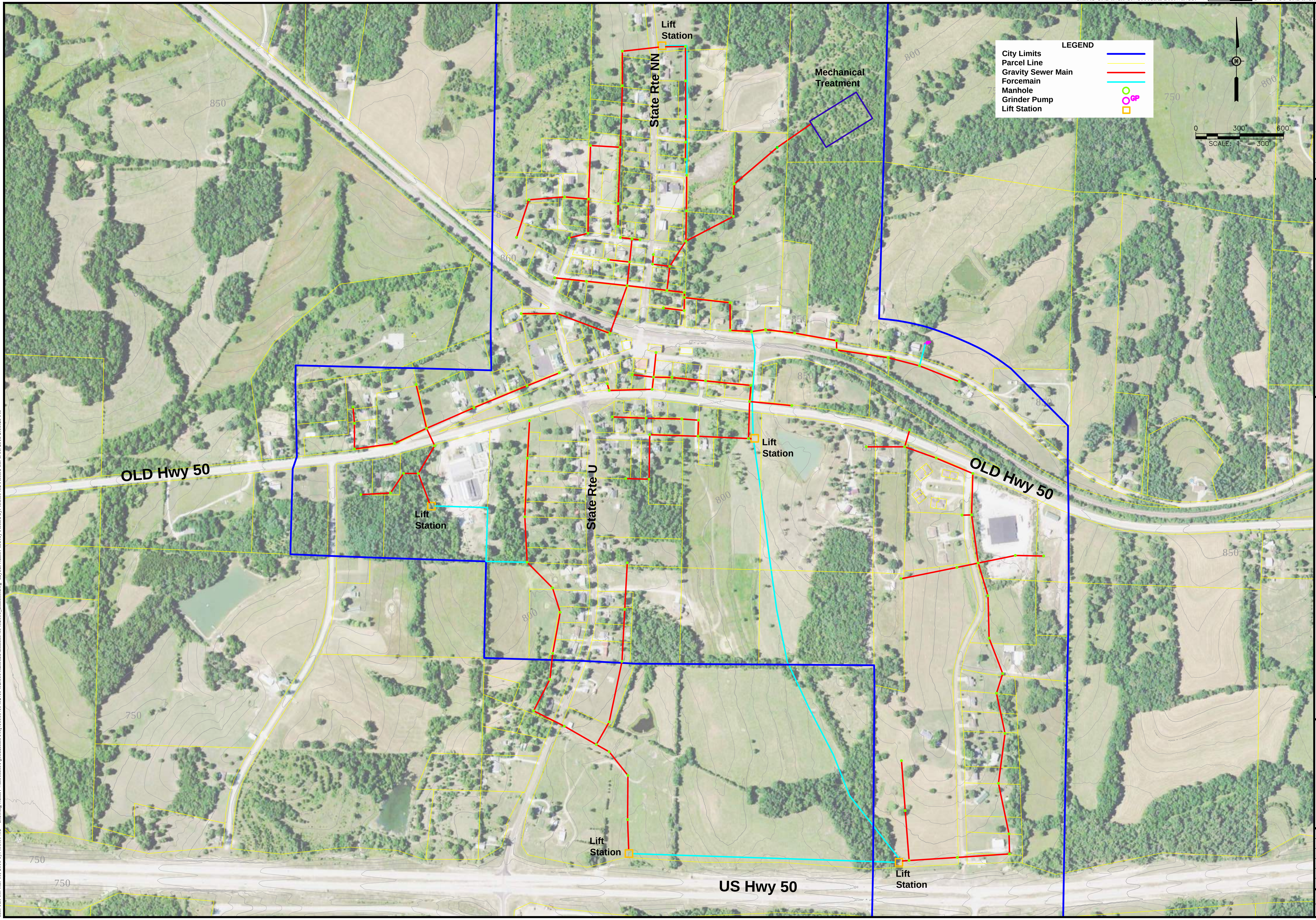

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1719 SOUTHRIDGE DR., SUITE 100 - JEFFERSON CITY, MO 65109-4000

COLLECTION SYSTEM ALTERNATE NO. 1 GRAVITY SYSTEM

CENTERTOWN WASTEWATER FACILITY PLAN
VILLAGE OF CENTERTOWN, MISSOURI

DRAFT DRAFT

SEALED DATE:	= = = =
DESIGNED BY:	KMT
DRAWN BY:	KAK
APPROVED BY:	GWD
DESIGN PROJ:	19492.000
DATE:	MARCH 2018
DRAWING NO:	
SHEET NO:	1 of 1

Last edit on: Mar 19, 2018 by: KAK00402 Drawing Name: 19492_000 Exhibits.dwg Layout Name: Gravity Plotted By: KAK00402 Posted on: 3/19/2018 2:03:20 PM

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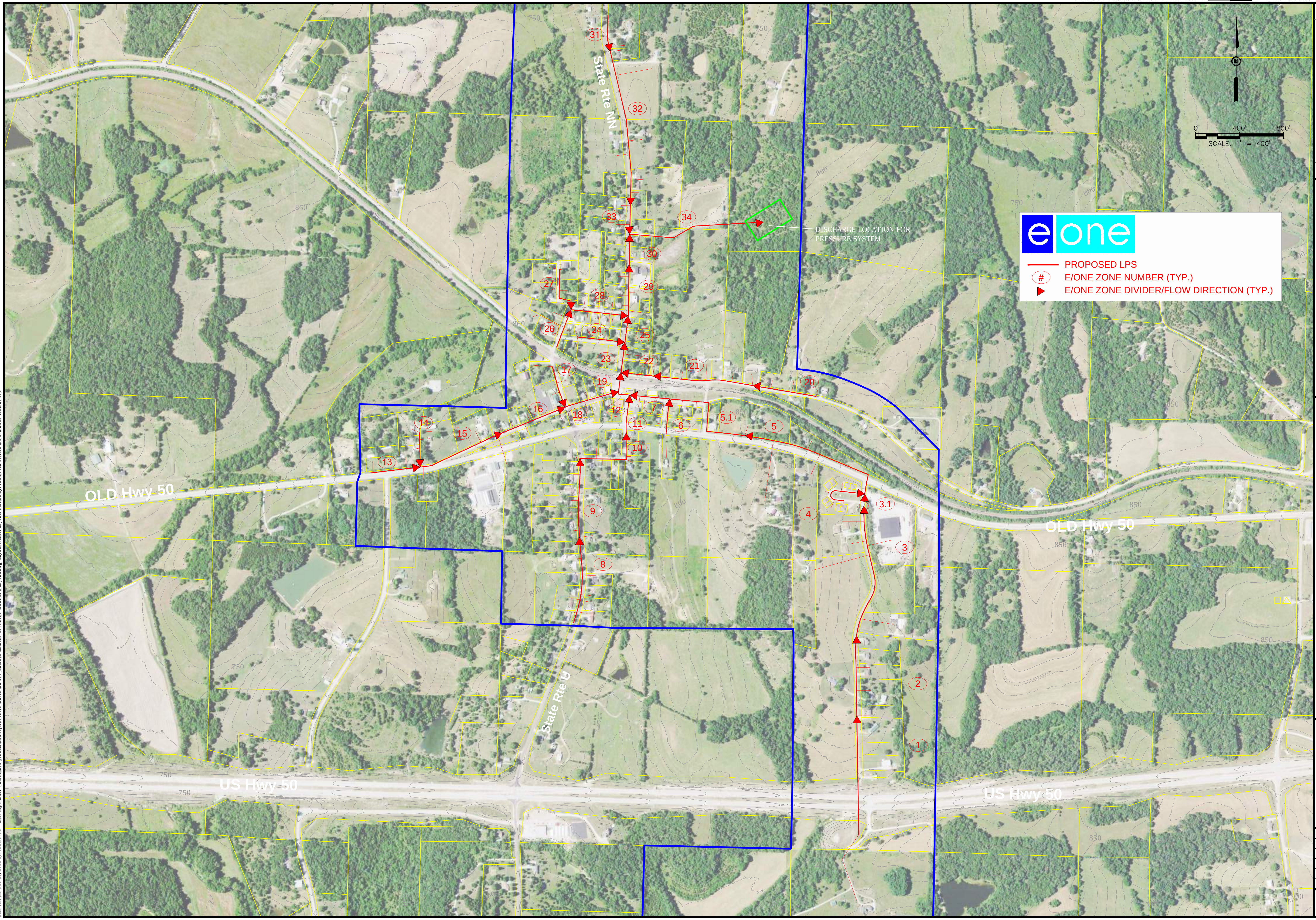

COLLECTION SYSTEM ALTERNATE NO. 3
PRESSURE SYSTEM

CENTERTOWN WASTEWATER FACILITY PLAN
VILLAGE OF CENTERTOWN, MISSOURI

Bartlett & West
1719 SOUTHRIDGE DR., SUITE 100 - JEFFERSON CITY, MO 65109.4000
PHONE 573.634.3181 - FAX 573.634.7904
MISSOURI CERTIFICATE OF AUTHORITY NO. 000167 - ENGINEERING
www.bartwest.com

DRAFT DRAFT

SEALED DATE:	====
DESIGNED BY:	KMT
DRAWN BY:	KAK
APPROVED BY:	GWD
DESIGN PROJ:	19492.000
DATE:	MARCH 2018
DRAWING NO:	
SHEET NO:	1 of 1

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Appendix G

Collection Systems Opinion of Probable Costs and Anticipated O&M Costs

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Preliminary Engineer's Opinion of Probable Cost

Village of Centertown, MO

Traditional Gravity System

March 2018

B&W Project No. 19492.000

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization	1	LS	$250,000	$250,000
2	8" SDR 35 PVC Sewer Main	28,600	LF	$56	$1,601,600
3	Grinder Pumps, Control Panel, Floats, Basin	1	EA	$10,000	$10,000
4	4" Service Laterals	6,500	LF	$35	$227,500
5	Standard Manhole	128	EA	$4,750	$608,000
6	Granular Street Repair	60	LF	$15	$900
7	Asphalt Street Repair	780	LF	$35	$27,300
8	4" Service Lateral Wyes	131	EA	$775	$101,525
9	Pump Station	5	EA	$60,000	$300,000
10	2" SDR 21 PVC Force Main	7,800	LF	$35	$273,000
11	Abandon Existing Septic Tanks	131	EA	$300	$39,300
12	Traffic Control	1	LS	$15,000	$15,000
13	Cleanup, Final Grading, Seed, Mulch & Fertilize	1	LS	$165,000	$165,000
14	Railroad Crossing	1	LS	$104,000	$104,000
				Construction Subtotal:	$3,723,125
				10% Contingency:	$372,313
				Total Estimated Construction Cost:	**$4,095,438**
	Non-Construction Costs (35%)				$1,433,403
	Easements				$10,000
				Total Project Costs	**$5,538,841**

Preliminary Engineer's Opinion of Probable Cost

Village of Centertown, MO

Small Diameter Gravity System

March 2018

B&W Project No. 19492.000

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization	1	LS	$220,000	$220,000
2	Septic Tanks (1000 gallon)	131	EA	$4,000	$524,000
3	Grinder Pumps, Control Panel, Floats, Basin	1	EA	$10,000	$10,000
3	4" Service Laterals	6,500	LF	$35	$227,500
4	4" Service Lateral Wyes & Connections to Existing Laterals	131	EA	$775	$101,525
5	4" SDR 35 PVC Sewer Main	28,600	LF	$35	$1,001,000
6	Standard Manholes	50	EA	$4,750	$237,500
7	4" Main Cleanouts	78	EA	$300	$23,400
8	Granular Street Repair	60	SY	$15	$900
9	Asphalt Street Repair	780	SY	$35	$27,300
10	Pump Station	5	EA	$60,000	$300,000
11	2" SDR 21 PVC Force Main	7,800	LF	$35	$273,000
12	Abandon Existing Septic Tanks	131	EA	$300	$39,300
13	Traffic Control	1	LS	$15,000	$15,000
14	Cleanup, Final Grading, Seed, Mulch & Fertilize	1	LS	$171,000	$171,000
15	Railroad Crossing	1	LS	$104,000	$104,000
				Construction Subtotal:	$3,275,425
				10% Contingency:	$327,543
				Total Estimated Construction Cost:	**$3,602,968**
	Non-Construction (35%)				$1,261,039
	Easements				$10,000
				Total Project Costs	**$4,874,006**

Preliminary Engineer's Opinion of Probable Cost

Village of Centertown, MO

Small Diameter Pressure System

March 2018

B&W Project No. 19492.000

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization	1	LS	$210,000	$210,000
2	Grinder Pumps, Control Panel, Floats, Basin	131	EA	$10,000	$1,310,000
3	Electric Service Cable	7,000	LF	$12	$84,000
4	1 1/4" Pressure Service Line	6,600	LF	$25	$165,000
5	Service Tap, Wye, Pit & Check Valve	131	EA	$2,250	$294,750
6	2" SDR 11 PVC Force Main	13,400	LF	$35	$469,000
7	3" SDR 11 PVC Force Main	4,700	LF	$40	$188,000
8	4" SDR 11 PVC Force Main	2,700	LF	$45	$121,500
9	Air/Vacuum Release Valves, Pits, & Assemblies	20	EA	$5,000	$100,000
10	Granular Street Repair	60	SY	$15	$900
11	Asphalt Street Repair	1,560	SY	$35	$54,600
12	Forcemain Cleanouts	30	EA	$300	$9,000
13	Abandon Existing Septic Tanks	131	EA	$300	$39,300
14	Traffic Control	1	LS	$15,000	$15,000
15	Cleanup, Final Grading, Seed, Mulch & Fertilize	1	LS	$98,000	$98,000
16	Railroad Crossing	1	LS	$52,000	$52,000
				Construction Subtotal:	$3,211,050
				10% Contingency:	$321,105
				Total Estimated Construction Cost:	**$3,532,155**
	Non-Construction Costs (35%)				$1,236,254
	Easements				$25,000
				Total Project Costs	**$4,793,409**

COLLECTION SYSTEMS

ENGINEER'S OPINION OF PROBABLE O&M COSTS

CONVENTIONAL GRAVITY COLLECTION SYSTEM

20 YEAR AVERAGE DAY (GAL)	40,200
NET ANNUAL (GAL)	14,673,000
ELECTRICAL COST ($/KW-HR)	$0.12

DESCRIPTION	FACTORS	CURRENT ANNUAL $
PUMP STATION POWER		$1,849
PUMPING HEAD (FT)	200	
OVERALL PUMPING EFFICIENCY	0.6	
KW-HR PER YEAR	15,407	
PUMP REPLACEMENT (PUMP STATION)		$4,013
ESTIMATED PUMP DESIGN LIFE (YR)	7	
COST OF PUMP ($)	2500	
INTEREST RATE	0.03	
ANNUAL/PRESENT FACTOR (A/P)	0.16	
EQUIVALENT UNIFORM ANNUAL COST ($)	401	
NUMBER OF PUMPS (1 duty + 1 standby)	2	
NUMBER OF PUMP STATIONS	5	
Minor Collection System Repairs		$1,800
Unit Hours per month	5	
Annual Hours	60	
Hourly Wage	30	
Check Pump Station Weekly		$7,800
Unit hours per week	5	
Annual hours	260	
Hourly wage	30	
Check Pump Station Quarterly		2400
Unit hours per quarterly check	20	
Annual hours	80	
Hourly wage	30	
GRINDER PUMP REPLACEMENT		$241
ESTIMATED PUMP DESIGN LIFE (YR)	7	
COST OF GRINDER PUMP ($)	1500	
INTEREST RATE	0.03	
ANNUAL/PRESENT FACTOR (A/P)	0.16	
EQUIVALENT UNIFORM ANNUAL COST ($)	241	
NUMBER OF GRINDER PUMPS	1	
TOTAL ESTIMATED ANNUAL O&M COST		**$19,000**

SMALL DIAMETER GRAVITY COLLECTION SYSTEM

20 YEAR AVERAGE DAY (GAL)	40,200
NET ANNUAL (GAL)	14,673,000
ELECTRICAL COST ($/KW-HR)	$0.12

DESCRIPTION	FACTORS	CURRENT ANNUAL $
PUMP STATION POWER		$1,849
PUMPING HEAD (FT)	200	
OVERALL PUMPING EFFICIENCY	0.6	
KW-HR PER YEAR	15,407	
PUMP REPLACEMENT (PUMP STATION)		$4,013
ESTIMATED PUMP DESIGN LIFE (YR)	7	
COST OF PUMP ($)	2500	
INTEREST RATE	0.03	
ANNUAL/PRESENT FACTOR (A/P)	0.16	
EQUIVALENT UNIFORM ANNUAL COST ($)	401	
NUMBER OF PUMPS (1 duty + 1 standby)	2	
NUMBER OF PUMP STATIONS	5	
SEPTIC TANK PUMPING		$26,338
YEARS BETWEEN PUMPING (YR)	3	
COST OF PUMPING SEPTIC TANK ($)	500	
INFLATION RATE	0.03	
ANNUAL/PRESENT FACTOR (A/P)	0.35	
EQUIVALENT UNIFORM ANNUAL COST ($)	177	
NUMBER OF SEPTIC TANKS	149	
MINOR COLLECTION SYSTEM REPAIRS & MAINTENANCE		$28,800
Unit Hours per month	80	
Annual Hours	960	
Hourly Wage	30	
Check Pump Station Weekly		$15,600
Unit hours per week	10	
Annual hours	520	
Hourly wage	30	
Check Pump Station Quarterly		4800
Unit hours per quarterly check	40	
Annual hours	160	
Hourly wage	30	
TOTAL ESTIMATED ANNUAL O&M COST		**$82,000**

LOW PRESSURE SYSTEM

20 YEAR AVERAGE DAY (GAL)	40,200
NET ANNUAL (GAL)	14,673,000
ELECTRICAL COST ($/KW-HR)	$0.12

DESCRIPTION	FACTORS	CURRENT ANNUAL $
GRINDER PUMP REPLACEMENT		$35,873
ESTIMATED PUMP DESIGN LIFE (YR)	7	
COST OF GRINDER PUMP ($)	1500	
INTEREST RATE	0.03	
ANNUAL/PRESENT FACTOR (A/P)	0.16	
EQUIVALENT UNIFORM ANNUAL COST ($)	241	
NUMBER OF GRINDER PUMPS	149	
MINOR COLLECTION SYSTEM REPAIRS & MAINTENANCE		$14,400
Unit Hours per month	40	
Annual Hours	480	
Hourly Wage	30	
GRINDER PUMP REPAIRS & MAINTENANCE LABOR		$35,880
Unit hours per week	23	
Annual hours	1196	
Hourly wage	30	
INDUSTRIAL / COMMERCIAL GRINDER PUMP REPLACEMENT		$4,013
ESTIMATED PUMP DESIGN LIFE (YR)	7	
COST OF GRINDER PUMP ($)	5000	
INTEREST RATE	0.03	
ANNUAL/PRESENT FACTOR (A/P)	0.16	
EQUIVALENT UNIFORM ANNUAL COST ($)	803	
NUMBER OF GRINDER PUMPS	5	
PUMP STATION POWER		$2,299
PUMPING HEAD (FT)	995	
OVERALL PUMPING EFFICIENCY	0.6	
KW-HR PER YEAR	76,648	
TOTAL ESTIMATED ANNUAL O&M COST		**$93,000**