SECTION I – MONITORING FREQUENCY

1. At a minimum, sludge or biosolids shall be tested for volume and percent total solids on a frequency that will accurately represent sludge quantities produced and disposed. Please see the table below.

TABLE 5

Design Sludge Production (dry tons per year)	Monitoring Frequency (See Notes 1, 2, and 3)			
	Metals, Pathogens and Vectors	Nitrogen TKN [1]	Nitrogen PAN [2]	Priority Pollutants and TCLP [3]
0 to 100	1 per year	1 per year	1 per month	1 per year
101 to 200	biannual	biannual	1 per month	1 per year
201 to 1,000	quarterly	quarterly	1 per month	1 per year
1,001 to 10,000	1 per month	1 per month	1 per week	--[4]
10,001 +	1 per week	1 per week	1 per day	--[4]

1. Test total Kjeldahl nitrogen, if biosolids application is 2 dry tons per acre per year or less.
2. Calculate plant available nitrogen (PAN) when either of the following occurs: 1) when biosolids are greater than 50,000 mg/kg TN; or 2) when biosolids are land applied at an application rate greater than two dry tons per acre per year.
3. Priority pollutants (40 CFR 122.21, Appendix D, Tables II and III) and toxicity characteristic leaching procedure (40 CFR 261.24) is required only for permit holders that must have a pre-treatment program.
4. One sample for each 1,000 dry tons of sludge.

Note 1: Total solids: A grab sample of sludge shall be tested one per day during land application periods for percent total solids. This data shall be used to calculate the dry tons of sludge applied per acre.
Note 2: Total Phosphorus: Total phosphorus and total potassium shall be tested at the same monitoring frequency as metals.
Note 3: Table 5 is not applicable for incineration and permit holders that landfill their sludge.

2. If you own a wastewater treatment lagoon or sludge lagoon that is cleaned out once a year or less, you may choose to sample only when the sludge is removed or the lagoon is closed. Test one composite sample for each 100 dry tons of sludge or biosolids removed from the lagoon during the year within the lagoon at closing. Composite sample must represent various areas at one-foot depth.
3. Additional testing may be required in the special conditions or other sections of the permit. Permittees receiving industrial wastewater may be required to conduct additional testing upon request from the Department.
4. At this time, the Department recommends monitoring requirements shall be performed in accordance with, "POTW Sludge Sampling and Analysis Guidance Document," United States Environmental Protection Agency, August 1989, and the subsequent revisions.

SECTION J – RECORD KEEPING AND REPORTING REQUIREMENTS

1. The permittee shall maintain records on file at the facility for at least five years for the items listed in these standard conditions and any additional items in the Special Conditions section of this permit. This shall include dates when the sludge facility is checked for proper operation, records of maintenance and repairs and other relevant information.
2. Reporting period
   a. By January 28th of each year, an annual report shall be submitted for the previous calendar year period for all mechanical wastewater treatment facilities, sludge lagoons, and sludge or biosolids disposal facilities.
   b. Permittees with wastewater treatment lagoons shall submit the above annual report only when sludge or biosolids are removed from the lagoon during the report period or when the lagoon is closed.
3. Report Forms. The annual report shall be submitted on report forms provided by the Department or equivalent forms approved by the Department.
4. Reports shall be submitted as follows:

Major facilities (those serving 10,000 persons or 1 million gallons per day) shall report to both the Department and EPA. Other facilities need to report only to the Department. Reports shall be submitted to the addresses listed as follows:

DNR regional office listed in your permit
(see cover letter of permit)
ATTN: Sludge Coordinator

EPA Region VII
Water Compliance Branch (WACM)
Sludge Coordinator
11201 Renner Blvd.
Lenexa, KS 66219

5. Annual report contents. The annual report shall include the following:
    a. Sludge and biosolids testing performed. Include a copy or summary of all test results, even if not required by the permit.
    b. Sludge or biosolids quantity shall be reported as dry tons for quantity generated by the wastewater treatment facility, the quantity stored on site at the end of the year, and the quantity used or disposed.
    c. Gallons and % solids data used to calculate the dry ton amounts.
    d. Description of any unusual operating conditions.
    e. Final disposal method, dates, and location, and person responsible for hauling and disposal.
        i. This must include the name, address for the hauler and sludge facility. If hauled to a municipal wastewater treatment facility, sanitary landfill, or other approved treatment facility, give the name of that facility.
        ii. Include a description of the type of hauling equipment used and the capacity in tons, gallons, or cubic feet.
    f. Contract Hauler Activities:
    If contract hauler, provide a copy of a signed contract from the contractor. Permittee shall require the contractor to supply information required under this permit for which the contractor is responsible. The permittee shall submit a signed statement from the contractor that he has complied with the standards contained in this permit, unless the contract hauler has a separate sludge or biosolids use permit.
    g. Land Application Sites:
        i. Report the location of each application site, the annual and cumulative dry tons/acre for each site, and the landowners name and address. The location for each spreading site shall be given as a legal description for nearest ¼, ¼, Section, Township, Range, and county, or UTM coordinates. The facility shall report PAN when either of the following occurs: 1) When biosolids are greater than 50,000 mg/kg TN; or 2) when biosolids are land applied at an application rate greater than two dry tons per acre per year.
        ii. If the "Low Metals" criteria are exceeded, report the annual and cumulative pollutant loading rates in pounds per acre for each applicable pollutant, and report the percent of cumulative pollutant loading which has been reached at each site.
        iii. Report the method used for compliance with pathogen and vector attraction requirements.
        iv. Report soil test results for pH, CEC, and phosphorus. If none was tested during the year, report the last date when tested and results.

RECEIVED

JUN 16 2015

MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM
FORM B: APPLICATION FOR OPERATING PERMIT FOR FACILITIES THAT RECEIVE PRIMARILY DOMESTIC WASTE AND HAVE A DESIGN FLOW LESS THAN OR EQUAL TO 100,000 GALLONS PER DAY

FOR AGENCY USE ONLY	
CHECK NUMBER	
DATE RECEIVED: 6-16-15	FEE SUBMITTED: -0-

READ THE ACCOMPANYING INSTRUCTIONS BEFORE COMPLETING THIS FORM

1. THIS APPLICATION IS FOR:

☐ An operating permit for a new or unpermitted facility. Construction Permit # _____
(Include completed antidegradation review or request for antidegradation review, see instructions)

☑ A site-specific operating permit renewal: Permit #MO- 0135305 Expiration Date 3/10/2016

☐ A site-specific operating permit modification: Permit #MO- _____ Reason: _____

☐ General permit (MOGD – Non POTWs discharging < 50,000 GPD *or* MOG823 – Land Application of Domestic Wastewater):
Permit #MO- _____ Expiration Date _____

1.1 Is the appropriate fee included with the application (see instructions for appropriate fee)? ☐ YES ☐ NO

2. FACILITY

NAME		TELEPHONE NUMBER WITH AREA CODE	
BCRSD Brown Station WWTF		(573) 443-2774	
ADDRESS (PHYSICAL)	CITY	STATE	ZIP CODE
O'Rear Road and North Brown Station Road	Columbia	MO	65204

2.1 Legal description: ¼, NW ¼, NW ¼, Sec. 10 , T 49n , R 12w County Boone

2.2 UTM Coordinates Easting (X): 563938 Northing (Y): 4322492
For Universal Transverse Mercator (UTM), Zone 15 North referenced to North American Datum 1983 (NAD83)

2.3 Name of receiving stream: Clays Fork

2.4 Number of outfalls: one Wastewater outfalls: one Stormwater outfalls: 0 Instream monitoring sites: 0

3. OWNER

NAME	EMAIL ADDRESS	TELEPHONE NUMBER WITH AREA CODE	
Boone County Regional Sewer District	dcooksey@bcrsd.com	(573) 441-0098	
ADDRESS	CITY	STATE	ZIP CODE
1314 North 7th street	Columbia	Mo	65201

3.1 Request review of draft permit prior to public notice? ☑ YES ☐ NO

3.2 Are you a publicly owned treatment works? ☑ YES ☐ NO
If yes, is the Financial Questionnaire attached? ☐ YES ☑ NO

3.3 Are you a privately owned treatment works? ☐ YES ☑ NO

3.4 Are you a privately owned treatment facility regulated by the Public Service Commission? ☐ YES ☑ NO

4. CONTINUING AUTHORITY: Permanent organization that will serve as the continuing authority for the operation, maintenance and modernization of the facility.

NAME	EMAIL ADDRESS	TELEPHONE NUMBER WITH AREA CODE	
Boone County Regional Sewer District	dcooksey@bcrsd.com	(573) 441-0098	
ADDRESS	CITY	STATE	ZIP CODE
1314 North Seventh Street	Columbia	Mo	65201

If the continuing authority is different than the owner, include a copy of the contract agreement between the two parties and a description of the responsibilities of both parties within the agreement.

5. OPERATOR

NAME	TITLE	CERTIFICATE NUMBER
Dwayne Cooksey	Operations Manager	1249
EMAIL ADDRESS		TELEPHONE NUMBER WITH AREA CODE
dcooksey@bcrsd.com		(573) 441-0098

6. FACILITY CONTACT

NAME		TITLE	
Dwayne Cooksey		Operations Manager	
EMAIL ADDRESS		TELEPHONE NUMBER WITH AREA CODE	
dcooksey@bcrsd.com		(573) 441-0098	
ADDRESS	CITY	STATE	ZIP CODE
1314 North Seventh Street	Columbia	Mo.	65257

MO 780-1512 (12-14)

NE Boone

7. DESCRIPTION OF FACILITY

7.1 Process Flow Diagram or Schematic: Provide a diagram showing the processes of the treatment plant. Show all of the treatment units, including disinfection (e.g. – chlorination and dechlorination), influents, and outfalls. Specify where samples are taken. Indicate any treatment process changes in the routing of wastewater during dry weather and peak wet weather. Include a brief narrative description of the diagram.
Attach sheets as necessary.

STEP System/Recirculating sand filter. Sludge disposal is handled by BCRSD. Design population equivalent is 19. Design flow is 1,850 gallon per day. Design sludge production is 0.37 dry tons/year.

7.2 Attach an aerial photograph or USGS topographic map showing the location of the facility and outfall.

MO 780-1512 (12-14)

8. ADDITIONAL FACILITY INFORMATION

8.1 Facility SIC code: _____ Discharge SIC code: 4952

8.2 Number of people presently connected or population equivalent (P.E.) 18.5 Design P.E. 18.5

8.3 Connections to the facility:

Number of units presently connected:

Homes 5 Trailers _____ Apartments _____ Other (including industrial) _____

Number of commercial establishments: _____

8.4 Design flow: 1,850 gpd | Actual flow: < 1,000 gallon per day

8.5 Will discharge be continuous through the year? ✓ Yes | No

Discharge will occur during the following months:

How many days of the week will discharge occur? 7

8.6 Is industrial wastewater discharged to the facility? | Yes ✓ No

If yes, attach a list of the industries that discharge to your facility

8.7 Does the facility accept or process leachate from landfills? | Yes ✓ No

8.8 Is wastewater land applied? | Yes ✓ No

If yes, is Form I attached? | Yes | No

8.9 Does the facility discharge to a losing stream or sinkhole? | Yes ✓ No

8.10 Has a wasteload allocation study been completed for this facility? Yes ✓ No

9. LABORATORY CONTROL INFORMATION

LABORATORY WORK CONDUCTED BY PLANT PERSONNEL In House

Lab work conducted outside of plant.	Yes	No
Push-button or visual methods for simple test such as pH, settlable solids.	Yes	No
Additional procedures such as dissolved oxygen, chemical oxygen demand, biological oxygen demand, titrations, solids, volatile content.	Yes	No
More advanced determinations such as BOD seeding procedures, fecal coliform, nutrients, total oils, phenols, etc.	Yes	No
Highly sophisticated instrumentation, such as atomic absorption and gas chromatograph.	Yes	No

10. COLLECTION SYSTEM

10.1 Length of pipe in the sewer collection system? 1.383 Feet, or _____ Miles (either unit is appropriate)

10.2 Does significant infiltration occur in the collection system? | Yes ✓ No

If yes, briefly explain any steps underway or planned to minimize inflow and infiltration:

11. BYPASSING

Does any bypassing occur in the collection system or at the treatment facility? | Yes ✓ No

If yes, explain:

MO 780-1512 (12-14)

12. SLUDGE HANDLING, USE AND DISPOSAL

12.1 Is the sludge a hazardous waste as defined by 10 CSR 25? ☐ Yes ☑ No

12.2 Sludge production, including sludge received from others: 0.37 Design dry tons/year 0.37 Actual dry tons/year

12.3 Capacity of sludge holding structures:
Sludge storage provided: 507 cubic feet; 1825 days of storage; 15 average percent solids of sludge;
☑ No sludge storage is provided. ☐ Sludge is stored in lagoon.

12.4 Type of Storage:
☐ Holding tank ☐ Building
☐ Basin ☐ Lagoon
☐ Concrete Pad ☑ Other (Describe) residential septic tanks and WWTF

12.5 Sludge Treatment:
☐ Anaerobic Digester ☐ Lagoon ☐ Composting
☑ Storage Tank ☐ Aerobic Digester ☐ Other (Attach description)
☐ Lime Stabilization ☐ Air or Heat Drying

12.6 Sludge Use or Disposal:
☐ Land Application ☐ Surface Disposal (Sludge Disposal Lagoon, Sludge held for more than two years)
☐ Contract Hauler ☑ Hauled to Another treatment facility
☐ Incineration ☐ Sludge Retained in Wastewater treatment lagoon
☐ Solid waste landfill

12.7 Person responsible for hauling sludge to disposal facility:
☑ By applicant ☐ By others (complete below)

NAME	EMAIL ADDRESS		
ADDRESS	CITY	STATE	ZIP CODE
CONTACT PERSON	TELEPHONE NUMBER WITH AREA CODE	PERMIT NO.	
		MO-	

12.8 Sludge use or disposal facility
☐ By applicant ☑ By others (Complete below.)

NAME	EMAIL ADDRESS		
City of Columbia			
ADDRESS	CITY	STATE	ZIP CODE
POB N	Columbia	MO	65202
CONTACT PERSON	TELEPHONE NUMBER WITH AREA CODE	PERMIT NO.	
Davie Sorrel	(573) 874-6286	MO- 0097837	

12.9 Does the sludge or biosolids disposal comply with federal sludge regulations under 40 CFR 503?
☑ Yes ☐ No (Explain)

13. CERTIFICATION

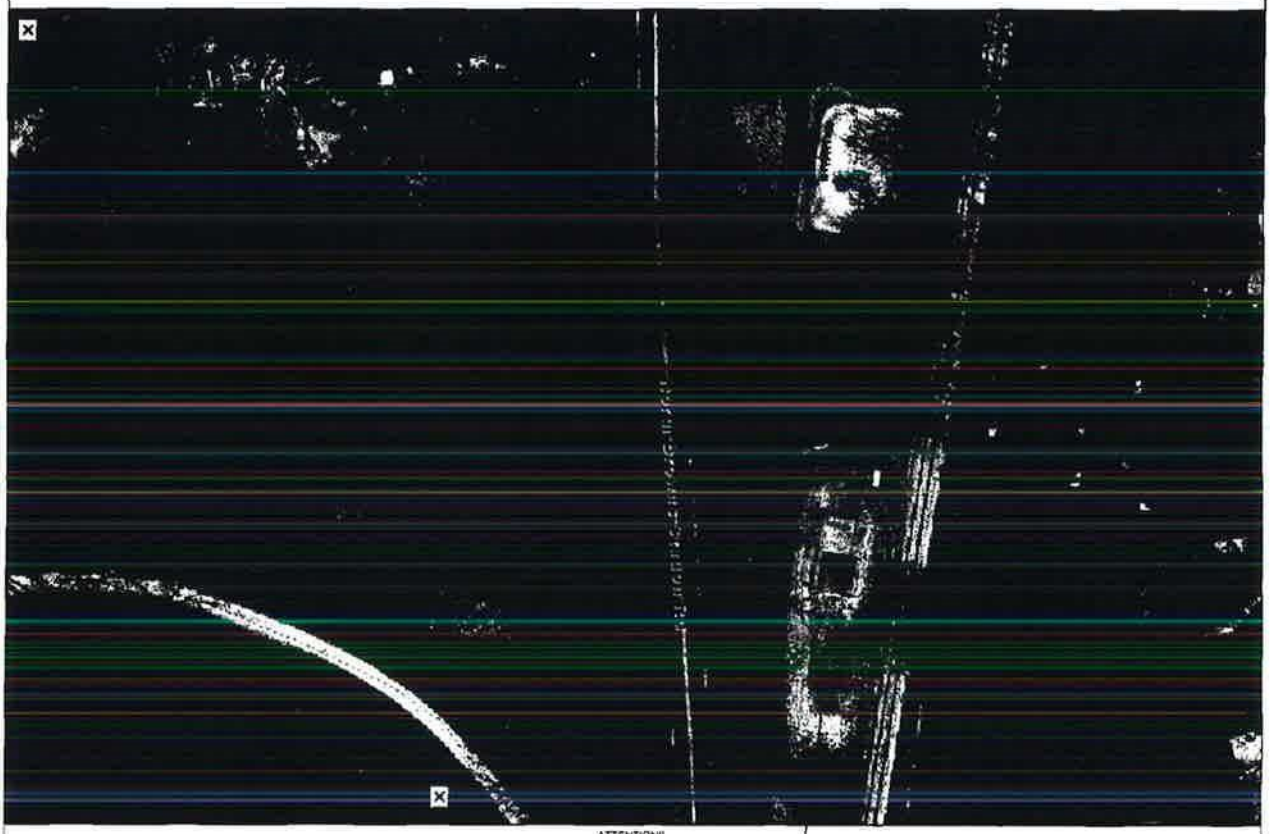
I certify that I am familiar with the information contained in the application, that to the best of my knowledge and belief such information is true, complete and accurate, and if granted this permit, I agree to abide by the Missouri Clean Water Law and all rules, regulations, orders and decisions, subject to any legitimate appeal available to applicant under the Missouri Clean Water Law.

NAME (TYPE OR PRINT)	OFFICIAL TITLE	TELEPHONE NUMBER WITH AREA CODE
Dwayne Cooksey	Operations Manager	(573) 441-0098
SIGNATURE		DATE SIGNED
Dwayne Cooksey Operations Manager		6/24/2015

MO 780-1512 (12-14)

Boone County Internet Parcel Map

Prepared by the Boone County Assessor's Office, (573) 886-4262

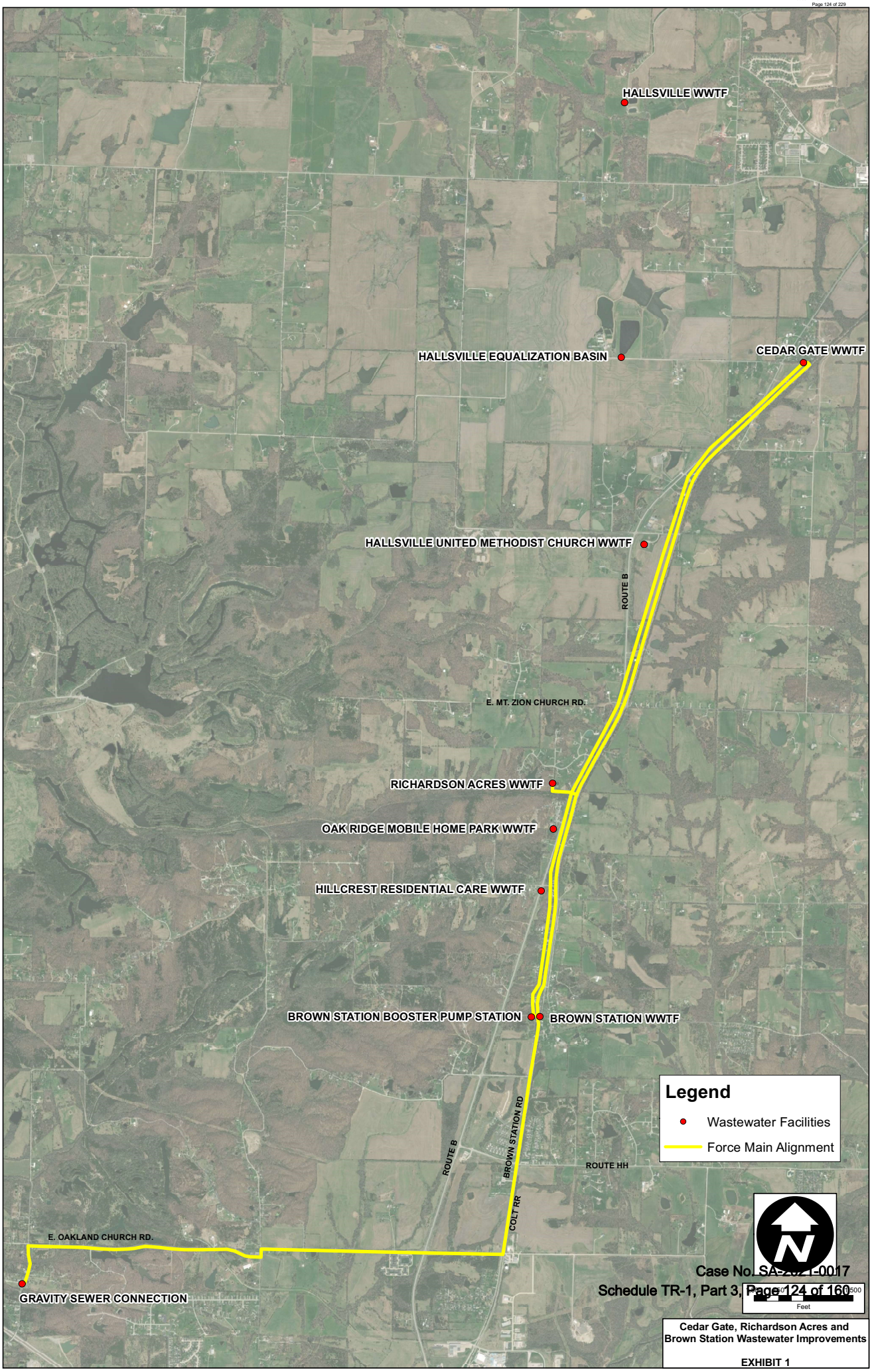


ATTENTION!!

DISCLAIMER; READ CAREFULLY: These maps were prepared for the inventory of real property based on the utilization of deeds, plans, and/or supportive data. In addition, map files are frequently changed to reflect changes in boundaries, lot lines and other geographic features resulting from changes in ownership, development and other causes. The existence, dimension, and location of features, as well as other information, should not be relied upon for any purpose without actual field verification. The County of Boone makes no warranty of any kind concerning the completeness or accuracy of information contained on these maps and assumes no liability or responsibility for the use or reuse of these maps by persons not affiliated with Boone County. Use of these maps by any person not affiliated with Boone County constitutes agreement by the user to assume full liability and responsibility for the verification of the accuracy of information shown on these maps.

Fifteen

APPENDIX B
EXHIBIT 1: PROPOSED IMPROVEMENTS



Case No. SA-2021-0017
Schedule TR-1, Part 3, Page 124 of 160

Cedar Gate, Richardson Acres and
Brown Station Wastewater Improvements

EXHIBIT 1

APPENDIX C

DAILY MONITORING REPORTS

CEDAR GATE DRM DATA

Date	Description	Influent/Effluent	Unit	Monthly Average	Daily Max
12/31/2019	Ammonia (as N) + unionized ammonia	End of Pipe	mg/L	13.2	
09/30/2019	Ammonia (as N) + unionized ammonia	End of Pipe	mg/L	14.3	
06/30/2019	Ammonia (as N) + unionized ammonia	End of Pipe	mg/L	17.1	
03/31/2019	Ammonia (as N) + unionized ammonia	End of Pipe	mg/L	17.4	
12/31/2018	Ammonia (as N) + unionized ammonia	End of Pipe	mg/L	11.5	
09/30/2018	Ammonia (as N) + unionized ammonia	End of Pipe	mg/L	8.1	
06/30/2018	Ammonia (as N) + unionized ammonia	End of Pipe	mg/L	25.2	
03/31/2018	Ammonia (as N) + unionized ammonia	End of Pipe	mg/L	35.4	
12/31/2017	Ammonia (as N) + unionized ammonia	End of Pipe	mg/L	22.7	
09/30/2017	Ammonia (as N) + unionized ammonia	End of Pipe	mg/L	8.1	
06/30/2017	Ammonia (as N) + unionized ammonia	End of Pipe	mg/L	11.2	
03/31/2017	Ammonia (as N) + unionized ammonia	End of Pipe	mg/L	33.9	
12/31/2016	Ammonia (as N) + unionized ammonia	End of Pipe	mg/L	18.5	
09/30/2016	Ammonia (as N) + unionized ammonia	End of Pipe	mg/L	11.8	
06/30/2016	Ammonia (as N) + unionized ammonia	End of Pipe	mg/L	22.1	
03/31/2016	Ammonia (as N) + unionized ammonia	End of Pipe	mg/L	2.2	
12/31/2015	Ammonia (as N) + unionized ammonia	End of Pipe	mg/L	9.5	
09/30/2015	Ammonia (as N) + unionized ammonia	End of Pipe	mg/L	13.4	
06/30/2015	Ammonia (as N) + unionized ammonia	End of Pipe	mg/L	12.3	
03/31/2015	Ammonia (as N) + unionized ammonia	End of Pipe	mg/L	40.3	
12/31/2019	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	9	
09/30/2019	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	17	
06/30/2019	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	16	
03/31/2019	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	19	
12/31/2018	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	10	
09/30/2018	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	25	
06/30/2018	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	14	
03/31/2018	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	43	
12/31/2017	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	14	
09/30/2017	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	7	
06/30/2017	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	13	
03/31/2017	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	41	
12/31/2016	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	10	
09/30/2016	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	11	
06/30/2016	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	43	
03/31/2016	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	26	
12/31/2015	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	11	
09/30/2015	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	13	
06/30/2015	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	34	
03/31/2015	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	116	
12/31/2019	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00295	0.003
11/30/2019	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0028	0.0028
10/31/2019	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0025	0.0029
09/30/2019	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0029	0.003
08/31/2019	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0021	0.0028
07/31/2019	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00305	0.0032
06/30/2019	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00295	0.003
05/31/2019	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00295	0.003
04/30/2019	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00295	0.003
03/31/2019	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00255	0.003
02/28/2019	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0032	0.0036
01/31/2019	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0033	0.0036
12/31/2018	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00255	0.003
11/30/2018	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00215	0.0029
10/31/2018	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00265	0.0034
09/30/2018	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00175	0.0021
08/31/2018	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00175	0.0021
07/31/2018	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0025	0.0029
06/30/2018	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0021	0.0028
05/31/2018	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0029	0.003
04/30/2018	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00201	0.00216
03/31/2018	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0026	0.0048
02/28/2018	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0021	0.0028
01/31/2018	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0014	0.0014
12/31/2017	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00155	0.0017
11/30/2017	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0012	0.00144
10/31/2017	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00155	0.0017
09/30/2017	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00127	0.0014
08/31/2017	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0021	0.0028
07/31/2017	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001	0.001
06/30/2017	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001	0.001

05/31/2017	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001	0.001
04/30/2017	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00122	0.00144
03/31/2017	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00122	0.00144
02/28/2017	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00122	0.00144
01/31/2017	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0014	0.0014
12/31/2016	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00122	0.00144
11/30/2016	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00144	0.00144
10/31/2016	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00144	0.0014
09/30/2016	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0012	0.00144
08/31/2016	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00122	0.00144
07/31/2016	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.012	0.014
06/30/2016	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0021	0.0028
05/31/2016	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0012	0.0014
04/30/2016	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00144	0.00144
03/31/2016	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001	0.001
02/29/2016	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0012	0.0014
01/31/2016	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00122	0.00144
12/31/2015	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00122	0.00144
11/30/2015	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00194	0.00288
10/31/2015	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001	0.001
09/30/2015	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0012	0.0014
08/31/2015	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001	0.001
07/31/2015	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0012	0.0014
06/30/2015	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0019	0.0029
05/31/2015	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0021	0.0029
04/30/2015	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00216	0.00288
03/31/2015	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00097	0.00144
02/28/2015	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d		
01/31/2015	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0027933	0.00428
12/31/2019	Total Suspended Solids (TSS)	End of Pipe	mg/L	6	
09/30/2019	Total Suspended Solids (TSS)	End of Pipe	mg/L	15	
06/30/2019	Total Suspended Solids (TSS)	End of Pipe	mg/L	10	
03/31/2019	Total Suspended Solids (TSS)	End of Pipe	mg/L	25	
12/31/2018	Total Suspended Solids (TSS)	End of Pipe	mg/L	12	
09/30/2018	Total Suspended Solids (TSS)	End of Pipe	mg/L	10	
06/30/2018	Total Suspended Solids (TSS)	End of Pipe	mg/L	13	
03/31/2018	Total Suspended Solids (TSS)	End of Pipe	mg/L	56	
12/31/2017	Total Suspended Solids (TSS)	End of Pipe	mg/L	14	
09/30/2017	Total Suspended Solids (TSS)	End of Pipe	mg/L	14	
06/30/2017	Total Suspended Solids (TSS)	End of Pipe	mg/L	13	
03/31/2017	Total Suspended Solids (TSS)	End of Pipe	mg/L	33	
12/31/2016	Total Suspended Solids (TSS)	End of Pipe	mg/L	6	
09/30/2016	Total Suspended Solids (TSS)	End of Pipe	mg/L	12	
06/30/2016	Total Suspended Solids (TSS)	End of Pipe	mg/L	33	
03/31/2016	Total Suspended Solids (TSS)	End of Pipe	mg/L	23	
12/31/2015	Total Suspended Solids (TSS)	End of Pipe	mg/L	24	
09/30/2015	Total Suspended Solids (TSS)	End of Pipe	mg/L	13	
06/30/2015	Total Suspended Solids (TSS)	End of Pipe	mg/L	72	
03/31/2015	Total Suspended Solids (TSS)	End of Pipe	mg/L	37	
12/31/2019	BOD, 5-day, 20 deg. C	Influent	mg/L	279	
12/31/2018	BOD, 5-day, 20 deg. C	Influent	mg/L	426	
12/31/2017	BOD, 5-day, 20 deg. C	Influent	mg/L	348	
12/31/2016	BOD, 5-day, 20 deg. C	Influent	mg/L	284	
12/31/2015	BOD, 5-day, 20 deg. C	Influent	mg/L	310	
12/31/2019	Total Suspended Solids (TSS)	Influent	mg/L	190	
12/31/2018	Total Suspended Solids (TSS)	Influent	mg/L	322	
12/31/2017	Total Suspended Solids (TSS)	Influent	mg/L	316	
12/31/2016	Total Suspended Solids (TSS)	Influent	mg/L	420	
12/31/2015	Total Suspended Solids (TSS)	Influent	mg/L	298	

RICHARDSON ACRES DMR DATA

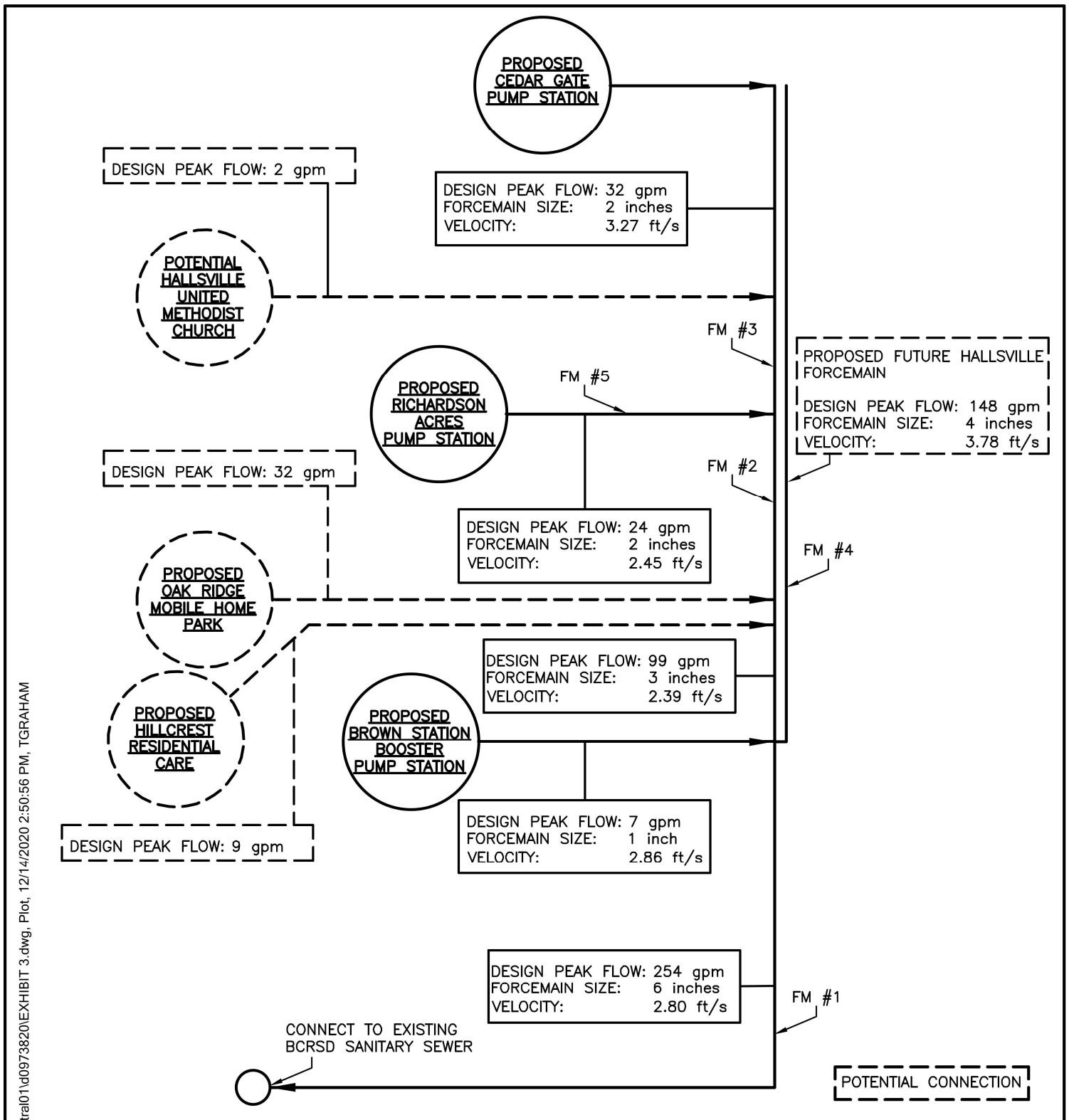
Date	Description	Influent/Effluent	Unit	Monthly Average	Daily Max
12/31/2019	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	9	
09/30/2019	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	14	
06/30/2019	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	37	
03/31/2019	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	14	
12/31/2018	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	8	
09/30/2018	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	18	
06/30/2018	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	12	
03/31/2018	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	15	
12/31/2017	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	13	
09/30/2017	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	6	
06/30/2017	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	10	
03/31/2017	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	9	
12/31/2016	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	8	
09/30/2016	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	17	
06/30/2016	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	34	
03/31/2016	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	10	
12/31/2015	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	16	
09/30/2015	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	19	
06/30/2015	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	27	
03/31/2015	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	14	
12/31/2019	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0038	0.0041
09/30/2019	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00436	0.0054
06/30/2019	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0042	0.0047
03/31/2019	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00445	0.0057
12/31/2018	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0037	0.0041
09/30/2018	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0032	0.0036
06/30/2018	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00288	0.00288
03/31/2018	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0038	0.0047
12/31/2017	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0036	0.0041
09/30/2017	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00344	0.0041
06/30/2017	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0031	0.0043
03/31/2017	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0034833	0.003927
12/31/2016	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0041713	0.0048
09/30/2016	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0039713	0.0042
06/30/2016	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.003638	0.004114
03/31/2016	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0036683	0.00432
12/31/2015	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0040205	0.004114
09/30/2015	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.004155667	0.004547
06/30/2015	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0035635	0.003927
03/31/2015	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.00288	0.00288
12/31/2019	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	2	
09/30/2019	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	0.8	
06/30/2019	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	0.3	
03/31/2019	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	5.6	
12/31/2018	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	0.6	
09/30/2018	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	2.7	
06/30/2018	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	1.1	
03/31/2018	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	11.5	
12/31/2017	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	4.2	
09/30/2017	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	1.1	
06/30/2017	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	3.6	
03/31/2017	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	9.2	
03/31/2015	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	8.4	
12/31/2019	Total Suspended Solids (TSS)	End of Pipe	mg/L	8	
09/30/2019	Total Suspended Solids (TSS)	End of Pipe	mg/L	9	
06/30/2019	Total Suspended Solids (TSS)	End of Pipe	mg/L	49	
03/31/2019	Total Suspended Solids (TSS)	End of Pipe	mg/L	15	
12/31/2018	Total Suspended Solids (TSS)	End of Pipe	mg/L	4	
09/30/2018	Total Suspended Solids (TSS)	End of Pipe	mg/L	42	
06/30/2018	Total Suspended Solids (TSS)	End of Pipe	mg/L	16	
03/31/2018	Total Suspended Solids (TSS)	End of Pipe	mg/L	13	
12/31/2017	Total Suspended Solids (TSS)	End of Pipe	mg/L	15	
09/30/2017	Total Suspended Solids (TSS)	End of Pipe	mg/L	17	
06/30/2017	Total Suspended Solids (TSS)	End of Pipe	mg/L	14	
03/31/2017	Total Suspended Solids (TSS)	End of Pipe	mg/L	9	
12/31/2016	Total Suspended Solids (TSS)	End of Pipe	mg/L	12	
09/30/2016	Total Suspended Solids (TSS)	End of Pipe	mg/L	32	
06/30/2016	Total Suspended Solids (TSS)	End of Pipe	mg/L	41.5	
03/31/2016	Total Suspended Solids (TSS)	End of Pipe	mg/L	27	
12/31/2015	Total Suspended Solids (TSS)	End of Pipe	mg/L	26	
09/30/2015	Total Suspended Solids (TSS)	End of Pipe	mg/L	38	
06/30/2015	Total Suspended Solids (TSS)	End of Pipe	mg/L	33	
03/31/2015	Total Suspended Solids (TSS)	End of Pipe	mg/L	33	
09/30/2018	BOD, 5-day, 20 deg. C	Influent	mg/L	79	
06/30/2018	BOD, 5-day, 20 deg. C	Influent	mg/L	105	
03/31/2018	BOD, 5-day, 20 deg. C	Influent	mg/L	190	
12/31/2017	BOD, 5-day, 20 deg. C	Influent	mg/L	55	
09/30/2017	BOD, 5-day, 20 deg. C	Influent	mg/L	83	
06/30/2017	BOD, 5-day, 20 deg. C	Influent	mg/L	102	
03/31/2017	BOD, 5-day, 20 deg. C	Influent	mg/L	177	
09/30/2018	Total Suspended Solids (TSS)	Influent	mg/L	42	
06/30/2018	Total Suspended Solids (TSS)	Influent	mg/L	64	
03/31/2018	Total Suspended Solids (TSS)	Influent	mg/L	72	
12/31/2017	Total Suspended Solids (TSS)	Influent	mg/L	25	
09/30/2017	Total Suspended Solids (TSS)	Influent	mg/L	32	
06/30/2017	Total Suspended Solids (TSS)	Influent	mg/L	53	
03/31/2017	Total Suspended Solids (TSS)	Influent	mg/L	28	

BROWN STATION DMR DATA

Date	Description	Influent/Effluent	Unit	Monthly Average	Daily Max
3/31/2015	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	3	
6/30/2015	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	3	
9/30/2015	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	3	
12/31/2015	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	3	
3/31/2016	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	3	
6/30/2016	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	4	
9/30/2016	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	3	
12/31/2016	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	3	
3/31/2017	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	5	
6/30/2017	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	4	
9/30/2017	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	3	
12/31/2017	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	3	
3/31/2018	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	6	
6/30/2018	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	5	
9/30/2018	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	3	
12/31/2018	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	4	
3/31/2019	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	3	
6/30/2019	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	3	
9/30/2019	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	3	
12/31/2019	BOD, 5-day, 20 deg. C	End of Pipe	mg/L	5	
3/31/2015	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	1000	1000
6/30/2015	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.0065667	0.00144
9/30/2015	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001	0.001
12/31/2015	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001352	0.00288
3/31/2016	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001	0.001
6/30/2016	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001	0.001
9/30/2016	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001	0.001
12/31/2016	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001	0.001
3/31/2017	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001	0.001
6/30/2017	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001	0.001
9/30/2017	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001	0.001
12/31/2017	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001	0.001
3/31/2018	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001	0.00178
6/30/2018	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001	0.001
9/30/2018	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001	0.001
12/31/2018	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001	0.001
3/31/2019	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001	0.001
6/30/2019	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001	0.001
9/30/2019	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001	0.001
12/31/2019	Flow, in conduit or thru treatment plant	End of Pipe	Mgal/d	0.001	0.001
3/31/2015	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	0.8	
6/30/2015	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	0.8	
9/30/2015	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	0.3	
12/31/2015	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	0.3	
3/31/2016	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	0.6	
6/30/2016	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	0.3	
9/30/2016	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	0.3	
12/31/2016	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	1.4	
3/31/2017	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	0.6	
6/30/2017	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	0.3	
9/30/2017	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	0.3	
12/31/2017	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	0.3	
3/31/2018	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	1.1	
6/30/2018	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	0.6	
9/30/2018	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	0.3	
12/31/2018	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	1.4	
3/31/2019	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	5.3	
6/30/2019	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	0.3	
9/30/2019	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	0.3	
12/31/2019	Nitrogen, ammonia total (as N)	End of Pipe	mg/L	0.3	
3/31/2015	Total Suspended Solids (TSS)	End of Pipe	mg/L	2	
6/30/2015	Total Suspended Solids (TSS)	End of Pipe	mg/L	3.5	
9/30/2015	Total Suspended Solids (TSS)	End of Pipe	mg/L	2	
12/31/2015	Total Suspended Solids (TSS)	End of Pipe	mg/L	3	
3/31/2016	Total Suspended Solids (TSS)	End of Pipe	mg/L	3	
6/30/2016	Total Suspended Solids (TSS)	End of Pipe	mg/L	7	
9/30/2016	Total Suspended Solids (TSS)	End of Pipe	mg/L	2	
12/31/2016	Total Suspended Solids (TSS)	End of Pipe	mg/L	3	
3/31/2017	Total Suspended Solids (TSS)	End of Pipe	mg/L	3	
6/30/2017	Total Suspended Solids (TSS)	End of Pipe	mg/L	3	
9/30/2017	Total Suspended Solids (TSS)	End of Pipe	mg/L	7	
12/31/2017	Total Suspended Solids (TSS)	End of Pipe	mg/L	6	
3/31/2018	Total Suspended Solids (TSS)	End of Pipe	mg/L	3	
6/30/2018	Total Suspended Solids (TSS)	End of Pipe	mg/L	8	
9/30/2018	Total Suspended Solids (TSS)	End of Pipe	mg/L	3	
12/31/2018	Total Suspended Solids (TSS)	End of Pipe	mg/L	3	
3/31/2019	Total Suspended Solids (TSS)	End of Pipe	mg/L	3	
6/30/2019	Total Suspended Solids (TSS)	End of Pipe	mg/L	3	
9/30/2019	Total Suspended Solids (TSS)	End of Pipe	mg/L	3	
12/31/2019	Total Suspended Solids (TSS)	End of Pipe	mg/L	3	

APPENDIX D

CONVEYANCE SYSTEM PROCESS SCHEMATIC



C:\pwworking\central01\d0973820\EXHIBIT 3.dwg, Plot, 12/14/2020 2:50:56 PM, TGRAHAM

EXHIBIT 3.dwg
12/14/2020 2:50 PM
Graham, Tyler

BCRSD
Boone County Regional Sewer District

HDR

Process Schematic

Cedar Gate, Richardson Acres and Brown Station Wastewater Improvements

EXHIBIT
3

APPENDIX E

PUMP/FORCE MAIN DESIGN CALCULATIONS

Boone County Regional Sewer District
Cedar Gate
Pump Station & Force Main Design Calculations
8-Oct-20

	PVC 2241
Static Lift	
Gravity Invert Elevation Into the PS (ft)	900.00
Assumed Depth Below Gravity Invert (ft)	6.00
Pump Center Line Elevation (ft)	894.00
High Point Elevation	935.00
Pump Static Lift Requred (ft)	**41.00**
Length Of Pipe	
PS Station (ft)	0
Discharge Point Station (ft)	15300
Total Pipe Length (ft)	**15300**
Pipe Diameter	
Nominal (in)	3
Pipe Type PVC D2241 SDR 21 Inside Diameter (in)	3
Pipe Area (sf)	0.05
Flow at 5 ft/sec (cfs)	0.25
Flow at 5 ft/sec (gpm)	110.2
Flow at 2 ft/sec (cfs)	0.10
Flow at 2 ft/sec (gpm)	44.1
System Flow - From Facility Plan	
Number of Future Residences	0
Number of Existing Residences	0
Total Residences in 20 Years	0
Future Flow at 3.7 capita/home and 100 gpd	0
Existing Flow at 3.7 capita/home and 100 gpd	0
Total Flow gpd	12200
Average Day Flow (gpm)	**8.5**
Peak Hour Flow (PF = 4 x Avg Day) gpm	**33.9**
Pump Head	
Hazen Williams Friction Coefficient New	150
Hazen Williams Friction Coefficient (20 Yrs)	130
Friction Head Calculation (C=150)	48.6
Friction Head Calculation (C=130)	63.4
Friction Head + Static Lift (C=150)	**89.6**
Friction Head + Static Lift (C=130)	**104.4**
Wetwell Size	
Diameter (ft)	6
Area (sf)	28.27
Water Depth (ft)	5
Volume (cf)	141.4
Volume (gallons)	1057.5
Detention Time Calculations	
Existing Avg Flow (gal/day)	12200
Volume of Forcemain (cf)	751
Volume of Forcemain (gal)	5618
Number of Changes/ day	2.17
Retention Time (hours)	11.05
More than 6 hours - Odor Control Required.	
Pump Operation - Future Conditions	
Average Day Flow Future (gpm)	8.5
Time to Fill Manhole (min)	124.81
Pump Design Flow (gpm)	33.9
Time to Drain Manhole (min)	34.0
Recommended Pump Design	
Flow = 34 gpm	
Head = 147 feet (104 + 43)	
Estimated Pump Horsepower at 50% Efficient(hp)	1.9

Boone County Regional Sewer District
Richardson Acres
Pump Station & Force Main Design Calculations
8-Oct-20

	PVC 2241
Static Lift	
Gravity Invert Elevation Into the PS (ft)	925.00
Assumed Depth Below Gravity Invert (ft)	6.00
Pump Center Line Elevation (ft)	919.00
High Point Elevation	930.00
Pump Static Lift Requred (ft)	**11.00**
Length Of Pipe	
PS Station (ft)	0
Discharge Point Station (ft)	1000
Total Pipe Length (ft)	**1000**
Pipe Diameter	
Nominal (in)	2
Pipe Type PVC D2241 SDR 21 Inside Diameter (in)	2
Pipe Area (sf)	0.02
Flow at 5 ft/sec (cfs)	0.11
Flow at 5 ft/sec (gpm)	49.0
Flow at 2 ft/sec (cfs)	0.04
Flow at 2 ft/sec (gpm)	19.6
System Flow - From Facility Plan	
Number of Future Residences	0
Number of Existing Residences	0
Total Residences in 20 Years	0
Future Flow at 3.7 capita/home and 100 gpd	0
Existing Flow at 3.7 capita/home and 100 gpd	0
Total Flow gpd	8500
Average Day Flow (gpm)	**5.9**
Peak Hour Flow (PF = 4 x Avg Day) gpm	**23.6**
Pump Head	
Hazen Williams Friction Coefficient New	150
Hazen Williams Friction Coefficient (20 Yrs)	130
Friction Head Calculation (C=150)	11.7
Friction Head Calculation (C=130)	15.3
Friction Head + Static Lift (C=150)	**22.7**
Friction Head + Static Lift (C=130)	**26.3**
Manhole Size	
Diameter (ft)	6
Area (sf)	28.27
Water Depth (ft)	5
Volume (cf)	141.4
Volume (gallons)	1057.5
Detention Time Calculations	
Existing Avg Flow (gal/day)	8500
Volume of Forcemain (cf)	22
Volume of Forcemain (gal)	163
Number of Changes/ day	52.09
Retention Time (hours)	0.46
Less than 6 hours - Odor Control Not Required.	
Pump Operation - Future Conditions	
Average Day Flow Future (gpm)	5.9
Time to Fill Manhole (min)	179.15
Pump Design Flow (gpm)	23.6
Time to Drain Manhole (min)	47.5
Recommended Pump Design	
Flow = 24 gpm	
Head = 69 feet (26 + 43)	
Estimated Pump Horsepower at 50% Efficient(hp)	0.6

Boone County Regional Sewer District
Brown Station Booster Pump Station
Pump Station & Force Main Design Calculations
8-Oct-20

	PVC 2241
Static Lift	
Gravity Invert Elevation Into the PS (ft)	920.00
Assumed Depth Below Gravity Invert (ft)	6.00
Pump Center Line Elevation (ft)	914.00
High Point Elevation	925.00
Pump Static Lift Requred (ft)	**11.00**
Length Of Pipe	
PS Station (ft)	0
Discharge Point Station (ft)	23200
Total Pipe Length (ft)	**23200**
Pipe Diameter	
Nominal (in)	6
Pipe Type PVC D2241 SDR 21 Inside Diameter (in)	6
Pipe Area (sf)	0.20
Flow at 5 ft/sec (cfs)	0.98
Flow at 5 ft/sec (gpm)	440.6
Flow at 2 ft/sec (cfs)	0.39
Flow at 2 ft/sec (gpm)	176.2
System Flow - From Facility Plan	
Number of Future Residences	0
Number of Existing Residences	0
Total Residences in 20 Years	0
Future Flow at 3.7 capita/home and 100 gpd	0
Existing Flow at 3.7 capita/home and 100 gpd	0
Total Flow gpd	91500
Average Day Flow (gpm)	**63.5**
Peak Hour Flow (PF = 4 x Avg Day) gpm	**254.2**
Pump Head	
Hazen Williams Friction Coefficient New	150
Hazen Williams Friction Coefficient (20 Yrs)	130
Friction Head Calculation (C=150)	105.1
Friction Head Calculation (C=130)	137.0
Friction Head + Static Lift (C=150)	**116.1**
Friction Head + Static Lift (C=130)	**148.0**
Manhole Size	
Diameter (ft)	6
Area (sf)	28.27
Water Depth (ft)	5
Volume (cf)	141.4
Volume (gallons)	1057.5
Detention Time Calculations	
Existing Avg Flow (gal/day)	91500
Volume of Forcemain (cf)	4555
Volume of Forcemain (gal)	34074
Number of Changes/ day	2.69
Retention Time (hours)	8.94
More than 6 hours - Odor Control Required.	
Pump Operation - Future Conditions	
Average Day Flow Future (gpm)	63.5
Time to Fill Manhole (min)	16.64
Pump Design Flow (gpm)	254.2
Time to Drain Manhole (min)	6.9
Recommended Pump Design	
Flow = 254 gpm	
Head = 148 feet	
Estimated Pump Horsepower at 50% Efficient(hp)	14.3

APPENDIX F

TYPICAL PUMP STATION SITE PLAN

TYPICAL PUMP STATION PLAN AND SECTION

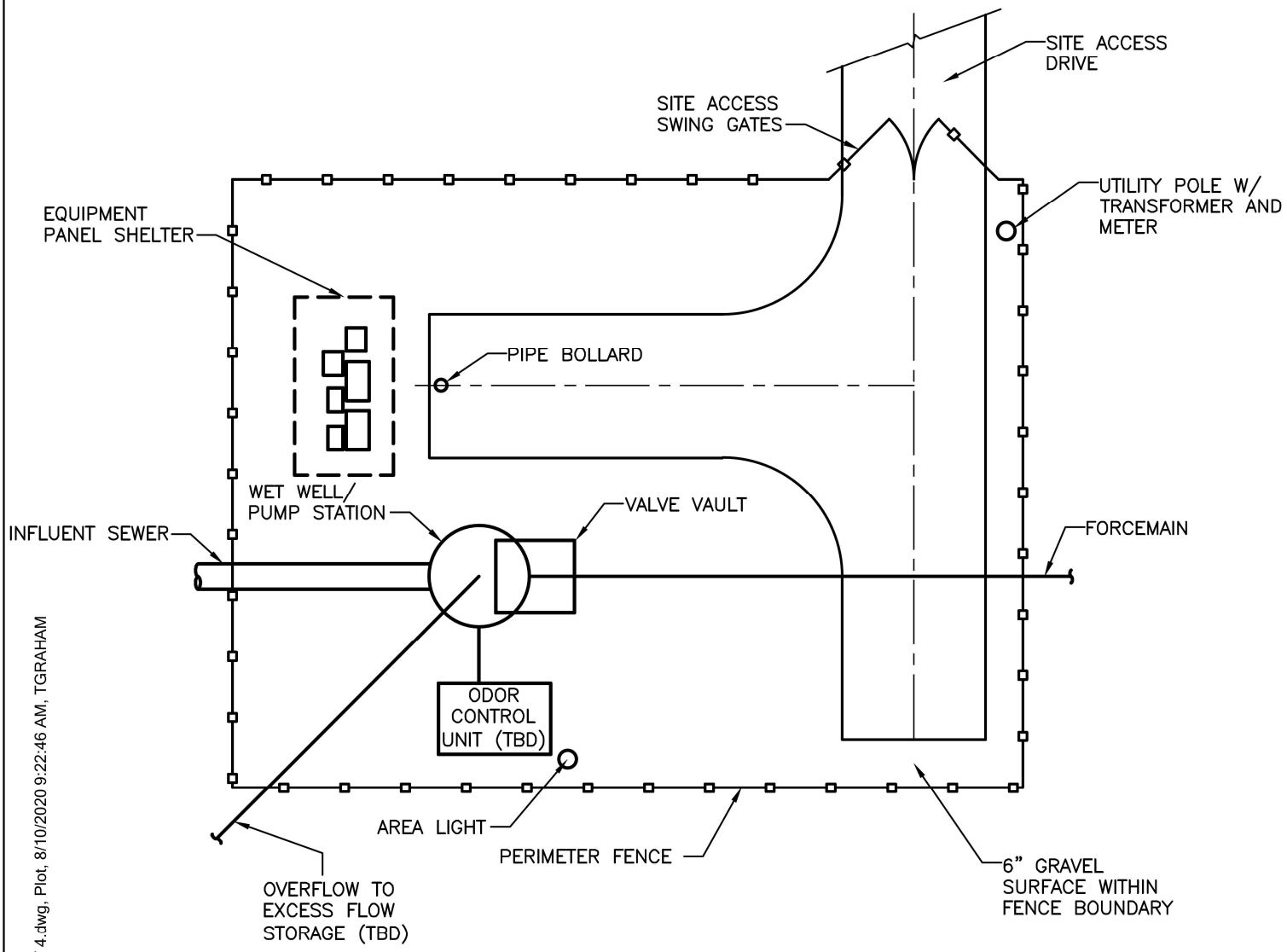


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EXHIBIT 4.dwg
8/10/2020 9:22 AM
Graham, Tyler

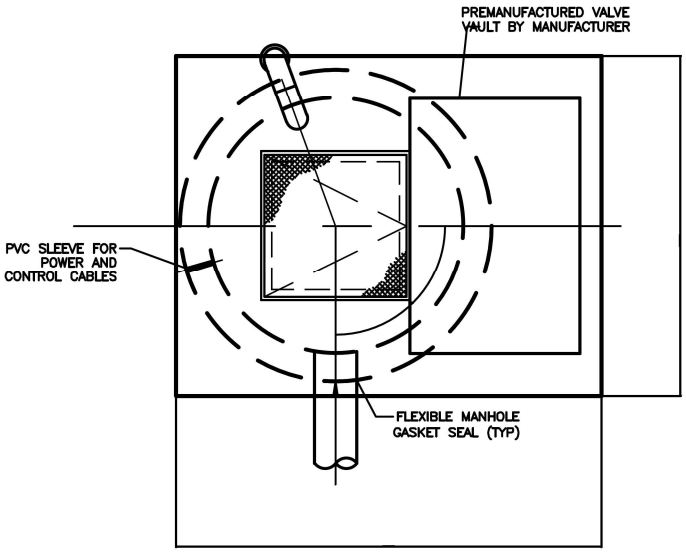
BCRSD
Boone County Regional Sewer District

HDR

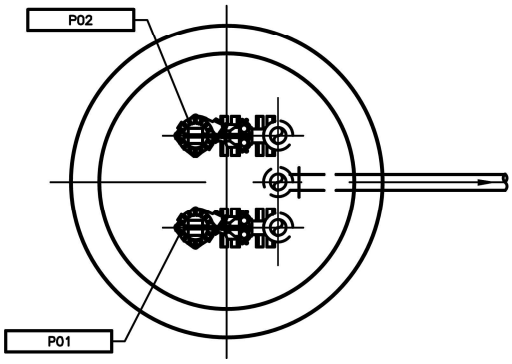
Typical Pump Station Site Plan

Cedar Gate, Richardson Acres and Brown Station Wastewater Improvements

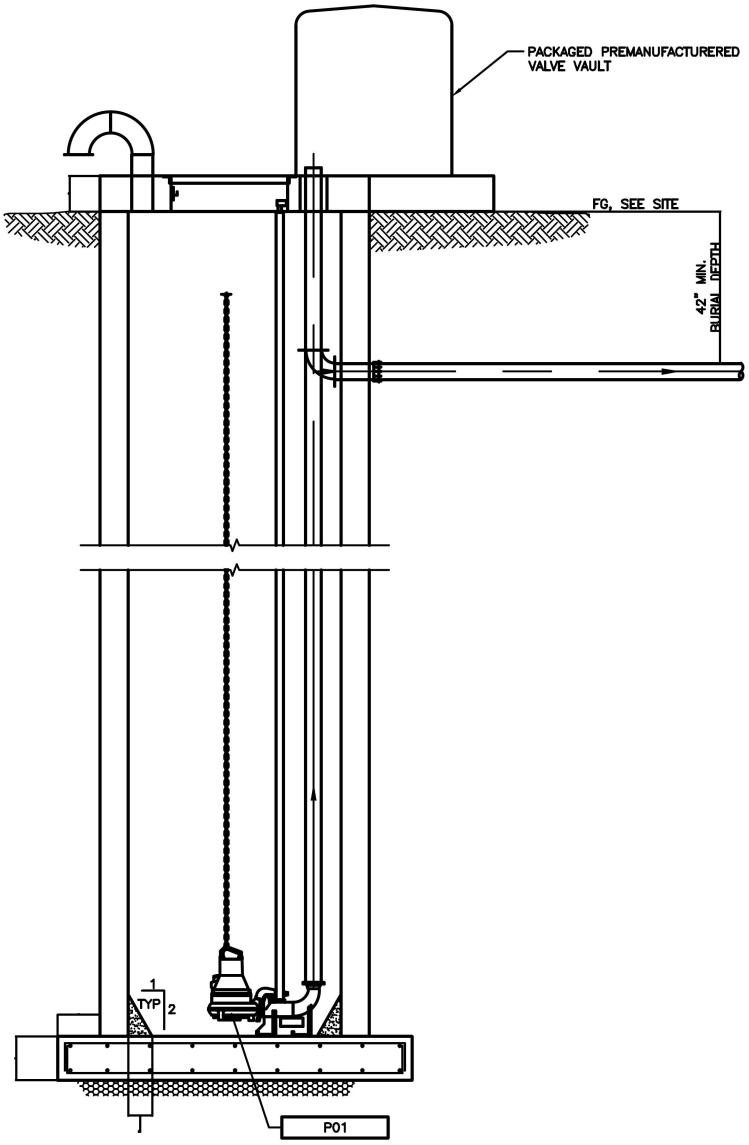
EXHIBIT
4



TYPICAL PUMP STATION – UPPER PLAN



TYPICAL PUMP STATION – LOWER PLAN



SECTION

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EXHIBIT 6.dwg
8/10/2020 9:26 AM
Graham, Tyler

BCRSD
Boone County Regional Sewer District

HDR

Typical Pump Station Plan and Sections

Cedar Gate, Richardson Acres and Brown Station Wastewater Improvements

EXHIBIT
6

APPENDIX G

PROJECT COST ESTIMATE

OPERATIONS AND MAINTENANCE COST ESTIMATE

ALTERNATIVE NO. 2

Base Year for cost Estimate	**2020**
First Year of Service	**2022**
Mid-Point of Construction	**2021**

Item		Base Year Cost	Mid-Point of Construction	First Year of Service																		
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Total, Project Costs		$925,100	$953,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NPV of Capital Cost at Base Year[1]			$916,346	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total NPV of Capital Costs[1]		*$916,000*																					
R&R		$7,823	-	$7,823	$7,823	$7,823	$7,823	$7,823	$7,823	$7,823	$7,823	$7,823	$7,823	$7,823	$7,823	$7,823	$7,823	$7,823	$7,823	$7,823	$7,823	$7,823	$7,823
Labor		$10,400	-	$11,033	$11,364	$11,705	$12,056	$12,418	$12,791	$13,174	$13,570	$13,977	$14,396	$14,828	$15,273	$15,731	$16,203	$16,689	$17,190	$17,705	$18,236	$18,784	$19,347
Electricity		$2,991	-	$3,173	$3,268	$3,366	$3,467	$3,571	$3,678	$3,789	$3,902	$4,019	$4,140	$4,264	$4,392	$4,524	$4,660	$4,799	$4,943	$5,092	$5,244	$5,402	$5,564
Total, O&M Costs		$21,214		$22,029	$22,456	$22,895	$23,347	$23,812	$24,292	$24,786	$25,295	$25,819	$26,359	$26,915	$27,488	$28,078	$28,686	$29,311	$29,956	$30,620	$31,304	$32,008	$32,734
NPV of O&M Cost at Base Year				$20,367	$19,963	$19,570	$19,189	$18,819	$18,460	$18,111	$17,772	$17,443	$17,122	$16,811	$16,509	$16,214	$15,928	$15,650	$15,379	$15,115	$14,858	$14,608	$14,365
Total NPV of O&M Costs		*$342,000*																					

NPV Summary

Capital Cost	$916,000
O&M	$342,000
Total NPV	***$1,258,000***

Economic Assumptions

Capital Escalation (Inflation) Rate	3.00%
O&M Escalation (Inflation) Rate	3.00%
Annual Interest (Discount) Rate	4.35%

Notes:

Base Year for cost Estimate	2020
First Year of Service	2022
Mid-Point of Construction	2021

Item		Base Year Cost	Mid-Point of Construction	First Year of Service																			
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Total, Project Costs		$1,340,000	$1,380,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NPV of Capital Cost at Base Year[1]			$1,326,923	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total NPV of Capital Costs[1]		*$1,327,000*																					
R&R		$7,387	-	$7,387	$7,387	$7,387	$7,387	$7,387	$7,387	$7,387	$7,387	$7,387	$7,387	$7,387	$7,387	$7,387	$7,387	$7,387	$7,387	$7,387	$7,387	$7,387	$7,387
Labor		$10,400	-	$11,033	$11,364	$11,705	$12,056	$12,418	$12,791	$13,174	$13,570	$13,977	$14,396	$14,828	$15,273	$15,731	$16,203	$16,689	$17,190	$17,705	$18,236	$18,784	$19,347
Electricity		$4,606	-	$4,887	$5,034	$5,185	$5,340	$5,500	$5,665	$5,835	$6,010	$6,191	$6,376	$6,568	$6,765	$6,968	$7,177	$7,392	$7,614	$7,842	$8,077	$8,320	$8,569
Total, O&M Costs		$22,394		$23,308	$23,785	$24,277	$24,784	$25,305	$25,843	$26,397	$26,967	$27,555	$28,160	$28,783	$29,425	$30,086	$30,767	$31,468	$32,191	$32,935	$33,701	$34,491	$35,304
NPV of O&M Cost at Base Year				$21,549	$21,145	$20,752	$20,371	$20,000	$19,639	$19,288	$18,947	$18,615	$18,292	$17,978	$17,672	$17,374	$17,084	$16,801	$16,529	$16,268	$15,996	$15,741	$15,492
Total NPV of O&M Costs		*$366,000*																					

NPV Summary

Capital Cost	$1,327,000
O&M	$366,000
Total NPV	***$1,693,000***

Economic Assumptions

Capital Escalation (Inflation) Rate	3.00%
O&M Escalation (Inflation) Rate	3.00%
Annual Interest (Discount) Rate	4.00%

Notes:

Base Year for cost Estimate 2020
First Year of Service 2022
Mid-Point of Construction 2021

Item		Base Year Cost	Mid-Point of Construction	First Year of Service																		
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Total Project Costs		$652,000	$672,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NPV of Capital Cost at Base Year[1]			$646,154	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total NPV of Capital Costs[1]		*$646,000*																					
R&R		$4,008	-	$4,008	$4,008	$4,008	$4,008	$4,008	$4,008	$4,008	$4,008	$4,008	$4,008	$4,008	$4,008	$4,008	$4,008	$4,008	$4,008	$4,008	$4,008	$4,008	$4,008
Labor		$10,400	-	$11,033	$11,364	$11,705	$12,056	$12,418	$12,791	$13,174	$13,570	$13,977	$14,396	$14,828	$15,273	$15,731	$16,203	$16,689	$17,190	$17,705	$18,236	$18,784	$19,347
Electricity		$4,606	-	$4,887	$5,034	$5,185	$5,340	$5,500	$5,665	$5,835	$6,010	$6,191	$6,376	$6,568	$6,765	$6,968	$7,177	$7,392	$7,614	$7,842	$8,077	$8,320	$8,569
Total O&M Costs		$19,015		$19,928	$20,406	$20,898	$21,405	$21,927	$22,464	$23,018	$23,588	$24,175	$24,780	$25,404	$26,046	$26,707	$27,388	$28,089	$28,811	$29,556	$30,322	$31,111	$31,924
NPV of O&M Cost at Base Year				$18,425	$18,141	$17,864	$17,593	$17,329	$17,071	$16,819	$16,573	$16,332	$16,097	$15,867	$15,642	$15,422	$15,207	$14,997	$14,791	$14,589	$14,392	$14,199	$14,010
Total NPV of O&M Costs		*$321,000*																					

NPV Summary

Capital Cost	$646,000
O&M	$321,000
Total NPV	***$967,000***

Economic Assumptions

Capital Escalation (Inflation) Rate	0.00%
O&M Escalation (Inflation) Rate	2.90%
Annual Interest (Discount) Rate	4.90%

Notes:

BOONE COUNTY REGIONAL SEWER DISTRICT
ALTERNATIVE #2 - CEDAR GATE WWTF IMPROVEMENTS
ENGINEER'S OPINION OF PROJECT COSTS
10/8/2020

Item Description	Est. Qty.	Unit	Unit Price	Extension
Intermediate Pump Station				
Excavation/Backfill	148	CY	$25	$3,698
Granular Bedding	1	CY	$50	$52
Package Pump Station	1	LS	$49,500	$49,500
Pump Controls	1	LS	$10,000	$10,000
Installation / Start-Up	50%			$31,625
Tertiary Nitrification				
Excavation/Backfill	86	CY	$25	$2,139
Granular Bedding	6	CY	$50	$286
Concrete Basins	51	CY	$1,500	$75,825
NitrOx System	1	LS	$117,500	$117,500
Installation / Start-Up	35%			$68,513
UV Disinfection				
Excavation/Backfill	3	CY	$25	$78
Granular Bedding	2	CY	$50	$89
Base Slab	2	CY	$1,000	$1,778
UV System	1	LS	$41,250	$41,250
Installation / Start-Up	35%			$15,118
SUBTOTAL				**$417,500**
Site Piping and Site Civil	15%			$62,625
Electrical and I&C	10%			$42,000
SUBTOTAL				**$522,100**
Contractor Items				
Mobilization	2%			$11,000
Bonding and Insurance	3%			$16,000
General Conditions, OH&P	10%			$55,000
SUBTOTAL				**$604,100**
Contingency	25%			$152,000
SUBTOTAL				**$756,100**
SRF Closing Costs	2%			$16,000
Engineering, Legal, and Administration	20%			$152,000
Temporary Easement (3)	1	AC	$1,000.00	$1,000
TOTAL PROJECT				**$925,100**
Notes:				
1. Assumes no rock excavation				
2. Assumes portable generator cost included in Richardson Acres cost.				

3. Assume temporary easement required for site staging and construction.

BOONE COUNTY REGIONAL SEWER DISTRICT
ALTERNATIVE #2 - RICHARDSON ACRES WWTF IMPROVEMENTS
ENGINEER'S OPINION OF PROJECT COSTS
10/8/2020

Item Description	Est. Qty.	Unit	Unit Price	Extension
Intermediate Pump Station				
Excavation/Backfill	150	CY	$25	$3,750
Granular Bedding	2	CY	$50	$100
Package Pump Station	1	LS	$48,000	$48,000
Pump Controls	1	LS	$10,000	$10,000
Installation / Start-Up	50%			$30,925
Tertiary Nitrification				
Excavation/Backfill	2,500	CY	$30	$75,000
SAGR (Nitrification Equipment, Including Blowers)	1	LS	$150,000	$150,000
Uniform Graded Clean Rock	960	CY	$35	$33,600
Insulating Woodchips	80	CY	$10	$800
Non-Woven Geotextile (8oz)	11,800	SF	$0.15	$1,800
HDPE Liner (60 mil)	7,840	SF	$1.50	$11,800
Wall Framing and Sheating	470	LF	$13	$6,200
Influent Flow Splitter Structure	1	EA	$5,000	$5,000
Piping, Fittings, Valves from Splitter to SAGR	1	LS	$10,000	$10,000
Effluent Level Control Manhole	2	EA	$5,000	$10,000
Installation / Start-Up [3]	40%			$121,680
UV Disinfection				
Excavation/Backfill	4	CY	$25	$100
Granular Bedding	2	CY	$50	$100
Base Slab	2	CY	$1,000	$2,000
UV System	1	LS	$40,500	$40,500
Installation / Start-Up	35%			$14,945
SUBTOTAL				**$576,300**
Site Piping and Site Civil	15%			$86,445
Portable Generator	1	EA	$36,000	$36,000
Electrical and I&C	10%			$57,630
SUBTOTAL				**$756,400**
Contractor Items				
Mobilization	2%			$16,000
Bonding and Insurance	3%			$24,000
General Conditions, OH&P	10%			$80,000

Item Description	Est. Qty.	Unit	Unit Price	Extension
SUBTOTAL				**$876,400**
Contingency	25%			$219,100
SUBTOTAL				**$1,095,500**
SRF Closing Costs	2%			$22,000
Engineering, Legal, and Administration	20%			$220,000
Temporary Easement [2]	1	AC	$2,500	$2,500
TOTAL PROJECT				**$1,340,000**
Notes:				
1. Assumes no rock excavation.				
2. Assume temporary easement required for site staging and construction.				
3. Utilizd 40% SAGR installation due to high anticipated labor requirement.				

BOONE COUNTY REGIONAL SEWER DISTRICT
ALTERNATIVE #2 - BROWN STATION WWTF IMPROVEMENTS
ENGINEER'S OPINION OF PROJECT COSTS
10/8/2020

Item Description	Est. Qty.	Unit	Unit Price	Extension
Intermediate Pump Station				
Excavation/Backfill	150	CY	$25	$3,750
Granular Bedding	2	EA	$50	$100
Package Pump Station	1	LS	$46,500	$46,500
Pump Controls	1	LS	$10,000	$10,000
Installation / Start-Up	50%	LS		$30,175
Tertiary Nitrification				
Excavation/Backfill	710	CY	$30	$21,300
SAGR (Nitrification Equipment, Including Blowers)	1	LS	$42,200	$42,200
Uniform Graded Clean Rock	270	CY	$35	$9,500
Insulating Woodchips	30	CY	$10	$300
Non-Woven Geotextile (8oz)	3,320	SF	$0.15	$500
HDPE Liner (60 mil)	2,210	SF	$1.50	$3,400
Wall Framing and Sheating	140	LF	$13	$1,900
Influent Flow Splitter Structure	1	EA	$5,000	$5,000
Piping, Fittings, Valves from Splitter to SAGR	1	LS	$10,000	$10,000
Effluent Level Control Manhole	2	EA	$5,000	$10,000
Installation / Start-Up [3]	40%			$41,640
UV Disinfection				
Excavation/Backfill	4	CY	$25	$100
Granular Bedding	2	CY	$50	$100
Base Slab	2	CY	$1,000	$2,000
UV System	1	LS	$39,750	$39,750
Installation / Start-Up	35%			$14,683
SUBTOTAL				**$292,900**
Site Piping and Site Civil	15%			$43,935
Electrical and I&C	10%			$29,290
SUBTOTAL				**$366,200**

Item Description	Est. Qty.	Unit	Unit Price	Extension
Contractor Items				
Mobilization	2%			$8,000
Bonding and Insurance	3%			$12,000
General Conditions, OH&P	10%			$39,000
SUBTOTAL				**$425,200**
Contingency	25%			$106,300
SUBTOTAL				**$531,500**
SRF Closing Costs	2%			$11,000
Engineering, Legal, and Administration	20%			$107,000
Temporary Easement [2]	1	AC	$2,500	$2,500
TOTAL PROJECT				**$652,000**
Notes:				
1. Assumes no rock excavation.				
2. Assume temporary easement required for site staging and construction.				
3. Utilizd 40% SAGR installation due to high anticipated labor requirement.				
4. Assumes portable generator cost included in Richardson Acres cost.				

BOONE COUNTY REGIONAL SEWER DISTRICT
CEDAR GATE WWTF IMPROVEMENTS
OPERATIONS AND MAINTENANCE COST ESTIMATE - ALT 2 WWTF

Replacement Costs

Inflation Rate	3%	Assumed
Interest Rate	4%	Assumed

Today's Replacement Costs

Item	5 YR - 10%	10 YR - 50%	15 YR - 10%	20 YR - 75%	Original Cost
Intermediate Pumps	$2,063	$10,313	$2,063	$15,469	$20,625
NitrOx System	$5,850	$29,250	$5,850	$43,875	$58,500
UV Equipment	$2,000	$2,000	$2,000	$2,000	
Total	$9,913	$41,563	$9,913	$61,344	

Future Replacement Costs

(Adjusted w/ Inflation)	Present Value	5 YR 1.16	10 YR 1.34	15 YR 1.56	20 YR 1.81
5 Year Equipment Cycle	$9,913	$11,491			
10 Year Equipment Cycle	$41,563		$55,857		
15 Year Equipment Cycle	$9,913			$15,443	
20 Year Equipment Cycle	$61,344				$110,794
Total	$122,731	$11,491	$55,857	$15,443	$110,794

Replacement Acnt. Deposit — **Required**

(Includes Interest)

	Annual Factor	Annual Deposit	5 YR $11,491	10 YR $55,857	15 YR $15,443	20 YR $110,794
			Future Replacement Funds			
SFF - 5 yrs	0.1846	$2,122	$11,491	$11,491	$11,491	$11,491
SFF - 10 yrs	0.0833	$3,695		$44,365	$20,015	$20,015
SFF - 15 yrs	0.0499	($802)			($16,062)	($4,345)
SFF - 20 yrs	0.0336	$2,809				$83,633
Total			$11,491	$55,857	$15,443	$110,794

Estimated Annual Replacement Costs — **Deposit** — **$7,823**

Labor Costs

Component	Days Per Week	Hours Per Day	Personnel	Rate	Overhead / Fringe	Cost
Daily Operator Attention	5	1.0	1	$25.00	$15.00	$10,400

Estimated Annual Labor Costs — **$10,400**

Electricity Usage Costs (Design Year)

Component	HP	Quantity	Total HP	Watts	Hours/day	kW-hrs/year
Intermediate Pumps	2.0	1	2	1,491	8	4,355
Nitrox System						
Nitrox Aeration Blowers	2.0	1	2	1,491	16	8,710
Nitrox Heating (Based on 1°C for 2 months and 3°C for 2 months Influ	-	-	-	-	-	17,611
UV Equipment	-	2	-	250	24	2,190
					kW-hrs/year =	32,866
					$/kW-hrs =	$0.09

Estimated Additional Annual Electricity Usage Costs (Design Year, Not Adjusted For Inflation) — **$2,991**

TOTAL — **$21,214**

BOONE COUNTY REGIONAL SEWER DISTRICT
RICHARDSON ACRES WWTF IMPROVEMENTS
OPERATIONS AND MAINTENANCE COST ESTIMATE - ALT 2 WWTF

Replacement Costs

Inflation Rate	3%	Assumed
Interest Rate	4%	Assumed

Today's Replacement Costs

Item	5 YR - 10%	10 YR - 50%	15 YR - 10%	20 YR - 75%	Original Cost
Intermediate Pumps	$2,000	$10,000	$2,000	$15,000	$20,000
SAGR - Aeration	$6,500	$6,500	$6,500	$6,500	
SAGR - Media	$0	$0	$0	$0	
Sand Filter Equipment					
UV Equipment	$2,000	$2,000	$2,000	$2,000	
Portable Standy Generator	$3,600	$18,000	$3,600	$27,000	$36,000
Total	$14,100	$36,500	$14,100	$50,500	

Future Replacement Costs
(Adjusted w/ Inflation)

	Present Value	5 YR 1.16	10 YR 1.34	15 YR 1.56	20 YR 1.81
5 Year Equipment Cycle	$14,100	$16,346			
10 Year Equipment Cycle	$36,500		$49,053		
15 Year Equipment Cycle	$14,100			$21,967	
20 Year Equipment Cycle	$50,500				$91,209
Total	$115,200	$16,346	$49,053	$21,967	$91,209

Replacement Acnt. Deposit **Required**
(Includes Interest)

	Annual Factor	Annual Deposit	5 YR $16,346	10 YR $49,053	15 YR $21,967	20 YR $91,209
			Future Replacement Funds			
SFF - 5 yrs	0.1846	$3,018	$16,346	$16,346	$16,346	$16,346
SFF - 10 yrs	0.0833	$2,724		$32,707	$14,755	$14,755
SFF - 15 yrs	0.0499	($456)			($9,134)	($2,471)
SFF - 20 yrs	0.0336	$2,101				$62,578
Total			$16,346	$49,053	$21,967	$91,209

Estimated Annual Replacement Costs **Deposit** **$7,387**

Labor Costs

Component	Days Per Week	Hours Per Day	Personnel	Rate	Overhead / Fringe	Cost
Daily Operator Attention	5	1.0	1	$25.00	$15.00	$10,400

Estimated Annual Labor Costs **$10,400**

Electricity Usage Costs (Design Year)

Component	HP	Quantity	Total HP	Watts	Hours/day	kW-hrs/year
Intermediate Pumps	2.0	2	4	2,983	8	8,710
SAGR Aeration Blowers	7.5	1	7.5	5,593	24	48,992
UV Equipment		1		250	24	2,190
					kW-hrs/year =	51,182
					$/kW-hrs =	$0.09

Estimated Additional Annual Electricity Usage Costs (Design Year, Not Adjusted For Inflation) **$4,606**

TOTAL **$22,394**

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BOONE COUNTY REGIONAL SEWER DISTRICT
BROWN STATION WWTF IMPROVEMENTS
OPERATIONS AND MAINTENANCE COST ESTIMATE - ALT 2 WWTF

Replacement Costs

Inflation Rate	3%	Assumed
Interest Rate	4%	Assumed

Today's Replacement Costs

Item	5 YR - 10%	10 YR - 50%	15 YR - 10%	20 YR - 75%	Original Cost
Intermediate Pumps	$1,938	$9,688	$1,938	$14,531	$19,375
SAGR - Aeration	$6,500	$6,500	$6,500	$6,500	
SAGR - Media	$0	$0	$0	$0	
Sand Filter Equipment					
UV Equipment	$2,000	$2,000	$2,000	$2,000	
Total	$10,438	$18,188	$10,438	$23,031	

Future Replacement Costs
(Adjusted w/ Inflation)

	Present Value	5 YR 1.16	10 YR 1.34	15 YR 1.56	20 YR 1.81
5 Year Equipment Cycle	$10,438	$12,100			
10 Year Equipment Cycle	$18,188		$24,442		
15 Year Equipment Cycle	$10,438			$16,261	
20 Year Equipment Cycle	$23,031				$41,597
Total	$62,094	$12,100	$24,442	$16,261	$41,597

Replacement Acnt. Deposit **Required**
(Includes Interest)

			5 YR $12,100	10 YR $24,442	15 YR $16,261	20 YR $41,597
	Annual Factor	Annual Deposit	Future Replacement Funds			
SFF - 5 yrs	0.1846	$2,234	$12,100	$12,100	$12,100	$12,100
SFF - 10 yrs	0.0833	$1,028		$12,343	$5,568	$5,568
SFF - 15 yrs	0.0499	($70)			($1,407)	($381)
SFF - 20 yrs	0.0336	$816				$24,309
Total			$12,100	$24,442	$16,261	$41,597

Estimated Annual Replacement Costs **Deposit** **$4,008**

Labor Costs

Component	Days Per Week	Hours Per Day	Personnel	Rate	Overhead / Fringe	Cost
Daily Operator Attention	5	1.0	1	$25.00	$15.00	$10,400

Estimated Annual Labor Costs **$10,400**

Electricity Usage Costs (Design Year)

Component	HP	Quantity	Total HP	Watts	Hours/day	kW-hrs/year
Intermediate Pumps	2.0	2	4	2,983	8	8,710
SAGR Aeration	7.5	1	7.5	5,593	24	48,992
UV Equipment		1		250	24	2,190
					kW-hrs/year =	51,182
					$/kW-hrs =	$0.09

Estimated Additional Annual Electricity Usage Costs (Design Year, Not Adjusted For Inflation) **$4,606**

TOTAL **$19,015**

ALTERNATIVE NO. 3

Base Year for cost Estimate	2020
First Year of Service	2022
Mid-Point of Construction	2021

Item		Base Year Cost	Mid-Point of Construction	First Year of Service																			
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Total Project Costs		$3,535,000	$3,641,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NPV of Capital Cost at Base Year[1]			$3,500,962	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total NPV of Capital Costs[1]		*$3,501,000*																					
R&R		$13,680	-	$13,680	$13,680	$13,680	$13,680	$13,680	$13,680	$13,680	$13,680	$13,680	$13,680	$13,680	$13,680	$13,680	$13,680	$13,680	$13,680	$13,680	$13,680	$13,680	$13,680
Labor		$12,480	-	$13,240	$13,637	$14,046	$14,468	$14,902	$15,349	$15,809	$16,284	$16,772	$17,275	$17,793	$18,327	$18,877	$19,443	$20,027	$20,628	$21,246	$21,884	$22,540	$23,216
Chemical		$5,400	-	$5,729	$5,901	$6,078	$6,260	$6,448	$6,641	$6,841	$7,046	$7,257	$7,475	$7,699	$7,930	$8,168	$8,413	$8,665	$8,925	$9,193	$9,469	$9,753	$10,046
Electricity		$5,880	-	$6,238	$6,425	$6,618	$6,817	$7,021	$7,232	$7,449	$7,672	$7,902	$8,139	$8,383	$8,635	$8,894	$9,161	$9,436	$9,719	$10,010	$10,311	$10,620	$10,939
Total O&M Costs		$37,440		$38,887	$39,643	$40,422	$41,224	$42,051	$42,902	$43,778	$44,681	$45,611	$46,569	$47,556	$48,572	$49,619	$50,697	$51,808	$52,952	$54,130	$55,343	$56,593	$57,881
NPV of O&M Cost at Base Year				$35,953	$35,243	$34,553	$33,883	$33,233	$32,602	$31,988	$31,393	$30,813	$30,251	$29,703	$29,171	$28,654	$28,150	$27,661	$27,184	$26,720	$26,268	$25,828	$25,400
Total NPV of O&M Costs		*$605,000*																					

NPV Summary

Project Cost	$3,501,000
O&M	$605,000
Total NPV	***$4,106,000***

Economic Assumptions

Capital Escalation (Inflation) Rate	3.00%
O&M Escalation (Inflation) Rate	3.00%
Annual Interest (Discount) Rate	4.80%

Notes:

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AMENDMENT 1 - RICHARDSON ACRES AND BROWN STATION WASTEWATER IMPROVEMENTS
BOONE COUNTY REGIONAL SEWER DISTRICT
ESTIMATE OF COST
OCTOBER 8, 2020

				Estimate of Cost	
Item No.	Item Description	Est. Qty.	Unit	Unit Price	Extension
1	Mobilization	1	LS	$80,000.00	$80,000.00
2	2 IN Force Main	1000	LF	$11.00	$11,000.00
3	3 IN Force Main	15300	LF	$14.00	$214,200.00
4	4 IN Force Main	29300	LF	$8.00	$234,400.00
5	6 IN Force Main	22200	LF	$21.00	$466,200.00
6	2 IN Combination Air Release/Vacuum Valve	22	EA	$4,800.00	$105,600.00
7	12 IN Horizontal Directional Drilling	300	LF	$170.00	$51,000.00
	CEDAR GATE PUMP STATION				
8	Submersable Non-Clog Pumps	0	LS	$40,000.00	$0.00
9	Submersable Grinder Pumps	1	LS	$25,000.00	$25,000.00
10	Odor Control Facility	0	LS	$90,000.00	$0.00
11	Pump Station (Excluding Submersible Pumps)	1	LS	$180,000.00	$180,000.00
12	Lagoon Fill Material	100	CY	$25.00	$2,500.00
13	Sludge Removal	1	LS	$50,000.00	$50,000.00
14	Wastewater Treatment Facility Closure	1	LS	$10,000.00	$10,000.00
	RICHARDSON ACRES PUMP STATION				
15	Submersable Non-Clog Pumps	0	LS	$40,000.00	$0.00
16	Submersable Grinder Pumps	1	LS	$25,000.00	$25,000.00
17	Odor Control Facility	0	LS	$90,000.00	$0.00
18	Pump Station (Excluding Submersible Pumps)	1	LS	$180,000.00	$180,000.00
19	Lagoon Fill Material	200	CY	$25.00	$5,000.00
20	Sludge Removal	1	LS	$50,000.00	$50,000.00
21	Wastewater Treatment Facility Closure	1	LS	$10,000.00	$10,000.00
	BOOSTER PUMP STATION AT BROWN STATION				
22	Submersable Non-Clog Pumps	1	LS	$40,000.00	$40,000.00
23	Submersable Grinder Pumps	0	LS	$25,000.00	$0.00
24	Odor Control Facility	1	LS	$90,000.00	$90,000.00
25	Pump Station (Excluding Submersible Pumps)	1	LS	$180,000.00	$180,000.00
26	Underground Pipe Storage	100	LF	$300.00	$30,000.00
27	Lagoon Fill Material	0	CY	$25.00	$0.00
28	Sludge Removal	0	LS	$50,000.00	$0.00
29	Wastewater Treatment Facility Closure	1	LS	$15,000.00	$15,000.00
30	Erosion Control Fence	45000	LF	$2.20	$99,000.00
31	Seeding	45000	LF	$2.00	$90,000.00
	CONSTRUCTION SUBTOTAL				$2,243,900.00
	Contingency (25%)		LS		$560,975.00
	CONSTRUCTION TOTAL				$2,804,875.00
	Easements		LS		$113,000.00
	SRF Closing Costs (2%)		LS		$56,097.50
	Engineering, Legal, Administration (20%)		LS		$560,975.00
	PROJECT TOTAL				$3,534,947.50

BOONE COUNTY REGIONAL SEWER DISTRICT
CEDAR GATE PUMP STATION
OPERATIONS AND MAINTENANCE COST ESTIMATE
10/06/20

Replacement Costs

Inflation Rate	3%	Assumed
Interest Rate	4%	Assumed

Today's Replacement Costs

Item	5 YR - 10%	10 YR - 25%	15 YR - 10%	20 YR - 50%	Original Cost
Pumps	$6,000	$7,500	$6,000	$15,000	$30,000
Liquid Odor Control	$8,000	$0	$8,000	$0	$0
Portable Standy Generator	$7,200	$0	$7,200	$0	$0
Total	$21,200	$7,500	$21,200	$15,000	

Future Replacement Costs

(Adjusted w/ Inflation)	Present Value	5 YR 1.16	10 YR 1.34	15 YR 1.56	20 YR 1.81	
5 Year Equipment Cycle	$21,200	$24,577				
10 Year Equipment Cycle	$7,500		$10,079			
15 Year Equipment Cycle	$21,200			$33,029		
20 Year Equipment Cycle	$15,000				$27,092	
Total	$64,900	$24,577	$10,079	$33,029	$27,092	

Replacement Acnt. Deposit

(Includes Interest)	Required Annual Factor	Annual Deposit	5 YR $24,577	10 YR $10,079	15 YR $33,029	20 YR $27,092
			Future Replacement Funds			
SFF - 5 yrs	0.1846	$4,538	$24,577	$24,577	$24,577	$24,577
SFF - 10 yrs	0.0833	($1,207)		($14,497)	($6,540)	($6,540)
SFF - 15 yrs	0.0499	$749			$14,992	$4,055
SFF - 20 yrs	0.0336	$168				$5,000
Total			$24,577	$10,079	$33,029	$27,092

Estimated Annual Replacement Costs — **Deposit** **$4,247**

Chemical Costs

Component	Gallons Per Day	Gallons Per Year	Cost Per Gallon	Cost
Bioxide (Future)	0	0	$3.00	$0

Estimated Annual Chemcial Costs **$0**

Labor Costs

Component	Days Per Week	Hours Per Day	Personnel	Rate	Overhead / Fringe	Cost
Lift Stations Week Day Staff (Operator)	2	1	1	$25.00	$15.00	$4,160

Estimated Annual Labor Costs **$4,160**

Electricity Usage Costs (Design Year)

Component	HP	Quantity	Total HP	Watts	Hours/day	kW-hrs/year
Pumps	4.0	1	4	2,983	8	8,710
Liquid Odor Control	0	0	0	0	12	0
					kW-hrs/year =	8,710
					$/kW-hrs =	$0.09

Estimated Additional Annual Electricity Usage Costs (Design Year, Not Adjusted For Inflation) **$784**

TOTAL **$9,191**

BOONE COUNTY REGIONAL SEWER DISTRICT
RICHARDSON ACRES PUMP STATION
OPERATIONS AND MAINTENANCE COST ESTIMATE
10/06/20

Replacement Costs

Inflation Rate	3%	Assumed
Interest Rate	4%	Assumed

Today's Replacement Costs

Item	5 YR - 10%	10 YR - 25%	15 YR - 10%	20 YR - 50%	Original Cost
Pumps	$6,000	$7,500	$6,000	$15,000	$30,000
Liquid Odor Control	$8,000	$0	$8,000	$0	$0
Portable Standy Generator	$7,200	$0	$7,200	$0	$0
Total	$21,200	$7,500	$21,200	$15,000	

Future Replacement Costs

(Adjusted w/ Inflation)	Present Value	5 YR 1.16	10 YR 1.34	15 YR 1.56	20 YR 1.81
5 Year Equipment Cycle	$21,200	$24,577			
10 Year Equipment Cycle	$7,500		$10,079		
15 Year Equipment Cycle	$21,200			$33,029	
20 Year Equipment Cycle	$15,000				$27,092
Total	$64,900	$24,577	$10,079	$33,029	$27,092

Replacement Acnt. Deposit — **Required**

(Includes Interest)	Annual Factor	Annual Deposit	5 YR $24,577	10 YR $10,079	15 YR $33,029	20 YR $27,092
			Future Replacement Funds			
SFF - 5 yrs	0.1846	$4,538	$24,577	$24,577	$24,577	$24,577
SFF - 10 yrs	0.0833	($1,207)		($14,497)	($6,540)	($6,540)
SFF - 15 yrs	0.0499	$749			$14,992	$4,055
SFF - 20 yrs	0.0336	$168				$5,000
Total			$24,577	$10,079	$33,029	$27,092

Estimated Annual Replacement Costs — **Deposit** — **$4,247**

Chemical Costs

Component	Gallons Per Day	Gallons Per Year	Cost Per Gallon	Cost
Bioxide (Future)	0	0	$3.00	$0

Estimated Annual Chemcial Costs — **$0**

Labor Costs

Component	Days Per Week	Hours Per Day	Personnel	Rate	Overhead / Fringe	Cost
Lift Stations Week Day Staff (Operator)	2	1	1	$25.00	$15.00	$4,160

Estimated Annual Labor Costs — **$4,160**

Electricity Usage Costs (Design Year)

Component	HP	Quantity	Total HP	Watts	Hours/day	kW-hrs/year
Pumps	2.0	1	2	1,491	8	4,355
Liquid Odor Control	0	0	0	0	12	0
					kW-hrs/year =	4,355
					$/kW-hrs =	$0.09

Estimated Additional Annual Electricity Usage Costs (Design Year, Not Adjusted For Inflation) — **$392**

TOTAL — **$8,799**

BOONE COUNTY REGIONAL SEWER DISTRICT
BROWN STATION BOOSTER PUMP STATION
OPERATIONS AND MAINTENANCE COST ESTIMATE
10/06/20

Replacement Costs

Inflation Rate	3%	Assumed
Interest Rate	4%	Assumed

Today's Replacement Costs

Item	5 YR - 10%	10 YR - 25%	15 YR - 10%	20 YR - 50%	Original Cost
Pumps	$6,000	$10,000	$6,000	$20,000	$40,000
Liquid Odor Control	$8,000	$2,500	$8,000	$5,000	$10,000
Portable Standy Generator	$7,200	$0	$7,200	$0	$0
Total	$21,200	$12,500	$21,200	$25,000	

Future Replacement Costs

(Adjusted w/ Inflation)	Present Value	5 YR 1.16	10 YR 1.34	15 YR 1.56	20 YR 1.81
5 Year Equipment Cycle	$21,200	$24,577			
10 Year Equipment Cycle	$12,500		$16,799		
15 Year Equipment Cycle	$21,200			$33,029	
20 Year Equipment Cycle	$25,000				$45,153
Total	$79,900	$24,577	$16,799	$33,029	$45,153

Replacement Acnt. Deposit — **Required**

(Includes Interest)	Annual Factor	Annual Deposit	5 YR $24,577	10 YR $16,799	15 YR $33,029	20 YR $45,153
			Future Replacement Funds			
SFF - 5 yrs	0.1846	$4,538	$24,577	$24,577	$24,577	$24,577
SFF - 10 yrs	0.0833	($648)		($7,778)	($3,509)	($3,509)
SFF - 15 yrs	0.0499	$597			$11,961	$3,235
SFF - 20 yrs	0.0336	$700				$20,849
Total			$24,577	$16,799	$33,029	$45,153

Estimated Annual Replacement Costs — **Deposit** — **$5,187**

Chemical Costs

Component	Gallons Per Day	Gallons Per Year	Cost Per Gallon	Cost
Bioxide (Future)	5	1,800	$3.00	$5,400

Estimated Annual Chemcial Costs — **$5,400**

Labor Costs

Component	Days Per Week	Hours Per Day	Personnel	Rate	Overhead / Fringe	Cost
Lift Stations Week Day Staff (Operator)	2	1	1	$25.00	$15.00	$4,160

Estimated Annual Labor Costs — **$4,160**

Electricity Usage Costs (Design Year)

Component	HP	Quantity	Total HP	Watts	Hours/day	kW-hrs/year
Pumps	15.0	1	15	11,185	12	48,992
Liquid Odor Control	1	1	1	746	12	3,266
					kW-hrs/year =	52,259
					$/kW-hrs =	$0.09

Estimated Additional Annual Electricity Usage Costs (Design Year, Not Adjusted For Inflation) — **$4,703**

TOTAL — **$19,450**

APPENDIX H

2019 USER RATE STUDY

SANITARY SEWER USE REGULATIONS

2019 USER RATE STUDY

BOONE COUNTY REGIONAL SEWER DISTRICT
BOONE COUNTY, MO
ASSUMPTIONS FOR RATE STUDY
Prepared by Stephen M. Connelly, CPA, PC
July 31, 2019

1 *CUSTOMERS*

We assume an annual growth rate of customers at 0.5%, plus any additional customer acquisitions. Our customer base is billed customers from the billing report.

2 *USAGE*

We used a calculated 5 year average monthly usage from the billing reports as our base. This generally reflects less average usage as more conservation is realized and usage is trending downward over time.

3 *RATES*

Rates are derived based on the necessary levels to meet the state mandated 1.10 debt service coverage ratio, cash requirements and other various assumptions regarding expenses.

4 *DEBT*

Debt is a function of the Capital Improvement Plan funding list for projects related to the recent MDNR Cost Analysis for Compliance. Additional capital purchases are factored into the fixed asset schedule as required. Debt is also fully recognized on the financial statements in the year of draw down.

Successful bond issue election of $31mm is assumed in 2021.
If the bond issues were to fail, projects would be paid for from current cash which would dramatically increase rates.

5 *INCOME STATEMENT ITEMS*

Items on the income statement are evaluated on an individual basis, based on known data. Absent specific additional information, expenses are assumed to increase at the historical inflation rate from 1914-2018 of 3.23%.

We assume a 4% annual increase in wholesale treatment expense which is nearly 1/3 of the annual operating budget. However, this line-item is highly variable and dependent on the City of Columbia, (City) their costs, and the resultant rates they charge. The City is currently negotiating an integrated management plan with MDNR which could result in higher annual increases than 4 per cent. Higher cost increases would necessarily result in higher rates charged by the District.

In 2019 and going forward, personnel expense assumes various retirements, replacements, etc. An additional full time administrative support position is added in 2021.
The timing of these changes are reflected in the income statements.