Exhibit No. 307

Commission – Exhibit 307
Draft Facility Plan (August 10, 2020)
File No. SA-2021-0017

HDR

Draft Facility Plan

Boone County Regional Sewer District

Amendment 1 - Richardson Acres and Brown Station Wastewater Improvements

August 10, 2020

STATE OF MISSOURI
BRYCE S. BANION
NUMBER
E-19567
REGISTERED PROFESSIONAL ENGINEER

1 Description of Need

1.1 Background

The Boone County Regional Sewer District (District) owns and operates the following Wastewater Treatment Facilities (WWTF):

1. Cedar Gate WWTF is located approximately 800 feet east of the intersection of Route B and E. Kemper Road southwest of Hallsville, MO. It is a two-cell aerated lagoon which currently serves approximately 28 homes. It discharges effluent into an unnamed tributary to Varnon Branch.
2. Richardson Acres WWTF is located approximately 600 feet west of Route B and 2,400 feet south of Mt. Zion Church Road. It is a two-cell aerated lagoon which currently serves approximately 24 homes. It discharges effluent into an unnamed tributary to Clays Fork.
3. Brown Station WWTF located approximately 650 feet north of the intersection of North Brown Station Road and O'Rear Road. It is a recirculating sand filter which currently serves approximately six homes. It discharges effluent into Clays Fork.

The Missouri State Operating Permits for all three WWTF's have expired on the following dates:

1. Cedar Gate WWTF: November 8, 2012
2. Richardson Acres WWTF: March 31, 2015
3. Brown Station WWTF: March 10, 2016

Each of these permits included effluent limitations for Biological Oxygen Demand (BOD), Total Suspended Solids (TSS), and ammonia. A summary of the final effluent limitations for these WWTFs is shown in Table 1-1 below. The complete Permits can be found in Appendix A.

Table 1-1 Summary of Final Efflu.ent Limitations

Effluent Parameter	Richardson Acres WWTF Final Effluent Limits (Effective Sep. 1, 2019)			Richardson Acres WWTF Final Effluent Limits (Effective Sep. 1, 2019)			Brown Station WWTF Final Effluent Limits (Effective Mar. 11, 2011)		
	Daily Max.	Weekly Avg.	Monthly Avg.	Daily Max.	Weekly Avg.	Monthly Avg.	Daily Max.	Weekly Avg.	Monthly Avg.
Flow (MGD)	Monitor Only		Monitor Only	Monitor Only		Monitor Only	Monitor Only		Monitor Only
BOD (mg/L)		65	45		65	45		45	30
TSS (mg/L)		120	80		110	70		45	30
pH	Monitor Only		Monitor Only	Monitor Only		Monitor Only	Monitor Only		Monitor Only
Ammonia as N (mg/L)	Monitor Only		Monitor Only						
(April 1 - Sept 30)				3.6		1.4	4.5		1.7
(Oct 1 - March 31)				7.5		2.9	7.9		3.0

The District faces several challenges in regards to the continuing operation of these WWTFs. In order to meet the above listed ammonia limitations, the WWTFs need to be upgraded. Although these permits do not currently have effluent limitations for bacteria, it is anticipated that future permits will include bacteria limitations which will require the implementation of disinfection facilities to maintain compliance.

Future impacts in regards to the addition of removal requirements for nutrients, such as total nitrogen and total phosphorous, are also expected to occur within upcoming permit renewal cycles. Therefore, it is prudent to consider these future requirements in the planning and design of any improvements to these facilities.

This Facility Plan also includes the piping infrastructure for conveying wastewater flows from the City of Hallsville, MO to the District's Rocky Fork WWTF.

1.2 Project Purpose

The purposes of the Facility Plan are as follows:

- Develop and evaluate three alternatives to address current and future wastewater treatment needs within the study area over the next 20 years and beyond.
  a. Alternative No. 1: Make no improvements to the existing facilities.
  b. Alternative No. 2: Improve existing WWTFs to meet current and anticipated future MDNR regulations.
  c. Alternative No. 3: Construct one pump station at each WWTF site, a booster pump station at Brown Station and associated force mains that will discharge wastewater into the District's sanitary sewer collection system where it will be treated at the District's Rocky Fork WWTF. Each existing WWTF will be decommissioned.
- Recommend the most cost-effective alternative that meets the 20-year need for wastewater service within the study area and meets the current and proposed regulations.
- Provide estimates of construction and operations/maintenance costs.
- Provide an estimated project schedule.

1.3 Scope

This Facility Plan has been prepared in accordance with the requirements specified in RSMO, 10-CSR 20-4 of the Missouri Codes of Rules and Regulations. Additionally, this Facility Plan was developed in conformance with RSMO 10-CSR 20-8 and most specifically, 10-CSR 20-8.10, entitled "Engineering – Reports, Plan, and Specifications".

The specific scope of this Facility Plan was developed to meet the following requirements of MDNR:

- The recommended plan shall meet state and federal design criteria. The design criteria of the project shall be accepted by all state agencies responsible for issuing construction and operating permits for wastewater systems.
- The recommended plan shall be technologically compatible with the topography and geology of the area and the administrative and operational capabilities of the District.

- All equipment and processes shall have a demonstrated proven record of performance under similar environmental and cultural conditions. The equipment selected must be accepted by the District as being capable of performing for the life of the indebtedness with reasonable operations and maintenance requirements. The equipment and processes must be evaluated in terms of long-term operational and managerial cost implications.
- All required construction techniques should be common to the State of Missouri, thus encouraging competitive pricing in construction contracts. Property owners, road and highway commissions, and other utility owners should accept the required construction techniques, including temporary disturbances as well as resulting permanent structures.

The project costs shall be established such that loan commitments can be obtained from participation in the MDNR State Revolving Fund (SRF) Loan program.

2 Projected Population, Flows, and Wastewater Loadings

The Cedar Gate WWTF is located in the Varnon Creek Watershed. The Richardson Acres and Brown Station WWTFs are located in the Rocky Fork Creek Watershed.

The existing wastewater flows currently treated by the Cedar Gate, Richardson Acres and Brown Station WWTFs and anticipated future design flows are discussed in the following sections.

2.1 Existing Wastewater Flows

Table 2-1 below summarizes the available flow data for the Cedar Gate WWTF, the Richardson Acres WWTF and the Brown Station WWTF. The permitted design flow and the permitted actual flow are taken from each facility's operating permit, while the average flow was calculated based upon the Daily Monitoring Reports (DMRs) provided by the District. The DMRs for the WWTFs include flow data from 2015 to 2019.

Table 2-1 Permitted & Metered Flows

WWTF	Permit Design Flow (gpd)	Permit Actual Flow (gpd)	DMR Average Flow (gpd)
Cedar Gate	11,000	4,348	2,043
Richardson Acres	8,510	3,198	3,704
Brown Station	1,850	Not Available	1,311

It is noted that the values derived for average daily flow from the DMRs are gathered on a quarterly basis and can vary significantly from sampling event to sampling event. Due to the wide variations in the reported flow, this Facility Plan will not rely on the reported flow data. Additional analysis utilizing MDNR guidelines for deriving wastewater flow will be employed. Those guidelines are as follows:

The MDNR Code of State Regulations 10 CSR 20-8.020, Section 11 allows for the following design criteria for single family residences:

- Density = 3.7 persons/residence
- Design flow = 75-100 gallons/capita/day. The more conservative value of 100 gallons/capita/day will be used in the calculation of the design flow.

Peak factors within the system are calculated in accordance with 10 CSR 20-8.110:

Peak Design Flow = $(18+\sqrt{\text{population}}) / (4+\sqrt{\text{population}})$, (population is in thousands)

<u>Cedar Gate Existing Service Area</u>

All dwellings within the existing service area are single family residences, except for one which is an abandoned convenience store. This Facility Plan will consider the wastewater contribution of the abandoned convenience store to be the equivalent of one single family residence. The actual number of houses within the existing service area was determined from information provided by the District and an analysis of aerial mapping. The Cedar Gate WWTF currently serves 29 lots.

Applying the above referenced MDNR guidelines, the existing wastewater flows and peak factors for the Cedar Gate WWTF are calculated in Table 2-2.

Table 2-2 Cedar Gate Design Data for Existing Service Area

WWTF	Existing Dwellings (each)	Calculated Population (persons)	Design Flow (gpd)	Peak Flow Factor	Peak Flow (gpd)	Peak Flow (gpm)
Cedar Gate	29	107	10,730	4.24	45,440	32

Richardson Acres Existing Service Area

All dwellings within the existing service area are single family residences. The actual number of houses within the existing service area was determined from information provided by the District and an analysis of aerial mapping. The Richardson Acres WWTF currently serves 22 lots.

Applying the above referenced MDNR guidelines, the existing wastewater flows and peak factors for the Richardson Acres WWTF are calculated in Table 2-3.

Table 2-3 Richardson Acres Design Data for Existing Service Area

WWTF	Existing Dwellings (each)	Calculated Population (persons)	Design Flow (gpd)	Peak Flow Factor	Peak Flow (gpd)	Peak Flow (gpm)
Richardson Acres	22	81	8,140	4.27	34,730	24

Brown Station Existing Service Area

All dwellings within the existing service area are single family residences. The actual number of houses within the existing service area was determined from information provided by the District and an analysis of aerial mapping. The Brown Station WWTF currently serves six lots.

Applying the above referenced MDNR guidelines, the existing wastewater flows and peak factors for the Brown Station WWTF are calculated in Table 2-4.

Table 2-4 Brown Station Design Data for Existing Service Area

WWTF	Existing Dwellings (each)	Calculated Population (persons)	Design Flow (gpd)	Peak Flow Factor	Peak Flow (gpd)	Peak Flow (gpm)
Brown Station	6	22	2,220	4.37	9,710	7

2.2 Projected Population and Wastewater Flows for Respective Service Areas

Cedar Gate Future Service Area

The District anticipates no future growth in the existing Cedar Gate service area.

Table 2-5 shows the current and projected number of houses in the service area for the Cedar Gate WWTF.

Table 2-5 Houses in Service Area

WWTF	Current Houses in Service Area (houses)	Anticipated Additional Houses in Future Service Area (houses)	Anticipated Total Houses in Future Service Area (houses)
Cedar Gate	28	0	28

The total projected design wastewater flows generated by existing development with no future development within the service area are shown in Table 2-2.

Richardson Acres Future Service Area

A potential future service area defined by the District includes approximately 102 acres west of the existing Richardson Acres Service Area that is not currently served by the Richardson Acres WWTF. Assuming a similar development density of 5.4 acres per lot in the future service area, the District would anticipate an additional 19 (102 acres/5.4 acres/lot) single family residences may be constructed on the 102 acre tract. The additional future wastewater flow from an anticipated 19 homes should be accounted for in the planning of the future improvements in the service area.

Table 2-6 shows the current and projected number of houses in the service area for the Richardson Acres WWTF.

Table 2-6 Houses in Service Area

WWTF	Current Houses in Service Area (houses)	Anticipated Additional Houses in Future Service Area (houses)	Anticipated Total Houses in Future Service Area (houses)
Richardson Acres	22	19	41

Population data specifically for the potential service area doesn't exist, so the determination of projected wastewater flows cannot be calculated by common population methodologies. Therefore, the same MDNR CSR guidelines used in Section 2.1 above will be used for this analysis, as well.

The total projected design wastewater flows generated by existing and future development within the service area are shown in Table 2-6.

Table 2-7 Projected Future Wastewater Flows

WWTF	Total Service Area (homes)	Total Service Area Population (persons)	Projected Average Wastewater Flow (gpd)	Peak Flow Factor	Projected Peak Wastewater Flow (gpd)	Projected Peak Wastewater Flow (gpm)
Richardson Acres	41	152	15,170	4.19	63,550	44

Peak factors within the system were calculated using the same formula used in Section 2.1.

Brown Station Future Service Area

A potential future service area defined by the District includes approximately 23 homes that are not currently served by the Brown Station WWTF. The additional future wastewater flow from an anticipated 23 homes should be accounted for in the planning of the future improvements in the service area.

Table 2-7 shows the current and projected number of houses in the service area for the Brown Station WWTF.

Table 2-7 Houses in Service Area

WWTF	Current Service Area (houses)	Anticipated Additional in Future Service Area (houses)	Anticipated Total in Future Service Area (houses)
Brown Station	6	23	29

Population data specifically for the potential service area doesn't exist, so the determination of projected wastewater flows cannot be calculated by common population methodologies. Therefore, the same MDNR CSR guidelines used in Section 2.1 above will be used for this analysis, as well.

The total projected design wastewater flows generated by existing and future development within the service area are shown in Table 2-8.

Table 2-8 Projected Future Wastewater Flows

WWTF	Total Service Area (homes)	Total Service Area Population (persons)	Projected Average Wastewater Flow (gpd)	Peak Flow Factor	Projected Peak Wastewater Flow (gpd)	Projected Peak Wastewater Flow (gpm)
Brown Station	29	107	10,730	4.24	45,442	32

Peak factors within the system were calculated using the same formula used in Section 2.1.

Hallsville Future Service Area

This Facility Plan includes the District receiving wastewater flows from the City of Hallsville and conveying them to the District's sanitary sewer system.

The wastewater flows will be derived from actual population data from "worldpopulationreview.com". According to aforementioned website, the City of Hallsville has a projected population of 1,586 in 2020. Assuming 1% growth per year over the next 20 years, the population will be 1,935.

Using the same MDNR CSR guidelines used in Section 2.1, the total projected design wastewater flows generated by existing and future development within the Hallsville Service Area are shown in Table 2-9.

WWTF	Total Service Area (homes)	Total Service Area Population (persons)	Projected Average Wastewater Flow (gpd)	Peak Flow Factor	Projected Peak Wastewater Flow (gpd)	Projected Peak Wastewater Flow (gpm)
Hallsville	-	1,935	193,510	3.60	696,030	483

Table 2-9 Projected Future Wastewater Flows

Peak factors within the system were calculated using the same formula used in Section 2.1.

It is noted that the projected average wastewater flow of 193,510 gpd is within 10% of the average daily design flow of 212,622 gpd for the Hallsville WWTF, as shown on its Operating Permit. This Facility Plan will use the more conservative wastewater flow value of 212,644 gpd or 148 gpm.

According to the Missouri Operating Permit, the City of Hallsville has approximately 53,992,000 gallons of storage volume in its lagoons. It is anticipated that these lagoons will be used to store peaks flows in the system.

2.3 Wastewater Loadings

Cedar Gate

Table 2-10 shows a summary of the DMRs provided taken from MDNR's Clean Water Information System 2015 to 2019. The data from the DMRs can be found in Appendix C.

Table 2-10 Wastewater Loadings Cedar Gate

Parameter	Value
Flow (Jan 2015 to Dec 2019)	
Average Daily Flow (gpd)	2,043
Max Daily Flow (gpd)	14,000
Influent Concentrations (Jan 2015 to Dec 2019)	
Average BOD_5 (mg/L)	329.4
Max BOD_5 (mg/L)	426
Average TSS (mg/L)	309.2
Max TSS (mg/L)	420
Effluent Concentrations (Jan 2015 to Dec 2019)	
Average BOD_5 (mg/L)	24.6
Average TSS (mg/L)	22.1
Effluent Ammonia (Jan 2015 to Dec 2019)	
Average Ammonia (mg/L)	17.4

There is no data available for ammonia concentration in the WWTF's influent flow. For the purpose of this Facility Plan, the influent ammonia concentration will be assumed to be 35 mg/L, which is typical for domestic type wastewater. As additional data becomes available, this concentration may be adjusted during the design phase, if necessary.

Table 4-2 Alternative No. 2: Cedar Gate, Richardson Acres and Brown Station WWTFs Anticipated Annual O&M Cost Estimate

Item Description	Cost
Power	$12,100
Labor	$31,200
Equipment Replacement	$19,200
Total	**$62,500**

4.3 Alternative No. 3 – Conveyance to the District's Sanitary Sewer System

This alternative consists of decommissioning the Cedar Gate WWTF, the Richardson Acres WWTF and the Brown Station WWTF from service and installing a pump station near each facility. Pumped wastewater flow from the new pump stations would be conveyed through a new force main and discharged to the District's sanitary sewer collection system. The point of connection would be an existing 8-inch sanitary sewer located approximately ¼ mile south of East Oakland Church Road on Wagon Trail Road. The wastewater would be treated at the District's Rocky Fork WWTF. This alternate also includes a force main from near Cedar Gate to the Brown Station Booster Pump Station dedicated solely to conveying flows from Hallsville to the aforementioned connection to the District's sanitary sewer collection system.

A layout of the proposed pump stations and conveyance improvements is shown on Exhibit 1 located in Appendix B.

Replacing the existing WWTFs with pump stations will eliminate three existing permitted WWTFs, thereby achieving MDNR's goal of eliminating such WWTFs whenever possible and providing regional solutions to wastewater treatment.

Each pump station would consist of the following components:

- ***Wet Well*** – Raw wastewater collected at the existing influent point will discharge into a wet well. Wet wells may be precast concrete type or prefabricated fiberglass type.
- ***Submersible Pumps*** – Duplex submersible pumps will be installed in a wet pit configuration. One firm pump capable of pumping the peak design capacity and one standby pump will be installed. Pumps will be non-clog or grinder type.
- ***Valve Vault*** – Plug and check valves will be installed in an easily accessible above-ground valve vault. Bypass connections for attaching auxiliary pumps will also be provided.
- ***Controls*** – Pumps will be operated by a conductivity rod with backup float level control. Local control panels will be suitable for outdoor installation or installed in a shelter. Automatic dialers and other remote monitoring communication will be provided.
- ***Emergency Operation of Pump Station*** – Per 10 CSR 20-8.130(8), "Pumping stations and collection systems shall be designed to prevent or minimize bypassing of raw sewage. For use during possible periods of extensive power outages, mandatory power reductions or uncontrolled storm events, consideration should be given to providing a controlled high-

level wet well overflow to supplement alarm systems and emergency power generation in order to prevent backup of sewage in basements...consideration shall also be given to installation of storage-detention tanks or basins".

1. ***Emergency Power Generation*** – In light of the CSR cited above, it is recommended that the District consider an option that includes the installation of either a portable or permanent emergency generator at the pump station to provide electrical power to the station during periods of power outages. Taken in conjunction with the cost and potential for onsite storage-detention, an informed decision regarding emergency power generation will be made during the design of the project.
2. ***Temporary Storage-Detention*** – Temporary storage of wastewater flows at the pump station site is an option that will be evaluated during design. The volume of storage, if needed, will be determined by the type of emergency power generation selected by the District.

- ***Odor Control*** – The need for odor control facilities will be evaluated during design. Both liquid odor control and carbon odor control will be considered. Liquid odor control is used to prevent corrosion and the generation of odors in force mains with long resident times. Through the use of a chemical feed skid system, odor control chemicals such as ferric chloride or bioxide may be injected at the pump station wet well or directly into the force main. Carbon odor control is used to treat odorous air that may be generated at pump station sites with longer wet well detention times or those pump stations adjacent to homes. Carbon odor control system pull air from the wet well and through a carbon filter media bed to remove odor causing compounds.

The anticipated project cost associated with this alternative is shown below in Table 4-3.

Table 4-3 Alternative No. 3: Anticipated Project Cost Estimate

Item Description	Cost
Pumping and Piping	$2,505,000
Easement Acquisition	$113,000
Engineering, Contingency, and SRF Closing Costs	1,090,000
Total	**3,708,000**

In addition to the anticipated capital costs, an O&M cost estimate was developed for this alternative. The estimate includes applicable power, labor, chemical, and replacement costs associated with operating and maintaining the proposed pump station. The annual cost is presented in Table 4-4 below.

Table 4-4 Alternative No. 3: Anticipated Annual O&M Cost Estimate

Item Description	Cost
Power	8,600
Labor	22,500
Chemical	4,300
Equipment Replacement	17,700
Total	**53,100**

5 Recommended Alternative

This section describes in greater detail the facilities associated with the recommended alternative.

5.1 Summary of Costs

The recommended alternative shall be selected based upon an evaluation of the total costs for each alternative and compliance with MDNR's stated goal of removing small treatment works from service. No costs were developed for Alternative No. 1, as this alternative was eliminated from further consideration in Section 4. Table 5-1 shows a summary of the costs for Alternatives No. 2 and 3.

Table 5-1 Summary of Costs

	Alternative No. 2	Alternative No. 3
Anticipated Project Costs	$2,672,700	$3,708,000
Anticipated Annual O&M Costs	$62,500	$53,100
TOTAL	$2,735,200	$3,761,100

Alternative No. 3 has higher project and O&M costs than Alternate 2. However, Alternate 3 meets the objectives of removing three small treatment facilities from service, providing a regional solution for wastewater treatment and accommodates the conveyance of anticipated wastewater flows from Hallsville to the Rocky Fork WWTF.

Based upon discussions with District staff and the objectives achieved, Alternative No. 3 is selected as the recommended alternative.

5.2 Conveyance to the District's Sanitary Sewer System

The conveyance system improvements will be sized using the flow analysis for existing service areas as presented in Tables 2-2 and 2-3. The nature, density and timing of future development within the respective service area is largely unknown at this time, making it difficult to determine if the projected peak flows will ever be realized within the next 20 years. It does not seem prudent to incur the greater capital cost of constructing pump stations and force mains, at this time, to accommodate anticipated peak flows that may take many years to occur, or perhaps, never occur at all. Therefore, this Facility Plan makes the following recommendations:

1. Design and construct the proposed facilities using a conservative design peak flow for the existing condition.
2. Design features into the proposed facilities that will readily accommodate future expansion of the facilities, if projected design flows are realized within the next 20 years.

The recommended improvements are shown on Exhibit 1 in Appendix B. A brief summary of the recommended improvements are as follows:

1. Pump Stations: Pump Stations will be constructed at Cedar Gate, Richardson Acres and a booster pump station at Brown Station
2. Force Main: Force main will be constructed as follows:
   a. (1) 6 inch from Sewer Connection Point to Brown Station Booster Pump
   b. (2) 3 inch from Brown Station Booster Pump to Richardson Acres Connection Point
   c. (3) 2 ½ inch from Richardson Acres Connection Point to Cedar Gate
   d. (4) 4 inch from Brown Station Booster Pump to near Cedar Gate (Hallsville Connection)
   e. (5) 2 inch from Richardson Acres to Cedar Gate Force Main
3. Under Ground Storage: Underground storage will be constructed at Brown Station Booster Pump Station
4. STEP Pumps at Brown Station: The force main for the STEP pumps that currently discharges to the recirculating sand filter will be extended to the proposed Brown Station Booster Pump Station
5. WWTF Closure: WWTFs will be closed at Cedar Gate, Richardson Acres and Brown Station

Capacity for the pump stations is shown below in Table 5-2. Detailed calculations associated with the pump station and force main can be found in Appendix E.

Table 5-2 Pump Station Parameters

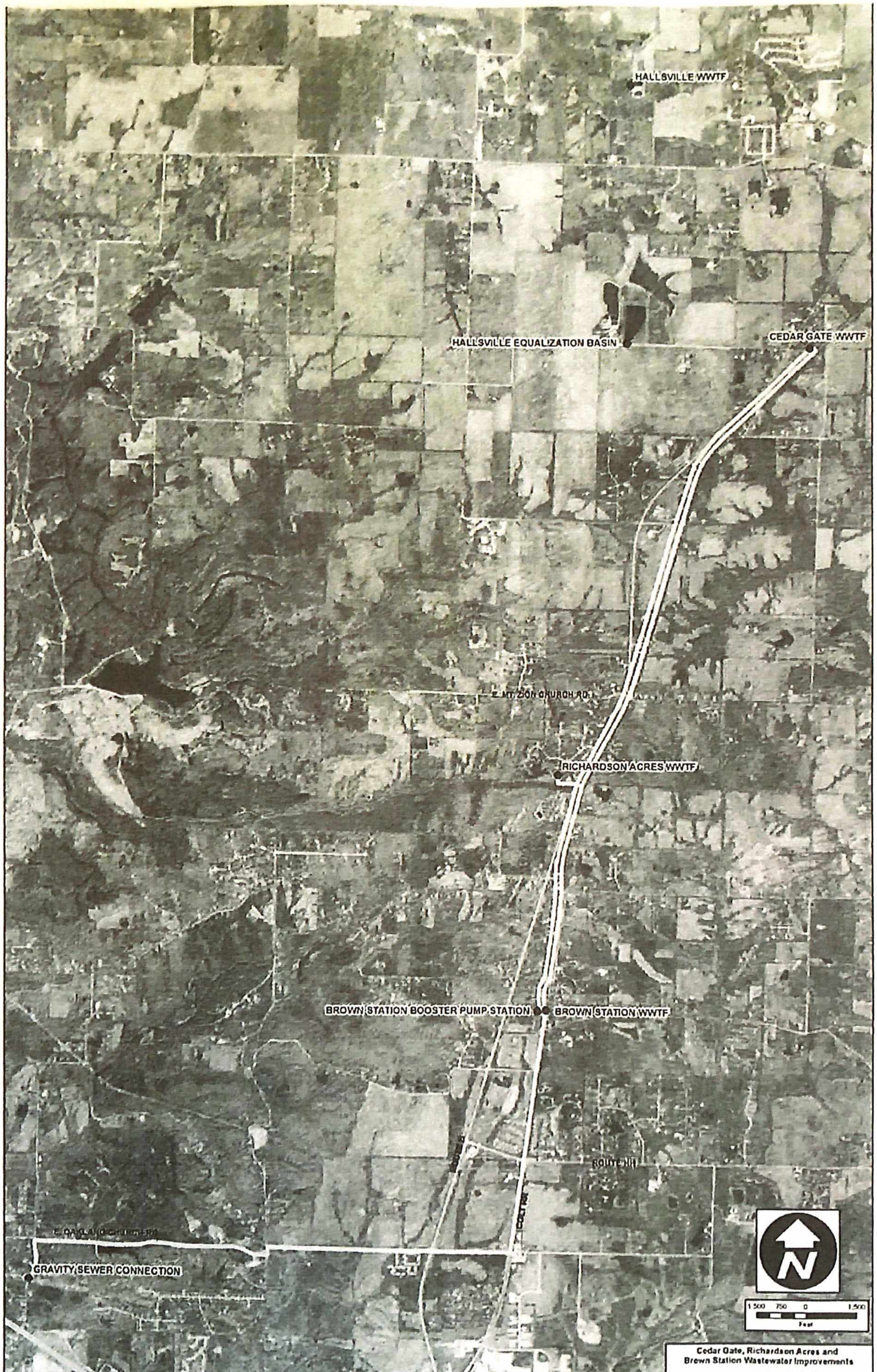
Location	Pump Capacity (gpm)	Total Dynamic Head (ft)
Cedar Gate	32	180
Richardson Acres	24	133
Brown Station Booster Pump Station	211	108

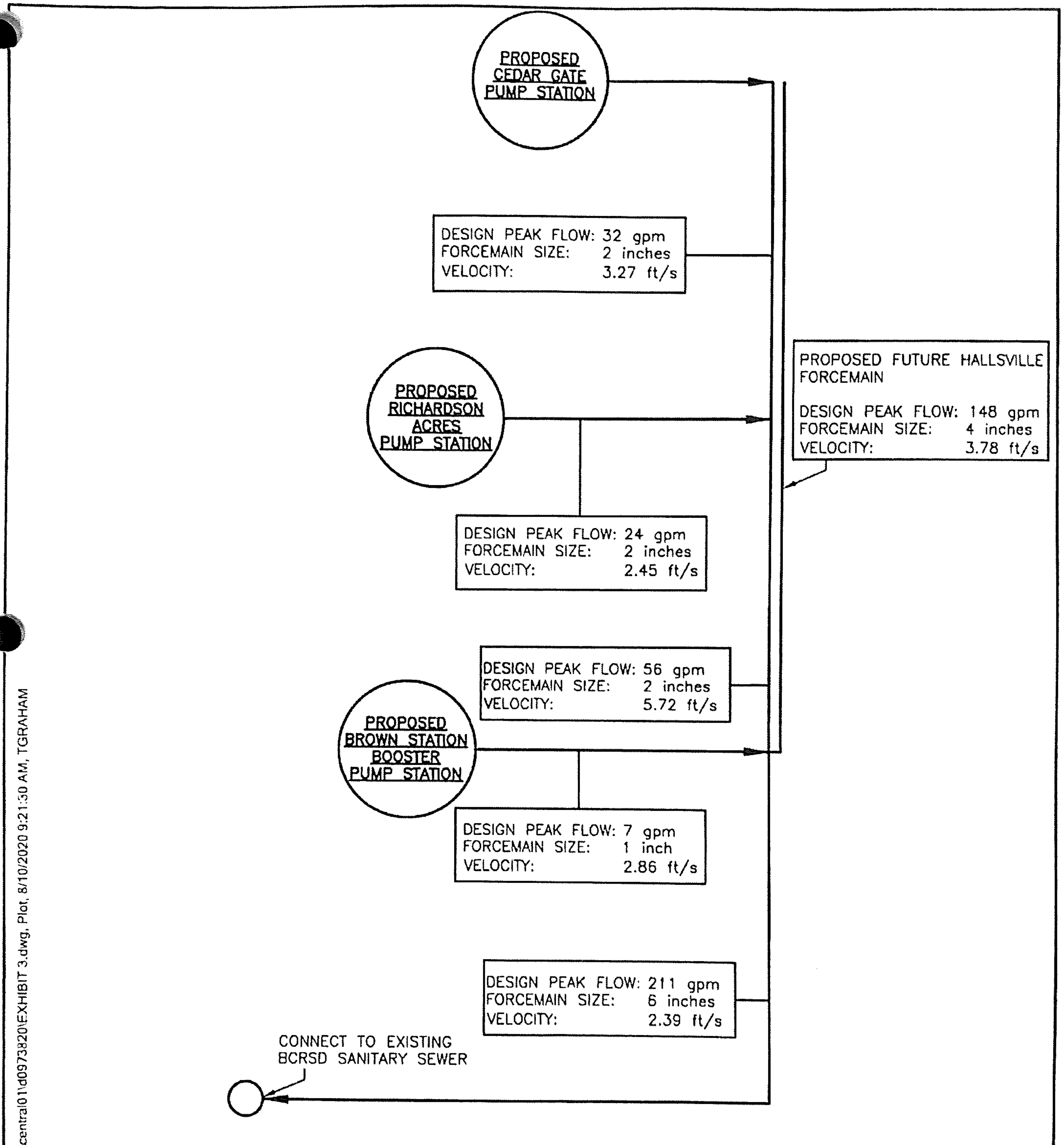
Pump station improvements will be located within a private dedicated easement. The proposed pump station locations are shown on Exhibit 2 in Appendix B. A conceptual site plan is located in Appendix F.

The force main improvements will be constructed in private dedicated easements in accordance with the District's preference. The locations of the proposed force mains are shown on Exhibit 2 located in Appendix B. Force mains will be sized to convey the peak flow in the system and optimized to provide an acceptable range of velocities and capacities. The MDNR recommended minimum velocity of 2 feet per second (fps) will be maintained at the design pumping rate.

APPENDIX B

EXHIBIT 1: PROPOSED IMPROVEMENTS


HALLSVILLE WWTF
HALLSVILLE EQUALIZATION BASIN
CEDAR GATE WWTF
E. MT. ZION CHURCH RD
RICHARDSON ACRES WWTF
BROWN STATION BOOSTER PUMP STATION
BROWN STATION WWTF
GRAVITY SEWER CONNECTION
N
1,500 750 0 1,500
Feet
Cedar Gate, Richardson Acres and
Brown Station Wastewater Improvements



BCRSD

HDR

Process Schematic

Cedar Gate, Richardson Acres and Brown Station Wastewater Improvements

EXHIBIT **3**