B. DESCRIPTION OF TREATMENT PLANT and COLLECTION SYSTEM

A. Overview The treatment facility is a sequencing batch reactor (SBR) type, activated sludge plant with a hydraulic design capacity of 0.22 million gallons per day and designed to serve a population equivalent of 2,200 people. The plant has been in continual use for some thirty years. This type plant is noted for two features; namely, the absences of primary or secondary clarification structures, and automatic timed control of different treatment processes which occur in a single basin. The basic processes are basin fill, aeration, settle, decant, and idle. Effluent withdrawn from a basin during the decant cycle is piped by gravity to an ultraviolet light disinfection chamber prior to discharge to the receiving stream. Treatment of waste sludge is accomplished in a separate aerated basin with final disposal by land application.

Primary elements in the treatment process at the Granby wastewater plant are listed as follows;

- Intake Structure – a fabricated steel, above grade, structure incorporating aerated grit removal, comminution of suspended debris, and a trash screen. Piping was added under drawings dated 4-1-08 to provide intended or emergency peak flow diversion of influent to an equalization basin.
- SBR Basins – dual reinforced concrete basins, each with a 24-foot by 42-foot water surface, 18-foot wall height, designed for 16-foot maximum side water depth. Each basin is piped to accomplish mixing of contents, aeration, clear supernatant decanting and waste sludge removal.
- Equalization Tank – originally constructed as the waste sludge holding tank, this 24-foot square, 16-foot side water depth tank was converted to a raw wastewater equalization tank after construction in 2009 of a separate sludge aeration/storage tank, and was provided with a 5 hp floating aerator. The existing sludge unloading pump was rebuilt to serve as a transfer pump.
- Disinfection Chamber – banks of ultraviolet lamps in dual, 24-inch square cross-section, open channels in the reinforced concrete floor of a separate building. The ultraviolet disinfection system consists of two modules, each having twenty-four, 28-watt lamps.
- In-Plant Pump Station – A wet well with a 3 hp pump to receive sludge basin decant and laboratory waste, then deliver same to the process treatment stream.
- Process Pumping & Aeration – dual 20 hp blowers discharging through a single air-line to the SBR basins. Recirculating/mixing pump, 10 hp, one for each SBR basin.
- Sludge Aeration/Storage Basin – a 36.5-foot diameter, 18-foot wall height concrete basin with a 25 hp floating aerator, a supernatant decant valve, and a 5 hp sludge unloading pump. A 1500-gallon tank truck is available to land apply fully digested sludge.
- Process Controls – a SCADA system coupled with programmable logic controls, time set points, and influent flow rate monitoring referenced to the design flow rate for automatic system operation, plus alternate manual control per plant operator preference.

B. Description of Treatment Process Elements

1. **Intake Structure** This element of the treatment process sets well above finish grade and is of fabricated carbon steel construction. Portions of the structure exhibit advanced deterioration. The grit removal mechanism is functional, although the minimal volume of grit collected does not appear to warrant its operation. Wastewater enters the structure at a height of 9.5 feet above grade and flows by gravity to and through the control building pump room piping, then into the SBR basins. The comminutor and bar screen are operable, which require continued use to minimize the clogging of the sludge aeration/mixing system.

2. **SBR Basins** Each of the dual reinforced concrete tanks provides 7,540 gallons of liquid volume per foot of depth. Thus, when operated with a "working depth" of 4 feet (current practice), 30,160 gallons is the volume that can be decanted within the five-stage sequencing cycle, and is the volume that can be received in the next fill sequence, unless sludge is wasted. Currently, the length of the settling period ahead of decant is set at 100 minutes and 30 minutes is allowed for decant. Assuming then that the fill and aeration stages are combined, the rate of fill cannot be greater than 30,160 gallons in 130 minutes, or 232 gallons per minute (334,080 gallons per day).

If raw wastewater flow is at the design rate of 220,000 gallons per day, 148 minutes would be available for fill and aeration. Consequently, 48 minutes could be allocated to static fill to develop anoxic conditions for ammonia removal and 100 minutes for aeration. These comparative computations pin-point the impact high rates of raw wastewater flow can have on the SBR basins. If the rate of influent flow exceeds a certain level, the time for treatment in each of the different stages is reduced and the degree of treatment declines.

In order for the control system to automatically sequence the plant, sensors in each of the basins gage the depth of the basin contents and the level of dissolved oxygen. The plant operator inputs maximum and minimum time periods for the different sequence stages. Input to the control system from the liquid level sensors is utilized by the program to determine when to start or stop a process stage. If the filling or emptying of a basin is not attained as determined by the level sensors within an allotted time period, the controls defer to the time set points to end a process stage and start the next stage of treatment.

Dissolved oxygen sensors transmit signals to the plant control system relating the level of dissolved oxygen in the mixed liquor during the aeration stage. The controls, through variable speed motor drives, modulates the volume of air delivered into the basin contents, thus maintaining dissolved oxygen at levels appropriate to the demand for oxygen. The reliability of the liquid level transducers and the dissolved oxygen sensors are critical to the operational reliability of the plant.

3. **Equalization Basin** Should influent wastewater flow rates exceed the capacity of the gravity flow pipework, or should a valve controlling influent to an SBR basin malfunction, flow can divert to this 69,000-gallon concrete basin. If aeration is needed to prevent an anaerobic condition in the basin contents, a floating aerator can be activated. At the inflow design rate of 153 gallons per minute, 100% of influent flow can be diverted for a seven and one-half hour period.

4. **In-Plant Pumping Station** The wetwell of this pumping unit is used to receive decanted supernatant from the waste sludge digester-storage vessel, and drainage from the laboratory-pump building. A single 3-hp, 200 gpm submersible pump delivers collected drainage to the treatment flow stream.

5. **Ultraviolet Disinfection System** Since discharge of treated effluent from the plant is intermittent, the germicidal lamps are started ahead of the decant sequence, and the duration of exposure is then contingent upon the rate of decanting. Decanting 4-feet of aeration basin supernatant in 30 minutes generates a flow of 1005 gallons per minute. The operating practice of intermittent flow coupled with starting and stopping the lamps, has been determined to provide satisfactory results, as evidenced by sampling and E. Coli testing per the MDNR operating permit requirements. The system does not have an ultraviolet light intensity monitoring system to alert plant operators to conditions when intensity is diminished to a level which could result in insufficient disinfection.

6. **Sludge Aeration/Storage Basin** Allowing 2 foot of wall height for freeboard, this storage vessel can store up to 125,000 gallons of waste sludge, and by use of a floating aerator, volatile solids can be reduced through continued aerobic digestion. A telescoping valve and a submersible pump are used to decant supernatant liquid back to the treatment process, thereby increasing the percent solids level of the sludge and reducing the volume to be hauled and distributed.

7. **Laboratory and Control Building** This building houses the laboratory, plant controls system, SCADA, plus the aeration blowers and recirculation pumps mentioned earlier.

C. WWTP INFLUENT LIFT STATION

A review of the original construction drawings reveals the primary lift station is equipped with two submersible wastewater pumps, powered by 25 hp motors, and each rated at 550 gallon per minute discharge capacity at 74.59 feet total dynamic head. An 8-inch force main carries the pump discharge to the plant inlet structure. The station wet well is shown to be 6 feet in diameter and 22 feet deep. Two sewer pipes discharge into the wet well, an 8-inch pipe at 6.5 feet above the well floor and a 12-inch pipe at 11.7 feet above the well floor. Originally, the float switches were set to provide for a 6-foot fill depth before starting a pump. Thus, at the start of a pumping cycle, the wet well would contain 1,272 gallons. At design flow of 0.22 MGD, wastewater would be flowing into the wet well at a rate of 153.7 gallons per minute and the wet well would fill to the pump start level in 8.28 minutes. At the start of a pumping cycle, 153.7 gpm of the 550 gpm pump discharge rate would be used to pump the incoming wastewater and the remaining 396.3 gpm of pumping rate would remove the initial 1,272 gallons. The ideal duration of the pumping cycle is 1,272 gallons divided by 396.3 gallons per minute, or 3.21 minute, while the volume pumped from the wet well to the treatment plant would be 3.21 minutes times 550 gallons per minute or 1,767.56 gallons. The time period for lift station fill and discharge is then 11.46 minutes and within that period of time 1,767.56 gallons is delivered into the treatment plant.

This computation is important in evaluating the treatment plant capabilities as all flow into the lift station wet well must be pumped to the treatment plant as there is no peak flow storage or surge capacity at the lift station. Further, the rate of flow from the lift station affects the time cycles of the different operating sequences in the treatment facility. As an example, assume a peak flow condition of 300% of design flow, 660,000 gallons per day. The flow rate into the lift station is then 458.3 gallons per minute, and the wet well is filled in 2.8 minutes. The net discharge rate from the station is 91.7 gallons per minute, the pump down time is 13.9 minutes, and the total volume pumped from the station is 7,629 gallons. At the treatment plant, 7,629 gallons is received within a 16.68-minute time period.

Should the flow rate into the lift station exceed the discharge rate of a single pump and the liquid level raises, a float switch will start the second pump.

The lift station has a 60-kw standby generator, diesel fueled, with automatic transfer switch to provide power to the station in the event the primary power source is interrupted.

D. WASTEWATER COLLECTION SYSTEM

The Capacity, Management, Operation and Maintenance Plan for the collection system relates the gravity portion consists of 20.75 miles (109,560 feet) of 8, 10, and 12-inch polyvinyl chloride (PVC) pipe and approximately 474 manholes. Also, within the collection system are three lift stations with duplex submersible pumps and six, simplex grinder pump lift stations. The duplex stations are rated at 80 gpm, while the simplex stations have 15 gpm pumps. The length of force main for these stations total some 2.79 miles (14,731 feet).

E. WASTEWATER FLOWS AND ORGANIC LOADS

Flows

For the 2014 engineering study, the monthly treatment plant operation records for the calendar years of 2011, 2012, and 2013 were examined,

In 2011, the volume entering the plant, recorded by the plant SBR control system, totaled 60,242,000 gallons with the computed average day volume of165,047 gallons per day (gpd), or 75.02% of the plants design hydraulic capacity. There were 22 days in 2011 when the influent flow was recorded at, or greater than, 0.22 MGD. The highest daily flows occurred in April and May of that year with 0.866 MG recorded on April 25th and 0.750 MG recorded on May 23rd. Both of these peak daily flows occurred during extended periods of rainfall. Plant records show rainfall to have occurred on 67 days in the calendar year.

During 2012, the total annual flow was 67,166,000 gallons, with a computed average daily flow of 184,016 gpd, or 83.64% of design capacity. The highest daily flow in the calendar year, 0.273 MG, occurred on March 21st during a period of rainfall. Design flow was exceeded on only 13 separate days. Rainfall was recorded at the plant to have occurred on 34 days that calendar year, although the total precipitation for the year was well below the normal expected total. 2012 was considered to be a year with drought conditions.

For 2013, the annual flow to the plant was recorded to be 72,707,000 gallons, yielding an average daily flow of 199,197 gpd, or 90.54% of the plant's design capacity. A flow equal or greater than 0.22 MGD occurred on 50 separate days, the highest being 0.62 MGD on October 31st. Records of rainfall at the plant indicate measurable precipitation occurred on 67 days and totaled 43.79 inches, an annual total amount considered to be "normally expected".

Later in an updated report, monthly monitoring reports for the twelve-month period, October 2014 through September 2015, were examined. Influent flow recordings revealed that during the period November 2014 through March 2015, and during September 2015 (those months without the peak day flow exceeding the design capacity), the daily flow ranged from 111,000 gallon per day (gpd) to 143,500 gallon per day; rates well below the 220,000 gpd design capacity. Even in the remaining seven months, if peak day flow rates greater than 220,000 gpd are subtracted, the averages for these months range from 122,970 gpd to 132,000 gpd. In this period, flows occurred at a rate greater than 220,000 gpd only during nine days. The average day flow during the subject twelve months was computed to be 130,250 gallon per day.

The flows for the 2011-2013 period were derived from the SBR control system and not the plant influent flow meter. It is suspected that the records of flows in that three-year period were overstated. The flows from the October 2014 – September 2015 period were taken from the influent flow meter, which was checked for accuracy in April 2015. By contrast to the previous three years, the average day flow for the 2014-2015 period was computed to be 132,000 gallon per day, well below the plants hydraulic design capacity.

For this Facility Plan, additional wastewater flows were examined, namely, the 2017 twelve-month calendar year, and the sixteen-month period of March 2018 through June 2019 (Flows for the months of January and February 2018 were unavailable).

In 2017, the annual volume treated was 47,394,000 gallons with the average daily flow computed to be 129,847 gpd. The maximum day flow was 1,100,000 gallons occurring on April 29th. In that month, flows greater than the 0.22 MGD plant design capacity occurred on six days, and on four days, daily flows exceeded 0.4 MGD. Total flow that month was 6,153,000 gallons with the average day flow of 205,100 gpd. However, if daily flows greater than design flow are subtracted, the adjusted average day flow drops to 128,000 gpd.

During the following month of May, total flow amounted to 5,422,000 gallons and the average day was 174,903 gpd. Again, subtracting the flows on days when design capacity was exceeded produced an adjusted average of 155,000 gpd. The maximum day flow was recorded as 477,000 gallons, with flows exceeding design capacity on four days in that month.

The only other month in 2017 in which flow exceeded design capacity was August when on the 22nd, 307,000 gallons entered the plant. The average day flow for August was 125,000 gpd, computed from a total during the month of 3,875,000 gallons.

For the period March 2018 through June 2019, the treatment plant received and treated 72,106,000 gallons, with the average day flow computed as 150,850 gpd. The maximum day flow occurred on June 23rd with 830,000 gallons entering the plant. Notable from the review of flow records is the number of days, twenty-three, when flow exceeded the design capacity. Twenty-one of the days occurred in the months of December 2018 through June 2019, with six days occurring in each month of June and May. The flow records for the period November through April 2018 revealed a low flow period of eight consecutive months wherein the peak day flow was less than 220,000 gpd. Thereafter, from December 2018 through June 2019, each consecutive month had at least one day of peak flow greater than design capacity.

Organic Load

For the twelve-month period January through December 2017, twelve samples of raw wastewater were analyzed yielding a BOD_5 load totaling 2,658 pounds. The volume of wastewater on those twelve days totaled 1,530,000 gallons. The average BOD_5 load may then be computed as 221.5 lbs. per day in a range of 123 to 297 lbs. per day.

In eleven months from January to December 2018 (February excluded), the BOD_5 load totaled 3,494 lbs. Flow on the eleven days samples were collected totaled 1,290,000 gallons. In this period, the average BOD_5 load is computed as 317.6 lbs. per day in a range of 257 to 375 lbs. per day.

More recently, in the first six months of 2019, the BOD_5 load totaled 1,434 lbs. in 861,000 gallons of raw wastewater, and yields an average of 239 lbs. per day. The organic load ranged from 124 to 287 lbs. per day.

By current design standards, the volumetric loading for an SBR plant is 5 to 15 pounds BOD_5 per day per 1000 cu. ft. of aeration basin volume. Considering the highest load of 375 lbs. per day in the twenty-nine months reviewed, the basin loading was 11.63 lbs. BOD_5 per day per 1000 cu. ft. At 15 lbs. per day per 1000 cu. ft. load rate, the basin could receive 484 lbs. per day BOD_5.

The efficiency of the SBR plant while operating with average day flow is evident by the level of BOD, Total Suspended Solids, ammonia, and total nitrogen determined by analysis of plant final effluent for the six-month period Jan – June of 2019. Effluent BOD_5 levels ranged from 5.5 to 17.7 mg/l in six tests, TSS from 1.4 to 29 mg/l in twenty-six tests, and ammonia from 0.54 to less than 0.10 mg/l in five tests.