SEWER FEASIBILITY STUDY

Prepared for:

Tucker County
Development Authority
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POTESTA

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SEWER FEASIBILITY STUDY FOR
TUCKER COUNTY DEVELOPMENT AUTHORITY
TUCKER COUNTY, WEST VIRGINIA

1.0 EXECUTIVE SUMMARY

The Tucker County Development Authority (TCDA) is committed to encouragement of growth and opportunity in the area, enhancement and maintenance of economic development, and preservation of Tucker County's values and heritage. The county's economy is largely based on the following industries: Manufacturing, Construction and Retail Trade. Tucker County is a rural county located in the beautiful mountainous area of northeastern West Virginia. It was created in Virginia and formed from Randolph County (which lies to the south) in 1856. The county is named for Henry St. George Tucker, an eminent jurist and statesman. The county is within a one-day drive of much of the eastern United States and Canada. The county is located within a 500-mile radius of more than 50% of the population of the United States. U.S. Route 48, otherwise known as Corridor H, will provide a four-lane highway through the county within the next few years. The road, much of which is currently in the design phase, will open the door to new markets along the East Coast. Tucker County is home to five Class IV municipalities including Davis, Hambleton, Hendricks, Thomas, and the county seat of Parsons. Overall, Tucker County is approximately 421 square miles. The elevation of the county ranges from 4,420 feet at the top of Weiss Knob to 1,450 feet where the Cheat River crosses the Tucker/Preston County line. Tucker County's mountainous terrain promotes healthy living and a great quality of life. Still, appropriate services and abundant resources make it possible for economic growth to flourish in this area.

The lack of wastewater capacity, primarily the capacity for treatment, however, has significantly limited economic development particularly in the Thomas and Davis area of Tucker County, stalling the construction of much needed affordable housing, the build-out of the Tucker County Industrial Park, development of the Corridor H area, as well as the growth of the Town of Davis (Davis) and City of Thomas (Thomas). The following provides a summary of the information gathered and the recommendations developed as part of this study:

Current Demand and Projected Growth

- Projecting baseline demand for Thomas (current average flow of 0.05 million gallons per day [MGD]) and Davis (0.24 MGD) shows these systems have an "existing demand" of around 0.34 MGD at the 10-year horizon.
- Coupling this baseline demand with projected residential/commercial development in the area as well as potential connections (Blackwater Falls State Park [BWFSP], Tucker County Landfill) the total treatment capacity needed within a 10-year horizon is estimated at 0.75 MGD, at minimum.
- If development accelerates, and privately held tracts are built-out to their potential, demand beyond the 10-year horizon could grow into the 2 to 4 MGD range. While this long-term development is largely speculative, it is important to consider when evaluating major improvements to the regional wastewater systems.

Town of Davis

- Davis' wastewater collection system is majorly impacted by Infiltration & Inflow (I&I). Davis' I&I is currently being studied and quantified by Rummel Klepper & Kahl (RK&K) consultants; however, a preliminary estimate suggests the magnitude of the I&I could be equivalent to several hundred single family homes (hydraulic loading equivalent, not organic loading equivalent).

- The Davis Wastewater Treatment Plant (WWTP) discharge permit is based on a flow of 0.12 MGD. The current average flow is 0.24 MGD with monthly averages as high as 0.37 MGD during wet periods.

- Davis' WWTP routinely exceeds mass-based limitations in their discharge. However, concentration-based permit limits are typically in compliance, i.e., the WWTP is meeting treatment goals under current conditions but is exceeding its permitted discharge load to the stream due an "inconsistency" between permitted flowrate and experienced flowrate.

- Through a combination of I&I separation and permit modifications, POTESTA believes Davis could accommodate modest growth (there is likely a couple hundred residential units of equivalent capacity that could be "freed up").

- However, to allow for more significant growth, much beyond say 0.30 MGD, major modifications to the WWTP would be necessary (e.g., conversion from a facultative lagoon to an aerated lagoon, installation of a nitrification polishing unit). These improvements would be technically challenging (e.g., would require taking an active WWTP offline, as well as the deepening of a lagoon in rocky terrain that is also in at least a portion of the floodplain), costly to implement, and given space limitations would likely "max out" at a capacity less than 1 MGD.

- In addition to the "constructability" limitations associated with increasing the capacity of the Davis WWTP, permit-related implications also begin to restrict its feasibility as larger treatment scenarios are considered, due to the Blackwater River's classification as a trout stream and current/proposed total maximum daily loads (TMDL). For example, permit limitations at 1 MGD would be 10 mg/L Biochemical Oxygen Demand (BOD) and 3 mg/L ammonia (about a third of current limits), and by 2 MGD the discharge fails anti-degradation review and would not be permittable. Therefore, looking beyond the current treatment facility (and receiving stream) is necessary for long term planning.

City of Thomas

- Thomas's WWTP routinely exceeds concentration limits for nitrogen (ammonia) and copper in their discharge. The WWTP's nominal design flow and permitted flow are 0.15 MGD. However, the system only averages 0.05 MGD with peak months of 0.11 MGD.

- Hydraulic and/or organic underloading does not appear to be a contributing factor in the WWTP's poor performance as it relates to ammonia removal. The challenges with meeting current treatment goals stem from the fact that the WWTP was not designed to meet current permit limitations (which would require the optimization of ammonia removal via nitrification). In addition – the above grade tanks and open-air lagoon coupled with the cold climate of the region inhibit treatment kinetics for much of the year.

- WWTP improvements such as insulation of the above grade tanks and lagoon, as well as the installation of a nitrification unit would be necessary to bring the WWTP into compliance under current conditions and would likely allow for modest growth.

- Water Quality studies and subsequent permit modifications such as a default mixing zone and a copper translator study would likely bring Thomas into compliance with copper, as well as provide some compliance benefit for ammonia.

- Thomas' I&I is not as high as Davis' and is more difficult to estimate without further study, given that their water system serves many customers outside of their sewer area. However, it may be a significant contributor to the fluctuation in influent BOD seen at the WWTP and further study should be included in planning for future system-wide upgrades.

- Following this combination of permit modifications and short-term improvements to the WWTP, the Thomas WWTP could likely accommodate some growth (equivalent to a couple hundred residential units) once it had demonstrated consistent compliance. However, given the age/condition of Thomas's WWTP facility and space limitations, the ability to keep pace with expected growth will likely be outstripped prior to the 10-year mark. Therefore, looking beyond the current treatment facility is necessary for long term planning.

Conclusions/Recommendations

- From a waste load allocation perspective, the North Fork of the Blackwater River is likely the only candidate for a receiving stream able to accommodate the projected long-term growth in the area (e.g., limits of BOD of 30 mg/L and ammonia of 4.65 mg/L at 2 MGD while the Blackwater mainstem fails anti-degradation review above 2 MGD).

- In the very short term - a combination of studies and permit modifications could benefit compliance at both the Davis and Thomas facilities (1–2-year timeline), such as a metal translator study (copper at Thomas), mixing zone studies, and increasing permitted flow at Davis. These studies and permit modifications would likely range from **$100,000 to $200,000.**

- It is important that each municipality formalize a compliance schedule with WVDEP to memorialize efforts to meet current treatment goals and increase capacity in the short term, as well as formalize a plan to transition to planned long term collection/treatment scenarios.

- In the short term at Davis - I&I reduction is the single most important infrastructure improvement. Combining this effort with a permit modification to increase flow to 0.30 MGD, the facility should be able to accommodate modest growth following these improvements. However, this "gained capacity" will be quickly outstripped if growth proceeds as projected (i.e., prior to a 10-year horizon). Estimates of I&I separation costs based on efforts from RK&K consultants are assumed to be **$6M**.

- In the short term at Thomas - permit modifications combined with facility improvements at the WWTP could bring the facility into compliance and allow for modest growth (once treatment efficacy is demonstrated). However, this gained capacity will also be quickly outstripped if growth proceeds as projected (i.e., prior to a 10-year horizon). Costs associated with the recommended Thomas WWTP improvements would likely range from **$750,000 to $1.25M.**

- Additional collection system improvements are also recommended for both the Davis and Thomas systems: I&I reduction at Thomas, connections to BWFSP and the Tucker County Landfill, as well as line extensions and pump station upgrades. These combined improvements could range from **$9.8M to $13.1M**

- To achieve the major increases in capacity needed to accommodate the projected demand in this region, the construction of a new, centralized WWTP is recommended. This facility would utilize modern treatment technologies and would need to discharge to the North Fork Blackwater River, potentially near Douglas. The treatment plant alone (nominal 1 MGD capacity initially, with room for expansion up to 2 MGD and beyond) could range from **$15.6M** to **$19.5M**. Coupled with the necessary pump stations, site development, decommissioning of existing facilities, and effluent line (together estimated at **$10.4M** to **$13.0M**) the total project cost for this centralized treatment facility to become operational could range from **$26M to $32.5M**. However, even if aggressively pursued, it is unlikely a centralized WWTP could be in operation prior to a 5-year timeline.

- Therefore, for a centralized WWTP to become operational prior to the existing facilities' capacities are again outstripped (following the recommended short-term measures to gain capacity), the planning and design of a centralized facility would need to begin immediately and at an accelerated pace, in parallel with the implementation of the recommended short-term improvements at the existing facilities.

- The development of a centralized WWTP would likely also require the formation of a new public utility.

END OF SECTION 1.0

2.0 CURRENT WASTEWATER INFRASTRUCTURE

The following sections provide a general overview of the current configuration of wastewater collection and treatment infrastructure in the Thomas and Davis region of Tucker County.

2.1 Town of Davis Wastewater System

Davis Municipal (Davis) is a sewer utility that operates a wastewater collection system and WWTP under NPDES Permit No. WV0024848 serving the following areas:

- Town of Davis
- Tucker County Industrial Park
- Corridor H (Rt. 48) – Rubenstein Juvenile Center
- Davis Center (Rt. 29)
- Pendleton Hills Condos
- Tuscan Ridge Subdivision

The approximate limits of Davis' current service area are illustrated in the map in **Appendix A**. The collection system was primarily constructed prior to 1960, and the treatment facility was constructed in the late 1960's. The following table summarizes its current configuration:

Table 1: Town of Davis Wastewater System – Overview

Population Served[1]	~ 840
Connections	435 (386 Residential, 49 Commercial)
Collection System	40,000 LF Gravity; 780 LF Force Main, 2 Pump Stations
Treatment Plant Design Flow	0.12 MGD to 0.30 MGD (minimal design information available) (currently averages 0.24 MGD with peak month of 0.37 MGD)
Treatment Technologies	Facultative Lagoon and Chlorination/Dechlorination
NPDES Permit	WV0024848 (Permitted Flow of 0.12 MGD)
Receiving Steam	Blackwater River
Combined Sewer Overflows (CSOs)	3

Source: Davis Municipal WVPSC Annual Report 2020
[1] Estimated based on US Census Persons per Household of 2.17 for Tucker County, 2015-2019

2.1.1 Davis - Discharge Monitoring Report Summary

A summary of recent discharge monitoring reports (DMRs, submitted by the utility monthly) for the years 2018 to 2021 is included in **Appendix B.** An overview is provided in the following table:

Table 2: Town of Davis DMR – Overview
July 2018 – July 2021 (NPDES WV0024848)

Parameter	No. of Exceedances
BOD – Quantity	23
BOD – Concentration	3
BOD - % Removal	4
Chlorine, Total Residual	0
Fecal Coliform	1
Copper, Total	0
Dissolved Oxygen	0
Flow	N/A – report only
Lead, Total	0
Nitrogen, Ammonia – Quantity	10
Nitrogen, Ammonia – Concentration	1
pH	0
TSS - % Removal	1
TSS – Quantity	29
TSS – Concentration	2
Zinc, Total	N/A – report only

Source: WVDEP eDMR Summary

As evidenced by this DMR data, the primary parameters that Davis has struggled to meet compliance on are Mass Loading Based Limitations such as BOD – Quantity (lbs./day); Nitrogen, Ammonia – Quantity (lbs./day); and Total Suspended Solids (TSS) – Quantity (lbs./day). The following ***Figure 1*** illustrates the relationship between influent flow and effluent concentrations of BOD, TSS, and ammonia.

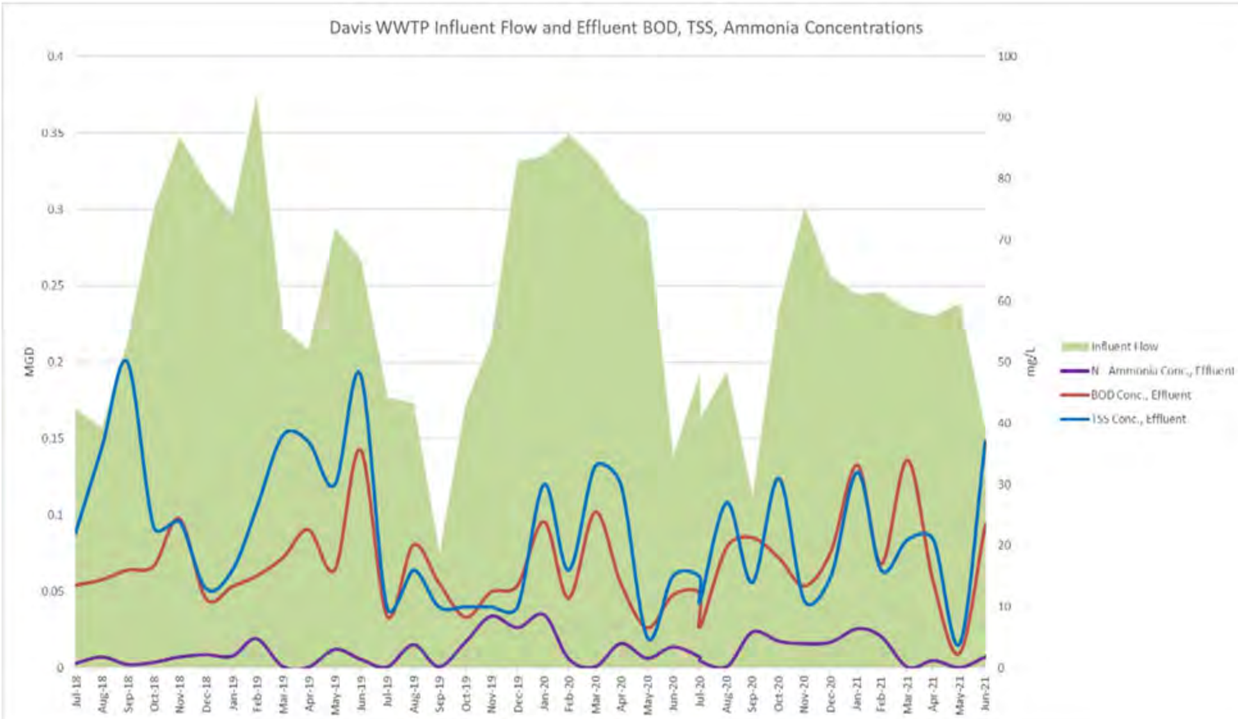


Figure 1 - Town of Davis WWTP Influent Flow and Effluent BOD, TSS, Ammonia Concentrations

As would be expected, effluent TSS and BOD concentrations are correlated with flowrate, i.e., as the WWTP experiences higher flowrates, its performance related to removing BOD and settling TSS is reduced (though there are some aberrations from this pattern that deserve further study). In addition, the months of the year with the most frequent precipitation (during which hydraulic overloading is most common) are also the months of lower temperatures. Lagoon performance is known to suffer under colder temperatures, as water temperature significantly slows the biological treatment processes that provide BOD and ammonia removal.

It is also worthy to note that effluent ammonia concentrations are only weakly correlated with flowrate and appear to elevate during colder months. Therefore, this decline in ammonia removal performance is more likely due to low temperature-inhibition of nitrifying bacteria in the lagoon than it is to hydraulic overloading, though they are certainly both contributing factors.

Despite the cold weather and elevated flow related impedances to performance, the Davis WWTP still typically meets the current concentration-based limits s and is able to meet treatment goals. It is mainly the mass-based limitations that are pushed out of compliance by the increased flow rate.

In summary, during consistently warm and dry weather, Davis' WWTP discharge rarely exceeds permit limitations in regards either to concentrations (e.g., mg/L) or mass loading (e.g., lbs./day). In addition, effluent concentrations typically stay in compliance even during these wet weather periods. However, during wet weather Davis regularly exceeds mass loading limits due to elevated flow with slightly elevated concentrations. This is due to the strong influence of I&I of stormwater and groundwater that can more than double the flow experienced at the WWTP during wet weather. Also, the mass-based limitations are computed based on the permitted flow, so if the permitted flow were to be increased to 0.30 MGD, almost all these exceedances would cease.

2.1.2 Davis – Collection System and I&I Overview

Davis' collection system currently serves an estimated population of 840 people via 435 connections (386 Residential, 49 Commercial) and consists of approximately 40,000 linear feet (LF) of gravity collection line, 780 LF of force main, and 2 pump stations. Based on a review of the systems DMR's and discussion with system operators/managers, it is evident that the Davis' system suffers from very significant I&I in their collection system.

Historically, Davis receives an average of approximately 52 inches of rain per year (years 1944 to 2007) which is significantly higher than the West Virginia average of 45 inches and the US average of 38 inches. However, in the past decade, increased wet weather has led to increased I&I year-round. For example, the average precipitation for the years 2017 to 2020 was 62, which is 10 inches greater than the long-term average.

Table 3: Tucker County Precipitation Data

Year	Total Precipitation (in)
2017	61
2018	71
2019	54
2020	62

Source: USGS

Due to the large contribution of I&I to the collection system and the wet climate, Davis's WWTP can experience more than double the flow during historically wet months (Dec - April) than it does during historically dry months (July – Oct). The following data provides an example of this pattern that was experienced within one twelve-month period:

- Average Daily Flow, December 2019 to April 2020 = 0.331 MGD
- Average Daily Flow, June 2020 to October 2020 = 0.160 MGD

The Town of Davis has recently contracted an engineering consultant RK&K to study, quantify, and make recommendations regarding the I&I experienced by their wastewater collection system. This work is ongoing and I&I estimates were not available at the time this report was prepared. Quantifying the I&I currently impacting the Davis collection system is outside the scope of this report; however, for the purposes of this discussion it is possible to make a preliminary, rough order-of-magnitude estimate of I&I by reviewing flows at the WWTP (i.e., comparing wet and dry months) as well as reviewing the volumes of drinking water produced by the municipal water treatment plant (WTP) serving this area.

Using a simple method of reviewing the WWTP flows between historically wet and historically dry months, it can be estimated that I&I volumes vary somewhere between 0.10 MGD during moderate wet weather to more than 0.15 MGD during severe wet weather.

In addition, under the assumption that most of the Town of Davis's drinking water customers are also sewer customers, and that there are few sewer customers supplied by wells or other drinking water systems, the following figures can also be reviewed to further estimate I&I:

- Between July 2019 and June 2020, the Davis Municipal WTP on average produced approximately 0.131 MGD of drinking water.
  - During this same period, only approximately 0.068 MGD of this water was "sold" water, the remainder of the 0.131 MGD was either accounted for as lost (0.011 MGD, assumed to not enter the sewer system) or unaccounted for (0.053 MGD, due to main leaks or non-metered usage, unknown how much of this entered the sewer system)
  - Therefore, the amount of drinking water that could have made its way into the sewer collection system for this period was somewhere between 0.068 MGD and 0.112 MGD
- For this same period (July 2019 – June 2020), the WWTP received an average of 0.241 MGD of combined sewer flow.
- Therefore, the I&I can be crudely estimated by taking the difference between drinking water likely to have entered the sewer system (i.e., sanitary-only flows) and the combined sewer flows recorded at the WWTP.
- In conclusion, the I&I for this period likely ranged on average between 0.129 MGD and 0.173 MGD, or around 150,000 gallons per day (gpd) (62% of all flow).
- This magnitude of I&I flow is equivalent to approximately 530 single family homes (with 3 residents per home).

2.1.3 Davis – WWTP Overview

The Davis WWTP (***Figure 2***) consists of a bar screen, a 6-acre facultative lagoon (un-lined) as primary and secondary treatment, and a chlorination/dechlorination unit serving as disinfection. The facility was constructed in the late 1960's, based on a design of "1 acre water surface per 200 persons" to serve a population of 1,200 according to a note on the original permit drawings. There are no current design guidelines from the WVDHHR to support a design capacity of surface area to population. POTESTA cannot confirm whether this was a design capacity decision at the time the lagoon was originally constructed or if it simply worked out to that based on the available area in which a lagoon could be built. To POTESTA's knowledge the facility has not had major improvements since then other than the recent increase of a portion of the southernmost embankment to increase available storage capacity/elevation to make this area consistent with the remaining embankment elevations. The WWTP discharge is located on the Blackwater River, between the Town of Davis and Blackwater Falls State Park.

Figure 2 - Town of Davis WWTP

Facultative lagoons are a common treatment system in rural areas with both relatively small populations and the available real estate to accommodate this land-intensive method. This "technology" has been in use in the United States for over 100 years, and as of 2002 there were over 7,000 facultative lagoons in operation in the United States. In summary, their defining characteristic is they are not mechanically mixed or mechanically aerated. The upper layer of water is passively aerated by the atmosphere as well as algal respiration. Aerobic microorganisms occupy the upper layer, while the bottom layer consists of sludge deposits and anaerobic microorganisms. The anoxic middle layer is occupied by facultative microorganisms.

These layers perform different functions and are typically stable during stratified periods of the year but can experience turnover and disruption in the Fall and Spring. BOD and ammonia removal are typically satisfactory in an adequately sized facultative lagoon; however, in colder climates, nitrification can be significantly inhibited during colder months, which can pose challenges meeting ammonia limits. While not typically optimized for denitrification, some facultative lagoons also achieve denitrification under favorable conditions.

Table 4: Facultative Lagoons – Pros and Cons

Pros	Cons
Easy to operate	Ammonia removal suffers during cold weather
Low energy costs	Land intensive (~1 acre for every 50 homes)
Produces less sludge compared to aerated processes	Difficult to predict ammonia removal
Good settling characteristics if sized properly	Requires periodic dredging

While it has been established that Davis's collection system suffers from significant I&I issues, and this leads to regular violation of mass loading limits, the Town of Davis, situated at 3,100 feet, is the highest municipality in West Virginia and experiences long durations of cold weather in the winter. From a review of Davis' recent DMRs, it is likely that ammonia removal is likely inhibited during the winter months, as nitrification activity is greatly reduced at water temperatures below 50 degrees F. Effluent concentrations of ammonia at the Davis WWTP typically range from below 1 mg/L to 3 mg/L in the warmer months and from 3 mg/L to 7 mg/L in the colder months. However, it should be noted that the Davis WWTP still typically maintains concentrations below their current permit limit (8.6 mg/L average monthly and 17.2 max daily) during the winter months.

Increased treatment capacity could be achieved by modifying the facultative lagoon to serve as an aerated lagoon (increase depth, add aerators and insulative covers) as well as installing a nitrification polishing unit (attached growth media). Converting a facultative or partial-mix aerated lagoon to complete mix configuration is in effect a lagoon expansion; the system can handle more flow and provide more treatment in the same or smaller footprint. Capacity could likely be increased up to approximately 1 MGD or beyond utilizing this approach. However, there are technical challenges such as rocky terrain, floodplain considerations, and the need to continue treatment operations during construction that would increase costs (Total project cost would likely be in excess of $4M). In addition to these technical and financial challenges with increasing the capacity of the Davis WWTP, as discussed in Section 4 permit-related implications also begin to restrict its feasibility as larger treatment scenarios are considered, due to the Blackwater River's classification as a trout stream and current/proposed TMDLs. For example, permit limitations at 1 MGD would be 10 mg/L BOD and 3 mg/L ammonia (about a third of current limits), and by 2 MGD the discharge fails anti-degradation review and would not be permittable. Therefore, looking beyond the currently treatment facility (and receiving stream) is necessary for long term planning.

In summary, the current issues experienced by the Davis WWTP are:

1. Very high rate of I&I leading to regular violations of mass-based permit limitations (e.g., lbs./day) even when concentration based limits (e.g., mg/L) remain in compliance.
2. Relatively low hydraulic retention time (HRT) would pose challenges meeting stricter BOD and ammonia limits if permitted flow was increased beyond approx. 0.30 MGD.

3. Being uncovered and in a cold climate, the lagoon experiences decreased performance, especially ammonia removal, during the colder months – would likely be an issue when if permitted flow is increased beyond approximately 0.30 MGD.
4. Improvements such as insulative covers, aeration equipment, lagoon deepening, and nitrification polishing units could increase capacity up to 1 MGD; however, such improvements would be costly and such investments may best be allocated towards a centralized facility.

2.1.4 Davis - Previous and Planned Improvement Projects

No major improvement projects are currently in progress. Davis has recently contracted an engineering consultant to study I&I.

2.2 City of Thomas Wastewater System

The City of Thomas Sewer (Thomas) is a sewer utility that operates a wastewater collection system and wastewater treatment plant (WWTP) under NPDES Permit No. WV0024856 serving the following areas:

- City of Thomas
- Cortland Acres (Rt. 48 West)
- Mountain State Brewing and surrounding development (Rt. 48 East)

The approximate limits of Thomas' current service area are illustrated in the map in **Appendix A.** The treatment plant was originally constructed in the late 1990's, and the following table summarizes its current configuration:

Table 5: City of Thomas Wastewater System Overview

Population Served[1]	~ 650
Connections	321 (300 Residential, 21 Commercial)
Collection System	13,424 LF Gravity; 1,225 LF Force Main, 2 Pump Stations
Treatment Plant Design Flow	0.15 MGD (currently averages 0.05 MGD with of peak month of 0.11 MGD)
Treatment Technologies	Two Aeration Tanks, Aerated Lagoon, and Chlorination/Dechlorination
NPDES Permit	WV0024856 (Permitted Flow of 0.15 MGD)
Receiving Steam	North Fork Blackwater River
Combined Sewer Overflows (CSOs)	1

Source: City of Thomas Sewer WVPSC Annual Report 2020
[1] *Estimated based on US Census Persons per Household of 2.17 for Tucker County, 2015-2019*

2.2.1 Thomas - Discharge Monitoring Report Summary

A summary of recent discharge monitoring reports (DMRs, submitted by the utility monthly) for the years 2018 to 2021 is included in **Appendix C.** An overview is provided here:

Table 6: City of Thomas DMR Overview
July 2018 – July 2021 (NPDES WV0024856)

Parameter	No. of Exceedances
Aluminum, Total	0
BOD – Quantity, Average	0
BOD – Quantity, Max	0
BOD – Concentration, Average	7
BOD – Concentration, Max	4
BOD - % Removal	4
Chlorine, Total Residual	0
Hexavalent Chromium	0
Fecal Coliform	0
Copper, Total	18
Dissolved Oxygen	10
Flow	N/A – report only
Iron, Total	5
Lead, Total	2
Nitrogen, TKN – Quantity, Average[1]	7
Nitrogen, TKN – Quantity, Max[1]	5
Nitrogen, TKN – Concentration, Average[1]	26
Nitrogen, TKN – Concentration, Max[1]	16
Nitrogen, Ammonia – Quantity, Average[1]	0
Nitrogen, Ammonia – Quantity, Max[1]	0
Nitrogen, Ammonia – Concentration, Average[1]	2
Nitrogen, Ammonia – Concentration, Max[1]	2
pH	0
TSS - % Removal	1
TSS – Quantity	0
TSS – Concentration	3
Zinc, Total	N/A – report only

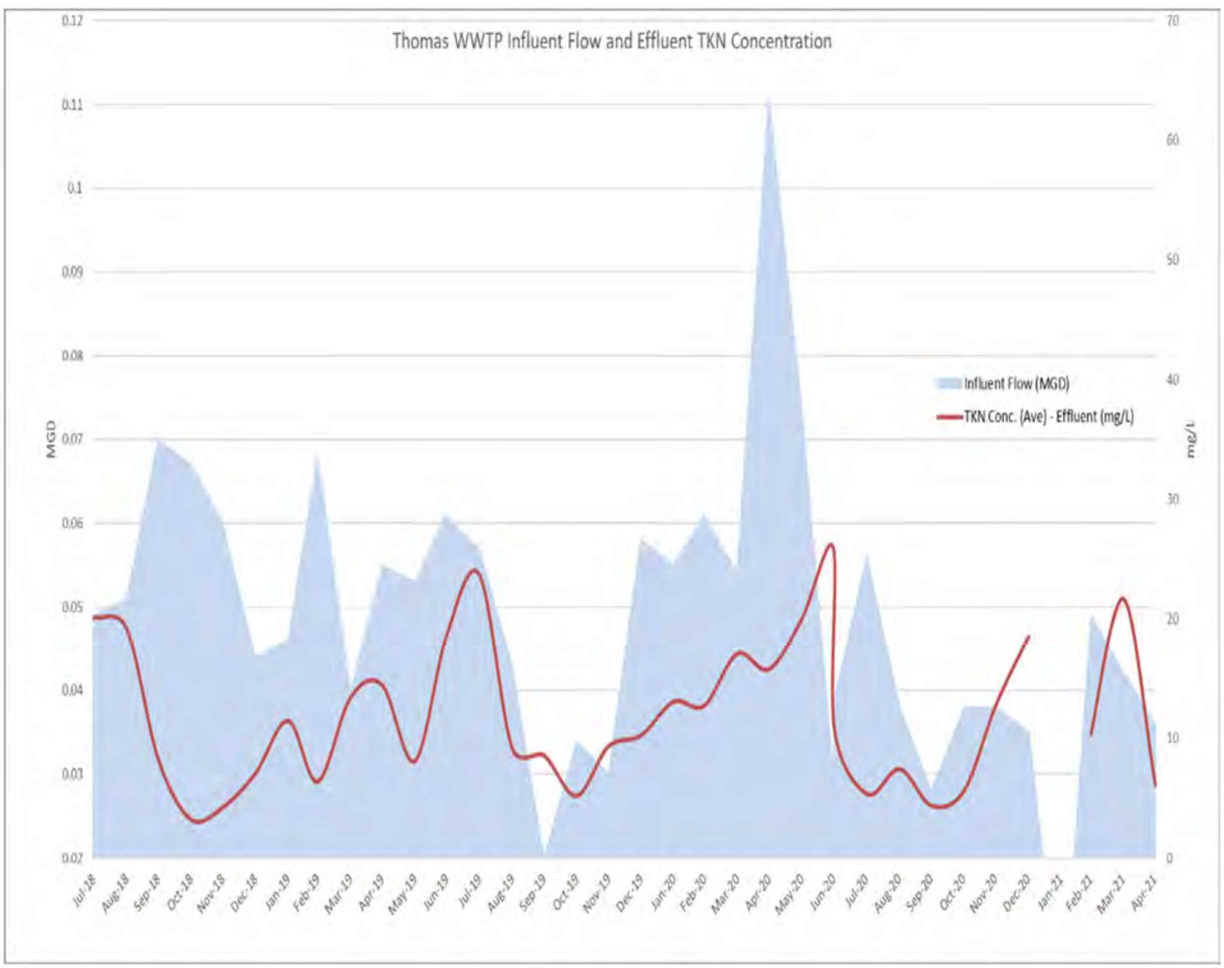
Source – WVDEP eDMR Summary

[1]*As of June 2021, Thomas' NPDES Permit has changed from reporting Nitrogen as TKN to Nitrogen as Ammonia, both are presented here for historical data.*

As evidenced by this DMR data, the primary parameters that Thomas has struggled meeting compliance on concentrations are nitrogen (previously reported as TKN, currently reported as ammonia) and copper, with occasional BOD and DO exceedances as well. While nitrogen is a common parameter of concern for municipal wastewater and requires the nitrification process to remove, elevated levels of copper are not as common. The removal of nitrogen is discussed in Section 2.2.3. The most common sources of copper in municipal sewage are stormwater runoff and corrosion of potable water plumbing (e.g., from cuprosolvent drinking water with low pH and hardness). In some collection systems, relatively high copper loads can be attributed to relatively few industrial users with elevated metals in their waste stream (e.g., metal plating, manufacturing, wood preservatives, brewing). Further study is needed to determine the source(s) of copper and whether action can be taken to reduce influent copper load.

As shown in ***Figure 3***, it was previously thought that the acceptance of leachate from the Tucker County Landfill (in quantities up to approximately 0.02 MGD) was a significant source of nitrogen and metals, and was contributing to “pass-through”, leading to high effluent levels of these parameters. However, since the Thomas WWTP ceased accepting landfill leachate in the year 2018, the frequency of exceedances has persisted, ruling this out as the main factor.

Figure 3 - City of Thomas WWTP Influent Flow and Effluent TKN Concentrations



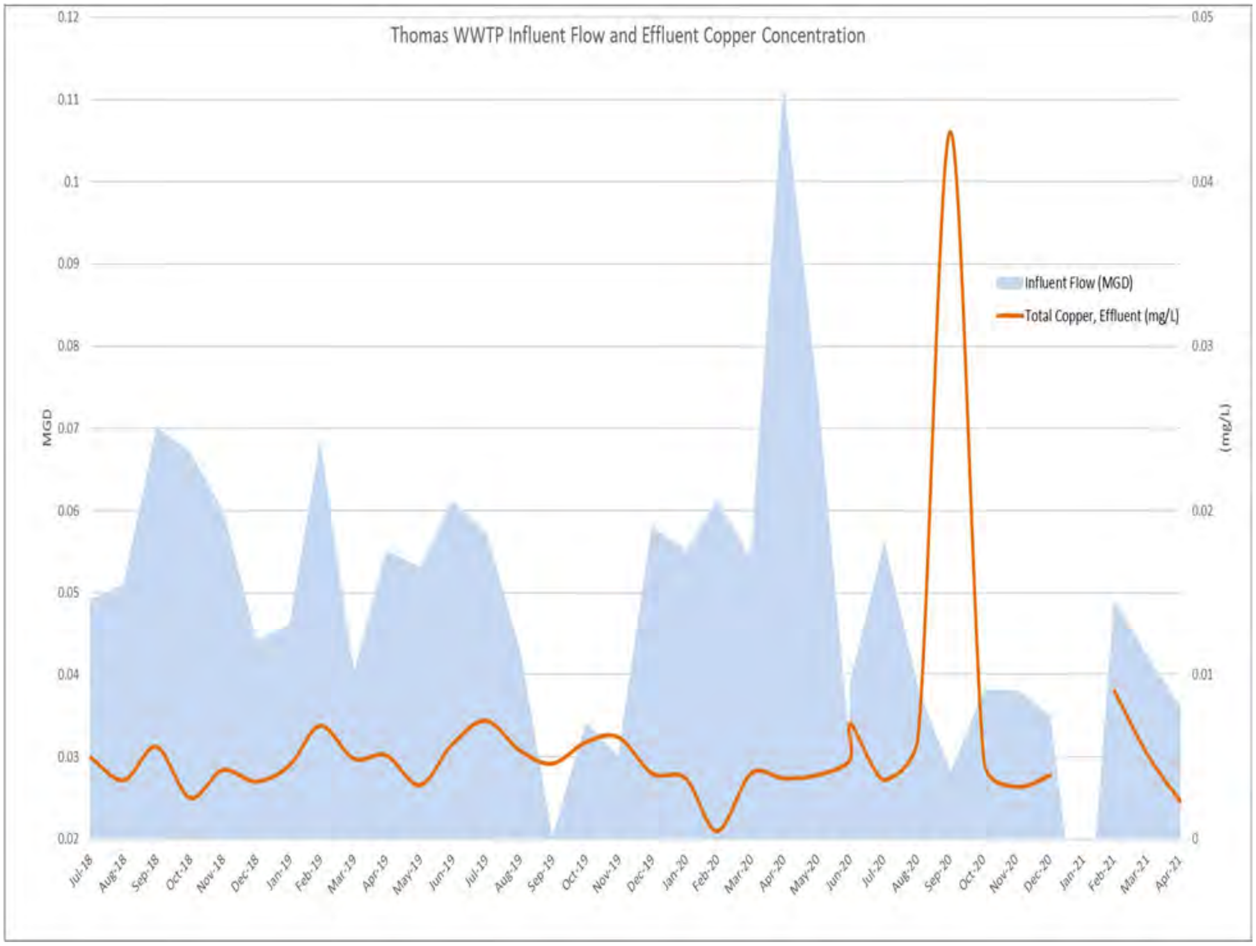


Figure 4 - City of Thomas WWTP Influent Flow and Effluent Copper Concentrations

As shown in ***Figure 4,*** there does not appear to be a strong correlation between influent flow and either TKN (nitrogen) or copper effluent concentrations. However, this data is based on a limited number of grab samples collected only twice monthly, on average. Further data collection/analysis would be required to make conclusions, but this data suggests that hydraulic overloading or underloading is likely not a contributing factor to Thomas' difficulties in meeting these treatment goals. Other factors contributing to these exceedances such as WWTP design, treatment technologies, and operational issues are discussed in Section 2.2.3 below.

2.2.2 Thomas – Collection System and I&I Overview

Thomas' collection system currently serves an estimated population of 650 people via 321 connections (300 Residential, 21 Commercial). Based on a review of the systems DMR's and discussion with system operators/managers, it is evident that the Thomas system does not experience near the magnitude of I&I in their collection system that Davis does. This is largely due to the historical layout of the system as well as sewer separation projects that have been previously undertaken by the Thomas. However, based on discussion with Thomas's operators and observation of the aggregate/debris present in their WWTP headworks, I&I is an issue in the Thomas collection system.

Thomas has recently contracted an engineering consultant (Civil & Environmental Consultants, CEC) to study, quantify, and make recommendations regarding the I&I experienced by their wastewater collection system. This work is ongoing and I&I estimates were not available at the time this report was prepared. Quantifying the I&I currently being experienced by the Thomas system is outside the scope of this report; however, for the purposes of this discussion it is possible to make a preliminary, rough order-of-magnitude estimate of I&I by comparing flows at the WWTP to the volumes of drinking water produced by the municipal water treatment plant (WTP) serving this area. This estimate relies on the over-simplified assumption that all of Thomas' drinking water customers are also sewer customers, and that there are little to no sewer customers supplied by wells or other drinking water systems. There is inherent error in this method as it is known that there are multiple large water users (e.g., Tucker County High School) that are not connected to the municipal sewer:

- Between July 2019 and June 2020, the Thomas WTP on average produced approximately 0.076 MGD of drinking water.
    - During this same period, only approximately 0.034 MGD of this water was "sold" water, the remainder of the 0.076 MGD was either accounted for as lost (0.016 MGD, assumed to not enter the sewer system) or unaccounted for (0.026 MGD, due to main leaks or non-metered usage, unknown how much of this entered the sewer system)
    - Therefore, the amount of drinking water that could have made its way into the sewer collection system for this period was somewhere between 0.034 MGD and 0.060 MGD
- For this same period (July 2019 – June 2020), the WWTP received an average of 0.051 MGD of combined sewer flow.
- Therefore, the I&I can be crudely estimated by taking the difference between drinking water likely to have entered the sewer system (i.e., sanitary-only flows) and the combined sewer flows recorded at the WWTP.
- In conclusion, the I&I for this period likely was less than 0.017 MGD ***(less than 33% of all flow).***

Based on conversation with Thomas' operators, I&I is still significant in the Thomas collection system, and further efforts are currently being taken to quantify and reduce I&I.

2.2.3 Thomas – WWTP Overview

As seen in ***Figure 5,*** the Thomas WWTP's treatment process consists of screening/grit removal at the headworks, two (2) approximately 200,000-gallon complete mix tanks (each with an internal wall, creating 4 tank cells total), a 0.1-acre aerated lagoon cell, and a 0.2 acre settling lagoon cell, followed by a chlorination/dechlorination unit serving for disinfection. The facility was constructed in the late 1990's with a nominal treatment capacity of 0.15 MGD and has not had significant improvements since then. The WWTP discharge is located on the North Fork Blackwater River, just below downtown Thomas and upstream of Douglas.

The aeration tanks, in effect, behave similarly to a complete-mix aerated lagoon (i.e., all solids are kept in suspension with a very high rate of aeration) and there is no sludge recycle (i.e., no return of activated sludge to control mixed liquor suspended solids [MLSS]). The subsequent aerated lagoon cell is a partially mixed lagoon followed by a settling cell.

Figure 5 – City of Thomas WWTP

In June 2018 correspondence with the WVDEP, Thomas identified the following as main contributors to their difficulty in meeting compliance: (i) increasingly stringent permit limits, (ii) operational issues such as low organic loading, low food to mass (F/M) ratio, lack of sludge return piping and insufficient Solids Retention Time (SRT), over-aeration of cells 3 and 4 inhibiting an anoxic zone. It was also claimed that the increased organic loading from the landfill leachate would serve to benefit operations and aid in meeting permit limitations. They also noted that they were relying on bioaugmentation (seeding with freeze dried bacteria) to increase nitrification.

Also, in the June 2018 correspondence, Thomas identified the following WWTP upgrades they believed would be required to achieve compliance:

- "Blower Piping and Timer modifications for Cells 3 and 4, to control DO concentrations after carbonaceous BOD removal in Cells 1 and 2. The City of Thomas and the Tucker County Landfill has low BOD (~100 mg/L) and therefore the WWTP influent results in insufficient food for biomass formation to support the large Sludge Retention Time (SRT). A robust biomass is needed to degrade the organic nitrogen component of TKN"

- "Sludge Return Pumping System to control the MLSS/MLVSS concentrations in the bioreactors (cells 1-4). The additional biosolids are needed for a more robust biomass as explained above. The Thomas WWTP staff will continue bioaugmentation with freeze-dried bacteria, but additional food is needed to support the biomass for the nitrification process in Cells 3 and 4."

- "Alkalinity Chemical Feed System to control the nitrification process pH near the optimum range of 7.8 to 8.0…."

- "…influent wastewater will need to be heated to greater than 45 degrees F and the above grade steel bioreactors insulated for the nitrification process to be successful in winter months"

Based on POTESTA's review of Thomas' treatment technologies, plant layout, permit limitations, as well as discussion with the operators, some of these conclusions/recommendations are valid; however, the reason for some of these conclusions/recommendations is not clear, such as why operators had aimed to create an anoxic zone in cell 3, the belief that the incoming waste stream was chronically deficient organically to maintain biomass, or the theory that accepting leachate would aid in treatment efficiency.

The following narrative summarizes the Thomas WWTP design and operations as they relate to the parameters with which Thomas has historically struggled to meet treatment goals: BOD, ammonia, copper, and dissolved oxygen.

BOD:

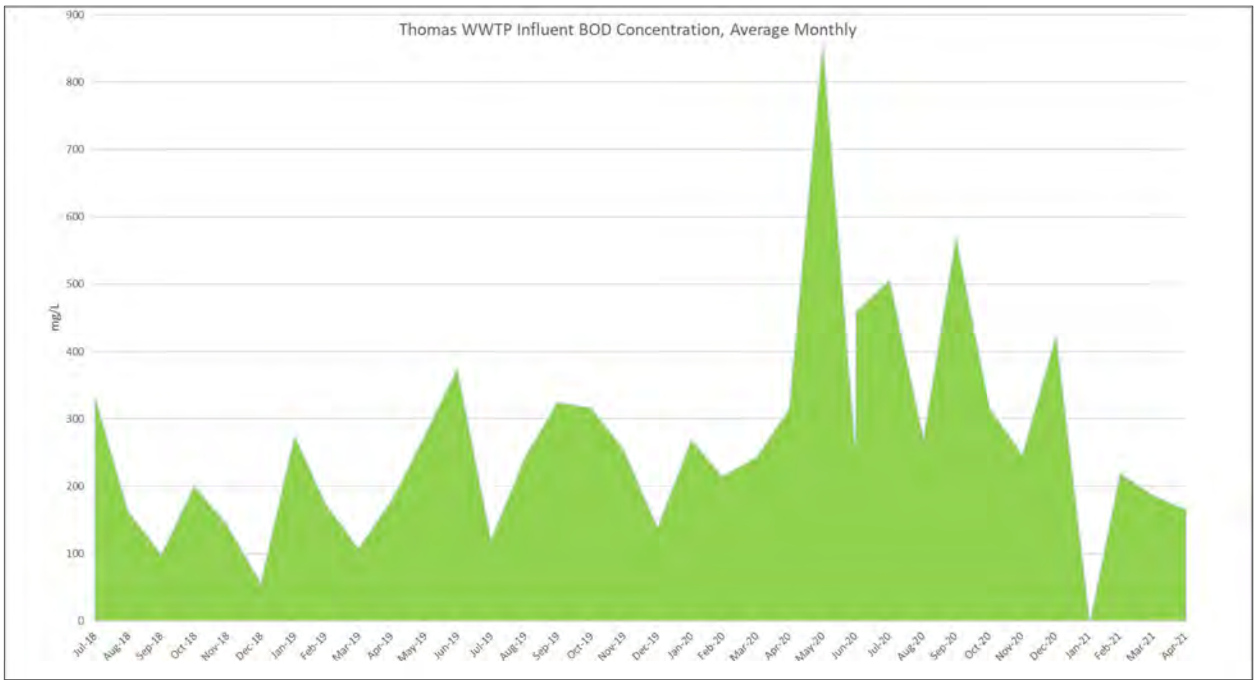


Figure 6 – City of Thomas WWTP Influent BOD Concentration, Average Monthly

As illustrated by ***Figure 6***, influent BOD at the Thomas WWTP has extreme variation, from very dilute (<100 mg/L) to highly concentrated (>800 mg/L). However, this data is based on a very limited number of grab samples, typically only two per month, so additional data collection would be required to establish daily/weekly trends and identify contributing factors. Likely contributors to this trend could be (i) the Thomas system is very small and therefore the irregular peaks/valleys of wastewater demand (and concentration) are more exaggerated, as they are not evened out as they would be by larger population, (ii) an industrial or commercial customer could be contributing significant BOD loading in a "batch" pattern (e.g. brewing/distilling, manufacturing, etc.), and (iii) I&I in the collection system coupled with its small size can create highly dilute influent. Regardless of the contributing factors, such variation in influent BOD concentrations pose a challenge to maintaining the consistent and healthy biomass required for biological treatment.

Despite this extreme variation in BOD loading, Thomas has been able to meet their BOD removal goals relatively consistently, despite issues in Summer/Fall 2020. It is possible that the fluctuations in BOD concentration are attenuated by sufficient hydraulic retention time in the aerated treatment process. For example – the hydraulic retention time (HRT) for the combined volume of the two aerated tanks at the average flow rate of 50,000 gpd is approximately 8 days, and the average influent BOD concentration of 263 mg/L, which is considered moderate-strength, typical for a municipal waste stream. So, if this average is regularly achieved over the course of a day or even a period of a couple days, regardless of spikes/drops, the effects of the BOD variation would be minimized by mixing/equalization, and sufficient contact time would be achieved for BOD removal. This theory is supported by the fact that the plant only experiences occasional exceedances on BOD and typically has BOD removal rates above 90%. This would be expected, as a typical HRT range to achieve effective BOD treatment in a complete mix aeration system with no sludge recycle (e.g., aerated lagoon) aiming to achieve 90%+ BOD removal is between 2 to 12 days, which Thomas' HRT is within.

However, if Thomas' flow rate were to increase, decreases in HRT in the aerated tanks may inhibit BOD removal, as HRT would slip to the bottom of the typical range for this treatment type:

Table 7: City of Thomas WWTP Hydraulic Capacity

Flow Rate (gpd)	HRT in Aerated Tanks, Combined V= 400,000 gal (days)
50,000	8
100,000	4
150,000	2.7
200,000	2

It should also be noted that BOD removal, while not as temperature sensitive as nitrification, does slow significantly with cooler temperatures. However, based on a review of Thomas' DMRs, BOD removal does not appear to suffer significantly in the cooler months. This would again suggest that aeration rate and HRT in the tanks and aerated lagoon cell are currently adequate for BOD removal even during the colder months. Based on simple design theory, the Thomas WWTP could accommodate additional flow and still meet BOD removal goals. However, due to the known variation in BOD and the very low temperatures experienced in the above-grade steel tanks and open lagoons, additional study is needed to estimate the WWTP's available capacity as it relates to BOD removal.

More influent/effluent sampling and operational monitoring would be necessary to confirm these theories. However, since (i) the current aeration rate and HRT are within acceptable design ranges for BOD removal, (ii) additional sewer customers may help to reduce BOD variation, and (iii) since exceedances for BOD are relatively rare compared to other parameters, this is not currently considered a major issue for the Thomas WWTP, and the Thomas WWTP currently has excess capacity as it relates to BOD removal.

Ammonia:

The ammonia limits on Thomas' discharge are relatively low compared to other treatment plants with which many regional operators and consultants have experience. Removal of ammonia in biological wastewater treatment is achieved through the process of nitrification, though most plants only achieve "partial nitrification" which results in residual ammonia in the effluent. To achieve the high level of ammonia removal needed to meet Thomas' treatment goals, the treatment process(es) must be optimized for nitrification.

The following generalized review of the nitrification process is helpful in the understanding of why the Thomas WWTP struggles to meet current treatment goals as it relates to ammonia:

1. The forms of nitrogen most common in wastewater are ammonia (NH4+), nitrate (NO3-) and organic nitrogen in the form of amines and other nitrogenated compounds. TKN is comprised of organic nitrogen + ammonia, and does not include nitrate and nitrite, and this organic nitrogen is typically converted to ammonia during biological treatment.

2. *Nitrification* is a two-step biological process where autotrophic bacteria oxidize the ammonium ion to nitrite (Nitrosomonas bacteria) and then oxidize nitrite to nitrate (Nilrobacter bacteria). Put simply – ammonia is consumed as food by bacteria in an aerobic process.

    a. *Denitrification* is also a biological process utilized in wastewater treatment which converts nitrate to nitrogen gas; however, it differs significantly from nitrification in that it is an anaerobic process that involves the use of a carbonaceous food source (BOD) and the use of nitrate/nitrite as the electron acceptor (in place of oxygen).

3. As an aerobic process, nitrification exhibits a significant oxygen demand (minimum DO level of 2.0 mg/L is recommended). It produces a relatively small biomass compared to heterotrophic processes (i.e., BOD removal), but also consumes significant alkalinity.

4. Nitrifying bacteria do not compete well against heterotrophic bacteria, so soluble BOD must be reduced (generally down to 20-30 mg/L) before nitrification can occur. Therefore – this process typically takes place later in the treatment train (near the end of the lagoon or in a tertiary treatment unit).

5. Nitrification is a relatively slow process, activated sludge plants (i.e., plants with sludge recycle) can nitrify in 6-48 hours, but lagoons and ponds sometimes require HRT of 30 days or longer.

6. Nitrification is enhanced at higher pHs; a range of 7.5-8.5 is ideal. Also - sufficient alkalinity must be present to buffer the pH, as acids are produced in the nitrification process. Some lagoons and polishing ponds are limited in nitrification by lack of alkalinity. Algae (during warmer months) can also compete for the available alkalinity and impede nitrification.

7. Nitrification is very sensitive to cold temperatures. The process slows almost completely around 40 degrees F.

8. Nitrifying bacteria are attached growth organisms (i.e., they must be attached to an object). In a completely mixed treatment scenario, that object is a floc particle, and therefore can be flushed/removed from the system rapidly. This is why most WWTPs with enhanced nitrification utilize activated sludge for biological treatment (longer SRT allows nitrifiers to be retained) as well as trickling filters or other forms of attached media to accommodate and retain a healthy population of nitrifying bacteria. In lagoons, nitrifiers can only attach to side slopes, baffles, and other solid matter and therefore are relatively limited.

In summary, if any of the required conditions for efficient and complete nitrification are not met (e.g., sufficient oxygen, minimal BOD, adequate retention time, pH and Alkalinity needs, warm temperatures, and adequate growth surface) the treatment process will only achieve partial nitrification.

From POTESTA's preliminary review of the Thomas WWTP design and operations, the following conclusions can be made related to ammonia removal:

- The above-grade steel tanks and un-covered lagoon significantly limits nitrification during cold and cooler months when water temperatures are consistently below 50 F. According to information provided by Rick Watson (previous assistance provider with Rural Community Assistance Program, RCAP), water temperatures in the WWTP can dip below 40 F for weeks at a time during cold periods.

- The lack of sludge recycle or an attached growth media significantly limits nitrification due to the inability to retain a nitrifying biomass.

- Retention time is likely inadequate under current conditions for complete nitrification, but if temperature and biomass retention issues are remedied, this may no longer be a limiting factor.

- Multi-seasonal monitoring of pH and alkalinity at the WWTP would be needed to determine whether pH and alkalinity may also be limiting nitrification. This data is not currently available.

- Dissolved oxygen levels are likely not a limiting factor, but further study is needed to confirm this.

<u>Copper:</u>

As noted in 2.2.1 above, further study is needed to establish the source of elevated copper in the influent wastewater. Separation of I&I, updates to residential plumbing, or modifications to drinking water treatment may alleviate this issue. Conventional municipal sewage treatment processes are not optimized for removal of metals and are often relatively ineffective at removal of copper. POTESTA believes that it may be more effective to pursue identification and reduction of the copper source(s) and/or a copper translator study (described in Section 4.3) than it would be to add treatment processes such as coagulation/settling or filtration to achieve copper removal at the WWTP.

Dissolved Oxygen:

The final two treatment steps at the Thomas WWTP (settling lagoon cell and chlorination/dechlorination), are both relatively slow-moving and non-aerated (i.e., do not gain oxygen) and the lagoon settling cell may experience significant oxygen demand/loss due to nitrification. Therefore, it is not unexpected that Thomas occasionally struggles with meeting DO limits. Most plants achieve a DO increase prior to the outlet with post-aeration, which Thomas does not currently have. A step aeration ladder was fabricated a few years ago and is currently on-site, but it is not installed.

2.2.4 Thomas - Previous and Planned Improvement Projects

No major improvement projects are currently in progress. Thomas has recently contracted an engineering consultant to study and develop plans for future improvements.

2.3 Tucker County Landfill

The Tucker County Landfill is an approximately 60-acre (permitted area) landfill that began operation in 1989 and is owned and operated by the Tucker County Solid Waste Authority with oversight currently being provide by the West Virginia Solid Waste Management Board. The landfill accepts only a small percentage (10-15%) of its waste from Tucker County. The majority of the waste is transported from Grant, Hampshire, Hardy, Mineral, Pendleton, and Randolph Counties as well as Garrett County Maryland. Significant surrounding land is also available for landfill expansion.

The landfill includes a leachate collection system that conveys leachate produced from various landfill cells to central locations. The following table summarizes leachate volumes produced at the landfill in recent history:

Table 8: Tucker County Landfill – Summary of Leachate Volumes

Fiscal Year	Daily Leachate Production Yearly Average (gpd) *rounded*	Daily Leachate Production Peak Month (gpd) *rounded*
2019-2020	19,000	32,000
2018-2019	30,000	55,000
2017-2018	23,000	39,000
2016-2017	25,000	46,000
2015-2016	17,000	32,000
2014-2015	16,000	33,000

While the average across a year's span is approximately 21,000 gpd in recent history, during spring runoff season and generally wet periods, peak production can average over 40,000 gpd for months at a time.

The landfill currently represents a significantly sized Industrial User that does not have access to nearby wastewater treatment. Prior to 2017, leachate was trucked from the landfill to Thomas WWTP (distance of approximately 2 miles) where up to 20,000 gpd was accepted for treatment. Following a 2017 consent order from WVDEP to the City of Thomas, leachate is no longer being accepted at the Thomas WWTP since 2018. Currently, all leachate is hauled to WWTP'S located in Moorefield, WV and/or Westernport, MD for disposal/treatment (both an approximate distance of 45 miles).

The following summarizes the treatment and hauling costs for the 2019-2020 fiscal year at the Tucker County Landfill:

- Total Leachate Volume = 7,030,901 gallons (average of ~19,300 gpd)
- Total Hauling Costs (contract hauling, maintenance, fuel, wages) = $162,059
- Total Treatment Costs = $173,343
- Total = $335,402, or ~ $0.48 per gallon

In addition, the liability and environmental risk associated with regularly hauling leachate over long distances is a concern for the Landfill. The development of a local treatment facility that could accept leachate from Tucker County Landfill would both greatly reduce Tucker County Landfill's financial burden of hauling (currently comprising nearly half of disposal costs), reduce risk associated with hauling leachate, and provide the receiving treatment system with a consistent, moderate-volume industrial user as a revenue stream.

For example, based on the 2020 PSC Reports, total annual operating revenues for the two local treatment facilities were $166,563 (Thomas) and $108,743 (Davis). Assuming the revenue gained from accepting the landfill leachate would be similar in magnitude to the current treatment fees paid by the landfill, ***the receiving facility would gain a revenue increase of 104% (Thomas) or 160% (Davis) while only increasing treatment volume by 43% (Thomas) or 9% (Davis).*** However, it is also important to note that leachate is a higher strength wastewater and has higher associated treatment costs per gallon (i.e., more aeration and sludge production per gallon treated), and elevated metal loading may restrict the total volume and rate at which leachate could be accepted.

In addition, before these facilities could consider accepting leachate from the Tucker County Landfill, WWTP upgrades and operational adjustments would be required to both demonstrate consistent compliance in the absence of accepting leachate and to gain the additional hydraulic/organic capacity needed to properly treat the leachate.

In general, landfill leachate can be high in organic and/or nutrient concentrations (i.e., BOD, nitrogen) and has the potential to be high in metals (e.g., iron, zinc, copper, etc.) with significant variations in pH. Pre-treatment is sometimes required prior to discharging leachate to a publicly owned treatment works (POTW) due to these elevated parameters. A summary of Tucker County Landfill's leachate testing is included in a DMR Summary in **Appendix D** (IU03 at Hardy County Wastewater Authority NDPES Permit No. WV0106038). **Table 9** shows an overview of the leachate characterization based on a 20,000 gpd max daily limit.

Table 9: Leachate Reporting Overview, August 2019 – June 2021

Tucker County Landfill

IU03 at Hardy County Wastewater Authority (NPDES WV0106038)

	BOD (mg/L)	TSS (mg/L)	pH	TKN (mg/L)	Copper, Total (mg/L)	Iron, Total (mg/L)	Lead, Total (mg/L)	Zinc, Total (mg/L)
Average	29	38	6.9 (min) 8.6 (max)	147	0.095	4.6	0.00013	0.017
Max	120	87		225	2.20	23.4	0.00300	0.042

Based on this limited review of the leachate characterization, the following can be concluded:

- BOD and TSS concentrations are significantly lower than typical municipal sewage (i.e., low organic and solid loading)
- pH is within a relatively neutral to slightly alkaline range and would likely not be problematic for receiving system.
- Lead is relatively low and would likely not be problematic for receiving system.
- Zinc concentrations are low to moderate. Would likely not lead to compliance issues; however, would require further study to evaluate potential for "pass through".
- Compared to typical municipal sewage with concentrations of 35-60 mg/L TKN, the landfill's leachate has high concentrations of TKN (average of 147 mg/L, 2019-2021). Receiving facility would need to have a dedicated and optimized nitrification process.
- Copper and iron concentrations are elevated and may pose challenges. Limits on volume as well as determination of blending rates may need to be established and monitored to stay within permit limitations, or pre-treatment may need to be considered. However, according to published research, insoluble copper removal rates at activated sludge treatment plants may range as high as 94% when operating at higher SRT (Santos et al., 2010). Further characterization of these metals (i.e., soluble vs insoluble) in the leachate is recommended during future study.
- In summary, further study and characterization of this waste stream is needed, but with optimized nutrient removal, strategic blending rates, and further data on metals removal rate, it may be feasible for local WWTP facility/facilities in Tucker County to accept leachate in the future.

2.4 Blackwater Falls State Park

The West Virginia Department of Natural Resources currently operates four (4) package sewage treatment plants at Blackwater Falls State Park. The four plants serve various areas of the park including the Pendleton Lake area, the campground, the lodge, and the two cabin areas. The plants have nominal capacities of 11,000 gpd, 4,000 gpd, 20,000 gpd, and 6,000 gpd, respectively for a combined nominal capacity of 41,000 gpd.

Based on discussion with WVDNR, it is understood that the Blackwater Falls State Park facility is interested in decommissioning their wastewater treatment facilities and having their wastewater be treated at a nearby facility.

The following summarizes the flow rates and number of exceedances for each of the four plants from 3rd quarter 2018 to 2nd quarter 2021:

Table 10: Blackwater Falls State Park

Summary of Flow Rates 3rd Quarter 2018 to 2nd Quarter 2021

Facility Name	Average Flow (gpd)	Max Flow (gpd)	Exceedances
Lodge/Restaurant (Outlet 001) NPDES WVG551188	10,000	14,550	1 (Fecal Coliform)
Campground/Lake/Baths (Outlet 002) NPDES WVG551189	1,270	2,880	3 (Fecal Coliform, BOD, TSS)
Cabins (Outlet 003) NPDES WVG55190	1,700	3,000	5 (Ammonia, Fecal Coliform, BOD (2), TSS)
New Cabins (Outlet 001) NPDES WVG551433	1,400	8,255	5 (Flow, Fecal Coliform, BOD (2), Ammonia)
Total	***14,370***	***28,685***	***14***

State Park visitation in Tucker County (including Blackwater Falls State Park and Canaan Valley Resort State Park) increased 27% from fiscal year 2019-20 to 2020-21. Visitation is expected to continue to increase in coming years. Therefore, the current and future wastewater demand of Blackwater Falls State Park is significant compared to the local municipalities' and should be considered during the sizing/upgrades of nearby treatment facilities.

To convey the wastewater from each of the park's facilities to the nearest municipal treatment facility (Davis WWTP), multiple pump stations would be required. In addition, the existing treatment facilities are located on both sides of the Blackwater River Canyon, so either a stream crossing would be required or two separate force mains that conveyed wastewater from either side of the river to the nearest connection point located within Davis' existing collection system.

POTESTA evaluated alternatives for conveying the Park's wastewater to the Davis WWTP and preliminary estimates are included in Section 5, though costs may vary significantly depending on alignment and other design alternatives.

2.5 Flow Diagram

The following diagram (***Figure 7***) summarizes the various wastewater sources and treatment systems in this area of Tucker County:

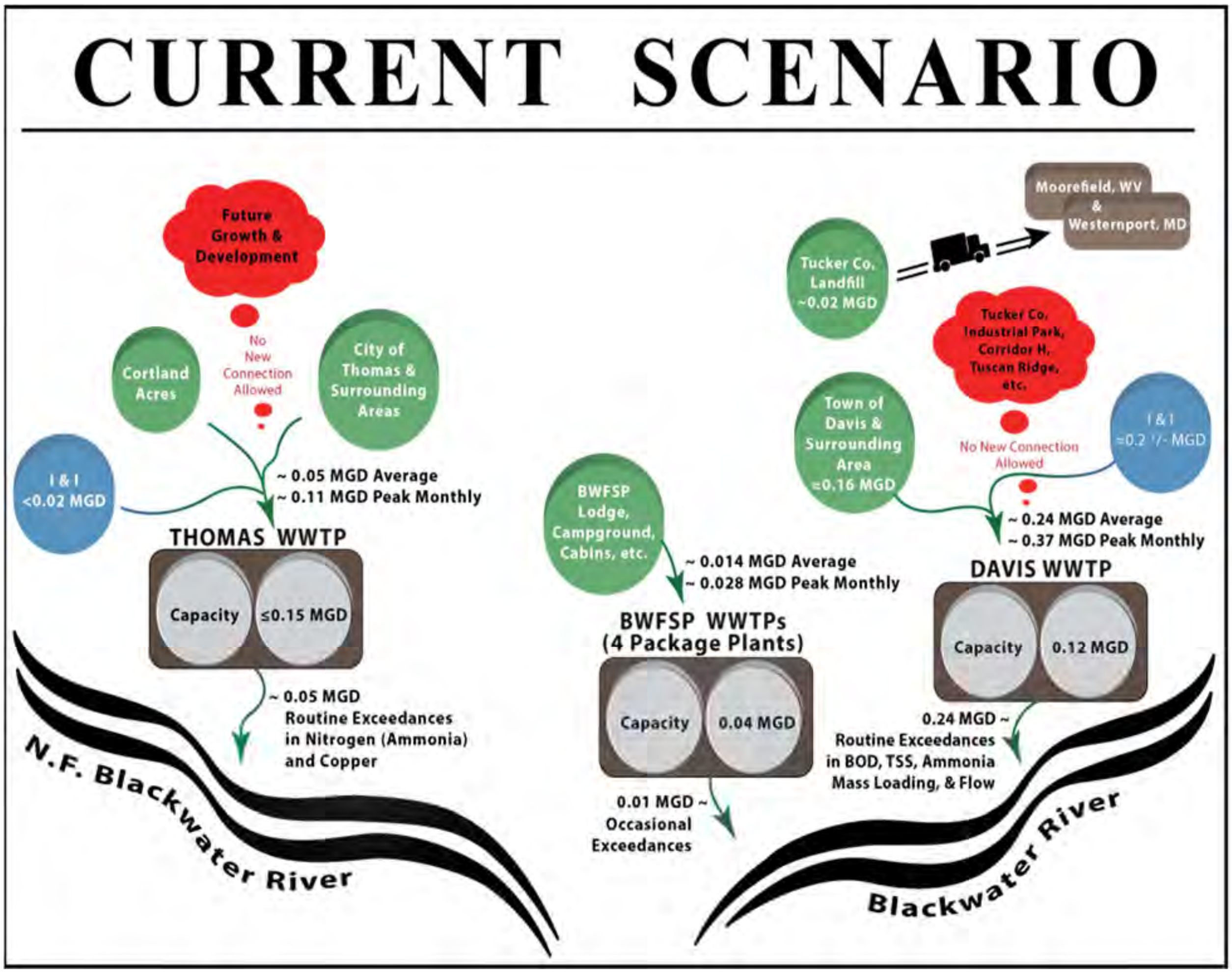


Figure 7 – Tucker County Various Wastewater Sources and Treatment Systems

END OF SECTION 2.0

3.0 PROJECTED GROWTH AND FUTURE WASTEWATER DEMAND

This section serves to summarize the anticipated future demand on the wastewater system(s) in the Thomas and Davis area of Tucker County due to significant projected increases in residential, commercial, and industrial development.

3.1 Potential Growth

Prior to the 2020-2021 increase in demand for residential housing in Tucker County, it was estimated that the County was already in need of 300+ workforce-level housing units, with most of these being needed in the Thomas/Davis and Canaan Valley areas. Following the surge in tourism/visitation as well as real estate demand experienced by Tucker County during the COVID 19 pandemic, demand for residential as well as commercial and industrial development has increased dramatically.

However, since most of this development is contingent on the availability of sewer, and since Thomas and Davis are currently not able to add customers to their systems, growth projections can only be developed based on surveys and/or anecdotal evidence, rather than on actual growth trends.

A recently completed economic study in September 2021 by Downstream Strategies for the City of Thomas projects the following potential growth in this area of Tucker County for the short to midterm:

- Various affordable housing projects (Cortland acres, Woodland Development Group, etc.) currently in the planning phase are slated to deliver approximately 192 affordable housing units in the Thomas/Davis and Corridor H area in the coming years.

- Current tourism growth could support as many as 11 additional restaurants with 102 employees in the next few years in this area of Tucker County.

- Over a thousand temporary construction-related workers will be required for the proposed construction of the Virgin Hyperloop Certification center. Many of these construction workers will rely on temporary housing and hotels, which if constructed could add significant demand to the wastewater system in this area.

- Once the Hyperloop facility is completed, it will sustain 150-200 permanent technology jobs in the area.

- Following the Hyperloop construction, an additional seven restaurants, with 66 employees, could be supported.

- Downstream Strategies concluded that in addition to the baseline demand of 300+ workforce-level housing units, following this economic growth there would be demand for another 400+ residential units.

In addition to these projections, POTESTA's discussion with private landowners in the area suggest that additional short-term development of private land in the Thomas/Davis and Corridor H area could consist of the following:

- 120 dwelling units in the existing Davis service area.
- 40 dwelling units in the existing Thomas service area.
- (These units are considered included in the projections of residential demand listed above but are provided as a secondary anecdote and to demonstrate that projects are currently being planned for the existing sewer service areas).

Also, there are currently 80 acres of undeveloped lots at the Tucker County Industrial Park that would likely be developed if sewer capacity was available. In addition, the Tuscan Ridge subdevelopment near Davis could add dozens more if it were completed.

Based on the above-referenced projected residential housing projects and commercial/industrial development, the following hypothetical scenario will be considered for a 10-year development horizon for this area of Tucker County:

1. Current baseline demand for over 300 residential units
2. Current baseline demand for 11 restaurants
3. Following Hyperloop facility construction and other regional commercial/residential development, future demand of:
   - 400 to 500 additional residential units
   - Numerous commercial and industrial businesses (300 to 400 employees total)
   - 7 additional restaurants
4. 80 Acres of Industrial Park Development
5. In summary, an additional estimated treatment capacity in the range of 0.25 MGD to 0.30 MGD would be required to accommodate this growth scenario.

Also, based on discussion with private landholders of property in this area of Tucker County, large-scale development beyond the 10-year timeline may be very significant. Projections provided to POTESTA by private landholders indicate a long-term increase in sewer demand that could range from 2 MGD to 4 MGD. It is POTESTA's understanding that this projected future development may extend from several miles east of the SR 92 and US Rt. 48 intersection and approximately 2 miles to the west of the same intersection as well as from just north of the City of Thomas to just south of the Town of Davis. The timing of the potential future development is in part controlled by the development of the Hyperloop project and the continued attraction of residents from major metropolitan areas to Tucker County.

3.2 Potential Connections - Landfill and BWF State Park

As discussed in Section 2.4 an additional 0.015 MGD to 0.03 MGD of treatment capacity would be required to accept the wastewater from the Blackwater Falls State Park.

As discussed in Section 2.3 , during months of peak leachate production, an additional 0.05 MGD of capacity to accept leachate from Tucker County Landfill. However, this may be limited to 0.02 MGD by permit requirements.

3.3 Current vs Future Flow Rates

Currently the Thomas WWTP averages approximately 0.05 MGD and the Davis WWTP averages approximately 0.24 MGD of influent flow allowing for a baseline growth of 10% over 5 years and 20% over 10 years, the “existing demand” totals to 0.34 MGD at the ten-year mark.

The combined wastewater demand from projected development and potential connections (State Park, Landfill) outlined above would exert up to an additional 0.38 MGD of wastewater demand on local treatment facility/facilities.

$$340{,}000\ gpd + 380{,}000\ gpd = 720{,}000\ gpd, \qquad SAY\ 0.75\ MGD$$

$$current\ demand\ (with\ baseline\ growth) + projected\ development = short\ to\ mid\ term\ treatment\ needs\ (< 10\ yrs)$$

Combining the existing demand and the projected demand, a minimum of approximately 0.75 MGD of combined treatment capacity could be required to serve the Thomas and Davis areas for the next ten years, with flexibility and space needed to quickly expand treatment capacity to grow up to 2 to 4 MGD beyond the ten year mark.

END OF SECTION 3.0

4.0 NPDES PERMITTING CONSIDERATIONS

4.1 Blackwater River TMDL Considerations

Background concentrations of the receiving stream can influence the permit limitations by demonstrating additional capacity (to be used in requesting a mixing zone) or by showing a reduced capacity of the stream to accept the discharge and maintain the existing uses of the stream. If a stream has a reduced capacity for a certain parameter, the stream is generally included on the WVDEP's 303(d) list of impairments and scheduled for TMDL development or a TMDL has already been developed. The Blackwater River, which currently accepts the Town of Davis' WWTP effluent, is listed on the WVDEP's 303(d) list for Conditions Not Allowable – Biological (CNA) from river mile 7.9 to the headwaters. TMDLs have been developed on the entire reach of Blackwater River for iron (trout), aluminum (trout), pH and dissolved oxygen. TMDLs have also been completed for the entire reach of the North Fork of the Blackwater River for aluminum, iron, and pH.

Mandated reductions to the effluent concentration and/or flow limitations are not likely for those parameters in which a TMDL already exists. However, the Blackwater River TMDL for CNA has not yet been completed and is scheduled to be developed in 2029. Once developed, the TMDL will identify the suspected source, or group of sources, contributing to the impairment and limit the loading to the stream to improve the conditions. If the Davis WWTP is determined to be a contributing source of the CNA impairment, then the current NPDES permit limitations for the outlets may be reduced to meet requirements of the TMDL. It is important to note that TMDL development typically limits future or expanded discharges rather than reducing existing permitting discharges; however, the impacts of the TMDL on the permit limitations cannot be fully known until the TMDL is complete.

4.2 Wasteload Allocation (WLA) Considerations

A wasteload allocation (WLA) is the portion of a receiving water's assimilative capacity that is allocated to one of its existing or future point sources of pollution. WLAs ensure that the water quality based effluent limits for permitted point source discharges will be protective of the designated uses of the waterbodies. Many NPDES permits, including most sewage permits, require that the applicant obtain a waste load allocation for the discharge and permit limitations are set accordingly.

Increases in flow from existing facilities or development of a new facility will result in the requirement to obtain a new or revised WLA. WLA evaluations are specific to the location of the discharge, receiving stream flow and discharge flow. The WLA evaluation will establish limitations for the parameters of biological oxygen demand and ammonia nitrogen, while ensuring that the discharge will comply with anti-degradation requirements and not result in a dissolved oxygen (DO) sag to the receiving stream. As part of this study, WLA evaluations have been completed for the following scenarios:

- Scenario 1: Maintain the Davis and Thomas WWTP locations and discharges, assuming upgrades to result in an increased discharge flow

- Scenario 2: Pump the Davis WWTP flow to the Thomas facility, increasing the Thomas WWTP discharge flow

- Scenario 3: Pump the Thomas WWTP flow to the Davis facility, increasing the Davis WWTP flow

- Scenario 4: Locate a centralized WWTP to accept the Davis and Thomas flows with discharge to Pendleton Creek

- Scenario 5: Locate a centralized WWTP to accept the Davis and Thomas flows with discharge to the North Fork of the Blackwater River, near Douglas

- Scenario 6: Locate a centralized WWTP to accept the Davis and Thomas flows with discharge to the Blackwater River.

The anticipated limitations associated with the above scenarios are presented in the ***Table 11***.

Table 11: Scenarios 1-6 Anticipated WLA Limitations

Facility	Evaluation Scenario	Discharge Flow (MGD)	BOD Summer (mg/L)	BOD Winter (mg/L)	Ammonia Nitrogen Summer (mg/L)	Ammonia Nitrogen Winter (mg/L)
Davis	1	0.25	30	30	7.8	7.8
Davis	1	0.3	30	30	5.45	5.45
Davis	1	0.35	30	30	4.25	4.25
Thomas	1	0.25	22	30	3.8	6.3
Thomas	2	0.5	22	30	5.3	6.3
Thomas	2	1.0	30	30	4.65	4.65
Thomas	2	2.0	30	30	4.65	4.65
Davis	3	0.5	20	20	3	3
Davis	3	1.0	10	10	2	2
Davis	3	2.0	Not permitted as failed anti-degradation review			
Centralized	4	Discharge to Pendleton Creek not permitted as it does not pass anti-degradation review				
Centralized	5	0.5	30	30	5.8	5.8
Centralized	5	1.0	30	30	4.65	4.65
Centralized	5	2.0	30	30	4.65	4.65
Centralized	6	0.5	20	20	3	3

Modeling for discharges to the North Fork of the Blackwater River shows that an increase in the plant design flow (i.e., effluent discharge) will improve the dissolved oxygen of the stream, as evidenced by the increase in the ammonia nitrogen summer limitations for the Thomas WWTP upgrade scenario. The North Fork ammonia nitrogen winter limitations do not change from what is currently in the Thomas permit, as they are calculated from the ammonia nitrogen water quality standard which is more stringent than the calculated ammonia nitrogen limitation to protect the dissolved oxygen sag of the stream. Similarly, in the Davis plant upgrade the ammonia nitrogen limitations are also calculated based on the ammonia nitrogen water quality standard. The DO limits will remain as a minimum of 6.0 mg/L throughout the various scenarios.

The remaining limitations, such as metals, within the Davis and Thomas NPDES permits are not anticipated to change significantly due to an increase in the facility flow. However, combining the discharge will likely result in the discharge being limited for the parameters currently included in the Thomas NPDES permit (as it is a more exhaustive list). The location of the discharge will define whether the permit limitations will remain as they are within the Thomas permit or if they will be decreased for discharge into the Blackwater River.

The water quality based permit limitations will generally be higher for discharges to the North Fork of the Blackwater River as compared to the Blackwater River for certain parameters. The Blackwater River is listed as a trout stream whereas the North Fork of the Blackwater is listed as a warm water fishery. The trout stream designation reduces the water quality criteria for parameters such as ammonia nitrogen and iron. The lowered ammonia nitrogen limits can be observed in ***Table 12*** above. The iron water quality criterion for the North Fork Blackwater River (I.e., warm water fishery) is 1.5 mg/L, whereas the criterion for the Blackwater River is 0.5 mg/L (trout fishery). It can be expected that the limitations currently included for iron on the Thomas NPDES permit (1.23 mg/L average monthly and 2.19 mg/L maximum daily) would be reduced to one-third of the value for discharge directly into the Blackwater River. The copper limitations currently placed on the Thomas discharge would likely remain whether the combined effluent would discharge into the North Fork of the Blackwater or the Blackwater mainstem. Additional reductions to the copper limits are not anticipated when discharging to the Blackwater mainstem as the trout stream designation does not impact copper.

4.3 Metals Translator Study

Development of a site-specific metals translator can allow for an increase of the existing water quality based permit limitations. The West Virginia Rule governing Water Quality Standards (46 CSR 1) sets the default translator ratio converting certain metals (i.e., aluminum, arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc) standards from total to dissolved based on concentrations observed statewide. This ratio for copper assumes that 96 percent of the metal measured in a sample is in the dissolved form, and the resulting NPDES permit limitations are set accordingly. Determination of the site-specific metals translator will often reduce the proportion of dissolved metal as it relates to the total metal, which will then result in an increase of the associated permit limitation. Thomas has frequently exceeded permit limits for copper and would likely benefit from development of a site-specific metals translator. Davis monitors for copper, lead, and zinc, all of which incorporate metals translators. However, Davis has not exhibited difficulty in achieving the current limitations for these parameters.

Metals translator studies are completed in accordance with modified methods of the USEPA guidance document, "*The Metals Translator: Guidance for Calculating a Total Recoverable Permit Limit from a Dissolved Criterion [EPA 823-B-96-007]*" and using guidance issued by the WVDEP. Typically, between 10 and 24 water samples are collected within the receiving stream, downstream of the point of discharge. The total and dissolved metal concentrations are obtained, and the data normalized to calculate the site-specific total to dissolved ratio. Once the site-specific translator is developed, a permit modification is submitted to the WVDEP to request recalculation of the associated permit limitations to incorporate use of the translator.

Development of a site-specific copper translator for the Thomas facility would likely show less than 80 percent of the copper in the receiving stream is present within the dissolved form. Implementation of a copper translator would likely increase the permit limitations for the Thomas WWTP to a point that compliance would likely be achieved for the average monthly limitations, assuming similar discharge concentrations to those reported for the past few years. Although copper limitations developed using a site-specific metals translator would also increase the maximum daily copper permit limitations, it is likely that maximum daily permit limit exceedances would still be observed as compared to the recent DMR data.

4.4 Mixing Zone Study

A mixing zone is an area where wastewater discharged from a permitted facility enters and mixes with a stream or water body. A mixing zone is an established area where water quality standards may be exceeded as long as acutely toxic conditions are prevented and all beneficial uses, such as drinking water, fish habitat, recreation, and other uses are protected. West Virginia Department of Environmental Protection's (WVDEP) Mixing Zone Guidance, Title 46, Series 1, Section 5 discusses the allowance and restrictions for mixing zones. In general, mixing zones can be applied to outfalls with the potential to contain toxic pollutants at concentrations in excess of the applicable water quality standards. Mixing zones may not be granted if they are not needed or disallowed. Mixing zones are not needed if the pollutant concentration in an outfall is not likely to exceed the applicable water quality standard, or if the upstream water quality is in violation of the applicable water quality standard.

If the stream is not impacted for the specific parameter, a site-specific or default mixing zone may be incorporated to request an increase of the water quality based permit limitations. Water quality based limitations include parameters such as aluminum, total residual chlorine, hexavalent chromium, copper, iron, lead, total kjeldahl nitrogen, ammonia nitrogen, and zinc. A default mixing zone would allow for dilutions of 3 times within the acute mixing zone and 5 times within the chronic mixing zone. To obtain a default mixing zone, background water quality (BWQ) of the receiving stream must be collected and submitted to the WVDEP with a request to incorporate default mixing. A site-specific mixing zone would likely allow for additional dilutions and higher permit limitations, but BWQ collection, field measurements and mixing zone modeling are required before a request can be submitted to the WVDEP.

A mixing zone would not currently be allowed for Town of Davis as existing discharge data do not show a need based on the quality of the discharge. Although Davis has reported multiple permit limit exceedances for ammonia nitrogen, BOD and TSS, these exceedances are within the quantity discharged (relating to the high discharge flow) rather than the quality of the discharge itself. The quality of the discharge for these parameters have primarily been in compliance with the permit limitations. As stated above, a mixing zone can only be granted by the WVDEP if it is shown to be necessary for the discharge.

As discussed in other sections or presented in the tables in the appendices of this report, Thomas has reported multiple water quality based permit limit exceedances for BOD, copper, iron, lead, total kjeldahl nitrogen and ammonia nitrogen. However, water quality studies such as inclusion of a mixing zone will not increase the BOD or TSS quality limits as they are technology based, rather than water quality based limitations. Additionally, Thomas could not obtain a mixing zone for iron due to the 303(d) listing and TMDL for the North Fork of the Blackwater River. Thomas could, however, benefit from a default or site-specific mixing zone for copper, TKN and ammonia nitrogen.

Limitations developed using a default mixing zone would increase TKN and ammonia nitrogen to a level at which the Thomas facility could show compliance based on recent DMR data. However, use of a default mixing zone does not allow for compliance with the recalculated maximum daily limitation for copper. Use of a site-specific mixing zone may show sufficient dilutions to allow for compliance with the copper limitations at Thomas, but additional studies will be necessary to determine the available dilutions. However, the application of a site-specific metals translator combined with the use of a default mixing zone is likely to increase the calculated permit limitations for copper to a level at which current data for Thomas would show compliance with both the average monthly and maximum daily limitations.

4.5 Real Time Water Quality Based Limitations

Discharge from the WWTP that incorporates use of real time flow monitoring of the receiving stream can result in an increase of the NPDES permit limitations. Real time water quality (also referred to as real time flow monitoring) can benefit the permittee through use of a mixing zone or during the wasteload allocation process. Both situations incorporate the real time flow of the receiving stream to result in higher discharge limitations than would be achieved using the typical 7Q10 low flow value of the receiving stream. Additional documentation is required when using real time water quality which includes maintenance of a daily log of the daily stream flow with monthly reporting of the average, maximum and minimum receiving stream flows to the WVDEP.

As discussed in sections above, many NPDES permits, including most sewage permits, require that the applicant obtain a waste load allocation for the discharge and permit limitations are set accordingly. WLA evaluations are routinely based on the 7Q10 low receiving stream flow and the maximum effluent discharge flow. The WLA evaluation will establish limitations for the parameters of biological oxygen demand and ammonia nitrogen, while ensuring that the discharge will comply with anti-degradation requirements and not result in a dissolved oxygen (DO) sag to the receiving stream. Increased receiving stream flow will often result in a higher WLA which will in turn provide higher ammonia and DO limitations. Therefore, when requested, the WVDEP will establish tiered limitations using various receiving stream flows. The permittee will monitor the receiving stream flow daily to determine which real time water quality based limitation is applicable for the specific day.

Real time water quality monitoring can also benefit a NPDES permit holder when making use of a site specific mixing zone. The available dilutions within a site specific mixing zone are determined partly based on the receiving stream flow. Similar to the WLA calculations, use of higher receiving stream flows often results in higher available dilutions which in turn will provide higher permit limitations for those parameters calculated using the water quality based effluent limitations. Water quality based limitations within the Davis and Thomas permits include parameters such as aluminum, total residual chlorine, hexavalent chromium, copper, iron, lead, total kjeldahl nitrogen, ammonia nitrogen, and zinc. When requested, the WVDEP will establish tiered limitations using the increased available dilutions from various receiving stream flows. The permittee will then monitor the receiving stream flow daily to determine which real time water quality based limitation is applicable for the specific day.

Use of real time flow monitoring is not anticipated to significantly improve permit limitations at either the Thomas or Davis WWTP’s. Application of real time flow monitoring to the Thomas WLA evaluation could result in an increase of the Thomas summer BOD limitations from 22 mg/L to 30 mg/L during higher flow events of the receiving stream. However, higher stream flow without increasing the effluent flow will likely reduce the ammonia nitrogen limitations at Thomas. Application of real time flow into the WLA for Davis is not anticipated to change the BOD or ammonia limitations. Application of real time flow for the water quality based parameters would only be beneficial if the facility is making use of a site-specific mixing zone. A site-specific mixing zone is not believed to be beneficial for current discharge configurations at either of the Thomas or Davis WWTPs.

END OF SECTION 4.0

5.0 ALTERNATIVES/RECOMMENDATIONS

5.1 Recommended Permit Modifications and Studies (1–2-year timeline)

POTESTA recommends the following efforts be completed to provide some relatively immediate relief on some parameters with which Davis and Thomas WWTP struggle to meet compliance:

1. Metal Translator Study for copper at the Thomas WWTP.

2. Mixing Zone Study for ammonia, and potentially copper, at the Thomas WWTP.

3. Permit modification to increase the permitted flow at Davis WWTP from 0.12 MGD to 0.30 MGD.

4. Develop a compliance schedule with the WVDEP, for both Thomas and Davis, that identifies planned permit modifications/studies, short term improvements, and the long-term plan for meeting compliance.

Each of these items require significant data collection, sampling/monitoring, documentation, and permit modifications in order to achieve. POTESTA estimates these efforts could be completed by an environmental consultant for a fee ranging from **$100,000 to $200,000**.

5.1.1 Thomas Metals Translator Study (1 year timeline to complete)

Completion of a metals translator study within the receiving stream at the Thomas WWTP would likely result in an increase of the copper permit limitations. A total of twelve (12) instream samples must be collected downstream of the outfall during low flow stream conditions to establish the site-specific metals translator. Sampling events must be separated by a minimum of seven (7) days and should generally be conducted from July through November to capture the low flow period. Upon completion of the sampling and receipt of the results from the laboratory, statistical analyses are completed, and the site-specific metals translator is developed. A NPDES permit modification is required to incorporate the site-specific metals translator into the permit limit calculations.

5.1.2 Thomas Default Mixing Zone (1 year timeline to complete)

Application of a default mixing zone for the Thomas WWTP would likely result in the increase of ammonia and copper limitations. In order to request use of the default mixing zone, a background water quality (BWQ) study must be completed. A BWQ study requires collection of 12 instream samples to be located upstream of the existing outfall. Sampling events must be separated by a minimum of seven (7) days and should be collected during low to normal flows of the receiving stream. Once results are received from the laboratory, the data will be a NPDES permit modification to request use of the default dilutions within the permit limit calculations.

5.1.3 Davis WWTP Permit Modification (1 year timeline to complete)

Modification of the Davis WWTP NPDES Permit (and associated Health Department permit, if necessary) to increase permitted flow from 0.12 MGD to 0.30 MGD, on the basis that several years of data support it is meeting treatment goals at this flow. This significantly reduce eliminate the mass-based permit exceedances that are currently experienced.

5.2 Recommended Collection System Improvements

5.2.1 Davis I&I Reduction (2–3-year timeline)

POTESTA believes this is the most important and cost-effective infrastructure improvement that can be done in the short term to reduce current treatment issues and gain additional capacity. The scope of the line replacements and separation effort needed to complete this task is currently being evaluated by another consultant, RK&K. Based on the preliminary conclusions of this study, **$6M has been assumed for this effort** (Total Project Cost, including construction as well as soft costs such as engineering/design and legal).

5.2.2 Thomas I&I Reduction (2–3-year timeline)

While not a problem to the extent that Davis' I&I is, the reduction of I&I in the Thomas collection system should also be considered one of the most cost-effective improvements that can be made to reduce treatment issues and gain additional capacity (e.g., I&I is likely contributing to the extreme variation in influent BOD concentrations seen at the Thomas WWTP). As with Davis, the scope of the line replacements and separation effort needed to complete this task is currently being evaluated by another consultant, CEC. Following the I&I evaluation, more accurate cost estimates can be prepared for this work, but POTESTA has assumed a rough-order-of-magnitude of **$1.3M to $2M for this effort** (Total Project Cost).

5.2.3 Connections, Extensions, Pump Station Upgrades (2–5-year timeline)

To accommodate growth, both collection systems will need to increase capacity and extend their range. In addition, collection system improvements will be required to provide connection to the Tucker County Landfill and Blackwater Falls State Park. Included in these improvements would be upgrades to the pump station currently located at the Tucker County Industrial Park; line extensions along Corridor H (Davis system) and towards Tucker County High School (Thomas system); upgrades to the main line and main pump station serving Davis' WWTP.

POTESTA has assumed a rough-order-of-magnitude costs as follows (Total Project Cost):

- BWFSP Connection $3M to $3.25M
- Tucker Co. Landfill Connection ~ $1M to $1.3M
- PS Upgrades, Extensions, Misc. Improvements ~ $2M to $3.25M

5.3 Recommended Treatment Improvements – Short Term (1-3-year timeline)

5.3.1 Davis WWTP Improvements

Currently, no improvements at the Davis WWTP are recommended. However, if the above-recommended permit modification and I&I reduction do not lead to the increased capacity anticipated, consideration of a nitrification polishing unit and/or lagoon improvements should be considered further.

5.3.2 Thomas WWTP Improvements

As discussed in Section 2.2, the primary conditions afflicting the Thomas WWTP are (i) a combination of conditions that are inhibiting nitrification (lack of attached growth media, insufficient retention time, inadequate alkalinity, etc.), and (ii) exposure to very cold temperatures (above-grade tanks and aerated un-covered lagoon) inhibiting nitrification and BOD removal.

Converting this plant to operate as an activated sludge process, by installing sludge recycle (RAS) that would be pumped back into the aeration tanks, would likely improve BOD and ammonia removal by allowing operational control of F/M and SRT. However, based on POTESTA's discussion with the operators and review of the design, it may prove difficult or prohibitively costly to provide adequate sludge collection/recycle. Currently the existing sludge basin in the settling pond and associated pumps do not allow for adequate sludge removal.

Therefore, POTESTA has considered means to enhance performance of the Thomas WWTP under its current configuration, which is effectively an aerated lagoon. POTESTA believes that Thomas WWTP could achieve its treatment goals under its current flow (~0.05 MGD) and up to 0.15 MGD with the following improvements:

- Add a floating cover to the steel tanks, for heat retention.
- Insulate the steel tanks' exterior with spray foam, for heat retention.
- Add covers to the two lagoon cells, for heat retention and algae inhibition, and to establish quiescent zone for settling by minimizing influence of wind and thermal currents.
- Add a nitrification polishing unit, e.g. a submerged growth reactor such as LPR by Lemna Technologies, or equivalent.
- Other repairs/improvements such as repair of the screening/headworks, modifications to the chlorination basin, improvements to the blower piping/controls, an alkalinity feed system, and addition of a post-aeration system would also improve treatment but are not recommended at this time based on the long-term option of a centralized WWTP.

POTESTA estimates these improvements could range from **$750,000 to $1.25M** (Total Project Cost).

5.4 Recommended Centralized WWTP– Long Term (7-10+ year timeline)

This recommendation considers construction of a centralized WWTP that would treat both the existing flow from Thomas and Davis as well as future wastewater demand from the surrounding area.

For the purpose of this report, POTESTA has assumed that the centralized plant would be located between Thomas and Davis and discharge to the North Fork of the Blackwater, near Douglas.

The centralized WWTP would need to have at minimum a capacity of 0.75 MGD to handle projected demand over the next 10 years, so POTESTA has assumed a nominal plant size of 0.75 MGD, with the ability to expand to 1.25 MGD and beyond (2+ MGD) with parallel treatment trains. The treatment technology would likely consist of membrane bioreactor (MBR) or similar process, configured in an arrangement to allow for parallel treatment trains to be brought online during peak or seasonal demand, and added on to accommodate future growth.

Based on similar sized facilities that have been constructed in West Virginia, POTESTA would expect costs for the new centralized WWTP with a 0.75 MGD to 1 MGD capacity to be in the **$15.6M to $19.5M range.** However, this only includes the treatment plant. To convey wastewater from the existing collection systems would require construction of multiple large pump stations and force mains to this centralized location. This alternative would also require decommissioning of the existing facilities and significant site development costs (access road, 3-phase power extension, etc.), as well as the potential construction of a significant effluent line from the plant location to the receiving stream. Adding in these other infrastructure improvements at an estimated value of **$10.4M to $13M,** it is estimated that the centralized treatment plant alternative would be between **$26M to $32.5M** (Total Project Cost).

Another consideration for this alternative is that it would likely require the creation of a new consolidated public service district, such as a "Tucker County Public Service District", to include Davis, Thomas, and the surrounding area.

5.5 Cost Summary

The following overall costs summarize the conceptual level improvements described above, for the primary improvements to the region's sewer infrastructure. "Total Project Cost" includes construction as well as soft costs such as engineering/design and legal.

Table 12: Preliminary Opinion of Probable Cost Summary
Tucker County, West Virginia
POTESTA Project No. 0102-20-0238

Category	Item	Total Project Cost - Low End (Millions)	Total Project Cost - High End (Millions)
Permit Modifications and Studies	Metal Translator Study, Mixing Zone Study, Real Time Water Quality Monitoring	$ 0.1	$ 0.2
Collection System and General Improvements	Davis I&I Improvements	$ 5.75	$ 6.25
	Thomas I&I Improvements	$ 1.3	$ 2.0
	BWFSP Connection	$ 3.0	$ 3.25
	Landfill Connection	$ 1.0	$ 1.3
	Extensions and PS Upgrades (Corridor H)	$ 2.0	$ 3.25
Treatment Improvements - Short Term	Davis WWTP Improvements	-	-
	Thomas WWTP Improvements	$ 0.75	$ 1.25
Treatment Improvements - Long Term	Centralized WWTP	$ 15.6	$ 19.5
	Pump Stations, Site Development, Effluent Line, Decommissioning WWTPs	$ 10.4	$ 13.0
	TOTAL	***$ 39.9***	***$ 50.0***

It should be noted that no preliminary engineering tasks were completed as part of this study. To prepare preliminary cost estimates with the level of detail adequate for funding applications, Preliminary Engineering Reports would need to be prepared for each of these items.

An overview of the timeline for these capacity improvements is illustrated in **Appendix F**.

5.5 O&M Costs

At this stage of planning, due to the uncertainty and conceptual-level nature of the recommended collection/treatment improvements, such as design elements of various features (e.g., number/type of pump stations <e.g., HP, run times>, treatment technologies <MBR vs activated sludge>, WWTP upgrade scope, centralized WWTP size/location, etc.) dollar value estimates of O&M costs were not prepared as part of this study. Further study would be required to prepare a present worth comparison and life cycle analysis of the alternatives of upgrading existing WWTP vs construction of a centralized WWTP. However, the following qualitative observations should be considered:

1. The existing WWTP facilities have been in use for over 20 years. Treatment equipment is typically considered to have a life span of 20 years (with concrete structures and passive elements having longer lifespans of up to 50 years). Therefore, when evaluating useful life or performing a present-worth analysis, improvements to existing WWTP facilities should not be considered to have the same analysis period as a new WWTP.

2. O&M costs related to power, treatment component replacement, and operational staff/labor will be significantly higher for the more labor-intensive “active” treatment technologies such as MBR’s as they would be compared to more “passive” treatment such as Davis’ current facultative lagoon.

END OF SECTION 5.0

6.0 CLOSING

This report has been prepared to aid the Tucker County Development Authority in their evaluation of sanitary sewer services in the areas surrounding the Town of Davis and City of Thomas. Its scope is limited to the specific project and location described herein and represents our understanding of the factors as presented in this report. If these factors change as additional data concerning this study is obtained, we should be informed so that we may examine the data and, if necessary, modify or revise the conclusions and recommendations presented in this report.

Respectfully submitted,

POTESTA & ASSOCIATES, INC.

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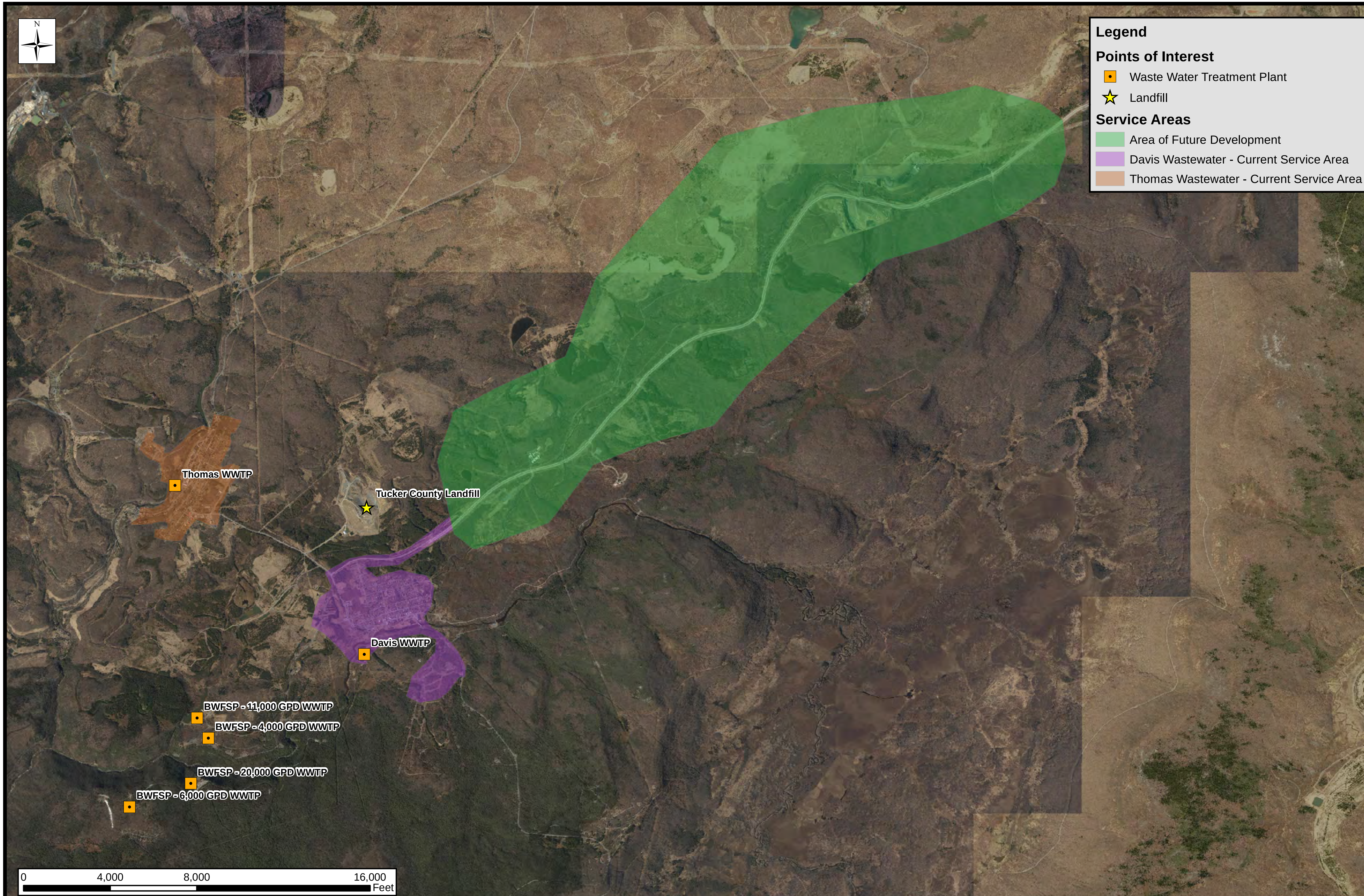
APPENDIX A



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MAPPING FOR VISUAL REPRESENTATION ONLY
TCDA - Town of Davis
Site Features - Sewer Improvements
Davis and Blackwater Quadrangles
Tucker County, West Virginia
For Informational Purposes Only

FIGURE 1

APPENDIX B

DISCHARGE MONITORING REPORT SUMMARY

TOWN OF DAVIS WASTEWATER TREATMENT PLANT

NPDES PERMIT NO. WV0024848

JULY 2018 THROUGH JULY 2020

Parameter	BOD - Quantity	BOD - Concentration	BOD % Removal	Chlorine, Total Residual	Coliform, Fecal	Copper, Total	Dissolved Oxygen (minimum)	Flow	Lead, Total	Nitrogen, Ammonia - Quantity	Nitrogen, Ammonia - Concentration	pH	Suspended Solids % Removal	Total Suspended Solids - Quantity	Total Suspended Solids - Concentration	Zinc, Total
Units	**lbs/day**	**mg/l**	**percent**	**mg/l**	**cnts/100 ml**	**mg/l**	**mg/l**	**mgd**	**mg/l**	**mg/l**	**mg/l**	**SU**	**percent**	**lbs/day**	**mg/l**	**mg/l**
Average Monthly Limit	**30**	**30**	**85**	**0.1**	**200**	**0.0059**	**Min 6**	**Report Only**	**Report Only**	**8.6**	**8.6**	**Min 6**	**65**	**45**	**45**	**Report Only**
Max Daily Limit	**60**	**60**	**minimum**	**0.1**	**400**	**0.013**		**Report Only**	**Report Only**	**17.2**	**17.2**	**Max 9**	**minimum**	**60**	**60**	**Report Only**
Jul-18	21	13.5	95	***0.01***	4	0.0021	6.5	0.169		1.1	0.71	6.9	86	34	22	
Aug-18	23	14.4	93	***0.01***	245	0.0031	6.25	0.157		2.8	1.78	7.8	61	56	36	
Sep-18	10	16	93	***0.01***	10	0.0032	6.7	0.213893	0.0004	0.3	0.55	6.5	73	30	50	0.016
Oct-18	47	16.7	81	***0.01***	10	0.0014	6.9	0.301		2.5	0.9	6.7	94	64	23	
Nov-18	68	24.4	65	***0.01***	10	0.0019	6.7	0.347		5	1.78	6.9	74	67	24	
Dec-18	37	11.3	95	***0.01***	4	0.0019	6.6	0.317	0.0005	7	2.14	6.8	93	42	13	0.013
Jan-19	49	13.3	90	***0.01***	4	0.0018	6.9	0.297		7.1	1.92	6.7	85	59	16	
Feb-19	38	15	93	***0.01***	2	0.0022	6.6	0.374		12.1	4.76	6.7	99	66	26	
Mar-19	41	18	96	***0.01***	4	0.0027	6.31	0.222	0.0003	0.5	0.22	6.5	99	86	38	0.013
Apr-19	28	22.6	95	***0.01***	4	0.0035	6.6	0.208		***0.2***	***0.1***	6.7	99	47	37	
May-19	39	16.1	98	***0.01***	2	0.0026	6.7	0.287535		7.4	3.01	6.8	97	73	30	
Jun-19	61	35.7	89	***0.01***	2	0.0029	6.9	0.266513	0.0007	2.4	1.41	6.9	95	82	48	0.011
Jul-19	11	8.51	97	***0.01***	2	0.0019	6.5	0.177		***0.2***	***0.14***	7.6	95	13	10	
Aug-19	18	20.1	97	***0.01***	2	0.003	6.5	0.173		3.4	3.78	8	98	14	16	
Sep-19	11	13.9	94	***0.01***	2	0.0016	6.3	0.07449	0.00053	***0.1***	***0.18***	6.8	99	8	10	0.0095
Oct-19	7	8.28	98	***0.01***	49	0.0023	6.7	0.171561		3.8	4.21	6.6	98	9	10	
Nov-19	27	12.4	95	***0.01***	4	0.0021	6.8	0.215		18.2	8.43	6.7	93	22	10	
Dec-19	29	13.5	87	***0.01***	2	0.0027	6.7	0.331	0.00075	14.3	6.56	6.5	91	22	10	0.0057
Jan-20	41	23.9	95	***0.01***	2	0.0019	6.8	0.335		15.1	8.67	7.5	96	52	30	
Feb-20	37	11.4	98	***0.01***	2	0.0033	6.4	0.349		4.8	1.46	6.5	99	52	16	
Mar-20	71	25.5	89	***0.01***	2	0.002	6.6	0.333	0.0005	***0.5***	***0.18***	6.5	96	92	33	0.012
Apr-20	22	13.8	94	***0.01***	4	0.0023	6.7	0.307		6.5	3.97	7.4	96	49	30	
May-20	23	6.54	97	***0.01***	4	0.0017	6.7	0.293		5.5	1.57	7.4	99	17	5	
Jun-20	9	11.9	96	***0.01***	2	0.0027	6.8	0.138	0.001	2.6	3.42	6.7	99	11	15	0.01
Jul-20	18	12.3	93	***0.01***	2	0.0032	6.8	0.191		2.7	1.79	6.9	99	23	15	
Aug-20	15	6.75	97	***0.01***	2	0.0018	6.9	0.164	NA	2.5	1.10	7.4	99	25	11	NA
Sep-20	46	19.7	91	***0.01***	4	0.0029	6.7	0.193	0.00062	***0.4***	***0.18***	6.9	98	63	27	0.0076
Oct-20	18	21.3	95	***0.01***	4	0.0013	6.8	0.112	NA	5	5.84	6.7	99	12	14	NA
Nov-20	29	18	97	***0.01***	2	0.0015	6.7	0.234	NA	6.9	4.35	6.6	99	49	31	NA
Dec-20	37	13.4	97	***0.01***	4	0.0012	6.7	0.301	0.0005	10.7	3.94	6.9	99	30	11	0.016
Jan-21	72	19	93	***0.1***	4	0.0011	6.9	0.256	NA	16.2	4.2	7.1	99	58	15	NA
Feb-21	75	33.2	94	***0.01***	10	0.0038	6.6	0.244	NA	14.4	6.39	6.7	98	72	32	NA
Mar-21	59	17	98	***0.01***	10	NA	6.5	0.246	0.00037	17.7	5.1	6.7	98	56	16	0.0215
Apr-21	17	34	76	***0.01***	10	NA	7.2	0.234	0.0005	***0.2***	***0.1***	6.7	98	41	21	NA
May-21	38	14	11	***0.01***	10	NA	6.7	0.230	***0.0024***	3.2	1.2	6.5	99	56	21	NA
Jun-21	***4***	***2.4***	**1**	***0.01***	10	NA	6.7	0.238	0.0005	***0.07***	***0.044***	6.9	99	***6***	***4***	0.015
Jul-21	38	23.4	95	***0.01***	10	NA	6.8	0.155	***0.0025***	2.9	1.8	7.2	97	60	37	NA
Number of Exceedances	23	3	4	0	1	0	0	0	0	10	1	0	1	29	2	0
Average Result	33.2	16.7	88	**0.012**	5	0.0023	6.7	0.2393	0	5.5	2.62	6.9	94.5	44	21.97	0.0125
Maximum Result	75	35.7	98	**0.1**	245	0.0038	7.2	0.374	0.0025	18.2	8.67	8.0	99	92	50	0.0215

Notes:

1. ***Bold italized values indicate the parameter was not detected at the MDL. The value presented is the MDL for that parameter.***
2. Yellow highlight indicates exceedance of average monthly limit and counts as 1 exceedance.
3. Orange highlight indicates exceedance of both average monthly and maximum daily limits and counts as 2 exceedances.
4. Discharge flows are entered as the average monthly result.

APPENDIX C

DISCHARGE MONITORING REPORT SUMMARY
CITY OF THOMAS WASTEWATER TREATMENT PLANT
NPDES PERMIT NO. WV0024856
JULY 2018 THROUGH JULY 2020

Parameter	Aluminum, Total	BOD - Quantity, Average	BOD - Quantity, Maximum	BOD - Concentration, Average	BOD - Concentration, Maximum	BOD % Removal	Chlorine, Total Residual	Hexavalent Chromium	Coliform, Fecal	Copper, Total	Dissolved Oxygen (minimum)	Flow	Iron, Total	Lead, Total	Nitrogen, Total Kjeldahl - Quantity, Average	Nitrogen, Total Kjeldahl - Quantity, Maximum	Nitrogen, Total Kjeldahl - Concentration, Average	Nitrogen, Total Kjeldahl - Concentration Maximum	Nitrogen, Ammonia - Quantity, Average	Nitrogen, Ammonia - Quantity, Maximum	Nitrogen, Ammonia - Concentration, Average	Nitrogen, Ammonia - Concentration, Maximum	pH	Suspended Solids % Removal	Total Suspended Solids - Quantity	Total Suspended Solids - Concentration	Zinc, Total
Units	**mg/l**	**lbs/day**	**lbs/day**	**mg/l**	**mg/l**	**%**	**mg/l**	**mg/l**	**cnts/100 ml**	**mg/l**	**mg/l**	**mgd**	**mg/l**	**mg/l**	**lbs/day**	**lbs/day**	**mg/l**	**mg/l**	**lbs/day**	**lbs/day**	**mg/l**	**mg/l**	**SU**	**%**	**lbs/day**	**mg/l**	**mg/l**
Average Monthly Limit	**0.33**	**27.5***		**22***		**85**	**0.012**	**0.005**	**200**	**0.0047**	**Min 6**	**Report Only**	**1.23**	**0.0024**	**7.1**		**5.7**		**4.6**		**3.7**		**Min 6**	**65**	**45**	**45**	**Report Only**
Max Daily Limit	**0.75**		**55***		**44***	**minimum**	**0.025**	**0.018**	**400**	**0.0137**		**Report Only**	**2.19**	**0.0054**		**14.2**		**11.4**		**9.3**		**7.4**	**Max 9**	**minimum**	**60**	**60**	**Report Only**
Jul-18	0.12	8.27	15.53	20	38	94	***0.001***	0.0005	***10***	0.00499	6	0.049	0.94	0.000786	8.173	12.059	20.13	24.1	NA	NA	NA	NA	7	97	5	11	NA
Aug-18	0.03	9.54	13.99	24.5	39	85	***0.001***	0.0004	***10***	0.00359	6.1	0.051	0.64	***0.00054***	10.63	21.91	19.2	26.2	NA	NA	NA	NA	7	96	4.66	13	NA
Sep-18	0.03	1.95	1.95	2	2	98	***0.001***	0.0006	***10***	0.00562	5.9	0.07	0.45	***0.00054***	7.156	14.343	8.3	14.7	NA	NA	NA	NA	7	79	8.782	9	NA
Oct-18	0.02	1.167	1.267	2	2	99	***0.001***	0.0004	***10***	0.00252	6	0.067	0.32	***0.00054***	1.687	3.522	3.26	6.6	NA	NA	NA	NA	7	97	1.267	2	NA
Nov-18	0.08	3.123	4.378	11.5	21	92	***0.001***	0.0006	***10***	0.00421	5.9	0.06	0.47	***0.00054***	2.29	3.467	4.25	6.3	NA	NA	NA	NA	7	92	14.945	22	NA
Dec-18	0.06	5.921	11.008	12	22	79	***0.001***	0.004	***10***	0.00351	5.9	0.044	0.67	***0.00054***	2.21	3.202	7.08	12.8	NA	NA	NA	NA	7	71	13.01	26	NA
Jan-19	0.004	5.695	6.004	16.5	17	94	***0.001***	0.0004	***10***	0.0045	6.2	0.046	0.73	0.000727	4.077	5.944	11.48	17.6	NA	NA	NA	NA	7	80	8.256	24	0.0281
Feb-19	0.1	10.667	13.667	21.1	26.2	88	***0.001***	0.0004	***10***	0.0069	6.2	0.068	0.7	0.00066	3.49	5.887	6.4	8.7	NA	NA	NA	NA	7	70	15.77	26.2	NA
Mar-19	0.08	12.61	14.3	26	36	76	***0.001***	0.001	***10***	0.0049	6	0.04	1.04	0.00101	5.055	9.276	13.4	22.7	NA	NA	NA	NA	7	72	37.25	58	NA
Apr-19	0.15	11.64	17.76	21.5	30	88	***0.001***	0.0004	***10***	0.0051	6.2	0.055	2.57	0.00178	7.021	16.579	14.43	28	NA	NA	NA	NA	7	94	16.579	28	NA
May-19	0.07	5.633	10.6	16.5	31	94	***0.001***	0.0004	***10***	0.0033	6	0.053	1.19	***0.00054***	4.818	10.93	8.12	11.5	NA	NA	NA	NA	7	98	6.496	19	NA
Jun-19	0.08	4.42	5.63	7.5	9	98	***0.001***	0.0004	***10***	0.0058	5.9	0.061	1.24	0.00061	11.526	12.084	18.58	21	NA	NA	NA	NA	7	98	9.073	17	NA
Jul-19	0.11	7.68	13.88	8.5	0.13	93	***0.001***	0.0005	***10***	0.0072	6.2	0.057	1.13	0.00098	12.851	25.086	23.68	31.9	NA	NA	NA	NA	7	97	24.55	28	NA
Aug-19	0.06	4.928	8.751	17	30	93	***0.002***	0.0033	***10***	0.0054	5.9	0.043	0.71	0.00061	2.263	3.269	9.225	11.2	NA	NA	NA	NA	7	93	3.794	13	NA
Sep-19	0.04	2.09	2.18	13	17	96	***0.001***	0.0006	***10***	0.0046	5.9	0.02	0.62	0.0006	1.783	2.7637	8.6	11.51	NA	NA	NA	NA	7	99	2.18	9	NA
Oct-19	0.02	6.755	8.206	19	24	94	***0.001***	0.0004	***10***	0.0059	6.2	0.034	0.22	***0.00054***	1.513	2.74	5.22	6.2	NA	NA	NA	NA	7	96	5.129	15	NA
Nov-19	0.03	6.588	7.472	25.5	32	90	***0.001***	0.0004	***10***	0.0062	6.1	0.03	0.41	0.00099	2.397	4.513	9.325	13.2	NA	NA	NA	NA	7	81	7.506	26	NA
Dec-19	0.04	21.51	27.89	26.5	38	81	***0.001***	0.0004	***10***	0.004	6	0.058	0.26	***0.00054***	6.558	8.779	10.26	12.6	NA	NA	NA	NA	7	72	20.683	21	NA
Jan-20	0.03	9.278	11.726	35	21	87	***0.001***	***0.0004***	***10***	0.0037	5.9	0.055	0.47	***0.00054***	5.51	6.42	13.05	14.6	NA	NA	NA	NA	7	96	11.108	26	0.0213
Feb-20	0.09	6.596	9.107	15	28	93	***0.001***	***0.0004***	***10***	***0.0005***	6	0.061	0.77	0.0007	11.158	28.401	12.725	13.9	NA	NA	NA	NA	7	97	42.909	21	NA
Mar-20	0.06	6.573	8.444	17	22	93	***0.001***	***0.0004***	***10***	0.004	6	0.054	0.61	0.00054	6.87	7.634	17.05	19.9	NA	NA	NA	NA	7	96	10.191	26	NA
Apr-20	0.07	9.224	9.349	15.7	19	95	***0.001***	***0.0004***	***10***	0.0037	6	0.111	1.04	0.00058	14.67	24.17	15.76	22.8	NA	NA	NA	NA	7.1	94	8.807	16	NA
May-20	0.128	10.799	15.549	17.2	18.6	98	***0.001***	***0.0004***	***10***	0.0039	6	0.074	1.68	0.00093	7.087	10.136	19.93	35.1	NA	NA	NA	NA	7	98	18.7	19	NA
Jun-20	0.138	7.467	7.889	39.1	43	85	***0.001***	***0.0004***	***10***	0.0048	5.9	0.03	2.16	0.001	5.796	7.886	25.92	39.8	NA	NA	NA	NA	7	93	5.804	29.5	NA
Jul-20	0.0835	9.634	17.684	36.70	68.4	92	0.001	***0.0004***	***10***	0.0070	6.0	0.039	0.991	0.0010	3.181	6.024	10.83	17.2	NA	NA	NA	NA	7.1	97	3.878	15.0	NA
Aug-20	0.0792	3.411	4.291	15.20	16.6	97	0.001	***0.0004***	***10***	0.0036	6.0	0.056	0.604	0.00092	1.496	3.175	5.375	7.1	NA	NA	NA	NA	7.1	99	3.748	14.5	NA
Sep-20	0.171	7.107	10.893	32.55	33.2	88	0.001	***0.0004***	***10***	0.0062	6.0	0.038	0.869	0.0012	3.117	7.339	7.450	8.9	NA	NA	NA	NA	7.0	97	5.954	17.0	NA
Oct-20	0.06	6.193	8.219	22.85	23.8	96	0.001	***0.0004***	***10***	0.043	5.9	0.028	0.3	0.0008	1.731	3.753	4.40	5.0	NA	NA	NA	NA	7.0	98	4.878	14.7	NA
Nov-20	0.00524	2.246	2.321	9.450	9.6	97	0.001	***0.0004***	***2***	0.0047	6.0	0.038	0.29	0.0009	1.885	4.705	5.675	9.1	NA	NA	NA	NA	7.0	36	5.328	22.0	NA
Dec-20	0.05	7.348	11.092	19.85	26.6	92	0.001	0.00042	***<200 and <200***	0.0032	5.9	0.038	0.289	0.0006	4.29	6.41	12.780	14.0	NA	NA	NA	NA	7.0	92	8.340	20	NA
Jan-21	0.07	3.311	4.181	17.0	21.8	96	0.001	0.00053	***<200 and <400***	0.0039	6.10	0.035	0.334	0.0063	4.242	4.891	18.50	25.5	NA	NA	NA	NA	7.0	99	3.356	17.5	0.0159
Feb-21																											
Mar-21	0.33	10.893	15.072	48.30	79.3	78	0.001	***0.005***	***<200 and <400***	0.0090	6.1	0.049	0.825	***0.0024***	4.098	6.825	10.38	14.5	NA	NA	NA	NA	7.0	94	10.008	50	NA
Apr-21	0.02	2.112	3.657	7.450	12.9	96	0.001	***0.0004***	***<200 and <400***	0.0051	6.0	0.042	0.626	0.0005	8.917	11.711	21.63	23.8	NA	NA	NA	NA	7.0	94	4.253	15.0	NA
May-21	0.03	5.742	10.985	9.9	17.8	94	0.002	0.00053	***<200 and <400***	0.0023	6.0	0.036	0.00045	0.00045	2.405	5.06	6.125	9.2	NA	NA	NA	NA	7.0	97	5.554	9.0	NA
Jun-21	NA	2.980	5.027	7.850	13.7	96	0.001	NA	***<200 and <400***	0.0039	6.1	0.043	0.67	NA	NA	NA	NA	NA	1.641	3.339	4.562	9.1	7.1	91	4.953	13.5	NA
Jul-21	NA	3.682	6.964	9.35	16.7	96	0.001	NA	***<200 and <400***	0.010	6.0	0.031	0.79	NA	NA	NA	NA	NA	1.317	2.177	5.05	8.7	7.0	85	10.634	25.5	NA
Number of Exceedances	0	0	0	7	4	4	0	0	0	18	10	0	5	2	7	5	26	16	0	0	2	2	0	1	0	3	0
Average Result	0.075	6.80	9.64	18.5	25.2	92	0.001	0.0008	10	0.0059	6.0	0.049	0.77	0.0010	5.352	9.14	12.02	16.7	1.479	2.758	4.81	8.9	7.0	90	10.37	20.5	0.0218
Maximum Result	0.33	21.51	27.89	48.30	79.3	99	0.002	0.0050	10	0.043	6.2	0.111	2.57	0.0063	14.67	28.401	25.92	39.8	1.641	3.339	5.05	9.1	7.1	99	42.909	58	0.0281

Notes:

1. ***Bold italized values indicate the parameter was not detected at the MDL. The value presented is the MDL for that parameter.***
2. Yellow highlight indicates exceedance of average monthly limit and counts as 1 exceedance.
3. Orange highlight indicates exceedance of both average monthly and maximum daily limits and counts as 2 exceedances.
4. BOD has summer and winter limitations. Summer limitations are 27.5 lbs/day average monthly and 55 lbs/day max daily; 22 mg/l average monthly and 44 mg/l maximum daily. Winter limitations are 37.5 lbs/day average monthly and 75 lbs/day max daily; 30 mg/l average monthly and 60 mg/l max daily.
5. TKN has summer and winter limitations. Summer limitations are 7.1 lbs/day average monthly and 14.2 lbs/day max daily; 5.7 mg/l average monthly and 11.4 mg/l maximum daily. Winter limitations are 11.5 lbs/day average monthly and 23 lbs/day max daily; 9.2 mg/l average monthly and 18.4 mg/l max daily.
6. Ammonia Nitrogen has summer and winter limitations. Summer limitations are 4.6 lbs/day average monthly and 9.3 lbs/day max daily; 3.7 mg/l average monthly and 7.4 mg/l maximum daily. Winter limitations are 7.9 lbs/day average monthly and 15.8 lbs/day max daily; 6.3 mg/l average monthly and 12.6 mg/l max daily.
7. NA represents not analyzed as the parameter is not required for sampling that timeframe.

total july 2019 to june 2020

0.051230769

APPENDIX D

DISCHARGE MONITORING REPORT SUMMARY

MOOREFIELD/HARDY COUNTY WASTEWATER AUTHORITY

NPDES PERMIT NO. WV0106038

TUCKER COUNTY LANDFILL OUTLET IU03

JULY 2018 THROUGH JULY 2021

Parameter	**Flow**	**BOD - Concentration**	**Total Suspended Solids - Concentration**	**pH**	**Nitrogen, Total Kjeldahl - Concentration**	**Copper, Total**	**Iron, Total**	**Lead, Total**	**Zinc, Total**
Units	**gpd**	**mg/l**	**mg/l**	**SU**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**
Average Monthly Limit	**Report Only**	**Report Only**	**Report Only**	**Min 6**	**Report Only**	**Report Only**	**Report Only**	**Report Only**	**Report Only**
Max Daily Limit	**20,000**	**500**	**500**	**Max 10**	**300**	**0.07**	**20**	**0.02**	**0.3**
Jul-18	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted
Aug-18	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted
Sep-18	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted
Oct-18	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted
Nov-18	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted
Dec-18	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted
Jan-19	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted
Feb-19	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted
Mar-19	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted
Apr-19	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted
May-19	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted
Jun-19	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted
Jul-19	12,613	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed
Aug-19	6,256	29	61	6.97	140	0.003	10.8	***0.005***	0.013
Sep-19	7,320	19	20	7.05	165	0.003	12.2	***0.005***	0.039
Oct-19	6,264	11.6	36	8.3	181	0.005	3.86	***0.003***	0.02
Nov-19	7,617	56	24	8.27	182	0.003	4.13	***0.005***	0.016
Dec-19	14,285	120	40	7.9	224	***0.003***	2.86	***0.005***	0.013
Jan-20	242,878	31	73	7.09	18.5	***0.003***	23.4	***0.005***	0.034
Feb-20	7,183	21	87	8.22	94.4	0.004	5.58	***0.005***	0.024
Mar-20	12,401	15	18	7.81	88	***0.003***	2.27	***0.005***	0.011
Apr-20	6,237	5.7	20	8.1	88.4	2.2	3.8	***0.003***	0.008
May-20	12,241	39.6	22	7.7	102	***0.005***	2.23	***0.01***	0.013
Jun-20	18,396	35.2	86	8	187	0.001	2.6	***0.003***	0.008
Jul-20	12,238	26.9	42	7.5	127	***0.001***	9.82	***0.003***	0.011
Aug-20	12,123	14.4	8	8.1	93.5	0.007	2.25	***0.003***	***0.007***
Sep-20	18,133	18.4	7	7.9	78.7	0.003	2.23	***0.003***	0.014
Oct-20	6,264	11.6	36	8.3	181	0.005	3.86	***0.003***	0.02
Nov-20	12,481	8.8	10	8.5	188	***0.003***	2.09	***0.002***	0.012
Dec-20	12,473	9.4	40	8.5	190	0.049	4	0.003	0.042
Jan-21	18,631	11.6	15	8.6	225	***0.003***	1.61	***0.003***	0.03
Feb-21	18,703	11.7	16	8.4	181	***0.003***	1.79	***0.003***	0.019
Mar-21	18,612	10.1	19.5	8.1	182	***0.003***	4.95	***0.002***	0.02
Apr-21	18,526	16.1	49.5	8.3	194	0.004	0.97	***0.003***	0.015
May-21	18,951	18.1	87	8.3	165	0.005	0.951	***0.003***	0.017
Jun-21	18,801	85	85	8.1	123	***0.003***	0.1	***0.003***	0.009
Jul-21	18,869	65.5	12	7.7	135	***0.003***	1.29	***0.002***	0.011
Number of Exceedances	1	0	0	0	0	1	1	0	0
Average Result	22,340	28.8	38.1	NA	147	0.095	4.57	0.00013	0.017
Maximum Result	242,878	120	87	8.6	225	2.2	23.4	0.003	0.042

Notes:

1. ***Bold italized values indicate the parameter was not detected at the MDL. The value presented is the MDL for that parameter.***

2. Yellow highlight indicates exceedance of maximum daily limit.

	eDMR has two results for one analysis - 0.003 for Max Daily and <0.003 for Average Monthly
	eDMR has two results for one analysis - 0.005 for Max Daily and <0.005 for Average Monthly
242,878	I am pretty sure this is an error
0.095	Long term avearge for Copper above limit

pH Minimum Result	6.97

APPENDIX E

BLACKWATER FALLS STATE PARK - LODGE RESTAURANT OUTLET 001															
SITE REGISTRATION NUMBER WVG551188															
Analytical Parameter	**Monitoring Period and Analytical Results**												**Laboratory Results Summary**		
	3rd Qtr 18	**4th Qtr 18**	**1st Qtr 19**	**2nd Qtr 19**	**3rd Qtr 19**	**4th Qtr 19**	**1st Qtr 20**	**2nd Qtr 20**	**3rd Qtr 20**	**4th Qtr 20**	**1st Qtr 21**	**2nd Qtr 21**	**Average**	**Minimum**	**Maximum**
Flow, MGD	0.01138	0.01455	0.01344	0.012280	0.01434	0.006272	0.01055	0.00688	0.012555	0.01336	0.0025	0.00190	0.01000	0.00190	0.01455
Biochemical Oxygen Demand (BOD), mg/l	< **2.12**	< **2.12**	< **2.12**	< **2.12**	< **2.12**	< **2.12**	< **2.12**	< **2.12**	< **2.12**	9.04	< **2.12**	< **2**	0.75	< **2**	9.04
Biochemical Oxygen Demand (BOD), lbs/day	< **0.201**	< **0.257**	< **0.238**	< **0.217**	< **0.254**	< **0.111**	< **0.187**	< **0.122**	< **0.222**	1.01	< **0.044**	< **0.0317**	0.084	< **0.0317**	1.01
Total Suspended Solids (TSS), mg/l	< **4**	< **4**	< **4**	< **4**	< **4**	4	4	5	< **4**	< **4**	9	3.5	2.1	< **4**	9
Total Suspended Solids (TSS), lbs/day	< **0.380**	< **0.485**	< **0.448**	< **0.410**	< **0.478**	0.209	0.352	0.287	< **0.419**	< **0.446**	0.188	0.0555	0.0910	< **0.380**	0.352
Total Ammonia Nitrogen, mg/l	1.28	< **0.14**	1.51	< **0.14**	< **0.18**	2.10	0.47	< **0.18**	< **0.18**	0.68	0.71	< **0.040**	0.563	< **0.040**	2.10
Total Ammonia Nitrogen, lbs/day	0.121	< **0.017**	0.169	< **0.014**	< **0.022**	0.110	0.041	< **0.010**	< **0.019**	0.076	0.015	< **0.0006**	0.044	< **0.0006**	0.169
Fecal coliform, Cnts/100ml	10	10	2	10	32	4	4	4	4	4	260	20	9.1	2	260
Dissolved Oxygen, mg/l	8.0	7.0	8.1	7.9	9.0	6.6	8.1	8.4	7.3	8.9	12.4	10.0	8.48	6.6	12.4
pH, Standard Units	7.0	7.9	7.1	7.6	8.0	6.7	7.9	7.0	7.1	7.9	8.4	7.7	N/A	6.7	8.4

BOD has Summer and Winter concentration limitations. Summer limitations are 10 mg/l Average Monthly, 20 mg/l Maximim Daily and 25 mg/l Instantaneous Maximum. Winter limitations are 20 mg/l Average Monthly, 40 mg/l Maximim Daily and 50 mg/l Instantaneous Maximum. Loadings are Report Only.

Ammonia Nitrogen has Summer and Winter concentration limitations. Summer limitations are 8 mg/l Average Monthly, 16 mg/l Maximim Daily and 20 mg/l Instantaneous Maximum. Winter limitations are 15 mg/l Average Monthly, 30 mg/l Maximim Daily and 37.5 mg/l Instantaneous Maximum. Loadings are Report Only.

1st Qtr 21 One Exceedance - 200 Cnts/100ml Monthly Geometric Mean Permit Limit Exceeded

One Permit Limit exceeded during 3 year span.

20,000 GPD (0.0200 MGD) Flow Limit was not exceeded during the past 3 years.

BLACKWATER FALLS STATE PARK - CAMPGROUND LAKE BATHS OUTLET 002															
SITE REGISTRATION NUMBER WVG551189															
Analytical Parameter	**Monitoring Period and Analytical Results**												**Laboratory Results Summary**		
	3rd Qtr 18	**4th Qtr 18**	**1st Qtr 19**	**2nd Qtr 19**	**3rd Qtr 19**	**4th Qtr 19**	**1st Qtr 20**	**2nd Qtr 20**	**3rd Qtr 20**	**4th Qtr 20**	**1st Qtr 21**	**2nd Qtr 21**	**Average**	**Minimum**	**Maximum**
Flow, MGD	0.00143	0.001	0.0005	0.0005	0.00144	0.0005	0.00183	0.0005	0.001	0.001	0.00288	0.0026	0.00127	0.001	0.00288
Biochemical Oxygen Demand (BOD), mg/l	8	13.2	< **2.12**	7	< **2.12**	20.7	< **2.12**	< **2.12**	45	9.92	4.13	2.7	9.22	< **2.12**	45
Biochemical Oxygen Demand (BOD), lbs/day	0.096	0.110	< **0.009**	0.031	< **0.025**	0.086	< **0.032**	< **0.009**	0.378	0.083	0.099	0.0585	0.078	< **0.009**	0.378
Total Suspended Solids (TSS), mg/l	6	9	< **4**	4	4	12	13	4	46	5	7	< **1**	9.2	< **1**	46
Total Suspended Solids (TSS), lbs/day	0.072	0.075	< **0.017**	0.017	0.048	0.050	0.198	0.017	0.384	0.042	0.168	< **0.0542**	0.089	< **0.017**	0.384
Fecal coliform, Cnts/100ml	10	10	2	10	84	4	4	4	1200	4	4	110	12.97	2	1200
Total Residual Chlorine, mg/l	< **100**	< **100**	< **100**	< **100**	< **100**	< **100**	< **100**	< **100**	< **100**	< **100**	< **100**	< **100**	< **100**	< **100**	< **100**
pH, Standard Units	7.8	7.1	7.1	8.0	8.1	6.8	8.3	6.4	7.1	6.8	8.8	8.5	N/A	6.4	8.8

3rd Qtr 18 Sampled twice - No Exceedances

4th Qtr 18 Sampled twice - No Exceedances

2nd Qtr 19 Sampled twice - No Exceedances

3rd Qtr 20 Sampled twice, probably in attempt to lower average - Results were 45 mg/l and 9 mg/l. No Exceedances

3rd Qtr 20 Sampled twice, probably in attempt to lower average - Results were 46 mg/l and 16 mg/l. One Exceedance of Average Monthly

3rd Qtr 20 Sampled twice, probably in attempt to lower average - Results were 1200 Cnts/100ml and XXX Cnts/100ml. Two Exceedances

Total Residual Chlorine limits are 0 ug/l Average Monthly, 0 ug/l Maximum Daily and 0 ug/l Instantaneous Maximum

Three Permit Limits exceeded during 3 year span.

11,000 GPD (0.0110 MGD) Flow Limit was not exceeded during the past 3 years.

BLACKWATER FALLS STATE PARK - CABINS OUTLET 003															
SITE REGISTRATION NUMBER WVG551190															
Analytical Parameter	**Monitoring Period and Analytical Results**												**Laboratory Results Summary**		
	3rd Qtr 18	**4th Qtr 18**	**1st Qtr 19**	**2nd Qtr 19**	**3rd Qtr 19**	**4th Qtr 19**	**1st Qtr 20**	**2nd Qtr 20**	**3rd Qtr 20**	**4th Qtr 20**	**1st Qtr 21**	**2nd Qtr 21**	**Average**	**Minimum**	**Maximum**
Flow, MGD	0.00128	0.0021	0.00138	0.00216	0.06801	0.0005	0.0028	0.0005	0.0005	0.00225	0.0030	0.00190	0.0072	0.0005	0.06801
Biochemical Oxygen Demand (BOD), mg/l	3.68	< **2.12**	< **2.12**	< **2.12**	21.2	2.51	< **2.12**	< **2.12**	12.6	< **2.12**	< **2.12**	< **2**	3.33	< **2**	21.2
Biochemical Oxygen Demand (BOD), lbs/day	0.039	< **0.037**	< **0.024**	< **0.038**	12.0	0.010	< **0.050**	< **0.009**	0.053	< **0.040**	< **0.053**	< **0.0317**	1.01	< **0.009**	12.0
Total Suspended Solids (TSS), mg/l	< **4**	< **4**	< **4**	< **4**	< **4**	< **4**	< **4**	< **4**	8	< **4**	37	3.5	4.0	3.5	37
Total Suspended Solids (TSS), lbs/day	< **0.043**	< **0.070**	< **0.046**	< **0.072**	< **2.27**	< **0.017**	< **0.093**	< **0.017**	0.033	< **0.075**	0.926	0.0555	0.0845	< **0.017**	0.926
Total Ammonia Nitrogen, mg/l	9.3	0.37	0.42	< **0.14**	< **0.18**	3.92	0.26	< **0.18**	< **0.18**	0.53	3.29	0.77	1.57	< **0.14**	9.3
Total Ammonia Nitrogen, lbs/day	0.100	0.006	0.005	< **0.003**	< **0.102**	0.016	0.006	< **0.001**	< **0.001**	0.010	0.082	0.0199	0.020	< **0.001**	0.100
Fecal coliform, Cnts/100ml	4000	10	2	10	4	4	4	4	4	4	4	20	8.94	2	4000
Dissolved Oxygen, mg/l	6.2	8.0	8.9	8.9	7.2	7.0	7.2	8.4	7.6	8.0	6.8	8.5	7.7	6.2	8.9
pH, Standard Units	7.5	7.1	7.3	8.2	7.4	6.9	8.0	6.8	7.2	8.0	7.6	7.8	N/A	6.8	8.2

BOD has Summer and Winter concentration limitations. Summer limitations are 5 mg/l Average Monthly, 10 mg/l Maximim Daily and 12.5 mg/l Instantaneous Maximum. Winter limitations are 10 mg/l Average Monthly, 20 mg/l Maximim Daily and 25 mg/l Instantaneous Maximum. Loadings are Report Only.

Ammonia Nitrogen has Summer and Winter concentration limitations. Summer limitations are 3 mg/l Average Monthly, 6 mg/l Maximim Daily and 7.5 mg/l Instantaneous Maximum. Winter limitations are 6 mg/l Average Monthly, 12 mg/l Maximim Daily and 15 mg/l Instantaneous Maximum. Loadings are Report Only.

3rd Qtr 19 Maximum Daily limit Exceeded.

1st Qtr 21 Average Monthly limit Exceeded.

3rd Qtr 19 Sampled twice, probably in attempt to lower average - Three Exceedances - Average Monthly, Maximum Daily and Instantaneous Maximum

3rd Qtr 20 Sampled twice, probably in attempt to lower average - Three Exceedances - Average Monthly, Maximum Daily and Instantaneous Maximum

3rd Qtr 18 Sampled three times, probably in attempt to lower average - Two Exceedances - Maximum Daily and Instantaneous Maximum

3rd Qtr 18 Sampled four times, probably in attempt to lower average - One Exceedance - Instantaneous Maximum

Eleven Permit Limits exceeded during 3 year span.

6,100 GPD (0.0061 MGD) Flow Limit was exceeded once during the past 3 years. This flow was an order of magnitude above the limit, so high that the average is also above the flow limit. Perhaps a typo or error?

BLACKWATER FALLS STATE PARK - NEW CABINS OUTLET 001															
SITE REGISTRATION NUMBER WVG551433															
Analytical Parameter	**Monitoring Period and Analytical Results**												**Laboratory Results Summary**		
	3rd Qtr 18	**4th Qtr 18**	**1st Qtr 19**	**2nd Qtr 19**	**3rd Qtr 19**	**4th Qtr 19**	**1st Qtr 20**	**2nd Qtr 20**	**3rd Qtr 20**	**4th Qtr 20**	**1st Qtr 21**	**2nd Qtr 21**	**Average**	**Minimum**	**Maximum**
Flow, MGD	0.008255	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.0018	0.002	0.0014	0.001	0.008255
Biochemical Oxygen Demand (BOD), mg/l	< **2.12**	< **2.12**	< **2.12**	< **2.12**	8.32	< **2.12**	< **2.12**	< **2.12**	23.1	< **2.12**	2.41	2.7	3.04	< **2.12**	23.1
Biochemical Oxygen Demand (BOD), lbs/day	< **0.146**	< **0.009**	< **0.009**	< **0.009**	0.035	< **0.009**	< **0.009**	< **0.009**	0.096	< **0.018**	0.036	0.0473	0.0179	< **0.009**	0.096
Total Suspended Solids (TSS), mg/l	< **4**	< **4**	< **4**	< **4**	4	< **4**	< **4**	< **4**	13	< **4**	< **4**	5	1.8	< **4**	13
Total Suspended Solids (TSS), lbs/day	< **0.275**	< **0.017**	< **0.017**	< **0.017**	0.017	< **0.017**	< **0.017**	< **0.017**	0.054	< **0.033**	< **0.060**	0.0876	0.0132	< **0.017**	0.0876
Total Ammonia Nitrogen, mg/l	1.78	0.64	< **0.14**	< **0.14**	1.16	0.53	0.25	< **0.18**	< **0.18**	1.64	3.04	3.5	1.05	< **0.14**	3.5
Total Ammonia Nitrogen, lbs/day	0.123	0.003	< **0.001**	< **0.001**	0.005	0.002	0.001	< **0.001**	< **0.001**	0.014	0.046	0.0613	0.0213	< **0.001**	0.123
Fecal coliform, Cnts/100ml	20	400	2	10	4	4	4	4	4	4	4	110	9.0	2	400
Dissolved Oxygen, mg/l	6.4	7.0	6.9	7.5	6.5	7.4	7.3	8.7	6.3	6.3	7.8	6.3	7.0	6.3	8.7
Total Residual Chlorine, mg/l	< **100**	< **100**	< **100**	< **100**	< **100**	< **100**	< **100**	< **100**	< **100**	< **100**	< **100**	N/A	< **100**	< **100**	< **100**
pH, Standard Units	7.0	7.1	7.2	8.2	7.6	6.8	8.2	6.9	7.0	6.4	8.0	7.5	N/A	6.4	8.2

BOD has Summer and Winter concentration limitations. Summer limitations are 5 mg/l Average Monthly, 10 mg/l Maximim Daily and 12.5 mg/l Instantaneous Maximum. Winter limitations are 10 mg/l Average Monthly, 20 mg/l Maximim Daily and 25 mg/l Instantaneous Maximum. Loadings are Report Only.

Ammonia Nitrogen has Summer and Winter concentration limitations. Summer limitations are 3 mg/l Average Monthly, 6 mg/l Maximim Daily and 7.5 mg/l Instantaneous Maximum. Winter limitations are 6 mg/l Average Monthly, 12 mg/l Maximim Daily and 15 mg/l Instantaneous Maximum. Loadings are Report Only.

3rd Qtr 18 Maximum Daily Limit exceeded, but not reported as such on the eDMR.

4th Qtr 18 Sampled twice, probably in attempt to lower average - No Exceedances

3rd Qtr 19 Sampled twice, probably in attempt to lower average - No Exceedances

3rd Qtr 20 Sampled twice, probably in attempt to lower average - Three Exceedances - Average Monthly, Maximum Daily and Instantaneous Maximum

2nd Qtr 21 Average Monthly limit Exceeded.

Total Residual Chlorine limits are 0 ug/l Average Monthly, 0 ug/l Maximum Daily and 0 ug/l Instantaneous Maximum

Four Permit Limits exceeded during 3 year span.

4,000 GPD (0.004 MGD) Flow Limit was exceeded once during the past 3 years. But the eDMR does not indicate that.

APPENDIX F

SEWER CAPACITY TIMELINE