Bays Mountain Park Wastewater System

Preliminary Engineering Report

Revised Nov. 2016

LDA ENGINEERING

WATER ■ WASTEWATER ■ STORMWATER ■ PUBLIC WORKS

LDAENGINEERING.COM

BAYS MOUNTAIN PARK & PLANETARIUM

This page left blank intentionally.

Contents

Tables

Figures

Appendix

SECTION 1.0: Introduction

LDA Engineering was requested by the City of Kingsport to investigate and recommend alternative wastewater solutions for Bays Mountain Park and Planetarium. The purpose of this report is to investigate the possible rehabilitation of the system, expansion of the system, alternative treatment systems, and the feasibility of disposing of wastewater from the park directly into the Kingsport wastewater collection system.

1.1 Background

Bays Mountain Park and Planetarium, located in Kingsport, TN, is a 3,550 acre nature preserve and the City of Kingsport's largest park. The park has approximately 230,000 to 240,000 visitors per year with seasonal summer peaks of 2,000 visitors per day. The parks water and sewer utilities include a 24,000 gallon well-fed water storage tank, a sand and gravel sewer treatment system, and two (2) septic systems with field drain lines. Less than 5,000 gallons per day (GDP) is being treated in the existing treatment system, but for all facilities, the park experiences an estimated 6,000 GPD, however the actual flows are unknown at this time. The flow that is being treated is coming from the Nature Center, the cabin, and the Homestead Building. All other facilities are currently on septic systems that do not drain to the existing wastewater treatment system.

The park installed the current wastewater treatment system in 1981. The sewer treatment system consists of a septic tank for solids removal, a sand and gravel filter for septic tank effluent filtration, and HTH chlorination tablets for disinfection. An aeration device was recently installed in the chlorine contact tank to improve dissolved oxygen in the effluent. The treated effluent then discharges into Dolan Branch at stream mile 1.5. The current allowable discharge is 5,000 gallons per day (GPD).

The park has expanded and added new facilities onto the original system. These expansions as well as the growing numbers of visitors to the park have placed strain on the original system. Additionally, high summer peak flows followed by periods of little or no flow create conditions within the system that adversely affect dissolved oxygen content, biological activity, and denitrification processes.

1.2 Field Investigation

The current site is summarized as follows: To the north of the existing system is the old Kingsport reservoir, now a lake, which is damned by a quarried rock wall constructed in 1916. The dam has a walkway across the top that leads to trails heading west. Bays Mountain Road approaches from the west up towards the dam and then curves towards to Nature Center. To the east is the Nature Center, main parking area, and observatory. To the west Dolan Branch stream crosses under Bays Mountain Road and begins to flow south towards property owned by Eastman Chemical Company. To the south is forest that is steeply-sloped down towards property owned by Eastman Chemical Company and Reservoir Road. LDA has conducted site visits to the project site to verify physical features of the project location.

LDA investigated the existing infrastructure including but not limited to:

- Location
- Structures and Facilities
- Utilities
- Visible environmental features such water resources and rock.
- Hardscape such as streets, curb, walks, buildings, and related structures
- Access to site

1.3 Data Review

The data LDA obtained was supplied by Bays Mountain's staff and the Tennessee Department of Water Resources. Bays Mountain's staff provided a plan and schematic of the existing wastewater treatment system. Utilizing information provided by Bays Mountain's staff, LDA used TDEC Water Permit Viewer to compile a list of documents pertaining to the permit and recent inspections. Based on the permits documents, it is apparent that the majority of the low dissolved oxygen violations occur during the warm summer months. This could be partially due to high organic loading on the system during peak days. The installation of the fine bubble aeration diffuser is a beneficial tool to add dissolved oxygen and help strip the chlorine and ammonia from the system. As visitation to the park increases, enlarging the size of the system would be even more beneficial as discussed later in this report.

Additionally, LDA reviewed the Bays Mountain Long Term Strategic Plan and the City of Kingsport Livability Report for Leisure Services. Included within the reports were discussions of existing and proposed amenities. Some of these amenities have already been implemented. However, due to a lack of existing infrastructure such as roads, parking, sewer, water, and other factors, not all amenities have been added. As part of the report a consideration of the parks ability to expand to allow for future expansion or amenities has been used as focal point for the recommendation for wastewater system alternatives.

SECTION 2.0: Wastewater System Alternatives

2.1 Do Nothing Alternative

Using the current system without making any improvements to the current treatment method, Bays Mountain Park would continue to see violations with low DO, high residual chlorine, and high ammonia. As the number of visitors to the park continues to increase, the current system will continue to deteriorate and fail to properly treat the effluent before it is discharged into Dolan Branch. Even with the installation of the aerator at the chlorine contact chamber, the current system is not configured to handle the loading rate of wastewater entering the system during peak summer months due to the undersized the septic tank configuration.

2.2 Rehabilitate the Existing System and Modify Flow to Onsite Systems

In order to rehab and upsize the current system, it would be necessary to increase the size of the septic tank and reconfigure the distribution system to a gravity manifold system for better distribution across the sand and gravel infiltration bed. It would potentially also be necessary to rehabilitate or replace portions of the sand and gravel filtration bed, replace the chlorine contact tank with a UV system, and increase the size of the aeration system recently installed. It may be noted that the addition of soda ash flushed into the toilets each day to raise the alkalinity of the influent may increase the system's ability to process and treat nitrogen. This could be a viable alternative to a commercial nitrogen removal retrofit. However, retrofitting the septic tank with a nitrogen removal filter would further increase the efficiency of the existing system and potentially extend its useful life.

The current septic tank is undersized for the system, having only a 1,500 gallon capacity. The required size for Bays Mountain Park is approximately 4,875 gallons. Dual 3,000 gallon capacity septic tanks would be necessary for the current flow rate and loading experienced during peak times in order to keep solids from entering the secondary treatment sand and gravel filter bed.

The current sand filter bed would also potentially need to be replaced or rehabilitated with new sand, gravel, and field lines. The current field lines are over thirty years old and may have issues with solids deposited in the pipe or deposited within the sand and gravel layers of the treatment system.

A small commercial or residential grade UV system could be installed in line with the existing outfall pipe. This would provide increased treatment efficacy and remove the potential for high chlorine residual discharge from the system.

As an alternative to a UV system, the park could explore the use of a peracetic acid dosing system. The peracetic acid dosing system uses peracetic acid to sterilize the effluent before it is discharged into Dolan Branch. Peracetic Acid is a colorless and odorless liquid made up of peroxide and acetic acid that does not affect effluent toxicity. It also does not result in residuals, mutagenic, or carcinogenic compounds after disinfection. Another potential alternative would be to add no flush toilets to the Nature Center. Installing the no flush toilets will aid in creating more capacity due to less water usage.

These improvements along with the suggestion from TDEC to install an aerator will give Bays Mountain Park much higher effluent quality and reduce violations.

Advantages of this alternative include:

- It is low cost.
- System may be monitored and rehabilitation in phases as needed to make it the "right size" and control costs.
- There are no required changes for NDPES permit.
- Staff is already familiar with system.
- It can be combined with Waterless or No Flush Toilets to decrease impact on Dolan Branch.

Disadvantages of this system include:

- It does not increase discharge capacity and, therefore, inhibits the park ability to expand services.
- It will require additional monitoring and adjustment to optimize treatment.
- Aging system components may fail requiring costly repair or replacement.

Please refer to the **Appendix C: Preliminary Existing System Rehabilitation Schedule** for the proposed steps and schedule for this alternative.

2.3 Rehabilitate Abandoned Waterline for Reuse as Gravity Sewer System

An abandoned water line, previously used to supply water to the City of Kingsport, runs along Dolan Branch and ends directly behind the Eastman Recreation Cabins maintenance facility. This facility is already connected to the City's sewer system. The abandoned water line could be lined and reused as a sewer line so that the wastewater from the park could be conveyed to the City's wastewater collection system. This would be an economical way to remedy the existing system issues by eliminating discharges to Dolan Branch.

After a field visit to locate the abandoned water line, LDA discovered that the almost 100-year-old eight-inch (8") cast iron pipe had seen many years of deterioration but was still intact along much of its length. There were several locations along the pipe where trees and rocks had fallen upon the pipe and where the pipe had separated due to the corrosion of the bolts themselves. Additionally, there was some cracking in a few areas as well as two places where the pipe had broken completely. The pipe supports where the water line crosses the stream were serviceable, and some rocks of the supports on the ground showing signs of wear. However, in general the abandoned waterline, as previously noted, is intact.

Rehabbing this abandoned line would include the potential of cured-in-place piping (CIPP). An alternative would include sliding a new smaller diameter HDPE pipe through the existing 8" pipe, cutting out sections of broken pipe and replacing them with 8" sleeves and spool pieces, and replacing the bolts. Connecting the existing water line to the City's sewer system would require construction activities on Eastman Chemical Company's property. Eastman Recreation

Facility is already on the City's sewer system, so connection to their system would require a connection and new piping to the abandoned water line.

Although there are access concerns and several stream crossings to contend with, this is an overall desirable and feasible option. LDA's visual assessment is provided in **Appendix A: Abandoned Waterline Observation Library**. Additionally, LDA conducted interviews with three contractors to determine the most feasible option for lining the pipe and access to repair broken sections of the abandoned water line. It was determined pushing a new pipe through or steam-cured felt lining were the most feasible alternatives and that it was feasible overall.

Advantages of this alternative include:

- It is relatively low cost for a new gravity sewer of this length and level of service.
- Discharge permit will no longer be needed as it will not discharge to Dolan Branch.
- Park may expand to capacity of new system, which allows for significant expansion of park facilities.
- There will be a significant reduction in staff requirements, maintenance, and material costs.
- It can be combined with Waterless or No Flush Toilets and low flow water use technology.

Disadvantages of this system include:

- It has moderate environmental impact due to access needs along the existing line for repair and lining.
- It has a higher cost than some alternatives.
- It will require easement and right-of-way coordination with Eastman Chemical Corporation.
- A line failure could possible mean expensive maintenance, therefore design must consider anti-clog and maintenance design.

2.4 On-Site Sewage Facilities

2.4.1 STEP (Septic Tank Effluent Pumping) and Onsite Low Pressure Pipe Collection System.

A Septic Tank Effluent System is a system that uses a septic tank to remove solids from the influent, a dosing tank to pump the wastewater to a distribution box, and small diameter distribution laterals that are perforated to allow effluent to seep into the ground. The dosing tank takes partially-clarified effluent from the septic tank and stores the water until the level in the tank rises enough to activate a float, which will then turn the pump on. The level controls are set for a specific pump sequence of one or two times daily, allowing breaks in between doses for the soil to absorb the wastewater. The pump moves the effluent through the supply line and manifold to the distribution laterals under low pressure. The laterals are a network of PVC pipes that have small, drilled holes through which the wastewater is distributed evenly. The laterals are placed in narrow trenches that allow enough storage volume so that the depth of the wastewater does not exceed two or three inches of the total trench depth during each dosing cycle.

Advantages of this system include:

- Shallow excavation of trenches promote evapotranspiration and growth of aerobic bacteria.
- Field lines can be located on sloping ground or on uneven terrain that would otherwise be unsuitable for gravity flow systems.
- Periodic dosing and resting cycles enhance and encourage aerobic conditions in the soil.
- It allows for placement of the field lines uphill from the nature center.
- It can overcome the problem of peak flows associated with gravity-fed conventional systems by sizing for all future amenities or facilities.
- Discharge permit will no longer be needed as it will not discharge to Dolan Branch.
- Park may expand to capacity of new system, which allows for significant expansion of park facilities.

Disadvantages of this system include:

- The soil where the trenches are excavated must have an acceptable soil absorption rate ranging from ten minutes per inch through seventy five minutes per inch.
- A minimum soil depth of thirty inches over any underlying restrictive horizon is required.
- There is potential for clogging of laterals by solids or roots.

- There are moderate to severe infiltration problems.
- There is increased maintenance of facility and land application area.

2.4.2 STEP with Discharge to Mound System

Mound systems are very similar to the STEP-LPP system mentioned above; however, instead of digging small trenches to lay distribution laterals, the mound would be built over top of the laterals. This would be used in the instance that there is poor percolation of the soil or if the topsoil layer is too shallow for the finished effluent to percolate into the soil due to shallow bedrock.

Advantages of this system include:

- It gives the ability to use land that would otherwise be unsuitable for in-ground or at-grade systems.
- Discharge permit will no longer be needed as it will not discharge to Dolan Branch.
- Park may expand to capacity of new system, which allows for significant expansion of park facilities.
- It minimizes excavation at the site.
- It overcomes the problem of peak flows associated with gravity-fed conventional systems.

Disadvantages of this system include:

- Construction costs are typically higher than those of conventional systems.
- Location of the mound may affect drainage patterns and limit land use options.
- It may not be aesthetically pleasing but may be landscaped if desired.

2.4.3 STEP with Subsurface Drip Dispersal System

A subsurface drip dispersal system consists of a septic tank for solids removal and a filtration system that prevents plugging of the drip emitters and forces septic tank effluent through 100-150 micron filters under high pressure that can be back flushed back to the septic tank. It also consists of a pump tank, a dosing controller, and a drip dispersal network with one or more zones consisting of supply lines, supply manifolds, drip laterals, return manifolds, and return lines that discharge back to the septic tank. Subsurface drip dispersal systems provide a unique opportunity for sites with steep slopes because they have a high gradient for downslope movement of water.

The drip tubing consists of small emitters typically placed at intervals 12 to 24 inches apart which allow wastewater to drip into the soil site. The drip emitter evenly distributes the wastewater over a large area and allow it to seep slowly in the soil where the effluent is removed by plant uptake and evapotranspiration from the surface.

Advantages of this system include:

- It has the ability to install on sloped surfaces, which allows for positive drainage.
- It is suitable in shallow soils which promotes evapotranspiration and growth of aerobic bacteria.
- It allows for the placement of the field lines upslope of the nature center.
- It evenly distributes final effluent to prevent surface accumulation and proper soil percolation.
- It overcomes the problem of peak flows associated with gravity-fed conventional systems.
- There is minimal soil and plant disturbance
- Discharge permit will no longer be needed as it will not discharge to Dolan Branch.
- Park may expand to capacity of new system, which allows for significant expansion of park facilities.

Disadvantages of this system include:

- Drip dispersal systems are typically more expensive than conventional systems.
- Additional maintenance is required due to the filter media, pumps, and the potential for clogging of the emitters due to suspended solids or roots.

2.5 Select Green Alternatives

2.5.1 Willow Tank Evaporative System

The willow tank evaporative system consists of a septic tank to remove solids, a dosing tank, and distribution laterals that discharge effluent into a lined area where willow trees are planted to reuse the wastewater. One particular detail about these systems is that the trees must be pruned annually due to the heavy metal buildup in the trees foliage. The cuttings may be used in several ways such as creating bark for textiles or biomass for fuel, compost, or fertilizer operations. This system would be combined with the LPP system as previously described in Section 2.3.

Advantages of this system include:

- It is a renewable and sustainable green infrastructure.
- There is a potential biomass stream for composting or biofuels.
- It provides potential harvestable product for textiles for revenue.
- Discharge permit will no longer be needed as it will not discharge to Dolan Branch.

- Park may expand to capacity of new system, which allows for significant expansion of park facilities.

Disadvantages of this system include:

- It may require the use of naturally digestible soaps, detergents, and cleaning agents
- It requires additional land not currently used in existing system in order to treat the wastewater properly.

2.5.2 No Flush or Waterless Toilet

Waterless or No Flush toilets can provide relief to the existing system and may be best combined with the Do Nothing and Rehabilitation of the Existing System options outlined in Sections 2.1 and 2.2 above. This alternative replaces the toilets connected to the existing system with a no flush or waterless toilet system. This would remove wastewater discharge to the existing system, transitioning the influent to grey water only from baths, sinks, dishwashers, and showers. Alternative soaps, cleaners, and non-traditional environmental cleaners used with this system have an additive effect.

Advantages of this system include:

- It is sustainable green infrastructure.
- It creates a potential compostable or biomass waste stream.
- There are energy and water savings.
- There are decreased material costs.
- There are decreased labor cost.
- It is low maintenance.
- There is decreased biological loading to existing system, improving
  - Remaining Useful Life,
  - BOD_5,
  - Nitrogen loading,
  - COD,
  - DO, and
  - pH.

Disadvantages of this system include:

- Selection of system will have to allow for peak volume or high flow conditions which may require substantial building or infrastructure improvements.

2.6 New Wastewater Collection System

The final and most robust of the alternatives is the construction and installation of a new collection system. This would consist of a low pressure system to collect wastewater from each facility onsite and then discharge it to a central pump station where it is pumped along Bays Mountain Road to a point where it can transition to a gravity sewer system. The existing City of Kingsport wastewater collection system would then be extended to the meet the new system at the top of the hill above the pay booth.

Advantages of the extended aeration process include:

- Discharge permit will no longer be needed as it will not discharge to Dolan Branch.
- Park may expand to capacity of new system, which allows for significant expansion of park facilities.
- It is low maintenance.
- It requires no additional demands for monitoring and maintenance by park staff.

Disadvantages of the extended aeration process include:

- There is high initial cost.
- Park would have to plan on regularly schedule maintenance and repair of pump systems.
- Long term replacement funds would have to be in place for replacement or rehab at end of design life cycle.

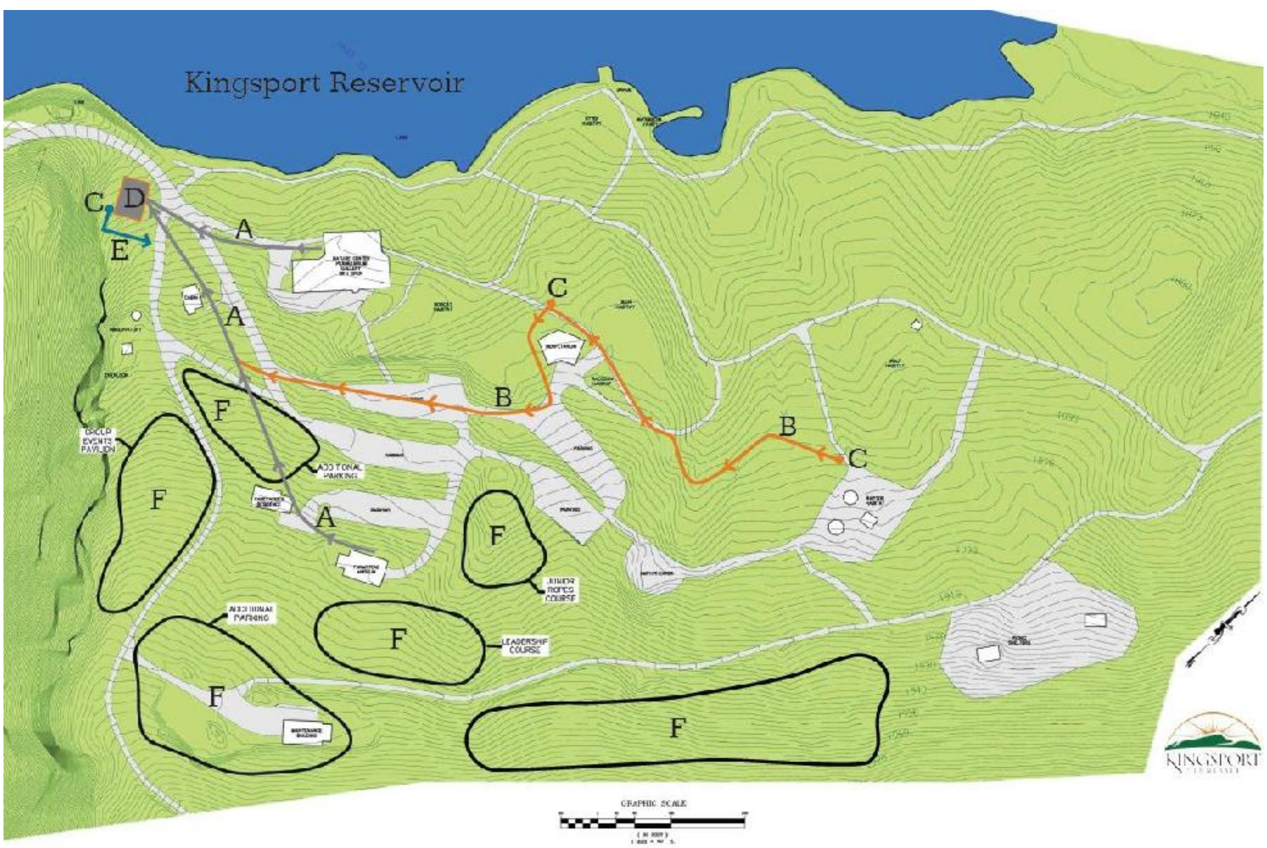
SECTION 3.0: Alternative Land and Route Planning

Additional measures and steps will be required during design to determine either the best route, location, or both for selected system alternatives.

3.1.1 On-Site STEP Wastewater System and Land Application Alternatives

The location of the alternative on-site wastewater systems including the STEP, LPP field lines, mound system, and willow tank systems will require an analysis of the entire property and selection of sites alternatives. A geotechnical and soils investigation would then be performed on selected locations to determine the best siting for the system. A review of existing documents for proposed park additions such as parking, facilities, and amenities was conducted. Utilizing maps developed under the *Bays Mountain Long Term Strategic Plan, May 2010*, we have highlighted areas for possible exploration of the aforementioned on-site systems. Please see Figure 3.1 and the associated legend outlined below for further description of the potential locations.

Figure 3.1 Land Application Route and Land Planning



As previously noted, a combination of gravity and pressure sewer system will be required to collect and distribute the wastewater from the existing and future facilities. After transport of wastewater to the general location of the existing treatment system, which would provide a possible system low point, the treated effluent would then be pumped up to a land application system such as a field line, mound, drip dispersal or willow tank system. These components are labeled as follows:

A. The grey line labeled A represents existing or future gravity sewer lines
B. The orange lines labeled B represents the possible location of pressure sewer lines used to collect wastewater from other facilities onsite
C. The facilities labeled C represent possible sewer pump lift stations
D. The facility labeled D represents the existing or new facility for initial treatment of wastewater.
E. The blue line E represents the treated or partially treated effluent pumped back to the land application system.
F. The facilities labeled F represent possible locations for future land application systems.

3.2 Alternative Wastewater Collection and Disposal

Each alternative will have unique challenges. In order to rehabilitate the existing waterline and reuse it as a sewer line, access must be made from the Eastman property to a point where the selected lining operation can be mobilized. Additionally, the damaged sections and stream crossings will have to be repaired along with cleaning and video inspection of the line prior to installation of the liner.

In the new system alternative, the low pressure distribution system will have to be carefully coordinated with the location of rock and bridges along the access drive in order to transition to a gravity system and tie into the existing wastewater collection system. The location of alternative collection and disposal systems are outlined in Figure 3.2 below.

Figure 3.2 Alternative Wastewater Collection Route Planning

Both systems will require the addition of pressurized wastewater collection systems at the Nature Center end of the collection system (upstream end) and additional sections of gravity sewer at the existing wastewater system (downstream end) to install the selected alternative.

The components are labeled as follows:

A. The distribution pump station for onsite wastewater would be located approximately where the existing sand and gravel filter sits now, labeled A on the map.
B. The orange line B represents the pressure sewer main along Bays Mountain Park Rd.
C. The blue line C represents the gravity portion of the new sewer system to the point of connection with the existing City of Kingsport wastewater collection system.
D. The grey line D represents the reused water line as a gravity sewer to the point of connection with existing sewer on Eastman Chemical Company property.
E. The green line E represents the new or existing gravity sewer system across Eastman Chemical Company's property to point of connection with the existing City of Kingsport wastewater collection system.

SECTION 4.0: Alternative Cost Estimates

4.1 Rehabilitation of Existing System Cost Estimate

Rehabilitation of the existing system will be assumed to require additional solids removal, nitrogen removal, and bacteriological treatment. Additionally, a new pressure manifold design, rehab of existing sand and gravel treatment system, and proper retrofit of the aeration system with bacteriological treatment system is factored as part the estimate.

Estimates of probable costs for each of the following components have been provided for comparison:

- Site Survey, Sampling, Metering, and Installation of additional septic tank
- Retrofit of tanks with nitrogen removal system
- Installation of gravity manifold
- Cleaning, repair, and rehabilitation of existing sand and gravel system
- Retrofit for installation of UV system and aeration system.
- Design Services

Estimate of probable cost for existing system rehabilitation is provided in Table 1 below.

Table 1 Existing System Rehabilitation Estimate of Probable Cost

Existing System Rehabilitation					
ITEM	DESCRIPTION	QUAN	UNIT	UNIT COST	TOTAL
1	Survey, Flow Monitoring and Sample Analysis	1	LS	$12,000.00	$12,000.00
2	Addition of Septic Tank	1	LS	$18,500.00	$ 18,500.00
3	Installation of Nitrogen Removal System	1	LS	$ 10,000.00	$ 10,000.00
4	Installation of Gravity Manifold	1	LS	$ 4,500.00	$ 4,500.00
5	Rehabilitation of Existing Gravel and Sand System	1	LS	$ 25,000.00	$ 25,000.00
6	Installation of a UV System	1	LS	$ 6,500.00	$ 6,500.00
7	Additional Power Utilities and Controls*	1	LS	$ 8,000.00	$ 8,000.00
8	Consulting Services	1	LS	$10,500.00	$10,500.00
Alt. 1	Remodel Restrooms on Septic Systems to No Flush Toilets	2	EA	$60,000.00	$120,000.00
				SUBTOTAL	$ 95,000.00
				CONTINGENCY	$ 19,000.00
				TOTAL	$114,000.00

*Addition of Waterless or No Flush Toilets would be synergetic with this effort; however, costs for this option would be atypical and specific remodeling of plumbing in existing facilities would need to be considered. Estimates per restroom altered is $60,000 per restroom.

4.2 Rehabilitate Abandoned Waterline for Reuse as Gravity Sewer System Cost Estimate

Rehabilitation of the abandoned water line for reuse as a sewer collection system will be assumed to include the repair of broken sections of 8" cast iron pipe, video, cleaning of 8" cast iron pipe, lining of 8" ductile iron pipe, and extension of sewer collection systems at either end to connect the Park to City of Kingsport wastewater collection system.

Estimates of probable cost for each of the following components have been provided for comparison:

- Repair of Broken Sections of 8" Cast Iron Pipe
- Cleaning and Video Inspection of 8" Cast Iron Pipe
- Lining of 8" Cast Iron Pipe
- Extension of upstream and downstream wastewater treatment system.
- Professional Services

Estimate of probable cost for reuse of abandoned waterline is provided in Table 2 below.

Table 2 Reuse of Abandoned Waterline Estimate of Probable Cost

Rehabilitate Abandoned Waterline					
ITEM	DESCRIPTION	QUAN	UNIT	UNIT COST	TOTAL
1	On-Site Distribution System	1	LS	$200,000	$200,000
2	Repair of Broken Sections of 8" Ductile Iron Pipe.	350	FT	$120.00	$42,000.00
3	Cleaning and Video of 8" Cast Iron Pipe	3,500	FT	$15.00	$52,500.00
4	Lining of 8" Cast Iron Pipe*	3,500	FT	$100.00	350,000.00
5	Extension of Wastewater System at Upstream End**	1	LS	$45,000.00	$45,000.00
6	Extension of Wastewater System at Downstream End	1	LS	$200,000.00	$ 200,000.00
7	Surveying	1	LS	$15,000.00	$ 15,000.00
8	Consulting Services	1	LS	$75,000.00	$75,000.00
				SUBTOTAL	$ 979,500.00
				CONTINGENCY	$200,000.00
				TOTAL	$1,179,500

*Liner type to be selected during design. Liner cost may vary from $65.00 per foot for steam-cured felt liner to $150.00 per foot for UV-cured liner.

4.3 STEP/LPP System and Land Application System Cost Estimate

The focus of the STEP/LPP alternative will be to collect flow from all existing facilities and select future facilities. From the collection point, the effluent would then be distributed to a land application system such as traditional trench, mound, or proprietary system.

Estimates of probable cost for each of the following components have been provided for comparison:

- Installation of STEP/LPP System for Collection and Distribution of Wastewater
- Installation of Land Application System
- Professional Services

Estimate of probable cost for STEP/LPP System is provided in the Table 3 below.

Table 3 Low Pressure System and Land Application System Estimate of Probable Cost

STEP/LPP system and Land Application System					
ITEM	**DESCRIPTION**	**QUAN**	**UNIT**	**UNIT COST**	**TOTAL**
1	Addition of Septic Tank	1	LS	$18,500.00	$18,500.00
2	Installation of LPP Wastewater Collection System	1	LS	$ 200,000.00	$200,000.00
3	Installation of Wastewater Distribution System	1	LS	$ 75,000.00	$75,000.00
4	Installation of Land Application System*	1	LS	$100,000.00	$100,000.00
5	Survey	1	LS	$ 12,000.00	$12,000.00
6	Consulting Services	1	LS	$65,000.00	$65,000.00
				SUBTOTAL	$470,500.00
				CONTINGENCY	$ 85,000.00
				TOTAL	$555,500.00

*Assumes land already owned and available for use by Bays Mountain for Selected Land Application System.

4.4 New Wastewater Collection System

The new wastewater collection system alternative will focus on construction of an onsite low pressure system for collection of onsite wastewater. The wastewater would then be discharged to a central pump station where it would pumped along Bays Mountain Road to an extension of the City of Kingsport wastewater collection system.

Estimates of probable cost for each of the following components have been provided for comparison:

- Installation of Low Pressure Collection System
- Installation of a Central Sewer Lift Station.
- Installation of Force Main
- Extension of City of Kingsport Wastewater Collection System
- Survey
- Professional Services

Estimate of probable cost for new collection system is provided in Table 5 below.

Table 4 New Wastewater Collection System Estimate of Probable Cost

New Wastewater Collection System					
ITEM	DESCRIPTION	QUAN	UNIT	UNIT COST	TOTAL
1	Installation of LPP Wastewater Collection System	1	LS	$ 200,000.00	$200,000.00
2	Sewer Lift Station	1	LS	$250,000.00	$250,000.00
3	Sewer Force Main	4,700	FT	$120.00	$564,000.00
4	Gravity Sewer	2,500	FT	$200.00	$500,000.00
5	Road Repair and Improvements	1	LS	$250,000	$250,000
6	Survey	1	LS	$ 3,500.00	$40,00.00
7	Consulting Services	1	LS	$135,000.00	$135,000.00
				SUBTOTAL	$1,689,00.00
				CONTINGENCY	$340,000.00
				TOTAL	$2,279,000.00

SECTION 5.0: Alternative Analysis

Through a series of two meetings with Bays Mountain Park Staff and City of Kingsport Parks and Recreation Staff, it was determined that the primary goal of the Preliminary Engineering Report was to assist staff in determining a course of action for the wastewater treatment system. Four main goals were determined to be drivers in the selection of a solution:

- Ability of the selected alternative to eliminate the need for a discharge permit and subsequently a discharge to Dolan Branch.
- Ability of the selected alternative to allow the parks facilities and amenities to expand.
- Reduction in overall maintenance and monitoring of the system.
- Ability to introduce sustainable or green applications with the selected alternative.

Rehabilitation of the existing system has been excluded from the recommendations on the basis that it does not meet the rating criteria and will be required regardless of any selected alternative.

The most favorable rated alternative is the rehabilitation and reuse of the abandoned waterline with the best score of 1. The next two highest rated were the new wastewater collection system and the land application system, followed by package plant as the least desirable alternative.

Due to the relatively close scores, the reused waterline and land application alternatives are the two systems recommended. However, each has its advantages and disadvantages:

- The waterline reuse project will be more expensive and construction time will be longer.
- The land application system will take much longer to plan, permit, and design but will be less expensive and have a shorter construction time.
- The land application system will still require a permit to operate; therefore, continual oversight by TDEC will remain with this option.

Although the initial cost is high, it appears that the key goal of the alternative should be to eliminate the discharge from onsite wastewater to Dolan Branch or the groundwater system. Only two alternatives accomplish this option; therefore, it is summarized that the reuse of the existing waterline is the most desirable. However, if in any instance it becomes as expensive a new system or infeasible, then a new collection system is recommended.

In order to recommend an alternative that meets the goals of these items, a simplified cost benefit analysis was conducted to score each alternative. A summary of simplified cost benefit ratings are outlined in Table 6 below.

Table 5: Simplified Alternative Cost Benefit Analysis

Simplified Alternative Cost Benefit							
Alternative	**Discharge Required**	**Expansion Capability**	**Maintenance and Monitoring**	**Sustainable or Green Application**	**Total Benefit**	**Cost**	**Cost Benefit**
Rehab Existing System	0	0	0	0	0	1	0
Rehab/Reuse Abandoned Waterline	1	1	1	1	4	4	1
LPP System and Land Application System	1	1	0	1	3	4	0.75
New Wastewater Collection System	1	1	1	0	3	4	0.75

5.1 Cost Benefit Rating Description

Discharge Required; was scored as a 0 or 1 with 0 representing the inability to eliminate a required discharge to Dolan Branch and 1 representing the ability to eliminate a discharge.

Expansion Capability; was scored as a 0 or 1 with 0 representing the inability to expand park facilities and 1 representing the ability to expand park facilities.

Maintenance and Monitoring; was scored as a 0 or 1 with 0 representing the same or additional level of M & M and 1 representing reduced level of M & M.

Sustainable or Green Application; was scored as a 0 or 1 with 0 representing the relative difficulty of incorporating sustainable or green applications and 1 representing the relative ease of incorporating sustainable or green applications.

Scaled Project Cost; was based upon the following scale:

$0 – $250,000 = 1

$250,000– $500,000 = 2

$500,000 – $750,000 = 3

$750,000 – $1,000,000 = 4

> $1.0M = 4

Benefit Cost = Total Benefit/Scaled Project Cost

SECTION 6.0: Items for Consideration and Next Steps

Throughout the development of the preliminary engineering report, several future factors were identified that could affect expansion, level of service, and use of Bays Mountain Park.

These factors are provided below for consideration:

- The latest planning document is dated 2010, and some of the proposed improvements have been installed. Installation of any proposed alternative should be coordinated with planned future wastewater use. It is recommended that the desired improvements requiring additional wastewater capacity be identified to assist in selection of a wastewater alternative.

- If sustainable or green alternatives are selected, it is recommended that educational and public outreach components be integrated into their use. The park is an excellent teaching, public education, and outreach facility.

- The location of any land application system will have to carefully planned around proposed park improvements related to access, exhibits, recreational areas, and proximity to rock and water resources. Additional soil and geotechnical studies will be required.

- If a new wastewater collection system is selected, this option should be coordinated with any improvements to Bays Mountain Road.

- Selection of land application system will require a state operating permit for the proposed system but will eliminate the need for a discharge permit.

- Planning for future system should be conducted closely with the help of City of Kingsport Water Resources staff, specifically wastewater distribution staff.

In addition to the selection of either the reused waterline alternative or the new collection system alternative, it is recommended that the above items be carefully considered and planned. The capacity of the selected alternative will greatly influence cost and required time and resources. Therefore, the critical path is determined to be the identification of future use, facilities, and amenities of the park and their impact on not only the wastewater system but also water system, transportation system, and other resources as each will impact the selected wastewater alternative in one form or another.

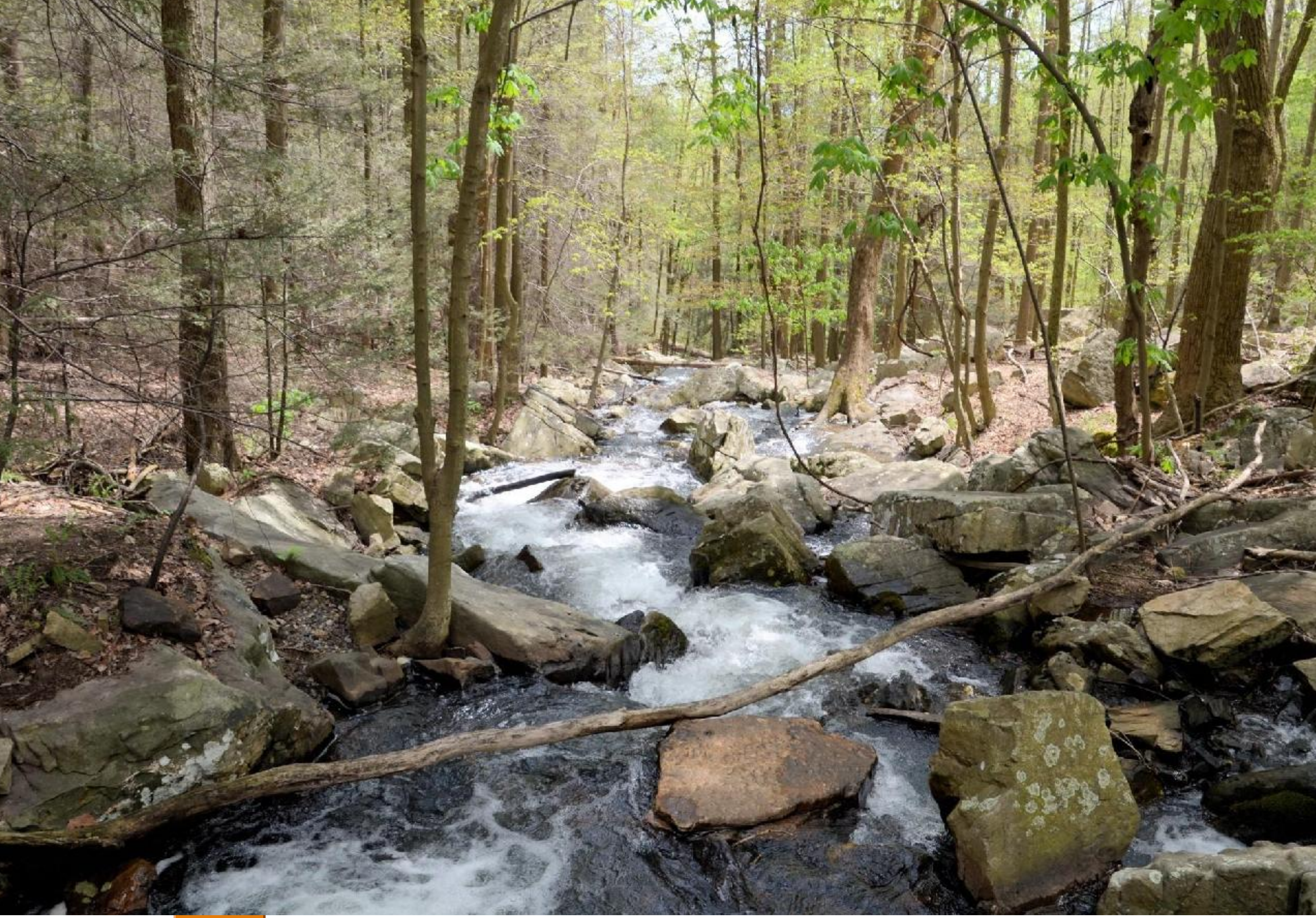
SECTION 7.0: Summary and Conclusions

In summary, there were several goals of selecting a new wastewater system identified as part of the preliminary engineering report. However, the primary goal was determined to be elimination of the discharge to Dolan Branch and thus remove the need for a discharge permit. Throughout development of this report, it became clear that the critical path to realizing this goal is the determination of future wastewater capacity needs for the park. Therefore, LDA recommends that a needs assessment of the Parks future wastewater system be conducted. The needs assessment, along with the preliminary engineering report will give City and Park staff confidence in selecting an alternate wastewater system that meets both current and future needs of Bays Mountain Park.

In conclusion, if a significant amount of new capacity is desired for the parks expansion then either the reused waterline or new wastewater collection system are the most desirable options. Whereas, if the same amount of flow or only slightly higher flow is all this needed then it becomes an operational decision. In this scenario, an operations permit for a land application system will have less risk than a discharge permit for flows to Dolan Branch. Therefore, the most desirable option is a new land application system sized to handle the required additional capacity.

At this time we recommend a two-step process; address immediate concerns and plan for future growth. The immediate need is to rehabilitate the existing system to bring it into compliance. Once the existing system is in compliance, determine the future needs of the park and install a system that eliminates the discharge to Dolan Branch and allows for the maximum possible expansion. The rehabilitated waterline and new wastewater collection system are the recommended systems to define further for future implementation.

This page left blank intentionally.



Appendix A: Abandoned Waterline Observation Library

WATER ■ WASTEWATER ■STORMWATER ■PUBLIC WORKS

LDAENGINEERING.COM

This page left blank intentionally.

Location of first manhole at bottom of mountain

Location of second manhole and water meter at bottom of mountain

Location of second manhole at bottom of mountain and first stream crossing of abandoned water line

First crossing of abandoned water line across Dolan Branch in Eastman Chemical Company property as well as an abandoned gate valve




Second crossing of Dolan Branch and depictions of how shallow pipe runs along trail




Depictions surface routing and taps in old water line

Photos showing rock pipe support and general surface routing of pipe

Photos showing fracture in pipe as well as rock pile pipe support and surface routing of abandoned line




Rock pipe supports are approximately 4-5 feet tall. Also about 2 feet of pipe fractured, unsure of cause. There are lots of rock debris




Pictures showing more debris and vegetation around old water line.

Photos showing debris around pipe, a tap, rock pipe supports, and complete separation of pipe.

Photos of surface crack along pipe, stone enveloping pipe support, and severe corrosion of bolt.

Location of first manhole at bottom of mountain

Photos of surface routing as well as a tap house.

Abandoned gate valve and tap house possibly used for sampling

Cast iron tee used to water to concrete structure across stream. Also photos of concrete pipe supports where the discharge from the concrete structure came back across the stream to reconnect with the main water line.




Photos of concrete structure across the stream from the water main




Photos of concrete structure across the stream from the water main as well as photos of the chlorine contact chamber with the newly installed aerator

Photos of surface routing and taps towards to the top of the mountain. Bays Mountain Road can be seen at the top of one of the photos.

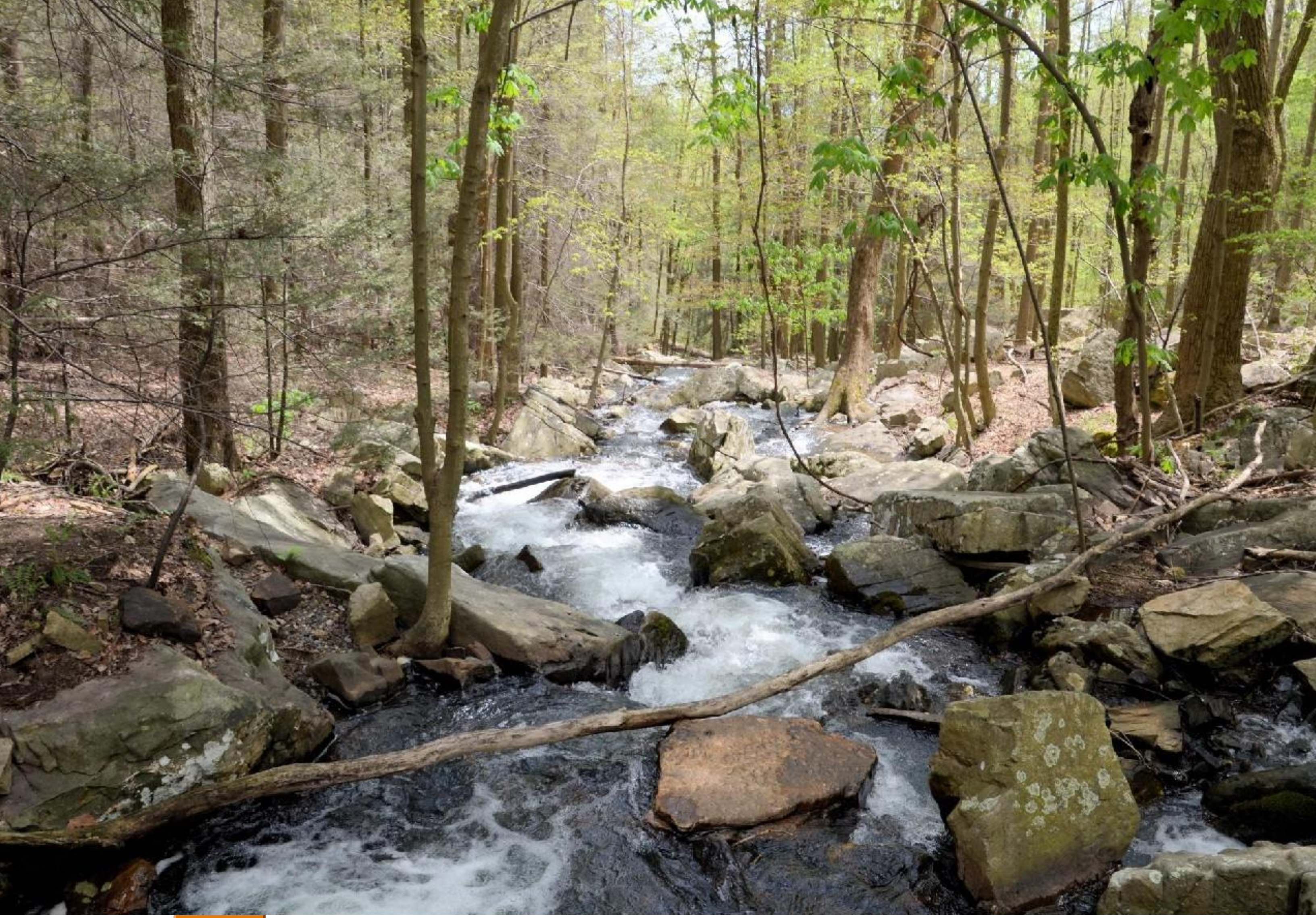
Photos of the current chlorine contact chamber and of the existing sand filtration bed.

Photos of sand filtration bed as well as potential sites for land application across the dam.

Photos of potential land application located up from the observatory.

Photos of the grade between the sand filtration bed and the chlorine contact chamber, the flow monitoring method used at the chlorine contact chamber, the newly installed aeration system, and the routing of the pipe to the discharge point.

Photos depicting the finished effluent as it discharges into the Dolan Branch at stream mile 1.5



Appendix B: Regulatory Requirements Summary

ENGINEERING

WATER ■ WASTEWATER ■STORMWATER ■PUBLIC WORKS

LDAENGINEERING.COM

BAYS MOUNTAIN PARK & PLANETARIUM

This page left blank intentionally.

Appendix B

Regulatory Requirements Summary

Wastewater System Permits

At the time of this report Bays Mountain Park was permitted under an individual discharge permit, TN0054941 for the discharge of treated domestic wastewater to Dolan Branch. The permitted flow rate is 0.005 million gallons per day or 5,000 gallons per day. The permit status at the time of the report was reissuance and the date of permit expiration is May 31st, 2018.

Three regulatory paths or options are available to Bays Mountain Park as alternatives are considered for the future wastewater system.

1. The existing discharge permit can be maintained. The permit can be revised as improvements, repairs or rehab takes place on the existing system. However, in order to discharge more than 5,000 gallons per day an anti-degradation study would be required on Dolan Branch.

2. The existing individual discharge permit would be eliminated with the installation of a land application system. However, the park would be required to submit plans for permits and obtain coverage with the issuance of a state operating permit for the new facility.

3. Reuse of the waterline for a sewer system or installation of a new wastewater collection system would eliminate the need for permits, as this system can be permitted as an extension of the City of Kingsport wastewater collection system. If the onsite collection system included any land application or sewer lift stations of certain size, the park could possibly be required to obtain coverage under a state operating permit for such facilities, but this would be determined under design phase depending on final design.

As the primary goal of eliminating the discharge to Dolan Branch, the new wastewater system is likely to alter the permit type and permit status of Bays Mountain Park. If a wastewater collection system connecting to City of Kingsport wastewater collection system is selected, and feasible, then it is recommended that the design allow coverage under current City of Kingsport operating permits.

Other Permit Considerations

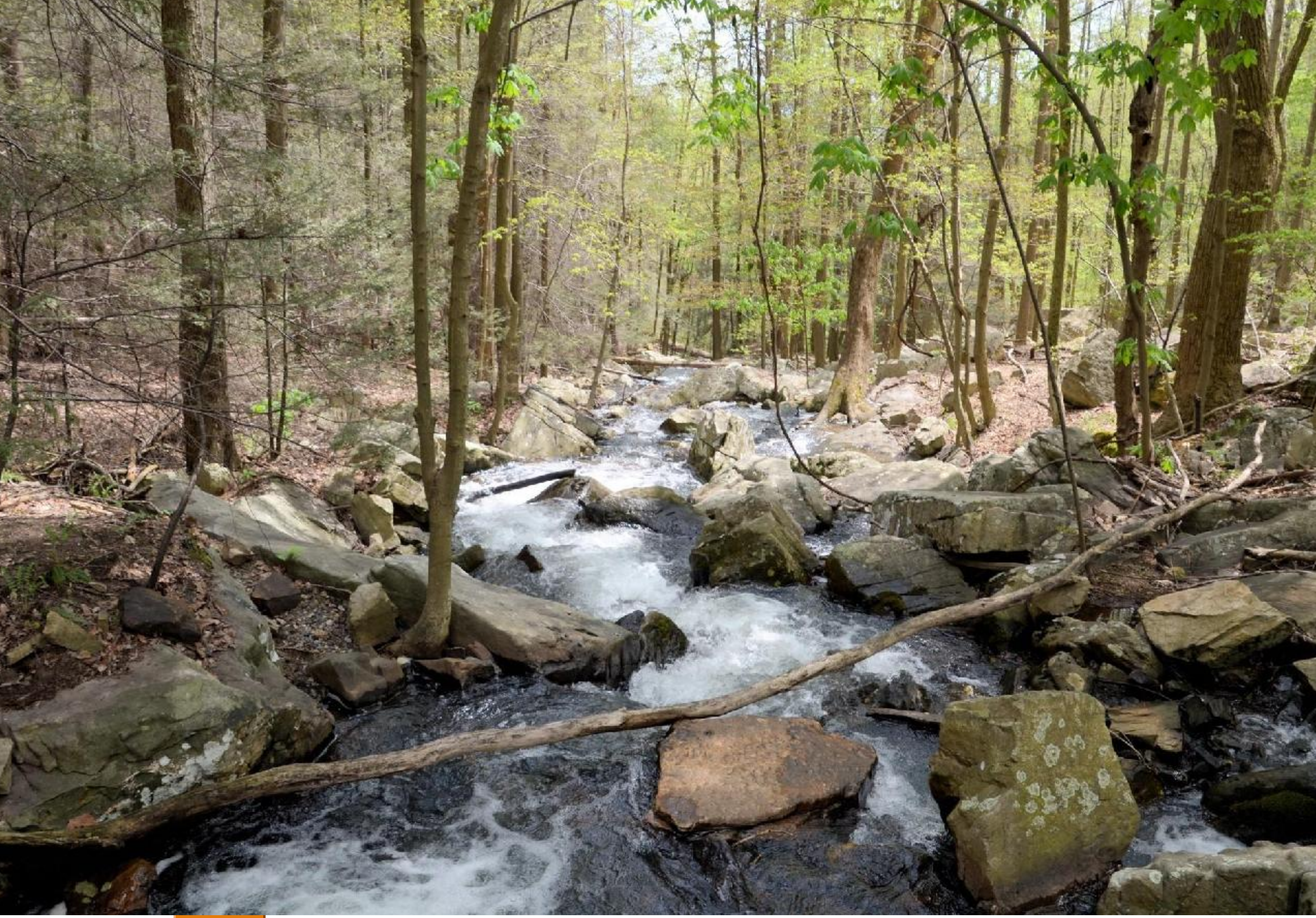
Other permit considerations are for the land disturbance and any proposed alterations to aquatic resources. These permits would primarily be for construction that disturbs more than one acre or for projects that will work in or adjacent to Dolan Branch.

1. If the total land disturbance for the selected alternative is over 1 acre, a submittal for coverage under the Construction General Permit will be required.

2. For work within the buffer of Dolan Branch and for up to (5) five crossings an General Aquatic Resources Alteration Permit will be required.

3. For work within Dolan Branch stream channel, or for more than (5) five crossings, an Individual Aquatic Resources Alteration Permit, 401 Water Quality Certification, and other permits may be required.

Determination of permits required will be dependent upon selected alternative and scope of work. However, upon selection of an alternative the schedule for design and construction should be adjusted based upon permitting time and constraints.



Appendix C: Preliminary System Rehabilitation Schedule

LDA ENGINEERING

WATER ■ WASTEWATER ■STORMWATER ■PUBLIC WORKS

BAYS MOUNTAIN PARK & PLANETARIUM

LDAENGINEERING.COM

This page left blank intentionally.

Preliminary System Rehabilitation Schedule