WORKING DRAFT REPORT

Clarksburg - Ten Mile Creek Area Sewer Facility Study

WSSC Contract PM0007A07

Job Number 23202537C

Washington Suburban Sanitary Commission

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CDM Smith

in association with

Environ-Civil Engineering, Ltd.

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Section 1
Introduction

1.1 Background

This "Clarksburg – Ten Mile Creek Area Sewer Facility Study" presents conceptual alternatives to provide public sewer service to areas northeast of Clarksburg Road on either side of Interstate 270 (I-270) in Montgomery County, MD. This area, located within the Ten Mile Creek watershed, includes "Stage 4 Ten Mile Creek East Development Area" or "Future Area Service Area C" as described in the Clarksburg Master Plan and Hyattstown Special study Area (June 1994), the Clarksburg Historic District and other properties in the vicinity of the Historic District. This work was performed under the WSSC Sewer Planning Basic Order Agreement: Clarksburg – Ten Mile Creek Area Sewer Facility Study (BOA Contract No. PM0007A07, Task Order No.20 - Job No. 23202537C).

The following documents were used as references in this report:

- Clarksburg Master Plan & Hyattstown Special Study Area (Approved and Adopted, June 1994)
- Montgomery County Resolution No. 17-1048: "Approval of Planning Board Draft 10 Mile Creek Area Limited Amendment to the Clarksburg Master Plan and Hyattstown Special Study Area" (Introduced and Adopted, April 2014)

1.2 Study Purpose

The objective is to perform a facility study for WSSC to provide public sanitary sewer service to areas in the Clarksburg – Ten Mile Creek Area. The study identifies and evaluates alternatives to serve planned development described in the Ten Mile Creek Area Limited Amendment to the Clarksburg Master Plan and Hyattstown Special Study Area as adopted by the Montgomery County Council.

1.3 Study Area

The study area includes the Stage 4 Ten Mile Creek East Development Area or Future Service Area C, the boundaries of which are delineated in Chapter 9 of the June 1994 Clarksburg Master Plan. This area is approximately 980 acres, 220 acres of which are located north of Clarksburg Road and east of I-270. The remaining area is located north of Clarksburg Road and west of I-270.

The study area also includes about 40 acres of the Clarksburg Historic District and about 30 acres of other properties in the vicinity (Northeast) of the Historic District.

Figure 1-1 provides an overview showing the study area and the downstream sewer facilities.

1.4 WSSC Sanitary Sewer System Downstream of Study Area

As shown in Figure 1-1, the study area is located in the northern portion of the Seneca Creek basin of the WSSC sanitary sewer system. **Figure 1-2** shows the study area and the WSSC sewer facilities that will receive the flows from the planned development. There are two main sewer reaches south of the study area. They are the newly constructed gravity sewers located in the Cabin Branch development west of I-270 and existing gravity sewers along Gateway Center Drive, east of I-270. Both sewer

reaches convey wastewater to either the Little Seneca Wastewater Pumping Station (WWPS) or the Crystal Rock WWPS, which in turn pump the wastewater to the gravity sewers feeding into the Seneca Wastewater Treatment Plant (WWTP).

The gravity sewers along Gateway Center drive have limited capacity to convey the wastewater flows from the Stage 4 Development Area when combined with other planned development. **Figure 1-3** shows the diameters, capacities and existing peak wastewater flows in the gravity sewers along Gateway Center Drive.

Conversely, the newly constructed gravity sewers, west of I-270 in Cabin Branch development were specifically sized to receive wastewater flows from the Stage 4 Development Area. Therefore, all conceptual alternatives described in this report are designed to convey the wastewater flows to two gravity sewer connection points in the Cabin Branch development at Clarksburg Road as shown on Figure 1-2.

1.5 2014 Ten Mile Creek Limited Amendment

Montgomery County Planning Department prepared a Limited Amendment to the 1994 Clarksburg Master Plan focusing on the Ten Mile Creek area in response to a request from the County Council. In April 2014, the County Council approved the Draft Ten Mile Creek Area Limited Amendment.

The Draft Limited Amendment included properties in the Stage 4 Development Area and documented a comprehensive analysis of the environmentally sensitive areas in the Ten Mile Creek Watershed. The limited amendment expanded Special Protection Areas, created new Environmental Overlay Zones, and also rezoned several of the properties located in the project area.

1.5.1 Special Protection Areas

Special Protection Areas (SPAs) established under the 1994 Clarksburg Master Plan included geographic areas "where identified sensitive environmental resources that require measures beyond current standards to assure those resources are protected to the greatest extent possible from development activities". Environmentally sensitive watersheds in Little Seneca Creek, Ten Mile Creek and Wildcat Branch were included in the SPAs. Since 1994, the Montgomery County DEP has been monitoring conditions in the Clarksburg SPA (which includes Stage 4 Development Area of the Ten Mile Creek). Under the Draft Limited Amendment, the SPA was amended to include additional areas east of I-270.

1.5.2 East and West Environmental Overlay Zones

Within the Special Protection Areas, the Draft Limited Amendment created the Clarksburg East and Clarksburg West Environmental Overlay Zones. These zones were created to regulate new development in properties within the overlay zones by establishing limits on maximum imperviousness and a minimum open space.

The Clarksburg East Environmental Overlay Zone includes properties east of I-270 within the Ten Mile Creek Watershed and has a maximum imperviousness limit of 15 percent with an open space requirement of 80 percent. The Clarksburg West Environmental Overlay Zone includes properties west of I-270 within the Ten Mile Creek Watershed and has a maximum imperviousness limit of 6 percent with an open space requirement of 80 percent.

1.5.3 Major Properties and Proposed Rezoning in Study Area

The project area includes four major properties, the Clarksburg Historic District, and a few other smaller properties east of I-270. The four major properties are designated as Egan/Mattlyn, Miles/Coppola, County Owned, and Pulte/King. The County Owned and Pulte/King properties are located west of I-270 while the rest are located east of I-270. These major properties are shown on **Figure 1-4** and discussed in the following sections. **Figure 1-5** provides details of the properties east of I-270 and **Figure 1-6** provides details of properties west of I-270.

1.5.3.1 Egan/Mattlyn Property

Egan/Mattlyn property encompasses approximately 100 acres in the northern portion of the study area, east of I-270 between I-270 and Frederick road. Approximately 33 acres is within an environmental buffer zone.

In the Draft Limited Amendment this property is zoned R-90 with a maximum density of three units per acre (approximately a 297 unit limit), or up to 3.66 units per acre with a Moderately Priced Dwelling Unit (MPDU) bonus. This property is in the Clarksburg East Environmental Overlay Zone.

1.5.3.2 Miles/Coppola Property

Miles/Coppola property includes 101 acres located east of I-270 south of Egan/Mattlyn property. Approximately 70 acres of this property is within an environmental buffer zone.

In the Draft Limited Amendment, 5 acres of this property near Clarksburg Road (near the Wright Property) is zoned CRT 2.0, C2, R2 and H120. The remaining property is zoned R-90 with a maximum density of three units per acre (approximately a 279 unit limit), or up to 3.66 units per acre with a Moderately Priced Dwelling Unit (MPDU) bonus. This property is in the Clarksburg East Environmental Overlay Zone.

1.5.3.3 County Owned Properties

Montgomery County owns more than 380 acres in the upper reaches of the Ten Mile Creek watershed, west of I-270 and north of Clarksburg Road. The site currently houses the County Correctional Facility. The property is heavily wooded and the county does not have any development plans for the property beyond the planned expansion of the correctional facility. Most of the wooded area on this property has been identified by the Parks Department as a Legacy Open Space Natural Resource that is suitable for transfer to Parks as a part of the Ten Mile Creek Conservation Park.

The Draft Limited Amendment included this area under the Clarksburg West Environmental Overlay Zone with no additional imperviousness permitted. In the future, the Environmental Overlay Zone may be amended to allow a minimal amount of imperviousness of less than 1 acre for the planned expansion of the correctional facility.

1.5.3.4 Pulte/King Properties

This property includes approximately 540 acres west of I-270 between Clarksburg Road and Shiloh Church Road.

This property is zoned RNC in the Draft Limited Amendment which allows optional method development with public sewer at a permitted density of one unit per acre, provided it meets the open space requirements. The amendment included these properties in Clarksburg West Environmental Overlay Zone. Also, a significant portion of the property (about 200 acres) falls within environmental

buffer zones. Some portions of the property may also be acquired by the Parks Department under the Legacy Open Space Program. As a result of the zoning change, development in this property may not be one single development but rather two separate developments.

1.5.3.5 Clarksburg Historic District

The Clarksburg Historic District includes multiple properties totaling approximately 40 acres. The district straddles Frederick Road on either side of Clarksburg Road. The western edge of the district is bound by Stringtown Road. The Draft Limited Amendment rezoned the properties in the Historic district to a CRT zone specifically, CRT 0.5, C 0.5, R 0.5 and H45. The district is excluded from the Clarksburg East Environmental Overlay Zone.

1.5.3.6 Other Properties

Three property parcels north of Egan/Mattlyn

There are three properties in the northern most portion of the study area. These properties are bound by Comus Road on the north, Frederick Road on the east, I-270 on the West, and Egan/Mattlyn property on the south.

The Draft Limited Amendment retained the existing zoning of R-200 for these properties but eliminated the potential to use a Planned Development Zone as a part of a single development plan with the Egan/Mattlyn property. The Clarksburg East Environmental Overlay Zone applies to areas within the Ten Mile Creek watershed.

Five property parcels between Egan/Mattlyn and Miles/Coppola Properties

There are five properties between Egan/Mattlyn and Miles/Coppola properties. Two of these properties are closer to I-270. Of these two properties, one houses an electric substation (Potomac Electric) while the other is almost entirely in an environmental buffer zone. The remaining three properties are smaller and closer to Frederick Road.

The Draft Limited Amendment rezoned all five properties to R-90. These properties are included in the Clarksburg East Environmental Overlay Zone.

Nine property parcels between Miles/Coppola and Frederick Road

There are nine property parcels between Miles/Coppola Property and Frederick Road. Of the nine parcels, five are vacant, two are residential, and two are commercial. These property parcels were rezoned to CRN 0.25, C 0.25, R 0.25 and H35. These properties are included in the Clarksburg East Environmental Overlay Zone.

Five properties north of Historic District along Frederick Road

Of the five property parcels north of the Historic District along Frederick Road, three are vacant. These parcels are rezoned to CRT 0.75, C 0.75, R 0.25 and H 65. These properties are also included in the Clarksburg East Environmental Overlay Zone.

Wright Property

The Wright property is a small one acre parcel at the intersection of Gateway Center Drive and Clarksburg Road. The Draft Limited Amendment rezoned this parcel to CRT 2.0, C2.0, R2.0 and H120, (similar to a portion of the Miles/Coppola Property) to allow for a possibility of joint development with Miles/Coppola also zoned CRT.

1.6 Report Overview

This section provides an overview of the purpose of the study, the study area, the WSSC sanitary sewer system downstream of the study area, the 2014 Draft Limited Amendment to the 1994 Clarksburg Master Plan, and an overview of this Facility Plan Report.

Section 2 of this report provides an overview of the data collected for the properties in the study area and estimates of existing and future flows based on proposed development.

Section 3 includes a discussion of the alternative development process and a description of each alternative identified to provide sewer service to the study area. Ten alternatives were developed, of which eight were selected for further evaluation.

Section 4 provides an evaluation of the selected alternatives and identifies the Preferred Approach.

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Figure 1-1
Project Study Area in Seneca Creek Basin

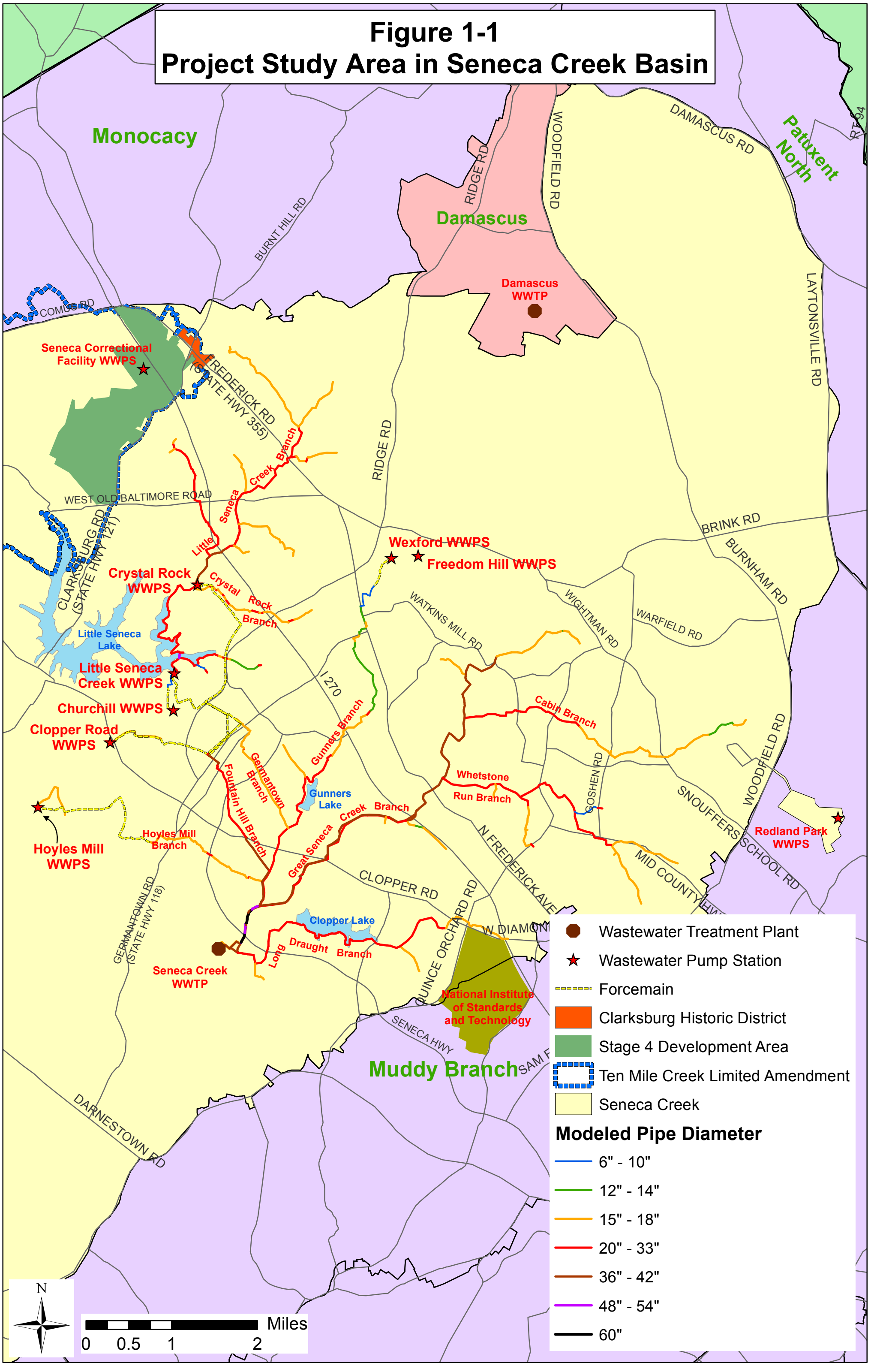


Figure 1-2
Study Area and Downstream WSSC Sewers

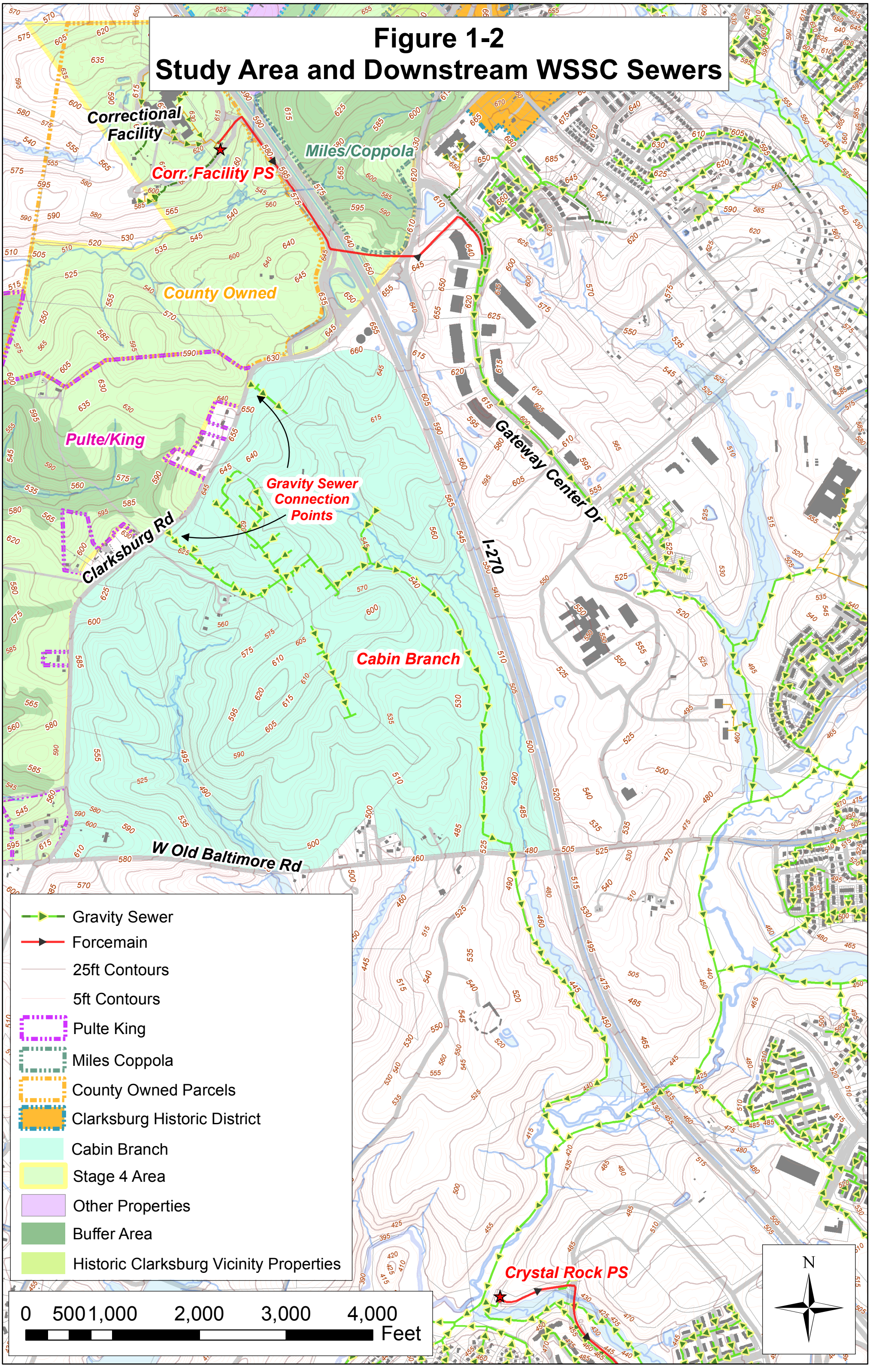
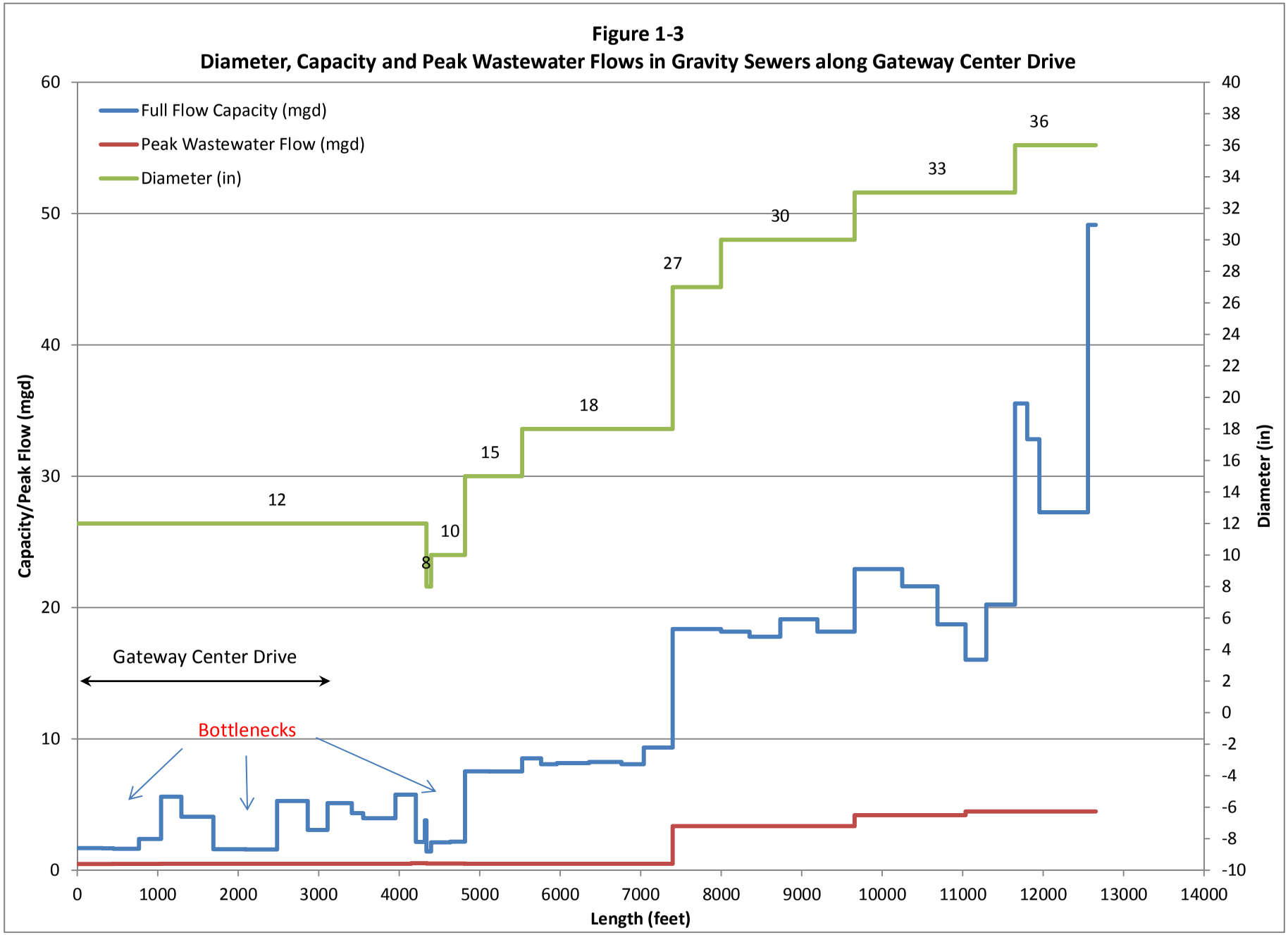
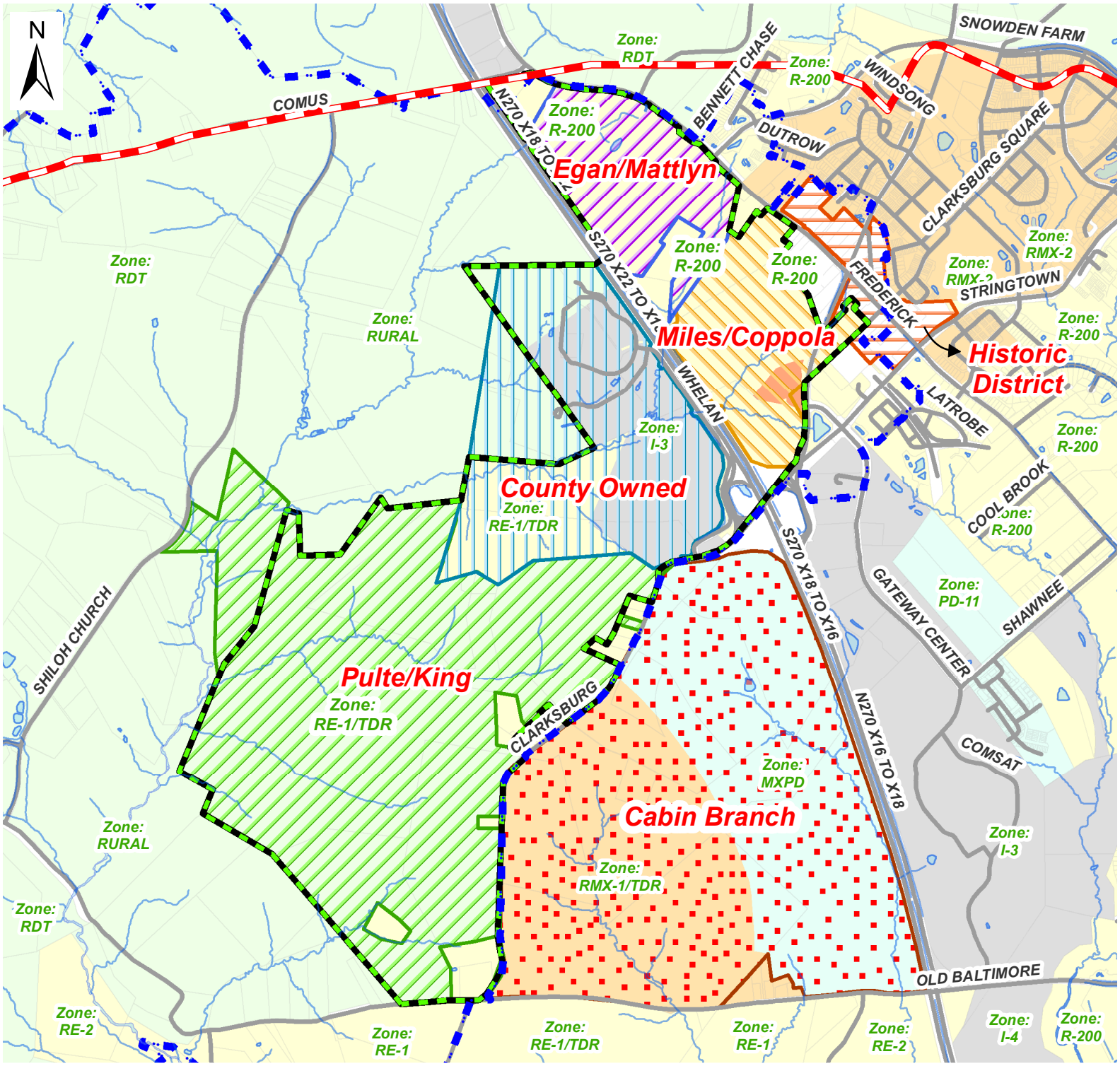


Figure 1-3
Diameter, Capacity and Peak Wastewater Flows in Gravity Sewers along Gateway Center Drive





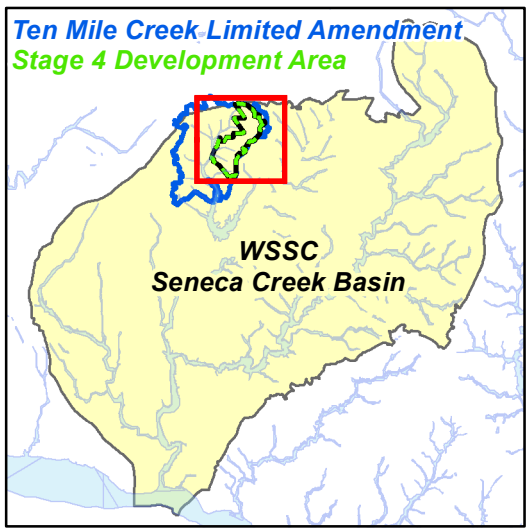
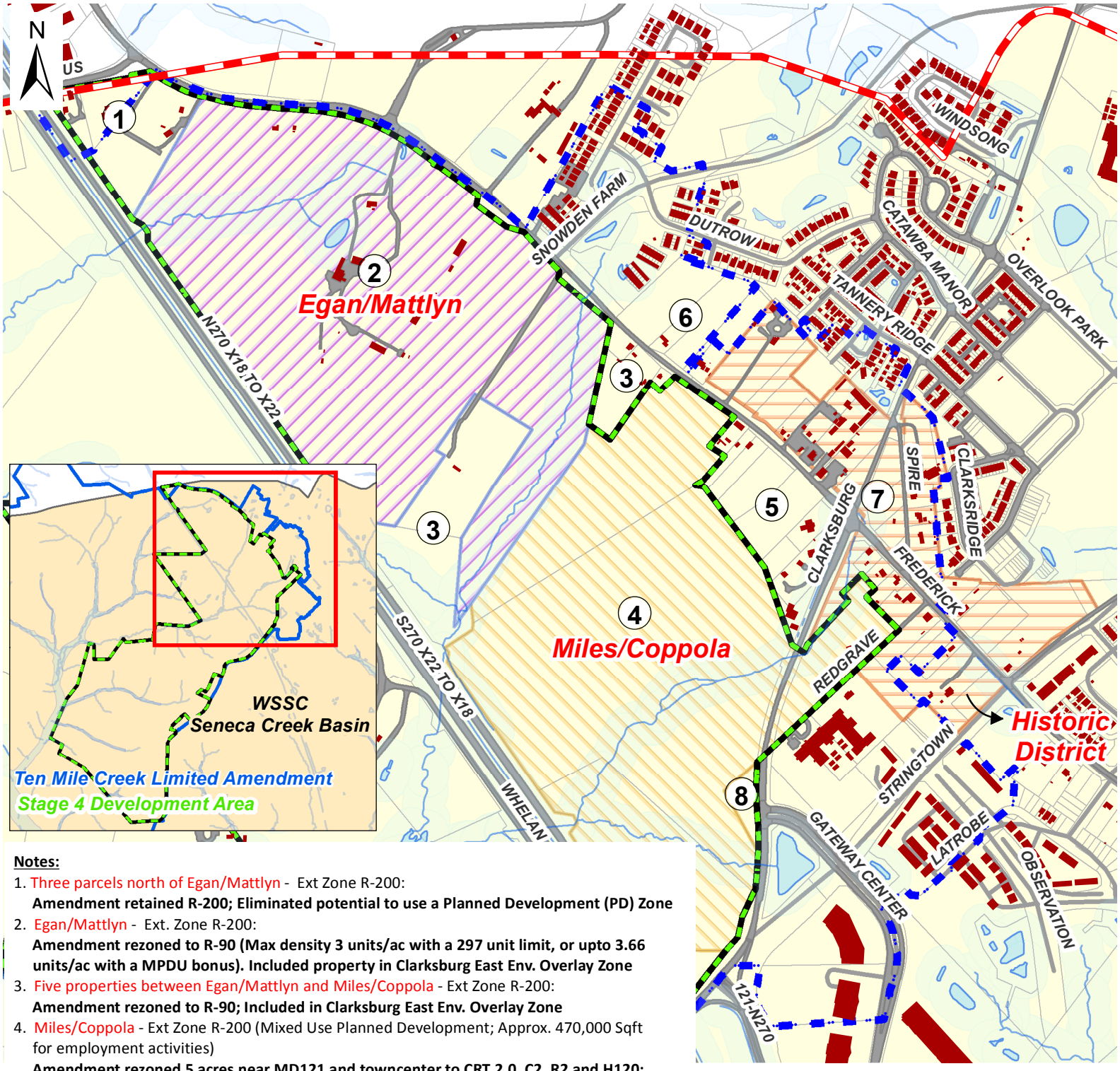


Figure 1-4
Stage 4 - Existing Zoning Map

- Seneca Creek Basin
- Ten Mile Creek Ltd. Amnd.
- Stage 4 Boundary
- Clarksburg Historic Distric
- Egan/Mattlyn
- Miles/Coppola
- County Owned Parcels
- Pulte/King
- Cabin Branch



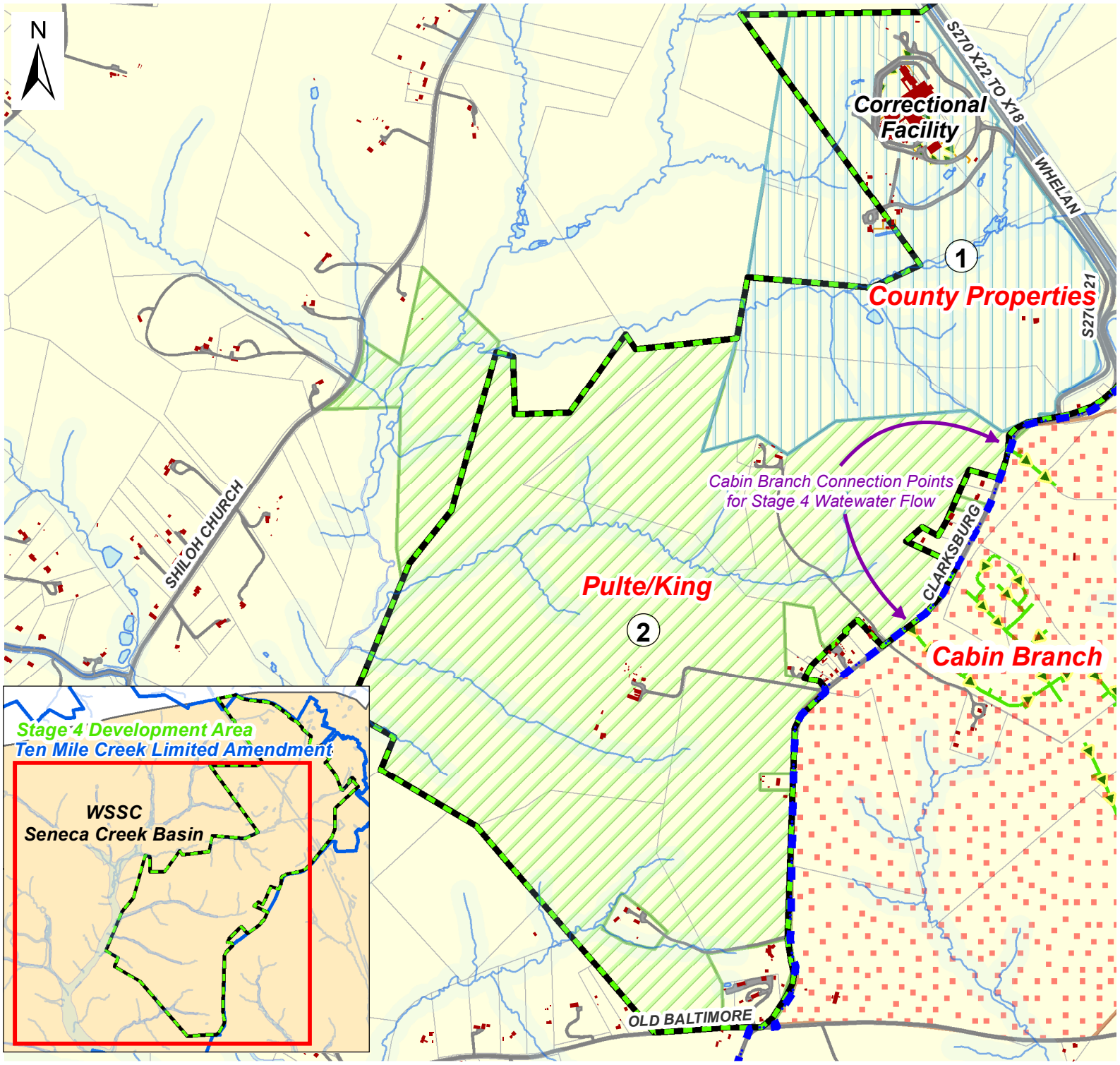
Notes:

1. Three parcels north of Egan/Mattlyn - Ext Zone R-200:
   Amendment retained R-200; Eliminated potential to use a Planned Development (PD) Zone
2. Egan/Mattlyn - Ext. Zone R-200:
   Amendment rezoned to R-90 (Max density 3 units/ac with a 297 unit limit, or upto 3.66 units/ac with a MPDU bonus). Included property in Clarksburg East Env. Overlay Zone
3. Five properties between Egan/Mattlyn and Miles/Coppola - Ext Zone R-200:
   Amendment rezoned to R-90; Included in Clarksburg East Env. Overlay Zone
4. Miles/Coppola - Ext Zone R-200 (Mixed Use Planned Development; Approx. 470,000 Sqft for employment activities)
   Amendment rezoned 5 acres near MD121 and towncenter to CRT 2.0, C2, R2 and H120; Mix of residential and commercial development. Rezoned the remainder of property to R-90 (Max density 3 units/ac with a 297 unit limit, or upto 3.66 units/ac with a MPDU bonus) Included property in Clarksburg East Env. Overlay Zone
5. Property Parcels between Miles/Coppola and MD355 - Ext Zone C-1, C-2 and R-200:
   Amendment rezoned to CRN 0.25, C0.25, R0.25 and H35. Included from Clarksburg East Env. Overlay Zone
6. Property Parcels North of Historic District - Ext Zone R-200:
   Rezoned to CRT 0.75, C 0.75, R 0.25, H 65.
7. Clarksburg Historic District)
   - Ext Zone C-1, C-2 and R-200:
   Amendment rezoned to CRT 0.5, C0.5, R0.5 and H45. Excluded from Clarksburg East Env. Overlay Zone
8. One-acre Wright property east of MD121 near the intersection with Gateway Center Drive
   - Ext Zone R-200:
   Amendment Rezoned to CRT 2.0, C2.0, R2.0, H 120. Allowed for the possibility of joint development with the portion ofthe Miles-Coppola property also zoned CRT.

Clarksburg East Env. Overlay Zone: 15% imperviousness limit and 80% open space requirement.

Figure 1-5
Stage 4
East of I-270 Rezoning

- Seneca Creek Basin
- Ten Mile Creek Ltd. Amnd.
- Stage 4 Boundary
- Clarksburg Historic Distric
- Egan/Mattlyn
- Miles/Coppola



Notes:

1. County Properties - Ext Zone I-3: Houses the County Correctional Facility
   Amendment includes the property in the Clarksburg West Environmental Zone with no additional imperviousness permitted. Forested areas should remain undisturbed and the designated portion protected under the Legacy Open Space Program. This plan intends to accommodate the small planned expansion of the correctional facility, but limits further development on the site.
2. Pulte/King - Ext Zone RE-1/TDR:
   Amendment includes the property in the Clarksburg West Environmental Zone Amendment rezoned to RNC (Rural Neighbourhood Cluster) with a permitted density of one unit per acre. MPDU beyond the minimum 12.5 percent would be in addition to the recommended density, in accordance with Chapter 25A of the Montgomery County Code, if the development does not exceed the impervious surface cap.

0 0.075 0.15 0.3 0.45 0.6 Miles

Figure 1-6
Stage 4 West of I-270 Rezoning

- Seneca Creek Basin
- Ten Mile Creek Ltd. Amnd.
- Stage 4 Boundary
- County Owned Parcels
- Pulte/King
- Cabin Branch

Clarksburg West Env. Overlay Zone: 6% imperviousness limit and 80% open space requirement.

Section 2
Existing and Future Wastewater Flows

This section describes the data collected for existing properties, procedures used to estimate existing and future wastewater flows for the planned development, and documents the projected wastewater flows. These wastewater flow estimates are used to evaluate and size sanitary sewer facilities to serve the proposed development.

2.1 Data Collection for Existing Properties

As described in Section 1, the study area includes numerous properties. Data for existing development in these properties were obtained from various sources including the Maryland Department of Assessments and Taxation, WSSC GIS Database, 2014 Draft Limited Amendment, GIS data from Montgomery County Planning Department, and the WSSC's Customer Services Information System (CSIS).

Data collected for the parcels included boundaries, area, any existing development information, existing and proposed zoning, WSSC account numbers, and the daily average water consumption (DAC) in gallons per day. Most of the study area is undeveloped, with existing development primarily located in the Clarksburg Historic district and vicinity. A few existing buildings are present on the Egan/Mattlyn property, east of I-270. The other major existing development is the County Correctional Facility, west of I-270.

Currently, none of the properties (with the exception of the County Correctional Facility) have public sewer service. The Montgomery County Water and Sewer Plan categorized all the properties in the study area under a planned service area needing public sewer service.

2.2 Seneca Correctional Facility Pump Station and Force Main

Currently, a small WSSC wastewater pumping station (Seneca Correctional Facility Pump Station – rated safe capacity 0.612 mgd) pumps the wastewater from the correctional facility to gravity sewers along Gateway Center Drive on the other side of I-270 via an 8 inch force main. The force main crosses I-270 and Clarksburg Road in a 5-foot diameter tunnel. The tunnel also carries a 16-inch water main that currently provides water service to the Correctional Facility.

Alternatives to provide sewer service to the Stage 4 Area discussed in later sections consider options to eliminate this pump station.

2.3 Existing Dry Weather Flow Procedures

WSSC design criteria for sizing new non-CIP (less than 15 inches in diameter) sewers and evaluating existing sewers were used to estimate the base, average, peak, and design wastewater flows for the existing development within and around the study area as described below. The study assumes that sewer service will be provided to this existing development.

One procedure for estimating the base sanitary flow (BSF) from the existing development is to use WSSC wastewater flow factors. Alternatively, BSF for existing land use can be assumed to equal the DAC. The larger of these two BSF estimates is used below.

Average wastewater flow (AWF) is calculated as follows:

$$AWF = 1.44 \times BSF$$

Peak Wastewater Flow (PWF) used for the evaluation of existing sanitary sewers is computed from the AWF using the Maryland Peaking Curve, which is computed as follows:

$PWF = 4 \times AWF$	when AWF is less than 0.25 mgd
$PWF = 3.2 \times (AWF)^{(5/6)}$	when AWF is between 0.25 and 16 mgd
$PWF = 2 \times AWF$	when AWF is greater than 16 mgd

The peak wastewater flow includes a wet weather inflow and infiltration allowance. Existing sewers are considered adequate if the full-flow capacity (estimated using a 0.013 Manning's roughness coefficient) is less than the peak wastewater flow plus pool backwash and pumped flow.

The Design Flow (DF) is used to size new sewers and includes a safety factor to account for uncertainties in land use and the flow generated from these land uses:

$DF = 1.5 \times PWF$	when PWF is less than or equal to 3.75 mgd
DF = 5.63 mgd	when PWF is between 3.75 mgd and 5.11 mgd
$DF = 1.1 \times PWF$	when PWF is greater than 5.11 mgd

2.4 Future Dry Weather Flows

Future BSF were developed based on proposed zoning, maximum permitted dwelling units, and other factors such as the Environmental Overlay Zones and Environmental Buffer Zones. Proposed zoning in the study area are as follows:

- R-200 (three parcels north of Egan/Mattlyn)
- R-90 (Egan/Mattyln and Miles/Coppola)
- RNC (Pulte/King)
- Four CRT/CRN zones (Clarksburg Historic District, Miles/Coppola, Wright Property and Others)

No new development is permitted in the County Owned properties. Future base sanitary flow estimates for properties zoned R-200 were based on a WSSC wastewater flow factor of 420 gpd/acre. Flow estimates for Egan/Mattlyn, Miles/Coppola, and Pulte/King properties were based on the latest information provided by the individual developers, using a factor of 143 gpd per dwelling unit.

For the properties zoned CRT and CRN, a maximum allowable area that can be developed (square footage) was estimated based on total FAR (Floor Area Ratio), limits on imperviousness and building

height restrictions. This area was then distributed among the commercial and residential components of the respective CRT/CRN zones. A WSSC wastewater flow factor of 0.048 gpd/square foot was used for the commercial development and a wastewater flow factor of 100 gpd/unit (typical for an apartment) was used for residential properties assuming 1,600 square feet per residential unit.

Peak and design wastewater flows were estimated using the procedures described in Section 2.3. **Table 2-1** summarizes the future BSF estimates for major properties in the study area.

Table 2-1 Future Base Sanitary Flow Estimates

Property	Estimated Future Base Sanitary Flow (gpd)
Egan/Mattlyn	51,900
Miles/Coppola	48,200
Historic District	44,100
Pulte/King	94,200
Misc./Other	28,300

Appendix A provides an overview of data collected and future BSF estimates for all the individual parcels in the study area.

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Section 3
Development of Alternatives

3.1 Development of Alternatives

This section documents potential alternatives developed to provide sanitary sewer service to the Clarksburg Ten Mile Creek study area. Selected feasible alternatives are evaluated in Section 4.

Sanitary sewer service is being considered for new development planned in the Clarksburg Ten Mile Creek area, referred to as the Stage 4 Area, in the following open land properties: Pulte/King, Egan/Mattlyn and Miles Coppola. In addition, sewer service is planned to be provided to Historic Clarksburg and other miscellaneous properties that currently rely on septic systems. Service is also to continue to be provided to the existing Correctional Facility.

This facility plan identifies an appropriate solution that serves these properties while minimizing cost and impacts to environmental resources (e.g., stream crossings, impervious areas) and the community during construction activities. Also, a consideration is given to implementability issues such as minimizing tunnel crossings of I-270 and avoiding construction of sewer facilities within stream buffer areas. Of primary concern is overall protection of the Ten Mile Creek watershed, which is a high quality stream within the plan area, with preservation of this natural resource deemed critical to the County's wellbeing.

The alternatives provide service through combinations of gravity sewers, pump stations, and force mains. The alternatives extend sanitary sewer service from the study area to existing WSSC sewers, which drain south via two gravity trunk sewers to the Crystal Rock or Little Seneca Wastewater Pump Stations (see **Figure 1-2**). The Cabin Branch sewers (west of I-270) have been sized to handle future flows from the Phase 4 Area. The sewers east of I-270 have limited capacity to convey Phase 4 flows when added to other planned development. Therefore, inherent in the development of alternatives is the need to direct Phase 4 Area flows to the existing WSSC sewers in the Cabin Branch basin.

3.2 Alternative 1

Alternative 1 (Gravity and 1 Pump Station) extends service to the Pulte/King area by constructing a new pump station (Pulte PS) at the lower elevations of this sub-sewershed. This pump station would receive wastewater from new gravity sewers in the planned development area and pump the flows through a force main discharging to a Cabin Branch gravity sewer connection point at Clarksburg Road. A small sewer reach to the north would collect wastewater and drain to a second gravity sewer connection point along Clarksburg Road.

A gravity trunk sewer would be installed along the northern portion of Ten Mile Creek to route much of the Egan/Mattlyn wastewater to the new Pulte PS. The Miles Coppola property would drain via gravity flow along a second trunk sewer adjacent to Ten Mile Creek also to the Pulte PS. Historic Clarksburg would be provided with sewer service with gravity sewers along Frederick Road to gravity sewers within the Miles/Coppola property and along Clarksburg Road. A small portion of properties in the southern area of Historic Clarksburg would drain to an existing WSSC manhole north of the area.

The existing Correctional Facility PS would be eliminated, with flows re-directed to the new trunk sewer along Ten Mile Creek.

This alternative would require construction of 1 new pump station, 27,570 feet of gravity sewer, 5,180 feet of force main, three tunnel crossings of I-270, 14 stream crossings and minor increases to impervious areas (3,200 SF). **Table 3-1** summarizes the gravity sewers and force main length (including lengths within buffer zones), tunneling and stream crossing requirements, and pump station flows. See **Figure 3-1** for a layout of Alternative 1.

3.3 Alternative 2

Alternative 2 (Gravity and 2 Pump Stations) provides service to the study area, with an approach similar to Alternative 1. However, the northern gravity trunk sewer along Ten Mile Creek is eliminated and instead a new pump station would be constructed at the Egan/Mattlyn property (Egan North PS). Flows from the Egan/Mattlyn area would be directed towards Frederick Road to travel via new gravity trunk sewers serving the Historic Clarksburg area. This reduces the total length of gravity sewer to 20,320 feet while increasing the force main length to 7,080 feet. The Correctional Facility pump station is eliminated. Two pump stations would be operated (Pulte PS and Egan North PS). Also, two I-270 tunnel crossings and 11 stream crossings would be necessary, and minor increases to impervious areas (6,400 SF).

Table 3-1 presents a summary of the alternative's components and **Figure 3-2** presents the layout of Alternative 2.

3.4 Alternative 3

Alternative 3 (Gravity and 3 Pump Stations) is similar to Alternative 2 but with the second gravity trunk sewer along Ten Mile Creek eliminated, through the addition of a third pump station (New Correctional Facility PS) and removing the existing Correctional Facility pump station. The Pulte PS would be moved further east towards Clarksburg Road. This reduces the total length of gravity sewer to 13,620 feet and decreases the force main length to 5,350 feet. Three pump stations would be operated (Pulte PS, Egan North PS and New Correctional Facility PS). Also, two I-270 tunnel crossings and 4 stream crossings are required and minor increases to impervious areas (9,600 SF).

Table 3-1 presents a summary of the alternative's components and **Figure 3-3** presents the layout of Alternative 3.

3.5 Alternative 4

Alternative 4 (Gravity and 4 Pump Stations) is similar to Alternative 3 with the exception of modifications to the conveyance system along Clarksburg Road north of I-270. A new pump station would be constructed (Clarksburg Road PS) with the new force main installed within the existing I-270 tunnel crossing (previously used for the Existing Correctional Facility PS which would be taken out of service). The existing 8-inch force main inside the 16-inch casing would be upsized to 10-inch diameter to accommodate additional flows. Both the New Correctional Facility PS and Clarksburg Road PS would discharge to a new gravity trunk sewer west of I-270 which drains to a Cabin Branch gravity sewer connection point along Clarksburg Road.

This alternative would have a gravity sewer length increased to 12,670 feet, while the force main length would increase to 7,050 feet. Four pump stations would be operated (Pulte PS, Egan North PS, New Correctional Facility PS and Clarksburg Road PS). Also, one new I-270 tunnel crossing and 3 stream crossings would be needed, and minor increases to impervious areas (12,800 SF).

Table 3-1 presents a summary of the alternative's components, and **Figure 3-4** presents the layout of Alternative 4.

3.6 Alternative 5

Alternative 5 (Gravity and 5 Pump Stations) is similar to Alternative 4 with the exception that the Existing Correctional Facility PS would continue to operate, with wastewater re-directed to a new gravity trunk sewer west of I-270. Also, much of the flow from the Miles/Coppola property would be re-routed via a new pump station (Miles PS) and discharge to the new gravity trunk sewer along Frederick Road that drains along Clarksburg Road to the Clarksburg Road PS. As with Alternative 4, the existing 8-inch force main inside the 16-inch casing would be upsized to 10-inch diameter to accommodate additional flows from the Clarksburg Road PS.

This alternative further reduces the total length of gravity sewer to 10,120 feet, while the force main length increases slightly to 7,310 feet. Five pump stations would operate (Pulte PS, Egan North PS, Clarksburg Road PS, Miles North PS, and Existing Correctional Facility PS). Also, this approach would eliminate the need for any new I-270 tunnel crossings and requires 3 stream crossings and minor increases to impervious areas (12,800 SF).

Table 3-1 presents a summary of the alternative's components and **Figure 3-5** presents the layout of Alternative 5.

3.7 Alternative 6

Alternative 6 (Gravity and 6 Pump Stations) is similar to Alternative 5 with the exception that the Existing Correctional Facility PS would continue to operate, with wastewater directed to the existing gravity trunk sewer east of I-270. Flow from the Egan property would be routed via two new pump stations (Egan North PS and Egan PS) and discharge to the new gravity trunk sewer along Frederick Road that drains to the Miles North PS. Also, a portion of the Miles/Coppola property would be served by a second pump station on the property (Miles PS) and routed to an existing gravity trunk sewer east of Clarksburg Road at Gateway Center Drive.

This alternative further reduces the total length of gravity sewer to 9,460 feet, and slightly decreases the force main length to 7,260 feet. Six pump stations would operate (Pulte PS, Egan North PS, Egan PS, Miles North PS, Miles PS, and Existing Correctional Facility PS). Also, this approach would eliminate the need for any new I-270 tunnel crossings and requires 2 stream crossings and minor increases to impervious areas (16,000 SF).

Table 3-1 presents a summary of the alternative's components and **Figure 3-6** presents the layout of Alternative 6.

3.8 Alternative 7

Alternative 7 (Gravity and 4 Pump Stations and Grinder Pump System) is similar to Alternative 6 with the exception that new pump stations on the Egan/Mattlyn property would be eliminated, and instead,

this area would be served with a grinder pump system that discharges to a new gravity trunk sewer along Frederick Road. The Egan/Mattlyn grinder system would consist of 2,600 feet of low pressure sewers and 383 individual grinder units.

This alternative would require 9,460 feet of gravity sewers and 4,310 feet of force main. Four pump stations would operate (Pulte PS, Miles North PS, Miles PS, and Existing Correctional Facility PS). Also, this approach would eliminate the need for any new I-270 tunnel crossings and requires 2 stream crossings and minor increases to impervious areas (9,600 SF).

Table 3-1 presents a summary of the alternative's components and **Figure 3-7** presents the layout of Alternative 7.

3.9 Alternative 8

Alternative 8 (Gravity and 5 Pump Stations) is similar to Alternative 6 with the exception that the Miles North PS is eliminated, and instead, this area is served by deep gravity sewers along Frederick Road and Observation Drive that discharge to a new truck sewer along Clarksburg Road.

This alternative would require 8,470 feet of gravity sewers and 7,140 feet of force main. Five pump stations would operate (Pulte PS, Egan North PS, Egan PS, Miles PS, and Existing Correctional Facility PS). Also, this approach would eliminate the need for any new I-270 tunnel crossings and requires 1 stream crossing and minor increases to impervious areas (12,800 SF).

Table 3-1 presents a summary of the alternative's components and **Figure 3-8** presents the layout of Alternative 8.

3.10 Alternative 9

Alternative 9 (Gravity and 4 Pump Stations and Grinder Pump System) is similar to Alternative 8 with the exception that Pulte PS would be eliminated, and instead, this area would be served with a grinder pump system that discharges to a new gravity trunk sewer along Clarksburg Road. The Pulte grinder system would consist of 3,500 feet of low pressure sewers and 284 individual grinder units.

This alternative would require 8,470 feet of gravity sewers and 5,490 feet of force main. Four pump stations would operate (Egan North PS, Egan PS, Miles PS, and Existing Correctional Facility PS). Also, this approach would eliminate the need for any new I-270 tunnel crossings and requires 1 stream crossing and minor increases to impervious areas (9,600 SF).

Table 3-1 presents a summary of the alternative's components and **Figure 3-9** presents the layout of Alternative 9.

3.11 Alternative 10

Alternative 10 (Gravity and 4 Pump Stations and Grinder Pump System – No Observation Drive) is similar to Alternative 9 with the exception that the central portion of Miles/Coppola property served by gravity sewer will discharge along a yet to be defined access road to this new development area. The Pulte grinder system would consist of 3,500 feet of low pressure sewers and 284 individual grinder units.

This alternative would require 8,100 feet of gravity sewers and 6,450 feet of force main. Four pump stations would operate (Egan North PS, Egan PS, Miles PS, and Existing Correctional Facility PS). Also, this approach would eliminate the need for any new I-270 tunnel crossings and requires 2 stream crossings and minor increases to impervious areas (9,600 SF).

Table 3-1 presents a summary of the alternative's components and **Figure 3-10** presents the layout of Alternative 10.

3.12 Alternatives Selected for Evaluation

The ten alternatives were initially screened based on consideration for impacts to the community and reasonably acceptable risk to the Ten Mile Creek watershed. The following provides the rationale for selecting eight of the alternatives for evaluation in Section 4:

- Alternative 1 was not selected. The potential risk to the sensitive ecosystem within the Ten Mile Creek during installation of the two gravity trunk sewers along the stream banks, and long term risk throughout operation of the gravity sewers was deemed unacceptable.
- Alternative 2 was not selected. Similar to Alternative 1, this alternative also relies on gravity trunk sewers along Ten Mile Creek. While the length of sewer within this sensitive ecosystem is less than Alternative 1, impacts during installation and long term risk was determined to be unacceptable.
- Alternative 3 was selected because it provides service to all of the development areas and Historic Clarksburg, while reducing the potential impacts to Ten Mile Creek, compared to Alternatives 1 and 2.
- Alternative 4 was selected because it reduces the length of gravity trunk sewers located within the buffer areas and number of I-270 tunnel and stream crossings compared to Alternative 3. An additional pump station will be necessary for this alternative, and the impacts to the community and long term operation and maintenance issues will need to be considered further in Section 4.
- Alternative 5 was selected for further evaluation. This alternative further reduces the length of gravity trunk sewers, eliminates the need for any new I-270 tunnel crossings, and minimizes impacts to the community during construction. This alternative requires five pump stations in operation, and the associated disruptions to the community and long term issues will need to be evaluated further in Section 4.
- Alternative 6 was selected for further evaluation. This alternative further reduces the length of gravity trunk sewers, eliminates the need for any new I-270 tunnel crossings, and minimizes impacts to the community during construction. This alternative requires the largest number of pump stations in operation, and the associated disruptions to the community and long term issues will need to be evaluated further in Section 4.
- Alternative 7 was selected for further evaluation. This alternative reduces the number of pump stations by using grinder pump systems in the Egan/Mattlyn area. The length of force mains is reduced, however, there would be low pressure sewers. The long term issues of operating hundreds of grinder pump systems will need to be evaluated further in Section 4.

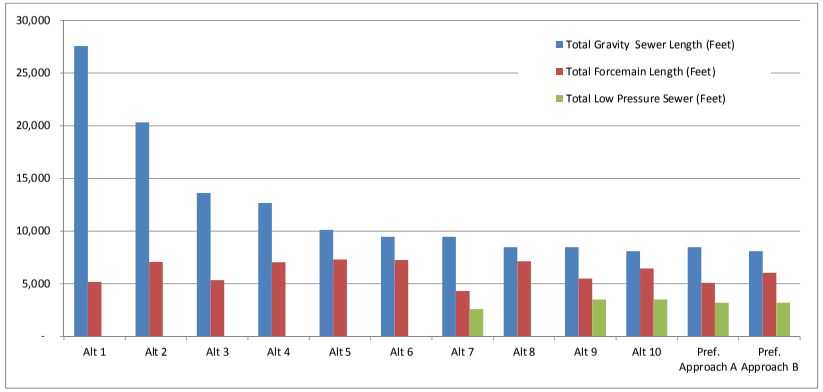
- Alternative 8 was selected for further evaluation. This alternative further reduces the length of gravity trunk sewers, while making use of deep gravity sewers to carry flow along Frederick Road and Observation Drive. The impacts to buildings and the community for tunneling through rock during construction of the deep gravity sewers will need to be evaluated further in Section 4.
- Alternative 9 was selected for further evaluation. This alternative reduces the number of pump stations by using grinder pump systems in the Egan/Mattlyn and Pulte areas. The long term issues of operating hundreds of grinder pump systems will need to be evaluated further in Section 4.
- Alternative 10 was selected for further evaluation. This alternative takes into consideration the possibility that Observation Drive is not available to install a gravity trunk sewer to Clarksburg Road. Instead, an access road for the future property development would provide a path for the new gravity trunk sewer. The issues with uncertainties of the access road location will need to be evaluated further in Section 4.

TABLE 3-1
SUMMARY OF ALTERNATIVE COMPONENTS

Sewer Lengths Summary

		Gravity Sewer (Feet)							Forcemain (Feet)											
	Description	Gravity Trunk Sewer Along Ten Mile Creek	Frederick Rd Sewer and other Misc	Clarksburg Rd Sewer	Spire St Sewer	Whelan Ln Gravity Sewer	Observation Drive and Other Misc	Deep Sewer (Frederick Rd and Observation Drive)	Pulte PS FM	Egan North PS FM	Egan Forcemain	New PS near Correctional Facility FM	Clarksburg Rd PS FM	Miles PS FM (North)	Miles PS FM	Existing Correctional Facility PS FM Redirect	Low Pressure Sewer	Total Gravity Sewer Length (Feet)	Total Forcemain Length (Feet)	Total Low Pressure Sewer (Feet)
Alternative 1	Gravity + 1 PS	21,090	4,360	1,550	570	-	-		5,180	-	-	-	-	-		-		**27,570**	**5,180**	**-**
Alternative 2	Gravity + 2 PS	13,840	4,360	1,550	570	-	-		5,180	1,900	-	-	-	-		-		**20,320**	**7,080**	**-**
Alternative 3	Gravity + 3 PS	5,160	3,690	2,710	570	1,490	-	-	1,650	1,900	-	1,800	-	-		-		**13,620**	**5,350**	**-**
Alternative 4	Gravity + 4 PS	3,330	3,690	3,590	570	1,490	-	-	1,650	1,900	-	1,800	1,700	-		-		**12,670**	**7,050**	**-**
Alternative 5	Gravity + 5 PS	780	3,690	3,590	570	1,490	-	-	1,650	1,900	-	-	1,700	1,400		660		**10,120**	**7,310**	**-**
Alternative 6	Gravity + 6 PS	780	4,360	2,530	570	-	1,220	-	1,650	1,600	1,350	-	-	1,400	1,260	-	-	**9,460**	**7,260**	**-**
Alternative 7	Gravity + 4 PS + Grinder Systems	780	4,360	2,530	570	-	1,220	-	1,650	-	-	-	-	1,400	1,260	-	2,600	**9,460**	**4,310**	**2,600**
Alternative 8	Gravity + 5 PS	-	2,000	2,530	570	-	1,620	1,750	1,650	2,050	2,180	-	-	-	1,260	-	-	**8,470**	**7,140**	**-**
Alternative 9	Gravity + 4 PS + Grinder Systems	-	2,000	2,530	570	-	1,620	1,750	-	2,050	2,180	-	-	-	1,260	-	3,500	**8,470**	**5,490**	**3,500**
Alternative 10	Gravity + 4 PS + Grinder Systems	-	5,000	2,530	570	-	-	-	-	2,050	3,140	-	-	-	1,260	-	3,500	**8,100**	**6,450**	**3,500**
Preferred Approach A	Gravity + 4 PS + Grinder Systems	-	2,000	2,530	570	-	1,620	1,750	1,650	-	2,180	-	-	-	1,260	-	3,200	**8,470**	**5,090**	**3,200**
Preferred Approach B	Gravity + 4 PS + Grinder Systems	-	5,000	2,530	570	-	-	-	1,650	-	3,140	-	-	-	1,260	-	3,200	**8,100**	**6,050**	**3,200**

	Description	Total Gravity Sewer Length (Feet)	Total Forcemain Length (Feet)	Total Low Pressure Sewer Length (Feet)	Total Gravity Sewer Length in buffer (Feet)	Total Forcemain Length in buffer (Feet)	Total Low Pressure Sewer Length in buffer (Feet)	Percentage of Gravity Sewer in buffer	Percentage of FM in buffer	Percentage of FM in buffer
Alternative 1	Gravity + 1 PS	27,570	5,180	-	20,400	-	-	74%	-	-
Alternative 2	Gravity + 2 PS	20,320	7,080	-	13,150	340	-	65%	5%	-
Alternative 3	Gravity + 3 PS	13,620	5,350	-	4,870	700	-	36%	13%	-
Alternative 4	Gravity + 4 PS	12,670	7,050	-	3,330	780	-	26%	11%	-
Alternative 5	Gravity + 5 PS	10,120	7,310	-	780	150	-	8%	2%	-
Alternative 6	Gravity + 6 PS	9,460	7,260	-	780	150	-	8%	2%	-
Alternative 7	Gravity + 4 PS + Grinder Systems	9,460	4,310	2,600	780	150	-	8%	3%	-
Alternative 8	Gravity + 5 PS	8,470	7,140	-	-	-	-	-	-	-
Alternative 9	Gravity + 4 PS + Grinder Systems	8,470	5,490	3,500	-	-	-	-	-	-
Alternative 10	Gravity + 4 PS + Grinder Systems	8,100	6,450	3,500	-	-	-	-	-	-
Preferred Approach A	Gravity + 4 PS + Grinder Systems	8,470	5,090	2,560	-	-	-	-	-	-
Preferred Approach B	Gravity + 4 PS + Grinder Systems	8,100	6,050	2,560	-	-	-	-	-	-



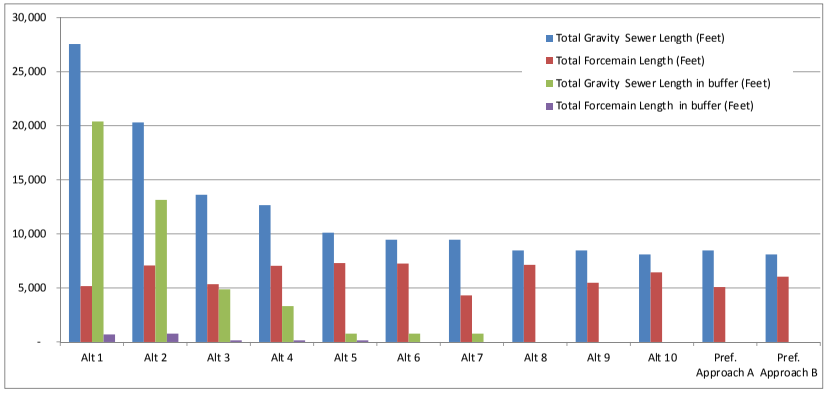


TABLE 3-1
SUMMARY OF ALTERNATIVE COMPONENTS

Tunnels Summary

	Description	No. of New Tunnels across I-270	FM in Existing Tunnel Abandoned (Yes/No)	Existing Tunnel used for New FM (Yes/No)
Alternative 1	Gravity + 1 PS	3	Yes	No
Alternative 2	Gravity + 2 PS	2	Yes	No
Alternative 3	Gravity + 3 PS	2	Yes	No
Alternative 4	Gravity + 4 PS	1	No	Yes
Alternative 5	Gravity + 5 PS	0	No	Yes
Alternative 6	Gravity + 6 PS	0	No	No
Alternative 7	Gravity + 4 PS + Grinder Systems	0	No	No
Alternative 8	Gravity + 5 PS	0	No	No
Alternative 9	Gravity + 4 PS + Grinder Systems	0	No	No
Alternative 10	Gravity + 4 PS + Grinder Systems	0	No	No
Preferred Approach A	Gravity + 4 PS + Grinder Systems	0	No	No
Preferred Approach B	Gravity + 4 PS + Grinder Systems	0	No	No

Stream Crossings Summary

	Description	Total No. of Stream Crossings	Main Trunk Sewer	Egan North Trunk Sewer	Frederick Rd Sewer	Clarksburg Rd Sewer	Spire St Sewer	Other
Alternative 1	Gravity + 1 PS	14	7	3	1	-	-	3
Alternative 2	Gravity + 2 PS	11	7	-	1	-	-	3
Alternative 3	Gravity + 3 PS	4	2	-	1	-	-	1
Alternative 4	Gravity + 4 PS	3	1	-	1	-	-	1
Alternative 5	Gravity + 5 PS	3	1	-	1	-	-	1
Alternative 6	Gravity + 6 PS	2	1	-	1	-	-	-
Alternative 7	Gravity + 4 PS + GS	2	1	-	1	-	-	-
Alternative 8	Gravity + 5 PS	1	-	-	1	-	-	-
Alternative 9	Gravity + 4 PS + GS	1	-	-	1	-	-	-
Alternative 10	Gravity + 4 PS + GS	2	-	-	2	-	-	-
Preferred Approach A	Gravity + 4 PS + GS	1	-	-	1	-	-	-
Preferred Approach B	Gravity + 4 PS + GS	2	-	-	2	-	-	-

Pump Stations Summary

Alternative	Description	Pulte PS	Egan North PS	Egan PS	New PS at Correctional Facility	Clarksburg Rd PS	Miles North PS	Miles PS	Existing Correctional Facility PS in use	Total Number of Pump stations in service
Alternative 1	Gravity + 1 PS	Yes	No	No	No	No	No	No	No	1
Alternative 2	Gravity + 2 PS	Yes	Yes	No	No	No	No	No	No	2
Alternative 3	Gravity + 3 PS	Yes	Yes	No	Yes	No	No	No	No	3
Alternative 4	Gravity + 4 PS	Yes	Yes	No	Yes	Yes	No	No	No	4
Alternative 5	Gravity + 5 PS	Yes	Yes	No	No	Yes	Yes	No	Yes	5
Alternative 6	Gravity + 6 PS	Yes	Yes	Yes	No	No	Yes	Yes	Yes	6
Alternative 7	Gravity + 4 PS + Grinder Systems	Yes	No	No	No	No	Yes	Yes	Yes	4
Alternative 8	Gravity + 5 PS	Yes	Yes	Yes	No	No	No	Yes	Yes	5
Alternative 9	Gravity + 4 PS + Grinder Systems	No	Yes	Yes	No	No	No	Yes	Yes	4
Alternative 10	Gravity + 4 PS + Grinder Systems	No	Yes	Yes	No	No	No	Yes	Yes	4
Preferred Approach A	Gravity + 4 PS + Grinder Systems	Yes	No	Yes	No	No	No	Yes	Yes	4
Preferred Approach B	Gravity + 4 PS + Grinder Systems	Yes	No	Yes	No	No	No	Yes	Yes	4

New Pump Station Sizing (mgd)

Alternative	Description	Pulte PS	Egan North PS	Egan PS	New PS at Correctional Facility	Clarksburg Rd PS	Miles PS (North)	Miles PS
Alternative 1	Gravity + 1 PS	1.98	-	-	-	-	-	-
Alternative 2	Gravity + 2 PS	1.98	0.17	-	-	-	-	-
Alternative 3	Gravity + 3 PS	0.27	0.17	-	1.71	-	-	-
Alternative 4	Gravity + 4 PS	0.27	0.17	-	1.45	0.26	-	-
Alternative 5	Gravity + 5 PS	0.27	0.17	-	-	0.94	0.68	-
Alternative 6	Gravity + 6 PS	0.27	0.022	0.30	-	-	0.47	0.94
Alternative 7	Gravity + 4 PS + Grinder Systems	0.27	-	-	-	-	0.47	0.94
Alternative 8	Gravity + 5 PS	0.27	0.022	0.32	-	-	-	0.94
Alternative 9	Gravity + 4 PS + Grinder Systems	-	0.022	0.32	-	-	-	0.94
Alternative 10	Gravity + 4 PS + Grinder Systems	-	0.02	0.46	-	-	-	0.94
Preferred Approach A	Gravity + 4 PS + Grinder Systems	0.27	-	0.32	-	-	-	0.94
Preferred Approach B	Gravity + 4 PS + Grinder Systems	0.27	-	0.46	-	-	-	0.94

**Sizing is based on Peak Wastewater Flow (PWF) as described in Appendix C, WSSC Design Criteria for Sewer Systems.*

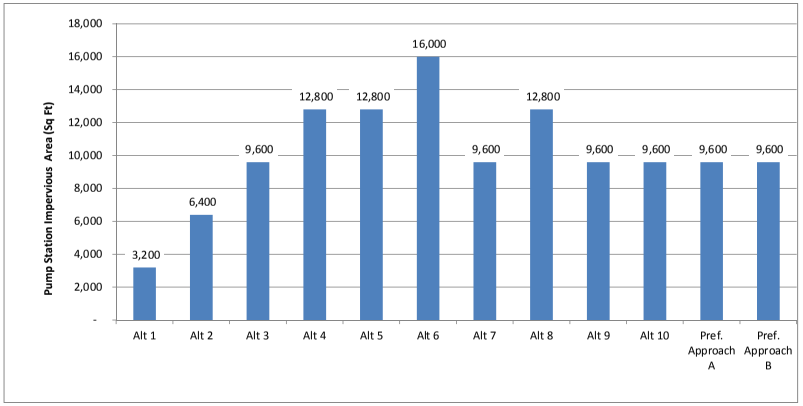


Figure 3-1
Alternative 1: Gravity + 1 Pump Station

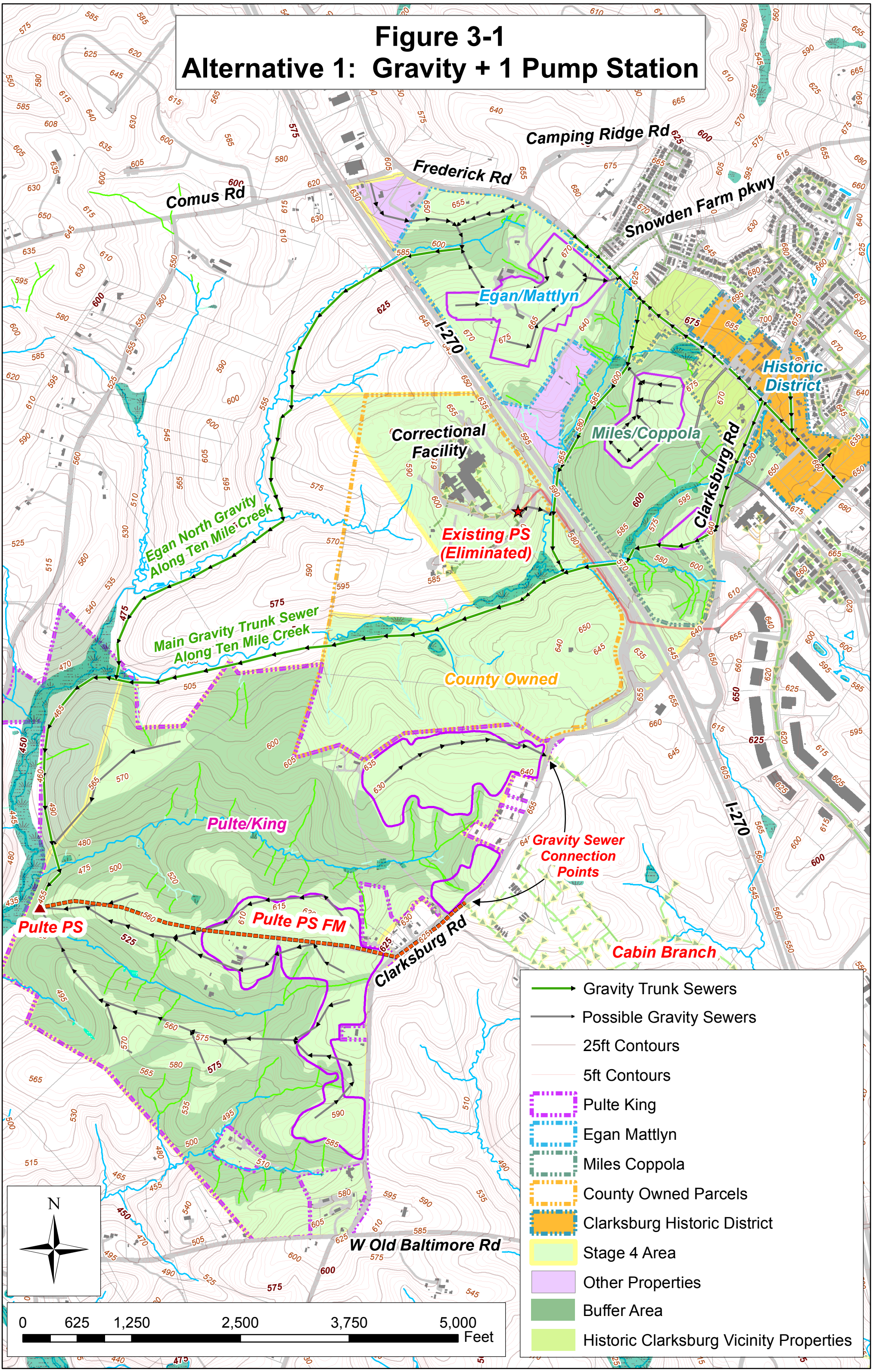


Figure 3-2
Alternative 2: Gravity + 2 Pump Stations

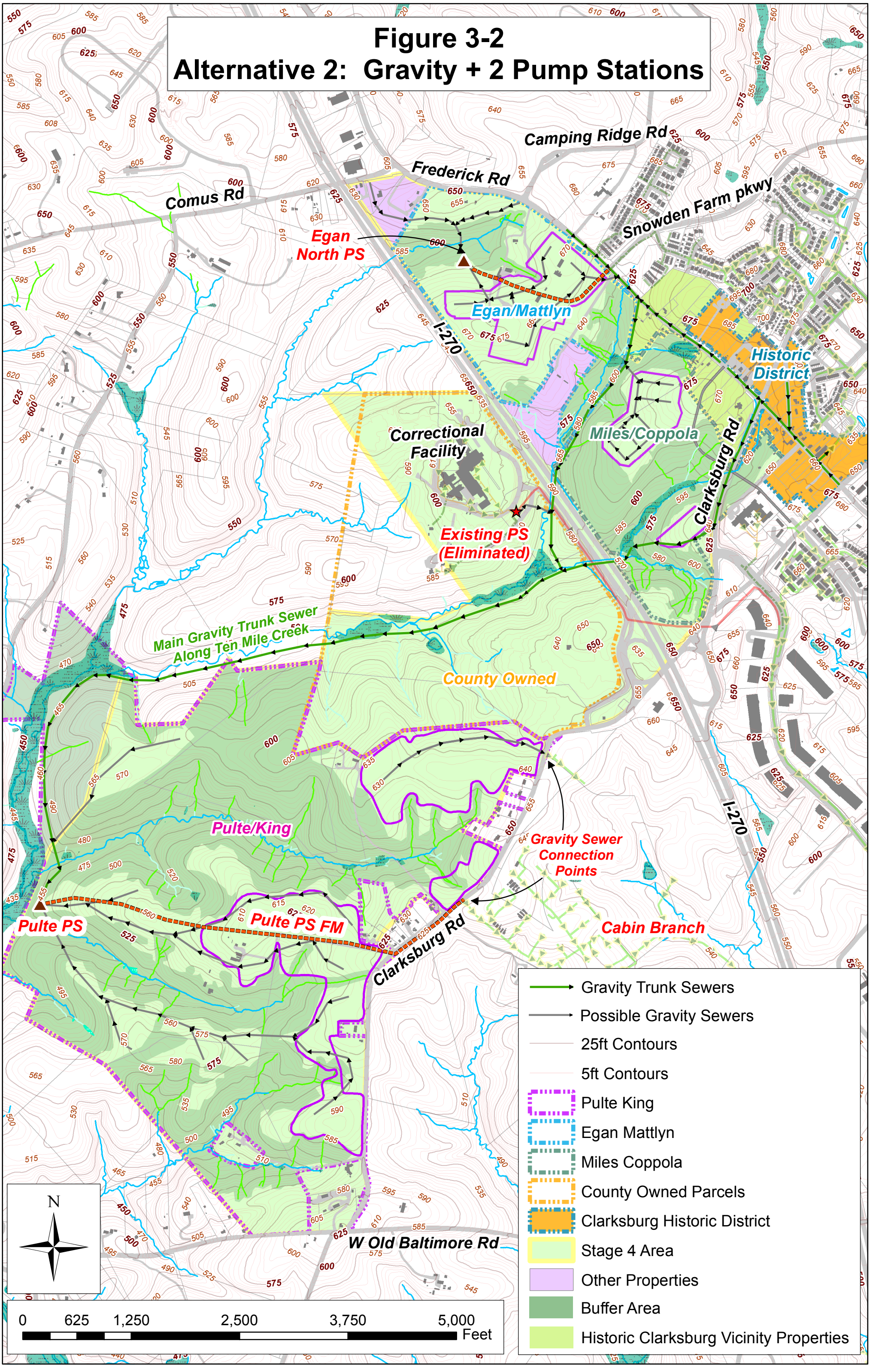


Figure 3-3
Alternative 3: Gravity + 3 Pump Stations

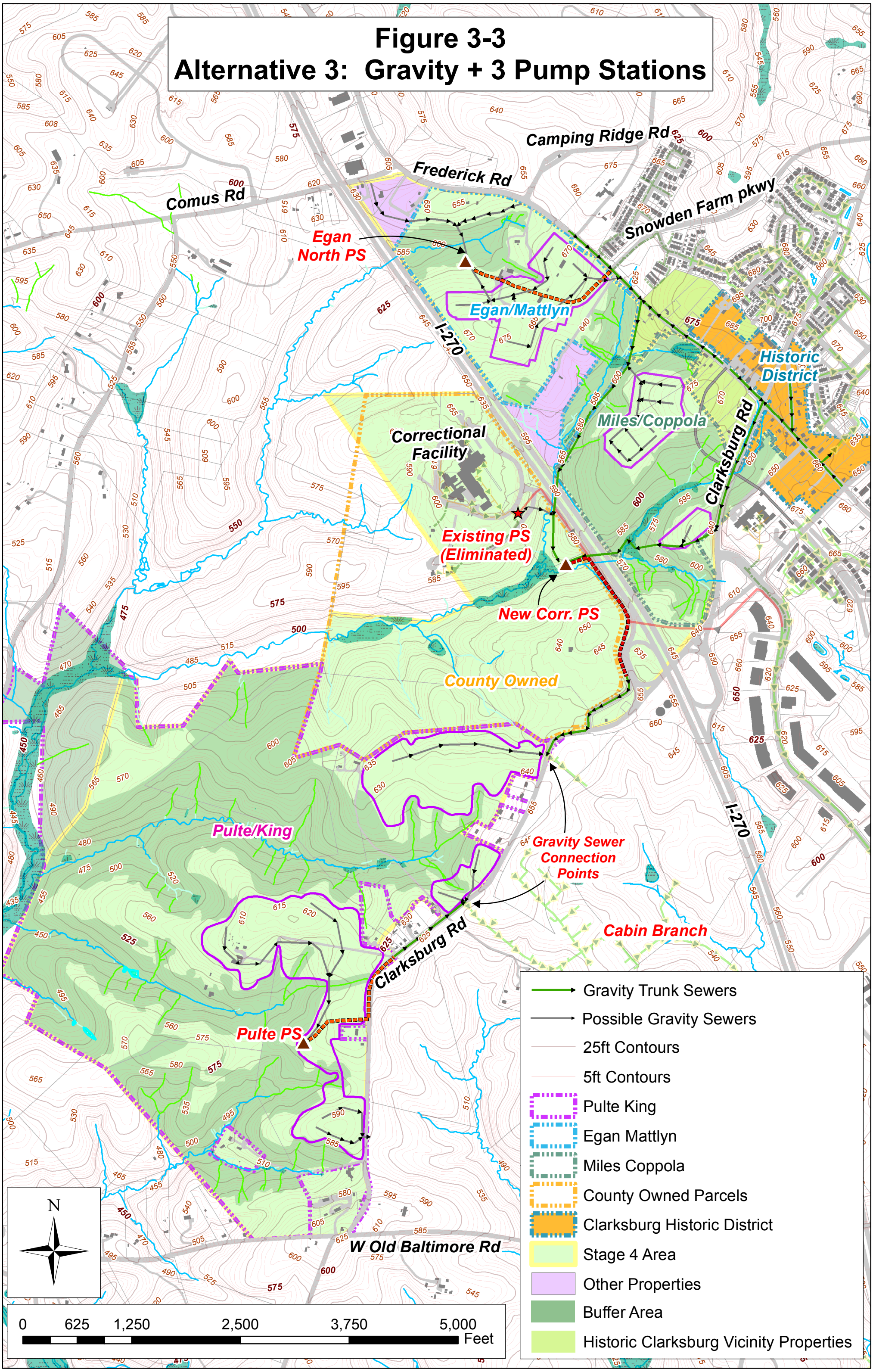


Figure 3-4
Alternative 4: Gravity + 4 Pump Stations

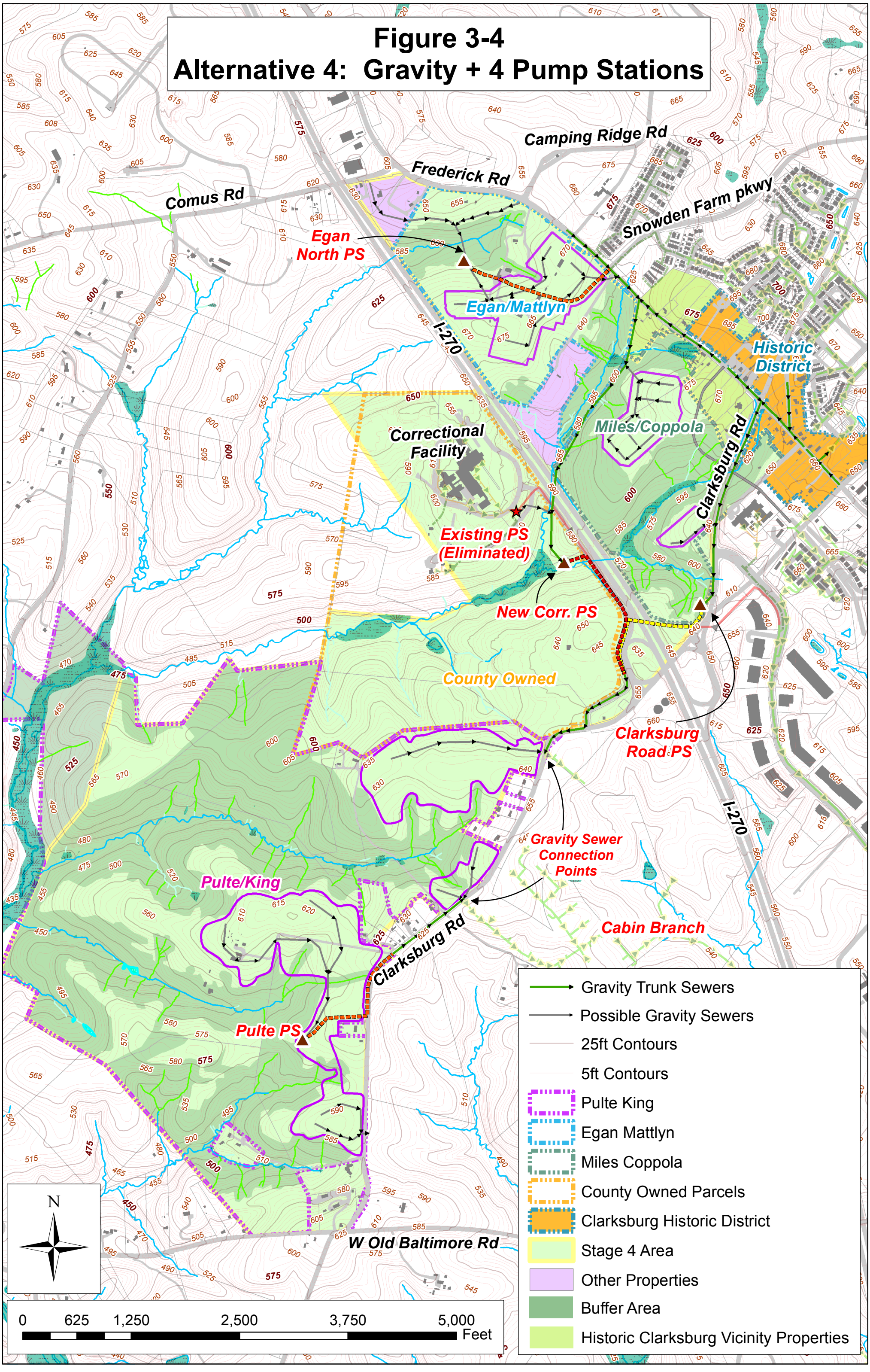


Figure 3-5
Alternative 5: Gravity + 5 Pump Stations

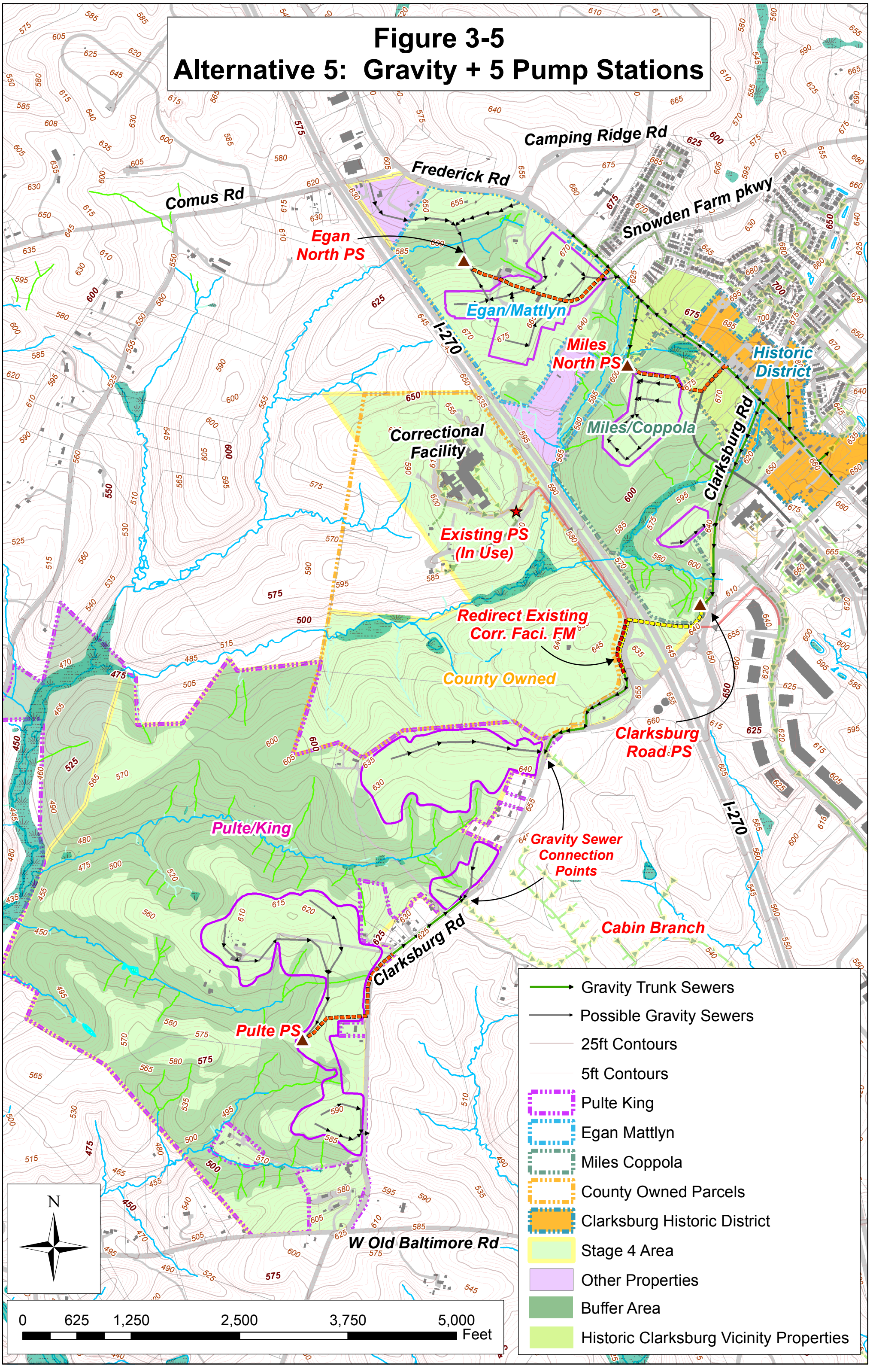


Figure 3-6
Alternative 6 - Gravity + 6 Pump Stations

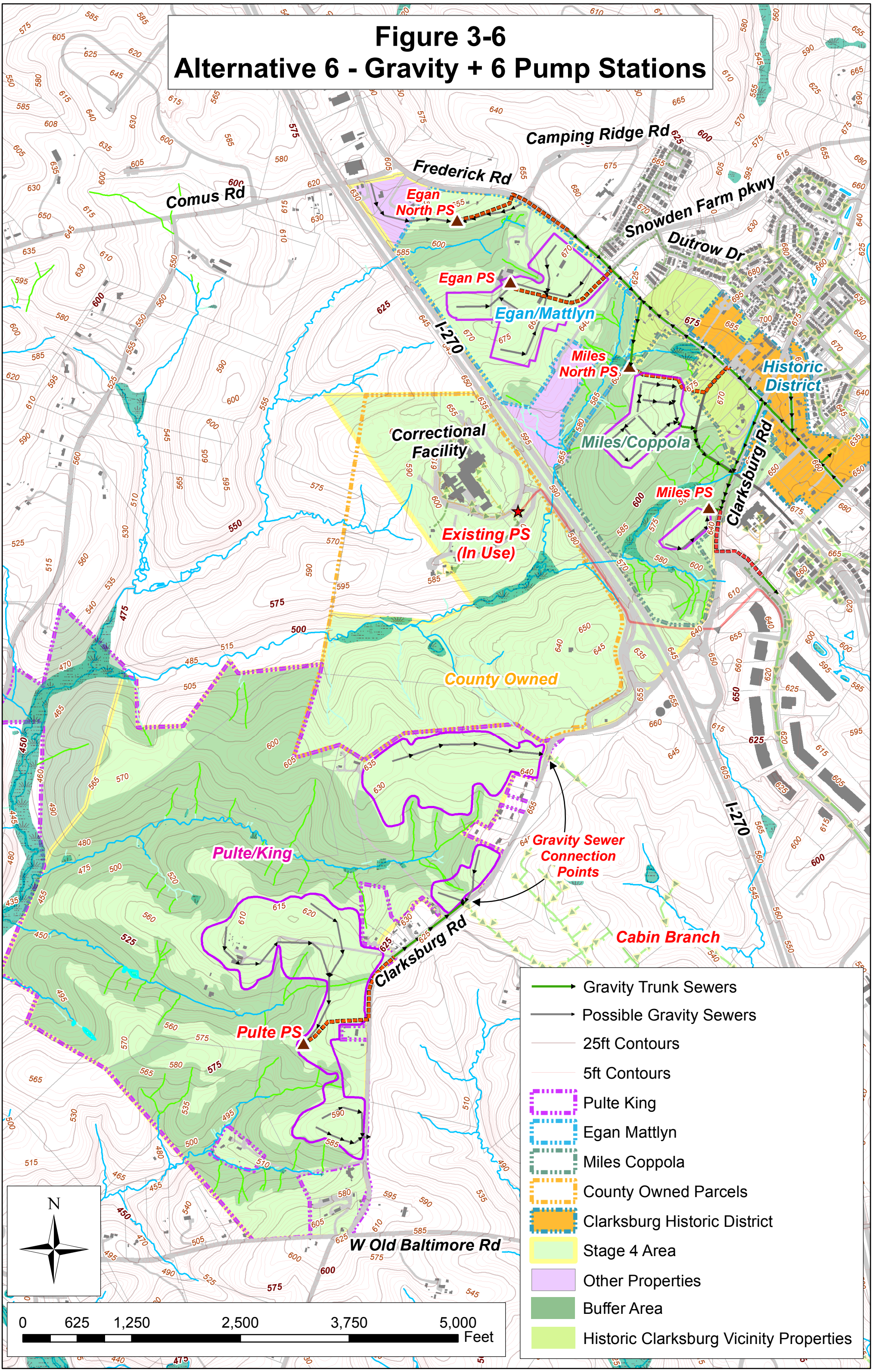


Figure 3-7
Alternative 7 - Gravity + 4 Pump Stations and Grinder Pump Systems

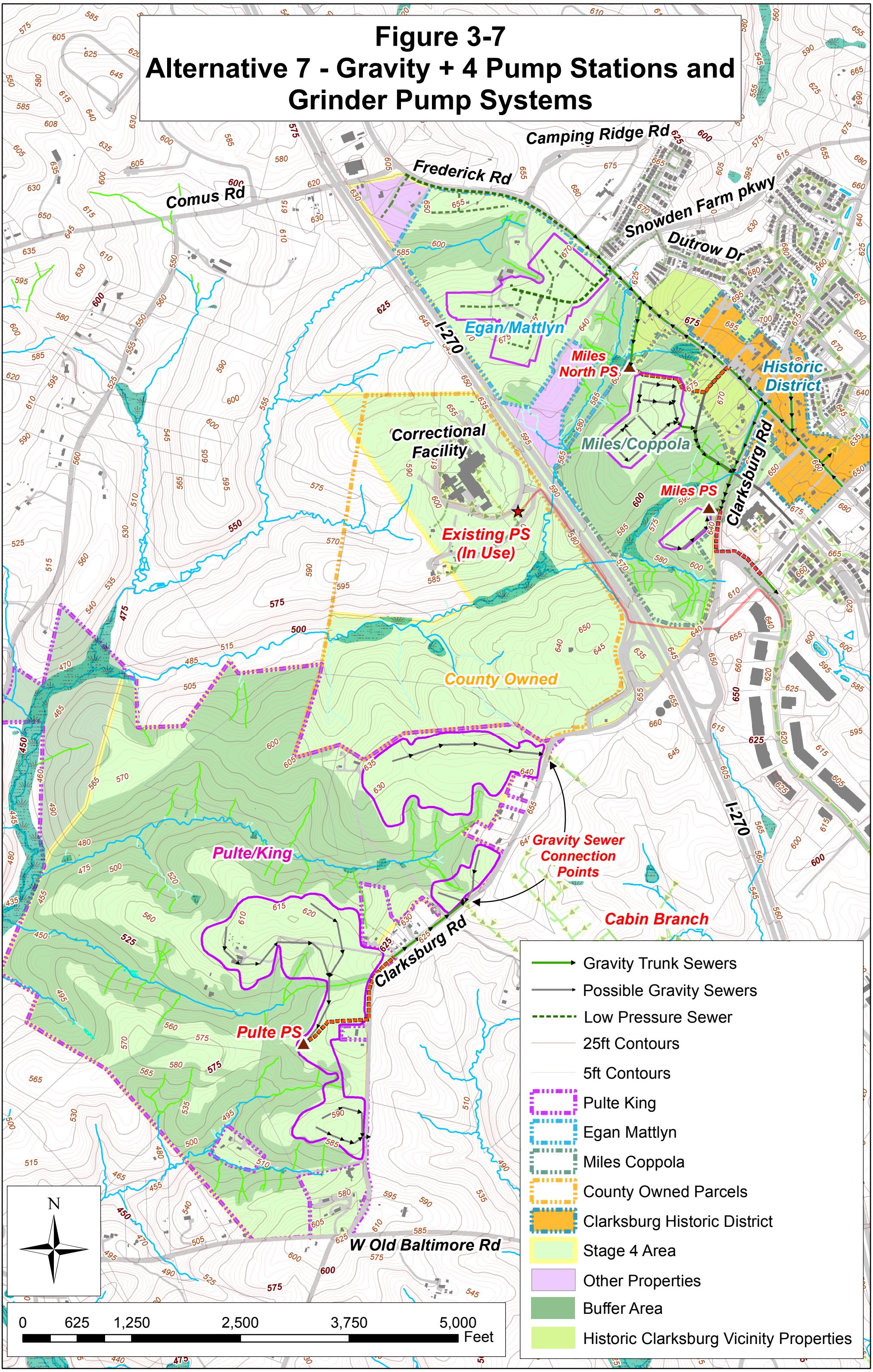


Figure 3-8
Alternative 8 - Gravity + 5 Pump Stations

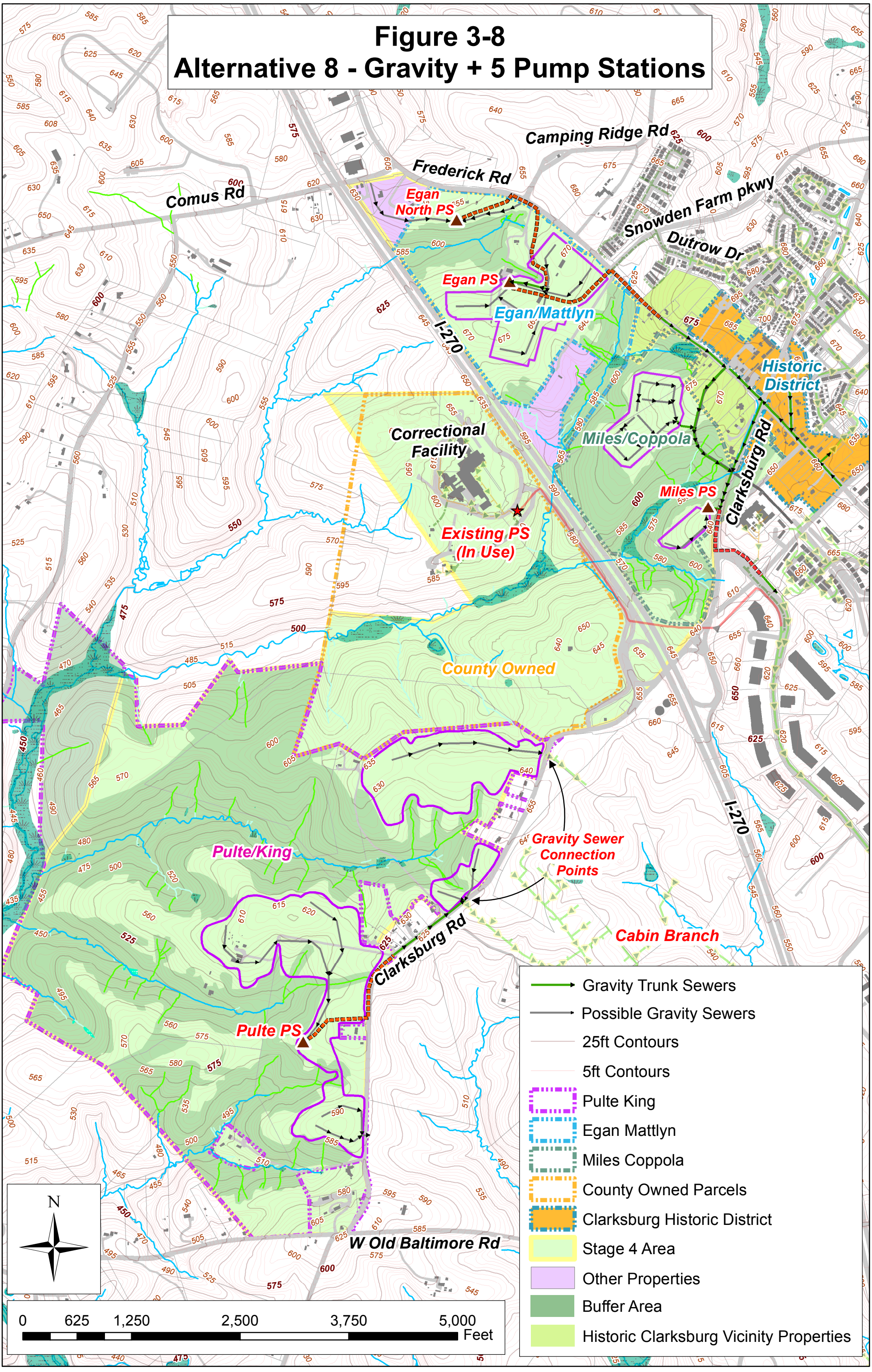


Figure 3-9
Alternative 9 - Gravity + 4 Pump Stations and Grinder Pump Systems

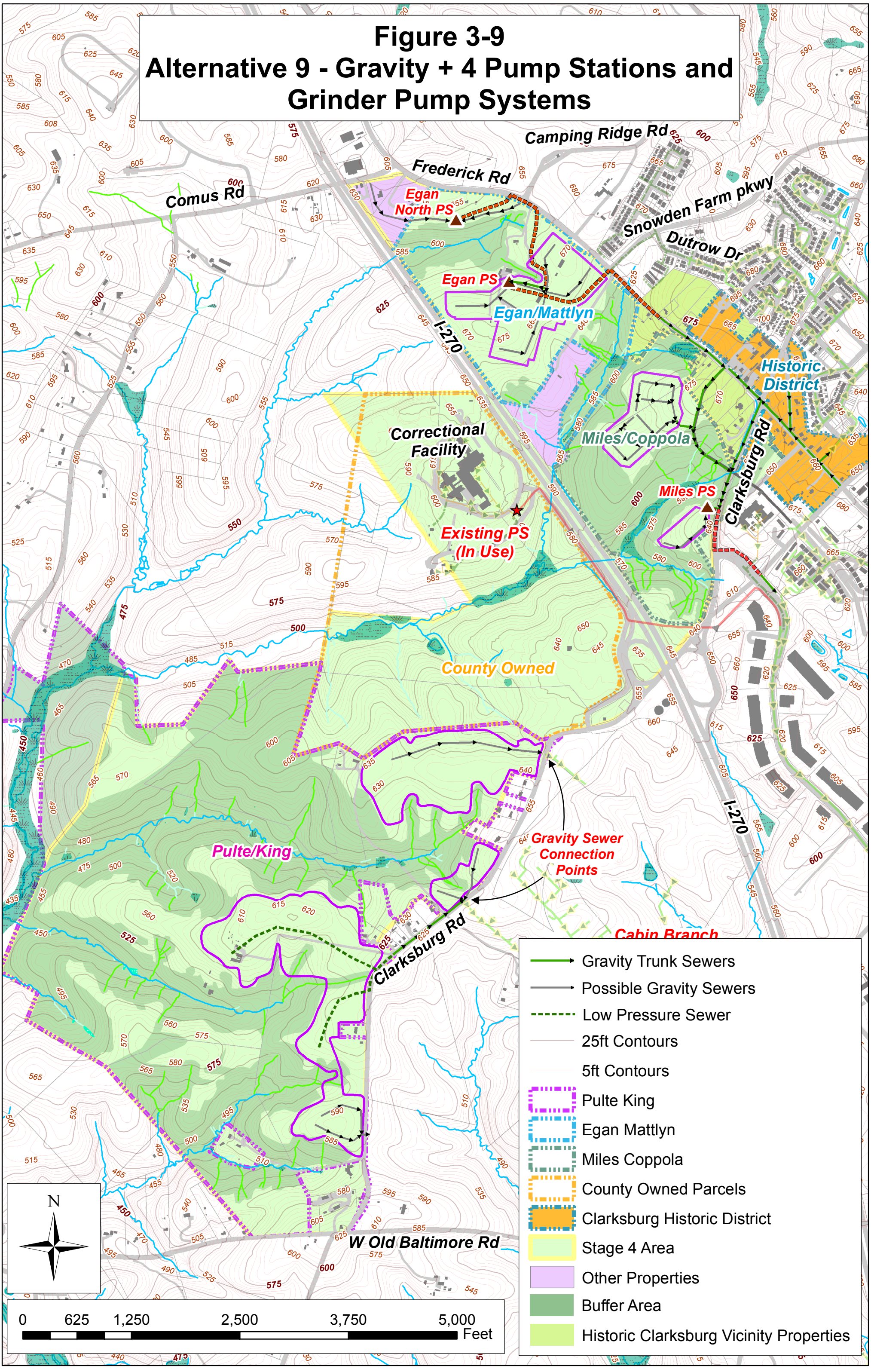
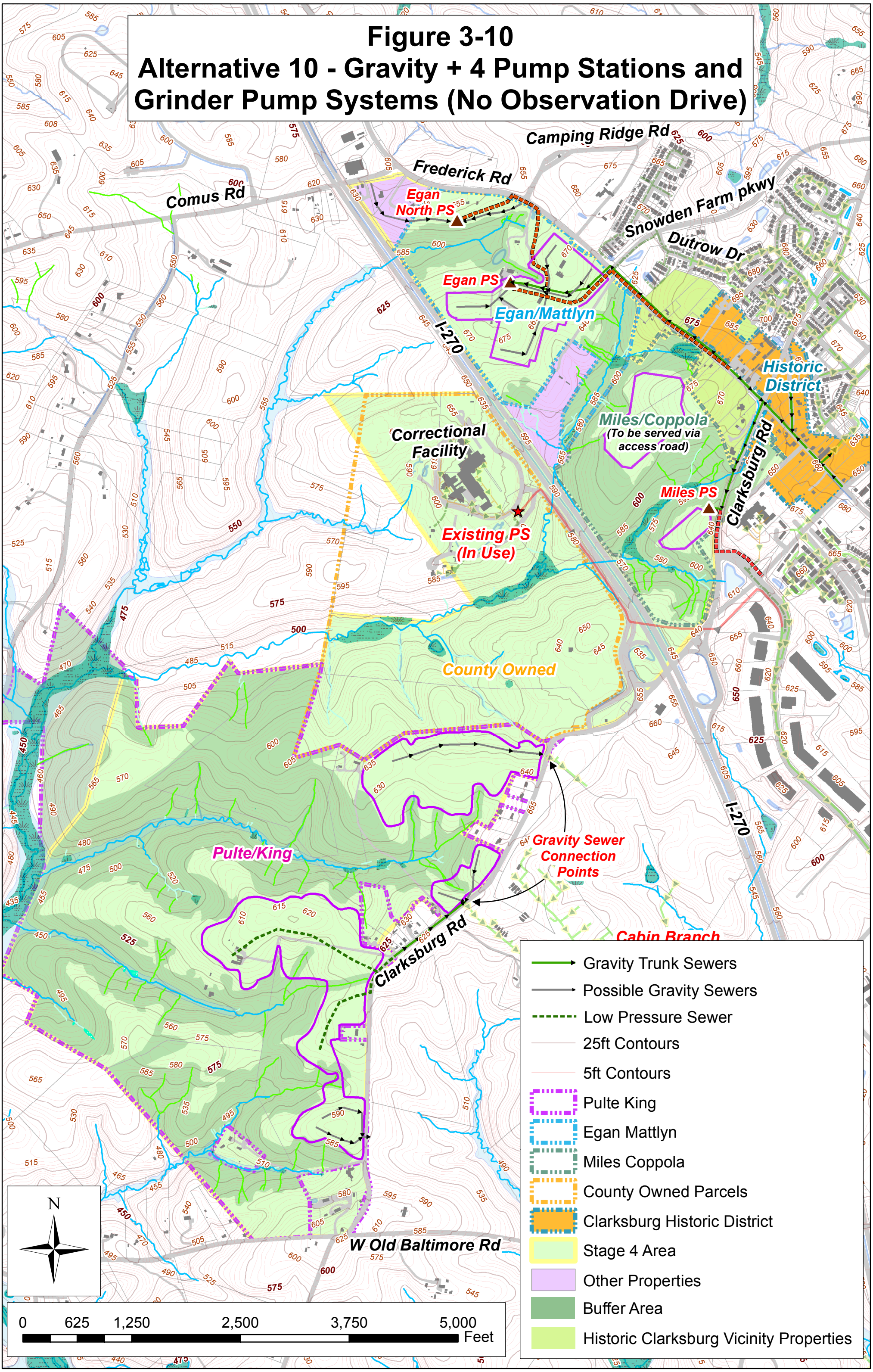


Figure 3-10
Alternative 10 - Gravity + 4 Pump Stations and Grinder Pump Systems (No Observation Drive)



Section 4
Evaluation of Alternatives

4.1 Introduction

This section documents the analysis of selected alternatives to provide sanitary sewer service to the Clarksburg Ten Mile Creek study area. In Section 3, eight alternatives were selected for evaluation from the ten identified major alternatives. At the end of this section, the "Preferred Approach" is discussed.

4.2 Evaluation Criteria

4.2.1 Opinion of Probable Cost

Planning-level order-of-magnitude costs were developed for each alternative. The American Association of Cost Engineers (AACE) defines order-of-magnitude as estimates made without detailed engineering data, and relies on the use of previous estimates and historical data from comparable work, estimating guides, handbooks, and costing curves. Order-of-magnitude cost estimates have an expected accuracy range of +50 to -30 percent.

The following planning level contingencies are included in the project cost estimates:

- Permits, bonds, and insurance (indirect costs) are 3.65 percent of the capital cost
- General conditions (GC) is 10 percent of the capital and indirect costs
- Overhead and profit (OH&P) is 10 percent of the capital and indirect costs
- Construction contingency is 30 percent of the capital, indirect, GC and OH&P costs
- Escalation is 3 percent to the mid-point of construction assumed to be September 2016

The economic analysis includes capital costs, annual operation and maintenance (O&M) costs, and present worth that include both capital and O&M costs. Present worth assumes a 25-year planning period at an interest rate of 6 percent.

Cost estimates for the eight alternatives were developed based on the lengths of new gravity sewers and force mains, number of pump stations and predicted flows, number of I-270 road crossings and stream crossings, and number of grinder pumps and lengths of low pressure sewers (where applicable). Cost estimates for the eight alternatives are provided on **Tables 4-1** through **4-8**, and the costs are summarized on **Table 4-9**.

The present worth cost to implement the alternatives are fairly similar in value, and range from $9M to $11M. Alternative 8 has the lowest present worth cost ($9,242,000) and Alternative 7 has the highest cost ($10,999,000).

Table 4-1 Cost Estimate for Alternative 3

Item	Unit	Unit Cost	Quantity	Cost
Traffic Control	LS	$178,000	1	$178,000
Gravity Sewers	LF	$215	13,620	$2,928,000
Force Mains	LF	$170	5,350	$910,000
Pulte Pump Station (0.27 mgd)	LS	$1,000,000	1	$1,000,000
Egan North Pump Station (0.14 mgd)	LS	$1,000,000	1	$1,000,000
New Pump Station at Correctional Facility (1.73 mgd)	LS	$1,200,000	1	$1,200,000
I-270 Crossings (two gravity sewers)	LF	$2,500	600	$1,500,000
Stream Crossings	EA	$15,000	4	$60,000
Total Capital Cost				**$8,776,000**
Long Term O&M Cost ($35,000/year x 3 pump stations)				**$1,342,000**
Present Worth				**$10,118,000**

Table 4-2 Cost Estimate for Alternative 4

Item	Unit	Unit Cost	Quantity	Cost
Traffic Control	LS	$168,000	1	$168,000
Gravity Sewers	LF	$215	12,670	$2,724,000
Force Mains	LF	$170	7,050	$1,198,000
Pulte Pump Station (0.27 mgd)	LS	$1,000,000	1	$1,000,000
Egan North Pump Station (0.14 mgd)	LS	$1,000,000	1	$1,000,000
New Pump Station at Correctional Facility (1.51 mgd)	LS	$1,200,000	1	$1,200,000
Clarksburg Road Pump Station (0.23 mgd)	LS	$1,000,000	1	$1,000,000
I-270 Crossing (one gravity sewer)	LF	$2,500	300	$750,000
Replace Force Main inside Existing Casing under I-270	LF	$275	300	$82,000
Stream Crossings	EA	$15,000	3	$45,000
Total Capital Cost				**$9,167,000**
Long Term O&M Cost ($35,000/year x 4 pump stations)				**$1,790,000**
Present Worth				**$10,957,000**

Table 4-3 Cost Estimate for Alternative 5

Item	Unit	Unit Cost	Quantity	Cost
Traffic Control	LS	$137,000	1	$137,000
Gravity Sewers	LF	$215	10,120	$2,176,000
Force Mains	LF	$170	7,310	$1,243,000
Reroute Existing Correctional Facility Force Main	LF	$170	650	$110,000
Pulte Pump Station (0.27 mgd)	LS	$1,000,000	1	$1,000,000
Egan North Pump Station (0.14 mgd)	LS	$1,000,000	1	$1,000,000
Clarksburg Road Pump Station (0.95 mgd)	LS	$1,000,000	1	$1,000,000
Miles North Pump Station (0.73 mgd)	LS	$1,000,000	1	$1,000,000
Use Existing Pump Station at Correctional Facility (0.61 mgd)	LS	$0	1	$0
Replace Force Main inside Existing Casing under I-270	LF	$275	300	$82,000
Stream Crossings	EA	$15,000	3	$45,000
Total Capital Cost				**$7,793,000**
Long Term O&M Cost ($35,000/year x 5 pump stations)				**$2,237,000**
Present Worth				**$10,030,000**

Table 4-4 Cost Estimate for Alternative 6

Item	Unit	Unit Cost	Quantity	Cost
Traffic Control	LS	$140,000	1	$140,000
Gravity Sewers	LF	$215	9,460	$2,034,000
Force Mains	LF	$170	7,260	$1,234,000
Pulte Pump Station (0.27 mgd)	LS	$1,000,000	1	$1,000,000
Egan North Pump Station (0.022 mgd)	LS	$800,000	1	$800,000
Egan Pump Station (0.30 mgd)	LS	$1,000,000	1	$1,000,000
Miles North Pump Station (0.47 mgd)	LS	$1,000,000	1	$1,000,000
Miles Pump Station (0.92 mgd)	LS	$1,000,000	1	$1,000,000
Use Existing Pump Station at Correctional Facility (0.61 mgd)	LS	$0	1	$0
Stream Crossings	EA	$15,000	2	$30,000
Total Capital Cost				**$8,238,000**
Long Term O&M Cost ($35,000/year x 6 pump stations)				**$2,684,000**
Present Worth				**$10,923,000**

Table 4-5 Cost Estimate for Alternative 7

Item	Unit	Unit Cost	Quantity	Cost
Traffic Control	LS	$140,000	1	$140,000
Gravity Sewers	LF	$215	9,460	$2,034,000
Force Mains	LF	$170	4,310	$733,000
Low Pressure Sewers	LF	$125	2,600	$325,000
Low Pressure Connections	EA	$125	383	$48,000
Grinder Pumps	EA	$5,000	383	$1,915,000
Pulte Pump Station (0.27 mgd)	LS	$1,000,000	1	$1,000,000
Miles North Pump Station (0.47 mgd)	LS	$1,000,000	1	$1,000,000
Miles Pump Station (0.92 mgd)	LS	$1,000,000	1	$1,000,000
Use Existing Pump Station at Correctional Facility (0.61 mgd)	LS	$0	1	$0
Stream Crossings	EA	$15,000	2	$30,000
Total Capital Cost				**$8,225,000**
Long Term O&M Cost ($35,000/year x 4 pump stations plus $200/year x 383 grinder pumps)				**$2,774,000**
Present Worth				**$10,999,000**

Table 4-6 Cost Estimate for Alternative 8

Item	Unit	Unit Cost	Quantity	Cost
Traffic Control	LS	$140,000	1	$140,000
Gravity Sewers	LF	$215	8,470	$1,821,000
Force Mains	LF	$170	7,140	$1,214,000
Pulte Pump Station (0.27 mgd)	LS	$1,000,000	1	$1,000,000
Egan North Pump Station (0.022 mgd)	LS	$800,000	1	$800,000
Egan Pump Station (0.30 mgd)	LS	$1,000,000	1	$1,000,000
Miles Pump Station (0.92 mgd)	LS	$1,000,000	1	$1,000,000
Use Existing Pump Station at Correctional Facility (0.61 mgd)	LS	$0	1	$0
Stream Crossings	EA	$15,000	1	$30,000
Total Capital Cost				**$7,005,000**
Long Term O&M Cost ($35,000/year x 5 pump stations)				**$2,237,000**
Present Worth				**$9,242,000**

Table 4-7 Cost Estimate for Alternative 9

Item	Unit	Unit Cost	Quantity	Cost
Traffic Control	LS	$140,000	1	$140,000
Gravity Sewers	LF	$215	8,470	$1,821,000
Force Mains	LF	$170	5,490	$933,000
Low Pressure Sewers	LF	$125	3,500	$438,000
Low Pressure Connections	EA	$125	284	$36,000
Grinder Pumps	EA	$5,000	284	$1,420,000
Egan North Pump Station (0.022 mgd)	LS	$800,000	1	$800,000
Egan Pump Station (0.30 mgd)	LS	$1,000,000	1	$1,000,000
Miles Pump Station (0.92 mgd)	LS	$1,000,000	1	$1,000,000
Use Existing Pump Station at Correctional Facility (0.61 mgd)	LS	$0	1	$0
Stream Crossings	EA	$15,000	1	$15,000
Total Capital Cost				**$7,603,000**
Long Term O&M Cost ($35,000/year x 4 pump stations plus $200/year x 284 grinder pumps)				**$2,518,000**
Present Worth				**$10,121,000**

Table 4-8 Cost Estimate for Alternative 10

Item	Unit	Unit Cost	Quantity	Cost
Traffic Control	LS	$140,000	1	$140,000
Gravity Sewers	LF	$215	8,100	$1,742,000
Force Mains	LF	$170	6,450	$1,096,000
Low Pressure Sewers	LF	$125	3,500	$438,000
Low Pressure Connections	EA	$125	284	$36,000
Grinder Pumps	EA	$5,000	284	$1,420,000
Egan North Pump Station (0.022 mgd)	LS	$800,000	1	$800,000
Egan Pump Station (0.30 mgd)	LS	$1,000,000	1	$1,000,000
Miles Pump Station (0.92 mgd)	LS	$1,000,000	1	$1,000,000
Use Existing Pump Station at Correctional Facility (0.61 mgd)	LS	$0	1	$0
Stream Crossings	EA	$15,000	2	$30,000
Total Capital Cost				**$7,702,000**
Long Term O&M Cost ($35,000/year x 4 pump stations plus $200/year x 284 grinder pumps)				**$2,518,000**
Present Worth				**$10,220,000**

Table 4-9 Cost Estimate Summary for Alternatives

Alternative	Capital Cost	Long Term O&M Cost	Present Worth
Alternative 3 - Gravity & 3 Pump Stations	$8,776,000	$1,342,000	$10,118,000
Alternative 4 - Gravity & 4 Pump Stations	$9,167,000	$1,790,000	$10,957,000
Alternative 5 - Gravity & 5 Pump Stations	$7,793,000	$2,237,000	$10,030,000
Alternative 6 - Gravity & 6 Pump Stations	$8,238,000	$2,684,000	$10,923,000
Alternative 7 - Gravity & 4 Pump Stations & Grinder Systems	$8,225,000	$2,774,000	$10,999,000
Alternative 8 - Gravity & 5 Pump Stations	$7,005,000	$2,237,000	$9,242,000
Alternative 9 - Gravity & 4 Pump Stations & Grinder Systems	$7,603,000	$2,518,000	$10,121,000
Alternative 10 - Gravity & 4 Pump Stations & Grinder Systems	$7,702,000	$2,518,000	$10,220,000

4.2.2 Reliability

In this context, reliability is a measure of the degree to which the alternative addresses immediate operational concerns and will continue to do so into the future. In general terms, pump stations are considered to have many safeguards and are very reliable, typically designed with redundant electrical systems (e.g., onsite backup generator or separate power feeds to each pump) and pumping systems (e.g., emergency backup pumps) to minimize risk of failure that could result in backup conditions and sewer overflows.

Grinder pump systems are fairly reliable, and failures generally impact the property where the failure occurs, and are associated with relatively small overflows, if any. Although grinder pump systems are equipped with alert systems to notify homeowners of pump failures (some tied to security systems that may require additional expense), the possibility exists that homeowners can experience a backup in their home before realizing that the alarm system has been activated regarding the failed pump. Repairs or replacement of the grinder pumps in the WSSC service area (usually located on the homeowner's property) are the responsibility of the homeowner, and not WSSC, requiring significant expense to the homeowner. Also, installation of a separate backup generator by homeowners is on a case by case basis, so when power fails, and the homeowner does not have a generator, they will not have sewer service capabilities, while a centralized pump station and force main have emergency backup power and provide more consistent service. As a result, while grinders may be considered to be a less expensive approach, with overflows likely to be smaller than for pump stations, pump stations overall provide a higher level of service to the WSSC customer.

Gravity sewers would be considered more reliable because they do not require any mechanical equipment or a continuous power source. Gravity sewers are hydraulically modeled and sized to meet current and future demands, such that overflows are not a likely scenario.

As a result, Alternative 3 which has the least number of pump stations, is considered the most reliable, while Alternative 6 would be less reliable given the need to maintain six pump stations.

4.2.3 Constructability

The potential construction challenges, such as accessibility, need for new land or easement acquisitions, and potential issues with subsurface conditions and dewatering during construction were evaluated.

Alternative 3 is expected to encounter the most hurdles during construction as more gravity sewers would be constructed. This would be partially offset by a lower length of force mains and less number of pump stations. In addition, this alternative includes the greatest number of I-270 tunnel crossings adding to potential issues with construction (e.g., dewatering of the jacking pits, open face versus closed face tunneling), and uncertainties in the types and possible changes in subsurface soil conditions (e.g., boulders/cobbles, excessively hard rock or mixed soil/rock conditions, highway fill) that may be encountered. Also, Alternative 8, which includes deep gravity sewers, would be the most likely to encounter rock during tunneling. A detailed geotechnical investigation would be necessary to determine the best course of action for selecting the tunneling approach.

Overall, Alternative 10 would have the least constructability issues, given that it includes the shortest length of gravity sewers.

4.2.4 Engineering Impacts

Engineering considerations were evaluated, including operational considerations and long term maintenance requirements.

Alternative 3 would have the least long term operational considerations given that it includes the lowest number of pump stations. Alternative 6 is expected to have the most maintenance requirements given that it includes operation of six pump stations.

4.2.5 Environmental Impacts

The potential adverse environmental impacts of the alternatives, such as damage to environmental receptors within Ten Mile Creek, stream crossings and construction activity near stream banks were analyzed. A more detailed assessment of environmental conditions may be needed to determine the impact of the alternatives on groundwater, surface water, air quality, historic sites, rare, threatened, and endangered species, wetlands, hazardous sites etc. within the project area. A detailed assessment would also help to determine structural and non-structural mitigation measures needed at locations where adverse impacts are unavoidable and develop mitigation costs.

Alternative 3 would have the greatest potential to impact the environment as this alternative has the largest number of stream crossings (4), length and percentage of gravity sewers in buffer zones (4,870 feet and 36 percent) and relatively high amount of force mains in buffer zones (700 feet and 13 percent), see **Table 3-1**. Alternatives 8, 9 and 10 would have less impact on the environment, given that they have relatively few stream crossings and no gravity sewers or force mains within buffer zones.

4.2.6 Community Impacts

Potential adverse impacts such as road closures during construction, construction duration and long term impacts on the local community were evaluated.

Most of the alternatives have similar levels of community disruption during construction, given that the same roadways would be impacted, requiring traffic control, and temporarily increasing

congestion. Alternative 8 is expected to have the most short term impact to the community with deep sewer tunneling in rock, which has the potential to cause vibration and damage to buildings and structures in the Historic Clarksburg district. These impacts would be minimized by geotechnical monitoring, as discussed further in Section 4.4.2. With respect to long term community impacts, Alternative 6 would have the most significant impact, with six pump stations and associated periodic visits for monitoring and maintenance, fuel delivery, potential noise and odor issues, and disturbance during future upgrades to the pump station to maintain operability.

4.3 Evaluation Summary

4.3.1 Ranking of Alternatives Based on Evaluation Criteria

Table 4-10 provides a scoring of the alternatives relative to each evaluation criteria with 1 being the highest rank or lowest impact and 3 being the lowest rank or highest impact. Using an equal weight for all criteria, Alternatives 9 and 10 have the lowest scores, and are more favorable for selection.

Table 4-10 Ranking Based on Evaluation Criteria

Alternative	Cost	Reliability	Constructability	Engineering Impacts	Environmental Impacts	Community Impacts	Total Score
Alternative 3 – Gravity & 3 Pump Stations	2	1	3	1	3	2	**12**
Alternative 4 – Gravity & 4 Pump Stations	3	2	3	2	3	2	**15**
Alternative 5 – Gravity & 5 Pump Stations	2	3	2	3	2	2	**14**
Alternative 6 – Gravity & 6 Pump Stations	3	3	2	3	2	3	**16**
Alternative 7 – Gravity & 4 Pump Stations & Grinder Systems	3	2	2	2	1	2	**12**
Alternative 8 – Gravity & 5 Pump Stations	1	3	2	3	1	3	**13**
Alternative 9 – Gravity & 4 Pump Stations & Grinder Systems	2	2	2	2	1	2	**11**
Alternative 10 – Gravity & 4 Pump Stations & Grinder Systems	2	2	2	2	1	2	**11**

Lower score indicates higher ranking or smaller impact.

4.3.2 Advantages and Disadvantages

Table 4-11 summarizes the pros and cons of each of the alternatives evaluated.

Table 4-11 Advantages and Disadvantages of Alternatives

Alternative	Pros	Cons
Alternative 3 – Gravity & 3 Pump Stations	▪ Moderate cost ▪ Higher reliability ▪ Lower engineering concerns ▪ Moderate impact on community	▪ Higher constructability issues with gravity sewer tunnels under I-270 ▪ Higher environmental impacts due to higher relative number of stream crossings and sewers and force mains constructed in buffer zones
Alternative 4 – Gravity & 4 Pump Stations	▪ Moderate reliability ▪ Moderate engineering concerns ▪ Moderate impacts on community	▪ Higher cost ▪ Higher constructability issues with longer gravity sewers ▪ Higher impacts on the environment due to steam crossings and sewers and force mains constructed in the buffer zones
Alternative 5 – Gravity & 5 Pump Stations	▪ Moderate cost ▪ Moderate constructability issues ▪ Moderate environmental impacts	▪ Lower reliability due to need for continuous power and possible equipment issues at 5 pump stations ▪ Higher engineering concerns from operational and long term maintenance requirements ▪ Moderate long term impacts on community from periodic maintenance visits and potential noise and odor issues at 5 pump stations
Alternative 6 – Gravity & 6 Pump Stations	▪ Moderate constructability issues ▪ Moderate environmental impacts	▪ Higher cost ▪ Lower reliability due to need for continuous power and possible equipment issues at 6 pump stations ▪ Higher engineering concerns from operational and long term maintenance requirements for 6 pump stations ▪ Higher long term impacts on community from periodic maintenance visits and potential noise and odor issues at 6 pump stations
Alternative 7 – Gravity & 4 Pump Stations & Grinder Pump Systems	▪ Moderate constructability issues ▪ Lower environmental impacts	▪ Higher cost ▪ Moderate reliability due to need for continuous power and possible equipment issues at 4 pump stations and 383 grinder pumps ▪ Moderate engineering concerns from operational and long term maintenance requirements for 4 pump stations and 383 grinder pumps ▪ Moderate long term impacts on community from periodic maintenance visits and potential noise and odor issues at 4 pump stations, and homeowner nuisance for maintaining grinder pumps
Alternative 8 – Gravity & 5 Pump Stations	▪ Lower cost ▪ Moderate constructability issues ▪ Lower environmental impacts	▪ Lower reliability due to need for continuous power and possible equipment issues at 5 pump stations ▪ Higher engineering concerns from operational and long term maintenance requirements for 5 pump stations ▪ Higher long term impacts on community from periodic maintenance visits and potential noise and odor issues at 5 pump stations
Alternative 9 – Gravity & 4 Pump Stations & Grinder Pump Systems	▪ Moderate cost ▪ Moderate constructability issues ▪ Lower environmental impacts	▪ Moderate reliability due to need for continuous power and possible equipment issues at 4 pump stations and 284 grinder pumps ▪ Moderate engineering concerns from operational and long term maintenance requirements for 4 pump stations and 284 grinder pumps ▪ Moderate long term impacts on community from periodic maintenance visits and potential noise and odor issues at 4 pump stations, and homeowner nuisance for maintaining grinder pumps

Alternative 10 – Gravity & 4 Pump Stations & Grinder Pump Systems	▪ Moderate cost ▪ Moderate constructability issues ▪ Lower environmental impacts	▪ Moderate reliability due to need for continuous power and possible equipment issues at 4 pump stations and 284 grinder pumps ▪ Moderate engineering concerns from operational and long term maintenance requirements for 4 pump stations and 284 grinder pumps ▪ Moderate long term impacts on community from periodic maintenance visits and potential noise and odor issues at 4 pump stations, and homeowner nuisance for maintaining grinder pumps

4.4 Additional Considerations

4.4.1 Recent Force Main Failures in WSSC System

During this study, a major wastewater force main break occurred at the Olney PS. The Olney PS force main's length is approximately 9,300 feet of 18-inch and 20-inch diameter ductile iron pipe, and was constructed in 1992.

Three breaks with significant failures occurred on the Olney PS 20-inch force main:

- July 29, 2015 (460,320 gallons)
- July 30, 2015 (533,906 gallons)
- August 12, 2015 (110,880 gallons) and associated Olney PS overflow (159,911 gallons)

Repairs were completed to the force main immediately following the August 2015 failure. As of the completion of this report, the cause of the force main break has not been fully determined, but preliminary indications are that Hydrogen Sulfide generation in the force main contributed to these breaks.

During the Community Advisory Committees meetings, WSSC staff informed the CAC that three other wastewater force main breaks with significant failures have occurred recently in the Sanitary District:

- March 5, 2013 (2,028,000 gallons) - Reddy Branch PS, Montgomery County
- October 29, 2013 (269,325 gallons) - Reddy Branch PS, Montgomery County
- May 3, 2015 (15,000 gallons) - Forest Heights PS, Prince George's County

Overall, annual overflow volume is trending lower in WSSC's service area since the Commission entered into a Consent Decree with the Environmental Protection Agency, U.S. Department of Justice, Maryland Department of the Environment and various environment groups, but WSSC acknowledges that the impact of force main breaks to the community can be significant and the Commission is striving to improve.

Currently, wastewater force main design is coordinated with the design of new wastewater pump stations. Generally 'uphill' pumping is preferred (the force main discharge point elevation is greater than the pump station) in order to keep the force main under pressure. Additional design requirements include:

- Minimum force main sizing is 4 inches in diameter.

- Force main should be designed without intermediate high points.
- If intermediate high points cannot be eliminated or if the design requires long, relatively flat alignments, the design may require air release and air and vacuum valves.

Also, WSSC determines during force main design as to whether Hydrogen Sulfide corrosion mitigation is required:

- Design may require downstream manholes and pipeline sections in gravity system to have interior coatings.
- Analysis is required to determine potential for Hydrogen Sulfide generation into proposed or existing sewers (using Pomeroy's Equation).
- Pipe layout design should minimize sewage detention time in system (preferably no downhill pumping or high points in the alignment).
- Selection of pipe and structure material (coatings, PVC, HDPE) is important, if substantial Hydrogen Sulfide generation is predicted and design changes (slope, size) cannot prevent it.

Finally, WSSC has commenced an Asset Management program to determine when existing assets (buried, facilities or 'vertical' assets, etc.) should be repaired or replaced (e.g., asset useful life, consequence of failure). Force mains are a point of concern within the Asset Management Program. Emergency Response Plans (ERP) for 'high risk' force mains are being developed. The intent of the ERP is to help WSSC respond to a failure, if it does happen. Currently, WSSC is working on a force main prioritization project that will provide us with a ranking of those existing high risk force mains. WSSC is also conducting condition assessment on force mains when possible. Unfortunately, limited technology exists to execute inspections on these assets. Many force mains are very long and cannot be out of service for extended periods of time. Currently, a general emergency response plan for all WSSC force mains is in development. Specific, site- and location-based emergency response plans will be developed eventually for all wastewater pump stations and force mains. However, since the wastewater pump stations and force mains being considered in this study will be brand new facilities, the site- and location-based ERPs will likely be developed and implemented at a later time after the facilities are built.

Figure 4-1 provides a comparison of force main lengths for the proposed pump stations in the various alternatives with those of Olney, Reddy Branch and Forest heights pump stations.

Figure 4-2 provides a comparison of size (capacity) of the proposed pump stations in the various alternatives with those of Olney, Reddy Branch and Forest Heights pump stations.

As shown in Figures 4-1 and 4-2, most of the proposed pumping stations in the alternatives are smaller than Olney, Reddy Branch or Forest Heights pump stations.

4.4.2 Emergency Response Plans

WSSC has put in place a comprehensive emergency response plan for sanitary overflows from force main failures. The plan provides the Utility Management Group of WSSC with information regarding equipment and techniques that can be utilized for short term responses to contain, store, and recover sanitary overflows. The plan includes an overview of overflow response equipment and techniques such as drain covers, berms, dams, pits, trenches, containment booms, vacuum systems, collapsible

tanks and bladders and culvert blocking. The plan also provides a matrix with a recommended method of containment based on the overflow scenario, flow and its location.

WSSC is currently in the process of developing site specific emergency response plans for the forty seven existing force mains in the WSSC sanitary sewer system. WSSC is finalizing a ranking system for these existing force mains based on factors such as size, age, failure history, valve and pipeline inspections, environmental features impacted etc. This evaluation also includes a detailed analysis of likelihood and consequence of failure for the force mains. WSSC will develop site specific emergency response plans based on the ranking. A couple of site specific emergency response plans (Horsepen Branch PS and Bladensburg Pressure Sewer) have already been developed and will serve as a template for future plans. Eventually, all existing force mains will have a site specific emergency response plan developed by WSSC.

4.4.3 Geotechnical Considerations for Gravity Sewer Construction

Inherent in each of the alternatives is the construction of gravity sewers of varying lengths and depths. Deeper sewer construction is more likely to encounter bedrock, requiring methods other than open cut. Depending on the final selection of gravity sewer locations and depths, construction methods to overcome rock may include tunneling or controlled blasting, with tunneling likely having less noise and vibration impacts to the community than controlled blasting.

With any gravity sewer tunneling or controlled blasting construction project, pre and post inspections, and geotechnical and structural monitoring will be necessary, particularly in the Historic Clarksburg district, where buildings and foundations would be expected to be more impacted by tunneling or blasting vibrations. A typical geotechnical monitoring program would consider employing the following components:

- Pre and post construction inspections and videotaping to document conditions.
- Surface Settlement Points - fixed markers placed on ground surface for purpose of monitoring changes in elevations of ground and monitored by optical survey methods to determine vertical displacements.
- Inclinometers in Soil - instruments installed in a drilled hole in soil to monitor lateral movements of the ground.
- Multiple Point Borehole Extensometers - instruments installed in a drilled borehole to monitor ground deformation at multiple locations below the ground surface.
- Utility Monitoring Points - fixed markers placed on utilities for purpose of monitoring changes in elevations of existing utilities and monitored by optical survey methods to determine vertical displacements.
- Optical Survey Prisms - instruments installed on the face or ground surface of a structure or object to monitor horizontal and vertical movements during construction by precision optical survey methods.
- Seismographs - electronic recording device with vibration transducer capable of monitoring and recording ground vibrations induced by construction activity.

The specific monitoring program would be documented in the construction plans and specifications, and used to detect movement during construction, with values compared to pre-selected action levels. Readings would be collected on a regular basis (e.g., continuous, daily, weekly) and reported. Should action levels be exceeded, work would be stopped and adjustments to the construction approach required before proceeding, to minimize disturbance and damage to existing features.

4.5 Preferred Approach

This report documents the evaluation of alternatives that could potentially be implemented to provide sewer service to the Clarksburg Ten Mile Creek study area. Based on these evaluations, a Preferred Approach has been developed and presented in **Figure 4-3** and **Figure 4-4**.

Preferred Approach 'A' (Figure 4-3) assumes that Observation Drive is available to route the gravity sewer to Clarksburg Road. Preferred Approach 'B' (Figure 4-4) assumes that Observation Drive is not available, and instead, service will be accomplished via a yet to be constructed access road to the new development area, to direct flows to the Miles PS along Clarksburg Road. The Preferred Approach for each of the properties is summarized below:

- Pulte - gravity system to onsite Pulte PS with option to implement a 100% grinder pump solution (central area) and gravity system with partial grinder systems (north and south area)
- Egan/Mattlyn – low pressure sewer system to Egan PS (north area) and gravity system to Egan PS (south area)
- Miles/Coppola – gravity system to Miles PS
- Historic District – gravity system to Miles PS

The Preferred Approach would provide the best balance of cost, reliability, constructability, engineering impacts, environmental impacts and community impacts.

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Figure 4-1
Comparison of Forcemain Lengths

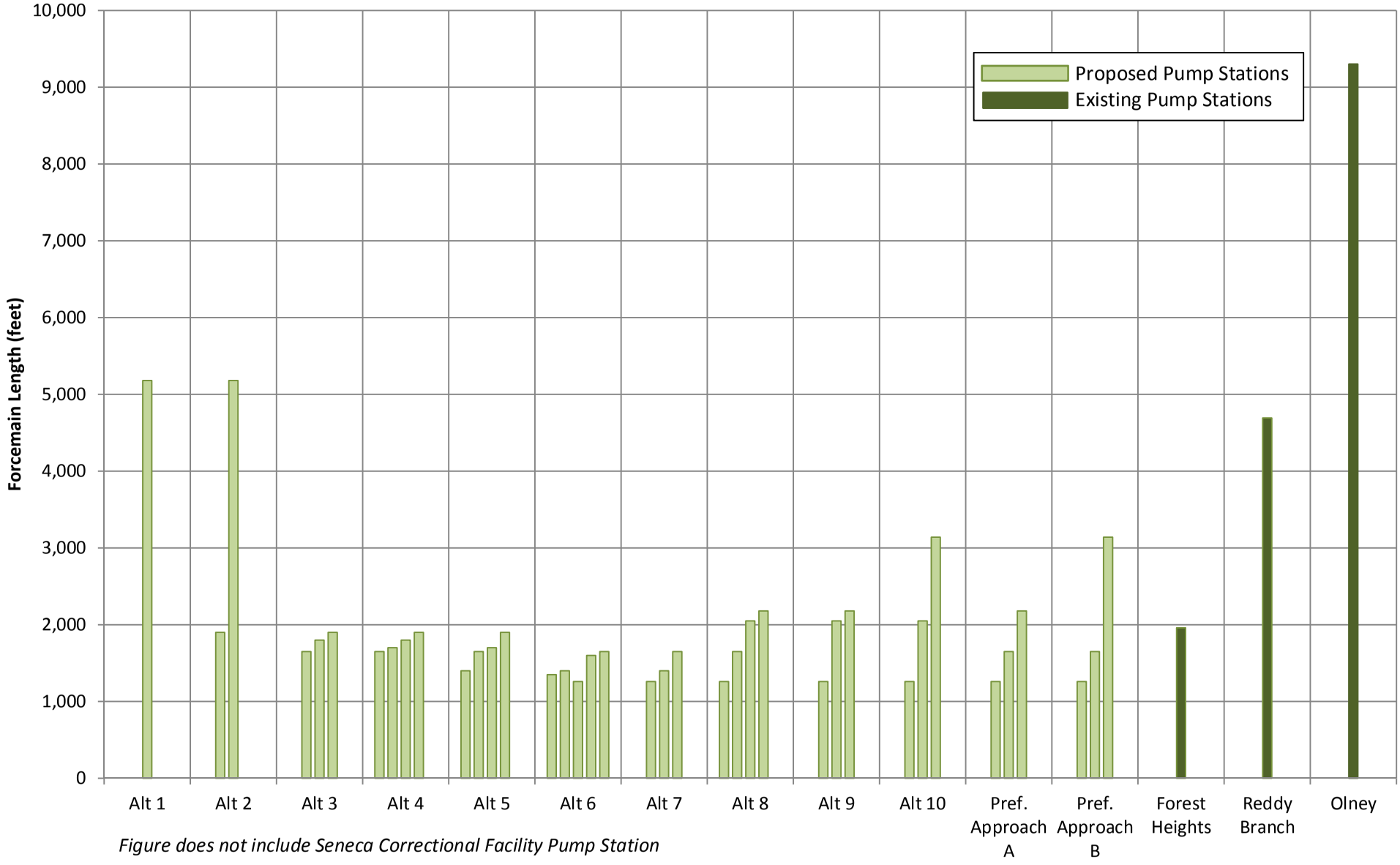


Figure does not include Seneca Correctional Facility Pump Station

Figure 4-2
Comparison of Pump Station Sizes

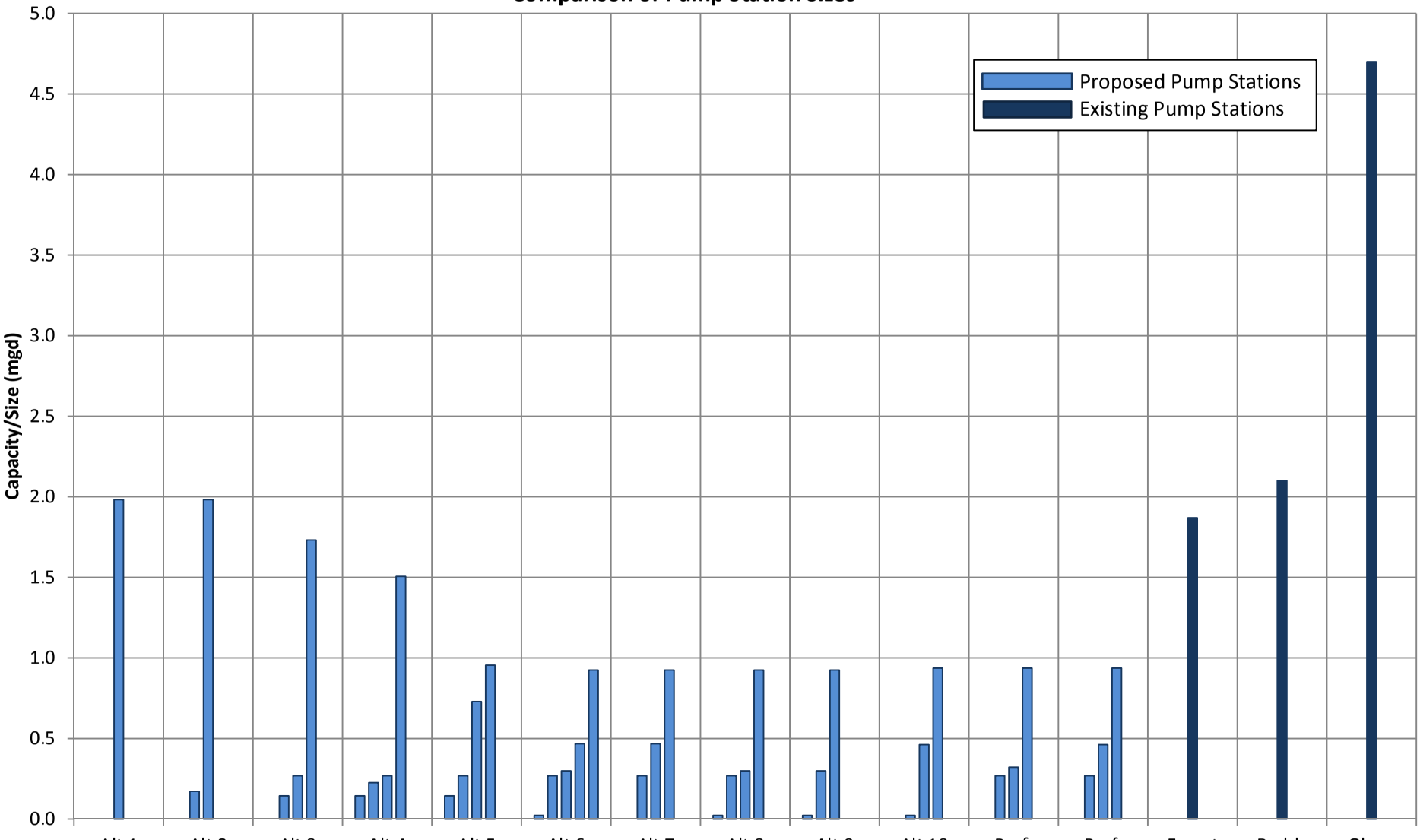
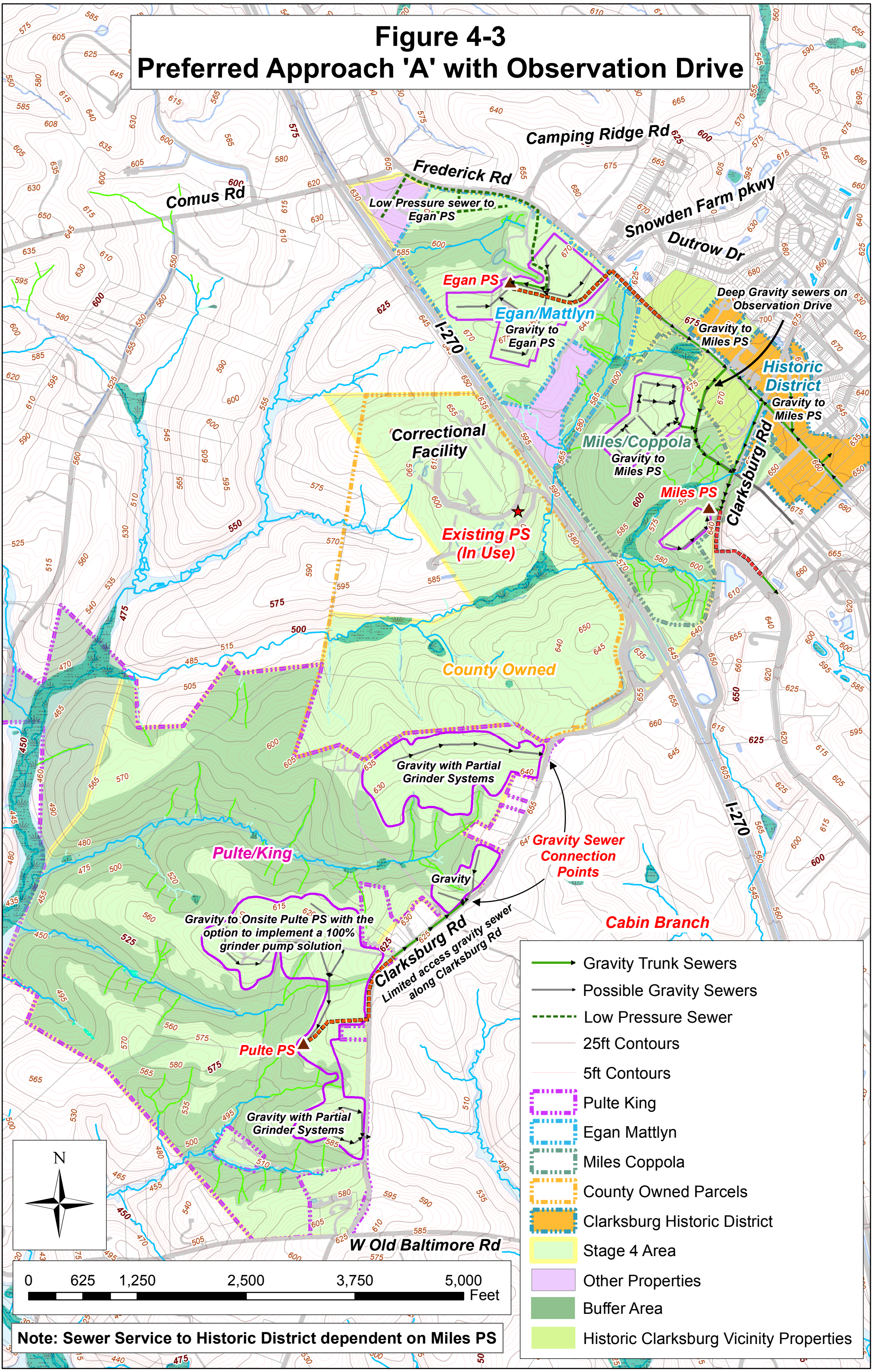


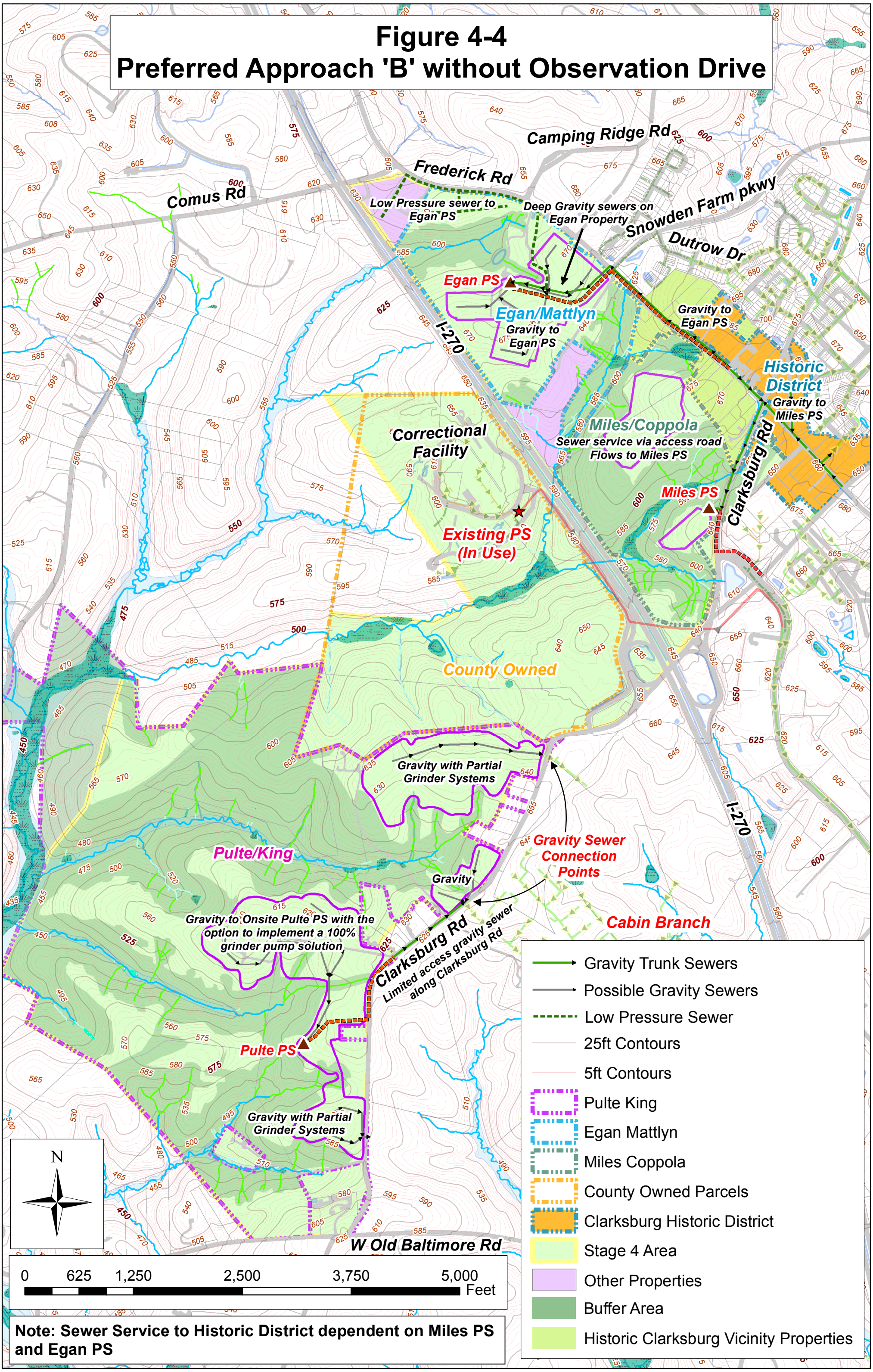
Figure does not include Seneca Correctional Facility Pump Station

Figure 4-3
Preferred Approach 'A' with Observation Drive



Note: Sewer Service to Historic District dependent on Miles PS

Figure 4-4
Preferred Approach 'B' without Observation Drive



Note: Sewer Service to Historic District dependent on Miles PS and Egan PS

APPENDIX A – FUTURE BASE SANITARY FLOW ESTIMATES DETAIL

Properties	Owner	Address	Tax ID	Size (acres)	Current Use	Proposed Zone	WSSC Wastewater Flow Factor (gpd/acre)	Daily Average Consumption DAC (gpd)	Base Sanitary Flow Estimate if developed under new zoning (gpd)
East of I-270									
3 Properties north of Egan/Mattlyn at the intersection of Comus Rd and MD355*	Dorothy Schaefer	14224 Comus Rd	00027657	1.11	Single Family Dwelling with outbuildings	R-200	420	-	466
	Potomac Conference Corp of Seventh Day Adventists	14210 Comus Rd	00018458	2.02	Conference Center	R-200	420	-	848
	Monacco Exclusive Renovation LLC	23820 Frederick Rd	00018174	6.12	House and Barns	R-200	420	-	2,570
Egan/Mattlyn	Mattlyn	23730 Frederick Rd	03441612	100.16	Residential/Barns (2,576 sqft)	R-90	750	-	51,909
Properties between Egan/Mattlyn and Miles/Coppola (3 Parcels near MD355)** Not in the Historic District	Coleen Culbertson	23540 Frederick Rd	00018881	0.58	Single family house (1,606 Sqft)	R-90	750	98	435
	Payne Family LLC	00000 Frederick Rd	00020508	2.90	Vacant	R-90	750	-	2,175
	Andre Paese	23530 Frederick Rd	00018846	0.23	Single family house (600 Sqft)	R-90	750	245	173
Properties between Egan/Mattlyn and Miles/Coppola (2 Parcels near I-270)***	Michael Redgrave	00000 Frederick Rd	00028162	6.23	Vacant, No access and in env. buffer	R-90	750	-	-
	Potomac Edison Co	00000 Frederick Rd	00027737	7.20	Electric Power substation	R-90	750	-	-
Miles/Coppola	Ardwin H Barsanti Rev Trust/Sandra D Cambell Et Al Trust	00000 Frederick Rd	00018824	5.00	Vacant	CRT 2.0, C2.0, R2.0, H 120	N/A	-	10,830
			00026128	93.54	Vacant	R-90	750	-	37,323
Clarksburg Historic District Vicinity (9 Parcels between Miles/Coppola and MD355)**** Not in the Historic District	Lawrence Musser	23506 Frederick Rd	00018857	0.60	2 Small buildings - Vacant	CRN 0.25, C0.25, R 0.25 H35	N/A	-	361
	Null	Null	U279767	0.60	Garage/Shed - Vacant	CRN 0.25, C0.25, R 0.25 H35	N/A	-	363
	L H Musser and sons	23500 Frederick Rd	00029623	0.93	Single Family Home (872 Sqft)	CRN 0.25, C0.25, R 0.25 H35	N/A	-	560
	Montgomery County	23420 Frederick Rd	00025716	2.08	Vacant	CRN 0.25, C0.25, R 0.25 H35	N/A	-	1,252
	Montgomery County	23410 Frederick Rd	00019395	3.06	Vacant	CRN 0.25, C0.25, R 0.25 H35	N/A	-	1,842
	Damascus Community Bank	23400 Frederick Rd	00016461	0.92	Commercial - bank (2892 Sqft)	CRN 0.25, C0.25, R 0.25 H35	N/A	1083	552
	Burge W Burkett Jr	00000 Frederick Rd	00017795	0.69	Vacant	CRN 0.25, C0.25, R 0.25 H35	N/A	-	415
	Bonnie W cooley & J F	23320 Clarksburg Rd	00030702	1.88	Single Family Home (1172 sqft)	CRN 0.25, C0.25, R 0.25 H35	N/A	98	1,130
	23300 Clarksburg Rd LLC	23300 Clarksburg Rd	00030713	0.71	Commercial - Gas station (3700 Sqft)	CRN 0.25, C0.25, R 0.25 H35	N/A	155	425
Clarksburg Historic District Vicinity (Other properties in the Historic Clarksburg District and Vicinity - East of Frederick Rd and North of the Historic District) *****	Carlisle J Maurice Jr & M A	23543 Frederick Rd	00029691	3.21	Vacant	CRT 0.75, C 0.25, R 0.5 H 65	N/A	-	4,631
	Puckett John C & M E	23535 Frederick Rd	00023466	0.56	Single Family Home (1,660 Sqft)	CRT 0.75, C 0.25, R 0.5 H 65	N/A	191	808
	Vu Chung D & Q T	23529 Frederick Rd	00030792	2.65	Vacant	CRT 0.75, C 0.25, R 0.5 H 65	N/A	-	3,823
	Le Duy Cong	00000 Frederick Rd	01926226	1.41	Vacant	CRT 0.75, C 0.25, R 0.5 H 65	N/A	-	2,034
	Le Duy Cong	23521 Frederick Rd	00030781	0.64	Single Family Home (1,480 Sqft)	CRT 0.75, C 0.25, R 0.5 H 65	N/A	245	923
Clarksburg Historic District	Clarksburg United Methodist	23419 Spire St	00018870	0.42	Church (924 Sqft)	CRT 0.5, C 0.5, R 0.5, H 45	N/A	5	505
	Hart Briget Kline &	23411 Spire St	00029942	0.52	Single Family Home (924 Sqft)	CRT 0.5, C 0.5, R 0.5, H 45	N/A	124	626
	Watkins William K & B L	23314 Frederick Rd	00030347	0.53	Single Family Home (990 Sqft)	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	641
	Potomac Holdings LLC	23200 Stringtown Rd	00018436	3.80	Vacant (1,352 Sqft)	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	4,573
	Aries Investment Group LLC	23329 Frederick Rd	00027316	0.82	Grocery / Deli (1,374 Sqft)	CRT 0.5, C 0.5, R 0.5, H 45	N/A	218	987
	Haddad Lana &	23415 Spire St	00019522	0.38	Single Family Home (1,415 Sqft)	CRT 0.5, C 0.5, R 0.5, H 45	N/A	109	454
	Muller Ebba H	23356 Frederick Rd	00026722	0.36	Single Family Home (1,652 Sqft)	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	431
	Espinoza Albert M & Dawn M	23345 Frederick Rd	00022267	0.46	Single Family Home (1,698 Sqft)	CRT 0.5, C 0.5, R 0.5, H 45	N/A	91	554
	Modjarrad Amir H Et Al	23321 Frederick Rd	00024404	0.48	Post Office (1,724 Sqft)	CRT 0.5, C 0.5, R 0.5, H 45	N/A	79	582
	Amaya Julio C & R L	23360 Frederick Rd	00030677	0.41	Single Family Home (1,728 Sqft)	CRT 0.5, C 0.5, R 0.5, H 45	N/A	171	492
	Nguyen Phuong Et Al	23515 Frederick Rd	00021387	3.89	Single Family Home (2,114 Sqft)	CRT 0.5, C 0.5, R 0.5, H 45	N/A	245	4,681
	Nnp Ii - Clarksburg LLC	23330 Frederick Rd	00021684	1.37	Single Family Home (2,560 Sqft)	CRT 0.5, C 0.5, R 0.5, H 45	N/A	245	1,643
	Lewis Nichole	23341 Frederick Rd	00024255	0.14	Commercial (2,868 Sqft)	CRT 0.5, C 0.5, R 0.5, H 45	N/A	78	172
	Randall Albert B & L M	23340 Frederick Rd	00020771	0.86	Single Family Home (3,510 Sqft)	CRT 0.5, C 0.5, R 0.5, H 45	N/A	203	1,035

APPENDIX A – FUTURE BASE SANITARY FLOW ESTIMATES DETAIL

	Hamerhill LLC	23310 Frederick Rd	00021673	2.83	Single Family Home (3,688 Sqft)	CRT 0.5, C 0.5, R 0.5, H 45	N/A	9	3,405
	M E Church North	23425 Spire St	00026048	1.91	Church / Cemetery	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	2,298
	Ben Lewis Real Estate LLC	23425 Frederick Rd	00021013	1.73	Retail - Other	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	2,082
	Ben Lewis Real Estate LLC	23421 Frederick Rd	00028127	0.47	Retail - Other	CRT 0.5, C 0.5, R 0.5, H 45	N/A	11	562
	Ben Lewis Real Estate LLC	23415 Frederick Rd	00019431	1.50	Retail - Other	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	1,805
	Conley Thomas W Et Al Tr	23407 Frederick Rd	00018642	1.65	Retail - Other	CRT 0.5, C 0.5, R 0.5, H 45	N/A	1020	1,986
	Montgomery County Maryland	23365 Frederick Rd	00018675	0.93	Vacant	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	1,119
	Ashley Wallace T & A J	23346 Frederick Rd	00022371	0.53	Single Family Home	CRT 0.5, C 0.5, R 0.5, H 45	N/A	70	635
	Montgomery County	23311 Frederick Rd	00030930	1.16	Vacant	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	1,396
	Montgomery County Maryland	21411 Spire Sd	00017807	0.95	Vacant	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	1,143
	Rudden Jerry N Et Al	00000 Stringtown Rd	03410212	0.35	Vacant	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	421
	Natelli Clarksburg LLC	00000 Frederick Rd	00020350	0.39	Vacant	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	471
Clarksburg Historic District	Mullen Laura L Et Al	00000 Frederick Rd	00026697	0.74	Vacant	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	890
	Natelli Clarksburg LLC	00000 Frederick Rd	00020372	0.89	Vacant	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	1,076
	Pleasants W D Sr & W D Jr	00000 Frederick Rd	00027681	1.15	Vacant	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	1,384
	Aries Investment Group LLC	00000 Frederick Rd	00027327	0.01	Vacant	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	10
	Darby Rodney H & A T	00000 Frederick Rd	00019008	0.59	Vacant	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	711
	Montgomery County Maryland	00000 Frederick Rd	00027670	0.20	Vacant	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	239
	Hardisty John T	00000 Frederick Rd	00027908	0.15	Vacant	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	182
	Montgomery County Maryland	00000 Frederick Rd	00027668	0.63	Vacant	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	762
	Woojung Inc	00000 Frederick Rd	00021365	0.80	Vacant	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	963
	Montgomery County Md	00000 Frederick Rd	03612240	0.53	Vacant	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	639
	Buffington Enterprises Ii LLC	23315 Frederick Rd	03678967	0.91	Retail	CRT 0.5, C 0.5, R 0.5, H 45	N/A	1810	-
	Darby Rodney H & A T	00000 Frederick Rd	03436901	0.41	Vacant	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	492
	Ferguson/Anderson L L C	00000 Frederick Rd	00023535	1.15	Vacant	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	1,384
	Clarksburg Meth Ch Tr	00000 Clarksburg Rd	00018482	0.55	Vacant	CRT 0.5, C 0.5, R 0.5, H 45	N/A	-	662
One-acre Wright property east of MD121 near the intersection with Gateway Center Drive	Ralph E Wright & JA	00000 Clarksburg Rd	00019156	1.17	Vacant	CRT 2.0, C 2.0, R 2.0, H 120	N/A	-	2,529
West of I-270									
	Shiloh farm Investments LLC	Null	00016871	67.47	Vacant	RNC (Rural Neighborhood Cluster)	N/A	-	
	Pulte Home Corp	Null	00019203	1.57	Single Family (1414 Sqft)	RNC (Rural Neighborhood Cluster)	N/A	-	
	King John R Jr Et Al	Null	00023012	69.59	Vacant	RNC (Rural Neighborhood Cluster)	N/A	-	
	King John R Jr Et Al	Null	00023023	51.75	Vacant	RNC (Rural Neighborhood Cluster)	N/A	-	
Pulte King Properties	King John R Jr Et Al	Null	00023034	0.90	Vacant	RNC (Rural Neighborhood Cluster)	N/A	-	
	King John R Jr Et Al	Null	00023045	16.38	Vacant	RNC (Rural Neighborhood Cluster)	N/A	-	
	Shiloh farm Investments LLC	Null	00028845	230.11	Mostly Vacant (Single Family - 1,664 sqft)	RNC (Rural Neighborhood Cluster)	N/A	-	
	Shiloh farm Investments LLC	Null	00029565	43.50	Vacant	RNC (Rural Neighborhood Cluster)	N/A	-	
	Shiloh farm Investments LLC	Null	01592550	59.60	Vacant	RNC (Rural Neighborhood Cluster)	N/A	-	94,237

*Three properties all zoned R-200. Amendment eliminated the potential to use a planned development zone. Parcels currently have single family houses and barns. No proposed development.

**Of the three parcels (zoned R-90) near MD355, the two smaller parcels currently have a single family home while the largest parcel is vacant.

***Even though these parcels are zoned R-90, they may not be suitable for future development. One parcel (owned by Michael Redgrave) has no access and is located in an enviromental buffer, while the other (owned by Potomac Edison Co) currently houses an electric substation.

****9 Parcels (5-Vacant, 2-Residential and 2-commercial) are all rezoned CRN 0.25, C 0.25, R0.25, H35.

*****5 Parcels (3-Vacant, 2-Residential) are all rezoned CRT 0.75, C 0.75, R0.25, H65.

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