COUNTY OF FAIRFAX

Department of Public Works and Environmental Services

TYSONS WASTEWATER CONVEYANCE SYSTEM MODIFICATIONS

Preliminary Engineering Report

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CDM Smith

Table of Contents

Section 1 Introduction 1-1
1.1 Background 1-1
1.2 Purpose 1-1
1.3 Existing System Description 1-2
1.3.1 Existing Pump Station 1-2
1.3.2 Existing Force Main 1-2
1.3.3 Existing Gravity Main 1-4
1.4 Anticipated/Future Design Flows 1-4
1.4.1 Design Flows 1-4
1.4.2 Design Flow Phasing 1-5
1.5 Applicable Regulations, Standards, Codes, and Guidelines 1-7
1.5.1 Virginia Sewage Collection and Treatment Regulations 1-10

Section 2 Proposed Site Design 2-1
2.1 Existing Site Conditions 2-1
2.1.1 Site History 2-1
2.1.2 Site Access 2-1
2.1.3 Topography 2-2
2.1.4 Site Drainage and Stormwater Management 2-5
2.1.5 Overhead Clearance and Electrical Service 2-5
2.1.6 RPA, Wetlands, and Floodplain 2-5
2.2 Proposed Pump Station Site Layout 2-6
2.2.1 Site Access 2-9
2.2.2 Proposed Utility Connections 2-9
2.2.3 Special Design Criteria 2-9
2.2.3.1 Tysons Urban Design Guidelines 2-10
2.2.3.2 VA DEQ Dulles Watershed Emergency Retention Storage Requirements 2-10
2.2.4 Neighborhood Integration – Aesthetics, Noise, and Lighting 2-14
2.2.5 Security 2-14
2.3 Environmental Assessment 2-15
2.4 Construction Phasing 2-15
2.4.1 Influent Flow Control 2-16
2.5 Preliminary Geotechnical Assessment 2-16
2.5.1 Regional Geology 2-16
2.5.2 Preliminary Geotechnical Evaluation 2-17
2.5.3 Proposed Geotechnical Investigation Program 2-17

Section 3 Pump Station Design Criteria 3-1
3.1 Introduction 3-1
3.2 Pump Station Configuration 3-1
3.2.1 Influent Manhole 3-1
3.2.2 Grinder Vault 3-4
3.2.3 Wet Well Design 3-5
3.2.4 Dry Well Design 3-6

3.2.5 Pump Selection and Force Main Considerations 3-6
3.2.6 Maintenance Room 3-18
3.2.7 Odor Control 3-18
3.2.7.1 Design Considerations 3-18
3.2.7.2 Carbon Adsorption Systems 3-19
3.2.7.3 Biological Systems 3-20
3.2.7.4 Installation Requirements 3-22
3.2.7.4.1 Civil/Structural 3-22
3.2.7.4.2 Electrical 3-22
3.2.7.4.3 Instrumentation and Control 3-23
3.2.7.5 Recommended Odor Control Treatment System 3-23
3.2.8 Wet Well Bypass 3-23
3.2.9 Flow Metering 3-24
3.2.10 Pump Station Modeling 3-24
3.3 Pump Station Implementation 3-25
3.4 Future Capacity Upgrades 3-26

Section 4 Gravity Sewer Routing 4-1
4.1 Introduction 4-1
4.2 Gravity Sewer Alignment Alternatives 4-1
4.2.1 General Assumptions 4-4
4.2.2 Route Alternative-1 4-4
4.2.2.1 Topography for Alternative-1 4-5
4.2.3 Route Alternative-2 4-5
4.2.3.1 Topography for Alternative-2 4-5
4.2.4 Route Alternative-3 4-5
4.2.4.1 Topography for Alternative-3 4-6
4.2.5 Route Alternative-4 4-6
4.2.5.1 Topography for Alternative-4 4-7
4.2.6 Route Alternative-5 4-7
4.2.6.1 Topography for Alternative-5 4-8
4.2.7 Route Alternative-6 4-8
4.2.7.1 Topography for Alternative 6A and Alternative 6B 4-12
4.3 Qualitative Evaluation of Alternatives 4-16
4.4 Quantitative Evaluation Criteria 4-18
4.4.1 Facilitate Expansion of the Current Pump Station Service Area 4-18
4.4.2 Relative Costs 4-18
4.4.3 Commercial/Residential Property Owners Impacts 4-19
4.4.4 Traffic Impacts 4-19
4.4.5 Environmental Impacts 4-19
4.4.6 Permitting 4-20
4.4.7 Constructability 4-20
4.4.8 Access/Operations and Maintenance 4-20
4.4.9 Utility Conflicts 4-20
4.4.10 Easements 4-21
4.4.11 Evaluation Criteria Weighting 4-21

4.5 Route Alternatives Analysis Recommendations 4-21
4.5.1 Recommended Alternative 4-23
4.6 Difficult Run Interceptor Diversion Structure 4-23

Section 5 Force Main Sewer Routing Analysis 5-1
5.1 Introduction 5-1
5.2 Description of the Proposed Force Main Alignments 5-1
5.2.1 Alternative 1 5-1
5.2.1.1 Summary of Potential Physical Constraints for Alternative 1 5-4
5.2.1.2 Topography for Alternative 1 5-6
5.2.2 Route Alternative 2 5-8
5.2.2.1 Summary of Potential Physical Constraints for Alternative 2 5-10
5.2.2.2 Topography for Alternative 2 5-13
5.2.3 Route Alternative 3 5-16
5.2.3.1 Summary of Potential Physical Constraints for Alternative 3 5-19
5.2.3.2 Topography for Alternative 3 5-21
5.2.4 Route Alternative 4 5-25
5.2.4.1 Summary of Potential Physical Constraints for Alternative 4 5-27
5.2.4.2 Topography for Alternative 4 5-28
5.2.5 Route Alternative 5 5-30
5.2.5.1 Summary of Potential Physical Constraints for Alternative 5 5-32
5.2.5.2 Topography for Alternative 5 5-32
5.2.6 Route Alternative 6 5-34
5.2.6.1 Summary of Potential Physical Constraints for Alternative 6 5-36
5.2.6.2 Topography for Alternative 6 5-37
5.2.7 Router Alternative 7 5-39
5.2.7.1 Summary of Potential Physical Constraints for Alternative 7 5-41
5.2.7.2 Topography for Alternative 7 5-42
5.2.8 Overall Figure of Potential Alternative Routings 5-44
5.3 Qualitative Evaluation of Alternatives 5-46
5.4 Quantitative Evaluation Criteria 5-48
5.4.1 Force Main Routing Through Vienna 5-48
5.4.2 Commercial/Residential Property Owners Impacts 5-48
5.4.3 Traffic Impacts 5-49
5.4.4 Environmental Impacts 5-49
5.4.5 Permitting 5-49
5.4.6 Constructability 5-49
5.4.7 Access/Operation and Maintenance 5-49
5.4.8 Utility Conflicts 5-50
5.4.9 Easements 5-50
5.4.10 Hydraulic Considerations 5-50
5.4.11 Relative Costs 5-50
5.4.12 Scoring Definitions 5-51
5.4.13 Evaluation Criteria Weighting 5-52
5.5 Route Alternatives Analysis Recommendations 5-52
5.5.1 Recommended Alternative 5-54

5.6 Preliminary Force Main Surge Analysis 5-44
5.6.1 Surge Analysis 5-44
5.6.2 Conclusions and Recommended Improvements 5-46

Section 6 Architectural Design Criteria 6-1
6.1 Architectural 6-1
6.1.1 Building Aesthetics 6-1
6.1.2 Code Analysis 6-2
6.1.3 Space Requirements 6-2
6.1.4 Building Design 6-4
6.1.4.1 Exterior Walls 6-4
6.1.4.2 Exterior Doors and Louvers 6-5
6.1.4.3 Roofs 6-5
6.1.4.4 Floors 6-5
6.1.4.5 Interior Walls 6-5
6.1.4.6 Ceilings 6-5
6.1.4.7 Interior Doors 6-5
6.1.4.8 Hardware 6-5
6.1.4.9 Accessibility Design Criteria 6-5

Section 7 Structural Design Criteria 7-1
7.1 Structural Description 7-1
7.2 Design Loads 7-2
7.2.1 Scope 7-2
7.2.2 Dead Loads 7-2
7.2.3 Live Loads 7-2
7.2.3.1 Uniform Live Loads 7-2
7.2.3.2 Equipment Loads 7-3
7.2.3.3 Impact Loads 7-3
7.2.4 Environmental Loads 7-3
7.2.4.1 Snow, Rainwater, and Ice Loads 7-3
7.2.4.2 Wind Loads 7-4
7.2.4.3 Seismic Loads 7-4
7.2.5 Process Liquid Loads 7-4
7.2.6 External Earth and Groundwater Loads 7-5
7.2.6.1 Design Grade Elevation 7-5
7.2.6.2 Design Groundwater Elevation 7-5
7.2.6.3 Groundwater Pressures 7-5
7.2.6.4 Lateral Soil and Groundwater Pressures 7-5
7.2.7 Combination of Loads 7-6
7.2.7.1 General 7-6
7.2.7.2 Liquid Containing or Below grade Structures 7-6
7.3 Foundation Design 7-7
7.3.1 Scope 7-7
7.3.2 Geotechnical Report 7-7
7.3.3 Frost Protection 7-7
7.3.4 Shallow Foundation Support 7-7

7.3.5 Buoyancy 7-7
7.4 Concrete Design 7-8
7.4.1 Scope 7-8
7.4.2 General Criteria 7-8
7.4.2.1 Codes and Standards 7-8
7.4.2.2 Materials and Design Strengths 7-8
7.4.2.3 Design Methods 7-9
7.5 Masonry Design 7-9
7.5.1 Scope 7-9
7.5.2 General Criteria 7-9
7.5.2.1 Codes and Standards 7-9
7.5.2.2 Materials and Design Strengths 7-9
7.5.2.3 Design Methods 7-10
7.6 Structural Metal Design 7-10
7.6.1 Scope 7-10
7.6.2 General Criteria 7-10
7.6.2.1 Codes and Standards 7-10
7.6.2.2 Materials and Design Strengths 7-10
7.6.2.3 Design Methods 7-11

Section 8 Electrical Design Criteria 8-1
8.1 Codes and Standards 8-1
8.2 Hazardous Area Classification 8-1
8.3 Electrical Distribution System 8-2
8.3.1 Load Analysis 8-2
8.3.2 Proposed Pump Station Electrical System 8-3
8.4 Electrical Design Concepts 8-6
8.4.1 Electrical Design Capacity 8-6
8.4.2 Utilization Voltages 8-6
8.4.3 Voltage Drop 8-6
8.5 Life Safety 8-6
8.6 Grounding System 8-7
8.7 Electrical System Analysis 8-7
8.7.1 Preliminary Analysis 8-7
8.7.2 Final Analysis (Short Circuit, Selective Coordination, and Arc Flash Analysis) 8-7
8.8 Equipment and Materials 8-7
8.8.1 Low Voltage Switchboard 8-8
8.8.2 Power Monitoring 8-8
8.8.3 Panelboards 8-8
8.8.4 Variable Frequency Drives(VFD) 8-8
8.8.5 Automatic Transfer Switches 8-9
8.8.6 General Purpose Dry-Type Transformers 8-9
8.8.7 Enclosure 8-9
8.8.8 Raceways 8-9
8.8.9 Wires 8-10
8.8.10 Underground Systems 8-11

8.9 Motors ... 8-11
8.9.1 General ... 8-11
8.9.2 Monitoring Devices for Process Motors ... 8-11
8.9.3 Motor Protection and Control ... 8-11
8.10 Lighting ... 8-12
8.10.1 General Requirements ... 8-12
8.10.2 Lighting Calculations ... 8-12
8.10.3 Lighting Illumination Levels ... 8-12
8.10.4 Circuiting and Switching ... 8-13
8.10.5 Emergency Lighting System ... 8-13
8.10.6 Damp Atmosphere Luminaires ... 8-13
8.11 Standby Power Systems ... 8-13
8.11.1 Generator Fuel Systems ... 8-13
8.11.2 Load Banks ... 8-15
8.12 Special Plant Systems ... 8-15
8.12.1 Fire Alarm System ... 8-15
8.12.2 Security System ... 8-15
8.12.3 Access Control ... 8-16
8.12.4 Lightning Protection ... 8-16

Section 9 Building Mechanical ... 9-1
9.1 Heating, Ventilating, and Air Conditioning (HVAC) ... 9-1
9.1.1 NFPA 820 and SCAT Analysis ... 9-1
9.1.1.1 Facility Description ... 9-1
9.1.1.2 NFPA 820 Requirements ... 9-1
9.1.1.3 SCAT Requirements ... 9-5
9.1.1.4 HVAC Design Criteria – Wet Well, Flow Splitter Box, and Grinder Vault ... 9-5
9.1.1.5 Design Criteria – Dry Well ... 9-6
9.1.2 USBC/International Mechanical Code Analysis ... 9-7
9.1.2.1 Electrical Room ... 9-7
9.1.2.2 Generator Room ... 9-7
9.1.2.3 Maintenance Room ... 9-8
9.1.2.4 Toilet Room and Janitor's Closet ... 9-8
9.1.3 HVAC Equipment and Materials ... 9-8
9.2 Plumbing ... 9-9
9.2.1 Plumbing Design Criteria ... 9-9
9.2.1.1 Sanitary Sewer System ... 9-10
9.2.1.2 Stormwater System ... 9-10
9.2.1.3 Water Systems ... 9-10
9.2.1.4 Natural Gas Systems ... 9-11
9.2.2 Plumbing Fixtures, Equipment, and Materials ... 9-11
9.3 Fire Protection ... 9-11

Section 10 Automation Design Criteria ... 10-1
10.1 Automation System ... 10-1
10.2 General Design Guidelines ... 10-1
10.2.1 General ... 10-1

10.2.2 Instrumentation 10-2
10.2.3 Valves and Gates 10-2
10.2.4 Pumps and Motors 10-3
10.2.5 PLC 10-3
10.3 Control Hierarchy 10-4
10.4 Control Philosophy 10-4

Section 11 Probable Construction Cost 11-1

11.1 Cost Estimate Basis 11-1

Section 12 Schedule 12-1

12.1 Project Schedule 12-1

List of Figures

Figure 1-1 Tysons Dodge Pump Station Service Area ... 1-3
Figure 1-2 Tysons West Pump Station Process Flow Diagram ... 1-6
Figure 2-1 Proposed Property for Pump Station ... 2-3
Figure 2-2 Topographic Map of Tysons West Area ... 2-4
Figure 2-3 Proposed Site Layout for Pump Station ... 2-8
Figure 2-4 24-Hour Retention Conceptual Layout ... 2-13
Figure 3-1 Floor Plans ... 3-2
Figure 3-2 Building Sections ... 3-3
Figure 3-3 Example of a Channel Monster Flex Grinder System by JWC Environmental and Manually Cleaned Bar Rack ... 3-5
Figure 3-4 Velocity Profile for Three Different Force Main Diameter Alternatives ... 3-9
Figure 3-5 Residence Time Profile for Three Different Force Main Diameter Alternatives ... 3-10
Figure 3-6 Total Dynamic Head Profile for Three Force Main Diameter Alternatives ... 3-11
Figure 3-7 Specific Energy Profile for Three Different Force Main Diameter Alternatives ... 3-12
Figure 3-8 Operating Costs Profile for Three Different Force Main Diameter Alternatives ... 3-13
Figure 3-9 Preliminary Pump and System Curves with One Pump in Operation ... 3-15
Figure 3-10 Preliminary Pump and System Curves with Two Pumps in Operation ... 3-16
Figure 3-11 Preliminary Pump and System Curves with Three Pumps in Operation ... 3-17
Figure 3-12 Parallel Bed Carbon Adsorber (Courtesy of Purafil) ... 3-20
Figure 3-13 Biotrickling Filter (Courtesy of BioAir Solutions) ... 3-21
Figure 4-1 Tysons West Gravity Sewer Alternatives ... 4-3
Figure 4-2 Tysons West Gravity Sewer Alternative – 6B ... 4-10
Figure 4-3 Approximate Location of Trenchless Crossing Under Leesburg Pike ... 4-11
Figure 4-4 View of Vesper Trail Looking Northeast ... 4-11
Figure 4-5 Grade Elevation for Alternative 6 Route Upstream Segment A and Downstream Segment ... 4-13
Figure 4-6 Grade Elevation for Alternative 6 Route Upstream Segment B ... 4-14
Figure 4-7 Grade Elevation for Alternative 6 Route Westwood Center Drive Segment ... 4-15
Figure 5-1 Tysons West PS Force Main Alternative - 1 ... 5-3
Figure 5-2 Residential Area and Offices Along Greensboro Drive ... 5-4
Figure 5-3 Metropolitan Office and Commercial Areas Along Greensboro Drive ... 5-5
Figure 5-4 Approximate Location of Chain Bridge Road/Maple Avenue Trenchless Crossing ... 5-5
Figure 5-5 High Volume Traffic on Chain Bridge Road/Maple Avenue ... 5-5
Figure 5-6 High Volume Traffic on Chain Bridge/Maple Avenue ... 5-6
Figure 5-7 Grade Elevation for Alternative 1 Route ... 5-7
Figure 5-8 Tysons West PS Force Main Alternative - 2 ... 5-9
Figure 5-9 Approximate Location of Trenchless Crossing (Leesburg Pike) ... 5-10
Figure 5-10 Approximate Location of Trenchless Installation Pit West of Leesburg Pike ... 5-11
Figure 5-11 Approximate Location of Trenchless Installation Pit East of Leesburg Pike ... 5-11
Figure 5-12 Sheraton Tyson Hotel Access Along Ashgrove Lane (Alternative 2A) ... 5-11
Figure 5-13 Westwood Village Condominium Residential Community Entrance on Ashgrove Lane ... 5-12

Figure 5-14 Spring Hill Metro Station Across from Leesburg Pike Alignment Pathway (Alt 2B) 5-12
Figure 5-15 Washington and Old Dominion Trail Crossing at Chain Bridge Road/ Maple Avenue 5-12
Figure 5-16 Alternative 2A..... 5-14
Figure 5-17 Alternative 2B..... 5-15
Figure 5-18 Tysons West PS Force Main Alternative - 3 5-18
Figure 5-19 Forested Area Near Drewlaine Drive 5-19
Figure 5-20 View of Forested Area from Abbotsford Drive (Alternative 3C) 5-20
Figure 5-21 Wolftrap Elementary School Along Beulah Road (Alternative 3C) 5-20
Figure 5-22 Approximate Location of Parking Lot Crossing in Madison High School (Downstream Segment) 5-20
Figure 5-23 Alternative 3A..... 5-22
Figure 5-24 Alternative 3B..... 5-23
Figure 5-25 Alternative 3C..... 5-24
Figure 5-26 Tysons West PS Force Main Alternative - 4 5-26
Figure 5-27 Approximate Location of Fairfax County Department of Transportation Property on Beulah Road 5-27
Figure 5-28 Flint Hill Elementary School Along Flint Hill Road..... 5-27
Figure 5-29 Alternative 4..... 5-29
Figure 5-30 Tysons West PS Force Main Alternative – 5 5-31
Figure 5-31 Alternative 5..... 5-33
Figure 5-32 Tysons West PS Force Main Alternative - 6 5-35
Figure 5-33 Potential Property Crossing Off Old Courthouse Road to Directly Rout the Force Main to Abbotsford Drive 5-36
Figure 5-34 View from Abbottsford Drive Looking East Across the Washington and Old Dominion Trail 5-36
Figure 5-35 Alternative 6..... 5-38
Figure 5-36 Tysons West PS Force Main Alternative - 7 5-40
Figure 5-37 Route 66 with At Grade Washington Metropolitan Area Transit Authority Metro Tracks (Looking Toward Cedar Lane Overpass) 5-41
Figure 5-38 Lee Highway to the South of Route 66..... 5-41
Figure 5-39 Alternative 7..... 5-43
Figure 5-40 Tysons West PS Force Main Alternatives 5-45
Figure 6-1 Pump Station Building Perspective View..... 6-1
Figure 6-2 Example of Potential Anti-Climb Security Fencing 6-2
Figure 6-3 Pump Station Building Layout 6-3
Figure 6-4 Pump Station Building South Elevation 6-4
Figure 6-5 Building Elevations..... 6-7
Figure 6-6 Perspective Views 6-8
Figure 8-1 Proposed Electrical Site Plan..... 8-4
Figure 8-2 One-Line Diagram..... 8-5
Figure 10-1 Pump Station P&ID..... 10-6

List of Tables

Table 1-1 Projected Design Flows for Tysons West Pump Station 1-5
Table 1-2 Virginia SCAT Regulations Applicable to the TWPS 1-10
Table 3-1 Grinder Design Criteria 3-5
Table 3-2 Pump Design Criteria 3-7
Table 3-3 Alternative Force Main Diameter Evaluation Results Summary 3-8
Table 3-4 Odor Control Design Criteria 3-19
Table 3-5 Carbon Adsorber Equipment Specifications 3-20
Table 3-6 Biotrickling Filter Equipment Specifications 3-22
Table 3-7 Odor Control Concrete Pad Dimensions 3-22
Table 3-8 Odor Control Estimated Energy Use 3-23
Table 3-9 Benefits of Enterprise Virtual Design and Construction 3-25
Table 3-10 Summary of Anticipated Flows with Force Main Velocity and Required Pumps 3-26
Table 4-1 Gravity Sewer Routing Alternatives Qualitative Evaluation 4-17
Table 4-2 Evaluation Criteria Weights 4-21
Table4-3 Gravity Sewer Routing Alternatives Quantitative Evaluation and Ranking 4-22
Table 5-1 Force Main Routing Alternatives Evaluation 5-47
Table 5-2 Screening Level Scoring Summary Table 5-51
Table 5-3 Evaluation Criteria Weights 5-52
Table 5-4 Force Main Routing Alternatives Quantitative Evaluation and Ranking 5-53
Table 6-1 Architectural Program Space Requirements 6-4
Table 8-1 Electrical Area Classifications 8-2
Table 8-2 Preliminary Operating Load Summary 8-2
Table 8-3 Illumination Levels 8-12
Table 9-1 Summary of NFPA 820 Table 4.2.2 Requirements 9-2
Table 11-1 AACE Class 4 Summary of OPCC 11-2
Table 12-1 Preliminary Project Schedule 12-2

Appendices

Appendix A Tysons West Gravity Routing
Appendix B Tysons Basin Expansion Memo

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Section 1
Introduction

1.1 Background

Tysons is a rapidly developing metropolitan community located along the Capital Beltway in the northeastern portion of Fairfax County. The northwestern portion of Tysons is currently occupied by a number of populated neighborhoods with numerous one- and two-story industrial/commercial buildings (car dealerships, auto repair centers, storage facilities, etc.). By 2055 this portion of Tysons will be transformed into a walkable, highly livable, urban center with as many as 100,000 residents and up to 200,000 people commuting to the area for work. This transformation will result in the redevelopment of many of the one-story commercial buildings, many of which will become multipurpose, high-rise buildings within the next decade.

As outlined in the Fairfax County Comprehensive Plan, this swift development will require upgrades to the existing wastewater conveyance system to provide additional wastewater pumping and conveyance capacity. Even with a potential rehabilitation or expansion, the condition and capacity of the existing Tysons Dodge Pump Station (TDPS) preclude it from meeting future wastewater demands and the Potomac Interceptor that receives flows from the TDPS does not have the capacity to accept the additional future flows. A new, larger pump station, the Tysons West Pump Station (TWPS), must be constructed to collect and convey wastewater to the Noman M. Cole Jr. Pollution Control Plant (NMCPCP).

1.2 Purpose

The purpose of this Preliminary Engineering Report (PER) is to provide a summary of the existing conditions; justification for the proposed wastewater conveyance system and pump station improvements; basic design criteria and components of the proposed new pump station, gravity main, and force main; proposed construction schedule; and Opinion of Probable Construction Cost (OPCC). The PER addresses the following topics from the scope of services:

- Requirements of 9VAC25-790-940 (various sections)
- Existing data (Section 1.3)
- Flow analysis (Section 1.4)
- Pump sizing and selection (Section 3.2.5)
- Pump station configuration (Section 3.2)
- Pump station phasing (Section 3.3)
- Construction phasing (Section 3.3)
- Preliminary design drawings (various sections)

- Discussion on pump station modeling (Section 3.2.10)
- Flow projections (Section 1.4.2)
- Surge analysis (Section 5)
- Three-dimensional (3D) renderings (Section 6)
- Project costs (Section 11)
- Project schedule (Section 12)

1.3 Existing System Description

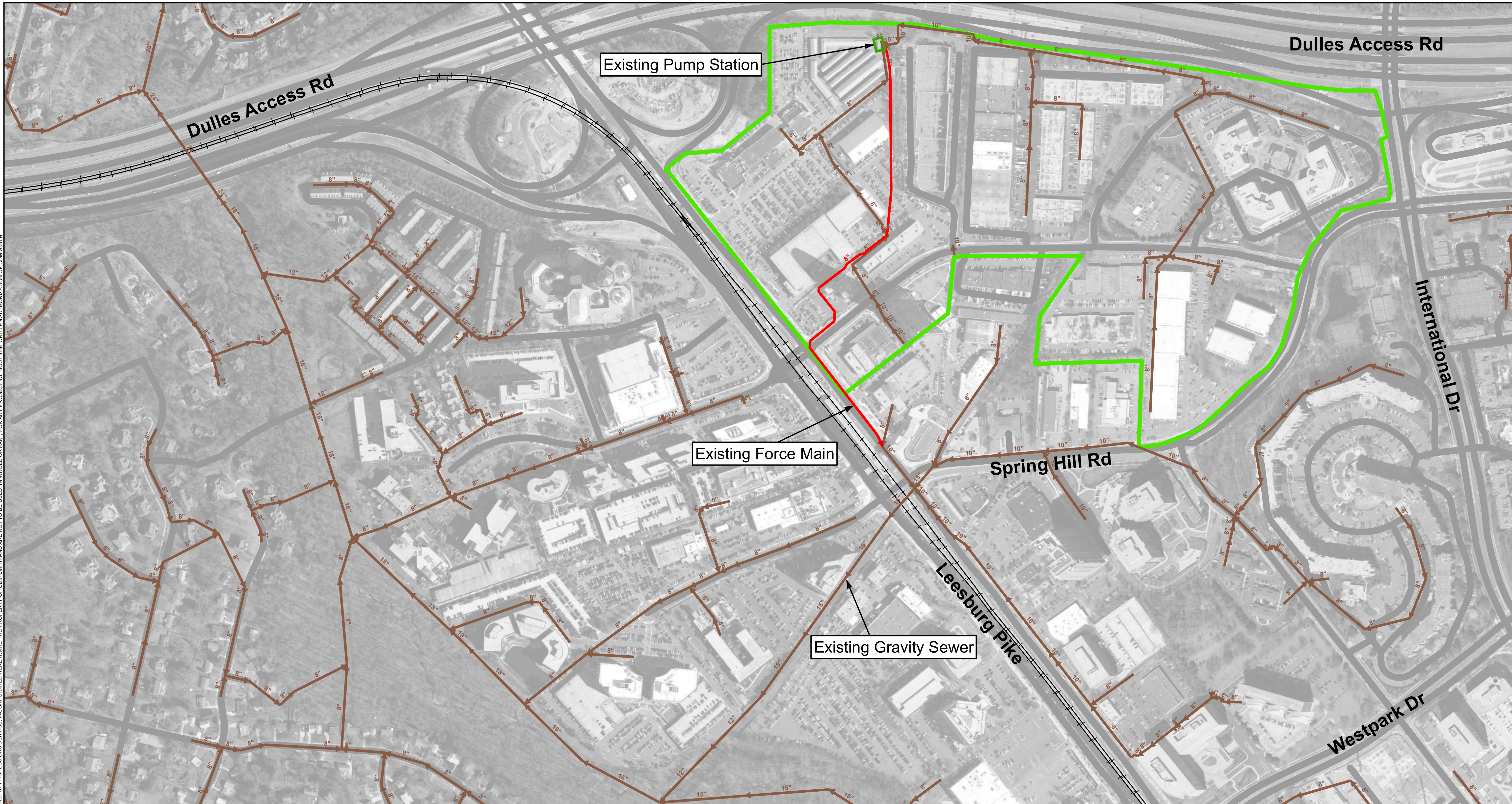
1.3.1 Existing Pump Station

TDPS is located near the intersection of the Dulles Toll Road and Route 7 (Leesburg Pike), and it services the northwestern portion of Tysons, outlined in **Figure 1-1**. The 52-year-old pump station is a 1 million gallons-per-day (mgd) submersible pump station with a below-ground wet well, two 40-horsepower (hp) pumps, a prefabricated control building, a 125-killowatt (kW) standby generator, and an external fuel storage tank. TDPS will be decommissioned and demolished as part of the construction of the new, larger TWPS. Section 2 includes the existing site details.

1.3.2 Existing Force Main

The TDPS force main consists of an 8-inch (in.) cast iron pipe that is approximately 2,200 feet (ft) long. The force main travels southeast from the pump station along Route 7 to the intersection of Spring Hill Road and Leesburg Pike, where it discharges into an existing 10-in. gravity main.

Fairfax County determined the force main was in poor condition and needs replacement when the need to convey additional flows was identified. The replacement was put on hold once the County identified the need to increase the capacity of the Tysons wastewater conveyance system.



Legend

- Force Main
- Gravity Sewer
- Existing Tysons Dodge Pump Station Location
- Existing Tysons Dodge Pump Station Sewer Service Area

0 375 750 1,500 *Feet*

Figure No. 1-1
Tysons Dodge Pump Station Service Area
March 2021

1.3.3 Existing Gravity Main

The existing 10-in. gravity sewer receives flow from the existing 8-in. force main starting at the intersection of Spring Hill Road and Route 7 and then:

- Expands to 15 in. in diameter as it combines with several other gravity sewers
- Crosses under Leesburg Pike at the elevated Spring Hill Metrorail Station
- Runs along the recently completed Vesper Trail near the Dominion Energy main transmission line
- Continues down the trail where it transitions into an 18-in. gravity sewer before it turns north and follows the Old Courthouse Spring Branch stream to the Dulles Toll Road
- Transitions into a 24-in. gravity sewer while crossing under the Dulles Toll Road, where it enters the Wolf Trap area of Fairfax County
- Reduces in diameter from 24 to 21 in. in the Wolf Trap area, then further reduces to 18 in. after crossing Jarret Valley Drive
- Discharges into a 21-in. gravity sewer when entering the Wolf Trap National Park for the Performing Arts
- Alternates between 21 and 24 in. along Wolf Trap Run and then transitions into a 30-in. main before increasing to 42 in. in diameter as it crosses Leesburg Pike near the intersection with Faulkner Drive
- Continues along Difficult Run, alternating between 54 and 66 in. in diameter until it discharges into an existing 78-in. gravity sewer that crosses the Potomac River into Maryland

1.4 Anticipated/Future Design Flows

1.4.1 Design Flows

Based on the Tysons Corner Sanitary Sewer Capacity Evaluation (Carollo Engineers 2020), the TWPS has a design capacity of 25 mgd peak wet weather (PWW) flow based on the following received flows shown in **Figure 1-2**:

- Up to 10 mgd from the proposed Tysons East Pump Station (TEPS)
- 10 mgd of flow from the Difficult Run Interceptor
- Up to 5 mgd from the local Tysons West sanitary sewer service area

The local Tysons West sanitary sewer service area is expected to be expanded as part of the construction of the new gravity main. **Appendix B** provides a discussion of the proposed sewer basin expansion. Section 4 includes details on the proposed gravity main and discussion on the alternative gravity main alignments proposed and evaluated as part of this PER.

1.4.2 Design Flow Phasing

The rate that flows will increase to the 25-mgd peak flow condition is dependent on development in the Tysons West area and Tysons East area. Growth in Tysons East is anticipated to be quicker than in Tysons West; however, the rate of growth in both areas may be slowed by the COVID-19 pandemic. It will be important to monitor the rate of development and resulting flow to TWPS to inform pump station phasing decisions.

TWPS will be constructed and commissioned around 2025. The following is anticipated:

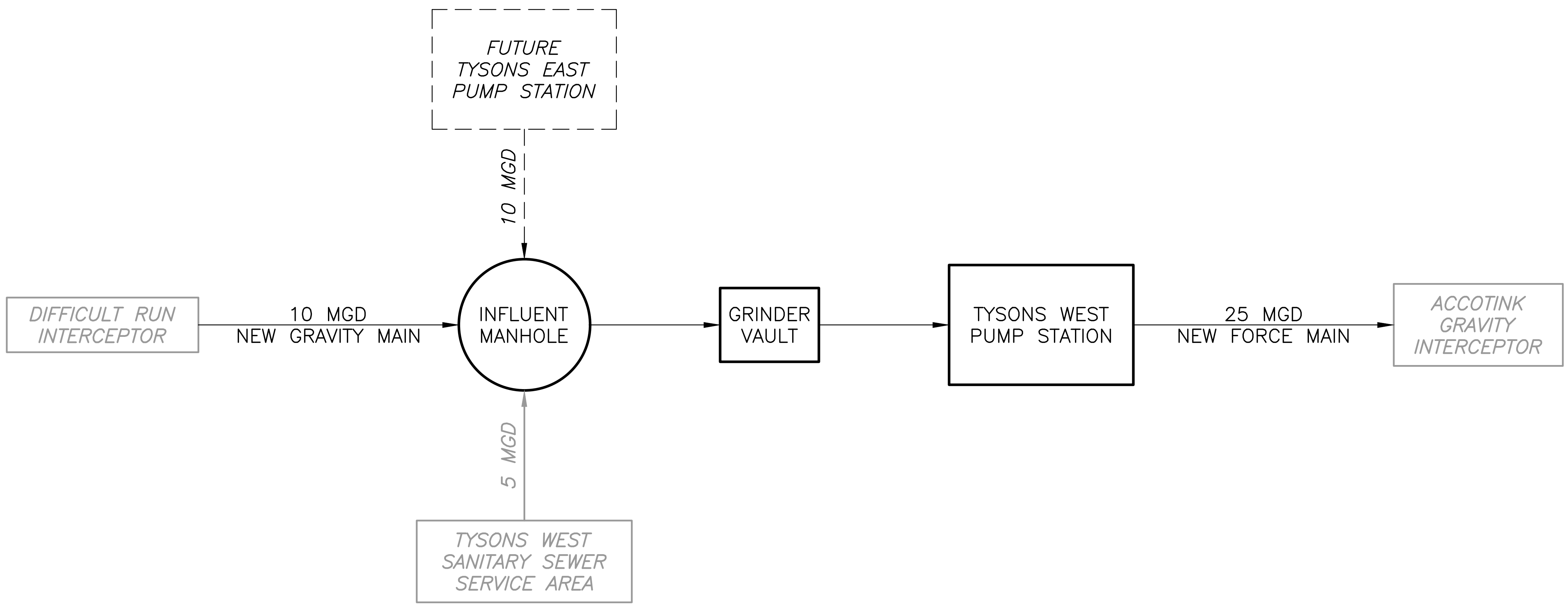
- During the initial operation of TWPS, 10 mgd of flow will be diverted from the Difficult Run Interceptor and approximately 1 mgd of PWW flow will come from the local Tysons West area, resulting in about 11 mgd of PWW flow. Flows from the local Tysons West area would be diverted from the existing TDPS as part of the commissioning process for the TWPS.
- The average daily flows (ADF) will be approximately 5 mgd initially, which is considerably lower than the PWW flows.
- TEPS and the force main to TWPS will be constructed and commissioned by 2027.
- Flows from TEPS will result in a total PWW flow and ADF of 15 mgd and 7 mgd, respectively, for the TWPS by 2027.
- Flows to TWPS will continue to increase and approach the ultimate design capacity of 25 mgd PWW and 12 mgd ADF as Tysons West and Tysons East areas continue to develop.
- Flows from TEPS and the Difficult Run Interceptor will be controlled to minimize peaking factors to 2.1. The primary source of peaking flows will be from the local TWPS sewershed

Table 1-1 summarizes the design flows for TWPS.

Table 1-1: Projected Design Flows for Tysons West Pump Station

Year		
	Average Daily	Peak Wet Weather
2025	5	11
2027	7	15
Buildout (2045)	12	25

Source: 50-Percent PER Discussion Meeting Summary December 1, 2020



CDM Smith

Figure No. 1-2
Process Flow Diagram
JANUARY 2021

1.5 Applicable Regulations, Standards, Codes, and Guidelines

The TWPS design will conform to the latest applicable guidelines, standards, and codes, as follows:

- Fairfax County Department of Public Works and Environmental Services (DPWES) *Wastewater Guidelines for Architects and Engineers*, Volume 2, Facility Design Manual
- Fairfax County *Public Facilities Manual*, including Article 10-0100: Sanitary Sewer Design Criteria
- American National Standards institute (ANSI)/Hydraulic Institute (HI)
- *The Virginia Uniform Statewide Building Code (USBC)*
  - *2015 Virginia Construction Code (USBC Part 1)*
  - *2015 International Building Code*
  - *2015 International Mechanical Code*
  - *2015 International Plumbing Code*
  - *2015 International Fuel Gas Code*

2015 International Energy Conservation Code with Virginia Amendments (Climate Zone 4a)

- *2015 Virginia Statewide Fire Prevention Code* (SFPC)
- 2010 Americans with Disabilities Act Accessibility Guidelines (ADAAG)
- Occupational Safety and Health Administration (OSHA)
- *National Electrical Safety Code* (NESC)
- National Fire Protection Association (NFPA) Codes and Standards
  - NFPA 13, *Standard for the Installation of Sprinkler Systems*
  - NFPA 30, *Flammable and Combustible Liquids Code*
  - NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*
  - NFPA 70, *National Electrical Code* (NEC 2014 Edition)
  - NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*
  - NFPA 101, *Life Safety Code*
  - NFPA 110, *Standard for Emergency and Standby Power Systems*

- NFPA 820, *Standard for Fire Protection in Wastewater Treatment and Collection Facilities*
- Other Applicable NFPA Standards

The following is a listing of the organizations with codes and standards that also will be used during the design:

- AA – The Aluminum Association
  - ADM1 – 2015 – *Aluminum Design Manual*: Part 1 – A Specification for Aluminum Structures
- ACI – American Concrete Institute
  - ACI 318-14 – *Building Code Requirements for Structural Concrete*
  - ACI 350-06 – Code Requirements for Environmental Engineering Concrete Structures
  - ACI 350.3-06 – *Seismic Design of Liquid-Containing Concrete Structures*
- AISC – American Institute of Steel Construction
  - AISC 360-10 – *Specification for Structural Steel Buildings*
  - AISC 341-10 – *Seismic Provisions for Structural Steel Buildings*
  - AISC *Detailing for Steel Construction*
  - AISC *Steel Construction Manual*, 14th Edition
- AISI – American Iron and Steel Institute
  - AISI S100-12 – *North American Specification for the Design of Cold-Formed Steel Structural Members*, 2012
- ASCE 7-10 – *Minimum Design Loads for Buildings and Other Structures*
- ASCE 8-02 – *Specification for the Design of Cold-Formed Stainless Steel Structural Members*
- AWS – American Welding Society
  - ANSI/AWS D1.1 – *Structural Welding Code – Steel*
  - ANSI/AWS D1.2 – *Structural Welding Code – Aluminum*
  - ANSI/AWS D1.6 – *Structural Welding Code – Stainless Steel*
- PCI – Precast/Prestressed Concrete Institute
  - *PCI Design Handbook*

- SDI – Steel Deck Institute
  - SDI 31 – *Design Manual for Composite Decks, Form Decks and Roof Decks*
- TMS – The Masonry Society
  - TMS 402-13/ACI 530-13/American Society of Civil Engineers (ASCE) 5-13 – *Building Code Requirements for Masonry Structures*
  - TMS 602-13/ACI 530.1-13/ASCE 6-13 – *Specification for Masonry Structures*
- American Society of Heating, Refrigeration and Air Conditioning (ASHRAE) Handbooks
- Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Duct Manuals
- Air Moving and Conditioning Association (AMCA)
- Air Conditioning and Refrigeration Institute (ARI)
- American National Standards Institute (ANSI)
- Institute of Electrical and Electronics Engineers (IEEE)
- Insulated Cable Engineers Association (ICEA)
- Illuminating Engineering Society (IES) *The Lighting Handbook*
- International Electrical Testing Association (NETA)
- National Electrical Manufacturers Association (NEMA)
- Underwriters Laboratories (UL)

UL 508 – *Industrial Control Equipment*

- Factory Mutual (FM)
- International Society of Automation (ISA)

ISA S5.1 – *Instrumentation Symbols and Identification*

ISA S5.2 – *Binary Logic Diagrams for Process Operations*

ISA S5.3 – *Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems*

ISA S5.4 – *Instrument Loop Diagrams*

ISA S5.5 – *Graphic Symbols for Process Displays*

ISA S20 – *Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves*

ISA RP60.6 – *Nameplates, Labels, and Tags for Control Centers*

1.5.1 Virginia Sewage Collection and Treatment Regulations

The design of the TWPS improvements will be in accordance with the latest version of the Virginia Sewer Collection and Treatment (SCAT) Regulations, 9 VAC 25-790. Part III, Article 1 addresses the specific requirements for collection and conveyance sewers. Part III, Article 2 addresses the specific requirements for sewage pumping stations. **Table 1-2** provides a summary of the SCAT Regulations applicable to TWPS.

TWPS upgrades will be performed in accordance with a Reliability Classification of Class I. This classification applies to pump stations whose location or discharge is sufficiently close to residences, public water supply sources, or recreational waters such that permanent or unacceptable damage could occur to the receiving waters or public health and welfare if normal operations were interrupted.

Table 1-2: Virginia Sewer Collection and Treatment Regulations Applicable to the Tysons Water Pump Station

Citation	Impacts
9 VAC 25-790-380. Sewage Pumping	▪ Mechanical and electrical equipment should be physically located above the 100-year flood elevation, or otherwise protected against damage. ▪ At least two pumps should be provided, each capable of handling flows 2½ times ADF. ▪ Pump suction and discharge piping should not be less than 4 in. in diameter. ▪ Design velocity should not exceed 8 feet per second (ft/sec) in the discharge piping. ▪ Provisions should be made to automatically alternate the pumps in use (lead-lag operation). ▪ Water supply should include a reduced pressure zone backflow prevention device. ▪ Wet well size and control settings should be designed and operated to avoid heat buildup from frequent starting, and to avoid septic conditions due to excessive detention time.
9 VAC 25-790-390. Reliability	▪ Reliability protection should prevent discharge of raw sewage to any waters, and to protect public health and welfare by preventing sewage backup to basements, streets, and other public and private property. ▪ Class I reliability is the provision for alternate motive forces sufficient to operate the pump station at peak flow rates within the time period that would result in overflow or backup. ▪ Class II reliability is the classification for alternative motive forces within 24 hours of overflow or backup. ▪ Class III reliability is not limited to a specific period of overflow or backup, determined on a case-by-case basis. ▪ Continuous operability should be met on a 24-hour basis, including provisions for alternate power sources or an auxiliary standby generator that can operate sufficient pumps to deliver the design peak flow.
9 VAC 25-790-400. Pumping Equipment	▪ Electric switchgear and motor control centers should be housed above grade and in a separate area. ▪ Three-phase motors and their starters should be protected from electrical overload and short circuits. ▪ Motors should have a low-voltage protection device.

Citation	Impacts
9 VAC 25-790-420. Alarm Systems	▪ Alarm systems for a Class I reliability system should monitor power supply to station, auxiliary power source, failure of pumps to discharge liquid, and high liquid levels in the wet well. ▪ A backup power supply should be provided for the alarm system.
9 VAC 25-790-430. Alternatives	▪ Submersible pumps should provide for disconnecting, removing, and reconnecting without requiring personnel to enter the wet well. ▪ Electrical controls should be located in a suitable housing for protection against weather and vandalism. ▪ Shut-off and check valves on pump discharge lines (>25 gallons per minute [gpm]) should be located in a separate vault outside the wet well.
9 VAC 25-790-440. Force Mains	▪ Force mains should be a minimum of 4 in. in diameter. ▪ Minimum self-scouring velocity of 2 ft/sec should be maintained, and a velocity of 8 ft/sec should not be exceeded. ▪ Air relief valves should be placed at force main high points to relieve air locking.

Section 2

Proposed Site Design

2.1 Existing Site Conditions

As shown in **Figure 2-1**, the pump station site is northwest of Tysons Corner, adjacent to the crossing of Route 7 and Route 267 (which includes the Dulles Toll Road and Dulles Access Road) along Industrial Way. The existing pump station is in an easement of a 3-acre property currently used as a self-storage facility. Fairfax County is considering purchasing the 3 acres of land to construct a new pump station facility near the existing Tysons Dodge Pump Station (TDPS).

This location was selected because it allows for the collection of flows from the existing basin using the existing collection system piping, the proposed new gravity main from the Difficult Run Interceptor (see **Section 4** for additional details), and the future Tysons East Pump Station (TEPS). Additionally, the site offers easy access to Route 267 and Route 7, which may be particularly valuable to other entities within the County that may be using the portions of the site not used by the new pump station (i.e., the Fairfax County Department of Transportation).

The site is zoned as I-4 (medium intensity industrial use) according to the Fairfax County Department of Tax Administration and is neither a historic site nor located in a floodplain. According to Fairfax County Zoning Ordinance, 15 percent (%) of the gross site area must be designed as open space. There are no side or rear building setback restrictions; however, there is a 40-foot (ft) front yard setback requirement that could be waived or reduced through a Fairfax County Board of Zoning Appeals approval process. The front, side, and rear of the site must be controlled by a 45-degree angle of bulk plane. There is a 2,239-square ft stream buffer around the concrete drainage ditch on the eastern side of the site. The maximum building height is 75 ft.

2.1.1 Site History

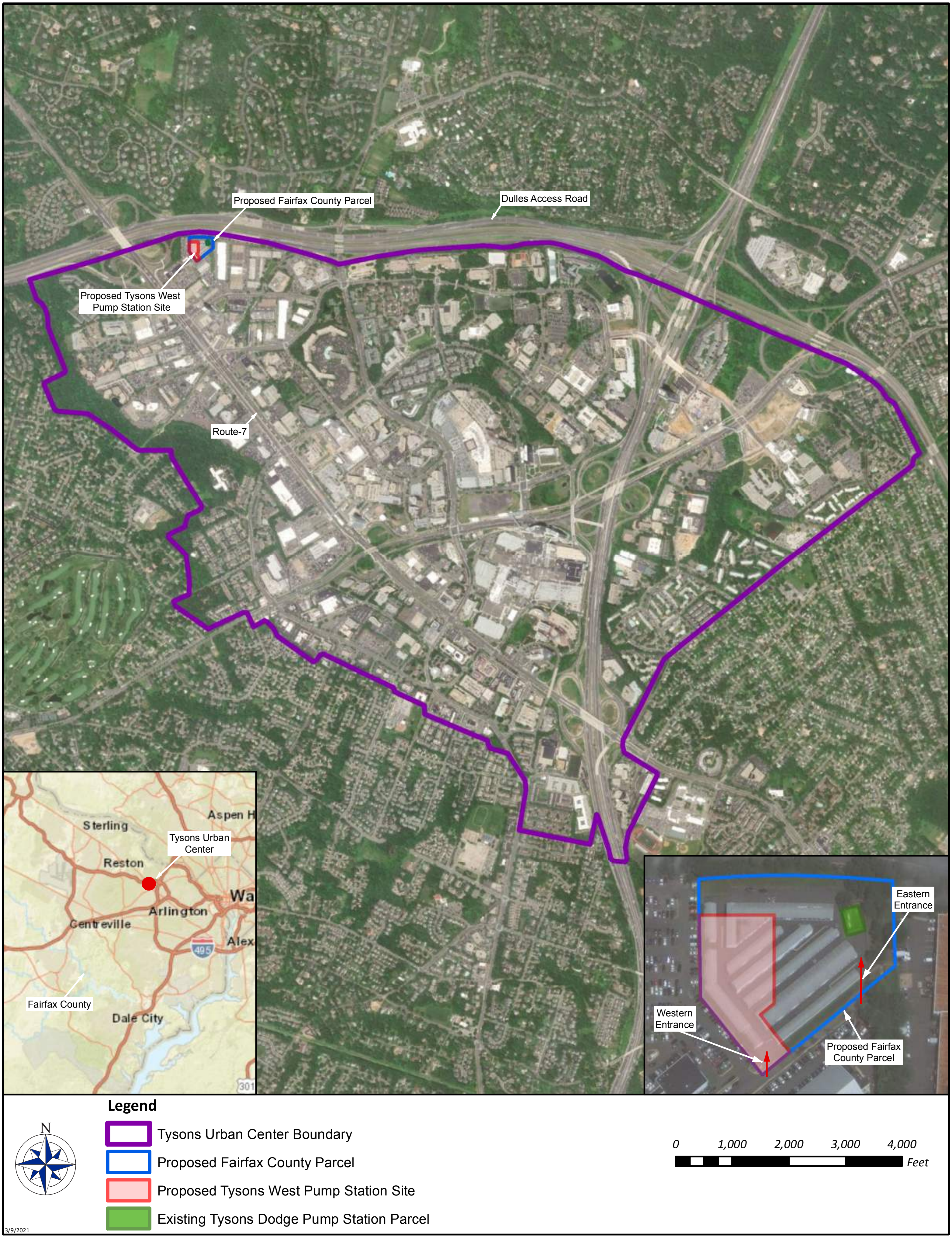
The site (Tax Map Number 029-1-01-0011) is owned by Tysons Self Storage (TMS Limited Partnership), which purchased the property in 1979 from Chrysler Realty Corporation. In 1993, Manor Investment Company purchased 40% of the limited partnership interests. According to the Fairfax County tax records, the site has been used for miscellaneous storage facilities since 1979. There is limited information on the property prior to 1979. The site was sold by private property owners to Chrysler Realty Corporation in 1967; prior to that, it was owned by various other private property owners dating back to 1907. The property use(s) prior to 1979 cannot be determined from the available tax record and deed information.

2.1.2 Site Access

Currently, the site is accessed from two locations along Industrial Way. The western, gate-controlled entrance provides access to Tysons Self Storage. The eastern entrance, which is also controlled by a gate, provides access to the storage facility and the pump station. There is no pedestrian access. TDPS record drawings indicate there is an existing right-of-way and easement from Route 7 down Industrial Way.

2.1.3 Topography

As shown in **Figure 2-2**, the site generally slopes at 1.5% from the highest point (elevation of approximately 364 ft) at the southwest corner to the lowest point (elevation approximately 358 ft) in the northeast corner.



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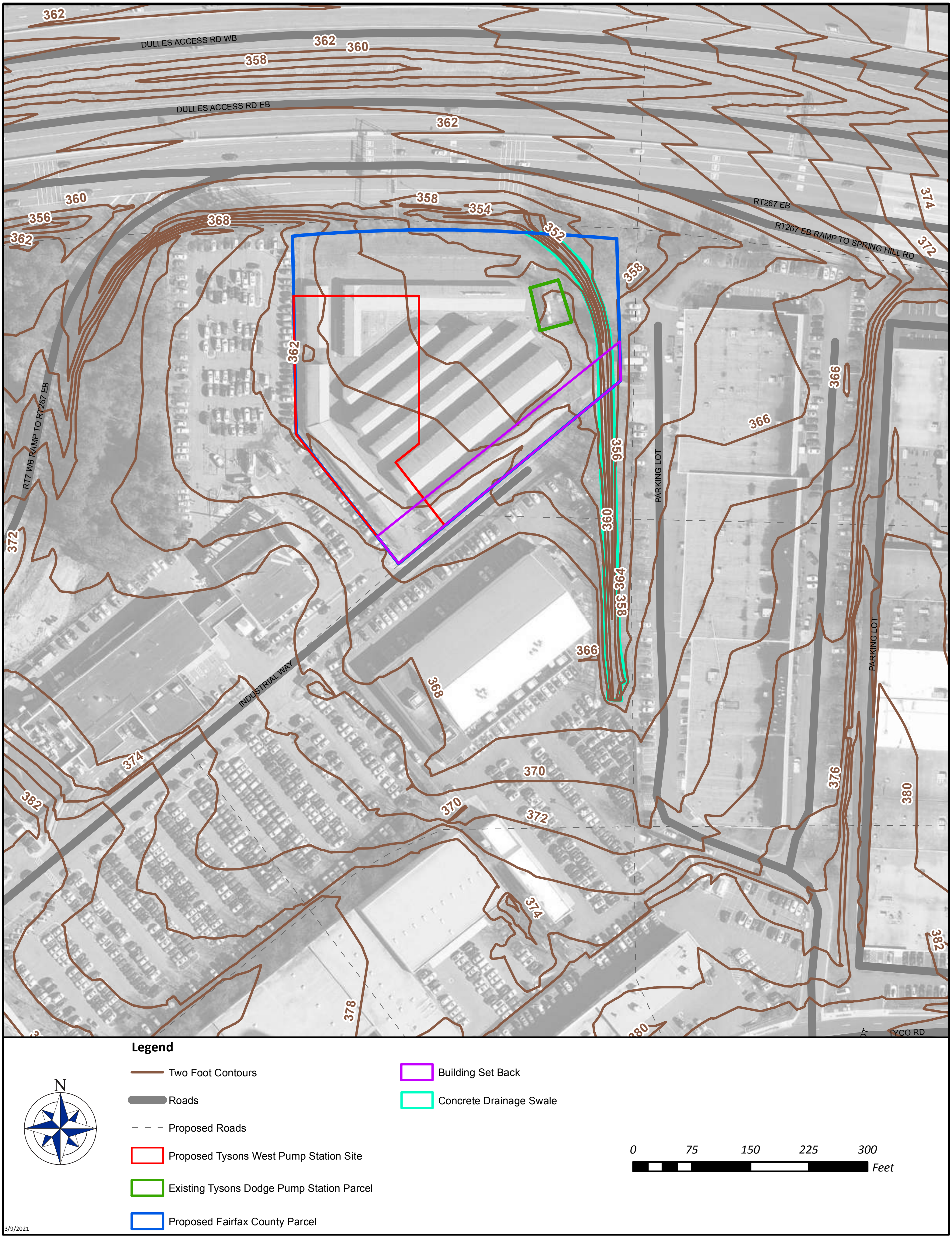

Figure No. 2-2
Topographic Map of Tysons West Area
March 2021

CDM Smith

2.1.4 Site Drainage and Stormwater Management

As mentioned previously, the site drains from the south to the northeast where stormwater enters an existing concrete channel and box culvert under Route 267. The existing concrete channel along the eastern property line conveys stormwater for the surrounding area. There are no proposed improvements to the concrete channel because this is outside of the proposed pump station site. Currently, stormwater flows from the adjacent property (Koons Tysons Toyota dealership to the west) through a 30-inch (in.) pipe across the site. The existing configuration of this drainage pipe uses a significant area of the site and has the potential to impact the location and orientation of the pump station and future development of the site. CDM Smith recommends relocating the storm drain to the perimeter of the property to limit space impacts. **Figure 2-3** shows the proposed storm drain modifications. These proposed modifications are conceptual and will need to be reviewed during the detailed design phase. All proposed site improvements will provide grading to promote positive drainage away from planned structures.

2.1.5 Overhead Clearance and Electrical Service

There are no overhead power lines at the site or on the existing access road to the site. Also, there are no other apparent unavoidable overhead obstructions (bridges, railroad, metro railway crossings, etc.) (existing or proposed) that would significantly limit overhead clearance to the site during construction or operation of the TWPS. Sufficient overhead clearance will be provided to allow maintenance and delivery vehicles unimpeded access to the pump station site. The clearance height requirements will be refined and reviewed as part of the detailed design phase; however, the intent is to limit overhead obstructions to the extent practical.

The only anticipated overhead restriction is the exterior portion of the proposed pump station monorail (**Figure 3-1** and **Figure 3-2**). The height of the monorail is set by the height required to maneuver the pumps through the pump station and load the pumps onto a truck bed. The monorail only restricts the overhead clearance next to one portion of the pump station and does not limit access to the surrounding site or site entrance. Therefore, overhead clearance is not anticipated to be a major challenge for the design and construction of TWPS.

The electrical service at the site will need to be upgraded to meet the power demands of the new pump station. New electrical services lines will be installed subsurface or coordinated with the new driveways and access roads. Refer to Section 8 of this report for additional details regarding the electrical service to the pump station.

2.1.6 Resource Protection Area, Wetlands, and Floodplain

The pump station site is not located within a resource protection area (RPA), and according to preliminary evaluations, it is unlikely that there are wetlands present. According to the Federal Emergency Management Agency (FEMA), the proposed site is located at or above the 0.2% annual chance flood event. The nearest 0.1% annual chance flood event (Zone A) is at approximately elevation 245 and located north of Route 267.

2.2 Proposed Pump Station Site Layout

The Siting Study Technical Memorandum provides evaluations for the two options for site layout. The selected option places the pump station in the northern portion of the site, with a north–south orientation, and a driveway running south, along the side of the building as shown in **Figure 2-3**. This layout option resulted in better use of the site while maximizing space between nearby publicly occupied spaces outside of the pump station site and noise/odor sources. The site will include the following features:

- Pump station – consisting of a dry well, wet well, maintenance room, electrical room, generator room with plenums, and an outdoor fuel storage tank area
- Odor control system
- Driveway with parking area
  - *One space per 1.5 employees on the major shift, plus one space per company vehicle according to Fairfax County Zoning Ordinance, Article 11, Part 106, Subpart 17*
  - *Turnaround area for a vacuum truck, fuel delivery, and odor control maintenance activities*
- Influent manhole
- Grinder vault
- Flow splitter box
- Load bank
- Placeholder for hydropneumatic surge suppression tank (if needed)
- Outdoor generator fuel storage area

This layout maximizes the space between the pump station and future mixed-use high-rise buildings, which will help with sound attenuation and visual screening of the pump station. Low-maintenance plantings will be included around the exterior of the site to provide additional screening. Exterior features, such as the odor control system, fuel storage tank, and potential surge suppression tank (see **Section 5.6** for additional discussion) will be screened using vertical architectural screening systems that mimic or complement the pump station architecture to reduce the visual impact of these industrial items. **Section 6** discusses the architectural features of the site in more detail.

The driveway entrance will include a locking security gate, which could be motorized and integrated into an access security system. Anti-climb/anti-cut, high-density metal mesh security fencing with spiked tops or similar anti-climb fence top features will be installed along the perimeter of the site. This type of fencing system will limit the visual impact of the security fence while offering a resilient and robust construction without compromising security. While barbed wire fencing is included in the Fairfax County DPWES *Wastewater Guidelines for Architects and Engineers,* Volume 2, Facility Design Manual, the barbed wire fencing will conflict with the surrounding aesthetics and the proposed fencing system type will provide similar security benefits. **Section 6.1.1** includes an example of the proposed fencing type. The final fencing type will be refined in the detailed design in coordination with Fairfax County.

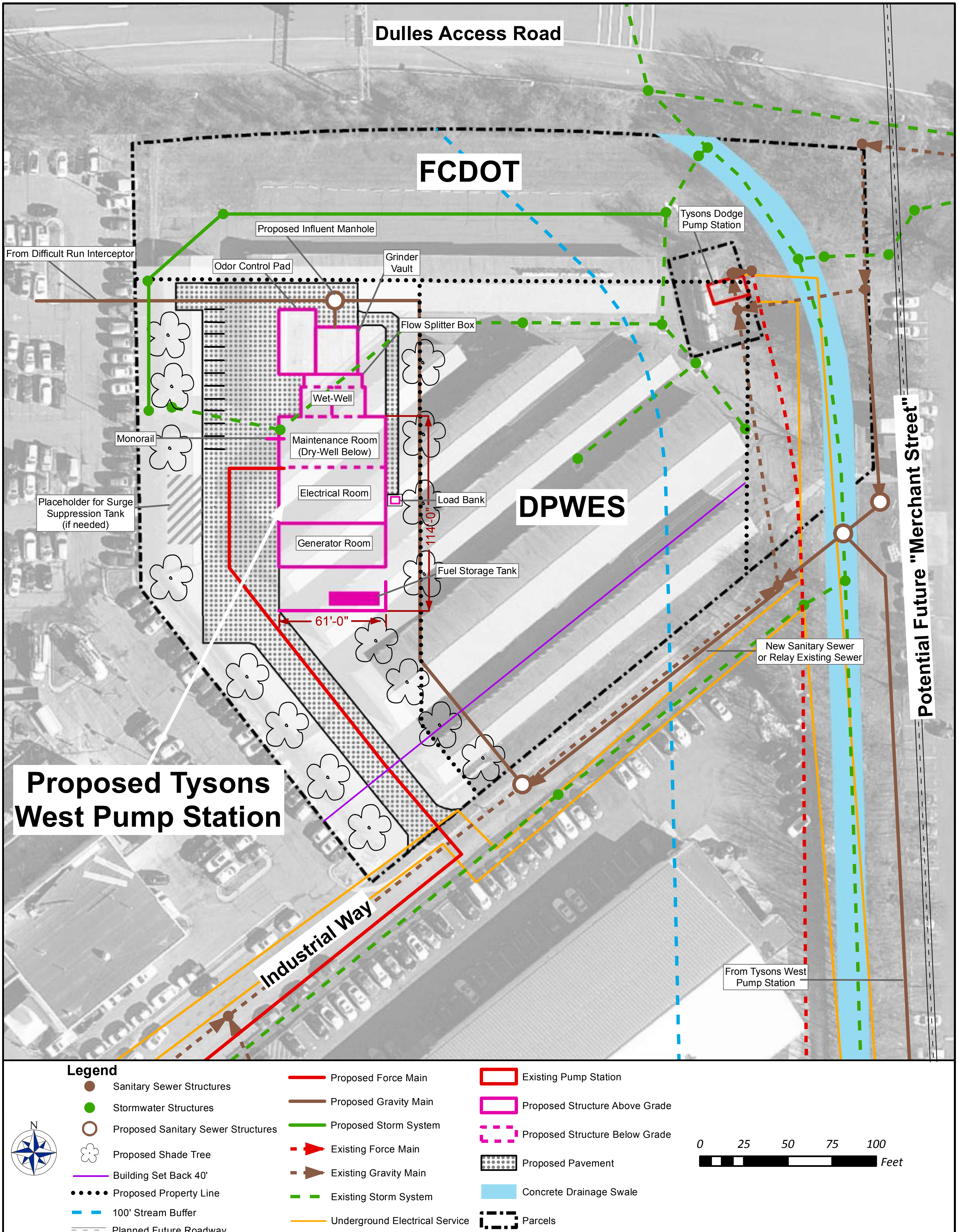

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Figure No. 2-3
Proposed Site Layout for Pump Station
March 2021

2.2.1 Site Access

It is recommended that the existing entrance from Industrial Way remain and vehicular access to TWPS is provided. The existing driveway will be replaced with a new 24-ft-wide paved surface and 24-ft radius to allow for ease of access. There is an existing easement for Verizon communication systems at the existing property entrance that is approximately 32 ft from the property line extending along Industrial Way. Keeping this area as an entrance to the pump station site should not interfere with this easement; though, if this area must remain accessible to Verizon at all times, it may affect the location of the security fencing and vehicle access gates. It is recommended that the security fencing and vehicle access gate be located outside of the Verizon easement to avoid any potential conflicts with the location of current or future communication lines.

According to TDPS record drawings, there is an existing right-of-way and easement down Industrial Way. The existing right-of-way and easement will provide access to the proposed pump station until Industrial Way is connected to the proposed Merchant Street and converted to a public through road. The pump station would not be accessible to the public; however, a new sidewalk would be installed outside of the pump station security fencing to allow pedestrians to walk along Industrial Way to the proposed linear park at the intersection of Industrial Way and the future Merchant Street. It is not anticipated that significant roadway improvements will be needed, and traffic control at the site is expected to be straightforward.

2.2.2 Proposed Utility Connections

The site is served by public (water and sanitary sewer) and private (electric and communications) utilities within the Industrial Way right-of-way. Many utilities in the Tysons West region will likely be upgraded over the next several years to facilitate anticipated growth and rapid development. As a result of these upgrades, utilities may be of sufficient size to support the proposed pump station and site amenities; this will be reviewed and confirmed in the detailed design phase in coordination with local utilities. The nearest electrical substation will need to be evaluated for capacity to meet the needs of the proposed pump station. There is an existing 2-in. natural gas line that extends about halfway down Industrial Way. The available natural gas and pressure of this existing 2-in. natural gas line is unknown. If natural gas fixtures are preferred, the existing natural gas line will need to be extended to service the pump station site. The available natural gas and pressure in the existing natural gas line will need to be evaluated during the detailed design phase.

The planned development in the region has the potential to impact the proposed utility capacity, location, and routing. These impacts will need to be evaluated throughout the design process and coordinated with local developers.

2.2.3 Special Design Criteria

The *Tysons Urban Design Guidelines* and the Virginia (VA) Department of Environmental Quality (DEQ) Dulles Policy requirements will need to be considered throughout the design development. The following sections how these requirements will be addressed in the pump station design.

2.2.3.1 Tysons Urban Design Guidelines

The *Tysons Urban Design Guidelines* provide recommendations to enhance the overall Tysons experience. The pump station design will align with these guidelines in the following ways:

- CDM Smith will use the approved development plans of the adjacent properties to guide the proposed design and blend the frontage of the site with the proposed street scape and linear park.
- CDM Smith will select plantings to provide screening at the street level and from the neighboring high-rise buildings with a bird's eye view of the area.

The use of a vegetative roof was considered as a potential additional measure to aid in the improvement of the overall aesthetic of the site from the neighboring high-rise buildings; however, the additional maintenance was not considered desirable. As a result, equipment can be located on the roof provided the equipment has appropriate screening measures to reduce the visual impact of the rooftop equipment. Additional provisions to meet the intent of the *Tysons Urban Design Guidelines* will be considered throughout the detailed design process.

2.2.3.2 Virginia Department of Environmental Quality Dulles Watershed Emergency Retention Storage Requirements

The proposed Tysons West Pump Station (TWPS) is located in the Dulles Watershed and will need to meet the reliability protection requirements of VA DEQ Sewer Collection and Treatment (SCAT) regulations (9VAC25-790-490) and the additional requirements of the Dulles Policy. The Dulles Policy requires that pump stations meet the Class I reliability requirements defined under the reliability protection section of the VA DEQ SCAT regulations. It also includes provisions for emergency storage and backup power systems to protect the local watershed from overflows. The following systems were considered as part of the preliminary design development to meet the Class I reliability requirements:

- Emergency generator with automatic transfer switch
- Monitor of main and auxiliary power supplies
- Failure of pump to discharge alarm
- High liquid level alarms in wet and dry wells
- Audio-visual alarm with telemetry
- Autodialer to a site manned 24 hours a day
- Difficult Run Interceptor and Scotts Run Interceptor remote flow diversion

New flow diversion structures will be constructed on the existing Difficult Run Interceptor and Scotts Run Interceptor. Diversion structures will provide the ability to divert flow away from TWPS. These diversion structures will improve the resiliency of the regional gravity sewer system and provide the County with the autonomy to temporarily redirect flows as needed to maintain sewer system operations.

According to Section E of 9VAC25-790-490, “Reliability Protection,” of the VA DEQ SCAT regulations, “[a]dditional flow storage capacity should provide up to a 24-hour detention of the peak design flow” must be provided for pump stations located in the Occoquan and Dulles Watersheds, which will include TWPS. To provide 24-hour detention time of the peak design flow, the County would have to provide 25 million gallons or about 3.3 million cubic ft of storage. Including the proposed wet well volume and some additional volume for free board, this could result in a 20-ft by 415-ft by 415-ft (height × length × width) storage structure. **Figure 2-4** includes a conceptual layout of the rough area required to store this amount of raw sewage. This conceptual layout will aid in assessing the practicality of storing 24 hours of the peak design flow for TWPS, and it is meant to provide a visual representation of the volume. There are various storage configurations and alternatives that could be considered; however, the magnitude of the impact would be considerable regardless of how the storage for the 24-hour detention was provided. A 24-hour detention basin would:

- Likely require the County to purchase considerably more land than required for TWPS, which represents a large financial investment and significant challenge in a densely populated urban area;
- Pose a significant challenge for odor control in a sensitive area;
- Likely need to be a closed storage space, because an open storage basin would pose a risk to public safety and health;
- Require means to prevent solids from settling in the storage structure or remove solids from the storage structure periodically;
- Conflict with the local aesthetics that would likely result in push back from local public, private, and other stakeholders;
- Add considerable cost to the project.

Given the significant challenges associated with providing 24-hour detention of the peak design flow, it is not considered practical or economical to meet the 24-hour emergency storage requirements of the Dulles Watershed Policy. Therefore, it is recommended that Fairfax County pursue a waiver for the 24-hour detention requirements of the Dulles Policy. The waiver application must include the following items and information:

- Topographic map showing the pump station and the closest stream/water bodies, as well as proximity to the Occoquan Reservoir
- Which facility will receive the wastewater flows
- Details on overflows at the pump station over the past 3 years (could apply to the existing TDPS)
- Estimation of inflow and infiltration (I&I) in the collection system serving the pump station and information on work done to address I&I in the collection system

- Information on overflows in the collection system servicing the collection system over the past 3 years
- Average and peak daily flows at the pump station over the past 3 years (could apply to the existing TDPS)
- Description of how the pump station will meet and/or exceed Class I reliability requirements
- Information on the existing storage capacity
- Basic design of the new pump station, including pump data
- Information regarding the future planned expansion/growth of the collection system, and whether the collection system has been modeled
- Emergency response plan for the pump station and a description of how quickly personnel can respond during an emergency
- Information about the supervisory control and data acquisition (SCADA) system and description of the remote monitoring and alarm notification system and backup systems

VA DEQ will be consulted during the early phases of the detailed design to ensure compliance with local, state, and federal regulations with special attention to the VA DEQ Dulles Watershed emergency retention storage requirements.

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Figure No. 2-4
24-Hour Detention Conceptual Layout
March 2021

2.2.4 Neighborhood Integration – Aesthetics, Noise, and Lighting

The pump station site will be in a highly visible location near future high-rise developments. Special consideration will be given to site aesthetics, odor, noise, and lighting. The site design will allow for safe footpaths for Fairfax County staff with visual access to the neighborhood. The site will be secure and not accessible to the public. At the street level, the pump station will complement neighboring buildings in style, materials, and setbacks.

Security fencing will be the closest component to the public, and it is important that the fencing blends with the aesthetics of the surrounding area while maintaining its function as a security feature. A low-visibility fencing system is recommended to decrease the visual impact of the security fencing. In addition, the fencing should be made of durable materials that match the aesthetics of the surrounding properties and the pump station, which may include coated black steel or similar materials/finishes.

Controlling noise, odor, and light pollution will be important because of the site's proximity to residential or commercial office spaces. At a minimum, the pump station will need to be compliant with the Fairfax County Noise Ordinance (Chapter 108.1) of the Fairfax County Codes and applicable VA DEQ SCAT regulations. According to Chapter 108.1-4-2, sound generation for mixed-use areas is limited to 65 and 100 decibels (dba) from 7 a.m. to 10 p.m. and 60 and 80 dba between 10 p.m. and 7 a.m. for continuous sound and impulse sound, respectively.

Sound limits are based on measurements at the property boundary. These limits exclude emergency work performed by Fairfax County to restore service and the operation of backup generators used during a power outage. A number of noise mitigation strategies will be integrated into the pump station design, including locating the generator inside the building with plenums on the intake and exhaust side, using a high-performance generator silencer, and housing the pumps in a dry well. Outdoor lighting will be provided for security, and to facilitate safe personnel travel to and from the pump station. The lighting will be oriented toward the ground, will be shielded, and will avoid cooler color light spectrums (e.g., dark sky–compliant) to minimize light pollution and excess light from entering neighboring properties.

2.2.5 Security

The pump station will be a secure location to prevent unauthorized personnel from gaining access and potentially causing harm either through physical damage to the pump station and conveyance system or a cyberattack through the network hardware in the pump station. The following security features can be integrated into the design to mitigate these threats:

- Metal anti-climb/cut-resistant fencing with pointed posts that complement the aesthetics of the surrounding architecture
- Locked gate
- Access card and closed-circuit television (CCTV) system, according to Fairfax County standards
- Locking vaults/manholes

- Exterior lighting
- Signage (e.g., no trespassing signs referencing penalties and fines)
- Physically and logically secured control system infrastructure
- Protected fuel storage tanks
- Locked network and control panel doors
- Port locks for unused RJ-45 and USB ports on network switches and other control system equipment (Unused Ethernet port switches will be disabled.)
- Any Fairfax County network security protocols to not allow any wireless networks

2.3 Environmental Assessment

CDM Smith conducted a desktop review of environmental records for sites located within a 1-mile radius of the proposed pump station to identify potential environmental impacts. This review indicated there is potential for environmental contamination to have impacted the pump station site. An environmental evaluation is not currently possible since Fairfax County does not own the land for the proposed pump station location. An environmental evaluation will be completed as an early design activity during the detailed design phase. The environmental evaluation will include:

- Phase 1 Environmental Site Assessment for the pump station site
- Wetland delineation (to confirm there are no wetlands present on the site)
- Chesapeake Bay Preservation Ordinance RPA delineation

2.4 Construction Phasing

The existing self-storage facilities located on the TWPS site will need to be demolished to prepare the site for pump station construction. The TWPS can be constructed while the existing TDPS remains in operation. All equipment and components of the TWPS will need to be constructed and installed, and all necessary permits for operating the pump station will need to be approved and received before the TWPS can receive flow and the commissioning process can begin. Once the TWPS is commissioned and fully operational, the TDPS will be decommissioned and demolished.

To decommission the TDPS, the sewer mains around the TDPS will need to be reconfigured to divert flow to the new TWPS. It is recommended that approximately 200 ft of new sewer main and one new manhole be installed along the east side of the TDPS site that connects to the existing manhole at the end of Industrial Way. The existing sewer main from the manhole at the end of Industrial Way to the manhole at the new sewer connection to the TWPS will need to be relayed or replaced if the existing sanitary sewer is in poor condition, to allow for gravity flow to the TWPS.

As discussed in **Section 1.4.2**, the increase in local sewerage flows is largely dependent on how quickly the Tysons West area develops. If development in the area progresses faster than expected and the County anticipates that the local sewerage flows will exceed the TDPS capacity before the TWPS is operational, then the County may need to consider temporary pumping or alternatives for expediting the TWPS construction process. It is possible that the COVID-19 pandemic has slowed development in the region, which may provide additional time for designing, permitting, constructing, and commissioning the TWPS.

2.4.1 Influent Flow Control

Diverting flow to the TWPS and decommissioning the TDPS can be completed in phases, and the TWPS could initially operate with flows from only the Difficult Run Interceptor. The new diversion structures that will be constructed on the Difficult Run Interceptor and Scotts Run Interceptor will allow flows to be directed toward or away from the TWPS. This diversion structure will be leveraged to facilitate startup and commissioning of the TWPS.

After the TWPS is commissioned and fully operational, flows from the TDPS will be diverted to the TWPS. As shown in **Figure 2-3**, a new gravity sewer connection and isolation valves could be installed along Industrial Way to divert wastewater to TWPS. The ability to isolate this sewer main will need to be reviewed with Fairfax County, and temporary provisions may be needed to provide enough time to install the new tee.

2.5 Preliminary Geotechnical Assessment

2.5.1 Regional Geology

The project site is located in the Piedmont Physiographic Province. Based on the *Geology Map of the Falls Church Quadrangle*, prepared for the Department of Interior, U.S. Geologic Survey in 1965, the site is mapped as Mather Gorge-Sykesville motif that consists of Mather George Formation with stromatic and lesser phlebitic migmatite (CZmm), and metagraywacke and semipelitic schist (CZmg) above the Sykesville Formation (Drake and Froelich, 1997). The motif is the classic precursory mélange in the central Appalachians on the Plummers Island thrust fault. The Mather Gorge thrust sheet was emplaced while the Sykesville Formation was being deposited, which resulted in the wraparound protuberances of Sykesville Formation in Mather Gorge olistoliths (Drake, 1985). The Mather Gorge Formation consists of light- to medium-gray, medium-grained, sedimentary mélange consisting of migmatite, quartz-rich schist, and metagraywacke. The Sykesville Formation (Cs) consists of light- to medium-gray, medium-grained, sedimentary mélange consisting of a quartzofeldspathic granofels that contain fragments and olistoliths of serpentine, metagabbro, ultramafic and mafic rocks, felsic metavolcanics rocks, and plagiogranite, as well as Mather Gorge migmatite (Drake, 1989).

The surface of the Mather Gorge-Sykesville motif is weathered into saprolite (Kirk, 1979). The saprolite is relatively thick (10 to 40 ft) and is made of soft, earthy, and clay-rich material formed in place by chemical weathering of the Piedmont bedrock (Kirk and Froelich, 1979). The saprolite (weathered rock) has physical and engineering properties, which generally results from the unweathered rock from which they are derived. The bedrock and saprolite are overlain by Pliocene Terrace Gravel (Tt3) and artificial fill (af). The Terrace Gravel is gray to yellowish-brown, thick- to thin-bedded, fairly well-rounded cobble and pebble gravel, interbedded with

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quartz sand, silt, and mica clay. The artificial fill consists of various sandy, silty, and gravely materials mainly of local origin fill due to construction.

2.5.2 Preliminary Geotechnical Evaluation

Based on the available historical borings on the Route 7 bridge over Route 267, the subsurface conditions of the project site may consist of a 35- to 70-ft thickness of very soft to hard clayey silt, silt and clay, sandy silt, and silt overlain on the saprolite. Fairfax County Soil Survey Reports identify the upper soils at the site to be Codorus silt loam. The soils associated with the soil series generally have characteristics of high shrink/swell potential, high compressibility, low bearing strength, and shallow water tables that may result in poor drainage and building settlement (FCPWES, 2013).

Based on the existing information, it is anticipated that overburden soils consisting of fill, very soft to hard cohesive soils, and weathered rock is anticipated to be encountered to depths between approximately 50 and 75 ft below existing grade. The groundwater is anticipated to be encountered within the upper 15 to 20 ft below ground surface (ft-bgs).

Existing subsurface data at the pump station site and along the gravity main and force main alignments are not available. Based on the proposed structural information and preliminary geotechnical evaluation, it is anticipated that the below-grade portions of the proposed pump station structures may be founded on shallow foundations, which are anticipated to result in a net unload of the bearing soils and/or weathered rock.

For the above-grade portions of the structures, it is anticipated that the structure may be founded on shallow foundations with a limited amount of over-excavation and replacement of up to 10 ft due to loose, surficial soils. For this preliminary design, it is assumed that uplift associated with the design groundwater level will be resisted by the dead weight of the structure plus weight of fill placed directly over the extension to the structure foundations. However, during detailed design, it may be necessary to review other alternatives to resist uplift, such as rock anchors socketed into the weathered rock layer.

Based on the depth of the proposed sewer, the gravity sewer is anticipated to be constructed with microtunneling techniques, and the force main is anticipated to be constructed using open-cut techniques with trenchless crossings (i.e., pipe jacking) at major roadway and utility crossings.

2.5.3 Proposed Geotechnical Investigation Program

As part of this final design, a geotechnical investigation program (i.e., drilling and laboratory testing) will be required to develop geotechnical foundation design recommendations and construction considerations for the proposed structures and pipelines. To support design of the new structures and pipelines, CDM Smith will perform a geotechnical investigation for the proposed wastewater conveyance system structures consisting of 47 test borings and laboratory testing. Details of the subsurface exploration program include:

- Subsurface Exploration Program
  - Pump station site

  - *Drill up to seven test borings to depths up to 75 ft-bgs. This includes up to three test borings conducted with up to 10 ft of rock coring to document bedrock conditions, if encountered.*
  - *Install at least one observation well up to 40 ft-bgs.*
  - *Obtain up to three Shelby tube samples.*
- Gravity sewer alignment
  - *Drill up to six borings to depths up to 60 ft-bgs. This includes up to three test borings and up to 10 ft of rock coring to document bedrock conditions, if encountered.*
  - *Install up to three observation wells up to 40 ft-bgs.*
  - *Obtain up to six Shelby tube samples.*
- Force main alignment
  - *Trenchless crossings (assuming up to five pipe jacking crossings)*
    - *Drill up to 10 test borings to depths up to 35 ft-bgs. This includes up to 10 ft of rock coring at five test borings to document bedrock conditions, if encountered.*
    - *Install up to five observation wells (one at each trenchless crossing) up to 30 ft-bgs.*
    - *Obtain up to five Shelby tube samples.*
- Open-cut alignment
    - *Drill up to 30 test borings to depths up to 20 ft-bgs. This includes up to 10 ft of rock coring at five test borings to document bedrock conditions, if encountered.*

CDM Smith will conduct geotechnical laboratory testing on select soil and rock samples as identified during the subsurface investigation in the field through its local laboratory testing partner. Geotechnical laboratory testing will include, but is not limited to, the following tests:

- Geotechnical Laboratory Testing Program
    - Moisture Content Tests (ASTM D2216)
    - Organic Content Tests (ASTM D2974)
    - Atterberg Limits Tests (ASTM D4318)
    - Grain Size Analyses with Wash of No. 200 Sieve (ASTM D6913)
    - Grain Size Analyses with Hydrometer (ASTM D6913 and ASTM D7928)
    - Corrosion Test Suite

- *pH tests (U.S. Environmental Protection Agency [EPA] Method SW9030B)*
- *Sulfide tests (EPA Method SW9056A)*
- *Chloride tests (EPA Method SW9056A)*
- *Resistivity tests (EPA Method SW9056A)*
- *Reduction-Oxidation tests (HACH Method 10228)*
- *Unconsolidated Undrained (UU) Triaxial Tests (ASTM D2850)*

Section 3

Pump Station Design Criteria

3.1 Introduction

The Tysons West Pump Station (TWPS) will be located on Industrial Way in western Tysons at the current location of Tysons Self Storage. Fairfax County is in the process of procuring the site, which is approximately 3 acres. Refer to **Section 2** for additional information on the overall site layout and civil site components.

3.2 Pump Station Configuration

The proposed configuration of TWPS is a dry well/wet well pump station with an influent manhole, grinder vault, flow splitter box, maintenance room, electrical room, generator room, fuel storage tank, load bank, odor control system, and flow meter valve vault.

3.2.1 Influent Manhole

As shown in **Figure 3-1** and **Figure 3-2**, a new influent manhole will be constructed and used to collect flows from the new gravity main that will connect to the Difficult Run Interceptor, local sanitary sewer service area, and future Tysons East Pump Station (TEPS). The manhole will convey wastewater flows to the new grinder vault via gravity through a 36-inch (in.) pipe. The manhole will be designed and constructed in accordance with the Fairfax County Public *Facilities Manual* (PFM).

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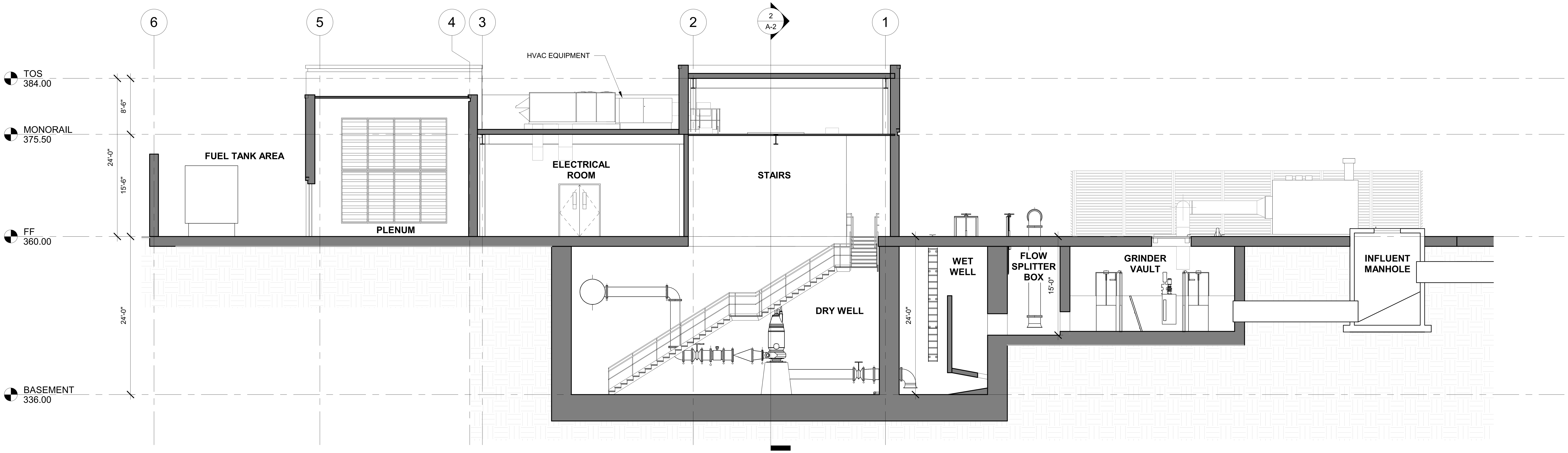
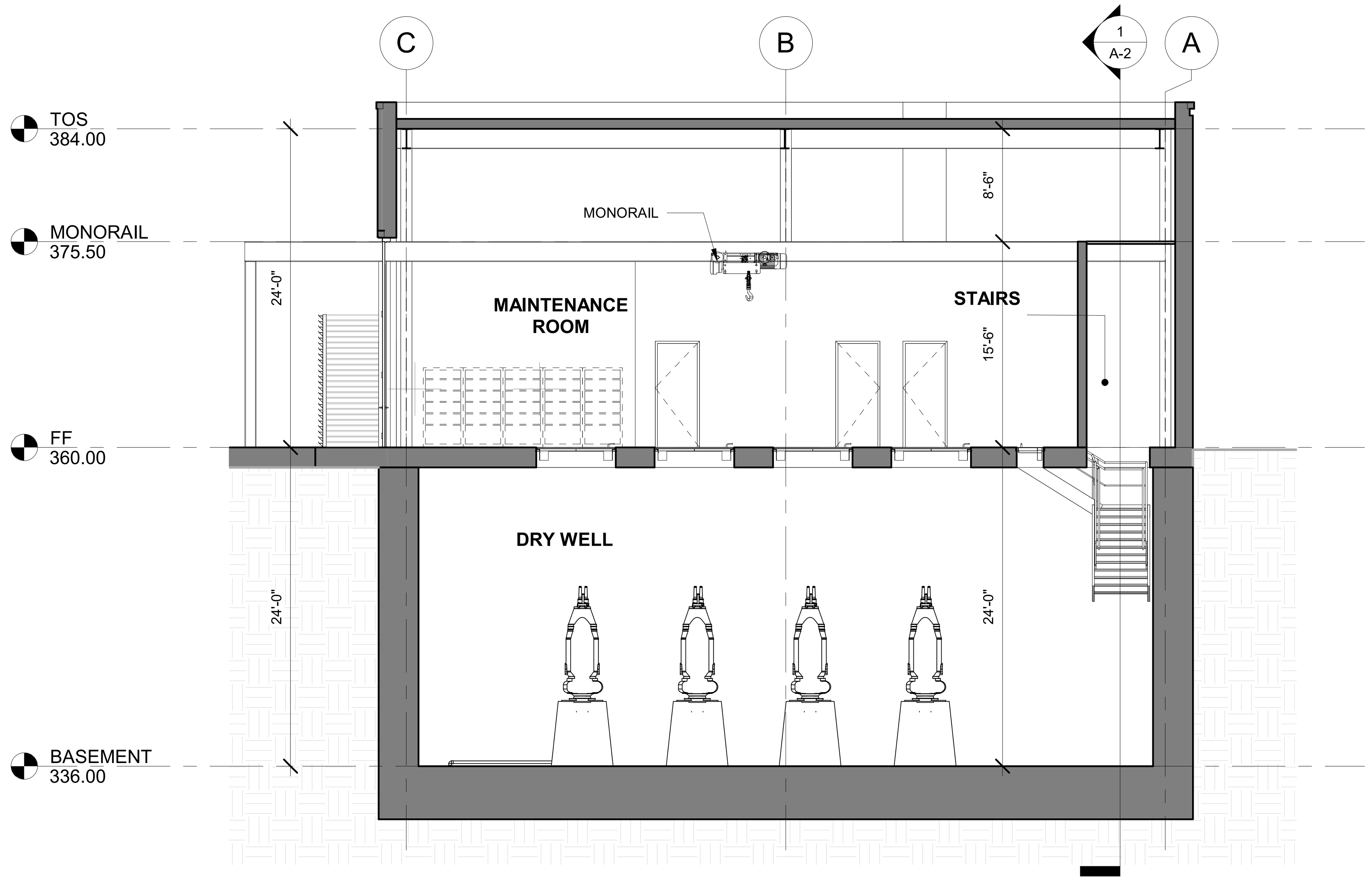
Figure No. 3-1
FLOOR PLANS
MARCH 2021



1
A-1
BUILDING SECTION
1/8" = 1'-0"



2
A-1
BUILDING SECTION
1/8" = 1'-0"

3D SECTION (N.T.S.)

5 0 5 10 15 20
1/8" = 1'-0"

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Figure No. 3-2
BUILDING SECTIONS
MARCH 2021

3.2.2 Grinder Vault

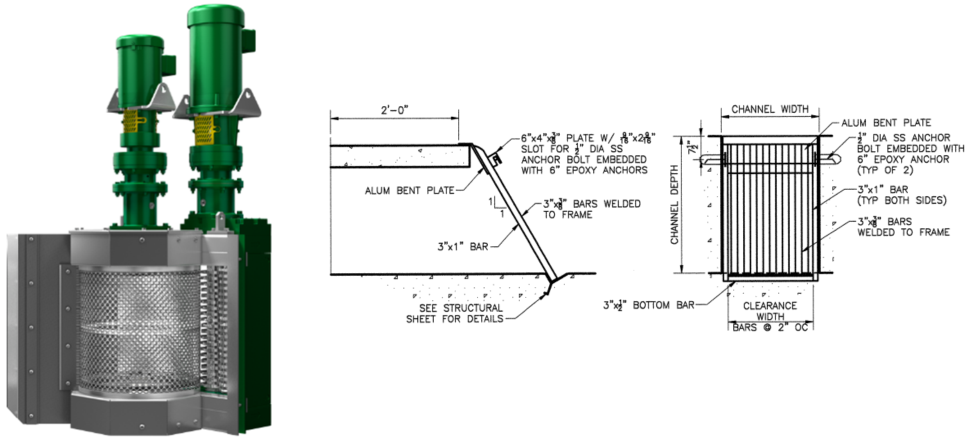
The County elected to employ a multiple rake and manual screens after issuance of this Document

As shown in **Figure 3-1,** a new grinder vault will be constructed to house a channel grinder, manual bar racks, bypass channel, and isolation gates. The channel grinder will reduce the size of solids in the wastewater to protect the downstream pumps and limit service outages associated with clogs. The expected useful life of a channel grinder varies widely on waste conditions, but could be considered to be approximately 5 to 6 years. It is recommended that a single channel grinder sized to treat the near future peak flows (~18 mgd) be installed initially and when that grinder requires replacement, the grinder be upsized to treat the ultimate design capacity of the pump station (25 mgd). This will prevent the County from having to pay for the operation and maintenance of a 25-mgd capacity grinder before the pump station is expected to receive 25 mgd of flow. The maximum flow capacity of the grinder will likely be greater than the design capacity of the pump station to provide a buffer in the event the actual flows exceed the anticipated design flows during the useful life of the grinder. The grinder vault channel will be sized to allow either of the proposed grinders to be installed (initial lower capacity grinder or future higher flow capacity replacement grinder). For some grinders, such as the JWC Environmental Channel Monster Flex (**Figure 3-3**), the increase in flow capacity could be accomplished by replacing the perforated drum with a larger perforated drum and the motors and grinder housing would not have to be replaced. It is not anticipated that the grinder will have issues treating the lower flows that are anticipated when the pump station is initially commissioned.

A manually cleaned bar rack with 2-inch openings will be located directly downstream of the grinder to collect larger rags and debris that may pass through the grinder or serve as backup screening should the grinder be removed. An example of a manually cleaned bar rack is shown in **Figure 3-3.**

A bypass channel will allow the grinder to be taken out of service for maintenance and repairs. The bypass channel will include a manually cleaned bar rack to facilitate the collection of debris and rags when flow is diverted through the grinder bypass channel using the slide gates. The channel grinder could be removed using the permanently installed davit crane system through a roughly 6-foot by 6-foot double-leaf hatch located directly above the grinder in the ceiling of the vault. A single leaf hatch will be provided in the corner of the vault to allow staff to remove debris that will accumulate on the bar racks directly from the vault using the davit crane. The permanent installed davit crane will be located adjacent to the hatches to allow the County to access either of the hatches using the davit crane.

Figure 3-3: Example of a Channel Monster Flex Grinder System by JWC Environmental and manually cleaned bar rack.



The grinder vault will be an enclosed space to help contain fugitive odors. Odor control equipment will be provided to control odors in this space and to provide the code required ventilation and electrical equipment classifications. The odor control, heating ventilation, air conditioning, and electrical design criteria are discussed in subsequent sections of this report. Personnel access will be provided through an enclosed stairway leading down from the ground surface to the grinder vault. Corrosion resistant removable grating will be installed across the channels to allow staff to safely navigate the space, and visually inspect the equipment and channel. The grinder design criteria are summarized in **Table 3-1**.

Table 3-1: Grinder design criteria.

Criteria	Value	
Design flow (mgd)	18	25
Maximum flow capacity (mgd)	20	40
Channel width (inches)	50	
Channel depth (inches)	90	
Motor horsepower	10	
Motor type	Immersible	
Equipment weight (pounds)	2,182	2,477
Solids diverter motor (horsepower)	1	1
Grinder motor (horsepower)	10	10
Control enclosures	NEMA 7	
Frame material	304SS	

3.2.3 Wet Well Design

The County elected to employ a trench style wet well after issuance of this Document

The proposed configuration of the TWPS is a dry well/wet well pump station with a flow splitter box, two wet wells that can be fully isolated, and a drywell containing four submersible pumps. The preliminary wet well design was developed in accordance with the Hydraulic Institute (HI) Standards for Rotodynamic Pumps (ANSI/HI 9.8-2018). Wastewater will flow by gravity from the grinder vault to a flow splitter box, where flow is diverted to both wet wells under normal operating conditions. Flow could be diverted to either of the wet wells using inlet slide gates, such that either wet well can be isolated for maintenance.

A partitioned space within the wet well is provided to reduce air entrainment into the pump suction piping from falling water. The partition wall will be designed to prevent flow from surcharging over the partition, while keeping the top of the partition wall below the maximum starting elevation of any of the pumps to prevent floating debris from accumulating in the partitioned space. Slots at the bottom of the partitioned space will distribute flow evenly into the wet well. The wet well will have a sloped floor in accordance with HI standards to promote gravity flow toward the inlet of the pumps. Fillets and/or baffles will likely be necessary to limit the formation of sidewall vortices, and will provide favorable flow conditions into the inlet of the pumps. A physical model study may be required to inform the design of such flow conditioning elements.

The wet well is sized to manage pump cycle times to meet the preliminary pump selection manufacturer's pump cycle requirements. The preliminary wet well design provides a maximum storage capacity of roughly 56,000 gallons with some additional storage capacity in the flow splitter box and influent manhole. See **Section 2.2.3.2** for discussion on regulatory storage capacity requirements. The wet well size, storage capacity, and pump cycle times will be refined throughout the development of the detailed design. In alignment with the Fairfax County Facility Design Guidelines manual, mixers or submerged chopper pumps with mixing nozzles may be installed in the wet well to prevent fats, oils, and grease (FOG) from accumulating and help scour grit. Provisions for managing grit accumulation and FOG will be further evaluated during the detailed design phase as the wet well design is refined and the best approach to managing grit and FOG accumulation can be better evaluated.

3.2.4 Dry Well Design

The dry well will house the four dry pit submersible pumps and associated valves, instruments, and appurtenances. Refer to **Section 3.2.5** for additional information on the preliminary pump selection. Flow from the four pumps will combine in a common discharge header, which will penetrate the wall of the dry well below grade and follow the alignment of the driveway. A sump will be located in the corner of the dry well to collect wash down water and a duplex sump pump with a float system will be used to pump water to the wet well. A durable grate will be provided over the sump to make the sump readily accessible and allow staff to inspect the sump without removing the grating.

3.2.5 Pump Selection and Force Main Considerations

The Pump Selection will be finalized after additional force main investigations

A preliminary pump selection was made based on a maximum peak wet weather flow of 25 mgd and by approximating the static and dynamic losses within the proposed force main. Each wet well will have four same size pumps (***385 – 450***) horsepower (hp)). This will allow three pumps to operate to meet the design capacity flow of 25 mgd with one pump serving as a standby pump. The preliminary pump design criteria are summarized in **Table 3-2**. The wet wells are sized to limit the number of pump starts per hour to less than the maximum number of pump starts recommended by the manufacturer.

Table 3-2: Pump design criteria.

Design Criteria	Data
Rated capacity (mgd)	8.33
Number of pumps (duty/standby)	4 (3/1)
Estimated TDH (feet)	***150 - 160***
Pump type	Submersible (solids handling)
Hydraulic efficiency at design point	80%
Horsepower (hp)	***385 - 450***
Rated motor speed (rpm)	1,190
Motor service	Submersible, class I, div. 2
Drive type	Variable speed with bypass motor starter
Electrical requirements	480 V, 3P, 60 hertz (Hz)

The proposed pump/motor dynamics will be evaluated during the detailed design phase in close coordination with pump manufacturers to mitigate the risk of excessive vibration, which can cause damage and lead to unreliable pump operation. The preliminary pump selection and configuration provides the following benefits:

- Simplifies spare parts inventory required for routine maintenance by using the same size pumps
- Allows Fairfax County to keep one pump as an on-the-shelf spare, which could replace any of the four pumps
- Provides one standby pump at the ultimate design capacity (25 mgd) and option to have more than one standby pump at lower flows
- Provides the flexibility to pump full range of anticipated flows: 5 mgd (average daily flows in 2025) to 25 mgd (peak wet weather at pump station ultimate build-out in 2045) (See **Section 1.4.2** for a summary of the anticipated flows.)
- Provides the flexibility to adapt pump station implementation should flows grow slower or faster than expected (See discussion in **Section 3.3** for additional information on pump station phasing.)

The force main size was selected based on the following criteria:

- Maintain flow velocities less than 8 feet per second (ft/s) under peak flow conditions
- Maintain flow velocities above 2 feet per second (ft/s) under initial flow conditions
- Minimize residence times
- Minimize total dynamic head (TDH) on the pumps
- Minimize specific energy and lifecycle costs

- Sized to provide adequate conveyance capacity under the initial low-flow conditions and future build-out capacity of the pump station with as much additional conveyance capacity as possible while balancing the other beforementioned criteria.

A 30-, 36-, and 42-inch diameter force main were evaluated based on the before-mentioned criteria across the anticipated flows. **Figure 3-4** through **Figure 3-8** display the results of these evaluations and **Table 3-3** summarizes the results. While the 36-inch force main and 42-inch force main provide considerable benefits for certain criteria they both have challenges in other criteria. The 36-inch force main represents a balanced approach in comparison to the 30-inch and 42-inch force main options; therefore, the 36-inch force main was selected and evaluated in the preliminary design. The 36-inch force main selection will be evaluated in more detail during the detailed design phase. See **Section 5** for information on the force main routing selection and preliminary surge analysis.

Table 3-3: Alternative force main diameter evaluation results summary.

Criteria	Force Main Diameter		
	30-inch	36-inch	42-inch
Velocity (ft/s)	Low	Intermediate	High
Residence Time (hours)	Low	Intermediate	High
TDH (feet)	High	Intermediate	Low
Estimated Specific Energy (kWh/MG)	High	Intermediate	Low
Estimated Lifecycle Cost ($/MG)	High	Intermediate	Low

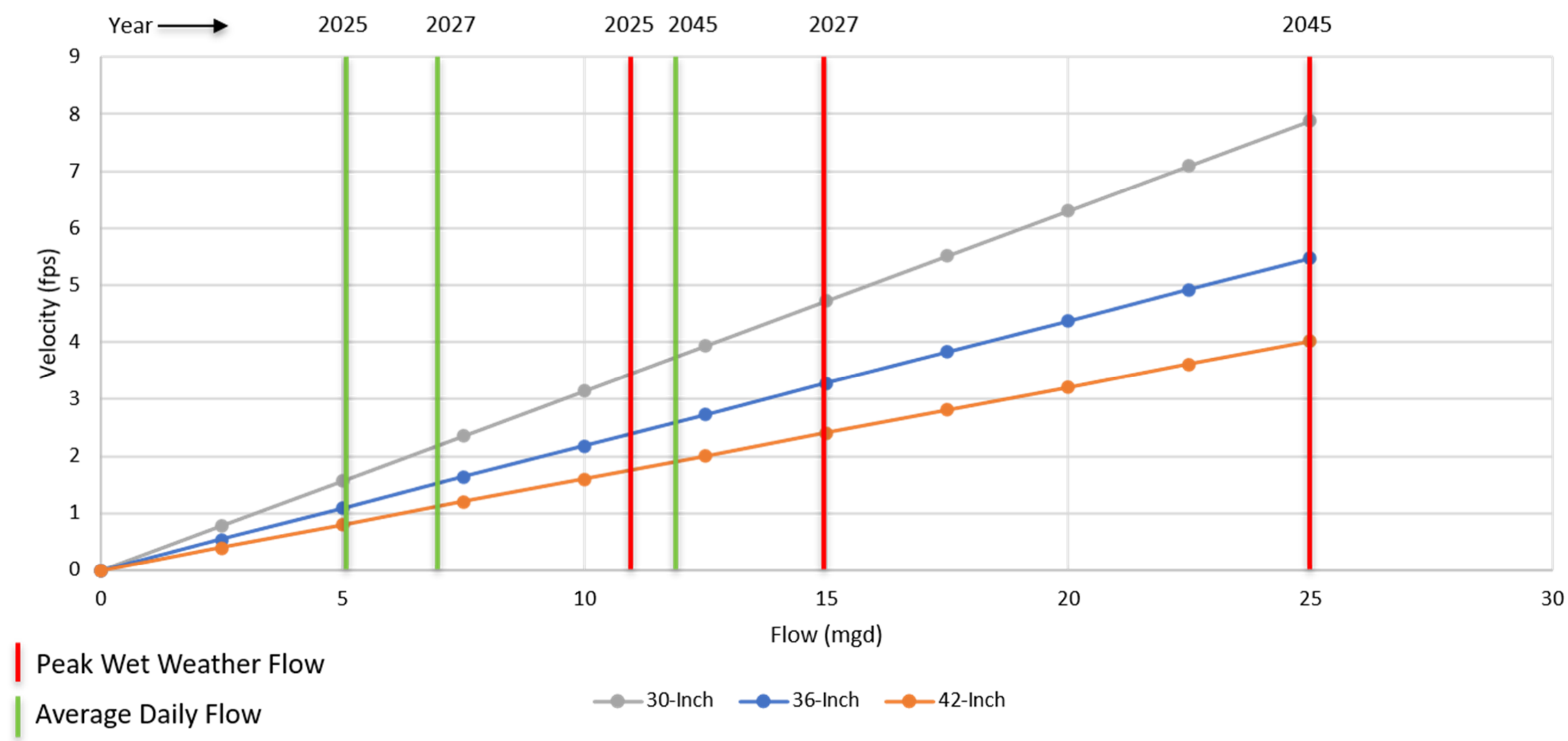


Figure 3-4: Velocity profile for three different force main diameter alternatives.

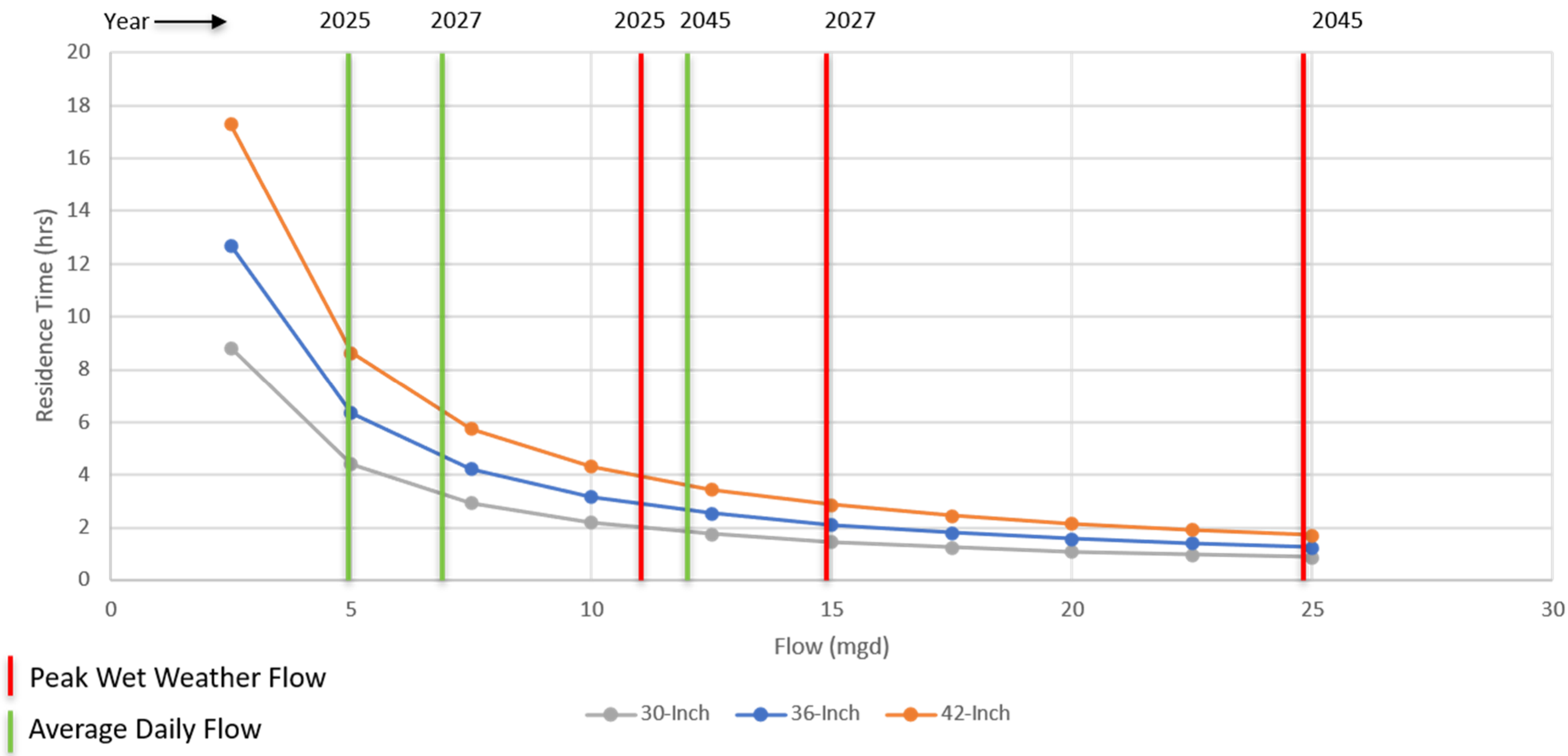


Figure 3-5: Residence time profile for three different force main diameter alternatives.

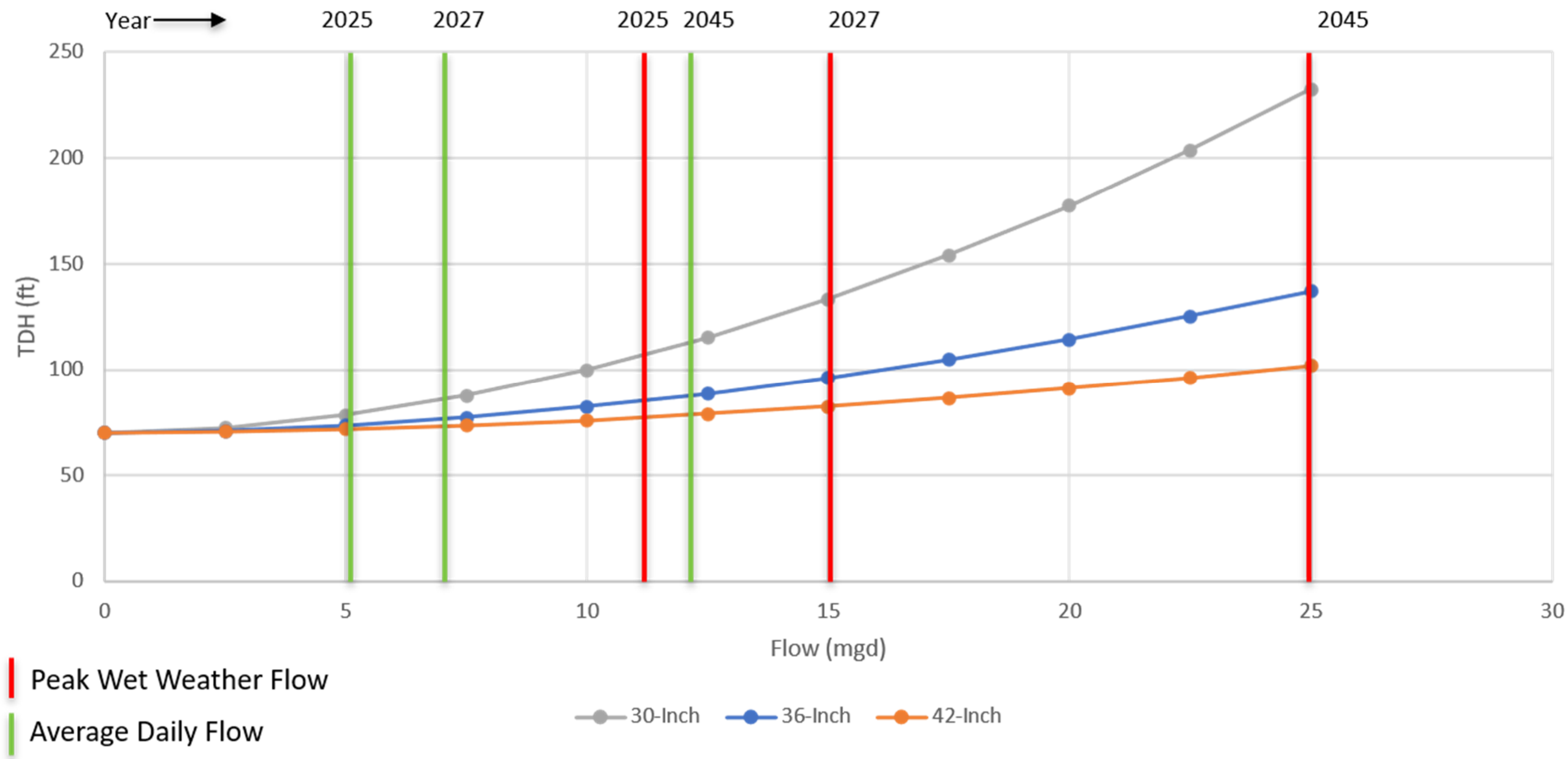


Figure 3-6: Total dynamic head profile for three different force main diameter alternatives.

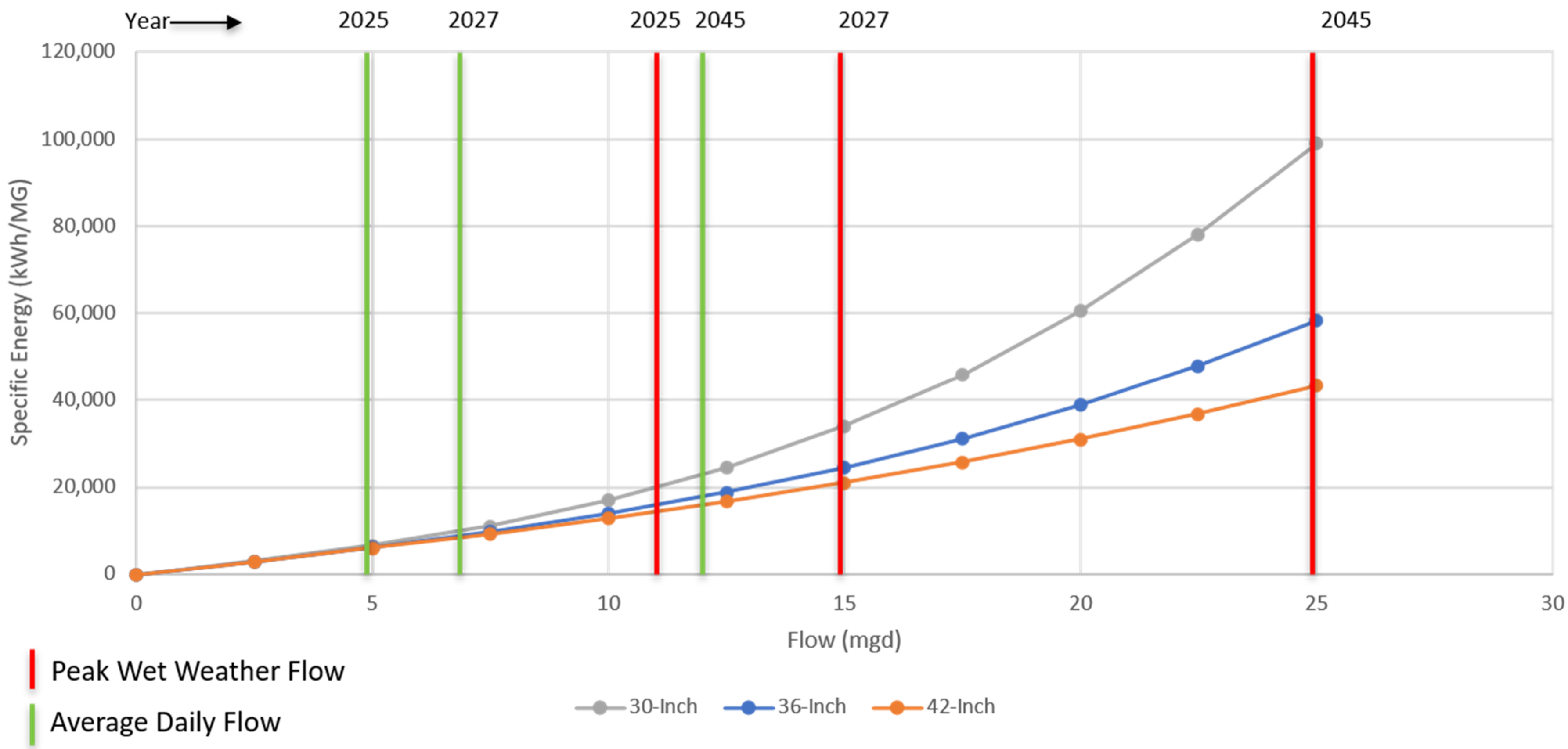


Figure 3-7: Specific energy profile for three different force main diameter alternatives.

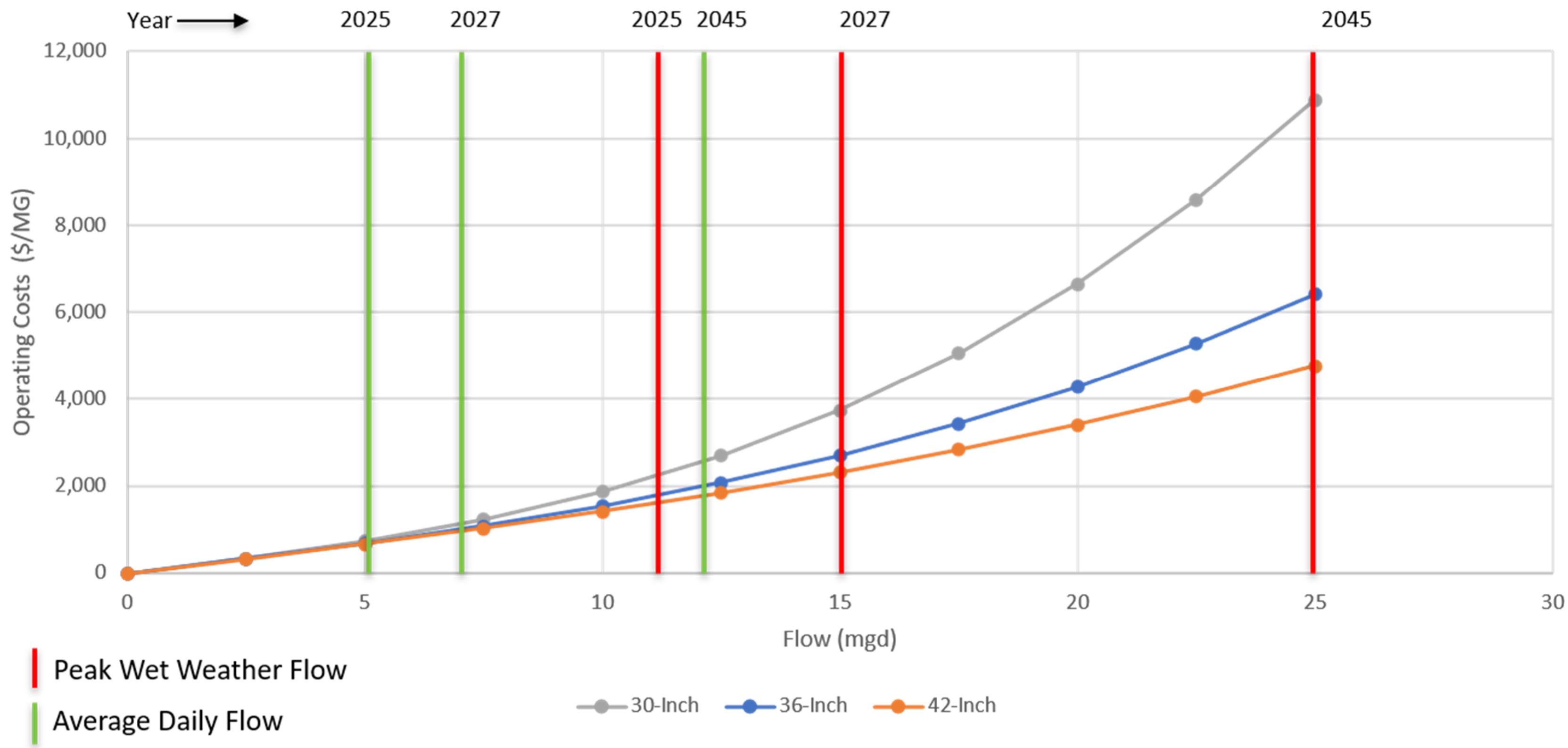


Figure 3-8: Operating costs profile for three different force main diameter alternatives.

Preliminary system curves and pump curves were developed based on the preliminary pump selection and flow through a 36-inch ductile iron force main. A c-factor of 120 was used for the high head system curve (solid blue line) and a c-factor of 140 was used for the low system curve (solid red line). The semi-opaque regions between the two system curves represent the anticipated peak wet weather flows for the three development years (2025, 2027, and 2045). See **Section 1.4.2** for additional information on the design flow phasing. **Figure 3-9, Figure 3-10**, and **Figure 3-11** show the preliminary pump and system curves for one pump, two pump, and three pump design scenarios, respectively.

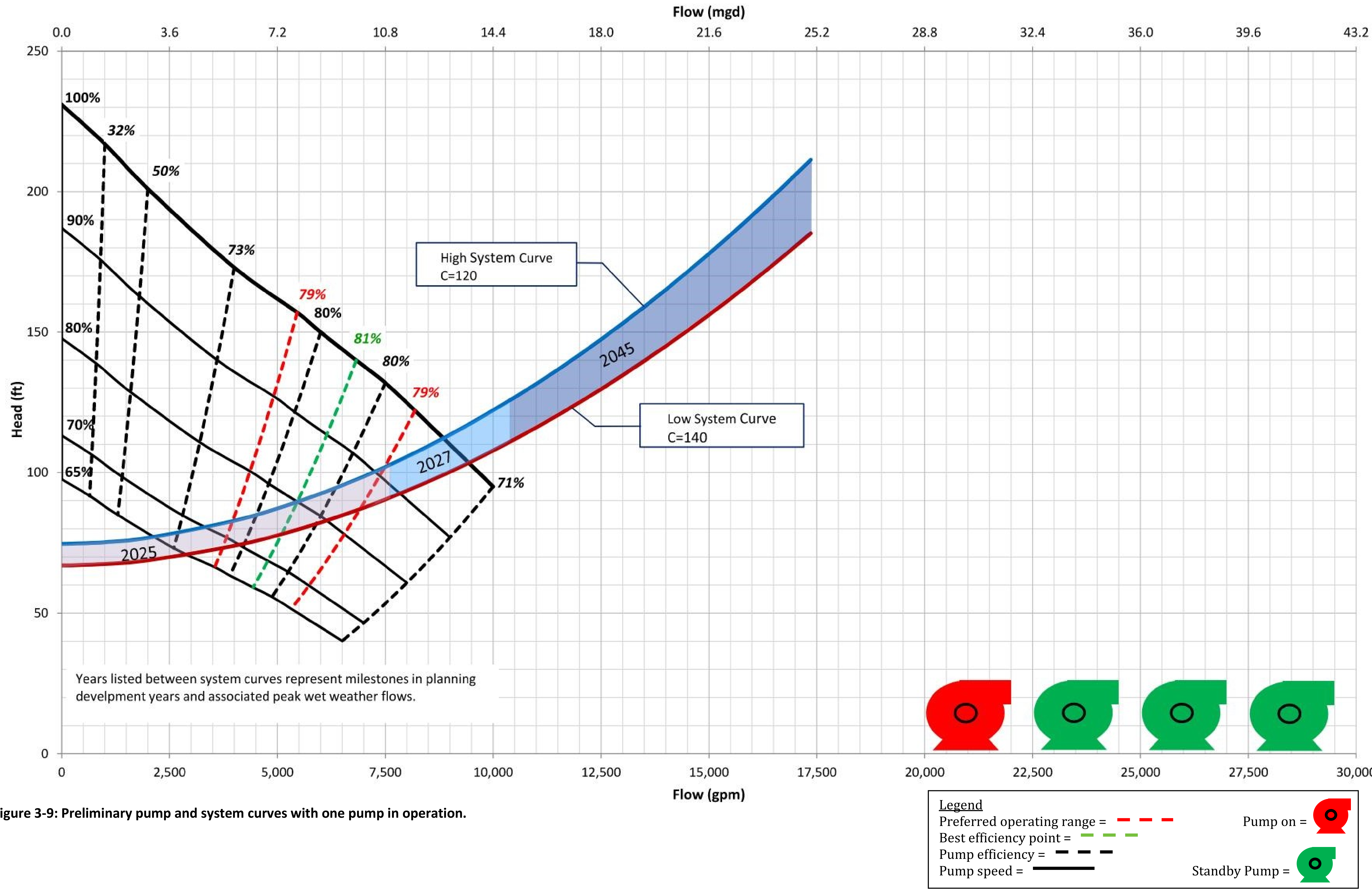


Figure 3-9: Preliminary pump and system curves with one pump in operation.

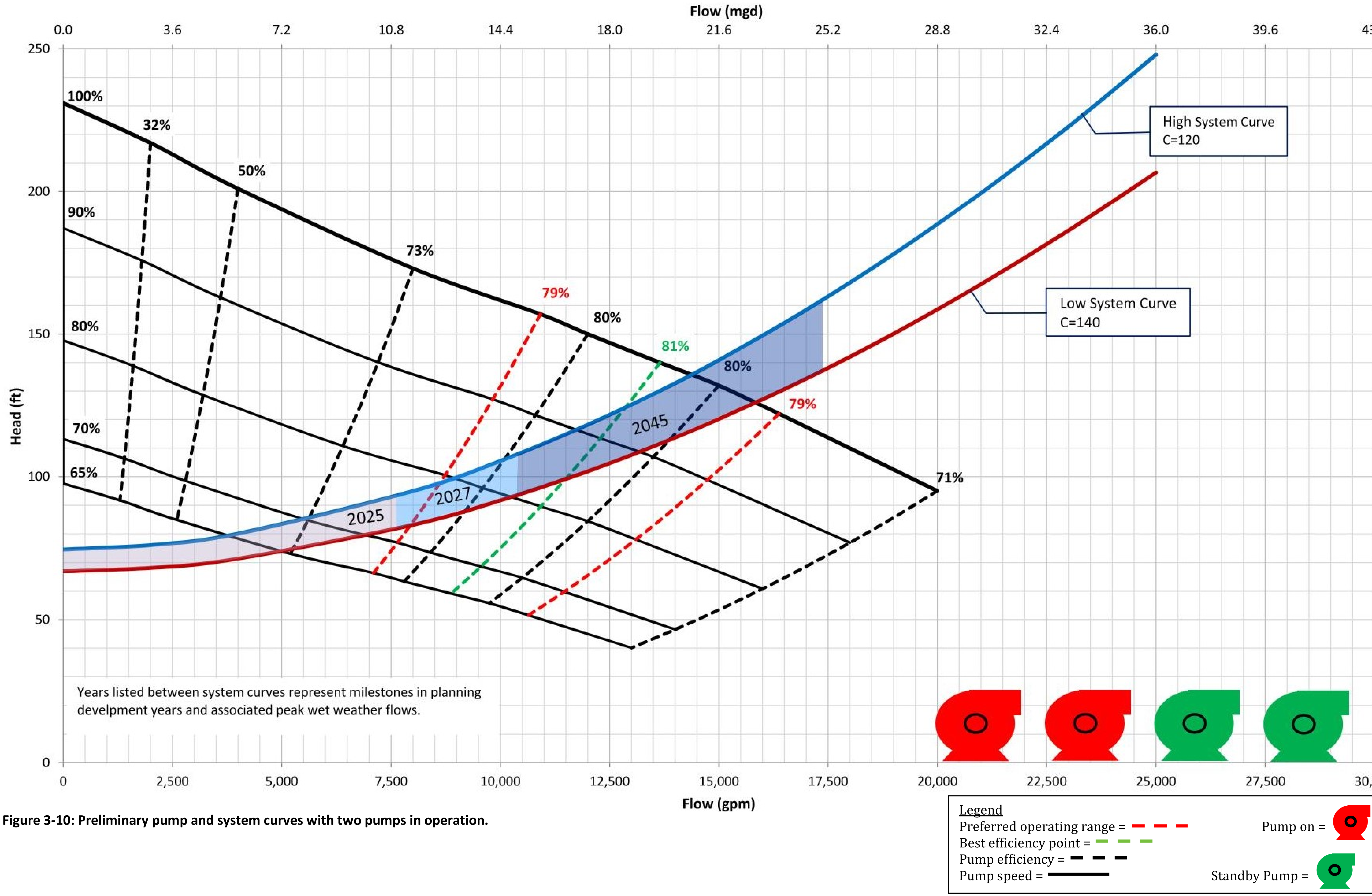


Figure 3-10: Preliminary pump and system curves with two pumps in operation.

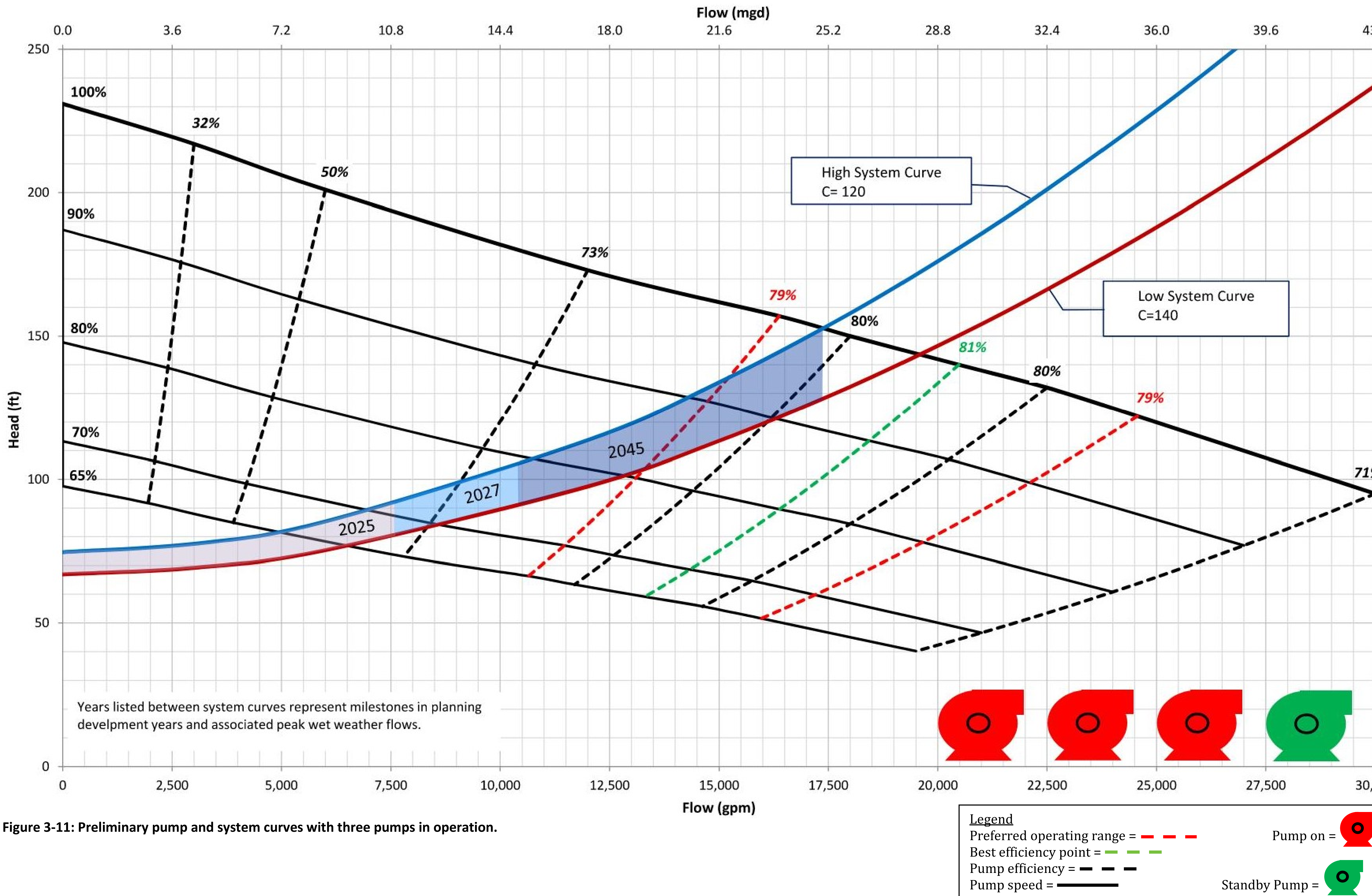


Figure 3-11: Preliminary pump and system curves with three pumps in operation.

3.2.6 Maintenance Room

A maintenance room will be located above the dry well, and will be an unoccupied space used primarily for storage and maintenance activities. Four hatches will be installed along the center of the room to allow the pumps to be removed from the dry well below using the monorail and hoist system. The hatches will be designed in accordance with the Fairfax County Facility Design Guidelines and equipped with fall protection grates and pneumatic lift assistance arms. The monorail and hoist system will be designed with enough capacity to lift the pumps and include some additional capacity to account for the potential for larger pumps to be installed in the future, which results in a rated capacity of approximately 5.0-tons with the current preliminary pump selection.

A monorail door will be provided on the west side of the maintenance room and will extend roughly 12-feet from the exterior face of the building to allow pumps to be loaded directly onto the back of a truck. The pumps are approximately 8.5-feet tall, which will result in approximately 4- to 5-feet of vertical clearance above grade when the pumps are lifted using the monorail system. If needed, the pumps could be laid down within the maintenance room and rigged horizontally to provide additional clearance to load the pumps directly onto the back of a truck.

3.2.7 Odor Control

The changing characteristics and mixed use of the local area requires consideration for a robust odor control system to eliminate noxious and unpleasant odors from impacting the surrounding areas. The treatment options evaluated in this section include carbon adsorption and biological treatment. The proposed odor control system will consist of two activated carbon (GAC) systems designed as duty/standby to provide redundancy so that one system can be taken offline for regular maintenance activities. A single duty adsorber unit will require that untreated air be exhausted directly to the atmosphere during media maintenance events. The odor control system is designed to ventilate the pump station odor sources to control fugitive emissions, treat the emissions, and exhaust them into the atmosphere. Initially, it will treat emissions from the existing flows and long detention times in the TEPS force main and Difficult Run gravity main.

The recommended odor control system will be designed to treat odorous emissions, primarily inorganic hydrogen sulfide (H_2S), generated from the grinder channels, influent channels, screening, and wet wells.

3.2.7.1 Design Considerations

The odor control design is a function of the pump station ventilation rate and the strength of odors. The ventilation rate is derived from headspace calculations in the wet well, flow splitter box, and grinder vault. The total headspace volume was then used to determine the total airflow at 12 air changes per hour (ACH), which results in a design airflow of 4,000 ft^3/min (CFM), with a 10% safety factor. A summary of the design criteria for the odor control system is included in **Table 3-4**. To confirm the strength of existing odors, OdaLog H_2S Gas Data Loggers will be installed upstream of the proposed pump station. The design currently assumes an average H_2S level of less than 5 parts per a million (ppm) as determined by hydrogen sulfide (H_2S) sampling performed upstream.

Table 3-4: Odor control design criteria.

Odor Control Calculations								
Location	Channel Dimensions (ft)			Number	Volume (ft^3)	Airflow at ACH (cfm)		
	L	W	HS			12	6	4
Grinder vault	25	22	15	1	8,250	1,650	825	550
Grinder vault enclosure	22	18	12	1	4,752	950	475	317
Flow splitter box	30	8	8	1	1,920	384	192	128
Wet well	24	17	8	2	3,264	653	326	218
Subtotals					18,186	3,637	1,819	1,212
Total with 10% SF						**4,000**		

The two treatment alternatives for odor control considered for the TWPS location include a carbon adsorption system and modular biological system. The advantages and disadvantages of each alternative is presented in this section. The volumetric loading rate (CFM) and odor strength in terms of ppm H_2S, were used to size and compare the alternative treatment systems. PureAir was used as the base of design for a carbon system, and BioAir Solutions was used as the basis of design for the biological equipment. The following criteria was considered when comparing the alternatives:

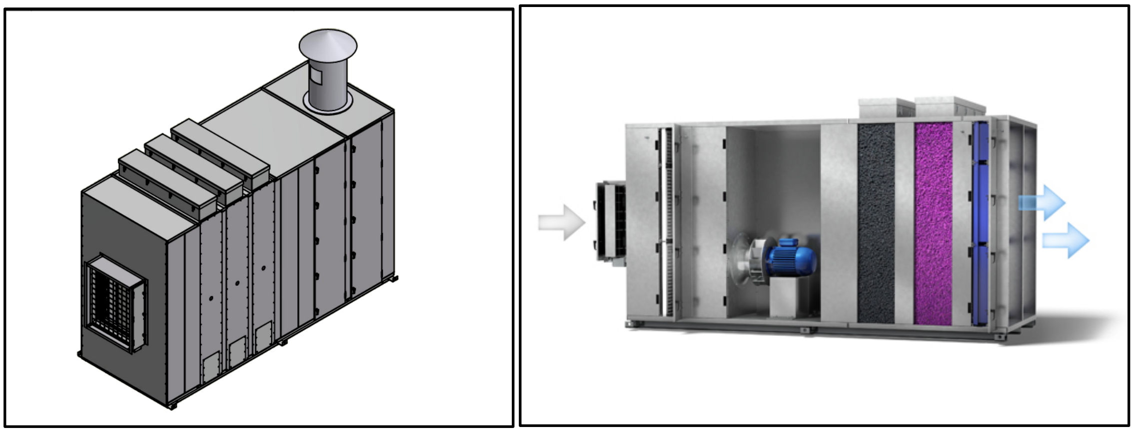
- Overall odor removal performance
- Required installation footprint
- Operations and maintenance requirements
- Fairfax County's preferences

3.2.7.2 Carbon Adsorption Systems

Carbon adsorption systems use an adsorptive media to remove odorous air contaminants from the air stream. Modern carbon designs are not regenerable and include both catalytic carbon and chemically impregnated carbon. Catalytic carbon converts H_2S to elemental sulfur and results in a nonhazardous product that can be landfilled when spent. In addition, alumina media impregnated with permanganate can provide a wide range of odor removal beyond H_2S; therefore, it is not unusual to blend media to meet specific influent conditions and exhaust requirements.

Carbon adsorption maintenance is minimal with simple equipment, including a carbon vessel, fan, and control. Carbon system designs include skid-mounted systems for small applications or multistage systems for higher airflow. **Figure 3-12** shows a single bed adsorbed unit.

Figure 3-12: Parallel bed carbon adsorber (courtesy of Purafil).



Carbon adsorption is most cost-effective for H_2S concentrations of less than 10 ppm H_2S, as concentrations greater than 10 ppm will accelerate carbon replacement requirements. The estimated carbon media life with <5 ppm H_2S concentration is 3 years.

The carbon system proposed is a horizontal flow arrangement with a grease filter/mist eliminator integrated into the front end and a fan installed upstream of the media sections integrated into the vessel. The exhaust will be directed vertically out the exhaust stack to aid in diffusion of the treated air.

Water is not required for modern carbon adsorption systems and maintenance is minimal. Fan maintenance, carbon use estimates, and odor removal performance is required to ensure the odor sources are ventilated properly and fugitive odors are not being released to the atmosphere. A small amount of condensate will drain from the vessels and fans back to the wet well. **Table 3-5** presents the equipment specifications for carbon adsorbers.

Table 3-5: Carbon adsorber equipment specifications.

Parameter	Specification
Number of beds	Horizontal Beds
Vessel Length and Width	13 ft. X 5.4 ft.
Vessel sidewall height	9.0 ft.
System pressure loss	6 in. wc.
Estimated carbon life	3 years

3.2.7.3 Biological Systems

Biological odor control systems, such as biofilters and biotrickling filters, can effectively remove H_2S at very high levels for many years without media replacement. They also are effective on lower levels of residual organic compounds from wastewater process air emissions. While these systems are very effective in treating H_2S, there may be a musty residual odor that may be offensive in very sensitive areas. In these situations, biological methods may require second-stage treatment or polishing to improve the air quality.

The vertical biofilters act as countercurrent scrubbers where air flows upward across a plastic media bed while water is sprayed along the top of the bed. A biofilm develops on the media and facilitates the movement of contaminants in the airstream into the biofilm. Bacteria in the biofilm degrade the contaminants for energy, which results in the removal of odorous compounds from the airstream. A biotrickling system is shown in **Figure 3-13**.

Figure 3-13: Biotrickling filter (courtesy of BioAir Solutions).

Biological systems are low-maintenance due to their simple process design, but are more complex than a carbon system. Like the carbon system, the biological filter requires a fan to transfer air from the odor source to the scrubber; however, in contrast to a carbon adsorber, an irrigation system is required to flow water over the media bed, and nutrient addition to the irrigation fluid is required. The equipment is limited to a vessel, a fan, and irrigation controls, where operations of the fan and irrigation system are key to maintaining optimum performance. Drainage is at a low pH and conveyance and deposition to the wet well must be considered. The equipment specifications for biotrickling filters is presented in **Table 3-6**.

Table 3-6: Biotrickling Filter Equipment Specifications.

Parameter	Specification
Filter diameter	6 ft.
Filter height[1]	15 ft.
Estimated media life [2]	> 20 years
System pressure loss	0.9 in. w.c.
Proposed media	Synthetic
Approximate water usage	≤ 1.0 gpm
Approximate nutrient usage	0.16 gal/day

[1] Excludes stack height.
[2] Based on the BioAir EcoBase synthetic media.

3.2.7.4 Installation Requirements

3.2.7.4.1 Civil/Structural

The odor control system will be located on a concrete pad that supports the vessel, fan(s), and control panels. **Table 3-7** includes approximate dimensions for the required concrete pad.

Table 3-7: Odor control concrete pad dimensions.

Treatment Alternative	Estimated Dimension
Carbon Adsorption System	15 ft. X 36 ft.
Biotrickling Filter	12 ft. X 24 ft.

Ductwork will be designed to convey air from each odor source to the fans, which will force air to the odor control system. The ductwork will be fiberglass located above ground with clearance for traffic or pedestrians as required. The layout will be coordinated with existing underground yard piping with supports designed to accommodate local wind loading on the duct itself. Both designs will include duty/standby fans located within sound enclosures; the carbon system will include a redundant carbon vessel to facilitate carbon replacement without losing treatment. The biological system does not require a stand-by reactor.

A water source for the biological trickling filter is required for irrigation and make-up water for the chemical scrubber. For a carbon absorption system, only drainage will be required. All irrigation and drainage systems will be buried piping.

3.2.7.4.2 Electrical

The required electrical power supply for a carbon adsorption system, biotrickling filter, and a chemical scrubber are all 480V/3-phase/60 Hz. The estimated energy use for each treatment alternative is presented in **Table 3-8**.

Table 3-8: Odor control estimated energy use.

Treatment Alternative	Estimated Energy Use
Carbon adsorption system	100 kWh/day
Biotrickling filter	75 kWh/day

3.2.7.4.3 Instrumentation and Control

All equipment options include a vendor-supplied control panel with dry contacts for connection to the local Programmable Logic Controller (PLC) that will be used to communicate status and alarm information to the County's SCADA system. The biological filters require minor operations and maintenance oversight but more than the carbon adsorption alternative. The odor control equipment is controlled from the vendor supplied control panel and, as such, no external signals or interlocks with other equipment are required. Signals for odor control fan status and duct pressure downstream of the fan will be monitored at the pump station location, as well as any major equipment alarm conditions.

3.2.7.5 Recommended Odor Control Treatment System

The recommended odor control treatment system is the horizontal flow carbon adsorber system. The decision is strongly based upon site constraints, including the quality of air required for such a sensitive location, the need to minimize maintenance truck traffic in the area, and high odor removal performance. Carbon systems can reduce odors to a greater extent and have less regular maintenance than biotrickling filter systems; however, the media must be replaced when spent, which is predicted to be 3 years. The entire system, including a dedicated fan for each system, grease filters, and duty/standby carbon vessels, is designed to provide a quiet and effective treatment system with redundancy in ventilation and treatment.

The caveat to this design is that the H_2S levels should average 5 ppm to maximize media life. Future analysis of the upstream sewer system will confirm existing H_2S concentrations and indicate whether systemic treatment in the form of chemical addition will be required to meet the H_2S strength limits.

3.2.8 Wet Well Bypass

Both halves of the wet well can be isolated using the slide gates in the flow splitter box to permit bypass of either side of the wet well. As discussed in **Section 3.2.2**, there will be provisions for isolating and bypassing the channel grinder for periodic maintenance. The entire pump station (wet wells and dry well) can be bypassed by closing both the slide gates between the flow splitter box and wet wells and connecting temporary bypass piping and pumps to one or both of the 20-inch bypass connections and a tee located on the force main downstream of the pump station. The tee on the force main will be located within the pump station site in a vault to allow Fairfax County staff to easily access the bypass connection. The two bypass connections within the flow splitter box will provide enough capacity to bypass the peak wet weather flow at the ultimate build out capacity of the pump station (25 mgd).

Providing a bypass valve between the influent manhole and grinder vault was considered; however, this arrangement would require the County to use temporary submersible pumps and/or suction piping within the influent manhole and prevent the County from leveraging the benefits of the grinder during bypass pumping operations, which could lead to clogs and disruptions in bypass pumping operations. Using permanently installed bypass suction piping can simplify the setup of bypass pumping operations and allow the County to focus on the operation of temporary pumping components above grade, which could be valuable during emergency situations when time is of the essence. If the County prefers to drop submersible pumps directly into the process flow and forgo the use of suction piping, the temporary bypass piping connections in the flow splitter box could be replaced with access hatches and guide rail systems.

3.2.9 Flow Metering

A single in-line magnetic flowmeter will be provided on each pump discharge in accordance with the Fairfax County Facility Design Guidelines Manual. Traditional mag meters can be installed in the horizontal on the straight run of elevated pump discharge piping; however, this would require an elevated platform to access the mag meter for maintenance. The lay length requirements of traditional mag meters would need to be confirmed during detailed design and the dry well length may need to be increased slightly to accommodate the traditional mag meter lay length requirements as the current pipe arrangement provides minimal straight pipe lay lengths. Advanced mag meters with limited upstream and downstream lay length requirements can be installed on the lower portion of horizontal pump discharge piping to improve access for maintenance and avoid having to increase the dry well length. The additional cost for the advanced mag meters may be justified in keeping the corridor below the elevated pump discharge segments open and not constrained by access platforms, and potentially avoiding the cost of extending the dry well slightly; however, the mag meter type can be reconsidered during detailed design to confirm the best approach to flow metering. The final location and installation conditions will need to be coordinated with mag meter manufacturers during detailed design.

3.2.10 Pump Station Modeling

The preliminary pump station layout was developed using a Building Information Modeling (BIM) method, which provides a number of benefits to the designer, constructor, and owner throughout the lifecycle of the project and facility. **Table 3-9** summarizes many of the benefits of virtual design and construction.

Table 3-9: Benefits of enterprise virtual design and construction.

Design Drawings/IFC Coordination	Subcontractor/Trade Level Shop Drawing Coordination	Existing Conditions Verification	Field Verification for Layout and Survey	As-built Creation	Quantification for Estimating and Change Order Pricing	IP Reuse
▪ Reduce field conflicts during construction ▪ Less rework ▪ Improved confidence and pricing of construction ▪ Improved interdisciplinary collaboration	▪ Reduce field conflicts during construction ▪ Less rework and change orders ▪ Improved confidence and pricing of Estimate to Complete ▪ Trade partner collaboration and efficiency in the field	▪ Reduce uncertainty of existing site conditions ▪ More efficient and cost effective ▪ Improves client confidence during proposal ▪ Improves confidence in pricing	▪ Validate subs' work for QC to reduce rework ▪ Improve efficiency for QC (time and accuracy of non-conformance) ▪ Reduce survey costs ▪ Improve accuracy with 3D	▪ Required by contract ▪ Added value to owner ▪ Reduce closeout time to get final payment ▪ Higher acceptance rate ▪ Potential add-on service for O&M, Asset Management	▪ Better estimating, less contingency ▪ Use estimate to determine if "over designed" ▪ Change order pricing is better supported ▪ Better info when procuring subs ▪ Trending from phase to phase before milestone	▪ Improved design ▪ Added value to client ▪ Improved confidence in cost

The model is currently at Level of Development 100, and provides a basic layout showing the various components of the pump station, rough dimensions of the major building features, and orientation of the building. Through the design process, this model will be developed to provide additional detail and information and produce bid-ready design drawings for construction. The model will be developed in accordance with Fairfax County's BIM standards as described in the Fairfax County Facility Design Guidelines Manual.

3.3 Pump Station Implementation

As discussed in **Section 1.4.2**, it is not expected that the flows to the TWPS will reach the build-out capacity of 25 mgd until approximately 2045 and flows will be considerably lower initially. This provides an opportunity to phase the pump installation and potential flexibility to adapt to changes in the regional flow projections.

As summarized in **Table 3-10**, the preliminary pump selection and configuration will provide Fairfax County with the ability to pump the average daily (ADF) and anticipated peak wet weather flows (PWW) in 2025 and 2027 using two duty pumps. Fairfax County can consider installing three pumps initially, which could provide capital cost-savings and adequate pump capacity until peak wet weather flows approach approximately 20 mgd. Once peak wet weather flows exceed approximately 20 mgd, the fourth pump will need to be installed to allow three pumps to operate with one standby pump. With three duty pumps and one standby pump, the pump capacity will be 25 mgd (pump station ultimate buildout capacity) under low- and high-head conditions. Based on the preliminary pump selection, force main routing, and hydraulic calculations, the maximum pumping capacity will be between approximately 25 and 28 mgd, depending on the water surface elevation in the wet well. The maximum pumping capacity (~28 mgd) would occur when the water surface elevation in the wet well was at the highest level.

Table 3-10: Summary of anticipated flows with force main velocity and required pumps.

Year	Average Daily Flow (mgd)	Peak Wet Weather Flow (mgd)	Force Main Velocity ADF/PWW (fps)	Number of Installed Pumps (duty/standby)
2025	5	11	1.1/2.4	2/1
2027	7	15	1.5/3.3	2/1
Build-out (2045)	12	25	2.6/5.5	3/1

Fairfax County can also consider trimming the impeller of the pumps if the actual flows do not match the current flow projections and less pumping capacity is required in the future. This would reduce the head on the pumps and operational costs. The approach to the pump station implementation and potential phasing of pump installations should be reviewed during the detailed design phase and compared to the latest flow projections to determine if the pump station phasing and implementation approach should be modified. The preliminary pump selection will be refined during the detailed design phase as additional design information becomes available.

3.4 Future Capacity Upgrades

The current pump station design flow of 25 mgd accounts for the anticipated increase in required wastewater conveyance and pumping capacity to address the rapid development of northwest Tysons. The design flow also includes provisions for receiving flows from the future TEPS that will be constructed to accommodate additional flows as a result of development in northeast Tysons. The following provisions give Fairfax County the ability to increase the flow capacity of the TWPS if needed in the future:

- The dry well has additional space to allow the proposed pumps to be replaced with larger pumps in the future should the pump station capacity exceed 25 mgd. Utilizing the existing suction piping, each pump could be increased in capacity to 9.1 mgd or a station capacity of 27.3 mgd based on a suction piping velocity of 8 ft/s.
- The perforated drum on the grinder can be replaced with a larger perforated drum to increase the flow capacity to approximately 40 mgd.
- The 36-inch force main provides additional flow capacity and, based on flow velocity, the force main could reasonably convey up to 40 mgd assuming a maximum velocity of 8 ft/s. Pump sizing and hydraulics would need to be reviewed in detail to confirm the expansion capacity. This type of expansion evaluation could be completed in the future if actual flows begin to significantly surpass flow projections and a pump station expansion is warranted.
- The electrical room is sized to provide space for future loads and provides 25% spare capacity.

Additional provisions can be integrated into the pump station design should expansion beyond 25 mgd be desirable and/or warranted. There is room on the site to expand the pump station structures if needed.

Section 4

Gravity Sewer Routing

4.1 Introduction

Based on the recommendations of the Tysons Corner Sanitary Sewer Master Plan (April, 2020), the new Tysons West Pump Station (TWPS) must collect flow from the local collection system, the Difficult Run Interceptor, and the future Tysons East Pump Station (TEPS). The estimated flows to the pump station are 10 million gallons per day (mgd) from the Difficult Run Interceptor, 10 mgd from future TEPS (assumed constant flow), and 5 mgd from the local Tysons West sanitary sewer service area. This results in a total design capacity of 25 mgd peak flow for TWPS. This section presents alternatives for the conveyance of flow from Difficult Run Interceptor and local Tysons West sanitary sewer service area to TWPS. The new force main from TEPS will be designed under the Tysons East project.

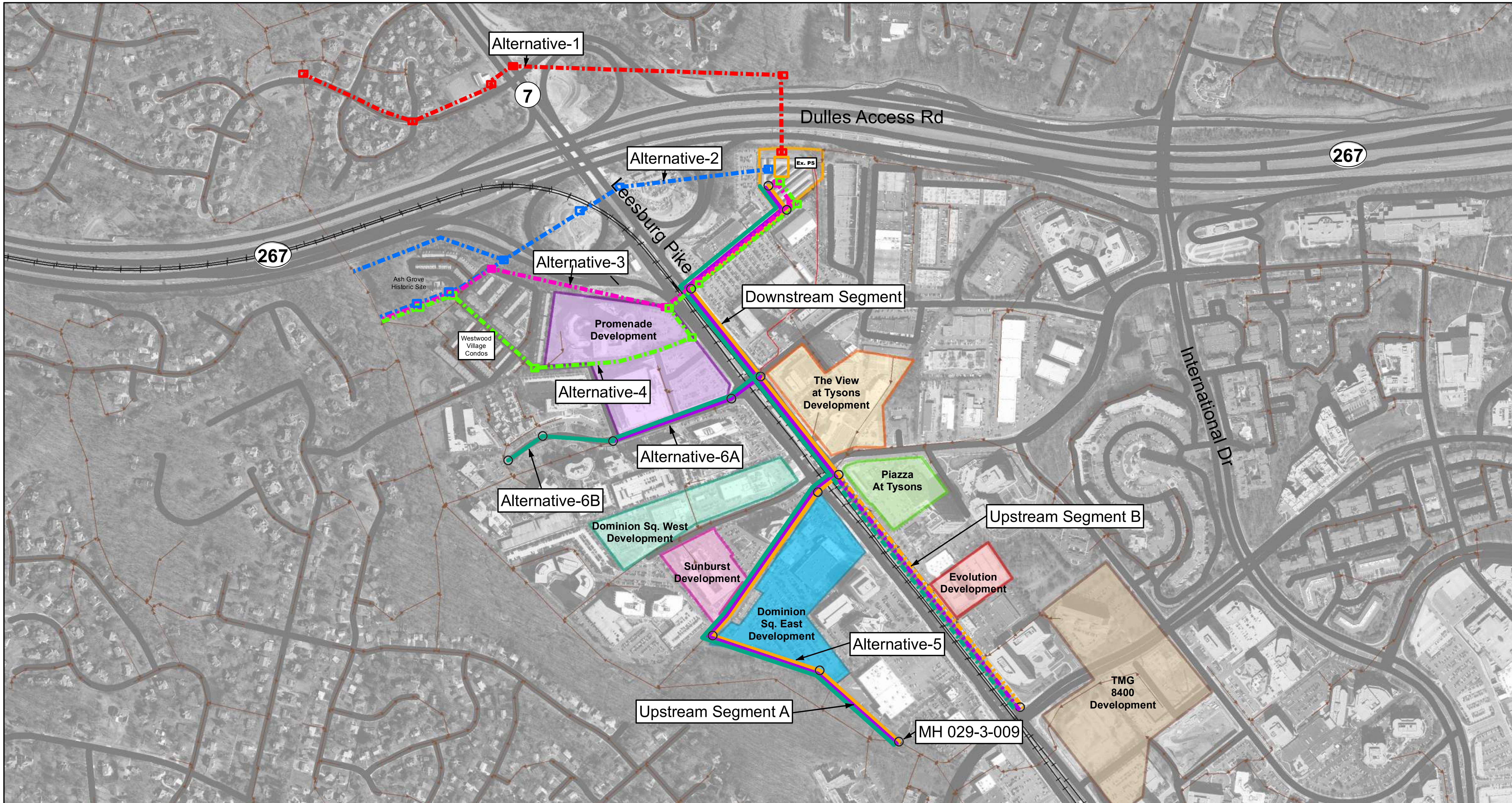
CDM Smith evaluated the feasibility of expanding the current pump station service area to increase the incoming flow from the local collection system. The Tysons West basin expansion will capture additional flows from only six developments with pending or recently approved applications that will be constructed along Route 7 between West Park Drive and Route 267. As presented in the Tysons Basin Expansion Memo prepared by CDM Smith (**Appendix B**), the new gravity trunk sewer can collect 2.96 mgd in addition to 7.04 mgd from the Difficult Run Interceptor, for a total of 10 mgd. Collecting additional flow from the local collection system will reduce the flow transferred by the existing Difficult Run Interceptor to the Difficult Run Pump Station, which is a stated goal of the Tysons Corner Sanitary Sewer Master Plan prepared by Carollo (January, 2020).

Tying in a new gravity sewer line to the Difficult Run Interceptor is one of the key elements of this project. The new gravity sewer line will convey approximately 10 mgd from the Difficult Run Interceptor to the new TWPS. This section of the Preliminary Engineering Report (PER) focuses on the evaluation of the potential routing alternatives and recommendations for the alignment of the new gravity sewer. The content in this section is based on the geographical information system (GIS) imagery, desktop study, and best available record data at the time the document was prepared; it does not include any site topographic survey or environmental studies.

4.2 Gravity Sewer Alignment Alternatives

Six preliminary gravity routing alignments were considered for connecting the Difficult Run Interceptor and the new TWPS. The potential gravity routing alternatives were selected by starting at the Difficult Run Interceptor alignment and choosing logical routes along existing roadways to the TWPS site. Alternatives 1 through 4 connect the Difficult Run Interceptor to the new pump station; Alternatives 5 and 6 serve as a gravity trunk sewer collecting the flow from new developments along Leesburg Pike, as well as the gravity connection to the Difficult Run Interceptor. **Figure 4-1** presents a plan view of all six proposed alternative alignments.

CDM Smith conducted preliminary investigations and field reconnaissance of the potential pipe routes. In addition to the use of GIS imagery and mapping provided by the Fairfax County Department of Public Works and Environmental Services (DPWES), sections of the project area were driven and walked to determine the best pipe alignment with respect to roadways, streams, utilities, and other infrastructure conflicts. This section provides a brief description of the alternatives and the existing conditions along the routes followed by the recommended alignment. **Appendix A** provides a full routing analysis memo**.**



Legend

- Force Main
- Gravity Sewer
- Roads
- Ex. PS Existing Sanitary Sewer Pump Station
- Proposed Tysons West PS Location
- Proposed Manhole
- Alternative - 1 ~ 3884 LF
- Alternative - 2 ~ 2802 LF
- Alternative - 3 ~ 3221 LF
- Alternative - 4 ~ 3801 LF
- Alternative - 5 ~ 7325 LF
- Alternative - 6A ~ 9135 LF
- Alternative - 6B ~ 8393 LF

N

Tysons West Gravity Sewer Alternatives

0 375 750 1,500 Feet

Figure 4-1

CDM Smith

4.2.1 General Assumptions

It is assumed that the new gravity sewer will be 36 inches in diameter based on the calculations for the total incoming flow from the existing sewer basin, the connection to Difficult Run Interceptor, and additional capacity from the six proposed developments along Leesburg Pike. A Manning's number of 0.013 was used for the calculations. The inverts at the pump station and connection points for each alternative were calculated based on the assumption that the entire length of alignment will be built according to the VA Sewer Collection and Treatment (SCAT) minimum-required slope of 0.058 feet (ft) per 100 ft, and there will be one manhole (with 0.2-foot drop) for every 500 ft of the pipe.

For all the alternatives, the connection point to the Difficult Run Interceptor will be constructed in a diversion structure to divert flow from the Difficult Run Interceptor to TWPS. The diversion structure will have an active flow control.

4.2.2 Route Alternative 1

Alternative 1 alignment will begin at the proposed diversion structure to the segment of the Difficult Run Interceptor crossing Jarrett Valley Road between Wellingham Court and Carrington Ridge Lane. The new gravity sewer then proceeds east along Jarrett Valley Drive for approximately 1,450 linear feet (lf), passing through a short residential neighborhood, Carrington, and crossing the intersection of Jarret Valley Drive and Leesburg Pike by open-cut construction. From the east side of the intersection, the alignment follows the path along the westbound ramp coming from Route 267 toward Leesburg Pike for approximately 250 lf, and it crosses under a walkway tunnel and the ramp behind a residential neighborhood in Mayhurst Boulevard. The alignment continues in an easterly direction for another 1,150 lf along the south edge of the residential neighborhood before going to a forested area for about 350 lf. The gravity line continues by crossing Route 267, where a tunneling installation is anticipated. The length of tunneling would be approximately 500 lf. The ultimate connection point for the gravity line would be the TWPS site located south of Route 267 at 8608 Leesburg Pike. The insertion pit for the tunneling would be located at the pump station site, and the receiving pit would be located south of the Mayhurst Boulevard residential neighborhood. The length of Alternative 1 is approximately 3,884 lf.

The entire alignment for Alternative 1 must be constructed using microtunneling considering the depth of the new gravity sewer. Along Jarrett Valley Drive, the alignment will be parallel to Dominion Energy's primary underground electrical distribution line for about 1,400 lf. The portion of the alignment that follows Jarrett Valley Drive will be near single-family homes and a chapel, which will impact accessibility during construction. A total of three microtunneling pits will be located along Jarret Valley Drive. The third microtunneling pit will be a launching pit located west of Leesburg Pike in the parking lot of McLean Islamic Center (MIC). The fourth microtunneling pit will be a receiving pit, which will be constructed in a triangle-shaped open green space adjacent to the ramp from Route 267 to Leesburg Pike, which is one of the main exits to neighborhoods surrounding Leesburg Pike. The fifth microtunneling pit will be located on the north side of Route 267, and the last pit will be constructed south of Route 267 at the new pump station site.

4.2.2.1 Topography for Alternative 1

The preliminary evaluation shows the invert elevation of the new gravity sewer line at the Difficult Run Interceptor tie-in location will be approximately at 319 ft. The invert of the new gravity sewer pipe at the new TWPS will be approximately at 315 ft (45 ft below grade).

CDM Smith used the available data from Upper Difficult Run Shed–Old Courthouse Run Trunk Sewers as-built drawings dated May 10, 1995, for this evaluation.

4.2.3 Route Alternative 2

For Alternative 2A, the alignment will begin at a segment of Difficult Run Interceptor located along Difficult Run Old Courthouse Spring Branch at a connection point south of Route 267 eastbound. The route will continue for approximately 800 ft along Route 267 eastbound. The first microtunneling pit will be located north of Northern Neck Drive in the forested area adjacent to Westwood Village Condominium residential community. From there, it crosses under three road ramps, two going from Route 267 eastbound to Leesburg Pike (one is an elevated ramp) and one from Leesburg Pike to Route 267 Eastbound. The second pit will be located inside the interchange loop ramps before an elevated metro railroad and Leesburg Pike crossing. The third microtunneling pit will be located inside the open space area within the interchange loop ramp east of Leesburg Pike, and the last pit will be at the new pump station site.

For Alternative 2B, the alignment will begin at a segment of Difficult Run Interceptor located along Difficult Run Old Courthouse Spring Branch at a connection point approximately 420 lf south of Route 267 eastbound. The route will continue for approximately 200 lf before arriving at the first microtunneling pit, which will be located at the Fairfax County Park Authority's Ash Grove property. The alignment will continue under Ash Grove property for approximately 450 lf. The second microtunneling pit will be located at the eastern side of Ash Grove property. The alignment then continues under Northern Neck Drive in Westwood Village Condominium residential community for approximately 350 lf before reaching the third microtunneling pit, which will be located north of Northern Neck Drive in the forested area. From there, the alignment routing is similar to Alternative 2A until reaching the connection point at the new pump station site.

The Dominion Energy transformer at the end of the northeastern side of the Northern Neck Drive parking lot, as well as overhead power lines, means the alignment most likely requires an easement from Westwood Village private property in this area. Permitting for this alternative could be challenging due to multiple crossings under the ramps.

4.2.3.1 Topography for Alternative 2

The preliminary evaluation shows that the invert elevation of the new gravity sewer line at the Difficult Run Interceptor tie-in location will be approximately at 330 ft for Alternative 2A and 333 ft for Alternative 2B. The invert of the new gravity sewer pipe at the new TWPS will be located at approximately 330 ft for Alternative 2A and 327 ft for Alternative 2B (30 ft below grade).

4.2.4 Route Alternative 3

Similar to Alternatives 1 and 2, almost the entire length of Alternative 3 will be constructed using a microtunneling method. Similar to Alternative 2B, Alternative 3 will begin at the segment of the

Difficult Run Interceptor, which is located along Difficult Run Old Courthouse Spring Branch at a connection point approximately 420 lf south of Route 267. The first 100 lf of the alignment will be open-cut construction before arriving at the first microtunneling pit, which will be located at the Fairfax County Park Authority's property (Ash Grove). The route will then cross under approximately 450 ft of Ash Grove property, before entering the second pit located at the eastern end of Ash Grove property adjacent to Westwood Village Condominium residential community. Once in Westwood Village property, the pipe travels under Northern Neck Drive for approximately 300 lf before reaching the third pit, which will be located north of Northern Neck Drive in the forested area. The alternative will turn southeast following Northern Neck Drive for 450 lf, followed by 750 lf adjacent to the Sheraton Tysons Hotel property, which will most likely require an easement from Sheraton. The alignment will continue, crossing under Leesburg Pike with the fourth and fifth pits being on the opposite sides of Leesburg Pike. From there, it continues along Industrial Way for approximately 900 lf before reaching the sixth pit, which will be located adjacent to the new pump station property. The alignment then travels northwest into the 8608 Leesburg Pike property for approximately 200 lf to reach the ultimate connection point at the TWPS site. The total length of Alternative 3 is approximately 3,221 ft.

Similar to Alternative 2, at the end of the northeastern side of the Northern Neck Drive parking lot, there is a Dominion Energy transformer and overhead power lines; therefore, the new gravity sewer most likely should be located in acquired easements inside the Westwood Village private property in this area. The portion of alignment located on the north side of the Westwood Village Condominiums and Sheraton Tysons properties runs parallel to a Dominion Energy overhead powerline for approximately 1,200 lf. This portion of pipeline would require an easement from Sheraton, Westwood Village Condominiums, and most likely a shared easement with Dominion Energy in some areas.

This alternative presents minimum traffic impacts on Leesburg Pike and Route 267 due to trenchless installations, but it could have potentially extensive impacts on the Sheraton property. Construction of the pit on the northern side of the Sheraton property may require closure of Ashgrove Lane on the northern and eastern sides of the Sheraton property. This could create operational and/or parking traffic disruptions for Sheraton. Construction of a trenchless installation pit on the east side of Leesburg Pike will require negotiating a large construction easement with business owners in that area. Additionally, the construction needs to be coordinated with businesses to minimize the impact on their operations (specifically Koons Tysons Toyota dealership and Collision Repair Center).

4.2.4.1 Topography for Alternative 3

The preliminary evaluation shows that the invert elevation of the new gravity sewer line at the Difficult Run Interceptor tie-in location will be located at approximately 333 ft. The invert of the new gravity sewer pipe at the new TWPS will be approximately at 329 ft (31 ft below grade).

4.2.5 Route Alternative 4

Similar to Alternatives 1, 2, and 3, almost the entire length of Alternative 4 will be constructed using a microtunneling method. Alternative 4 alignment will begin from the same Difficult Run Interceptor location as proposed in the Alternative 2B and 3 alignments, followed by crossing under Fairfax County Park Authority property (Ash Grove). Starting from the second microtunneling pit at the eastern side of the Ash Grove property adjacent to Ashgrove House Lane, the alignment will turn southeast and pass through the middle of the Westwood Village residential area along Ashgrove Lane for approximately 700 lf before arriving at the third microtunneling pit. The third pit will be located on Ashgrove Lane across from the 8614 Ashgrove Lane property. The alignment will continue by passing through a primarily commercial area south of Sheraton Tysons for approximately 1,100 lf before arriving at the fourth pit, which will be located at the intersection of Ashgrove Lane and Leesburg Pike. This alternative will cross under Leesburg Pike in the same location as Alternative 3. The route will then follow Industrial Way and enter the new pump station in the same way as Alternative 3. The total length of Alternative 4 is approximately 3,800 ft.

A large portion of the Alternative 4 alignment will be in acquired easements within Westwood Village private property. This alternative will have minimum traffic impacts on Leesburg Pike and Route 267 due to trenchless installations, but it will have some impacts on the Sheraton property and Westwood Village Residential Community due to the location of the microtunneling pits. Trenchless crossing installation under Leesburg Pike may require a temporary closure of a section of Ashgrove Lane on the eastern and northern sides of the Sheraton property due to the location of the pit. This could present operational and/or parking traffic disruptions for Sheraton. Construction of a trenchless installation pit on the east side of Leesburg Pike will require negotiating a large construction easement with business owners in that area. Additionally, open-cut construction in that area needs to be coordinated with businesses to minimize the impact on their operations (specifically, the Koons Tysons Toyota Dealership and Collision Repair Center).

4.2.5.1 Topography for Alternative 4

The preliminary evaluation of the Alternative 4 new gravity sewer shows that the invert elevation of the new gravity sewer line at the Difficult Run Interceptor tie-in location will be located at approximately 333 ft. The invert of the new gravity sewer pipe at the new TWPS will be approximately at 329 ft (31 ft below grade).

4.2.6 Route Alternative 5

The Alternative 5 alignment consists of three segments: Upstream Segment A, Upstream Segment B, and the Downstream Segment. The entire length of Alternative 5, with the exception of the trenchless crossing of Leesburg Pike, will be constructed by open-cut construction.

Upstream Segment A: This segment of Alternative 5 starts at manhole 029-3-009 on the Difficult Run Interceptor and continues northwest along the western edge of Properties 8433, 8449, 8459, and 8525 (Fairfax County property numbers) for approximately 1,450 lf. The alignment then continues along Vesper Trail northeast for approximately 1,000 lf until it reaches the intersection of Spring Hill Road and Leesburg Pike. The alignment continues by crossing under Leesburg Pike, where trenchless installation is anticipated. The length of the trenchless crossing is approximately 250 lf. Upstream Segment A collects the flow from the Difficult Run Interceptor and three new developments: Dominion Square East, Sunburst, and eastern Dominion Square West.

Upstream Segment B: This upstream segment starts at the intersection of Leesburg Pike and Westpark Drive, continuing along Leesburg Pike for approximately 2,100 lf until it reaches the intersection of Leesburg Pike and Spring Hill Road. This segment collects the flow from the Evolution and Piazza at Tysons developments before merging with the Upstream Segment A segment coming from the West. This segment could be extended as far as West Park Drive if needed.

Downstream Segment: The downstream segment of the trunk sewer line collects the flow from Upstream Segment A and Upstream Segment B. The line continues northwest along Leesburg Pike for approximately 1,400 lf. The trunk sewer line then turns northeast and continues along Industrial Way for approximately 1,000 lf until it reaches the TWPS. The total length of Alternative 5 is approximately 7,300 lf.

A big portion of Alternative 5 Upstream Segment A will be in acquired easements from private properties. This alternative will have an extensive impact on Vesper Trail. This alternative potentially could have large traffic impacts on Leesburg Pike due to open-cut crossings at intersections and commercial building entrances; however, a trenchless method could be used to construct the downstream segment of Alternative 5 to minimize traffic disruptions along Leesburg Pike. Additionally, open-cut construction in the Industrial Way area needs to be coordinated with businesses to minimize impacts on their operations (specifically, the Koons Tysons Toyota Dealership and Collision Repair Center).

4.2.6.1 Topography for Alternative 5

The preliminary evaluation of the Alternative 5 new gravity sewer shows that the invert elevation of the new gravity sewer line at the Difficult Run Interceptor tie-in location will be at approximately 386 ft. The invert of the new gravity sewer pipe at the new TWPS will be located at approximately 352 ft (8 ft below grade).

4.2.7 Route Alternative 6

Alternative 6 is similar to Alternative 5 with the addition of one branch, which will be constructed along the Westwood Center Drive to collect the flow from the Promenade development and existing properties along Westwood Center Drive. Two variations of Alternative 6 were developed and investigated to examine the extent of existing properties that can be served by Variations A and B.

Alternative 6A: Alternative 6A was developed based on the assumption that the upstream and downstream portions of the alignment will be constructed with minimum slope and minimum grade cover requirements to the extent possible. The goal was to minimize the cost of construction and avoid any deep manholes. The flow and depth calculations for the Westwood Center Drive segment showed it can serve the Promenade development and existing Properties 8601, 8603, 8605, and 8607. The total length of Alternative 6A is approximately 8,400 lf.

Alternative 6B: Alternative 6B was developed based on the assumption that the upstream and downstream segments can be lowered to a point in which none of the manholes will be deeper than 40 ft. Flow and depth calculations for the Westwood Center Drive branch showed the branch can serve the Promenade development and existing Properties 8601, 8603, and 8605, and all the properties along Westwood Center Drive, except 8620 and 8619. Upstream and downstream portions of the alignment will be constructed with minimum slope and minimum grade cover requirements to the extent possible to minimize the cost of construction and to avoid any deep manholes. Calculations for the Westwood Center Drive branch showed the branch can serve the

Promenade development and existing Properties 8601, 8603, 8605, and 8607. The total length of Alternative 6B is approximately 9,200 lf. Figure 4-2 shows the route for Alternative 6B, which is the selected alternative. The full Gravity Sewer Routing Memorandum in **Appendix A** presents the alignment of each of the other alternatives.

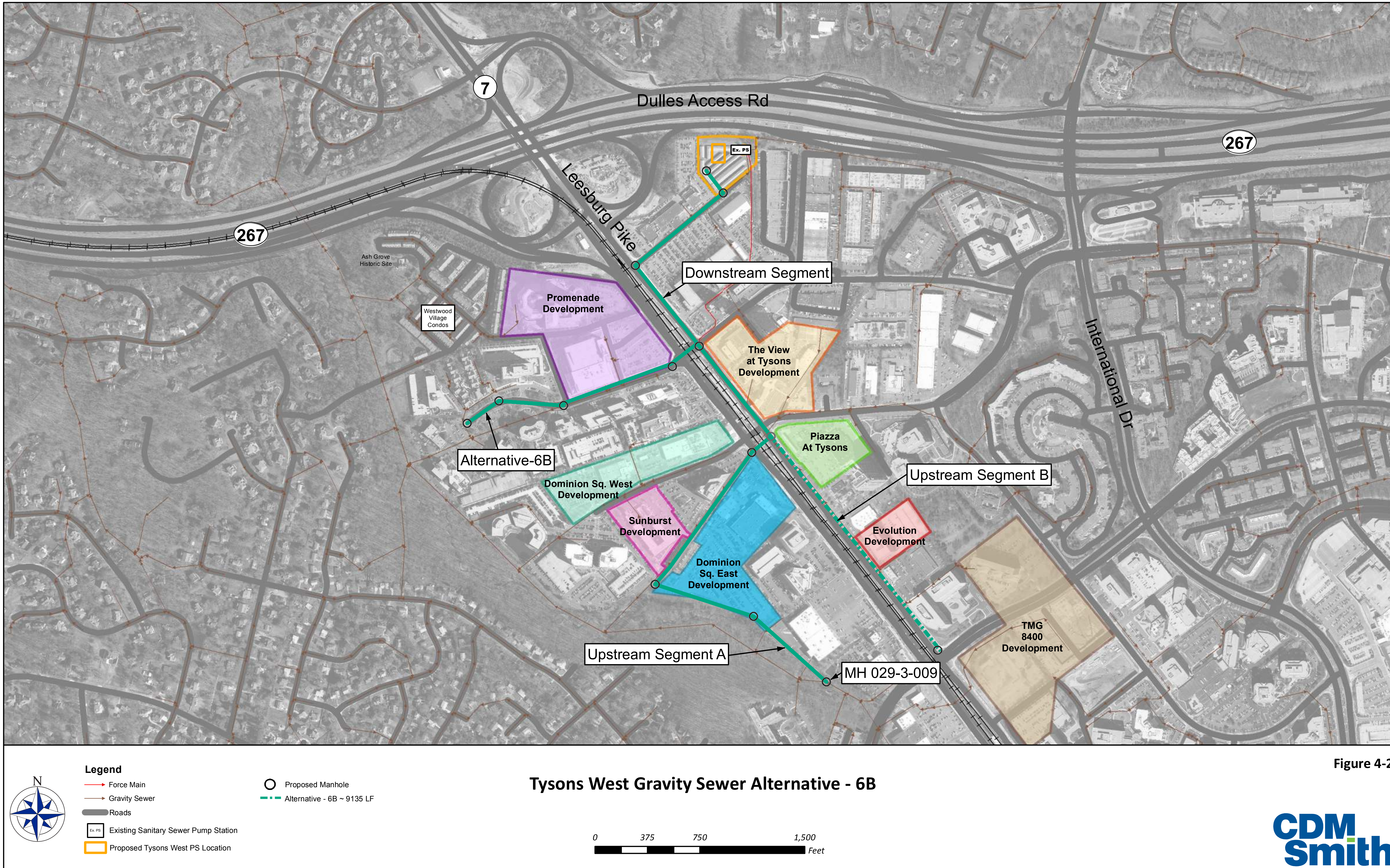


Figure 4-2

Tysons West Gravity Sewer Alternative - 6B

CDM Smith

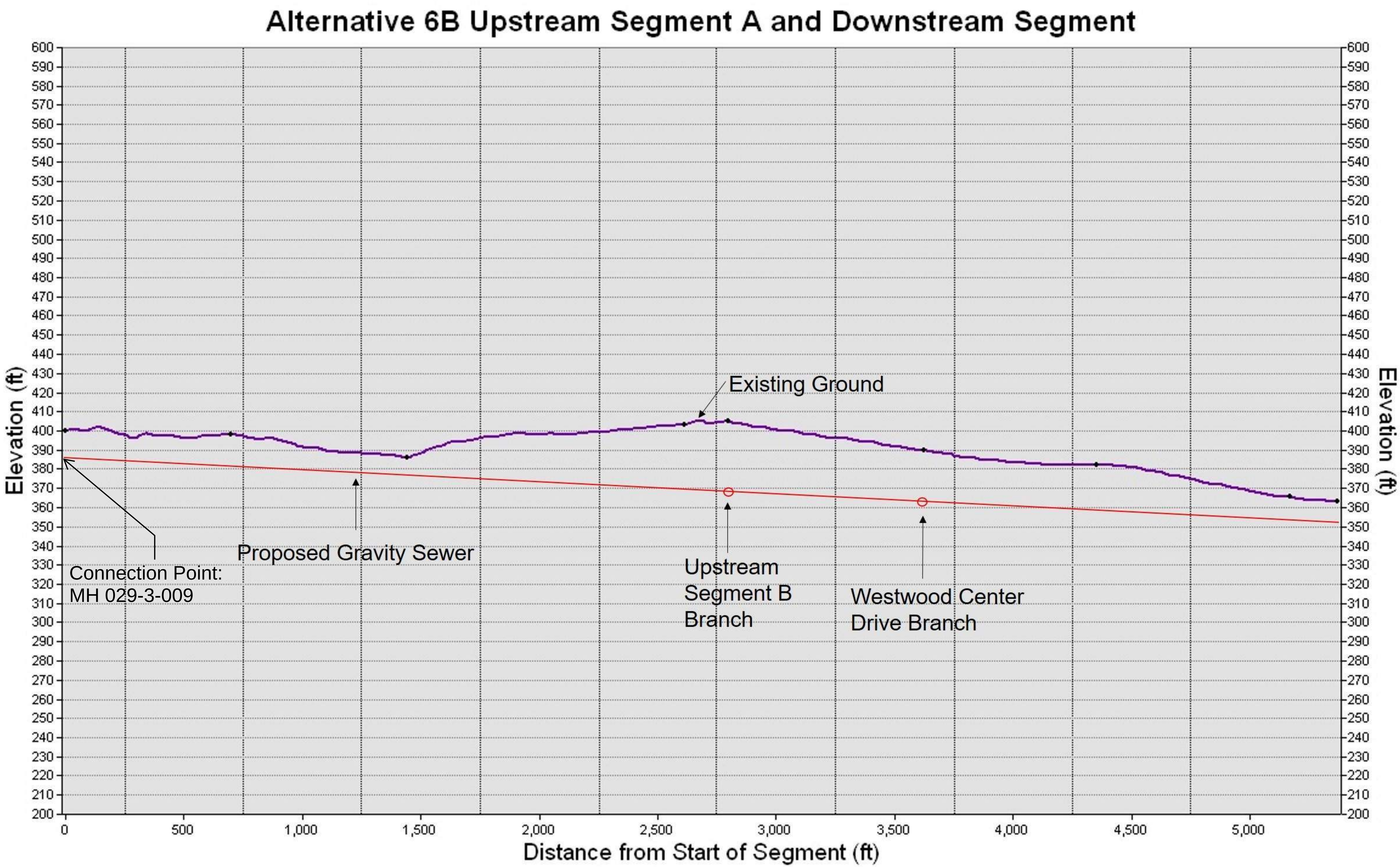
Similar to Alternative 5, a big portion of Alternative 6, Upstream Segment A will be in acquired easements from private properties. Alternative 6 will have an extensive impact on Vesper Trail. This alternative potentially could have a large traffic impact on Leesburg Pike and Westwood Center Drive due to open-cut crossings at intersections and commercial building entrances; however, a trenchless method could be used to construct the downstream segment of Alternative 6 to minimize traffic disruptions along Leesburg Pike. Additionally, open-cut construction in the Industrial Way area needs to be coordinated with businesses to minimize the impact on their operations (specifically, Koons Tysons Toyota Dealership and Collision Repair Center). Figures 4-3 and 4-4 present some of the critical locations of routing for Alternative 6B.

Figure 4-3
Approximate Location of Trenchless Crossing under Leesburg Pike

Figure 4-4
View of Vesper Trail Looking Northeast

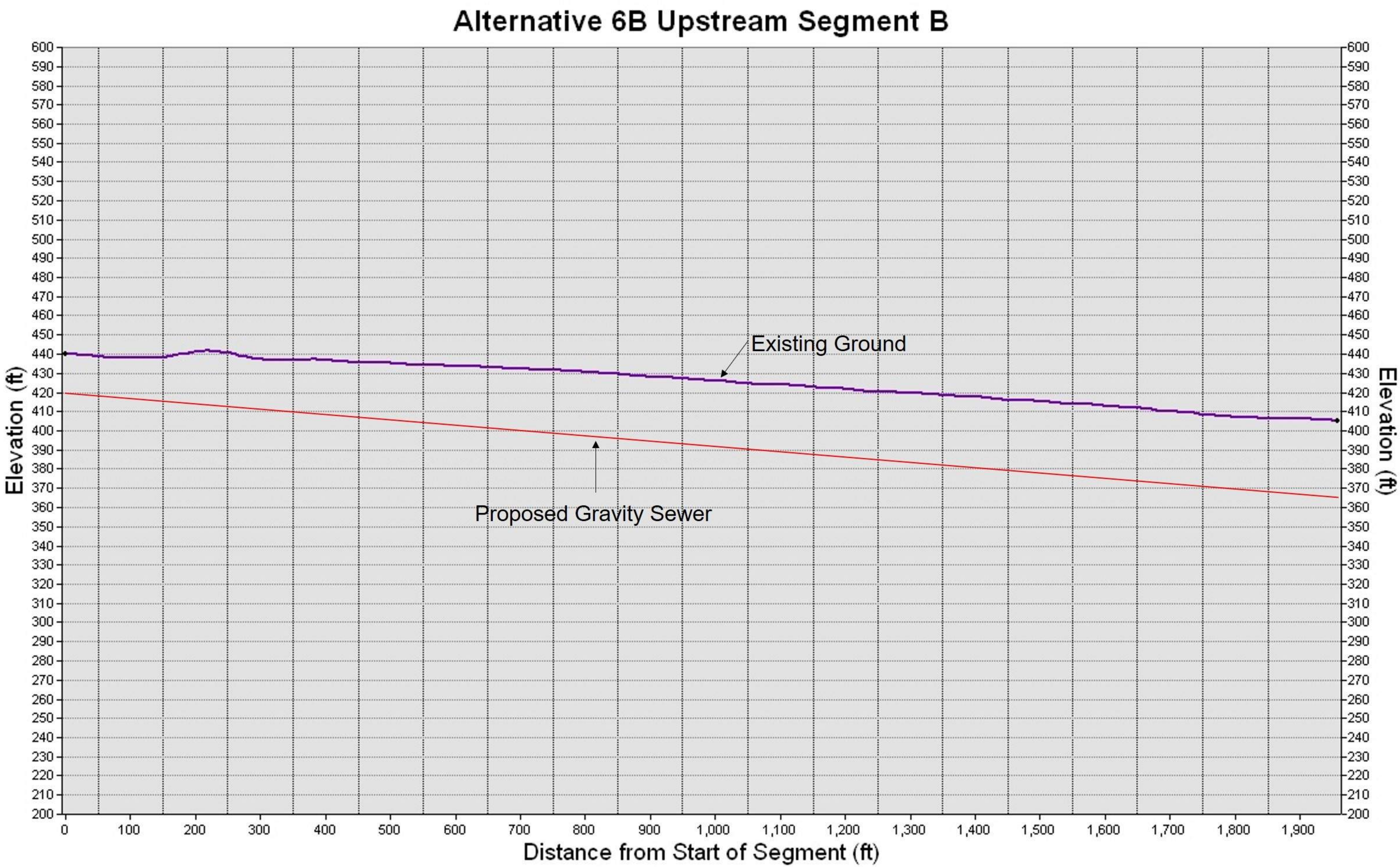
4.2.7.1 Topography for Alternative 6A and Alternative 6B

The preliminary evaluation of the Alternative 6A and Alternative 6B new gravity sewers shows that the invert elevation of the new gravity sewer line at the Difficult Run Interceptor tie-in location will be located at approximately 386 ft. The invert of the new gravity sewer pipe at the new TWPS will be located at approximately 353.0 ft (8 ft below grade). **Figure 4-5** presents the approximate grade elevation for the Upstream Segment A and the downstream segment of both Alternatives 6A and 6B. The Difficult Run Interceptor tie-in location (manhole 029-3-009) is shown on the left end, and the pump station connection point is on the right end of the figure. **Figure 4-6** presents the approximate grade elevation for Upstream Segment B of both Alternatives 6A and 6B. **Figure 4-7** presents the approximate grade elevation for the Westwood Center Drive segment of Alternative 6B. The upstream location is shown on the left and the downstream tie-in location is shown on the right end of the figures.



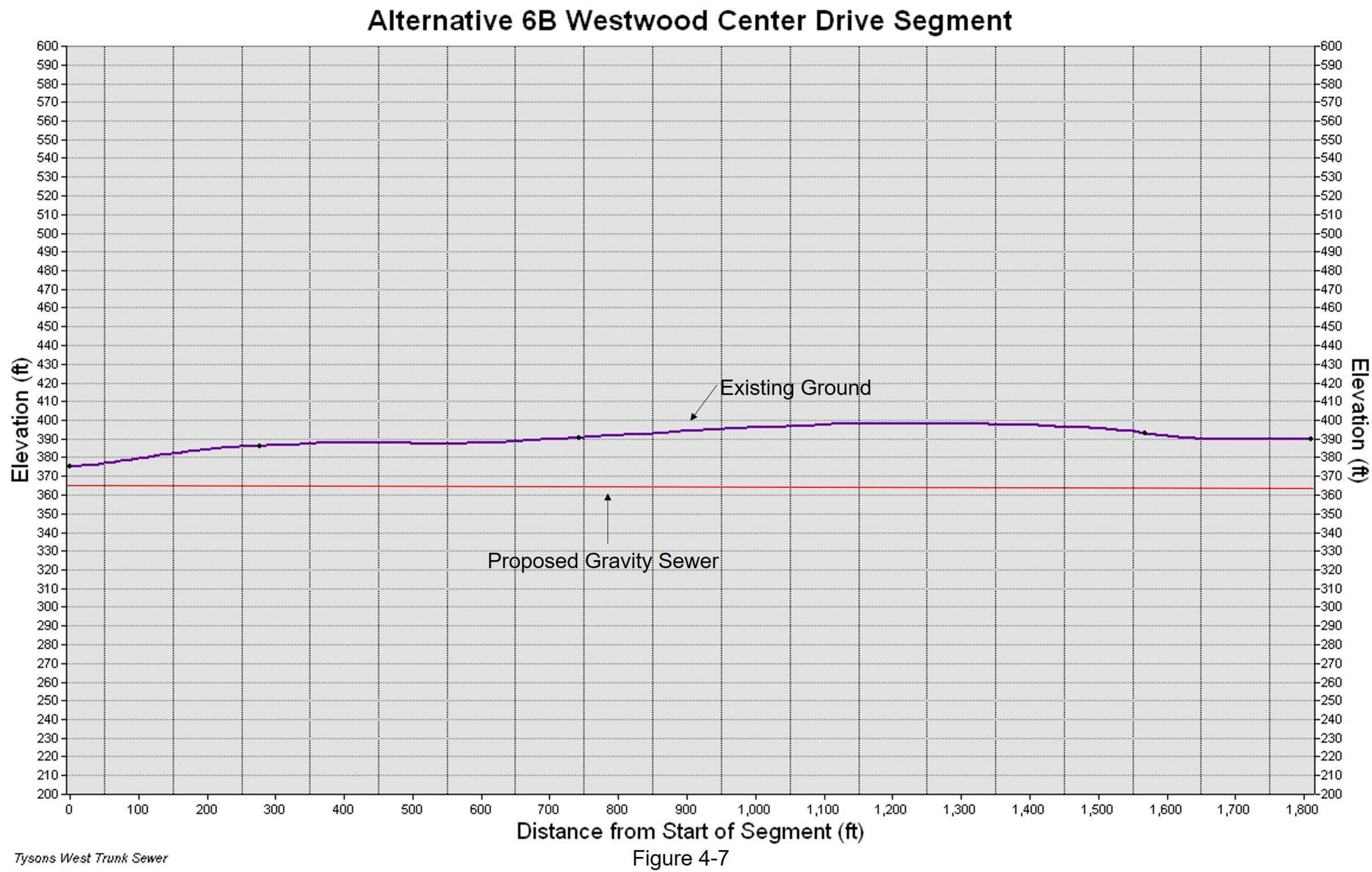
Alternative 6B Upstream Segment A and Downstream Segment
Elevation (ft)
Distance from Start of Segment (ft)
Existing Ground
Proposed Gravity Sewer
Connection Point:
MH 029-3-009
Upstream
Segment B
Branch
Westwood Center
Drive Branch

Figure 4-5



Tysons West Trunk Sewer

Figure 4-6


Alternative 6B Westwood Center Drive Segment
Existing Ground
Proposed Gravity Sewer
Elevation (ft)
Distance from Start of Segment (ft)
Tysons West Trunk Sewer
Figure 4-7

4.3 Qualitative Evaluation of Alternatives

CDM Smith conducted a qualitative evaluation of Alternatives 1 through 6 for the new gravity sewer line. The advantages and disadvantages of each of the six potential routes listed in **Table 4-1** were evaluated based on the best available information.

Table 4-1: Gravity Sewer Routing Alternatives Qualitative Evaluation

	Alternative-1	Alternative-2	Alternative-3	Alternative-4	Alternative-5	Alternative-6A	Alternative-6B
Length (LF)	3,884	2,802	3,221	3,801	7,325	8,393	9,135
Trenchless Length (LF)	3,634	2,802	3,021	3,601	200	400	400
Parcels Crossing	This alternative doesn't cross any private parcels. It goes along the road and behind a residential community.	This alternative crosses one private parcel (Westwood Village Condo in open parking lot). It also crosses a Fairfax County Park Authority property (Ash Grove).	This alternative crosses two private parcels (Westwood Village Condo open parking lot, private road and Sheraton Tysons property). It also crosses a Fairfax County Park Authority property (Ash Grove).	This alternative crosses two private parcels (Westwood Village Condo open parking lot area and Sheraton Tysons property). It also crosses a Fairfax County Park Authority property (Ash Grove).	This alternative crosses four private parcels: 8433, 8449, 8459 and 8525 Leesburg Pike.	This alternative crosses four private parcels: 8433, 8449, 8459 and 8525 Leesburg Pike.	This alternative crosses four private parcels: 8433, 8449, 8459 and 8525 Leesburg Pike.
Metro Crossing	NO	Yes (overhead)	Yes (overhead)	Yes (overhead)	Yes (overhead)	Yes (overhead)	Yes (overhead)
Potential Utility Corssings*	• 15" Stormwater line crossings at 8 locations • 8" water line crossing at 2 locations • 12" water line crossing at 1 location • Underground electrical ductbank crossings at 3 locations	• 8" sewer line crossing at one location • Underground electrical ductbank crossings at 3 locations • 1 overhead power crossing	• 18" stormwater line crossings at 3 locations • 8" sewer line crossing at 3 locations • 8" water line crossing at 2 locations • 12" water line crossing at 2 locations • 24" water line crossing at 1 location • Underground electrical ductbank crossings at 7 locations • 2 overhead power crossings	• 15" stormwater line crossings at 6 locations • 18" stormwater line crossings at 5 locations • 30" stormwater line crossing at 1 location • 36" stormwater line crossing at 1 location • 8" sewer line crossing at 3 locations • 8" water line crossing at 2 locations • 12" water line crossing at 2 locations • 24" water line crossing at 1 location • Underground electrical ductbank crossings at 12 locations	• 15" stormwater line crossings at 2 locations • 18" stormwater line crossing at 3 locations • 21" stormwater line crossing at 2 location • 24" stormwater line crossing at 1 location • 27" stormwater line crossing at 1 location • 30" stormwater line crossing at 2 locations • 36" stormwater line crossing at 1 location • 8" sewer line crossing at 4 locations • 10" sewer line crossing at 4 locations • 8" water line crossing at 5 locations • 24" water line crossing at 2 locations • Underground electrical ductbank crossings at 4 locations • 1 overhead power crossing	• 15" stormwater line crossings at 4 locations • 18" stormwater line crossing at 3 locations • 21" stormwater line crossing at 3 locations • 24" stormwater line crossing at 1 location • 27" stormwater line crossing at 1 location • 30" stormwater line crossing at 2 locations • 36" stormwater line crossing at 1 location • 8" sewer line crossing at 5 locations • 10" sewer line crossing at 4 locations • 8" water line crossing at 7 locations • 12" water line crossing at 2 location • 24" water line crossing at 2 locations • Underground electrical ductbank crossings at 6 locations • 1 overhead power crossing	• 15" stormwater line crossings at 4 locations • 18" stormwater line crossing at 3 locations • 21" stormwater line crossing at 3 locations • 24" stormwater line crossing at 3 locations • 27" stormwater line crossing at 1 location • 30" stormwater line crossing at 2 locations • 36" stormwater line crossing at 1 location • 8" sewer line crossing at 5 locations • 10" sewer line crossing at 4 locations • 8" water line crossing at 9 locations • 12" water line crossing at 2 location • 24" water line crossing at 2 locations • Underground electrical ductbank crossings at 7 locations • 1 overhead power crossing
Major Road Crossings	• Trenchless crossing under Dulless Access Road (Rt-267) • Trenchless crossing under Leesburg Pike • Trenchless crossing under 267 ramp to Leesburg Pike	• Trenchless crossing under Leesburg Pike • 4 trenchless ramp crossings: + Leesburge pike N to Rt267 EB Ramp + Rt267 EB ramp to Leesburg Pike N + Rt267 EB ramp to Leesburg Pike S + Leesburge pike S to Rt267 EB Ramp	• Trenchless crossing under Leesburg Pike	• Trenchless crossing under Leesburg Pike	• Trenchless crossing under Leesburg Pike	• 2 Trenchless crossings under Leesburg Pike	• 2 Trenchless crossings under Leesburg Pike
Permits Required	VDOT, MWAA, USACOE	VDOT, MWAA, USACOE, WMATA, FCPA	VDOT, MWAA, USACOE, WMATA, FCPA	VDOT, MWAA, USACOE, WMATA, FCPA	VDOT, WMATA, FCPA	VDOT, WMATA, FCPA	VDOT, WMATA, FCPA
Potential Easement Requirements	One easement from McLean Hundred HOA.	Two easements. One from Westwood Village Condominums and one from Fairfax Park Authority.	Three easements. from Westwood Village Condominums, Sheraton Tysons and Fairfax Park Authority.	Three easements. from Westwood Village Condominums, Sheraton Tysons and Fairfax Park Authority.	Six easements. from FCDOT, Fairfax Park Authority, and private parcels: 8433, 8449, 8459 and 8525 Leesburg Pike.	Six easements. from FCDOT, Fairfax Park Authority, and private parcels: 8433, 8449, 8459 and 8525 Leesburg Pike.	Six easements. from FCDOT, Fairfax Park Authority, and private parcels: 8433, 8449, 8459 and 8525 Leesburg Pike.
Environmental Concerns	• Wetland crossing	• Some tree removal • Wetland and Park crossing	• Largest tree removal among alternatives • Wetland and park crossing	• Wetland and Park crossing	-	-	-
Community/Social Impact	Large impact on residential neighberhood along Jarrett Valley Dr	Some impact on Westwood Village Condominum	Some impact on Westwood Village Condominum Large impact on Sheraton	Large impact on Westwood Village Condominum Some impact on Sheraton	Large impact on Vesper Trail Some impact on Route-7	Large impact on Vesper Trail Some impact on Route-8	Large impact on Vesper Trail Some impact on Route-9
Historic Site?	No	Yes (Ashgrove)	Yes (Ashgrove)	Yes (Ashgrove)	No	No	No
Cost	$$$$$	$$$	$$$$$	$$$$$	$$$	$$$	$$$$
Pros	• Capture the most amount of flow from Difficult Run interceptor • No open cut road crossing • No metro crossing • Minimum number of easements required • No historic site crossing	• No open cut road crossing • Minimum community/social impact • Shortest route • Minimum number of utility crossings	• No open cut road crossing • Minimal impact on Dulles Toll Road operation	• No open cut road crossing • Minimal impact on Dulles Toll Road operation	• Facilitate basin expansion • Minimum number of permits required • No historic site crossing • Shortest tunneling segment • No impact on Dulles Toll Road operation	• Facilitate basin expansion • Minimum number of permits required • No historic site crossing • Shortest tunneling segment • No impact on Dulles Toll Road operation	• Capture the most amount of flow from Service Area • Facilitate basin expansion • Minimum number of permits required • No historic site crossing • Shortest tunneling segment • No impact on Dulles Toll Road operation
Cons	• Large community impact • Complexities related with Tunneling under Rt 267 and the permitting requirements • Longest tunneling route • High cost	• Most number of permits required • Historic site crossing	• Most number of permits required • Highest impact on Sheraton property • High cost • Historic site crossing	• Most number of permits required • High cost • Historic site crossing	• Several open cut road or commercial building entrance crossings which require road closures and traffic management plans • Most number of easements required	• Several open cut road or commercial building entrance crossings which require road closures and traffic management plans • Most number of utility crossings • Most number of easements required	• Several open cut road or commercial building entrance crossings which require road closures and traffic management plans • Most number of utility crossings • Most number of easements required

4.4 Quantitative Evaluation Criteria

Routes were evaluated based on a number of criteria relevant to designing, constructing, and operating a sanitary sewer gravity main. These criteria include:

- Facilitate expansion of the current pump station service area
- Relative costs
- Commercial/residential landowner impacts
- Traffic impacts
- Environmental impacts
- Permitting
- Constructability
- Access/operation and maintenance (number of manholes and their depth)
- Utility conflicts
- Easements
- Other obstructions

A description of each of these criteria follows.

4.4.1 Facilitate Expansion of the Current Pump Station Service Area

In preparation for the design and construction of the new TWPS, CDM Smith collected available information for the upcoming developments in the Tysons West District and performed an evaluation of the feasibility of expanding the current pump station service area to increase the pump station's incoming flow from the local collection system. Flow from the Difficult Run Interceptor is flowed from across a drainage divide. Collecting additional flow volume from the local collection system will reduce the flow volume transferred by the existing Difficult Run Interceptor to the Difficult Run Pump Station, which is a stated goal of the Tysons Corner Sanitary Sewer Master Plan (Carollo Engineers, April 2020). The Tysons West basin expansion will capture additional flows only from developments with pending or recently approved applications that will be constructed along Leesburg Pike between West Park Drive and Route 267.

Due to the strong desire of Fairfax County DPWES to expand the current pump station service area and large potential impact that the basin expansion could have on the project cost and future developments, this criterion was assigned a weighting factor of 15 percent (%).

4.4.2 Relative Costs

Planning level costs were assigned to each route alternative for comparison purposes. The cost evaluations for each route included the cost for installation of pipe based on the type of installation, cost of restoration, cost of stream or wetland crossings, and the cost for trenchless installation under roads and railroads.

The cost comparisons included items that are not significant cost discriminators between routing options, such as seeding, bedding, etc. Costs did not include rock excavation. Depth to rock is unknown for the alternatives and not expected to be a significant discriminator among the route segments, so it was not considered in the evaluation. Rock quantities and locations, however, will be very important information used to determine the final construction cost estimate. For this reason, geotechnical investigations are recommended as part of the final design to provide an indication of the actual depth of rock along the selected alignment. With cost being one of the critical factors in selecting the new gravity sewer routing, this criterion was assigned an initial weighting factor of 10%.

4.4.3 Commercial/Residential Property Owners Impacts

Alignment options for the new gravity sewer were developed with the goal of minimizing impacts to individual properties located along the selected route as much as practical. Impacts can be temporary, such as limitation of access to properties during construction, removal and restoration of lawns, gardens, fences, sidewalks, and/or driveways associated with trenching. Impacts can also be permanent, such as the removal of large trees or structures within the transfer force main right-of-way. Pipeline routes will be adjusted, where possible, to reduce permanent impacts.

It is anticipated that the new gravity sewer will be placed in acquired easements from private properties in some areas, though large portions of the potential routes follow either existing utility easements or public road rights-of-way. These easements and rights-of-way will be used temporarily during construction, which will reduce the amount of additional temporary construction easement required. Because of the potential impacts construction could have on the commercial and residential landowners and, consequently, on the project schedule and cost, this criterion was assigned a weighting factor of 10%.

4.4.4 Traffic Impacts

Construction of a gravity sewer line along heavily traveled streets will impact traffic flow. Various sections of road along the proposed alignments serve residential and commercial establishments. Traffic Management Plans (TMPs) will be required for any construction in the Virginia Department of Transportation (VDOT) or Fairfax County roads rights-of-way. Because of this, traffic impacts need to be considered during route evaluation. The new gravity sewer should be constructed so that access to the roadways from the side streets always remains open to local traffic and emergency vehicles to the extent practicable. Due to the potential impact that the traffic impacts could have on the project schedule and cost, this criterion was assigned a weighting factor of 10%.

4.4.5 Environmental Impacts

Environmental impacts considered for the gravity sewer routing analysis included wetland impacts and stream crossings. These impacts are generally greater for the tie-in to the Difficult Run Interceptor portions of the route, which are located along the stream, than for already disturbed areas in or adjacent to existing roads. This is due to the larger impacts on the stream, wetlands, and environmentally sensitive areas adjacent to the tie-in location. Environmental impacts can increase design and construction schedule and cost. Environmental impacts can also lengthen the time required to obtain permits. The impacts also might increase the number of permits and reviews needed. No stream crossings are anticipated for any of the alternatives; however, all six alternatives will have some impacts on potential wetland areas. Because of the potential consequences the environmental impacts could have on project permitting, schedule, and cost, this criterion was assigned a weighting factor of 5%.

4.4.6 Permitting

The ability to acquire the necessary permits is a critical factor to the success of this project. The route will be subject to review by regulatory agencies, depending on the pipe installation methodology (e.g., open-cut versus trenchless) and location of road or easement crossings.

All VDOT road crossings will require VDOT permits, and, depending on the impact on the road and pipe installation methodology, the development of TMPs. Obtaining a United States Army Corps of Engineers (USACE) Nationwide Permit will be most likely required for all the alternatives due to potential impacts on the wetlands in tie-in locations. USACE might require mitigation for unavoidable wetland or stream impacts. Approvals will also be needed for the crossing of rights-of-way or easements owned by Dominion Energy and Washington Gas. Due to the potential impact of permitting on the project schedule and cost, this criterion was assigned a weighting factor of 5%.

4.4.7 Constructability

The ease with which the project can be constructed greatly impacts the overall project cost and often the impact on local property owners. Constructability issues, which will be considered as part of the route evaluation process, include contractor access to the site, ability to store materials and access to potential project staging areas, speed of construction (which is potentially higher in the low-volume traffic areas or outside the roads due to minimal traffic impact), and construction safety. As a result of the large potential impact of constructability on project schedule and cost, this criterion was assigned a weighting factor of 15%.

4.4.8 Access/Operations and Maintenance

The new gravity sewer has to be accessible for future operations and maintenance (O&M) once the pipeline is put in service. Access is easiest when the alignment follows existing roads and manholes are shallow. It is most difficult in remote, wooded, and wetland areas, where the manholes are deep. Future O&M will be easiest when there are fewer manholes. Due to the large potential impact that access and O&M could have on the future O&M cost, this criterion was assigned a weighting factor of 15%.

4.4.9 Utility Conflicts

Preliminary information was obtained for most of the known existing utilities along the proposed alignments, including stormwater lines, sanitary sewer lines, communication/cable lines, water, and Dominion Energy's overhead and underground power lines. Information regarding existing utilities' gas lines was obtained through communication with the utility owner to the extent practicable before submission of the final PER. Particular attention will be given to utilities that cannot easily be moved, such as large water mains and sewers, power transmission lines and towers, and large gas lines. The depth and exact alignment of the proposed gravity sewer will be further adjusted as necessary after the PER and during the design phase to avoid conflicts with utilities.

Since pipes are in easements on private properties, potential conflicts with existing utilities will be minimized, but it cannot be completely eliminated. The design will have to address these conflicts, and the contractor will have to handle each conflict properly as the pipe is installed.

Because of the potential impact that the utility conflicts could have on the project schedule and cost, this criterion was assigned an initial weighting factor of 10%.

4.4.10 Easements

Easements will be required from private landowners for all six alternatives; however, the length of easements required varies for each alternative. Easements will include both permanent and temporary construction easements. Depending on the route selected, purchasing easements may be costly. Alternative 1 requires the least amount of easement from private landowners. Due to the potential impact of easement acquisition on the project schedule and cost, this criterion was assigned a weighting factor of 5%.

4.4.11 Evaluation Criteria Weighting

Each of the evaluation criteria have been weighted to reflect their relative importance to the construction and operation of the new gravity sewer. **Table 4-2** lists the relative weights for each of the evaluated criteria, based on engineering experience. The weighting factors will be adjusted as necessary to factor in County's staff input. The weights used for each criterion reflect the relative importance of project cost, as well as an increased focus on the project's impacts on property and commercial/business interests along each alignment.

Table 4-2: Evaluation Criteria Weights

Evaluation Criteria	Weight (percentage basis)
Facilitate expansion of the current pump station service area	15
Relative cost	10
Commercial/residential property owners impacts	10
Traffic impacts	10
Environmental impacts	5
Permitting	5
Constructability	15
Access/operation and maintenance	15
Utility conflicts	10
Easement	5

4.5 Route Alternatives Analysis Recommendations

After initial screening and discussion with County staff, alternative routes were evaluated in more detail and ranked to provide a quantitative determination of the most appropriate option. Each route option was assigned a ranking between 1 and 5 for each of the criteria used in the evaluation, with 5 being the most favorable score (lowest impact) and 1 being the most unfavorable score (highest impact). The total score was determined by multiplying the individual criteria scores by the assigned weight presented in **Table 4-2** and then summing the weighted scores. **Table 4-3** presents the final criteria ranking tabulation.

Table 4-3: Gravity Sewer Routing Alternatives Quantitative Evaluation and Ranking

Weight %	15		10		10		10		5		5		15		15		10		5		100	
	Facilitate Basin Expansion		Relative Cost		Commercial/Residential Property Owners Impacts		Traffic Impacts		Environmental Impacts		Permitting		Constructability		Access/Operation and Maintenance		Utility Conflicts		Easement		Total Score	Rank
	Score	Comments	Score	Comments	Score	Comments	Score	Comments	Score	Comments	Score	Comments	Score	Comments	Score	Comments	Score	Comments	Score	Comments		
Alternative-1	1	Do not facilitate basin expansion	3	$$$$$	4	Large impact on residential area	4	Some impact on residential neighborhood north of Rt-267, require basic traffic management plans	2	Some impact on wetlands and stream	3	Moderate permitting effort required	2	Longest tunneling route, complexity of tunneling under Dulles Toll Road, very deep tunnel alignment	2	Maintenance access issues due to depth of tunnel	5	Minimum number of utility crossings	5	Minimum number of easements required	285	5
Alternative-2	1	Do not facilitate basin expansion	5	$$$	5	minimal impact on residental and commercial property owners	5	Minimial traffic impact	1	Some impact on wetlands, one stream crossing	2	Maximum number of permits required	3	Long tunneling route, complexity of tunneling under several ramps to/from Dulles Toll Road, very deep tunnel alignment	2	Maintenance access issues due to depth of tunnel	5	Minimum number of utility crossings	4	Moderate number of easements required	325	4
Alternative-3	1	Do not facilitate basin expansion	3	$$$$$	4	Moderate impact on commercial and residential owners	3	Some impact on Ashgrove Lane traffic, require basic traffic management plans	2	Some impact on wetlands and stream	2	Maximum number of permits required	3	Long tunneling route, very deep tunnel alignment	2	Maintenance access issues due to depth of tunnel	4	Moderate number of utility crossings	3	Moderate number of easements required	265	6
Alternative-4	1	Do not facilitate basin expansion	3	$$$$$	4	Moderate impact on commercial and residential owners	3	Some impact on Ashgrove Lane traffic, require basic traffic management plans	2	Some impact on wetlands and stream	2	Maximum number of permits required	3	Long tunneling route, very deep tunnel alignment	2	Maintenance access issues due to depth of tunnel	3	Moderate number of utility crossings	3	Moderate number of easements required	255	7
Alternative-5	3	Facilitate basin expansion to some extent	5	$$$	3	Large impact on vesper trails and Route-7	2	Require complex traffic management plans	4	Minimal impact on wetlands and stream	4	Minimum number of permits required	4	Potential challenges for Construction along Vesper Trail	4	Limited access along Vesper Trail	2	Maximum number of utility crossings	2	Maximum number of easements required	335	3
Alternative-6A	4	Facilitate basin expansion to some extent	4	$$$$	3	Large impact on vesper trails and Route-7	2	Require complex traffic management plans	4	Minimal impact on wetlands and stream	4	Minimum number of permits required	4	Potential challenges for Construction along Vesper Trail	4	Limited access along Vesper Trail	2	Maximum number of utility crossings	2	Maximum number of easements required	340	2
Alternative-6B	5	Facilitate basin expansion	4	$$$$	3	Large impact on vesper trails and Route-7	2	Require complex traffic management plans	4	Minimal impact on wetlands and stream	4	Minimum number of permits required	4	Potential challenges for Construction along Vesper Trail	4	Limited access along Vesper Trail	2	Maximum number of utility crossings	2	Maximum number of easements required	355	1

4.5.1 Recommended Alternative

Based on the evaluation of each of the route alternatives and the criteria used in the evaluation, the optimal gravity route alignment is Alternative 6B.

Alternative 6B offers multiple advantages, including providing the necessary infrastructure for accommodating the maximum possible flow from the local collection system, fewer permits, zero impact on Route 267, and a very short microtunnel segment. Collecting the additional flow will reduce the flow transferred by the existing Difficult Run Interceptor to Difficult Run Pump Station, which is a stated goal of the Tysons Corner Sanitary Sewer Master Plan. According to the Master Plan hydraulic model results, many sections of existing piping in the Tysons West service area will need to be replaced with larger pipes. The resulting community impacts and cost of replacing these pipes would be significant, and this is a critical drawback for the alternatives that do not facilitate basin expansion. Other advantages include improved constructability, better access for future maintenance, and fewer environmental impacts compared to Alternatives 1 through 4.

Another advantage of Alternative 6B is that it will collect approximately 3 mgd from seven new developments along Leesburg Pike, including the Evolution, Piazza at Tysons, the View at Tysons, Dominion Square West, Dominion Square East, Tysons West Promenade, and Sunburst. In addition, the new gravity sewer will handle up to 7 mgd from the Difficult Run Interceptor that currently flows to the Difficult Run Pump Station. CDM Smith did not perform an evaluation of the current or future flow in the Difficult Run Interceptor. A large flow reduction in the Difficult Run Interceptor potentially could cause maintenance issues in the interceptor due to very low flow and a possible need to downsize the line in the future.

There are some drawbacks for the recommended alternative, including larger traffic impacts. Leesburg Pike is a heavily traveled road, and traffic control will be required for a big portion of the construction for Alternative 6B. Access to commercial properties along Leesburg Pike will also be affected during construction. The alternative would likely require an extended project schedule to allow for the time needed for property acquisition. Additionally, Alternative 6B has the greatest number of locations where an existing utility must be crossed compared to all other alternatives. Although there may be challenges associated with utility crossings, easement acquisition, and construction along Vesper Trail, this alignment avoids a substantial deep microtunneling installation, which is costly and provides limited maintenance accessibility.

Based on the results of quantitative evaluation, discussions with County staff, and considering the advantages and disadvantages discussed above, Alternative 6B is the preferred approach for the installation of gravity sewer main for the TWPS.

4.6 Difficult Run Interceptor Diversion Structure

Flow will be diverted from the Difficult Run Interceptor to the TWPS. The proposed diversion structure (located at the intersection of the Difficult Run Interceptor and the Tysons West sewer will allow complete diversion of the Difficult Run Interceptor, flow splits between the Difficult Run Interceptor and TWPS or bypassing the TWPS. The control will be automated to include a flow setpoint to the TWPS which will require a flowmeter. Flow will be diverted using modulating sluice gates to control flow direction.

In addition, the flow control and management of the TEPS, Difficult Run Pump Station, and TWPS will be determined as the design progresses.

Section 5

Force Main Sewer Routing Analysis

5.1 Introduction

Tysons West Pump Station (TWPS) will collect flow from the local sewer collection system, the Difficult Run Interceptor, and the future Tysons East Pump Station (TEPS). The total estimated peak flow to the pump station will be 25 mgd.

A new force main connecting the TWPS to the Accotink Interceptor is a key element of the project. This section of the Preliminary Engineering Report (PER) focuses on the evaluation of the potential routing alternatives and recommendations for the alignment of the new Tysons West sewer force main. The content in this section is based on geographical information system (GIS) data, aerial imagery, desktop studies, and the best available record analyses at the time the document was prepared. It did not include a topographic survey, subsurface utility engineering, or environmental field studies.

5.2 Description of the Proposed Force Main Alignments

Potential force main routing alternatives were selected by starting at the TWPS site and choosing logical routes along existing roadways to the discharge point into the Accotink Interceptor Sewer. The force main will be 36 inches (in.) in diameter as discussed in Section 3.

Seven alternatives were developed. The following subsections provide a description of each of the alternatives and the existing conditions along the routes.

5.2.1 Alternative 1

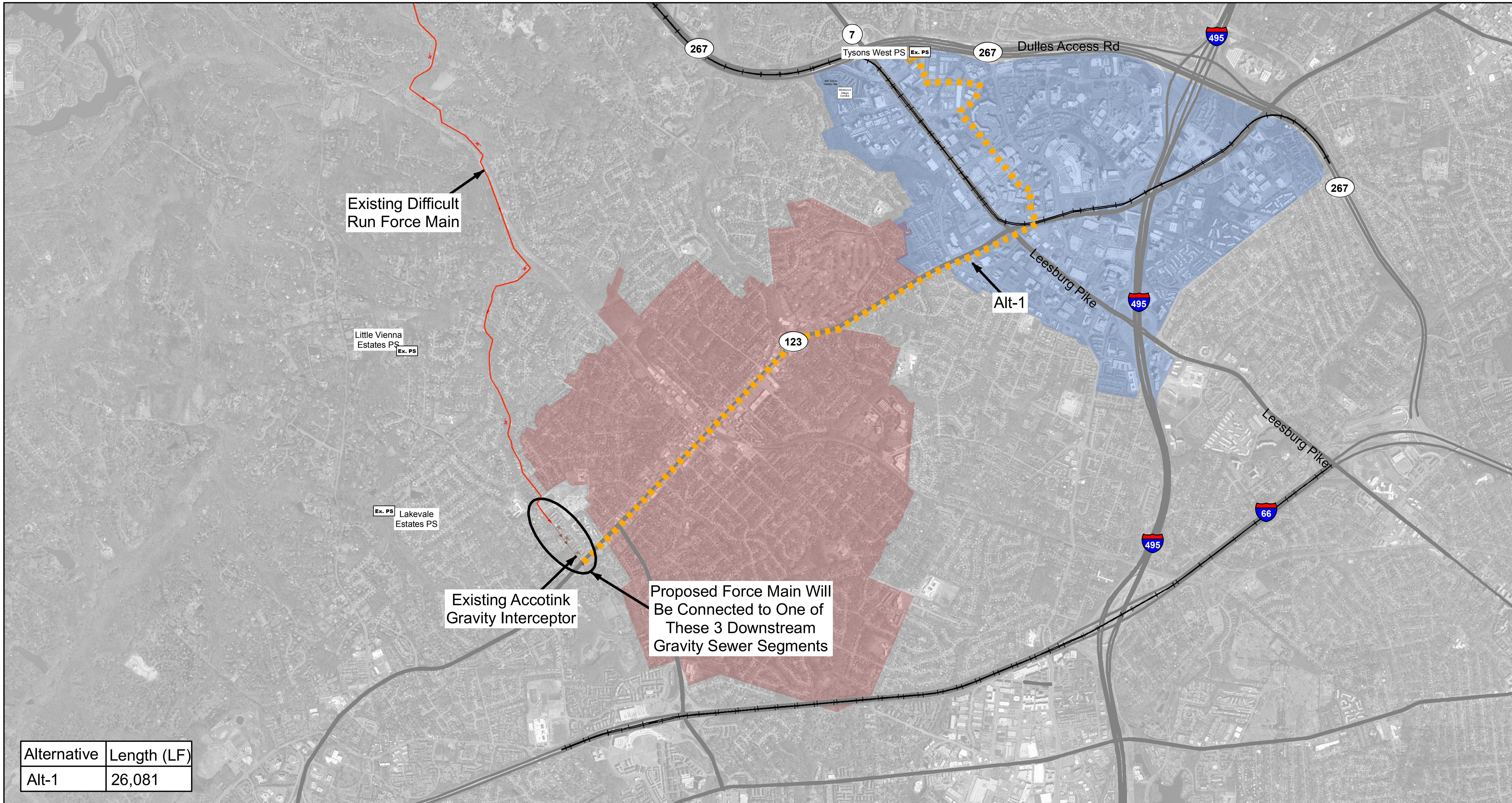
Alternative 1 alignment will begin at the pump station and continue south for approximately 1,100 linear feet (lf) in the parking lot of Auto Plus Auto Parts, turning east on Tyco Road for approximately 1,600 lf. At the intersection of Tyco Road and Spring Hill Road, the alignment will turn south following Spring Hill Road for approximately 1,060 lf. The alignment then will turn southeast on Greensboro Drive, continuing for approximately 3,170 lf until it reaches Pinnacle Drive.

The force main will continue in a southeasterly direction for another 1,050 lf along Pinnacle Drive, then it will cross under a Metro tunnel before crossing under Chain Bridge Road/Maple Avenue (Route 123). This Metro crossing will likely require a trenchless installation of approximately 150 lf. The trenchless crossing alignment will continue under the Leesburg Pike and two ramps, one going from Leesburg Pike eastbound to Chain Bridge Road/Maple Avenue and one from Chain Bridge Road/Maple Avenue to Leesburg Pike. The length of trenchless installation for this section will be approximately 1,400 lf.

The new force main will continue for approximately 300 lf in an open field, then it will continue southwest along the fields between Chain Bridge Road/Maple Avenue and Boone Boulevard for approximately 1,000 lf to the intersection of Chain Bridge Road/Maple Avenue and Old

Courthouse Road. It is anticipated that crossing under Old Courthouse Road will require a trenchless installation using horizontal directional drilling (HDD). The length of this trenchless crossing will be approximately 120 lf.

The force main will then continue southwest for about 14,700 lf along Chain Bridge Road/Maple Avenue. The force main will continue along Chain Bridge Road/Maple Avenue and cross the Washington and Old Dominion Trail, which is owned by Northern Virginia Regional Park Authority. Additionally, the force main will cross Wolftrap Creek at the intersection of Beulah Road Northeast (NE) and Chain Bridge Road/Maple Avenue East. The discharge point of the force main will be on the northbound lane of Chain Bridge Road/Maple Avenue near the intersection of Glengyle Drive and Chain Bridge Road. The total length of Alternative 1 will be approximately 26,000 ft. **Figure 5-1** shows the route for Alternative 1.



Alternative	Length (LF)
Alt-1	26,081

Legend

- Roads
- Ex. PS — Existing Sanitary Sewer Pump Station
- Tysons Corner Boundary
- Town of Vienna Boundary
- Proposed Tysons West PS Location
- Alternative - 1

N

Tysons West PS Force Main Alternative - 1

0 1,650 3,300 6,600 Feet

Figure 5-1

CDM Smith

5.2.1.1 Summary of Potential Physical Constraints for Alternative 1

Along the parking lot of the Auto Plus Auto Parts building and Tyco Road, the alignment will run parallel to Dominion Energy's underground electrical distribution line for about 1,000 lf. A major portion of the alignment along Greensboro Drive and Chain Bridge Road/Maple Avenue will be near condominiums, medical centers, strip malls, shopping centers, and office spaces in a very high-traffic area. This alignment will impact accessibility for residents, shoppers, and medical center visitors during construction. Additionally, along Chain Bridge Road/Maple Avenue in the Town of Vienna, the new force main will be parallel to several other utilities, which will make the construction of a wide trench for a large force main very challenging.

This alternative will cross under a Metro tunnel at the intersection of Chain Bridge Road/Maple Avenue and Pinnacle Drive. Microtunneling under the Metro could be difficult to design, permit, and construct, requiring a permit from Metropolitan Washington Airports Authority (MWAA). Due to lane closure requirements, the alternative will impact traffic at several intersections and business entrances on Chain Bridge Road/Maple Avenue. This will affect both businesses and residences. This route crosses the Washington and Old Dominion Trail, which is an important pedestrian and biking arterial in the region. A comprehensive traffic management plan will be needed for this alternative. **Figures 5-2 through 5-6** show some critical locations of Alternative 1 routing.

Figure 5-2
Residential Area and Offices along Greensboro Drive

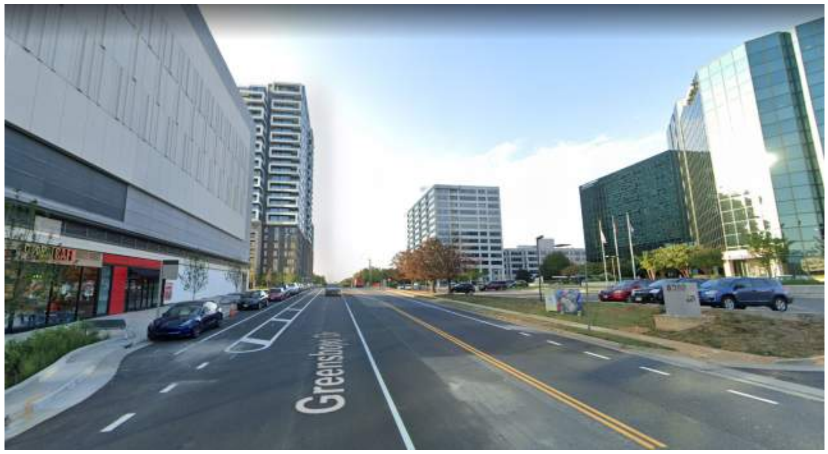


Figure 5-3
Metropolitan Office and Commercial Areas along Greensboro Drive

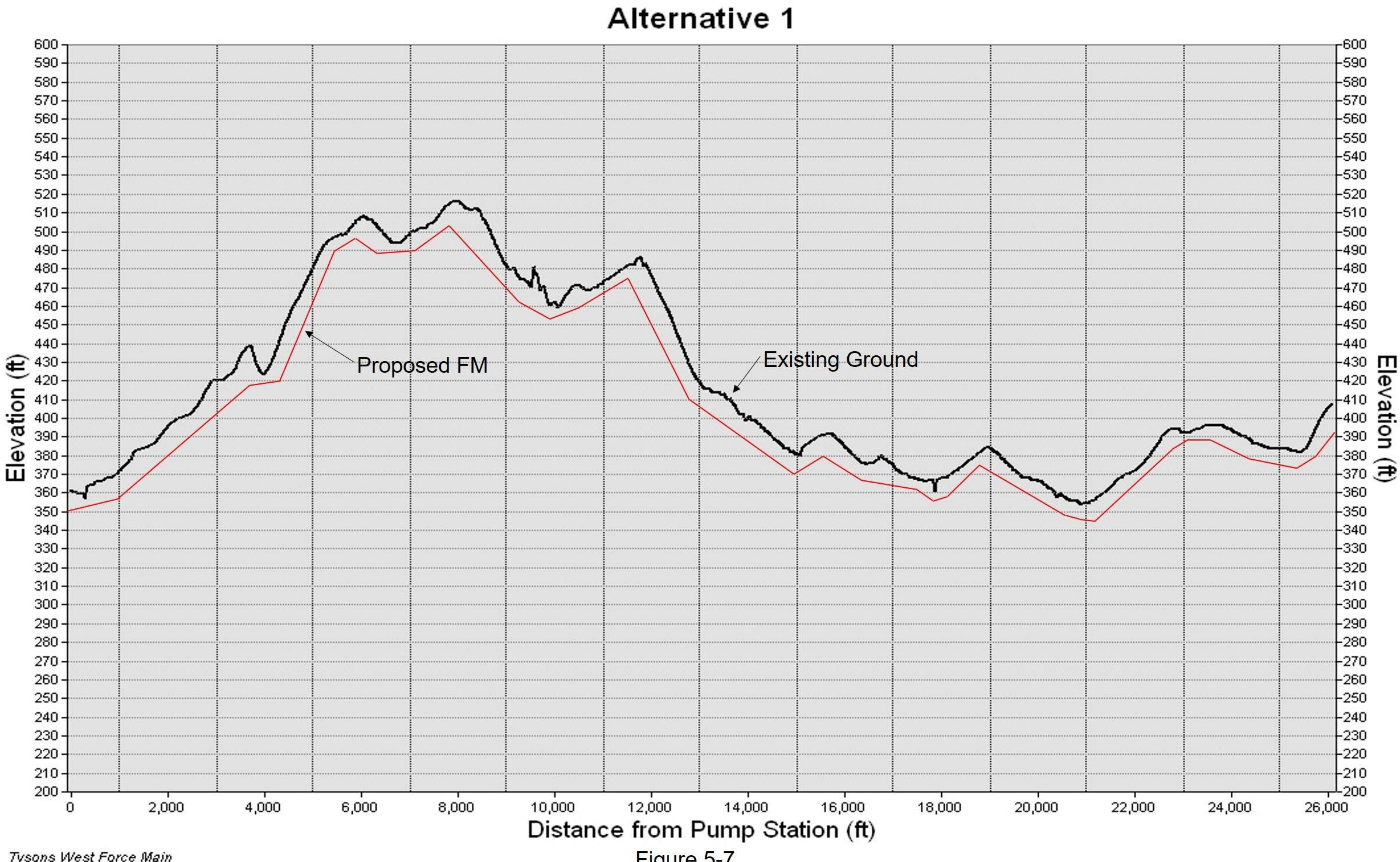
Figure 5-4
Approximate Location of Chain Bridge Road/Maple Avenue Trenchless Crossing

Figure 5-5
High-Volume Traffic on Chain Bridge Road/Maple Avenue

Figure 5-6
High-Volume Traffic on Chain Bridge Road/Maple Avenue

5.2.1.2 Topography for Alternative 1

Figure 5-7 presents the approximate grade elevation for Alternative 1, starting from TWPS shown on the left and the gravity sewer transition point on the right. The figure shows there are approximately 16 high points along the route of the force main.


Alternative 1
Elevation (ft)
Proposed FM
Existing Ground
Distance from Pump Station (ft)
Tysons West Force Main
Figure 5-7

5.2.2 Route Alternative 2

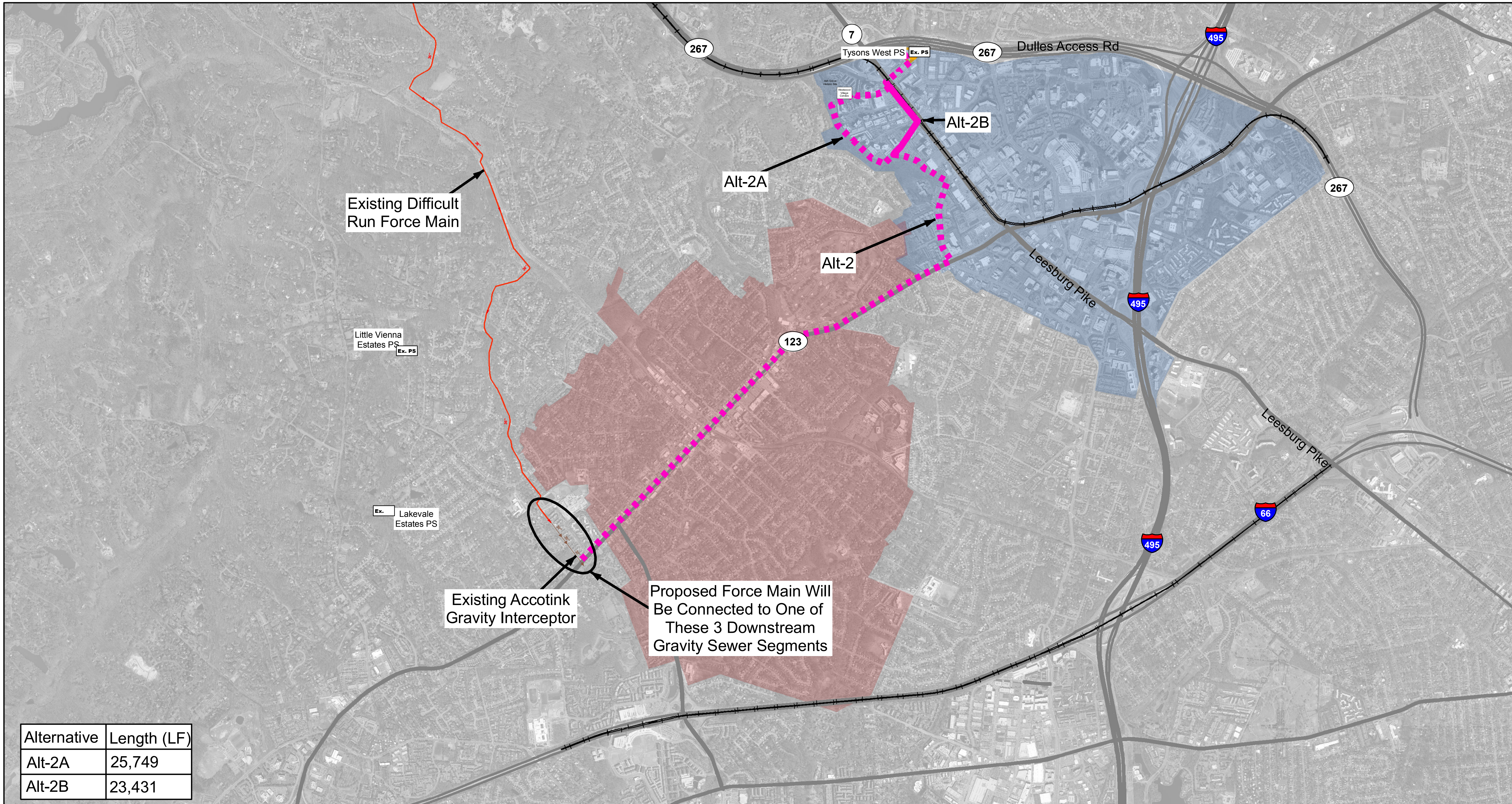
Alternative 2 will begin at the TWPS site and run approximately 1,100 lf southwest along Industrial Way. The force main will then cross Leesburg Pike perpendicularly using a trenchless method. The force main will continue along the Leesburg Pike for about 200 lf to the entrance of Ashgrove Lane. From there, Alternative 2 will have two sub-options: Alternatives 2A and 2B.

Alternative 2A will follow Ashgrove Lane through a commercial area south of the Sheraton Tysons building for approximately 1,100 lf southwest toward Ashgrove House Lane. An easement from the Sheraton property will be necessary for this option. The alignment will then follow along Northern Neck Drive southeast of the Westwood Village Condominiums for approximately 600 lf. The force main will continue southeast for about 2,700 lf through the forested area between commercial buildings and Old Courthouse Spring Branch toward the Vesper Trail. Fairfax County Park Authority owns most of this forested area along the stream.

For Alternative 2B, instead of entering Ashgrove Lane, the force main will continue southeast along Leesburg Pike for approximately 1,600 lf. The force main will then follow the Vesper Trail for about 1,750 lf to the forested area between Old Courthouse Spring Branch and Raglan Road Park.

From the Vesper Trail between Old Courthouse Spring Branch and Raglan Road Park, both Alternatives 2A and 2B will continue along the western edge of Properties 8433, 8449, 8459, and 8525 (Fairfax County property numbers) for approximately 1,450 lf. The route will then turn right on Gosnell Road and continue south for about 2,500 lf. The force main will turn southwest at the intersection of Gosnell Road and Chain Bridge Road/Maple Avenue, continuing along Chain Bridge Road/Maple Avenue for approximately 15,000 lf to the discharge point located along southbound Chain Bridge Road/Maple Avenue at the intersection of Glengyle Drive and Chain Bridge Road.

The route then will cross the Washington and Old Dominion Trail, which is an important pedestrian and biking arterial in the region. The force main also will cross Wolftrap Creek at the intersection of Beulah Road NE and Chain Bridge Road/Maple Avenue East. The total length of Alternative 2A will be approximately 25,500 lf, and Alternative 2B will be approximately 24,000 lf. **Figure 5-8** shows the routes for Alternatives 2A and 2B.



Alternative	Length (LF)
Alt-2A	25,749
Alt-2B	23,431

Legend

- Roads
- Existing Sanitary Sewer Pump Station
- Tysons Corner Boundary
- Town of Vienna Boundary
- Proposed Tysons West PS Location
- Alternative - 2

0 1,650 3,300 6,600 Feet

Figure 5-8

Tysons West PS Force Main Alternative - 2

CDM Smith

5.2.2.1 Summary of Potential Physical Constraints for Alternative 2

Both variants of Alternative 2 will pass through the Town of Vienna.

From TWPS, Dominion Energy power lines run underground along Industrial Way. There are also underground power lines present on the west side of Leesburg Pike. The force main will continue parallel to Dominion Energy's primary underground electric distribution line for about 1,400 lf along Leesburg Pike, which will increase the chance of potential conflicts.

For Alternative 2A, at the end of Ash Grove Lane, the force main will enter the Westwood Village Condominiums property, so an easement will be necessary. While Alternative 2A presents minimal traffic impacts on Leesburg Pike, the impacts on the Sheraton property will be extensive when compared to the other alternatives. Open-cut construction on the southern and eastern sides of the Sheraton property may require closure of the portion of Ash Grove Lane east of the Sheraton property due to the location of the trench. This could lead to parking and traffic disruptions for the Sheraton property. Construction of a trenchless installation pit on the east side of Leesburg Pike will require a large construction easement from business owners in that area, which could impact their operations (specifically, Koons Tysons Toyota Dealership and Collision Repair Center).

For Alternative 2B, the force main will continue parallel to Dominion Energy's underground electric distribution line for about 1,400 lf along Leesburg Pike. Additionally, Alternative 2B will cross the Silver Line Metro line near the Spring Hill Metro station, which could potentially impact access to the Metro station during construction. The Alternative 2B alignment will continue along the Leesburg Pike and follow the Vesper Trail into Vienna. The routes will cross the Washington and Old Dominion Trail, which is an important pedestrian and biking arterial in the region. The majority of the alignment will be routed along the right-of-way of Chain Bridge Road/Maple Avenue. Lane closures will likely be necessary, resulting in lane closures that will cause business and residential disruptions. Off-hours construction and using service roads for staging could minimize the traffic impact along Chain Bridge Road/Maple Avenue.

Figures 5-9 through 5-15 show the critical locations of routing for Alternative 2A and Alternative 2B.

Figure 5-9
Approximate Location of Trenchless Crossing (Leesburg Pike)

Figure 5-10
Approximate Location of Trenchless Installation Pit West of Leesburg Pike

Figure 5-11
Approximate Location of Trenchless Installation Pit East of Leesburg Pike

Figure 5-12
Sheraton Tyson Hotel Access along Ashgrove Lane (Alternative 2A)

Figure 5-13
Westwood Village Condominium Residential Community Entrance on Ashgrove Lane

Figure 5-14
Spring Hill Metro Station across from Leesburg Pike Alignment Pathway (Alternative 2B)

Figure 5-15
Washington and Old Dominion Trail Crossing at Chain Bridge Road/Maple Avenue

5.2.2.2 Topography for Alternative 2

Figure 5-16 and **Figure 5-17** present the approximate grade elevation for the two variations of Alternative 2, starting from TWPS on the left and the gravity sewer transition point on the right. There are 14 and 13 high points along the entire route for both Alternatives 2A and 2B, respectively.

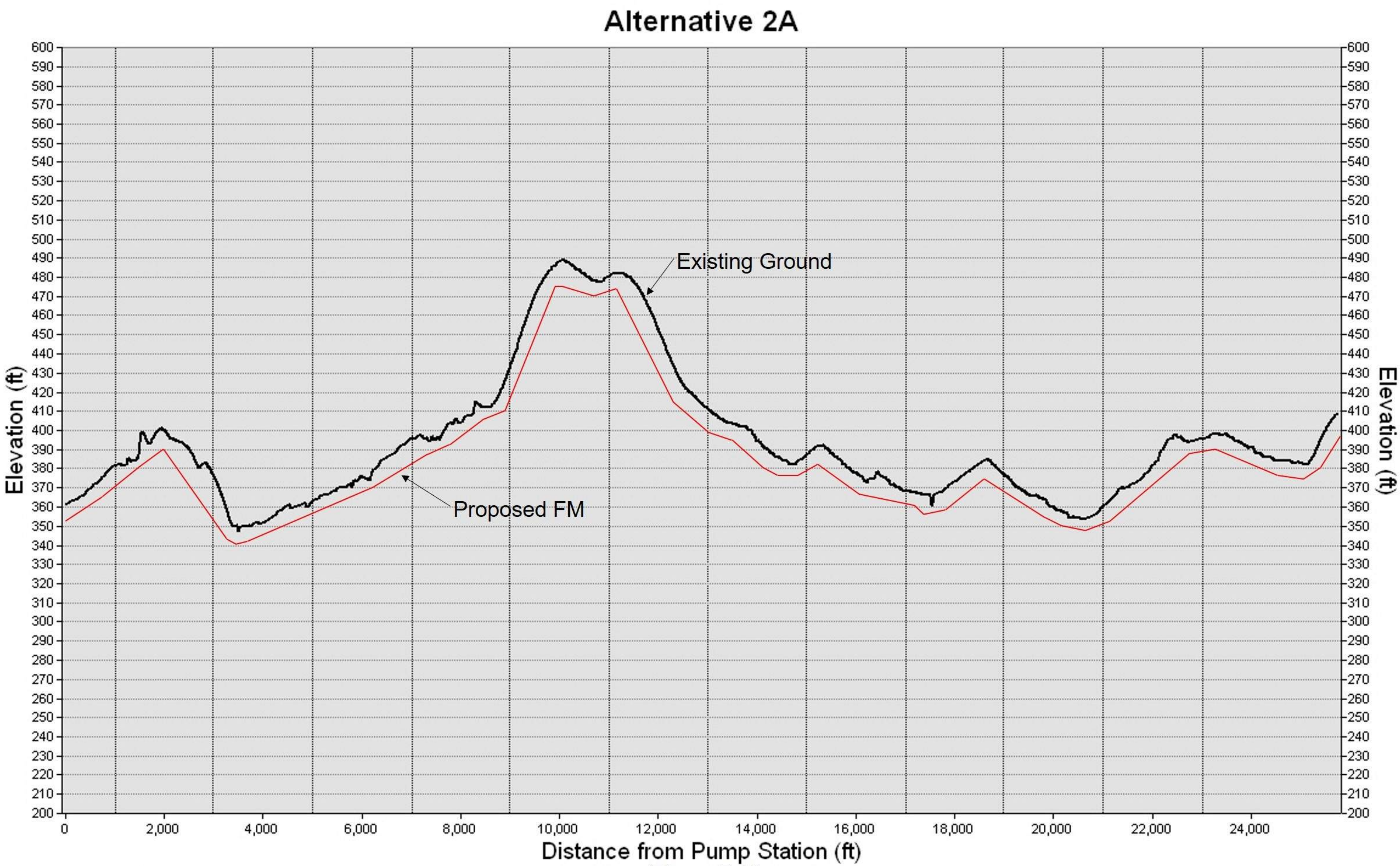
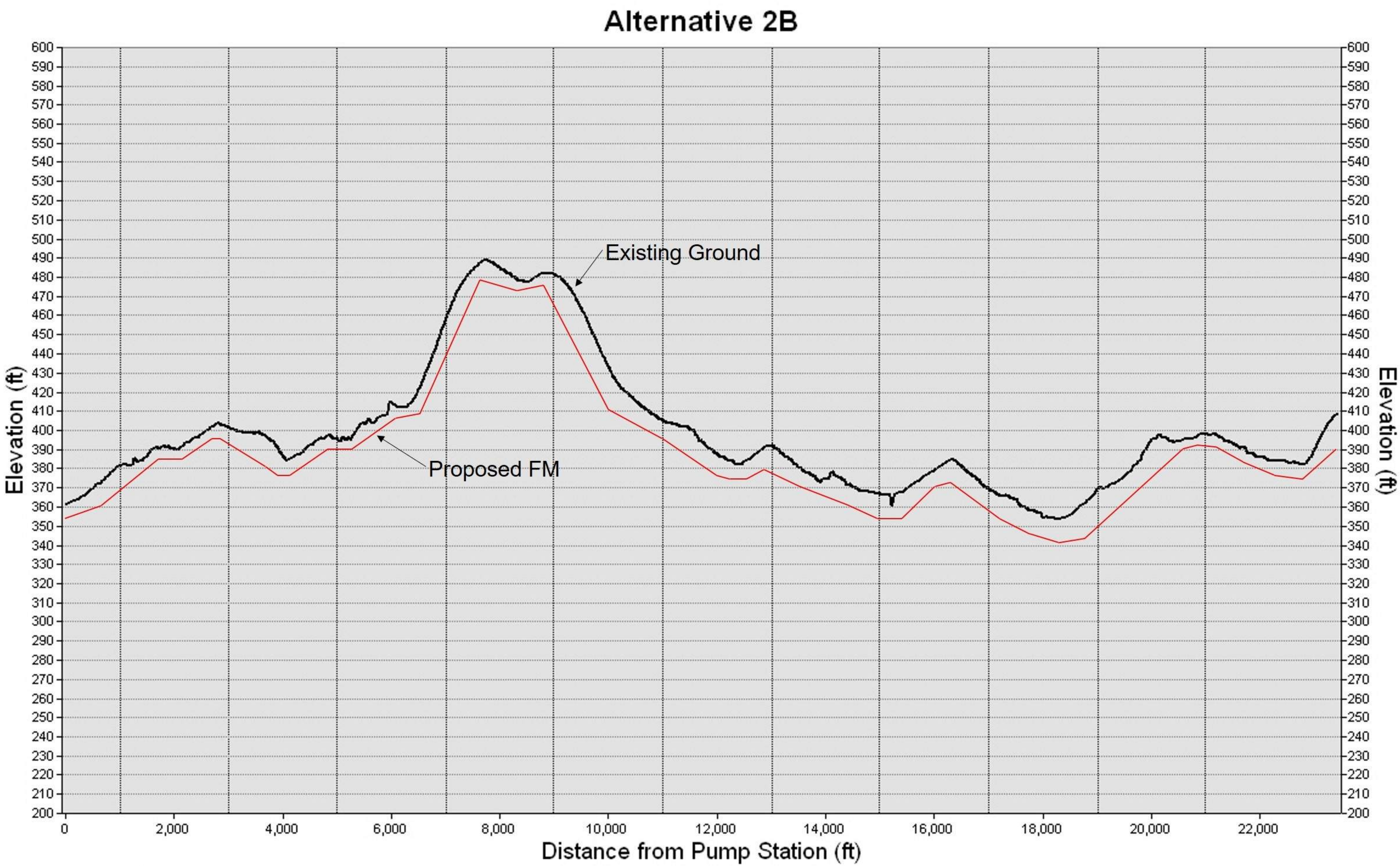


Figure 5-16

Tysons West Force Main



Tysons West Force Main

Figure 5-17

5.2.3 Route Alternative 3

Similar to Alternative 2, Alternative 3 will begin at the TWPS site and proceed approximately 1,100 lf southwest along Industrial Way. The route then will cross under Leesburg Pike using a trenchless method and continue along Ashgrove Lane north of the Sheraton property for approximately 750 lf. The alignment will then continue west through the forested area between eastbound Route 267 and Northern Neck Drive for approximately 1,000 lf. The alignment then will enter the forested area owned by Fairfax County Park Authority and continue for approximately 700 lf before entering Montmorency Drive. The alignment will continue west along Montmorency Drive for approximately 2,500 lf until it reaches Bois Avenue. The alignment will turn south and continue along Bois Avenue for approximately 450 lf, and then will turn southwest and continue along Besley Road for approximately 1,600 lf before arriving at the intersection of Old Courthouse Road. The alignment will continue by crossing under Old Courthouse Road using a trenchless method, then continue through the dense wooded area along the eastern branch of Wolftrap Creek for approximately 500 lf. Alternative 3 will have three sub-options: 3A, 3B, and 3C.

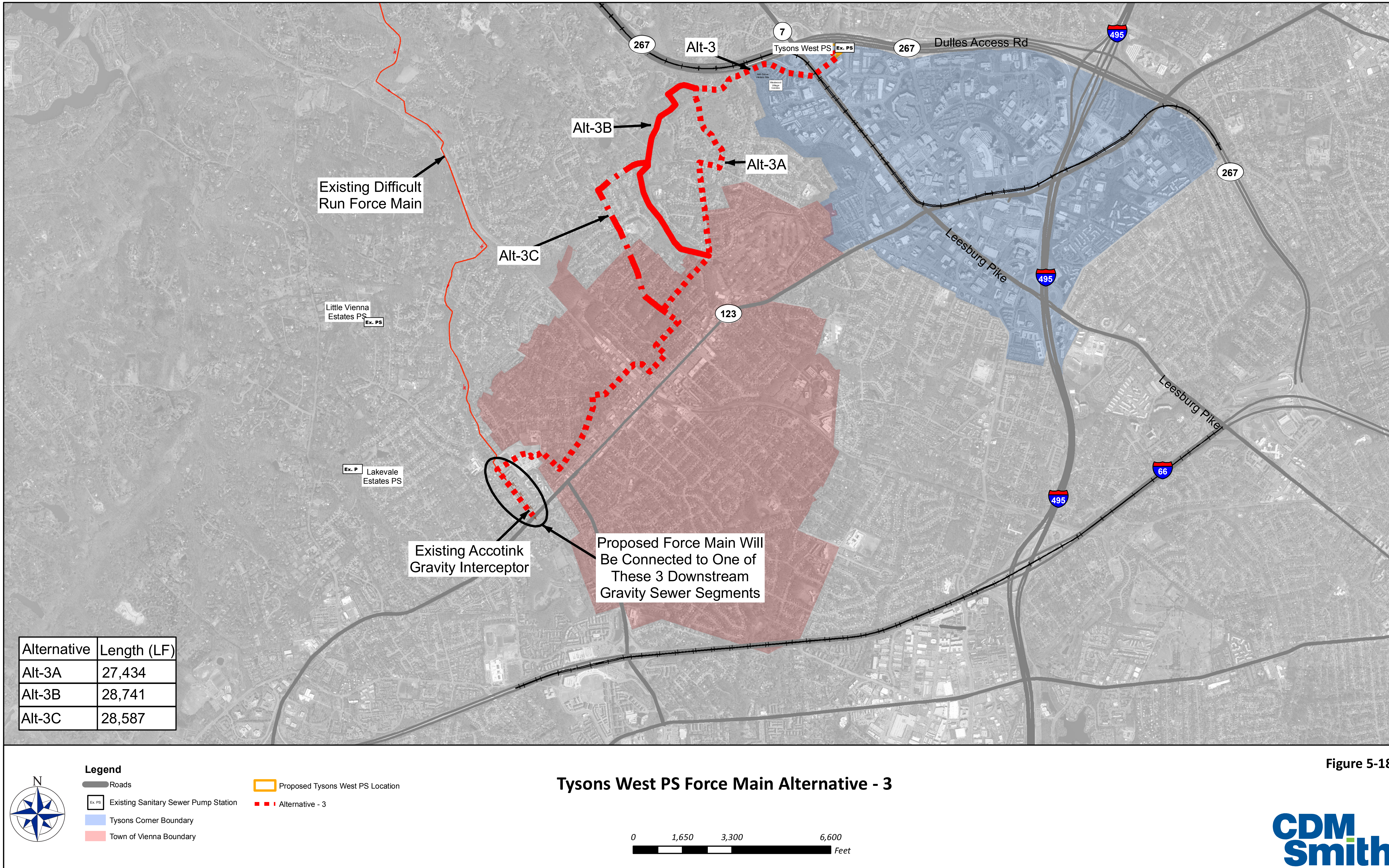
Alternative 3A will continue south along the eastern branch of Wolftrap Creek between residential neighborhoods for approximately 1,900 lf, and it will continue through the small, forested area for about 270 lf to Drewlaine Drive. The force main will follow along the southeast of Drewlaine Drive for approximately 845 lf then turn west to Old Courthouse Road, continuing for about 650 lf. At the intersection between Old Courthouse Road and Creek Crossing Road, the route will proceed south along Creek Crossing Road NE for approximately 5,500 lf. At the intersection of Creek Crossing Road NE and Beulah Road, the force main will turn southeast following Beulah Road for 700 lf.

For Alternative 3B, the alignment will continue southwest along Montmorency Drive for an additional 1,530 lf, then it will continue through the forested area behind a residential neighborhood for 270 lf. The route will follow along Wolftrap Creek south through Springlake Park, Wolftrap Stream Valley Park, and Foxstone Park for approximately 6,300 lf. The force main then will turn southwest and continue along Creek Crossing Road for about 2,115 lf. The alternative will turn southeast following Beulah Road for 700 lf.

Similar to Alternative 3B, Alternative 3C will continue along southwest Montmorency Drive for an additional 1,530 lf, then continue through the forested area owned by Fairfax County Park Authority, behind a residential complex for 270 lf. The route will follow along Wolftrap Creek south through Springlake Park for about 2,100 lf, and then will turn southwest to continue along Abbotsford Drive for 1,800 lf. The route will turn again toward Beulah Road NE and continue along the road for approximately 5,280 lf. Wolftrap Elementary School is located along Beulah Road NE.

For approximately 3,500 lf, the next segment of the alignment for all three variations of Alternative 3 will be located along Ayr Hill Avenue NE. The alignment will turn left to Park Street NE at the intersection of Ayr Hill Avenue NE and Park Street NE. It will continue by turning southwest to Church Street NE at the intersection of Park Street NE and Church Street NE. The force main will then turn northwest and continue along Mill Street NE for approximately 600 lf. The alignment will continue by turning southwest to Ayr Hill Avenue NE before crossing the

Washington and Old Dominion Trail. The alignment will continue along West Street NW for about 480 lf before turning south following Windover Avenue for approximately 2,750 lf. The force main then will continue northwest along Nutley Street for 800 lf, and then it will follow west around Madison High School's parking lots through a path between the school building and the football stadium for approximately 1,650 lf. Through the parking lot and small, wooded area located southeast from Sunrise Road, the route will continue southeast along Glengyle Drive for approximately 1,960 lf to reach the discharge point. The total length of Alternative 3A will be approximately 26,300 lf; Alternative 3B will be approximately 27,500 lf; and Alternative 3C will be approximately 27,350 lf. **Figure 5-18** shows the route for Alternative 3 and its variations.



Alternative	Length (LF)
Alt-3A	27,434
Alt-3B	28,741
Alt-3C	28,587

Figure 5-18

Tysons West PS Force Main Alternative - 3

CDM Smith

5.2.3.1 Summary of Potential Physical Constraints for Alternative 3

The upstream segment for all three variations of Alternative 3 will be the same. The impact on the Sheraton property could potentially be extensive due to limited space. Open-cut construction on the northern and eastern sides of the Sheraton property may require closure of the portion of Ash Grove Lane located east and north of the Sheraton property. This could lead to parking and traffic disruptions. At the end of the northeastern side of the Northern Neck Drive parking lot, there is a Dominion Energy transformer and overhead power lines. The force main will require easements. Further, there are two stream crossings along the upstream segment of this route.

The construction of a trenchless installation pit on the east side of Leesburg Pike will require a large construction easement from business owners in that area, which could impact their operations (specifically, Koons Tysons Toyota Dealership and Collision Repair Center).

Alignments for all three Alternative 3 variations will run parallel to Cox Communications conduits for approximately 1,600 lf along Montmorency Drive. For Alternatives 3B and 3C, the force main will run an additional 1,400 lf along the same road, parallel to the Cox Communications lines. For Alternative 3C, the force main will be located across from Wolftrap Elementary School along Beulah Road. There is one stream crossing along the midstream segment of all three variations of this alternative route. All Alternative 3 variations cross the Washington and Old Dominion Trail, which is an important pedestrian and biking arterial in the region. All Alternative 3 variations will be routed through the residential areas in the Town of Vienna, which will cause significant disruption.

The downstream segment for all three variations of Alternative 3 is the same. The force main will cross the James Madison High School/Louise Archer Elementary property, and an easement will be required from the high school. This could potentially impact operations and traffic for both schools.

Figures 5-19 through 5-22 show some of the critical routing elements for Alternative 3.

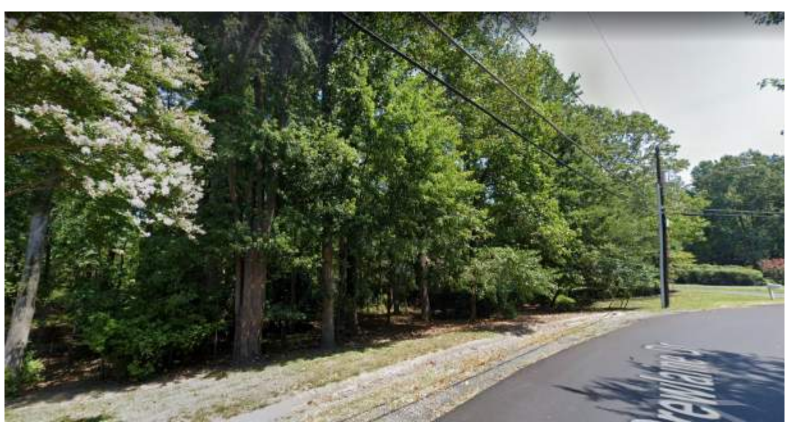


Figure 5-19
Forested Area near Drewlaine Drive

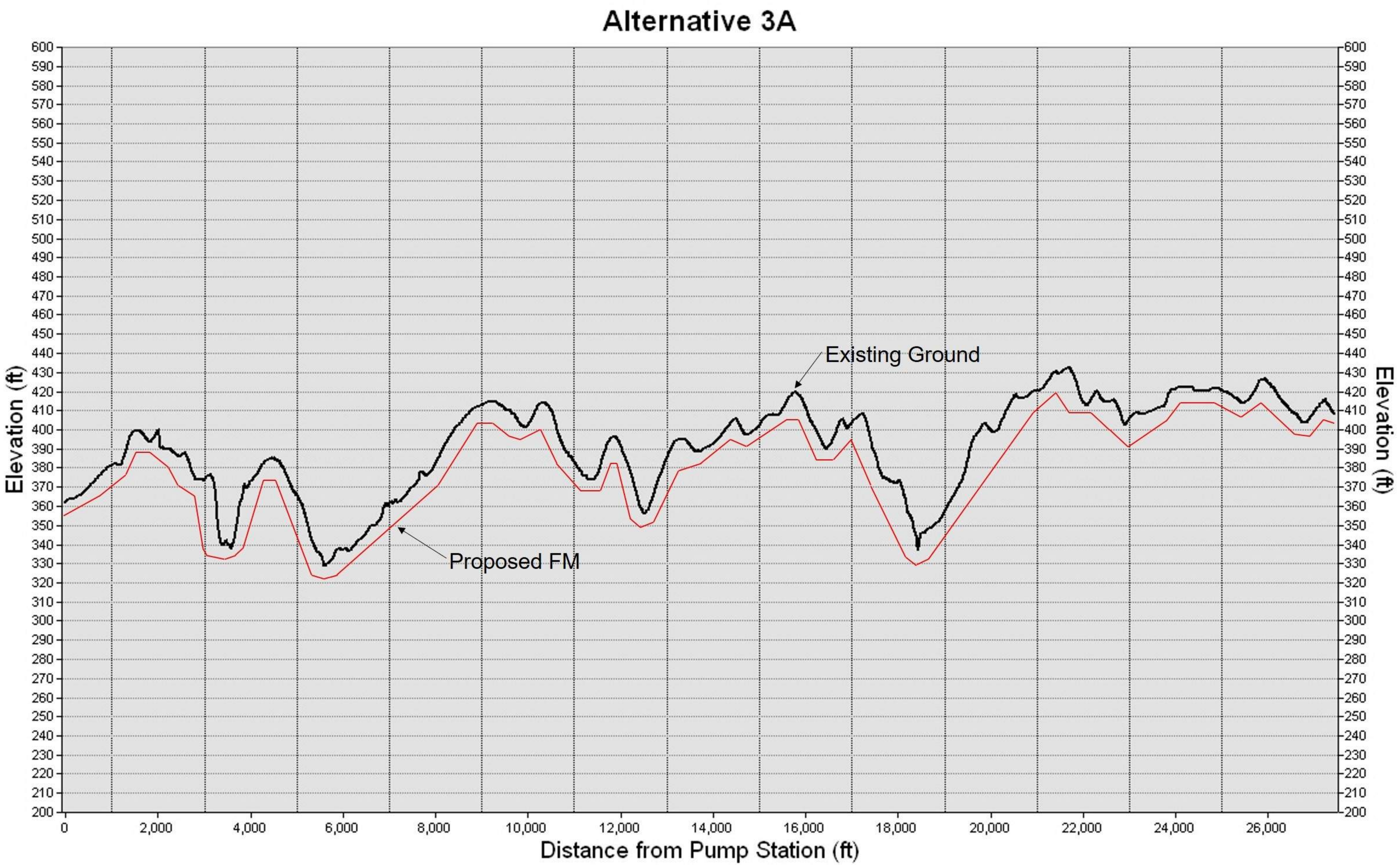
Figure 5-20
View of Forested Area from Abbotsford Drive (Alternative 3C)

Figure 5-21
Wolftrap Elementary School along Beulah Road (Alterative 3C)

Figure 5-22
Approximate Location of Parking Lot Crossing in Madison High School (Downstream Segment)

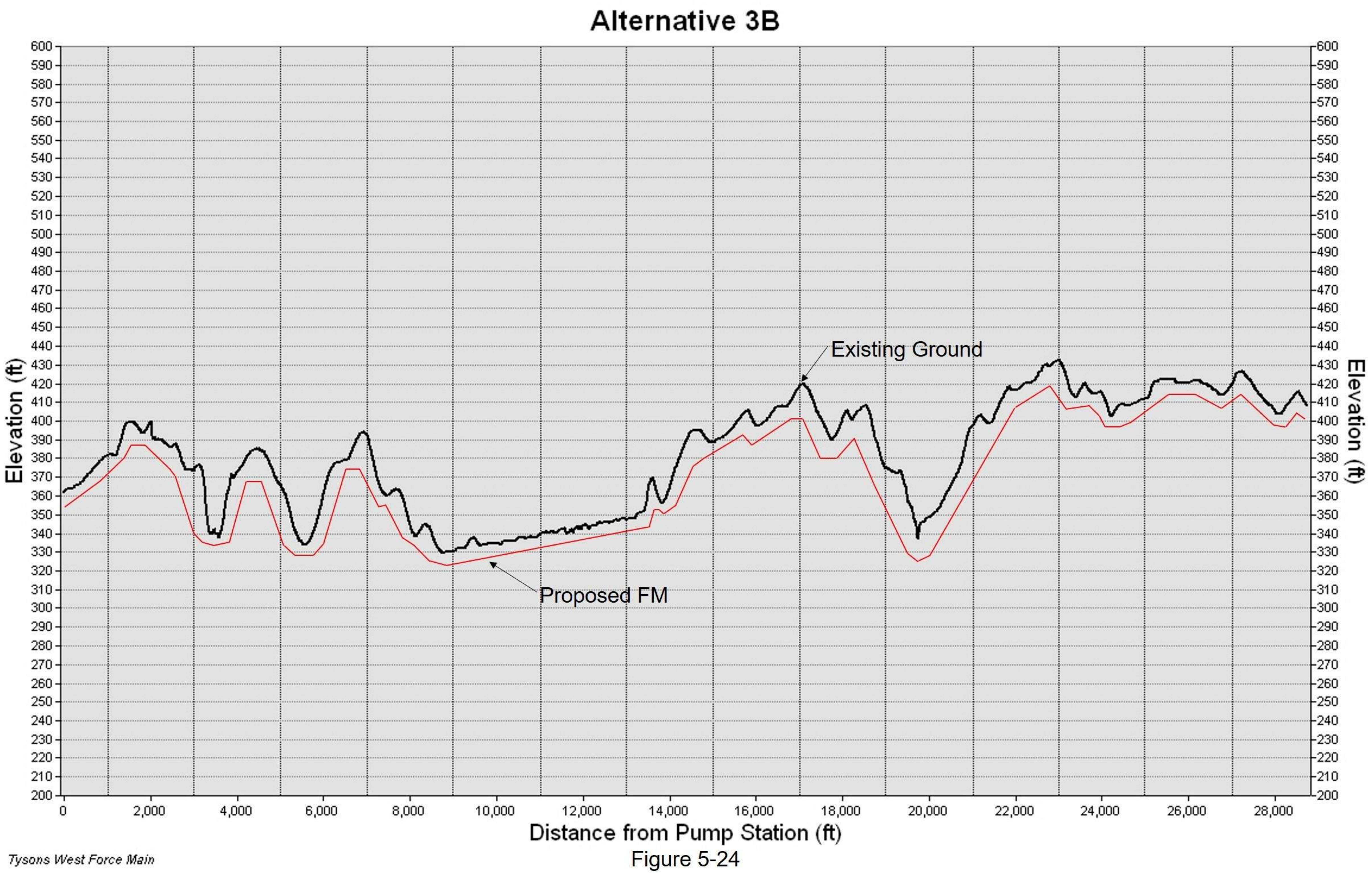
5.2.3.2 Topography for Alternative 3

Figures 5-23, 5-24, and **5-25** show the approximate grade elevation for the three variations of the Alternative 3 route starting from the TWPS shown on the left and the gravity sewer connection point on the right. The figures show there are 27, 27, and 28 high points along the entire route of Alternatives 3A, 3B, and 3C, respectively.



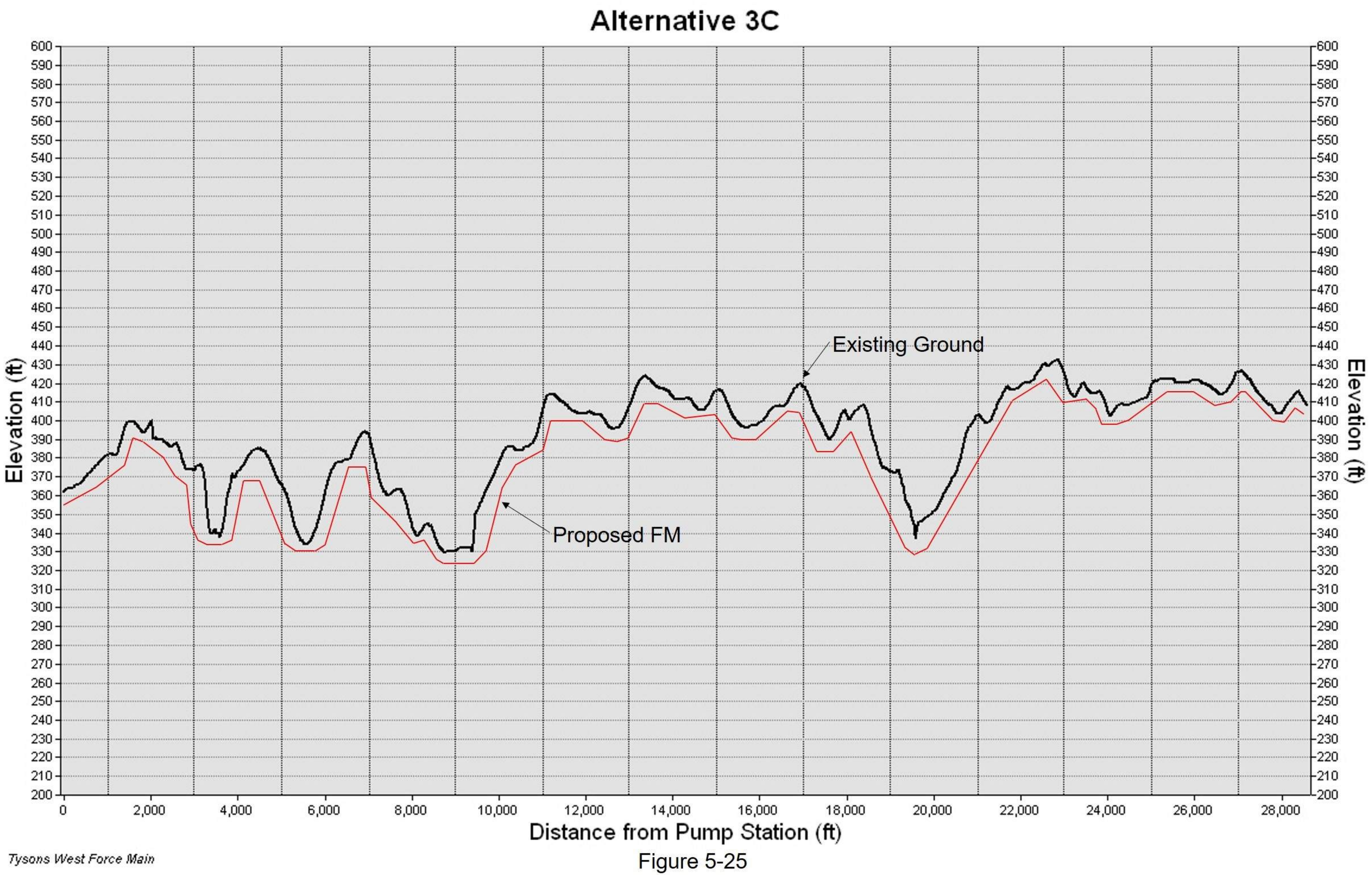
Tysons West Force Main

Figure 5-23



Alternative 3B
Existing Ground
Proposed FM
Elevation (ft)
Elevation (ft)
Distance from Pump Station (ft)
Tysons West Force Main

Figure 5-24



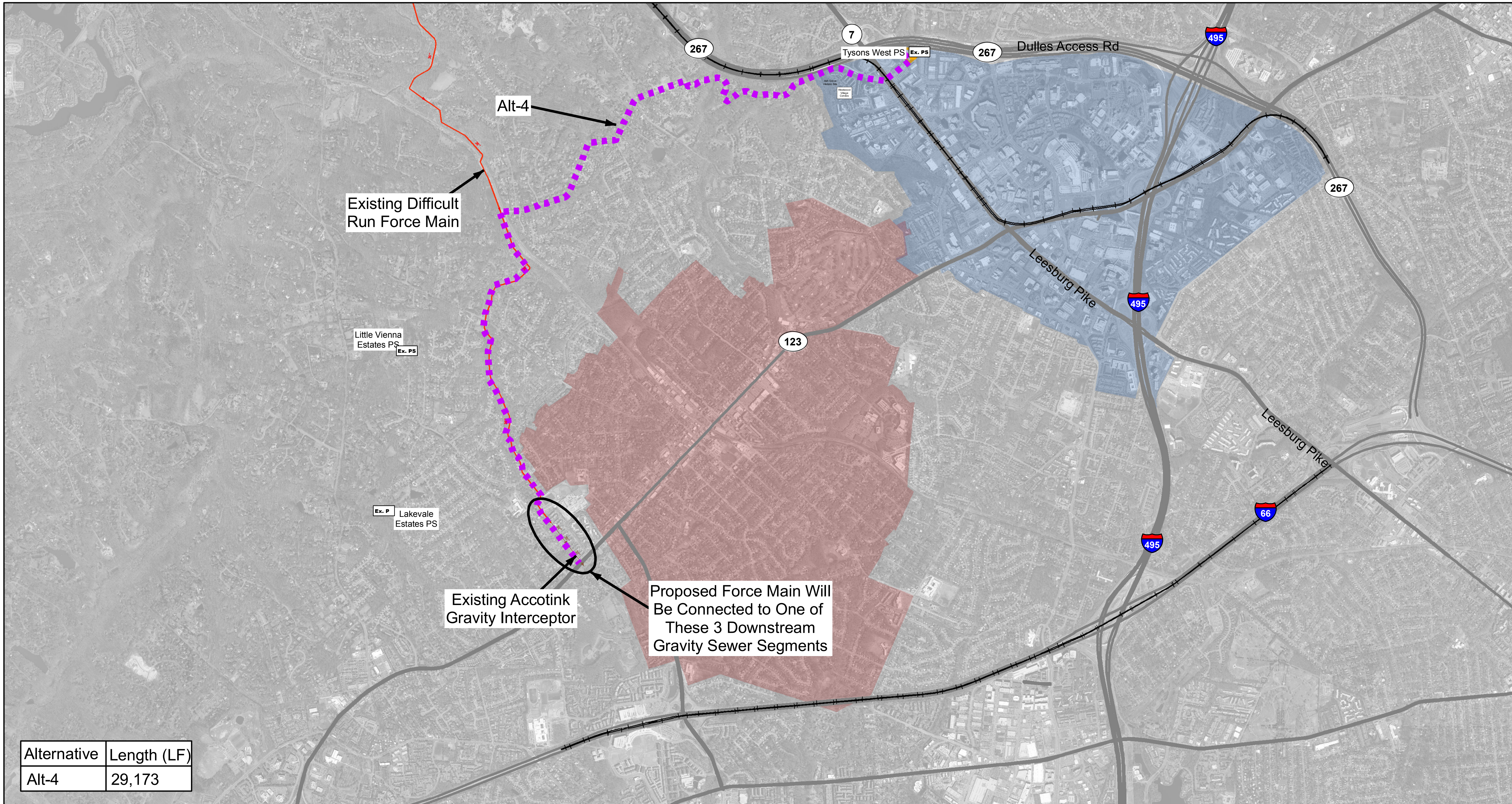
Alternative 3C
Existing Ground
Proposed FM
Elevation (ft)
Distance from Pump Station (ft)
Tysons West Force Main

Figure 5-25

5.2.4 Route Alternative 4

Alternative 4 will begin at the TWPS site and proceed approximately 1,100 lf southwest along Industrial Way. The route then will cross under Leesburg Pike using a trenchless method, and it will continue along Ashgrove Lane north of the Sheraton Tysons Hotel for approximately 750 lf. The alignment will then continue west through the forested area between eastbound Route 267 and Northern Neck Drive for approximately 1,000 lf. The alignment then will enter the forested area owned by Fairfax County Park Authority and continue for approximately 700 lf before entering Montmorency Drive. The alignment will continue west along Montmorency Drive for approximately 2,500 lf until it reaches Bois Avenue. The alignment then will turn north and continue along Bois Avenue for approximately 1,900 lf before arriving at the intersection of Bois Avenue and Gelding Lane. The alignment will continue north along Gelding Lane for approximately 150 lf before turning west, and it will continue along Trap Road for 1,600 lf. The alignment then will turn south to continue along Beulah Road for about 1,380 lf. From there, the line will turn west toward Clarks Crossing Road and continue along the road for about 4,540 lf until it reaches the Washington and Old Dominion Regional Trail.

The route then will follow the Difficult Run force main southeast along the Piney Branch Creek for approximately 8,800 lf until it reaches north of Jerry Lane Northwest. From there it will continue, following the Difficult Run force main alignment along Carey Lane and Glengyle Drive for approximately 2,380 lf, to reach the connection point along southbound Chain Bridge Road/Maple Avenue at the intersection of Glengyle Drive and Chain Bridge Road. The total length of Alternative 4 will be approximately 28,000 ft. **Figure 5-26** shows the route for Alternative 4.



Alternative	Length (LF)
Alt-4	29,173

Legend

- Roads
- Ex. PS Existing Sanitary Sewer Pump Station
- Tysons Corner Boundary
- Town of Vienna Boundary
- Proposed Tysons West PS Location
- Alternative - 4

0 1,650 3,300 6,600 Feet

Tysons West PS Force Main Alternative - 4

Figure 5-26

CDM Smith

5.2.4.1 Summary of Potential Physical Constraints for Alternative 4

Alternative 4 will have no impact on Leesburg Pike and Chain Bridge Road/Maple Avenue, which are very high-volume traffic areas in the Town of Vienna, because the majority of this alignment will be along the right-of-way of residential areas north of the Town of Vienna. The impact on the Sheraton property is potentially extensive. Open-cut construction on the northern and eastern sides of the Sheraton property may require closure of the portion of Ash Grove Lane east and north of the Sheraton. This could lead to parking and traffic disruptions. Construction of a trenchless installation pit on the east side of Leesburg Pike will require a large construction easement from businesses in that area, which could impact their operations (specifically, Koons Tysons Toyota Dealership and Collision Repair Center).

At the end of the northeastern side of the Northern Neck Drive parking lot, there is a Dominion Energy transformer and overhead power lines; therefore, the force main should be located in the acquired easements in this area. The route will cross the Washington and Old Dominion Trail, which is an important pedestrian and biking arterial in the region.

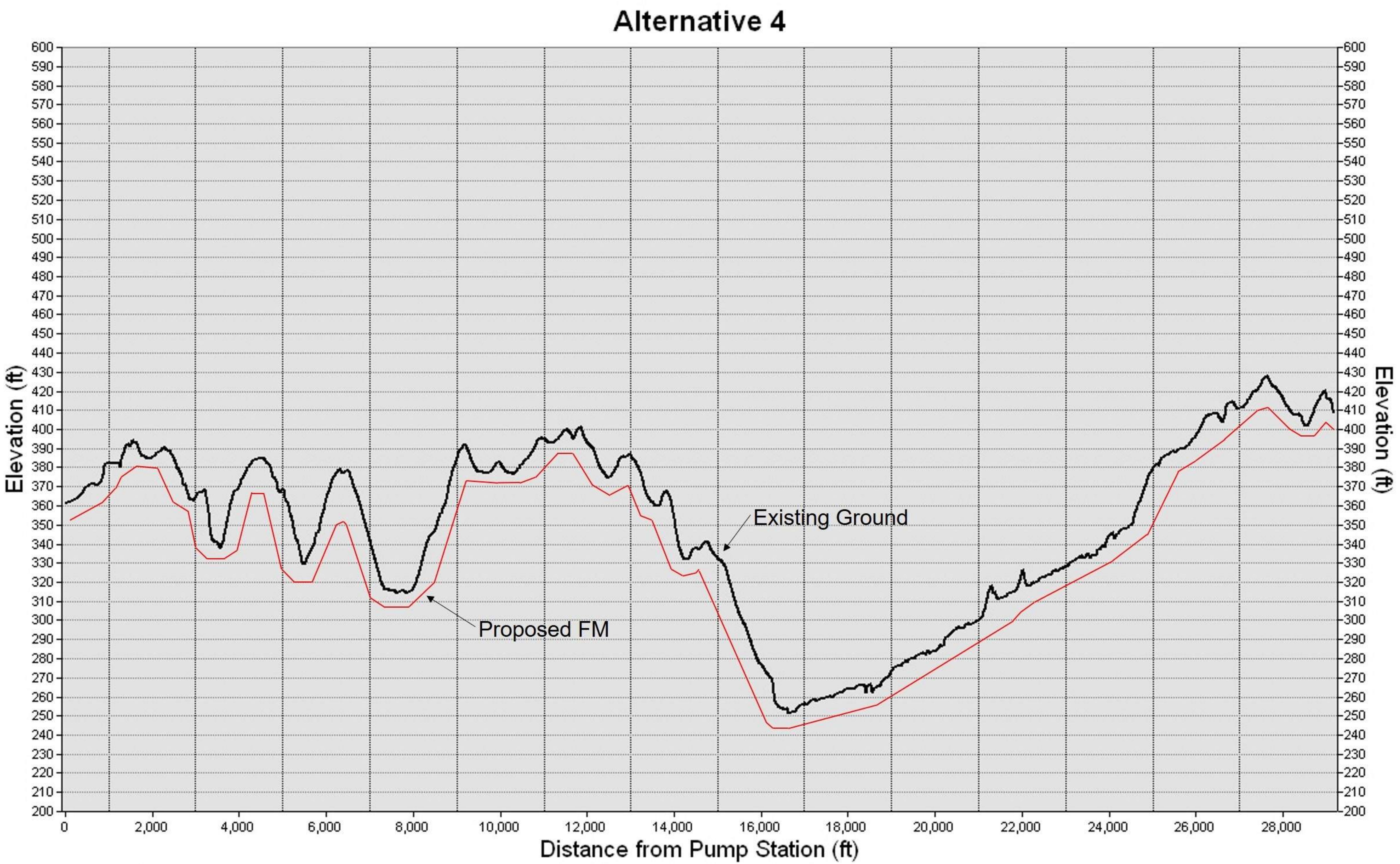
Along Flint Hill Road, the force main will be located across from Flint Hill Elementary School. This could potentially impact school operations and traffic. **Figures 5-27** and **5-28** show some of the critical locations along the Alternative 4 route.

Figure 5-27
Approximate Location of Fairfax County Department of Transportation Property on Beulah Road

Figure 5-28
Flint Hill Elementary School along Flint Hill Road

5.2.4.2 Topography for Alternative 4

Figure 5-29 presents the approximate grade elevation for the Alternative 4 route, starting from TWPS on the left and the gravity sewer transition point on the right. The figure shows there are approximately 25 major high points along the entire route of the force main.



Tysons West Force Main

Figure 5-29

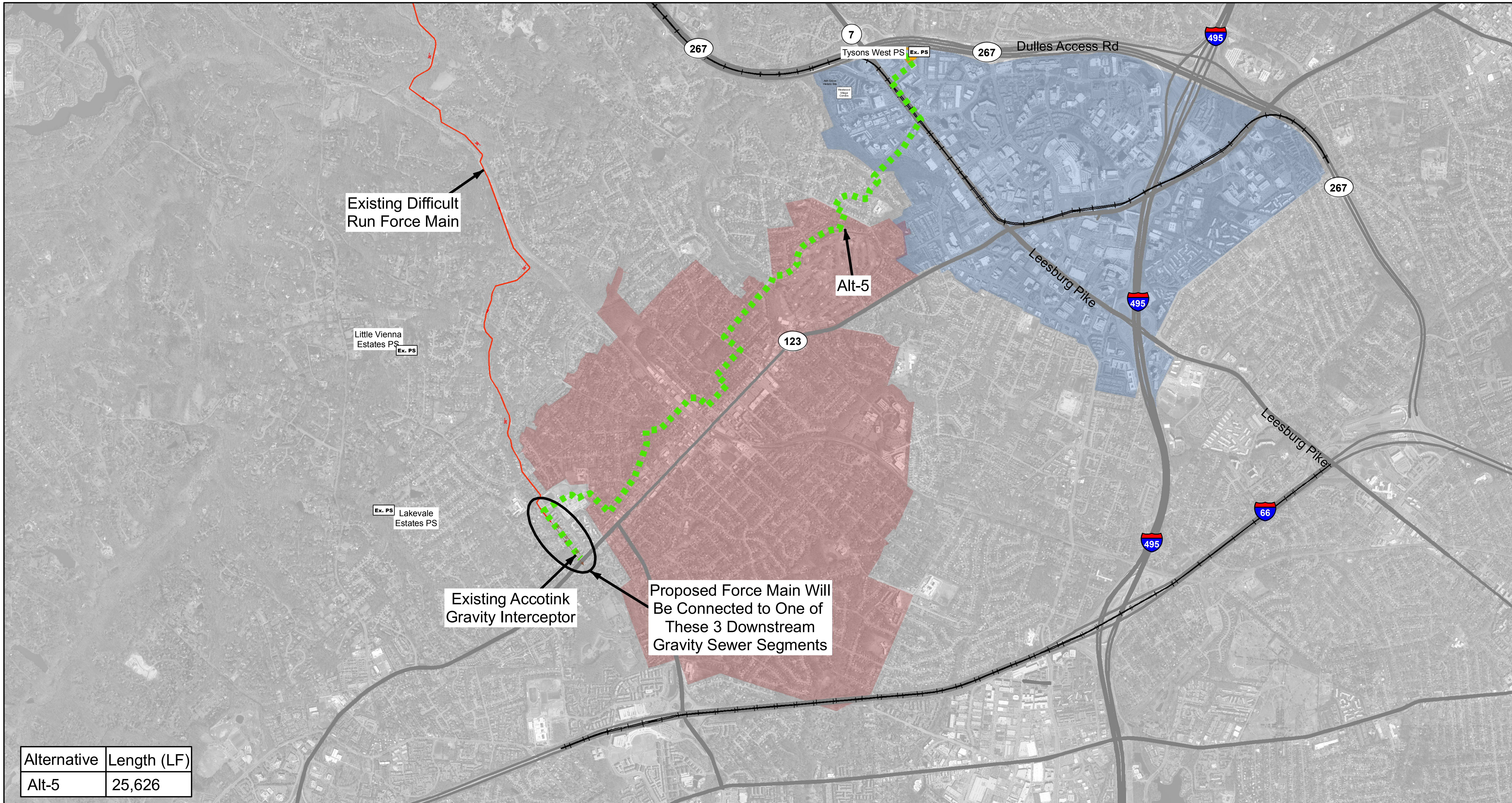
5.2.5 Route Alternative 5

The Alternative 5 alignment will begin at the TWPS and proceed approximately 1,100 lf southwest along Industrial Way. The force main will then cross under Leesburg Pike using an appropriate trenchless method. The force main will continue along Leesburg Pike for about 200 lf to the entrance of Ashgrove Lane. The force main then will continue southeast along Leesburg Pike for approximately 1,600 lf. From this point, the alignment will follow a southwesterly route in an approximately parallel direction to Chain Bridge Road/Maple Avenue on its eastern side.

The force main will continue along Vesper Trail for about 2,200 lf and turn left on Higdon Drive. The route will continue on Higdon Drive for 270 lf and then turn right on Pine Valley Road, continuing southwest for 620 lf until turning right on Westwood Drive. The route will continue along Westwood Drive for 1,300 lf before turning left on Old Courthouse Road. The route will continue along Old Courthouse Road for 1,500 lf before turning right on Course Street NE. At the end of Course Street NE, the route will turn right on Fairway Drive NE and continue for 4,000 lf until turning left at the intersection of Creek Crossing Road NE. The route will follow south along Creek Crossing Road NE for approximately 2,500 lf. At the intersection of Creek Crossing Road NE and Beulah Road, the force main will turn southeast, following Beulah Road for 700 lf before turning right and continuing southwest along Ayr Hill Avenue NE.

The alignment will turn left to Park Street NE at the intersection of Ayr Hill Avenue NE and Park Street NE. The alignment will continue by turning southwest to Church Street NE at the intersection of Park Street NE and Church Street NE. The force main will then turn northwest and continue along Mill Street NE for approximately 600 lf. The alignment will continue by turning southwest to Ayr Hill Avenue NE before crossing Washington and Old Dominion Trail. The alignment will continue along West Street NW for about 480 lf before turning south, following along Windover Avenue for approximately 2,750 lf. The force main will then continue northwest along Nutley Street for 800 lf, and then it will follow west around James Madison High School's parking lots through a path between the school building and the football stadium for approximately 1,650 lf. Through the parking lot and very small, wooded area southeast from Sunrise Road, the route will continue southeast along Glengyle Drive for approximately 1,960 lf to reach the connection point along southbound Chain Bridge Road/Maple Avenue at the intersection of Glengyle Drive and Chain Bridge Road/Maple Avenue.

The total length of Alternative 5 will be approximately 25,626 lf. **Figure 5-30** shows the route for Alternative 5.



Alternative	Length (LF)
Alt-5	25,626

Figure 5-30

Tysons West PS Force Main Alternative - 5

Legend

- Roads
- Ex. PS Existing Sanitary Sewer Pump Station
- Tysons Corner Boundary
- Town of Vienna Boundary
- Proposed Tysons West PS Location
- Alternative - 5

N

0 1,650 3,300 6,600 Feet

CDM Smith

5.2.5.1 Summary of Potential Physical Constraints for Alternative 5

There are Dominion Energy underground power lines along Industrial Way. There are also underground primary power lines present on the west side of Leesburg Pike. The force main will continue parallel to Dominion Energy's underground electric distribution line for about 1,400 lf along Leesburg Pike, which will increase the chance of potential conflict.

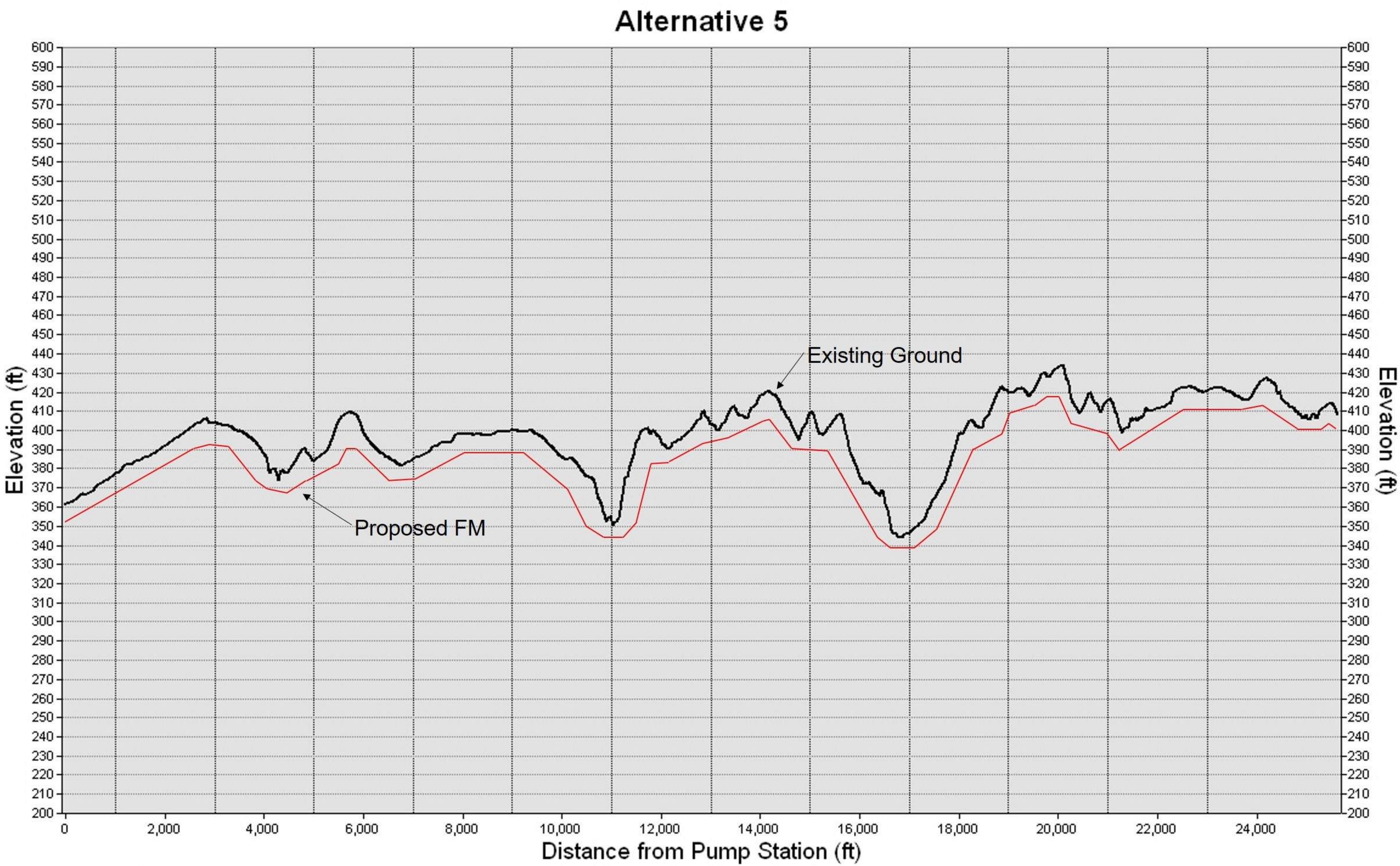
The construction of a trenchless installation pit on the east side of Leesburg Pike will require a large construction easement with business owners in that area (specifically, Koons Tysons Toyota Dealership and Collision Repair Center) and may affect their operation. The construction in this area will need to be coordinated with the Spring Hill Metro station.

Because the majority of this alignment will be along the right-of-way of residential and commercial areas in the Town of Vienna, Alternative 5 will have no impact on Leesburg Pike and Chain Bridge Road/Maple Avenue, which are very high-volume traffic areas. The alignment will be in the right-of-way; however, easements may be required in some areas.

The force main will also cross the James Madison High School property, requiring an easement from the high school. This could potentially impact school operations and traffic.

5.2.5.2 Topography for Alternative 5

Figure 5-31 presents the approximate grade elevation for the Alternative 5 route, starting from TWPS on the left and the gravity sewer transition point on the right. The figure shows there are approximately 36 major high/low points along the entire route of the force main.



Tysons West Force Main

Figure 5-31

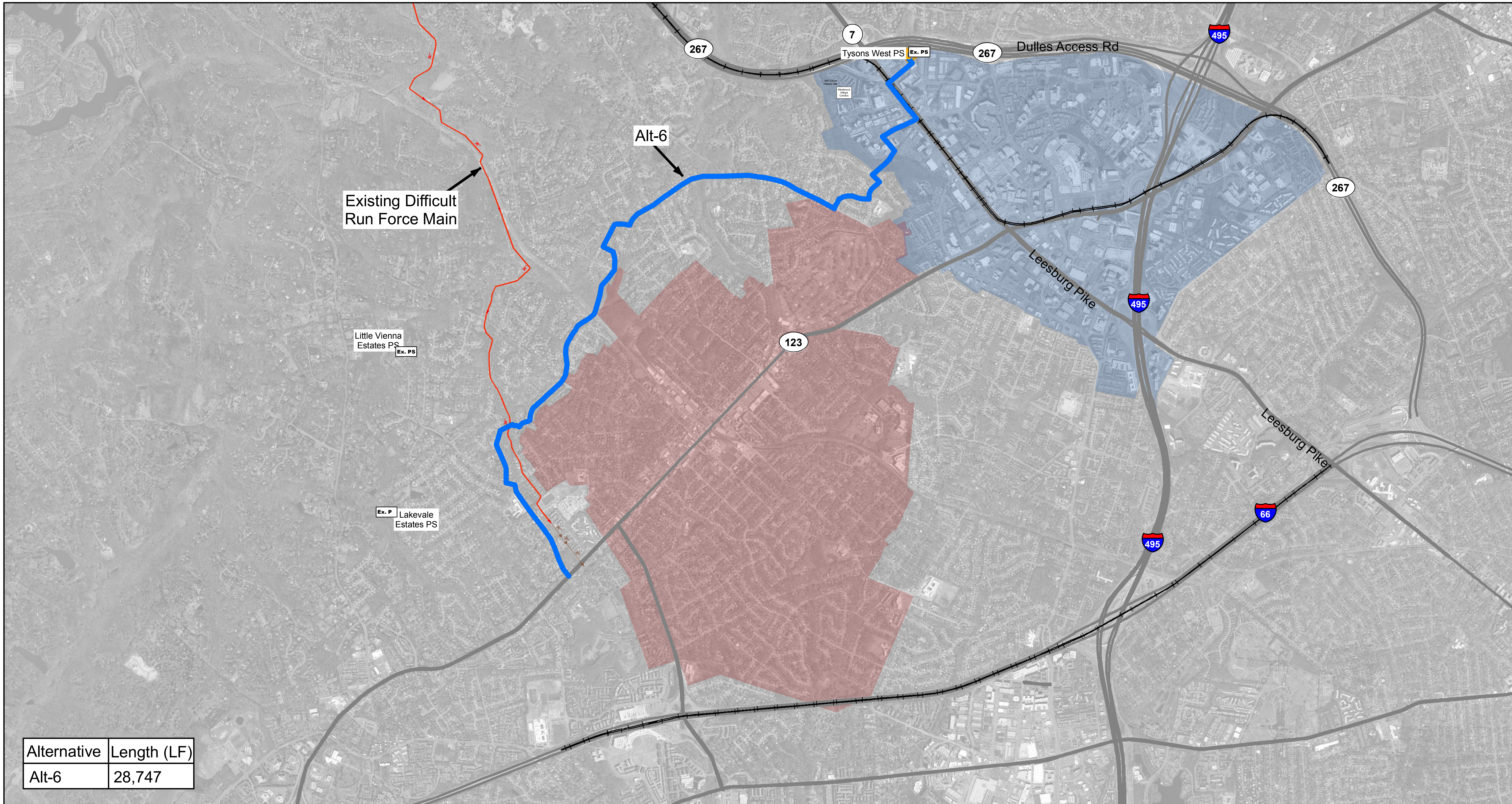
5.2.6 Route Alternative 6

Alternative 6 alignment will begin at the TWPS site and will run approximately 1,100 lf southwest along Industrial Way. The force main will then cross perpendicularly under Leesburg Pike using an appropriate trenchless method. The force main will continue southeast along Leesburg Pike for approximately 1,600 lf.

The force main will continue along the Vesper Trail for about 2,200 lf and turn left on Higdon Drive. The route will continue down Higdon Drive for 270 lf and then turn right on Pine Valley Road, continuing southwest for 620 lf until turning right on Westwood Drive. The route will continue along Westwood Drive for 1,300 lf before turning right on Old Courthouse Road. The route will continue along Old Courthouse Road for 3,700 lf before crossing through the forested area and under Wolftrap Stream to reach Abbotsford Drive. The force main will then travel 2,600 lf down Abbotsford Drive and turn right onto Percussion Way. The force main will continue along Percussion Way before turning left on Labrador Lane. The force main will continue 800 lf down Labrador Lane before turning left on Macy Avenue. The force main will travel 600 lf down Macy Avenue before crossing private property, traveling southwest.

The force main will continue 1,900 lf through new private property easements, Eudora Park, and across the Washington and Old Dominion Trail to meet the west section of Abbotsford Drive. The force main will continue 4,000 lf down Abbotsford Drive until veering right onto Rhapsody Drive. The force main will continue 400 lf down Rhapsody Drive before turning right onto a walking trail. It then will travel 900 lf on the walking trail through the park toward Riviera Drive. The force main then will travel south for 1,800 lf down Rivera Drive. It then will turn left onto Route 672 for 350 lf and then turn right, heading south down Flint Hill Road. Finally, the force main will travel 3,300 lf down Flint Hill Road to meet Chain Bridge Road/Maple Avenue outside the Town of Vienna limits. The force main will connect with the Accotink Gravity Interceptor.

The total length of Alternative 6 will be approximately 28,107 lf. **Figure 5-32** shows the route for Alternative 6.



Alternative	Length (LF)
Alt-6	28,747

Legend

- Roads
- Existing Sanitary Sewer Pump Station
- Tysons Corner Boundary
- Town of Vienna Boundary
- Proposed Tysons West PS Location
- Alternative - 6

0 2,500 5,000 10,000 Feet

Figure 5-32

Tysons West PS Force Main Alternative - 6

CDM Smith

5.2.6.1 Summary of Potential Physical Constraints for Alternative 6

Alternative 6 will be located completely outside the Town of Vienna limits; however, this alternative will travel through densely populated residential areas where construction will impact residents.

Due to the narrow width of section of Old Courthouse Road and other residential roads, sewer installation may necessitate detours and temporary road closures during construction. Abbotsford Drive has a vegetated median with well-established trees. Because of the size of the force main, the trees would likely need to be removed and replaced.

To minimize the overall length of the force main, the route will cross forested park areas and, in some cases, private property where new easements will be required. The route will also cross the Washington and Old Dominion Trail, which is an important pedestrian and biking arterial in the region.

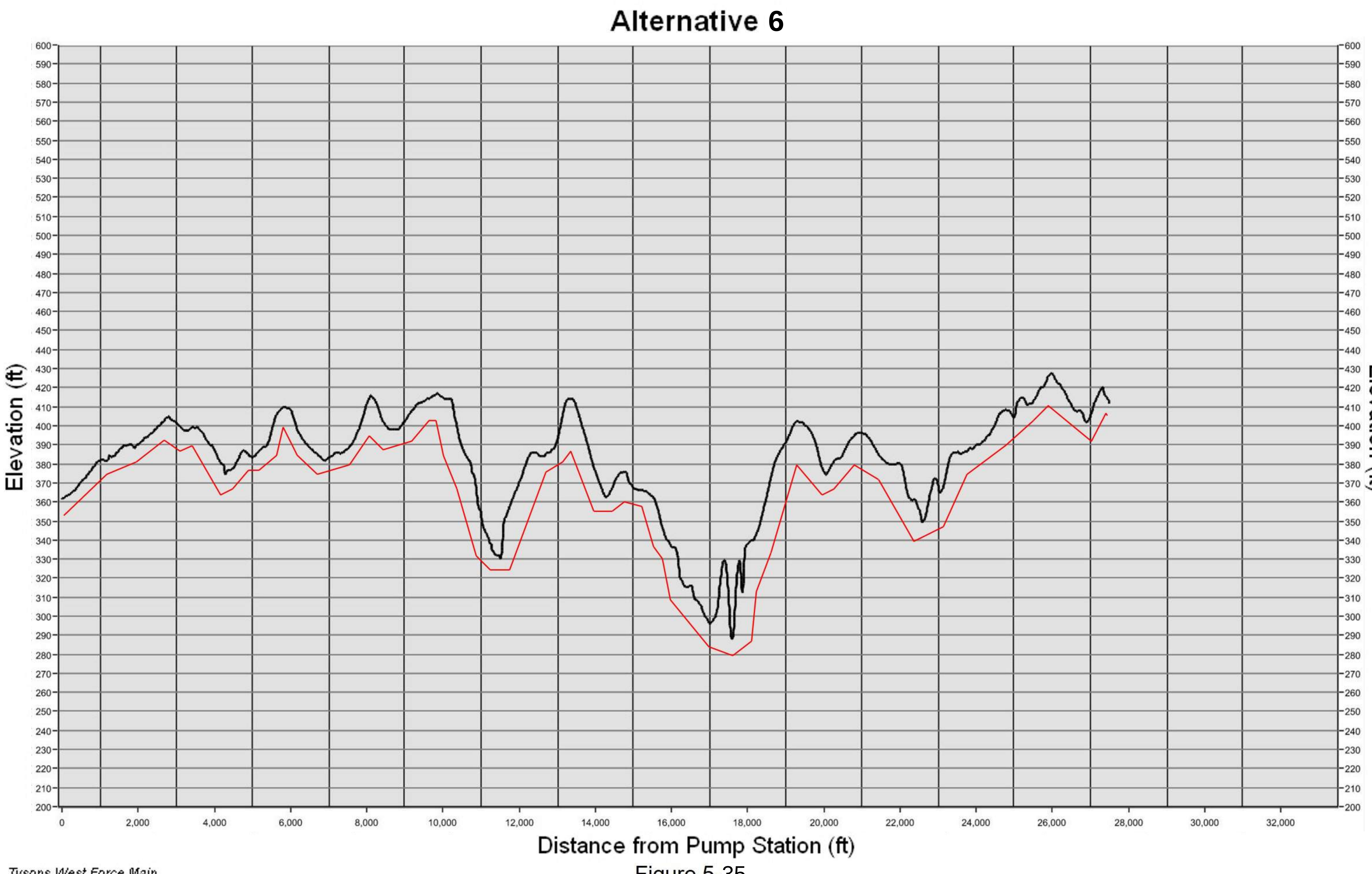
The force main route through Eudora will require expensive and highly disruptive construction. Due to the marshy soils and stream crossings the decision between trenchless and open cut installation methods will be evaluated during the detailed design phase.

Figure 5-33
Potential Property Crossing off Old Courthouse Road to Directly Route the Force Main to Abbotsford Drive

Figure 5-34
View from Abbotsford Drive Looking East across the Washington and Old Dominion Trail

5.2.6.2 Topography for Alternative 6

Figure 5-35 presents the approximate grade elevation for the Alternative 6 route, starting from TWPS on the left and the gravity sewer transition point on the right. The figure shows there are approximately 22 major high points along the entire route of the force main.



Alternative 6
Elevation (ft)
Distance from Pump Station (ft)
Tysons West Force Main

Figure 5-35

5.2.7 Route Alternative 7

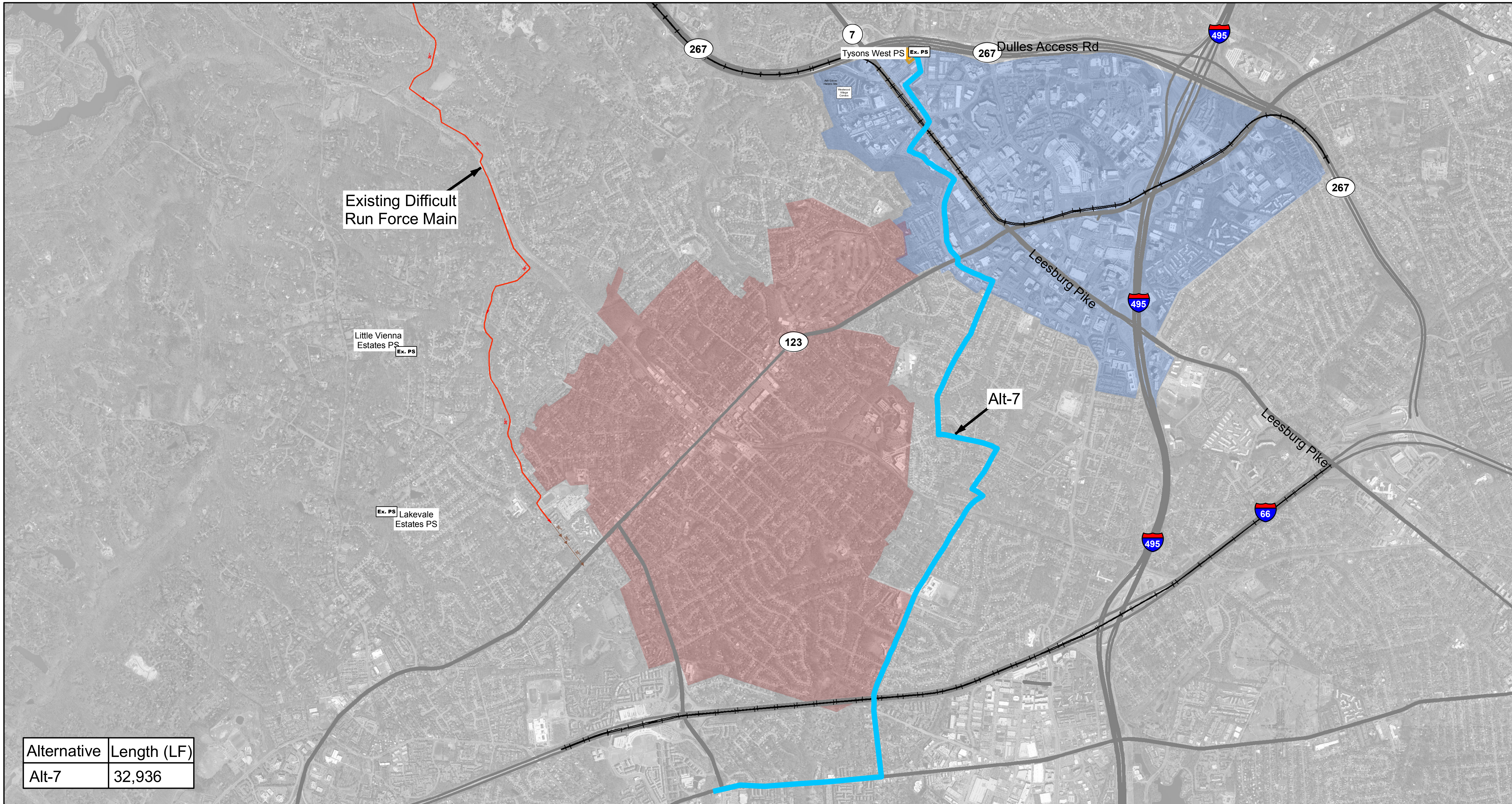
Alternative 7 alignment will begin at the TWPS and will run approximately 1,100 lf southwest along Industrial Way. The force main will then cross perpendicularly under Leesburg Pike using an appropriate trenchless method. The force main will continue southeast along Leesburg Pike for approximately 1,600 lf.

The force main will then follow along the Vesper Trail for about 1,750 lf to the forested area between Old Courthouse Spring Branch and Raglan Road Park. From Vesper Trail between Old Courthouse Spring Branch and Raglan Road Park, the force main will continue along the western edge of Properties 8433, 8449, 8459, and 8525 (Fairfax County Property Identification numbers) for approximately 1,450 lf. Past these properties, the route will turn right on Gosnell Road. The force main will continue south on Gosnell Road for 4,000 lf. The force main will turn right, down Woodford Road, and continue down it for 5,200 lf. The force main will turn left onto Electric Avenue and travel 1,800 lf to Williams Avenue, continuing 1,500 lf down Williams Avenue. The force main will turn left onto Overlook Street for 400 lf and then turn right onto Cedar Lane (State Route 698).

The force main will travel 7,000 lf to Route 66 down Cedar Lane. The force main will then cross Route 66, which also has an at-grade Washington Metropolitan Area Transit Authority (WMATA) Metro line through the middle of the highway.

After crossing Route 66, the force main will travel 2,400 lf south down Cedar Lane until reaching Lee Highway. The force main will turn right onto Lee Highway for 5,200 lf to where it connects to the Accotink Interceptor.

The total length of Alternative 7 will be approximately 32,936 lf. **Figure 5-36** shows the route for Alternative 7.



Alternative	Length (LF)
Alt-7	32,936

Legend

- Roads
- Existing Sanitary Sewer Pump Station
- Tysons Corner Boundary
- Town of Vienna Boundary
- Proposed Tysons West PS Location
- Alternative - 7

0 2,500 5,000 10,000 Feet

Figure 5-36

Tysons West PS Force Main Alternative - 7

CDM Smith

5.2.7.1 Summary of Potential Physical Constraints for Alternative 7

Alternative 7 will not traverse through the Town of Vienna because most of the alignment is through residential and commercial areas south of the Town of Vienna. This is the longest alignment option, more than 15 percent (%) longer, than the recommended Alternative 6 alignment.

This alignment will impact residential properties and three schools along Cedar Lane (Thoreau Middle, Cedar Lane, and Fairhill Elementary), which is a narrow road that may require detours and road closures. This force main alignment will cross Route 66, which will require extensive permitting and complex trenchless construction under Route 66 and WMATA train tracks (Figure **5-37**).

The downstream section of this alignment will be routed along Lee Highway, which is a highly trafficked local arterial (as shown in Figure 5-37) that will require traffic control measures.

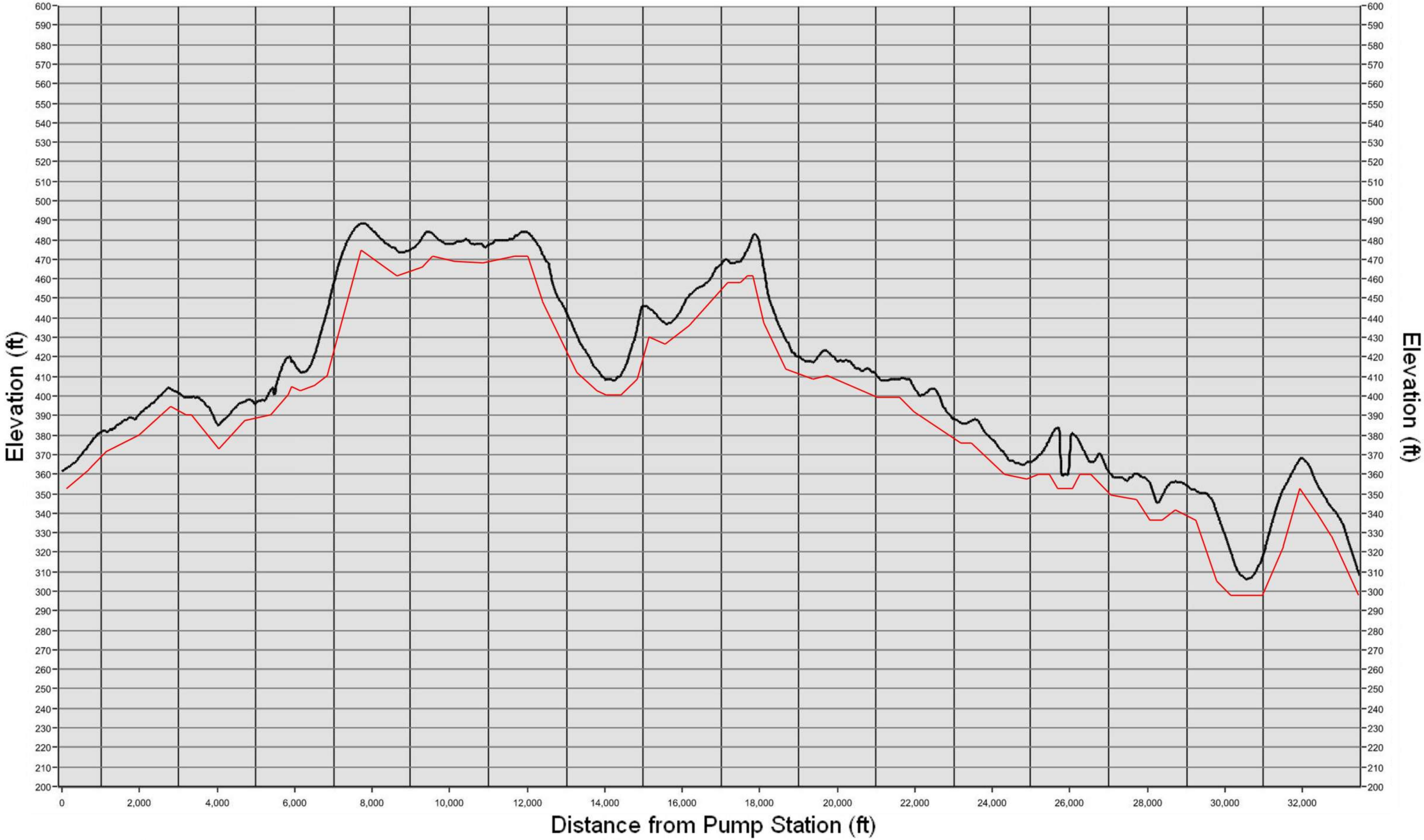
Figure 5-37
Route 66 with At-Grade Washington Metropolitan Area Transit Authority Metro Tracks (Looking Toward Cedar Lane Overpass)

Figure 5-38
Lee Highway to the South of Route 66

5.2.7.2 Topography for Alternative 7

Figure 5-39 presents the approximate grade elevation for the Alternative 7 route, starting from TWPS on the left and the gravity sewer transition point on the right. The figure shows there are approximately 26 high points along the entire route of the force main.

Alternative 7

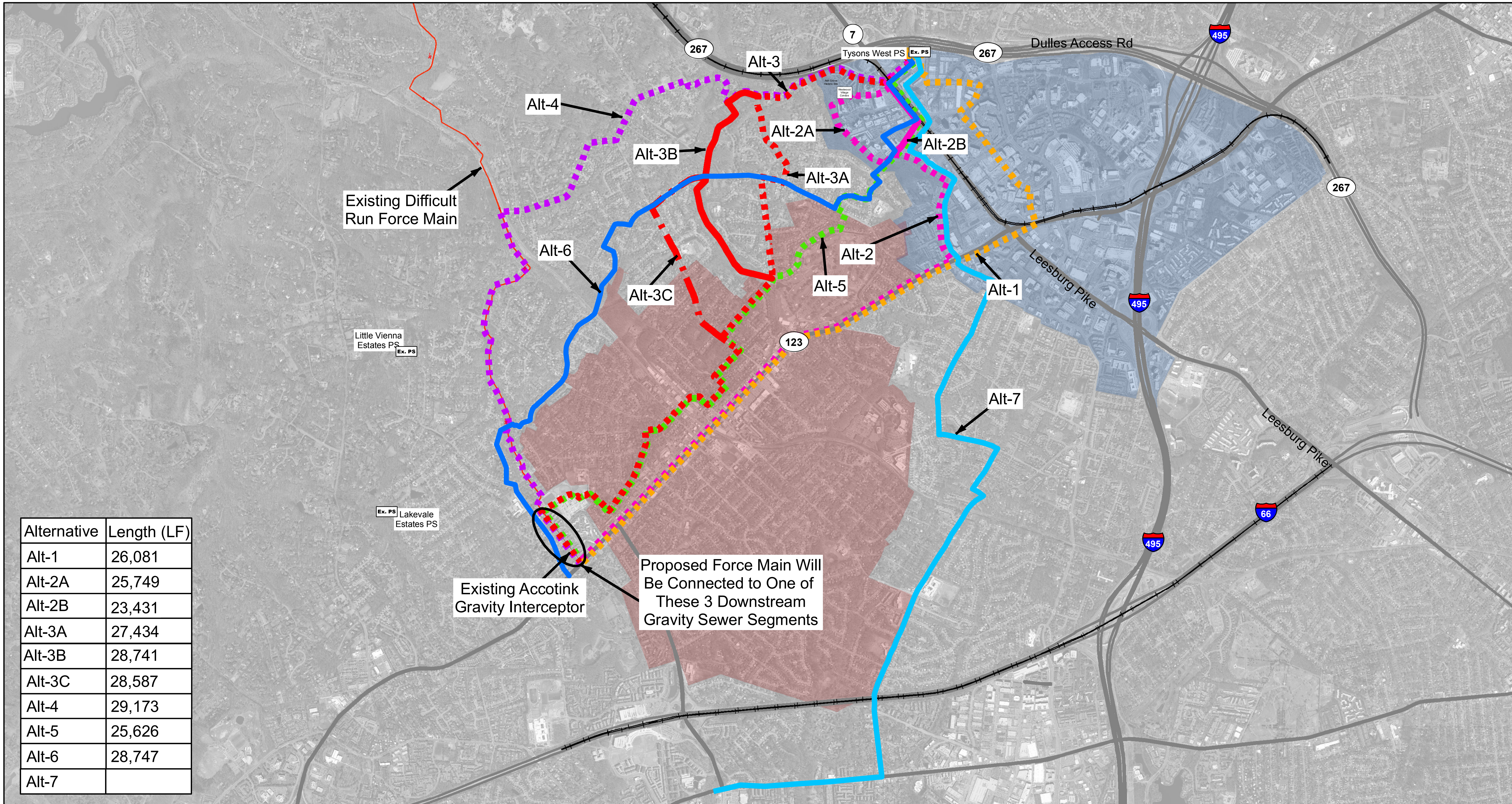


Tysons West Force Main

Figure 5-39

5.2.8 Overall Figure of Potential Alternative Routings

Figure 5-40 presents a plan view of all five of the proposed alternative alignments.



Alternative	Length (LF)
Alt-1	26,081
Alt-2A	25,749
Alt-2B	23,431
Alt-3A	27,434
Alt-3B	28,741
Alt-3C	28,587
Alt-4	29,173
Alt-5	25,626
Alt-6	28,747
Alt-7	

Legend

- Roads
- Existing Sanitary Sewer Pump Station
- Tysons Corner Boundary
- Town of Vienna Boundary
- Proposed Tysons West PS Location
- Alternative - 1
- Alternative - 2
- Alternative - 3
- Alternative - 4
- Alternative - 5
- Alternative - 6
- Alternative - 7

0 2,500 5,000 10,000 Feet

Tysons West PS Force Main Alternatives

Figure 5-40

CDM Smith

5.3 Qualitative Evaluation of Alternatives

CDM Smith conducted a qualitative evaluation of the seven potential alternatives for the new sewer force main. Advantages and disadvantages of each of the seven potential routes (listed in **Table 5-1)** were evaluated based on geographical information system (GIS) data, aerial imagery, desktop studies, and the best available record analyses at the time the document was prepare.

Table 5-1: Force Main Routing Alternatives Evaluation

	Alternative-1	Alternative-2A	Alternative-2B	Alternative-3A	Alternative-3B
Length (LF)	26,081	25,749	23,431	27,434	28,741
Parcels Crossing	This alternative crosses a Northern Virginia Regional Park Authority property (Washington and Old Dominion Trail).	This alternative crosses two private parcels (Westwood Village Condo open parking lot area and Sheraton Tysons property). It also crosses Fairfax County Park Authority property (Raglan Road Park) and Northern Virginia Regional Park Authority property (Washington and Old Dominion Trail).	This alternative crosses Fairfax County Park Authority property (Raglan Road Park) and Northern Virginia Regional Park Authority property (Washington and Old Dominion Trail).	This alternative crosses two private parcels (Sheraton Tysons property and Madison High School). It also crosses Fairfax County Park Authority property (Ash Grove) and Northern Virginia Regional Park Authority property (Washington and Old Dominion Trail).	This alternative crosses two private parcels (Sheraton Tysons property and Madison High School). It also crosses Fairfax County Park Authority property (Ash Grove) and Northern Virginia Regional Park Authority properties (Springlake Park, Wolftrap Stream Valley Park, Foxstone Park and Washington and Old Dominion Trail).
Metro Crossing	YES (underground metro tunnel)	YES (overhead)	YES (overhead)	YES (overhead)	YES (overhead)
Potential Utility Crossings	• 60" stormwater line crossings at 1 location • 48" stormwater line crossings at 1 location • 42" stormwater line crossing at 1 location • 36" stormwater line crossings at 4 locations • 24" stormwater line crossings at 3 locations • 21" stormwater line crossing at 1 location • 18" stormwater line crossing at 3 locations • 12" sewer line crossing at 1 location • 10" sewer line crossing at 1 location • 8" sewer line crossing at 13 locations • 4" sewer line crossing at 1 location • 24" water line crossing at 1 location • 12" water line crossing at 2 locations • 8" water line crossing at 3 locations • COX cable crossings multiple locations • Underground primary power crossing	• 42" stormwater line crossing at 1 location • 36" stormwater line crossings at 3 locations • 34" stormwater line crossings at 1 location • 24" stormwater line crossing at 1 location • 18" stormwater line crossing at 2 locations • 18" sewer line crossing at 1 location • 15" sewer line crossing at 2 locations • 10" sewer line crossing at 1 location • 8" sewer line crossing at 8 locations • 12" sewer line crossing at 1 location • 12" water line crossing at 1 location • 8" water line crossing at 5 locations • COX cable crossings multiple locations • Underground power crossing • Overhead power crossings	• 42" stormwater line crossing at 1 location • 36" stormwater line crossings at 3 locations • 24" stormwater line crossings at 1 location • 21" stormwater line crossing at 1 location • 18" stormwater line crossing at 1 location • 15" sewer line crossing at 2 locations • 12" sewer line crossing at 1 location • 10" sewer line crossing at 1 location • 8" sewer line crossing at 7 locations • 12" sewer line crossing at 1 location • 12" water line crossing at 1 location • 8" water line crossing at 5 locations • COX cable crossings multiple locations • Underground power line crossings	• 48" stormwater line crossing at 1 location • 36" stormwater line crossings at 1 location • 30" stormwater line crossings at 1 location • 21" stormwater line crossing at 6 locations • 15" stormwater line crossing at 1 location • 24" stormwater line crossing at 1 location • 18" stormwater line crossing at 2 locations • 15" sewer line crossing at 1 location • 8" sewer line crossing at 11 locations • 12" water line crossing at 1 location • 8" water line crossing at 1 location • COX cable crossings multiple locations • Overhead power crossings	• 48" stormwater line crossing at 1 location • 36" stormwater line crossings at 1 location • 30" stormwater line crossings at 1 location • 24" stormwater line crossing at 1 location • 21" stormwater line crossing at 4 locations • 18" stormwater line crossing at 2 locations • 21" sewer line crossing at 1 location • 8" sewer line crossing at 8 locations • 12" water line crossing at 1 location • 8" water line crossing at 1 location • COX cable crossings multiple locations • Overhead power crossings
Number of Crossings	36	27	25	27	21
Major Road Crossings	• Trenchless crossing under Chain Bridge Road, Leesburg Pike, Old Courthouse Road and ramps connecting Chain Bridge Road and Leesburg Pike	• Trenchless crossing under Leesburg Pike	• Trenchless crossing under Leesburg Pike	• Trenchless crossing under Leesburg Pike and Old Courthouse Road	• Trenchless crossing under Leesburg Pike and Old Courthouse Road
Permits Required	VDOT, WMATA, USACOE, NOVAPARKS, Town of Vienna	VDOT, WMATA, USACOE, NOVAPARKS, FCPA, Town of Vienna	VDOT, WMATA, USACOE, NOVAPARKS, FCPA, Town of Vienna	VDOT, WMATA, USACOE, MWAA, FCPA, NOVAPARKS, Town of Vienna	VDOT, WMATA, USACOE, MWAA, FCPA, NOVAPARKS, Town of Vienna
Potential Easement Requirements	One easement. From Northern Virginia Regional Park Authority.	Seven easements. From Westwood Village Condominiums, Sheraton Tysons, Fairfax County Park Authority, Northern Virginia Regional Park Authority, and private parcels.	Six easements. From Sheraton Tysons, Fairfax County Park Authority, Northern Virginia Regional Park Authority, and private parcels.	Six easements. From Dominion, Westwood Village Condominiums, Sheraton Tysons, Fairfax County Park Authority, Northern Virginia Regional Park Authority and Fairfax County Schools.	Six easements. From Dominion, Westwood Village Condominiums, Sheraton Tysons, Fairfax County Park Authority, Northern Virginia Regional Park Authority and Fairfax County Schools.
Environmental Concerns	• Stream crossing at 1 location	• Wetland and Park crossing • Stream crossing at 2 locations	• Possible wetland crossing • Stream crossing at 2 locations	• Wetland and Park crossing • Stream crossing at 3 locations	• Wetland and Park crossing • Stream crossing at 3 locations
Community/Social Impact	Large impact on the businesses and commercial properties along Greensboro Drive and Chain Bridge Road	Large impact on the businesses and commercial properties along Chain Bridge Road, Westwood Village Condominum and Sheraton property	Some impact on Sheraton, large impact on residential neighborhood along Gosnell Drive and businesses and commercial properties along Chain Bridge Road	Large impact on Sheraton and Madison High School, and residential neighborhoods north of Chain Bridge Road	Large impact on Sheraton and Madison High School, and residential neighborhoods north of Chain Bridge Road
Historic Site?	NO	NO	NO	NO	NO
Cost	$$$$	$$$$	$$$$	$$$$$	$$$$$
Pros	• Minimum number of easements required • Smallest environmental impact	• Shorter route	• Shortest route • Small environmental impact	• Minimal impact on major roads (Chain Bridge and Leesburg Pike)	• Minimal impact on major roads (Chain Bridge and Leesburg Pike)
Cons	• Large community and social impact • Complexities and high cost related with Tunneling under an underground Metro tunnel, several roads and ramps • Complexities and high cost of traffic management plan • Large impact on Leesburg Pike and Chain Bridge Road • Largest number of road crossings • Greatest number of utility crossings	• Large community and social impact • Complexities and high cost of traffic management plan • Large impact on Chain Bridge Road • Most number of easements	• Large community and social impact • Complexities and high cost of traffic management plan • Large impact on Chain Bridge Road	• More permits required comparing to Alt-1 and Alt-2 • Large impact on Sheraton and Madison High School operation	• More permits required comparing to Alt-1 and Alt-2 • Large impact on Sheraton and Madison High School operation
Avoids Town of Vienna?	NO	NO	NO	NO	NO

	Alternative-3C	Alternative-4	Alternative-5	Alternative-6 (North)	Alternative-7 (South)
Length (LF)	28,587	29,173	25,626	27,507	33,456
Parcels Crossing	This alternative crosses three private parcels (Sheraton Tysons property, Wolftrap Elementary School and Madison High School). It also crosses Fairfax County Park Authority property (Ash Grove) and Northern Virginia Regional Park Authority properties (Springlake Park and Washington and Old Dominion Trail).	This alternative crosses two private parcels (Sheraton Tysons property and Flint Hill Elementary School). It also crosses Fairfax County Park Authority property (Ash Grove) and Northern Virginia Regional Park Authority properties (Washington and Old Dominion Trail).	This alternative crosses Fairfax County Park Authority property (Raglan Road Park) and Northern Virginia Regional Park Authority property (Washington and Old Dominion Trail).	This alternative crosses Fairfax County Park Authority property (Eudora Park, Raglan Road Park, Wolftrap Stream Valley Park) and the Northern Virginia Park Authority property (Washington and Old Dominion Trail). Also crosses a significant number of private parcels.	This alternative crosses Route 66 which has an at-grade WMATA track running through the median and goes along Cedar Lane which is in front of Thoreau Middle School and Cedar Lane School.
Metro Crossing	YES (overhead)	YES (overhead)	YES (overhead)	YES (overhead)	YES (overhead and at grade) - Rt 7 and Rt 66
Potential Utility Crossings	• 48" stormwater line crossing at 1 location • 36" stormwater line crossings at 1 location • 30" stormwater line crossings at 1 location • 24" stormwater line crossing at 1 location • 21" stormwater line crossing at 4 locations • 18" stormwater line crossing at 3 locations • 8" sewer line crossing at 10 locations • 12" water line crossing at 1 location • 8" water line crossing at 1 location • COX cable crossings multiple locations • Overhead power crossings	•6" water main line crossing at 1 location •8" water main line crossing at 1 location •12" water main line crossing at 1 location •16" water main line crossing at 1 location •24" water main line crossing at 1 location •Unknown diameter stormwater line crossing at 22 locations •10" stormwater line crossing at 4 location •18" stormwater line crossing at 2 locations •21" stormwater line crossing at 2 location •24" stormwater line crossing at 2 locations •30" stormwater line crossing at 2 locations •36" stormwater line crossing at 1 location •48" stormwater line crossing at 2 locations •8" gravity sewer line crossing at 31 locations •10" gravity sewer line crossing at 1 location •12" gravity sewer line crossing at 2 locations •21" gravity sewer line crossing at 2 location •24" gravity sewer line crossing at 1 location •36" force main sewer line crossing at 2 location •Cox line crossings at 10 locations •Underground electric crossings at 3 locations •Gas line crossings at 1 locations	• 54" stormwater line crossings at 1 location • 36" stormwater line crossings at 4 locations • 30" stormwater line crossing at 2 locations • 27" stormwater line crossings at 2 locations • 24" stormwater line crossings at 1 location • 21" stormwater line crossing at 2 locations • 18" stormwater line crossing at 3 locations • 15" stormwater line crossing at 3 locations • 18" sewer line crossing at 1 location • 15" sewer line crossing at 1 location • 10" sewer line crossing at 1 location • 8" sewer line crossing at 11 locations • 24" water line crossing at 1 location • 6" water line crossing at 3 locations • COX cable crossings multiple locations • Underground primary power crossing • Overhead power crossings	• 6" water main line crossing at 1 location • 8" water main line crossing at 4 locations • 12" water main line crossing at 4 locations • 24" water main line crossing at 1 location • Unknown diameter stormwater line crossing at 35 locations • 15" stormwater line crossing at 1 location • 18" stormwater line crossing at 5 locations • 21" stormwater line crossing at 1 location • 27" stormwater line crossing at 1 location • 30" stormwater line crossing at 2 locations • 36" stormwater line crossing at 2 locations • 48" stormwater line crossing at 1 location • 8" gravity sewer line crossing at 43 locations • 12" gravity sewer line crossing at 1 location • 15" gravity sewer line crossing at 3 locations • 18" gravity sewer line crossing at 1 location • 21" gravity sewer line crossing at 1 location • 36" force main sewer line crossing at 1 location • Cox line crossings at 11 locations • Underground electric crossings at 8 locations • Gas line crossings at 5 locations	• 6" water main line crossing at 6 locations • 8" water main line crossing at 17 locations • 10" water main line crossing at 2 locations • 12" water main line crossing at 5 locations • 16" water main line crossing at 1 location • 20" water main line crossing at 2 locations • 1" water lateral line crossing at 27 locations • 2" water lateral line crossing at 2 locations • Unknown diameter water lateral line crossing at 26 locations • Unknown diameter stormwater line crossing at 26 locations • 6" stormwater line crossing at 2 locations • 15" stormwater line crossing at 3 locations • 18" stormwater line crossing at 5 locations • 19" stormwater line crossing at 1 location • 21" stormwater line crossing at 2 locations • 24" stormwater line crossing at 3 locations • 27" stormwater line crossing at 1 location • 30" stormwater line crossing at 2 locations • 36" stormwater line crossing at 3 locations • 42" stormwater line crossing at 1 location • 72" stormwater line crossing at 1 location • 96" stormwater line crossing at 1 location • 8" gravity sewer line crossing at 44 locations • 15" gravity sewer line crossing at 3 location • 21" gravity sewer line crossing at 1 location • 36" gravity sewer line crossing at 1 location • Cox line crossings at 11 locations • Underground electric crossings at 9 locations • Gas line crossings at 7 locations
Number of Crossings	23	95	36	107	73
Major Road Crossings	• Trenchless crossing under Leesburg Pike and Old Courthouse Road	• Trenchless crossing under Leesburg Pike and Old Courthouse Road	• Trenchless crossing under Leesburg Pike and Old Courthouse Road	• Trenchless crossing under Leesburg Pike • Crossing under Beulah Rd, Malcolm Rd and Lawyers Rd	• Trenchless crossing under Leesburg Pike and Route 66 • Crossing under Chainbridge Rd
Permits Required	VDOT, WMATA, USACOE, MWAA, FCPA, NOVAPARKS, Town of Vienna	VDOT, WMATA, USACOE, MWAA, FCPA, NOVAPARKS	VDOT, WMATA, USACOE, MWAA, FCPA, NOVAPARKS, Town of Vienna	VDOT, WMATA, USACOE, MWAA, FCPA, NOVAPARKS	VDOT, WMATA, USACOE, MWAA, FCPA, NOVAPARKS
Potential Easement Requirements	Six easements. From Dominion, Westwood Village Condominiums, Sheraton Tysons, Fairfax County Park Authority, Northern Virginia Regional Park Authority and Fairfax County Schools.	Five easements. From Dominion, Westwood Village Condominiums, Sheraton Tysons, Fairfax County Park Authority and Northern Virginia Regional Park Authority.	Three easements. Fairfax County Park Authority, Northern Virginia Regional Park Authority and Fairfax County Schools.	Eleven easements. Private parcels, Vesper Trail, Fairfax County Schools, Fairfax County Park Authority and Northern Virginia Regional Park Authority.	Seven easements. From Sheraton Tysons, Fairfax County Park Authority, Northern Virginia Regional Park Authority, and private parcels.
Environmental Concerns	• Wetland and Park crossing • Stream crossing at 3 locations	• Wetland and Park crossing • Stream crossing at 4 locations	• Wetland and Park crossing • Stream crossing at 2 locations	• Wetland and Park crossing • Stream crossing at 2 locations	• Possible wetland crossing in Raglan Road Park, only if private properties (8433, 8449, 8459 and 8525) do not allow easements
Community/Social Impact	Large impact on Sheraton and Madison High School, and residential neighborhoods north of Chain Bridge Road	Large impact on Sheraton and some impact on residential neighborhoods north of Chain Bridge Road, some impact on James Madison High School	Large impact on Madison High School, and residential neighborhoods north of Chain Bridge Road	Large impact on residential neighborhoods north of Chain Bridge Road	Moderate impact on Cedar Lane and schools along the proposed routing
Historic Site?	NO	NO	NO	Unknown	Unknown
Cost	$$$$$	$$$$$	$$$$	$$$$$	$$$$$$
Pros	• Minimal impact on major roads (Chain Bridge and Leesburg Pike)	• Minimal impact on major roads (Chain Bridge and Leesburg Pike) • Minimal social and community impact • Does not require Town of Vienna Approval • Minimum number of utility crossings	• Minimal impact on major roads (Chain Bridge and Leesburg Pike) • Small environmental impact	• Does not require Town of Vienna Approval	• Does not require Town of Vienna Approval • Routing through roadways for the majority of the route, potential reduction in impacts to businesses/residences
Cons	• More permits required comparing to Alt-1 and Alt-2 • Large impact on Sheraton and Madison High School operation	• More permits required comparing to Alt-1 and Alt-2 • Larger impact on wetlands and streams	• Large community and social impact • Large impact on Madison High School operation • Greatest number of utility crossings	• Large residential impact with many easements that need to be taken • There are no good roadways to follow north of Town of Vienna, need to cross under backyards on private property • Need to cross streams & W&OD trail	• Longest route of all alternates • Two WMATA crossings (one overhead and one at grade) • Crossing Route 66 - very busy and significant ongoing construction/lane widening
Avoids Town of Vienna?	NO	YES	NO	YES	YES

5.4 Quantitative Evaluation Criteria

Route selection will be based on a number of criteria relevant to the design, construction, and operation of a sewer force main. These criteria include:

- Force main routed through Vienna? (Y/N)
- Commercial/residential landowner impacts
- Traffic impacts
- Environmental impacts
- Permitting
- Constructability
- Access/operation and maintenance (O&M)
- Utility conflicts
- Easements
- Hydraulic considerations
- Relative costs
- Other obstructions

A description of each of these criteria follows.

5.4.1 Force Main Routing Through Vienna

The Town of Vienna owns, maintains, and operates their own independent wastewater collection system. Fairfax County is constructing these improvements for its customers and will therefore install the collection system modifications outside of the Town of Vienna. As a result, route alternatives options that are in the Town of Vienna limits were no longer considered feasible and were removed from consideration, however, to document their analysis, they will remain in the document.

5.4.2 Commercial/Residential Property Owners Impacts

Alignment options for the new sewer force main were developed with the goal of minimizing impacts along the selected route as much as practical. Impacts can be temporary, such as removal and restoration of lawns, gardens, fences, sidewalks, and/or driveways associated with trenching. Impacts can also be long-term or permanent, such as removal of large trees or utility relocations along the force main alignment. The full impacts will not be known until field investigations, topographic surveys, and utility location surveys, of the entire alignment are completed. Pipeline routes will be adjusted during detail design, where possible, to reduce both temporary and permanent impacts.

Large portions of the force main routes follow either existing utility easements or public/private road rights-of-way, however sections of the force main will require easements from private or public/park properties. Additional temporary construction easements will be required for construction activities. Due to the potential impacts construction could have on the commercial and residential landowners and, as a result, on project schedule and cost, this criterion was assigned a weighting factor of 15%.

5.4.3 Traffic Impacts

Construction of a new sewer force main along heavily congested streets will impact traffic flow. Traffic Management Plans (TMPs) will be required for any construction in the Virginia Department of Transportation (VDOT) or County road rights-of-way. Because of this, traffic impacts need to be considered when the routes are evaluated. The new sewer force main should be constructed so that access to roadways from side streets always remains open to local traffic and emergency vehicles to the extent practicable. Based on the impacts traffic could have on the project schedule and cost, this criterion was assigned a weighting factor of 10%.

5.4.4 Environmental Impacts

Environmental impacts considered included wetland impacts, stream crossings, and tree removal, which can increase design and construction schedule and cost. Environmental impacts can also extend the time required to obtain permits and increase the number of permits necessary. All alternatives will have at least one stream crossing, and some alternatives will have impacts on wetland areas. The full potential of these impacts will not be known until wetland delineation and other environmental investigations and surveys of the entire alignment are completed. The alignment will be modified to reduce environmental impacts. Due to the potential effects environmental impacts could have on the project permitting, schedule, and cost, this criterion was assigned a weighting factor of 10%.

5.4.5 Permitting

The ability and ease to acquire the necessary permits is a critical factor to the success of this project. The route will be subject to review by regulatory agencies, depending on the pipe installation methodology (e.g., open-cut versus trenchless), and the location of road or easement crossings, which may mitigate potential impacts.

All VDOT road crossings will require permits from VDOT and the development of TMPs. Obtaining United States Army Corps of Engineers (USACE) Nationwide Permits will likely be required for alternatives with potential impacts on the wetlands and streams. Mitigation may be required by USACE for unavoidable wetland or stream impacts. Approvals will also be needed for the crossing of any right-of-way or easement owned by Dominion Energy and Washington Gas. Due to the potential impact permitting could have on the project schedule and cost, this criterion was assigned a weighting factor of 10%.

5.4.6 Constructability

The ease and speed with which the project can be constructed greatly impacts the overall project cost and surrounding property impacts. Constructability issues, where considered during the route evaluation process, include contractor access to the site, ability to store materials, access to potential project staging areas, speed of construction, and construction safety. Due to the impact constructability could have on the project schedule and cost, this criterion was assigned a weighting factor of 10%.

5.4.7 Access/Operation and Maintenance

The new sewer force main must be accessible for O&M considerations once the pipeline is in service. Future O&M and construction access issues were evaluated as part of the routing analysis. Due to the potential impact that the construction access and future O&M could have on the project schedule and cost, this criterion was assigned a weighting factor of 10%.

5.4.8 Utility Conflicts

The entire region includes congested rights-of-way. Potential conflicts with existing utilities cannot be eliminated. The design will have to address these conflicts. For this reason, routes were evaluated to minimize conflicts between utilities, particularly large utilities that are not easily moved. The full impacts of existing utilities will not be known until utility location surveys of the entire alignment are completed. The depth and exact alignment of the proposed force main will be adjusted as necessary during final design to avoid conflicts with utilities. Due to the potential impact the utility conflicts could have on the project schedule and cost, this criterion was assigned a weighting factor of 10%.

5.4.9 Easements

Easements will be required from private landowners for all seven alternatives; however, the length of easements required varies for each alternative. Easements will include both permanent and temporary construction easements. Due to the potential impact that easement acquisition could have on the project schedule and cost, this criterion was assigned a weighting factor of 5%.

5.4.10 Hydraulic Considerations

Hydraulic considerations include the physical features and the resulting pump performance requirements that contribute to both construction and operation costs. Physical features like length, elevation change, number of bends, and high/low points contribute to construction costs associated with the costs of pumping. Elevation change is the difference in elevation between the pump station and the highest point along the route. The larger the elevation change, the larger the pump horsepower will be. Number of bends is a measure of fitting costs and minor hydraulic losses, which also increase the pump power. High and low points tend to increase the operation and maintenance of the facility and can increase the likelihood of odors venting along the alignment.

Brake horsepower is a measure of the power necessary to overcome the total head and convey the design discharge, and it was used as the metric for comparison. This criterion will be evaluated in more detail as the design progresses.

5.4.11 Relative Costs

Relative costs were assigned to each route alternative for comparison purposes. The cost evaluations for each route included the cost for installation of pipe for each route based on the type of installation, cost of restoration, cost for stream or wetland crossings, and others.

Cost comparisons did not include rock excavation. Depth to rock is unknown for the alternatives and it is not expected to be a significant discriminator among the route segments, so it was not considered in the evaluation. However, rock quantities and locations will be very important information used to determine the final construction cost estimate. Therefore, geotechnical investigations will be part of the final design to provide an indication of the actual depth of rock along the selected alignment. Due to cost being one of the critical factors in selecting the new force main routing, this criterion was assigned a weighting factor of 10%.

5.4.12 Scoring Definitions

The following table summarizes the definitions for how the criteria were scored.

Table 5-2: Screening Level Scoring Summary

Criteria	1	2	3	4	5
Force Main Avoids Vienna?	Force main routes through the Town Vienna have been eliminated.				
Commercial/Residential Property Owners Impacts	Very Large Impact	Large Impact	Moderate Impact	Low Impact	No Impact
Traffic Impacts	Very Large Impact	Large Impact	Moderate Impact	Low Impact	No Impact
Environmental impacts	Very Large Impact	Large Impact	Moderate Impact	Low Impact	No Impact
Permitting	5 permits or more	4 permits	3 permits	2 permits	1 permit
Constructability	Extremely Challenging	Highly Challenging	Moderately Challenging	Slightly Challenging	Minimally Challenging
Access/Operation and Maintenance	Extremely Difficult to Access	Highly Difficult to Access	Moderately Difficult to Access	Slightly Difficult to Access	Minimally Difficult to Access
Hydraulic Considerations	Number of highpoints/low points (number) static head (number), length, horsepower ranked worst to best				
Potential Utility Conflicts	25 potential conflicts or more	20 to 24 potential conflicts	15 to 19 potential conflicts	10 to 14 potential conflicts	Less than 10 potential conflicts
Easements	More than 7 easements	6 or 7 easements	4 or 5 easements	2 or 3 easements	1 or fewer easements
Relative Costs	Very High ($$$$$$)	High ($$$$$)	Moderate ($$$$)	Low ($$$)	Very Low ($$)

5.4.13 Evaluation Criteria Weighting

Each of the evaluation criteria noted above have been weighted to reflect their relative importance to the construction and operation of the new sewer force main. **Table 5-3** lists the relative weights for each of the evaluated criteria and is based on engineering judgment. The weighting factors were discussed with County staff and represent the consensus opinion. The weights used for each criterion reflect the relative importance of project cost, as well as an increased focus on the project's impacts to property and commercial/business interests along each alignment.

The first criterion listed in **Table 5-2** is a yes/no decision. Only if the force main routing has an answer of yes will it be evaluated using the evaluation criteria in **Table 5-3**.

Table 5-3: Evaluation Criteria Weights

Evaluation Criteria	Weight (percentage basis)
Commercial/residential property owners impacts	15
Traffic impacts	10
Environmental impacts	10
Permitting	10
Constructability	10
Access/O&M	10
Hydraulic considerations	10
Utility conflicts	10
Easements	5
Relative cost	10

Each route option was assigned a score between 1 and 5 for each of the criteria used in the evaluation, with 5 being the most favorable score and 1 being the most unfavorable score as defined in **Table 5-2**. The total score will be determined by multiplying the individual criteria scores by the assigned weight presented in **Table 5-3,** and then summing the weighted scores. **Table 5-4** presents the final criteria ranking tabulation.

5.5 Route Alternatives Analysis Recommendations

CDM Smith evaluated and ranked the alternative routes to provide a quantitative determination of the most appropriate option. Each route option was assigned a ranking between 1 and 5 for each of the criteria used in the evaluation, with 5 being the most favorable score (lowest impact) and 1 being the most unfavorable score (highest impact). The total score was determined by multiplying the individual criteria scores by the assigned weight presented in **Table 5-3,** and then summing up the weighted scores. **Table 5-4** presents the final criteria ranking tabulation.

Table 5-4: Force Main Routing Alternatives Quantitative Evaluation and Ranking

Weight %	15		10		10		10		10		10		10		10		5		10		100	
	Commercial/Residential Property		Traffic Impacts		Environmental Impacts		Permitting		Constructability		Access/Operation and Maintenance		Hydraulic Considerations		Utility Conflicts		Easement		Relative Cost		Total Score	Rank
	Score	Comments	Score	Comments	Score	Comments	Score	Comments	Score	Comments	Score	Comments	Score	Comments	Score	Comments	Score	Comments	Score	Comments		
Alternative-1		Very large impact on commercial and low impact on residential properties		Large impact on Chain Bridge Road/Maple Avenue, require complex traffic management plans		Low impact, stream crossing at 1 location		VDOT, WMATA, USACOE, NOVAPARKS, Town of Vienna		Highly challenging (Limited space for trench along Rt-123, underground metro tunnel crossing)		Minimally difficult to access		16 high points		25 conflicts or more		One easement. From Northern Virginia Regional Park Authority.		High $$$$$		
Alternative-2A		Moderate impact on commercial and on residential properties		Large impact on Chain Bridge Road/Maple Avenue, require complex traffic management plans		Moderate impact, wetland and Park crossing, stream crossing at 2 locations		VDOT, WMATA, USACOE, NOVAPARKS, FCPA, Town of Vienna		Moderately challenging (Limited space for trench along Rt-123)		Minimally difficult to access (Limited maintenance access along Vesper Trail and a short run of the alignment along stream)		14 high points		25 conflicts or more		Seven easements. From Westwood Village Condominiums, Sheraton Tysons, Fairfax County Park Authority, Northern Virginia Regional Park Authority, and private parcels.		Moderate $$$$		
Alternative-2B		Moderate impact on commercial and low impact on residential properties		Large impact on Chain Bridge Road/Maple Avenue, require complex traffic management plans		Moderate impact, wetland crossing, stream crossing at 2 locations		VDOT, WMATA, USACOE, NOVAPARKS, FCPA, Town of Vienna		Moderately challenging (Limited space for trench along Rt-123)		Minimally difficult to access (Limited maintenance access along Vesper Trail)		13 high points		25 conflicts or more		Six easements. From Sheraton Tysons, Fairfax County Park Authority, Northern Virginia Regional Park Authority, and private parcels.		Moderate $$$$		
Alternative-3A		Large impact on residential and low impact on commercial properties		Moderate traffic impact, require basic traffic management plans		Moderate impact, wetland and Park crossing, stream crossing at 3 locations		VDOT, WMATA, USACOE, MWAA, FCPA, NOVAPARKS, Town of Vienna		Highly Challenging (Potential challenges for construction along stream and in James Madison High School)		Moderately difficult to access (Limited maintenance access along stream portion of alignment)		27 high points		25 conflicts or more		Six easements. From Dominion, Westwood Village Condominiums, Sheraton Tysons, Fairfax County Park Authority, Northern Virginia Regional Park Authority and Fairfax County Schools.		Very High $$$$$$		
Alternative-3B		Large impact on residential and low impact on commercial properties		Moderate traffic impact, require basic traffic management plans		Large impact, wetland and Park crossing, stream crossing at 3 locations, construction along stream		VDOT, WMATA, USACOE, MWAA, FCPA, NOVAPARKS, Town of Vienna		Extremely Challenging (Potential challenges for construction along a very narrow stream and in James Madison High School)		Moderately difficult to access (Limited maintenance access along stream portion of alignment)		27 high points		20-24 potential conflicts		Six easements. From Dominion, Westwood Village Condominiums, Sheraton Tysons, Fairfax County Park Authority, Northern Virginia Regional Park Authority and Fairfax County Schools.		High $$$$$		
Alternative-3C		Large impact on residential and low impact on commercial properties		Moderate traffic impact, require basic traffic management plans		Moderate impact, wetland and Park crossing, stream crossing at 3 locations		VDOT, WMATA, USACOE, MWAA, FCPA, NOVAPARKS, Town of Vienna		Highly Challenging (Potential challenges for construction along stream and in James Madison High School)		Moderately difficult to access (Limited maintenance access along stream portion of alignment)		28 high points		25 conflicts or more		Six easements. From Dominion, Westwood Village Condominiums, Sheraton Tysons, Fairfax County Park Authority, Northern Virginia Regional Park Authority and Fairfax County Schools.		Very High $$$$$$		
Alternative-4	**2**	**Large impact on residential and low impact on commercial properties**	**3**	**Moderate traffic impact, require basic traffic management plans**	**2**	**Large impact, wetland and Park crossing, stream crossing at 4 locations, construction along stream**	**1**	**VDOT, WMATA, USACOE, MWAA, FCPA, NOVAPARKS**	**2**	**Highly Challenging (challenges for construction along stream and parallel to existing force main)**	**2**	**Highly difficult to access (Limited maintenance access along segment of the pipe parallel to stream)**	**2**	**25 high points, 375 hp**	**2**	**20-24 potential conflicts**	**3**	**Five easements. From Dominion, Westwood Village Condominiums, Sheraton Tysons, Fairfax County Park Authority and Northern Virginia Regional Park Authority.**	**2**	**High $$$$$**	**2.05**	**2**
Alternative-5		Moderate impact on residential and low impact on commercial properties		Moderate traffic impact, require basic traffic management plans		Moderate impact, wetland and Park crossing, stream crossing at 2 locations		VDOT, WMATA, USACOE, MWAA, FCPA, NOVAPARKS, Town of Vienna		Moderately challenging		Highly difficult to access (Limited maintenance access along Vesper Trail)		36 high points		25 conflicts or more		Three easements. Fairfax County Park Authority, Northern Virginia Regional Park Authority and Fairfax County Schools.		Moderate $$$$		
Alternative-6 (North)	**2**	**Large impact on residential and low impact on commercial properties**	**3**	**Moderate traffic impact, require basic traffic management plans**	**3**	**Moderate impact, wetland and Park crossing, stream crossing at 3 locations**	**1**	**VDOT, WMATA, USACOE, MWAA, FCPA, NOVAPARKS**	**3**	**Moderately Challenging (routed under backyards and across park lands)**	**2**	**Highly difficult to access (Limited access through residential areas, parks, streams etc.)**	**3**	**22 high points, 350 hp**	**1**	**25 conflicts or more**	**1**	**Eleven easements. Private parcels, Vesper Trail, Fairfax County Schools, Fairfax County Park Authority and Northern Virginia Regional Park Authority.**	**2**	**High $$$$$**	**2.15**	**1**
Alternative-7 (South)	**1**	**Very large impact on residential and moderate impact on commercial properties**	**1**	**Very Large traffic impact, require extensive traffic management plans**	**4**	**Low Impact, possible wetland crossing in Raglan Road Park, only some private properties**	**1**	**VDOT, WMATA, USACOE, FCPA, NOVAPARKS**	**1**	**Extremely Challenging (crossing under Route 66 & WMATA twice, much longer route)**	**1**	**Extremely difficult to access (Crossing under Route 66 and Along Route 29)**	**1**	**26 high points, 450 hp**	**1**	**25 conflicts or more**	**2**	**Seven easements. From Sheraton Tysons, Fairfax County Park Authority, Northern Virginia Regional Park Authority, and private parcels.**	**1**	**Very High $$$$$$**	**1.35**	**3**

5.5.1 Recommended Alternative

Based on the results of quantitative evaluation, the criteria used were from evaluations and discussions with County staff and key outside stakeholders. Alternatives 4, 6 ,and 7 are the only three routes that do not travel through the Town of Vienna; therefore, these are the only feasible alternatives. Of the three, Alternative 6 is the shortest, has the lowest environmental impact, does not impact Route 66, and minimizes disruptions to businesses and commuter traffic. This alternative, however, does have impact on residential areas north of the Town of Vienna. Alternative 6 is the recommended force main route alignment. This alternative will be further developed during detailed design.

Section 6

Architectural Design Criteria

An architectural programming technical memo was prepared and used as the basis for determining what to include in the Tysons West Pump Station (TWPS) building footprint. The total building gross area will be approximately 9,200 square feet. Programmatically, the process mechanical area is placed at the basement level of the building and the control area is on the first-floor level.

6.1 Architectural

6.1.1 Building Aesthetics

Since the pump station site is located in a highly visible location, in close proximity to near-future high-rise developments, the TWPS building aesthetics will be planned to match the surrounding neighborhood. The goal for the building design is to contextualize the most relevant architectural features of adjacent buildings regarding shape, color, texture, proportion, patterns, etc. The design will complement neighboring buildings in style, materials, and setbacks.

The building design will be utilitarian in function and sophisticated siting. As portrayed in **Figure 6-1**, the building's upper level will be a mixture of concrete masonry units (CMU), both split-faced and color-specific, and an insulated membrane EPDM (ethylene propylene diene monomer) flat roof system. Insulated overhead doors and fiberglass-reinforced plastic (FRP) doors and frames will be used for ingress and egress. Material colors and textures will match the surrounding buildings.

Figure 6-1
Pump Station Building Perspective View

The site perimeter fencing will be high-density metal mesh, allowing a clear view of the building and providing high security to the facility. The intention of installing a see-through fence is to visually integrate the building into the neighborhood. **Figure 6-2** shows an example of the secuity fencing. The final fencing selection will need to be coordinated with Fairfax County during the detailed design development.

Figure 6-2
Example of Potential Anti-Climb Security Fencing (Photo courtesty ofLinkland Fencing System)

6.1.2 Code Analysis

The life-safety, egress, and fire protection, as well as the strength, serviceability, and quality of materials will be designed to meet the expectations of the currently adopted building codes and standards for Tysons.

The project will be designed in accordance with the National Fire Protection Agency (NFPA) and the Americans with Disabilities Act Accessibility Guidelines (ADAAG) standards, using industry-standard materials and efficient practices. In general, the building will use nonstructural veneer walls, steel roof beams or trusses, and metal deck construction.

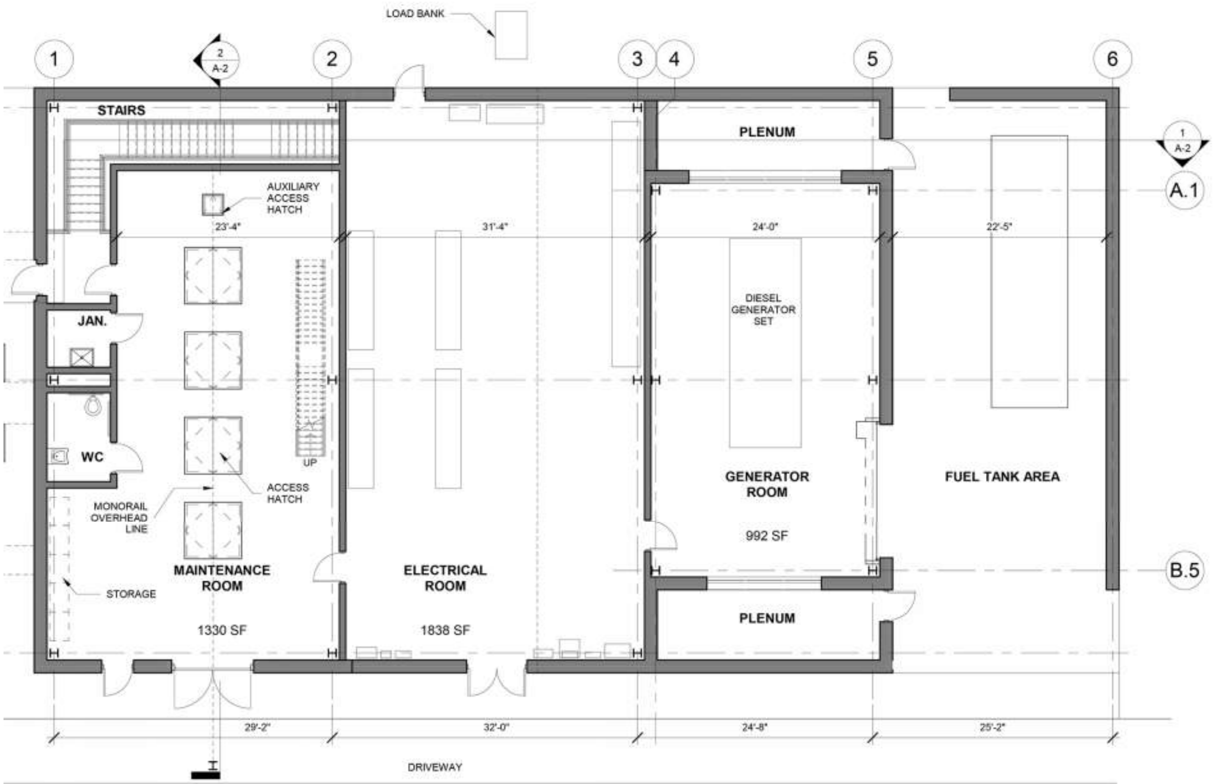
The TWPS building will be classified in accordance with the state building code as Utility and Miscellaneous, Group U. The construction type for the building will be noncombustible, unprotected construction or Type II-B construction. This construction category does not require fire-resistance-rated exterior walls or roofs.

6.1.3 Space Requirements

The combined open and enclosed control areas at the first-floor level have approximate dimensions of 200 feet (ft) by 65 ft, or 13,000 square feet. The process mechanical area at the basement level is divided into two separate spaces and has a building gross area of approximately 4,900 square feet. The control area at the first-floor level has an enclosed covered space, an enclosed open-to-sky space, and screened spaces with a building gross area of approximately 5,700 square feet. The overall size for the TWPS building will be established by the uses described in **Table 6-1**. **Figure 6-3** shows the preliminary building layout using the space requirements.

Figure 6-5 and **Figure 6-6** include the preliminary architectural plans and elevations.

Figure 6-3
Pump Station Building Layout



- **Basement Level** – The process mechanical area of the building will include three distinct spaces: (1) dry well, (2) wet well and flow splitter box, and (3) grinder vault. The dry well has access through the maintenance room. The wet well will have access through two exterior floor hatches. The grinder vault will have access through an enclosed stairwell. The depth of the basement will be determined by the responsible process mechanical engineer.
- **First-Floor Level** – The control area of the pump station will comprise enclosed spaces, including a maintenance room, restroom, electrical room, generator room, janitor's closet, stairs, and plenums. The height of the TWPS building will be determined by the recommended monorail installation height required for the removal of the pumps located in the basement.

Table 6-1: Architectural Program Space Requirements[1]

Room Name	Area (square feet)
Basement level (process mechanical area)	**3,720**
Dry well	2590
Wet wells (combined)	350
Flow splitter box	240
Grinder fault	540
First-floor level (control area)	**4,925**
Maintenance room	1330
Restroom	70
Electrical room	1840
Generator room	995
Plenums (combined)	350
Janitor’s closet	40
Stairs	300
TOTAL	**8,645**

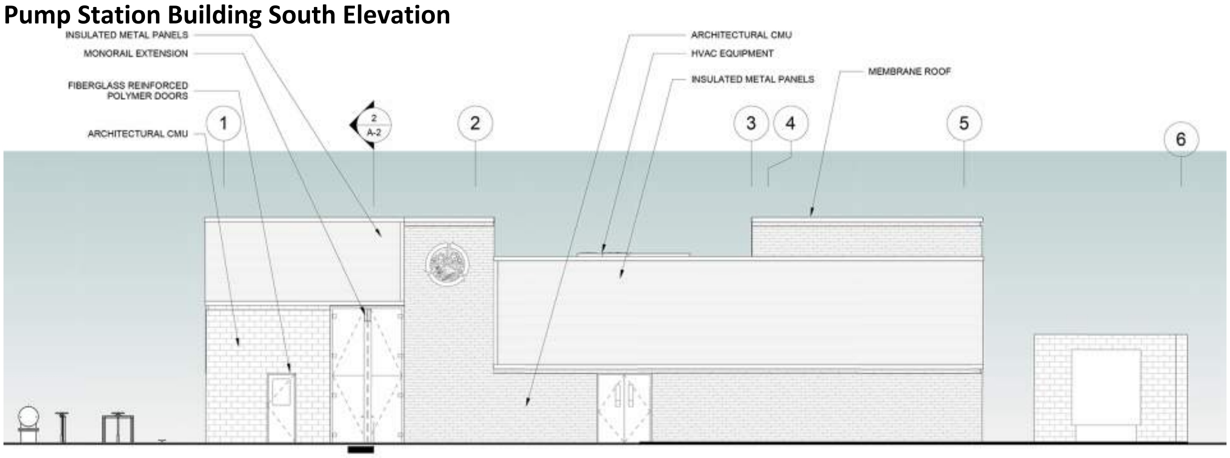
[1]Areas do not include walls.

6.1.4 Building Design

6.1.4.1 Exterior Walls

As shown in **Figure 6-4**, the exterior walls of the upper level of the TWPS building will be composed of a cavity wall assembly with a CMU backup. The exterior wall will be constructed of 4-inch face masonry CMU with a combination of split-face and ground-face textures. The exterior CMU will enhance the overall appearance of the facility, as well as provide durability and ease of maintenance, in addition to hardening against vandalism and damage by delivery and/or maintenance vehicles. The generator room will have exterior acoustical cavity-slot resonator CMU walls.

Figure 6-4
Pump Station Building South Elevation



6.1.4.2 Exterior Doors and Louvers

All single and double swing exterior doors will be made of FRP panels and frames, with a paint finish. Overhead doors at the control area of the TWPS building will be electrically operated, overhead coiling Kynar-coated insulated steel slat doors. Overhead doors in the generator room will be covered with a removable sound-barrier blanket.

Louvers will be installed for heating, ventilation, and air conditioning (HVAC) equipment support, for air intake and exhaust for the diesel generator set and for mechanical equipment screening. All louvers will be aluminum and installed at the exterior face of the exterior walls.

6.1.4.3 Roofs

The roof over the TWPS building will be an EPDM membrane over a flat roof system. The roofing membrane will be protected with rubber walking mats for equipment maintenance. A roof parapet will visually block the mechanical equipment installed at the TWPS roof.

6.1.4.4 Floors

Concrete floors will be provided throughout the upper and lower levels of the building. All floors will have a sealer-hardener coating with a nonskid broom finish.

6.1.4.5 Interior Walls

Interior partition walls in the control area (first floor) will be full-height CMU to provide proper maintenance resistance. The generator room will have interior acoustical cavity-slot resonator CMU walls. All interior walls will have code-compliant, fire-resistant ratings where required.

6.1.4.6 Ceilings

The basement access stairwell, the restroom, and the janitor's closet will have a 10-ft ceiling height that will consist of square edge 2-ft by 2-ft mold-resistant ceiling tiles. The generator room will have a suspended sound barrier ceiling with two layers, an intermediate gypsum barrier ceiling and a lower layer of mold-resistant acoustical ceiling tiles. The other control areas will be exposed to the building roof structure.

6.1.4.7 Interior Doors

All interior doors will be made of FRP panels and frames, with a paint finish.

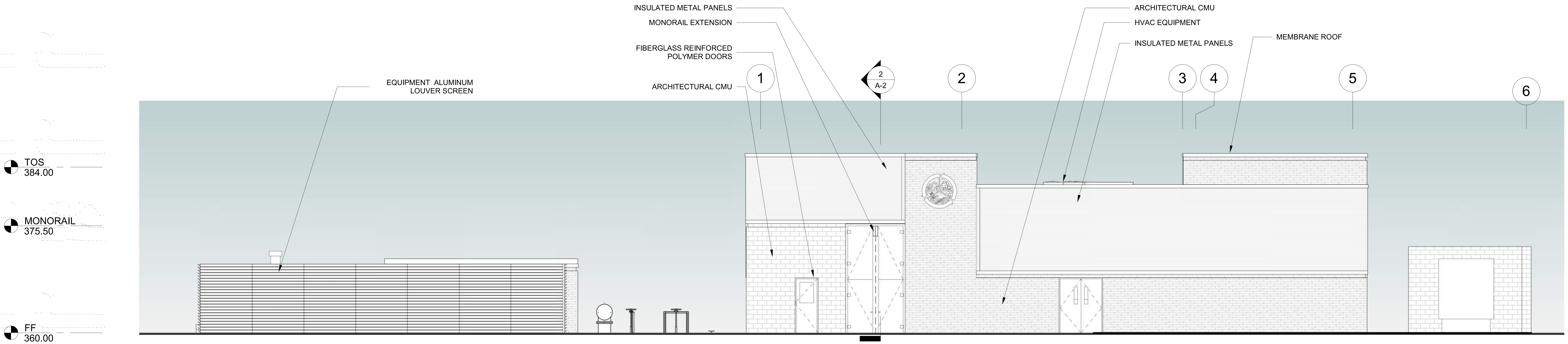
6.1.4.8 Hardware

All hardware for the exterior doors will be Americans with Disabilities Act (ADA)-compliant with lever-type handles. Lock cylinders are planned for all doors, except the toilet room door. Exterior and interior door locksets will be commercial duty conforming to ANSI/BHMA (American National Standards Institute/Builders Hardware Manufacturers Association) A156.13. Exterior doors and fire doors will have automatic closers in compliance with exit and emergency code requirements.

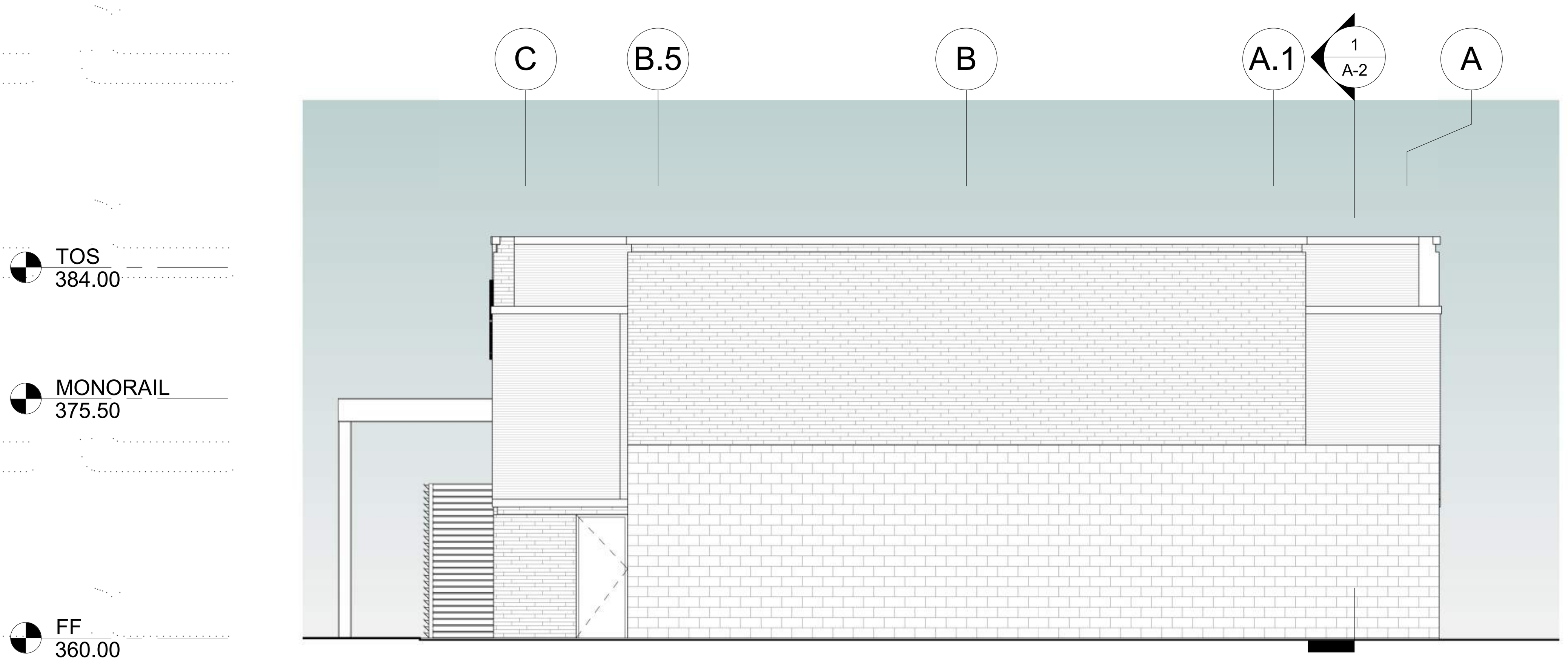
6.1.4.9 Accessibility Design Criteria

All control and process areas of the TWPS building frequented only by personnel for maintenance, repair, or monitoring of equipment will not be required to comply with the accessibility and barrier-free requirements of the ADA and Architectural Barriers Acts (ABA). The

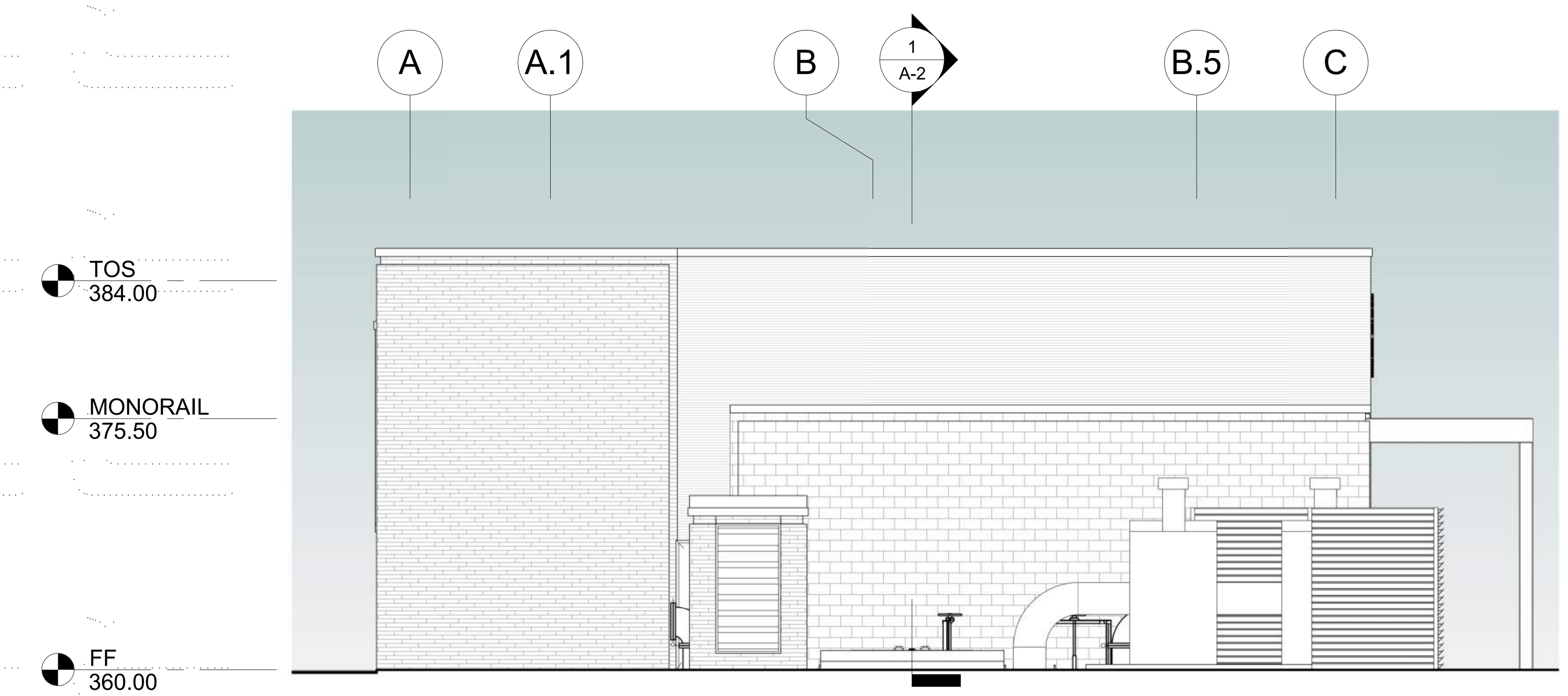
2015 International Building Code commentary states: “Structures housing accessory equipment that is part of a utility or communications system are often classified as Group U occupancies when there is no intent that these structures be occupied except for servicing and maintaining the equipment within the structure. A pumphouse for a water or sewage system or an equipment building at the base of a tele-communications tower are examples of such buildings.”



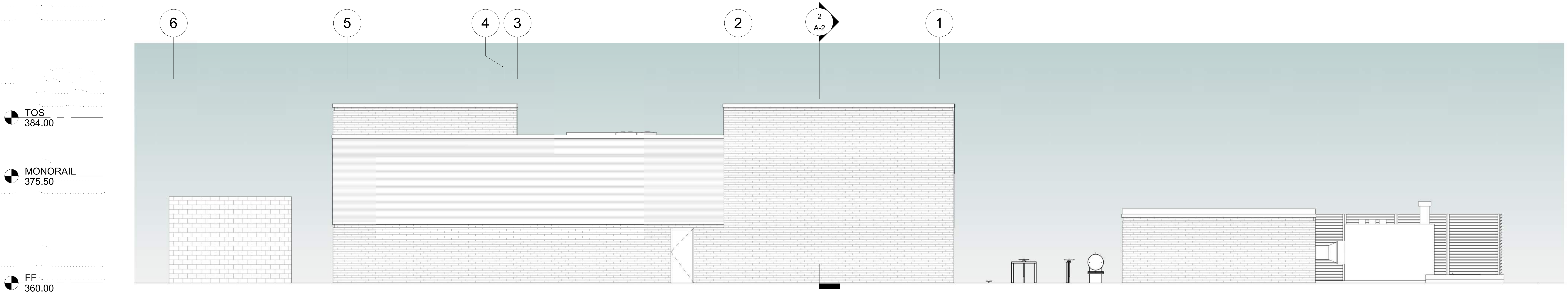
1 SOUTH ELEVATION
1/8" = 1'-0"



2 EAST ELEVATION
1/8" = 1'-0"



3 WEST ELEVATION
1/8" = 1'-0"



4 NORTH ELEVATION
1/8" = 1'-0"

5 0 5 10 15 20
1/8" = 1'-0"

CDM Smith

Figure No. 6-5
BUILDING ELEVATIONS
MARCH 2021

PERSPECTIVE VIEW 1

PERSPECTIVE VIEW 2

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Figure No. 6-6
PERSPECTIVE VIEWS
MARCH 2021

Section 7

Structural Design Criteria

7.1 Structural Description

The project consists of the following structures: influent manhole, grinder vault, pump station, surge relief vault, and flow meter vault.

Influent Manhole

The influent manhole will be a below-grade concrete structure fabricated from circular precast concrete manhole sections with top slab. The manhole will have an inside diameter of 10 feet, and will be approximately 13-feet deep.

Grinder Vault

The grinder vault will consist of the below-grade vault, and an above-grade enclosure building. The below-grade vault will be constructed from cast-in-place concrete. It will have interior dimensions of approximately 25-feet by 21-feet and 6-inches, and will be approximately 15-feet deep. The structure is anticipated to be soil-bearing with a mat foundation, and will share a wall with the flow splitter box. The vault will have a grinder channel and a bypass channel. Access into the vault will be by stairs.

An enclosure building will be provided at the top of the stairs for access restriction and containment of foul odors. The building will be constructed from load-bearing CMU walls with a cast-in-place concrete roof slab.

The odor control system will be located next to the grinder vault, and will have architectural screens to obscure the visibility of the vessels and ductwork.

Pump Station:

The below-ground portion of the pump station will be constructed of cast-in-place concrete. It will include a flow splitter box, two wetwells, and a drywell pump room. The structure will be approximately 24-feet deep, and is anticipated to be soil-bearing with a mat foundation. Excavation of the site during construction may require temporary support of excavation. It is anticipated that the temporary support excavation system will not conflict or interact with the new structure.

The superstructure is approximately 90-ft long by 61-ft wide by 24-ft tall, and includes a maintenance room, electrical room, generator room, restroom, and janitor’s closet. The superstructure will overhang the below-grade drywell pump room, such that the superstructure is partially supported by the drywell walls. The remainder of the superstructure is anticipated to be supported by soil-bearing shallow foundation elements. The superstructure will be a steel frame building utilizing moment-frames as the lateral force resisting system. The roof will consist of steel beams and steel roof decking. Interior partitions will be non-load-bearing concrete masonry walls. The exterior walls will be non-load-bearing concrete masonry with an architectural concrete masonry and insulated metal panel veneer.

HVAC units will be located on the roof of the structure above the electrical room. Stairs in the maintenance room will provide access to the HVAC equipment. The electrical room roof will be lower than the maintenance room roof to provide walk-out access from the maintenance room stairs. The exterior wall parapets will be tall enough in this area to provide the required fall protection, as well provide some screening for the roof top equipment.

The exterior fuel tank area will be approximately 61-ft long by 23-ft wide and will have 15-ft tall concrete masonry screen walls to conceal the fuel tank.

Surge Relief and Flow Meter Vaults

Both the surge relief vault and the flow meter vault will be below-grade precast concrete vaults with top slabs at grade. Since these vaults are located within the main driveway to the pump station, the vaults and access hatches will be designed for AASHTO HS20 wheel loads.

7.2 Design Loads

7.2.1 Scope

All applicable loads and load combinations will be determined as required by the governing code, occupancy, site and environmental effects, equipment, and processes. Appropriate load combinations will be established, as well as appropriate allowable stresses, load factors, and safety factors (as applicable). These criteria will be established at the beginning of preliminary design, and confirmed at the beginning of final design.

7.2.2 Dead Loads

Dead loads are those resulting from the weight of all fixed construction, such as walls, partitions, floors, roofs, cladding, equipment bases, and all permanent, stationary equipment.

Numerical values for the dead load of well-defined components of a structure will be used as documented in the following publications:

- ASCE 7
- AISC Manual
- CRSI Handbook
- Manufacturer's catalogs for fabricated components

7.2.3 Live Loads

Live loads will consist of all loads due to occupancy, furnishings, and equipment. Live load reduction will not be employed for members of large influence area in the design of environmental and industrial facilities, due to the relatively high probability of simultaneous loads on all areas.

7.2.3.1 Uniform Live Loads

▪ Stairways	100 pounds per sq ft (psf)
▪ Process areas	200 psf
▪ Electrical rooms	300 psf
▪ Unrestricted vehicular areas	AASHTO HS20
▪ Hatches and gratings	To match the adjacent floor

7.2.3.2 Equipment Loads

Loads from equipment will be considered live loads. The maximum loads and support details for each major piece of equipment will be provided by the discipline designing or specifying it. Final weights of process mechanical equipment will be established during preliminary design. Preliminary weights of building service equipment (HVAC, plumbing, and electrical) will be established during preliminary design, and confirmed during final design.

In addition to the mechanism's static dead load, design will be performed for other effects, such as those due to operation, maintenance, and malfunction. Examples include, but are not limited to, the following:

- All equipment: contents
- All equipment: design will be performed for required maintenance procedures, such as the removal of a large components, and the placing of it temporarily on the adjacent structure

7.2.3.3 Impact Loads

Static loads will be increased for the effects of impact by the following percentages:

- Vehicular loads: in accordance with the AASHTO specification
- Monorail supports: 25% of hoist capacity. 10% of the sum of the hoist capacity and hoist weight will be applied as a longitudinal load
- Light machinery supports, shaft or motor-driven: 20% of the operating weight (minimum), or manufacturer's recommendation
- Hangers supporting floors or balconies: 33% of live load reaction

7.2.4 Environmental Loads

7.2.4.1 Snow, Rainwater, and Ice Loads

Snow loads will be developed from the following criteria in accordance with the governing code[s]. Appropriate modification factors, drifting effects, and uneven distributions will be considered for each structure.

- Ground snow load: 25 psf
- Importance factor: 1.10
- Exposure factor: 1.0

Roofs will be designed for retained water to its maximum depth (accounting for deflection), assuming that the primary drainage system is blocked. Overflow scuppers, or other secondary drainage systems may be used to control this load. This criterion will be coordinated with architectural and plumbing disciplines.

Atmospheric ice formation will be considered in areas of high mist and on appropriate elements, such as cable supports, and above-ground piping and ducting.

7.2.4.2 Wind Loads

Wind loads will be developed from the following criteria in accordance with the governing code[s]. Appropriate shape modification factors, uneven distributions, and orthogonal effects will be considered for each structure. Main wind-force resisting systems, as well as appropriate components and cladding, will be designed for internal and external effects. Increased allowable stresses, or reduced load factors will be used as appropriate.

- Basic wind speed: 120 miles per hour (mph)
- Importance factor: 1.0
- Exposure category: Exposure B

Internal loads due to positive or negative air pressure caused by mechanical or process systems will not be considered wind loads. These loads will be considered in the manner of a process liquid load.

7.2.4.3 Seismic Loads

Seismic loads will be developed from the following criteria in accordance with the governing code[s]. Increased allowable stresses or reduced load factors will be used, as appropriate.

- Mapped spectral accelerations for short periods (per ASCE 7): S_S: 0.129 g

- Mapped spectral accelerations for 1-sec period (per ASCE 7): S1: 0.053 g

- Risk Category: III
- Seismic Design Category: B
- Site Class: Site Class D (Assumed)

Superstructures

Loads on the seismic resisting system will be developed in accordance with the governing code[s] for the particular system. The site soil factor will be used as recommended in the geotechnical report. Loads from mechanical and architectural components not covered by the governing code will be developed in accordance with the International Building Code.

Substructures

Seismic loads due to lateral earth pressure will be developed in accordance with the Mononobe-Okabe method and recommendations of the geotechnical report. The geotechnical report will address the susceptibility of the foundation bearing materials to liquefaction.

7.2.5 Process Liquid Loads

Design will be performed for liquid loads assuming liquid surface at the maximum working level using an additional durability factor. In addition, design will be performed assuming the liquid surface at the maximum possible level under surcharge conditions without the additional durability factor.

Where cells of a tank communicate so that one cannot be isolated from an adjacent cell (by valves, gates, stoplogs, or other normal operational means), the separating walls will not be designed for liquid on one side only. However, design will be performed for a 12-inch minimum water level differential on either side of the wall to account for flow lag and minor dynamic effects, unless hydraulic or seismic analyses indicate a different level.

Elements acting as or affected by screens (which remove trash or other solids from flow) will be designed for liquid to its maximum level, assuming the screen is completely blocked. Elements acting as flow baffles (at which blockage is unlikely) will be designed for a 12 inch minimum water level differential, unless hydraulic or seismic analyses indicate a different level.

Closed liquid containing structures will, whenever possible, be vented to preclude pressurization or depressurization. However, certain structures may experience pressure or vacuum effects due to particular mechanical or process systems, or the malfunction of systems or components. In such cases, design will be performed for the maximum water, air, or gas pressure as provided by the mechanical-process discipline in preliminary design.

7.2.6 External Earth and Groundwater Loads

Earth and groundwater loads will be developed from the following criteria in accordance with the project geotechnical report and the governing code[s]:

7.2.6.1 Design Grade Elevation

Design will be performed for ground surface at finish grade. Substructures will be designed to permit the external excavation to be backfilled after the construction of the ground level slab. Should substantial economic advantages be realized by altering this criterion, limits of backfill requirements will be indicated in the contract documents.

7.2.6.2 Design Groundwater Elevation

Based on FEMA flood maps the project site is outside of the 500-year flood plain. The design will be performed for groundwater at the following elevation:

- Normal elevation: 5 ft below-grade (Assumed)

7.2.6.3 Groundwater Pressures

Design will be performed for pressures generated by groundwater acting laterally, downward and upward, as appropriate. Load factors appropriate for live loads will be used. Design will be performed for groundwater at the normal elevation for normal allowable stresses or load factors, as appropriate.

7.2.6.4 Lateral Soil and Groundwater Pressures

Hydrostatic

The following equivalent fluid pressures will be used in preliminary design for well-graded, granular, mineral soils with a moist unit weight of 120 pounds per cubic foot (pcf). Soil pressures for final design will be developed in accordance with the geotechnical report. Design for cantilevered walls of environmental engineering structures will be performed for at-rest soil pressures.

Pressure Condition Groundwater	Pressure Coefficient	Equivalent Lateral Fluid Pressures	
		Above Groundwater	Below Groundwater
At-rest (1)	0.5	60 pcf	90 pcf
Active (1)	0.33	40 pcf	80 pcf
Passive (2)	3	360 pcf	170 pcf

(1) Minimum
(2) Maximum

Surcharge

Walls to which vehicles can reasonably be expected to approach within a distance equal to half the wall height will be designed for a uniform surcharge equal to 2 ft of soil.

7.2.7 Combination of Loads

7.2.7.1 General

Design will be performed for combinations of loads, along with appropriate load factors or allowable stresses, in accordance with the governing code[s]. In the absence of specific direction by the code, the most severe distribution, concentration, and combination of design loads and forces will be used. These combinations may be limited by practical considerations, such as the following:

- Combination of certain loads will not be considered when the probability of their simultaneous occurrence is negligible. Such loads include wind and seismic on superstructures, and seismic, live load surcharge, and flood on substructures.
- The effects of any load type (other than dead load) will not be used to reduce the effects of another load type. A maximum of 90% of the dead load will be used in any combination where it reduces the effects of another load type.

7.2.7.2 Liquid Containing or Below-grade Structures

Design will be performed for structures that contain liquids, extend below grade, or both, for the following load combinations:

- Liquid-containing compartments full, no backfill for liquid containing compartments. No reduction will be made for any counteracting soil pressure on the face remote from a contained liquid unless approved.
- Backfill and groundwater with liquid-containing compartments empty and full.
- Liquid containing compartments empty or full in any combination.

Note that tightness testing will be required for liquid containing structures in most cases.

7.3 Foundation Design

7.3.1 Scope

Criteria will be established for the design of structure foundations in coordination with the geotechnical recommendations. Permanent structure foundation elements will be designed to distribute loads to the supporting soil, or rock in accordance with their allowable loads, and to accommodate predicted deformations of the structure caused by settlement or movement of the supporting elements. Structure foundation elements will be designed to resist effects of groundwater, including buoyancy.

7.3.2 Geotechnical Report

The geotechnical report will provide a description of the subsurface conditions, as well as recommendations for design and construction. The draft report will be reviewed for applicability and feasibility of the recommendations to the preliminary structural design. Comments will be provided to the geotechnical engineer for incorporation in the final report.

7.3.3 Frost Protection

Protection will be provided for structures against excessive heave or settlement due to the action of frost. In most cases, the bearing level of frost-susceptible foundation elements will be established below the frost depth of 2'-0". For minor structures that are tolerant to some movement, bearing level may be established above the frost depth, provided that frost formation can be inhibited in the zone between the bearing level and frost depth by providing a layer of free-draining material.

7.3.4 Shallow Foundation Support

Design of shallow foundation elements (footings and mats), including excavation and backfill limits and details, will be performed in accordance with the recommendations of the geotechnical report.

To the extent possible, buried piping and ductbanks will be maintained outside the influence zone of the foundation elements. Limits of this zone will be established based on bearing materials, and characteristics as documented in the geotechnical report. At a minimum, this zone will be defined by a line extended outward and downward from the bottom corners of a foundation element at a 1 vertical to 1 horizontal slope. A reinforced concrete encasement or other appropriate protection will be provided for any utilities extending into this zone.

7.3.5 Buoyancy

Buoyancy is defined as the condition of instability resulting when uplift forces due to groundwater exceed resisting forces due to dead load and anchorage systems. Design will be performed in accordance with the following.

Complete Structures

For groundwater at the design level, structures will be designed to resist buoyancy considering only the structure dead load, soil directly above the structure, and footing extensions. The effects of live loads, liquid contents (unless relief valves are used), vertical soil friction, and soil cohesion will be neglected. When anchorage systems are used, they will be designed to resist the net uplift force transmitted to the components of the anchorage. The structure will be designed for a minimum factor of safety of 1.10.

Partially Complete Structures

Since the contractor will normally be required to maintain a dewatered excavation, it will be assumed that groundwater will be maintained, at any given time, at or below the surface of the backfill currently in place. If the completed portion of the structure has insufficient resistance against pressures generated in this condition, the groundwater elevations at which the structure is stable will be provided in the contract documents.

7.4 Concrete Design

7.4.1 Scope

Design of all cast-in-place, site-cast, and precast concrete structures will be performed, except as indicated below. Member sizes, reinforcement, and details will be determined in accordance with the governing code[s].

Design of site concrete work, such as paving, curbing, and sidewalks will be performed by the civil discipline. Design of the following structures and elements will be performed by the fabricator or erector, in accordance with criteria provided in the contract documents:

- Precast site structures, including manholes, vaults, pipe, culverts, and headwalls
- Precast architectural elements, including wall panels, copings, and sills

7.4.2 General Criteria

7.4.2.1 Codes and Standards

Concrete structures will be designed in accordance with the following, as appropriate.

- General structures: ACI 318-14
- Environmental engineering structures: ACI 350-06
- Reinforcing steel, welding: AWS D1.4

The influent manhole, grinder vault, and pump station will be designed in accordance with ACI 350. Other miscellaneous site concrete pads and structures will be designed in accordance with ACI 318.

7.4.2.2 Materials and Design Strengths

Design will be performed for concrete with the following minimum 28-day compressive strengths (f'_c).

- Structural concrete: 4,500 pounds per square inch (psi)
- Precast concrete: 5,000 psi

Design will be performed for the strengths and properties of the following materials:

- Deformed reinforcing bars: ASTM A615, Grade 60
- Deformed reinforcing bars, welded, or field bent: ASTM A706

- Welded wire fabric, plain: ASTM A1064
- Welded wire fabric, deformed: ASTM A1064

7.4.2.3 Design Methods

Environmental engineering structures will be designed by the Strength Design Method (Ultimate Strength) with the modified allowable stresses, durability coefficients, and serviceability requirements recommended in ACI 350-06 Appendix C for the appropriate sanitary exposure. Structures other than environmental engineering structures will be designed by the Strength Design Method.

7.5 Masonry Design

7.5.1 Scope

The size and layout of all load-bearing masonry elements (exterior walls, bearing walls, shearwalls, pilasters, columns, beams, and lintels) as designed by the architectural discipline will be reviewed to ensure a continuous and stable loadbearing system. Design of all loadbearing and non-loadbearing elements (such as partition walls and veneer) and their connections will be performed in accordance with applicable criteria.

7.5.2 General Criteria

7.5.2.1 Codes and Standards

Design of masonry structures, elements, and details will be performed in accordance with the following:

- Concrete and clay masonry: TMS 402 and TMS 602

7.5.2.2 Materials and Design Strengths

Design will be performed for the specified strengths and properties of the following materials:

- Masonry units:
  - Concrete masonry units ASTM C90 (2800 psi)
- Mortar and grout:
  - Mortar ASTM C270, Type S (1800 psi)
  - Grout ASTM C476, Fine Grout (2000 psi)
- Reinforcement:
  - Deformed bars ASTM A615, Grade 60
  - Joint reinforcing ASTM A82

The specified compressive strength of masonry, f'_m, will be as follows:

- Concrete masonry 2,000 psi

7.5.2.3 Design Methods

Design will be performed for all masonry elements and their components in accordance with Allowable Stress Design (ASD) methods specified in the applicable codes and standards. Where approved, elements may be designed using specified empirical methods.

7.6 Structural Metal Design

7.6.1 Scope

Design of structural metal structures, systems, elements, and details will be performed, except as indicated below, in accordance with the applicable criteria. Such systems include supports for odor control ductwork and elevated yard piping.

Design of the following structures and elements will be performed by the fabricator or vendor in accordance with criteria provided in the contract documents:.

- Access hatches
- Pre-engineered buildings and stairways
- Castings, such as manhole covers and trench grates
- Piping, ductwork, and conduit hangers and supports

7.6.2 General Criteria

Environmental exposure will be considered when selecting metals. The potential for galvanic corrosion of dissimilar metals in the presence of an electrolyte will be considered when selecting metals.

7.6.2.1 Codes and Standards

Design of metal structures and elements will be performed in accordance with the following.

- Structural and miscellaneous steel: AISC Specification – ASD (unless otherwise noted)
- Steel deck, general: SDI Manual
- Steel deck, diaphragms: SDI Diaphragm Manual
- Aluminum: AA Aluminum Design Manual
- Stainless steel: AISC Design Guide 27
- Welding, steel: AWS D1.1
- Welding, aluminum: AWS D1.2
- Welding, stainless steel: AWS D1.6

7.6.2.2 Materials and Design Strengths

Design will be performed for the specified strengths and properties of the following materials

- Steel:
  - Structural steel wide flange shapes: ASTM A 992
  - Other structural steel shapes, plate, and bars: ASTM A 36
  - Structural steel tubing: ASTM A500, Grade B

- Structural steel pipe: ASTM A53
- High strength steel bolts: ASTM A 325 (galvanized)
- Anchor bolts and threaded rods: ASTM F1554 Grade 36 (galvanized)
- Welding electrodes: AWS E70XX

- Aluminum:
  - Aluminum extruded shapes: ASTM B221, 6061-T6
  - Aluminum sheet and plate: ASTM B209, 6061-T6
  - Aluminum extruded pipe: ASTM B429, 6063-T6 or 6061-T6

- Stainless steel:
  - Stainless steel shapes: ASTM A276, Type 316
  - Stainless steel plate and sheet: ASTM A167, Type 304 or 316
  - Stainless steel bolts: ASTM A276, Type 316

- Post-installed anchorage:
  - Aluminum structures: Type 316 stainless steel
  - Stainless steel structures: Type 316 stainless steel
  - Galvanized steel structures: Galvanized steel
  - Submerged applications: Type 316 stainless steel

7.6.2.3 Design Methods

Design of structural metals will be performed in accordance with ASD methods specified in the referenced codes and standards.

Section 8

Electrical Design Criteria

The electrical work associated with the Tysons West Pump Station (TWPS) project includes the electrical design of the power distribution, lighting, grounding, and special systems, including fire alarm and lightning protection to serve the pump station.

8.1 Codes and Standards

The design will conform to the latest adopted editions of the applicable guidelines, standards, and codes outlined in Section 1.

8.2 Hazardous Area Classification

National Fire Protection Association (NFPA) Standard 820, *Standard for Fire Protection in Wastewater Treatment and Collection Facilities* (2020 Edition), establishes the requirements for protections against fire and explosion hazards in wastewater treatment plants and collection facilities. The standard identifies the various areas of a wastewater collection facility based on the process, and it defines the potential hazard and the required electrical area classification. Additional requirements for fire protection (e.g., fire detection/fire alarm systems, combustible gas detection) are also dictated by this standard.

Electrical equipment installed in hazardous areas classified as Class I, Division 1 or Class I, Division 2, are required to be rated National Electrical Manufacturers Association (NEMA) 7, explosion-proof. NFPA 820 allows a declassification of Class I, Division 1 spaces to a Class I, Division 2 space. To declassify this type of area, continuous ventilation at 12 air changes per hour with ventilation monitoring needs to be provided. Declassifying the area will still require NEMA 7 explosion-proof electrical equipment to be provided.

Additionally, NFPA 820 allows a declassification of Class I, Division 2 spaces to an unclassified location. To declassify this area, continuous ventilation at six air changes per hour with ventilation monitoring needs to be provided. Declassifying the area by ventilation will allow the use of unclassified, standard electrical equipment to be installed in the space.

Additionally, the National Electrical Code (NEC) requires power/control conduits entering or leaving hazardous areas to be provided with explosion-proof seal-offs.

Table 8-1 lists the electrical area classifications for the pump station. Refer to Section 9 for hazardous classification details for each area.

Table 8-1: Electrical area classifications.

Area	NFPA 820 Area Classification	Ventilation
▪ Grinder vault	Class I, Division 1	Refer to Section 9
▪ Flow splitter box	Class I, Division 1	
▪ Wet well	Class I, Division 1	
▪ Dry well	Unclassified	
▪ Electrical room ▪ Maintenance room ▪ Water closet ▪ Janitor room	Unclassified	
▪ Generator room ▪ Plenum	Unclassified	
▪ Fuel tank area	Unclassified	
▪ Odor control	Class I, Division 2	

8.3 Electrical Distribution System

8.3.1 Load Analysis

Based on the preliminary load calculations, the approximate total estimated operating load for the pump station is 2,026.1kVAF. This value includes the maximum amount of equipment anticipated to be in operation, future loads, and 25% spare capacity. A preliminary operating load summary is shown in **Table 8-2.**

Table 8-2: Preliminary operating load summary.

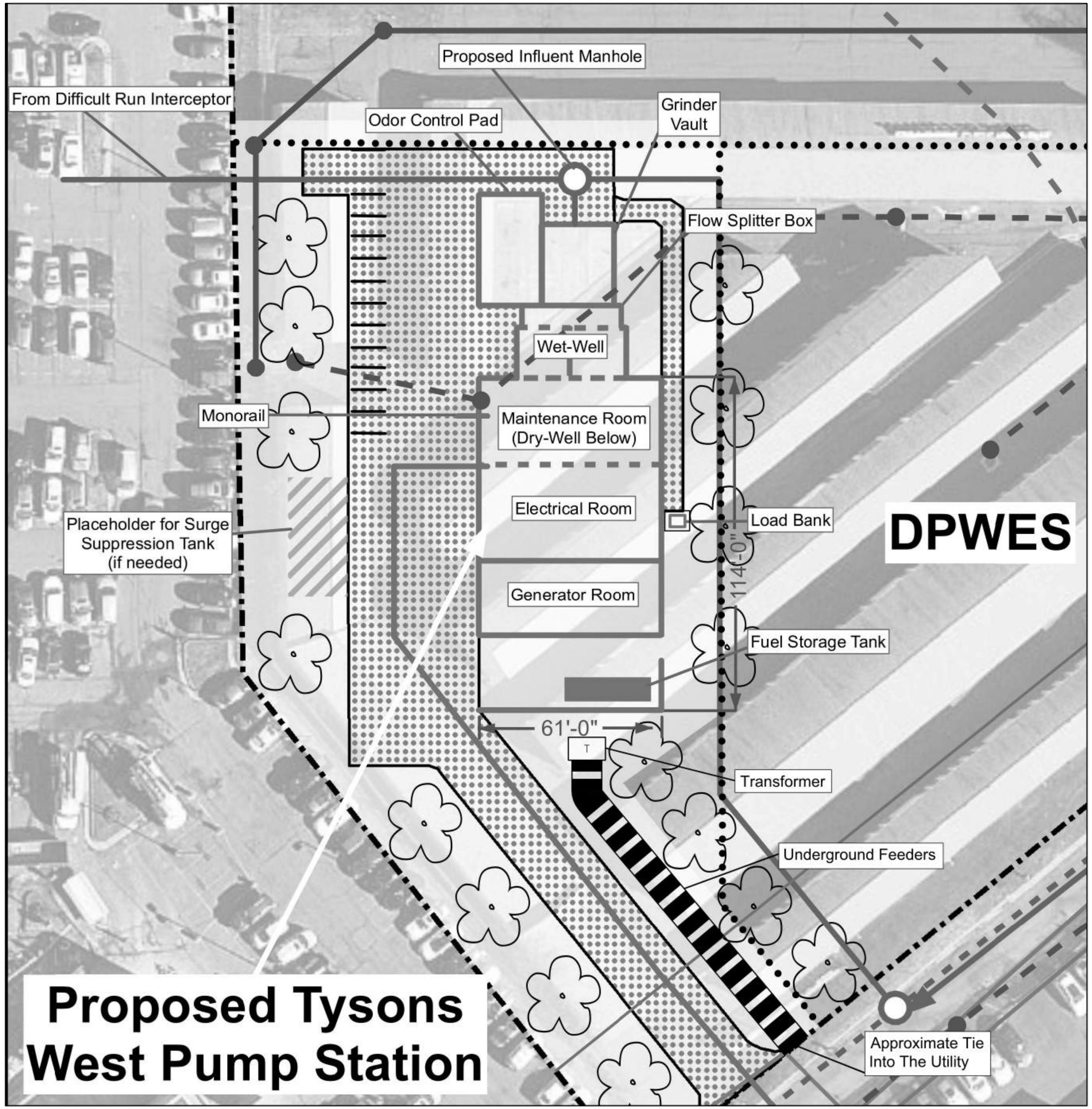
Load	Size	kVA
▪ Pump No. 1	385 HP	420.6
▪ Pump No. 2	385 HP	420.6
▪ Pump No. 3	385 HP	420.6
▪ Roof Mounted Air Conditioning Unit No. 1	56.6 A	47.1
▪ Roof Mounted Air Conditioning Unit No. 2	56.6 A	47.1
▪ Dry well make-up air unit	100 kW	100.0
▪ Grinder vault make-up air unit	40 kW	40.0
▪ Miscellaneous Loads o Odor control o Grinder o Lighting o Fans o Other LV loads	125.0 kVA	125.0
▪ **Total of Operating Loads**		**1,620.9**
▪ 25% Spare Capacity		405.2
▪ **Total (including Spare Capacity)**		**2,026.1**

8.3.2 Proposed Pump Station Electrical System

Power for the new TWPS will be provided from Dominion Energy (to be coordinated) via underground service. The new electrical distribution system design will provide a reliable source of power with a double-ended switchboard and a standby diesel generator. The incoming utility power feeders will be stepped down to 480V, via a utility-owned transformer, and terminate in a service-entrance rated 480V, 3-phase, 3-wire switchboard. Standby power will be provided via a 1500kW, 480/277V, 3-phase, standby diesel-engine generator. The utility power supply and the standby generator will be connected through a main-tie-main configuration in the double-ended switchboard that eliminates a common point of failure. The switchboard will contain transfer controls to allow automatic transfer upon loss of utility power with interlocking mechanism to prevent inadvertent parallel of the two sources. Duty and standby pumps and equipment will be fed from each side of the double-ended switchboard so that if one side of the switchboard is out of service the redundant loads on the opposite side of the switchboard bus will remain energized and in service. Lighting panelboards and non-redundant critical loads will be fed from both sides of the switchboard through an automatic transfer switch for increased reliability and maintenance. Continuous power for PLCs, SCADA, and critical instruments will be supplied by an uninterruptible power supply (UPS).

The County has requested provisions for connecting the electrical system to a temporary generator when the onsite generator is not available. Due to the size of the standby power this pump station, a connection box with multiple camlock connectors will be needed to connect to a temporary generator. Additionally, the switchboard will require a dedicated circuit breaker for the camlock connection box that will be interlocked with the onsite generator circuit breaker. Details will be provided during future submittals.

The proposed routing for the incoming electric utility feeders and a one-line diagram are shown in **Figures 8-1** and **8-2**, respectively.



ELECTRICAL SITE

PLAN

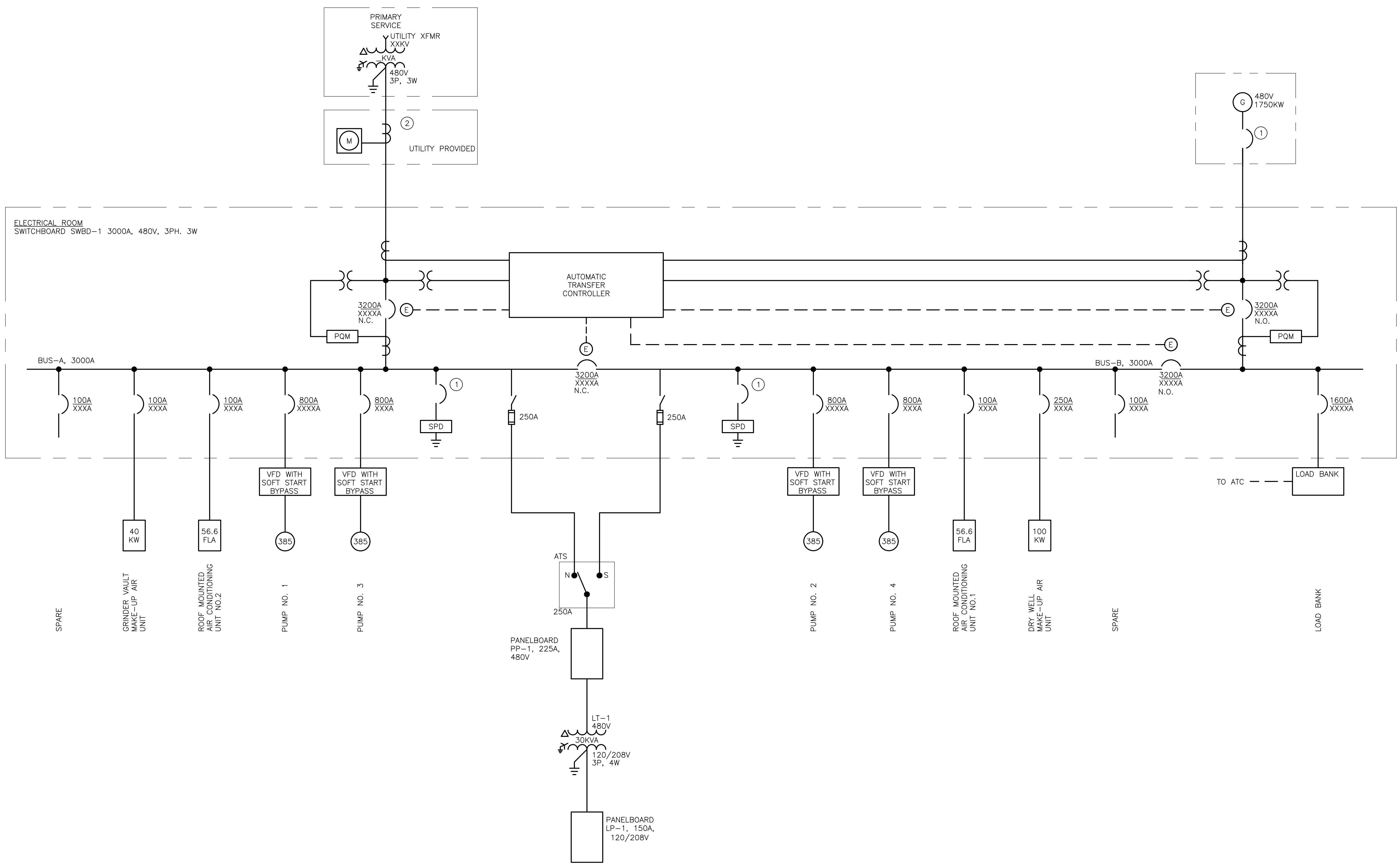
NOT TO SCALE

CDM Smith

Figure No. 8-1
PROPOSED ELECTRICAL SITE PLAN
MARCH 2021

KEYED NOTES:

1. SIZED PER MANUFACTURER.
2. METER AND CT LOCATION TO BE COORDINATED WITH UTILITY.



CDM Smith

Figure No. 8-2
ONE-LINE DIAGRAM
MARCH 2021

8.4 Electrical Design Concepts

8.4.1 Electrical Design Capacity

The electrical equipment capacity will be designed for the anticipated loads, planned future loads, plus 25% spare capacity for switchboards, transformers, and panelboards. Electrical room dimensions will be sized for the electrical equipment with spare capacity and future loads, but will not include 25% spare area.

8.4.2 Utilization Voltages

- LED lighting – 120 volts, single-phase
- Power panelboards – 480 volts, 3-phase
- Lighting panelboards – 120/208 volts, 3-phase
- Emergency lighting - 120 volts, single-phase
- Convenience outlets - 120 volts, single-phase
- Motor control - 120 Volts, single-phase
- Motors, less than 1/2 hp - 120 volts, single-phase
- Motors, equal to or greater than 1/2 hp - 460 volts, 3-phase

8.4.3 Voltage Drop

Conductors will be sized for a maximum voltage drop of 2% for feeder conductors, and 3% for branch circuit conductors at full-connected load. Total maximum voltage drop will be no more than 5%.

8.5 Life Safety

Life safety systems will be designed in accordance with the applicable codes. In general, life safety systems will consist of emergency egress lighting and fire alarm systems. The following items will be incorporated into the electrical design for personnel safety:

- The facility electrical distribution system will be solidly grounded, unless otherwise required by the design and coordinated with Fairfax County
- All electrical distribution equipment will be rated for the calculated available fault current
- All electrical equipment will have lockout capability, and will follow Fairfax County's lock-out, tag-out (LOTO) procedure
- Lockable safety disconnects will be provided within sight of all 480V motors where required by the NEC. For the dry pit submersible motors and grinder, disconnect switches will not be provided, as they meet the NEC exception for introducing increased or additional hazards, as the grinder is located in a hazardous location and the dry pit submersible pumps are rated in excess of 100HP and are on VFDs. Emergency stop pushbuttons will be provided near the equipment
- All low voltage branch circuits (120 VAC) in the facility will be provided with Ground Fault Current Interruption Device (GFCIs)

- Arc-flash labeling will be required in the equipment specifications for all electrical power equipment in accordance with the NEC and NFPA 70E
- Testing and commissioning of the electrical distribution equipment will be performed in accordance to NETA standards
- Emergency stop pushbuttons will be provided near the grinder and other associated equipment as applicable.

8.6 Grounding System

The grounding system will be designed to meet the requirements of the NEC, and will be measured by the fall-of-potential method. The grounding systems will be solidly grounded, and include connecting bare copper ground ring, ground rods, major rebar in concrete foundations, structural steel, electrical equipment, separately derived sources, and a local ground bar.

GFCI receptacles will be provided per NEC in required locations. All circuits will have ground conductors sized based upon NEC 250.66 for separately derived sources, and NEC 250.122 for feeder and branch circuits.

8.7 Electrical System Analysis

The facility electrical distribution system and equipment will be designed to minimize arc flash hazards wherever possible. Circuit breakers will be specified with adjustable electronic trip units where applicable to mitigate high arc flash hazards.

8.7.1 Preliminary Analysis

During the design phase, the maximum available fault current, with sufficient accuracy, will be calculated to determine the required interrupting ratings of all protective devices.

In addition, a preliminary coordination and arc flash analysis will be performed to establish the range of protective device settings that will result in reasonable selectivity of device operation for both three-phase and ground faults, and select equipment to minimize the arc flash incident energy as much as possible.

8.7.2 Final Analysis (Short Circuit, Selective Coordination, and Arc Flash Analysis)

During construction, final short circuit analysis, selective coordination study, and arc flash analysis will be completed after the equipment manufacturers have been determined, and shop drawings have been approved.

8.8 Equipment and Materials

All power distribution equipment will be installed in an environmentally-controlled electrical room on concrete housekeeping pads.

Surge protective devices (SPD) will be provided on each bus of the switchboard, control panels, and panelboards.

Power monitoring will be provided for the facility’s main distribution equipment, and be connected to SCADA.

8.8.1 Low Voltage Switchboard

A double-ended switchboard will be provided to be front accessible, and be completely isolated between sections by vertical steel barriers. The switchboard will be constructed with tin-plated, air-insulated copper phase and ground busses rated for the maximum short circuit current identified in the power system analysis.

Circuit breakers will be molded-case, insulated-case, or draw-out type depending on the breaker size and requirements. Circuit breakers will be controlled by thermal-magnetic trip units up to 250A, and by adjustable microprocessor-based integral trip units protective functions above 250A.

The switchboard will be service-entrance rated, and a vertical section will be designed in accordance with the utility requirements. It will be electrically interlocked to prevent the paralleling of the utility source and the generator source.

8.8.2 Power Monitoring

Power monitoring will be provided to measure the power quality and consumption for the pump station and on individual pumps. All power monitors will be networked to the PLC via Modbus TCP/IP. If the pump has a VFD or soft starter equipped with power monitoring via network interface, this interface may be used instead of a separate power monitor.

8.8.3 Panelboards

Panelboards will have molded case, bolted-in-place circuit breakers with an integrated short-circuit rating suitable for the available fault current. Panelboards will be furnished with integral SPD devices.

8.8.4 Variable Frequency Drives (VFD)

During the design phase, a preliminary harmonic analysis will be performed to confirm that total harmonic distortion for both voltage and current will not exceed the values stipulated in the latest edition of IEEE-519. VFDs will either be of an inherently low harmonic design or be provided with Line Input Reactors or other harmonic mitigation devices to ensure that the voltage and current harmonics are within the limits as specified by IEEE 519 at the point of common connection.

All VFDs will have the following protection functions:

- Input phase loss
- Output phase loss
- Motor overload
- Output short circuit
- Output ground fault

All VFDs will be provided with a reduced voltage soft start bypass motor starter. Coordination with the County will occur during the detailed design phase to determine the type of motor starter.

Power and control wires for VFDs will be installed in separate conduits. Where circuit length between the VFD and the motor exceeds the VFD manufacturer's recommendations, VFD cables or a sine-wave output filter will be provided.

8.8.5 Automatic Transfer Switches

Automatic transfer switches will be provided with a bypass isolation switch.

8.8.6 General Purpose Dry-Type Transformers

General purpose dry-type transformers will be provided as follows:

- Transformers will incorporate a 220°C insulation system and be designed not to exceed a 115°C temperature rise above 40°C ambient at full load
- Transformers will be energy efficient type, meeting the efficiency levels specified in DOE standards
- Transformer will have four full capacity taps, two 2-1/2 percent above, and two 2-1/2 percent below rated primary voltage
- Transformer windings will be copper
- The engineer will take into account the transformer K-factor rating requirement during design and specify accordingly

8.8.7 Enclosure

Electrical enclosures will be NEMA types as follows:

- NEMA 1 in dry, non-process, indoor, above grade locations
- NEMA 12 in "DUST" locations
- NEMA 4X Type 316 stainless steel in outdoor locations, rooms below grade including basements, and buried vaults and "DAMP," "WET," or "CORROSIVE" locations, as shown on the drawings
- NEMA 7 in hazardous classified locations

8.8.8 Raceways

Raceways will be provided as follows:

- General
  - All conduits will be one-trade size larger than required
  - Cable trays will not be permitted, unless otherwise noted by the County
- Indoors
  - All exposed wiring will be in rigid galvanized steel or aluminum conduit in non-corrosive areas or unless specified otherwise. Aluminum threads will be coated with thread sealant

  - Rigid galvanized steel conduit will be used at all locations within structures for process instrumentation wiring, shielded control wiring, data highway wiring, and I/O wiring
  - PVC-coated rigid galvanized steel conduit will be used in all process areas and areas designated as wet or corrosive
- Outdoors
  - PVC-coated rigid galvanized steel conduit will be used in all process areas and areas designated as outdoors
- Underground
  - Type Schedule 40 polyvinyl chloride (PVC) conduit will be used for concrete-encased underground ductbanks
  - Rigid galvanized steel conduit will be used at all locations underground for process instrumentation wiring, shielded control wiring, data highway wiring, and I/O wiring
  - Power/control conduits will be separated from signal conduits at a minimum of 6 inches apart
- Hazardous Areas - All Locations – Class I, Division 1 and 2
  - Exposed conduit for power wiring, lighting, switch, and receptacle circuits – galvanized rigid steel (GRS) for dry areas; PVC-coated GRS for damp, corrosive, and outdoor areas
  - Concealed conduit for power wiring, lighting, switch, and receptacle circuits - galvanized rigid steel

8.8.9 Wires

The following basis of materials selection is included in the design for wires and cables of 600V or less:

- Wires and cables will be annealed copper
- Wire for lighting, receptacles, and other circuits not exceeding 150V to ground will be NEC type THHN/THWN
- Wire for indoor circuits will be NEC Type THHN/THWN
- Wire for outdoor circuits will be NEC Type XHHW
- Color of insulation will be:
  - 480V
    - *Phase A – brown*
    - *Phase B – orange*
    - *Phase C – yellow*

        - *Neutral – grey*
    - 120/208V
        - *Phase wires – black, red, or blue*
        - *Neutral – white*
- Equipment grounding conductors will be NEC Type THHN/THWN
- Multi-conductor control cable will be 600V, No. 14 AWG stranded , Type XLP insulated with PVC jacket
- Multi-conductor power cable will be stranded, 600V, Type PVC insulated with PVC jacket, Type “TC” with ground
- Process instrumentation wire will be twisted pair, No. 16 AWG stranded, 600V, Type PVC insulated, aluminum tape shield, with PVC jacket

8.8.10 Underground Systems

Electrical ductbanks will be reinforced concrete-encased with detectable marking tape. The minimum conduit size for ductbanks will be 1-inch, and ductbanks located below vehicular traffic paths will be provided with 25% spare conduits

8.9 Motors

8.9.1 General

Induction motors will be 120/208V single phase for fractional HP sizes, and 460V 3-phase for integral HP sizes. Three-phase motors will be NEMA premium efficiency, 1.15 service factor, and 1.0 service factor for VFD applications. Totally enclosed fan cooled (TEFC), or totally enclosed non-ventilated (TENV) motors will be used in process areas, and will be provided with thermal cutouts in the windings. Anti-condensation heaters for outdoor motors. All motors serving variable speed applications shall be Inverter Duty per NEMA MG1, Part 31, and be provided with motor winding thermal protection.

8.9.2 Monitoring Devices for Process Motors

Process motors 50HP and larger will provided with bearing vibration and temperature sensors.

8.9.3 Motor Protection and Control

Motor starters will be provided with control power transformers (CPT) to provide 120V supply to relays, timers, switches, and pilot lights. Each motor will have thermal overload protection in on all phases.

Low-voltage motor protection will be provided for the dry pit submersible pumps.

8.10 Lighting

8.10.1 General Requirements

The lighting system will be designed to meet the Commonwealth of Virginia's energy code requirements. Lighting levels, and maintained foot-candles, will meet the recommendations of IESNA's Lighting Handbook and the guidelines given here. All luminaires shall meet UL's specifications and be rated for the area where they will be installed.

8.10.2 Lighting Calculations

Recommended foot-candle levels for each space will be calculated for maintained illumination, as IESNA recommends in association for the local and national energy codes. COMcheck calculations will be performed to ensure the lighting design meets the requirements of the applicable energy codes.

8.10.3 Lighting Illumination Levels

Energy-efficient lighting illumination will be provided in accordance with IESNA guidelines and applicable energy codes. The interior lighting system will be designed in accordance with IESNA recommended foot-candle levels. Exterior lighting will be for driveways, parking lots, and located above each door. The interior and exterior lighting system will be designed using the following illumination levels defined in **Table 8-3** below.

Table 8-3: Illumination levels.

Area	Intensity (Foot-Candle)
▪ Grinder vault ▪ Dry well electrical room ▪ Generator room ▪ Maintenance room ▪ Water closet ▪ Janitor's room	30
▪ Fuel tank area ▪ Stairs ▪ Plenum	5
▪ Roadway ▪ Parking	0.4

- Interior lighting will consist of high-efficiency LED-type luminaires
- Exterior lighting will utilize LED luminaires with full cutoff in compliance with the "dark sky" criteria

8.10.4 Circuiting and Switching

Interior lighting circuits will be switched and circuited to provide uniform light reduction.

Exterior lighting circuits will be controlled using a photocell switch and a lighting control panel with HAND-OFF-AUTO (HOA) selector switches to allow manual control. Additional exterior lighting will be provided where outdoor work is expected.

8.10.5 Emergency Lighting System

Emergency illumination must be provided in all appropriate spaces as required to protect life, property, and equipment.

Adequate lighting levels will be maintained for safe building egress and critical process plant functions. Emergency lighting will be located outside egress doors for safe egress away from buildings. Emergency lighting will be located near switchboards and any equipment locations that need to be monitored on a continual basis.

Emergency luminaires for life safety will be standardized and used throughout the pump station. Either normal lighting luminaires with integral battery/charger within the light fixtures.

Emergency egress lighting will be provided with 90-minute battery backup units in selected luminaires, and exit signs will be provided to identify the path of egress. Exterior egress lighting for door entrances and exits will be provided on the exterior of all buildings.

8.10.6 Damp Atmosphere Luminaires

Luminaires located in damp areas will be NEMA 4X rated for use in damp locations.

8.11 Standby Power Systems

An indoor, standby, diesel generator will be provided and sized for the operating load and planned future load, plus 25% spare capacity.

8.11.1 Generator Fuel Systems

The fuel system work will consist of providing a new above-ground diesel fuel storage tank and associated piping and accessories in the generator room for the new standby generator. Above-ground fuel piping will be provided between the standby generator day tank and the above-ground double-wall diesel fuel storage tank. Fuel piping will also be provided between the new day tank and new generator. An electronic leak detection system will be provided to monitor the fuel tank interstitial secondary containment, and fuel tank level. Local alarms will be provided, as well as remote monitoring through SCADA. The fuel tank will be provided with stairs and platforms for ease of access for refueling and observation of ports/gauges at the top of the tank. The fuel systems will be secured and located within the fencing perimeter.

The fuel tank will be sized to have a useable capacity that will provide a minimum 72-hour run time. Sizing of the fuel tank will consider the required fuel fill limiting device, and the height of the fuel supply line foot valve above the bottom of the tank to determine the useable capacity.

The following is a summary of the proposed fuel system equipment and materials:

- Above-ground fuel storage tank will be a double wall protected storage tank (UL 2085). The tank will be a double wall steel insulated storage tank with a primary inner steel tank and a secondary outer steel tank. Interstitial space between the primary tank and secondary tank will be filled with insulation or lightweight concrete. Tank construction and installation will meet the requirements for NFPA 30 and NFPA 37

    - Alternately the primary steel tank will be concrete encased with a high density membrane secondary containment

- The fuel tank will be provided with the following components:
    - Stairs/platform to facilitate fuel tank filling and observation of ports/gauges on top of the tank
    - Fill port with spill containment. A remote fuel fill station will be considered due to the size of the fuel tank in lieu of tank-mounted fill port to eliminate the need for stairs/platform.
    - Fill-limiting device to shut-off the flow of fuel fill at 90 to 95 % of tank capacity
    - Double poppet foot valve on generator fuel supply line
    - Normal vents and emergency vents in accordance with the requirements of NFPA 30
    - Spill kit
    - Bollards will be provided around exterior fuel tanks for vehicle impact protection
- Aboveground fuel piping will be Schedule 80 black steel
    - Aboveground fuel piping located within a flood plain will be double-wall piping consisting of Schedule 80 black steel primary fuel piping with FRP secondary containment piping
- Fuel piping systems will include the following:
    - A fuel filtration and oil water separation will be provided between the day tank and the generator. Fuel filters will be a minimum of 2 microns. A duplex system with parallel fuel filter/oil water separators will be provided to allow servicing/filter replacement during generator operation
    - An anti-siphon valve will be provided on the bulk fuel storage tank generator supply line to prevent siphoning of fuel due to a fuel line break
    - A fusible valve will be provided on the generator fuel supply from the bulk fuel storage tank inside the generator room to shut-off the flow of fuel in the event of a fire
    - A shut-off solenoid valve will be provided at the day tank
    - A strainer with manual bypass will be provided upstream of the day tank
    - Normally open lockable isolation valves will be provided at the bulk storage tank fuel supply and fuel return connections to allow isolation of the tank during maintenance
    - A permanent fuel polishing system will be provided to treat stagnant fuel in the bulk storage tank

- Hangers, supports, and anchors will be stainless steel
- Electronic leak and level detection will be a packaged system with remote monitoring through SCADA. The following will be provided:
  - Fuel tank interstitial leak detection with local and remote alarms
  - Continuous level monitoring via SCADA
  - High tank level alarm with local and remote alarms
  - Low tank level alarm with local and remote alarms
- Day tank will be double-wall and provided with the following:
  - Maximum size – 200 gallons
  - Normal vents and emergency vents in accordance with the requirements of NFPA 30
  - Electronic leak and level detection system
  - Fuel supply pump drawing fuel from the bulk fuel storage tank, and fuel return pump to discharge excess/overflow fuel back to the bulk-storage tank. Check valves will be provided on the discharge of each pump

8.11.2 Load Banks

A permanent load bank, sized for 50% generator capacity, will be provided to allow for periodic generator testing without interruption of power to the electrical system. Per manufacturer recommendations, diesel generators should to be approximately 50% loaded to avoid operating the generator lightly loaded during power outages (which causes issues such as wet stacking that reduce the life of the generator) the load bank will automatically switch on partially/in steps to ensure a minimum load is maintained on the generator, and it will automatically switch off when larger/sufficient loads are operating on the generator.

The load bank will be located outdoors due to the heat generated; however, noise considerations will be evaluated when determining the final location during detailed design.

8.12 Special Plant Systems

8.12.1 Fire Alarm System

A code analysis will be performed to determine applicable codes, including NFPA 820, and use-types to determine if a fire alarm system is required. The fire alarm system will be addressable type and in accordance with the requirements of NFPA 72.

8.12.2 Security System

Closed circuit television (CCTV) will be provided in accordance with Fairfax County standards.

8.12.3 Access Control

Access control will be provided in accordance with Fairfax County standards.

8.12.4 Lightning Protection

A lightning protection assessment will be performed to determine if lightning protection is required. If it is determined to be required, the design will be performed by a firm that specializes in lightning protection.

Section 9

Building Mechanical

This section describes the heating, ventilation, and air conditioning (HVAC), plumbing, fire protection, and generator fueling system design criteria.

9.1 Heating, Ventilating, and Air Conditioning

9.1.1 NFPA 820 and SCAT Analysis

The purpose of National Fire Protection Association (NFPA) 820 is to provide a degree of fire and explosion protection for life, property, continuity of mission, and protection of the environment. The following analysis is based on the 2020 edition of NFPA 820.

The Sewer Collection and Treatment (SCAT) regulations govern the design, construction, and operation of sewerage systems and treatment works to ensure that they are consistent with public health and water quality objectives of the Commonwealth of Virginia. The ventilation requirements defined in the SCAT regulations are strictly for the protection of personnel accessing the facilities, unlike the ventilation requirements defined in NFPA 820, which are primarily for the mitigation of fire and explosion hazards within the facilities.

9.1.1.1 Facility Description

The facility will include a pump station building and grinder vault. The proposed pump station building is divided into a flow splitter box, wet well, dry well, maintenance room, toilet room, janitor's closet, electrical room, generator room, and an open-air fuel storage area.

Neither the scope of NFPA 820 nor SCAT covers the maintenance room, toilet room, janitor's closet, electrical room, generator room, and fuel storage area.

9.1.1.2 NFPA 820 Requirements

The proposed wet well, dry well, flow splitter box, and grinder vault are collection systems. NFPA 820, Table 4.2.2, Rows 14, 15, 27, and 30 covers the design and construction of the components associated with wastewater collection and transport systems. **Table 9-1** summarizes the requirements for each space.

Table 9-1: Summary of NFPA 820 Table 4.2.2 Requirements

Row	Line	Location and Function	Fire and Explosion Hazard	Ventilation	Extent of Classified Location	National Electrical Code (NEC) Hazardous Location Classification (All Class 1, Group D)	Materials of Construction	Fire Protection Measures
14	a	Wastewater pumping station wet wells – liquid side of a pumping station serving sanitary sewer or combined system	Possible ignition of flammable gases and floating flammable solids	No ventilation or ventilated at less than 12 air changes per hour	Entire room or space	Division 1	Non-combustible material, Limited combustible material, Low flame spread index	Combustible gas detection system required if mechanically ventilated or opens into a building interior
14	b	Wastewater pumping station wet wells – liquid side of a pumping station serving sanitary sewer or combined system	Possible ignition of flammable gases and floating flammable solids	Continuously ventilated at 12 air changes per hour	Entire room or space	Division 2	Non-combustible material, Limited combustible material, Low flame spread index	Combustible gas detection system (if enclosed)
15	a	Below-grade or partially below-grade wastewater pumping station dry well – pump room physically separated from wet well; pumping of wastewater from a sanitary or combined sewer system through closed pumps and pipes	Buildup of vapors from flammable or combustible liquids	Continuously ventilated at 6 air changes per hour in accordance with Chapter 9	Entire space or room	Unclassified	Non-combustible material, Limited combustible material, Low flame spread index	Fire extinguisher

Row	Line	Location and Function	Fire and Explosion Hazard	Ventilation	Extent of Classified Location	National Electrical Code (NEC) Hazardous Location Classification (All Class 1, Group D)	Materials of Construction	Fire Protection Measures
15	b	Below-grade or partially below-grade wastewater pumping station dry well – pump room physically separated from wet well; pumping of wastewater from a sanitary or combined sewer system through closed pumps and pipes	Buildup of vapors from flammable or combustible liquids	No ventilation or ventilated at less than 6 air changes per hour	Entire space or room	Division 2	Noncombustible material, limited combustible material, low flame spread index	Fire extinguisher
18	c	Odor control and ventilation systems serving classified locations	Leakage and ignition of flammable gases and vapors	Not enclosed, open to the atmosphere	Areas within 3 feet (ft) of leakage sources, such as fans, dampers, flexible connections, flanges, pressurized unwelded ductwork, and odor control vessels	Division 2	Noncombustible material, limited combustible material, low flame spread index	Fire extinguisher
18	d	Odor control and ventilation systems serving classified locations	Leakage and ignition of flammable gases and vapors	Not enclosed, open to the atmosphere	Areas beyond 3 ft	Unclassified	Noncombustible material, limited combustible material, low flame spread index	No requirement
27	a	Diversion structure (flow splitter box)	Buildup of vapors from flammable or combustible liquids	Not normally ventilated	Enclosed space	Division 1	In accordance with Chapter 8	No requirement

Row	Line	Location and Function	Fire and Explosion Hazard	Ventilation	Extent of Classified Location	National Electrical Code (NEC) Hazardous Location Classification (All Class 1, Group D)	Materials of Construction	Fire Protection Measures
27	b	Diversion structure (slow splitter box)	Buildup of vapors from flammable or combustible liquids	Continuously ventilated at 12 air changes per hour	Enclosed space	Division 2	Same as above	No requirement
30	a	Below-grade valve vault with exposed wastewater service (grinder vault)	Possible buildup ignition of gases and floating flammable solids	Not normally ventilated	Enclosed space	Division 1	Noncombustible material	No requirement
30	b	Below-grade valve vault with exposed wastewater service (grinder vault)	Possible buildup ignition of gases and floating flammable solids	Continuously ventilated at 12 air changes per hour	Enclosed space	Division 2	Noncombustible material, limited combustible material, low flame spread index	No requirement
NA	NA	Electrical room	NA	NA	NA	Unclassified	NA	NA
NA	NA	Generator room	NA	NA	NA	Unclassified	NA	NA
NA	NA	Maintenance room	NA	NA	NA	Unclassified	NA	NA
NA	NA	Janitor’s closet	NA	NA	NA	Unclassified	NA	NA
NA	NA	Toilet room	NA	NA	NA	Unclassified	NA	NA
NA	NA	Fuel tank area	NA	NA	NA	Unclassified	NA	NA

NA: Not covered under the scope of NFPA 820

Note: Un-highlighted rows indicate the hazardous area classification, ventilation requirements, and fire protection measures that will be implemented for each space.

9.1.1.3 Sewer Collection and Treatment Requirements

Section 9VAC25-790-380, Article 2 Sewage Pump Stations, Paragraph B describes the ventilation requirements for pump-enclosed spaces within pump stations during all periods when the pump station is manned.

The minimum ventilation requirements for a wet well consist of providing a properly screened passive vent with a minimum diameter of 4 inches. The purpose of the vent is to provide air intake/air relief during draw down and filling of the wet well. If screens or mechanical equipment requiring periodic maintenance and inspection are located in the wet well, mechanical ventilation is required at the time of access by maintenance personnel. Mechanical ventilation of wet wells is required to be 12 air changes per hour if continuous or 30 air changes if intermittent.

Dry wells in which the pumps are permanently mounted below the ground must be provided with mechanical ventilation, and they must be arranged to independently ventilate the dry well. No specific air change rate is listed for dry well ventilation systems. In climates where excessive moisture or low temperatures are present, consideration should be given to the installation of automatic heating and dehumidification systems.

Ventilation for flow splitter boxes and grinder vaults are not specifically addressed in the SCAT regulations. For the purposes of this analysis, flow splitter boxes are treated as wet wells without mechanical equipment, and grinder vaults are treated as wet wells with mechanical equipment.

9.1.1.4 Heating, Ventilation, and Air Conditioning Design Criteria – Wet Well, Flow Splitter Box, and Grinder Vault

The wet well, flow splitter box, and grinder vault will be provided with odor control ventilation. Refer to Section 3.2.7 for the odor control system design criteria.

The wet well, flow splitter box, and grinder vault are contiguous spaces and will be ventilated at a minimum of 12 air changes per hour continuously, as required by the SCAT regulations, due to the grinder equipment, which requires periodic maintenance. However, this ventilation rate will not be used to reduce the electrical hazard classification from Class 1, Division 1 to Class 1, Division 2. The wet well, flow splitter box, and grinder vault will have an electrical hazard classification Class 1, Division 1 in accordance with Table 4.2.2, Row 30, Line a. The wet well and flow splitter box will not be provided with heating systems. The grinder vault will be provided with a covered enclosure to contain odors and an access stair for grinder maintenance. Freeze protection is not required for the process systems in the grinder vault. Heating systems can be provided if desired for worker comfort during occupancy.

Fire protection measures required by NFPA 820 include:

- Wet well – A combustible gas detection system will be provided in accordance with the requirements of Paragraph 7.4.
- Flow splitter box and grinder vault – No requirements are needed.

9.1.1.5 Design Criteria – Dry Well

The dry well will be ventilated at a minimum of six air changes per hour continuously to reduce the electrical hazard classification from Class 1, Division 2 to Unclassified in accordance with Table 4.2.2, Row 15, Line a.

Exhaust ventilation will be provided by two inline exhaust fans. Exhaust discharge to the exterior will be through wall-mounted louvers directed to a grassy area behind the pump station building. Tempered make-up air will be provided by a dedicated, packaged, roof-mounted make-up unit with an electric heating section. The heating design condition will be a minimum temperature of 50 degrees Fahrenheit (°F)±5°F. Physical override timers will be provided to allow the space temperature to be increased to 60°F±5°F for maintenance activities when the area is occupied.

Temperature/trouble alarms will be provided to alert plant operators if the space temperature drops below 40°F (adjustable). The space will be maintained at a negative pressure compared to the exterior and adjacent rooms. The dry well will be ventilated and heated only, and no cooling or humidity control will be provided.

Fire protection measures required by NFPA 820 for the dry well include the following:

- Fire extinguishers will be provided in accordance with the requirements of Chapter 7, Paragraph 7.2.5.

The following additional requirements of NFPA 820 will be provided for ventilation systems serving the dry well:

- Ventilation monitoring will be provided in accordance with the requirements of Chapter 7, Paragraph 7.5, and will include alarm signaling systems in accordance with Paragraph 7.6. This includes both local alarm systems and remote alarm systems at a constantly attended location.
- Ventilation systems (both supply and exhaust) with a capacity of 2,000 cubic feet per minute (CFM) or greater will be provided with smoke detectors for automatic shutdown in accordance with the requirements of Chapter 8, Paragraph 8.3.8.2.
- According to the requirements of Chapter 9, both mechanical supply and exhaust will be provided (Paragraph 9.2.4), as well as ductwork and air distribution devices to encourage scavenging of all portions of the space to prevent short-circuiting, and to promote the removal of both heavier- and lighter-than-air gases and vapors (Paragraph 9.2.8).
- The ventilation rate for the dry well will be reduced by 50 percent (%) (three air changes per hour) when the following criteria are met, according to the requirements of Paragraph 9.3.2:
    - The low ventilation rate will not be less than 50% of the required six air changes per hour.
    - The low ventilation rate will only operate when the outdoor ambient temperature is 50°F or less.

- The high ventilation rate will be in operation whenever the outdoor ambient temperature is above 50°F, whenever the space is occupied, or whenever the ventilation is activated by approved combustible gas detectors set to function at 10% of the lower flammable limit (LFL) or 0.5 LEL per meter (LEL-m).

9.1.2 Uniform Statewide Building Code/International Mechanical Code Analysis

The purpose of the International Mechanical Code (IMC) is to establish minimum standards to provide a reasonable level of safety, health, property protection, and public welfare by regulating and controlling the design, construction, installation, quality of materials, location, operation, and maintenance or use of mechanical systems used to provide control of environmental conditions and related processes within buildings.

IMC does not specifically address spaces in the pump station, with the exception of the toilet room and janitor's closet. The most similar occupancy category is a warehouse, which requires 0.06 CFM per square foot of outside air when the space is occupied. As such, Paragraph 9.1.1 describes the wastewater process area design criteria, and the design criteria for the remaining areas will be as follows. These design criteria exceed the requirements of the IMC.

9.1.2.1 Electrical Room

The electrical room will be conditioned to maintain operation of the electrical equipment and to reduce the effects of heat and humidity on the electrical equipment. The cooling design condition will be a maximum temperature of 80°F±5°F. Since the electrical room includes wastewater pump variable frequency drives (VFDs), which are critical to the pump station operation, a redundant air conditioning system will be provided. Units will be sized 100% of the peak cooling load. The heating design condition will be a minimum temperature of 50°F±5°F. Physical override timers will be provided to allow the space temperature to be increased to 60ºF±5°F for maintenance activities when the area is occupied. Temperature/trouble alarms will be provided to alert plant operators if the space temperature rises above 95°F (adjustable).

Packaged direct expansion heat pump rooftop air conditioning units will be provided for the electrical room. Units will be provided with auxiliary electric heating sections to supplement the heat pump and to provide emergency heat during extreme temperatures. The units will include economizer sections for energy reduction.

9.1.2.2 Generator Room

The generator room will be ventilated by the generator-mounted radiator fan during generator operation. The generator room will be ventilated with outside air at a minimum rate of six air changes per hour (intermittent) to provide summer ventilation and heat removal ventilation after generator operation. Exhaust ventilation will be provided by wall-mounted exhaust fans discharging into the generator exhaust plenum, or by inline exhaust fans discharging through a wall-mounted louver into the generator exhaust plenum. Make-up air will be provided by wall-mounted intake louvers located in the inner wall of the generator intake plenum. Louvers will be provided with motor-operated shut-off dampers, which will fail to open during a loss of power. The exhaust systems will be thermostat-controlled with a set point of 85°F±5°F (adjustable). Heating systems will be provided to maintain a minimum temperature of 50°F±5°F. Physical override timers will be provided to allow the space temperature to be increased to 60°F±5°F for maintenance activities when the area is occupied. Heating will be provided by wall-mounted electric unit heaters. The generator room will be ventilated and heated only, and no cooling or humidity control will be provided.

The generator will be provided with an exhaust shroud discharging through a wall-mounted louver located in the inner wall of the generator exhaust plenum. A counterbalanced gravity exhaust damper will be mounted to the interior side of the exhaust louver. The generator will be provided with exhaust piping routed through an exhaust silencer. The generator exhaust piping will discharge to the exterior either through the outer generator exhaust plenum wall or through the top of the exhaust plenum. The generator exhaust piping and silencer will be insulated with high-temperature insulation to protect personnel and to reduce heat gain within the space.

9.1.2.3 Maintenance Room

The maintenance room will be ventilated with outside air at a minimum rate of six air changes per hour (intermittent) to provide summer ventilation. Manual control will be provided to allow operation of the exhaust system when the space is occupied. Exhaust ventilation will be provided by an inline exhaust fan. Exhaust discharge to the exterior will be through a wall-mounted louver directed to a grassy area behind the pump station building. Make-up air will be provided by wall-mounted intake louvers. Louvers will be provided with motor-operated shut-off dampers. The exhaust system will be thermostat-controlled with a set point of 85°F±5°F (adjustable). Heating systems will be provided to maintain a minimum temperature of 50°F±5°F. Physical override timers will be provided to allow the space temperature to be increased to 60°F±5°F for maintenance activities when the area is occupied. Heating will be provided by wall-mounted electric unit heaters. The maintenance room will be ventilated and heated only, and no cooling or humidity control will be provided.

9.1.2.4 Toilet Room and Janitor’s Closet

The toilet room and janitor’s closet will be ventilated when occupied with outside air, as required by the IMC. Ventilation rate will be 70 CFM per applicable plumbing fixture. Exhaust ventilation will be provided by inline exhaust fans. Exhaust discharge to the exterior will be through wall-mounted louvers directed to a grassy area behind the pump station building. Make-up air will be provided by wall-mounted intake louvers located in the maintenance room. Air will be transferred to the space through undercut doors or door grilles. The fans will be controlled by the light switch located in each room. Heating for the spaces will be provided by transfer air from the maintenance room. The toilet room and janitor’s closet will be provided with commercial wall-mounted electric heaters with integral thermostats. The toilet room and janitor’s closet will be ventilated and heated only, and no cooling or humidity control will be provided.

9.1.3 Heating, Ventilation, and Air Conditioning Equipment and Materials

The following is a summary of the proposed HVAC equipment and materials:

- Supply and return air ductwork for electrical rooms will be constructed of galvanized steel meeting Sheet Metal and Air Conditioning Contractors National Association (SMACNA) standards with external fiberglass insulation.

- Make-up air and exhaust ductwork for the dry well, maintenance room, generator room, toilet room, and janitor's closet will be constructed of aluminum meeting SMACNA standards. External fiberglass insulation will be provided as applicable.
- Odor control exhaust ductwork for the wet well, flow splitter box, and grinder vault will be constructed of fiberglass-reinforced plastic (FRP) meeting SMACNA standards. Resins will be selected for typical containments associated with wastewater treatment facilities.
- Generator exhaust shroud will be constructed of a minimum 12-gauge aluminum meeting SMACNA standards.
- Generator exhaust piping and silencer will be Type 316 stainless steel with high-temperature insulation.
- Hangers and supports will be either galvanized steel, aluminum, or stainless steel, and will match duct material provided. Support spacing and the size of hangers will be as specified in the SMACNA standards.
- Air distribution devices will be aluminum construction with off-white enamel or anodized mill finish.
- Exhaust fans will be wall-mounted, or inline type, and an all-aluminum construction (when possible).
- Make-up air units will be packaged units with electric heating sections.
- Air conditioning systems will be packaged, roof-mounted, direct expansion heat pump units with auxiliary electric heating coils.
- Equipment housings for exhaust fans, make-up air units, and air conditioning units will be provided with corrosion-resistant coatings suitable for the intended application.
- Air conditioning unit condenser coils and evaporator coils will be provided with corrosion-resistant coil coatings suitable for the intended application.
- Unit heaters will be electric.
- Condensate piping will be Schedule 40 polyvinyl chloride (PVC).
- Control systems will be local standard electric/electronic self-contained modular control systems. Direct digital control systems will not be provided.

9.2 Plumbing

9.2.1 Plumbing Design Criteria

Plumbing systems will be provided for the new pump station and will include the following components.

9.2.1.1 Sanitary Sewer System

Plumbing sanitary drainage, waste, and vent (DWV) systems will be provided for the pump station, dry well, maintenance room, toilet room, and janitor's closet.

The dry well will be provided with sump pumps that discharge to the pump station wet well. Refer to Section 3.2.4 for additional requirements.

The maintenance room will be equipped with floor drains for general floor drainage. The toilet room will be provided with a wall-mounted lavatory sink and wall-mounted water closet. The janitor's closet will include a floor-mounted mop basin. Gravity drainage from the fixtures will be routed to the pump station wet well. All sanitary piping systems will be provided with vents to the exterior of the building according to the requirements of the plumbing code.

The generator room and fuel storage area will not be equipped with sanitary drainage.

9.2.1.2 Stormwater System

Based on the proposed building roofing systems for the pump station, roof drainage will be provided by sheet flow off the roof, or by gutter and downspouts. If required by final design, primary and secondary roof drainage systems with interior rain leader piping will be provided.

The generator room intake and exhaust plenums will be provided with area drains routed to the stormwater system.

9.2.1.3 Water Systems

Potable hot, tempered, and cold water systems will be provided for the pump station plumbing fixtures. Cold water will be provided to the toilet room water closet and lavatory and the janitor's closet mop basin. Hot water will be provided to the toilet room lavatory and the janitor's closet mop basin. The toilet room lavatory will be provided with an under-sink mixing valve to deliver tempered water to the lavatory as required by the International Plumbing Code (IPC).

The generator room will include a portable eyewash station, which can be used in the generator room for the battery charging area and in the fuel storage area for filling operations.

Non-potable protected water systems will be provided for wash-down systems in the grinder vault, pump station dry well, maintenance room, and for process water usage if required by final design.

Reduced pressure zone (RPZ)-type backflow preventers will be provided for all connections to potable water mains. Two separate backflow preventers will be provided for the pump station to avoid cross contamination of the potable fixtures within the facility. Backflow preventers serving potable fixtures (lavatory, water closet, and mop basin) will be designated as "POTABLE WATER," and backflow preventers serving process/washdown fixtures will be designated as "PROTECTED WATER."

A small tank-type electric water heater will be mounted above the mop basin in the janitor's closet to provide hot water for the plumbing fixtures. Alternately, instantaneous electric water heaters will be considered during final design.

9.2.1.4 Natural Gas Systems

Natural gas will be considered for building heating systems, hot water heating systems, and generator fueling if a natural gas source is available near the site. Refer to Section 2.2.2 for additional information.

9.2.2 Plumbing Fixtures, Equipment, and Materials

The following is a summary of the proposed plumbing fixtures, equipment, and materials:

- Sanitary DWV piping and stormwater piping will be Schedule 40 PVC with DWV fittings.
- Sump pump discharge will be Schedule 80 PVC with pressure fittings.
- Potable and protected water piping for the pump station dry well, maintenance room, toilet, and janitor's closet will be Type K copper pipe with cast copper or brass fittings.
  - Fittings will be constructed with flanged, threaded, and lead-free solder joints.
- Protected water piping for the grinder vault will be Schedule 80 chlorinated polyvinyl chloride (CPVC) with pressure fittings.
- Above-grade natural gas piping will be Schedule 40 black steel.
  - Fittings will be malleable iron for piping sizes 2 inches and smaller with a pressure of 2 pounds per square inch (psi) and lower.
  - Fittings will be welded for piping sizes 2 inches and larger, and for piping with a pressure greater than 2 psi.
- Below-grade natural gas piping will be polyethylene (PE) with fusion fittings.
- Hangers, supports, and anchors will be stainless steel.
- Hose stations will be 50-ft industrial hose with stainless steel hangers and chrome-plated brass hose bib fixtures.
- Emergency fixtures will be self-contained portable eyewash units provided with a plug-in heating jacket and waste container.
- Backflow preventers for plumbing systems will be RPZ devices.
- Water heaters will be commercial electric tank-type or instantaneous electric type.
- Toilet fixtures will be commercial-grade white vitreous china and cast iron with chrome-plated brass supply fixtures.

9.3 Fire Protection

Based on the requirements of the Uniform Statewide Building Code (USBC), the Statewide Fire Prevention Code (SFPC), and the preliminary code analysis provided in Section 6.1.2, the new pump station will not require a fire suppression system.

Fire alarm systems will be provided as required by final design and shown on the electrical drawings. Fire hydrants will be provided as required by final design and shown on the civil drawings. Fire extinguishers will be provided as required by final design and shown on the architectural drawings.

Section 10

Automation Design Criteria

This section describes the proposed automation, instrumentation, and process control system for Fairfax County's supervisory control and data acquisition (SCADA) system at the new Tysons West Pump Station (TWPS).

10.1 Automation System

Fairfax County operates a SCADA system that provides remote monitoring and control of all pump stations within the wastewater collection system.

The new pump station will be provided with a Modicon M340 programmable logic controller (PLC)–based control system to monitor and control the facility. The PLC will interface with the process instrumentation and equipment at the pump station, and it will be designed for unmanned, automatic operation. To provide local monitoring and control through the SCADA system, a Modicon touch screen operator interface terminal (OIT) will be installed on the PLC control panel. In the event of a PLC failure, a backup control system, consisting of a Modicon Zelio programmable relay, will be installed to keep the pump station operational until the PLC system can be restored.

The new pump station will communicate with the Robert P. McMath facility using a private, high-speed network from Cox Communications. The County will remotely monitor and control the pump station through their GE Proficy human machine interface (HMI) system.

Additional elements of the new automation system at the pump station will be provided in accordance with the facilities design manual.

10.2 General Design Guidelines

The following design guidelines are recommended for the automation design.

10.2.1 General

- Local manual control is required for all equipment. Once a device is switched to local, control of the device will be independent of (and unaffected by) the actions (or absence) of a PLC.

- Hardwired, safety interlocks will be used to prevent equipment from operating under undesirable conditions. The PLC system will not be used in this manner. **Figure 10-1** shows the presently planned hardwired interlocks, which will be further developed during the final design.

- All equipment/device controls will be equipped to provide positive feedback confirmation to the PLC.

- Equipment or devices that require bumpless control will be provided with start and stop pushbuttons (open and close for valves) with a separate local/remote selector switch.
- Equipment or devices that default in the "off" state (upon power restoration during an outage) will be provided with local start and stop pushbuttons with a separate local/remote selector switch.
- Emergency stop switches will be provided for all equipment to reduce hazardous situations that could damage equipment and/or create an increased risk of harm to individuals. Emergency stop switches will be located near the equipment.
- Power monitoring will be provided for the pump station's main electrical distribution equipment. Key electrical data (equipment status, voltage, current, etc.) will be monitored by the SCADA system.

10.2.2 Instrumentation

- Transmitters and transducers will be mounted as close as possible to the measurement point.
- Instrumentation will be readily and safely accessible (no confined space areas) from grade or permanent platforms to facilitate ease of maintenance.
- All instrumentation will be designed for continuous online process monitoring, and it will conform to all codes and requirements set forth by Fairfax County.
- Communications for analog instrumentation will be provided as 4-20 mA signals.
- In general, all instrumentation will be interfaced directly to the PLC. See Figure 10-1 for additional details.

10.2.3 Valves and Gates

- Three full open/full close gates are anticipated in the pump station for isolation of the flow splitter wet wells. Full open/full close–type valves and gates that are remotely controlled by the PLC require limit switches for both the fully opened and fully closed positions.
- Modulating gates are planned for the Difficult Run Interceptor Diversion Structure to control flow diversion to the pump station. Modulating valves or gates that are remotely controlled by the PLC will be added during final design; these valves require limit switches for both the fully opened and fully closed positions. Valve positional feedback (percentage opened) will be provided for remote monitoring.
- Limit switch monitoring for manually controlled valves (field control only) will be handled on a case-by-case basis. Instances requiring limit switch monitoring include the following:
  - Improper position may result in health or safety risk.
  - Improper position may lead to damage to other equipment.

    - Improper position may lead to an operation being out of compliance with operating regulations.
    - Improper position may result in an environmental hazard.

- Limit switches and position-sensing transmitters will be either of the following:
    - Furnished by the manufacturer of the gate as an integral part of the gate assembly
    - Furnished by the manufacturer of the control actuator as an integral part of the actuator assembly

10.2.4 Pumps and Motors

- All sewage pumps will be variable speed driven.
- All variable frequency drives (VFD) must be networked to provide system data to the SCADA system. Networking must be limited to monitoring only. Device control (and essential monitoring) will be accomplished through hardwired signals.
- All motors that are remotely controlled require monitoring of the motor for status indication by the PLC.

10.2.5 Programmable Logic Controller

- As noted, the new pump station will be equipped with a Modicon M340 PLC-based control system to monitor and control the facility.
- The PLC system will be integrated into the County's SCADA system for remote monitoring (and control) by the HMI system.
- All calculations of totals will be performed at the lowest possible level with the value carried up through higher levels. Higher levels will not recalculate totals except for purposes of verification of the original calculation, which will always be treated as the primary total for purposes of reporting.
- All automated control strategies will be executed using the PLC. Under no circumstances will automated control logic or software interlocks be performed by the top-end HMI system.
- Control devices will be connected in such a fashion that fail-safe operation is ensured in the case of a PLC failure.
- Where multiple mechanical components are provided for process redundancy, their field connections to input/output (I/O) modules must be arranged such that the failure of a single I/O module will not disable all mechanical components of the redundant system. This applies to all I/O types.

10.3 Control Hierarchy

A hierarchical redundancy approach is achieved by having layers of control, including SCADA supervisory control and hardwired control at local field devices and panels. The SCADA system will offer both remote manual and automatic supervisory control over all pump station equipment and processes. SCADA supervisory control will consist of selecting an operational mode (automatic or manual), transmitting control mode, and set points to the remote PLC systems at each pump station. In turn, each of these commands will activate preprogrammed control algorithms within the PLC software logic. The final hierarchical control level will be hardwired manual control at the equipment's motor starter, VFD, motor control center (MCC), or local control panel. This layer allows operations staff to control the process without the need for external control equipment.

In general, all new process equipment controlled by a PLC will be provided with a local/off/remote (L/O/R) switch located at the equipment's motor starter, VFD, MCC, or local control panel. The local position will allow an operator to start/stop, open/close, and control the speed of equipment, as applicable for that piece of equipment. In this mode, all hardwired safety devices are in service for personnel safety and the prevention of equipment damage.

The “off” position of the L/O/R switch shuts the equipment down and prevents it from starting.

The “remote” position of the L/O/R switch transfers control to the PLC. The remote position of the switch is monitored by the PLC to determine the equipment's availability for remote operation. In remote mode, the operator will be able to control the pump station from either the PLC or remotely through the SCADA system.

10.4 Control Philosophy

The pump station will be designed for unmanned, automatic operation. Figure 10-1 provides a preliminary piping and instrumentation diagram (P&ID) showing the various equipment components and proposed signals (). Flow entering the pump station will first pass through an influent manhole before entering the grinder vault. The grinder will be provided with a local control panel for operation. Because the grinder will always be running when the pump station is online, the County prefers to operate the grinder locally through the local control panel, as opposed to SCADA; however, the grinder will be monitored by SCADA.

After the grinder vault, flow passes through to the flow splitter box where it can be directed to one of two wet wells. Actuator-controlled, fully closing slide gates will be used to allow flow to enter each wet well. The slide gate controls will be interfaced to the SCADA system to allow for remote manual operation. An interconnecting, actuator-controlled slide gate will be provided to hydraulically link the two wet wells.

Each wet well will be equipped with redundant level instrumentation and float switches for monitoring and control. The continuous level feedback will be used to control the sewage pumps based on operator-enterable level set points. A high-level float switch, wired to the PLC, will be used for alarming purposes, and a high-high level switch will be wired to both the backup control system and to the alarm dialer.

Pumping will be accomplished with four VFD-driven pumps, all wired to the PLC. Each wet well will have a dedicated pair of pumps. Under normal operation where both wet wells are online, automatic operation will follow a lead/lag1/lag 2 scheme. The fourth pump in sequence will serve as a backup to the lead pump. When operating, the pump speeds will modulate to maintain an operator-enterable control level set point. If desired to prevent force main surcharging, a cascade loop consisting of a level controller and a flow controller can be implemented, in addition to the standard wet well level controller. There may be low-flow conditions during the first couple of years of pump station operation that require an alternative pump operation configuration to prevent an excessive number of pump starts. This will be reviewed and evaluated as part of the detailed design phase. If necessary, this alternative pump operation configuration will be further developed during the detailed design phase.

Station discharge flow will be measured via magnetic flow meters on the discharge lines of each pump. The instantaneous flow rate will be monitored by the PLC, and the daily totalized station flow will also be calculated.

All pump station alarms will be monitored by the PLC. An Antx Aquavx Scout alarm dialer will be provided for independent, remote alarm notification.

The aforementioned controls will be achieved by interfacing the PLC with field equipment. In the event of a PLC failure, the backup control system will operate the pump station in a temporary manner until the PLC can be restored. The system will control the pumps based on the high-high level switch. Upon activation of the high-high level switch, the lead pump will run at a predetermined speed configurable at the VFD. The lead pump will continue to run during a timed sequence, initiated on the deactivation of the high-high level switch. Additional pumps will start if the high-high level switch does not deactivate after a predetermined period. Should the backup control system call for operation of a pump while the PLC is still operating, the pump will run at the predetermined speed regardless of commands/controls from the PLC.

At the SCADA supervisory control level, operation of the pump station will be coordinated with other components of the wastewater collection system. Communications will need to be available to the future Tysons East Pump Station (TEPS) and the Difficult Run Interceptor diversion box to limit or prevent flows to the TWPS from these locations should a failure occur at the TWPS.

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Figure No. 10-1
PUMP STATION P&ID
MARCH 2021

Section 11

Probable Construction Cost

11.1 Cost Estimate Basis

The engineer's preliminary Opinion of Probable Construction Cost (OPCC) is summarized in **Table 11-1** and represents an Association for the Advancement of Cost Engineering (AACE) Class 4 cost estimate.

The OPCC was developed using preliminary quantity calculations and equipment supplier quotations based on the design concepts described in this preliminary engineering report. For the purpose of this cost estimate, it was assumed that the selected gravity main alternative would be Alternative 6B and the selected force main alternative would be Alternative 5, which are the recommended routings described in Sections 4 and 5, respectively. The cost estimate does not include the cost of procuring the property.

The following markups are incorporated in the totals shown in **Table 11-1**:

- General conditions (GC) – 10 percent (%)
- Permits, insurance, bonds – 3.65%
- Overhead and profit (OH&P) – 10%
- Contingency – 20%
- Escalation to midpoint of construction (per year) – 3%

The estimated costs shown in **Table 11-1** are escalated to the midpoint of construction to provide a planning-level estimate of actual construction cost bids. Contingency cost is an allowance that reflects the uncertainty associated with a construction cost opinion based on a "predesign" study of the indicated facilities. Contingency costs include items that are recognized as unquantified within the estimate. Since this contingency is based solely on the facilities and improvements listed in **Table 11-1**, it should not be viewed as a potential budget for other facilities and improvements that are not described in this table.

The cost opinion presented herein represents CDM Smith's best engineering judgment, and it assumes that several competitive bids are received; however, actual costs are largely dictated by market conditions at the time of bidding. Accordingly, CDM Smith cannot guarantee that bids and actual construction costs will not vary from the opinion presented herein.

Table 11-1: AACE Class 4 Summary of Opinion of Probable Construction Cost

Line Item	Concept/Screening Level Cost Estimate
Pump station[1]	$18,900,000
Gravity main (36-inch)[2]	$24,100,000
Force main (36-inch)[2]	$33,000,000
TOTAL ESTIMATED COST TO CONSTRUCT	$76,000,000

[1] This line item includes electrical; heating, ventilation, and air conditioning (HVAC); plumbing; automation; odor control; site work; and yard piping estimated costs.
[2] Updated February 2022

The expected accuracy range for an AACE Class 4 cost estimate is between -30% and +50% of the concept/screening level cost estimate. The range in the total estimated cost to construct the pump station, gravity main, and force main is $53,200,000 (on the low end of the cost estimate) to $114,800,000. The difference in the conceptual cost estimate values from the 50% PER submittal can be attributed mostly to the reduction in the force main diameter and length and escalation with the advancement of the project schedule.

CDM Smith would expect a guaranteed maximum price (GMP) from the construction manager at risk (CMAR) to be approximately $114,800,000 at this stage of design. As the design progresses and is refined, and contingencies are reduced, the cost of the project will converge on a more precise figure.

Section 12

Schedule

12.1 Project Schedule

Table 12-1 presents a preliminary project schedule. The table details the anticipated project duration from the preliminary design phase through the construction phase. This schedule will be updated as the design progresses. The schedule makes various assumptions with respect to durations and relationships for activities related to design, permitting, procurement (land acquisitions, guaranteed maximum price [GMP], and approval), construction, startup and testing, and closeout. For the purpose of developing this preliminary project schedule, it was assumed that the land acquisition would be completed during the design phase. The project schedule was developed based on a construction manager at risk (CMAR) delivery method.

Critical factors for meeting the projected GMP approval date for the pump station construction include the following:

- Acquiring the pump station property (anticipated completion by the second quarter of 2021)
- Obtaining the permits identified in the Permitting Plan, including Fairfax County Site Plan approval, and compliance with the County zoning regulations
- Assuming building permits will be approved prior to GMP approval
- Completing the public facilities review process and public outreach

CDM Smith partnered with local public outreach experts and will work closely with Fairfax County to navigate the public facilities' review process and respond to public concerns/questions in a timely fashion. It is recommended that a permitting schedule be reviewed and updated regularly with the project schedule to ensure deliverables dates are met and permit applications are submitted on time.

The construction phase of the pump station facilities, gravity main, and force main are expected to last approximately 25 months. Actual start and finish dates for construction are dependent on the durations of final design (~2-year duration assumed) and GMP review and approval (1-month duration assumed). These have been conservatively estimated at this stage. The critical path for the project is projected to go through design, permit approval, GMP approval, and construction of the gravity main and force main.

CDM Smith recommends the project team (County, Contractor, and CDM Smith) collaborate on this schedule to refine durations, determine any additional key milestones, and ensure the schedule logic is appropriate for a CMAR project delivery model.

Table 12-1: Preliminary Project Schedule

Schedule Item	Estimated Start Date	Estimated End Date	Estimated Duration
Notice to proceed design phase	May 2021	May 2021	N/A
Design of gravity main, force main, and pump station	May 2021	February 2023	22 Months
35% Design deliverable	May 2021	March 2022	11 Months
70% Design deliverable	May 2022	September2022	5 Months
95% Design deliverable	September 2022	December 2022	4 Months
100% Design deliverable	December 2022	February 2023	3 Months
Construction of gravity main, force main, and pump station	December 2023[1]	January 2026	25 Months

N/A = not applicable

[1] This start date accounts for several permitting activities that are prerequisites for the start of construction.

Appendix A

Tysons West Gravity Routing

CDM Smith

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Section 1

Gravity Sewer Routing Analysis

1.1 Introduction

Based on the recommendations of Tysons Corner Sanitary Sewer Master Plan (January 2020), the new Tysons West Pump Station must collect flow from the local collection system, the Difficult Run Interceptor, and the future Tysons East Pump Station. The estimated flows to the pump station are 10 MGD from the Difficult Run Interceptor, 10 MGD from future Tysons East Pump Station (assumed constant flow), and 5 MGD from the local Tysons West sanitary sewer service area. This results in a total design capacity of 25 MGD peak flow for the Tysons West pump station.

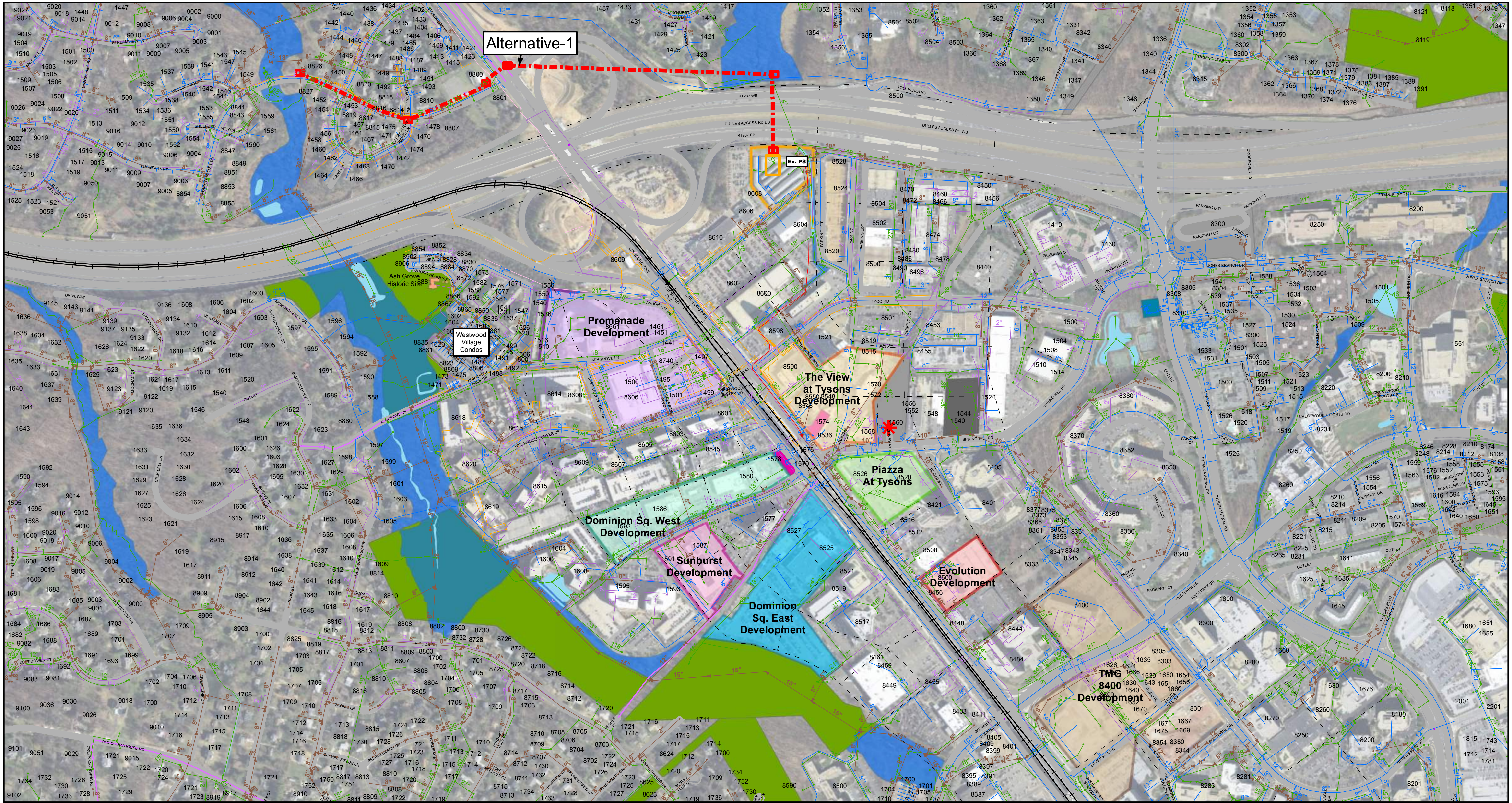
Tying in a new gravity sewer line to the Difficult Run Interceptor is one of the key elements of this project. The new gravity sewer line will be conveying approximately 10 MGD from the Difficult Run Interceptor to the new Tysons West pump station. This section of the PER focuses on evaluation of the potential routing alternatives and recommendations for the alignment of the new gravity sewer. This section is developed based on the GIS imagery, desktop study, and best available record data at the time that this document was prepared and does not include any site topographic survey or environmental studies.

1.2 Gravity Sewer Alignment Alternatives

Six preliminary gravity routing alignments were considered for connecting Difficult Run Interceptor and the new pump station. The potential gravity routing alternatives were selected by starting at the Difficult Run interceptor alignment and choosing logical routes along existing roadways to the Tysons West pump station site. The first four alternatives (Alternatives 1 through 4) will connect the Difficult Run Interceptor to the new pump station, however, the last two alternatives (Alternative 5 and 6) will serve as a gravity trunk sewer collecting the flow from new developments along Leesburg Pike as well as the gravity connection to the Difficult Run Interceptor. A description of the alternatives and the existing conditions along the routes are provided in the following sections followed by the recommended alignment.

1.2.1 Route Alternative-1

Alternative-1 alignment will begin at a connection point to the segment of Difficult Run Interceptor crossing Jarrett Valley Road between Wellingham Court and Carrington Ridge Lane. The new gravity sewer then proceeds east along Jarrett Valley Drive for approximately 1,450 Linear Feet (LF) passing through a short residential neighborhood, Carrington, and crossing the intersection of Jarret Valley Drive and Leesburg Pike by open cut construction. From the east side of intersection, the alignment follows the path along the westbound ramp coming from Dulles Access Toll Road (Rt-267) toward Leesburg Pike for approximately 250 LF and crosses under a walkway tunnel and the ramp behind a residential neighborhood in Mayhurst Boulevard. The alignment continues in an easterly direction for another 1,150 LF along the south edge of the residential neighborhood before going to a forested area for about 350 LF. The gravity line continues by crossing Rt-267, which is anticipated to require a tunneling installation. The length of tunneling would be approximately 500 LF. The ultimate connection point for the gravity line would be the Tysons West Pump Station site located south of Rt-267 at 8608 Leesburg Pike. The insertion pit for the tunneling would be located at the pump station site, and the receiving pit would be located south of the Mayhurst Boulevard residential neighborhood. The total length of Alternative-1 is approximately 3,884 ft. The route for Alternative-1 is shown in Figure-1.



Legend

Fire Stations
Hospitals
Police Stations
Schools
Existing Sanitary Sewer Pump Station
FCDOT Capital Projects
Sanitary Sewer Manholes
Stormwater Manholes

Force Main
Gravity Sewer
Stormwater
Water Service Lines
Underground Dominion Energy Power
Overhead Dominion Energy Power
FCDOT Capital Projects
Railroads
Cox Cable
Roads
Concept Roads
Water Features
Floodplain Delineations

Historic Sites
USA Owned Property
Town Owned Property
WMATA Owned Property
FCWA Owned Property
FCPA Owned Property
Northern Virginia Regional Park Authority Owned Property
County Owned Property
Buildings
Parcels

Proposed Tysons West PS Location
Alternative 1 ~ 3884 LF

0 345 690 1,380 Feet

Figure-1

Tysons West Gravity Sewer Alternative -1

CDM Smith

1.2.1.1 Summary of Potential Physical Constraints for Alternative-1

The entire length of alignment for Alternative-1 must be constructed using a microtunneling method considering depth of the new gravity sewer. Along the Jarrett Valley Drive, the alignment will be parallel to Dominion Energy's primary underground electric distribution line for about 1,400 LF. The alignment portion traveling along Jarrett Valley Drive will be near single family homes and a Chapel, which will negatively impact accessibility for residents and Chapel visitors during construction. A total of three microtunneling pits will be located along Jarret Valley Drive as shown in Figure-1. The third microtunneling pit will be a launching pit located west of Leesburg Pike in the parking lot of McLean Islamic Center (MIC).

The fourth microtunneling pit will be a receiving pit which will be constructed in a triangle shaped open green space adjacent to the ramp from 267 to Leesburg Pike which is one of the main exits to neighborhoods surrounding Leesburg Pike. The fifth microtunneling pit will be located on the north side of Rt-267, and the last pit will be constructed south of Rt-267 at the new pump station site.

Pictures 1 to 5 shows some critical locations of routing for Alternative-1:

Picture-1: Residential area along Jarrett Valley Drive

Picture-2: Intersection of Leesburg Pike and Jarret Valley Drive looking northwest

Picture-3: Approximate location of microtunneling pit adjacent to Rt-267 ramp

Picture-4: Approximate location of fifth microtunneling pit - Forested area south of Mayhurst Blvd residential area

Picture-5: Approximate location of fifth microtunneling pit - Acoustic walls along Rt-267 WB/south of Mayhurst Blvd residential area

1.2.1.2 Topography for Alternative-1

It is assumed that the new gravity sewer will be 30-inch in diameter based on the recommendations presented in the Tysons Corner Sanitary Sewer Master Plan (January 2020). Preliminary evaluation of the Alternative-1 new gravity sewer shows that the invert elevation of the new gravity sewer line at Difficult Run Interceptor tie-in location will be approximately at 319.0 ft. Assuming that the entire length of alignment will be built per VA SCAT minimum required slope of 0.058 feet per 100 feet, and there will be one manhole (with a 0.2 feet drop) for every 500 feet of the pipe, the invert of the new gravity sewer pipe at the new Tysons West Pump Station will be approximately at 315.0 ft (45 feet below grade).

It should be noted that CDM Smith utilized the available data from as-built drawings dated May 10, 1995 for this evaluation, and there is a note on the drawing stating "realignment see: 7392". It is also notable that the alignment of Difficult Run Interceptor located north of Rt-267, doesn't match the alignment shown on GIS drawings received from the County. CDM Smith will revisit the topography evaluation for Alternative-1 as necessary if any more recent set of as-built drawings received after submission of the 50% PER.

Figure-2 presents the approximate grade elevation for Alternative-1 route starting from Difficult Run Interceptor tie-in location shown on the left end of the figure and the Pump Station connection point on the right end of the figure.

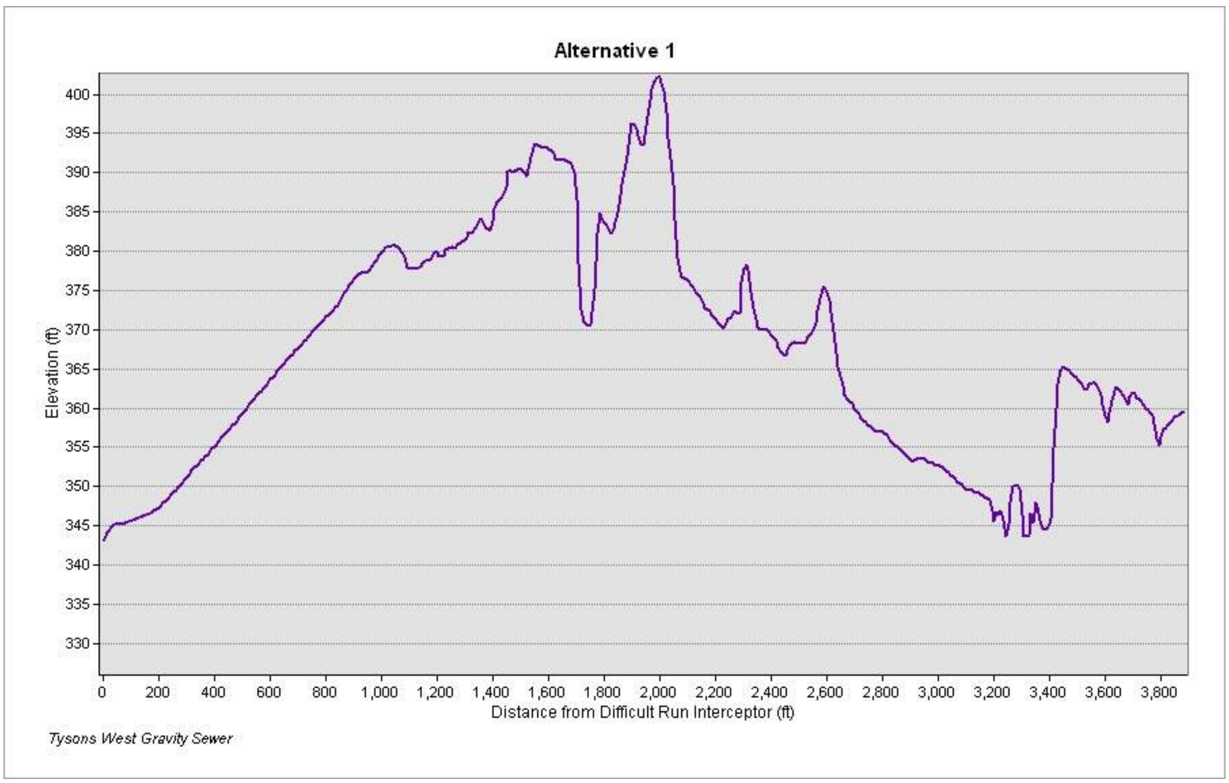


Figure-2: Grade elevation for Alternative-1 route

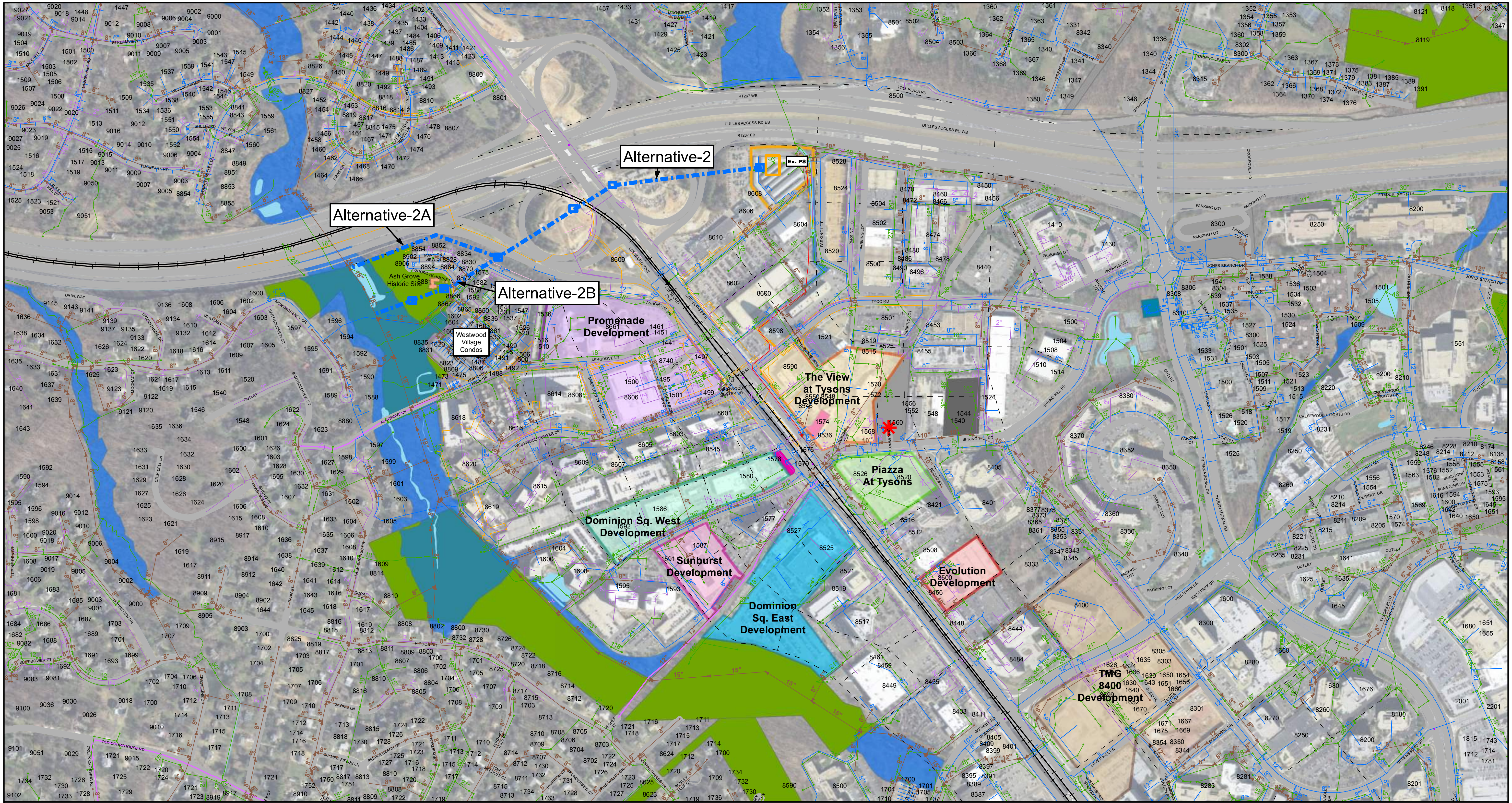
1.2.2 Route Alternative-2

For Alternative-2A alignment will begin at a segment of Difficult Run Interceptor which is located along Difficult Run Old Courthouse Spring Branch at a connection point south of Rt-267

Eastbound. The route will then continue for approximately 800 feet along Rt-267 Eastbound. The first microtunneling pit will be located north of Northern Neck Drive in a forested area adjacent to Westwood Village Condominium residential community. From there, it crosses under three road ramps, two going from Rt-267 Eastbound to Leesburg Pike (one is an elevated ramp), and one from Leesburg Pike to Rt-267 Eastbound. The second pit will be located inside the interchange loop ramps before elevated metro railroad and Leesburg Pike crossing. The third microtunneling pit will be located inside the interchange loop ramps open space area east of Leesburg Pike and the last pit will be at the new pump station site.

For Alternative-2B alignment will begin at a segment of Difficult Run Interceptor which is located along Difficult Run Old Courthouse Spring Branch at a connection point approximately 420 LF south of Rt-267 Eastbound. The route will continue for approximately 200 LF before arriving at the first microtunneling pit which will be located at the Fairfax County Park Authority's property (Ash Grove). The alignment will continue under Ash Grove property for approximately 450 LF. The second microtunneling pit will be located at the eastern side of Ash Grove property. The alignment then continues under Northern Neck Drive in Westwood Village Condominium residential community for approximately 350 LF before reaching the third pit microtunneling pit which will be located north of Northern Neck Drive in a forested area. From there, the alignment routing is similar to Alternative-2A until reaching the ultimate connection point at the new pump station site.

The route for Alternative-2 variations is shown in Figure-3.



Legend

- Fire Stations
- Hospitals
- Police Stations
- Schools
- Existing Sanitary Sewer Pump Station
- FCDOT Capital Projects
- Sanitary Sewer Manholes
- Stormwater Manholes
- Force Main
- Gravity Sewer
- Stormwater
- Water Service Lines
- Underground Dominion Energy Power
- Overhead Dominion Energy Power
- FCDOT Capital Projects
- Railroads
- Cox Cable
- Roads
- Concept Roads
- Water Features
- Floodplain Delineations
- Historic Sites
- USA Owned Property
- Town Owned Property
- WMATA Owned Property
- FCWA Owned Property
- FCPA Owned Property
- Northern Virginia Regional Park Authority Owned Property
- County Owned Property
- Buildings
- Parcels
- Proposed Tysons West PS Location
- Alternative 2A ~ 2802 LF
- Alternative 2B ~ 1055 LF

0 345 690 1,380 Feet

Figure-3

Tysons West Gravity Sewer Alternative -2

1.2.2.1 Summary of Potential Physical Constraints for Alternative-2

At the end of the northeastern side of Northern Neck Drive parking lot, there is a Dominion Energy's transformer as well as overhead power lines; therefore, the alignment most likely requires an easement from Westwood Village private property in this area. The permitting for this alternative could be challenging due to multiple crossing under the ramps. Pictures 6 to 10 below shows the critical locations of routing for Alternative-2:

Picture-6: Approximate location of ramp trenchless crossing (west of elevated ramp)

Picture-7: Approximate location of ramp trenchless crossing (east of elevated ramp)

Picture-8: Approximate location of ramp trenchless crossings for eastern portion of pipeline

Picture-9: Approximate location of the trenchless installation pit west of Leesburg Pike

Picture-10: Approximate location of the trenchless installation pit east of Leesburg Pike

1.2.2.2 Topography for Alternative-2

It is assumed that the new gravity sewer will be 30-inch in diameter based on the recommendations presented in the Tysons Corner Sanitary Sewer Master Plan (January 2020). Preliminary evaluation of the Alternative-2 new gravity sewer shows that the invert elevation of the new gravity sewer line at Difficult Run Interceptor tie-in location will be approximately at 3XX ft for Alternative-2A and 333.0 ft for Alternative-2B. Assuming that the entire length of alignment will be built per VA SCAT minimum required slope of 0.058 feet per 100 feet, and there will be one manhole (with a 0.2 feet drop) for every 500 feet of the pipe, the invert of the new gravity sewer pipe at the new Tysons West Pump Station will be approximately at 330.0 ft (approximately 30 feet below grade).

Figure-4 and Figure-5 presents the approximate grade elevation for Alternative-2A and Alternative-2B routings starting from Difficult Run Interceptor tie-in location shown on the left end of the figures and the Pump Station connection point on the right end of the figures.

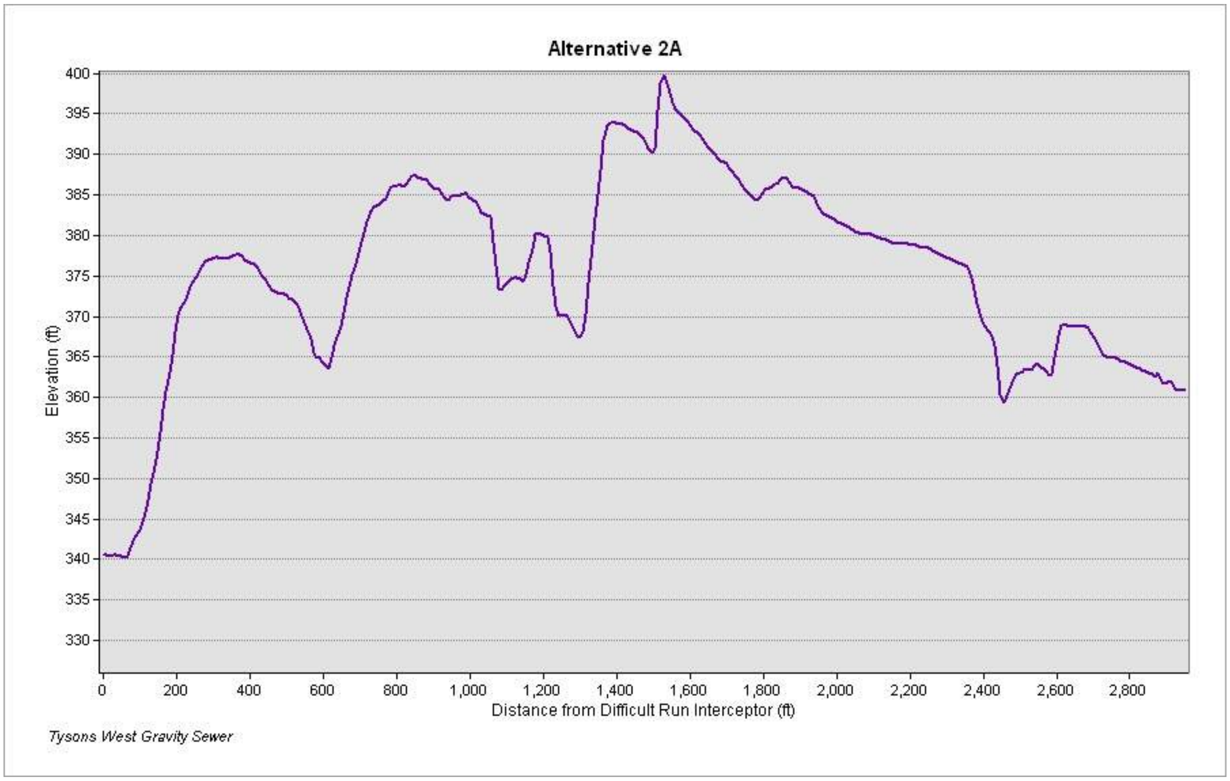


Figure-4: Grade elevation for Alternative-2A route

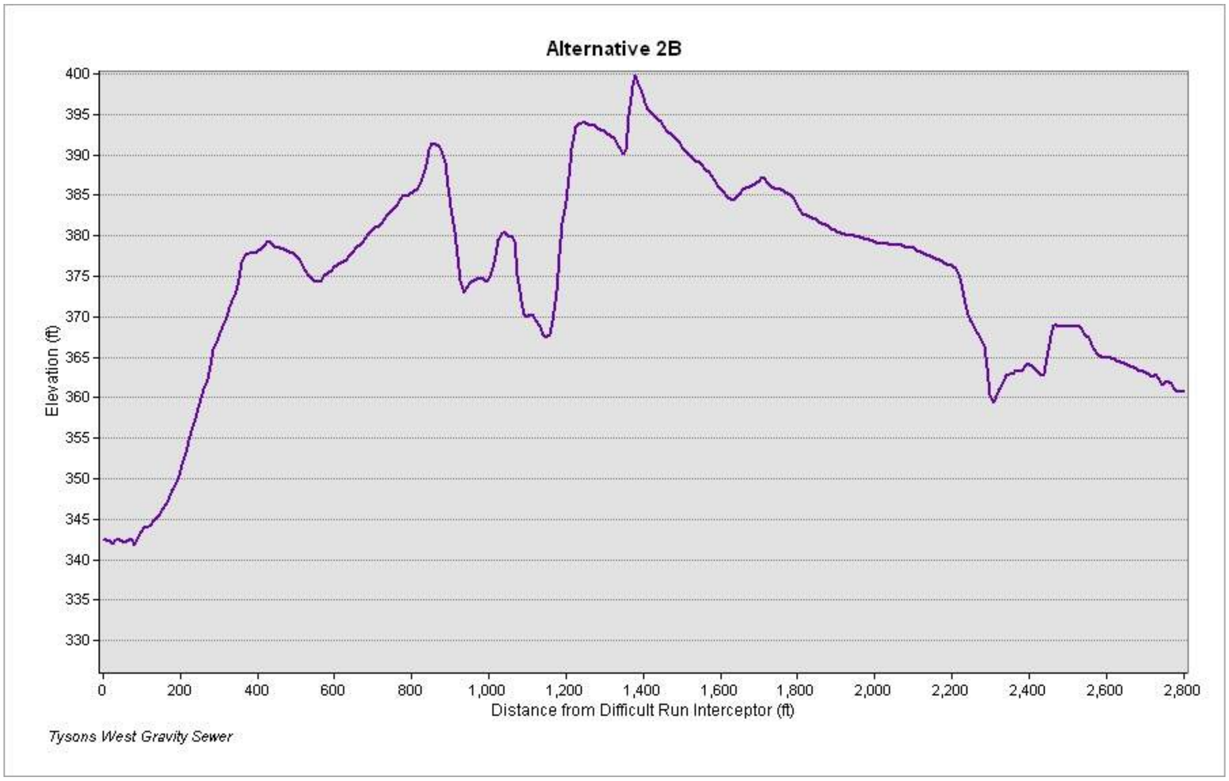


Figure-5: Grade elevation for Alternative-2B route

1.2.3 Route Alternative-3

Similar to Alternative-1 and Alternative-2, almost the entire length of Alternative-3 will be constructed using a microtunneling method. Similar to Alternative-2B, Alternative-3 will begin at the segment of Difficult Run Interceptor which is located along Difficult Run Old Courthouse Spring Branch at a connection point approximately 420 LF south of Rt-267. The first 100 LF of the alignment will be open cut construction before arriving at the first microtunneling pit which will be located at the Fairfax County Park Authority's property (Ash Grove). The route will then cross under approximately 450 feet of Ash Grove property, before entering the second pit located at the eastern end of Ash Grove property adjacent to Westwood Village Condominium residential community. Once in Westwood Village property, the pipe travels under Northern Neck Drive for approximately 300 LF before reaching the third pit which will be located at north of Northern Neck Drive in a forested area. The alternative will turn southeast following the Northern Neck Drive for 450 LF followed by 750 LF adjacent to the Sheraton Tysons property which most likely will require obtaining an easement from Sheraton. The alignment will continue by crossing under Leesburg Pike with fourth and fifth pit being on the two opposite sides of Leesburg Pike. From there, it continues along Industrial Way for approximately 900 LF before reaching the sixth pit which will be located adjacent to the new pump station property. The alignment then travels northwest into the 8608 Leesburg Pike property for approximately 200 LF to reach the ultimate connection point at the Tysons West Pump Station site. The total length of Alternative-3 is approximately 3,221 ft. The route for Alternative-3 is shown in Figure-6.

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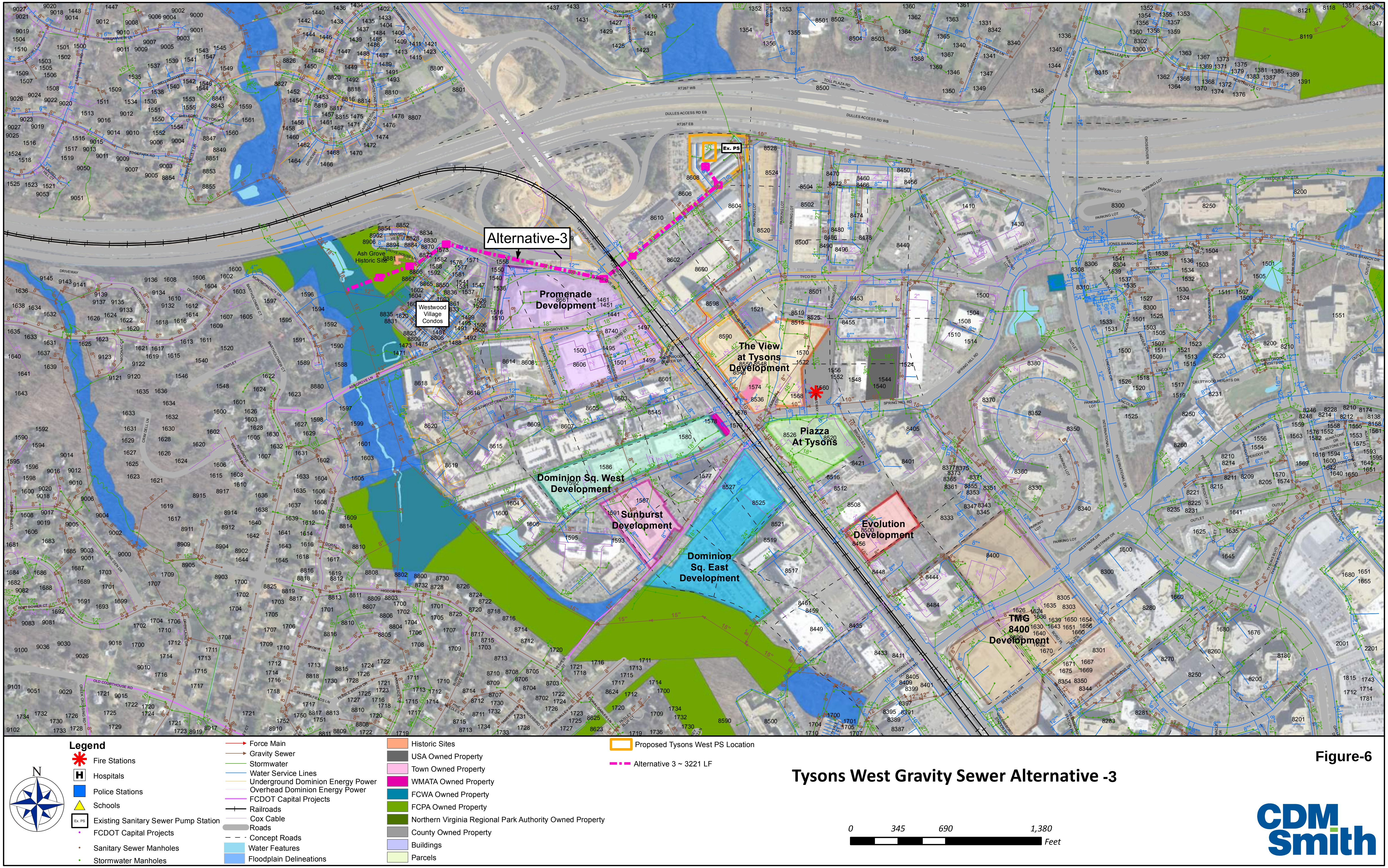


Figure-6

Tysons West Gravity Sewer Alternative -3

CDM Smith

1.2.3.1 Summary of Potential Physical Constraints for Alternative-3

Similar to Alternative-2, at the end of the northeastern side of Northern Neck Drive parking lot, there is a Dominion Energy's transformer as well as overhead power lines; therefore, the new gravity sewer most likely should be located in acquired easements inside Westwood Village private property in this area. The portion of alignment located on the north of Westwood Village Condominiums and Sheraton Tysons properties, runs parallel to a Dominion overhead powerline for approximately 1,200 LF. This portion of pipeline would require acquiring an easement from Sheraton, Westwood Village Condominiums, and most likely a shared easement with Dominion Power in some areas.

This alternative could potentially have minimum traffic impacts on Leesburg Pike and Rt-267 due to trenchless installations, however, the impact on Sheraton property could be extensive. Construction of the pit located on the northern side of Sheraton property may require closure of Ashgrove Lane on the northern and eastern side of Sheraton property. This could lead to some operational and/or parking traffic disruptions for Sheraton. Construction of trenchless installation pit on the east side of Leesburg Pike will require negotiating a large construction easement with business owners in that area which could adversely impact their operations (specifically Koons Tysons Toyota dealership and Collision Repair Center). Pictures 11 to 14 below shows some of the critical locations of routing for Alternative-3:

Picture-11: Approximate location of trenchless crossing under Leesburg Pike

Picture-12: View of Ashgrove Lane at Northeast corner of Sheratons Tysons

Picture-13: Approximate location of trenchless installation pit west of Leesburg Pike

Picture-14: Approximate location of trenchless installation pit east of Leesburg Pike

1.2.3.2 Topography for Alternative-3

It is assumed that the new gravity sewer will be 30-inch in diameter based on the recommendations presented in the Tysons Corner Sanitary Sewer Master Plan (January 2020). Preliminary evaluation of the Alternative-3 new gravity sewer shows that the invert elevation of the new gravity sewer line at Difficult Run Interceptor tie-in location will be approximately at 333.0 ft. Assuming that the entire length of alignment will be built per VA SCAT minimum required slope of 0.058 feet per 100 feet, and there will be one manhole (with a 0.2 feet drop) for every 500 feet of the pipe, the invert of the new gravity sewer pipe at the new Tysons West Pump Station will be approximately at 329.0 ft (approximately 31 feet below grade).

Figure-7 presents the approximate grade elevation for Alternative-3 route starting from Difficult Run Interceptor tie-in location shown on the left end of the figure and the Pump Station connection point on the right end of the figure.

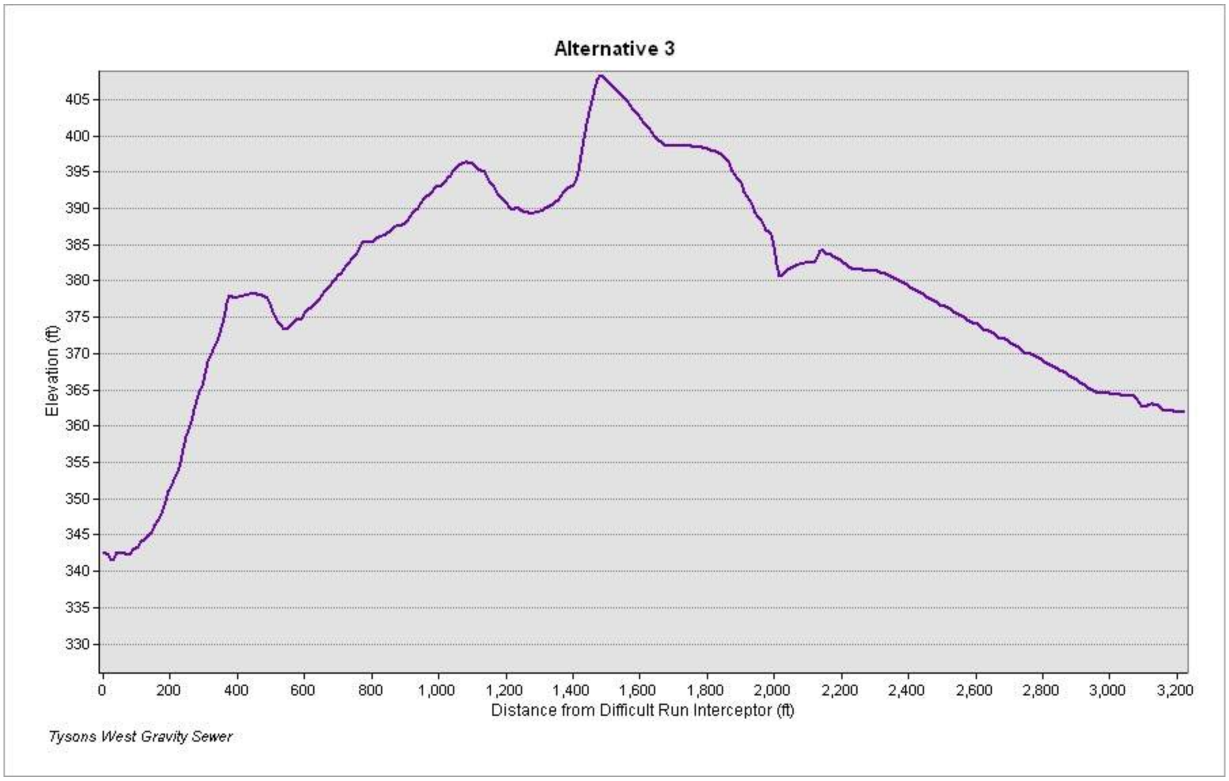


Figure-7: Grade elevation for Alternative-3 route

1.2.4 Route Alternative-4

Similar to Alternative-1, 2 and 3, almost the entire length of Alternative-4 will be constructed using a microtunneling method. Alternative-4 alignment will begin from the same Difficult Run Interceptor location as proposed in Alternative-2B and 3 alignments, followed by crossing under Fairfax County Park Authority property (Ash Grove). Starting from second microtunneling pit at eastern side of the Ash Grove property adjacent to Ashgrove House Lane, the alignment will turn southeast and passes through middle of Westwood Village residential area along Ashgrove Lane for approximately 700 LF before arriving at third microtunneling pit. The third pit will be located in Ashgrove Lane across 8614 Ashgrove Lane property. The alignment will continue by passing through a primary commercial area south of Sheraton Tysons for approximately 1,100 LF before arriving at fourth pit which will be located at the intersection of Ashgrove Lane and Leesburg Pike. This alternative will cross under Leesburg Pike in the same location as Alternative 3. The route will then follow Industrial Way and enter the new pump station in the same way as Route Alternative 3. The total length of Alternative-4 is approximately 3,800 ft. The route for Alternative-4 is shown in Figure-8.

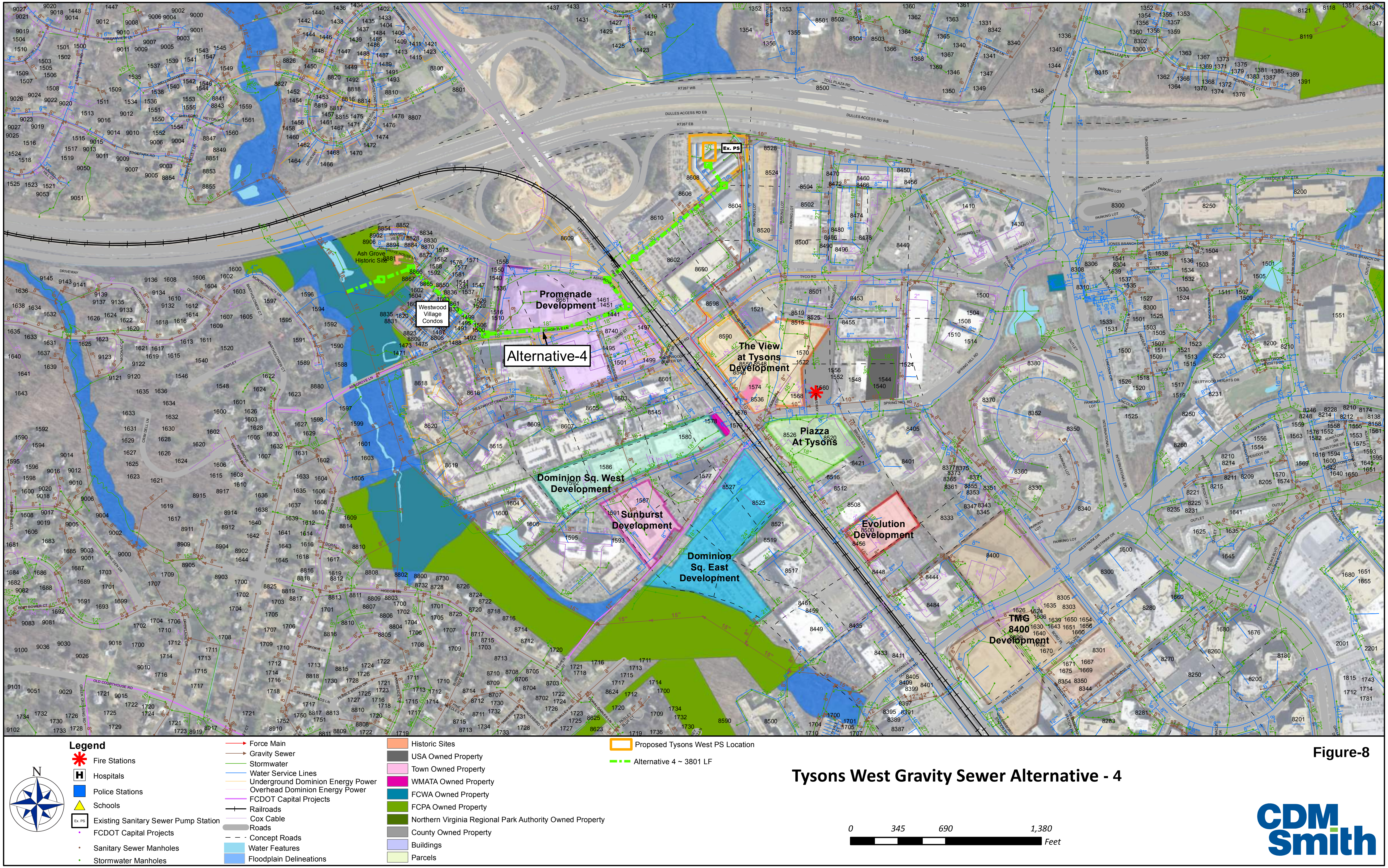


Figure-8

Tysons West Gravity Sewer Alternative - 4

1.2.4.1 Summary of Potential Physical Constraints for Alternative-4

A big portion of Alternative-4 alignment will be in acquired easements within Westwood Village private property. This alternative will have minimum traffic impacts on Leesburg Pike and Rt-267 due to trenchless installations, however, it will have some impact on Sheraton property and Westwood Village Residential Community due to location of the microtunneling pits. Trenchless crossing installation under Leesburg Pike may require a temporary closure of a section of Ashgrove Lane located on the eastern and northern side of Sheraton property due to location of the pit. This could lead to some operational and/or parking traffic disruptions for Sheraton. Construction of trenchless installation pit on the east side of Leesburg Pike will require negotiating a large construction easement with business owners in that area which could adversely impact their operations (specifically Koons Tysons Toyota dealership and Collision Repair Center). Pictures 15 and 16 below shows some of the critical locations of routing for Alternative-3:

Picture-15: Commercial areas located along Ashgrove Lane (south of Sheraton) looking east

Picture-16: Westwood Village Condominium Residential Community entrance on Ashgrove Lane

CDM Smith

1.2.4.2 Topography for Alternative-4

It is assumed that the new gravity sewer will be 30-inch in diameter based on the recommendations presented in the Tysons Corner Sanitary Sewer Master Plan (January 2020). Preliminary evaluation of the Alternative-4 new gravity sewer shows that the invert elevation of the new gravity sewer line at Difficult Run Interceptor tie-in location will be approximately at 333.0 ft. Assuming that the entire length of alignment will be built per VA SCAT minimum required slope of 0.058 feet per 100 feet, and there will be one manhole (with a 0.2 feet drop) for every 500 feet of the pipe, the invert of the new gravity sewer pipe at the new Tysons West Pump Station will be approximately at 329.0 ft (approximately 31 feet below grade). Figure-9 presents the approximate grade elevation for Alternative-4 route starting from Difficult Run Interceptor tie-in location shown on the left end of the figure and the Pump Station connection point on the right end of the figure.

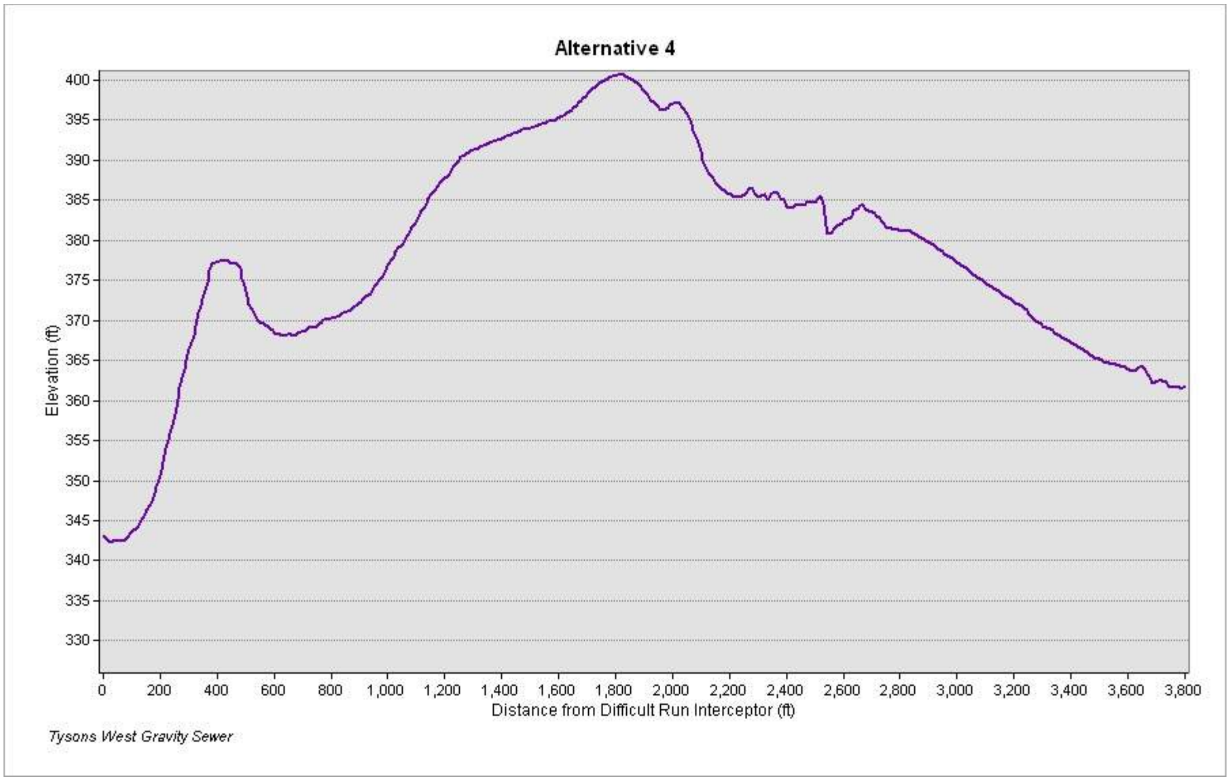


Figure-9: Grade elevation for Alternative-4 route

1.2.5 Route Alternative-5

Alternative 5 alignment consists of three segments designated as Upstream Segment A, Upstream Segment B and downstream segment as described below. The entire length of Alternative-5 except trenchless crossing of Leesburg Pike will be constructed by open cut construction.

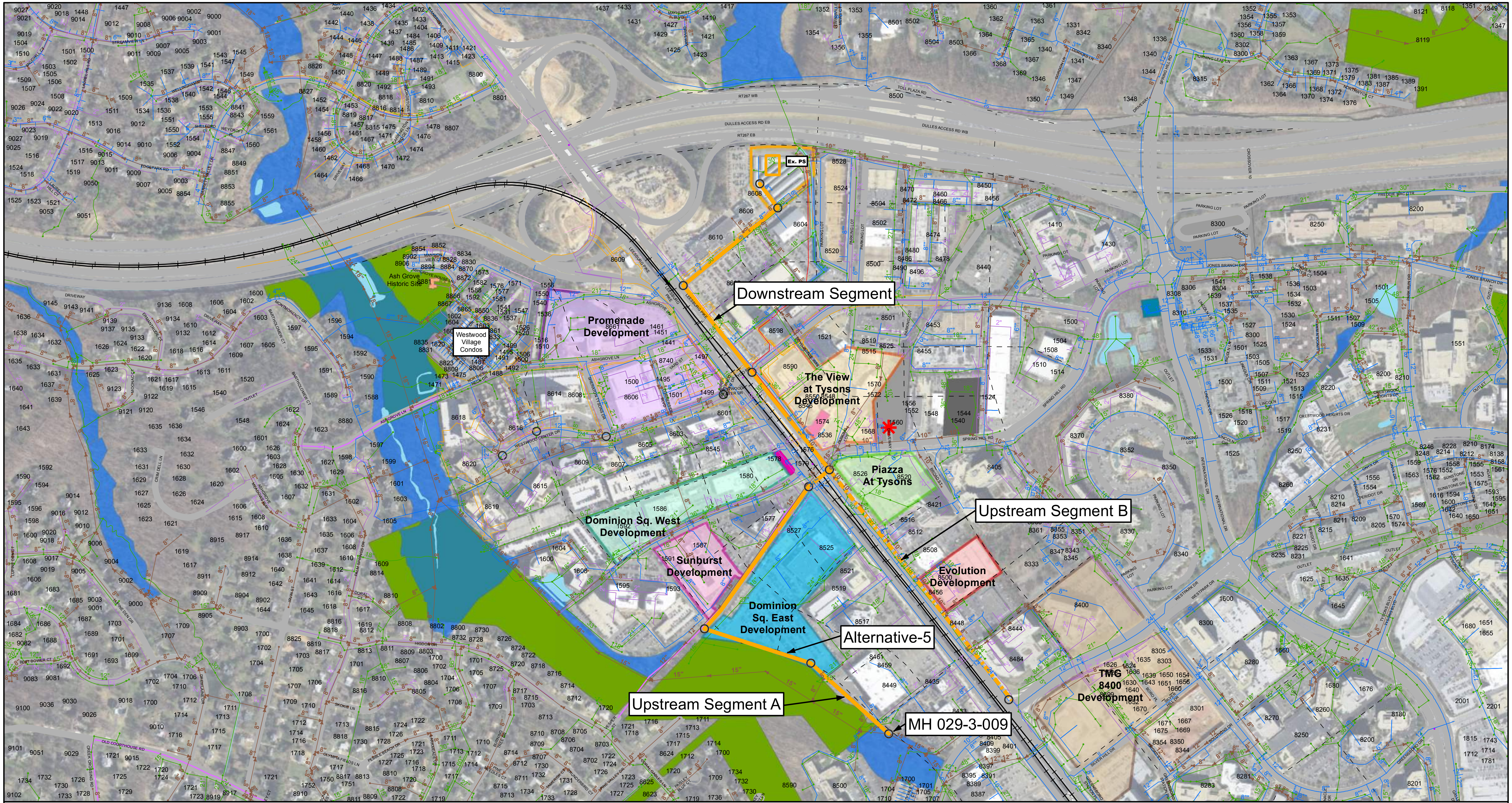
Upstream Segment A: This segment of Alternative-5 starts at MH 029-3-009 on the Difficult Run Interceptor and continues toward northwest along the western edge of properties 8433, 8449, 8459 and 8525 for approximately 1,450 LF. The alignment then continues along Vesper Trail toward northeast for approximately 1,000 LF until it reaches the intersection of Spring Hill Road and Leesburg Pike. The alignment continues by crossing under Leesburg Pike, which is anticipated to require trenchless installation. The length of trenchless crossing is approximately 250 LF.

Upstream Segment A collects the flow from Difficult Run Interceptor and three new developments including Dominion Square East, Sunburst, and eastern Dominion Square West.

Upstream Segment B: This upstream segment starts at intersection of Leesburg Pike and Westpark Drive and continues along Leesburg Pike for approximately 2,100 LF until it reaches the intersection of Leesburg Pike and Spring Hill Road. This segment collects the flow from the Evolution and Piazza at Tysons developments before merging with the Upstream Segment A segment coming from West. This segment could potentially be extended as far as West Park Drive if needed.

Downstream Segment: The downstream segment of the trunk sewer line collects the flow from Upstream Segment A and Upstream Segment B. The line continues toward northwest along Leesburg Pike for approximately 1,400 LF. The trunk sewer line then turns toward northeast and continue along Industrial Way for approximately 1,000 LF until it reaches the Tysons West Pump Station.

The total length of Alternative-5 is approximately 7,300 LF. The route for Alternative-5 is shown in Figure-10.



Legend

- Fire Stations
- Hospitals
- Police Stations
- Schools
- Existing Sanitary Sewer Pump Station
- FCDOT Capital Projects
- Sanitary Sewer Manholes
- Stormwater Manholes
- Force Main
- Gravity Sewer
- Stormwater
- Water Service Lines
- Underground Dominion Energy Power
- Overhead Dominion Energy Power
- FCDOT Capital Projects
- Railroads
- Cox Cable
- Roads
- Concept Roads
- Water Features
- Floodplain Delineations
- Historic Sites
- USA Owned Property
- Town Owned Property
- WMATA Owned Property
- FCWA Owned Property
- FCPA Owned Property
- Northern Virginia Regional Park Authority Owned Property
- County Owned Property
- Buildings
- Parcels
- Proposed Tysons West PS Location
- Proposed Manhole
- Alternative 5 ~ 7325 LF

Figure-10

Tysons West Gravity Sewer Alternative - 5

0 345 690 1,380 Feet

CDM Smith

1.2.5.1 Summary of Potential Physical Constraints for Alternative-5

A big portion of Alternative-5 Upstream Segment A will be in acquired easements from private properties. This alternative will have an extensive impact on Vesper trail. This alternative could potentially have large traffic impacts on Leesburg Pike due to open cut crossings at intersections and commercial building entrances, however, a trenchless method could be utilized to construct the downstream segment of Alternative-5 to minimize traffic disruptions along Leesburg Pike. Additionally, open cut construction in the Industrial Way area could adversely impact the operations of the businesses (specifically Koons Tysons Toyota dealership and Collision Repair Center). Pictures 17 and 18 below shows some of the critical locations of routing for Alternative-5.

Picture-17: Approximate location of trenchless installation pit west of Leesburg Pike

Picture-18: View of Vesper Trail Looking Northeast

1.2.5.2 Topography for Alternative-5

It is assumed that the new gravity sewer will be 30-inch in diameter based on the recommendations presented in the Tysons Corner Sanitary Sewer Master Plan (January 2020). Preliminary evaluation of the Alternative-5 new gravity sewer shows that the invert elevation of the new gravity sewer line at Difficult Run Interceptor tie-in location will be approximately at

385.0 ft. Assuming that the entire length of alignment will be built per VA SCAT minimum required slope of 0.058 feet per 100 feet, the invert of the new gravity sewer pipe at the new Tysons West Pump Station will be approximately at 352.0 ft (approximately 11 feet below grade). Figure-11 presents the approximate grade elevation for Alternative-5 Upstream Segment A and downstream segment starting from Difficult Run Interceptor tie-in location shown on the left end of the figure and the Pump Station connection point on the right end of the figure.

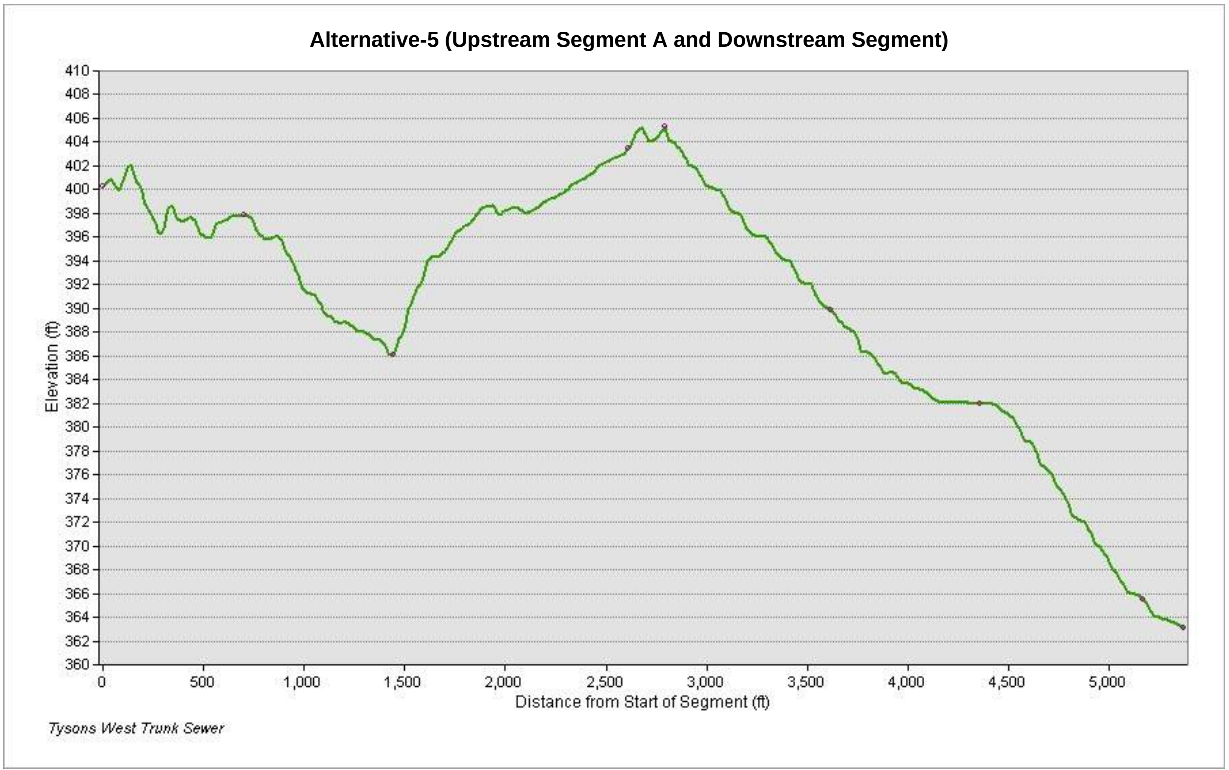


Figure-11: Grade elevation for Alternative-5 route

1.2.6 Route Alternative-6

Alternative-6 is similar to Alternative-5 with addition of one branch which will be constructed along the Westwood Center Drive in order to collect the flow from Promenade development and existing properties along Westwood Center Drive. Two variations of Alternative-6 were developed and investigated to examine the extent of existing properties that can be served by each of the two variations A and B.

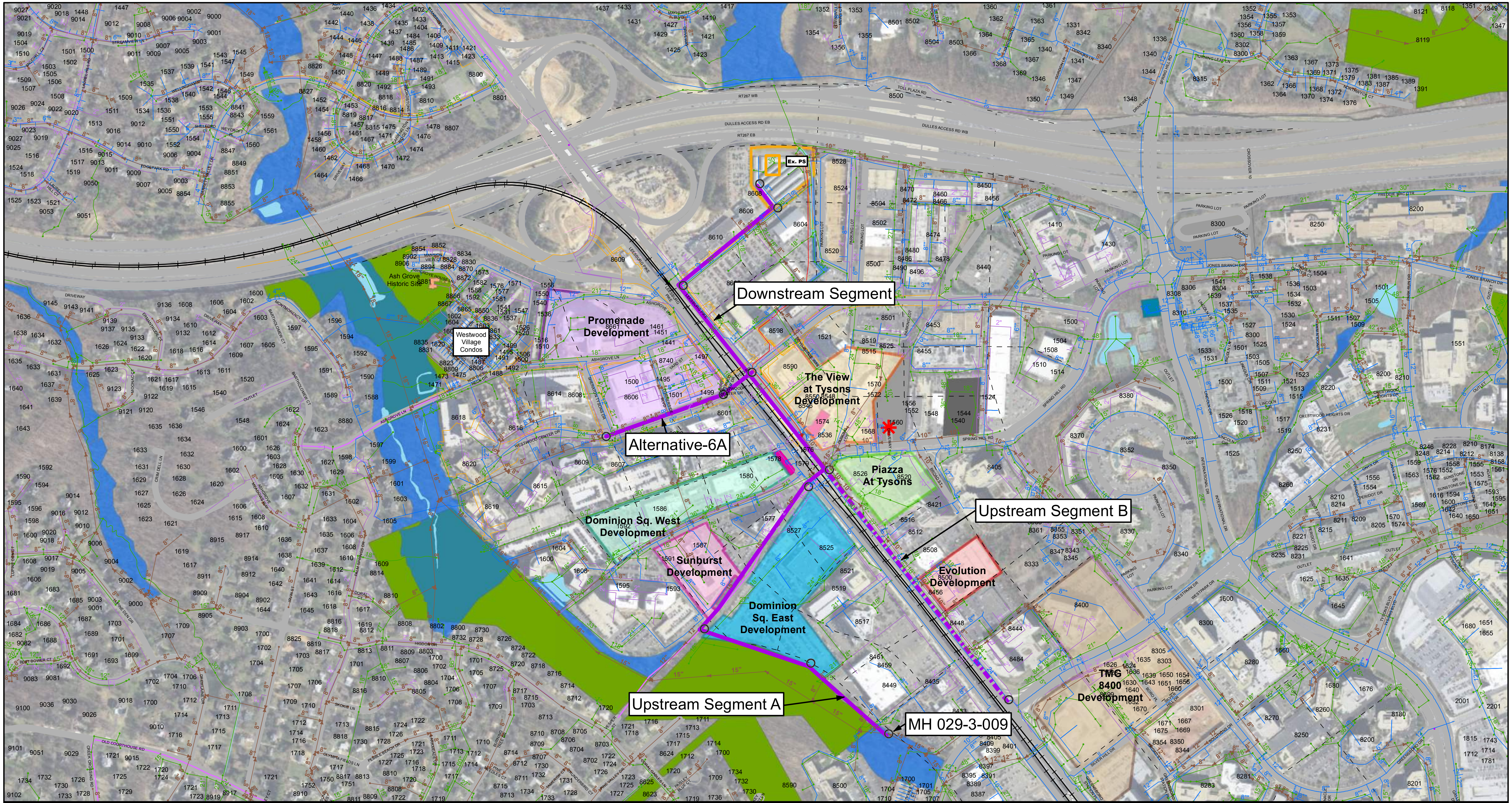
Alternative-6A: Alternative-6A was developed based on the assumption that the upstream and downstream portions of the alignment will be constructed with minimum slope and minimum grade cover requirements to the extent possible. The goal was to minimize the cost of construction and avoid any deep manholes. The flow and depth calculations for the Westwood Center Drive segment showed that it can serve Promenade development and existing properties 8601, 8603, 8605, and 8607.

The total length of Alternative-6A is approximately 8,400 LF. The route for Alternative-6A is shown in Figure-12.

Alternative-6B: Alternative-6B was developed based on the assumption that the upstream and downstream segments can be lowered to a point which none of the manholes will be deeper than 40 feet. The flow and depth calculations for the Westwood Center Drive branch showed that the branch can serve Promenade development and existing properties 8601, 8603, 8605, and all the properties along Westwood Center Drive except 8620 and 8619.

upstream and downstream portions of the alignment will be constructed with minimum slope and minimum grade cover requirements to the extent possible in order to minimize the cost of construction and avoiding any deep manholes. The calculations for the Westwood Center Drive branch showed that the branch can serve Promenade development and existing properties 8601, 8603, 8605, and 8607.

The total length of Alternative-6B is approximately 9,200 LF. The route for Alternative-6B is shown in Figure-13.



Legend

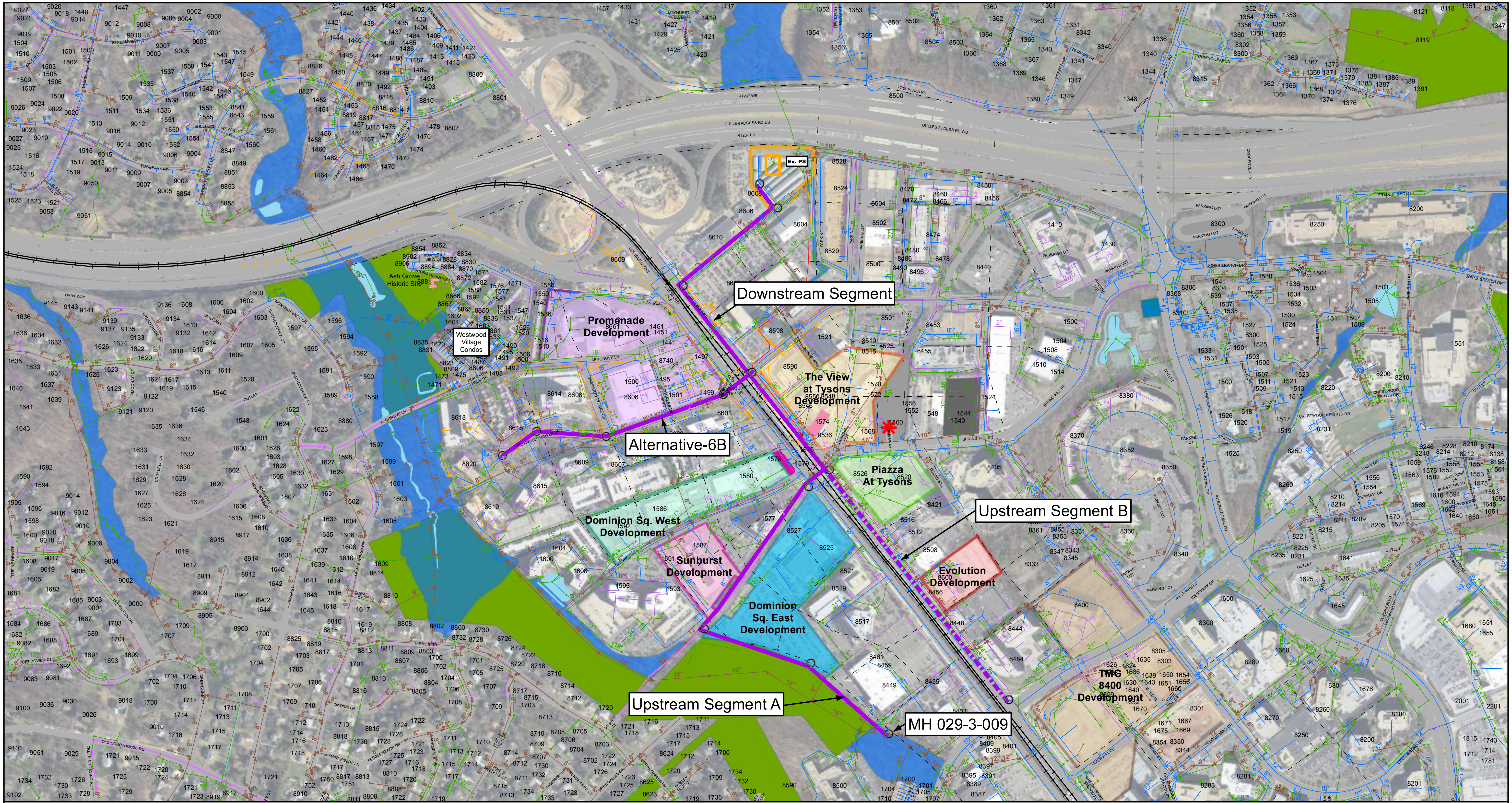
Fire Stations
Hospitals
Police Stations
Schools
Existing Sanitary Sewer Pump Station
FCDOT Capital Projects
Sanitary Sewer Manholes
Stormwater Manholes
Force Main
Gravity Sewer
Stormwater
Water Service Lines
Underground Dominion Energy Power
Overhead Dominion Energy Power
FCDOT Capital Projects
Railroads
Cox Cable
Roads
Concept Roads
Water Features
Floodplain Delineations
Historic Sites
USA Owned Property
Town Owned Property
WMATA Owned Property
FCWA Owned Property
FCPA Owned Property
Northern Virginia Regional Park Authority Owned Property
County Owned Property
Buildings
Parcels
Proposed Tysons West PS Location
Proposed Manhole
Alternative 6A ~ 8393 LF

0 345 690 1,380 Feet

Figure-12

Tysons West Gravity Sewer Alternative - 6A

CDM Smith



Legend

- Fire Stations
- Hospitals
- Police Stations
- Schools
- Existing Sanitary Sewer Pump Station
- FCDOT Capital Projects
- Sanitary Sewer Manholes
- Stormwater Manholes
- Force Main
- Gravity Sewer
- Stormwater
- Water Service Lines
- Underground Dominion Energy Power
- Overhead Dominion Energy Power
- FCDOT Capital Projects
- Railroads
- Cox Cable
- Roads
- Concept Roads
- Water Features
- Floodplain Delineations
- Historic Sites
- USA Owned Property
- Town Owned Property
- WMATA Owned Property
- FCWA Owned Property
- FCPA Owned Property
- Northern Virginia Regional Park Authority Owned Property
- County Owned Property
- Buildings
- Parcels
- Proposed Tysons West PS Location
- Proposed Manhole
- Alternative 6B ~ 9135 LF

0 345 690 1,380 Feet

Figure-13

Tysons West Gravity Sewer Alternative - 6B

CDM Smith

1.2.6.1 Summary of Potential Physical Constraints for Alternative-6

Similar to Alternative-5, a big portion of Alternative-6 Upstream Segment A will be in acquired easements from private properties. Alternative-6 will have an extensive impact on Vesper trail. This alternative could potentially have large traffic impacts on Leesburg Pike and Westwood Center Drive due to open cut crossings at intersections and commercial building entrances, however, a trenchless method could be utilized to construct the downstream segment of Alternative-6 to minimize traffic disruptions along Leesburg Pike. Additionally, open cut construction in the Industrial Way area could adversely impact the operations of the businesses (specifically Koons Tysons Toyota dealership and Collision Repair Center).

1.2.6.2 Topography for Alternative-6

It is assumed that the new gravity sewer will be 36-inch in diameter based on the flow calculations for the total incoming flow from existing sewer basin, connection to Difficult Run Interceptor and additional capacity from the proposed developments along Leesburg Pike. Preliminary evaluation of the Alternative-6 new gravity sewer shows that the invert elevation of the new gravity sewer line at Difficult Run Interceptor tie-in location will be approximately at 385.0 ft. Assuming that the entire length of alignment will be built per VA SCAT minimum required slope of 0.058 feet per 100 feet, the invert of the new gravity sewer pipe at the new Tysons West Pump Station will be approximately at 352.0 ft (approximately 11 feet below grade). Figure-14 presents the approximate grade elevation for Alternative-6 Upstream Segment A and downstream segment. Difficult Run Interceptor tie-in location (MH 029-3-009) is shown on the left end and the Pump Station connection point on the right end of the figure. Figure 15 and 16 presents the approximate grade elevation for Upstream Segment B and Westwood Center Drive segment respectively. Upstream location is shown on the left and downstream tie-in location is shown on the right end of the figures.

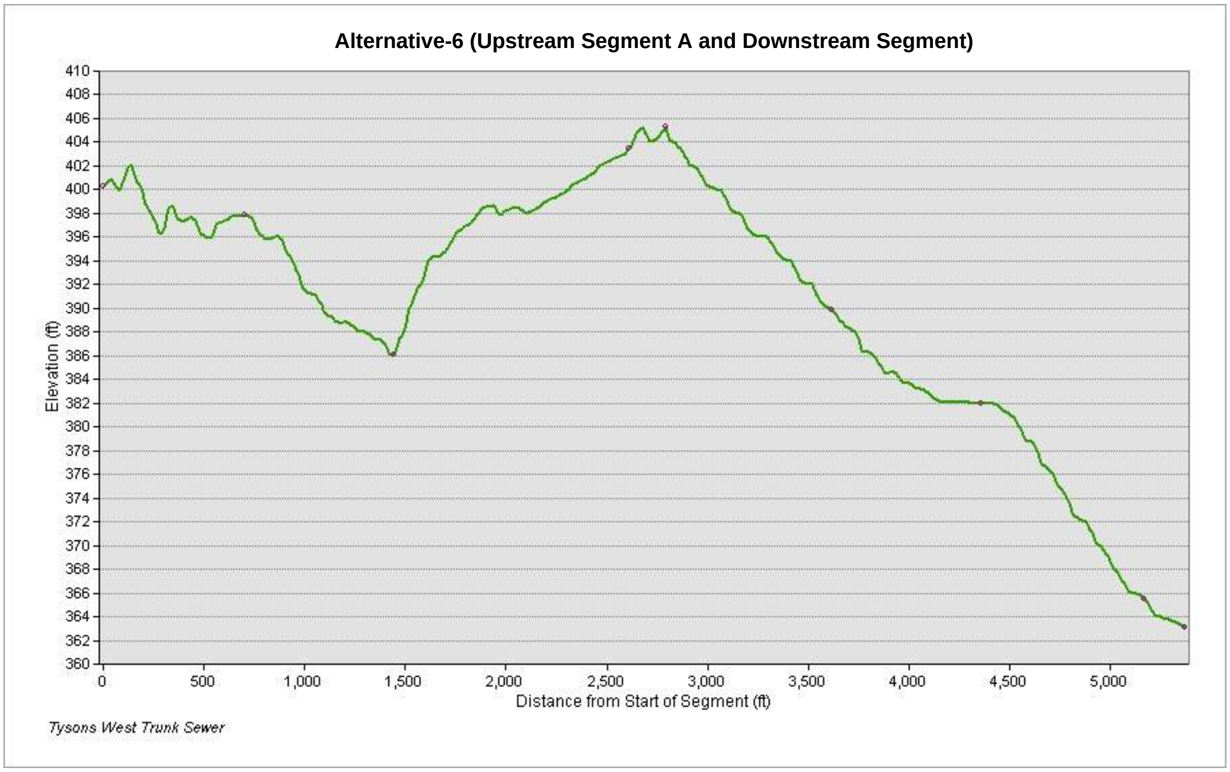


Figure-14: Grade elevation for Alternative-6 route Upstream Segment A and Downstream Segment

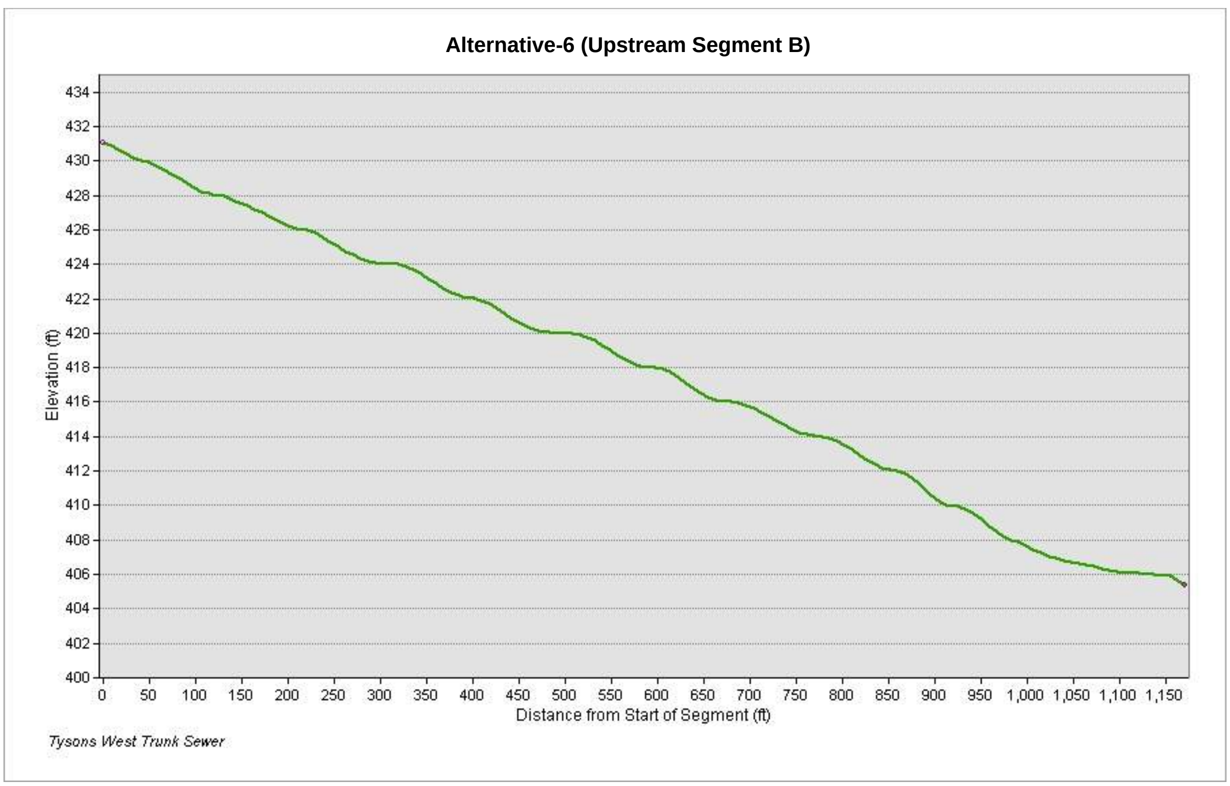


Figure-15: Grade elevation for Alternative-6 route Upstream Segment B

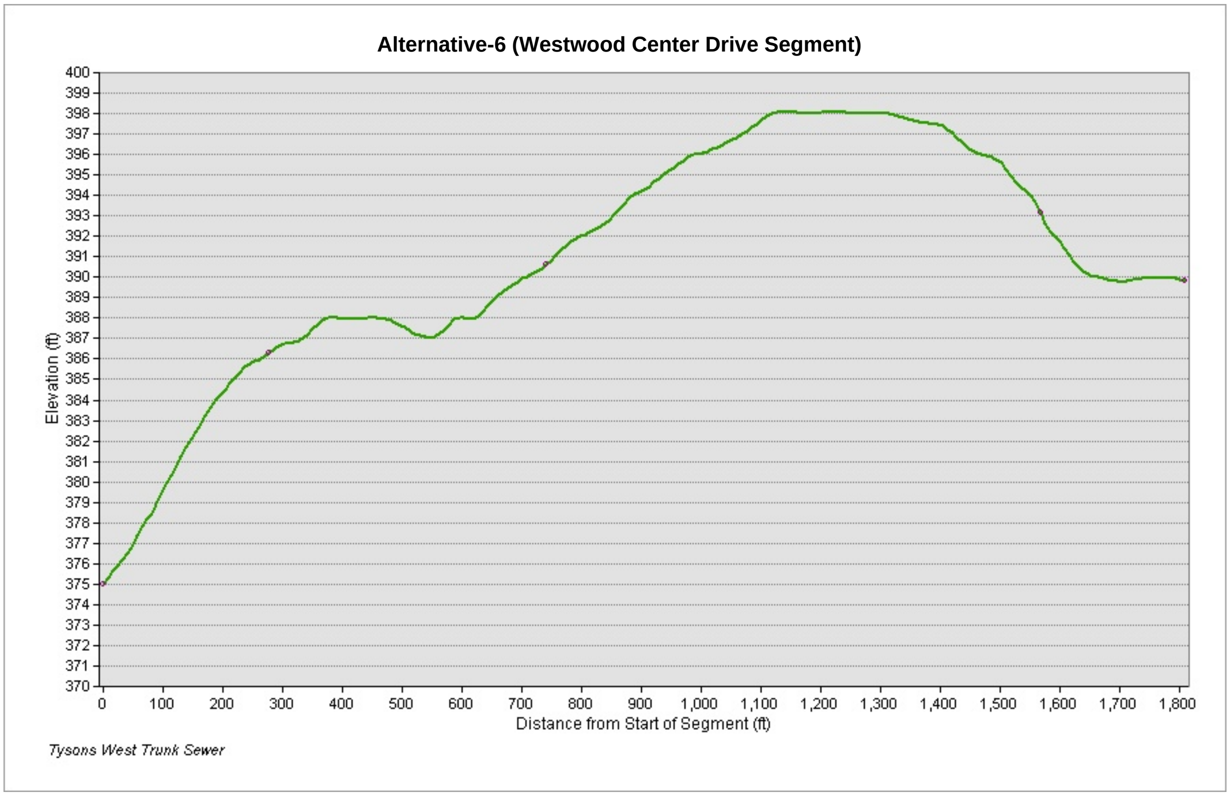


Figure-16: Grade elevation for Alternative-6 route Westwood Center Drive Segment

1.2.5 Overall Figure of Potential Alternative Routings

Figure-17 presents a plan view of all the six proposed alternative alignments. Figure-18 is similar to Figure-17 except with aerial imagery added on the background for better visualization of the earth features.

Figure-17

Tysons West Gravity Sewer Alternatives

Legend

- Fire Stations
- Hospitals
- Police Stations
- Schools
- Existing Sanitary Sewer Pump Station
- FCDOT Capital Projects
- Sanitary Sewer Manholes
- Stormwater Manholes
- Force Main
- Gravity Sewer
- Stormwater
- Water Service Lines
- Underground Dominion Energy Power
- Overhead Dominion Energy Power
- FCDOT Capital Projects
- Railroads
- Cox Cable
- Roads
- Concept Roads
- Water Features
- Floodplain Delineations
- Historic Sites
- USA Owned Property
- Town Owned Property
- WMATA Owned Property
- FCWA Owned Property
- FCPA Owned Property
- Northern Virginia Regional Park Authority Owned Property
- County Owned Property
- Buildings
- Parcels
- Proposed Tysons West PS Location
- Proposed Manhole
- Alternative 1 ~ 3884 LF
- Alternative 2 ~ 2802 LF
- Alternative 3 ~ 3221 LF
- Alternative 4 ~ 3801 LF
- Alternative 5 ~ 7325 LF
- Alternative 6 ~ 9135 LF

0 345 690 1,380 Feet

CDM Smith

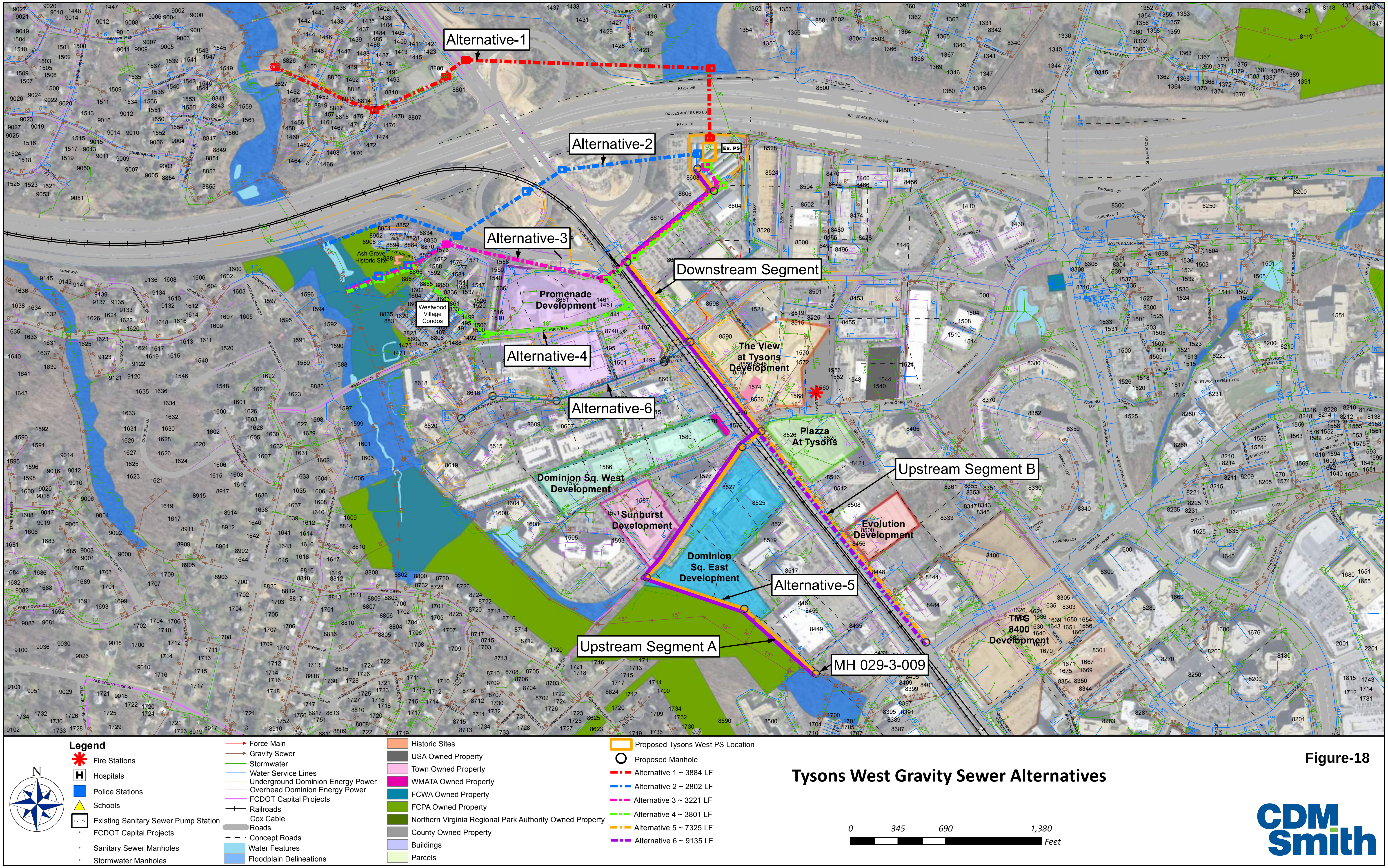


Figure-18

Tysons West Gravity Sewer Alternatives

1.3 Qualitative Evaluation of Alternatives

CDM Smith conducted a qualitative evaluation of the 6 potential alternatives for the new gravity sewer line. The advantages and disadvantages of each of the 6 potential routes were evaluated based on the best available information and listed in Table 1-1.

Table 1-1: Gravity Sewer Routing Alternatives Qualitative Evaluation							
	Alternative-1	Alternative-2	Alternative-3	Alternative-4	Alternative-5	Alternative-6A	Alternative-6B
Length (LF)	3,884	2,802	3,221	3,801	7,325	8,393	9,135
Trenchless Length (LF)	3,634	2,802	3,021	3,601	200	400	400
Parcels Crossing	This alternative doesn't cross any private parcels. It goes along the road and behind a residential community.	This alternative crosses one private parcel (Westwood Village Condo in open parking lot). It also crosses a Fairfax County Park Authority property (Ash Grove).	This alternative crosses two private parcels (Westwood Village Condo open parking lot, private road and Sheraton Tysons property). It also crosses a Fairfax County Park Authority property (Ash Grove).	This alternative crosses two private parcels (Westwood Village Condo open parking lot area and Sheraton Tysons property). It also crosses a Fairfax County Park Authority property (Ash Grove).	This alternative crosses four private parcels: 8433, 8449, 8459 and 8525 Leesburg Pike.	This alternative crosses four private parcels: 8433, 8449, 8459 and 8525 Leesburg Pike.	This alternative crosses four private parcels: 8433, 8449, 8459 and 8525 Leesburg Pike.
Metro Crossing	NO	Yes (overhead)	Yes (overhead)	Yes (overhead)	Yes (overhead)	Yes (overhead)	Yes (overhead)
Potential Utility Corssings*	• 15" Stormwater line crossings at 8 locations • 8" water line crossing at 2 locations • 12" water line crossing at 1 location • Underground electrical ductbank crossings at 3 locations	• 8" sewer line crossing at one location • Underground electrical ductbank crossings at 3 locations • 1 overhead power crossing	• 18" stormwater line crossings at 3 locations • 8" sewer line crossing at 3 locations • 8" water line crossing at 2 locations • 12" water line crossing at 2 locations • 24" water line crossing at 1 location • Underground electrical ductbank crossings at 7 locations • 2 overhead power crossings	• 15" stormwater line crossings at 6 locations • 18" stormwater line crossings at 5 locations • 30" stormwater line crossing at 1 location • 36" stormwater line crossing at 1 location • 8" sewer line crossing at 3 locations • 8" water line crossing at 2 locations • 12" water line crossing at 2 locations • 24" water line crossing at 1 location • Underground electrical ductbank crossings at 12 locations	• 15" stormwater line crossings at 2 locations • 18" stormwater line crossing at 3 locations • 21" stormwater line crossing at 2 location • 24" stormwater line crossing at 1 location • 27" stormwater line crossing at 1 location • 30" stormwater line crossing at 2 locations • 36" stormwater line crossing at 1 location • 8" sewer line crossing at 4 locations • 10" sewer line crossing at 4 locations • 8" water line crossing at 5 locations • 24" water line crossing at 2 locations • Underground electrical ductbank crossings at 4 locations • 1 overhead power crossing	• 15" stormwater line crossings at 4 locations • 18" stormwater line crossing at 3 locations • 21" stormwater line crossing at 3 locations • 24" stormwater line crossing at 1 location • 27" stormwater line crossing at 1 location • 30" stormwater line crossing at 2 locations • 36" stormwater line crossing at 1 location • 8" sewer line crossing at 5 locations • 10" sewer line crossing at 4 locations • 8" water line crossing at 7 locations • 12" water line crossing at 2 location • 24" water line crossing at 2 locations • Underground electrical ductbank crossings at 6 locations • 1 overhead power crossing	• 15" stormwater line crossings at 4 locations • 18" stormwater line crossing at 3 locations • 21" stormwater line crossing at 3 locations • 24" stormwater line crossing at 3 locations • 27" stormwater line crossing at 1 location • 30" stormwater line crossing at 2 locations • 36" stormwater line crossing at 1 location • 8" sewer line crossing at 5 locations • 10" sewer line crossing at 4 locations • 8" water line crossing at 9 locations • 12" water line crossing at 2 location • 24" water line crossing at 2 locations • Underground electrical ductbank crossings at 7 locations • 1 overhead power crossing
Major Road Crossings	• Trenchless crossing under Dulless Access Road (Rt-267) • Trenchless crossing under Leesburg Pike • Trenchless crossing under 267 ramp to Leesburg Pike	• Trenchless crossing under Leesburg Pike • 4 trenchless ramp crossings: + Leesburg pike N to Rt267 EB Ramp + Rt267 EB ramp to Leesburg Pike N + Rt267 EB ramp to Leesburg Pike S + Leesburge pike S to Rt267 EB Ramp	• Trenchless crossing under Leesburg Pike	• Trenchless crossing under Leesburg Pike	• Trenchless crossing under Leesburg Pike	• 2 Trenchless crossings under Leesburg Pike	• 2 Trenchless crossings under Leesburg Pike
Permits Required	VDOT, MWAA, USACOE	VDOT, MWAA, USACOE, WMATA, FCPA	VDOT, MWAA, USACOE, WMATA, FCPA	VDOT, MWAA, USACOE, WMATA, FCPA	VDOT, WMATA, FCPA	VDOT, WMATA, FCPA	VDOT, WMATA, FCPA
Potential Easement Requirements	One easement from McLean Hundred HOA.	Two easements. One from Westwood Village Condominums and one from Fairfax Park Authority.	Three easements. from Westwood Village Condominums, Sheraton Tysons and Fairfax Park Authority.	Three easements. from Westwood Village Condominums, Sheraton Tysons and Fairfax Park Authority.	Six easements. from FCDOT, Fairfax Park Authority, and private parcels: 8433, 8449, 8459 and 8525 Leesburg Pike.	Six easements. from FCDOT, Fairfax Park Authority, and private parcels: 8433, 8449, 8459 and 8525 Leesburg Pike.	Six easements. from FCDOT, Fairfax Park Authority, and private parcels: 8433, 8449, 8459 and 8525 Leesburg Pike.
Environmental Concerns	• Wetland crossing	• Some tree removal • Wetland and Park crossing	• Largest tree removal among alternatives • Wetland and park crossing	• Wetland and Park crossing	-	-	-
Community/Social Impact	Large impact on residential neighberhood along Jarrett Valley Dr	Some impact on Westwood Village Condominum	Some impact on Westwood Village Condominum Large impact on Sheraton	Large impact on Westwood Village Condominum Some impact on Sheraton	Large impact on Vesper Trail Some impact on Route-7	Large impact on Vesper Trail Some impact on Route-8	Large impact on Vesper Trail Some impact on Route-9
Historic Site?	No	Yes (Ashgrove)	Yes (Ashgrove)	Yes (Ashgrove)	No	No	No
Cost	$$$$$	$$$	$$$$$	$$$$$	$$$	$$$	$$$$
Pros	• Capture the most amount of flow from Difficult Run interceptor • No open cut road crossing • No metro crossing • Minimum number of easements required • No historic site crossing	• No open cut road crossing • Minimum community/social impact • Shortest route • Minimum number of utility crossings	• No open cut road crossing • Minimal impact on Dulles Toll Road operation	• No open cut road crossing • Minimal impact on Dulles Toll Road operation	• Facilitate basin expansion • Minimum number of permits required • No historic site crossing • Shortest tunneling segment • No impact on Dulles Toll Road operation	• Facilitate basin expansion • Minimum number of permits required • No historic site crossing • Shortest tunneling segment • No impact on Dulles Toll Road operation	• Capture the most amount of flow from Service Area • Facilitate basin expansion • Minimum number of permits required • No historic site crossing • Shortest tunneling segment • No impact on Dulles Toll Road operation
Cons	• Large community impact • Complexities related with Tunneling under Rt 267 and the permitting requirements • Longest tunneling route • High cost	• Most number of permits required • Historic site crossing	• Most number of permits required • Highest impact on Sheraton property • High cost • Historic site crossing	• Most number of permits required • High cost • Historic site crossing	• Several open cut road or commercial building entrance crossings which require road closures and traffic management plans • Most number of easements required	• Several open cut road or commercial building entrance crossings which require road closures and traffic management plans • Most number of utility crossings • Most number of easements required	• Several open cut road or commercial building entrance crossings which require road closures and traffic management plans • Most number of utility crossings • Most number of easements required

1.4 Quantitative Evaluation Criteria

Routes were evaluated based on a number of criteria relevant to designing, constructing, and operating a sanitary sewer gravity main. These criteria include the following:

- Facilitate expansion of the current pump station service area
- Relative costs
- Commercial/Residential landowner Impacts
- Traffic Impacts
- Environmental Impacts
- Permitting
- Constructability
- Access/Operation and Maintenance
- Utility Conflicts
- Easements
- Other obstructions

A description of each of these criteria follows.

1.4.1 Facilitate Expansion of the Current Pump Station Service Area

In preparation for design and construction of the new Tysons West Pump Station, CDM Smith collected the available information for the upcoming developments in the Tysons West District and performed an evaluation of the feasibility of expanding the current pump station service area in order to increase the pump station incoming flow from local collection system. Collecting additional flow volume from the local collection system will reduce the flow volume transferred by the existing Difficult Run Interceptor to Difficult Run Pump Station which is a stated goal of the Tysons Corner Sanitary Sewer Master Plan. The Tysons West basin expansion will capture additional flows only from developments with pending or recently approved applications that will be constructed along Leesburg Pike between West Park Drive and Dulles Toll Road (Rt-267).

Alignment alternatives 5 and 6 for the new gravity sewer was developed with the goal of facilitating expansion of the current pump station service area by collecting flow from new developments along Leesburg Pike. Due to large potential impact that basin expansion could have on the project cost and also future developments, this criterion was assigned a weighting factor of 15 percent.

1.4.2 Relative Costs

Planning level costs were assigned to each route alternative for comparison purposes. The final PER will include cost estimates developed by CDM Smith Construction Division (CCI) based on bid tabulations from recent projects and CDM Smith's experience with similar projects. The cost evaluations for each route will include the cost for installation of pipe for each route based on type of installation, cost of restoration, cost for stream or wetland crossings, and the cost for trenchless installation under roads and railroads. The cost of easement acquisition will be factored into the cost based on the input received from the County.

The cost comparisons will not include items that are not significant cost discriminators between routing options such as seeding, bedding, etc. Costs will also not include rock excavation. Depth to rock is unknown for the alternatives and not expected to be a significant discriminator among the route segments, so it will not be considered in the evaluation. However, rock quantities and locations will be very important information used to determine the final construction cost estimate. Therefore, geotechnical investigations are recommended as part of the final design to provide an indication of the actual depth of rock along the selected alignment. Due to cost being one of the critical factors in selecting the new gravity sewer routing, this criterion was assigned an initial weighting factor of 10 percent.

1.4.3 Commercial/Residential Property Owners Impacts

Alignment options for the new gravity sewer was developed with the goal of minimizing impacts to individual properties located along the selected route as much as practicable. Impacts can be temporary, such as removal and restoration of lawns, gardens, fences, sidewalks, and/or driveways associated with trenching. Impacts can also be permanent, such as removal of large trees or structures within the transfer force main right-of-way. Pipeline routes will be adjusted, where possible, to reduce permanent impacts.

It is anticipated that the new gravity sewer will be placed in acquired easements from private properties in some areas, however, large portions of the potential routes follow either existing utility easements, or public/road rights-of-ways. These easements and rights-of-ways will be utilized temporarily during construction and will allow the amount of additional temporary construction easement required to be reduced. Due to potential impact that construction could have on the commercial and residential land owners, and as a result on project schedule and cost, this criterion was assigned a weighting factor of 10 percent.

1.4.4 Traffic Impacts

Construction of a gravity sewer line along heavily traveled streets will impact traffic flow. Various sections of the roads along the proposed alignments serve residential and commercial establishments. Traffic Management Plans (TMPs) will be required for any construction in the VDOT or County roads right-of-way. Because of this, the implications of the traffic impacts need to be considered when the routes are evaluated. The new gravity sewer should be constructed so that access to roadways from side streets always remains open to local traffic and emergency vehicles to the extent practicable. Due to potential impact traffic impacts could have on the project schedule and cost, this criterion was assigned a weighting factor of 10 percent.

1.4.5 Environmental Impacts

Environmental impacts that were considered for the new gravity sewer routing analysis included wetland impacts and stream crossings. These impacts generally are greater for the tie-in to Difficult Run Interceptor portions of the route than for already disturbed areas in or adjacent to existing roads. Environmental impacts can increase design and construction schedule and cost. Environmental impacts can also lengthen the time required to obtain permits and increase the number of permits and reviews needed. It is anticipated that there will be no stream crossings for any of the alternatives, however, all 6 alternatives will have some impacts on potential wetland areas. Due to potential impact environmental impacts could have on the project permitting, schedule and cost, this criterion was assigned a weighting factor of 5 percent.

1.4.6 Permitting

The ability and ease to acquire the necessary permits is a critical factor to the success of this project. The route will be subject to review by regulatory agencies, depending on the pipe installation methodology (i.e. open-cut versus trenchless) and location of road or easement crossings.

All VDOT road crossings will require obtaining permits from VDOT and developing TMPs depending on the impact on the road and pipe installation methodology. Obtaining United States Army Corps of Engineers (USACE) Nationwide Permit will be most likely required for all the alternatives due to potential impacts on the wetlands in tie-in locations. Mitigation may be required by the USACE for unavoidable wetland or stream impacts. Approvals will also be needed for the crossing of the right-of-way or easements owned by Dominion Energy and Washington Gas. Due to potential impact permitting could have on the project schedule and cost, this criterion was assigned a weighting factor of 5 percent.

1.4.7 Constructability

The ease with which the project can be constructed greatly impacts the overall project cost and often the impact to local property owners. Constructability issues which will be considered as part of the route evaluation process include contractor access to the site, ability to store materials and access to potential project staging areas, speed of construction, and construction safety. Due to large potential impact that constructability could have on the project schedule and cost, this criterion was assigned a weighting factor of 15 percent.

1.4.8 Access/Operation and Maintenance

The new gravity sewer has to be accessible during construction and for operational and maintenance considerations once the pipeline has been put into service. Access is easiest when the alignment follows existing roads, and it is most difficult on the remote, wooded and wetland areas. Future O&M and construction access issues will be evaluated as part of the routing analysis. Due to large potential impact that construction access and future O&M could have on the project schedule and cost, this criterion was assigned a weighting factor of 15 percent.

1.4.9 Utility Conflicts

Preliminary information was obtained for most of the known existing utilities along the proposed alignments including stormwater lines, sanitary sewer lines, communication/cable lines, water and Dominion overhead and underground power lines. Existing utilities information for gas lines will also be obtained through communication with the utility owner to the extent practicable before submission of final PER. Particular attention will be given to utilities that cannot easily be moved, such as large water mains and sewers, power transmission lines and towers, and large gas lines.

Due to the placement of the pipe in easements on private properties, potential conflicts with existing utilities will be minimized, but cannot be completely eliminated. The design will have to address these conflicts, and the contractor will have to handle each conflict properly as the pipe is installed. For this reason, routes will be evaluated to minimize conflicts between utilities, particularly large utilities that are not easily moved. It should be noted, however, that the depth and exact alignment of the proposed gravity sewer will be further adjusted as necessary after the PER and during the design phase to avoid conflicts with utilities. Due to potential impact utility conflicts could have on the project schedule and cost, this criterion was assigned an initial weighting factor of 10 percent.

1.4.10 Easement

Easements will be required from private landowners for all the 6 alternatives, however the length of easements required varies for each alternative. Easements include both permanent and temporary construction easements. Depending on the route selected, purchasing easements may be costly. Alternative-1 requires the least amount of easement from private landowners. The anticipated easement requirements for construction of the pipeline specific to the selected alternative will be evaluated in the final PER. Due to potential impact easement acquisition could have on the project schedule and cost, this criterion was assigned a weighting factor of 5 percent.

1.4.11 Evaluation Criteria Weighting

Each of the evaluation criteria noted above have been weighted to reflect their relative importance to the construction and operation of the new gravity sewer. Table 1-2 lists the relative weights for each of the evaluated criteria and are based on engineering experience. The weighting factors will be adjusted as necessary to factor in County's staff input. The weights that were used for each criterion reflect the relative importance of project cost as well as an increased focus on the project's impacts to property and commercial/business interests along each alignment.

Table 1-2: Evaluation Criteria Weights

Evaluation Criteria	Weight (percentage basis)
Facilitate Expansion of the Current Pump Station Service Area	15
Relative Cost	10
Commercial/Residential Property Owners Impacts	10
Traffic Impacts	10
Environmental Impacts	5
Permitting	5
Constructability	15
Access/Operation and Maintenance	15
Utility Conflicts	10
Easement	5

1.5 Route Alternatives Analysis Recommendations

After initial screening and discussion with the County staff, alternative routes were evaluated in more detail and ranked in order to provide a quantitative determination of the most appropriate option. Each route option was assigned a ranking between 1 and 5 for each of the criteria used in the evaluation, with 5 being the most favorable score (lowest impact) and 1 being the most unfavorable score (highest impact). The total score was determined by adding first multiplying the individual criteria scores by the assigned weight presented in Table 1-2 and then summing up the weighted scores. The final criteria ranking tabulation is presented in Table 1-3.

Table 1-3: Gravity Sewer Routing Alternatives Quantitative Evaluation and Ranking

Weight %	15		10		10		10		5		5		15		15		10		5		100	
	Facilitate Basin Expansion		Relative Cost		Commercial/Residential Property Owners Impacts		Traffic Impacts		Environmental Impacts		Permitting		Constructability		Access/Operation and Maintenance		Utility Conflicts		Easement		Total Score	Rank
	Score	Comments	Score	Comments	Score	Comments	Score	Comments	Score	Comments	Score	Comments	Score	Comments	Score	Comments	Score	Comments	Score	Comments		
Alternative-1	1	Do not facilitate basin expansion	3	$$$$$	4	Large impact on residential area	4	Some impact on residential neighborhood north of Rt-267, require basic traffic management plans	2	Some impact on wetlands and stream	3	Moderate permitting effort required	2	Longest tunneling route, complexity of tunneling under Dulles Toll Road, very deep tunnel alignment	2	Maintenance access issues due to depth of tunnel	5	Minimum number of utility crossings	5	Minimum number of easements required	285	5
Alternative-2	1	Do not facilitate basin expansion	5	$$$	5	minimal impact on residental and commercial property owners	5	Minimial traffic impact	1	Some impact on wetlands, one stream crossing	2	Maximum number of permits required	3	Long tunneling route, complexity of tunneling under several ramps to/from Dulles Toll Road, very deep tunnel alignment	2	Maintenance access issues due to depth of tunnel	5	Minimum number of utility crossings	4	Moderate number of easements required	325	4
Alternative-3	1	Do not facilitate basin expansion	3	$$$$$	4	Moderate impact on commercial and residential owners	3	Some impact on Ashgrove Lane traffic, require basic traffic management plans	2	Some impact on wetlands and stream	2	Maximum number of permits required	3	Long tunneling route, very deep tunnel alignment	2	Maintenance access issues due to depth of tunnel	4	Moderate number of utility crossings	3	Moderate number of easements required	265	6
Alternative-4	1	Do not facilitate basin expansion	3	$$$$$	4	Moderate impact on commercial and residential owners	3	Some impact on Ashgrove Lane traffic, require basic traffic management plans	2	Some impact on wetlands and stream	2	Maximum number of permits required	3	Long tunneling route, very deep tunnel alignment	2	Maintenance access issues due to depth of tunnel	3	Moderate number of utility crossings	3	Moderate number of easements required	255	7
Alternative-5	3	Facilitate basin expansion to some extent	5	$$$	3	Large impact on vesper trails and Route-7	2	Require complex traffic management plans	4	Minimal impact on wetlands and stream	4	Minimum number of permits required	4	Potential challenges for Construction along Vesper Trail	4	Limited access along Vesper Trail	2	Maximum number of utility crossings	2	Maximum number of easements required	335	3
Alternative-6A	4	Facilitate basin expansion to some extent	4	$$$$	3	Large impact on vesper trails and Route-7	2	Require complex traffic management plans	4	Minimal impact on wetlands and stream	4	Minimum number of permits required	4	Potential challenges for Construction along Vesper Trail	4	Limited access along Vesper Trail	2	Maximum number of utility crossings	2	Maximum number of easements required	340	2
Alternative-6B	5	Facilitate basin expansion	4	$$$$	3	Large impact on vesper trails and Route-7	2	Require complex traffic management plans	4	Minimal impact on wetlands and stream	4	Minimum number of permits required	4	Potential challenges for Construction along Vesper Trail	4	Limited access along Vesper Trail	2	Maximum number of utility crossings	2	Maximum number of easements required	355	1

1.5.1 Recommended Alternative

Based on the evaluation of each of the route alternatives and the criteria used in the evaluation, the optimal gravity route alignment is Alternative-6B. This alignment offers multiple advantages including providing the necessary infrastructure for accommodating the maximum possible flow from local collection system, fewer permits, zero impact on Dulles Toll Road, and very short microtunnel segment. Collecting the additional flow will reduce the flow volume transferred by the existing Difficult Run Interceptor to Difficult Run Pump Station which is a stated goal of the Tysons Corner Sanitary Sewer Master Plan. Other advantages include improved constructability, better access for future maintenance and fewer environmental impacts comparing to alternatives 1 to 4. Alternatives 1 to 4 have more environmental impacts due to location of the connection point to Difficult Run Interceptor which is in a potential wetland area adjacent to a stream.

There are also some drawbacks for the recommended alternative including larger traffic impacts comparing to alternatives 1 to 4. Leesburg Pike is a heavily traveled road, and traffic control will be required for a big portion of the construction for Alternative-6B. Access to commercial properties along Leesburg Pike will also be affected during construction. The alternative would likely require an extended project schedule to allow for the additional time needed for property acquisition. Additionally, Alternative-6B has the greatest number of locations where an existing utility must be crossed comparing to all other alternatives.

The new gravity sewer will collect approximately 3.0 MGD from 7 new development along Leesburg Pike including the Evolution, Piazza at Tysons, the View at Tysons, Dominion Square West, Dominion Square East, Tysons West Promenade, and Sunburst. In addition, the new gravity sewer can handle up to 7.00 MGD from Difficult Run Interceptor that currently flows to the Difficult Run Pump Station. It should be noted that CDM Smith did not perform an evaluation of the current or future flow in the Difficult Run Interceptor. A large flow reduction in the Difficult Run Interceptor could potentially cause maintenance issues in the Interceptor due to very low flow and possible need for downsizing the line in the future.

Based on the above considerations and discussions with the County staff, Alternative-6B is the preferred approach for installation of gravity alignment for Tysons West pump station. Though there may be challenges associated with utility crossings, easement acquisition and construction along Vesper Trail, this alignment avoids a substantial deep microtunneling installation which is costly and provides limited maintenance accessibility.

Appendix B

Tysons Basin Expansion Memo

CDM Smith

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Section 1

Tysons West Basin Expansion Analysis

1.1 Introduction and Objective

Based on the recommendations of Tysons Corner Sanitary Sewer Master Plan (January 2020), Fairfax County is moving forward with a project to design a new pump station, called Tysons West Pump Station, which will collect flow from the local collection system, the Difficult Run Interceptor, and the future Tysons East Pump Station. The Tysons West Pump Station will replace the existing Tysons Dodge Pump Station which serves the northwestern portion of Tysons West District as outlined in the Tysons Corner Urban Center Plan. The estimated flows to the new pump station are 10 MGD from the Difficult Run Interceptor, 10 MGD from future Tysons East Pump station (assumed constant flow), and 5 MGD from the local Tysons West sanitary sewer service area. This results in a total design capacity of 25 MGD peak flow for the Tysons West pump station.

In preparation for design and construction of the new Tysons West Pump Station, CDM Smith collected the available information for the upcoming developments in the Tysons West District and performed an evaluation of the feasibility of expanding the current pump station service area in order to increase the pump station incoming flow from local collection system. Collecting additional flow volume from the local collection system will reduce the flow volume transferred by the existing Difficult Run Interceptor to Difficult Run Pump Station which is a stated goal of the Tysons Corner Sanitary Sewer Master Plan. The Tysons West basin expansion will capture additional flows only from developments with pending or recently approved applications that will be constructed along Route-7 between West Park Drive and Dulles Toll Road (Rt-267).

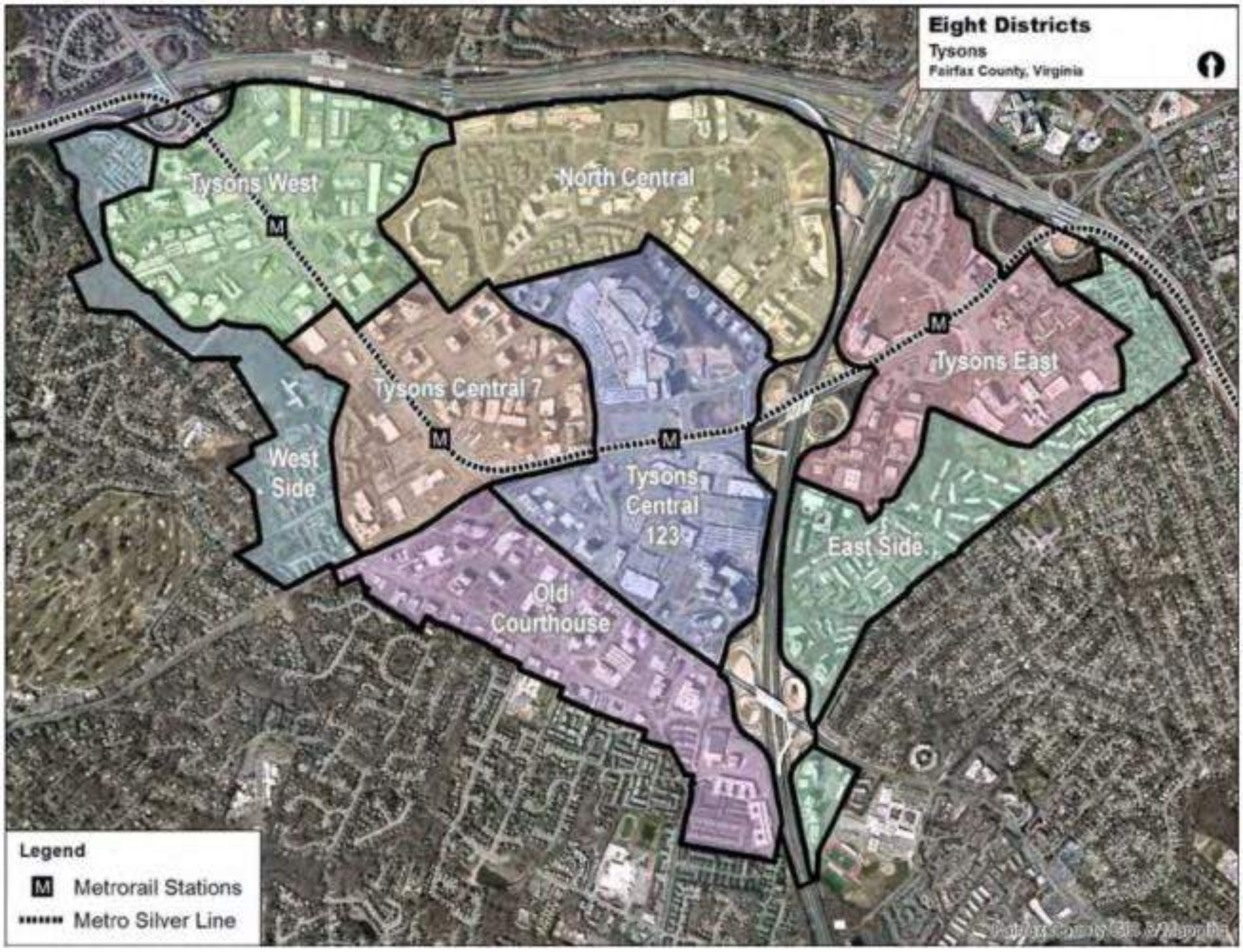

Figure 1-1: Tysons Corner Districts

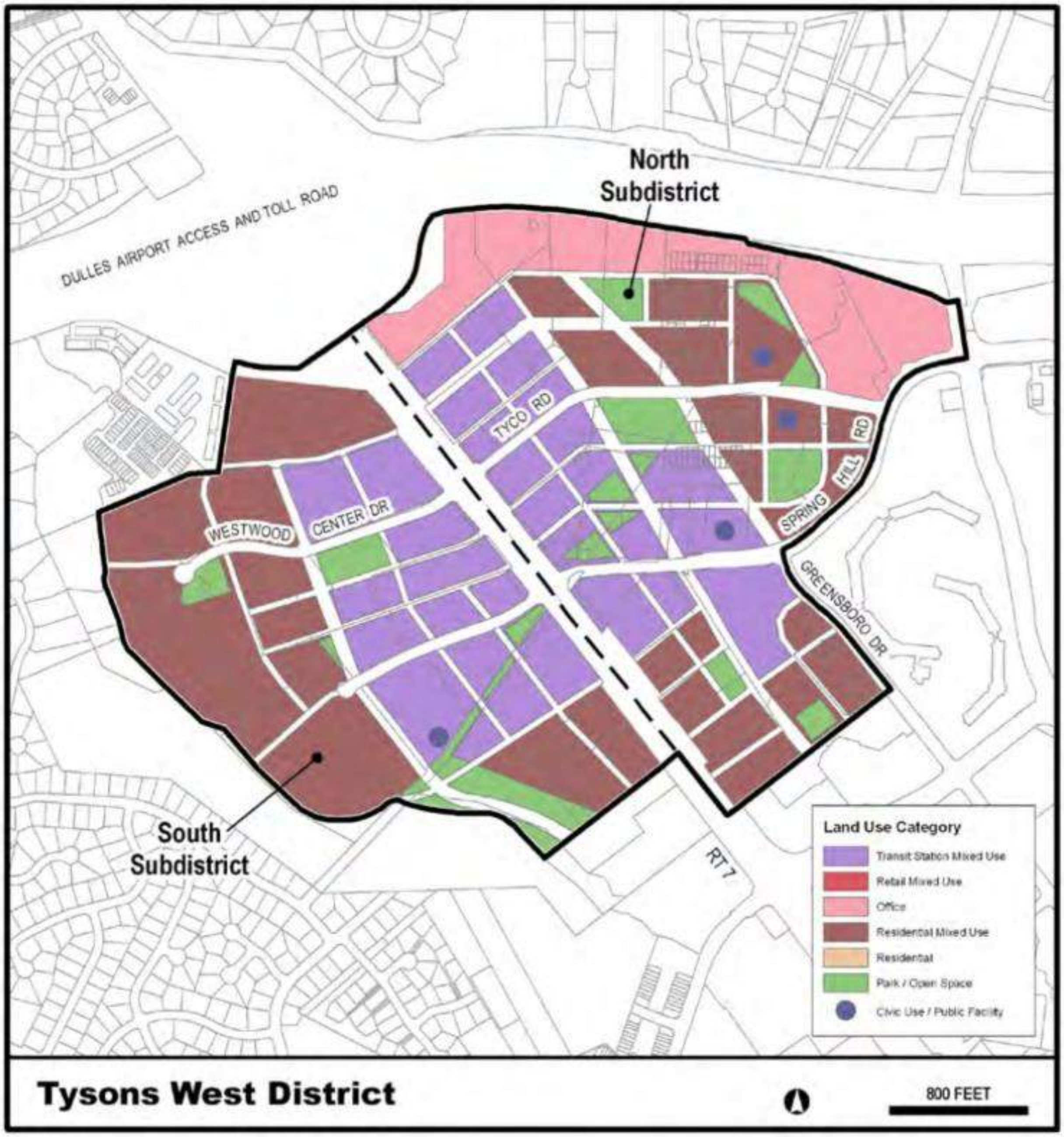

Figure 1-2: Tysons West District

To accomplish this goal, building a new trunk sewer line along route-7 is required. This technical memorandum focuses on feasibility of the service area expansion and recommendations for the alignment of the new gravity trunk sewer. This draft technical memorandum is developed based on the GIS imagery, desktop study, and best available record data at the time that this document was prepared and does not include any site topographic survey or environmental studies. This technical memorandum will be completed after review by the County staff.

1.2 Description of the New Developments in Tysons West

There are currently seven active developments in Tysons West District. Table 1-1 provides a comprehensive list of these developments along with the name of developers, address of the development and the status of rezoning applications. The rezoning application for three of these developments are being reviewed at the time of writing this memo. The rezoning applications for the other four developments have been approved; however, construction has not started.

Table 1-1: Summary of New Developments in Tysons West District

Development Name	Developer	Address	Rezoning Application Status	Application No.
The Evolution	8500 CDC LP	8448 Leesburg Pike, Vienna, VA 22182	UNDER REVIEW	RZ 2017-PR-021
Piazza at Tysons	Tysons MK, LLC and Tysons MK II, LLC	8520 & 8526 Leesburg Pike, Vienna, VA 22182	UNDER REVIEW	RZ 2019-PR-004
The View at Tysons	Tysons Development LLC	8550 & 8590 Leesburg Pike, Vienna, VA 22182	UNDER REVIEW	FDP 2017-PR-010
Dominion Square West	Carrs-DB-1 LLC	1580 to 1586 Spring Hill Rd, Vienna, VA, 22182	APPROVED	RZ 2011-HM-012
Dominion Square East	Carrs-DB-1 LLC	1591 Spring Hill Rd Tysons, VA 22182	APPROVED	RZ 2011-HM-013
Tysons West Promenade	TYSONS WEST RESIDENTIAL, L.L.C. AND JBG/TYSONS HOTEL, L.L.C.	1560 Spring Hill Rd, McLean, VA 22102	APPROVED	RZ 2011-HM-032
Sunburst	1587 Springhill Holdings, Inc.	1587 Spring Hill Rd, Vienna, VA 22182	APPROVED	RZ 2011-HM-027

A description of all the seven developments listed in the table above are provided in the following sections. The total square footage and flow information for each category of land use for the developments is presented in Table 1-2 in Section 1.2.8 of this memorandum. Figure 1-3 shows the alignment for the Gravity Trunk Sewer.

It is notable that one additional rezoning application for a large 9.4 acre office/retail development project called “TMG 8400 Westport Drive” was submitted to the County at the time of writing this memorandum. This new development will be on the west side of Leesburg Pike just south of The Evolution Development. CDM Smith will update this memorandum after receiving the preliminary plans for this new development.

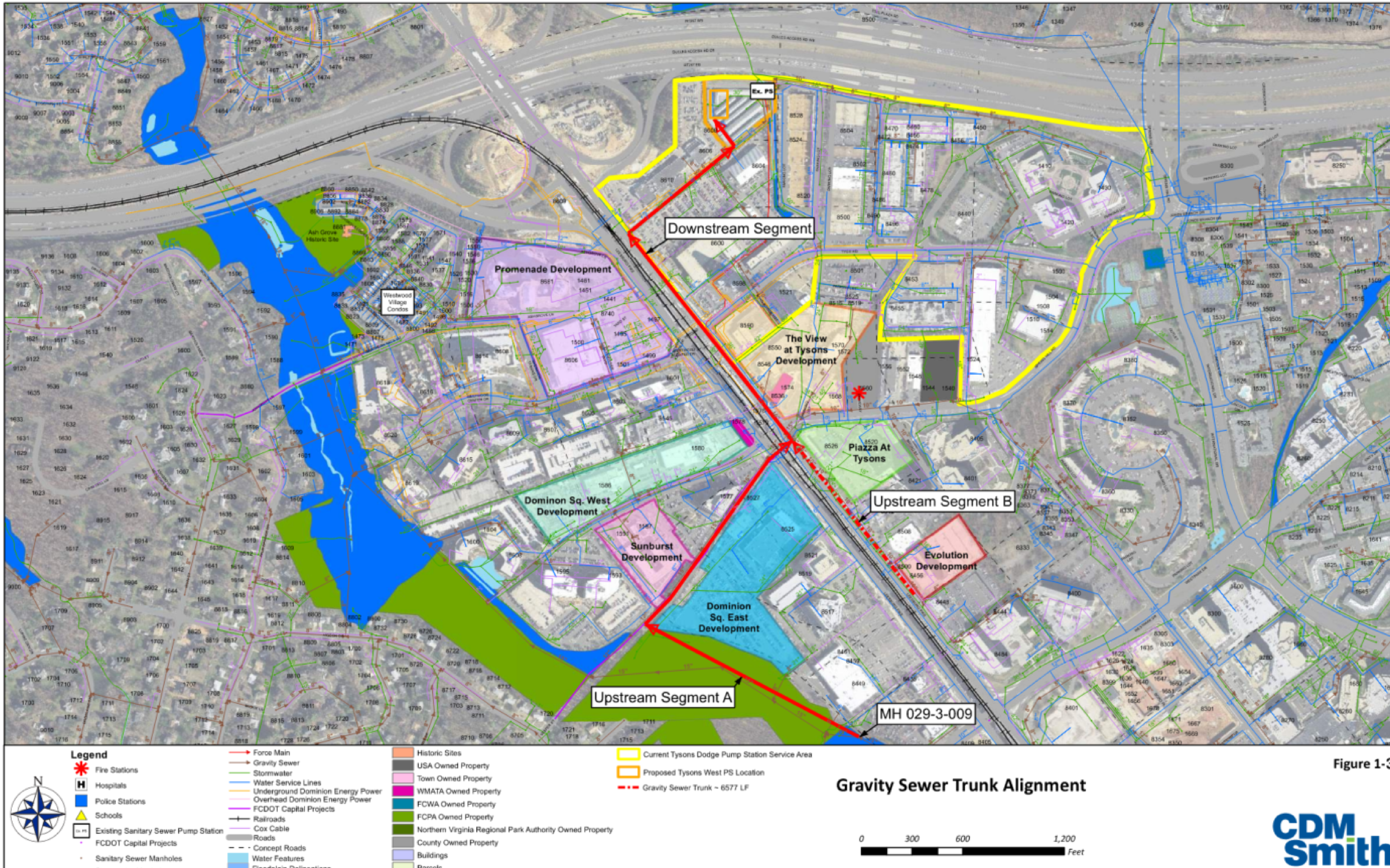

Figure 1-3

Gravity Sewer Trunk Alignment

1.2.1 The Evolution

The Evolution Development will be located on the southbound side of Route 7, one-half mile south of the Spring Hill Metro Station. Currently, the property is occupied by a seven-story commercial building.

The Developer proposed one building that would accommodate 1,400 Workforce Dwelling Units (WDUs). These WDUs would make up 100% of the total units available in the development.

1.2.2 The Piazza at Tysons

The Piazza Development will be located on the northeast corner of Spring Hill Road and Leesburg Pike intersection, with most of the site (including portions of all proposed buildings) within 1/8 of a mile of the Spring Hill Metro Station. The development is bounded on the south by Leesburg Pike, on the west by Spring Hill Road, on the north by Broad Street, and on the east by West Street.

The overall mix use proposed by the developer is approximately 35% office, 48% residential, 4% hotel and 13% retail.

1.2.3 The View at Tysons

The View at Tysons Development will be located on the northwest corner of Spring Hill Road and Leesburg Pike intersection directly adjacent to the Spring Hill Metro Station, with frontage on Leesburg Pike and Spring Hill Road. Currently, the property is occupied by a Metro parking lot, car dealerships and service areas, as well as one low-rise office building.

The Developer proposed four buildings, that will have retail, office, hotel and condominium uses. A fifth building is proposed as a Performing Arts Center.

1.2.4 Dominion Square West

The Dominion Square West Development will be located on the northbound side of Leesburg Pike about 500 ft west of Spring Hill Road. The Dominion Square West include redevelopment of an area which is currently developed with several automobile dealerships.

The Developer proposed six new buildings, including a mix of office, retail, and residential uses. The buildings would range in height from 85 to 400 feet, with the taller(??) structures closer to the Spring Hill Metrorail station. The site will include an athletic field, two elevated sky-parks and a Metro Plaza extension. The proposed public facilities will serve the high volume of pedestrian activity associated with Metro accessibility to the Spring Hill Metro Station.

1.2.5 Dominion Square East

The Dominion Square East will be located on the southeast corner of Leesburg Pike and Spring Hill Road and includes a portion of a County-owned parcel which contains overhead electrical transmission lines.

The Developer proposed to redevelop the area which is currently occupied by several automobile dealerships. The new development will include six buildings, including a mix of office, retail, residential and hotel uses. The buildings would range in height from 140 to 350 feet, with the taller structures closer to the Spring Hill Metro station. The proposed layout includes a full size rectangular athletic field and several rooftop park spaces. As part of the redevelopment, the Developer will dedicate land to accommodate a new electrical substation.

1.2.6 Tysons West Promenade

The Tysons West Promenade will be located on the southwest corner of Leesburg Pike and the ramp from Rt 267 eastbound to Leesburg Pike. The site is currently developed with a hotel and conference center (Sheraton Premier), surface parking and retail use with structured parking (Walmart, fitness center).

The redevelopment will add a mix of uses that integrate with the existing uses. Three new buildings are planned, including residential and office uses with ground floor retail. The new buildings range in height from 95 to 225 feet. The existing hotel/conference center and retail use will remain.

1.2.7 The Sunburst

The site is currently occupied with a two-story motel and a restaurant. The new development will include two redevelopment options. Option A contains three residential buildings; Option B proposes two residential buildings and one office building. Each building will have retail space included. The Development will dedicate land to accommodate a new electrical substation. For the purpose of evaluation, Option B was selected for the flow calculations since it has the highest flow among all the three options.

1.2.8 Gravity Trunk Sewer Alternative

As an alternative to the gravity sewer connection to Difficult Run Interceptor which was recommended in the Tysons Corner Sanitary Sewer Master Plan (January 2020) and discussed in the Gravity Routing Technical Memorandum dated April 2020, building a new gravity trunk sewer is considered. This trunk sewer line will collect the flow from both Difficult Run Interceptor and the new developments in Tysons West District. Preliminary evaluation of the grade elevation and depth of the existing sewer in the area shows that six of the seven new developments could be served by this new gravity trunk sewer. It is likely that western parts of Dominion Square West cannot be served by gravity and may require building a small on-premise lift station to pump the flow to the new gravity sewer trunk which will be located on the east of this development. The only new development which could not be served by the new gravity trunk sewer (due to elevation and depth constraints) is the Tysons West Promenade.

Route 7 is an east-west elevation high-point. Existing buildings which currently discharge to the Difficult Run Interceptor would continue to do so. Topography is not favorable for redirecting flow towards Route 7 for these locations.

The new trunk sewer line consists of three segments designated as Upstream Segment A, Upstream Segment B and downstream segment as described below:

Upstream Segment A: This segment of trunk sewer line starts at MH 029-3-009 on the Difficult Run Interceptor and continues toward northwest in a forested area along the eastern edge of Raglan Rd Park property for approximately 1,450 LF. The alignment then continues along Vesper Trail toward northeast for approximately 1,000 LF until it reaches the intersection of Spring Hill Road and Leesburg Pike. The alignment continues by crossing under Leesburg Pike, which is anticipated to require trenchless installation. The length of trenchless crossing is approximately 250 LF.

Upstream Segment A collects the flow from Difficult Run Interceptor and three new developments including Dominion Square East, Sunburst, and eastern Dominion Square West.

Upstream Segment B: This upstream segment starts at intersection of Leesburg Pike and Westpark Drive and continues along Leesburg Pike for approximately 2,100 LF until it reaches the intersection of Leesburg Pike and Spring Hill Road. This segment collects the flow from the Evolution and Piazza at Tysons developments before merging with the Upstream Segment A segment coming from West. This segment could potentially be extended as far as West Park Drive if needed.

Downstream Segment: The downstream segment of the trunk sewer line collects the flow from Upstream Segment A and Upstream Segment B. The line continues toward northwest along Leesburg Pike for approximately 1,400 LF. The trunk sewer line then turns toward northeast and continue along Industrial Way for approximately 1,000 LF until it reaches the Tysons West Pump Station.

1.2.8 Summary of Flow Data for the New Developments

Table 1-2 presents the flow calculations and a detailed breakdown of land use for each of the six developments that will be served by the new gravity trunk sewer.

Table 1-2: Flow Calculations for Tysons West New Developments

DEVELOPMENT INFORMATION											FLOW FACTORS					Total Flow	
Development	Building No.	No. of Dwellings	Residential sq. ft.	Dwellings (avg/unit) sq. ft.	Hotel Rooms	Hotel sq. ft.	Retail sq. ft.	Office sq. ft.	Theater Seats	Total Area sq. ft.	Dwelling Flow (gpd/ea) 300	Hotel Flow(gpd/ea) 130	Retail Flow (gpd/sf) 0.25	Office Flow (gpd/sf) 0.2	Theater Flow (gpd/seat) 5	gpd	MGD
The View at Tysons	C-1	0	0	0	0	0	37622	544756	0	582378	0	0	9406	108951	0	118357	0.118
	D-1	125	246518	1972	250	294808	11123	0	0	552449	37500	32500	2781	0	0	72781	0.073
	C-2A	395	562491	1424	0	0	7948	0	0	570439	118500	0	1987	0	0	120487	0.120
	C-2B	310	331415	1069	0	0	14827	0	0	346242	93000	0	3707	0	0	96707	0.097
	C-3	0	0	0	0	0	20187	873830	0	894017	0	0	5047	174766	0	179813	0.180
	PAC	0	0	0	0	0	0	0	525	42624	0	0	0	0	2625	2625	0.003
		830	**1140424**		**250**	**294808**	**91707**	**1418586**		**2988149**	**249000**	**32500**	**22927**	**283717**	**2625**	**590769**	**0.591**
Piazza at Tysons	A	450	540000	1200	0	0	15000	0	0	555000	135000	0	3750	0	0	138750	0.139
	B	325	390000	1200	350	250000	24000	0	0	664000	97500	45500	6000	0	0	149000	0.149
	C	0	0	0	0	0	52000	675000	0	727000	0	0	13000	135000	0	148000	0.148
		775	**930000**		**350**	**250000**	**91000**	**675000**	**0**	**1946000**	**232500**	**45500**	**22750**	**135000**	**0**	**435750**	**0.436**
The Evolution	**NA**	**1400**	**1680000**	**1200**	**0**	**0**	**0**	**0**	**0**	**1680000**	**420000**	**0**	**0**	**0**	**0**	**420000**	**0.420**
Dominion Square West	C1	0	0	0	0	0	20000	475000	0	495000	0	0	5000	95000	0	100000	0.100
	C2	0	0	0	0	0	20000	450000	0	470000	0	0	5000	90000	0	95000	0.095
	C3	420	420000	1000	0	0	15000	0	0	435000	126000	0	3750	0	0	129750	0.130
	C4	430	430000	1000	0	0	15000	0	0	445000	129000	0	3750	0	0	132750	0.133
	C5	320	320000	1000	0	0	15000	0	0	335000	96000	0	3750	0	0	99750	0.100
	C6	330	330000	1000	0	0	5000	0	0	335000	99000	0	1250	0	0	100250	0.100
		1500	**1500000**		**0**	**0**	**90000**	**925000**	**0**	**2515000**	**450000**	**0**	**22500**	**185000**	**0**	**657500**	**0.658**
Dominion Square East	C7	0	0	0	0	0	20000	450000	0	470000	0	0	5000	90000	0	95000	0.095
	C8	0	0	0	0	0	20000	400000	0	420000	0	0	5000	80000	0	85000	0.085
	C9	0	0	0	250	250000	15000	0	0	265000	0	32500	3750	0	0	36250	0.036
	C10	0	0	0	0	0	40000	365000	0	405000	0	0	10000	73000	0	83000	0.083
	C11	250	250000	1000	0	0	15000	0	0	265000	75000	0	3750	0	0	78750	0.079
	C12	250	250000	1000	0	0	15000	0	0	265000	75000	0	3750	0	0	78750	0.079
		500	**500000**		**250**	**250000**	**125000**	**1215000**	**0**	**2090000**	**150000**	**0**	**31250**	**243000**	**0**	**456750**	**0.457**
Sunburst	S1	350	340000	971	0	0	10000	0	0	350000	105000	0	2500	0	0	107500	0.108
	S2	365	365000	1000	0	0	10000	0	0	375000	109500	0	2500	0	0	112000	0.112
	S3 (Option B)	400	400000	1000	0	0	5000	0	0	405000	120000	0	1250	0	0	121250	0.121
	S4		0	0	0	0	5000	275000	0	280000	0	0	1250	55000	0	56250	0.056
	S5 (public facility)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000
		1115	**1105000**		**0**	**0**	**30000**	**275000**	**0**	**1410000**	**334500**	**0**	**7500**	**55000**	**0**	**397000**	**0.397**
																	2.958

Table 1-3 provides a summary of flow information, land use category and total area for the 6 new developments that will be connected to the new gravity sewer trunk.

Table 1-3: Summary of New Developments Total Flow, Area, and Land Category

Development			
The Evolution	Residential	2.99	0.42
Piazza at Tysons	Transit Station Mixed-use Residential/Retail/Office/Hotel	4.31	0.44
The View at Tysons	Transit Station Mixed-use Residential/Retail/Office/Hotel	8.35	0.59
Dominion Square West	Retail/Office/Residential Mixed Use	7.63	0.46
Dominion Square East	Retail/Office/Residential Mixed Use	12.28	0.40
Sunburst	Residential/Office/Retail Mixed Use	4.93	0.66
		Total:	**2.96**

As presented in the Table 1.3, the new gravity trunk sewer will collect 2.96 MGD from the 6 new developments. In addition, the new trunk sewer can handle up to 7.04 MGD from Difficult Run Interceptor that currently flows to the Difficult Run Pump Station. It should be noted that CDM Smith did not perform an evaluation of the current or future flow in the Difficult Run Interceptor. A large flow reduction in the Difficult Run Interceptor could potentially cause maintenance issues in the Interceptor due to very low flow and possible need for downsizing the line in the future.

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