

Concept Study - Final Report
Edwin Raynor Boulevard
Old Crown Drive to Fort Smallwood Road
Open End Agreement No. 8575
AA DPW No. H539612



Prepared For:



Prepared By:



March 14, 2018

TABLE OF CONTENTS

INTRODUCTION 1

DESIGN 1

PLAN 5

UTILITIES 6

STORMWATER MANAGEMENT 8

COST ESTIMATION 12

Appendices

- Appendix A - Roll Plan and Typical Sections
- Appendix B - SWM ESD Computations
- Appendix C - Concept Cost Estimate
- Appendix D - Concept Cost Estimate for Mill & Overlay

Note: The project's email address: H539612@docs.e-builder.net

INTRODUCTION

In August 2007, Anne Arundel County Department of Public Works (DPW) prepared a Conceptual Design Report for Edwin Raynor Boulevard from Magothy Bridge Road to MD 173 (Fort Smallwood Road). The focus of the report was to provide improvements for bicyclists and pedestrians along this section of Edwin Raynor Boulevard. DPW then prepared a 30% Schematic Design Report detailing recommendations based on the Conceptual Design Report. DPW proceeded with 65% Design Development Plans (Contract H542001) in November 2010 (referred to herein as "65% Design Development.") with pedestrian and bicycle improvements along Edwin Raynor Boulevard from Derring Road to MD 173. However, the project was placed on hold, and eventually cancelled by the County following the milestone submission. The 65% Design Plans include widening to provide on-street bike lanes and sidewalks (on both sides) along Edwin Raynor Boulevard from MD 100 to MD 173 (Fort Smallwood Road). There is renewed interest in the project since the County initiated CIP project H569400 (ped / bike enhancements along MD 177, along Edwin Raynor to Old Crown, and the reason this study starts at Old Crown). A County planning study was also performed on MD 177 (Mountain Road), which included improvements to Edwin Raynor Boulevard at the MD 177 intersection. Old Crown Drive County.

The County's goal was to value engineer the previous design in an attempt to reduce cost and impacts. The County requested that URS evaluate an alternative concept for bicyclist and pedestrian improvements, including a 10-foot wide multi-use trail on one side of Edwin Raynor Boulevard and 5-foot sidewalk on the other side from Old Crown Drive to Fort Smallwood Road. The multi-use trail will be 10-feet wide or 12-feet wide when no grass buffer strip is possible between the trail and curb. This study did not investigate roadway widening or bike lanes. The primary goal of this concept study is to identify significant impacts (right-of-way, utilities and environmental resources) and to develop a preliminary construction cost estimate.

DESIGN

From the Small Area Plans it is determined that Edwin Raynor Boulevard is classified as a Minor Arterial. The Anne Arundel County Pedestrian and Bicycle Master Plan (Page 68, Table 7 Project Code 10010) lists this as a Project Prioritization Tier II site. Tier 2 routes meet at least one of the following criteria:

1. The road segment is recommended for improvement by the local government in a local/regional bicycle and/or pedestrian plan;
2. The road segment has a Bicycle Level of Comfort of "E" or "F".

Further, the Pedestrian and Bicycle Master Plan evaluates that the project would provide a continuous walking / biking route to Northeast High School, reducing the bus requirement thereby saving the County operating money. The following Evaluation Form documents the scoring:

Evaluation Criteria Form

Anne Arundel County Pedestrian and Bicycle Master Plan Project Evaluation Criteria Form

Project Name:

Edwin Raynor Boulevard
Old Crown Drive to Fort Smallwood Road

SERVICE

- _____ Completes a missing link
(+1 max; link of 1/4 mi or less)
- _____ Provides access to transit
(+1 for each transit route)
- 1 Provides access to an Elementary, Middle, High School or College
(+1 for each school or college) (Northeast High School)
- 1 Provides access to a Recreational Facility (Tick Neck Park)
(+1 for each Community Recreational Center, Senior Center, or Park Entrance)
- 1 Provides access to a Shopping Center
(+1 for each Shopping Center) (Chesterfield Plaza)
- _____ Provides access to a Government Facility
(+1 for each Government Facility)
- 1 Enhances community/economic development objectives
(+1 max)
- 1 Provides or enhances countywide and/or regional network connectivity
(+1 max; Greater than 1/4 mile link between networks)
- 5 TOTAL

STRUCTURE (+1 max for each)

- 1 Availability of public right-of-way (ROW)
- 1 Avoids private right-of-way (ROW) or has the potential for a partnership with the property owner
- 1 Avoids or minimizes potential regulatory hurdles
- _____ Short-term implementation
- 1 Constructability
- 4 TOTAL

PROJECT EVALUATION CRITERIA SCORE (SERVICE + STRUCTURE)

9 TOTAL

The posted speed limit in the corridor is 40 mph. Lane widths are proposed to be maintained at 11 feet, which may also assist to reduce speeding in the corridor.

Design parameters and criteria were developed for typical sections for each unique segment along Edwin Raynor Boulevard. Resources for establishing these criteria include County requirements and design policies from the following:

- Anne Arundel County Design Manual
- AASHTO Guide for Bicycle Facilities 2012
- AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities 2004
- AASHTO Policy on Geometric Design of Highways and Streets 2011
- Americans with Disabilities Act Accessibility Guidelines
- SHA Bike Policy Design Guide 2015
- SHA Guidelines for Traffic Barrier Placement and End Treatment Design 2006

See ‘Existing, Required and Provided’ criterion in **Table 1** that examines and lists the various items.

Table 1: 'Existing, Required and Provided' Criterion:

	Criterion	EXISTING	REQUIRED	PROVIDED	REMARKS
ROADWAY	Design Speed	40 mph (Posted)	45 mph	45 mph	
	Stopping Sight Distance		360 ft		AASHTO Green Book 2011, Table 3.1
	Centerline to Face of Curb Distance		18 ft	18 ft	Anne Arundel County Design Manual, P-2
	Lane Widths		11 ft	11 ft	AASHTO Green Book 2011, pg. 7-29
	Turn Lane Widths		10 ft		AASHTO Green Book 2011, pg. 7-30
	Shoulder Widths	10 ft	2 ft	6 ft	AASHTO Green Book 2011, pg. 4-10 (4' to 6' preferable)
	Bike Lane Widths	N/A	5' + gutter pan	5' to 6' + gutter pan	SHA Bike Policy and Design Guide, Table 2.1
	Clear Zone/Roadside Grading		24 ft	24 ft	SHA Guidelines for Traffic Barrier Placement and End Treatment Design 2006, Table 1
	Max. Foreslopes & Grass Median Slopes		2:1	2:1	
	Max. Backslopes in Cut (within clear zone)		2:1	2:1	
SIDEWALK AND MULTI-USE TRAIL	Sidewalk Width	4 ft	4 ft	5 ft	County Requirement 4', ADA Standard 5'
	Sidewalk Cross Slope		2%	2%	Anne Arundel County Standard No. 1/15
	Sidewalk Buffer Slope		4%	4%	Anne Arundel County Standard No. 1/15
	Sidewalk Thickness		4"	4"	Anne Arundel County Standard No. 1/15
	Multi-use Trail Width - No Grass Buffer	N/A	10 ft	12 ft	SHA Bike Policy Design Guide, pg 7.1
	Multi-use Trail Width - With Grass Buffer	N/A	10 ft	10 ft	SHA Bike Policy Design Guide, pg 7.1
	Trail Shoulder Width (Grass)	N/A	2 ft	2 ft	SHA Bike Policy Design Guide, pg 7.1
	Maximum Trail Shoulder Slope	N/A	6:1	6:1	SHA Bike Policy Design Guide, pg 7.2
	Open Section Buffer	N/A	6 ft	6 ft	AASHTO Guide for the Planning, Design, and Operation of Ped Facilities 2004
	Horizontal Clearance		3 ft		SHA Bike Policy Design Guide, pg 7.2
	Vertical Clearance		8 ft		SHA Bike Policy Design Guide, pg 7.2 (10' recommended)
	Minimum Grade		0.50%		Recommended for drainage and constructability
	Maximum Grade (running slope)		4.50%		SHA Bike Policy and Design Guide, ADA (Except if following Road Grades)
	Max. Cross slope (for design)		2.00%		SHA Bike Policy Design Guide, pg 7.2
	Safety Fence Requirements				
Max. Drop Behind 3:1 Slopes	N/A	6 ft		AASHTO Guide for Bicycle Facilities, pg 5-6	
Max. Drop Behind 2:1 Slopes	N/A	4 ft		AASHTO Guide for Bicycle Facilities, pg 5-6	

PLAN

See Appendix A for the a roll plan of the plan for the corridor and the Typical Sections.

The study determined the east side Edwin Raynor Boulevard was the most advantageous for placement of the multi-use trail. Use of the northbound eastern side of Edwin Raynor Boulevard minimizes environmental impact, reduces earthwork and minimizes right-of-way needs. Placement of the multi-use trail on the east side allows for the sidewalk on the western side to remain between Tick Neck Road and Ft. Smallwood Road.

Use of a grass buffer of 3 feet in width between the back of curb and multi-use trail is advantageous because it will buffer trail users and increase safety. In addition, it reduces pavement because a 10 foot trail may be used whereas a 12 foot trail would be needed if there is no buffer and the trail is placed at back of curb. There are also minimal utility impacts on the eastern side, and no major utility relocation would be expected. Median guardrail is proposed between roadway and trail to provide needed safety to trail users.

A retaining wall will be required on the west side between Old Crown Drive and Marble Arch Drive, for a distance of about 475 linear feet. This same segment of road matches the proposed lane configuration and roadway widening proposed in the 65% Design Development plans to account for future work from Mountain Road to Old Crown Drive.

Guardrail will be needed to protect motorists where steep 2:1 sideslopes exist. Safety fencing for pedestrian will be placed at top of slope, especially where slopes may be hazardous such as at the 96" culvert. Some private wooden screen fences or chain link fences may be impacted and will require replacement because either of encroachment or right-of-way needs. New decorative fencing may be required at other locations.

Drainage design will match the configuration of the 65% Design Development plans in terms of inlet placement and piping.

Traffic signal upgrades will be required at two intersections, including ADA upgrades - at Old Crown Drive and Ft. Smallwood Road. Ramps and crosswalks will need to match the multi-use trail width.

Pavement design recommendations are based on the site visit results, pavement condition and the 65% Design Development Plans. This study recommends additional full-depth pavement between Countryside Drive and Ripple Court, which was not account for in the 65% estimate.



Typical pavement condition

UTILITIES

As part of the concept study, URS evaluated the utilities designated on the 65% Design Development Plan Submission of November of 2010. The Utility Matrix developed identifies the location of the major utilities along the project corridor.

The matrix is divided into sections based on segments between the major intersections along Edwin Raynor Boulevard. The matrix identifies three (3) possible locations for each utility and segment; LT indicates that the utility falls left of the alignment and outside of the existing edge of pavement, ROAD indicates that the existing utility is located under the existing pavement box and may be either left or right of the alignment, and RT indicates that the utility falls right of the alignment and outside of the existing edge of pavement. An “X” indicates that the utility runs along the majority, if not the entire corresponding segment at the identified location.

UTILITY MATRIX																
Side Street Left	Sanitary Sewer			Water			Electric			Gas			Telephone/ Communications			Side Street Right
	LT	ROAD	RT	LT	ROAD	RT	LT	ROAD	RT	LT	ROAD	RT	LT	ROAD	RT	
Littleton Way to Bradley Dr							X			X		X	X		X	Old Crown Dr to Marble Arch Dr
Bradley Dr to Countryside Dr							X						X		X	Marble Arch Dr to Countryside Dr
Countryside Dr to Ripple Ct				X									X			Countryside Dr to Ripple Ct
Ripple Ct to Tick Neck Rd					X		X						X		X	Ripple Ct to Pekin Dr
Tick Neck Rd to Park Entrance	UNKNOWN														Pekin Dr to Fort Smallwood Rd	

NOTE:

- X under "LT" column indicates utility falls outside the existing pavement, left of the alignment
- X under "Road" column indicates utility falls inside the existing pavement
- X under "RT" column indicates utility falls outside the existing pavement, right of the alignment
- Fiber Optic Cable From Country Side Dr to Ripple Ct LT based on field observation and is not shown on the roll plot

It is important to note that all electric along the corridor is underground, meaning there are no expected impacts to utility poles based on the developed concept. Based on a field investigation in February of 2017, there has been a recently installed fiber optic cable the runs along the west side of Edwin Raynor Boulevard from Bradley Drive to Tick Neck Road. This utility does not appear on the roll plan.

Lastly, the utility designation from the 65% Design Development Plan stops at the intersection of Edwin Raynor Boulevard and Tick Neck Road. Therefore, potential utility conflicts are unknown for the final segment of the project.

To supplement the Utility Matrix, a Utility Crossing Table was developed to show the location where utilities cross the alignment.

UTILITY CROSSING TABLE	
UTILITY	STATION
Water	Sta. 167+16
Sanitary	Sta. 167+28
Gas	Sta. 167+62
Electric	Sta. 167+67
Electric	Sta. 167+73
Telephone	Sta. 167+76
Telephone	Sta. 167+78
Gas	Sta. 170+87
Telephone	Sta. 172+12
Sanitary	Sta. 172+68
Water	Sta. 172+80
Electric	Sta. 173+19
Telephone	Sta. 173+20
Telephone	Sta. 173+30
Telephone	Sta. 173+35
Telephone	Sta. 184+46
Water	Sta. 184+73
Telephone	Sta. 185+16
Electric	Sta. 185+19
Telephone	Sta. 185+25
Sanitary	Sta. 186+92
Sanitary	Sta. 193+59
Water	Sta. 199+99
Electric	Sta. 204+72
Telephone	Sta. 204+90
Water	Sta. 210+91
Gas	Sta. 211+10
Electric	Sta. 211+21
Telephone	Sta. 211+23
Telephone	Sta. 211+37
Electric	Sta. 211+40

STORMWATER MANAGEMENT

INTRODUCTION

URS evaluated the conceptual stormwater management (SWM) options for the project. The conceptual SWM design was prepared in accordance with the requirements as stipulated in the Maryland Department of the Environment's (MDE) *2000 Maryland Stormwater Design Manual, Volumes I and II* including the April, 2009 update. The 2009 revisions to the SWM Manual promotes use of small scaled, nonstructural Environmental Site Design (ESD) to mimic natural pre-development patterns, to the maximum extent practicable (MEP). Providing the full computed ESD volume satisfies both the water quality and channel protection volume. Pedestrian and bike improvements were originally designed along Edwin Raynor from Derring to MD 173 under County Contract # H542001; however that contract has subsequently been removed from the County's CIP. A renewed interest in project has come about since the County initiated CIP project H569400 (Ped/Bike enhancements along MD 177, which includes along Edwin Raynor to Old Crown). Based on this information, it was determined to begin this study at Old Crown Drive.

ANALYSIS

Environmental Site Design (ESD) sizing criteria is used to determine the overall requirement for water quality. An impervious area analysis indicates the existing site area within the proposed Limit of Disturbance (LOD) is 49% impervious. Therefore, the proposed stormwater management design will follow the Redevelopment Policy as defined in Section 5.5 of the Stormwater Design Manual.

Per the redevelopment criteria, at least 50% of the existing impervious area within the LOD is required to be reduced and/or ESD practices should be implemented to provide water quality treatment for the same amount of existing impervious area. Any net increase in impervious area will be treated 100% per the new development policy. The computations to support this determination are shown in Table 2 below with detailed support computations in Appendix B.

Table 2: Impervious Area Summary

Edwin Raynor	Existing Conditions		Proposed Conditions	
	Impervious Area (ac)	Total Area (ac)	Impervious Area (ac)	Total Area (ac)
LOD				
Total	3.32	6.77	4.41	6.77
Imperviousness	49%		65%	

The proposed improvements will include 1.52 acres of new impervious, but 0.43 acres of removed impervious result in result in a net increase of 1.09 acres of impervious area. According to the USDA’s Soil Maps, the soil type within the project is predominately Hydrologic Soil Group Type A. Thus, per Table 5.3 of the SWM Manual, a PE (rainfall target used to determine ESD goal to mimic wooded condition, and to size ESD practices) of 2.2” for Type A soils is required to provide both water quality and quantity treatment for the 1.09 acre net impervious area increase based on the percent impervious of the entire project area. Any reconstructed impervious surfaces within the LOD will use 1.0” for 50% of the existing surface. The required ESDv for the project is determined to be 13,770 cubic feet and the Impervious Area Requiring Treatment (IART) is 1.91 Acres

Table 3: Water Quality Treatment Summary

Project Site	Impervious Area Requiring Treatment (ac)	Impervious Area Requiring Treatment Provided (ac)	ESDv Required (cf)	ESDv Provided (cf)
Edwin Raynor Blvd.	2.69	1.91	13,770	14,886

The project site provides several opportunities to implement the ESD requirement:

Swales

Swales are ESD practices that provide conveyance, water quality treatment, and flow attenuation of stormwater runoff. Swales with a minimum of a 2-foot bottom and 3:1 side slopes as well as maximum channel slopes of 4% will provide pollutant removal through vegetative filtering, sedimentation, biological uptake, and infiltration into the underlying soil media. This option will be suitable where outfall and tie-in points are available. The linear nature of the project will provide adequate locations to place swales behind the back of the multi-use trail; however will require additional right-of-way to implement. Since the multi-trail will be installed in closed roadway sections, modified open back COG inlets will be required to convey the flows to the facilities.

In order to meet the ESD requirements, three grass swales were proposed along the east side (multi-use trail side) of Edwin Raynor Boulevard. These locations were selected based on minimizing the amount of ROW required as well as identifying sites where stable outfalls could be provided from the facility.

Micro-Bioretention

Micro-Bioretention facilities are practices that capture and treat runoff from discrete impervious areas by passing it through a filter bed mixture of sand, soil, and organic matter. Stormwater runoff is stored temporarily and returned to the conveyance system and partially infiltrated into the soil. Micro-bioretention is an ESD practice constrained by a maximum drainage area of

20,000 square feet. The location where a facility is feasible is limited due to the amount of space required for the facility footprint and the ROW needed as a result.

Two micro-bioretenion facilities are proposed at the north end of the project at the intersection of Edwin Raynor Boulevard & Fort Smallwood Road. This site was chosen due to the amount of ROW available at the south east corner of the intersection for an ESD facility. Due to the drainage area requirement, two micro-bioretenion facilities are proposed side by side to maximize the ESD by utilizing all the space available to the MEP at this location.

Table 4 summarizes the individual ESDv provided for each facility.

Table 4: ESD Facilities Summary

Name	Facility Type	Drainage Area (ac)	ESDv Provided (cf)	Impervious Area Treated (ac.)
MB-1	Micro-Bioretenion	0.45	2,696	0.35
MB-2	Micro-Bioretenion	0.45	2,120	0.27
GS-1	Grass Swale	0.26	1,326	0.17
GS-2	Grass Swale	0.93	4,756	0.61
GS-3	Grass Swale	0.80	3,988	0.51
TOTAL			14,886	1.91

Based on the computations, ESD has been provided in excess of the maximum extent practicable (MEP) via the use of two micro-bioretenion facilities and three grass swales. The proposed ESD practice will fulfill the Water Quality Volume (WQv) and Channel Protection Volume (CPv) for this project thus satisfying both the water quality and quantity requirements. However, the impervious area requiring treatment falls short of design goal. All ESD Computations for the site requirements and facility design are in **Appendix A**.

ALTERNATIVE ASSESSMENT

The following options may be considered as alternatives or supplemental to the facilities described above to help meet the ESD requirements to the MEP as necessary on the project.

Filtterra[®] Devices

Filtterra[®] devices are MDE approved proprietary devices that are similar to bioretention in its function and application. They take up little space and are confined in a concrete box. The devices are installed upstream of an existing or proposed inlet structure to capture surface runoff from the street and sidewalk. This option would be feasible for this project area because of the linearity of the project and the presence of closed section. Some of the advantages of Filtterra[®] are minimal earthwork, change in localized drainage pattern will be minimal, and minimal ROW acquisition. The drawbacks for this practice include initial cost, maintenance cost, and possible utility impact. In addition, the maximum contributing area is 0.48 acres and can limit their feasibility on the project.

Stream Restoration

Based on MDE’s Manual Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated - Guidance for National Pollutant Discharge Elimination System Stormwater Permits (Aug. 2014), stream restoration can be used to provide impervious acre credits for a given project. Table 3.E of the manual specifies that the impervious acre equivalent for stream restoration is 0.01 acre / LF of stream restoration. Depending on the condition of the stream that passes under Edwin Raynor Boulevard at Sta. 193+25, this option may be considered for the project. Further investigation of the stream will be required in order to determine if this is worth consideration by the County and feasible to help meet stormwater requirements.

PERMEABLE PAVEMENT

Although, the County does not have an interest in permeable pavement at this time, it is prudent to note that the use of permeable pavement on the multi-use trail would minimize the amount of right-of-way needed to implement ESD facilities and meet the project requirements.

Based on the guidance in the MDE Environmental Site Design (ESD) Process & Computations July 2010, the equivalent ESD Volume for the permeable pavement was calculated. Although further investigations are required to determine infiltration rates of the soil and locations of all utilities, it was assumed all areas of the trail proposed were feasible for permeable pavement due the presence of predominately Type A soils throughout. The table below shows that the multi-use trail has the potential to provide 10,300 cubic feet of ESD Volume, meeting roughly 75% of the project requirements.

Table 5: Permeable Pavement Summary

Subbase	ESDv/Sq. Ft of Pavement	Area of Trail (SF)	ESDv Provided
12”	0.206	50,000	10,300

CONCLUSION

The concept stormwater management design developed for this study meets the ESD requirements for the project. The ESD volume is provided by 5 different potential facilities; 2 micro-bioretention facilities and 3 grass swales. Filterra® devices, stream restoration, and permeable pavements are other alternatives that may be examined to help meet ESD requirements and minimize the amount of ROW required for the project.

COST ESTIMATION

Concept Study Estimate:

A 15% Concept Cost Estimate is located in Appendix C. The estimated cost is \$5,119,821 excluding administrative and overhead costs and right-of-way costs for Fee Simple and Required Easement.

The prior 65% Design Development Estimate dated December 2010 was analyzed for a reduced limits option to match the limits of this Concept Study. Its total is \$3,999,872.

To value engineer this project some scope reductions will need to occur.

Mill & Overlay Estimate:

Also, a probable conceptual estimate of cost just for Mill & Overlay of the existing roadway limits is provided in Appendix D.

Appendix A **Roll Plan, Typical Sections and Cross-Sections**

See attached roll plan and typical sections

Appendix B
SWM ESD Computations

ESD Requirements

Project : Edwin Raynor Blvd.

Designed by: DMT

Checked by: SJM

POI: Study Area

Date: 1/18/2018

1. Determine Development Condition for SWM Study Area

SWM Study Area = 6.77 ac (Area within LOD)
 Existing Imp. = 3.32 ac
 % Impervious = 49 %
 POI qualifies as **RE-development**

2. Determine Impervious Area to be Treated (IART)

HSG	IAnew	IArec (ac.)	Loss of Water Quality (ac.)	IA rem (ac.)	IART
A	1.520	2.760	0.000	0.430	2.69
B					0.00
C					0.00
D					0.00
	1.52	2.76	0.00	0.43	2.69

If New Development:

$$IART = IA_{new} + IA_{rec} + LOWQ - IA_{rem}$$

$$IART = \underline{\hspace{2cm}} \text{ ac}$$

If ReDevelopment:

$$IART = (IA_{new} - IA_{rem}) + 0.5(IA_{rec} + IA_{rem}) + LOWQ$$

$$IART = \underline{2.69} \text{ ac}$$

3. Determine Pe Required

Find P_E

HSG	IART (ac.)	P_E (in)
A	2.69	2.2
B	0.00	0.0
C	0.00	0.0
D	0.00	0.0
	2.69	2.20

use Table 5.3 and Proposed % Impervious of the Drainage Area

<= PE weighted

4. Determine WQv Required

$$WQv = (1.0" \times 0.95 \times IART) / 12$$

$$WQv = \underline{9,259} \text{ cf}$$

5. Determine ESDv Required

If New Development:

$$\text{ESDv} = \text{Pe} \times 0.95 \times \text{IART} / 12$$

$$\text{ESDv} = \underline{\hspace{2cm}} \text{ cf}$$

If ReDevelopment:

$$\text{ESDv} = (\text{Pe} \times 0.95 \times [\text{IAnew} - \text{IArem}]) / 12 + (1" \times 0.95 \times (50\%) [\text{IArec} + \text{IArem}]) / 12 + (1" \times 0.95 \times \text{LOWQ}) / 12$$

$$\text{ESDv} = \underline{13,770} \text{ cf}$$

If New Development:

$$\text{ESDv min} = 1" \times 0.95 \times \text{IART} / 12$$

$$\text{ESDv min} = \underline{0} \text{ cf}$$

If ReDevelopment:

$$\text{ESDv min} = 1" \times 0.95 \times \Delta \text{Ai} / 12$$

$$\text{ESDv min} = \underline{3,759} \text{ cf}$$

6. Determine Recharge Volume Required (Rev)

Rev is met if WQ is provided by ESDv measures without sub-drains. If not, provide Rev below sub-drains.

Find S

HSG	IArec (ac.)	Recharge Factor (S)
A	2.69	0.38
B	0.00	0.26
C	0.00	0.13
D	0.00	0.07
	2.69	0.38

<= S weighted

If New Development:

$$\text{Rev} = \text{S} \times 0.95 \times \text{IART} / 12$$

$$\text{Rev} = \underline{\hspace{2cm}} \text{ cf}$$

If ReDevelopment:

$$\text{Rev} = \text{S} \times 0.95 \times \Delta \text{Ai} / 12$$

$$\text{Rev} = \underline{1,428} \text{ cf}$$

Project: Edwin Raynor Project No. _____ Printed 1/18/2018
 Description: ESD Calculations Computed By DMT Date 5/26/2017
Grass Swale 1 - Sta. 193+00 Checked By SJM Date 6/22/2017

Pre-Development Conditions: Grass Swale, ESD 1

HSG	RCN	Area (ac)	Percent (%)
A	38	0.26	100.0%
B	55		0.0%
C	70		0.0%
D	77		0.0%

Total 0.26

GS-1

Composite RCN for "Woods in Good Condition"

$$RCN_{woods} = 38$$

Target P_E Using Table 5.3:

$$\begin{aligned} \text{Imp. Area} &= 0.17 \text{ ac} \\ \text{Total Area} &= 0.26 \text{ ac} \\ I &= 65.4\% \end{aligned}$$

P_E by Soil Group

$$\begin{aligned} A &= 2.2 \text{ in} \\ B &= 0 \text{ in} \\ C &= 0 \text{ in} \\ D &= 0 \text{ in} \end{aligned}$$

$$\text{Target } P_E = 2.20 \text{ in}$$

Environmental Site Design Volume:

$$\begin{aligned} R_v &= 0.05 + 0.009(I) \\ &= 0.64 \\ Q_E &= P_E \times R_v \\ &= 1.405 \text{ in} \\ \text{ESD}_v &= (Q_E \times A) / 12 \\ &= 1326 \text{ cf} \end{aligned}$$

Environmental Site Design Discharge:

$$\begin{aligned} CN &= 70 \\ T_c &= 5 \text{ min} \\ I_a &= 0.86 \\ I_a/P_E &= 0.39 \\ q_u &= 1000 \text{ from Figure D.11.1} \\ Q_p &= q_u \times A \times Q_E \\ &= 0.57 \text{ cfs} \end{aligned}$$

Project: Edwin Raynor Project No. 0 Printed 1/18/2018
 Description: ESD Calculations Computed By DMT Date 5/26/2017
Grass Swale 1 - Sta. 193+00 Checked By SJM Date 6/22/2017

Swale Properties: Grass Swale, ESD 1

Actual Facility Properties

Average Bottom Width= 4 ft
 Length= 300 ft
 $A_{f, actual} = 1200$ sf

Determination of Surface Area:

Drainage Area (DA) = 0.26 ac
 Facility Area (A_f) = 0.03 ac
 $A_f/DA = 10.60\% > 2\%$

10-Year Flow Depth:

Q10 = cfs (from TR55 calcs)
 d10= ft (from FlowMaster)
 Note: Assumes n value of 0.15.

Proposed ESD Flow Depth:

Pe = 2.20
 Q1 = cfs (from TR55 calcs)
 d1= ft (from FlowMaster)
 v1= ft/sec (from FlowMaster)

Freeboard

Roadway Elevation =
 Swale bottom Elev. = ft
 Water Elevation = 0 ft
 Freeboard = 0.00 ft

Project: Edwin Raynor Project No. _____ Printed 1/18/2018
 Description: ESD Calculations Computed By DMT Date 5/26/2017
Grass Swale 2 - Sta. 195+00 Checked By SJM Date 6/22/2017

Pre-Development Conditions: Grass Swale, ESD 2

HSG	RCN	Area (ac)	Percent (%)
A	38	0.93	100.0%
B	55		0.0%
C	70		0.0%
D	77		0.0%

GS-2

Total 0.93

Composite RCN for "Woods in Good Condition"

$$RCN_{woods} = 38$$

Target P_E Using Table 5.3:

$$\begin{aligned} \text{Imp. Area} &= 0.61 \text{ ac} \\ \text{Total Area} &= 0.93 \text{ ac} \\ I &= 65.6\% \end{aligned}$$

P_E by Soil Group

$$\begin{aligned} A &= 2.2 \text{ in} \\ B &= 0 \text{ in} \\ C &= 0 \text{ in} \\ D &= 0 \text{ in} \end{aligned}$$

$$\text{Target } P_E = 2.20 \text{ in}$$

Environmental Site Design Volume:

$$\begin{aligned} R_v &= 0.05 + 0.009(I) \\ &= 0.64 \\ Q_E &= P_E \times R_v \\ &= 1.409 \text{ in} \\ \text{ESD}_v &= (Q_E \times A) / 12 \\ &= 4756 \text{ cf} \end{aligned}$$

Environmental Site Design Discharge:

$$\begin{aligned} CN &= 70 \\ T_c &= 5 \text{ min} \\ I_a &= 0.86 \\ I_a/P_E &= 0.39 \\ q_u &= 1000 \text{ from Figure D.11.1} \\ Q_p &= q_u \times A \times Q_E \\ &= 2.05 \text{ cfs} \end{aligned}$$

Project: Edwin Raynor Project No. 0 Printed 1/18/2018
 Description: ESD Calculations Computed By DMT Date 5/26/2017
Grass Swale 2 - Sta. 195+00 Checked By SJM Date 6/22/2017

Swale Properties: Grass Swale, ESD 2

Actual Facility Properties

Average Bottom Width= 4 ft
 Length= 570 ft
 $A_{f, actual} = 2280$ sf

Determination of Surface Area:

Drainage Area (DA) = 0.93 ac
 Facility Area (A_f) = 0.05 ac
 $A_f/DA = 5.63\% > 2\%$

10-Year Flow Depth:

Q10 = cfs (from TR55 calcs)
 d10= ft (from FlowMaster)
 Note: Assumes n value of 0.15.

Proposed ESD Flow Depth:

Pe = 2.20
 Q1 = cfs (from TR55 calcs)
 d1= ft (from FlowMaster)
 v1= ft/sec (from FlowMaster)

Freeboard

Roadway Elevation =
 Swale bottom Elev. = ft
 Water Elevation = 0 ft
 Freeboard = 0.00 ft

Project: Edwin Raynor Project No. _____ Printed 1/18/2018
 Description: ESD Calculations Computed By DMT Date 5/26/2017
Grass Swale 3 - Sta. 205+00 Checked By SJM Date 6/22/2017

Pre-Development Conditions: Grass Swale, ESD 3

HSG	RCN	Area (ac)	Percent (%)
A	38	0.80	100.0%
B	55		0.0%
C	70		0.0%
D	77		0.0%

GS-3

Total 0.80

Composite RCN for "Woods in Good Condition"

$$RCN_{woods} = 38$$

Target P_E Using Table 5.3:

$$\begin{aligned} \text{Imp. Area} &= 0.51 \text{ ac} \\ \text{Total Area} &= 0.80 \text{ ac} \\ I &= 63.8\% \end{aligned}$$

P_E by Soil Group

$$\begin{aligned} A &= 2.2 \text{ in} \\ B &= 0 \text{ in} \\ C &= 0 \text{ in} \\ D &= 0 \text{ in} \end{aligned}$$

$$\text{Target } P_E = 2.20 \text{ in}$$

Environmental Site Design Volume:

$$\begin{aligned} R_v &= 0.05 + 0.009(I) \\ &= 0.62 \\ Q_E &= P_E \times R_v \\ &= 1.373 \text{ in} \\ \text{ESD}_v &= (Q_E \times A) / 12 \\ &= 3988 \text{ cf} \end{aligned}$$

Environmental Site Design Discharge:

$$\begin{aligned} CN &= 70 \\ T_c &= 5 \text{ min} \\ I_a &= 0.86 \\ I_a/P_E &= 0.39 \\ q_u &= 1000 \text{ from Figure D.11.1} \\ Q_p &= q_u \times A \times Q_E \\ &= 1.72 \text{ cfs} \end{aligned}$$

Project: Edwin Raynor Project No. 0 Printed 1/18/2018
 Description: ESD Calculations Computed By DMT Date 5/26/2017
Grass Swale 3 - Sta. 205+00 Checked By SJM Date 6/22/2017

Swale Properties: Grass Swale, ESD 3

Actual Facility Properties

Average Bottom Width= 4 ft
 Length= 540 ft
 $A_{f, actual} = 2160$ sf

Determination of Surface Area:

Drainage Area (DA) = 0.80 ac
 Facility Area (A_f) = 0.05 ac
 $A_f/DA = 6.20\% > 2\%$

10-Year Flow Depth:

Q10 = cfs (from TR55 calcs)
 d10= ft (from FlowMaster)
 Note: Assumes n value of 0.15.

Proposed ESD Flow Depth:

Pe = 2.20
 Q1 = cfs (from TR55 calcs)
 d1= ft (from FlowMaster)
 v1= ft/sec (from FlowMaster)

Freeboard

Roadway Elevation =
 Swale bottom Elev. = ft
 Water Elevation = 0 ft
 Freeboard = 0.00 ft

Project: Edwin Raynor Project No. _____ Printed 1/18/2018
 Description: ESD Calculations Computed By DMT Date 5/26/2017
Micro-Bioretenion 1 Checked By SJM Date 6/22/2017

Pre-Development Conditions: Micro-Bioretenion, ESD 4

HSG	RCN	Area (ac)	Percent (%)
A	38	0.45	100.0%
B	55		0.0%
C	70		0.0%
D	77		0.0%
Total		0.45	

MB-1

Composite RCN for "Woods in Good Condition"

$$RCN_{woods} = 38$$

Target P_E Using Table 5.3:

$$\begin{aligned} \text{Imp. Area} &= 0.35 \text{ ac} \\ \text{Total Area} &= 0.45 \text{ ac} \\ I &= 77.8\% \end{aligned}$$

P_E by Soil Group

$$\begin{aligned} A &= 2.4 \text{ in} \\ B &= 0 \text{ in} \\ C &= 0 \text{ in} \\ D &= 0 \text{ in} \end{aligned}$$

$$\text{Target } P_E = 2.20 \text{ in}$$

Environmental Site Design Volume:

$$\begin{aligned} R_v &= 0.05 + 0.009(I) \\ &= 0.75 \\ Q_E &= P_E \times R_v \\ &= 1.650 \text{ in} \\ ESD_v &= (Q_E \times A) / 12 \\ &= 2696 \text{ cf} \end{aligned}$$

Project: Edwin Raynor Project No. _____ Printed 1/18/2018
 Description: ESD Calculations Computed By DMT Date 5/26/2017
Micro-Bioretenion 2 Checked By SJM Date 6/22/2017

Pre-Development Conditions: Micro-Bioretenion, ESD 5

HSG	RCN	Area (ac)	Percent (%)
A	38	0.45	100.0%
B	55		0.0%
C	70		0.0%
D	77		0.0%
Total		0.45	

MB-2

Composite RCN for "Woods in Good Condition"

$$RCN_{woods} = 38$$

Target P_E Using Table 5.3:

$$\begin{aligned} \text{Imp. Area} &= 0.27 \text{ ac} \\ \text{Total Area} &= 0.45 \text{ ac} \\ I &= 60.0\% \end{aligned}$$

P_E by Soil Group

$$\begin{aligned} A &= 2.0 \text{ in} \\ B &= 0 \text{ in} \\ C &= 0 \text{ in} \\ D &= 0 \text{ in} \end{aligned}$$

$$\text{Target } P_E = 2.20 \text{ in}$$

Environmental Site Design Volume:

$$\begin{aligned} R_v &= 0.05 + 0.009(I) \\ &= 0.59 \\ Q_E &= P_E \times R_v \\ &= 1.298 \text{ in} \\ ESD_v &= (Q_E \times A) / 12 \\ &= 2120 \text{ cf} \end{aligned}$$

Project: Edwin Raynor Project No. _____ Printed 1/18/2018
 Description: ESD Calculations Computed By DMT Date 5/26/2017
Grass Swale 4 - Sta. 175+00 Checked By SJM Date 6/22/2017

Pre-Development Conditions: Grass Swale, ESD 6

HSG	RCN	Area (ac)	Percent (%)
A	38	0.34	100.0%
B	55		0.0%
C	70		0.0%
D	77		0.0%

GS-4

Total 0.34

Composite RCN for "Woods in Good Condition"

$$\text{RCN}_{\text{woods}} = 38$$

Target P_E Using Table 5.3:

Imp. Area = 0.17 ac
 Total Area = 0.34 ac
 I = 50.0%

P_E by Soil Group

A = 1.8 in
 B = 0 in
 C = 0 in
 D = 0 in

Target P_E = 2.20 in

Environmental Site Design Volume:

$$\begin{aligned} R_v &= 0.05 + 0.009(I) \\ &= 0.50 \\ Q_E &= P_E \times R_v \\ &= 1.100 \text{ in} \\ \text{ESD}_v &= (Q_E \times A) / 12 \\ &= 1358 \text{ cf} \end{aligned}$$

Environmental Site Design Discharge:

$$\begin{aligned} \text{CN} &= 70 \\ T_c &= 5 \text{ min} \\ I_a &= 0.86 \\ I_a/P_E &= 0.39 \\ q_u &= 1000 \text{ from Figure D.11.1} \\ Q_p &= q_u \times A \times Q_E \\ &= 0.58 \text{ cfs} \end{aligned}$$

Appendix C
Concept Cost Estimate

EDWIN RAYNOR BOULEVARD
 15% CONCEPT COST ESTIMATE
 BIKE TRAIL AND SIDEWALK OPTION

SEPTEMBER 2017

CATEGORY	DESCRIPTION	15% CONCEPT COST ESTIMATE
1	PRELIMINARY	\$887,212
2	GRADING	\$328,250
3	DRAINAGE	\$830,570
4	STRUCTURES	\$293,313
5	PAVING	\$1,208,304
6	SHOULDERS	\$1,179,702
7	LANDSCAPING	\$121,550
8	SIGNING & LIGHTING	\$224,510
9	UTILITIES	\$46,410
TOTAL CONSTRUCTION COST ESTIMATE		\$5,119,821

The following items are excluded from this Construction Cost Estimate:

- Administration and Overhead
- Right of Way
 - Fee Simple - 24,000 SF
 - Required Easement - 18,000 SF
 - Existing Easement (To Be Used) - 13,000 SF

The following was assumed for this Construction Cost Estimate:

- Proposed pavement section: 2" HMA for Surface, 6" HMA for Base, 8" GAB (matches 65% DD dated 2010)
- Proposed trail section: 2" HMA for Surface, 4" GAB

EDWIN RAYNOR BOULEVARD
 15% CONCEPT COST ESTIMATE
 BIKE TRAIL AND SIDEWALK OPTION

SEPTEMBER 2017

ITEM NUMBER	CATEGORY CODE	CATEGORY 1 - PRELIMINARY	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
1001		CLEARING AND GRUBBING	\$17,500.00	LS	1	\$17,500.00
1002		MAINTENANCE OF TRAFFIC (6% OF CAT. 2-8, includes Ped MOT)	\$193,209.11	LS	1	\$193,209.11
1003		CONSTRUCTION STAKEOUT (2.5% OF CAT. 2-8)	\$80,503.79	LS	1	\$80,503.79
1004		MOBILIZATION (5% OF CAT. 1-8)	\$161,007.59	LS	1	\$161,007.59
1005		TEMPORARY CONCRETE BARRIER FOR MAINTENANCE OF TRAFFIC	\$25.00	LF	5,900	\$147,500.00
1006		RESET TEMPORARY CONCRETE BARRIER FOR MAINTENANCE OF TRAFFIC	\$5.00	LF	8,000	\$40,000.00
1007		ARROW PANEL FOR MAINTENANCE OF TRAFFIC	\$20.00	UD	125	\$2,500.00
1008		DRUMS FOR WARNING AND CHANNELIZATION	\$75.00	EA	70	\$5,250.00
1009		TEMPORARY CRASH CUSHIONS FOR MOT - QUADGUARD CZ	\$3,000.00	EA	2	\$6,000.00
1010		RESET TEMPORARY CRASH CUSHIONS FOR MOT - QUADGUARD CZ	\$500.00	EA	4	\$2,000.00
1011		PORTABLE VARIABLE MESSAGE SIGN FOR MAINTENANCE OF TRAFFIC	\$150.00	UD	180	\$27,000.00

SUBTOTAL						\$682,470.49
CONTINGENCY					30%	\$204,742.00
CATEGORY 1 SUBTOTAL						\$887,212.49

ITEM NUMBER	CATEGORY CODE	CATEGORY 2 - GRADING	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
2001		CLASS 1 EXCAVATION	\$25.00	CY	4,500	\$112,500.00
2002		COMMON BORROW	\$30.00	CY	4,500	\$135,000.00
2003		TEST PIT EXCAVATION	\$100.00	CY	50	\$5,000.00

SUBTOTAL						\$252,500.00
CONTINGENCY					30%	\$75,750.00
CATEGORY 2 SUBTOTAL						\$328,250.00

ITEM NUMBER	CATEGORY CODE	CATEGORY 3 - DRAINAGE	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
3001		ESD FACILITIES	\$200,000.00	LS	1	\$200,000.00
3002		EROSION AND SEDIMENT CONTROL	\$150,000.00	LS	1	\$150,000.00
3003		18 INCH REINFORCED CONCRETE PIPE, CLASS IV	\$100.00	LF	1550	\$155,000.00
3004		60 INCH CORRUGATED METAL PIPE	\$150.00	LF	16	\$2,400.00
3005		STANDARD 10' COG INLET	\$3,000.00	EA	9	\$27,000.00
3006		STANDARD 15' COG INLET	\$4,000.00	EA	2	\$8,000.00
3007		STANDARD 20' COG INLET	\$5,000.00	EA	1	\$5,000.00
3008		ROTATED 10 FOOT COG INLET	\$6,000.00	EA	2	\$12,000.00
3009		MODIFIED 10 FOOT OPEN BACK COG	\$4,500.00	EA	13	\$58,500.00
3010		MODIFIED 10 FOOT OPEN BACK COS	\$4,500.00	EA	1	\$4,500.00
3011		STANDARD REINFORCED CONCRETE PIPE END SECTION	\$1,000.00	EA	4	\$4,000.00
3012		CONCRETE ENDWALL	\$5,000.00	EA	2	\$10,000.00
3013		STANDARD MANHOLE	\$2,500.00	EA	1	\$2,500.00

SUBTOTAL						\$638,900.00
CONTINGENCY					30%	\$191,670.00
CATEGORY 3 SUBTOTAL						\$830,570.00

ITEM NUMBER	CATEGORY CODE	CATEGORY 4 - STRUCTURES	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
4001		RETAINING WALL (CAST CONCRETE, 7' AVERAGE HEIGHT, FOOTING, AND SAFETY RAILING)	\$475.00	LF	475	\$225,625.00

SUBTOTAL						\$225,625.00
CONTINGENCY					30%	\$67,688.00
CATEGORY 4 SUBTOTAL						\$293,313.00

ITEM NUMBER	CATEGORY CODE	CATEGORY 5 - PAVING	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
5001		HOT MIX ASPHALT FOR SURFACE	\$80.00	TON	3,200	\$256,000.00
5002		HOT MIX ASPHALT FOR BASE	\$75.00	TON	4,500	\$337,500.00
5003		GRADED AGGREGATE BASE COURSE	\$10.00	SY	25,500	\$255,000.00
5004		GRINDING ASPHALT PAVEMENT 0 INCH TO 2 INCH	\$5.00	SY	14,300	\$71,500.00
5005		4 INCH WHITE SOLID PAVEMENT MARKINGS	\$0.20	LF	11,000	\$2,200.00
5006		4 INCH DOUBLE YELLOW SOLID PAVEMENT MARKINGS	\$0.60	LF	5,250	\$3,150.00
5007		12 INCH WHITE SOLID PAVEMENT MARKINGS	\$1.10	LF	1,550	\$1,705.00
5008		24 INCH WHITE PREFORMED THERMOPLASTIC PAVEMENT MARKING LINES	\$2.05	LF	210	\$430.50
5009		4 INCH WHITE SOLID PAVEMENT MARKINGS (10' - 30')	\$0.25	LF	300	\$75.00
5010		4 INCH WHITE SOLID PAVEMENT MARKINGS (3' - 9')	\$0.25	LF	175	\$43.75
5011		WHITE PAVEMENT MARKING LEGENDS AND SYMBOLS	\$100.00	EA	10	\$1,000.00
5012		WHITE PAVEMENT MARKING ARROW	\$70.00	EA	10	\$700.00
5013		WHITE PAVEMENT MARKING LETTER	\$40.00	EA	4	\$160.00

SUBTOTAL						\$929,464.25
CONTINGENCY					30%	\$278,840.00
CATEGORY 5 SUBTOTAL						\$1,208,304.25

EDWIN RAYNOR BOULEVARD
 15% CONCEPT COST ESTIMATE
 BIKE TRAIL AND SIDEWALK OPTION

SEPTEMBER 2017

ITEM NUMBER	CATEGORY CODE	CATEGORY 6 - SHOULDERS	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
6001		COMBINATION CURB AND GUTTER	\$30.00	LF	7,350	\$220,500.00
6002		MULTI-USE TRAIL	\$10.00	SF	50,000	\$500,000.00
6003		CONCRETE SIDEWALK	\$5.00	SF	22,500	\$112,500.00
6004		TRAFFIC BARRIER W BEAM	\$25.00	LF	825	\$20,625.00
6005		MEDIAN TRAFFIC BARRIER W BEAM	\$30.00	LF	650	\$19,500.00
6006		TRAFFIC BARRIER END TREATMENT (ANY TYPE)	\$1,000.00	EA	8	\$8,000.00
6007		REMOVAL AND DISPOSAL OF EXISTING TRAFFIC BARRIER W BEAM	\$2.50	LF	535	\$1,337.50
6008		SAFETY FENCE	\$20.00	LF	1,250	\$25,000.00
SUBTOTAL						\$907,462.50
CONTINGENCY						30% \$272,239.00
CATEGORY 6 SUBTOTAL						\$1,179,701.50

ITEM NUMBER	CATEGORY CODE	CATEGORY 7 - LANDSCAPING	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
7001		PLACING FURNISHED TOPSOIL, 2 INCH DEPTH	\$4.00	SY	10,000	\$40,000.00
7002		TURFGRASS ESTABLISHMENT	\$1.00	SY	10,000	\$10,000.00
7003		TEMPORARY SEED	\$0.75	SY	14,000	\$10,500.00
7004		TEMPORARY MULCH	\$0.75	SY	14,000	\$10,500.00
7005		DECORATIVE FENCING	\$75.00	LF	150	\$11,250.00
7006		STREET TREES	\$450.00	EA	25	\$11,250.00
SUBTOTAL						\$93,500.00
CONTINGENCY						30% \$28,050.00
CATEGORY 7 SUBTOTAL						\$121,550.00

ITEM NUMBER	CATEGORY CODE	CATEGORY 8 - SIGNING & LIGHTING	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
8001		SIGNAL IMPROVEMENTS AT OLD CROWN DRIVE AND FT. SMALLWOOD ROAD	\$165,000.00	LS	1	\$165,000.00
8002		RELOCATE / NEW SHEET ALUMINUM SIGNING	\$22.00	SF	350	\$7,700.00
SUBTOTAL						\$172,700.00
CONTINGENCY						30% \$51,810.00
CATEGORY 8 SUBTOTAL						\$224,510.00

ITEM NUMBER	CATEGORY CODE	CATEGORY 9 - UTILITIES	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
9001		REMOVAL AND RELOCATE ROADWAY LIGHTING STRUCTURE	\$3,100.00	EA	4	\$12,400.00
9002		ADJUST EXISTING HANDHOLE	\$1,350.00	EA	3	\$4,050.00
9003		ADJUST WATER VALVE BOX	\$800.00	EA	1	\$800.00
9004		RELOCATE COMMUNICATIONS JUNCTION BOX	\$3,500.00	EA	3	\$10,500.00
9005		ADJUST FIRE HYDRANT AND VALVE	\$7,950.00	EA	1	\$7,950.00
SUBTOTAL						\$35,700.00
CONTINGENCY						30% \$10,710.00
CATEGORY 9 SUBTOTAL						\$46,410.00

EDWIN RAYNOR BOULEVARD
 65% DD COST ESTIMATE
 (prepared by Greenhorne O'Mara, Inc.)
 REDUCED LIMITS OPTION
 DECEMBER 2010

CATEGORY	DESCRIPTION	65% DD COST - 2010
1	PRELIMINARY	\$938,005
2	GRADING	\$217,750
3	DRAINAGE	\$654,992
4	STRUCTURES	\$0
5	PAVING	\$1,119,228
6	SHOULDERS	\$812,390
7	LANDSCAPING	\$90,171
8	SIGNING & LIGHTING	\$167,336
9	MATERIALS	\$0
TOTAL CONSTRUCTION COST ESTIMATE		\$3,999,872

The following items are excluded from this Construction Cost Estimate:

- Utility Relocations
- Administration and Overhead
- Right of Way

The following was assumed for this Construction Cost Estimate:

Proposed pavement section: 2" HMA for Surface, 6" HMA for Base, 8" GAB (per 65% DD pavement typical)

EDWIN RAYNOR BOULEVARD
65% DD COST ESTIMATE
(prepared by Greenhorne O'Mara, Inc.)
REDUCED LIMITS OPTION
DECEMBER 2010

ITEM NUMBER	CATEGORY CODE	CATEGORY 1 - PRELIMINARY	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
1001		CLEARING AND GRUBBING	\$100,000.00	LS	1	\$100,000.00
1002		MAINTENANCE OF TRAFFIC (8% OF CAT. 2-8)	\$188,422.45	LS	1	\$188,422.45
1003		CONSTRUCTION STAKEOUT (2% OF CAT. 2-8)	\$47,105.61	LS	1	\$47,105.61
1004		MOBILIZATION (5% OF CAT. 1-8)	\$117,764.03	LS	1	\$117,764.03
1005		TEMPORARY CONCRETE BARRIER FOR MAINTENANCE OF TRAFFIC	\$25.00	LF	5,900	\$147,500.00
1006		RESET TEMPORARY CONCRETE BARRIER FOR MAINTENANCE OF TRAFFIC	\$5.00	LF	8,000	\$40,000.00
1007		ARROW PANEL FOR MAINTENANCE OF TRAFFIC	\$20.00	UD	125	\$2,500.00
1008		DRUMS FOR WARNING AND CHANNELIZATION	\$75.00	EA	70	\$5,250.00
1009		TEMPORARY CRASH CUSHIONS FOR MOT - C	\$3,000.00	EA	2	\$6,000.00
1010		RESET TEMPORARY CRASH CUSHIONS FOR MOT - QUADGUARDCZ	\$500.00	EA	4	\$2,000.00
1011		PORTABLE VARIABLE MESSAGE SIGN FOR MAINTENANCE OF TRAFFIC	\$100.00	UD	250	\$25,000.00
1012		PROTECTION VEHICLE FOR MAINTENANCE OF TRAFFIC	\$200.00	UD	125	\$25,000.00
1013		TRUCK MOUNTED ATTENUATORS	\$150.00	EA	100	\$15,000.00

SUBTOTAL						\$721,542.08
CONTINGENCY					30%	\$216,463.00
CATEGORY 1 SUBTOTAL						\$938,005.08

ITEM NUMBER	CATEGORY CODE	CATEGORY 2 - GRADING	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
2001		CLASS 1 EXCAVATION	\$25.00	CY	3,500	\$87,500.00
2002		COMMON BORROW	\$30.00	CY	2,500	\$75,000.00
2003		TEST PIT EXCAVATION	\$100.00	CY	50	\$5,000.00

SUBTOTAL						\$167,500.00
CONTINGENCY					30%	\$50,250.00
CATEGORY 2 SUBTOTAL						\$217,750.00

ITEM NUMBER	CATEGORY CODE	CATEGORY 3 - DRAINAGE	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
3001		E&SC AND SWM (25% OF ROADWAY & STORMDRAIN QUANTITY)	\$397,939.81	LS	1	\$397,939.81
3002		18 INCH REINFORCED CONCRETE PIPE, CLASS IV	\$100.00	LF	650	\$65,000.00
3003		60 INCH CORRUGATED METAL PIPE	\$150.00	EA	16	\$2,400.00
3004		STANDARD 10' COG INLET	\$3,000.00	EA	6	\$18,000.00
3005		STANDARD 15' COG INLET	\$4,000.00	EA	2	\$8,000.00
3006		STANDARD 20' COG INLET	\$5,000.00	EA	2	\$10,000.00
3007		STANDARD MANHOLE	\$2,500.00	EA	1	\$2,500.00

SUBTOTAL						\$503,839.81
CONTINGENCY					30%	\$151,152.00
CATEGORY 3 SUBTOTAL						\$654,991.81

ITEM NUMBER	CATEGORY CODE	CATEGORY 4 - STRUCTURES	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
NO CATEGORY 4 ITEMS						

SUBTOTAL						\$0.00
CONTINGENCY					30%	\$0.00
CATEGORY 4 SUBTOTAL						\$0.00

ITEM NUMBER	CATEGORY CODE	CATEGORY 5 - PAVING	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
5001		HOT MIX ASPHALT FOR SURFACE	\$80.00	TON	3,231	\$258,480.00
5002		HOT MIX ASPHALT FOR BASE	\$75.00	TON	3,878	\$290,850.00
5003		GRADED AGGREGATE BASE COURSE	\$10.00	SY	21,975	\$219,750.00
5004		GRINDING ASPHALT PAVEMENT 0 INCH TO 2 INCH	\$5.00	SY	16,480	\$82,400.00
5005		4 INCH WHITE SOILD PAVEMENT MARKINGS	\$0.20	LF	11,000	\$2,200.00
5006		4 INCH DOUBLE YELLOW SOILD PAVEMENT MARKINGS	\$0.60	LF	5,250	\$3,150.00
5007		12 INCH WHITE SOILD PAVEMENT MARKINGS	\$1.10	LF	1,550	\$1,705.00
5008		24 INCH WHITE PREFORMED THERMOPLASTIC PAVEMENT MARKING LINES	\$2.05	LF	210	\$430.50
5009		4 INCH WHITE SOILD PAVEMENT MARKINGS (10' - 30')	\$0.25	LF	300	\$75.00
5010		4 INCH WHITE SOILD PAVEMENT MARKINGS (3' - 9')	\$0.25	LF	175	\$43.75
5011		WHITE PAVEMENT MARKING LEGENDS AND SYMBOLS	\$100.00	EA	10	\$1,000.00
5012		WHITE PAVEMENT MARKING ARROW	\$70.00	EA	10	\$700.00
5013		WHITE PAVEMENT MARKING LETTER	\$40.00	EA	4	\$160.00

SUBTOTAL						\$860,944.25
CONTINGENCY					30%	\$258,284.00
CATEGORY 5 SUBTOTAL						\$1,119,228.25

EDWIN RAYNOR BOULEVARD
65% DD COST ESTIMATE
(prepared by Greenhorne O'Mara, Inc.)
REDUCED LIMITS OPTION
DECEMBER 2010

ITEM NUMBER	CATEGORY CODE	CATEGORY 6 - SHOULDERS	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
6001		COMBINATION CURB AND GUTTER	\$30.00	LF	3,310	\$99,300.00
6002		CONCRETE SIDEWALK	\$7.00	SF	32,615	\$228,305.00
6003		TRAFFIC BARRIER W BEAM	\$30.00	LF	2,687	\$80,610.00
6004		TRAFFIC BARRIER END TREATMENT (ANY TYPE)	\$1,000.00	EA	8	\$8,000.00
6005		SAFETY FENCE	\$20.00	LF	435	\$8,700.00
6006		RETAINING WALL	\$200,000.00	LS	1	\$200,000.00
SUBTOTAL						\$624,915.00
CONTINGENCY						30% \$187,475.00
CATEGORY 6 SUBTOTAL						\$812,390.00

ITEM NUMBER	CATEGORY CODE	CATEGORY 7 - LANDSCAPING	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
7001		PLACING FURNISHED TOPSOIL, 2 INCH DEPTH	\$4.00	SY	10,671	\$42,684.00
7002		TURFGRASS ESTABLISHMENT	\$1.00	SY	10,671	\$10,671.00
7003		TEMPORARY SEED	\$0.75	SY	10,671	\$8,003.25
7004		TEMPORARY MULCH	\$0.75	SY	10,671	\$8,003.25
SUBTOTAL						\$69,361.50
CONTINGENCY						30% \$20,809.00
CATEGORY 7 SUBTOTAL						\$90,170.50

ITEM NUMBER	CATEGORY CODE	CATEGORY 8 - SIGNING & LIGHTING	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
8000		ELECTRICAL CABLE - 2 CONDUCTOR (ALUMINUM SHIELDED)	\$2.50	LF	1,800	\$4,500.00
8001		ELECTRICAL CABLE - 2 CONDUCTOR (NO. 14 AWG)	\$1.50	LF	500	\$750.00
8002		ELECTRICAL CABLE - 3 CONDUCTOR (NO. 14 AWG)	\$2.00	LF	900	\$1,800.00
8003		ELECTRICAL CABLE - 5 CONDUCTOR (NO. 14 AWG)	\$2.50	LF	450	\$1,125.00
8004		ELECTRICAL CABLE - 7 CONDUCTOR (NO. 14 AWG)	\$2.75	LF	1,000	\$2,750.00
8005		ELECTRICAL CABLE - 2 CONDUCTOR (NO. 12 AWG)	\$1.50	LF	150	\$225.00
8006		SAW CUT FOR SIGNAL (LOOP DETECTOR)	\$10.00	LF	432	\$4,320.00
8007		12" LED VEHICULAR TRAFFIC SIGNAL HEAD SECTION	\$350.00	EA	44	\$15,400.00
8008		8 " VEHICULAR TRAFFIC SIGNAL HEAD SECTION	\$300.00	EA	4	\$1,200.00
8009		16" LED PEDESTRIAN SIGNAL HEAD SECTION	\$250.00	EA	8	\$2,000.00
8010		2" SCHEDULE 80 RIGID PVC CONDUIT - TRENCHED	\$10.00	LF	650	\$6,500.00
8011		3" SCHEDULE 80 RIGID PVC CONDUIT - TRENCHED	\$15.00	LF	20	\$300.00
8012		3" SCHEDULE 80 RIGID PVC CONDUIT - SLOTTED	\$50.00	LF	200	\$10,000.00
8013		LOOP DETECTORS	\$1.50	LF	1,000	\$1,500.00
8014		SIGNAL HANDBOXES	\$1,100.00	EA	5	\$5,500.00
8015		PUSH BUTTONS AND SIGNS	\$175.00	EA	4	\$700.00
8016		8 PHASE FULLY ACTUATED TRAFFIC SIGNAL CONTROLLER AND CABINET	\$8,000.00	EA	1	\$8,000.00
8017		INSTALL TRAFFIC SIGNS ON TRAFFIC SIGNAL MAST ARMS	\$100.00	SF	14	\$1,400.00
8018		INSTALL TRAFFIC SIGNS ON TRAFFIC SIGNAL MAST ARM POLE AND PEDESTAL POLES	\$125.00	SF	4	\$500.00
8019		SIGNAL POLES AND MAST ARMS -50' X 46' TWIN ARMS	\$14,000.00	EA	2	\$28,000.00
8020		PEDESTAL POLES - 10' BREAKAWAY	\$1,500.00	EA	2	\$3,000.00
8021		STEEL LIGHTING BRACKET ARMS - 20'	\$1,500.00	EA	4	\$6,000.00
8022		H.P.S. LAMP & LUMINAIRE - 250 WATT	\$500.00	EA	4	\$2,000.00
8023		REMOVE EXISTING SIGNAL POLE, MAST ARMS, PEDESTALS, CONTRTOLLER, LIGHT BRACKET AND VEHICULAR AND PEDESTRIAN SIGNALS AND SIGNS	\$5,000.00	LS	1	\$5,000.00
8024		REMOVE EXISTING JUNCTION BOXES AND WIRING CAP AND ABANDON IN PLACE EXISTING CONDUITS	\$1,000.00	LS	1	\$1,000.00
8025		GROUND MOUNTED SIGN SUPPORTS	\$3,000.00	LS	1	\$3,000.00
8026		INSTALL SHEET ALUMINUM SIGNS	\$25.00	SF	150	\$3,750.00
8027		RELOCATE SHEET ALUMINUM SIGNS	\$15.00	SF	100	\$1,500.00
8028		INTERCONNECT	\$7,000.00	LS	1	\$7,000.00
SUBTOTAL						\$128,720.00
CONTINGENCY						30% \$38,616.00
CATEGORY 8 SUBTOTAL						\$167,336.00

ITEM NUMBER	CATEGORY CODE	CATEGORY 9 - MATERIALS	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
NO CATEGORY 9 ITEMS						
SUBTOTAL						\$0.00
CONTINGENCY						30% \$0.00
CATEGORY 9 SUBTOTAL						\$0.00

EDWIN RAYNOR BOULEVARD
 15% CONCEPT COST ESTIMATE
 BIKE TRAIL AND SIDEWALK OPTION

SEPTEMBER 2017

CATEGORY	DESCRIPTION	COMPARISON	
		15% CONCEPT 2017	65% DD ESTIMATE 2010
1	PRELIMINARY	\$887,212	\$938,005
2	GRADING	\$328,250	\$217,750
3	DRAINAGE	\$830,570	\$654,992
4	STRUCTURES	\$293,313	\$0
5	PAVING	\$1,208,304	\$1,119,228
6	SHOULDERS	\$1,179,702	\$812,390
7	LANDSCAPING	\$121,550	\$90,171
8	SIGNING & LIGHTING	\$224,510	\$167,336
9	UTILITIES	\$46,410	\$0
TOTAL		\$5,119,821	\$3,999,872

The following items are excluded from this 30% Concept Cost Estimate:

- Administration and Overhead
- Right of Way

The following was assumed for this Construction Cost Estimate:

Proposed pavement section: 2" HMA for Surface, 6" HMA for Base, 8" GAB (per G&O pavement typical)

Appendix D
Concept Cost Estimate for Mill & Overlay

EDWIN RAYNOR BOULEVARD
 15% CONCEPT COST ESTIMATE
MILL AND OVERLAY
 December 5, 2017

CATEGORY	DESCRIPTION	TOTAL
1	PRELIMINARY	\$446,016
2	GRADING	\$0
3	DRAINAGE	\$0
4	STRUCTURES	\$0
5	PAVING	\$658,593
6	SHOULDERS	\$7,800
7	LANDSCAPING	\$0
8	SIGNING & LIGHTING	\$0
9	UTILITIES	\$1,040

TOTAL CONSTRUCTION COST ESTIMATE \$1,113,449

The following was assumed for this Construction Cost Estimate:

- Total project length is approximately 5,180 LF / 0.98 miles
- The work will consist of patching, grinding and resurfacing the existing pavement. Proposed resurfacing: 0 to 2 inch mill, and 2 inch overlay
- Includes shoulders
- Includes pavement markings and MOT
- Asphalt support fabric (may be optional)

The following items are excluded from this Concept Cost Estimate:

- Administration and Overhead
- Right-of-Way
- Traffic signal modifications
- Repair / replace existing inlets; clean existing pipes; upgrade existing ADA ramps to meet current standards
- Trail, sidewalk, curb and gutter repair/replacement
- Roadway widening, drainage and other improvements

ITEM NUMBER	CATEGORY CODE	CATEGORY 1 - PRELIMINARY	UNIT COST	UNIT	QUANTITY	TOTAL COST
1001		PRICE ADJUSTMENT FOR DIESEL FUEL	\$1.00	EA	3,500	\$3,500.00
1002		REMOVAL OF EXISTING PAVEMENT LINE MARKINGS, ANY WIDTH	\$3.00	LF	2,000	\$6,000.00
1003		MAINTENANCE OF TRAFFIC	\$1,200.00	UD	100	\$120,000.00
1004		ASPHALT FOR MAINTENANCE OF TRAFFIC	\$110.00	TON	40	\$4,400.00
1005		ARROW PANEL FOR MAINTENANCE OF TRAFFIC	\$75.00	UD	70	\$5,250.00
1006		TEMPORARY TRAFFIC SIGNS HIGH PERFORMANCE WIDE ANGLE RETROREFLECTIVE	\$12.00	SF	500	\$6,000.00
1007		FLAGGER	\$45.00	HR	1,500	\$67,500.00
1008		DRUMS FOR MAINTENANCE OF TRAFFIC	\$25.00	EA	30	\$750.00
1009		PROTECTION VEHICLE	\$400.00	UD	30	\$12,000.00
1010		MOBILIZATION	\$100,000.00	LS	1	\$100,000.00
1011		CONES FOR MAINTENANCE OF TRAFFIC	\$3.00	EA	75	\$225.00
1012		4 INCH WHITE SOLID PAVEMENT MARKINGS	\$0.20	LF	11,000	\$2,200.00
1013		4 INCH DOUBLE YELLOW SOLID PAVEMENT MARKINGS	\$0.60	LF	5,250	\$3,150.00
1014		12 INCH WHITE SOLID PAVEMENT MARKINGS	\$1.10	LF	1,550	\$1,705.00
1015		24 INCH WHITE PREFORMED THERMOPLASTIC PAVEMENT MARKING LINES	\$2.05	LF	210	\$430.50
1016		4 INCH WHITE SOLID PAVEMENT MARKINGS (10' - 30')	\$0.25	LF	300	\$75.00
1017		4 INCH WHITE SOLID PAVEMENT MARKINGS (3' - 9')	\$0.25	LF	175	\$43.75
1018		WHITE PAVEMENT MARKING LEGENDS AND SYMBOLS	\$100.00	EA	10	\$1,000.00
1019		WHITE PAVEMENT MARKING ARROW	\$70.00	EA	10	\$700.00
1020		WHITE PAVEMENT MARKING LETTER	\$40.00	EA	4	\$160.00
1021		TEMPORARY ORANGE CONSTRUCTION FENCE	\$8.00	LF	1,000	\$8,000.00
SUBTOTAL						\$343,089.25
CONTINGENCY						30% \$102,926.78
CATEGORY 1 SUBTOTAL						\$446,016.03

EDWIN RAYNOR BOULEVARD

15% CONCEPT COST ESTIMATE

MILL AND OVERLAY

December 5, 2017

ITEM NUMBER	CATEGORY CODE	CATEGORY 2 - GRADING	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
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SUBTOTAL \$0.00
CONTINGENCY 30% \$0.00

CATEGORY 2 SUBTOTAL						\$0.00
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ITEM NUMBER	CATEGORY CODE	CATEGORY 3 - DRAINAGE	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
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SUBTOTAL \$0.00
CONTINGENCY 30% \$0.00

CATEGORY 3 SUBTOTAL						\$0.00
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ITEM NUMBER	CATEGORY CODE	CATEGORY 4 - STRUCTURES	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
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SUBTOTAL \$0.00
CONTINGENCY 30% \$0.00

CATEGORY 4 SUBTOTAL						\$0.00
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ITEM NUMBER	CATEGORY CODE	CATEGORY 5 - PAVING	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
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5001		ASPHALT SUPPORT FABRIC	\$3.00	SY	29,500	\$88,500.00
5002		SUPERPAVE ASPHALT MIX 12.5MM FOR SURFACE, PG 64S-22, LEVEL 2	\$87.00	TON	3,280	\$285,360.00
5003		GRINDING ASPHALT PAVEMENT 0 INCH TO 2 INCH	\$4.50	SY	29,500	\$132,750.00

SUBTOTAL \$506,610.00
CONTINGENCY 30% \$151,983.00

CATEGORY 5 SUBTOTAL						\$658,593.00
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ITEM NUMBER	CATEGORY CODE	CATEGORY 6 - SHOULDERS	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
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6001		SAFETY FENCE	\$8.00	LF	750	\$6,000.00
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SUBTOTAL \$6,000.00
CONTINGENCY 30% \$1,800.00

CATEGORY 6 SUBTOTAL						\$7,800.00
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ITEM NUMBER	CATEGORY CODE	CATEGORY 7 - LANDSCAPING	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
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SUBTOTAL \$0.00
CONTINGENCY 30% \$0.00

CATEGORY 7 SUBTOTAL						\$0.00
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ITEM NUMBER	CATEGORY CODE	CATEGORY 8 - SIGNING & LIGHTING	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
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SUBTOTAL \$0.00
CONTINGENCY 30% \$0.00

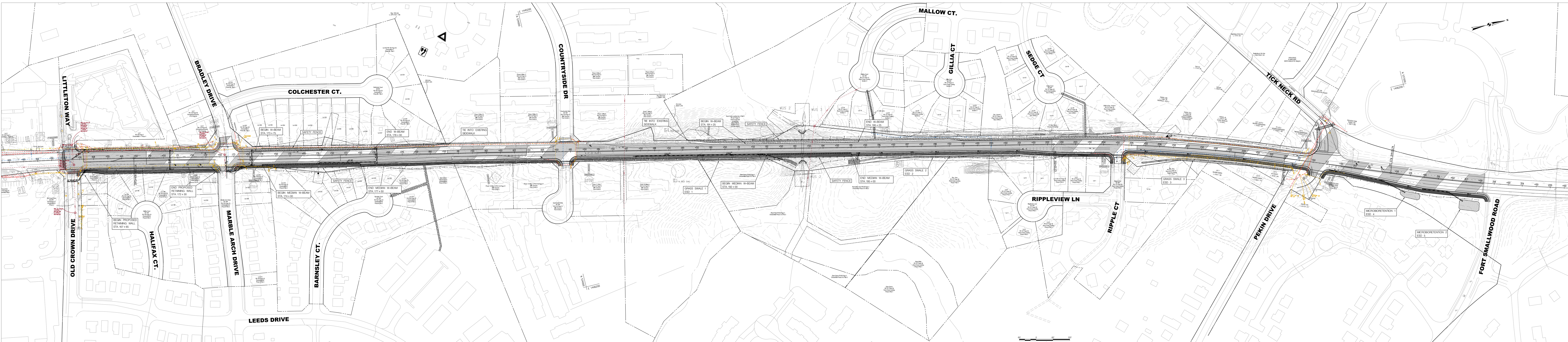
CATEGORY 8 SUBTOTAL						\$0.00
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ITEM NUMBER	CATEGORY CODE	CATEGORY 9 - UTILITIES	UNIT COST	UNIT	TOTAL QUANTITY	TOTAL COST
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9001		ADJUST UTILITIES	\$450.00	EA	1	\$450.00
9002		ADJUST FIRE HYDRANT VALVE	\$350.00	EA	1	\$350.00

SUBTOTAL \$800.00
CONTINGENCY 30% \$240.00

CATEGORY 9 SUBTOTAL						\$1,040.00
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LEGEND

- PROPOSED MULTUSE TRAIL
- PROPOSED SIDEWALK
- PROPOSED MILL AND OVERLAY
- PROPOSED FULL DEPTH RECONSTRUCTION

CLIENT:
ARUNDEL COUNTY DEPARTMENT OF PUBLIC WORKS

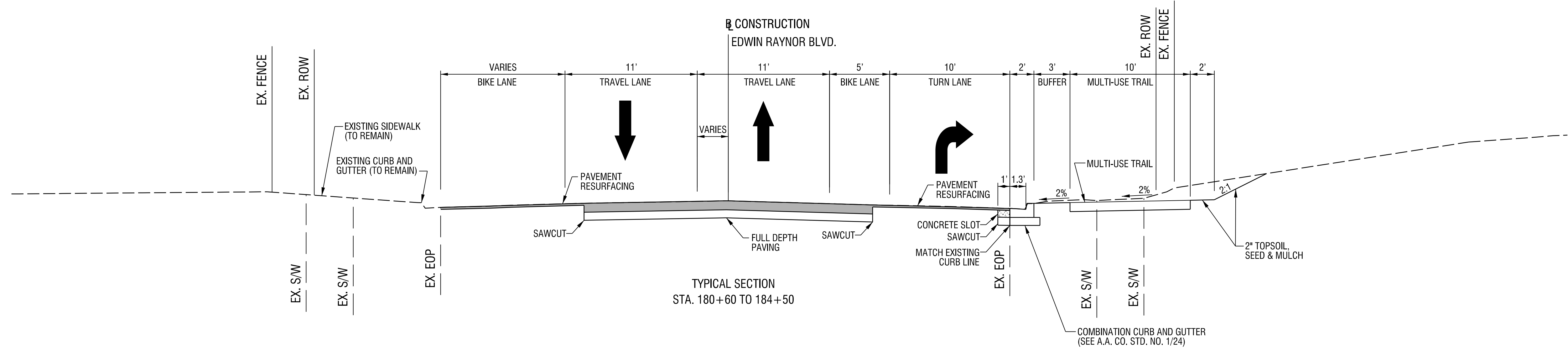
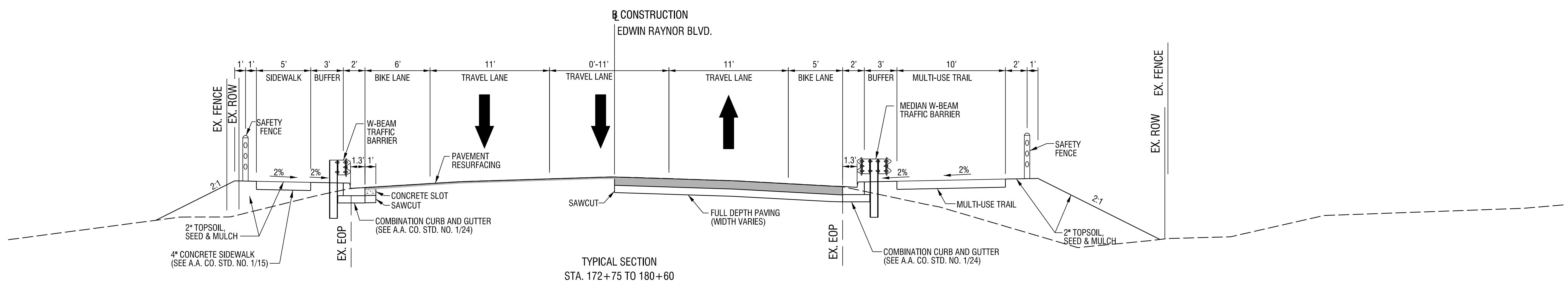
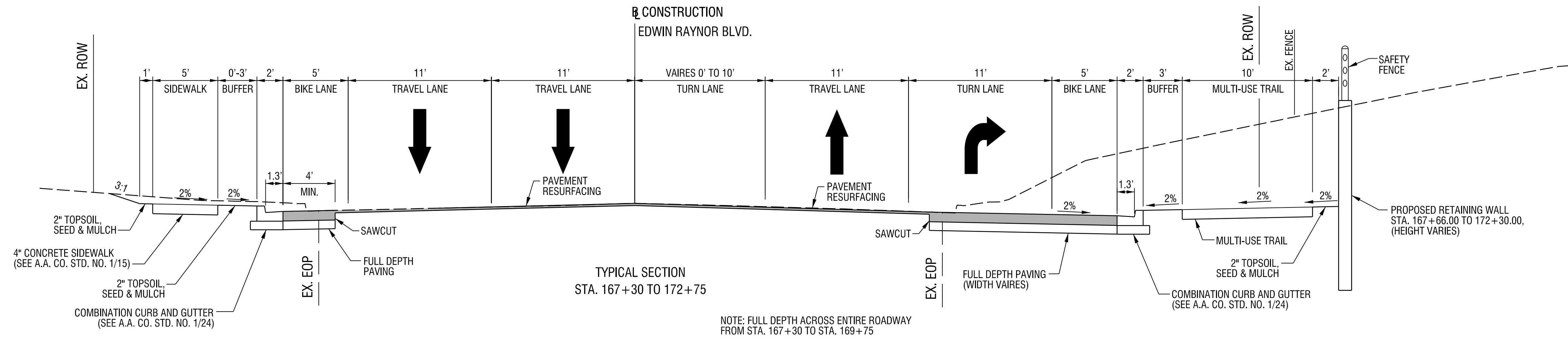
PROFESSIONAL CERTIFICATION	DATE	REVISION DESCRIPTION	BY	DATE

DESIGN:
AECOM
4 NORTH PARK DRIVE, SUITE 300
HUNT VALLEY, MARYLAND 21030
DISTRICT 410.785.7220
FAX 410.785.6618

APPROVED		DATE		APPROVED		DATE	

ANNE ARUNDEL COUNTY
DEPARTMENT OF PUBLIC WORKS
SCALE: 1" = 40'
DRAWN BY: CDF
CHECKED BY: CDF
DATE APPROVED:

EDWIN RAYNOR BLVD STUDY
1580 MILLERSVILLE, MARYLAND 21088
ANNE ARUNDEL COUNTY
DATE: MAY 2017

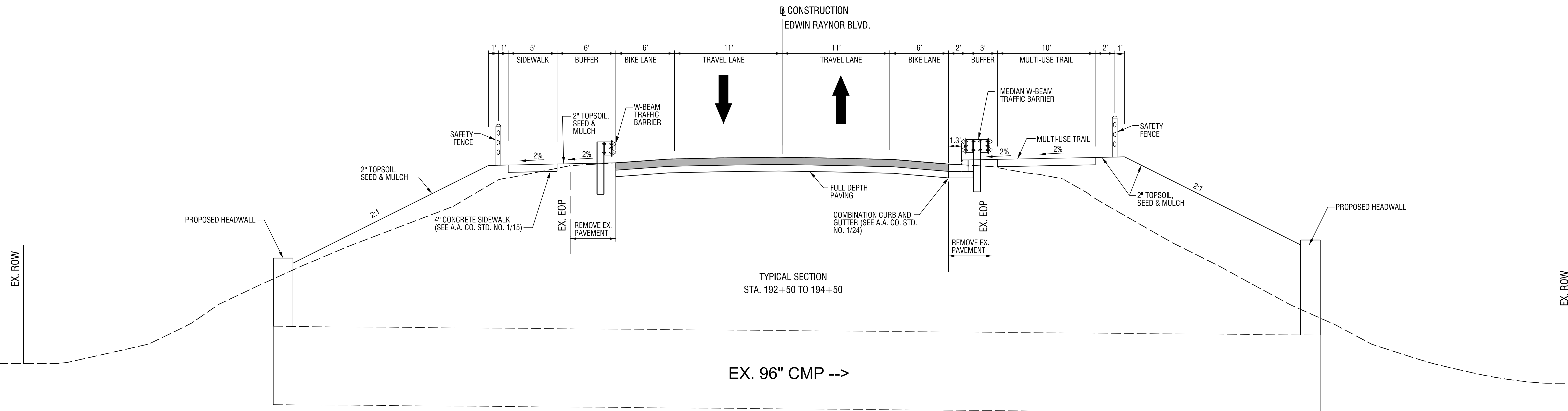
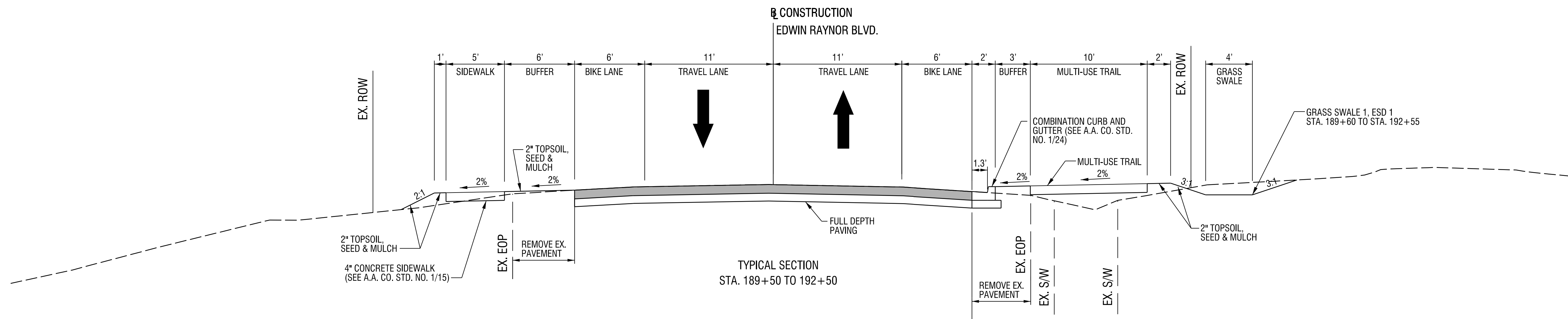
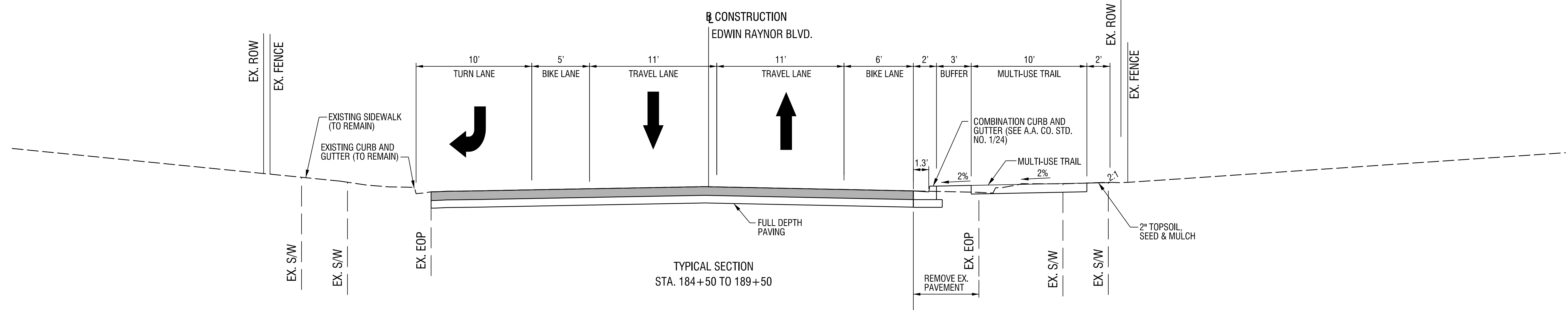


OWNER/DEVELOPER:
 ANNE ARUNDEL COUNTY, MARYLAND
 DEPARTMENT OF PUBLIC WORKS
 2664 RIVA ROAD
 ANNAPOLIS, MD 21401
 (410) 222-7000

NO.	REVISION	BY	DATE

AECOM
 4 NORTH PARK DRIVE, SUITE 300
 HUNT VALLEY, MARYLAND 21030
 DIRECT 410.785.7220
 FAX 410.785.6818

ANNE ARUNDEL COUNTY DEPARTMENT OF PUBLIC WORKS		SUBD. #
PROJECT #		TYPICAL SECTIONS
DESIGNED BY: DMT	SCALE: 1" = 5'	EDWIN RAYNOR BOULEVARD STUDY FROM OLD CROWN DRIVE TO FORT SMALLWOOD ROAD
CHECKED BY:	SHEET NO. 1 OF 4	
DATE: 5/2017	QUAD. NO.	ANNE ARUNDEL COUNTY DEPARTMENT OF PUBLIC WORKS 2664 RIVA ROAD, ANNAPOLIS, MD 21401
APPROVED:	DATE	
CHIEF ENGINEER		
REVIEW ENGINEER:		

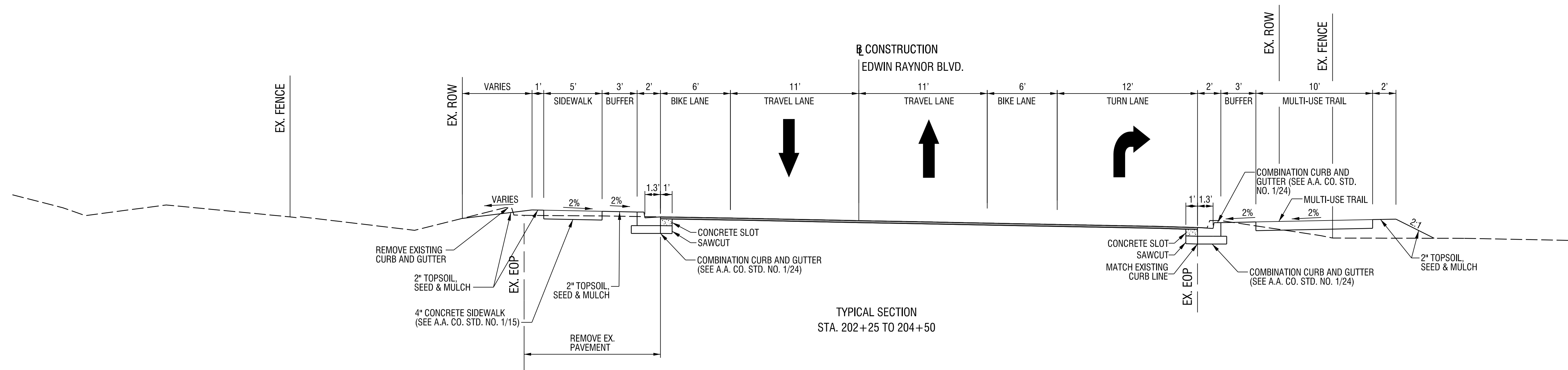
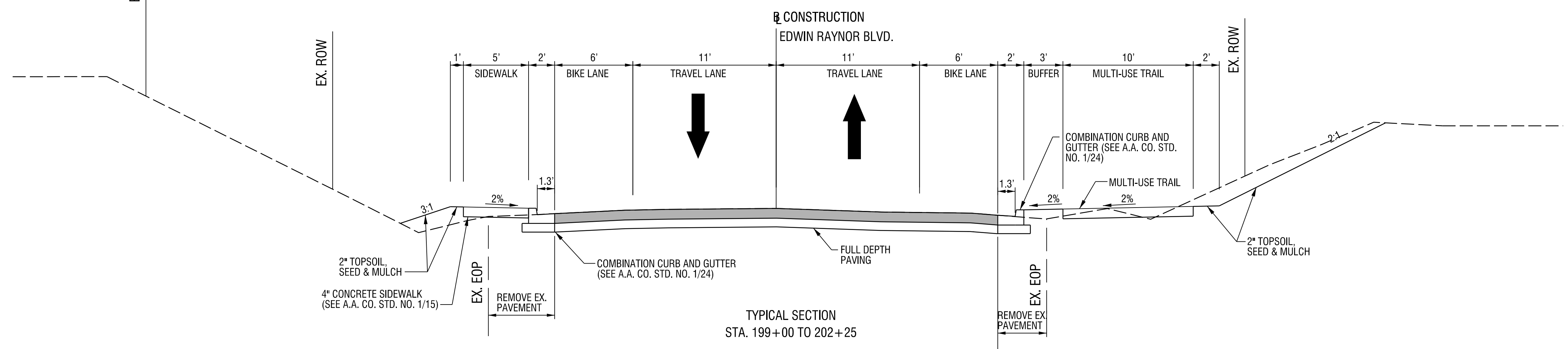
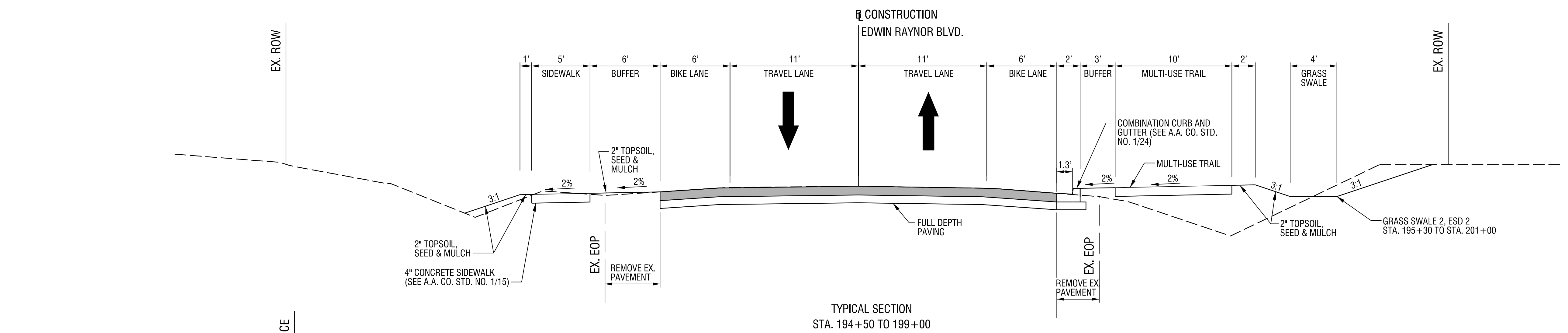


OWNER/DEVELOPER:
ANNE ARUNDEL COUNTY, MARYLAND
DEPARTMENT OF PUBLIC WORKS
2664 RIVA ROAD
ANNAPOLIS, MD 21401
(410) 222-7000

NO.	REVISION	BY	DATE

AECOM
4 NORTH PARK DRIVE, SUITE 300
HUNT VALLEY, MARYLAND 21030
DIRECT 410.785.7220
FAX 410.785.6818

ANNE ARUNDEL COUNTY				DEPARTMENT OF PUBLIC WORKS		SUBD. #	
DESIGNED BY: DMT				SCALE: 1" = 5'		PROJECT #	
CHECKED BY:				SHEET NO. 2 OF 4		TYPICAL SECTIONS	
DATE: 5/2017				QUAD. NO.		EDWIN RAYNOR BOULEVARD STUDY	
REVIEW ENGINEER:				DATE:		FROM OLD CROWN DRIVE TO FORT SMALLWOOD ROAD	
DATE				DATE		ANNE ARUNDEL COUNTY	
DATE				DATE		DEPARTMENT OF PUBLIC WORKS	
DATE				DATE		2664 RIVA ROAD, ANNAPOLIS, MD 21401	

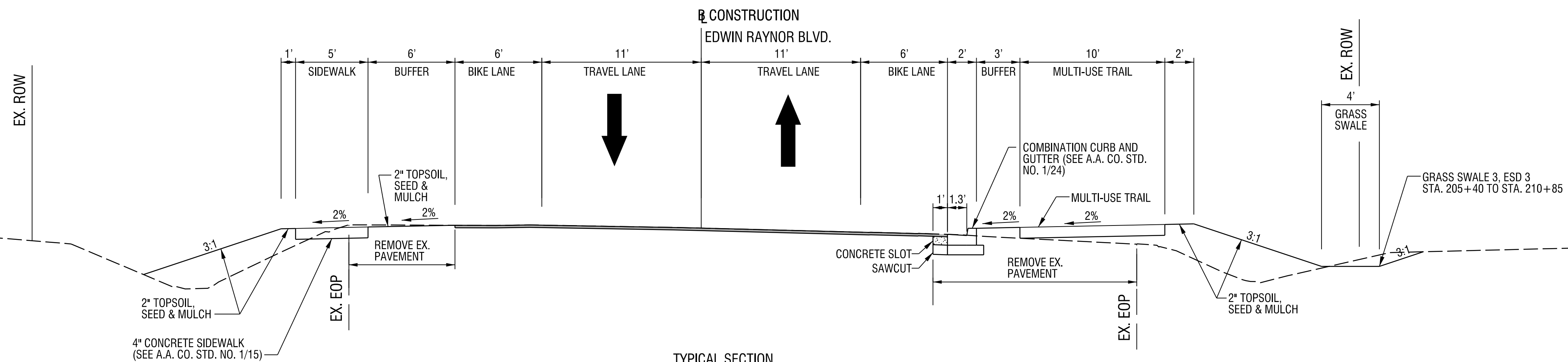


OWNER/DEVELOPER:
 ANNE ARUNDEL COUNTY, MARYLAND
 DEPARTMENT OF PUBLIC WORKS
 2664 RIVA ROAD
 ANNAPOLIS, MD 21401
 (410) 222-7000

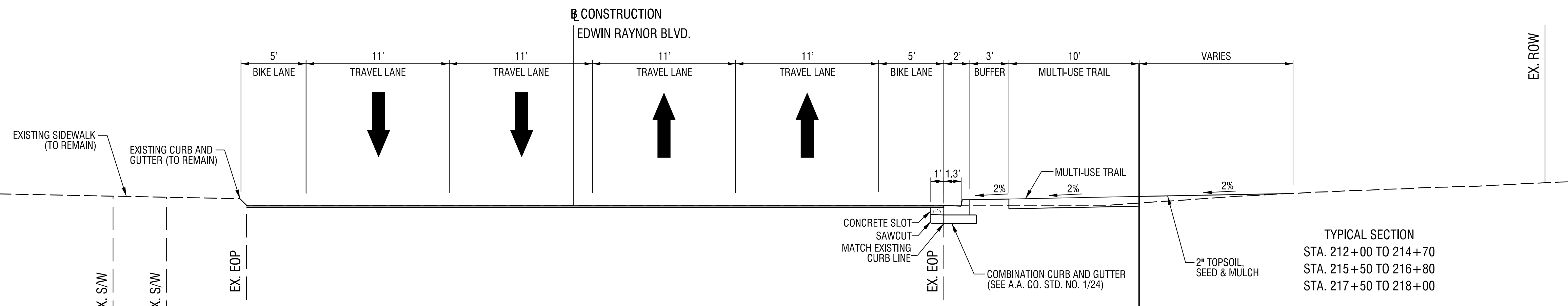
NO.	REVISION	BY	DATE

AECOM
 4 NORTH PARK DRIVE, SUITE 300
 HUNT VALLEY, MARYLAND 21030
 DIRECT 410.785.7220
 FAX 410.785.6818

ANNE ARUNDEL COUNTY DEPARTMENT OF PUBLIC WORKS				SUBD. #	
APPROVED: DATE				PROJECT #	
CHIEF ENGINEER				TYPICAL SECTIONS	
REVIEW ENGINEER: DATE				EDWIN RAYNOR BOULEVARD STUDY FROM OLD CROWN DRIVE TO FORT SMALLWOOD ROAD	
					ANNE ARUNDEL COUNTY DEPARTMENT OF PUBLIC WORKS 2664 RIVA ROAD, ANNAPOLIS, MD 21401

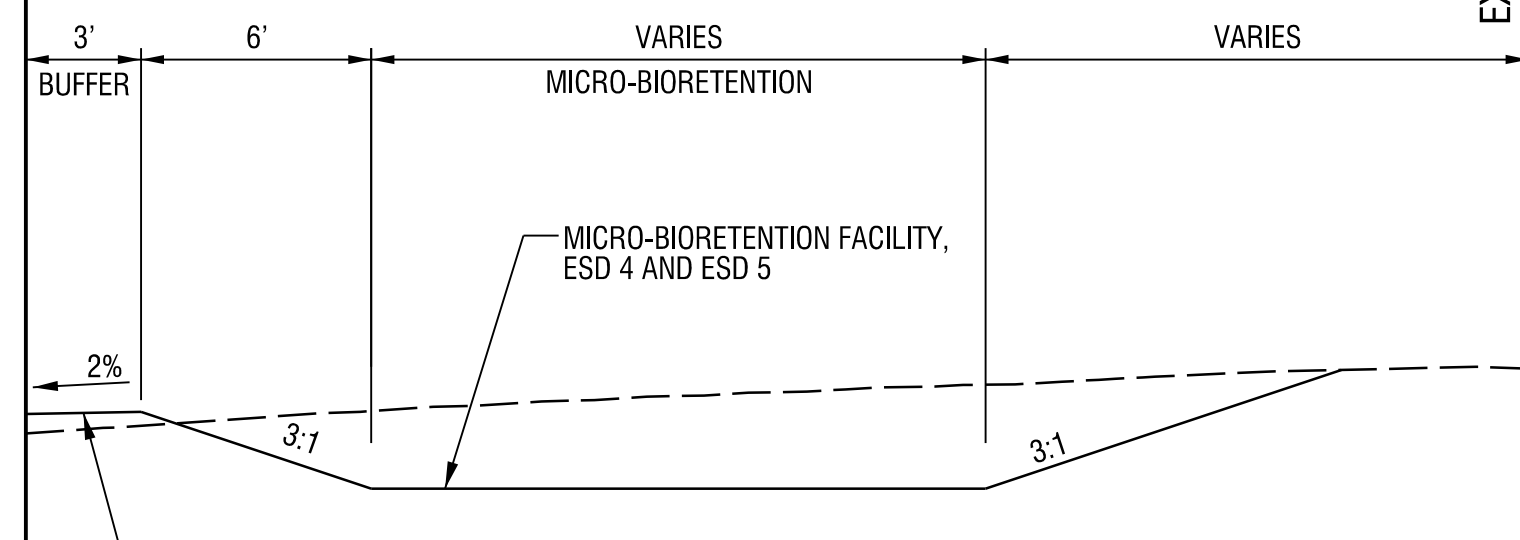


TYPICAL SECTION
STA. 204+50 TO 212+00



TYPICAL SECTION
STA. 212+00 TO 218+00

TYPICAL SECTION
STA. 212+00 TO 214+70
STA. 215+50 TO 216+80
STA. 217+50 TO 218+00



TYPICAL SECTION
STA. 214+70 TO 215+50
STA. 216+80 TO 217+50

OWNER/DEVELOPER:
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2664 RIVA ROAD
ANNAPOLIS, MD 21401
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NO.	REVISION	BY	DATE

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4 NORTH PARK DRIVE, SUITE 300
HUNT VALLEY, MARYLAND 21030
DIRECT 410.785.7220
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ANNE ARUNDEL COUNTY DEPARTMENT OF PUBLIC WORKS				SUBD. #
REVISION				PROJECT #
DATE	BY	APPROVED:	DATE	TYPICAL SECTIONS
				EDWIN RAYNOR BOULEVARD STUDY FROM OLD CROWN DRIVE TO FORT SMALLWOOD ROAD ANNE ARUNDEL COUNTY DEPARTMENT OF PUBLIC WORKS 2664 RIVA ROAD, ANNAPOLIS, MD 21401