US Army Corps
of Engineers
Baltimore District

# METROPOLITAN WASHINGTON, DISTRICT OF COLUMBIA COASTAL STORM RISK MANAGEMENT FEASIBILITY STUDY

## INTEGRATED FEASIBILITY REPORT & ENVIONMENTAL ASSESSMENT

## APPENDIX A:

## CIVIL ENGINEERING

APRIL 2024

APPENDIX A CIVIL ENGINEERING

METROPOLITAN WASHINGTON DISTRICT OF COLUMBIA

COASTAL STORM RISK MANAGEMENT FEASIBILITY STUDY

NORTHERN VIRGINIA

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## 1. INTRODUCTION

### 1.1 Purpose and Scope of Civil Appendix

The purpose of this appendix is to present the Civil Engineering investigations/studies conducted for the Metropolitan Washington District of Columbia Coastal Storm Risk Management Feasibility Study (DC Coastal Study). This Appendix investigated and evaluated a holistic way of protecting the study area from flood inundation associated with storm frequencies of 100-year to the 500-year event. Many flood risk management measures were assessed, evaluated, and ranked as partially and marginally feasible through the plan formulation process. Selected measures considered were elevated roads, earthen levees, floodwalls, and closure structures.

This civil engineering design investigation resulted in the preliminary design of these structures at strategic locations as a product of Hydrologic and Hydraulic (H&H) studies given water surface elevations at multiple control areas critical to the flood protection of the study area. The designs were sufficient to generate baseline quantities and cost estimates to determine the cost of the Recommended Plan.

## 2. EXISTING CONDITIONS

### 2.1 Study Area

The Middle Potomac River watershed encompasses approximately 11,500 square miles, includes a diverse landscape with urban, rural, and natural areas in six different eco-regions and four states and the District of Columbia (D.C.). The DC Coastal Study area encompasses approximately 76 square miles and includes the Northern Virginia jurisdictions within the Middle Potomac watershed boundary, from Arlington County south to include a portion of Prince William County. Within the study area, the Virginia side of the Potomac River contains approximately 135 miles of Potomac River shoreline. The population within the study area is approximately 155,000.

The study area was reduced to four main planning areas after the Alternatives Milestone: Ronald Reagan Washington National Airport (Reagan Airport), Arlington Water Pollution Control Plant (WPCP), Four Mile Run, and Belle Haven. As the study continued Regan and Four Mile Run were eliminated. The County of Fairfax, Virginia provided a letter on 29 March 2022 supporting the proposed levee and floodwall improvements in Belle Haven. Representatives of the County attended in-person and virtual public meetings in June 2022 during which community members expressed their views and opposition on the project in the Belle View neighborhood. Comments were also received and reviewed during the public comment period. After the public comment period, alternate options for alignment of the proposed coastal storm risk reduction features were explored. No substantially different alignment of proposed coastal storm risks reduction features were found to be acceptable. County of Fairfax representatives also engaged leaders of the affected community and elected officials in an outreach effort to gain support and promote flood risk management. Community opposition to the Recommended Plan remained consistent throughout this process. Therefore, as stated in an email received March 13, 2023, “Fairfax County will not support the project as proposed at the present time, and thus will not be providing the USACE with a letter of intent. Measures for coastal storm risk reduction in the Belle Haven community will not be pursued further through this feasibility study.”

2.2 Site Description

1. Reagan Airport, is a national airport located in Arlington, Virginia, across the Potomac River from Washington, D.C. The airport is operated by the Metropolitan Washington Airports Authority (MWAA) and serves the National Capital Region (NCR). The airport is located 5 miles (8.0 km) from downtown Washington D.C. The area footprint of Reagan Airport covers approximately 1.34 square miles. The airport is bounded to the east and south by the Potomac River. The airport contains approximately 2.84 miles (15,000 feet) of shoreline along the Potomac River. It is bounded on the West by the George Washington Memorial Parkway (GWMP). See Figure C-1.
   The airport is critical infrastructure for transportation.

Figure C-1. Ronald Reagan Washington National Airport

2. Arlington WPCP is located in South Arlington, Virginia at 3402 South Glebe Road. The plant is bounded to the south along the bank of a stream named Four Mile Run. A local bike trail runs along the north bank of the stream and the WPCP. The plant treats 23 million gallons of wastewater each day from local residences and businesses and is critical infrastructure to the northern Virginia area. See Figure C-2

Figure C-2. Arlington Water Pollution Control Plant (north bank) and Four Mile Run (south bank)

3. Four Mile Run is located in Alexandria, Virginia just south of WPCP along Four Mile Run stream. The proposed alternative starts just west of the bridge at Mt. Vernon Avenue and travels east thru Four Mile Run Park. The park covers about 5 acres along the south bank of Four Mile Run. The park is dotted with trails, sport fields, and wetland habitat. See Figure C-2

4. Belle Haven is a community that consists of mostly residential single-family housing located south of Alexandria, Virginia. The proposed Belle Haven alignment is bounded to the north by a Golf Course and to the east side by GWMP on the west-bank of the Potomac River, which is owned by the National Park Service. The west is bordered by Fort Hunt Road. See Figure Concept Design Plans.

2.3 Level of Protection

1. Reagan Airport
   - Flooding Level of Protection for Reagan Airport was for a 500-year coastal storm with Intermediate Sea Level Change (2080) + 95% confidence level at elevation **14.3** feet (ft) NAVD 88 (The North American Vertical Datum of 1988 is the vertical control datum). Reagan Airport's level of protection is higher than other designated commercial and residential areas because it must remain operational in the event of a flood event.

2. Arlington WPCP
   - 300-year coastal storm with Intermediate Sea Level Change (2080) + 90% confidence level at elevation **14.3 ft** NAVD 88. The WPCP level of protection is higher than commercial and residential area because it must remain operational in the event of a flood event.
3. Four Mile Run
   - 100-year coastal storm with Intermediate Sea Level Change (2080) + 95% confidence level at elevation **13.9** ft NAVD 88

4. Belle Haven
   - 100-year coastal storm with Intermediate Sea Level Change (2080) + 95% confidence level at elevation **13.0** ft NAVD 88

See Hydrology & Hydraulic, Appendix B for additional information.

2.4 Proposed Structural Alignment

Four alternatives were evaluated for this study, and it was determined that the Recommended Plan is a combination of Arlington WPCP and Belle Haven. Concept Design Plans are included as attachments to this appendix.

1. Reagan Airport: The proposed alignment includes 16,606 Linear Feet of raised perimeter roads, concrete floodwalls and aluminum stop log closures. The alignment follows the perimeter road located on the outside of the airport. The perimeter road would be removed and replaced with an earthen levee. The levee would be designed with heavy duty asphalt on top of the levee. The asphalt would be designed so that it can support large maintenance vehicles. However, the perimeter road could not be raised at the end of the runways. Therefore, stop log closures would be needed at the end of the runways. The length of closures around the airport totals 6,313 ft. The amount and length of closures are necessary for the airport to remain operational before flooding events occur. The closures will add to the cost estimate and will take many man-hours to install. Because of the drainage patterns around the airport, pump stations were not further evaluated during the feasibility study.

2. Arlington WPCP: The proposed alternative includes 1,180 ft of concrete T-Wall (See Concept Design Plans), 1,280 ft of 1 ft concrete elevated curb, and 70 ft of closure. The proposed floodwall is located along the existing fence located around the plant along the bike path along Four Mile Run (See Figure C-3) along with a power line seen in (Figure C-4). A 70 ft long

aluminum stop log closure would be placed at the end of the alignment located across South Eads Street. The material for the stop logs will be placed on-site in an existing building. T-walls will be constructed near large transmission poles that run East -West along Four Mile Run. The floodwall would need to be installed around the existing power poles and their foundations. Flap gates will be installed at all stormwater conduits to prevent backflow. Sluice gates will be installed at the 36-inch and 60-inch stormwater conduits.

Clarification:

a) Influent is the wastewater entering the WPCP. Effluent is the treated wastewater leaving the WPCP.
b) There are two pump stations at the facility.
c) The facility is at approximate elevation 14.3-14.5 ft NAVD88.

There are two pump stations at the facility. The first is located on the east side of the property. The east side pump station is used for wastewater overflow in the event influent enters beyond the capacity of the facility. The east side pump station has a capacity of 2 mgd (million gallons per day). The influent is discharged into Four Mile Run. The second pump station is on the west side and used to recycle a portion of the treated water for the purpose of clearing filters and continuing the biological processes of the plant.

The main effluent outfall is a 72-inch conduit located on the west side of the facility that is designed to handle 23 mgd of discharge. This conduit is shown on the 1978 as-built drawings as Drainage Structure #49 at station 459+35. The effluent discharges from the facility via gravity flow and is not pumped. The existing high ground of the channel is at approximately 13.5 ft NAVD88 at the location of the 72-inch effluent conduit. The invert of the 72-inch effluent conduit is 5.8 ft NAVD88.

After further discussion with the WPCP, the plant can redirect inflow internally without discharging the existing 72” outfall during 16-hour high water event. Therefore, there is no need for an additional pump station.

The outfall should be lined to handle any additional water pressure. The outfall will be equipped with flap gate and sluice gate(where needed to prevent any backflow from entering the plant. This should meet all the requirement for EM 1110-2-3105 both old (1999) and new (2020) versions have specific requirements for backflow prevention in conjunction with EM 1110-2-2902. See HH Appendix B for additional information.

Figure C-3. See Concept Design Plans for additional information on Arlington WPCP


Figure C-4. Transmission power pole located near Arlington WPCP

3. Four Mile Run: The proposed alignment starts west of Mount Vernon Avenue with 24 ft of Concrete I-wall and 60 ft replacement of an existing 13-ft-high concrete wall. A 70 linear ft of aluminum stop-log closure would be installed across Mount Vernon Road. A 190 linear ft I-wall would extend into the Four Mile Run Park. The existing trail would be removed and replaced with an earthen levee with asphalt installed over the crown of the levee. The levee would be installed as to not disturb the wetland areas that exist in the park. Two (2) pump stations would be needed on two unnamed tributaries that flow into Four Mile Run. Some wetlands would be disturbed for the installation of culverts and pump stations.

4. Belle Haven: This proposed alignment starts along Belle Haven Road to the north and then runs south parallel to the GWMP (Figure C-5 next page). The alignment then turns west through high density units and would tie-into high ground at Westgrove Dog Park. Four aluminum stop-log closures would be needed; first across driveway to a lift station located at 1400 Belle, second on Bell Haven Road, third on 10th Street, fourth on Belle View Blvd. There are two (2) proposed pump stations located on the south end of the alignment on 2 unnamed tributaries that flow into the Dyke Marsh Wildlife Preserve. The proposed length of the alignment is 7,253 linear ft: which is 6,260 ft of T-walls, 473 ft of earthen levee, 220 ft pump stations, and 300 ft of closures.

Figure C-5. Belle Haven

## 3. APPLICABLE DESIGN STANDARDS AND CRITERIA

### 3.1 General

Improvements to site protection from floodwaters are required to follow federal, state, and local standards. This appendix combines all of these standards to come up with the most effective, safe design. Emphasis is on the use of USACE engineering circulars and manuals. Below is the list of standards referenced.

1. AASHTO 2018. A Policy on Geometric Design of Highway and Streets.197263

2. EM 1110-2-2102, Water stops and Other Preformed Joint Materials for Civil Works Structures, U.S. Army Corps of Engineers, Washington DC; September 1995.

3. EM 1110-2-2104, Strength Design for Reinforced-Concrete Hydraulic Structures, U.S. Army Corps of Engineers, Washington DC; November 2016.

4. EM 1110-2-2502, Retaining and Flood Walls, U.S. Army Corps of Engineers, Washington DC; 29 September 1989.

5. EM 1110-2-2705 - Structural Design of Closure Structures for Local Flood Protection Projects

6. ENGINEERING PRINCIPLES AND PRACTICES Chapter 5-Design of Floodwalls and Levees, FEMA (44 CFR60.3(c )(2))

7. EM 1110-2-1913 – Design and Construction of Levees U.S. Army Corps of Engineers, Washington DC; April 2000.

### 3.2 Design Criteria

The structural measure for Reagan Airport were designed to the maximum water surface elevation inundation for the 500-year Coastal Flood Event using the Intermediate curve for Sea Level Rise for (2080) and 95% confidence level. The structural measure for Arlington WPCP were designed to the maximum water surface elevation inundation for the 300-year Coastal Flood Event using the Intermediate curve for Sea Level Rise for (2080) and 90% confidence level. Four Mile Run and Belle Haven were designed for the 100-year Coastal Storm Event, using the Intermediate curve for Sea Level Rise (2080) and 95% confidence level. The foundation of the selected T-wall a was designed per geo-tech and structural recommendations.

#### 3.2.1 Civil

AutoCAD Civil 3D will be used to create the alignments, profiles, cross sections and layouts for the floodwalls, road elevations with design guidance from EM 1110-2-2502, Retaining and Flood Walls and ENGINEERING PRINCIPLES AND PRACTICES Chapter 5-Design of Floodwalls and Levees, FEMA (44 CFR60.3(c )(2)). Specifications, base design and preliminary estimates from the Sponsor and flow rates from the H&H engineer enable the complete design of the bypass culvert, thickness set, and foundation dimensions.

## 3.3 Design Considerations

Design considerations included aesthetics, storage and maintenance of closures, and cost.

### 3.3.1 Interior Drainage

Interior drainage always forms a part of the Flood Risk Management (FRM) structure. Interior drainage includes all water runoff, seepage (water going under or thorough the levee), and water collection on the landward side of the levee system. The analysis for interior drainage must identify and demonstrate the potential runoff paths from the impacted drainage area. For feasibility level analysis, preliminary assumptions estimated two (2) culvert and two (2) pump stations for the Belle Haven Area. The two (2) culverts and two (2) pump stations will be optimized to handle runoff for a 100-year storm event during Pre-Construction, Engineering and Design (PED).

Further analysis of interior drainage at Arlington WWCP:

There are four existing storm drainpipes that will flow under the proposed floodwall and 2 sewer effluent pipes. The existing pipes will need to be encased in concrete for future maintenance as well as protection from the additional weight of the floodwall. Flap gates and sluice gates (where needed) will be added to the outfall to prevent backflow into the Wastewater Control Point. There are no proposed pump station at the WWCP facility.

### 3.3.2 Utility Incorporation into the Design:

Underground utility analysis will be completed during PED

### 3.3.4 Pump Station

Pump station consideration has been removed from further analysis for Arlington WPCP, Belle Haven, and Four Mile Run.

### 3.3.5 Survey Data Source

(Washington DC, Maryland, Virginia) LIDAR, Army Geospatial Center (2008), UTM Zone 18 North, NAD8, NADV88 Meters converted to US feet.

(Washington DC, Maryland, Virginia) Post Sandy LIDAR, Army Geospatial Center (2012) (Published 2014), UTM Zone 18 North, NAD8, NADV88 Meters converted to US feet.

# NORTHERN VIRGINIA COASTAL FLOOD STUDY

PLANS FOR

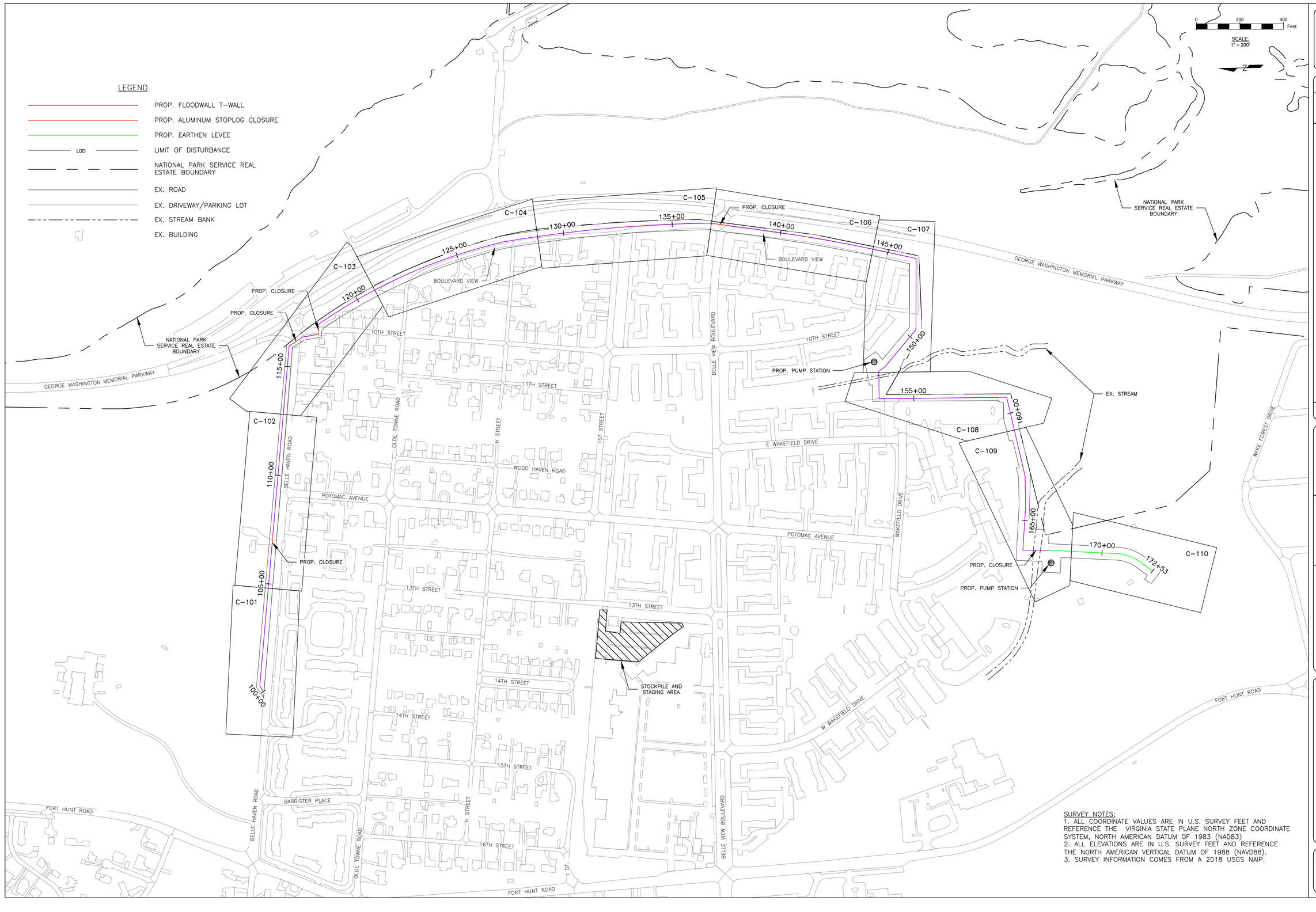
# BELLE HAVEN FLOOD RISK MANAGEMENT PROJECT
# CONCEPT DESIGN

BELLE HAVEN, VA


DEPARTMENT OF THE ARMY

BALTIMORE DISTRICT, CORPS OF ENGINEERS

BALTIMORE, MARYLAND




SURVEY NOTES:
1. ALL COORDINATE VALUES ARE IN U.S. SURVEY FEET AND REFERENCE THE VIRGINIA STATE PLANE NORTH ZONE COORDINATE SYSTEM, NORTH AMERICAN DATUM OF 1983 (NAD83)
2. ALL ELEVATIONS ARE IN U.S. SURVEY FEET AND REFERENCE THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).
3. SURVEY INFORMATION COMES FROM A 2018 USGS NAIP.

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BALTIMORE, MARYLAND

ENGINEERING DIVISION

NORTHERN VIRGINIA COASTAL FLOOD STUDY

# BELLE HAVEN FRMP CONCEPT DESIGN

## KEY MAP SHEET

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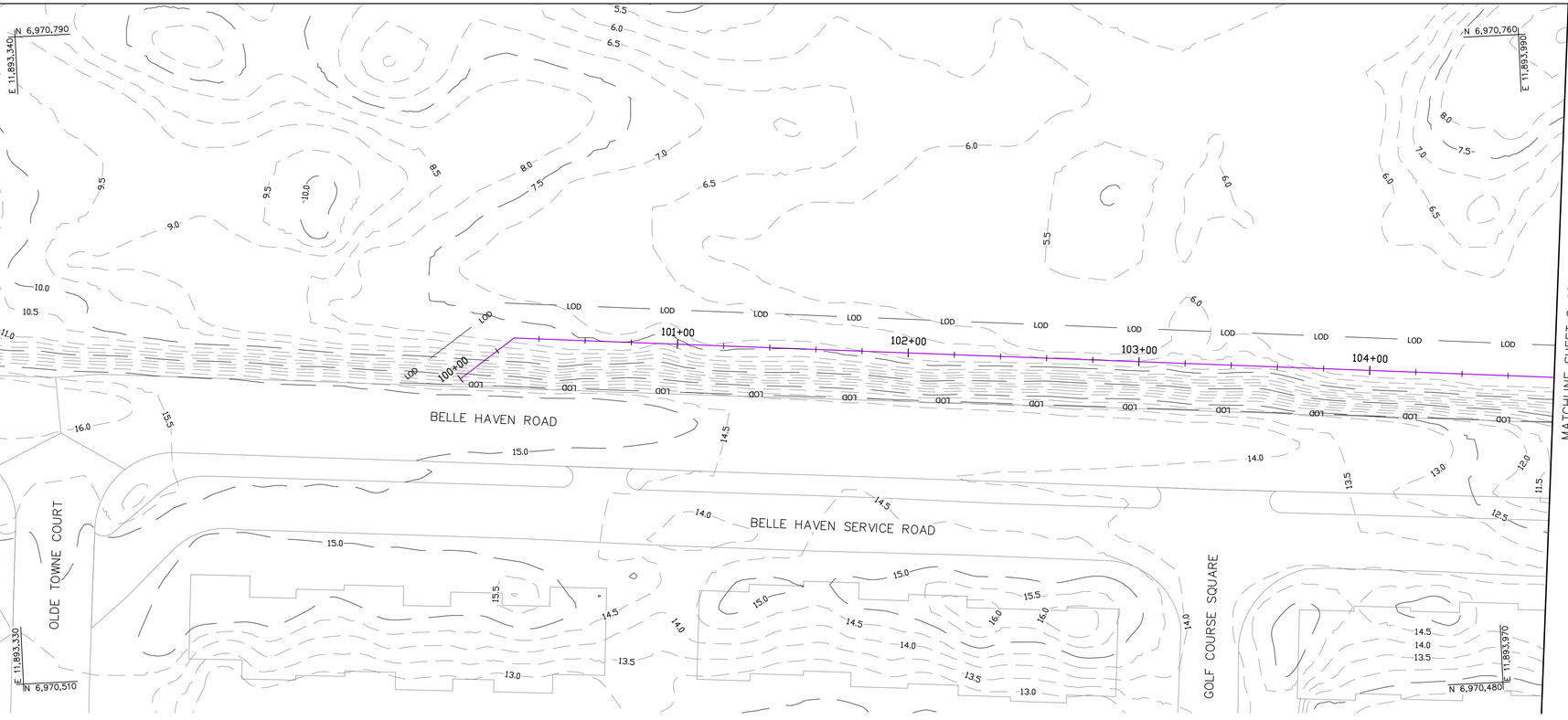


0 30' 60'

PLAN AND PROFILE VIEW SCALE:
1" = 30'

## BELLE HAVEN PROFILE

STATIONS 100+00 TO 104+80
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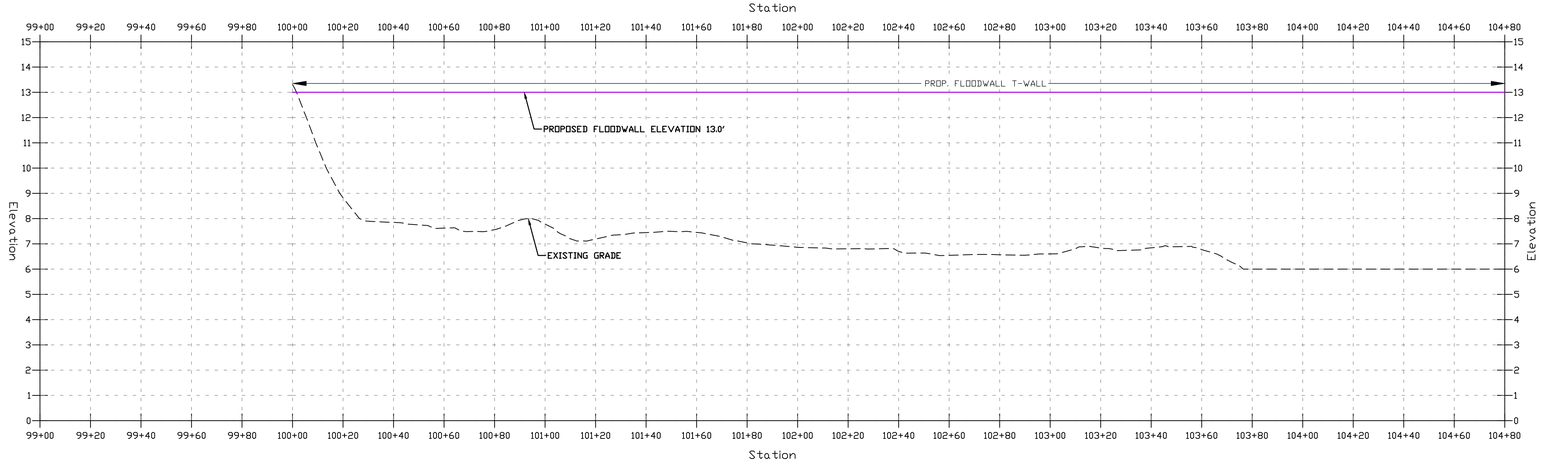


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NORTHERN VIRGINIA COASTAL FLOOD STUDY

BELLE HAVEN FRMP CONCEPT DESIGN
STATIONS 100+00 TO 104+80

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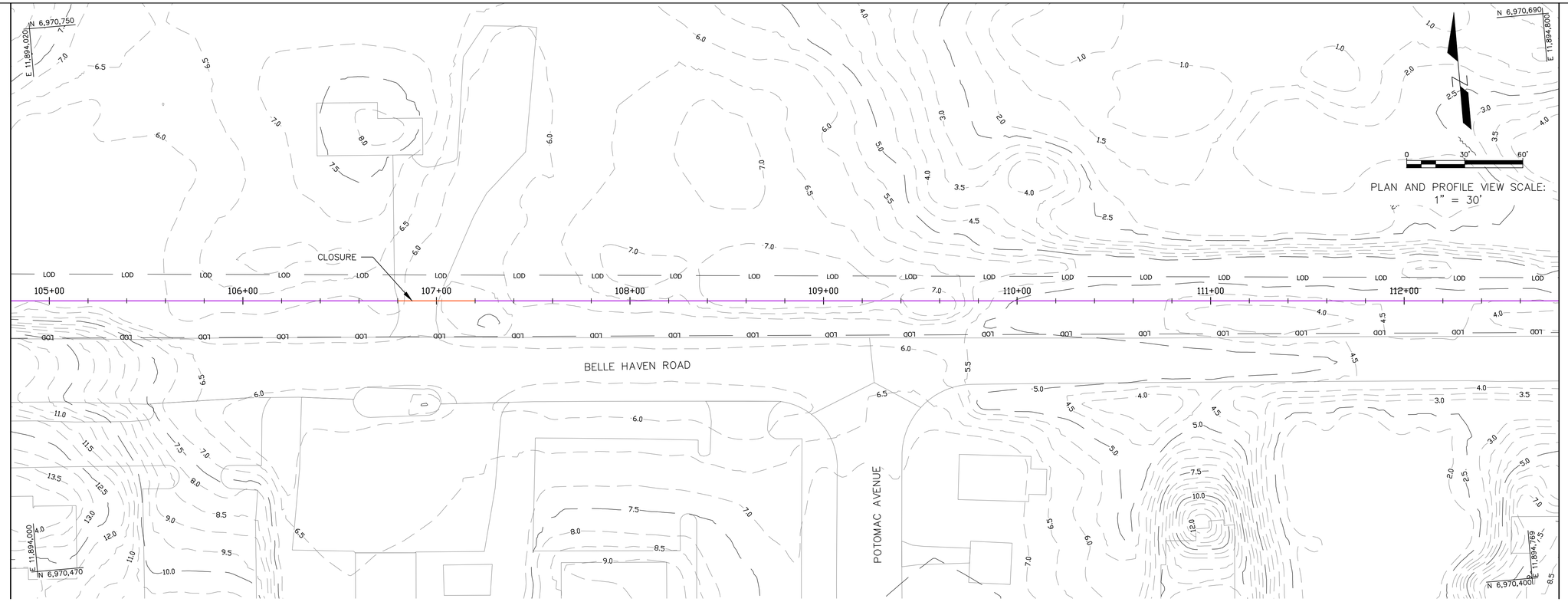


## BELLE HAVEN PROFILE

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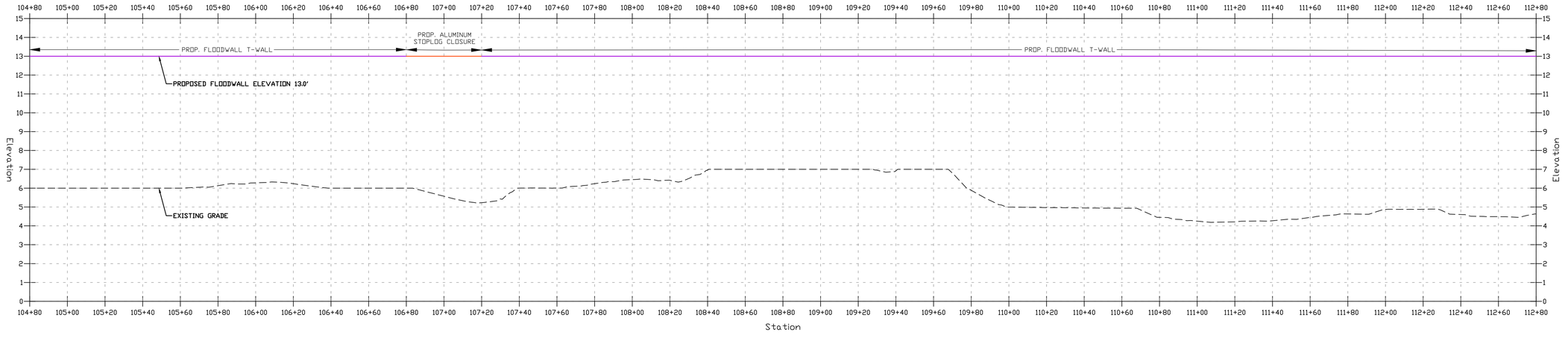


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BELLE HAVEN FRMP CONCEPT DESIGN
STATIONS 104+80 TO 112+80

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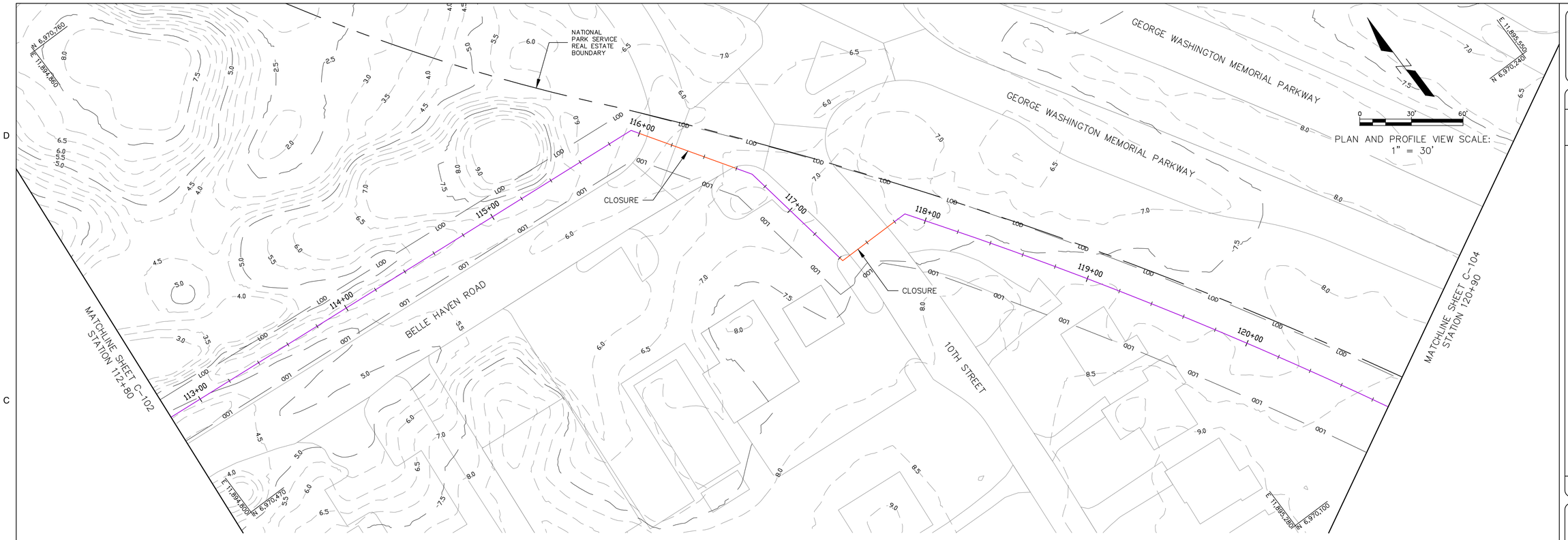


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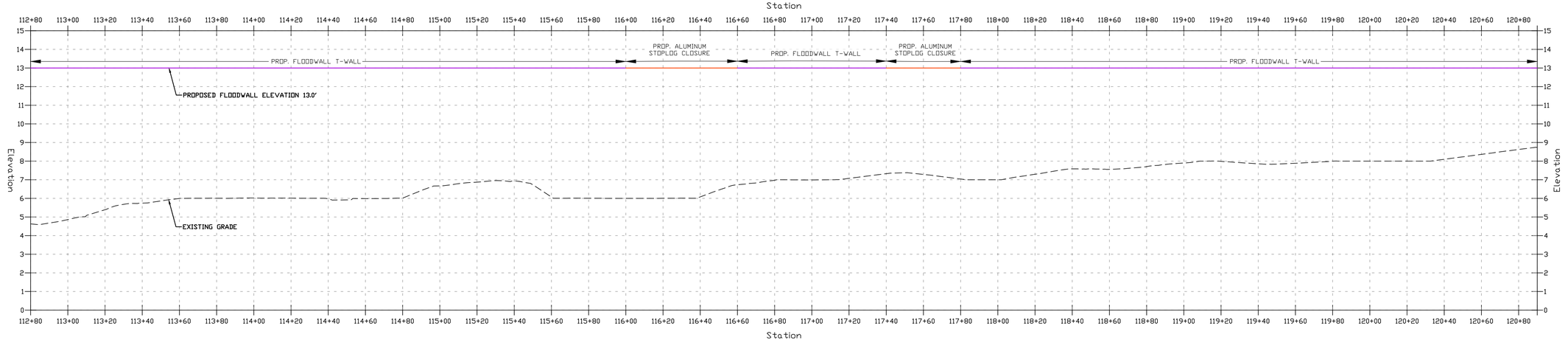


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BELLE HAVEN FRMP CONCEPT DESIGN
STATIONS 112+80 TO 120+90

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## BELLE HAVEN PROFILE

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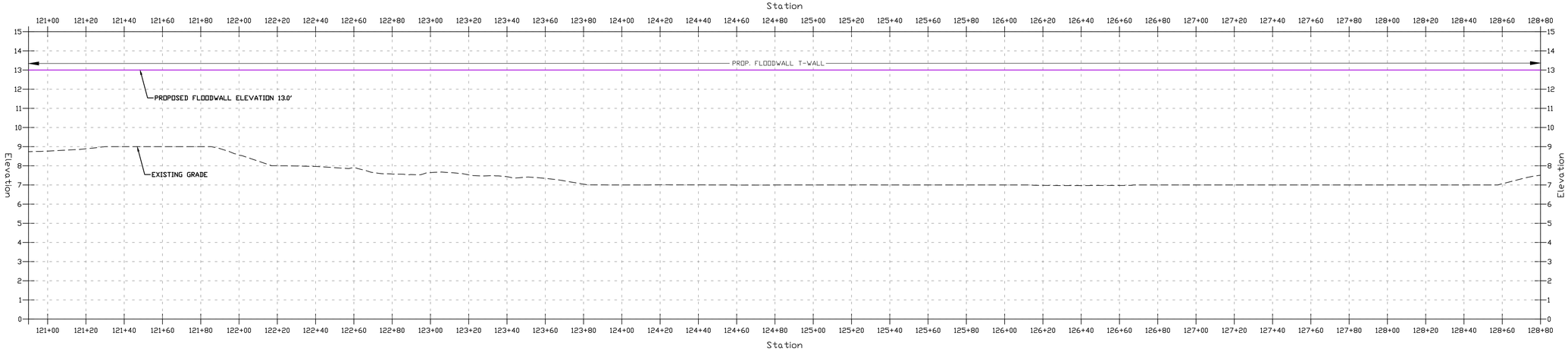


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BELLE HAVEN FRMP CONCEPT DESIGN
STATIONS 120+90 TO 128+80

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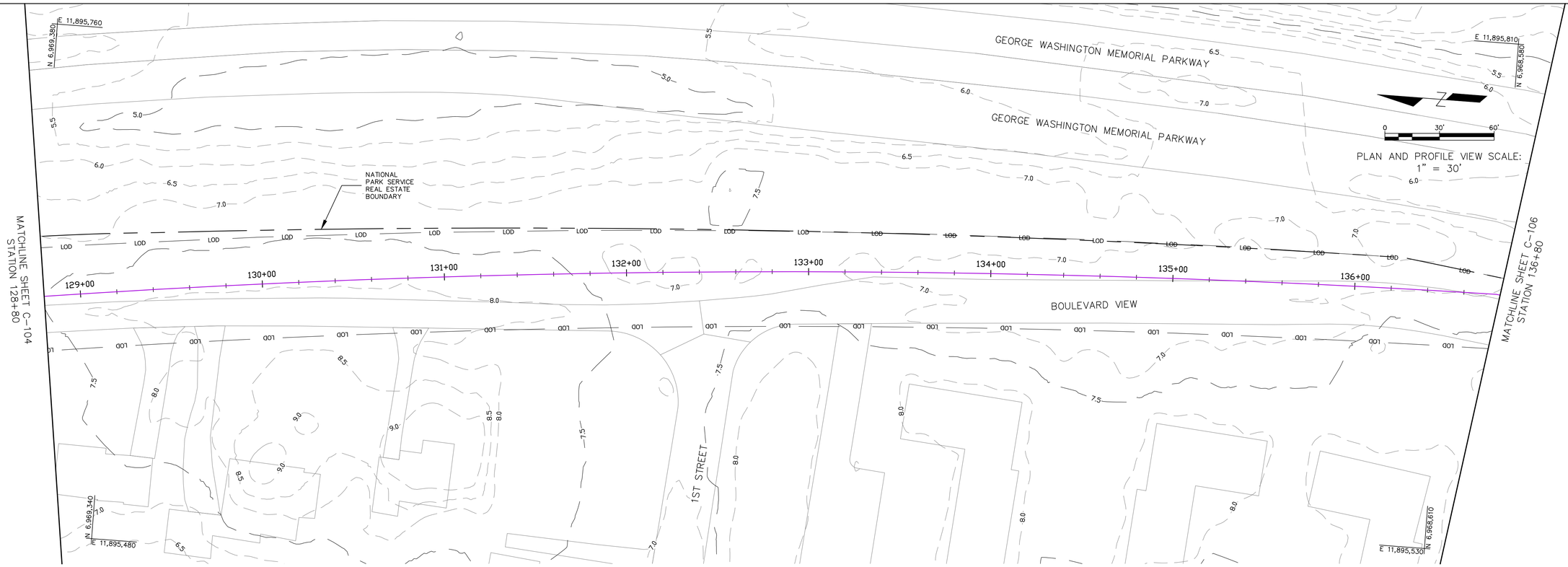


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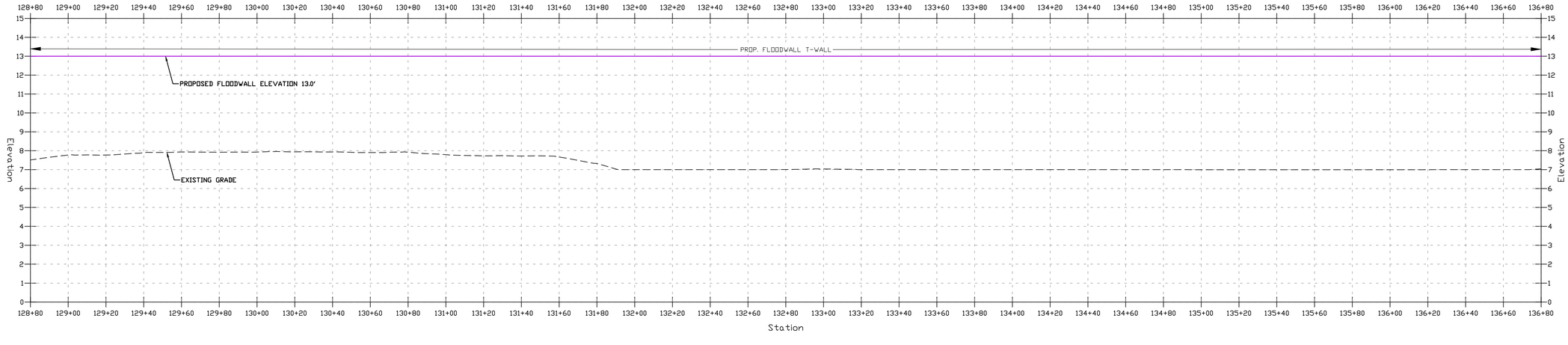


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STATIONS 128+80 TO 136+80

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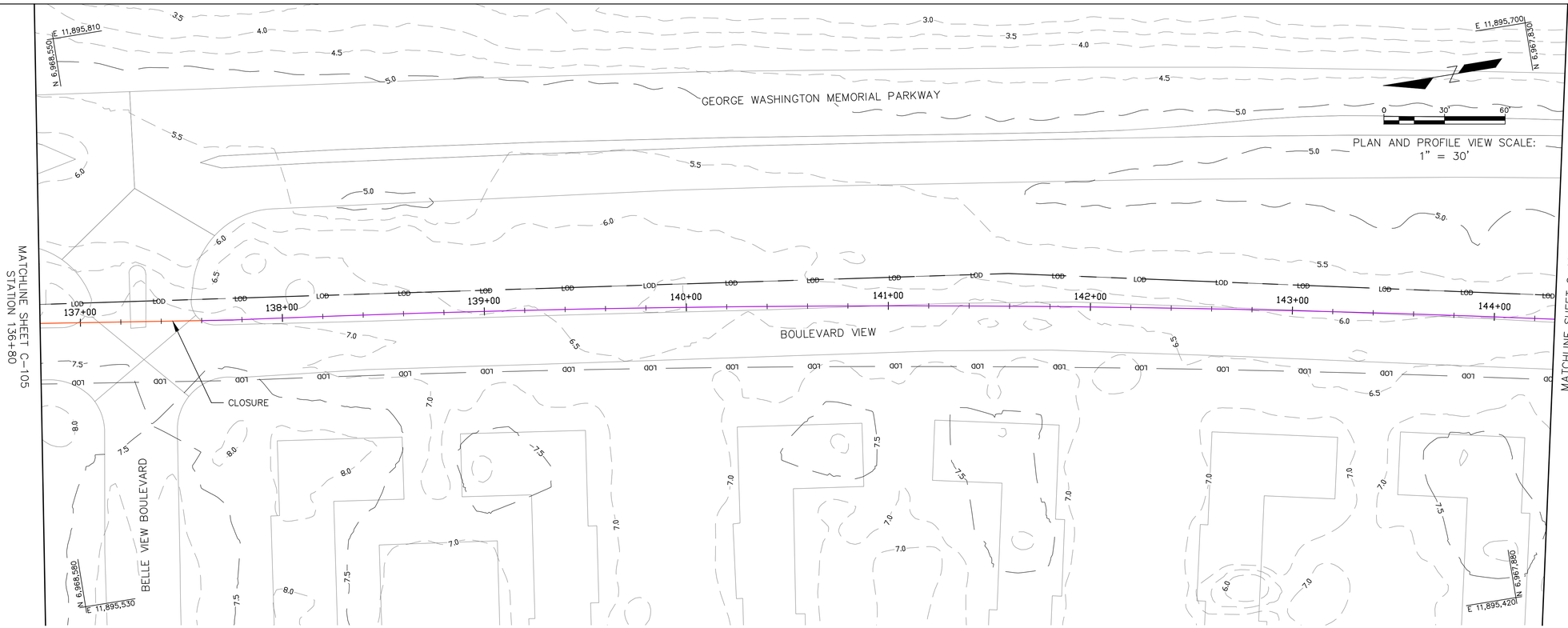


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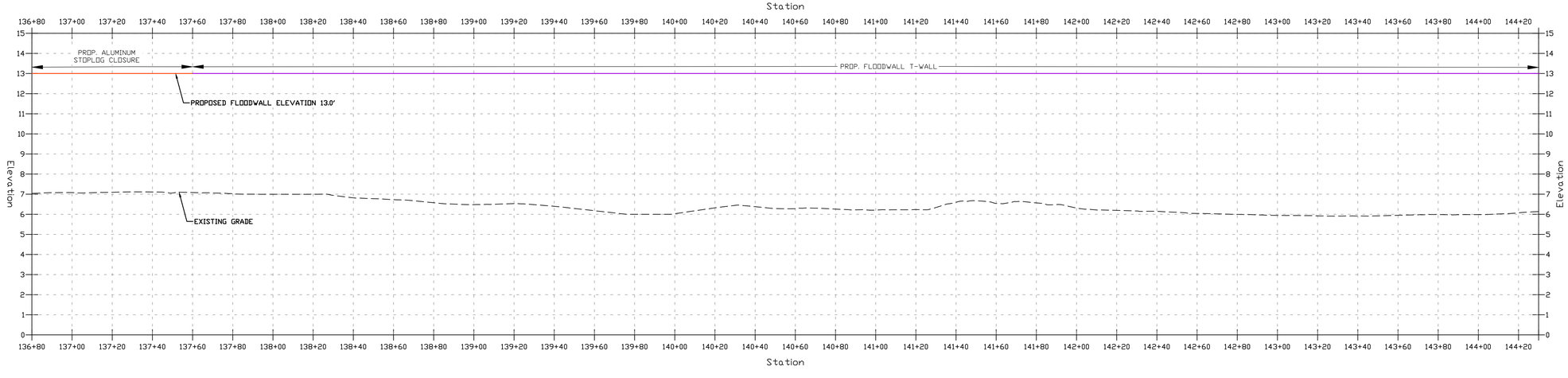


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NORTHERN VIRGINIA COASTAL FLOOD STUDY

BELLE HAVEN FRMP CONCEPT DESIGN
STATIONS 136+80 TO 144+30

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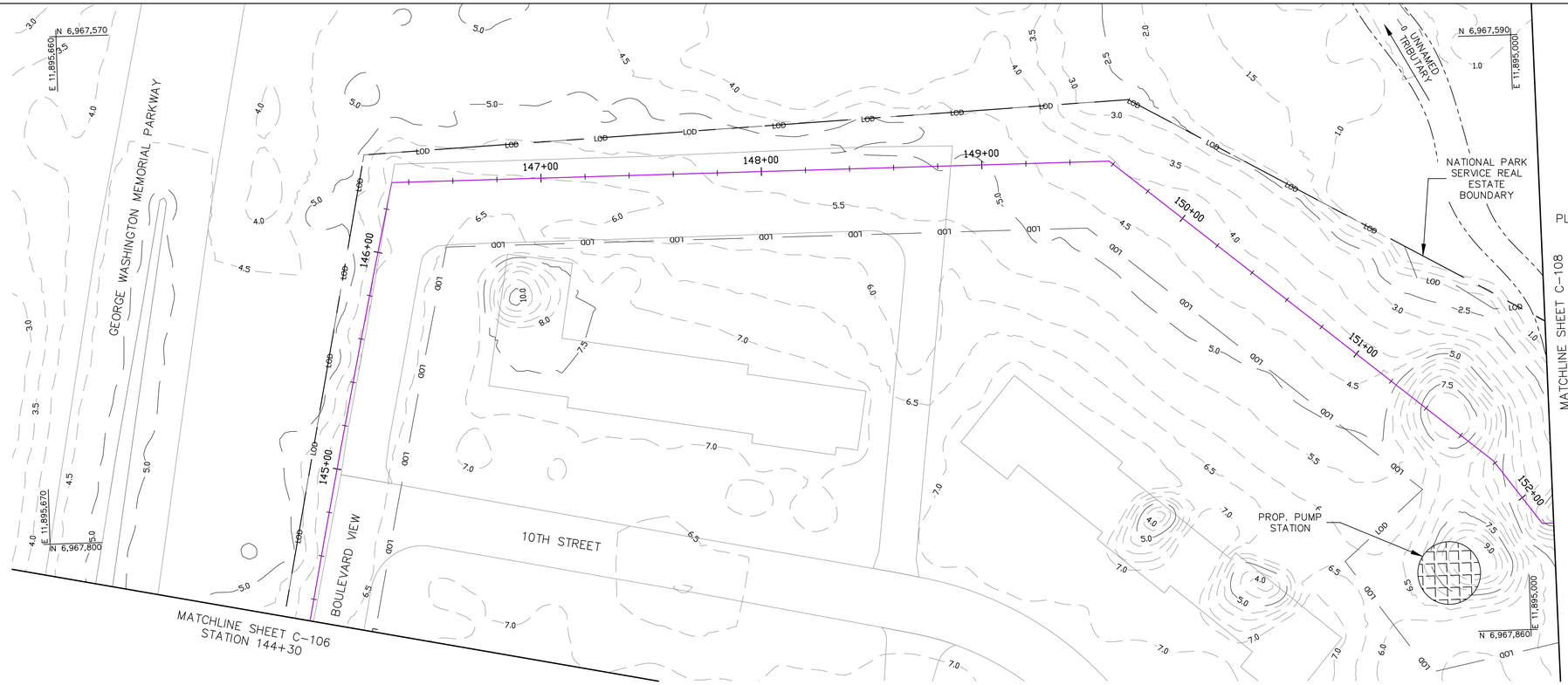


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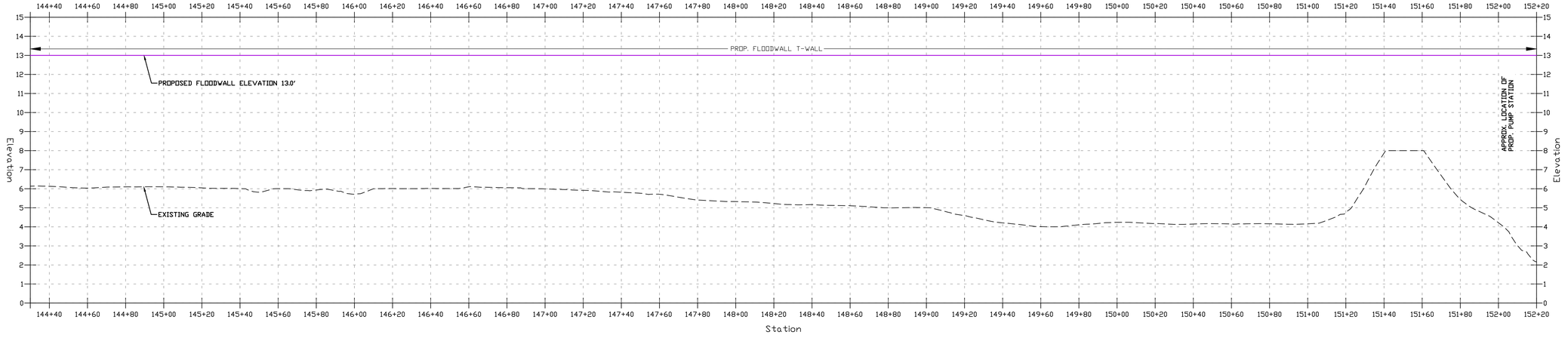
## BELLE HAVEN PROFILE

STATIONS 144+30 TO 152+20
VERTICAL EXAGGERATION= 10

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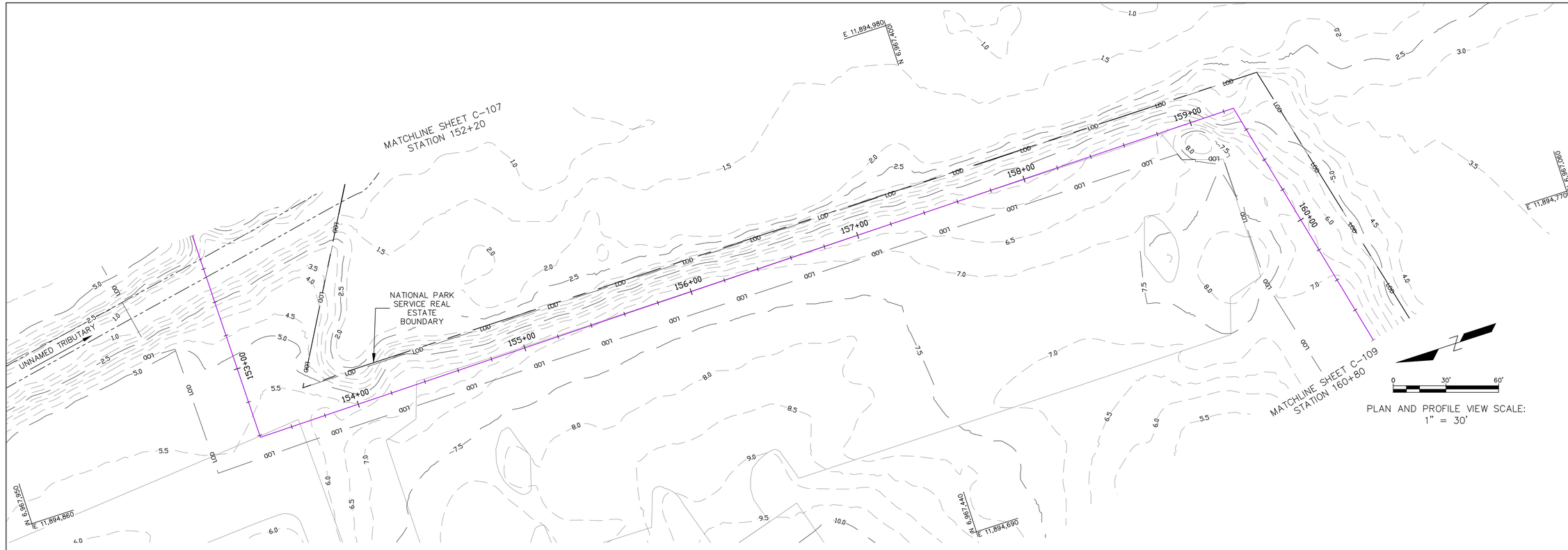
BELLE HAVEN FRMP CONCEPT DESIGN

STATIONS 144+30 TO 152+20

**SHEET IDENTIFICATION**

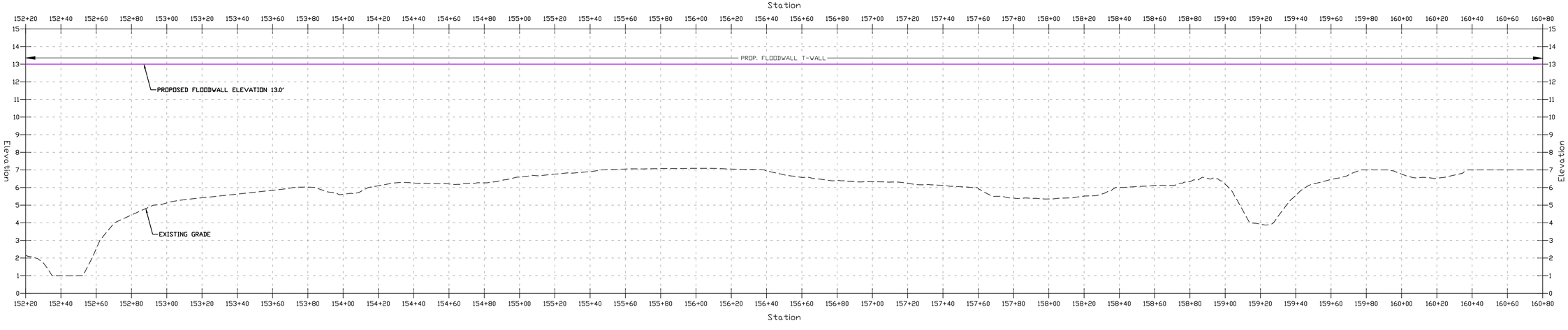
C-107




PLAN AND PROFILE VIEW SCALE:
1" = 30'

## BELLE HAVEN PROFILE

STATIONS 152+20 TO 160+80
VERTICAL EXAGGERATION= 10

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Baltimore District

| MARK | DESCRIPTION | DATE | APPR'D |
|---|---|---|---|

ISSUE DATE: JANUARY, 2023
SOLICITATION NO.: --
CONTRACT NO.: --
FILE / MAP NUMBER:
DESIGN BY:
DRAWN BY:
CKD BY:
SBMT BY:
PLOT DATE:
PLOT SCALE:
FILE NAME: XXCC-108.DWG
SIZE: 22" x 34"

US ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT
BALTIMORE, MARYLAND

ENGINEERING DIVISION

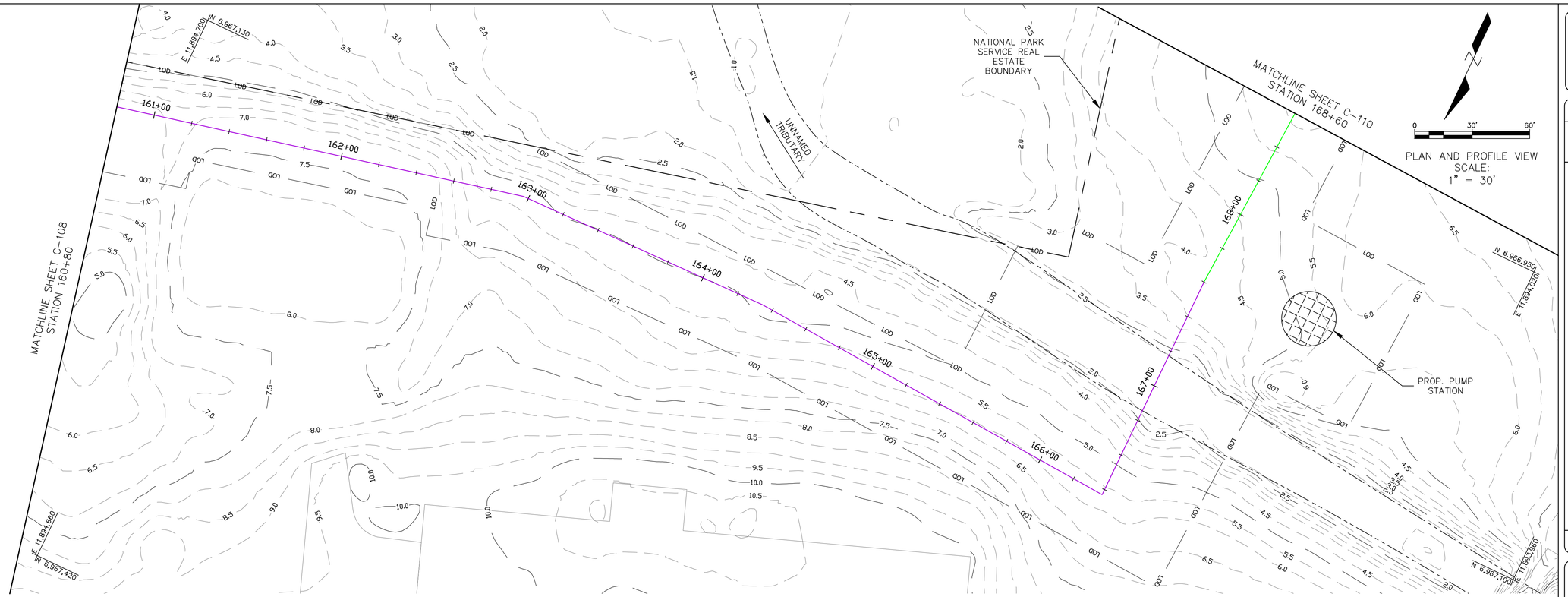
NORTHERN VIRGINIA COASTAL FLOOD STUDY

BELLE HAVEN FRMP CONCEPT DESIGN

STATIONS 152+20 TO 160+80

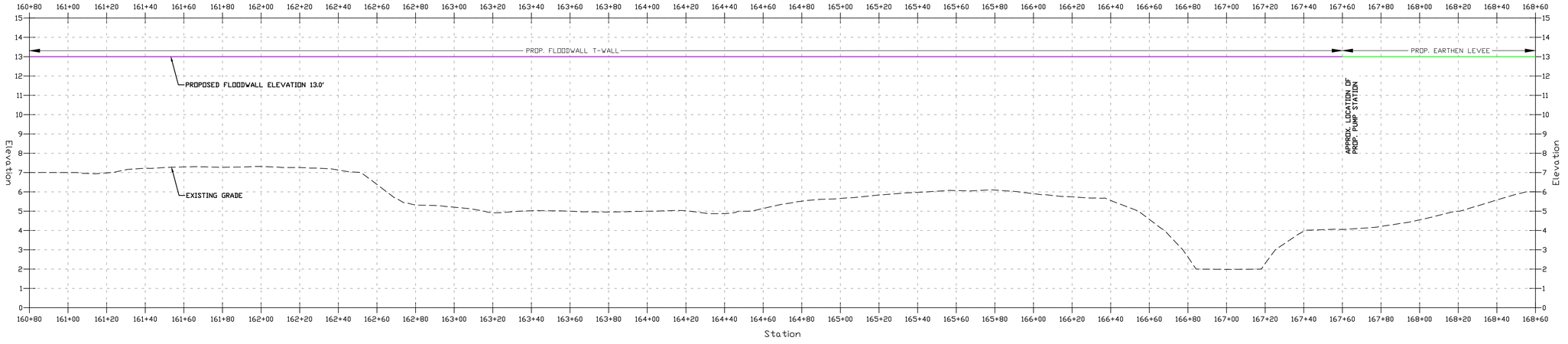
**SHEET IDENTIFICATION**

C-108




## BELLE HAVEN PROFILE

STATIONS 160+80 TO 168+60
VERTICAL EXAGGERATION= 10

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| DESIGN BY: | | ISSUE DATE: JANUARY, 2023 | |
| DRAWN BY: | CKD BY: | SOLICITATION NO.: — | |
| SBMT BY: | PLOT DATE: | CONTRACT NO.: — | |
| | PLOT SCALE: | FILE / MAP NUMBER: | |
| | SIZE: 22" x 34" | FILE NAME: XXSC-109.DWG | |

US ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT
BALTIMORE, MARYLAND

ENGINEERING DIVISION

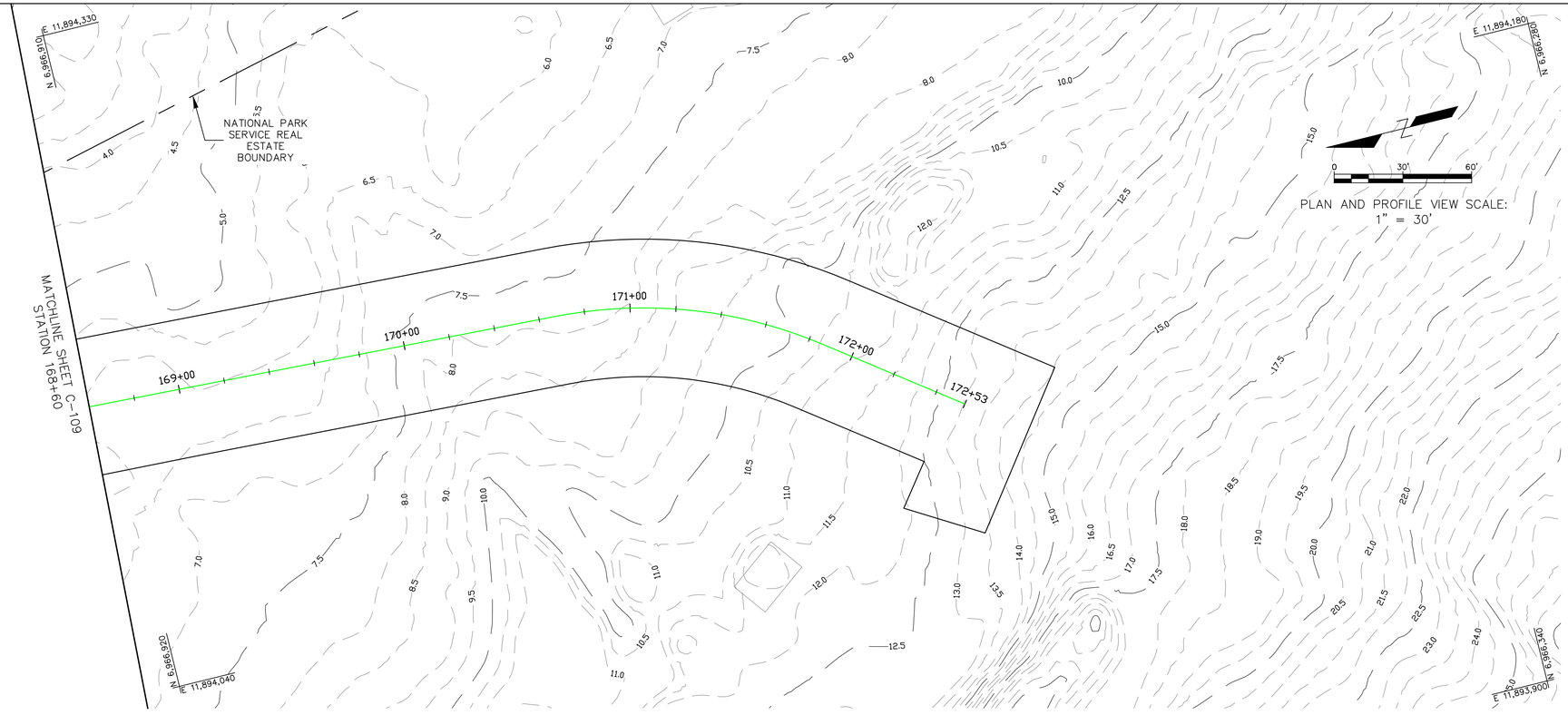
NORTHERN VIRGINIA COASTAL FLOOD STUDY

BELLE HAVEN FRMP CONCEPT DESIGN

STATIONS 160+80 TO 168+60

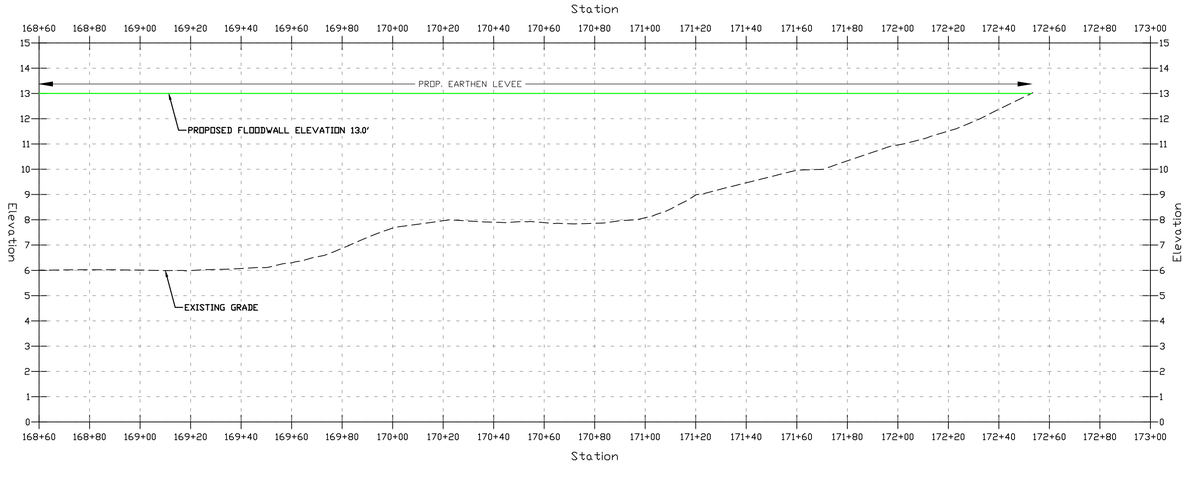
**SHEET IDENTIFICATION**

C-109




## BELLE HAVEN PROFILE

STATIONS 168+60 TO 172+54
VERTICAL EXAGGERATION= 10

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ISSUE DATE: JANUARY, 2023
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DESIGN BY:
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CKD BY:
SBMT BY:
PLOT DATE:
PLOT SCALE: 1:1
FILE NAME: XXCC110.DWG
SIZE: 22" x 34"

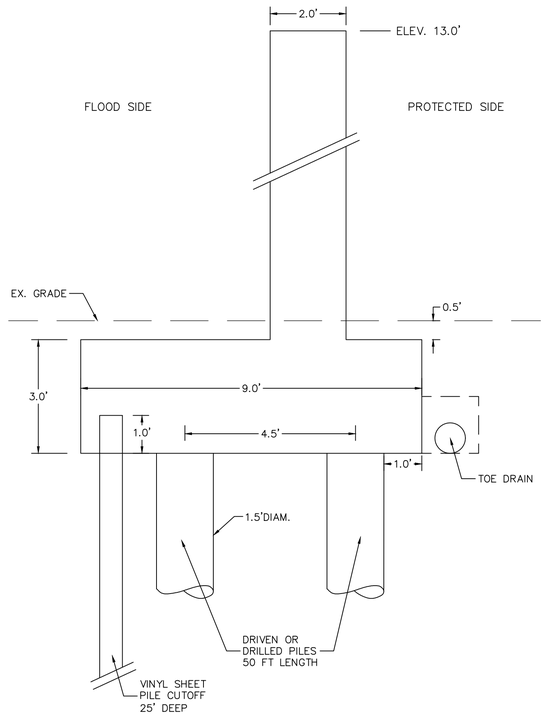
US ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT
BALTIMORE, MARYLAND

ENGINEERING DIVISION

NORTHERN VIRGINIA COASTAL FLOOD STUDY

BELLE HAVEN FRMP CONCEPT DESIGN
STATIONS 168+60 TO 172+54

**SHEET IDENTIFICATION**
C-110

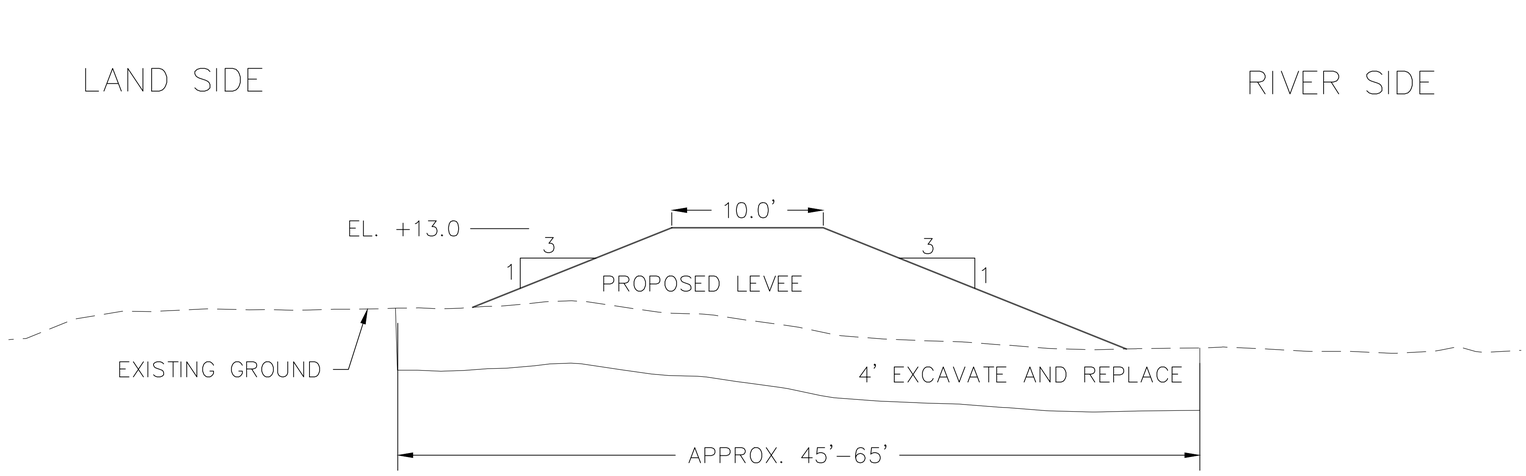



TYPICAL PILE-SUPPORTED FLOOD WALL SECTION

0 2 4 Feet

SCALE:
1" = 2'

| PILE SPACING BY WALL HEIGHT | |
|---|---|
| WALL HEIGHT | SPACING (CENTER TO CENTER) |
| 12.0' | 6.0' |
| 11.0' | 6.0' |
| 10.0' | 8.0' |
| 9.0' | 8.0' |
| 8.0' | 8.0' |
| 6.0' | 10.0' |
| 5.0' | 10.0' |




# TYPICAL EARTHEN LEVEE CROSS SECTION

NOT TO SCALE

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| DRAWN BY: | CKD BY: | SOLICITATION NO.: --- | |
| SBMT BY: | PLOT DATE: | CONTRACT NO.: --- | |
| | PLOT SCALE: 1:1 | FILE / MAP NUMBER: | |
| | | SIZE: 22" x 34" | FILE NAME: XXCC-301.DWG |

US ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT
BALTIMORE, MARYLAND

ENGINEERING DIVISION

NORTHERN VIRGINIA COASTAL FLOOD STUDY

BELLE HAVEN FRMP CONCEPT DESIGN
PILE-SUPPORTED FLOODWALL
AND EARTHEN LEVEE TYPICAL SECTIONS

**SHEET IDENTIFICATION**
C-301

# NORTHERN VIRGINIA COASTAL FLOOD STUDY

PLANS FOR

# ARLINGTON WATER POLLUTION CONTROL PLANT
# FLOOD RISK MANAGEMENT PROJECT
# CONCEPT DESIGN

ARLINGTON, VA

DEPARTMENT OF THE ARMY

BALTIMORE DISTRICT, CORPS OF ENGINEERS

BALTIMORE, MARYLAND


LEGEND

- PROP. FLOODWALL T–WALL
- PROP. FLOODWALL I–WALL
- PROP. ALUMINUM STOPLOG CLOSURE
- PROP. FLOODWALL ELEVATED CURB
- LOD — LIMIT OF DISTURBANCE
- EX. SHORELINE
- EX. ROAD/DRIVEWAY/PARKING LOT
- EX. BUILDING

SURVEY NOTES:
1. ALL COORDINATE VALUES ARE IN U.S. SURVEY FEET AND REFERENCE THE VIRGINIA STATE PLANE NORTH ZONE COORDINATE SYSTEM, NORTH AMERICAN DATUM OF 1983 (NAD83)
2. ALL ELEVATIONS ARE IN U.S. SURVEY FEET AND REFERENCE THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).
3. SURVEY INFORMATION COMES FROM A 2018 USGS NAIP.

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Baltimore District

| MARK | DESCRIPTION | DATE | APPR'D |
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|---|---|---|---|
| DESIGN BY: | | ISSUE DATE: JANUARY, 2023 | |
| DRAWN BY: | CKD BY: | SOLICITATION NO.: --- | |
| SBMT BY: | PLOT DATE: | CONTRACT NO.: --- | |
| | PLOT SCALE: | FILE / MAP NUMBER: FILE 7 / MAP 7 OF 20 | |
| | SIZE: 22" X 34" | FILE NAME: GI102.DWG | |

US ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT
BALTIMORE, MARYLAND

ENGINEERING DIVISION

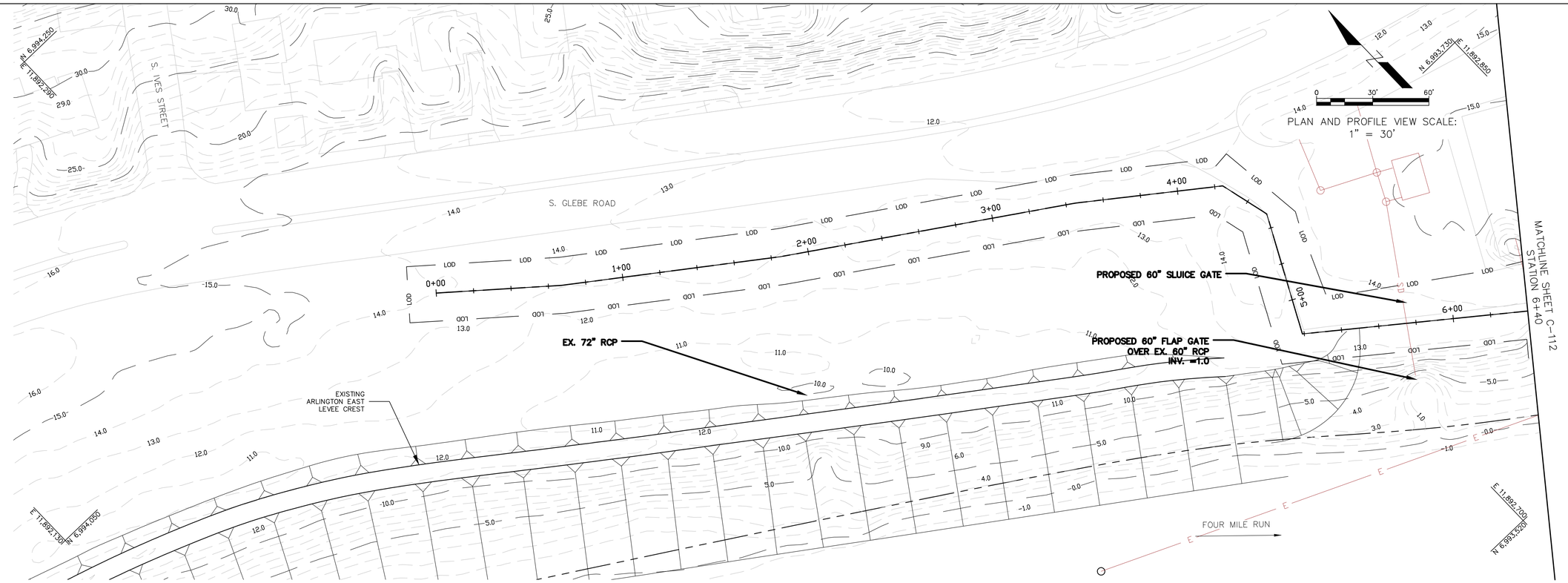
NORTHERN VIRGINIA COASTAL FLOOD STUDY

ARLINGTON WPCP FRMP CONCEPT DESIGN

KEY MAP SHEET

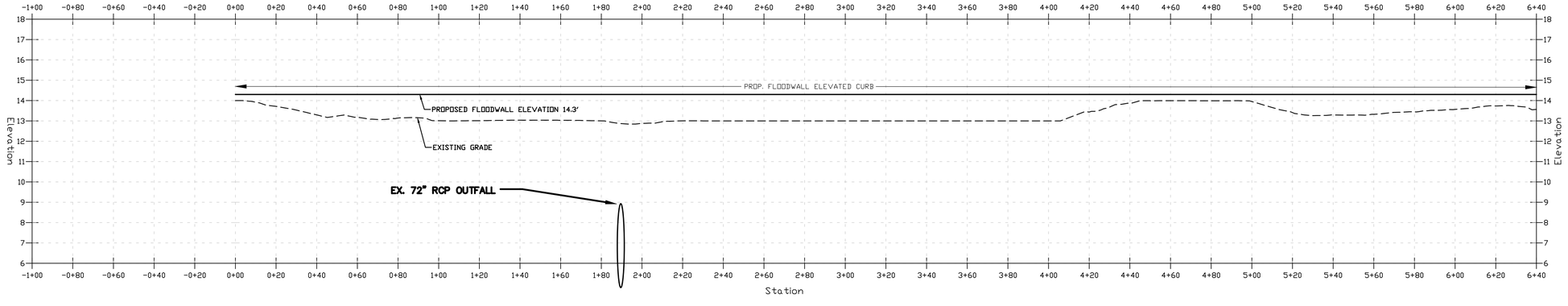
**SHEET IDENTIFICATION**

GI101




## ARLINGTON WPCP PROFILE

STATIONS 0+00 TO 6+40
VERTICAL EXAGGERATION= 10




US Army Corps of Engineers ®
Baltimore District

| MARK | DESCRIPTION | DATE | APPR'D |
|---|---|---|---|

ISSUE DATE: JANUARY, 2023
SOLICITATION NO.: ---
CONTRACT NO.: ---
FILE / MAP NUMBER: 017_24741DE6.SV$.DWG

DESIGN BY:
DRAWN BY:
CKD BY:
SBMT BY:
PLOT DATE:
PLOT SCALE: 1:1
SIZE: 22" x 34"
FILE NAME: XXXC-111_1_13017_24741DE6.SV$.DWG

US ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT
BALTIMORE, MARYLAND

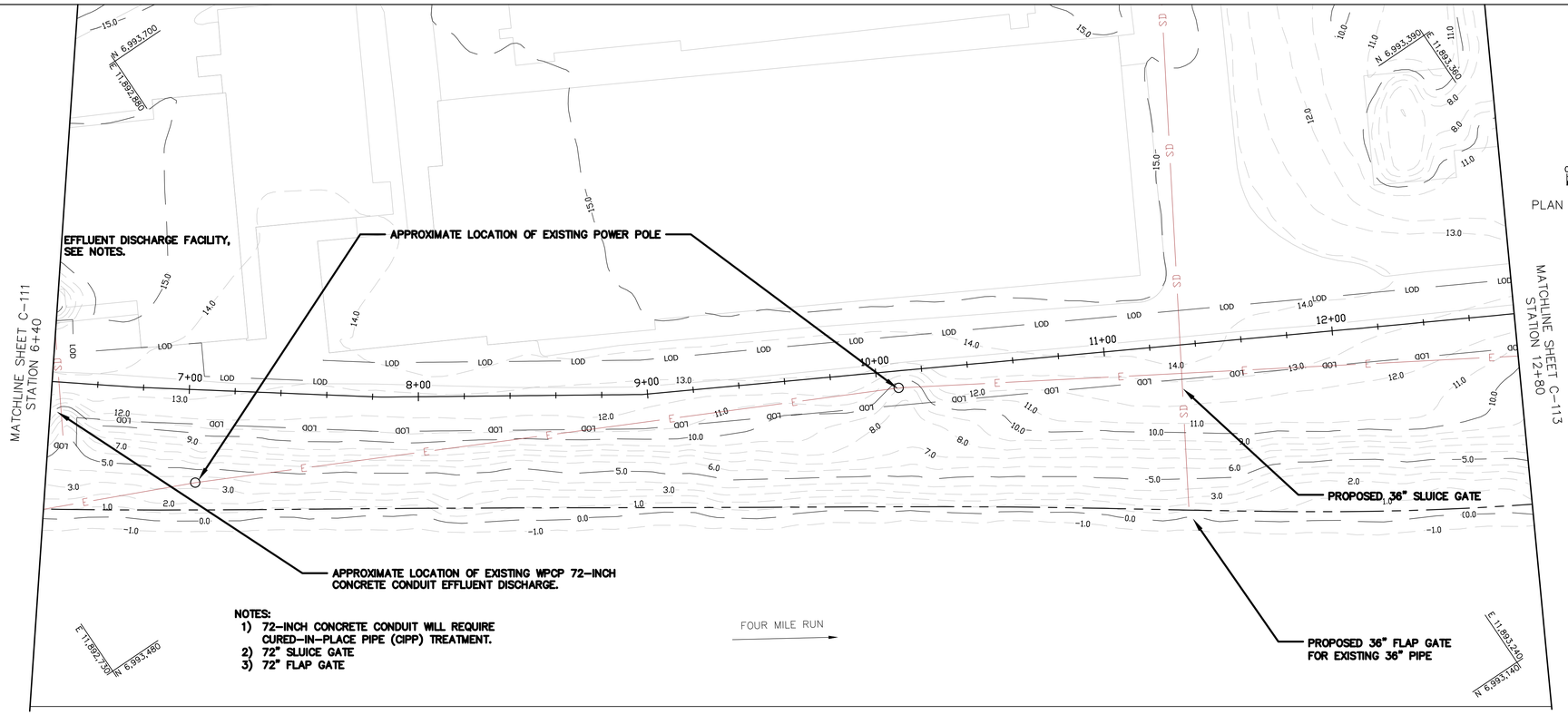
ENGINEERING DIVISION

NORTHERN VIRGINIA COASTAL FLOOD STUDY

# ARLINGTON WPCP FRMP CONCEPT DESIGN
# STATIONS 0+00 TO 6+40

**SHEET IDENTIFICATION**

C-111

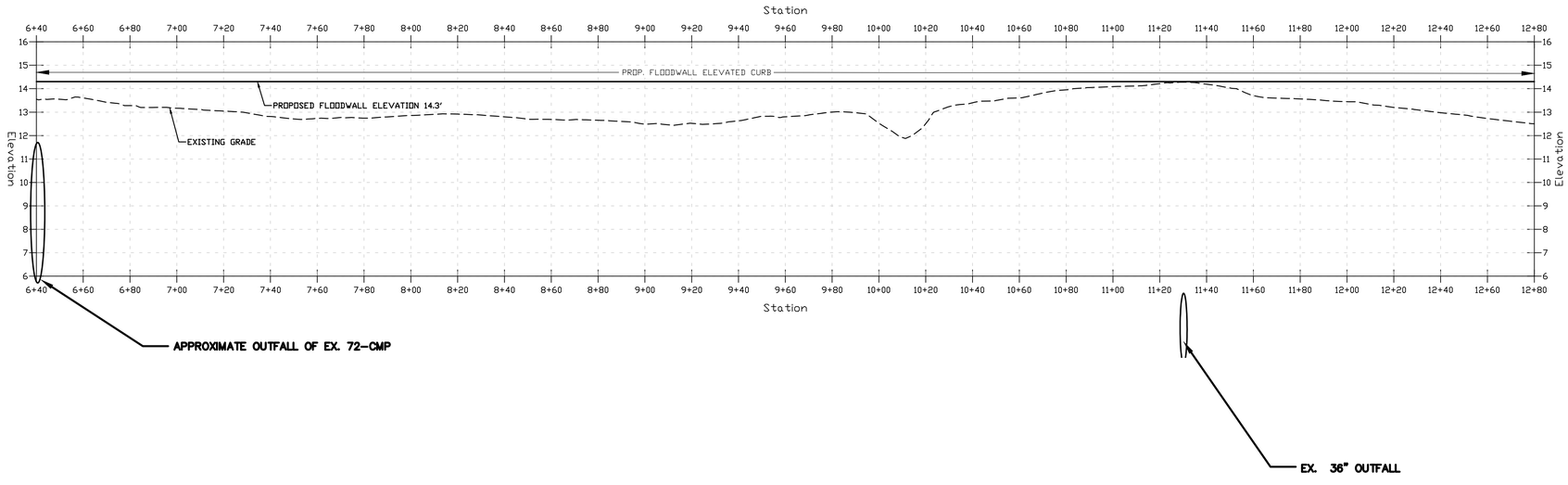



NOTES:
1) 72-INCH CONCRETE CONDUIT WILL REQUIRE CURED-IN-PLACE PIPE (CIPP) TREATMENT.
2) 72" SLUICE GATE
3) 72" FLAP GATE

0 30' 60'

PLAN AND PROFILE VIEW SCALE:
1" = 30'

STATIONS 6+40 TO 12+80
VERTICAL EXAGGERATION= 10
ARLINGTON WPCP PROFILE

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|---|---|---|---|

ISSUE DATE: JANUARY, 2023
SOLICITATION NO.: ---
CONTRACT NO.: ---
FILE / MAP NUMBER:
DESIGN BY:
DRAWN BY:
CKD BY:
SBMT BY:
PLOT DATE:
PLOT SCALE: 1:1
SIZE: 22" x 34"
FILE NAME: XXXC-112.DWG

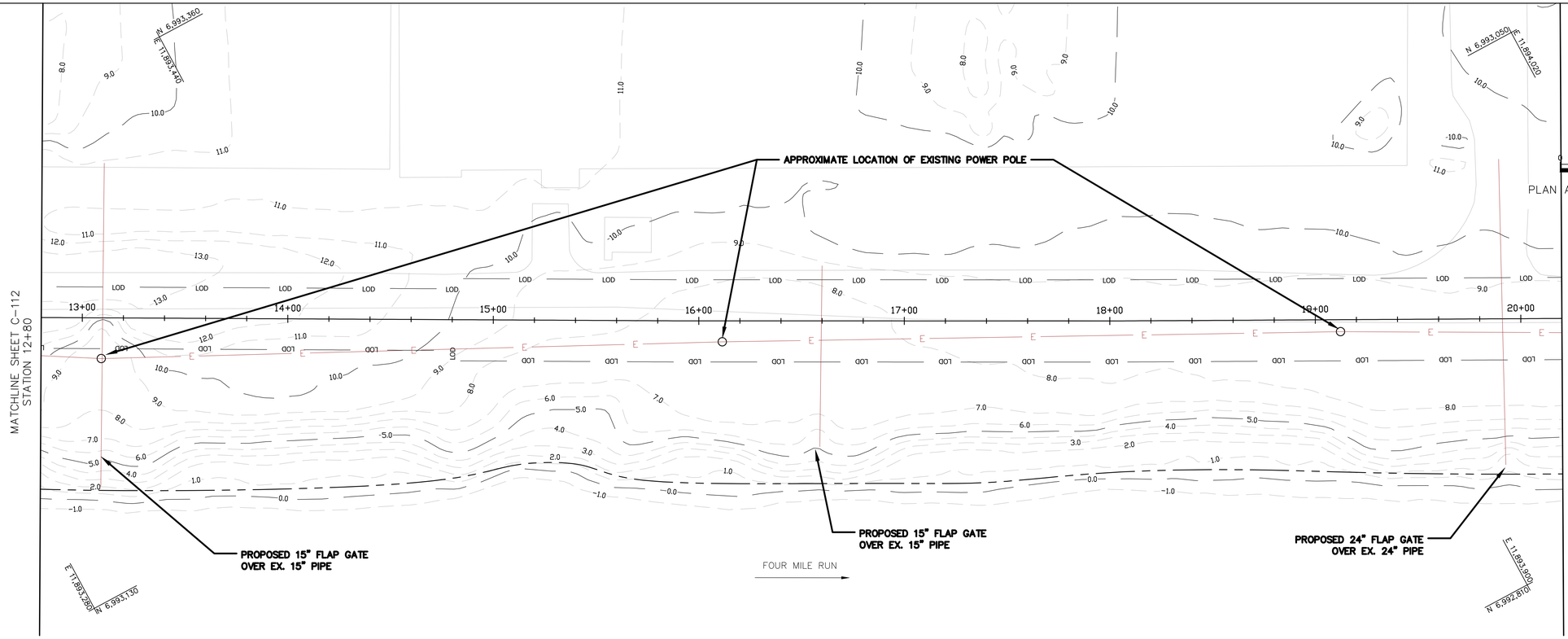
US ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT
BALTIMORE, MARYLAND

ENGINEERING DIVISION

NORTHERN VIRGINIA COASTAL FLOOD STUDY

ARLINGTON WPCP FRMP CONCEPT DESIGN
STATIONS 6+40 TO 12+80

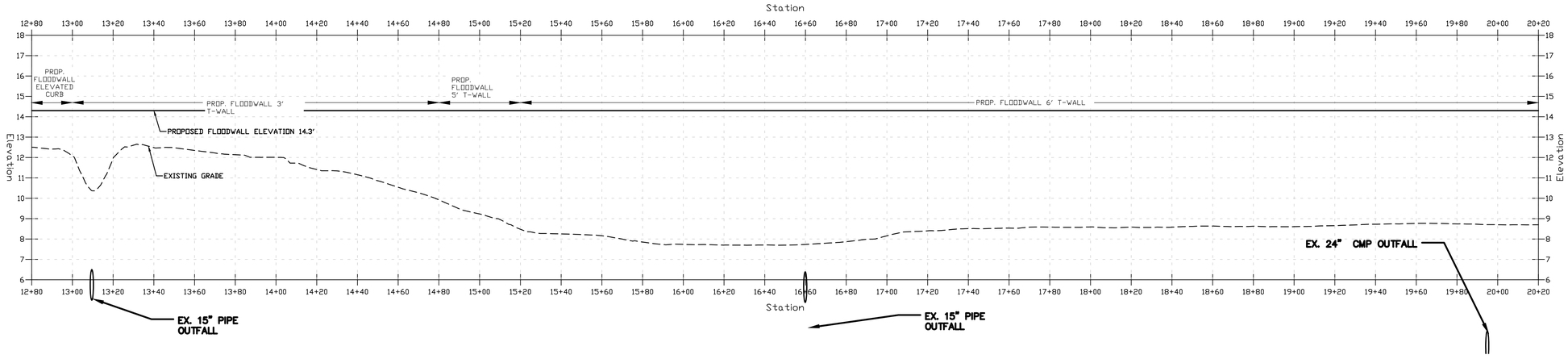
SHEET IDENTIFICATION
C-112




PLAN AND PROFILE VIEW SCALE: 1" = 30'

## ARLINGTON WPCP PROFILE

STATIONS 12+80 TO 20+20
VERTICAL EXAGGERATION= 10




US Army Corps of Engineers ®
Baltimore District

| MARK | DESCRIPTION | DATE | APPR'D |
|---|---|---|---|

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|---|---|
| ISSUE DATE: | JANUARY, 2023 |
| SOLICITATION NO.: | -- |
| CONTRACT NO.: | -- |
| FILE / MAP NUMBER: | |
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| DRAWN BY: | |
| CKD BY: | |
| SBMT BY: | |
| PLOT DATE: | |
| PLOT SCALE: | 1:1 |
| SIZE: | 22" x 34" |
| FILE NAME: | XXXC-113.DWG |

US ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT
BALTIMORE, MARYLAND

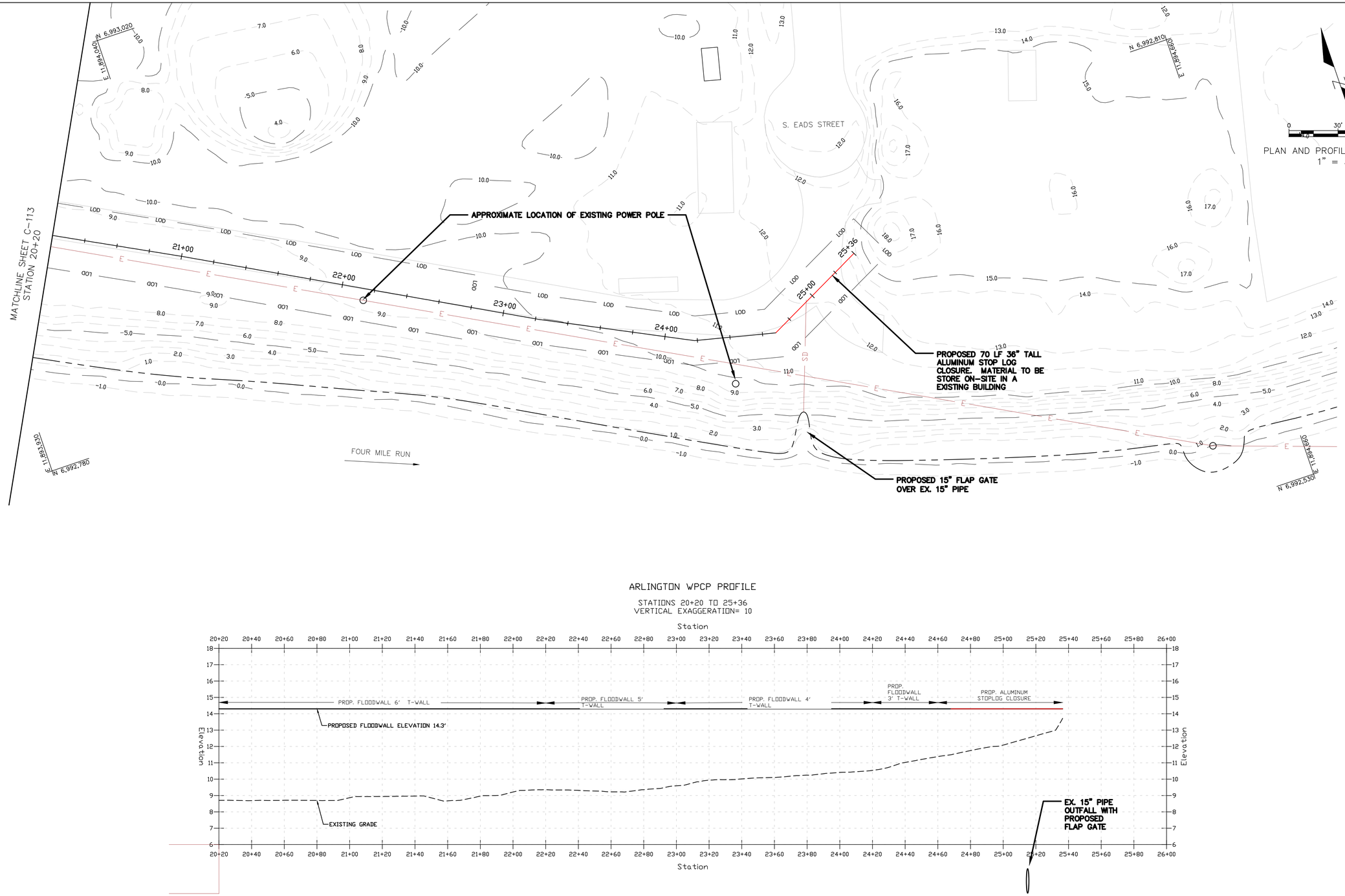
ENGINEERING DIVISION

NORTHERN VIRGINIA COASTAL FLOOD STUDY

ARLINGTON WPCP FRMP CONCEPT DESIGN
STATIONS 12+80 TO 20+20

**SHEET IDENTIFICATION**

C-113




## ARLINGTON WPCP PROFILE

STATIONS 20+20 TO 25+36
VERTICAL EXAGGERATION= 10




US Army Corps of Engineers ®
Baltimore District

| | DATE | APPR'D |
|---|---|---|
| DESCRIPTION | | |
| MARK | | |

ISSUE DATE: JANUARY, 2023
SOLICITATION NO.: ---
CONTRACT NO.: ---
FILE / MAP NUMBER:
DESIGN BY:
DRAWN BY:
CKD BY:
SBMT BY:
PLOT DATE:
PLOT SCALE: 1"=30'
SIZE: 22" x 34"
FILE NAME: XXXC-114.DWG

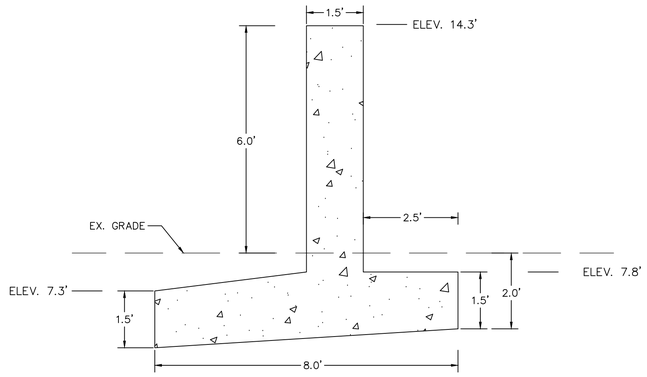
US ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT
BALTIMORE, MARYLAND

ENGINEERING DIVISION

NORTHERN VIRGINIA COASTAL FLOOD STUDY

ARLINGTON WPCP FRMP CONCEPT DESIGN
STATIONS 20+20 TO 25+36

**SHEET IDENTIFICATION**
C-114



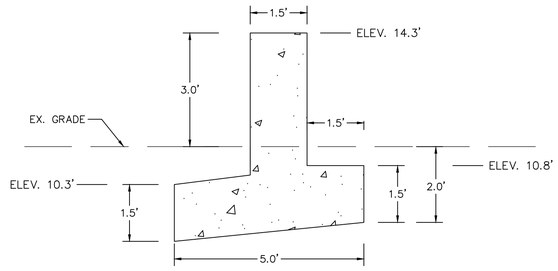

6 FOOT T-WALL
TYPICAL SECTION

0 2 4 Feet

SCALE:
1" = 2'

6 FOOT WALL TYPICAL SECTION

STATIONS:
15+20 TO 22+20



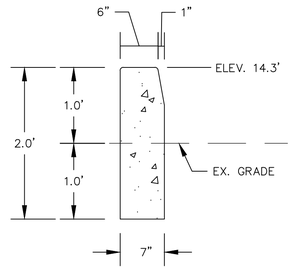

3 FOOT T-WALL
TYPICAL SECTION

3 FOOT WALL TYPICAL SECTION

STATIONS:
13+00 TO 14+80
24+20 TO 24+70

0 2 4 Feet

SCALE:
1" = 2'

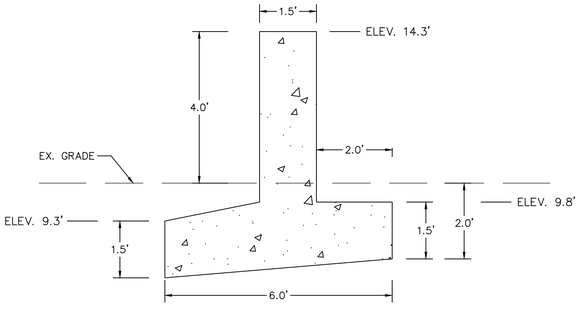



1 FOOT ELEVATED CURB TYPICAL SECTION

STATIONS:
0+00 TO 13+00

0 1 2 Feet

SCALE:
1" = 1'



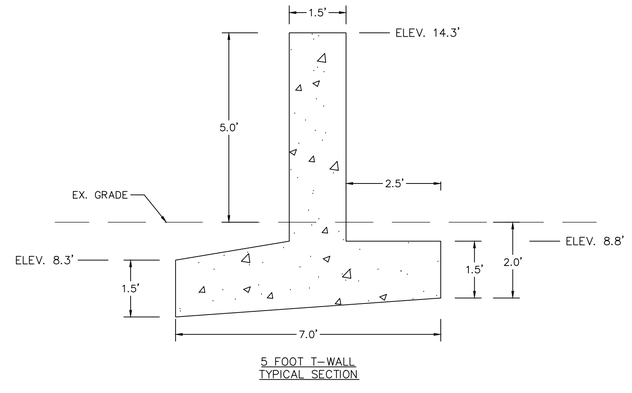

4 FOOT T-WALL
TYPICAL SECTION

4 FOOT WALL TYPICAL SECTION

STATIONS:
23+00 TO 24+20

0 2 4 Feet

SCALE:
1" = 2'




5 FOOT T-WALL
TYPICAL SECTION

0 2 4 Feet

SCALE:
1" = 2'

5 FOOT WALL TYPICAL SECTION

STATIONS:
14+80 TO 15+20
22+20 TO 23+00

US Army Corps of Engineers ®
Baltimore District

| MARK | DESCRIPTION | DATE | APPR'D |
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|---|---|
| DESIGN BY: | |
| DRAWN BY: | CAD BY: |
| SBMT BY: | PLOT DATE: |
| | PLOT SCALE: 1:1 |
| SIZE: 22" x 34" | FILE NAME: XXXC-301.DWG |
| ISSUE DATE: JANUARY, 2023 | |
| SOLICITATION NO.: --- | |
| CONTRACT NO.: --- | |
| FILE / MAP NUMBER: | |

US ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT
BALTIMORE, MARYLAND

ENGINEERING DIVISION

NORTHERN VIRGINIA COASTAL FLOOD STUDY

ARLINGTON WPCP FRMP CONCEPT DESIGN
FLOODWALL AND CURB
TYPICAL SECTIONS

SHEET IDENTIFICATION
C-301