

TOWN OF GRAND LAKE STORMWATER MANAGEMENT PLAN



SEPTEMBER 2024

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Sub-Consultants

Horizontal Scale & Orientation

Legend

Revision	By	Appd.	YY.MM.DD
Issued	By	Appd.	YY.MM.DD
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Client/Project
TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

Project Milestone

Sheet Name
COVER

2023007041	NTS
Project No.	Horizontal Scale

GENERAL NOTES & LEGEND

1.

THESE PLANS ARE INTENDED TO PROVIDE THE TOWN OF GRAND LAKE WITH DESIGN DOCUMENTS TO OBTAIN CONTRACTOR BIDS. THESE DESIGNS MAY NEED TO BE MODIFIED AFTER ADDITIONAL INFORMATION IS OBTAINED SUCH AS, BUT NOT LIMITED TO, GROUND SURVEY, UTILITY LOCATIONS, ETC.
2.

UTILITIES HAVE NOT BEEN LOCATED AS PART OF THE DESIGN FOR THIS PROJECT. MODIFICATIONS TO THESE DESIGNS MAY BE REQUIRED IF UTILITY CONFLICTS ARE FOUND.
3.

THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK. CONTRACTOR TO CALL FOR UTILITY LOCATOR AT LEAST 3 CALENDAR DAYS BEFORE EXCAVATION. THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE CAUSED BY THEIR FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL ABOVE GROUND AND UNDERGROUND UTILITIES. IN THE EVENT THAT THE CONTRACTOR UTILITY VERIFICATION RESULTS IN EXISTING STRUCTURES OR UTILITIES BEING IN CONFLICT WITH THE PROPOSED WORK OF THIS CONTRACT, THE CONTRACTOR SHALL IMMEDIATELY NOTIFY UTILITIES AND COORDINATE ANY NEEDED MODIFICATIONS TO THE PROPOSED WORK.
4.

THE CONTRACTOR SHALL COORDINATE WITH ALL AFFECTED UTILITY OWNERS TO ESTABLISH THE REQUIREMENTS AND METHODS TO ACCOMMODATE THE PROTECTION, TEMPORARY SUPPORT, ADJUSTMENT OR RELOCATION OF UTILITIES PRIOR TO THE START OF CONSTRUCTION.
5.

OVERHEAD UTILITIES ARE NOT INDICATED ON PROFILE OR SECTION DRAWINGS.
6.

THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROTECTING AND MAINTAINING IN CONTINUOUS OPERATION, ALL EXISTING STRUCTURES. NOT ALL POTENTIALLY IMPACTED STRUCTURES MAY BE SHOWN ON THE DRAWINGS AND IT IS THE CONTRACTOR'S RESPONSIBILITY TO IDENTIFY AND PROTECT ALL STRUCTURES INCLUDING BUT NOT LIMITED TO STREETS, CURB AND GUTTER, BRIDGE PIERS AND ABUTMENTS, CREEK BANK PROTECTION OF VARIOUS TYPES, CREEK DROP STRUCTURES, SIGNS, PEDESTRIAN WALKS, RETAINING WALLS AND FENCING. IN THE EVENT THAT A STRUCTURE OR UTILITY IS DAMAGED DURING CONSTRUCTION THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE TOWN OF GRAND LAKE (TOWN) IN WRITING AND MAKE REPAIRS PER TOWN SPECIFICATIONS.
7.

THE CONTRACTOR SHALL CONFIRM THE RECEIPT OF ALL NECESSARY PERMITS AND APPROVALS BEFORE THE START OF CONSTRUCTION.
8.

ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE STANDARDS OF THE TOWN UNLESS SPECIFICALLY DETAILED OTHERWISE ON THESE PLANS AND ASSOCIATED SPECIFICATIONS. ANY ELEMENT OF CONSTRUCTION WHICH IS NOT ADDRESSED EITHER BY THESE PLANS AND SPECIFICATIONS OR BY THE STANDARDS OF THE TOWN SHALL CONFORM TO THE STANDARD SPECIFICATIONS OF THE NATURAL RESOURCES CONSERVATION SERVICE.
9.

THE CONTRACTOR SHALL MAINTAIN AT THE SITE AT ALL TIMES ONE SIGNED COPY OF THE PROJECT DRAWINGS AND SPECIFICATIONS, ONE COPY OF THE STORMWATER MANAGEMENT PLAN AND ONE COPY OF ALL REQUIRED PERMITS.
10.

THE CONTRACTOR SHALL CONDUCT THEIR OPERATIONS IN SUCH A WAY THAT THE AREA OF DISTURBANCE IS MINIMIZED. ALL EXISTING TREES, SHRUBS AND VEGETATION SHALL BE PROTECTED UNLESS OTHERWISE NOTED ON THE DRAWINGS. NO TREES SHALL BE REMOVED WITHOUT APPROVAL FROM THE TOWN.
11.

FOR ALL SITE GRADING, SMOOTH, PARABOLIC TRANSITIONS SHALL BE MADE BETWEEN CHANGES IN SLOPE. ALL FILL MATERIAL SHALL BE COMPACTED.
12.

THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR PROVIDING STABLE EXCAVATIONS AND TEMPORARY SLOPES AND FOR SATISFYING ALL APPLICABLE FEDERAL, STATE AND LOCAL REGULATIONS.
13.

CONSTRUCTION OF THE PROPOSED WORK WILL TAKE PLACE WITHIN THE CHANNEL AND WATER CONTROL MEASURES WILL BE REQUIRED. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE ACCEPTANCE AND CONTROL OF DRAINAGE WATER FROM AREAS ADJACENT TO THE SAN MIGUEL RIVER AND FOR FLOW WITHIN THE SAN MIGUEL RIVER AND ITS TRIBUTARIES INCLUDING STORMWATER OUTFALLS. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR ESTABLISHING MEANS AND METHODS OF GROUND AND SURFACE WATER CONTROL APPROPRIATE FOR CONSTRUCTION IN ACCORDANCE WITH THE REQUIREMENTS OF THE PROJECT DRAWINGS AND SPECIFICATIONS AND ALL APPLICABLE FEDERAL, STATE AND LOCAL REGULATIONS AND PERMITS.
14.

THE CONTRACTOR SHALL PREPARE AND MAINTAIN THE STORMWATER MANAGEMENT PLAN AND OBTAIN THE NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT THROUGH THE COLORADO DEPARTMENT OF PUBLIC HEALTH & ENVIRONMENT AND ALL OTHER APPROPRIATE FEDERAL, STATE AND LOCAL PERMITS.
15.

CONTRACTOR SHALL BE RESPONSIBLE FOR AS-BUILT DRAWINGS TO BE SUBMITTED TO THE TOWN, IN ACCORDANCE WITH THE CONTRACT DOCUMENTS.
16.

THE CONTRACTOR SHALL PROVIDE AND MAINTAIN DAILY ON-SITE GPS SURVEY CONTROL.
17.

CONTRACTOR SHALL FENCE OFF CRITICAL AREAS TO BE PROTECTED AT THE DISCRETION OF THE TOWN.
18.

THE CONTRACTOR SHALL DEVELOP A TRAFFIC CONTROL PLAN IF REQUIRED BY THE TOWN.
19.

CONSTRUCTION TOLERANCES:
- 19.1.

HORIZONTAL=PER PLAN
- 19.2.

VERTICAL=0.10 FEET
20.

CHANGES TO THESE DESIGN PLANS SHALL NOT BE ALLOWED UNLESS APPROVED IN WRITING BY THE DESIGN ENGINEER .
21.

ALL DESIGNS WERE SIZED FOR THE 2-YEAR STORM.
22.

DESIGNS BASED ON 2020 USGS LiDAR. DISCREPANCIES BETWEEN THIS LiDAR DATA AND GROUND-BASED SURVEY DATA. ACTUAL GROUND ELEVATIONS SHALL BE SURVEYED PRIOR TO CONSTRUCTION. IF SIGNIFICANT DISCREPANCIES EXIST THE DESIGNS CONTAINED HEREIN MAY NEED TO BE MODIFIED.
23.

ALL DAYLIGHT SLOPED SHALL BE COVERED WITH NEDIA KOIR MAT 900 (OR APPROVED EQUAL) AND INSTALLED PER MANUFACTURERS RECOMMENDATIONS.
24.

ALL DISTURBED AREAS SHALL BE REVEGETATED WITH NATIVE WETLAND, RIPARIAN, AND/OR UPLAND SEED MIXES, DEPENDING ON HYDROLOGIC ZONE. CONTRACTOR TO CONSULT WITH A QUALIFIED ECOLOGIST FOR SPECIFIC RECOMMENDATIONS.

SURVEY CONTROL

DESIGNS BASED ON 2020 USGS LiDAR
NAD 83 COLORADO STATE PLANES NORTH, U.S. FOOT
NAVD 88

SPECIFICATIONS

1.

BIORETENTION & GRASS SWALE
- 1.1.

MILE HIGH FLOOD DISTRICT SPECIFICATIONS
2.

ROCK SWALE
- 2.1.

MILE HIGH FLOOD DISTRICT SPECIFICATIONS
3.

REINFORCED CONCRETE PIPE & INLETS
- 3.1.

COLORADO DEPARTMENT OF TRANSPORTATION



WATERVATION

130 W. Sackett Ave., Unit A
Salida, CO 81201
www.water-vation.com

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Horizontal Scale & Orientation

Legend

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	Dwn.	Chkd.	Dsgn. 24.09.12



Client/Project

TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

Project Milestone

Sheet Name

GENERAL NOTES

2023007041	NTS
Project No.	Horizontal Scale

C:\Users\lucab@hif\water\water\Drawings\Projects\202300704_Grand Lake Stormwater Management Plan\3_CD03\Sheet_1\CD03.dwg
2024/09/16 9:50 AM By: Lucas Beckett

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44	XSEC_CDW
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66	DETAIL_CDOT TYPE C INLET
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TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

Project Milestone

Sheet Name
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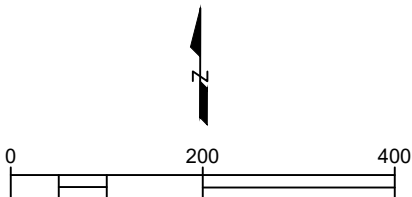
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Project No.	Horizontal Scale



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GRASS SWALE
INFILTRATION BASIN
ROCK CHECK SWALE

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GRAND LAKE, CO

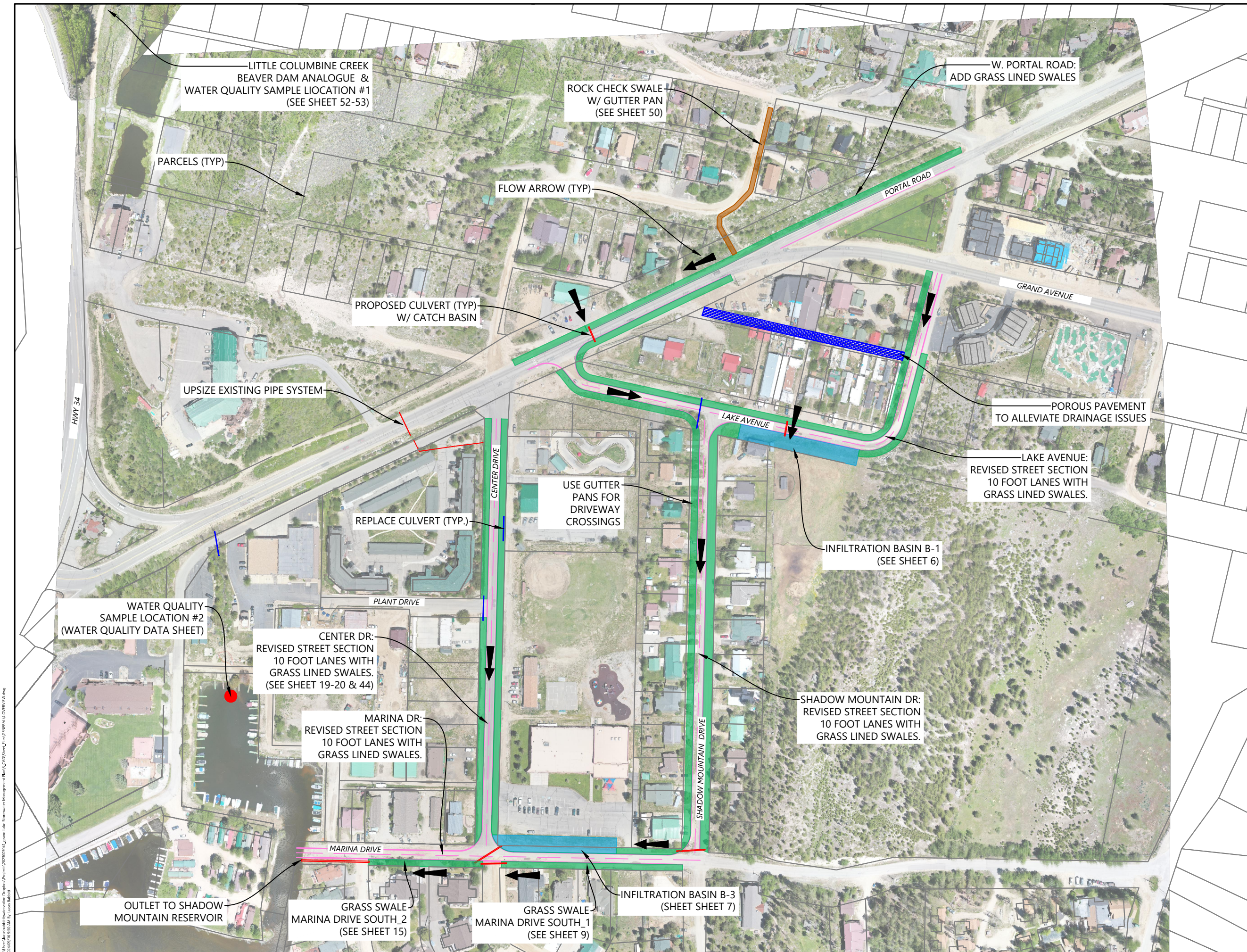
Sheet Name

CONCEPT PLAN

2023007041 1" = 200'

Project No. Horizontal Scale

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C:\Users\lucab@water-ation\Documents\Projects\20230704_Grand Lake Stormwater Management Plan\CDN\Sheet_Rev\GEMPA\LA OVERVIEW.dwg
2024/09/16 9:50 AM By: Lucas Beckett

BASELINE WATER QUALITY DATA					
LOCATION	DESCRIPTION	TOTAL COLIFORM (MPN/100mL)	E. COLI (MPN/100mL)	ORTHO-PHOSPHATE (mg/L)	NITRATE-NITRITE (mg/L)
#1	LITTLE COLUMBINE CREEK	325.5	79.8	<0.05	0.120
#2	MARINA	613.1	7.40	<0.05	0.099

Definitions

MPN/100mL = Most Probable Number per 100 milliliters

mg/L = Milligrams per liter

Water quality analysis performed by Colorado Department of Public Health & Environment

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Legend

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Client/Project
TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN

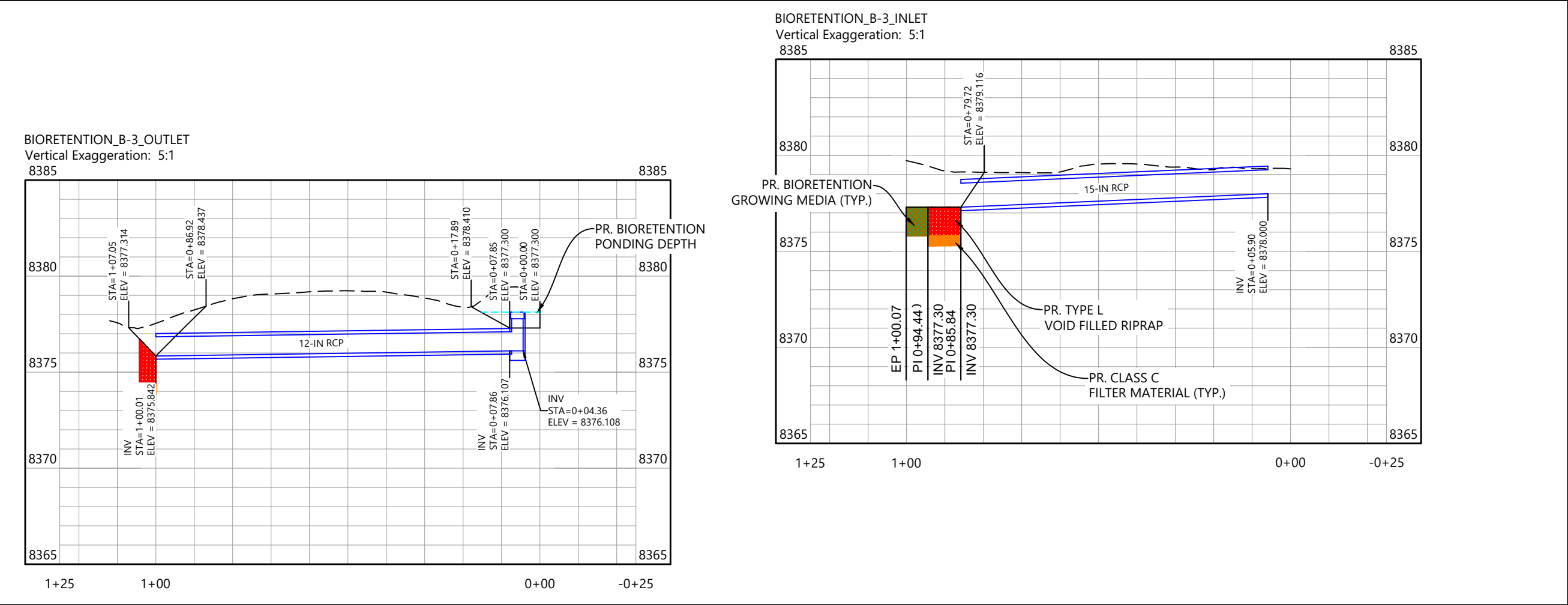
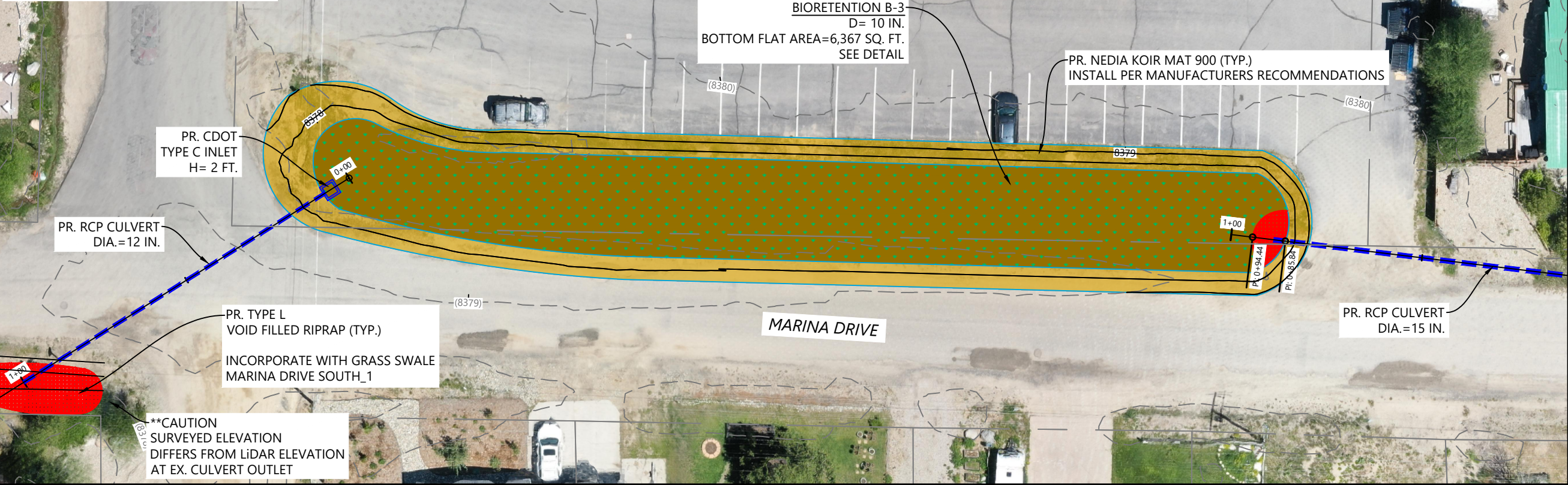
GRAND LAKE, CO


Project Milestone

Sheet Name
WATER QUALITY DATA

2023007041	NTS
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- NOTES:
1. CONTOUR DATA FROM 2020 USGS LiDAR
 2. VERIFY ACTUAL ELEVATIONS W/ GROUND SURVEY PRIOR TO CONSTRUCTION
 3. DESIGN BASED ON THE 2-YEAR STORM





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0 30 60


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TOWN OF GRAND LAKE
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PRELIMINARY

Sheet Name

BIORETENTION B-3

2023007041 1" = 30'

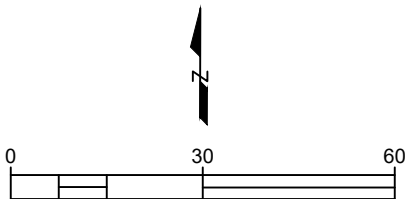
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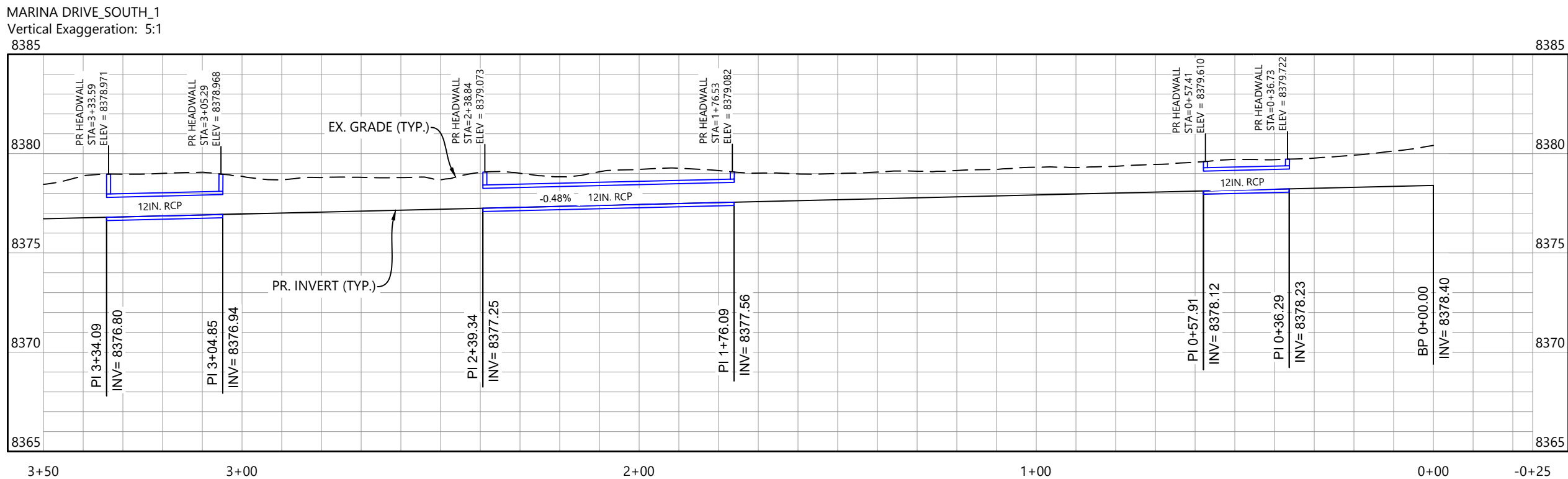
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TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

Project Milestone

Sheet Name
GRASS SWALE_MDS_1 (1)

2023007041	1" = 30'
Project No.	Horizontal Scale

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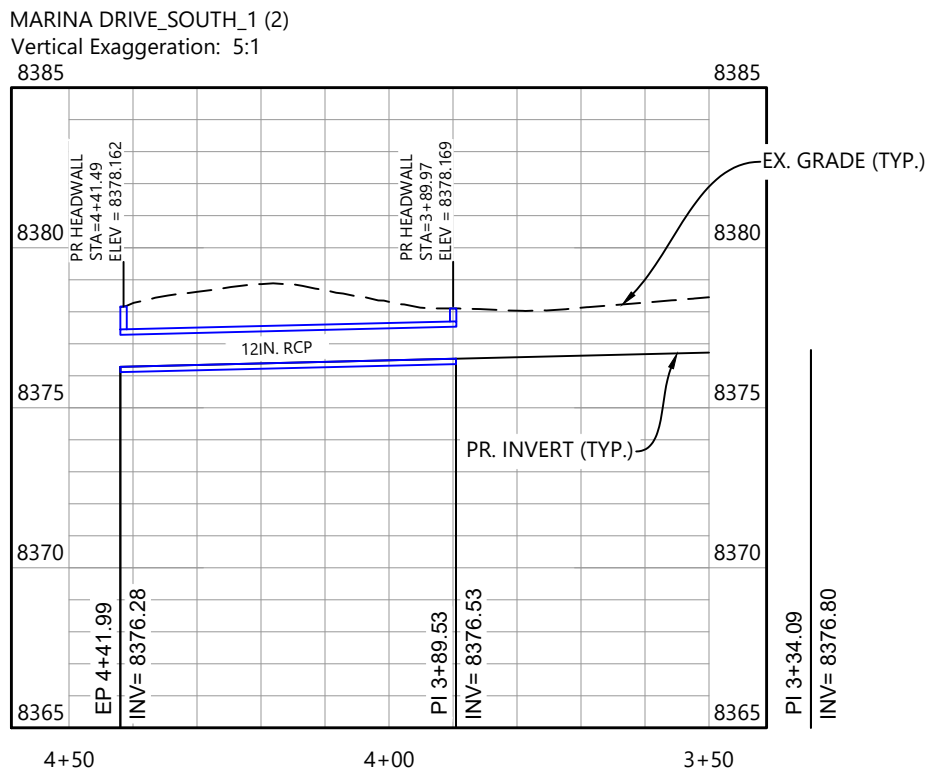


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TOWN OF GRAND LAKE
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Sheet Name
GRASS SWALE MDS 1 (2)

2023007041	1" = 30'
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2023007041	1" = 2'
Project No.	Horizontal

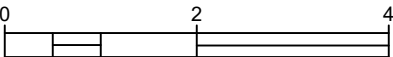
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Client/Project

TOWN OF GRAND LAKE

STORMWATER MANAGEMENT PLAN

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Project Milestone

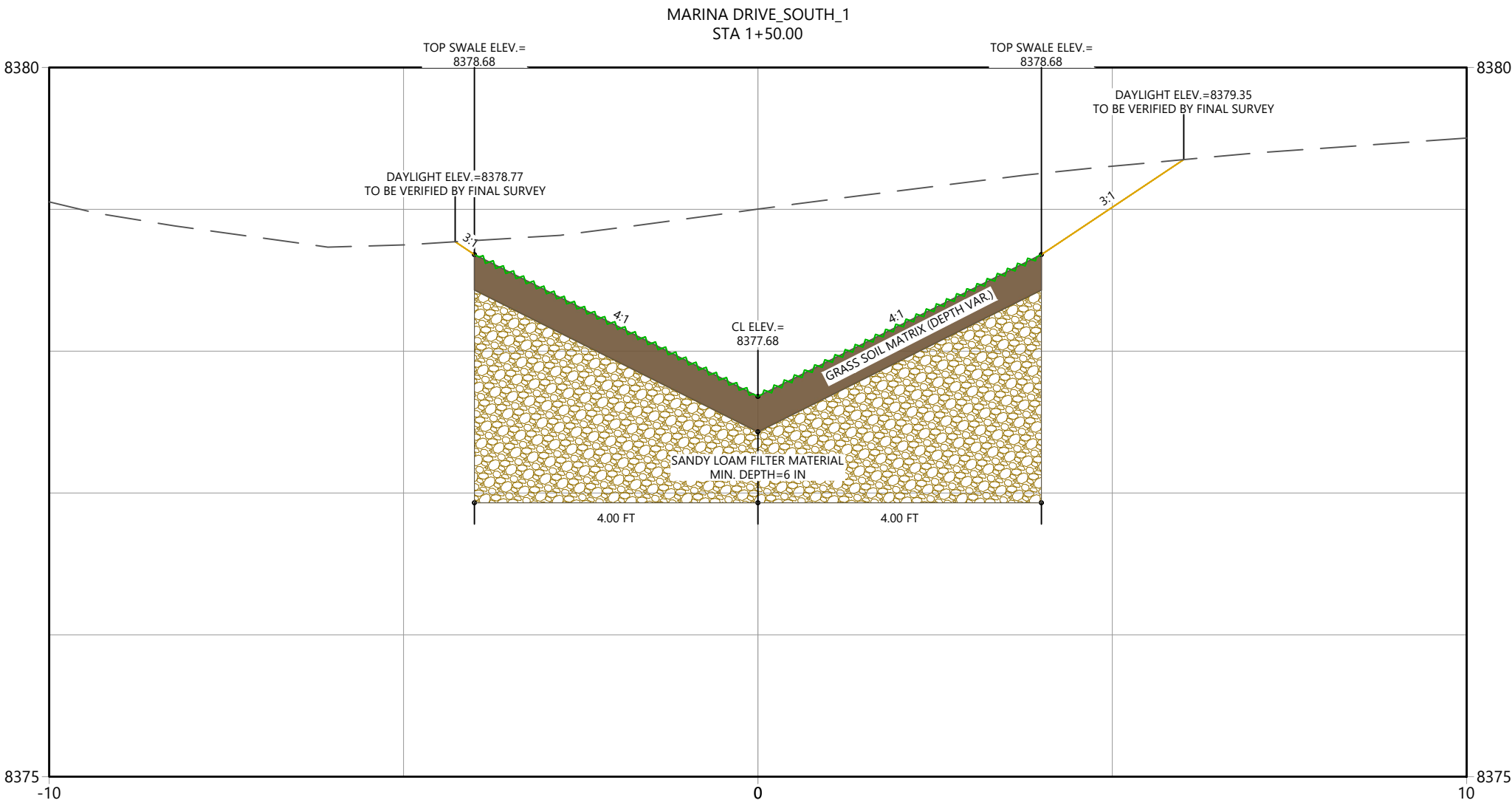
Sheet Name

XSEC_MDS_1 (2)

2023007041 1" = 2'

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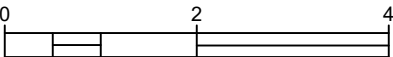
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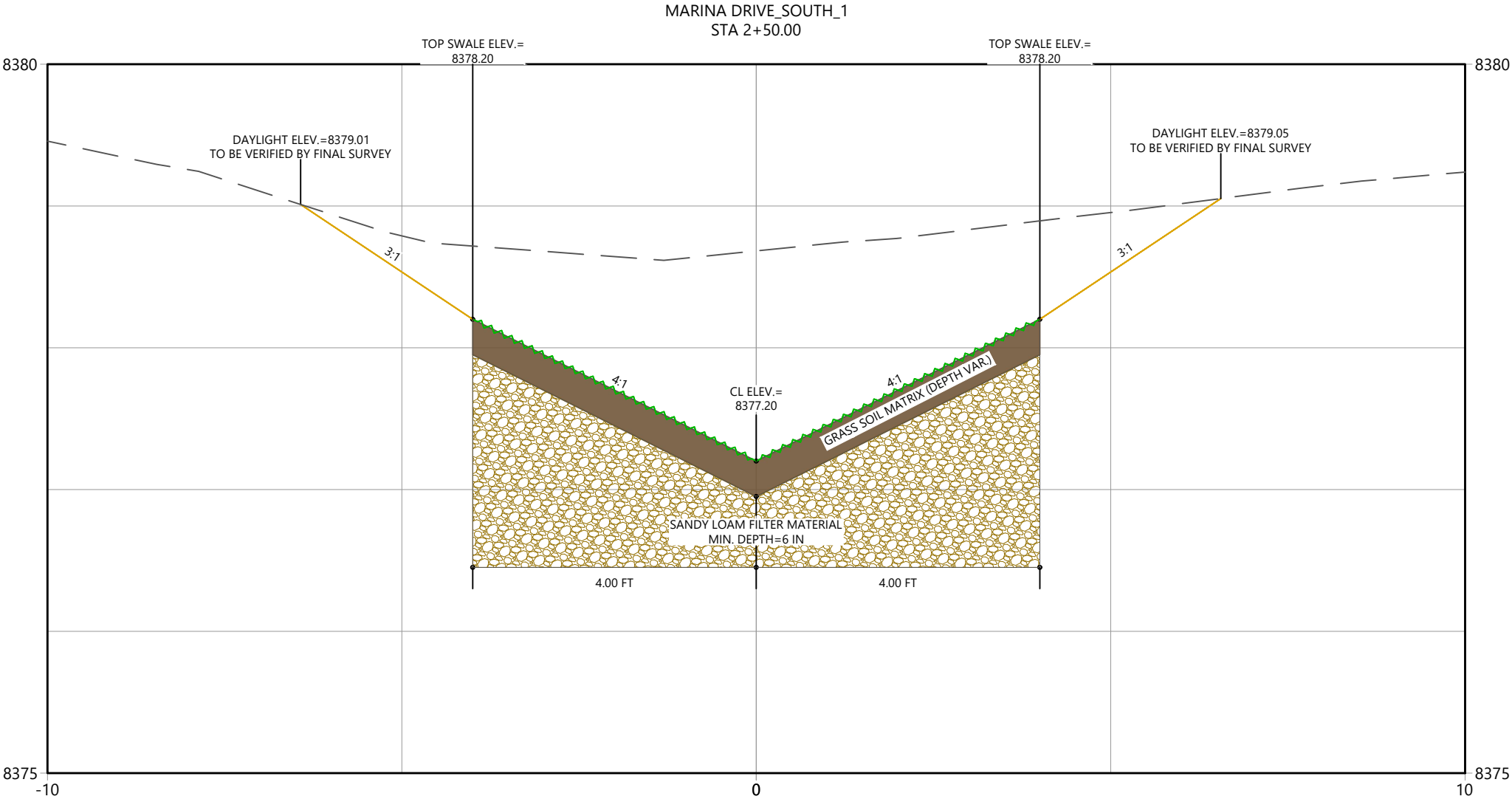
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Sheet Name	
XSEC_MDS_1 (3)	
2023007041	1" = 2'
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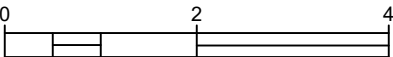
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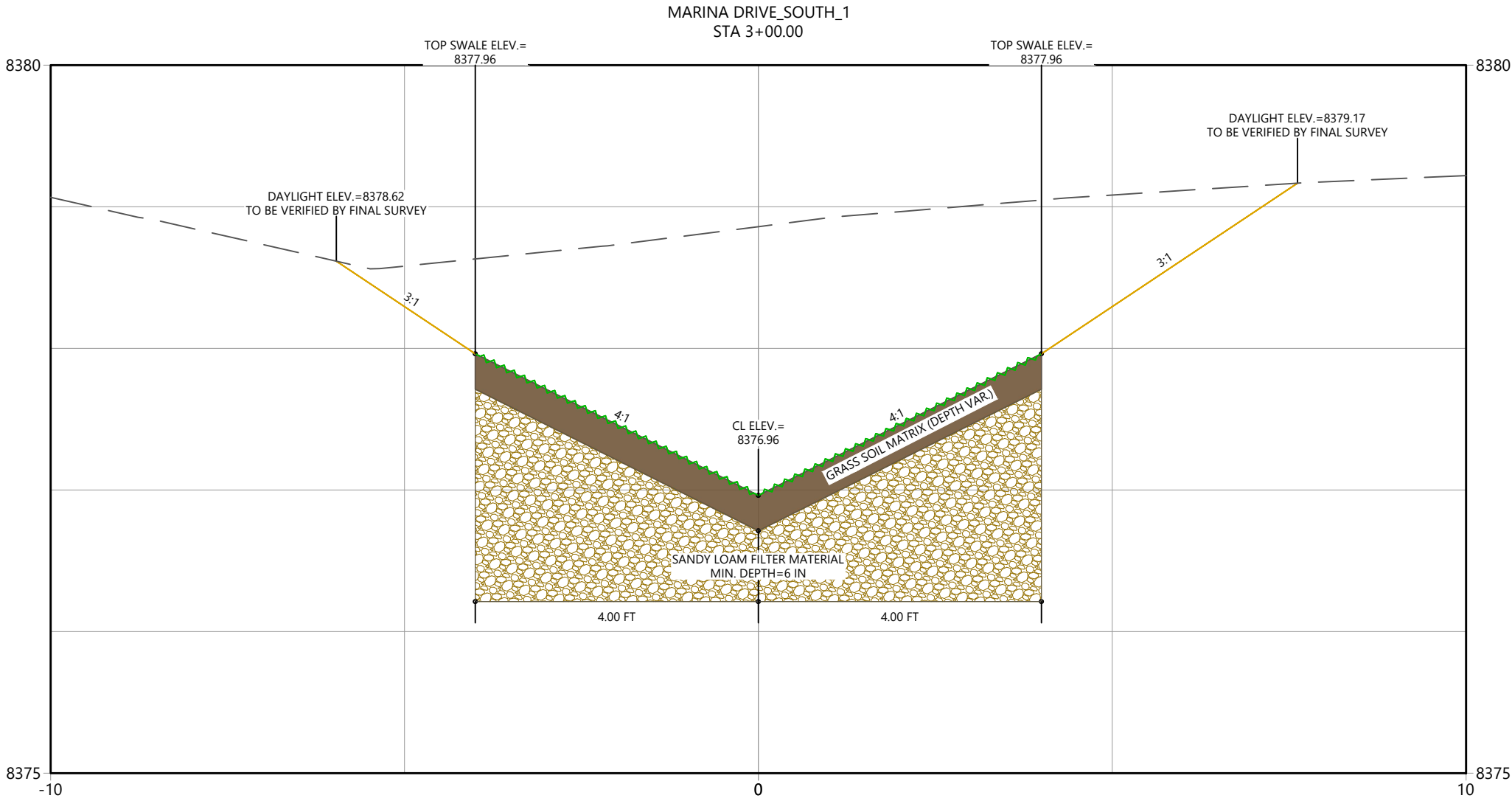
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Project Milestone	

Sheet Name	
XSEC_MDS_1 (4)	
2023007041	1" = 2'
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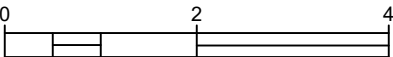
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TOWN OF GRAND LAKE

STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

Project Milestone

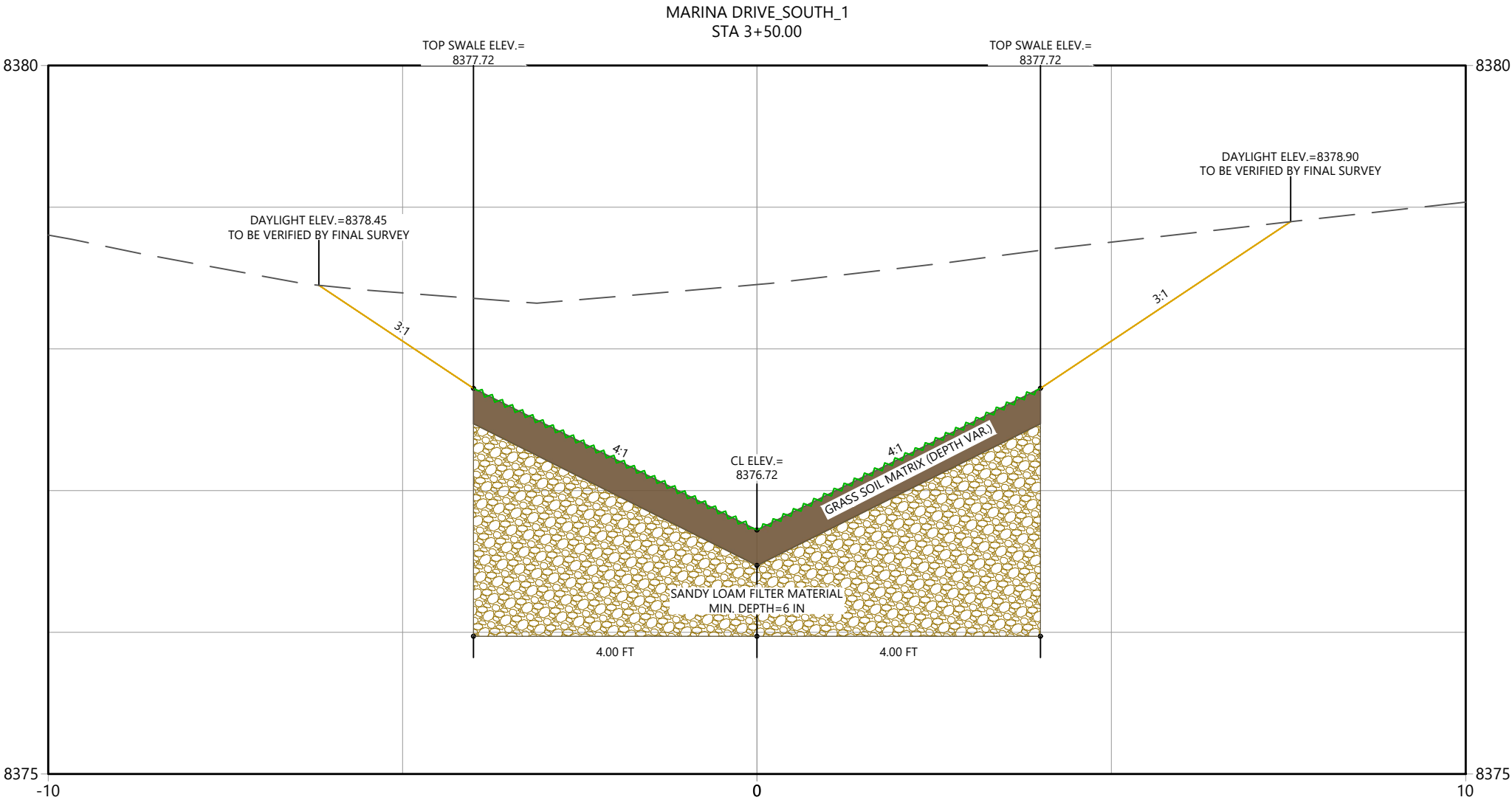
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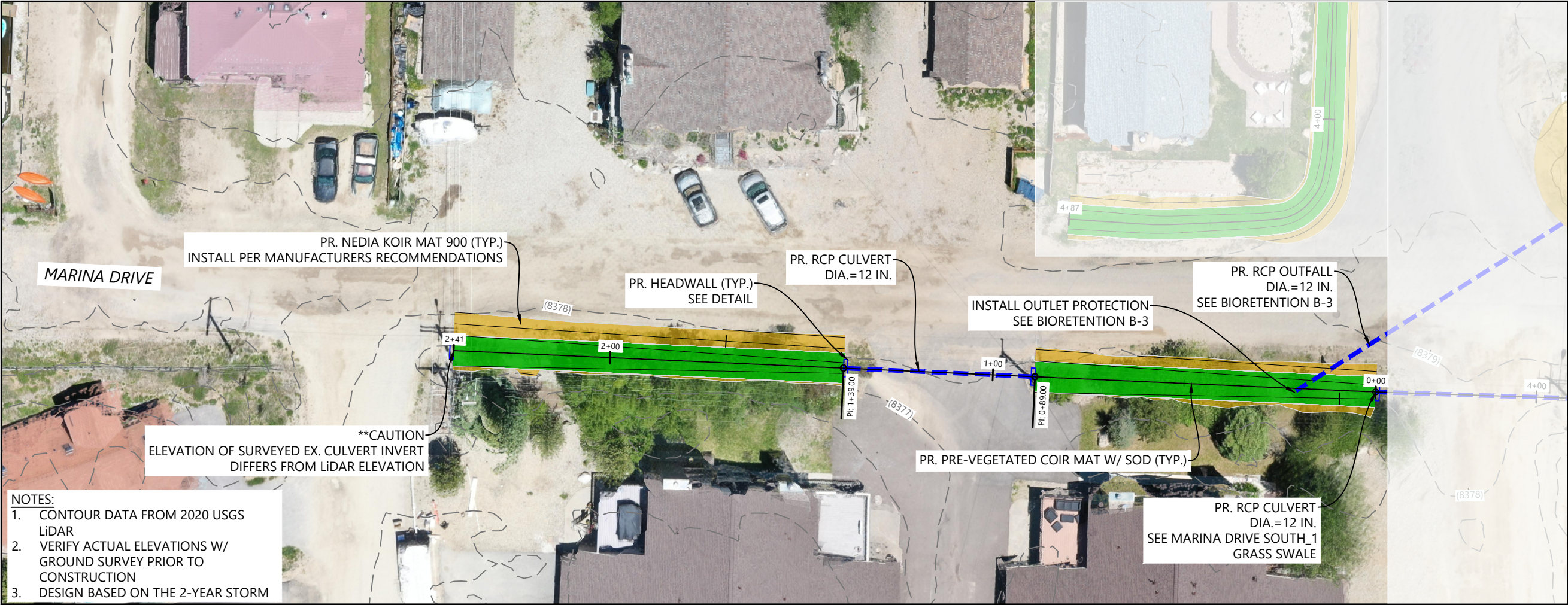
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2023007041 1" = 2'

Project No. Horizontal Scale

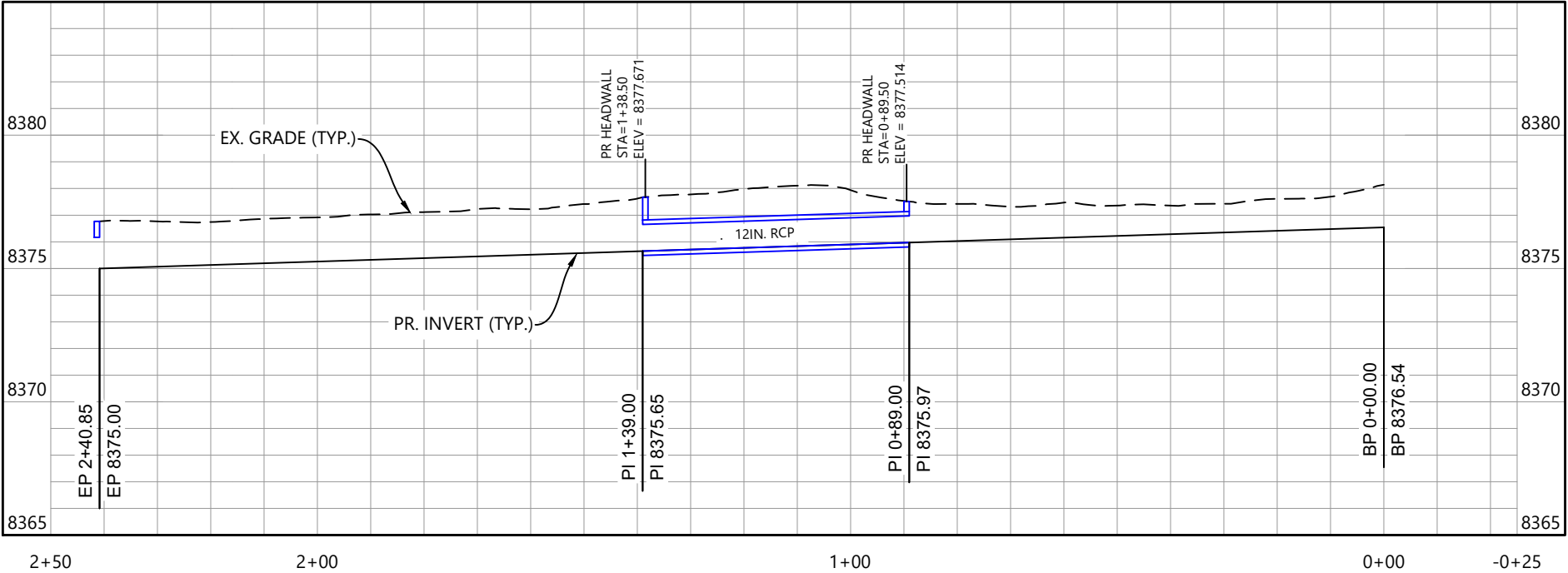
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- NOTES:
1. CONTOUR DATA FROM 2020 USGS LIDAR
 2. VERIFY ACTUAL ELEVATIONS W/ GROUND SURVEY PRIOR TO CONSTRUCTION
 3. DESIGN BASED ON THE 2-YEAR STORM

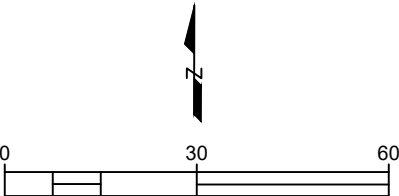
MARINA DRIVE_SOUTH_2
Vertical Exaggeration: 5:1
8385



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Client/Project
**TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN**

GRAND LAKE, CO

Project Milestone

Sheet Name

GRASS SWALE_MDS_2

2023007041 **1" = 30'**

Project No. Horizontal Scale

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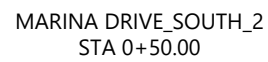


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File Name:	----	----	24.09.12
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Sheet Name
XSEC_MDS_2

2023007041 1" = 2'

Sheet 17 of 68



TOP SWALE ELEV.=
8377.22

TOP SWALE ELEV.=
8377.22

DAYLIGHT ELEV.=8377.13
TO BE VERIFIED BY FINAL SURVEY

-10:1

4:7

CL ELEV.=
8376.22

4:1

SOIL MATRIX (DEPTH VAR.)

SANDY LOAM FILTER MATERIAL
MIN. DEPTH=6 IN

4.00 FT

4.00 FT

3:1

DAYLIGHT ELEV.=8378.19
TO BE VERIFIED BY FINAL SURVEY

\\c:\Users\lucasbabbitt\wateration Dropbox\Projects\20230704_1_grand lake Stormwater Management Plan\3_CAD\Working\DESIGN_PRELIMINARY.dwg
2024/09/16 9:52 AM By: Lucas Babbitt

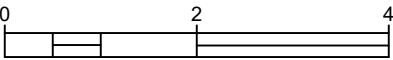
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Horizontal Scale & Orientation



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Permit-Seal

Client/Project

TOWN OF GRAND LAKE

STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

Project Milestone

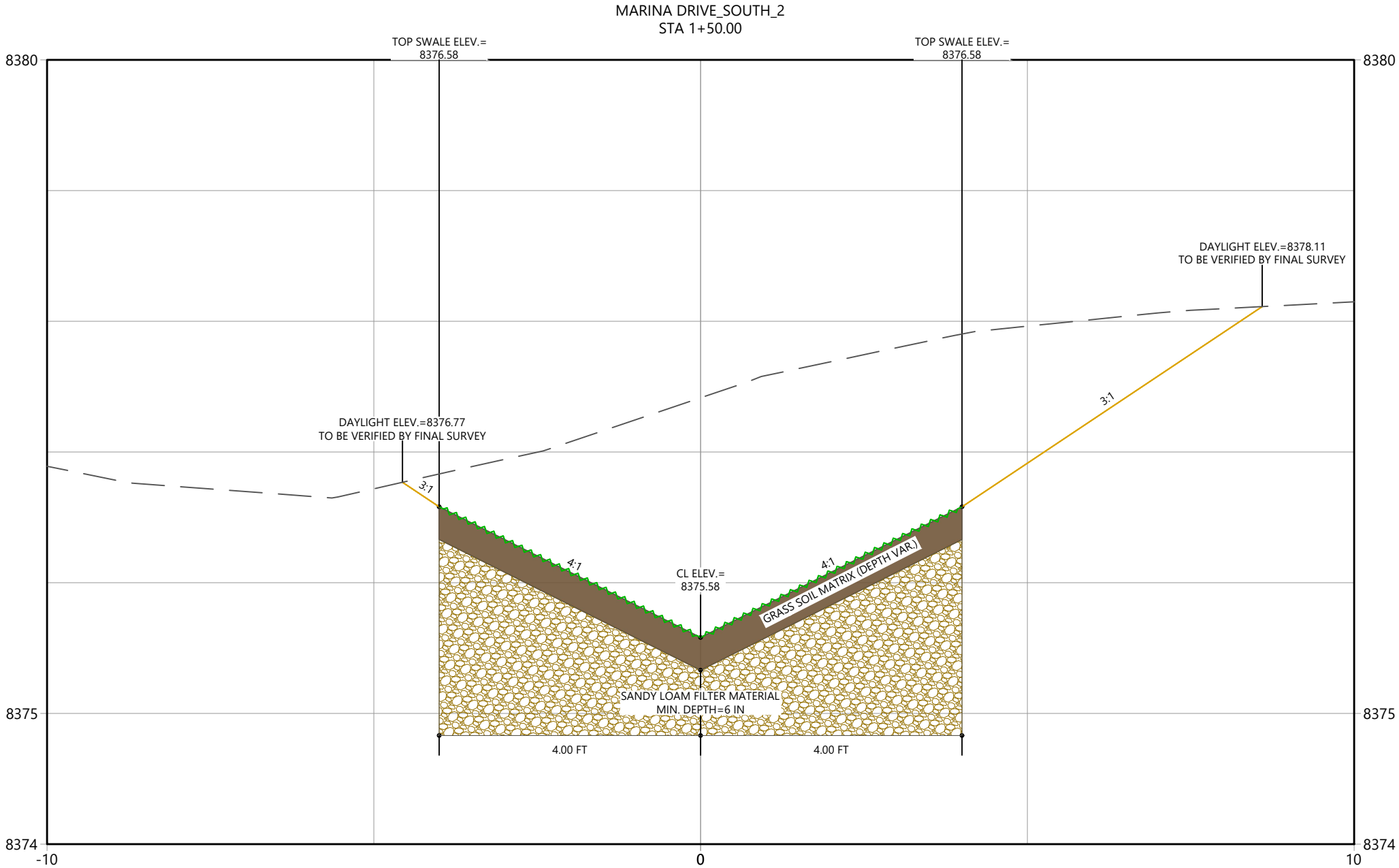
Sheet Name

XSEC_MDS_2 (2)

2023007041 1" = 2'

Project No. Horizontal Scale

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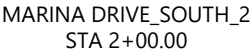


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File Name:	----	----	24.09.12
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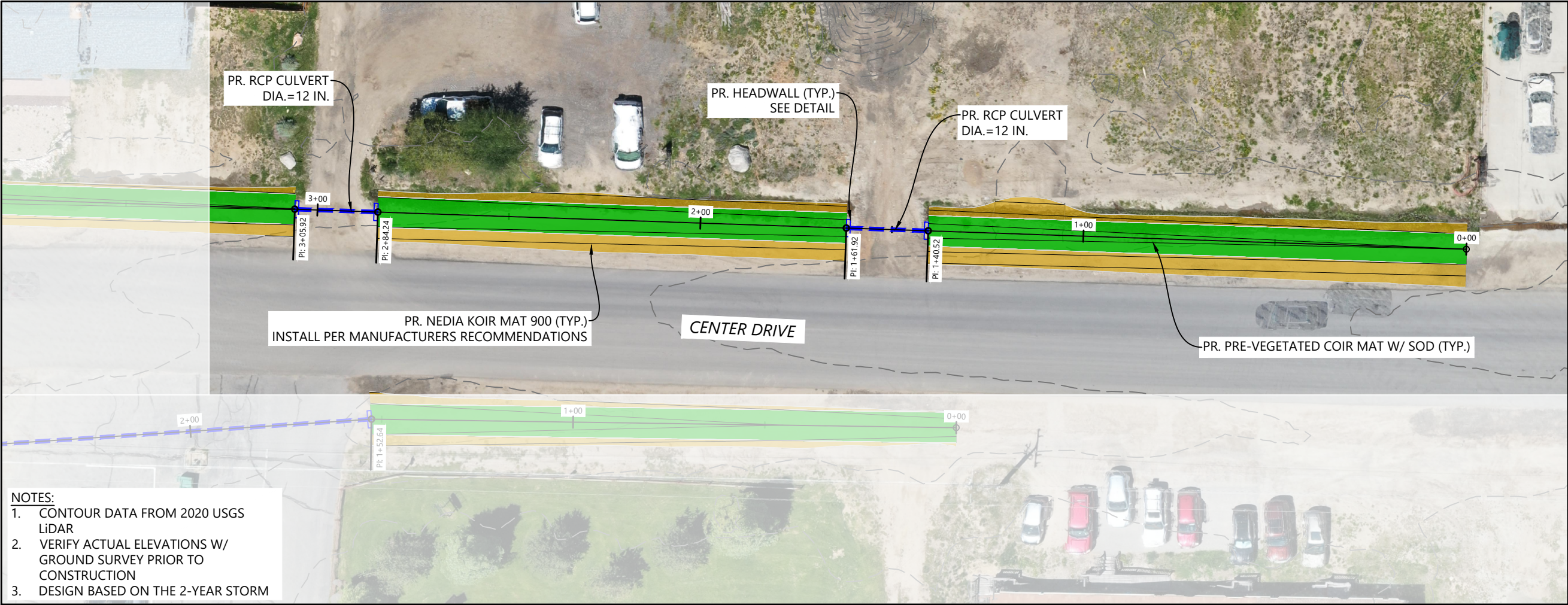
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Project No. _____ Horizontal Scale _____

Sheet 19 of 68

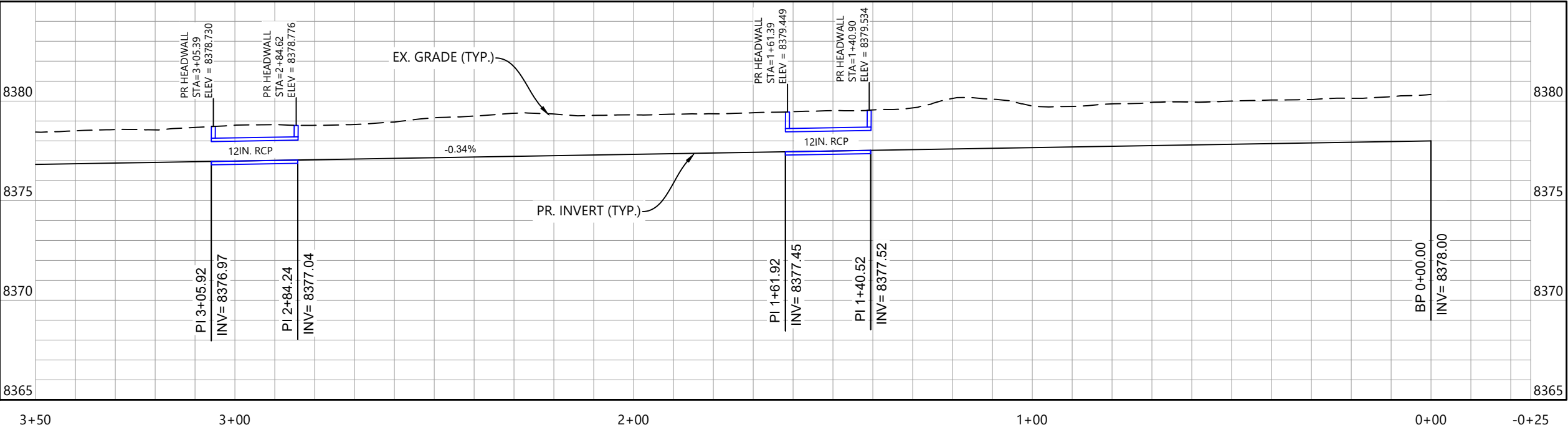


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- NOTES:
- 1. CONTOUR DATA FROM 2020 USGS LIDAR
 - 2. VERIFY ACTUAL ELEVATIONS W/ GROUND SURVEY PRIOR TO CONSTRUCTION
 - 3. DESIGN BASED ON THE 2-YEAR STORM

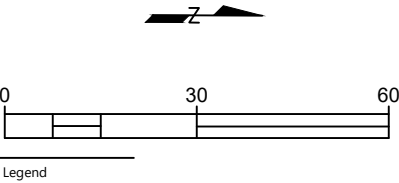
CENTER DRIVE WEST
Vertical Exaggeration: 5:1
8385



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Horizontal Scale & Orientation



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Client/Project
**TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN**

GRAND LAKE, CO

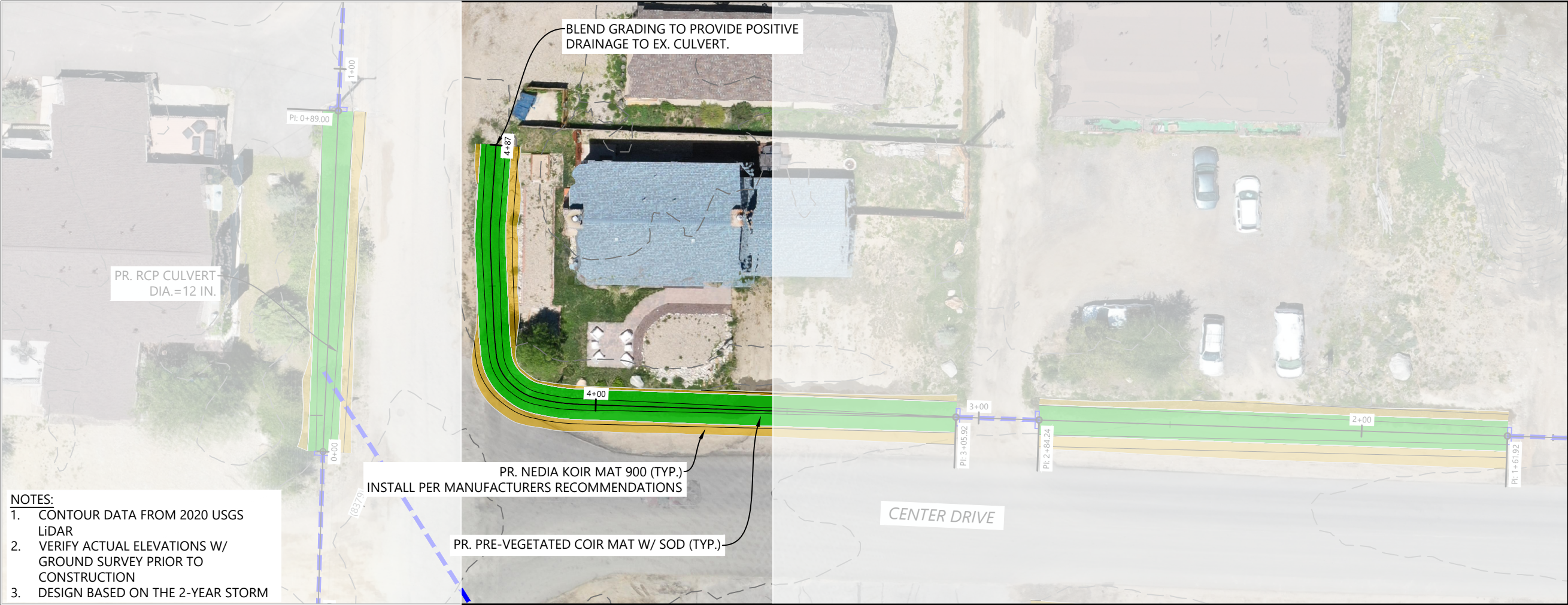
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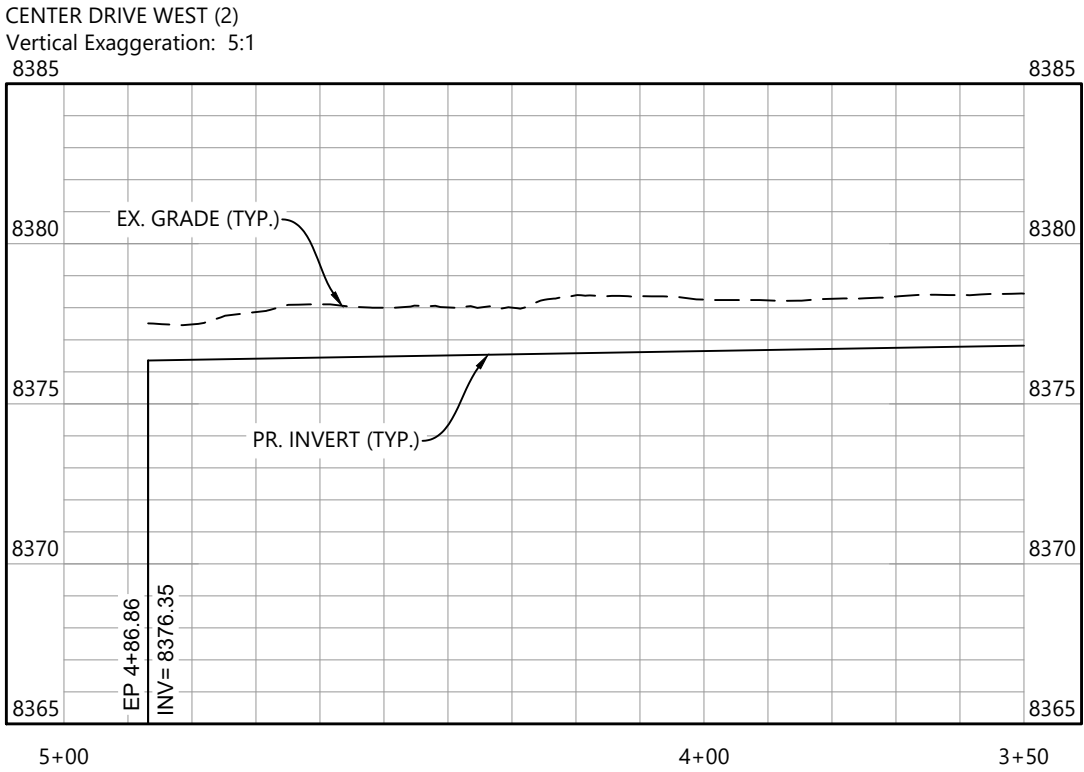
GRASS SWALE_CDW (1)

2023007041 1" = 30'
Project No. Horizontal Scale

Sheet 20 of 68



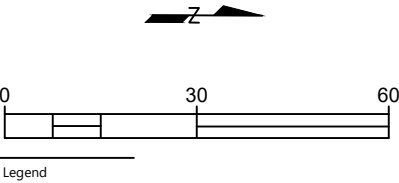
- NOTES:
1. CONTOUR DATA FROM 2020 USGS LIDAR
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 3. DESIGN BASED ON THE 2-YEAR STORM



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Horizontal Scale & Orientation



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Client/Project
TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

Project Milestone

Sheet Name
GRASS SWALE_CDW (2)

2023007041 1" = 30'
Project No. Horizontal Scale

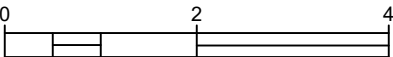
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TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

Project Milestone

Sheet Name

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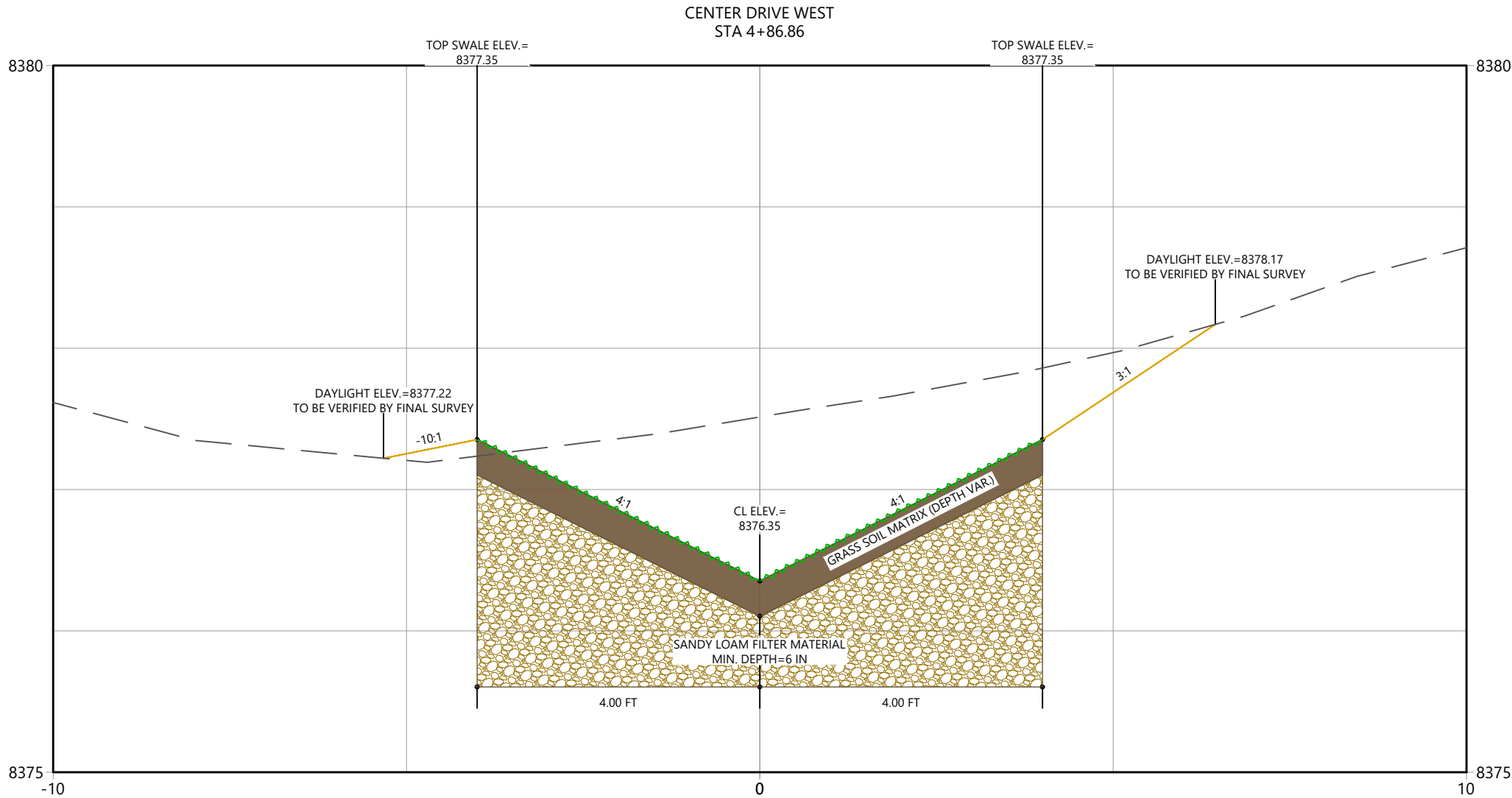
2023007041

Custom

Project No.

Horizontal Scale

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2024/09/16 9:53 AM By: Lucas Babitt

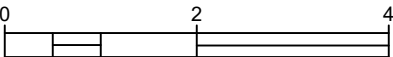
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Client/Project

TOWN OF GRAND LAKE

STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

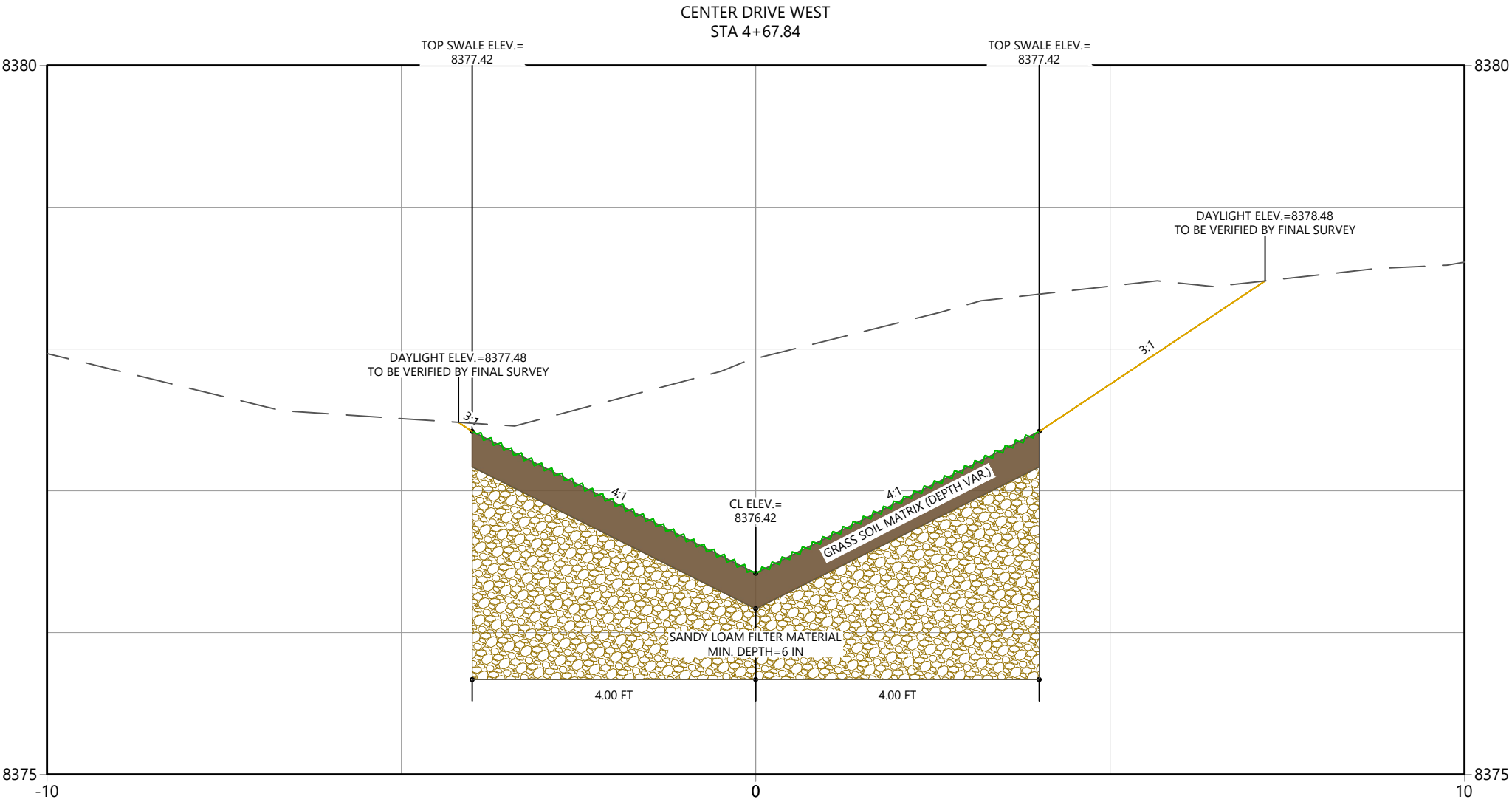
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Sheet Name

XSEC_CDW (22)

2023007041	Custom
Project No.	Horizontal Scale

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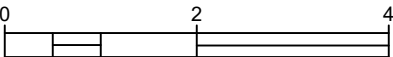
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TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

Project Milestone

Sheet Name

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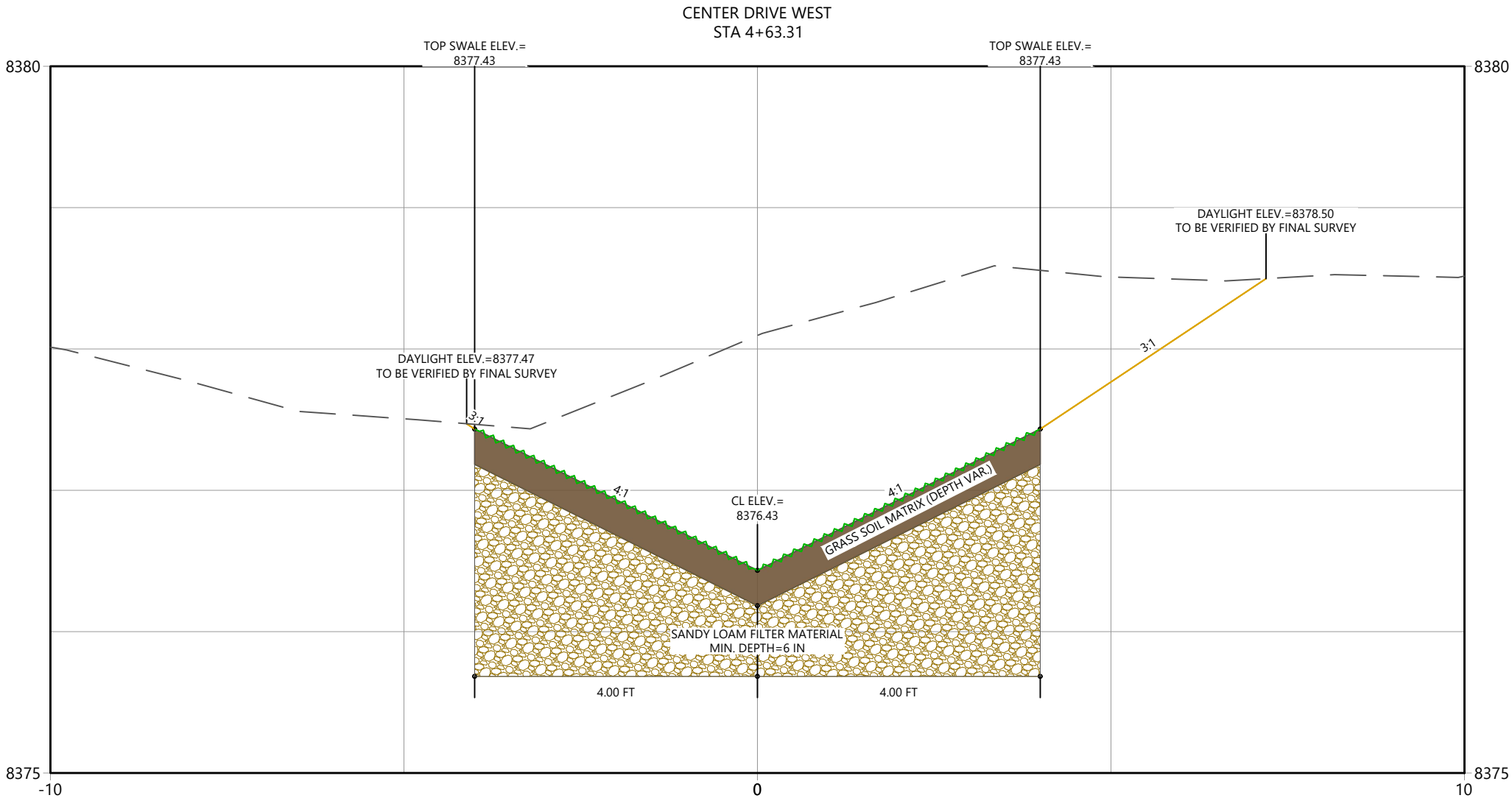
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Horizontal Scale

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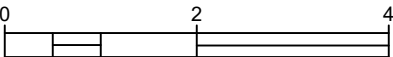
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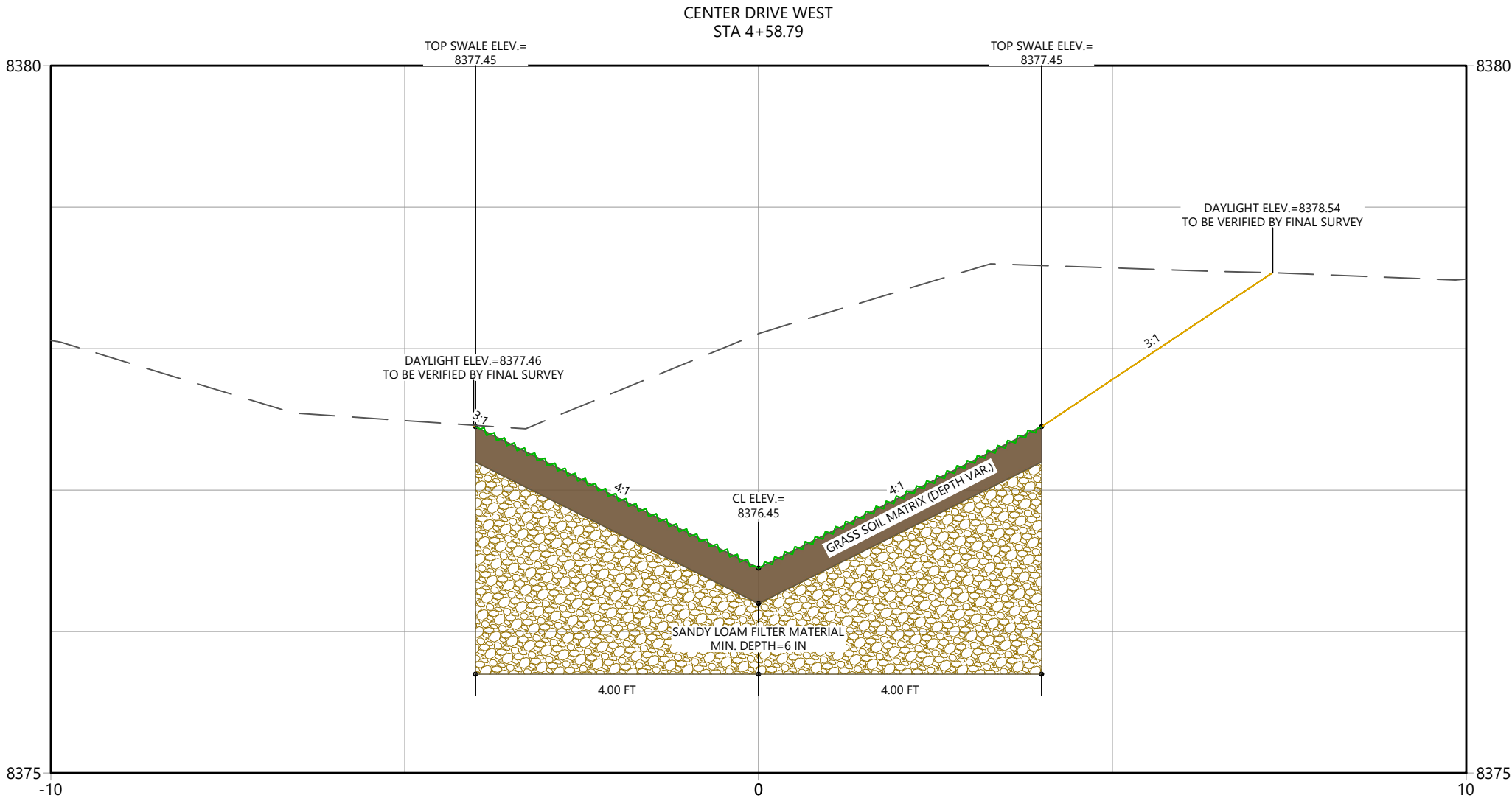
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TOWN OF GRAND LAKE	
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GRAND LAKE, CO	
Project Milestone	

Sheet Name	
XSEC_CDW (20)	
2023007041	Custom
Project No.	Horizontal Scale

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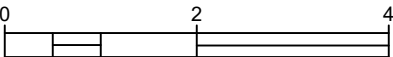
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TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

Project Milestone

Sheet Name

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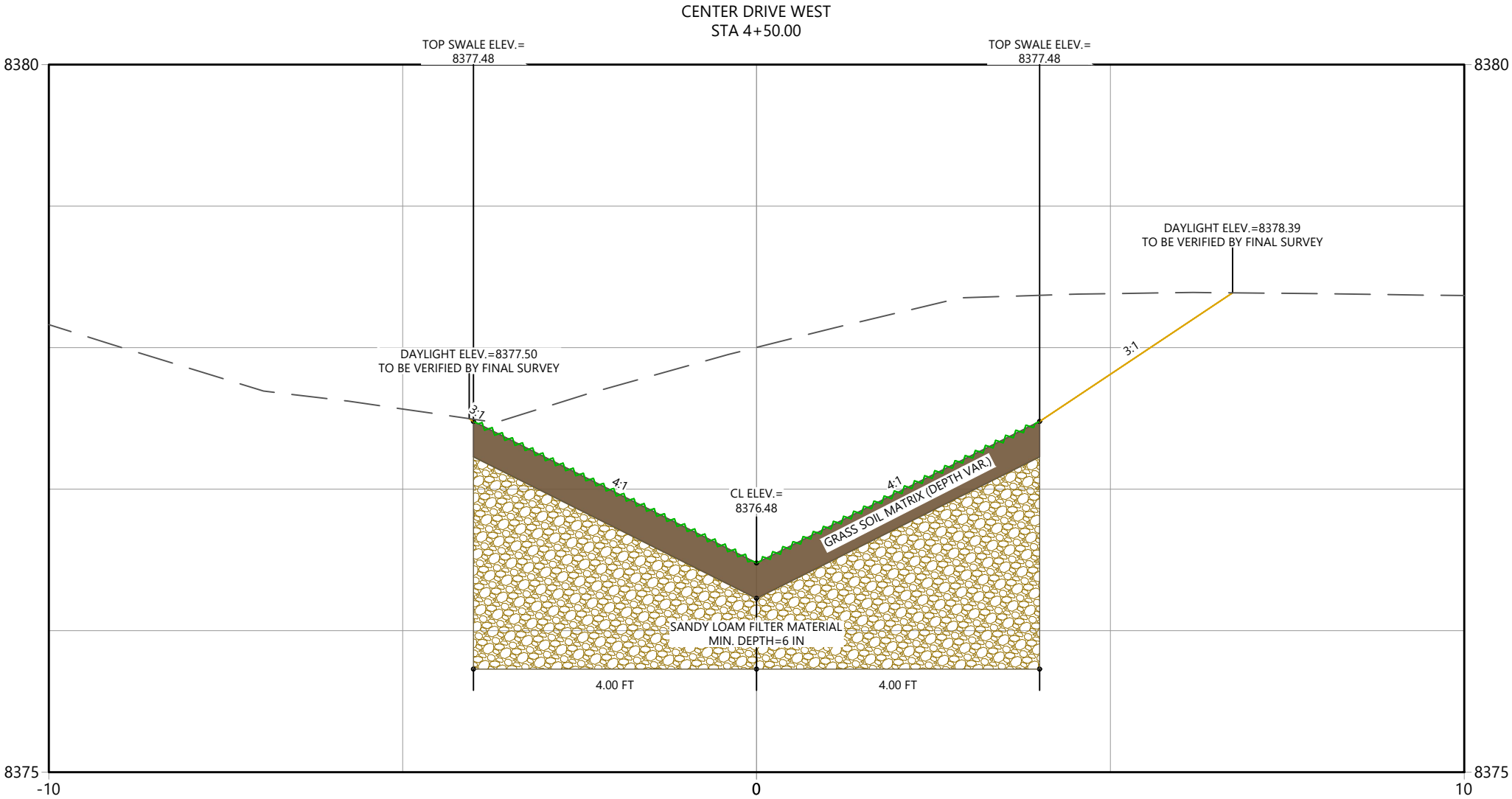
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Custom

Project No.

Horizontal Scale

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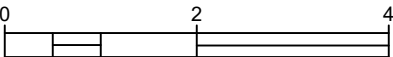
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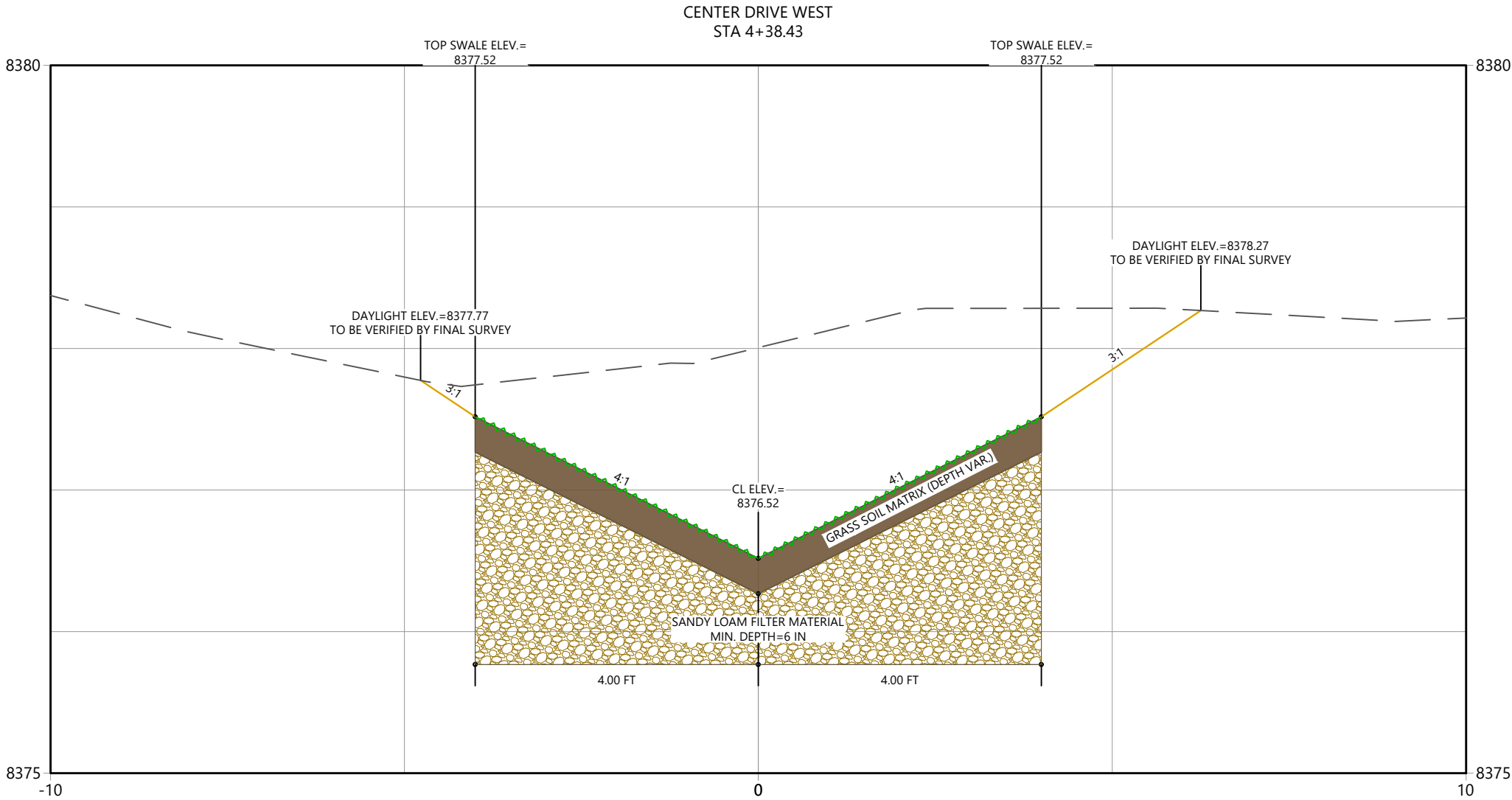


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Client/Project	TOWN OF GRAND LAKE STORMWATER MANAGEMENT PLAN
Project Milestone	----
Sheet Name	XSEC_CDW (18)
2023007041	Custom
Project No.	Horizontal Scale



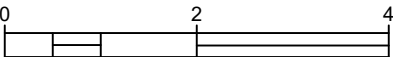
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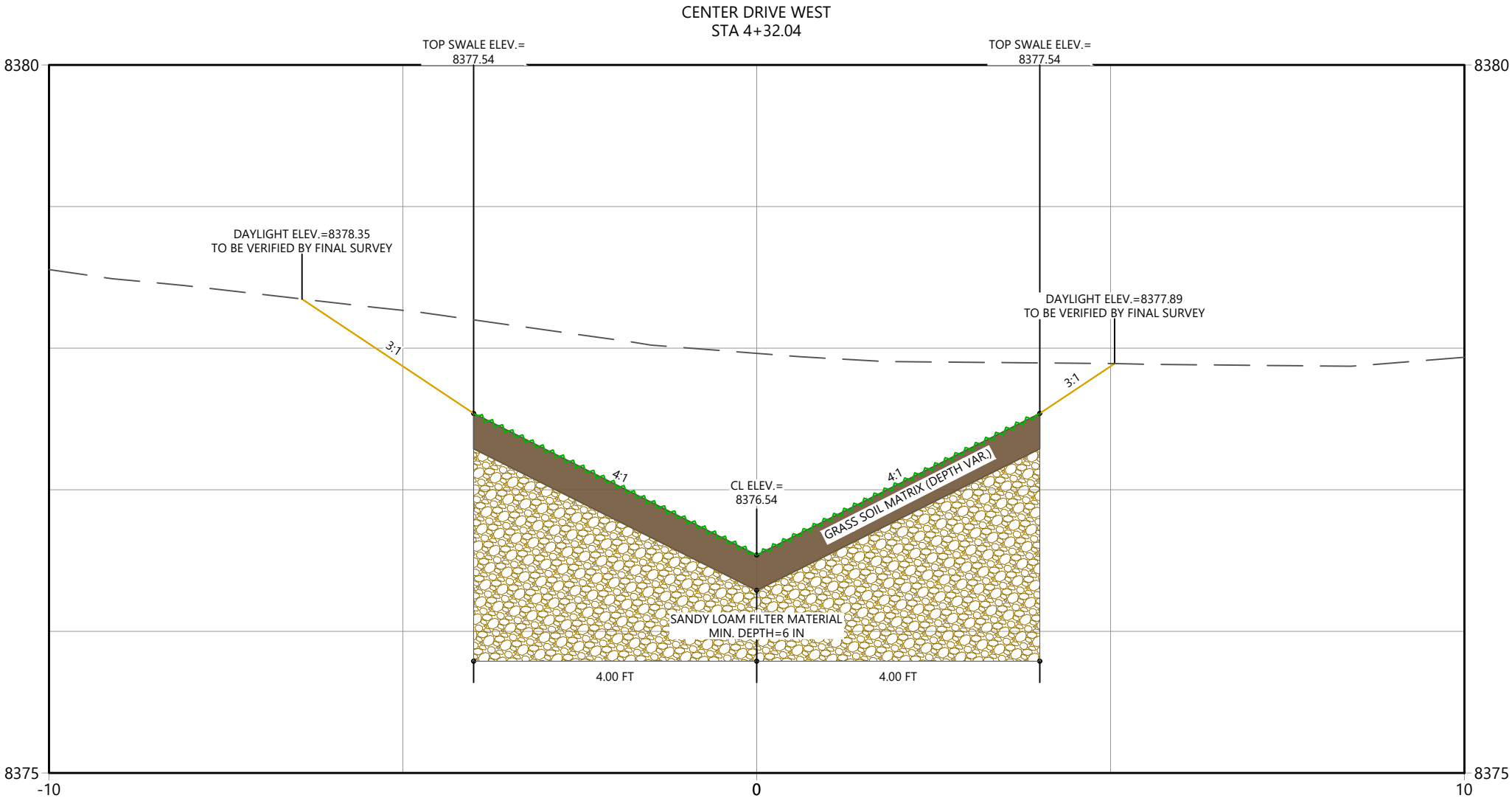
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TOWN OF GRAND LAKE	
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GRAND LAKE, CO	
Project Milestone	

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XSEC_CDW (17)	
2023007041	Custom
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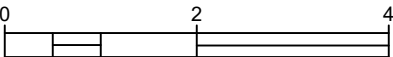
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TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

Project Milestone

Sheet Name

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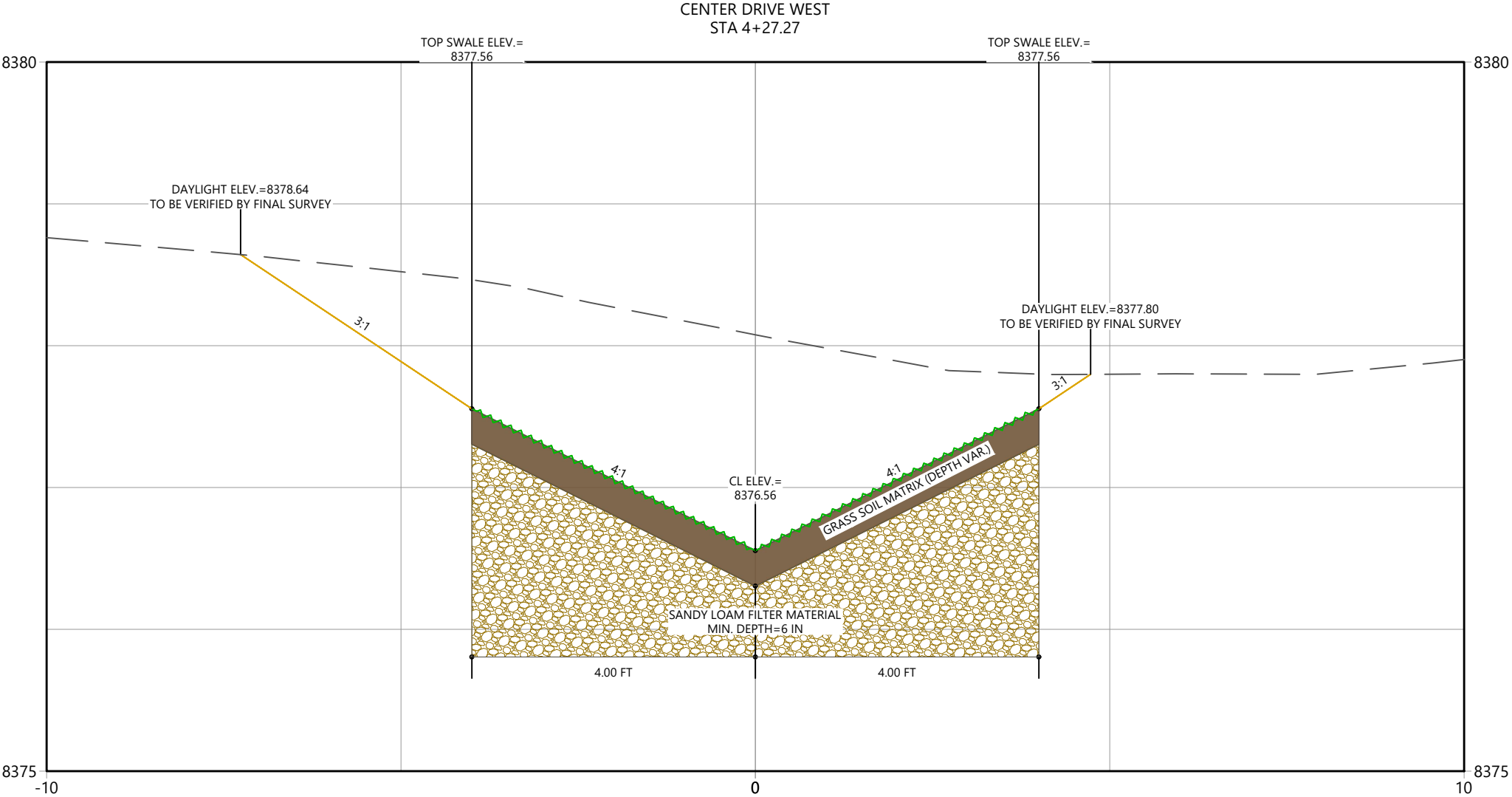
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Project No.

Horizontal Scale

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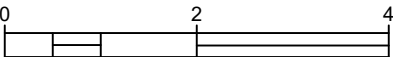
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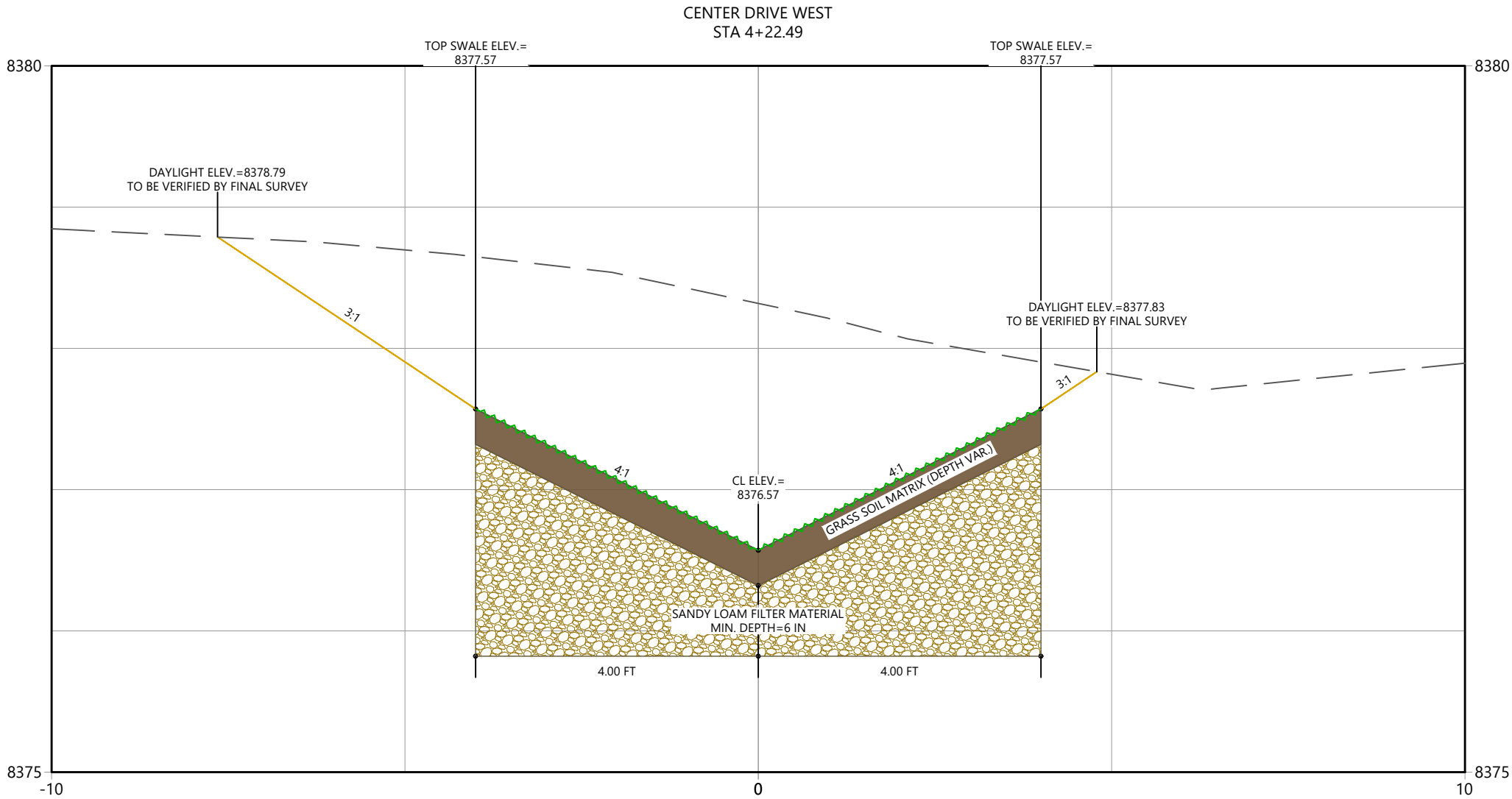
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GRAND LAKE, CO	
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XSEC_CDW (15)	
2023007041	Custom
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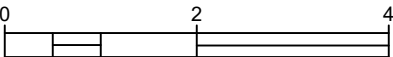
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TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

Project Milestone

Sheet Name

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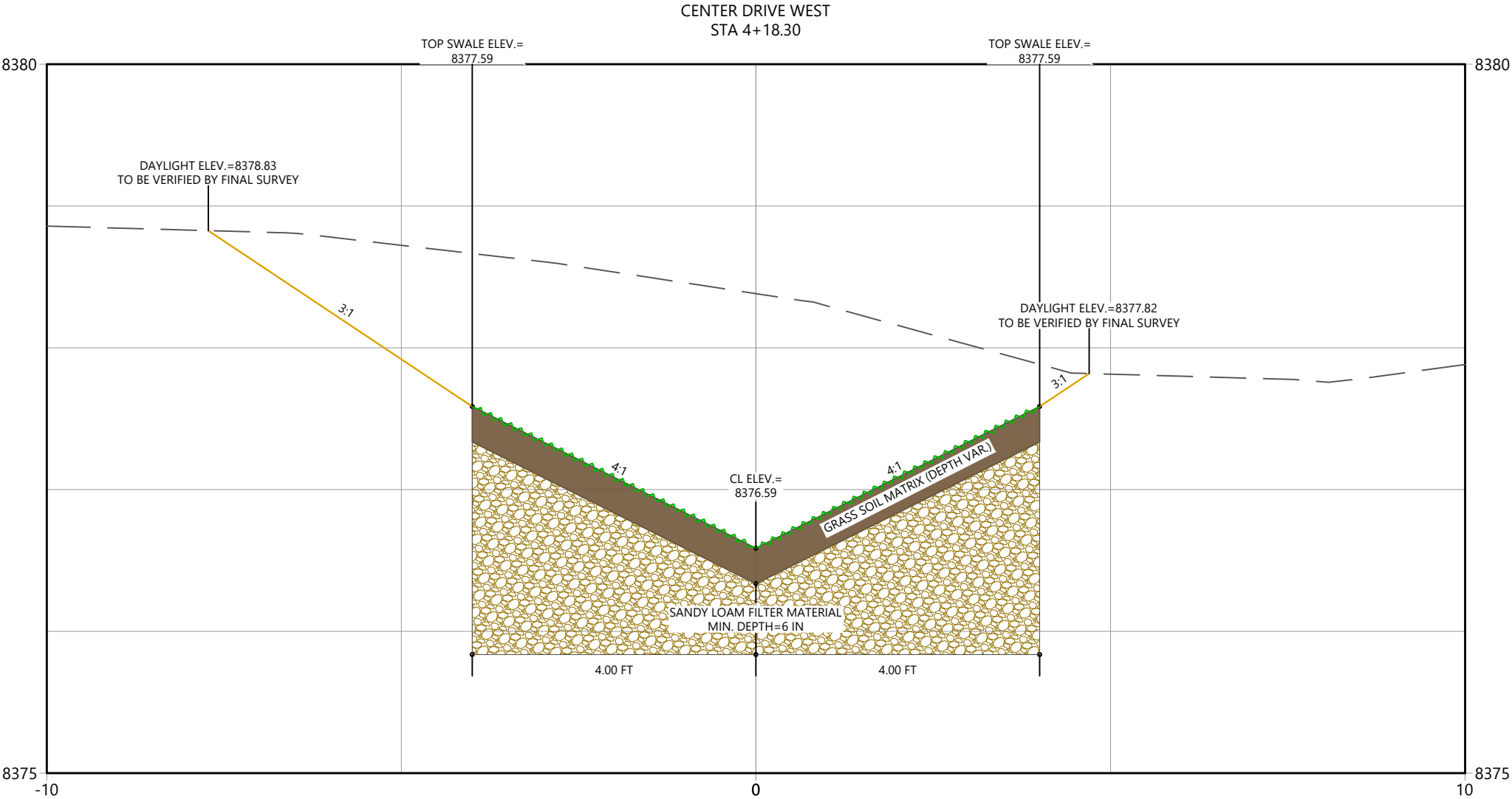
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Project No.

Horizontal Scale

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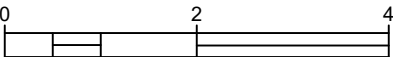
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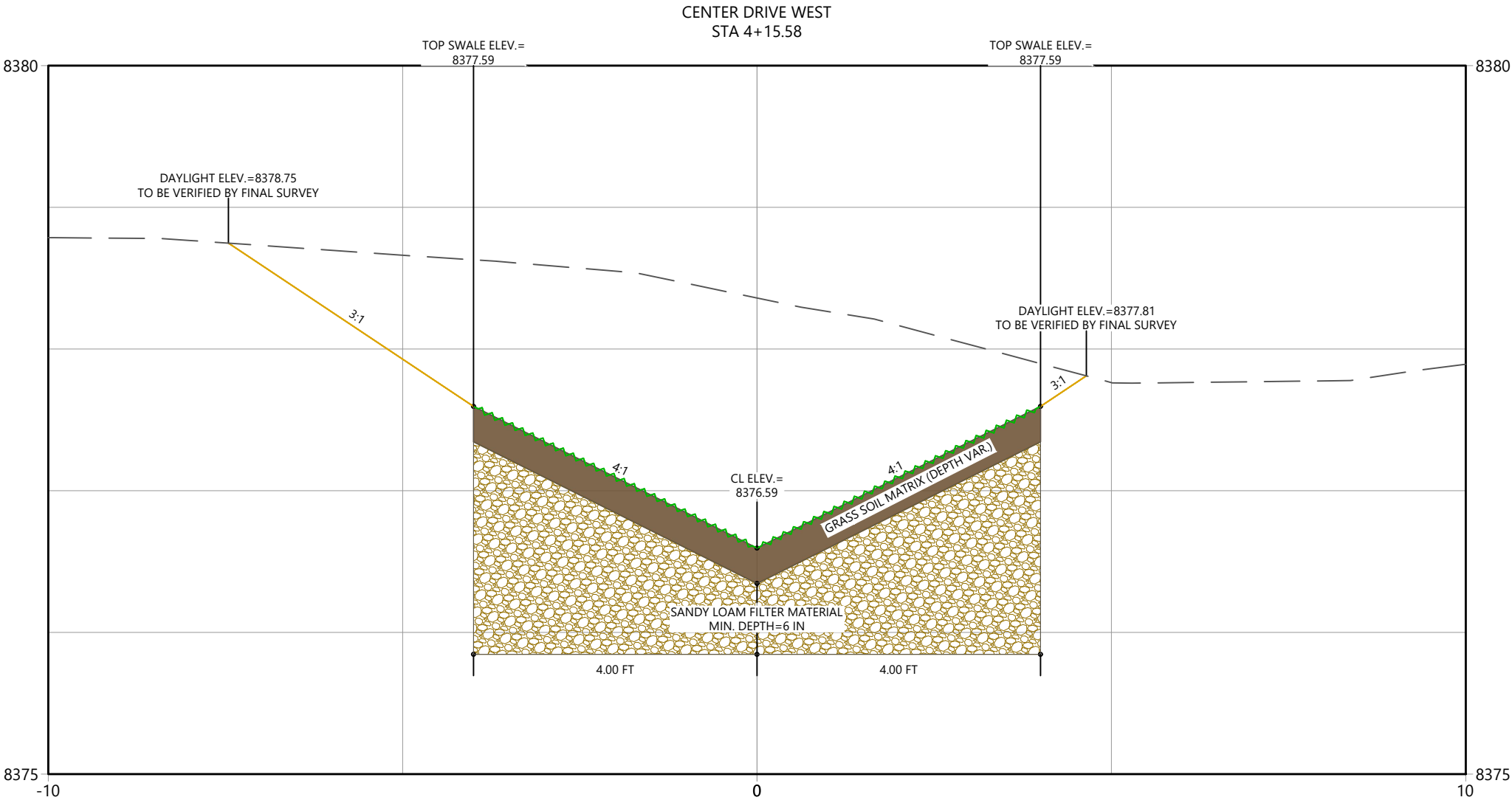
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GRAND LAKE, CO	
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XSEC_CDW (13)	
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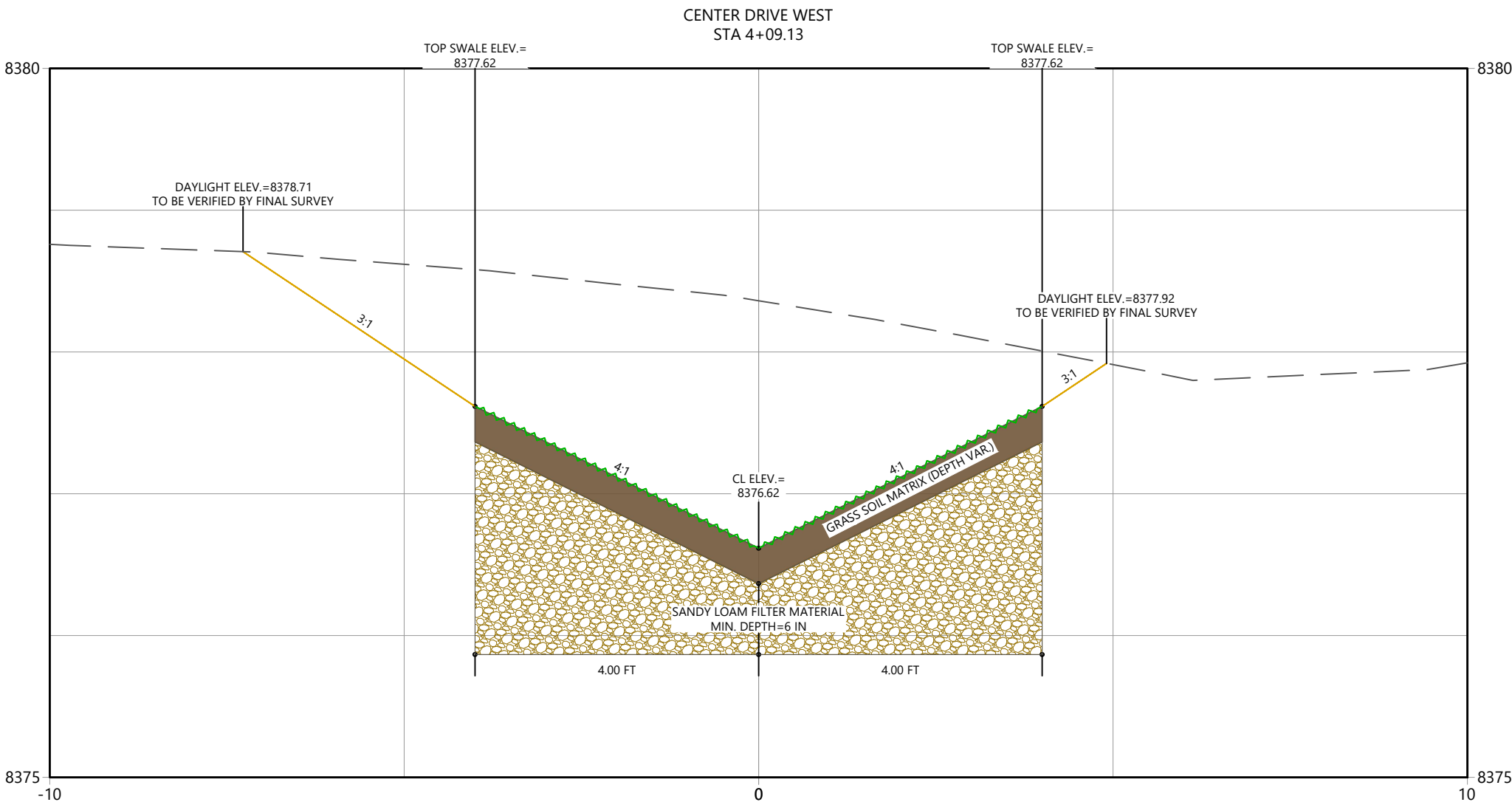


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Sheet Name
XSEC_CDW (12)

2023007041	Custom
Project No.	Horizontal Scale

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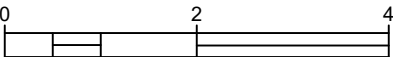
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Horizontal Scale & Orientation



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Client/Project

TOWN OF GRAND LAKE

STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

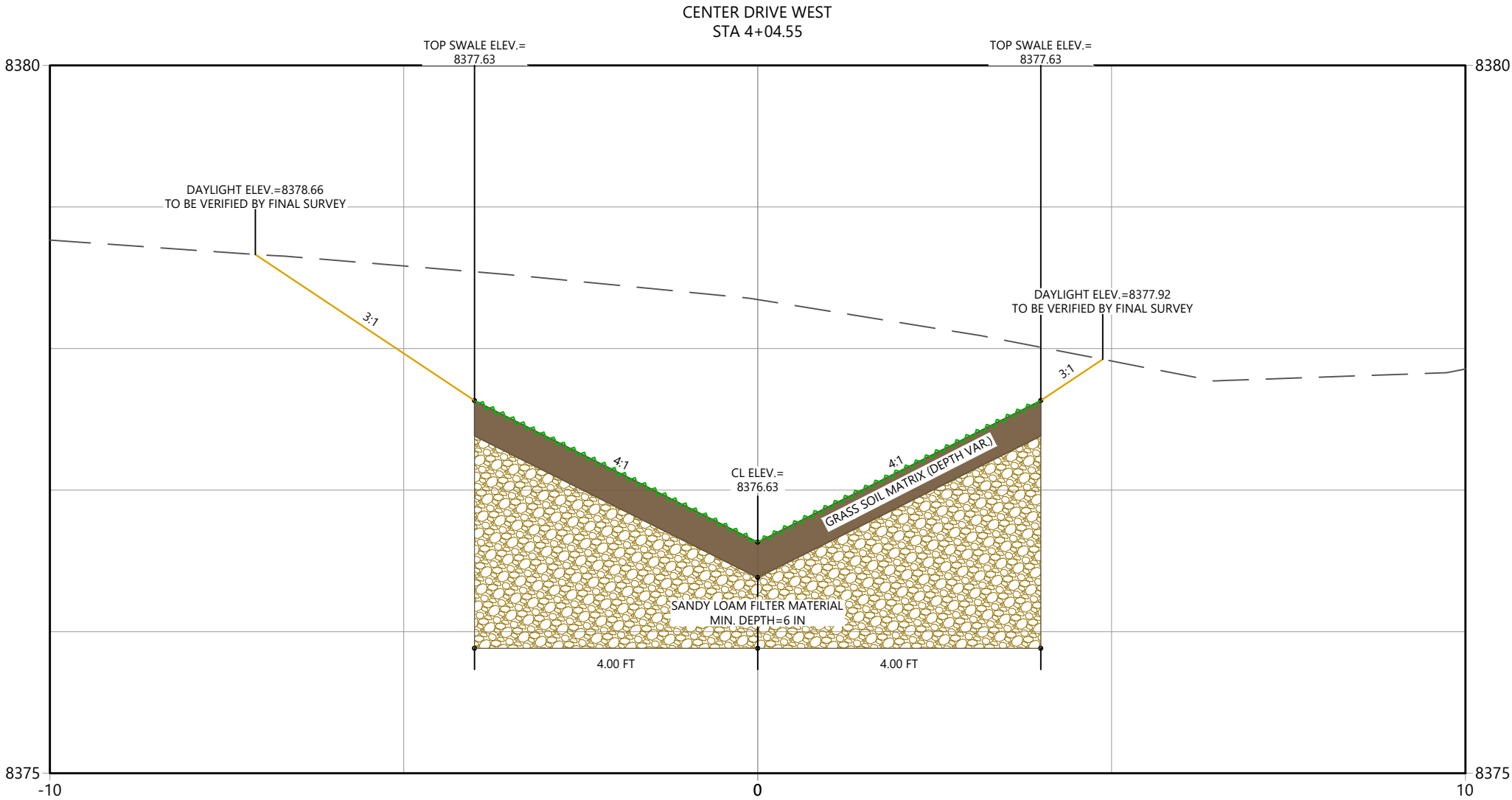
Project Milestone

Sheet Name

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2023007041	Custom
Project No.	Horizontal Scale

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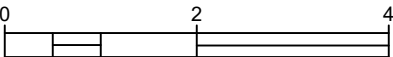
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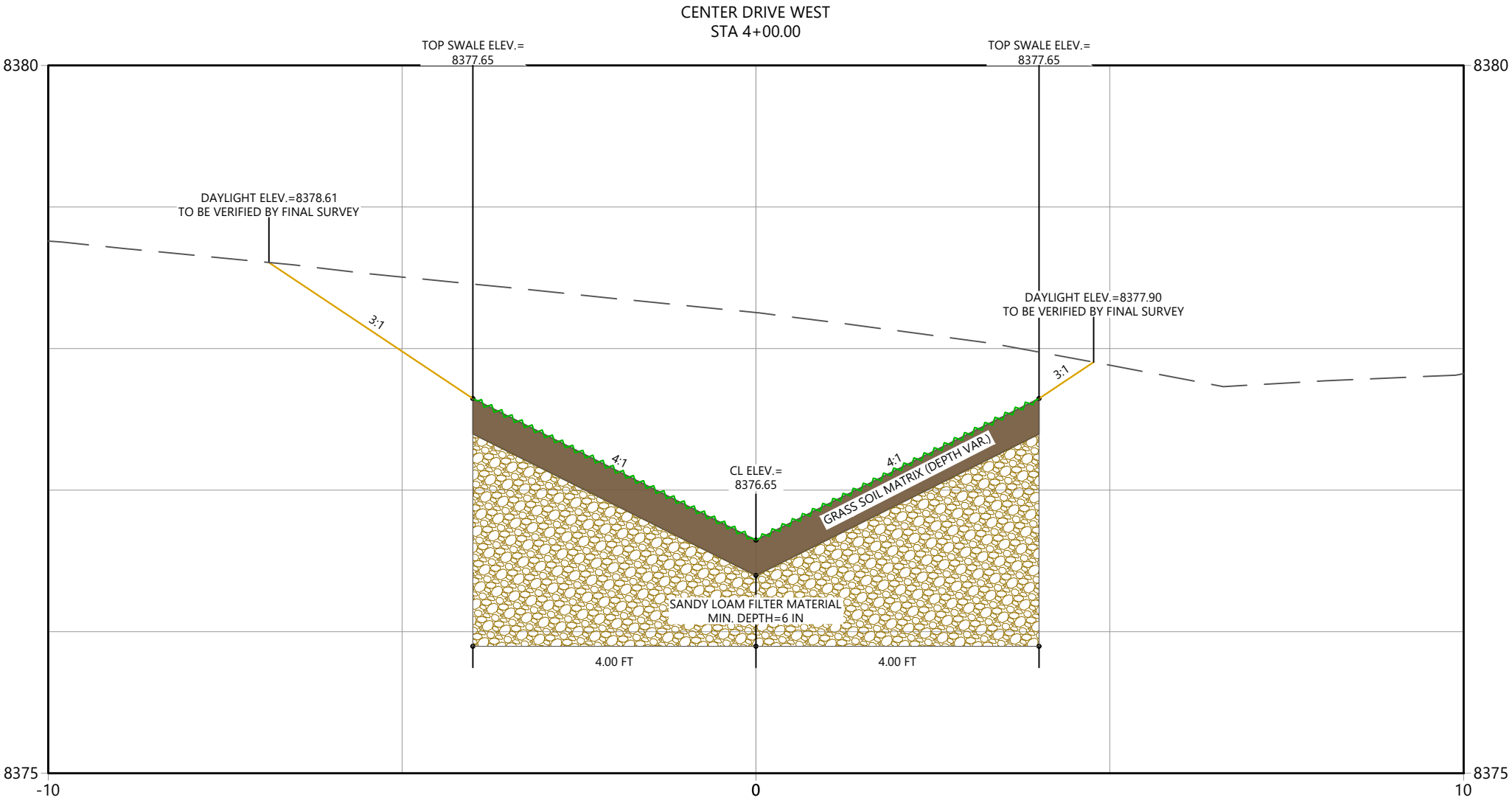
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Client/Project	
TOWN OF GRAND LAKE	
STORMWATER MANAGEMENT PLAN	
GRAND LAKE, CO	
Project Milestone	

Sheet Name	
XSEC_CDW (10)	
2023007041	Custom
Project No.	Horizontal Scale
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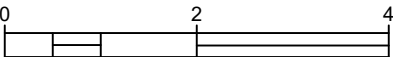
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Horizontal Scale & Orientation



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TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

Project Milestone

Sheet Name

XSEC_CDW (9)

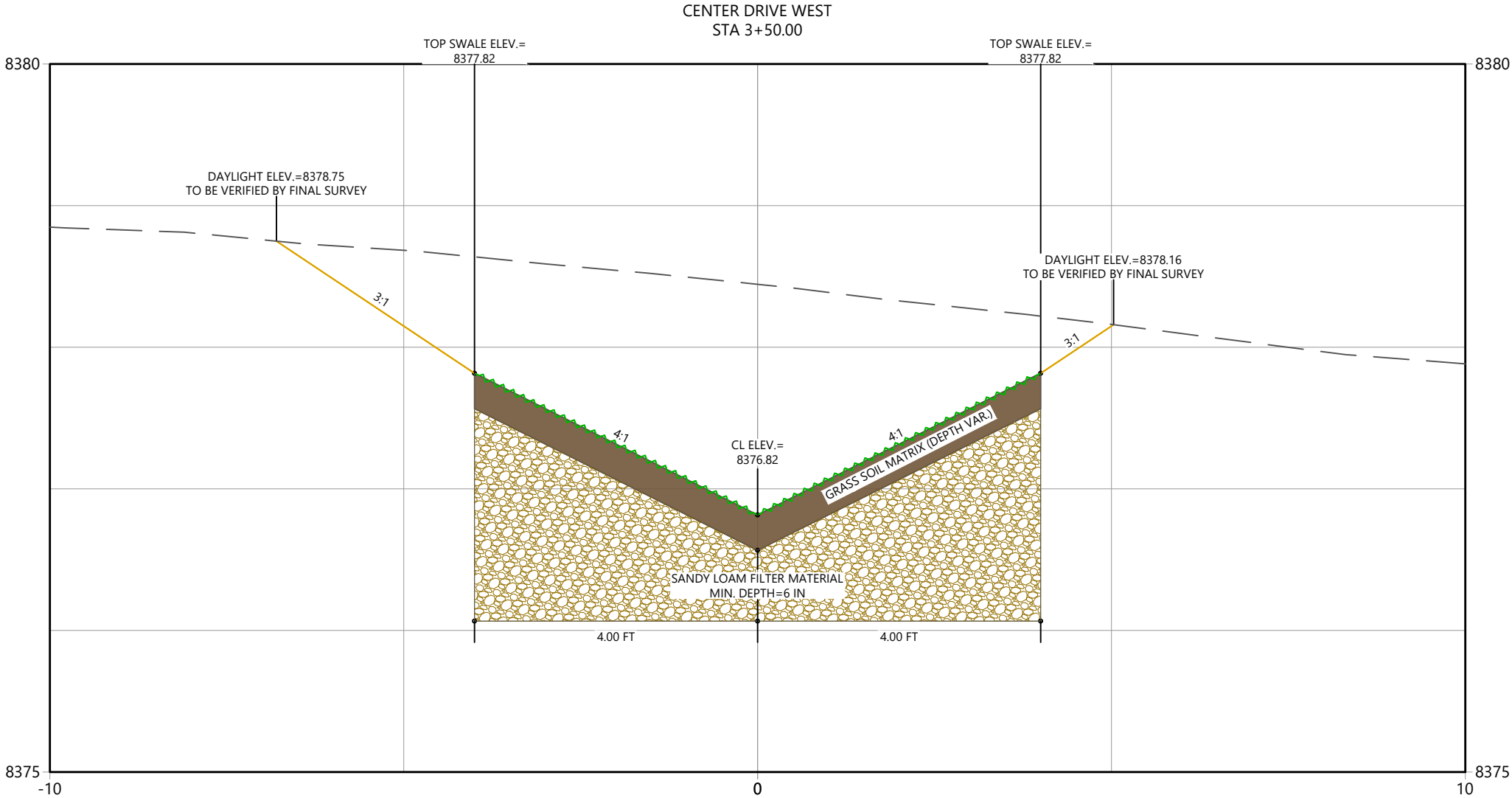
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Custom

Project No.

Horizontal Scale

Sheet 36 of 68



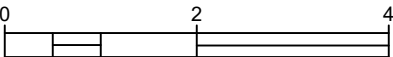
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Horizontal Scale & Orientation



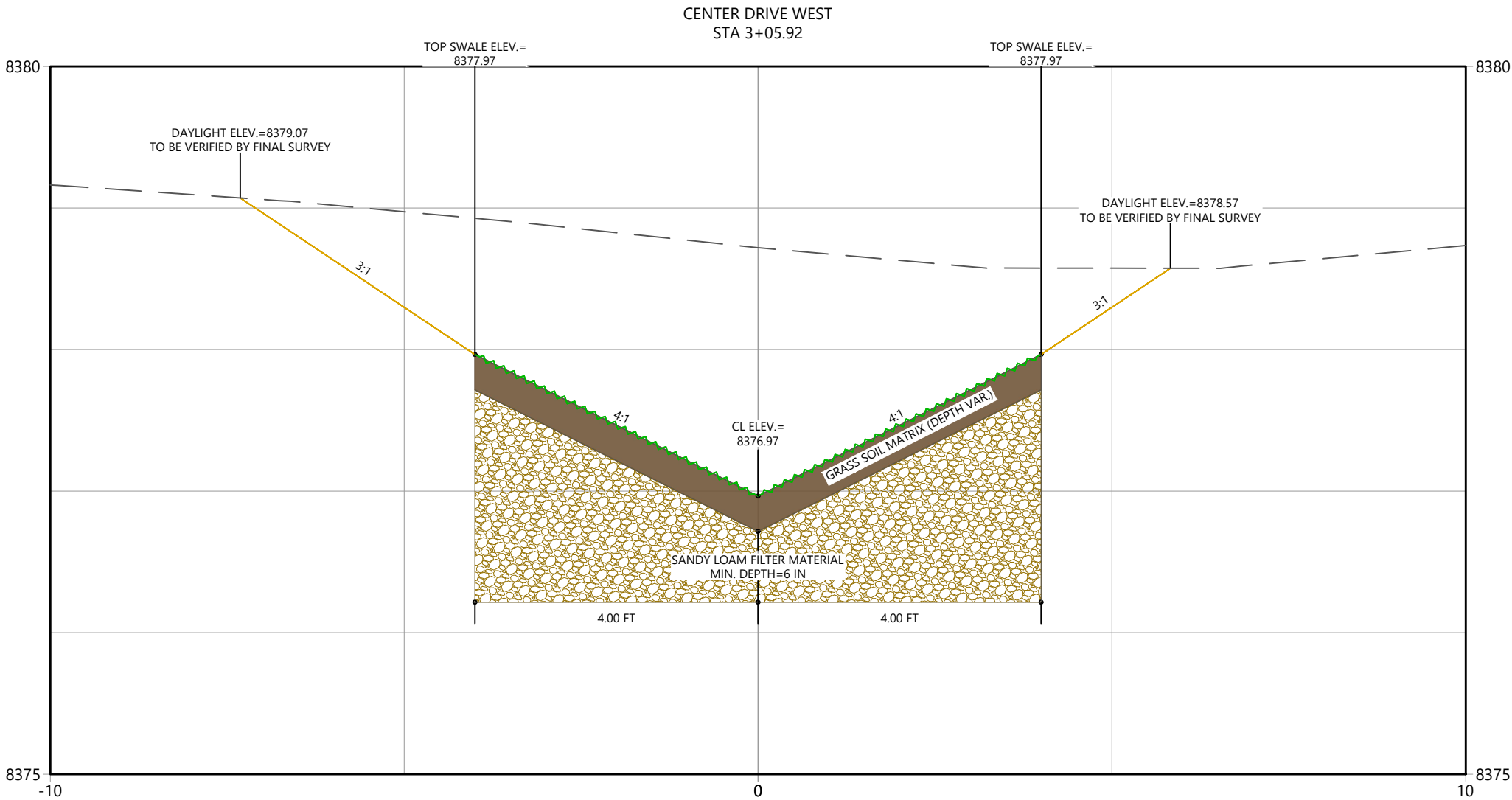
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Issued	By	Appd.	YY.MM.DD
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Permit-Seal

Client/Project	
TOWN OF GRAND LAKE	
STORMWATER MANAGEMENT PLAN	
GRAND LAKE, CO	
Project Milestone	

Sheet Name	
XSEC_CDW (8)	
2023007041	Custom
Project No.	Horizontal Scale
Sheet 37	of 68



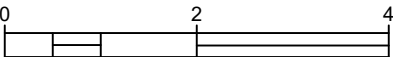
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Sub-Consultants

Horizontal Scale & Orientation



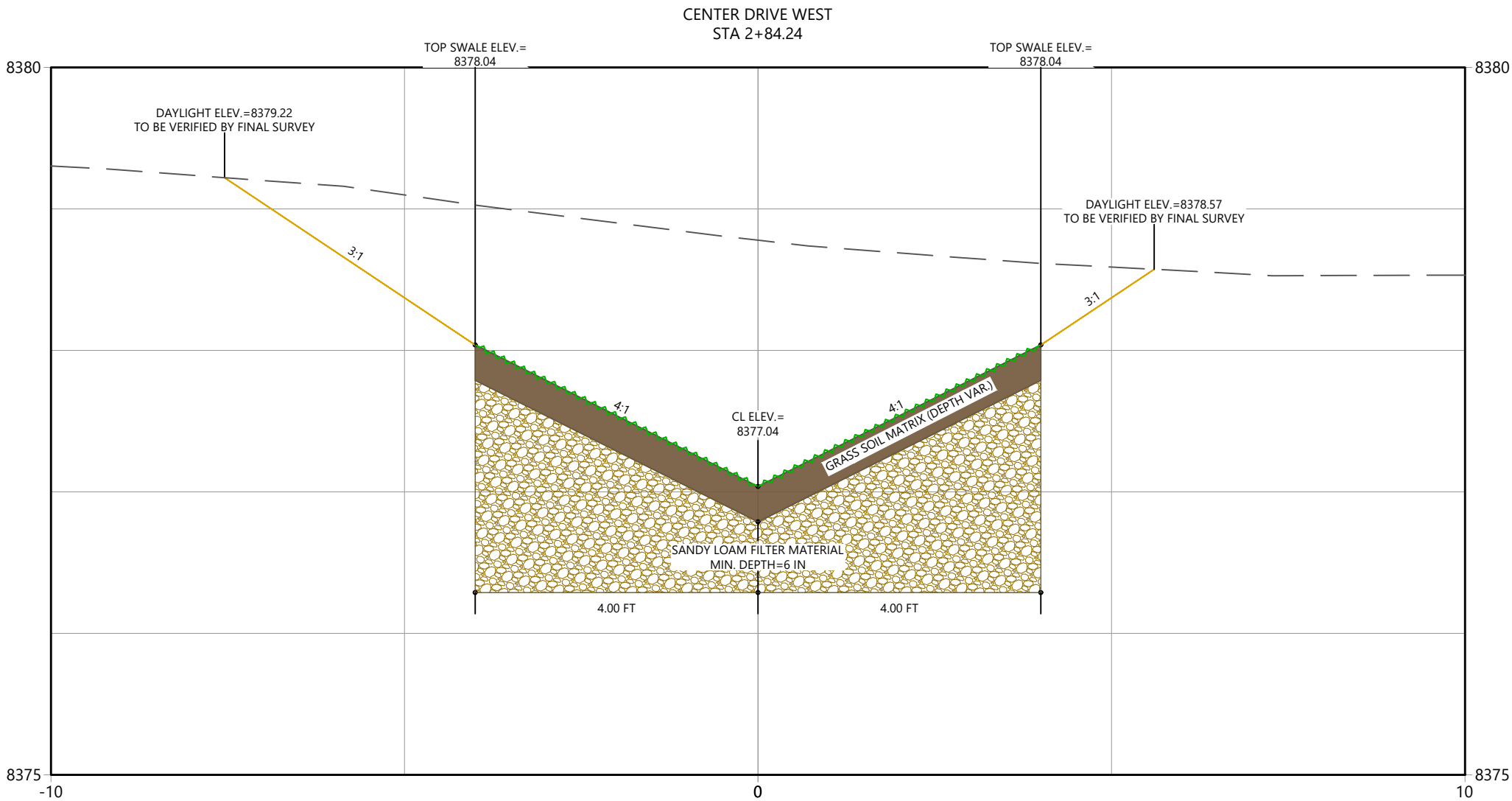
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Client/Project	
TOWN OF GRAND LAKE	
STORMWATER MANAGEMENT PLAN	
GRAND LAKE, CO	
Project Milestone	

Sheet Name	
XSEC_CDW (7)	
2023007041	Custom
Project No.	Horizontal Scale
Sheet 38	of 68



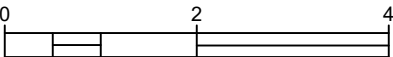
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Client/Project

TOWN OF GRAND LAKE

STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

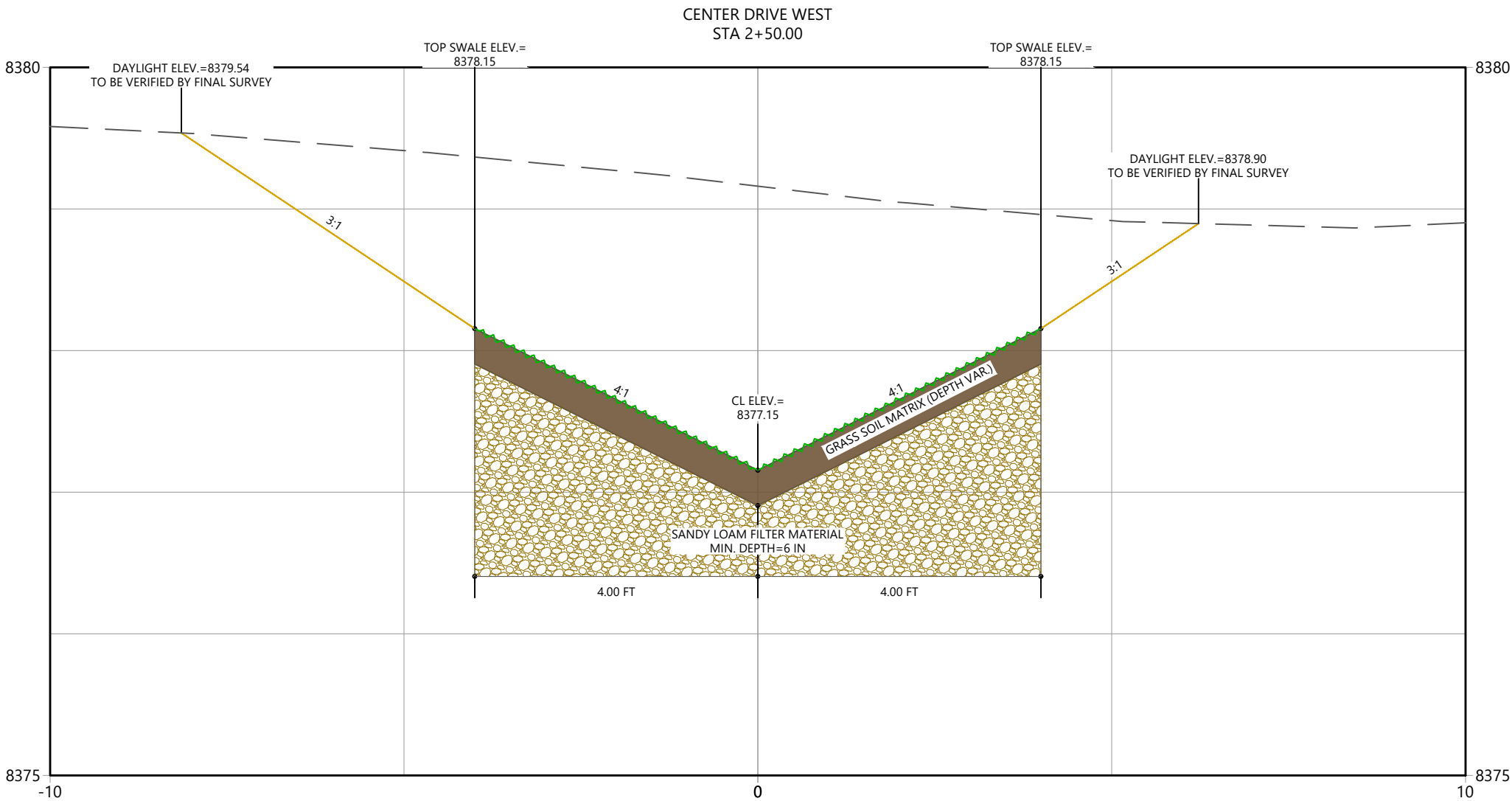
Project Milestone

Sheet Name

XSEC_CDW (6)

2023007041	Custom
Project No.	Horizontal Scale

Sheet 39 of 68



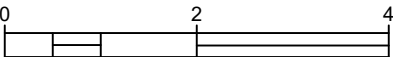
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Horizontal Scale & Orientation



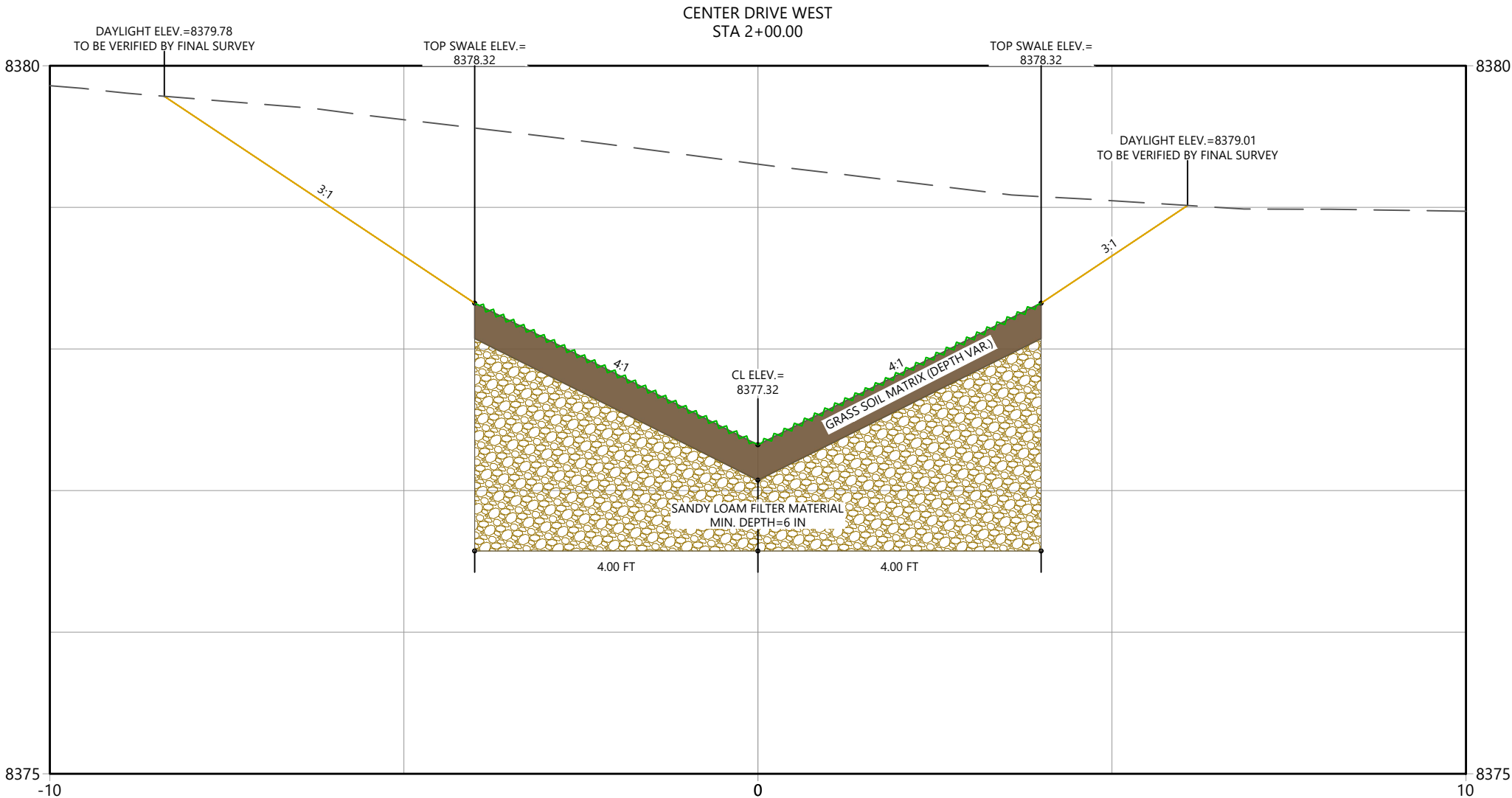
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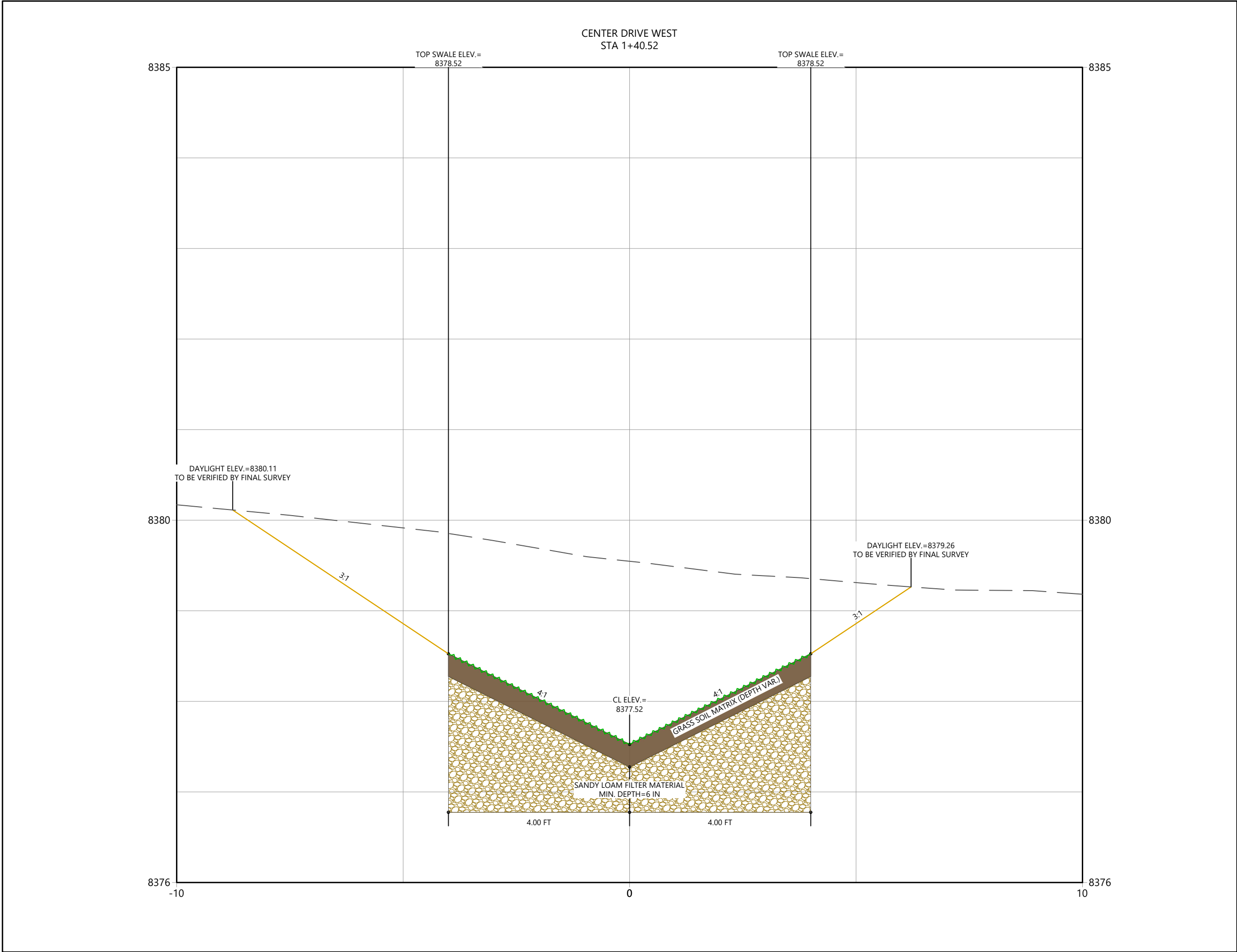
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Client/Project	
TOWN OF GRAND LAKE	
STORMWATER MANAGEMENT PLAN	
GRAND LAKE, CO	
Project Milestone	

Sheet Name	
XSEC_CDW (5)	
2023007041	Custom
Project No.	Horizontal Scale
Sheet 40	of 68



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2024/09/16 9:55 AM By: Lucas Babitt

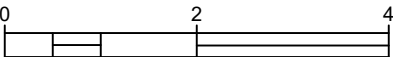


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Client/Project
TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

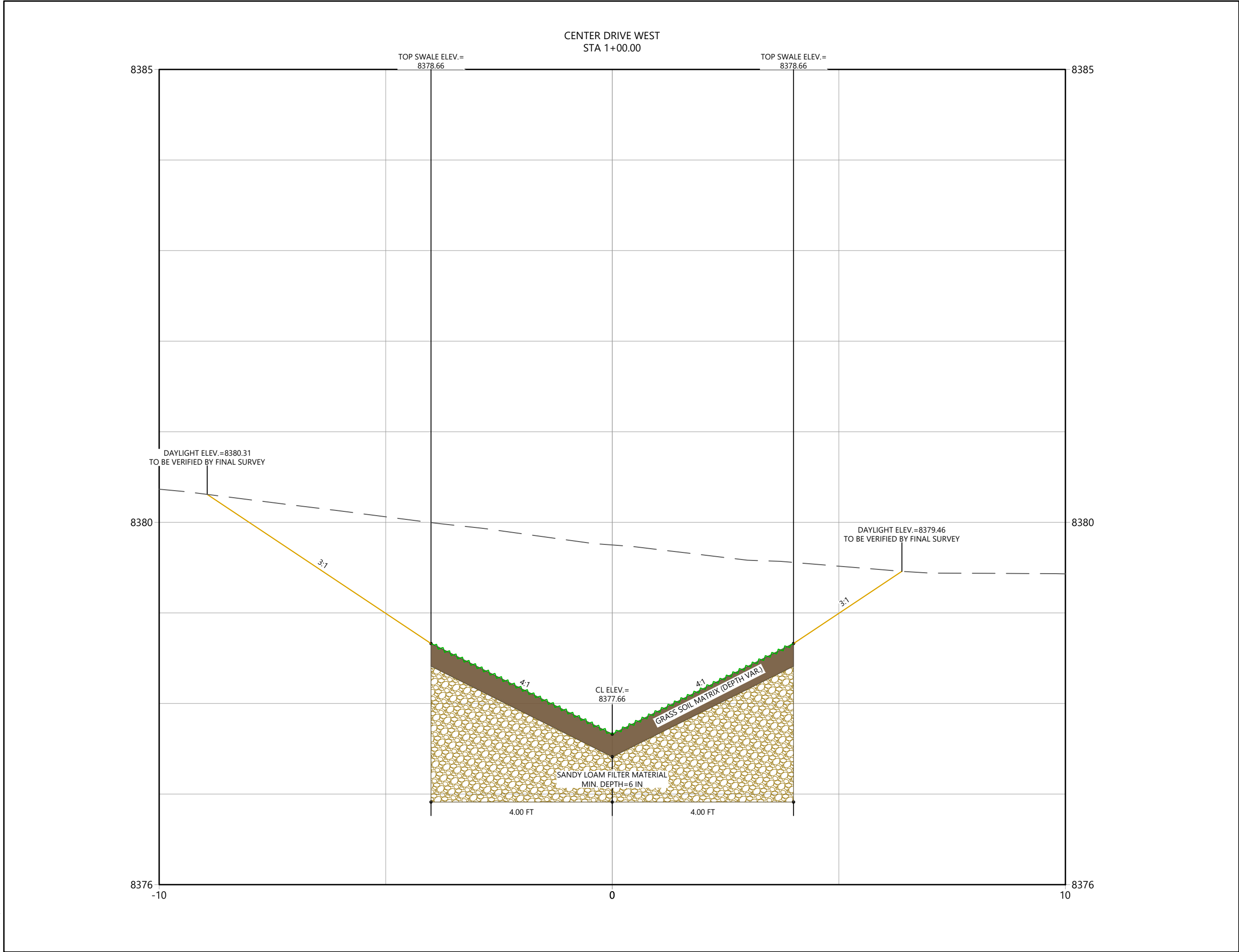
Project Milestone

Sheet Name
XSEC_CDW (4)

2023007041 Custom
Project No. Horizontal Scale

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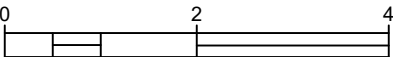
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STORMWATER MANAGEMENT PLAN**

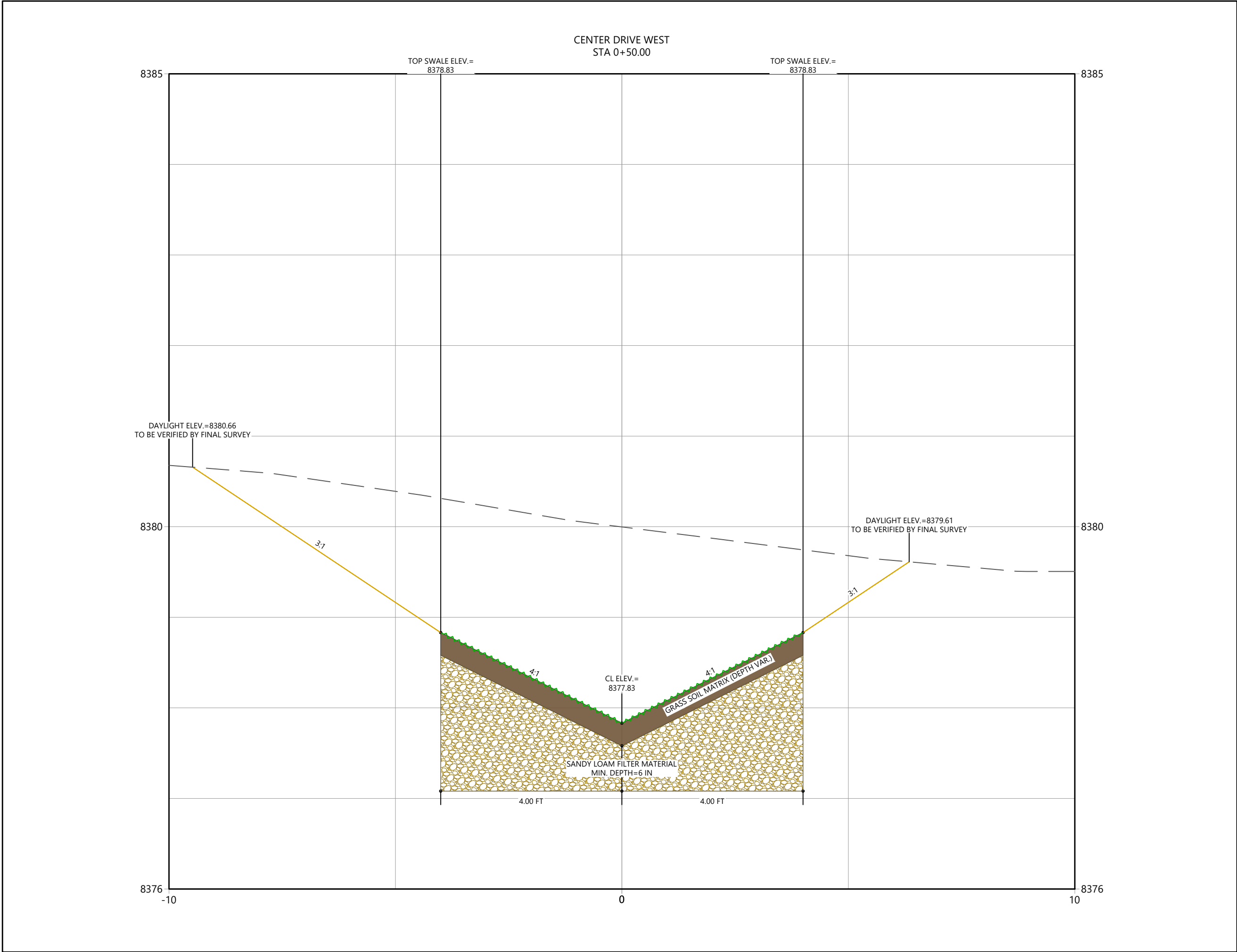
GRAND LAKE, CO

Project Milestone

Sheet Name
XSEC_CDW (3)

2023007041	Custom
Project No.	Horizontal Scale

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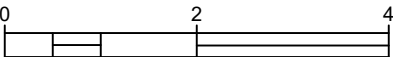


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STORMWATER MANAGEMENT PLAN**

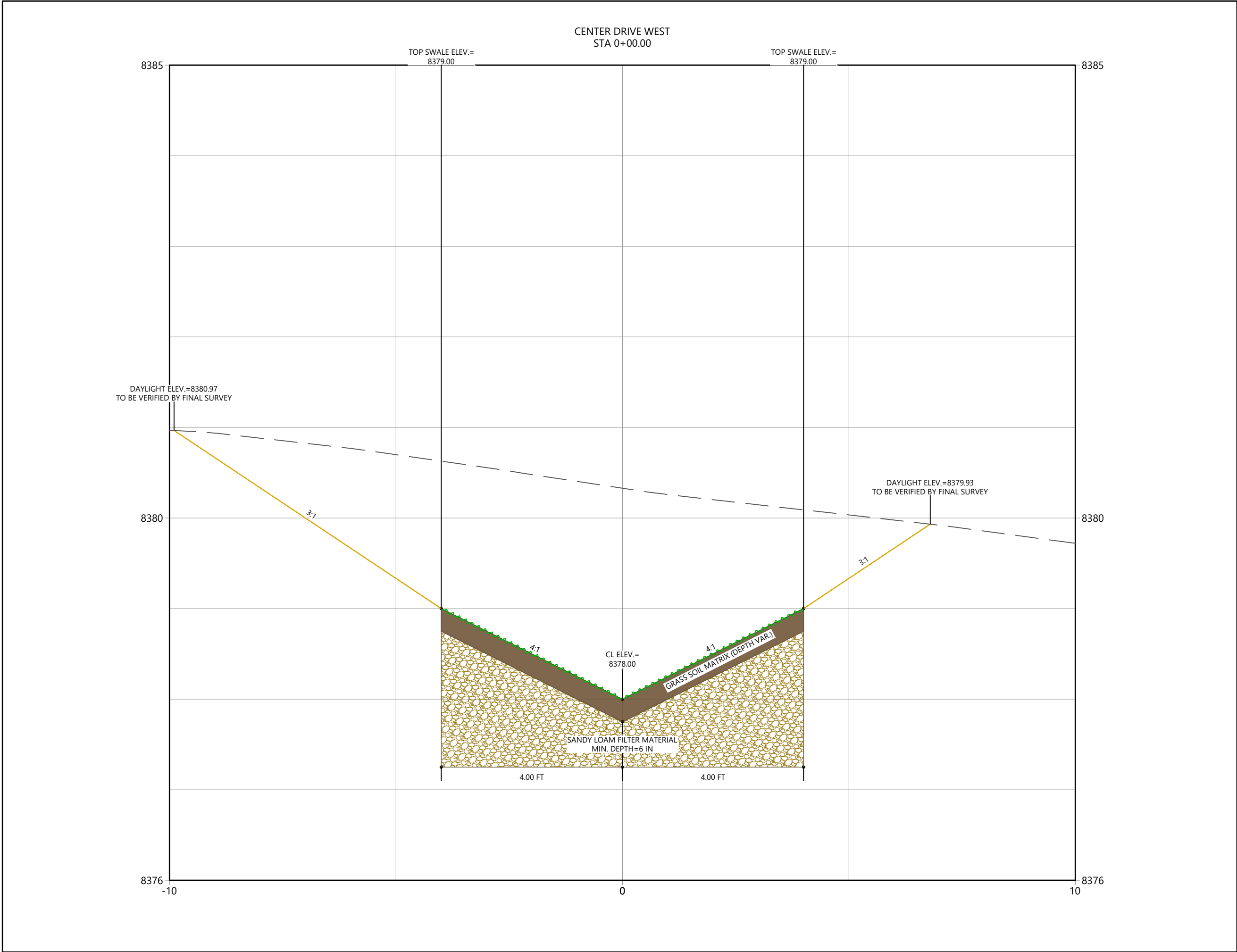
GRAND LAKE, CO

Project Milestone

Sheet Name
XSEC_CDW (2)

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Project No. Horizontal Scale

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GRAND LAKE, CO

Project Milestone

Sheet Name
XSEC_CDW

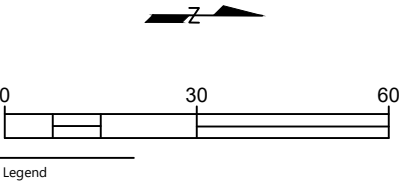
2023007041 1" = 2'
Project No. Horizontal Scale

Sheet 44 of 68

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Horizontal Scale & Orientation



- NOTES:
1. CONTOUR DATA FROM 2020 USGS LIDAR
 2. VERIFY ACTUAL ELEVATIONS W/ GROUND SURVEY PRIOR TO CONSTRUCTION
 3. DESIGN BASED ON THE 2-YEAR STORM

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TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN

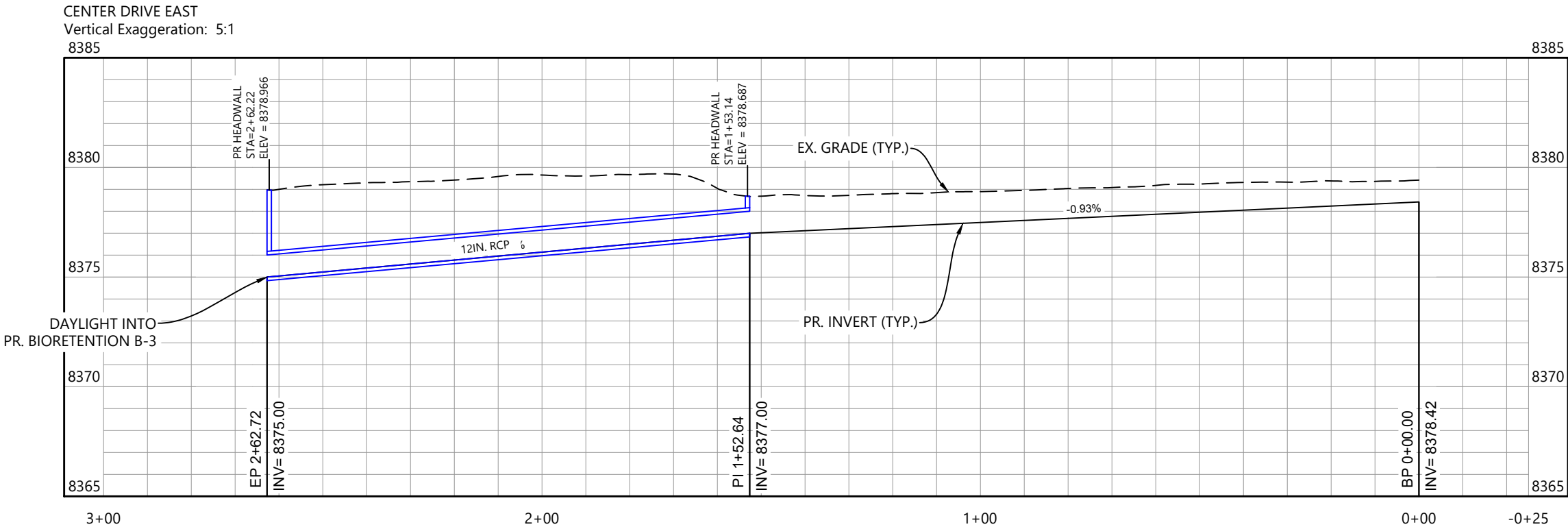
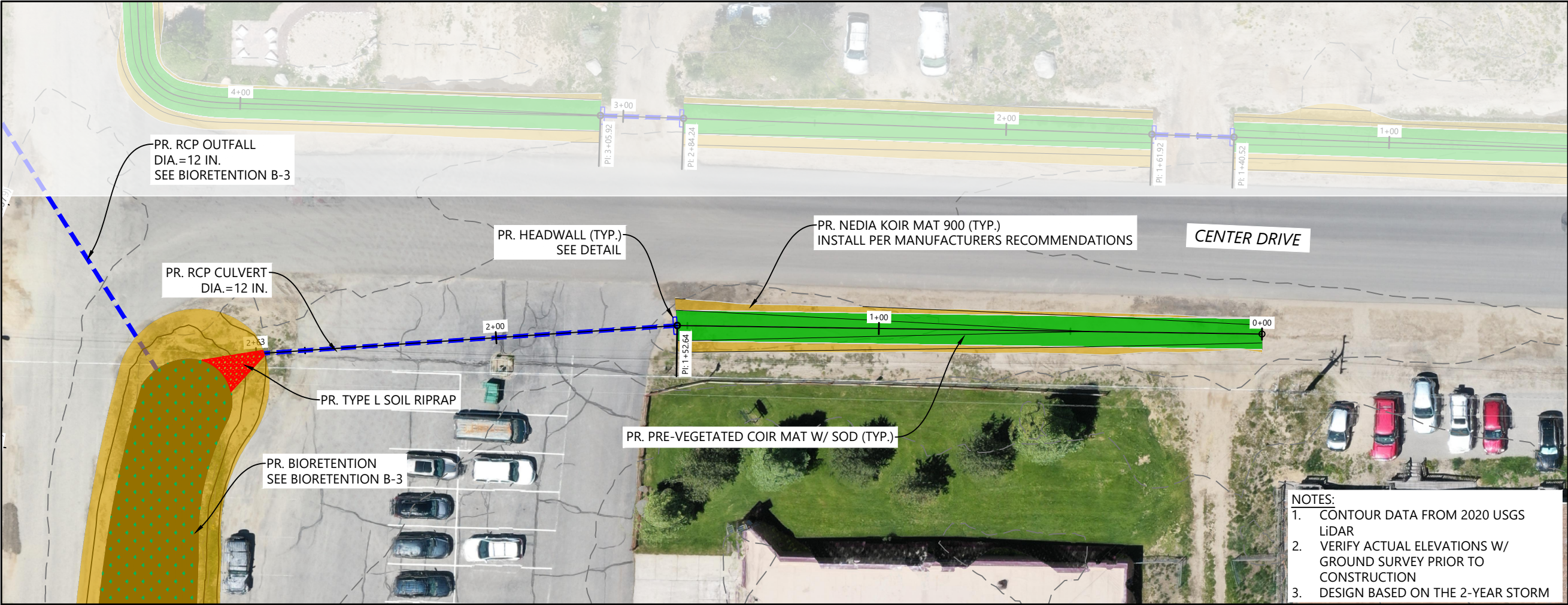
GRAND LAKE, CO

Project Milestone

Sheet Name
GRASS SWALE_CDE

2023007041 1" = 30'
Project No. Horizontal Scale

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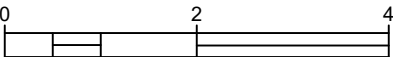
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TOWN OF GRAND LAKE

STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

Project Milestone

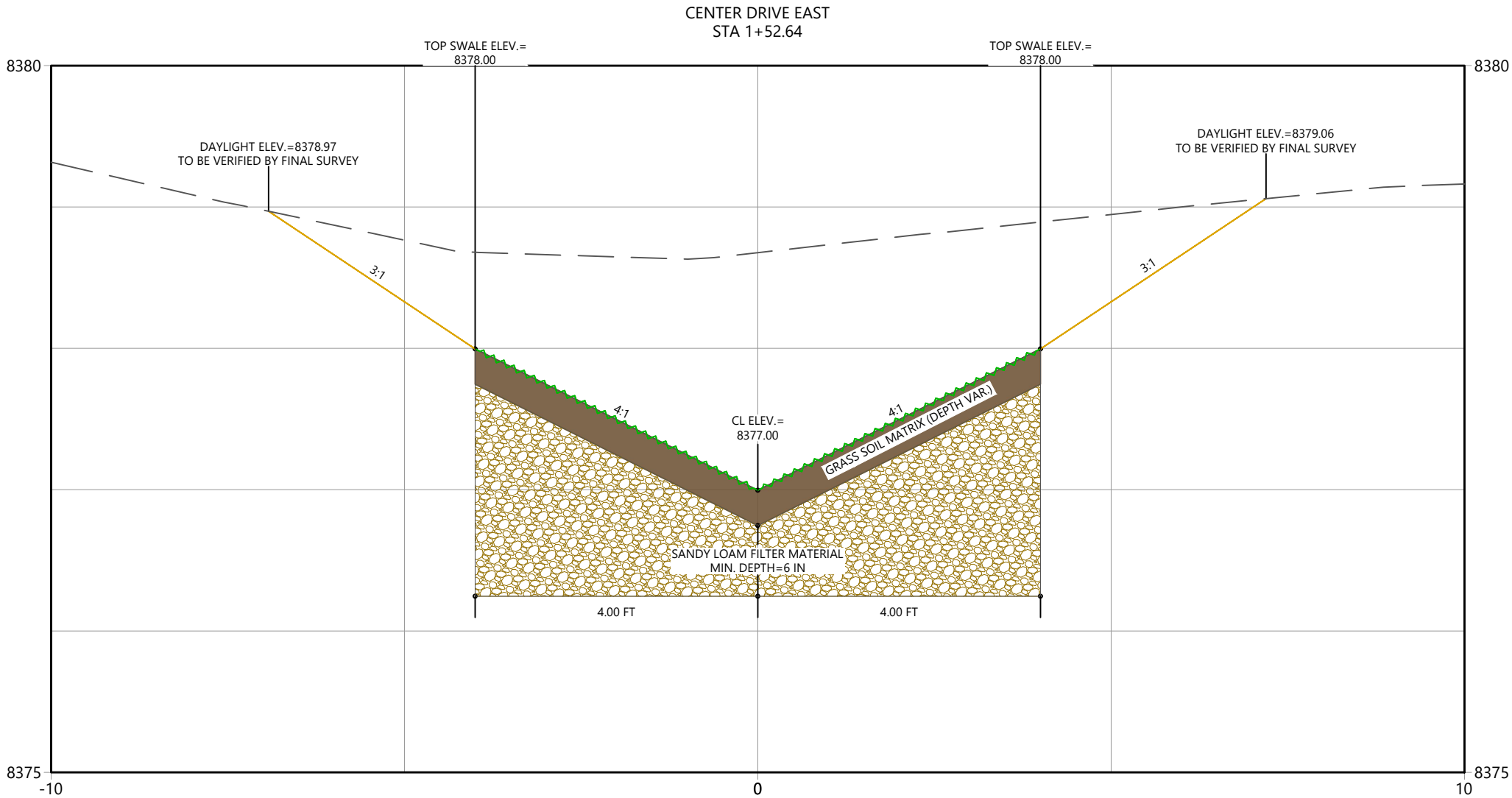
Sheet Name

XSEC_CDE (5)

2023007041 1" = 2'

Project No. Horizontal Scale

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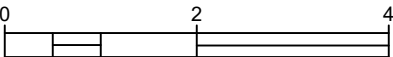
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TOWN OF GRAND LAKE

STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

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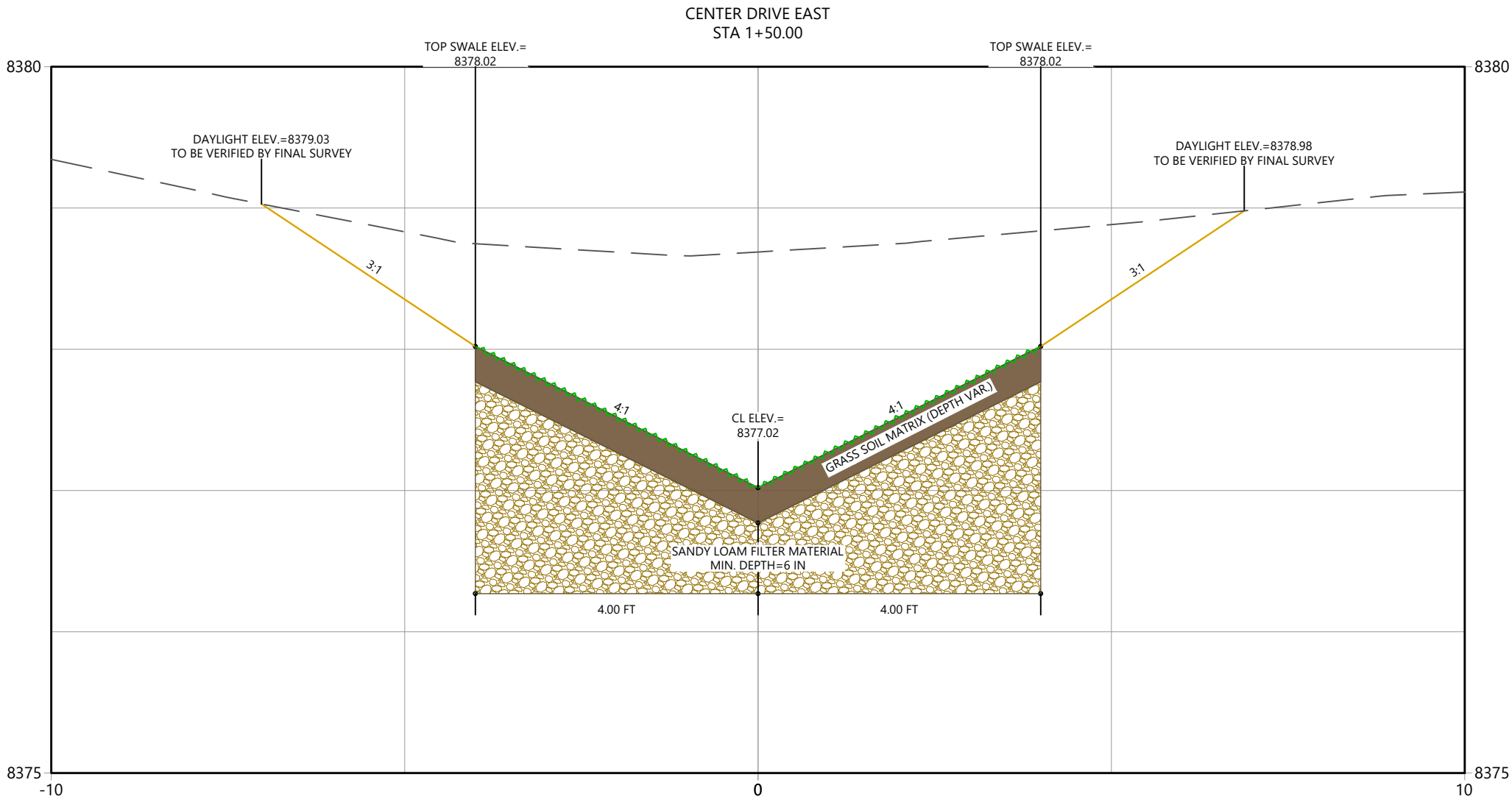
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XSEC_CDE (4)

2023007041 1" = 2'

Project No. Horizontal Scale

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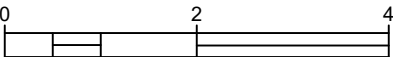
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TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

Project Milestone

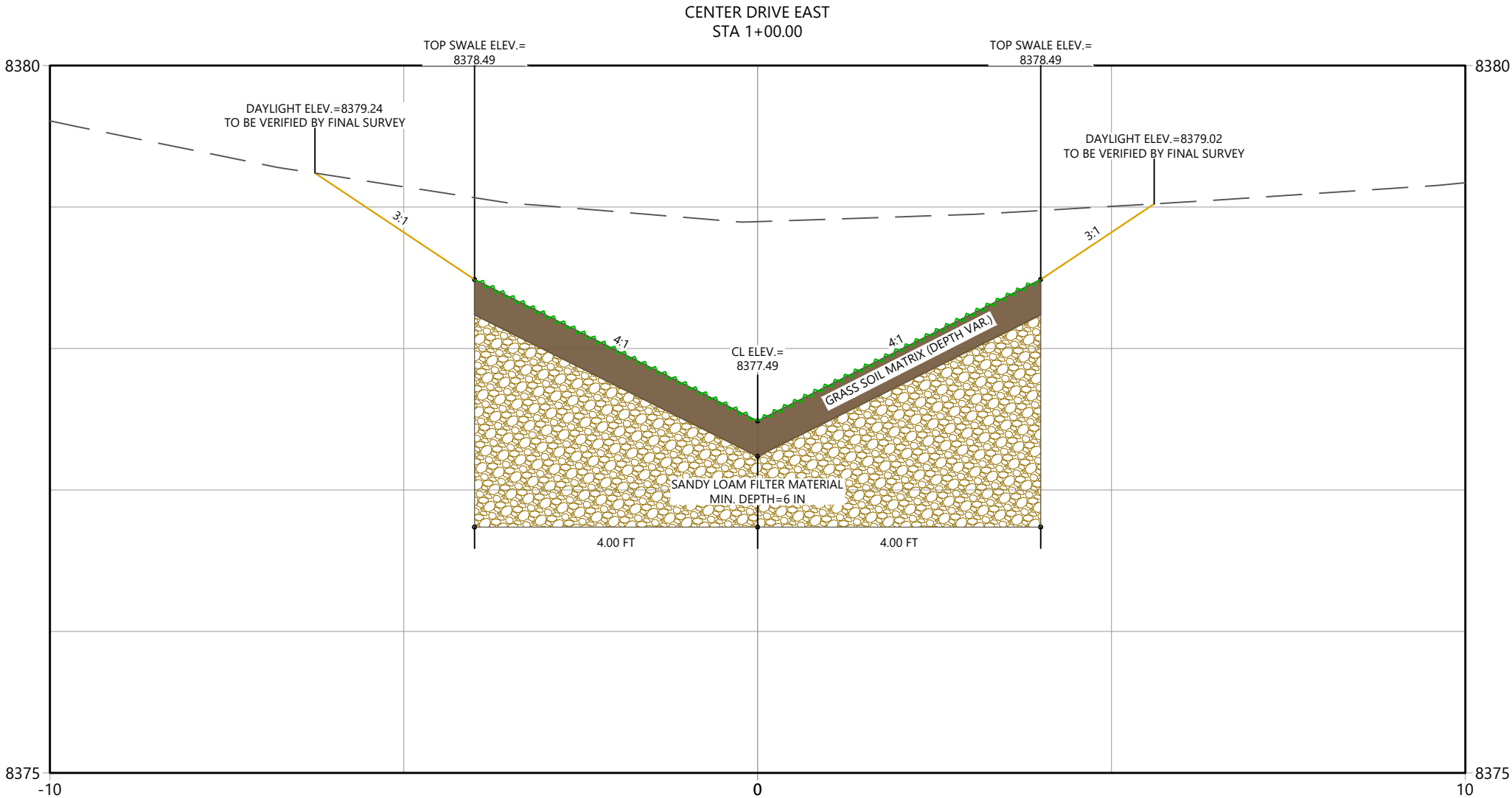
Sheet Name

XSEC_CDE (3)

2023007041 1" = 2'

Project No. Horizontal Scale

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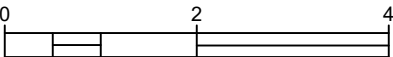
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TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

Project Milestone

Sheet Name

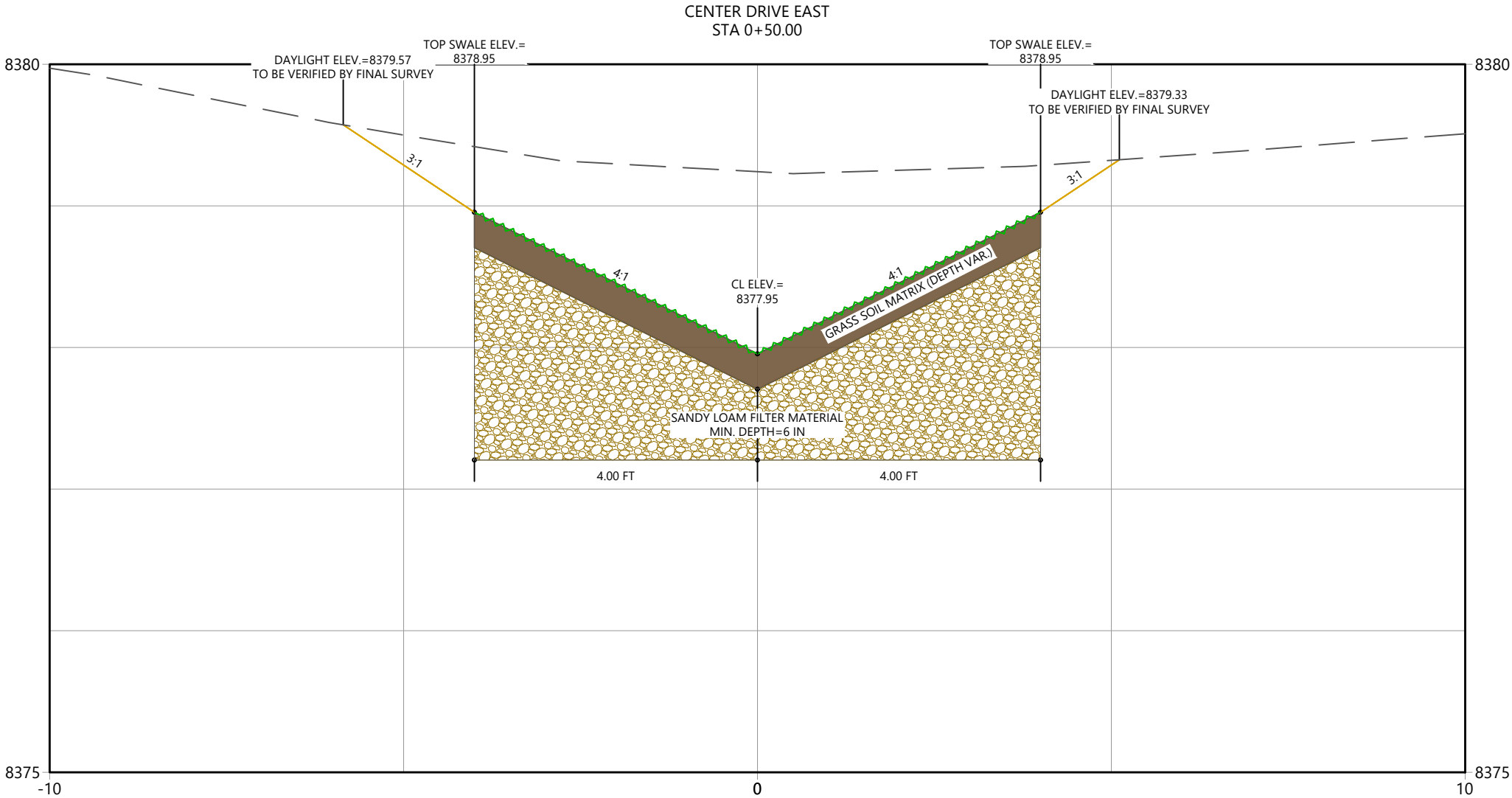
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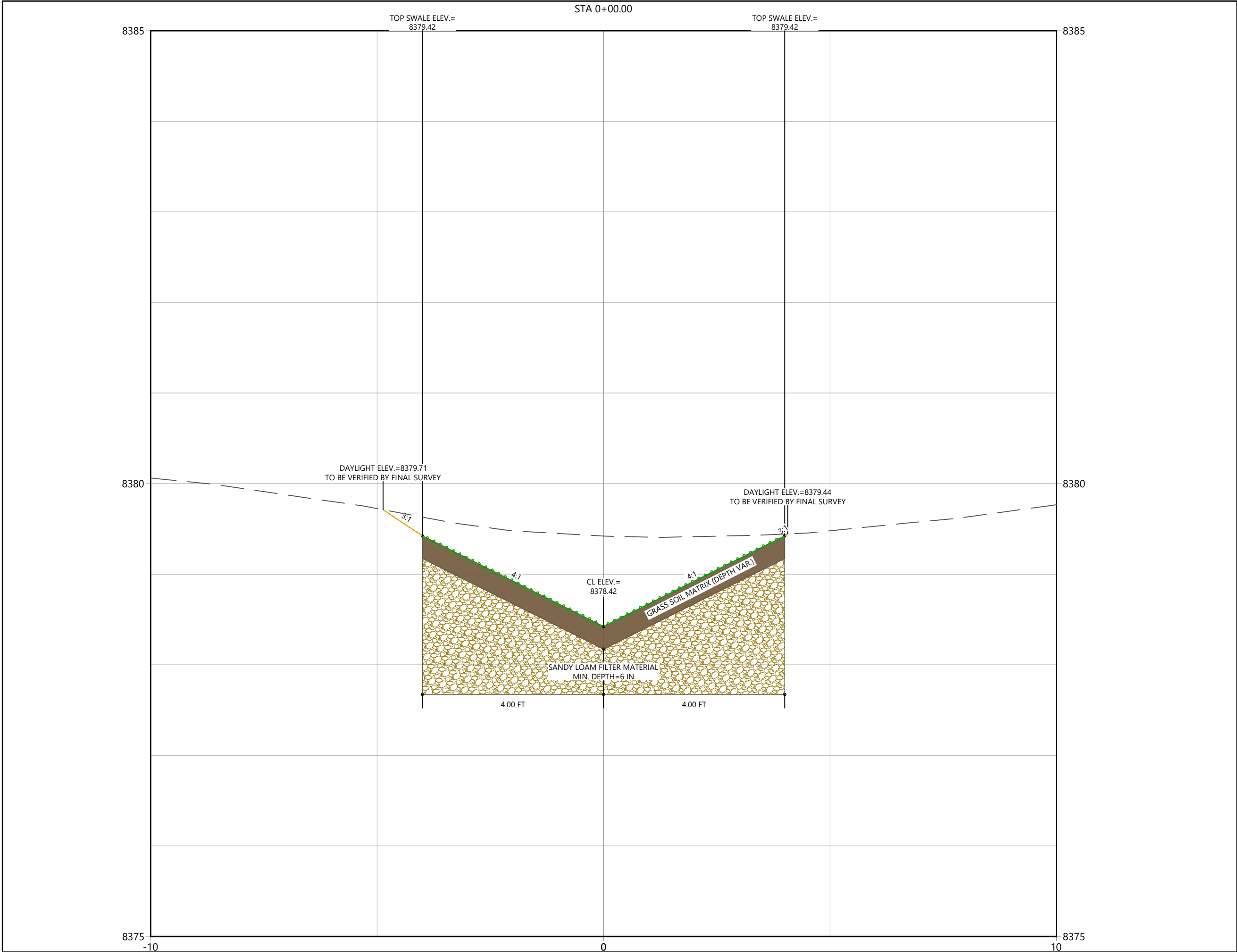
Project No.

Horizontal Scale

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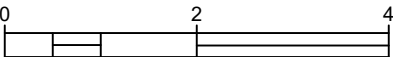
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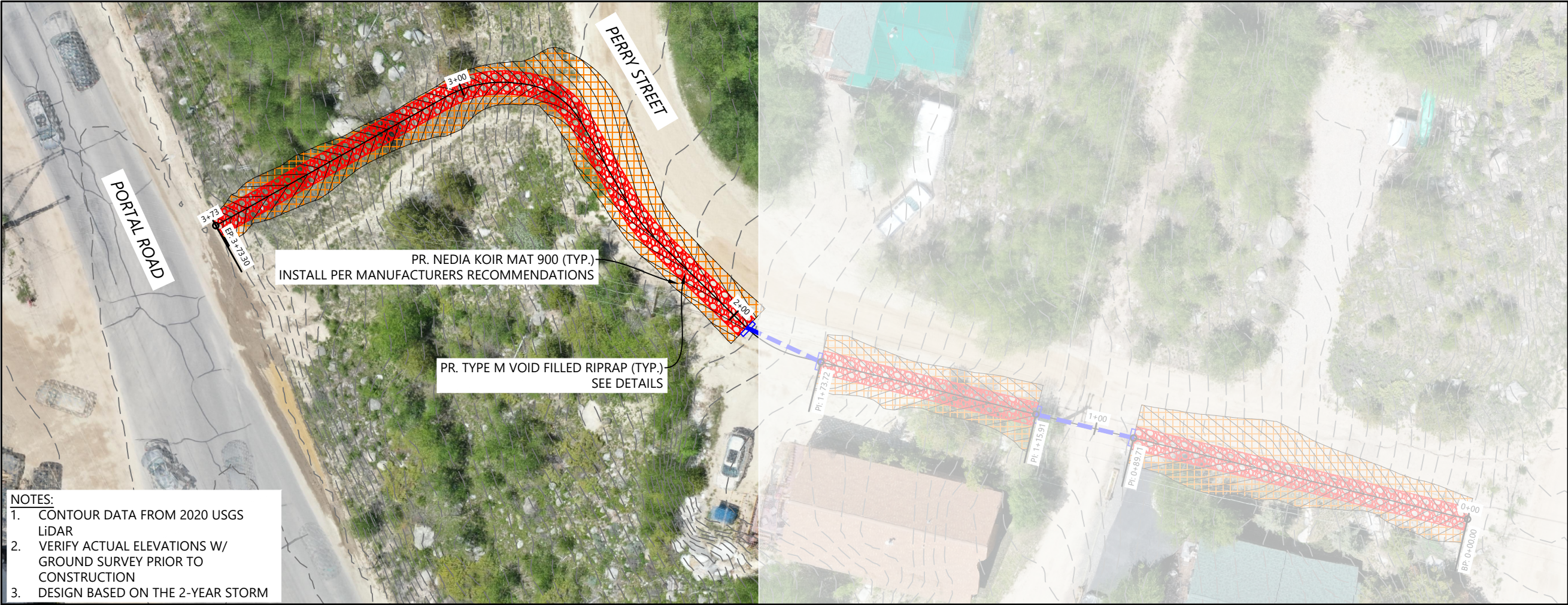
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**TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN**

GRAND LAKE, CO

Project Milestone

Sheet Name
XSEC_CDE

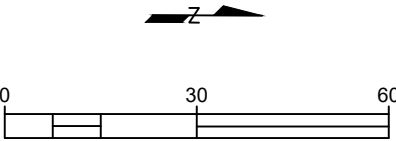
2023007041 1" = 2'
Project No. Horizontal Scale



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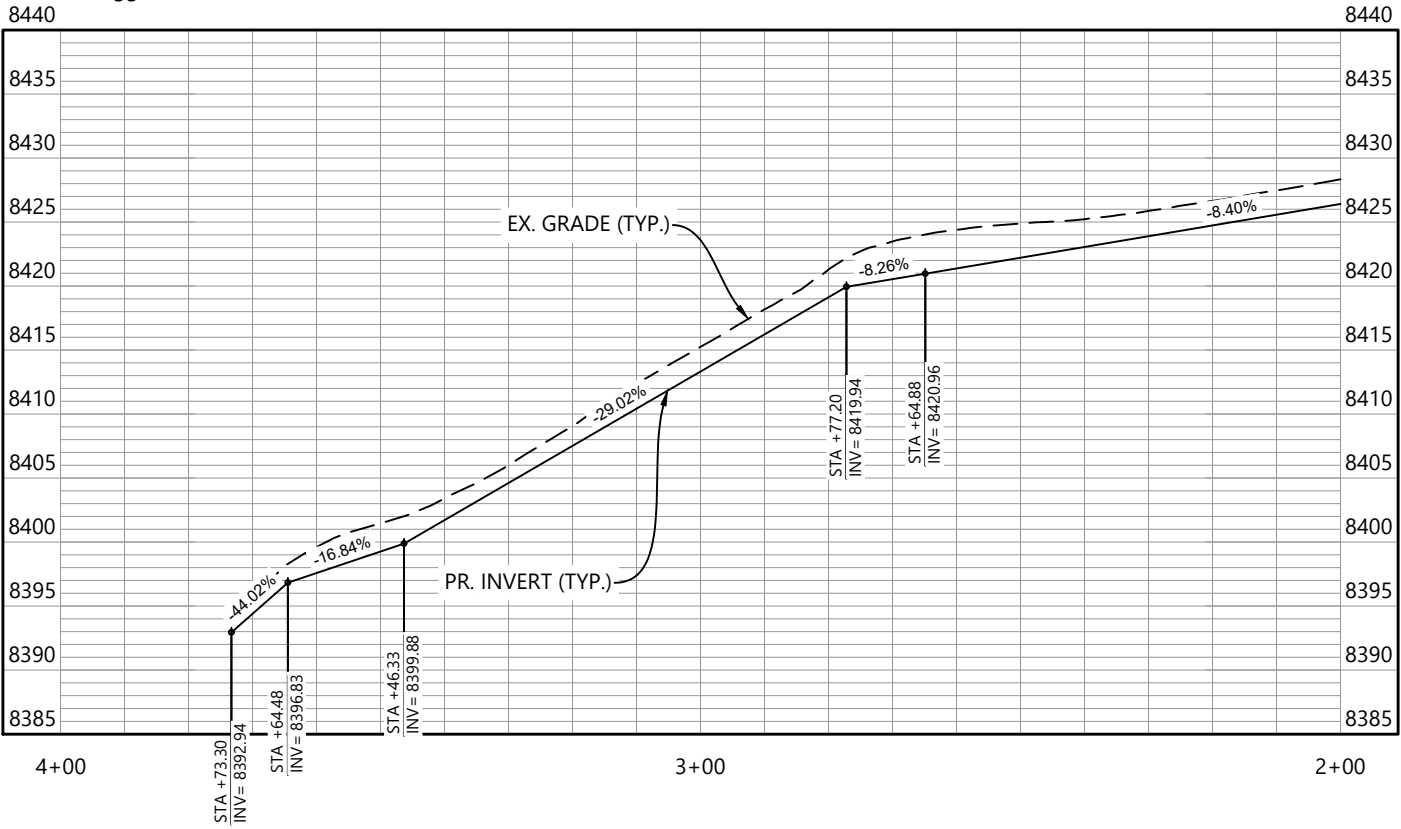
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Horizontal Scale & Orientation



Legend

ROCK SWALE (1)
Vertical Exaggeration: 2:1



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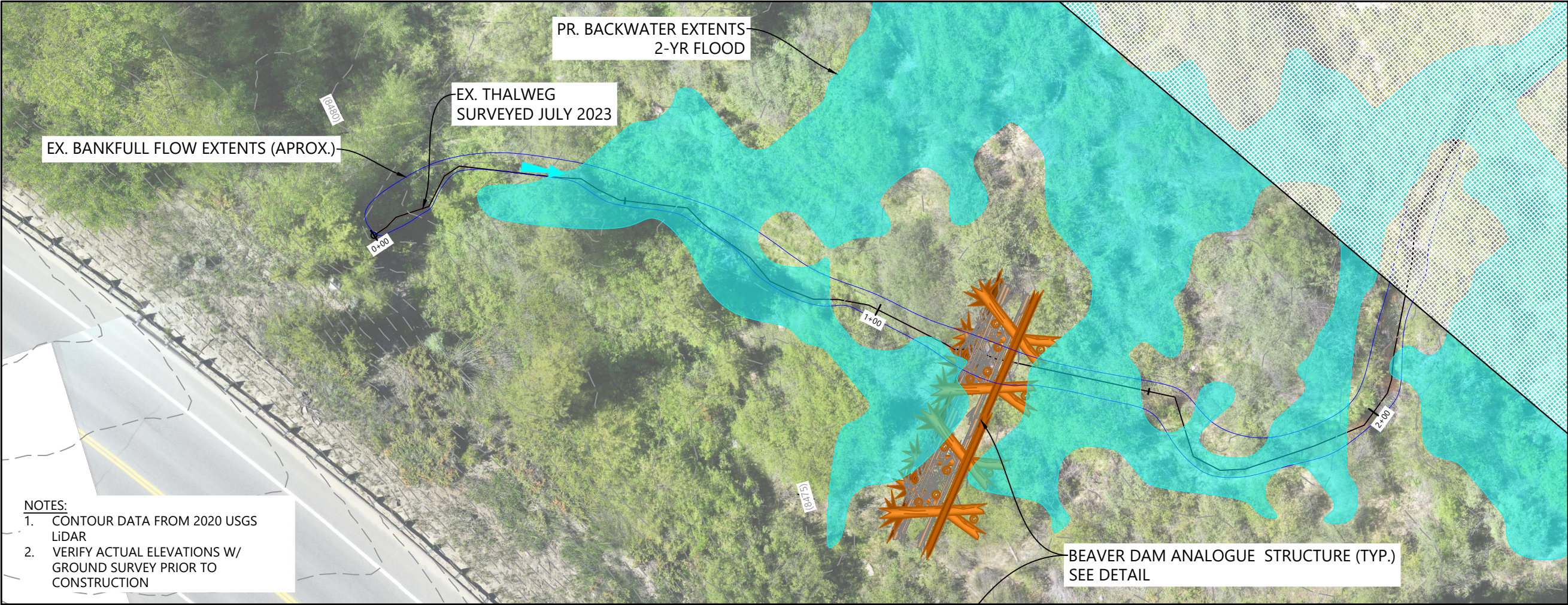
Client/Project
TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

Project Milestone

Sheet Name
ROCK SWALE (2)

2023007041 1" = 30'
Project No. Horizontal Scale



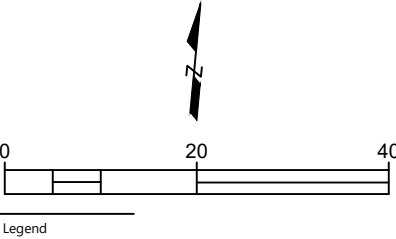
- NOTES:
- 1. CONTOUR DATA FROM 2020 USGS LiDAR
 - 2. VERIFY ACTUAL ELEVATIONS W/ GROUND SURVEY PRIOR TO CONSTRUCTION



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**TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN**

GRAND LAKE, CO

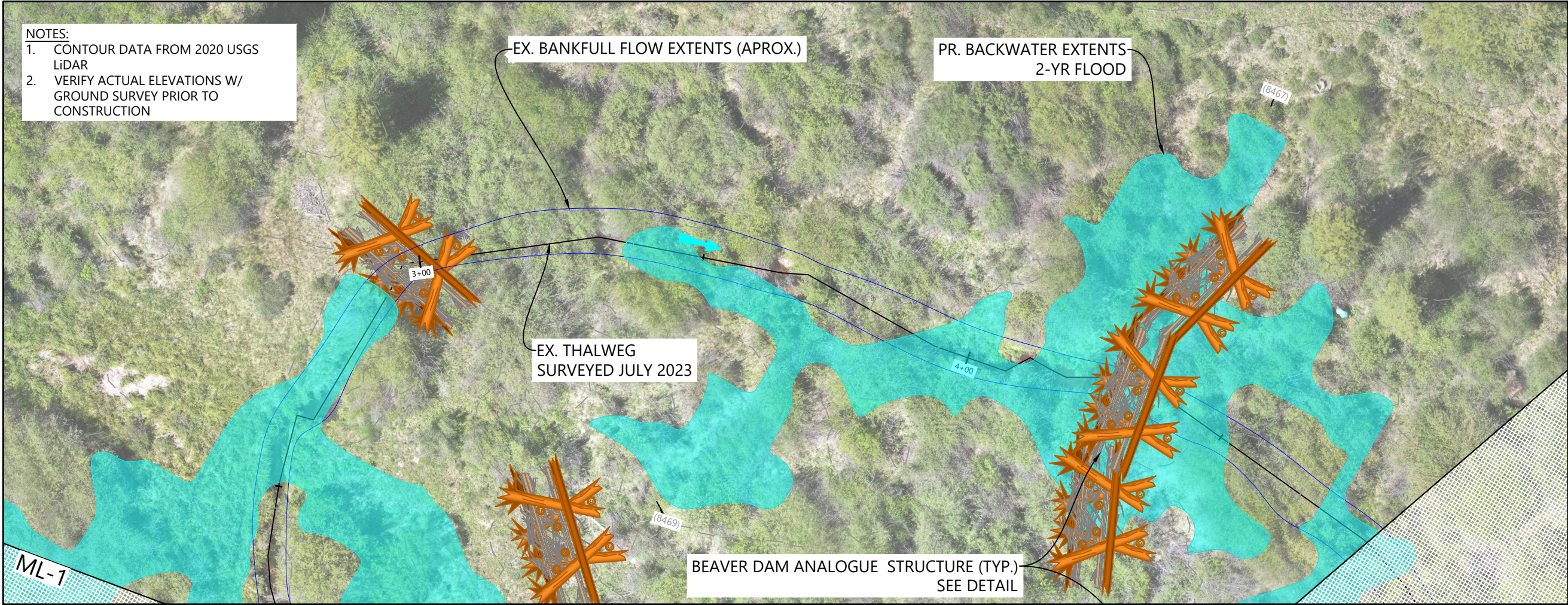
Project Milestone

Sheet Name

LITTLE COLUMBINE CREEK - (1)

2023007041 **1" = 20'**

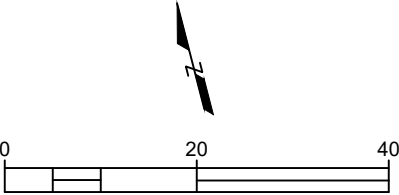
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STORMWATER MANAGEMENT PLAN**

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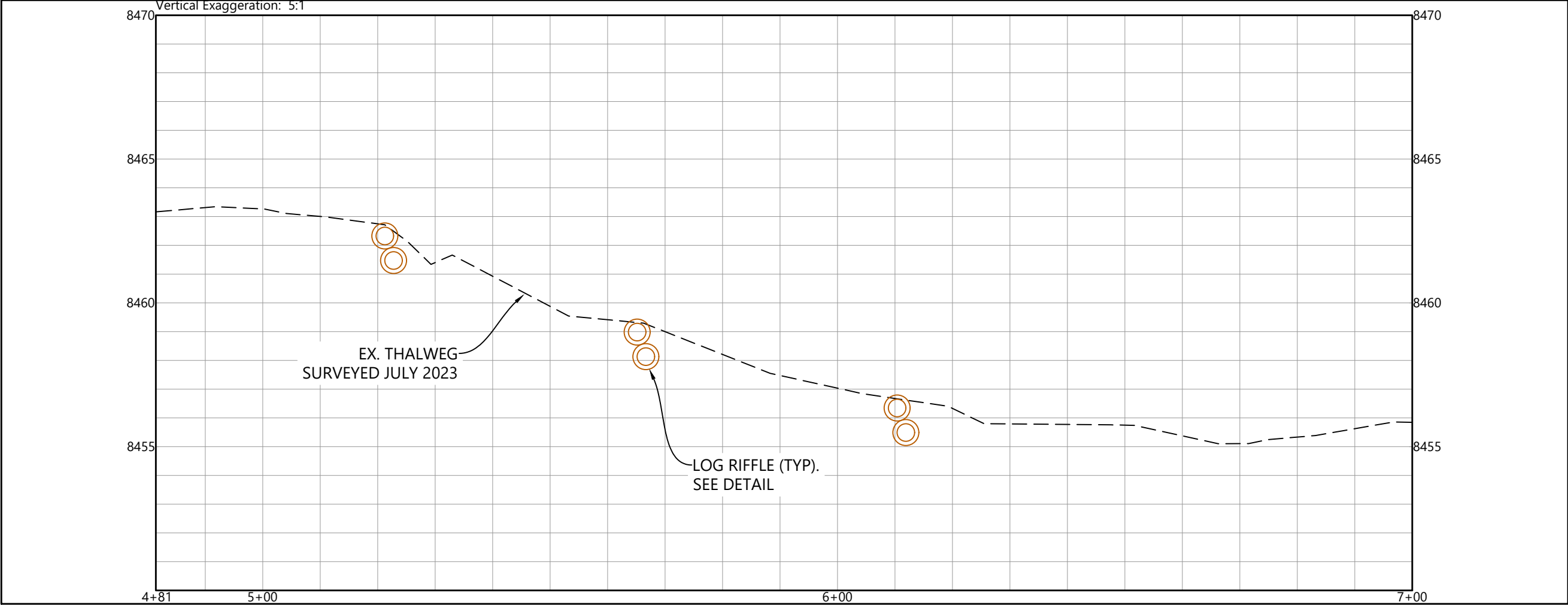
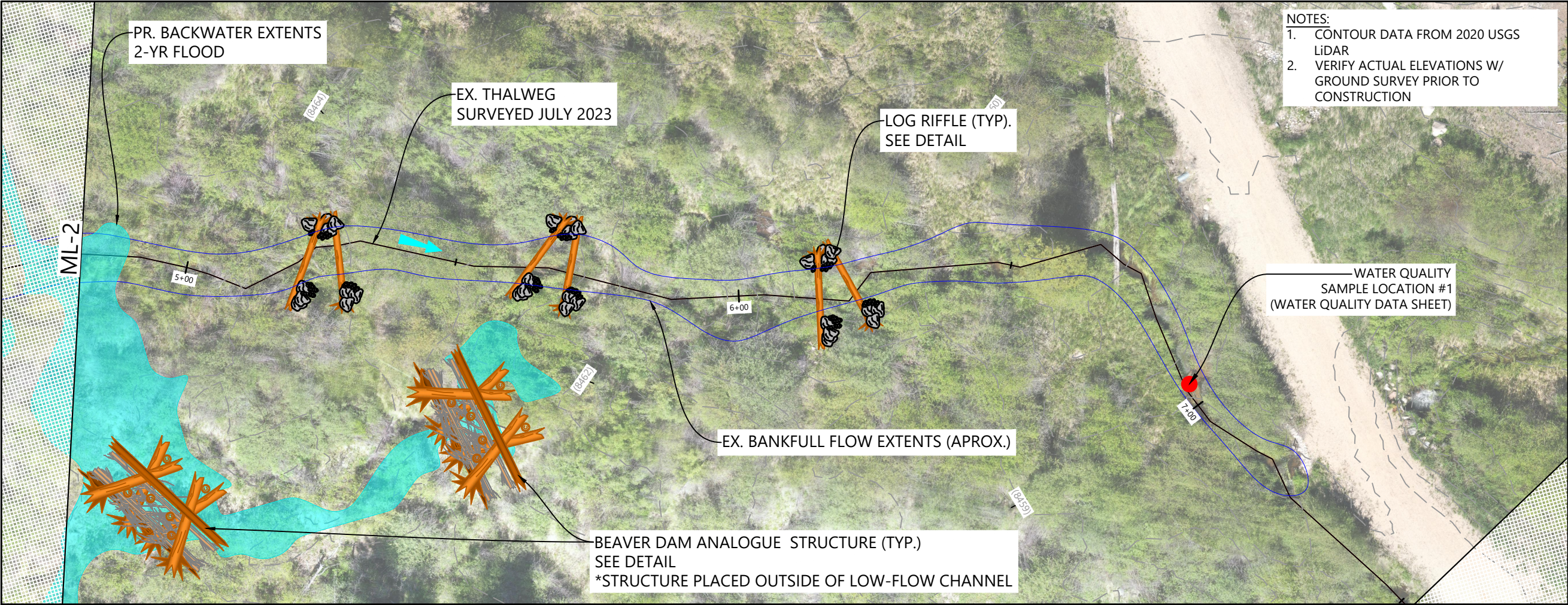
Project Milestone

Sheet Name

LITTLE COLUMBINE CREEK - (2)

2023007041 1" = 20'
Project No. Horizontal Scale

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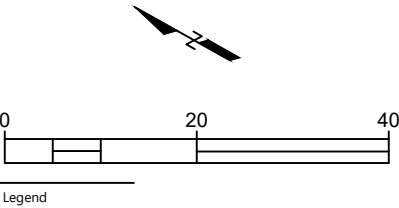


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1. CONTOUR DATA FROM 2020 USGS LiDAR
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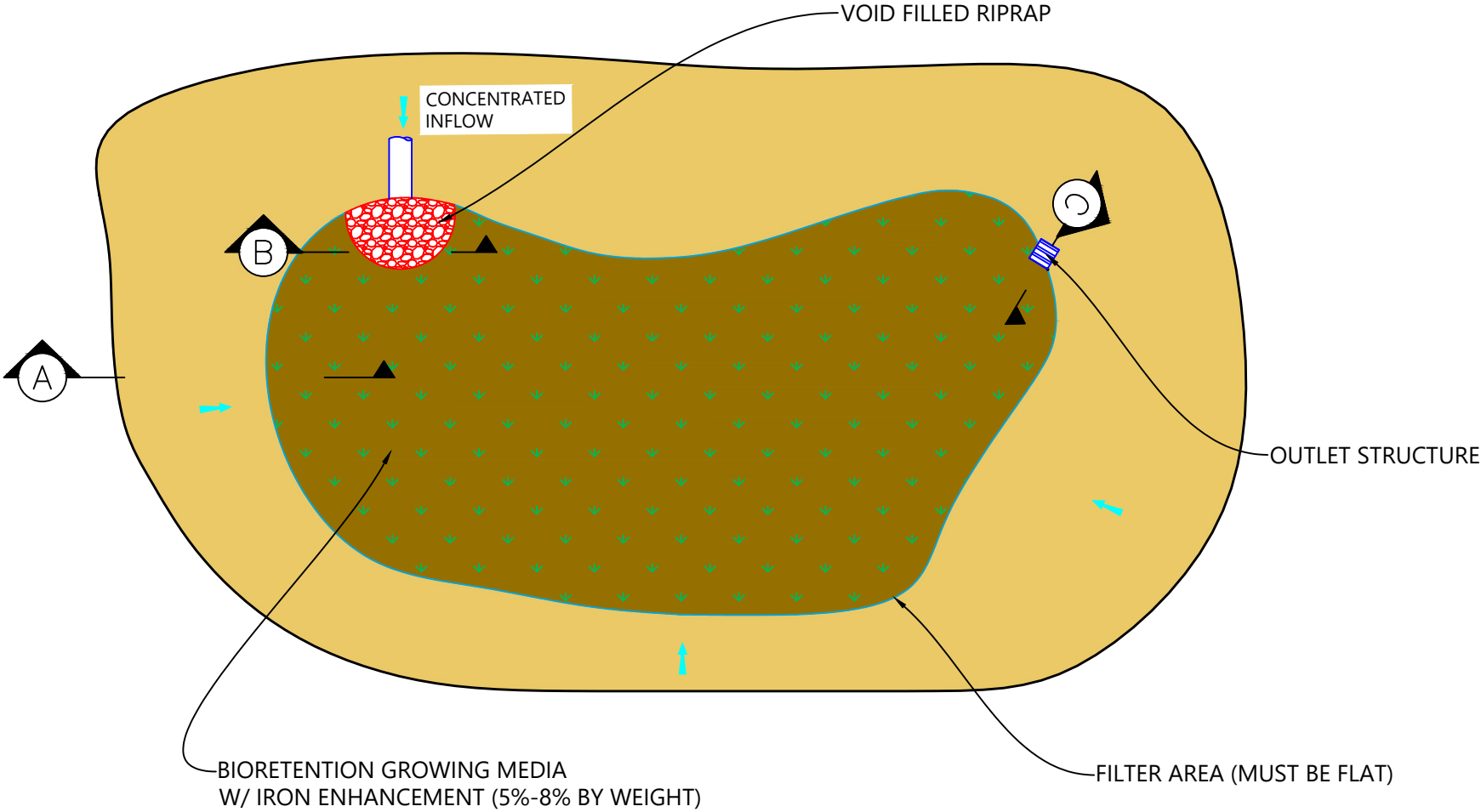
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Sheet Name
LITTLE COLUMBINE CREEK - (3)

2023007041 1" = 20'
Project No. Horizontal Scale

TYPICAL BIORETENTION DETAIL



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Client/Project
TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

Project Milestone

Sheet Name
DETAIL_BIORETENTION

2023007041 NTS
Project No. Horizontal Scale

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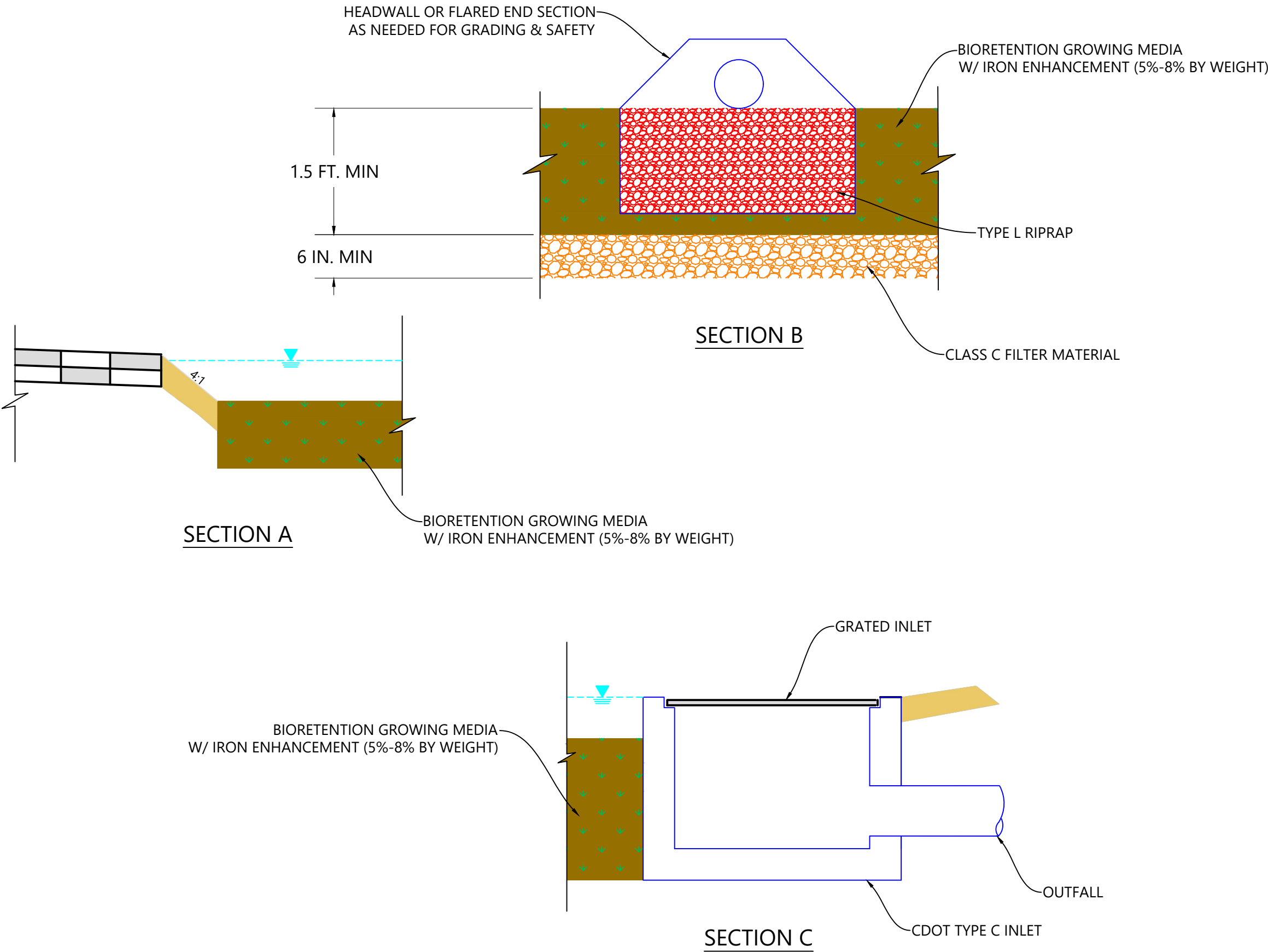
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TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

Project Milestone

Sheet Name
DETAIL_BIORETENTION CONT.

2023007041	NTS
Project No.	Horizontal Scale



TYPICAL BIORETENTION DETAIL (CONT.)

SPECIFICATIONS

1-208-354-3691

Mat Material: 100% Biodegradable coconut fiber, plugged with native wetland plants.

Typical Plants: Sedges, rushes, wetland grasses, bulrushes and spike rushes.

Custom Orders: Wetland Sod can be custom grown to your species specifications.

Pricing: Stock Wetland Sod mixes, \$205.44 per mat (\$3.96/ft²). Delivery and installation can be arranged but are not included in sales price.

Length: 16.2 ft (5 m)

Width: 3.2 ft (1 m)

Area: 52 ft² (5 m²)

Coir Mat Thickness: 2.75 in (7 cm)

Weight: 100-150 lbs per unit

Plant Height: 8" - 36" depending on plant species.

Plant Coverage: Minimum of 50% root and 50% shoot coverage.



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WETLAND SOD
Pre-vegetated Coir Erosion Control Mats



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Sheet Name
DETAIL_WETLAND SOD

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Wetland Sod
Installation Guidelines

Delivery Related

- 1. Wetland Sod mat delivery should be scheduled to coincide with immediate job site installation. If mats cannot be immediately installed, they can be stored in a shady location for no more than **three** days and must be kept thoroughly saturated and covered (tarped) during that time. In hot, dry weather mats should be stored under the same conditions for no more than **two** days.
- 2. Mats are delivered rolled and are most easily moved by two people with hay hooks. NFNP does not use pallets to ship Wetland Sod.
- 3. Each Wetland Sod mat is approximately 16.2 feet in length and 3.2 feet wide. Per mat weights vary seasonally between 120 - 170 pounds.
- 4. Each mat is banded with a species classification tag for identification. For example, a mix with *Carex nebrascensis*, *Carex aquatilis* and *Juncus arcticus* will read **CnCaJa**.

Installation Related

- 1. Mats are simply moved to the installation site, unrolled and then staked down. Ensure that the plant roots and the bottom of the mat are in direct contact with the soil. **Space between the mat bottom and ground caused by folds, wrinkles or upturned mat edges will create a void that will allow the root system to dry out. Installing mats over large rocks, tree branches, very rough ground or anything that prevents root-to-soil contact should be avoided or remedied prior to installation.**
- 2. Mats should **not** be installed on slopes steeper than 2.5:1. Some die-back can be expected when slopes exceed 3:1 steepness
- 3. NFNP recommends the following staking pattern for Wetland Sod installation:
 - a. Drive stakes through the mat at a slight angle and leave about 4” of the stake protruding above the mat.
 - b. Use eight to twelve, 16” wooden stakes per mat for installations involving moving water (i.e. stream channels, windward lake shores, storm water retention areas).
 - c. Use six to eight, 16” wooden stakes per mat for site conditions without erosive characteristics (i.e. pond and lake shorelines, wetland areas)



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Installation Related ~ Continued

- 4. Ideally, mats should be installed in water depths of 2 inch to 4 inches. If site hydrology at the time of installation is lacking, plants will need supplemental irrigation. Additional irrigation will need to be provided during the first 3-4 weeks in order to ensure plant root establishment in surrounding soils. Conversely, if water levels are too deep at installation or during the first month after installation, the plants can die. After roots are well established, plants can tolerate periodic hydrologic famine or deeper water conditions.

Stream Bank Application Comments

On stream banks we recommend Wetland Sod installation just after peak flows, when water levels are gradually dropping. Supplemental irrigation may be required to fully establish the vegetation, but it will generally be fully rooted and ready for high water the following spring. The time required for roots to provide adequate anchoring depends on growing conditions including heat, light, and moisture.

In our experience, it is virtually impossible to pull up rooted coir manually after as little as 2-3 weeks at warm, low elevation sites or 4-5 weeks at cooler, high elevation sites. Although there is little data on initial or long-term performance of pre-planted coir in high energy channel environments, we have worked on projects where installed material was exposed to intense flows from storm runoff within several weeks after installation and was not dislodged or damaged

Other Useful Information

Labor/Installation

NFNP does not provide installation services. We have, however, compiled data from various clients to provide some guidelines with respect to anticipated installation times.

Based on that data, average installation time per mat is approximately .40 labor hours (24 minutes). This figure includes time for unloading, handling, on site distribution, and installation. Of course this is an average, installation times and labor requirements can vary significantly from site-to-site depending primarily on site accessibility.

Use of a 4-wheeler or utility vehicle is not required but may make handling easier and installation faster depending upon site conditions.



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DETAIL_WETLAND SOD (2)

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LOG RIFFLE STRUCTURE



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LOG RIFFLE EXAMPLE

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STORMWATER MANAGEMENT PLAN

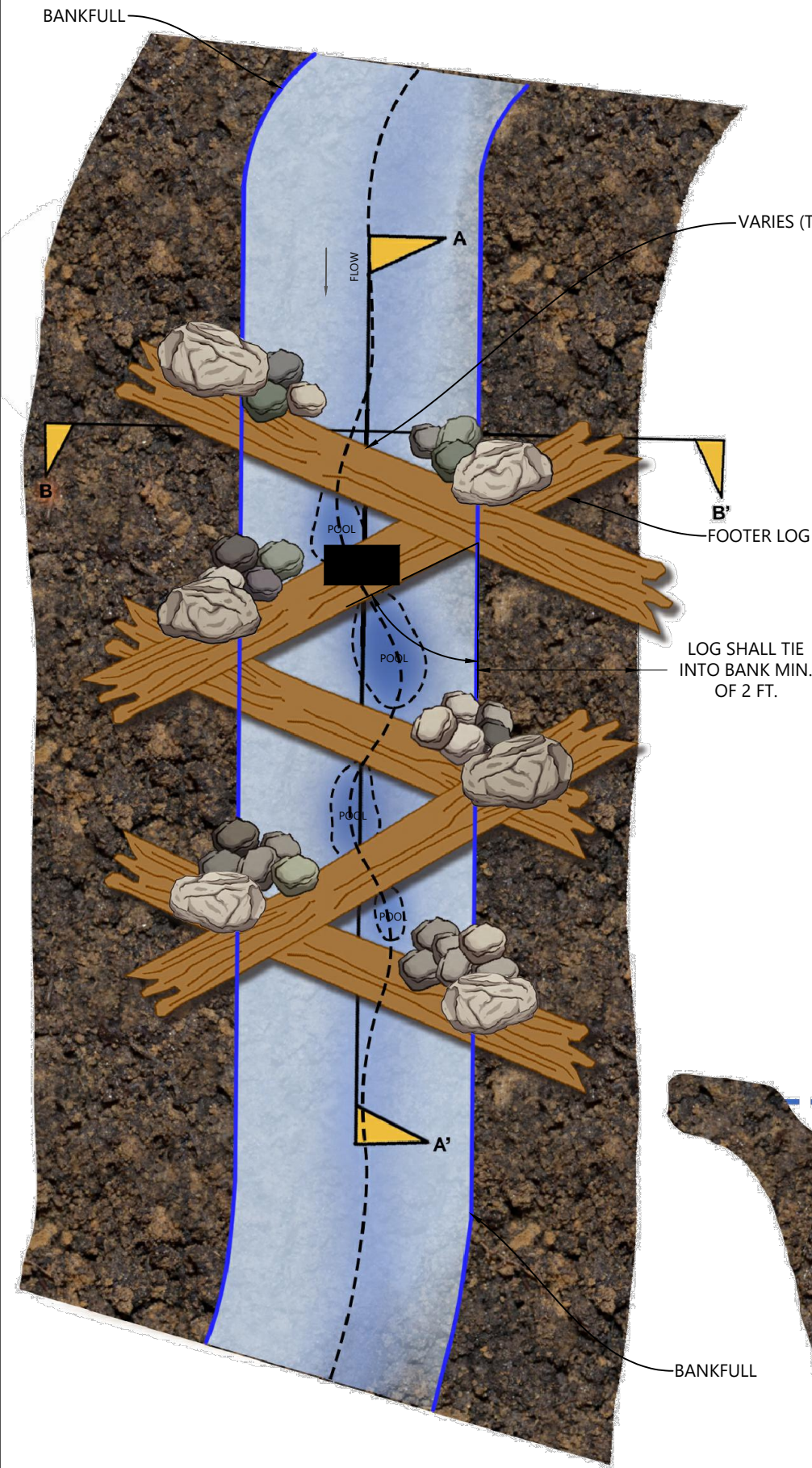
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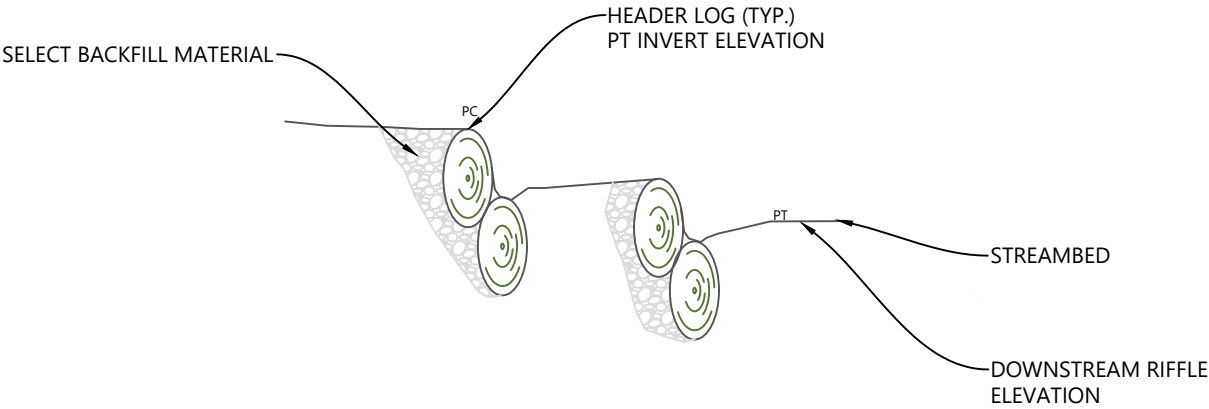
Sheet Name
DETAIL_LOG RIFFLE

2023007041 NTS
Project No. Horizontal Scale

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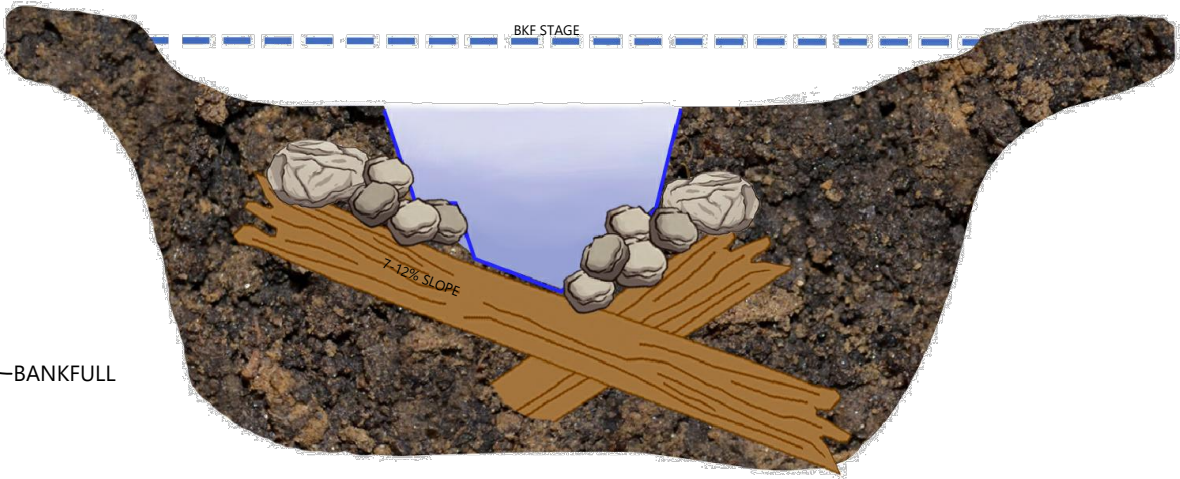


PLAN VIEW



PROFILE A-A'

- NOTES:
- BOULDERS SHALL BE USED TO ANCHOR LOGS UNLESS DIRECTED BY ON-SITE CONSTRUCTION MANAGER.
 - LOGS SHALL OVERLAP AND ANCHOR THE LOG SILL DIRECTLY UPSTREAM.
 - THE LOG SILLS SHALL ALL BE DESIGNED TO BE SUBMERGED OR COVERED AT LOW FLOWS. LOW FLOW DEPTH OF 1.0 FEET.
 - THE MAX DROP FROM ONE LOG TO THE NEXT SHALL NOT EXCEED 0.50 FEET.
 - ALL GAPS SHALL BE CHINKED WITH ON-SITE COBBLE MATERIAL FROM THE UPSTREAM FACE.
 - ALL MATERIALS ARE TO BE APPROVED BY ENGINEER OR ENGINEER'S ONSITE CONSTRUCTION MANAGER.
 - LOG ALIGNMENT AND LOCATION IS BASED ON THE PLAN VIEW DRAWINGS
 - ALL LOGS SHALL ANGLE TOWARDS THE DOWNSTREAM BEND/POOL.
 - LOG LENGTH = 12 FEET.



SECTION B-B'

BEAVER DAM ANALOGUE STRUCTURE

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BEAVER DAM ANALOGUE STRUCTURE EXAMPLE

2023007041	NTS
Project No.	Horizontal Scale



BEAVER DAM STRUCTURE ON DuNOIR RIVER, WY

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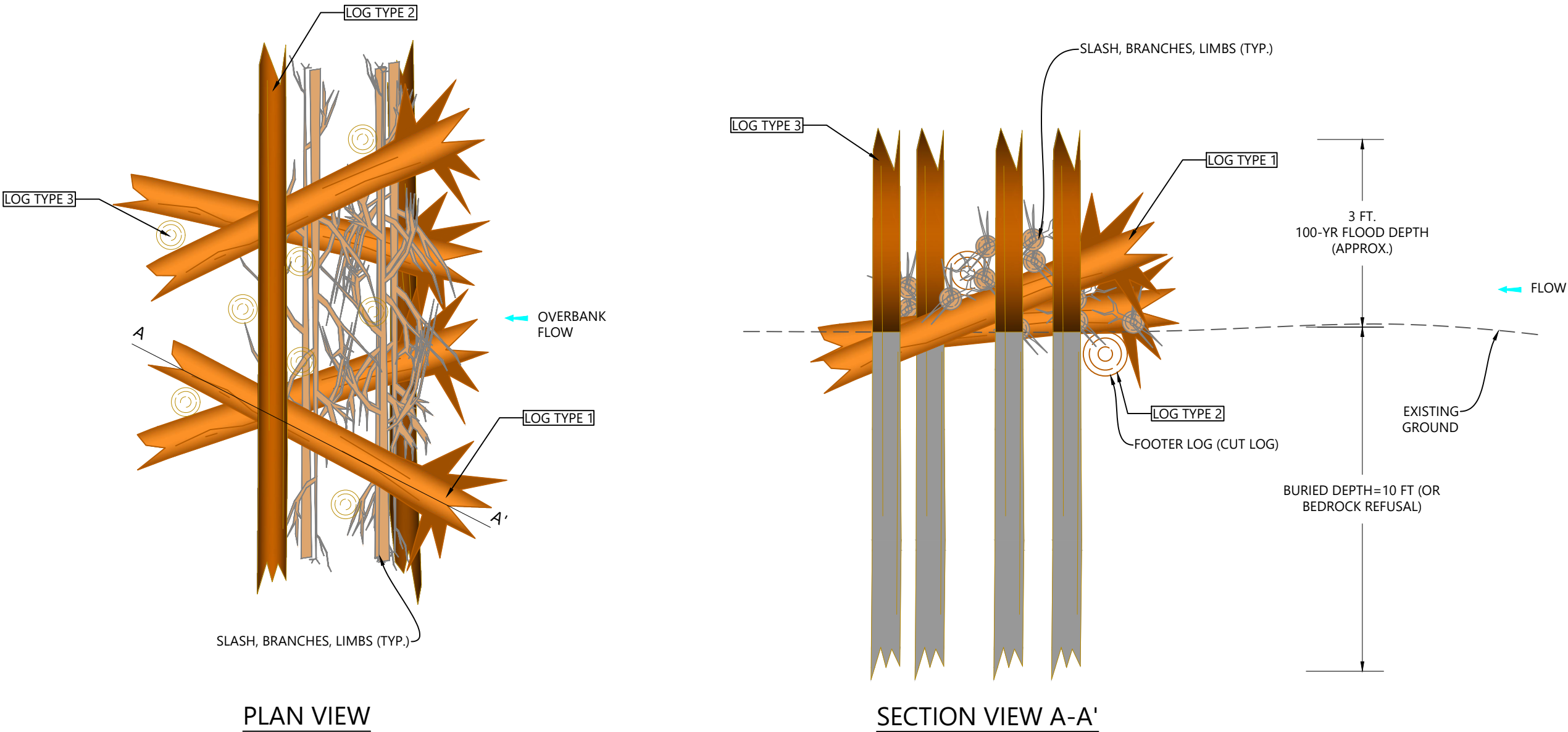
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Sheet Name
DETAIL_BEAVER DAM ANALOGUE STRUCTURE

2023007041 NTS
Project No. Horizontal Scale

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- NOTES:
- ALL KEY LOGS SHALL BE PLACED ON THE FLOODPLAIN SURFACE. NO EXCAVATION OR BURIAL OF LOGS SHALL BE CONDUCTED.
 - PILES SHALL BE DRIVEN OR PUSHED INTO THE GROUND WITHOUT EXCAVATION.
 - ALL EXPOSED LOG ENDS SHALL HAVE BROKEN ENDS RATHER THAN SAW CUT ENDS.
 - FLOODPLAIN WOOD ASSEMBLAGE DETAIL IS TYPICAL AND IS INTENDED TO BE CONFIGURED IN MULTIPLE ORIENTATIONS AS DIRECTED BY THE ENGINEER.
 - 100-YEAR WATER SURFACE DEPTH IS APPROXIMATELY 3 FEET ABOVE FINAL GRADE.
 - PILE LOGS SHALL BE DRIVEN TO A DEPTH OF 10 FEET BELOW FINISHED GRADE (OR BEDROCK REFUSAL).

LARGE WOOD SCHEDULE			
LOG TYPE	LOG TYPE	LOG SIZE	QUANTITY PER STRUCTURE
1	SURFACE	12"-18" DIA. X 20'-30' LONG, WITH ROOTWAD ATTACHED	4
2	SURFACE	12"-18" DIA. X 20'-30' LONG, CUT LOG	2
3	PILE	12"-18" DIA. X 10'-15' LONG, CUT LOG	10

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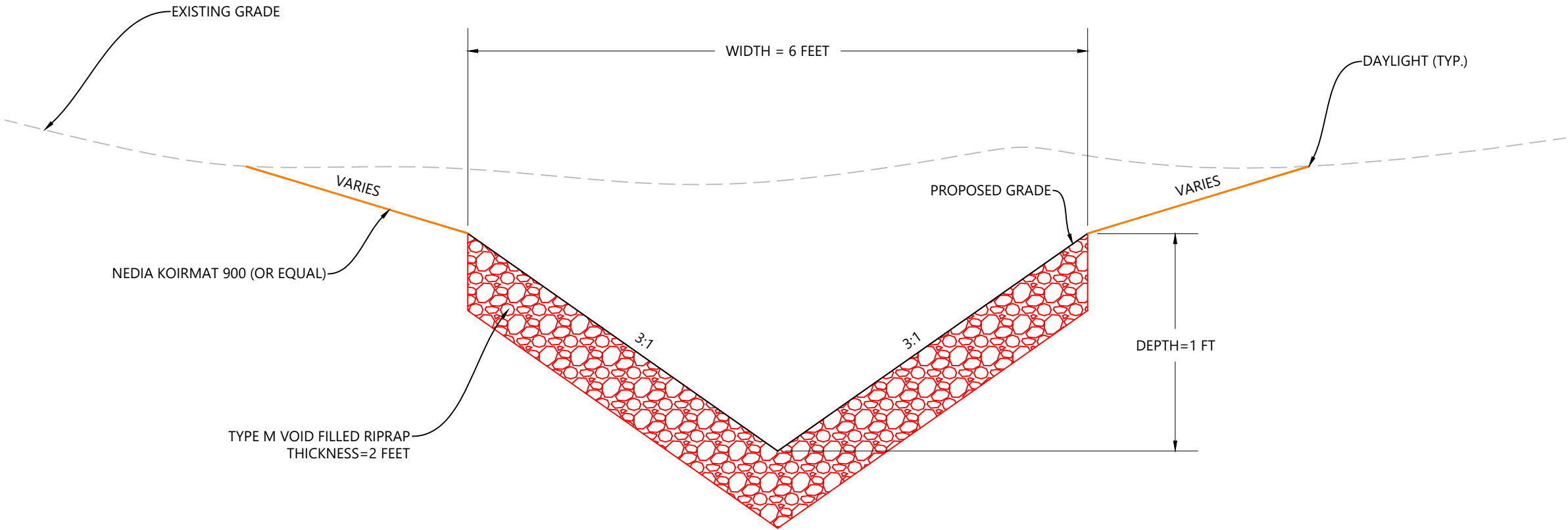
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Sheet Name
DETAIL_ROCK SWALE TYPICAL SECTION

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ROCK SWALE TYPICAL SECTION

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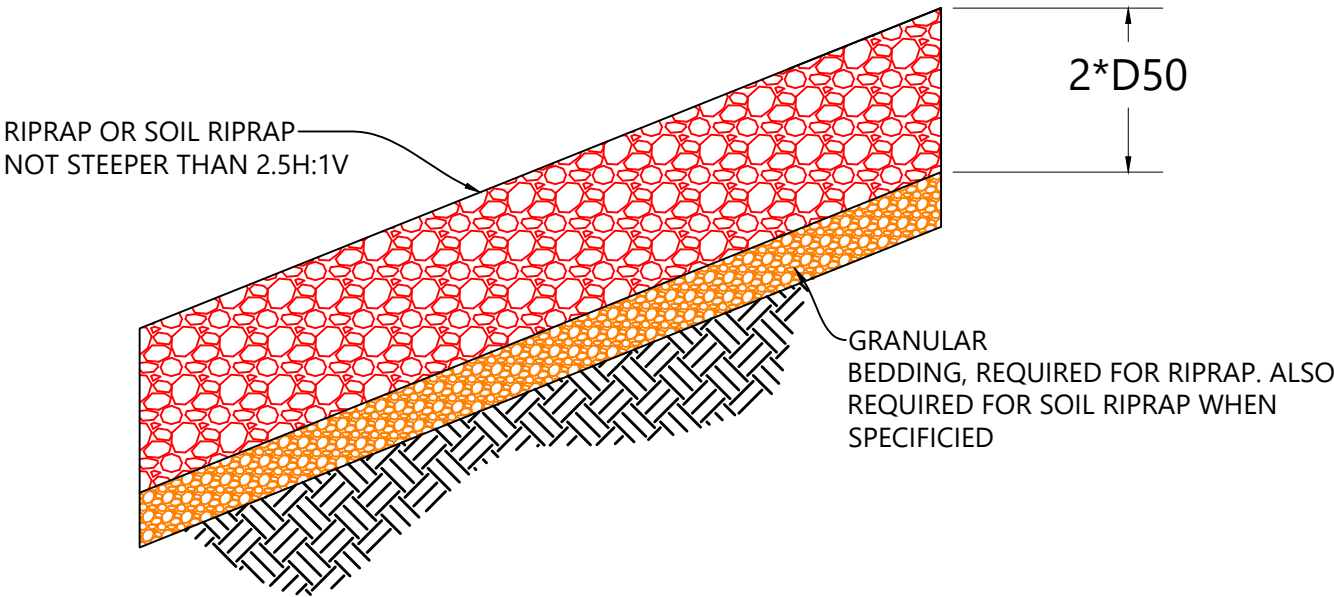
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Sheet Name	DETAIL_VOID FILLED RIPRAP
2023007041	NTS
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NOTES:

1. ELEVATION TOLERANCES FOR THE SOIL RIPRAP SHALL BE 0.10 FEET. THICKNESS OF SOIL RIPRAP SHALL BE NO LESS THAN THICKNESS SHOWN AND NO MORE THAN 2-INCHES GREATER THAN THE THICKNESS SHOWN.
2. WHERE "SOIL RIPRAP" IS DESIGNATED ON THE CONTRACT DRAWINGS, RIPRAP VOIDS ARE TO BE FILLED WITH NATIVE SOIL. THE RIPRAP SHALL BE PRE-MIXED WITH THE NATIVE SOIL AT THE FOLLOWING PROPORTIONS BY VOLUME: 65 PERCENT RIPRAP AND 35 PERCENT SOIL. THE SOIL USED FOR MIXING SHALL BE NATIVE TOPSOIL AND SHALL HAVE A MINIMUM FINES CONTENT OF 15 PERCENT. THE SOIL RIPRAP SHALL BE INSTALLED IN A MANNER THAT RESULTS IN A DENSE, INTERLOCKED LAYER OF RIPRAP WITH RIPRAP VOIDS FILLED COMPLETELY WITH SOIL. SEGREGATION OF MATERIALS SHALL BE AVOIDED AND IN NO CASE SHALL THE COMBINED MATERIAL CONSIST PRIMARILY OF SOIL; THE DENSITY AND INTERLOCKING NATURE OF RIPRAP IN THE MIXED MATERIAL SHALL ESSENTIALLY BE THE SAME AS IF THE RIPRAP WAS PLACED WITHOUT SOIL.
3. WHERE SPECIFIED (TYPICALLY AS "BURIED SOIL RIPRAP"), A SURFACE LAYER OF TOPSOIL SHALL BE PLACED OVER THE SOIL RIPRAP ACCORDING TO THE THICKNESS SPECIFIED ON THE CONTRACT DRAWINGS. THE TOPSOIL SURFACE LAYER SHALL BE COMPACTED TO APPROXIMATELY 85% OF MAXIMUM DENSITY AND WITHIN TWO PERCENTAGE POINTS OF OPTIMUM MOISTURE IN ACCORDANCE WITH ASTM D698. TOPSOIL SHALL BE ADDED TO ANY AREAS THAT SETTLE.
4. ALL SOIL RIPRAP THAT IS BURIED WITH TOPSOIL SHALL BE REVIEWED AND APPROVED BY THE ENGINEER PRIOR TO ANY TOPSOIL PLACEMENT.



RIPRAP DESIGNATION	% SMALLER THAN GIVEN SIZE BY WEIGHT	INTERMEDIATE ROCK DIMENSION (INCHES)	D ₅₀ * (INCHES)
TYPE VL	70 - 100	12	6
	50 - 70	9	
	35 - 50	6	
	2 - 10	2	
TYPE L	70 - 100	15	9
	50 - 70	12	
	35 - 50	9	
	2 - 10	3	
TYPE M	70 - 100	21	12
	50 - 70	18	
	35 - 50	12	
	2 - 10	4	
TYPE H	70 - 100	30	18
	50 - 70	24	
	35 - 50	18	
	2 - 10	6	
*D ₅₀ = MEAN ROCK SIZE			

RIPRAP AND SOIL RIPRAP PLACEMENT AND GRADATION

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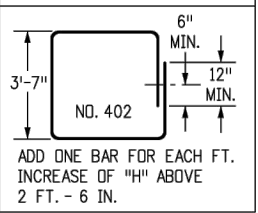
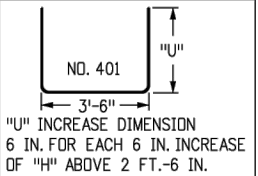
QUANTITIES FOR ONE INLET

H	CONCRETE (CU. YDS.)	STEEL (LBS.)	NO. STEPS REQ'D.
2'-6"	1.0	76	0
3'-0"	1.1	81	0
3'-6"	1.2	97	0
4'-0"	1.3	102	1
4'-6"	1.5	117	2
5'-0"	1.6	123	2
5'-6"	1.7	138	2
6'-0"	1.9	143	3
6'-6"	2.0	159	3
7'-0"	2.1	164	3
7'-6"	2.2	180	4
8'-0"	2.4	185	4
8'-6"	2.5	200	4
9'-0"	2.6	206	5
9'-6"	2.8	221	5
10'-0"	2.9	236	6
11'-6"	3.3	252	6

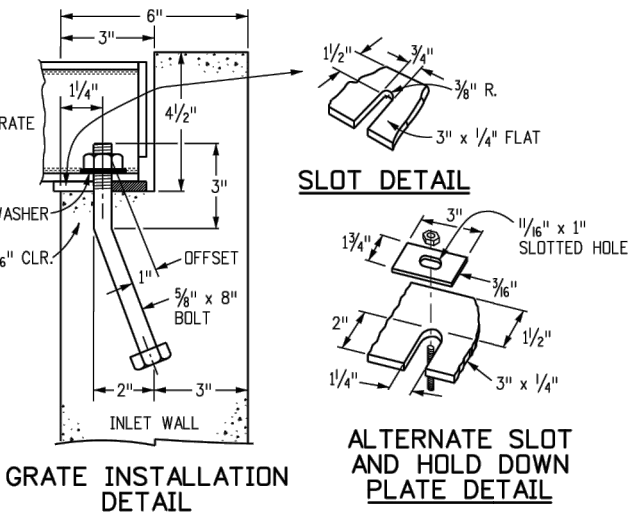
PIPE INSIDE DIAMETER SHALL BE 30 IN. OR LESS. CONCRETE AND STEEL QUANTITIES ARE FOR ONE ENTIRE INLET BEFORE DEDUCTION FOR VOLUME OCCUPIED BY PIPE. WEIGHT OF STEEL INCLUDES A RING FOR THE MAXIMUM PIPE DIAMETER.

BAR LIST FOR H = 2 FT.-6 IN. AND BENDING DIAGRAM

MARK	NO. REQ'D.	HEIGHT	LENGTH
401	2	2'-2 1/2"	8'-0"
401	6	2'-7"	8'-8"
402	4	"U"	15'-4"

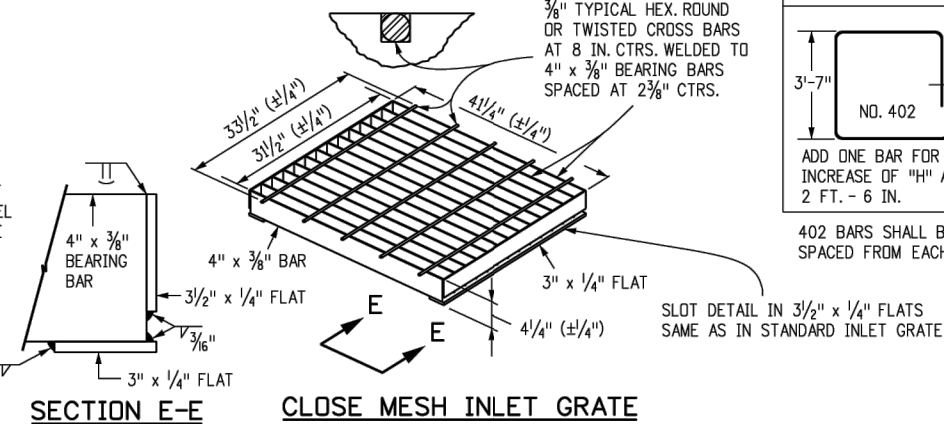


402 BARS SHALL BE EQUALLY SPACED FROM EACH OTHER.



GENERAL NOTES

- INLET TYPE C IS NOT HS-20 RATED AND SHALL NOT BE PLACED IN PAVED ROADWAYS. THIS INLET SHALL BE USED ONLY OUTSIDE PAVED ROADWAYS.
- CONCRETE SHALL BE CLASS B. INLET MAY BE CAST-IN-PLACE OR PRECAST.
- REINFORCING BARS SHALL BE GRADE 60, EPOXY COATED, AND DEFORMED #4, AND SHALL HAVE A MIN. 2 INCH CLEARANCE. CUT OR BEND AROUND PIPES AS REQUIRED.
- CONCRETE SLOPE AND DITCH PAVING SHALL BE IN ACCORDANCE WITH SECTION 507. REINFORCEMENT FOR CONCRETE SLOPE PAVING SHALL BE 6 X 6 - W1.4 X W1.4 OR 6 X 6 - W2.1 X W2.1.
- STRUCTURAL STEEL FOR GRATES AND GRATE INSTALLATION HARDWARE SHALL BE GALVANIZED, AND SHALL BE IN ACCORDANCE WITH SUBSECTION 712.06.
- THE STANDARD INLET GRATES SHALL BE USED ON ALL TYPE C INLETS UNLESS CLOSE MESH INLET GRATES ARE SPECIFIED ON THE PLANS.
- CLOSE MESH GRATES ARE RECOMMENDED WHERE FOOT TRAFFIC OR BICYCLE ROUTES ARE IN CLOSE PROXIMITY TO GRATE. THIS GRATE IS NOT ADA COMPLIANT OR BICYCLE FRIENDLY AND SHALL NOT BE PLACED DIRECTLY IN SIDEWALKS, CROSSWALKS OR BIKE PATHS.
- STEPS SHALL BE PROVIDED WHEN INLET DIMENSION "H" IS EQUAL TO OR GREATER THAN 3 FEET - 6 INCHES AND SHALL CONFORM TO AASHTO M 199.
- SEE STANDARD PLAN M-604-11, FOR REINFORCEMENT AROUND THE PIPE OPENING.
- ALL INLETS SHALL HAVE A 4 INCH DIA. METAL MEDALLION WITH A "NO DUMPING DRAINS TO STREAM" MESSAGE ON IT. THE MEDALLION SHALL HAVE A FISH SYMBOL WITH A BLUE BACKGROUND. IT SHALL BE FIRMLY ATTACHED TO THE TOP OF THE INLET WITH A PERMANENT FASTENER.

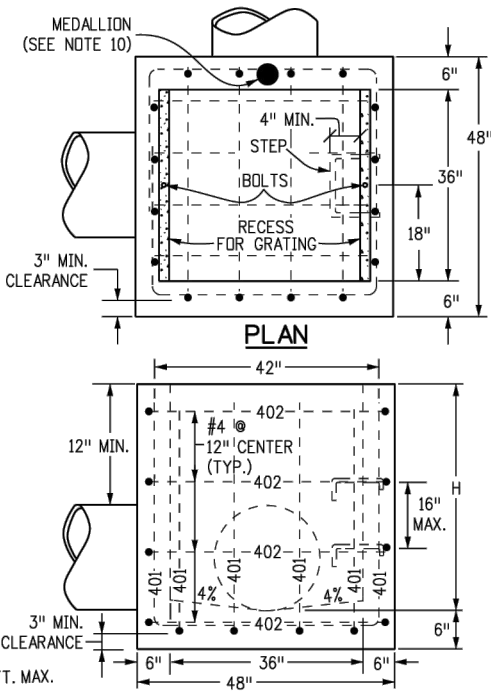


SECTION E-E

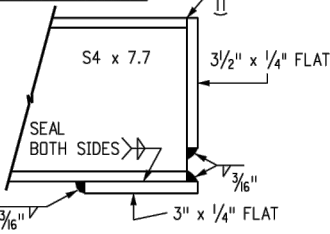
CLOSE MESH INLET GRATE

STEEL GRATE QUANTITIES

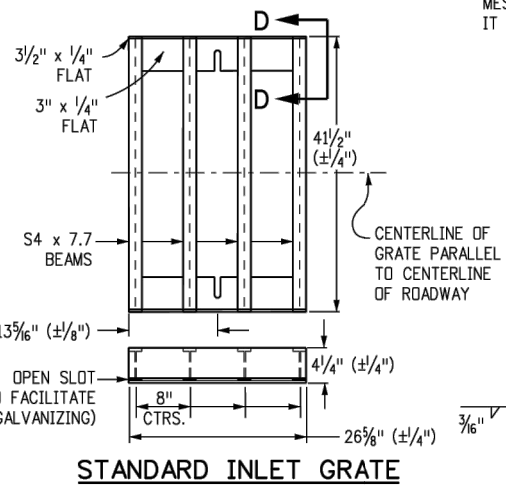
NO. PIECES	DESCRIPTION	LENGTH	LBS PER FT.	WEIGHT (LBS.)
4	S4 x 7.7 BEAM	41"	7.90	106
2	3 1/2" x 1/4" FLAT	26 5/8"	2.98	13
2	3" x 1/4" FLAT	26 5/8"	2.55	12
TOTAL LBS. - 131				



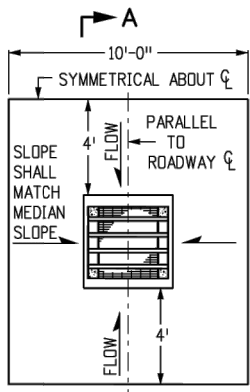
ELEVATION CONCRETE INLET



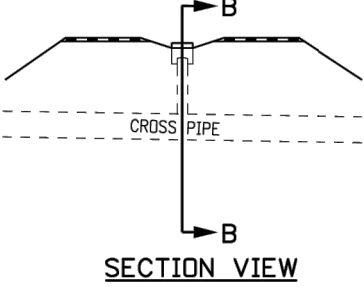
SECTION D-D



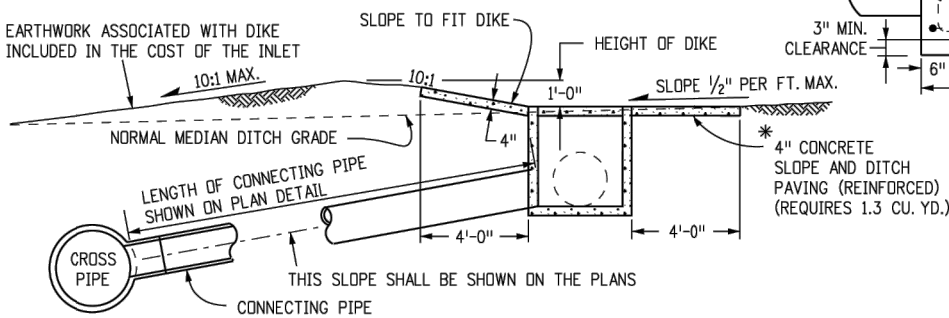
STANDARD INLET GRATE



INLET WITH DITCH PAVING

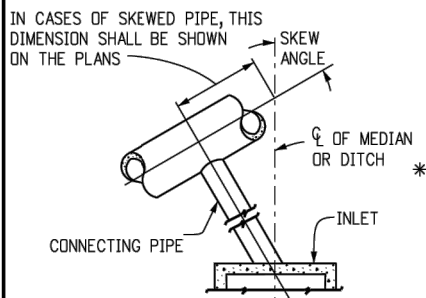


SECTION VIEW

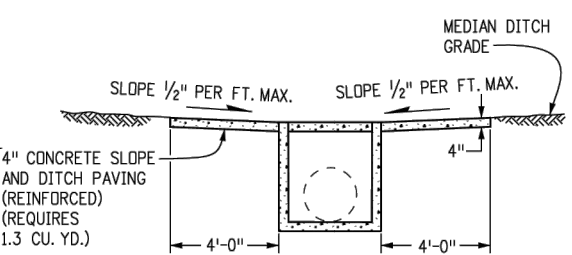


SECTION A-A

INLET ON GRADE (FLOW FROM ONE DIRECTION)



INLET CONNECTED TO A SKEWED CROSS PIPE



SECTION A-A

INLET AT BOTTOM OF VERTICAL CURVE (FLOW FROM TWO DIRECTIONS)

Computer File Information				Sheet Revisions	
Creation Date: 07/31/19				Date:	Comments
Designer Initials: JBK	(R-X)				
Last Modification Date: 07/31/19	(R-X)				
Detailer Initials: LTA	(R-X)				
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)				

Colorado Department of Transportation
2829 West Howard Place
CDDT HQ, 3rd Floor
Denver, CO 80204
Phone: 303-757-9021 FAX: 303-757-9868
Project Development Branch JBK

INLET, TYPE C

Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO. M-604-10
Standard Sheet No. 1 of 1

Project Sheet Number:



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TOWN OF GRAND LAKE
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Project Milestone

Sheet Name

DETAIL_CDOT TYPE C INLET

2023007041 NTS

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TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

Project Milestone

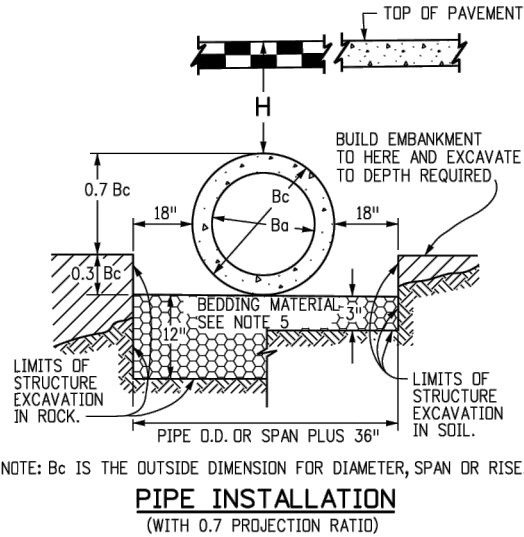
Sheet Name
DETAIL_CDOT_RCP

2023007041 NTS
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- GENERAL NOTES
- REINFORCED CONCRETE PIPE
- FILL HEIGHTS GREATER THAN MAXIMUM ALLOWED IN THE HEIGHTS OF FILL TABLE ON THIS SHEET REQUIRE SPECIAL DESIGN OF STRUCTURE.
 - PIPE DESIGN IS BASED ON SAFETY FACTOR OF 1.33 ON ULTIMATE STRENGTH.
 - THE HEIGHTS OF FILL OVER TOP OF PIPE ARE BASED ON UNIT WEIGHT OF SOIL AT 135 LBS. PER CUBIC FT.
 - PIPE CLASS IS DETERMINED FROM 0.01 IN. CRACK D-LOAD.
 - BEDDING IS CLASS B (MODIFIED) (FROM CONCRETE PIPE DESIGN MANUAL-AMERICAN CONCRETE PIPE ASSOCIATION) WITH SETTLEMENT RATIO $R = 0.0_{sd}$ (YIELDING BED). BEDDING MATERIAL FOR RIGID PIPE IN SOIL SHALL BE 3 IN. LOOSE THICKNESS STRUCTURE BACKFILL CLASS 2. BEDDING MATERIAL FOR RIGID PIPE IN ROCK SHALL BE 12 IN. LOOSE THICKNESS STRUCTURE BACKFILL CLASS 1.
 - CHANGES IN DESIGN FACTORS REQUIRE COMPENSATING CHANGES IN PIPE DESIGN.
 - MINIMUM WALL THICKNESS DIMENSIONS ARE BASED ON AASHTO M 170 (WALL B) FOR CIRCULAR PIPE, AND AASHTO M 207 FOR ELLIPTICAL PIPE.
 - SPACING FOR MULTIPLE PIPE INSTALLATIONS SHALL CONFORM TO THE DETAILS SHOWN ON STANDARD PLAN M-206-1.
 - WHEN A PIPE IS TO BE EXTENDED, THE SAME PIPE MATERIAL AND SIZE AS IN THE ORIGINAL PIPE INSTALLATION SHALL BE USED.

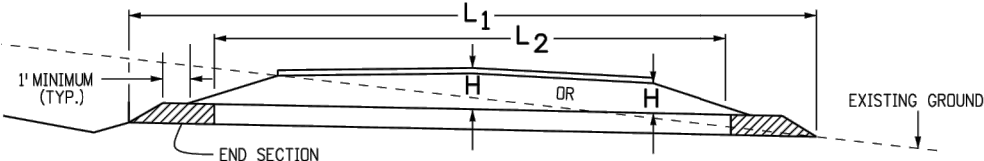
- NONREINFORCED CONCRETE PIPE
- AT THE OPTION OF THE CONTRACTOR, NONREINFORCED CONCRETE PIPE CONFORMING TO AASHTO M 86 MAY BE USED IN LIEU OF REINFORCED CONCRETE PIPE FOR ALL SIZES 36 INCHES IN DIAMETER AND SMALLER. THE NONREINFORCED CONCRETE PIPE SHALL MEET THE SAME D-LOAD TO PRODUCE THE ULTIMATE LOAD UNDER THE THREE-EDGE BEARING METHOD AS SPECIFIED FOR REINFORCED CONCRETE PIPE IN CONFORMANCE WITH AASHTO M 170. THE CONTRACTOR SHALL PROVIDE WRITTEN CERTIFICATION OF CONFORMANCE. THE WALL THICKNESS OF THE NONREINFORCED PIPE MAY BE INCREASED AS REQUIRED TO MEET D-LOAD REQUIREMENT.
 - ALL REQUIREMENTS FOR REINFORCED CONCRETE PIPE, EXCEPT THOSE REFERRING TO REINFORCEMENT, SHALL APPLY TO NONREINFORCED CONCRETE PIPE.



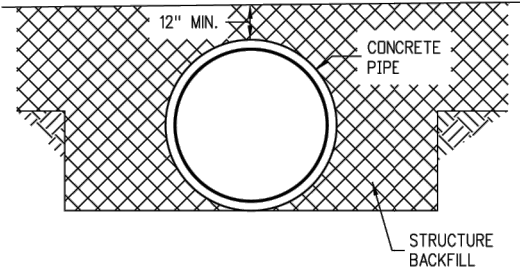
CIRCULAR (CIR)			VERTICAL ELLIPTICAL (VE)				HORIZONTAL ELLIPTICAL (HE)			
PIPE SIZE = Ba (INSIDE DIA)	WALL THICKNESS	0.3 Bc (OUTSIDE DIA)	SPAN	RISE	WALL THICKNESS	0.3 OUTSIDE RISE	SPAN	RISE	WALL THICKNESS	0.3 OUTSIDE RISE
IN.		FT.	IN.			FT.	IN.			FT.
12	2	0.40								
15	2-1/4	0.49								
18	2-1/2	0.58					23	14	2-3/4	0.49
21	2-3/4	0.66								
24	3	0.75					30	19	3-1/4	0.66
27	3-1/4	0.84					34	22	3-1/2	0.73
30	3-1/2	0.92					38	24	3-3/4	0.79
33	3-3/4	1.01								
36	4	1.10	29	45	4-1/2	1.35	45	29	4-1/2	0.95
42	4-1/2	1.28	34	53	5	1.58	53	34	5	1.10
48	5	1.45	38	60	5-1/2	1.78	60	38	5-1/2	1.23
54	5-1/2	1.62	43	68	6	2.00	68	43	6	1.38
60	6	1.80	48	76	6-1/2	2.23	76	48	6-1/2	1.53
66	6-1/2	1.97	53	83	7	2.43	83	53	7	1.68
72	7	2.15	58	91	7-1/2	2.65	91	58	7-1/2	1.83
78	7-1/2	2.32	63	98	8	2.85	98	63	8	1.98
84	8	2.50	68	106	8-1/2	3.08	106	68	8-1/2	2.13
90	8-1/2	2.68	72	113	9	3.28	113	72	9	2.25
96	9	2.85	77	121	9-1/2	3.50	121	77	9-1/2	2.40
102	9-1/2	3.02	82	128	9-3/4	3.69	128	82	9-3/4	2.54
108	10	3.20	87	136	10	3.90	136	87	10	2.68

△ ALSO EQUIVALENT ROUND DIMENSION FOR ELLIPTICAL PIPE.

DIMENSIONS FOR REINFORCED CONCRETE PIPE
(FOR INFORMATION ONLY)



- NOTE: USE THE H THAT IS GREATER FOR MAXIMUM ALLOWABLE FILL HEIGHT.
- H = HEIGHT OF FILL OVER TOP OF PIPE, INCLUDING PAVEMENT THICKNESS.
- L_1 = LENGTH OF PIPE TO BE MEASURED WHEN PLACED IN ACCORDANCE WITH SECTION 624.
- L_2 = LENGTH OF PIPE TO BE MEASURED WHEN PLACED IN ACCORDANCE WITH SECTION 603.



CONSTRUCTION
MINIMUM COVER FOR RIGID PIPE

TYPE OF PIPE	HEIGHT OF FILL OVER TOP OF PIPE, H (FEET)					
	CLASS OF PIPE (0.01 IN. CRACK D-LOAD)					
	CLASS CIR II CLASS VE II CLASS HE II	CLASS CIR III CLASS VE III CLASS HE III	CLASS CIR IV CLASS VE IV CLASS HE IV	CLASS CIR V CLASS VE V	CLASS VE VI	
	1000 D	1350 D	2000 D	3000 D	4000 D	
CIRCULAR (CIR)	1 TO 18	1 TO 25	± 25 TO 37	± 37 TO 45		
VERTICAL ELLIPTICAL (VE)	1 TO 18	1 TO 25	± 25 TO 37	± 37 TO 45	± 45 TO 62	
HORIZONTAL ELLIPTICAL (HE)	1 TO 18	1 TO 25	± 25 TO 37			

ALLOWABLE RANGE OF HEIGHTS FOR FILL
OVER REINFORCED CONCRETE PIPE
(ALL SIZES)

Computer File Information		Sheet Revisions		<div>Colorado Department of Transportation</div> <div> 2829 West Howard Place CDOT HQ, 3rd Floor Denver, CO 80204 Phone: 303-757-9021 FAX: 303-757-9868</div> <div>Project Development Branch JBK</div>	REINFORCED CONCRETE PIPE		STANDARD PLAN NO.	
Creation Date: 07/31/19		Date:	Comments		M-603-2			
Designer Initials: JBK	(R-X)							
Last Modification Date: 07/31/19	(R-X)							
Detailer Initials: LTA	(R-X)							
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English		(R-X)		Issued by the Project Development Branch: July 31, 2019		Project Sheet Number:		

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Sub-Consultants

Horizontal Scale & Orientation

Legend

Revision	By	Appd.	YY.MM.DD
Issued	By	Appd.	YY.MM.DD
File Name:	----	----	24.09.12
	Dwn.	Chkd.	Dsgn.



Client/Project
TOWN OF GRAND LAKE
STORMWATER MANAGEMENT PLAN

GRAND LAKE, CO

Project Milestone

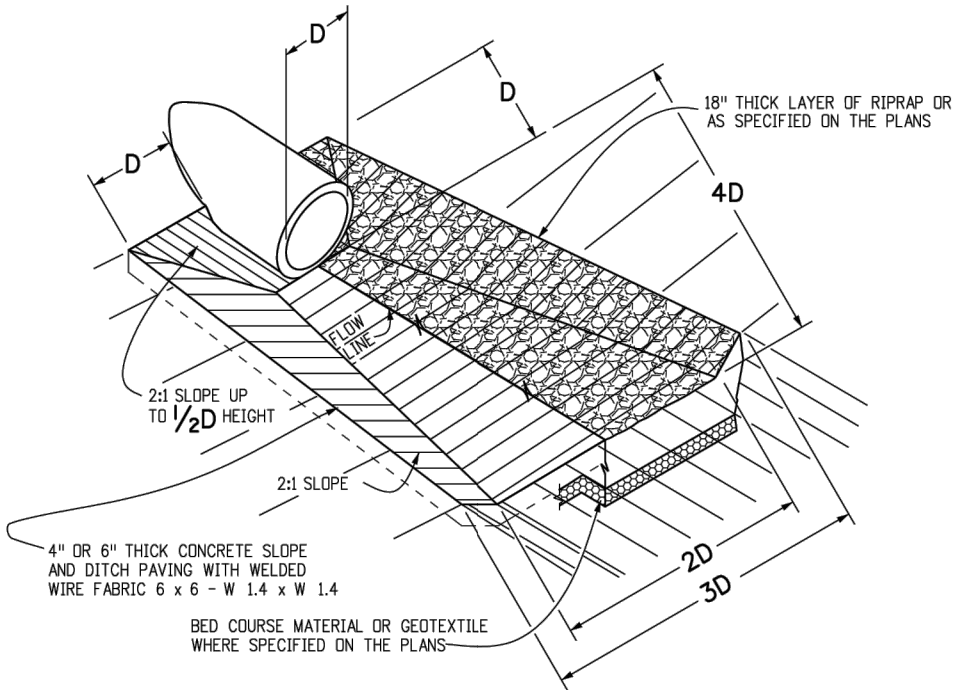
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DETAIL_CDOT END SECTION

2023007041 NTS
Project No. Horizontal Scale

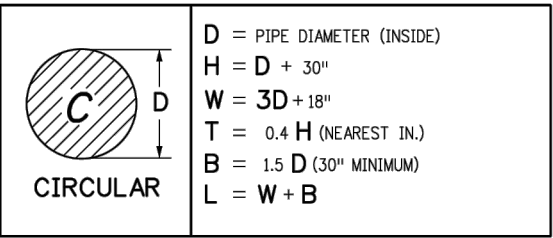
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GENERAL NOTES

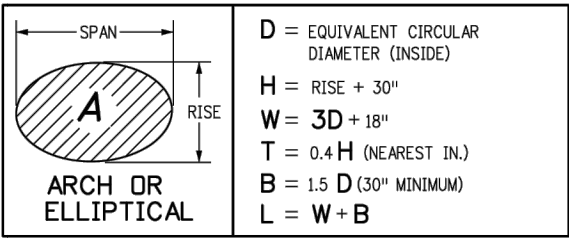
- FOR SIZE AND LOCATION OF PIPES, SEE THE PLANS.
- ALL CONCRETE SHALL BE CLASS B.
- FOOTINGS IN ROCK SHALL BE POURED OUT TO ROCK AND NOT FORMED IN ACCORDANCE WITH SUBSECTION 601.09(b).
- EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED $\frac{3}{4}$ IN.
- HEADWALL SHALL HAVE REINFORCING STEEL INSTALLED IN A PATTERN SIMILAR TO STANDARD PLAN M-601-10.
- THE COST OF REINFORCING STEEL SHALL BE INCLUDED IN THE WORK UNLESS THE STEEL QUANTITIES ARE LISTED IN THE PLANS AND ARE PAID FOR SEPARATELY.



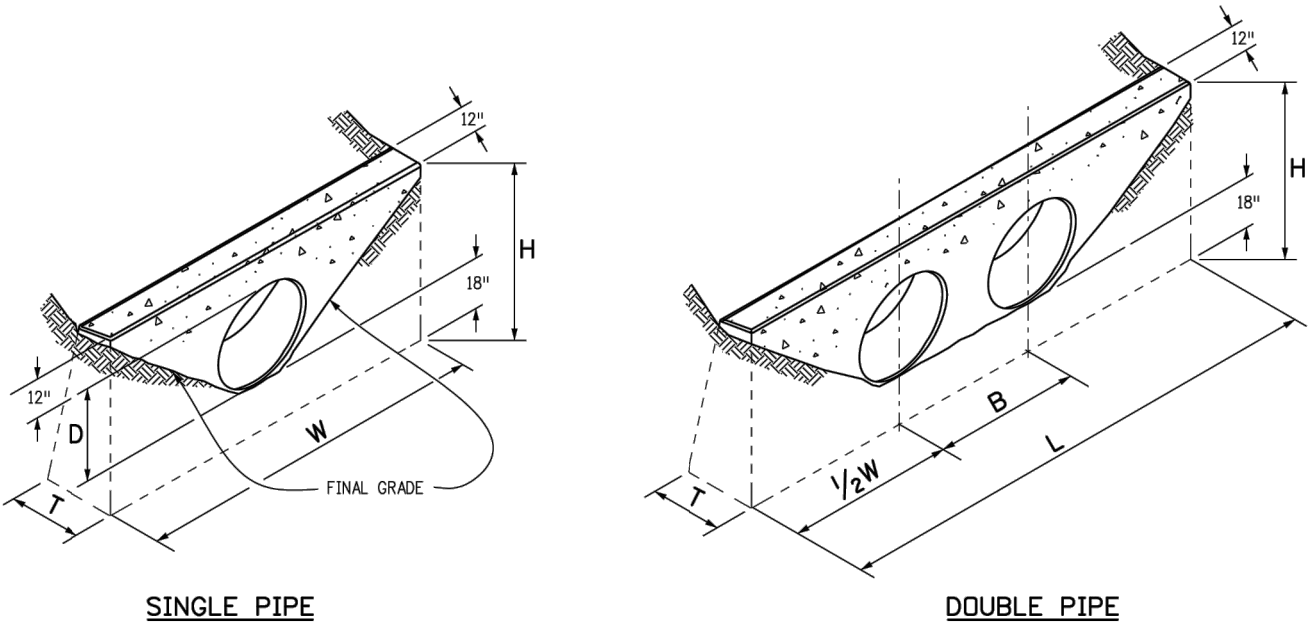
PIPE OUTLET PAVING
MAY BE USED WITH MULTIPLE PIPES.



TYPE OF PIPE HEADWALL DIMENSIONS



TYPE OF PIPE HEADWALL DIMENSIONS



SINGLE PIPE

DOUBLE PIPE

CONCRETE HEADWALL INSTALLATIONS
SEE STANDARD PLAN M-601-10 FOR REINFORCING DETAILS.

PIPE		PIPE DIAMETER (AND EQUIVALENT DIAMETER) (IN.)											
		18		24		30		36		42		48	
TYPE	MATERIAL	SINGLE	DOUBLE	SINGLE	DOUBLE	SINGLE	DOUBLE	SINGLE	DOUBLE	SINGLE	DOUBLE	SINGLE	DOUBLE
CIRCULAR	RIGID	1.0	1.3	1.5	2.0	2.0	2.7	2.8	3.6	3.6	4.6	4.6	6.0
	FLEXIBLE	1.1	1.4	1.6	2.1	2.2	3.0	3.0	4.0	3.9	5.3	5.0	6.8
ELLIPTICAL	RIGID	23 x 14		30 x 19		38 x 24		45 x 29		53 x 34		60 x 38	
		0.9	1.2	1.3	1.6	1.7	2.2	2.3	2.9	2.9	3.7	3.5	4.4
ARCH	METAL	22 x 13		29 x 18		36 x 22		43 x 27		50 x 31		58 x 36	
		0.9	1.3	1.4	1.9	1.8	2.4	2.4	3.4	3.2	4.4	3.4	5.0

CONCRETE QUANTITIES FOR ONE CONCRETE HEADWALL (CUBIC YARDS)

THICKNESS	MATERIAL	PIPE DIAMETER (IN.)					
		18	24	30	36	42	48
4"	CONCRETE	0.4	0.8	1.2			
6"	CONCRETE				2.6	3.6	4.7
18"	RIPRAP	2.0	3.5	5.4	7.8	10.7	13.9

PIPE OUTLET PAVING (CUBIC YARDS)
NOTE: VOLUME OCCUPIED BY PIPE HAS BEEN DEDUCTED.

Computer File Information		Sheet Revisions		Colorado Department of Transportation 2829 West Howard Place CDOT HQ, 3rd Floor Denver, CO 80204 Phone: 303-757-9021 FAX: 303-757-9868 Project Development Branch JBK	HEADWALLS AND PIPE OUTLET PAVING Issued by the Project Development Branch: July 31, 2019	STANDARD PLAN NO. M-601-12 Standard Sheet No. 1 of 1 Project Sheet Number:	
Creation Date: 07/31/19		Date:	Comments				
Designer Initials: JBK	(R-X)						
Last Modification Date: 07/31/19	(R-X)						
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