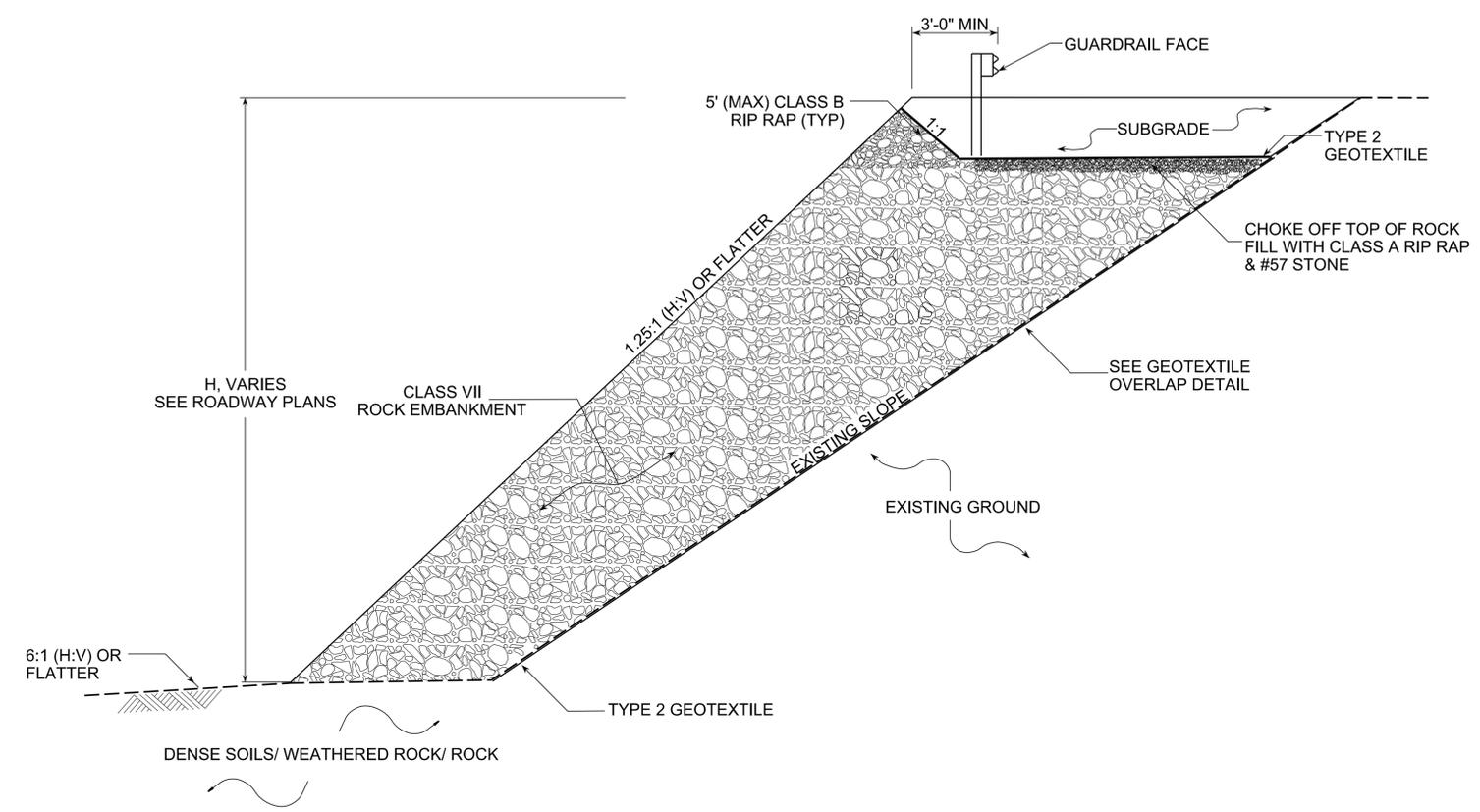




GEOTECHNICAL ENGINEER   Signed by: <i>Robert E. Kral</i> DATE: 12/3/2025	ENGINEER    SIGNATURE: _____ DATE: _____
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	



**PARTIALLY GROUTED ROCK EMBANKMENT DETAIL**  
 -L944- STA. 12+00.00 TO 14+25.00, RT  
 -L944- STA. 18+00.00 TO 18+50.00, RT

- NOTES:**
1. THE MAXIMUM ALLOWABLE HEIGHT FOR THE ROCK EMBANKMENT DETAIL IS 80'.
  2. FOR ROCK EMBANKMENT, BENCH EXISTING SLOPE IN ACCORDANCE WITH SECTION 235 OF THE STANDARD SPECIFICATIONS, WHERE POSSIBLE.
  3. FOR PARTIALLY GROUTED ROCK EMBANKMENTS, SEE PARTIALLY GROUTED ROCK FILL AND ROCK EMBANKMENTS SPECIAL PROVISION AND ROCK FILL DETAILS ON SHEETS W-4 AND W-5.

PROJECT NO.: W03293  
 POLK COUNTY  
 STATION: -L944- STA. 12+00.00 TO 18+50.00, RT  
 SHEET 2 OF 5

PREPARED BY: KND	DATE: 10/25
REVIEWED BY: REK	DATE: 10/25

Prepared in the Office of:



**CAROLINAS  
GEOTECHNICAL  
GROUP**  
 1805 SARDIS ROAD NORTH  
 SUITE 100  
 CHARLOTTE, NC 28270  
 (980) 339-8684

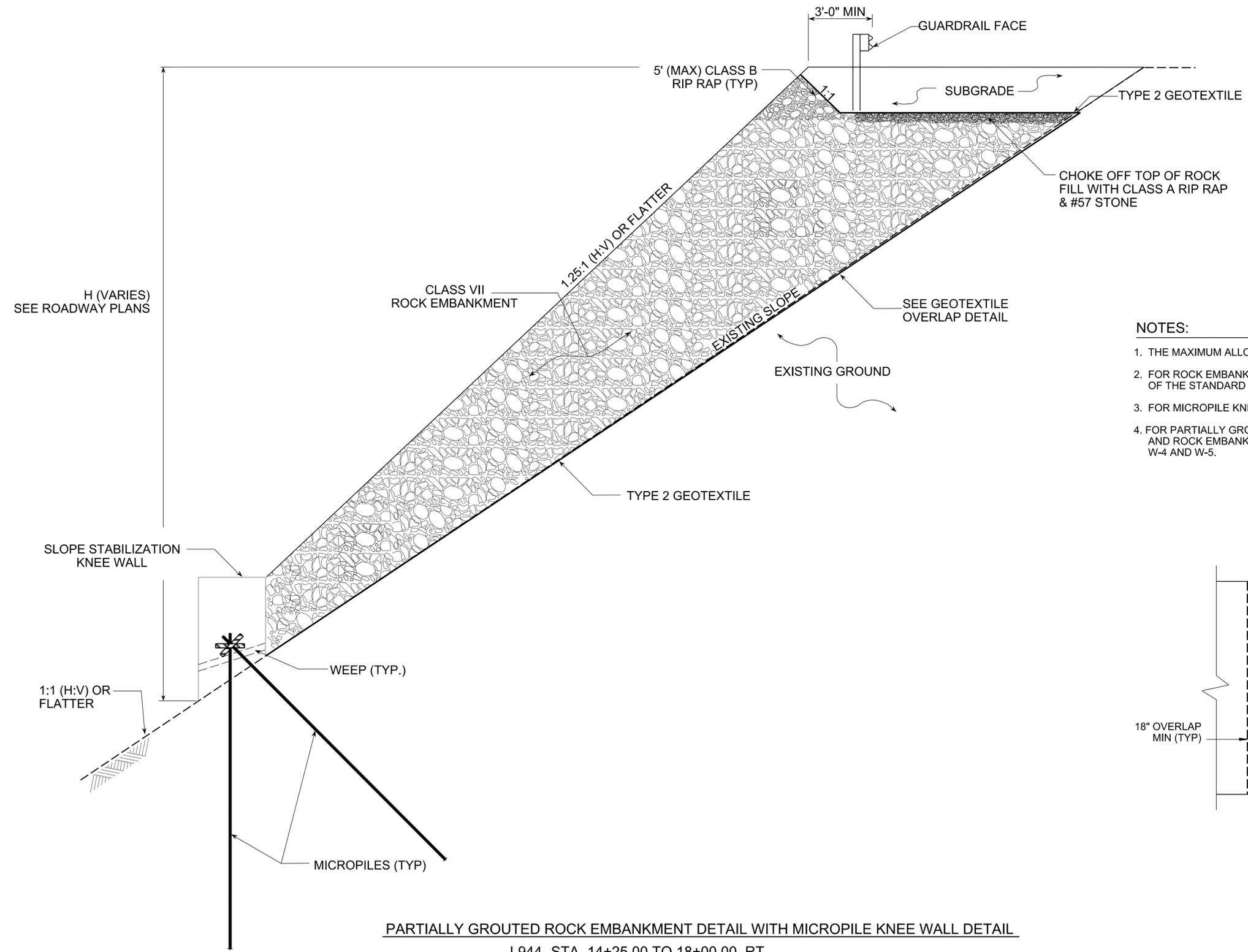


NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
  
**GEOTECHNICAL  
ENGINEERING UNIT**

REVISIONS					
NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

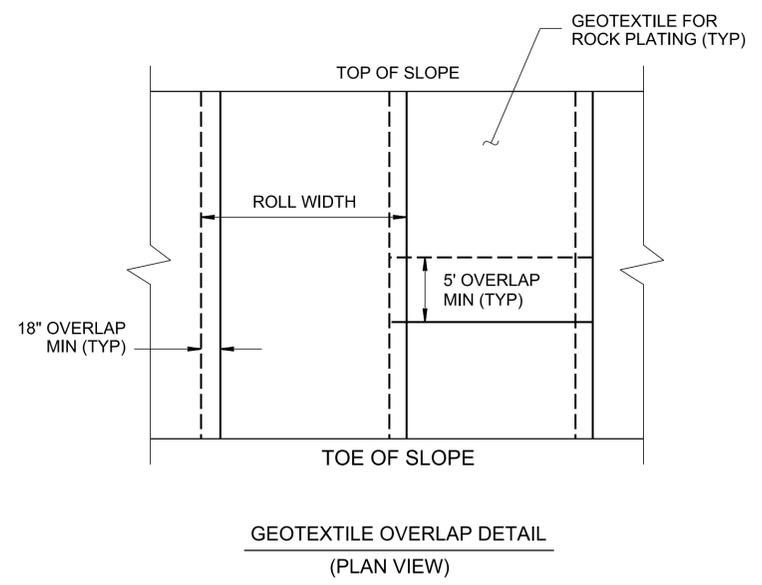
SHEET NO. W-2

GEOTECHNICAL ENGINEER  Robert E. Kral 12/3/2025 DATE	ENGINEER    SIGNATURE DATE
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	



**NOTES:**

1. THE MAXIMUM ALLOWABLE HEIGHT FOR THE ROCK EMBANKMENT DETAIL IS 80'.
2. FOR ROCK EMBANKMENT, BENCH EXISTING SLOPE IN ACCORDANCE WITH SECTION 235 OF THE STANDARD SPECIFICATIONS, WHERE POSSIBLE.
3. FOR MICROPILE KNEE WALL, SEE THE MICROPILE GRADE BEAM SPECIAL PROVISION.
4. FOR PARTIALLY GROUTED ROCK EMBANKMENTS, SEE PARTIALLY GROUTED ROCK FILL AND ROCK EMBANKMENTS SPECIAL PROVISION AND ROCK FILL DETAILS ON SHEETS W-4 AND W-5.



**PARTIALLY GROUTED ROCK EMBANKMENT DETAIL WITH MICROPILE KNEE WALL DETAIL**  
 -L944- STA. 14+25.00 TO 18+00.00, RT

PROJECT NO.: W03293  
 POLK COUNTY  
 STATION: -L944- STA. 12+00.00 TO 18+50.00, RT  
 SHEET 3 OF 5

PREPARED BY: KND	DATE: 10/25
REVIEWED BY: REK	DATE: 10/25

Prepared in the Office of:



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GEOTECHNICAL  
GROUP**  
 1805 SARDIS ROAD NORTH  
 SUITE 100  
 CHARLOTTE, NC 28270  
 (980) 339-8684

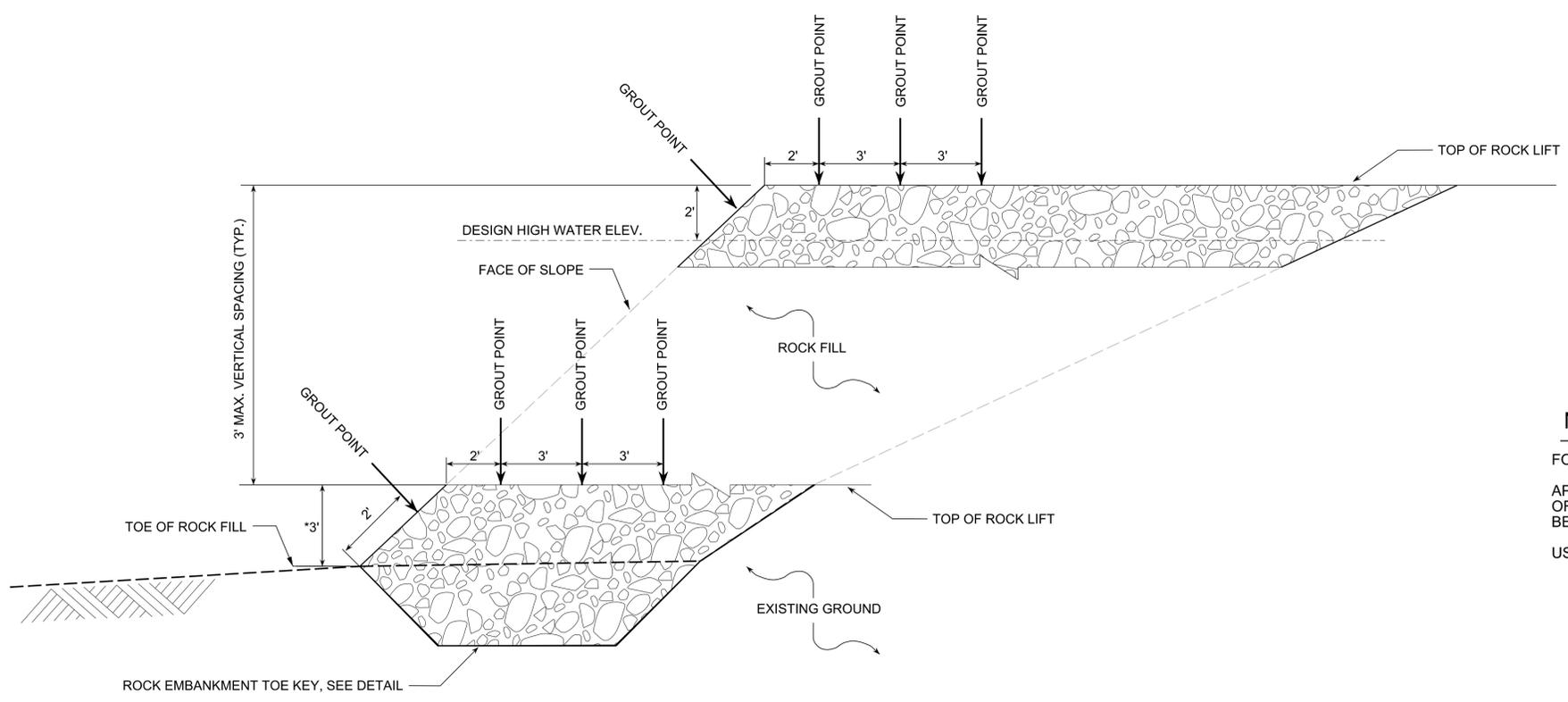


NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
  
**GEOTECHNICAL  
ENGINEERING UNIT**

REVISIONS						SHEET NO. W-3
NO.	BY	DATE	NO.	BY	DATE	
1			3			
2			4			

**SITE 944 RETAINING WALL  
 ROCK EMBANKMENT &  
 ROCK EMBANKMENT WITH  
 MICROPILE KNEE WALL**

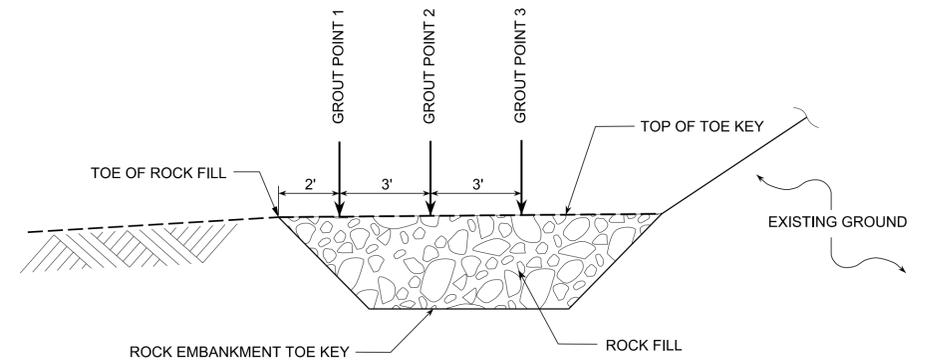
GEOTECHNICAL ENGINEER  SEAL 042642 ROBERT E. KRAL	ENGINEER  _____ SIGNATURE DATE
Signed by: <i>Robert E. Kral</i> 12/3/2025 _____ SIGNATURE DATE	
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	



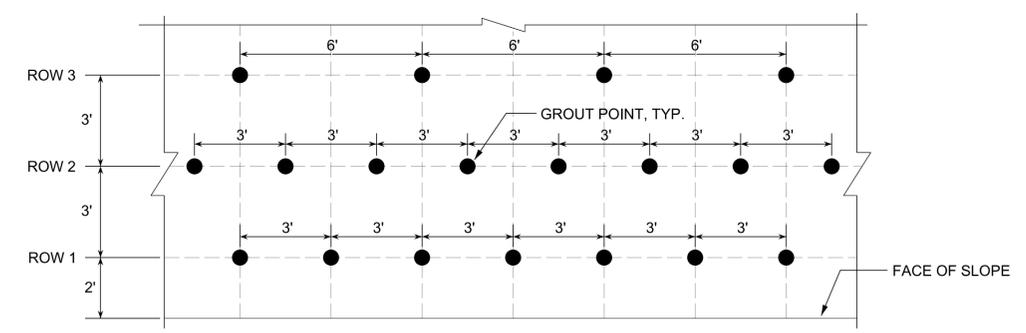
**PARTIALLY GROUTED ROCK FILL - ROCK FILL SECTION**  
 \* IF NO TOE KEY, START GROUTING AT THE TOP OF THE FIRST 3-FT LIFT

**NOTES:**

- FOR PARTIALLY GROUTED ROCK FILL, SEE THE PARTIALLY GROUTED ROCK FILL SPECIAL PROVISION.
- APPLY GROUT ON THE SLOPE FACE AND AT THE TOP OF EACH 3 FT LIFT OF ROCK FILL. APPLY 3 CUBIC FEET OF GROUT AT EACH GROUT POINT IN THE PATTERNS SHOWN ON PAGE 2. THE HIGHEST GROUT POINT WILL BE THE TOP OF THE ROCK EMBANKMENT.
- USE PARTIALLY GROUTED ROCK FILL FROM TOE TO AT LEAST 2FT ABOVE THE 500-YR FLOOD ELEVATION.



**PARTIALLY GROUTED ROCK FILL - TOE KEY DETAIL**



**PARTIALLY GROUTED ROCK FILL - PLAN VIEW GROUT POINTS**  
 VIEW FROM FRONT TOP

**PARTIALLY GROUTED ROCK FILL DETAILS**

PROJECT NO.: W03293

POLK COUNTY

STATION: -L944- STA. 12+00.00 TO 18+50.00, RT

SHEET 4 OF 5

PREPARED BY: KND	DATE: 10/25
REVIEWED BY: REK	DATE: 10/25

Prepared in the Office of:



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 1805 SARDIS ROAD NORTH  
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 CHARLOTTE, NC 28270  
 (980) 339-8684



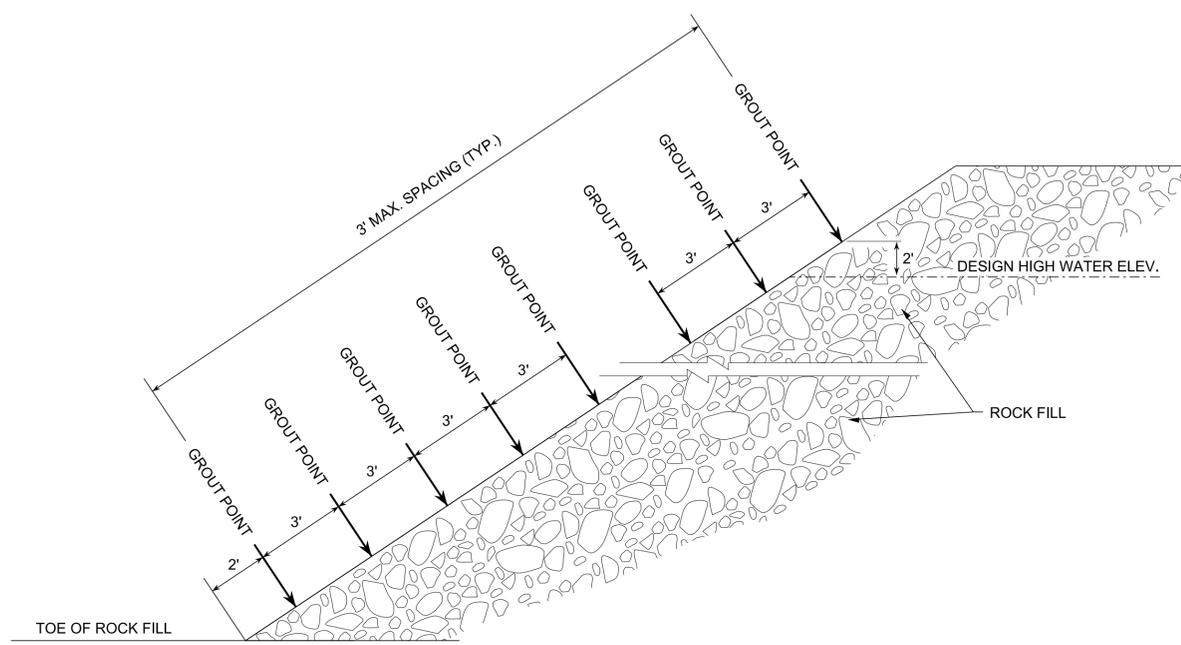
NORTH CAROLINA  
 DEPARTMENT OF TRANSPORTATION  
 DIVISION OF HIGHWAYS  
  
**GEOTECHNICAL ENGINEERING UNIT**

SITE 944 RETAINING WALL  
 ROCK EMBANKMENT &  
 ROCK EMBANKMENT WITH  
 MICROPILE KNEE WALL

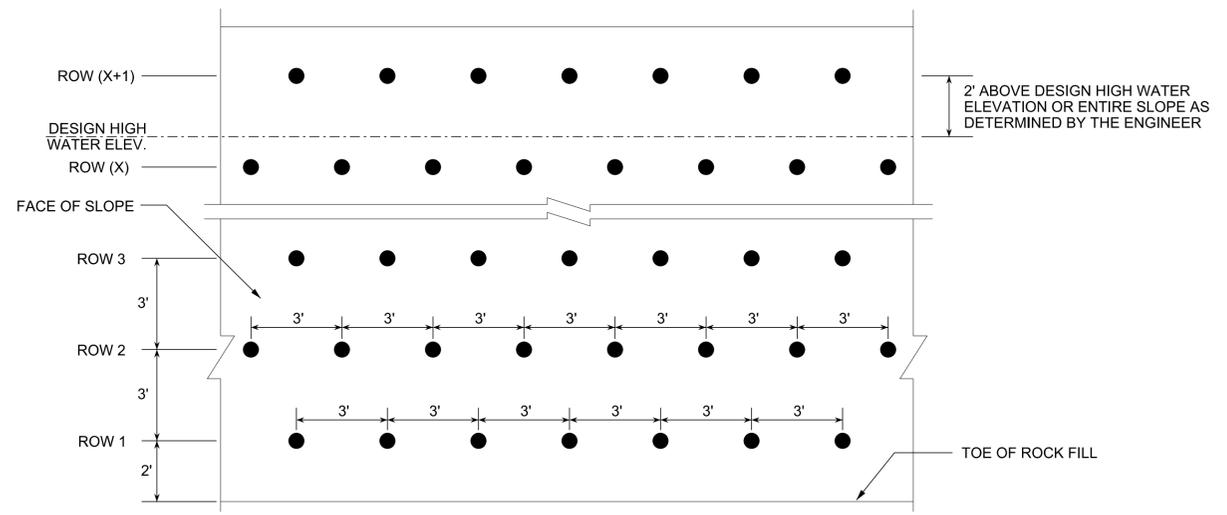
REVISIONS					
NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

SHEET NO. W-4

GEOTECHNICAL ENGINEER   SEAL 042642 ENGINEER ROBERT E. KRAL	ENGINEER    _____ SIGNATURE      DATE
Signed by: <i>Robert E. Kral</i> 12/3/2025 _____      DATE	
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	



PARTIALLY GROUTED ROCK FILL - SLOPE FACE DETAIL



PARTIALLY GROUTED ROCK FILL - SLOPE FACE GROUT POINTS  
VIEW FROM FRONT SLOPE FACE

PARTIALLY GROUTED ROCK FILL DETAILS

PROJECT NO.: W03293  
POLK COUNTY  
 STATION: -L944- STA. 12+00.00 TO 18+50.00, RT  
 SHEET 5 OF 5

PREPARED BY: KND	DATE: 10/25
REVIEWED BY: REK	DATE: 10/25

Prepared in the Office of:



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GEOTECHNICAL  
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 1805 SARDIS ROAD NORTH  
 SUITE 100  
 CHARLOTTE, NC 28270  
 (980) 339-8684



NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
  
**GEOTECHNICAL  
ENGINEERING UNIT**

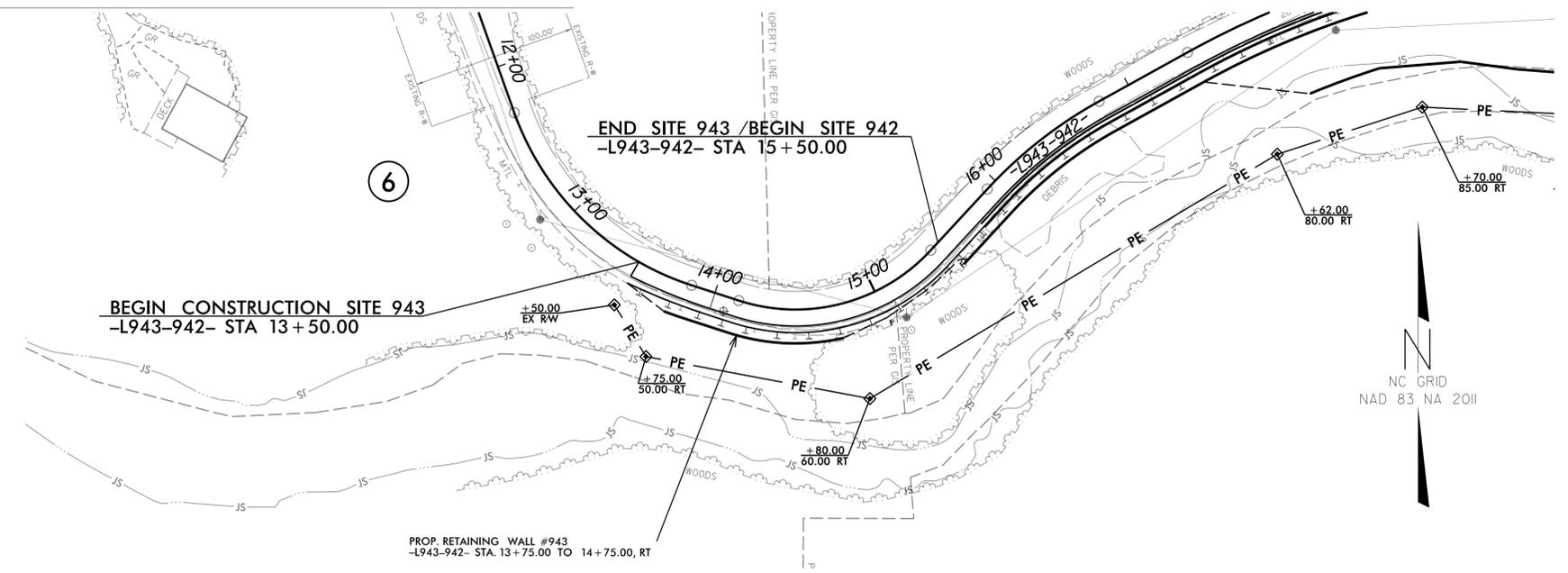
SITE 944 RETAINING WALL  
 ROCK EMBANKMENT &  
 ROCK EMBANKMENT WITH  
 MICROPILE KNEE WALL

REVISIONS					
NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

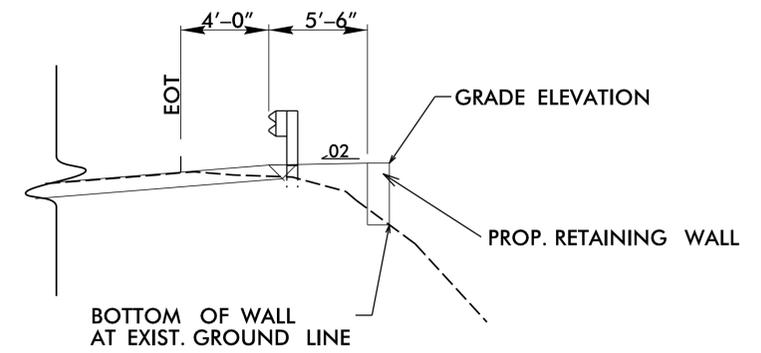
SHEET NO. W-5

# SITE 943 RETAINING WALL:

GEOTECHNICAL ENGINEER  Signed by: <i>Robert E. Kral</i> DATE: 12/3/2025	ENGINEER SIGNATURE: _____ DATE: _____
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	



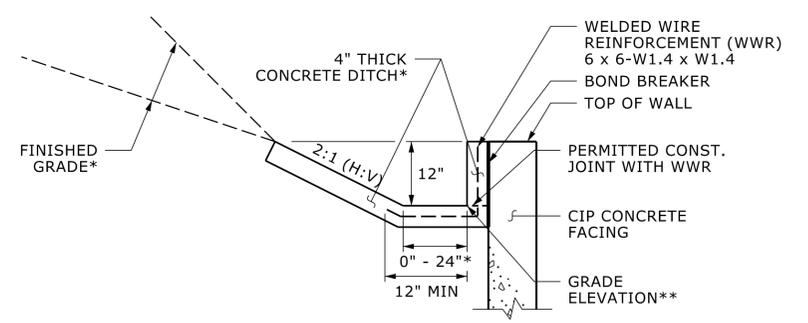
**SITE 943 - PLAN**  
NOT TO SCALE



**SECTION THROUGH RETAINING WALL**  
-L943-942- STA. 13+50.00, RT TO STA. 15+50.00, RT

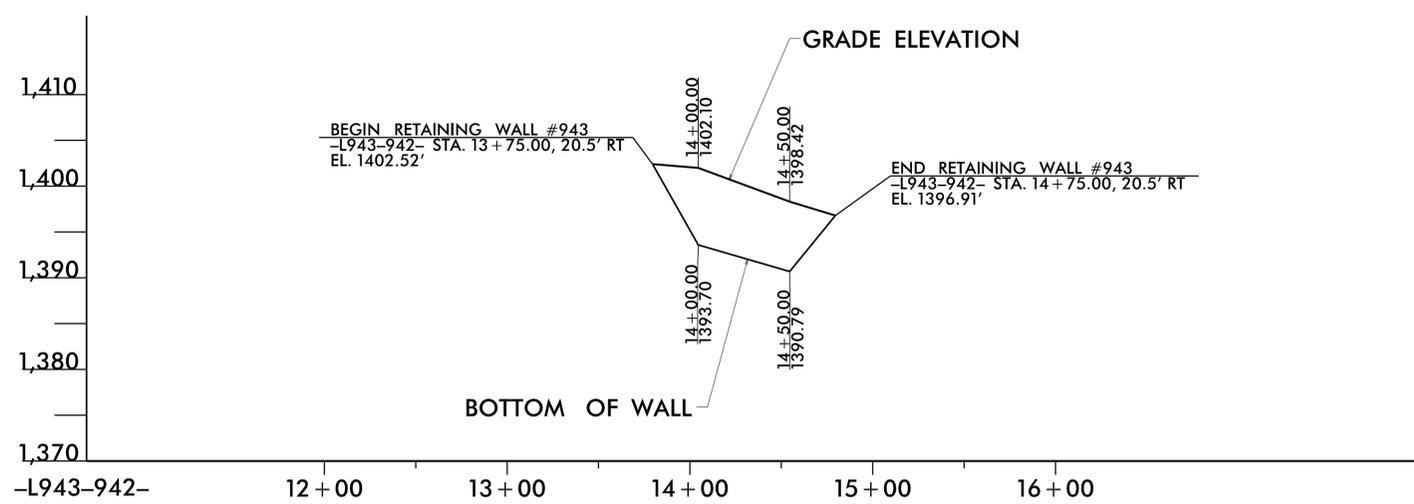
ESTIMATED SITE 943 WALL QUANTITIES	
SOIL NAIL RETAINING WALL	610 SF
MICROPILE GRADE BEAM	200 LF

SITE 943 RETAINING WALL			
STA. -L943-942-	GRADE ELEVATION (FT)	BOTTOM OF WALL ELEVATION (FT)	WALL DESIGN HEIGHT "H" (FT)
13+75.00	1,402.52	1,402.52	0.00
14+00.00	1,402.10	1,393.70	8.40
14+50.00	1,398.42	1,390.79	7.63
14+75.00	1,396.91	1,396.91	0.00



### CONCRETE DITCH BEHIND WALL WITH CONCRETE FACING

\*SEE ROADWAY PLANS FOR CONCRETE DITCH AND FINISHED GRADE DETAILS.  
 \*\*SEE WALL ENVELOPE FOR GRADE ELEVATIONS.



## RETAINING WALL #943 - ENVELOPE

NOT TO SCALE  
(LOOKING AT FACE OF WALL)

THE WALL ENVELOPE DOES NOT ACCURATELY DEPICT THE ACTUAL WALL FACE OF WALL #943 AT THE FOLLOWING LOCATIONS:  
 -L943-942- STA. 13+75.00 TO 13+85.15, RT  
 AND -L943-942- STA. 14+15.15 TO 14+75.00, RT

PREPARED BY: KND	DATE: 10/25
REVIEWED BY: REK	DATE: 10/25

RETAINING WALL ENVELOPE AND WALL LAYOUT PROVIDED BY TGS JULY 29, 2025.

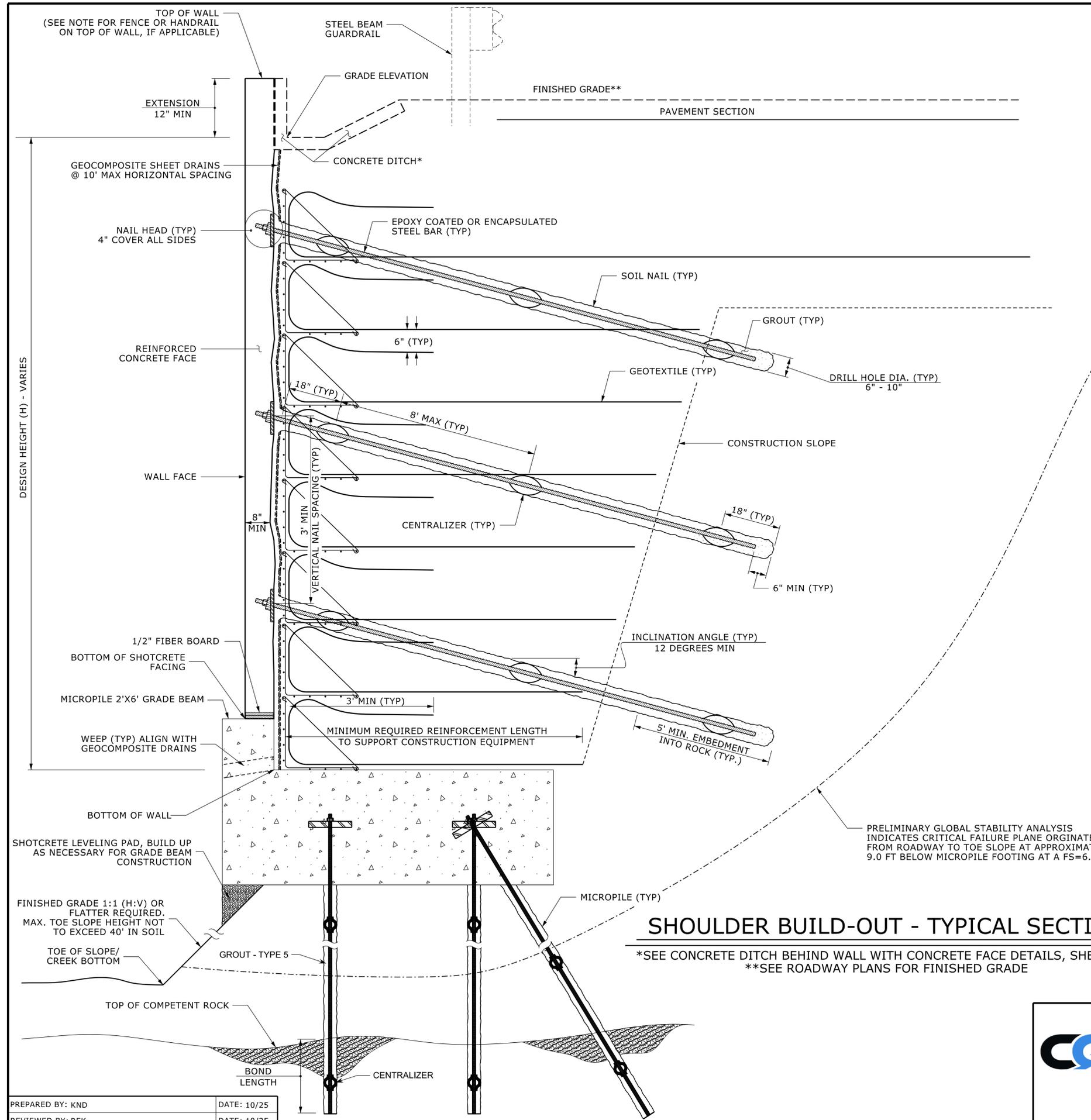
PROJECT NO.: W03293  
 POLK COUNTY  
 RETAINING WALL: -L943-942- STA. 13+75.00 TO 14+75.00, RT  
 SHEET 1 OF 2

Prepared in the Office of:



**CAROLINAS GEOTECHNICAL GROUP**  
 1805 SARDIS ROAD NORTH  
 SUITE 100  
 CHARLOTTE, NC 28270  
 (980) 339-8684

REVISIONS						SHEET NO. W-6
NO.	BY	DATE	NO.	BY	DATE	
1			3			
2			4			



### SHOULDER BUILD-OUT - TYPICAL SECTION

\*SEE CONCRETE DITCH BEHIND WALL WITH CONCRETE FACE DETAILS, SHEET W-1  
 \*\*SEE ROADWAY PLANS FOR FINISHED GRADE

GEOTECHNICAL ENGINEER  Signed by: Robert E. Kral 12/3/2025 DATE	ENGINEER SIGNATURE DATE
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	

#### NOTES:

- FOR SOIL NAIL SHOULDER BUILD-OUT, SEE SOIL NAIL RETAINING WALLS SPECIAL PROVISION.
- FOR MICROPILE GRADE BEAM, SEE MICROPILE GRADE BEAM SPECIAL PROVISION.
- FOR MICROPILES, SEE MICROPILE GRADE BEAM SPECIAL PROVISION.
- DESIGN MICROPILE GRADE BEAM FOR A MINIMUM OF 5 FEET OF GROUND LOSS BELOW GRADE BEAM.
- MICROPILE CASING MAY BE REQUIRED.
- ESTABLISH THE BACK OF SOIL NAIL WALL FACE AT A 3.5' OR GREATER OFFSET FROM THE BACK OF THE EXISTING OR PROPOSED GUARDRAIL POST.
- EXTEND THE TOP TWO LAYERS OF GEOTEXTILE TO CENTERLINE OF ROAD.
- FOR SOIL NAIL RETAINING WALLS, SEE SOIL NAIL RETAINING WALLS SPECIAL PROVISION.
- FOR STEEL BEAM GUARDRAIL, SEE ROADWAY PLANS AND SECTION 862 OF THE STANDARD SPECIFICATIONS.
- BEFORE BEGINNING SOIL NAIL WALL DESIGN FOR SITE 943 RETAINING WALL, SURVEY WALL LOCATION AND SUBMIT A REVISED WALL PROFILE VIEW (WALL ENVELOPE) FOR REVIEW. DO NOT START WALL DESIGN OR CONSTRUCTION UNTIL THE REVISED WALL ENVELOPE IS ACCEPTED.
- DESIGN SITE 943 RETAINING WALL FOR THE FOLLOWING:
  - 1) DESIGN HEIGHT (H) = WALL HEIGHT + WALL EMBEDMENT
  - 2) DESIGN LIFE = 75 YEARS
  - 3) MINIMUM WALL EMBEDMENT DEPTH = 1 FT
  - 4) ASSUMED BORROW MATERIAL PARAMETERS, SEE SECTION 1018 OF THE STANDARD SPECIFICATIONS
    - UNIT WEIGHT,  $\gamma = 120$  PCF
    - FRICTION ANGLE,  $\phi = 30$  DEGREES
    - COHESION,  $c = 0$  PSF
  - 5) IN-SITU ASSUMED MATERIAL PARAMETERS RESIDUAL SOIL:
    - UNIT WEIGHT,  $\gamma = 120$  PCF
    - FRICTION ANGLE,  $\phi = 30$  DEGREES
    - COHESION,  $c = 0$  PSF
  - 6) IN-SITU ASSUMED MATERIAL PARAMETERS WEATHERED ROCK:
    - UNIT WEIGHT,  $\gamma = 134$  PCF
    - FRICTION ANGLE,  $\phi = 32$  DEGREES
    - COHESION,  $c = 500$  PSF
  - 7) IN-SITU ASSUMED MATERIAL PARAMETERS CRYSTALLINE ROCK:
    - UNIT WEIGHT,  $\gamma = 170$  PCF
    - FRICTION ANGLE,  $\phi = 34$  DEGREES
    - COHESION,  $c = 1,000$  PSF
- EXISTING OR FUTURE OBSTRUCTIONS SUCH AS FOUNDATIONS, FENCE OR HANDRAIL POSTS, PAVEMENTS, PIPES, INLETS OR UTILITIES MAY INTERFERE WITH SOIL NAILS FOR SITE 943 RETAINING WALL.
- "TEMPORARY SHORING" MAY BE REQUIRED FOR SITE 943 RETAINING WALL IN ACCORDANCE WITH THE TEMPORARY SHORING PROVISION. SEE ROADWAY OR TRAFFIC CONTROL PLANS.

PRELIMINARY GLOBAL STABILITY ANALYSIS INDICATES CRITICAL FAILURE PLANE ORIGINATES FROM ROADWAY TO TOE SLOPE AT APPROXIMATELY 9.0 FT BELOW MICROPILE FOOTING AT A FS=6.29

PROJECT NO.: W03293  
 POLK COUNTY  
 RETAINING WALL: -L943-942- STA. 13+75.00 TO 14+75.00, RT  
 SHEET 2 OF 2

Prepared in the Office of:

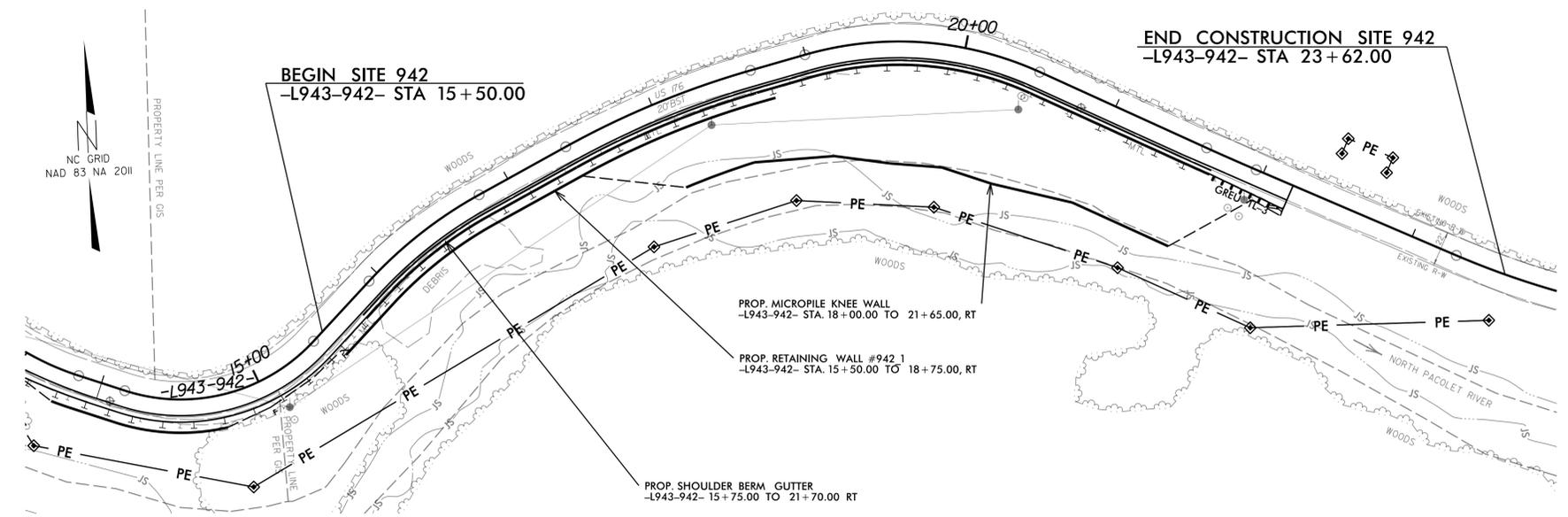
**CAROLINAS GEOTECHNICAL GROUP**  
 1805 SARDIS ROAD NORTH  
 SUITE 100  
 CHARLOTTE, NC 28270  
 (980) 339-8684

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W-7
2			4			

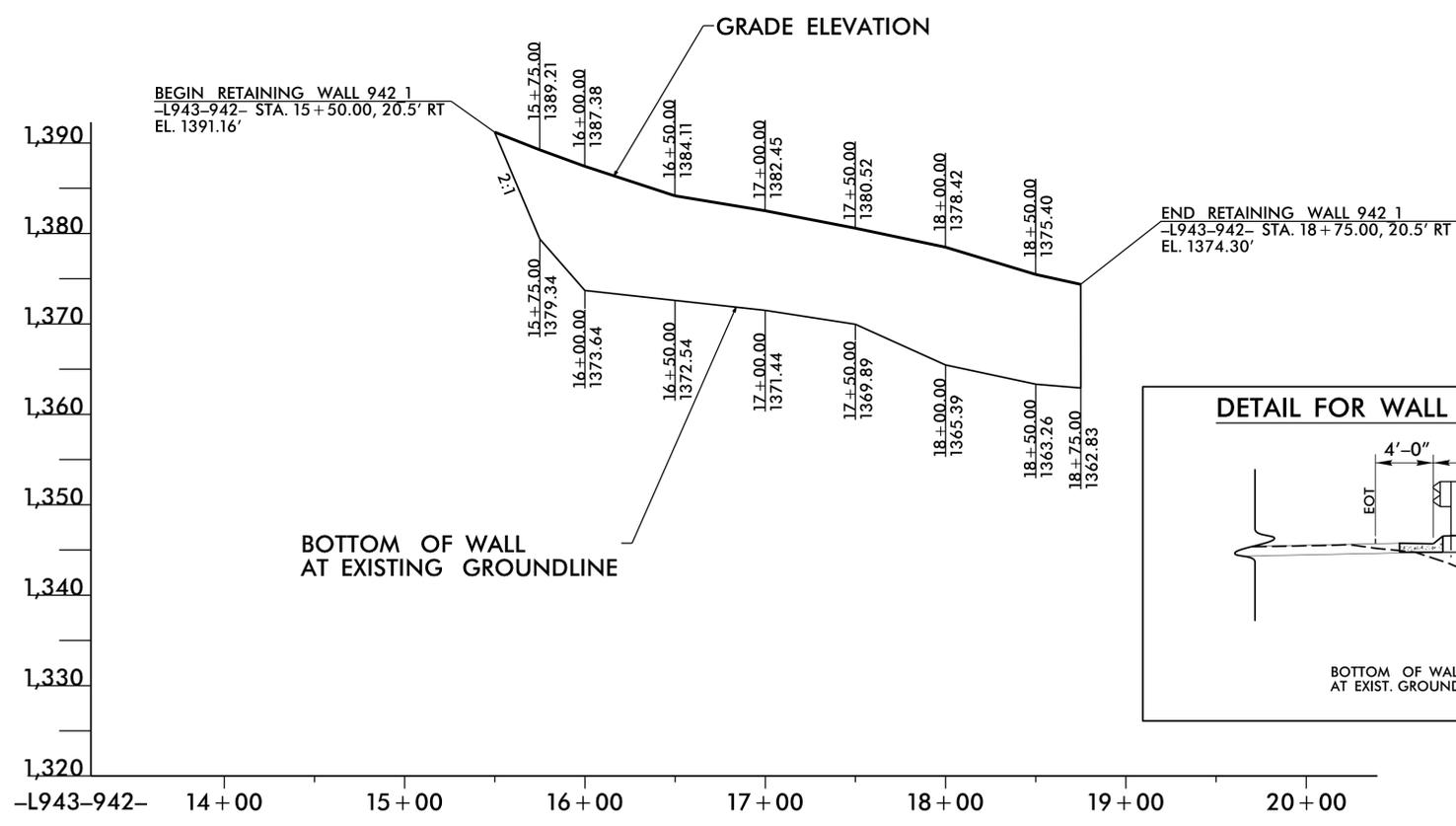
PREPARED BY: KND      DATE: 10/25  
 REVIEWED BY: REK      DATE: 10/25

# SITE 942 RETAINING WALL:

GEOTECHNICAL ENGINEER  Robert E. Neal 12/3/2025 DATE	ENGINEER _____ SIGNATURE _____ DATE
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	



**SITE 942 - PLAN**  
NOT TO SCALE

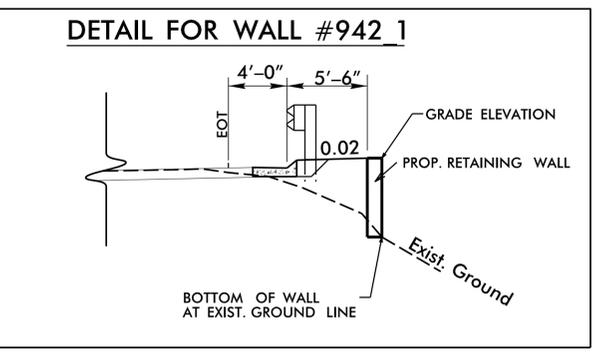
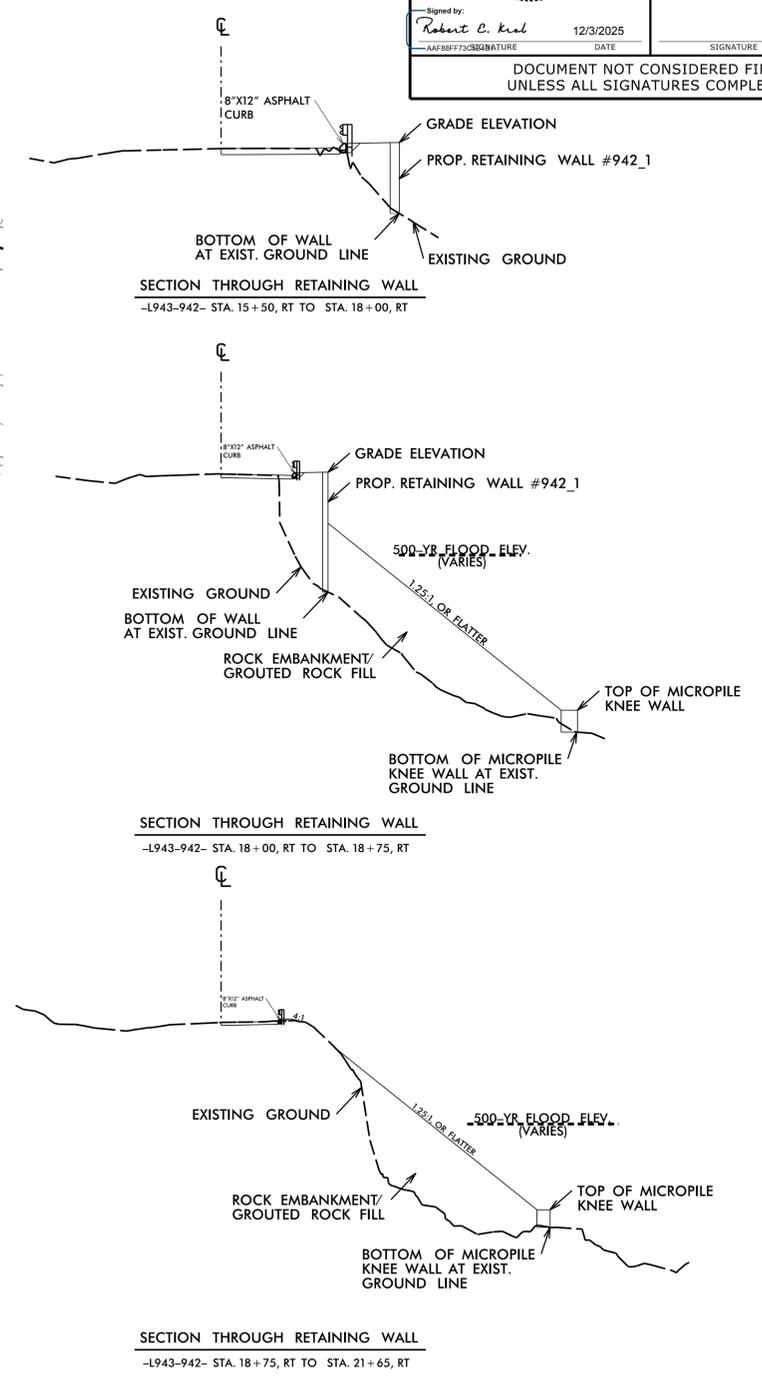


**RETAINING WALL #942\_1 - ENVELOPE**  
NOT TO SCALE  
(LOOKING AT FACE OF WALL)

THE WALL ENVELOPE DOES NOT ACCURATELY DEPICT THE ACTUAL WALL FACE OF WALL #942\_1 AT THE FOLLOWING LOCATIONS:  
 -L943-942- STA. 15+93.02 TO 16+79.71, RT  
 AND -L943-942- STA. 17+40.92 TO 18+64.72, RT

PREPARED BY: KND	DATE: 10/25
REVIEWED BY: REK	DATE: 10/25

RETAINING WALL ENVELOPE AND DESIGN LAYOUT PROVIDED BY TGS JULY 30, 2025.



Prepared in the Office of:



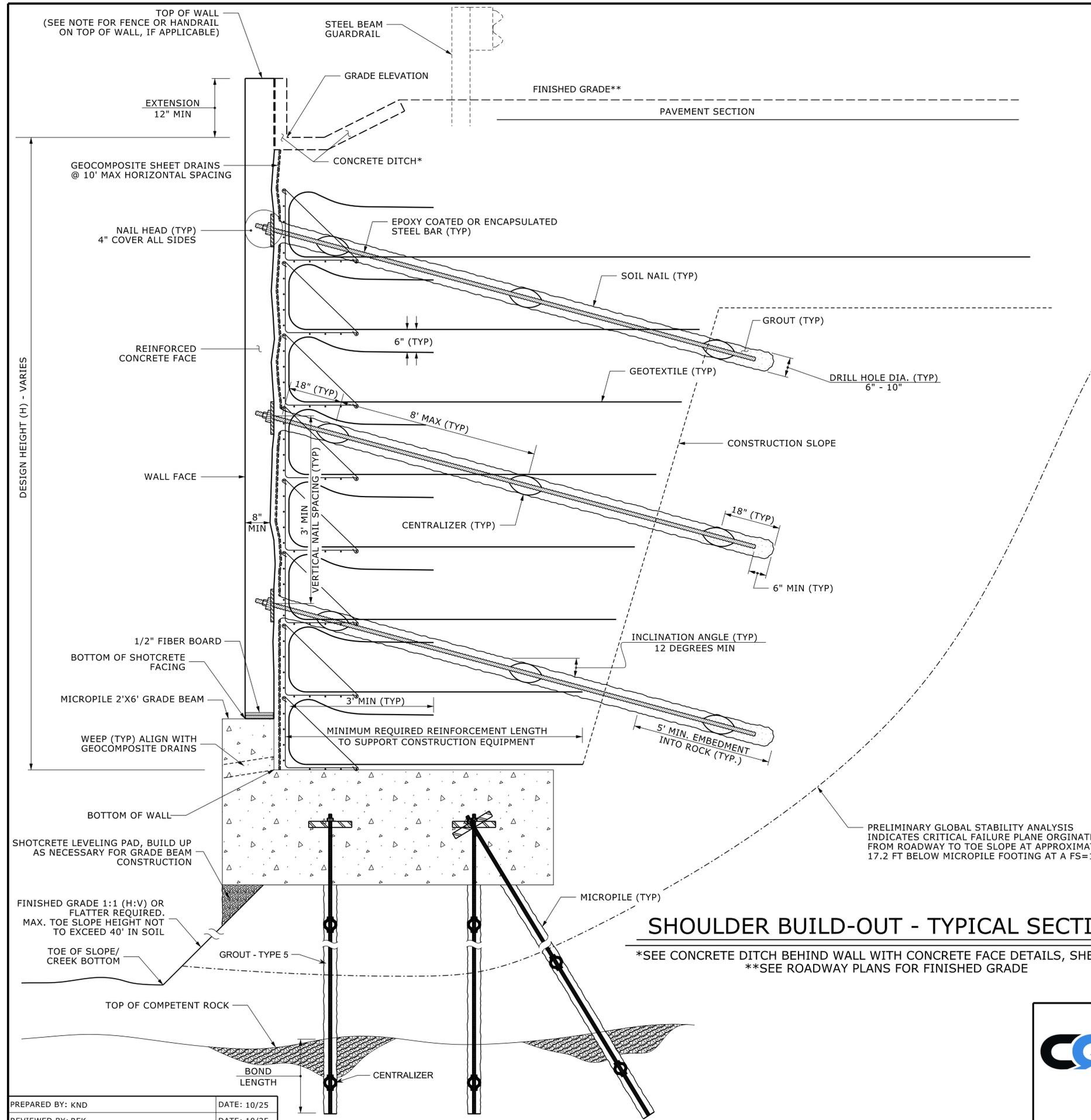
**CAROLINAS  
GEOTECHNICAL  
GROUP**  
 1805 SARDIS ROAD NORTH  
 SUITE 100  
 CHARLOTTE, NC 28270  
 (980) 339-8684

**SITE 942 RETAINING WALL  
SHOULDER BUILD-OUT &  
ROCK EMBANKMENT WITH  
MICROPILE KNEE WALL**

REVISIONS					
NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

SHEET NO. W-8

PROJECT NO.: W03293  
 POLK COUNTY  
 STATION: -L943-942- STA. 15+50.00 TO 23+62.00, RT  
 SHEET 1 OF 4



### SHOULDER BUILD-OUT - TYPICAL SECTION

\*SEE CONCRETE DITCH BEHIND WALL WITH CONCRETE FACE DETAILS, SHEET W-6  
 \*\*SEE ROADWAY PLANS FOR FINISHED GRADE

GEOTECHNICAL ENGINEER  SEAL 042642 ROBERT E. NEAL	ENGINEER _____ SIGNATURE
Signed by: Robert E. Neal DATE: 12/3/2025	DATE: _____ SIGNATURE: _____ DATE: _____
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	

### NOTES:

- FOR SOIL NAIL SHOULDER BUILD-OUT, SEE SOIL NAIL RETAINING WALLS SPECIAL PROVISION.
- FOR MICROPILE GRADE BEAM, SEE MICROPILE GRADE BEAM SPECIAL PROVISION.
- FOR MICROPILES, SEE MICROPILE GRADE BEAM SPECIAL PROVISION.
- DESIGN MICROPILE GRADE BEAM FOR A MINIMUM OF 5 FEET OF GROUND LOSS BELOW GRADE BEAM.
- MICROPILE CASING MAY BE REQUIRED.
- ESTABLISH THE BACK OF SOIL NAIL WALL FACE AT A 3.5' OR GREATER OFFSET FROM THE BACK OF THE EXISTING OR PROPOSED GUARDRAIL POST.
- EXTEND THE TOP TWO LAYERS OF GEOTEXTILE TO CENTERLINE OF ROAD.
- FOR SOIL NAIL RETAINING WALLS, SEE SOIL NAIL RETAINING WALLS SPECIAL PROVISION.
- DESIGN SOIL NAIL RETAINING WALL AND MICROPILE GRADE BEAM FOR INTERNAL, EXTERNAL, AND GLOBAL STABILITY.
- FOR STEEL BEAM GUARDRAIL, SEE ROADWAY PLANS AND SECTION 862 OF THE STANDARD SPECIFICATIONS.
- BEFORE BEGINNING SOIL NAIL WALL DESIGN FOR SITE 942 RETAINING WALL, SURVEY WALL LOCATION AND SUBMIT A REVISED WALL PROFILE VIEW (WALL ENVELOPE) FOR REVIEW. DO NOT START WALL DESIGN OR CONSTRUCTION UNTIL THE REVISED WALL ENVELOPE IS ACCEPTED.
- DESIGN SITE 942 RETAINING WALL FOR THE FOLLOWING:
  - 1) DESIGN HEIGHT (H) = WALL HEIGHT + WALL EMBEDMENT
  - 2) DESIGN LIFE = 75 YEARS
  - 3) MINIMUM WALL EMBEDMENT DEPTH = 1 FT
  - 4) ROCK EMBANKMENT PARAMETERS:
    - UNIT WEIGHT,  $\gamma = 135$  PCF
    - FRICTION ANGLE,  $\phi = 42$  DEGREES
    - COHESION,  $c = 0$  PSF
  - 5) ASSUMED BORROW MATERIAL PARAMETERS, SEE SECTION 1018 OF THE STANDARD SPECIFICATIONS
    - UNIT WEIGHT,  $\gamma = 120$  PCF
    - FRICTION ANGLE,  $\phi = 30$  DEGREES
    - COHESION,  $c = 0$  PSF
  - 6) IN-SITU ASSUMED MATERIAL PARAMETERS RESIDUAL SOIL:
    - UNIT WEIGHT,  $\gamma = 120$  PCF
    - FRICTION ANGLE,  $\phi = 30$  DEGREES
    - COHESION,  $c = 0$  PSF
  - 7) IN-SITU ASSUMED MATERIAL PARAMETERS CRYSTALLINE ROCK:
    - UNIT WEIGHT,  $\gamma = 170$  PCF
    - FRICTION ANGLE,  $\phi = 34$  DEGREES
    - COHESION,  $c = 1,000$  PSF
- EXISTING OR FUTURE OBSTRUCTIONS SUCH AS FOUNDATIONS, FENCE OR HANDRAIL POSTS, PAVEMENTS, PIPES, INLETS OR UTILITIES MAY INTERFERE WITH SOIL NAILS FOR SITE 942 RETAINING WALL.
- "TEMPORARY SHORING" MAY BE REQUIRED FOR SITE 942 RETAINING WALL IN ACCORDANCE WITH THE TEMPORARY SHORING PROVISION. SEE ROADWAY OR TRAFFIC CONTROL PLANS.

PRELIMINARY GLOBAL STABILITY ANALYSIS INDICATES CRITICAL FAILURE PLANE ORIGINATES FROM ROADWAY TO TOE SLOPE AT APPROXIMATELY 17.2 FT BELOW MICROPILE FOOTING AT A FS=1.9

PROJECT NO.: W03293  
 POLK COUNTY  
 STATION: -L943-942- STA. 15+50.00 TO 23+62.00, RT  
 SHEET 2 OF 4

PREPARED BY: KND	DATE: 10/25
REVIEWED BY: REK	DATE: 10/25

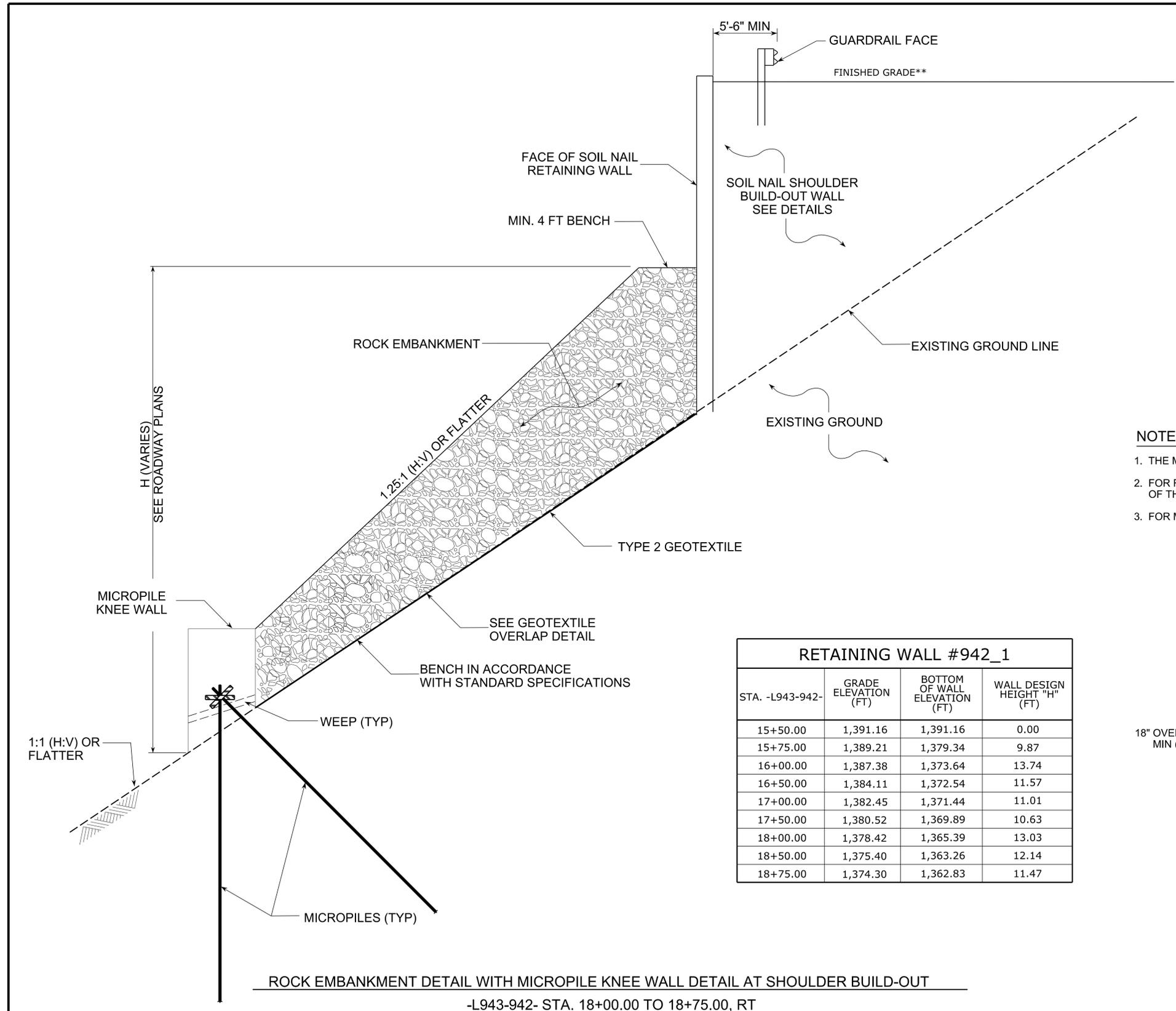
Prepared in the Office of:



**CARLINAS  
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 1805 SARDIS ROAD NORTH  
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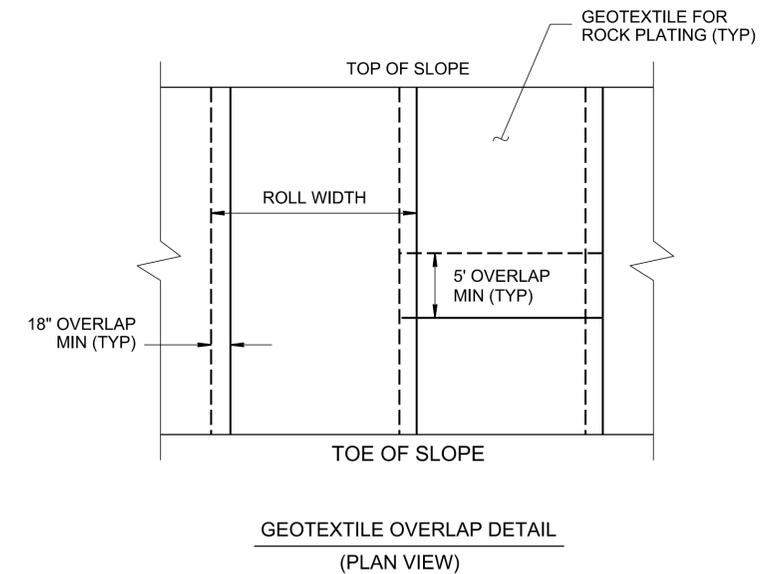
REVISIONS						SHEET NO. W-9
NO.	BY	DATE	NO.	BY	DATE	
1			3			
2			4			

GEOTECHNICAL ENGINEER  SEAL 042642 ENGINEER ROBERT E. KRAL	ENGINEER    _____ DATE _____ SIGNATURE
Signed by: <u>Robert E. Kral</u> 12/3/2025 DATE	
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	



- NOTES:**
1. THE MAXIMUM ALLOWABLE HEIGHT FOR THE ROCK EMBANKMENT DETAIL IS 80'.
  2. FOR ROCK EMBANKMENT, BENCH EXISTING SLOPE IN ACCORDANCE WITH SECTION 235 OF THE STANDARD SPECIFICATIONS, WHERE POSSIBLE.
  3. FOR MICROPILE KNEE WALL, SEE THE MICROPILE GRADE BEAM SPECIAL PROVISION.

RETAINING WALL #942_1			
STA. -L943-942-	GRADE ELEVATION (FT)	BOTTOM OF WALL ELEVATION (FT)	WALL DESIGN HEIGHT "H" (FT)
15+50.00	1,391.16	1,391.16	0.00
15+75.00	1,389.21	1,379.34	9.87
16+00.00	1,387.38	1,373.64	13.74
16+50.00	1,384.11	1,372.54	11.57
17+00.00	1,382.45	1,371.44	11.01
17+50.00	1,380.52	1,369.89	10.63
18+00.00	1,378.42	1,365.39	13.03
18+50.00	1,375.40	1,363.26	12.14
18+75.00	1,374.30	1,362.83	11.47



ROCK EMBANKMENT DETAIL WITH MICROPILE KNEE WALL DETAIL AT SHOULDER BUILD-OUT  
 -L943-942- STA. 18+00.00 TO 18+75.00, RT

PROJECT NO.: W03293  
 POLK COUNTY  
 STATION: -L943-942- STA. 15+50.00 TO 23+62.00, RT  
 SHEET 3 OF 4

PREPARED BY: KND	DATE: 10/25
REVIEWED BY: REK	DATE: 10/25

Prepared in the Office of:



**CAROLINAS GEOTECHNICAL GROUP**  
 1805 SARDIS ROAD NORTH  
 SUITE 100  
 CHARLOTTE, NC 28270  
 (980) 339-8684

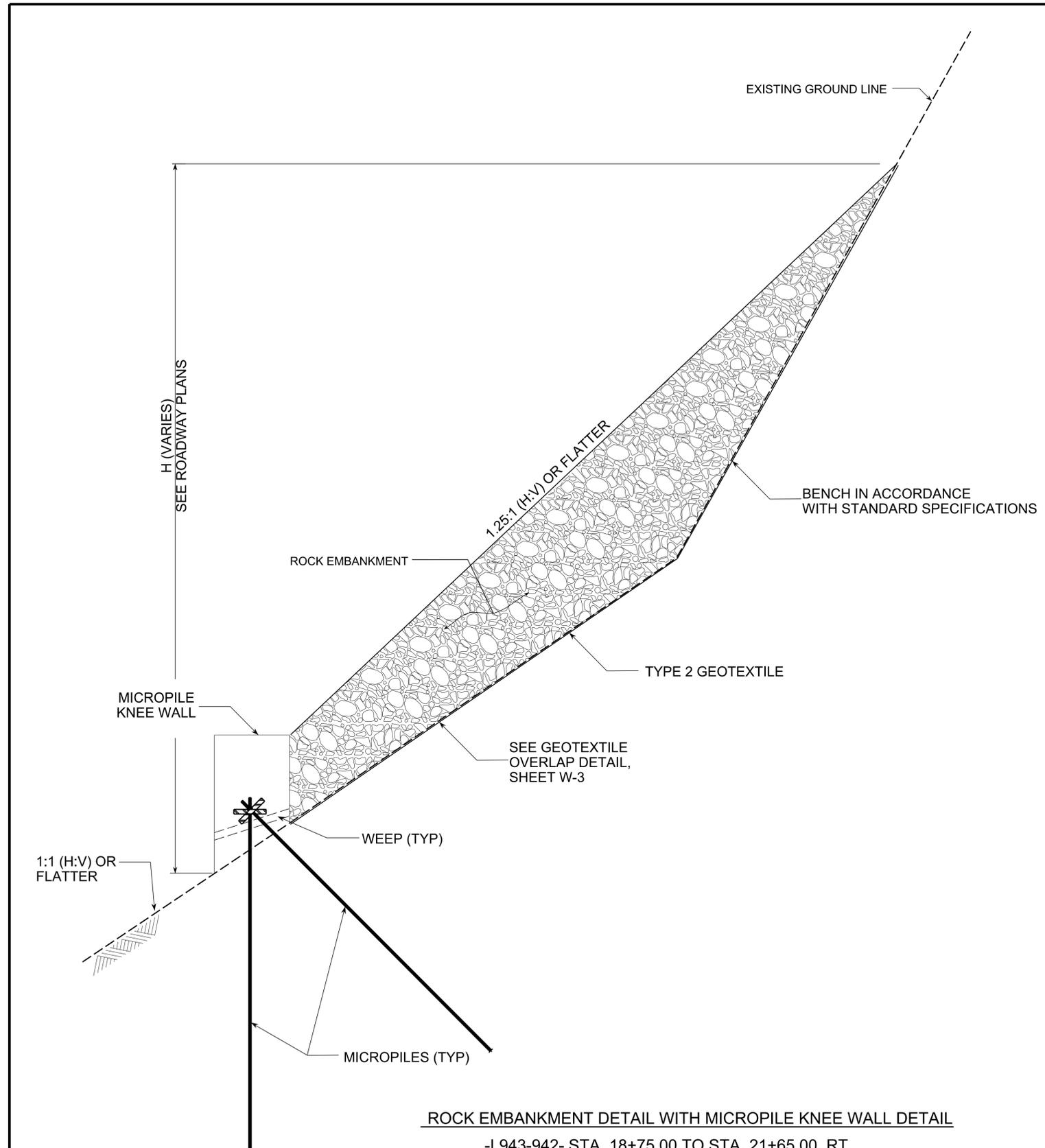


NORTH CAROLINA  
 DEPARTMENT OF TRANSPORTATION  
 DIVISION OF HIGHWAYS  
**GEOTECHNICAL ENGINEERING UNIT**

SITE 942 RETAINING WALL SHOULDER BUILD-OUT & ROCK EMBANKMENT WITH MICROPILE KNEE WALL					
REVISIONS					
NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

SHEET NO. W-10

GEOTECHNICAL ENGINEER  SEAL 042642 ROBERT E. KRAL	ENGINEER    _____ SIGNATURE DATE
Signed by: <i>Robert E. Kral</i> 12/3/2025 DATE	
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	



ESTIMATED QUANTITIES - SITE 942	
SOIL NAIL RETAINING WALL	3,680 SF
MICROPILE GRADE BEAM	325 LF
ROCK EMBANKMENTS	16,800 TON
GEOTEXTILE FOR ROCK EMBANKMENTS	3,850 SY
MICROPILE GRADE BEAM	365 LF
GROUT FOR ROCK FILL	750 CY

ROCK EMBANKMENT WITH MICROPILE KNEE WALL						
STA. -L943-942-	TOP OF SLOPE OFFSET (FT)	TOP OF KNEE WALL OFFSET (FT)	TOP OF WALL ELEVATION (FT)	BOTTOM OF KNEE WALL ELEVATION (FT)	500-YR FLOOD ELEVATION (FT)	MIN. ROCK FILL ELEVATION (FT)
18+00.00	20.5' RT	55.0' RT	1342.1	1338.1	1364.3	1366.3
18+50.00	20.5' RT	55.0' RT	1341.6	1337.6	1361.4	1363.4
19+00.00	19.5' RT	65.0' RT	1341.0	1337.0	1360.3	1362.3
19+50.00	19.5' RT	75.0' RT	1340.3	1336.3	1354.3	1356.3
20+00.00	19.5' RT	75.0' RT	1338.6	1334.6	1343.5	1345.5
20+50.00	19.5' RT	75.0' RT	1341.1	1337.1	1348.6	1350.6
21+00.00	19.5' RT	65.0' RT	1329.8	1325.8	1342.0	1344.0
21+50.00	19.5' RT	65.0' RT	1325.4	1321.4	1344.0	1346.0

**ROCK EMBANKMENT DETAIL WITH MICROPILE KNEE WALL DETAIL**  
 -L943-942- STA. 18+75.00 TO STA. 21+65.00, RT

PROJECT NO.: W03293  
 POLK COUNTY  
 STATION: -L943-942- STA. 15+50.00 TO 23+62.00, RT  
 SHEET 4 OF 4

PREPARED BY: KND	DATE: 10/25
REVIEWED BY: REK	DATE: 10/25

Prepared in the Office of:



**CAROLINAS GEOTECHNICAL GROUP**  
 1805 SARDIS ROAD NORTH  
 SUITE 100  
 CHARLOTTE, NC 28270  
 (980) 339-8684



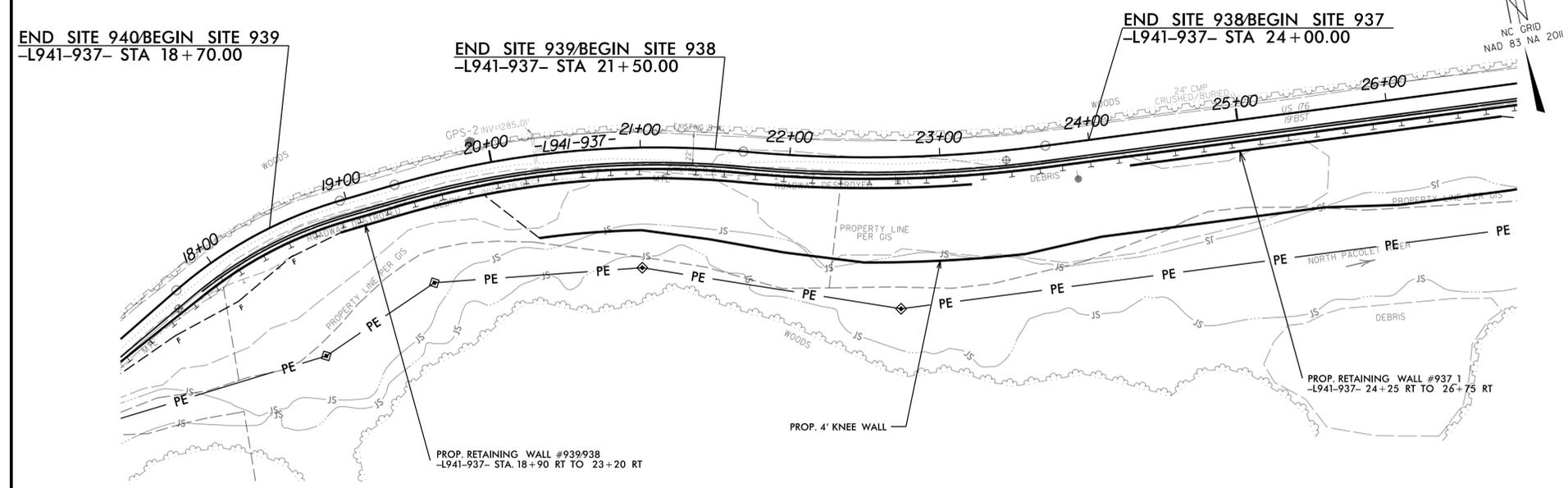
NORTH CAROLINA  
 DEPARTMENT OF TRANSPORTATION  
 DIVISION OF HIGHWAYS  
**GEOTECHNICAL ENGINEERING UNIT**

**SITE 942 RETAINING WALL SHOULDER BUILD-OUT & ROCK EMBANKMENT WITH MICROPILE KNEE WALL**

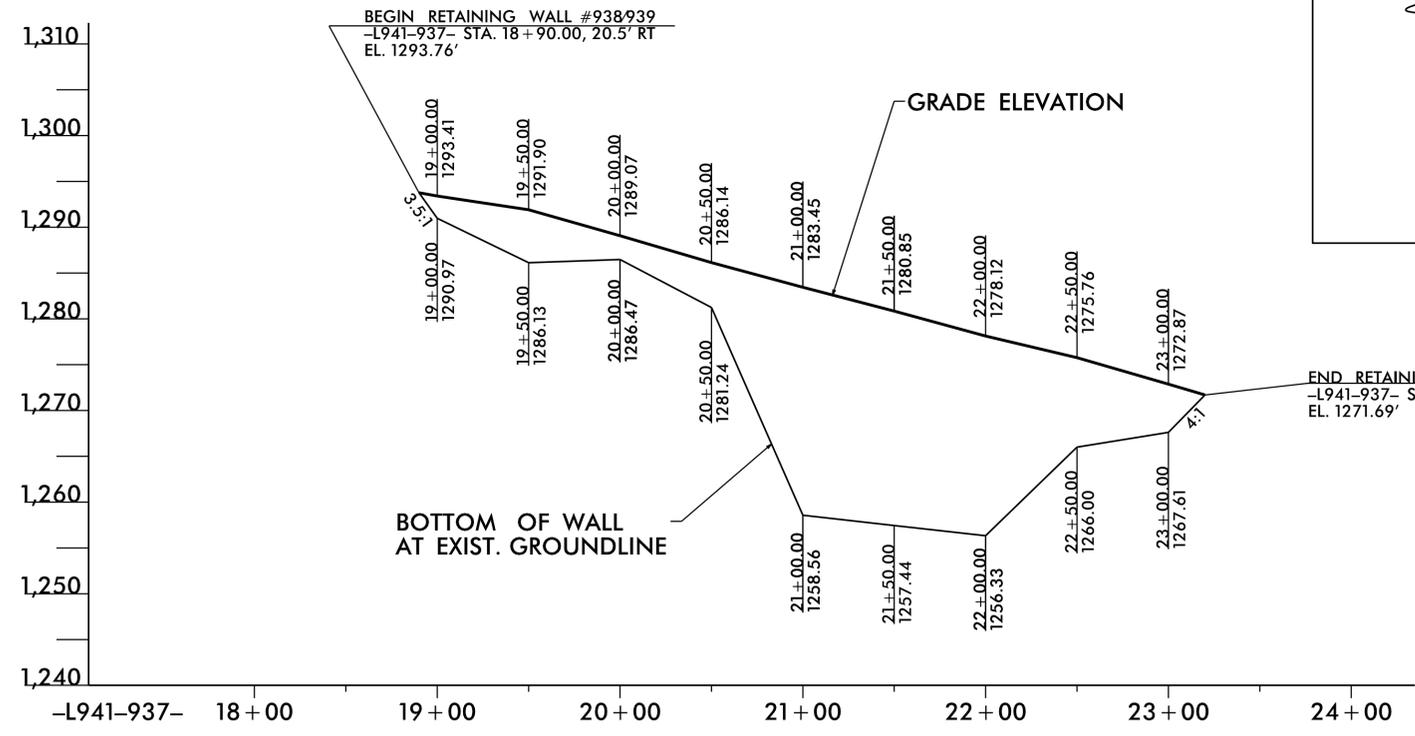
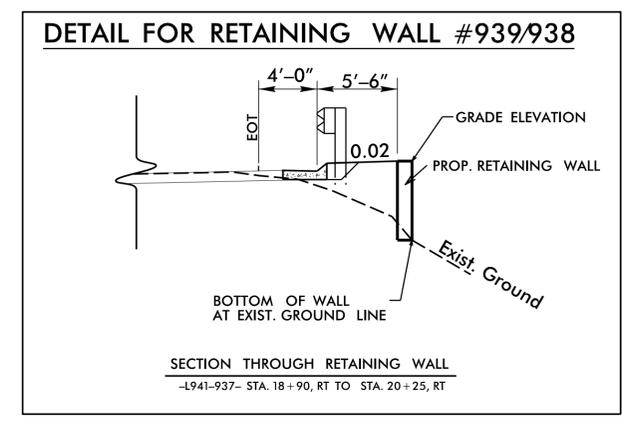
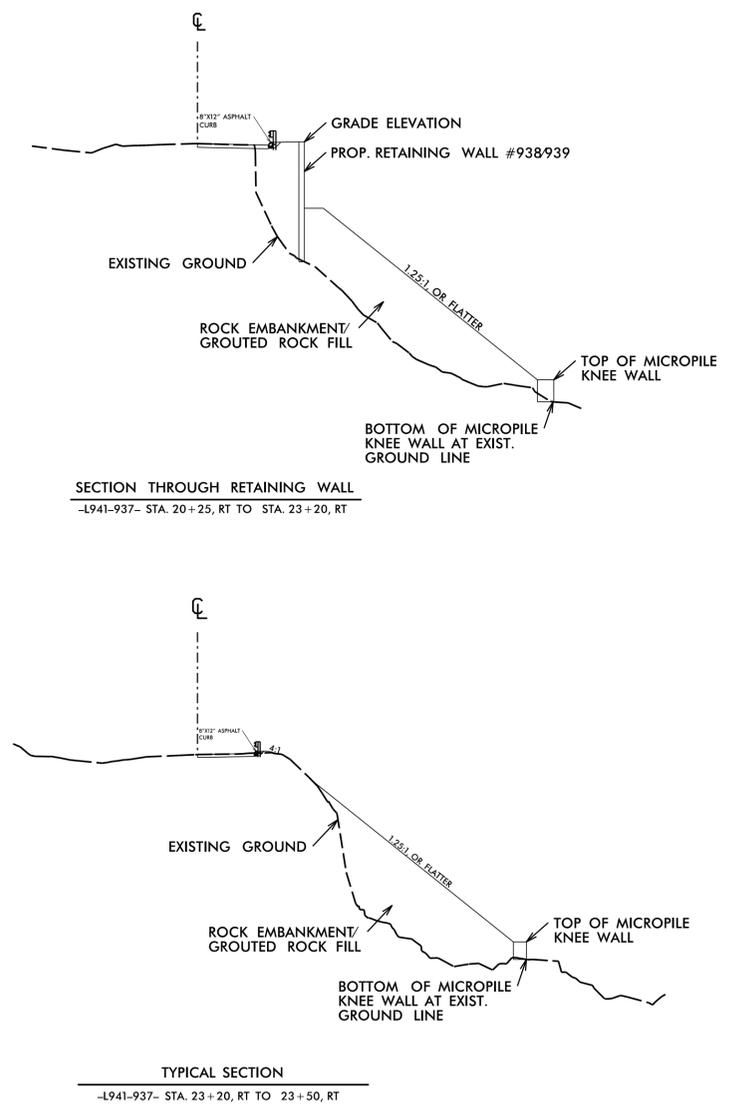
REVISIONS						SHEET NO. W-11
NO.	BY	DATE	NO.	BY	DATE	
1			3			
2			4			

# SITE 938 /939 RETAINING WALL:

GEOTECHNICAL ENGINEER  Robert E. Neal 12/3/2025 DATE	ENGINEER _____ SIGNATURE _____ DATE
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	



**SITE 938 /939 - PLAN**  
NOT TO SCALE



## RETAINING WALL #938 /939 - ENVELOPE

NOT TO SCALE  
(LOOKING AT FACE OF WALL)

SITE 939: BEGIN RETAINING WALL TO -L941-937- STA. 21+50.00  
 SITE 938: -L941-937- STA. 21+50.00 TO END RETAINING WALL

PROJECT NO.: W03293  
 POLK COUNTY  
 STATION: -L941-937- STA. 18+70.00 TO 23+50.00, RT  
 SHEET 1 OF 4

PREPARED BY: KND	DATE: 10/25
REVIEWED BY: REK	DATE: 10/25

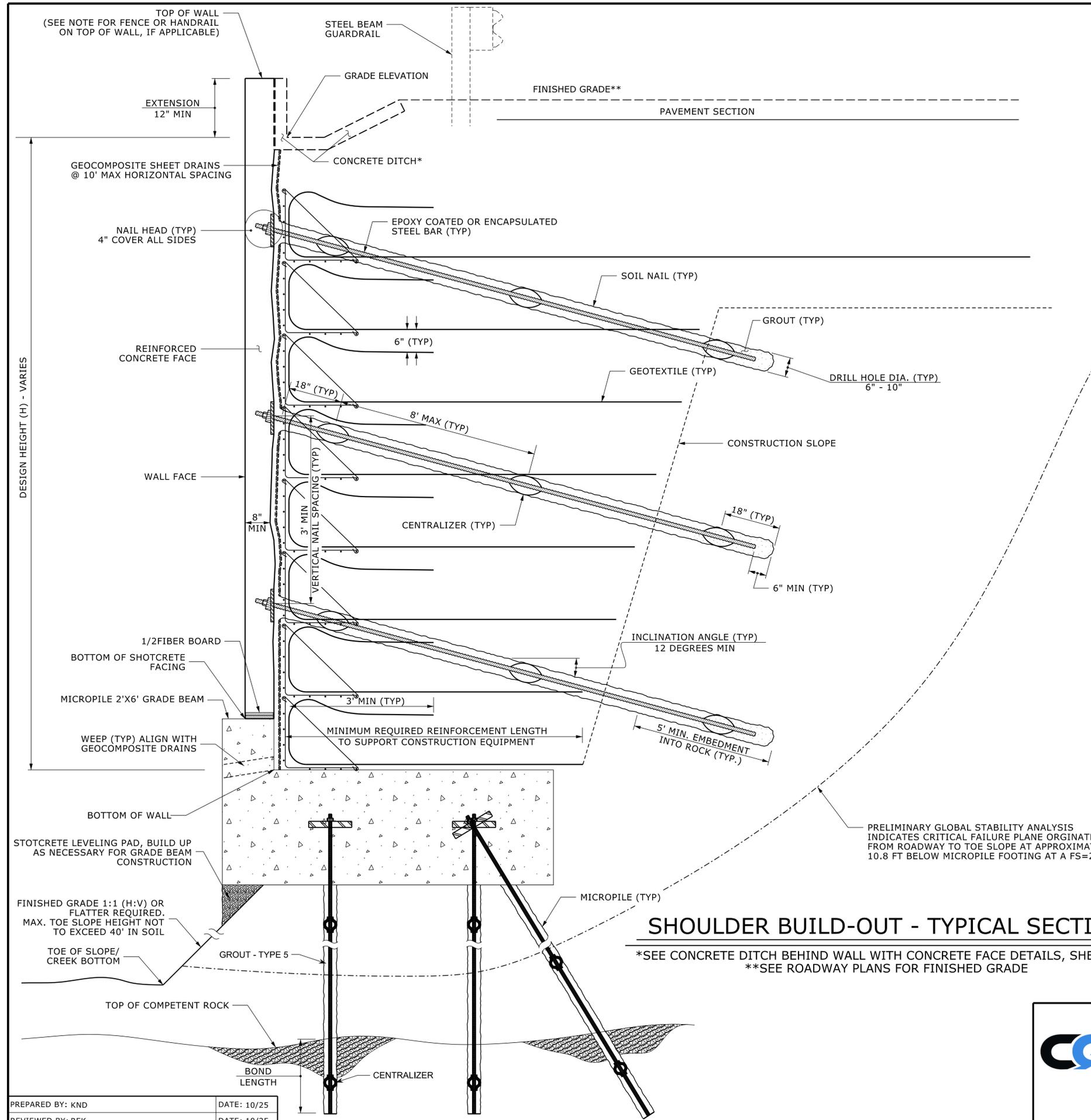
RETAINING WALL ENVELOPES AND DESIGN LAYOUT PROVIDED BY TGS JULY 30, 2025.

Prepared in the Office of:



**CAROLINAS  
 GEOTECHNICAL  
 GROUP**  
 1805 SARDIS ROAD NORTH  
 SUITE 100  
 CHARLOTTE, NC 28270  
 (980) 339-8684

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W-12
2			4			



### SHOULDER BUILD-OUT - TYPICAL SECTION

\*SEE CONCRETE DITCH BEHIND WALL WITH CONCRETE FACE DETAILS, SHEET W-6  
 \*\*SEE ROADWAY PLANS FOR FINISHED GRADE

GEOTECHNICAL ENGINEER  Robert E. Kral 12/3/2025	ENGINEER DATE SIGNATURE
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	

- NOTES:**
- FOR SOIL NAIL SHOULDER BUILD-OUT, SEE SOIL NAIL RETAINING WALLS SPECIAL PROVISION.
  - FOR MICROPILE GRADE BEAM, SEE MICROPILE GRADE BEAM SPECIAL PROVISION.
  - FOR MICROPILES, SEE MICROPILE GRADE BEAM SPECIAL PROVISION.
  - DESIGN MICROPILE GRADE BEAM FOR A MINIMUM OF 5 FEET OF GROUND LOSS BELOW GRADE BEAM.
  - MICROPILE CASING MAY BE REQUIRED.
  - ESTABLISH THE BACK OF SOIL NAIL WALL FACE AT A 3.5' OR GREATER OFFSET FROM THE BACK OF THE EXISTING OR PROPOSED GUARDRAIL POST.
  - EXTEND THE TOP TWO LAYERS OF GEOTEXTILE TO CENTERLINE OF ROAD.
  - FOR SOIL NAIL RETAINING WALLS, SEE SOIL NAIL RETAINING WALLS SPECIAL PROVISION.
  - DESIGN SOIL NAIL RETAINING WALL AND MICROPILE GRADE BEAM FOR INTERNAL, EXTERNAL, AND GLOBAL STABILITY.
  - FOR STEEL BEAM GUARDRAIL, SEE ROADWAY PLANS AND SECTION 862 OF THE STANDARD SPECIFICATIONS.
  - BEFORE BEGINNING SOIL NAIL WALL DESIGN FOR RETAINING WALL #938/939, SURVEY WALL LOCATION AND SUBMIT A REVISED WALL PROFILE VIEW (WALL ENVELOPE) FOR REVIEW. DO NOT START WALL DESIGN OR CONSTRUCTION UNTIL THE REVISED WALL ENVELOPE IS ACCEPTED.
  - DESIGN RETAINING WALL #938/939 FOR THE FOLLOWING:
    - 1) DESIGN HEIGHT (H) = WALL HEIGHT + WALL EMBEDMENT
    - 2) DESIGN LIFE = 75 YEARS
    - 3) MINIMUM WALL EMBEDMENT DEPTH = 1 FT
    - 4) ROCK EMBANKMENT PARAMETERS:
      - UNIT WEIGHT,  $\gamma = 135$  PCF
      - FRICTION ANGLE,  $\phi = 42$  DEGREES
      - COHESION,  $c = 0$  PSF
    - 5) ASSUMED BORROW MATERIAL PARAMETERS, SEE SECTION 1018 OF THE STANDARD SPECIFICATIONS
      - UNIT WEIGHT,  $\gamma = 120$  PCF
      - FRICTION ANGLE,  $\phi = 30$  DEGREES
      - COHESION,  $c = 0$  PSF
    - 6) IN-SITU ASSUMED MATERIAL PARAMETERS RESIDUAL SOIL:
      - UNIT WEIGHT,  $\gamma = 120$  PCF
      - FRICTION ANGLE,  $\phi = 30$  DEGREES
      - COHESION,  $c = 0$  PSF
    - 7) IN-SITU ASSUMED MATERIAL PARAMETERS CRYSTALLINE ROCK:
      - UNIT WEIGHT,  $\gamma = 170$  PCF
      - FRICTION ANGLE,  $\phi = 34$  DEGREES
      - COHESION,  $c = 1,000$  PSF
  - EXISTING OR FUTURE OBSTRUCTIONS SUCH AS FOUNDATIONS, FENCE OR HANDRAIL POSTS, PAVEMENTS, PIPES, INLETS OR UTILITIES MAY INTERFERE WITH SOIL NAILS FOR RETAINING WALL #938/939.
  - "TEMPORARY SHORING" MAY BE REQUIRED FOR RETAINING WALL #938/939 IN ACCORDANCE WITH THE TEMPORARY SHORING PROVISION. SEE ROADWAY OR TRAFFIC CONTROL PLANS.

PROJECT NO.: W03293  
 POLK COUNTY  
 STATION: -1941-937- STA. 18+70.00 TO 23+50.00, RT  
 SHEET 2 OF 4

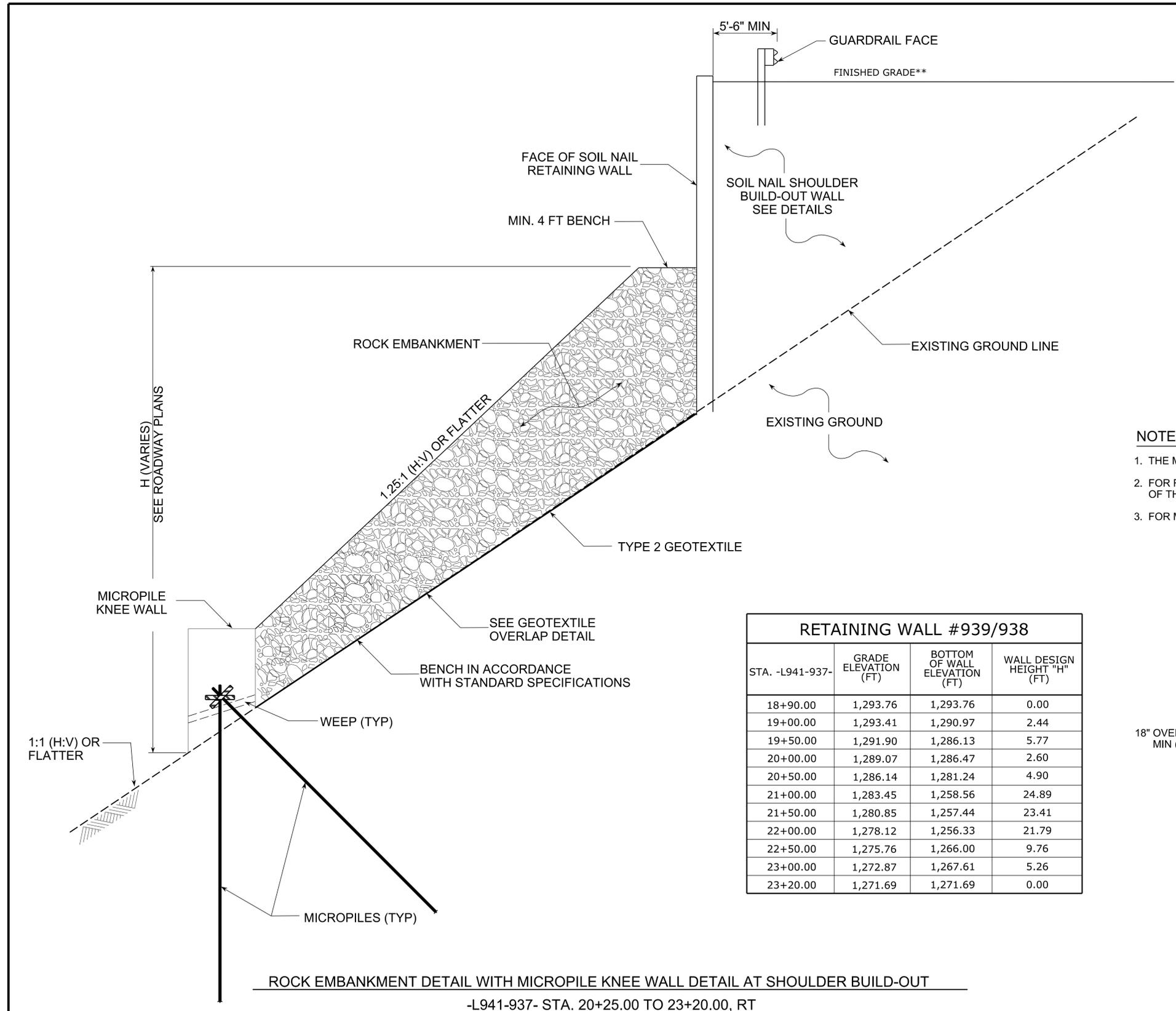
PREPARED BY: KND DATE: 10/25  
 REVIEWED BY: REK DATE: 10/25

Prepared in the Office of:

**CAROLINAS GEOTECHNICAL GROUP**  
 1805 SARDIS ROAD NORTH  
 SUITE 100  
 CHARLOTTE, NC 28270  
 (980) 339-8684

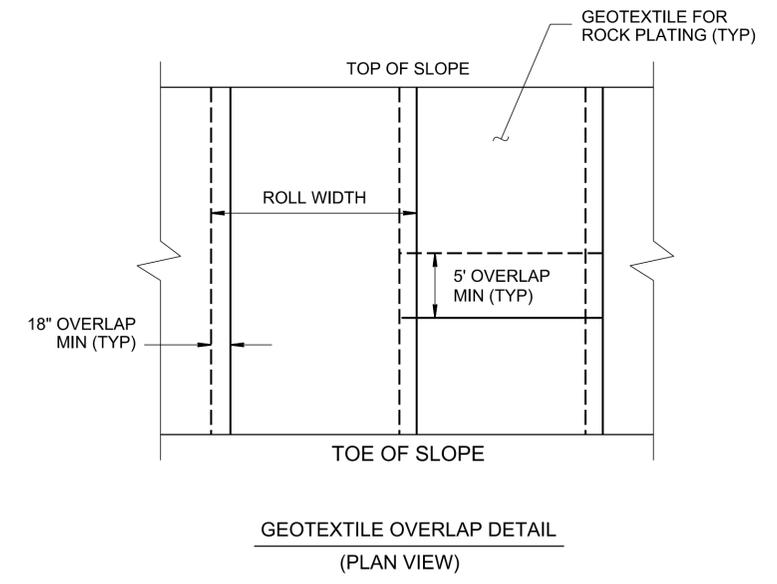
REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W-13
2			4			

GEOTECHNICAL ENGINEER  SEAL 042642 ROBERT E. KRAL	ENGINEER    _____ SIGNATURE
Signed by: <i>Robert E. Kral</i> 12/3/2025 DATE	_____ DATE
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	



- NOTES:**
1. THE MAXIMUM ALLOWABLE HEIGHT FOR THE ROCK EMBANKMENT DETAIL IS 80'.
  2. FOR ROCK EMBANKMENT, BENCH EXISTING SLOPE IN ACCORDANCE WITH SECTION 235 OF THE STANDARD SPECIFICATIONS, WHERE POSSIBLE.
  3. FOR MICROPILE KNEE WALL, SEE THE MICROPILE GRADE BEAM SPECIAL PROVISION.

RETAINING WALL #939/938			
STA. -L941-937-	GRADE ELEVATION (FT)	BOTTOM OF WALL ELEVATION (FT)	WALL DESIGN HEIGHT "H" (FT)
18+90.00	1,293.76	1,293.76	0.00
19+00.00	1,293.41	1,290.97	2.44
19+50.00	1,291.90	1,286.13	5.77
20+00.00	1,289.07	1,286.47	2.60
20+50.00	1,286.14	1,281.24	4.90
21+00.00	1,283.45	1,258.56	24.89
21+50.00	1,280.85	1,257.44	23.41
22+00.00	1,278.12	1,256.33	21.79
22+50.00	1,275.76	1,266.00	9.76
23+00.00	1,272.87	1,267.61	5.26
23+20.00	1,271.69	1,271.69	0.00



**ROCK EMBANKMENT DETAIL WITH MICROPILE KNEE WALL DETAIL AT SHOULDER BUILD-OUT**  
 -L941-937- STA. 20+25.00 TO 23+20.00, RT

PROJECT NO. : W03293  
 POLK COUNTY  
 STATION: -L941-937- STA. 18+70.00 TO 23+50.00, RT  
 SHEET 3 OF 4

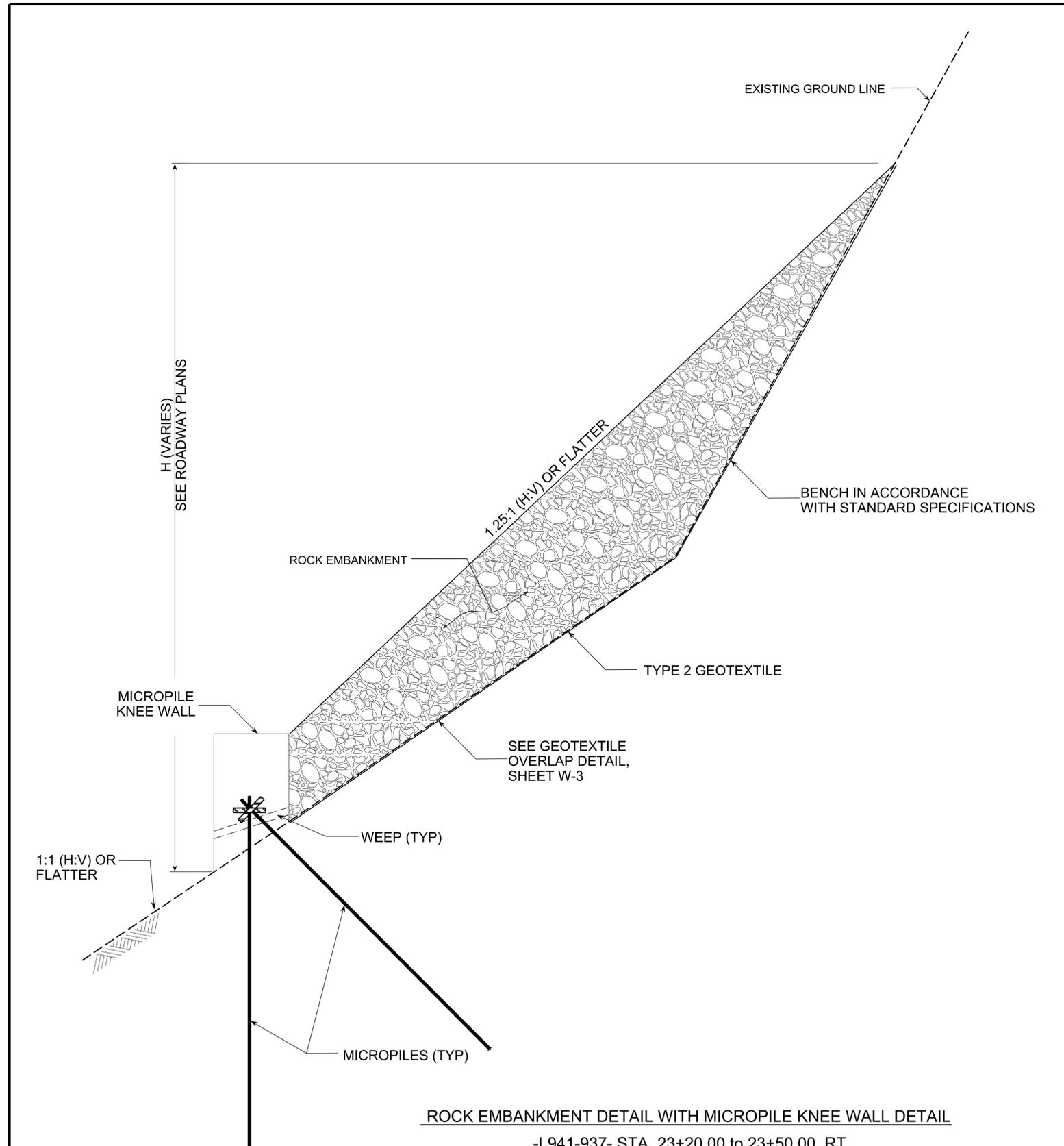
PREPARED BY: KND	DATE: 10/25
REVIEWED BY: REK	DATE: 10/25

Prepared in the Office of:  
  
**CAROLINAS GEOTECHNICAL GROUP**  
 1805 SARDIS ROAD NORTH  
 SUITE 100  
 CHARLOTTE, NC 28270  
 (980) 339-8684

  
 NORTH CAROLINA  
 DEPARTMENT OF TRANSPORTATION  
 DIVISION OF HIGHWAYS  
  
**GEOTECHNICAL ENGINEERING UNIT**

REVISIONS						SHEET NO. W-14
NO.	BY	DATE	NO.	BY	DATE	
1			3			
2			4			

GEOTECHNICAL ENGINEER   SEAL 042642 ENGINEER ROBERT E. KRAL	ENGINEER
Signed by:  AUF88FT356 SIGNATURE	12/3/2025 DATE
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	



ESTIMATED QUANTITIES - SITE 939	
SOIL NAIL RETAINING WALL #938/939	2,575 SF
MICROPILE GRADE BEAM	260 LF
ROCK EMBANKMENTS	4,250 TON
GEOTEXTILE FOR ROCK EMBANKMENTS	1,050 SY
MICROPILE GRADE BEAM	125 LF
GROUT FOR ROCK FILL	150 CY

ESTIMATED QUANTITIES - SITE 938	
SOIL NAIL RETAINING WALL #938/939	2,350 SF
MICROPILE GRADE BEAM	200 LF
ROCK EMBANKMENTS	6,800 TON
GEOTEXTILE FOR ROCK EMBANKMENTS	1,675 SY
MICROPILE GRADE BEAM	200 LF
GROUT FOR ROCK FILL	375 CY

ROCK EMBANKMENT WITH MICROPILE KNEE WALL						
STA. -L941-937-	TOP OF SLOPE OFFSET (FT)	TOP OF KNEE WALL OFFSET (FT)	TOP OF KNEE WALL ELEVATION (FT)	BOTTOM OF KNEE WALL ELEVATION (FT)	500-YR FLOOD ELEVATION (FT)	MIN. ROCK FILL ELEVATION (FT)
20+50.00	29.6' RT	55.0' RT	1245.8	1241.8	1281.7	1283.7
21+00.00	20.5' RT	55.0' RT	1241.2	1237.2	1274.0	1276.0
21+50.00	20.5' RT	60.0' RT	1239.8	1235.8	1270.0	1272.0
22+00.00	20.5' RT	65.0' RT	1237.5	1233.5	1262.7	1264.7
22+50.00	20.5' RT	70.0' RT	1234.0	1230.0	1256.2	1258.2
23+00.00	20.5' RT	70.0' RT	1233.0	1229.0	1255.8	1257.8
23+50.00	19.5' RT	70.0' RT	1233.3	1229.3	1247.7	1249.7

**ROCK EMBANKMENT DETAIL WITH MICROPILE KNEE WALL DETAIL**  
-L941-937- STA. 23+20.00 to 23+50.00, RT

PROJECT NO. : W03293  
 POLK COUNTY  
 STATION: -L941-937- STA. 18+70.00 TO 23+50.00, RT  
 SHEET 4 OF 4

PREPARED BY: KND	DATE: 10/25
REVIEWED BY: REK	DATE: 10/25

Prepared in the Office of:



**CAROLINAS  
GEOTECHNICAL  
GROUP**  
 1805 SARDIS ROAD NORTH  
 SUITE 100  
 CHARLOTTE, NC 28270  
 (980) 339-8684



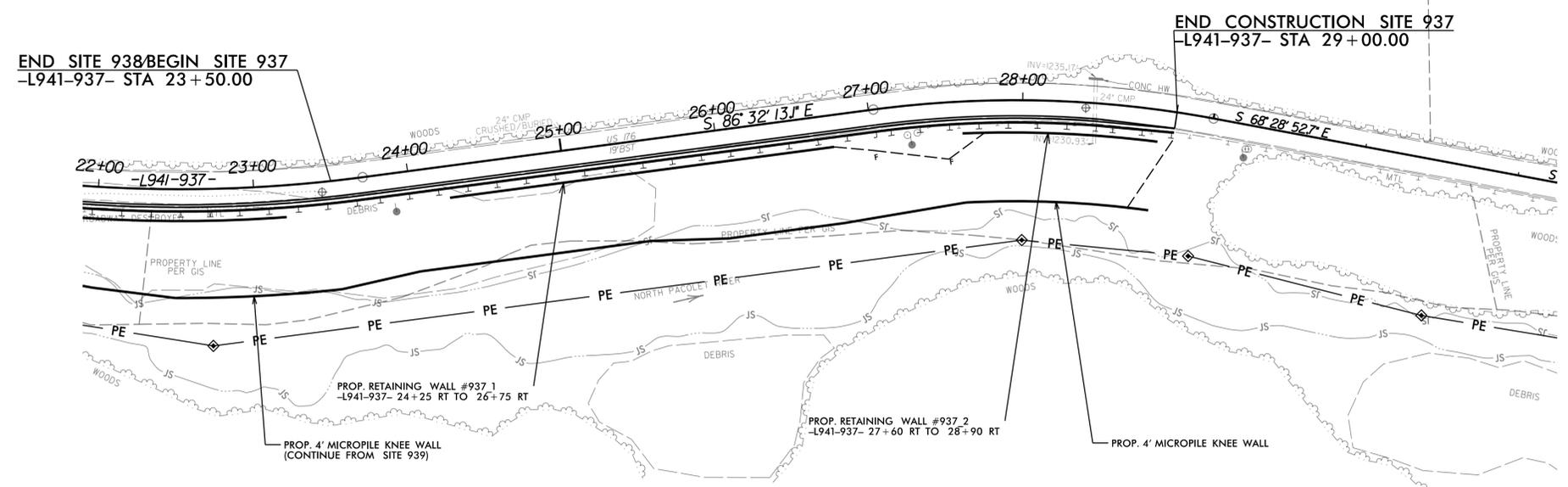
NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
  
**GEOTECHNICAL  
ENGINEERING UNIT**

RETAINING WALL #938/939  
 SHOULDER BUILD-OUT &  
 ROCK EMBANKMENT WITH  
 MICROPILE KNEE WALL

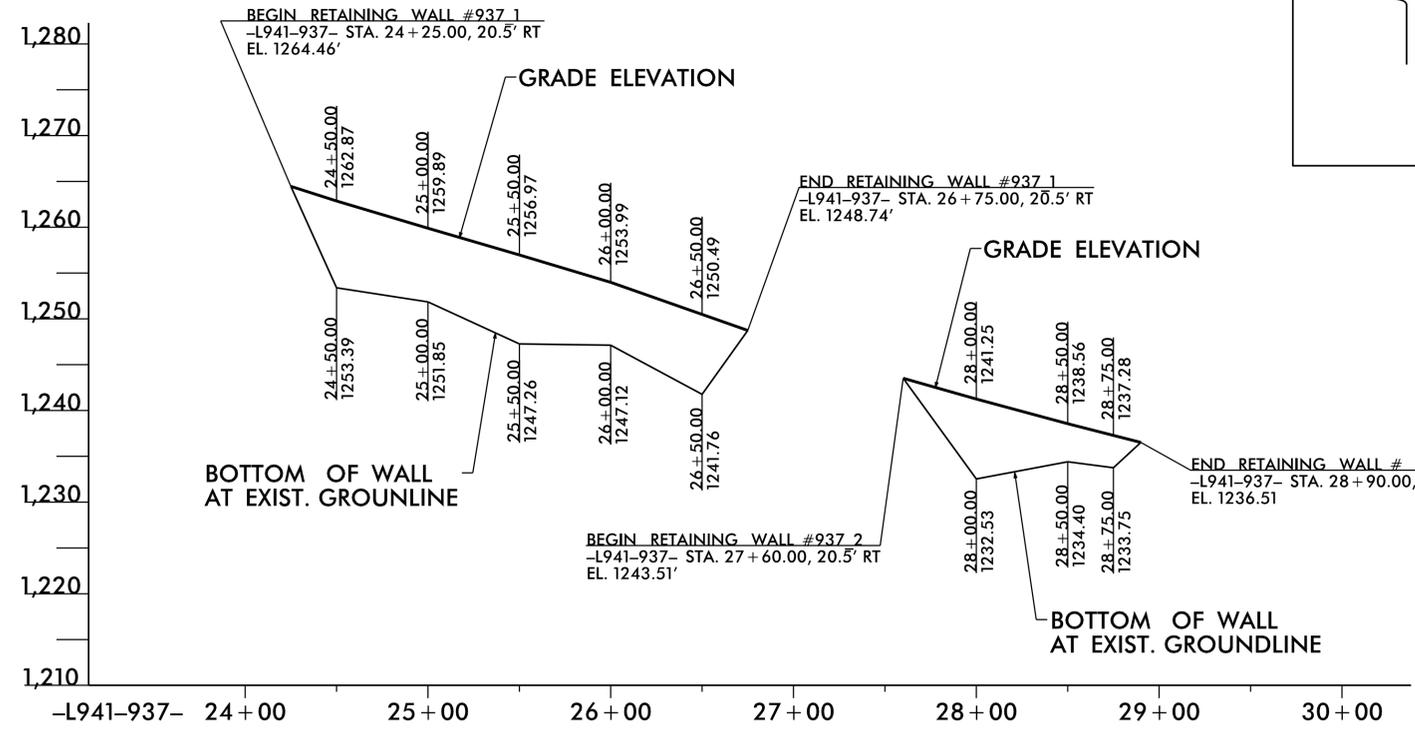
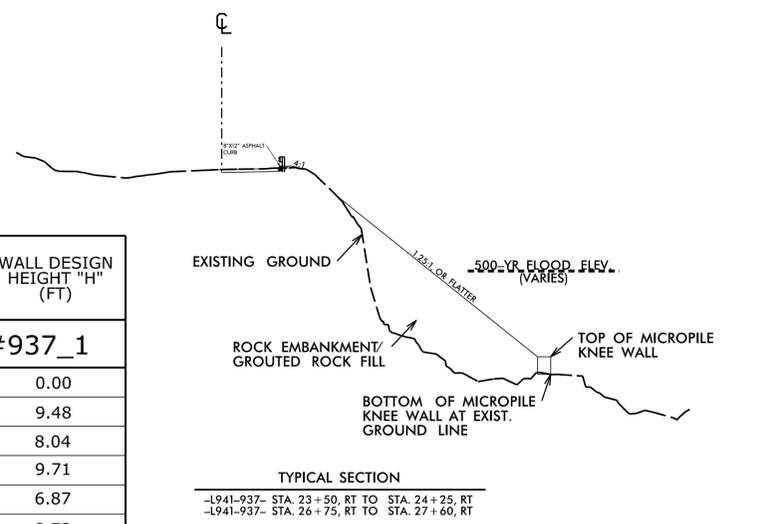
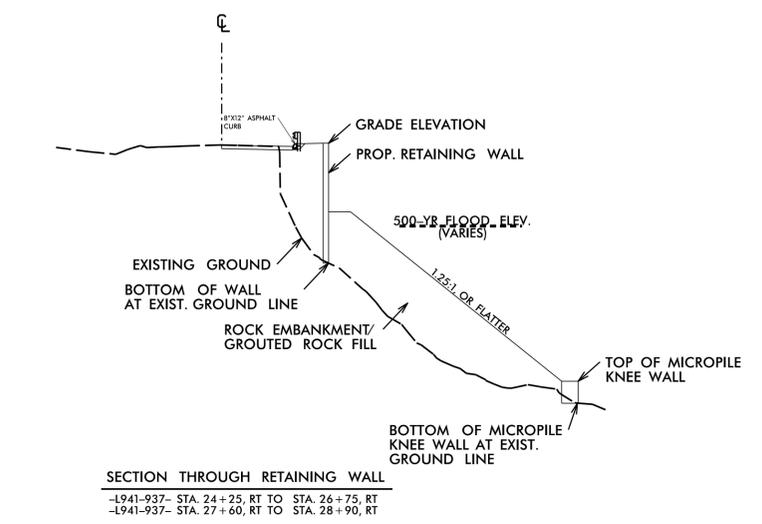
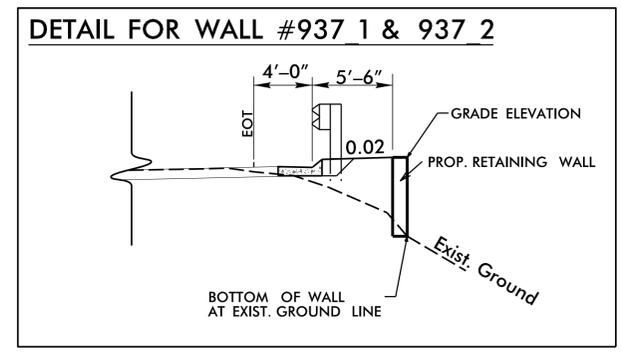
REVISIONS						SHEET NO. W-15
NO.	BY	DATE	NO.	BY	DATE	
1			3			
2			4			

# SITE 937 RETAINING WALLS:

GEOTECHNICAL ENGINEER  Signed by: <i>Robert E. Kral</i> DATE: 12/3/2025	ENGINEER SIGNATURE: _____ DATE: _____
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	



**SITE 937 - PLAN**  
NOT TO SCALE



**RETAINING WALL #937\_1 & #937\_2 - ENVELOPE**  
NOT TO SCALE  
(LOOKING AT FACE OF WALL)

THE WALL ENVELOPE DOES NOT ACCURATELY DEPICT THE ACTUAL WALL FACE OF WALL #937\_2 AT THE FOLLOWING LOCATIONS:  
-L941-937- STA. 27 + 60.00 TO 28 + 90.00, RT

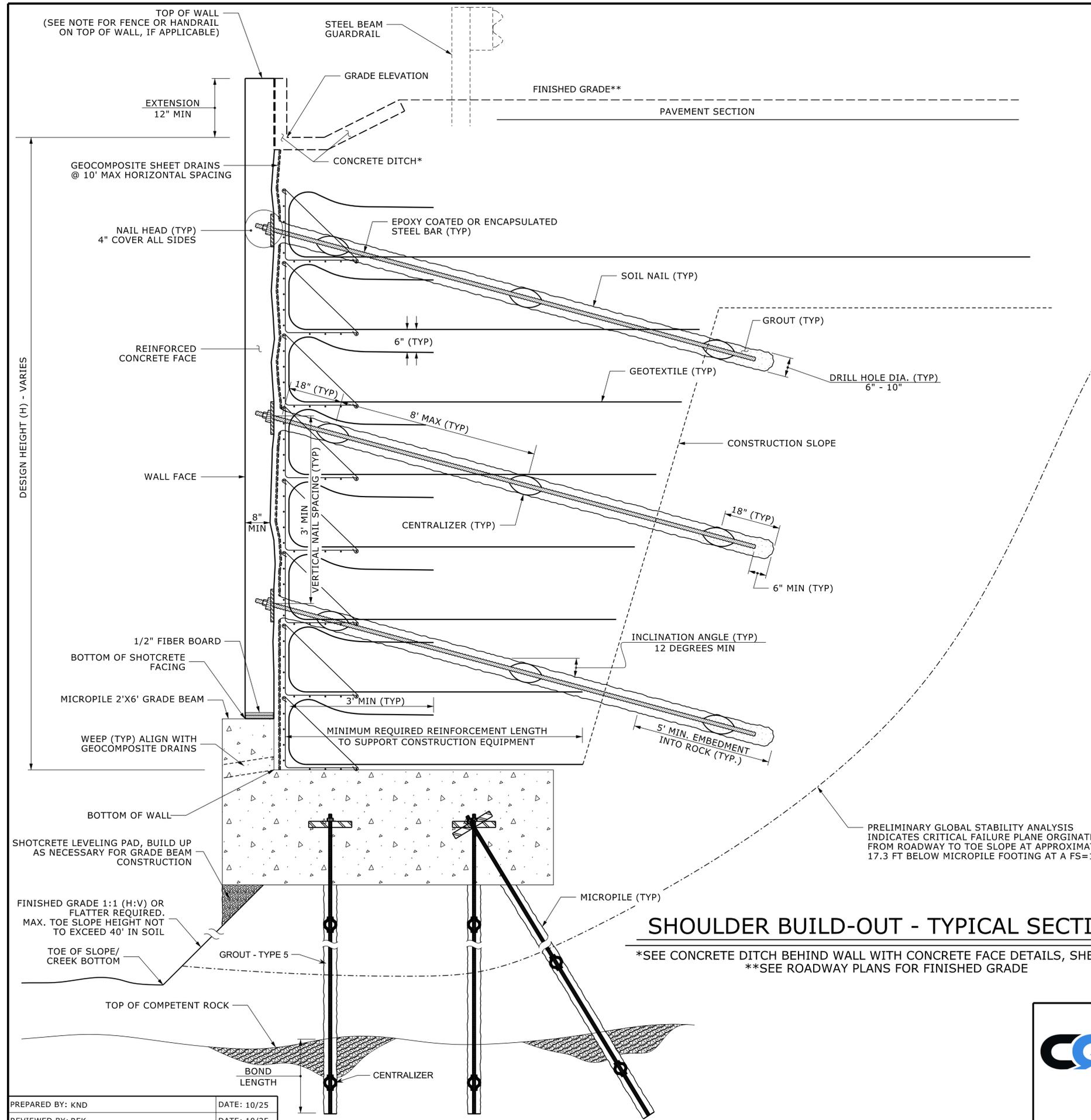
STA. -L941-937-	GRADE ELEVATION (FT)	BOTTOM OF WALL ELEVATION (FT)	WALL DESIGN HEIGHT "H" (FT)
<b>SITE 937 RETAINING WALL #937_1</b>			
24+25.00	1,264.46	1,264.46	0.00
24+50.00	1,262.87	1,253.39	9.48
25+00.00	1,259.89	1,251.85	8.04
25+50.00	1,256.97	1,247.26	9.71
26+00.00	1,253.99	1,247.12	6.87
26+50.00	1,250.49	1,241.76	8.73
26+75.00	1,248.74	1,248.74	0.00
<b>SITE 937 RETAINING WALL #937_2</b>			
27+60.00	1,243.51	1,243.41	0.00
28+00.00	1,241.25	1,232.53	8.72
28+50.00	1,238.56	1,234.40	4.16
28+75.00	1,237.28	1,233.75	3.53
28+90.00	1,236.51	1,236.51	0.00

PROJECT NO.: W03293  
POLK COUNTY  
STATION: -L941-937- STA. 23+50.00 TO 29+00.00, RT  
SHEET 1 OF 4

PREPARED BY: KND DATE: 10/25  
REVIEWED BY: REK DATE: 10/25  
RETAINING WALL ENVELOPES AND DESIGN LAYOUT PROVIDED BY TGS JULY 30, 2025.

Prepared in the Office of:  
  
**CAROLINAS GEOTECHNICAL GROUP**  
 1805 SARDIS ROAD NORTH  
 SUITE 100  
 CHARLOTTE, NC 28270  
 (980) 339-8684

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W-16
2			4			



### SHOULDER BUILD-OUT - TYPICAL SECTION

\*SEE CONCRETE DITCH BEHIND WALL WITH CONCRETE FACE DETAILS, SHEET W-6  
 \*\*SEE ROADWAY PLANS FOR FINISHED GRADE

GEOTECHNICAL ENGINEER  Robert E. Kral 12/3/2025 DATE	ENGINEER _____ SIGNATURE _____ DATE
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	

### NOTES:

- FOR SOIL NAIL SHOULDER BUILD-OUT, SEE SOIL NAIL RETAINING WALLS SPECIAL PROVISION.
- FOR MICROPILE GRADE BEAM, SEE MICROPILE GRADE BEAM SPECIAL PROVISION.
- FOR MICROPILES, SEE MICROPILE GRADE BEAM SPECIAL PROVISION.
- DESIGN MICROPILE GRADE BEAM FOR A MINIMUM OF 5 FEET OF GROUND LOSS BELOW GRADE BEAM.
- MICROPILE CASING MAY BE REQUIRED.
- ESTABLISH THE BACK OF SOIL NAIL WALL FACE AT A 3.5' OR GREATER OFFSET FROM THE BACK OF THE EXISTING OR PROPOSED GUARDRAIL POST.
- EXTEND THE TOP TWO LAYERS OF GEOTEXTILE TO CENTERLINE OF ROAD.
- FOR SOIL NAIL RETAINING WALLS, SEE SOIL NAIL RETAINING WALLS SPECIAL PROVISION.
- DESIGN SOIL NAIL RETAINING WALL AND MICROPILE GRADE BEAM FOR INTERNAL, EXTERNAL, AND GLOBAL STABILITY.
- FOR STEEL BEAM GUARDRAIL, SEE ROADWAY PLANS AND SECTION 862 OF THE STANDARD SPECIFICATIONS.
- BEFORE BEGINNING SOIL NAIL WALL DESIGN FOR SITE 937 RETAINING WALL, SURVEY WALL LOCATION AND SUBMIT A REVISED WALL PROFILE VIEW (WALL ENVELOPE) FOR REVIEW. DO NOT START WALL DESIGN OR CONSTRUCTION UNTIL THE REVISED WALL ENVELOPE IS ACCEPTED.
- DESIGN SITE 937 RETAINING WALL FOR THE FOLLOWING:
  - 1) DESIGN HEIGHT (H) = WALL HEIGHT + WALL EMBEDMENT
  - 2) DESIGN LIFE = 75 YEARS
  - 3) MINIMUM WALL EMBEDMENT DEPTH = 1 FT
  - 4) ROCK EMBANKMENT PARAMETERS:  
 UNIT WEIGHT,  $\gamma = 135$  PCF  
 FRICTION ANGLE,  $\phi = 42$  DEGREES  
 COHESION,  $c = 0$  PSF
  - 5) ASSUMED BORROW MATERIAL PARAMETERS, SEE SECTION 1018 OF THE STANDARD SPECIFICATIONS  
 UNIT WEIGHT,  $\gamma = 120$  PCF  
 FRICTION ANGLE,  $\phi = 30$  DEGREES  
 COHESION,  $c = 0$  PSF
  - 6) IN-SITU ASSUMED MATERIAL PARAMETERS RESIDUAL SOIL:  
 UNIT WEIGHT,  $\gamma = 120$  PCF  
 FRICTION ANGLE,  $\phi = 30$  DEGREES  
 COHESION,  $c = 0$  PSF
  - 7) IN-SITU ASSUMED MATERIAL PARAMETERS CRYSTALLINE ROCK:  
 UNIT WEIGHT,  $\gamma = 170$  PCF  
 FRICTION ANGLE,  $\phi = 34$  DEGREES  
 COHESION,  $c = 1,000$  PSF
- EXISTING OR FUTURE OBSTRUCTIONS SUCH AS FOUNDATIONS, FENCE OR HANDRAIL POSTS, PAVEMENTS, PIPES, INLETS OR UTILITIES MAY INTERFERE WITH SOIL NAILS FOR SITE 937 RETAINING WALL.
- "TEMPORARY SHORING" MAY BE REQUIRED FOR SITE 937 RETAINING WALL IN ACCORDANCE WITH THE TEMPORARY SHORING PROVISION. SEE ROADWAY OR TRAFFIC CONTROL PLANS.

PRELIMINARY GLOBAL STABILITY ANALYSIS INDICATES CRITICAL FAILURE PLANE ORIGINATES FROM ROADWAY TO TOE SLOPE AT APPROXIMATELY 17.3 FT BELOW MICROPILE FOOTING AT A FS=1.9

PROJECT NO.: W03293  
 POLK COUNTY  
 STATION: -L941-937- STA. 23+50.00 TO 29+00.00, RT  
 SHEET 2 OF 4

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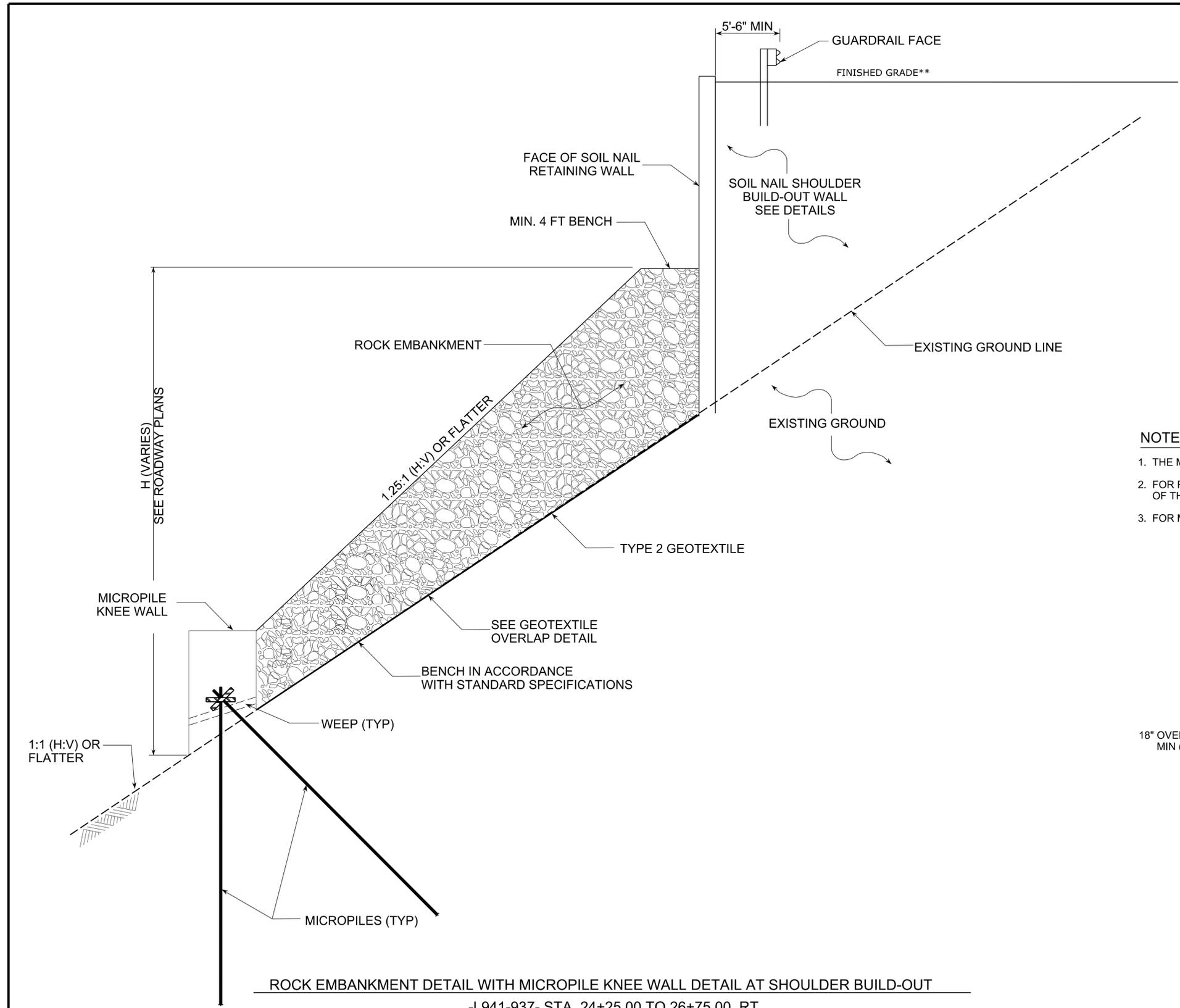


**CAROLINAS GEOTECHNICAL GROUP**  
 1805 SARDIS ROAD NORTH  
 SUITE 100  
 CHARLOTTE, NC 28270  
 (980) 339-8684

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W-17
2			4			

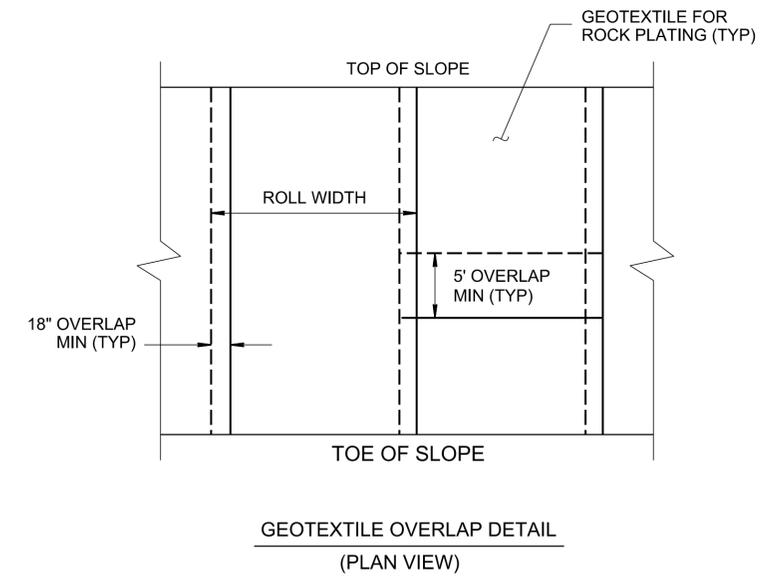
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 DATE: 10/25  
 REVIEWED BY: REK  
 DATE: 10/25

GEOTECHNICAL ENGINEER  SEAL 042642 ENGINEER ROBERT E. KRAL	ENGINEER    _____ SIGNATURE DATE
Signed by: <u>Robert E. Kral</u> 12/3/2025 DATE SIGNATURE DATE	
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**NOTES:**

1. THE MAXIMUM ALLOWABLE HEIGHT FOR THE ROCK EMBANKMENT DETAIL IS 80'.
2. FOR ROCK EMBANKMENT, BENCH EXISTING SLOPE IN ACCORDANCE WITH SECTION 235 OF THE STANDARD SPECIFICATIONS, WHERE POSSIBLE.
3. FOR MICROPILE KNEE WALL, SEE THE MICROPILE GRADE BEAM SPECIAL PROVISION.



**ROCK EMBANKMENT DETAIL WITH MICROPILE KNEE WALL DETAIL AT SHOULDER BUILD-OUT**

-L941-937- STA. 24+25.00 TO 26+75.00, RT  
 -L941-937- STA. 27+60.00 TO 28+90.00, RT

PROJECT NO.: W03293

POLK COUNTY

STATION: -L941-937- STA. 23+50.00 TO 29+00.00, RT

SHEET 3 OF 4

PREPARED BY: KND	DATE: 10/25
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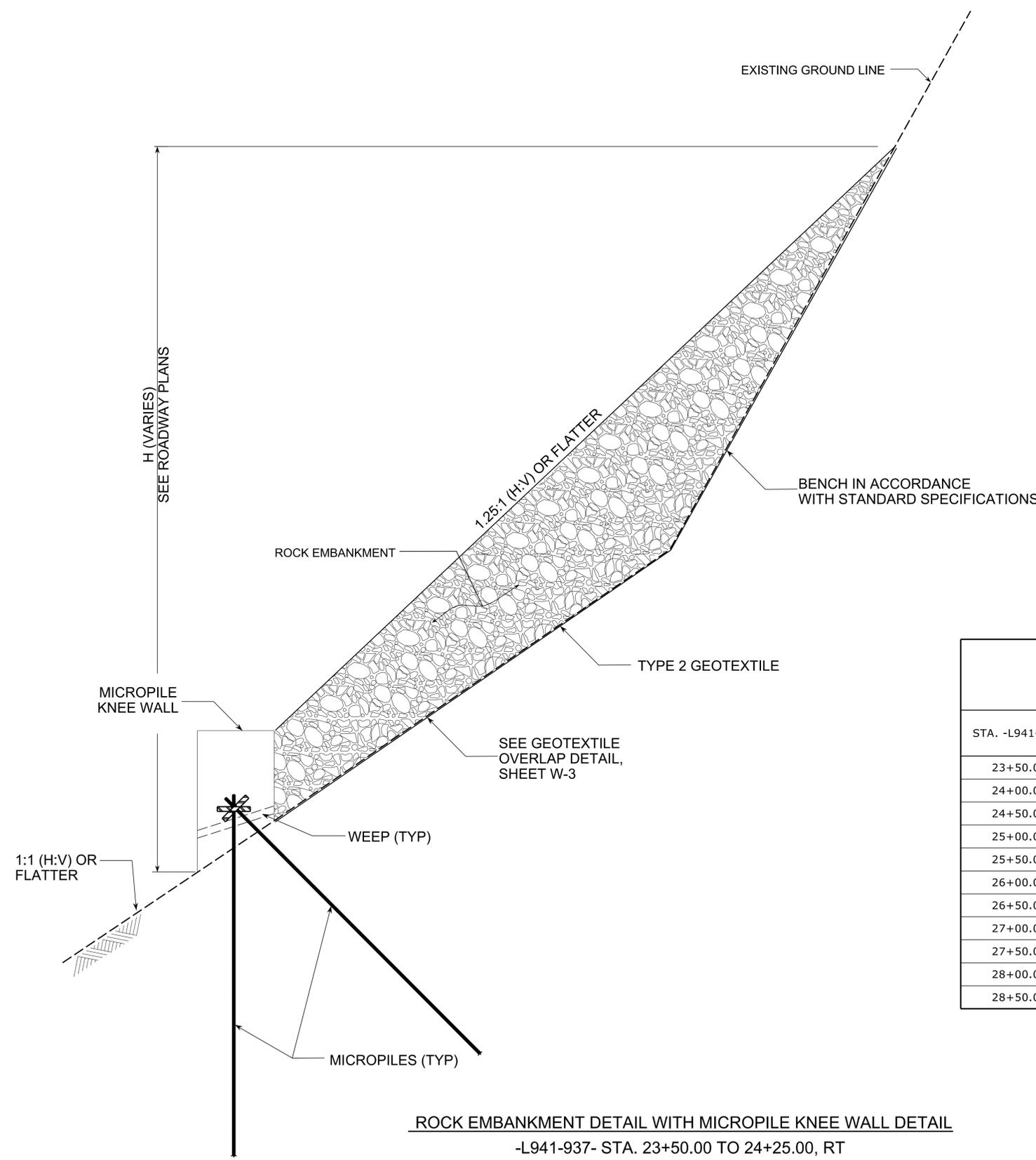


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REVISIONS						SHEET NO. W-18
NO.	BY	DATE	NO.	BY	DATE	
1			3			
2			4			

GEOTECHNICAL ENGINEER  Robert E. Krul 12/3/2025	ENGINEER _____ SIGNATURE DATE
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ESTIMATED QUANTITIES - SITE 937	
SOIL NAIL RETAINING WALL #937_1	1,920 SF
SOIL NAIL RETAINING WALL #937_2	620 SF
MICROPILE GRADE BEAM	380 LF
ROCK EMBANKMENTS	17,100 TON
GEOTEXTILE FOR ROCK EMBANKMENTS	4,350 SY
MICROPILE GRADE BEAM	540 LF
GROUT FOR ROCK FILL	1,200 CY

ROCK EMBANKMENT WITH MICROPILE KNEE WALL						
STA. -L941-937-	TOP OF SLOPE OFFSET (FT)	TOP OF KNEE WALL OFFSET (FT)	TOP OF KNEE WALL ELEVATION (FT)	BOTTOM OF KNEE WALL ELEVATION (FT)	500-YR FLOOD ELEVATION (FT)	MIN. ROCK FILL ELEVATION (FT)
23+50.00	19.5' RT	70.0' RT	1233.3	1229.3	1247.7	1249.7
24+00.00	19.5' RT	65.0' RT	1234.6	1230.6	1245.9	1247.9
24+50.00	20.5' RT	65.0' RT	1226.5	1222.5	1252.2	1254.2
25+00.00	20.5' RT	65.0' RT	1221.4	1217.4	1237.6	1239.6
25+50.00	20.5' RT	65.0' RT	1218.8	1214.8	1236.7	1238.7
26+00.00	20.5' RT	39.8' RT	1215.6	1211.6	1230.7	1232.7
26+50.00	20.5' RT	70.0' RT	1211.8	1207.8	1231.1	1233.1
27+00.00	19.5' RT	69.1' RT	1207.2	1203.2	1235.1	1237.1
27+50.00	19.5' RT	65.8' RT	1516.1	1212.1	1227.7	1229.7
28+00.00	32.2' RT	65.0' RT	1197.6	1193.63	1228.9	1230.9
28+50.00	20.5' RT	65.0' RT	1201.6	1197.6	1221.1	1223.1

**ROCK EMBANKMENT DETAIL WITH MICROPILE KNEE WALL DETAIL**  
 -L941-937- STA. 23+50.00 TO 24+25.00, RT  
 -L941-937- STA. 26+75.00 TO 27+60.00, RT

PROJECT NO.: W03293  
 POLK COUNTY  
 STATION: -L941-937- STA. 23+50.00 TO 29+00.00, RT  
 SHEET 4 OF 4

PREPARED BY: KND DATE: 10/25  
 REVIEWED BY: REK DATE: 10/25

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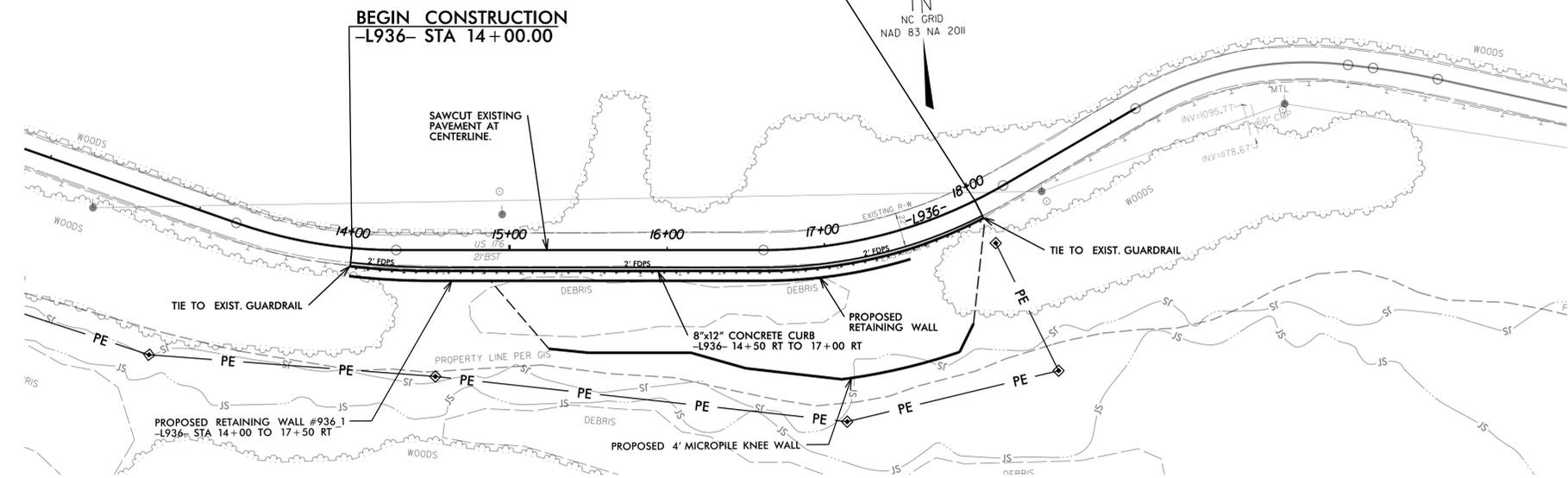
NORTH CAROLINA  
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**GEOTECHNICAL ENGINEERING UNIT**

**SITE 937 RETAINING WALLS  
 SHOULDER BUILD-OUT &  
 ROCK EMBANKMENT WITH  
 MICROPILE KNEE WALL**

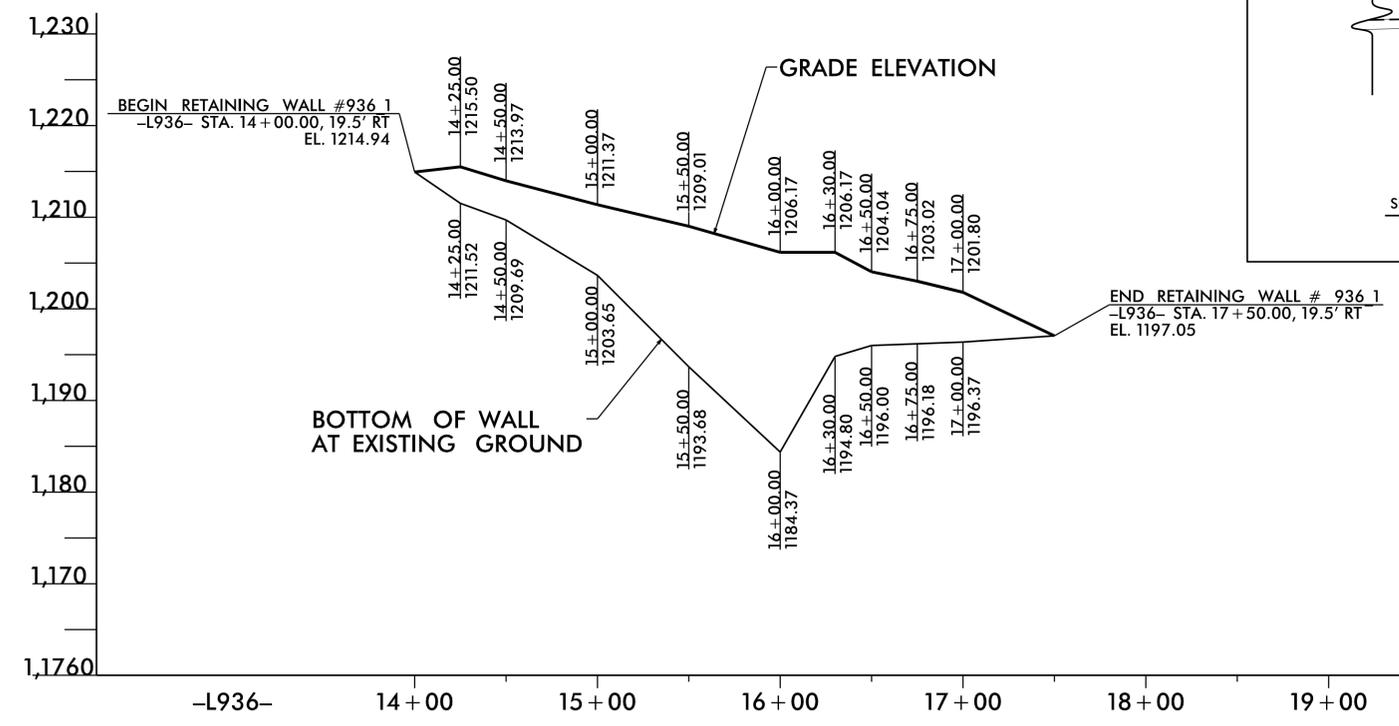
REVISIONS						SHEET NO. W-19
NO.	BY	DATE	NO.	BY	DATE	
1			3			
2			4			

# SITE 936 RETAINING WALL: END CONSTRUCTION

-L936- STA 18+00.00



**SITE 936 - PLAN**  
NOT TO SCALE

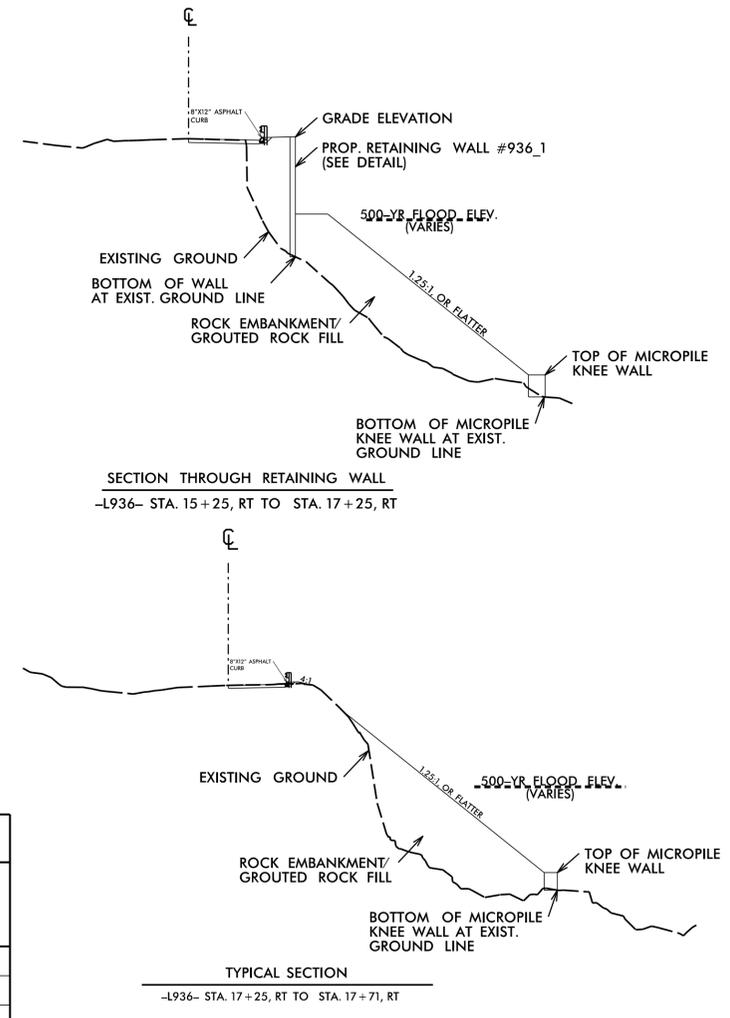
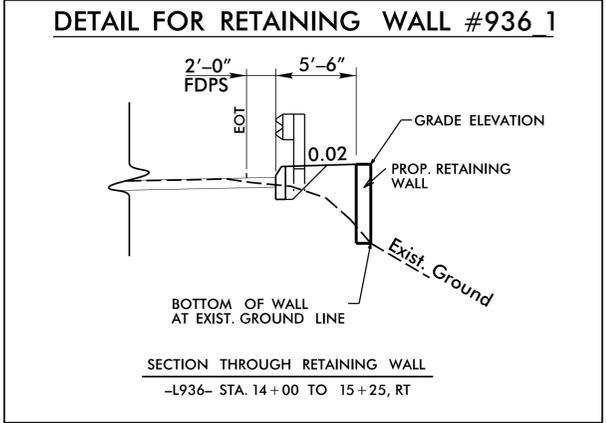


**RETAINING WALL #936 1 - ENVELOPE**  
NOT TO SCALE (LOOKING AT FACE OF WALL)

THE WALL ENVELOPE DOES NOT ACCURATELY DEPICT THE ACTUAL WALL FACE OF WALL #936 1 AT THE FOLLOWING LOCATIONS:  
-L936- STA. 14+00.00 TO 14+50.00, RT  
AND -L936- STA. 16+61.11 TO 17+50.00, RT

PREPARED BY: KND DATE: 10/25  
REVIEWED BY: REK DATE: 10/25

RETAINING WALL ENVELOPE AND DESIGN LAYOUT PROVIDED BY TGS JULY 25, 2025.



SITE 936 RETAINING WALL			
STA. -L936-	GRADE ELEVATION (FT)	BOTTOM OF WALL ELEVATION (FT)	WALL DESIGN HEIGHT "H" (FT)
14+00.00	1,214.94	1,214.94	0.00
12+25.00	1,215.50	1,211.52	3.98
14+50.00	1,213.97	1,209.69	4.28
15+00.00	1,211.37	1,203.65	7.72
15+50.00	1,209.01	1,193.68	15.33
16+00.00	1,206.17	1,184.37	21.80
16+30.00	1,206.17	1,194.80	11.37
16+50.00	1,204.04	1,196.00	8.04
16+75.00	1,203.02	1,196.18	6.84
17+00.00	1,201.80	1,196.37	5.43
17+50.00	1,197.05	1,197.05	0.00

GEOTECHNICAL ENGINEER

ENGINEER

SEAL 042642

ROBERT E. KRAL

Signed by: Robert E. Kral DATE: 12/3/2025

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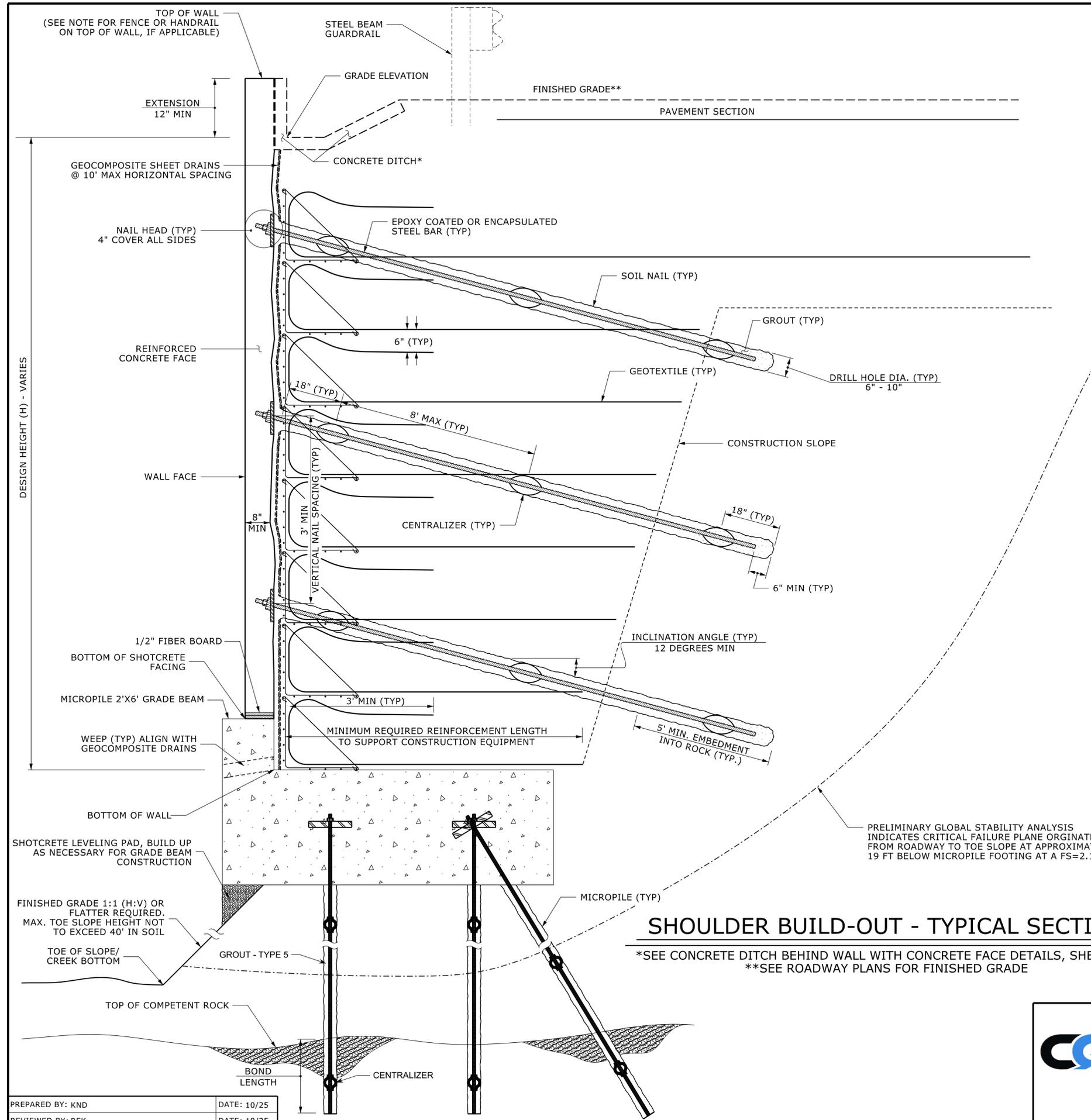
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SITE 936 RETAINING WALL SHOULDER BUILD-OUT & ROCK EMBANKMENT WITH MICROPILE KNEE WALL

REVISIONS					
NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

SHEET NO. W-20



### SHOULDER BUILD-OUT - TYPICAL SECTION

\*SEE CONCRETE DITCH BEHIND WALL WITH CONCRETE FACE DETAILS, SHEET W-6  
 \*\*SEE ROADWAY PLANS FOR FINISHED GRADE

GEOTECHNICAL ENGINEER  Robert E. Kral 12/3/2025 DATE	ENGINEER _____ SIGNATURE _____ DATE
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### NOTES:

- FOR SOIL NAIL SHOULDER BUILD-OUT, SEE SOIL NAIL RETAINING WALLS SPECIAL PROVISION.
- FOR MICROPILE GRADE BEAM, SEE MICROPILE GRADE BEAM SPECIAL PROVISION.
- FOR MICROPILES, SEE MICROPILE GRADE BEAM SPECIAL PROVISION.
- DESIGN MICROPILE GRADE BEAM FOR A MINIMUM OF 5 FEET OF GROUND LOSS BELOW GRADE BEAM.
- MICROPILE CASING MAY BE REQUIRED.
- ESTABLISH THE BACK OF SOIL NAIL WALL FACE AT A 3.5' OR GREATER OFFSET FROM THE BACK OF THE EXISTING OR PROPOSED GUARDRAIL POST.
- EXTEND THE TOP TWO LAYERS OF GEOTEXTILE TO CENTERLINE OF ROAD.
- FOR SOIL NAIL RETAINING WALLS, SEE SOIL NAIL RETAINING WALLS SPECIAL PROVISION.
- DESIGN SOIL NAIL RETAINING WALL AND MICROPILE GRADE BEAM FOR INTERNAL, EXTERNAL, AND GLOBAL STABILITY.
- FOR STEEL BEAM GUARDRAIL, SEE ROADWAY PLANS AND SECTION 862 OF THE STANDARD SPECIFICATIONS.
- BEFORE BEGINNING SOIL NAIL WALL DESIGN FOR SITE 936 RETAINING WALL, SURVEY WALL LOCATION AND SUBMIT A REVISED WALL PROFILE VIEW (WALL ENVELOPE) FOR REVIEW. DO NOT START WALL DESIGN OR CONSTRUCTION UNTIL THE REVISED WALL ENVELOPE IS ACCEPTED.
- DESIGN SITE 936 RETAINING WALL FOR THE FOLLOWING:
  - 1) DESIGN HEIGHT (H) = WALL HEIGHT + WALL EMBEDMENT
  - 2) DESIGN LIFE = 75 YEARS
  - 3) MINIMUM WALL EMBEDMENT DEPTH = 1 FT
  - 4) ROCK EMBANKMENT PARAMETERS:
    - UNIT WEIGHT,  $\gamma = 135$  PCF
    - FRICTION ANGLE,  $\phi = 42$  DEGREES
    - COHESION,  $c = 0$  PSF
  - 5) ASSUMED BORROW MATERIAL PARAMETERS, SEE SECTION 1018 OF THE STANDARD SPECIFICATIONS
    - UNIT WEIGHT,  $\gamma = 120$  PCF
    - FRICTION ANGLE,  $\phi = 30$  DEGREES
    - COHESION,  $c = 0$  PSF
  - 6) IN-SITU ASSUMED MATERIAL PARAMETERS RESIDUAL SOIL:
    - UNIT WEIGHT,  $\gamma = 120$  PCF
    - FRICTION ANGLE,  $\phi = 30$  DEGREES
    - COHESION,  $c = 0$  PSF
  - 7) IN-SITU ASSUMED MATERIAL PARAMETERS CRYSTALLINE ROCK:
    - UNIT WEIGHT,  $\gamma = 170$  PCF
    - FRICTION ANGLE,  $\phi = 34$  DEGREES
    - COHESION,  $c = 1,000$  PSF
- EXISTING OR FUTURE OBSTRUCTIONS SUCH AS FOUNDATIONS, FENCE OR HANDRAIL POSTS, PAVEMENTS, PIPES, INLETS OR UTILITIES MAY INTERFERE WITH SOIL NAILS FOR SITE 936 RETAINING WALL.
- "TEMPORARY SHORING" MAY BE REQUIRED FOR SITE 936 RETAINING WALL IN ACCORDANCE WITH THE TEMPORARY SHORING PROVISION. SEE ROADWAY OR TRAFFIC CONTROL PLANS.

PRELIMINARY GLOBAL STABILITY ANALYSIS INDICATES CRITICAL FAILURE PLANE ORIGINATES FROM ROADWAY TO TOE SLOPE AT APPROXIMATELY 19 FT BELOW MICROPILE FOOTING AT A FS=2.1

PROJECT NO.: W03293  
 POLK COUNTY  
 STATION: -L936- STA. 14+00.00 TO 18+00.00, RT  
 SHEET 2 OF 6

PREPARED BY: KND	DATE: 10/25
REVIEWED BY: REK	DATE: 10/25

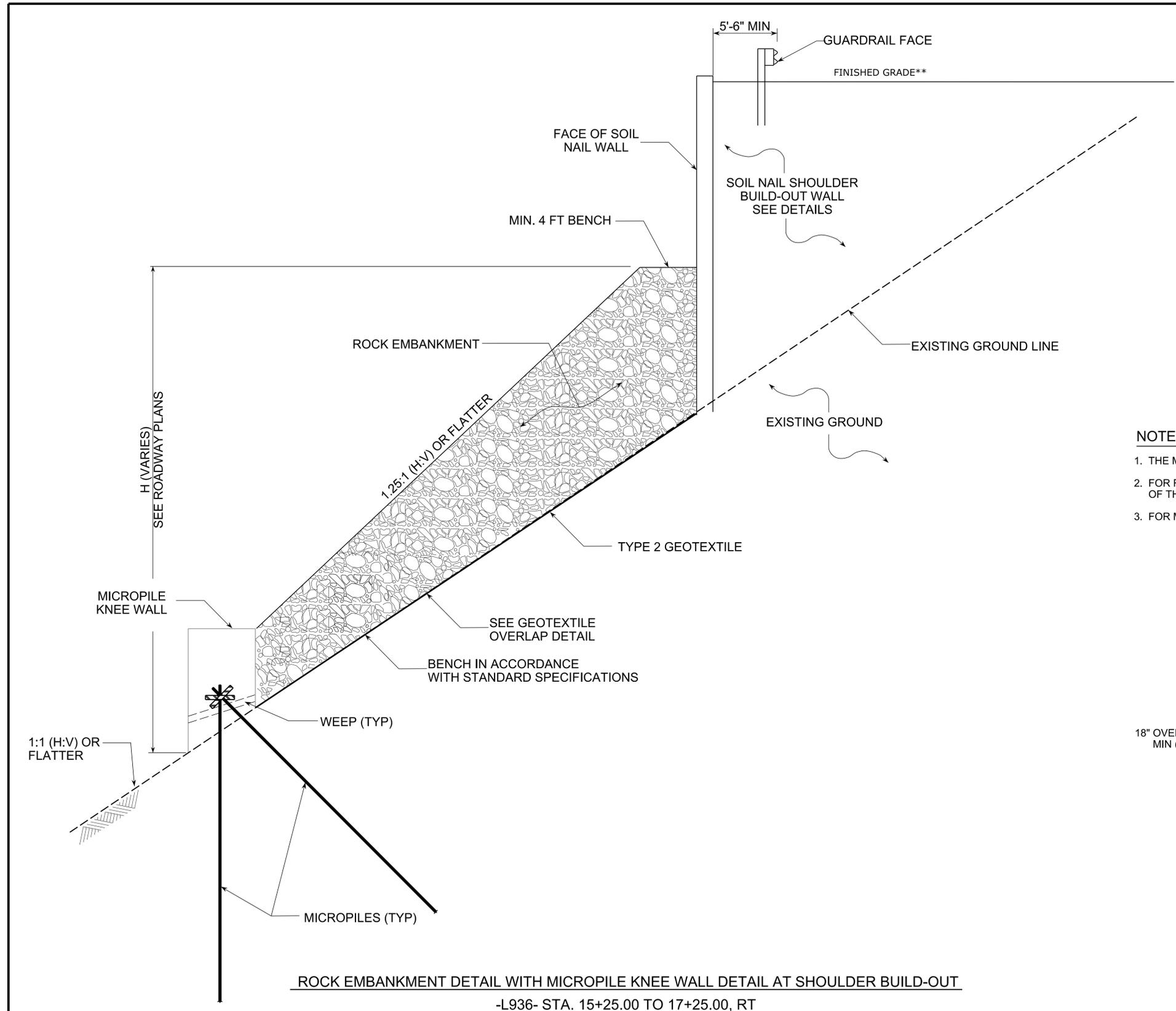
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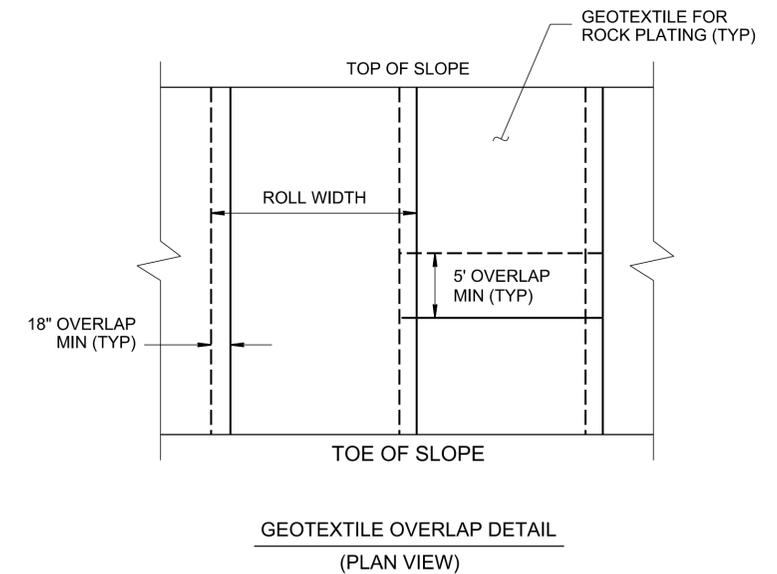
REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W-21
2			4			

GEOTECHNICAL ENGINEER  SEAL 042642 ENGINEER ROBERT E. KRAL	ENGINEER    _____ SIGNATURE DATE
Signed by: <u>Robert E. Kral</u> 12/3/2025 DATE	
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	



**NOTES:**

1. THE MAXIMUM ALLOWABLE HEIGHT FOR THE ROCK EMBANKMENT DETAIL IS 80'.
2. FOR ROCK EMBANKMENT, BENCH EXISTING SLOPE IN ACCORDANCE WITH SECTION 235 OF THE STANDARD SPECIFICATIONS, WHERE POSSIBLE.
3. FOR MICROPILE KNEE WALL, SEE THE MICROPILE GRADE BEAM SPECIAL PROVISION.



**ROCK EMBANKMENT DETAIL WITH MICROPILE KNEE WALL DETAIL AT SHOULDER BUILD-OUT**  
 -L936- STA. 15+25.00 TO 17+25.00, RT

PROJECT NO.: W03293  
 POLK COUNTY  
 STATION: -L936- STA. 14+00.00 TO 18+00.00, RT  
 SHEET 3 OF 6

PREPARED BY: KND	DATE: 10/25
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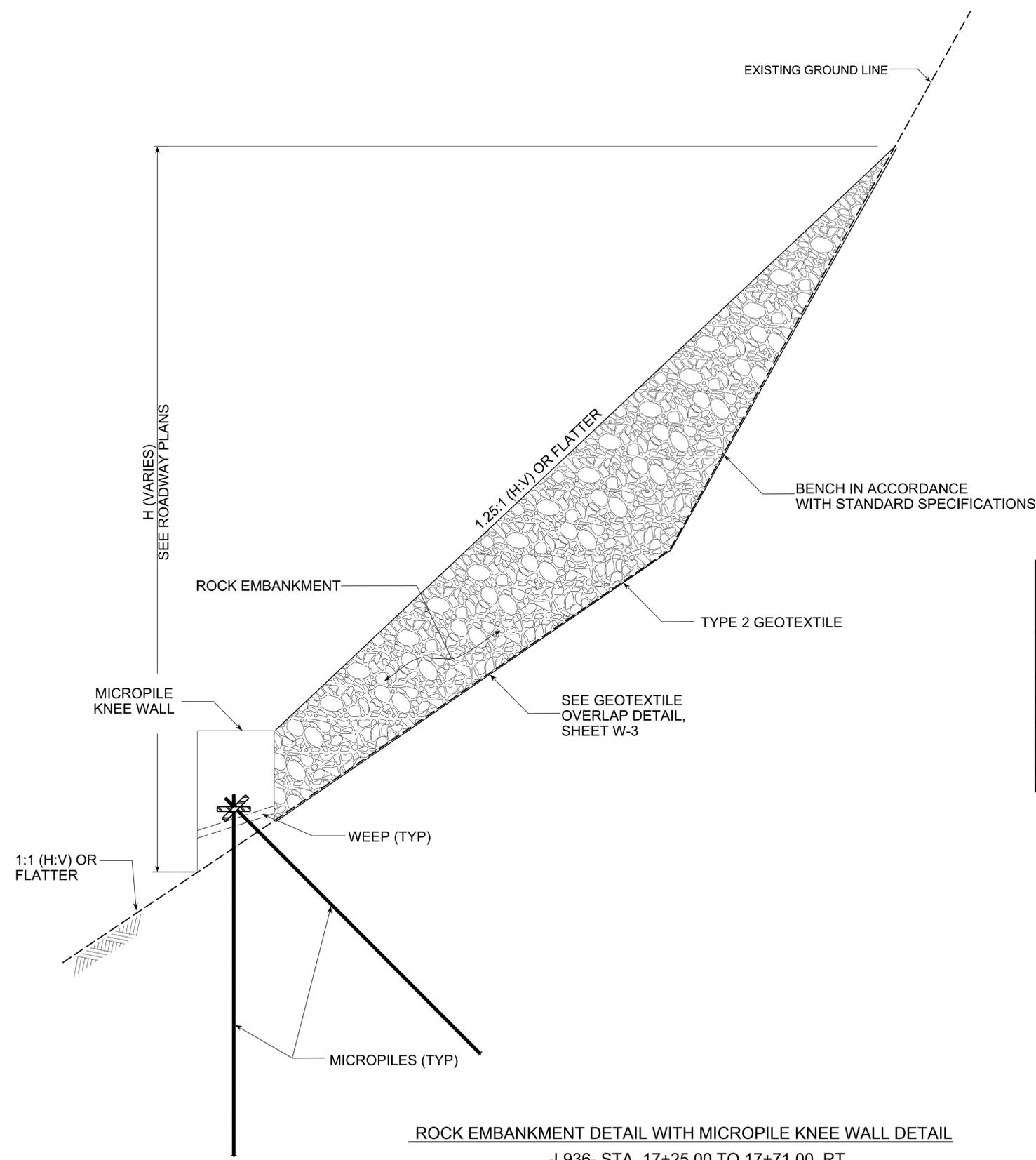
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REVISIONS						SHEET NO. W-22
NO.	BY	DATE	NO.	BY	DATE	
1			3			
2			4			

GEOTECHNICAL ENGINEER   Signed by: <i>Robert E. Krahl</i> 12/3/2025 DATE	ENGINEER    SIGNATURE DATE
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ESTIMATED QUANTITIES - SITE 936	
SOIL NAIL RETAINING WALL	3,200 SF
MICROPILE GRADE BEAM	280 LF
ROCK EMBANKMENTS	11,700 TON
GEOTEXTILE FOR ROCK EMBANKMENTS	2,800 SY
MICROPILE GRADE BEAM	250 LF
GROUT FOR ROCK FILL	650 CY

ROCK EMBANKMENT WITH MICROPILE KNEE WALL						
STA. -L936-	TOP OF SLOPE OFFSET (FT)	TOP OF KNEE WALL OFFSET (FT)	TOP OF KNEE WALL ELEVATION (FT)	BOTTOM OF KNEE WALL ELEVATION (FT)	500-YR FLOOD ELEVATION (FT)	MIN. ROCK FILL ELEVATION (FT)
15+50.00	19.5' RT	65.0' RT	1167.6	1163.6	1193.8	1195.8
16+00.00	19.5' RT	65.0' RT	1162.9	1158.9	1191.1	1193.1
16+50.00	26.1' RT	75.0' RT	1160.7	1156.7	1180.2	1182.2
17+00.00	27.5' RT	85.0' RT	1144.6	1140.6	1173.9	1175.9
17+50.00	17.3' RT	85.0' RT	1139.2	1135.2	1168.5	1170.5

**ROCK EMBANKMENT DETAIL WITH MICROPILE KNEE WALL DETAIL**  
-L936- STA. 17+25.00 TO 17+71.00, RT

PROJECT NO.: W03293  
 POLK COUNTY  
 STATION: -L936- STA. 14+00.00 TO 18+00.00, RT  
 SHEET 4 OF 6

PREPARED BY: KND	DATE: 10/25
REVIEWED BY: REK	DATE: 10/25

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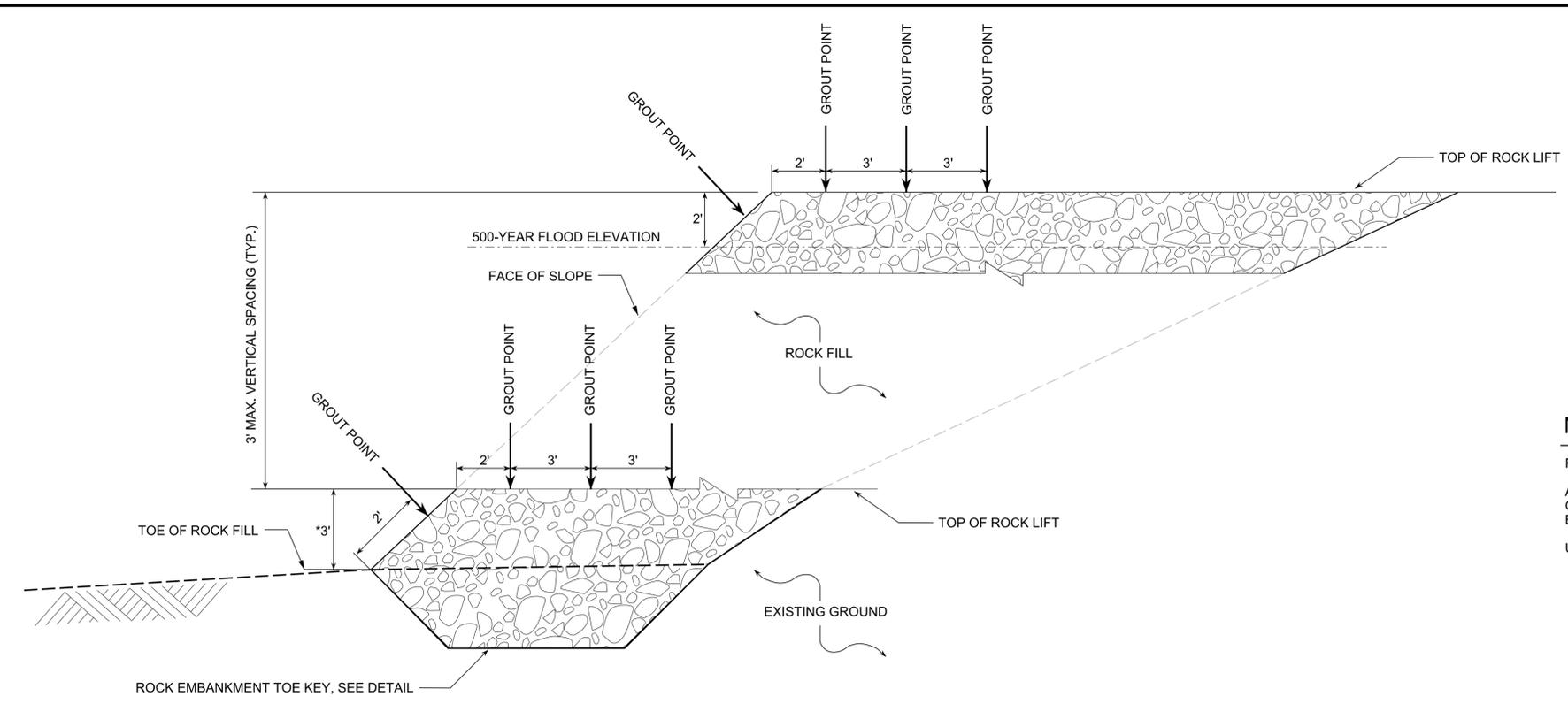
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**SITE 936 RETAINING WALL  
SHOULDER BUILD-OUT &  
ROCK EMBANKMENT WITH  
MICROPILE KNEE WALL**

REVISIONS					
NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

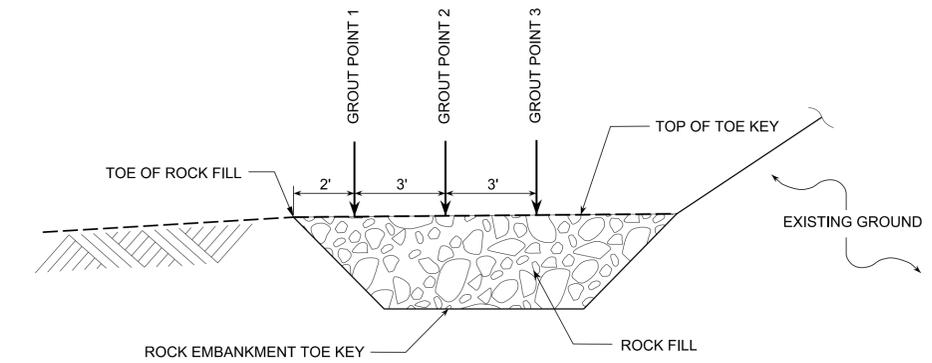
SHEET NO. W-23

GEOTECHNICAL ENGINEER  SEAL 042642 ROBERT E. KRAL	ENGINEER  _____ SIGNATURE DATE
Signed by: <u>Robert E. Kral</u> 12/3/2025 _____ SIGNATURE DATE	
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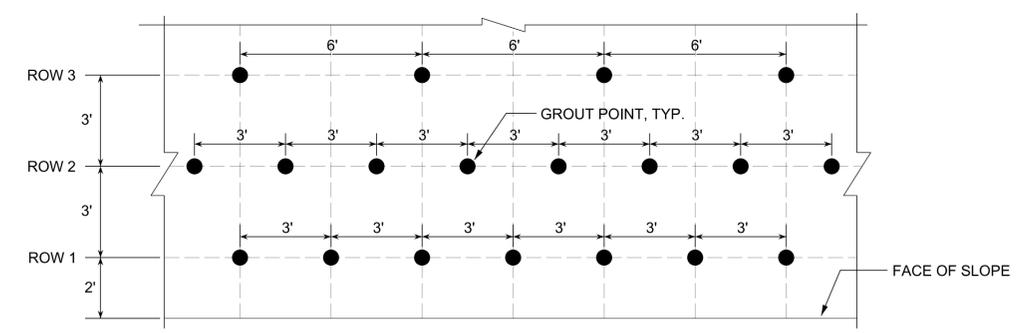
**NOTES:**

- FOR PARTIALLY GROUTED ROCK FILL, SEE THE PARTIALLY GROUTED ROCK FILL SPECIAL PROVISION.
- APPLY GROUT ON THE SLOPE FACE AND AT THE TOP OF EACH 3 FT LIFT OF ROCK FILL. APPLY 3 CUBIC FEET OF GROUT AT EACH GROUT POINT IN THE PATTERNS SHOWN ON PAGE 2. THE HIGHEST GROUT POINT WILL BE THE TOP OF THE ROCK EMBANKMENT.
- USE PARTIALLY GROUTED ROCK FILL FROM TOE TO AT LEAST 2FT ABOVE THE 500-YR FLOOD ELEVATION.



**PARTIALLY GROUTED ROCK FILL - ROCK FILL SECTION**  
 \* IF NO TOE KEY, START GROUTING AT THE TOP OF THE FIRST 3-FT LIFT

**PARTIALLY GROUTED ROCK FILL - TOE KEY DETAIL**



**PARTIALLY GROUTED ROCK FILL - PLAN VIEW GROUT POINTS**  
 VIEW FROM FRONT TOP

**PARTIALLY GROUTED ROCK FILL DETAILS**

PROJECT NO.: W03293  
POLK COUNTY  
 SITE 942 STATION: -L943-942- STA. 15+50.00 TO 23+62.00, RT  
 SITE 939/938 STATION: -L941-937- STA. 18+70.00 TO 23+50.00, RT  
 SITE 937 STATION: -L941-937- STA. 23+50.00 TO 29+00.00, RT  
 SITE 936 STATION: -L936- STA. 14+00.00 TO 18+00.00, RT

SHEET 5 OF 6

PREPARED BY: KND	DATE: 10/25
REVIEWED BY: REK	DATE: 10/25

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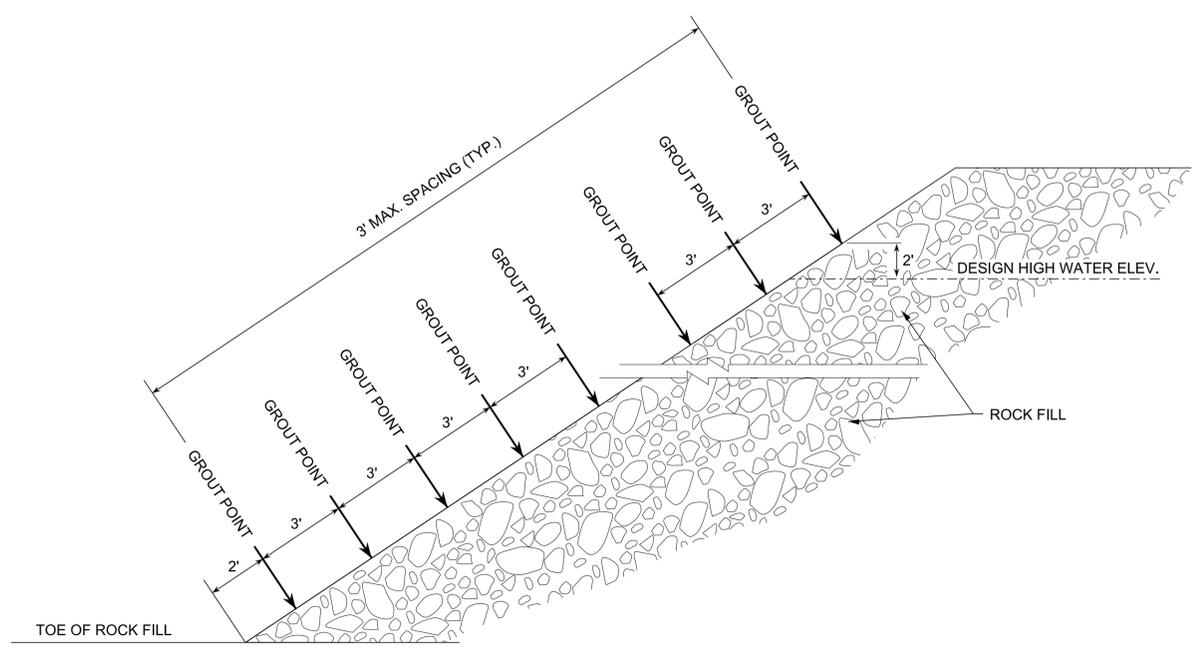


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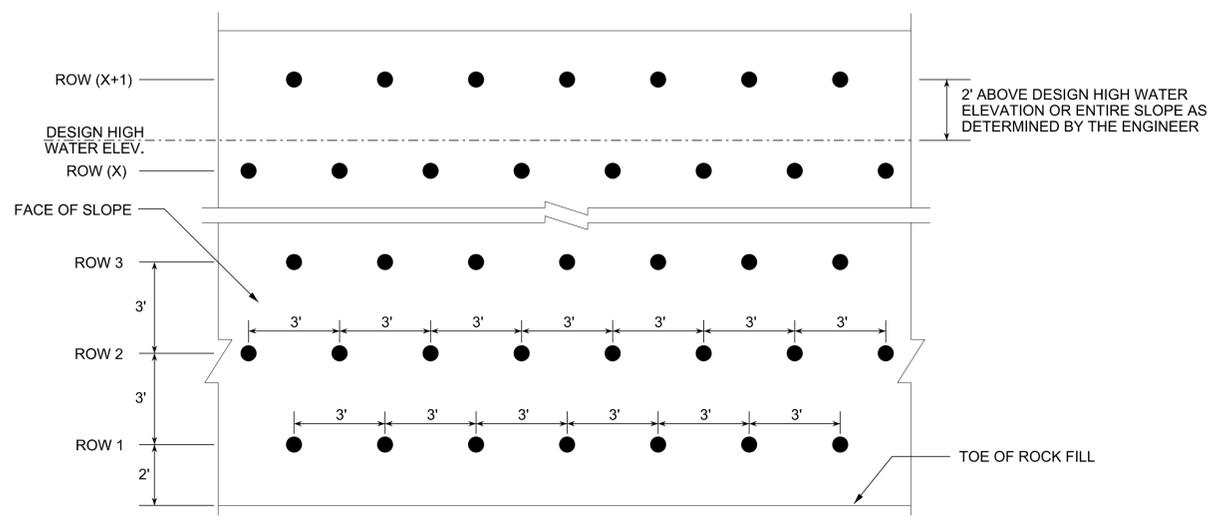
PARTIALLY GROUTED ROCK FILL NOTES & DETAILS					
REVISIONS					
NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

SHEET NO. W-24

GEOTECHNICAL ENGINEER  Signed by: <i>Robert E. Krul</i> PROFESSIONAL ENGINEER ROBERT E. KRUL	ENGINEER     DATE: 12/3/2025 SIGNATURE: _____ DATE: _____
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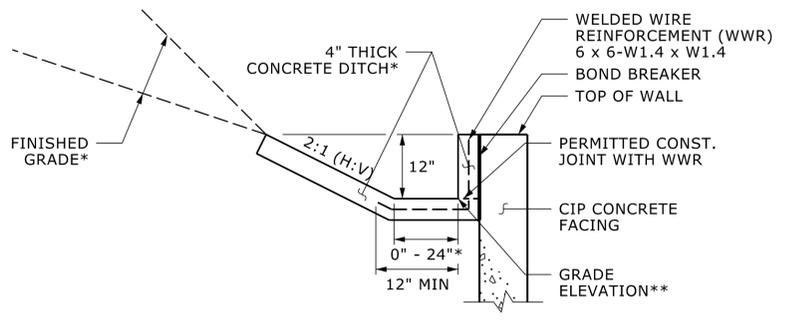


PARTIALLY GROUTED ROCK FILL - SLOPE FACE DETAIL



PARTIALLY GROUTED ROCK FILL - SLOPE FACE GROUT POINTS  
VIEW FROM FRONT SLOPE FACE

PARTIALLY GROUTED ROCK FILL DETAILS



CONCRETE DITCH BEHIND WALL WITH CONCRETE FACING

\*SEE ROADWAY PLANS FOR CONCRETE DITCH AND FINISHED GRADE DETAILS.  
 \*\*SEE WALL ENVELOPE SHEET AND TABLE ON SHEET W-1 FOR GRADE ELEVATIONS.

PROJECT NO.: W03293  
 POLK COUNTY  
 SITE 942 STATION: -L943-942- STA. 15+50.00 TO 23+62.00, RT  
 SITE 939/938 STATION: -L941-937- STA. 18+70.00 TO 23+50.00, RT  
 SITE 937 STATION: -L941-937- STA. 23+50.00 TO 29+00.00, RT  
 SITE 936 STATION: -L936- STA. 14+00.00 TO 18+00.00, RT  
 SHEET 6 OF 6

PREPARED BY: KND	DATE: 10/25
REVIEWED BY: REK	DATE: 10/25

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**GEOTECHNICAL ENGINEERING UNIT**

**PARTIALLY GROUTED ROCK FILL NOTES & DETAILS**

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W-25
2			4			