

Highway 24 Drainage Memo

Existing Conditions

The existing box culvert under Highway 24 was modeled in HY-8 version 8.00.2 with a design discharge of 484 cfs. The two-cell box opening was modeled as 2-12'W x 4.83'H due to the short walls installed at the downstream end of each box. The upstream and downstream invert elevation of 6850.5 and length of 45.5 feet is based on the survey provided. The analysis also used a starting tailwater elevation of 6853, a Manning's roughness coefficient (n-value) of 0.013, and an entrance loss coefficient of 0.5 for a square-edge headwall.

The resulting headwater elevation of 6854.51 does not overtop the top of roadway elevation of 6858, and the resulting HW/D is 0.83, as shown in the results table below.

Total Discharge	Culvert Discharge	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	HW / D	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
100.00	100.00	6853.07	1.40	2.57	0.53	7-H2t	NA	0.81	2.50	2.50	1.67	0.00
160.00	160.00	6853.18	1.91	2.68	0.55	7-H2t	NA	1.11	2.50	2.50	2.67	0.00
220.00	220.00	6853.33	2.36	2.83	0.59	7-H2t	NA	1.38	2.50	2.50	3.67	0.00
280.00	280.00	6853.54	2.76	3.04	0.63	7-H2t	NA	1.62	2.50	2.50	4.67	0.00
340.00	340.00	6853.78	3.13	3.28	0.68	7-H2t	NA	1.84	2.50	2.50	5.67	0.00
400.00	400.00	6854.07	3.48	3.57	0.74	7-H2t	NA	2.05	2.50	2.50	6.67	0.00
484.00	484.00	6854.51	3.94	4.01	0.83	7-H2t	NA	2.33	2.50	2.50	8.07	0.00
520.00	520.00	6854.70	4.13	4.20	0.87	7-H2t	NA	2.44	2.50	2.50	8.67	0.00
580.00	580.00	6855.02	4.45	4.52	0.93	7-H2c	NA	2.63	2.63	2.50	9.20	0.00
640.00	640.00	6855.32	4.76	4.82	1.00	7-H2c	NA	2.81	2.81	2.50	9.50	0.00
700.00	700.00	6855.62	5.07	5.12	1.06	7-H2c	NA	2.98	2.98	2.50	9.79	0.00

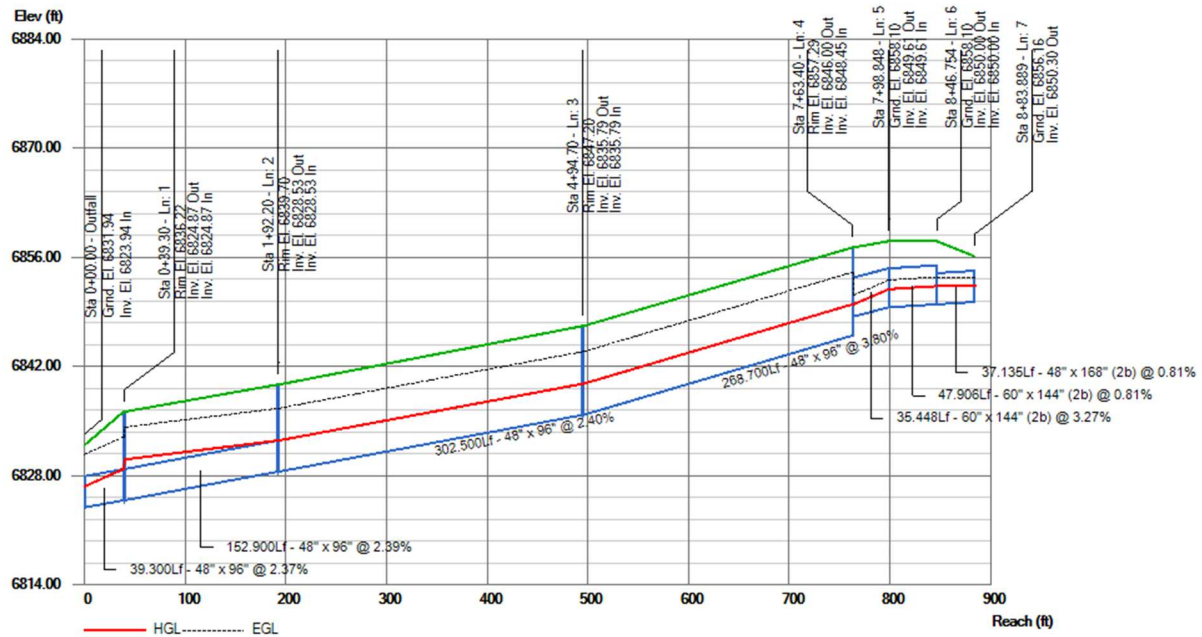
Various tailwater elevations were tested in the analysis. A higher TW of 6853.5 resulted in a slightly higher HW of 6854.59 and a lower exit velocity of 6.72 fps. Similarly, a higher TW of 6854 resulted in a slightly higher HW of 6854.81 and a lower exit velocity of 5.76 fps. A TW of 6855 resulted in a HW of 6855.5 and an exit velocity of 4.48 fps.

Proposed Conditions

The proposed box culvert extension was modeled in Hydraflow Storm Sewers, a tool in Civil 3D Autocad 2025. The short walls at the invert of the existing culverts will be removed so that the full capacity of the 2-12'W x 6'H culverts can be used. The culverts will be extended upstream and downstream per the CDOT plans prepared by HDR dated July 27, 2026 and provided to DBC for the analysis. The downstream extension of the box culverts will be connected to the proposed Falcon Field 8'W x 4'H box culvert via a junction box. The entire system was modeled for the 1% AC Base Level Engineering (BLE) flows prepared and

provided by the CWCB during the design process (484 cfs at Highway 24, and 521 cfs at the downstream limits of the Falcon Field development).

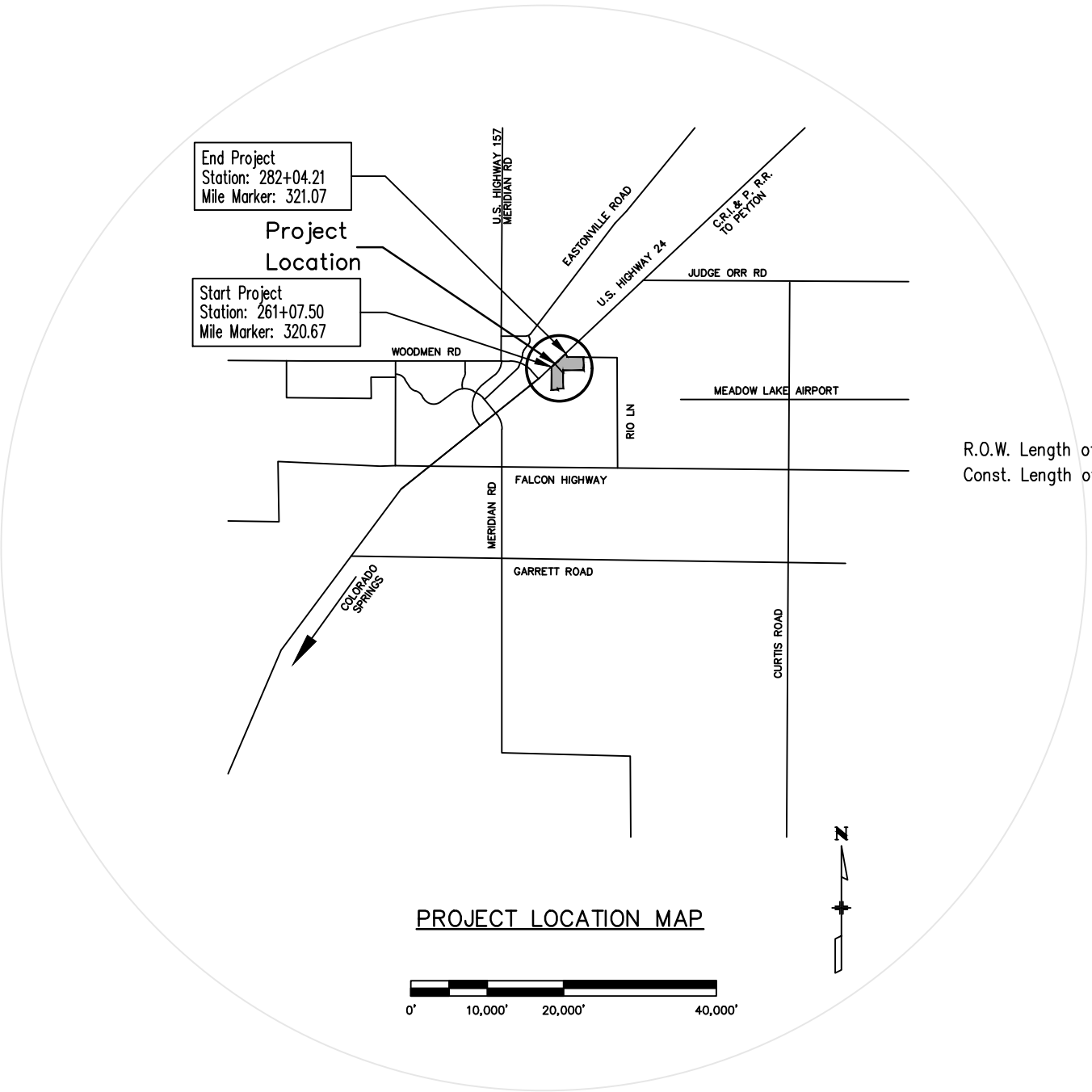
The proposed Hydraflow results are shown below. The proposed HGL at the upstream and downstream ends of the existing box culverts of 6852.33 and 6851.94 are lower than existing. The proposed velocity in the existing boxes of 8.66 fps is similar to existing.



Line No.	Line Length (ft)	Line Size (in)	n-value	Pipe	Flow Rate (cfs)	Capacity Full (cfs)	Vel Ave (ft/s)	Invert Dn (ft)	Invert Up (ft)	HGL Dn (ft)	HGL Up (ft)	EGL Dn (ft)	EGL Up (ft)	Gmd/Rim Elev Dn (ft)	Gmd/Rim Elev Up (ft)	Energy Loss (ft)	Line Slope (%)
1	39.300	48 x 96	0.013		521.00	681.78	20.20	6823.94	6824.87	6826.64	6828.87	6830.76	6832.99	0.00	6836.22	0.000	2.37
2	152.900	48 x 96	0.013		521.00	685.61	16.28	6824.87	6828.53	6830.11	6832.53	6834.23	6836.65	6836.22	6839.70	2.113	2.39
3	302.500	48 x 96	0.013		521.00	686.55	16.28	6828.53	6835.79	6832.53	6839.79	6836.65	6843.91	6839.70	6847.20	4.181	2.40
4	268.700	48 x 96	0.013		521.00	683.85	16.28	6835.79	6846.00	6839.79	6850.00	6843.91	6854.12	6847.20	6857.29	3.714	3.80
5	35.448	60 x 144(2b)	0.013		484.00	3623.75	10.84	6848.45	6849.61	6850.00	6851.94	6851.17	6853.10	6857.29	6858.10	0.000	3.27
6	47.906	60 x 144(2b)	0.013		484.00	1808.01	8.66	6849.61	6850.00	6851.94	6852.33	6853.10	6853.50	6858.10	6858.10	0.000	0.81
7	37.135	48 x 168(2b)	0.013		484.00	1544.57	7.83	6850.00	6850.30	6852.33	6852.40	6853.38	6853.45	6858.10	6856.16	0.000	0.81

DEPARTMENT OF TRANSPORTATION
STATE OF COLORADO

AUXILIARY LANE CONSTRUCTION BID PLANS
AT US HIGHWAY 24, EL PASO COUNTY
ACCESS PERMIT NO: _____



SHEET NO.	INDEX OF SHEETS
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R.O.W. Length of Project = 2096.71 Feet/0.02 Miles
Const. Length of Project = 2096.71 Feet/0.02 Miles

Print Date: 06/16/2026		Sheet Revisions			Colorado Department of Transportation		As Constructed	Cover Sheet			Project No./Code
File Name: CVR		Date:	Comments	Init.	1480 Quail Lake Loop, Suite A Colorado Springs, CO 80906 Phone: (719) 527-5807 Region 2		No Revisions:				Number
Horiz. Scale: 1"=10,000' Vert. Scale: As Noted							Revised:	Designer: TM			Code
PREPARED BY: Drexel, Barrell & Co. Engineers • Surveyors 101 SAWATCH ST. #100 COLORADO SPRINGS, COLORADO 80903 (719) 260-0887 CONTACT: TIM MCCONNELL, P.E.							Void:	Detailer: KV			Sheet Number 1 OF 15
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Print Date: 06/16/2026		Sheet Revisions		Colorado Department of Transportation		As Constructed		Standard Plans List		Project No./Code	
File Name: CVR		Date:	Comments	Init.		No Revisions:	Number				
Horiz. Scale: Vert. Scale: As Noted						Revised:	Designer: TM		Code		
PREPARED BY: Drexel, Barrell & Co. Engineers • Surveyors 101 SAWATCH ST. #100 COLORADO SPRINGS, COLORADO 80903 (719) 260-0887 CONTACT: TIM MCCONNELL, P.E.						Void:	Detailer: KV		Sheet Number 2 OF 15		
				Region 2							

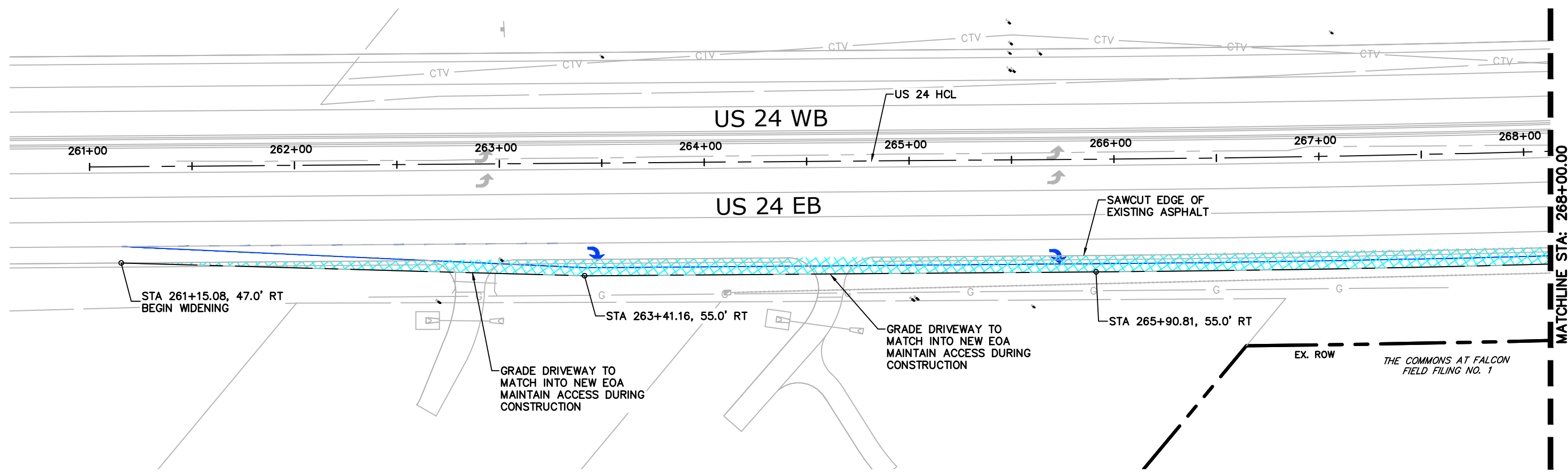
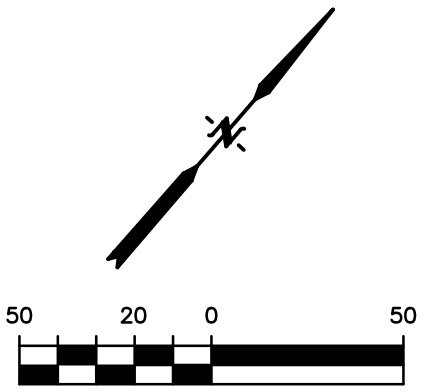
1. THIS PROJECT SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE MOST CURRENT EDITIONS, AT THE TIME OF PROJECT BID ADVERTISEMENT, OF THE COLORADO DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES, COLORADO DEPARTMENT OF TRANSPORTATION STANDARD PLANS, M AND S STANDARDS, THE NATIONAL ELECTRICAL CODE (NEC), COOT FIELD MATERIALS MANUAL, SURVEY MANUAL, AND CO STATE HIGHWAY ACCESS CODE
2. DILUTED EMULSIFIED ASPHALT FOR TACK COAT SHALL CONSIST OF 1 PART EMULSIFIED ASPHALT AND 1 PART WATER.
3. WATER SHALL BE USED AS A DUST PALLIATIVE ALONG US 24 WHERE REQUIRED. LOCATIONS SHALL BE AS DIRECTED BY THE ENGINEER. DUST CONTROL FOR US 24 SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR. THE COST OF THIS WORK WILL NOT BE PAID FOR SEPARATELY, BUT SHALL BE INCLUDED IN THE WORK.
4. THE FOLLOWING SHALL BE FURNISHED WITH EACH BITUMINOUS PAVER:
- a. A SKI TYPE DEVICE AT LEAST 30 FEET IN LENGTH.
- b. SHORT SKI OR SHOE.
- c. 6-INCH SHOE IS REQUIRED FOR SAFETY EDGE TAPER.
- d. AT LEAST 1500 FEET OF CONTROL LINE AND STAKES.
5. ANY LAYER OF BITUMINOUS PAVEMENT THAT IS TO HAVE A SUCCEEDING LAYER PLACED THEREON SHALL BE COMPLETED FULL WIDTH BEFORE SUCCEEDING LAYER IS PLACED.
6. PROOF ROLLING WILL BE REQUIRED FOR SUBGRADE AND CLASS 6 VERIFICATION BEFORE PLACING PAVEMENTS. THE COST FOR PROOF ROLLING SHALL BE INCLUDED IN THE WORK.
7. ASPHALT LONGITUDINAL JOINTS SHALL BE CONSTRUCTED 6 TO 12 INCHES FROM CENTERLINES, LANE LINES AND OUTSIDE EDGE OF TRAVEL LANES IN ACCORDANCE WITH SECTION 401.16. THE CONTRACTOR SHALL SUBMIT A JOINT PLAN 3 DAYS PRIOR TO THE PRE-PAVE MEETING.
8. SAFETY EDGE IS REQUIRED ON ALL PAVED AREAS NOT CONTAINING GUARDRAIL OR CURB AND GUTTER. A SAFETY EDGE PLAN SHALL BE SUBMITTED AT LEAST 3 DAYS PRIOR TO THE PRE-PAVE CONFERENCE.
9. ALL TRAVEL LANES ARE SUBJECT TO SMOOTHNESS INCENTIVE/DISINCENTIVE PAYMENTS. PAVEMENT SMOOTHNESS INCENTIVE/DISINCENTIVE SHALL BE BASED ON INCHES/MILE.
10. THE SMOOTHNESS CATEGORY FOR THIS PROJECT IS MRI CATEGORY A
11. PUBLIC APPROACHES SHALL BE PAVED IN ACCORDANCE WITH STANDARD PLAN M-203-1.
12. THE CONTRACTOR SHALL NOT PARK ANY VEHICLES OR EQUIPMENT IN, OR DISTURB ANY AREAS NOT APPROVED BY THE ENGINEER.
13. PRIOR TO PLACING ANY LAYER OF BITUMINOUS PAVEMENT, THE PAVED SURFACE SHALL BE SWEEPED AND CLEANED BEFORE APPLICATION OF THE TACK COAT. THIS WILL NOT BE PAID FOR SEPARATELY. A TACK COAT SHALL BE APPLIED BETWEEN EVERY BITUMINOUS LAYER AND ON THE MILLED SURFACE.
14. THE CONTRACTOR SHALL SUBMIT A PAVING SEQUENCE SCHEDULE TO THE PROJECT ENGINEER AT LEAST 5 WORKING DAYS PRIOR TO THE PRE-PAVING CONFERENCE. PAVING SHALL NOT BEGIN UNTIL THE SCHEDULE HAS BEEN ACCEPTED IN WRITING BY THE PROJECT ENGINEER.
15. THE CONTRACTOR SHALL COORDINATE THE SHOULDERING OPERATION SUCH THAT FULL COMPLIANCE TO THE EXISTING GRADES IS OBTAINED ON A DAILY BASIS FOLLOWING THE PAVING OPERATION FOR THE AFFECTED AREA UNLESS OTHERWISE APPROVED BY THE ENGINEER.
16. WHERE NEW PAVEMENT IS TO ABUT EXISTING PAVEMENT, THE EXISTING PAVEMENT SHALL BE REMOVED TO A NEAT VERTICAL LINE USING A CUTTING SAW OR OTHER METHOD AS APPROVED BY THE PROJECT ENGINEER.
17. THE SEVERITY OF SULFATE EXPOSURE FOR THIS PROJECT IS CLASS 2.
18. MOISTURE-DENSITY CONTROL WILL BE REQUIRED FOR THE FULL DEPTH OF EMBANKMENTS ON THIS PROJECT.
19. DEPTH OF MOISTURE-DENSITY CONTROL FOR THIS PROJECT SHALL BE AS FOLLOWS: FULL DEPTH OF ALL EMBANKMENTS.
20. THE CONTRACTOR WILL MAINTAIN AND PREVENT PONDING IN LIVE LANES OF TRAFFIC. IT IS THE CONTRACTOR'S RESPONSIBILITY TO PROVIDE AS NECESSARY ANY TEMPORARY DRAINAGE WAYS FROM MILLED SURFACES. THIS WORK SHALL BE CONSIDERED INCIDENTAL.
21. IN WIDENING AREAS CLEARING AND GRUBBING WILL BE REQUIRED BEFORE EXCAVATION AND EMBANKMENT WORK BEGINS.
22. THE MINIMUM THICKNESS OF TOPSOIL SHALL BE 6 INCHES.
23. COMPACTION SHALL BE IN ACCORDANCE WITH SECTION 203.07.
24. THE CONTRACTOR SHALL MAINTAIN PAVEMENT MARKING DAILY ON THE ROADWAYS DURING ALL PHASES OF CONSTRUCTION IN FULL COMPLIANCE WITH THE MUTCD AND COOT STANDARDS.
25. ASPHALT JOINTS SHALL BE CONSTRUCTED IN ACCORDANCE WITH SECTION 401.16 OF THE STANDARD SPECIFICATIONS. A LONGITUDINAL JOINT AND PAVEMENT MARKING PLAN SHALL BE SUBMITTED AT LEAST 3 DAYS PRIOR TO THE PRE-PAVE CONFERENCE.
26. A PAVEMENT MARKING PLAN SHALL BE SUBMITTED BY THE CONTRACTOR PRE-CONSTRUCTION MEETING, PER SUBSECTION 627.03A OF THE STANDARD SPECIFICATIONS. ALL NEW PAVEMENT MARKINGS SHALL MATCH EXISTING MARKINGS UNLESS OTHERWISE SHOWN IN THE PLANS OR APPROVED BY THE PROJECT ENGINEER.
27. THE FOLLOWING CLEAR ZONE CRITERIA SHALL BE USED DURING THIS PROJECT: 30 FEET FROM EDGE OF TRAVELLED WAY.

28. THE CONTRACTOR SHALL PROTECT ALL EXISTING SURVEY MONUMENTATION DESIGNATED TO REMAIN FROM DAMAGE DURING CONSTRUCTION OPERATIONS. ANY MONUMENTS DISTURBED BY THE CONTRACTOR THAT ARE NOT DESIGNATED FOR RELOCATION, SHALL BE RESET AT THE CONTRACTOR'S EXPENSE. THE CONTRACTOR AND ENGINEER SHALL NOTE THOSE MONUMENTS IN THE FIELD PRIOR TO CONSTRUCTION.
29. THE CONTRACTOR SHALL LIMIT CONSTRUCTION ACTIVITIES TO THOSE AREAS WITHIN THE LIMITS OF DISTURBANCE AND/OR TOES OF SLOPE AS SHOWN IN THE PLANS. THE CONTRACTOR SHALL ALSO PERFORM CONSTRUCTION ACTIVITIES TO AVOID UNNECESSARY IMPACTS TO EXISTING VEGETATION. ANY DISTURBANCE BEYOND THESE LIMITS SHALL BE RESTORED TO ORIGINAL CONDITIONS BY THE CONTRACTOR AT HIS/HER OWN EXPENSE. CONSTRUCTION ACTIVITIES, IN ADDITION TO NORMAL CONSTRUCTION PROCEDURES SHALL INCLUDE THE PARKING OF VEHICLE OR EQUIPMENT, DISPOSAL OF LITTER, AND ANY OTHER ACTION WHICH WOULD ALTER EXISTING CONDITIONS. DURING ALL CONSTRUCTION ACTIVITIES, INCLUDING FENCING, THE CONTRACTOR SHALL KEEP ALL EQUIPMENT AND MATERIALS WITHIN THE LIMITS OF THE DISTURBANCE AREA.
30. THE CONTRACTOR SHALL KEEP ALL OPERATIONS WITHIN THE ESTABLISHED PROJECT RIGHT-OF-WAY AND/OR EASEMENT LIMITS. CONSTRUCTION ACTIVITIES, STAGING, PARKING, OR OFFSITE DISPOSAL SHALL NOT ENCROACH UPON PRIVATE LANDS WITHOUT WRITTEN APPROVAL FROM THE PROPERTY OWNER OR LAND MANAGEMENT AGENCY.
31. NATIVE VEGETATION COVER SHALL BE PRESERVED TO THE MAXIMUM EXTENT PRACTICABLE. WHERE EXCAVATION IS REQUIRED, ONLY THE MINIMAL AMOUNT OF AREA SHALL BE CLEARED OR GRADED IN ORDER TO MAINTAIN VEGETATIVE GROUND COVER FOR EROSION PROTECTION. EQUIPMENT OPERATION OFF THE HIGHWAY PRISM SHALL BE MINIMIZED TO THE EXTENT PRACTICABLE TO PREVENT POTENTIAL IMPACTS TO BIOLOGICAL RESOURCES.
32. IF ARCHAEOLOGICAL RESOURCES ARE DISCOVERED DURING PROJECT CONSTRUCTION, WORK IN THE IMMEDIATE AREA OF THE FIND SHOULD CEASE, AND THE COOT ARCHAEOLOGIST, GREG WOLFF (303-757-9158 | GREG.WOLFF@STATE.CO.US), SHOULD BE CONTACTED IMMEDIATELY PER SECTION 107.23 OF THE STANDARD SPECIFICATION.
33. TEMPORARY STAGING AREAS FOR CONSTRUCTION EQUIPMENT AND MATERIALS SHALL UTILIZE PREVIOUSLY DISTURBED AREAS SUCH AS AGRICULTURAL FIELDS, ROADS, GRAVELED PARKING AREAS AND SHOULDER PULL OUTS. MAJOR REPAIRS TO CONSTRUCTION EQUIPMENT SHALL BE PERFORMED OFFSITE WHERE PRACTICAL. TEMPORARY ACCESS STAGING AREAS WILL BE LOCATED SUFFICIENTLY FAR FROM WETLANDS, STREAMS OR OTHER WATER BODIES TO PRECLUDE DISCHARGES OF NON-PROJECT RELATED FILL MATERIAL INTO THESE AREAS.
34. THE CONTRACTOR SHALL HAVE ONE COPY OF THE PLANS APPROVED BY THE COLORADO DEPARTMENT OF TRANSPORTATION, ONE COPY OF THE APPROPRIATE STANDARDS AND SPECIFICATIONS, AND ONE COPY OF ALL NECESSARY PERMITS AT THE JOB SITE AND AVAILABLE AT ALL TIMES.
35. THIS PROJECT IS NOT DESIGNATED AS A SIGNIFICANT PROJECT; A FORMAL TRANSPORTATION MANAGEMENT PLAN (TMP) IS NOT REQUIRED.



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File Name: NOTES			Date:	Comments	Init.	 Region 2	1480 Quail Lake Loop, Suite A Colorado Springs, CO 80906 Phone: (719) 527-5807	No Revisions:				Number	
Horiz. Scale: N/A Vert. Scale: As Noted								Revised:	Designer: TM			Code	
PREPARED BY:  Drexel, Barrell & Co. Engineers • Surveyors 101 SAWATCH ST. #100 COLORADO SPRINGS, COLORADO 80903 (719) 260-0887 CONTACT: TIM MCCONNELL, P.E.								Void:	Detailer: KV				
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LEGEND



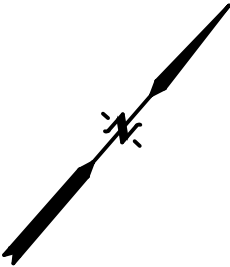
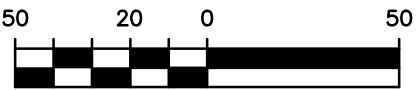
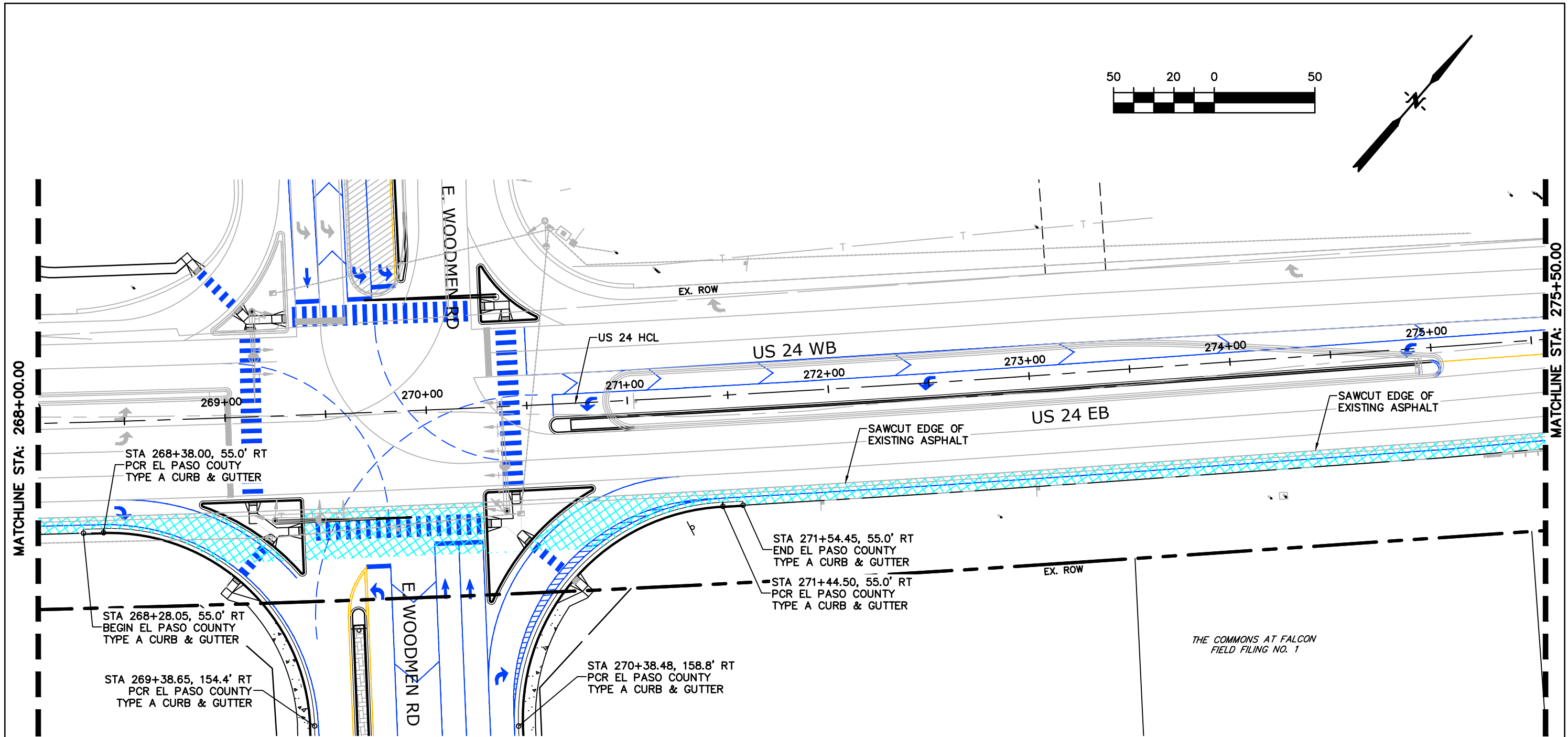
WIDENING AREA
FULL DEPTH ASPHALT

NOTES

1. SAWCUT ALONG EXISTING SHOULDER STRIPE AND REMOVE ASPHALT MAT OF THE EXISTING SHOULDER.
2. EXISTING PAVEMENT ADJACENT TO THE WIDENING SHALL BE MILLED AND OVERLAID AS DETAILED IN THE TYPICAL SECTIONS.
3. FOR DITCH AND CULVERT EXTENSION DETAILS SEE DRAINAGE PLANS.



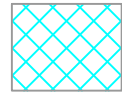
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Horiz. Scale: Vert. Scale: As Noted							Revised:							
PREPARED BY: Drexel, Barrell & Co. Engineers • Surveyors 101 SAWATCH ST. #100 COLORADO SPRINGS, COLORADO 80903 (719) 260-0887 CONTACT: TIM MCCONNELL, P.E.							Detailer: KV		Code					
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MATCHLINE STA: 268+00.00

MATCHLINE STA: 275+50.00

LEGEND



WIDENING AREA
FULL DEPTH ASPHALT

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THE COMMONS AT FALCON
FIELD FILING NO. 1



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Engineers • Surveyors
101 SAWATCH ST. #100
COLORADO SPRINGS, COLORADO 80903
(719) 260-0887 CONTACT: TIM MCCONNELL, P.E.

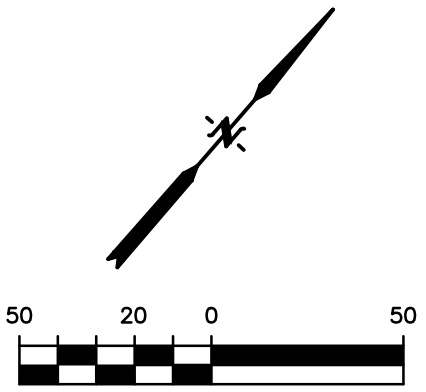
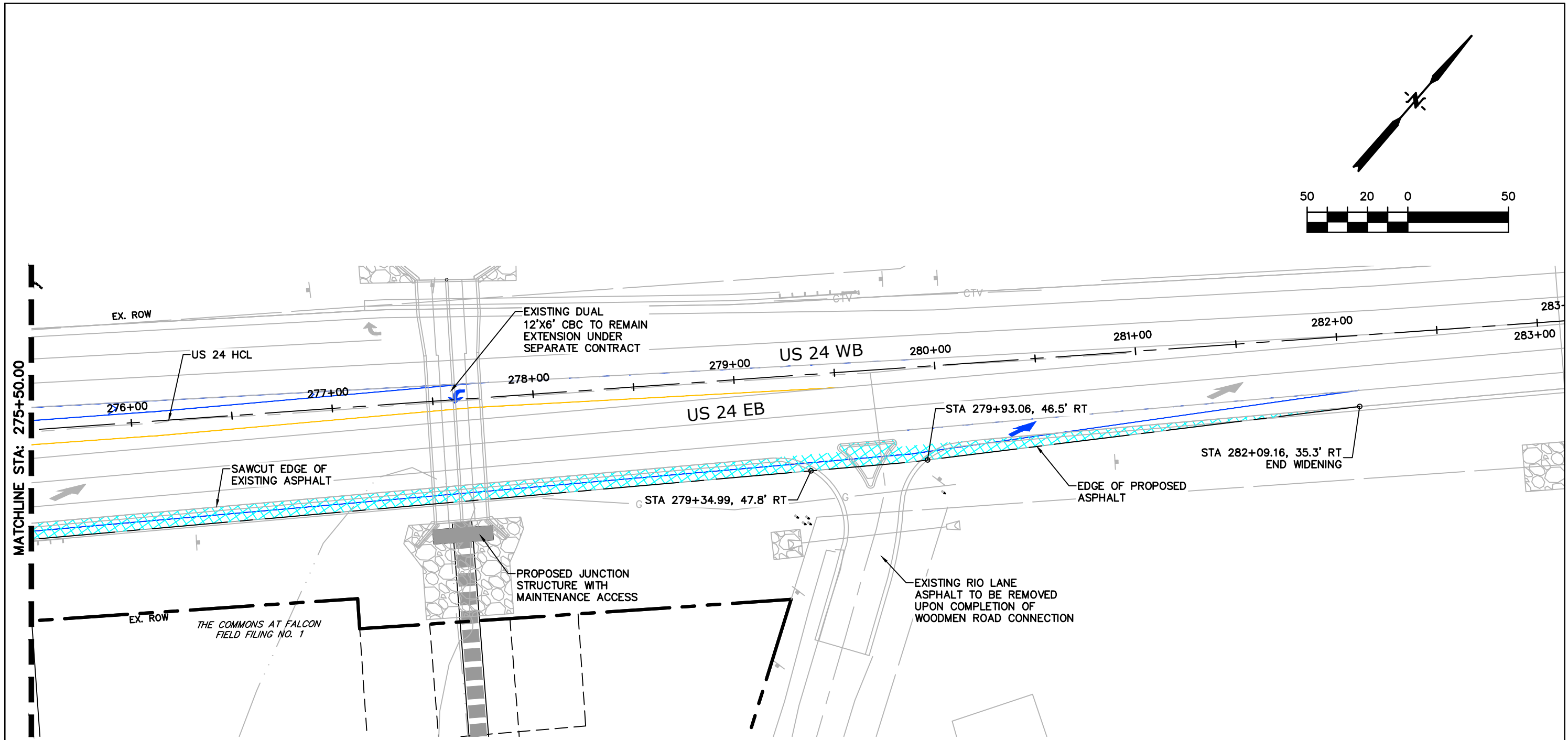
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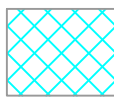
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Colorado Springs, CO 80906
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Region 2

As Constructed		US 24 Roadway Plans		Project No./Code	
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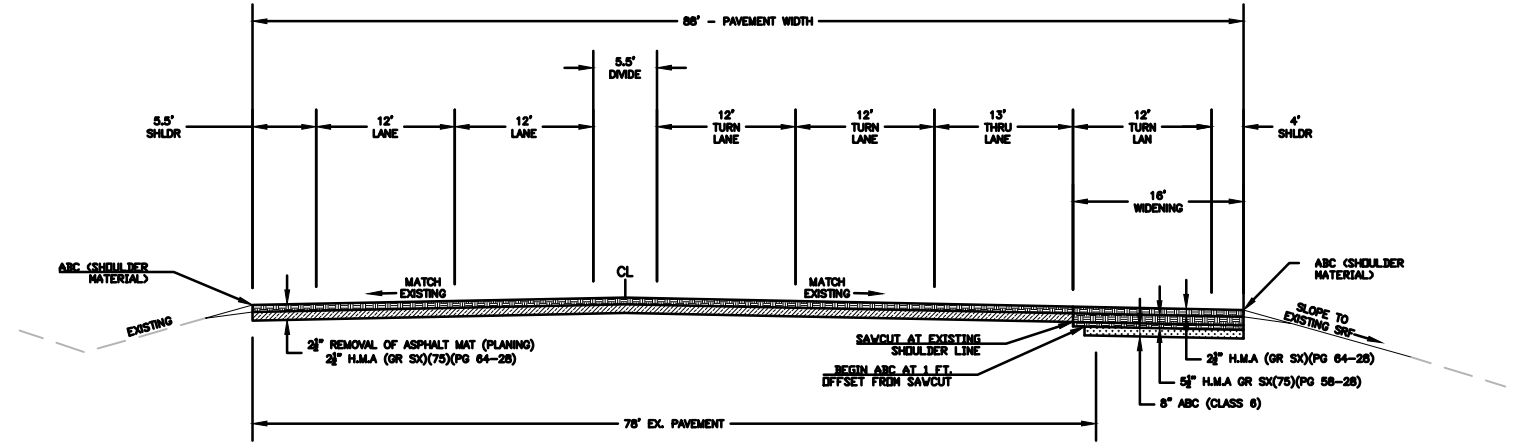
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FULL DEPTH ASPHALT

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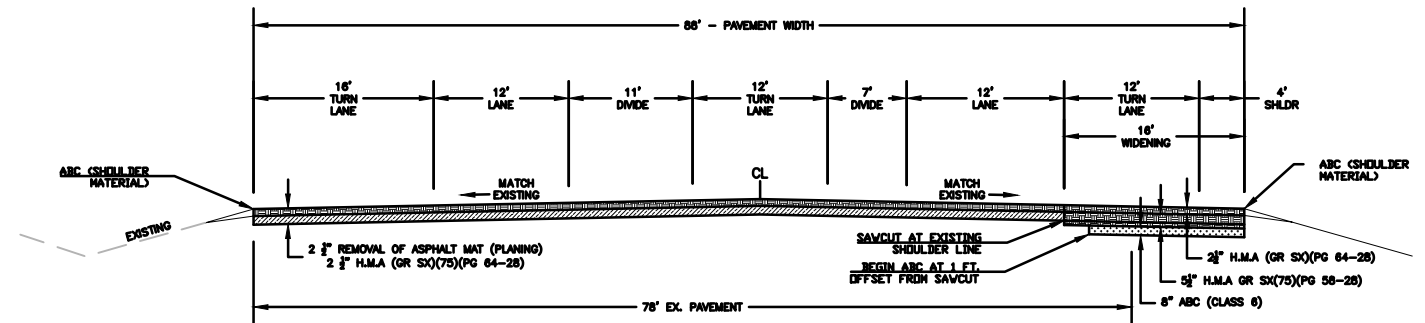
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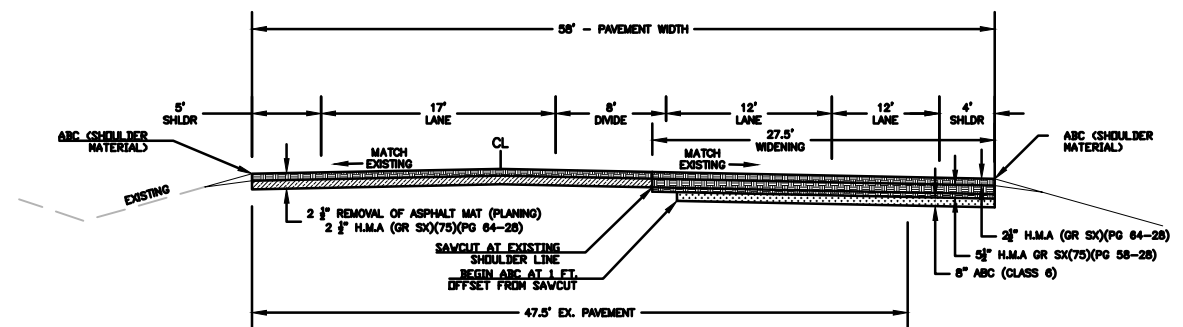
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STA. LOCATION: 271+81.04

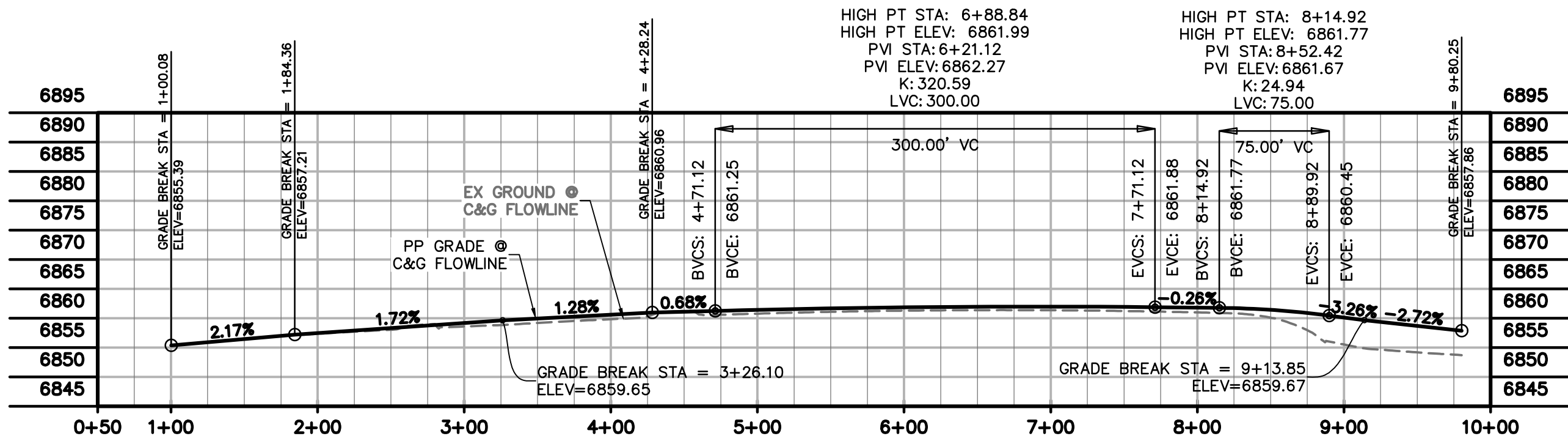


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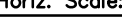
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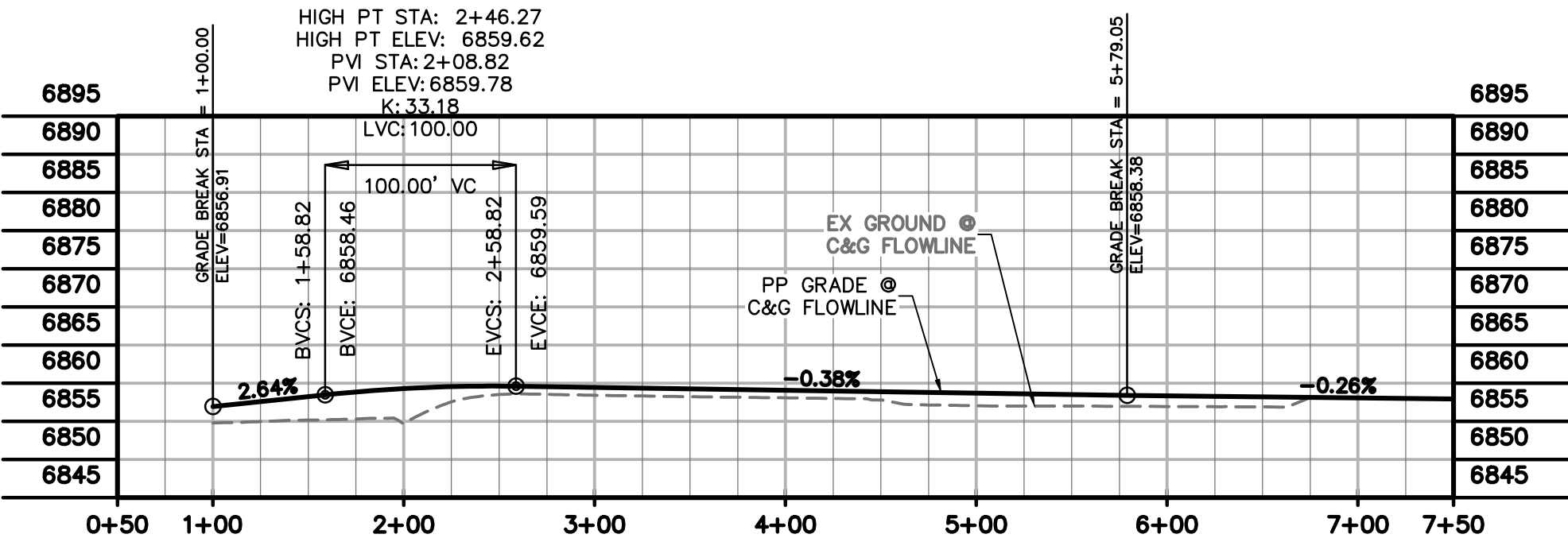
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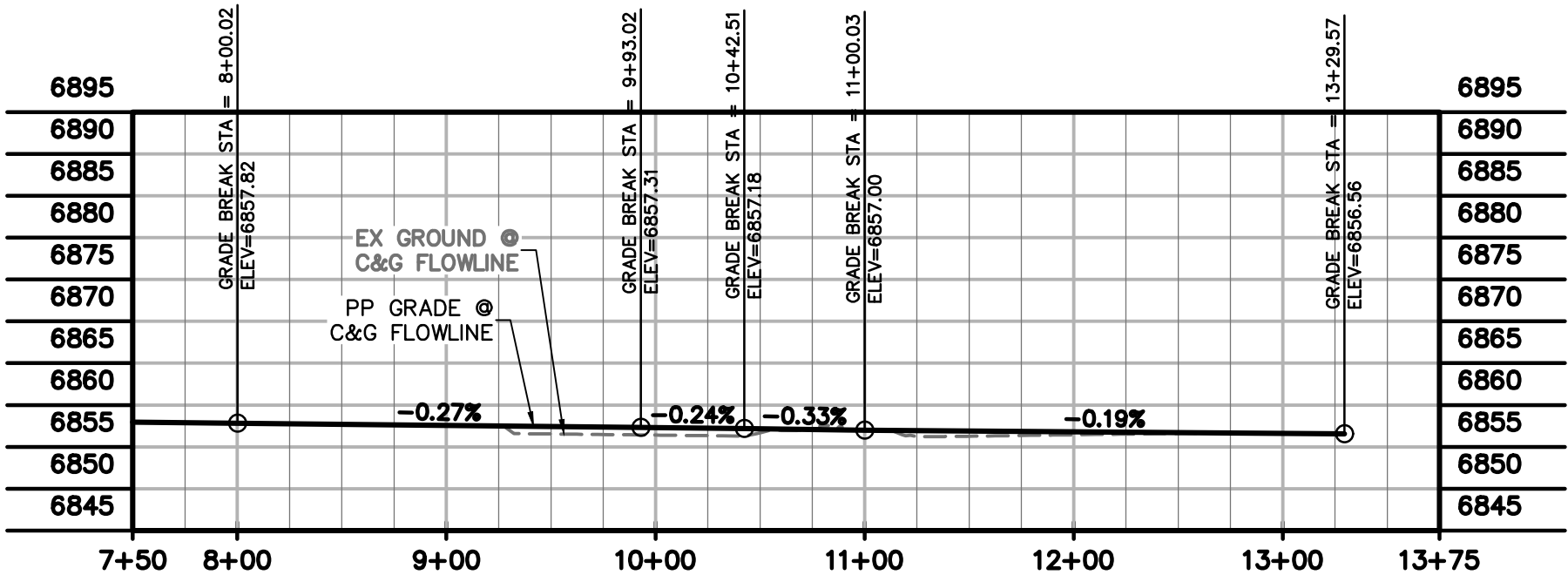
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VERT. 1"=20'



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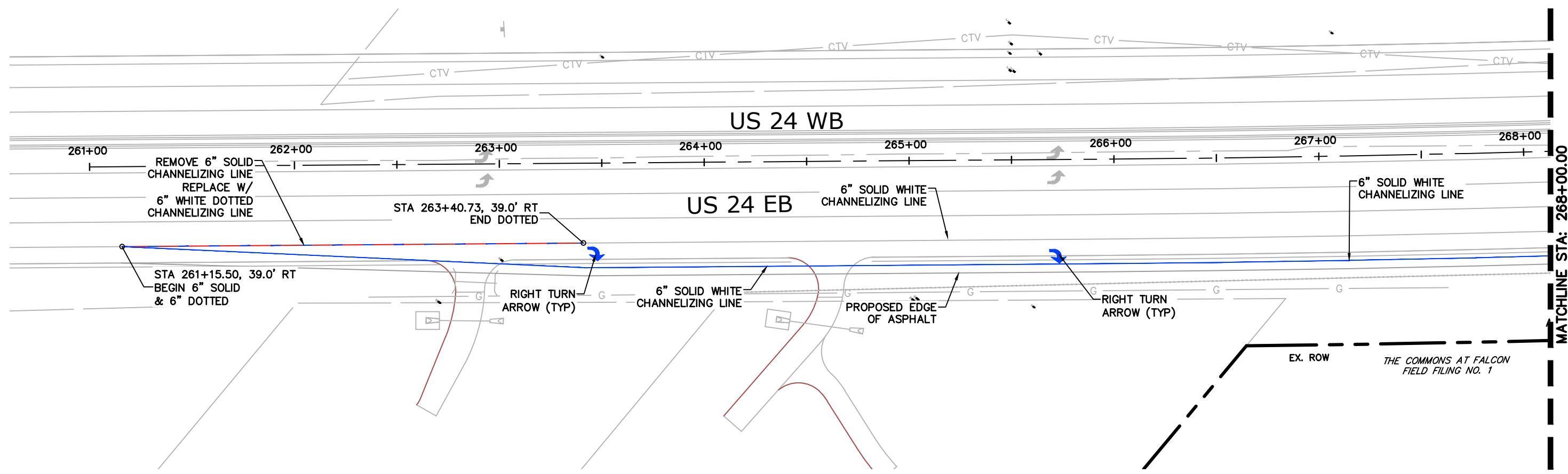
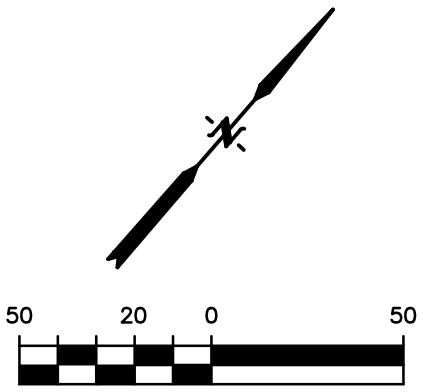
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SCALE: HORIZ. 1"=80'
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EOA NE OF E. WOODMEN ROAD CONT.
SCALE: HORIZ. 1"=80'
VERT. 1"=20'



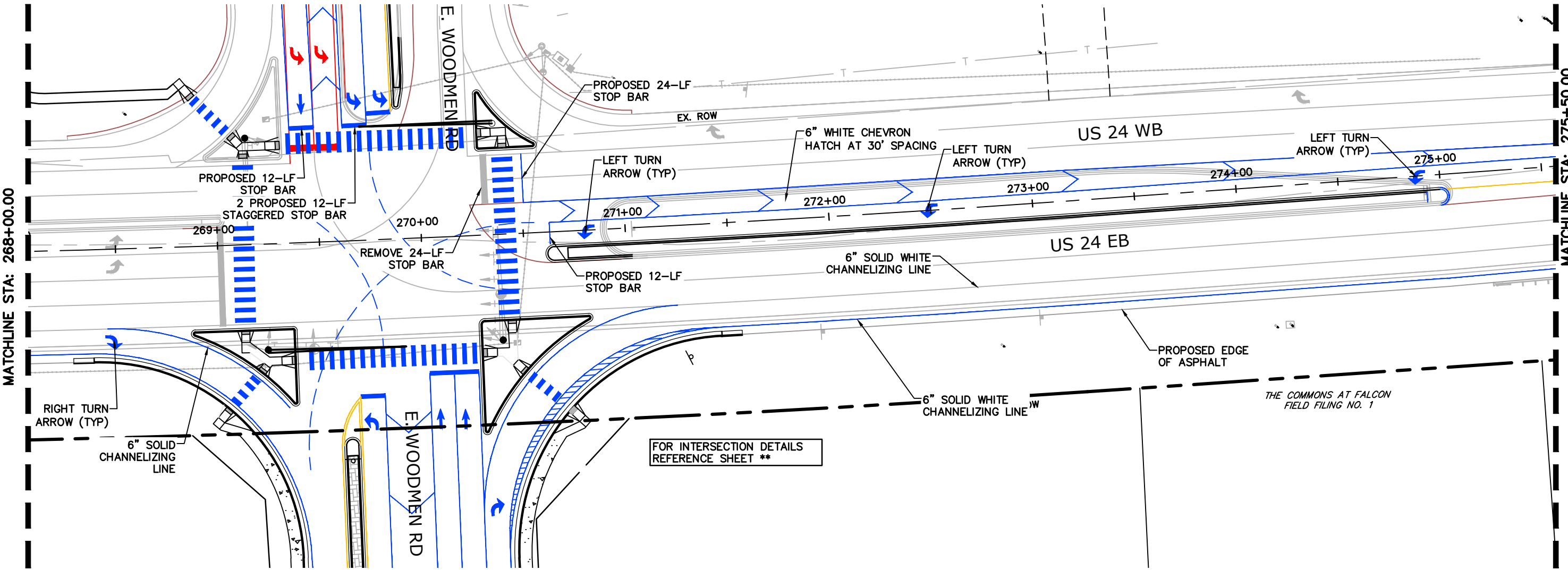
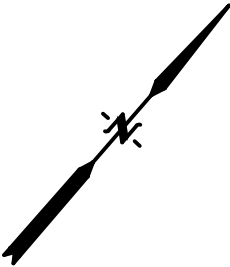
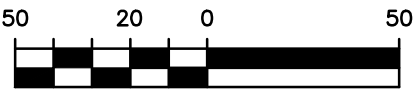
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- LEGEND**
- EXISTING STRIPING TO REMAIN
 - EXISTING STRIPING TO BE REMOVED
 - PROPOSED WHITE STRIPING
 - PROPOSED YELLOW STRIPING



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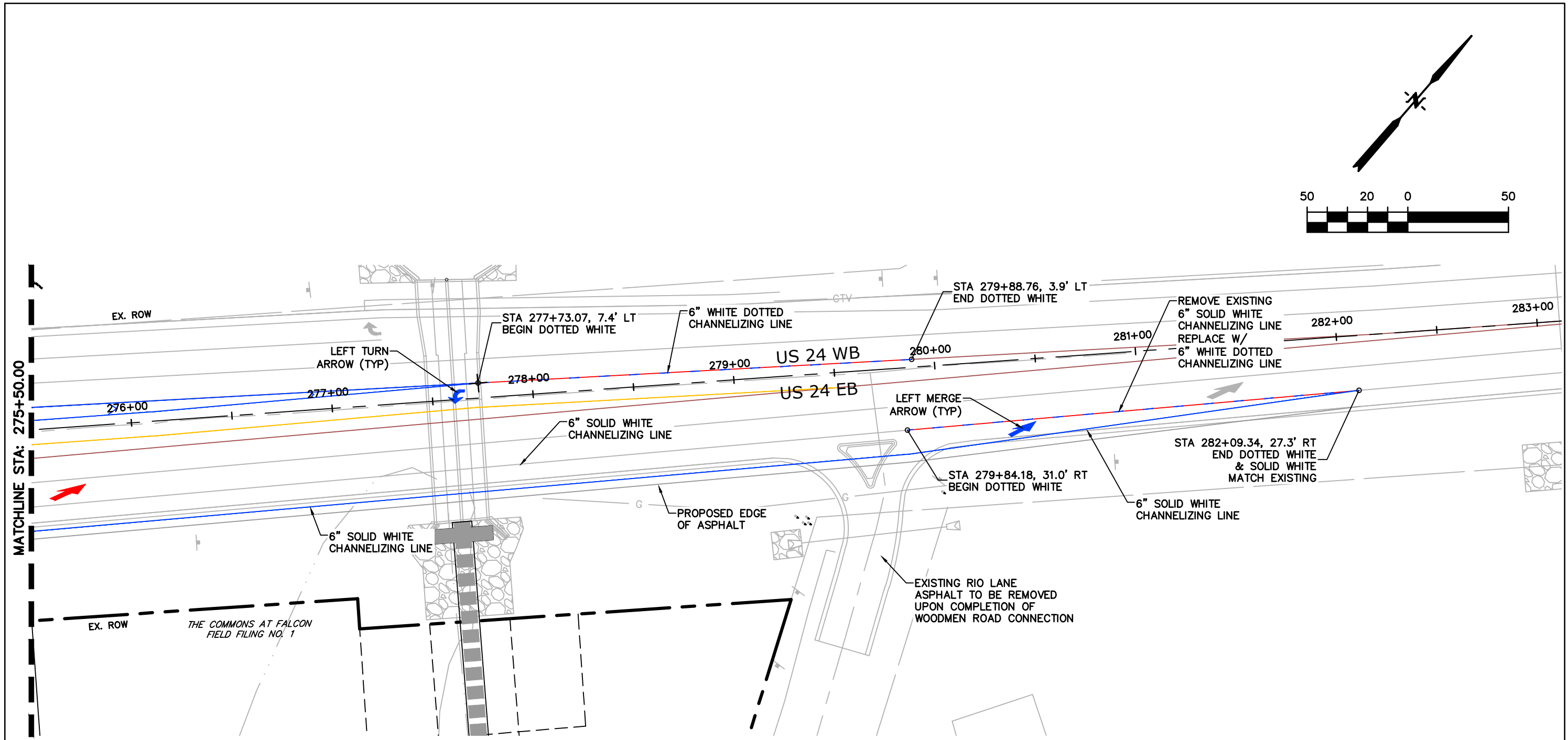
LEGEND

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- EXISTING STRIPING TO BE REMOVED
- PROPOSED WHITE STRIPING
- PROPOSED YELLOW STRIPING



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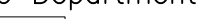


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