

OWNER

Access and Internal Roads

Calculation



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Rev. A, Issued for Review

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Project:



TORUS

, County,

ISSUE SUMMARY AND APPROVAL

This page records each issue of CIV-CAL-003. The preparer, reviewer and approver sign for each revision.

Rev.	Date	Issue purpose	Description
A	2026-09-29	Issued for Review	First issue

Contributors

Rev.	Discipline	Prepared by	Reviewed by	Approved by
A	Civil			

CONTENTS

1.	OBJECTIVE.....	1
2.	METHODOLOGY	1
3.	DESIGN INPUTS.....	1
4.	ASSUMPTIONS.....	2
5.	REFERENCES	2
6.	CALCULATION.....	3
	6.1. DESIGN VEHICLES AND TRAFFIC.....	3
	6.2. AGGREGATE THICKNESS.....	4
	6.3. ROAD LAYOUT	5
	6.4. TURNING AT THE COUNTY ROAD ENTRANCE	6
	6.5. TURNING AT THE INTERNAL CORNERS	6
	6.6. COUNTY ROAD ENTRANCE	8
	6.7. QUANTITIES	9
7.	RESULTS AND CONCLUSIONS	9

FIGURES AND TABLES

Table 3-1: Design Inputs.....	1
Table 6-1: Design Vehicles	3



Table 6-2: Traffic Over 20 Years.....3

Table 6-3: Aggregate Thickness by Giroud and Han.....4

Table 6-4: Internal Roads.....5

Table 6-5: Turning at the County Road Entrance.....6

Table 6-6: Swept Path at Internal Corners 7

Table 6-7: Intersection Sight Distance at 45 mph 8

Table 6-8: Aggregate and Geotextile Quantities 9

APPENDICES

APPENDIX A. OVERALL SITE PLAN 11

APPENDIX B. CIVIL SECTIONS AND DETAILS 13

1. OBJECTIVE

This calculation designs the aggregate-surfaced access road, internal roads and station pad for the . It sets the design vehicles and traffic, sizes the aggregate section, checks that the design vehicles can turn at the county road entrance and at the internal road corners, lays out the entrance, and computes the aggregate and geotextile quantities.

2. METHODOLOGY

The roads are unpaved, carry low traffic of heavy vehicles, and are built on a soft clay subgrade. TORUS therefore used the Giroud and Han (2004) method, which was developed for exactly this case: it predicts the aggregate thickness that limits rutting to a set depth for a given number of wheel passes, and it accounts directly for a geotextile at the subgrade. The AASHTO 1993 procedure for aggregate-surfaced roads was considered, but it is calibrated for higher traffic and gives no direct way to credit the separation geotextile, so it was not used.

Traffic over 20 years was converted to passes of the 18 kip standard axle with the fourth-power law, counting every axle of a tandem or tridem group as a single axle. For aggregate roads this is conservative, because it ignores the load spreading between closely spaced axles. The loaded vacuum truck axle and the all-terrain crane were also checked directly at their own wheel loads and tire pressures, since a small number of heavy passes can govern an unpaved road.

Turning at the county road entrance was checked with the single-unit offtracking relation. The internal roads meet at square corners, so each design vehicle was placed on its AASHTO minimum turning path with the outer wheel path tangent to both outer road edges. The swept path was then checked against every equipment footprint, above-grade pipe and pipe support on the plot plan, and any paving needed outside the road rectangles was added as a corner fillet.

3. DESIGN INPUTS

Table 3-1 lists the inputs.

Table 3-1: Design Inputs

Input	Value	Source
Access road	20 ft gravel, 608 ft beyond the pad, 618 ft from gate to county road	GEN-DB-001; CIV-DWG-002
Internal roads	R-1 to R-7, 20 ft wide except the 12 ft pig handling lane R-7	MEC-DWG-001 plot plan
Subgrade CBR (soaked)	3	Assumed lean clay (HOLD H-07)

Input	Value	Source
Aggregate CBR	80	Type A, assumed; confirm by source test
Allowable rut depth	50 mm (2 in) permanent roads; 75 mm (3 in) construction traffic and pad	Giroud and Han (2004)
Standard axle	80 kN (18 kip), dual tires, 550 kPa (80 psi)	Giroud and Han (2004)
Design life	20 years	Owner
County road	Section-line road, 66 ft right-of-way, 45 mph	Assumed (HOLD H-05)
Equipment weights for lifting	Typical vendor values	HOLD H-15

4. ASSUMPTIONS

1. The subgrade has a soaked CBR of 3. *Verification required (HOLD H-07).* If the tests on borings RB-1 to RB-3 give a lower value, the section shall be rechecked.
2. The vacuum truck visits every two weeks for 20 years. This is conservative against the Owner's expected liquids rate. *Verification required (HOLD H-20).*
3. The crane is a 100 t class all-terrain crane with five 26.5 kip axles on single tires at 130 psi. The lift contractor confirms (HOLD H-15).
4. The county road is straight and level near the entrance, with a 45 mph design speed. *Verification required (HOLD H-02, H-05).*
5. The landowner grazes cattle on the pasture crossed by the access road. *Verification required (HOLD H-03).*

5. REFERENCES

1. Giroud, J.P. and Han, J. (2004), Design Method for Geogrid-Reinforced Unpaved Roads, Parts I and II, ASCE Journal of Geotechnical and Geoenvironmental Engineering, 130(8).
2. AASHTO, A Policy on Geometric Design of Highways and Streets, 7th Edition (2018).
3. AASHTO M 288, Geosynthetic Specification for Highway Applications.
4. Standard Specifications for Highway Construction (2019), Section 703.01.
5. GEN-DB-001, Basis of Design.
6. MEC-DWG-001, Plot Plan.
7. CIV-RPT-001, Civil Design Criteria and Site Description; CIV-CAL-001, Earthwork and Grading; CIV-CAL-002, Hydrology and Drainage.
8. ELE-CAL-005, Grounding, for the crushed rock surfacing.

9. CIV-DWG-002, Overall Site Plan (Appendix A); CIV-DWG-004, Civil Sections and Details (Appendix B).

6. CALCULATION

6.1. DESIGN VEHICLES AND TRAFFIC

Table 6-1 lists the design vehicles. The vacuum truck that empties T-101 is the heaviest regular vehicle. The all-terrain crane that sets H-101 is the heaviest vehicle of all, but it makes only a few passes during construction.

Table 6-1: Design Vehicles

Vehicle	Axle loads (kip)	Gross weight (kip)	Use
Pickup (AASHTO P)	3.5 and 4.5	8	Daily operations
Service truck (SU-30 class)	6 and 12	18	Maintenance, analyzer bottles, filter elements
Vacuum truck, 130 bbl (SU-40 class)	18, and 3 x 19.2 loaded	76	Emptying T-101
Water truck, 4,000 gal (SU-30 class)	12, and 2 x 17	46	Construction water and hydrotest supply
Lowboy tractor-trailer (WB-62)	12, 2 x 17, 2 x 17	80	Equipment, skid and building deliveries
All-terrain crane, 100 t class	5 x 26.5	132	Setting H-101, V-101 and the meter skid

Each axle load is converted to equivalent standard axles with the fourth-power law:

Load equivalency, fourth-power law

$$ESAL = \sum_{passes} \sum_{axles} \left(\frac{W_{axle}}{18 \text{ kip}} \right)^4$$

Table 6-2 gives the 20-year traffic. It totals 4,956 standard axle passes, and TORUS used 5,000 for design. The loaded vacuum truck and the construction haul of aggregate, fill and concrete make up most of it; the thousands of pickup trips add almost nothing.

Table 6-2: Traffic Over 20 Years

Vehicle	Passes	ESAL per pass	ESAL, 20 yr
Pickup (AASHTO P)	29,200	0.005	156
Service truck, 1-ton flatbed (SU-30 class)	4,160	0.210	873
Vacuum truck 130 bbl, loaded (SU-40 class, tri-axle)	520	4.884	2,539

Vehicle	Passes	ESAL per pass	ESAL, 20 yr
Vacuum truck 130 bbl, empty	520	0.553	288
Water truck 4,000 gal, loaded (SU-30 class, tandem)	150	1.789	268
Aggregate haul, tandem dump 22 t (loaded)	160	1.789	286
Fill import, tandem dump 14 CY (loaded)	175	1.789	313
Concrete truck 10 CY (loaded)	42	3.115	131
WB-62 lowboy, equipment delivery (legal loads)	30	3.380	101
Total			4,956

6.2. AGGREGATE THICKNESS

The Giroud and Han equation gives the aggregate thickness h that limits the rut depth s after N passes of a wheel load P at tire pressure p on a subgrade of bearing ratio CBR_{sg} :

Giroud and Han (2004), Eq. 23

$$h = \frac{0.868 + (0.661 - 1.006J^2)(r/h)^{1.5} \log N}{1 + 0.204 (R_E - 1)} \left[\sqrt{\frac{P/(\pi r^2)}{(s/f_s)(1 - 0.9 e^{-(r/h)^2}) N_c f_c CBR_{sg}}} - 1 \right] r$$

where $r = \sqrt{P/(\pi p)}$ is the radius of the tire contact area, $R_E = \min(3.48 CBR_{bc}^{0.3}/CBR_{sg}, 5.0)$ is the modulus ratio of base to subgrade, $f_s = 75$ mm and $f_c = 30$ kPa. With a geotextile at the subgrade $J = 0$ and the bearing capacity factor $N_c = 5.14$; without one, $N_c = 3.14$. Because h appears on both sides, it was solved by iteration.

For the standard axle, $P = 40$ kN and $p = 550$ kPa, so $r = 0.152$ m and $R_E = 4.32$. With $N = 5,000$ and $s = 50$ mm, the thickness is 8.0 in with a geotextile and 13.3 in without. Table 6-3 gives every case checked.

Table 6-3: Aggregate Thickness by Giroud and Han

Case	Wheel load (kN)	Tire pressure (kPa)	Passes	Rut (mm)	With geotextile (in)	Without (in)
Standard axle, 20-yr ESAL	40	550	5,000	50	8.0	13.3
All-terrain crane, single tire, construction	59	896	20	75	3.8	7.5
Vacuum truck tridem axle, direct	43	550	1,560	50	7.2	12.7
Pad: service truck, 500 passes	27	550	500	75	2.0	5.7

The standard axle case (20-year ESAL) governs, at 8.0 in. TORUS specifies a 12 in section: it covers the governing case with a third to spare, which allows for the uncertain subgrade strength until the geotechnical tests are available, and it lets the roads be built in two 6 in lifts. The geotextile saves 5.3

in of aggregate in the standard-axle case and, as important, keeps the aggregate from punching into the wet clay, which is how unpaved roads on clay usually fail. The pad outside the roads carries only pickups and the occasional service truck, and needs 5.7 in without a geotextile; 6 in is specified as the practical minimum lift.

Access road, entrance and internal roads: 12 in Type A aggregate on woven stabilization geotextile (AASHTO M 288, Class 1) over 12 in of moisture-conditioned subgrade. Pad: 6 in Type A aggregate over 12 in of moisture-conditioned subgrade.

6.3. ROAD LAYOUT

The access road runs east from the main gate on centerline Y = 62 to the county road, 20 ft wide with 2 ft aggregate shoulder tapers. Its crown is 12 in above existing ground and it falls with the land at about 1.2 %, with 4:1 side slopes down to roadside ditches D-6 and D-7 (CIV-CAL-002). The internal roads are defined on the plot plan (MEC-DWG-001) and summarized in Table 6-4. Roads R-1 to R-4 form a U-shaped loop from the main gate around the north of the process area to the emergency gate. The loop cannot close along the east side because the outlet piping runs above grade from SDV-103 to the outlet riser there. R-5 is the T-101 truck stand, R-6 the spur to analyzer shelter B-101, and R-7 the 12 ft pig handling lane to the pig receiver closure.

Table 6-4: Internal Roads

Road	Use	X from (ft)	X to (ft)	Y from (ft)	Y to (ft)	Width (ft)	Area (ft ²)
R-1	Main entry (from east gate)	106	250	52	72	20	2,880
R-2	East leg	227	247	72	190	20	2,360
R-3	North leg	5	247	170	190	20	4,840
R-4	West leg to emergency gate	0	25	116	170	25	1,350
R-5	T-101 truck stand / turnaround	25	45	116	136	20	400
R-6	B-101 spur	114	134	72	110	20	760
R-7	Pig handling lane (12 ft)	2	14	30	116	12	1,032

Note 1: The union of R-1 to R-7 and the 10 ft by 20 ft gate apron between the fence and the pad edge is 13,422 ft². R-2 and R-3 overlap at the northeast corner, and the overlap is counted once.

The vacuum truck enters at the main gate, follows R-1, R-2, R-3 and R-4, backs into the R-5 stand, and leaves the way it came. R-4, R-5 and R-7 together form the turnaround. The truck connects to the T-101 hose connection on the containment north wall, under the south edge of R-5.

Two buried pipes cross under roads: 12"-G-1042-A6 under R-3 at (220, 180) with 4.0 ft of cover; 2"-F-1051-A1 under R-6 at (124, 78) with 4.0 ft of cover. Both meet the 48 in minimum cover of GEN-DB-001, and both are backfilled with select fill or flowable fill across the road width plus 2 ft (CIV-DWG-004, detail 1).

The deep anode well DW-101 for the cathodic protection system lies outside the fence at (285, -45). It needs only annual access by pickup, so TORUS provides a 109 ft grassed track, 12 ft wide, from the access road rather than an aggregate road. The track crosses ditch D-7 at grade on a turf reinforcement mat (27 yd²), which avoids a culvert. The drilling rig works from a temporary 30 ft by 30 ft pad that is restored afterwards.

6.4. TURNING AT THE COUNTY ROAD ENTRANCE

The entrance has a 30 ft throat and 50 ft radius returns. Offtracking of a single-unit vehicle on a curve of radius R with wheelbase L is:

AASHTO Green Book, Section 2.8

$$OT = R - \sqrt{R^2 - L^2}$$

The swept width, vehicle width plus offtracking, must fit within the width of the mouth at the middle of the return, which is $30 + 2R(1 - \cos 45^\circ) = 59.3$ ft. For the lowboy the effective wheelbase combines tractor and trailer, $\sqrt{20^2 + 41^2}$ ft, and for the all-wheel-steer crane half the wheelbase is used. Table 6-5 shows that every design vehicle turns in the entrance.

Table 6-5: Turning at the County Road Entrance

Vehicle	Minimum radius (ft)	Wheelbase used (ft)	Offtracking (ft)	Swept width (ft)	Available (ft)	Acceptable
P (pickup)	24.0	11.0	1.2	8.2	59	Yes
SU-30 (service / water truck)	42.0	20.0	4.2	12.2	59	Yes
SU-40 (vacuum truck 130 bbl)	51.2	25.0	6.7	14.7	59	Yes
WB-62 (equipment lowboy)	44.8	45.6	29.5	38.0	59	Yes
AT crane 100 t, all-wheel steer	36.0	9.0	0.8	10.6	59	Yes

6.5. TURNING AT THE INTERNAL CORNERS

For each corner, the turning center C is fixed by placing the vehicle's outer wheel path, of radius R_o , tangent to both outer road edges. The vehicle then sweeps the ring between its inner rear wheel path R_i and R_o :

AASHTO minimum turning path



$$R_i \leq |P - C| \leq R_o$$

Any part of that ring outside the road rectangles must be paved as a corner fillet, and no equipment, above-grade pipe or pipe support may lie within it. Table 6-6 gives the results for the four corners on the truck route.

Table 6-6: Swept Path at Internal Corners

Corner	Vehicle	Ro / Ri (ft)	Fillet (ft ²)	Obstructions in path	Nearest obstruction inside turn	Clearance (ft)
C1, R-1 to R-2	P (pickup)	24 / 14	0	None		
C1, R-1 to R-2	SU-30 (water / service)	42 / 28	5	None	Line 1041	12.9
C1, R-1 to R-2	SU-40 (vacuum truck)	51 / 36	62	None	Line 1041	8.8
C1, R-1 to R-2	AT crane (all-wheel steer)	36 / 20	5	None	Line 1171	16.1
C2, R-2 to R-3	P (pickup)	24 / 14	0	None		
C2, R-2 to R-3	SU-30 (water / service)	42 / 28	5	None	IJ-102	7.8
C2, R-2 to R-3	SU-40 (vacuum truck)	51 / 36	67	None	IJ-102	2.8
C2, R-2 to R-3	AT crane (all-wheel steer)	36 / 20	5	None	IJ-102	7.8
C3, R-3 to R-4	P (pickup)	24 / 14	26	None		
C3, R-3 to R-4	SU-30 (water / service)	42 / 28	0	None	VS-101	14.5
C3, R-3 to R-4	SU-40 (vacuum truck)	51 / 36	19	None	VS-101	10.4
C3, R-3 to R-4	AT crane (all-wheel steer)	36 / 20	0	None		
C4, R-4 into R-5	P (pickup)	24 / 14	0	None		
C4, R-4 into R-5	SU-30 (water / service)	42 / 28	0	None		
C4, R-4 into R-5	SU-40 (vacuum truck)	51 / 36	105	PS-145, Line 1070	Line 1070	0.5
C4, R-4 into R-5	AT crane (all-wheel steer)	36 / 20	0	None		



The fillets needed at corners C1, C2 and C3 total 174 ft² (C1 62 ft², C2 67 ft², C3 46 ft²), and are clear of every obstruction. They are added to the road quantities and shown on CIV-DWG-002. At C3 the fillet includes the 5 ft strip between the end of R-3 and the fence, which pickups need. At C4 a forward turn by the vacuum truck into the R-5 stand would strike pipe support PS-145 and the vent header, so the truck backs into the stand from R-4 instead. The outlet riser lies 2.8 ft inside the vacuum truck's turn at C2 and is protected by bollards (STR-CAL-002).

Lowboy deliveries follow the access road and R-1, unload by crane, and reverse out to the pad entrance; during construction they turn in the laydown area south of the pad. A swept-path check with vehicle-specific software shall be made during detailed design.

6.6. COUNTY ROAD ENTRANCE

The entrance is surfaced with the 12 in road section, flush with the edge of the county road. CUL-1, a 36 in corrugated metal pipe 96 ft long with concrete headwalls, carries the county road ditch under the driveway (CIV-CAL-002). The first 50 ft of the access road is held to 2 % grade so that a stopped truck can pull out.

The access road crosses about 550 ft of pasture. TORUS assumed the landowner grazes cattle there and provides a 20 ft by 8 ft steel cattle guard rated for AASHTO HL-93 loading at X = 830, on concrete sills with a cleanout pit, with 16 ft wing fences and a 16 ft bypass gate for oversize loads and livestock. A gate alone was considered, but it would have to be opened and closed by every vehicle, including the emergency responders. The cattle guard shall be deleted if the landowner does not require it (HOLD H-03).

The intersection sight distance for a vehicle turning out of the entrance from a stop is:

AASHTO Green Book, Section 9.5, cases B1 and B2

$$ISD = 1.47 V t_g$$

and the stopping sight distance on the county road is:

AASHTO Green Book, Section 3.2

$$SSD = 1.47 V t + 1.075 \frac{V^2}{a} = 1.47(45)(2.5) + 1.075 \frac{45^2}{11.2} = 360 \text{ ft}$$

Table 6-7 gives the required intersection sight distances at 45 mph.

Table 6-7: Intersection Sight Distance at 45 mph

Design vehicle	Time gap, left turn (s)	ISD, left turn (ft)	Time gap, right turn (s)	ISD, right turn (ft)
Passenger car	7.5	496	6.5	430
Single-unit truck	9.5	628	8.5	562
Combination truck	11.5	761	10.5	695

The survey shall confirm that the county road is clear of obstructions for at least the combination-truck distance in both directions from a point 14.5 ft back from the edge of the county road (HOLD H-02, H-05). If it is not, the entrance shall be moved along the county road. The driveway requires a County permit (HOLD H-05).

6.7. QUANTITIES

Table 6-8 gives the aggregate and geotextile quantities, with compacted aggregate at 140 lb/ft³ (1.89 tons per cubic yard) and geotextile with 10 % for laps and waste.

Table 6-8: Aggregate and Geotextile Quantities

Item	Area	Thickness (in)	Volume (CY)	Weight (tons)	Geotextile (yd ²)
Access road and entrance	608 ft x 22 ft average, plus 1,673 ft ² of returns	12	557	1,053	1,988
Internal roads, gate apron and corner fillets	13,596 ft ²	12	504	952	1,662
Pad surfacing and west apron	45,091 ft ² , less crushed rock deduction	6	800	1,512	0
Total			1,861	3,517	3,650

Note 1: The pad area excludes the 1,513 ft² of mats and slabs in STR-CAL-002.

The electrical area (X 176 to 250, Y 0 to 40) is surfaced with 4 in of clean crushed rock for step and touch potential control (ELE-CAL-005). Its net area is 2,857 ft² and the electrical quantity is 38.8 CY. Finished grade does not change there, so the rock replaces the top 4 in of the 6 in pad surfacing, leaving a 2 in Type A leveling course beneath it. The pad aggregate above is reduced by 35.3 CY (67 tons) for this; the rock itself is carried in the electrical material take-off.

7. RESULTS AND CONCLUSIONS

TORUS draws the following conclusions:

1. The 20-year design traffic is 5,000 standard axle passes, most of it from the loaded vacuum truck and construction haul.
2. The access road, entrance and internal roads need 8.0 in of aggregate; a 12 in Type A section on woven stabilization geotextile is specified. The pad takes 6 in of Type A.
3. Every design vehicle turns in the county road entrance. At the internal corners the vacuum truck needs 174 ft² of corner fillets, which are clear of all equipment and pipe, and it backs into the T-101 stand.
4. Aggregate totals 3,517 tons: 1,053 tons on the access road, 952 tons on the internal roads and 1,512 tons on the pad. Geotextile totals 3,650 yd².

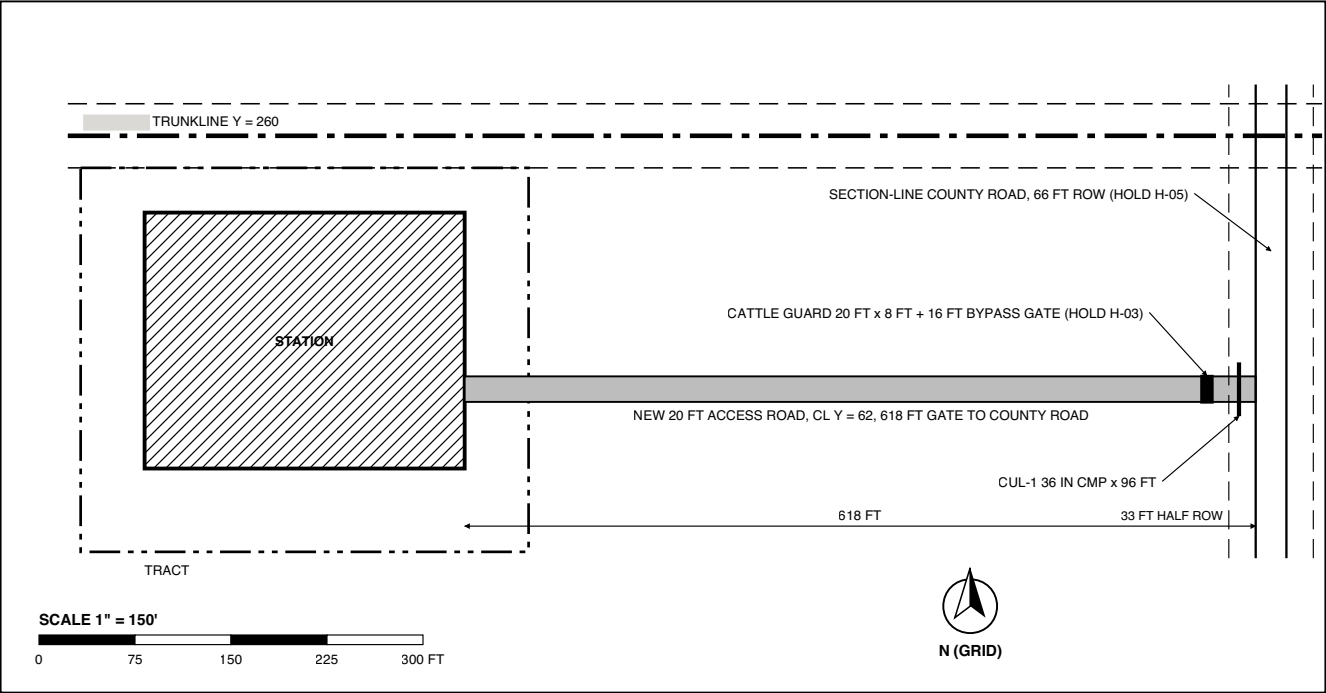
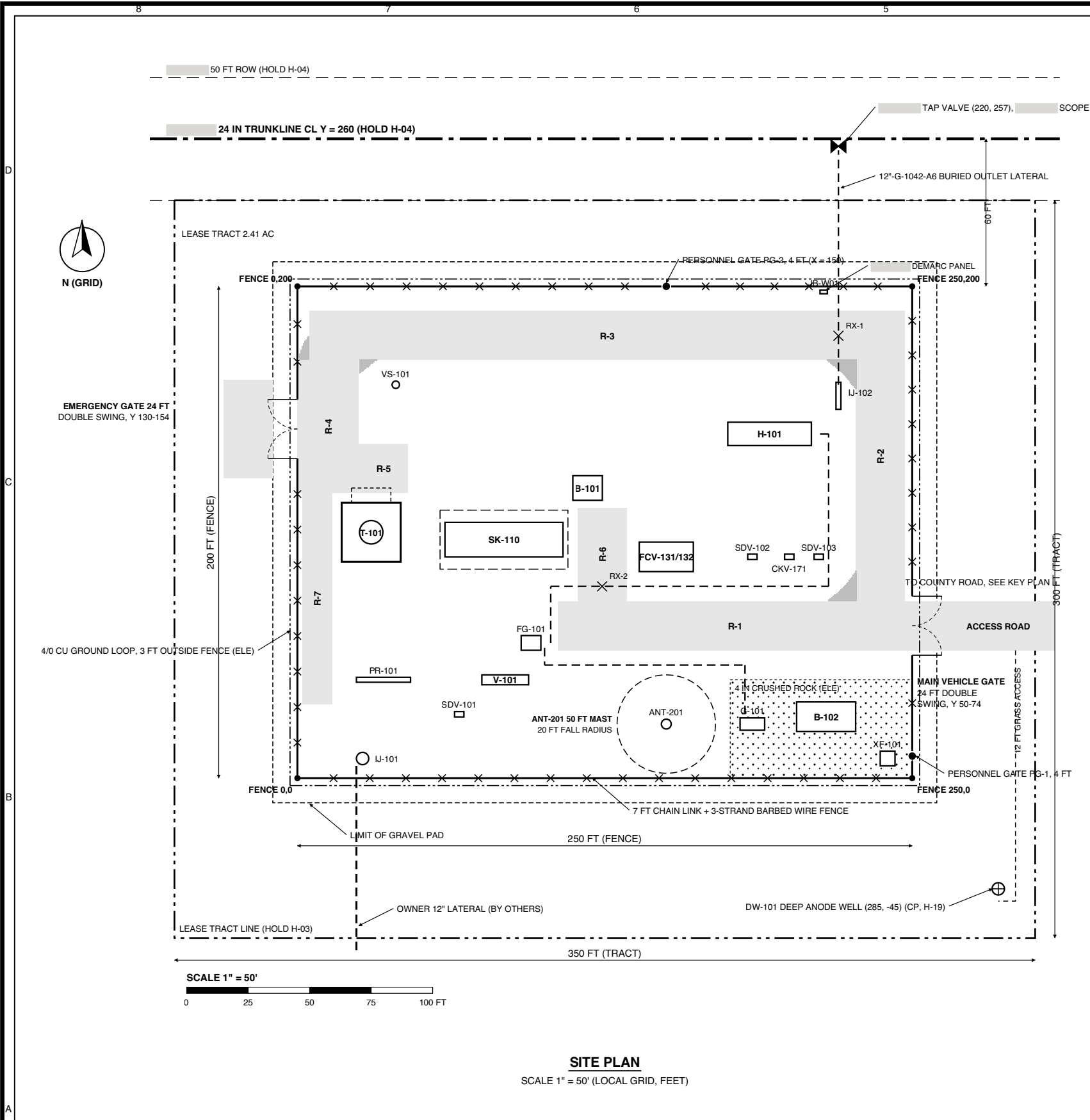
5. A cattle guard with a bypass gate is provided at the pasture line, subject to the landowner (HOLD H-03).

The open items are the subgrade CBR (HOLD H-07), the vacuum truck frequency (HOLD H-20), the crane and lift data (HOLD H-15), the county road speed, sight distance and driveway permit (HOLD H-02, H-05), and the landowner's requirements (HOLD H-03). The corner fillets shall be added to the plot plan.



APPENDIX A. OVERALL SITE PLAN





KEY COORDINATES (LOCAL GRID, FT; STATE PLANE TIE BY SURVEY, HOLD H-02)

POINT	X	Y
FENCE SW / SE CORNER	0 / 250	0
FENCE NW / NE CORNER	0 / 250	200
TRACT SW / NE CORNER	-50 / 300	-65 / 235
PAD LIMITS	-10 TO 260	-10 TO 210
MAIN GATE CL	250	62
EMERGENCY GATE CL	0	142
ACCESS ROAD END (COUNTY EDGE)	868	62
CUL-1 CL	855	62
CATTLE GUARD CL	830	62
IJ-101 INLET	26.5	8
OUTLET RISER / IJ-102	220	160 / 152.5
TAP VALVE	220	257
T-101	30	100
H-101 CENTRE	192.0	140
ANT-201 MAST / JB-W01	150 / 214	22 / 197.5
DW-101 ANODE WELL	285	-45

LEGEND

- FENCE (7 FT CHAIN LINK)
- LEASE TRACT LINE
- ROW LINE
- TRUNKLINE CL
- BURIED PIPE (BY THIS PACKAGE OR OTHERS)
- GRAVEL ROAD (12 IN SECTION)
- LIMIT OF GRAVEL PAD (6 IN)
- SK-110 CANOPY OUTLINE
- BURIED ROAD CROSSING RX-n
- PERSONNEL GATE
- 4/0 GROUND LOOP (ELE, FOR COORDINATION)
- 4 IN CRUSHED ROCK (ELE)
- CORNER FILLET (CIV-CAL-003)
- DW-101 ANODE WELL + GRASS TRACK

NOTES / REFERENCES

- LOCAL GRID: ORIGIN SW FENCE CORNER, X EAST, Y NORTH, FT. SURVEY TIE TO NAD83 S / NAVD88 (H-02).
 - TRACT PLACEMENT ASSUMED (H-03). TRUNKLINE, ROW AND TAP BY THE RECEIVING OPERATOR (H-04).
 - LAYOUT, ROADS R-1 TO R-7 AND BURIED PIPE PER MEC-DWG-001 PLOT PLAN.
 - CROSSINGS RX-n PER PLOT PLAN, 48 IN MIN COVER. ELE / CP / TELECOM ITEMS SHOWN FOR COORDINATION ONLY.
 - FOUNDATIONS: STR-DWG-001. GROUND LOOP: ELE-CAL-005. DW-101: CP DRAWINGS (H-19).
 - GRADING: CIV-DWG-003. SECTIONS AND DETAILS: CIV-DWG-004. ESC: CIV-DWG-005.
- REF: CIV-CAL-003
- REF: GEN-DB-001 SEC 10.1

REVISIONS

REV	DATE	DESCRIPTION	BY	CHK	APP
A	2026-09-29	ISSUED FOR REVIEW (IFR)			

PRELIMINARY - ISSUED FOR REVIEW - NOT FOR CONSTRUCTION

ENGINEER OF RECORD SEAL

NOT SEALED
PRELIMINARY

PE NO. _____

PROJECT

120 MMSCFD RECEIPT INTO _____

COUNTY, _____
DISCIPLINE: CIVIL
SCALE: AS SHOWN

OVERALL SITE PLAN

TRACT, ROW, ACCESS ROAD, FENCE AND GATES

DRAWN: _____ CHECKED: _____ APPROVED: _____

DWG NO. _____

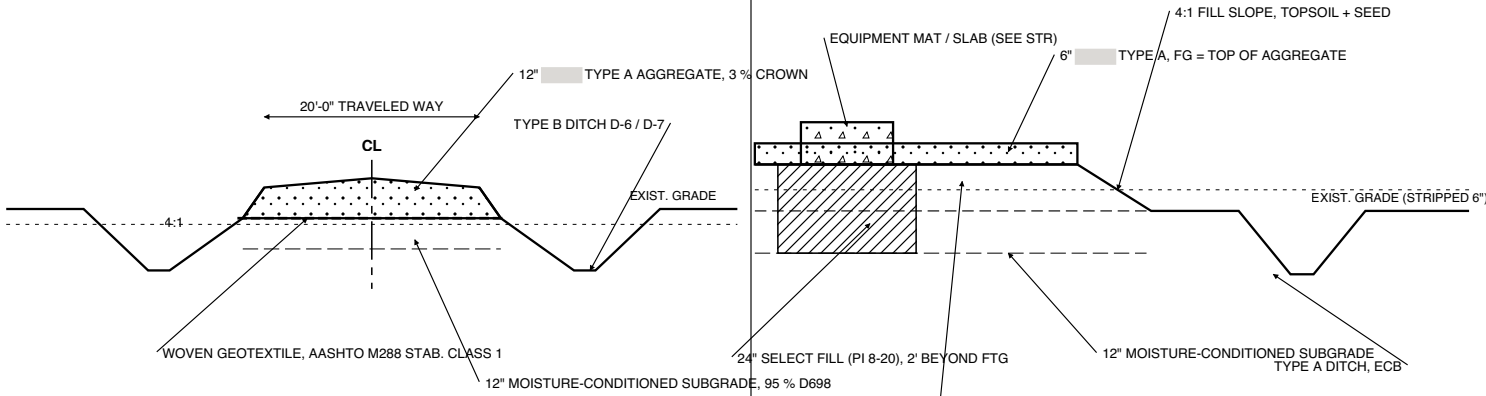
CIV-DWG-002

SHEET 1 OF 1 REV A

APPENDIX B. CIVIL SECTIONS AND DETAILS



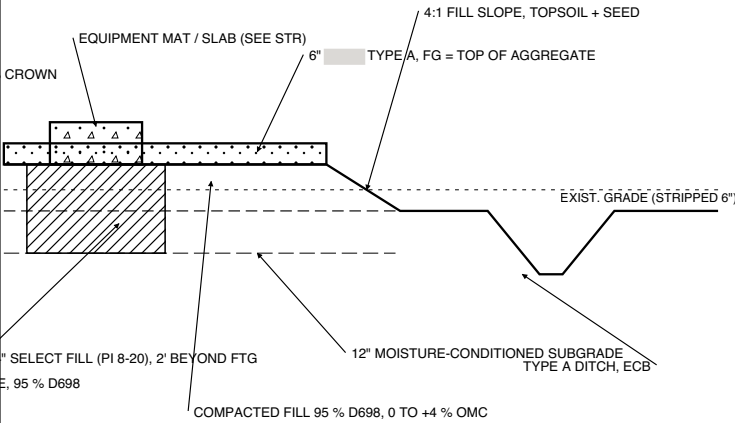
PIPE CROSSINGS (PLOT PLAN): RX-1 12"-G-1042-A6 UNDER R-3, COVER 4.0 FT; RX-2 2"-F-1051-A1 UNDER R-6, COVER 4.0 FT.
INTERNAL ROADS R-1 TO R-7 (R-7 12 FT WIDE): SAME SECTION, TOP FLUSH WITH PAD, NO DITCHES.
48 IN MIN COVER BELOW TOP OF ROAD; SELECT FILL OR CLSM BACKFILL IN THE ROAD WIDTH + 2 FT.



1

ACCESS ROAD TYPICAL SECTION

NTS, VERTICAL EXAGGERATION 3X



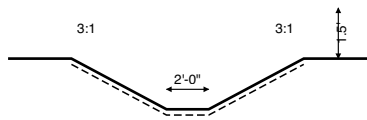
2

PAD EDGE AND SELECT FILL SECTION

NTS

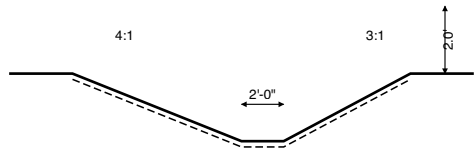
TYPE A: PAD INTERCEPTOR / SWALE

DITCHES D-1, D-2, D-3, D-4, D-5



TYPE B: ACCESS ROAD DITCH

DITCHES D-6, D-7

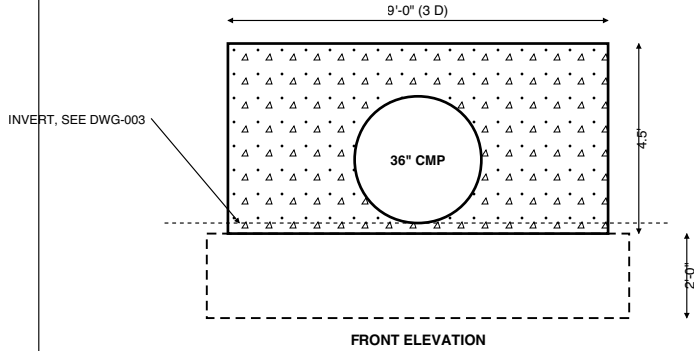


LINING: SEED + STRAW/COCONUT ECB (DOUBLE NET), STAPLED 1.5/SY.
ANCHOR TRENCH 6" x 6" AT TOP OF SLOPE, 6" OVERLAPS SHINGLED DOWNSTREAM.
DASHED LINE = ECB. FLOWLINE SLOPES PER CIV-DWG-003.

3

DITCH SECTIONS

NTS

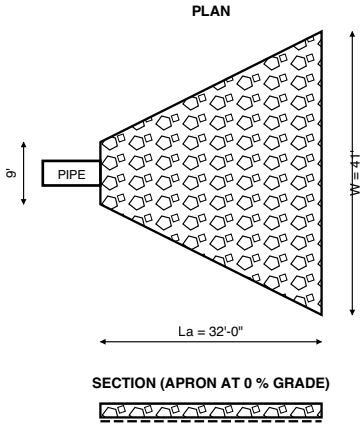


CUL-1: 36 IN CMP, 2-2/3 x 1/2 IN CORR., 14 GA, ALUMINIZED TYPE 2,
96 FT, S = 0.8 %, 12 IN MIN COVER. HEADWALL EACH END.
HEADWALL: 4,000 PSI CONCRETE, 10 IN THICK, #4 @ 12 IN EACH WAY EACH FACE,
FOOTING 2 FT BELOW INVERT (FROST + SCOUR), 2 FT CLEAR BEYOND WALL.
BEDDING: 6 IN TYPE A; STRUCTURAL BACKFILL 1.5 FT EACH SIDE AND
1 FT OVER CROWN, 6 IN LIFTS BOTH SIDES TOGETHER, 95 % D698.
RIPRAP TOE APRON 5 FT AT INLET; OUTLET APRON PER DETAIL 5.
COUNTY MAY REQUIRE SAFETY END SECTIONS INSTEAD (HOLD H-05).

4

CULVERT CUL-1 HEADWALL

NTS

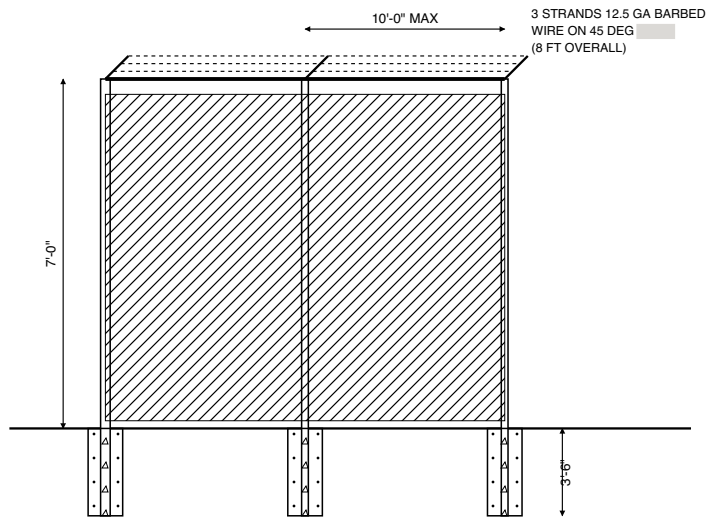


CUL-1 OUTLET: d50 = 6 IN, dmax = 9 IN, THICKNESS 12 IN, 43 TONS.
CUL-1 INLET TOE: 5 FT x 6 FT, SAME STONE.
SE OUTFALL: 10 x 11 FT, SAME STONE.
THEN LEVEL SPREADER 35 FT, 0.0 % LIP ON UNDISTURBED GRADE.
STONE: TYPE I PLAIN RIPRAP OR GRADED STONE, SG >= 2.5.
NONWOVEN GEOTEXTILE 8 OZ/SY UNDER ALL RIPRAP (DASHED).
TOTAL RIPRAP 50 TONS (CIV-CAL-002).

5

RIPRAP APRON AND LEVEL SPREADER

NTS

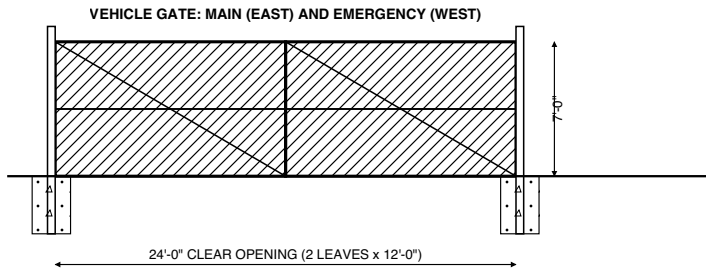


FABRIC: 9 GA GALV. CHAIN LINK, 2 IN MESH, 84 IN HIGH, KNUCKLED BOTTOM,
2 IN MAX GROUND CLEARANCE. LINE POSTS 2-3/8 IN OD SCH 40 @ 10 FT MAX;
TERMINAL / CORNER POSTS 2-7/8 IN OD; GATE POSTS 4 IN OD (24 FT LEAVES).
TOP RAIL 1-5/8 IN, 7 GA BOTTOM TENSION WIRE. FOOTINGS 3,000 PSI:
12 IN DIA x 42 IN (LINE), 18 IN DIA x 48 IN (TERMINAL / GATE).
BRACE AND TRUSS AT EVERY TERMINAL. GROUND FENCE PER ELECTRICAL.

6

CHAIN LINK FENCE

NTS

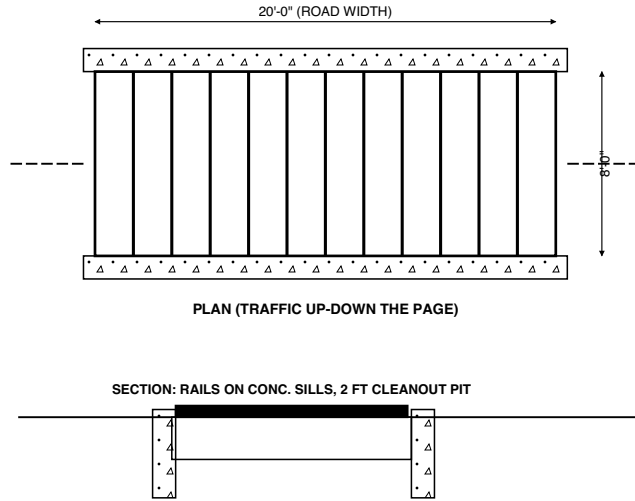


FRAMES 2 IN OD SCH 40 GALV., WELDED, FABRIC TO MATCH FENCE, 3-STRAND
BARBED WIRE EXTENSION; DIAGONAL 3/8 IN TRUSS ROD EACH LEAF.
DROP BAR, CENTER STOP EMBEDDED IN CONCRETE, HOLD-OPEN KEEPERS AT 90 DEG.
PADLOCK HASP; EMERGENCY GATE WITH PANIC-OPEN CHAIN AND KNOX PADLOCK (OWNER).
PERSONNEL GATES (2): 4 FT x 7 FT SINGLE LEAF, SELF-CLOSING, OPENS OUTWARD,
PANIC HARDWARE INSIDE (EGRESS WITHOUT KEY). GATE ZS-211 SWITCH PER INS.

7

VEHICLE AND PERSONNEL GATES

NTS



PREFABRICATED STEEL CATTLE GUARD, AASHTO HL-93 RATED (CRANE AXLE 26.5 KIP),
20 FT x 8 FT, ON CAST-IN-PLACE SILLS 12 IN x 42 IN, 4,000 PSI, #5 CONT. x 4.
WING FENCES 16 FT EACH SIDE (4-STRAND BARBED), TIE TO PASTURE FENCE.
16 FT TUBULAR STEEL BYPASS GATE ADJACENT. LOCATION X = 830, Y = 62.
DELETE IF THE LANDOWNER DOES NOT REQUIRE (HOLD H-03).

8

CATTLE GUARD

NTS

NOTES / REFERENCES

- ALL DETAILS NOT TO SCALE. DIMENSIONS GOVERN.
 - AGGREGATE: TYPE A (SECTION 703.01), GEOTEXTILE: AASHTO M288 (CIV-CAL-003).
 - COMPACTION AND MOISTURE PER CIV-CAL-001 SECTION 8, EXPANSIVE CLAY RULES: CIV-RPT-001.
 - DRAINAGE SIZES FROM CIV-CAL-002. CONCRETE 4,000 PSI, REBAR ASTM A615 GR 60.
 - CUL-1 SIZE, END TREATMENT AND INVERTS SUBJECT TO COUNTY PERMIT AND SURVEY (HOLD H-05, H-02).
- REF: CIV-CAL-001/002/003
REF: CIV-RPT-001

REVISIONS

REV	DATE	DESCRIPTION	BY	CHK	APP
A	2026-09-29	ISSUED FOR REVIEW (IFR)			

PRELIMINARY - ISSUED FOR REVIEW - NOT FOR CONSTRUCTION

ENGINEER OF RECORD SEAL

NOT SEALED
PRELIMINARY

PE NO. _____

PROJECT

120 MMSCFD RECEIPT INTO _____

COUNTY, _____
DISCIPLINE: CIVIL
SCALE: NTS

CIVIL SECTIONS AND DETAILS

ROAD, PAD, DITCH, CULVERT, RIPRAP, FENCE
DRAWN: _____ CHECKED: _____ APPROVED: _____
DWG NO. **CIV-DWG-004**
SHEET 1 OF 1 REV A