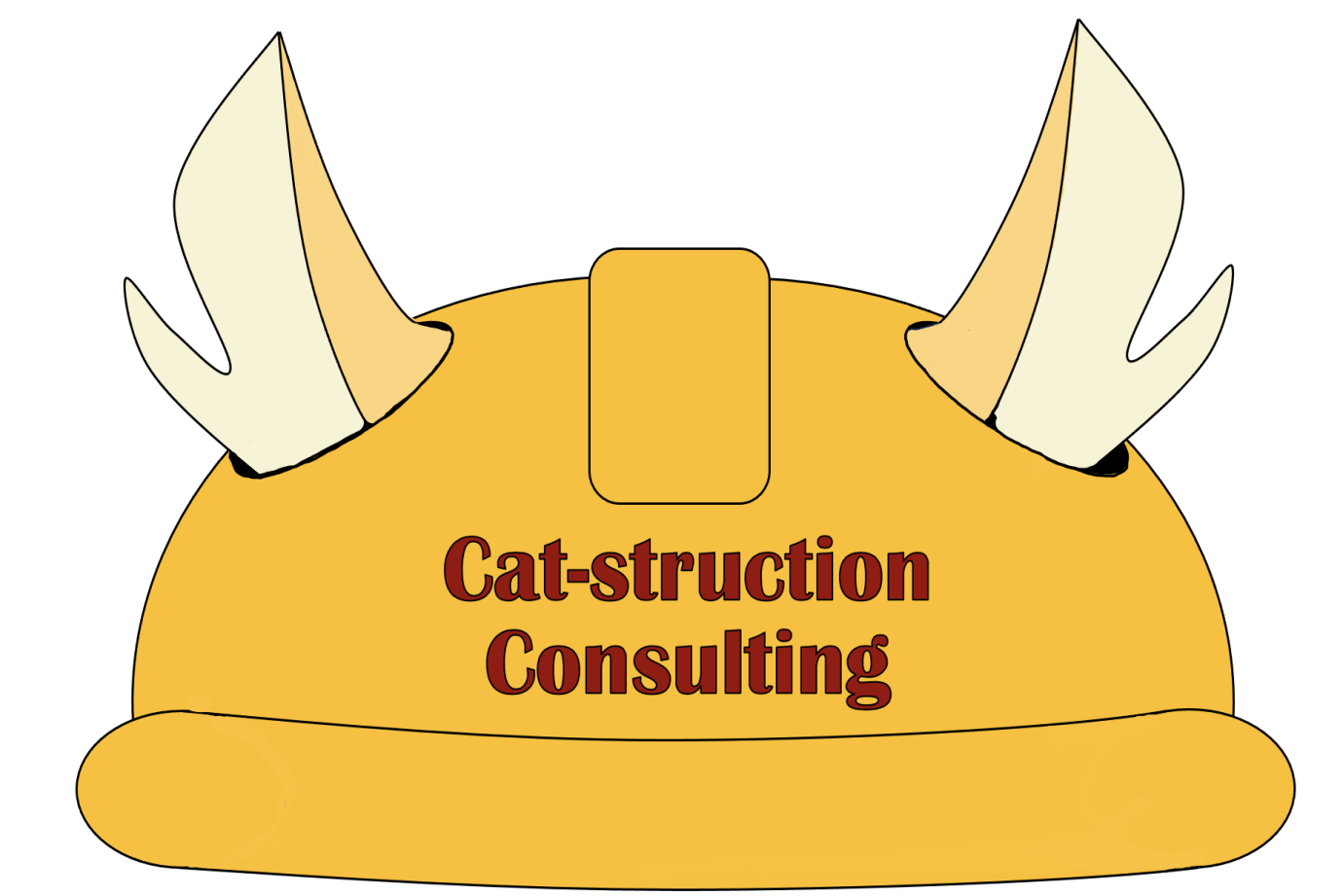


# C2.05 – High Performance Box Culvert Bridge



Kamden Dziuk  
 Arturo Figueroa  
 Bryan Uptmore  
 Julian Garcia

Project  
 sponsor:  
 TxDOT



## Project Overview



TxDOT has supplied us with plans containing a proposed bridge over Panna Maria Creek located on N FM 81 Rd, Hobson TX. Our task was to create an alternative design to combat the harsh environment of site.

Our environmental obstacles include:

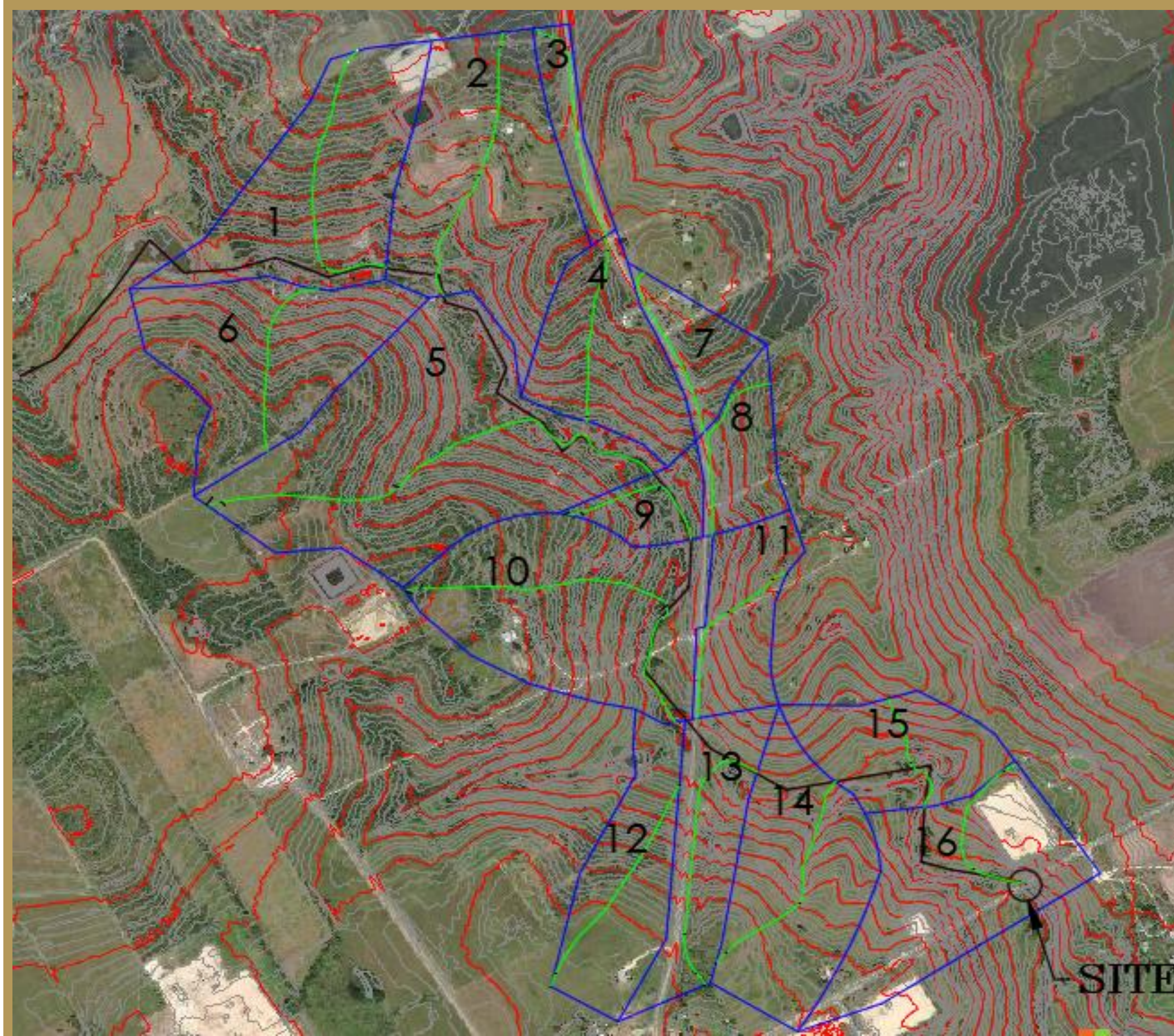
- An influx in existing hydraulic conditions
- Silica rich soil due to excessive oil drilling
- Increase in large oil truck traffic

## HPC Mix Design

Mix Constituents	Class C (HPC): 25% Fly Ash
Cement Type II Portland	15777 lbs
Fly Ash (Class F)	23547 lbs
Silica Fume	7536 lbs
Coarse Aggregate	31553 lbs
Fine Sand Aggregate	15777 lbs
Water/Reducers	3221 L ~ 4294 L
Maximum W/cm	0.53
Permeability (AASHTO T277)	750 coulombs

- According to TxDOT's Corrosion Protection Guide, our project is located within the Corpus Christi District (CRP) near the border of the San Antonio District (SAT)
- Location contains chlorine and sulfate due to the mild coastal environment.

## Existing Hydrology Conditions

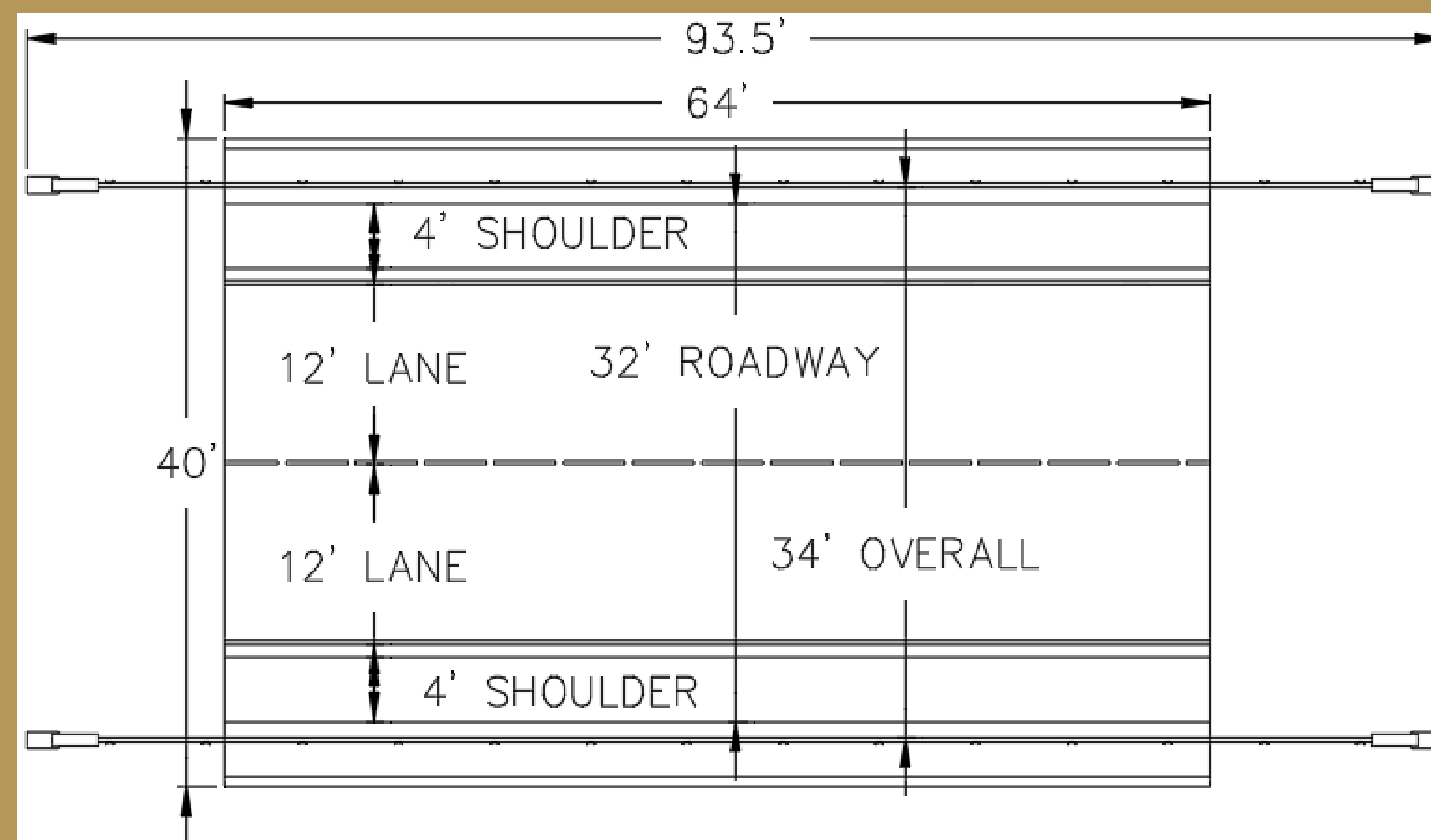
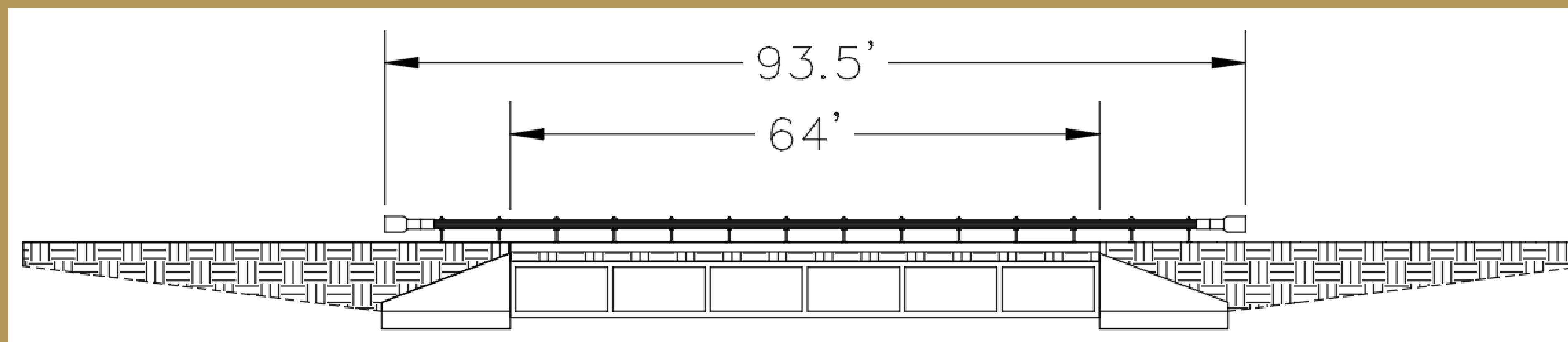


Drainage Area	Drainage Area (ac)	T <sub>c</sub>	Q <sub>2</sub> (cfs)	Q <sub>10</sub> (cfs)	Q <sub>25</sub> (cfs)	Q <sub>100</sub> (cfs)
Area 1	35.59	20.62	26.47	37.12	44.16	55.62
Area 2	43.56	164.36	14.79	20.89	24.85	31.41
Area 3	6.80	42.18	3.56	4.94	5.85	7.34
Area 4	22.02	22.84	16.85	23.62	28.10	35.39
Area 5	64.38	31.74	35.61	49.43	58.60	73.49
Area 6	33.46	59.73	19.51	27.08	32.10	40.26
Area 7	9.45	14.15	8.40	11.87	14.16	17.86
Area 8	10.67	25.30	7.94	11.13	13.24	16.67
Area 9	7.10	29.31	6.04	8.46	10.07	12.68
Area 10	43.83	51.47	22.61	31.38	37.20	46.65
Area 11	14.95	17.90	9.53	13.37	15.90	20.03
Area 12	22.15	27.68	20.66	28.98	34.47	43.42
Area 13	20.15	151.52	8.60	12.15	14.45	18.26
Area 14	31.89	127.85	13.80	19.49	23.18	29.30
Area 15	18.48	10.00	21.12	29.85	35.59	44.91
Area 16	34.84	16.68	33.32	46.72	55.58	70.00
<b>Total</b>	<b>419.32</b>	<b>813.32</b>	<b>268.79</b>	<b>376.47</b>	<b>447.50</b>	<b>563.29</b>

Rational Method,  $Q = CiA$

Our existing hydrology analysis was conducted using the standard from the TxDOT Hydraulic Design Manual. As for our final calculations, we used the Rational Method to calculate the predicted values for 2, 10, 25, and 100 year design storms.

## Final Design



- Parameters of our final design:
- Culvert Area = 300 ft<sup>2</sup>
  - Allowable Discharge = 2901 cfs
  - Allowable Velocity = 9.67 ft/s
  - F.O.S. = 5.15
  - Structural Capacity Increase of 80 MPa to 120 MPa

## Sustainability Evaluation

Envision Grading	Score		
Credit Category	Available	Earned	Percent
Quality of Life	96	84	88
Leadership	132	103	78
Resource Allocation	162	39	24
Natural World	200	154	77
Climate & Resilience	190	62	33
<b>Total Points / %</b>	<b>780</b>	<b>442</b>	<b>57</b>

## Capital and Life Cycle Cost

Materials	Cost (\$)
Rails	\$11,900.00
Box Culvert	\$345,600.00
Road Slab	\$348,600.00
Wing Walls	\$26,400.00
Construction	\$73,000.00
<b>Initial Cost</b>	<b>\$805,500.00</b>

## Net Present Value (NPV)

Initial Cost	\$805,500.00
Maintenance Cost	\$18,000.00
Rehabilitation Cost	\$278,000.00
<b>Total</b>	<b>\$1,101,500.00</b>