I45 FRONTAGE ROAD IMPROVEMENT PROJECT

CMPZ ENGINEERINGS

CVEN 456/766 Team 4

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Introduction

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PhD student — Familiar with AutoCAD, Civil 3D, ArcGIS, Matlab, C++.

Demetrius Moore
Undergraduate student — Familiar with Civil 3D, lots of practical experience in civil engineering projects.

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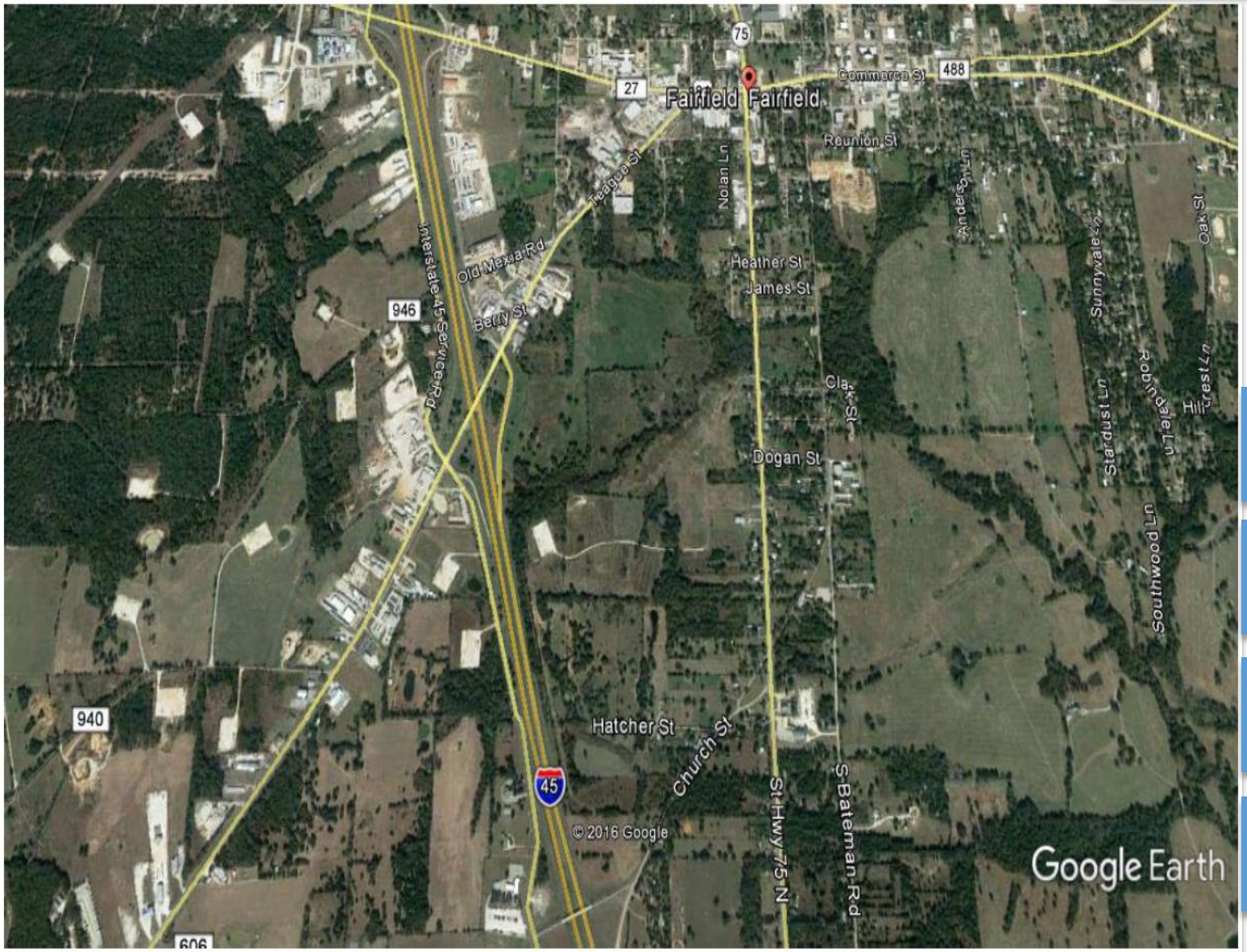
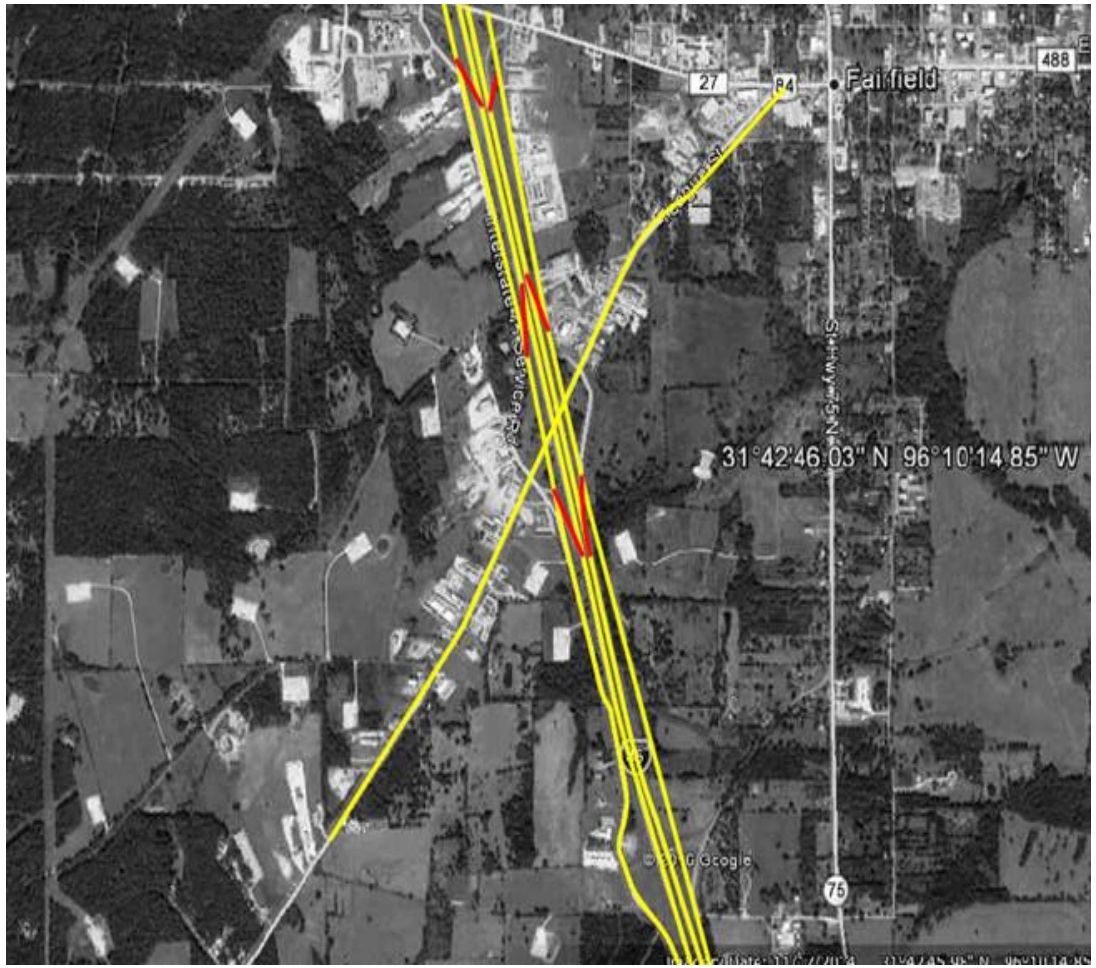
Master student — Familiar with AutoCAD, VISSIM, TransCAD, JMP.

Project Summary Our Goal

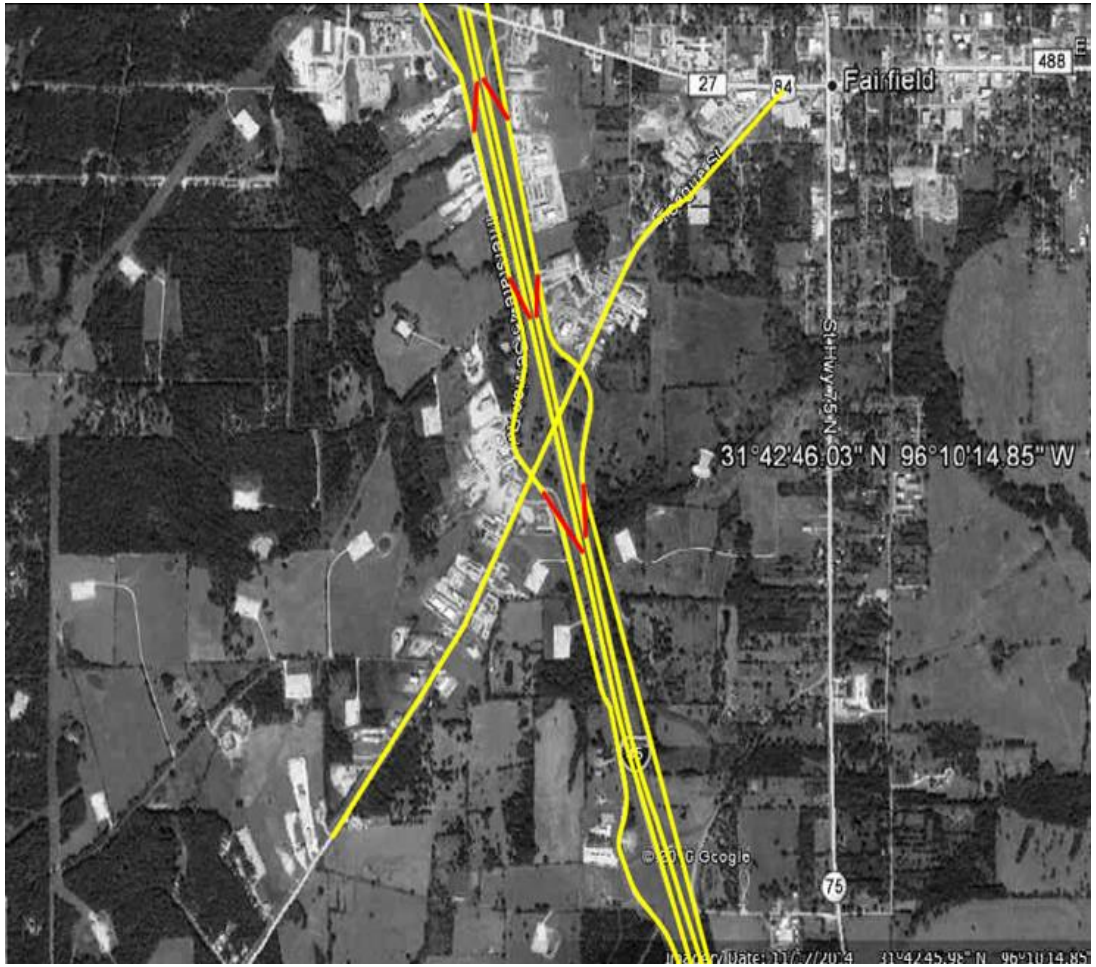


1. Improve the frontage road
2. Change the two-way frontage road to one-way
3. Improve ramps
4. Improve intersection

COMPARISON OF PROPOSED ALIGNMENTS

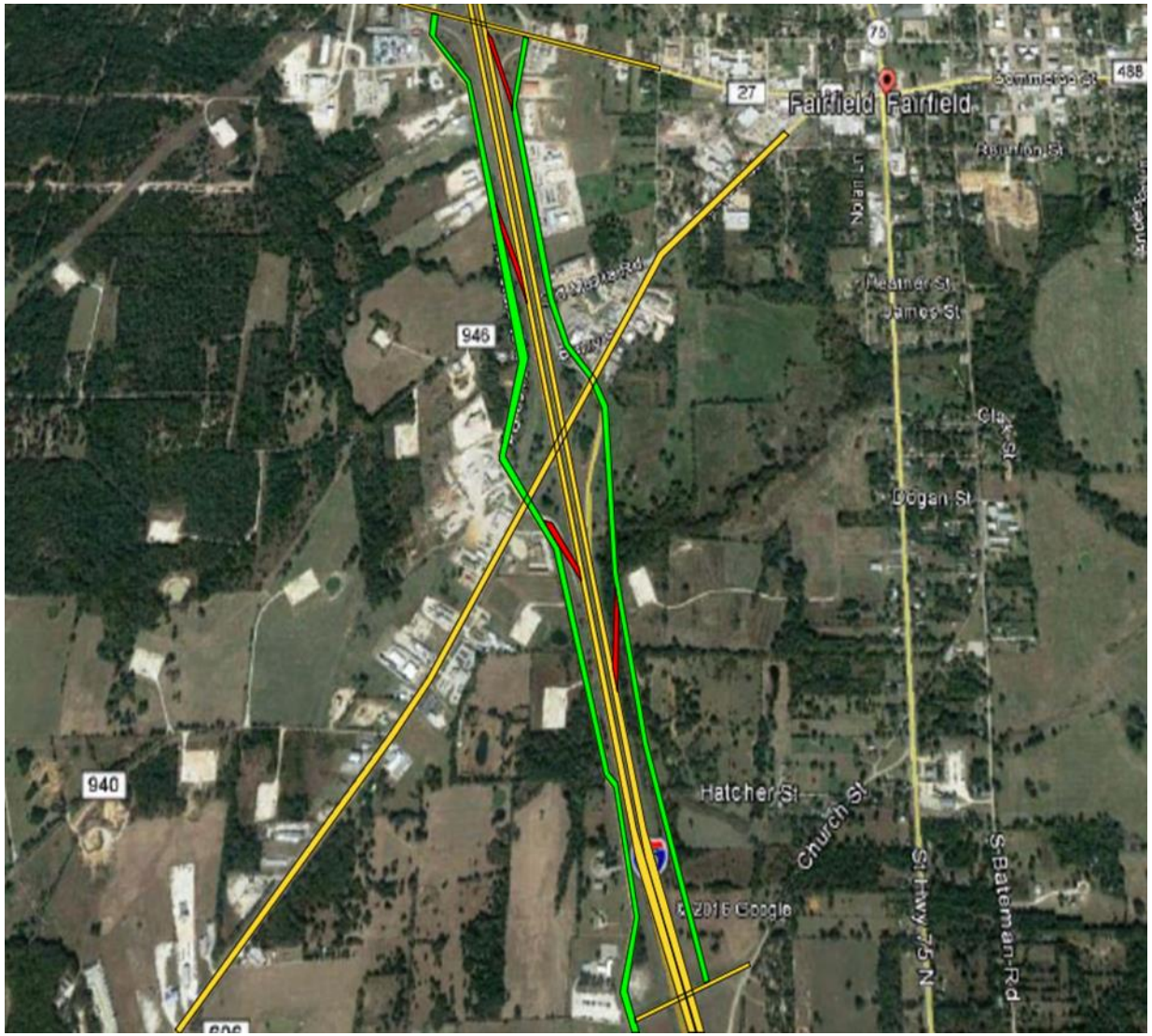


Alignment A



Alignment B

THE FINAL PLAN



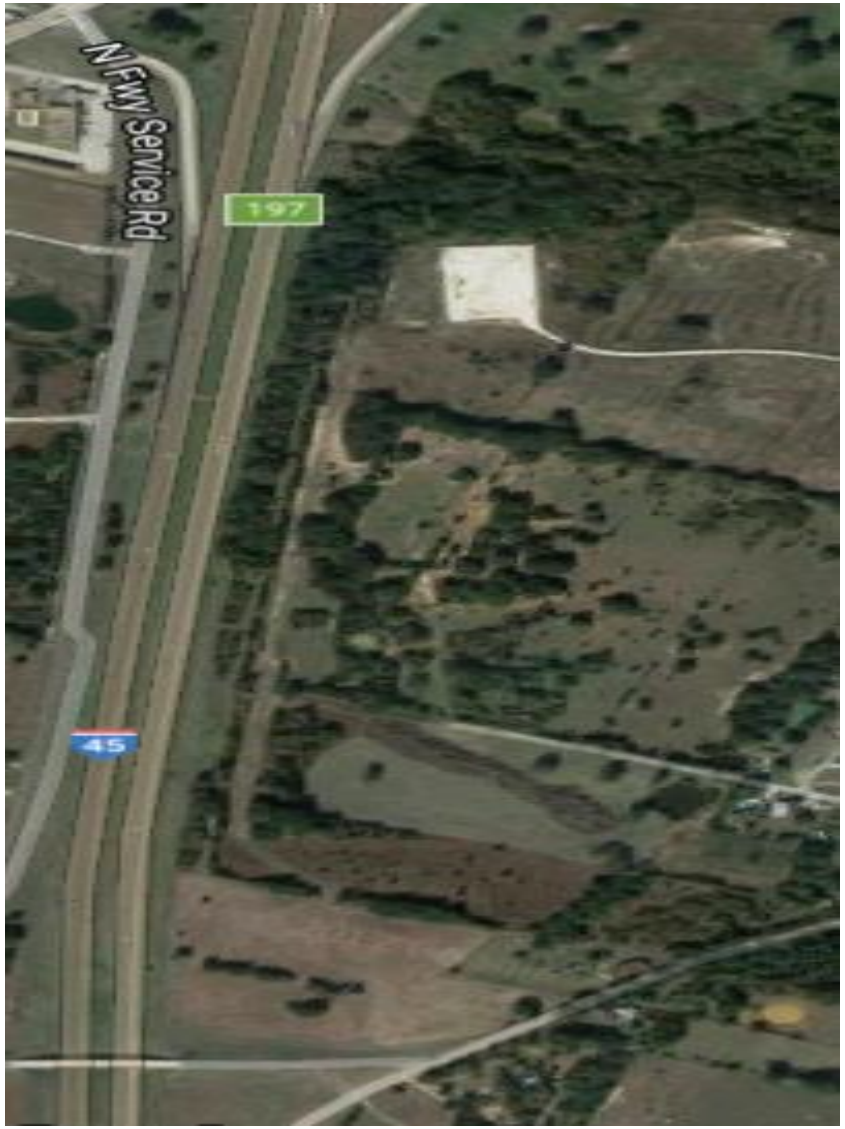
- Based on Alignment B with modified ramps
- Avoid ramp entrances near ramp exits to avoid weaving section
- Ensure frontage roads meet intersections at 90° angle

RAMP LOCATIONS

- Access ramp prior to northbound frontage road between US Hwy 84 and FM 27 to ensure access to major intersections and existing properties along frontage road.
- Relocate ramp along southbound frontage road between FM 27 and US Hwy 84 to allow more pass-by traffic along frontage road section
- Ramp to I-45 prior to FM 27 intersection to allow exit from frontage road passed private properties
- Maintain ramp to I-45 southbound following US Hwy 84 intersection.
- Ramps modified to account for only one direction of access.
  - Previous ramps were designed to accommodate both directions of travel.

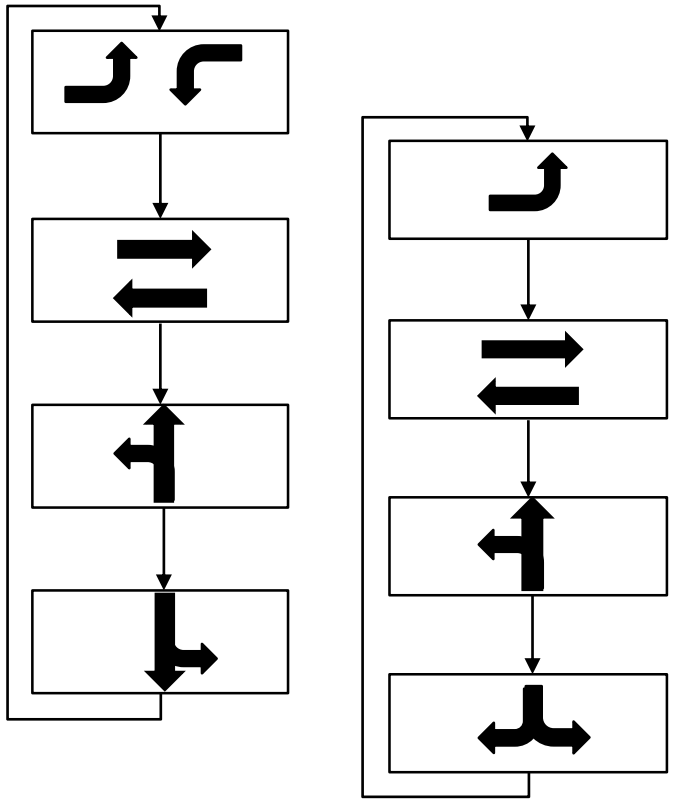
RIGHT OF WAY CONSIDERATION

- Addition of frontage road for northbound traffic between Church St. and US Hwy 84
- New location does not infringe on any developed property
- May increase noise pollution on private property on Hatcher Road approximately 500 feet from proposed location of frontage road
- Cost estimate of ROW preparation: $35,000/mile

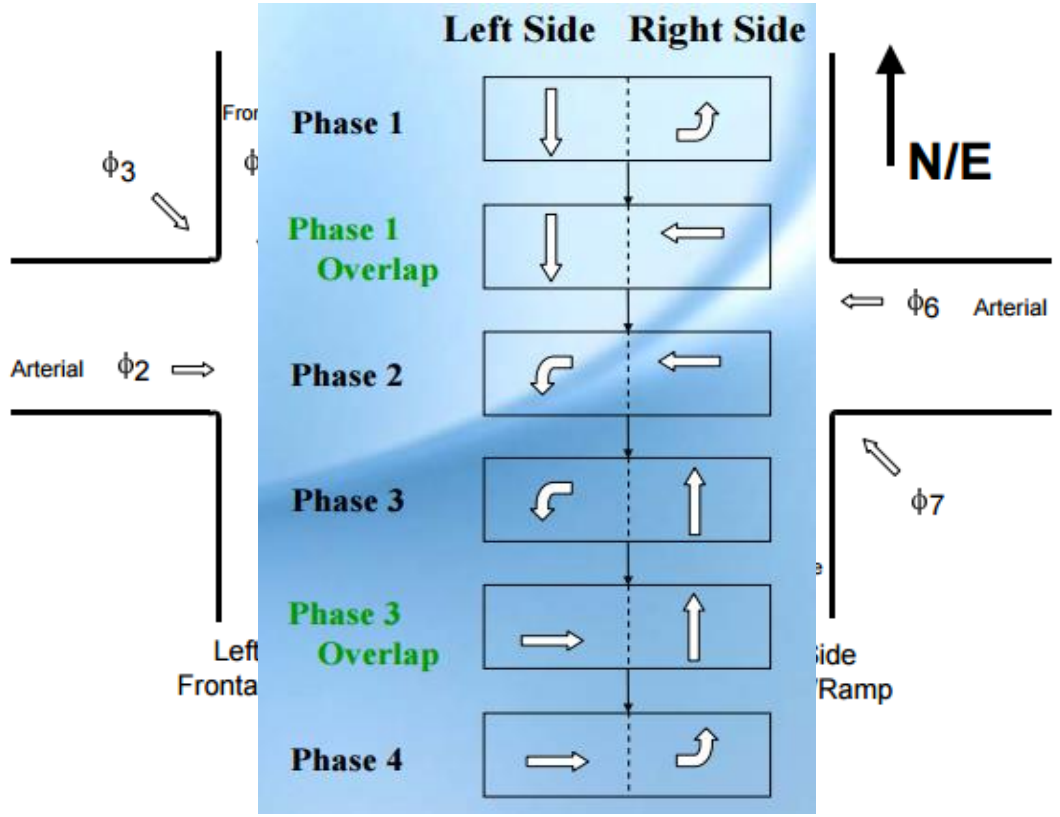


TRAFFIC ANALYSIS

- Before improvement.

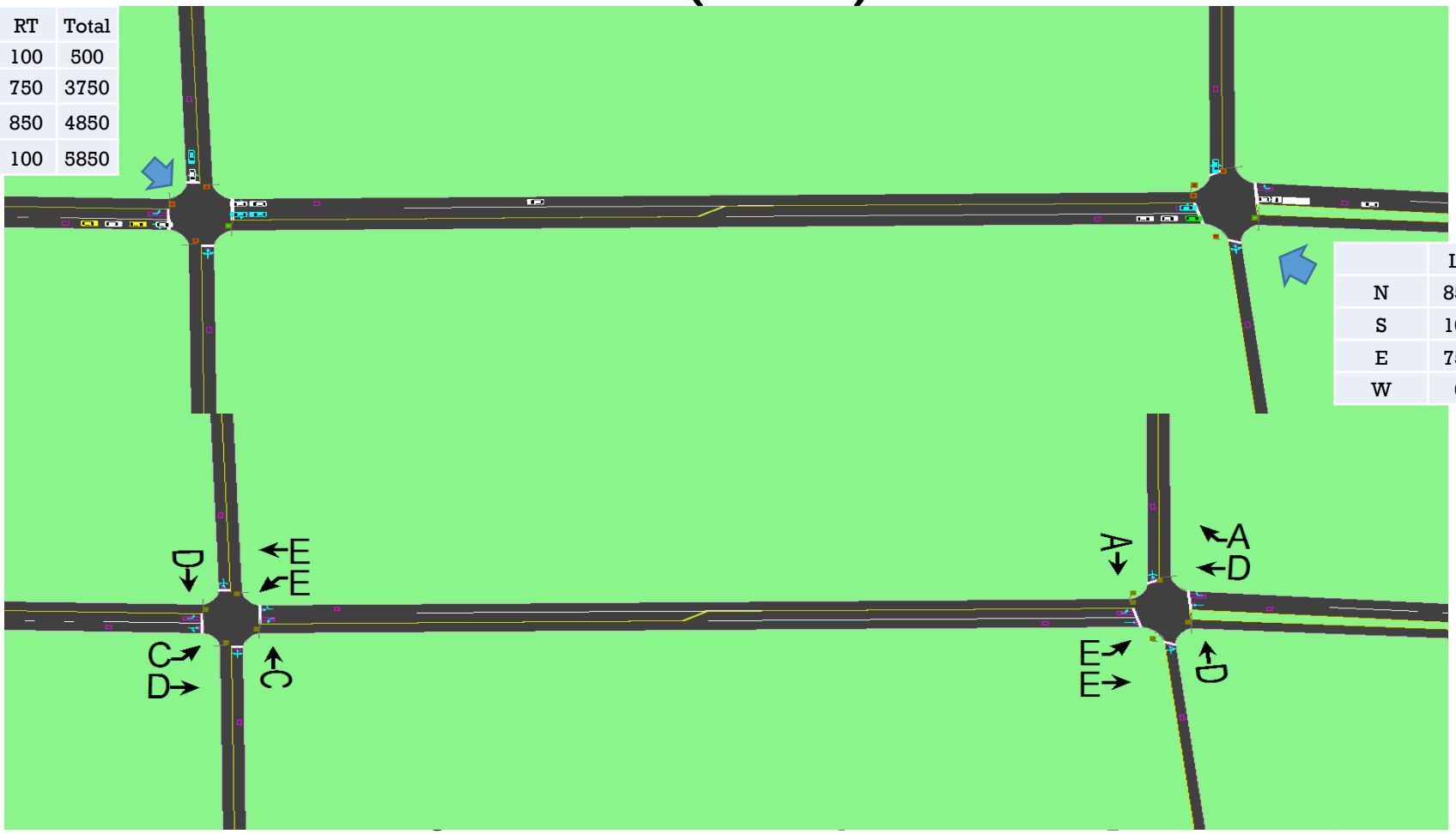


After improvement.



LOS ANALYSIS
BEFORE IMPROVEMENT (2020)

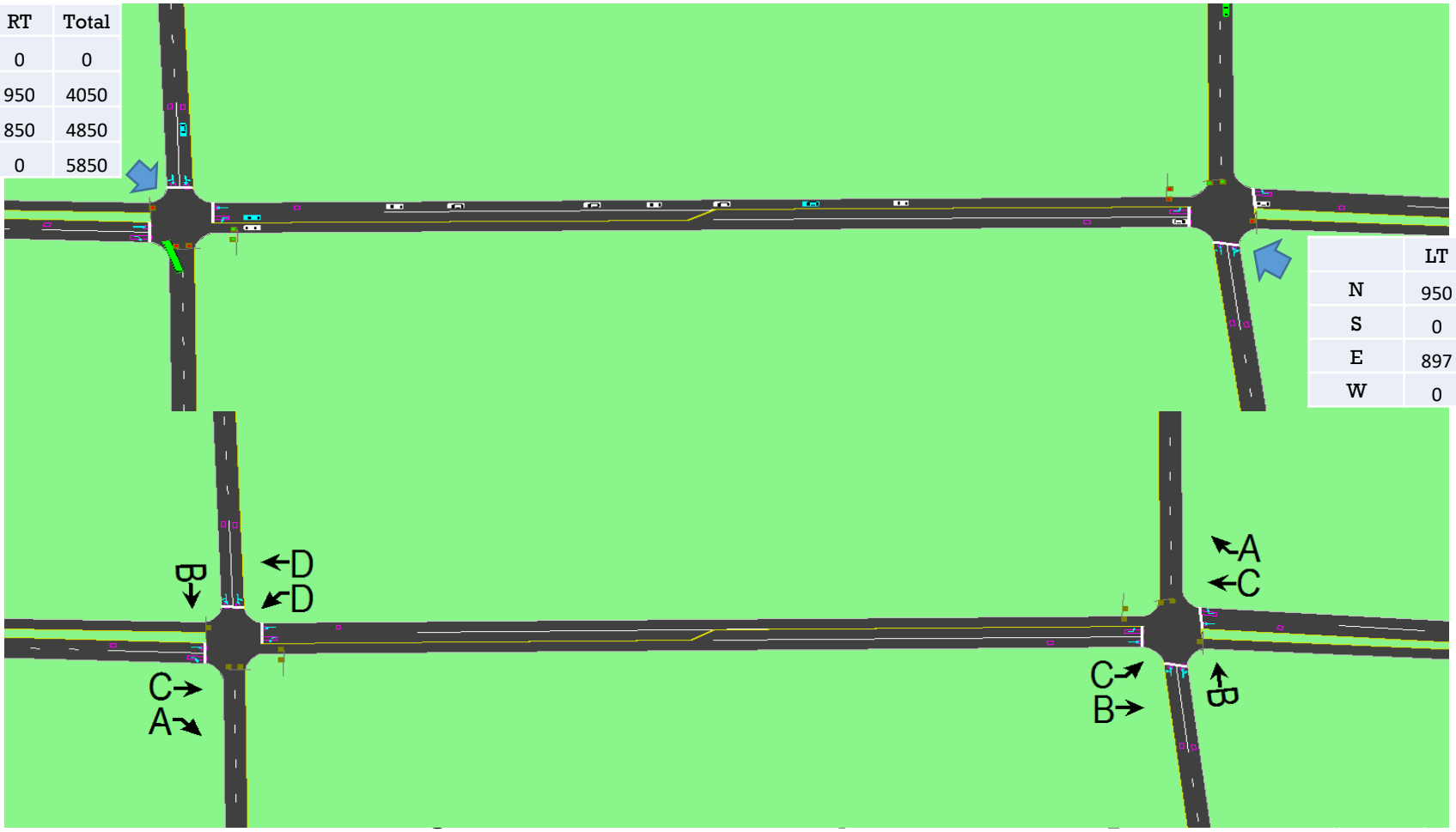
	LT	TR	RT	Total
N	100	300	100	500
S	850	2150	750	3750
E	100	3900	850	4850
W	1650	4100	100	5850



	LT	TR	RT	Total
N	850	1500	1550	3900
S	100	0	200	300
E	750	4100	0	4850
W	0	4900	850	5750

LOS ANALYSIS
AFTER IMPROVEMENT (2020)

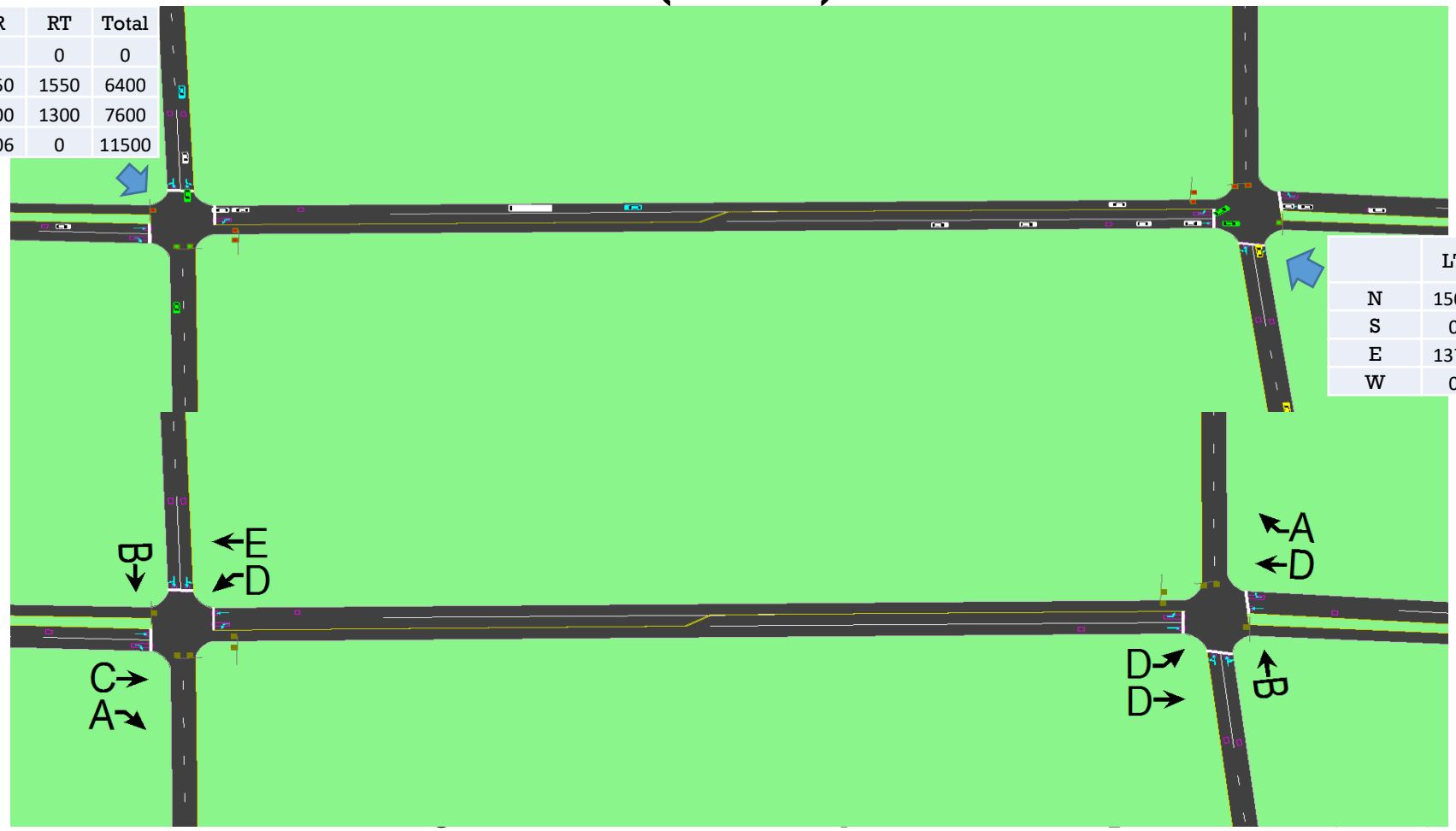
	LT	TR	RT	Total
N	0	0	0	0
S	950	2150	950	4050
E	0	4000	850	4850
W	1650	4200	0	5850



	LT	TR	RT	Total
N	950	1800	1650	4400
S	0	0	0	0
E	897	4903	0	5800
W	0	4900	850	5750

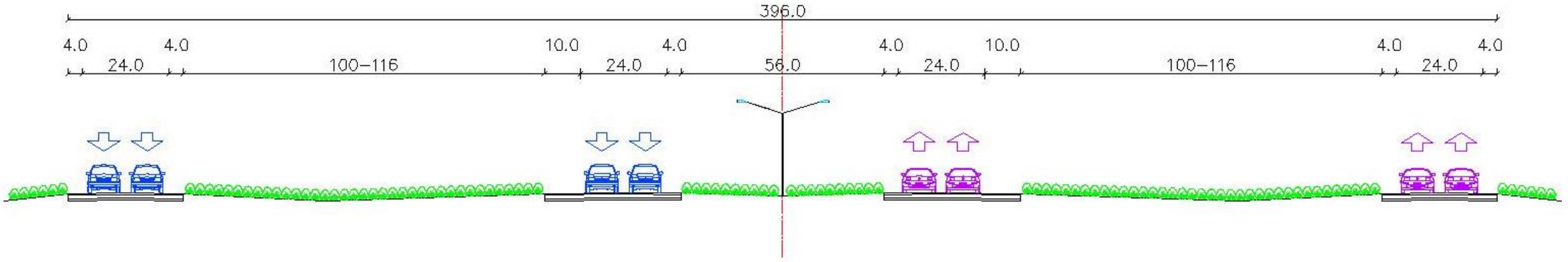
LOS ANALYSIS
AFTER IMPROVEMENT (2050)

	LT	TR	RT	Total
N	0	0	0	0
S	1500	3350	1550	6400
E	0	6300	1300	7600
W	3194	8306	0	11500



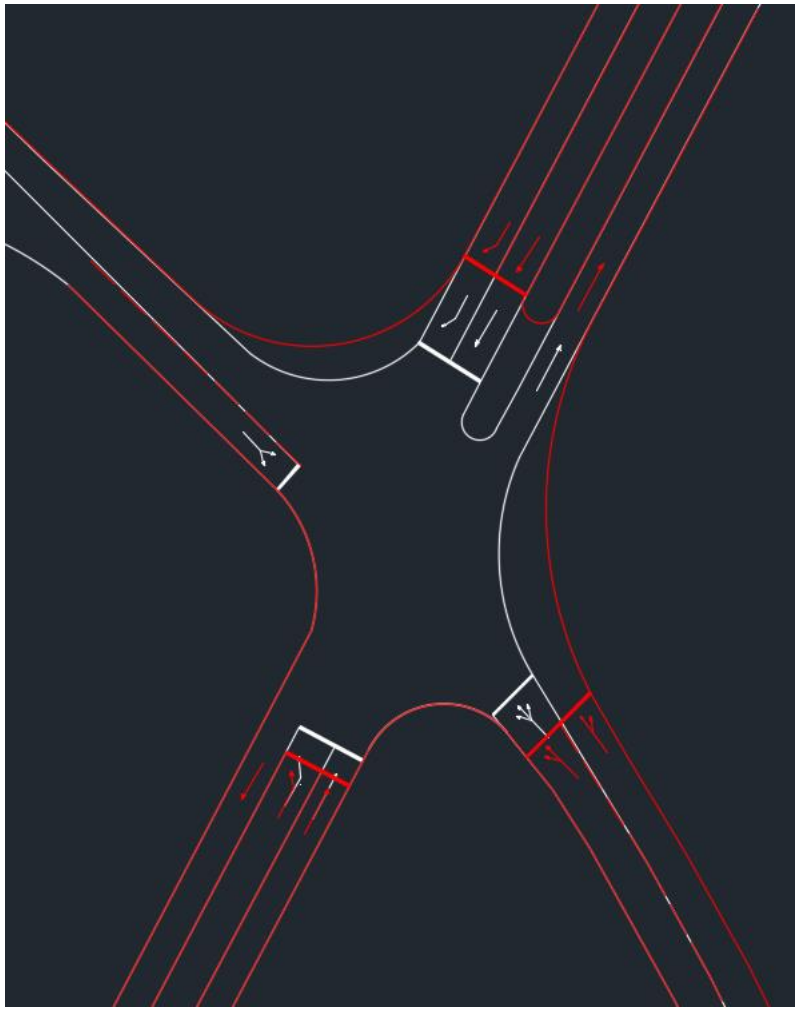
	LT	TR	RT	Total
N	1500	2750	2550	6800
S	0	0	0	0
E	1377	7723	0	9100
W	0	7500	1300	8800

CROSS SECTIONS PROFILES DESIGN

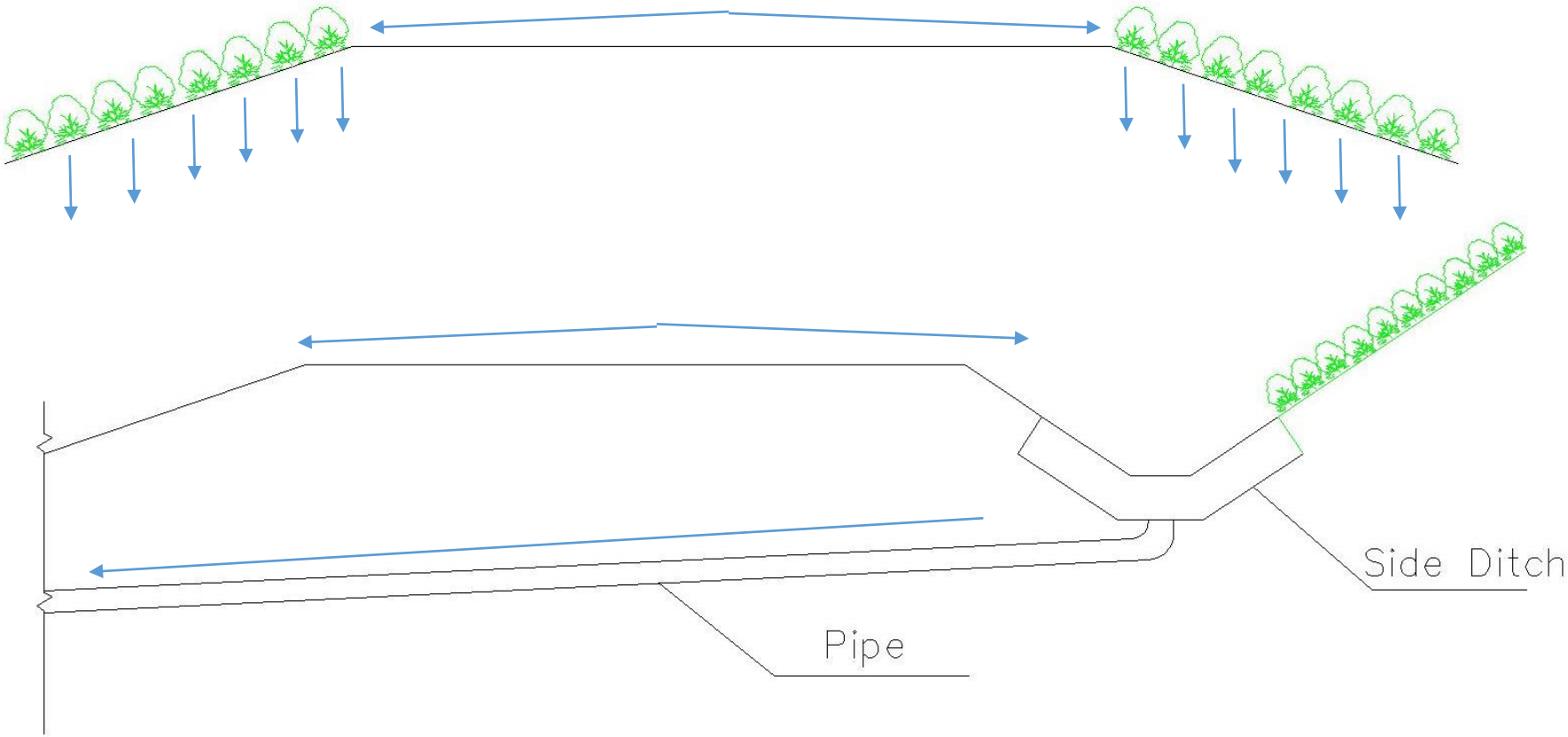


No.	PVI Station	PVI Elevation	Grade In	Grade Out	A (Grade Change)	Profile Curve Type	Sub-Entity Type	Profile Curve Length	K Value	Curve Radius
1	0+00.00'	488.79'		0.61%						
2	2+00.00'	490.00'	0.61%	0.54%	0.07%	Crest	Symmetric Parabola	5.88'	84	8400.00'
3	8+00.00'	493.22'	0.54%	-1.24%	1.77%	Crest	Symmetric Parabola	149.07'	84	8400.00'
4	16+00.00'	483.31'	-1.24%	1.07%	2.30%	Sag	Symmetric Parabola	221.12'	96	9600.00'
5	24+87.10'	492.76'	1.07%	-0.93%	2.00%	Crest	Symmetric Parabola	167.82'	84	8400.00'
6	47+50.30'	471.65'	-0.93%	0.51%	1.44%	Sag	Symmetric Parabola	138.29'	96	9600.00'
7	61+69.58'	478.86'	0.51%	0.15%	0.36%	Crest	Symmetric Parabola	30.17'	84	8400.00'
8	61+97.56'	478.90'	0.15%							

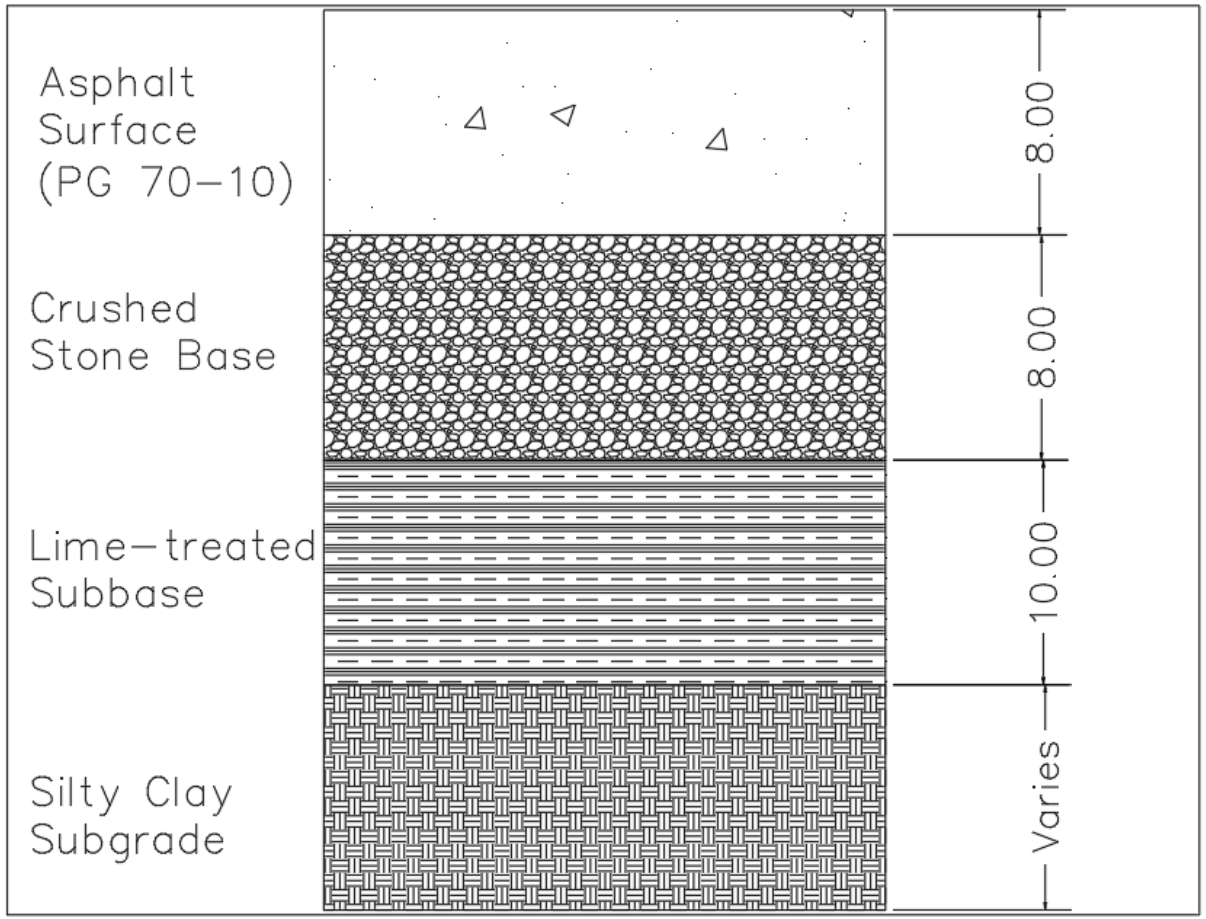
INTERSECTION IMPROVEMENT-EAST INTERSECTION



DRAINAGE



PAVEMENT DESIGN



- Cross-section of ramps and frontage roads
- Design life: 50 years
- Requires periodic mill and inlay maintenance of the surface layer.
- Cross-section for existing frontage roads if significant damage exists

ECONOMIC ANALYSIS

- Total construction/maintenance cost: $6,336,882.
- Total cost with salvage value: $6,336,882*0.9=$5,703,194
- Assume the user cost of do-nothing alternative is $50,000,000 per mile.
- Benefit: ($50,000,000-$40,993,742)*1.17=$10,567,322.44 heavy vehicle/hour.
- B/C ratio= $10,567,322.44/$6,070,122=1.74

Construction Cost

Section	User Cost				
	A to B	Unit cost	B to A	Factor/mi	Unit Cost Total two way
1	Initial construction cost ($/mile)	$2,000,000	$20,467,273	1.17	$2,340,000
2	Removal of shrubs ($/sq.yd)	$0.50	$20,545,709	0.12	$4,803,034
3	Embankment (fill) ($/cu.yd)	$5.50	$20,676,436	6,485.37	$35,670
4	Excavation (cut) ($/cu.yd)	$5.50	$20,545,709	0.10	$4,067,363
5	Preparation of ROW ($/mi)	$35,000	$20,388,837	1.17	$40,950
6	Pavement ($/sq.yd)	$40.00	$20,467,273	0.11	$4,584,666
7	Drainage structures ($/each)	$50,000	$20,650,290	1.00	$50,000
8	Bridge/overpass ($/sq.ft)	$80.00	$20,414,983	0.34	$13,976,301
9	Construction of unsignalized intersections ($/intersection)	$2,000,000	$20,467,273	4.00	$2,440,000
10	Construction of signalized intersections ($/intersection)	$3,200,000	$20,545,709	0.02	$916,537
11	Construction of ramps ($/each)	$610,000	$20,598,000	0.22	$9,144,044
				Total	**$6,070,122**

Maintenance Cost

		Unit cost		Unit	Cost
				Total	**$40,993,742**
1	Maintenance ($/lane-mi/yr)	$8,892		30	**$266,760**
2	Removal of shrubs ($/sq.yd)	$0.50	$20,545,709	0.02	$143,289
3	Embankment (fill) ($/cu.yd)	$5.50	$20,676,436	6,485.37	$35,670
4	Excavation (cut) ($/cu.yd)	$5.50	$20,545,709	0.10	$4,067,363
5	Preparation of ROW ($/mi)	$35,000	$20,388,837	1.17	$40,950
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11	Construction of ramps ($/each)	$610,000	$20,598,000	0.22	$9,144,044
				Total	**$6,070,122**

Table 1 Detailed User Cost Calculation Results

Table 2 Detailed Construction/Maintenance Cost Calculation Results

ADDITIONAL CONSIDERATIONS

- Extending northbound frontage road and allowing ramp access to frontage road prior to Church street
  - If more traffic along new frontage road section is desired
- Ensure traffic merges to single lane when approaching two-way sections of frontage road
- Approximately 5 minutes (1.5 miles) additional travel time for traffic diverted by one-way modification
  - Additional user cost of <$3.00 per trip

Thank You!