Jerome Marking, Signage, and Parking Modifications

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List of Abbreviations/Terms

NB: Northbound
SB: Southbound
EB: Eastbound
WB: West Bound

Acknowledgements

Albert Sengstock – Jerome Zoning Administrator and Client
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Shephard Wesnitzer, Inc – Reference for surveying data in Jerome, AZ

1.0 Project Background and Existing Conditions

The current infrastructure in Jerome is in need of repair and requires maintenance improvements to its internal road system. The increase in tourism has put pressure on parking and traffic services throughout the town, and as a result, pavement markings have faded over time. The town's main arterial road, State Route 89A, is generally well maintained; however, traffic flow has the potential to be more efficient through improvements such as paving on street parking areas with additional striping, pavement markings, and signage (Town of Jerome, 2015). It is understood that one of the main concerns of the town is that the existing parking space is not sufficient to sustain the high demand for parking as tourism increases and affects the traffic circulation throughout Jerome (Sengstock, 2016).

Additionally, it is understood that another main concern is to design parking stalls considering the turning radiuses of vehicles approximately 50' in length (Sengstock, 2016). Fire engines are unable to successfully make some turns throughout the town due to vehicles parking along the sides of the street and around corners. An increase in clearer signs are also needed throughout the town, and can aid in creating smoother traffic flow and decrease problematic parking (Sengstock, 2016). The purpose of this project is to modify the existing parking in Jerome in order to meet the increasing demand brought on by local tourism and to enhance the traffic flow along State Route 89A. Figure 1.1 below shows the project site location and the parking lots that were in consideration for design.

Figure 1.1: Parking Lots and On-Street Parking Locations (Google Maps, 2016)

2.0 Data Collection and Methods

The following sections explain the data collection methods used for analysis to determine design recommendations in response to the client's concerns.

2.1 Parking Use Study

A parking use study was needed in order to determine the total amount of vehicles occupying a parking space over the course of an 8 hour day and an average of how long

each vehicle was parked. Only parking areas with a capacity of more than 4 vehicles and of frequent use were considered. In total, there were three parking lots and four different on-street parking areas that were analyzed. Figure 2.1 below shows all of the parking areas that were considered in this study.

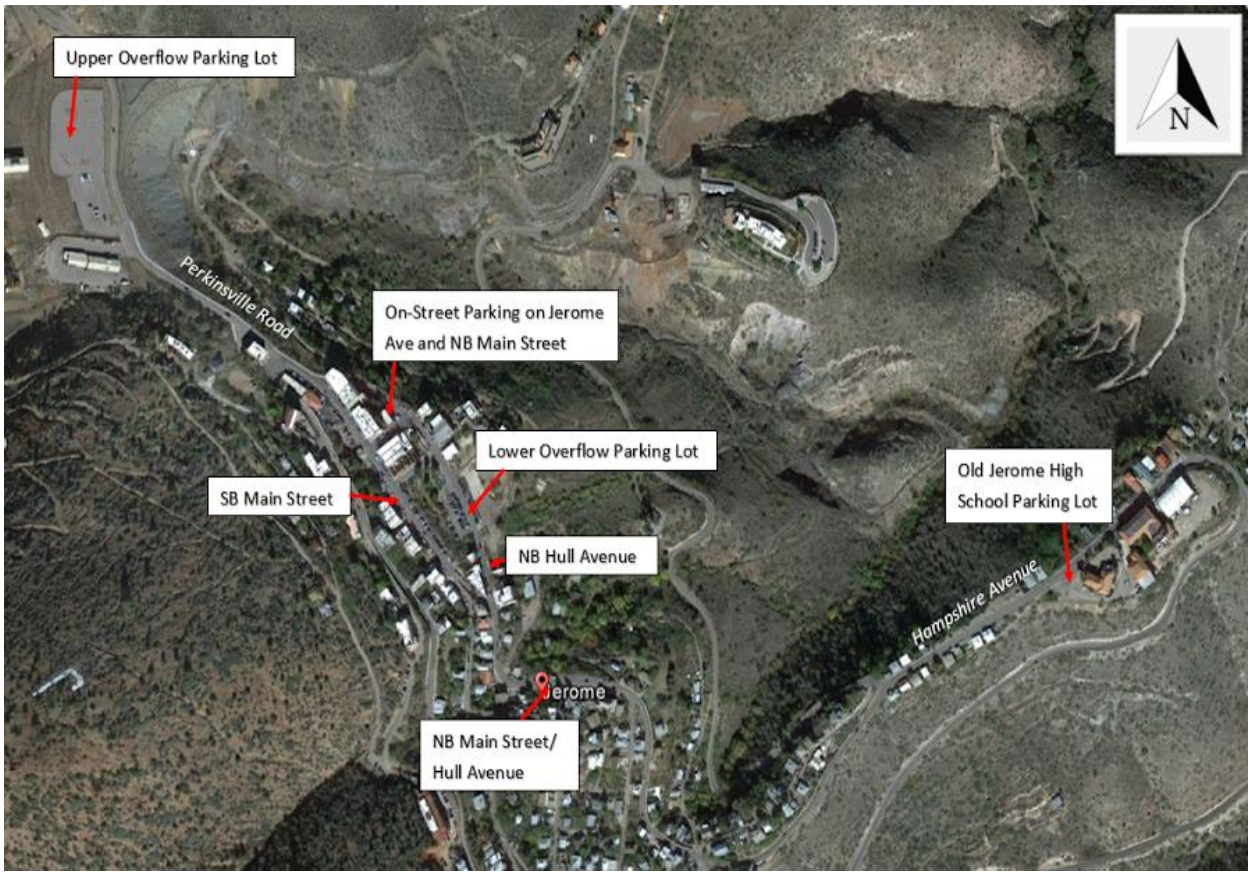

Figure 2.1: Overview of Jerome Parking Areas (Google Maps, 2016)

The amounts of vehicles occupying a parking stall were counted in one hour blocks for a total of eight hours. These results display the peak hours in which vehicles require parking, as well as the total vehicle density in the specified parking lot for the entire duration of the study period. The data was collected on two separate Saturdays in late August to ensure consistency and to accommodate for peak hour volumes during the weekends and during peak tourist season.

The average vehicle per hour value was found by compiling the total number of vehicles in each lot and dividing by the number of hours the study was conducted. The average lot duration was found by dividing 8 hours by the total sum of vehicles for each area. The average vehicles per hour were rounded up to the nearest whole number to be conservative. Table 2.1 below shows the compiled data determined for each parking area. Each individual parking area is explained in detail in the following sections 2.1.1-2.1.7.

Table 2.1: Parking Use Study Data

Location	Total Vehicles	Avg Veh/Hr	Duration (Hr/Veh)
Lower Overflow P. Lot	18.0	3.0	1.5
Upper Overflow P. Lot	112.0	14.0	1.69
Old Jerome High School P. Lot	31.0	4.0	0.26
NB Hull Avenue	249.0	32.0	0.46
NB Main Street-Hull Avenue	57.0	8.0	2.71
SB Main Street	107.0	14.0	1.69
On-Street Parking North of Jerome Avenue and NB Main Street	287.0	36.0	0.51

2.1.1 Upper Overflow Parking Lot

Figure 2.1.1 below shows the map of the Upper Overflow Parking Lot, and Table 2.1.1 shows the data collected from the parking study.

Figure 2.1.1: Upper Overflow Parking Lot Map (Google Maps, 2016)

Table 2.1.1: Upper Overflow Parking Lot Data

Upper Parking Lot					
Times	**Number of cars**	**Motorcycle**	**Handicap**	**Rv/oversize parking**	**Total**
9am-10am	1	0	0	0	1
10am-11am	2	0	0	0	2
11am-12pm	14	0	0	0	14
12pm-1pm	22	0	2	0	24
1pm-2pm	23	0	1	0	24
2pm-3pm	15	0	0	2	17
3pm-4pm	19	0	0	0	19
4pm-5pm	11	0	0	0	11
Sum	107	0	3	2	112
Avg Veh/Hr	13.375	0	0.375	0.25	14
Duration (Hr/Veh)	0.075	0.000	2.667	4.000	1.685

The Upper Overflow Parking Lot occupied a total of 112 vehicles in an eight hour segment with an average duration of 14 vehicles per hour. It was observed that this parking lot didn't begin experiencing high vehicle volumes until the afternoon hours, from around 12:00pm-4pm.

2.1.2 Lower Overflow Parking Lot

Figure 2.1.2 below shows the map of the Lower Overflow Parking Lot, and Table 2.1.2 shows the data collected from the parking study.

Figure 2.1.2: Lower Overflow Parking Lot Map (Google Maps, 2016)

Table 2.1.2: Lower Overflow Parking Lot Data

Lower Overflow Parking Lot				
Times	**Number of cars**	**Motorcycle**	**Handicap**	**Total**
8am-9am	11	1	0	12
9am-10am	28	0	0	28
10am-11am	55	2	0	57
11am-12pm	34	0	0	34
12pm-1pm	38	0	0	38
1pm-2pm	28	0	0	28
2pm-3pm	24	2	0	26
3pm-4pm	25	1	0	26
Sum	243	6	0	249
Avg Veh/Hr	30.375	0.75	0	32
Duration (Hr/Veh)	0.032921811	1.333333333	0	0.45541838

The Lower Overflow Parking Lot experienced high traffic volumes at a total of 249 vehicles in an eight-hour period. The average vehicle duration rounded up to approximately 32 vehicles per hour, and each vehicle occupied a stall for approximately 27 minutes.

2.1.3 On-Street Parking on Jerome Avenue and Northbound Main Street

Figure 2.1.3 below shows the map of the On-Street Parking on Jerome Avenue and Northbound Main Street and Table 2.1.3 shows the data collected from the parking study.

Figure 2.1.3: On-Street Parking on Jerome Ave and NB Main Street Map (Google Maps, 2016)

Table 2.1.3: On-Street Parking on Jerome Ave and NB Main Street Data

On-Street Parking on Jerome Ave. and NB Main Street				
Times	**Number of cars**	**Motorcycle**	**Handicap**	**Veh/Hr**
8am-9am	35	1	0	36
9am-10am	37	1	0	38
10am-11am	42	5	2	49
11am-12pm	40	4	3	47
12pm-1pm	20	13	0	33
1pm-2pm	17	12	1	30
2pm-3pm	18	8	0	26
3pm-4pm	18	10	0	28
Sum	227	54	6	287
Avg Veh/Hr	28.375	6.75	0.75	35.875
Duration (Hr/Veh)	0.035242291	0.14814815	1.3333333	0.5055746

These on-street parking areas experienced the highest traffic volumes at a total of 287 cars in an eight hour period with an average stall occupation time of 30 minutes. It also experienced the highest motorcycle and handicap parking volumes.

2.1.4 Northbound on Hull Avenue

Figure 2.1.4 below shows the map of Northbound on Hull Avenue, and Table 2.1.4 shows the data collected from the parking study.

Figure 2.1.4: NB Hull Avenue Map (Google Maps, 2016)

Table 2.1.4: NB Hull Avenue Data

NB Hull Avenue				
Times	**Number of cars**	**Motorcycle**	**Handicap**	**Total**
9am-10am	0	0	0	0
10am-11am	0	0	0	0
11am-12pm	1	0	0	1
12pm-1pm	3	0	0	3
1pm-2pm	4	0	0	4
2pm-3pm	4	0	0	4
3pm-4pm	1	2	0	3
4pm-5pm	3	0	0	3
Sum	16	2	0	18
Avg. Veh/Hr	2	0.25	0	2.25
Avg Hr/Veh	0.5	4	0	1.5

This on-street parking section experienced 18 vehicles total in an 8-hour period, with each vehicle having an average stall duration of 90 minutes and the total density is around 3 vehicles per hour.

2.1.5 Southbound on Main Street

Figure 2.1.5 below shows the map of Southbound on Main Street, and Table 2.1.5 shows the data collected from the parking study.

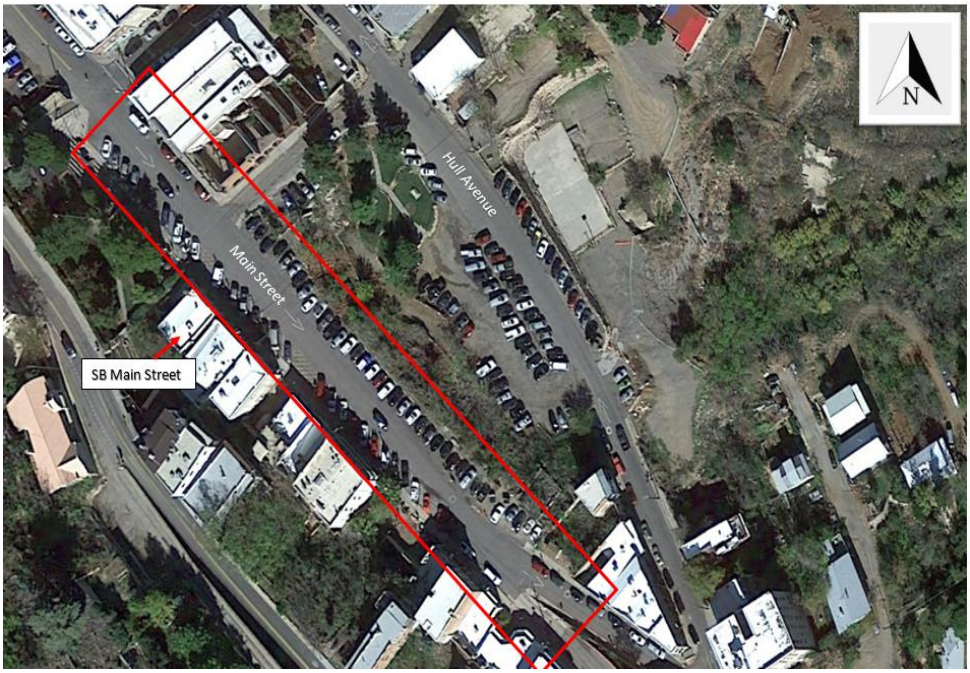

Figure 2.1.5: SB on Main Street Map (Google Maps, 2016)

Table 2.1.5: SB on Main Street Data

SB on Main Street				
Times	**Number of cars**	**Motorcycle**	**Handicap**	**Total**
8am-9am	15	3	0	18
9am-10am	16	1	0	17
10am-11am	12	0	1	13
11am-12pm	11	1	0	12
12pm-1pm	12	1	1	14
1pm-2pm	9	0	0	9
2pm-3pm	10	1	0	11
3pm-4pm	12	1	0	13
Sum	97	8	2	107
Avg Veh/Hr	12.125	1	0.25	13.375
Duration (Hr/Veh)	0.082474227	1	4	1.69415808

This on-street parking area had 107 total vehicles with an average parking duration of 100 minutes and a density of 14 vehicles per hour.

2.1.6 Old Jerome High School Parking Lot

Figure 2.1.6 below shows the map of the Old Jerome High School Parking Lot and Table 2.1.6 shows the data collected from the parking study.

Figure 2.1.6: Old Jerome High School Parking Lot Map (Google Maps, 2016)

Table 2.1.6: Old Jerome High School Parking Lot Data

Old Jerome High School Parking Lot				
Times	**Number of cars**	**Motorcycles**	**Handicap**	**Total**
9am-10am	4	0	0	4
10am-11am	7	0	0	7
11am-12pm	4	0	0	4
12pm-1pm	3	0	0	3
1pm-2pm	6	0	0	6
2pm-3pm	4	0	0	4
3pm-4pm	2	0	0	2
4pm-5pm	1	0	0	1
Sum	31	0	0	31
Avg Veh/Hr	3.875	0	0	3.875
Duration (Hr/Veh)	0.258064516	0	0	0.25806

Old Jerome High School parking area had a total amount 31 vehicles over 8 hours, with a density of approximately 4 vehicles per hour, and an occupational parking time of nearly 15 minutes which is pretty low compared to upper parking lots in the town, which is due to this parking lot is the farthest parking lot from the center of the town and therefore, people prefer to park closer to downtown area around the shops.

2.1.7 Northbound on Main Street/Hull Avenue

Figure 2.1.7 below shows the map of the Upper Overflow Parking Lot, and Table 2.1.7 shows the data collected from the parking study.

Figure 2.1.7: NB on Main Street/Hull Avenue Map (Google Maps, 2016)

Table 2.1.7: NB on Main Street/Hull Avenue Data

NB on Main Street/Hull Avenue				
Times	**Number of cars**	**Motorcycle**	**Handicap**	**Total**
8am-9am	2	0	0	2
9am-10am	4	0	0	4
10am-11am	6	0	0	6
11am-12pm	8	1	0	9
12pm-1pm	12	0	0	12
1pm-2pm	10	0	0	10
2pm-3pm	7	0	0	7
3pm-4pm	7	0	0	7
Sum	56	1	0	57
Avg Veh/Hr	7	0.125	0	7.125
Duration (Hr/Veh)	0.142857143	8	0	2.71428571

According to data, this parking area had a total amount of 57 vehicles, an occupational parking time of approximately 165 minutes, and density of around 8 vehicles per hour. This area has the highest parking occupational time. Peak hour was between 12 pm- 1pm when other parking lots were experiencing high amount of vehicles and parking spots got filled up in the town during this time.

2.2 Supplemental Surveying

Initially, GPS surveying equipment was going to be used to collect all of the necessary data for the project. However, due to equipment issues, supplemental surveying was conducted, in order to stay on schedule, by using the industry standard practice of measuring out stations using a US customary measuring wheel, with accuracy to the nearest inch. 71 stations were laid out within the project boundary and used field notes to record the locations of existing signs, parking stalls, and other various pavement markings.

2.3 AutoCAD Civil 3D Data Implementation

The collected field data was uploaded into AutoCAD Civil 3D in reference to the stations laid out during the field visits. The field data was compared to Google Maps to ensure the collected field measurements and placement were reasonable. An existing conditions map was created showing lane widths, sign locations, striping locations, pavement locations, and all roadway geometry. The existing conditions map was then used as a base map to design and revise signs, parking, and pavement markings.

2.4 Turning Radius Design

For turning radii, the geometry of the roadway limited the recommended design vehicle to be considered, which must be 50 feet or less in length. The recommended design vehicle was determined, using the AASHTO green book, to be an intermediate semitrailer, WB-40, with a design length of 45.5 feet. The minimum turning radius for

the design vehicle, WB-40, is 40 feet. The turning radii were analyzed by drawing in the minimum turning radii in reference to the center of the corners at the intersections of interests.

3.0 Design Alternatives

Following the data collection process, there were three evident design alternatives The first option was to maintain status quo. The second option was mitigation of immediate concerns. The third option was to redesign the entire corridor. For each option, the potential cost of implementation, potential impacts to historical atmosphere, potential impacts to the local economy, acceptability by the town, amount of time necessary to implement, and amount of time to design were all considered when selecting the final design. Some of the limitations given by the client were to keep cost to a minimum given that the town had a limited budget, the project would be implemented by a small staff within the Jerome Public Works Department, maintain the historical streetscape, and keep the opinions of the town locals in mind. After careful consideration of all three designs, the second option of mitigating the immediate concerns was chosen.

4.0 Final Design

An overview of our recommended design is explained in the following sections. See the design sheets as a reference.

4.1 Parking Lots and On Street Parking

The capacity of the existing parking areas was analyzed to determine areas that could be modified in regards to striping. In the Upper Overflow Parking Lot, it is recommended to implement 11 additional parallel parking stalls. In the Lower Overflow Parking Lot, it is recommended that 0-degree parking stalls be changed to 30-degree parking stalls in order to improve accessibility in the parking lot. Additionally, it is recommended that yellow painted, wooden 2”x4” blocks be used as parking delineators in the gravel areas in place of pavement striping. This will ensure that the parking space boundaries are clearer and won’t erode over time. Figure 4.1.1 and Figure 4.1.2 below show an example of the proposed implementation of yellow wooden parking delineators. Figure 4.1.1 shows the installation process, which includes staking the wooden blocks into the gravel.

Figure 4.1.1: Installation of Wooden Delineators [Fed.US, 2016]

Figure 4.1.2: Wooden Delineators After Installation [Fed.US, 2016]

The capacity of the Old Jerome High School Parking Lot was observed, however, the team needs to coordinate with the land owner to get recommendations before design.

Red curb markings are recommended in various areas to ensure public safety and optimize flow of traffic. Two handicap parking stalls are recommended to be added along Main Street in order to be in compliance with ADA standards. The team also recommends a portion of parking be striped for motorcycles only, to limit the amount of full-sized parking stalls being taken by motorcycles. A total of eight on-street parking stalls were added along Main Street. Two crosswalks were also added to increase pedestrian safety.

4.2 Signage Implementations

Approximately 130 existing and/or new signs were analyzed within the project boundaries. In total, it is recommended that a total of thirteen new signs be implemented. Parking Directional, Destination Directional, No Parking, Pedestrian Crossing, and Handicap signs are some of the new signs that are being recommended. Additionally, it is recommended that a total of 4 hand-made signs be removed in order to meet MUTCD compliance. Faded signs are recommended to be replaced but may still be used at this time. Sign pole type is recommended to be a 2.5-inch square tube with a slip base. All signs must be mounted a minimum of 7 feet from existing grade to the bottom of the sign.

4.3 Turning Radius for Jerome Fire Department

The two main intersections of concern for design were Hull Avenue at Jerome Avenue and Jerome Avenue at Main Street. These two intersections were analyzed using AutoCAD Civil 3D and it was determined that both intersections met the minimum turning radii requirements with the recommended parking striping changes implemented.

5.0 Cost Analysis

The cost analysis includes the cost of engineering services, estimated labor costs to implement the recommended design, and the cost of all the materials that would be required if the design were to be implemented.

5.1 Material and Labor

For new striping, the cost of materials includes red, yellow, blue, and standard dry traffic water-based paint, as well as the cost to rent striping removal equipment. For new signage, the material cost includes the cost of the signs, posts, and concrete to install the signs. For the wooden delineator blocks, the material cost includes the 2”x4”x8’ blocks, yellow paint, and steel anchor nails to secure them in place.

For labor cost, it was assumed that there would be 2 laborers working at $11/hour. The standard ADOT installation rates were used when determining the installation rates. Table 5.1.1, Table 5.1.2, and Table 5.1.3 below show a breakdown of the costs and the total cost to implement the design. In total, the total material cost and labor cost came out to about $7,577.

Table 5.1: Total Striping Cost

Total Striping Cost			
Labor Cost	**Total LF**	**Cost ($/LF)**	**Total Cost**
Yellow	4979	$0.10	$497.90
White	1754	$0.10	$175.40
Red	1459	$0.10	$ 145.90
Blue	260	$0.10	$26.00
Paint Removal Rate	842	$1.10	$926.20
Material Cost	**Total Gallons**	**Cost/5 Gallon**	**Total Cost**
Yellow	20	$ 110.00	$440.0
White	5	$110.00	$110.0
Red	5	$110.00	$110.0
Blue	1	$23.00	$23.0
Labor Cost	**Labor Cost/Hour**	**Total Hours**	**Total Cost**
Removal	$11.00	19	$418
All New Striping	$11.00	38	$836
		TOTAL STRIPING COST	**$ 3,708**

Table 5.1.2: Total Signage

Signage Material Cost			
Sign Type	**Quantity**	**Cost/Sign**	**Total**
D4-1	5	$52.15	$261
R7-8	1	$23.60	$24
R5-1	1	$41.80	$42
R7-1	1	$18.60	$19
W11-2	1	$41.80	$42
R7-6	1	$18.60	$19
D1-1	1	$91.45	$91
W16-09P	1	$22.85	$23
R8-3gP	1	$23.45	$23
Sign Posts	**Quantity**	**Cost/Post**	**Total**
12' Galvanized 2" Square Posts	20	448.45	$897
Labor Cost	**Rate/hour**	**Hours**	**Total**
2 Laborers	$11.00	14	$308
		TOTAL SIGNAGE COST	**$1,748**

Table 5.1.3: Total Wooden Delineator Cost

Wooden Delineators Cost			
Amount of 2"x4"x8' Blocks	**Cost/Each**	**Total**	
154	$2.77		$427
Labor Cost	**Rate/Hour**	**Hours**	**Total**
2 Laborers	$11	77	$1694
		TOTAL WOOD COST	**$2,121**

5.2 Cost of Engineering Services

Throughout the course of the project, the worked hours were sectioned into the following positions: Senior Engineer (SENG), Engineer (ENG), Engineer in Training (E.I.T), Intern (INT), and Administrative Assistant (AA). This cost of services also includes the cost of 4 site visits to the project site. The total cost of engineering services is around $30,500. Table 5.2.1 shows a breakdown of the cost of engineering services.

Table 5.21: Cost of Engineering Services

Actual Hours/Cost				
1.0 Personnel	**Classification**	**Hours**	**Rate, $/Hr**	**Cost**
	SENG	48	$200	$9,506
	ENG	97	$75	$7,280
	E.I.T.	213	$50	$10,644
	INT	119	$20	$2,383
	AA	7	$55	$405
2.0 Travel	4 site visits @ 152 miles/visit	$0.54/mile	$82/visit	$328
3.0 Total				**$30,546**

6.0 Summary of Project Cost and Scheduling

The final start date and worked hours differed from the projected start date and hours mentioned in the project. The total hours worked decreased 294 hours from the original proposed hours, which decreased the cost around $16,000. The biggest source of hour decrease was due to equipment restraints. Initially, 112 hours were scheduled out to complete the surveying tasks with GPS surveying equipment. Using the measuring wheel method, the data collection was able to be completed in only 16 hours. Table 6.1 below shows the projected hours/cost from the proposal and can be compared with Table 5.2 in the above section.

Table 6.1.1: Projected Hours/Cost

Projected Hours/Cost				
1.0 Personnel	**Classification**	**Hours**	**Rate, $/Hr**	**Cost**
	Seng	71	$200	$14,200
	Eng	145	$75	$10,875
	E.I.T.	318	$50	$15,900
	Int	178	$20	$3,560
	AA	11	$55	$605
	Total Personnel			$45,140
2.0 Travel	14 site visits @ 152 miles/visit	$0.54/mile	$82/visit	$1,149
3.0 Total				**$46,289**

Since there were some complications with gaining access to appropriate equipment, the project was behind schedule for the majority of semester. Task 3.0, the Parking Survey/Study, was actually completed ahead of schedule in replacement of the surveying task to ensure that the project didn't fall too far behind. Since the measuring wheel was used for data collection, the 50% design submittal was able to be submitted on time. Overall, the final design was completed and submitted on time. Table 6.2 below displays the projected start and end dates versus the actual start and end dates.

Table 6.1.2: Actual Schedule vs. Projected Schedule

Task	Start Date	End Date	Actual Start Date	Actual End Date
1.0 Field Evaluation				
1.1 Parking	8/14/2016	8/15/2016	2/12/2016	2/12/2016
1.2 Signage	8/14/2016	8/15/2016	2/12/2016	2/12/2016
1.3 Striping/Markings	8/14/2016	8/15/2016	2/12/2016	2/12/2016
2.0 Surveying				
2.1 Parking Area	8/15/2016	8/18/2016	9/10/2016	9/11/2016
2.2 Signage	8/19/2016	8/22/2016	9/10/2016	9/11/2016
2.3 Striping	8/23/2016	8/28/2016	9/10/2016	9/11/2016
2.4 Data Upload & Analysis	8/15/2016	8/28/2016	9/16/2016	9/30/2016
3.0 Parking Survey/Study	8/29/2016	9/5/2016	8/13/2016	8/20/2016
3.1 Data Upload & Analysis	8/29/2016	9/5/2016	8/21/2016	9/4/2016
4.0 Design				
4.1 Existing Conditions	9/5/2016	9/19/2016	8/14/2016	10/1/2016
4.2 Parking	9/19/2016	10/3/2016	10/2/2016	11/10/2016
4.3 Signage	10/3/2016	10/10/2016	10/2/2016	11/10/2016
4.4 Striping	10/3/2016	10/10/2016	10/2/2016	11/10/2016
4.5 Marking	10/3/2016	10/10/2016	10/2/2016	11/10/2016
4.6 Standards & Codes	10/5/2016	10/10/2016	10/2/2016	11/10/2016
5.0 Project Management				
5.1 50% Submittal	9/5/2016	10/14/2016	8/14/2016	10/12/2016
5.2 Final Design Report	10/17/2016	11/18/2016	10/12/2016	12/9/2016
5.3 Final Presentation	11/18/2016	12/9/2016	11/21/2016	12/9/2016
5.4 Website	11/18/2016	12/9/2016	12/13/2016	12/13/2016

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7.0 Appendices

See attached design sheets.