FINAL REPORT

Daybreak Parkway Intersection Re-Alignment and Restriping

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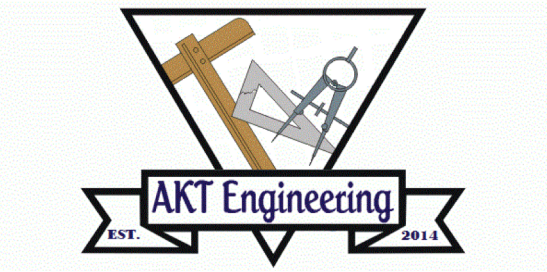

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14 April 2015

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Executive Summary

The final design and analysis of the intersection proposed for development north of Daybreak Parkway, roughly at 5415 West, is contained in this report. Work completed includes a proposed intersection design, with ¾ access to the north and south legs; a geotechnical report with recommended pavement depths of 4 inches of hot mix asphalt on top of 10 inches of base material; a partial traffic study with trip generation for the proposed development north of the intersection; a cost estimate totaling $529,000; and utility relocation.

Introduction

The community of Daybreak prides itself on its ability to provide a friendly, vibrant community with a balanced transportation system. There are currently 4,000 residential units in existence. With a projection of over 20,000 residential units by the year 2022, a 500% increase, the community will require exceptional regional connectivity in addition to its existing local network. An example of this connectivity is a roadway that will connect South Jordan City to a future commercial center in Daybreak. AKT Engineering is committed to providing the safest, most efficient connection of these communities while maximizing the adjacent developable area.

The project for Kennecott Land is located at 5415 W Daybreak Parkway, South Jordan UT. The site and its vicinity are shown in Figure 1. AKT Engineering was asked to make suggestions for a new intersection that would accommodate the development of a commercial area to the north and act as a connector to Herriman, City to the south of Daybreak Parkway. This intersection is vital in ensuring proper traffic flow along Daybreak Parkway and between the cities of Herriman and South Jordan.

Figure 1. Site Location of Proposed Intersection

AKT Engineering assumed the data from the Geotechnical Report, which was created by AMEC Earth and Environmental, Inc. in 2008, and the Traffic Study conducted by Hales Engineering in 2012 were still valid. The Geotechnical Report did not actually cover the area being considered for the intersection, but it was assumed that the subgrade was similar along Daybreak Parkway. AKT Engineering also anticipated that the land use for the overall development would more accurately reflect a shopping center, rather than individual retail uses.

The area of Daybreak Parkway adjacent to the proposed development is not a state roadway, although to the east, it is considered Utah State Route 175. The Utah Department of Transportation (UDOT) considers the area where Daybreak Parkway as a state route to be a Class 3 (System Priority – Urban Importance (S-U)) or a Class 5 (Regional Priority – Urban Importance (R-PU)) road for purposes of access management, as defined by UDOT's administrative rule R930-6 (UDOT 2013a,b). This designation, if extended along the whole route, has implications for driveway spacing and access types available to the site.

Limitations to this project included a preferred pre-designed alignment by Kennecott Land as well as existing intersections to the east and west of the proposed design site.

DELIVERABLES

AKT Engineering has been working to produce CAD drawings of the recommended intersection layout and pavement cross-section. These drawings are found in Appendices A and B, respectively, of the report. Appendix C contains a close up of the right turn channelization island designed for the north/south approaches of the intersection, and Appendix D has the cost estimate for the project. A discussion of the utility relocation is also included in this report.

Disclaimer

This area is immediately adjacent to the future Mountain View Corridor freeway. It is assumed that this will be a major interchange within the South Jordan/Herriman area and, therefore, the area immediately surrounding the future interchange will, at some point, have state road and access management status. It is further assumed that the category will be either 3 (S-U) or 5 (R-PU), as Daybreak is classified further east as a state road. This makes an important difference in whether or not access may be appropriate. If designated category 3, then according to R930-6, §2(b)(iii)(D), "Direct access service to abutting land is subordinate to providing service to through traffic movements," (UDOT 2013a). In other words, placing access directly from this critical link to the development in review may be detrimental for the long-term potential of this corridor.

From the same R930-6, it has a minimum space from an interchange to the first right-in, right-out driveway and full intersection. It is assumed that a ¾ or full access driveway would be counted as an intersection, using 1) guidance from the American Association of State Highway and Transportation Officials (AASHTO), "Driveway terminals are, in effect, low-volume intersections…" and "the function of driveways is similar to that of public intersections," (AASHTO 2011), and 2) the R930-6 document specifically calls out "right-in, right-out driveways," and "intersections" as the two access types to be considered for minimum distances from an interchange.

Based on these minimum distances and the assumption that Daybreak Parkway would receive an interchange with the future Mountain View Corridor, it would be against UDOT policy and good access management practice to allow anything more than one right-in, right-out access for the development in question *if* Daybreak is classified as a Class 5 roadway when Mountain View Corridor is completed. Otherwise (classified as a Class 3 Roadway), the minimum spacing puts even the first full intersection (with Freedom Park Drive) very close to the minimum standard of 1,320 feet from the interchange to crossroad spacing standard (UDOT 2013a).

Because of these considerations, we recommend that in final construction, the site be oriented to have access from Freedom Park Drive, and if access is still desired on Daybreak Parkway, the access should be limited to a right-in, right-out drive. To encourage compliance with this restriction, consideration should be given to placing a median barrier between Mountain View Corridor and Freedom Park Drive along Daybreak Parkway. A single alternative access could be placed on the frontage road to Mountain View Corridor, which would by default encourage right-in, right out by definition. In the area of the development, Mountain View Corridor is a classification 10 roadway (UDOT 2013b), meaning that there is no allowance for a private driveway, which makes direct access also difficult.

Intersection Design

The intersection at 5415 West Daybreak Parkway, South Jordan UT was designed in accordance with standards set forth by the cities of Herriman and South Jordan. AASHTO recommendations were also taken into consideration for the design. The alignment for the north-end of the intersection was shifted towards the east. This change was made because the offset in the original alignment would create safety hazards for cars attempting to turn left out of the north and south-ends of the intersection. Cars would be sharing left-turn space between approaching traffic. Also, drivers coming out of the north-end of the intersection would not know if a car turning left from the south-end intended to turn left or make a slight left and then right into the commercial center. This original section of danger **is boxed in Appendix E.**

Using the traffic study conducted by Hales Engineering, an intersection with two-thirds access was designed. The reason behind this choice was that approximately 500 feet to the east and west of the proposed location are signalized intersections. A new signalized intersection would be redundant and left-turns from the north/south approach would only cause more possible accidents.

A high-visibility crosswalk will be used to allow pedestrians to cross east to west on at the newly designed intersection. The crosswalk will be 6 feet wide. This type of crosswalk was chosen because it is more visible to the pedestrian and driver and its maintenance is more cost effective. Curb ramps with flares will be provided to allow those with disabilities easier access. The curb ramp will also have a raised tactile surface to help vision-impaired pedestrians.

High-back curb will be used, as per South Jordan City specifications. The curb will be 6 inches wide at the top, 6 inches deep to the gutter, 8 inches deep overall, and have a gutter that is 24 inches wide.

A 12 foot lane with a 4 foot bike lane was chosen for the intersection. The 12 foot auto lane will provide drivers with the desirable lateral clearance from bikers and ensure that they are comfortable maneuvering their vehicle. Studies have shown that bikers generally stay in the middle of the lane. A 4 foot bike lane allows bikers to safely and comfortably bike alongside cars without having to swerve or cause auto drivers to swing into opposing lanes to avoid coming too close.

A park strip will be placed adjacent to the traveled-way curb. This strip will be 3 feet wide and will serve as space for streetlights, fire hydrants, and aesthetic vegetation. Adjacent to the park strip will be a sidewalk that is 6 feet wide. It will be made of all-weather material. The sidewalk needs to be greater than 5 feet to eliminate the need for a passing section for accessibility.

Right turn channelization islands were designed for drivers heading north/south at the new intersection. In the study "Best Design Practices for Walking and Driving" conducted by the Michigan Department of Transportation, it was shown that right turn channelization islands reduce potential crashes for motor vehicles and pedestrians while enhancing their visibility. This island will also act as a reminder to drivers that they are not able to go thru or turn left at the intersection onto Daybreak Parkway. The island will provide an 80 degree angle between vehicle flows to increase vehicle visibility. The design meets the 2:1 length to width ratio specified by AASHTO and is 8 inches thick. A detailed drawing of the proposed design is found in Appendix C.

Signage

Signage recommendations for the Daybreak Parkway intersection were made in accordance with Manual on Uniform Traffic Control Devices (MUTCD) 2009 and standards set forth by the City of Herriman and South Jordan.

A stop sign will be placed for traffic heading north/south on the new intersection. The sign will be 36" x 36" to accommodate multi-lane traffic. The bottom of the sign shall be 6 feet above the top of the curb and the sign shall be located 6 feet from the edge of the shoulder to ensure adequate lateral clearance for motorists. The stop bar for this sign will be 18" wide and 5 feet from the inner crosswalk line.

A "Right Turn Only" sign will be placed 200 feet before the intersection in accordance with MUTCD standards to ensure drivers approaching Daybreak Parkway from the north/south do not attempt to make left-hand turns. If needed, they may approach the intersections approximately 500 feet to the east/west where the intersection is signalized in order to make a left turn.

A 12" x 36" pedestrian crossing sign will be located at the intersection on the north/south approaches to alert cars that pedestrians may be crossing. These will be located on the right hand side of the park strip just before the intersection.

Pavement Design

The pavement section was designed in accordance with standards set forth by the city of South Jordan and using information from the Geotechnical Report by AMEC. The design California Bearing Ratio (CBR) for the existing subgrade was 10. South Jordan City specifies that a pavement section consisting of 4 inches or asphalt concrete be placed on 10 inches of untreated base course, with the base course being compacted in two equal lifts over the prepared subgrade. The water table is deep enough that the subgrade does not have a high potential for frost hazard, so a non-woven geotextile is not required between the subgrade and base course. A 3% cross-slope was selected to ensure that proper drainage would occur.

The previous standard pavement section was verified using WinPAS software and the following assumptions:

- Two-Way Average Daily Traffic (ADT) was set to 3,071 based on the Traffic Report from Hales Engineering.
- A directional distribution factor was set to 100% because the pavements were designed to resist the worse combination of traffic.
- A design lane distribution factor of 100% was used because trucks and cars will both be using the road.
- A growth rate of 3% was assumed to match the development of Daybreak in coming years.
- A factor corresponding to 1% trucks was assumed because there is limited truck traffic in this area.
- A terminal serviceability of 2.50 was used to match South Jordan City design specifications.
- A 20 year design life was used to match South Jordan City design specifications.
- 90% reliability for the pavement was used to match South Jordan City design specifications.
- The standard deviation for the asphalt pavement was set to be 0.45 as per South Jordan City design specifications.

- The drainage coefficient for the asphalt pavement was set to 1.0 to match national standards.
- For the asphalt pavement, layer coefficients for the untreated base course and asphalt cement concrete were assumed to be 0.10 and 0.40 respectively.
- The resilient modulus of the subgrade was assumed to be 9,400 psi, which corresponds to a CBR of 10.
- It was assumed that the total number of flexible equivalent single axle loads (ESALs) was equal to two-thirds of the rigid ESAL's as is common practice in transportation engineering.

The design pavement section was confirmed to be sufficient to withstand the projected traffic.

Trip Generation

Trip generation predictions were performed based on the land uses shown in the AutoCAD drawing of the site provided. These were based on the ITE Trip Generation Manual, 8th Edition. The site could be classified in two different ways: it fits the definition of a Shopping Center (with outbuildings), and also could be analyzed with each land use individually on each parcel. Analyzed individually, there is a more pronounced peak trip generation at the PM peak, with fewer overall weekday trips; analyzed as a shopping center there are more weekday trips, but the PM peak trip generation is much less pronounced. The data are shown in

Table 1.

Table 1. Trip Generation Rates

Analyzed as:	Shopping Center	Individual Uses
Weekday Trip Generation	26,660	22,434
PM Peak Trip Generation	1,050	1,710

With either trip generation rate, the PM Peak trip generation falls below the assumptions shown in the previously prepared traffic study (2012) concerning the future traffic generated by this site. The traffic generation assumption predicts a development pattern with 3,000 PM Peak hour trips north of Daybreak Parkway. With even fewer vehicles using the site than the traffic study assumes, the LOS analysis will become even more optimistic, and the recommendations of that study likely hold true.

It was assumed that the junior anchors next to the anchor were specialty retail, that restaurants were high-turnover sit-down, banks had walk-in, not drive-thru,

facilities, and that retail pads G and H were also specialty retail (Appendix E). This influences which trip-generation charts are appropriate for use. It should also be noted that the supermarket anchor is larger than many of the data points in the ITE trip generation manual; while it is deemed accurate enough for this study, more data could be useful for this large of an anchor. Because of this, it was felt that for future analysis, the Shopping Center, rather than the breakout of individual uses, should be used for future analysis.

Utilities Allocation

It was assumed that the guidelines for conduit published by the City of Ocala, FL, are reasonable to base necessary digging for utilities location (City of Ocala 2012). The site has approximately 1940 feet of frontage, it is assumed this length will need to be excavated to the depth shown in the figure. This includes a total face area to excavate of 11.75 ft^2 for the utilities assumed to exist subsurface. This means a total of 850 cubic yards of material must be handled; it is assumed that this may be stored on-site and be used to backfill the trench.

Cost Analysis

The total cost for the intersection design was about $529,000. For the purpose of this project, we designed the new connection to Daybreak Parkway 200 feet in the north and south direction in order to derive the cost for pavement, striping, etc. A majority of the costs were selected from prior projects in the state of Utah as well as projects elsewhere in the United States. Please note that this number only reflects the material and labor cost for construction. No design labor was included.

Conclusion

AKT Engineering has provided a preliminary design for the intersection at 5415 West Daybreak Parkway, South Jordan, UT in accordance with the MUTCD and AASHTO guidelines. Cross-sections of the pavement are also included with a cost analysis and the validity of the prior traffic study was confirmed by a traffic generation study.

REFERENCES

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City of Ocala (2012). Fiber Conduit Rules and Regulations. <http://www.ocalafl.org/uploadedFiles/Utility_Services_Redesign/Fiber%20Conduit_Rules_and_Regulations_rev07122012.pdf>. 16 March 2015.

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U.S. Department of Transportation. *Manual on Uniform Traffic Control Devices (MUTCD).* 2009.

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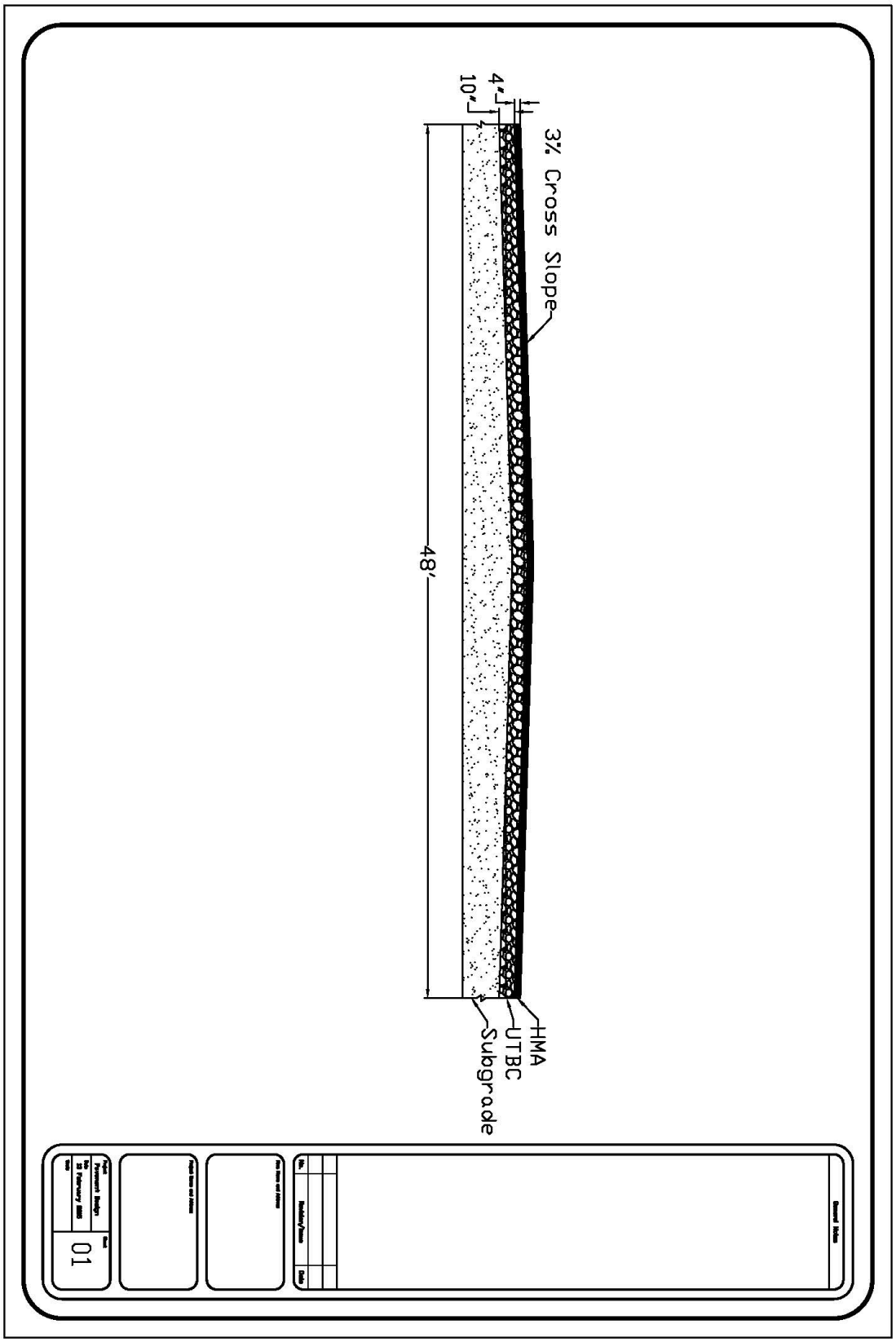
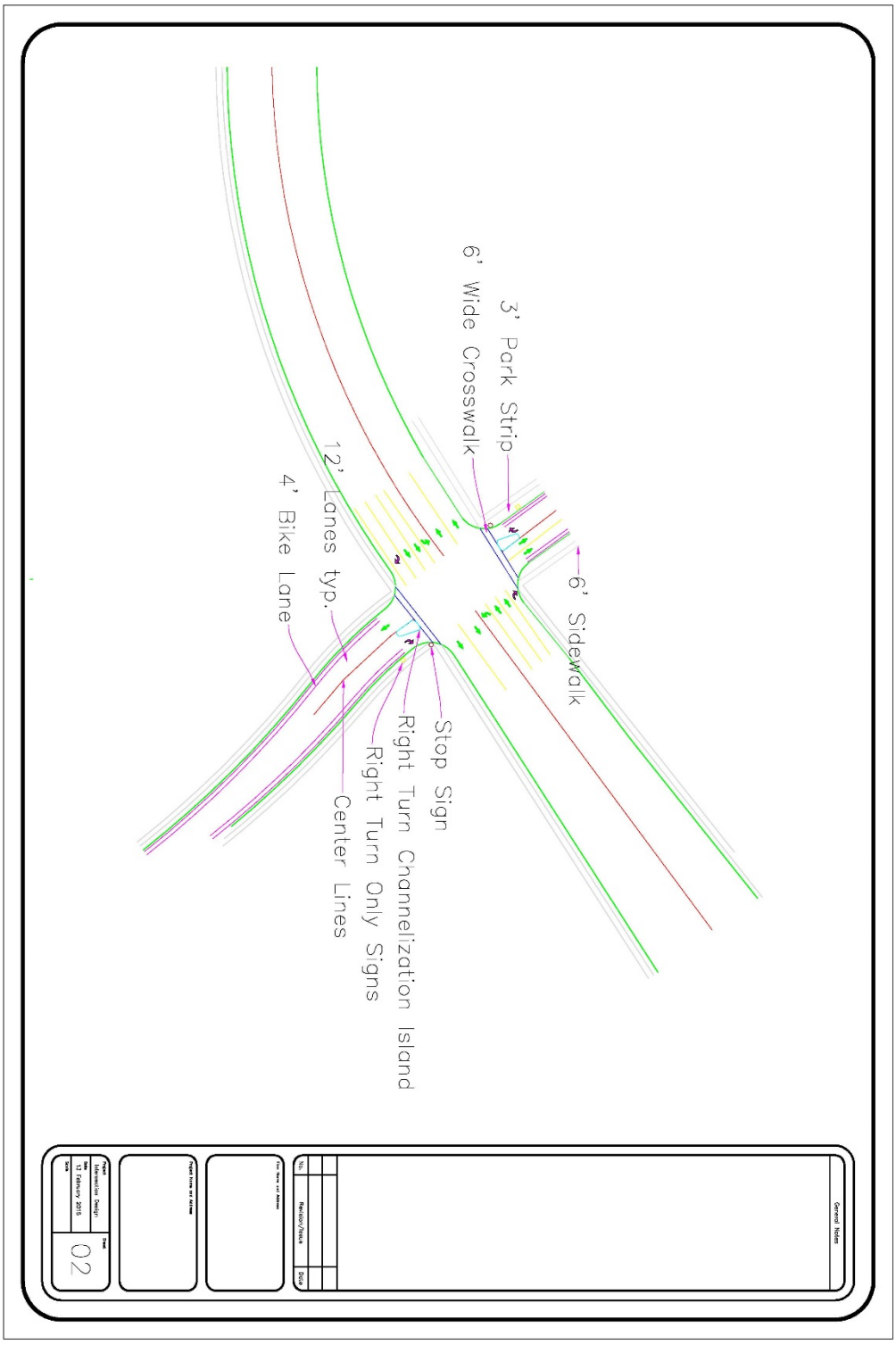
Appendix

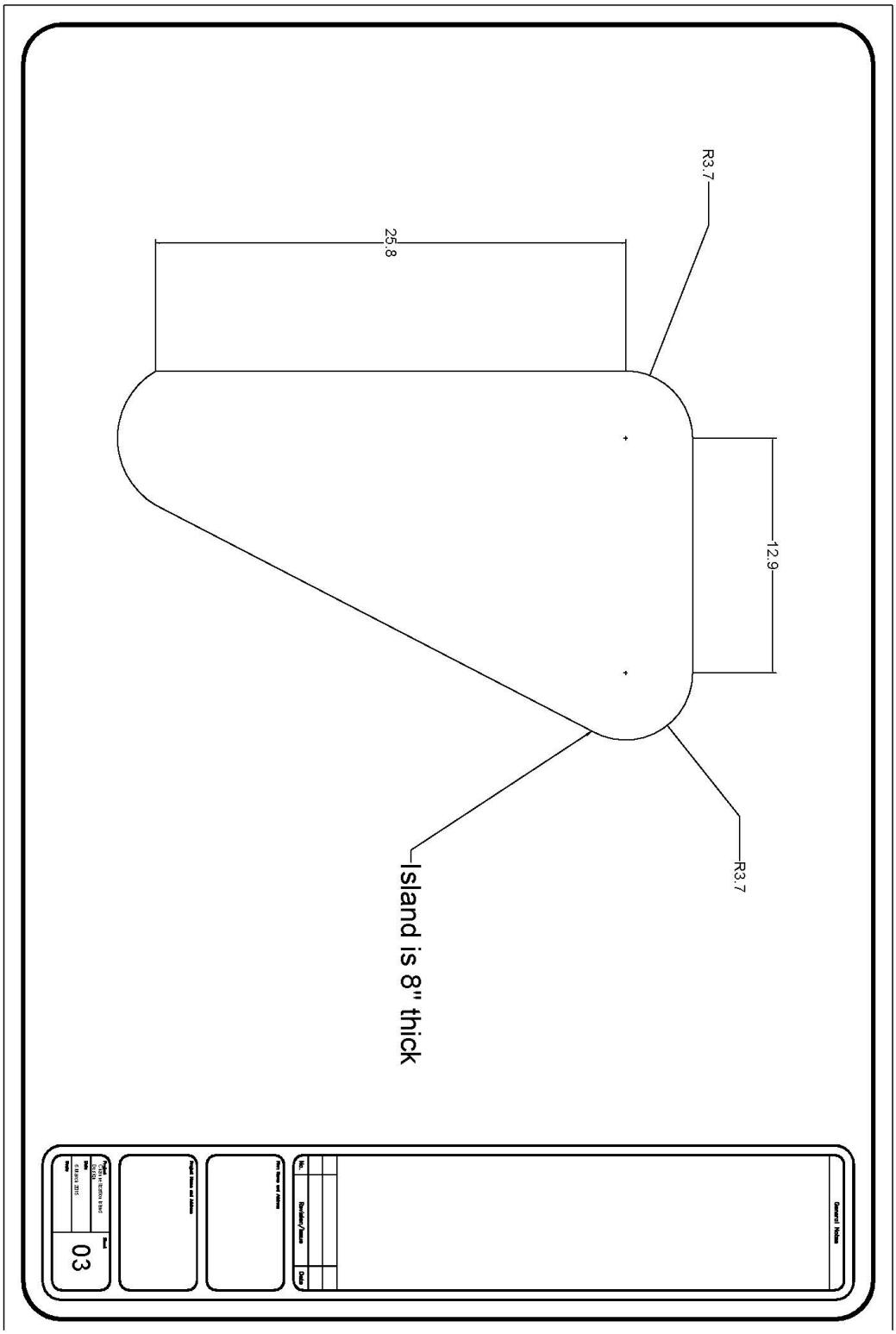
Appendix A- Pavement Design



Appendix B- Intersection Design



APPENDIX C- RIGHT TURN CHANNELIZATION ISLAND



INTERSECTION CONSTRUCTION COSTS WORKSHEET

Category	Items	Quantity	Estimated Cost	T
Pavement Design	Asphalt [Sq-Yd]	2300	$18.00	
	Base [Sq-Yd]	2300	$10.00	
	Construction [Sq-Yd]	2300	$22.00	
Intersection Design	MUTCD Traffic Sign [EA]	6	$500.00	
	Lane/Bike Striping Paint [gal]	25	$52.00	
	Pavement Marking Paint (Crosswalk, stop line) [EA]	5	$58.00	
	Pavement Arrows [EA]	4	$200.00	
	Bike Lane Symbols [EA]	4	$325.00	
	Curb Ramp	4	$1,048.00	
	Curb [LF]	100	$60.00	
	6' Sidewalk w/ 6" Base [LF]	4800	$26.00	
	3' Park Strip [LF]	2400	$10.00	
	Sprinkler System for Park Strips	1	$3,500.00	
	Pork Chop	1	$5,200.00	
Utility Relocation	Excavation (Cubic Yards)	850	$96.00	
	Conduit Pipe (HDPE 4", 4 pipes, 1940 feet, Labor Included)	7760	$0.51	
	Power Conduit Pipe (6" HDPE, 2 Pipes, 1940 Feet, Labor Included)	3880	$0.74	
	Utilties are responsible for own cabling through conduits			
Total				

Subtotal	$
Contingency - Add 20%	$
Mobility (10% Total Project)	$
Engineering Fee (10% Total Proj.)	$
Total	**$**

APPENDIX E- SITE PLAN