Lawrence Transit Center Locational Analysis

Final Report | April 7th, 2014

City of Lawrence KANSAS

Table of Contents

Table of Figures

Executive Summary

This study was initiated to determine a candidate site, and conceptual costs, for a new transit center which would also serve as the major transfer hub for the city transit routes. This study first used a GIS process and various socio-economic and transit-related geographic parameters, to identify a general geographical area to focus the study's attention. Multiple sites within this geographical area were further examined for suitability as a transit center, based off of their general development constraints, impact on the transit route structure, and opportunities for synergy with existing or potential land use and ridership patterns. After an evaluation and continued discussion with the study team and presentation to the City Commission, the project focused on evaluating two separate sites of 925 Iowa, and 2021 Stewart Avenue.

The sub-total site costs were higher for 925 Iowa, primarily due to reconfiguring the adjacent parking lot, and repaving 9th Street between Iowa Street and Rockledge Road to handle additional wear and tear from buses. Once the additional required vehicle is taken into account, the total capital costs were $460,000 higher for 925 Iowa than those for the 2021 Stewart Avenue site. Conversely, the annual operating cost for the Stewart Avenue site is approximately $122,000 more than the 925 Iowa site primarily due to route re-networking. These costs are displayed in Table ES.1.

An important caveat is the fact that land acquisition costs are not included in these cost summaries. The site at 925 Iowa is actually a collection of multiple parcels owned by multiple legal entities, and complicated by the fact that parking spaces in a parcel may be legally allocated as the parking for another parcel. This will likely complicate the acquisition process. 2012 Stewart Avenue and the two parcels to the north, by contrast, are owned by KU Endowment.

Table ES.1 Cost Comparison Summary

		925 Iowa	2021 Stewart Avenue
Capital	Direct Site Costs*	$ 1,840,150	$ 1,879,657
	Adjacent Costs	$ 296,200	$ 132,650
	Roadway Improvements	$ 1,376,412	$ 861,751
	Contingency	$ 771,373	$ 600,902
	Sub-total site costs	*$ 4,284,135*	*$ 3,474,960*
	Additional Vehicle Costs	$ 310,000	$ 620,000
	Rts that added 1 vehicle	Rt 1	Rt 1, Rt 6
	Total Capital Costs	**$ 4,594,135**	**$ 4,094,960**
Annual	Route Renetworking	$ 366,061	$ 487,769
	Maintenance	$ 30,000	$ 30,000
	Water, sewer, electric	$ 14,500	$ 14,500
	Vandalism Repair	$ 3,000	$ 3,000
	Total Annual Costs	**$ 413,561**	**$ 535,269**

These costs do not include land acquisition costs.

Chapter 1 Introduction

Project Purpose

Lawrence, Kansas, is home to two transit systems, which from the perspective of residents and users, operate as a single system serving both the city of Lawrence and the University of Kansas (KU). The two primary centers of the transit systems are downtown Lawrence at 9th and New Hampshire, and the University of Kansas. Both of these locations serve as both activity centers in their own right, and primary transit hubs where most routes of each respective system come together and allow passenger transfer opportunities. Route 11 and Route 10 connect the two transit hubs.

Opportunities exist regarding improving the transit centers. The current downtown transit center at 9th and New Hampshire is challenged with the small geographic area of downtown, continued developmental pressure, and impacts with businesses. These have presented continual and ongoing operational issues over the years. Lawrence Transit has been forced to incur capital and operational expenses as development pressure or business impacts required the downtown transit center to relocate or reconfigure multiple times. Over the past several years, the focus of the downtown transit operations has shifted from opposite corners on 9th and Massachusetts to the northeast corner of 9th and New Hampshire, and currently operates at two separate locations on New Hampshire and 9th Street. The current configuration lacks dedicated off-street passenger parking, limits dwell-time opportunities for transit vehicles, and requires passengers to walk 75 yards and cross a street to make some transit connections. In addition, the southwest corner of this intersection is the site of a recently completed multistory building, and the southeast and northeast corners of the intersection are currently experiencing in various stages of development or construction with multistory buildings.

These events have emphasized the need to initiate a process that will identify a permanent location for a city transit hub. This will allow Lawrence Transit to engage in long-term operational planning and capital investments by knowing the location, size, and capacity of the transit center. This will give Lawrence Transit more certainty in planning vehicle-type acquisition and capital investments such as bus turn-outs along the likely alignments accessing a new transit center.

Study Team

Olsson Associates is completing this project under contract to the city of Lawrence through Lawrence Transit. A stakeholder group was formed to assist in the development and review of the site selection process and development of the conceptual site plan. The stakeholder group was composed of representatives from the city's transit staff, planning department, and geographic information system (GIS) staff. In addition, KU Parking & Transit, and MV Transportation—the service provider to both Lawrence Transit and KU On Wheels (KUOW)—were also represented. The stakeholder group met throughout the study to review results, provide input, and visit potential sites.

In addition, presentations were made to the Lawrence City Commission throughout the process so their direction and input could be taken into account. Opportunities were available for public comment at the City Commission meetings.

Chapter 2 Initial Site Selection

GIS Process

GIS software was used to identify candidate sites. Generally, GIS was used to define a general geographical area of interest, and then spatial queries were applied to parcels inside that geographical boundary to identify those parcels more appropriate to the site of a transit center.

Site Size

Through discussions with the Lawrence Transit administrator, it was determined that a new transit center would be required to accommodate three 40-foot city buses and five 30-foot city buses, and provide street side accommodations for two 40-foot KU buses. In addition, at the April 11th project kick-off meeting, the study team indicated a desire for the site to accommodate a driver/supervisor break room and restroom. It was determined that 1.5 acres at a minimum would be required to accommodate this facility.

Centers Map

The City of Lawrence's GIS coordinator created a map with various geographic centers identified. These centers included:

- Mean center of urban growth area
- Mean center of Lawrence destinations (grocers, medical facilities, employment assistance, social service agencies, middle or high schools)
- Mean center of street intersections
- Center of the minimum boundary of existing city routes, including flex zone
- Center of the minimum boundary of existing KU routes
- Mean center of Lawrence employers, weighted by number employed
- Center of Lawrence city limits, including islands
- Mean center of Lawrence block groups with low to moderate income over 50 percent, weighted by population
- Mean center of Lawrence census block groups, weighted by population

Figure 1 displays this map. The various centers are clustered around the 15th and Iowa streets area. Full-size versions of maps discussed in this document are included in the Appendix A. Next, a half-mile buffer was created around these centers, and parcels equal to or greater than 1.5 acres were identified. This resulted in 116 parcels, displayed in Figure 2.

Figure 1: Mean Center Map

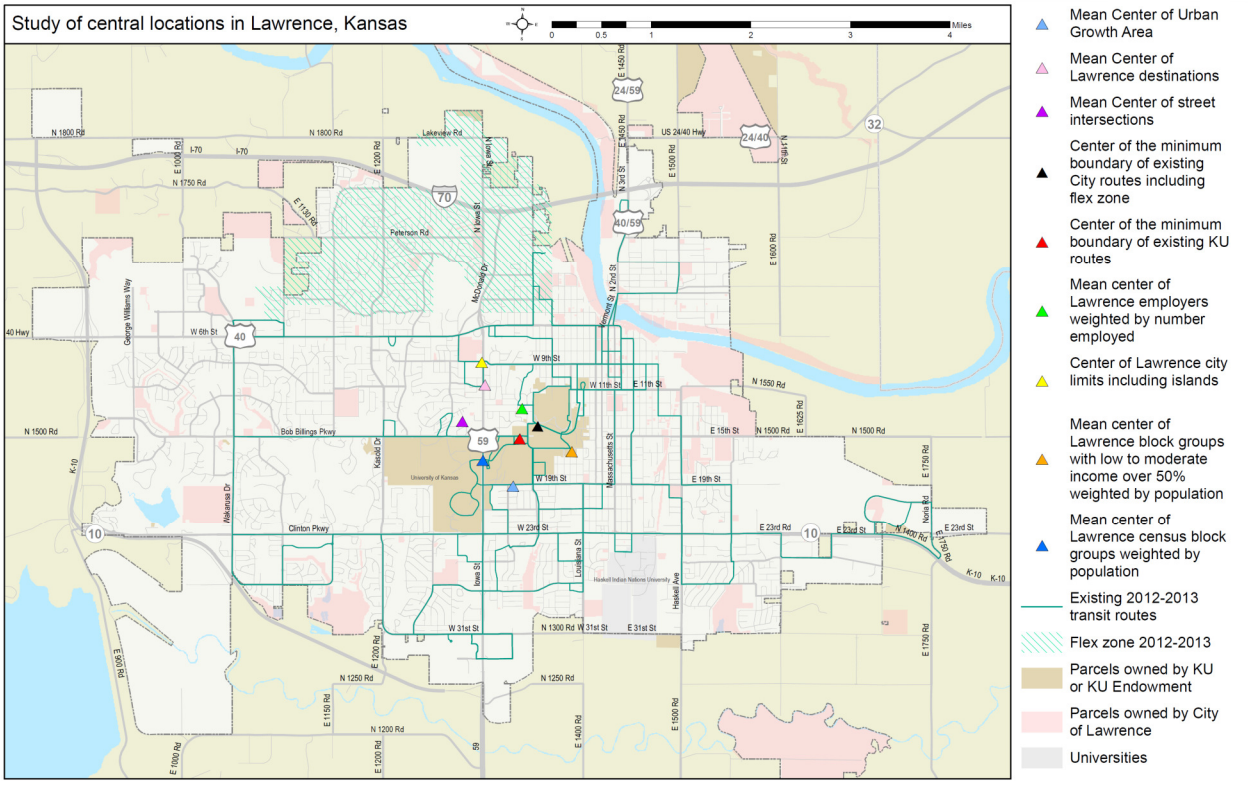
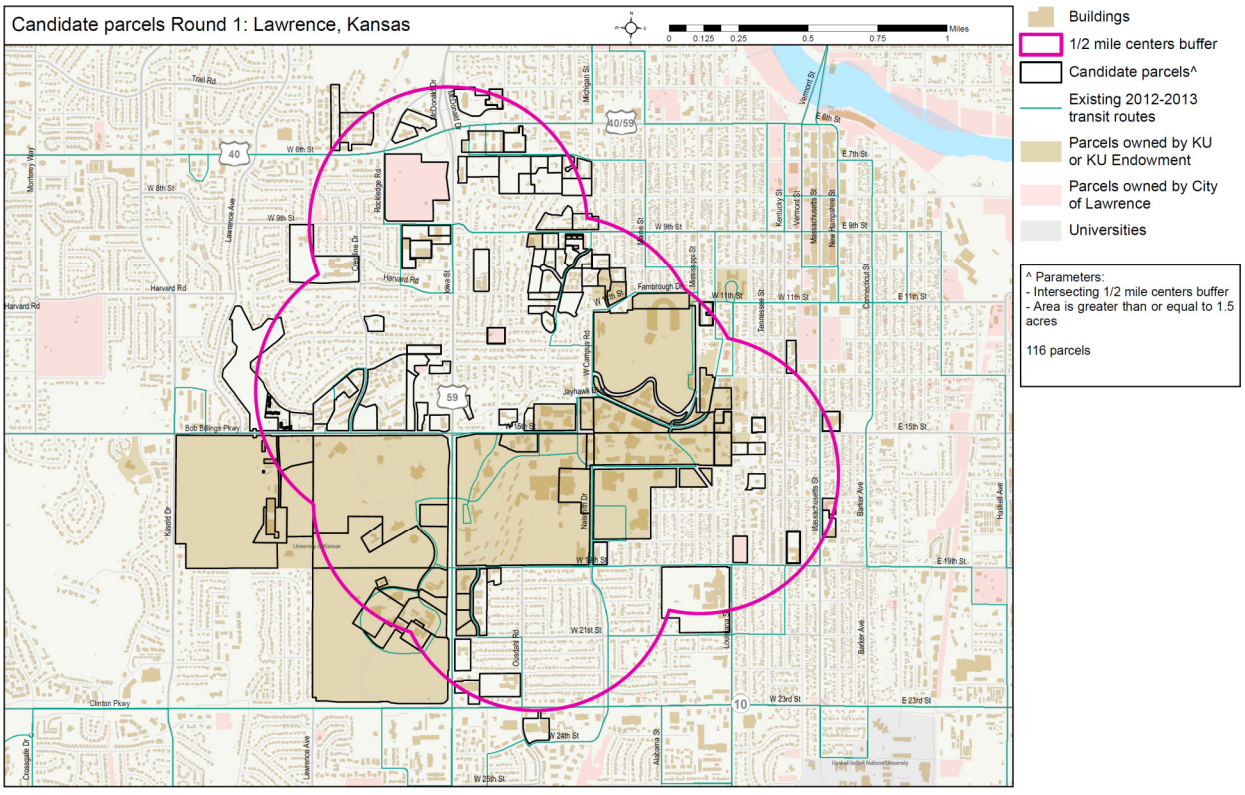


Figure 2: Candidate parcels Round 1 – Parcels above 1.5 acres



Of the 116 parcels identified in Round 1, the GIS process in Round 2 selected only those parcels that were within 330 feet (half a block) of roads classified as collector or higher. Doing this would limit transit vehicles from traveling on local streets or deep into residential neighborhoods. This resulted in 86 parcels, which are displayed in Figure 3.

Round 3 excluded properties that were a sensitive land use, including parks, golf courses, school district property, churches, cemeteries, or historic properties. In addition, an historic environs buffer of 200 to 500 feet was placed around historic properties or landmarks. Lawrence's Historic Resources Commission typically has to review development within this buffer. Finally, sites that did not have more than 1.5 acres beyond the 100-year flood plain were also excluded. After these exclusions, 68 parcels remained. They are displayed in Figure 4.

Round 4 selected from the remaining parcels that were not multi-family housing. Only 49 parcels remained and are displayed in Figure 5 along with Lawrence's existing land use.

Figure 3: Round 2 – Within 330 feet of collector street or above

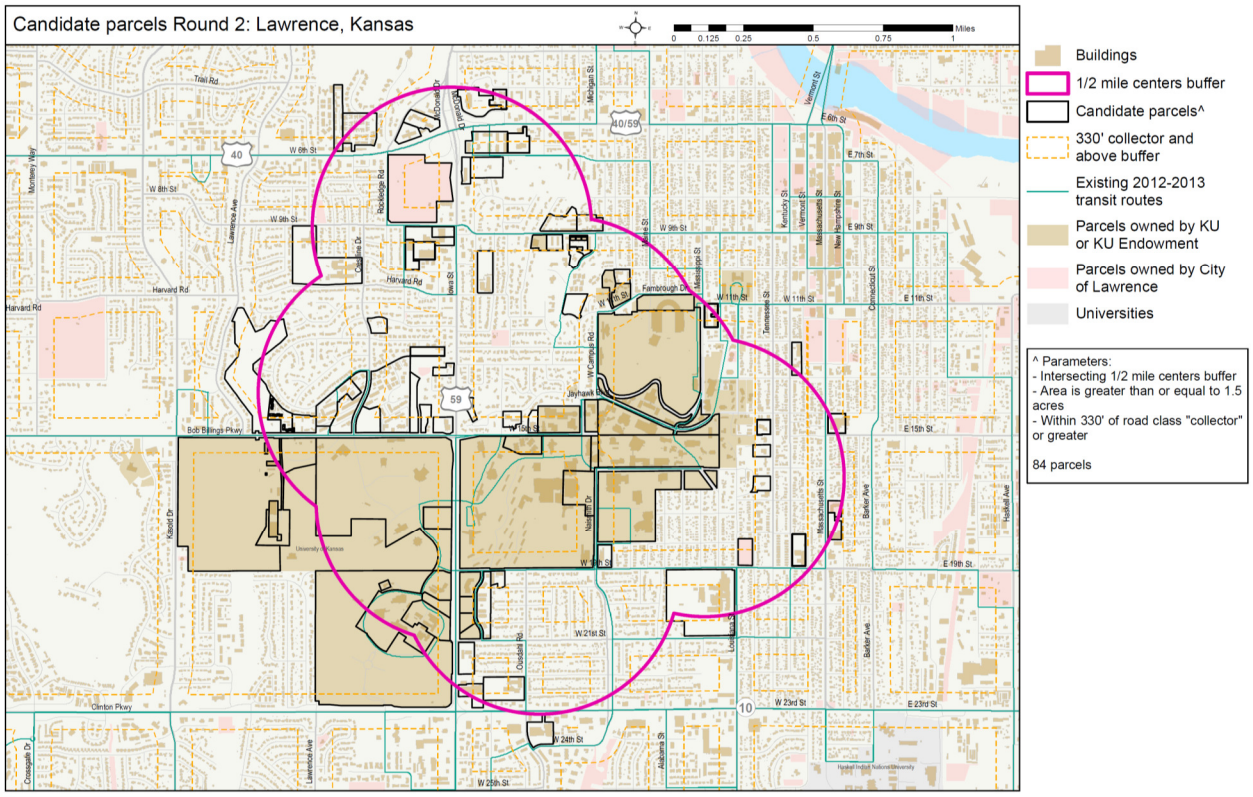


Figure 4: Round 3 – Not a sensitive land use

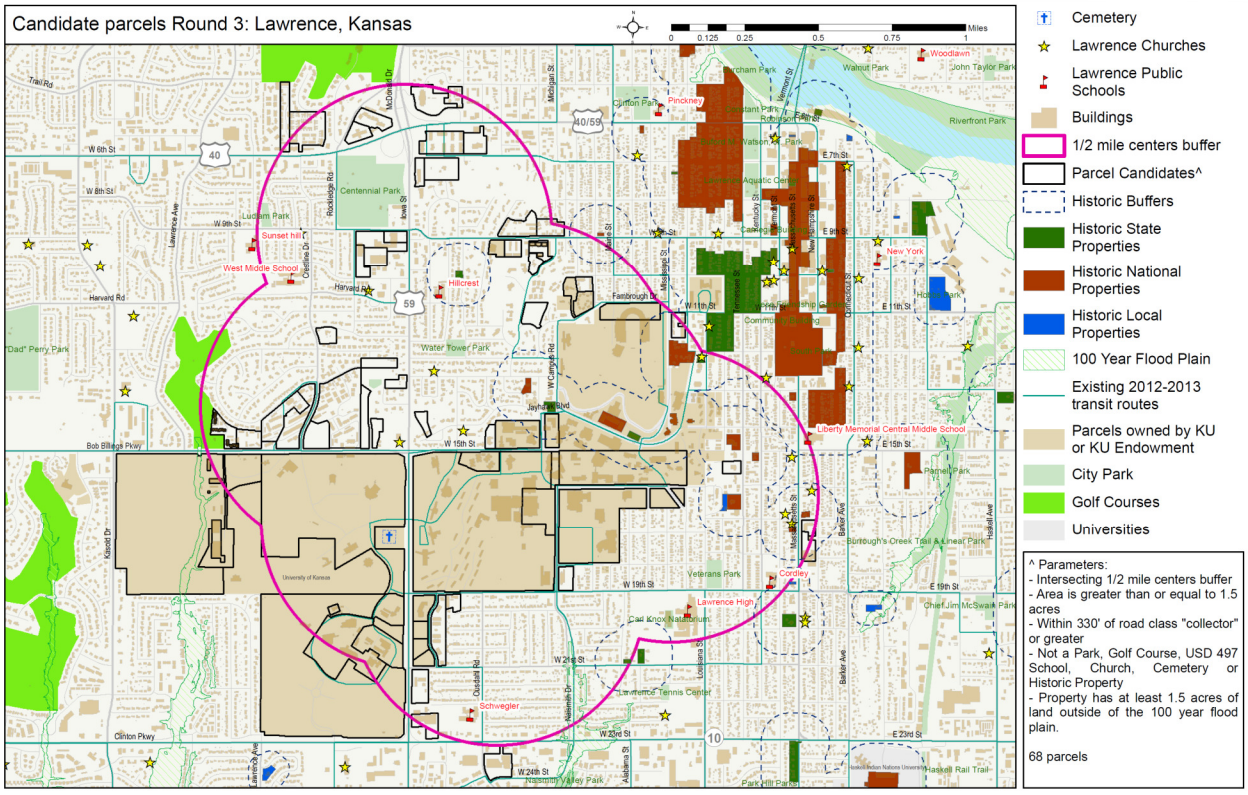
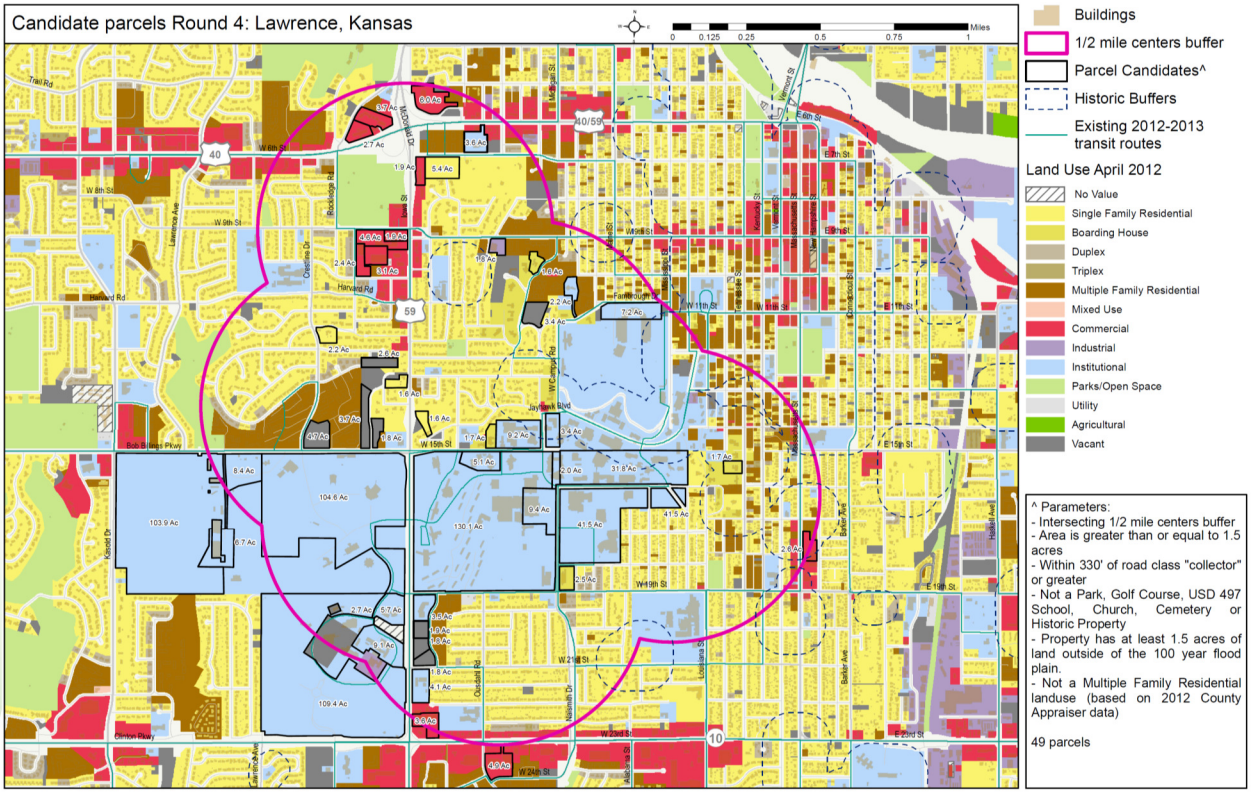


Figure 5: Round 4 – Not multi-family

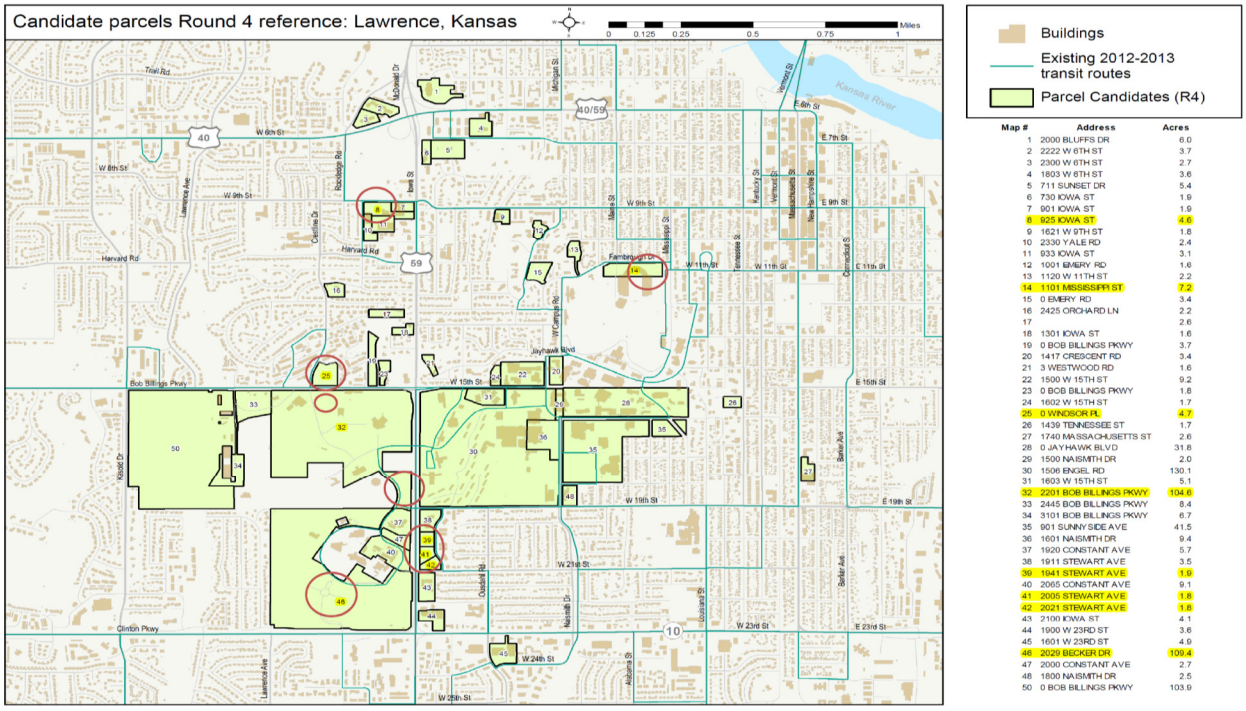


Of the remaining parcels, a more subjective selection process selected seven sites for further review. This selection was based on the sites' existing land use (many of the parcels were vacant), ease of vehicle access to major travel corridors, and potential for redevelopment. Sites selected were:

- 2029 Becker Drive (KU Park & Ride)
- 2021 Stewart Avenue
- Northwest corner of 19th Street and Iowa Street
- Northeast corner of Crestline Drive and Bob Billings Parkway
- Southeast corner of Crestline Drive and Bob Billings Parkway
- 925 Iowa Street (southeast corner of 9th Street and Centennial Drive)
- 1101 Mississippi (northwest of Memorial Stadium)

The sites are displayed in Figure 6.

Figure 6: Initial candidate site location

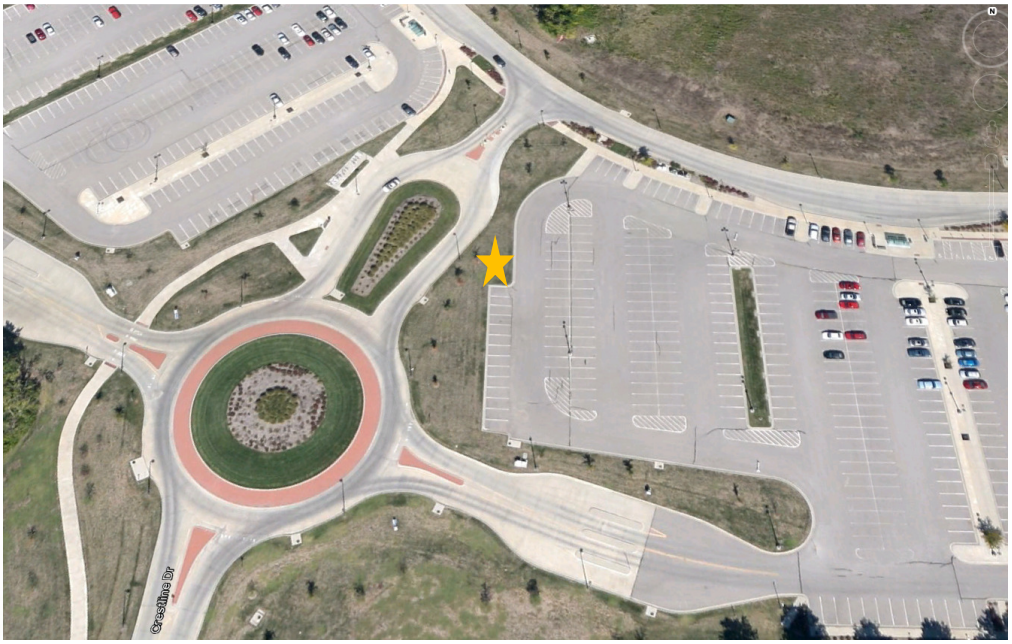


These sites were visited by the study team. The details and study team comments of each site are summarized as follows.

2029 Becker Drive (KU Park & Ride)
Current Land Use: Institutional
Future Land Use: Public / Semi-Public
Parcel Size: 109.4 Acres
Total Appraised Value: $2,468,030 (entire parcel)
Notes: Site is part of larger parcel.
Study Team Comments: • Crestline Drive is becoming a main entrance to KU. • High synergy potential to serve both KU needs and city needs. • The existing horseshoe median north of the round-about on Crestline Drive was originally designed to accommodate additional buses. • Existing traffic would make horseshoe median unsuitable for a transit center. • A likely location for a new transit center would be in the parking lot east of the horseshoe median. • Accessing this site will likely require intensive transit network restructuring.

Sources: City of Lawrence GIS Department, Horizon 2020. Douglas County Appraiser.

Figure 7: 2029 Becker Drive

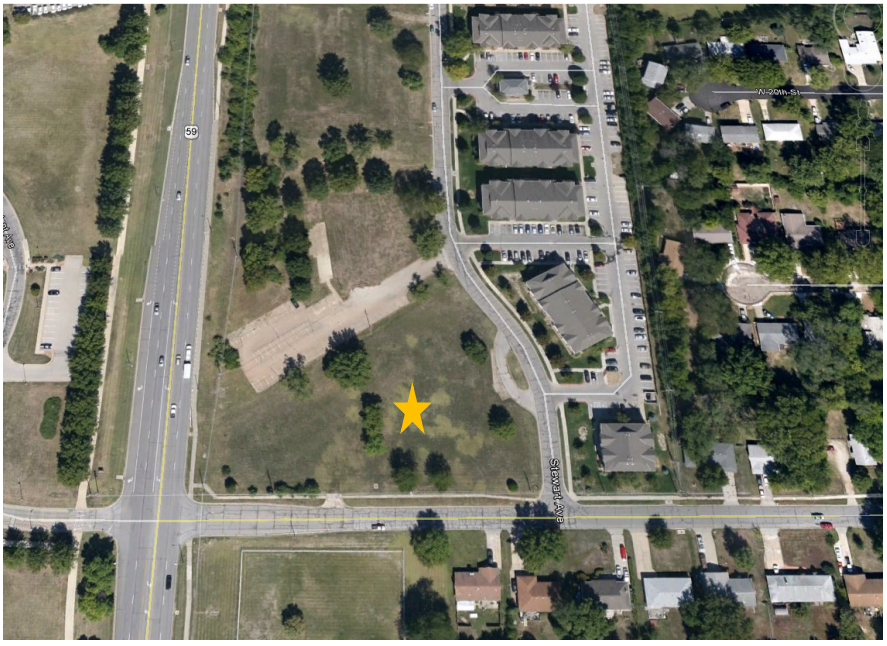


Source: Google Earth
Note: Site location is generalized

2021 Stewart Avenue
Current Land Use: Vacant
Future Land Use: Medium / High-Density Residential
Parcel Size: 1.8 Acres
Total Appraised Value: $651,060
Study Team Comments: • Southern-most parcel of these three vacant parcels would be best. • Transit center at this location could be seen as duplicative of nearby KU Park & Ride. • An additional stop light would be required at 21st Street and Iowa. Questions about queuing on 19th Street to Iowa affecting access from Stewart Avenue to 19th Street. • Surrounding residential is multi-family, or likely renters in single-family houses.

Sources: City of Lawrence GIS Department, Horizon 2020. Douglas County Appraiser.

Figure 8: 2021 Stewart Avenue

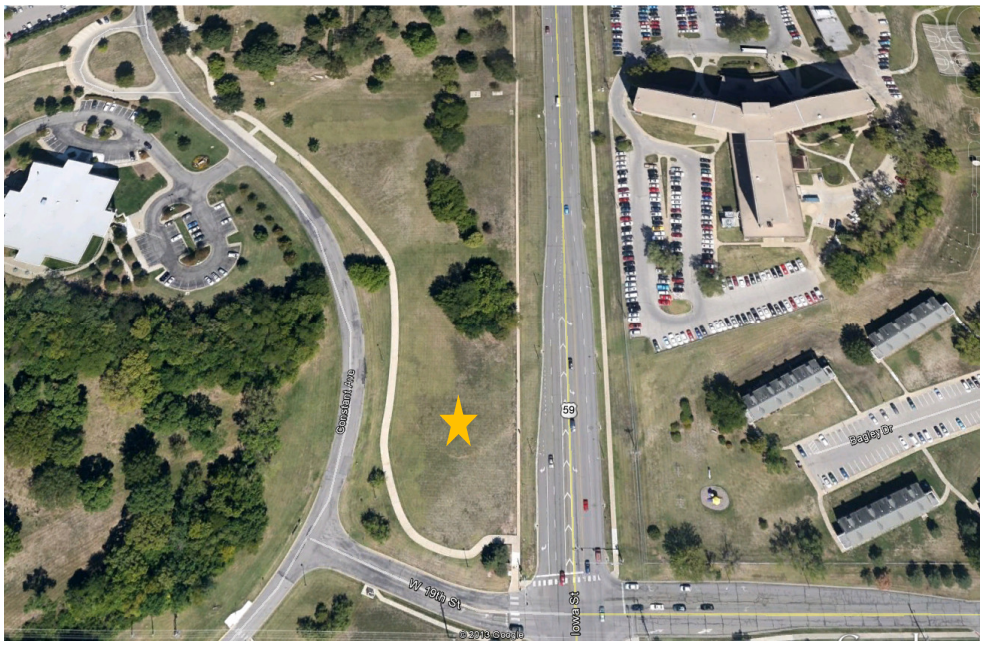


Source: Google Earth
Note: Site location is generalized

NW Corner of 19th and Iowa
Current Land Use: Institutional
Future Land Use: Public / Semi-Public
Parcel Size: 104.6 Acres
Total Appraised Value: $7,748,860
Notes: Site is part of larger parcel.
Study Team Comments: • KU master plan has this location designated a major gateway to KU.

Sources: City of Lawrence GIS Department, Horizon 2020. Douglas County Appraiser.

Figure 9: Northwest corner of 19th and Iowa

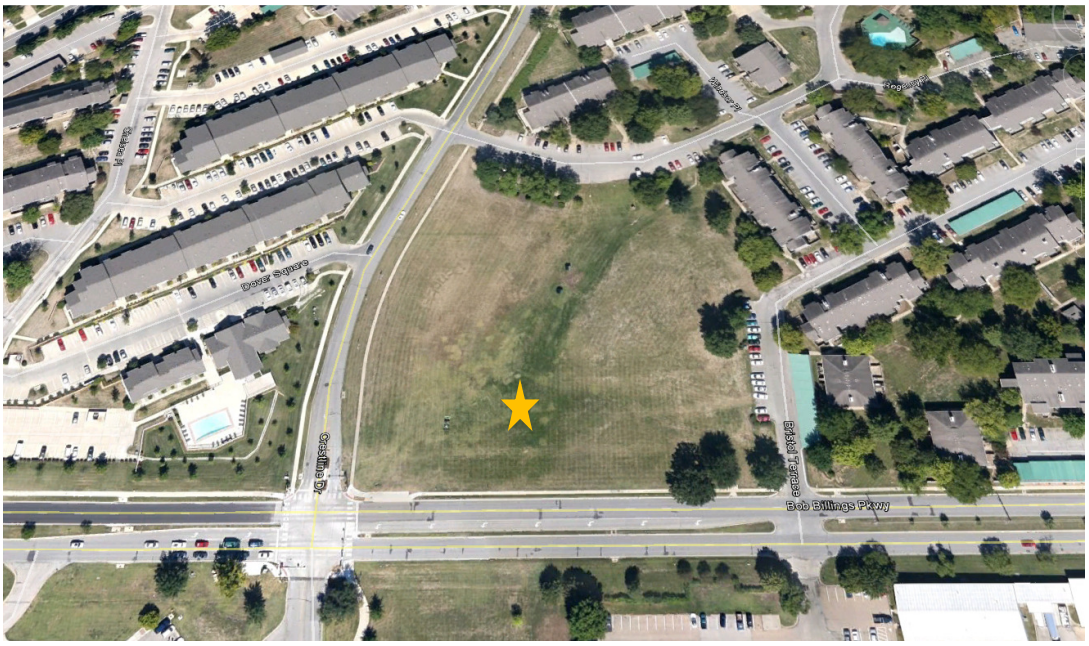


Source: Google Earth
Note: Site location is generalized

Northeast corner of Crestline Drive and Bob Billings Parkway
Current Land Use: Vacant
Future Land Use: Medium / High-Density Residential
Parcel Size: 4.7 Acres
Total Appraised Value: $534,320
Study Team Comments: • Transit center may not be the highest and best use for this particular site. • Would be less accepted by neighborhood than southeast corner of intersection.

Sources: City of Lawrence GIS Department, Horizon 2020. Douglas County Appraiser.

Figure 10: Northeast corner of Crestline Drive and Bob Billings Parkway

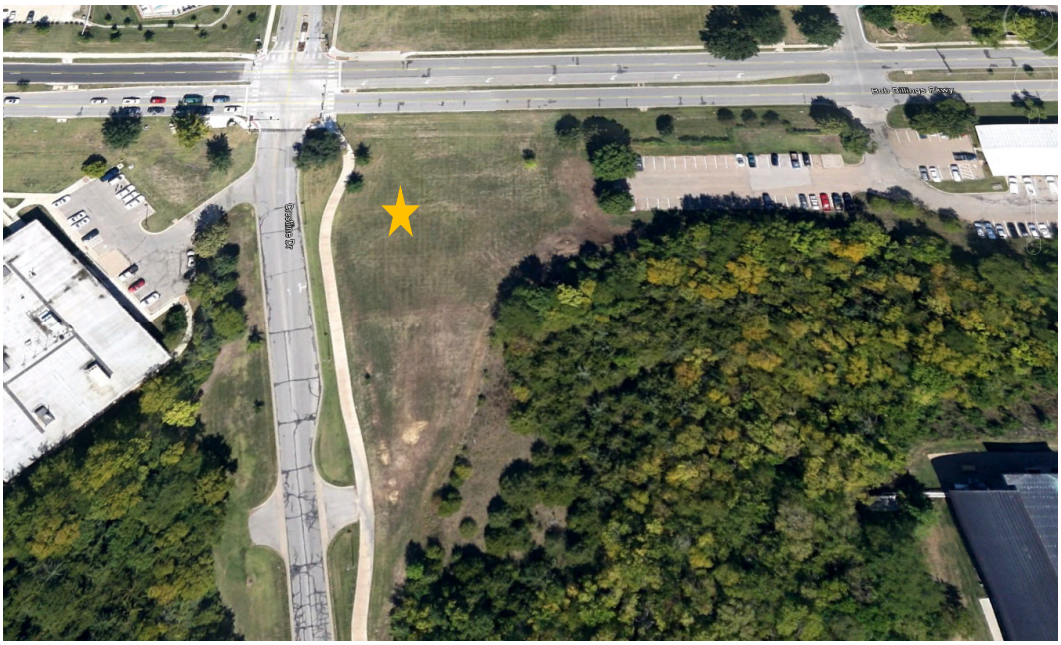


Source: Google Earth
Note: Site location is generalized

Southeast corner of Crestline Drive and Bob Billings Parkway
Current Land Use: Institutional (vacant)
Future Land Use: Public / Semi-Public
Parcel Size: 104.6 Acres
Total Appraised Value: $7,748,860
Notes: Site is part of larger parcel.
Study Team Comments: • Possible topography issues. • Would be better accepted by neighborhood than northeast corner of intersection. • Some concerns about distance from Iowa Street. • Site grading to address topography would be required.

Sources: City of Lawrence GIS Department, Horizon 2020. Douglas County Appraiser.

Figure 11: Southeast corner of Crestline Drive and Bob Billings Parkway



Source: Google Earth
Note: Site location is generalized

925 Iowa Street (southeast corner of 9th Street and Centennial Drive)
Current Land Use: Commercial
Future Land Use: Commercial
Parcel Size: 4.6 Acres
Total Appraised Value: $1,898,000 (entire parcel)
Notes: Site is part of larger parcel.
Study Team Comments: • A stop light would be required at Rockledge Road and 9th Street to handle additional transit vehicles. • "Lots of good things going for it." • High synergy possible with surrounding land uses. • Mitigation measures may be required for adjacent residential uses.

Sources: City of Lawrence GIS Department, Horizon 2020. Douglas County Appraiser.

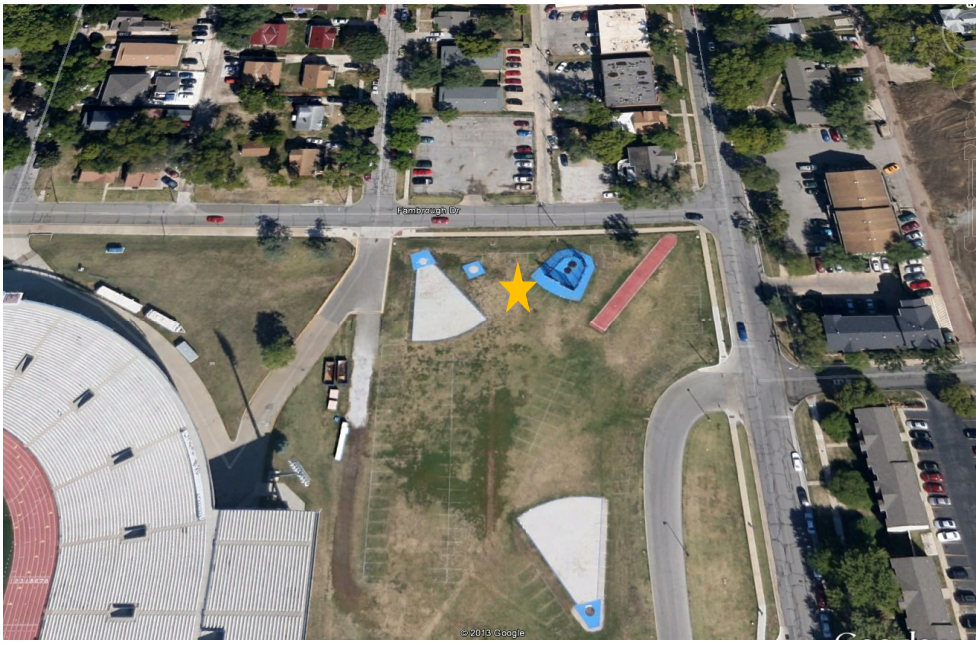
Figure 12: 925 Iowa (southeast corner of 9th Street and Centennial Drive)

Source: Google Earth
Note: Site location is generalized

1101 Mississippi (northwest of Memorial Stadium)
Current Land Use: Institutional
Future Land Use: Public / Semi-Public
Parcel Size: 7.2 Acres
Total Appraised Value: $222,240
Study Team Comments: • There's long been a desire to correct existing off-set intersection. • KU track and field area could be relocated to new Rock Chalk Park. • High opportunities for synergy to serve both city needs and KU needs, as well as athletic events. • Surrounding residential land use is predominately, but not completely, rental. • Mitigation measures may be required for adjacent residential uses.

Sources: City of Lawrence GIS Department, Horizon 2020. Douglas County Appraiser.

Figure 13: 1101 Mississippi (northwest of Memorial Stadium)



Source: Google Earth
Note: Site location is generalized

Discussion and Evaluation

The seven final sites were evaluated according to criteria broadly discussed by the study team throughout the project. The criteria are:

- Safety (lower risk for pedestrian conflicts, unsignalized left turns, etc.)
- Surrounding land use is compatible
- Opportunities for synergy
- No need for additional traffic control
- Future land use compatible to redevelopment
- Major grading is not required
- Central to existing system or ridership patterns

Each of the sites was evaluated against the above criteria. One of three scores was given for how well each site met each criterion. A score of 1, symbolized by an empty circle, means the site does not adequately address the criterion. A score of 2, symbolized by a half-circle, means the site does address part of the criterion, with some qualifications. A score of 3, symbolized by a full circle, means the site met the criterion. Figure 14 displays the matrix for the initial sites.

Figure 14: Initial Site Matrix Evaluation

Site	Safety (Lower risk for pedestrian conflict, unsignalized left turns)	Surrounding existing land use is compatible	Opportunity for Synergy	No need for additional traffic control	Future land use compatible to redevel.	Major site grading not required	Central to existing system / ridership	Summary (1 = low, 3 = high)
2029 Becker Drive (KU Park and Ride)	●	●	◒	●	●	●	○	2.6
2021 Stewart Avenue	◒	◒	○	○	●	●	◒	2.0
NW Corner of 19th and Iowa	◒	●	○	◒	○	◒	◒	1.9
SE Corner of Crestline Drive and Bob Billings Parkway	●	●	○	●	●	○	○	2.1
NE Corner of Crestline Drive and Bob Billings Parkway	◒	○	○	◒	○	○	○	1.3
925 Iowa Street (SE corner of 9th St and Centennial Dr)	◒	●	◒	◒	●	●	◒	2.4
1101 Mississippi (NW of Memorial Stadium)	◒	◒	●	●	●	●	●	2.7

Legend	Wt.	Guide
○	1	Does not adequately meet criterion
◒	2	Addresses part of the criterion, with some qualifications
●	3	Best meets criterion

Safety:

Most of the sites evaluated have some potential for pedestrian or vehicular conflicts. 2029 Becker Drive was ranked higher because the existing land use already separates pedestrians and vehicles. The southeast corner of Crestline Drive and Bob Billings Parkway was also ranked higher because the site is not near other major pedestrian or vehicle trip generators.

Surrounding existing land use is compatible:

Some sites are in areas adjacent to residential and may be less suitable for a transit center than in areas surrounded by institutional land or commercial.

Opportunity for synergy:

Most sites do not have an inherent opportunity to synergize with the existing land use, nearby attractions, or the transit systems. Both 2029 Becker Drive and 925 Iowa Street could leverage existing activity currently located at their sites. The parcel at 1101 Mississippi was ranked higher due to potential opportunities interacting well with KUOW and athletic functions.

No need for additional traffic control:

For the safe operation of a transit center, some sites would need additional traffic control measures beyond those currently in place. 2021 Stewart Avenue would likely require an additional traffic signal on Iowa Street, and may have queuing issues to access westbound 19th Street. Other sites—such as the northwest corner of 19th and Iowa, the northeast corner of Crestline Drive and Bob Billings Parkway, and 925 Iowa—would require additional evaluation to determine if additional traffic controls were needed.

Future land use is compatible to redevelopment:

KU has indicated that the northwest corner of 19th and Iowa is envisioned to be a gateway feature for the university, and likely incompatible with a transit center. The northeast corner of Crestline Drive and Bob Billings Parkway appears a likely candidate for an expansion of existing high-density residential.

Major site grading not required:

Both the northeast and southeast corners of Crestline Drive and Bob Billings Parkway may require substantial grading, while the northwest corner of 19th and Iowa may also require some level of grading. While 1101 Mississippi may require substantial grading, it is assumed that this would be done anyway to realign the intersection at 11th and Mississippi.

Central to existing system / ridership:

Some sites are less centrally located to the major routes or ridership. For instance, 2029 Becker Drive may require additional time commitments to egress and ingress a transit center located near the middle of a large parcel.

Summary:

The grade that each site met for each criterion was averaged. With a score of 2.7, 1101 Mississippi was ranked highest. Second highest with a score of 2.6 was 2029 Becker Drive, and 925 South Iowa was ranked third with a score of 2.4. These three sites moved forward to the next level of evaluation.

Chapter 3 Site Selection Refinement

This chapter describes the three candidate sites that resulted from a preliminary location analysis using a combination of GIS analysis and qualitative criteria[1]. This chapter will present site plans for the three sites, costs associated with orienting the transit network to serve each site, and additional vehicle costs to maintain system frequency. The three candidate sites are listed below and are identified on Figure 15:

- 925 Iowa
- 2029 Becker Drive
- 1101 Mississippi

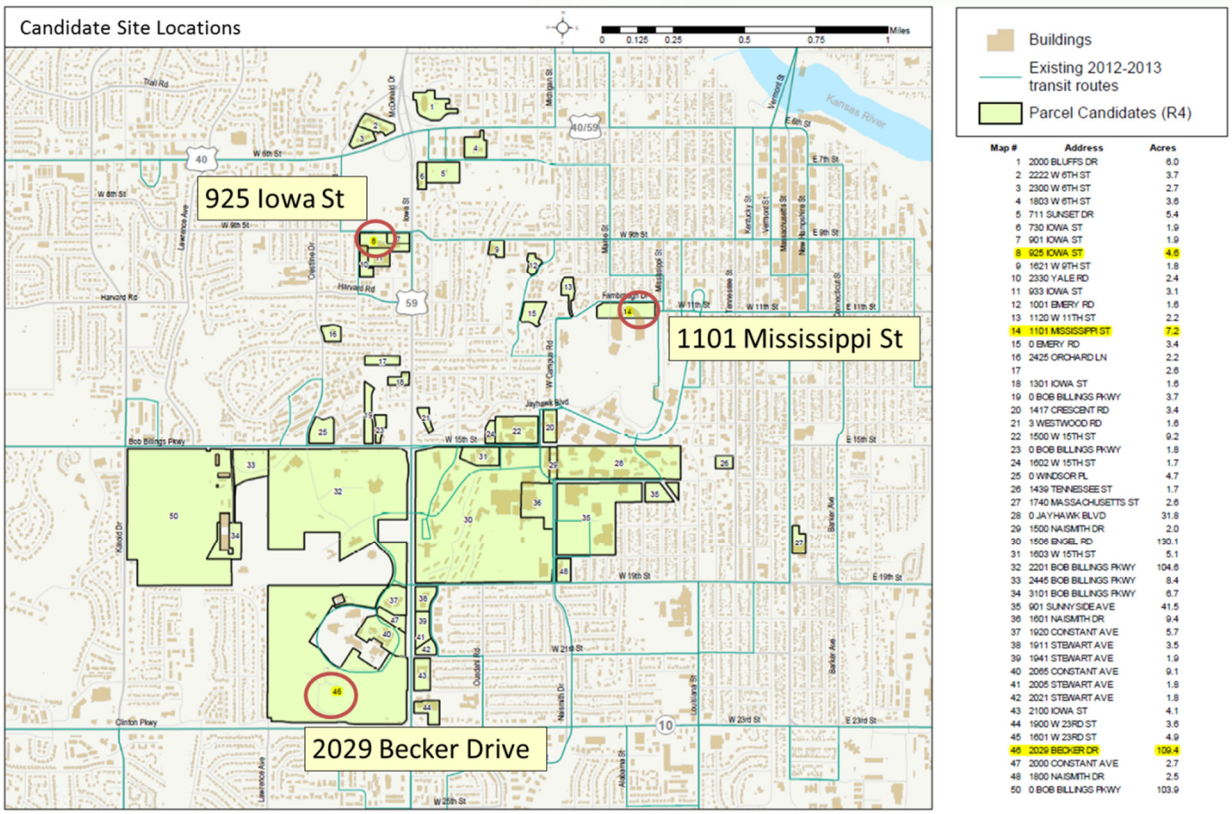
Table 1 summarizes the costs identified in this chapter. The parcel at 1101 Mississippi has the highest site development costs at $2.7 million, but because of lower costs associated with renetworking, has the lowest overall costs at $2.8 million. The parcel at 925 Iowa has the next lowest total costs of $3.2 million. Although 2029 Becker Drive has the lowest site costs, it ends up having the highest overall costs, primarily due to higher renetworking costs and the need to buy additional vehicles to maintain the system's current frequency.

Table 1: Comparison of all costs

	2029 Becker Drive	1101 Mississippi	925 Iowa
Direct Site Costs	$ 1,818,975	$ 1,910,100	$ 1,840,150
Adjacent Costs	$ 213,280	$ 337,375	$ 296,200
20 Percent Contingency	$ 406,451	$ 449,495	$ 427,270
Sub-total site costs	*$ 2,438,706*	*$ 2,696,970*	*$ 2,563,620*
Renetworking Costs	$ 534,725	$ 101,632	$ 366,061
Additional Vehicle Costs	$ 690,000	$ -	$ 310,000
Total Costs	**$ 3,663,431**	**$ 2,798,602**	**$ 3,239,681**

Figure 15: Candidate Site Locations

[1] The process used to arrive at these three sites is described in the June 11, 2013, memo titled *Lawrence Transit Center Locational Analysis – GIS Process and Initial Candidate Site Discussion*, and is included in Appendix B.



Map #	Address	Acres
1	2000 BLUFFS DR	6.0
2	2222 W 6TH ST	3.7
3	2300 W 6TH ST	2.7
4	1803 W 6TH ST	3.6
5	711 SUNSET DR	5.4
6	730 IOWA ST	1.9
7	901 IOWA ST	1.9
8	925 IOWA ST	4.6
9	1621 W 9TH ST	1.8
10	2330 YALE RD	2.4
11	933 IOWA ST	3.1
12	1001 EMERY RD	1.6
13	1120 W 11TH ST	2.2
14	1101 MISSISSIPPI ST	7.2
15	0 EMERY RD	3.4
16	2425 ORCHARD LN	2.2
17		2.6
18	1301 IOWA ST	1.6
19	0 BOB BILLINGS PKWY	3.7
20	1417 CRESCENT RD	3.4
21	3 WESTWOOD RD	1.6
22	1500 W 15TH ST	9.2
23	0 BOB BILLINGS PKWY	1.8
24	1602 W 15TH ST	1.7
25	0 WINDSOR PL	4.7
26	1439 TENNESSEE ST	1.7
27	1740 MASSACHUSETTS ST	2.6
28	0 JAYHAWK BLVD	31.8
29	1500 NAISMITH DR	2.0
30	1506 ENGEL RD	130.1
31	1603 W 15TH ST	5.1
32	2201 BOB BILLINGS PKWY	104.6
33	2445 BOB BILLINGS PKWY	8.4
34	3101 BOB BILLINGS PKWY	6.7
35	901 SUNNYSIDE AVE	41.5
36	1601 NAISMITH DR	9.4
37	1920 CONSTANT AVE	5.7
38	1911 STEWART AVE	3.5
39	1941 STEWART AVE	1.9
40	2065 CONSTANT AVE	9.1
41	2005 STEWART AVE	1.8
42	2021 STEWART AVE	1.8
43	2100 IOWA ST	4.1
44	1900 W 23RD ST	3.6
45	1601 W 23RD ST	4.9
46	2029 BECKER DR	109.4
47	2000 CONSTANT AVE	2.7
48	1800 NAISMITH DR	2.5
50	0 BOB BILLINGS PKWY	103.9

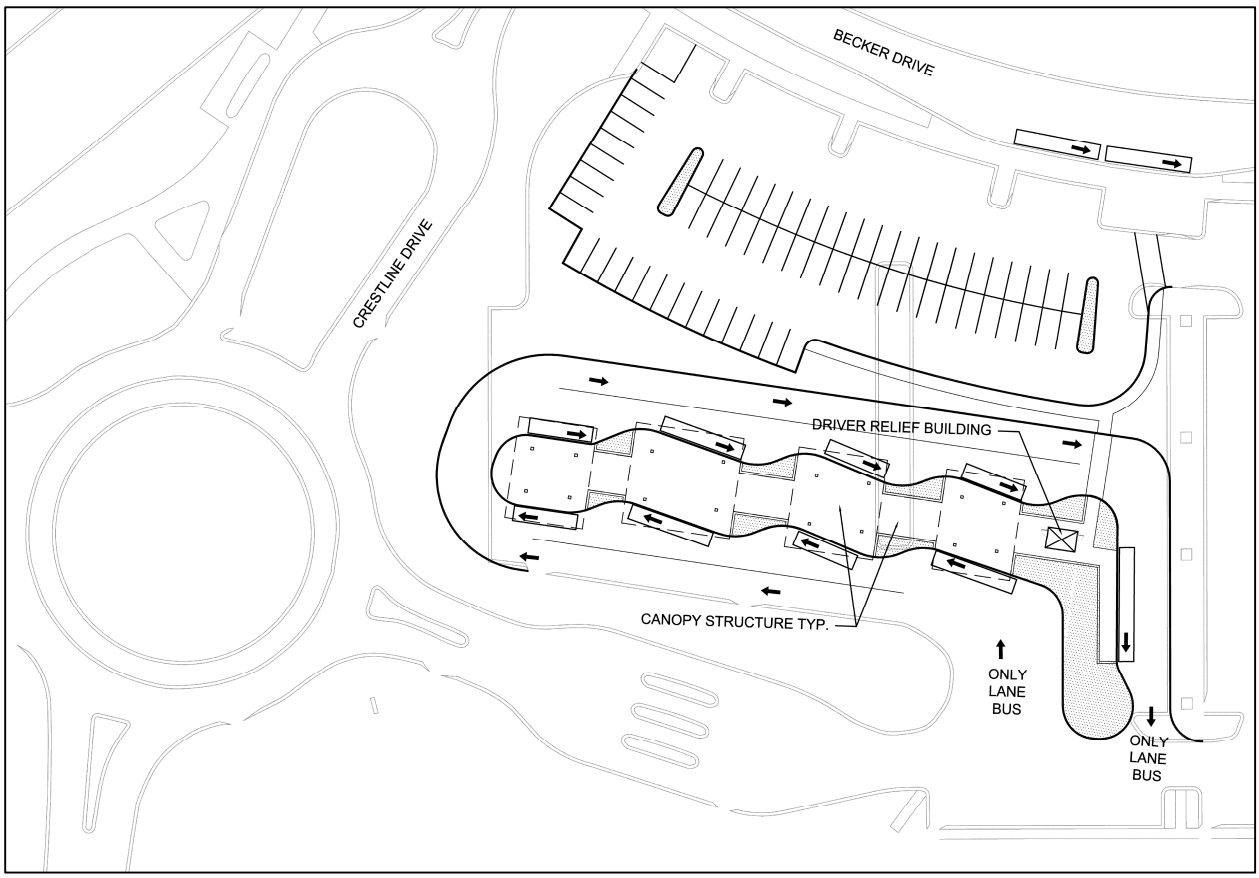
Sources: City of Lawrence GIS Department, modified by Olsson Associates
Conceptual layouts for each site

A conceptual layout was developed for each site. Each concept met the general criteria desired for a transit center as identified in discussions with the study team. The purpose of the conceptual layouts at this stage is not to arrive at the best layout for that site, but rather to determine the practicality and operational challenges or opportunities of the potential transit center location and to arrive at order of magnitude costs for developing each site. The full site plans and cost sheets are included in Appendix C.

2029 Becker Drive (KU Park & Ride) Conceptual Layout

The conceptual layout for 2029 Becker Drive is presented in Figure 16. The transit center would be built inside an existing parking lot at the KU Park & Ride facility. This would result in a loss of 125 parking spaces. The layout features a horseshoe-shaped design adjacent to Crestline Drive. Nine buses would use the interior space of the transit center, while two additional buses would utilize the existing bus pull-outs at the existing Park & Ride facility. The total project cost would be $2,438,706, including a 20 percent contingency, and $213,000 to reconfigure the parking lot to the north of the transit center.

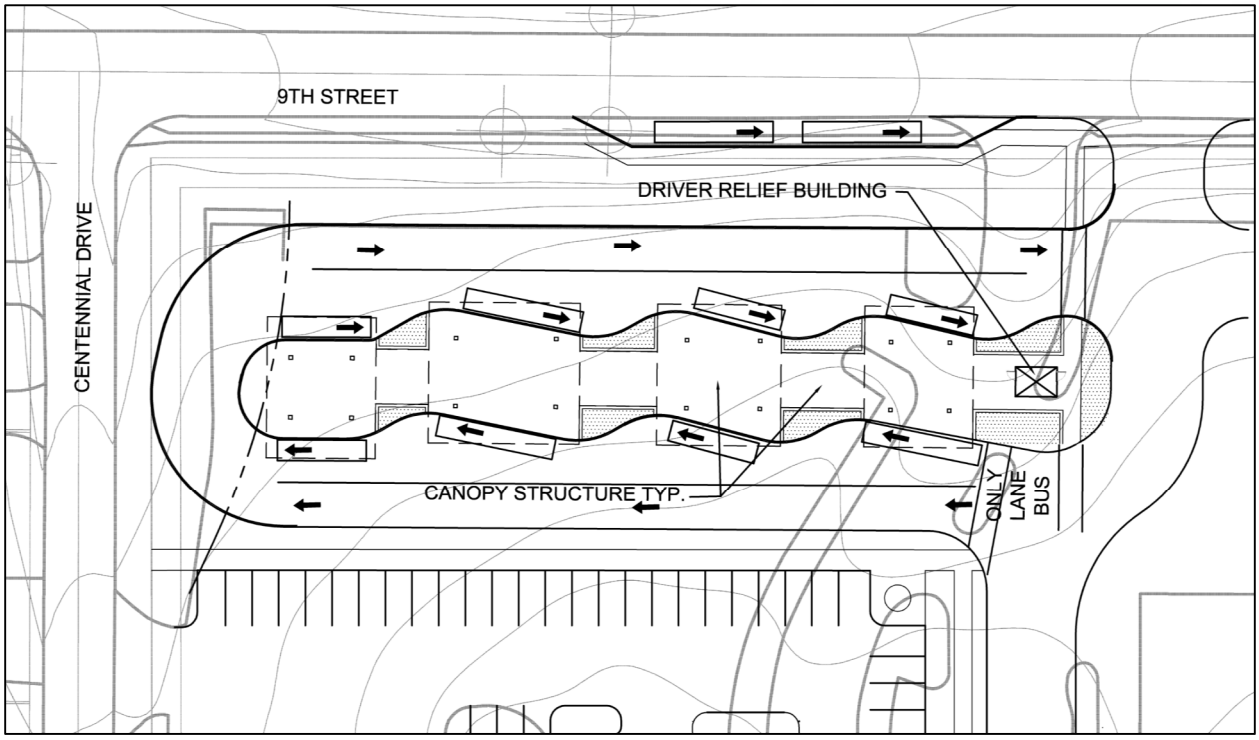
Figure 16: Site plan excerpt for 2029 Becker Drive



925 Iowa Street Conceptual Layout

The conceptual layout for 925 Iowa Street is presented in Figure 17. The layout features a horseshoe-shaped design placed in the existing parking lot at the southeast corner of Centennial Drive and 9th Street, with buses accessing the center from 9th Street through the parking lot access lane. This layout buffers the effects of transit center operations on the single-family uses to the east. Eight buses would use the interior space of the transit center, while two additional buses would utilize bus pull-outs on 9th Street. This layout would result in the loss of approximately 85 parking spaces. The total project costs would be $2,563,620, including a 20 percent contingency, and $296,000 to reconfigure the parking lot.

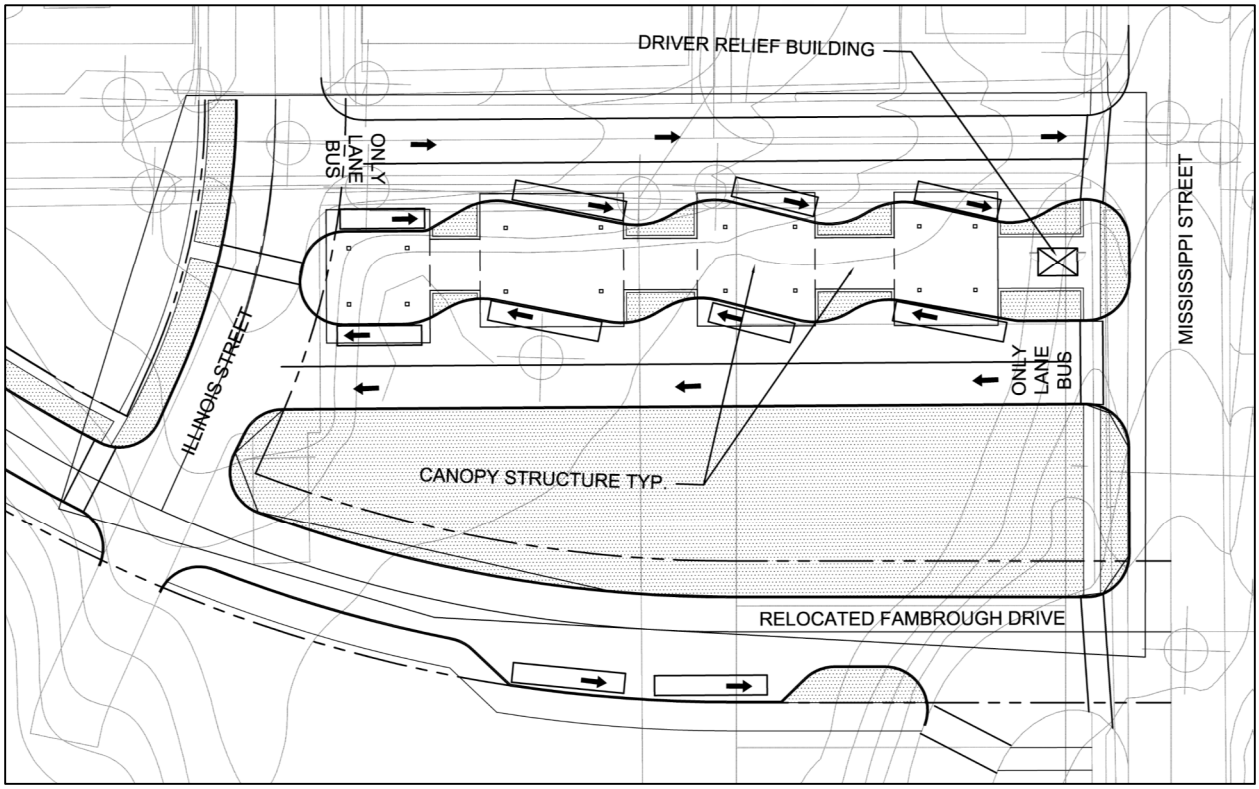
Figure 17: Site plan excerpt for 925 Iowa



1101 Mississippi Conceptual Layout

The conceptual layout for 1101 Mississippi is presented in Figure 18. The layout features a parallel transit center adjacent to a reconfigured 11th Street / Fambrough Drive. Eight buses would use the interior space of the transit center, while two additional buses would utilize bus pull-outs on a relocated Fambrough Drive. The total project costs would be $2,696,970, including a 20 percent contingency, and $337,000 to relocate Illinois Street and Fambrough Drive. It should be noted that reconfiguring the intersection at 11th and Mississippi has been discussed before and that these costs may be incurred regardless if a transit center is built at this location.

Figure 18: Site plan excerpt for 1101 Mississippi



Transit network changes required to serve each site

One component of the site evaluation process was to determine the additional cost or savings that would be incurred to reconfigure the transit network around the transit center. These cost changes would be the result of both revenue mile additions (savings associated with the network change) and the change in the number of vehicles required to serve a transit center location should the route's frequency stay the same. A full-scale redrawing of the network is beyond the scope of this project, so relatively simple and direct adjustments were made to the network to serve each candidate site. These adjustments are focused on determining the required change in revenue miles to reach each candidate site and were not necessarily made in accordance with serving transit-dependent populations or major activity centers or optimizing the resulting network.

This analysis focused on city routes currently serving the downtown transit center, including the following routes:

- Route 1
- Route 3
- Route 4
- Route 6
- Route 7
- Route 10
- Route 11

Route 5 and Route 9 were not included in this analysis as they are both cross-town routes that did not previously access the downtown transit center. Routes that only operate while KU is in session were not included in this analysis. Some of those routes may have minor route changes to serve a new transit center, but their underlying focus will remain serving the KU campus. Both schedule variations of Route 11 were analyzed, as the city may be responsible for part of the cost if route changes require an additional vehicle. In addition, the following assumptions were made for the network analysis:

- The cost would be $5.00 per revenue mile.
- The number of daily runs per route would remain the same.
- The frequency per route would remain the same.
- Service to downtown would continue where feasible for specific routes.

The alignments used for this analysis are included in Appendix D. It should be stressed that these alignments are illustrative only and are only for the purpose of this analysis. The alignments have not been subject to the same level of analysis that would occur before actual network changes.

Table 2 presents the additional network costs that would be incurred to serve each of the three candidate sites, compared to the existing service. The site at 1101 Mississippi would incur the least additional cost of $102,000, while serving a transit center at 2029 Becker Drive would require an additional $535,000 beyond current expenses. It should be noted that many of the route alignments used for this analysis continue to serve major portions of downtown, thus explaining why cost savings are not realized. A policy decision to adjust service to downtown may result in higher savings.

Table 2: Savings or costs above existing transit center location

Daily Savings or Costs above existing	Route 1	Route 3	Route 4	Route 6	Route 7	Route 10	Route 11A	Route 11B	Annual Cost Difference
925 Iowa	$ 483.86	$ 35.89	$ 13.53	$ 165.48	$ 101.13	$ 39.97	$ 333.42	$ 333.42	**$ 366,061**
1101 Mississippi	$ 261.17	$ (19.62)	$ (54.14)	$ 132.02	$ 94.91	$ (148.09)	$ 59.50	$ 59.50	**$ 101,632**
2029 Becker Drive (KU P&R)	$ 471.99	$ 242.77	$ 164.91	$ 587.21	$ (19.89)	$ 2.40	$ 264.47	$ 264.47	**$ 534,725**

Table 3 presents the number of additional buses that may be required to serve each candidate location. Additional buses on a route would be necessary if the route frequency stays the same but revenue miles were added beyond what the existing number of buses could serve. It was assumed that a route could be optimized to absorb up to another 0.19 vehicles (i.e, if a route indicated that it would need 1.19 buses, then that route could probably be optimized to get by with just one bus).

As the table indicates, to serve 925 Iowa, Route 1 would likely need an additional bus. An additional bus for Route 11B was not included, as the vehicles required are still below what's currently necessary to serve Route 11A. The total cost for the additional vehicle for Route 1 would be $310,000.

No additional vehicles would be required for 1101 Mississippi, although Route 1 and Route 7 may have to be optimized.

Serving 2029 Becker Drive would require the most additional vehicles. Additional vehicles would likely be required for Route 1, Route 4, and Route 6. The additional costs for these vehicles would be $690,000.

Table 3: Number of buses required to serve each location

Number of Buses	Route 1	Route 3	Route 4	Route 6	Route 7	Route 10	Route 11A	Route 11B	Additional
Cost of Bus	$ 310,000	$ 70,000	$ 70,000	$ 310,000	$ 310,000	$ 310,000	$ 375,000	$ 375,000	Vehicle Costs
Existing	0.87	0.30	1.00	1.80	0.95	0.95	2.53	1.90	
925 Iowa	1.32	0.35	1.02	2.01	1.06	0.99	3.02	2.26	$ 310,000
1101 Mississippi	1.11	0.27	0.92	1.96	1.06	0.80	2.62	1.96	
2029 Becker Drive (KU P&R)	1.30	0.64	1.23	2.53	0.93	0.95	2.92	2.19	$ 690,000

Discussion

Table 4 displays all of the costs associated with each of the three sites. The highest site development costs occur at 1101 Mississippi ($2.7 million). Because of lower costs associated with renetworking, though, this site has the lowest overall costs at $2.8 million. The next lowest total costs occur at 925 Iowa ($3.2 million), and 2029 Becker Drive, although having the lowest site costs, ends up having the highest overall costs, primarily due to higher renetworking costs and having to buy additional vehicles to maintain the system's current frequency.

Table 4: Comparison of all costs

	2029 Becker Drive	1101 Mississippi	925 Iowa
Direct Site Costs	$ 1,818,975	$ 1,910,100	$ 1,840,150
Adjacent Costs	$ 213,280	$ 337,375	$ 296,200
20 Percent Contingency	$ 406,451	$ 449,495	$ 427,270
Sub-total site costs	*$ 2,438,706*	*$ 2,696,970*	*$ 2,563,620*
Renetworking Costs	$ 534,725	$ 101,632	$ 366,061
Additional Vehicle Costs	$ 690,000	$ -	$ 310,000
Total Costs	**$ 3,663,431**	**$ 2,798,602**	**$ 3,239,681**

Further Evaluation of Sites

After a presentation on June 25, 2013, the Lawrence City Commission directed the study team to further evaluate a potential transit center at 925 Iowa. Concepts and costs were developed and prepared. Simultaneously, KU was finishing a master planning process that projected university land use and development patterns for the next twenty years. During that time, the KU Master Plan consulting team became aware of the seven initial sites that were reviewed for the transit center locational analysis. One of those sites, 2021 Stewart Avenue, appeared well situated to serve both the future needs of the city as well as the future extensive development that KU forecasted would occur on campus property centered on 19th Street and Iowa Street. Concurrent further analysis of 925 Iowa revealed potential difficulties related to transit center operations at that location, topography issues, and negative impacts to the overall route system in relation to current major destinations. The geographical location of 925 Iowa is not as well suited as the 2021 Stewart Avenue site for a centralized operations point for the system. Topography issues at 925 Iowa would also necessitate the construction of a retaining wall, which would further complicate the Americans with Disabilities Act (ADA) pedestrian access from adjacent land uses. Additionally, to further mitigate impacts to adjacent residential land

uses, moving the site slightly eastward may be desired, but increases the multiple ownership issue.

In light of these issues, together with the new information on 2021 Stewart Avenue, the city project manager directed Olsson Associates to evaluate 2021 Stewart Avenue for use as a transit center.

Chapter 4 Final Site Evaluation

This chapter describes the construction, maintenance, and operations costs of a conceptualized transit center at 2021 Stewart Avenue. In addition, this chapter describes the process that led to the focus on 2021 Stewart Avenue, and compares the site with the costs associated with 925 Iowa.

2021 Stewart Avenue Conceptual Layout

A concept was developed for the parcel at 2021 Stewart Avenue in consultation with the study team. This includes locations for ten transit vehicles inside the transit center, a southbound bus pull-out on Stewart Avenue accommodating two buses, and dual bus pull-outs on the far sides of the 21st Street and Iowa intersections. These pull-outs would accommodate an additional two vehicles each. In total, the transit center will be able to accommodate 16 transit vehicles.

Pedestrian connectivity would be facilitated through a mid-block crossing north of the transit center across Stewart Avenue. Unsignalized pedestrian crossings would be marked east-west across Stewart Avenue at 21st Street and across the transit vehicle entrances. A four-way signalized crosswalk would be built at the 21st Street and Iowa Street intersection. Major pedestrian paths would also connect the perimeter sidewalks and bus pull-outs to the interior of the transit center. Bike parking facilities would be provided in the transit center, adjacent to the future building footprint.

The transit center would buffer residential uses to the east and south through extensive landscaping and coniferous foliage. Figure 19 displays the rendering of the transit center. The full-size rendering, as well as elevations is included in Appendix E.

Figure 19: 2021 Stewart Avenue rendering (excerpt)

Traffic Impacts of 2021 Stewart, and 925 Iowa

Traffic impacts for a transit center at either 2021 Stewart Avenue or 925 Iowa Street were examined and compared. A transit center at 925 Iowa is not expected to grow car traffic, but is expected to grow bus traffic, with ten buses existing the site and ten buses entering the site per peak hour. The following modification are recommended to mitigate the impact:

- An additional southbound left turn lane on Rockledge Road.
- Repaving of Rockledge Road from National Lane to 9th Street, and for 9th Street from Rockledge Road to Iowa Street is recommended due to the poor quality of the existing pavement and the adverse impacts experienced by additional transit vehicles.

A transit center itself at 2021 Stewart Avenue is not expected to grow car traffic, but is expected to grow bus traffic, with 19 buses entering and 21 buses exiting the transit center during a peak hour. This additional bus traffic will warrant a traffic signal at 21st Street and Iowa Street. The proposed addition of a traffic signal is estimated to grow cut-through traffic along 21st Street by 20%. To mitigate the additional bus traffic and cut-through traffic, some intersection lane modifications are recommended. These include:

- Adding a northbound right turn lane from Iowa Street onto 21st Street,
- Extend the taper of the westbound left turn lane from 21st Street onto Iowa, from 50 feet to 150 fee plus taper.

- Repaving of 21st Street from Iowa Street to Stewart Avenue, and Stewart Avenue from 21st Street to the transit center entrance is recommended due to the poor quality of the existing pavement and the adverse impacts experienced by additional transit vehicles.

In addition, general intersection improvements associated with the installation of a traffic signal are recommended. These general improvements include:

- The restriping on Iowa Street of a northbound left turn lane onto eastbound 21st Street, and
- Adding a left turn lane to the west leg of 21st Street and Iowa Street.

Table 5 displays the cost of each improvement.

Table 5 Related Roadway Improvement Costs

925 Iowa - Related Roadway Improvement Costs

9th Street Repaving Repave north leg of Rocklege	$	1,376,412
Contingency	$	344,103
Opinion of Probable Cost	$	1,720,515

2021 Stewart - Related Roadway Improvement Costs

Extend Westbound Left turn lane from 50' to 150' plus taper*	$	39,983
Add Left Turn Lane to the West Leg of 21st & Iowa	$	82,076
Add NB Right Turn Lane to 21st & Iowa	$	92,877
Repave W. 21st St. and Stewart St from Iowa to Transit Center Entrance	$	521,798
Install Traffic Signal at 21st St. & Iowa, northbound 150' Left-Turn Lane	$	165,000
Contingency	$	198,440
Opinion of Probable Cost	$	1,060,191

*Would be included in repavement. Is not included in contingency or total.

The full traffic study is included as Appendix F, including improvement costs, and pavement conditions.

Costs Comparison of 2021 Stewart with 925 Iowa

The total cost for the 2021 Stewart Avenue transit center is identified in Table 6, along with comparable costs for 925 Iowa. Total costs for the two sites are included in Appendix F. The additional traffic mitigation items identified above were included for each site. Maintenance costs were derived from discussions with other transit agencies in the region regarding their

average annual maintenance, utility, and vandalism repair costs for transit centers of similar size and scope[2].

Annual and capital costs to reroute the existing bus network from their current downtown orientation, to each of the respective candidate sites were included. Due to its location further away from the existing downtown location, these renetworking costs were higher for 2021 Stewart Avenue. To maintain current route frequency the City would have to buy two additional vehicles to serve 2021 Stewart Avenue, or one additional vehicle to serve 925 Iowa. The renetworking process is explained in more detail in previous memos[3].

The sub-total site costs were higher for 925 Iowa, primarily due to reconfiguring the adjacent parking lot, and repaving 9th Street between Iowa Street and Rockledge Road to handle additional wear and tear from buses. Once the additional required vehicles are taken into account, the total capital costs were $460,000 higher than 2021 Stewart Avenue. The Stewart Avenue site does have a higher annual costs, again, primarily due to route renetworking. Adding the capital costs to the annual costs, however, and 2021 Stewart Avenue is $337,000 less expensive than 925 Iowa.

A very important caveat is the fact that land acquisition costs are not included in these cost summaries. The site at 925 Iowa is actually a collection of multiple parcels owned by multiple legal entities, and complicated by the fact that parking spaces in a parcel may be legally allocated as the parking for another parcel. This will likely complicate the acquisition process. 2012 Stewart Avenue and the two parcels to the north, by contrast, are owned by KU Endowment.

[2] Email conversations with Mary Hunt, city of Independence, regarding Independence Transit Center, Independence, Missouri; Shawn Strate, Johnson County Transit, regarding Mission Transit Center, Mission, Kansas.
[3] "Lawrence Transit Center Locational Analysis – Round 2 candidate site evaluation." June 11, 2013.

Table 6: Cost Comparison Summary

		925 Iowa	2021 Stewart Avenue
Capital	Direct Site Costs*	$ 1,840,150	$ 1,879,657
	Adjacent Costs	$ 296,200	$ 132,650
	Roadway Improvements	$ 1,376,412	$ 861,751
	Contingency	$ 771,373	$ 600,902
	Sub-total site costs	*$ 4,284,135*	*$ 3,474,960*
	Additional Vehicle Costs	$ 310,000	$ 620,000
	Rts that added 1 vehicle	Rt 1	Rt 1, Rt 6
	Total Capital Costs	**$ 4,594,135**	**$ 4,094,960**
Annual	Route Renetworking	$ 366,061	$ 487,769
	Maintenance	$ 30,000	$ 30,000
	Water, sewer, electric	$ 14,500	$ 14,500
	Vandalism Repair	$ 3,000	$ 3,000
	Total Annual Costs	**$ 413,561**	**$ 535,269**

These costs do not include land acquisition costs.

Phasing of 2021 Stewart

The 2021 Stewart Avenue transit center, as rendered, only occupies one parcel of the three vacant parcels south of the fire station at 19th and Iowa. The site plan accommodates a future 2,500-square foot building (not included in the cost estimates). In addition, the transit center and parcel abuts an existing parking lot that could be repaved in the future to support Park & Ride elements. The parking lot as currently configured could support approximately 48 parking spaces. This amount of parking would be a minimum needed to support an express service such as the K-10 Connector, or a future Park & Ride service on I-70. If the transit center is to serve as a Park & Ride for the existing KU Park & Ride service, than additional parking lots would have to be constructed on the additional two parking lots. The remaining two parcels fully built out for parking would be able to accommodate approximately 450 parking spaces. This includes the area with the existing parking lot. This assumes that there are no major topographical or other constraints on developing the land. The costs or other impacts cited in this report do not include the development of any parking lots.

Chapter 5 Funding analysis

The purpose of this chapter is to discuss funding options for designing and constructing a new transit center. This includes a review of federal, state, and local funding opportunities.

Federal Funding Sources

The Congestion Mitigation and Air Quality (CMAQ) Improvement Program

The primary purpose of the Congestion Mitigation and Air Quality (CMAQ) Improvement Program is to fund projects and programs in air quality nonattainment and maintenance areas for ozone, carbon monoxide (CO), and small particulate matter (PM-10), which reduce transportation-related emissions.

CMAQ funds may be used to establish new or expanded transportation projects or programs that reduce emissions, including capital investments in transportation infrastructure, congestion relief efforts, diesel engine retrofits, or other capital projects. These funds can be used for capital expenditures related to the creation of a transit center, and they would be applicable as match to any federal capital funding awarded to the project. Previously, CMAQ funding was limited to three years. Interim guidance for the new federal transportation program, MAP-21, allows the same amount of funding to be spread out over five years. Applications for this program would be sent from Lawrence Transit or the city of Lawrence to the Lawrence-Douglas County metropolitan planning organization (MPO). In fiscal year (FY) 2013, the state of Kansas received $9.5 million from this program, before set asides[4].

Federal Transit Administration Section 5309 Capital Investment Grant Program – Bus and Bus Facilities

The Buses and Bus Related Equipment and Facilities program provides capital assistance for new and replacement buses, related equipment, and facilities. Eligible capital projects include the purchasing of buses for fleet and service expansion, bus maintenance and administrative facilities, transfer facilities, bus malls, transportation centers, intermodal terminals, Park & Ride stations, acquisition of replacement vehicles, bus rebuilds, bus preventive maintenance, passenger amenities such as passenger shelters and bus stop signs, accessory and miscellaneous equipment such as mobile radio units, supervisory vehicles, fare boxes, computers, and shop and garage equipment.

These funds are generally earmarked by congress and could be used for capital expenditures related to the development of a transit center. This would include vehicle acquisition, station development, traffic signal priority and other technology infrastructure, and Park & Ride facilities. In FY 2012, Lawrence received more than $1.8 million[5]. Applications for this program would be sent from Lawrence Transit or the city of Lawrence to the Lawrence-Douglas County MPO.

Federal Transit Administration Section 5307 Urban Area Formula Grants

This program provides funding to urban areas for transit capital, job access and reverse commute projects, transportation-related planning, and operating expenses in some cases.

---

[4] Federal Highway Administration. Revised Apportionment of Federal-aid Highway Program Funds for FY 2013. <http://www.fhwa.dot.gov/legsregs/directives/notices/n4510765/n4510765_t1.cfm>

[5] Federal Transit Administration. FY 2012 Funding by State. http://www.fta.dot.gov/grants/12853.html

Funds from this source could be used for such capital expenditures as vehicle acquisition, station development, traffic signal priority, other technology infrastructure, and Park & Ride facilities. Federal shares cover 80 percent for capital assistance and 50 percent for operating assistance[6].

Allocation of Section 5307 funds depends on an urban area's size. Funding for urban areas of 50,000 to 199,999 in population is based on population, population density, and number of low-income individuals; whereas, areas over 200,000 in population receive funds based on the level of public transportation service provision in addition to population levels.

Federal Transit Administration Section 5339 Bus and Bus Facilities Program

The Bus and Bus Facilities program provides capital assistance for new and replacement buses, related equipment, and facilities. Eligible capital projects include the purchasing of buses for fleet and service expansion, bus maintenance and administrative facilities, transfer facilities, bus malls, transportation centers, intermodal terminals, Park & Ride stations, acquisition of replacement vehicles, bus rebuilds, bus preventive maintenance, passenger amenities such as passenger shelters and bus stop signs, accessory and miscellaneous equipment such as mobile radio units, supervisory vehicles, fare boxes, computers, and shop and garage equipment. FY 2014 has authorized funding for $428 million. Annually, $65.5 million is to be allocated, where a minimum of $1.25 million is available for each state. Remaining funds are distributed by a formula based on population, vehicle revenue miles, and passenger miles[7].

Applications for this program should be sent from Lawrence Transit directly to the Federal Transit Administration (FTA) and would require a 20 percent local match.

Surface Transportation Program (STP)

The Federal Highway Administration (FHWA) allocates STP funds to be used toward various types of multimodal and roadway projects on federal-aid highways. These funds can be used for transit capital costs, Intelligent Transportation Systems (ITS) capital improvements, bicycle/pedestrian infrastructure, car and vanpool projects, fringe and corridor parking facilities, and intercity/intracity bus terminals and facilities. After deductions for Transportation Alternatives (TA) and State Planning and Research (SPR), the FHWA sub-allocates 50 percent of the state's remaining funds to areas based on their share of the state's population. The remaining 50 percent is allocated to any area of the state. Transit typically competes with other road and bridge projects for these funds.

Approximately $1.6 million is expected in 2014 for the city of Lawrence. Lawrence receive funds from the Kansas Department of Transportation (KDOT).

State Funding Sources

T-WORKS Program

The Kansas Urban Public Transit component of the state's transportation program, T-WORKS [Transportation Works for Kansas] provides annual funding for transit operators. These funds can be used for capital and/or operations costs related to the creation of a new transit center,

[6] Federal Transit Administration. MAP-21: Urbanized Area Formula Grants. <http://www.fta.dot.gov/documents/MAP-21_Fact_Sheet_-_Urbanized_Area_Formula_Grants.pdf>
[7] Federal Transit Administration. MAP-21 Transit Programs Summary. http://www.fta.dot.gov/documents/MAP21_essay_style_summary_v5_MASTER.pdf

and they would be applicable as match to any federal capital funding awarded to the project. T-WORKS allocates $2.2 million to Lawrence Transit over the length of the ten-year program.

Local Funding Sources

Numerous sources of local funding could be used for generation capital construction costs and/or operational funding for a transit center. These include sales taxes, property taxes, general fund transfers, or special taxing districts. There may be opportunities to coordinate funding between city sources and university-associated sources. In the past, sales and property tax increases were determined by Lawrence voters. KU student fees are determined by the KU Student Senate.

Sales Tax

Currently, the local funding for the city transit system in Lawrence comes from a quarter-cent sales tax. In 2012, the quarter-cent sales tax brought in $3.7 million[8]. The current total sales tax rate is 8.85 percent, which includes the state portion of 6.3 percent, a 1 percent county portion, and a 1.55 percent city portion.

Property Tax

Construction of the transit center could be funded through a property tax mill levy increase One mill is equivalent to one dollar for every thousand dollars assessed property value.. An increase of 1 mill will provide $800,000 more in revenue for the city[9]. The current mill levy is at 124.808 – 29.534 City, 35.769 Douglas County, 1.500 State, 58.005 USD #497.

Student Fees

KU students pay a $73.50 semester fee to support the KUOW portion of the coordinated KU – city transit system in Lawrence. In addition, transfers from KU parking permit fees also supplement KUOW funding.

Transportation Development Districts (TDD)

A Transportation Development District (TDD) is a special taxing district whereby a petitioner of 100 percent of the landowners in an area request either the levy of special assessments or the imposition of a sales tax of up to 1 percent on goods and services sold within a given area. Upon creation of a TDD by a municipality, the revenue generated by TDD special assessments or sales tax under Kansas law may pay the costs of transportation infrastructure improvements in and around the new development.

A TDD could be established around a transit center to generate funding for the capital construction costs. Funds generated from the TDD would be applicable as match to any federal capital funding awarded to the project.

Community Improvement District

A Community Improvement District (CID) enables financing of certain projects through special assessments or a sales tax. Eligible projects include the acquisition, construction, and

[8] http://www.lawrenceks.org/finance/system/files/2012+Sales+Tax+Distribution+December.pdf

[9] http://www.lawrenceks.org/budget_files/2012/2012_recommended_budget.pdf

refurbishing and equipping of transportation facilities, streetscaping, and landscaping. Projects can be funded with general or special obligation bonds or on a pay-as-you-go basis.

Tax Increment Financing (TIF) District

In Kansas, Tax Increment Financing (TIF) can use city sales taxes, city franchise fees, and increased property taxes that have been generated by a real estate development within a TIF district to pay for certain eligible costs associated with that development. Eligible project costs that may be subsidized in TIF districts include land acquisition, demolition, public and site improvements, and certain consulting and administrative costs. Sales Tax Revenue bonds, commonly known as STAR bonds, may also be issued prior to the redevelopment of a TIF district if financing assistance is required before construction begins. The bonds would then be paid off with the additional revenue generated by that district.

In-Kind Match

Local entities, jurisdictions, or business can provide in-kind matches (commonly in the form of real estate, buildings, equipment, or volunteer time) that would count toward the local share for the purposing of matching federal grants. The in-kind contributions would be valued at fair market value. The in-kind contribution cannot have been paid by another federal grant and cannot have been included as an in-kind match toward another federal grant. To count as an in-kind match, property ownership may be required to be legally transferred or a long-term lease signed for the length of the federal share of the property. Federal regulation 49 C.F.R. § 18.24 provides more information on in-kind matches.

Funding Summary

New transit centers can be funded a myriad of ways. Generally, pursuing a FTA Section 5339 grant would be a primary source to investigate federal participation. This grant would be submitted by Lawrence Transit. Capital projects are generally eligible for an up to 80 percent federal share. FTA Section 5307 may also be used for this project, but this funding is also used toward bus replacement and maintenance and so may be less suitable for this type of capital cost. The local match for the federal share may be partially achieved from T-WORKS, the state transportation program. Local funds would likely be generated through revenues from the existing sales tax and passenger fares. The property that the transit center is located on could count as a local source of match. There may be some stipulations involved; the property would either have to be turned over to the city to count as a local match or have a signed lease that lasts through the lifetime of the federal share of the transit center. In addition, the property in question could not have been used to pay for another federal grant and cannot have been included as an in-kind match toward another federal grant. The appraised value of 2021 Stewart Avenue is $651,000.

Chapter 6 Conclusion

This study was initiated to determine a candidate site, and conceptual costs, for a new transit center which would also serve as the major transfer hub for the city transit routes. The new location would replace the existing downtown transit center as the system hub, as the downtown transit center has been challenged with the small geographic area of downtown, continued developmental pressure, and impacts on businesses. This study first used a GIS process and various socio-economic and transit-related geographic parameters, to identify a general geographical area to focus the study's attention. Multiple sites within this geographical area were further examined for suitability as a transit center, based off of their general development constraints, impact on the transit route structure, and opportunities for synergy with existing or potential land use and ridership patterns. After an evaluation and continued discussion with the study team and presentation to the City Commission, the project focused on evaluating two separate sites of 925 Iowa, and 2021 Stewart Avenue.

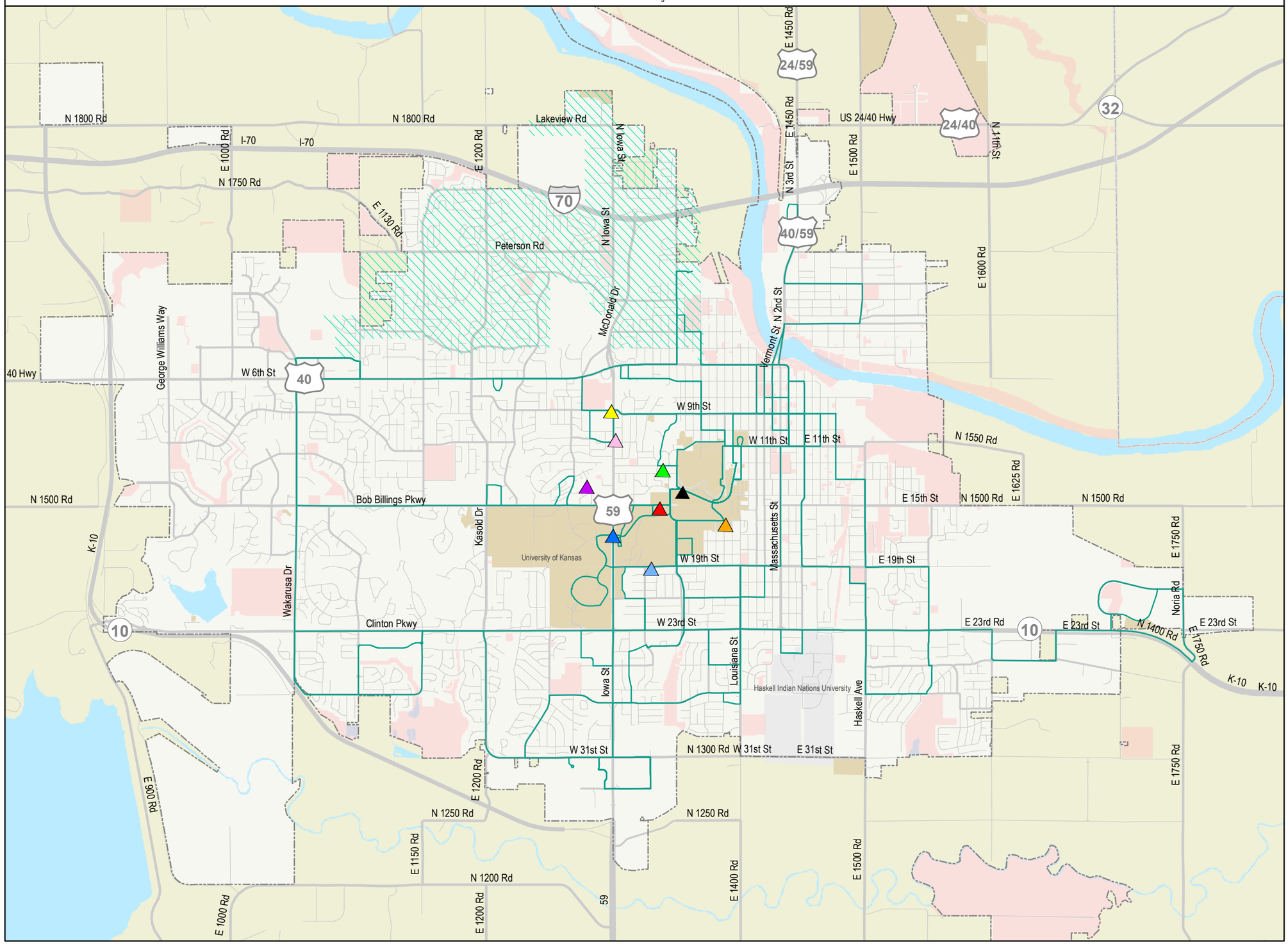
Due to its location further away from the existing downtown location, re-networking costs were higher for 2021 Stewart Avenue. To maintain current route frequency the City would have to buy two additional vehicles to serve 2021 Stewart Avenue, or one additional vehicle to serve 925 Iowa.

The sub-total site costs were higher for 925 Iowa, primarily due to reconfiguring the adjacent parking lot, and repaving 9th Street between Iowa Street and Rockledge Road to handle additional wear and tear from buses. Once the additional required vehicles are taken into account, the total capital costs were $460,000 higher than those for the 2021 Stewart Avenue site. Conversely, the annual operating cost for the Stewart Avenue site is approximately $122,000 more than the 925 Iowa site, again, primarily due to route re-networking.

An important caveat is the fact that land acquisition costs are not included in these cost summaries. The site at 925 Iowa is actually a collection of multiple parcels owned by multiple legal entities, and complicated by the fact that parking spaces in a parcel may be legally allocated as the parking for another parcel. This will likely complicate the acquisition process. 2012 Stewart Avenue and the two parcels to the north, by contrast, are owned by KU Endowment.

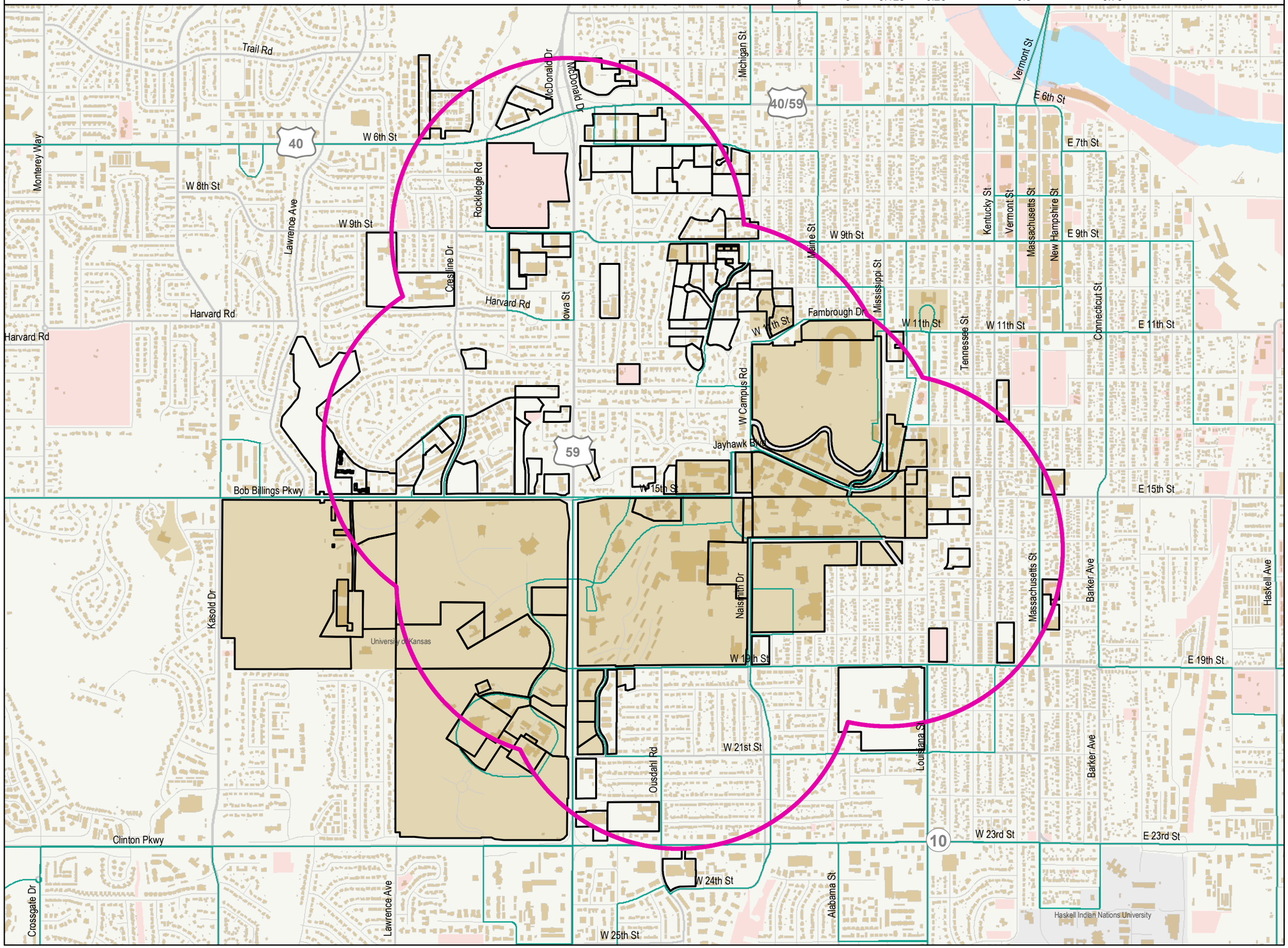
Appendix A - GIS Analysis Maps

Study of central locations in Lawrence, Kansas



- Mean Center of Urban Growth Area
- Mean Center of Lawrence destinations
- Mean Center of street intersections
- Center of the minimum boundary of existing City routes including flex zone
- Center of the minimum boundary of existing KU routes
- Mean center of Lawrence employers weighted by number employed
- Center of Lawrence city limits including islands
- Mean center of Lawrence block groups with low to moderate income over 50% weighted by population
- Mean center of Lawrence census block groups weighted by population
- Existing 2012-2013 transit routes
- Flex zone 2012-2013
- Parcels owned by KU or KU Endowment
- Parcels owned by City of Lawrence
- Universities

Candidate parcels Round 1: Lawrence, Kansas



Buildings

1/2 mile centers buffer

Candidate parcels^

Existing 2012-2013 transit routes

Parcels owned by KU or KU Endowment

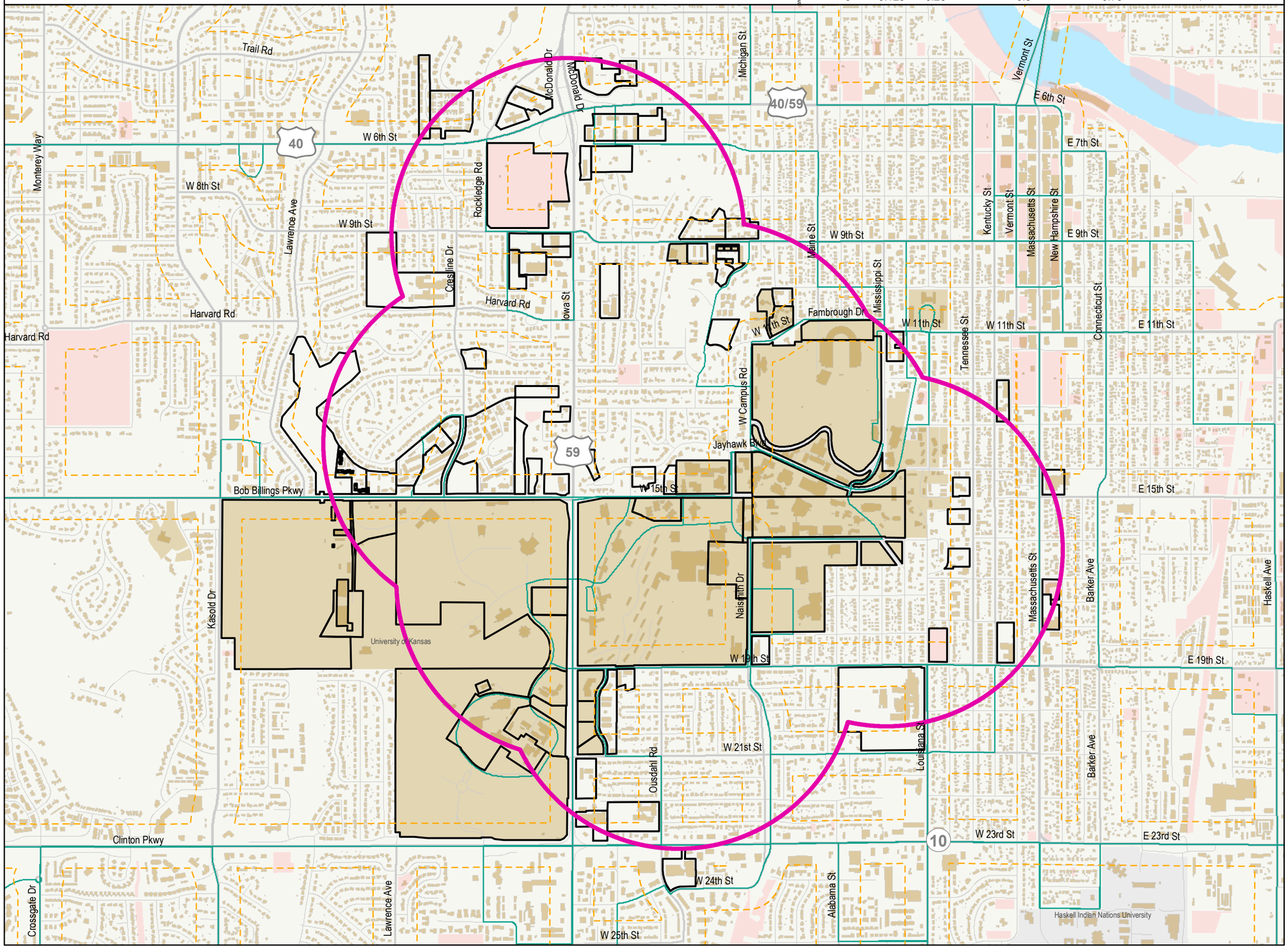
Parcels owned by City of Lawrence

Universities

^ Parameters:
- Intersecting 1/2 mile centers buffer
- Area is greater than or equal to 1.5 acres

116 parcels

Candidate parcels Round 2: Lawrence, Kansas



Buildings

1/2 mile centers buffer

Candidate parcels^

330' collector and above buffer

Existing 2012-2013 transit routes

Parcels owned by KU or KU Endowment

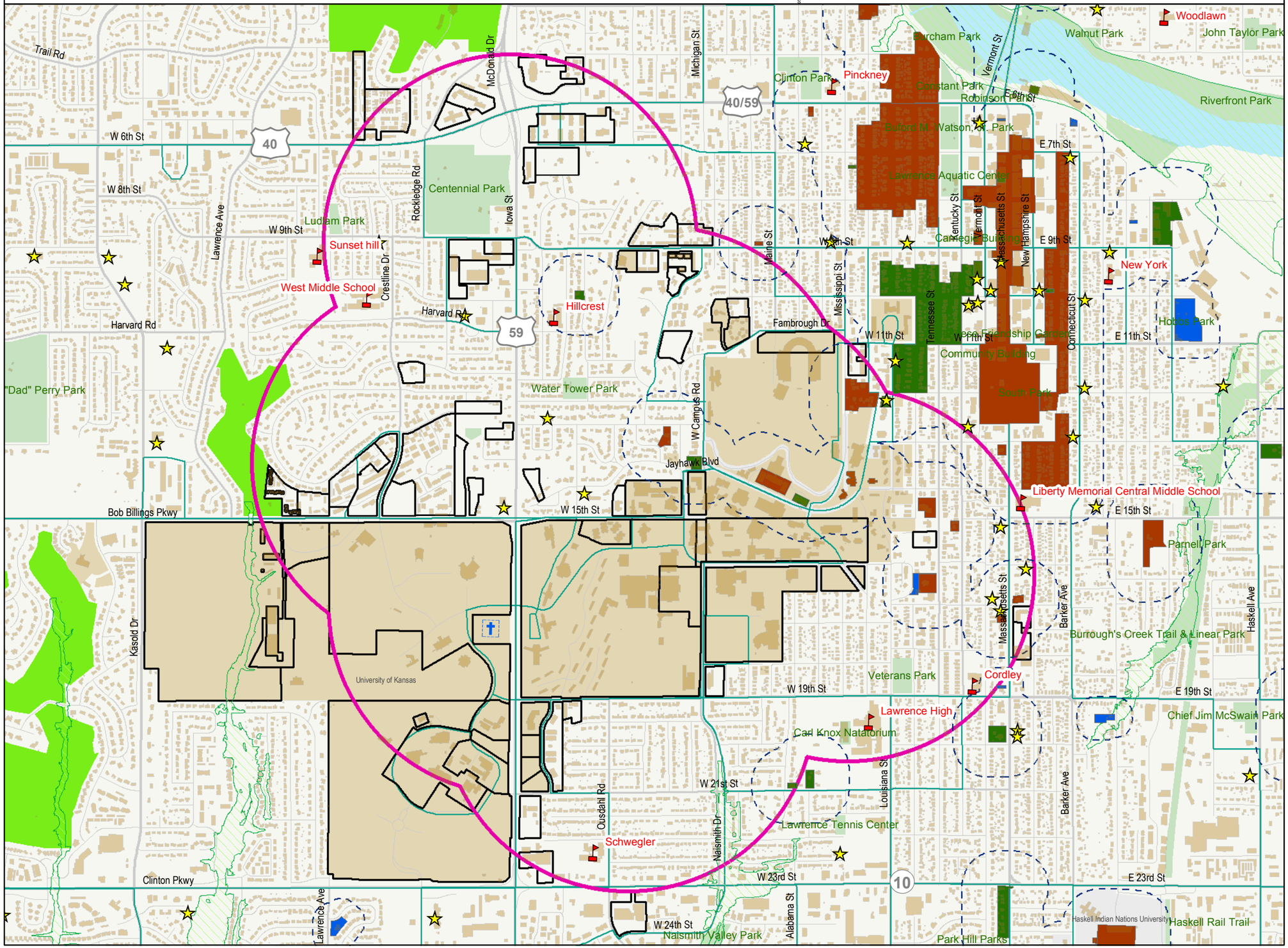
Parcels owned by City of Lawrence

Universities

^ Parameters:
- Intersecting 1/2 mile centers buffer
- Area is greater than or equal to 1.5 acres
- Within 330' of road class "collector" or greater

84 parcels

Candidate parcels Round 3: Lawrence, Kansas

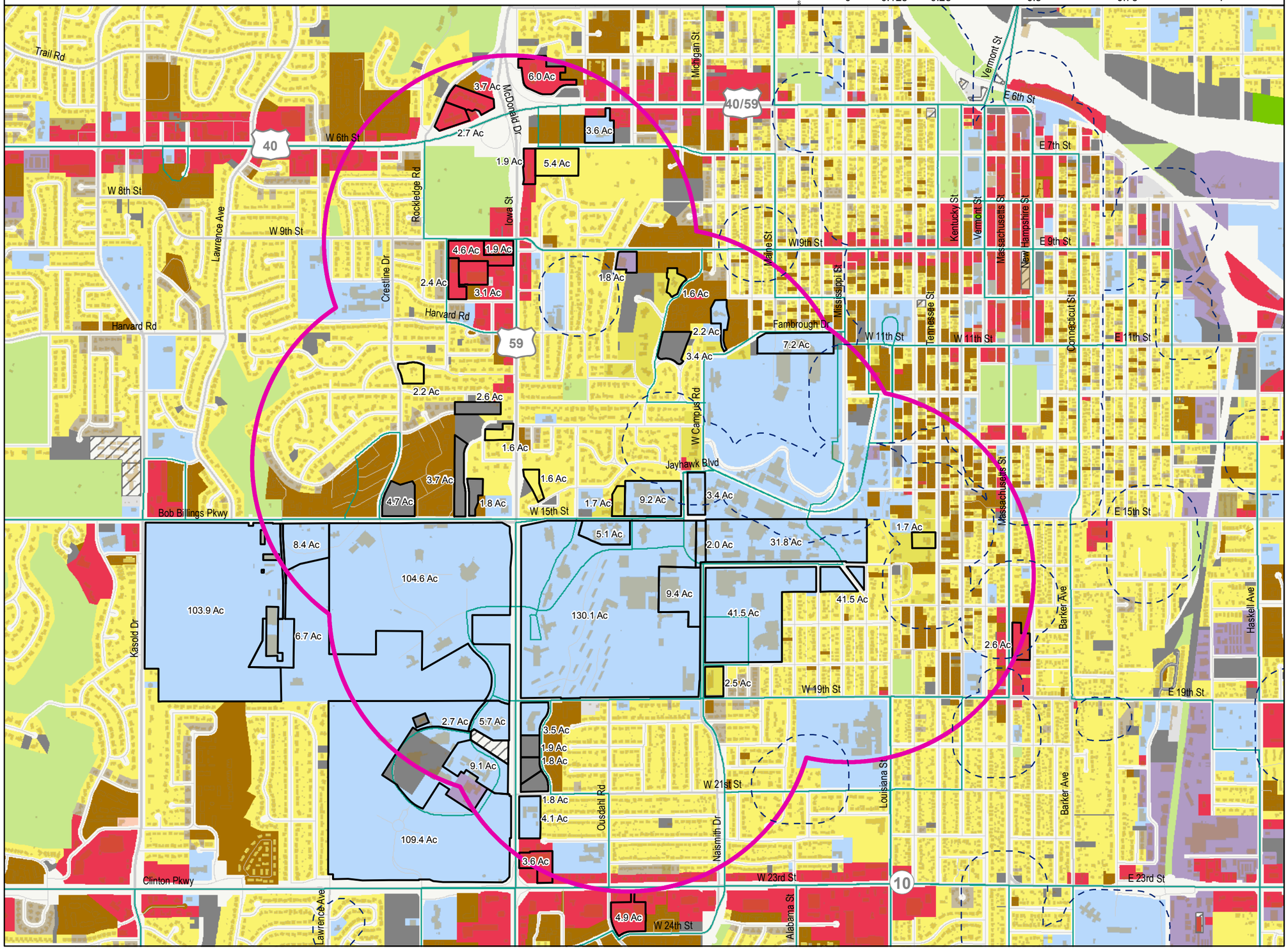


- Cemetery
- Lawrence Churches
- Lawrence Public Schools
- Buildings
- 1/2 mile centers buffer
- Parcel Candidates^
- Historic Buffers
- Historic State Properties
- Historic National Properties
- Historic Local Properties
- 100 Year Flood Plain
- Existing 2012-2013 transit routes
- Parcels owned by KU or KU Endowment
- City Park
- Golf Courses
- Universities

^ Parameters:
- Intersecting 1/2 mile centers buffer
- Area is greater than or equal to 1.5 acres
- Within 330' of road class "collector" or greater
- Not a Park, Golf Course, USD 497 School, Church, Cemetery or Historic Property
- Property has at least 1.5 acres of land outside of the 100 year flood plain.

68 parcels

Candidate parcels Round 4: Lawrence, Kansas



- Buildings
- 1/2 mile centers buffer
- Parcel Candidates^
- Historic Buffers
- Existing 2012-2013 transit routes

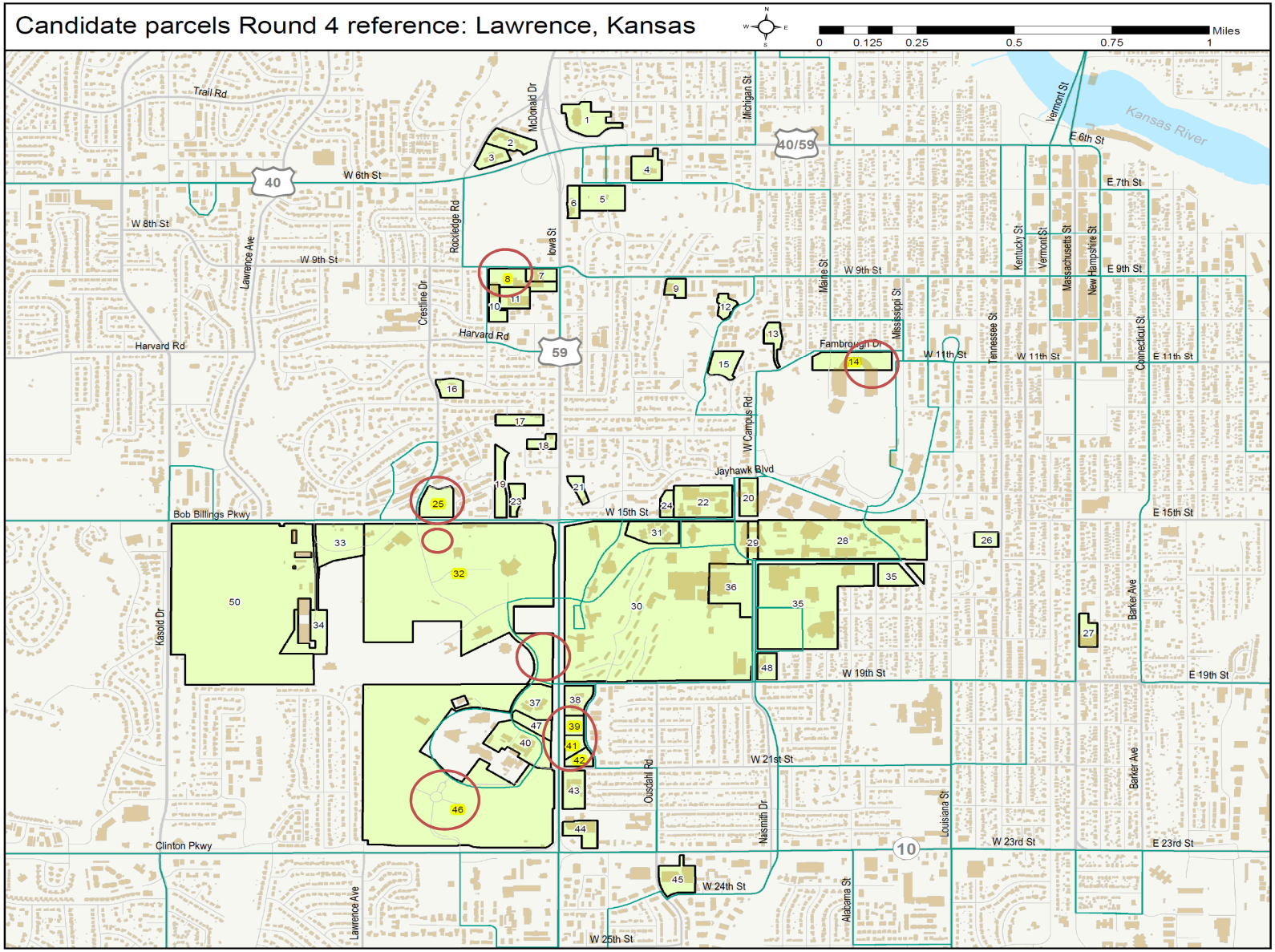
Land Use April 2012

- No Value
- Single Family Residential
- Boarding House
- Duplex
- Triplex
- Multiple Family Residential
- Mixed Use
- Commercial
- Industrial
- Institutional
- Parks/Open Space
- Utility
- Agricultural
- Vacant

^ Parameters:
- Intersecting 1/2 mile centers buffer
- Area is greater than or equal to 1.5 acres
- Within 330' of road class "collector" or greater
- Not a Park, Golf Course, USD 497 School, Church, Cemetery or Historic Property
- Property has at least 1.5 acres of land outside of the 100 year flood plain.
- Not a Multiple Family Residential landuse (based on 2012 County Appraiser data)

49 parcels

Candidate parcels Round 4 reference: Lawrence, Kansas



Buildings

Existing 2012-2013 transit routes

Parcel Candidates (R4)

Map #	Address	Acres
1	2000 BLUFFS DR	6.0
2	2222 W 6TH ST	3.7
3	2300 W 6TH ST	2.7
4	1803 W 6TH ST	3.6
5	711 SUNSET DR	5.4
6	730 IOWA ST	1.9
7	901 IOWA ST	1.9
8	925 IOWA ST	4.6
9	1621 W 9TH ST	1.8
10	2330 YALE RD	2.4
11	933 IOWA ST	3.1
12	1001 EMERY RD	1.6
13	1120 W 11TH ST	2.2
14	1101 MISSISSIPPI ST	7.2
15	0 EMERY RD	3.4
16	2425 ORCHARD LN	2.2
17		2.6
18	1301 IOWA ST	1.6
19	0 BOB BILLINGS PKWY	3.7
20	1417 CRESCENT RD	3.4
21	3 WESTWOOD RD	1.6
22	1500 W 15TH ST	9.2
23	0 BOB BILLINGS PKWY	1.8
24	1602 W 15TH ST	1.7
25	0 WINDSOR PL	4.7
26	1439 TENNESSEE ST	1.7
27	1740 MASSACHUSETTS ST	2.6
28	0 JAYHAWK BLVD	31.8
29	1500 NAISMITH DR	2.0
30	1506 ENGEL RD	130.1
31	1603 W 15TH ST	5.1
32	2201 BOB BILLINGS PKWY	104.6
33	2445 BOB BILLINGS PKWY	8.4
34	3101 BOB BILLINGS PKWY	6.7
35	901 SUNNYSIDE AVE	41.5
36	1601 NAISMITH DR	9.4
37	1920 CONSTANT AVE	5.7
38	1911 STEWART AVE	3.5
39	1941 STEWART AVE	1.9
40	2065 CONSTANT AVE	9.1
41	2005 STEWART AVE	1.8
42	2021 STEWART AVE	1.8
43	2100 IOWA ST	4.1
44	1900 W 23RD ST	3.6
45	1601 W 23RD ST	4.9
46	2029 BECKER DR	109.4
47	2000 CONSTANT AVE	2.7
48	1800 NAISMITH DR	2.5
50	0 BOB BILLINGS PKWY	103.9

Appendix B – GIS Process and Initial Candidate Site Discussion Memo

MEMO

	Overnight
	Regular Mail
	Hand Delivery
X	Email

TO:	Bob Nugent, Lawrence Transit
FROM:	Tom Worker-Braddock, Olsson Associates
RE:	Lawrence Transit Center Locational Analysis - GIS Process and Initial Candidate Site Discussion
DATE:	June 11th, 2013
PROJECT #:	013-0542
PHASE:	2

This memo is to summarize the process that identified a preliminary list of potential sites for new transit center. The selection process is generally summarized as using GIS software to identify various central locations, performing a series of GIS queries to identify sites with characteristics suitable for a transit center, a field trip to visit sites, and then an evaluation of the sites against criteria previously identified by the study team.

GIS Methodology

The consultant and city's GIS Coordinator met in late March to discuss the general availability of data, and approach to apply GIS queries in identifying candidate location for a possible transit center. Minutes from the March 22nd, 2013 meet are included in the appendix.

Site Size

Through discussions with the Lawrence Transit Administrator, it was determined that a new transit center would be required to accommodate three, 40 foot city buses, five 30 foot city buses, and provide street side accommodations for two, 40 foot KU buses. In addition, the study team at the April 11th Project Kick-Off meeting indicated a desire for the site to accommodate a driver/supervisor break room and restroom. It was determined that 1.5 acres at a minimum would be required to accommodate this facility.

Centers Map

Lawrence's GIS Coordinator created a map with various geographic centers identified. These centers included:

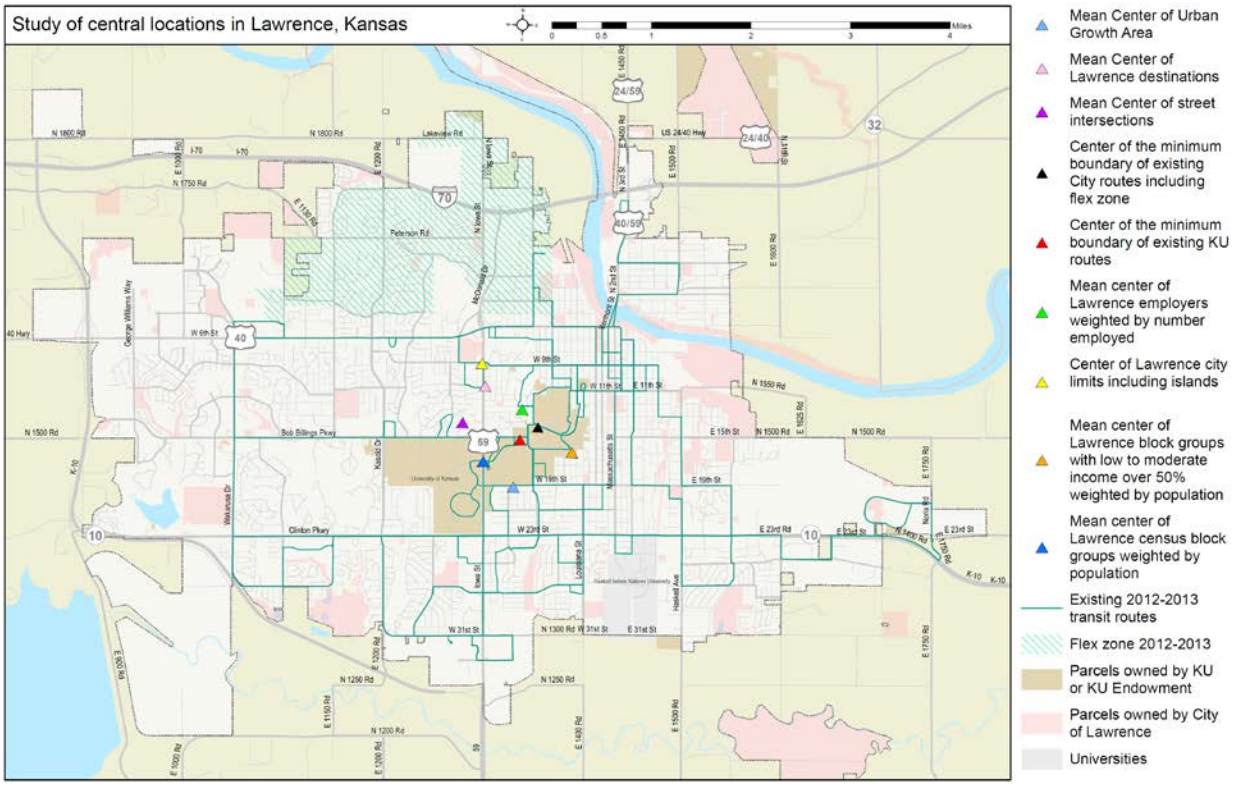
- Mean Center of Urban Growth Area

7301 West 133rd Street, Suite 200 **TEL** 913.381.1170
Overland Park, KS 66213-4750 **FAX** 913.381.1174 www.olssonassociates.com

- Mean Center of Lawrence destinations (grocers, medical facilities, employment assistance, social service agencies, middle or high schools)
- Mean Center of street intersections
- Center of the minimum boundary of existing City routes including flex zone
- Center of the minimum boundary of existing KU routes
- Mean center of Lawrence employers weighted by number employed
- Center of Lawrence city limits including islands
- Mean center of Lawrence block groups with low to moderate income over 50% weighted by population
- Mean center of Lawrence census block groups weighted by population

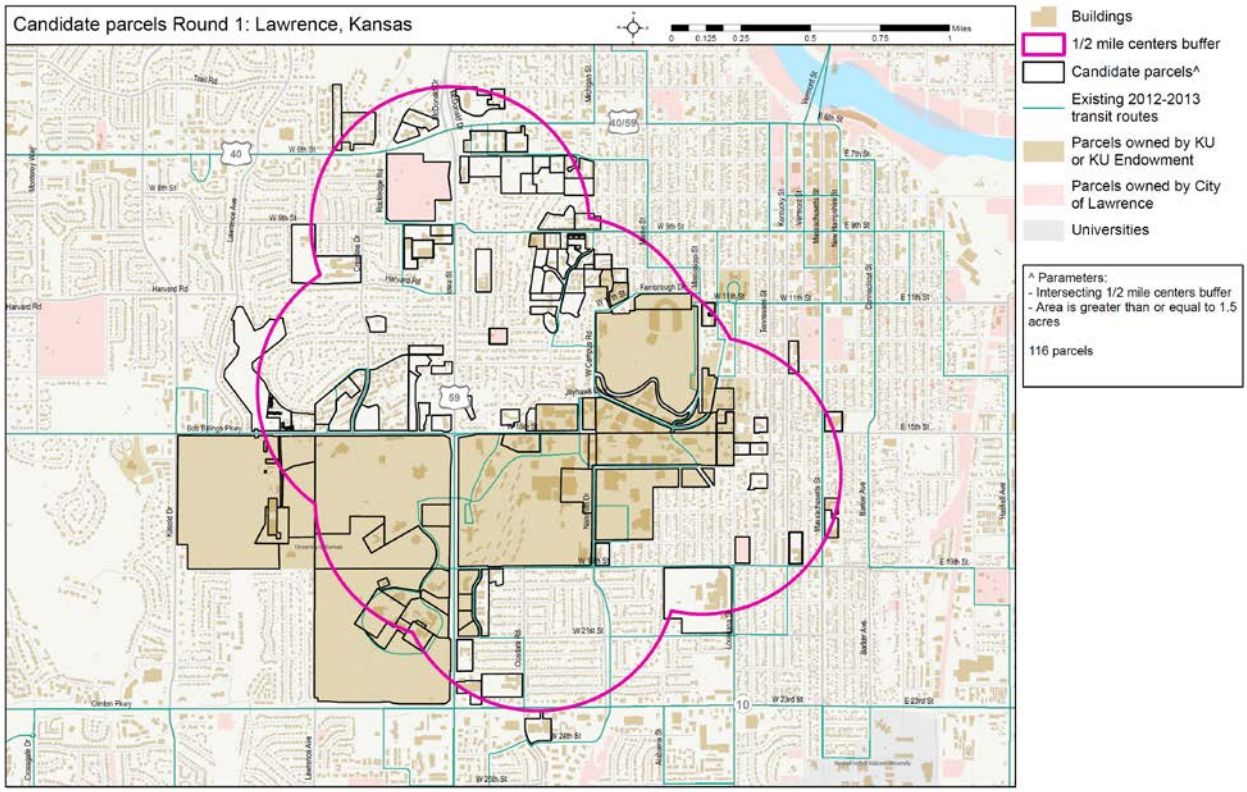
Figure 1 displays this map. The various centers are clustered around the 15th and Iowa area. Full size versions of maps discussed in this document are included in the appendix.

Figure 1: Mean Center Map



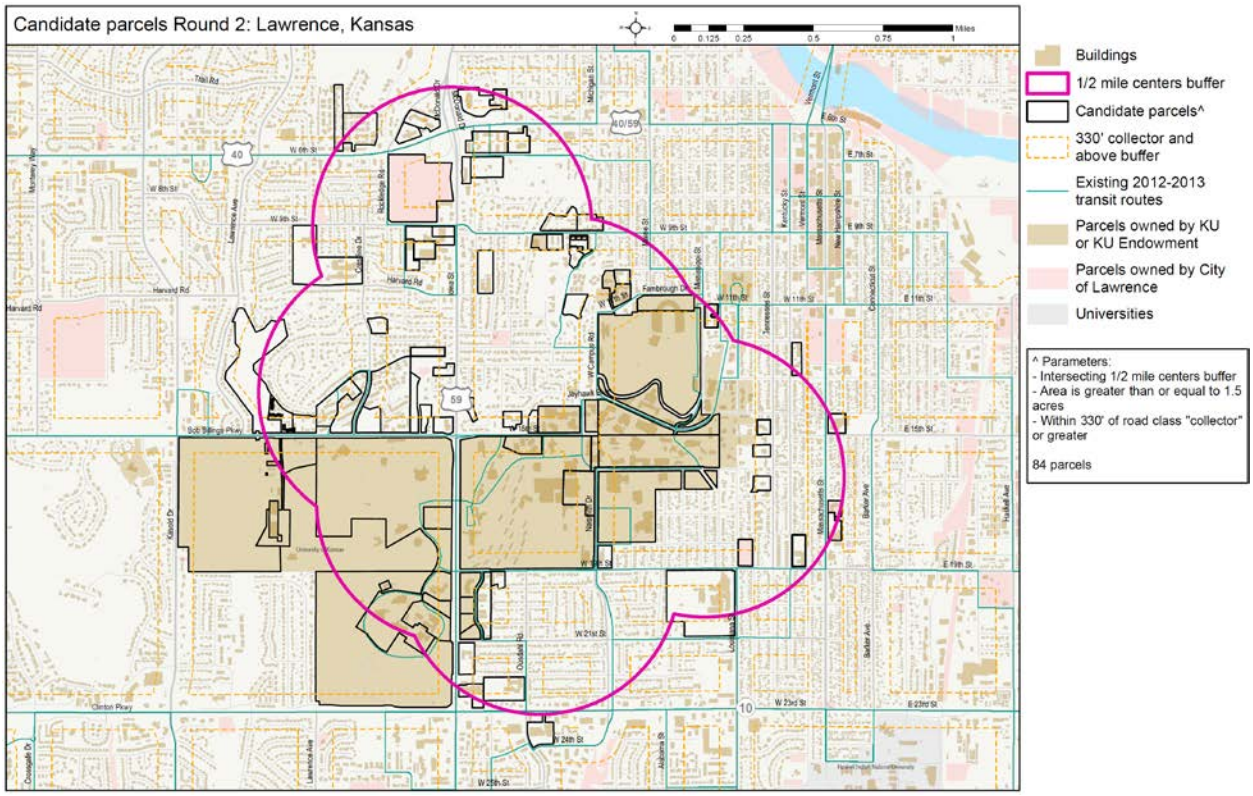
Next, a half mile buffer was created around these centers, and parcels equal to or greater than 1.5 acres were identified. This resulted in 116 parcels, displayed in Figure 2.

Figure 2: Candidate parcels Round 1 – Parcels above 1.5 acres



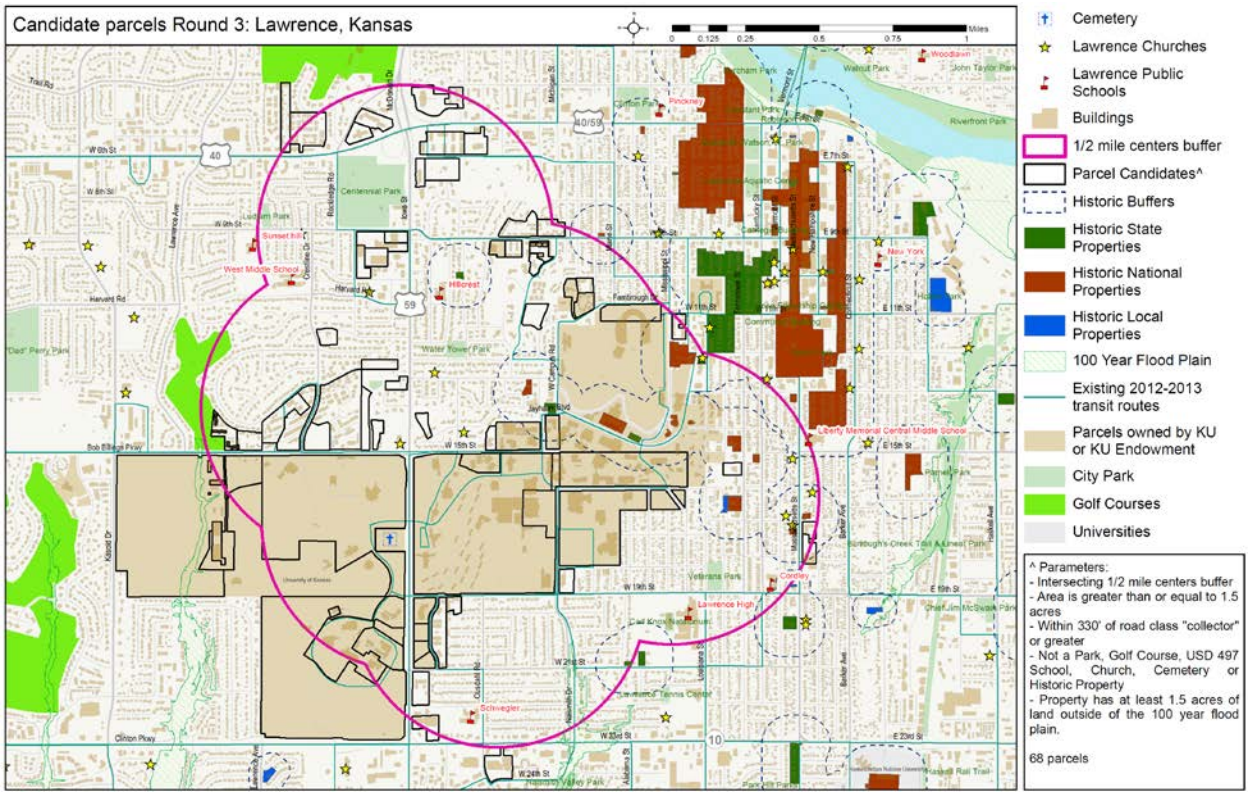
Round 2 of the GIS process selected of those 116 parcels, only those parcels that were within 330 feet (half a block) of road classified as collector or higher. This would limit transit vehicles from traveling on local streets or deep into residential neighborhoods. This resulted in 86 parcels, and is displayed in Figure 3

Figure 3: Round 2 – Within 330 feet of collector street or above



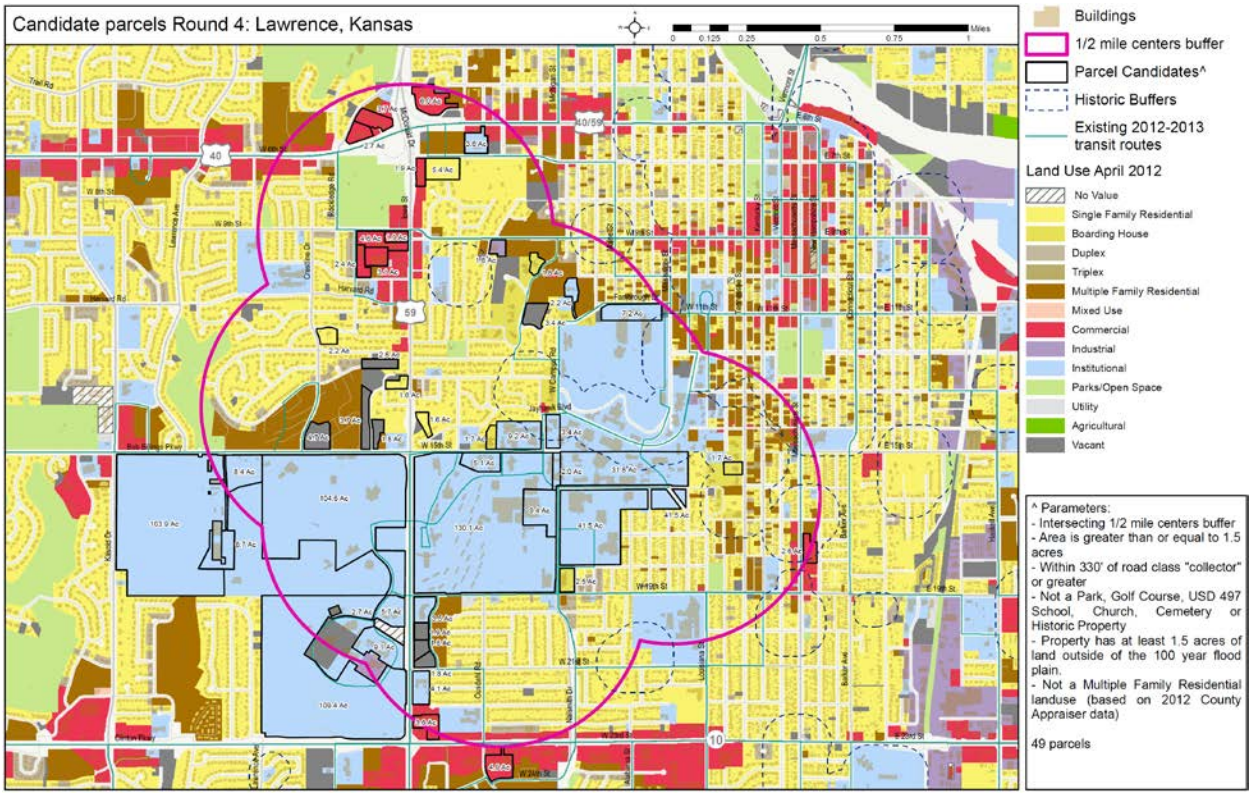
Round 3 excluded properties that were a sensitive land use, including parks, golf courses, school district property, churches, cemeteries, or historic properties. In addition an historic environs buffer of 200 to 500 feet was placed around historic properties or landmarks. Lawrence's Historic Resources Commission typically has to review development within this buffer. Finally, sites that did not have more than 1.5 acres beyond the 100 year flood plain were also excluded. 68 parcels remained after these exclusions, and are displayed in Figure 4.

Figure 4: Round 3 – Not a sensitive land use.



The fourth selected from the remaining parcels that were not multi-family housing. 49 parcels remained and are displayed in Figure 5, along with Lawrence's existing land use.

Figure 5: Round 4 – Not multi-family



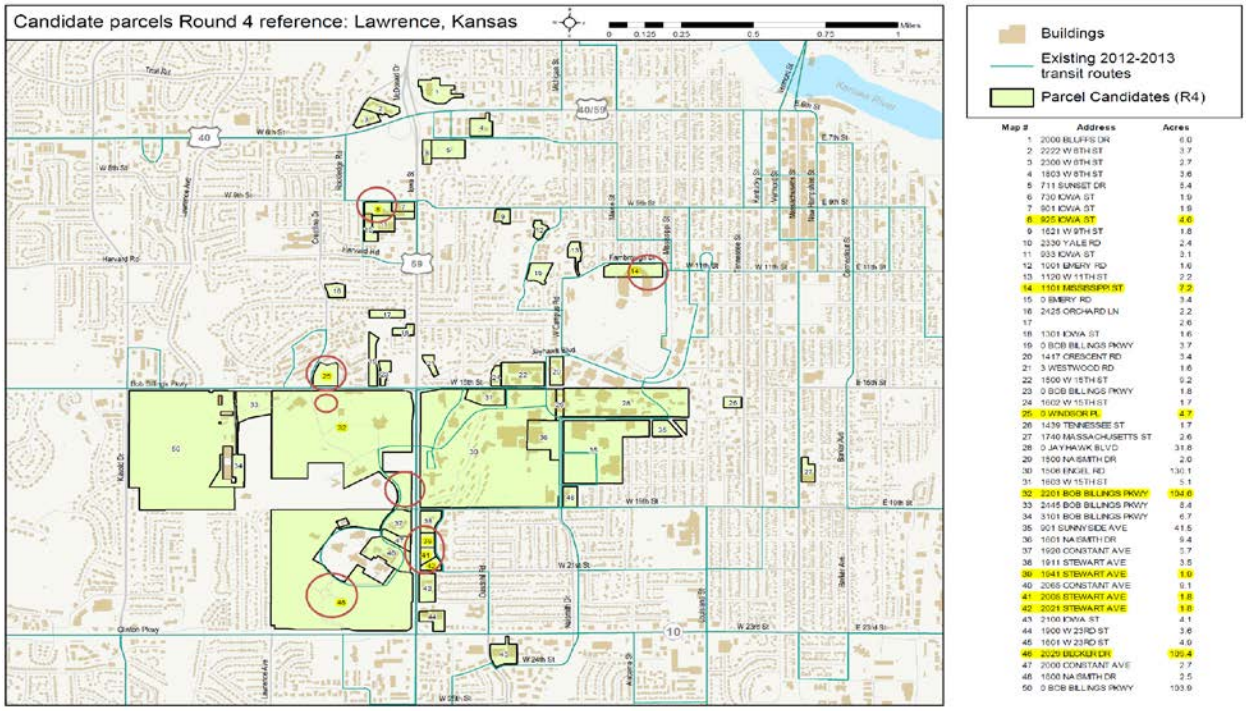
Initial Candidate Site Discussion

Of the remaining parcels, a more subjective selection process selected seven sites for further, review. This selection was based on their existing land use (many of the parcels were vacant), ease of vehicle access to major travel corridors, and potential for redevelopment. Sites selected were:

- 2029 Beck Drive (KU Park and Ride)
- 2021 Stewart Avenue
- NW Corner of 19th and Iowa
- NE Corner of Crestline Drive and Bob Billings Parkway
- SE Corner of Crestline Drive and Bob Billings Parkway
- 925 Iowa Street (SE corner of 9th Street and Centennial Drive)
- 1101 Mississippi (northwest of Memorial Stadium)

The sites are displayed in Figure 6.

Figure 6: Initial candidate site location

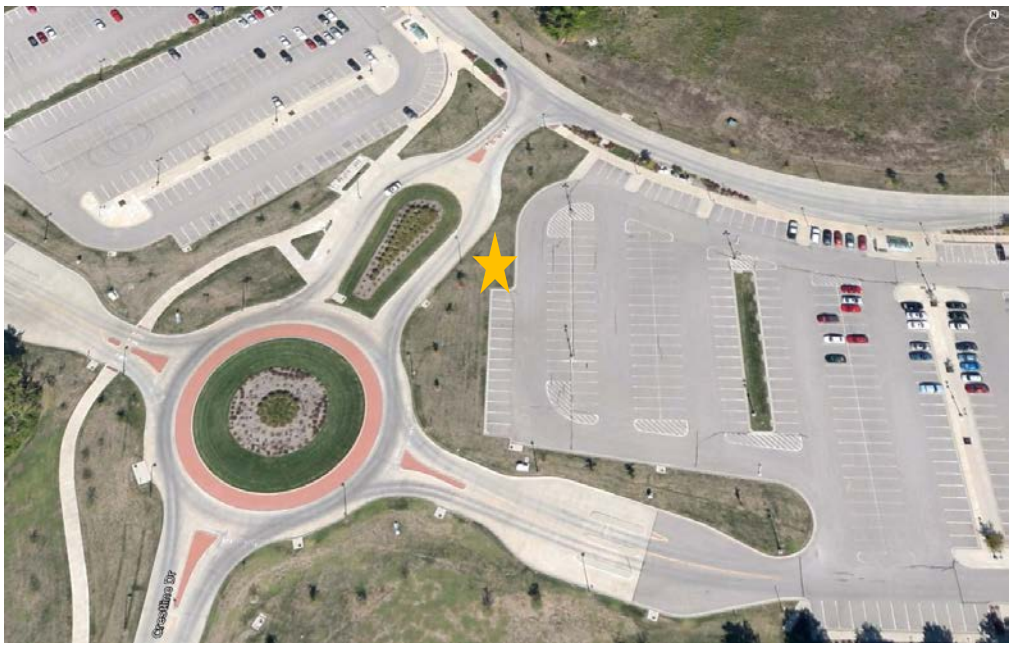


These sites were visited by the study team. The details and study team comments of each site are summarized as follows.

2029 Becker Drive (KU Park and Ride)
Current Land Use: Institutional
Future Land Use: Public / Semi-Public
Parcel Size: 109.4 Acres
Total Appraised Value: $2,468,030 (entire parcel)
Notes: Site is part of larger parcel.
Study Team Comments: • Crestline Drive becoming a main entrance to KU. • High synergy potential to serve both KU needs and City needs. • The existing horse-shoe median north of the round-about on Crestline Drive was originally designed to accommodate additional buses. • Existing traffic would make horse-shoe median unsuitable for a transit center. • A likely location for a new transit center would be in the parking lot east of the horse-shoe median. • Accessing this site will likely require intensive transit network restructuring.

Sources: City of Lawrence GIS Department, Horizon 2020. Douglas County Appraiser.

Figure 7: 2029 Becker Drive

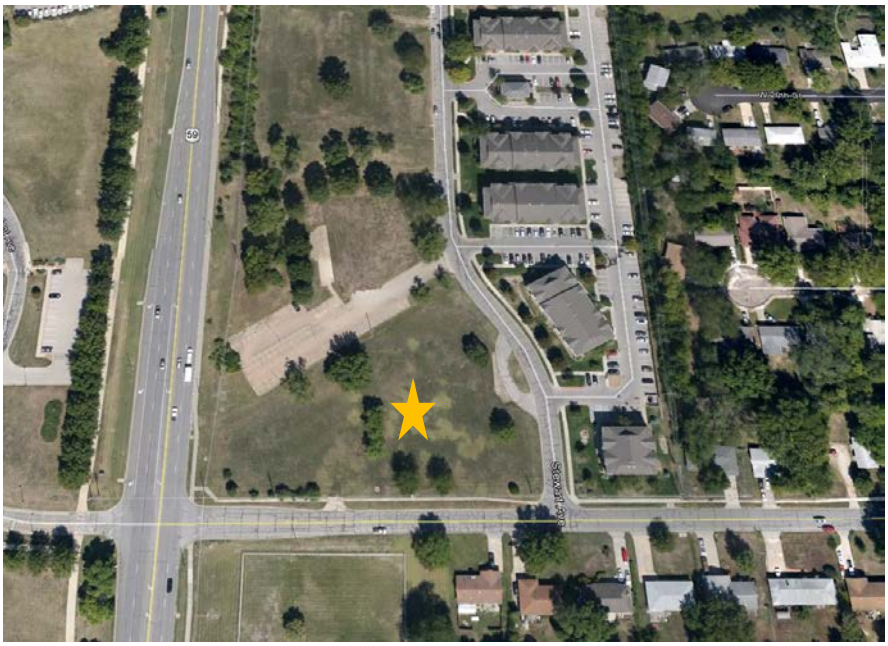


Source: Google Earth
Note: Site location is generalized

2021 Stewart Avenue
Current Land Use: Vacant
Future Land Use: Medium / High Density Residential
Parcel Size: 1.8 Acres
Total Appraised Value: $651,060
Study Team Comments: • Southern-most parcel of these three vacant parcels would be best. • Transit center at this location could be seen as duplicative of nearby KU Park & Ride. • An additional stop light would be required at 21st Street and Iowa. Questions about queuing on 19th Street to Iowa affecting access from Stuart Avenue to 19th Street. • Surrounding residential is multi-family, or likely renters in single-family houses.

Sources: City of Lawrence GIS Department, Horizon 2020. Douglas County Appraiser.

Figure 8: 2021 Stewart Avenue

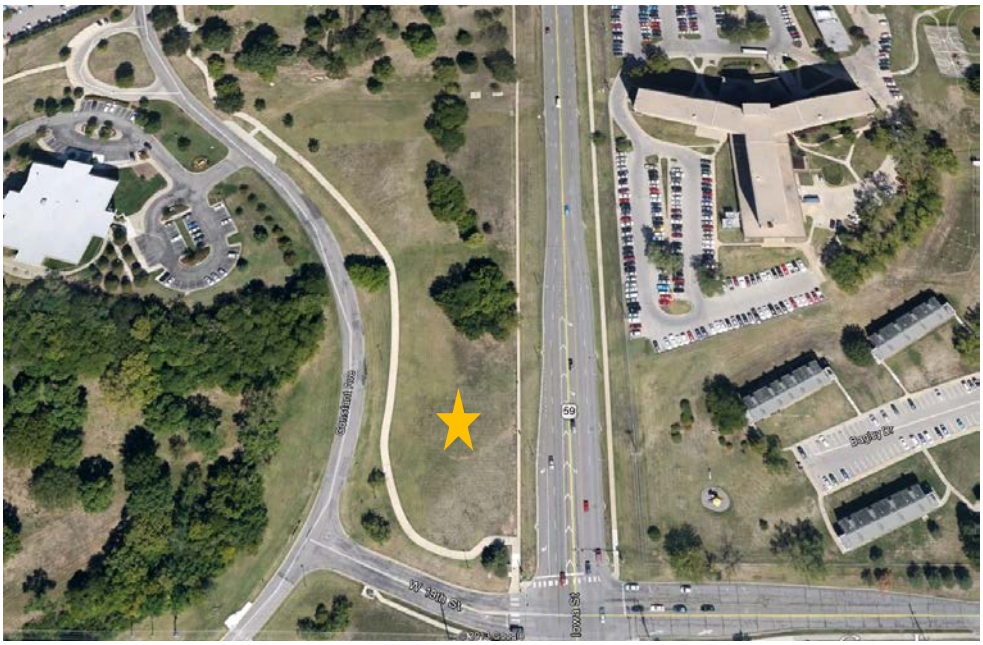


Source: Google Earth
Note: Site location is generalized

NW Corner of 19th and Iowa
Current Land Use: Institutional
Future Land Use: Public / Semi-Public
Parcel Size: 104.6 Acres
Total Appraised Value: $7,748,860
Notes: Site is part of larger parcel.
Study Team Comments: • KU master plan has this location designated a major gateway to KU.

Sources: City of Lawrence GIS Department, Horizon 2020. Douglas County Appraiser.

Figure 9: NW Corner of 19th and Iowa

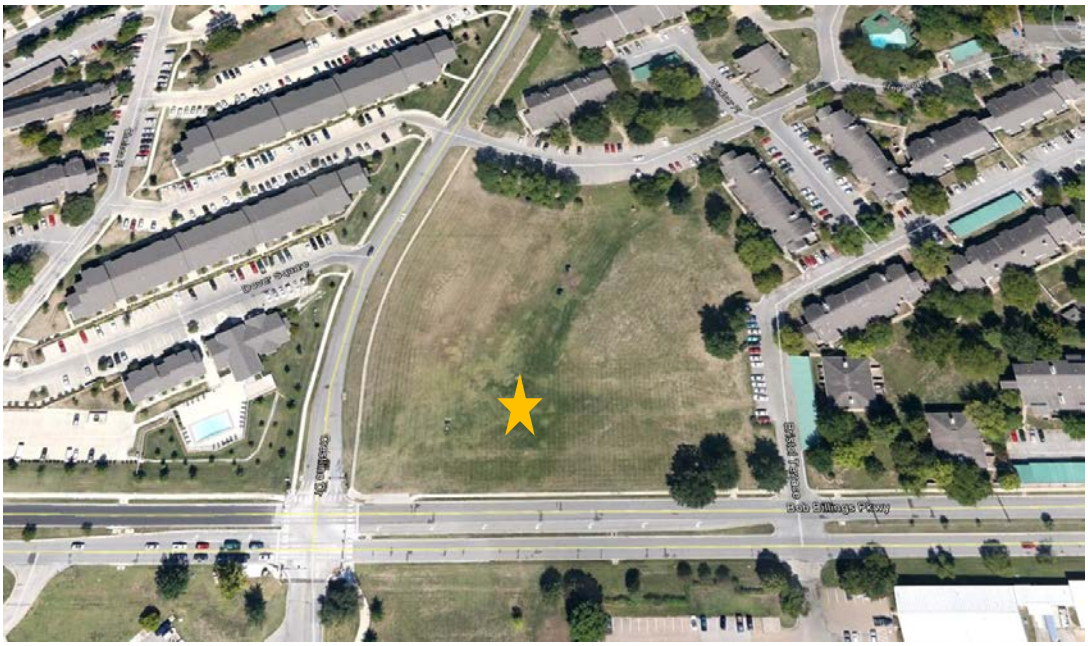


Source: Google Earth
Note: Site location is generalized

NE Corner of Crestline Drive and Bob Billings Parkway
Current Land Use: Vacant
Future Land Use: Medium / High Density Residential
Parcel Size: 4.7 Acres
Total Appraised Value: $534,320
Study Team Comments: • Transit center may not be the highest and best use for this particular site. • Would be less accepted by neighborhood than SE corner of intersection

Sources: City of Lawrence GIS Department, Horizon 2020. Douglas County Appraiser.

Figure 10: NE Corner of Crestline Drive and Bob Billings Parkway

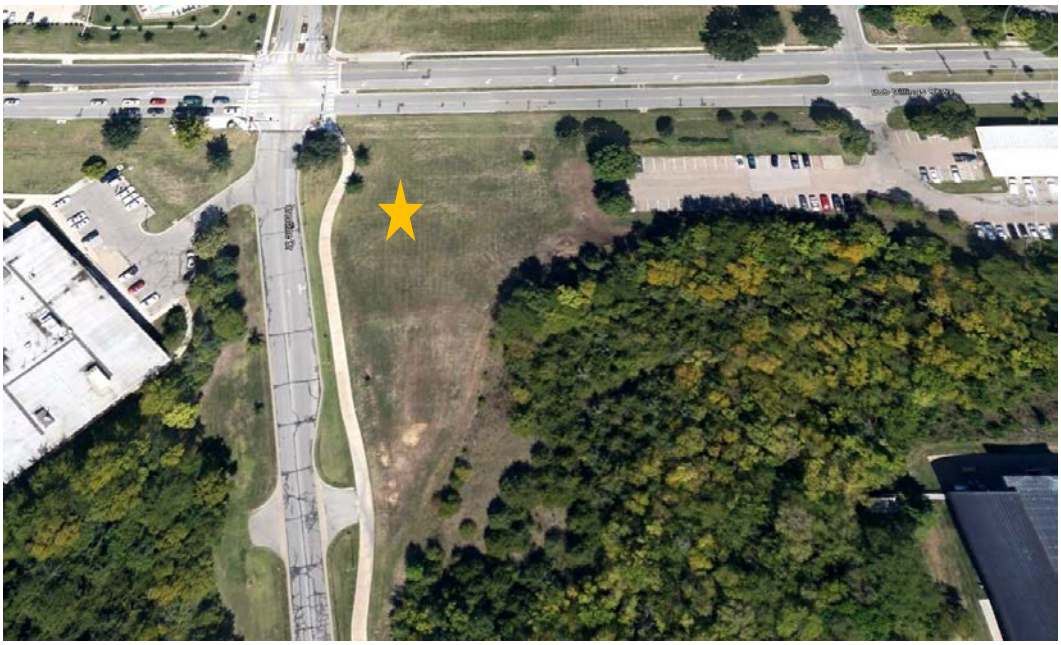


Source: Google Earth
Note: Site location is generalized

SE Corner of Crestline Drive and Bob Billings Parkway
Current Land Use: Institutional (vacant)
Future Land Use: Public / Semi-Public
Parcel Size: 104.6 Acres
Total Appraised Value: $7,748,860
Notes: Site is part of larger parcel.
Study Team Comments: • Possible topography issues. • Would be better accepted by neighborhood than NE corner of intersection. • Some concerns about distance from Iowa Street. • Site grading to address topography would be required.

Sources: City of Lawrence GIS Department, Horizon 2020. Douglas County Appraiser.

Figure 11: SE Corner of Crestline Drive and Bob Billings Parkway



Source: Google Earth
Note: Site location is generalized

925 Iowa Street (SE Corner of 9th Street and Centennial Drive)
Current Land Use: Commercial
Future Land Use: Commercial
Parcel Size: 4.6 Acres
Total Appraised Value: $1,898,000 (entire parcel)
Notes: Site is part of larger parcel.
Study Team Comments: • A stop light would be required at Rockledge Road and 9th Street to handle additional transit vehicles. • "Lots of good things going for it" • High synergy possible with surrounding land uses. • Mitigation measures may be required for adjacent residential uses.

Sources: City of Lawrence GIS Department, Horizon 2020. Douglas County Appraiser.

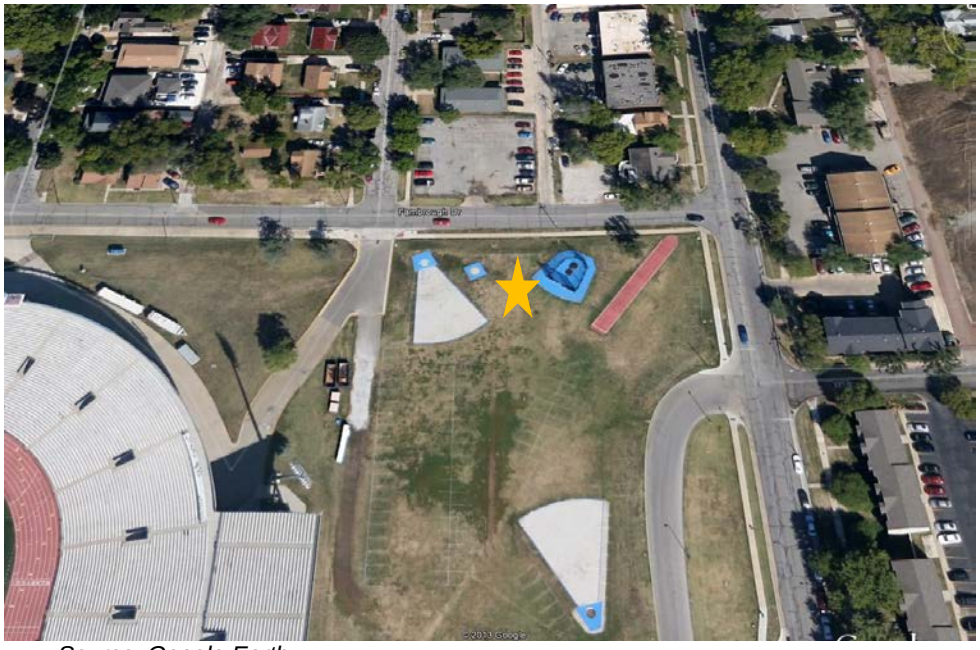
Figure 12: 925 Iowa (SE Corner of 9th Street and Centennial Drive)

Source: Google Earth
Note: Site location is generalized

1101 Mississippi (NW of Memorial Stadium)
Current Land Use: Institutional
Future Land Use: Public / Semi-Public
Parcel Size: 7.2 Acres
Total Appraised Value: $222,240
Study Team Comments: • There's long been a desire to correct existing off-set intersection. • KU Track and Field area could be relocated to new Rock Chalk Park. • High opportunities for synergy to serve both City needs and KU needs, as well as athletic events. • Surrounding residential land use is predominately, but not completely, rental. • Mitigation measures may be required for adjacent residential uses.

Sources: City of Lawrence GIS Department, Horizon 2020. Douglas County Appraiser.

Figure 13: 1101 Mississippi



Source: Google Earth
Note: Site location is generalized

Discussion and Evaluation

The seven sites were evaluated according to criteria broadly discussed by the study team throughout the project. The criteria are:

- Safety (lower risk for pedestrian conflicts, unsignalized left turns, etc).
- Surrounding land use is compatible
- Opportunities for synergy
- No need for additional traffic control
- Future land use compatible to redevelopment
- Major grading is not required
- Central to existing system or ridership patterns

Each of the sites were evaluated on how they best met the criteria. One of three scores was given for how well each site met each criterion. A score of 1, symbolized by an empty circle, meant the site does not adequately address the criterion. A score of 2, symbolized by a half-circle, meant the site does address part of the criterion, with some qualifications. A score of 3, symbolized by a full circle, meant that the site met the criterion. Figure 14 displays the matrix for the initial sites.

Figure 14: Initial Site Matrix Evaluation

Site	Safety (Lower risk for pedestrian conflict, unsignalized left turns)	Surrounding existing land use is compatible	Opportunity for Synergy	No need for additional traffic control	Future land use compatible to redevel.	Major site grading not required	Central to existing system / ridership	Summary (1 = low, 3 = high)
2029 Becker Drive (KU Park and Ride)	●	●	◒	●	●	●	○	2.6
2021 Stewart Avenue	◒	◒	○	○	●	●	◒	2.0
NW Corner of 19th and Iowa	◒	●	○	◒	○	◒	◒	1.9
SE Corner of Crestline Drive and Bob Billings Parkway	●	●	○	●	●	○	○	2.1
NE Corner of Crestline Drive and Bob Billings Parkway	◒	○	○	◒	○	○	○	1.3
925 Iowa Street (SE corner of 9th St and Centennial Dr)	◒	●	◒	◒	●	●	◒	2.4
1101 Mississippi (NW of Memorial Stadium)	◒	◒	●	●	●	●	●	2.7

Legend	Wt.	Guide
○	1	Does not adequately meet criterion
◒	2	Addresses part of the criterion, with some qualifications
●	3	Best meets criterion

Safety:

Most of the sites evaluated have some potential for pedestrian or vehicular conflicts. 2029 Becker Drive was ranked higher because the existing land use already separates pedestrians and vehicles. The SE corner of Crestline drive and Bob Billings Parkway was also ranked higher because the site is not near other major pedestrian or vehicle trip generators.

Surrounding existing land use is compatible:

Some sites were in areas adjacent to residential, and may be less suitable for a transit center than in areas that were surrounded by institutional land or commercial.

Opportunity for synergy:

Most sites did not have an inherent opportunity to synergize with the existing land use, nearby attractions, or the transit systems. Both 2029 Becker Drive and 925 Iowa could leverage existing activity currently located at their sites. 1101 Mississippi was ranked higher due to potential opportunities interacting well with KU on Wheels, and athletic functions.

No need for additional traffic control:

Some sites would need additional traffic control measure beyond those currently in place, for the safe operation of a transit center. 2021 Stewart Avenue would likely require an additional traffic signal on Iowa Street, and may have queuing issues to access westbound 19th Street. Other sites, such as NW Corner of 19th and Iowa, NE Corner of Crestline Drive and Bob Billings Parkway, and 925 Iowa, would require additional evaluation to determine if additional traffic control was needed.

Future land use is compatible to redevelopment:

KU has indicated that the NW corner of 19th and Iowa is envisioned to be a gateway feature for the university, and likely incompatible with a transit center. The NE Corner of Crestline Drive and Bob Billings Parkway appears a likely candidate for an expansion of existing high density residential.

Major site grading not required:

Both the northeast and southeast corner of Crestline Drive and Bob Billings Parkway may require substantial grading, while the NW corner of 19th and Iowa may also require some level of grading. While 1101 Mississippi may require substantial grading, it was assumed that this would be done anyways to realign the 11th and Mississippi intersection.

Central to existing system / ridership:

Some sites are less centrally located to the major routes or ridership. 2029 Becker Drive, for instance, may require additional time commitments to egress and ingress a transit center located near the middle of a large parcel.

Summary:

The grade that each site met for each criterion was averaged. 1101 Mississippi was ranked highest with a score of 2.7. 2029 Becker Drive was ranked second highest with a score of 2.6. 925 South Iowa was ranked third with a score of 2.4. These three sites will move forward to the next level of evaluation.

CC: File

Lawrence Transit Center Locational Analysis - GIS Process and Initial Candidate Site Discussion

Appendix

7301 West 133rd Street, Suite 200
Overland Park, KS 66213-4750

TEL 913.381.1170
FAX 913.381.1174

www.olssonassociates.com

Meeting Minutes

Project:	Lawrence Transit Center Location Analysis
Location:	Lawrence City Hall
Date & Time:	March 22nd, 2013. 4:00 pm to 5:00 pm
RE:	Preliminary GIS Preparation
PROJECT #:	013-0542
PHASE:	1

NAME	ORGANIZATION	PHONE #	EMAIL
Micah Seybold	City of Lawrence	785-832-3325	mseybold@lawrenceks.org
Tom Worker-Braddock	Olsson Associates	913.381.1170	tworkerbraddock@olssonassociates.com

Micah Seybold and Tom Worker-Braddock to discuss the preliminary data requirements and map requirements in preparation for the April 11th kick-off meeting.

Maps will be prepared for the Kick-off meeting in 11x17 format, but will prepare 8.5x11 maps for the report.

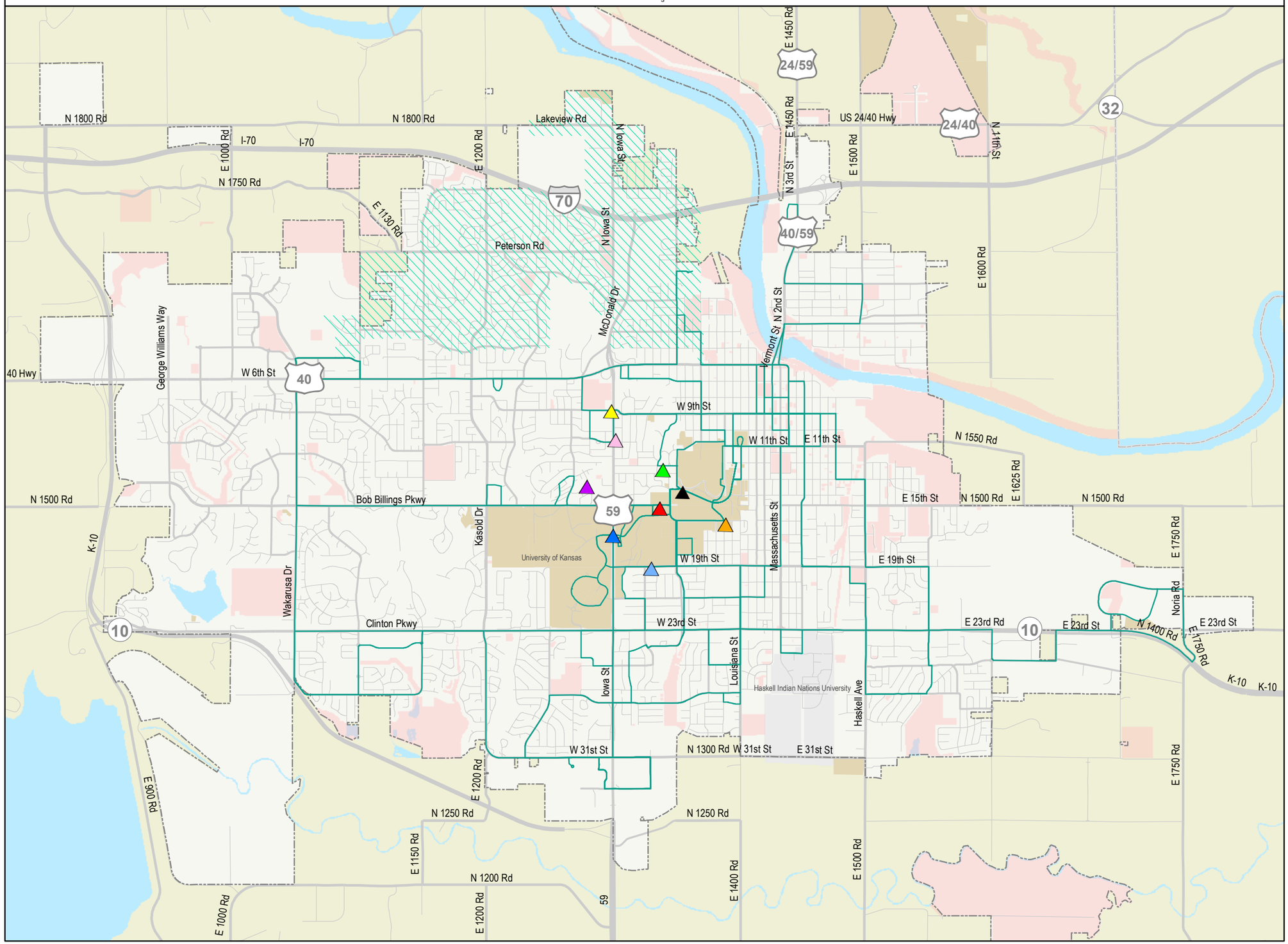
Micah will prepare the following maps:

- Mean of Center map (indicating mean centers of: city routes, KU routes, employers, City Limits, low to moderate income population by block group, population by block group, city road network). One possible method to calculate the road network center is to convert intersections into points, and determine the center of the points. These maps will indicate KU and City property..
- Map of major employers (>100 employees) and major attractions (grocery stores, social service agencies, pharmacies, other medical providers).

There was discussion about the limited availability of property data. Information on "For Sale" property is not exportable to GIS format, but is queryable by property size. This can be used on a somewhat limited basis once transit center requirements are identified in the kick-off meeting. County assessor's data is currently only available by individual properties, and not through a geospatial database. Tom will follow up to see if there's a better way to access the assessor's data.

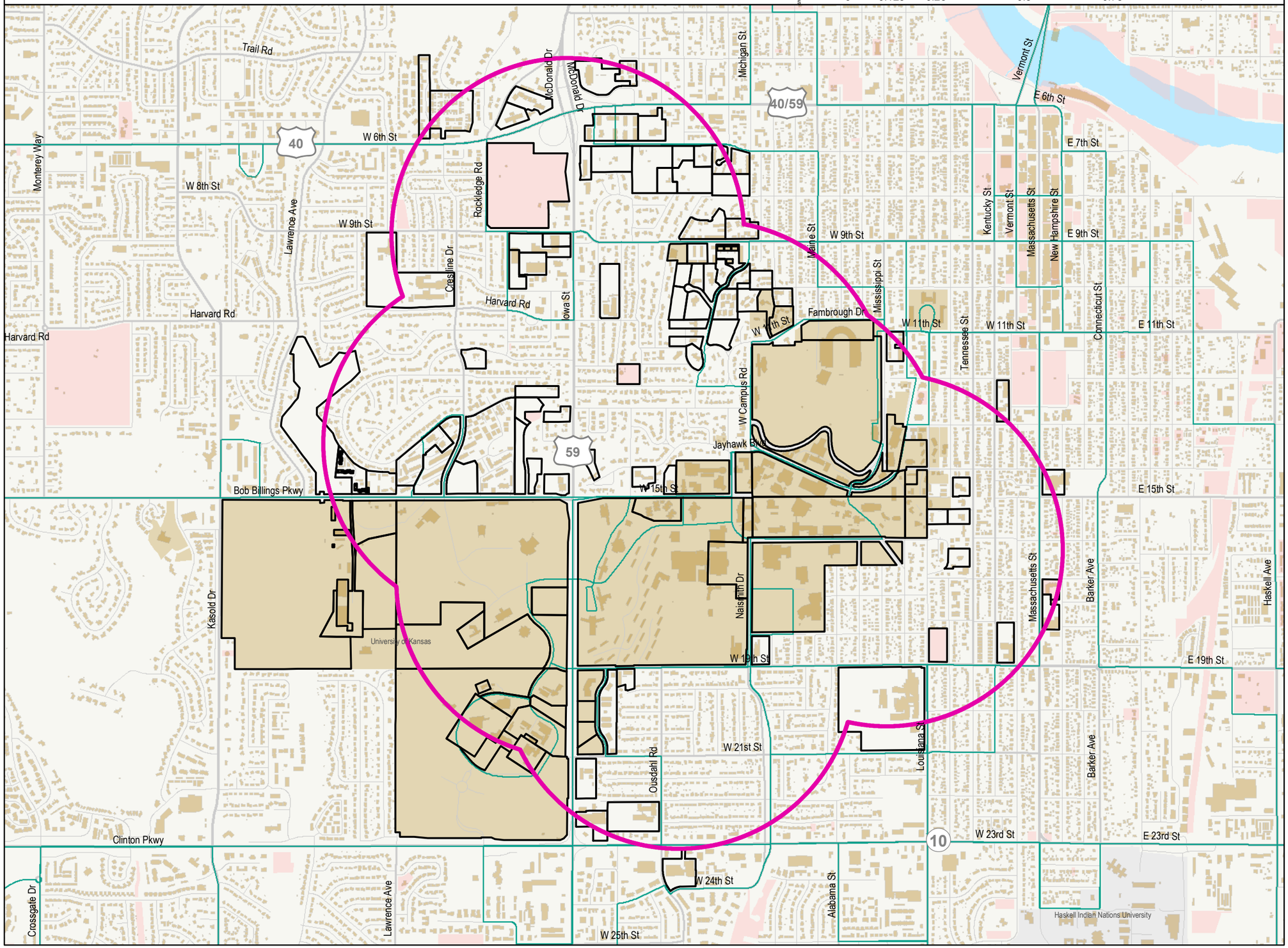
7301 West 133rd Street, Suite 200 **TEL** 913.381.1170
Overland Park, KS 66213-4750 **FAX** 913.381.1174 www.olssonassociates.com

Study of central locations in Lawrence, Kansas



- Mean Center of Urban Growth Area
- Mean Center of Lawrence destinations
- Mean Center of street intersections
- Center of the minimum boundary of existing City routes including flex zone
- Center of the minimum boundary of existing KU routes
- Mean center of Lawrence employers weighted by number employed
- Center of Lawrence city limits including islands
- Mean center of Lawrence block groups with low to moderate income over 50% weighted by population
- Mean center of Lawrence census block groups weighted by population
- Existing 2012-2013 transit routes
- Flex zone 2012-2013
- Parcels owned by KU or KU Endowment
- Parcels owned by City of Lawrence
- Universities

Candidate parcels Round 1: Lawrence, Kansas



Buildings

1/2 mile centers buffer

Candidate parcels^

Existing 2012-2013 transit routes

Parcels owned by KU or KU Endowment

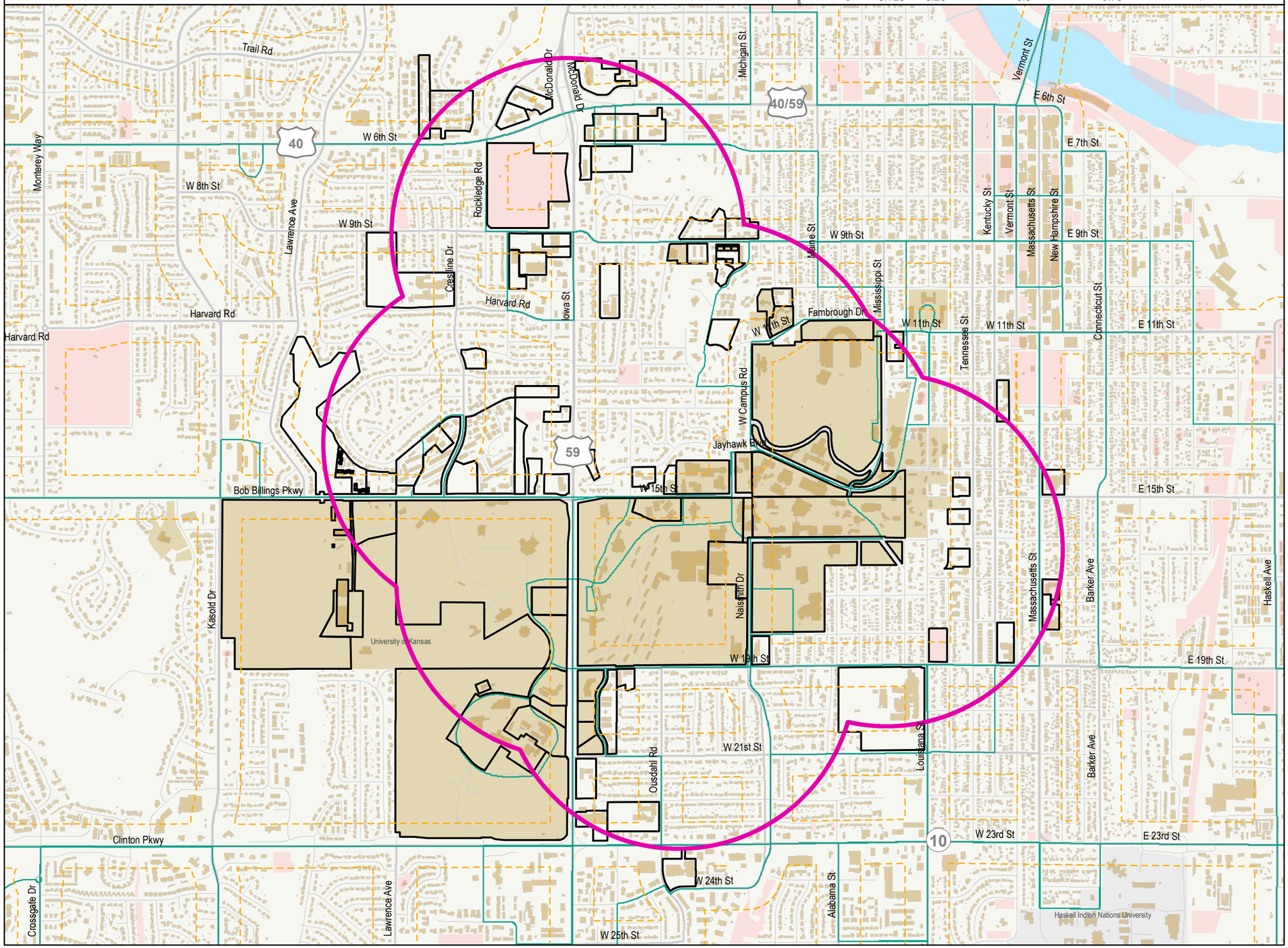
Parcels owned by City of Lawrence

Universities

^ Parameters:
- Intersecting 1/2 mile centers buffer
- Area is greater than or equal to 1.5 acres

116 parcels

Candidate parcels Round 2: Lawrence, Kansas



Buildings

1/2 mile centers buffer

Candidate parcels^

330' collector and above buffer

Existing 2012-2013 transit routes

Parcels owned by KU or KU Endowment

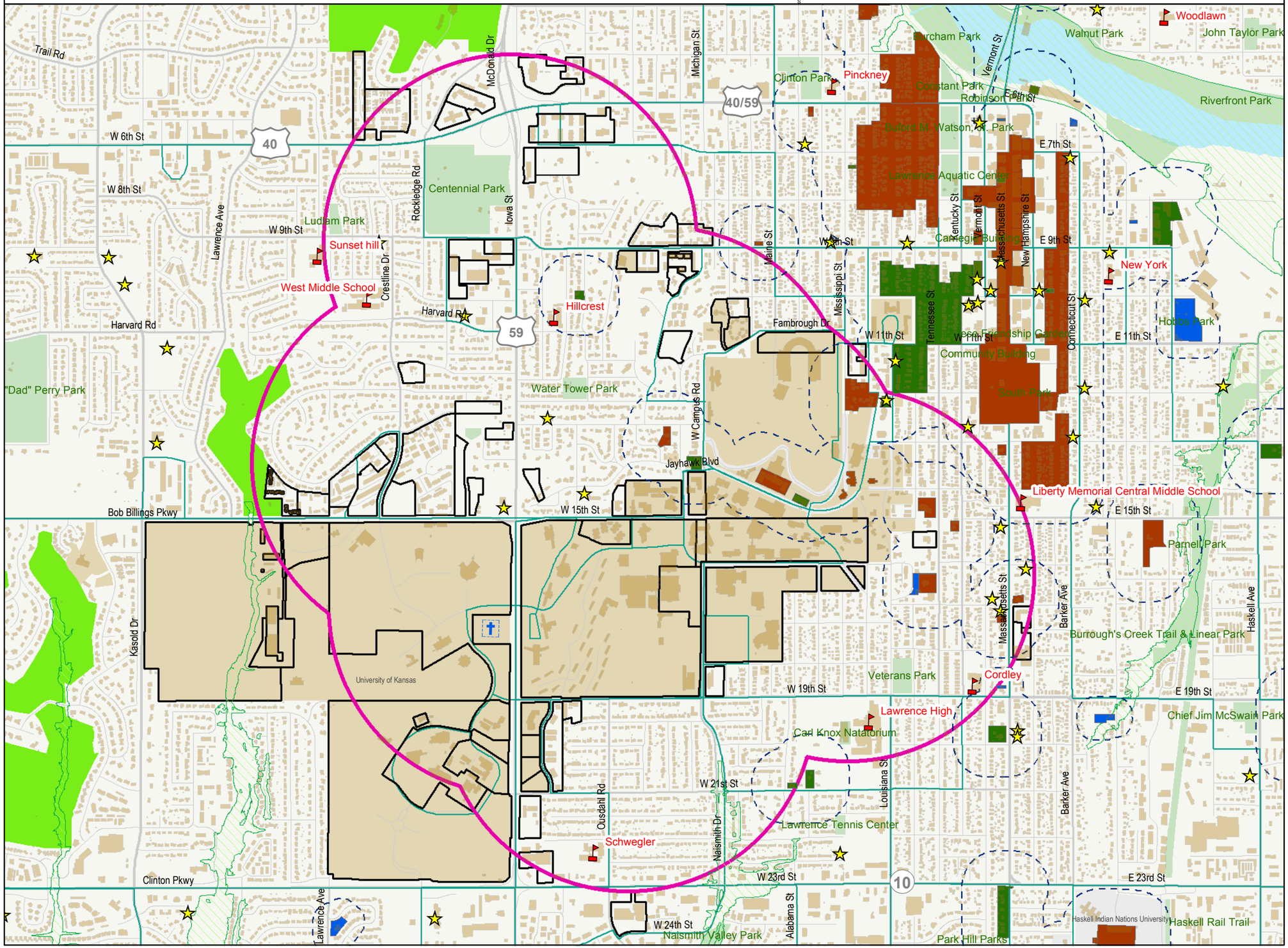
Parcels owned by City of Lawrence

Universities

^ Parameters:
- Intersecting 1/2 mile centers buffer
- Area is greater than or equal to 1.5 acres
- Within 330' of road class "collector" or greater

84 parcels

Candidate parcels Round 3: Lawrence, Kansas

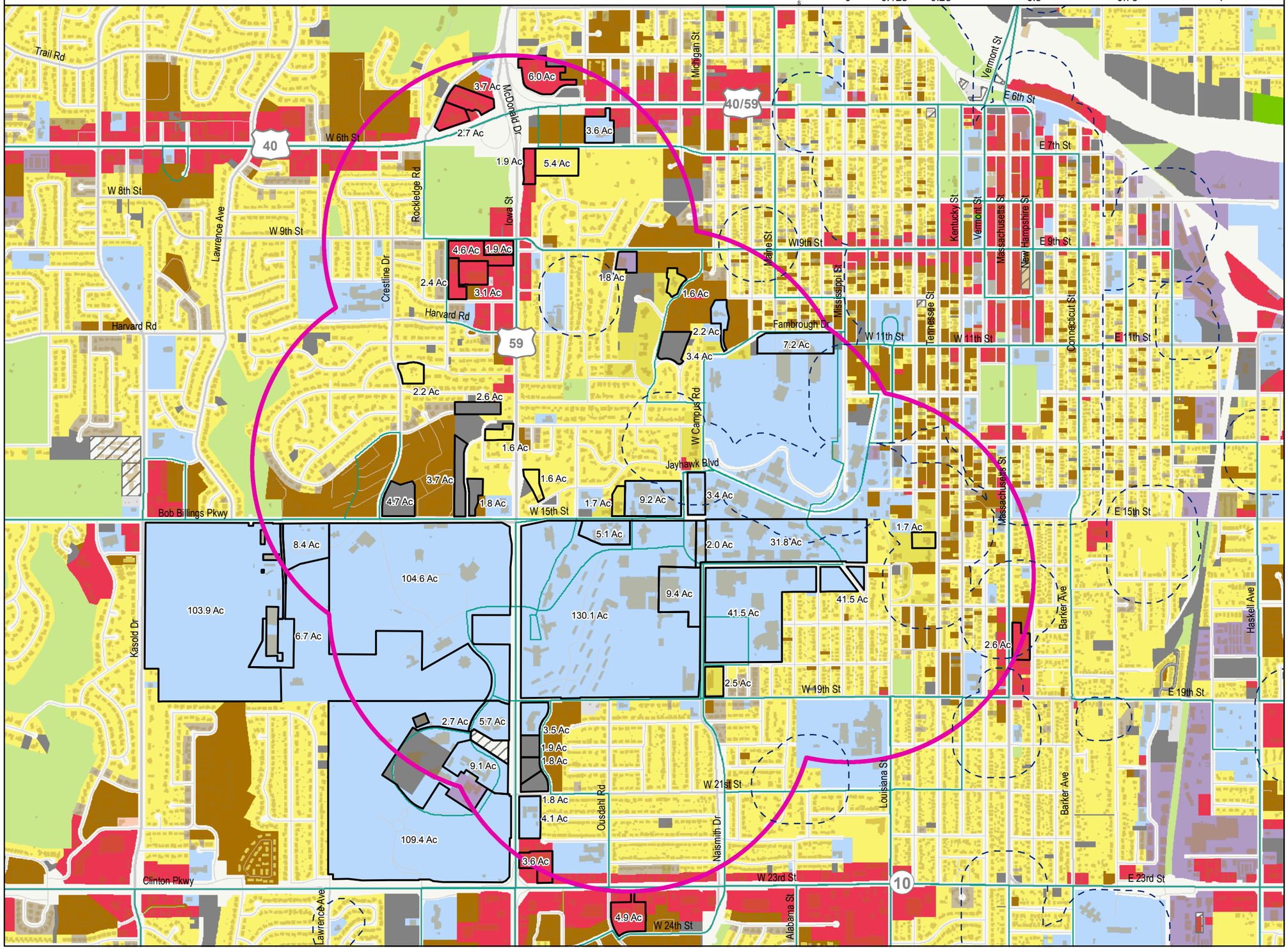


- Cemetery
- Lawrence Churches
- Lawrence Public Schools
- Buildings
- 1/2 mile centers buffer
- Parcel Candidates^
- Historic Buffers
- Historic State Properties
- Historic National Properties
- Historic Local Properties
- 100 Year Flood Plain
- Existing 2012-2013 transit routes
- Parcels owned by KU or KU Endowment
- City Park
- Golf Courses
- Universities

^ Parameters:
- Intersecting 1/2 mile centers buffer
- Area is greater than or equal to 1.5 acres
- Within 330' of road class "collector" or greater
- Not a Park, Golf Course, USD 497 School, Church, Cemetery or Historic Property
- Property has at least 1.5 acres of land outside of the 100 year flood plain.

68 parcels

Candidate parcels Round 4: Lawrence, Kansas



- Buildings
- 1/2 mile centers buffer
- Parcel Candidates^
- Historic Buffers
- Existing 2012-2013 transit routes

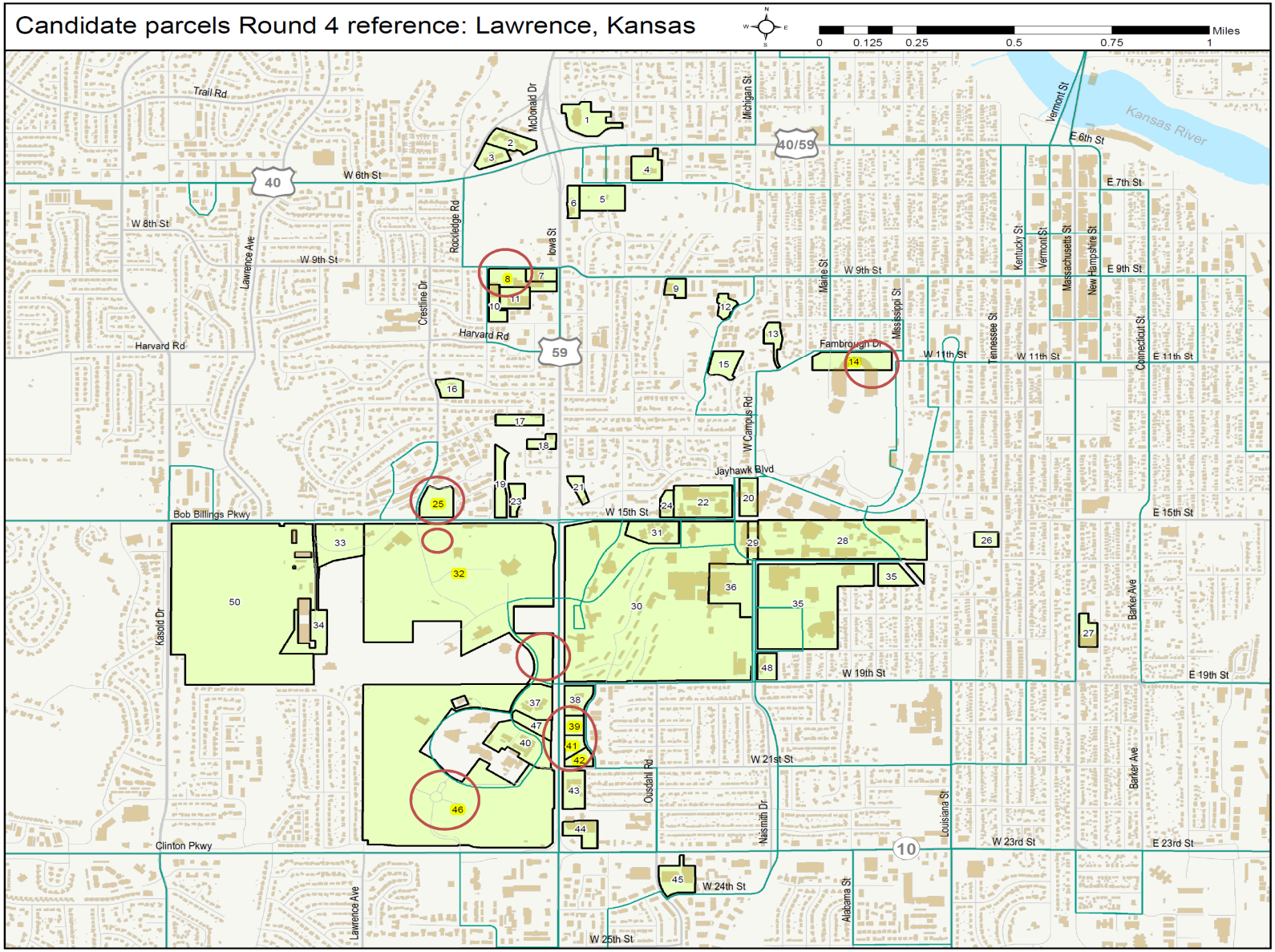
Land Use April 2012

- No Value
- Single Family Residential
- Boarding House
- Duplex
- Triplex
- Multiple Family Residential
- Mixed Use
- Commercial
- Industrial
- Institutional
- Parks/Open Space
- Utility
- Agricultural
- Vacant

^ Parameters:
- Intersecting 1/2 mile centers buffer
- Area is greater than or equal to 1.5 acres
- Within 330' of road class "collector" or greater
- Not a Park, Golf Course, USD 497 School, Church, Cemetery or Historic Property
- Property has at least 1.5 acres of land outside of the 100 year flood plain.
- Not a Multiple Family Residential landuse (based on 2012 County Appraiser data)

49 parcels

Candidate parcels Round 4 reference: Lawrence, Kansas



Buildings

Existing 2012-2013 transit routes

Parcel Candidates (R4)

Map #	Address	Acres
1	2000 BLUFFS DR	6.0
2	2222 W 6TH ST	3.7
3	2300 W 6TH ST	2.7
4	1803 W 6TH ST	3.6
5	711 SUNSET DR	5.4
6	730 IOWA ST	1.9
7	901 IOWA ST	1.9
8	925 IOWA ST	4.6
9	1621 W 9TH ST	1.8
10	2330 YALE RD	2.4
11	933 IOWA ST	3.1
12	1001 EMERY RD	1.6
13	1120 W 11TH ST	2.2
14	1101 MISSISSIPPI ST	7.2
15	0 EMERY RD	3.4
16	2425 ORCHARD LN	2.2
17		2.6
18	1301 IOWA ST	1.6
19	0 BOB BILLINGS PKWY	3.7
20	1417 CRESCENT RD	3.4
21	3 WESTWOOD RD	1.6
22	1500 W 15TH ST	9.2
23	0 BOB BILLINGS PKWY	1.8
24	1602 W 15TH ST	1.7
25	0 WINDSOR PL	4.7
26	1439 TENNESSEE ST	1.7
27	1740 MASSACHUSETTS ST	2.6
28	0 JAYHAWK BLVD	31.8
29	1500 NAISMITH DR	2.0
30	1506 ENGEL RD	130.1
31	1603 W 15TH ST	5.1
32	2201 BOB BILLINGS PKWY	104.6
33	2445 BOB BILLINGS PKWY	8.4
34	3101 BOB BILLINGS PKWY	6.7
35	901 SUNNYSIDE AVE	41.5
36	1601 NAISMITH DR	9.4
37	1920 CONSTANT AVE	5.7
38	1911 STEWART AVE	3.5
39	1941 STEWART AVE	1.9
40	2065 CONSTANT AVE	9.1
41	2005 STEWART AVE	1.8
42	2021 STEWART AVE	1.8
43	2100 IOWA ST	4.1
44	1900 W 23RD ST	3.6
45	1601 W 23RD ST	4.9
46	2029 BECKER DR	109.4
47	2000 CONSTANT AVE	2.7
48	1800 NAISMITH DR	2.5
50	0 BOB BILLINGS PKWY	103.9

Appendix C – Initial site cost estimates

2029 Becker Drive

Preliminary Opinion of Probable Construction Costs

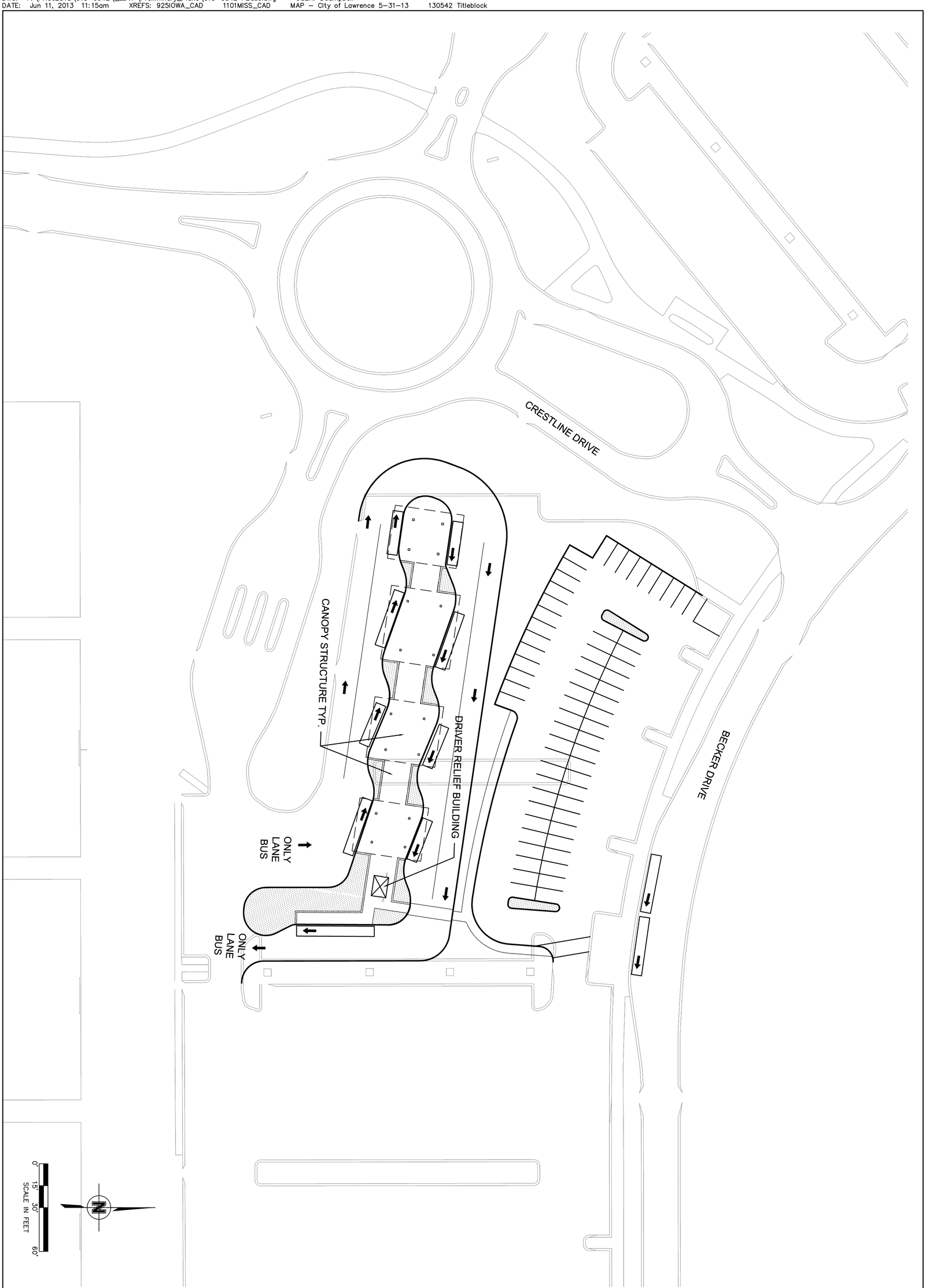
11-Jun-13

	Transit Center	QTY	UNITS	COST	TOTAL
1	Mobilization	1	LS	$48,000.00	$48,000.00
2	Clearing/Grubing/limited site demolition	1	LS	$85,000.00	$85,000.00
3	Structure / 9,000 sq ft	1	LS	$900,000.00	$900,000.00
4	Restroom Building	1	LS	$100,000.00	$100,000.00
5	Information Kiosk	1	EA	$15,000.00	$15,000.00
6	Construction Staking	1	LS	$10,000.00	$10,000.00
7	Earthwork	4000	CY	$12.00	$48,000.00
8	Monument Sign with Utility Hookup	1	LS	$10,000.00	$10,000.00
9	Private Utilities	1	LS	$40,000.00	$40,000.00
10	Retaining walls	0	SFF	$20.00	$0.00
11	Erosion Control	1	LS	$18,000.00	$18,000.00
12	Seeding	0.7	ACRE	$2,000.00	$1,400.00
13	ADA ram-conc. w/ truncated domes	5	EA	$1,800.00	$9,000.00
14	bollards	20	EA	$900.00	$18,000.00
15	Pavement Markings	1	LS	$4,500.00	$4,500.00
16	Site Lighting	10	EA	$6,000.00	$60,000.00
17	Traffic Control	1	LS	$18,000.00	$18,000.00
18	Irrigation	1	LS	$7,000.00	$7,000.00
19	Landscaping	1	LS	$60,000.00	$60,000.00
20	Bench	20	EA	$2,000.00	$40,000.00
21	Bike rack	2	EA	$2,500.00	$5,000.00
22	Litter receptacle	6	EA	$1,250.00	$7,500.00
23	Digital Reader Board	8	EA	$10,000.00	$80,000.00
24	New Curb and Gutter	1390	LF	$20.00	$27,800.00
25	Decorative Crosswalk	710	SF	$20.00	$14,200.00
26	Concrete Pavement 10"	2965	SY	$75.00	$222,375.00
27	Concrete Sidewalk 4"	8400	SF	$5.50	$46,200.00
28	Storm Sewer Inlets	4	EA	$3,000.00	$12,000.00
29	Storm Sewer Pipe	600	LF	$75.00	$45,000.00
		Transit Center Sub-Total			$1,818,975.00

	Reconfigured Parking Lot	QTY	UNITS	COST	TOTAL
1	Asphalt Pavement 8"	2515	SY	$45.00	$113,175.00
2	New Curb & Gutter	620	LF	$20.00	$12,400.00
3	Concrete Sidewalk 4"	1310	SF	$5.50	$7,205.00
5	Pavement Markings	1	LS	$2,500.00	$2,500.00
3	Storm Sewer Inlets	4	EA	$3,000.00	$12,000.00
4	Storm Sewer Pipe	200	LF	$75.00	$15,000.00
6	Landscape	1	LS	$15,000.00	$15,000.00
5	Site Lighting	6	EA	$6,000.00	$36,000.00
		Transit Center Sub-Total			$213,280.00

Project Sub-Total:	**$2,032,255.00**
Contingency 20%	**$406,451.00**
Project Total:	**$2,438,706.00**

DWG: F:\PROJECTS\013-0542_LDVP\Preliminary_Plans\013-0542 PBase.dwg USER: Dcampbell
DATE: Jun 11, 2013 11:15am XREFS: 925IOWA_CAD 1101MISS_CAD MAP - City of Lawrence 5-31-13 130542 Titleblock



SHEET C100

drawn by: CAD
checked by: ENG
approved by: ENG
QC check by: ENG
project no.: 130542
drawing no.: 130542 PBASE.DWG
date: 06.11.13

WEST CAMPUS

LAWRENCE TRANSIT CENTER
CONCEPT DESIGN

LAWRENCE, KANSAS 2013

REV. NO.	DATE	REVISIONS DESCRIPTION	BY

REVISIONS

OLSSON ASSOCIATES
7301 West 133rd Street, Suite 200
Overland Park, KS 66213-4750
TEL 913.381.1170
FAX 913.381.1174
www.olssonassociates.com

9th St. & Iowa St. Transit Center

Preliminary Opinion of Probable Construction Costs

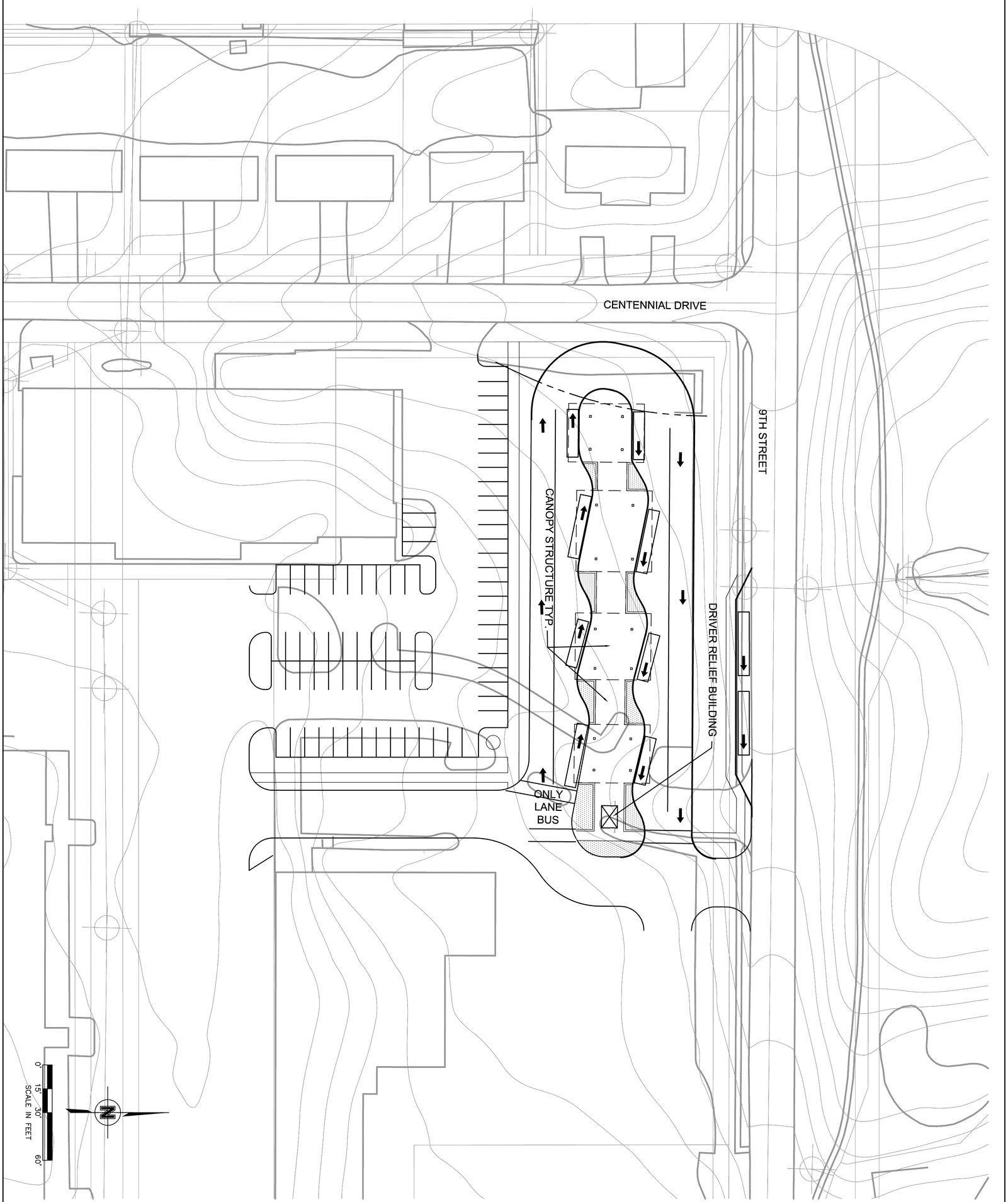
11-Jun-13

	Transit Center	QTY	UNITS	COST	TOTAL
1	Mobilization	1	LS	$48,000.00	$48,000.00
2	Clearing/Grubing/limited site demolition	1	LS	$85,000.00	$85,000.00
3	Structure / 9,000 sq ft	1	LS	$900,000.00	$900,000.00
4	Restroom Building	1	LS	$100,000.00	$100,000.00
5	Information Kiosk	1	EA	$15,000.00	$15,000.00
6	Construction Staking	1	LS	$10,000.00	$10,000.00
7	Earthwork	8000	CY	$12.00	$96,000.00
8	Monument Sign with Utility Hookup	1	LS	$10,000.00	$10,000.00
9	Private Utilities	1	LS	$30,000.00	$30,000.00
10	Retaining walls	1600	SFF	$20.00	$32,000.00
11	Erosion Control	1	LS	$18,000.00	$18,000.00
12	Seeding	0.7	ACRE	$2,000.00	$1,400.00
13	ADA ram-conc. w/ truncated domes	5	EA	$1,800.00	$9,000.00
14	bollards	20	EA	$900.00	$18,000.00
15	Pavement Markings	1	LS	$4,500.00	$4,500.00
16	Site Lighting	10	EA	$6,000.00	$60,000.00
17	Traffic Control	1	LS	$18,000.00	$18,000.00
18	Irrigation	1	LS	$7,000.00	$7,000.00
19	Landscaping	1	LS	$50,000.00	$50,000.00
20	Bench	20	EA	$2,000.00	$40,000.00
21	Bike rack	2	EA	$2,500.00	$5,000.00
22	Litter receptacle	6	EA	$1,250.00	$7,500.00
23	Digital Reader Board	8	EA	$10,000.00	$80,000.00
24	New Curb and Gutter	1400	LF	$20.00	$28,000.00
25	Decorative Crosswalk	710	SF	$20.00	$14,200.00
26	Concrete Pavement 10"	2474	SY	$75.00	$185,550.00
27	Concrete Sidewalk 4"	8000	SF	$5.50	$44,000.00
28	Storm Sewer Inlets	4	EA	$3,000.00	$12,000.00
29	Storm Sewer Pipe	600	LF	$75.00	$45,000.00
		Transit Center Sub-Total			$1,840,150.00

	Reconfigured Parking Lot	QTY	UNITS	COST	TOTAL
1	Asphalt Pavement 8"	3780	SY	$45.00	$170,100.00
2	New Curb & Gutter	1400	LF	$20.00	$28,000.00
3	Concrete Sidewalk 4"	3200	SF	$5.50	$17,600.00
3	Storm Sewer Inlets	4	EA	$3,000.00	$12,000.00
4	Storm Sewer Pipe	200	LF	$75.00	$15,000.00
5	Pavement Markings	1	LS	$2,500.00	$2,500.00
6	Landscape	1	LS	$15,000.00	$15,000.00
7	Site Lighting	6	EA	$6,000.00	$36,000.00
		Transit Center Sub-Total			$296,200.00

Project Sub-Total:	**$2,136,350.00**
Contingency 20%	**$427,270.00**
Project Total:	**$2,563,620.00**

DWG: F:\PROJECTS\013-0542_LDVP\Preliminary_Plans\013-0542 PBase.dwg USER: Dcampbell
DATE: Jun 11, 2013 11:15am XREFS: 925IOWA_CAD 1101MISS_CAD MAP - City of Lawrence 5-31-13 130542 Titleblock



SHEET
C100

drawn by: CAD
checked by: ENG
approved by: ENG
QA/QC by: ENG
project no.: 130542
drawing no.: 130542 PBASE.DWG
date: 06.11.13

9TH and IOWA

LAWRENCE TRANSIT CENTER
CONCEPT DESIGN

LAWRENCE, KANSAS 2013

REV. NO.	DATE	REVISIONS DESCRIPTION	BY

REVISIONS

OLSSON ASSOCIATES
7301 West 133rd Street, Suite 200
Overland Park, KS 66213-4750
TEL 913.381.1170
FAX 913.381.1174
www.olssonassociates.com

11th Street & Mississippi St Transit Center

Preliminary Opinion of Probable Construction Costs

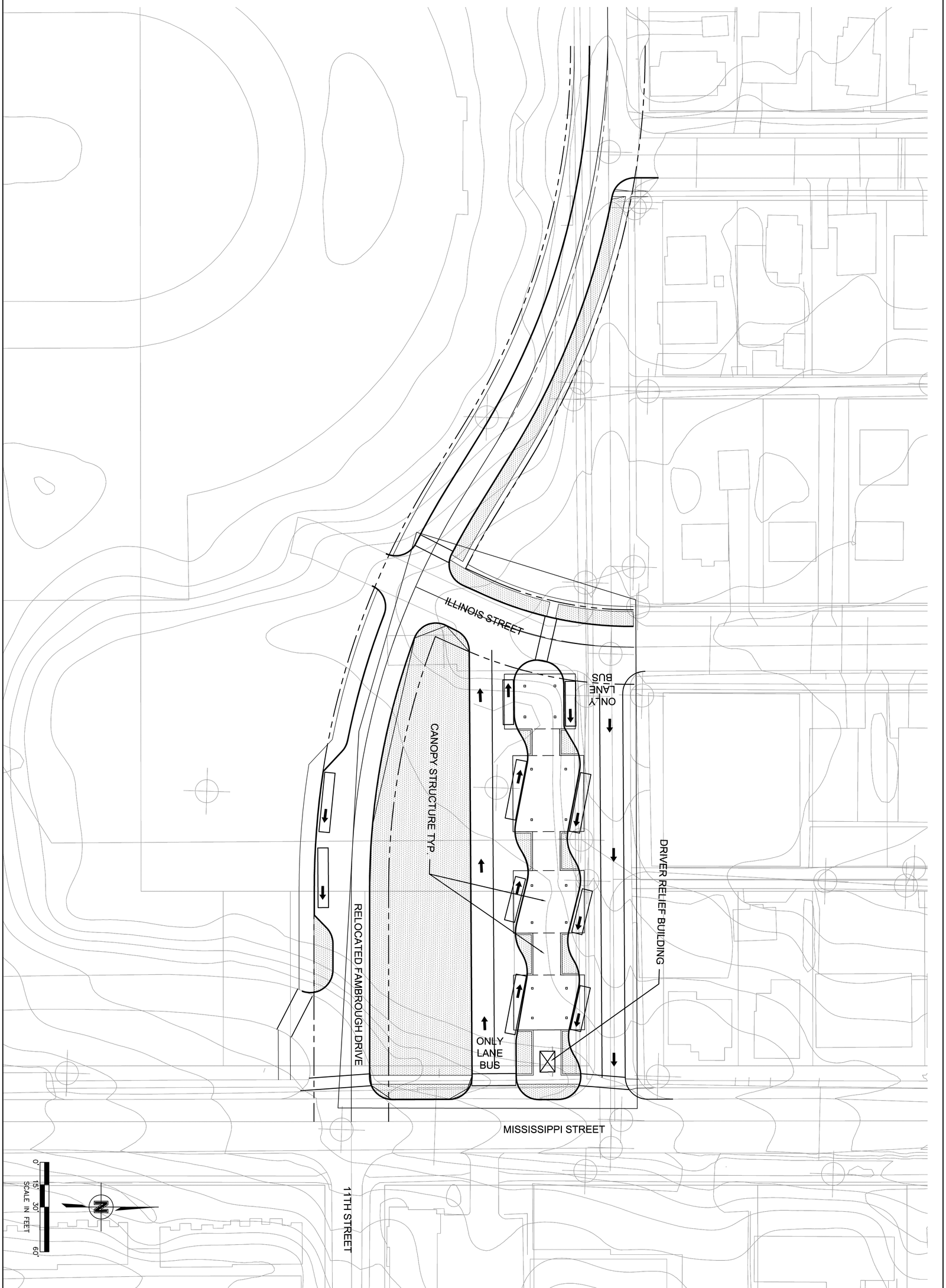
11-Jun-13

	Transit Center	QTY	UNITS	COST	TOTAL
1	Mobilization	1	LS	$48,000.00	$48,000.00
2	Clearing/Grubing/limited site demolition	1	LS	$15,000.00	$15,000.00
3	Structure / 9,000 sq ft	1	LS	$900,000.00	$900,000.00
4	Restroom Building	1	LS	$100,000.00	$100,000.00
5	Information Kiosk	1	EA	$15,000.00	$15,000.00
6	Construction Staking	1	LS	$10,000.00	$10,000.00
7	Earthwork	15000	CY	$12.00	$180,000.00
8	Monument Sign with Utility Hookup	1	LS	$10,000.00	$10,000.00
9	Private Utilities	1	LS	$30,000.00	$30,000.00
10	Retaining walls	840	SFF	$20.00	$16,800.00
11	Erosion Control	1	LS	$18,000.00	$18,000.00
12	Seeding	0.7	ACRE	$2,000.00	$1,400.00
13	ADA ram-conc. w/ truncated domes	5	EA	$1,800.00	$9,000.00
14	bollards	20	EA	$900.00	$18,000.00
15	Pavement Markings	1	LS	$4,500.00	$4,500.00
16	Site Lighting	10	EA	$6,000.00	$60,000.00
17	Traffic Control	1	LS	$18,000.00	$18,000.00
18	Irrigation	1	LS	$8,000.00	$8,000.00
19	Landscaping	1	LS	$70,000.00	$70,000.00
20	Bench	20	EA	$2,000.00	$40,000.00
21	Bike rack	2	EA	$2,500.00	$5,000.00
22	Litter receptacle	6	EA	$1,250.00	$7,500.00
23	Digital Reader Board	8	EA	$10,000.00	$80,000.00
24	New Curb and Gutter	1285	LF	$20.00	$25,700.00
25	Decorative Crosswalk	710	SF	$20.00	$14,200.00
26	Concrete Pavement 10"	2240	SY	$75.00	$168,000.00
27	Concrete Sidewalk 4"	8000	SF	$5.50	$44,000.00
28	Storm Sewer Inlets	4	EA	$3,000.00	$12,000.00
29	Storm Sewer Pipe	600	LF	$75.00	$45,000.00
		Transit Center Sub-Total			$1,910,100.00

	Public Streets Relocation	QTY	UNITS	COST	TOTAL
1	Fambrough Drive	755	LF	$375.00	$283,125.00
2	Illinois Street	155	LF	$350.00	$54,250.00
		Public Streets Relocation Sub-Total			$337,375.00

Project Sub-Total:	**$2,247,475.00**
Contingency 20%	**$449,495.00**
Project Total:	**$2,696,970.00**

DWG: F:\PROJECTS\013-0542_LDVP\Preliminary_Plans\013-0542 PBase.dwg USER: Dcampbell
DATE: Jun 11, 2013 11:15am XREFS: 925IOWA_CAD 1101MISS_CAD MAP - City of Lawrence 5-31-13 130542 Titleblock



SHEET C100

drawn by: CAD
checked by: ENG
approved by: ENG
QA/QC by: ENG
project no.: 130542
drawing no.: 130542 PBASE.DWG
date: 06.11.13

11th and MISSISSIPPI

LAWRENCE TRANSIT CENTER
CONCEPT DESIGN

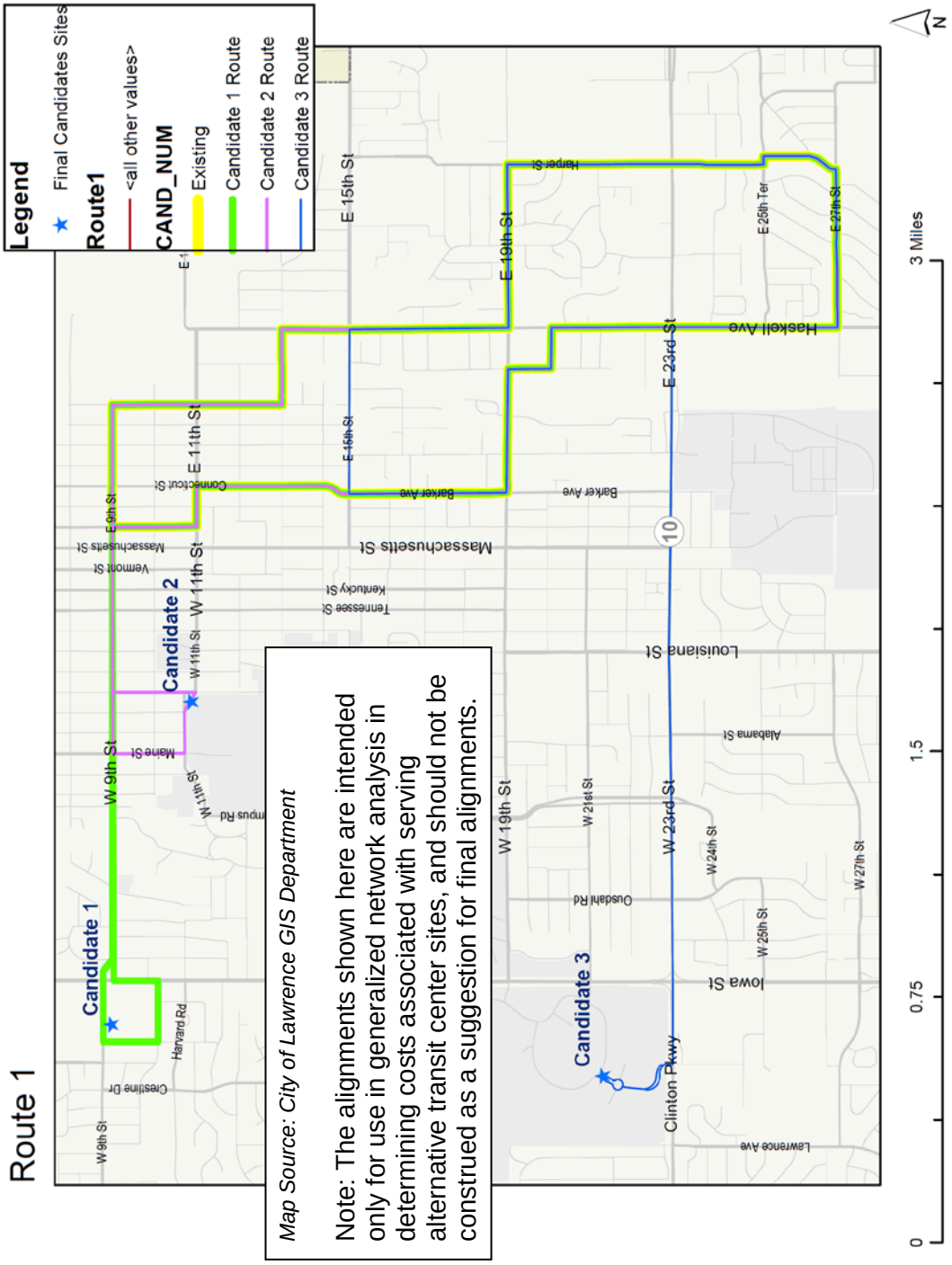
LAWRENCE, KANSAS 2013

REV. NO.	DATE	REVISIONS DESCRIPTION	BY

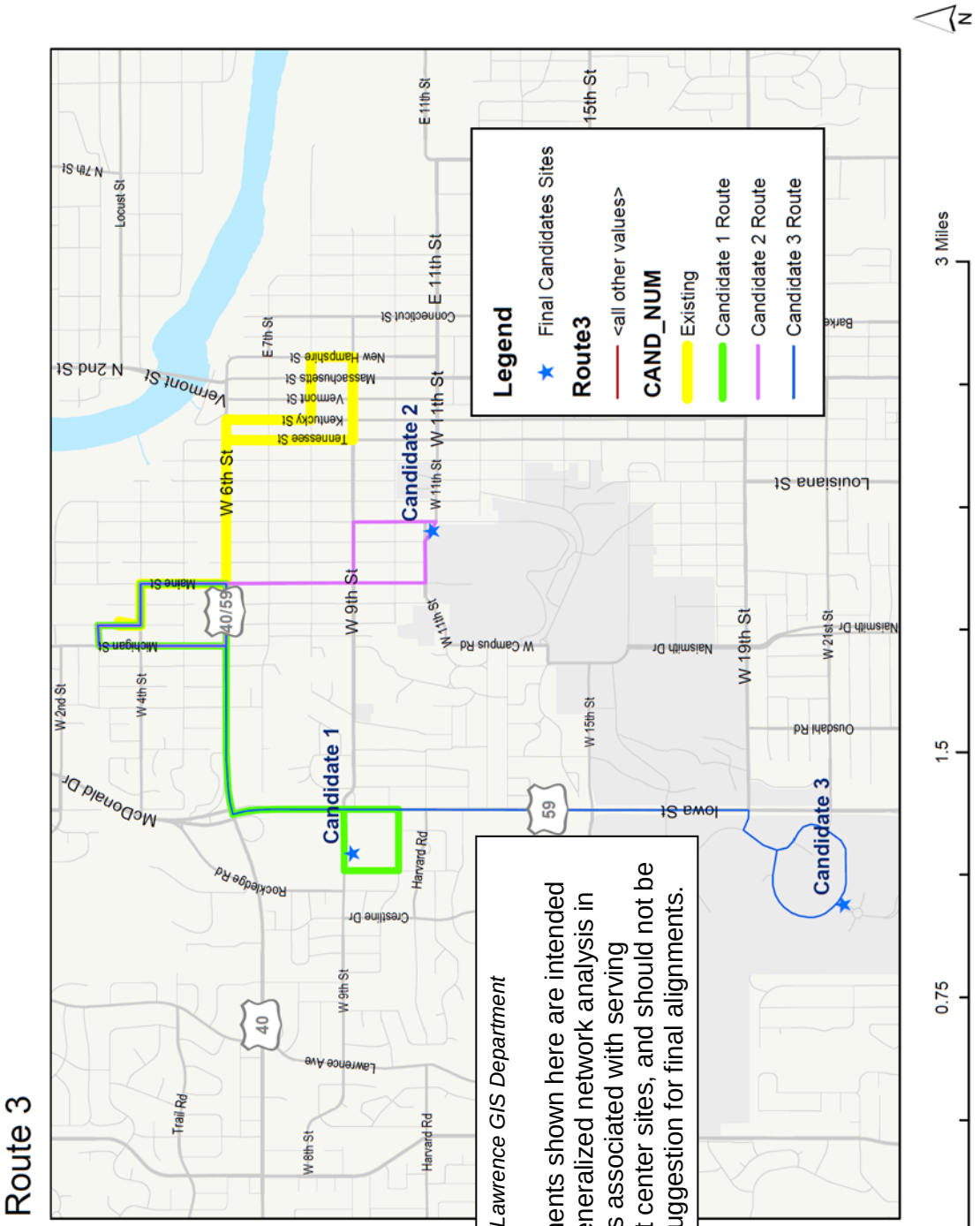
REVISIONS

OLSSON ASSOCIATES
7301 West 133rd Street, Suite 200
Overland Park, KS 66213-4750
TEL 913.381.1170
FAX 913.381.1174
www.olssonassociates.com

Appendix D – Illustrative Alignments for network analysis


Legend
Final Candidates Sites
Route1
<all other values>
CAND_NUM
Existing
Candidate 1 Route
Candidate 2 Route
Candidate 3 Route
Route 1
Candidate 1
Candidate 2
Candidate 3
Massachusetts St
Louisiana St
Iowa St
E 15th St
E 19th St
E 23rd St
W 9th St
W 11th St
W 19th St
W 23rd St
Haskell Ave
Harper St
Barker Ave
Clinton Pkwy
Harvard Rd
Ousdahl Rd
Alabama St
Maine St
Vermont St
Connecticut St
Tennessee St
Kentucky St
Lawrence Ave
10
N
0
0.75
1.5
3 Miles
Map Source: City of Lawrence GIS Department
Note: The alignments shown here are intended only for use in generalized network analysis in determining costs associated with serving alternative transit center sites, and should not be construed as a suggestion for final alignments.

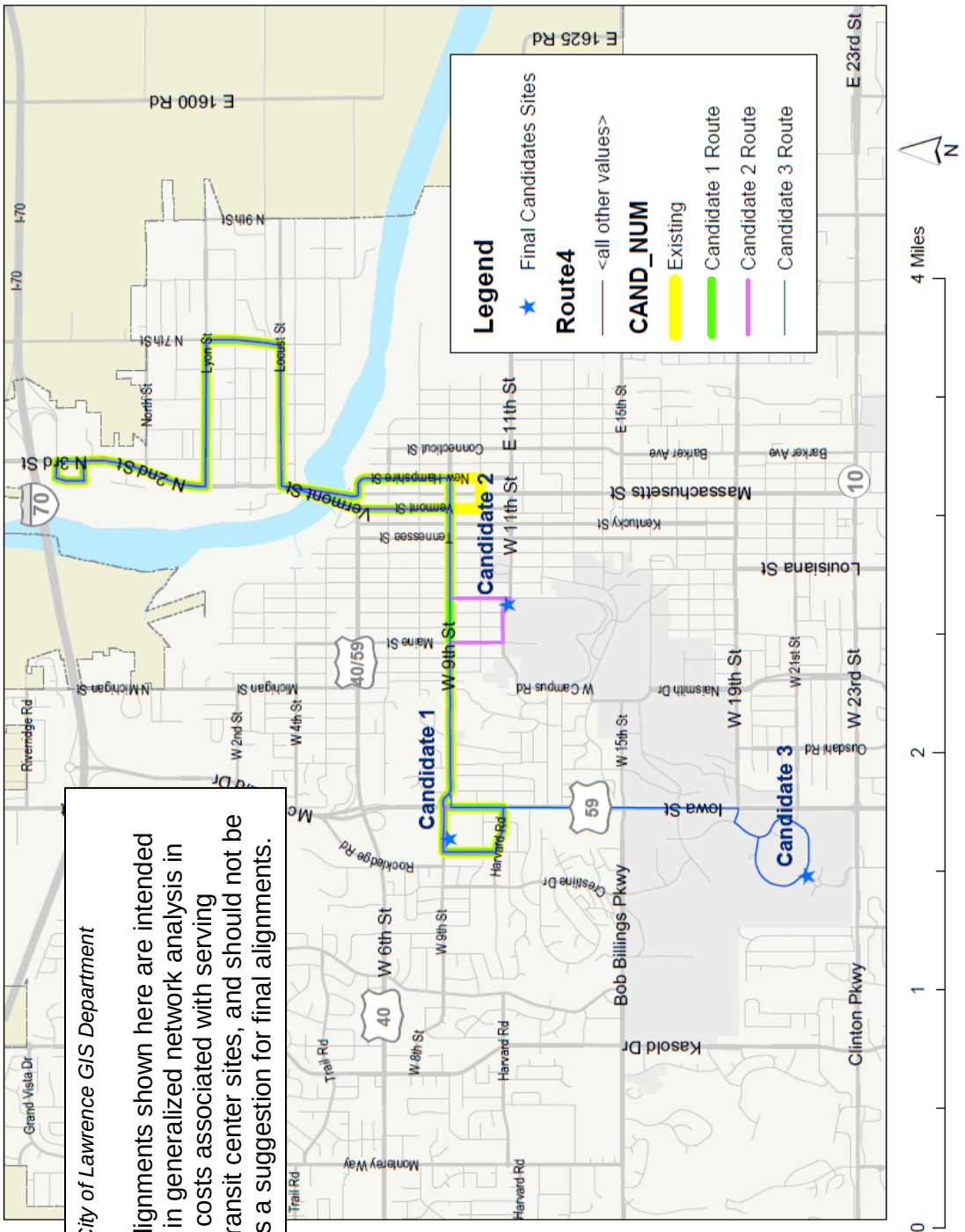
Route 3



Map Source: City of Lawrence GIS Department

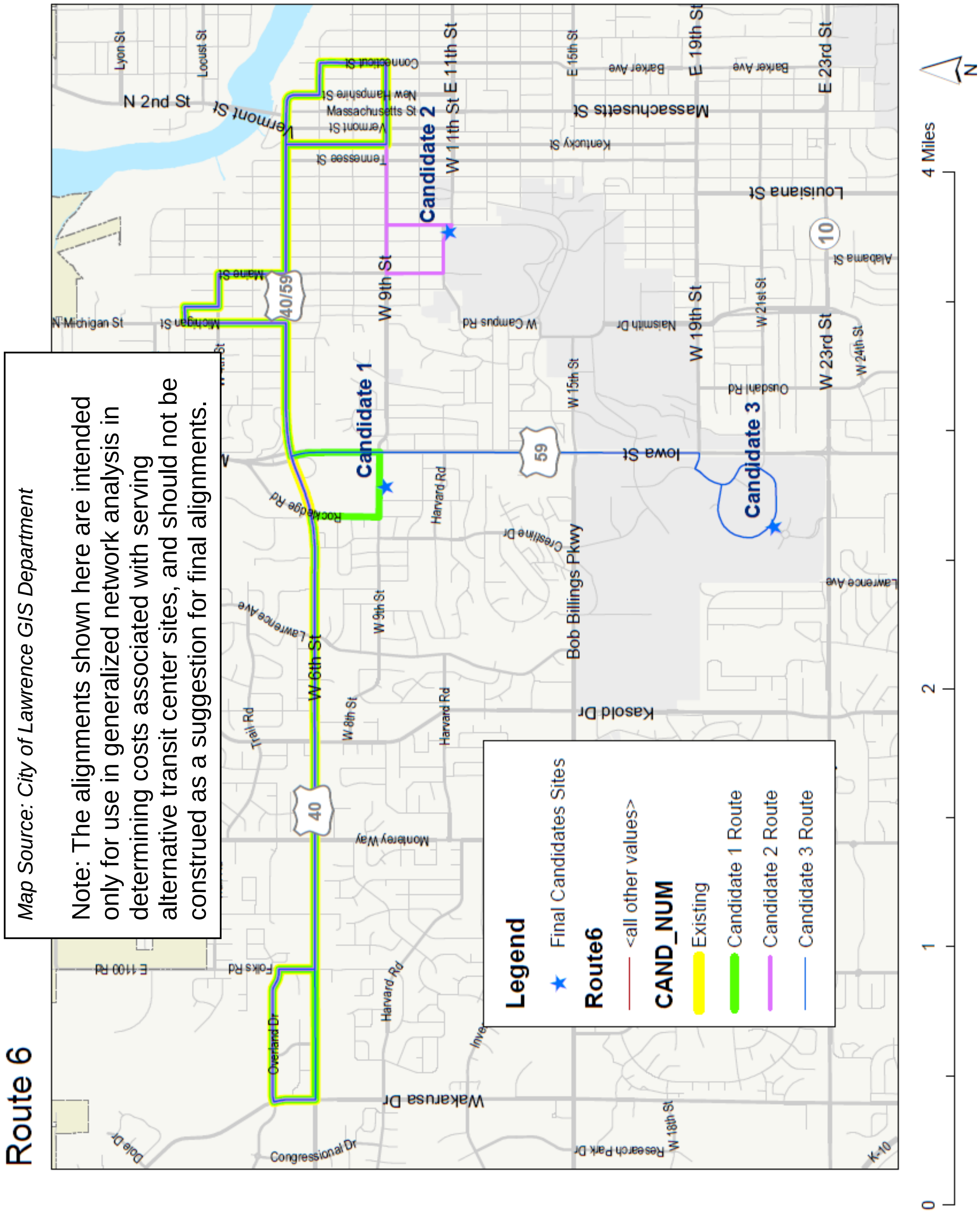
Note: The alignments shown here are intended only for use in generalized network analysis in determining costs associated with serving alternative transit center sites, and should not be construed as a suggestion for final alignments.

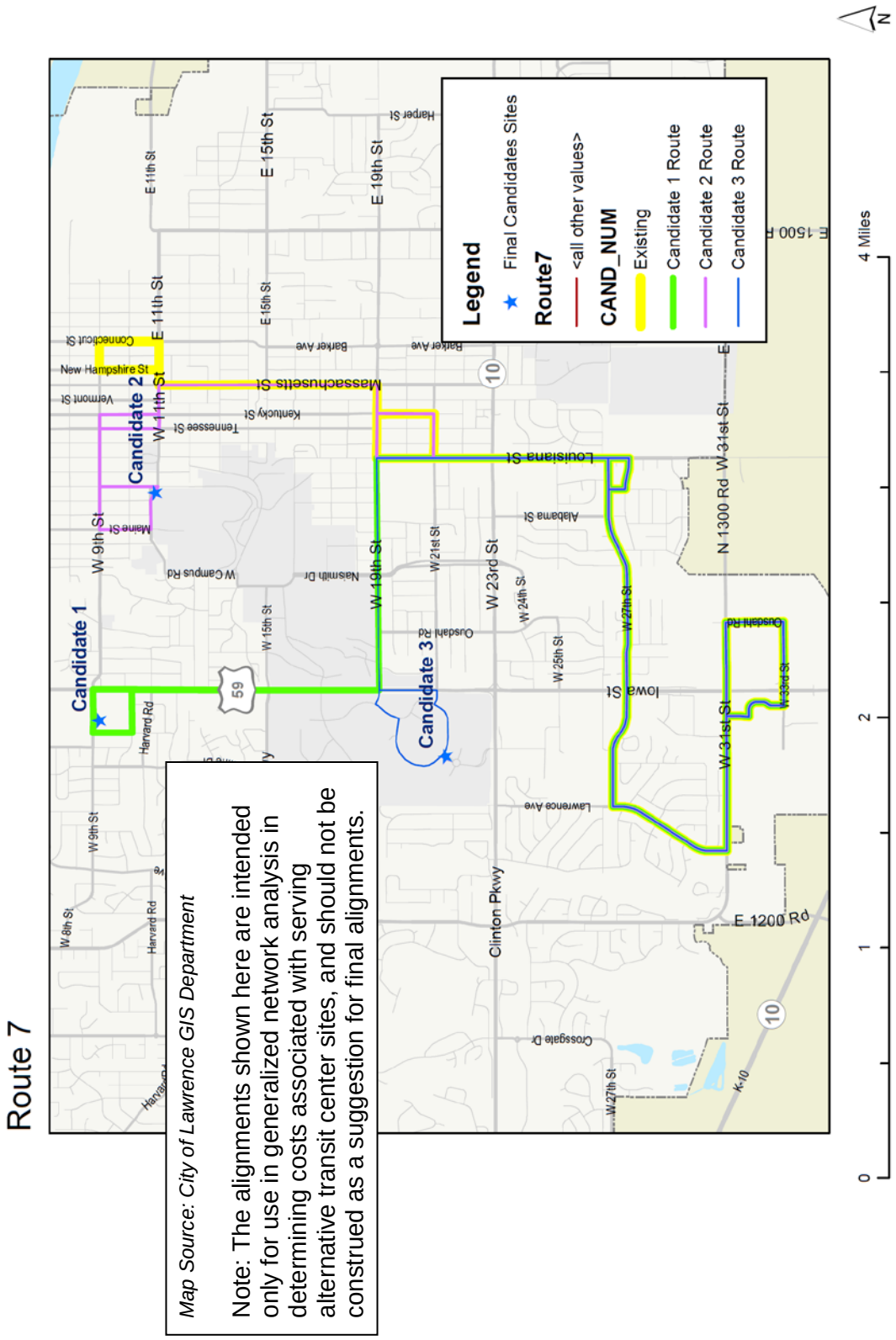
Route 4



Map Source: City of Lawrence GIS Department

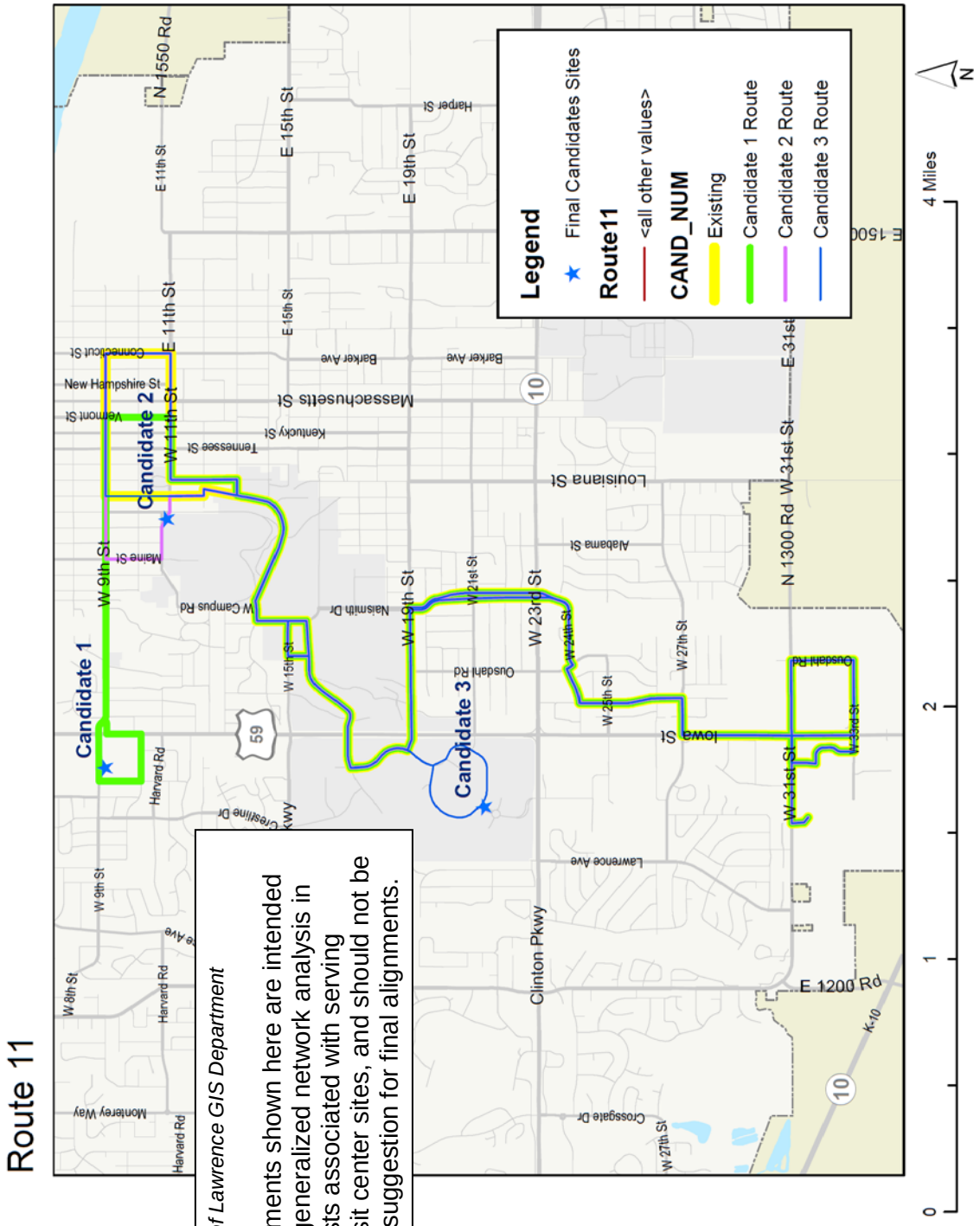
Note: The alignments shown here are intended only for use in generalized network analysis in determining costs associated with serving alternative transit center sites, and should not be construed as a suggestion for final alignments.


Route 6
Map Source: City of Lawrence GIS Department
Note: The alignments shown here are intended only for use in generalized network analysis in determining costs associated with serving alternative transit center sites, and should not be construed as a suggestion for final alignments.
Legend
Final Candidates Sites
Route6
<all other values>
CAND_NUM
Existing
Candidate 1 Route
Candidate 2 Route
Candidate 3 Route
Candidate 1
Candidate 2
Candidate 3
W 6th St
W 9th St
Iowa St
Massachusetts St
Vermont St
Wakarusa Dr
Kasold Dr
Bob Billings Pkwy
W 19th St
W 23rd St
Louisiana St
N 2nd St
0
1
2
4 Miles
N



Map Source: City of Lawrence GIS Department

Note: The alignments shown here are intended only for use in generalized network analysis in determining costs associated with serving alternative transit center sites, and should not be construed as a suggestion for final alignments.



Map Source: City of Lawrence GIS Department

Note: The alignments shown here are intended only for use in generalized network analysis in determining costs associated with serving alternative transit center sites, and should not be construed as a suggestion for final alignments.

Appendix E – 2021 Site Rendering and Elevations

Lawrence Transit Center - w 21ST & STEWART AVE

October 02, 2013

OLSSON ASSOCIATES

1" = 30'-0"

N

Disclaimer:
Elevation drawings are based on conceptual site plan created for costing and conceptualization purpose only. Eventual design details and elements may differ.

ELEVATION CUT at 21ST STREET LOOKING NORTH

ELEVATION FROM 21st STREET & STEWART AVE. LOOKING NORTHWEST

Conceptual Transit Center

21st & Iowa, Lawrence, Kansas

April 7, 2014

OLSSON ASSOCIATES

1" = 20'-0"

N

ELEVATION CUT at 21ST STREET LOOKING NORTH

Disclaimer:
Elevation drawings are based on conceptual site plan created for costing and conceptualization purpose only. Eventual design details and elements may differ.

Conceptual Transit Center

21st & Iowa, Lawrence, Kansas

April 7, 2014

OLSSON ASSOCIATES

1" = 30'-0"

N

ELEVATION FROM 21st STREET & STEWART AVE. LOOKING NORTHWEST

Disclaimer:
Elevation drawings are based on conceptual site plan created for costing and conceptualization purpose only. Eventual design details and elements may differ.

Conceptual Transit Center

21st & Iowa, Lawrence, Kansas

April 7, 2014

OLSSON ASSOCIATES

1" = 30'-0"

N

Appendix F – Final site costs and Traffic Study

9th St. & Iowa St. Transit Center

Preliminary Opinion of Probable Construction Costs

11-Sep-13

	Transit Center	QTY	UNITS	COST	TOTAL
1	Mobilization	1	LS	$48,000.00	$48,000.00
2	Clearing/Grubing/limited site demolition	1	LS	$85,000.00	$85,000.00
3	Structure / 9,000 sq ft	1	LS	$900,000.00	$900,000.00
4	Restroom Building	1	LS	$100,000.00	$100,000.00
5	Information Kiosk	1	EA	$15,000.00	$15,000.00
6	Construction Staking	1	LS	$10,000.00	$10,000.00
7	Earthwork	8000	CY	$12.00	$96,000.00
8	Monument Sign with Utility Hookup	1	LS	$10,000.00	$10,000.00
9	Private Utilities	1	LS	$30,000.00	$30,000.00
10	Retaining walls	1600	SFF	$20.00	$32,000.00
11	Erosion Control	1	LS	$18,000.00	$18,000.00
12	Seeding	0.7	ACRE	$2,000.00	$1,400.00
13	ADA ram-conc. w/ truncated domes	5	EA	$1,800.00	$9,000.00
14	bollards	20	EA	$900.00	$18,000.00
15	Pavement Markings	1	LS	$4,500.00	$4,500.00
16	Site Lighting	10	EA	$6,000.00	$60,000.00
17	Traffic Control	1	LS	$18,000.00	$18,000.00
18	Irrigation	1	LS	$7,000.00	$7,000.00
19	Landscaping	1	LS	$50,000.00	$50,000.00
20	Bench	20	EA	$2,000.00	$40,000.00
21	Bike rack	2	EA	$2,500.00	$5,000.00
22	Litter receptacle	6	EA	$1,250.00	$7,500.00
23	Digital Reader Board	8	EA	$10,000.00	$80,000.00
24	New Curb and Gutter	1400	LF	$20.00	$28,000.00
25	Decorative Crosswalk	710	SF	$20.00	$14,200.00
26	Concrete Pavement 10"	2474	SY	$75.00	$185,550.00
27	Concrete Sidewalk 4"	8000	SF	$5.50	$44,000.00
28	Storm Sewer Inlets	4	EA	$3,000.00	$12,000.00
29	Storm Sewer Pipe	600	LF	$75.00	$45,000.00
		Transit Center Sub-Total			$1,840,150.00

	Off-Site Improvements	QTY	UNITS	COST	TOTAL
		Off-Site Improvements Sub-Total			$0.00

	Reconfigured Parking Lot	QTY	UNITS	COST	TOTAL
1	Asphalt Pavement 8"	3780	SY	$45.00	$170,100.00
2	New Curb & Gutter	1400	LF	$20.00	$28,000.00
3	Concrete Sidewalk 4"	3200	SF	$5.50	$17,600.00
3	Storm Sewer Inlets	4	EA	$3,000.00	$12,000.00
4	Storm Sewer Pipe	200	LF	$75.00	$15,000.00
5	Pavement Markings	1	LS	$2,500.00	$2,500.00
6	Landscape	1	LS	$15,000.00	$15,000.00
7	Site Lighting	6	EA	$6,000.00	$36,000.00
		Reconfigured Parking Lot Sub-Total			$296,200.00

Project Sub-Total:	**$2,136,350.00**
Contingency 20%	**$427,270.00**
Project Total:	**$2,563,620.00**

21st Street & Stewart Drive

Preliminary Opinion of Probable Construction Costs

2-Oct-13

	Transit Center	QTY	UNITS	COST	TOTAL
1	Mobilization	1	LS	$48,000.00	$48,000.00
2	Clearing/Grubing/limited site demolition	1	LS	$45,000.00	$45,000.00
3	Structure / 9,000 sq ft	1	LS	$900,000.00	$900,000.00
4	Restroom Building	1	LS	$100,000.00	$100,000.00
5	Information Kiosk	1	EA	$15,000.00	$15,000.00
6	Construction Staking	1	LS	$10,000.00	$10,000.00
7	Earthwork	5000	CY	$12.00	$60,000.00
8	Monument Sign with Utility Hookup	1	LS	$10,000.00	$10,000.00
9	Private Utilities	1	LS	$30,000.00	$30,000.00
10	Retaining walls	0	SFF	$20.00	$0.00
11	Erosion Control	1	LS	$18,000.00	$18,000.00
12	Seeding	1	ACRE	$2,000.00	$2,000.00
13	ADA ramp-conc. w/ truncated domes	6	EA	$1,800.00	$10,800.00
14	bollards	20	EA	$900.00	$18,000.00
15	Pavement Markings	1	LS	$4,500.00	$4,500.00
16	Site Lighting	10	EA	$6,000.00	$60,000.00
17	Traffic Control	1	LS	$18,000.00	$18,000.00
18	Irrigation	1	LS	$7,000.00	$7,000.00
19	Landscaping	1	LS	$60,000.00	$60,000.00
20	Bench	20	EA	$2,000.00	$40,000.00
21	Bike rack	2	EA	$2,500.00	$5,000.00
22	Litter receptacle	6	EA	$1,250.00	$7,500.00
23	Digital Reader Board	8	EA	$10,000.00	$80,000.00
24	New Curb and Gutter	1851	LF	$20.00	$37,020.00
25	Decorative Crosswalk	1000	SF	$20.00	$20,000.00
26	Concrete Pavement 10"	3444	SY	$75.00	$258,300.00
27	Concrete Sidewalk 4"	10734	SF	$5.50	$59,037.00
28	Storm Sewer Inlets	4	EA	$3,000.00	$12,000.00
29	Storm Sewer Pipe	500	LF	$75.00	$37,500.00
			Transit Center Sub-Total		$1,879,657.00

	Off-Site Improvements	QTY	UNITS	COST	TOTAL
1	Demolition	1	LS	$30,000.00	$30,000.00
2	Traffic Control	1	LS	$25,000.00	$25,000.00
3	Asphalt Pavement 8"	320	SY	$45.00	$14,400.00
4	New Curb & Gutter	320	LF	$20.00	$6,400.00
5	Concrete Sidewalk 4"	1700	SF	$5.50	$9,350.00
6	Pavement Markings	1	LS	$3,000.00	$3,000.00
7	Storm Sewer Inlet Modification	2	LS	$6,500.00	$13,000.00
8	Storm Sewer Pipe	40	LF	$75.00	$3,000.00
9	Landscape	1	LS	$4,500.00	$4,500.00
10	Site Lighting	4	EA	$6,000.00	$24,000.00
			Off-Site Improvements Sub-Total		$132,650.00

Project Sub-Total:	**$2,012,307.00**
Contingency 20%	**$402,461.40**
Project Total:	**$2,414,768.40**

ENGINEER'S ESTIMATE (CONSTRUCTION COSTS)

(Concept Level)

Client: City of Lawrence
Project: Lawrence Transit Center Location Analysis
Project Number: 013-0542
Date: 2/25/2014

SUMMARY OF COSTS

Item	EXISTING PLUS TRANSIT CENTER - 9TH ST & ROCKLEDGE ROAD			
1	**Replacing the pavement on 9th between Rockledge and Iowa as well as the N. leg of Rockledge in order to install a left turn lane**			
	a. Reconstruct N. Leg of Rockledge to add left turn lane and			
	9th St. from Rockledge to Iowa including new storm sewer.	**SUBTOTAL**		**$1,376,412.00**
	b. Rebuild sidewalks and entrances.	**CONTINGENCY**	**25%**	**$344,103.00**
		OPINION OF PROBABLE COST		**$1,720,515.00**

TOTAL CONSTRUCTION COSTS WITH CONTINGENCY $1,720,515.00

EXISTING PLUS TRANSIT CENTER - 21st St. & Iowa Street				
2	**Extend Westbound Left turn lane from 50' to 150' plus taper**			
	a. Widen existing pavement to achieve 150' left turn bay.			
	b. Mill and overlay existing pavement in order to	**SUBTOTAL**		**$39,983.00**
	install clean pavement markings.	**CONTINGENCY**	**20%**	**$7,996.60**
		OPINION OF PROBABLE COST		**$47,979.60**
3	**Add Left Turn Lane to the West Leg of 21st & Iowa**			
	a. Widen existing pavement from Iowa to Becker Drive to achieve			
	a 150' left turn bay	**SUBTOTAL**		**$82,076.00**
	b. Mill and overlay existing pavement in order to	**CONTINGENCY**	**20%**	**$16,415.20**
	install clean pavement markings.	**OPINION OF PROBABLE COST**		**$98,491.20**
	c. Replace two ADA ramps.			
4	**Add NB Right Turn Lane to 21st & Iowa**			
	a. Widen existing pavement to achieve 250' right turn bay.			
	b. Replace one ADA ramp.	**SUBTOTAL**		**$92,877.00**
	c. Replace 5' sidewalk.	**CONTINGENCY**	**20%**	**$18,575.40**
	d. Move 2 curb inlets east.	**OPINION OF PROBABLE COST**		**$111,452.40**
5	**Replace W. 21st St. from Iowa to Stewart and Stewart St from 21st St. to Transit Center Entrance**			
	a. Total reconstruction of pavement with 10" concrete.			
	b. New sidewalk.	**SUBTOTAL**		**$521,798.00**
	c. Install 8 ADA ramps	**CONTINGENCY**	**25%**	**$130,449.50**
	d. Rebuild entrance on the east side of Stewart.	**OPINION OF PROBABLE COST**		**$652,247.50**
	e. Install new storm sewer system.			
6	**Install Traffic Signal at 21st St. & Iowa and Restripe the South Leg to Include a 150' Left-Turn Lane**			
	a. Traffic Signal and Pavement Markings			
		SUBTOTAL		**$165,000.00**
		CONTINGENCY	**20%**	**$33,000.00**
		OPINION OF PROBABLE COST		**$198,000.00**

TOTAL CONSTRUCTION COSTS FOR ITEMS 3 THROUH 6 WITH CONTINGENCY $1,060,191.10

The Engineer, using his or her professional judgment, has developed this stated Opinion of Probable Construction Cost based upon the design status identified above. Development of this Opinion has included consideration of design input level; however, the circumstances under which the work is expected to be undertaken, the cost and availability of materials, labor and services, probable bidder response and the economic conditions at the time of bid solicitation are beyond the control of the Engineer and will impact actual bid costs. Should bidding be delayed, these costs should be reviewed and, if necessary, adjusted to a more applicable *Engineering News Record* Construction Cost Index.

ENGINEER'S ESTIMATE (CONSTRUCTION COSTS)

(Concept Level)

Client: City of Lawrence
Project: Lawrence Transit Center Location Analysis
Project Number: 013-0542
Date: 2/25/2014

	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST $	COST $
	EXISTING PLUS TRANSIT CENTER - 9TH ST & ROCKLEDGE ROAD				
	Replacing the pavement on 9th between Rockledge and Iowa as well as the N. leg of Rockledge in order to install a left turn lane				
1	Removal of Existing Structures	1	Lump Sum	$25,000.00	$25,000.00
2	Unclassified Excavation	5500	Cu. Yd.	$25.00	$137,500.00
3	Compaction of Earthwork (All types)	4000	Cu. Yd.	$18.00	$72,000.00
4	Fly Ash	385	Ton	$45.00	$17,325.00
5	Manipulation for Fly Ash Treated Subgrade (9")	6914	Sq. Yd.	$5.50	$38,027.00
6	Concrete Pavement (8")(NRDJ)	5775	Sq. Yd.	$80.00	$462,000.00
7	Concrete Driveway (6")	561	Sq. Yd.	$55.00	$30,855.00
8	Curb and Gutter Combined	3034	Lin. Ft.	$25.00	$75,850.00
9	Sidewalk Construction (4")	7951	Sq. Ft.	$5.00	$39,755.00
10	Sidewalk Ramp	25	Each	$2,500.00	$62,500.00
11	Inlet (Curb)(6'x4')(Complete)	10	Each	$5,000.00	$50,000.00
12	Inlet (Curb)(6'x6')(Complete)	4	Each	$6,500.00	$26,000.00
13	Junction Box (5'x5')(Complete)	4	Each	$5,000.00	$20,000.00
14	15" Storm Sewer (RCP Class III)	250	Lin. Ft.	$75.00	$18,750.00
15	24" Storm Sewer (RCP Class III)	470	Lin. Ft.	$110.00	$51,700.00
16	30" Storm Sewer (RCP Class III)	500	Lin. Ft.	$130.00	$65,000.00
17	36" Storm Sewer (RCP Class III)	500	Lin. Ft.	$165.00	$82,500.00
18	Modification of Storm Structure	4	Each	$2,500.00	$10,000.00
19	Sod	3700	Sq. Yd.	$4.50	$16,650.00
20	Pavement Marking & Signing	1	Lump Sum	$25,000.00	$25,000.00
21	Traffic Control	1	Lump Sum	$10,000.00	$10,000.00
22	Contractor Construction Staking	1	Lump Sum	$20,000.00	$20,000.00
23	Erosion Control	1	Lump Sum	$20,000.00	$20,000.00
			SUBTOTAL		**$1,376,412.00**
			CONTINGENCY	**25%**	**$344,103.00**
			OPINION OF PROBABLE COST		**$1,720,515.00**
	EXISTING PLUS TRANSIT CENTER - 21ST ST & IOWA STREET				
	Extend Westbound Left turn lane from 50' to 150' plus taper				
1	Removal of Existing Structures	1	Lump Sum	$2,000.00	$2,000.00
2	Unclassified Excavation	53	Cu. Yd.	$36.00	$1,908.00
3	Compaction of Earthwork (All types)	50.00	Cu. Yd.	$18.00	$900.00
4	Aggregate for base (AB-3)	66	Ton	$35.00	$2,310.00
5	Milling (2.5")	1042	Sq. Yd.	$2.50	$2,605.00
6	Asphalt Surface Course 2.5"	158	Ton	$70.00	$11,060.00
7	Concrete Pavement (7")	70	Sq. Yd.	$75.00	$5,250.00
8	Curb and Gutter Combined	318	Lin. Ft.	$25.00	$7,950.00
9	Pavement Marking	1	Lump Sum	$1,000.00	$1,000.00
10	Traffic Control	1	Lump Sum	$2,500.00	$2,500.00
11	Contractor Construction Staking	1	Lump Sum	$1,500.00	$1,500.00
12	Erosion Control	1	Lump Sum	$1,000.00	$1,000.00
			SUBTOTAL		**$39,983.00**
			CONTINGENCY	**20%**	**$7,996.60**
			OPINION OF PROBABLE COST		**$47,979.60**

OLSSON ASSOCIATES

ENGINEER'S ESTIMATE (CONSTRUCTION COSTS)

(Concept Level)

Client: City of Lawrence
Project: Lawrence Transit Center Location Analysis
Project Number: 013-0542
Date: 2/25/2014

	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST $	COST $
	Add Left Turn Lane to the West Leg of 21st & Iowa				
1	Removal of Existing Structures	1	Lump Sum		
2	Unclassified Excavation	324	Cu. Yd.	$36.00	$11,664.00
3	Compaction of Earthwork (All types)	324	Cu. Yd.	$18.00	$5,832.00
4	Aggregate for base (AB-3)	167	Ton	$35.00	$5,845.00
5	Milling (2.5")	758	Sq. Yd.	$2.50	$1,895.00
6	Asphalt Surface Course 2.5"	147	Ton	$70.00	$10,290.00
7	Concrete Pavement (7")	292	Sq. Yd.	$75.00	$21,900.00
8	Curb and Gutter Combined	546	Lin. Ft.	$25.00	$13,650.00
9	Sidewalk Construction (4")	100	Sq. Ft.	$5.00	$500.00
10	Sidewalk Ramp	2	Each	$2,500.00	$5,000.00
11	Pavement Marking	1	Lump Sum	$1,500.00	$1,500.00
12	Traffic Control	1	Lump Sum	$1,000.00	$1,000.00
13	Contractor Construction Staking	1	Lump Sum	$1,500.00	$1,500.00
14	Erosion Control	1	Lump Sum	$1,500.00	$1,500.00
			SUBTOTAL		**$82,076.00**
			CONTINGENCY	**20%**	**$16,415.20**
			OPINION OF PROBABLE COST		**$98,491.20**
	Add NB Right Turn Lane to 21st & Iowa				
1	Removal of Existing Structures	1	Lump Sum	$1,000.00	$1,000.00
2	Unclassified Excavation	327	Cu. Yd.	$36.00	$11,772.00
3	Compaction of Earthwork (All types)	300	Cu. Yd.	$18.00	$5,400.00
4	Aggregate for base (AB-3)	163	Ton	$35.00	$5,705.00
6	Asphalt Surface Course 2.5"	50	Ton	$70.00	$3,500.00
7	Concrete Pavement (7")	356	Sq. Yd.	$75.00	$26,700.00
8	Curb and Gutter Combined	327	Lin. Ft.	$25.00	$8,175.00
9	Sidewalk Construction (4")	1465	Sq. Ft.	$5.00	$7,325.00
10	Sidewalk Ramp	1	Each	$2,500.00	$2,500.00
11	Inlet (Curb)(6'x4')(Complete)	2	Each	$5,000.00	$10,000.00
12	18" Storm Sewer (RCP Class III)	20	Lin. Ft.	$90.00	$1,800.00
13	Modification of Storm Structure	2	Each	$2,500.00	$5,000.00
14	Pavement Marking	1	Lump Sum	$500.00	$500.00
15	Traffic Control	1	Lump Sum	$1,000.00	$1,000.00
16	Contractor Construction Staking	1	Lump Sum	$1,000.00	$1,000.00
17	Erosion Control	1	Lump Sum	$1,500.00	$1,500.00
			SUBTOTAL		**$92,877.00**
			CONTINGENCY	**20%**	**$18,575.40**
			OPINION OF PROBABLE COST		**$111,452.40**

OLSSON ASSOCIATES

ENGINEER'S ESTIMATE (CONSTRUCTION COSTS)

(Concept Level)

Client: City of Lawrence
Project: Lawrence Transit Center Location Analysis
Project Number: 013-0542
Date: 2/25/2014

	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST $	COST $
	Replace W. 21st St. from Iowa to Stewart and Stewart St from 21st St. to North Transit Center Entrance				
1	Removal of Existing Structures	1	Lump Sum	$5,000.00	$5,000.00
2	Unclassified Excavation	3266	Cu. Yd.	$25.00	$81,650.00
3	Compaction of Earthwork (All types)	980	Cu. Yd.	$18.00	$17,640.00
4	Fly Ash	182	Ton	$45.00	$8,190.00
5	Manipulation for Fly Ash Treated Subgrade (9")	3266	Sq. Yd.	$5.50	$17,963.00
6	Concrete Pavement (8")(NRDJ)	1870	Sq. Yd.	$80.00	$149,600.00
7	Concrete Driveway (6")	97	Sq. Yd.	$55.00	$5,335.00
8	Curb and Gutter Combined	1673	Lin. Ft.	$25.00	$41,825.00
9	Sidewalk Construction (4")	5269	Sq. Ft.	$5.00	$26,345.00
10	Sidewalk Ramp	8	Each	$2,500.00	$20,000.00
11	Inlet (Curb)(6'x4')(Complete)	6	Each	$5,000.00	$30,000.00
12	18" Storm Sewer (RCP Class III)	100	Lin. Ft.	$90.00	$9,000.00
13	24" Storm Sewer (RCP Class III)	680	Lin. Ft.	$110.00	$74,800.00
14	30" Storm Sewer (RCP Class III)	30	Lin. Ft.	$130.00	$3,900.00
15	Modification of Storm Structure	1	Each	$2,500.00	$2,500.00
16	Sod	1900	Sq. Yd.	$4.50	$8,550.00
17	Pavement Marking	1	Lump Sum	$2,000.00	$2,000.00
18	Traffic Control	1	Lump Sum	$10,000.00	$10,000.00
19	Contractor Construction Staking	1	Lump Sum	$2,500.00	$2,500.00
20	Erosion Control	1	Lump Sum	$5,000.00	$5,000.00
			SUBTOTAL		**$521,798.00**
			CONTINGENCY	**25%**	**$130,449.50**
			OPINION OF PROBABLE COST		**$652,247.50**
	Install Traffic Signal at 21st St. & Iowa and Restripe the South Leg to Include a 150' Left-Turn Lane				
1	Traffic Signal and Pavement Markings	1	Lump Sum	$165,000.00	$165,000.00
			SUBTOTAL		**$165,000.00**
			CONTINGENCY	**20%**	**$33,000.00**
			OPINION OF PROBABLE COST		**$198,000.00**

The Engineer, using his or her professional judgment, has developed this stated Opinion of Probable Construction Cost based upon the design status identified above. Development of this Opinion has included consideration of design input level; however, the circumstances under which the work is expected to be undertaken, the cost and availability of materials, labor and services, probable bidder response and the economic conditions at the time of bid solicitation are beyond the control of the Engineer and will impact actual bid costs. Should bidding be delayed, these costs should be reviewed and, if necessary, adjusted to a more applicable *Engineering News Record* Construction Cost Index.

LAWRENCE TRANSIT CENTER LOCATION ANALYSIS

9TH STREET & ROCKLEDGE ROAD / 21ST STREET & IOWA STREET

LAWRENCE, KANSAS

TRAFFIC IMPACT STUDY

FEBRUARY 2014

OA Project No. 2013-0542

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

This report studies traffic impacts regarding the proposed construction of the Lawrence Transit Center that is proposed to be located in two possible sites within the City. The first location, 925 Iowa Street, is in the southeast quadrant of the intersection of 9th Street and Centennial Drive and the second location, 2021 Stewart Avenue, is in the northeast quadrant of the intersection of 21st Street & Iowa Street. Both locations are located in Lawrence, Kansas. The approximate locations for the Transit Center are shown in the vicinity maps, **Figures 1-2**.

The objective of this study is to evaluate the existing traffic and roadway conditions and the traffic impacts expected from the proposed Transit Center. The appropriate intersection geometrics and traffic control improvements necessary to accommodate the increased traffic on the study area roadways were identified. For the purpose of this study the Existing and Existing plus Proposed Transit Center scenarios were evaluated for the AM and PM peak hour periods. City of Lawrence staff was contacted regarding the scope of the project.

The study area intersections included:

- 9th Street & Rockledge Road
- 9th Street & Iowa Street
- 21st Street & Iowa Street
- 21st Street & Ousdahl Road
- 21st Street & Naismith Drive

2.0 DESCRIPTION OF PROPOSED TRANSIT CENTER

The proposed Transit Center will be located in the City of Lawrence, KS. There are two locations being reviewed for the proposed Transit Center.

2.1 Description of Proposed Transit Center – 9th Street and Rockledge Road

The Transit Center is proposed to be located along 9th Street on the east side of Centennial Drive. The Transit Center will be bound by 9th Street to the north, the Pool Room's parking lot to the east, a commercial building to the south, and Centennial Drive to the west. The proposed Transit Center includes an oval Transit Center with approximately eight bus slots going around the center and two bus slots on the south side of the road, along 9th Street.

Access to the site is proposed via one full access drive. The proposed drive will relocate an existing drive east approximately 45'.

The site plan for the proposed Transit Center is illustrated in **Figure 3**.

2.1.1 Roadway Classification and Characteristics

Completing an analysis of the existing traffic and roadway conditions in the vicinity of the Transit Center site allows for a comparison to aid in determining the impact of the proposed Transit Center site to the surrounding roadway network.

In the vicinity of the study site, 9th Street is an east/west two-lane undivided major collector with a posted speed limit of 30 mph. In the project area, undivided local streets that intersect with 9th Street are stop controlled. Study intersections along 9th Street include Rockledge Road.

Iowa Street is a north/south four-lane undivided principal arterial with a posted speed limit of 35 mph. The intersection of 9th Street and Iowa Street is a signalized intersection with auxiliary left-turn lanes on all approaches and auxiliary right-turn lanes in the eastbound and westbound directions.

Rockledge Road is a north/south two-lane undivided major collector with no posted speed limit. Rockledge Road provides access to residential streets.

2.2 Description of Proposed Transit Center – 21st Street and Iowa Street

The Transit Center is proposed to be located along 21st Street on the east side of Iowa Street. A parking lot to the north, Stewart Street to the east, 21st Street to the south, and Iowa Street to the west will bind the Transit Center. The proposed Transit Center includes an oval Transit Center with approximately eight bus slots going around the center and two bus slots on south side of the center.

Access to the site along 21st Street is proposed via two full access drives. Drive 1 will be located along Stewart Avenue and Drive 2 will be located along 21st Street.

The site plan for the proposed Transit Center is illustrated in **Figure 4**.

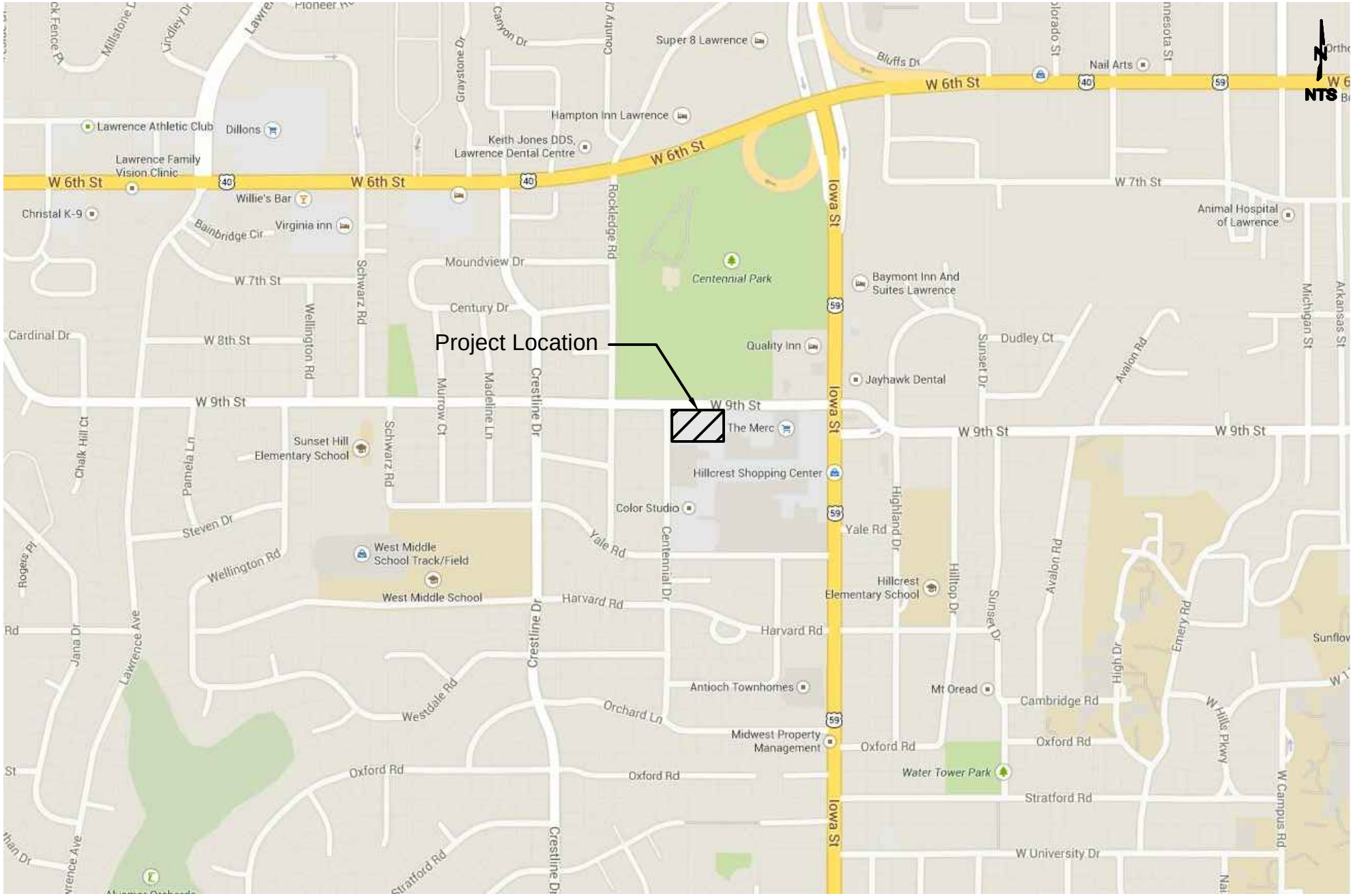
2.2.1 Roadway Classification and Characteristics

In the vicinity of the study site, 21st Street is an east/west two-lane undivided local roadway with a posted speed limit of 30 mph. 21st Street is stop-controlled at all study intersections.

Iowa Street is a north/south four-lane undivided principle arterial with a posted speed limit of 40 mph. Iowa Street has a two-way left-turn lane going northbound at the intersection of 21st Street and Iowa Street.

Ousdahl Road is a north/south two-lane undivided local roadway with no posted speed limit. Ousdahl Road provides access to residential streets. The intersection of 21st Street and Ousdahl Road is an all-way stop controlled intersection.

Naismith Drive is a north/south two-lane divided major collector with a posted speed limit of 30 mph. Naismith has auxiliary left-turn lanes in the northbound and southbound directions.

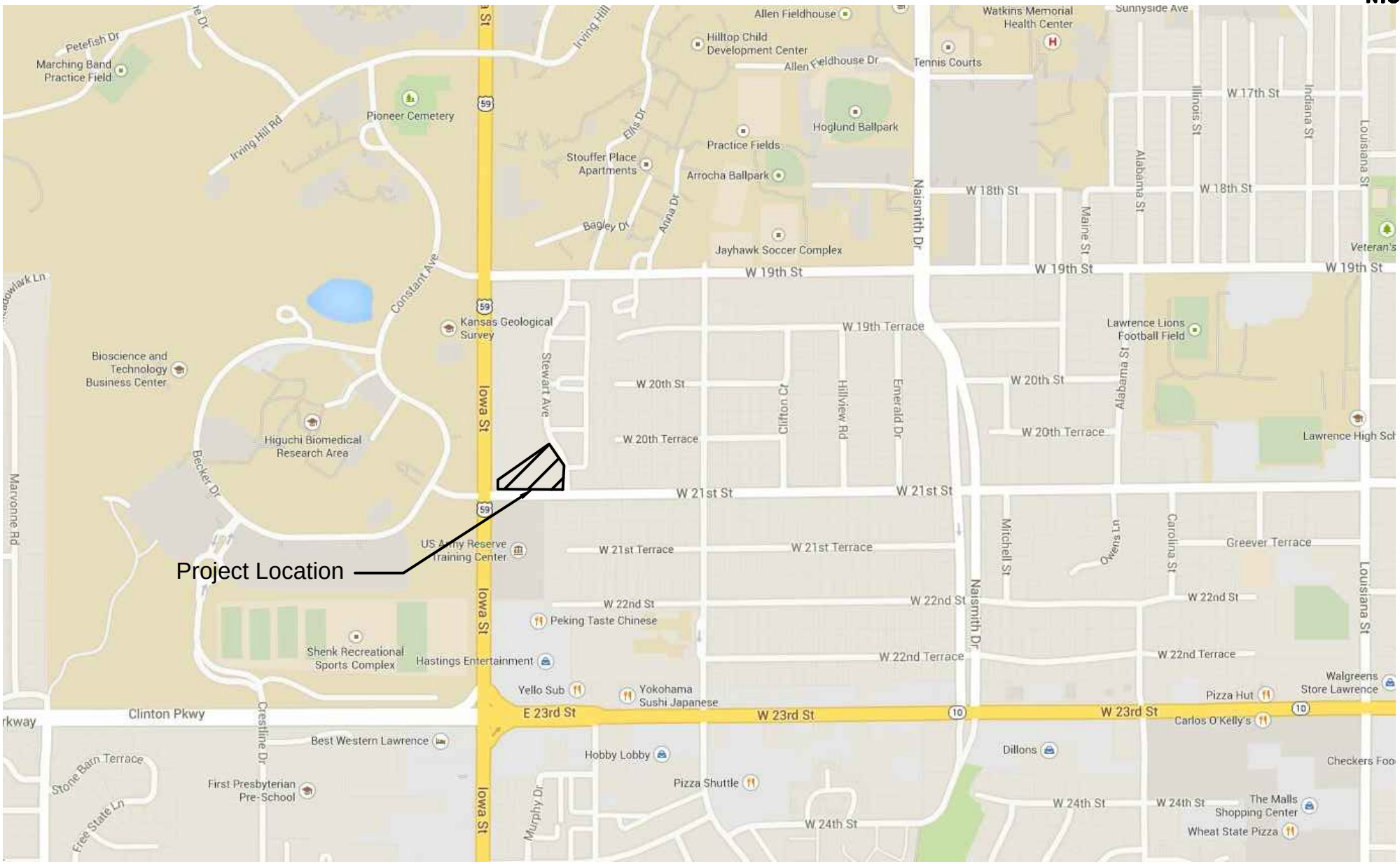


SOURCE: GOOGLE MAPS

PROJECT NO: 013-0542 DRAWN BY: JMS DATE: 2-12-14	Vicinity Map 9th Street & Rockledge Road	OLSSON ASSOCIATES 7301 West 133rd Street Suite 200 Overland Park, KS 66213-4750 TEL 913.381.1170 FAX 913.381.1174

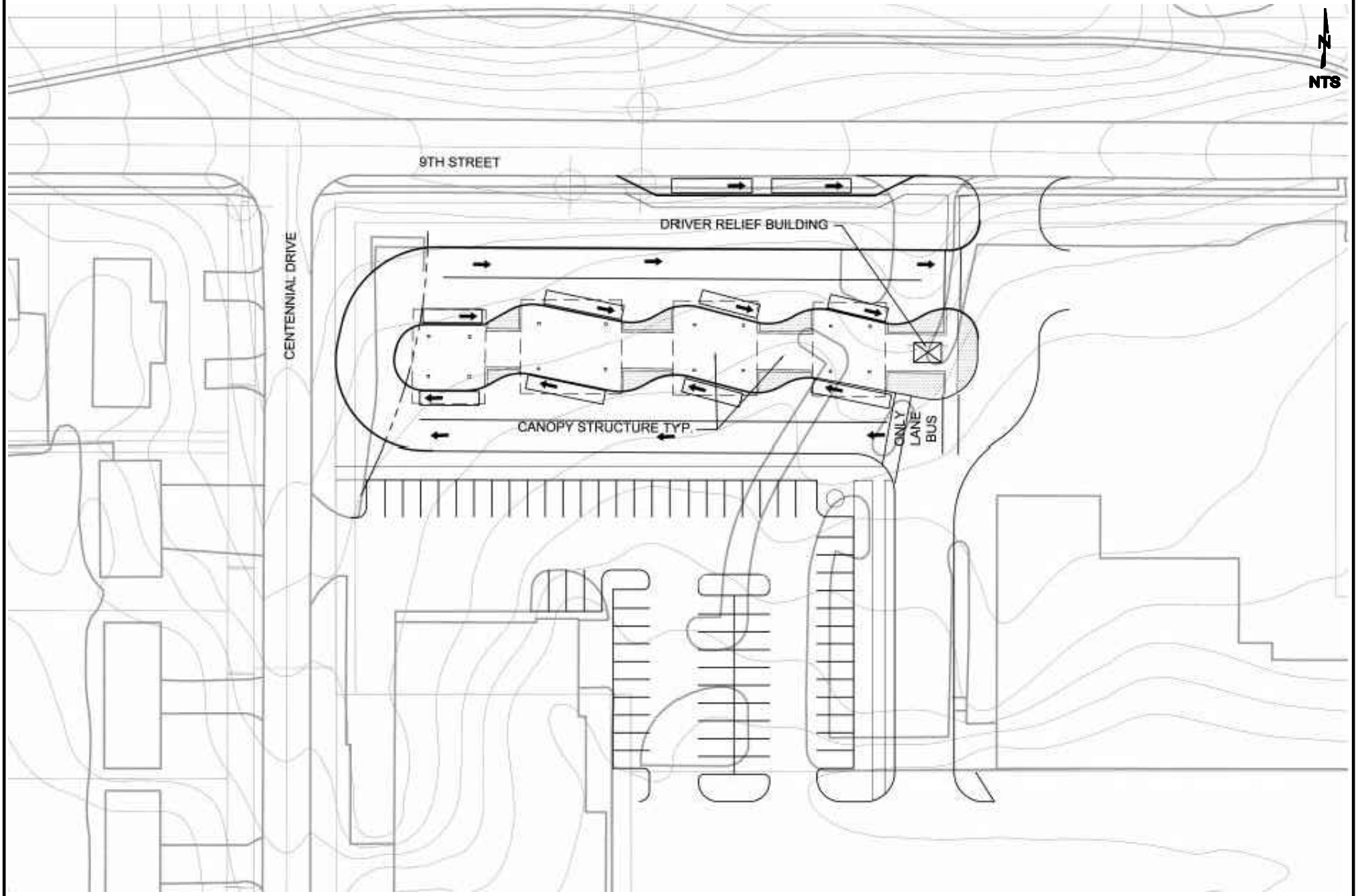
FIGURE

1

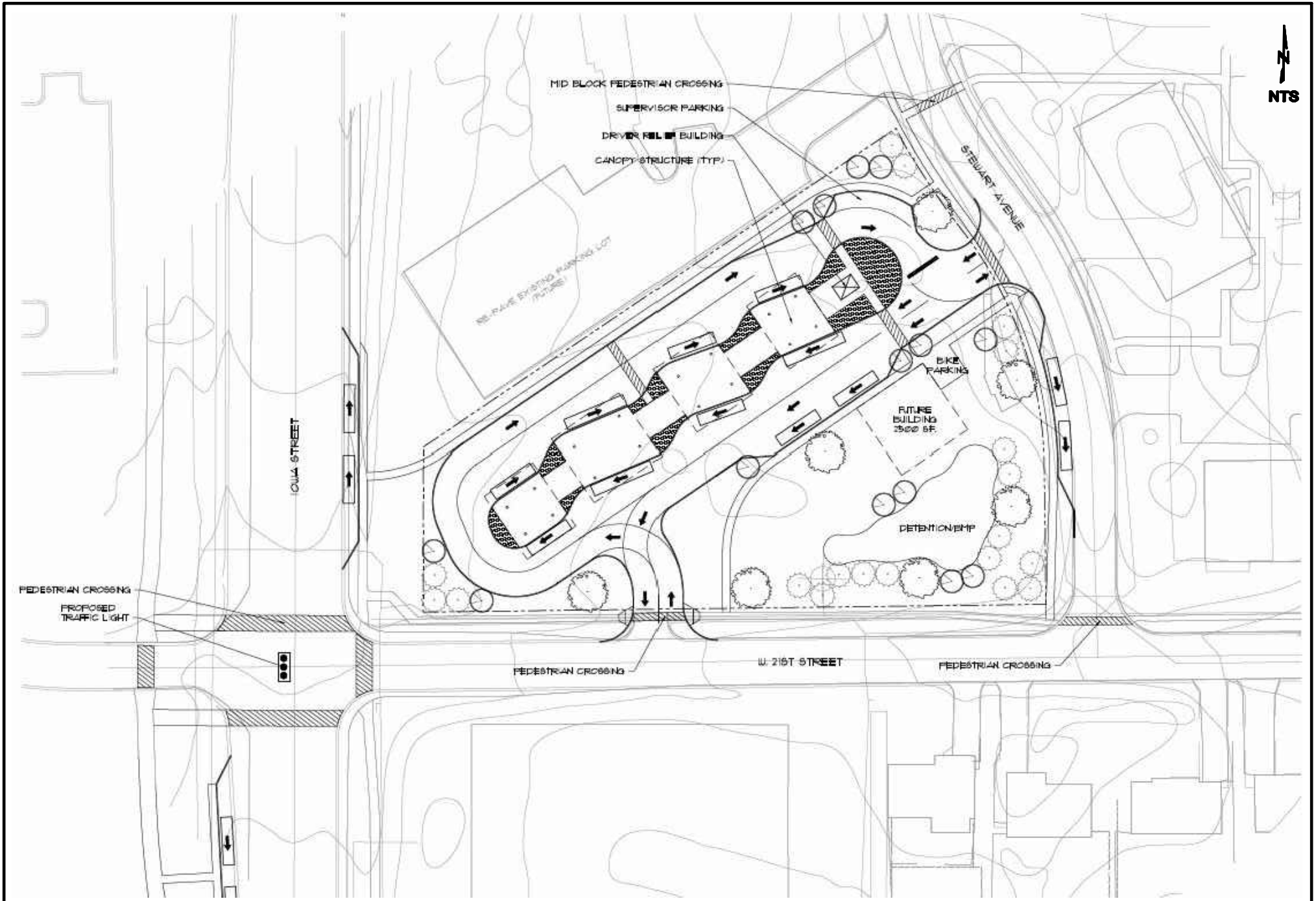


SOURCE: GOOGLE MAPS

PROJECT NO: 013-0542 DRAWN BY: JMS DATE: 2-12-14	Vicinity Map 21st Street & Iowa Street	OLSSON ASSOCIATES	7301 West 133rd Street Suite 200 Overland Park, KS 66213-4750 TEL 913.381.1170 FAX 913.381.1174	FIGURE 2



PROJECT NO: 013-0542	Site Plan 9th Street & Rockledge Road	OLSSON ASSOCIATES 7301 West 133rd Street Suite 200 Overland Park, KS 66213-4750 TEL 913.381.1170 FAX 913.381.1174	FIGURE
DRAWN BY: JMS			3
DATE: 2-12-14			



PROJECT NO: 013-0542	Site Plan 21st Street & Iowa Street	OLSSON ASSOCIATES 7301 West 133rd Street Suite 200 Overland Park, KS 66213-4750 TEL 913.381.1170 FAX 913.381.1174	FIGURE
DRAWN BY: JMS			4
DATE: 2-12-14			

3.0 DATA COLLECTION

Olsson Associates collected AM and PM peak hour traffic counts at the intersections of 9th Street and Rockledge Road and 21st Street and Iowa Street. This traffic count data was collected on December 10th-12th, 2013. Based on the traffic count data, the AM peak hour period for both intersections is from 7:30 to 8:30 AM. The PM peak hour period for 9th Street and Rockledge Road is from 4:45 to 5:45 PM and for 21st Street and Iowa Street the peak hour is from 5:00 to 6:00 PM.

Additional turning movement counts were collected at the intersections of 9th Street and Iowa Street, 21st Street and Ousdahl Road, and 21st Street and Naismith Drive. The count data was collected on January 29th-30th and February 6th and 11th, 2014. This count data was utilized in determining any geometric changes needed within the site area.

In addition to manual turning movement counts, Olsson Associates completed machine 24-hour counts along each approach at the study intersections of 9th Street and Rockledge Road and 21st Street and Iowa Street on December 10th-11th, 2013.

Traffic count data is included in the **Appendix**.

4.0 EXISTING TRAFFIC CONDITIONS

The analysis of existing conditions is based on the traffic counts collected for the study intersections. **Sections 2.1.1** and **2.2.1** detail roadway classification and intersection characteristics for the existing network. Existing traffic volumes used for analysis are illustrated in **Figures 5** and **8**. The existing intersection geometrics and traffic control for the study area intersections are illustrated in **Figures 6** and **9**.

4.1 9th Street & Rockledge Road Existing Conditions

The existing conditions for the 9th Street and Rockledge Road site, east of the intersection of 9th Street and Rockledge Road, were reviewed and signal warrant analysis and capacity analysis were completed.

4.1.1 Signal Warrant Analysis

The Manual on Uniform Traffic Control Devices (MUTCD – 2009 Edition) provides eight signal warrants for evaluation of signalization at intersections. Typically, traffic signal warrants are based on a complete review of traffic information including volumes, pedestrians, accidents experience, and traffic progression. The preliminary need for signalization at the study intersections were evaluated based on the Eight-Hour Vehicular Warrant (Warrant 1), Four-Hour Vehicular Volume (Warrant 2), Peak Hour Warrant (Warrant 3) and Crash Experience (Warrant 7) contained in the MUTCD.

To account for Warrant 1, Eight-Hour Warrant, two conditions were evaluated, Condition A – Minimum Vehicular Volume and Condition B – Interruption of Continuous Traffic. This warrant is based on accepted criteria used by agencies for the construction year at an intersection using projected volumes. Signal warrant analysis for the Eight-Hour Warrant was completed for the intersection of 9th Street and Rockledge Road. Based on existing volumes the intersection does not satisfy the Eight-Hour Warrant criteria for the existing conditions.

Signal warrant analysis for Warrant 2, Four-Hour Vehicular Volume Warrant, was completed for the intersection of 9th Street and Rockledge Road under the existing conditions. The study intersection does not satisfy the criteria based on Warrant 2.

Signal warrant analysis for Warrant 3, Peak Hour Warrant, was completed for the intersection of 9th Street and Rockledge Road under existing conditions. The intersection does not satisfy the peak hour warrant criteria based on Warrant 3 during the PM peak hour period.

To account for Warrant 7, Crash Experience, three criteria must be met. If one criterion is not met then the warrant is not satisfied. **Table 1** shows the crash history for the past three years at the intersection of 9th Street and Rockledge Road.

Table 1: Intersection Crash History

9th Street & Rockledge Road				
	Crashes			
Year	Fatal	Injury	PDO	Total
2011	0	0	3	3
2012	0	1	2	3
2013	0	0	4	4

The second criteria for crash experience involves five or more reported crashes, or types susceptible to correction by a traffic control signal, have occurred within a 12-month period, each crash involving personal injury or property damage apparently exceeding the applicable requirements for a reportable crash. The study intersection does not satisfy the criteria based on Warrant 7.

Signal warrant analysis sheets can be found in the **Appendix**.

4.1.2 Capacity Analysis

Signalized intersection capacity analyses were performed using SYNCHRO, version 8.0, based on the Highway Capacity Manual (HCM) delay methodology. Unsignalized capacity analyses were performed in accordance with Chapter 17 of the HCM using the Highway Capacity Software (HCS+), version 5.6. For simplicity, the amount of delay is equated to a grade or Level of Service (LOS) based on thresholds of driver acceptance. A letter grade between A and F is assigned, where LOS A represents the best operation. **Table 2** represents the LOS associated with intersection control delay, in seconds per vehicle (sec/veh), for signalized and unsignalized intersections.

Table 2: Intersection Level of Service Summary

Level-of-Service Criteria		
Level of Service (LOS)	**Stop Control** Approach Delay sec/veh	**Signal Control** Control Delay sec/veh
A	≤ 10	≤ 10
B	>10 and ≤ 15	>10 and ≤ 20
C	>15 and ≤ 25	>20 and ≤ 35
D	>25 and ≤ 35	>35and ≤ 55
E	>35 and ≤ 50	>55 and ≤ 80
F	>50	>80

Capacity analysis was completed as discussed above for the signalized study intersection of 9th Street and Iowa Street. Signal timing data as provided by the City of

Lawrence were unaltered for analysis purposes. **Table 3** further details level of service for this intersection. Capacity analysis sheets are included in the **Appendix**.

Table 3: Existing Signalized Intersection Analysis

Intersection	AM Peak Hour	PM Peak Hour
9th Street and Iowa Street	C (30.6)	D (50.4)

*LOS (Delay in Seconds)

During both the AM and PM peak hours the overall operation of the intersection of 9th Street and Iowa Street is acceptable. All individual movements operate at LOS D or better during the AM and PM peak hour with the following exceptions. During the PM peak hour period the southbound left-turn movement and the northbound and southbound thru movements operate at a LOS E. Queuing is not expected to exceed beyond the available storage.

Unsignalized capacity analysis was conducted for the intersection of 9th Street and Rockledge Road. During both the AM and PM peak hour periods the southbound movement is operating at LOS F. During the AM and PM peak hour periods the southbound movement is expected to have a queue length of approximately 7 and 5 vehicles respectively. Unsignalized side street movements can be expected to operate at a lower level of service during the peak hour periods as the higher major street movements are accommodated.

Figure 7 illustrates existing conditions level of service and 95th percentile queue lengths. Capacity analysis sheets are included in the **Appendix**.

4.1.3 Existing Recommendations - 9th Street & Rockledge Road

The intersection of 9th Street and Iowa Street is currently operating at acceptable overall and individual levels of service during the AM and PM peak hour periods with the following exception. During the PM peak hour period the southbound left-turn movement and the northbound and southbound thru movements operate at a LOS E. The intersection of 9th Street and Rockledge Road operates at acceptable levels of service with the exception of the southbound movement during the AM and PM peak hour periods that operates at a LOS F. Current volumes at the intersection of 9th Street and Rockledge Road do not satisfy Warrants 1, 2, 3 or 7 for signalization. Conditions at 9th Street and Rockledge Road will be monitored under the existing plus bus scenario; however no further recommendations are necessary under existing operations.

4.2 21st Street & Iowa Street Existing Conditions

The existing conditions for the 21st Street and Iowa Street site were reviewed and signal warrant analysis and capacity analysis were completed.

4.2.1 Signal Warrant Analysis

Signal warrant analysis for the study intersection of 21st Street and Iowa Street was performed using the methodologies described in **Section 4.1.1**. The Eight-Hour Vehicular Warrant (Warrant 1), Four-Hour Vehicular Volume (Warrant 2) and Peak Hour Warrant (Warrant 3) were evaluated.

Signal warrant analysis was completed for the intersection of 21st Street and Iowa Street. Based on existing traffic volumes the intersection of 21st Street and Iowa Street does not satisfy Warrants 1 or 2 for signalization.

Signal warrant analysis for Warrant 3, Peak Hour Warrant, was completed for the intersection of 21st Street and Iowa Street under existing conditions. The intersection satisfies the peak hour warrant criteria based on Warrant 3 during the PM peak hour period.

To account for Warrant 7, Crash Experience, three criteria must be met. **Table 4** shows the crash history for the past three years at the intersection of 9th Street and Rockledge Road.

Table 4: Intersection Crash History

21st Street & Iowa Street				
	Crashes			
Year	Fatal	Injury	PDO	Total
2011	0	2	4	6
2012	0	5	8	13
2013	0	2	4	6

The second criteria for crash experience involves five or more reported crashes, or types susceptible to correction by a traffic control signal, have occurred within a 12-month period, each crash involving personal injury or property damage apparently exceeding the applicable requirements for a reportable crash. This criterion is met during all three studied years. A criterion involving alternative configurations and observations is also involved in the Crash Experience Warrant. With the Peak Hour Warrant met, during the PM peak hour period, further analysis is not required to install a signal.

Signal warrant analysis sheets can be found in the **Appendix**.

4.2.2 Capacity Analysis

Capacity analysis was performed using the methodologies described in **Section 4.1.2**.

Unsignalized capacity analysis was conducted for the study intersections along 21st Street. During both the AM and PM peak hours the individual movements at the

intersections of 21st Street and Iowa Street, 21st Street and Ousdahl Road, and 21st Street and Naismith Drive operate at acceptable levels of service with the following exceptions. At the intersection of 21st Street and Iowa Street, the eastbound and westbound movements operate at a LOS F during the AM and PM peak hours. Higher peak hour side street movements are causing increased delay and the warrant for signalization. The intersection will be evaluated as signalized intersection control in future condition scenarios.

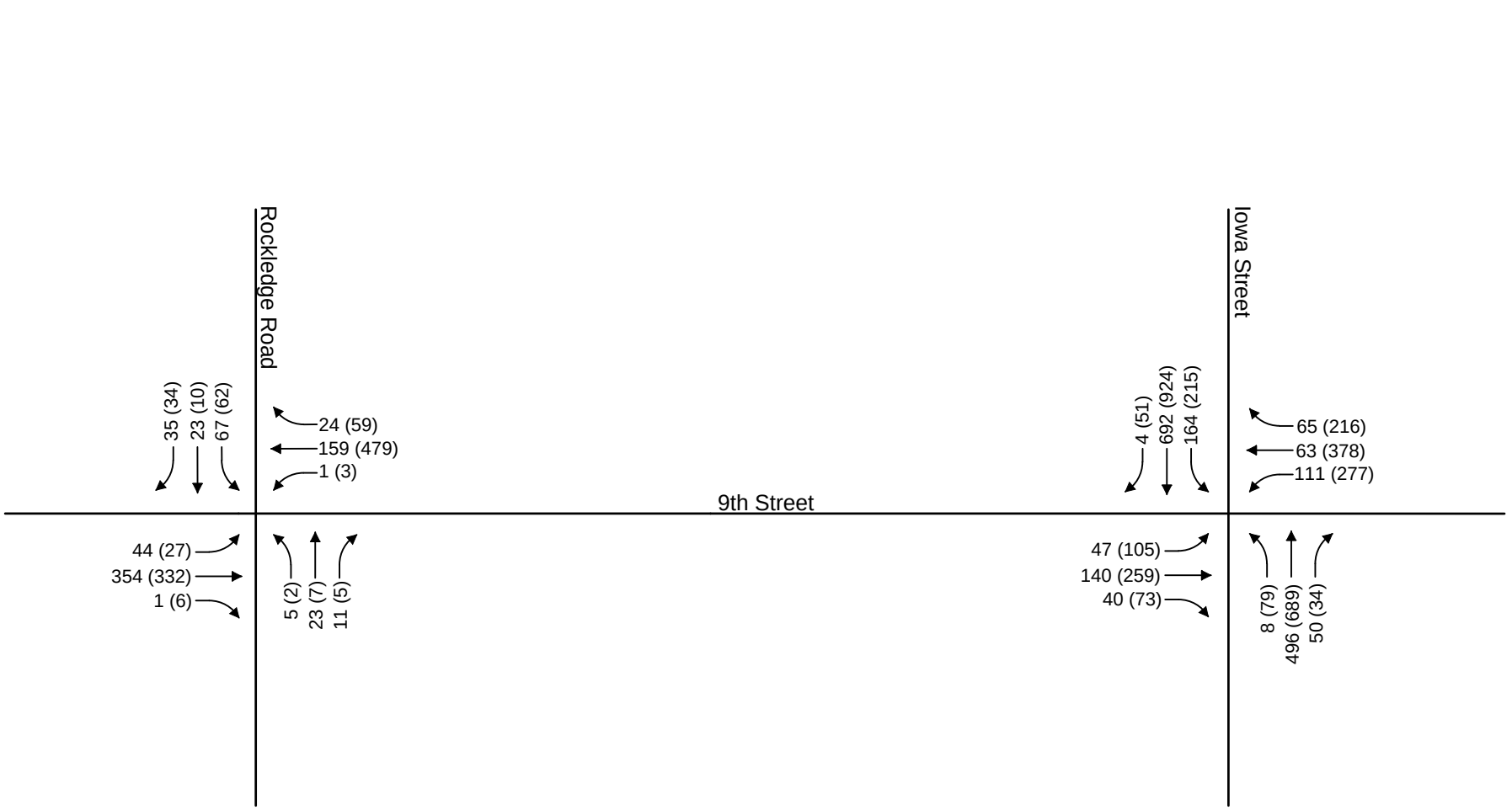
Figure 10 illustrates existing conditions level of service and 95th percentile queue lengths. Capacity analysis sheets are included in the **Appendix**.

4.2.3 Existing Recommendations - 21st Street & Iowa Street

The intersections of 21st Street with Iowa Street, Ousdahl Road, and Naismith Drive are currently operating at acceptable levels of service during the AM and PM peak hour periods with the following exceptions. The eastbound and westbound movements at the intersection of 21st Street and Iowa Street operate at a LOS F during both the AM and PM peak hour periods. Signal warrant analysis was performed for the intersection of 21st Street and Iowa Street. The intersection satisfies the Peak Hour Warrant under existing conditions. The following roadway improvements are recommended:

21st Street & Iowa Street

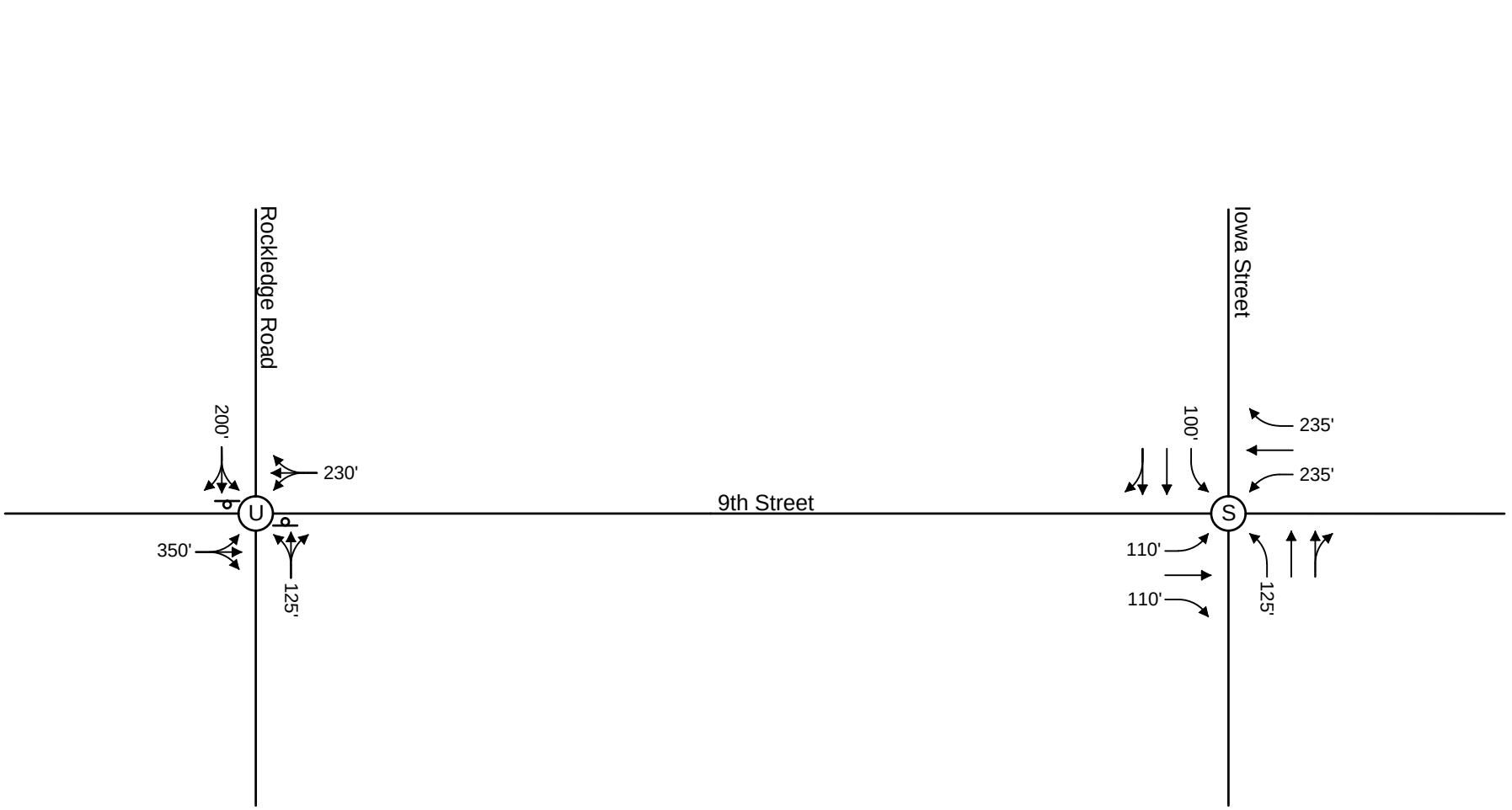
- Install a traffic signal at the intersection of 21st Street and Iowa Street. This will help the side street levels of service, queue lengths, and the delay times, particularly during peak hour periods.



LEGEND

XX' - AM (PM) Peak Hour Volumes

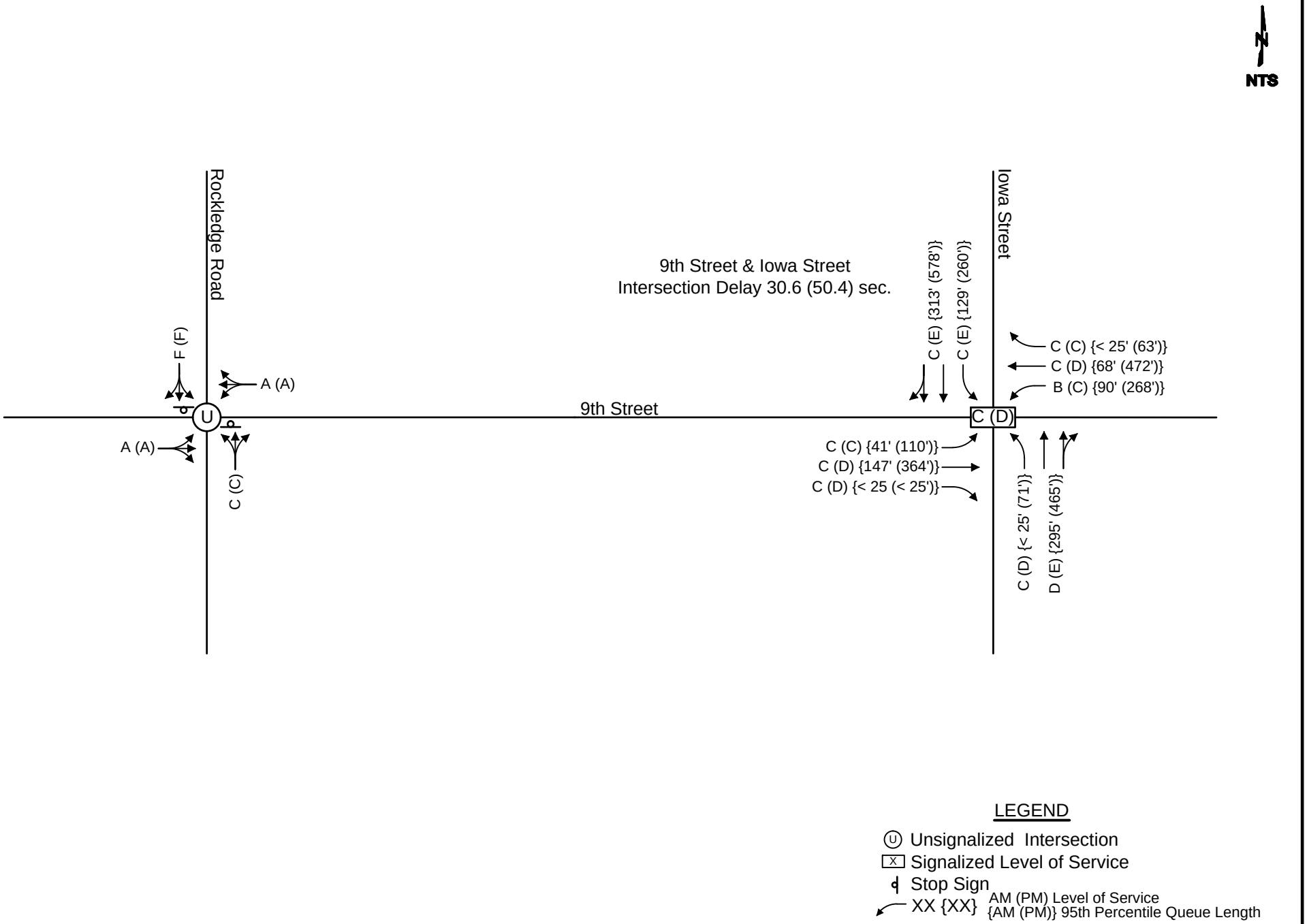
PROJECT NO: 013-0542 DRAWN BY: JMS DATE: 2-10-14	Existing Peak Hour Volumes 9th Street & Rockledge Road	OLSSON ASSOCIATES	7301 West 133rd Street Suite 200 Overland Park, KS 66213-4750 TEL 913.381.1170 FAX 913.381.1174	FIGURE 5



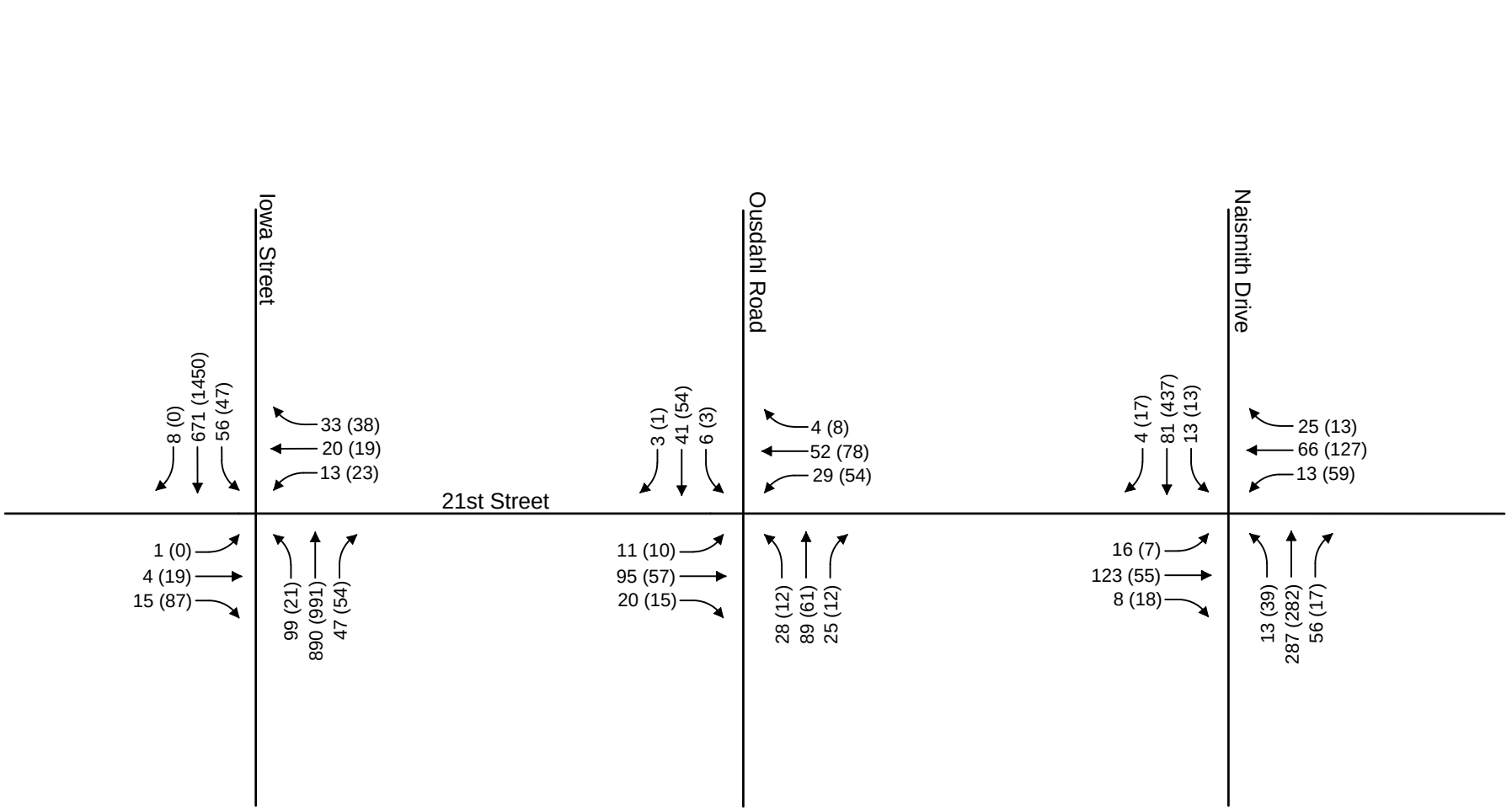
LEGEND

- (U) Unsignalized Intersection
- (S) Signalized Intersection
- Stop Sign
- XX' - Turn Bay Storage Length

PROJECT NO: 013-0542 DRAWN BY: JMS DATE: 2-10-14	Existing Lane Configurations & Traffic Control 9th Street & Rockledge Road	OLSSON ASSOCIATES	7301 West 133rd Street Suite 200 Overland Park, KS 66213-4750 TEL 913.381.1170 FAX 913.381.1174	FIGURE 6



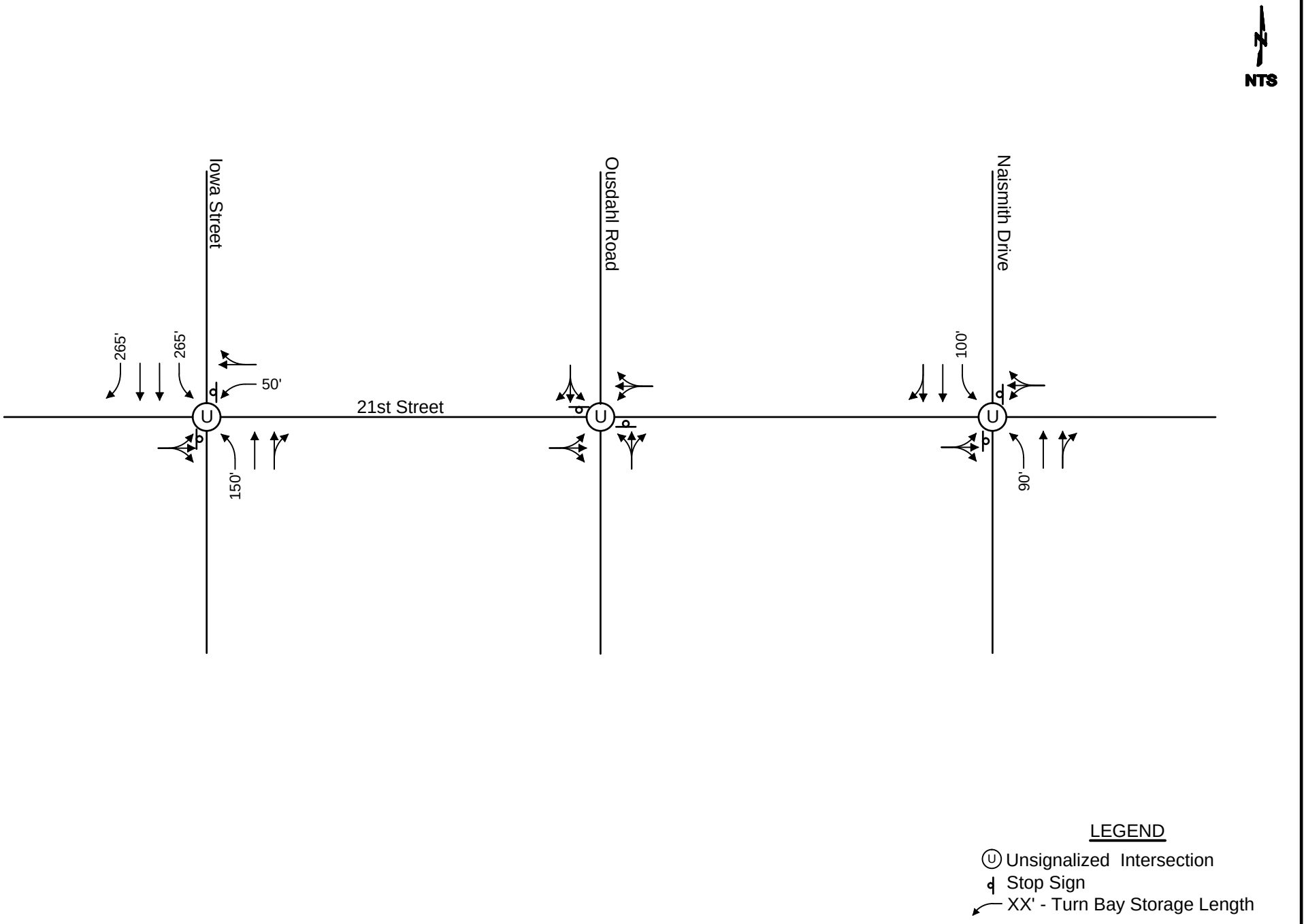
PROJECT NO: 013-0542 DRAWN BY: JMS DATE: 2-10-14	Existing Level of Service 9th Street & Rockledge Road	OLSSON ASSOCIATES 7301 West 133rd Street Suite 200 Overland Park, KS 66213-4750 TEL 913.381.1170 FAX 913.381.1174	FIGURE 7



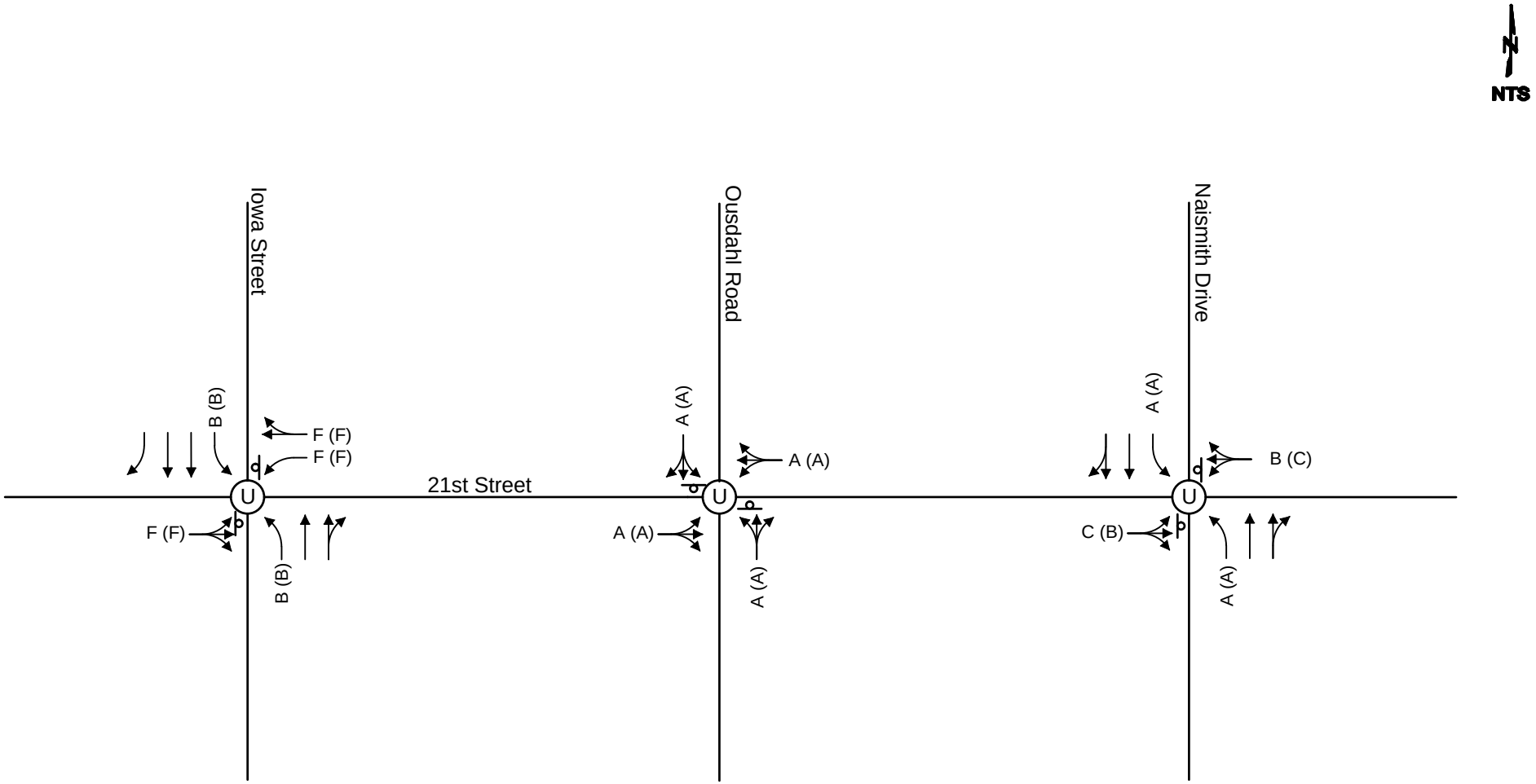
LEGEND

XX' - AM (PM) Peak Hour Volumes

PROJECT NO: 013-0542 DRAWN BY: JMS DATE: 2-10-14	Existing Peak Hour Volumes 21st Street & Iowa Street	OLSSON ASSOCIATES 7301 West 133rd Street Suite 200 Overland Park, KS 66213-4750 TEL 913.381.1170 FAX 913.381.1174	FIGURE 8



PROJECT NO: 013-0542	Existing Lane Configurations & Traffic Control 21st Street & Iowa Street	OLSSON ASSOCIATES	FIGURE
DRAWN BY: JMS		7301 West 133rd Street Suite 200 Overland Park, KS 66213-4750 TEL 913.381.1170 FAX 913.381.1174	9
DATE: 2-10-14			



LEGEND

- (U) Unsignalized Intersection
- [X] Signalized Level of Service
- Stop Sign
- XX {XX} AM (PM) Level of Service {AM (PM)} 95th Percentile Queue Length

PROJECT NO: 013-0542 DRAWN BY: JMS DATE: 2-10-14	Existing Level of Service 21st Street & Iowa Street	OLSSON ASSOCIATES 7301 West 133rd Street Suite 200 Overland Park, KS 66213-4750 TEL 913.381.1170 FAX 913.381.1174	FIGURE 10

5.0 EXISTING PLUS TRANSIT CENTER CONDITIONS

The proposed Transit Center is located in the City of Lawrence, KS. The proposed Transit Center is oval shaped with approximately eight bus slots going around the center and two bus slots on the side of the center. The existing plus Transit Center scenario reviews expected operations of the roadway network based on the addition of proposed Transit Center traffic to existing traffic volumes.

5.1 9th Street and Rockledge Road Proposed Transit Center Conditions

The addition of the Transit Center is not expected to grow car traffic, but is expected to grow bus traffic. Routes going through the City of Lawrence were reviewed and, with the addition of the Transit Center along 9th Street, it was found that during either peak hour period there would be 10 busses entering the site and 10 busses exiting the site. **Table 5** shows the directions in which the busses will be traveling.

Table 5: Proposed Bus Trips to/from Transit Center

9th Street & Rockledge Road				
	Number of Busses			
	AM		PM	
From/To	Entering	Exiting	Entering	Exiting
NB Iowa to WB 9th	1		1	
EB 9th to SB Iowa		1		1
SB Iowa to WB 9th	3		3	
EB 9th to NB Iowa		3		3
EB 9th to EB 9th	4		4	
WB 9th to WB 9th		4		4
SB Rockledge to EB 9th	2		2	
WB 9th to NB Rockledge		2		2
Total	**10**	**10**	**10**	**10**

The AM and PM peak hour bus trips for the proposed Transit Center are illustrated in **Figure 11**. The resulting existing plus Transit Center peak hour traffic volumes are illustrated in **Figure 12** and **Figure 13** illustrates the existing plus Transit Center lane configurations and traffic control.

5.1.1 Access

Access to the site is proposed via one full access drive along 9th Street. Drive 1 is a proposed drive approximately 365' east of the intersection 9th Street and Rockledge Road. This drive will be replacing an existing drive that is located approximately 50' west of the proposed drive.

5.1.2 Signal Warrant Analysis

Signal warrant analysis for the study intersection of 21st Street and Iowa Street was performed using the methodologies described in **Section 4.1.1**. The Eight-Hour Vehicular Warrant (Warrant 1), Four-Hour Vehicular Volume (Warrant 2) and Peak Hour Warrant (Warrant 3) were evaluated.

Signal warrant analysis was completed for the intersection of 9th Street and Rockledge Road. Based on existing traffic volumes the intersection of 9th Street and Rockledge Road does not satisfy Warrants 1, 2, or 3 for signalization. Signal warrant analysis sheets can be found in the **Appendix**.

5.1.3 Capacity Analysis

Capacity analysis was performed using the methodologies described in **Section 4.1.2** for the signalized study intersection of 9th Street and Iowa Street. Signal timing data as provided by the City of Lawrence were unaltered for analysis purposes. **Table 6** further details level of service for this intersection. Capacity analysis sheets are included in the **Appendix**.

Table 6: Existing plus Transit Center Signalized Intersection Analysis

Intersection	AM Peak Hour *	PM Peak Hour *
9th Street and Iowa Street	C (30.8)	D (50.3)

*LOS (Delay in Seconds)

During both the AM and PM peak hours the overall operation of the intersection of 9th Street and Iowa Street is acceptable. All individual movements operate at LOS D or better during the AM and PM peak hour with the following exceptions. During the PM peak hour period the northbound and southbound left-turn and thru movements operate at a LOS E. Queuing is not expected to exceed beyond the available storage, but there is an extended queue for the westbound movements.

Unsignalized capacity analysis was conducted for the intersection of 9th Street and Rockledge Road. It is recommended to add a southbound left-turn lane at the intersection of 9th Street & Rockledge Road to reduce queuing and improve delay. The existing plus transit center conditions were analyzed with a 150' southbound left-turn lane in place. During both the AM and PM peak hour periods the southbound left-turn movement is expected to operate at LOS E and F, respectively. The southbound movement is expected to have a queue length of approximately 3 and 2 vehicles, during the AM and PM peak hour periods, respectively. Unsignalized side street movements can be expected to operate at a lower level of service during the peak hour periods as the higher major street movements are accommodated.

Figure 14 illustrates existing conditions level of service and 95th percentile queue lengths. Capacity analysis sheets are included in the **Appendix**.

5.1.4 Existing plus Transit Center Recommendations-9th Street & Rockledge Road

The intersection of 9th Street and Iowa Street is expected to operate at an overall acceptable level of service during the AM and PM peak hour periods. The addition of bus traffic did not change the levels of service for the individual movements along 9th Street and had a minimal effect on Iowa Street and Rockledge Road. There is an extended queue length for the westbound movements at the intersection of 9th Street and Iowa Street. Existing plus Transit Center volumes at the intersection of 9th Street and Rockledge Road do not satisfy Warrants 1, 2, or 3 for signalization. The following roadway improvements are recommended:

9th Street & Rockledge Road

- The southbound left-turn is operating at a LOS E with increased delay and queuing. The addition of a dedicated southbound left-turn lane with 150' of storage plus taper will reduce queuing and improve delay.
- A traffic signal is not warranted for the intersection of 9th Street and Rockledge Road; however, the City may have specific policy regarding protected left-turns for transit vehicles.

9th Street & Iowa Street

- There is higher delay and extended queue lengths during peak periods for some movements at the intersection of 9th Street and Iowa Street. Incremental improvements in extending turn-lanes are not expected to have a significant impact on capacity and queuing. More significant geometric improvements are expected to have significant right-of-way and capital costs.

5.2 21st Street and Iowa Street Proposed Transit Center Conditions

The addition of the Transit Center is not expected to grow passenger car traffic, but is expected to grow bus traffic. Routes going through the City of Lawrence were reviewed and with the addition of the Transit Center along 21st Street it was found that during the AM peak hour there are expected to be 19 busses entering the site and 21 busses leaving the site. During the PM peak hour there are expected to be 20 busses entering the site and 23 busses leaving the site. **Table 7** shows the directions in which the busses will be traveling.

Table 7: Proposed Bus Trips to/from Transit Center

21st Street & Iowa Street				
	Number of Busses			
	AM		PM	
From/To	Entering	Exiting	Entering	Exiting
NB Iowa to Stewart	4		3	
Stewart to SB Iowa		5		6
SB Iowa to Stewart	7		7	
Stewart to NB Iowa		6		4
WB 21st to Stewart	4		5	
Stewart to EB 21st		4		5
19th to Stewart	4		5	
Stewart to 19th		6		8
Total	**19**	**21**	**20**	**23**

Based on discussions with the City of Lawrence the proposed addition of a traffic signal at the intersection of 21st Street and Iowa Street is expected to grow cut-through passenger car traffic along 21st Street. Based on a review of the area and discussions with the City of Lawrence staff cut-through traffic was estimated to grow by approximately 20%. The distribution of traffic growth was split evenly between the southbound right-turns and northbound left-turns at Ousdahl Road and Naismith Drive. The AM and PM peak hour bus and cut-through trips for the proposed Transit Center are illustrated in **Figure 15**. The resulting existing plus Transit Center peak hour traffic volumes are illustrated in **Figure 16** and **Figure 17** illustrates the existing plus Transit Center lane configurations and traffic control.

5.2.1 Access

Access to the site is proposed via two full access drives. Drive 1 is a proposed full access drive located along Stewart Avenue approximately 270' north of the 21st Street and Stewart Avenue intersection. This drive will be replacing two existing drives that are located just south of the proposed drive. Drive 2 is a proposed full access drive located along 21st Street approximately 225' east of the intersection of 21st Street and Iowa Street. This drive will be replacing an existing concrete drive approach.

5.2.2 Capacity Analysis

Capacity analysis was performed using the methodologies described in **Section 4.1.2** for the signalized study intersection of 21st Street and Iowa Street. The signal was given a reasonable cycle length and the signal split timings were optimized. **Table 8** further details level of service for this intersection. Capacity analysis sheets are included in the **Appendix**.

Table 8: Existing plus Transit Center Signalized Intersection Analysis

Intersection	AM Peak Hour *	PM Peak Hour *
21st Street and Iowa Street	A (9.7)	B (12.7)

*LOS (Delay in Seconds)

During the AM and PM peak hour periods the overall operations of the intersection of 21st Street and Iowa Street are expected to be acceptable. All individual movements are expected to operate at LOS D or better during the AM and PM peak hour periods with the following exceptions. During the AM and PM peak hour periods the westbound left-turn movement is expected to operate at a LOS E and F, respectively, with a queue that is not expected to exceed beyond the available storage. The proposed signalized intersection was analyzed with a westbound left-turn lane that was extended to 150' to accommodate the vehicle growth, and for optimal signal operations the west leg was modified to mirror the east-leg with one left-turn lane and a thru/right-turn lane. The signal timings include a reasonable cycle length of 120 seconds during the AM and PM peak hour periods with optimized split times. A 150' northbound left-turn lane should be striped.

Unsignalized capacity analysis was conducted for the intersections of 21st Street with Ousdahl Road and Naismith Drive. All individual movements are expected to operate at a LOS D or better during the AM and PM peak hour periods.

Figure 18 illustrates existing conditions level of service and 95th percentile queue lengths. Capacity analysis sheets are included in the **Appendix**.

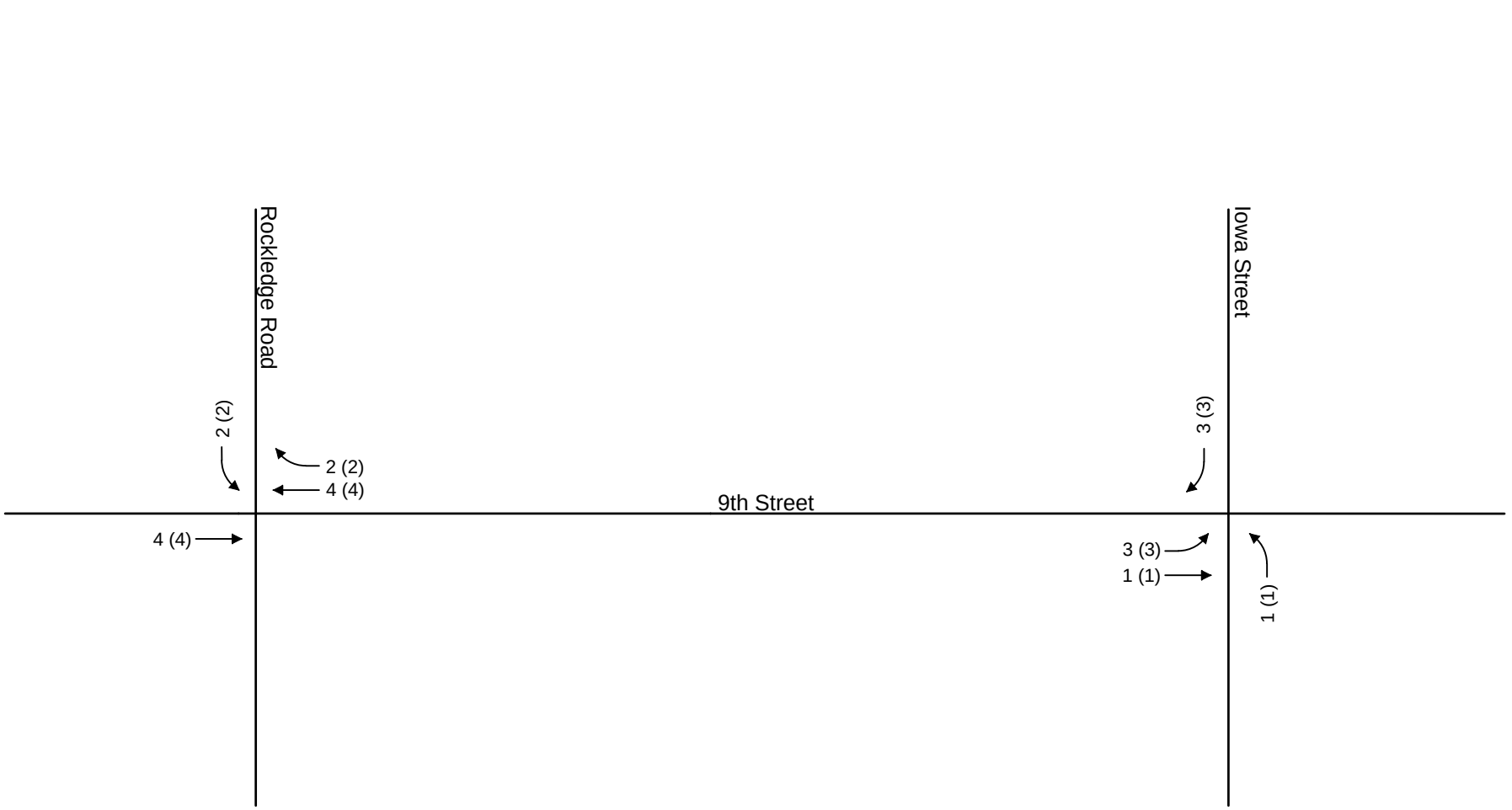
5.2.3 Existing plus Transit Center Recommendations - 21st Street & Iowa Street

With the addition of the traffic signal the intersection of 21st Street and Iowa Street is expected to have an overall good operation with a slight increase in side street traffic as Iowa Street is accommodated. The westbound left-turn movement is expected to operate at a LOS E and F during both the AM and PM peak hour periods, respectively. The addition of bus and cut-through traffic had minimal effect on the levels of service for the individual movements for the unsignalized intersections along 21st Street. The following roadway improvements are recommended:

21st Street & Iowa Street

- Extend the westbound left-turn lane from 50' to 150' of storage plus taper.
- Restripe the northbound approach of 21st Street and Iowa Street to have a 150' dedicated left-turn lane that transitions to the existing two-way left-turn lane.
- For optimal signal operation, the west leg of the intersection should mirror the east leg's configuration, which includes a left-turn lane with 150' of storage plus taper and a thru/right-turn lane.

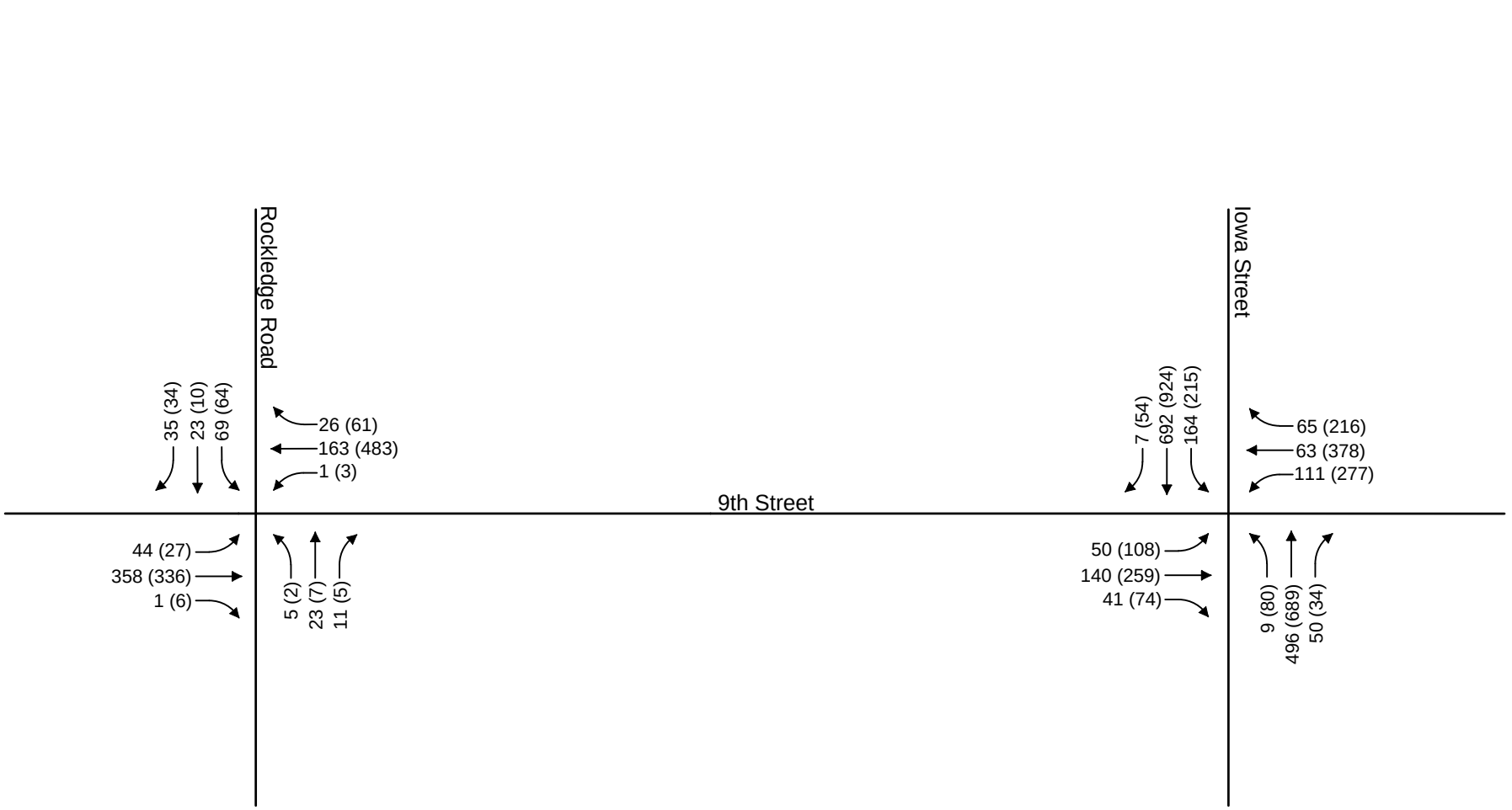
- The addition of a northbound auxiliary right-turn lane would benefit operations by removing vehicular and bus traffic from mainline Iowa Street traffic.



LEGEND

XX' - AM (PM) Peak Hour Bus Trips

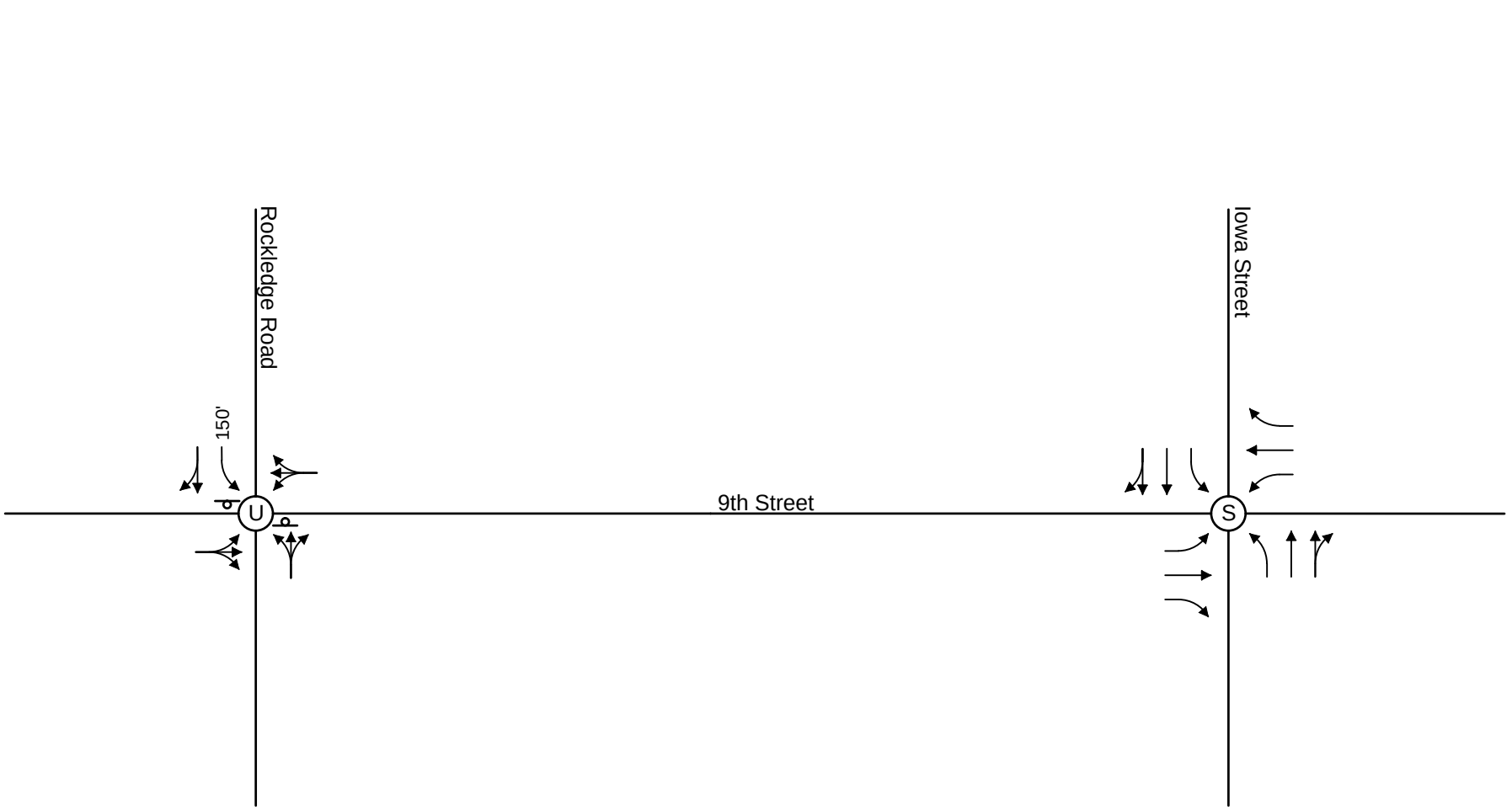
PROJECT NO: 013-0542 DRAWN BY: JMS DATE: 2-10-14	Bus Trip Distribution 9th Street & Rockledge Road	OLSSON ASSOCIATES 7301 West 133rd Street Suite 200 Overland Park, KS 66213-4750 TEL 913.381.1170 FAX 913.381.1174	FIGURE 11



LEGEND

XX' - AM (PM) Peak Hour Volumes

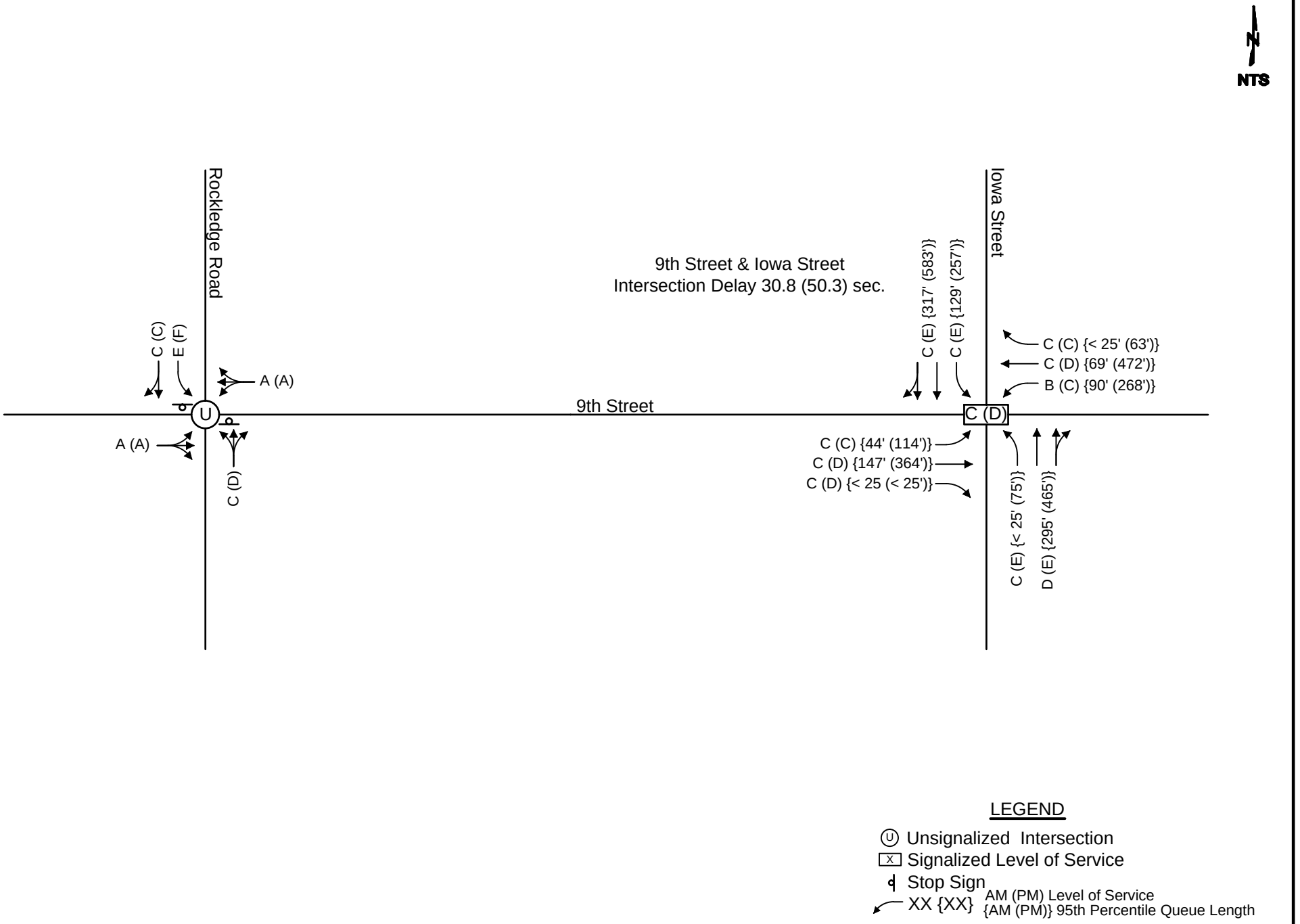
PROJECT NO: 013-0542 DRAWN BY: JMS DATE: 2-10-14	Existing + Transit Center Peak Hour Volumes 9th Street & Rockledge Road	OLSSON ASSOCIATES	7301 West 133rd Street Suite 200 Overland Park, KS 66213-4750 TEL 913.381.1170 FAX 913.381.1174	FIGURE 12



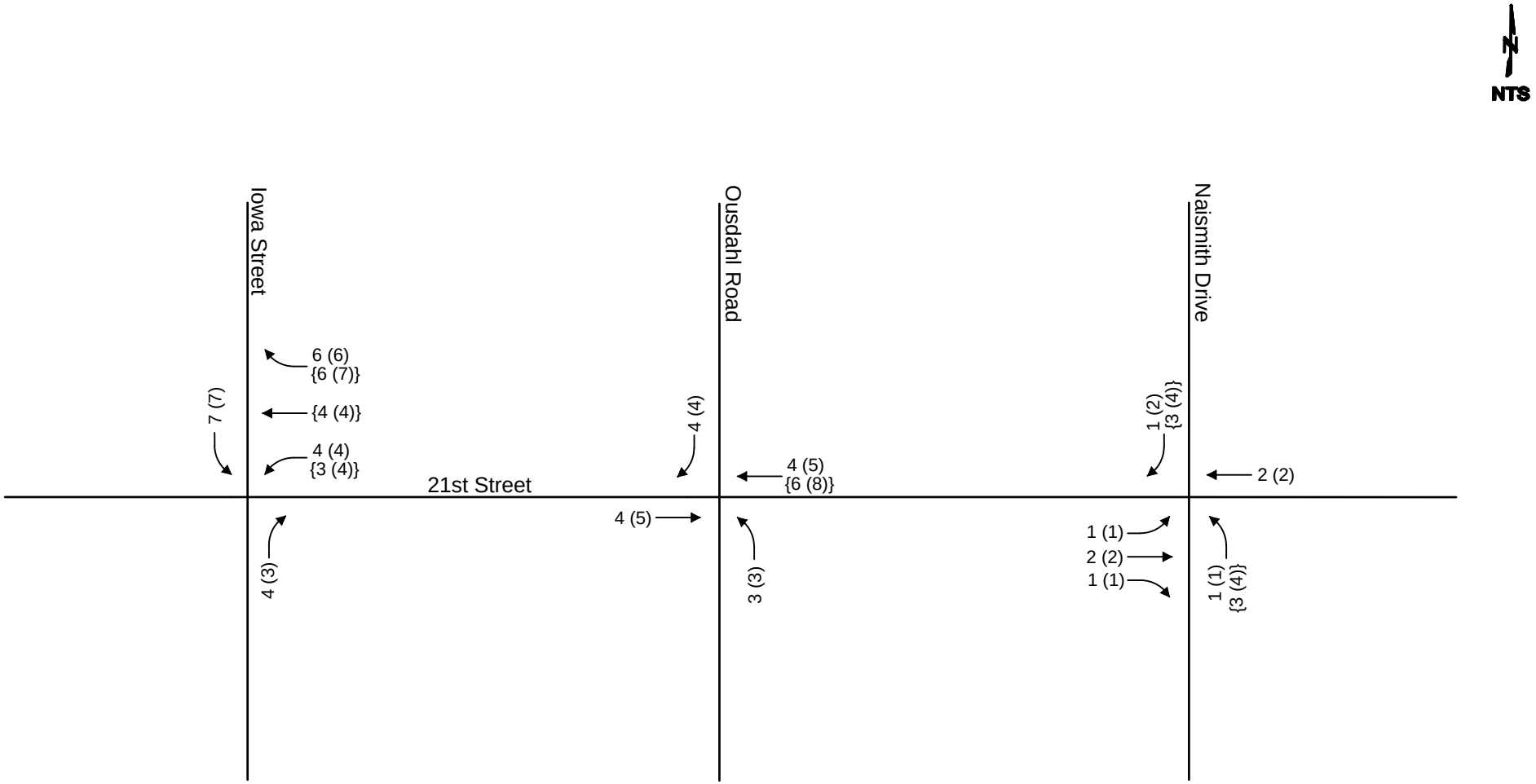
LEGEND

- (U) Unsignalized Intersection
- (S) Signalized Intersection
- Stop Sign
- XX' - Turn Bay Storage Length

PROJECT NO: 013-0542 DRAWN BY: JMS DATE: 2-10-14	Existing + Transit Center Lane Configurations & Traffic Control 9th Street & Rockledge Road	OLSSON ASSOCIATES 7301 West 133rd Street Suite 200 Overland Park, KS 66213-4750 TEL 913.381.1170 FAX 913.381.1174	FIGURE 13



PROJECT NO: 013-0542 DRAWN BY: JMS DATE: 2-10-14	Existing + Transit Center Level of Service 9th Street & Rockledge Road	OLSSON ASSOCIATES 7301 West 133rd Street Suite 200 Overland Park, KS 66213-4750 TEL 913.381.1170 FAX 913.381.1174	FIGURE 14

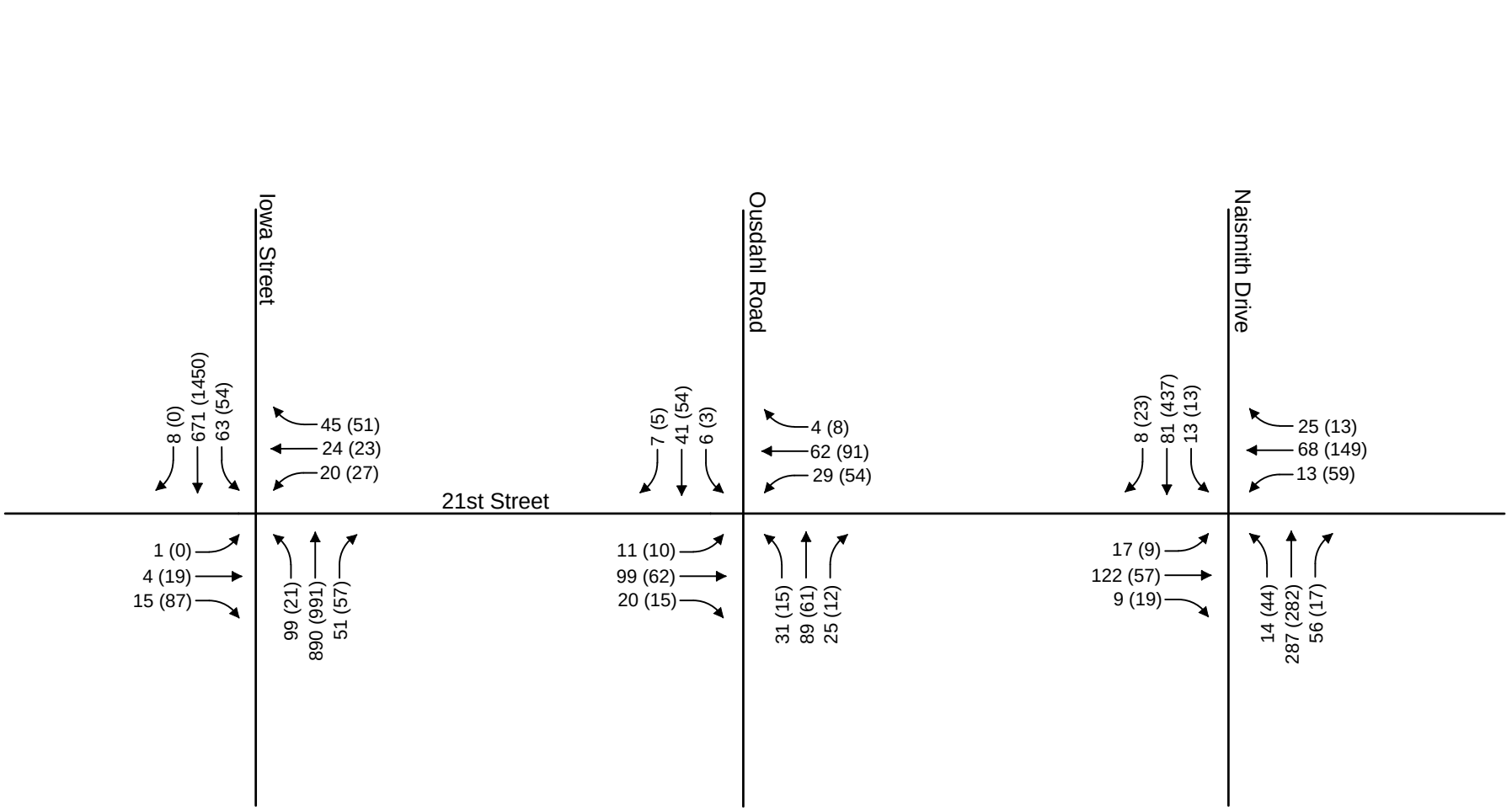


LEGEND

XX' - AM (PM) Peak Hour Bus Trips

{XX'} - AM (PM) Peak Hour Cut-Through Trips

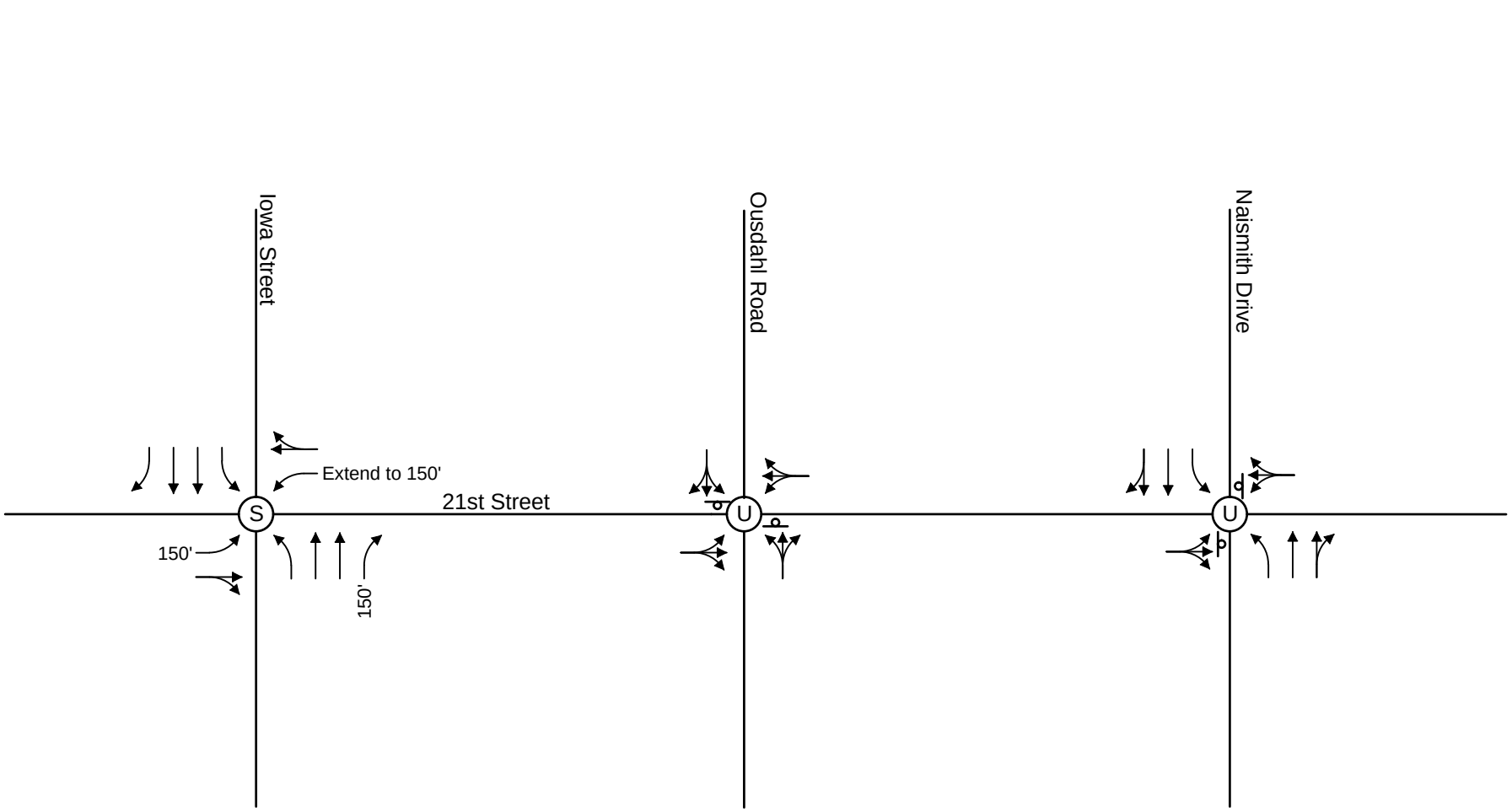
PROJECT NO: 013-0542 DRAWN BY: JMS DATE: 2-10-14	Bus and Cut-Through Traffic Trip Distribution 21st Street & Iowa Street	OLSSON ASSOCIATES 7301 West 133rd Street Suite 200 Overland Park, KS 66213-4750 TEL 913.381.1170 FAX 913.381.1174	FIGURE 15



LEGEND

XX' - AM (PM) Peak Hour Volumes

PROJECT NO: 013-0542 DRAWN BY: JMS DATE: 2-10-14	Existing + Transit Center Peak Hour Volumes 21st Street & Iowa Street	OLSSON ASSOCIATES	7301 West 133rd Street Suite 200 Overland Park, KS 66213-4750 TEL 913.381.1170 FAX 913.381.1174	FIGURE 16



LEGEND

- (U) Unsignalized Intersection
- (S) Signalized Intersection
- Stop Sign
- XX' - Turn Bay Storage Length

PROJECT NO: 013-0542 DRAWN BY: JMS DATE: 2-10-14	Existing + Transit Center Lane Configurations & Traffic Control 21st Street & Iowa Street	OLSSON ASSOCIATES 7301 West 133rd Street Suite 200 Overland Park, KS 66213-4750 TEL 913.381.1170 FAX 913.381.1174	FIGURE 17

LEGEND

- (U) Unsignalized Intersection
- [X] Signalized Level of Service
- Stop Sign
- XX {XX} AM (PM) Level of Service {AM (PM)} 95th Percentile Queue Length

PROJECT NO: 013-0542 DRAWN BY: JMS DATE: 2-10-14	Existing + Transit Center Level of Service 21st Street & Iowa Street	OLSSON ASSOCIATES 7301 West 133rd Street Suite 200 Overland Park, KS 66213-4750 TEL 913.381.1170 FAX 913.381.1174	FIGURE 18

6.0 RECOMMENDATIONS & CONCLUSIONS

This study considered the impacts regarding the proposed construction of the Lawrence Transit Center that is proposed to be located in two possible sites within the City of Lawrence, KS. One location was along 9th Street in the southeast corner of 9th Street and Centennial Drive. The other location was along 21st Street in the northeast corner of 21st Street and Iowa Street. The study determined the impacts that the proposed Lawrence Transit Center will have on traffic operations. Based on the results of the capacity analyses and field observations, the following conclusions and recommendations are made for the study area. Cost estimates for the recommended improvements at both site locations are summarized below in **Table 9**; full cost estimates are included in the **Appendix**.

Table 9: Summarized Cost Estimate for Proposed Recommendations

925 Iowa - Related Roadway Improvement Costs	
9th Street Repaving	
Repave North Leg of Rockledge	$ 1,376,412
Contingency	$ 344,103
Opinion of Probable Cost	$ 1,720,515
2021 Stewart - Related Roadway Improvement Costs	
Extend Westbound Left-Turn Lane from 50' to 150' plus taper*	$ 39,983
Add Left-Turn Lane to the West Leg of 21st & Iowa	$ 82,076
Add Northbound Right-Turn Lane to 21st & Iowa	$ 92,877
Repave W. 21st St and Stewart St from Iowa to Trasit Center Entrance	$ 521,798
Install Traffic Signal at 21st St and Iowa, Northbound 150' Left-Turn Lane	$ 165,000
Contingency	$ 198,440
Opinion of Probable Cost	$ 1,060,191

*Would be included in repavement. Is not included in contingency or total.

Existing Recommendations - 9th Street & Rockledge Road

The intersection of 9th Street and Iowa Street is currently operating at acceptable overall levels of service during the AM and PM peak hour periods; some individual movements operate at a LOS E during the PM peak hour period. The intersection of 9th Street and Rockledge Road operates at acceptable levels of service with the exception of the southbound movement, which operates at a LOS F during the AM and PM peak hour periods. Current volumes at the intersection of 9th Street and Rockledge Road do not satisfy Warrants 1, 2, 3, or 7 for signalization. Conditions at 9th Street and Rockledge Road will be monitored under the existing plus bus scenario; however no further recommendations are necessary under existing operations.

Existing Recommendations - 21st Street & Iowa Street

The intersections of 21st Street with Iowa Street, Ousdahl Road, and Naismith Drive are currently operating at acceptable levels of service during the AM and PM peak hour periods with the following exceptions. The eastbound and westbound movements at the intersection of 21st Street and Iowa Street operate at a LOS F during both the AM and PM peak hour periods. Signal warrant analysis was performed for the intersection of 21st Street and Iowa Street. The intersection satisfies the Peak Hour Warrant under existing conditions. The following roadway improvements are recommended:

21st Street & Iowa Street

- Install a traffic signal at the intersection of 21st Street and Iowa Street. This will help the side street levels of service, queue lengths, and the delay times.

Existing plus Transit Center Recommendations - 9th Street & Rockledge Road

The intersection of 9th Street and Iowa Street is expected to operate at an overall acceptable level of service during the AM and PM peak hour periods. The addition of bus traffic did not change the levels of service for the individual movements along 9th Street and had a minimal effect on Iowa Street and Rockledge Road. There is an extended queue length for the westbound movements at the intersection of 9th Street and Iowa Street. Existing plus Transit Center volumes at the intersection of 9th Street and Rockledge Road do not satisfy Warrants 1, 2, or 3 for signalization. The following roadway improvements are recommended:

9th Street & Rockledge Road

- The southbound left-turn is operating at a LOS E with increased delay and queuing. The addition of a dedicated southbound left-turn lane with 150' of storage plus taper will reduce queuing and improve delay.
- A traffic signal is not warranted for the intersection of 9th Street and Rockledge Road; however, the City may have specific policy regarding protected left-turns for transit vehicles.

9th Street & Iowa Street

- There is higher delay and extended queue lengths during peak periods for some movements at the intersection of 9th Street and Iowa Street. Incremental improvements in extending turn-lanes are not expected to have a significant impact on capacity and queuing. More significant geometric improvements are expected to have significant right-of-way and capital costs.

Existing plus Transit Center Recommendations - 21st Street & Iowa Street

With the addition of the traffic signal the intersection of 21st Street and Iowa Street is expected to have an overall good operation with a slight increase in side street traffic as Iowa Street is accommodated. The westbound left-turn movement is expected to operate at a LOS E and F during both the AM and PM peak hour periods, respectively. The addition of bus and cut-through traffic had minimal effect on the levels of service for

the individual movements for the unsignalized intersections along 21st Street. The following roadway improvements are recommended:

21st Street & Iowa Street

- Extend the westbound left-turn lane from 50' to 150' of storage plus taper.
- Restripe the northbound approach of 21st Street and Iowa Street to have a 150' dedicated left-turn lane that transitions to the existing two-way left-turn lane.
- For optimal signal operation, the west leg of the intersection should mirror the east leg's configuration, which includes a left-turn lane with 150' of storage plus taper and a thru/right-turn lane.
- The addition of a northbound auxiliary right-turn lane would benefit operations by removing vehicular and bus traffic from mainline Iowa Street traffic

.

APPENDIX

Traffic Counts – 9th Street (24-hour)

OLSSON ASSOCIATES
7301 West 133rd Street
Overland Park, KS 66213
www.olssonassociates.com

Site Code: ROCKLEDGE NB
Station ID:

Latitude: 0' 0.0000 South

Start Time	10-Dec-13 Tue	Channel 1
12:00 AM		*
12:15		*
12:30		*
12:45		*
01:00		*
01:15		*
01:30		*
01:45		*
02:00		*
02:15		*
02:30		*
02:45		*
03:00		*
03:15		*
03:30		*
03:45		*
04:00		*
04:15		*
04:30		*
04:45		*
05:00		*
05:15		*
05:30		*
05:45		*
06:00		*
06:15		*
06:30		*
06:45		*
07:00		*
07:15		*
07:30		*
07:45		*
08:00		*
08:15		*
08:30		*
08:45		*
09:00		*
09:15		*
09:30		*
09:45		*
10:00		*
10:15		*
10:30		*
10:45		*
11:00		*
11:15		*
11:30		*
11:45		*
Total		0
Peak	-	-
Vol.	-	-
P.H.F.		

-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

OLSSON ASSOCIATES
7301 West 133rd Street
Overland Park, KS 66213
www.olssonassociates.com

Site Code: ROCKLEDGE NB
Station ID:

Latitude: 0' 0.0000 South

Start Time	10-Dec-13 Tue	Channel 1
12:00 PM		*
12:15		*
12:30		5
12:45		6
01:00		1
01:15		2
01:30		2
01:45		3
02:00		1
02:15		2
02:30		4
02:45		3
03:00		**6**
03:15		**15**
03:30		**6**
03:45		**5**
04:00		2
04:15		2
04:30		6
04:45		5
05:00		6
05:15		4
05:30		5
05:45		3
06:00		4
06:15		3
06:30		3
06:45		3
07:00		3
07:15		0
07:30		1
07:45		1
08:00		1
08:15		4
08:30		2
08:45		2
09:00		1
09:15		2
09:30		0
09:45		1
10:00		0
10:15		1
10:30		0
10:45		0
11:00		0
11:15		2
11:30		0
11:45		1
Total		129
Peak	-	15:00
Vol.	-	32
P.H.F.		0.533

OLSSON ASSOCIATES
7301 West 133rd Street
Overland Park, KS 66213
www.olssonassociates.com

Site Code: ROCKLEDGE NB
Station ID:

Latitude: 0' 0.0000 South

Start Time	11-Dec-13 Wed	Channel 1
12:00 AM		0
12:15		0
12:30		0
12:45		0
01:00		0
01:15		0
01:30		0
01:45		0
02:00		0
02:15		0
02:30		0
02:45		1
03:00		0
03:15		0
03:30		0
03:45		0
04:00		0
04:15		0
04:30		0
04:45		0
05:00		0
05:15		0
05:30		1
05:45		1
06:00		1
06:15		0
06:30		1
06:45		2
07:00		0
07:15		3
07:30		**8**
07:45		**13**
08:00		**14**
08:15		**4**
08:30		2
08:45		4
09:00		1
09:15		1
09:30		2
09:45		2
10:00		1
10:15		2
10:30		2
10:45		4
11:00		1
11:15		6
11:30		1
11:45		3
Total		81
Peak	-	07:30
Vol.	-	39
P.H.F.		0.696

OLSSON ASSOCIATES
7301 West 133rd Street
Overland Park, KS 66213
www.olssonassociates.com

Site Code: ROCKLEDGE NB
Station ID:

Latitude: 0' 0.0000 South

Start Time	11-Dec-13 Wed	Channel 1
12:00 PM		3
12:15		2
12:30		2
12:45		*
01:00		*
01:15		*
01:30		*
01:45		*
02:00		*
02:15		*
02:30		*
02:45		*
03:00		*
03:15		*
03:30		*
03:45		*
04:00		*
04:15		*
04:30		*
04:45		*
05:00		*
05:15		*
05:30		*
05:45		*
06:00		*
06:15		*
06:30		*
06:45		*
07:00		*
07:15		*
07:30		*
07:45		*
08:00		*
08:15		*
08:30		*
08:45		*
09:00		*
09:15		*
09:30		*
09:45		*
10:00		*
10:15		*
10:30		*
10:45		*
11:00		*
11:15		*
11:30		*
11:45		*
Total		7
Peak	-	-
Vol.	-	-
P.H.F.		
Grand Total		217
Percent		
ADT		ADT 65
		AADT 65

OLSSON ASSOCIATES
7301 West 133rd Street
Overland Park, KS 66213
www.olssonassociates.com

Site Code:
Station ID: Rockledge Rd SB

Latitude: 0' 0.0000 Undefined

Start Time	10-Dec-13 Tue	Channel 1
12:00 AM		*
12:15		*
12:30		*
12:45		*
01:00		*
01:15		*
01:30		*
01:45		*
02:00		*
02:15		*
02:30		*
02:45		*
03:00		*
03:15		*
03:30		*
03:45		*
04:00		*
04:15		*
04:30		*
04:45		*
05:00		*
05:15		*
05:30		*
05:45		*
06:00		*
06:15		*
06:30		*
06:45		*
07:00		*
07:15		*
07:30		*
07:45		*
08:00		*
08:15		*
08:30		*
08:45		*
09:00		*
09:15		*
09:30		*
09:45		*
10:00		*
10:15		*
10:30		*
10:45		*
11:00		*
11:15		*
11:30		*
11:45		*
Total		0
Peak	-	-
Vol.	-	-
P.H.F.		

-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

OLSSON ASSOCIATES
7301 West 133rd Street
Overland Park, KS 66213
www.olssonassociates.com

Site Code:
Station ID: Rockledge Rd SB

Latitude: 0' 0.0000 Undefined

Start Time	10-Dec-13 Tue	Channel 1
12:00 PM		*
12:15		*
12:30		20
12:45		19
01:00		19
01:15		12
01:30		21
01:45		20
02:00		17
02:15		13
02:30		17
02:45		29
03:00		19
03:15		**39**
03:30		**30**
03:45		**27**
04:00		**25**
04:15		27
04:30		27
04:45		22
05:00		17
05:15		28
05:30		29
05:45		27
06:00		20
06:15		24
06:30		19
06:45		20
07:00		15
07:15		11
07:30		13
07:45		10
08:00		11
08:15		10
08:30		12
08:45		14
09:00		13
09:15		8
09:30		14
09:45		3
10:00		5
10:15		9
10:30		6
10:45		3
11:00		4
11:15		2
11:30		5
11:45		4
Total		759
Peak	-	15:15
Vol.	-	121
P.H.F.		0.776

OLSSON ASSOCIATES
7301 West 133rd Street
Overland Park, KS 66213
www.olssonassociates.com

Site Code:
Station ID: Rockledge Rd SB

Latitude: 0' 0.0000 Undefined

Start Time	11-Dec-13 Wed	Channel 1
12:00 AM		3
12:15		1
12:30		3
12:45		2
01:00		2
01:15		5
01:30		0
01:45		0
02:00		2
02:15		4
02:30		2
02:45		1
03:00		3
03:15		1
03:30		2
03:45		1
04:00		0
04:15		0
04:30		1
04:45		1
05:00		2
05:15		5
05:30		2
05:45		1
06:00		2
06:15		4
06:30		10
06:45		7
07:00		15
07:15		10
07:30		21
07:45		21
08:00		**35**
08:15		**36**
08:30		**20**
08:45		**24**
09:00		15
09:15		16
09:30		18
09:45		17
10:00		22
10:15		14
10:30		18
10:45		17
11:00		14
11:15		18
11:30		27
11:45		16
Total		461
Peak	-	08:00
Vol.	-	115
P.H.F.		0.799

OLSSON ASSOCIATES
7301 West 133rd Street
Overland Park, KS 66213
www.olssonassociates.com

Site Code:
Station ID: Rockledge Rd SB

Latitude: 0' 0.0000 Undefined

Start Time	11-Dec-13 Wed	Channel 1
12:00 PM		18
12:15		21
12:30		22
12:45		*
01:00		*
01:15		*
01:30		*
01:45		*
02:00		*
02:15		*
02:30		*
02:45		*
03:00		*
03:15		*
03:30		*
03:45		*
04:00		*
04:15		*
04:30		*
04:45		*
05:00		*
05:15		*
05:30		*
05:45		*
06:00		*
06:15		*
06:30		*
06:45		*
07:00		*
07:15		*
07:30		*
07:45		*
08:00		*
08:15		*
08:30		*
08:45		*
09:00		*
09:15		*
09:30		*
09:45		*
10:00		*
10:15		*
10:30		*
10:45		*
11:00		*
11:15		*
11:30		*
11:45		*
Total		61
Peak	-	-
Vol.	-	-
P.H.F.		
Grand Total		1281
Percent		
ADT		ADT 395

AADT 395

Date/Time/Volume/Average Speed/Temperature Report

21ST Street

HI-Star ID: 6098
Street: 9th Street
State: Ks
City: Lawrence
County: Douglas

Begin: Dec/10/2013 12:00:00 PM
Lane: EB
Oper: JRC
Posted: 35
AADT Factor: 1

End: Dec/11/2013 12:00:00 PM
Hours: 24.00
Period: 15
Raw Count: 3408
AADT Count: 3,408

Date And Time Range	Period Volume	Average Speed	Roadway Temperature	Roadway Surface Wet/Dry
Tue,Dec/10/2013				
[12:00-12:15]	0	0 MPH	62 F	---
[12:15-12:30]	4	45 MPH	62 F	---
[12:30-12:45]	46	28 MPH	52 F	---
[12:45-13:00]	67	29 MPH	52 F	---
[13:00-13:15]	50	29 MPH	48 F	---
[13:15-13:30]	51	31 MPH	44 F	---
[13:30-13:45]	45	28 MPH	42 F	---
[13:45-14:00]	52	31 MPH	41 F	---
[14:00-14:15]	54	29 MPH	39 F	---
[14:15-14:30]	45	31 MPH	39 F	---
[14:30-14:45]	47	30 MPH	37 F	---
[14:45-15:00]	52	28 MPH	39 F	---
[15:00-15:15]	70	27 MPH	37 F	---
[15:15-15:30]	89	27 MPH	37 F	---
[15:30-15:45]	66	27 MPH	35 F	---
[15:45-16:00]	68	29 MPH	35 F	---
[16:00-16:15]	72	28 MPH	33 F	---
[16:15-16:30]	59	32 MPH	33 F	---
[16:30-16:45]	72	30 MPH	33 F	---
[16:45-17:00]	85	30 MPH	31 F	---
[17:00-17:15]	107	30 MPH	31 F	---
[17:15-17:30]	88	29 MPH	31 F	---
[17:30-17:45]	85	27 MPH	31 F	---
[17:45-18:00]	64	27 MPH	33 F	---
[18:00-18:15]	63	27 MPH	33 F	---
[18:15-18:30]	75	29 MPH	33 F	---
[18:30-18:45]	61	28 MPH	33 F	---
[18:45-19:00]	38	31 MPH	35 F	---
[19:00-19:15]	44	29 MPH	35 F	---
[19:15-19:30]	25	29 MPH	35 F	---
[19:30-19:45]	28	28 MPH	35 F	---
[19:45-20:00]	25	29 MPH	37 F	---
[20:00-20:15]	19	27 MPH	37 F	---
[20:15-20:30]	21	29 MPH	37 F	---
[20:30-20:45]	20	28 MPH	37 F	---
[20:45-21:00]	22	31 MPH	37 F	---

Date/Time/Volume/Average Speed/Temperature Report

21ST Street

HI-Star ID: 6098
Street: 9th Street
State: Ks
City: Lawrence
County: Douglas

Begin: Dec/10/2013 12:00:00 PM
Lane: EB
Oper: JRC
Posted: 35
AADT Factor: 1

End: Dec/11/2013 12:00:00 PM
Hours: 24.00
Period: 15
Raw Count: 3408
AADT Count: 3,408

Date And Time Range	Period Volume	Average Speed	Roadway Temperature	Roadway Surface Wet/Dry
Tue,Dec/10/2013				
[21:00-21:15]	33	28 MPH	37 F	---
[21:15-21:30]	13	35 MPH	37 F	---
[21:30-21:45]	12	28 MPH	37 F	---
[21:45-22:00]	13	31 MPH	39 F	---
[22:00-22:15]	14	29 MPH	39 F	---
[22:15-22:30]	14	28 MPH	39 F	---
[22:30-22:45]	5	28 MPH	39 F	---
[22:45-23:00]	7	31 MPH	39 F	---
[23:00-23:15]	10	31 MPH	41 F	---
[23:15-23:30]	7	32 MPH	41 F	---
[23:30-23:45]	9	28 MPH	41 F	---
[23:45-00:00]	5	28 MPH	41 F	---
Tue,Dec/10/2013	2021	29 MPH	39 F	
Wed,Dec/11/2013				
[00:00-00:15]	5	28 MPH	41 F	---
[00:15-00:30]	9	31 MPH	41 F	---
[00:30-00:45]	5	30 MPH	41 F	---
[00:45-01:00]	1	32 MPH	41 F	---
[01:00-01:15]	3	27 MPH	41 F	---
[01:15-01:30]	3	26 MPH	41 F	---
[01:30-01:45]	5	28 MPH	41 F	---
[01:45-02:00]	3	34 MPH	42 F	---
[02:00-02:15]	2	30 MPH	42 F	---
[02:15-02:30]	2	28 MPH	42 F	---
[02:30-02:45]	1	22 MPH	42 F	---
[02:45-03:00]	0	0 MPH	42 F	---
[03:00-03:15]	1	32 MPH	42 F	---
[03:15-03:30]	1	32 MPH	42 F	---
[03:30-03:45]	0	0 MPH	41 F	---
[03:45-04:00]	0	0 MPH	41 F	---
[04:00-04:15]	1	18 MPH	41 F	---
[04:15-04:30]	2	20 MPH	41 F	---
[04:30-04:45]	1	28 MPH	41 F	---
[04:45-05:00]	6	36 MPH	39 F	---
[05:00-05:15]	9	32 MPH	39 F	---
[05:15-05:30]	5	31 MPH	39 F	---

Date/Time/Volume/Average Speed/Temperature Report

21ST Street

HI-Star ID: 6098
Street: 9th Street
State: Ks
City: Lawrence
County: Douglas

Begin: Dec/10/2013 12:00:00 PM
Lane: EB
Oper: JRC
Posted: 35
AADT Factor: 1

End: Dec/11/2013 12:00:00 PM
Hours: 24.00
Period: 15
Raw Count: 3408
AADT Count: 3,408

Date And Time Range	Period Volume	Average Speed	Roadway Temperature	Roadway Surface Wet/Dry
Wed,Dec/11/2013				
[05:30-05:45]	11	32 MPH	39 F	---
[05:45-06:00]	22	28 MPH	39 F	---
[06:00-06:15]	15	30 MPH	39 F	---
[06:15-06:30]	14	30 MPH	39 F	---
[06:30-06:45]	24	31 MPH	41 F	---
[06:45-07:00]	34	29 MPH	41 F	---
[07:00-07:15]	54	27 MPH	41 F	---
[07:15-07:30]	63	28 MPH	41 F	---
[07:30-07:45]	88	27 MPH	41 F	---
[07:45-08:00]	134	27 MPH	39 F	---
[08:00-08:15]	98	28 MPH	39 F	---
[08:15-08:30]	79	29 MPH	39 F	---
[08:30-08:45]	82	28 MPH	37 F	---
[08:45-09:00]	72	31 MPH	37 F	---
[09:00-09:15]	51	29 MPH	37 F	---
[09:15-09:30]	45	31 MPH	37 F	---
[09:30-09:45]	50	31 MPH	35 F	---
[09:45-10:00]	45	29 MPH	35 F	---
[10:00-10:15]	38	30 MPH	35 F	---
[10:15-10:30]	32	28 MPH	35 F	---
[10:30-10:45]	42	30 MPH	31 F	---
[10:45-11:00]	51	27 MPH	33 F	---
[11:00-11:15]	46	30 MPH	37 F	---
[11:15-11:30]	35	29 MPH	41 F	---
[11:30-11:45]	44	28 MPH	41 F	---
[11:45-12:00]	53	30 MPH	37 F	---
Wed,Dec/11/2013	1387	29 MPH	39 F	
Dec/10/2013 12:00:00 PM Dec/11/2013 12:00:00 PM	3408	29 MPH	39 F	

OLSSON ASSOCIATES
7301 West 133rd Street
Overland Park, KS 66213
www.olssonassociates.com

Site Code: 9 WB
Station ID:

Latitude: 0' 0.0000 South

Start Time	10-Dec-13 Tue	Channel 1
12:00 AM		*
12:15		*
12:30		*
12:45		*
01:00		*
01:15		*
01:30		*
01:45		*
02:00		*
02:15		*
02:30		*
02:45		*
03:00		*
03:15		*
03:30		*
03:45		*
04:00		*
04:15		*
04:30		*
04:45		*
05:00		*
05:15		*
05:30		*
05:45		*
06:00		*
06:15		*
06:30		*
06:45		*
07:00		*
07:15		*
07:30		*
07:45		*
08:00		*
08:15		*
08:30		*
08:45		*
09:00		*
09:15		*
09:30		*
09:45		*
10:00		*
10:15		*
10:30		*
10:45		*
11:00		*
11:15		*
11:30		*
11:45		*
Total		0
Peak	-	-
Vol.	-	-
P.H.F.		

-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

OLSSON ASSOCIATES
7301 West 133rd Street
Overland Park, KS 66213
www.olssonassociates.com

Site Code: 9 WB
Station ID:

Latitude: 0' 0.0000 South

Start Time	10-Dec-13 Tue	Channel 1
12:00 PM		*
12:15		*
12:30		82
12:45		69
01:00		73
01:15		58
01:30		63
01:45		54
02:00		63
02:15		57
02:30		74
02:45		81
03:00		85
03:15		86
03:30		68
03:45		87
04:00		104
04:15		112
04:30		**127**
04:45		**112**
05:00		**155**
05:15		**152**
05:30		122
05:45		109
06:00		103
06:15		71
06:30		125
06:45		59
07:00		61
07:15		57
07:30		58
07:45		54
08:00		52
08:15		41
08:30		58
08:45		48
09:00		40
09:15		47
09:30		33
09:45		46
10:00		31
10:15		22
10:30		20
10:45		24
11:00		13
11:15		12
11:30		13
11:45		16
Total		3097
Peak	-	16:30
Vol.	-	546
P.H.F.		0.881

OLSSON ASSOCIATES
7301 West 133rd Street
Overland Park, KS 66213
www.olssonassociates.com

Site Code: 9 WB
Station ID:

Latitude: 0' 0.0000 South

Start Time	11-Dec-13 Wed	Channel 1
12:00 AM		8
12:15		10
12:30		8
12:45		12
01:00		6
01:15		4
01:30		10
01:45		7
02:00		4
02:15		6
02:30		0
02:45		3
03:00		1
03:15		3
03:30		1
03:45		2
04:00		0
04:15		2
04:30		3
04:45		1
05:00		2
05:15		3
05:30		7
05:45		7
06:00		5
06:15		16
06:30		19
06:45		13
07:00		30
07:15		35
07:30		45
07:45		55
08:00		52
08:15		31
08:30		29
08:45		42
09:00		41
09:15		44
09:30		48
09:45		31
10:00		36
10:15		37
10:30		40
10:45		51
11:00		**57**
11:15		**71**
11:30		**63**
11:45		**52**
Total		1053
Peak	-	11:00
Vol.	-	243
P.H.F.		0.856

OLSSON ASSOCIATES
7301 West 133rd Street
Overland Park, KS 66213
www.olssonassociates.com

Site Code: 9 WB
Station ID:

Latitude: 0' 0.0000 South

Start Time	11-Dec-13 Wed	Channel 1
12:00 PM		85
12:15		56
12:30		64
12:45		*
01:00		*
01:15		*
01:30		*
01:45		*
02:00		*
02:15		*
02:30		*
02:45		*
03:00		*
03:15		*
03:30		*
03:45		*
04:00		*
04:15		*
04:30		*
04:45		*
05:00		*
05:15		*
05:30		*
05:45		*
06:00		*
06:15		*
06:30		*
06:45		*
07:00		*
07:15		*
07:30		*
07:45		*
08:00		*
08:15		*
08:30		*
08:45		*
09:00		*
09:15		*
09:30		*
09:45		*
10:00		*
10:15		*
10:30		*
10:45		*
11:00		*
11:15		*
11:30		*
11:45		*
Total		205
Peak	-	-
Vol.	-	-
P.H.F.		
Grand Total		4355
Percent		
ADT		ADT 1,390
		AADT 1,390

Traffic Counts – 9th Street (TMC)

OLSSON ASSOCIATES

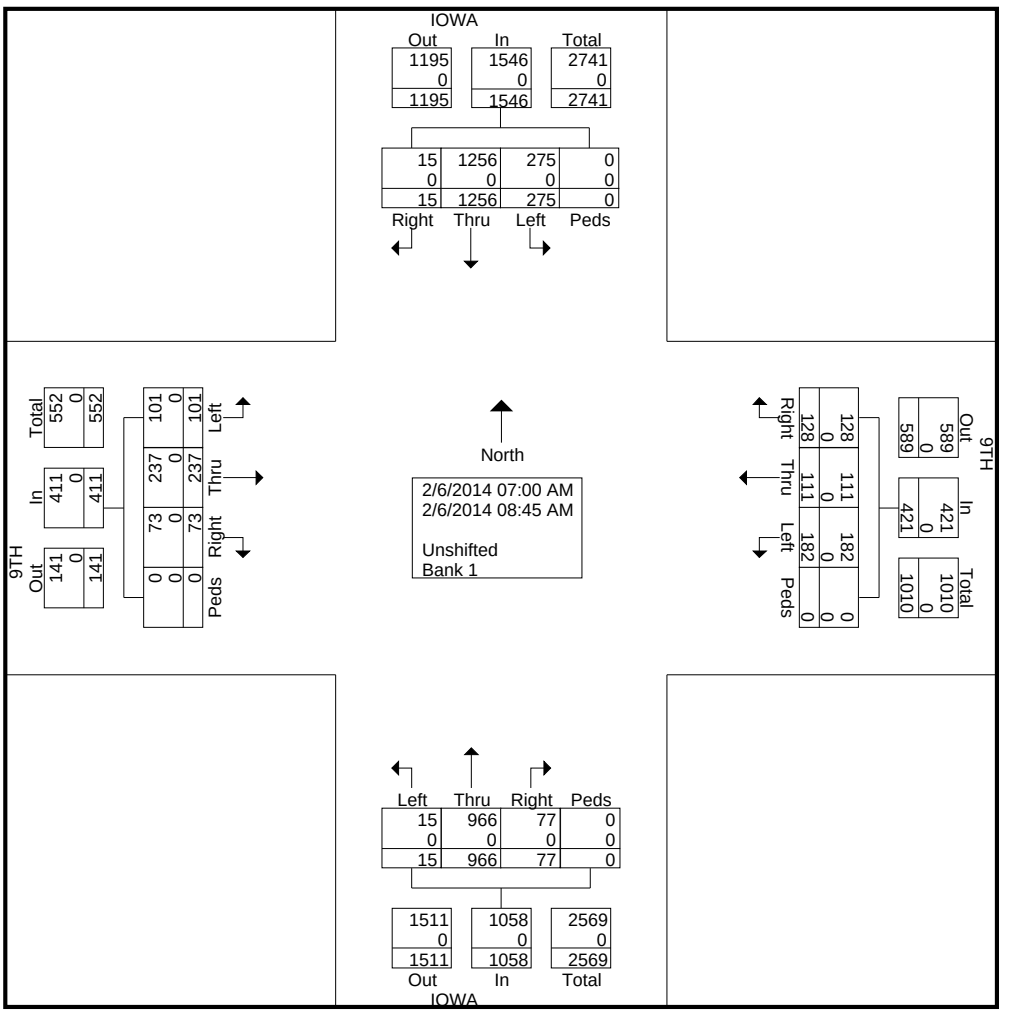
7301 WEST 133RD STREET SUITE 200
OVERLAND PARK, KANSAS 66213

9TH & IOWA
AM COUNT
TAYOLR & FRIEND

File Name : 9TH & IOWA AM MERGED
Site Code : 00000000
Start Date : 2/6/2014
Page No : 1

Groups Printed- Unshifted - Bank 1

	IOWA From North					9TH From East					IOWA From South					9TH From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00 AM	2	98	17	0	117	9	5	7	0	21	3	107	0	0	110	9	9	15	0	33	281
07:15 AM	3	154	26	0	183	21	11	18	0	50	5	137	2	0	144	14	16	12	0	42	419
07:30 AM	0	157	42	0	199	15	14	23	0	52	7	132	2	0	141	10	28	18	0	56	448
07:45 AM	0	208	45	0	253	17	21	33	0	71	31	126	1	0	158	9	35	10	0	54	536
Total	5	617	130	0	752	62	51	81	0	194	46	502	5	0	553	42	88	55	0	185	1684
08:00 AM	2	185	49	0	236	19	16	24	0	59	6	126	2	0	134	13	37	12	0	62	491
08:15 AM	2	142	28	0	172	14	12	31	0	57	6	112	3	0	121	8	40	7	0	55	405
08:30 AM	2	149	32	0	183	14	15	22	0	51	5	124	1	0	130	4	39	13	0	56	420
08:45 AM	4	163	36	0	203	19	17	24	0	60	14	102	4	0	120	6	33	14	0	53	436
Total	10	639	145	0	794	66	60	101	0	227	31	464	10	0	505	31	149	46	0	226	1752
Grand Total	15	1256	275	0	1546	128	111	182	0	421	77	966	15	0	1058	73	237	101	0	411	3436
Apprch %	1	81.2	17.8	0		30.4	26.4	43.2	0		7.3	91.3	1.4	0		17.8	57.7	24.6	0		
Total %	0.4	36.6	8	0	45	3.7	3.2	5.3	0	12.3	2.2	28.1	0.4	0	30.8	2.1	6.9	2.9	0	12	
Unshifted	15	1256	275	0	1546	128	111	182	0	421	77	966	15	0	1058	73	237	101	0	411	3436
% Unshifted	100	100	100	0	100	100	100	100	0	100	100	100	100	0	100	100	100	100	0	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



OLSSON ASSOCIATES

7301 WEST 133RD STREET SUITE 200
OVERLAND PARK, KANSAS 66213

9TH & IOWA
AM COUNT
TAYOLR & FRIEND

File Name : 9TH & IOWA AM MERGED
Site Code : 00000000
Start Date : 2/6/2014

	IOWA From North					9TH From East					IOWA From South					9TH From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
07:15 AM	**3**	154	26	0	183	**21**	11	18	0	50	5	**137**	**2**	0	144	**14**	16	12	0	42	419
07:30 AM	0	157	42	0	199	15	14	23	0	52	7	132	2	0	141	10	28	**18**	0	56	448
07:45 AM	0	**208**	45	0	**253**	17	**21**	**33**	0	**71**	**31**	126	1	0	**158**	9	35	10	0	54	**536**
08:00 AM	2	185	**49**	0	236	19	16	24	0	59	6	126	2	0	134	13	**37**	12	0	**62**	491
Total Volume	5	704	162	0	871	72	62	98	0	232	49	521	7	0	577	46	116	52	0	214	1894
% App. Total	0.6	80.8	18.6	0		31	26.7	42.2	0		8.5	90.3	1.2	0		21.5	54.2	24.3	0		
PHF	.417	.846	.827	.000	.861	.857	.738	.742	.000	.817	.395	.951	.875	.000	.913	.821	.784	.722	.000	.863	.883

Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:15 AM					07:30 AM					07:15 AM					07:30 AM					
+0 mins.	**3**	154	26	0	183	15	14	23	0	52	5	**137**	**2**	0	144	10	28	**18**	0	56	
+15 mins.	0	157	42	0	199	17	**21**	**33**	0	**71**	7	132	2	0	141	9	35	10	0	54	
+30 mins.	0	**208**	45	0	**253**	**19**	16	24	0	59	**31**	126	1	0	**158**	**13**	37	12	0	**62**	
+45 mins.	2	185	**49**	0	236	14	12	31	0	57	6	126	2	0	134	8	**40**	7	0	55	
Total Volume	5	704	162	0	871	65	63	111	0	239	49	521	7	0	577	40	140	47	0	227	
% App. Total	0.6	80.8	18.6	0		27.2	26.4	46.4	0		8.5	90.3	1.2	0		17.6	61.7	20.7	0		
PHF	.417	.846	.827	.000	.861	.855	.750	.841	.000	.842	.395	.951	.875	.000	.913	.769	.875	.653	.000	.915	

OLSSON ASSOCIATES

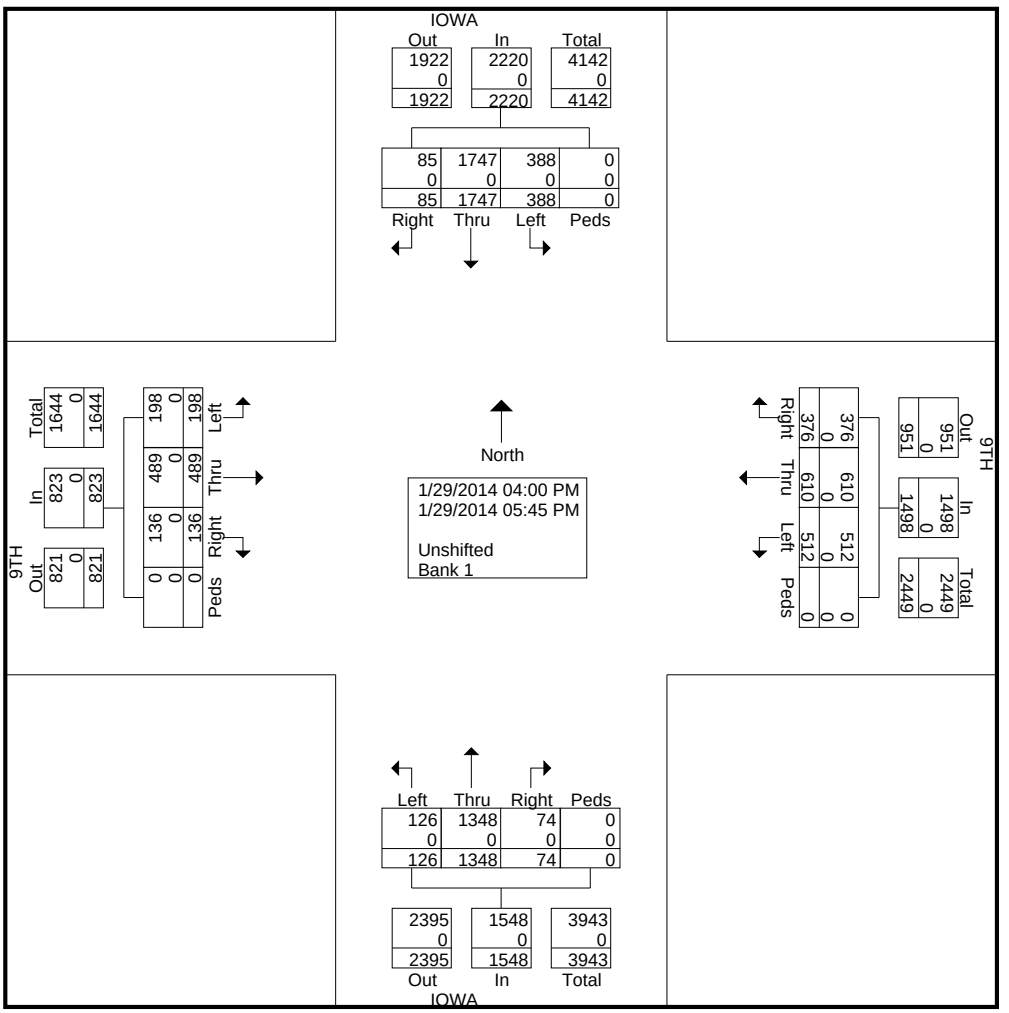
7301 WEST 133RD STREET SUITE 200
OVERLAND PARK, KANSAS 66213

9TH & IOWA
PM COUNT
TAYOLR & FRIEND

File Name : 9TH & IOWA PM MERGED
Site Code : 00000000
Start Date : 1/29/2014
Page No : 1

Groups Printed- Unshifted - Bank 1

	IOWA From North					9TH From East					IOWA From South					9TH From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
04:00 PM	8	225	31	0	264	42	56	66	0	164	8	176	9	0	193	14	57	27	0	98	719
04:15 PM	9	163	38	0	210	33	56	54	0	143	7	169	17	0	193	16	54	13	0	83	629
04:30 PM	13	194	39	0	246	45	64	61	0	170	16	148	12	0	176	9	50	28	0	87	679
04:45 PM	8	237	48	0	293	46	71	64	0	181	4	155	17	0	176	19	64	20	0	103	753
Total	38	819	156	0	1013	166	247	245	0	658	35	648	55	0	738	58	225	88	0	371	2780
05:00 PM	9	221	53	0	283	59	104	73	0	236	10	160	16	0	186	18	62	28	0	108	813
05:15 PM	14	245	64	0	323	54	100	68	0	222	13	199	34	0	246	17	62	27	0	106	897
05:30 PM	20	221	50	0	291	57	103	72	0	232	7	175	12	0	194	19	71	30	0	120	837
05:45 PM	4	241	65	0	310	40	56	54	0	150	9	166	9	0	184	24	69	25	0	118	762
Total	47	928	232	0	1207	210	363	267	0	840	39	700	71	0	810	78	264	110	0	452	3309
Grand Total	85	1747	388	0	2220	376	610	512	0	1498	74	1348	126	0	1548	136	489	198	0	823	6089
Apprch %	3.8	78.7	17.5	0		25.1	40.7	34.2	0		4.8	87.1	8.1	0		16.5	59.4	24.1	0		
Total %	1.4	28.7	6.4	0	36.5	6.2	10	8.4	0	24.6	1.2	22.1	2.1	0	25.4	2.2	8	3.3	0	13.5	
Unshifted	85	1747	388	0	2220	376	610	512	0	1498	74	1348	126	0	1548	136	489	198	0	823	6089
% Unshifted	100	100	100	0	100	100	100	100	0	100	100	100	100	0	100	100	100	100	0	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



OLSSON ASSOCIATES

7301 WEST 133RD STREET SUITE 200
OVERLAND PARK, KANSAS 66213

9TH & IOWA
PM COUNT
TAYOLR & FRIEND

File Name : 9TH & IOWA PM MERGED
Site Code : 00000000
Start Date : 1/29/2014

	IOWA From North					9TH From East					IOWA From South					9TH From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 05:00 PM																					
05:00 PM	9	221	53	0	283	**59**	**104**	**73**	0	**236**	10	160	16	0	186	18	62	28	0	108	813
05:15 PM	14	**245**	64	0	**323**	54	100	68	0	222	**13**	**199**	**34**	0	**246**	17	62	27	0	106	**897**
05:30 PM	**20**	221	50	0	291	57	103	72	0	232	7	175	12	0	194	19	**71**	**30**	0	**120**	837
05:45 PM	4	241	**65**	0	310	40	56	54	0	150	9	166	9	0	184	**24**	69	25	0	118	762
Total Volume	47	928	232	0	1207	210	363	267	0	840	39	700	71	0	810	78	264	110	0	452	3309
% App. Total	3.9	76.9	19.2	0		25	43.2	31.8	0		4.8	86.4	8.8	0		17.3	58.4	24.3	0		
PHF	.588	.947	.892	.000	.934	.890	.873	.914	.000	.890	.750	.879	.522	.000	.823	.813	.930	.917	.000	.942	.922

Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	05:00 PM					04:45 PM					05:00 PM					05:00 PM				
+0 mins.	9	221	53	0	283	46	71	64	0	181	10	160	16	0	186	18	62	28	0	108
+15 mins.	14	**245**	64	0	**323**	**59**	**104**	**73**	0	**236**	**13**	**199**	**34**	0	**246**	17	62	27	0	106
+30 mins.	**20**	221	50	0	291	54	100	68	0	222	7	175	12	0	194	19	**71**	**30**	0	**120**
+45 mins.	4	241	**65**	0	310	57	103	72	0	232	9	166	9	0	184	**24**	69	25	0	118
Total Volume	47	928	232	0	1207	216	378	277	0	871	39	700	71	0	810	78	264	110	0	452
% App. Total	3.9	76.9	19.2	0		24.8	43.4	31.8	0		4.8	86.4	8.8	0		17.3	58.4	24.3	0	
PHF	.588	.947	.892	.000	.934	.915	.909	.949	.000	.923	.750	.879	.522	.000	.823	.813	.930	.917	.000	.942

OLSSON ASSOCIATES

7301 WEST 133RD STREET SUITE 200
OVERLAND PARK, KANSAS 66213

9th Street & Rockledge Rd
AM & PM Counts
Taylor Count

File Name : 9th Street & Rockledge Rd Merged
Site Code : 00000000
Start Date : 12/10/2013
Page No : 1

Groups Printed- Unshifted - Bank 1

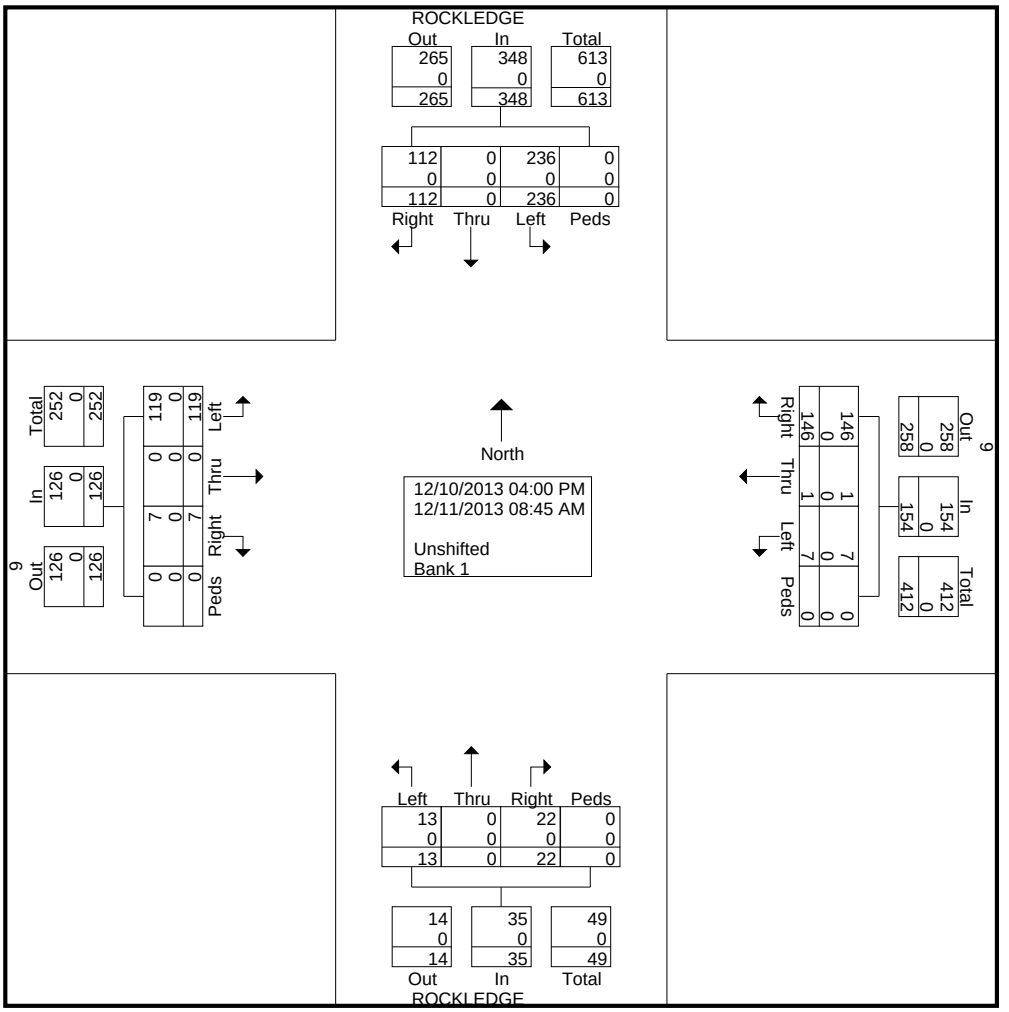
	ROCKLEDGE From North					9 From East					ROCKLEDGE From South					9 From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
04:00 PM	5	0	21	0	26	14	0	1	0	15	1	0	1	0	2	0	0	8	0	8	51
04:15 PM	7	0	16	0	23	11	0	0	0	11	0	0	1	0	1	0	0	3	0	3	38
04:30 PM	6	0	14	0	20	15	0	2	0	17	1	0	2	0	3	0	0	11	0	11	51
04:45 PM	12	0	10	0	22	20	0	0	0	20	1	0	1	0	2	3	0	10	0	13	57
Total	30	0	61	0	91	60	0	3	0	63	3	0	5	0	8	3	0	32	0	35	197
05:00 PM	7	0	15	0	22	15	0	1	0	16	2	0	1	0	3	1	0	7	0	8	49
05:15 PM	9	0	19	0	28	15	0	2	0	17	2	0	0	0	2	1	0	7	0	8	55
05:30 PM	6	0	18	0	24	9	0	0	0	9	0	0	0	0	0	1	0	3	0	4	37
05:45 PM	4	0	13	0	17	11	0	0	0	11	0	0	1	0	1	0	0	5	0	5	34
Total	26	0	65	0	91	50	0	3	0	53	4	0	2	0	6	3	0	22	0	25	175
*** BREAK ***																					
07:00 AM	5	0	5	0	10	0	1	0	0	1	0	0	0	0	0	0	0	6	0	6	17
07:15 AM	11	0	10	0	21	3	0	0	0	3	1	0	0	0	1	0	0	7	0	7	32
07:30 AM	5	0	11	0	16	6	0	0	0	6	0	0	1	0	1	1	0	6	0	7	30
07:45 AM	17	0	16	0	33	9	0	0	0	9	8	0	3	0	11	0	0	21	0	21	74
Total	38	0	42	0	80	18	1	0	0	19	9	0	4	0	13	1	0	40	0	41	153
08:00 AM	7	0	27	0	34	3	0	0	0	3	3	0	0	0	3	0	0	12	0	12	52
08:15 AM	6	0	13	0	19	6	0	1	0	7	0	0	1	0	1	0	0	5	0	5	32
08:30 AM	5	0	13	0	18	5	0	0	0	5	1	0	0	0	1	0	0	5	0	5	29
08:45 AM	0	0	15	0	15	4	0	0	0	4	2	0	1	0	3	0	0	3	0	3	25
Total	18	0	68	0	86	18	0	1	0	19	6	0	2	0	8	0	0	25	0	25	138
Grand Total	112	0	236	0	348	146	1	7	0	154	22	0	13	0	35	7	0	119	0	126	663
Apprch %	32.2	0	67.8	0		94.8	0.6	4.5	0		62.9	0	37.1	0		5.6	0	94.4	0		
Total %	16.9	0	35.6	0	52.5	22	0.2	1.1	0	23.2	3.3	0	2	0	5.3	1.1	0	17.9	0	19	
Unshifted	112	0	236	0	348	146	1	7	0	154	22	0	13	0	35	7	0	119	0	126	663
% Unshifted	100	0	100	0	100	100	100	100	0	100	100	0	100	0	100	100	0	100	0	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

OLSSON ASSOCIATES

7301 WEST 133RD STREET SUITE 200
OVERLAND PARK, KANSAS 66213

9th Street & Rockledge Rd
AM & PM Counts
Taylor Count

File Name : 9th Street & Rockledge Rd Merged
Site Code : 00000000
Start Date : 12/10/2013
Page No : 2



OLSSON ASSOCIATES

7301 WEST 133RD STREET SUITE 200
OVERLAND PARK, KANSAS 66213

9th Street & Rockledge Rd
AM & PM Counts
Taylor Count

File Name : 9th Street & Rockledge Rd Merged
Site Code : 00000000
Start Date : 12/10/2013

	ROCKLEDGE From North					9 From East					ROCKLEDGE From South					9 From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:30 PM																					
04:30 PM	6	0	14	0	20	15	0	**2**	0	17	1	0	**2**	0	**3**	0	0	**11**	0	11	51
04:45 PM	**12**	0	10	0	22	**20**	0	0	0	**20**	1	0	1	0	2	**3**	0	10	0	**13**	**57**
05:00 PM	7	0	15	0	22	15	0	1	0	16	**2**	0	1	0	3	1	0	7	0	8	49
05:15 PM	9	0	**19**	0	**28**	15	0	2	0	17	2	0	0	0	2	1	0	7	0	8	55
Total Volume	34	0	58	0	92	65	0	5	0	70	6	0	4	0	10	5	0	35	0	40	212
% App. Total	37	0	63	0		92.9	0	7.1	0		60	0	40	0		12.5	0	87.5	0		
PHF	.708	.000	.763	.000	.821	.813	.000	.625	.000	.875	.750	.000	.500	.000	.833	.417	.000	.795	.000	.769	.930

Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:45 PM					04:30 PM					04:30 PM					04:30 PM					
+0 mins.	**12**	0	10	0	22	15	0	**2**	0	17	1	0	**2**	0	**3**	0	0	**11**	0	11	
+15 mins.	7	0	15	0	22	**20**	0	0	0	**20**	1	0	1	0	2	**3**	0	10	0	**13**	
+30 mins.	9	0	**19**	0	**28**	15	0	1	0	16	**2**	0	1	0	3	1	0	7	0	8	
+45 mins.	6	0	18	0	24	15	0	2	0	17	2	0	0	0	2	1	0	7	0	8	
Total Volume	34	0	62	0	96	65	0	5	0	70	6	0	4	0	10	5	0	35	0	40	
% App. Total	35.4	0	64.6	0		92.9	0	7.1	0		60	0	40	0		12.5	0	87.5	0		
PHF	.708	.000	.816	.000	.857	.813	.000	.625	.000	.875	.750	.000	.500	.000	.833	.417	.000	.795	.000	.769	

Traffic Counts – 21st Street (24-hour)

Date/Time/Volume/Average Speed/Temperature Report

HI-Star ID: 5898	Begin: Dec/10/2013 12:00:00 PM	End: Dec/11/2013 12:00:00 PM
Street: Iowa St.	Lane: NB Inside	Hours: 24.00
State: Ks	Oper: JRC	Period: 15
City: Lawrence	Posted: 40	Raw Count: 6427
County: Douglas	AADT Factor: 1	AADT Count: 6,427

Date And Time Range	Period Volume	Average Speed	Roadway Temperature	Roadway Surface Wet/Dry
Tue,Dec/10/2013				
[12:00-12:15]	101	34 MPH	44 F	---
[12:15-12:30]	101	34 MPH	46 F	---
[12:30-12:45]	116	32 MPH	46 F	---
[12:45-13:00]	111	34 MPH	46 F	---
[13:00-13:15]	98	33 MPH	46 F	---
[13:15-13:30]	118	33 MPH	46 F	---
[13:30-13:45]	105	33 MPH	46 F	---
[13:45-14:00]	101	33 MPH	46 F	---
[14:00-14:15]	109	33 MPH	46 F	---
[14:15-14:30]	93	35 MPH	46 F	---
[14:30-14:45]	121	32 MPH	46 F	---
[14:45-15:00]	107	33 MPH	44 F	---
[15:00-15:15]	100	34 MPH	41 F	---
[15:15-15:30]	117	34 MPH	41 F	---
[15:30-15:45]	119	33 MPH	39 F	---
[15:45-16:00]	94	35 MPH	39 F	---
[16:00-16:15]	110	34 MPH	37 F	---
[16:15-16:30]	125	33 MPH	37 F	---
[16:30-16:45]	117	32 MPH	35 F	---
[16:45-17:00]	108	32 MPH	35 F	---
[17:00-17:15]	132	32 MPH	33 F	---
[17:15-17:30]	145	30 MPH	33 F	---
[17:30-17:45]	127	31 MPH	33 F	---
[17:45-18:00]	137	33 MPH	31 F	---
[18:00-18:15]	138	32 MPH	31 F	---
[18:15-18:30]	116	32 MPH	31 F	---
[18:30-18:45]	108	33 MPH	33 F	---
[18:45-19:00]	122	33 MPH	33 F	---
[19:00-19:15]	109	32 MPH	33 F	---
[19:15-19:30]	82	33 MPH	33 F	---
[19:30-19:45]	65	32 MPH	33 F	---
[19:45-20:00]	73	34 MPH	35 F	---
[20:00-20:15]	60	33 MPH	35 F	---
[20:15-20:30]	78	33 MPH	35 F	---
[20:30-20:45]	50	35 MPH	35 F	---
[20:45-21:00]	92	33 MPH	37 F	---

Date/Time/Volume/Average Speed/Temperature Report

HI-Star ID: 5898	Begin: Dec/10/2013 12:00:00 PM	End: Dec/11/2013 12:00:00 PM
Street: Iowa St.	Lane: NB Inside	Hours: 24.00
State: Ks	Oper: JRC	Period: 15
City: Lawrence	Posted: 40	Raw Count: 6427
County: Douglas	AADT Factor: 1	AADT Count: 6,427

Date And Time Range	Period Volume	Average Speed	Roadway Temperature	Roadway Surface Wet/Dry
Tue,Dec/10/2013				
[21:00-21:15]	60	33 MPH	37 F	---
[21:15-21:30]	48	35 MPH	37 F	---
[21:30-21:45]	51	33 MPH	37 F	---
[21:45-22:00]	58	32 MPH	37 F	---
[22:00-22:15]	44	33 MPH	37 F	---
[22:15-22:30]	40	33 MPH	37 F	---
[22:30-22:45]	39	34 MPH	37 F	---
[22:45-23:00]	31	35 MPH	37 F	---
[23:00-23:15]	27	34 MPH	39 F	---
[23:15-23:30]	19	35 MPH	39 F	---
[23:30-23:45]	18	33 MPH	39 F	---
[23:45-00:00]	15	35 MPH	39 F	---
Tue,Dec/10/2013	4255	33 MPH	38 F	
Wed,Dec/11/2013				
[00:00-00:15]	24	34 MPH	39 F	---
[00:15-00:30]	16	33 MPH	39 F	---
[00:30-00:45]	14	33 MPH	39 F	---
[00:45-01:00]	15	32 MPH	41 F	---
[01:00-01:15]	7	33 MPH	41 F	---
[01:15-01:30]	13	34 MPH	41 F	---
[01:30-01:45]	4	34 MPH	41 F	---
[01:45-02:00]	13	32 MPH	41 F	---
[02:00-02:15]	4	30 MPH	41 F	---
[02:15-02:30]	12	33 MPH	41 F	---
[02:30-02:45]	8	33 MPH	41 F	---
[02:45-03:00]	4	33 MPH	41 F	---
[03:00-03:15]	3	33 MPH	41 F	---
[03:15-03:30]	2	40 MPH	41 F	---
[03:30-03:45]	5	35 MPH	41 F	---
[03:45-04:00]	6	33 MPH	41 F	---
[04:00-04:15]	5	33 MPH	41 F	---
[04:15-04:30]	3	34 MPH	41 F	---
[04:30-04:45]	4	32 MPH	39 F	---
[04:45-05:00]	8	32 MPH	39 F	---
[05:00-05:15]	10	32 MPH	39 F	---
[05:15-05:30]	16	34 MPH	39 F	---

Date/Time/Volume/Average Speed/Temperature Report

HI-Star ID: 5898	Begin: Dec/10/2013 12:00:00 PM	End: Dec/11/2013 12:00:00 PM
Street: Iowa St.	Lane: NB Inside	Hours: 24.00
State: Ks	Oper: JRC	Period: 15
City: Lawrence	Posted: 40	Raw Count: 6427
County: Douglas	AADT Factor: 1	AADT Count: 6,427

Date And Time Range	Period Volume	Average Speed	Roadway Temperature	Roadway Surface Wet/Dry
Wed,Dec/11/2013				
[05:30-05:45]	19	34 MPH	39 F	---
[05:45-06:00]	38	34 MPH	39 F	---
[06:00-06:15]	29	34 MPH	39 F	---
[06:15-06:30]	40	35 MPH	39 F	---
[06:30-06:45]	56	35 MPH	39 F	---
[06:45-07:00]	72	35 MPH	39 F	---
[07:00-07:15]	66	33 MPH	39 F	---
[07:15-07:30]	88	35 MPH	39 F	---
[07:30-07:45]	110	35 MPH	39 F	---
[07:45-08:00]	140	34 MPH	39 F	---
[08:00-08:15]	102	34 MPH	39 F	---
[08:15-08:30]	107	34 MPH	39 F	---
[08:30-08:45]	95	34 MPH	37 F	---
[08:45-09:00]	114	35 MPH	37 F	---
[09:00-09:15]	66	34 MPH	35 F	---
[09:15-09:30]	57	34 MPH	35 F	---
[09:30-09:45]	78	35 MPH	35 F	---
[09:45-10:00]	93	33 MPH	33 F	---
[10:00-10:15]	52	33 MPH	31 F	---
[10:15-10:30]	68	35 MPH	33 F	---
[10:30-10:45]	78	34 MPH	35 F	---
[10:45-11:00]	93	32 MPH	37 F	---
[11:00-11:15]	68	32 MPH	37 F	---
[11:15-11:30]	74	33 MPH	39 F	---
[11:30-11:45]	82	33 MPH	41 F	---
[11:45-12:00]	91	33 MPH	41 F	---
Wed,Dec/11/2013	2172	34 MPH	39 F	
Dec/10/2013 12:00:00 PM Dec/11/2013 12:00:00 PM	6427	33 MPH	39 F	

Date/Time/Volume/Average Speed/Temperature Report

HI-Star ID: 6100	Begin: Dec/10/2013 12:00:00 PM	End: Dec/11/2013 12:00:00 PM
Street: Iowa St.	Lane: NB Outside	Hours: 24.00
State: Ks	Oper: JRC	Period: 15
City: Lawrence	Posted: 40	Raw Count: 7988
County: Douglas	AADT Factor: 1	AADT Count: 7,988

Date And Time Range	Period Volume	Average Speed	Roadway Temperature	Roadway Surface Wet/Dry
Tue,Dec/10/2013				
[12:00-12:15]	102	36 MPH	44 F	---
[12:15-12:30]	122	37 MPH	46 F	---
[12:30-12:45]	133	34 MPH	46 F	---
[12:45-13:00]	154	36 MPH	46 F	---
[13:00-13:15]	133	36 MPH	46 F	---
[13:15-13:30]	127	36 MPH	46 F	---
[13:30-13:45]	121	36 MPH	48 F	---
[13:45-14:00]	130	36 MPH	46 F	---
[14:00-14:15]	141	35 MPH	48 F	---
[14:15-14:30]	104	36 MPH	46 F	---
[14:30-14:45]	128	34 MPH	46 F	---
[14:45-15:00]	146	35 MPH	46 F	---
[15:00-15:15]	126	35 MPH	42 F	---
[15:15-15:30]	130	36 MPH	41 F	---
[15:30-15:45]	150	34 MPH	41 F	---
[15:45-16:00]	130	36 MPH	39 F	---
[16:00-16:15]	122	36 MPH	39 F	---
[16:15-16:30]	111	36 MPH	37 F	---
[16:30-16:45]	127	34 MPH	37 F	---
[16:45-17:00]	124	35 MPH	35 F	---
[17:00-17:15]	144	34 MPH	35 F	---
[17:15-17:30]	105	32 MPH	33 F	---
[17:30-17:45]	134	34 MPH	33 F	---
[17:45-18:00]	142	34 MPH	33 F	---
[18:00-18:15]	154	34 MPH	31 F	---
[18:15-18:30]	140	34 MPH	31 F	---
[18:30-18:45]	147	33 MPH	31 F	---
[18:45-19:00]	129	35 MPH	31 F	---
[19:00-19:15]	112	35 MPH	33 F	---
[19:15-19:30]	91	36 MPH	33 F	---
[19:30-19:45]	82	36 MPH	33 F	---
[19:45-20:00]	84	35 MPH	33 F	---
[20:00-20:15]	69	36 MPH	35 F	---
[20:15-20:30]	85	36 MPH	35 F	---
[20:30-20:45]	98	37 MPH	35 F	---
[20:45-21:00]	76	37 MPH	37 F	---

Date/Time/Volume/Average Speed/Temperature Report

HI-Star ID: 6100	Begin: Dec/10/2013 12:00:00 PM	End: Dec/11/2013 12:00:00 PM
Street: Iowa St.	Lane: NB Outside	Hours: 24.00
State: Ks	Oper: JRC	Period: 15
City: Lawrence	Posted: 40	Raw Count: 7988
County: Douglas	AADT Factor: 1	AADT Count: 7,988

Date And Time Range	Period Volume	Average Speed	Roadway Temperature	Roadway Surface Wet/Dry
Tue,Dec/10/2013				
[21:00-21:15]	69	36 MPH	37 F	---
[21:15-21:30]	69	37 MPH	37 F	---
[21:30-21:45]	58	36 MPH	37 F	---
[21:45-22:00]	65	36 MPH	37 F	---
[22:00-22:15]	62	37 MPH	37 F	---
[22:15-22:30]	59	35 MPH	37 F	---
[22:30-22:45]	53	37 MPH	37 F	---
[22:45-23:00]	47	37 MPH	37 F	---
[23:00-23:15]	44	36 MPH	39 F	---
[23:15-23:30]	42	37 MPH	39 F	---
[23:30-23:45]	30	36 MPH	39 F	---
[23:45-00:00]	26	36 MPH	39 F	---
Tue,Dec/10/2013	4977	36 MPH	39 F	
Wed,Dec/11/2013				
[00:00-00:15]	26	37 MPH	41 F	---
[00:15-00:30]	19	36 MPH	41 F	---
[00:30-00:45]	20	36 MPH	41 F	---
[00:45-01:00]	14	37 MPH	41 F	---
[01:00-01:15]	11	40 MPH	41 F	---
[01:15-01:30]	12	36 MPH	41 F	---
[01:30-01:45]	7	33 MPH	41 F	---
[01:45-02:00]	11	34 MPH	41 F	---
[02:00-02:15]	6	33 MPH	42 F	---
[02:15-02:30]	8	38 MPH	41 F	---
[02:30-02:45]	11	42 MPH	41 F	---
[02:45-03:00]	6	35 MPH	41 F	---
[03:00-03:15]	12	40 MPH	41 F	---
[03:15-03:30]	11	37 MPH	41 F	---
[03:30-03:45]	11	35 MPH	41 F	---
[03:45-04:00]	14	39 MPH	41 F	---
[04:00-04:15]	2	25 MPH	41 F	---
[04:15-04:30]	12	40 MPH	41 F	---
[04:30-04:45]	16	37 MPH	39 F	---
[04:45-05:00]	11	37 MPH	39 F	---
[05:00-05:15]	17	36 MPH	39 F	---
[05:15-05:30]	24	38 MPH	39 F	---

Date/Time/Volume/Average Speed/Temperature Report

HI-Star ID: 6100	Begin: Dec/10/2013 12:00:00 PM	End: Dec/11/2013 12:00:00 PM
Street: Iowa St.	Lane: NB Outside	Hours: 24.00
State: Ks	Oper: JRC	Period: 15
City: Lawrence	Posted: 40	Raw Count: 7988
County: Douglas	AADT Factor: 1	AADT Count: 7,988

Date And Time Range	Period Volume	Average Speed	Roadway Temperature	Roadway Surface Wet/Dry
Wed,Dec/11/2013				
[05:30-05:45]	50	37 MPH	37 F	---
[05:45-06:00]	50	36 MPH	37 F	---
[06:00-06:15]	35	39 MPH	39 F	---
[06:15-06:30]	75	39 MPH	39 F	---
[06:30-06:45]	87	38 MPH	39 F	---
[06:45-07:00]	93	36 MPH	39 F	---
[07:00-07:15]	104	36 MPH	39 F	---
[07:15-07:30]	132	35 MPH	39 F	---
[07:30-07:45]	155	36 MPH	39 F	---
[07:45-08:00]	165	34 MPH	39 F	---
[08:00-08:15]	125	35 MPH	39 F	---
[08:15-08:30]	132	34 MPH	39 F	---
[08:30-08:45]	144	35 MPH	37 F	---
[08:45-09:00]	141	36 MPH	37 F	---
[09:00-09:15]	101	38 MPH	35 F	---
[09:15-09:30]	106	37 MPH	35 F	---
[09:30-09:45]	111	36 MPH	33 F	---
[09:45-10:00]	109	35 MPH	31 F	---
[10:00-10:15]	87	37 MPH	33 F	---
[10:15-10:30]	93	37 MPH	35 F	---
[10:30-10:45]	107	37 MPH	37 F	---
[10:45-11:00]	125	37 MPH	37 F	---
[11:00-11:15]	71	36 MPH	39 F	---
[11:15-11:30]	99	36 MPH	41 F	---
[11:30-11:45]	106	35 MPH	42 F	---
[11:45-12:00]	127	35 MPH	42 F	---
Wed,Dec/11/2013	3011	36 MPH	39 F	
Dec/10/2013 12:00:00 PM Dec/11/2013 12:00:00 PM	7988	36 MPH	39 F	

Date/Time/Volume/Average Speed/Temperature Report

HI-Star ID: 6097	Begin: Dec/10/2013 12:00:00 PM	End: Dec/11/2013 12:00:00 PM
Street: Iowa St.	Lane: SB Inside	Hours: 24.00
State: Ks	Oper: JRC	Period: 15
City: Lawrence	Posted: 40	Raw Count: 7817
County: Douglas	AADT Factor: 1	AADT Count: 7,817

Date And Time Range	Period Volume	Average Speed	Roadway Temperature	Roadway Surface Wet/Dry
Tue,Dec/10/2013				
[12:00-12:15]	147	42 MPH	44 F	---
[12:15-12:30]	161	43 MPH	44 F	---
[12:30-12:45]	148	43 MPH	46 F	---
[12:45-13:00]	116	42 MPH	46 F	---
[13:00-13:15]	131	44 MPH	46 F	---
[13:15-13:30]	106	45 MPH	48 F	---
[13:30-13:45]	115	44 MPH	48 F	---
[13:45-14:00]	116	46 MPH	48 F	---
[14:00-14:15]	126	43 MPH	48 F	---
[14:15-14:30]	163	41 MPH	48 F	---
[14:30-14:45]	151	44 MPH	46 F	---
[14:45-15:00]	126	43 MPH	46 F	---
[15:00-15:15]	150	42 MPH	44 F	---
[15:15-15:30]	144	42 MPH	41 F	---
[15:30-15:45]	166	44 MPH	41 F	---
[15:45-16:00]	176	42 MPH	39 F	---
[16:00-16:15]	187	41 MPH	39 F	---
[16:15-16:30]	178	42 MPH	37 F	---
[16:30-16:45]	158	43 MPH	37 F	---
[16:45-17:00]	167	43 MPH	35 F	---
[17:00-17:15]	194	39 MPH	35 F	---
[17:15-17:30]	189	41 MPH	35 F	---
[17:30-17:45]	190	42 MPH	33 F	---
[17:45-18:00]	172	42 MPH	33 F	---
[18:00-18:15]	141	44 MPH	33 F	---
[18:15-18:30]	120	44 MPH	31 F	---
[18:30-18:45]	119	43 MPH	31 F	---
[18:45-19:00]	96	43 MPH	31 F	---
[19:00-19:15]	109	43 MPH	31 F	---
[19:15-19:30]	93	43 MPH	33 F	---
[19:30-19:45]	62	44 MPH	33 F	---
[19:45-20:00]	60	44 MPH	33 F	---
[20:00-20:15]	81	44 MPH	33 F	---
[20:15-20:30]	67	45 MPH	35 F	---
[20:30-20:45]	82	44 MPH	35 F	---
[20:45-21:00]	75	45 MPH	35 F	---

Date/Time/Volume/Average Speed/Temperature Report

HI-Star ID: 6097	Begin: Dec/10/2013 12:00:00 PM	End: Dec/11/2013 12:00:00 PM
Street: Iowa St.	Lane: SB Inside	Hours: 24.00
State: Ks	Oper: JRC	Period: 15
City: Lawrence	Posted: 40	Raw Count: 7817
County: Douglas	AADT Factor: 1	AADT Count: 7,817

Date And Time Range	Period Volume	Average Speed	Roadway Temperature	Roadway Surface Wet/Dry
Tue,Dec/10/2013				
[21:00-21:15]	95	43 MPH	35 F	---
[21:15-21:30]	81	42 MPH	35 F	---
[21:30-21:45]	62	45 MPH	35 F	---
[21:45-22:00]	53	45 MPH	35 F	---
[22:00-22:15]	61	47 MPH	37 F	---
[22:15-22:30]	44	46 MPH	37 F	---
[22:30-22:45]	46	43 MPH	37 F	---
[22:45-23:00]	36	43 MPH	37 F	---
[23:00-23:15]	33	44 MPH	37 F	---
[23:15-23:30]	33	43 MPH	37 F	---
[23:30-23:45]	35	44 MPH	39 F	---
[23:45-00:00]	32	45 MPH	39 F	---
Tue,Dec/10/2013	5393	43 MPH	38 F	
Wed,Dec/11/2013				
[00:00-00:15]	39	45 MPH	39 F	---
[00:15-00:30]	31	45 MPH	39 F	---
[00:30-00:45]	23	44 MPH	39 F	---
[00:45-01:00]	17	44 MPH	39 F	---
[01:00-01:15]	11	44 MPH	39 F	---
[01:15-01:30]	4	48 MPH	39 F	---
[01:30-01:45]	11	45 MPH	39 F	---
[01:45-02:00]	10	48 MPH	41 F	---
[02:00-02:15]	12	46 MPH	41 F	---
[02:15-02:30]	7	43 MPH	41 F	---
[02:30-02:45]	12	47 MPH	41 F	---
[02:45-03:00]	13	44 MPH	41 F	---
[03:00-03:15]	8	44 MPH	41 F	---
[03:15-03:30]	12	48 MPH	41 F	---
[03:30-03:45]	6	42 MPH	41 F	---
[03:45-04:00]	6	45 MPH	41 F	---
[04:00-04:15]	6	48 MPH	41 F	---
[04:15-04:30]	9	48 MPH	39 F	---
[04:30-04:45]	10	49 MPH	39 F	---
[04:45-05:00]	12	46 MPH	39 F	---
[05:00-05:15]	13	49 MPH	39 F	---
[05:15-05:30]	12	51 MPH	39 F	---

Date/Time/Volume/Average Speed/Temperature Report

HI-Star ID: 6097	Begin: Dec/10/2013 12:00:00 PM	End: Dec/11/2013 12:00:00 PM
Street: Iowa St.	Lane: SB Inside	Hours: 24.00
State: Ks	Oper: JRC	Period: 15
City: Lawrence	Posted: 40	Raw Count: 7817
County: Douglas	AADT Factor: 1	AADT Count: 7,817

Date And Time Range	Period Volume	Average Speed	Roadway Temperature	Roadway Surface Wet/Dry
Wed,Dec/11/2013				
[05:30-05:45]	23	48 MPH	39 F	---
[05:45-06:00]	27	46 MPH	39 F	---
[06:00-06:15]	36	45 MPH	39 F	---
[06:15-06:30]	51	45 MPH	39 F	---
[06:30-06:45]	58	46 MPH	39 F	---
[06:45-07:00]	67	44 MPH	39 F	---
[07:00-07:15]	68	45 MPH	39 F	---
[07:15-07:30]	86	44 MPH	39 F	---
[07:30-07:45]	75	46 MPH	39 F	---
[07:45-08:00]	123	42 MPH	39 F	---
[08:00-08:15]	90	44 MPH	39 F	---
[08:15-08:30]	103	45 MPH	39 F	---
[08:30-08:45]	66	45 MPH	37 F	---
[08:45-09:00]	92	43 MPH	37 F	---
[09:00-09:15]	73	46 MPH	35 F	---
[09:15-09:30]	86	43 MPH	35 F	---
[09:30-09:45]	73	47 MPH	33 F	---
[09:45-10:00]	82	46 MPH	31 F	---
[10:00-10:15]	95	45 MPH	33 F	---
[10:15-10:30]	101	44 MPH	35 F	---
[10:30-10:45]	90	43 MPH	35 F	---
[10:45-11:00]	102	44 MPH	37 F	---
[11:00-11:15]	117	43 MPH	37 F	---
[11:15-11:30]	109	45 MPH	39 F	---
[11:30-11:45]	133	42 MPH	39 F	---
[11:45-12:00]	114	44 MPH	41 F	---
Wed,Dec/11/2013	2424	45 MPH	39 F	
Dec/10/2013 12:00:00 PM Dec/11/2013 12:00:00 PM	7817	44 MPH	38 F	

OLSSON ASSOCIATES
7301 West 133rd Street
Overland Park, KS 66213
www.olssonassociates.com

Site Code:
Station ID: 21st Street EB

Latitude: 0' 0.0000 Undefined

Start Time	10-Dec-13 Tue	Channel 1
12:00 AM		*
12:15		*
12:30		*
12:45		*
01:00		*
01:15		*
01:30		*
01:45		*
02:00		*
02:15		*
02:30		*
02:45		*
03:00		*
03:15		*
03:30		*
03:45		*
04:00		*
04:15		*
04:30		*
04:45		*
05:00		*
05:15		*
05:30		*
05:45		*
06:00		*
06:15		*
06:30		*
06:45		*
07:00		*
07:15		*
07:30		*
07:45		*
08:00		*
08:15		*
08:30		*
08:45		*
09:00		*
09:15		*
09:30		*
09:45		*
10:00		*
10:15		*
10:30		*
10:45		*
11:00		*
11:15		*
11:30		*
11:45		*
Total		0
Peak	-	-
Vol.	-	-
P.H.F.		

-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

OLSSON ASSOCIATES
7301 West 133rd Street
Overland Park, KS 66213
www.olssonassociates.com

Site Code:
Station ID: 21st Street EB

Latitude: 0' 0.0000 Undefined

Start Time	10-Dec-13 Tue	Channel 1
12:00 PM		34
12:15		12
12:30		13
12:45		13
01:00		12
01:15		9
01:30		15
01:45		14
02:00		3
02:15		8
02:30		9
02:45		11
03:00		10
03:15		11
03:30		13
03:45		16
04:00		24
04:15		14
04:30		21
04:45		16
05:00		**39**
05:15		**27**
05:30		**22**
05:45		**17**
06:00		14
06:15		11
06:30		8
06:45		8
07:00		11
07:15		6
07:30		4
07:45		0
08:00		4
08:15		3
08:30		4
08:45		3
09:00		9
09:15		5
09:30		5
09:45		6
10:00		3
10:15		1
10:30		2
10:45		0
11:00		0
11:15		0
11:30		2
11:45		2
Total		494
Peak	-	17:00
Vol.	-	105
P.H.F.		0.673

OLSSON ASSOCIATES
7301 West 133rd Street
Overland Park, KS 66213
www.olssonassociates.com

Site Code:
Station ID: 21st Street EB

Latitude: 0' 0.0000 Undefined

Start Time	11-Dec-13 Wed	Channel 1
12:00 AM		1
12:15		0
12:30		1
12:45		1
01:00		0
01:15		0
01:30		0
01:45		0
02:00		1
02:15		2
02:30		0
02:45		0
03:00		0
03:15		1
03:30		0
03:45		1
04:00		1
04:15		0
04:30		0
04:45		0
05:00		0
05:15		2
05:30		0
05:45		0
06:00		1
06:15		1
06:30		0
06:45		1
07:00		5
07:15		3
07:30		2
07:45		4
08:00		6
08:15		4
08:30		3
08:45		6
09:00		3
09:15		3
09:30		1
09:45		8
10:00		6
10:15		6
10:30		9
10:45		3
11:00		**6**
11:15		**11**
11:30		**15**
11:45		**28**
Total		146
Peak	-	11:00
Vol.	-	60
P.H.F.		0.536

OLSSON ASSOCIATES
7301 West 133rd Street
Overland Park, KS 66213
www.olssonassociates.com

Site Code:
Station ID: 21st Street EB

Latitude: 0' 0.0000 Undefined

Start Time	11-Dec-13 Wed	Channel 1
12:00 PM		49
12:15		*
12:30		*
12:45		*
01:00		*
01:15		*
01:30		*
01:45		*
02:00		*
02:15		*
02:30		*
02:45		*
03:00		*
03:15		*
03:30		*
03:45		*
04:00		*
04:15		*
04:30		*
04:45		*
05:00		*
05:15		*
05:30		*
05:45		*
06:00		*
06:15		*
06:30		*
06:45		*
07:00		*
07:15		*
07:30		*
07:45		*
08:00		*
08:15		*
08:30		*
08:45		*
09:00		*
09:15		*
09:30		*
09:45		*
10:00		*
10:15		*
10:30		*
10:45		*
11:00		*
11:15		*
11:30		*
11:45		*
Total		49
Peak	-	-
Vol.	-	-
P.H.F.		
Grand Total		689
Percent		
ADT		ADT 200

AADT 200

Date/Time/Volume/Average Speed/Temperature Report

HI-Star ID: 5899
Street: 21ST Street
State: Ks
City: Lawrence
County: Douglas

Begin: Dec/10/2013 12:00:00 PM
Lane: WB
Oper: JRC
Posted: 35
AADT Factor: 1

End: Dec/11/2013 12:00:00 PM
Hours: 24.00
Period: 15
Raw Count: 651
AADT Count: 651

Date And Time Range	Period Volume	Average Speed	Roadway Temperature	Roadway Surface Wet/Dry
Tue,Dec/10/2013				
[12:00-12:15]	0	0 MPH	60 F	---
[12:15-12:30]	3	47 MPH	62 F	---
[12:30-12:45]	0	0 MPH	60 F	---
[12:45-13:00]	4	0 MPH	58 F	---
[13:00-13:15]	4	28 MPH	56 F	---
[13:15-13:30]	11	31 MPH	54 F	---
[13:30-13:45]	11	28 MPH	54 F	---
[13:45-14:00]	9	25 MPH	54 F	---
[14:00-14:15]	7	29 MPH	54 F	---
[14:15-14:30]	7	33 MPH	52 F	---
[14:30-14:45]	10	27 MPH	52 F	---
[14:45-15:00]	9	29 MPH	50 F	---
[15:00-15:15]	17	26 MPH	48 F	---
[15:15-15:30]	25	28 MPH	46 F	---
[15:30-15:45]	16	29 MPH	44 F	---
[15:45-16:00]	28	28 MPH	42 F	---
[16:00-16:15]	11	27 MPH	41 F	---
[16:15-16:30]	18	28 MPH	39 F	---
[16:30-16:45]	5	29 MPH	37 F	---
[16:45-17:00]	27	27 MPH	33 F	---
[17:00-17:15]	19	28 MPH	33 F	---
[17:15-17:30]	24	30 MPH	31 F	---
[17:30-17:45]	16	28 MPH	33 F	---
[17:45-18:00]	21	27 MPH	33 F	---
[18:00-18:15]	18	24 MPH	33 F	---
[18:15-18:30]	15	27 MPH	35 F	---
[18:30-18:45]	11	20 MPH	35 F	---
[18:45-19:00]	10	29 MPH	35 F	---
[19:00-19:15]	8	27 MPH	37 F	---
[19:15-19:30]	3	27 MPH	37 F	---
[19:30-19:45]	3	29 MPH	37 F	---
[19:45-20:00]	3	26 MPH	37 F	---
[20:00-20:15]	7	22 MPH	37 F	---
[20:15-20:30]	9	28 MPH	37 F	---
[20:30-20:45]	8	28 MPH	37 F	---
[20:45-21:00]	8	24 MPH	39 F	---

Date/Time/Volume/Average Speed/Temperature Report

HI-Star ID: 5899
Street: 21ST Street
State: Ks
City: Lawrence
County: Douglas

Begin: Dec/10/2013 12:00:00 PM
Lane: WB
Oper: JRC
Posted: 35
AADT Factor: 1

End: Dec/11/2013 12:00:00 PM
Hours: 24.00
Period: 15
Raw Count: 651
AADT Count: 651

Date And Time Range	Period Volume	Average Speed	Roadway Temperature	Roadway Surface Wet/Dry
Tue,Dec/10/2013				
[21:00-21:15]	20	28 MPH	39 F	---
[21:15-21:30]	7	27 MPH	39 F	---
[21:30-21:45]	5	27 MPH	39 F	---
[21:45-22:00]	2	23 MPH	39 F	---
[22:00-22:15]	1	22 MPH	39 F	---
[22:15-22:30]	5	24 MPH	39 F	---
[22:30-22:45]	1	28 MPH	39 F	---
[22:45-23:00]	2	28 MPH	39 F	---
[23:00-23:15]	0	0 MPH	41 F	---
[23:15-23:30]	2	25 MPH	41 F	---
[23:30-23:45]	3	26 MPH	41 F	---
[23:45-00:00]	3	24 MPH	41 F	---
Tue,Dec/10/2013	456	27 MPH	42 F	
Wed,Dec/11/2013				
[00:00-00:15]	3	23 MPH	41 F	---
[00:15-00:30]	0	0 MPH	41 F	---
[00:30-00:45]	1	22 MPH	41 F	---
[00:45-01:00]	1	0 MPH	42 F	---
[01:00-01:15]	2	33 MPH	42 F	---
[01:15-01:30]	2	23 MPH	42 F	---
[01:30-01:45]	0	0 MPH	42 F	---
[01:45-02:00]	0	0 MPH	42 F	---
[02:00-02:15]	0	0 MPH	42 F	---
[02:15-02:30]	0	0 MPH	42 F	---
[02:30-02:45]	0	0 MPH	42 F	---
[02:45-03:00]	1	22 MPH	42 F	---
[03:00-03:15]	0	0 MPH	42 F	---
[03:15-03:30]	0	0 MPH	42 F	---
[03:30-03:45]	0	0 MPH	42 F	---
[03:45-04:00]	0	0 MPH	42 F	---
[04:00-04:15]	1	32 MPH	42 F	---
[04:15-04:30]	0	0 MPH	42 F	---
[04:30-04:45]	1	22 MPH	41 F	---
[04:45-05:00]	2	28 MPH	41 F	---
[05:00-05:15]	2	27 MPH	41 F	---
[05:15-05:30]	1	22 MPH	41 F	---

Date/Time/Volume/Average Speed/Temperature Report

HI-Star ID: 5899	Begin: Dec/10/2013 12:00:00 PM	End: Dec/11/2013 12:00:00 PM
Street: 21ST Street	Lane: WB	Hours: 24.00
State: Ks	Oper: JRC	Period: 15
City: Lawrence	Posted: 35	Raw Count: 651
County: Douglas	AADT Factor: 1	AADT Count: 651

Date And Time Range	Period Volume	Average Speed	Roadway Temperature	Roadway Surface Wet/Dry
Wed,Dec/11/2013				
[05:30-05:45]	1	18 MPH	41 F	---
[05:45-06:00]	2	23 MPH	41 F	---
[06:00-06:15]	1	28 MPH	41 F	---
[06:15-06:30]	3	21 MPH	41 F	---
[06:30-06:45]	2	25 MPH	41 F	---
[06:45-07:00]	1	42 MPH	41 F	---
[07:00-07:15]	5	26 MPH	41 F	---
[07:15-07:30]	11	29 MPH	41 F	---
[07:30-07:45]	12	30 MPH	41 F	---
[07:45-08:00]	23	27 MPH	41 F	---
[08:00-08:15]	16	28 MPH	41 F	---
[08:15-08:30]	7	30 MPH	41 F	---
[08:30-08:45]	13	30 MPH	39 F	---
[08:45-09:00]	15	26 MPH	37 F	---
[09:00-09:15]	4	30 MPH	37 F	---
[09:15-09:30]	6	25 MPH	37 F	---
[09:30-09:45]	8	31 MPH	35 F	---
[09:45-10:00]	8	27 MPH	33 F	---
[10:00-10:15]	4	26 MPH	31 F	---
[10:15-10:30]	3	26 MPH	33 F	---
[10:30-10:45]	7	26 MPH	37 F	---
[10:45-11:00]	2	25 MPH	39 F	---
[11:00-11:15]	4	30 MPH	41 F	---
[11:15-11:30]	7	27 MPH	41 F	---
[11:30-11:45]	9	30 MPH	42 F	---
[11:45-12:00]	4	33 MPH	44 F	---
Wed,Dec/11/2013	195	25 MPH	40 F	
Dec/10/2013 12:00:00 PM Dec/11/2013 12:00:00 PM	651	27 MPH	41 F	

Traffic Counts – 21st Street (TMC)

OLSSON ASSOCIATES

7301 WEST 133RD STREET SUITE 200
OVERLAND PARK, KANSAS 66213

21st St. & Iowa
AM & PM Count
Taylor & Friend

File Name : Not Named 8
Site Code : 00000000
Start Date : 12/11/2013
Page No : 1

Groups Printed- Unshifted - Bank 1

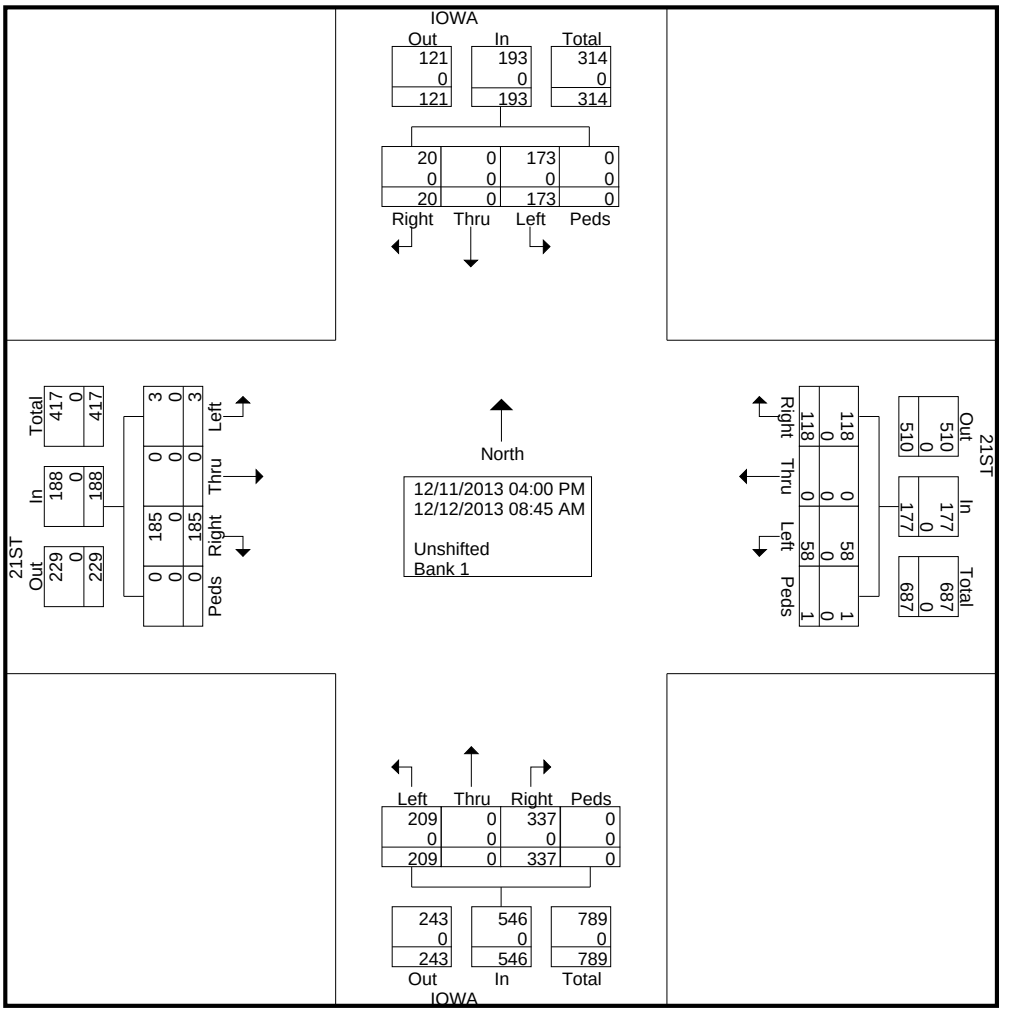
	IOWA From North					21ST From East					IOWA From South					21ST From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
04:00 PM	1	0	12	0	13	5	0	3	1	9	12	0	7	0	19	22	0	1	0	23	64
04:15 PM	0	0	10	0	10	5	0	4	0	9	9	0	9	0	18	13	0	0	0	13	50
04:30 PM	0	0	9	0	9	0	0	7	0	7	10	0	9	0	19	19	0	0	0	19	54
04:45 PM	0	0	4	0	4	8	0	5	0	13	9	0	9	0	18	13	0	0	0	13	48
Total	1	0	35	0	36	18	0	19	1	38	40	0	34	0	74	67	0	1	0	68	216
05:00 PM	0	0	14	0	14	10	0	3	0	13	12	0	4	0	16	36	0	0	0	36	79
05:15 PM	0	0	13	0	13	11	0	9	0	20	15	0	5	0	20	28	0	0	0	28	81
05:30 PM	0	0	9	0	9	10	0	4	0	14	17	0	6	0	23	13	0	0	0	13	59
05:45 PM	0	0	11	0	11	7	0	7	0	14	10	0	6	0	16	10	0	0	0	10	51
Total	0	0	47	0	47	38	0	23	0	61	54	0	21	0	75	87	0	0	0	87	270
*** BREAK ***																					
07:00 AM	0	0	5	0	5	6	0	1	0	7	1	0	6	0	7	5	0	1	0	6	25
07:15 AM	3	0	9	0	12	8	0	0	0	8	136	0	14	0	150	4	0	0	0	4	174
07:30 AM	1	0	7	0	8	5	0	1	0	6	6	0	19	0	25	3	0	1	0	4	43
07:45 AM	2	0	18	0	20	12	0	6	0	18	12	0	30	0	42	6	0	0	0	6	86
Total	6	0	39	0	45	31	0	8	0	39	155	0	69	0	224	18	0	2	0	20	328
08:00 AM	2	0	20	0	22	5	0	2	0	7	18	0	24	0	42	2	0	0	0	2	73
08:15 AM	3	0	11	0	14	11	0	4	0	15	11	0	26	0	37	4	0	0	0	4	70
08:30 AM	3	0	10	0	13	5	0	1	0	6	27	0	15	0	42	3	0	0	0	3	64
08:45 AM	5	0	11	0	16	10	0	1	0	11	32	0	20	0	52	4	0	0	0	4	83
Total	13	0	52	0	65	31	0	8	0	39	88	0	85	0	173	13	0	0	0	13	290
Grand Total	20	0	173	0	193	118	0	58	1	177	337	0	209	0	546	185	0	3	0	188	1104
Apprch %	10.4	0	89.6	0		66.7	0	32.8	0.6		61.7	0	38.3	0		98.4	0	1.6	0		
Total %	1.8	0	15.7	0	17.5	10.7	0	5.3	0.1	16	30.5	0	18.9	0	49.5	16.8	0	0.3	0	17	
Unshifted	20	0	173	0	193	118	0	58	1	177	337	0	209	0	546	185	0	3	0	188	1104
% Unshifted	100	0	100	0	100	100	0	100	100	100	100	0	100	0	100	100	0	100	0	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

OLSSON ASSOCIATES

7301 WEST 133RD STREET SUITE 200
OVERLAND PARK, KANSAS 66213

21st St. & Iowa
AM & PM Count
Taylor & Friend

File Name : Not Named 8
Site Code : 00000000
Start Date : 12/11/2013
Page No : 2



OLSSON ASSOCIATES

7301 WEST 133RD STREET SUITE 200
OVERLAND PARK, KANSAS 66213

21st St. & Iowa
AM & PM Count
Taylor & Friend

File Name : Not Named 8
Site Code : 00000000
Start Date : 12/11/2013

	IOWA From North					21ST From East					IOWA From South					21ST From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 05:00 PM																					
05:00 PM	0	0	**14**	0	**14**	10	0	3	0	13	12	0	4	0	16	**36**	0	0	0	**36**	79
05:15 PM	0	0	13	0	13	**11**	0	**9**	0	**20**	15	0	5	0	20	28	0	0	0	28	**81**
05:30 PM	0	0	9	0	9	10	0	4	0	14	**17**	0	**6**	0	**23**	13	0	0	0	13	59
05:45 PM	0	0	11	0	11	7	0	7	0	14	10	0	6	0	16	10	0	0	0	10	51
Total Volume	0	0	47	0	47	38	0	23	0	61	54	0	21	0	75	87	0	0	0	87	270
% App. Total	0	0	100	0		62.3	0	37.7	0		72	0	28	0		100	0	0	0		
PHF	.000	.000	.839	.000	.839	.864	.000	.639	.000	.763	.794	.000	.875	.000	.815	.604	.000	.000	.000	.604	.833

Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	05:00 PM					05:00 PM					04:45 PM					04:30 PM				
+0 mins.	0	0	**14**	0	**14**	10	0	3	0	13	9	0	**9**	0	18	19	0	0	0	19
+15 mins.	0	0	13	0	13	**11**	0	**9**	0	**20**	12	0	4	0	16	13	0	0	0	13
+30 mins.	0	0	9	0	9	10	0	4	0	14	15	0	5	0	20	**36**	0	0	0	**36**
+45 mins.	0	0	11	0	11	7	0	7	0	14	**17**	0	6	0	**23**	28	0	0	0	28
Total Volume	0	0	47	0	47	38	0	23	0	61	53	0	24	0	77	96	0	0	0	96
% App. Total	0	0	100	0		62.3	0	37.7	0		68.8	0	31.2	0		100	0	0	0	
PHF	.000	.000	.839	.000	.839	.864	.000	.639	.000	.763	.779	.000	.667	.000	.837	.667	.000	.000	.000	.667

OLSSON ASSOCIATES

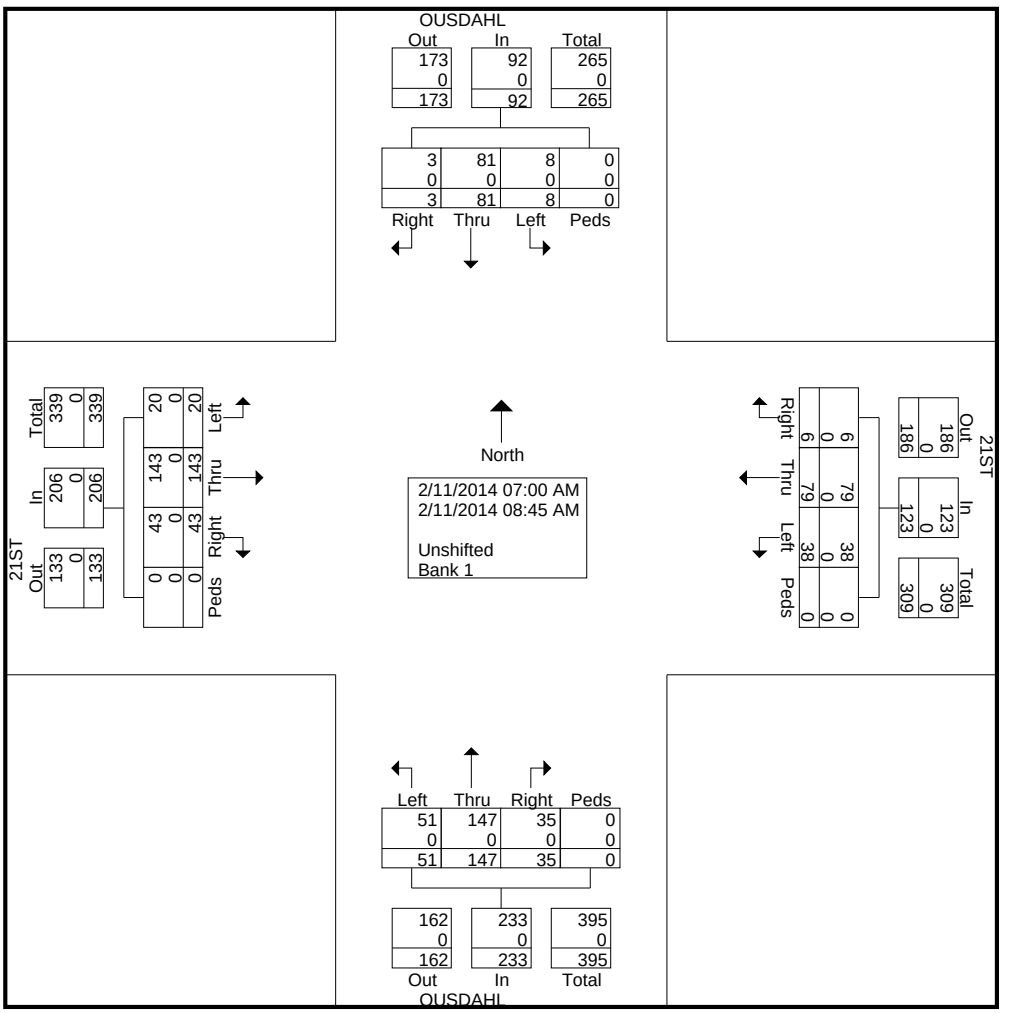
7301 WEST 133RD STREET SUITE 200
OVERLAND PARK, KANSAS 66213

21ST & OUSDAHL
AM COUNT
TAYLOR

File Name : 21ST & OUSDAHL AM
Site Code : 00000000
Start Date : 2/11/2014
Page No : 1

Groups Printed- Unshifted - Bank 1

	OUSDAHL From North					21ST From East					OUSDAHL From South					21ST From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00 AM	0	7	0	0	7	2	9	2	0	13	1	5	3	0	9	4	11	2	0	17	46
07:15 AM	0	5	0	0	5	0	3	2	0	5	6	18	5	0	29	4	17	0	0	21	60
07:30 AM	1	5	1	0	7	0	6	3	0	9	10	27	11	0	48	7	24	2	0	33	97
07:45 AM	1	8	4	0	13	2	24	13	0	39	10	27	8	0	45	3	47	8	0	58	155
Total	2	25	5	0	32	4	42	20	0	66	27	77	27	0	131	18	99	12	0	129	358
08:00 AM	1	12	0	0	13	2	15	10	0	27	2	13	6	0	21	3	14	0	0	17	78
08:15 AM	0	16	1	0	17	0	7	3	0	10	3	22	3	0	28	7	10	1	0	18	73
08:30 AM	0	19	0	0	19	0	8	3	0	11	1	20	10	0	31	14	9	1	0	24	85
08:45 AM	0	9	2	0	11	0	7	2	0	9	2	15	5	0	22	1	11	6	0	18	60
Total	1	56	3	0	60	2	37	18	0	57	8	70	24	0	102	25	44	8	0	77	296
Grand Total	3	81	8	0	92	6	79	38	0	123	35	147	51	0	233	43	143	20	0	206	654
Apprch %	3.3	88	8.7	0		4.9	64.2	30.9	0		15	63.1	21.9	0		20.9	69.4	9.7	0		
Total %	0.5	12.4	1.2	0	14.1	0.9	12.1	5.8	0	18.8	5.4	22.5	7.8	0	35.6	6.6	21.9	3.1	0	31.5	
Unshifted	3	81	8	0	92	6	79	38	0	123	35	147	51	0	233	43	143	20	0	206	654
% Unshifted	100	100	100	0	100	100	100	100	0	100	100	100	100	0	100	100	100	100	0	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



OLSSON ASSOCIATES

7301 WEST 133RD STREET SUITE 200
OVERLAND PARK, KANSAS 66213

21ST & OUSDAHL
AM COUNT
TAYLOR

File Name : 21ST & OUSDAHL AM
Site Code : 00000000
Start Date : 2/11/2014
Page No : 2

	OUSDAHL From North					21ST From East					OUSDAHL From South					21ST From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	**1**	5	1	0	7	0	6	3	0	9	**10**	**27**	**11**	0	**48**	**7**	24	2	0	33	97
07:45 AM	1	8	**4**	0	13	**2**	**24**	**13**	0	**39**	10	27	8	0	45	3	**47**	**8**	0	**58**	**155**
08:00 AM	1	12	0	0	13	2	15	10	0	27	2	13	6	0	21	3	14	0	0	17	78
08:15 AM	0	**16**	1	0	**17**	0	7	3	0	10	3	22	3	0	28	7	10	1	0	18	73
Total Volume	3	41	6	0	50	4	52	29	0	85	25	89	28	0	142	20	95	11	0	126	403
% App. Total	6	82	12	0		4.7	61.2	34.1	0		17.6	62.7	19.7	0		15.9	75.4	8.7	0		
PHF	.750	.641	.375	.000	.735	.500	.542	.558	.000	.545	.625	.824	.636	.000	.740	.714	.505	.344	.000	.543	.650

Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:45 AM					07:45 AM					07:15 AM					07:00 AM				
+0 mins.	**1**	8	**4**	0	13	**2**	**24**	**13**	0	**39**	6	18	5	0	29	4	11	2	0	17
+15 mins.	1	12	0	0	13	2	15	10	0	27	**10**	**27**	**11**	0	**48**	4	17	0	0	21
+30 mins.	0	16	1	0	17	0	7	3	0	10	10	27	8	0	45	**7**	24	2	0	33
+45 mins.	0	**19**	0	0	**19**	0	8	3	0	11	2	13	6	0	21	3	**47**	**8**	0	**58**
Total Volume	2	55	5	0	62	4	54	29	0	87	28	85	30	0	143	18	99	12	0	129
% App. Total	3.2	88.7	8.1	0		4.6	62.1	33.3	0		19.6	59.4	21	0		14	76.7	9.3	0	
PHF	.500	.724	.313	.000	.816	.500	.563	.558	.000	.558	.700	.787	.682	.000	.745	.643	.527	.375	.000	.556

OLSSON ASSOCIATES

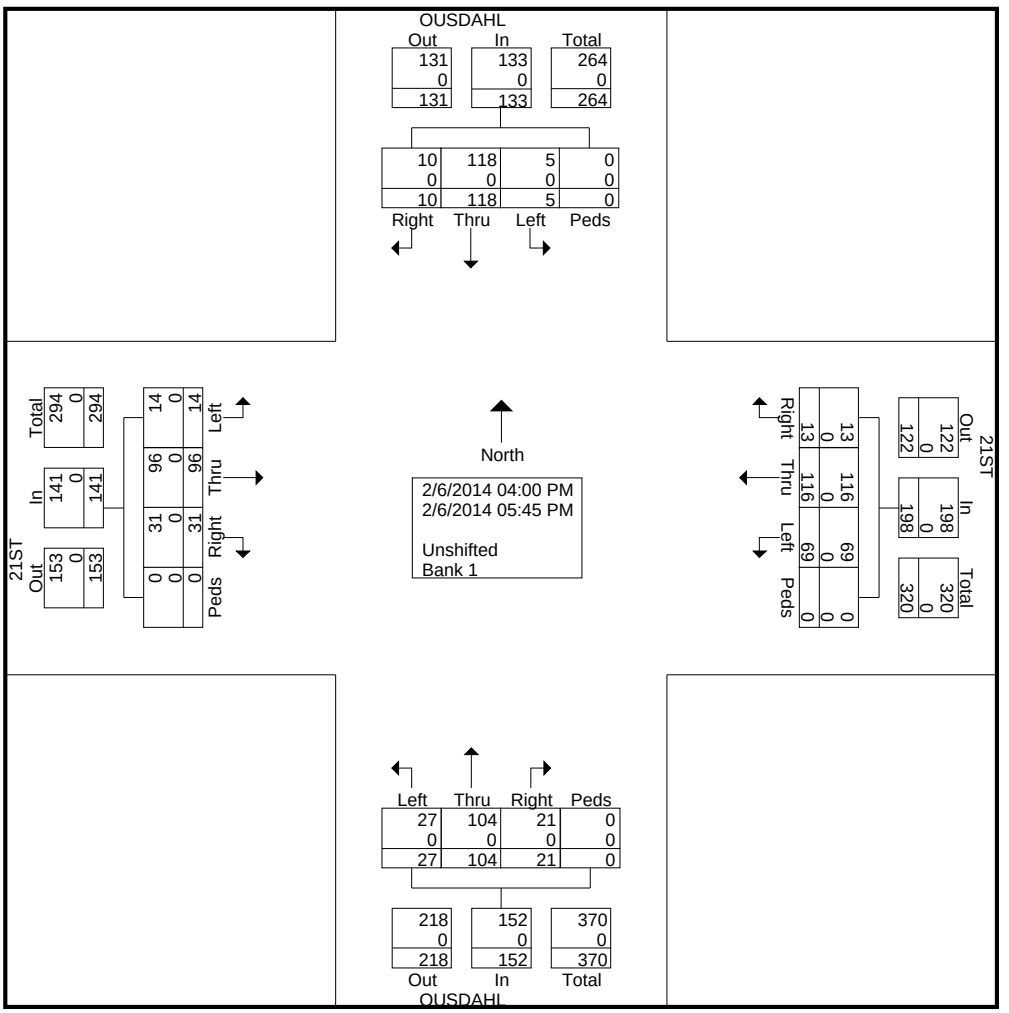
7301 WEST 133RD STREET SUITE 200
OVERLAND PARK, KANSAS 66213

21ST & OUSDAHL
PM COUNT
TAYOLR

File Name : 21ST & OUSDAHL PM
Site Code : 00000000
Start Date : 2/6/2014
Page No : 1

Groups Printed- Unshifted - Bank 1

	OUSDAHL From North					21ST From East					OUSDAHL From South					21ST From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
04:00 PM	2	20	1	0	23	3	14	3	0	20	3	6	6	0	15	5	12	1	0	18	76
04:15 PM	3	12	0	0	15	0	4	2	0	6	3	13	2	0	18	6	13	1	0	20	59
04:30 PM	2	14	0	0	16	2	10	4	0	16	0	11	4	0	15	3	8	1	0	12	59
04:45 PM	2	18	1	0	21	0	10	6	0	16	3	13	3	0	19	2	6	1	0	9	65
Total	9	64	2	0	75	5	38	15	0	58	9	43	15	0	67	16	39	4	0	59	259
05:00 PM	0	17	0	0	17	0	12	6	0	18	1	12	1	0	14	3	10	1	0	14	63
05:15 PM	0	15	1	0	16	0	22	13	0	35	1	19	5	0	25	4	10	3	0	17	93
05:30 PM	1	11	0	0	12	4	16	18	0	38	3	13	3	0	19	2	18	4	0	24	93
05:45 PM	0	11	2	0	13	4	28	17	0	49	7	17	3	0	27	6	19	2	0	27	116
Total	1	54	3	0	58	8	78	54	0	140	12	61	12	0	85	15	57	10	0	82	365
Grand Total	10	118	5	0	133	13	116	69	0	198	21	104	27	0	152	31	96	14	0	141	624
Apprch %	7.5	88.7	3.8	0		6.6	58.6	34.8	0		13.8	68.4	17.8	0		22	68.1	9.9	0		
Total %	1.6	18.9	0.8	0	21.3	2.1	18.6	11.1	0	31.7	3.4	16.7	4.3	0	24.4	5	15.4	2.2	0	22.6	
Unshifted	10	118	5	0	133	13	116	69	0	198	21	104	27	0	152	31	96	14	0	141	624
% Unshifted	100	100	100	0	100	100	100	100	0	100	100	100	100	0	100	100	100	100	0	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



OLSSON ASSOCIATES

7301 WEST 133RD STREET SUITE 200
OVERLAND PARK, KANSAS 66213

21ST & OUSDAHL
PM COUNT
TAYOLR

File Name : 21ST & OUSDAHL PM
Site Code : 00000000
Start Date : 2/6/2014

	OUSDAHL From North					21ST From East					OUSDAHL From South					21ST From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 05:00 PM																					
05:00 PM	0	**17**	0	0	**17**	0	12	6	0	18	1	12	1	0	14	3	10	1	0	14	63
05:15 PM	0	15	1	0	16	0	22	13	0	35	1	**19**	**5**	0	25	4	10	3	0	17	93
05:30 PM	**1**	11	0	0	12	**4**	16	**18**	0	38	3	13	3	0	19	2	18	**4**	0	24	93
05:45 PM	0	11	**2**	0	13	4	**28**	17	0	**49**	**7**	17	3	0	**27**	**6**	**19**	2	0	**27**	**116**
Total Volume	1	54	3	0	58	8	78	54	0	140	12	61	12	0	85	15	57	10	0	82	365
% App. Total	1.7	93.1	5.2	0		5.7	55.7	38.6	0		14.1	71.8	14.1	0		18.3	69.5	12.2	0		
PHF	.250	.794	.375	.000	.853	.500	.696	.750	.000	.714	.429	.803	.600	.000	.787	.625	.750	.625	.000	.759	.787

Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:00 PM					05:00 PM					05:00 PM					05:00 PM				
+0 mins.	2	**20**	**1**	0	**23**	0	12	6	0	18	1	12	1	0	14	3	10	1	0	14
+15 mins.	**3**	12	0	0	15	0	22	13	0	35	1	**19**	**5**	0	25	4	10	3	0	17
+30 mins.	2	14	0	0	16	**4**	16	**18**	0	38	3	13	3	0	19	2	18	**4**	0	24
+45 mins.	2	18	1	0	21	4	**28**	17	0	**49**	**7**	17	3	0	**27**	**6**	**19**	2	0	**27**
Total Volume	9	64	2	0	75	8	78	54	0	140	12	61	12	0	85	15	57	10	0	82
% App. Total	12	85.3	2.7	0		5.7	55.7	38.6	0		14.1	71.8	14.1	0		18.3	69.5	12.2	0	
PHF	.750	.800	.500	.000	.815	.500	.696	.750	.000	.714	.429	.803	.600	.000	.787	.625	.750	.625	.000	.759

OLSSON ASSOCIATES

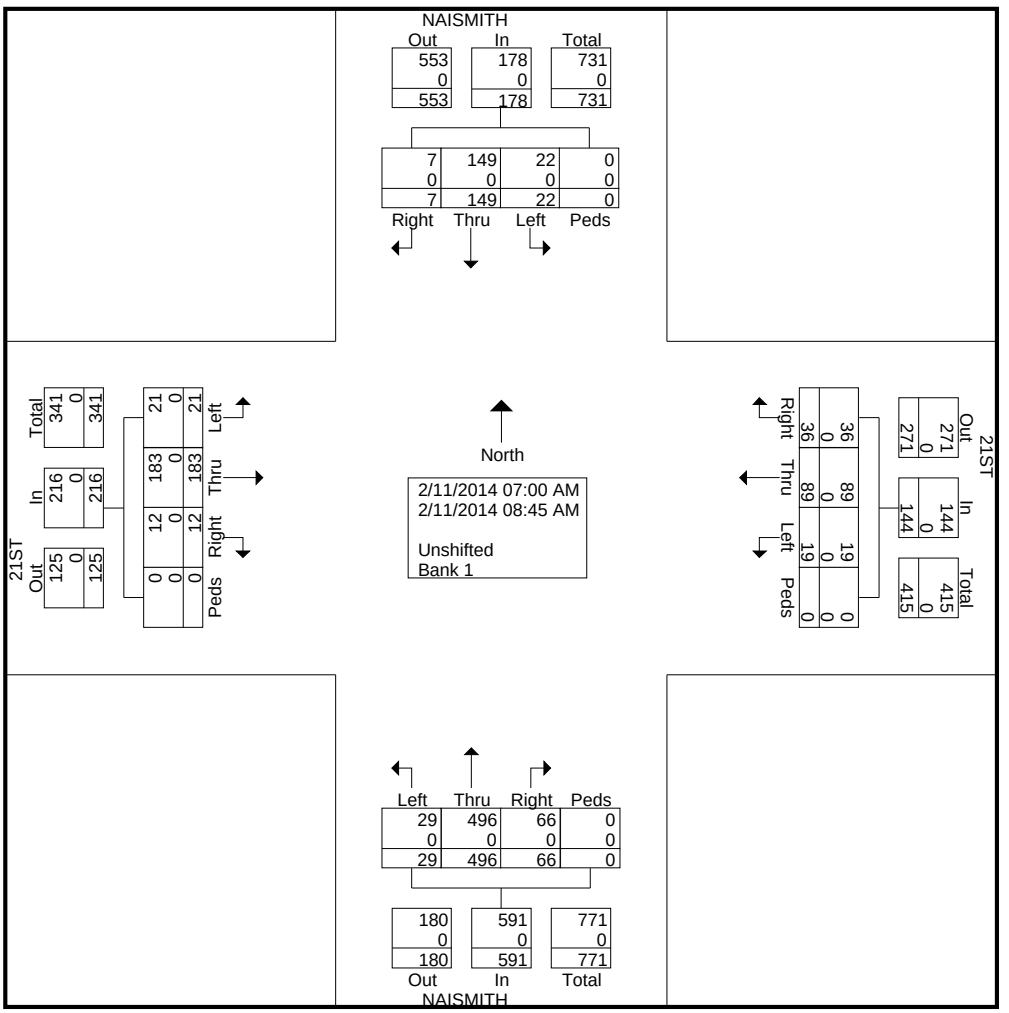
7301 WEST 133RD STREET SUITE 200
OVERLAND PARK, KANSAS 66213

21ST & NAISMITH
AM COUNT
TAYOLR

File Name : 21ST & NAISMITH AM
Site Code : 00000000
Start Date : 2/11/2014
Page No : 1

Groups Printed- Unshifted - Bank 1

	NAISMITH From North					21ST From East					NAISMITH From South					21ST From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00 AM	0	20	1	0	21	3	10	3	0	16	3	26	3	0	32	0	17	1	0	18	87
07:15 AM	0	13	4	0	17	4	3	1	0	8	2	44	2	0	48	2	23	1	0	26	99
07:30 AM	1	17	2	0	20	6	6	4	0	16	6	76	2	0	84	4	31	4	0	39	159
07:45 AM	1	25	8	0	34	6	30	5	0	41	32	95	3	0	130	2	59	5	0	66	271
Total	2	75	15	0	92	19	49	13	0	81	43	241	10	0	294	8	130	11	0	149	616
08:00 AM	1	18	2	0	21	11	20	3	0	34	14	54	6	0	74	1	17	3	0	21	150
08:15 AM	1	21	1	0	23	2	10	1	0	13	4	65	2	0	71	1	13	4	0	18	125
08:30 AM	2	16	1	0	19	1	2	0	0	3	3	78	7	0	88	1	11	2	0	14	124
08:45 AM	1	19	3	0	23	3	8	2	0	13	2	58	4	0	64	1	12	1	0	14	114
Total	5	74	7	0	86	17	40	6	0	63	23	255	19	0	297	4	53	10	0	67	513
Grand Total	7	149	22	0	178	36	89	19	0	144	66	496	29	0	591	12	183	21	0	216	1129
Apprch %	3.9	83.7	12.4	0		25	61.8	13.2	0		11.2	83.9	4.9	0		5.6	84.7	9.7	0		
Total %	0.6	13.2	1.9	0	15.8	3.2	7.9	1.7	0	12.8	5.8	43.9	2.6	0	52.3	1.1	16.2	1.9	0	19.1	
Unshifted	7	149	22	0	178	36	89	19	0	144	66	496	29	0	591	12	183	21	0	216	1129
% Unshifted	100	100	100	0	100	100	100	100	0	100	100	100	100	0	100	100	100	100	0	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



OLSSON ASSOCIATES

7301 WEST 133RD STREET SUITE 200
OVERLAND PARK, KANSAS 66213

21ST & NAISMITH
AM COUNT
TAYOLR

File Name : 21ST & NAISMITH AM
Site Code : 00000000
Start Date : 2/11/2014
Page No : 2

	NAISMITH From North					21ST From East					NAISMITH From South					21ST From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	**1**	17	2	0	20	6	6	4	0	16	6	76	2	0	84	**4**	31	4	0	39	159
07:45 AM	1	**25**	**8**	0	**34**	6	**30**	**5**	0	**41**	**32**	**95**	3	0	**130**	2	**59**	**5**	0	**66**	**271**
08:00 AM	1	18	2	0	21	**11**	20	3	0	34	14	54	**6**	0	74	1	17	3	0	21	150
08:15 AM	1	21	1	0	23	2	10	1	0	13	4	65	2	0	71	1	13	4	0	18	125
Total Volume	4	81	13	0	98	25	66	13	0	104	56	290	13	0	359	8	120	16	0	144	705
% App. Total	4.1	82.7	13.3	0		24	63.5	12.5	0		15.6	80.8	3.6	0		5.6	83.3	11.1	0		
PHF	1.00	.810	.406	.000	.721	.568	.550	.650	.000	.634	.438	.763	.542	.000	.690	.500	.508	.800	.000	.545	.650

Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:30 AM					07:30 AM					07:45 AM					07:15 AM					
+0 mins.	**1**	17	2	0	20	6	6	4	0	16	**32**	**95**	3	0	**130**	2	23	1	0	26	
+15 mins.	1	**25**	**8**	0	**34**	6	**30**	**5**	0	**41**	14	54	6	0	74	**4**	31	4	0	39	
+30 mins.	1	18	2	0	21	**11**	20	3	0	34	4	65	2	0	71	2	**59**	**5**	0	**66**	
+45 mins.	1	21	1	0	23	2	10	1	0	13	3	78	**7**	0	88	1	17	3	0	21	
Total Volume	4	81	13	0	98	25	66	13	0	104	53	292	18	0	363	9	130	13	0	152	
% App. Total	4.1	82.7	13.3	0		24	63.5	12.5	0		14.6	80.4	5	0		5.9	85.5	8.6	0		
PHF	1.000																				

OLSSON ASSOCIATES

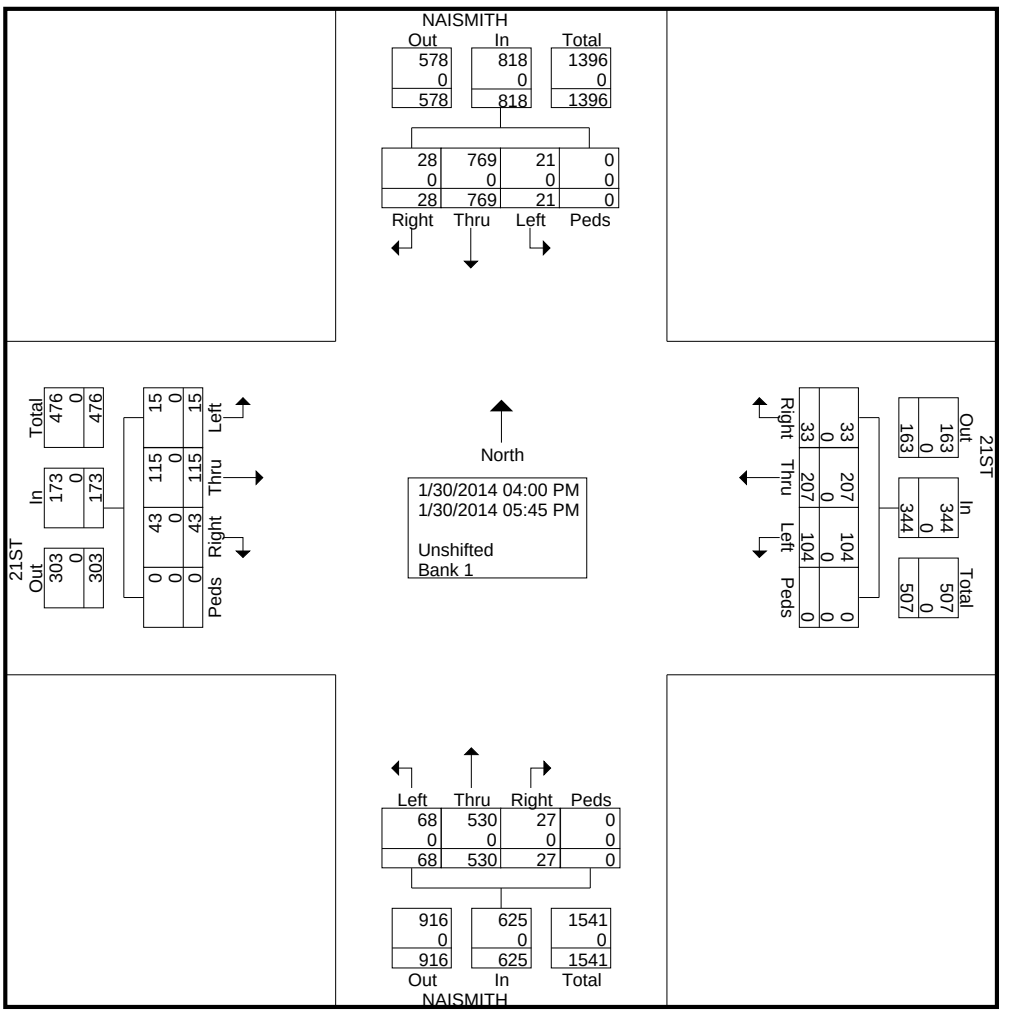
7301 WEST 133RD STREET SUITE 200
OVERLAND PARK, KANSAS 66213

21ST & NAISMITH
PM COUNT
TAYLOR

File Name : 21ST & NAISMITH PM
Site Code : 00000000
Start Date : 1/30/2014
Page No : 1

Groups Printed- Unshifted - Bank 1

	NAISMITH From North					21ST From East					NAISMITH From South					21ST From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
04:00 PM	3	117	4	0	124	6	35	23	0	64	2	70	5	0	77	7	21	5	0	33	298
04:15 PM	0	80	1	0	81	7	24	11	0	42	1	67	6	0	74	7	12	0	0	19	216
04:30 PM	3	67	1	0	71	2	7	5	0	14	3	53	10	0	66	9	16	1	0	26	177
04:45 PM	5	68	2	0	75	5	14	6	0	25	4	58	8	0	70	2	11	2	0	15	185
Total	11	332	8	0	351	20	80	45	0	145	10	248	29	0	287	25	60	8	0	93	876
05:00 PM	5	95	3	0	103	4	30	6	0	40	7	63	8	0	78	5	12	2	0	19	240
05:15 PM	8	123	6	0	137	2	29	21	0	52	2	63	10	0	75	6	19	1	0	26	290
05:30 PM	1	136	3	0	140	4	39	17	0	60	4	78	11	0	93	4	13	1	0	18	311
05:45 PM	3	83	1	0	87	3	29	15	0	47	4	78	10	0	92	3	11	3	0	17	243
Total	17	437	13	0	467	13	127	59	0	199	17	282	39	0	338	18	55	7	0	80	1084
Grand Total	28	769	21	0	818	33	207	104	0	344	27	530	68	0	625	43	115	15	0	173	1960
Apprch %	3.4	94	2.6	0		9.6	60.2	30.2	0		4.3	84.8	10.9	0		24.9	66.5	8.7	0		
Total %	1.4	39.2	1.1	0	41.7	1.7	10.6	5.3	0	17.6	1.4	27	3.5	0	31.9	2.2	5.9	0.8	0	8.8	
Unshifted	28	769	21	0	818	33	207	104	0	344	27	530	68	0	625	43	115	15	0	173	1960
% Unshifted	100	100	100	0	100	100	100	100	0	100	100	100	100	0	100	100	100	100	0	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



OLSSON ASSOCIATES

7301 WEST 133RD STREET SUITE 200
OVERLAND PARK, KANSAS 66213

21ST & NAISMITH
PM COUNT
TAYLOR

File Name : 21ST & NAISMITH PM
Site Code : 00000000
Start Date : 1/30/2014

	NAISMITH From North					21ST From East					NAISMITH From South					21ST From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 05:00 PM																					
05:00 PM	5	95	3	0	103	**4**	30	6	0	40	**7**	63	8	0	78	5	12	2	0	19	240
05:15 PM	**8**	123	**6**	0	137	2	29	**21**	0	52	2	63	10	0	75	**6**	**19**	1	0	**26**	290
05:30 PM	1	**136**	3	0	**140**	4	**39**	17	0	**60**	4	**78**	**11**	0	**93**	4	13	1	0	18	**311**
05:45 PM	3	83	1	0	87	3	29	15	0	47	4	78	10	0	92	3	11	**3**	0	17	243
Total Volume	17	437	13	0	467	13	127	59	0	199	17	282	39	0	338	18	55	7	0	80	1084
% App. Total	3.6	93.6	2.8	0		6.5	63.8	29.6	0		5	83.4	11.5	0		22.5	68.8	8.8	0		
PHF	.531	.803	.542	.000	.834	.813	.814	.702	.000	.829	.607	.904	.886	.000	.909	.750	.724	.583	.000	.769	.871

Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	05:00 PM					05:00 PM					05:00 PM					04:00 PM				
+0 mins.	5	95	3	0	103	**4**	30	6	0	40	**7**	63	8	0	78	7	**21**	**5**	0	**33**
+15 mins.	**8**	123	**6**	0	137	2	29	**21**	0	52	2	63	10	0	75	7	12	0	0	19
+30 mins.	1	**136**	3	0	**140**	4	**39**	17	0	**60**	4	**78**	**11**	0	**93**	**9**	16	1	0	26
+45 mins.	3	83	1	0	87	3	29	15	0	47	4	78	10	0	92	2	11	2	0	15
Total Volume	17	437	13	0	467	13	127	59	0	199	17	282	39	0	338	25	60	8	0	93
% App. Total	3.6	93.6	2.8	0		6.5	63.8	29.6	0		5	83.4	11.5	0		26.9	64.5	8.6	0	
PHF	.531	.803	.542	.000	.834	.813	.814	.702	.000	.829	.607	.904	.886	.000	.909	.694	.714	.400	.000	.705

Existing Signal Warrants

TRAFFIC SIGNAL WARRANT ANALYSIS - VOLUME WARRANTS

KANSAS DEPARTMENT OF TRANSPORTATION - BUREAU OF TRAFFIC ENGINEERING

Major Street : 9th Street
Minor Street : Rockledge Road
City : Lawrence
County : Douglas

Time Count Began : 12:00 PM
Date : 12/10/13
Day of Week of Count: Tuesday

Is the intersection in a community with a population less than 10,000 or are speeds greater than 40 mph? no

	Major Street	Minor Street
Adjustment factor for day of week and month of year of count	1	1
Number of Lanes	1	1

Time Beginning	Major Street Approach Volumes EAST	WEST	Total	≡	Minor Street Approach Volumes NORTH	SOUTH	*
12:00 m	20	38	58		0	9	9
1:00	14	27	41		0	7	7
2:00	5	13	18		1	9	9
3:00 am	2	7	9		0	7	7
4:00	10	6	16		0	2	2
5:00	47	19	66		2	10	10
6:00 am	87	53	140		4	23	23
7:00	339	166	505		24	67	67
8:00	331	154	485		24	115	115
9:00 am	191	164	355		6	66	66
10:00	163	164	327		9	71	71
11:00	178	243	421		11	75	75
12:00 n	117	274	391		10	84	84
1:00	198	248	446		29	112	112
2:00	198	275	473		15	90	90
3:00 pm	293	326	619		13	91	91
4:00	288	455	743		16	80	80
5:00	344	538	882		18	102	102
6:00 pm	237	358	595		8	95	95
7:00	122	230	352		5	57	57
8:00	82	199	281		7	42	42
9:00 pm	71	166	237		4	37	37
10:00	40	97	137		3	25	25
11:00	31	54	85		3	10	10
24HR Total	3408	4274			212	1286	

Note: ≡ Total of both approaches.
* The HIGHEST approach only.

NOTE: Basic minimum hourly volumes (unreduced)

NOTE: No adjust ment made

Warrant #1 - Condition A

Percent of Warrant Volumes Met Major	Minor
12	6
8	5
4	6
2	5
3	1
13	7
28	15
101	45
97	77
71	44
65	47
84	50
78	56
89	75
95	60
124	61
149	53
176	68
119	63
70	38
56	28
47	25
27	17
17	7
Warranting Volumes 500	150
Hours Met	0
Warrant Met	No

Warrant #1 - Condition B

Percent of Warrant Volumes Met Major	Minor
8	12
5	9
2	12
1	9
2	3
9	13
19	31
67	89
65	153
47	88
44	95
56	100
52	112
59	149
63	120
83	121
99	107
118	136
79	127
47	76
37	56
32	49
18	33
11	13
Warranting Volumes 750	75
Hours Met	1
Warrant Met	No

Warrant #1 - Combination of Conditions A & B

For this warrant vehicle volume requirements for conditions A and B are reduced to **80% Factor**

NOTE: Conditions A and B **SHALL BOTH** meet a minimum of 8 hours. However, the 8 hours satisfying condition A **NEED NOT** be the same as the 8 hours satisfying condition B.

Condition	A	B
Hours Met	0	3
Warrant Met	No	

Warrant #2

Warrant Volume	Percent of Warrant
0	*****
0	*****
0	*****
0	*****
0	*****
0	*****
0	*****
250	27
260	44
0	*****
0	*****
290	26
310	27
280	40
270	33
200	46
160	50
130	78
210	45
0	*****
0	*****
0	*****
0	*****
0	*****
Warranting Volumes From MUTCD Fig. 4C-1	
Hours Met	0
Warrant Met	No

***** Major Street volume is so low that no Minor Street warrant exists

Warrant #3

Warrant Volume	Percent of Warrant
0	*****
0	*****
0	*****
0	*****
0	*****
0	*****
0	*****
410	16
420	27
0	*****
0	*****
0	*****
0	*****
450	25
430	21
350	26
290	28
240	43
360	26
0	*****
0	*****
0	*****
0	*****
0	*****
Warranting Volumes From MUTCD Fig. 4C-3	
Hours Met	0
Warrant Met	No

TRAFFIC SIGNAL WARRANT ANALYSIS - VOLUME WARRANTS

KANSAS DEPARTMENT OF TRANSPORTATION - BUREAU OF TRAFFIC ENGINEERING

Major Street : Iowa Street
Minor Street : 21st Street
City : Lawrence
County : Douglas

Time Count Began : 12:00 PM
Date : 12/10/13
Day of Week of Count: Tuesday

Is the intersection in a community with a population less than 10,000 or are speeds greater than 40 mph? no

	Major Street	Minor Street
Adjustment factor for day of week and month of year of count	1	1
Number of Lanes	2	1

Time Beginning	Major Street Approach Volumes NORTH	SOUTH	Total	≡	Minor Street Approach Volumes EAST	WEST	*
12:00 m	148	164	312		5	5	5
1:00	78	55	133		0	4	4
2:00	59	64	123		3	1	3
3:00 am	64	54	118		2	0	2
4:00	61	54	115		1	4	4
5:00	224	131	355		2	6	6
6:00 am	487	340	827		3	7	7
7:00	960	648	1608		14	51	51
8:00	960	678	1638		19	51	51
9:00 am	721	604	1325		15	26	26
10:00	703	714	1417		24	16	24
11:00	718	935	1653		60	23	60
12:00 n	940	1084	2024		72	7	72
1:00	933	1005	1938		50	35	50
2:00	949	1108	2057		31	33	33
3:00 pm	966	1253	2219		50	86	86
4:00	944	1433	2377		75	61	75
5:00	1066	1497	2563		105	80	105
6:00 pm	1054	978	2032		41	54	54
7:00	698	636	1334		21	17	21
8:00	608	542	1150		14	32	32
9:00 pm	478	460	938		25	34	34
10:00	375	555	930		6	9	9
11:00	221	269	490		4	8	8
24HR Total	14415	15261			642	650	

Note: ≡ Total of both approaches.
* The HIGHEST approach only.

NOTE: Basic minimum hourly volumes (unreduced)

NOTE: No adjust ment made

Warrant #1 - Condition A

Percent of Warrant Volumes Met Major	Minor
52	3
22	3
21	2
20	1
19	3
59	4
138	5
268	34
273	34
221	17
236	16
276	40
337	48
323	33
343	22
370	57
396	50
427	70
339	36
222	14
192	21
156	23
155	6
82	5
Warranting Volumes 600	150
Hours Met	0
Warrant Met	No

Warrant #1 - Condition B

Percent of Warrant Volumes Met Major	Minor
35	7
15	5
14	4
13	3
13	5
39	8
92	9
179	68
182	68
147	35
157	32
184	80
225	96
215	67
229	44
247	115
264	100
285	140
226	72
148	28
128	43
104	45
103	12
54	11
Warranting Volumes 900	75
Hours Met	3
Warrant Met	No

Warrant #1 - Combination of Conditions A & B

For this warrant vehicle volume requirements for conditions A and B are reduced to **80% Factor**

NOTE: Conditions A and B **SHALL BOTH** meet a minimum of 8 hours. However, the 8 hours satisfying condition A **NEED NOT** be the same as the 8 hours satisfying condition B.

Condition	A	B
Hours Met	0	5
Warrant Met	No	

Warrant #2

Warrant Volume	Percent of Warrant
0	*****
0	*****
0	*****
0	*****
0	*****
0	*****
190	4
80	64
80	64
80	33
80	30
80	75
80	90
80	63
80	41
80	108
80	94
80	131
80	68
80	26
110	29
160	21
160	6
340	2
Warranting Volumes From MUTCD Fig. 4C-1	
Hours Met	2
Warrant Met	No

Warrant #3

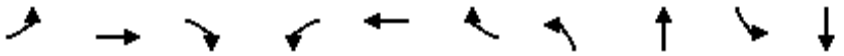
Warrant Volume	Percent of Warrant
0	*****
0	*****
0	*****
0	*****
0	*****
0	*****
340	2
100	51
100	51
180	14
160	15
100	60
100	72
100	50
100	33
100	86
100	75
100	105
100	54
180	12
220	15
290	12
300	3
0	*****
Warranting Volumes From MUTCD Fig. 4C-3	
Hours Met	1
Warrant Met	Yes

***** Major Street volume is so low that no Minor Street warrant exists

Existing Capacity Analysis – 9th Street

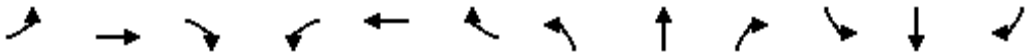
Queues
21: Iowa St & 9th St

2/13/2014



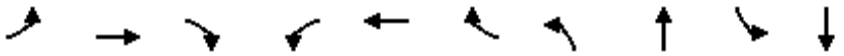
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	72	159	52	132	84	76	12	653	195	842
v/c Ratio	0.13	0.25	0.08	0.24	0.12	0.10	0.05	0.59	0.58	0.57
Control Delay	18.9	30.8	0.2	20.0	26.8	2.9	18.8	36.5	27.0	29.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	18.9	30.8	0.2	20.0	26.8	2.9	18.8	36.5	27.0	29.0
Queue Length 50th (ft)	30	88	0	58	43	0	5	215	89	238
Queue Length 95th (ft)	41	147	0	90	68	17	12	295	129	313
Internal Link Dist (ft)		1231			786			1357		767
Turn Bay Length (ft)	110		110	235		235	125		100	
Base Capacity (vph)	647	631	627	592	699	724	343	1100	392	1490
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.11	0.25	0.08	0.22	0.12	0.10	0.03	0.59	0.50	0.57

Intersection Summary



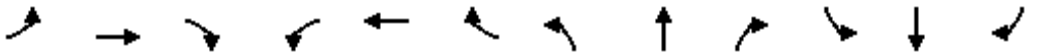
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	47	140	40	111	63	65	8	496	50	164	692	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.3	5.3	5.3	4.3	5.3	5.3	4.3	5.3		4.3	5.3	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97		1.00	1.00	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	3438		1770	3534	
Flt Permitted	0.70	1.00	1.00	0.57	1.00	1.00	0.26	1.00		0.22	1.00	
Satd. Flow (perm)	1308	1863	1583	1065	1863	1583	483	3438		415	3534	
Peak-hour factor, PHF	0.65	0.88	0.77	0.84	0.75	0.86	0.67	0.94	0.40	0.84	0.83	0.50
Adj. Flow (vph)	72	159	52	132	84	76	12	528	125	195	834	8
RTOR Reduction (vph)	0	0	34	0	0	46	0	17	0	0	1	0
Lane Group Flow (vph)	72	159	18	132	84	30	12	636	0	195	841	0
Turn Type	pm+pt	NA	Perm	pm+pt	NA	custom	pm+pt	NA		pm+pt	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2		2	6		4	8			4		
Actuated Green, G (s)	47.7	41.5	41.5	54.7	45.0	47.2	39.5	37.1		53.9	47.2	
Effective Green, g (s)	47.7	41.5	41.5	54.7	45.0	47.2	39.5	37.1		53.9	47.2	
Actuated g/C Ratio	0.40	0.35	0.35	0.46	0.38	0.39	0.33	0.31		0.45	0.39	
Clearance Time (s)	4.3	5.3	5.3	4.3	5.3	5.3	4.3	5.3		4.3	5.3	
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0	2.0	2.0	2.0		2.0	2.0	
Lane Grp Cap (vph)	543	644	547	542	698	622	184	1062		327	1390	
v/s Ratio Prot	0.01	0.09		c0.02	0.05		0.00	0.19		c0.06	c0.24	
v/s Ratio Perm	0.05		0.01	c0.09		0.02	0.02			0.21		
v/c Ratio	0.13	0.25	0.03	0.24	0.12	0.05	0.07	0.60		0.60	0.61	
Uniform Delay, d1	22.7	28.1	26.0	19.4	24.5	22.5	27.5	35.1		22.4	29.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.0	0.9	0.1	0.1	0.4	0.1	0.1	2.5		1.9	2.0	
Delay (s)	22.7	29.0	26.1	19.4	24.9	22.7	27.5	37.6		24.3	30.9	
Level of Service	C	C	C	B	C	C	C	D		C	C	
Approach Delay (s)		26.9			21.8			37.5			29.7	
Approach LOS		C			C			D			C	

Intersection Summary			
HCM 2000 Control Delay	30.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	19.2
Intersection Capacity Utilization	54.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	119	285	76	292	415	235	136	844	256	1063
v/c Ratio	0.35	0.49	0.14	0.61	0.58	0.34	0.76	0.86	0.90	0.89
Control Delay	27.5	48.9	0.5	31.4	42.8	5.7	59.6	60.9	71.8	56.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.5	48.9	0.5	31.4	42.8	5.7	59.6	60.9	71.8	56.8
Queue Length 50th (ft)	65	232	0	178	331	6	77	409	192	512
Queue Length 95th (ft)	110	364	0	268	472	63	71	465	260	578
Internal Link Dist (ft)		1231			786			1357		767
Turn Bay Length (ft)	110		110	235		235	125		100	
Base Capacity (vph)	352	577	582	522	710	732	192	1032	330	1310
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.34	0.49	0.13	0.56	0.58	0.32	0.71	0.82	0.78	0.81

Intersection Summary



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	105	259	73	277	378	216	79	689	34	215	924	51
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	6.0		5.0	6.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	3507		1770	3499	
Flt Permitted	0.40	1.00	1.00	0.38	1.00	1.00	0.10	1.00		0.09	1.00	
Satd. Flow (perm)	736	1863	1583	699	1863	1583	178	3507		164	3499	
Peak-hour factor, PHF	0.88	0.91	0.96	0.95	0.91	0.92	0.58	0.87	0.65	0.84	0.94	0.64
Adj. Flow (vph)	119	285	76	292	415	235	136	792	52	256	983	80
RTOR Reduction (vph)	0	0	55	0	0	149	0	4	0	0	4	0
Lane Group Flow (vph)	119	285	21	292	415	86	136	840	0	256	1059	0
Turn Type	pm+pt	NA	custom	pm+pt	NA	custom	pm+pt	NA		pm+pt	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2		8	6		4	8			4		
Actuated Green, G (s)	55.6	46.5	41.8	71.3	57.2	50.9	52.6	41.8		66.7	50.9	
Effective Green, g (s)	55.6	46.5	41.8	71.3	57.2	50.9	52.6	41.8		66.7	50.9	
Actuated g/C Ratio	0.37	0.31	0.28	0.48	0.38	0.34	0.35	0.28		0.44	0.34	
Clearance Time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	6.0		5.0	6.0	
Vehicle Extension (s)	2.0	3.0	2.0	2.0	3.0	2.0	2.0	2.0		2.0	2.0	
Lane Grp Cap (vph)	335	577	441	473	710	537	177	977		285	1187	
v/s Ratio Prot	0.02	0.15		c0.08	0.22		0.06	0.24		c0.12	0.30	
v/s Ratio Perm	0.11		0.01	c0.21		0.05	0.21			c0.28		
v/c Ratio	0.36	0.49	0.05	0.62	0.58	0.16	0.77	0.86		0.90	0.89	
Uniform Delay, d1	32.3	42.2	39.6	26.3	36.9	34.6	38.0	51.3		44.1	47.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	3.0	0.0	1.7	3.5	0.1	16.3	7.6		27.8	8.6	
Delay (s)	32.6	45.2	39.6	28.0	40.4	34.7	54.3	58.9		71.9	55.5	
Level of Service	C	D	D	C	D	C	D	E		E	E	
Approach Delay (s)		41.2			35.1			58.3			58.7	
Approach LOS		D			D			E			E	

Intersection Summary			
HCM 2000 Control Delay	50.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	79.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*JMS*
Agency/Co.	*Olsson Associates*
Date Performed	*12/10/2013*
Analysis Time Period	*7:30 am*

Site Information

Intersection	*Rockledge Rd & 9th St*
Jurisdiction	*City of Lawrence*
Analysis Year	*Existing Conditions 2014*

Project Description *013-0542*

East/West Street: *9th Street* | North/South Street: *Rockledge Road*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*44*	*354*	*1*	*1*	*159*	*24*
Peak-Hour Factor, PHF	*0.52*	*0.78*	*0.25*	*0.25*	*0.81*	*0.67*
Hourly Flow Rate, HFR (veh/h)	*84*	*453*	*4*	*4*	*196*	*35*
Percent Heavy Vehicles	*2*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration	*LTR*			*LTR*		
Upstream Signal		*0*			*1*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*5*	*23*	*11*	*67*	*23*	*35*
Peak-Hour Factor, PHF	*0.42*	*0.52*	*0.34*	*0.62*	*0.34*	*0.51*
Hourly Flow Rate, HFR (veh/h)	*11*	*44*	*32*	*108*	*67*	*68*
Percent Heavy Vehicles	*2*	*2*	*2*	*2*	*2*	*2*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration		*LTR*			*LTR*	

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LTR*	*LTR*		*LTR*			*LTR*	
v (veh/h)	*84*	*4*		*87*			*243*	
C (m) (veh/h)	*1337*	*1104*		*311*			*284*	
v/c	*0.06*	*0.00*		*0.28*			*0.86*	
95% queue length	*0.20*	*0.01*		*1.12*			*7.32*	
Control Delay (s/veh)	*7.9*	*8.3*		*21.0*			*62.2*	
LOS	*A*	*A*		*C*			*F*	
Approach Delay (s/veh)	--	--	*21.0*			*62.2*		
Approach LOS	--	--	*C*			*F*		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*JMS*
Agency/Co.	*Olsson Associates*
Date Performed	*12/10/2013*
Analysis Time Period	*5:00 pm*

Site Information

Intersection	*Rockledge Rd & 9th St*
Jurisdiction	*City of Lawrence*
Analysis Year	*Existing Conditions 2014*

Project Description *013-0542*

East/West Street: *9th Street* | North/South Street: *Rockledge Road*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*27*	*332*	*6*	*3*	*479*	*59*
Peak-Hour Factor, PHF	*0.68*	*0.84*	*0.50*	*0.38*	*0.86*	*0.74*
Hourly Flow Rate, HFR (veh/h)	*39*	*395*	*12*	*7*	*556*	*79*
Percent Heavy Vehicles	*2*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration	*LTR*			*LTR*		
Upstream Signal		*0*			*1*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*2*	*7*	*5*	*62*	*10*	*34*
Peak-Hour Factor, PHF	*0.50*	*0.58*	*0.63*	*0.82*	*0.25*	*0.71*
Hourly Flow Rate, HFR (veh/h)	*4*	*12*	*7*	*75*	*40*	*47*
Percent Heavy Vehicles	*2*	*2*	*2*	*2*	*2*	*2*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration		*LTR*			*LTR*	

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LTR*	*LTR*		*LTR*			*LTR*	
v (veh/h)	*39*	*7*		*23*			*162*	
C (m) (veh/h)	*914*	*1152*		*205*			*210*	
v/c	*0.04*	*0.01*		*0.11*			*0.77*	
95% queue length	*0.13*	*0.02*		*0.37*			*5.35*	
Control Delay (s/veh)	*9.1*	*8.1*		*24.8*			*63.4*	
LOS	*A*	*A*		*C*			*F*	
Approach Delay (s/veh)	--	--	*24.8*			*63.4*		
Approach LOS	--	--	*C*			*F*		

Existing Capacity Analysis – 21st Street

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*JMS*
Agency/Co.	*Olsson Associates*
Date Performed	*12/11/2013*
Analysis Time Period	*7:30 am*

Site Information

Intersection	*Iowa St & 21st St*
Jurisdiction	*City of Lawrence*
Analysis Year	*Existing Conditions 2014*

Project Description *013-0542*

East/West Street: *21st Street* | North/South Street: *Iowa Street*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*99*	*890*	*47*	*56*	*671*	
Peak-Hour Factor, PHF	*0.83*	*0.85*	*0.65*	*0.70*	*0.85*	*0.67*
Hourly Flow Rate, HFR (veh/h)	*119*	*1047*	*72*	*80*	*789*	*0*
Percent Heavy Vehicles	*2*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*1*	*2*	*0*	*1*	*2*	*0*
Configuration	*L*	*T*	*TR*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*1*	*4*	*15*	*13*	*20*	*33*
Peak-Hour Factor, PHF	*0.25*	*0.25*	*0.63*	*0.54*	*0.56*	*0.69*
Hourly Flow Rate, HFR (veh/h)	*4*	*16*	*23*	*24*	*35*	*47*
Percent Heavy Vehicles	*2*	*2*	*2*	*2*	*2*	*2*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*1*	*1*	*0*
Configuration		*LTR*		*L*		*TR*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*	*L*	*L*		*TR*		*LTR*	
v (veh/h)	*119*	*80*	*24*		*82*		*43*	
C (m) (veh/h)	*827*	*620*	*19*		*65*		*0*	
v/c	*0.14*	*0.13*	*1.26*		*1.26*			
95% queue length	*0.50*	*0.44*	*3.33*		*6.71*			
Control Delay (s/veh)	*10.1*	*11.7*	*587.2*		*306.1*			
LOS	*B*	*B*	*F*		*F*		*F*	
Approach Delay (s/veh)	--	--	*369.7*					
Approach LOS	--	--	*F*					

HCS+™ Version 5.6 Generated: 2/12/2014 5:16 PM

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*JMS*
Agency/Co.	*Olsson Associates*
Date Performed	*12/10/2013*
Analysis Time Period	*5:00 pm*

Site Information

Intersection	*Iowa St & 21st St*
Jurisdiction	*City of Lawrence*
Analysis Year	*Existing Conditions 2014*

Project Description *013-0542*

East/West Street: *21st Street* | North/South Street: *Iowa Street*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*21*	*991*	*54*	*47*	*1450*	
Peak-Hour Factor, PHF	*0.88*	*0.94*	*0.79*	*0.84*	*0.92*	*0.92*
Hourly Flow Rate, HFR (veh/h)	*23*	*1054*	*68*	*55*	*1576*	*0*
Percent Heavy Vehicles	*2*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*1*	*2*	*0*	*1*	*2*	*0*
Configuration	*L*	*T*	*TR*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*0*	*19*	*87*	*23*	*19*	*38*
Peak-Hour Factor, PHF	*0.92*	*0.53*	*0.60*	*0.64*	*0.68*	*0.86*
Hourly Flow Rate, HFR (veh/h)	*0*	*35*	*144*	*35*	*27*	*44*
Percent Heavy Vehicles	*2*	*2*	*2*	*2*	*2*	*2*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*1*	*1*	*0*
Configuration		*LTR*		*L*		*TR*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*	*L*	*L*		*TR*		*LTR*	
v (veh/h)	*23*	*55*	*35*		*71*		*179*	
C (m) (veh/h)	*414*	*618*	*0*		*38*		*0*	
v/c	*0.06*	*0.09*			*1.87*			
95% queue length	*0.18*	*0.29*			*7.62*			
Control Delay (s/veh)	*14.2*	*11.4*			*638.4*			
LOS	*B*	*B*	*F*		*F*		*F*	
Approach Delay (s/veh)	--	--						
Approach LOS	--	--						

HCS+™ Version 5.6

Generated: 2/12/2014 5:17 PM

ALL-WAY STOP CONTROL ANALYSIS

General Information

Analyst	*JMS*
Agency/Co.	*Olsson Associates*
Date Performed	*12/11/2013*
Analysis Time Period	*7:30 am*

Site Information

Intersection	*Ousdahl Rd & 21st St*
Jurisdiction	*City of Lawrence*
Analysis Year	*Existing Conditions 2014*

Project ID *013-0542*

East/West Street: *21st Street* North/South Street: *Ousdahl Road*

Volume Adjustments and Site Characteristics

Approach	Eastbound			Westbound		
Movement	L	T	R	L	T	R
Volume (veh/h)	*11*	*95*	*20*	*29*	*52*	*4*
%Thrus Left Lane						

Approach	Northbound			Southbound		
Movement	L	T	R	L	T	R
Volume (veh/h)	*28*	*89*	*25*	*6*	*41*	*3*
%Thrus Left Lane						

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	*LTR*		*LTR*		*LTR*		*LTR*	
PHF	*0.53*		*0.54*		*0.75*		*0.62*	
Flow Rate (veh/h)	*237*		*155*		*188*		*79*	
% Heavy Vehicles	*2*		*2*		*2*		*2*	
No. Lanes	*1*		*1*		*1*		*1*	
Geometry Group	*1*		*1*		*1*		*1*	
Duration, T	*0.25*							

Saturation Headway Adjustment Worksheet

Prop. Left-Turns	*0.1*		*0.3*		*0.2*		*0.1*	
Prop. Right-Turns	*0.2*		*0.0*		*0.2*		*0.1*	
Prop. Heavy Vehicle	*0.0*		*0.0*		*0.0*		*0.0*	
hLT-adj	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*
hRT-adj	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*
hHV-adj	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*
hadj, computed	*-0.0*		*0.1*		*-0.0*		*0.0*	

Departure Headway and Service Time

hd, initial value (s)	*3.20*		*3.20*		*3.20*		*3.20*	
x, initial	*0.21*		*0.14*		*0.17*		*0.07*	
hd, final value (s)	*4.78*		*5.00*		*4.98*		*5.20*	
x, final value	*0.31*		*0.22*		*0.26*		*0.11*	
Move-up time, m (s)	*2.0*		*2.0*		*2.0*		*2.0*	
Service Time, t_s (s)	*2.8*		*3.0*		*3.0*		*3.2*	

Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Capacity (veh/h)	*487*		*405*		*438*		*329*	
Delay (s/veh)	*9.96*		*9.37*		*9.72*		*8.87*	
LOS	*A*		*A*		*A*		*A*	
Approach: Delay (s/veh)	*9.96*		*9.37*		*9.72*		*8.87*	
LOS	*A*		*A*		*A*		*A*	
Intersection Delay (s/veh)	*9.62*							
Intersection LOS	*A*							

ALL-WAY STOP CONTROL ANALYSIS

General Information

Analyst	*JMS*
Agency/Co.	*Olsson Associates*
Date Performed	*12/10/2013*
Analysis Time Period	*5:00 pm*

Site Information

Intersection	*Ousdahl Rd & 21st St*
Jurisdiction	*City of Lawrence*
Analysis Year	*Existing Condtions 2014*

Project ID *013-0542*

East/West Street: *21st Street* North/South Street: *Ousdahl Road*

Volume Adjustments and Site Characteristics

Approach	Eastbound			Westbound		
Movement	L	T	R	L	T	R
Volume (veh/h)	*10*	*57*	*15*	*54*	*78*	*8*
%Thrus Left Lane						

Approach	Northbound			Southbound		
Movement	L	T	R	L	T	R
Volume (veh/h)	*12*	*61*	*12*	*3*	*54*	*1*
%Thrus Left Lane						

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	*LTR*		*LTR*		*LTR*		*LTR*	
PHF	*0.71*		*0.71*		*0.72*		*0.76*	
Flow Rate (veh/h)	*114*		*197*		*116*		*75*	
% Heavy Vehicles	*2*		*2*		*2*		*2*	
No. Lanes	*1*		*1*		*1*		*1*	
Geometry Group	*1*		*1*		*1*		*1*	
Duration, T	*0.25*							

Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
Prop. Left-Turns	*0.1*		*0.4*		*0.1*		*0.0*	
Prop. Right-Turns	*0.2*		*0.1*		*0.1*		*0.0*	
Prop. Heavy Vehicle	*0.0*		*0.0*		*0.0*		*0.0*	
hLT-adj	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*
hRT-adj	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*
hHV-adj	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*
hadj, computed	*-0.1*		*0.1*		*-0.0*		*0.0*	

Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
hd, initial value (s)	*3.20*		*3.20*		*3.20*		*3.20*	
x, initial	*0.10*		*0.18*		*0.10*		*0.07*	
hd, final value (s)	*4.57*		*4.60*		*4.73*		*4.83*	
x, final value	*0.14*		*0.25*		*0.15*		*0.10*	
Move-up time, m (s)	*2.0*		*2.0*		*2.0*		*2.0*	
Service Time, t_s (s)	*2.6*		*2.6*		*2.7*		*2.8*	

Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Capacity (veh/h)	*364*		*447*		*366*		*325*	
Delay (s/veh)	*8.34*		*9.13*		*8.57*		*8.38*	
LOS	*A*		*A*		*A*		*A*	
Approach: Delay (s/veh)	*8.34*		*9.13*		*8.57*		*8.38*	
LOS	*A*		*A*		*A*		*A*	
Intersection Delay (s/veh)	*8.71*							
Intersection LOS	*A*							

HCS+™ Version 5.6 Generated: 2/12/2014 5:52 PM

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*JMS*
Agency/Co.	*Olsson Associates*
Date Performed	*12/11/2013*
Analysis Time Period	*7:30 am*

Site Information

Intersection	*Naismith Dr & 21st St*
Jurisdiction	*City of Lawrence*
Analysis Year	*Existing Conditions 2014*

Project Description *013-0542*

East/West Street: *21st Street* | North/South Street: *Naismith Drive*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)				*13*	*81*	*4*
Peak-Hour Factor, PHF	*0.92*	*0.92*	*0.92*	*0.41*	*0.81*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*31*	*99*	*4*
Percent Heavy Vehicles	*2*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*1*	*2*	*0*
Configuration				*L*	*T*	*TR*
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)		*123*	*8*	*13*	*66*	
Peak-Hour Factor, PHF	*0.92*	*0.51*	*0.50*	*0.65*	*0.55*	*0.92*
Hourly Flow Rate, HFR (veh/h)	*0*	*241*	*16*	*20*	*119*	*0*
Percent Heavy Vehicles	*2*	*2*	*2*	*2*	*2*	*2*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration			*TR*	*LT*		

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*	*LT*					*TR*
v (veh/h)		*31*	*139*					*257*
C (m) (veh/h)		*1623*	*677*					*728*
v/c		*0.02*	*0.21*					*0.35*
95% queue length		*0.06*	*0.77*					*1.59*
Control Delay (s/veh)		*7.3*	*11.7*					*12.6*
LOS		*A*	*B*					*B*
Approach Delay (s/veh)	--	--	*11.7*			*12.6*		
Approach LOS	--	--	*B*			*B*		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*JMS*
Agency/Co.	*Olsson Associates*
Date Performed	*12/11/2013*
Analysis Time Period	*7:30 am*

Site Information

Intersection	*Naismith Dr & 21st St*
Jurisdiction	*City of Lawrence*
Analysis Year	*Existing Conditions 2014*

Project Description *013-0542*

East/West Street: *21st Street* | North/South Street: *Naismith Drive*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*13*	*287*	*56*			
Peak-Hour Factor, PHF	*0.54*	*0.78*	*0.44*	*0.92*	*0.92*	*0.92*
Hourly Flow Rate, HFR (veh/h)	*24*	*367*	*127*	*0*	*0*	*0*
Percent Heavy Vehicles	*2*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*1*	*2*	*0*	*0*	*0*	*0*
Configuration	*L*	*T*	*TR*			
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*16*	*120*			*66*	*25*
Peak-Hour Factor, PHF	*0.80*	*0.51*	*0.92*	*0.92*	*0.55*	*0.57*
Hourly Flow Rate, HFR (veh/h)	*19*	*235*	*0*	*0*	*119*	*43*
Percent Heavy Vehicles	*2*	*2*	*2*	*2*	*2*	*2*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration	*LT*					*TR*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*				*TR*	*LT*		
v (veh/h)	*24*				*162*	*254*		
C (m) (veh/h)	*1623*				*535*	*444*		
v/c	*0.01*				*0.30*	*0.57*		
95% queue length	*0.05*				*1.27*	*3.50*		
Control Delay (s/veh)	*7.3*				*14.6*	*23.4*		
LOS	*A*				*B*	*C*		
Approach Delay (s/veh)	--	--	*14.6*			*23.4*		
Approach LOS	--	--	*B*			*C*		

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*JMS*	Intersection	*Naismith Dr & 21st St*
Agency/Co.	*Olsson Associates*	Jurisdiction	*City of Lawrence*
Date Performed	*12/10/2013*	Analysis Year	*Existing Conditions 2014*
Analysis Time Period	*5:00 pm*		

Project Description *013-0542*

East/West Street: *21st Street* | North/South Street: *Naismith Drive*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)				*13*	*437*	*17*
Peak-Hour Factor, PHF	*0.92*	*0.92*	*0.92*	*0.54*	*0.80*	*0.53*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*24*	*546*	*32*
Percent Heavy Vehicles	*2*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*1*	*2*	*0*
Configuration				*L*	*T*	*TR*
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)		*49*	*18*	*59*	*127*	
Peak-Hour Factor, PHF	*0.92*	*0.75*	*0.75*	*0.70*	*0.81*	*0.92*
Hourly Flow Rate, HFR (veh/h)	*0*	*65*	*24*	*84*	*156*	*0*
Percent Heavy Vehicles	*2*	*2*	*2*	*2*	*2*	*2*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration			*TR*	*LT*		

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*	*LT*					*TR*
v (veh/h)		*24*	*240*					*89*
C (m) (veh/h)		*1623*	*427*					*460*
v/c		*0.01*	*0.56*					*0.19*
95% queue length		*0.05*	*3.37*					*0.71*
Control Delay (s/veh)		*7.3*	*23.7*					*14.7*
LOS		*A*	*C*					*B*
Approach Delay (s/veh)	--	--	*23.7*			*14.7*		
Approach LOS	--	--	*C*			*B*		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*JMS*
Agency/Co.	*Olsson Associates*
Date Performed	*12/10/2013*
Analysis Time Period	*5:00 pm*

Site Information

Intersection	*Naismith Dr & 21st St*
Jurisdiction	*City of Lawrence*
Analysis Year	*Existing Conditions*

Project Description *013-0542*

East/West Street: *21st Street* | North/South Street: *Naismith Drive*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*39*	*282*	*17*			
Peak-Hour Factor, PHF	*0.89*	*0.90*	*0.61*	*0.92*	*0.92*	*0.92*
Hourly Flow Rate, HFR (veh/h)	*43*	*313*	*27*	*0*	*0*	*0*
Percent Heavy Vehicles	*2*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*1*	*2*	*0*	*0*	*0*	*0*
Configuration	*L*	*T*	*TR*			
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*7*	*55*			*147*	*13*
Peak-Hour Factor, PHF	*0.58*	*0.75*	*0.92*	*0.92*	*0.85*	*0.81*
Hourly Flow Rate, HFR (veh/h)	*12*	*73*	*0*	*0*	*172*	*16*
Percent Heavy Vehicles	*2*	*2*	*2*	*2*	*2*	*2*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration	*LT*					*TR*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*				*TR*	*LT*		
v (veh/h)	*43*				*188*	*85*		
C (m) (veh/h)	*1623*				*535*	*497*		
v/c	*0.03*				*0.35*	*0.17*		
95% queue length	*0.08*				*1.57*	*0.61*		
Control Delay (s/veh)	*7.3*				*15.3*	*13.7*		
LOS	*A*				*C*	*B*		
Approach Delay (s/veh)	--	--	*15.3*			*13.7*		
Approach LOS	--	--	*C*			*B*		

Existing + Busses Signal Warrants

TRAFFIC SIGNAL WARRANT ANALYSIS - VOLUME WARRANTS

KANSAS DEPARTMENT OF TRANSPORTATION - BUREAU OF TRAFFIC ENGINEERING

Major Street : 9th Street
Minor Street : Rockledge Road
City : Lawrence
County : Douglas

Time Count Began : 12:00 PM
Date : 12/10/13
Day of Week of Count: Tuesday

Is the intersection in a community with a population less than 10,000 or are speeds greater than 40 mph? no

	Major Street	Minor Street
Adjustment factor for day of week and month of year of count	1	1
Number of Lanes	1	1

Time Beginning	Major Street Approach Volumes EAST	WEST	Total	≡	Minor Street Approach Volumes NORTH	SOUTH	*
12:00 m	20	38	58		0	9	9
1:00	14	27	41		0	7	7
2:00	5	13	18		1	9	9
3:00 am	2	7	9		0	7	7
4:00	10	6	16		0	2	2
5:00	47	19	66		2	10	10
6:00 am	91	58	149		4	25	25
7:00	343	172	515		24	69	69
8:00	335	159	494		24	117	117
9:00 am	195	170	365		6	68	68
10:00	166	169	335		9	72	72
11:00	182	249	431		11	77	77
12:00 n	120	279	399		10	85	85
1:00	202	254	456		29	114	114
2:00	201	280	481		15	91	91
3:00 pm	297	332	629		13	93	93
4:00	292	460	752		16	82	82
5:00	348	544	892		18	104	104
6:00 pm	241	364	605		8	97	97
7:00	126	236	362		5	59	59
8:00	82	199	281		7	42	42
9:00 pm	71	166	237		4	37	37
10:00	40	97	137		3	25	25
11:00	31	54	85		3	10	10
24HR Total	3461	4352			212	1311	

Note: ≡ Total of both approaches.
* The HIGHEST approach only.

NOTE: Basic minimum hourly volumes (unreduced)

NOTE: No adjust ment made

Warrant #1 - Condition A

Percent of Warrant Volumes Met Major	Minor
12	6
8	5
4	6
2	5
3	1
13	7
30	17
103	46
99	78
73	45
67	48
86	51
80	57
91	76
96	61
126	62
150	55
178	69
121	65
72	39
56	28
47	25
27	17
17	7
Warranting Volumes 500	150
Hours Met	0
Warrant Met	No

Warrant #1 - Condition B

Percent of Warrant Volumes Met Major	Minor
8	12
5	9
2	12
1	9
2	3
9	13
20	33
69	92
66	156
49	91
45	96
57	103
53	113
61	152
64	121
84	124
100	109
119	139
81	129
48	79
37	56
32	49
18	33
11	13
Warranting Volumes 750	75
Hours Met	2
Warrant Met	No

Warrant #1 - Combination of Conditions A & B

For this warrant vehicle volume requirements for conditions A and B are reduced to **80% Factor**

NOTE: Conditions A and B **SHALL BOTH** meet a minimum of 8 hours. However, the 8 hours satisfying condition A **NEED NOT** be the same as the 8 hours satisfying condition B.

Condition	A	B
Hours Met	0	4
Warrant Met	No	

Warrant #2

Warrant Volume	Percent of Warrant
0	*****
0	*****
0	*****
0	*****
0	*****
0	*****
0	*****
250	28
260	45
0	*****
0	*****
290	27
300	28
270	42
260	35
200	47
160	51
120	87
210	46
0	*****
0	*****
0	*****
0	*****
0	*****
Warranting Volumes From MUTCD Fig. 4C-1	
Hours Met	0
Warrant Met	No

Warrant #3

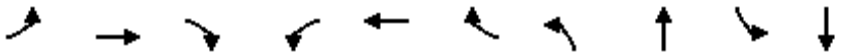
Warrant Volume	Percent of Warrant
0	*****
0	*****
0	*****
0	*****
0	*****
0	*****
0	*****
410	17
420	28
0	*****
0	*****
0	*****
0	*****
440	26
420	22
350	27
290	28
240	43
360	27
0	*****
0	*****
0	*****
0	*****
0	*****
Warranting Volumes From MUTCD Fig. 4C-3	
Hours Met	0
Warrant Met	No

***** Major Street volume is so low that no Minor Street warrant exists

Existing + Busses Capacity Analysis – 9th Street

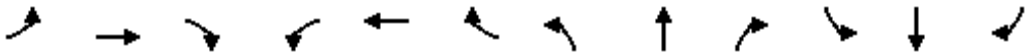
Queues
21: Iowa St & 9th St

2/13/2014



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	77	159	53	132	84	76	13	653	195	848
v/c Ratio	0.14	0.25	0.09	0.24	0.12	0.10	0.06	0.59	0.59	0.57
Control Delay	19.1	30.8	0.3	20.0	27.1	2.9	18.9	36.5	27.0	29.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.1	30.8	0.3	20.0	27.1	2.9	18.9	36.5	27.0	29.2
Queue Length 50th (ft)	33	88	0	58	44	0	5	215	89	242
Queue Length 95th (ft)	44	147	0	90	69	17	12	295	129	317
Internal Link Dist (ft)		1231			786			1357		767
Turn Bay Length (ft)	110		110	235		235	125		100	
Base Capacity (vph)	611	631	584	595	693	724	307	1100	392	1479
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.25	0.09	0.22	0.12	0.10	0.04	0.59	0.50	0.57

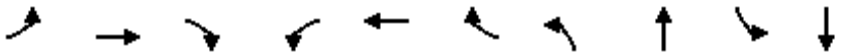
Intersection Summary



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	50	140	41	111	63	65	9	496	50	164	692	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.3	5.3	5.3	4.3	5.3	5.3	4.3	5.3		4.3	5.3	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97		1.00	1.00	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1671	1863	1553	1770	1863	1583	1597	3438		1770	3506	
Flt Permitted	0.70	1.00	1.00	0.58	1.00	1.00	0.26	1.00		0.22	1.00	
Satd. Flow (perm)	1236	1863	1553	1075	1863	1583	429	3438		413	3506	
Peak-hour factor, PHF	0.65	0.88	0.77	0.84	0.75	0.86	0.67	0.94	0.40	0.84	0.83	0.50
Adj. Flow (vph)	77	159	53	132	84	76	13	528	125	195	834	14
RTOR Reduction (vph)	0	0	37	0	0	46	0	17	0	0	1	0
Lane Group Flow (vph)	77	159	16	132	84	30	13	636	0	195	847	0
Heavy Vehicles (%)	8%	2%	4%	2%	2%	2%	13%	2%	2%	2%	2%	45%
Turn Type	pm+pt	NA	custom	pm+pt	NA	custom	pm+pt	NA		pm+pt	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2		8	6		4	8			4		
Actuated Green, G (s)	48.2	41.6	37.0	54.4	44.7	47.1	39.4	37.0		53.8	47.1	
Effective Green, g (s)	48.2	41.6	37.0	54.4	44.7	47.1	39.4	37.0		53.8	47.1	
Actuated g/C Ratio	0.40	0.35	0.31	0.45	0.37	0.39	0.33	0.31		0.45	0.39	
Clearance Time (s)	4.3	5.3	5.3	4.3	5.3	5.3	4.3	5.3		4.3	5.3	
Vehicle Extension (s)	2.0	3.0	2.0	2.0	3.0	2.0	2.0	2.0		2.0	2.0	
Lane Grp Cap (vph)	520	645	478	543	693	621	164	1060		326	1376	
v/s Ratio Prot	0.01	0.09		c0.02	0.05		0.00	0.19		c0.06	c0.24	
v/s Ratio Perm	0.05		0.01	c0.09		0.02	0.02			0.21		
v/c Ratio	0.15	0.25	0.03	0.24	0.12	0.05	0.08	0.60		0.60	0.62	
Uniform Delay, d1	22.5	28.0	29.0	19.5	24.7	22.6	27.6	35.2		22.5	29.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.0	0.9	0.1	0.1	0.4	0.1	0.1	2.5		2.0	2.1	
Delay (s)	22.6	28.9	29.1	19.6	25.1	22.7	27.7	37.7		24.4	31.3	
Level of Service	C	C	C	B	C	C	C	D		C	C	
Approach Delay (s)		27.3			22.0			37.5			30.0	
Approach LOS		C			C			D			C	

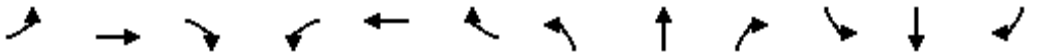
Intersection Summary			
HCM 2000 Control Delay	30.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	19.2
Intersection Capacity Utilization	54.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	123	285	77	292	415	235	138	844	256	1067
v/c Ratio	0.38	0.50	0.14	0.61	0.59	0.34	0.78	0.85	0.89	0.90
Control Delay	28.5	49.2	0.5	31.7	43.3	5.7	61.7	59.9	70.1	57.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.5	49.2	0.5	31.7	43.3	5.7	61.7	59.9	70.1	57.0
Queue Length 50th (ft)	68	234	0	179	335	6	79	405	189	514
Queue Length 95th (ft)	114	364	0	268	472	63	75	465	257	583
Internal Link Dist (ft)		1231			786			1357		767
Turn Bay Length (ft)	110		110	235		235	125		100	
Base Capacity (vph)	338	572	577	519	703	732	190	1032	333	1303
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.36	0.50	0.13	0.56	0.59	0.32	0.73	0.82	0.77	0.82

Intersection Summary



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	108	259	74	277	378	216	80	689	34	215	924	54
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	6.0		5.0	6.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1719	1863	1568	1770	1863	1583	1752	3507		1770	3481	
Flt Permitted	0.39	1.00	1.00	0.37	1.00	1.00	0.09	1.00		0.09	1.00	
Satd. Flow (perm)	707	1863	1568	695	1863	1583	175	3507		170	3481	
Peak-hour factor, PHF	0.88	0.91	0.96	0.95	0.91	0.92	0.58	0.87	0.65	0.84	0.94	0.64
Adj. Flow (vph)	123	285	77	292	415	235	138	792	52	256	983	84
RTOR Reduction (vph)	0	0	55	0	0	149	0	4	0	0	5	0
Lane Group Flow (vph)	123	285	22	292	415	86	138	840	0	256	1062	0
Heavy Vehicles (%)	5%	2%	3%	2%	2%	2%	3%	2%	2%	2%	2%	8%
Turn Type	pm+pt	NA	custom	pm+pt	NA	custom	pm+pt	NA		pm+pt	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2		8	6		4	8			4		
Actuated Green, G (s)	55.5	46.2	42.2	71.0	56.7	51.1	53.1	42.2		67.0	51.1	
Effective Green, g (s)	55.5	46.2	42.2	71.0	56.7	51.1	53.1	42.2		67.0	51.1	
Actuated g/C Ratio	0.37	0.31	0.28	0.47	0.38	0.34	0.35	0.28		0.45	0.34	
Clearance Time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	6.0		5.0	6.0	
Vehicle Extension (s)	2.0	3.0	2.0	2.0	3.0	2.0	2.0	2.0		2.0	2.0	
Lane Grp Cap (vph)	324	573	441	470	704	539	176	986		287	1185	
v/s Ratio Prot	0.02	0.15		c0.08	0.22		0.06	0.24		c0.12	c0.31	
v/s Ratio Perm	0.12		0.01	c0.21		0.05	0.22			0.28		
v/c Ratio	0.38	0.50	0.05	0.62	0.59	0.16	0.78	0.85		0.89	0.90	
Uniform Delay, d1	32.6	42.4	39.3	26.5	37.3	34.5	37.9	51.0		43.3	46.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.3	3.1	0.0	1.8	3.6	0.1	18.7	7.0		26.8	8.9	
Delay (s)	32.8	45.5	39.3	28.3	40.9	34.5	56.5	57.9		70.1	55.8	
Level of Service	C	D	D	C	D	C	E	E		E	E	
Approach Delay (s)		41.3			35.4			57.7			58.6	
Approach LOS		D			D			E			E	

Intersection Summary			
HCM 2000 Control Delay	50.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	79.6%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*JMS*
Agency/Co.	*Olsson Associates*
Date Performed	*12/10/2013*
Analysis Time Period	*7:30 am*

Site Information

Intersection	*Rockledge Rd & 9th St*
Jurisdiction	*City of Lawrence, KS*
Analysis Year	*Existing + Bus 2014*

Project Description *013-0542*

East/West Street: *9th Street* | North/South Street: *Rockledge Road*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*44*	*358*	*1*	*1*	*163*	*26*
Peak-Hour Factor, PHF	*0.52*	*0.78*	*0.25*	*0.25*	*0.81*	*0.67*
Hourly Flow Rate, HFR (veh/h)	*84*	*458*	*4*	*4*	*201*	*38*
Percent Heavy Vehicles	*2*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration	*LTR*			*LTR*		
Upstream Signal		*0*			*1*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*5*	*23*	*11*	*69*	*23*	*35*
Peak-Hour Factor, PHF	*0.42*	*0.52*	*0.34*	*0.62*	*0.34*	*0.51*
Hourly Flow Rate, HFR (veh/h)	*11*	*44*	*32*	*111*	*67*	*68*
Percent Heavy Vehicles	*2*	*2*	*2*	*5*	*2*	*2*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*1*	*1*	*0*
Configuration		*LTR*		*L*		*TR*

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LTR*	*LTR*		*LTR*		*L*		*TR*
v (veh/h)	*84*	*4*		*87*		*111*		*135*
C (m) (veh/h)	*1328*	*1099*		*306*		*199*		*404*
v/c	*0.06*	*0.00*		*0.28*		*0.56*		*0.33*
95% queue length	*0.20*	*0.01*		*1.14*		*2.98*		*1.44*
Control Delay (s/veh)	*7.9*	*8.3*		*21.4*		*43.8*		*18.3*
LOS	*A*	*A*		*C*		*E*		*C*
Approach Delay (s/veh)	--	--	*21.4*			*29.8*		
Approach LOS	--	--	*C*			*D*		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*JMS*
Agency/Co.	*Olsson Associates*
Date Performed	*12/10/2013*
Analysis Time Period	*5:00 pm*

Site Information

Intersection	*Rockledge Rd & 9th St*
Jurisdiction	*City of Lawrence, KS*
Analysis Year	*Existing + Bus 2014*

Project Description *013-0542*

East/West Street: *9th Street* | North/South Street: *Rockledge Road*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*27*	*336*	*6*	*3*	*483*	*61*
Peak-Hour Factor, PHF	*0.68*	*0.84*	*0.50*	*0.38*	*0.86*	*0.74*
Hourly Flow Rate, HFR (veh/h)	*39*	*400*	*12*	*7*	*561*	*82*
Percent Heavy Vehicles	*2*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration	*LTR*			*LTR*		
Upstream Signal		*0*			*1*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*2*	*7*	*5*	*64*	*10*	*34*
Peak-Hour Factor, PHF	*0.50*	*0.58*	*0.63*	*0.82*	*0.25*	*0.71*
Hourly Flow Rate, HFR (veh/h)	*4*	*12*	*7*	*78*	*40*	*47*
Percent Heavy Vehicles	*2*	*2*	*2*	*5*	*2*	*2*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*1*	*1*	*0*
Configuration		*LTR*		*L*		*TR*

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LTR*	*LTR*		*LTR*		*L*		*TR*
v (veh/h)	*39*	*7*		*23*		*78*		*87*
C (m) (veh/h)	*907*	*1147*		*200*		*154*		*282*
v/c	*0.04*	*0.01*		*0.12*		*0.51*		*0.31*
95% queue length	*0.13*	*0.02*		*0.38*		*2.45*		*1.27*
Control Delay (s/veh)	*9.1*	*8.2*		*25.3*		*50.2*		*23.4*
LOS	*A*	*A*		*D*		*F*		*C*
Approach Delay (s/veh)	--	--	*25.3*			*36.1*		
Approach LOS	--	--	*D*			*E*		

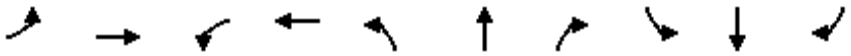
HCS+™ Version 5.6

Generated: 2/25/2014 9:58 AM

Existing + Busses Capacity Analysis – 21st Street

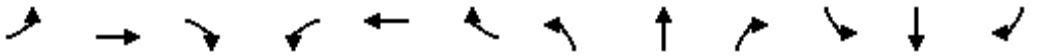
Queues
3: Iowa St & 21st St

2/25/2014



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	4	40	37	108	119	1047	78	90	789	12
v/c Ratio	0.05	0.25	0.40	0.59	0.21	0.40	0.07	0.23	0.30	0.01
Control Delay	49.0	30.1	63.1	38.7	3.1	6.9	2.0	3.6	6.2	0.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.0	30.1	63.1	38.7	3.1	6.9	2.0	3.6	6.2	0.0
Queue Length 50th (ft)	3	12	28	37	12	135	2	9	93	0
Queue Length 95th (ft)	4	0	36	38	26	197	9	18	140	0
Internal Link Dist (ft)		212		1246		720			581	
Turn Bay Length (ft)	150		150		150		150	265		265
Base Capacity (vph)	237	413	265	412	652	2603	1097	484	2596	1178
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.02	0.10	0.14	0.26	0.18	0.40	0.07	0.19	0.30	0.01

Intersection Summary



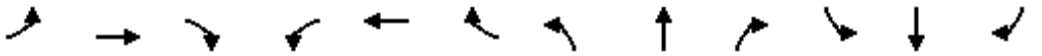
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	1	4	15	20	24	45	99	890	51	63	671	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.91		1.00	0.91		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1695		1480	1574		1770	3539	1468	1597	3539	1583
Flt Permitted	0.55	1.00		0.73	1.00		0.33	1.00	1.00	0.25	1.00	1.00
Satd. Flow (perm)	1018	1695		1138	1574		621	3539	1468	414	3539	1583
Peak-hour factor, PHF	0.25	0.25	0.63	0.54	0.56	0.69	0.83	0.85	0.65	0.70	0.85	0.67
Adj. Flow (vph)	4	16	24	37	43	65	119	1047	78	90	789	12
RTOR Reduction (vph)	0	22	0	0	54	0	0	0	17	0	0	3
Lane Group Flow (vph)	4	18	0	37	54	0	119	1047	61	90	789	9
Heavy Vehicles (%)	2%	2%	2%	22%	2%	15%	2%	2%	10%	13%	2%	2%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2		2	6		6
Actuated Green, G (s)	9.9	9.9		9.9	9.9		95.4	88.3	88.3	94.8	88.0	88.0
Effective Green, g (s)	9.9	9.9		9.9	9.9		95.4	88.3	88.3	94.8	88.0	88.0
Actuated g/C Ratio	0.08	0.08		0.08	0.08		0.80	0.74	0.74	0.79	0.73	0.73
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	83	139		93	129		561	2604	1080	394	2595	1160
v/s Ratio Prot		0.01			c0.03		0.01	c0.30		c0.01	0.22	
v/s Ratio Perm	0.00			0.03			0.16		0.04	0.17		0.01
v/c Ratio	0.05	0.13		0.40	0.42		0.21	0.40	0.06	0.23	0.30	0.01
Uniform Delay, d1	50.7	51.1		52.2	52.3		2.8	5.9	4.4	3.2	5.5	4.3
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	0.4		2.8	2.2		0.2	0.5	0.1	0.3	0.3	0.0
Delay (s)	51.0	51.5		55.0	54.5		3.0	6.4	4.5	3.5	5.8	4.3
Level of Service	D	D		E	D		A	A	A	A	A	A
Approach Delay (s)		51.4			54.6			6.0			5.5	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	9.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.39		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	49.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	181	42	93	24	1054	72	64	1576
v/c Ratio	0.66	0.78	0.43	0.09	0.40	0.06	0.17	0.59
Control Delay	30.2	120.7	26.7	3.8	7.4	1.7	4.0	9.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.2	120.7	26.7	3.8	7.4	1.7	4.0	9.0
Queue Length 50th (ft)	46	32	24	3	153	0	8	285
Queue Length 95th (ft)	28	48	43	10	229	11	20	425
Internal Link Dist (ft)	212		1246		720			581
Turn Bay Length (ft)		150		150		150	265	
Base Capacity (vph)	358	82	298	256	2607	1131	372	2680
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.51	0.51	0.31	0.09	0.40	0.06	0.17	0.59

Intersection Summary



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	19	87	27	23	51	21	991	57	54	1450	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95	1.00	1.00	0.95	
Frt		0.88		1.00	0.90		1.00	1.00	0.85	1.00	1.00	
Flt Protected		1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1639		1543	1568		1770	3539	1509	1570	3539	
Flt Permitted		1.00		0.32	1.00		0.12	1.00	1.00	0.24	1.00	
Satd. Flow (perm)		1639		520	1568		230	3539	1509	393	3539	
Peak-hour factor, PHF	0.92	0.53	0.60	0.64	0.68	0.86	0.88	0.94	0.79	0.84	0.92	0.92
Adj. Flow (vph)	0	36	145	42	34	59	24	1054	72	64	1576	0
RTOR Reduction (vph)	0	106	0	0	53	0	0	0	20	0	0	0
Lane Group Flow (vph)	0	75	0	42	40	0	24	1054	52	64	1576	0
Heavy Vehicles (%)	2%	2%	2%	17%	2%	14%	2%	2%	7%	15%	2%	2%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2		2	6		6
Actuated Green, G (s)		12.5		12.5	12.5		91.0	87.4	87.4	94.0	88.9	
Effective Green, g (s)		12.5		12.5	12.5		91.0	87.4	87.4	94.0	88.9	
Actuated g/C Ratio		0.10		0.10	0.10		0.76	0.73	0.73	0.78	0.74	
Clearance Time (s)		5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		170		54	163		220	2577	1099	357	2621	
v/s Ratio Prot		0.05			0.03		0.00	0.30		c0.01	c0.45	
v/s Ratio Perm				c0.08			0.08		0.03	0.13		
v/c Ratio		0.44		0.78	0.25		0.11	0.41	0.05	0.18	0.60	
Uniform Delay, d1		50.5		52.4	49.4		5.4	6.3	4.6	3.5	7.3	
Progression Factor		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		1.8		49.7	0.8		0.2	0.5	0.1	0.2	1.0	
Delay (s)		52.3		102.1	50.2		5.6	6.8	4.7	3.8	8.3	
Level of Service		D		F	D		A	A	A	A	A	
Approach Delay (s)		52.3			66.4			6.6			8.1	
Approach LOS		D			E			A			A	

Intersection Summary			
HCM 2000 Control Delay	12.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	61.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

ALL-WAY STOP CONTROL ANALYSIS

General Information

Analyst	*JMS*
Agency/Co.	*Olsson Associates*
Date Performed	*12/11/2013*
Analysis Time Period	*7:30 am*

Site Information

Intersection	*Ousdahl Rd & 21st St*
Jurisdiction	*City of Lawrence*
Analysis Year	*Existing + Bus + Cut-Thru 2014*

Project ID *013-0542*

East/West Street: *21st Street* North/South Street: *Ousdahl Road*

Volume Adjustments and Site Characteristics

Approach	Eastbound			Westbound		
Movement	L	T	R	L	T	R
Volume (veh/h)	*11*	*99*	*20*	*29*	*62*	*4*
%Thrus Left Lane						

Approach	Northbound			Southbound		
Movement	L	T	R	L	T	R
Volume (veh/h)	*31*	*89*	*25*	*6*	*41*	*7*
%Thrus Left Lane						

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	*LTR*		*LTR*		*LTR*		*LTR*	
PHF	*0.53*		*0.54*		*0.75*		*0.63*	
Flow Rate (veh/h)	*245*		*173*		*192*		*85*	
% Heavy Vehicles	*5*		*6*		*2*		*2*	
No. Lanes	*1*		*1*		*1*		*1*	
Geometry Group	*1*		*1*		*1*		*1*	
Duration, T	*0.25*							

Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
Prop. Left-Turns	*0.1*		*0.3*		*0.2*		*0.1*	
Prop. Right-Turns	*0.2*		*0.0*		*0.2*		*0.1*	
Prop. Heavy Vehicle	*0.0*		*0.1*		*0.0*		*0.0*	
hLT-adj	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*
hRT-adj	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*
hHV-adj	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*
hadj, computed	*0.0*		*0.1*		*-0.0*		*-0.0*	

Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
hd, initial value (s)	*3.20*		*3.20*		*3.20*		*3.20*	
x, initial	*0.22*		*0.15*		*0.17*		*0.08*	
hd, final value (s)	*4.91*		*5.13*		*5.09*		*5.26*	
x, final value	*0.33*		*0.25*		*0.27*		*0.12*	
Move-up time, m (s)	*2.0*		*2.0*		*2.0*		*2.0*	
Service Time, t_s (s)	*2.9*		*3.1*		*3.1*		*3.3*	

Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Capacity (veh/h)	*495*		*423*		*442*		*335*	
Delay (s/veh)	*10.35*		*9.80*		*9.97*		*9.01*	
LOS	*B*		*A*		*A*		*A*	
Approach: Delay (s/veh)	*10.35*		*9.80*		*9.97*		*9.01*	
LOS	*B*		*A*		*A*		*A*	
Intersection Delay (s/veh)	*9.95*							
Intersection LOS	*A*							

ALL-WAY STOP CONTROL ANALYSIS

General Information

Analyst	*JMS*
Agency/Co.	*Olsson Associates*
Date Performed	*12/10/2013*
Analysis Time Period	*5:00 pm*

Site Information

Intersection	*Ousdahl Rd & 21st St*
Jurisdiction	*City of Lawrence, KS*
Analysis Year	*Existing + Bus + Cut-Thru 2014*

Project ID *013-0542*

East/West Street: *21st Street* | North/South Street: *Ousdahl Road*

Volume Adjustments and Site Characteristics

Approach	Eastbound			Westbound		
Movement	L	T	R	L	T	R
Volume (veh/h)	*10*	*62*	*15*	*54*	*91*	*8*
%Thrus Left Lane						

Approach	Northbound			Southbound		
Movement	L	T	R	L	T	R
Volume (veh/h)	*15*	*61*	*12*	*3*	*54*	*5*
%Thrus Left Lane						

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	*LTR*		*LTR*		*LTR*		*LTR*	
PHF	*0.72*		*0.71*		*0.72*		*0.73*	
Flow Rate (veh/h)	*119*		*215*		*121*		*84*	
% Heavy Vehicles	*8*		*5*		*2*		*2*	
No. Lanes	*1*		*1*		*1*		*1*	
Geometry Group	*1*		*1*		*1*		*1*	
Duration, T	*0.25*							

Saturation Headway Adjustment Worksheet

Prop. Left-Turns	*0.1*		*0.4*		*0.2*		*0.0*	
Prop. Right-Turns	*0.2*		*0.1*		*0.1*		*0.1*	
Prop. Heavy Vehicle	*0.1*		*0.0*		*0.0*		*0.0*	
hLT-adj	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*
hRT-adj	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*-0.6*
hHV-adj	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*
hadj, computed	*0.1*		*0.1*		*-0.0*		*0.0*	

Departure Headway and Service Time

hd, initial value (s)	*3.20*		*3.20*		*3.20*		*3.20*	
x, initial	*0.11*		*0.19*		*0.11*		*0.07*	
hd, final value (s)	*4.75*		*4.70*		*4.83*		*4.89*	
x, final value	*0.16*		*0.28*		*0.16*		*0.11*	
Move-up time, m (s)	*2.0*		*2.0*		*2.0*		*2.0*	
Service Time, t_s (s)	*2.8*		*2.7*		*2.8*		*2.9*	

Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Capacity (veh/h)	*369*		*465*		*371*		*334*	
Delay (s/veh)	*8.63*		*9.52*		*8.76*		*8.52*	
LOS	*A*		*A*		*A*		*A*	
Approach: Delay (s/veh)	*8.63*		*9.52*		*8.76*		*8.52*	
LOS	*A*		*A*		*A*		*A*	
Intersection Delay (s/veh)	*9.00*							
Intersection LOS	*A*							

HCS+™ Version 5.6 Generated: 2/25/2014 1:47 PM

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*JMS*
Agency/Co.	*Olsson Associates*
Date Performed	*12/11/2013*
Analysis Time Period	*7:30 am*

Site Information

Intersection	*Naismith Dr & 21st St*
Jurisdiction	*City of Lawrence*
Analysis Year	*Existing + Bus + Cut-Thru 2014*

Project Description *013-0542*

East/West Street: *21st Street* | North/South Street: *Naismith Drive*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)				*13*	*81*	*8*
Peak-Hour Factor, PHF	*0.92*	*0.92*	*0.92*	*0.41*	*0.81*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*31*	*99*	*8*
Percent Heavy Vehicles	*2*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*1*	*2*	*0*
Configuration				*L*	*T*	*TR*
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)		*126*	*9*	*13*	*69*	
Peak-Hour Factor, PHF	*0.92*	*0.51*	*0.50*	*0.65*	*0.55*	*0.92*
Hourly Flow Rate, HFR (veh/h)	*0*	*247*	*18*	*20*	*125*	*0*
Percent Heavy Vehicles	*2*	*4*	*13*	*2*	*6*	*2*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration			*TR*	*LT*		

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*	*LT*					*TR*
v (veh/h)		*31*	*145*					*265*
C (m) (veh/h)		*1623*	*668*					*724*
v/c		*0.02*	*0.22*					*0.37*
95% queue length		*0.06*	*0.82*					*1.68*
Control Delay (s/veh)		*7.3*	*11.9*					*12.8*
LOS		*A*	*B*					*B*
Approach Delay (s/veh)	--	--	*11.9*			*12.8*		
Approach LOS	--	--	*B*			*B*		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*JMS*
Agency/Co.	*Olsson Associates*
Date Performed	*12/11/2013*
Analysis Time Period	*7:30 am*

Site Information

Intersection	*Naismith Dr & 21st St*
Jurisdiction	*City of Lawrence*
Analysis Year	*Existing + Bus + Cut-Thru 2014*

Project Description *013-0542*

East/West Street: *21st Street* | North/South Street: *Naismith Drive*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*14*	*287*	*56*			
Peak-Hour Factor, PHF	*0.54*	*0.78*	*0.44*	*0.92*	*0.92*	*0.92*
Hourly Flow Rate, HFR (veh/h)	*25*	*367*	*127*	*0*	*0*	*0*
Percent Heavy Vehicles	*9*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*1*	*2*	*0*	*0*	*0*	*0*
Configuration	*L*	*T*	*TR*			
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*17*	*122*			*68*	*25*
Peak-Hour Factor, PHF	*0.80*	*0.51*	*0.92*	*0.92*	*0.55*	*0.57*
Hourly Flow Rate, HFR (veh/h)	*21*	*239*	*0*	*0*	*123*	*43*
Percent Heavy Vehicles	*8*	*4*	*2*	*2*	*5*	*2*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration	*LT*					*TR*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*				*TR*	*LT*		
v (veh/h)	*25*				*166*	*260*		
C (m) (veh/h)	*1578*				*528*	*439*		
v/c	*0.02*				*0.31*	*0.59*		
95% queue length	*0.05*				*1.34*	*3.73*		
Control Delay (s/veh)	*7.3*				*14.9*	*24.4*		
LOS	*A*				*B*	*C*		
Approach Delay (s/veh)	--	--	*14.9*			*24.4*		
Approach LOS	--	--	*B*			*C*		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*JMS*
Agency/Co.	*Olsson Associates*
Date Performed	*12/10/2013*
Analysis Time Period	*5:00 pm*

Site Information

Intersection	*Naismith Dr & 21st St*
Jurisdiction	*City of Lawrence*
Analysis Year	*Existing + Bus + Cut-Thru 2014*

Project Description *013-0542*

East/West Street: *21st Street* | North/South Street: *Naismith Drive*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)				*13*	*437*	*23*
Peak-Hour Factor, PHF	*0.92*	*0.92*	*0.92*	*0.54*	*0.80*	*0.53*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*24*	*546*	*43*
Percent Heavy Vehicles	*2*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*1*	*2*	*0*
Configuration				*L*	*T*	*TR*
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)		*53*	*19*	*59*	*134*	
Peak-Hour Factor, PHF	*0.92*	*0.75*	*0.75*	*0.70*	*0.81*	*0.92*
Hourly Flow Rate, HFR (veh/h)	*0*	*70*	*25*	*84*	*165*	*0*
Percent Heavy Vehicles	*2*	*10*	*7*	*2*	*4*	*2*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration			*TR*	*LT*		

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*	*LT*					*TR*
v (veh/h)		*24*	*249*					*95*
C (m) (veh/h)		*1623*	*416*					*445*
v/c		*0.01*	*0.60*					*0.21*
95% queue length		*0.05*	*3.79*					*0.80*
Control Delay (s/veh)		*7.3*	*25.7*					*15.3*
LOS		*A*	*D*					*C*
Approach Delay (s/veh)	--	--	*25.7*			*15.3*		
Approach LOS	--	--	*D*			*C*		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*JMS*
Agency/Co.	*Olsson Associates*
Date Performed	*12/10/2013*
Analysis Time Period	*5:00 pm*

Site Information

Intersection	*Naismith Dr & 21st St*
Jurisdiction	*City of Lawrence*
Analysis Year	*Existing + Bus + Cut-Thru 2014*

Project Description *013-0542*

East/West Street: *21st Street* | North/South Street: *Naismith Drive*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*44*	*282*	*17*			
Peak-Hour Factor, PHF	*0.89*	*0.90*	*0.61*	*0.92*	*0.92*	*0.92*
Hourly Flow Rate, HFR (veh/h)	*49*	*313*	*27*	*0*	*0*	*0*
Percent Heavy Vehicles	*4*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*1*	*2*	*0*	*0*	*0*	*0*
Configuration	*L*	*T*	*TR*			
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*9*	*57*			*149*	*13*
Peak-Hour Factor, PHF	*0.58*	*0.75*	*0.92*	*0.92*	*0.85*	*0.81*
Hourly Flow Rate, HFR (veh/h)	*15*	*76*	*0*	*0*	*175*	*16*
Percent Heavy Vehicles	*24*	*6*	*2*	*2*	*3*	*2*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration	*LT*					*TR*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*				*TR*	*LT*		
v (veh/h)	*49*				*191*	*91*		
C (m) (veh/h)	*1610*				*523*	*474*		
v/c	*0.03*				*0.37*	*0.19*		
95% queue length	*0.09*				*1.66*	*0.70*		
Control Delay (s/veh)	*7.3*				*15.8*	*14.4*		
LOS	*A*				*C*	*B*		
Approach Delay (s/veh)	--	--	*15.8*			*14.4*		
Approach LOS	--	--	*C*			*B*		

Cost Estimates of Proposed Improvements

ENGINEER'S ESTIMATE (CONSTRUCTION COSTS)

(Concept Level)

Client: City of Lawrence
Project: Lawrence Transit Center Location Analysis
Project Number: 013-0542
Date: 2/25/2014

	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST $	COST $
	EXISTING PLUS TRANSIT CENTER - 9TH ST & ROCKLEDGE ROAD				
	Replacing the pavement on 9th between Rockledge and Iowa as well as the N. leg of Rockledge in order to install a left turn lane				
1	Removal of Existing Structures	1	Lump Sum	$25,000.00	$25,000.00
2	Unclassified Excavation	5500	Cu. Yd.	$25.00	$137,500.00
3	Compaction of Earthwork (All types)	4000	Cu. Yd.	$18.00	$72,000.00
4	Fly Ash	385	Ton	$45.00	$17,325.00
5	Manipulation for Fly Ash Treated Subgrade (9")	6914	Sq. Yd.	$5.50	$38,027.00
6	Concrete Pavement (8")(NRDJ)	5775	Sq. Yd.	$80.00	$462,000.00
7	Concrete Driveway (6")	561	Sq. Yd.	$55.00	$30,855.00
8	Curb and Gutter Combined	3034	Lin. Ft.	$25.00	$75,850.00
9	Sidewalk Construction (4")	7951	Sq. Ft.	$5.00	$39,755.00
10	Sidewalk Ramp	25	Each	$2,500.00	$62,500.00
11	Inlet (Curb)(6'x4')(Complete)	10	Each	$5,000.00	$50,000.00
12	Inlet (Curb)(6'x6')(Complete)	4	Each	$6,500.00	$26,000.00
13	Junction Box (5'x5')(Complete)	4	Each	$5,000.00	$20,000.00
14	15" Storm Sewer (RCP Class III)	250	Lin. Ft.	$75.00	$18,750.00
15	24" Storm Sewer (RCP Class III)	470	Lin. Ft.	$110.00	$51,700.00
16	30" Storm Sewer (RCP Class III)	500	Lin. Ft.	$130.00	$65,000.00
17	36" Storm Sewer (RCP Class III)	500	Lin. Ft.	$165.00	$82,500.00
18	Modification of Storm Structure	4	Each	$2,500.00	$10,000.00
19	Sod	3700	Sq. Yd.	$4.50	$16,650.00
20	Pavement Marking & Signing	1	Lump Sum	$25,000.00	$25,000.00
21	Traffic Control	1	Lump Sum	$10,000.00	$10,000.00
22	Contractor Construction Staking	1	Lump Sum	$20,000.00	$20,000.00
23	Erosion Control	1	Lump Sum	$20,000.00	$20,000.00
			SUBTOTAL		**$1,376,412.00**
			CONTINGENCY	**25%**	**$344,103.00**
			OPINION OF PROBABLE COST		**$1,720,515.00**
	EXISTING PLUS TRANSIT CENTER - 21ST ST & IOWA STREET				
	Extend Westbound Left turn lane from 50' to 150' plus taper				
1	Removal of Existing Structures	1	Lump Sum	$2,000.00	$2,000.00
2	Unclassified Excavation	53	Cu. Yd.	$36.00	$1,908.00
3	Compaction of Earthwork (All types)	50.00	Cu. Yd.	$18.00	$900.00
4	Aggregate for base (AB-3)	66	Ton	$35.00	$2,310.00
5	Milling (2.5")	1042	Sq. Yd.	$2.50	$2,605.00
6	Asphalt Surface Course 2.5"	158	Ton	$70.00	$11,060.00
7	Concrete Pavement (7")	70	Sq. Yd.	$75.00	$5,250.00
8	Curb and Gutter Combined	318	Lin. Ft.	$25.00	$7,950.00
9	Pavement Marking	1	Lump Sum	$1,000.00	$1,000.00
10	Traffic Control	1	Lump Sum	$2,500.00	$2,500.00
11	Contractor Construction Staking	1	Lump Sum	$1,500.00	$1,500.00
12	Erosion Control	1	Lump Sum	$1,000.00	$1,000.00
			SUBTOTAL		**$39,983.00**
			CONTINGENCY	**20%**	**$7,996.60**
			OPINION OF PROBABLE COST		**$47,979.60**

OLSSON ASSOCIATES

ENGINEER'S ESTIMATE (CONSTRUCTION COSTS)

(Concept Level)

Client: City of Lawrence
Project: Lawrence Transit Center Location Analysis
Project Number: 013-0542
Date: 2/25/2014

	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST $	COST $
	Add Left Turn Lane to the West Leg of 21st & Iowa				
1	Removal of Existing Structures	1	Lump Sum		
2	Unclassified Excavation	324	Cu. Yd.	$36.00	$11,664.00
3	Compaction of Earthwork (All types)	324	Cu. Yd.	$18.00	$5,832.00
4	Aggregate for base (AB-3)	167	Ton	$35.00	$5,845.00
5	Milling (2.5")	758	Sq. Yd.	$2.50	$1,895.00
6	Asphalt Surface Course 2.5"	147	Ton	$70.00	$10,290.00
7	Concrete Pavement (7")	292	Sq. Yd.	$75.00	$21,900.00
8	Curb and Gutter Combined	546	Lin. Ft.	$25.00	$13,650.00
9	Sidewalk Construction (4")	100	Sq. Ft.	$5.00	$500.00
10	Sidewalk Ramp	2	Each	$2,500.00	$5,000.00
11	Pavement Marking	1	Lump Sum	$1,500.00	$1,500.00
12	Traffic Control	1	Lump Sum	$1,000.00	$1,000.00
13	Contractor Construction Staking	1	Lump Sum	$1,500.00	$1,500.00
14	Erosion Control	1	Lump Sum	$1,500.00	$1,500.00
			SUBTOTAL		**$82,076.00**
			CONTINGENCY	**20%**	**$16,415.20**
			OPINION OF PROBABLE COST		**$98,491.20**
	Add NB Right Turn Lane to 21st & Iowa				
1	Removal of Existing Structures	1	Lump Sum	$1,000.00	$1,000.00
2	Unclassified Excavation	327	Cu. Yd.	$36.00	$11,772.00
3	Compaction of Earthwork (All types)	300	Cu. Yd.	$18.00	$5,400.00
4	Aggregate for base (AB-3)	163	Ton	$35.00	$5,705.00
6	Asphalt Surface Course 2.5"	50	Ton	$70.00	$3,500.00
7	Concrete Pavement (7")	356	Sq. Yd.	$75.00	$26,700.00
8	Curb and Gutter Combined	327	Lin. Ft.	$25.00	$8,175.00
9	Sidewalk Construction (4")	1465	Sq. Ft.	$5.00	$7,325.00
10	Sidewalk Ramp	1	Each	$2,500.00	$2,500.00
11	Inlet (Curb)(6'x4')(Complete)	2	Each	$5,000.00	$10,000.00
12	18" Storm Sewer (RCP Class III)	20	Lin. Ft.	$90.00	$1,800.00
13	Modification of Storm Structure	2	Each	$2,500.00	$5,000.00
14	Pavement Marking	1	Lump Sum	$500.00	$500.00
15	Traffic Control	1	Lump Sum	$1,000.00	$1,000.00
16	Contractor Construction Staking	1	Lump Sum	$1,000.00	$1,000.00
17	Erosion Control	1	Lump Sum	$1,500.00	$1,500.00
			SUBTOTAL		**$92,877.00**
			CONTINGENCY	**20%**	**$18,575.40**
			OPINION OF PROBABLE COST		**$111,452.40**

ENGINEER'S ESTIMATE (CONSTRUCTION COSTS)

(Concept Level)

Client: City of Lawrence
Project: Lawrence Transit Center Location Analysis
Project Number: 013-0542
Date: 2/25/2014

	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST $	COST $
	Replace W. 21st St. from Iowa to Stewart and Stewart St from 21st St. to North Transit Center Entrance				
1	Removal of Existing Structures	1	Lump Sum	$5,000.00	$5,000.00
2	Unclassified Excavation	3266	Cu. Yd.	$25.00	$81,650.00
3	Compaction of Earthwork (All types)	980	Cu. Yd.	$18.00	$17,640.00
4	Fly Ash	182	Ton	$45.00	$8,190.00
5	Manipulation for Fly Ash Treated Subgrade (9")	3266	Sq. Yd.	$5.50	$17,963.00
6	Concrete Pavement (8")(NRDJ)	1870	Sq. Yd.	$80.00	$149,600.00
7	Concrete Driveway (6")	97	Sq. Yd.	$55.00	$5,335.00
8	Curb and Gutter Combined	1673	Lin. Ft.	$25.00	$41,825.00
9	Sidewalk Construction (4")	5269	Sq. Ft.	$5.00	$26,345.00
10	Sidewalk Ramp	8	Each	$2,500.00	$20,000.00
11	Inlet (Curb)(6'x4')(Complete)	6	Each	$5,000.00	$30,000.00
12	18" Storm Sewer (RCP Class III)	100	Lin. Ft.	$90.00	$9,000.00
13	24" Storm Sewer (RCP Class III)	680	Lin. Ft.	$110.00	$74,800.00
14	30" Storm Sewer (RCP Class III)	30	Lin. Ft.	$130.00	$3,900.00
15	Modification of Storm Structure	1	Each	$2,500.00	$2,500.00
16	Sod	1900	Sq. Yd.	$4.50	$8,550.00
17	Pavement Marking	1	Lump Sum	$2,000.00	$2,000.00
18	Traffic Control	1	Lump Sum	$10,000.00	$10,000.00
19	Contractor Construction Staking	1	Lump Sum	$2,500.00	$2,500.00
20	Erosion Control	1	Lump Sum	$5,000.00	$5,000.00
			SUBTOTAL		**$521,798.00**
			CONTINGENCY	**25%**	**$130,449.50**
			OPINION OF PROBABLE COST		**$652,247.50**
	Install Traffic Signal at 21st St. & Iowa and Restripe the South Leg to Include a 150' Left-Turn Lane				
1	Traffic Signal and Pavement Markings	1	Lump Sum	$165,000.00	$165,000.00
			SUBTOTAL		**$165,000.00**
			CONTINGENCY	**20%**	**$33,000.00**
			OPINION OF PROBABLE COST		**$198,000.00**

The Engineer, using his or her professional judgment, has developed this stated Opinion of Probable Construction Cost based upon the design status identified above. Development of this Opinion has included consideration of design input level; however, the circumstances under which the work is expected to be undertaken, the cost and availability of materials, labor and services, probable bidder response and the economic conditions at the time of bid solicitation are beyond the control of the Engineer and will impact actual bid costs. Should bidding be delayed, these costs should be reviewed and, if necessary, adjusted to a more applicable *Engineering News Record* Construction Cost Index.

Geotechnical Memo

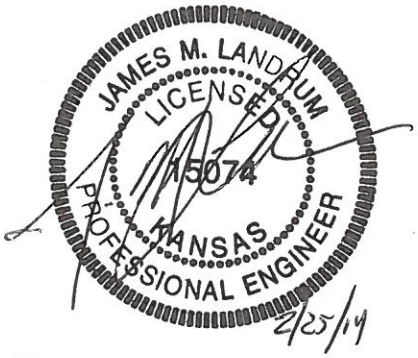
MEMORANDUM

OLSSON ASSOCIATES

1802 East 123rd Street · Olathe, Kansas 66061 · 913-829-0078

Date: February 25, 2014
To: Paul Moore, PE – Olsson Associates
From: Christy Wilson, EI – Olsson Associates
James Landrum, PE – Olsson Associates

Re: **Lawrence Transit Center Location Analysis**
Lawrence, Kansas
OA Project Number: 013-0542



In general accordance with our Agreement for Professional Services, ***Olsson Associates*** obtained seven pavement cores and associated subgrade samples for the referenced project. Three pavement cores were obtained at the West 9th Street and Rockledge Road location. Four pavement cores were obtained at the West 21st Street and Stewart Avenue location. The approximate core locations are shown on the attached core location maps. This memorandum discusses the conditions encountered at each location and provides our opinions about the existing pavement and recommendations for minimum pavement thicknesses.

Field Exploration

We obtained the pavement core samples at the locations shown using an electric core drill. We then used a thin walled tube pushed into the ground to obtain a soil subgrade sample at each core location. The pavement cores and soil samples were sealed and returned to the laboratory. The core locations were then backfilled and patched.

At our laboratory, we visually observed and photographed each core. Photographs are attached. Where possible, we performed moisture content, dry density and compressive strength tests on each subgrade sample. We also performed four Atterberg limit tests to aid in the classification of the soils.

Pavement/Subgrade Conditions

At both sites, the pavement consisted of 2.5 to 6 inches of Asphaltic Concrete (AC) underlain by 5 to 8 inches of Portland Cement Concrete (PCC). The pavement thicknesses are shown in Table 1. As seen in the attached photographs, portions of the pavement were degraded to an extent that it was not possible to obtain an exact measurement.

Figure 1: Pavement Conditions

Location		Total Thickness (in)	AC Thickness (in)	PCC Thickness (in)	Notes
9th Street	B-1	9	2.5	6.5	
	B-2	11	3	8	Portions of PCC were broken
	B-3	11	6	5	
21st Street	B-4	8.5	2.5	6	
	B-5	9.5	2.5	7	
	B-6	10.5	2.5	8	Portions of PCC were broken
	B-7	10.5	2.5	8	Portions of PCC were broken

The underlying subgrade consisted of firm to stiff, low to moderate plasticity clay soils mixed with variable sand, silt and gravel. Test results are provided in Table 2.

Figure 2: Subgrade Conditions

Location		Depth of Sample (ft)	Material	Moisture Content (%)	Dry Density (pcf)	Unconfined Strength (tsf)	Atterberg Limits (LL, PL, PI)
9th Street	B-1	0.8 – 1.8	Fill – Clay, gravel	19	106	2.0	24, 19, 5
	B-2	1.0 – 2.0	Fill – Clay, sand, silt, gravel	23	104	1.4	
	B-3	1.0 – 2.0	Fill – Clay, silt, gravel	28	103	1.8	35, 19, 16
21st Street	B-4	0.8 – 1.8	Fill – Clay, silt, gravel	25	104	0.9	
	B-5	0.8 – 2.0	Fill – Clay, sand, silt	20	112	--	27, 19, 8
	B-6	1.0 – 1.8	Fill – Sandstone, silt	13	--	--	
	B-7	1.0 – 2.0	Fill – Clay, weathered shale, sand, silt	28	100	--	42, 24, 18

Visual Reconnaissance

We visually observed the condition of the existing pavements at each location. The pavement surface appeared to be aged and was showing several signs of distress. The distresses we observed included reflective cracking, raveling, potholes and related fatigue (alligator) cracking.

We observed reflective cracking at both locations. This distress is caused by differential movement of the underlying Portland Cement Concrete (PCC) pavement resulting in the PCC joints to be transferred through to the surface of the Asphaltic Concrete (AC) pavement. These cracks allow water to infiltrate into the pavements and subgrade, and can lead to further deterioration and increased maintenance.

We also observed raveling at both locations, but it was more severe at the West 21st Street site. This type of distress causes the pavement surface to be worn away and aggregate particles to be dislodged resulting in loose debris on the pavement, roughness of the surface and ponded water in the raveled locations. Raveling at these locations was likely caused by the asphalt binder breaking down as the pavement ages resulting in a loss of bond between the binder and aggregate.

At both locations, we observed potholes and associated alligator, or fatigue cracking that was generally located in areas subjected to repeated traffic loadings. The alligator cracking consisted of moderate to severely interconnected cracks as shown in Figure 1.

Figure 1: Pothole

Pavement Considerations

At both locations, the pavement section currently consists of 2.5 to 6 inches of AC underlain by 5 to 8 inches of PCC. The core samples we obtained show that the PCC was weathered and broken. Reflective cracking was also occurring through the AC pavement at the joint locations. The AC pavement was generally aged and in poor condition. In our opinion, these pavement sections have deteriorated and should be replaced.

Following removal of the pavement, the exposed subgrade should be observed for signs of soft or disturbed areas. Proofrolling should be accomplished using a fully loaded, tandem-axle dump truck or other equipment providing an equivalent subgrade loading. Following proofrolling, the upper 9 inches of the exposed subgrade should be stabilized with Class "C" fly ash. The estimated required quantities are approximately 15 percent Class "C" fly ash based on dry unit weights.

Pavement Design

Table 3 shows the calculated ESAL units based on traffic data collected as a part of this project. The ESAL units are based on a 20 year design life, 2 percent growth, and a 9 inch thick fly ash stabilized soil subgrade.

Figure 3: Accumulated 20-year ESAL Units

Flexible	Rigid
2,500,000	2,400,000

Table 4 summarizes minimum pavement thicknesses for full-depth asphaltic concrete (AC) and Portland cement concrete (PCC) based on this design and traffic data. The AC pavement should be constructed with a minimum 2 inch thick surface course.

Figure 3: Minimum Pavement Thicknesses

Flexible	Rigid
10" Asphaltic Concrete 9" Fly Ash Treated Subgrade	8" Portland Cement Concrete 9" Fly Ash Treated Subgrade

In our opinion, PCC pavements perform better at intersections that are subject to stopping and turning traffic.

Limitations

The analysis presented in this memorandum is based on the data collected at the core locations. This memorandum does not reflect variations that could occur between the core locations or from the modifying effects of weather. The nature and extent of such variations may not become evident until construction. The memorandum also does not include either specifically or by implication any environmental, biological or archeological assessment of the site.

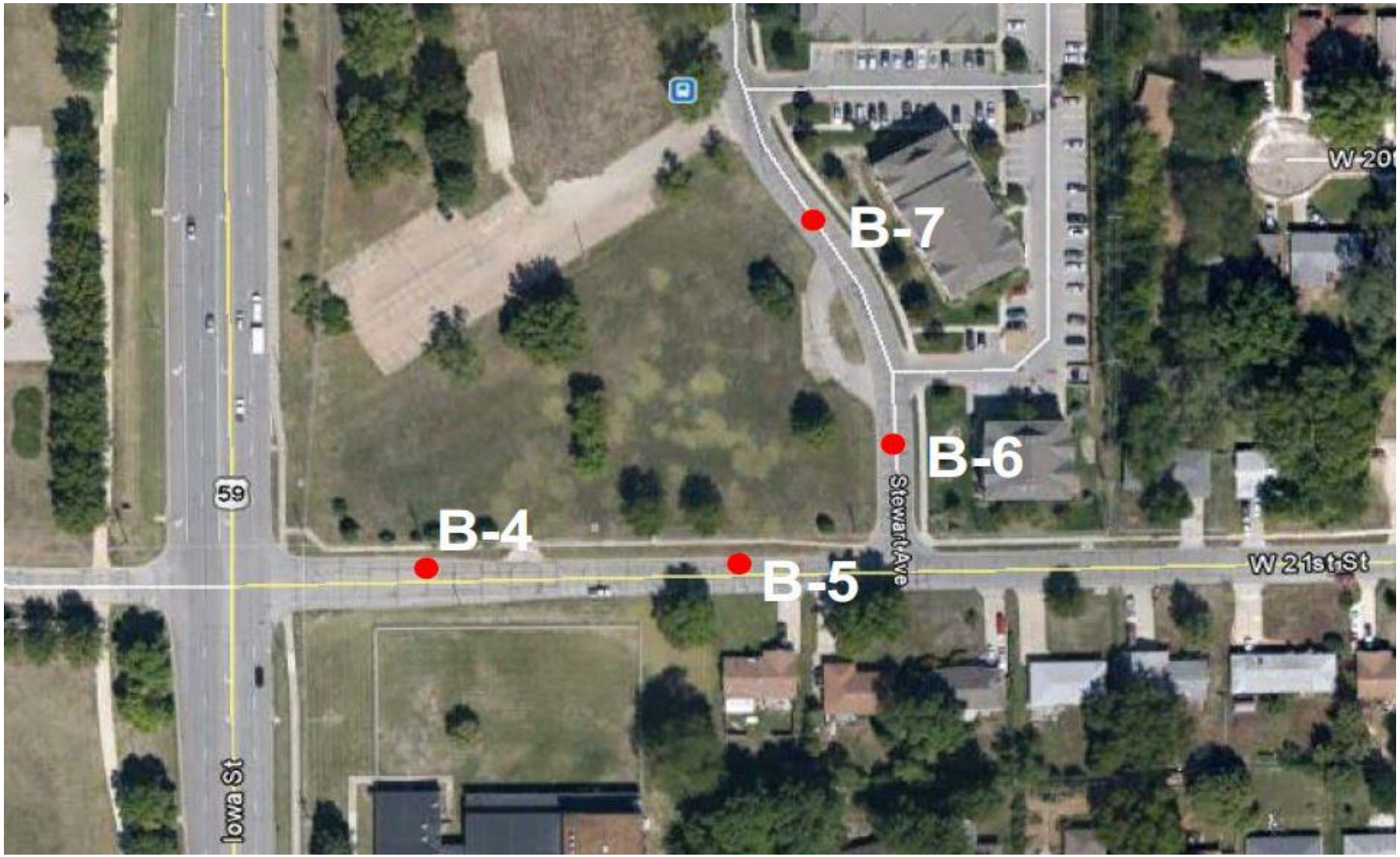
This memorandum has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, express or implied, are intended or made.

Core Location Map - West 9th Street

OLSSON ASSOCIATES

North

Scale: n.t.s.	**Lawrence Transit Center**
Project No. 013-0542	**Lawrence, Kansas**
Approved by: CLW	
Date: 2/19/14	



Core Location Map - West 21st Street

OLSSON ASSOCIATES

North

Scale: n.t.s.	**Lawrence Transit Center**
Project No. 013-0542	**Lawrence, Kansas**
Approved by: CLW	
Date: 2/19/14	

Pavement Core Photographs

OLSSON ASSOCIATES

Project No. 013-0542	
Approved by: CLW	
Date: 2/19/14	

Lawrence Transit Center - 9th Street

Lawrence, Kansas

Pavement Core Photographs

OLSSON ASSOCIATES

Project No. 013-0542	**Lawrence Transit Center - 21st Street**
Approved by: CLW	**Lawrence, Kansas**
Date: 2/19/14	

Pavement Core Photographs

OLSSON ASSOCIATES

Project No. 013-0542	
Approved by: CLW	
Date: 2/19/14	

Lawrence Transit Center - 21st Street

Lawrence, Kansas