Central High School Redevelopment Project

Draft Alternative Urban Areawide Review (AUAR)

February 2024

Prepared for:

RGU: City of Duluth

Prepared by:

Stantec Consulting Services Inc.
One Carlson Parkway, Suite 100
Plymouth, Minnesota 55426

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Mitigation Plan

Mitigation strategies are identified in each item of the AUAR.

Draft Alternative Urban Areawide Review (AUAR)

This most recent Environmental Assessment Worksheet (EAW) form and guidance documents are available at the Environmental Quality Board (EQB)'s website at**:** https://www.eqb.state.mn.us/ The EAW form provides information about a project that may have the potential for significant environmental effects. Guidance documents provide additional detail and links to resources for completing the EAW form.

Introduction

An Alternative Urban Areawide Review (AUAR) is an alternative to an Environmental Impact Statement (EIS) that responds to the items in the EAW form to the level of analysis similar to an EIS. Minnesota Rules Chapter 4410.3610, subp. 4 states that "the content and format [of an AUAR document] must be similar to that of an EAW but must provide for a level of analysis comparable to that of an EIS for impacts typical of urban residential, commercial warehousing, and light industrial development and associated infrastructure."

An AUAR consists of three steps: Scoping EAW, Draft AUAR and Final AUAR. A Draft AUAR Order and Scoping EAW was published in the EQB Monitor on December 5, 2023, initiating a 30-day comment period that concluded on January 4, 2024. Responses to comments received on the Scoping EAW were included in the Final AUAR Order adopted by the City of Duluth Planning Commission on January 9, 2024. Comments received were considered in the preparation of the Draft AUAR.

The EQB's revised EAW form (December 2022 version) was used as a basis for preparing this AUAR. The twenty-two items in the EAW form provide information about proposed development scenarios within the AUAR area, existing conditions, existing plans, anticipated impacts, and potential avoidance, minimization, and mitigation measures. The EQB's EAW and AUAR Guidelines provide additional details and resources for completing the EAW form for an AUAR and conducting the AUAR review process.

Cumulative potential effects are addressed collectively under EAW Item 21.

Note to reviewers: Comments must be submitted to the RGU during the 30-day comment period following notice of the Draft AUAR in the *EQB Monitor*. Pursuant to Minnesota Rules 4410.3610, Subpart 5, comments should address the accuracy and completeness of information, potential impacts that warrant further investigation, further information that may be required in order to secure permits for specific projects in the future, mitigation measures or procedures necessary to prevent significant environmental impacts within the AUAR area at the time the development occurs.

1. Project Title

Central High School Redevelopment Project

2. Proposer

Proposer:	City of Duluth, Department of Planning and Economic Development
Contact person:	Ryan Pervenanze
Title:	Manager of Planning and Development Division
Address:	City Hall Room 160, 411 W. First St.
City, State, ZIP:	Duluth, MN, 55802
Phone:	(218) 730 - 5580
Email:	rpervenanze@duluthmn.gov

3. Responsible Governmental Unit (RGU)

RGU Agency:	City of Duluth
Contact person:	Kyle Deming
Title:	Senior Planner
Address:	City Hall, Room 160, 411 W. First St.
City, State, ZIP:	Duluth, MN, 55802
Phone:	(218) 730 - 5580
Email:	kdeming@DuluthMN.gov

4. Reason for AUAR Preparation

Not applicable to an AUAR. Minnesota Rules 4410.3610, Subpart 1 allow for eligible projects to be reviewed through the AUAR procedures instead of the EAW and EIS procedures. Pursuant to Minnesota Rules Chapter 4410.3610, Subpart 5a additional procedures are required when certain large specific projects are reviewed. A Scoping EAW was prepared and noticed on December 5, 2023 in accordance with these procedures to guide this Draft AUAR. Minnesota Rules Chapter 4410.4300, Subpart 14 and Minnesota Rules 4410.4400, Subpart 11 pertain to Scenario A (Business Park). Minnesota Rules Chapter 4410.4300 Subpart 32 and 4410.4400 Subpart 21 pertain to the Scenario B (Mixed Use Scenario).

5. Project Location

County: St. Louis County

City/Township: City of Duluth

PLS Location (¼, ¼, Section, Township, Range): Township 50 North, Range 14 West, Section 21

Watershed (81 major watershed scale): St. Louis River and Lake Superior - South

GPS Coordinates: Latitude 46.796296, Longitude -92.115402

Tax Parcel Number: 010-0435-00030, 010-0435-00020, 010-2710-06240, 101-0435-00010 (part of), 010-2710-06180, 010-0435-00040, 010-2710-06185

At a minimum attach each of the following to the EAW:

- County map showing the general location of the project;
- U.S. Geological Survey 7.5 minute, 1:24,000 scale map indicating project boundaries (photocopy acceptable); and
- Site plans showing all significant project and natural features, pre-construction site plan and post-construction site plan.

- List of data sources, models, and other resources (from the Item-by-Item Guidance: *Climate Adaptation and Resilience* or other) used for information about current Minnesota climate trends and how climate change is anticipated to affect the general location of the project during the life of the project (as detailed below in Item 7. Climate Adaptation and Resilience).

6. Project Description

a. Provide the brief project summary to be published in the EQB Monitor, (approximately 50words).

The City of Duluth (City) is preparing an AUAR for an approximately 80-acre area on the site of the former Central High School near Central Entrance and H. Courtney Drive in the City of Duluth, St. Louis County, Minnesota. Two development scenarios will be evaluated as part of the AUAR which include a business park scenario consistent with the city's adopted Comprehensive Plan, and a mixed residential and commercial use scenario.

b. Give a complete description of the proposed project and related new construction, including infrastructure needs. If the project is an expansion include a description of the existing facility. Emphasize: 1) construction, operation methods and features that will cause physical manipulation of the environment or will produce wastes, 2) modifications to existing equipment or industrial processes, 3) significant demolition, removal or remodeling of existing structures, and 4) timing and duration of construction activities

Existing Conditions

The AUAR area encompasses approximately 80 acres of land on the site of the former Central High School near Central Entrance and H. Courtney Drive in the City of Duluth, St. Louis County, Minnesota. Figure 1 (United States Geological Survey (USGS) Topographic Map) and Figure 2 (Project Location Area Map) in Appendix A show the AUAR area. The AUAR area consists of the demolished Central High School building area and associated infrastructure including the Secondary Technical Center (STC) building, the former track field, tennis courts, parking lots, and road system serving the AUAR area.

The Duluth School District recently constructed a new District Service Center building and Transportation Building on the property adjacent to the northwestern boundary of the AUAR area along Portia Johnson Drive. The District Service Center consists of office and administrative uses. The Transportation Building includes bus storage, offices, a repair shop, and a bus wash bay. An existing building was also repurposed as a Facilities Building that includes offices, utilities shop, print shop, and storage.

Additionally, two broadcast towers are located in the southern portion of the AUAR area. Approximately 27 acres of wooded area exists within the AUAR area primarily along the northern, eastern, and southern edges of the AUAR area. Portions of both the Duluth Traverse and Central Entrance trails fall within the AUAR area.

Proposed Project

Following developer interest in the Central High School Redevelopment Site in summer 2023, the City of Duluth decided to conduct this AUAR to plan for future development and to evaluate environmental impacts for the maximum potential buildout of the AUAR area.

Proposed AUAR Development Scenarios

Two development scenarios were considered as part of the AUAR which include one scenario that is

consistent with the City's adopted Comprehensive Plan (Imagine Duluth 2035 – Forward Together[1]), and another scenario consisting of a mixed commercial and residential development pattern. The mixed use scenario is based on a potential development proposed by a private developer and incorporates elements that the City intends to pursue as part of the overall development of the AUAR area. The two development scenarios are further described below:

- Scenario A: Business Park Scenario

  The business park scenario would consist of approximately 360,000 square feet of light industrial/ warehouse distribution uses at full buildout, consistent with the City's future land use map in its adopted Comprehensive Plan. Surface parking would be included in this scenario, and the site would be accessed via the existing entrance at Central Entrance/Trunk Highway (TH) 194 and H. Courtney Drive. Future potential connections are shown including the extension of Portia Johnson Drive to a new entrance on Blackman Avenue to the west and a potential connection to Lake Avenue and the residential neighborhood to the southeast of the AUAR area.

  Both the Duluth Traverse and Central Entrance trails would remain within the AUAR area, although slight adjustments to alignment may be necessary depending on the future site layout. The scenario proposes that the existing broadcast towers would remain, as well as the approximately 27 acres of wooded area. Exhibit 1 depicts Development Scenario A.

- Scenario B: Mixed Use Scenario (Maximum Development)

  The mixed commercial and residential scenario (mixed use) were studied in this AUAR as the maximum development scenario. This scenario is intended to maximize development of the AUAR area and represents the "worst case scenario" for environmental impacts studied in the AUAR. The actual development, encompassing plans proposed by a private developer, may represent a modified version of this development scenario, which may include fewer residential units and less commercial development depending on market forces. The City of Duluth has also proposed elements within this scenario that were explored as part of the full buildout of the AUAR area, including additional connections to adjacent neighborhoods, open space and development of property owned by the school district within the AUAR area.

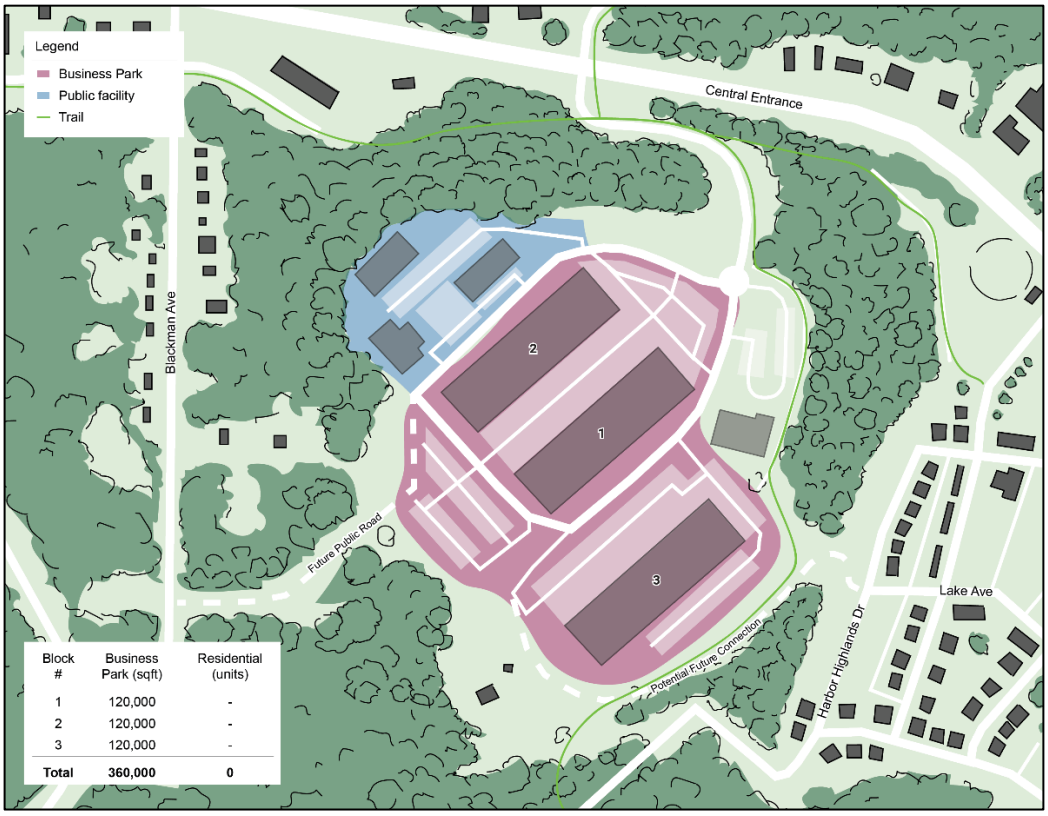
  At full buildout, the mixed use scenario would consist of 1,590 units of residential and 124,000 square feet of commercial development. Potential commercial uses considered in this AUAR include hotel, restaurant, pre-school, alternative school, and other neighborhood-serving commercial uses. Residential development is proposed to consist of a mix of densities including apartments and townhomes. The scenario would include a mix of surface and structured parking.

  The AUAR area would be accessed via the existing entrance at Central Entrance (TH 194)/H. Courtney Drive. Future potential connections are shown including the extension of Portia Johnson Drive to Blackman Avenue to the west and a potential connection to Lake Avenue and the residential neighborhood to the southeast of the AUAR area.

  Both the Duluth Traverse and Central Entrance trails would remain within the AUAR area, although slight adjustments to alignment may be necessary depending on the future site layout. This scenario proposes the addition of trailhead and a small park facility with restrooms. The scenario proposes that the existing broadcast towers would remain, as well as most of the approximately 27 acres of wooded area. Exhibit 2 depicts Development Scenario B.

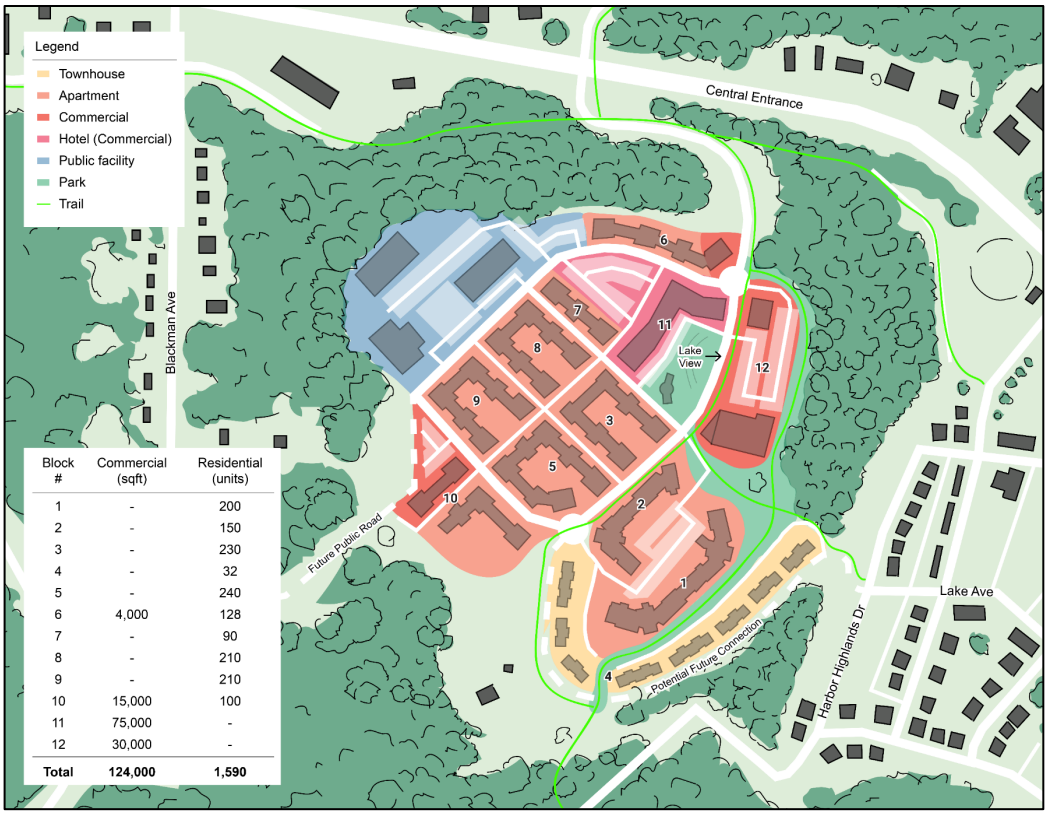
[1] City of Duluth. Imagine Duluth 2035 – Forward Together. Adopted June 25, 2018. https://duluthmn.gov/media/rtgk5tin/imagine-duluth-2035-combined_website_temp.pdf

Exhibit 1: Development Scenario A - Business Park



Block #	Business Park (sqft)	Residential (units)
1	120,000	-
2	120,000	-
3	120,000	-
Total	**360,000**	**0**

Exhibit 2: Development Scenario B – Mixed Use (Maximum Development)



Block #	Commercial (sqft)	Residential (units)
1	-	200
2	-	150
3	-	230
4	-	32
5	-	240
6	4,000	128
7	-	90
8	-	210
9	-	210
10	15,000	100
11	75,000	-
12	30,000	-
Total	**124,000**	**1,590**

1) *Construction, operation methods and features that will cause physical manipulation of the environment or will produce wastes*

Both Development Scenarios would include construction of new buildings and associated access roadways, parking areas and utility infrastructure improvements. In early phases of development, activities will primarily be redevelopment of previously developed land. In later phases, site preparation would include grading, excavation and vegetation removal. It is anticipated that full buildout of the AUAR area would include the construction of roadway connections to the west and southeast as described in the Development Scenario descriptions above. Much of the AUAR area was previously developed, but capacity of municipal sanitary sewer and water supply would need to be studied and potentially increased for later phases of development depending on the intensity of development. Stormwater infrastructure would be constructed to accommodate the increase in impervious surfaces.

2) *Modifications to existing equipment or industrial processes*

Not applicable – no planned modifications to existing equipment or industrial processes.

3) *Significant demolition, removal or remodeling of existing structures*

The former Central High School building has already been demolished to prepare the site for redevelopment. An existing 52,775 square foot building (referred to as the Secondary Technical Center building) within the AUAR area may be demolished or remodeled as part of the redevelopment project. Other existing structures include a small storage building near the former high school running track and the dugouts at the former ballfield will be demolished.

4) *Timing and duration of construction activities*

It is anticipated that construction on a first phase of the mixed use project may begin as early as 2024 with some utility and roadway installation to service a multi-family residential structure on the former football field. It is anticipated that full buildout of the AUAR area would occur over the course of several years. The timing of development would be driven by market conditions. For the purposes of analyses completed as part of the AUAR, it was assumed full buildout would occur by 2045.

c. **Project magnitude**

Table 1 summarizes the project magnitude.

Table 1. Project Magnitude

Description	Development Scenario A	Development Scenario B
Total Project Acreage	79.7	79.7
Linear project length	N/A	N/A
Number and type of residential units	N/A	1590 units of medium to high density housing (32 townhomes + 1558 apartments)
Residential building area (in square feet)	N/A	1,479,000
Commercial building area (in square feet)	N/A	124,000
Industrial building area (in square feet)	360,000	N/A
Institutional building area (in square feet)	N/A	N/A
Other uses – specify (in square feet)	N/A	N/A
Structure height(s)	1-story	7-story maximum

d. Explain the project purpose; if the project will be carried out by a governmental unit, explain the need for the project and identify its beneficiaries.

The purpose of completing this AUAR is to plan for and study the potential development of the AUAR study area. An AUAR is being conducted to study two development scenarios and intensities and to ensure that the environmental review incorporates the "worst case scenario" for full buildout of the AUAR area.

e. Are future stages of this development including development on any other property planned or likely to happen? **X Yes ☐ No**
If yes, briefly describe future stages, relationship to present project, timeline and plans for environmental review.

The purpose of this AUAR is to evaluate the full buildout of future potential development. It is anticipated that development would occur in phases based on market conditions. For the purposes of analyses completed as part of the AUAR, it was assumed full buildout would occur by 2045.

f. Is this project a subsequent stage of an earlier project? **☐ Yes X No**
If yes, briefly describe the past development, timeline and any past environmental review.

7. Climate Adaptation and Resilience

a. Describe the climate trends in the general location of the project (see guidance: Climate Adaptation and Resilience) and how climate change is anticipated to affect that location during the life of the project.

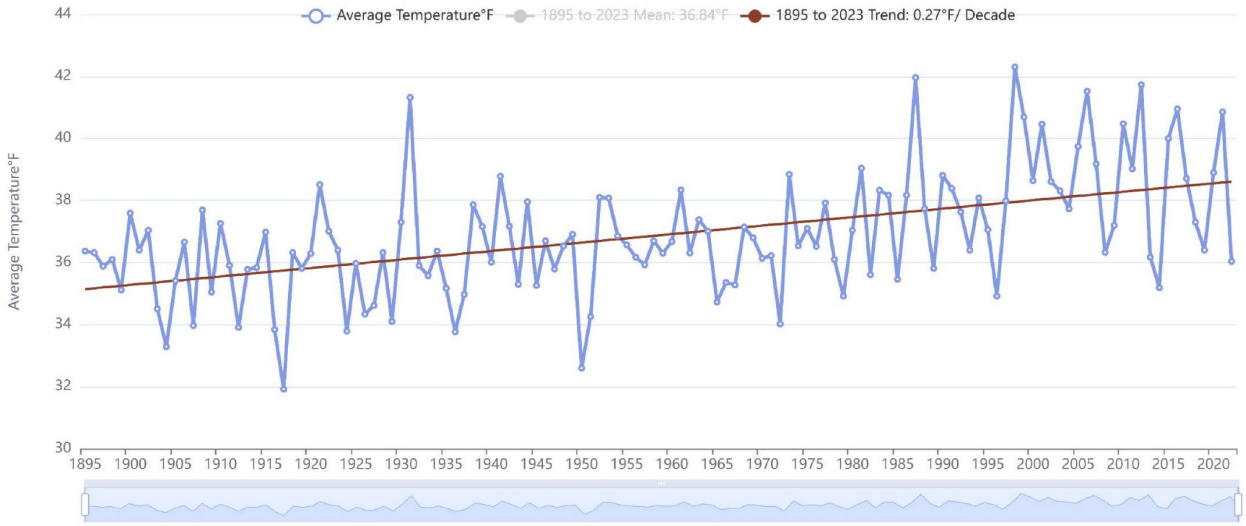
In general, Minnesota is anticipated to experience an increase in temperature, precipitation, and more frequent extreme precipitation events resulting from climate change. In Minnesota, annual average temperatures have risen two degrees over the past century and up to three degrees in the northern part of the state. The highest average temperature increases have occurred during the winter. Since 1895, temperatures during the winter have increased at a rate two to three times higher than during the summer. In particular, winter warming rates have risen more sharply in recent decades. [2] Current climate warming trends, most notably during the winter, are anticipated to continue.[3]

Heavy rain events have become more frequent in Minnesota and more intense. From 1973 to 2020, Minnesota experienced 17 mega-rain events[4] with a notable increase since 2000. Of these 17 events, three occurred in the 1970s, two in the 1980s, one in the 1990s, six mega-rain events occurred in the 2000s, four in the 2010s, and one in 2020. Thus, in the past 21 years (2000 to 2020), almost two times as many mega rain events occurred compared to the prior 27 years (1973 to 1999).[5]

Climate trends for St. Louis County parallel the overall statewide trends, indicating Minnesota's climate is becoming warmer and wetter. Exhibits 3 and 4 illustrate historical average annual temperature and precipitation trends from 1895 to 2023, respectively. During this time period, the County experienced an average annual temperature increase of 0.27 degrees Fahrenheit (°F) per decade and an annual precipitation increase of 0.20 inches per decade.

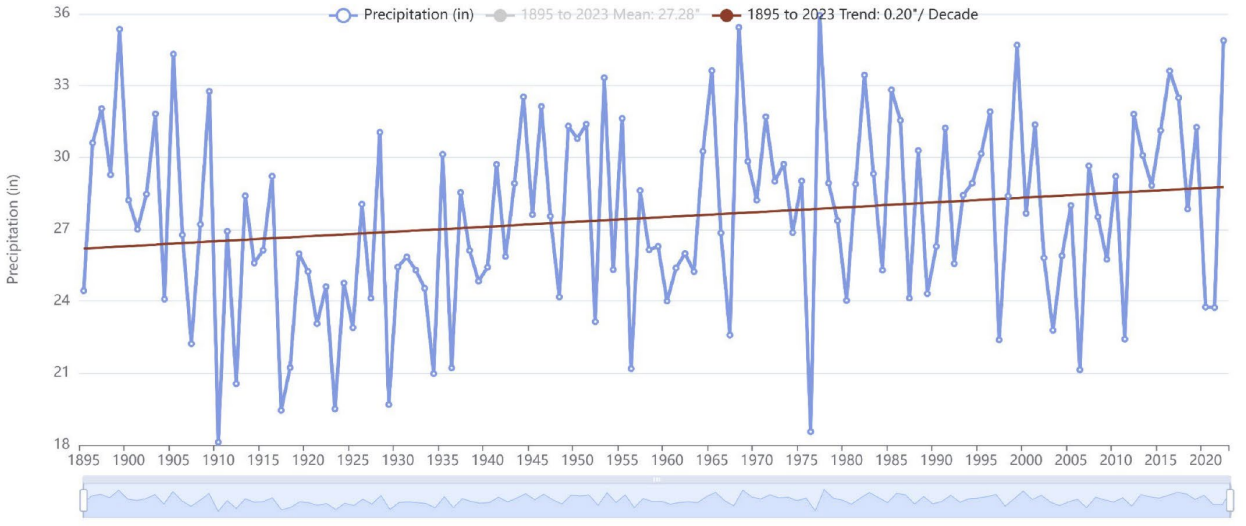
[2] DNR. Climate Trends. Accessed January 2024. https://www.dnr.state.mn.us/climate/climate_change_info/climate-trends.html
[3] MnDOT. Minnesota Go Climate Change Report. 2021. Accessed January 2024. https://www.minnesotago.org/trends/climate-change
[4] Mega-rain events are defined as events in which six inches of rain covers more than 1,000 square miles and the core of the event tops eight inches. Accessed January 2024. https://www.dnr.state.mn.us/climate/summaries_and_publications/mega_rain_events.html
[5] DNR. Historic Mega-Rain Events in Minnesota. Accessed January 2024. https://www.dnr.state.mn.us/climate/summaries_and_publications/mega_rain_events.html

Exhibit 3: Historical Annual Average Temperature in St. Louis County (1895 – 2023)



Source: Minnesota Department of Natural Resources.
https://arcgis.dnr.state.mn.us/ewr/climateexplorer/main/historical

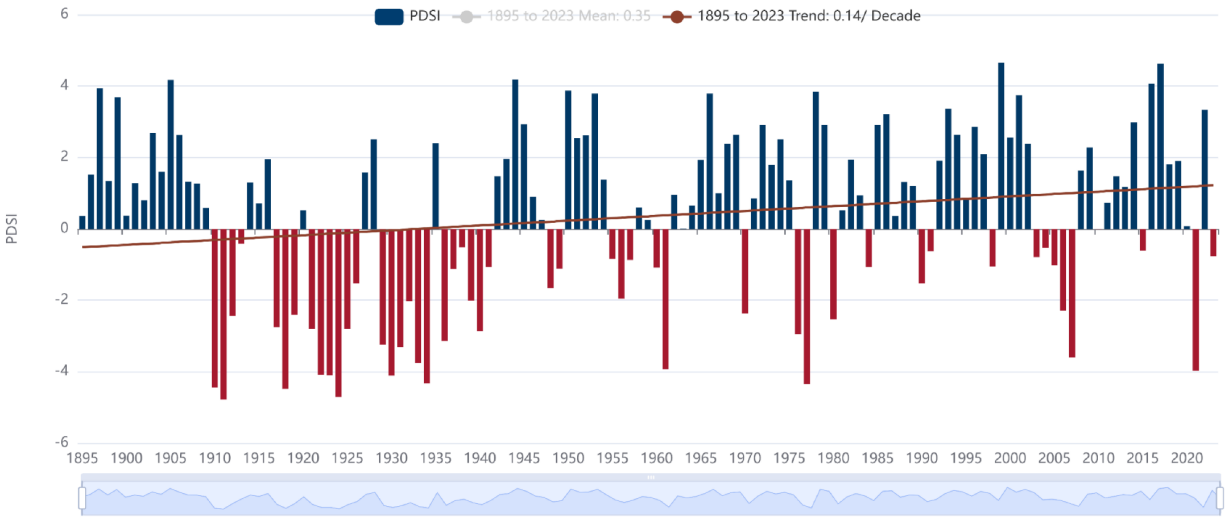
Exhibit 4: Historical Annual Average Precipitation in St. Louis County (1895 – 2023)



Source: Minnesota Department of Natural Resources.
https://arcgis.dnr.state.mn.us/ewr/climateexplorer/main/historical

The Palmer Drought Severity Index (PDSI) utilizes temperature and precipitation data to estimate relative soil moisture conditions and serves as an indicator of long-term drought conditions. The index ranges from -5 to +5 indicating dry and wet conditions, respectively. PDSI values are reported on a monthly basis. Exhibit 5 shows historic PDSI values for the month of August from 1895 to 2023 for St. Louis County, which indicates an increase of 0.14 per decade. Generally, the PDSI historical data indicates that the region is experiencing a wetter climate.

Exhibit 5: Historical PDSI Values for St. Louis County (1895 – 2023)

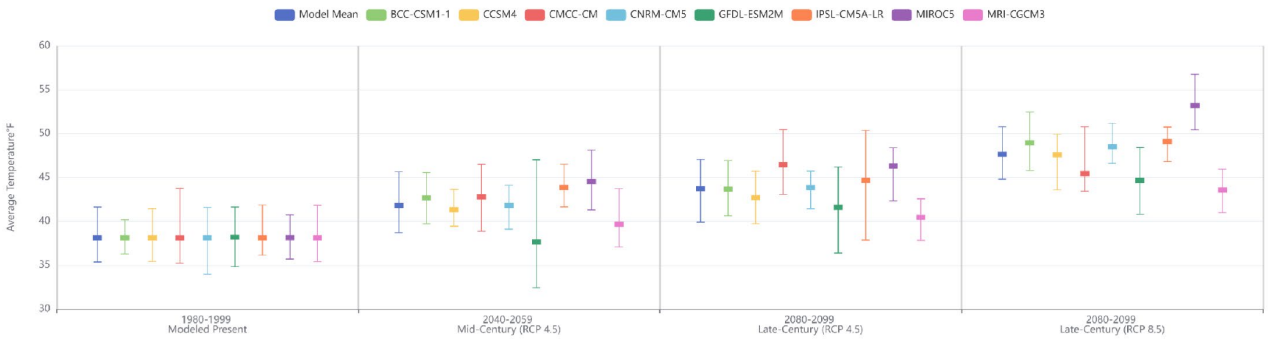


Source: Minnesota Department of Natural Resources.
https://arcgis.dnr.state.mn.us/ewr/climateexplorer/main/historical

Projected climate trends indicate that temperatures within the County will continue to increase. Exhibit 6 illustrates projected temperatures for the County. Several climate models are shown in the projected temperature analysis. The model mean, shown in blue, illustrates the average of all models included in the analysis. Exhibit 6 shows the modeled present condition, mid-century (2040-2059) at Representative Concentration Pathway (RCP) 4.5, late-century (2080-2099) at RCP 4.5, and late-century (2080-2099) at RCP 8.5. RCP is a greenhouse gas concentration scenario used by the Intergovernmental Panel on Climate Change in the fifth assessment report. RCP 4.5 is an intermediate scenario in which emissions decline after peaking around 2040 and RCP 8.5 represents a worst-case scenario in which emissions continue rising through the 21st century.

Under the RCP 4.5 scenario, the annual temperature is anticipated to increase within the County from a modeled present mean of 38.2°F (1980-1999) to a mid-century (2040-2059) model mean of 41.8°F and a late-century (2080-2099) model mean of 43.7°F. Under the RCP 8.5 worst-case scenario, the County would experience a late-century (2080-2099) model mean temperature of 47.6°F.

Exhibit 6: Projected Temperatures in St. Louis County

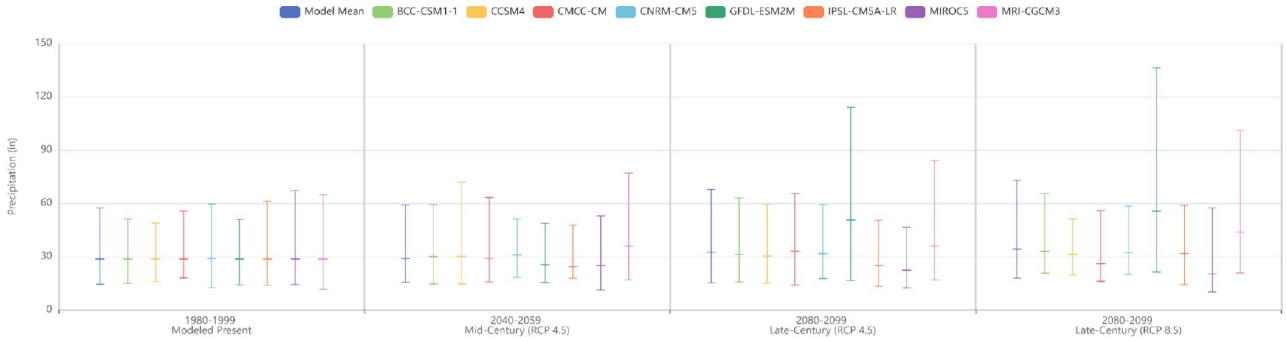


Source: Minnesota Department of Natural Resources.
https://arcgis.dnr.state.mn.us/ewr/climateexplorer/main/historical

Exhibit 7 presents projected average annual precipitation for St. Louis County. Under the RCP 4.5 scenario, the annual precipitation is anticipated to increase within the County from a modeled present

mean of 28.6 inches (1980-1999) to a mid-century (2040-2059) model mean of 28.8 inches and a late-century (2080-2099) model mean of 32.5 inches. Under the RCP 8.5 worst-case scenario, the County would experience a late-century (2080-2099) model mean precipitation of 34.2 inches. In comparison to the modeled present mean (1980-1999), the late-century (2080-2099) modeled mean annual precipitation would increase by approximately 1.4 percent under the RCP 4.5 scenario and increase by approximately 2 percent under the RCP 8.5 scenario.

Exhibit 7: Projected Precipitation in St. Louis County



Source: Minnesota Department of Natural Resources.
https://arcgis.dnr.state.mn.us/ewr/climateexplorer/main/historical

b. For each Resource Category in the table below: Describe how the project's proposed activities and how the project's design will interact with those climate trends. Describe proposed adaptations to address the project effects identified.

Table 2 summarizes climate considerations for the development scenarios, climate risks and vulnerabilities for proposed future development, and potential adaptations.

Table 2. Climate Considerations and Adaptations

Resource Category	Climate Considerations	Project Information	Adaptations
Project Design	Projected climate trends include increasing temperatures, precipitation, and frequency of heavy rainfall events. Minnesota is trending towards warmer temperatures. Urban heat islands occur when impervious surfaces, such as roofs and paved surfaces, absorb heat during the day and release it at night, amplifying the warming trend.	The AUAR studies two development scenarios. Scenario A is a business park consistent with the city's adopted Comprehensive Plan. Scenario B is a mixed residential and commercial use scenario. Buildings, roadways, and parking areas associated with either development scenario would increase impervious surfaces. Increased impervious surfaces would increase volume of stormwater runoff and potential flooding risk during heavy rain events.	Future projects will follow proposed and recommended actions based within the City of Duluth Population Vulnerability Assessment and Climate Adaptation Framework (2018) as well as the Climate Action Work Plan (2022). To mitigate anticipated projected temperature increases and local heat island effects, future projects should consider siting buildings to minimize loss of existing trees and natural areas within the AUAR area. Additional measures to minimize heat island effects may include strategically planting trees to increase shading near buildings to reduce energy use associated

Resource Category	Climate Considerations	Project Information	Adaptations
		Impervious surfaces may create local heat island effects by absorbing heat during daytimes hours and radiating it at night leading to an increase in surface temperatures.	with air conditioning and incorporating green building design features such as green roofs or cool roofs to reduce energy costs, GHG emissions, and improve stormwater runoff rates.
Land Use	Heavier rainfall expected to bring a higher risk of localized flooding. Increased temperatures may create public health crises primarily for the vulnerable communities such as children and the elderly.	The majority of the AUAR area currently consists of previously developed land, wooded/forest, and brush/grassland. Conversion from undeveloped land to developed land would increase impervious surfaces and may contribute to local heat island effects.	Scenario A does not propose critical facilities such as hospitals, daycare centers, public utilities, or schools within the AUAR area. Scenario B may potentially include a pre-school or alternative school. No other critical facilities are proposed under Scenario B. Future projects will evaluate measures to avoid and minimize impacts to existing wetlands within the AUAR area. Future projects may mitigate potential increased risk of flooding associated with a projected increase in heavy rainfall events by constructing green infrastructure features such as rain gardens, catch basins, and infiltration systems. Local heat island effects from adding impervious surface to the AUAR area may be mitigated by avoiding removal of existing tree canopy and the planting of new trees to increase shade in developed areas.
Water Resources	Addressed in item 12		
Contamination/ Hazardous Materials/Wastes	The AUAR area is projected to experience an increased in precipitation and heavy rainfall events, resulting in an increased risk of localized flooding.	Any potential light industrial uses (Scenario A) may require storage of hazardous materials and wastes. The projected increased flood risks and storm events pose a risk for the safe storage of these materials.	Increased precipitation may increase chance of localized flooding. However, given that the proposed development scenarios would be occur at high point at the top of a hill, it is anticipated that localized flooding risk is low. If future project proposes storage of hazardous materials and waste, proposers will need to implement safe storage measures in accordance with the Minnesota Pollution Control Agency (MPCA) and local regulations in place at the time that they are proposed to

Resource Category	Climate Considerations	Project Information	Adaptations
			prevent spills and releases of hazardous materials.
Fish, Wildlife, Plant Communities and Sensitive Ecological Resources	Addressed in item 14		

The City of Duluth adopted the Duluth Population Vulnerability Assessment and Climate Adaptation Framework in 2018, as well as a Climate Action Work Plan in 2022. Both of these documents identify strategies for reducing greenhouse gas (GHG) emissions and increasing resilience and adaptation to climate related threats. Strategies from these plans that could be incorporated into future development of the AUAR area are summarized below:

- Consider strategic tree planting for heat island mitigation.
- Consider porous paving, de-paving, vegetation and/or more reflective surfaces in parking areas to reduce and cool impervious surfaces.
- Design stormwater infrastructure on-site to accommodate anticipated future storm levels (further discussion of this in Item 12, Water Resources).
- Consider using sustainable building guidelines for development within the AUAR area.

8. Cover Types

Estimate the acreage of the site with each of the following cover types before and after development.

Table 3 identifies the existing and proposed cover types. Figure 3, Appendix A illustrates existing land cover.

Land cover in the AUAR area was determined based on the National Land Cover Database (NLCD) geospatial data accessed in October 2023. The majority of the AUAR area, 35 acres of the approximately 79.7 acres or 44 percent of the total AUAR area, is classified as grass/shrub. Table 4 and Table 5 summarizes estimated potential green infrastructure best management practices (BMPs) and tree canopy impacts, respectively.

Table 3. Cover Types

Cover Types	Before (approx. acres)	After (approx. acres)	
		Scenario A	Scenario B
Wetlands and shallow lakes (<2 meters deep) [1]	2.0	2.0	2.0
Deep lakes (>2 meters deep)	-	-	-
Wooded/forest	27.2	27.2	27.2
Rivers/streams[2]	-	-	-
Brush/grassland	34.1	-	-
Cropland	-	-	-
Livestock rangeland/pastureland	-	-	-
Lawn/landscaping	-	12.6	14.4
Green infrastructure TOTAL (from Table	-	2.9	2.8

Cover Types	Before (approx. acres)	After (approx. acres)	
		Scenario A	Scenario B
4 below*)[3]			
Impervious surface	15.9	34.8	33.1
Stormwater Pond (wet sedimentation basin)[4]	0.2	0.2	0.2
Other (bare soil)	0.3	-	-
TOTAL	**79.7**	**79.7**	**79.7**

Note the following features are not included in the NLCD geospatial data. Further quantification and review of cover types would be completed for the AUAR.

[1] Wetlands based on field delineation data and DNR NWI data.

[2] Clarkhouse Creek, while not captured, flows across the southern boundary of the AUAR area, south of the broadcast tower. There are approximately 500 feet of the creek within the AUAR area.

[3] Specific stormwater BMPs would be determined at the time that future projects area proposed and designed. It is assumed that green infrastructure features would be considered.

[4] A stormwater pond occurs approximately 0.1 mile south of Central Entrance on the west side of H. Courtney Drive, and a stormwater collection area occurs on the eastern portion of the AUAR study area, immediately west of Lake Avenue, that discharges to the storm sewer on Lake Avenue.

Table 4. Green Infrastructure

Green Infrastructure*	Before (acreage)	After (acreage)	
		Scenario A	Scenario B
Constructed infiltration systems (infiltration basins/infiltration trenches/ rainwater gardens/bioretention areas without underdrains/swales with impermeable check dams) [5]	-	2.9	2.8
Constructed tree trenches and tree boxes	-	-	-
Constructed wetlands	-	-	-
Constructed green roofs	-	-	-
Constructed permeable pavements	-	-	-
Other (describe) Landfill-based geothermal system	-	-	-
TOTAL*	**-**	**2.9**	**2.8**

[5] *As described in Item 12.b.ii, portions of the AUAR area includes soil types conducive for infiltration basin systems. It is anticipated that future development would consider infiltration basin system. Specific stormwater BMPs would be determined at the time that future projects are proposed and designed.*

Table 5. Tree Canopy

Trees	Scenario A		Scenario B	
	Percent	Number	Percent	Number
Percent tree canopy removed or number of mature trees removed during development	-	-	-	-
Number of new trees planted	-	-	-	-

The AUAR area is heavily wooded in some areas, much of which is undevelopable due to its slope and elevation. The AUAR proposes that the existing 27.2 acres of wooded/forest land within the AUAR area

would be preserved in both development scenarios. Additionally, City Code section 50-25.9 provides for the preservation and replacement of any trees removed during redevelopment of the AUAR area, should limited tree removal be necessary.

The number and percentage of new trees planted will be determined by the City's landscaping requirements in Article 4, Section 50-25 of the City's zoning code.

9. Permits and Approvals Required

List all known local, state and federal permits, approvals, certifications and financial assistance for the project. Include modifications of any existing permits, governmental review of plans and all direct and indirect forms of public financial assistance including bond guarantees, Tax Increment Financing and infrastructure. All of these final decisions are prohibited until all appropriate environmental review has been completed. See Minnesota Rules, Chapter 4410.3100.

Table 6 identifies permits and approvals anticipated to be required for the development scenarios.

Table 6. Permits and Approvals

Unit of Government	Type of Application	Status
Federal		
U.S. Army Corps of Engineers (USACE)	Section 404 Permit[1]	To be submitted, if required
U.S. Fish and Wildlife Service (USFWS)	Section 7 ESA Consultation[2]	To be completed, if required
State		
Minnesota Department of Transportation (MnDOT)	(e.g., Drainage Permit, Right-of-way permit for work within or affecting MnDOT right-of-way)	To be submitted, if required
Minnesota Department of Health (MDH)	Water Main Plan Review	To be submitted, if required
Minnesota Department of Natural Resources (DNR)	Temporary Water Appropriation Permit for construction dewatering	To be submitted, if required
DNR	Natural Heritage Information System (NHIS) concurrence	To be submitted, if required
MPCA	401 Water Quality Certification	To be submitted, if required
MPCA, City of Duluth	National Pollutant Discharge Elimination System (NPDES) MS4 Stormwater Discharge Permit, MS4 Statement of Compliance	To be submitted, if required
MPCA	Construction Site Stormwater Permit	To be submitted, if required
Local		
City of Duluth	Preliminary and Final Plat, Minor Subdivision, and/or a CIC (Common Interest Communities) Plat	To be submitted, if required
City of Duluth	Sign Permits	To be submitted, if required
City of Duluth	Certificate of Occupancy	To be submitted, if required
City of Duluth	Fill Permit	To be submitted, if required
City of Duluth	Erosion and Sediment Control Permits	To be submitted, if required
City of Duluth	Water and Sewer Main Extension Permits	To be submitted, if required
City of Duluth	Water and Sewer Connection Permits	To be submitted, if required

Unit of Government	Type of Application	Status
City of Duluth	Utility Easement Dedications	To be submitted, if required
City of Duluth	Building Permits	To be submitted, if required
City of Duluth	Blasting Permit/ Blasting Plan	To be submitted, if required
City of Duluth	Full Drainage Study	To be submitted, if required
City of Duluth/South St. Louis Soil and Water Conservation District	Wetland Conservation Act (Boundary Approval/Replacement Plan)[1]	To be submitted, if required

[1] The first phase of the project (Scenario B) is not anticipated to result in wetland impacts, therefore, wetland permitting and mitigation would not be required. If future development would result in wetland impacts, permitting and mitigation may be required.
[2] Section 7 ESA consultation would be required if future projects have a federal nexus.

10. Land use

a. Describe:

i. Existing land use of the site as well as areas adjacent to and near the site, including parks and open space, cemeteries, trails, prime or unique farmlands.

The majority of the AUAR area consists of previously developed land. The Central High School building has been removed, however, the parking lot, STC building, the football field, running track, adjacent storage structure, and dugouts remain. Northwest of the AUAR area, the Duluth School District owns a District Service Center building, Transportation Building, and Facilities Building. Portions of the Duluth Traverse and Central Entrance trails are within and adjacent to the AUAR area. The Duluth Traverse trail connects the AUAR area to Hilltop Park, approximately 0.5 miles southeast of the AUAR area. The AUAR area includes about 27 acres of wooded open space. Figure 4 in Appendix A shows the existing parks, trails and other recreational areas.

North: Central Entrance is directly north of the AUAR area. Several commercial businesses are located along the north side of Central Entrance as well as multi-family and detached residential areas and institutional uses, including Marshall School. Central Entrance Trail, a paved multi-use trail facility, runs along the northern boundary of the AUAR area on the south side of Central Entrance from Arlington Avenue/County State Aid Highway (CSAH) 90 to Village View Drive. This trail provides a connection to businesses along the Central Entrance corridor and intersects the Duluth Traverse trail. The Duluth Traverse, a multi-use natural surface trail facility, extends north-south through the AUAR area. The Duluth Traverse connects Chambers Grove Park, approximately 12 miles southwest of the AUAR area, to Lester Park, approximately six miles northeast of the AUAR area.

South: The land south of the AUAR area is an area platted for low-density residential development (Summit Park Division of Duluth). The area is largely undeveloped and heavily wooded. There are a few rural residential properties and several radio towers in the vicinity south of the AUAR area. Clarkhouse Creek and associated wetlands flow near the south AUAR boundary. The Duluth Traverse trail continues south of the AUAR area.

East: There is a medium density residential neighborhood east of the AUAR area which consists mostly of townhomes. Most of this neighborhood (Harbor Highlands) was developed as mixed-income rental housing and is owned by the Duluth Housing and Redevelopment Authority (HRA). These properties offer rental units at market rates, below-market rates, and income-based public housing rental rates. There are supportive community uses in the neighborhood including the Harbor Highlands Community Center (YMCA), Young Minds Learning Center and Highlands Park. South of this development are single-family homes.

West: The land west of the AUAR area consists of a strip of single-family detached residential homes along Blackman Avenue and a 200-unit apartment building. Additionally, there is a Tru by Hilton Hotel west of the AUAR area adjacent to Central Entrance.

There are no cemeteries or areas of prime or unique farmland within or near the AUAR area.

ii. Plans. Describe planned land use as identified in comprehensive plan (if available) and any other applicable plan for land use, water, or resources management by a local, regional, state, or federal agency.

The City's Comprehensive Plan (Imagine Duluth 2035), which was adopted in 2018, guides the AUAR area as business park, with areas near the edges guided open space, traditional neighborhood and urban residential. The Future Land Use map is shown in Appendix A, Figure 5. As required by MN Statute and EQB Guidelines, Scenario A reflects the Future Land Use in the City's Comprehensive Plan.

It should be noted that the Comprehensive Plan was developed in 2018, prior to the market disturbances caused by COVID, as well as the general trend toward smaller more consolidated office space. While Scenario A reflects the Comprehensive Plan, Scenario B is based on a potential development proposed by a private developer and incorporates elements that the City intends to pursue as part of the overall development of the AUAR area. Scenario B also reflects the MU-P (Mixed Use Planned) zoning of the AUAR area.

The City has also adopted several plans for open space including the most recent Essential Spaces: – Duluth Parks, Recreation, Open Space and Trails Plan, adopted in October 2022. This Plan builds on other planning efforts such as the Duluth Parks and Recreation Master Plan (2010) and Duluth Trail and Bikeway Plan (2011). These plans include goals and action items relevant to the AUAR area, including a priority to fill park system amenity gaps to enhance trails, trailheads, natural areas, and neighborhood connections to park spaces, supporting the commitment in the AUAR to retain both the Central Entrance and Duluth Traverse trails within the AUAR area (shown in Figure 4, Appendix A). Plans also support park system investments through either park dedication, in-lieu fees or public-private partnership, which could all provide additional and enhanced park space either within or nearby the AUAR area.

iii. Zoning, including special districts or overlays such as shoreland, floodplain, wild and scenic rivers, critical area, agricultural preserves, etc.

Land within the AUAR area is zoned MU-P (Mixed Use-Planned) and R-1 (Residential – Traditional). Regulations for this district are included in Article 2, Section 50-15.7 and Section 50-14.5, respectively, of the City's zoning code called the Unified Development Chapter (UDC). Additional regulations within the zoning code will apply including the Permitted Uses in Article 3 and Development Standards in Article 4.

Land adjacent to the AUAR area is zoned R-1, R-P, MU-I, MU-N, and MU-C. These zoning districts are regulated by Article 2, Sections 50.14-3, 50-14.7, 50-15.4, 50-15.2, and 50-15.3, as well as the permitted uses and development standards in Articles 3 and 4. Zoning within and adjacent to the AUAR area is mapped in Figure 6, Appendix A.

Pursuant to Section 50-18 of the City of Duluth Legislative Code, the requirements of the Natural Resources Overlay District would apply to wetland, floodplain, and shoreland areas. Item 12.b.iv identifies wetland resources within the AUAR area. Item 12.a.i identifies areas of regulated floodplain and floodway associated with Brewery Creek and Clarkhouse Creek in the northwestern and southwestern portions of the AUAR area, respectively. Appendix B provides the FEMA FIRMette for the AUAR area.

iv. If any critical facilities (i.e. facilities necessary for public health and safety, those storing hazardous materials, or those with housing occupants who may be insufficiently mobile) are proposed in floodplain areas and other areas identified as at risk for localized flooding, describe the risk potential considering changing precipitation and event intensity.

Development Scenario B proposes housing within the AUAR area. At this point there are no areas identified as floodplain or at risk for localized flooding. Climate and resilience measures will be incorporated in Project design within the AUAR area as discussed in Item 7, Table 2.

b. Discuss the project's compatibility with nearby land uses, zoning, and plans listed in Item 10a above, concentrating on implications for environmental effects.

Nearby Land Uses

Nearby land uses are discussed in Item 10a.i. and include residential, open space and commercial business along Central Entrance. With either Scenario A or B, City Code requirements will apply to mitigate any incompatibilities including requirements for screening, lighting, building façade, landscaping and tree preservation.

Zoning

Zoning of the AUAR area, discussed in Item 10a.iii. is compatible with Scenario B, mixed use. Zoning is not compatible with Scenario A, and would need to be adjusted should that be the preferred development scenario.

Plans

The Future Land Use of the AUAR area, discussed in Item 10a.ii. is compatible with Scenarios A and B.

c. Identify measures incorporated into the proposed project to mitigate any potential incompatibility as discussed in Item 10b above and any risk potential.

Specific mitigation measures are included in the list below. Major incompatibilities are not anticipated, as development scenarios would be either compatible with the City's Comprehensive Plan (Scenario A), or zoning (Scenario B) for the AUAR area.

Item 10 Mitigation Strategies

- Provide adequate screening to existing properties, especially residential uses to the east and west. Screening could include preservation of existing wooded areas.
- Retain Central Entrance and Duluth Traverse trails within the AUAR area. Minor rerouting may be necessary to accomplish this depending on specific development plans.
- Ensure that lighting, building form and façade, landscaping and tree preservation meet specifications in Article 4 of the City Code.

11. Geology, Soils and Topography/Land Forms

a. Geology - Describe the geology underlying the AUAR area and identify and map any susceptible geologic features such as sinkholes, shallow limestone formations, unconfined/shallow aquifers, or karst conditions. Discuss any limitations of these features for the project and any effects the project could have on these features. Identify any project designs or mitigation measures to address effects to geologic features.

The surficial deposits consist of a loamy glacial till. Glacial till deposits are typically unconsolidated

and poorly sorted and can be comprised predominantly of sand, silt, and clay, with pebble to boulder sized rocks scattered throughout. Figure 7 shows the surficial geology across the AUAR area, as described by the Minnesota Geologic Survey.[6]

The bedrock within the AUAR area consists of igneous rocks from the Keweenawan Supergroup and the Midcontinent Rift Intrusive Supersite, which are predominately gabbro, andesite, and undifferentiated basalt to basaltic andesite. The depth to bedrock identified by the MGS (2022) within the AUAR area is shown to be less than 50 feet below ground surface (bgs). Figure 8 shows the bedrock geology beneath the surficial deposits within the AUAR area, as described by the MGS (2022).

Figure 9 shows the location of wells within a one-quarter mile of the AUAR area identified by the Minnesota Department of Health (MDH) Minnesota Well Index (MWI) database.[7] Appendix C provides the well logs for wells shown on Figure 9. The well logs describe the surficial geology to be glacial till (predominately sandy clay, with some clay, silty sand, clayey sand, and gravel). Based on the well logs, the depth to bedrock is estimated between 4 to 24 feet below ground surface (bgs).

No susceptible geologic features such as sinkholes, shallow limestone formations, or karst conditions (formed from the dissolution of soluble carbonate rocks) were identified underlying the AUAR area.

The occurrence of groundwater in the AUAR area is cited within one-quarter mile radius in Item 12a. Based on the depth to bedrock (estimated between 4 to 24 feet bgs) and depth to groundwater (estimated between 10.5 to 36 feet bgs) in the area, it is anticipated that bedrock and/or groundwater could be encountered during construction.

b. Soils and topography - Describe the soils on the site, giving NRCS (SCS) classifications and descriptions, including limitations of soils. Describe topography, any special site conditions relating to erosion potential, soil stability or other soils limitations, such as steep slopes, highly permeable soils. Provide estimated volume and acreage of soil excavation and/or grading. Discuss impacts from project activities (distinguish between construction and operational activities) related to soils and topography. Identify measures during and after project construction to address soil limitations including stabilization, soil corrections or other measures. Erosion/sedimentation control related to stormwater runoff should be addressed in response to Item 12.b.ii.

Table 7 below describes the 2023 United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO) soil map units within the AUAR area.[8] Based on the SSURGO soils data, the AUAR area soils are expected to have shallow bedrock and large areas of disturbance related to previous development. The majority of the AUAR area (96 percent) is mapped as some mix of Urban Land, Rock Outcrop, Mesaba soil, and Barto soil. The "Urban Land" designation is used to indicate areas of urban development and disturbance. These areas are highly altered from their natural condition and typically feature soils impacted by cutting, grading, filling, compaction, and impervious cover. Rock Outcrop areas feature surficial (at or near surface) bedrock with little or no soil cover. Mesaba and Barto are glacial till soils formed in bedrock-controlled surfaces and feature approximately 12 to 30 inches of gravelly sandy loam or gravelly loam over bedrock. Figure 10, Appendix A illustrates soil classification types for the AUAR area.

[6] MGS, Geologic Atlas of St. Louis County, Minnesota, C-51, Bauer, E.J.; Jirsa, M.A.; Block, A.R.; Boerboom, T.J.; Chandler, V.M.; Peterson, D.M.; Wagner, K.G.; McDonald, J.M.; Dengler, E.L.; Meyer, G.N.; Hamilton, J.D. (Minnesota Geological Survey, 2022). Retrieved from the University of Minnesota Digital Conservancy, https://conservancy.umn.edu/handle/11299/254417.

[7] Minnesota Well Index, Minnesota Department of Health, Version 2.1.2. Accessed October 2023. https://mnwellindex.web.health.state.mn.us/

[8] 2023 Soil Survey Geographic Database. Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Accessed October 2023 via ESRI ArcGIS Online services.

Shallow bedrock, disturbed soils, gravelly soils, and steep slopes create risks for water erosion, sloughing, and overall soil stability. Area soils are expected to be significantly disturbed with potentially high gravel content and shallow bedrock. The AUAR area is situated on the summit and side slopes of a glacially-derived hill feature. Much of the summit and portions of the side slopes have been graded for the previous high school facility development. Slopes exceed 40 percent in some areas. Well construction logs, cited in Section 11a, identified bedrock within 4 to 24 feet of the surface near the southern base of AUAR area. Bedrock depth is likely shallower on the slopes and summit. Runoff rates may be high on steep slopes, previously disturbed areas, and areas of very shallow or exposed bedrock.

The majority of soils throughout the AUAR area have undergone past development, with most areas having received past cut-fill, grading and impervious surfaces which likely altered the characteristics beyond what can be interpreted from the SSURGO data. Non-disturbed areas of the AUAR area appear to have other limitations based on soil wetness, shallow bedrock, or other factors. Based on soil borings conducted by Braun Intertec Corporation in November 2023, fill soils are present throughout the majority of the AUAR area.

Table 7. USDA Soil Map Units Within the AUAR Area

Map Unit Symbol	Map Unit Name	Hydrologic Group	Wind Erodibility Group	K*f* (Water Erodibility factor)	Acres Within AUAR Area	% AUAR Area
F163D	Urban land-Mesaba-Rock outcrop complex, 1 to 18 percent slopes	*No rating*	*No rating*	0.36	41.45	52
F160F	Rock outcrop-Mesaba-Barto complex, 18 to 60 percent slopes	*No rating*	*No rating*	0.40	34.96	44
F137B	Normanna-Canosia-Hermantown complex, 0 to 8 percent slopes	B/D	5	0.43	1.81	2
F143A	Giese muck, depressional, 0 to 1 percent slopes	C/D	5	0.47	1.50	2
				TOTAL	**79.72**	**100.0**

The hydrologic soil groups are:

- **Group A**: Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
- **Group B**: Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained, or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
- **Group C**: Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
- **Group D**: Soils having a very slow infiltration rate (high runoff potential). These consist chiefly of soils with high clay content, soils that have a high-water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.
- **Dual Groups**: Dual Group designations (A/D, B/D, or C/D) are used to indicate naturally wet soils

that belong to Group D due to a high water table but would meet the drainage class or textural criteria for Group A, B, or C if drained. Dual Group soils should be treated as Group D soils in the absence of effective artificial drainage.

The soil erodibility factors are:

- **Wind Erodibility Group**: Soils are assigned a Wind Erodibility Group (WEG) rating based on their inherent vulnerability to soil particle detachment from wind forces. Values range from 1 (most erodible) to 8 (least erodible).

- **Water Erodibility Factor (K*f*)**: The Soil Erodibility Factor (K*f* or "rock free") is a unitless quantitative description of the inherent vulnerability of a soil to water erosion. It provides a measurement of soil particles' susceptibility to detachment from rain drops or surface runoff. Values range from 0.02 (least erodible) to 0.69 (most erodible). Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Item 11 *Mitigation Strategies*

Geology

- If groundwater dewatering is required during construction and expected to exceed 10,000 gallons per day or 1 million gallons per year, a temporary dewatering permit could be required by the DNR. Additionally, groundwater should be tested for contamination before dewatering activities begin. If the groundwater is found to be contaminated, state and local agency input would be required to select an appropriate discharge location and/or on-site treatment of contaminated water.

- If blasting is required to complete construction within the bedrock, a geotechnical review should be completed beforehand.

Soils/Topography/Erosion Control

- Land alteration and site restoration activities would be regulated by federal, state, and/or local rules. Based on soil survey data and overall site conditions, there are special concerns regarding erosion potential, steep slopes, soil stability, or highly permeable soils. Existing regulatory requirements, described below, will be sufficient to prevent groundwater contamination, excessive erosion, and excessive sediment migration.

- Site preparation and the subsequent development of individual sites would require a National Pollution Discharge Elimination System (NPDES) MS4 Stormwater Discharge Permit and Construction Stormwater permit for stormwater management associated with site grading and preparation. The permit is issued by the MPCA following U.S. Environmental Protection Agency (EPA) rules. The permit application includes a Stormwater Pollution Prevention Plan (SWPPP) with detailed erosion and sediment control plans for all aspects of the Project, including post-construction permanent stormwater management. Individual end users may also be required to obtain their own stormwater permits depending on the degree of land disturbance. The type of individual site development permit needed would depend on type of use. Certain industrial facilities require an Industrial Stormwater permit from MPCA, which could include ongoing monitoring and sampling to ensure pollutants (including sediment) do not exceed pre-determined thresholds.

- Site preparation and the subsequent development of individual sites would also require compliance with the following provisions set forth in the City of Duluth Legislative Code[9] Unified Development Chapter (City Code): Prior to site disturbance, the developer must obtain City permits appropriate

[9] City of Duluth. Legislative Code Unified Development Chapter. Accessed January 2024. https://library.municode.com/mn/duluth/codes/legislative_code?nodeId=Chapter%2050%20-%20Article%20I%20-%20General%20Provisions

for their proposed development. The City will require a detailed Geotechnical investigation to determine strength, stability, and bearing capacity of the site's soils to ensure that stability risks are accounted for in the civil design. The City will require a comprehensive Erosion & Sediment Control (ESC) plan and stormwater management plan. The City will apply post-construction stormwater performance standards meant to limit the quality, rate, and volume of runoff leaving the site. The City may impose stricter controls than the MPCA permit conditions or City Code standards if deemed necessary by the City Engineer. The Code requires ongoing monitoring of ESC and stormwater management during and after construction. Responsibility for permanent maintenance and operations of the stormwater system will be determined during the permitting process.

The permit may require ongoing monitoring and reporting during construction. Post-construction monitoring may also be required. Erosion and sediment control practices must be maintained throughout construction and must be subject to both routine and storm-event inspections by the applicant. Regulatory representatives must be allowed on site to conduct their own inspections as deemed necessary by the regulatory authority.

12. Water Resources

a. Describe surface water and groundwater features on or near the site in a.i. and a.ii. below.

i. Surface water - lakes, streams, wetlands, intermittent channels, and county/judicial ditches. Include any special designations such as public waters, shoreland classification and floodway/floodplain, trout stream/lake, wildlife lakes, migratory waterfowl feeding/resting lake, and outstanding resource value water. Include the presence of aquatic invasive species and the water quality impairments or special designations listed on the current MPCA 303d Impaired Waters List that are within 1 mile of the project. Include DNR Public Waters Inventory number(s), if any.

Surface Waters

A review of DNR geospatial data determined that there are no lakes, state designated trout streams or lakes[10], wildlife lakes[11], migratory waterfowl feeding/resting lakes[12], or lakes of biological significance[13] within the AUAR area.

The City of Duluth Streams data set indicates that Clarkhouse Creek is located along the southern boundary of the AUAR area and flows east. Additionally, Brewery Creek is located north of the AUAR area and crosses the northwest corner of the AUAR area at the intersection of H. Courtney Drive and Central Entrance. Figure 11, Appendix A identifies surface waters in the vicinity of the AUAR area. Lake Superior, classified as a lake of outstanding biological significance, is located one mile southeast of the AUAR area.

DNR Public Waters

According to the DNR National Wetland Inventory (NWI) Wetland Finder[14] and geospatial data, no DNR Public Waters or Watercourses are located within the AUAR area.

Two DNR Public Waters and three DNR Public Watercourses are located within a mile of the AUAR area. Lake Superior, Public Water No. 69129101, is located approximately one mile southeast of

[10] DNR. 2020. State Designated Trout Streams, Minnesota. Available at: https://gisdata.mn.gov/dataset/env-trout-stream-designations. Accessed October 2023.
[11] DNR. 2016. Designated Wildlife Lakes. Available at: https://gisdata.mn.gov/dataset/env-designated-wildlife-lakes. Accessed October 2023.
[12] DNR. 2016. Migratory Waterfowl Feeding and Resting Areas. Available at: https://gisdata.mn.gov/dataset/env-migratory-waterfowl-areas. Accessed October 2023.
[13] DNR. 2020. Lakes of Biological Significance. Available at: https://gisdata.mn.gov/dataset/env-lakes-of-biological-significe. Accessed October 2023.
[14] DNR. 2022. NWI Wetland Finder. Available at: https://arcgis.dnr.state.mn.us/ewr/wetlandfinder/. Accessed October 2023.

the AUAR area, and Public Water Basin No. 69096702 is located approximately one mile to the south.

Buckingham Creek (S-002-000.5) and an unnamed creek tributary (S-002-000.5-002) is located approximately 0.7 miles southwest; Coffee Creek (S-002-000.7-002) and its small tributary (S-002-000.7.004) are located approximately 0.8 miles west; West Branch Chester Creek (S-003-010) is located approximately one mile northwest; and an unnamed tributary (S-003-006) of Chester Creek is located 0.8 miles northeast of the AUAR area. Figure 11, Appendix A identifies DNR Public Waters within and in close proximity to the AUAR area. All surface waters flow to Lake Superior, a State-designated Outstanding Resource Value Water.

Wetland Resources

The DNR National Wetland Inventory (NWI) geospatial data identifies a NWI wetland within the AUAR area. The wetland is comprised of a freshwater shrub-scrub (PSS1D) and freshwater emergent (PEM1D) wetland within one wetland complex, located in the southwestern corner of the AUAR area (Figure 12, Appendix A).

A wetland delineation (Figure 12, Appendix A) was conducted in June 2021 by WSP USA, Inc. and covered the majority of the AUAR area. A portion of the AUAR area not delineated at that time was the southcentral portion of the AUAR area around the broadcast towers. The 2021 delineation identified three wetlands: a Type 6 alder thicket wetland in the southwestern corner that corresponds with the shrub-scrub NWI wetland; a Type 6 shrub-scrub wetland located in the southeastern corner of the AUAR area; and a Type 2 fresh meadow wetland located midway along the eastern AUAR boundary. Total acreage of existing wetlands within the AUAR area is about 2 acres. Figure 12, Appendix A identifies wetland features within and in the vicinity of the AUAR area.

MPCA 303d Impaired Waters List

A review of the MPCA's 2022 Impaired Waters List[15] identified no impaired waters within the AUAR area. Lake Superior, Assessment Unit Identification (AUID) 16-0001-00, is located slightly over one mile southeast of the AUAR area and is impaired for aquatic consumption due to the presence of mercury (Hg) and polychlorinated biphenyls (PCB) in fish tissue (Figure 10, Appendix A). No Total Maximum Daily Load (TMDL) has been established for Lake Superior. Several aquatic invasive species (AIS) have been identified in Lake Superior and the St. Louis River (Lake Superior's largest tributary) including Eurasian watermilfoil, New Zealand mudsnail, round goby, ruffe, spiny waterflea, viral hemorrhagic septicemia (VHS), white perch and zebra mussels.[16] No other impaired waters were located within one mile of the AUAR area.

Floodway/Floodplain

The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) panel 2704210025C generated through the National Flood Hazard Layer (NFHL) mapping tool[17] indicates that the majority of the AUAR area is within Zone C, or an area of minimal flood hazard. A small area in the northwest corner of the AUAR area, covering the roadway of the main entrance to the AUAR area at intersection of H. Courtney Drive and Central Entrance, is within the regulated 500-year floodplain (0.2% annual chance of flooding) and floodway associated with Brewery Creek (Figure 10, Appendix A). A second area starting in the southwestern corner and running along the southern boundary of the AUAR area is located within a regulated 100- and 500-year floodplains (1 percent and 0.2 percent annual chance of flooding) and floodway associated with Clarkhouse Creek

[15] MPCA. 2022. Impaired Waters Viewer (IWAV). Available at: https://mpca.maps.arcgis.com/apps/webappviewer/index.html?id=fcfc5a12d2fd4b16bc95bb535d09ae82. Accessed October 2023.
[16] St. Louis County. 2023. County Land Explorer GIS Map. Available at: https://gis.stlouiscountymn.gov/landexplorer/xplorer (stlouiscountymn.gov). Accessed October 2023.
[17] FEMA. 2021. National Flood Hazard Layer FIRMette. Available at: https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd. Accessed October 2023.

and is located near the western entrance to the AUAR area. Appendix B provides the FEMA FIRMette for the AUAR area. The AUAR area is located on a hill and averages approximately 650-700 feet above the elevation of Lake Superior.

St. Louis County and FEMA are in the process of updating the FIRMs. Preliminary FIRMs have been prepared and are currently published for public review and comment. Once all comments and appeals have been addressed, the preliminary FIRMS will be adopted by FEMA and become effective, which is anticipated in 2024. Figure 10, Appendix A shows the preliminary FEMA regulated flood hazards areas.

Since the City of Duluth is an MS4 (municipal separate storm sewer), development within the AUAR area would require an Erosion and Sediment Control permit from the City of Duluth. As part of the permit, the AUAR area would be regularly inspected for compliance and may require an erosion control plan to minimize transport of sediment off-site.

The development scenarios are anticipated to avoid impacts to the preliminary FEMA floodways (1 percent and 0.2 percent annual chance flood elevations). If development were to be proposed within the regulated floodplain or floodway, the developer would be required to work with the City of Duluth fulfill required floodplain permitting and mitigation requirements.

ii. Groundwater – aquifers, springs, seeps. Include: 1) depth to groundwater; 2) if project is within a MDH wellhead protection area; 3) identification of any onsite and/or nearby wells, including unique numbers and well logs if available. If there are no wells known on site or nearby, explain the methodology used to determine this.

Based on a review of geospatial data from the Minnesota Department of Health (MDH), the AUAR area is not located within a Drinking Water Supply Management Area (DWSMA) or Wellhead Protection Area (WPA).[18,19] A review of the Minnesota Well Index database for the AUAR area identified no domestic water wells within the AUAR area.[20]

An environmental borehole (Unique Well ID No. 340357) was identified within the AUAR area. The location of the boring is shown on Figure 9. Table 7 shows the borehole was advanced to a depth of 20 feet below ground surface (bgs). The well log in Appendix C shows this well was sealed/ decommissioned in 2018 and groundwater was not reported.

Table 8. Verified Wells Within the AUAR Area

Well ID	Use Type	Location within AUAR Area	Depth (ft.)	Depth to Groundwater (ft.)
340357	Environmental Borehole	South	20	Not Reported

The underlying geology cited in Section 11a describes the occurrence of the surficial and bedrock geology at the Site.

The MWI database[1] was reviewed for adjacent properties located one-quarter mile radius from the AUAR area property boundary. Figure 9, Appendix A shows four domestic water wells and one

[18] Wellhead Protection Areas, Minnesota Department of Health. Accessed January 2024. https://gisdata.mn.gov/dataset/water-wellhead-protection-areas

[19] Drinking Water Supply Management Areas, Minnesota Department of Health, Accessed January 2024. https://gisdata.mn.gov/dataset/water-drinking-water-supply

[20] Minnesota Well Index, Minnesota Department of Health, Version 2.1.2. Accessed October 2023. https://mnwellindex.web.health.state.mn.us/.

monitor well within the radius from the property boundary.

The domestic water wells were advanced through the surficial glacial till deposits into the bedrock. The depths of the domestic water wells are between 189 and 405 feet below ground surface (bgs) as summarized on Table 9 and in Appendix C. The reported depth to groundwater ranged between 23 to 36 feet bgs as summarized on Table 9 and in Appendix C.

The monitor well was advanced into the surficial glacial till deposits. The depth of the monitoring well is 17.5 feet bgs as summarized on Table 9 and in Appendix C. The reported depth to groundwater is 10.5 feet bgs as summarized on Table 9 and in Appendix C.

Table 9. Verified Wells Adjacent to the AUAR Area

Well ID	Use Type	Location from AUAR Area	Depth (ft.)	Depth to Groundwater (ft.)
778106	Domestic	South	405	Not Reported
745808	Domestic	West	189	23
754614	Domestic	South	264	36
835884	Domestic	West	340	30
821830	Monitor Well	Northwest	17.5	10.5

Based on the reported depth to groundwater in the monitoring well within the surficial glacial deposits, groundwater in the area could be relatively shallow. If groundwater is encountered during construction, dewatering could be necessary.

b. Describe effects from project activities on water resources and measures to minimize or mitigate the effects in Item b.i. through Item b.iv. below.

i. Wastewater - For each of the following, describe the sources, quantities and composition of all sanitary, municipal/domestic and industrial wastewater produced or treated at the site.

1) ***If the wastewater discharge is to a publicly owned treatment facility, identify any pretreatment measures and the ability of the facility to handle the added water andwaste loadings, including any effects on, or required expansion of, municipal wastewater infrastructure.***

The Western Lake Superior Sanitary District (WLSSD) serves a 530-square mile area that includes 17 municipal customers, including the City of Duluth. A substantial portion of wastewater influent received by the WLSSD wastewater treatment facility (WWTF), approximately 50 to 60 percent, originates from industrial sources, including two large pulp and paper mills. WLSSD conveys and treats approximately 36 million gallons per day (MGD) of wastewater. The flow and peak flow design capacity of the WWTF is 48.4 MGD and 100 MGD, respectively.[21] The Total suspended solids (TSS) and biochemical oxygen demand (BOD) design capacity of the WWTF is 112,000 lbs. per day and 121,000 lbs. per day, respectively.

The City of Duluth owns, operates, and maintains 53 wastewater pumping stations including five storage facilities with a storage capacity of 14 million gallons. The City's sanitary sewer infrastructure system is comprised of approximately 440 miles of collection sewer interceptors.

[21] WLSSD. Draft Comprehensive Wastewater Plan. March 2023. Accessed January 2024. https://wlssd.com/wp-content/uploads/2022/12/2023-Comprehensive-Plan-Document-BOARD-DRAFT.pdf

Under existing conditions, the AUAR area is largely comprised of undeveloped, vacant land. Prior to closure of the Central High School in 2012, the AUAR included several school facilities that were connected to the City of Duluth's sanitary sewer collection system.

It is anticipated that the AUAR area would connect to the City of Duluth's sanitary sewer collection system at a location to be determined by the City. The connection point(s) would be selected based off available capacity and/or the feasibility to construct or improve downstream infrastructure to accommodate the additional flow.

Based on a preliminary assessment of the existing sanitary collection infrastructure, it is anticipated that wastewater generated by the proposed development would be conveyed to two potential connection points to the City's sanitary sewer system, an existing 8-inch to 18-inch pipe near Harbor Highlands Drive east of the AUAR area, and an existing 8-inch to 36-inch connection point near Central Entrance and H. Courtney Drive that parallels Brewery Creek and eventually runs down 4th Avenue East. The City's sanitary sewer model shows that connection point in Harbor Highlands Drive could accommodate between 201,000 and 357,000 gallons per day (GPD). The City is currently calibrating their model to determine the actual capacity of this connection point.

Two scenarios are proposed for the AUAR area. Scenario A proposes a business park and Scenario B consists of a mixed use (commercial and residential) development. Wastewater flow estimates were prepared for the full buildout of each scenario based on the estimated building square footages and number of housing units for the specified uses. Total wastewater flow was estimated to be 14,193 gallons per day (GPD) and 470,500 GPD for the full buildout of Scenario A and B, respectively.

The maximum flow from Scenario B (worst case scenario) exceeds the estimated capacity of the connection point in Harbor Highlands Drive. Therefore, the City has advised that sanitary sewer flows may need to be split between the two connection points described above. Additionally, connecting the AUAR area sanitary sewer flows to either connection may require improvements to the sewer collection infrastructure system such as replacement of sewer piping to expand pipe capacity. At the time that the proposed development approaches capacity of the existing sewer collection infrastructure system, the developer and the City of Duluth would determine the appropriate improvements needed to accommodate increased wastewater flows generated by development.

From the connection points, wastewater would be conveyed to the existing WWTF located at 2626 Courtland Street in the City of Duluth, approximately 2.5 miles southwest of the AUAR area. The WWTF is permitted by the MPCA to treat industrial and domestic wastewater prior to discharge into the St. Louis River.

The existing WWTF is permitted for an average wet weather design flow (AWWDF) of 48.4 MGD with a carbonaceous biological oxygen demand of 300 milligrams per liter (mg/L). According to the WLSSD Draft Comprehensive Wastewater Plan (March 2023), the projected 2042 annual average influent flow is 35.5 MGD, and the projected 2042 average daily loads of BOD and TSS are 59,860 lbs. per day and 57,888 lbs. per day, respectively. Therefore, the current WWTF would have sufficient capacity through the 2042 design period to treat the proposed wastewater flows from the AUAR area. This additional wastewater flow would then contribute an additional 745 lbs. per day of biochemical oxygen demand (BOD) and 824 lbs. per day of total suspended solids (TSS).

Any new sanitary sewer in the AUAR area would be constructed in accordance with City standards. The developer would be responsible for sanitary sewer connection fees related to

the proposed development, construction of local sewer components to serve the development, and MPCA/NPDES sanitary sewer extension permits.

2) ***If the wastewater discharge is to a subsurface sewage treatment systems (SSTS), describe the system used, the design flow, and suitability of site conditions for sucha system. If septic systems are part of the project, describe the availability of septage disposal options within the region to handle the ongoing amounts generated as a result of the project. Consider the effects of current Minnesota climate trends and anticipated changes in rainfall frequency, intensity and amount with this discussion.***

None of the wastewater generated from the AUAR area would discharge to a subsurface sewage treatment system (SSTS).

3) ***If the wastewater discharge is to surface water, identify the wastewater treatment methods and identify discharge points and proposed effluent limitations to mitigate impacts. Discuss any effects to surface or groundwater from wastewater discharges, taking into consideration how current Minnesota climate trends and anticipated climate change in the general location of the project may influence the effects.***

Wastewater conveyed and treated by WLSSD is ultimately discharged into the St. Louis River. WLSSD treatment system staff closely monitor effluent discharged to the St. Louis River to prevent pollution. The WLSSD laboratory conducts regular sampling of effluent to ensure compliance with all State and Federal water quality standards.

Climate Trends

Considering current and future climate trends, increasing temperatures and precipitation could have an impact on sewer infrastructure and operations by increasing pressure on the existing capacity of the wastewater treatment and conveyance system. More frequent mega-rain events have the potential to increase the frequency of sanitary sewer overflow (SSO) events. Additionally, increasing occurrences of precipitation and melting snow may result in increasing inflow and infiltration (I&I) sanitary sewer system issues. In general, climate trends may result in increasing challenges to wastewater infrastructure and operations.[22]

ii. Stormwater - Describe changes in surface hydrology resulting from change of land cover. Describe the routes and receiving water bodies for runoff from the project site (major downstream water bodies as well as the immediate receiving waters). Discuss environmental effects from stormwater discharges on receiving waters post construction including how the project will affect runoff volume, discharge rate and change in pollutants. Consider the effects of current Minnesota climate trends and anticipated changes in rainfall frequency, intensity and amount with this discussion. For projects requiring NPDES/SDS Construction Stormwater permit coverage, state the total number of acres that will be disturbed by the project and describe the stormwater pollution prevention plan (SWPPP), including specific best management practices to address soil erosion and sedimentation during and after project construction. Discuss permanent stormwater management plans, including methods of achieving volume reduction to restore or maintain the natural hydrology of the site using green infrastructure practices or other stormwater management practices. Identify any receiving waters that have construction-related water impairments or are classified as special as defined in the Construction Stormwater permit. Describe additional requirements for special and/or impaired waters.

[22] WLSSD. Draft Comprehensive Wastewater Plan. March 2023. Accessed January 2024. https://wlssd.com/wp-content/uploads/2022/12/2023-Comprehensive-Plan-Document-BOARD-DRAFT.pdf

Existing Conditions

Figure 11, Appendix A provides an overview of the AUAR area, water resources and drainage patterns. Stormwater generally flows in four directions in the AUAR area. The northeast corner (east of H. Courtney Dr.) flows overland to Central Entrance/TH 194 where it is captured by MnDOT's storm sewer system for the roadway. This MnDOT storm sewer discharges to Brewery Creek several blocks from the AUAR area. The east and southeast portion of the site discharges toward the Harbor Highlands neighborhood where it is captured by the City's storm sewer system and discharged to Clarkhouse Creek several blocks from the AUAR area. The southerly portion of the site flows directly to Clarkhouse Creek and wetlands associated with the creek. Parts of the northwesterly portions of the AUAR area are captured by the City's storm sewer system in Portia Johnson Drive and H. Courtney Drive and treated by a storm water detention basin before discharging to Brewery Creek.

Both Brewery and Clarkhouse Creek flow into conduits that date to the turn of the last century before discharging to Lake Superior (in the case of Brewery Creek) and the Duluth/Superior Harbor (in the case of Clarkhouse Creek. The last 4,300 feet of Brewery Creek conduit is buried and flows under homes, businesses, apartment buildings, and through the neighborhoods containing two hospitals. The last 3,000 feet of Clarkhouse Creek conduit is buried under 1st Avenue West and I-35, flowing through the heart of the downtown.

Two stormwater collection areas are denoted in Table 3 in Item 8, Cover Types.

Proposed Conditions

Two development scenarios are being considered as part of the AUAR. The scenarios would change the existing land use from vacant brush/grassland to either business park or mixed use as described in Item 6. Both scenarios assume public trail facilities would remain, along with roughly 28 acres of undeveloped forest and adjacent wetland. Scenario A is a Business Park which consists of approximately 360,000 square feet of light industrial warehouse space and associated parking. Scenario B (maximum development scenario) is a mixed use of residential and commercial property with associated parking. It is anticipated that stormwater management would be needed to meet temporary and permanent volume, rate control and water quality requirements associated with local (City) and State National Pollutant Discharge Elimination System (NPDES)/State Disposal System (SDS) Construction Stormwater permit stormwater requirements, including updates to any of the existing BMPs. Stormwater modeling would be conducted to determine the requirements and the BMP sizing to meet those requirements. As part of the modeling process, opportunities to incorporate climate change and resiliency would be performed. BMPs could include stormwater storage for rate control; infiltration, filtration, or bioretention for volume control and water quality treatment; rainwater/stormwater harvesting for reuse for volume control and water quality treatment as well as to reduce potable water demand; and temporary erosion and sediment control features such as vegetative restoration, storm drain inlet protection, construction entrance protection, and silt fence.

The tables below show requirements for new development and redevelopment. It is anticipated that the majority of the AUAR area would be considered redevelopment. Guidance from the City suggests that these requirements would be weighted for these types of development. The City has different requirements above and below the Bluff Line (Skyline Pkwy); the development is located above the Bluff Line and would need to follow those requirements as referenced below.

Rate Control

The City of Duluth has established rate control requirements that vary depending on whether the area is new- or re-development and whether the area is above or below the bluff line (Table 10). These rates are required to be met for all ATLAS 14 Type II storm events (Table 11). The City also requires rate calculations and modeling to consider:

- All impervious areas to be connected
- Curve numbers cannot be weighted unless approved by the City
- Flow cannot be diverted from one minor or major system to another minor or major system

Table 10. Storm Events and Precipitation Values for Rate Control Requirements

Development Type	Post-Development Peak Flow Rates at Each Discharge Point Shall Not Exceed
New Development	75% of predevelopment peak flow rates for 10 and 100 year events; and 90% of predevelopment peak flow rate for 2 year event
Redevelopment	Predevelopment peak flow rates for all storm events

Table 11. Storm Events and Precipitation Values for Rate Control Requirements

NOAA ATLAS-14 24-hour NRCS Type II Storm Event	Precipitation
2-Year	2.7 inches
10-Year	4.0 inches
100-Year	6.4 inches
100-year 10-day snow melt*	8.1 inches

** Frozen ground conditions*

Volume Management

The two regulatory bodies (City and MPCA) have different stormwater management requirements (Table 12). The AUAR assumes the development would meet the most stringent stormwater requirements set by the regulatory bodies. The AUAR area is almost entirely composed of well drained Mesaba-Rock Outcrop Complex soils; however, depth to bedrock for these soils is usually within 40 inches. The shallow bedrock may limit the application of infiltration practices because infiltration practices must be 3 feet above bedrock. The AUAR area would achieve City and MPCA water quality volume requirements using infiltration practices where feasible. The design of BMPs would need to meet the MPCA requirement of a maximum infiltration rate of 8.3 inches per hour.

Table 12. Volume Control

Regulatory Agency	Requirements
MPCA	One-inch times the sum of the new and fully reconstructed impervious surface.
City of Duluth	The volume of stormwater runoff discharged from a proposed project shall not exceed the pre-development site conditions

Water Quality Treatment

The City requires water quality treatment based on Total Suspended Solids (TSS) and Total Phosphorus (TP) removals in proposed conditions (Table 13). The City also requires at least ninety-five (95) percent of newly added impervious runoff to be directed to water quality treatment areas. If

it is impractical to direct 95 percent of the added impervious surface to water quality area, alternate methods may be used in combination so long as 95 percent is treated, and all peak flow requirements are fulfilled.

Table 13. Water Quality Treatment Requirements

Development Type	New and Existing Impervious Surface	Required Treatment
New Development	> 3,000 sq. ft.	No net increase of TSS/TP from predevelopment conditions.
Redevelopment	≥ 1 acre	50% TSS removal. No net increase in TP from pre-project condition.

Table 14 summarizes the developable area, impervious amount and stormwater management required to meet the MPCA volume requirement of 1-inch times the new and reconstructed impervious surface for each development scenario. Additional requirements may be necessary to meet City guidelines and would be considered during design.

Table 14. Stormwater Management Impervious Area and BMPs

Development Scenario	Area (acres)	Impervious Area (Acres)[1]	BMP (acre-feet)[2]
A – Business Park	80	34.8	2.90
B – Mixed Use	80	33.1	2.76

[1] Assumes impervious area based off SCS/NRCS TR-55 publication.

[2] Used 1-inch runoff times the impervious surface to determine required volume.

Climate Trends

Considering current and future climate trends, it is likely that the volume and frequency of large rainfall events will increase over time. This trend will be a necessary consideration when designing and implementing stormwater infrastructure and BMPs; including the need to review adjustments to comprehensive site plans during potential phases of construction. The stormwater management plan should be designed so that emergency overflows are routed away from adjacent development, especially openings of structures, allowing for continual access for emergency vehicles. Additionally, the overflow system should be designed to avoid directing or concentrating flows that negatively impact public infrastructure or natural resources. Maximizing green infrastructure should be considered during design. Additionally, the South Saint Louis Soil and Water Conservation District is developing their one watershed one plan, which may include goals the AUAR should consider when developing.

Chloride Management

The substantial increase in impervious area along with climate trends would increase the application of chloride within the AUAR area compared to existing conditions. Future proposed development should apply MPCA and local agency guidance, such as smart salting, to manage the increase in chloride.

iii. Water appropriation – Describe if the project proposes to appropriate surface or groundwater (including dewatering). Describe the source, quantity, duration, use and purpose of the water use and if a DNR water appropriation permit is required. Describe any well abandonment. If connecting to an existing municipal water supply, identify the wells to be used as a water source and any effects on, or required expansion of, municipal water infrastructure. Discuss environmental effects from water appropriation, including an assessment of the water resources available for appropriation. Discuss how the proposed water use is resilient in the event of changes in total precipitation, large precipitation events, drought, increased temperatures, variable surface water flows and elevations, and longer growing seasons. Identify any measures to avoid, minimize, or mitigate environmental effects from the water appropriation. Describe contingency plans should the appropriation volume increase beyond infrastructure capacity or water supply for the project diminish in quantity or quality, such as reuse of water, connections with another water source, or emergency connections.

No existing wells are present within the AUAR area as described in Item 12.a.ii. The AUAR area is connected to municipal water services. An existing water main extends to the AUAR area and includes an 8-inch high density polyethylene (HDPE) Water Main loop. The City of Duluth owns, operates, and maintains the Lakewood Water Treatment Plant which provides city water sourced from Lake Superior. The City also owns, operates, and maintains 15 water reservoirs. The water system is capable of providing a maximum of approximately 68 MGD or treated water. On average, the Lakewood Water Treatment Plant provides approximately 13 MGD of treated water.

It is estimated that Scenario A would create a water demand of 16,000 GPD and Scenario B would demand 518,000 GPD on an average day basis. -The AUAR area is served by the Woodland System with a water tower in the Woodland neighborhood near Mankato Street and Minneapolis Avenue.

Projected water demands for the area would be utilized in planning additional distribution infrastructure, if needed. Any new distribution infrastructure would be constructed in accordance with the City of Duluth's current Water Master Plan or Comprehensive Plan and according to the City's Engineering Guidelines.

Construction-related water appropriations within the AUAR area include the potential for construction dewatering. As described in Item 11.a, the depth to groundwater is estimated to be between 10.5 to 36 feet below ground surface. If dewatering is necessary for construction activities, a DNR Water Appropriation Permit would be required for any dewatering of volumes that meet or exceed 10,000 gallons per day or one million gallons per year.

Climate change trends may affect surface water and groundwater interactions that may lead to long-term uncertainty regarding surface and groundwater levels, aquifer recharge, and groundwater flow. This may result in impacts to groundwater supply availability, quality, and quantity. Surface and groundwater quantity is driven by the balance of atmospheric input from precipitation (recharge) and losses due to evapotranspiration.[23] Opportunities to utilize water efficient fixtures and equipment, along with water reuse and recycling measures should be considered at the time that a specific project is proposed to minimize water supply needs.

iv. Surface Waters

a) Wetlands - Describe any anticipated physical effects or alterations to wetland features such as draining, filling, permanent inundation, dredging and vegetative removal. Discuss direct and indirect environmental effects from physical modification of wetlands, including the anticipated effects that any proposed wetland alterations may

[23] DNR. *Climate's Impact on Water Availability*. Updated October 19, 2021 https://www.dnr.state.mn.us/climate/water_availability.html

have to the host watershed, taking into consideration how current Minnesota climate trends and anticipated climate change in the general location of the project may influence the effects. Identify measures to avoid (e.g., available alternatives that were considered), minimize, or mitigate environmental effects to wetlands. Discuss whether any required compensatory wetland mitigation for unavoidable wetland impacts will occur in the same minor or major watershed and identify those probable locations.

Impacts to wetlands are regulated by the Minnesota Wetland Conservation Act (WCA) and the U.S. Army Corps of Engineers (USACE) under Section 404 of the Clean Water Act. The City of Duluth is the WCA local governmental unit (LGU) for the AUAR area. If wetland impacts associated with future development of the AUAR area are unavoidable a wetland replacement plan would be required. The developer would be required to demonstrate avoidance and minimization of wetland impacts to the greatest practicable extent. The Board of Water and Soil Resources (BWSR), USACE, LGU, and other appropriate stakeholders would be consulted during this process. The AUAR area is located within Bank Service Area (BSA) 1. Purchase of wetland bank credits following siting priority requirements would be used to provide mitigation for any impacted wetlands.

Site plans would avoid wetland impacts where possible. The proposed development scenarios are anticipated to avoid direct impacts to both the NWI wetland features and the field-delineated wetlands. If future proposed development were to impact wetlands within the AUAR area, the developer would need to work with the City of Duluth, the WCA LGU. Per Section 50-18 (Natural Resources Overlay District) of the City of Duluth Legislative Code, future projects would be required to comply with the minimum building and impervious surface setbacks for General Development Waters and Natural Environmental Waters which would apply to Brewery Creek and Clarkhouse Creek, respectively.[24]

Climate trends in the AUAR area predict wetter, warmer climate, and more intense precipitation events. Wetlands are important natural features that attenuate and store runoff from precipitation events. In addition to maintaining wetlands within the AUAR area, the proposed development scenarios would incorporate stormwater features to mitigate the impacts of runoff from precipitation events on wetlands and other water features within the AUAR area.

b) Other surface waters- Describe any anticipated physical effects or alterations to surface water features (lakes, streams, ponds, intermittent channels, county/judicialditches) such as draining, filling, permanent inundation, dredging, diking, stream diversion, impoundment, aquatic plant removal and riparian alteration. Discuss direct and indirect environmental effects from physical modification of water features, taking into consideration how current Minnesota climate trends and anticipated climate change in the general location of the project may influence the effects. Identify measures to avoid, minimize, or mitigate environmental effects to surface water features, including in-water Best Management Practices that are proposed to avoid or minimize turbidity/ sedimentation while physically altering thewater features. Discuss how the project will change the number or type of watercraft on any water body, including current and projected watercraft usage.

Under the proposed development scenarios, physical effects or alterations to other surface water features are expected to be minimal. Brewery and Clarkhouse Creeks are located on the edges of the AUAR area, on the northwest and southwest, respectively. Future land use for the areas of streams within the AUAR area are proposed as Open Space and are proposed to remain in a natural area because of the presence of surface water features. The creeks are not anticipated to be impacted directly by development. City stormwater rules would require no

[24] City of Duluth. Legislative Code. Table 50-18.1.D-1: Minimum Shoreland Area Standards. December 2021. Article 2, Page 65. Accessed January 2024. https://duluthmn.gov/media/12567/nro-12-21.pdf

increase in flow rate or volume to these creeks or any storm sewer systems.

The AUAR area is within an area expected to experience warmer and wetter conditions, with more frequent intense precipitation events due to climate change. Runoff to surface water during intense precipitation events can cause water quality impacts; however, stormwater management features within the AUAR area would be required to mitigate impacts by slowing and reducing the amount of stormwater that flows offsite per City stormwater rules.

Construction and erosion control BMPs such as silt fence, sediment control logs, rock construction entrances, etc., would be used during construction to protect wetlands and other surface waters from runoff and sedimentation. Stormwater management would be designed to treat stormwater runoff and control runoff volume to minimize impacts to water resources and is further described section 12b.ii. above. The project is not anticipated to change the number or type of watercraft on any waterbodies.

Item 12 Mitigation Strategies

Groundwater

- Any wells encountered during construction of the AUAR area that are no longer in use (or are not planned to be used following completion of construction) are required to be sealed by a licensed well contractor according to Minnesota Well Code. Wells may be allowed to remain open if an annual Unused Well Permit is obtained and conditions of the permit are followed.

- Groundwater dewatering is cited in Item 11 as a mitigation strategy.

Wastewater

- Based on a preliminary assessment, it is anticipated that two potential connections points to the City's sewer collection infrastructure system may be necessary to accommodate wastewater generated by the development scenarios. Additionally, improvements to the sewer collection system may be required as development approaches full buildout and other surrounding development occurs which could constrain capacity of the system. Further analysis and/or downstream modeling should be performed at the time that capacity constraints are anticipated. Proposed developers should coordinate with the City of Duluth Public Works and Utilities Department and WLSSD as development is proposed to confirm the need for improvements to the City's sewer and WLSSD's collection infrastructure system.

Water Appropriation

- The DNR is the state permitting agency for water appropriations. Temporary dewatering that exceeds 10,000 gallons per day or 1,000,000 gallons per year would require a permit from the Minnesota DNR.

- If water utilized for dust control is taken from a river or stream, a DNR water appropriation permit would be required. Products containing chloride for dust suppression in areas draining to DNR Public Waters should be avoided.

- Water pressure boosting systems may be needed for buildings and should be confirmed as development is proposed.

Stormwater Management

- BMPs (e.g., silt fence, sediment control logs, etc.) will be utilized during construction to avoid and minimize turbidity, sedimentation, stormwater runoff, and other potential effects to surface waters in the vicinity of the AUAR area.

- Future development will be required to implement stormwater BMPs in compliance with the City of Duluth and MPCA regulations in place at the time that the project is proposed. Development within the AUAR area would be required to comply with the above the Bluff Line requirements. Future developments will require a City-approved stormwater management plan for each phase that, among other requirements, must show how projected water flows won't exceed the capacity of the downstream system.

- Additional BMPs may be required as part of the Construction Stormwater Permit given the AUAR area ultimately drains to Lake Superior. Specific BMPs requirements would be identified based on the specific conditions of future development and the regulations and requirements in place at the time that development is proposed.

- BMPs and wildlife-friendly erosion and sediment control devices shall be used during construction activities as required by the NPDES Permit, SWPPP, and Construction Site Stormwater Permit to prevent sediment-laden stormwater runoff from the AUAR area into receiving wetlands and waterbodies, which could adversely impact habitats of aquatic species.

- Future proposers should apply MPCA and the local agency guidance, such as smart salting, to manage the increase in chloride.

Wetland Resources/Surface Waters

- Wetland impacts are not anticipated under the proposed development scenarios. Measures to avoid and minimize impacts to wetlands would be required to be evaluated if wetlands were to be impacted.

- If future proposed development would result in wetland impacts, a wetland replacement and mitigation plan would be required in accordance with all regulations and requirements in place at the time of final design and permitting.

13. Contamination/Hazardous Materials/Wastes

a. Pre-project site conditions - Describe existing contamination or potential environmental hazards on or in close proximity to the project site such as soil or ground water contamination, abandoned dumps, closed landfills, existing or abandoned storage tanks, and hazardous liquid or gas pipelines. Discuss any potential environmental effects from pre-project site conditions that would be caused or exacerbated by project construction and operation. Identify measures to avoid, minimize or mitigate adverse effects from existing contamination or potential environmental hazards. Include development of a Contingency Plan or Response Action Plan.

The MPCA's What's In My Neighborhood (WIMN) online database was used to identify potentially contaminated sites within the AUAR area and within one-half mile of the AUAR area.[25] One site was identified within the AUAR area and 51 were identified with one-half mile of the AUAR area. These sites are identified in Table 15 and Figure 13, Appendix A.

[25] MPCA. *What's In My Neighborhood*. Accessed January 2024. https://www.pca.state.mn.us/about-mpca/whats-in-my-neighborhood

Table 15. MPCA WIMN Database Inquiry Results

Site ID	Site Name	MPCA Program	Status
Within the AUAR area			
12549	ISD 709 Central High School	• Hazardous Waste • Petroleum Remediation (2) • Underground Tanks	Active Inactive Active
Within One-Half Mile of the AUAR area			
250591	DSC/Transportation Buildings	• Construction Stormwater	Active
257104	Independent School District 709	• Construction Stormwater	Active
28037	ISD 709 Secondary Campus	• Hazardous Waste	Inactive
214756	Planned Parenthood – Duluth	• Hazardous Waste	Active
22640	Daniel J Loban DDS PA	• Hazardous Waste	Inactive
23093	Duluth Ready Mix Concrete Inc	• Hazardous Waste	Inactive
139395	Falks Pharmacies – Nursing	• Hazardous Waste	Active
25053	Dougherty Veterinary Clinic	• Hazardous Waste	Active
103341	Central High School Entrance Rd	• Construction Stormwater	Inactive
60647	Central High School Athletic Facilities	• Construction Stormwater	Inactive
225345	Tru by Hilton	• Construction Stormwater	Active
253411	Windwood Townhomes	• Construction Stormwater • Wastewater	Active
26021	Marshall School	• Hazardous Waste • Petroleum Remediation • Underground Tanks	Active Inactive Active
113450	Superior View Condominiums	• Underground Tanks	Active
186181	Superior Vista Condominiums	• Petroleum Remediation	Inactive
145168	Minnesota State Patrol - District 2700	• Hazardous Waste	Inactive
113155	Mn Dept Of Transportation	• Petroleum Remediation (3) • Aboveground Tanks • Underground Tanks	Inactive Active Active
255745	Skyridge Flats Senior Housing	• Construction Stormwater	Active
200765	First United Methodist Church	• Petroleum Remediation	Inactive
125804	Harbor Highlands Hope VI Revitalization	• Construction Stormwater	Active
253432	Arris Duluth	• Construction Stormwater	Active
190255	Ahlin Residence	• Petroleum Remediation	Inactive
23551	Exhaust Pros – Duluth	• Hazardous Waste • Brownfields • Petroleum Remediation (2) • Underground Tanks	Active Inactive Inactive/Active Inactive
196139	Dr. Maryland Office Building Property	• Brownfields	Inactive
24187	Vacant Lots	• Hazardous Waste	Inactive
23632	Gold Crown Service – Duluth	• Hazardous Waste	Inactive
112268	Formerly Central Cyles	• Petroleum Remediation • Underground Tanks	Inactive Inactive
108306	Vacant Lot	• Underground Tanks	Inactive
27507	First Photo – 326	• Hazardous Waste	Inactive

Site ID	Site Name	MPCA Program	Status
14412	Family Dollar Store 11002	• Hazardous Waste	Inactive
13647	Northtown Motors	• Hazardous Waste • Petroleum Remediation (2)	Inactive Inactive
94606	Checker Auto Parts 1878	• Hazardous Waste	Inactive
23636	All Tune & Lube – Duluth	• Hazardous Waste	Inactive
26453	Goodyear Tire & Gemini Automotive	• Hazardous Waste • Petroleum Remediation	Inactive Inactive
117438	Hayes Subaru	• Petroleum Remediation (2) • Aboveground Tanks • Underground Tanks	Inactive Active Active
23088	Duluth Heights Dental Office – 303	• Hazardous Waste	Inactive
107408	Central Entrance Ico	• Petroleum Remediation • Underground Tanks	Inactive Inactive
110255	AutoZone 3793	• Hazardous Waste • Petroleum Remediation	Active Inactive
25658	Highland Chateau	• Hazardous Waste • Underground Tanks	Inactive Active
145577	Solvay House	• Hazardous Waste	Active
251472	Essentia Health Amberwing	• Hazardous Waste	Active
139811	Amberwing Development	• Construction Stormwater	Inactive
36137	Atow Truck Auto Service	• Hazardous Waste	Inactive
148048	Central Entrance Short Stop	• Underground Tanks	Active
190695	Como Oil Co	• Petroleum Remediation	Inactive
157504	Residence - 24 & 30 E 9th St	• Hazardous Waste	Inactive
157322	Residence	• Hazardous Waste	Inactive
191525	Sam Stone Residence	• Petroleum Remediation	Inactive
24186	V Baker Trucking Inc	• Hazardous Waste	Inactive
26809	JS Print Group	• Hazardous Waste • Brownfields	Active Inactive
253998	Rush Property	• Petroleum Remediation	Active

Note: Sites or areas with identified Petroleum Remediation or Brownfields listings in the above table should be assumed to have residual soil, groundwater, and/or vapor impacts.

A review of the Minnesota Department of Agriculture (MDA) WIMN database did not identify any sites within the AUAR area or within one-half mile of the AUAR area. A review of the MPCA Institutional Controls (IC) interactive online map was also conducted and no records were identified within the AUAR area or within one-half mile of the AUAR area. Finally, a review of the MPCA Petroleum Remediation Program (PRP) online map was conducted. Two listings were identified within the AUAR area with several additional listings identified within one-half mile of the AUAR area. The majority of identified PRP listings were also identified on the MPCA WIMN online database as identified above in Table 15; however, Former Duluth Ready Mix and Duluth Ready Mix located to the approximately 125 feet northeast of the AUAR area was identified with two Petroleum Remediation listings not identified on the WIMN database, Leak Site Nos. LS0000499 and LS0005919, which have both been issued regulatory closure status. Based on our review of the address shown for this site on the PRP online map, the former Duluth Ready Mix site was incorrectly plotted and appears to be located approximately 1.5 miles northwest of the AUAR area.

No pipelines were identified within the AUAR area or within one-half mile of the AUAR area on the National Pipeline Mapping System. According to the Minnesota Department of Health (MDH) Well Index database, one sealed environmental bore hole was identified near the two broadcast towers on the southern portion of the AUAR area.

Available historical documents associated with the AUAR area were reviewed including a General Excavation Report dated March 6, 2023 and an MPCA Petroleum Tank Release Site File Closure letter dated March 27, 2023. Both documents were prepared for the Duluth school district. The General Excavation Report indicates a 6,000-gallon fuel oil underground storage tank (UST) was removed from the AUAR area on November 29, 2022. During removal, the 6,000-gallon tank appeared to have been installed with a former 30,000-gallon fuel oil UST which was also removed on November 29, 2022. The former tank basin was located along the northwest side of the former Central High School building on the northwest portion of the AUAR area. Two bottom soil samples were collected from soils beneath the 30,000-gallon UST, and excavated soils were placed back into the basin. Analytical results from the two bottom soil samples identified diesel range organics (DRO) at concentrations of 56.4 and 1,010 milligrams per kilogram (mg/kg). Petroleum contaminated soils within the former tank basin were removed in January and February 2023 with approximately 1,050 cubic yards of impacted soil hauled off-site for disposal at the approved landfill. The final extent of excavation was approximately 100 feet in length, 40 feet wide, and 30 feet deep with bedrock at the base of the excavation. One of the nine confirmation soil samples collected from the final excavation limits had a DRO concentration of 11.1 mg/kg. The other eight soil samples did not have DRO concentrations above laboratory reporting limits. The MPCA issued regulatory closure for Leak Site No. LS0021939 on March 27, 2023.

In the event that potentially contaminated soils or other potentially hazardous materials are encountered during construction, work would be halted, and plans would be developed to properly handle and treat contaminated soil and/or groundwater. Any contaminated soils or other potentially hazardous materials encountered during construction would be handled and managed in accordance with MPCA guidance and any other applicable requirements.

If an environmental investigation is completed in the AUAR area with impacts identified, a Construction Contingency Plan (CCP) or Response Action Plan (RAP) will be prepared and approved by the MPCA Voluntary Investigation and Cleanup and/or Brownfield programs. The CCP or RAP would detail the response actions to be undertaken during the redevelopment and provide field decisions-making guidance in the event unanticipated impacts are encountered during redevelopment activities.

b. Project related generation/storage of solid wastes - Describe solid wastes generated/stored during construction and/or operation of the project. Indicate method of disposal. Discuss potential environmental effects from solid waste handling, storage and disposal. Identify measures to avoid, minimize or mitigate adverse effects from the generation/storage of solid waste including source reduction and recycling.

Construction

Future proposed developments will require demolition of certain existing structures in the AUAR area which may include the STC building, the former track field, tennis courts, parking lots, and road system serving the AUAR area. Therefore, the proposed development will require pre-demolition regulated building materials surveys prior to demolition of any existing structures. Identified asbestos-containing materials and regulated materials should be removed by licensed contractors prior to demolition. Appropriate permits and notifications must be submitted to the MPCA and/or MDH prior to completing abatement and demolition activities.

The disposal of solid wastes generated by clearing the construction area is a common occurrence associated with construction projects. Construction wastes would be primarily non-hazardous and would be managed as municipal solid waste (MSW) or construction/demolition debris. Additional items that may require removal and offsite recycling/disposal include existing vegetation (e.g., trees and shrubs), components associated with the irrigation system, fencing, and other items that may be present on the property.

Post-Construction

Two development scenarios were used as the bases for estimating MSW generation. Scenario A – a business park consisting of approximately 360,000 square feet of light industrial warehouse distribution and Scenario B – mixed commercial and residential consisting of 1,590 units of residential and 124,000 square feet of commercial development. Solid waste generated by the two scenarios would be primarily managed as MSW.

The California Department of Resources Recycling and Recovery (CalRecycle) provides a list of estimated solid waste generation rates for office, industrial, service, and other establishments for general planning purposes and should be reviewed at the time a future project is proposed to estimate the approximate amount of MSW produced on a yearly basis. Based on estimated solid waste generate rates of 1.42 lbs. per 100 square feet per day for office/warehouse uses, it was estimated that development Scenario A may produce approximately 2.56 tons of MSW per year. Based on the estimated solid waste generate rates between 3.6 and 11.4 lbs. per residential unit per day and between 2.5 and 13 lbs. per 1000 square feet per day for commercial uses, it was estimated that development Scenario B may produce between approximately 3.02 tons and 9.87 tons of MSW per year. The collection of MSW would be managed by a licensed waste hauler. The Project would adhere to all MPCA requirements and other regulations pertaining to the use, handling, and disposal of solid waste. Recycling areas would be provided in compliance with the Minnesota State Building code.

Future proposed development will be required to undertake acceptable methods to minimize excess waste materials. When and where feasible, items will be evaluated for recycling or reuse prior to disposal at an offsite landfill. All solid waste minimization, avoidance, and disposal measures will be handled by the contractor under provisions outlined in their contract. Solid wastes generated during future operations would be subject to compliance with local, state, and federal regulations on waste reduction and recycling.

c. Project related use/storage of hazardous materials - Describe chemicals/hazardous materials used/stored during construction and/or operation of the project including method of storage. Indicate the number, location and size of any new above or below ground tanks to store petroleum or other materials. Indicate the number, location, size and age of existing tanks on the property that the project will use. Discuss potential environmental effects from accidental spill or release of hazardous materials. Identify measures to avoid, minimize or mitigate adverse effects from the use/storage of chemicals/hazardous materials including source reduction and recycling. Include development of a spill prevention plan.

Hazardous materials in the form of used oils/lubricants, waste paints, or other materials may be used and stored during construction. The contractor would be required to manage and store all hazardous materials for construction in accordance with MPCA requirements and other applicable regulatory requirements be met. Fueling activities during construction will comply with the MPCA operating and containment requirements. Prior to any construction activities, a spill prevention plan will be prepared to provide best management plans to minimize and mitigate petroleum and hazardous materials spills. If aboveground or underground storage tanks are identified within the AUAR prior to construction, they should be removed in accordance with local, state, and federal requirements.

Based on our current understanding, the development will be a business park of light industrial warehouse distribution (Scenario A) or mixed commercial and residential (Scenario B). The types of chemicals, storage volumes, and locations of potential future operators in the AUAR area will need to be reviewed at the time a future project is proposed. No aboveground or underground storage tanks would be installed within the AUAR area as part of post-construction operations. If necessary, a spill prevention plan will be prepared to provide best management plans to minimize and mitigate petroleum and hazardous material spills following construction activities.

d. Project related generation/storage of hazardous wastes - Describe hazardous wastes generated/stored during construction and/or operation of the project. Indicate method of disposal. Discuss potential environmental effects from hazardous waste handling, storage, and disposal. Identify measures to avoid, minimize or mitigate adverse effects from the generation/storage of hazardous waste including source reduction and recycling

No significant amount of generated or stored hazardous waste is anticipated to result from construction activities. The contractor would be required to manage and dispose of hazardous waste consistent with applicable laws and regulations during construction. Any amount of hazardous materials or waste would be stored in locked containers during construction.

Upon review of available information, various construction materials that are regulated by the MPCA and the EPA may be present within the buildings currently in the AUAR Area. In accordance with requirements by the MPCA and EPA, the buildings under consideration for demolition require a comprehensive survey conducted by an MDH accredited Asbestos Inspector to identify accessible suspect asbestos-containing material (ACM) and other regulated materials as defined by the MPCA. PER State of Minnesota and federal regulations regarding ACM, all friable and non-friable materials that may become friable, with greater than one percent asbestos which would be disturbed, must be identified and removed prior to renovation or demolition. All rules and regulations would need to be followed, including, but not limited to notification, permit acquisition, abatement and disposal of ACM at a landfill approved to accept asbestos-containing waste. Asbestos abatement activities at the AUAR area would follow rules and regulations by the State of Minnesota and the EPA including notification and payment of applicable permit fees. Based upon the findings of the survey, an EPA Identification Number for Regulated Waste Activity may need to be obtained for the disposal of regulated materials. At the conclusion of the abatement and building decommissioning activities, a report summarizing the activities would be generated and given to the building owner.

The MPCA allows, without sampling, disposal of demolition debris that may contain Lead Based Paint (LBP) coatings. Therefore, if a building is scheduled for demolition, suspect LBP coatings do not require sampling. In addition, the MPCA allows, without sampling, disposal of demolition debris that may contain PCB-containing caulks, sealants and coatings. Therefore, if a building was constructed after 1979 or is scheduled for demolition, suspect PCB-containing caulks do not require sampling. A final report documenting the findings of the survey shall be completed. Based on the findings of the building survey, if a project specification is generated, it must be written by an MDH accredited Asbestos Project Designer.

Hazardous wastes which may include household hazardous waste may be generated post-construction at future facilities in the AUAR area. If hazardous waste is generated by the post-construction facility in the AUAR area, proper storage and handling would occur onsite, and the facilities would adhere to county and EPA regulations for disposal.

Item 13 Mitigation Strategies

- At the time of development, a CCP or a waste management plan shall be prepared to address proper handling, treatment, storage, and disposal of solid wastes; hazardous materials; petroleum products; and other regulated materials/wastes that are used or generated during construction. The CCP or waste management plan would also establish protocols to minimize impacts to soil and groundwater in the event a release of hazardous substances or petroleum occurs during construction.

- If soil contamination is discovered through due diligence testing or during development, the developer or other responsible party will be required to report the release to the MN Duty Officer and appropriately mitigate the contaminants according to the type of development planned and in compliance with state and federal requirements. Completion of a RAP/CCP that details appropriate methods to handle and dispose of any such materials that are encountered may be necessary. The

RAP would be submitted to the MPCA for review and approval.

- Demolition and construction wastes shall either be recycled or disposed in the proper facilities. Solid wastes shall be managed according to MPCA and other regulatory requirements.

- In the event demolition is required, complete a pre-demolition Hazardous Building Materials Survey of the existing buildings in accordance with MDH and MPCA requirements prior to the start of demolition activities to determine if any regulated materials are present. Mitigate any identified regulated material prior to demolition for proper disposal according to local, State and federal requirements. Demolition wastes will either be recycled or disposed in the proper state-licensed facilities.

- Aboveground or underground storage tanks identified within the AUAR area prior to or during construction should be removed in accordance with local, state, and federal requirements.

- Fueling activities during construction will comply with MPCA operating and containment requirements. Prior to construction activities, a spill prevention control and countermeasure (SPCC) plan will be prepared to provide best management plans to minimize and mitigate petroleum and hazardous materials spills.

- Depending on the type of final development, a spill prevention plan will be prepared to provide best management plans to minimize and mitigate petroleum and hazardous material spills following construction activities.

14. Fish, Wildlife, Plant Communities, and Sensitive Ecological Resources (Rare Features)

a. Describe fish and wildlife resources as well as habitats and vegetation on or in near the site.

The AUAR area is located in the Laurentian Mixed Forest Province (212), Northern Superior Uplands Section (212L), and North Shore Highlands Subsection (212Lb) as defined by the DNR in the *Field Guide to the Native Plant Communities of Minnesota the Laurentian Mixed Fores Province* (2003). Current land use within this subsection includes urban development, residential homes, small businesses, farming, forest management, recreation/tourism, logging, and mining. Native vegetation consists of white pine-red pine forest (*Pinus strobus* and *P. resinosa*, respectively) and mixed hardwood-pine forest, forested wetlands, peatlands, lakes, rivers, rock outcrops, and shorelands. However, logging has converted much of the pine forests to quaking aspen (*Populus tremuloides*) and paper birch (*Betula papyrifera*) and other regenerative forest types.[26,27]

The land cover within the AUAR area was reviewed and is described in Item 8 (Cover Types). The primary land cover type within the AUAR area is classified as brush/grassland based on NLCD geospatial data. The majority of this are consists of previously disturbed land. The former Central High School building was recently demolished within the AUAR area. Forested areas (deciduous and coniferous trees) occupy approximately 27.2 acres or 34 percent of the AUAR area based on NLCD geospatial data. Wetlands are rare within the AUAR area and comprise less than two acres of land based on field delineation and NWI geospatial data. Remaining cover types include impervious surface (roads, parking, and buildings) and bare soil. Figure 3, Appendix A illustrates land cover types within the AUAR area based on NLCD geospatial data.[28] Table 3 details land cover types identified within the AUAR area.

All cover types within the AUAR could provide limited foraging or roaming habitat for a variety of urban

[26] DNR. 1999. Minnesota Geospatial Commons – Ecological Sections of Minnesota. Available at: https://gisdata.mn.gov/dataset/geos-ecological-class-system. Accessed January 2024.
[27] DNR. 2000. Ecological Classification System. Available at: https://www.dnr.state.mn.us/ecs/index.html. Accessed January 2024.
[28] USGS. 2021. National Land Cover Database. Available at: https://www.usgs.gov/centers/eros/science/national-land-cover-database. Accessed November 2023.

wildlife species, including squirrels, rabbits, deer, coyotes, foxes, passerine birds, raptors, and other small mammals. Minor water features (e.g., intermittent water collection features, recognized as rain puddles or similar) could provide limited habitat for aquatic species such as turtles, fish, frogs, and toads within the AUAR area. It is anticipated that there is limited habitat for fish or wildlife. Limited habitat resources are present within the AUAR area due to the isolation of habitat and extent of past disturbance from development.

b. Describe rare features state-listed (endangered, threatened or special concern) species, native plant communities, Minnesota Biological Survey Sites of Biodiversity Significance, and other sensitive ecological resources on or within close proximity to the site. Provide the license agreement number (LA-) and/or correspondence number (MCE) from which the data were obtained and attach the Natural Heritage Review letter from the DNR. Indicate if any additional habitat or species survey work has been conducted within the site and describe the results.

Under Stantec's Limited License to Use Copyrighted Material (LA 2022-023) related to Rare Features Data, the DNR Natural Heritage Information System (NHIS) was searched in October 2023 to identify species within a one-mile radius of the AUAR area and other natural features (DNR 2023a)[29]. The NHIS search did not indicate any records within the AUAR area. Records of three rare species were identified within the one-mile review area. A formal NHIS review request was submitted to the DNR on November 6, 2023 through the Minnesota Conservation Explorer system (MCE No. 2023-00835) and a response from the DNR was provided on January 11, 2023. Impact minimization measures, specifically for bat species, are detailed below in Item 14 – Mitigation Strategies. Appendix D includes the initial MCE response letter received from the DNR.

Native Plant Communities and Sites of Biodiversity Significance

Based on a review of the DNR MCE portal (DNR undated-a)[30] and NHIS database, no native plant communities are present within one mile of the AUAR area. One Minnesota Biological Survey (MBS) site (Duluth Lakewalk to Lester River) is located approximately one mile southeast of the AUAR area along the Lake Superior shoreline. This MBS site has been determined to be below the minimum biodiversity threshold for statewide significance and is not anticipated to be impacted by future development in the AUAR area.

State – Listed Species

The NHIS search did not indicate any records within the AUAR area. Records of three rare species were identified within one mile of the AUAR area: the Blanding's turtle (*Emydoidea blandingii*; threatened), the peregrine falcon (*Falco peregrinus*; special concern), and the lake sturgeon (*Acipenser fulvescens*; special concern).

Blanding's Turtle

Blanding's turtles require wetland complexes with adjacent sand uplands to sustain viable populations. Calm, shallow waters, including wetlands associated with rivers and streams with rich aquatic vegetation are preferred. This turtle occurs on a variety of wetland and riverine types throughout Minnesota. The species generally prefers marshes, bottomland wetlands, deeper marshes, and backwater pools in summer and winter; and ephemeral wetlands in spring and early summer. Female Blanding's turtles prefer to nest in open sandy uplands. Although they prefer undeveloped land, they have been known to nest in agricultural fields, residential property (low density suburb housing), gardens, under power lines, and in road shoulders (especially dirt roads). Females may travel up to 1.6 kilometers (1 mile) overland from their resident marsh to their nest site at which time they are vulnerable to predators and road mortality. Hatchlings leave the nest from mid-August through early October.

[29] DNR. 2023a. Natural Heritage Information System. Available at: https://www.dnr.state.mn.us/nhnrp/nhis.html. Accessed October 2023.
[30] DNR. undated-a. Minnesota Conservation Explorer. Available at: https://mce.dnr.state.mn.us/content/explore. Accessed January 2024.

Because eggs are laid far from water, hatchlings are vulnerable to predators, automobiles, and desiccation while traveling from the nest to a wetland.[31] A complex of wetlands associated with streams and rivers and open sandy uplands are not present in the AUAR area.

Peregrine Falcon

Peregrine falcons nest on cliff ledges along rivers and lakes, as well as on skyscrapers and bridges in urban settings. Non-forested, open areas are preferred for hunting.[32] The AUAR area consists of previously developed, disturbed land and does not contain suitable nesting habitat, cliff ledges or skyscrapers, for the peregrine falcon. Therefore, impacts on the peregrine falcon are not anticipated as result of development.

Lake Sturgeon

The lake sturgeon is a primitive fish species that is found in large rivers and lakes characterized by moderately clear waters and substrates consisting of firm sand, gravel, or rubble. As adults, individuals of the species are generally found at depths of at least 1.5 meters, while spawning adults can be found at depths between 60 and 149 centimeters. In Minnesota, lake sturgeon have been observed in the Mississippi River, St. Croix River, Red River, and Rainy River, as well as in Lake Superior, Lake of the Woods, and the Boundary Waters Canoe Area.[33]
The AUAR area does not contain any large rivers or lakes that could support the lake sturgeon. The nearest suitable habitat is Lake Superior, which is just over one mile southeast of the AUAR area where no impacts are anticipated to occur. As such, this species does not occur within the AUAR area, and impacts are not anticipated as a result of development.

Federally – Listed Species

A review of the United States Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) tool[34] was conducted in November of 2023 to identify federally listed species, those species proposed for federal listing, and candidates for federal listing. Six species were identified from this review that have the potential to occur within the AUAR area: the northern long-eared bat (*Myotis septentrionalis*; endangered), the tricolored bat (*Perimyotis subflavus*; proposed endangered), the Canada lynx (*Lynx canadensis*; threatened), the gray wolf (*Canis lupus*; threatened), the rufa red knot (*Calidris canutus rufa*; threatened), and the monarch butterfly (*Danaus plexippus*; candidate). Appendix D includes the species list generated through the USFWS IPaC review tool.

Northern Long-eared Bat

Suitable roosting, forage, and travel habitat for northern long-eared bat (NLEB) in the summer consists of a wide variety of contiguous forested and wooded habitats with varying tree density and amounts of canopy closure. While roosting, NLEB is generally found in deep crevices in areas such as forests and woodlots (i.e., live trees and/or snags greater than or equal to three inches in diameter at breast height that have exfoliating bark, cracks, crevices, and/or cavities) as well as linear features such as fence

[31] DNR Division of Ecological Resources. 2008. Endangered, Threatened, and Species Concern Species of Minnesota – Blanding's Turtle (*Emydoidea blandingii*). Available at: https://files.dnr.state.mn.us/natural_resources/animals/reptiles_amphibians/turtles/blandings_turtle/factsheet.pdf. Accessed January 2024.
[32] DNR. 2024a. Rare Species Guide – Peregrine Falcon (*Falco peregrinus*). Available at: https://www.dnr.state.mn.us/rsg/profile.html?action=elementDetail&selectedElement=ABNKD06070. Accessed January 2024.
[33] DNR. 2024b. Rare Species Guide – Lake Sturgeon (*Acipenser fulvescens*). Available at: https://www.dnr.state.mn.us/rsg/profile.html?action=elementDetail&selectedElement=AFCAA01020. Accessed January 2024.

[34] USFWS. 2023a. Information for Planning and Consultation. Available at: https://ipac.ecosphere.fws.gov/. Accessed November 2023.

rows, riparian forests, and other wooded corridors. NLEB roosts in both live trees and snags.[35,36,37] Additional summer habitat for the NLEB consists of areas adjacent to wooded areas, namely emergent wetlands and edges of agricultural fields, old fields, and pastures. The NLEB has also been observed roosting in human-made structures, such as buildings, barns, bridges, and bat houses.[38] During winter months, NLEB hibernates in caves or abandoned mines.[37]

According to NLCD data collected in October 2023, the AUAR area contains approximately 27.2 acres of forest and 1.31 acres of wetland, both of which have the potential to provide summer roosting and foraging habitat for the NLEB (Figure 3, Appendix A). Contiguous forest is also present adjacent to the AUAR area, primarily to the southwest, according to recent aerial imagery.[39] Therefore, the NLEB may occur within the AUAR area. Notably, the DNR NHIS review did not identify occurrences of the NLEB, maternity roost trees, or hibernacula within the AUAR or within one mile of the AUAR area. If tree clearing is necessary between April 1 and November 14, there may be impacts to NLEB. However, if clearing takes place between November 15 and March 31, inclusive, no impacts to NLEB would occur.

Tricolored Bat

During the non-hibernating seasons, tricolored bats will roost in live and dead leaf clusters of live or dead deciduous hardwood trees. Tricolored bats have also been observed roosting in artificial structures such as barns, bridges, roofs, and other concrete structures. During the winter, tricolored bats hibernate in caves and mines. If mines or caves are not present within the region, they have been observed hibernating in road-associated culverts, tree cavities, and abandoned water wells.[40]
The AUAR area contains approximately 27.2 acres of forest that may provide suitable roosting habitat for the tricolored bat. Therefore, this species may occur within the AUAR area. Provided that tree clearing may be required within the AUAR area, impacts on the tricolored bat may occur as a result of development. The tricolored bat is proposed to be listed as federally endangered but is not regulated by the USFWS at this time. Impacts will need to be reassessed if and when a listing status is finalized.

Canada Lynx

In Minnesota, the Canada lynx inhabits boreal spruce-fir forests, also known as taiga, that are characterized by deep snow, dense forest cover, and stable populations of snowshoe hares.[41] While the AUAR contains approximately 27.2 acres of forest, it is located in a highly developed area with limited forest density that would not provide suitable habitat for the Canada lynx. As such, this species is unlikely to occur in the AUAR area. Tree clearing amounts, if required, will need to be determined, but impacts are not anticipated for this species.

Gray Wolf

The gray wolf inhabits a wide range of habitats, including temperate forests, mountains, tundra, taiga, grasslands, and deserts (USFWS 2023c)[42]. While grasslands (35 acres) and forest (27.2 acres) are present within the AUAR area (Figure 3, Appendix A), they are located in a developed area that would not provide suitable habitat for the gray wolf. Additionally, gray wolves are known to be more successful

[35] Sasse, D.B., and P.J. Perkins. 1996. Summer roosting ecology of northern long-eared bats (*Myotis septentrionalis*) in the White Mountain National Forest. Bats and forests symposium. British Columbia Ministry of Forests Working Paper 23:91-101.
[36] Foster, R.W. and A. Kurta. 1999. Roosting ecology of the northern bat. (*Myotis septentrionalis*) and comparisons with the endangered Indiana bat (*Myotis sodalis*). Journal of Mammalogy 80:659-672.
[37] Owen, S.F.; Menzel, M.A.; Ford, M.W.; Chapman, B.R,; Miller, K.V.; Edwards, J.W.; and Wood, P.B. 2003. Homerange size and habitat use by the northern Myotis (*Myotis septentrionalis*). American Midland Naturalist 150: 352-359.
[38] USFWS. 2022a. Rangewide-Wide Indiana Bat & Northern Long-Eared Bat Survey Guidelines. Available at: https://www.fws.gov/media/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines. Accessed March 2023.
[39] Google Earth. 2023. Aerial Imagery dated 5/10/2023 of St. Louis County, Minnesota.
[40] USFWS. 2022. Tricolored Bat (*Perimyotis subflavus*). U.S. Fish & Wildlife Service. Available: https://fws.gov/species/tricolored-bat-perimyotis-subflavus. Accessed January 2023.
[41] USFWS. 2023b. Canada Lynx. Available at: https://www.fws.gov/species/canada-lynx-lynx-canadensis. Accessed January 2024.
[42] USFWS. 2023c. Gray Wolf. Available at: https://www.fws.gov/species/gray-wolf-canis-lupus. Accessed January 2024.

where human and road densities are low.[43] As such, this species is unlikely to occur in the AUAR area. Tree clearing, if required, will need to be determined, but impacts are not anticipated for this species.

Rufa Red Knot

Rufa red knots are a coastal species of shorebird that utilize muddy or sandy coastal areas, bays, estuaries, tidal flats, tidal inlets, sand spits, islets, shoals, and sandbars with abundant opportunities for mollusk foraging. Nesting occurs in tundra habitats with little vegetation, often within 600 feet of a freshwater wetland. Inland saline lakes, and potentially inland freshwater habitats, such as wetlands and riverine sandbars, may provide stopover sites for this species during migration.[44]

The AUAR area does not contain coastal areas, sandbars, or other open water features that would be suitable habitat for the rufa red knot. As such, the rufa red knot is unlikely to occur in the AUAR area. The nearest suitable habitat is Lake Superior, which is just over one mile southeast of the AUAR area where no impacts are anticipated to occur. According to NLCD data, approximately 2 acres of wetlands are present in the AUAR area. While freshwater wetlands may provide stopover sites for this species, a site of this size is unlikely to provide adequate foraging opportunities for migrating shorebirds. As such impacts on this species are not anticipated to occur as a result of development in the AUAR area.

Monarch Butterfly

The monarch butterfly is a migratory butterfly that exists in two main populations within the United States divided by the Rocky Mountains: the eastern population that overwinters in the mountains of Mexico, and the western population that overwinters along the southern pacific coast of California.[45] Monarch butterflies are a widespread species found in fields, prairies, savannahs, and most places where their host plant milkweed (*Asclepias* spp.) occurs throughout the United States and southern Canada. This species generally occurs in areas with high densities of native nectar sources. During late summer and migration, adults use nectar species such as black-eyed Susan (*Rudbeckia hirta*), narrow-leaved coneflower (*Echinacea angustifolia*), and rough blazing star (*Liatris aspera*).[46] However, the presence of milkweed is required as it is the only plant on which monarch caterpillars can feed.[47]

While approximately 35 acres of grassland is present within the AUAR area, native nectar sources and milkweed are likely limited due to disturbance by surrounding residential and commercial developments. However, given the wide range of habitats this species can be found in, it may occur within the AUAR area. Use of native seeds mixes in the AUAR area, would enhance habitat for the monarch butterfly within the AUAR area. The monarch butterfly is a candidate for federal listing; therefore, impacts will need to be reassessed if and when a listing status is finalized.

Migratory Birds

Fifteen migratory birds of conservation concern (BBC) and two eagle species have the potential to occur within the AUAR area according to the USFWS IPaC results. These species and their habitat requirements are detailed in Table 16 using data from the Cornell Lab of Ornithology.[48]

[43] Mech, L. D. 1989. Wolf population survival in an area of high road density. *American Midland Naturalist*, 387-389.
[44] USFWS. 2023d. Rufa Red Knot. Available at: https://www.fws.gov/species/rufa-red-knot-calidris-canutus-rufa. Accessed January 2024.
[45] United States Department of Agriculture [USDA] Forest Service. undated. Migration and Overwintering. Available at: https://www.fs.fed.us/wildflowers/pollinators/Monarch_Butterfly/migration/. Accessed November 2021.

[46] DNR. 2022. Butterfly Gardens. Available at: https://www.dnr.state.mn.us/gardens/butterfly/index.html. Accessed March 2022.
[47] National Wildlife Federation. undated. Monarch Butterfly. Available at: https://www.nwf.org/Educational-Resources/Wildlife-Guide/Invertebrates/Monarch-Butterfly. Accessed December 2021.
[48] Cornell Lab of Ornithology. 2024a. All About Birds. Ithaca, New York. Available at: https://www.allaboutbirds.org/news/#. Accessed January 2024.

Table 16. Migratory Birds Listed as BBC with the Potential to Occur within the AUAR Area

Common Name	Scientific Name	Nesting, Foraging, and/or Migration Habitat
Bald eagle*	*Haliaeetus leucocephalus*	Forested areas (conifers and deciduous trees) near large bodies of open water. Open uplands near open water in winter.
Black tern	*Chlidonias niger*	Breeds in large freshwater wetlands, preferably dense marshes at least 50 acres in size, near open prairies or northern forests. Migrants are found in a variety of wetland habitats, along coastlines, and tropical ocean waters.
Black-billed cuckoo	*Coccyzus erythropthalmus*	Dense woodlands, forest, thickets, and scrub.
Bobolink	*Dolichonyx oryzivorus*	Breeds in open areas (grasslands, tallgrass and mixed prairie, hayfields, meadows); coastal areas pre-migration.
Canada warbler	*Cardellina canadensis*	Breeds in mixed conifer and deciduous forest with shrubby and mossy understory near water; forested wetlands. Found in parks, forest edges, and woodlots during migration.
Chimney swift	*Chaetura pelagica*	Breeds in rural and urban settings in chimneys, tree cavities, and caves. Forage over open habitats, forests, ponds, and residential areas.
Common tern	*Sterna hirundo*	Breeds on rocky islands, barrier beaches, and saltmarshes. Gather during the winter and to forage over open waters.
Connecticut warbler	*Oporornis agilis*	Breeds in wet forest, such as poplar forests and spruce bogs, and drier forest, such as pine-oak forests and jack pine barrens, both with dense undergrowth, edges, vine tangles, and forest gaps. Nests are well hidden in undergrowth.
Evening grosbeak	*Coccothraustes vespertinus*	Breeds in mature and second-growth coniferous forests (spruce-fir, pine-oak, pinyon-juniper, and aspen), and sometimes in deciduous forests, parks, and orchards. Wintering birds can also be found in urban areas in woodlots.
Golden eagle*	*Aquila chrysaetos*	Nests are generally built on cliffs. General habitat consists of open and semi-open grasslands, mountains, canyonlands, rimrock terrain, and riverside cliffs and bluffs. Developed areas and uninterrupted forested areas are avoided.
Golden-winged warbler	*Vermivora chrysoptera*	Breeds in open woodlands, wet thickets, shrub, tamarack bogs, aspen or willow stands, and wetlands.
Lesser yellowlegs	*Tringa flavipes*	Breeds in open woodlands with marshes, bogs, and/or ponds; during migration found in fresh and brackish wetlands.
Long-eared owl	*Asio otus*	Dense vegetation, open grasslands and shrublands, and open coniferous or deciduous woodlands.
Olive-sided flycatcher	*Contopus cooperi*	Boreal forest openings and edges with meadows, rivers, or streams and dead or dying trees.
Pectoral sandpiper	*Calidris melanotos*	Breeds in wet coastal tundra dominated by grasses and sedges. Nests are built on raised hummocks or ridges. Migrants utilize wet

Common Name	Scientific Name	Nesting, Foraging, and/or Migration Habitat
		grassy environments, such as sewage ponds, plowed farm fields, sod farms, rice fields, and saltwater/freshwater marshes.
Ruddy turnstone	*Arenaria interpres morinella*	Breeds along rocky coasts and in tundra with marshes, streams, and ponds. Migrants utilize rocky and sandy beaches, mudflats, shorelines of freshwater lakes, and deltas.
Wood thrush	*Hylocichla mustelina*	Mature deciduous and mixed forests with trees that are at least 50 feet tall, a moderate understory, open forest floor with moist soil and decaying leaf litter, and nearby water.
*These species are not listed as BBC but warrant special attention under the Bald and Golden Eagle Protection Act (BGEPA).		

Two of the 17 migratory bird species with the potential to occur in the AUAR area are the bald eagle and the golden eagle. These species are not listed as BCC but warrant special attention under the Bald and Golden Eagle Protection Act (BGEPA). Forested areas present in and around the AUAR area are unsuitable nesting habitat for either eagle species but substantial numbers of both do migrate along the south shore of Lake Superior especially in the fall. Both eagle species may pass through the AUAR area. As planning progresses, coordination with the USFWS is recommended.

The forested areas, grasslands, and wetlands within and in the immediate vicinity of the AUAR area may provide nesting, foraging, and/or migration habitat for the black tern, black-billed cuckoo, bobolink, Canada warbler, chimney swift, Connecticut warbler, evening grosbeak, golden-winged warbler, lesser yellowlegs, long-eared owl, olive-sided flycatcher, pectoral sandpiper, and wood thrush. No suitable habitat, including rocky coasts, open waters, beaches, and tundra, is present in the AUAR area to support the common tern or the ruddy turnstone.

Duluth is located within the Mississippi Flyway, one of four major migration paths used by birds during spring and fall migration.[49] When migrating birds reach neighboring Lake Superior, many species are more likely to follow the lakeshore than cross open water; flying over land provides opportunities to stop and refuel while the open water frequently does not.[50,51] Therefore, raptors are funneled over Hawk Ridge, a migration observatory in Duluth, each fall.[52] Given that the AUAR area is approximately one mile from the Lake Superior shore, it is anticipated that large numbers of migrating birds pass over or near the AUAR area each spring and fall.

c. Discuss how the identified fish, wildlife, plant communities, rare features and ecosystems may be affected by the project including how current Minnesota climate trends and anticipated climate change in the general location of the project may influence the effects. Include a discussion on introduction and spread of invasive species from the project construction and operation. Separately discuss effects to known threatened and endangered species.

Native Plant Communities and Sites of Biodiversity Significance

Based on a review of the DNR MCE portal and the NHIS database, no native plant communities or Minnesota Biological Survey (MBS) sites of biodiversity significance are present within the AUAR area or within one mile of the AUAR area. The Duluth Lakewalk to Lester River MBS site is located

[49] Fritts, R. 2022. Avian Superhighways: The Four Flyways of North America. American Bird Conservancy. Available at: https://abcbirds.org/blog/north-american-bird-flyways/. Accessed January 2024.
[50] Smith, J. 2017. The Ocean Flyway: The Surprising Open Water Routes of Songbird Migrations. The Nature Conservancy. Available at: https://blog.nature.org/2017/09/21/ocean-flyway-surprising-open-water-routes-songbird-migrations/. Accessed January 2024.
[51] Hawk Ridge. undated(a). About the Migration. Available at: https://www.hawkridge.org/birds-migration/about-the-migration/. Accessed January 2024.
[52] Hawk Ridge. undated(b). Migration Statistics. Available at: https://www.hawkridge.org/birds-migration/migration-statistics/. Accessed January 2024.

approximately one mile southeast of the AUAR area along the Lake Superior shoreline. This site has been determined to be below the minimum biodiversity threshold for statewide significance and is not anticipated to be impacted by development in the AUAR area.

Future development may impact plant communities through fragmentation and edge disturbances that can promote establishment of invasive species or damage critical rooting zones.

Impacts Analysis for State-Listed Species

Blanding's Turtle

No impacts to Blanding's turtle are anticipated given the DNR's NHIS review response and the absence of habitat.

Blanding's turtles are also sensitive to both temperature and precipitation changes. Increasing average temperature in Minnesota are anticipated to result in increased physiological stress and reduced reproductive success for this species. Additionally, precipitation changes are likely to impact the availability of freshwater wetland habitats needed by Blanding's turtles for overwintering, shelter, and foraging.[53]

Peregrine Falcon

While suitable nesting habitat is not present in the AUAR area, peregrine falcons migrate through the region every fall. The addition of structures with glass into this environment may result in in-flight collisions.

Given the warming climate trend in Minnesota, overall suitable habitat for the peregrine falcon is anticipated to increase, but this comes at the expense of a loss of wintering grounds for the species.[54] The development of the AUAR area is not expected to negatively impact peregrine falcon continued existence in the area or its regional population.

Lake Sturgeon

The closest suitable habitat from the AUAR area for the lake sturgeon is Lake Superior. No impacts are anticipated for Lake Superior or the lake sturgeon.

While suitable habitat for the lake sturgeon (rivers and lakes) is not present within the AUAR area and impacts are not anticipated as a result of future development in the AUAR area, warming temperatures and more frequent extreme rain events in the vicinity are anticipated to negatively impact this species. Lake sturgeon have varying habitat needs based on their life cycle, including streams, shores, and deep rivers and lakes, and changes in climate cues may impact these natural cycles. For instance, changes in water flow timing and amounts as a result of higher precipitation or decreased snow melt will likely negatively impact movements to spawning and nursery sites. Additionally, warming water temperatures will likely result in altered behaviors and changes in prey and habitat availability.[55]

Impacts Analysis for Federally-Listed Species

Northern Long-eared Bat

Development within the AUAR may impact suitable NLEB roosting and foraging habitat (contiguous

[53] Lyons, M.P., Nikiel, C.A., LeDee, O.E., and Boyles, R. 2023. Potential effects of climate change on *Emydoidea blandingii* (Blanding's turtle): U.S. Geological Survey Open-File Report 2021-1104-D, https://pubs.usgs.gov/of/2021/1104/d/ofr20211104d.pdf. Accessed January 2024.

[54] Audubon. 2019. Climate Threatened – Peregrine Falcon. Available at: https://climate2014.audubon.org/birds/perfal/peregrine-falcon. Accessed January 2024.

[55] Embke, H.S., Nikiel, C.A., and Lyons, M.P. 2023. Potential effects of climate change on *Acipenser fulvescens* (lake sturgeon): U.S. Geological Survey Open-File Report 2021–1104–E, 41 p., https://doi.org/10.3133/ofr20211104E. Accessed January 2024.

forest and wetlands) on the site. Tree clearing within the AUAR area could result in habitat loss and take of individual NLEBs if conducted during NLEB active seasons (April 1-November 15). Additional stressors to the species include lighting, noise, and structural activities that may disturb individuals roosting in man-made structures.

As discussed in Item 7 (Climate Adaptation and Resilience), Minnesota's climate is trending warmer with more extreme precipitation events. Changes in temperature and precipitation may influence the NLEBs available suitable roosting and foraging habitat, as well as prey availability.[56] Although a less significant stressor compared to white-nose syndrome, climate change variables may negatively affect the NLEB.[57]

Tricolored Bat

Development within the AUAR may impact suitable tricolored bat roosting habitat (forest) on the site. Tree clearing within the AUAR area could result in habitat loss and fatalities. Additional stressors to the species include lighting, noise, and structural activities that may disturb individuals roosting in man-made structures. Impacts will need to be reassessed if and when a listing status is finalized.

The tricolored bat is susceptible to climate change. For instance, changes in temperature and precipitation could have impacts on habitat availability, prey availability, and reproductive success with more frequent droughts leading to decreased survival and reproduction and more extreme rain events leading to decreased foraging opportunity.[58]

Canada Lynx

Development in the AUAR area is not anticipated to impact the Canada lynx. The presence of human habitation and urban development reduces forest density and create conditions that Canada lynx avoid (Ruediger et al 2000). Tree clearing within the AUAR area, if proposed, will need to be quantified.

Deep snow habitats used by the Canada lynx are anticipated to become less common as the climate trends warmer. Besides decreasing the amount of suitable habitat available to this species, this opens previously inaccessible habitat to other species, such as the bobcat (*Lynx rufus*) and the coyote (*Canis latrans*). This added competition for resources would put further stress on this species.[59]

Gray Wolf

Development within the AUAR is not anticipated to impact the gray wolf. Existing forest density is low and surrounding residential and commercial development reduces available habitat for this species. Tree clearing within the AUAR area, if proposed, will need to be quantified.

Given the wide range of habitats and climates the gray wolf can inhabit, they are thought to be resilient to climate change according to a 2017-2020 winter tracking survey and climate change/land use prediction study conducted in Michigan, Wisconsin, and Minnesota. It was found that wolf habitat is anticipated to remain stable or even increase under average global temperature increases of 3-5 degrees Celsius. (Learn 2024)[60].

[56] USFWS. 2022c. Northern Long-Eared Bat Overview. Available at: https://www.fws.gov/species/northern-long-eared-bat-myotis-septentrionalis. Accessed January 2024.
[57] USFWS 2022d. Final Rule 87 FR 73488: Endangered and Threatened Wildlife and Plants; Endangered Species Status for Northern Long-Eared Bat. Available at: https://www.federalregister.gov/documents/2022/11/30/2022-25998/endangered-and-threatened-wildlife-and-plants-endangered-species-status-for-northern-long-eared-bat. Accessed January 2024.
[58] USFWS. 2022e. Proposed Rule 87 FR 56381: Endangered and Threatened Wildlife and Plants; Endangered Species Status for Tricolored Bat. Available at: https://www.federalregister.gov/documents/2022/09/14/2022-18852/endangered-and-threatened-wildlife-and-plants-endangered-species-status-for-tricolored-bat. Accessed January 2024.
[59] Marrotte, R. R., & Bowman, J. 2021. Seven decades of southern range dynamics of Canada lynx. *Ecology and Evolution*, *11*(9), 4644-4655.
[60] Learn, Joshua Rapp. 2024. Great Lakes Wolves Resilient to Climate, Land Use Change. The Wildlife Society. Available at: https://wildlife.org/great-lakes-wolves-resilient-to-climate-land-use-change/. Accessed January 2024.

Rufa Red Knot

Coastal areas and other suitable stopover habitat are absent in the AUAR area. Despite the lack of habitat, a small possibility exists that migrants could pass through this area during migration. These migrants may be at slight risk for window collision when flying through a newly developed area.

While impacts on the rufa red knot are not anticipated as a result of future development in the AUAR area, additional wetlands and lakes in the near vicinity (over one mile away) of the AUAR area may provide stopover sites. According to the Cornell Lab of Ornithology (2024b)[61], these migratory stopover sites are anticipated to be impacted the most by climate change and sea-level rise in comparison to breeding and overwintering habitats.

Monarch Butterfly

Milkweed and native nectar sources are likely limited in the AUAR area due to disturbance by surrounding residential and commercial development. However, given the wide range of habitats the monarch butterfly can occupy, removing or damaging vegetation in the AUAR area could impact the species. If a native seed mix is used to re-vegetate the site post-construction, then development within the AUAR area may be a net positive for the species. The monarch butterfly is a candidate for federal listing; therefore, impacts will need to be reassessed if and when a listing status is finalized.
As discussed in Item 7 (Climate Adaptation and Resilience), climate change is anticipated to result in increasing temperatures in Minnesota, which may increase the number of days and the area in which monarch butterfly populations will be exposed to unsuitably high temperatures. This can result in them using up fat stores too quickly and may result in them incorrectly judging when to enter and exit states of dormancy (diapause).[62]

Migratory Birds

Construction activities and development within the AUAR area may result in the taking of migratory birds protected under the Migratory Bird Treaty Act (MBTA). The MBTA makes it illegal to take (i.e., to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct) any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to Federal regulations.

Although the provisions of the MBTA are applicable throughout the entire year, most migratory bird nesting activity in Minnesota occurs approximately from May 15 to August 1. Based on the IPaC species review results (Appendix D), the fifteen migratory BCC species with the potential to occur in the AUAR area are most likely to be in the AUAR area from May 1 to August 31 with the exception of the lesser yellowlegs, pectoral sandpiper, and ruddy turnstone that breed elsewhere. If construction activities occur within vegetated areas of the AUAR area, it may result in the taking of migratory birds, eggs, young, and/or active nests if conducted during the bird nesting timeframe in Minnesota. Additionally, the risk of collision with man-made structures, especially those with glass, is predicted to be present within the AUAR area given the large number of migrants that pass through the Duluth lakeshore area to avoid crossing over Lake Superior.

The potential for migratory eagles to be in the AUAR area warrants further attention under the BGEPA.

Urban wildlife

Urban wildlife such as squirrels, mice, rabbits, raccoons, deer, coyotes, foxes, and other small mammals may be impacted by the development within the AUAR area, such as through the removal

[61] Cornell Lab of Ornithology. 2024. All About Birds – Red Knot Conservation. Ithaca, New York. Available at: https://www.allaboutbirds.org/guide/Red_Knot/lifehistory#conservation. Accessed January 2024.

[62] Kobilinksy, Dana. 2019. Watch: Temperature Drives Internal Clock for Monarchs. The Wildlife Society. Available at: https://wildlife.org/watch-temperature-drives-internal-clock-for-monarchs/. Accessed January 2024.

grasslands and forest. Additionally, lighting may have the potential to negatively impact wildlife. These species are generally adaptable to change and would likely relocate to other undeveloped areas.

Invasive species

Noxious weeds and invasive species in Minnesota are managed through the MDA under Minnesota Statutes Section 18.78, the DNR, and local ordinances. BMPs during construction activities and operation within the AUAR area should be implemented to minimize the introduction or spread of noxious weeds and invasive species. These practices include cleaning vehicles and equipment of mud and dirt from other construction areas, removing seeds that attach to clothing or equipment, minimizing soil disturbance, not moving potentially contaminated materials between sites, and staying on designated roads/trails.[63,64]

d. Identify measures that will be taken to avoid, minimize, or mitigate the adverse effects to fish, wildlife, plant communities, ecosystems, and sensitive ecological resources.

Sightings of any rare species during any future development within the AUAR area will be reported to the DNR Nongame Wildlife specialist. The proposer will follow the guidance that is received to avoid impacts.

Wildlife friendly erosion control devices should be used both to protect wetlands and other habitats from sediment-laden stormwater runoff and to prevent injury to wildlife.
Although the DNR NHIS review did not identify maternity roost trees for the NLEB within the AUAR area, tree clearing should occur outside of the bat active season of April 1 to November 15 when possible. If this is not possible, consultation with the USFWS may be required. Any temporary lighting should also be directed away from wooded areas during the bat active season.

Native seed should be used in revegetation plans within the AUAR area in order to provide suitable habitat for species like the monarch butterfly and to prevent the spread of invasive plants and noxious weeds.

New structures within the AUAR area should incorporate bird-safe building designs, such as the use of fritted glass, which can be more easily seen by birds, thus decreasing collisions.

When possible, removal of vegetation should occur outside of the bird nesting window to minimize potential take of migratory birds, if present. If vegetation clearing cannot be avoided during the peak breeding season for migratory birds (approximately May 15 to August 1), a qualified biologist should conduct a pre-construction breeding bird survey within the AUAR area to determine the absence or presence of breeding birds and their nests. Pre-construction breeding bird surveys may include:

1. Pre-construction surveys that occur before tree and shrub clearing activities commence. The area surveyed will include the areas where potential suitable habitat has been identified and tree or shrub clearing has not been completed.

2. If an occupied nest is observed during the survey, the nest tree will be flagged and avoided during the breeding season or until the fledglings have left the area. Consult with the USFWS to avoid take of the species.

3. Upon completion, the survey results will be submitted to the USFWS, as appropriate. If breeding birds are not present, construction can proceed with no restrictions.

[63] USDA National Invasives Species Information Center. undated. Best Management Practices. Available at: https://www.invasivespeciesinfo.gov/subject/best-management-practices. Accessed January 2023.
[64] DNR. 2023b. Terrestrial Invasive Species. Available at: https://www.dnr.state.mn.us/invasives/terrestrial/index.html. Accessed January 2023.

Item 14 Mitigation Strategies

- Per the DNR MCE response letter, tree clearing should be avoided from June 1 through August 15 to avoid the destruction of bat maternity roosting colonies during the pup rearing season.

- Tree removal, if necessary, is recommended to occur during the bat inactive season of November 15 to March 31, inclusive.

- When possible, removal of vegetation should occur outside of the bird nesting window to minimize potential take of migratory birds, if present. If vegetation clearing cannot be avoided during the peak breeding season for migratory birds (approximately May 15 to August 1), a qualified biologist should conduct a pre-construction breeding bird survey within the AUAR area to determine the absence or presence of breeding birds and their nests.

- The Minnesota B3 Guidelines identify strategies for developing bird-safe buildings, including the option of fritted glass. These guidelines may be considered on a voluntary basis.

- BMPs and wildlife-friendly erosion and sediment control devices should be used during construction activities as required by the NPDES Permit, SWPPP, and Construction Site Stormwater Permit to prevent sediment-laden stormwater runoff from the AUAR area into receiving wetlands and waterbodies, which could adversely impact habitats of aquatic semi-aquatic species, such as the Blanding's turtle and shorebirds.

- Erosion control blankets and mulch products will be limited to those that do not contain plastic mesh netting or synthetic (plastic) fiber additives, respectively, in areas that drain to Public Waters.

- Native plants should be incorporated into vegetation plans for landscaping open spaces within the AUAR area, including stormwater basins, and to enhance wildlife habitat and to help prevent the establishment of invasive plants and noxious weeds. Where feasible, Board of Water and Soil Resources (BWSR) or MnDOT seed mixes with native species should be used for stormwater features, parkland, and landscaping in order to provide habitat for the federal candidate monarch butterfly and other pollinators.

- Herbicide, fungicide, and insecticide use within the AUAR area will be minimized to the extent practicable. If the application of these products is necessary during construction or operation within the AUAR area, application should be limited to targeted outbreaks and will be targeted toward the nuisance species.

- Invasive species prevention measures should be implemented during construction to prevent the movement of invasive species on trucks, heavy equipment, off-highway vehicles, and equipment and tools to reduce the likelihood of introducing invasive species from off site. Measures may include requiring contractors and others working on site to arrive and leave with clean equipment free from visible plants, seeds, mud, and dirt clods. Other measures may include using weed-free seed and mulch products and avoiding the re-use of the top six inches of stockpiled materials (mulch, soil, gravel) that may contain more weed seeds.

- The results of the DNR NHIS review are typically valid for one year. The NHIS database must be consulted prior to the commencement of construction activities within the AUAR area to identify any new records of rare or otherwise significant species, native plant communities, and other natural features within the AUAR area vicinity.

15. Historic Properties

Describe any historic structures, archeological sites, and/or traditional cultural properties on or in close proximity to the site. Include: 1) historic designations, 2) known artifact areas, and 3) architectural features. Attach letter received from the State Historic Preservation Office (SHPO). Discuss any anticipated effects to historic properties during project construction and operation. Identify measures that will be taken to avoid, minimize, or mitigate adverse effects to historic properties.

A Minnesota State Historic Preservation Office (SHPO) database inventory query was completed to identify the presence of architectural or archaeological resources within the vicinity of the AUAR area. Based on this database review, no previously conducted archaeological surveys or previously identified archaeological resources are documented within the AUAR area. One architectural resource (SL-DUL-00354) is documented within the AUAR area; however, it was demolished in 2022.

Two archaeological sites (21SL1117 and 21SL0986) have been identified within one mile of the AUAR area (see Table 17). Neither site has been evaluated for eligibility on the National Register of Historic Places (NRHP). There are no previously identified cemeteries within one mile of the AUAR area.

Table 17. Archaeological Sites within 1 Mile of the AUAR Area

Site No.	Cultural Affiliation	Site Type	NRHP Eligibility
21SL1117	Precontact	Isolated Find	Unevaluated
21SL0986	Post-contact	Homestead/Artifact Scatter	Unevaluated

Three archaeological surveys have been conducted within one mile of the AUAR area. The surveys were completed between 2007 and 2019 (see Table 18). No previously conducted surveys overlap the AUAR area, also referenced above.

Table 18. Previously Conducted Surveys within One Mile of the AUAR Area

Document No.	Title	Authors	Year
SL-2007-10	Phase I Archaeological Survey for the Lawcon Project, Duluth, St. Louis County, Minnesota	Stephan L. Mulholland & Susan C. Mulholland	2007
SL-2017-16	FY17 Red Sites Archaeological Surveys, St. Louis River RAP, Duluth, St. Louis County, Minnesota: Minnesota Slip and Slip 3 Phase I Archaeological Survey	S.C. Mulholland & R. Beebe	2017
SL-2019-06	Twin Ports Interchange, Duluth, St. Louis County, Minnesota, SP 6982-322, 2019 Summary of Archaeological Investigations	Two Pines Resource Group, LLC	2019

There are 203 historic architectural resources documented within one mile of the AUAR area (see Table 19). Of these, 191 resources have not been evaluated for eligibility on the NRHP, one has been determined ineligible, and ten are listed on the NRHP. Site SL-DUL-00354, the Duluth Central High School, is mapped within the AUAR area, however the property was demolished in 2022. No previously inventoried architectural resources within a half mile of the AUAR area are listed on or eligible for the NRHP, based on the desktop review.

Table 19. Historic Architectural Resources within 1 Mile of the AUAR Area

Resource No.	Name/Type	Address/Location	NRHP Eligibility
SL-DUL-00078	Duluth Masonic Temple	4 2nd St. W.	Listed
SL-DUL-00081	Engine House No. 1	101 East Third St	Listed
SL-DUL-00354	Duluth Central High School	800 Central Entrance E.	Demolished
SL-DUL-00656	Munger Terrace	405 Mesaba Ave.	Listed
SL-DUL-00956	Duluth Public Library	520 Superior St. W.	Listed
SL-DUL-01680	Sacred Heart Cathedral	211 4th St. W.	Listed
SL-DUL-01869	St. Mark's African Methodist Episcopal Church	530 North 5th Ave. E.	Listed
SL-DUL-02351	Sacred Heart Cathedral Grade School	206 4th St. W.	Listed
SL-DUL-02387	Cathedral School	206 4th St. W.	Listed
SL-DUL-02390	Young Women's Christian Association of Duluth (YWCA)	202 2nd St. W.	Listed
SL-DUL-02395	Duluth Central High School	Lake Ave. & 2nd St.	Listed
SL-DUL-01530	Luke A. Marvin House	123 3rd St. W.	Eligible
SL-DUL-01534	San Marcos Apartments	222-224 3rd St. W.	Eligible
SL-DUL-02370	Carnegie Building/Duluth Public Library	101 2nd St. W.	Eligible
XX-ROD-00109	Trunk Highway 194	Unknown	Not Eligible
SL-DUL-00067	Commercial Electric	118-120 North 1st Ave. W.	Unevaluated
SL-DUL-00069	Peter Pan Cleaners	122 North 3rd Ave. W.	Unevaluated
SL-DUL-00072	Edgell Communications	120-122 North 2nd Ave. W.	Unevaluated
SL-DUL-00075	commercial building	120 2nd St. W.	Unevaluated
SL-DUL-00076	commercial building-Duluth Teachers Credit Union	28 2nd St. W.	Unevaluated
SL-DUL-00077	commercial building-pawnshop	18-20 2nd St. W.	Unevaluated
SL-DUL-00079	Ward Ames/ Barnes/ YMCA Building	4 2nd St. E.	Unevaluated
SL-DUL-00080	Chatham Apartments	10 2nd St. E.	Unevaluated
SL-DUL-00082	apartment	28-32 2nd St. E.	Unevaluated
SL-DUL-00083	house	108 2nd St. E.	Unevaluated
SL-DUL-00084	commercial building	112 2nd St. E.	Unevaluated
SL-DUL-00086	St. Regis Apartments	117-129 North 2nd Ave. E.	Unevaluated
SL-DUL-00231	parking ramp	16-20 North 2nd Ave. W.	Unevaluated
SL-DUL-00251	Plaunt Company Plumbing	121-123 North 1st Ave. W.	Unevaluated
SL-DUL-00252	Chum Drop-In Center	125 N. 1st Ave. W	Unevaluated
SL-DUL-00353	City of Duluth Garage	Central Entrance & Myrtle	Unevaluated
SL-DUL-00534	Washington School	Lake Ave. N. & 3rd St.	Unevaluated

Resource No.	Name/Type	Address/Location	NRHP Eligibility
SL-DUL-00548	house	520 Lake Ave. N.	Unevaluated
SL-DUL-00652	Cascade Park Gazebo	Mesaba & 6th St. E.	Unevaluated
SL-DUL-00657	house	609 Mesaba Ave.	Unevaluated
SL-DUL-00761	Cathedral High School	1215 Rice Lake Road	Unevaluated
SL-DUL-00794	Cook House	501 West Skyline Drive	Unevaluated
SL-DUL-01259	C & H Auto Sales	105 E. 2nd St.	Unevaluated
SL-DUL-01260	house	113 2nd St. E.	Unevaluated
SL-DUL-01261	house	117-119 2nd St. E.	Unevaluated
SL-DUL-01262	commercial building	127 2nd St. E.	Unevaluated
SL-DUL-01263	Crawford Mortuary	131 2nd St. E.	Unevaluated
SL-DUL-01412	apartments	113-119 3rd St. E.	Unevaluated
SL-DUL-01413	apartments	114-124 3rd St. E.	Unevaluated
SL-DUL-01414	apartments	121-123 3rd St. E.	Unevaluated
SL-DUL-01415	apartments	125-127 3rd St. E.	Unevaluated
SL-DUL-01416	apartments	201-203 3rd St. E.	Unevaluated
SL-DUL-01417	apartments	209-211 3rd St. E.	Unevaluated
SL-DUL-01418	St. Mary's School of Nursing-Nurses Residence	231 3rd St. E.	Unevaluated
SL-DUL-01419	apartments	301-307 3rd St. E.	Unevaluated
SL-DUL-01420	apartments	317 3rd St. E.	Unevaluated
SL-DUL-01528	Buckingham	18-26 3rd St. W.	Unevaluated
SL-DUL-01529	Cascade Hotel	101 3rd St. W.	Unevaluated
SL-DUL-01531	apartments	124 3rd St. W.	Unevaluated
SL-DUL-01532	Charles A. Duncan House	131 3rd St. W.	Unevaluated
SL-DUL-01533	house	213 3rd St. W.	Unevaluated
SL-DUL-01535	house	226 3rd St. W.	Unevaluated
SL-DUL-01536	house	310-312 3rd St. W.	Unevaluated
SL-DUL-01538	house	319 3rd St. W.	Unevaluated
SL-DUL-01539	apartments	421 3rd St. W.	Unevaluated
SL-DUL-01540	Frank A. Brewer House	427 3rd St. W.	Unevaluated
SL-DUL-01541	house	523 3rd St. W.	Unevaluated
SL-DUL-01542	house	525 3rd St. W.	Unevaluated
SL-DUL-01543	house	527 3rd St. W.	Unevaluated
SL-DUL-01583	house	9-11 4th St. E.	Unevaluated
SL-DUL-01584	house	13-15 4th St. E.	Unevaluated
SL-DUL-01586	apartments	120 4th St. E.	Unevaluated
SL-DUL-01587	apartments	214-216 4th St. E.	Unevaluated
SL-DUL-01588	house	224 4th St. E.	Unevaluated

Resource No.	Name/Type	Address/Location	NRHP Eligibility
SL-DUL-01590	house	226 4th St. E.	Unevaluated
SL-DUL-01591	Arthur, Charles H. and Elizabeth, House	230 4th St. E.	Unevaluated
SL-DUL-01592	Messiah Lutheran Church	4th St. and 3rd Ave. E.	Unevaluated
SL-DUL-01593	Jeffrey Black Building	332 4th St. E.	Unevaluated
SL-DUL-01594	commercial building	401 4th St. E.	Unevaluated
SL-DUL-01595	commercial building	407 4th St. E.	Unevaluated
SL-DUL-01596	The Barber	419 4th St. E.	Unevaluated
SL-DUL-01681	Chancery Building	215 4th St. W.	Unevaluated
SL-DUL-01682	house	331 4th St. W.	Unevaluated
SL-DUL-01683	house	332 4th St. W.	Unevaluated
SL-DUL-01684	house	515 4th St. W.	Unevaluated
SL-DUL-01685	house	517-519 4th St. W.	Unevaluated
SL-DUL-01686	house	521-523 4th St. W.	Unevaluated
SL-DUL-01687	house	525 4th St. W.	Unevaluated
SL-DUL-01688	house	527 4th St. W.	Unevaluated
SL-DUL-01689	house	529-531 4th St. W.	Unevaluated
SL-DUL-01690	house	715 4th St. W.	Unevaluated
SL-DUL-01691	house	721-723 4th St. W.	Unevaluated
SL-DUL-01699	apartments	8 5th St. E.	Unevaluated
SL-DUL-01700	house	25 5th St. E.	Unevaluated
SL-DUL-01701	apartments	30-34 5th St. E.	Unevaluated
SL-DUL-01702	house	116 5th St. E.	Unevaluated
SL-DUL-01703	apartments	322-324 5th St. E.	Unevaluated
SL-DUL-01704	Evergreen Apartments	402-404 5th St. E.	Unevaluated
SL-DUL-01705	duplex	407 5th St. E.	Unevaluated
SL-DUL-01706	duplex	417 5th St. E.	Unevaluated
SL-DUL-01707	house	421 5th St. E.	Unevaluated
SL-DUL-01708	duplex	617 E 5th St	Unevaluated
SL-DUL-01710	duplex	619 E 5th St	Unevaluated
SL-DUL-01770	apartments	201-203 5th St. W.	Unevaluated
SL-DUL-01771	apartments	231 5th St. W.	Unevaluated
SL-DUL-01772	apartments	325 5th St. W.	Unevaluated
SL-DUL-01773	apartments	631 5th St. W.	Unevaluated
SL-DUL-01785	apartments	109-111 5 1/2 St. W.	Unevaluated
SL-DUL-01787	house	301 6th St. E.	Unevaluated
SL-DUL-01788	house	310 6th St. E.	Unevaluated
SL-DUL-01790	house	314 6th St. E.	Unevaluated

Resource No.	Name/Type	Address/Location	NRHP Eligibility
SL-DUL-01792	house	511 6th St. E.	Unevaluated
SL-DUL-01793	house	517-517 1/2 6th St. E.	Unevaluated
SL-DUL-01794	house	629 6th St. E.	Unevaluated
SL-DUL-01825	apartments	24-26 7th St. E.	Unevaluated
SL-DUL-01826	apartments	221-223 7th St. E.	Unevaluated
SL-DUL-01827	apartments	221-223 7th St. E.	Unevaluated
SL-DUL-01828	apartments	725-727 7th St. E.	Unevaluated
SL-DUL-01842	house	215 7th St. W.	Unevaluated
SL-DUL-01843	house	531 7th St. W.	Unevaluated
SL-DUL-01844	house	602 7th St. W.	Unevaluated
SL-DUL-01845	house	101 8th St. E.	Unevaluated
SL-DUL-01860	apartments	213-215 North 2nd Ave. E.	Unevaluated
SL-DUL-01861	apartments	214-216 North 2nd Ave. E.	Unevaluated
SL-DUL-01862	apartments	219 North 2nd Ave. E.	Unevaluated
SL-DUL-01863	Tri Towers Apartments	222 North 2nd Ave. E.	Unevaluated
SL-DUL-01864	apartments	310-316 North 2nd Ave. E.	Unevaluated
SL-DUL-01865	apartments	313-315 3rd Ave. E.	Unevaluated
SL-DUL-01867	house	524 North 4th Ave. E.	Unevaluated
SL-DUL-01876	Old Fire Hall	901 North 7th Ave. E.	Unevaluated
SL-DUL-02007	duplex	412-414 North 2nd Ave. W.	Unevaluated
SL-DUL-02008	house	329 North 4th Ave. E.	Unevaluated
SL-DUL-02010	apartments	419-421 1/2 North 5th Ave. W.	Unevaluated
SL-DUL-02340	apartments	122-126 4th St. W.	Unevaluated
SL-DUL-02341	apartments	129-131 4th St. W.	Unevaluated
SL-DUL-02343	house	19 4th St. W.	Unevaluated
SL-DUL-02345	commercial building	105-107 4th St. W.	Unevaluated
SL-DUL-02346	commercial building	103 4th St. W.	Unevaluated
SL-DUL-02349	house	432 4th Ave. W.	Unevaluated
SL-DUL-02355	house	631 North 6th Ave. W.	Unevaluated
SL-DUL-02356	Calvary Baptist Church	432 6th St. E.	Unevaluated
SL-DUL-02362	apartments	128 4th St. W.	Unevaluated
SL-DUL-02365	Sacred Heart Cathedral Convent	North 2nd Ave. W.	Unevaluated
SL-DUL-02501	Bob Dylan's Boyhood Home	519 3rd Ave. N	Unevaluated
SL-DUL-02505	Fire Hall #1	22 East Second St	Unevaluated
SL-DUL-02670	St. Josephata Parish Church	417 3rd Ave. E	Unevaluated
SL-DUL-02813	Temple Adas Israel Synagogue	302 E 3RD ST	Unevaluated

Resource No.	Name/Type	Address/Location	NRHP Eligibility
SL-DUL-02814	St. Mary Star of the Sea Catholic Church (St. Mary's Polish Catholic Church)	325 E 3RD ST	Unevaluated
SL-DUL-02816	St. Mary's Hospital	407 E 3RD ST	Unevaluated
SL-DUL-02817	Kaarbos Auto Repair	331 E 4th St.	Unevaluated
SL-DUL-02818	Goering Bldg.	413 E 4th St.	Unevaluated
SL-DUL-02819	Beschenbossel Building	415 E 4th St.	Unevaluated
SL-DUL-02820	Bell Apartment	502 E 4th St.	Unevaluated
SL-DUL-02821	Tufia Bldg.	513 E 4th St.	Unevaluated
SL-DUL-02824	Duplex	308 E.5th St.	Unevaluated
SL-DUL-02825	Flats (in rear)	309 E.5th St.	Unevaluated
SL-DUL-02826	Duplex	311 E. 5th St.	Unevaluated
SL-DUL-02827	Double House	405 E. 5th St.	Unevaluated
SL-DUL-02828	Nettleton Elementary School	108 E. 6th St.	Unevaluated
SL-DUL-02829	Double House	222 E. 6th St.	Unevaluated
SL-DUL-02830	Double House	224 E. 6th St.	Unevaluated
SL-DUL-02831	Duplex	414 E. 6th St.	Unevaluated
SL-DUL-02832	Flats	419 N 1st Ave. W.	Unevaluated
SL-DUL-02833	Flats	417 N 2nd Ave. W.	Unevaluated
SL-DUL-02834	Double House	521 N 3rd Ave. W.	Unevaluated
SL-DUL-02835	Flats	517 N 4th Ave. W.	Unevaluated
SL-DUL-02836	Bartholdi Block	501 E 4th St.	Unevaluated
SL-DUL-03087	commercial building	101-103 West Fourth St	Unevaluated
SL-DUL-03089	apartment building	407-413 North First Ave West	Unevaluated
SL-DUL-03162	House	514 E. 12th St.	Unevaluated
SL-DUL-03163	House	522 E. 12th St.	Unevaluated
SL-DUL-03164	House	526 E. 12th St.	Unevaluated
SL-DUL-03609	House	623 E. 5th St.	Unevaluated
SL-DUL-03610	2 Houses	613 E. 5th St.	Unevaluated
SL-DUL-03611	House	609 E. 5th St.	Unevaluated
SL-DUL-03612	Automotive Parts Headquarters Inc.	502 N. 6th Ave. E.	Unevaluated
SL-DUL-03613	? Auto Repair-Retail Store	531 E. 5th St.	Unevaluated
SL-DUL-03614	SMDC Health System building	412 N. 5th Ave. E.	Unevaluated
SL-DUL-03626	Bayview Manor Apartments	621 East Upham Road	Unevaluated
SL-DUL-03627	Windwood Townhomes Complex	807 East Upham Road	Unevaluated
SL-DUL-03628	Windwood Townhomes Building 1	807 East Upham Road	Unevaluated
SL-DUL-03629	Windwood Townhomes Building 2	807 East Upham Road	Unevaluated

Resource No.	Name/Type	Address/Location	NRHP Eligibility
SL-DUL-03630	Windwood Townhomes Building 3	807 East Upham Road	Unevaluated
SL-DUL-03631	Windwood Townhomes Building 4	807 East Upham Road	Unevaluated
SL-DUL-03632	Windwood Townhomes Building 5	807 East Upham Road	Unevaluated
SL-DUL-03633	Windwood Townhomes Building 6	807 East Upham Road	Unevaluated
SL-DUL-03731	house	708 E 6th St	Unevaluated
SL-DUL-03732	house	517 N 7th Ave E	Unevaluated
SL-DUL-03733	house	526 N 7th Ave E	Unevaluated
SL-DUL-03819	Duplex	221-223 3rd St E	Unevaluated
SL-DUL-03829	Duplex	119-121 4th St E	Unevaluated
SL-DUL-03830	Duplex	206-208 4th St E	Unevaluated
SL-DUL-03847	Apartment Building	605-607 6th St E	Unevaluated
SL-DUL-03848	Duplex	614-616 6th St E	Unevaluated
SL-DUL-03864	Triplex	25-29 4th St W	Unevaluated
SL-DUL-03867	Triplex	10 5th St W	Unevaluated
SL-DUL-03868	Triplex	18 5th St W	Unevaluated
SL-DUL-03869	Triplex	20 5th St W	Unevaluated
SL-DUL-03870	Duplex	24 5th St W	Unevaluated
SL-DUL-03871	Duplex	107 5th St W	Unevaluated
SL-DUL-03875	Duplex	609-611 N 4th Ave E	Unevaluated
SL-DUL-03880	Apartment Building	407-409-411-413 N 1st Ave W	Unevaluated
SL-DUL-03881	Apartment Building	507-509-511-513 N 1st Ave W	Unevaluated
SL-DUL-03882	Duplex	512-514 N 1st Ave W	Unevaluated
SL-DUL-03883	Duplex	311-313 N 2nd Ave W	Unevaluated
SL-DUL-03884	Triplex	319 N 4th Ave W	Unevaluated
SL-DUL-03885	Triplex	325-327 N 4th Ave W	Unevaluated
SL-DUL-03930	Bridge 69575	TH 194 over 2ND AVE W RAMP	Unevaluated

Historic Aerials and Maps

On the Trygg historical map and 1857 Bureau of Land Management General Land Office survey map the Rice Lake Trail is shown running either through or adjacent to the AUAR area. The 1914 St. Louis County plat map shows M.E. Ewing and Dul. H. Ld. Co as the owners of the land within the AUAR area.[65] The 1935 topographic quadrangle map of Duluth depicts the AUAR as “Gravel Pit Reservoirs”.

Historic aerial imagery between 1939 and 1971 show the area of the AUAR as open field.

[65] Hixon & Co. Township 50 North – Range 14 West, Duluth, St. Louis County, 1914. Accessed January 2024. https://historicmapworks.com/Map/US/166967/Township+50+North+++Range+14+West++Duluth/St.+Louis+County+1914/Minnesota/

Item 15 Mitigation Strategies

Archaeology

- A Phase I Archaeological Survey shall be conducted before or at the time development is proposed. The survey must meet the requirements of the Secretary of the Interior's Standards for Identification and Evaluation and should include an evaluation of NRHP eligibility for any properties that are identified. If historic, cultural, or archaeologically significant features are identified during the Phase I Survey, a Phase II survey may be required. Coordination and consultation with the SHPO will be necessary.

- If a future project takes advantage of federal funding, or requires a federal permit or license, a Section 106 review will be required along with consultation with the SHPO.

Architectural

- No previously inventoried architectural resources within a half mile of the AUAR area are listed on or eligible for the NRHP, based on the desktop review.

- Based on the preliminary desktop review, a historic architectural property survey is not recommended at this time. If a future project takes advantage of federal financial assistance, or requires a federal permit or license, a Section 106 review would be required along with consultation with the SHPO.

16. Visual

Describe any scenic views or vistas on or near the project site. Describe any project related visual effects such as vapor plumes or glare from intense lights. Discuss the potential visual effects from the project. Identify any measures to avoid, minimize, or mitigate visual effects.

Redevelopment of the AUAR area would include demolition of remaining buildings and associated infrastructure and construction of either a business park (Scenario A) or mixed use development (Scenario B). In either redevelopment scenario, the use of the AUAR area would change from its former institutional use. In both Scenario A and B, the Duluth Traverse and Central Entrance trails would remain within the AUAR area, although slight adjustments to alignment may be necessary depending on the future site layout. For both scenarios, the existing broadcast (radio) towers would remain, as well as the approximately 27 acres of wooded area.
The AUAR area is located on a hill and averages approximately 650-700 feet above the elevation of Lake Superior. The AUAR area slopes down to the east towards Lake Superior. Due to its elevation and location, the AUAR area has scenic views of Lake Superior, historic downtown Duluth and Canal Park, all below the AUAR area. Views of the AUAR area from surrounding areas are obscured due to the steep change in elevation, as well as the existing trees and vegetation.

Considerations for Scenario A

Scenario A would involve the construction of a business park with approximately 360,000 square feet of light industrial/warehouse distribution uses at full buildout. Buildings would be one-story and likely only visible from the neighborhood to the southeast and from the area below the AUAR area. Development would be required to adhere to all development standards in the City Code including setbacks from the property line, building façade materials, exterior lighting, sign appearance, screening, landscaping and tree preservation. City requirements include that all lighting be downcast and may not cast light beyond the property lines. Additionally, for industrial uses, there are specific requirements for building façade and screening, especially when adjacent to residential uses to ensure that the impact to residential uses is mitigated to the extent possible. Additional mitigation measures to protect birds and other wildlife may be considered, as proposed in Item 14 – Fish, Wildlife, Plant Communities, and Sensitive Ecological Resources (Rare Features).

Considerations for Scenario B

Scenario B (maximum development scenario) would involve the construction of a mixed residential and commercial development with approximately 1,590 units of residential and 124,000 square feet of commercial space at full buildout. Buildings would be a maximum of seven stories and would be visible from the neighborhood to the southeast and partially visible from both Central Entrance and the residential neighborhood to the west. Similar to Scenario A, the mixed use development would be required to adhere to all development standards in the City Code. Additionally, within mixed use districts, building design requirements apply, which further regulate building and site appearance including building placement and façade. While buildings would likely be visible from adjacent neighborhoods, the appearance would be similar to other mixed use developments throughout the City of Duluth. Because the development would be at the top of a hill, it is unlikely that it would block scenic views of Lake Superior for other existing development in the area. Similar to Scenario A, additional mitigation measures to protect birds and other wildlife may be considered, as proposed in Item 14 – Fish, Wildlife, Plant Communities, and Sensitive Ecological Resources (Rare Features).

Item 16 Mitigation Strategies

- Exterior lighting would meet or exceed requirements in the City's zoning code Article 4, Section 50-31.
- Building form and façade would meet or exceed requirements in the City's zoning code Article 4, Section 50-30.
- Screening would meet or exceed requirements in the City's zoning code Article 4, Section 50-26.
- Landscaping and tree preservation would meet or exceed requirements in the City's zoning code Article 4, Section 50-25.
- Wooded areas and vegetative buffers will be retained to provide additional screening to adjacent properties as much as feasible.
- Developer will comply with any additional visual impact assessments or mitigation measures proposed by the City during the development review process for individual projects within the AUAR area.

17. Air

a. Stationary source emissions - Describe the type, sources, quantities and compositions of any emissions from stationary sources such as boilers or exhaust stacks. Include any hazardous air pollutants, criteria pollutants. Discuss effects to air quality including any sensitive receptors, human health or applicable regulatory criteria. Include a discussion of any methods used assess the project's effect on air quality and the results of that assessment. Identify pollution control equipment and other measures that will be taken to avoid, minimize, or mitigate adverse effects from stationary source emissions.

In accordance with the EQB's AUAR guidance document[66], this item is not applicable to an AUAR as any stationary air emission sources large enough to merit environmental review would require individual review. Pursuant to Minnesota Rules 4410.3610, Subpart 1, the AUAR process is not allowed to satisfy mandatory environmental review for several heavy industrial uses. Scenario A includes light industrial/warehouse distribution uses. Scenario B does not propose any industrial uses. No heavy industrial uses were considered as part of this AUAR. If future heavy industrial uses are proposed within

[66] EQB. Alternative Urban Areawide Review Documents: Recommended Content and Format. Updated September 2008. https://www.eqb.state.mn.us/sites/eqb/files/documents/AUAR%20guidance%20%28form%29%20-9-09.pdf

the AUAR area, this AUAR process would not replace the preparation of a state Environmental Assessment Worksheet (EAW) or Environmental Impact Statement (EIS) if mandatory thresholds are met, including Minnesota Rules 4410.4300, Subpart 15 which defines mandatory environmental review thresholds related to air pollution. The following paragraph describes potential sources of low-level air emissions typically associated with industrial development.

Generally, industrial facilities may utilize natural gas and electric-powered equipment, which would emit low levels of greenhouse gas emissions (GHG) as well as hazardous air pollutants (HAPs) and criteria pollutants, such as Nitrogen Oxides (NOx), Carbon Monoxide (CO), Sulfur Dioxide (SO2), and particulate matter (PM). An inventory of potential electric and natural gas equipment to be installed as part of future development within the AUAR area is not known at this time. Generally, air emissions associated with light industrial uses are relatively insignificant and the facilities would not require an air permit. Future industrial developers within the AUAR area would be responsible for determining air permit applicability or exemption determinations based on the equipment to be installed with their project prior to initiating construction.

b. Vehicle emissions - Describe the effect of the project's traffic generation on air emissions. Discuss the project's vehicle-related emissions effect on air quality. Identify measures (e.g. traffic operational improvements, diesel idling minimization plan) that will be taken to minimize or mitigate vehicle-related emissions.

Motorized vehicles affect air quality by emitting air borne pollutants. The changes in traffic volumes, travel patterns, and roadway locations for either development scenario may affect air quality by changing the number of vehicles and the congestion levels in the AUAR area. It is not anticipated that the development scenarios would include transportation improvement projects that would be considered regionally significant per 40 CFR Part 93.

Criteria pollutants identified by the U.S. Environmental Protection Agency (EPA) are ozone, particulate matter (PM), carbon monoxide (CO), nitrogen dioxide (NO_2), lead, and sulfur dioxide (SO_2). In Minnesota, air quality analysis for transportation projects primarily addresses localized CO emissions and Mobile Source Air Toxics (MSATs). The AUAR area is not located within a nonattainment or maintenance area for criteria pollutants.

Carbon Monoxide

The AUAR area is not located within a CO maintenance or nonattainment area. Future development within the AUAR area is expected to generate increased vehicular traffic, which would result in a relatively small increase in CO emissions and other vehicle related emissions. The EPA has approved a CO hot spot screening method designed to identify intersections that may result in CO emissions that exceed air quality standards. This screening method assumes that intersections with a total daily traffic volume exceeding 82,300 vehicles per day may result in potential CO impacts that exceed air quality standards. A traffic impact study was completed for the development scenarios, which is discussed in Item 20 of this AUAR. Based on this study, intersections within the study area would not generate traffic exceeding 82,300 vehicles per day. Therefore, it is not anticipated that vehicle emissions generated by the development scenarios would have the potential to significantly impact CO air pollution.

Mobile Source Air Toxics (MSAT)

In addition to the criteria air pollutants, the EPA also regulates air toxics. The Federal Highway Administration (FHWA) provides guidance for the assessment of Mobile Source Air Toxic (MSAT) effects for transportation projects. A qualitative evaluation of MSATs has been performed for the AUAR, the scope and methods of which have been developed in collaboration with MnDOT, MPCA, and FHWA.

Controlling air toxic emissions became a national priority with the passage of the Clean Air Act Amendments (CAAA) of 1990, whereby Congress mandated that the EPA regulate 188 air toxics, also

known as hazardous air pollutants. The EPA assessed this expansive list in its rule on the Control of Hazardous Air Pollutants from Mobile Sources (Federal Register, Vol. 72, No. 37, page 8430, February 26, 2007), and identified a group of 93 compounds emitted from mobile sources that are part of EPA's Integrated Risk Information System (IRIS).[67] In addition, EPA identified nine compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers or contributors and non-cancer hazard contributors from the 2011 National Air Toxics Assessment (NATA).[68] These are *1,3-butadiene, acetaldehyde, acrolein, benzene, diesel particulate matter (diesel PM), ethylbenzene, formaldehyde, naphthalene, and polycyclic organic matter.* While FHWA considers these the priority mobile source air toxics, the list is subject to change and may be adjusted in consideration of future EPA rules.

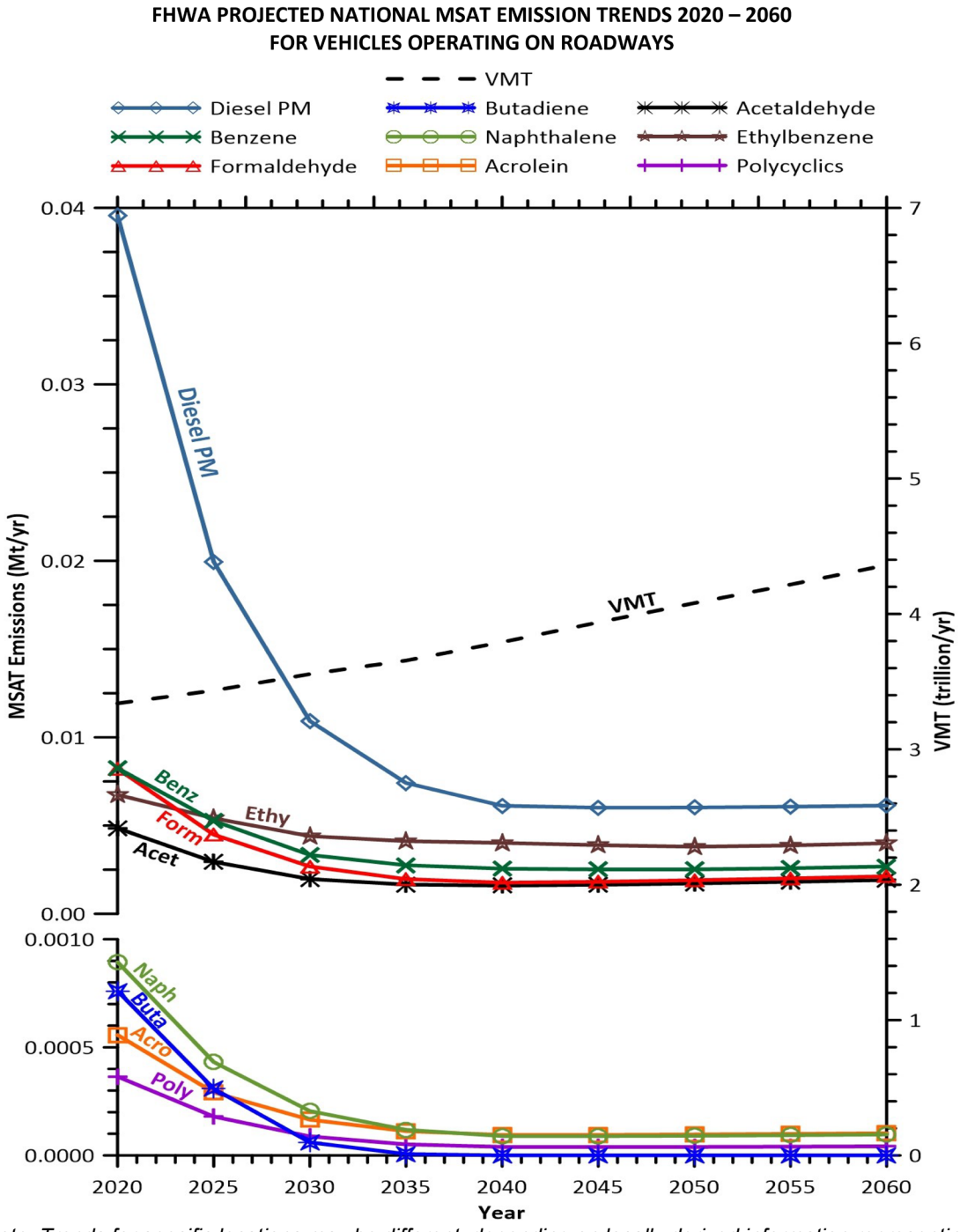
Motor Vehicle Emissions Simulator (MOVES)

According to EPA, MOVES3 is a major revision to MOVES2014 and improves upon it in many respects. MOVES3 includes new data, new emissions standards, and new functional improvements and features. It incorporates substantial new data for emissions, fleet, and activity developed since the release of MOVES2014. These new emissions data are for light- and heavy-duty vehicles, exhaust and evaporative emissions, and fuel effects. MOVES3 also adds updated vehicle sales, population, age distribution, and vehicle miles travelled (VMT) data. In the November 2020 EPA issued MOVES3 Mobile Source Emissions Model Questions and Answers 4 EPA states that for on-road emissions, MOVES3 updated heavy-duty (HD) diesel and compressed natural gas (CNG) emission running rates and updated HD gasoline emission rates. They updated light-duty (LD) emission rates for hydrocarbon (HC), carbon monoxide (CO) and nitrogen oxide (NOx) and updated light-duty (LD) particulate matter (PM) rates, incorporating new data on Gasoline Direct Injection (GDI) vehicles.

Using EPA's MOVES3 model, as shown in Exhibit 8, FHWA estimates that even if VMT increases by 31 percent from 2020 to 2060 as forecast, a combined reduction of 76 percent in the total annual emissions for the priority MSAT is projected for the same time period.

[67] https://www.epa.gov/iris
[68] https://www.epa.gov/national-air-toxics-assessment

Exhibit 8: FHWA Projected National MSAT Emission Trends 2020 – 2060 for Vehicles Operating on Roadways



Note: Trends for specific locations may be different, depending on locally derived information representing vehicle-miles travelled, vehicle speeds, vehicle mix, fuels, emission control programs, meteorology, and other factors
Source: EPA MOVES3 model runs conducted by FHWA, March 2021.

Diesel PM is the dominant component of MSAT emissions, making up 36 to 56 percent of all priority MSAT pollutants by mass, depending on calendar year. Users of MOVES3 will notice some differences in emissions compared with MOVES2014. MOVES3 is based on updated data on some emissions and pollutant processes compared to MOVES2014, and also reflects the latest Federal emissions standards in place at the time of its release. In addition, MOVES3 emissions forecasts are based on slightly higher

VMT projections than MOVES2014, consistent with nationwide VMT trends.

Qualitative MSAT Analysis

For each Development Scenario in this AUAR, the amount of MSAT emitted would be proportional to the average daily traffic (ADT), assuming that other variables such as fleet mix are the same for each development scenario. The ADT estimated for each of the development scenarios is higher than that for the No Build Alternative, because the new development attracts trips that would not otherwise occur in the area. Appendix F provides the Traffic Impact Study which present trip generation estimates associated with the development scenarios. This increase in ADT means MSAT under the development scenarios would probably be higher than the No Build Alternative in the study area. There could also be localized differences in MSAT from indirect effects of the development scenarios such as associated access traffic, emissions of evaporative MSAT (e.g., benzene) from parked cars, and emissions of diesel particulate matter from delivery trucks.

Because the estimated ADT under each of the development scenarios are nearly the same, it is expected there would be no appreciable difference in overall MSAT emissions between the two development scenarios. For both development scenarios, emissions are virtually certain to be lower than present levels in the design year as a result of the EPA's national control programs that are projected to reduce annual MSAT emissions by over 76 percent from 2020 to 2060 (Updated Interim Guidance on Mobile Source Air Toxic Analysis in NEPA Documents, Federal Highway Administration, January 18, 2023). Local conditions may differ from these national projections in terms of fleet mix and turnover, ADT growth rates, and local control measures. However, the magnitude of the EPA-projected reductions is so great (even after accounting for ADT growth) that MSAT emissions in the study area are likely to be lower in the future than they are today.

Potential Impacts

Future development is expected to generate increased vehicular traffic, which may result in a relatively small increase in CO emissions and other vehicle related emissions.

The increase in traffic associated with new development was considered in a qualitative evaluation of MSATs. The increased traffic could lead to higher MSAT emissions near the AUAR area. Therefore, under both development scenarios there may be localized areas where ambient concentrations of MSATs would be higher than under existing conditions. However, the magnitude and duration of these potential differences cannot be reliably quantified, due to incomplete or unavailable information in forecasting project-specific health impacts. On a region-wide basis, EPA's vehicle and fuel regulations, coupled with fleet turnover, will cause substantial reductions over time that in almost all cases the MSAT levels in the future will be significantly lower than today.

c. Dust and odors – Describe sources, characteristics, duration, quantities, and intensity of dust andodors generated during project construction and operation. (Fugitive dust may be discussed under item 17a). Discuss the effect of dust and odors in the vicinity of the project including nearby sensitive receptors and quality of life. Identify measures that will be taken to minimize or mitigate the effects of dust and odors.

The proposed development scenarios are not anticipated to produce dust or odors during operation but may generate temporary dust and odors during construction. The majority of the AUAR area consists of previously developed; now undeveloped land. To the northwest of the AUAR area, the Duluth School District has facilities. Additionally, within the northeast portion of the AUAR area, the Secondary Technical Center building is currently not in use. Nearby sensitive receptors would include residential neighborhoods to the west and east of the AUAR area.

Potential odors would likely be associated with exhaust from diesel engines and fuel storage. Dust generated during construction would be minimized through standard dust control measures such as

applying water to exposed soils and limiting the duration of exposed soils to the extent possible. Construction contractors would be required to comply with the City's Construction Standards which include implementing adequate dust control measures to meet all air quality regulations and minimize the potential to create a nuisance to adjacent property owners. Dust levels, after construction is complete, would be minimal as all surfaces will be paved or revegetated. With these mitigation measures in place, the quality of life for nearby residences is not anticipated to be affected.

Item 17 Mitigation Strategies

- BMPs shall be implemented during construction to control dust, which may include the following minimization and mitigation measures:
    - Minimization of land disturbance during site preparation
    - Use of watering trucks to minimize dust
    - Covering of trucks while hauling soil/debris off-site, or transferring materials
    - Stabilization of dirt piles if they are not removed immediately
    - Use of dust suppressants on unpaved areas
    - Minimization of unnecessary vehicle and machinery idling
    - Products containing chloride would be avoided as a dust suppressant in areas that drain to wetlands or public waters
- Any proposed development that meets mandatory EAW or EIS thresholds shall analyze stationary source air emissions consistent with their specific project components.

18. Greenhouse Gas (GHG) Emissions/Carbon Footprint

a. GHG Quantification: For all proposed projects, provide quantification and discussion of project GHG emissions. Include additional rows in the tables as necessary to provide project-specific emission sources. Describe the methods used to quantify emissions. If calculation methods are not readily available to quantify GHG emissions for a source, describe the process used to come to that conclusion and any GHG emission sources not included in the total calculation.

The Greenhouse Gas (GHG) emissions for the proposed development scenarios are calculated using the Simplified Greenhouse Gas Emissions Calculator (SGEC) tool and are based on the methodologies for developing a carbon footprint described in Minnesota Environmental Quality Board's (EQB's) EAW Guidance (July 2023). Table 20 shows the emission categories for the proposed development scenarios' carbon footprint calculations, as provided in the EQB Guidance.

Table 20. Emission Categories for Carbon Footprint

Category	Scope	Project Phase	Type of Emissions
Direct Emissions	Scope 1	Construction	Combustion (Mobile Sources)
	Scope 1	Operations	Combustion (Mobile Sources)
	Scope 1	Operations	Combustion (Stationary Sources)
Indirect Emissions	Scope 2	Operations	Off-site Electricity (Market-Based and Location-Based)
	Scope 3	Operations	Off-site Waste Management

A description of the carbon footprint associated with the proposed development scenarios is provided below.

Construction Emissions

GHG emissions from construction of each of the two proposed scenarios are associated with fuel combustion in the mobile construction equipment and on-road vehicles. For on-road vehicles (commuting construction workers, dump trucks and semi-trucks), emissions are calculated by estimating the number of vehicles, miles traveled (estimated to be 20 miles per day for workers, 60 miles per day for heavy duty trucks), gallons of fuel used (using default mileage rates), and emission factors from the U.S. EPA's Emission Factors Hub (https://www.epa.gov/climateleadership/ghg-emission-factors-hub, updated April 2022).

For off-road vehicles, the quantity and horsepower of cranes, backhoes, loaders, bulldozers, excavators, and skid steers was estimated based on other similar development projects. The default fuel consumption rate of 0.05 gallons per horsepower-hour[69] is used to determine the fuel usage for all equipment. Similar to the on-road vehicles, emission factors from the Emission Factors Hub are used to calculate GHG emissions.

Per EQB's Revised EAW Guidance, total construction emissions for each scenario are divided by the lifetime of the project, estimated to be 50 years.

Operational Emissions – Mobile Sources

Average daily trips associated with each scenario are provided in Table 21.

Table 21. Average Trips per Day

Scenario A – Business Park/Warehouse[1]	Trips /Day	Scenario B – Mixed Use[2]	Trips/Day
Warehouse Workers	150	Resident	7,230
Warehouse Shipping Vehicles	100	Retail Facilities (Hotel, Restaurant, Retail)	5,449
		Deliveries	15

[1] *Estimated based on 50 employees per warehouse building.*
[2] *Based on traffic study in Transportation Section of the EAW for Scenario B.*

For Scenario A, it is conservatively estimated that daily trips take place for 260 days per year (5 days per week, 52 weeks per year). The daily commute for warehouse workers is estimated to be 30 miles round trip. The same distance is assumed for heavy duty shipping trucks, 30 miles per trip.

For Scenario B, the maximum daily weekday trips were conservatively assumed to occur for 365 days per year. Trip distance for residents, retail facility customers, and delivery trucks is estimated at 5 miles per trip.

Gas mileage for light duty vehicles (residents, warehouse workers, and retail) is estimated based on the U.S. Department of Transportation's Bureau of Transportation Average Fuel Efficiency for Light Duty Vehicles. Delivery trucks and shipping vehicles are assumed to be heavy-duty diesel trucks. Gas mileage for the diesel trucks is based on U.S. Department of Transportation, Federal Highway

[69] Based on South Coast Air Quality Management District CEQA Air Quality Handbook, Table A9-3E.

Administration data from 2020. GHG emissions associated with these trips are calculated using the Emission Factors Hub.

Operational Emissions – Stationary Combustion

The projected natural gas usage for the buildings associated with each scenario is estimated using the U.S. Energy Information Administration's Commercial Buildings Energy Consumption Survey (CBECS, 2018). The CBECS provides natural gas intensities in standard cubic feet per square foot per year for several different building activity categories.

Natural gas combustion GHG emissions are calculated using emission factors from the Emission Factors Hub.

Operational Emissions – Offsite Electricity Production

Similar to natural gas usage, electricity needs for the proposed buildings are estimated using the CBECS, which provides electricity usage intensity in kilowatt-hours per square foot of building space per year. GHG emissions occur offsite (Scope 2) when the electricity is generated. The SGEC tool calculates GHG emissions from electricity generation on a regional basis (defined by U.S. EPA using data from the EIA and the North American Electric Reliability Corporation (NERC)), using average emission factors based on the mix of fuels used to generate the electricity in each region. For the proposed development scenarios, the Midwest Reliability Organization West (MROW) region is used. The electricity generation in MROW is comprised of approximately 50 percent fossil fuels (coal and natural gas), 9 percent nuclear and approximately 40 percent renewables (hydro, wind, and solar).

Operational Emissions - Waste Management

GHG emissions from waste management for both scenarios are associated with the waste generation estimates and how that waste is handled. For Scenario A, a waste generation rate for warehouses of 1.0 pounds per 100 square foot per day was used, based on estimates from the National Solid Waste Management Association. It is further estimated that the waste generated by the warehouse will be composed of 50 percent mixed recyclables and 50 percent municipal solid waste.

For Scenario B, for residential waste, a default waste generation rate of 4.9 pounds per person per day (lb/person/day) was obtained from the U.S. EPA's Fact Sheet, 2018 – Municipal Solid Waste Generation, Recycling and Disposal in the United States: Facts and Figures for 2018. The report breaks down the waste generation rate into recycled (1.2 lb/person/day), composted (0.4 lb/person/day), landfilled (2.4 lb/person/day), combusted (0.6 lb/person/day) and other food management (0.3 lb/person/day). Applying these rates to the number of residential units and conservatively assuming four residents per unit, yields a total waste generation rate of 5,687 tons per year.

Waste generation estimates were also made for the proposed school, restaurant, and hotel.

GHG emissions for each waste management type are estimated based on emission factors from the U.S. EPA's Waste Reduction Model (WARM).

Summary

A summary of GHG emissions is provided in Table 22. Emissions are presented in tons per year of carbon dioxide equivalent, which takes into account each GHG's global warming potential (GWP). Detailed emission calculations are provided in Appendix E Greenhouse Gas Analysis Calculations.

Table 22. GHG Emissions Summary (CO2e in short tons per year)

Scope	Source	Scenario A	Scenario B
Direct Emissions			
Scope 1	Construction – Mobile Sources*	43	2,886
Scope 1	Operations – Mobile Sources	1,959	10,553
Scope 1	Operations – Stationary Combustion	438	4,701
Indirect Emissions			
Scope 2	Operations – Purchased Electricity	1,189	12,290
Scope 3	Off-Site Waste Management	221	2,174
Total		**3,846**	**32,604**

**Note that construction emissions are annualized over the life of the project, estimated to be 50 years.*

b. GHG Assessment

i. Describe any mitigation considered to reduce the project's GHG emissions.

The following possible activities may be considered to help mitigate the proposed development scenarios' GHG emissions:

- Keeping as many existing trees as possible.
- Energy-efficient lighting in buildings and parking lots.
- Use of energy-efficient building materials.
- Installation of energy-efficient appliances, windows and heating, ventilation, and air conditioning (HVAC) units.
- Use of programmable thermostats.
- Use of renewable energy sources and electric/hybrid vehicles.

ii. Describe and quantify reductions from selected mitigation, if proposed to reduce the project's GHG emissions. Explain why the selected mitigation was preferred.

Implementation of some of the elements of the City of Duluth's Climate Action Work Plan 2022-2027, such as reducing per-person, single occupancy driving citywide, enabling increased installation and procurement of clean energy for residents and businesses, and reducing residential and commercial solid waste through increased diversion will greatly reduce the GHG emissions from the proposed development scenarios.

iii. Quantify the proposed projects predicted net lifetime GHG emissions (total tons/#of years) and how those predicted emissions may affect achievement of the Minnesota Next Generation Energy Act goals and/or other more stringent state or local GHG reduction goals.

The lifetime for the proposed development scenarios is estimated at 50 years. Thus, the conservative estimates of lifetime emissions associated with the proposed development scenarios are approximately 192,318 tons for Scenario A and 1,630,203 tons for Scenario B. The proposed development scenarios' GHG emissions will have minimal effect on the State of

Minnesota's or the local area's GHG reduction goals.

Item 18 Mitigation Strategies

- Proposed development within the AUAR area would preserve as many of the existing trees as possible. Current development scenarios propose to preserve all 27 acres of existing wooded area.
- Proposed development within the AUAR area would use energy-efficient lighting in buildings and parking lots where feasible.
- Proposed development within the AUAR area would use energy-efficient building materials where feasible.
- Proposed development within the AUAR area would include the installation of energy-efficient appliances, windows and heating, ventilation, and air conditioning (HVAC) units, where feasible.
- Proposed development within the AUAR area would include installation of programmable thermostats where feasible.
- Proposed development within the AUAR area would use renewable energy sources and install plug-ins for electric/hybrid vehicles where feasible.
- Proposed development within the AUAR area would prioritize non-motorized connections and use of transit where feasible to reduce single-occupancy trips.

19. Noise

Describe sources, characteristics, duration, quantities, and intensity of noise generated during project construction and operation. Discuss the effect of noise in the vicinity of the project including 1) existing noise levels/sources in the area, 2) nearby sensitive receptors, 3) conformance to state noise standards, and 4) quality of life. Identify measures that will be taken to minimize or mitigate the effects of noise.

In accordance with the EQB's AUAR guidance document[70], it is not required to address construction noise unless there is some unusual reason to do so. No unusual circumstances are anticipated for the development scenarios that would warrant conducting a quantitative noise analysis.

The State of Minnesota's noise rules (Minn. Rules Ch. 7030) establish noise limits by noise area classifications (NACs) based on land use at the location of the person that hears noise. The MPCA enforces noise standards at industrial facilities for which it has issued an air permit. MnDOT is responsible for state highway noise mitigation and coordinates with the FHWA and the MPCA to evaluate road projects for noise impacts and possible mitigation measures.
Noise impacts in Minnesota are evaluated by measuring and/or modeling the noise levels that are exceeded 10 percent and 50 percent of the time during the hours of the day and/or night that have the loudest scenario. These numbers are identified as the L10 and L50 levels, respectively. The L10 value is the noise level that is exceeded for a total of 10 percent, or 6 minutes, of an hour. The L50 value is the noise level that is exceeded for a total of 50 percent, or 30 minutes, of an hour.

For traffic noise analyses, traffic volume, types of vehicles, operating speed, topography, and distance from the road to the receptor influences the traffic noise level at the receptor. The sound level decreases as distance from a source increases. A general rule regarding sound level decrease due to increasing distance

[70] EQB. Alternative Urban Areawide Review Documents: Recommended Content and Format. Updated September 2008. https://www.eqb.state.mn.us/sites/eqb/files/documents/AUAR%20guidance%20%28form%29%20-9-09.pdf

from a line source (roadway) that is commonly used is: beyond approximately 50 feet from the sound source, each doubling of distance from the line source over hard ground (such as pavement or water) will reduce the sound level by 3 dBA, whereas each doubling of distance over soft ground (such as vegetated or grassy ground) results in a sound level decrease of 4.5 dBA.

1) *Existing noise levels/sources in the area*

Existing noise sources include vehicle traffic along Central Entrance, H. Courtney Drive and Portia Johnson Drive. Additional nearby noise sources include bus traffic traveling from/to the School District Transportation Building, commercial and military aircraft overflights, and medical helicopter overflights.

2) *Nearby sensitive receptors*

The majority of the AUAR area consists of previously developed, now undeveloped land. Duluth School District has facilities, including a District Service Center building and Transportation Building, which are located adjacent to the northwest boundary of the AUAR area. Additionally, within the northeastern portion of the AUAR area, the Secondary Technical Center building is present which is not currently in use. Nearby sensitive receptors would residential neighborhoods along Blackman Avenue to the west and Harbor Highlands Drive to the east.

3) *Conformance to State noise standards*

Minnesota's noise pollution rules[71] are based on statistical calculations that quantify noise levels over a one-hour monitoring period. The L10 calculation is the noise level that is exceeded for 10 percent, or 6 minutes, of the hour, and the L50 calculation is the noise level exceeded for 50 percent, or 30 minutes, of the hour. There is no limit on maximum noise.

The statutory limits for a residential location are L10 = 65 dBA and L50 = 60 dBA during the daytime (7:00 a.m. – 10:00 p.m.) and L10 = 55 dBA and L50 = 50 dBA during the nighttime (10:00 p.m. – 7:00 a.m.). This means that during the one-hour period of monitoring, daytime noise levels cannot exceed 65 dBA for more than 10 percent of the time or 60 dBA more than 50 percent of the time. Table 23 summarizes noise standard classifications by land use.

Table 23. Noise Area Classifications (NAC)

NAC	Common land use associated with the Noise Area Classification	Daytime (dBA) L10	Daytime (dBA) L50	Nighttime (dBA) L10	Nighttime (dBA) L50
1	Residential housing, religious activities, camping and picnicking areas, health services, hotels, educational services	65	60	55	50
2	Retail, business and government services, recreational activities, transit passenger terminals	70	65	70	65
3	Manufacturing, fairgrounds and amusement parks, agricultural and forestry activities	80	75	80	75

[71]More information on Minnesota Noise rules, Minn. Rules Ch. 7030, may be found at: https://www.pca.state.mn.us/sites/default/files/p-gen6-01.pdf

NACs are based on the land use at the location of the person who hears the noise, which does not always correspond with the zoning of an area. Therefore, noise from an industrial facility near a residential area is held to the NAC 1 standards if it can be heard on a residential property. By state law, the future proposed development in the AUAR area must comply with state noise standards. Future land uses must also comply with the local noise requirements pursuant to Duluth's Legislative Code, which includes the city's ordinances.

Chapter 50-25 of the City's Legislative Code establishes landscaping and tree preservation requirements. Pursuant to Section 50-25.5, buffer areas are required to be provided when specific types of differing land uses occur adjacent to each other, including where boundaries of mixed use are adjacent to a residential zone district. A landscape buffer may consist of natural landscape materials or an opaque wall, berm, fence or dense vegetative screen is required. Specific landscape buffer requirements are described in Sections 50-25.5.A and 50-25.5.C for proposed multi-family residential and industrial uses abutting residential uses, respectively.

4) Quality of life

Minimal noise impacts are anticipated to result from Scenario A or Scenario B. The primary source of noise from either a business park scenario or a mixed use development scenario would likely be generated from additional traffic in the area. Short term noise impacts are anticipated to occur during construction.

It is anticipated that blasting may be required during construction of utilities and building foundations as a result of shallow bedrock within the AUAR area. Necessary notifications would be sent to adjacent property owners prior to blasting, and these activities would be managed to the extent possible and only occur during the day between 8:00 a.m. and 5:00 p.m. in accordance with the City's Standard Construction Specifications. Construction contractors would be required to comply the City's rock blasting and vibration control standards.[72] Additional mitigation measures related to blasting are detailed below.

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- The AUAR area would be developed, such that where feasible, land use activities sensitive to noise would be appropriately setback from existing noise sources with the intent to sufficiently reduce the potential for noise impacts. Additionally, landscape buffers would be required to be implemented where differing land uses occur in accordance with Chapter 50-25.5 of the City's Legislative Code. Setback distances and potential mitigation measures should be reviewed relative to the sensitive receptors, described in the above section, to determine the potential for the project to exceed state noise standards.

- Future proposers would be advised to coordinate with the MPCA and MnDOT during project development and planning, as needed, to review roadway noise levels and setbacks. Noise modeling is an effective way to plan land use and development and is encouraged in the planning and engineering stages of the future development. Conducting baseline noise monitoring, in addition to modeling, may also be beneficial to ensure compliance with state noise standards.

- Per Minnesota Statute 116.07, Subd. 2a, existing or newly constructed segments of road or highway under local jurisdiction are exempt from State noise standards, except for roadways for which full control of access has been acquired. If required per MnDOT guidance, traffic noise analysis shall be conducted to model the existing and build condition near the AUAR area. The traffic noise modeling will be completed using the FHWA Traffic Noise Model (TNM).

[72] City of Duluth. Construction Standards 2019. April 5, 2019. https://duluthmn.gov/media/7290/2019-construction-standard_final_rev05april2019.pdf Accessed January 2024.

- Where feasible, equipment used for any future construction-related activities should be fitted with the appropriate mufflers.

- Construction contractors would be required to comply with rock blasting and vibration control requirements in accordance with the City's 2019 Standard Construction Specifications, which includes compliance with Occupational Safety and Health Administration (OSHA) Safety and Health Standards 29 CRF, Part 1926, Subpart U (Blasting and Use Explosives). All blasting operations are required to be performed in accordance with the provisions of the City's Standard Construction Specifications and all other applicable federal, state, and local regulations. A Blasting Plan is required to be submitted not less than three weeks prior to any drilling or blasting operations to the City Engineer.

- Additional mitigation measures outlined in the California Department of Transportation (Caltrans) Transportation and Construction Vibration Guidance Manual (2020)[73] may be applied to minimize adverse impacts of vibration and air overpressure associated with blasting. These measures include, but are not limited to, conducting a pre-blast survey, informing the public about any blasting activities, and avoiding blasting during windy conditions.

20. Transportation

a. Describe traffic-related aspects of project construction and operation. Include: 1) existing and proposed additional parking spaces, 2) estimated total average daily traffic generated, 3) estimated maximum peak hour traffic generated and time of occurrence, 4) indicate source of trip generation rates used in the estimates, and 5) availability of transit and/or other alternativetransportation modes.

1) Existing and proposed additional parking spaces

Existing parking spaces within the AUAR area will be removed or reconfigured for use in future proposed developments. These developments would be required to comply with parking requirements pursuant to the City of Duluth's zoning ordinance based on the local regulations in place at the time that a project is proposed.

2) Total average daily traffic generated

The Development Scenario B, which presents a larger impact, is anticipated to generate 12,679 trips per day at full buildout.

3) Maximum peak hour traffic generated and time of occurrence

The maximum peak hour traffic generated by Development Scenario B is expected to be 1,103 trips during the p.m. peak hour (4:30-5:30 p.m.)

4) Source of trip generation rates

Trip generation rates were based on the Trip Generation, Eleventh Edition, published by the Institute of Transportation Engineers.

5) Availability of transit and/or other alternative transportation modes:

Duluth Transit Authority (DTA) has bus routes throughout Duluth, including the Go Line – Green

[73] Caltrans. 2020. Transportation and Construction Vibration Guidance Manual. Available at: https://dot.ca.gov/-/media/dot-media/programs/environmental-analysis/documents/env/tcvgm-apr2020-a11y.pdf. Accessed January 2024.

with multiple stops on Central Entrance.[74] Two bus transit routes have stops located near the AUAR area at H. Courtney Drive/Central Entrance. Route 112 provides hourly service between the Miller Hill Super One grocery and the Woodland neighborhood via UMD and the College of St. Scholastica. The Go Line - Green route provides 15-minute service from downtown Duluth to Walmart via the medical district and Miller Hill Mall. At the Miller Hill Mall, Route 107 provides service every 30 minutes along Trinity Road to Lake Superior College, Lincoln Park, and Downtown. Additionally, at downtown Duluth, Go Line - Green transit users can access the Go Line - Blue every 15 minutes for service east to UMD and west to Spirit Valley. The broader transit network for the City of Duluth was reviewed and is available at: https://www.duluthtransit.com/home/getting-there/routes-schedules/.

b. Discuss the effect on traffic congestion on affected roads and describe any traffic improvements necessary. The analysis must discuss the project's impact on the regional transportation system.If the peak hour traffic generated exceeds 250 vehicles or the total daily trips exceeds 2,500, a traffic impact study must be prepared as part of the EAW. Use the format and procedures described in the Minnesota Department of Transportation's Access Management Manual, Chapter 5 (available at: http://www.dot.state.mn.us/accessmanagement/resources.html) or a similar local guidance.

MnDOT, along with regional and local partners, is currently completing a corridor study for Central Entrance to determine the future character of the roadway to better serve all transportation modes and future growth and development. The study is being conducted in advance of reconstruction of the corridor from US 53 to Mesaba Avenue, with design work in 2024-2025 and construction starting in 2026-2027. The corridor study will include the development of year 2048 traffic volume forecasts that account for future development along the corridor, including the proposed Central High School redevelopment project. The analysis of these traffic volumes will inform the ultimate cross section and intersection layouts for the corridor.

Several alternatives for the Central Entrance Corridor are under consideration including four-lane, three-lane, and one-way pair roadway concepts. Since the ultimate layout for the corridor is yet to be determined, the traffic forecasts and analysis for this study are focused on the first phase of development (2025 Build Condition), which includes construction of a 200-unit multi-family residential project. Future updates to the AUAR will account for additional development and the ultimate design of Central Entrance.

Traffic analyses were completed for the study intersections for all scenarios during the weekday a.m. and p.m. peak hours using Synchro software. The initial analysis was completed using existing geometrics and intersection control. Capacity analysis results are presented in terms of level of service (LOS), which is defined in terms of traffic delay at the intersection. Delay was calculated based on the Highway Capacity Manual, Sixth Edition, published by the Transportation Research Board (TRB). LOS ranges from A to F. LOS A represents the best operation, with little delay for each vehicle using the intersection. LOS F represents the worst operation with excessive delay.

A complete Traffic Impact Study was completed with existing and future volumes. The Traffic Impact Study includes relevant figures including existing traffic volumes, future peak traffic volumes, and traffic operations analysis results. The following provides a summary of the traffic operations for Development Scenario B. Appendix F includes the detailed Traffic Impact Study.

The conclusions drawn from the information and analyses presented in the study are as follows:

- The proposed development Scenario B was used in the analysis and is expected to generate 993 trips during the weekday a.m. peak hour, 1,103 trips during the weekday p.m. peak hour, and 12,679 total weekday trips.

[74] DTA. Routes and Schedules. Accessed November 2023. https://www.duluthtransit.com/home/getting-there/routes-schedules

- Under existing conditions, the intersections with minor leg approaches that are controlled with stop signs on Central Entrance and Mesaba Avenue operate at poor levels of service during the a.m. and p.m. peak hours. This is due to the amount of through traffic on the major roadway, which results in large delays for vehicles entering the intersection from the minor roadway. While not desirable, this condition is common at stop controlled minor approaches to high volume roadways.

- Under 2025 Build conditions, movements and intersections operate largely the same as the 2025 No-Build scenario with no changes to LOS results during the a.m. and p.m. peak hours resulting from the proposed Phase 1 development.

c. Identify measures that will be taken to minimize or mitigate project related transportation effects.

Based on the results of the traffic impact analysis, mitigation measures are not warranted for the first phase of development. Given that a recommended alternative for Central Entrance is not known at this time, it is not possible to identify potential mitigation measures for future phases of development. The City of Duluth is coordinating with MnDOT to incorporate the planned development of the AUAR area into the Central Entrance Corridor Study. At the time that future phases of the development are proposed it is recommended that additional traffic analyses are completed to determine if mitigation measures are needed. This AUAR is required to be updated every five years. At the time that an AUAR update occurs, the traffic analysis should be reevaluated.

Item 20 Mitigation Strategies

- Under 2025 Build conditions, movements and intersections operate largely the same as the 2025 No-Build scenario with no changes to LOS results during the a.m. and p.m. peak hours due to the proposed Phase 1 development. Therefore, no mitigation is needed for the proposed Phase 1 development.

- As additional development is proposed for the site, the traffic analysis will be updated to determine if mitigation measures are needed for the existing roadway network prior to reconstruction of Central Entrance.

21. Cumulative Potential Effects

a. Describe the geographic scales and timeframes of the project related environmental effects that could combine with other environmental effects resulting in cumulative potential effects.

Full buildout of the AUAR area is anticipated to occur over several years and be driven by market conditions. For the purposes of analyses completed as part of the AUAR, it was assumed full buildout would occur by 2045. It is anticipated that the first phase of development consisting of a 200-unit multi-family housing project may start construction as early as 2024. The timing and duration of future phases is not currently known. Other projects in the surrounding area that are currently known to be in construction, operation, or planned were considered in the cumulative potential effects.

b. Describe any reasonably foreseeable future projects (for which a basis of expectation has been laid) that may interact with environmental effects of the proposed project within the geographic scales and timeframes identified above.

The following resources were used to complete a review of any reasonably foreseeable future projects near the AUAR study area, and the interaction of potential environmental effects:

- City of Duluth Development Happenings Projects Map[75] (accessed January 30, 2024)
- Minnesota EQB Environmental Review Projects database[76] (accessed January 30, 2024)
- MnDOT Northeast Minnesota Regional Information, District 1 Projects webpage[77] (accessed January 30, 2024)

EQB Projects Database

Based on a review of the EQB's project database, there are four other projects currently completing State environmental review processes in the City of Duluth and surrounding communities.

Buckingham Creek and Buckingham Tributary 2 Channel and Floodplain Restoration Project EAW

- Development Location: The Project is located in Enger Park Golf Course at 1801 West Skyline Parkway in the City of Duluth, St. Louis County, Minnesota.
- Proposer: South St. Louis Soil and Water Conservation District
- Project Description: The Project proposes to restore ecosystem function along an approximately 3,500-foot section of Buckingham Creek and its tributary in Enger Park Golf Course.
- Schedule: The Project is anticipated to be construction from May to September 2024.

Blatnik Bridge Replacement Project Environmental Assessment (EA)/ EAW

- Development Location: John A. Blatnik Bridge (Minnesota Bridge No. 9030, Wisconsin Bridge No. B-16-5) on I-535 between the City of Duluth, Minnesota and City of Superior, Wisconsin.
- Proposer: MnDOT and Wisconsin Department of Transportation (WisDOT)
- Project Description: The Project proposes to replace the existing Blatnik Bridge along I-535 between the City of Duluth, Minnesota and City of Superior, Wisconsin access the St. Louis Bay and reconstruct an interchange in the City of Superior that routes I-535 directly to US 53.
- Schedule: The Project is yet to be designed with no start of construction scheduled at this time.

Hermantown Business Park AUAR

- Development Location: The AUAR area is located near the intersection of US 53 and County Road 101 (Ugstad Road) the City of Hermantown, St. Louis, County, Minnesota.
- Proposer: City of Hermantown
- Project Description: The proposed development scenario would construct a business park consisting of 22 buildings with a combined area of 942,000 square feet consisting of light industrial, warehousing, and commercial uses such as retail and offices.
- Schedule: The full buildout of the AUAR is anticipated to occur by 2050.

[75] City of Duluth. Development Happenings Housing Projects Map. Accessed January 2024. https://duluthmn.gov/planning-development/housing/development-happenings/
[76] EQB. Environmental Review Projects Interactive Map. Accessed January 2024. https://pca-gis02.pca.state.mn.us/EQB/
[77] MnDOT. Northeast Minnesota Regional Information. Accessed January 2024. https://www.dot.state.mn.us/d1/projects.html

City of Duluth Development Projects

Skyridge Flats Senior Apartments

- Development Location: The Project is located near the Central Entrance/ Village View Drive intersection in the City of Duluth.
- Proposer: The Housing and Redevelopment Authority of Duluth
- Project Description: The proposed project is the fifth phase of the HOPE VI plan awarded in 2002 and would construct 70 units of affordable one-bedroom apartments for seniors. In addition to residential units, the project would include offices, common space, and support space to accommodate case management and senior service coordination activities.
- Schedule: Under construction with occupancy anticipated in December 2024.

MnDOT Projects

Hwy 194/ Central Entrance – Corridor Study and Construction

- Development Location: The Project Corridor includes the section of Hwy 194/ Central Entrance from Trinity Road to Mesaba Avenue in the City of Duluth
- Proposer: MnDOT District 1
- Project Description: The project proposes to reconstruct Hwy 194/Central Entrance within the Project Corridor to improve traffic flow and pedestrian safety. Several concepts were evaluated as part of the 2021 Central Entrance Vision Plan including four-lane, three-lane, and one-way pair roadway concepts. A preferred alternative has not been selected at this time. It is anticipated that the project will include lane reconfiguration, pedestrian/bicyclist improvements, ADA-compliant infrastructure improvements, streetscaping, and transit accommodation improvements.
- Schedule: Construction is anticipated to begin in 2026 to 2027.

c. Discuss the nature of the cumulative potential effects and summarize any other available information relevant to determining whether there is potential for significant environmental effects due to these cumulative effects.

Based on the information obtained for and summarized in Item 21.b., potential cumulative effects may include:

Stormwater

Stormwater travels along the ground surface in a different manner once lawn/grass is replaced by impervious surfaces including building rooftops and paved parking areas. The proposed development projects would have the potential to increase impervious surface area with the development of buildings, parking lots, and roadways. Additionally, the proposed Central Entrance Reconstruction Project may have the potential to increase impervious surface area compared to existing conditions which would be determined at the time that a preferred alternative is selected and final design has been completed. Collectively, these projects along with the scenarios described in this AUAR would be required to meet stormwater management requirements, including BMPs, falling under the authority of the MPCA and City of Duluth.

Wastewater/Water Appropriation

Item 12.b.i and iii. outlines the wastewater generation and water demand estimates that would be associated with the development scenarios described in this AUAR. It is anticipated that the City's water supply system has sufficient capacity to accommodate future development. Other proposed developments within the City of Duluth would increase the overall demand on the City's sewer collection infrastructure system. As described in the mitigation strategies in Item 12, developers will need to closely coordinate with City Engineering staff to ensure system capacity and determine if improvements to existing infrastructure would be required. As additional development is proposed, further analysis and modeling of the sewer collection infrastructure system may be required.

Transportation/Traffic

The proposed development scenarios in this AUAR and other developments, such as the Skyridge Flats Senior Apartments, will result in additional vehicle trips/traffic on local roadways. A traffic analysis was prepared as part of this AUAR and it was determined that mitigation measures would not be required for construction of the first phase of development, consisting of construction of an approximately 200-unit multi-family housing development. At this time, the proposed improvements to Central Entrance are not known. The City is coordinating with MnDOT District 1 on the preparation of the Central Entrance Corridor Study to incorporate the planned development of this AUAR into the corridor study and inform the selection of a preferred alternative for Central Entrance. It is required that this AUAR is updated every five years. At the time that this AUAR is updated, the traffic impact analysis should be re-evaluated to consider the proposed improvements to Central Entrance and timing of development. Other future projects proposed in the area that are anticipated to result in substantial traffic generation would need to complete any required traffic analysis to obtain all permits and approvals from the City and other agencies.

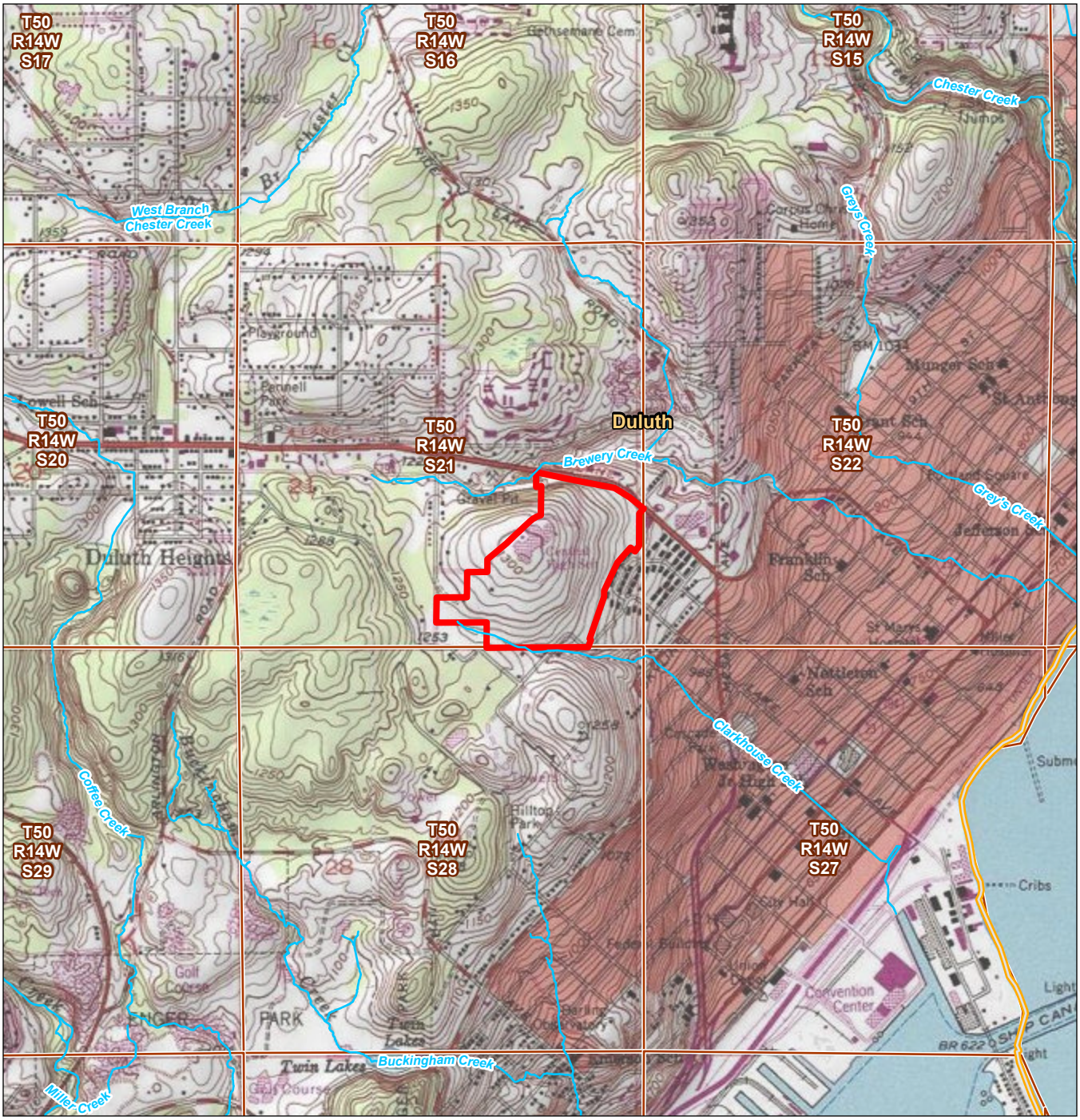
22. Other Potential Environmental Effects

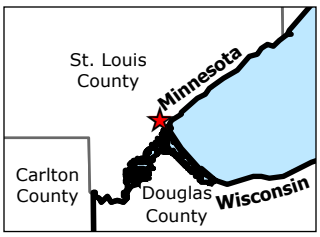
If the project may cause any additional environmental effects not addressed by items 1 to 19, describe the effects here, discuss how the environmentwill be affected, and identify measures that will be taken to minimize and mitigate these effects.

No other potential environmental effects are anticipated that are not addressed by Items 1 through 21.

Appendix A

Figures





Legend

- City of Duluth Streams
- AUAR Area
- Municipal Boundary
- Township, Range & Section Boundary

0 1,000 2,000 Feet

(At original document size of 8.5x11)
1:24,000

N

Stantec

Project Location
T50N, R14W, S21
Duluth, St. Louis Co., MN

Prepared by KJM on 2024-02-02

Client/Project
City of Duluth
Duluth Central High School Redevelopment Site
Scoping EAW

227706270

Figure No.
1

Title
Project Location USGS Topo Map

Notes
1. Coordinate System: NAD 1983 HARN Adj MN St Louis CS96 Feet
2. Data Sources: Stantec, City of Duluth, MnGeo, MnDOT
3. Background: USGS Northfield 7.5 Minute Quadrangle

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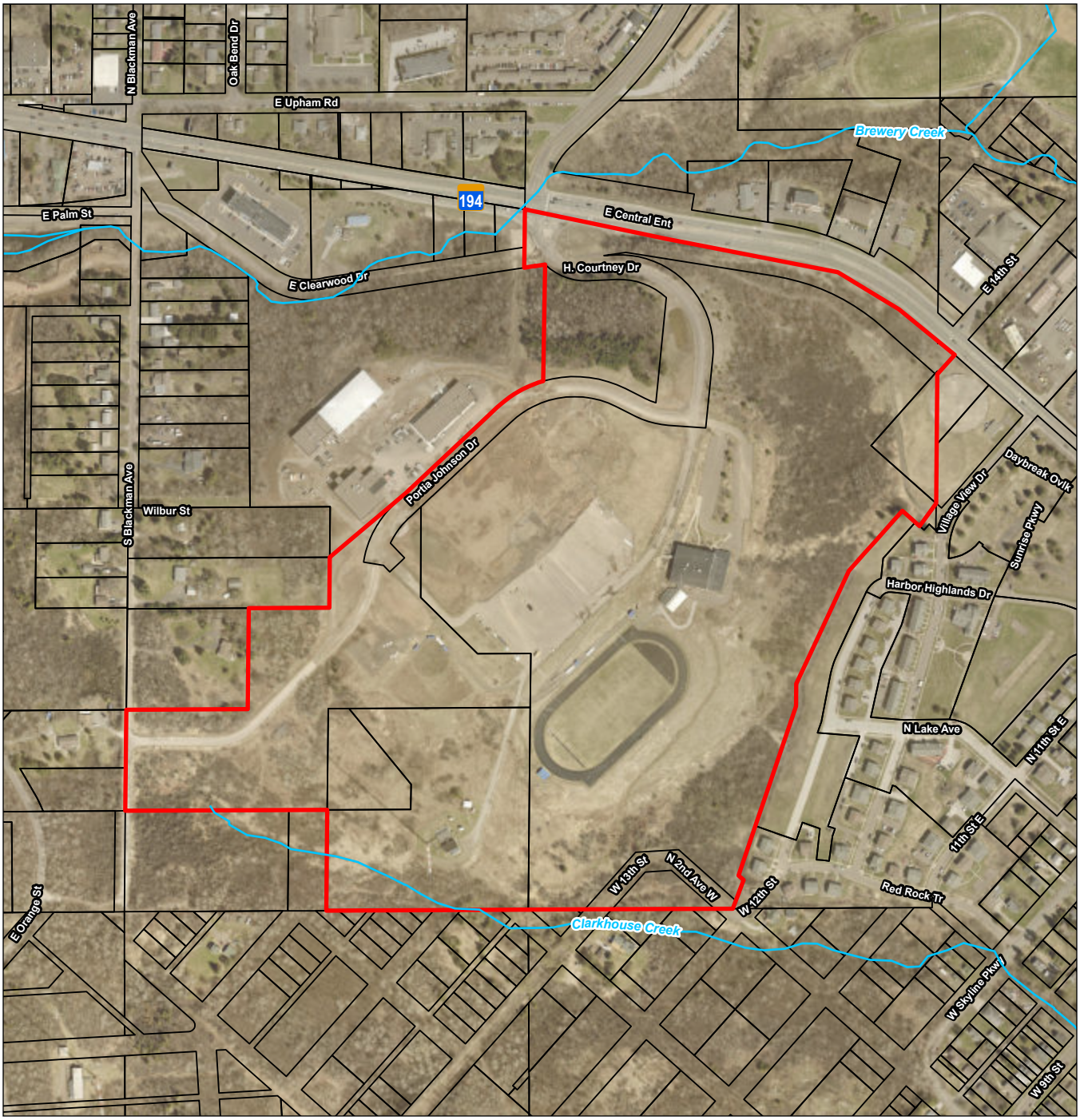
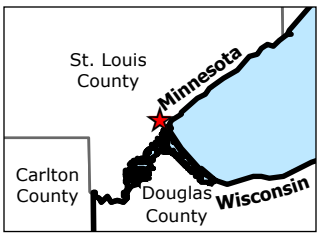




Legend

- City of Duluth Streams
- AUAR Area
- Parcel Boundary

0 250 500 Feet

(At original document size of 8.5x11)
1:6,000

N

Stantec

Notes

1. Coordinate System: NAD 1983 HARN Adj MN St Louis CS96 Feet
2. Data Sources: Stantec, City of Duluth, St. Louis Co., MnDOT
3. Background: 2023 St. Louis Co.

Project Location
T50N, R14W, S21
Duluth, St. Louis Co., MN

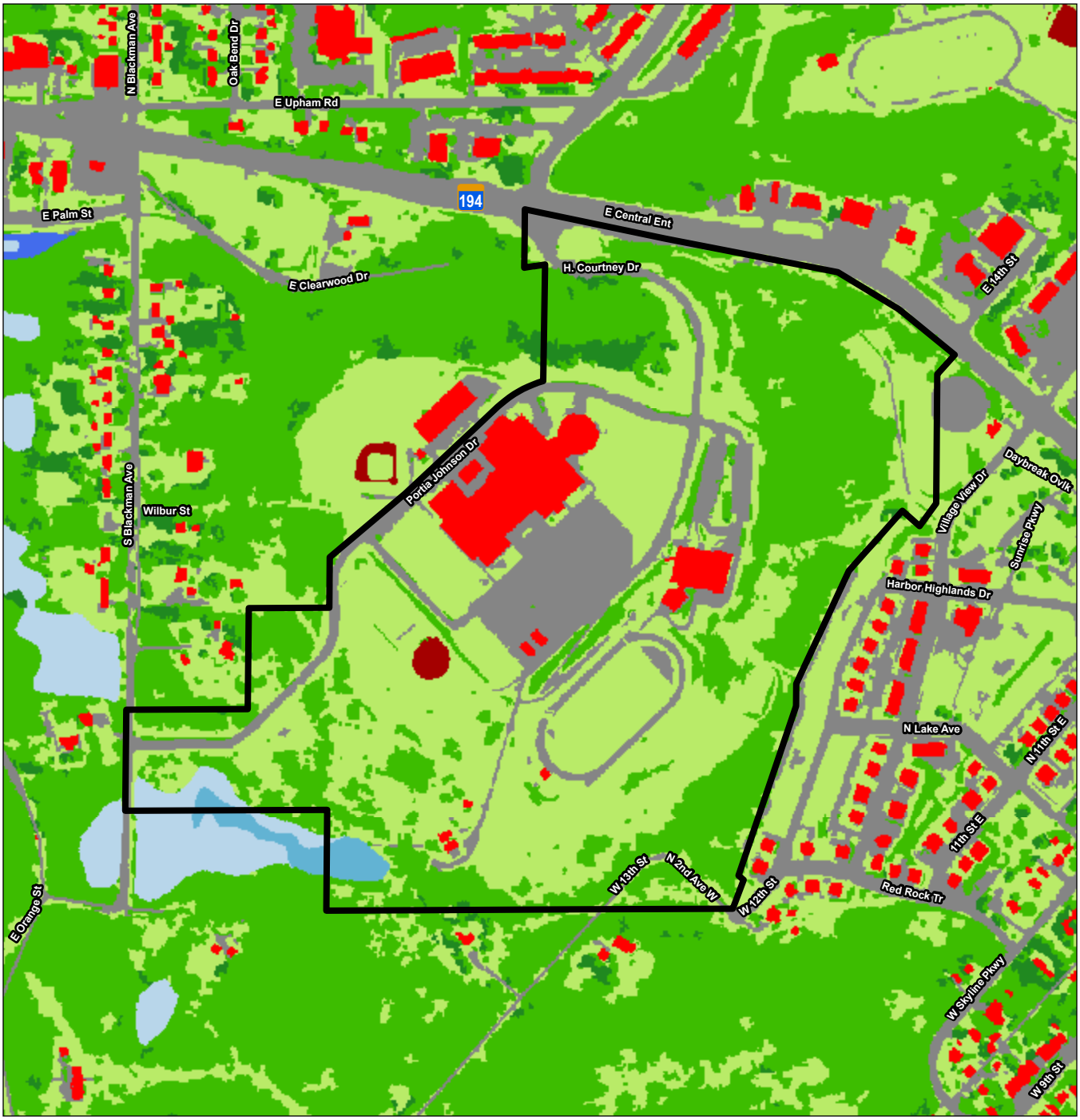
Prepared by KJM on 2024-02-02

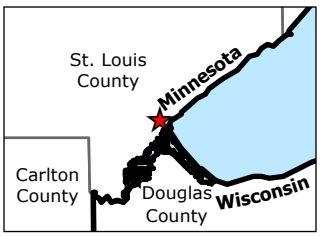
Client/Project
City of Duluth
Duluth Central High School Redevelopment Site Scoping EAW

227706270

Figure No.
2

Title
Project Location Aerial Map





Notes
1. Coordinate System: NAD 1983 HARN Adj MN St Louis CS96 Feet
2. Data Sources: Stantec, MnGeo
3. Background: UMN Duluth 1-meter Land Cover 2016

Legend
- AUAR Area

Duluth Land Cover 2016
- Grass/Shrub
- Bare Soil
- Buildings
- Roads/Paved Surfaces
- Lakes/Ponds
- Deciduous Tree Canopy
- Coniferous Tree Canopy
- Emergent Wetland
- Forested/Shrub Wetland

0 250 500 Feet
(At original document size of 8.5x11)
1:6,000

N

Stantec

Project Location
T50N, R14W, S21
Duluth, St. Louis Co., MN

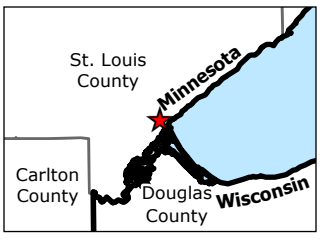
Prepared by KJM on 2024-02-02

Client/Project
227706270
City of Duluth
Duluth Central High School Redevelopment Site
Scoping EAW

Figure No.
3

Title
Land Cover

V:\227\active\227706270\03_data\gis_cad\gis\proj\eaw\eaw.aprx Revised: 2024-02-02 By: kjmueller



Legend
- Existing Trail
- AUAR Area
- Park Boundary

0 500 1,000 Feet
(At original document size of 8.5x11)
1:12,000

N

Notes
1. Coordinate System: NAD 1983 HARN Adj MN St Louis CS96 Feet
2. Data Sources: Stantec, City of Duluth, St. Louis Co., MnDOT
3. Background: 2023 St. Louis Co.

Stantec

Project Location
T50N, R14W, S21
Duluth, St. Louis Co., MN

Prepared by KJM on 2024-02-05

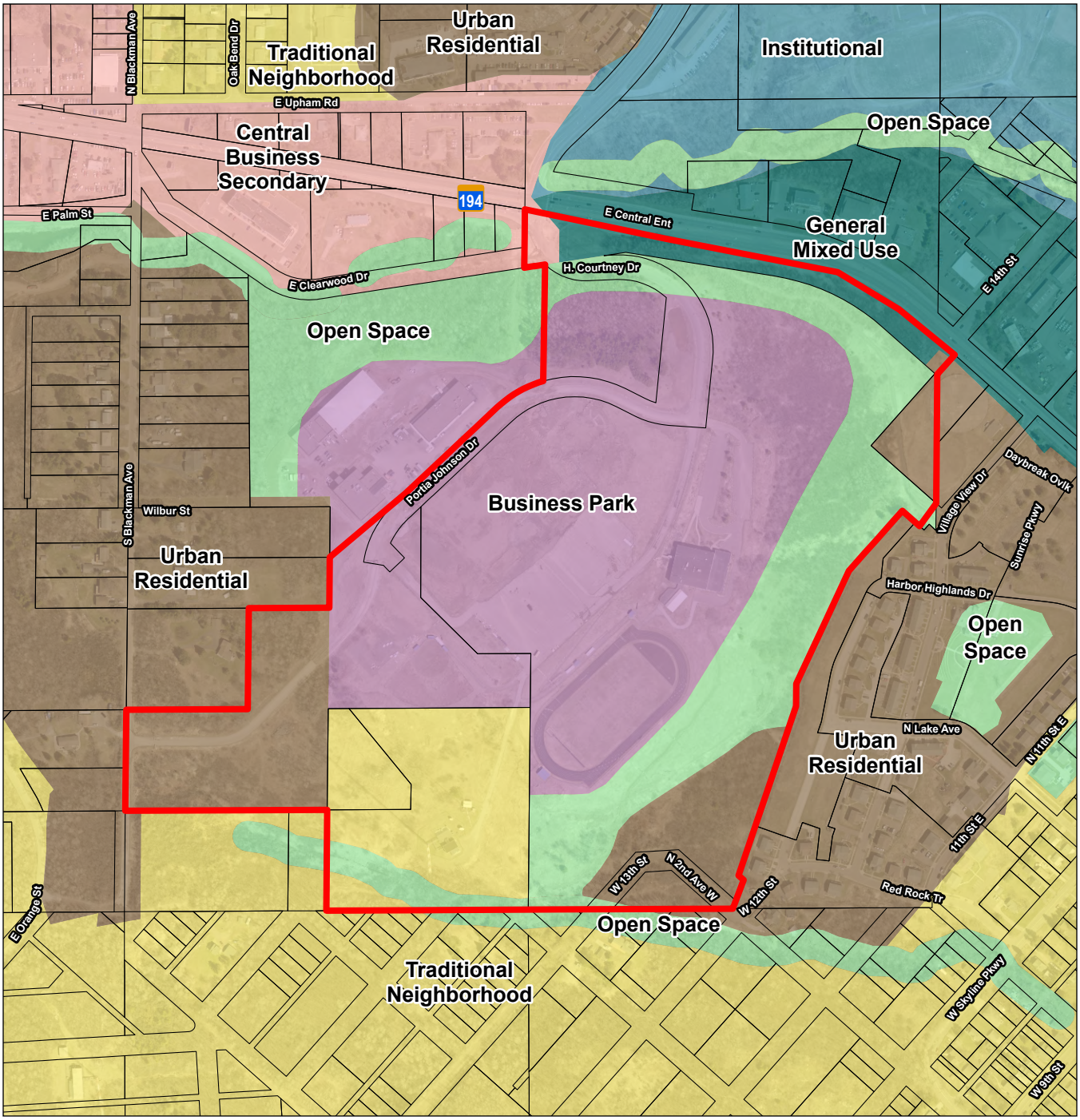
Client/Project
City of Duluth
Duluth Central High School Redevelopment Site Scoping EAW

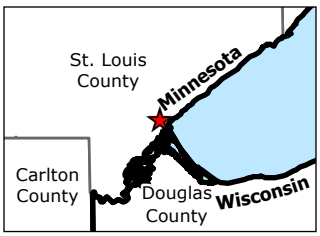
227706270

Figure No.
4

Title
Parks Trails and Other Recreational Areas

V:\2277\active\227706270\03_data\gis_cad\gis\pro\eaw\eaw.aprx Revised: 2024-02-05 By: kjmueller





Notes
1. Coordinate System: NAD 1983 HARN Adj MN St Louis CS96 Feet
2. Data Sources: Stantec, City of Duluth, St. Louis Co., MnGeo, MnDOT
3. Background: 2023 St. Louis Co.

Legend
- AUAR Area
- Parcels

Future Land Use
- Business Park
- Central Business Secondary
- General Mixed Use
- Institutional
- Open Space
- Traditional Neighborhood
- Urban Residential

0 250 500 Feet
(At original document size of 8.5x11)
1:6,000

N

Stantec

Project Location
T50N, R14W, S21
Duluth, St. Louis Co., MN

Prepared by KJM on 2024-02-05

Client/Project
City of Duluth
Duluth Central High School Redevelopment Site
Scoping EAW

227706270

Figure No.
5

Title
Future Land Use

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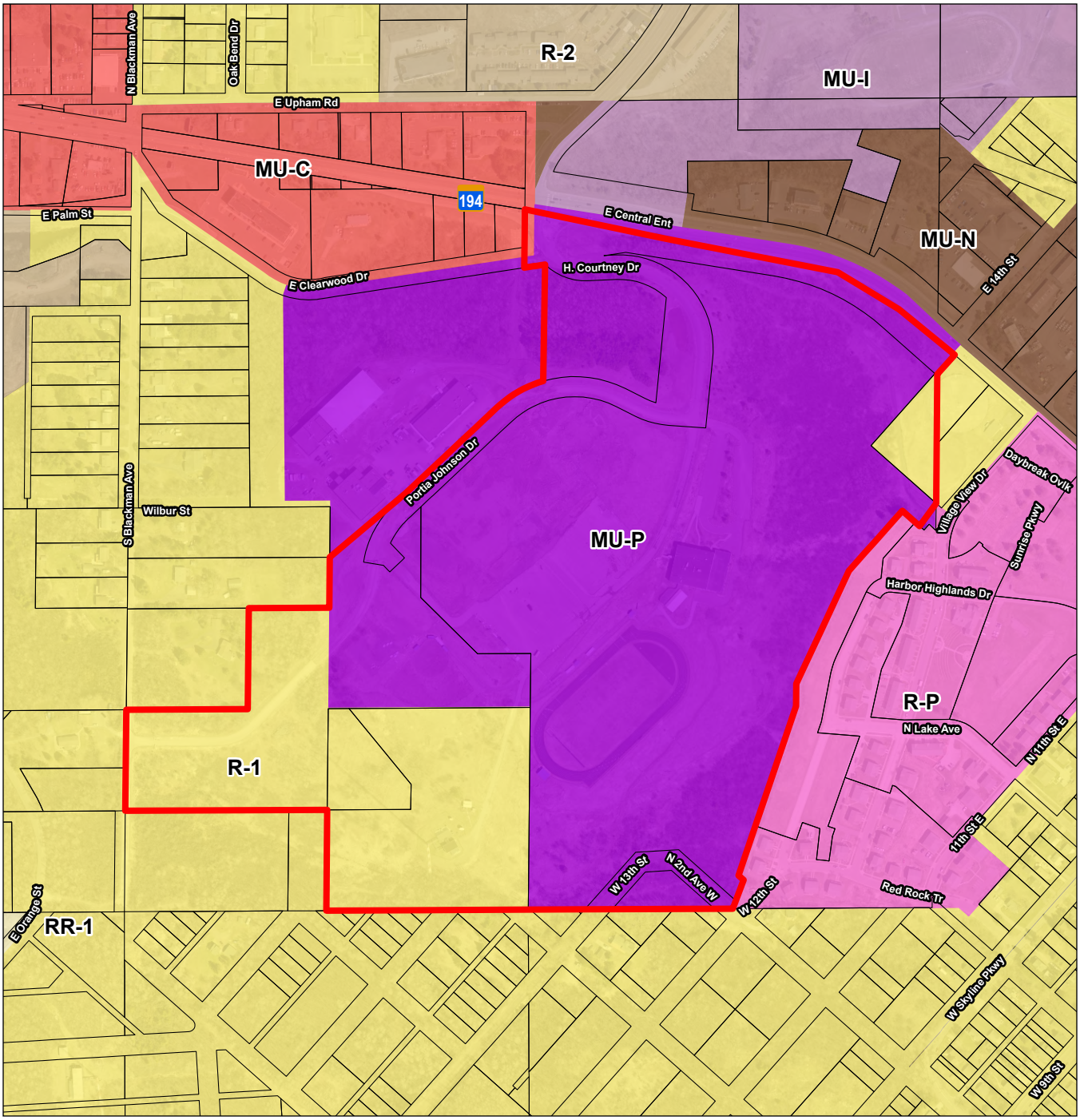
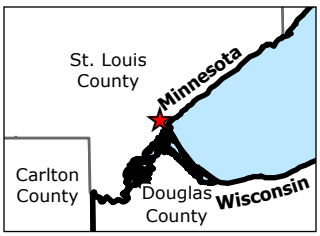




Notes
1. Coordinate System: NAD 1983 HARN Adj MN St Louis CS96 Feet
2. Data Sources: Stantec, City of Duluth, St. Louis Co., MnGeo, MnDOT
3. Background: 2023 St. Louis Co.

Legend
- AUAR Area
- Parcels

City of Duluth Zoning
- MU-C (Mixed Use Commercial)
- MU-I (Mixed Use Institutional)
- MU-N (Mixed Use Neighborhood)
- MU-P (Mixed Use Planned)
- R-1 (Residential Traditional)
- R-2 (Residential Urban)
- R-P (Residential Planned)
- RR-1 (Rural Residential 1)

0 250 500 Feet
(At original document size of 8.5x11)
1:6,000

N

Stantec

Project Location
T50N, R14W, S21
Duluth, St. Louis Co., MN

Prepared by KJM on 2024-02-05

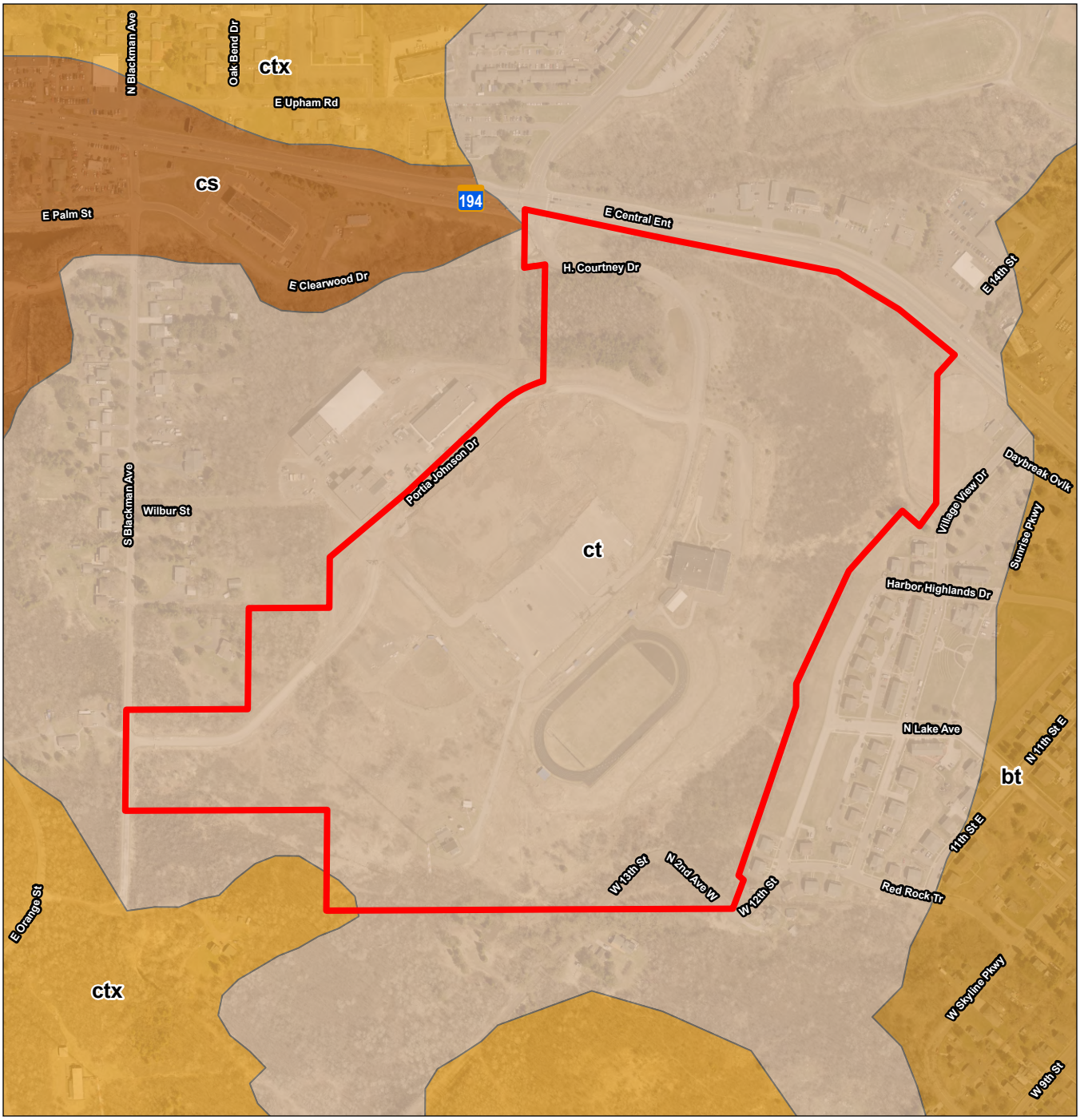
Client/Project
City of Duluth
Duluth Central High School Redevelopment Site
Scoping EAW

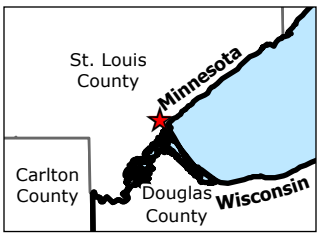
227706270

Figure No.
6

Title
Zoning

V:\227\active\227706270\03_data\gis_cad\gis\proj\eaw\eaw.aprx Revised: 2024-02-05 By: kjmueller





Notes

1. Coordinate System: NAD 1983 HARN Adj MN St Louis CS96 Feet
2. Data Sources: Stantec, MnGeo, MnDOT, MGS C-51
3. Background: 2023 St. Louis Co.

Legend

- AUAR Area

Surficial Geology

- bt - Glacial Till
- cs - Glacial Stream Sediment, Outwash
- ct - Glacial Till
- ctx - diamicton, sand/gravel, lacustrine complex

0 250 500 Feet

(At original document size of 8.5x11)
1:6,000

N

Stantec

Project Location
T50N, R14W, S21
Duluth, St. Louis Co., MN

Prepared by KJM on 2024-02-05

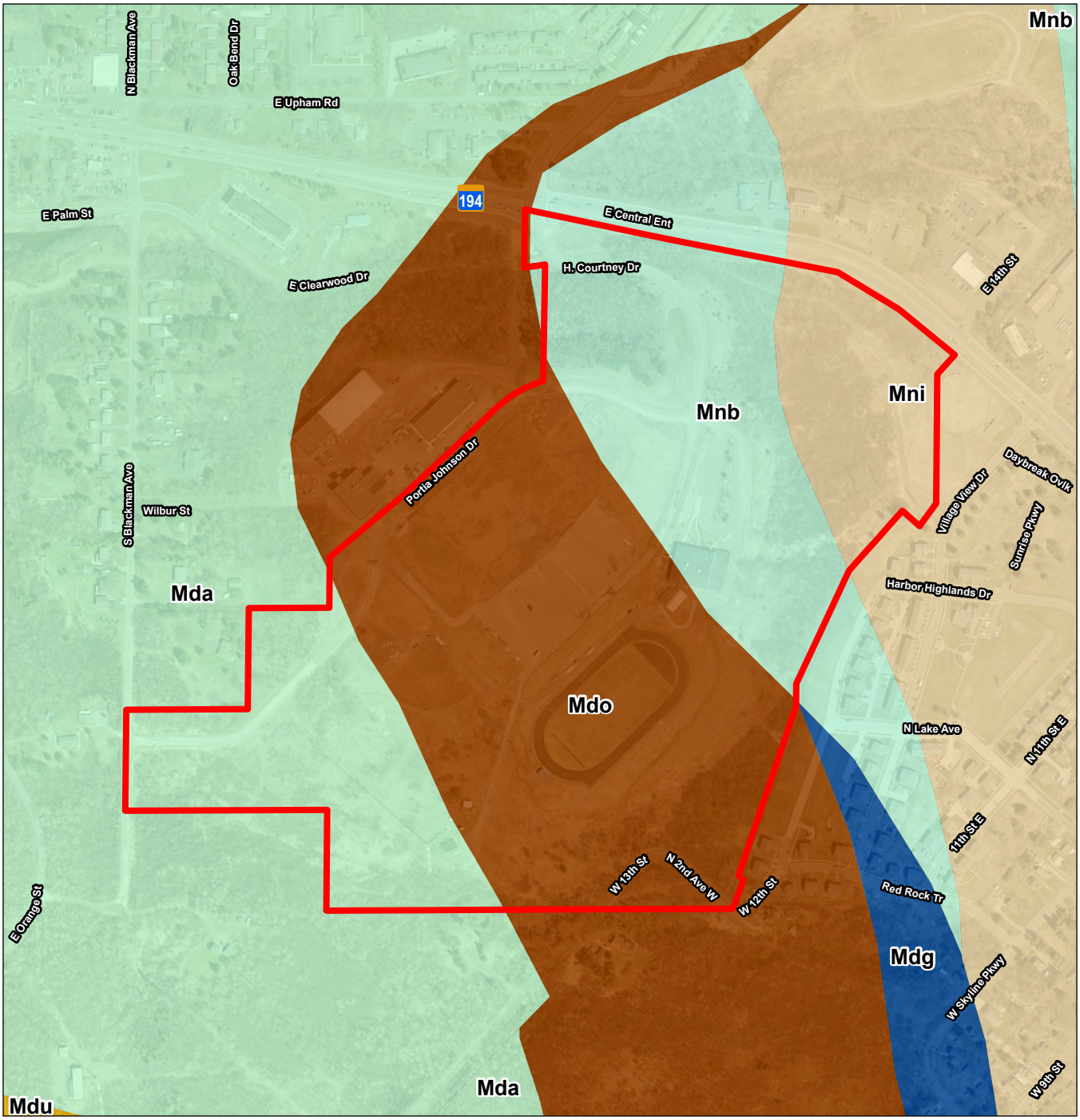
Client/Project
City of Duluth
Duluth Central High School Redevelopment Site
Scoping EAW

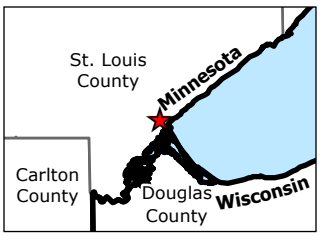
227706270

Figure No.
7

Title
Surface Geology Map

V:\227\active\227706270\03_data\gis_cad\gis\pro\eaw\eaw.aprx Revised: 2024-02-05 By: kjmueller





Notes

1. Coordinate System: NAD 1983 HARN Adj MN St Louis CS96 Feet
2. Data Sources: Stantec, MnGeo, MnDOT, MGS C-51
3. Background: 2023 St. Louis Co.

Legend

- AUAR Area

Bedrock Geology

- Mdo, Porphyritic ophitic olivine leucogabbro
- Mdu, Upper contact zone - ferrodiorite, ferromonzodiorite, ferrogabbro
- Mda, Anorthosite, troctolitic anorthosite, olivine gabbroic anorthosite, anorthositic gabbro
- Mdg, Ferromonzodiorite to granophyre
- Mnb, Undifferentiated basalt to basaltic andesite flows
- Mni, Icelandite

0 250 500 Feet

(At original document size of 8.5x11)
1:6,000

N

Stantec

Project Location
T50N, R14W, S21
Duluth, St. Louis Co., MN

Prepared by KJM on 2024-02-05

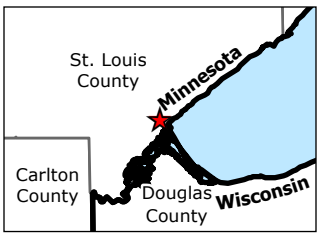
Client/Project
City of Duluth
Duluth Central High School Redevelopment Site
Scoping EAW

227706270

Figure No.
8

Title
Bedrock Geology Map

V:\227\active\227706270\03_data\gis_cad\gis\proj\eaw\eaw.aprx Revised: 2024-02-05 By: kjmueller



Legend

- AUAR Area
- 1/4 Mile Radius

Field Verified Wells

- Domestic
- Monitoring Well
- Environmental Bore Hole

0 450 900 Feet

(At original document size of 8.5x11)
1:10,800

N

Stantec

Notes

1. Coordinate System: NAD 1983 HARN Adj MN St Louis CS96 Feet
2. Data Sources: Stantec, City of Duluth, MnGeo, MnDOT, MDA, MGS
3. Background: 2023 St. Louis Co.

Project Location
T50N, R14W, S21
Duluth, St. Louis Co., MN

Prepared by KJM on 2024-02-05

Client/Project
City of Duluth
Duluth Central High School Redevelopment Site
Scoping EAW

227706270

Figure No.
9

Title
Minnesota Well Index Map

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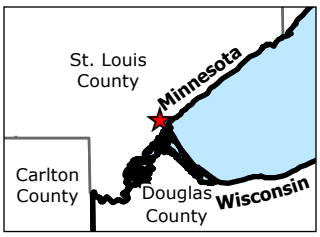

Legend
- AUAR Area
- Soil Map Unit

0 250 500 Feet
(At original document size of 8.5x11)
1:6,000

N

Notes
1. Coordinate System: NAD 1983 HARN Adj MN St Louis CS96 Feet
2. Data Sources: Stantec, MnGeo, MnDOT, NRCS
3. Background: 2023 St. Louis Co.

Stantec

Project Location
T50N, R14W, S21
Duluth, St. Louis Co., MN

Prepared by KJM on 2024-02-05

Client/Project
227706270
City of Duluth
Duluth Central High School Redevelopment Site
Scoping EAW

Figure No.
10

Title
Soils Classification Map

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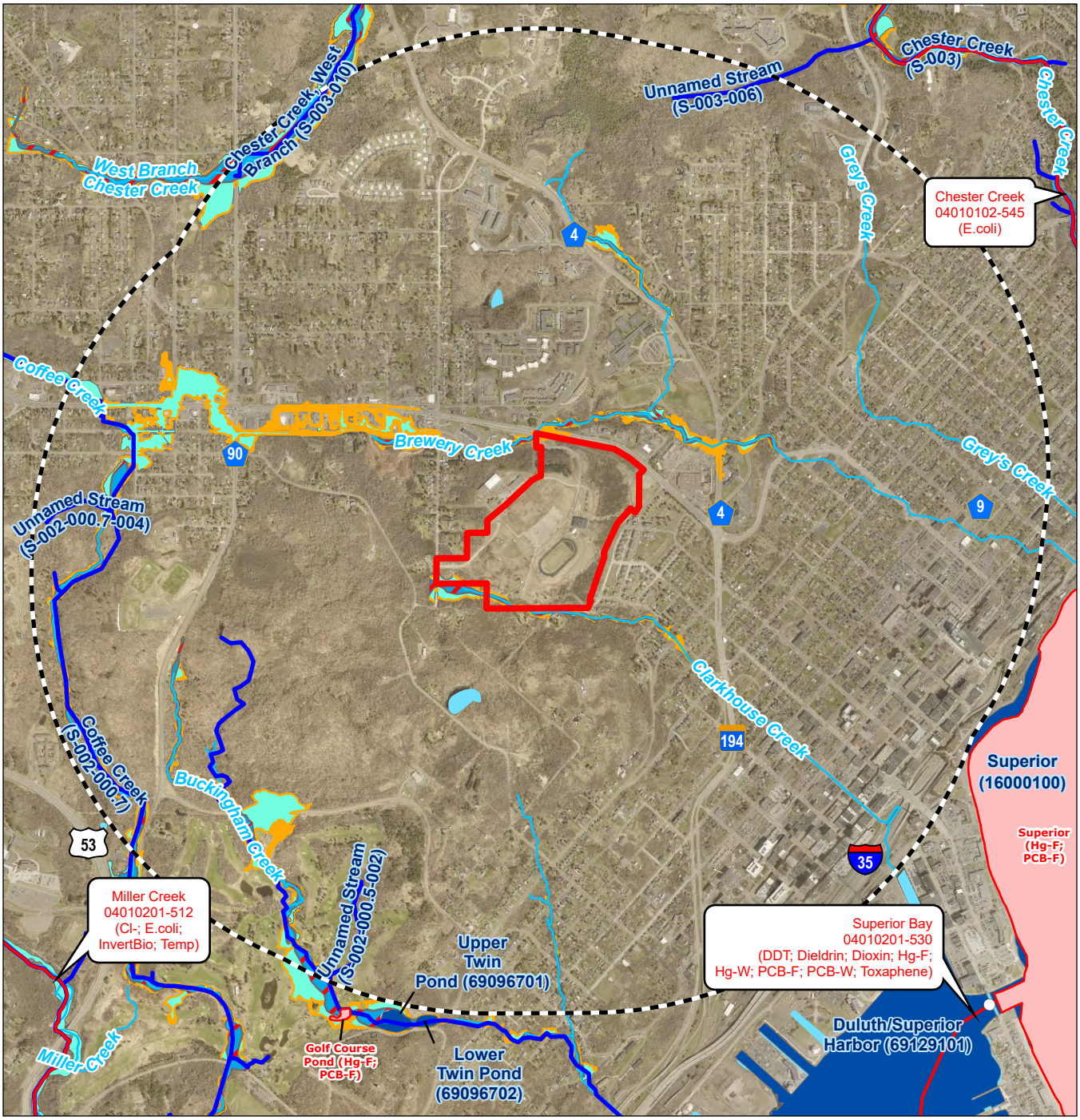

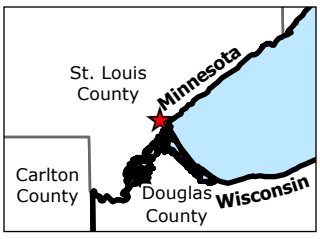

Notes
1. Coordinate System: NAD 1983 HARN Adj MN St Louis CS96 Feet
2. Data Sources: Stantec, City of Duluth, MnDNR, MnDOT, MPCA, USGS, FEMA
3. Background: 2023 St. Louis Co.

Legend
- AUAR Area
- 1 Mile Radius
- 2022 MPCA Impaired Streams (Draft)
- 2022 MPCA Impaired Lakes (Draft)

Minnesota Public Waters Delineations
- Public Water Watercourse
- Public Waters Basins
- City of Duluth Streams
- Waterbody

FEMA Flood Hazard (Preliminary)
- 1% Annual Chance Flood Hazard
- Floodway
- 0.2% Annual Chance Flood Hazard

0 1,000 2,000 Feet
(At original document size of 8.5x11)
1:24,000

N

Stantec

Project Location
T50N, R14W, S21
Duluth, St. Louis Co., MN

Prepared by KJM on 2024-02-05

Client/Project 227706270
City of Duluth
Duluth Central High School Redevelopment Site
Scoping EAW

Figure No.
11

Title
Water Resources Map

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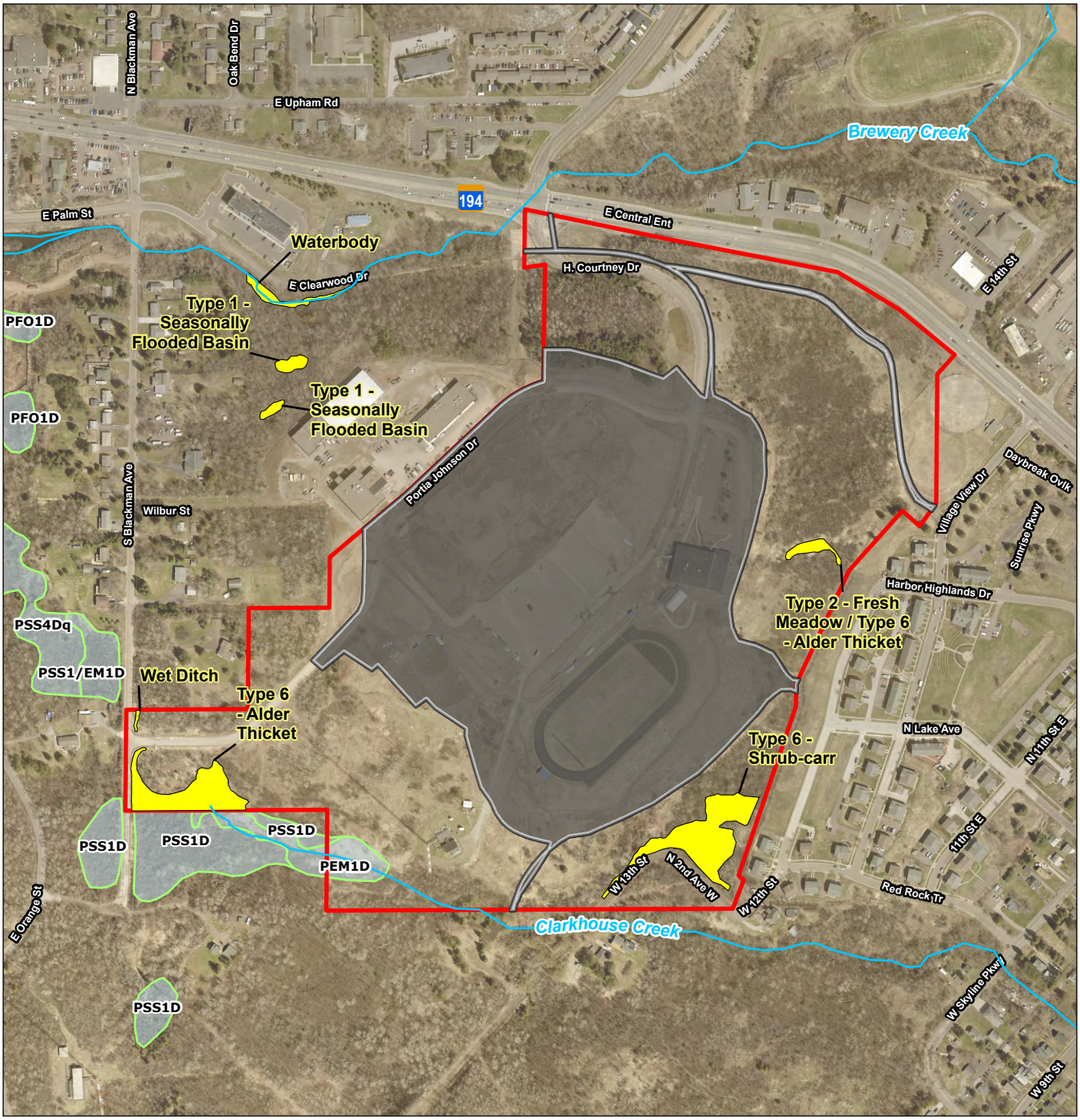

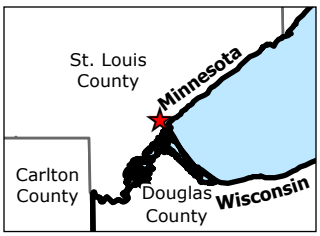

Legend

- City of Duluth Streams
- Field Delineated Wetland
- National Wetlands Inventory Feature
- Conceptual Development Area
- AUAR Area

0 250 500 Feet

(At original document size of 8.5x11)
1:6,000

N

Notes

1. Coordinate System: NAD 1983 HARN Adj MN St Louis CS96 Feet
2. Data Sources: Stantec, City of Duluth, St. Louis Co., MnDOT, MnDNR, WSB
3. Background: 2023 St. Louis Co.

Stantec

Project Location
T50N, R14W, S21
Duluth, St. Louis Co., MN

Prepared by KJM on 2024-02-05

Client/Project
227706270
City of Duluth
Duluth Central High School Redevelopment Site
Scoping EAW

Figure No.
12

Title
Wetlands Map

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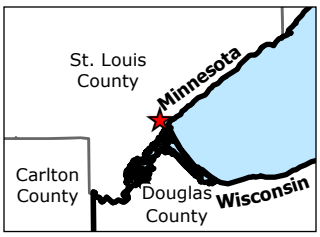

Notes
1. Coordinate System: NAD 1983 HARN Adj MN St Louis CS96 Feet
2. Data Sources: Stantec, MnGeo, MnDOT, MPCA
3. Background: 2023 St. Louis Co.

Legend
- AUAR Area
- 1/4 Mile Radius

MPCA Sites
Program Name
- Multiple Programs
- Hazardous Waste
- Investigation and Cleanup
- Tanks

0 450 900 Feet
(At original document size of 8.5x11)
1:10,800

N

Stantec

Project Location
T50N, R14W, S21
Duluth, St. Louis Co., MN

Prepared by KJM on 2024-02-05

Client/Project
City of Duluth
Duluth Central High School Redevelopment Site
Scoping EAW

227706270

Figure No.
13

Title
MPCA WIMN Potentially Contaminated Sites

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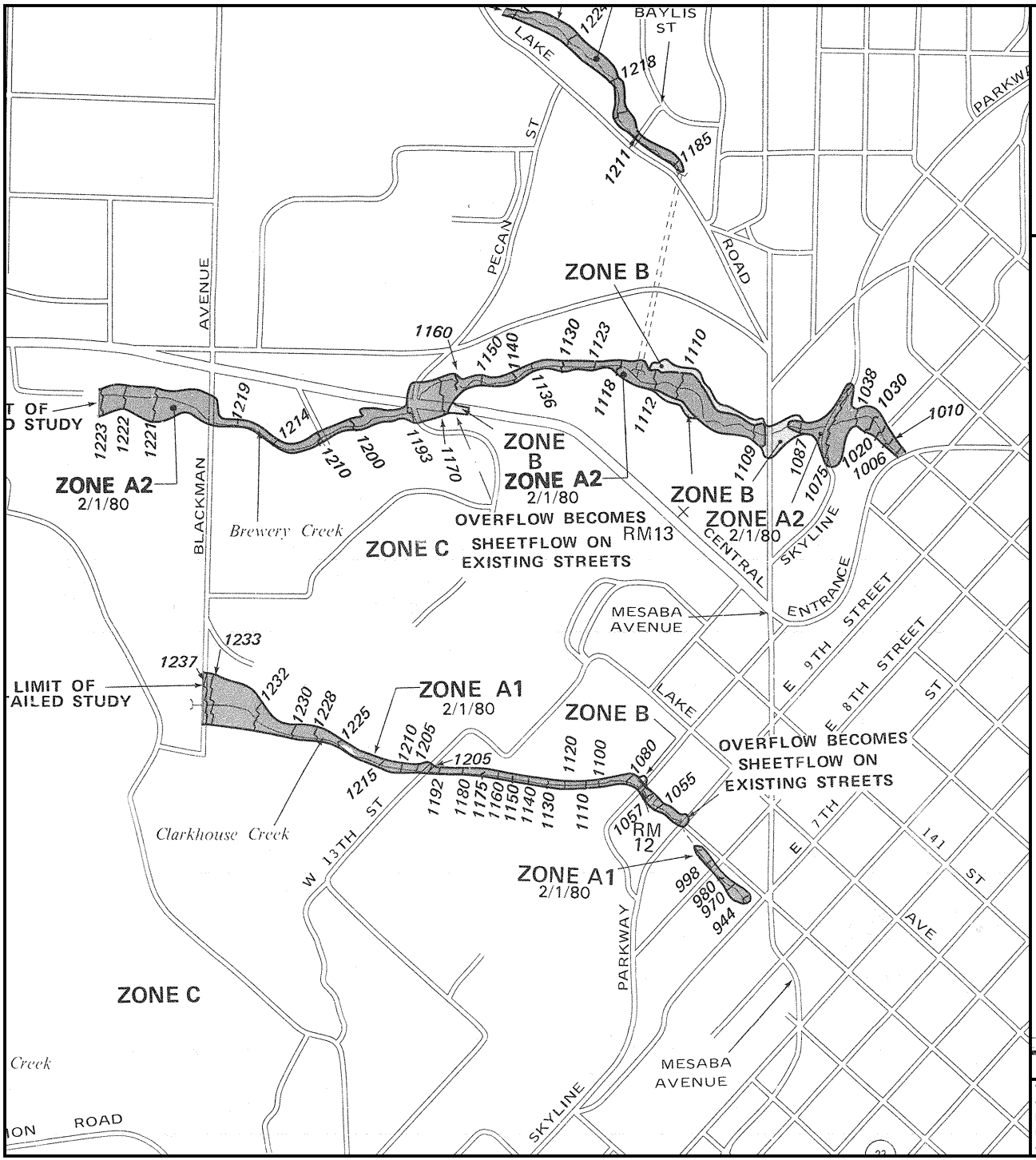
Appendix B

FEMA FIRMette



APPROXIMATE SC

1000 0

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

CITY OF
DULUTH,
MINNESOTA
ST LOUIS COUNTY

PANEL 25 OF 45
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
270421 0025 C

MAP REVISED:
APRIL 2, 1982

Federal Emergency Management Agency

Appendix C

MDH Well Log Reports

Minnesota Unique Well Number

340357

County St. Louis
Quad Duluth
Quad ID 244D

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING REPORT

Minnesota Statutes Chapter 1031

Entry Date 08/02/2018
Update Date 09/04/2018
Received Date

Well Name	Township	Range	Dir	Section	Subsection
	50	14	W	21	DCDACC

Elevation 1243 **Elev. Method** LiDAR 1m DEM (MNDNR)

Address

Well 1421 N. 3RD AV W DULUTH MN 55811

Stratigraphy Information

Geological Material	From	To (ft.)	Color	Hardness
CLAYEY SAND	0	15	BROWN	MEDIUM
SILTY SAND	15	20	BROWN	MEDIUM

Remarks

SEALED 6-4-2018 BY 3704.

Well Depth	Depth Completed	Date Well Completed
20 ft.	20 ft.	06/04/2018

Drill Method **Drill Fluid**

Use environ. bore hole **Status** Sealed

Well Hydrofractured? **Yes** ☐ **No** ☐ **From** **To**

Casing Type **Joint**
Drive Shoe? **Yes** ☐ **No** ☐ **Above/Below**

Open Hole From ft. To ft.

Screen? ☐ **Type** **Make**

Static Water Level

Pumping Level (below land surface)

Wellhead Completion

Pitless adapter manufacturer Model

☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

Grouting Information Well Grouted? ☒ Yes ☐ No ☐ Not Specified

Material	Amount		From	To
bentonite	2	Sacks	ft. 2	ft.

Nearest Known Source of Contamination

feet Direction Type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed

Manufacturer's name

Model Number HP Volt

Length of drop pipe ft Capacity g.p. Typ

Abandoned

Does property have any not in use and not sealed well(s)? ☐ Yes ☒ No

Variance

Was a variance granted from the MDH for this well? ☐ Yes ☐ No

Miscellaneous

First Bedrock Aquifer

Last Strat sand+silt-brown Depth to Bedrock ft

Located by Minnesota Geological Survey

Locate Method Digitization (Screen) - Map (1:24,000) (15 meters or

System UTM - NAD83, Zone 15, Meters X 567358 Y 5182649

Unique Number Verification Site Plan Input Date 08/02/2018

Angled Drill Hole

Well Contractor

Licensee Business	Lic. or Reg. No.	Name of Driller
Twin Ports Testing II, Inc.	3704	HALVORSON, M.

Minnesota Unique Well Number

745808

County St. Louis
Quad Duluth
Quad ID 244D

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING REPORT

Minnesota Statutes Chapter 1031

Entry Date 07/28/2009
Update Date 12/05/2019
Received Date 03/01/2007

Well Name	Township	Range	Dir	Section	Subsection
RAPPANA,	50	14	W	21	CDDABD

Elevation 1241 **Elev. Method** LiDAR 1m DEM (MNDNR)

Address

C/W 615 BLACKMAN AV S DULUTH MN 55811

Stratigraphy Information

Geological Material	From	To (ft.)	Color	Hardness
SANDY CLAY	0	18	BROWN	MEDIUM
ROCK	18	189	GRAY	HARD

Remarks

DRILLING METHOD= DRIVEN ROTARY.
GROUTING INFORMATION: DRIVEN WITH 8 MESH.

Well Depth 189 ft. **Depth Completed** 189 ft. **Date Well Completed** 03/01/2007

Drill Method Multiple methods used **Drill Fluid** Water

Use domestic **Status** Active

Well Hydrofractured? Yes ☐ No ☒ **From** **To**

Casing Type Single casing **Joint** Welded
Drive Shoe? Yes ☒ No ☐ **Above/Below**

Casing Diameter	Weight	Hole Diameter
6 in. To 26 ft.	19 lbs./ft.	6 in. To 189 ft.
		0 in. To ft.

Open Hole From 26 ft. To 189 ft.

Screen? ☐ **Type** **Make**

Static Water Level

23 ft. land surface Measure 03/01/2007

Pumping Level (below land surface)

160 ft. 2 hrs. Pumping at 2 g.p.m.

Wellhead Completion

Pitless adapter manufacturer BAKER Model BULLDOG
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

Grouting Information Well Grouted? ☒ Yes ☐ No ☐ Not Specified

Material	Amount	From	To
bentonite		ft.	ft.

Nearest Known Source of Contamination

55 feet East Direction Sewer Type
Well disinfected upon completion? ☒ Yes ☐ No

Pump ☐ Not Installed Date Installed 06/01/2007
Manufacturer's name STA-RITE
Model Number J HP 0.75 Volt 220
Length of drop pipe 160 ft Capacity 10 g.p. Typ Submersible

Abandoned

Does property have any not in use and not sealed well(s)? ☐ Yes ☒ No

Variance

Was a variance granted from the MDH for this well? ☐ Yes ☒ No

Miscellaneous

First Bedrock Duluth Cplx-anorth.series Aquifer Duluth Cplx-
Last Strat Duluth Cplx-anorth.series Depth to Bedrock 18 ft
Located by Minnesota Geological Survey
Locate Method Digitization (Screen) - Map (1:12,000) (>15 meters)
System UTM - NAD83, Zone 15, Meters X 566974 Y 5182707
Unique Number Verification Address verification Input Date 04/28/2016

Angled Drill Hole

Well Contractor

Licensee Business	Lic. or Reg. No.	Name of Driller
Dennys Drilling, Inc.	1779	KOEPP, D.

Minnesota Unique Well Number

754614

County St. Louis
Quad Duluth
Quad ID 244D

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING REPORT

Minnesota Statutes Chapter 1031

Entry Date 07/28/2009
Update Date 12/05/2019
Received Date 01/11/2008

Well Name	Township	Range	Dir	Section	Subsection
VUKELICH,	50	14	W	28	ABBABB

Elevation 1248 **Elev. Method** LiDAR 1m DEM (MNDNR)

Address

C/W 413 15TH ST W DULUTH MN 55811

Stratigraphy Information

Geological Material	From	To (ft.)	Color	Hardness
SANDY CLAY	0	4	BROWN	MEDIUM
ROCK	4	264	GRAY	HARD

Remarks

DRILLING METHOD= DRIVEN ROTARY.

Well Depth	Depth Completed	Date Well Completed
264 ft.	264 ft.	10/03/2007

Drill Method Multiple methods used **Drill Fluid** Water

Use domestic **Status** Active

Well Hydrofractured? Yes [X] No [ ] **From** 45 ft. **To** 264 ft.

Casing Type Single casing **Joint** Welded
Drive Shoe? Yes [X] No [ ] **Above/Below**

Casing Diameter	Weight	Hole Diameter
6 in. To 19 ft.	19 lbs./ft.	10 in. To 19 ft.
		6 in. To 264 ft.

Open Hole From 19 ft. To 264 ft.

Screen? [ ] **Type** **Make**

Static Water Level

36 ft. land surface Measure 10/04/2007

Pumping Level (below land surface)

250 ft. 2 hrs. Pumping at g.p.m.

Wellhead Completion

Pitless adapter manufacturer BAKER Model BULLDOG

[ ] Casing Protection [X] 12 in. above grade
[ ] At-grade (Environmental Wells and Borings ONLY)

Grouting Information Well Grouted? [X] Yes [ ] No [ ] Not Specified

Material	Amount	From	To
neat cement	8 Sacks	6 ft.	19 ft.

Nearest Known Source of Contamination

90 feet West Direction Sewer Type

Well disinfected upon completion? [X] Yes [ ] No

Pump [ ] Not Installed Date Installed

Manufacturer's name STA-RITE

Model Number J HP 1 Volt 220

Length of drop pipe 240 ft Capacity 10 g.p. Typ Submersible

Abandoned

Does property have any not in use and not sealed well(s)? [ ] Yes [X] No

Variance

Was a variance granted from the MDH for this well? [ ] Yes [X] No

Miscellaneous

First Bedrock Duluth Cplx-anorth.series Aquifer Duluth Complex
Last Strat Duluth Complex Depth to Bedrock 4 ft
Located by Minnesota Geological Survey
Locate Method GPS SA Off (averaged) (15 meters)
System UTM - NAD83, Zone 15, Meters X 567136 Y 5182534
Unique Number Verification Address verification Input Date 07/05/2017

Angled Drill Hole

Well Contractor

Licensee Business	Lic. or Reg. No.	Name of Driller
Dennys Drilling, Inc.	1779	NELSON, C.

Minnesota Unique Well Number

778106

County St. Louis
Quad Duluth
Quad ID 244D

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING REPORT
Minnesota Statutes Chapter 1031

Entry Date 03/31/2011
Update Date 12/05/2019
Received Date 09/24/2010

Well Name	Township	Range	Dir	Section	Subsection
COLE, EITHAN	50	14	W	28	AABBBA

Elevation 1196 **Elev. Method** LiDAR 1m DEM (MNDNR)

Address

Well 224 13TH ST W DULUTH MN 55806
Contact 2857 EXETER ST DULUTH MN 55806

Stratigraphy Information

Geological Material	From	To (ft.)	Color	Hardness
DIRTY GRAVEL	0	9	BROWN	SOFT
CLAY/GRAVEL	9	11	BROWN	MEDIUM
CLAY	11	24	RED/BRN	MEDIUM
GRANITE	24	405	GRAY	HARD

Remarks

Well Depth 405 ft. **Depth Completed** 405 ft. **Date Well Completed** 09/24/2010

Drill Method Multiple methods used **Drill Fluid**

Use domestic **Status** Active

Well Hydrofractured? Yes [X] No [ ] **From** 120 ft. **To** 405 ft.

Casing Type Single casing **Joint** Other
Drive Shoe? Yes [X] No [ ] **Above/Below**

Casing Diameter		Weight		Hole Diameter	
6 in. To 24 ft.		19.4 lbs./ft.		6 in. To 405 ft.	

Open Hole From 24 ft. To 405 ft.

Screen? [ ] **Type** **Make**

Static Water Level

Pumping Level (below land surface)

Wellhead Completion
Pitless adapter manufacturer Model
[ ] Casing Protection [X] 12 in. above grade
[ ] At-grade (Environmental Wells and Borings ONLY)

Grouting Information Well Grouted? [X] Yes [ ] No [ ] Not Specified

Material	Amount	From	To
driven casing seal		ft. 24	ft.

Nearest Known Source of Contamination
100 feet Direction Type
Well disinfected upon completion? [X] Yes [ ] No

Pump [X] Not Installed Date Installed
Manufacturer's name
Model Number HP Volt
Length of drop pipe ft Capacity g.p. Typ

Abandoned
Does property have any not in use and not sealed well(s)? [ ] Yes [X] No

Variance
Was a variance granted from the MDH for this well? [ ] Yes [X] No

Miscellaneous
First Bedrock M.Prot.mafic intr.undif. Aquifer Duluth Complex
Last Strat Duluth Complex Depth to Bedrock 24 ft
Located by Minnesota Geological Survey
Locate Method Digitization (Screen) - Map (1:12,000) (>15 meters)
System UTM - NAD83, Zone 15, Meters X 567480 Y 5182526
Unique Number Verification Address verification Input Date 04/28/2016

Angled Drill Hole

Well Contractor
Bob Kent Well Drilling 1886 KENT, B.
Licensee Business Lic. or Reg. No. Name of Driller

Minnesota Unique Well Number

821830

County St. Louis
Quad Duluth
Quad ID 244D

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING REPORT

Minnesota Statutes Chapter 1031

Entry Date 04/26/2017
Update Date 09/17/2020
Received Date 04/17/2017

Well Name	Township	Range	Dir	Section	Subsection
DULUTH MW	50	14	W	21	DBBBCB

Elevation 1227 **Elev. Method** LiDAR 1m DEM (MNDNR)

Address

Contact 411 FIRST ST W DULUTH MN 55802

Stratigraphy Information

Geological Material	From	To (ft.)	Color	Hardness
TOP SOIL	0	2	BROWN	
SANDY CLAY	2	10	BROWN	
CLAYEY SAND	10	18	BROWN	

Remarks

LICENSEE BUSINESS: DAKOTA TECHNOLOGIES.

Well Depth 17.5 ft. **Depth Completed** 17.5 ft. **Date Well Completed** 04/04/2017

Drill Method Auger (non-specified) **Drill Fluid**

Use monitor well **Status** Active

Well Hydrofractured? Yes ☐ No ☒ **From** **To**

Casing Type Single casing **Joint**

Drive Shoe? Yes ☐ No ☒ **Above/Below**

Casing Diameter	Weight	Hole Diameter
2 in. To 7.5 ft.	lbs./ft.	10 in. To 17.5 ft.

Open Hole From ft. To ft.

Screen? ☒ **Type** plastic **Make** JOHNSON

Diameter	Slot/Gauze	Length	Set
2 in.	10	10 ft.	7.5 ft. 17.5 ft.

Static Water Level

10.5 ft. land surface Measure 04/04/2017

Pumping Level (below land surface)

Wellhead Completion

Pitless adapter manufacturer PRO TOP Model

☐ Casing Protection ☒ 12 in. above grade

☐ At-grade (Environmental Wells and Borings ONLY)

Grouting Information Well Grouted? ☒ Yes ☐ No ☐ Not Specified

Material	Amount	From	To
bentonite	1 Sacks	ft.	5.5 ft.

Nearest Known Source of Contamination

feet Direction Type

Well disinfected upon completion? ☐ Yes ☒ No

Pump ☒ Not Installed Date Installed

Manufacturer's name

Model Number HP Volt

Length of drop pipe ft Capacity g.p. Typ

Abandoned

Does property have any not in use and not sealed well(s)? ☐ Yes ☒ No

Variance

Was a variance granted from the MDH for this well? ☐ Yes ☒ No

Miscellaneous

First Bedrock Aquifer Quat. Water

Last Strat clay+sand-brown Depth to Bedrock ft

Located by Minnesota Geological Survey

Locate Method Digitization (Screen) - Map (1:12,000) (>15 meters)

System UTM - NAD83, Zone 15, Meters X 567038 Y 5183292

Unique Number Verification Site Plan Input Date 05/01/2017

Angled Drill Hole

Well Contractor

Licensee Business	Lic. or Reg. No.	Name of Driller
Dakota Technologies	3553	EYSTAD, C.

Minnesota Unique Well Number

835884

County St. Louis
Quad Duluth
Quad ID 244D

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING REPORT
Minnesota Statutes Chapter 1031

Entry Date 12/04/2018
Update Date 12/05/2019
Received Date 10/31/2018

Well Name	Township	Range	Dir	Section	Subsection
DRCC	50	14	W	21	CDBDCA

Elevation 1299 **Elev. Method** LiDAR 1m DEM (MNDNR)

Address

Contact 5629 GRAND AV DULUTH MN 55807
Well 320 ORANGE ST E DULUTH MN 55811

Stratigraphy Information

Geological Material	From	To (ft.)	Color	Hardness
CLAY	0	12	RED	MEDIUM
GRANITE	12	17	GRAY	MED-HRD
GRANITE	17	340	GRAY	SFT-MED

Remarks
DRILLERS: CRAIG & HEATH SUNNARBORG.

Well Depth 340 ft. **Depth Completed** 340 ft. **Date Well Completed** 10/19/2018

Drill Method Non-specified Rotary **Drill Fluid** Water

Use domestic **Status** Active

Well Hydrofractured? Yes ☐ No ☒ **From** **To**

Casing Type Single casing **Joint** Welded
Drive Shoe? Yes ☒ No ☐ **Above/Below**

Casing Diameter	Weight	Hole Diameter
6 in. To 17 ft.	lbs./ft.	10 in. To 17 ft.
		6 in. To 340 ft.

Open Hole From 17 ft. To 340 ft.

Screen? ☐ **Type** **Make**

Static Water Level
30 ft. land surface Measure 10/19/2018

Pumping Level (below land surface)
330 ft. 1 hrs. Pumping at 1.5 g.p.m.

Wellhead Completion
Pitless adapter manufacturer Model
☒ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

Grouting Information Well Grouted? ☒ Yes ☐ No ☐ Not Specified

Material	Amount	From	To
neat cement	2 Sacks	12 ft.	17 ft.
bentonite	2 Sacks	ft.	12 ft.

Nearest Known Source of Contamination
50 feet Southwes Direction Sewer Type
Well disinfected upon completion? ☒ Yes ☐ No

Pump ☒ Not Installed Date Installed
Manufacturer's name
Model Number HP Volt
Length of drop pipe ft Capacity g.p. Typ

Abandoned
Does property have any not in use and not sealed well(s)? ☐ Yes ☒ No

Variance
Was a variance granted from the MDH for this well? ☐ Yes ☒ No

Miscellaneous
First Bedrock Duluth Cplx-anorth.series Aquifer Duluth Complex
Last Strat Duluth Complex Depth to Bedrock 17 ft
Located by Minnesota Geological Survey
Locate Method GPS SA Off (averaged) (15 meters)
System UTM - NAD83, Zone 15, Meters X 566773 Y 5182790
Unique Number Verification Tax Records Input Date 02/14/2019

Angled Drill Hole

Well Contractor
Sunnarborg Well Drilling Inc. 1295 SEE REMARKS
Licensee Business Lic. or Reg. No. Name of Driller

Appendix D

NHIS Initial Response and IPaC Species List

DEPARTMENT OF NATURAL RESOURCES

Minnesota Department of Natural Resources
Division of Ecological & Water Resources
500 Lafayette Road, Box 25
St. Paul, MN 55155-4025

January 11, 2024
Correspondence # MCE 2023-00835

Erin Sejkora
Stantec

RE: Natural Heritage Review of the proposed Central High School Redevelopment Project AUAR, T50N R14W Sections 21-22; St. Louis County

Dear Erin Sejkora,

As requested, the Minnesota Natural Heritage Information System has been reviewed to determine if the proposed project has the potential to impact any rare species or other significant natural features. Based on the project details provided with the request, the following rare features may be impacted by the proposed project:

State-listed Species

- The Natural Heritage Information System (NHIS) tracks bat roost trees and hibernacula plus some acoustic data, but this information is not exhaustive. Even if there are no bat records listed nearby, all seven of Minnesota's bats, including the federally endangered northern long-eared bat (*Myotis septentrionalis*), can be found throughout Minnesota. During the active season (approximately April-November) bats roost underneath bark, in cavities, or in crevices of both live and dead trees. Tree removal can negatively impact bats by destroying roosting habitat, especially during the pup rearing season when females are forming maternity roosting colonies and the pups cannot yet fly. To minimize these impacts, **the DNR recommends that tree removal be avoided from June 1 through August 15.**

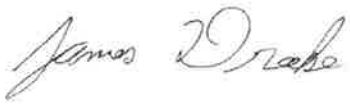
- Please visit the DNR Rare Species Guide for more information on the habitat use of these species and recommended measures to avoid or minimize impacts.

Federally Protected Species

- To ensure compliance with federal law, conduct a federal regulatory review using the U.S. Fish and Wildlife Service's (USFWS) online Information for Planning and Consultation (IPaC) tool.

Thank you for consulting us on this matter and for your interest in preserving Minnesota's rare natural resources.

Sincerely,



James Drake
Natural Heritage Review Specialist
James.F.Drake@state.mn.us

Cc: Jessica Parson

IPaC **U.S. Fish & Wildlife Service**

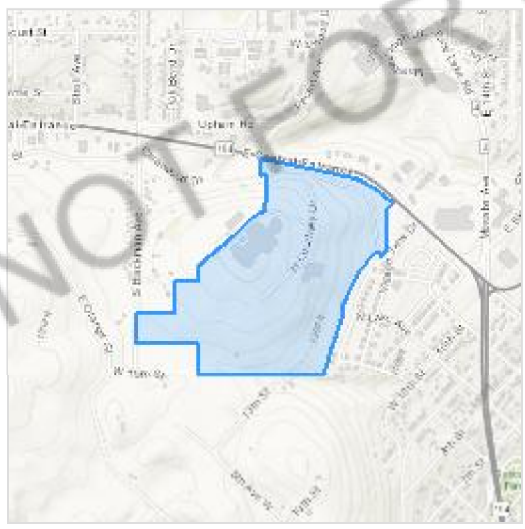
IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

St. Louis County, Minnesota



Local office

Minnesota-Wisconsin Ecological Services Field Office

(952) 858-0793
(952) 646-2873

3815 American Blvd East
Bloomington, MN 55425-1659

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

---

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information. IPaC only shows species that are regulated by USFWS (see FAQ).

2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS
Canada Lynx Lynx canadensis There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/3652	Threatened
Gray Wolf Canis lupus There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/4488	Threatened
Northern Long-eared Bat Myotis septentrionalis Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9045	Endangered
Tricolored Bat Perimyotis subflavus Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/10515	Proposed Endangered

Birds

NAME	STATUS
Rufa Red Knot Calidris canutus rufa Wherever found There is **proposed** critical habitat for this species. https://ecos.fws.gov/ecp/species/1864	Threatened

Insects

NAME	STATUS

Monarch Butterfly Danaus plexippus Candidate

Wherever found

No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/9743

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

There are no critical habitats at this location.

You are still required to determine if your project(s) may have effects on all above listed species.

Bald & Golden Eagles

Bald and golden eagles are protected under the Bald and Golden Eagle Protection Act[1] and the Migratory Bird Treaty Act[2].

Any person or organization who plans or conducts activities that may result in impacts to bald or golden eagles, or their habitats[3], should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

Additional information can be found using the following links:

- Eagle Managment https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

There are bald and/or golden eagles in your project area.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle Haliaeetus leucocephalus This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds Dec 1 to Aug 31
Golden Eagle Aquila chrysaetos This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1680	Breeds Jan 1 to Aug 31

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum

probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.

3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

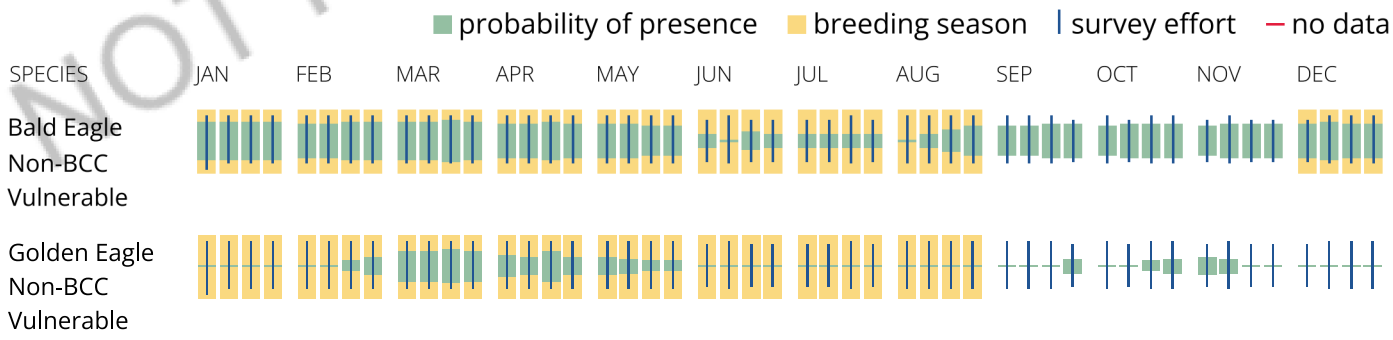
Breeding Season (▪)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



What does IPaC use to generate the potential presence of bald and golden eagles in my specified location?

The potential for eagle presence is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply). To see a list of all birds potentially present in your project area, please visit the Rapid Avian Information Locator (RAIL) Tool.

What does IPaC use to generate the probability of presence graphs of bald and golden eagles in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the Rapid Avian Information Locator (RAIL) Tool.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur. Please contact your local Fish and Wildlife Service Field Office if you have questions.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats[3] should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds Dec 1 to Aug 31
Black Tern *Chlidonias niger* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3093	Breeds May 15 to Aug 20
Black-billed Cuckoo *Coccyzus erythropthalmus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9399	Breeds May 15 to Oct 10
Bobolink *Dolichonyx oryzivorus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 20 to Jul 31
Canada Warbler *Cardellina canadensis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 20 to Aug 10

Chimney Swift Chaetura pelagica — Breeds Mar 15 to Aug 25
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Common Tern Sterna hirundo hirundo — Breeds May 1 to Aug 31
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA

Connecticut Warbler Oporornis agilis — Breeds Jun 15 to Aug 10
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Evening Grosbeak Coccothraustes vespertinus — Breeds May 15 to Aug 10
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Golden Eagle Aquila chrysaetos — Breeds Jan 1 to Aug 31
This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.
https://ecos.fws.gov/ecp/species/1680

Golden-winged Warbler Vermivora chrysoptera — Breeds May 1 to Jul 20
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/8745

Lesser Yellowlegs Tringa flavipes — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9679

Long-eared Owl asio otus — Breeds Mar 1 to Jul 15
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/3631

Olive-sided Flycatcher Contopus cooperi — Breeds May 20 to Aug 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/3914

Pectoral Sandpiper Calidris melanotos This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Ruddy Turnstone Arenaria interpres morinella This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds elsewhere
Wood Thrush Hylocichla mustelina This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 10 to Aug 31

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

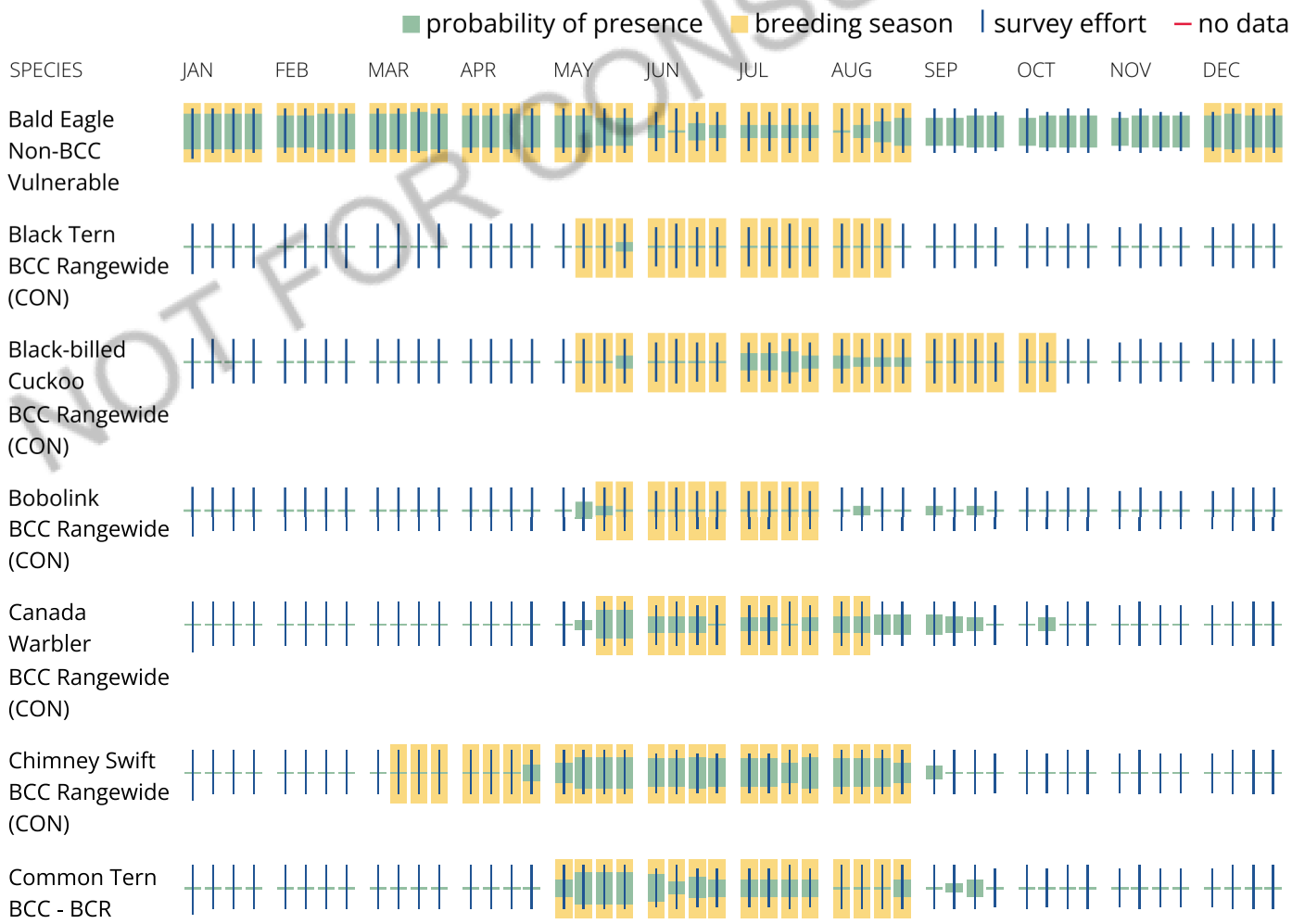
Breeding Season (▪)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

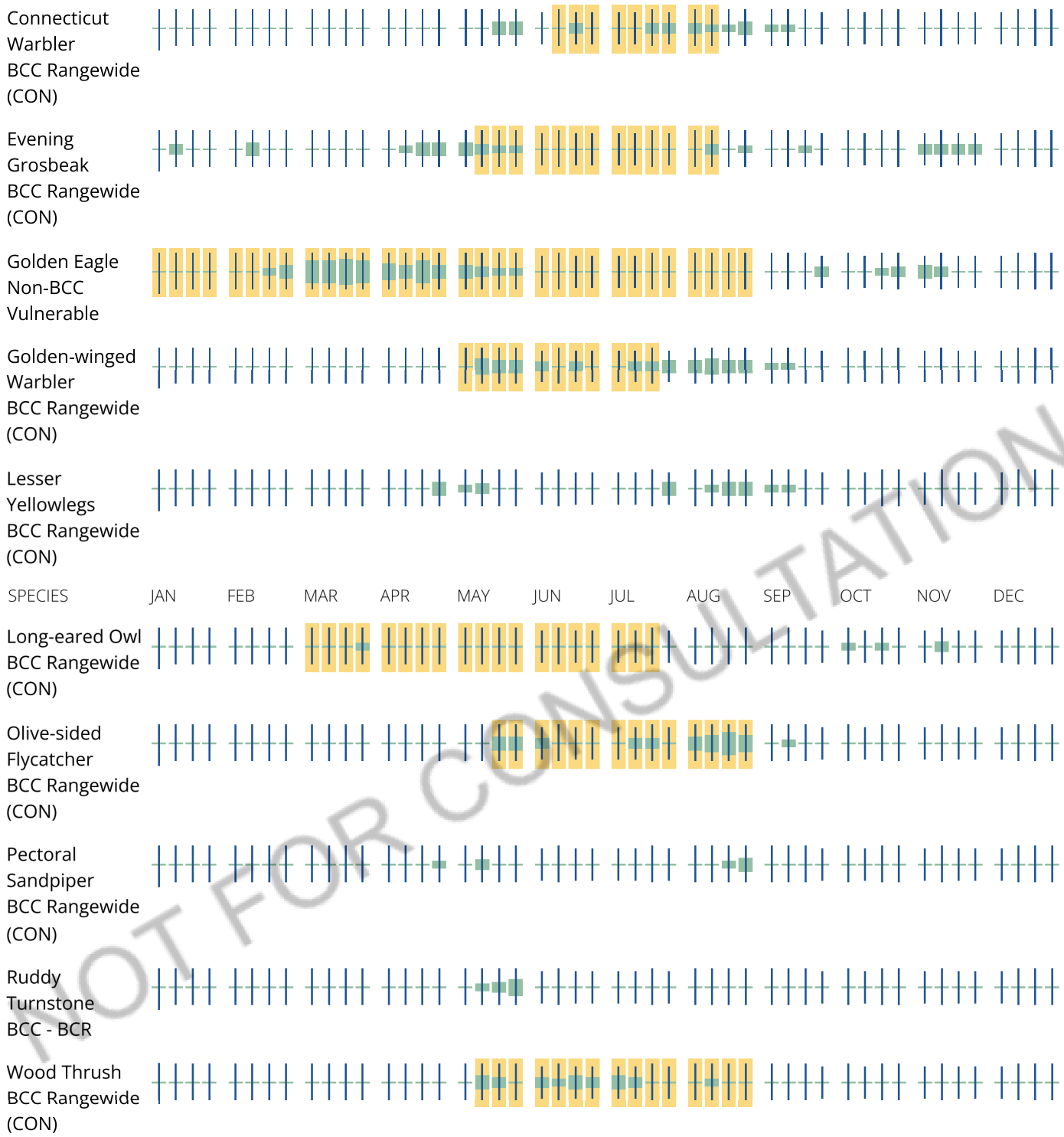
Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.





Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the list of migratory birds that potentially occur in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the Rapid Avian Information Locator (RAIL) Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets.

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may query your location using the RAIL Tool and look at the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

There are no refuge lands at this location.

Fish hatcheries

There are no fish hatcheries at this location.

Wetlands in the National Wetlands Inventory (NWI)

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

FRESHWATER EMERGENT WETLAND

PEM1D

FRESHWATER FORESTED/SHRUB WETLAND

PSS1D

RIVERINE

R4SBC

A full description for each wetland code can be found at the National Wetlands Inventory website

NOTE: This initial screening does **not** replace an on-site delineation to determine whether wetlands occur. Additional information on the NWI data is provided below.

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

Appendix E

Greenhouse Gas Calculations Summary

Duluth Central High School Redevelopment Project
GHG Emissions Summary

		Scenario A - Business Park/Warehouses				Scenario B - Mixed Use			
Scope	**Source**	**CO_2 (ton/yr)**	**CH_4 (ton/yr)**	**N_2O (ton/yr)**	**CO_2e (ton/yr)**	**CO_2 (ton/yr)**	**CH_4 (ton/yr)**	**N_2O (ton/yr)**	**CO_2e (ton/yr)**
Direct Emissions									
Scope 1	Construction - Mobile Sources Onroad - Gasoline and Diesel	14	0.0001	0.0004	14	458	0.003	0.012	461
Scope 1	Construction - Mobile Sources Non-road - Diesel	29	0.003	0.002	29	2,359	0.22	0.20	2,425
Scope 1	Operations - Stationary Combustion - Natural Gas	438	0.0083	0.00080	438	4,696	0.089	0.0086	4,701
Scope 1	Operations - Mobile Sources - Gasoline and Diesel	1,942	0.017	0.044	1,955	10,508	0.18	0.13	10,553
Indirect Emissions									
Scope 2	Purchased Electricity	1,181	0.13	0.018	1,189	12,203	1.3	0.18	12,290
Scope 2	Waste - Operations				221				2,174
Total		**3,602**	**0.2**	**0.07**	**3,846**	**30,224**	**1.8**	**0.54**	**32,604**
				Lifetime	192,318			Lifetime	1,630,203

Duluth Central High School Development

Source ID	Description	Building Activity	Number of Residential Units	Square Footage per Unit[1,2]	Scenario A - Business Park			Scenario B - Mixed Use		
					Bldg Square Footage	Natural Gas Combustion (scf/yr)	Electricity Usage (kWh/yr)	Bldg Square Footage	Natural Gas Combustion (scf/yr)	Electricity Usage (kWh/yr)
Light Industrial	Warehouse/Light Industrial	Warehouse and Storage			360,000	7,308,000	2,376,000			
Retail	Restaurant, other neighborhood serving commercial uses	Retail						19,000	644,100	267,900
School	Preschool/Alternative School	Education						30,000	1,164,000	309,000
Hotel	Hotel	Lodging						75,000	3,697,500	1,155,000
Townhomes	Townhomes	Lodging	32	1200				38,400	1,893,120	591,360
Apartments	Apartments	Lodging	1558	925				1,440,600	71,021,580	22,185,240
		Total			**360,000**	**7,308,000**	**2,376,000**	**1,603,000**	**78,420,300**	**24,508,500**

1. Townhome square footage estimate based on approximate average of current townhome listings for Duluth, MN.
2. Apartment square footage estimate based on total residential development (1,479,000 square feet) minus townhomes square footage. Per unit square footage is this total divided by the number of units (1558).

Scope 1 Emissions from Stationary Combustion Sources

EPA CENTER FOR CORPORATE CLIMATE LEADERSHIP
U.S. Environmental Protection Agency

Guidance

(A) Enter annual data for each combustion unit, facility, or site (by fuel type) in ORANGE cells on **Table 1**. Example entry is shown in first row (*GREEN Italics*).

- Select "Fuel Combusted" from drop down box.
- Enter "Quantity Combusted" and choose the appropriate units from the drop down box in the unit column. If it's necessary to convert units, common heat contents can be found on the "Heat Content" sheet and unit conversions on the "Unit Conversion" sheet.

(B) If fuel is consumed in a facility but stationary fuel consumption data are not available, an estimate should be made for completeness. See the "Items to Note" section of the Help sheet for suggested estimation approaches.

(C) Biomass CO_2 emissions are not reported in the total emissions, but are reported separately at the bottom of the sheet.

Table 1. Stationary Source Fuel Combustion

Source ID	Source Description	Source Area (sq ft)	Fuel Combusted	Fuel State (solid, liquid, gas)	Quantity Combusted	Units
BLR-012	*East Power Plant*	*12,517*	*Natural Gas*	*Gas*	*10,000*	*MMBtu*
Warehouse	Warehouse/Light Industrial	360,000	Natural Gas	Gas	7,308,000	SCF

GHG Emissions

Total Organization-Wide Stationary Source Combustion by Fuel Type

Fuel Type	Quantity Combusted	Units
Coal and Coke - Solid		
Anthracite Coal	0	short ton
Bituminous Coal	0	short ton
Sub-bituminous Coal	0	short ton
Lignite Coal	0	short ton
Mixed (Commercial Sector)	0	short ton
Mixed (Electric Power Sector)	0	short ton
Mixed (Industrial Coking)	0	short ton
Mixed (Industrial Sector)	0	short ton
Coal Coke	0	short ton
Other Fuels - Solid		
Municipal Solid Waste	0	short ton
Petroleum Coke (Solid)	0	short ton
Plastics	0	short ton
Tires	0	short ton
Biomass Fuels - Solid		
Agricultural Byproducts	0	short ton
Peat	0	short ton
Solid Byproducts	0	short ton
Wood and Wood Residuals	0	short ton
Gaseous Fuels		
Natural Gas	7,308,000	scf
Propane Gas	0	scf
Landfill Gas	0	scf
Petroleum Products		
Distillate Fuel Oil No. 2	0	gallons
Residual Fuel Oil No. 6	0	gallons
Kerosene	0	gallons
Liquefied Petroleum Gases (LPG)	0	gallons
Biomass Fuels - Liquid		
Biodiesel (100%)	0	gallons
Ethanol (100%)	0	gallons
Rendered Animal Fat	0	gallons
Vegetable Oil	0	gallons

Total Organization-Wide CO_2, CH_4 and N_2O Emissions from Stationary Source Fuel Combustion

Fuel Type	CO_2 (kg)	CH_4 (g)	N_2O (g)
Coal and Coke - Solid			
Anthracite Coal	0.0	0.0	0.0
Bituminous Coal	0.0	0.0	0.0
Sub-bituminous Coal	0.0	0.0	0.0
Lignite Coal	0.0	0.0	0.0
Mixed (Commercial Sector)	0.0	0.0	0.0
Mixed (Electric Power Sector)	0.0	0.0	0.0
Mixed (Industrial Coking)	0.0	0.0	0.0
Mixed (Industrial Sector)	0.0	0.0	0.0
Coal Coke	0.0	0.0	0.0
Other Fuels - Solid			
Municipal Solid Waste	0.0	0.0	0.0
Petroleum Coke (Solid)	0.0	0.0	0.0
Plastics	0.0	0.0	0.0
Tires	0.0	0.0	0.0
Gaseous Fuels			
Natural Gas	397,847.5	7,527.2	730.8
Propane Gas	0.0	0.0	0.0
Landfill Gas	0.0	0.0	0.0
Petroleum Products			
Distillate Fuel Oil No. 2	0.0	0.0	0.0
Residual Fuel Oil No. 6	0.0	0.0	0.0
Kerosene	0.0	0.0	0.0
Liquefied Petroleum Gases (LPG)	0.0	0.0	0.0
Total Fossil Fuel Emissions	**397,847.5**	**7,527.2**	**730.8**
Biomass Fuels - Solid			
Agricultural Byproducts	0.0	0.0	0.0
Peat	0.0	0.0	0.0
Solid Byproducts	0.0	0.0	0.0
Wood and Wood Residuals	0.0	0.0	0.0
Biomass Fuels - Liquid			
Biodiesel (100%)	0.0	0.0	0.0
Ethanol (100%)	0.0	0.0	0.0
Rendered Animal Fat	0.0	0.0	0.0
Vegetable Oil	0.0	0.0	0.0
Total Non-Fossil Fuel Emissions	**0.0**	**0.0**	**0.0**
Total Emissions for all Fuels	**397,847.5**	**7,527.2**	**730.8**

Total CO_2 Equivalent Emissions (metric tons) - Stationary Combustion	**398.3**
Total Biomass CO_2 Equivalent Emissions (metric tons) - Stationary Combustion	**0.0**

EPA CENTER FOR CORPORATE CLIMATE LEADERSHIP
U.S. Environmental Protection Agency

Scope 1 Emissions from Stationary Combustion Sources

Guidance

(A) Enter annual data for each combustion unit, facility, or site (by fuel type) in ORANGE cells on **Table 1**. Example entry is shown in first row (*GREEN Italics*).

- Select "Fuel Combusted" from drop down box.
- Enter "Quantity Combusted" and choose the appropriate units from the drop down box in the unit column. If it's necessary to convert units, common heat contents can be found on the "Heat Content" sheet and unit conversions on the "Unit Conversion" sheet.

(B) If fuel is consumed in a facility but stationary fuel consumption data are not available, an estimate should be made for completeness. See the "Items to Note" section of the Help sheet for suggested estimation approaches.

(C) Biomass CO_2 emissions are not reported in the total emissions, but are reported separately at the bottom of the sheet.

Table 1. Stationary Source Fuel Combustion

Source ID	Source Description	Source Area (sq ft)	Fuel Combusted	Fuel State (solid, liquid, gas)	Quantity Combusted	Units
BLR-012	*East Power Plant*	*12,517*	*Natural Gas*	*Gas*	*10,000*	*MMBtu*
Other Comr	Restaurant, other neighborhood serving commercial uses	19,000	Natural Gas	Gas	644,100	SCF
School	Preschool/Alternative School	30,000	Natural Gas	Gas	1,164,000	SCF
Hotel	Hotel	75,000	Natural Gas	Gas	3,697,500	SCF
Townhome	Townhomes	38,400	Natural Gas	Gas	1,893,120	SCF
Apts	Apartments	1,440,600	Natural Gas	Gas	71,021,580	SCF

GHG Emissions

Total Organization-Wide Stationary Source Combustion by Fuel Type

Fuel Type	Quantity Combusted	Units
Coal and Coke - Solid		
Anthracite Coal	0	short ton
Bituminous Coal	0	short ton
Sub-bituminous Coal	0	short ton
Lignite Coal	0	short ton
Mixed (Commercial Sector)	0	short ton
Mixed (Electric Power Sector)	0	short ton
Mixed (Industrial Coking)	0	short ton
Mixed (Industrial Sector)	0	short ton
Coal Coke	0	short ton
Other Fuels - Solid		
Municipal Solid Waste	0	short ton
Petroleum Coke (Solid)	0	short ton
Plastics	0	short ton
Tires	0	short ton
Biomass Fuels - Solid		
Agricultural Byproducts	0	short ton
Peat	0	short ton
Solid Byproducts	0	short ton
Wood and Wood Residuals	0	short ton
Gaseous Fuels		
Natural Gas	78,420,300	scf
Propane Gas	0	scf
Landfill Gas	0	scf
Petroleum Products		
Distillate Fuel Oil No. 2	0	gallons
Residual Fuel Oil No. 6	0	gallons
Kerosene	0	gallons
Liquefied Petroleum Gases (LPG)	0	gallons
Biomass Fuels - Liquid		
Biodiesel (100%)	0	gallons
Ethanol (100%)	0	gallons
Rendered Animal Fat	0	gallons
Vegetable Oil	0	gallons

Total Organization-Wide CO_2, CH_4 and N_2O Emissions from Stationary Source Fuel Combustion

Fuel Type	CO_2 (kg)	CH_4 (g)	N_2O (g)
Coal and Coke - Solid			
Anthracite Coal	0.0	0.0	0.0
Bituminous Coal	0.0	0.0	0.0
Sub-bituminous Coal	0.0	0.0	0.0
Lignite Coal	0.0	0.0	0.0
Mixed (Commercial Sector)	0.0	0.0	0.0
Mixed (Electric Power Sector)	0.0	0.0	0.0
Mixed (Industrial Coking)	0.0	0.0	0.0
Mixed (Industrial Sector)	0.0	0.0	0.0
Coal Coke	0.0	0.0	0.0
Other Fuels - Solid			
Municipal Solid Waste	0.0	0.0	0.0
Petroleum Coke (Solid)	0.0	0.0	0.0
Plastics	0.0	0.0	0.0
Tires	0.0	0.0	0.0
Gaseous Fuels			
Natural Gas	4,269,201.1	80,772.9	7,842.0
Propane Gas	0.0	0.0	0.0
Landfill Gas	0.0	0.0	0.0
Petroleum Products			
Distillate Fuel Oil No. 2	0.0	0.0	0.0
Residual Fuel Oil No. 6	0.0	0.0	0.0
Kerosene	0.0	0.0	0.0
Liquefied Petroleum Gases (LPG)	0.0	0.0	0.0
Total Fossil Fuel Emissions	**4,269,201.1**	**80,772.9**	**7,842.0**
Biomass Fuels - Solid			
Agricultural Byproducts	0.0	0.0	0.0
Peat	0.0	0.0	0.0
Solid Byproducts	0.0	0.0	0.0
Wood and Wood Residuals	0.0	0.0	0.0
Biomass Fuels - Liquid			
Biodiesel (100%)	0.0	0.0	0.0
Ethanol (100%)	0.0	0.0	0.0
Rendered Animal Fat	0.0	0.0	0.0
Vegetable Oil	0.0	0.0	0.0
Total Non-Fossil Fuel Emissions	**0.0**	**0.0**	**0.0**
Total Emissions for all Fuels	**4,269,201.1**	**80,772.9**	**7,842.0**

Total CO_2 Equivalent Emissions (metric tons) - Stationary Combustion	**4,273.6**
Total Biomass CO_2 Equivalent Emissions (metric tons) - Stationary Combustion	**0.0**

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Scope 2 Emissions from Purchase of Electricity

EPA CENTER FOR CORPORATE CLIMATE LEADERSHIP
U.S. Environmental Protection Agency

Guidance

The Indirect Emissions from Purchased Electricity Guidance document provides guidance for quantifying two scope 2 emissions totals, using a **location-based method** and a **market-based method**. The organization should quantify and report both totals in its GHG inventory. The location-based method considers average emission factors for the electricity grids that provide electricity. The market-based method considers contractual arrangements under which the organization procures electricity from specific sources, such as renewable energy.

(A) Enter total annual electricity purchased in kWh and each eGRID subregion for each facility or site in ORANGE cells of **Table 1**.
(B) If electricity consumption data are not available for a facility, an estimate should be made for completeness.
See the "Items to Note" section of the Help sheet for suggested estimation approaches.
(C) Select "eGRID subregion" from drop box and enter "Electricity Purchased."
- Use map (Figure 1) at bottom of sheet to determine appropriate eGRID subregion. If subregion cannot be determined from the map, find the correct subregion by entering the location's zip code into EPA's Power Profiler:
https://www.epa.gov/egrid/power-profiler#/
(D) See the market-based emission factor hierarchy on the market-based method Help sheet. If any of the first four types of emission factors are applicable, enter the factors in the yellow cells marked as "<enter factor>". If not, leave the yellow cells as is, and eGRID subregion factors will be used for market-based emissions.
Example entry is shown in first row (*GREEN Italics*) for a facility that purchases RECs for 100% of its consumption, and therefore has a market-based emission factor of 0.

Help - Market-Based Method

Tips: Enter electricity usage by location and then look up the eGRID subregion for each location.
If you purchase renewable energy that is less than 100% of your site's electricity, see the example in the market-based method Help sheet.

Table 1. Total Amount of Electricity Purchased by eGRID Subregion

					Market-Based *Use these cells to enter applicable market-based emission factors*						Location-Based		
					Emission Factors			Emissions			Emissions		
Source ID	Source Description	Source Area (sq ft)	eGRID Subregion *where electricity is consumed*	Electricity Purchased (kWh)	CO_2 Emissions (lb/MWh)	CH_4 Emissions (lb/MWh)	N_2O Emissions (lb/MWh)	CO_2 Emissions (lb)	CH_4 Emissions (lb)	N_2O Emissions (lb)	CO_2 Emissions (lb)	CH_4 Emissions (lb)	N_2O Emissions (lb)
Bldg-012	*East Power Plant*	*12,517*	*HIMS (HICC Miscellaneous)*	*200,000*	*0*	*0*	*0*	*0.0*	*0.0*	*0.0*	*226,880.0*	*27.0*	*4.2*
Warehouse	Warehouse/Light Industrial	360,000	MROW (MRO West)	2,376,000	<enter factor>	<enter factor>	<enter factor>	2,366,020.8	254.2	35.6	2,366,020.8	254.2	35.6
					<enter factor>	<enter factor>	<enter factor>						
					<enter factor>	<enter factor>	<enter factor>						
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					<enter factor>	<enter factor>	<enter factor>						
					<enter factor>	<enter factor>	<enter factor>						
Total Emissions for All Sources				2,376,000				2,366,020.8	254.2	35.6	2,366,020.8	254.2	35.6

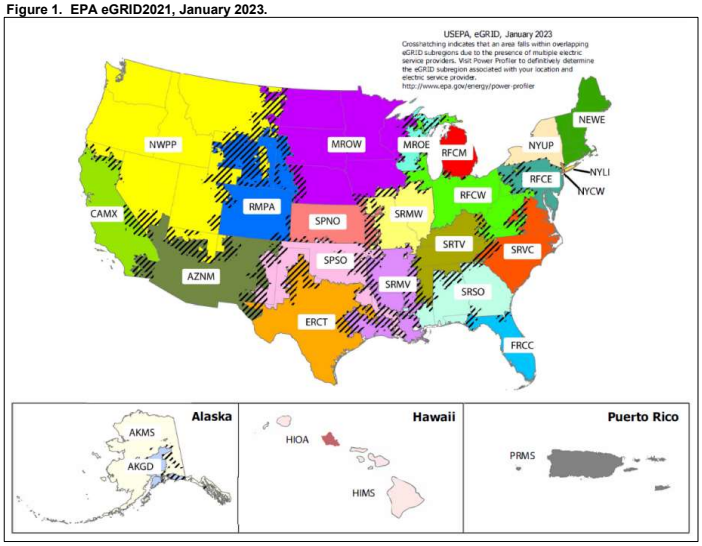
GHG Emissions

CO_2 Equivalent Emissions (metric tons)	
Location-Based Electricity Emissions	1,080.9
Market-Based Electricity Emissions	1,080.9

Notes:

1. CO_2, CH_4 and N_2O emissions are estimated using methodology provided in EPA's Center for Corporate Climate Leadership Greenhouse Gas Inventory Guidance - Indirect Emissions from Purchased Electricity (January 2016).

Figure 1. EPA eGRID2021, January 2023.



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Scope 2 Emissions from Purchase of Electricity

EPA CENTER FOR CORPORATE CLIMATE LEADERSHIP U.S. Environmental Protection Agency

Guidance

The Indirect Emissions from Purchased Electricity Guidance document provides guidance for quantifying two scope 2 emissions totals, using a **location-based method** and a **market-based method**. The organization should quantify and report both totals in its GHG inventory. The location-based method considers average emission factors for the electricity grids that provide electricity. The market-based method considers contractual arrangements under which the organization procures electricity from specific sources, such as renewable energy.

(A) Enter total annual electricity purchased in kWh and each eGRID subregion for each facility or site in ORANGE cells of **Table 1**.
(B) If electricity consumption data are not available for a facility, an estimate should be made for completeness.
See the "Items to Note" section of the Help sheet for suggested estimation approaches.
(C) Select "eGRID subregion" from drop box and enter "Electricity Purchased."
- Use map (Figure 1) at bottom of sheet to determine appropriate eGRID subregion. If subregion cannot be determined from the map, find the correct subregion by entering the location's zip code into EPA's Power Profiler:
https://www.epa.gov/egrid/power-profiler#/
(D) See the market-based emission factor hierarchy on the market-based method Help sheet. If any of the first four types of emission factors are applicable, enter the factors in the yellow cells marked as "<enter factor>". If not, leave the yellow cells as is, and eGRID subregion factors will be used for market-based emissions.
Example entry is shown in first row (*GREEN Italics*) for a facility that purchases RECs for 100% of its consumption, and therefore has a market-based emission factor of 0.

Help - Market-Based Method

Tips: Enter electricity usage by location and then look up the eGRID subregion for each location.
If you purchase renewable energy that is less than 100% of your site's electricity, see the example in the market-based method Help sheet.

Table 1. Total Amount of Electricity Purchased by eGRID Subregion

					Market-Based *Use these cells to enter applicable market-based emission factors*						Location-Based		
					Emission Factors			Emissions			Emissions		
Source ID	**Source Description**	**Source Area (sq ft)**	**eGRID Subregion** *where electricity is consumed*	**Electricity Purchased (kWh)**	**CO_2 Emissions (lb/MWh)**	**CH_4 Emissions (lb/MWh)**	**N_2O Emissions (lb/MWh)**	**CO_2 Emissions (lb)**	**CH_4 Emissions (lb)**	**N_2O Emissions (lb)**	**CO_2 Emissions (lb)**	**CH_4 Emissions (lb)**	**N_2O Emissions (lb)**
Bldg-012	*East Power Plant*	*12,517*	*HIMS (HICC Miscellaneous)*	*200,000*	*0*	*0*	*0*	*0.0*	*0.0*	*0.0*	*226,880.0*	*27.0*	*4.2*
Restaurant,	Retail	19,000	MROW (MRO West)	267,900	<enter factor>	<enter factor>	<enter factor>	266,774.8	28.7	4.0	266,774.8	28.7	4.0
Preschool/A	Education	30,000	MROW (MRO West)	309,000	<enter factor>	<enter factor>	<enter factor>	307,702.2	33.1	4.6	307,702.2	33.1	4.6
Hotel	Lodging	75,000	MROW (MRO West)	1,155,000	<enter factor>	<enter factor>	<enter factor>	1,150,149.0	123.6	17.3	1,150,149.0	123.6	17.3
Townhome	Lodging	38,400	MROW (MRO West)	591,360	<enter factor>	<enter factor>	<enter factor>	588,876.3	63.3	8.9	588,876.3	63.3	8.9
Apartments	Lodging	1,440,600	MROW (MRO West)	22,185,240	<enter factor>	<enter factor>	<enter factor>	22,092,062.0	2,373.8	332.8	22,092,062.0	2,373.8	332.8
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					<enter factor>	<enter factor>	<enter factor>						
					<enter factor>	<enter factor>	<enter factor>						
Total Emissions for All Sources				24,508,500				24,405,564.3	2,622.4	367.6	24,405,564.3	2,622.4	367.6

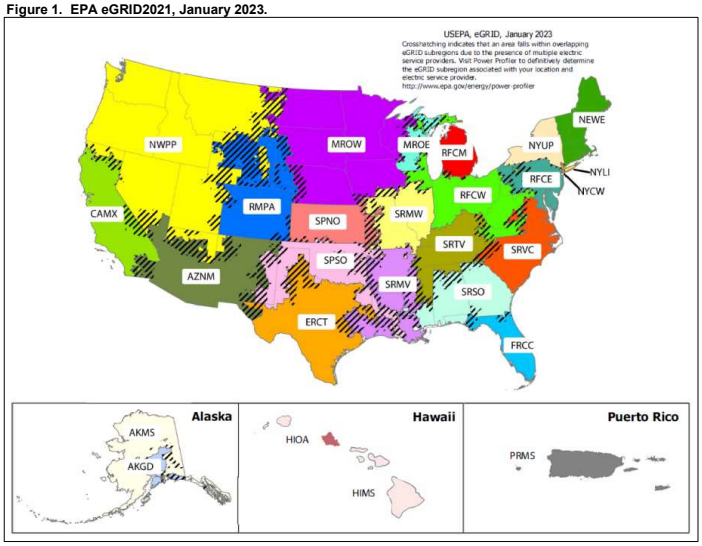
GHG Emissions

CO_2 Equivalent Emissions (metric tons)	
Location-Based Electricity Emissions	11,149.8
Market-Based Electricity Emissions	11,149.8

Notes:

1. CO_2, CH_4 and N_2O emissions are estimated using methodology provided in EPA's Center for Corporate Climate Leadership Greenhouse Gas Inventory Guidance - Indirect Emissions from Purchased Electricity (January 2016).

Figure 1. EPA eGRID2021, January 2023.



Construction Emissions - Scenario A
Mobile Source Information

Construction Project Lifetime	1	Years (estimate)
	50	Years (estimate)

									Annual		Total for Project		Emission Factors[5]			Total Emissions (ton)				Emissions Annualized over Project Lifetime (50 yrs)			
Onroad/Off-Road	Vehicle Type[1]	Number of Vehicles per Day[2]	Fuel Type	Vehicle Year[3]	VMT (miles per day, per vehicle)[2]	Miles per Gallon[4]	Fuel Usage (gal/day, all vehicles)	Days Per Year[2]	Miles Traveled (mi/yr, all vehicles)	Fuel Usage (gal/yr, all vehicles)	Miles Traveled (mi)	Fuel Usage (gal)	CO2 (kg/gal)	CH4 (g/mile)	N2O (g/mile)	CO2 (short ton)	CH4 (short ton)	N2O (short ton)	CO2e (short ton)	CO2 (short ton/yr)	CH4 (short ton/yr)	N2O (short ton/yr)	CO2e (short ton/yr)
Onroad	Light Duty Vehicles - Laborers (commute)	30	Gas	2011	20	21.4	28.08	260	156,000	7,301	156,000	7,301	8.78	0.0072	0.0052	70.51	0.0012	0.00089	71	1.4	0.00002	0.00002	1.416
	Heavy Duty Trucks - Dump Trucks (onsite and offsite)	12	Diesel	2011	60	7.6	94.74	260	187,200	24,632	187,200	24,632	10.21	0.0095	0.0431	276.64	0.0020	0.0089	279	5.5	0.00004	0.0002	5.587
	Heavy Duty Trucks - Semis (onsite and offsite)	12	Diesel	2011	60	6.2	116.13	260	187,200	30,194	187,200	30,194	10.21	0.0095	0.0431	339.10	0.0020	0.0089	342	6.8	0.00004	0.0002	6.836
															Total	**686**	**0.005**	**0.019**	**692**	**13.7**	**0.00010**	**0.0004**	**13.8**

1. Vehicle types are defined by the Federal Highway Administration (FHWA). Light duty vehicle, short wheel base replaces the old category passenger car and includes passenger cars, light trucks, vans and sport utility vehicles with a wheelbase (WB) equal to or less than 121 inches. Light duty, long wheel base replaces "Other 2-axle, 4-tire vehicle and includes large passenger cars, vans, pickup trucks, and sport/utility vehicles with wheelbases larger than 121 inches. Light Duty Vehicles includes all vehicles in the short and long wheel base category.

2. Estimates based on similar project for warehouse construction of similar square footage.

3. Assumed, based on the national average age of cars and light trucks on the road in 2021 (https://www.usatoday.com/story/money/cars/2022/05/24/average-american-car-12-years-old/9907901002/).

4. For light duty vehicles, based on 1995-2020: U.S. Department of Transportation, Federal Highway Administration, Highway Statistics (Washington, DC: Annual Issues), table VM-1, available at http://www.fhwa.dot.gov/policyinformation/statistics.cfm as of Dec. 29, 2021. For heavy duty vehicles, average miles per gallon values from the U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 2020 (November 2022), Table VM-1.

5. Emission factors based on the U.S. EPA's Emission Factors Hub (https://www.epa.gov/climateleadership/ghg-emission-factors-hub, updated April 2022).

									Emission Factors[4]			Total Project Emissions				Emissions Annualized over Project Lifetime (50 yrs)			
Onroad/Offroad	Vehicle Type	Number of Vehicles[1]	Fuel type	Engine Size (hp)[1]	Consumption Rate (gal per hp-hr)[2]	Hours per Year[3]	Total Gallons per Year	Total Gallons for Project	CO2 (kg/gal)	CH4 (g/gal)	N2O (g/gal)	CO2 (short ton)	CH4 (short ton)	N2O (short ton)	CO2e (short ton)	CO2 (short ton/yr)	CH4 (short ton/yr)	N2O (short ton/yr)	CO2e (short ton/yr)
Off-road	Crane	1	Diesel	250	0.05	2,080	26,000	26,000	10.21	0.94	0.87	292.01	0.027	0.025	300	5.8	0.0005	0.0005	6.0
	Backhoe	1	Diesel	125	0.05	2,080	13,000	13,000	10.21	0.94	0.87	146.00	0.013	0.012	150	2.9	0.0003	0.0002	3.0
	Loader	1	Diesel	250	0.05	2,080	26,000	26,000	10.21	0.94	0.87	292.01	0.027	0.025	300	5.8	0.0005	0.0005	6.0
	Excavator	2	Diesel	250	0.05	2,080	52,000	52,000	10.21	0.94	0.87	584.01	0.054	0.050	600	11.7	0.0011	0.0010	12.0
	Skid Steer	2	Diesel	50	0.05	2,080	10,400	10,400	10.21	0.94	0.87	116.80	0.011	0.010	120	2.3	0.0002	0.0002	2.4
	Total	7					127,400	127,400			Total	**1,431**	**0.132**	**0.122**	**1,470**	**28.6**	**0.00263**	**0.0024**	**29.4**

1. Estimates based on similar project for warehouse construction of similar square footage.

2. Off-road mobile source fuel usage based on South Coast Air Quality Management District CEQA Air Quality Handbook, Table A9-3E.

3. Based on 8 hr/day, 5 day/wk, 52 wk/yr.

4. Emission factors based on the U.S. EPA's Emission Factors Hub (https://www.epa.gov/climateleadership/ghg-emission-factors-hub, updated April 2022).

Construction Emissions - Scenario B
Mobile Source Information

Construction Project Lifetime: 20 Years (estimate)

50 Years (estimate)

									Annual		Total for Project		Emission Factors[5]			Total Emissions (ton)				Emissions Annualized over Project Lifetime (50 yrs)			
Onroad/Off-Road	Vehicle Type[1]	Number of Vehicles per Day[2]	Fuel Type	Vehicle Year[3]	VMT (miles per day, per vehicle)[2]	Miles per Gallon[4]	Fuel Usage (gal/day, all vehicles)	Days Per Year[2]	Miles Traveled (mi/yr, all vehicles)	Fuel Usage (gal/yr, all vehicles)	Miles Traveled (mi)	Fuel Usage (gal)	CO2 (kg/gal)	CH4 (g/mile)	N2O (g/mile)	CO2 (short ton)	CH4 (short ton)	N2O (short ton)	CO2e (short ton)	CO2 (short ton/yr)	CH4 (short ton/yr)	N2O (short ton/yr)	CO2e (short ton/yr)
Onroad	Light Duty Vehicles - Laborers (commute)	50	Gas	2011	20	21.4	46.80	260	260,000	12,168	5,200,000	243,359	8.78	0.0072	0.0052	2,350.36	0.0412	0.02974	2,360	47.0	0.00082	0.00059	47.205
	Heavy Duty Trucks - Dump Trucks (onsite and offsite)	20	Diesel	2011	60	7.6	157.89	260	312,000	41,053	6,240,000	821,053	10.21	0.0095	0.0431	9,221.24	0.0652	0.2958	9,311	184.4	0.00130	0.0059	186.221
	Heavy Duty Trucks - Semis (onsite and offsite)	20	Diesel	2011	60	6.2	193.55	260	312,000	50,323	6,240,000	1,006,452	10.21	0.0095	0.0431	11,303.46	0.0652	0.2958	11,393	226.1	0.00130	0.0059	227.865
															Total	**22,875**	**0.172**	**0.621**	**23,065**	**457.5**	**0.00343**	**0.0124**	**461.3**

1. Vehicle types are defined by the Federal Highway Administration (FHWA). Light duty vehicle, short wheel base replaces the old category passenger car and includes passenger cars, light trucks, vans and sport utility vehicles with a wheelbase (WB) equal to or less than 121 inches. Light duty, long wheel base replaces "Other 2-axle, 4-tire vehicle and includes large passenger cars, vans, pickup trucks, and sport/utility vehicles with wheelbases larger than 121 inches. Light Duty Vehicles includes all vehicles in the short and long wheel base category.

2. Estimates based on similar development projects.

3. Assumed, based on the national average age of cars and light trucks on the road in 2021 (https://www.usatoday.com/story/money/cars/2022/05/24/average-american-car-12-years-old/9907901002/).

4. For light duty vehicles, based on 1995-2020: U.S. Department of Transportation, Federal Highway Administration, Highway Statistics (Washington, DC: Annual Issues), table VM-1, available at http://www.fhwa.dot.gov/policyinformation/statistics.cfm as of Dec. 29, 2021. For heavy duty vehicles, average miles per gallon values from the U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 2020 (November 2022), Table VM-1.

5. Emission factors based on the U.S. EPA's Emission Factors Hub (https://www.epa.gov/climateleadership/ghg-emission-factors-hub, updated April 2022).

									Emission Factors[4]			Total Project Emissions				Emissions Annualized over Project Lifetime (50 yrs)			
Onroad/Offroad	Vehicle Type	Number of Vehicles[1]	Fuel type	Engine Size (hp)[1]	Consumption Rate (gal per hp-hr)[2]	Hours per Year[3]	Total Gallons per Year	Total Gallons for Project	CO2 (kg/gal)	CH4 (g/gal)	N2O (g/gal)	CO2 (short ton)	CH4 (short ton)	N2O (short ton)	CO2e (short ton)	CO2 (short ton/yr)	CH4 (short ton/yr)	N2O (short ton/yr)	CO2e (short ton/yr)
Off-road	Crane	4	Diesel	250	0.05	2,080	104,000	2,080,000	10.21	0.94	0.87	23360.48	2.151	1.991	24,007	467.2	0.0430	0.0398	480.1
	Backhoe	6	Diesel	125	0.05	2,080	78,000	1,560,000	10.21	0.94	0.87	17520.36	1.613	1.493	18,006	350.4	0.0323	0.0299	360.1
	Loader	8	Diesel	250	0.05	2,080	208,000	4,160,000	10.21	0.94	0.87	46720.96	4.301	3.981	48,015	934.4	0.0860	0.0796	960.3
	Excavator	4	Diesel	250	0.05	2,080	104,000	2,080,000	10.21	0.94	0.87	23360.48	2.151	1.991	24,007	467.2	0.0430	0.0398	480.1
	Skid Steer	6	Diesel	50	0.05	2,080	31,200	624,000	10.21	0.94	0.87	7008.14	0.645	0.597	7,202	140.2	0.0129	0.0119	144.0
	Total	28					525,200	10,504,000			Total	**117,970**	**10.861**	**10.052**	**121,238**	**2,359.4**	**0.21722**	**0.2010**	**2,424.8**

1. Estimates based on similar development projects.

2. Off-road mobile source fuel usage based on South Coast Air Quality Management District CEQA Air Quality Handbook, Table A9-3E.

3. Based on 8 hr/day, 5 day/wk, 52 wk/yr.

4. Emission factors based on the U.S. EPA's Emission Factors Hub (https://www.epa.gov/climateleadership/ghg-emission-factors-hub, updated April 2022).

Operational Emissions - Scenario A
Mobile Source - Operations

													Emission Factors[7]			Emissions			
Onroad/Off-Road	**Vehicle Type[1]**	**Vehicle Driver**	**Daily Trips[2]**	**Fuel Type**	**Vehicle Year[3]**	**VMT (miles per trip)[4]**	**Miles per Gallon[5]**	**Fuel Usage (gal/day, all vehicles)**	**Days Per Year[6]**	**Miles per Year (per Vehicle)**	**Miles per Year All Vehicles**	**Fuel Usage (gal/yr, all vehicles)**	**CO2 (kg/gal)**	**CH4 (g/mile)**	**N2O (g/mile)**	**CO2 (short ton/yr)**	**CH4 (short ton/yr)**	**N2O (short ton/yr)**	**CO2e (short ton/yr)**
Onroad	Light Duty Vehicle, Short Wheel Base (Passenger Cars, small trucks and SUVs)	Warehouse Workers	150	Gas	2011	30	21.4	210.60	260	7,800	1,170,000	54,756	8.78	0.0072	0.0052	529	0.0093	0.0067	531
	Heavy Duty Trucks	Shipping	100	Diesel	2011	30	6.2	483.87	260	7,800	780,000	125,806	10.21	0.0095	0.0431	1,413	0.0082	0.037	1,424
															Total	**1,942**	**0.02**	**0.04**	**1,955**

1. Assumes employees drive gasoline powered light duty vehicles and deliveries are made by heavy duty diesel vehicles.

2. Estimate, based on 50 employees per warehouse. Estimate 100 daily semi-trailer trips per day.

3. Assumed, based on the national average age of cars and light trucks on the road in 2021 (https://www.usatoday.com/story/money/cars/2022/05/24/average-american-car-12-years-old/9907901002/).

4. Assumes 5 miles per trip for all vehicles.

5. For light duty vehicles, based on 1995-2020: U.S. Department of Transportation, Federal Highway Administration, Highway Statistics (Washington, DC: Annual Issues), table VM-1, available at http://www.fhwa.dot.gov/policyinformation/statistics.cfm as of Dec. 29, 2021. For heavy duty vehicles, average miles per gallon values from the U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 2020 (November 2022), Table VM-1.

6. Assume daily trips take place 365 days per year.

7. Emission factors based on the U.S. EPA's Emission Factors Hub (https://www.epa.gov/climateleadership/ghg-emission-factors-hub, updated April 2022).

Operational Emissions - Scenario B
Mobile Source - Operations

													Emission Factors[7]			Emissions			
Onroad/Off-Road	**Vehicle Type[1]**	**Vehicle Driver**	**Daily Trips[2]**	**Fuel Type**	**Vehicle Year[3]**	**VMT (miles per trip)[4]**	**Miles per Gallon[5]**	**Fuel Usage (gal/day, all vehicles)**	**Days Per Year[6]**	**Miles per Year (per Vehicle)**	**Miles per Year All Vehicles**	**Fuel Usage (gal/yr, all vehicles)**	**CO2 (kg/gal)**	**CH4 (g/mile)**	**N2O (g/mile)**	**CO2 (short ton/yr)**	**CH4 (short ton/yr)**	**N2O (short ton/yr)**	**CO2e (short ton/yr)**
Onroad	Light Duty Vehicle, Short Wheel Base (Passenger Cars, small trucks and SUVs)	Resident	7230	Gas	2011	5	21.4	1691.81	365	1,825	13,194,750	617,512	8.78	0.0072	0.0052	5,964	0.10	0.075	5,989
		Retail Facilities	5449	Gas	2011	5	21.4	1275.06	365	1,825	9,944,425	465,397	8.78	0.0072	0.0052	4,495	0.0788	0.05688	4,514
	Heavy Duty Trucks (Deliveries)	Parcel and Supply Deliveries	15	Diesel	2011	5	6.2	12.10	365	1,825	27,375	4,415	10.21	0.0095	0.0431	50	0.00029	0.0013	50
															Total	**10,508**	**0.18**	**0.13**	**10,553**

1. Assumes residents and employees drive gasoline powered light duty vehicles and deliveries are made by heavy duty diesel vehicles.

2. Trip generation estimates represent peak weekday trips and are based on the Trip Generation, Eleventh Edition, published by the Institute of Transportation Engineers. It is conservatively assumed for this analysis that the daily trips occur 365 days per year.

3. Assumed, based on the national average age of cars and light trucks on the road in 2021 (https://www.usatoday.com/story/money/cars/2022/05/24/average-american-car-12-years-old/9907901002/).

4. Assumes 5 miles per trip for all vehicles.

5. For light duty vehicles, based on 1995-2020: U.S. Department of Transportation, Federal Highway Administration, Highway Statistics (Washington, DC: Annual Issues), table VM-1, available at http://www.fhwa.dot.gov/policyinformation/statistics.cfm as of Dec. 29, 2021. For heavy duty vehicles, average miles per gallon values from the U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 2020 (November 2022), Table VM-1.

6. Assume daily trips take place 365 days per year.

7. Emission factors based on the U.S. EPA's Emission Factors Hub (https://www.epa.gov/climateleadership/ghg-emission-factors-hub, updated April 2022).

Waste Generation and Disposal Estimates

	Waste Generation Rate for Warehouses (lb/100 sq ft/day)*	Building Area (square feet)	Total Waste per Day (lb/day)	Total Waste per Year (ton/yr)	Percent of Waste Recycled (paper, cardboard)	Amount of Waste Recycled (ton/yr)	Landfilled Waste	Amount of Waste Landfilled (ton/yr)
Waste Generation per Person per Day	1.0	360,000	3,600	657	50%	329	50%	329

** Source: National Solid Waste Management Association (https://www.wastecare.com/usefulinfo/Waste_Generated_by_Industry.htm)*

EPA CENTER FOR CORPORATE CLIMATE LEADERSHIP
U.S. Environmental Protection Agency

Scope 3 Emissions from Waste

Guidance

(A) Enter annual waste data in ORANGE cells. Example entry is shown in first row (*GREEN Italics*).

(B) First, choose the appropriate material then the disposal method from the drop down options. For the average-data method, use one of the mixed material types, such as mixed MSW. If the exact waste material is not available, consider an appropriate proxy. For example, dimensional lumber can be used as a proxy for wood furniture.

(C) Choose an appropriate disposal method. Note that not all disposal methods are available for all materials. If there is a #NA or # Value error in the emissions column, you must pick a new material type or appropriate disposal method.

Table 1. Waste Disposal Weight by Waste Material and Disposal Method (CO_2, CH_4 and N_2O)

Source ID	Source Description	Waste Material	Disposal Method	Weight	Unit	CO_2e Emissions (kg)
Bldg-012	*East Power Plant Finished Goods*	*Copper Wire*	*Landfilled*	*1,000*	*metric ton*	*22,040*
Warehouse	Warehouse	Mixed MSW municipal solid waste	Landfilled	329	metric ton	*188,244*
Warehouse	Warehouse	Mixed Recyclables	Recycled	329	metric ton	*32,581*

GHG Emissions

Total Emissions by Disposal Method

Waste Material	CO_2e (kg)
Recycled	32,581
Landfilled	188,244
Combusted	-
Composted	-
Anaerobically Digested (Dry Digestate with Curing)	-
Anaerobically Digested (Wet Digestate with Curing)	-

Total CO_2 Equivalent Emissions (metric tons) - Waste	**220.8**

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U.S. Environmental Protection Agency

Scope 3 Emissions from Waste

Guidance

(A) Enter annual waste data in ORANGE cells. Example entry is shown in first row (*GREEN Italics*).

(B) First, choose the appropriate material then the disposal method from the drop down options. For the average-data method, use one of the mixed material types, such as mixed MSW. If the exact waste material is not available, consider an appropriate proxy. For example, dimensional lumber can be used as a proxy for wood furniture.

(C) Choose an appropriate disposal method. Note that not all disposal methods are available for all materials. If there is a #NA or # Value error in the emissions column, you must pick a new material type or appropriate disposal method.

Table 1. Waste Disposal Weight by Waste Material and Disposal Method (CO_2, CH_4 and N_2O)

Source ID	Source Description	Waste Material	Disposal Method	Weight	Unit	CO_2e Emissions (kg)
Bldg-012	*East Power Plant Finished Goods*	*Copper Wire*	*Landfilled*	*1,000*	*metric ton*	*22,040*
Residential - Landfilled	Residential - Landfilled	Mixed MSW municipal solid waste	Landfilled	2,786	short ton	*1,448,554*
Residential - Recycled	Residential - Recycled	Mixed Recyclables	Recycled	1,393	short ton	*125,356*
Residential - Composted	Residential - Composted	Mixed Organics	Composted	464	short ton	*78,928*
Residential - Combusted	Residential - Combusted	Mixed MSW municipal solid waste	Combusted	696	short ton	*299,461*
Hotel	Hotel - Landfilled	Mixed MSW municipal solid waste	Landfilled	98	short ton	*50,700*
School	School - Landfilled	Mixed MSW municipal solid waste	Landfilled	3	short ton	*1,352*
Restaurant	Restaurant - Landfilled	Mixed MSW municipal solid waste	Landfilled	326	short ton	*169,676*

GHG Emissions

Total Emissions by Disposal Method

Waste Material	CO_2e (kg)
Recycled	125,356
Landfilled	1,670,282
Combusted	299,461
Composted	78,928
Anaerobically Digested (Dry Digestate with Curing)	-
Anaerobically Digested (Wet Digestate with Curing)	-

Total CO_2 Equivalent Emissions (metric tons) - Waste	**2,174.0**

Appendix F

Traffic Impact Analysis

File #227706270
February 9, 2024

Traffic Impact Study for Central High School Redevelopment in Duluth, MN

Prepared for:
City of Duluth, MN

411 W. First St.
Duluth MN 55802

Prepared by:

Stantec Consulting Services Inc.
One Carlson Parkway, #100
Plymouth, MN 55447
Phone: 7963-479-4200
Fax: 763-479-4242

Table of Contents

FIGURES

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

DATE: February 9, 2024

Edward F. Terhaar
License No. 24441

1.0 Executive Summary

The purpose of this Traffic Impact Study is to evaluate the impacts of the proposed redevelopment of the Central High School site located in Duluth, MN. This study is part of an Alternative Urban Areawide Review (AUAR) for the proposed project. The project site is generally located on the south side of Central Entrance at Hank Courtney Drive.

Based on discussions with City staff, this study examined weekday a.m. and p.m. peak hour traffic impacts of the proposed development at the following intersections:

- Central Entrance (TH 194)/Arlington Avenue
- Arlington Avenue/Palm Street
- Central Entrance (TH 194)/Blackman Avenue
- Blackman Avenue/Palm Street/Clearwood Drive
- Central Entrance (TH 194)/Pecan Ave/Hank Courtney Drive
- Rice Lake Road/Hickory Street/Chinook Drive
- Rice Lake Road/Pecan Avenue
- Central Entrance (TH 194)/13th Street
- Central Entrance (TH 194)/Mesaba Avenue/Rice Lake Road
- Mesaba Avenue (TH 194)/Skyline Parkway/9th Street
- Mesaba Avenue (TH 194)/Lake Avenue

The following development scenarios were considered for the site:

- Scenario A: Business Park Scenario

  The business park scenario would consist of approximately 360,000 square feet of light industrial/ warehouse distribution uses at full buildout, consistent with the City's future land use map in its adopted Comprehensive Plan. Surface parking would be included in this scenario, and the site would be accessed via the existing entrance Central Entrance and Hank Courtney Drive. Future potential connections are shown including the extension of Portia Johnson Drive to a new entrance on Blackman Avenue to the west and a potential connection to Lake Avenue and the residential neighborhood to the southeast of the AUAR area.

- Scenario B: Mixed Use Scenario (Maximum Development)

  The mixed commercial and residential scenario (mixed use) will be studied in this AUAR as the maximum development scenario. This scenario is intended to maximize development of the AUAR area and represents the "worst case scenario" for environmental impacts studied in the AUAR. The actual development, encompassing plans proposed by a private developer, may represent a modified version of this development scenario, which may include fewer residential units and less commercial development depending on market forces. The City of Duluth has also proposed elements within this scenario that will be explored as part of the full buildout of the AUAR area, including additional connections to adjacent neighborhoods, open space and development of property owned by the school district within the AUAR area.

  At full buildout, the mixed use scenario would consist of 1,590 units of residential and 124,000 square feet of commercial development. Potential commercial uses

considered in this AUAR include hotel, restaurant, and other neighborhood-serving commercial uses. Residential development is proposed to consist of a mix of densities including apartments and townhomes. The scenario would include a mix of surface and structured parking.

The AUAR area would be accessed via the existing entrance from Central Entrance (TH 194) and Hank Courtney Drive. Future potential connections are shown including the extension of Portia Johnson Drive to Blackman Avenue to the west and a potential connection to Lake Avenue and the residential neighborhood to the southeast of the AUAR area.

Scenario B was chosen for analysis because it represents this worst case scenario from a traffic operations perspective. The project proposer has indicated the first phase of the project would consist of a 200-unit apartment building located in the southeast portion of the site. For the purposes of the AUAR, we are assuming apartment building would be operational 2025.

Detailed phasing information for the remainder of the development has yet to be developed and will be market driven. For purpose of the AUAR, full buildout was assumed to occur by 2045.

The conclusions drawn from the information and analyses presented in this report are as follows:

- The proposed development Scenario B was used in the analysis and is expected to generate 993 trips during the weekday a.m. peak hour, 1,103 trips during the weekday p.m. peak hour, and 12,679 total weekday trips.

- Under existing conditions, the minor leg approaches controlled with stop signs on Central Entrance and Mesaba Avenue operate at poor levels of service during the a.m. and p.m. peak hours. This is due to the amount of through traffic on the major roadway, which results in large delays for vehicles turning from the minor roadway. While not desirable, this condition is common at stop controlled minor approaches to high volume roadways.

- Under 2025 Build conditions, movements and intersections operate largely the same as the 2025 No-Build scenario with no changes to LOS results during the a.m. and p.m. peak hours due to the proposed Phase 1 development.

The following mitigation strategies are recommended based on the results of the analyses in this report:

- Under 2025 Build conditions, movements and intersections operate largely the same as the 2025 No-Build scenario with no changes to LOS results during the a.m. and p.m. peak hours due to the proposed Phase 1 development. Therefore no mitigation is needed for the proposed Phase 1 development.

- As additional development is proposed for the site, the traffic analysis will be updated to determine if mitigation measures are needed for the existing roadway network prior to reconstruction of Central Entrance.

2.0 Purpose and Background

The purpose of this Traffic Impact Study is to evaluate the impacts of the proposed redevelopment of the Central High School site located in Duluth, MN. This study is part of an Alternative Urban Areawide Review (AUAR) for the proposed project. The project site is generally located on the south side of Central Entrance at Hank Courtney Drive. The project location is shown in **Figure 1**.

Based on discussions with City staff, this study examined weekday a.m. and p.m. peak hour traffic impacts of the proposed development at the following intersections:

- Central Entrance (TH 194)/Arlington Avenue
- Arlington Avenue/Palm Street
- Central Entrance (TH 194)/Blackman Avenue
- Blackman Avenue/Palm Street/Clearwood Drive
- Central Entrance (TH 194)/Pecan Ave/Hank Courtney Drive
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- Rice Lake Road/Pecan Avenue
- Central Entrance (TH 194)/13th Street
- Central Entrance (TH 194)/Mesaba Avenue/Rice Lake Road
- Mesaba Avenue (TH 194)/Skyline Parkway/9th Street
- Mesaba Avenue (TH 194)/Lake Avenue

Development Scenarios

The following development scenarios were considered for the site:

- Scenario A: Business Park Scenario

  The business park scenario would consist of approximately 360,000 square feet of light industrial/ warehouse distribution uses at full buildout, consistent with the City's future land use map in its adopted Comprehensive Plan. Surface parking would be included in this scenario, and the site would be accessed via the existing entrance Central Entrance and Hank Courtney Drive. Future potential connections are shown including the extension of Portia Johnson Drive to a new entrance on Blackman Avenue to the west and a potential connection to Lake Avenue and the residential neighborhood to the southeast of the AUAR area.

  Both the Duluth Traverse and Central Entrance trails would remain within the AUAR area, although slight adjustments to alignment may be necessary depending on the future site layout. The scenario proposes that the existing broadcast towers would remain, as well as the approximately 27 acres of wooded area.

- Scenario B: Mixed Use Scenario (Maximum Development)

  The mixed commercial and residential scenario (mixed use) will be studied in this AUAR as the maximum development scenario. This scenario is intended to maximize development of the AUAR area and represents the "worst case scenario" for environmental impacts studied in the AUAR. The actual development, encompassing plans proposed by a private developer, may represent a modified version of this development scenario, which may include fewer residential units and less commercial

development depending on market forces. The City of Duluth has also proposed elements within this scenario that will be explored as part of the full buildout of the AUAR area, including additional connections to adjacent neighborhoods, open space and development of property owned by the school district within the AUAR area.

At full buildout, the mixed use scenario would consist of 1,590 units of residential and 124,000 square feet of commercial development. Potential commercial uses considered in this AUAR include hotel, restaurant, and other neighborhood-serving commercial uses. Residential development is proposed to consist of a mix of densities including apartments and townhomes. The scenario would include a mix of surface and structured parking.

The AUAR area would be accessed via the existing entrance from Central Entrance (TH 194) and Hank Courtney Drive. Future potential connections are shown including the extension of Portia Johnson Drive to Blackman Avenue to the west and a potential connection to Lake Avenue and the residential neighborhood to the southeast of the AUAR area.

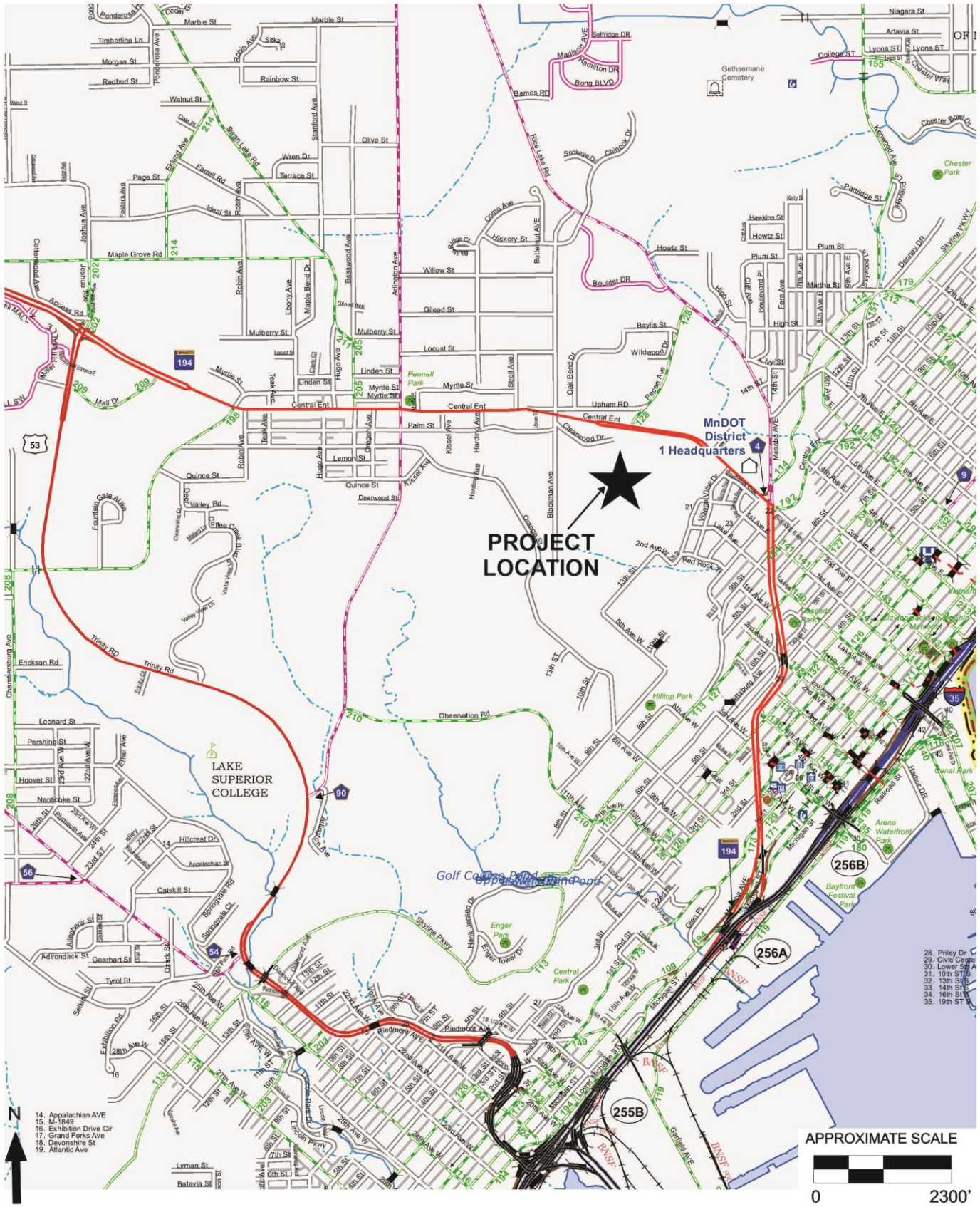
Both the Duluth Traverse and Central Entrance trails would remain within the AUAR area, although slight adjustments to alignment may be necessary depending on the future site layout. This scenario proposes the addition of trailhead and a small park facility with restrooms. The scenario proposes that the existing broadcast towers would remain, as well as most of the approximately 27 acres of wooded area.

The development scenarios are shown in **Figures 2 and 3**.

Development Phasing

The project proposer has indicated the first phase of the project would consist of a 200-unit apartment building located in the southeast portion of the site. For the purposes of the AUAR, we are assuming apartment building would be operational 2025.

Detailed phasing information for the remainder of the development has yet to be developed and will be market driven. For purpose of the AUAR, full buildout was assumed to occur by 2045.



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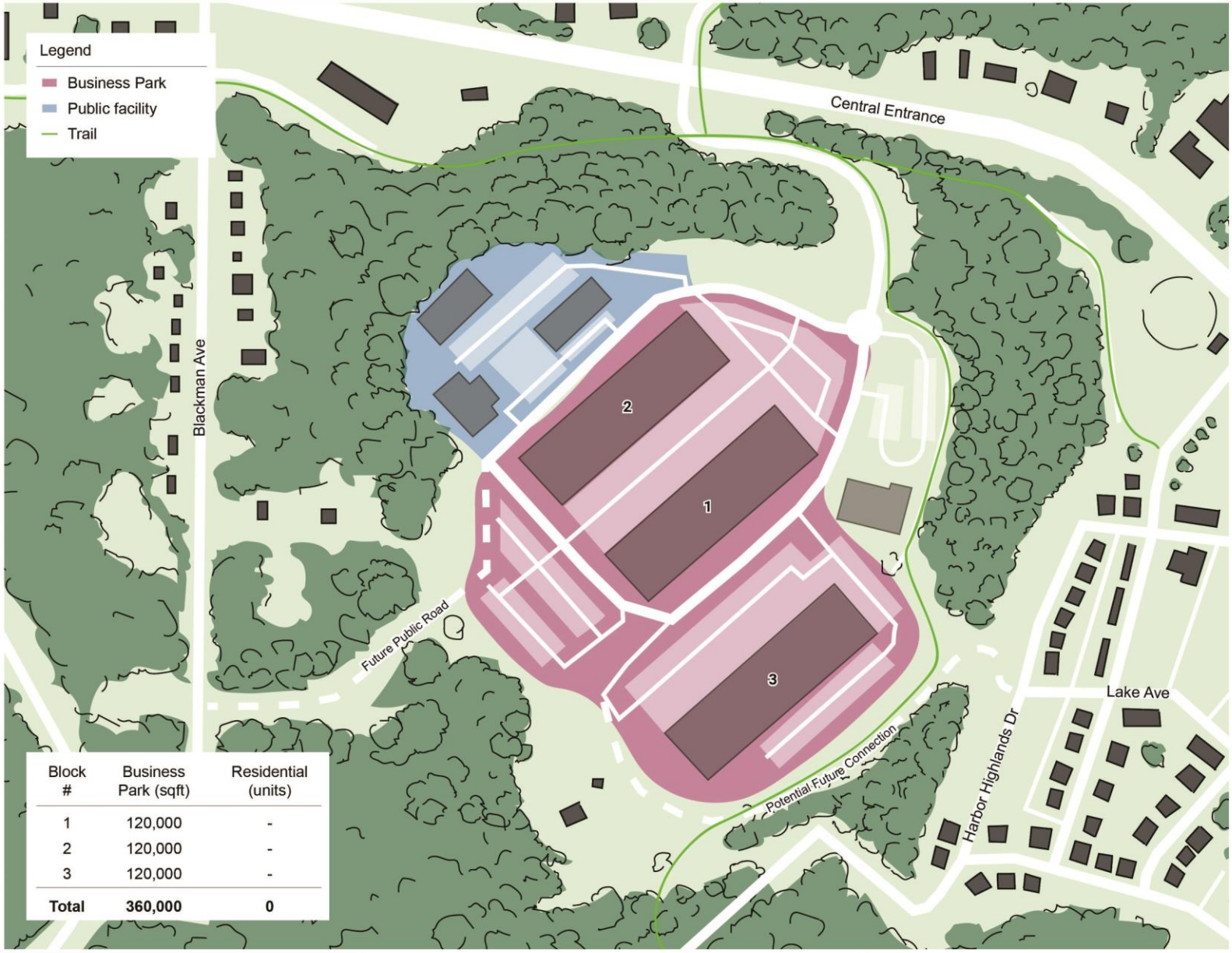
TRAFFIC IMPACT STUDY FOR CENTRAL HIGH SCHOOL REDEVELOPMENT IN DULUTH, MN

FIGURE 1

PROJECT LOCATION



Block #	Business Park (sqft)	Residential (units)
1	120,000	-
2	120,000	-
3	120,000	-
Total	**360,000**	**0**

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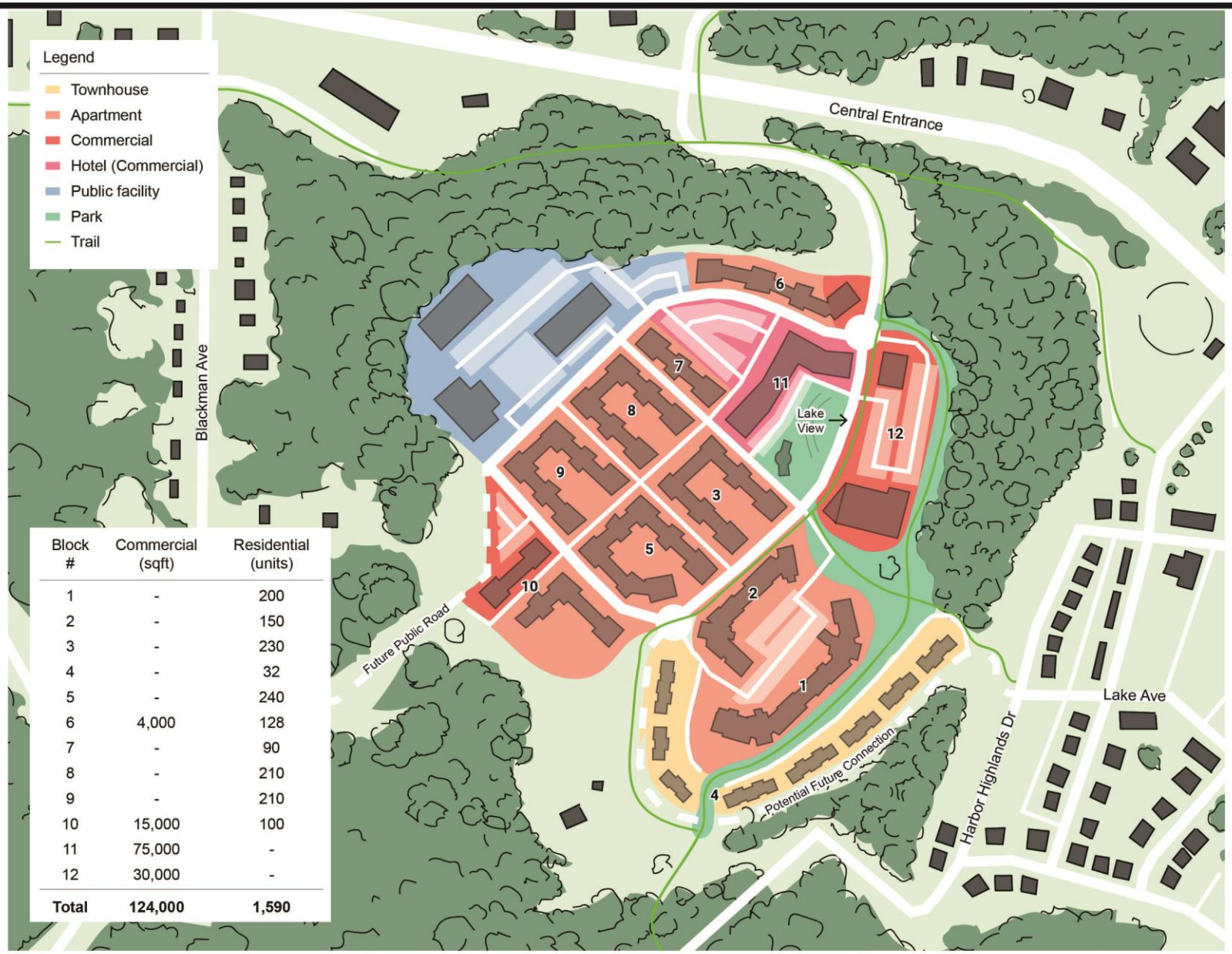
TRAFFIC IMPACT STUDY FOR
CENTRAL HIGH SCHOOL
REDEVELOPMENT
IN DULUTH, MN

FIGURE 2

DEVELOPMENT SCENARIO A



Block #	Commercial (sqft)	Residential (units)
1	-	200
2	-	150
3	-	230
4	-	32
5	-	240
6	4,000	128
7	-	90
8	-	210
9	-	210
10	15,000	100
11	75,000	-
12	30,000	-
Total	**124,000**	**1,590**

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TRAFFIC IMPACT STUDY FOR
CENTRAL HIGH SCHOOL
REDEVELOPMENT
IN DULUTH, MN

FIGURE 3

DEVELOPMENT SCENARIO B

3.0 Existing Conditions

The AUAR area consists of the demolished Central High School building area and associated infrastructure including the Secondary Technical Center (STC) building, the former track field, tennis courts, parking lots, and road system serving the AUAR area.

The Duluth School District recently constructed a new District Service Center building and Transportation Building on the property adjacent to the northwestern boundary of the AUAR area along Portia Johnson Drive. The District Service Center consists of office and administrative uses. The Transportation Building includes bus storage, offices, a repair shop, and a bus wash bay. An existing building was also repurposed as a Facilities Building that includes offices, utilities shop, print shop, and storage.

Additionally, two broadcast towers are located in the southern portion of the AUAR area. Approximately 27 acres of wooded area exists within the AUAR area primarily along the northern, eastern, and southern edges of the AUAR area. Portions of both the Duluth Traverse and Central Entrance trails fall within the AUAR area.

Near the project location, Central Entrance and Mesaba Avenue are four-lane divided roadways with turn lanes and traffic signal control at major intersections. The remainder of the roadways in the study area are two-lane undivided local roadways.

Existing conditions near the proposed project location are described below.

Central Entrance (TH 194)/Arlington Avenue

This four-way intersection is controlled with a traffic signal. The eastbound and westbound approaches provide one left turn lane, one through lane, and one through/right turn lane. The northbound approach provides one left turn lane and one through/right turn lane. The southbound approach provides one left turn lane, one through lane, and one right turn lane.

Arlington Avenue/Palm Street

This four-way intersection is controlled with stop signs on the eastbound and westbound approaches. All approaches provide one left turn/through/right turn lane.

Central Entrance (TH 194)/Blackman Avenue

This four-way intersection is controlled with stop signs on the northbound and southbound approaches. The eastbound and westbound approaches provide one left turn lane, one through lane, and one through/right turn lane. The northbound and southbound approaches provide one left turn/through/right turn lane.

Blackman Avenue/Palm Street/Clearwood Drive

This four-way intersection is controlled with stop signs on the eastbound and westbound approaches. All approaches provide one left turn/through/right turn lane.

Central Entrance (TH 194)/Pecan Ave/Hank Courtney Drive

This four-way intersection is controlled with a traffic signal. The eastbound and westbound approaches provide one left turn lane, two through lanes, and one right turn lane. The northbound and southbound approaches provide one left turn/through lane and one right turn lane.

Rice Lake Road/Hickory Street/Chinook Drive

This four-way intersection is controlled with stop signs on the northbound and southbound approaches. The eastbound and westbound approaches provide one left turn lane, one through lane, and one right turn lane. The northbound and southbound approaches provide one left turn/through/right turn lane.

Rice Lake Road/Pecan Avenue

This three-way intersection is controlled with a stop sign on the northbound approach. The eastbound approach provides one through lane and one right turn lane. The westbound approach provides one left turn lane and one through lane. The northbound approach provides one left turn lane and one right turn lane.

Central Entrance (TH 194)/13th Street

This four-way intersection is controlled with stop signs on the northbound and southbound approaches. The eastbound and westbound approaches provide one left turn lane, one through lane, and one through/right turn lane. The northbound and southbound approaches provide one left turn/through/right turn lane.

Central Entrance (TH 194)/Mesaba Avenue/Rice Lake Road

This four-way intersection is controlled with a traffic signal. The eastbound approach provides one left turn lane, two through lanes, and one right turn lane. The westbound approach provides one left turn lane, one through lane, and one through/right turn lane. The northbound approach provides one left turn lane, one left turn/through lane, and one through/right turn lane. The southbound approach provides one left turn lane, one through lane, and one through/right turn lane.

Mesaba Avenue (TH 194)/Skyline Parkway/9th Street

This four-way intersection is controlled with stop signs on the eastbound and westbound approaches. The northbound approach provides one left turn/through lane and one through/right turn lane. The southbound approach provides one left turn lane, one through lane, and one through/right turn lane. The eastbound and westbound approaches provide one left turn/through/right turn lane.

Mesaba Avenue (TH 194)/Lake Avenue

This three-way intersection is controlled with a stop sign on the eastbound approach. The northbound approach provides one left turn lane and two through lanes. The southbound approach provides one through lane and one through/right turn lane. The eastbound approach provides one right turn lane. The eastbound approach is limited to right turns only by the raised median on Mesaba Avenue.

Traffic Volume Data

Existing weekday traffic volume data for the Central Entrance intersections was obtained from MnDOT and SRF Consulting Group. This data was collected as part of the ongoing Central Entrance Corridor Study. Turn movement volumes at the remainder of the intersections were recorded in November, 2023. Existing traffic volume data is presented later in this report.

4.0 Traffic Forecasts

Central Entrance Corridor Study

MnDOT, along with regional and local partners, is currently completing a corridor study for Central Entrance to determine the future character of the roadway to better serve all transportation modes and future growth and development. The study is being conducted in advance of reconstruction of the corridor from US 53 to Mesaba Avenue, which is expected to begin in 2026-2027. The corridor study includes the development of year 2048 traffic volume forecasts that account for future development along the corridor, including the proposed Central High School redevelopment project. The analysis of these traffic volumes will result in the ultimate cross section and intersection layouts for the corridor.

Since the ultimate layout for the corridor is yet to be determined, the traffic forecasts and analysis for this study focused on the short term scenario for the study area only. Future updates to the AUAR will account for additional development and the ultimate design of Central Entrance.

Traffic Forecast Scenarios

Traffic forecasts and analyses were completed for the year 2025 to account for the short term development scenario. Specifically, weekday a.m. and p.m. peak hour traffic forecasts were completed for the following scenarios:

- *2023 Existing*. Existing volumes were determined through traffic counts and MnDOT data at the subject intersections. The existing volume information includes trips generated by the uses near the project site.

- *2025 No-Build*. Existing volumes at the subject intersections were increased by 0.5 percent per year to determine 2025 No-Build volumes. The 0.5 percent per year growth rate was calculated using traffic forecasts developed for the Central Entrance Corridor Study.

- *2025 Build*. Trips generated by Phase 1 of the proposed development were added to the 2025 No-Build volumes to determine 2025 Build.

Trip Generation for Proposed Project

The expected new development trips were calculated based on data presented in Trip Generation, Eleventh Edition, published by the Institute of Transportation Engineers. These calculations represent total trips that will be generated by the proposed development. The resultant trip generation estimates are shown in **Tables 4-1 and 4-2**.

Table 4-1
Weekday Trip Generation for Scenario A – Business Park

Land Use (ITE code)	Size	Weekday AM Peak Hour			Weekday PM Peak Hour			Weekday Daily
		In	Out	Total	In	Out	Total	Total
Business Park (770)	360,000 SF	388	68	456	117	333	450	4539
School District Buildings (528)	220 Employees	119	38	157	23	114	137	845
Totals		**507**	**106**	**613**	**140**	**447**	**587**	**5384**

Notes: SF=square feet

Table 4-2
Weekday Trip Generation for Scenario B – Mixed Use

Land Use (ITE code)	Size	Weekday AM Peak Hour			Weekday PM Peak Hour			Weekday Daily
		In	Out	Total	In	Out	Total	Total
Apartments (221)	200 DU	18	58	76	48	30	78	908
Apartments (221)	150 DU	13	41	54	36	23	59	669
Apartments (221)	230 DU	21	69	90	55	35	90	1051
Townhouse (220)	32 DU	3	10	13	10	6	16	216
Apartments (221)	240 DU	22	72	94	57	37	94	1098
Apartments (221)	128 DU	10	35	45	31	19	50	564
Apartments (221)	90 DU	6	22	28	22	13	35	383
Apartments (221)	210 DU	19	62	81	50	32	82	955
Apartments (221)	210 DU	19	62	81	50	32	82	955
Apartments (221)	100 DU	7	25	32	24	15	39	431
Hotel (310)	75,000 SF	38	30	68	42	41	83	1202
Restaurant (932)	30,000 SF	158	129	287	166	106	272	3216
Retail (822)	19,000 SF	26	18	44	61	62	123	1031
Subtotals		**360**	**633**	**993**	**652**	**451**	**1103**	**12679**
School District Buildings (528)	220 Employees	119	38	157	23	114	137	845
Totals		**479**	**671**	**1150**	**675**	**565**	**1240**	**13524**

Notes: SF=square feet, DU = dwelling units

Phase 1 of the project would consist of a 200-unit apartment building located in the southeast portion of the site. The resultant trip generation estimates are shown in **Table 4-3**.

Table 4-3
Weekday Trip Generation for Phase 1 Development

Land Use (ITE code)	Size	Weekday AM Peak Hour			Weekday PM Peak Hour			Weekday Daily
		In	Out	Total	In	Out	Total	Total
Apartments (221)	200 DU	18	58	76	48	30	78	908

Note: DU = dwelling units

Trip Distribution Percentages

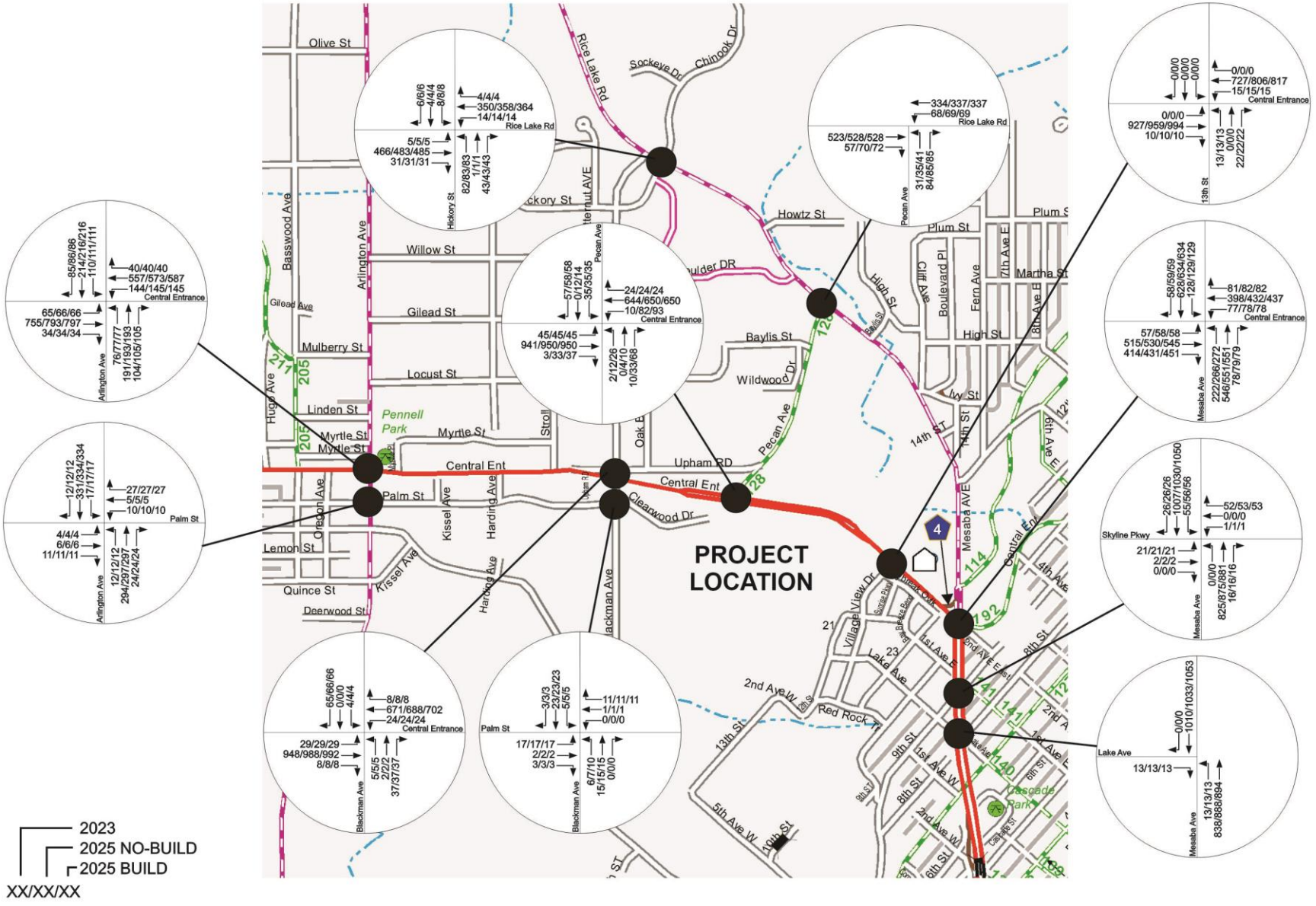
Trip distribution percentages for the subject development trips were established based on the nearby roadway network, existing and expected future traffic patterns, and location of the subject development in relation to major attractions and population concentrations.

The distribution percentages for trips generated by the proposed development are described below:

- 35 percent to/from the south on Mesaba Avenue
- 25 percent to/from the east on Central Entrance
- 25 percent to/from the west on Central Entrance
- 15 percent to/from the west on Palm Street
- 10 percent to/from the north on Pecan Street

Traffic Volumes

Development trips from Table 4-3 were assigned to the surrounding roadway network using the preceding trip distribution percentages. Traffic volumes were established for all the forecasting scenarios described earlier during the weekday a.m. and p.m. peak hours. The resultant peak hour volumes are shown in **Figures 4 and 5**.

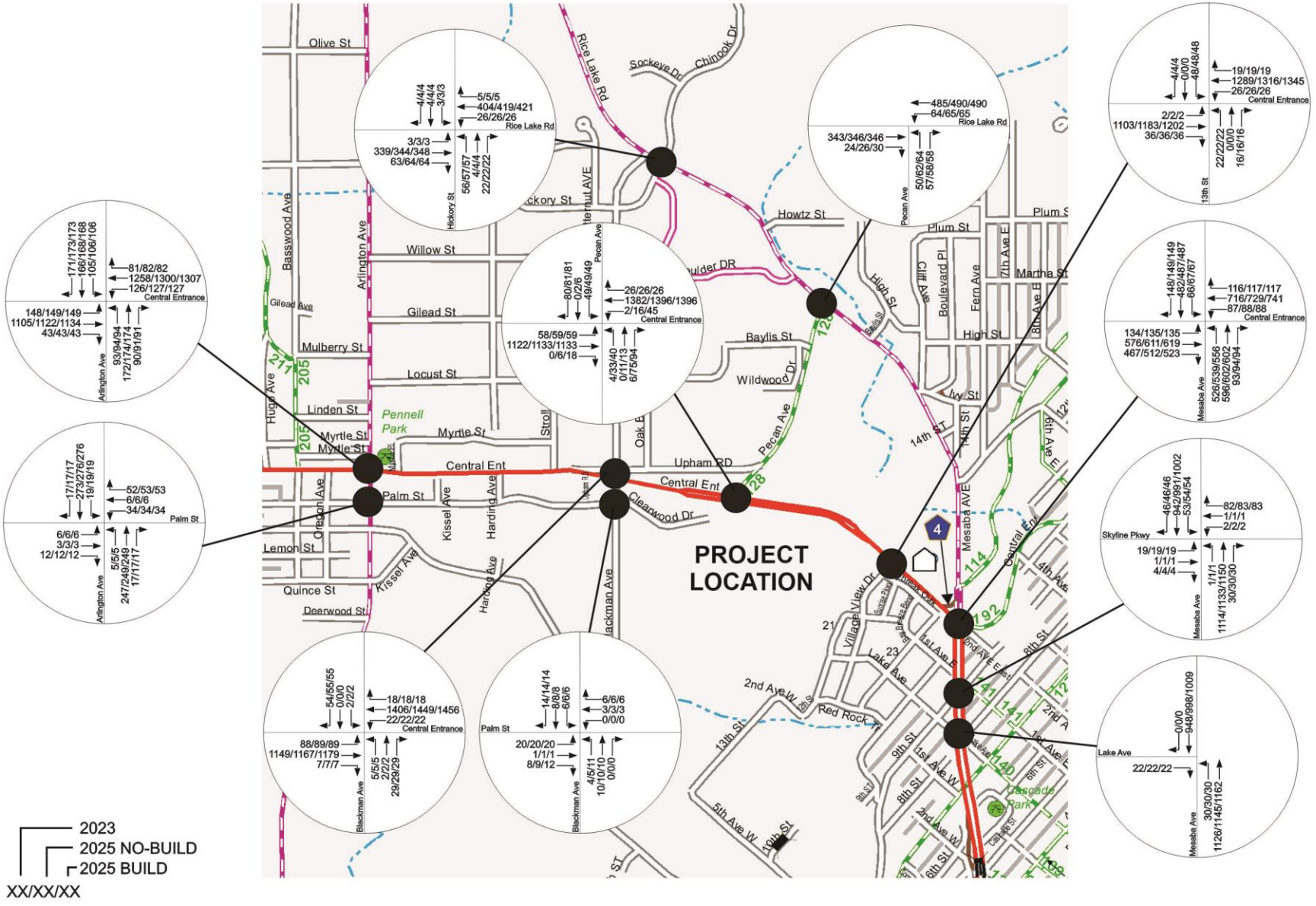


Stantec

TRAFFIC IMPACT STUDY FOR
CENTRAL HIGH SCHOOL
REDEVELOPMENT
IN DULUTH, MN

FIGURE 4

WEEKDAY AM PEAK HOUR VOLUMES



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TRAFFIC IMPACT STUDY FOR
CENTRAL HIGH SCHOOL
REDEVELOPMENT
IN DULUTH, MN

FIGURE 5

WEEKDAY PM PEAK HOUR VOLUMES

5.0 Traffic Analysis

Intersection Level of Service Analysis

Traffic analyses were completed for the subject intersections for all scenarios described earlier during the weekday a.m. and p.m. peak hours using Synchro software. Initial analysis was completed using existing geometrics and intersection control.

Capacity analysis results are presented in terms of level of service (LOS), which is defined in terms of traffic delay at the intersection. LOS ranges from A to F. LOS A represents the best intersection operation, with little delay for each vehicle using the intersection. LOS F represents the worst intersection operation with excessive delay. The following is a detailed description of the conditions described by each LOS designation:

- Level of service A corresponds to a free flow condition with motorists virtually unaffected by the intersection control mechanism. For a signalized or an unsignalized intersection, the average delay per vehicle would be approximately 10 seconds or less.

- Level of service B represents stable flow with a high degree of freedom, but with some influence from the intersection control device and the traffic volumes. For a signalized intersection, the average delay ranges from 10 to 20 seconds. An unsignalized intersection would have delays ranging from 10 to 15 seconds.

- Level of service C depicts a restricted flow which remains stable, but with significant influence from the intersection control device and the traffic volumes. The general level of comfort and convenience changes noticeably at this level. The delay ranges from 20 to 35 seconds for a signalized intersection and from 15 to 25 seconds for an unsignalized intersection at this level.

- Level of service D corresponds to high-density flow in which speed and freedom are significantly restricted. Though traffic flow remains stable, reductions in comfort and convenience are experienced. The control delay for this level is 35 to 55 seconds for a signalized intersection and 25 to 35 seconds for an unsignalized intersection.

- Level of service E represents unstable flow of traffic at or near the capacity of the intersection with poor levels of comfort and convenience. The delay ranges from 55 to 80 seconds for a signalized intersection and from 35 to 50 seconds for an unsignalized intersection at this level.

- Level of service F represents forced flow in which the volume of traffic approaching the intersection exceeds the volume that can be served. Characteristics often experienced include long queues, stop-and-go waves, poor travel times, low comfort and convenience, and increased accident exposure. Delays over 80 seconds for a signalized intersection and over 50 seconds for an unsignalized intersection correspond to this level of service.

The LOS results are described below. All LOS worksheets are included in the Appendix for further detail.

2023 Existing

Weekday A.M. and P.M. Peak Hour LOS Results

Intersection	Traffic Control	AM Peak Hour LOS	PM Peak Hour LOS
Central Entrance/Arlington Ave	Signal	C/D	C/E
Arlington Ave/Palm St	EB/WB stop	A/B	A/B
Central Entrance/Blackman Ave	NB/SB stop	A/C	A/F
Blackman Ave/Palm St/Clearwood Dr	EB/WB stop	A/A	A/A
Central Entrance/Pecan Ave/Hank Courtney Dr	Signal	A/D	A/D
Rice Lake Rd/Hickory St/Chinook Dr	NB/SB stop	A/E	A/C
Rice Lake Rd/Pecan Ave	NB stop	A/D	A/C
Central Entrance/13th St	NB/SB stop	A/E	C/F
Central Entrance/Mesaba Ave/Rice Lake Rd	Signal	D/D	D/E
Mesaba Ave/Skyline Pkwy/9th St	EB/WB stop	A/F	A/F
Mesaba Ave/Lake Ave	EB stop	A/B	A/B

Note: Level of service results presented with overall intersection LOS followed by worst movement LOS.

During the a.m. peak hour, the eastbound movements at Mesaba Avenue/Skyline Parkway/9th Street operate at LOS F while the overall intersection operates at LOS A. All other movements and intersections operate at LOS E or better.

During the p.m. peak hour, the following movements operate at LOS F:

- Northbound and southbound at Central Entrance/Blackman Avenue
- Northbound and southbound at Central Entrance/13th Street
- Eastbound at Mesaba Avenue/Skyline Parkway/9th Street

All intersections operate at LOS D or better and all other movements operate at LOS E or better.

2025 No-Build

Weekday A.M. and P.M. Peak Hour LOS Results

Intersection	Traffic Control	AM Peak Hour LOS	PM Peak Hour LOS
Central Entrance/Arlington Ave	Signal	C/D	C/E
Arlington Ave/Palm St	EB/WB stop	A/B	A/B
Central Entrance/Blackman Ave	NB/SB stop	A/C	A/F
Blackman Ave/Palm St/Clearwood Dr	EB/WB stop	A/A	A/A
Central Entrance/Pecan Ave/Hank Courtney Dr	Signal	A/D	B/D
Rice Lake Rd/Hickory St/Chinook Dr	NB/SB stop	A/E	A/C
Rice Lake Rd/Pecan Ave	NB stop	A/D	A/C
Central Entrance/13th St	NB/SB stop	A/F	C/F
Central Entrance/Mesaba Ave/Rice Lake Rd	Signal	D/D	D/E
Mesaba Ave/Skyline Pkwy/9th St	EB/WB stop	A/F	A/F
Mesaba Ave/Lake Ave	EB stop	A/B	A/B

Note: Level of service results presented with overall intersection LOS followed by worst movement LOS.

During the a.m. peak hour, the following movements operate at LOS F:

- Northbound and southbound at Central Entrance/13th Street
- Eastbound at Mesaba Avenue/Skyline Parkway/9th Street

All intersections operate at LOS D or better and all other movements operate at LOS E or better.

During the p.m. peak hour, the following movements operate at LOS F:

- Northbound and southbound at Central Entrance/Blackman Avenue
- Northbound and southbound at Central Entrance/13th Street
- Eastbound at Mesaba Avenue/Skyline Parkway/9th Street

All intersections operate at LOS D or better and all other movements operate at LOS E or better.

2025 Build

Weekday A.M. and P.M. Peak Hour LOS Results

Intersection	Traffic Control	AM Peak Hour LOS	PM Peak Hour LOS
Central Entrance/Arlington Ave	Signal	C/D	C/E
Arlington Ave/Palm St	EB/WB stop	A/B	A/B
Central Entrance/Blackman Ave	NB/SB stop	A/C	A/F
Blackman Ave/Palm St/Clearwood Dr	EB/WB stop	A/A	A/A
Central Entrance/Pecan Ave/Hank Courtney Dr	Signal	B/D	B/D
Rice Lake Rd/Hickory St/Chinook Dr	NB/SB stop	A/E	A/C
Rice Lake Rd/Pecan Ave	NB stop	A/D	A/C
Central Entrance/13th St	NB/SB stop	A/F	C/F
Central Entrance/Mesaba Ave/Rice Lake Rd	Signal	D/D	D/E
Mesaba Ave/Skyline Pkwy/9th St	EB/WB stop	A/F	A/F
Mesaba Ave/Lake Ave	EB stop	A/B	A/B

Note: Level of service results presented with overall intersection LOS followed by worst movement LOS.

During the a.m. peak hour, the following movements operate at LOS F:

- Northbound and southbound at Central Entrance/13th Street
- Eastbound at Mesaba Avenue/Skyline Parkway/9th Street

All intersections operate at LOS D or better and all other movements operate at LOS E or better.

During the p.m. peak hour, the following movements operate at LOS F:

- Northbound and southbound at Central Entrance/Blackman Avenue
- Northbound and southbound at Central Entrance/13th Street
- Eastbound at Mesaba Avenue/Skyline Parkway/9th Street

All intersections operate at LOS D or better and all other movements operate at LOS E or better.

Operations Summary

Under existing conditions, the minor leg approaches controlled with stop signs on Central Entrance and Mesaba Avenue operate at poor levels of service during the a.m. and p.m. peak hours. This is due to the amount of through traffic on the major roadway, which results in large delays for vehicles turning from the minor roadway. While not desirable, this condition is common at stop controlled minor approaches to high volume roadways.

Under 2025 No-Build conditions, movements and intersections operate largely the same as the existing scenario with the approaches at Central Entrance/13th Street degrading one letter-grade during the a.m. peak hour. Delay per vehicle also increases on the approaches that already operate at LOS F.

Under 2025 Build conditions, movements and intersections operate largely the same as the 2025 No-Build scenario with no changes to LOS results during the a.m. and p.m. peak hours due to the proposed Phase 1 development.

Mitigation Strategies

Under 2025 Build conditions, movements and intersections operate largely the same as the 2025 No-Build scenario with no changes to LOS results during the a.m. and p.m. peak hours due to the proposed Phase 1 development. Therefore no mitigation is needed for the proposed Phase 1 development.

As additional development is proposed for the site, the traffic analysis will be updated to determine if mitigation measures are needed for the existing roadway network prior to reconstruction of Central Entrance.

6.0 Conclusions and Recommendations

The conclusions drawn from the information and analyses presented in this report are as follows:

- The proposed development Scenario B was used in the analysis and is expected to generate 993 trips during the weekday a.m. peak hour, 1,103 trips during the weekday p.m. peak hour, and 12,679 total weekday trips.

- Under existing conditions, the minor leg approaches controlled with stop signs on Central Entrance and Mesaba Avenue operate at poor levels of service during the a.m. and p.m. peak hours. This is due to the amount of through traffic on the major roadway, which results in large delays for vehicles turning from the minor roadway. While not desirable, this condition is common at stop controlled minor approaches to high volume roadways.

- Under 2025 Build conditions, movements and intersections operate largely the same as the 2025 No-Build scenario with no changes to LOS results during the a.m. and p.m. peak hours due to the proposed Phase 1 development.

The following mitigation strategies are recommended based on the results of the analyses in this report:

- Under 2025 Build conditions, movements and intersections operate largely the same as the 2025 No-Build scenario with no changes to LOS results during the a.m. and p.m. peak hours due to the proposed Phase 1 development. Therefore no mitigation is needed for the proposed Phase 1 development.

- As additional development is proposed for the site, the traffic analysis will be updated to determine if mitigation measures are needed for the existing roadway network prior to reconstruction of Central Entrance.

7.0 Appendix

- Turn Movement Volumes
- Level of Service Worksheets

Intersection: Pecan Ave/Rice Lake Rd
Date: 11/16/2023

Time Period	NB Left	NB Thru	NB Right	SB Left	SB Thru	SB Right	EB Left	EB Thru	EB Right	WB Left	WB Thru	WB Right
6:00 AM	3	0	3	0	0	0	0	35	2	1	30	0
6:15 AM	3	0	4	0	0	0	0	43	7	4	42	0
6:30 AM	1	0	5	0	0	0	0	84	2	4	49	0
6:45 AM	3	0	10	0	0	0	0	70	6	3	49	0
7:00 AM	6	0	5	0	0	0	0	76	4	12	54	0
7:15 AM	8	0	17	0	0	0	0	115	12	10	102	0
7:30 AM	7	0	25	0	0	0	0	176	18	18	86	0
7:45 AM	11	0	22	0	0	0	0	136	17	28	92	0
8:00 AM	5	0	20	0	0	0	0	96	12	12	54	0
8:15 AM	8	0	10	0	0	0	0	81	7	5	43	0
8:30 AM	3	0	27	0	0	0	0	107	7	8	47	0
8:45 AM	3	0	12	0	0	0	0	66	7	14	55	0
9:00 AM	7	0	15	0	0	0	0	72	7	6	46	0
9:15 AM	5	0	2	0	0	0	0	50	6	9	32	0
9:30 AM	2	0	9	0	0	0	0	55	12	8	53	0
9:45 AM	2	0	5	0	0	0	0	78	7	10	42	0
10:00 AM	3	0	6	0	0	0	0	59	7	11	44	0
10:15 AM	5	0	9	0	0	0	0	47	3	14	44	0
10:30 AM	3	0	4	0	0	0	0	63	6	10	43	0
10:45 AM	7	0	6	0	0	0	0	50	7	13	51	0
11:00 AM	6	0	11	0	0	0	0	45	4	13	55	0
11:15 AM	9	0	7	0	0	0	0	47	6	15	50	0
11:30 AM	8	0	7	0	0	0	0	56	11	9	56	0
11:45 AM	6	0	9	0	0	0	0	50	4	14	65	0
12:00 PM	8	0	6	0	0	0	0	49	7	6	67	0
12:15 PM	6	0	11	0	0	0	0	52	16	6	65	0
12:30 PM	3	0	11	0	0	0	0	75	3	9	54	0
12:45 PM	7	0	9	0	0	0	0	62	6	10	52	0
1:00 PM	2	0	15	0	0	0	0	61	7	8	67	0
1:15 PM	6	0	8	0	0	0	0	59	8	13	59	0
1:30 PM	3	0	14	0	0	0	0	74	10	9	54	0
1:45 PM	13	0	13	0	0	0	0	77	4	17	82	0
2:00 PM	12	0	17	0	0	0	0	74	8	12	78	0
2:15 PM	6	0	14	0	0	0	0	83	9	8	81	0
2:30 PM	2	0	11	0	0	0	0	76	6	17	69	0
2:45 PM	8	0	16	0	0	0	0	82	12	15	64	0
3:00 PM	8	0	28	0	0	0	0	81	13	28	114	0
3:15 PM	11	0	19	0	0	0	0	75	6	13	111	0
3:30 PM	8	0	14	0	0	0	0	79	11	21	110	0
3:45 PM	13	0	14	0	0	0	0	74	10	16	93	0
4:00 PM	9	0	9	0	0	0	0	91	13	24	100	0
4:15 PM	8	0	11	0	0	0	0	82	11	13	104	0
4:30 PM	18	0	12	0	0	0	0	96	5	15	118	0
4:45 PM	8	0	19	0	0	0	0	83	6	19	134	0
5:00 PM	10	0	13	0	0	0	0	85	5	14	110	0
5:15 PM	14	0	13	0	0	0	0	79	8	16	123	0
5:30 PM	8	0	11	0	0	0	0	62	9	13	78	0
5:45 PM	11	0	13	0	0	0	0	64	4	8	66	0
6:00 PM	4	0	13	0	0	0	0	58	5	7	68	0
6:15 PM	3	0	3	0	0	0	0	62	3	11	54	0
6:30 PM	6	0	11	0	0	0	0	33	9	11	49	0
6:45 PM	1	0	8	0	0	0	0	37	3	5	45	0

Intersection: Chinook Dr/Hickory St /Rice Lake Rd
Date: 11/16/2023

Time Period	NB Left	NB Thru	NB Right	SB Left	SB Thru	SB Right	EB Left	EB Thru	EB Right	WB Left	WB Thru	WB Right
6:00 AM	2	0	1	0	0	0	0	26	0	0	31	0
6:15 AM	4	0	0	0	0	0	0	41	1	0	41	0
6:30 AM	2	0	2	2	0	2	0	71	3	0	43	0
6:45 AM	15	0	3	0	0	0	0	61	2	3	51	1
7:00 AM	11	0	4	0	0	0	0	70	4	3	60	0
7:15 AM	24	0	11	1	0	1	0	104	9	1	108	0
7:30 AM	34	0	10	0	0	1	1	148	10	3	95	1
7:45 AM	16	1	10	2	2	1	0	131	7	7	97	1
8:00 AM	8	0	12	5	2	3	3	83	5	3	50	2
8:15 AM	10	0	7	0	0	0	0	73	5	5	45	2
8:30 AM	15	0	10	2	0	3	1	84	7	2	50	2
8:45 AM	8	0	7	2	0	2	1	56	4	3	52	1
9:00 AM	8	1	14	0	0	1	0	50	1	0	53	0
9:15 AM	4	0	8	0	1	3	1	43	12	2	32	1
9:30 AM	11	0	11	0	0	1	0	40	4	2	52	0
9:45 AM	8	0	8	2	0	2	0	70	8	2	43	1
10:00 AM	4	0	6	1	0	0	2	50	3	2	41	2
10:15 AM	8	1	7	0	0	1	1	42	11	5	37	0
10:30 AM	9	0	6	2	0	1	1	49	12	4	40	0
10:45 AM	10	0	6	1	1	2	0	44	7	5	52	1
11:00 AM	6	0	6	0	2	2	0	45	11	9	48	0
11:15 AM	6	1	6	1	1	0	1	49	7	5	48	0
11:30 AM	8	0	9	1	0	0	1	53	10	4	52	0
11:45 AM	10	1	10	1	0	0	2	43	9	4	60	2
12:00 PM	13	1	7	0	0	1	2	38	8	10	61	1
12:15 PM	14	1	4	1	1	1	2	56	6	6	55	0
12:30 PM	9	1	14	0	0	0	1	58	11	8	45	0
12:45 PM	16	1	8	1	0	2	1	62	12	10	44	2
1:00 PM	11	1	2	1	1	1	1	62	12	8	58	0
1:15 PM	8	2	6	0	2	1	1	57	9	0	60	1
1:30 PM	15	1	11	0	0	1	1	61	17	3	50	1
1:45 PM	16	2	3	1	0	5	0	65	6	6	77	2
2:00 PM	15	0	5	0	0	1	0	70	20	4	75	1
2:15 PM	15	0	4	2	0	1	0	86	10	5	77	0
2:30 PM	8	0	8	0	0	1	0	63	13	11	55	0
2:45 PM	10	1	11	1	2	0	0	83	16	8	56	2
3:00 PM	13	1	5	1	0	0	0	84	17	8	103	1
3:15 PM	12	0	11	0	0	0	1	66	18	14	94	0
3:30 PM	17	0	8	0	0	1	0	78	21	19	90	2
3:45 PM	17	0	9	1	3	1	3	65	15	7	86	2
4:00 PM	16	1	10	1	2	1	0	85	7	4	97	0
4:15 PM	10	1	2	1	1	2	1	90	13	7	94	2
4:30 PM	11	1	3	1	1	1	1	88	18	8	107	0
4:45 PM	19	1	7	0	0	0	1	76	25	7	106	3
5:00 PM	20	0	1	1	0	1	1	78	21	10	81	0
5:15 PM	14	0	2	0	0	0	1	71	20	6	107	1
5:30 PM	11	1	4	1	1	1	1	58	18	3	70	2
5:45 PM	13	1	3	0	0	0	2	55	14	6	54	2
6:00 PM	8	0	8	2	0	1	0	41	12	4	52	0
6:15 PM	10	1	2	1	0	0	2	48	16	3	40	0
6:30 PM	8	0	3	0	0	2	0	36	7	3	40	0
6:45 PM	7	0	7	1	0	0	0	27	9	1	36	0

Intersection: MnDOT Access/E 13th St/MNTH 194
Date: 11/16/2023

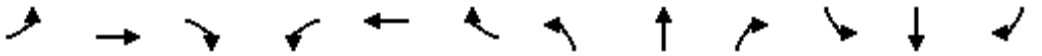
Time Period	NB Left	NB Thru	NB Right	SB Left	SB Thru	SB Right	EB Left	EB Thru	EB Right	WB Left	WB Thru	WB Right
6:00 AM	0	0	0	0	0	0	0	76	0	1	53	0
6:15 AM	1	0	0	0	0	1	0	99	0	0	45	1
6:30 AM	0	0	0	0	0	0	0	181	1	1	71	0
6:45 AM	3	0	2	1	0	0	0	174	1	1	100	0
7:00 AM	1	0	3	0	0	0	0	161	0	3	93	0
7:15 AM	6	0	3	0	0	0	0	218	1	0	118	0
7:30 AM	5	0	9	0	0	0	0	245	2	2	178	0
7:45 AM	3	0	1	0	0	0	0	286	2	4	223	0
8:00 AM	3	0	8	0	0	0	0	193	4	4	161	0
8:15 AM	2	0	4	0	0	0	0	203	2	5	165	0
8:30 AM	4	0	3	0	0	0	0	175	8	4	130	0
8:45 AM	1	0	2	1	0	2	0	180	1	3	215	0
9:00 AM	1	0	2	0	0	0	0	151	4	2	146	0
9:15 AM	3	0	0	0	0	0	1	187	4	2	194	0
9:30 AM	4	0	4	0	0	0	0	199	3	2	181	0
9:45 AM	5	0	1	0	0	0	0	181	1	2	218	0
10:00 AM	1	0	0	0	0	1	0	182	2	2	203	0
10:15 AM	5	0	1	0	0	0	0	191	6	4	207	0
10:30 AM	0	0	1	0	0	0	0	194	3	1	185	0
10:45 AM	2	0	1	0	0	0	0	171	4	3	235	0
11:00 AM	6	0	2	6	0	0	0	197	6	3	237	2
11:15 AM	3	0	2	3	0	0	0	186	2	2	252	2
11:30 AM	4	0	1	2	0	0	0	208	0	1	239	1
11:45 AM	5	0	1	2	0	0	0	211	7	3	286	2
12:00 PM	4	0	2	0	0	0	0	228	2	3	240	0
12:15 PM	6	0	2	0	0	1	0	250	5	3	298	0
12:30 PM	3	0	2	0	0	0	0	280	3	4	243	0
12:45 PM	7	0	0	1	0	0	0	225	6	2	256	1
1:00 PM	6	0	1	1	0	1	0	248	5	5	237	1
1:15 PM	3	0	0	0	0	1	0	230	4	3	235	2
1:30 PM	3	0	6	0	0	0	0	264	6	2	232	0
1:45 PM	9	0	2	2	0	0	0	249	2	3	235	4
2:00 PM	7	0	4	4	0	0	0	221	5	5	254	8
2:15 PM	3	0	3	3	0	1	0	235	12	3	277	2
2:30 PM	5	0	3	2	0	0	0	229	6	6	276	6
2:45 PM	8	0	3	2	0	1	0	252	10	1	269	7
3:00 PM	5	0	1	1	0	0	0	259	2	1	284	2
3:15 PM	4	0	2	0	0	0	0	237	3	2	315	3
3:30 PM	7	0	5	28	0	0	0	254	8	7	334	15
3:45 PM	5	0	1	48	1	4	2	266	6	3	357	21
4:00 PM	4	0	3	40	0	0	1	278	9	6	339	28
4:15 PM	5	0	2	39	0	1	0	281	3	7	348	17
4:30 PM	8	0	3	9	0	1	1	258	13	6	351	1
4:45 PM	5	0	7	0	0	1	0	272	6	7	318	0
5:00 PM	4	0	4	0	0	1	1	292	14	6	272	1
5:15 PM	5	0	4	0	0	0	0	251	6	2	268	1
5:30 PM	1	0	0	0	0	0	0	234	7	1	174	0
5:45 PM	7	0	0	0	0	1	0	203	7	2	188	0
6:00 PM	5	0	1	0	0	0	0	227	10	5	158	1
6:15 PM	2	0	2	1	0	2	0	203	7	4	141	0
6:30 PM	7	0	2	0	1	0	0	186	4	1	136	0
6:45 PM	3	0	2	0	0	0	0	152	7	5	135	0

Intersection: MNTH 194 /E Skyline Pkwy/E Ninth St
Date: 11/16/2023

Time Period	NB Left	NB Thru	NB Right	SB Left	SB Thru	SB Right	EB Left	EB Thru	EB Right	WB Left	WB Thru	WB Right
6:00 AM	0	67	0	2	54	2	3	0	0	2	0	4
6:15 AM	0	63	0	0	73	1	5	1	0	0	1	2
6:30 AM	0	100	2	10	128	2	3	0	0	1	0	5
6:45 AM	0	115	2	10	152	5	2	0	1	1	0	8
7:00 AM	0	124	0	11	174	3	5	0	0	0	1	4
7:15 AM	0	158	3	7	229	6	3	0	0	0	0	6
7:30 AM	0	186	3	19	281	6	7	0	0	0	0	13
7:45 AM	0	189	7	17	278	6	6	0	0	1	0	20
8:00 AM	0	126	3	12	219	8	5	2	0	0	0	13
8:15 AM	0	148	2	9	176	8	8	0	1	0	0	10
8:30 AM	0	134	1	7	196	7	6	0	0	0	0	5
8:45 AM	0	161	3	6	145	5	5	1	0	0	1	16
9:00 AM	0	128	2	13	132	4	5	0	0	0	0	7
9:15 AM	0	116	3	9	127	5	6	1	2	0	0	10
9:30 AM	0	141	1	11	155	4	2	0	2	2	2	8
9:45 AM	0	139	0	10	131	3	2	0	0	0	0	5
10:00 AM	0	146	3	16	126	7	1	0	0	0	1	15
10:15 AM	0	130	2	7	118	9	4	1	1	0	0	10
10:30 AM	0	118	2	10	134	4	5	0	1	1	0	11
10:45 AM	0	122	3	4	111	9	5	1	0	1	0	14
11:00 AM	0	148	2	13	143	4	2	1	0	1	1	11
11:15 AM	0	156	6	8	130	1	5	0	0	0	0	14
11:30 AM	0	175	3	11	172	4	4	0	0	1	1	4
11:45 AM	0	176	2	11	141	11	3	0	1	0	0	14
12:00 PM	1	197	6	12	153	9	6	1	0	0	1	5
12:15 PM	0	160	2	5	164	5	6	0	0	0	1	15
12:30 PM	0	169	8	13	203	6	6	1	0	0	1	21
12:45 PM	0	156	2	8	163	6	2	0	0	0	0	11
1:00 PM	0	186	6	11	154	5	2	0	0	0	1	14
1:15 PM	0	166	0	5	138	9	3	0	0	0	0	10
1:30 PM	0	176	4	13	183	4	4	0	0	2	0	5
1:45 PM	0	179	5	14	173	6	5	1	0	0	0	8
2:00 PM	1	188	2	10	174	17	4	0	0	0	1	10
2:15 PM	0	193	2	11	169	5	1	0	1	0	0	27
2:30 PM	0	176	2	11	184	6	3	1	2	1	1	15
2:45 PM	0	204	3	8	168	9	7	0	0	0	0	15
3:00 PM	0	227	3	19	215	10	3	1	1	0	0	6
3:15 PM	0	230	1	10	200	18	6	1	0	0	1	14
3:30 PM	0	253	3	13	205	10	8	0	0	0	0	13
3:45 PM	0	236	3	10	232	14	5	1	1	0	0	15
4:00 PM	1	297	3	6	222	13	3	1	3	0	0	19
4:15 PM	0	260	3	11	239	8	7	0	0	0	0	18
4:30 PM	0	298	14	11	226	16	3	1	0	1	0	30
4:45 PM	1	254	7	16	241	8	5	0	3	0	1	19
5:00 PM	0	239	6	15	236	14	4	0	1	1	0	15
5:15 PM	0	229	3	9	223	12	6	1	2	0	0	9
5:30 PM	0	164	4	9	187	5	5	1	2	0	0	14
5:45 PM	0	147	1	12	200	7	2	0	1	0	0	7
6:00 PM	0	161	2	13	162	5	2	0	0	0	0	6
6:15 PM	0	132	1	16	174	7	6	0	0	0	0	11
6:30 PM	0	128	1	9	129	6	3	0	1	0	0	7
6:45 PM	0	133	4	5	114	4	2	0	0	0	0	4

Intersection: MNTH 194/N Lake Ave
Date: 11/16/2023

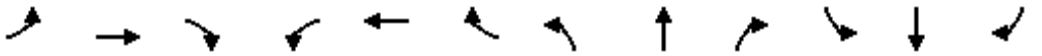
Time Period	NB Left	NB Thru	NB Right	SB Left	SB Thru	SB Right	EB Left	EB Thru	EB Right	WB Left	WB Thru	WB Right
6:00 AM	0	68	0	0	56	0	0	0	1	0	0	0
6:15 AM	1	61	0	0	74	0	0	0	3	0	0	0
6:30 AM	2	109	0	0	124	0	0	0	3	0	0	0
6:45 AM	2	114	0	0	155	0	0	0	4	0	0	0
7:00 AM	3	129	0	0	171	0	0	0	7	0	0	0
7:15 AM	4	160	0	0	227	0	0	0	0	0	0	0
7:30 AM	2	190	0	0	278	0	0	0	1	0	0	0
7:45 AM	2	196	0	0	287	0	0	0	9	0	0	0
8:00 AM	5	126	0	0	218	0	0	0	3	0	0	0
8:15 AM	2	145	0	0	173	1	0	0	7	0	0	0
8:30 AM	4	139	0	0	192	0	0	0	3	0	0	0
8:45 AM	6	163	0	0	148	0	0	0	8	0	0	0
9:00 AM	3	125	0	0	131	0	0	0	5	0	0	0
9:15 AM	6	120	0	0	130	0	0	0	2	0	0	0
9:30 AM	2	142	0	0	155	0	0	0	7	0	0	0
9:45 AM	1	137	0	0	131	0	0	0	3	0	0	0
10:00 AM	3	148	0	0	128	1	0	0	6	0	0	0
10:15 AM	1	132	0	0	120	0	0	0	3	0	0	0
10:30 AM	3	120	0	0	135	0	0	0	2	0	0	0
10:45 AM	3	126	0	0	115	0	0	0	2	0	0	0
11:00 AM	1	152	0	0	145	0	0	0	2	0	0	0
11:15 AM	2	158	0	0	130	0	0	0	2	0	0	0
11:30 AM	2	182	0	0	170	0	0	0	1	0	0	0
11:45 AM	5	175	0	0	147	0	0	0	4	0	0	0
12:00 PM	3	204	0	0	152	0	0	0	4	0	0	0
12:15 PM	8	161	0	0	165	0	0	0	9	0	0	0
12:30 PM	2	178	0	0	205	0	0	0	2	0	0	0
12:45 PM	2	154	0	0	163	0	0	0	1	0	0	0
1:00 PM	1	192	0	0	153	0	0	0	3	0	0	0
1:15 PM	2	166	0	0	140	0	0	0	5	0	0	0
1:30 PM	4	180	0	0	183	0	1	0	2	0	0	0
1:45 PM	1	181	0	0	174	0	0	0	1	0	0	0
2:00 PM	4	193	0	0	174	0	1	0	1	0	0	0
2:15 PM	5	190	0	0	172	0	0	0	3	0	0	0
2:30 PM	5	183	0	0	183	0	0	0	2	0	0	0
2:45 PM	9	207	0	0	168	0	0	0	5	0	0	0
3:00 PM	5	235	0	0	217	0	0	0	11	0	0	0
3:15 PM	11	229	0	0	198	0	0	0	1	0	0	0
3:30 PM	6	253	0	0	198	1	0	0	6	0	0	0
3:45 PM	9	236	0	0	240	0	0	0	9	0	0	0
4:00 PM	7	300	0	0	225	0	0	0	7	0	0	0
4:15 PM	10	265	0	0	239	0	0	0	5	0	0	0
4:30 PM	9	303	0	0	222	0	0	0	8	0	0	0
4:45 PM	6	248	0	0	248	0	0	0	5	0	0	0
5:00 PM	5	247	0	0	239	0	0	0	4	0	0	0
5:15 PM	8	222	0	0	220	0	0	0	4	0	0	0
5:30 PM	2	167	0	0	188	1	0	0	4	0	0	0
5:45 PM	4	151	0	0	201	0	0	0	4	0	0	0
6:00 PM	6	167	0	0	162	0	0	0	3	0	0	0
6:15 PM	5	128	0	0	174	0	0	0	4	0	0	0
6:30 PM	5	132	0	0	132	0	0	0	6	0	0	0
6:45 PM	4	134	0	0	114	0	0	0	2	0	0	0



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	65	755	34	144	557	40	76	191	104	110	214	85
Future Volume (veh/h)	65	755	34	144	557	40	76	191	104	110	214	85
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	71	821	37	157	605	43	83	208	113	120	233	92
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	444	1568	71	384	1599	114	295	237	129	239	425	360
Arrive On Green	0.05	0.45	0.45	0.07	0.48	0.48	0.05	0.21	0.21	0.07	0.23	0.23
Sat Flow, veh/h	1781	3463	156	1781	3365	239	1781	1140	619	1781	1870	1585
Grp Volume(v), veh/h	71	421	437	157	319	329	83	0	321	120	233	92
Grp Sat Flow(s),veh/h/ln	1781	1777	1842	1781	1777	1827	1781	0	1759	1781	1870	1585
Q Serve(g_s), s	1.9	15.3	15.3	4.2	10.3	10.4	3.3	0.0	15.9	4.7	9.9	4.3
Cycle Q Clear(g_c), s	1.9	15.3	15.3	4.2	10.3	10.4	3.3	0.0	15.9	4.7	9.9	4.3
Prop In Lane	1.00		0.08	1.00		0.13	1.00		0.35	1.00		1.00
Lane Grp Cap(c), veh/h	444	804	834	384	845	869	295	0	365	239	425	360
V/C Ratio(X)	0.16	0.52	0.52	0.41	0.38	0.38	0.28	0.00	0.88	0.50	0.55	0.26
Avail Cap(c_a), veh/h	477	804	834	470	845	869	321	0	440	261	501	424
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	12.2	17.7	17.7	13.0	15.1	15.1	26.3	0.0	34.6	26.7	30.7	28.5
Incr Delay (d2), s/veh	0.2	2.4	2.3	0.7	1.3	1.3	0.5	0.0	15.9	1.6	1.1	0.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	6.5	6.7	1.6	4.3	4.4	1.4	0.0	8.3	2.1	4.5	1.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	12.4	20.1	20.0	13.7	16.4	16.4	26.8	0.0	50.5	28.3	31.8	28.9
LnGrp LOS	B	C	C	B	B	B	C	A	D	C	C	C
Approach Vol, veh/h		929			805			404			445	
Approach Delay, s/veh		19.5			15.9			45.6			30.3	
Approach LOS		B			B			D			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	10.7	45.2	9.1	25.0	8.7	47.3	10.9	23.2
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	10.5	31.5	5.9	24.1	5.8	36.2	7.5	22.5
Max Q Clear Time (g_c+I1), s	6.2	17.3	5.3	11.9	3.9	12.4	6.7	17.9
Green Ext Time (p_c), s	0.1	4.7	0.0	1.3	0.0	4.2	0.0	0.8

Intersection Summary	
HCM 6th Ctrl Delay	24.3
HCM 6th LOS	C



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	45	941	3	10	644	24	2	1	10	35	1	57
Future Volume (veh/h)	45	941	3	10	644	24	2	1	10	35	1	57
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	49	1023	3	11	700	26	2	1	0	38	1	62
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	605	2574	1148	441	2482	1107	5	2		101	3	92
Arrive On Green	0.04	0.72	0.72	0.01	0.70	0.70	0.00	0.00	0.00	0.06	0.06	0.06
Sat Flow, veh/h	1781	3554	1585	1781	3554	1585	1207	603	1585	1738	46	1585
Grp Volume(v), veh/h	49	1023	3	11	700	26	3	0	0	39	0	62
Grp Sat Flow(s),veh/h/ln	1781	1777	1585	1781	1777	1585	1810	0	1585	1783	0	1585
Q Serve(g_s), s	0.7	10.0	0.0	0.2	6.7	0.5	0.1	0.0	0.0	1.9	0.0	3.5
Cycle Q Clear(g_c), s	0.7	10.0	0.0	0.2	6.7	0.5	0.1	0.0	0.0	1.9	0.0	3.5
Prop In Lane	1.00		1.00	1.00		1.00	0.67		1.00	0.97		1.00
Lane Grp Cap(c), veh/h	605	2574	1148	441	2482	1107	7	0		104	0	92
V/C Ratio(X)	0.08	0.40	0.00	0.02	0.28	0.02	0.41	0.00		0.38	0.00	0.67
Avail Cap(c_a), veh/h	636	2574	1148	516	2482	1107	362	0		357	0	317
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	3.4	4.8	3.4	4.1	5.1	4.2	44.7	0.0	0.0	40.8	0.0	41.5
Incr Delay (d2), s/veh	0.1	0.5	0.0	0.0	0.3	0.0	33.4	0.0	0.0	2.2	0.0	8.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	3.0	0.0	0.0	2.1	0.1	0.1	0.0	0.0	0.9	0.0	1.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	3.5	5.3	3.4	4.1	5.4	4.2	78.1	0.0	0.0	43.0	0.0	49.7
LnGrp LOS	A	A	A	A	A	A	E	A		D	A	D
Approach Vol, veh/h		1075			737			3			101	
Approach Delay, s/veh		5.2			5.3			78.1			47.1	
Approach LOS		A			A			E			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	5.7	69.7		9.7	8.0	67.4		4.9				
Change Period (Y+Rc), s	4.5	4.5		4.5	4.5	4.5		4.5				
Max Green Setting (Gmax), s	5.0	31.0		18.0	5.1	30.9		18.0				
Max Q Clear Time (g_c+I1), s	2.2	12.0		5.5	2.7	8.7		2.1				
Green Ext Time (p_c), s	0.0	7.3		0.2	0.0	5.1		0.0				

Intersection Summary		
HCM 6th Ctrl Delay	7.6	
HCM 6th LOS	A	

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (veh/h)	222	546	78	128	628	58	57	515	414	77	398	81
Future Volume (veh/h)	222	546	78	128	628	58	57	515	414	77	398	81
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	241	593	0	139	683	0	62	560	0	84	433	88
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	608	1277		482	962		182	664		180	586	118
Arrive On Green	0.34	0.34	0.00	0.27	0.27	0.00	0.04	0.19	0.00	0.05	0.20	0.20
Sat Flow, veh/h	1781	3741	0	1781	3647	0	1781	3554	1585	1781	2946	594
Grp Volume(v), veh/h	241	593	0	139	683	0	62	560	0	84	260	261
Grp Sat Flow(s),veh/h/ln	1781	1870	0	1781	1777	0	1781	1777	1585	1781	1777	1763
Q Serve(g_s), s	12.4	14.9	0.0	7.4	20.8	0.0	3.4	18.3	0.0	4.5	16.5	16.7
Cycle Q Clear(g_c), s	12.4	14.9	0.0	7.4	20.8	0.0	3.4	18.3	0.0	4.5	16.5	16.7
Prop In Lane	1.00		0.00	1.00		0.00	1.00		1.00	1.00		0.34
Lane Grp Cap(c), veh/h	608	1277		482	962		182	664		180	353	351
V/C Ratio(X)	0.40	0.46		0.29	0.71		0.34	0.84		0.47	0.74	0.74
Avail Cap(c_a), veh/h	608	1277		482	962		204	814		186	412	409
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	30.1	30.9	0.0	34.6	39.5	0.0	38.3	47.1	0.0	38.1	45.1	45.2
Incr Delay (d2), s/veh	1.9	1.2	0.0	1.5	4.4	0.0	1.1	6.8	0.0	1.9	5.7	6.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.6	6.9	0.0	3.4	9.6	0.0	1.5	8.7	0.0	2.1	7.8	7.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	32.0	32.1	0.0	36.1	43.9	0.0	39.4	53.9	0.0	40.0	50.8	51.4
LnGrp LOS	C	C		D	D		D	D		D	D	D
Approach Vol, veh/h		834			822			622			605	
Approach Delay, s/veh		32.1			42.6			52.5			49.6	
Approach LOS		C			D			D			D	

Timer - Assigned Phs		2	3	4		6	7	8				
Phs Duration (G+Y+Rc), s		45.5	10.6	26.9		37.0	9.2	28.4				
Change Period (Y+Rc), s		4.5	4.5	4.5		4.5	4.5	4.5				
Max Green Setting (Gmax), s		35.5	6.5	27.5		32.5	6.2	27.8				
Max Q Clear Time (g_c+I1), s		16.9	6.5	20.3		22.8	5.4	18.7				
Green Ext Time (p_c), s		4.6	0.0	2.2		3.6	0.0	2.1				

Intersection Summary	
HCM 6th Ctrl Delay	43.2
HCM 6th LOS	D

Notes

User approved volume balancing among the lanes for turning movement.

Unsignalized Delay for [NBR, SER, SBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	1.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	4	6	11	10	5	27	12	294	24	17	331	12
Future Vol, veh/h	4	6	11	10	5	27	12	294	24	17	331	12
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	4	7	12	11	5	29	13	320	26	18	360	13

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	779	775	367	771	768	333	373	0	0	346	0	0
Stage 1	403	403	-	359	359	-	-	-	-	-	-	-
Stage 2	376	372	-	412	409	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	313	329	678	317	332	709	1185	-	-	1213	-	-
Stage 1	624	600	-	659	627	-	-	-	-	-	-	-
Stage 2	645	619	-	617	596	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	289	318	678	299	321	709	1185	-	-	1213	-	-
Mov Cap-2 Maneuver	289	318	-	299	321	-	-	-	-	-	-	-
Stage 1	615	589	-	650	618	-	-	-	-	-	-	-
Stage 2	604	610	-	588	585	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	13.9	13.2	0.3	0.4
HCM LOS	B	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1185	-	-	429	482	1213	-	-
HCM Lane V/C Ratio	0.011	-	-	0.053	0.095	0.015	-	-
HCM Control Delay (s)	8.1	0	-	13.9	13.2	8	0	-
HCM Lane LOS	A	A	-	B	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.2	0.3	0	-	-

Intersection	
Int Delay, s/veh	4.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	17	2	3	1	1	11	6	15	1	5	23	3
Future Vol, veh/h	17	2	3	1	1	11	6	15	1	5	23	3
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	18	2	3	1	1	12	7	16	1	5	25	3

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	74	68	27	70	69	17	28	0	0	17	0	0
Stage 1	37	37	-	31	31	-	-	-	-	-	-	-
Stage 2	37	31	-	39	38	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	916	823	1048	922	822	1062	1585	-	-	1600	-	-
Stage 1	978	864	-	986	869	-	-	-	-	-	-	-
Stage 2	978	869	-	976	863	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	900	817	1048	913	816	1062	1585	-	-	1600	-	-
Mov Cap-2 Maneuver	900	817	-	913	816	-	-	-	-	-	-	-
Stage 1	974	861	-	982	866	-	-	-	-	-	-	-
Stage 2	962	866	-	968	860	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	9.1	8.6	2	1.2
HCM LOS	A	A		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1585	-	-	909	1025	1600	-	-
HCM Lane V/C Ratio	0.004	-	-	0.026	0.014	0.003	-	-
HCM Control Delay (s)	7.3	0	-	9.1	8.6	7.3	0	-
HCM Lane LOS	A	A	-	A	A	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.1	0	0	-	-

Intersection	
Int Delay, s/veh	1.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	29	948	8	24	671	8	5	2	37	4	1	65
Future Vol, veh/h	29	948	8	24	671	8	5	2	37	4	1	65
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	300	-	-	300	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	32	1030	9	26	729	9	5	2	40	4	1	71

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	738	0	0	1039	0	0	1516	1889	520	1366	1889	369
Stage 1	-	-	-	-	-	-	1099	1099	-	786	786	-
Stage 2	-	-	-	-	-	-	417	790	-	580	1103	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	864	-	-	665	-	-	82	70	501	106	70	628
Stage 1	-	-	-	-	-	-	227	287	-	351	401	-
Stage 2	-	-	-	-	-	-	584	400	-	467	285	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	864	-	-	665	-	-	68	65	501	90	65	628
Mov Cap-2 Maneuver	-	-	-	-	-	-	68	65	-	90	65	-
Stage 1	-	-	-	-	-	-	219	276	-	338	385	-
Stage 2	-	-	-	-	-	-	497	384	-	410	274	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	0.4	23	15.2
HCM LOS			C	C

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	247	864	-	-	665	-	-	429
HCM Lane V/C Ratio	0.194	0.036	-	-	0.039	-	-	0.177
HCM Control Delay (s)	23	9.3	-	-	10.6	-	-	15.2
HCM Lane LOS	C	A	-	-	B	-	-	C
HCM 95th %tile Q(veh)	0.7	0.1	-	-	0.1	-	-	0.6

Intersection	
Int Delay, s/veh	1

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	0	927	10	15	727	0	13	1	22	1	1	1
Future Vol, veh/h	0	927	10	15	727	0	13	1	22	1	1	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	300	-	-	300	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	83	83	83	83	83	83	83	83	83	83	83	83
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	1117	12	18	876	0	16	1	27	1	1	1

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	876	0	0	1129	0	0	1598	2035	565	1471	2041	438
Stage 1	-	-	-	-	-	-	1123	1123	-	912	912	-
Stage 2	-	-	-	-	-	-	475	912	-	559	1129	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	766	-	-	615	-	-	71	56	468	89	56	567
Stage 1	-	-	-	-	-	-	219	279	-	295	351	-
Stage 2	-	-	-	-	-	-	539	351	-	481	277	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	766	-	-	615	-	-	68	54	468	81	54	567
Mov Cap-2 Maneuver	-	-	-	-	-	-	68	54	-	81	54	-
Stage 1	-	-	-	-	-	-	219	279	-	295	341	-
Stage 2	-	-	-	-	-	-	520	341	-	452	277	-

Approach	SE	NW	NE	SW
HCM Control Delay, s	0	0.2	41.9	45.7
HCM LOS			E	E

Minor Lane/Major Mvmt	NELn1	NWL	NWT	NWR	SEL	SET	SER	SWLn1
Capacity (veh/h)	140	615	-	-	766	-	-	92
HCM Lane V/C Ratio	0.31	0.029	-	-	-	-	-	0.039
HCM Control Delay (s)	41.9	11	-	-	0	-	-	45.7
HCM Lane LOS	E	B	-	-	A	-	-	E
HCM 95th %tile Q(veh)	1.2	0.1	-	-	0	-	-	0.1

Intersection	
Int Delay, s/veh	2.6

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	0	825	16	55	1007	26	21	2	0	1	0	52
Future Vol, veh/h	0	825	16	55	1007	26	21	2	0	1	0	52
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	125	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	88	88	88	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	938	18	63	1144	30	24	2	0	1	0	59

Major/Minor	Major1			Major2			Minor2			Minor1		
Conflicting Flow All	1174	0	0	956	0	0	1754	2241	587	1646	2247	478
Stage 1	-	-	-	-	-	-	1285	1285	-	947	947	-
Stage 2	-	-	-	-	-	-	469	956	-	699	1300	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	591	-	-	715	-	-	54	42	453	65	41	534
Stage 1	-	-	-	-	-	-	174	233	-	281	338	-
Stage 2	-	-	-	-	-	-	544	335	-	397	230	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	591	-	-	715	-	-	45	38	453	58	37	534
Mov Cap-2 Maneuver	-	-	-	-	-	-	45	38	-	58	37	-
Stage 1	-	-	-	-	-	-	174	212	-	281	338	-
Stage 2	-	-	-	-	-	-	484	335	-	358	210	-

Approach	NB	SB	NE	SW
HCM Control Delay, s	0	0.5	169.3	14
HCM LOS			F	B

Minor Lane/Major Mvmt	NELn1	NBL	NBT	NBR	SBL	SBT	SBR	SWLn1
Capacity (veh/h)	44	591	-	-	715	-	-	462
HCM Lane V/C Ratio	0.594	-	-	-	0.087	-	-	0.13
HCM Control Delay (s)	169.3	0	-	-	10.5	-	-	14
HCM Lane LOS	F	A	-	-	B	-	-	B
HCM 95th %tile Q(veh)	2.2	0	-	-	0.3	-	-	0.4

Intersection	
Int Delay, s/veh	0.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	13	13	838	1010	0
Future Vol, veh/h	0	13	13	838	1010	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Yield	-	None	-	None
Storage Length	-	-	125	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	86	86	86	86	86	86
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	15	15	974	1174	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	587	1174	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	4.14	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	2.22	-	-	-
Pot Cap-1 Maneuver	0	453	591	-	-	-
Stage 1	0	-	-	-	-	-
Stage 2	0	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	453	591	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	13.2	0.2	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	591	-	453	-	-
HCM Lane V/C Ratio	0.026	-	0.033	-	-
HCM Control Delay (s)	11.3	-	13.2	-	-
HCM Lane LOS	B	-	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.1	-	-

Intersection	
Int Delay, s/veh	5.1

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	5	466	31	14	350	4	82	1	43	8	4	6
Future Vol, veh/h	5	466	31	14	350	4	82	1	43	8	4	6
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	250	-	250	250	-	250	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	84	84	84	84	84	84	84	84	84	84	84	84
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	6	555	37	17	417	5	98	1	51	10	5	7

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	422	0	0	592	0	0	1027	1023	555	1063	1055	417
Stage 1	-	-	-	-	-	-	567	567	-	451	451	-
Stage 2	-	-	-	-	-	-	460	456	-	612	604	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1137	-	-	984	-	-	213	236	531	201	226	636
Stage 1	-	-	-	-	-	-	508	507	-	588	571	-
Stage 2	-	-	-	-	-	-	581	568	-	480	488	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1137	-	-	984	-	-	204	231	531	178	221	636
Mov Cap-2 Maneuver	-	-	-	-	-	-	204	231	-	178	221	-
Stage 1	-	-	-	-	-	-	505	504	-	585	561	-
Stage 2	-	-	-	-	-	-	560	558	-	430	486	-

Approach	SE	NW	NE	SW
HCM Control Delay, s	0.1	0.3	36.4	20.9
HCM LOS			E	C

Minor Lane/Major Mvmt	NELn1	NWL	NWT	NWR	SEL	SET	SERSWLn1
Capacity (veh/h)	259	984	-	-	1137	-	- 248
HCM Lane V/C Ratio	0.579	0.017	-	-	0.005	-	- 0.086
HCM Control Delay (s)	36.4	8.7	-	-	8.2	-	- 20.9
HCM Lane LOS	E	A	-	-	A	-	- C
HCM 95th %tile Q(veh)	3.3	0.1	-	-	0	-	- 0.3

Intersection	
Int Delay, s/veh	2.5

Movement	NBL	NBR	SET	SER	NWL	NWT
Lane Configurations						
Traffic Vol, veh/h	31	84	523	57	68	334
Future Vol, veh/h	31	84	523	57	68	334
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	150	0	-	100	250	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	83	83	83	83	83	83
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	37	101	630	69	82	402

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1196	630	0	0	699	0
Stage 1	630	-	-	-	-	-
Stage 2	566	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	206	482	-	-	898	-
Stage 1	531	-	-	-	-	-
Stage 2	568	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	187	482	-	-	898	-
Mov Cap-2 Maneuver	187	-	-	-	-	-
Stage 1	531	-	-	-	-	-
Stage 2	516	-	-	-	-	-

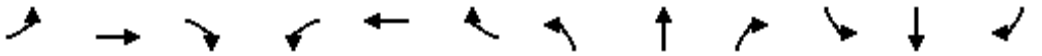
Approach	NB	SE	NW
HCM Control Delay, s	18.3	0	1.6
HCM LOS	C		

Minor Lane/Major Mvmt	NBLn1	NBLn2	NWL	NWT	SET	SER
Capacity (veh/h)	187	482	898	-	-	-
HCM Lane V/C Ratio	0.2	0.21	0.091	-	-	-
HCM Control Delay (s)	29	14.4	9.4	-	-	-
HCM Lane LOS	D	B	A	-	-	-
HCM 95th %tile Q(veh)	0.7	0.8	0.3	-	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	66	793	34	145	573	40	77	193	105	111	216	86
Future Volume (veh/h)	66	793	34	145	573	40	77	193	105	111	216	86
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	72	862	37	158	623	43	84	210	114	121	235	93
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	435	1563	67	370	1596	110	296	239	130	239	428	363
Arrive On Green	0.05	0.45	0.45	0.07	0.47	0.47	0.05	0.21	0.21	0.07	0.23	0.23
Sat Flow, veh/h	1781	3471	149	1781	3373	233	1781	1140	619	1781	1870	1585
Grp Volume(v), veh/h	72	441	458	158	328	338	84	0	324	121	235	93
Grp Sat Flow(s),veh/h/ln	1781	1777	1844	1781	1777	1829	1781	0	1759	1781	1870	1585
Q Serve(g_s), s	1.9	16.3	16.3	4.2	10.7	10.8	3.3	0.0	16.1	4.7	10.0	4.3
Cycle Q Clear(g_c), s	1.9	16.3	16.3	4.2	10.7	10.8	3.3	0.0	16.1	4.7	10.0	4.3
Prop In Lane	1.00		0.08	1.00		0.13	1.00		0.35	1.00		1.00
Lane Grp Cap(c), veh/h	435	800	830	370	841	865	296	0	368	239	428	363
V/C Ratio(X)	0.17	0.55	0.55	0.43	0.39	0.39	0.28	0.00	0.88	0.51	0.55	0.26
Avail Cap(c_a), veh/h	467	800	830	454	841	865	321	0	440	261	501	424
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	12.3	18.1	18.1	13.4	15.3	15.3	26.2	0.0	34.5	26.6	30.6	28.4
Incr Delay (d2), s/veh	0.2	2.7	2.6	0.8	1.4	1.3	0.5	0.0	16.2	1.6	1.1	0.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	7.0	7.2	1.7	4.5	4.6	1.4	0.0	8.4	2.1	4.5	1.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	12.5	20.8	20.7	14.2	16.7	16.7	26.7	0.0	50.7	28.3	31.7	28.8
LnGrp LOS	B	C	C	B	B	B	C	A	D	C	C	C
Approach Vol, veh/h		971			824			408			449	
Approach Delay, s/veh		20.2			16.2			45.8			30.2	
Approach LOS		C			B			D			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	10.7	45.0	9.2	25.1	8.7	47.1	10.9	23.3
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	10.5	31.5	5.9	24.1	5.8	36.2	7.5	22.5
Max Q Clear Time (g_c+I1), s	6.2	18.3	5.3	12.0	3.9	12.8	6.7	18.1
Green Ext Time (p_c), s	0.1	4.8	0.0	1.3	0.0	4.3	0.0	0.8

Intersection Summary	
HCM 6th Ctrl Delay	24.6
HCM 6th LOS	C



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	45	950	33	82	650	24	12	4	33	35	12	58
Future Volume (veh/h)	45	950	33	82	650	24	12	4	33	35	12	58
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	49	1033	36	89	707	26	13	4	0	38	13	63
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	585	2383	1063	451	2420	1079	26	8		81	28	96
Arrive On Green	0.04	0.67	0.67	0.05	0.68	0.68	0.02	0.02	0.00	0.06	0.06	0.06
Sat Flow, veh/h	1781	3554	1585	1781	3554	1585	1378	424	1585	1344	460	1585
Grp Volume(v), veh/h	49	1033	36	89	707	26	17	0	0	51	0	63
Grp Sat Flow(s),veh/h/ln	1781	1777	1585	1781	1777	1585	1801	0	1585	1803	0	1585
Q Serve(g_s), s	0.7	12.2	0.7	1.3	7.1	0.5	0.8	0.0	0.0	2.5	0.0	3.5
Cycle Q Clear(g_c), s	0.7	12.2	0.7	1.3	7.1	0.5	0.8	0.0	0.0	2.5	0.0	3.5
Prop In Lane	1.00		1.00	1.00		1.00	0.76		1.00	0.75		1.00
Lane Grp Cap(c), veh/h	585	2383	1063	451	2420	1079	35	0		109	0	96
V/C Ratio(X)	0.08	0.43	0.03	0.20	0.29	0.02	0.49	0.00		0.47	0.00	0.66
Avail Cap(c_a), veh/h	616	2383	1063	462	2420	1079	360	0		361	0	317
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	4.1	6.9	5.0	4.7	5.7	4.7	43.7	0.0	0.0	40.9	0.0	41.4
Incr Delay (d2), s/veh	0.1	0.6	0.1	0.2	0.3	0.0	10.3	0.0	0.0	3.1	0.0	7.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	4.1	0.2	0.4	2.4	0.1	0.5	0.0	0.0	1.2	0.0	1.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	4.2	7.5	5.1	4.9	6.0	4.7	54.0	0.0	0.0	43.9	0.0	48.7
LnGrp LOS	A	A	A	A	A	A	D	A		D	A	D
Approach Vol, veh/h		1118			822			17			114	
Approach Delay, s/veh		7.2			5.9			54.0			46.6	
Approach LOS		A			A			D			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	9.0	64.9		10.0	8.0	65.8		6.2				
Change Period (Y+Rc), s	4.5	4.5		4.5	4.5	4.5		4.5				
Max Green Setting (Gmax), s	5.0	31.0		18.0	5.1	30.9		18.0				
Max Q Clear Time (g_c+I1), s	3.3	14.2		5.5	2.7	9.1		2.8				
Green Ext Time (p_c), s	0.0	7.1		0.3	0.0	5.1		0.0				

Intersection Summary			
HCM 6th Ctrl Delay		9.2	
HCM 6th LOS		A	

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (veh/h)	266	551	79	129	634	59	58	530	431	78	432	82
Future Volume (veh/h)	266	551	79	129	634	59	58	530	431	78	432	82
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	289	599	0	140	689	0	63	576	0	85	470	89
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	600	1261		482	962		175	678		180	605	114
Arrive On Green	0.34	0.34	0.00	0.27	0.27	0.00	0.04	0.19	0.00	0.05	0.20	0.20
Sat Flow, veh/h	1781	3741	0	1781	3647	0	1781	3554	1585	1781	2984	562
Grp Volume(v), veh/h	289	599	0	140	689	0	63	576	0	85	279	280
Grp Sat Flow(s),veh/h/ln	1781	1870	0	1781	1777	0	1781	1777	1585	1781	1777	1769
Q Serve(g_s), s	15.4	15.2	0.0	7.5	21.0	0.0	3.4	18.8	0.0	4.6	17.8	18.0
Cycle Q Clear(g_c), s	15.4	15.2	0.0	7.5	21.0	0.0	3.4	18.8	0.0	4.6	17.8	18.0
Prop In Lane	1.00		0.00	1.00		0.00	1.00		1.00	1.00		0.32
Lane Grp Cap(c), veh/h	600	1261		482	962		175	678		180	360	359
V/C Ratio(X)	0.48	0.48		0.29	0.72		0.36	0.85		0.47	0.77	0.78
Avail Cap(c_a), veh/h	600	1261		482	962		197	814		185	412	410
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	31.5	31.4	0.0	34.6	39.6	0.0	38.1	46.9	0.0	37.8	45.2	45.3
Incr Delay (d2), s/veh	2.8	1.3	0.0	1.5	4.6	0.0	1.2	7.3	0.0	1.9	7.8	8.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.1	7.1	0.0	3.5	9.8	0.0	1.5	9.0	0.0	2.1	8.6	8.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	34.2	32.7	0.0	36.1	44.1	0.0	39.3	54.2	0.0	39.7	53.1	53.7
LnGrp LOS	C	C		D	D		D	D		D	D	D
Approach Vol, veh/h		888			829			639			644	
Approach Delay, s/veh		33.2			42.8			52.8			51.6	
Approach LOS		C			D			D			D	

Timer - Assigned Phs		2	3	4		6	7	8				
Phs Duration (G+Y+Rc), s		44.9	10.7	27.4		37.0	9.2	28.8				
Change Period (Y+Rc), s		4.5	4.5	4.5		4.5	4.5	4.5				
Max Green Setting (Gmax), s		35.5	6.5	27.5		32.5	6.2	27.8				
Max Q Clear Time (g_c+I1), s		17.4	6.6	20.8		23.0	5.4	20.0				
Green Ext Time (p_c), s		4.8	0.0	2.1		3.5	0.0	2.1				

Intersection Summary		
HCM 6th Ctrl Delay		44.0
HCM 6th LOS		D

Notes

User approved volume balancing among the lanes for turning movement.

Unsignalized Delay for [NBR, SER, SBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	1.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	4	6	11	10	5	27	12	297	24	17	334	12
Future Vol, veh/h	4	6	11	10	5	27	12	297	24	17	334	12
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	4	7	12	11	5	29	13	323	26	18	363	13

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	785	781	370	777	774	336	376	0	0	349	0	0
Stage 1	406	406	-	362	362	-	-	-	-	-	-	-
Stage 2	379	375	-	415	412	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	310	326	676	314	329	706	1182	-	-	1210	-	-
Stage 1	622	598	-	657	625	-	-	-	-	-	-	-
Stage 2	643	617	-	615	594	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	286	315	676	296	318	706	1182	-	-	1210	-	-
Mov Cap-2 Maneuver	286	315	-	296	318	-	-	-	-	-	-	-
Stage 1	613	587	-	648	616	-	-	-	-	-	-	-
Stage 2	602	608	-	586	583	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	13.9	13.3	0.3	0.4
HCM LOS	B	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1182	-	-	426	479	1210	-	-
HCM Lane V/C Ratio	0.011	-	-	0.054	0.095	0.015	-	-
HCM Control Delay (s)	8.1	0	-	13.9	13.3	8	0	-
HCM Lane LOS	A	A	-	B	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.2	0.3	0	-	-

Intersection	
Int Delay, s/veh	4.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	17	2	8	1	1	11	7	15	1	5	23	3
Future Vol, veh/h	17	2	8	1	1	11	7	15	1	5	23	3
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	18	2	9	1	1	12	8	16	1	5	25	3

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	76	70	27	75	71	17	28	0	0	17	0	0
Stage 1	37	37	-	33	33	-	-	-	-	-	-	-
Stage 2	39	33	-	42	38	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	914	821	1048	915	819	1062	1585	-	-	1600	-	-
Stage 1	978	864	-	983	868	-	-	-	-	-	-	-
Stage 2	976	868	-	972	863	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	898	814	1048	900	812	1062	1585	-	-	1600	-	-
Mov Cap-2 Maneuver	898	814	-	900	812	-	-	-	-	-	-	-
Stage 1	973	861	-	978	864	-	-	-	-	-	-	-
Stage 2	959	864	-	959	860	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	9	8.6	2.2	1.2
HCM LOS	A	A		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1585	-	-	930	1024	1600	-	-
HCM Lane V/C Ratio	0.005	-	-	0.032	0.014	0.003	-	-
HCM Control Delay (s)	7.3	0	-	9	8.6	7.3	0	-
HCM Lane LOS	A	A	-	A	A	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.1	0	0	-	-

Intersection	
Int Delay, s/veh	1.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	29	988	8	24	688	8	5	2	37	4	1	66
Future Vol, veh/h	29	988	8	24	688	8	5	2	37	4	1	66
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	300	-	-	300	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	32	1074	9	26	748	9	5	2	40	4	1	72

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	757	0	0	1083	0	0	1570	1952	542	1407	1952	379
Stage 1	-	-	-	-	-	-	1143	1143	-	805	805	-
Stage 2	-	-	-	-	-	-	427	809	-	602	1147	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	850	-	-	640	-	-	75	63	485	99	63	619
Stage 1	-	-	-	-	-	-	213	273	-	342	393	-
Stage 2	-	-	-	-	-	-	576	392	-	453	272	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	850	-	-	640	-	-	61	58	485	83	58	619
Mov Cap-2 Maneuver	-	-	-	-	-	-	61	58	-	83	58	-
Stage 1	-	-	-	-	-	-	205	263	-	329	377	-
Stage 2	-	-	-	-	-	-	487	376	-	396	262	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	0.4	24.9	15.7
HCM LOS			C	C

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	228	850	-	-	640	-	-	413
HCM Lane V/C Ratio	0.21	0.037	-	-	0.041	-	-	0.187
HCM Control Delay (s)	24.9	9.4	-	-	10.9	-	-	15.7
HCM Lane LOS	C	A	-	-	B	-	-	C
HCM 95th %tile Q(veh)	0.8	0.1	-	-	0.1	-	-	0.7

Intersection	
Int Delay, s/veh	1.2

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	0	959	10	15	806	0	13	1	22	1	1	1
Future Vol, veh/h	0	959	10	15	806	0	13	1	22	1	1	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	300	-	-	300	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	83	83	83	83	83	83	83	83	83	83	83	83
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	1155	12	18	971	0	16	1	27	1	1	1

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	971	0	0	1167	0	0	1683	2168	584	1585	2174	486
Stage 1	-	-	-	-	-	-	1161	1161	-	1007	1007	-
Stage 2	-	-	-	-	-	-	522	1007	-	578	1167	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	706	-	-	594	-	-	61	46	455	73	46	527
Stage 1	-	-	-	-	-	-	208	268	-	258	317	-
Stage 2	-	-	-	-	-	-	506	317	-	468	266	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	706	-	-	594	-	-	58	45	455	66	45	527
Mov Cap-2 Maneuver	-	-	-	-	-	-	58	45	-	66	45	-
Stage 1	-	-	-	-	-	-	208	268	-	258	307	-
Stage 2	-	-	-	-	-	-	488	307	-	439	266	-

Approach	SE	NW	NE	SW
HCM Control Delay, s	0	0.2	50	54.7
HCM LOS			F	F

Minor Lane/Major Mvmt	NELn1	NWL	NWT	NWR	SEL	SET	SER	SWLn1
Capacity (veh/h)	122	594	-	-	706	-	-	76
HCM Lane V/C Ratio	0.356	0.03	-	-	-	-	-	0.048
HCM Control Delay (s)	50	11.3	-	-	0	-	-	54.7
HCM Lane LOS	F	B	-	-	A	-	-	F
HCM 95th %tile Q(veh)	1.4	0.1	-	-	0	-	-	0.1

Intersection	
Int Delay, s/veh	2.9

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	0	875	16	56	1030	26	21	2	0	1	0	53
Future Vol, veh/h	0	875	16	56	1030	26	21	2	0	1	0	53
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	125	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	88	88	88	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	994	18	64	1170	30	24	2	0	1	0	60

Major/Minor	Major1			Major2			Minor2			Minor1		
Conflicting Flow All	1200	0	0	1012	0	0	1810	2325	600	1717	2331	506
Stage 1	-	-	-	-	-	-	1313	1313	-	1003	1003	-
Stage 2	-	-	-	-	-	-	497	1012	-	714	1328	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	577	-	-	681	-	-	49	37	444	58	36	512
Stage 1	-	-	-	-	-	-	167	226	-	259	318	-
Stage 2	-	-	-	-	-	-	523	315	-	388	223	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	577	-	-	681	-	-	40	34	444	51	33	512
Mov Cap-2 Maneuver	-	-	-	-	-	-	40	34	-	51	33	-
Stage 1	-	-	-	-	-	-	167	205	-	259	318	-
Stage 2	-	-	-	-	-	-	461	315	-	348	202	-

Approach	NB	SB	NE	SW
HCM Control Delay, s	0	0.5	205.7	14.5
HCM LOS			F	B

Minor Lane/Major Mvmt	NELn1	NBL	NBT	NBR	SBL	SBT	SBR	SWLn1
Capacity (veh/h)	39	577	-	-	681	-	-	439
HCM Lane V/C Ratio	0.67	-	-	-	0.093	-	-	0.14
HCM Control Delay (s)	205.7	0	-	-	10.8	-	-	14.5
HCM Lane LOS	F	A	-	-	B	-	-	B
HCM 95th %tile Q(veh)	2.4	0	-	-	0.3	-	-	0.5

Intersection	
Int Delay, s/veh	0.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	13	13	888	1033	0
Future Vol, veh/h	0	13	13	888	1033	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Yield	-	None	-	None
Storage Length	-	-	125	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	86	86	86	86	86	86
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	15	15	1033	1201	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	601	1201	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	4.14	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	2.22	-	-	-
Pot Cap-1 Maneuver	0	443	577	-	-	-
Stage 1	0	-	-	-	-	-
Stage 2	0	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	443	577	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	13.4	0.2	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	577	-	443	-	-
HCM Lane V/C Ratio	0.026	-	0.034	-	-
HCM Control Delay (s)	11.4	-	13.4	-	-
HCM Lane LOS	B	-	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.1	-	-

Intersection	
Int Delay, s/veh	5.5

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	5	483	31	14	358	4	83	1	43	8	4	6
Future Vol, veh/h	5	483	31	14	358	4	83	1	43	8	4	6
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	250	-	250	250	-	250	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	84	84	84	84	84	84	84	84	84	84	84	84
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	6	575	37	17	426	5	99	1	51	10	5	7

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	431	0	0	612	0	0	1056	1052	575	1092	1084	426
Stage 1	-	-	-	-	-	-	587	587	-	460	460	-
Stage 2	-	-	-	-	-	-	469	465	-	632	624	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1129	-	-	967	-	-	203	227	518	192	217	628
Stage 1	-	-	-	-	-	-	496	497	-	581	566	-
Stage 2	-	-	-	-	-	-	575	563	-	468	478	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1129	-	-	967	-	-	194	222	518	169	212	628
Mov Cap-2 Maneuver	-	-	-	-	-	-	194	222	-	169	212	-
Stage 1	-	-	-	-	-	-	494	495	-	578	556	-
Stage 2	-	-	-	-	-	-	554	553	-	419	476	-

Approach	SE	NW	NE	SW
HCM Control Delay, s	0.1	0.3	40.5	21.6
HCM LOS			E	C

Minor Lane/Major Mvmt	NELn1	NWL	NWT	NWR	SEL	SET	SERSWLn1
Capacity (veh/h)	246	967	-	-	1129	-	- 238
HCM Lane V/C Ratio	0.615	0.017	-	-	0.005	-	- 0.09
HCM Control Delay (s)	40.5	8.8	-	-	8.2	-	- 21.6
HCM Lane LOS	E	A	-	-	A	-	- C
HCM 95th %tile Q(veh)	3.7	0.1	-	-	0	-	- 0.3

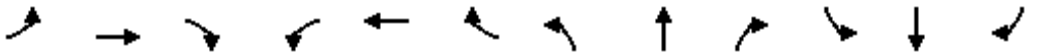
Intersection	
Int Delay, s/veh	2.6

Movement	NBL	NBR	SET	SER	NWL	NWT
Lane Configurations						
Traffic Vol, veh/h	35	85	528	70	69	337
Future Vol, veh/h	35	85	528	70	69	337
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	150	0	-	100	250	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	83	83	83	83	83	83
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	42	102	636	84	83	406

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1208	636	0	0	720	0
Stage 1	636	-	-	-	-	-
Stage 2	572	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	202	478	-	-	882	-
Stage 1	527	-	-	-	-	-
Stage 2	565	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	183	478	-	-	882	-
Mov Cap-2 Maneuver	183	-	-	-	-	-
Stage 1	527	-	-	-	-	-
Stage 2	512	-	-	-	-	-

Approach	NB	SE	NW
HCM Control Delay, s	19.2	0	1.6
HCM LOS	C		

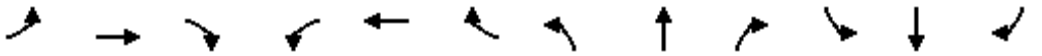
Minor Lane/Major Mvmt	NBLn1	NBLn2	NWL	NWT	SET	SER
Capacity (veh/h)	183	478	882	-	-	-
HCM Lane V/C Ratio	0.23	0.214	0.094	-	-	-
HCM Control Delay (s)	30.5	14.6	9.5	-	-	-
HCM Lane LOS	D	B	A	-	-	-
HCM 95th %tile Q(veh)	0.9	0.8	0.3	-	-	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	66	797	34	145	587	40	77	193	105	111	216	86
Future Volume (veh/h)	66	797	34	145	587	40	77	193	105	111	216	86
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	72	866	37	158	638	43	84	210	114	121	235	93
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	429	1563	67	369	1599	108	296	239	130	239	428	363
Arrive On Green	0.05	0.45	0.45	0.07	0.47	0.47	0.05	0.21	0.21	0.07	0.23	0.23
Sat Flow, veh/h	1781	3472	148	1781	3379	227	1781	1140	619	1781	1870	1585
Grp Volume(v), veh/h	72	443	460	158	335	346	84	0	324	121	235	93
Grp Sat Flow(s),veh/h/ln	1781	1777	1844	1781	1777	1829	1781	0	1759	1781	1870	1585
Q Serve(g_s), s	1.9	16.4	16.4	4.2	11.0	11.1	3.3	0.0	16.1	4.7	10.0	4.3
Cycle Q Clear(g_c), s	1.9	16.4	16.4	4.2	11.0	11.1	3.3	0.0	16.1	4.7	10.0	4.3
Prop In Lane	1.00		0.08	1.00		0.12	1.00		0.35	1.00		1.00
Lane Grp Cap(c), veh/h	429	800	830	369	841	866	296	0	368	239	428	363
V/C Ratio(X)	0.17	0.55	0.55	0.43	0.40	0.40	0.28	0.00	0.88	0.51	0.55	0.26
Avail Cap(c_a), veh/h	461	800	830	453	841	866	321	0	440	261	501	424
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	12.4	18.1	18.1	13.4	15.4	15.4	26.2	0.0	34.5	26.6	30.6	28.4
Incr Delay (d2), s/veh	0.2	2.8	2.7	0.8	1.4	1.4	0.5	0.0	16.2	1.6	1.1	0.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	7.0	7.3	1.7	4.6	4.7	1.4	0.0	8.4	2.1	4.5	1.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	12.6	20.9	20.8	14.2	16.8	16.8	26.7	0.0	50.7	28.3	31.7	28.8
LnGrp LOS	B	C	C	B	B	B	C	A	D	C	C	C
Approach Vol, veh/h		975			839			408			449	
Approach Delay, s/veh		20.2			16.3			45.8			30.2	
Approach LOS		C			B			D			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	10.7	45.0	9.2	25.1	8.7	47.1	10.9	23.3
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	10.5	31.5	5.9	24.1	5.8	36.2	7.5	22.5
Max Q Clear Time (g_c+I1), s	6.2	18.4	5.3	12.0	3.9	13.1	6.7	18.1
Green Ext Time (p_c), s	0.1	4.8	0.0	1.3	0.0	4.4	0.0	0.8

Intersection Summary	
HCM 6th Ctrl Delay	24.6
HCM 6th LOS	C



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	45	950	37	93	650	24	26	10	68	35	14	58
Future Volume (veh/h)	45	950	37	93	650	24	26	10	68	35	14	58
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	49	1033	40	101	707	26	28	11	0	38	15	63
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	571	2322	1036	440	2364	1054	45	18		79	31	97
Arrive On Green	0.04	0.65	0.65	0.05	0.67	0.67	0.03	0.03	0.00	0.06	0.06	0.06
Sat Flow, veh/h	1781	3554	1585	1781	3554	1585	1296	509	1585	1295	511	1585
Grp Volume(v), veh/h	49	1033	40	101	707	26	39	0	0	53	0	63
Grp Sat Flow(s),veh/h/ln	1781	1777	1585	1781	1777	1585	1806	0	1585	1806	0	1585
Q Serve(g_s), s	0.8	12.8	0.8	1.6	7.5	0.5	1.9	0.0	0.0	2.6	0.0	3.5
Cycle Q Clear(g_c), s	0.8	12.8	0.8	1.6	7.5	0.5	1.9	0.0	0.0	2.6	0.0	3.5
Prop In Lane	1.00		1.00	1.00		1.00	0.72		1.00	0.72		1.00
Lane Grp Cap(c), veh/h	571	2322	1036	440	2364	1054	62	0		110	0	97
V/C Ratio(X)	0.09	0.44	0.04	0.23	0.30	0.02	0.62	0.00		0.48	0.00	0.65
Avail Cap(c_a), veh/h	602	2322	1036	448	2364	1054	361	0		361	0	317
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	4.6	7.6	5.5	5.3	6.3	5.1	42.9	0.0	0.0	40.9	0.0	41.3
Incr Delay (d2), s/veh	0.1	0.6	0.1	0.3	0.3	0.0	9.8	0.0	0.0	3.2	0.0	7.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	4.4	0.3	0.5	2.5	0.2	1.0	0.0	0.0	1.2	0.0	1.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	4.7	8.2	5.6	5.6	6.6	5.2	52.6	0.0	0.0	44.1	0.0	48.6
LnGrp LOS	A	A	A	A	A	A	D	A		D	A	D
Approach Vol, veh/h		1122			834			39			116	
Approach Delay, s/veh		8.0			6.4			52.6			46.5	
Approach LOS		A			A			D			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	9.1	63.3		10.0	8.0	64.4		7.6				
Change Period (Y+Rc), s	4.5	4.5		4.5	4.5	4.5		4.5				
Max Green Setting (Gmax), s	5.0	31.0		18.0	5.1	30.9		18.0				
Max Q Clear Time (g_c+I1), s	3.6	14.8		5.5	2.8	9.5		3.9				
Green Ext Time (p_c), s	0.0	7.0		0.3	0.0	5.1		0.1				

Intersection Summary			
HCM 6th Ctrl Delay		10.3	
HCM 6th LOS		B	

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (veh/h)	272	551	79	129	634	59	58	545	451	78	437	82
Future Volume (veh/h)	272	551	79	129	634	59	58	545	451	78	437	82
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	296	599	0	140	689	0	63	592	0	85	475	89
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	594	1247		482	962		177	692		179	618	115
Arrive On Green	0.33	0.33	0.00	0.27	0.27	0.00	0.04	0.19	0.00	0.05	0.21	0.21
Sat Flow, veh/h	1781	3741	0	1781	3647	0	1781	3554	1585	1781	2990	557
Grp Volume(v), veh/h	296	599	0	140	689	0	63	592	0	85	281	283
Grp Sat Flow(s),veh/h/ln	1781	1870	0	1781	1777	0	1781	1777	1585	1781	1777	1770
Q Serve(g_s), s	15.9	15.3	0.0	7.5	21.0	0.0	3.4	19.3	0.0	4.5	17.9	18.1
Cycle Q Clear(g_c), s	15.9	15.3	0.0	7.5	21.0	0.0	3.4	19.3	0.0	4.5	17.9	18.1
Prop In Lane	1.00		0.00	1.00		0.00	1.00		1.00	1.00		0.31
Lane Grp Cap(c), veh/h	594	1247		482	962		177	692		179	367	366
V/C Ratio(X)	0.50	0.48		0.29	0.72		0.36	0.86		0.47	0.77	0.77
Avail Cap(c_a), veh/h	594	1247		482	962		199	814		184	412	410
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	32.0	31.8	0.0	34.6	39.6	0.0	37.8	46.7	0.0	37.6	44.9	45.0
Incr Delay (d2), s/veh	3.0	1.3	0.0	1.5	4.6	0.0	1.2	7.9	0.0	1.9	7.5	8.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.4	7.1	0.0	3.5	9.8	0.0	1.5	9.3	0.0	2.1	8.6	8.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	35.0	33.1	0.0	36.1	44.1	0.0	39.0	54.6	0.0	39.5	52.4	53.0
LnGrp LOS	C	C		D	D		D	D		D	D	D
Approach Vol, veh/h		895			829			655			649	
Approach Delay, s/veh		33.7			42.8			53.1			51.0	
Approach LOS		C			D			D			D	

Timer - Assigned Phs		2	3	4		6	7	8				
Phs Duration (G+Y+Rc), s		44.5	10.7	27.9		37.0	9.2	29.3				
Change Period (Y+Rc), s		4.5	4.5	4.5		4.5	4.5	4.5				
Max Green Setting (Gmax), s		35.5	6.5	27.5		32.5	6.2	27.8				
Max Q Clear Time (g_c+I1), s		17.9	6.5	21.3		23.0	5.4	20.1				
Green Ext Time (p_c), s		4.7	0.0	2.0		3.5	0.0	2.1				

Intersection Summary	
HCM 6th Ctrl Delay	44.1
HCM 6th LOS	D

Notes

User approved volume balancing among the lanes for turning movement.

Unsignalized Delay for [NBR, SER, SBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	1.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	4	6	11	10	5	27	12	297	24	17	334	12
Future Vol, veh/h	4	6	11	10	5	27	12	297	24	17	334	12
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	4	7	12	11	5	29	13	323	26	18	363	13

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	785	781	370	777	774	336	376	0	0	349	0	0
Stage 1	406	406	-	362	362	-	-	-	-	-	-	-
Stage 2	379	375	-	415	412	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	310	326	676	314	329	706	1182	-	-	1210	-	-
Stage 1	622	598	-	657	625	-	-	-	-	-	-	-
Stage 2	643	617	-	615	594	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	286	315	676	296	318	706	1182	-	-	1210	-	-
Mov Cap-2 Maneuver	286	315	-	296	318	-	-	-	-	-	-	-
Stage 1	613	587	-	648	616	-	-	-	-	-	-	-
Stage 2	602	608	-	586	583	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	13.9	13.3	0.3	0.4
HCM LOS	B	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1182	-	-	426	479	1210	-	-
HCM Lane V/C Ratio	0.011	-	-	0.054	0.095	0.015	-	-
HCM Control Delay (s)	8.1	0	-	13.9	13.3	8	0	-
HCM Lane LOS	A	A	-	B	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.2	0.3	0	-	-

Intersection	
Int Delay, s/veh	4.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	17	2	9	1	1	11	10	15	1	5	23	3
Future Vol, veh/h	17	2	9	1	1	11	10	15	1	5	23	3
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	18	2	10	1	1	12	11	16	1	5	25	3

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	82	76	27	82	77	17	28	0	0	17	0	0
Stage 1	37	37	-	39	39	-	-	-	-	-	-	-
Stage 2	45	39	-	43	38	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	905	814	1048	905	813	1062	1585	-	-	1600	-	-
Stage 1	978	864	-	976	862	-	-	-	-	-	-	-
Stage 2	969	862	-	971	863	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	887	806	1048	888	805	1062	1585	-	-	1600	-	-
Mov Cap-2 Maneuver	887	806	-	888	805	-	-	-	-	-	-	-
Stage 1	971	861	-	969	856	-	-	-	-	-	-	-
Stage 2	950	856	-	957	860	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	9	8.6	2.8	1.2
HCM LOS	A	A		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1585	-	-	926	1022	1600	-	-
HCM Lane V/C Ratio	0.007	-	-	0.033	0.014	0.003	-	-
HCM Control Delay (s)	7.3	0	-	9	8.6	7.3	0	-
HCM Lane LOS	A	A	-	A	A	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.1	0	0	-	-

Intersection	
Int Delay, s/veh	1.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	29	988	8	24	702	8	5	2	37	4	1	66
Future Vol, veh/h	29	988	8	24	702	8	5	2	37	4	1	66
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	300	-	-	300	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	32	1074	9	26	763	9	5	2	40	4	1	72

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	772	0	0	1083	0	0	1577	1967	542	1422	1967	386
Stage 1	-	-	-	-	-	-	1143	1143	-	820	820	-
Stage 2	-	-	-	-	-	-	434	824	-	602	1147	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	839	-	-	640	-	-	74	62	485	96	62	612
Stage 1	-	-	-	-	-	-	213	273	-	335	387	-
Stage 2	-	-	-	-	-	-	570	385	-	453	272	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	839	-	-	640	-	-	61	57	485	80	57	612
Mov Cap-2 Maneuver	-	-	-	-	-	-	61	57	-	80	57	-
Stage 1	-	-	-	-	-	-	205	263	-	322	371	-
Stage 2	-	-	-	-	-	-	481	369	-	396	262	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	0.4	24.9	16
HCM LOS			C	C

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	228	839	-	-	640	-	-	405
HCM Lane V/C Ratio	0.21	0.038	-	-	0.041	-	-	0.191
HCM Control Delay (s)	24.9	9.5	-	-	10.9	-	-	16
HCM Lane LOS	C	A	-	-	B	-	-	C
HCM 95th %tile Q(veh)	0.8	0.1	-	-	0.1	-	-	0.7

Intersection	
Int Delay, s/veh	1.2

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	0	994	10	15	817	0	13	1	22	1	1	1
Future Vol, veh/h	0	994	10	15	817	0	13	1	22	1	1	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	300	-	-	300	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	83	83	83	83	83	83	83	83	83	83	83	83
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	1198	12	18	984	0	16	1	27	1	1	1

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	984	0	0	1210	0	0	1733	2224	605	1620	2230	492
Stage 1	-	-	-	-	-	-	1204	1204	-	1020	1020	-
Stage 2	-	-	-	-	-	-	529	1020	-	600	1210	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	698	-	-	572	-	-	56	43	441	68	42	522
Stage 1	-	-	-	-	-	-	195	255	-	253	312	-
Stage 2	-	-	-	-	-	-	501	312	-	455	254	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	698	-	-	572	-	-	53	42	441	61	41	522
Mov Cap-2 Maneuver	-	-	-	-	-	-	53	42	-	61	41	-
Stage 1	-	-	-	-	-	-	195	255	-	253	302	-
Stage 2	-	-	-	-	-	-	482	302	-	426	254	-

Approach	SE	NW	NE	SW
HCM Control Delay, s	0	0.2	55.5	59.2
HCM LOS			F	F

Minor Lane/Major Mvmt	NELn1	NWL	NWT	NWR	SEL	SET	SER	SWLn1
Capacity (veh/h)	113	572	-	-	698	-	-	70
HCM Lane V/C Ratio	0.384	0.032	-	-	-	-	-	0.052
HCM Control Delay (s)	55.5	11.5	-	-	0	-	-	59.2
HCM Lane LOS	F	B	-	-	A	-	-	F
HCM 95th %tile Q(veh)	1.6	0.1	-	-	0	-	-	0.2

Intersection	
Int Delay, s/veh	3.1

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	0	881	16	56	1050	26	21	2	0	1	0	53
Future Vol, veh/h	0	881	16	56	1050	26	21	2	0	1	0	53
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	125	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	88	88	88	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	1001	18	64	1193	30	24	2	0	1	0	60

Major/Minor	Major1			Major2			Minor2			Minor1		
Conflicting Flow All	1223	0	0	1019	0	0	1837	2355	612	1736	2361	510
Stage 1	-	-	-	-	-	-	1336	1336	-	1010	1010	-
Stage 2	-	-	-	-	-	-	501	1019	-	726	1351	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	566	-	-	677	-	-	47	35	436	56	35	509
Stage 1	-	-	-	-	-	-	162	221	-	257	316	-
Stage 2	-	-	-	-	-	-	521	313	-	382	217	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	566	-	-	677	-	-	38	32	436	49	32	509
Mov Cap-2 Maneuver	-	-	-	-	-	-	38	32	-	49	32	-
Stage 1	-	-	-	-	-	-	162	200	-	257	316	-
Stage 2	-	-	-	-	-	-	459	313	-	342	196	-

Approach	NB	SB	NE	SW
HCM Control Delay, s	0	0.5	224.1	14.7
HCM LOS			F	B

Minor Lane/Major Mvmt	NELn1	NBL	NBT	NBR	SBL	SBT	SBR	SWLn1
Capacity (veh/h)	37	566	-	-	677	-	-	434
HCM Lane V/C Ratio	0.706	-	-	-	0.094	-	-	0.141
HCM Control Delay (s)	224.1	0	-	-	10.9	-	-	14.7
HCM Lane LOS	F	A	-	-	B	-	-	B
HCM 95th %tile Q(veh)	2.5	0	-	-	0.3	-	-	0.5

Intersection	
Int Delay, s/veh	0.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	13	13	894	1053	0
Future Vol, veh/h	0	13	13	894	1053	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Yield	-	None	-	None
Storage Length	-	-	125	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	86	86	86	86	86	86
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	15	15	1040	1224	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	612	1224	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	4.14	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	2.22	-	-	-
Pot Cap-1 Maneuver	0	436	565	-	-	-
Stage 1	0	-	-	-	-	-
Stage 2	0	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	436	565	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	13.6	0.2	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	565	-	436	-	-
HCM Lane V/C Ratio	0.027	-	0.035	-	-
HCM Control Delay (s)	11.5	-	13.6	-	-
HCM Lane LOS	B	-	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.1	-	-

Intersection	
Int Delay, s/veh	5.6

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	5	485	31	14	364	4	83	1	43	8	4	6
Future Vol, veh/h	5	485	31	14	364	4	83	1	43	8	4	6
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	250	-	250	250	-	250	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	84	84	84	84	84	84	84	84	84	84	84	84
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	6	577	37	17	433	5	99	1	51	10	5	7

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	438	0	0	614	0	0	1065	1061	577	1101	1093	433
Stage 1	-	-	-	-	-	-	589	589	-	467	467	-
Stage 2	-	-	-	-	-	-	476	472	-	634	626	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1122	-	-	965	-	-	200	224	516	189	214	623
Stage 1	-	-	-	-	-	-	494	495	-	576	562	-
Stage 2	-	-	-	-	-	-	570	559	-	467	477	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1122	-	-	965	-	-	191	219	516	167	209	623
Mov Cap-2 Maneuver	-	-	-	-	-	-	191	219	-	167	209	-
Stage 1	-	-	-	-	-	-	492	493	-	573	552	-
Stage 2	-	-	-	-	-	-	549	549	-	417	475	-

Approach	SE	NW	NE	SW
HCM Control Delay, s	0.1	0.3	41.5	21.9
HCM LOS			E	C

Minor Lane/Major Mvmt	NELn1	NWL	NWT	NWR	SEL	SET	SERSWLn1
Capacity (veh/h)	243	965	-	-	1122	-	- 235
HCM Lane V/C Ratio	0.622	0.017	-	-	0.005	-	- 0.091
HCM Control Delay (s)	41.5	8.8	-	-	8.2	-	- 21.9
HCM Lane LOS	E	A	-	-	A	-	- C
HCM 95th %tile Q(veh)	3.7	0.1	-	-	0	-	- 0.3

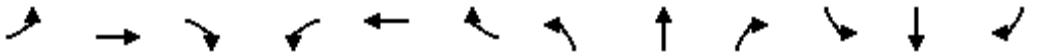
Intersection	
Int Delay, s/veh	2.8

Movement	NBL	NBR	SET	SER	NWL	NWT
Lane Configurations						
Traffic Vol, veh/h	41	85	528	72	69	337
Future Vol, veh/h	41	85	528	72	69	337
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	150	0	-	100	250	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	83	83	83	83	83	83
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	49	102	636	87	83	406

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1208	636	0	0	723	0
Stage 1	636	-	-	-	-	-
Stage 2	572	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	202	478	-	-	879	-
Stage 1	527	-	-	-	-	-
Stage 2	565	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	183	478	-	-	879	-
Mov Cap-2 Maneuver	183	-	-	-	-	-
Stage 1	527	-	-	-	-	-
Stage 2	512	-	-	-	-	-

Approach	NB	SE	NW
HCM Control Delay, s	20.2	0	1.6
HCM LOS	C		

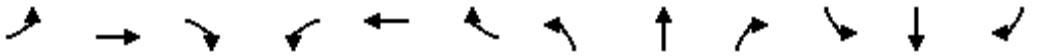
Minor Lane/Major Mvmt	NBLn1	NBLn2	NWL	NWT	SET	SER
Capacity (veh/h)	183	478	879	-	-	-
HCM Lane V/C Ratio	0.27	0.214	0.095	-	-	-
HCM Control Delay (s)	31.8	14.6	9.5	-	-	-
HCM Lane LOS	D	B	A	-	-	-
HCM 95th %tile Q(veh)	1	0.8	0.3	-	-	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	148	1105	43	126	1258	81	93	172	90	105	166	171
Future Volume (veh/h)	148	1105	43	126	1258	81	93	172	90	105	166	171
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	161	1201	47	137	1367	88	101	187	98	114	180	186
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	251	1741	68	289	1669	107	281	212	111	213	347	294
Arrive On Green	0.07	0.50	0.50	0.06	0.49	0.49	0.06	0.18	0.18	0.06	0.19	0.19
Sat Flow, veh/h	1781	3486	136	1781	3390	218	1781	1156	606	1781	1870	1585
Grp Volume(v), veh/h	161	612	636	137	715	740	101	0	285	114	180	186
Grp Sat Flow(s),veh/h/ln	1781	1777	1846	1781	1777	1831	1781	0	1761	1781	1870	1585
Q Serve(g_s), s	4.0	23.7	23.7	3.4	30.8	31.0	4.1	0.0	14.2	4.7	7.8	9.7
Cycle Q Clear(g_c), s	4.0	23.7	23.7	3.4	30.8	31.0	4.1	0.0	14.2	4.7	7.8	9.7
Prop In Lane	1.00		0.07	1.00		0.12	1.00		0.34	1.00		1.00
Lane Grp Cap(c), veh/h	251	887	922	289	874	901	281	0	323	213	347	294
V/C Ratio(X)	0.64	0.69	0.69	0.47	0.82	0.82	0.36	0.00	0.88	0.54	0.52	0.63
Avail Cap(c_a), veh/h	282	887	922	334	874	901	281	0	354	213	380	322
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	18.4	17.2	17.2	14.1	19.4	19.5	27.9	0.0	35.8	28.9	33.0	33.8
Incr Delay (d2), s/veh	4.1	4.4	4.2	1.2	8.4	8.3	0.8	0.0	20.8	2.6	1.2	3.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.8	10.1	10.4	1.3	13.8	14.3	1.8	0.0	7.8	2.1	3.6	4.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	22.4	21.6	21.4	15.3	27.8	27.8	28.7	0.0	56.7	31.5	34.2	37.3
LnGrp LOS	C	C	C	B	C	C	C	A	E	C	C	D
Approach Vol, veh/h		1409			1592			386			480	
Approach Delay, s/veh		21.6			26.7			49.3			34.8	
Approach LOS		C			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	9.8	49.4	9.6	21.2	10.4	48.8	9.8	21.0
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	7.5	41.1	5.1	18.3	7.5	41.1	5.3	18.1
Max Q Clear Time (g_c+I1), s	5.4	25.7	6.1	11.7	6.0	33.0	6.7	16.2
Green Ext Time (p_c), s	0.1	7.6	0.0	0.9	0.1	5.6	0.0	0.3

Intersection Summary	
HCM 6th Ctrl Delay	28.1
HCM 6th LOS	C



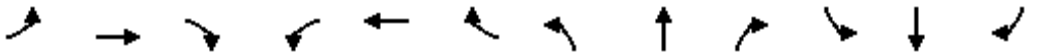
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	58	1122	1	2	1382	26	4	1	6	49	1	80
Future Volume (veh/h)	58	1122	1	2	1382	26	4	1	6	49	1	80
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	63	1220	1	2	1502	28	4	1	0	53	1	87
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	305	2535	1131	342	2388	1065	9	2		135	3	123
Arrive On Green	0.04	0.71	0.71	0.00	0.67	0.67	0.01	0.01	0.00	0.08	0.08	0.08
Sat Flow, veh/h	1781	3554	1585	1781	3554	1585	1439	360	1585	1750	33	1585
Grp Volume(v), veh/h	63	1220	1	2	1502	28	5	0	0	54	0	87
Grp Sat Flow(s),veh/h/ln	1781	1777	1585	1781	1777	1585	1798	0	1585	1783	0	1585
Q Serve(g_s), s	0.9	13.5	0.0	0.0	21.6	0.5	0.2	0.0	0.0	2.6	0.0	4.8
Cycle Q Clear(g_c), s	0.9	13.5	0.0	0.0	21.6	0.5	0.2	0.0	0.0	2.6	0.0	4.8
Prop In Lane	1.00		1.00	1.00		1.00	0.80		1.00	0.98		1.00
Lane Grp Cap(c), veh/h	305	2535	1131	342	2388	1065	12	0		138	0	123
V/C Ratio(X)	0.21	0.48	0.00	0.01	0.63	0.03	0.43	0.00		0.39	0.00	0.71
Avail Cap(c_a), veh/h	326	2535	1131	436	2388	1065	360	0		357	0	317
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	7.0	5.6	3.7	5.3	8.4	4.9	44.5	0.0	0.0	39.5	0.0	40.5
Incr Delay (d2), s/veh	0.3	0.7	0.0	0.0	1.3	0.0	22.6	0.0	0.0	1.8	0.0	7.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	4.2	0.0	0.0	7.3	0.2	0.2	0.0	0.0	1.2	0.0	2.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	7.3	6.3	3.7	5.3	9.7	5.0	67.1	0.0	0.0	41.3	0.0	47.8
LnGrp LOS	A	A	A	A	A	A	E	A		D	A	D
Approach Vol, veh/h		1284			1532			5			141	
Approach Delay, s/veh		6.3			9.6			67.1			45.3	
Approach LOS		A			A			E			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	4.7	68.7		11.5	8.5	65.0		5.1				
Change Period (Y+Rc), s	4.5	4.5		4.5	4.5	4.5		4.5				
Max Green Setting (Gmax), s	5.0	31.0		18.0	5.0	31.0		18.0				
Max Q Clear Time (g_c+I1), s	2.0	15.5		6.8	2.9	23.6		2.2				
Green Ext Time (p_c), s	0.0	8.0		0.4	0.0	5.5		0.0				

Intersection Summary	
HCM 6th Ctrl Delay	10.0
HCM 6th LOS	A

Notes

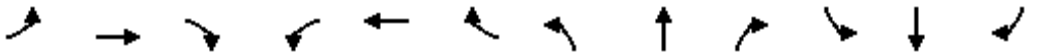
Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	149	1122	43	127	1300	82	94	174	91	106	168	173
Future Volume (veh/h)	149	1122	43	127	1300	82	94	174	91	106	168	173
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	162	1220	47	138	1413	89	102	189	99	115	183	188
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	241	1735	67	284	1665	105	281	214	112	213	350	296
Arrive On Green	0.07	0.50	0.50	0.06	0.49	0.49	0.06	0.18	0.18	0.06	0.19	0.19
Sat Flow, veh/h	1781	3489	134	1781	3396	213	1781	1156	605	1781	1870	1585
Grp Volume(v), veh/h	162	621	646	138	737	765	102	0	288	115	183	188
Grp Sat Flow(s),veh/h/ln	1781	1777	1846	1781	1777	1832	1781	0	1761	1781	1870	1585
Q Serve(g_s), s	4.0	24.3	24.3	3.4	32.5	32.9	4.1	0.0	14.3	4.7	7.9	9.8
Cycle Q Clear(g_c), s	4.0	24.3	24.3	3.4	32.5	32.9	4.1	0.0	14.3	4.7	7.9	9.8
Prop In Lane	1.00		0.07	1.00		0.12	1.00		0.34	1.00		1.00
Lane Grp Cap(c), veh/h	241	884	918	284	871	898	281	0	326	213	350	296
V/C Ratio(X)	0.67	0.70	0.70	0.49	0.85	0.85	0.36	0.00	0.88	0.54	0.52	0.63
Avail Cap(c_a), veh/h	272	884	918	328	871	898	281	0	354	213	380	322
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.0	17.5	17.5	14.5	20.0	20.1	27.8	0.0	35.7	28.8	33.0	33.7
Incr Delay (d2), s/veh	5.4	4.6	4.5	1.3	10.0	10.0	0.8	0.0	21.3	2.8	1.2	3.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.9	10.4	10.8	1.4	14.8	15.4	1.8	0.0	7.9	2.1	3.7	4.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	24.4	22.1	22.0	15.8	29.9	30.1	28.6	0.0	57.0	31.5	34.2	37.3
LnGrp LOS	C	C	C	B	C	C	C	A	E	C	C	D
Approach Vol, veh/h		1429			1640			390			486	
Approach Delay, s/veh		22.3			28.8			49.6			34.8	
Approach LOS		C			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	9.8	49.3	9.6	21.3	10.5	48.6	9.8	21.1
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	7.5	41.1	5.1	18.3	7.5	41.1	5.3	18.1
Max Q Clear Time (g_c+I1), s	5.4	26.3	6.1	11.8	6.0	34.9	6.7	16.3
Green Ext Time (p_c), s	0.1	7.5	0.0	0.9	0.1	4.6	0.0	0.3

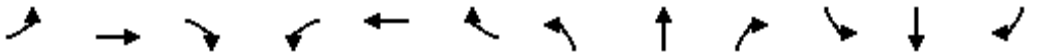
Intersection Summary	
HCM 6th Ctrl Delay	29.3
HCM 6th LOS	C



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	149	1134	43	127	1307	82	94	174	91	106	168	173
Future Volume (veh/h)	149	1134	43	127	1307	82	94	174	91	106	168	173
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	162	1233	47	138	1421	89	102	189	99	115	183	188
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	240	1736	66	281	1665	104	281	214	112	213	350	296
Arrive On Green	0.07	0.50	0.50	0.06	0.49	0.49	0.06	0.18	0.18	0.06	0.19	0.19
Sat Flow, veh/h	1781	3490	133	1781	3397	212	1781	1156	605	1781	1870	1585
Grp Volume(v), veh/h	162	627	653	138	741	769	102	0	288	115	183	188
Grp Sat Flow(s),veh/h/ln	1781	1777	1846	1781	1777	1832	1781	0	1761	1781	1870	1585
Q Serve(g_s), s	4.0	24.7	24.7	3.4	32.8	33.2	4.1	0.0	14.3	4.7	7.9	9.8
Cycle Q Clear(g_c), s	4.0	24.7	24.7	3.4	32.8	33.2	4.1	0.0	14.3	4.7	7.9	9.8
Prop In Lane	1.00		0.07	1.00		0.12	1.00		0.34	1.00		1.00
Lane Grp Cap(c), veh/h	240	884	918	281	871	898	281	0	326	213	350	296
V/C Ratio(X)	0.68	0.71	0.71	0.49	0.85	0.86	0.36	0.00	0.88	0.54	0.52	0.63
Avail Cap(c_a), veh/h	271	884	918	325	871	898	281	0	354	213	380	322
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.1	17.6	17.6	14.7	20.1	20.2	27.8	0.0	35.7	28.8	33.0	33.7
Incr Delay (d2), s/veh	5.6	4.8	4.6	1.3	10.2	10.3	0.8	0.0	21.3	2.8	1.2	3.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.9	10.6	11.0	1.4	15.0	15.6	1.8	0.0	7.9	2.1	3.7	4.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	24.7	22.4	22.2	16.0	30.3	30.4	28.6	0.0	57.0	31.5	34.2	37.3
LnGrp LOS	C	C	C	B	C	C	C	A	E	C	C	D
Approach Vol, veh/h		1442			1648			390			486	
Approach Delay, s/veh		22.6			29.2			49.6			34.8	
Approach LOS		C			C			D			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	9.8	49.3	9.6	21.3	10.5	48.6	9.8	21.1
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	7.5	41.1	5.1	18.3	7.5	41.1	5.3	18.1
Max Q Clear Time (g_c+I1), s	5.4	26.7	6.1	11.8	6.0	35.2	6.7	16.3
Green Ext Time (p_c), s	0.1	7.5	0.0	0.9	0.1	4.4	0.0	0.3

Intersection Summary	
HCM 6th Ctrl Delay	29.5
HCM 6th LOS	C



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	59	1133	18	45	1396	26	40	13	94	49	6	81
Future Volume (veh/h)	59	1133	18	45	1396	26	40	13	94	49	6	81
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	64	1232	20	49	1517	28	43	14	0	53	7	88
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	281	2274	1014	349	2256	1006	57	19		124	16	125
Arrive On Green	0.04	0.64	0.64	0.04	0.63	0.63	0.04	0.04	0.00	0.08	0.08	0.08
Sat Flow, veh/h	1781	3554	1585	1781	3554	1585	1360	443	1585	1582	209	1585
Grp Volume(v), veh/h	64	1232	20	49	1517	28	57	0	0	60	0	88
Grp Sat Flow(s),veh/h/ln	1781	1777	1585	1781	1777	1585	1802	0	1585	1791	0	1585
Q Serve(g_s), s	1.1	17.2	0.4	0.8	24.5	0.6	2.8	0.0	0.0	2.9	0.0	4.9
Cycle Q Clear(g_c), s	1.1	17.2	0.4	0.8	24.5	0.6	2.8	0.0	0.0	2.9	0.0	4.9
Prop In Lane	1.00		1.00	1.00		1.00	0.75		1.00	0.88		1.00
Lane Grp Cap(c), veh/h	281	2274	1014	349	2256	1006	76	0		141	0	125
V/C Ratio(X)	0.23	0.54	0.02	0.14	0.67	0.03	0.75	0.00		0.43	0.00	0.71
Avail Cap(c_a), veh/h	301	2274	1014	378	2256	1006	360	0		358	0	317
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	8.9	8.9	5.9	6.7	10.5	6.1	42.6	0.0	0.0	39.5	0.0	40.4
Incr Delay (d2), s/veh	0.4	0.9	0.0	0.2	1.6	0.1	13.6	0.0	0.0	2.0	0.0	7.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	6.1	0.1	0.3	8.8	0.2	1.5	0.0	0.0	1.3	0.0	2.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	9.3	9.9	5.9	6.8	12.1	6.2	56.3	0.0	0.0	41.6	0.0	47.6
LnGrp LOS	A	A	A	A	B	A	E	A		D	A	D
Approach Vol, veh/h		1316			1594			57			148	
Approach Delay, s/veh		9.8			11.8			56.3			45.1	
Approach LOS		A			B			E			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.0	62.1		11.6	8.5	61.6		8.3				
Change Period (Y+Rc), s	4.5	4.5		4.5	4.5	4.5		4.5				
Max Green Setting (Gmax), s	5.0	31.0		18.0	5.0	31.0		18.0				
Max Q Clear Time (g_c+I1), s	2.8	19.2		6.9	3.1	26.5		4.8				
Green Ext Time (p_c), s	0.0	6.8		0.4	0.0	3.6		0.2				

Intersection Summary		
HCM 6th Ctrl Delay	13.4	
HCM 6th LOS	B	

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (veh/h)	556	602	94	67	487	149	135	619	523	88	741	117
Future Volume (veh/h)	556	602	94	67	487	149	135	619	523	88	741	117
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	453	865	0	73	529	0	147	673	0	96	805	127
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	557	1169		358	714		185	1008		243	833	131
Arrive On Green	0.31	0.31	0.00	0.20	0.20	0.00	0.07	0.28	0.00	0.05	0.27	0.27
Sat Flow, veh/h	1781	3741	0	1781	3647	0	1781	3554	1585	1781	3075	485
Grp Volume(v), veh/h	453	865	0	73	529	0	147	673	0	96	465	467
Grp Sat Flow(s),veh/h/ln	1781	1870	0	1781	1777	0	1781	1777	1585	1781	1777	1783
Q Serve(g_s), s	28.1	24.8	0.0	4.1	16.8	0.0	7.2	20.1	0.0	4.6	31.0	31.0
Cycle Q Clear(g_c), s	28.1	24.8	0.0	4.1	16.8	0.0	7.2	20.1	0.0	4.6	31.0	31.0
Prop In Lane	1.00		0.00	1.00		0.00	1.00		1.00	1.00		0.27
Lane Grp Cap(c), veh/h	557	1169		358	714		185	1008		243	481	483
V/C Ratio(X)	0.81	0.74		0.20	0.74		0.80	0.67		0.39	0.97	0.97
Avail Cap(c_a), veh/h	557	1169		358	714		185	1008		251	481	483
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	38.0	36.9	0.0	40.0	45.0	0.0	33.1	38.0	0.0	30.6	43.2	43.2
Incr Delay (d2), s/veh	12.3	4.2	0.0	1.3	6.8	0.0	21.1	1.7	0.0	1.0	32.5	32.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	14.1	11.9	0.0	1.9	8.1	0.0	4.2	8.9	0.0	2.1	17.8	17.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	50.4	41.1	0.0	41.2	51.8	0.0	54.2	39.7	0.0	31.7	75.7	75.6
LnGrp LOS	D	D		D	D		D	D		C	E	E
Approach Vol, veh/h		1318			602			820			1028	
Approach Delay, s/veh		44.3			50.6			42.3			71.6	
Approach LOS		D			D			D			E	

Timer - Assigned Phs		2	3	4		6	7	8				
Phs Duration (G+Y+Rc), s		42.0	10.9	38.5		28.6	12.4	37.0				
Change Period (Y+Rc), s		4.5	4.5	4.5		4.5	4.5	4.5				
Max Green Setting (Gmax), s		37.5	6.9	33.5		24.1	7.9	32.5				
Max Q Clear Time (g_c+I1), s		30.1	6.6	22.1		18.8	9.2	33.0				
Green Ext Time (p_c), s		4.2	0.0	3.5		1.7	0.0	0.0				

Intersection Summary	
HCM 6th Ctrl Delay	52.3
HCM 6th LOS	D

Notes

User approved volume balancing among the lanes for turning movement.

Unsignalized Delay for [NBR, SER, SBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	2.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	6	3	12	34	6	53	5	249	17	19	276	17
Future Vol, veh/h	6	3	12	34	6	53	5	249	17	19	276	17
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	7	3	13	37	7	58	5	271	18	21	300	18

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	674	650	309	649	650	280	318	0	0	289	0	0
Stage 1	351	351	-	290	290	-	-	-	-	-	-	-
Stage 2	323	299	-	359	360	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	368	388	731	383	388	759	1242	-	-	1273	-	-
Stage 1	666	632	-	718	672	-	-	-	-	-	-	-
Stage 2	689	666	-	659	626	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	329	378	731	367	378	759	1242	-	-	1273	-	-
Mov Cap-2 Maneuver	329	378	-	367	378	-	-	-	-	-	-	-
Stage 1	663	619	-	714	669	-	-	-	-	-	-	-
Stage 2	627	663	-	631	613	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	12.7	13.6	0.1	0.5
HCM LOS	B	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1242	-	-	493	521	1273	-	-
HCM Lane V/C Ratio	0.004	-	-	0.046	0.194	0.016	-	-
HCM Control Delay (s)	7.9	0	-	12.7	13.6	7.9	0	-
HCM Lane LOS	A	A	-	B	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.1	0.7	0	-	-

Intersection	
Int Delay, s/veh	5.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	20	1	12	1	3	6	11	10	1	6	8	14
Future Vol, veh/h	20	1	12	1	3	6	11	10	1	6	8	14
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	22	1	13	1	3	7	12	11	1	7	9	15

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	72	67	17	74	74	12	24	0	0	12	0	0
Stage 1	31	31	-	36	36	-	-	-	-	-	-	-
Stage 2	41	36	-	38	38	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	919	824	1062	916	816	1069	1591	-	-	1607	-	-
Stage 1	986	869	-	980	865	-	-	-	-	-	-	-
Stage 2	974	865	-	977	863	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	902	814	1062	896	806	1069	1591	-	-	1607	-	-
Mov Cap-2 Maneuver	902	814	-	896	806	-	-	-	-	-	-	-
Stage 1	978	866	-	972	858	-	-	-	-	-	-	-
Stage 2	957	858	-	960	860	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	8.9	8.8	3.6	1.6
HCM LOS	A	A		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1591	-	-	951	957	1607	-	-
HCM Lane V/C Ratio	0.008	-	-	0.038	0.011	0.004	-	-
HCM Control Delay (s)	7.3	0	-	8.9	8.8	7.2	0	-
HCM Lane LOS	A	A	-	A	A	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.1	0	0	-	-

Intersection	
Int Delay, s/veh	4.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	89	1179	7	22	1456	18	5	2	29	2	1	55
Future Vol, veh/h	89	1179	7	22	1456	18	5	2	29	2	1	55
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	300	-	-	300	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	97	1282	8	24	1583	20	5	2	32	2	1	60

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1603	0	0	1290	0	0	2320	3131	645	2477	3125	802
Stage 1	-	-	-	-	-	-	1480	1480	-	1641	1641	-
Stage 2	-	-	-	-	-	-	840	1651	-	836	1484	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	404	-	-	533	-	-	20	11	415	15	11	327
Stage 1	-	-	-	-	-	-	132	188	-	104	156	-
Stage 2	-	-	-	-	-	-	326	155	-	328	187	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	404	-	-	533	-	-	12	8	415	9	8	327
Mov Cap-2 Maneuver	-	-	-	-	-	-	12	8	-	9	8	-
Stage 1	-	-	-	-	-	-	100	143	-	79	149	-
Stage 2	-	-	-	-	-	-	253	148	-	227	142	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	1.2	0.2	201.8	71.2
HCM LOS			F	F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	49	404	-	-	533	-	-	113
HCM Lane V/C Ratio	0.799	0.239	-	-	0.045	-	-	0.558
HCM Control Delay (s)	201.8	16.7	-	-	12.1	-	-	71.2
HCM Lane LOS	F	C	-	-	B	-	-	F
HCM 95th %tile Q(veh)	3.3	0.9	-	-	0.1	-	-	2.7

Intersection	
Int Delay, s/veh	22.5

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	2	1202	36	26	1345	19	22	0	16	48	0	4
Future Vol, veh/h	2	1202	36	26	1345	19	22	0	16	48	0	4
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	300	-	-	300	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	91	91	91	91	91	91	91	91	91	91	91	91
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	2	1321	40	29	1478	21	24	0	18	53	0	4

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1499	0	0	1361	0	0	2142	2902	681	2212	2912	750
Stage 1	-	-	-	-	-	-	1345	1345	-	1547	1547	-
Stage 2	-	-	-	-	-	-	797	1557	-	665	1365	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	443	-	-	501	-	-	28	16	393	~ 24	15	354
Stage 1	-	-	-	-	-	-	160	218	-	119	174	-
Stage 2	-	-	-	-	-	-	346	172	-	416	214	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	443	-	-	501	-	-	26	15	393	~ 22	14	354
Mov Cap-2 Maneuver	-	-	-	-	-	-	26	15	-	~ 22	14	-
Stage 1	-	-	-	-	-	-	159	217	-	118	164	-
Stage 2	-	-	-	-	-	-	322	162	-	396	213	-

Approach	SE	NW	NE	SW
HCM Control Delay, s	0	0.2	273.6	$ 972.9
HCM LOS			F	F

Minor Lane/Major Mvmt	NELn1	NWL	NWT	NWR	SEL	SET	SER	SWLn1
Capacity (veh/h)	43	501	-	-	443	-	-	24
HCM Lane V/C Ratio	0.971	0.057	-	-	0.005	-	-	2.381
HCM Control Delay (s)	273.6	12.6	-	-	13.2	-	-	$ 972.9
HCM Lane LOS	F	B	-	-	B	-	-	F
HCM 95th %tile Q(veh)	3.9	0.2	-	-	0	-	-	7.1

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	3.1

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	1	1150	30	54	1002	46	19	1	4	2	1	83
Future Vol, veh/h	1	1150	30	54	1002	46	19	1	4	2	1	83
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	125	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	93	93	93	93	93	93	93	93	93	93	93	93
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	1	1237	32	58	1077	49	20	1	4	2	1	89

Major/Minor	Major1			Major2			Minor2			Minor1		
Conflicting Flow All	1126	0	0	1269	0	0	1839	2489	563	1910	2497	635
Stage 1	-	-	-	-	-	-	1218	1218	-	1255	1255	-
Stage 2	-	-	-	-	-	-	621	1271	-	655	1242	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	616	-	-	543	-	-	47	29	470	41	29	421
Stage 1	-	-	-	-	-	-	191	251	-	182	241	-
Stage 2	-	-	-	-	-	-	442	237	-	421	245	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	616	-	-	543	-	-	33	26	470	36	26	421
Mov Cap-2 Maneuver	-	-	-	-	-	-	33	26	-	36	26	-
Stage 1	-	-	-	-	-	-	190	224	-	181	240	-
Stage 2	-	-	-	-	-	-	345	236	-	371	219	-

Approach	NB	SB	NE	SW
HCM Control Delay, s	0	0.6	203.6	22.7
HCM LOS			F	C

Minor Lane/Major Mvmt	NELn1	NBL	NBT	NBR	SBL	SBT	SBR	SWLn1
Capacity (veh/h)	39	616	-	-	543	-	-	295
HCM Lane V/C Ratio	0.662	0.002	-	-	0.107	-	-	0.313
HCM Control Delay (s)	203.6	10.9	0	-	12.4	-	-	22.7
HCM Lane LOS	F	B	A	-	B	-	-	C
HCM 95th %tile Q(veh)	2.4	0	-	-	0.4	-	-	1.3

Intersection	
Int Delay, s/veh	0.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	22	30	1162	1009	0
Future Vol, veh/h	0	22	30	1162	1009	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Yield	-	None	-	None
Storage Length	-	-	125	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	23	31	1210	1051	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	526	1051	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	4.14	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	2.22	-	-	-
Pot Cap-1 Maneuver	0	496	658	-	-	-
Stage 1	0	-	-	-	-	-
Stage 2	0	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	496	658	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12.6	0.3	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	658	-	496	-	-
HCM Lane V/C Ratio	0.047	-	0.046	-	-
HCM Control Delay (s)	10.7	-	12.6	-	-
HCM Lane LOS	B	-	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.1	-	-

Intersection	
Int Delay, s/veh	2.3

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	3	348	64	26	421	5	57	4	22	3	4	4
Future Vol, veh/h	3	348	64	26	421	5	57	4	22	3	4	4
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	250	-	250	250	-	250	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	3	366	67	27	443	5	60	4	23	3	4	4

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	448	0	0	433	0	0	876	874	366	916	936	443
Stage 1	-	-	-	-	-	-	372	372	-	497	497	-
Stage 2	-	-	-	-	-	-	504	502	-	419	439	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1112	-	-	1127	-	-	269	288	679	253	265	615
Stage 1	-	-	-	-	-	-	648	619	-	555	545	-
Stage 2	-	-	-	-	-	-	550	542	-	612	578	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1112	-	-	1127	-	-	259	280	679	237	258	615
Mov Cap-2 Maneuver	-	-	-	-	-	-	259	280	-	237	258	-
Stage 1	-	-	-	-	-	-	646	617	-	553	532	-
Stage 2	-	-	-	-	-	-	529	529	-	586	576	-

Approach	SE	NW	NE	SW
HCM Control Delay, s	0.1	0.5	21	16.8
HCM LOS			C	C

Minor Lane/Major Mvmt	NELn1	NWL	NWT	NWR	SEL	SET	SERSWLn1
Capacity (veh/h)	311	1127	-	-	1112	-	- 317
HCM Lane V/C Ratio	0.281	0.024	-	-	0.003	-	- 0.037
HCM Control Delay (s)	21	8.3	-	-	8.2	-	- 16.8
HCM Lane LOS	C	A	-	-	A	-	- C
HCM 95th %tile Q(veh)	1.1	0.1	-	-	0	-	- 0.1

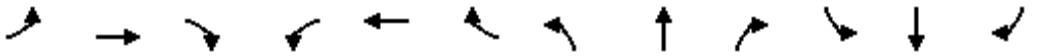
Intersection	
Int Delay, s/veh	2.6

Movement	NBL	NBR	SET	SER	NWL	NWT
Lane Configurations						
Traffic Vol, veh/h	64	58	346	30	65	490
Future Vol, veh/h	64	58	346	30	65	490
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	150	0	-	100	250	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	67	61	364	32	68	516

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1016	364	0	0	396	0
Stage 1	364	-	-	-	-	-
Stage 2	652	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	264	681	-	-	1163	-
Stage 1	703	-	-	-	-	-
Stage 2	518	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	249	681	-	-	1163	-
Mov Cap-2 Maneuver	249	-	-	-	-	-
Stage 1	703	-	-	-	-	-
Stage 2	488	-	-	-	-	-

Approach	NB	SE	NW
HCM Control Delay, s	18.1	0	1
HCM LOS	C		

Minor Lane/Major Mvmt	NBLn1	NBLn2	NWL	NWT	SET	SER
Capacity (veh/h)	249	681	1163	-	-	-
HCM Lane V/C Ratio	0.271	0.09	0.059	-	-	-
HCM Control Delay (s)	24.7	10.8	8.3	-	-	-
HCM Lane LOS	C	B	A	-	-	-
HCM 95th %tile Q(veh)	1.1	0.3	0.2	-	-	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	59	1133	6	16	1396	26	33	11	75	49	2	81
Future Volume (veh/h)	59	1133	6	16	1396	26	33	11	75	49	2	81
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	64	1232	7	17	1517	28	36	12	0	53	2	88
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	283	2359	1052	332	2270	1012	52	17		134	5	124
Arrive On Green	0.04	0.66	0.66	0.02	0.64	0.64	0.04	0.04	0.00	0.08	0.08	0.08
Sat Flow, veh/h	1781	3554	1585	1781	3554	1585	1352	451	1585	1719	65	1585
Grp Volume(v), veh/h	64	1232	7	17	1517	28	48	0	0	55	0	88
Grp Sat Flow(s),veh/h/ln	1781	1777	1585	1781	1777	1585	1803	0	1585	1784	0	1585
Q Serve(g_s), s	1.1	16.1	0.1	0.3	24.2	0.6	2.4	0.0	0.0	2.6	0.0	4.9
Cycle Q Clear(g_c), s	1.1	16.1	0.1	0.3	24.2	0.6	2.4	0.0	0.0	2.6	0.0	4.9
Prop In Lane	1.00		1.00	1.00		1.00	0.75		1.00	0.96		1.00
Lane Grp Cap(c), veh/h	283	2359	1052	332	2270	1012	70	0		139	0	124
V/C Ratio(X)	0.23	0.52	0.01	0.05	0.67	0.03	0.69	0.00		0.39	0.00	0.71
Avail Cap(c_a), veh/h	303	2359	1052	397	2270	1012	361	0		357	0	317
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	8.7	7.8	5.1	6.4	10.3	6.0	42.7	0.0	0.0	39.5	0.0	40.5
Incr Delay (d2), s/veh	0.4	0.8	0.0	0.1	1.6	0.1	11.2	0.0	0.0	1.8	0.0	7.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	5.5	0.0	0.1	8.7	0.2	1.3	0.0	0.0	1.2	0.0	2.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	9.1	8.6	5.1	6.5	11.8	6.0	53.9	0.0	0.0	41.3	0.0	47.8
LnGrp LOS	A	A	A	A	B	A	D	A		D	A	D
Approach Vol, veh/h		1303			1562			48			143	
Approach Delay, s/veh		8.6			11.7			53.9			45.3	
Approach LOS		A			B			D			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.2	64.2		11.5	8.5	62.0		8.0				
Change Period (Y+Rc), s	4.5	4.5		4.5	4.5	4.5		4.5				
Max Green Setting (Gmax), s	5.0	31.0		18.0	5.0	31.0		18.0				
Max Q Clear Time (g_c+I1), s	2.3	18.1		6.9	3.1	26.2		4.4				
Green Ext Time (p_c), s	0.0	7.2		0.4	0.0	3.8		0.1				

Intersection Summary			
HCM 6th Ctrl Delay		12.6	
HCM 6th LOS		B	

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (veh/h)	539	602	94	67	487	149	135	611	512	88	729	117
Future Volume (veh/h)	539	602	94	67	487	149	135	611	512	88	729	117
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	447	848	0	73	529	0	147	664	0	96	792	127
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	563	1181		358	714		186	1010		240	815	131
Arrive On Green	0.32	0.32	0.00	0.20	0.20	0.00	0.07	0.28	0.00	0.05	0.27	0.27
Sat Flow, veh/h	1781	3741	0	1781	3647	0	1781	3554	1585	1781	3067	492
Grp Volume(v), veh/h	447	848	0	73	529	0	147	664	0	96	459	460
Grp Sat Flow(s),veh/h/ln	1781	1870	0	1781	1777	0	1781	1777	1585	1781	1777	1782
Q Serve(g_s), s	27.5	24.1	0.0	4.1	16.8	0.0	7.2	19.7	0.0	4.7	30.7	30.7
Cycle Q Clear(g_c), s	27.5	24.1	0.0	4.1	16.8	0.0	7.2	19.7	0.0	4.7	30.7	30.7
Prop In Lane	1.00		0.00	1.00		0.00	1.00		1.00	1.00		0.28
Lane Grp Cap(c), veh/h	563	1181		358	714		186	1010		240	472	474
V/C Ratio(X)	0.79	0.72		0.20	0.74		0.79	0.66		0.40	0.97	0.97
Avail Cap(c_a), veh/h	563	1181		358	714		186	1010		240	472	474
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	37.5	36.3	0.0	40.0	45.0	0.0	33.3	37.8	0.0	31.2	43.6	43.6
Incr Delay (d2), s/veh	11.1	3.8	0.0	1.3	6.8	0.0	19.9	1.6	0.0	1.1	34.0	33.9
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	13.6	11.5	0.0	1.9	8.1	0.0	4.1	8.8	0.0	2.1	17.8	17.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	48.5	40.1	0.0	41.2	51.8	0.0	53.2	39.4	0.0	32.3	77.6	77.5
LnGrp LOS	D	D		D	D		D	D		C	E	E
Approach Vol, veh/h		1295			602			811			1015	
Approach Delay, s/veh		43.0			50.6			41.9			73.3	
Approach LOS		D			D			D			E	

Timer - Assigned Phs		2	3	4		6	7	8				
Phs Duration (G+Y+Rc), s		42.4	10.4	38.6		28.6	12.6	36.4				
Change Period (Y+Rc), s		4.5	4.5	4.5		4.5	4.5	4.5				
Max Green Setting (Gmax), s		37.9	5.9	34.1		24.1	8.1	31.9				
Max Q Clear Time (g_c+I1), s		29.5	6.7	21.7		18.8	9.2	32.7				
Green Ext Time (p_c), s		4.6	0.0	3.6		1.7	0.0	0.0				

Intersection Summary	
HCM 6th Ctrl Delay	52.2
HCM 6th LOS	D

Notes

User approved volume balancing among the lanes for turning movement.

Unsignalized Delay for [NBR, SER, SBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	2.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	6	3	12	34	6	53	5	249	17	19	276	17
Future Vol, veh/h	6	3	12	34	6	53	5	249	17	19	276	17
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	7	3	13	37	7	58	5	271	18	21	300	18

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	674	650	309	649	650	280	318	0	0	289	0	0
Stage 1	351	351	-	290	290	-	-	-	-	-	-	-
Stage 2	323	299	-	359	360	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	368	388	731	383	388	759	1242	-	-	1273	-	-
Stage 1	666	632	-	718	672	-	-	-	-	-	-	-
Stage 2	689	666	-	659	626	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	329	378	731	367	378	759	1242	-	-	1273	-	-
Mov Cap-2 Maneuver	329	378	-	367	378	-	-	-	-	-	-	-
Stage 1	663	619	-	714	669	-	-	-	-	-	-	-
Stage 2	627	663	-	631	613	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	12.7	13.6	0.1	0.5
HCM LOS	B	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1242	-	-	493	521	1273	-	-
HCM Lane V/C Ratio	0.004	-	-	0.046	0.194	0.016	-	-
HCM Control Delay (s)	7.9	0	-	12.7	13.6	7.9	0	-
HCM Lane LOS	A	A	-	B	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.1	0.7	0	-	-

Intersection	
Int Delay, s/veh	5.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	20	1	9	1	3	6	9	10	1	6	8	14
Future Vol, veh/h	20	1	9	1	3	6	9	10	1	6	8	14
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	22	1	10	1	3	7	10	11	1	7	9	15

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	68	63	17	68	70	12	24	0	0	12	0	0
Stage 1	31	31	-	32	32	-	-	-	-	-	-	-
Stage 2	37	32	-	36	38	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	925	828	1062	925	821	1069	1591	-	-	1607	-	-
Stage 1	986	869	-	984	868	-	-	-	-	-	-	-
Stage 2	978	868	-	980	863	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	909	820	1062	908	813	1069	1591	-	-	1607	-	-
Mov Cap-2 Maneuver	909	820	-	908	813	-	-	-	-	-	-	-
Stage 1	980	866	-	978	863	-	-	-	-	-	-	-
Stage 2	963	863	-	966	860	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	8.9	8.8	3.3	1.6
HCM LOS	A	A		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1591	-	-	946	961	1607	-	-
HCM Lane V/C Ratio	0.006	-	-	0.034	0.011	0.004	-	-
HCM Control Delay (s)	7.3	0	-	8.9	8.8	7.2	0	-
HCM Lane LOS	A	A	-	A	A	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.1	0	0	-	-

Intersection	
Int Delay, s/veh	4.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	89	1167	7	22	1449	18	5	2	29	2	1	55
Future Vol, veh/h	89	1167	7	22	1449	18	5	2	29	2	1	55
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	300	-	-	300	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	97	1268	8	24	1575	20	5	2	32	2	1	60

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1595	0	0	1276	0	0	2302	3109	638	2462	3103	798
Stage 1	-	-	-	-	-	-	1466	1466	-	1633	1633	-
Stage 2	-	-	-	-	-	-	836	1643	-	829	1470	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	407	-	-	540	-	-	21	11	419	16	11	329
Stage 1	-	-	-	-	-	-	134	191	-	105	158	-
Stage 2	-	-	-	-	-	-	328	156	-	331	190	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	407	-	-	540	-	-	12	8	419	9	8	329
Mov Cap-2 Maneuver	-	-	-	-	-	-	12	8	-	9	8	-
Stage 1	-	-	-	-	-	-	102	146	-	80	151	-
Stage 2	-	-	-	-	-	-	255	149	-	230	145	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	1.2	0.2	201.8	71.2
HCM LOS			F	F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	49	407	-	-	540	-	-	113
HCM Lane V/C Ratio	0.799	0.238	-	-	0.044	-	-	0.558
HCM Control Delay (s)	201.8	16.6	-	-	12	-	-	71.2
HCM Lane LOS	F	C	-	-	B	-	-	F
HCM 95th %tile Q(veh)	3.3	0.9	-	-	0.1	-	-	2.7

Intersection	
Int Delay, s/veh	20.8

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	2	1183	36	26	1316	19	22	0	16	48	0	4
Future Vol, veh/h	2	1183	36	26	1316	19	22	0	16	48	0	4
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	300	-	-	300	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	91	91	91	91	91	91	91	91	91	91	91	91
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	2	1300	40	29	1446	21	24	0	18	53	0	4

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1467	0	0	1340	0	0	2105	2849	670	2169	2859	734
Stage 1	-	-	-	-	-	-	1324	1324	-	1515	1515	-
Stage 2	-	-	-	-	-	-	781	1525	-	654	1344	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	456	-	-	510	-	-	29	17	399	~ 26	17	363
Stage 1	-	-	-	-	-	-	165	224	-	125	180	-
Stage 2	-	-	-	-	-	-	354	178	-	422	219	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	456	-	-	510	-	-	27	16	399	~ 24	16	363
Mov Cap-2 Maneuver	-	-	-	-	-	-	27	16	-	~ 24	16	-
Stage 1	-	-	-	-	-	-	164	223	-	125	170	-
Stage 2	-	-	-	-	-	-	330	168	-	402	218	-

Approach	SE	NW	NE	SW
HCM Control Delay, s	0	0.2	262.6	$ 870.8
HCM LOS			F	F

Minor Lane/Major Mvmt	NELn1	NWL	NWT	NWR	SEL	SET	SERSWLn1
Capacity (veh/h)	44	510	-	-	456	-	- 26
HCM Lane V/C Ratio	0.949	0.056	-	-	0.005	-	- 2.198
HCM Control Delay (s)	262.6	12.5	-	-	12.9	-	-$ 870.8
HCM Lane LOS	F	B	-	-	B	-	- F
HCM 95th %tile Q(veh)	3.8	0.2	-	-	0	-	- 7

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	3.1

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	1	1133	30	54	991	46	19	1	4	2	1	83
Future Vol, veh/h	1	1133	30	54	991	46	19	1	4	2	1	83
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	125	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	93	93	93	93	93	93	93	93	93	93	93	93
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	1	1218	32	58	1066	49	20	1	4	2	1	89

Major/Minor	Major1			Major2			Minor2			Minor1		
Conflicting Flow All	1115	0	0	1250	0	0	1819	2459	558	1886	2467	625
Stage 1	-	-	-	-	-	-	1207	1207	-	1236	1236	-
Stage 2	-	-	-	-	-	-	612	1252	-	650	1231	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	622	-	-	553	-	-	48	30	473	43	30	428
Stage 1	-	-	-	-	-	-	194	254	-	187	246	-
Stage 2	-	-	-	-	-	-	447	242	-	424	248	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	622	-	-	553	-	-	34	27	473	38	27	428
Mov Cap-2 Maneuver	-	-	-	-	-	-	34	27	-	38	27	-
Stage 1	-	-	-	-	-	-	193	227	-	186	245	-
Stage 2	-	-	-	-	-	-	350	241	-	374	222	-

Approach	NB	SB	NE	SW
HCM Control Delay, s	0	0.6	195.4	22
HCM LOS			F	C

Minor Lane/Major Mvmt	NELn1	NBL	NBT	NBR	SBL	SBT	SBR	SWLn1
Capacity (veh/h)	40	622	-	-	553	-	-	303
HCM Lane V/C Ratio	0.645	0.002	-	-	0.105	-	-	0.305
HCM Control Delay (s)	195.4	10.8	0	-	12.3	-	-	22
HCM Lane LOS	F	B	A	-	B	-	-	C
HCM 95th %tile Q(veh)	2.3	0	-	-	0.3	-	-	1.3

Intersection	
Int Delay, s/veh	0.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	22	30	1145	998	0
Future Vol, veh/h	0	22	30	1145	998	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Yield	-	None	-	None
Storage Length	-	-	125	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	23	31	1193	1040	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	520	1040	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	4.14	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	2.22	-	-	-
Pot Cap-1 Maneuver	0	501	664	-	-	-
Stage 1	0	-	-	-	-	-
Stage 2	0	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	501	664	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12.5	0.3	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	664	-	501	-	-
HCM Lane V/C Ratio	0.047	-	0.046	-	-
HCM Control Delay (s)	10.7	-	12.5	-	-
HCM Lane LOS	B	-	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.1	-	-

Intersection	
Int Delay, s/veh	2.3

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	3	344	64	26	419	5	57	4	22	3	4	4
Future Vol, veh/h	3	344	64	26	419	5	57	4	22	3	4	4
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	250	-	250	250	-	250	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	3	362	67	27	441	5	60	4	23	3	4	4

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	446	0	0	429	0	0	870	868	362	910	930	441
Stage 1	-	-	-	-	-	-	368	368	-	495	495	-
Stage 2	-	-	-	-	-	-	502	500	-	415	435	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1114	-	-	1130	-	-	272	290	683	255	267	616
Stage 1	-	-	-	-	-	-	652	621	-	556	546	-
Stage 2	-	-	-	-	-	-	552	543	-	615	580	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1114	-	-	1130	-	-	261	282	683	239	260	616
Mov Cap-2 Maneuver	-	-	-	-	-	-	261	282	-	239	260	-
Stage 1	-	-	-	-	-	-	650	619	-	554	533	-
Stage 2	-	-	-	-	-	-	531	530	-	589	578	-

Approach	SE	NW	NE	SW
HCM Control Delay, s	0.1	0.5	20.9	16.7
HCM LOS			C	C

Minor Lane/Major Mvmt	NELn1	NWL	NWT	NWR	SEL	SET	SERSWLn1
Capacity (veh/h)	313	1130	-	-	1114	-	- 319
HCM Lane V/C Ratio	0.279	0.024	-	-	0.003	-	- 0.036
HCM Control Delay (s)	20.9	8.3	-	-	8.2	-	- 16.7
HCM Lane LOS	C	A	-	-	A	-	- C
HCM 95th %tile Q(veh)	1.1	0.1	-	-	0	-	- 0.1

Intersection	
Int Delay, s/veh	2.6

Movement	NBL	NBR	SET	SER	NWL	NWT
Lane Configurations						
Traffic Vol, veh/h	62	58	346	26	65	490
Future Vol, veh/h	62	58	346	26	65	490
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	150	0	-	100	250	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	65	61	364	27	68	516

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1016	364	0	0	391	0
Stage 1	364	-	-	-	-	-
Stage 2	652	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	264	681	-	-	1168	-
Stage 1	703	-	-	-	-	-
Stage 2	518	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	249	681	-	-	1168	-
Mov Cap-2 Maneuver	249	-	-	-	-	-
Stage 1	703	-	-	-	-	-
Stage 2	488	-	-	-	-	-

Approach	NB	SE	NW
HCM Control Delay, s	17.9	0	1
HCM LOS	C		

Minor Lane/Major Mvmt	NBLn1	NBLn2	NWL	NWT	SET	SER
Capacity (veh/h)	249	681	1168	-	-	-
HCM Lane V/C Ratio	0.262	0.09	0.059	-	-	-
HCM Control Delay (s)	24.5	10.8	8.3	-	-	-
HCM Lane LOS	C	B	A	-	-	-
HCM 95th %tile Q(veh)	1	0.3	0.2	-	-	-

Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (veh/h)	526	596	93	66	482	148	134	576	467	87	716	116
Future Volume (veh/h)	526	596	93	66	482	148	134	576	467	87	716	116
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	440	832	0	72	524	0	146	626	0	95	778	126
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	574	1206		355	708		183	992		248	809	131
Arrive On Green	0.32	0.32	0.00	0.20	0.20	0.00	0.06	0.28	0.00	0.05	0.26	0.26
Sat Flow, veh/h	1781	3741	0	1781	3647	0	1781	3554	1585	1781	3062	496
Grp Volume(v), veh/h	440	832	0	72	524	0	146	626	0	95	451	453
Grp Sat Flow(s),veh/h/ln	1781	1870	0	1781	1777	0	1781	1777	1585	1781	1777	1781
Q Serve(g_s), s	26.7	23.3	0.0	4.0	16.6	0.0	7.2	18.5	0.0	4.6	30.1	30.1
Cycle Q Clear(g_c), s	26.7	23.3	0.0	4.0	16.6	0.0	7.2	18.5	0.0	4.6	30.1	30.1
Prop In Lane	1.00		0.00	1.00		0.00	1.00		1.00	1.00		0.28
Lane Grp Cap(c), veh/h	574	1206		355	708		183	992		248	469	471
V/C Ratio(X)	0.77	0.69		0.20	0.74		0.80	0.63		0.38	0.96	0.96
Avail Cap(c_a), veh/h	574	1206		355	708		183	992		248	469	471
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	36.6	35.4	0.0	40.1	45.1	0.0	33.6	37.8	0.0	31.2	43.6	43.6
Incr Delay (d2), s/veh	9.4	3.2	0.0	1.3	6.8	0.0	21.7	1.3	0.0	1.0	31.8	31.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	13.0	11.1	0.0	1.9	8.0	0.0	4.2	8.2	0.0	2.1	17.2	17.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	46.0	38.7	0.0	41.4	52.0	0.0	55.3	39.1	0.0	32.2	75.4	75.4
LnGrp LOS	D	D		D	D		E	D		C	E	E
Approach Vol, veh/h		1272			596			772			999	
Approach Delay, s/veh		41.2			50.7			42.2			71.3	
Approach LOS		D			D			D			E	

Timer - Assigned Phs		2	3	4		6	7	8				
Phs Duration (G+Y+Rc), s		43.2	10.4	38.0		28.4	12.2	36.2				
Change Period (Y+Rc), s		4.5	4.5	4.5		4.5	4.5	4.5				
Max Green Setting (Gmax), s		38.7	5.9	33.5		23.9	7.7	31.7				
Max Q Clear Time (g_c+I1), s		28.7	6.6	20.5		18.6	9.2	32.1				
Green Ext Time (p_c), s		5.1	0.0	3.5		1.7	0.0	0.0				

Intersection Summary	
HCM 6th Ctrl Delay	51.2
HCM 6th LOS	D

Notes

User approved volume balancing among the lanes for turning movement.

Unsignalized Delay for [NBR, SER, SBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	2.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	6	3	12	34	6	52	5	247	17	19	273	17
Future Vol, veh/h	6	3	12	34	6	52	5	247	17	19	273	17
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	7	3	13	37	7	57	5	268	18	21	297	18

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	667	644	306	643	644	277	315	0	0	286	0	0
Stage 1	348	348	-	287	287	-	-	-	-	-	-	-
Stage 2	319	296	-	356	357	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	372	391	734	386	391	762	1245	-	-	1276	-	-
Stage 1	668	634	-	720	674	-	-	-	-	-	-	-
Stage 2	693	668	-	661	628	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	333	381	734	369	381	762	1245	-	-	1276	-	-
Mov Cap-2 Maneuver	333	381	-	369	381	-	-	-	-	-	-	-
Stage 1	665	621	-	716	671	-	-	-	-	-	-	-
Stage 2	632	665	-	633	615	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	12.6	13.5	0.1	0.5
HCM LOS	B	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1245	-	-	497	522	1276	-	-
HCM Lane V/C Ratio	0.004	-	-	0.046	0.192	0.016	-	-
HCM Control Delay (s)	7.9	0	-	12.6	13.5	7.9	0	-
HCM Lane LOS	A	A	-	B	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.1	0.7	0	-	-

Intersection	
Int Delay, s/veh	5.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	20	1	8	1	3	6	4	10	1	6	8	14
Future Vol, veh/h	20	1	8	1	3	6	4	10	1	6	8	14
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	22	1	9	1	3	7	4	11	1	7	9	15

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	56	51	17	56	58	12	24	0	0	12	0	0
Stage 1	31	31	-	20	20	-	-	-	-	-	-	-
Stage 2	25	20	-	36	38	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	941	840	1062	941	833	1069	1591	-	-	1607	-	-
Stage 1	986	869	-	999	879	-	-	-	-	-	-	-
Stage 2	993	879	-	980	863	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	928	834	1062	928	827	1069	1591	-	-	1607	-	-
Mov Cap-2 Maneuver	928	834	-	928	827	-	-	-	-	-	-	-
Stage 1	983	866	-	996	876	-	-	-	-	-	-	-
Stage 2	980	876	-	967	860	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	8.9	8.8	1.9	1.6
HCM LOS	A	A		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1591	-	-	958	969	1607	-	-
HCM Lane V/C Ratio	0.003	-	-	0.033	0.011	0.004	-	-
HCM Control Delay (s)	7.3	0	-	8.9	8.8	7.2	0	-
HCM Lane LOS	A	A	-	A	A	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.1	0	0	-	-

Intersection	
Int Delay, s/veh	3.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	88	1149	7	22	1406	18	5	2	29	2	1	54
Future Vol, veh/h	88	1149	7	22	1406	18	5	2	29	2	1	54
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	300	-	-	300	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	96	1249	8	24	1528	20	5	2	32	2	1	59

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1548	0	0	1257	0	0	2258	3041	629	2404	3035	774
Stage 1	-	-	-	-	-	-	1445	1445	-	1586	1586	-
Stage 2	-	-	-	-	-	-	813	1596	-	818	1449	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	424	-	-	549	-	-	22	13	425	17	13	341
Stage 1	-	-	-	-	-	-	138	195	-	113	166	-
Stage 2	-	-	-	-	-	-	339	165	-	336	194	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	424	-	-	549	-	-	13	10	425	11	10	341
Mov Cap-2 Maneuver	-	-	-	-	-	-	13	10	-	11	10	-
Stage 1	-	-	-	-	-	-	107	151	-	87	159	-
Stage 2	-	-	-	-	-	-	267	158	-	237	150	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	1.1	0.2	164.2	56.3
HCM LOS			F	F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	55	424	-	-	549	-	-	129
HCM Lane V/C Ratio	0.711	0.226	-	-	0.044	-	-	0.48
HCM Control Delay (s)	164.2	15.9	-	-	11.9	-	-	56.3
HCM Lane LOS	F	C	-	-	B	-	-	F
HCM 95th %tile Q(veh)	3	0.9	-	-	0.1	-	-	2.2

Intersection	
Int Delay, s/veh	17.2

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	2	1103	36	26	1289	19	22	0	16	48	0	4
Future Vol, veh/h	2	1103	36	26	1289	19	22	0	16	48	0	4
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	300	-	-	300	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	91	91	91	91	91	91	91	91	91	91	91	91
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	2	1212	40	29	1416	21	24	0	18	53	0	4

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1437	0	0	1252	0	0	2002	2731	626	2095	2741	719
Stage 1	-	-	-	-	-	-	1236	1236	-	1485	1485	-
Stage 2	-	-	-	-	-	-	766	1495	-	610	1256	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	468	-	-	552	-	-	35	20	427	~ 30	20	371
Stage 1	-	-	-	-	-	-	187	246	-	131	187	-
Stage 2	-	-	-	-	-	-	361	185	-	448	241	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	468	-	-	552	-	-	33	19	427	~ 28	19	371
Mov Cap-2 Maneuver	-	-	-	-	-	-	33	19	-	~ 28	19	-
Stage 1	-	-	-	-	-	-	186	245	-	130	177	-
Stage 2	-	-	-	-	-	-	338	175	-	428	240	-

Approach	SE	NW	NE	SW
HCM Control Delay, s	0	0.2	181.3	$ 708.4
HCM LOS			F	F

Minor Lane/Major Mvmt	NELn1	NWL	NWT	NWR	SEL	SET	SERSWLn1
Capacity (veh/h)	54	552	-	-	468	-	- 30
HCM Lane V/C Ratio	0.773	0.052	-	-	0.005	-	- 1.905
HCM Control Delay (s)	181.3	11.9	-	-	12.7	-	-$ 708.4
HCM Lane LOS	F	B	-	-	B	-	- F
HCM 95th %tile Q(veh)	3.3	0.2	-	-	0	-	- 6.6

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	2.7

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	1	1114	30	53	942	46	19	1	4	2	1	82
Future Vol, veh/h	1	1114	30	53	942	46	19	1	4	2	1	82
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	125	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	93	93	93	93	93	93	93	93	93	93	93	93
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	1	1198	32	57	1013	49	20	1	4	2	1	88

Major/Minor	Major1			Major2			Minor2			Minor1		
Conflicting Flow All	1062	0	0	1230	0	0	1754	2384	531	1837	2392	615
Stage 1	-	-	-	-	-	-	1152	1152	-	1216	1216	-
Stage 2	-	-	-	-	-	-	602	1232	-	621	1176	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	652	-	-	562	-	-	54	34	493	47	33	434
Stage 1	-	-	-	-	-	-	210	270	-	192	252	-
Stage 2	-	-	-	-	-	-	453	248	-	442	263	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	652	-	-	562	-	-	39	30	493	42	30	434
Mov Cap-2 Maneuver	-	-	-	-	-	-	39	30	-	42	30	-
Stage 1	-	-	-	-	-	-	209	243	-	191	251	-
Stage 2	-	-	-	-	-	-	358	247	-	392	236	-

Approach	NB	SB	NE	SW
HCM Control Delay, s	0	0.6	161.8	21
HCM LOS			F	C

Minor Lane/Major Mvmt	NELn1	NBL	NBT	NBR	SBL	SBT	SBR	SWLn1
Capacity (veh/h)	45	652	-	-	562	-	-	315
HCM Lane V/C Ratio	0.573	0.002	-	-	0.101	-	-	0.29
HCM Control Delay (s)	161.8	10.5	0	-	12.1	-	-	21
HCM Lane LOS	F	B	A	-	B	-	-	C
HCM 95th %tile Q(veh)	2.1	0	-	-	0.3	-	-	1.2

Intersection	
Int Delay, s/veh	0.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	22	30	1126	948	0
Future Vol, veh/h	0	22	30	1126	948	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Yield	-	None	-	None
Storage Length	-	-	125	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	23	31	1173	988	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	-	494	988	0	-	0
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	4.14	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	2.22	-	-	-
Pot Cap-1 Maneuver	0	521	695	-	-	-
Stage 1	0	-	-	-	-	-
Stage 2	0	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	-	521	695	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12.2	0.3	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	695	-	521	-	-
HCM Lane V/C Ratio	0.045	-	0.044	-	-
HCM Control Delay (s)	10.4	-	12.2	-	-
HCM Lane LOS	B	-	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.1	-	-

Intersection	
Int Delay, s/veh	2.2

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	3	339	63	26	404	5	56	4	22	3	4	4
Future Vol, veh/h	3	339	63	26	404	5	56	4	22	3	4	4
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	250	-	250	250	-	250	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	3	357	66	27	425	5	59	4	23	3	4	4

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	430	0	0	423	0	0	849	847	357	889	908	425
Stage 1	-	-	-	-	-	-	363	363	-	479	479	-
Stage 2	-	-	-	-	-	-	486	484	-	410	429	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1129	-	-	1136	-	-	281	299	687	264	275	629
Stage 1	-	-	-	-	-	-	656	625	-	568	555	-
Stage 2	-	-	-	-	-	-	563	552	-	619	584	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1129	-	-	1136	-	-	270	291	687	247	268	629
Mov Cap-2 Maneuver	-	-	-	-	-	-	270	291	-	247	268	-
Stage 1	-	-	-	-	-	-	654	623	-	566	542	-
Stage 2	-	-	-	-	-	-	542	539	-	593	582	-

Approach	SE	NW	NE	SW
HCM Control Delay, s	0.1	0.5	20.1	16.3
HCM LOS			C	C

Minor Lane/Major Mvmt	NELn1	NWL	NWT	NWR	SEL	SET	SER	SWLn1
Capacity (veh/h)	324	1136	-	-	1129	-	-	329
HCM Lane V/C Ratio	0.266	0.024	-	-	0.003	-	-	0.035
HCM Control Delay (s)	20.1	8.2	-	-	8.2	-	-	16.3
HCM Lane LOS	C	A	-	-	A	-	-	C
HCM 95th %tile Q(veh)	1.1	0.1	-	-	0	-	-	0.1

Intersection	
Int Delay, s/veh	2.3

Movement	NBL	NBR	SET	SER	NWL	NWT
Lane Configurations						
Traffic Vol, veh/h	50	57	343	24	64	485
Future Vol, veh/h	50	57	343	24	64	485
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	150	0	-	100	250	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	53	60	361	25	67	511

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1006	361	0	0	386	0
Stage 1	361	-	-	-	-	-
Stage 2	645	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	267	684	-	-	1172	-
Stage 1	705	-	-	-	-	-
Stage 2	522	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	252	684	-	-	1172	-
Mov Cap-2 Maneuver	252	-	-	-	-	-
Stage 1	705	-	-	-	-	-
Stage 2	492	-	-	-	-	-

Approach	NB	SE	NW
HCM Control Delay, s	16.5	0	1
HCM LOS	C		

Minor Lane/Major Mvmt	NBLn1	NBLn2	NWL	NWT	SET	SER
Capacity (veh/h)	252	684	1172	-	-	-
HCM Lane V/C Ratio	0.209	0.088	0.057	-	-	-
HCM Control Delay (s)	23	10.8	8.3	-	-	-
HCM Lane LOS	C	B	A	-	-	-
HCM 95th %tile Q(veh)	0.8	0.3	0.2	-	-	-