LLOYDMINSTER

WIGFIELD NEIGHBOURHOOD STRUCTURE PLAN

MAY 2023

CONTENTS

01 INTRODUCTION & PURPOSE

WHAT IS A NEIGHBOURHOOD STRUCTURE PLAN?

A Neighbourhood Structure Plan (NSP) is a non-statutory planning document that is informed by the related statutory Area Structure Plan (ASP), which for this NSP is the Wigfield ASP Bylaw 18-2023, used to support a detailed development proposal. An NSP does not require a bylaw process to be approved. Instead, it is reviewed for compliance with the statutory ASP by City of Lloydminster Administration, which then decides whether to approve the document and allow it to be used to support subsequent applications, such as redistricting, subdivision and development.

The 2017 Community Facilities Master Plan (WSP, Architecture49 & Yates, Thorn and Associates) highlighted increasing demand for existing facilities and identified the need for greater connectivity between trail systems. Furthermore, the Lloydminster Recreation Facilities Feasibility Study, prepared by Gibs Gage Architects in 2020, highlighted an immediate need for the replacement of existing facilities and identified the Wigfield site as an area able to provide strong mobility connections to residential areas and accommodate supporting uses and functional elements in a comprehensive manner.

The proposed recreational and event facility site described in this Wigfield Neighbourhood Structure Plan (NSP) provides a suitable location to develop a replacement facility for existing ageing recreation infrastructure and, being largely an undeveloped site, provides opportunities to further develop appropriate ancillary uses to ensure the amenities are well connected and accessible (Gibs Gage, 2020).

The purpose of the Wigfield NSP is to provide a more detailed analysis of the site conditions, suitability for development, proposed uses and servicing requirements than made available in the guiding policy document, the Wigfield ASP. This NSP will support subsequent redistricting, subdivision and development applications in support of the proposed phased development.

The Wigfield NSP applies to approximately 38.8 ha of land described as the south portion of NW 36-49-28-W3M, located in Lloydminster, SK, south of 44 Street (Highway 16) and along the easternmost municipal boundary (see Figure 1).

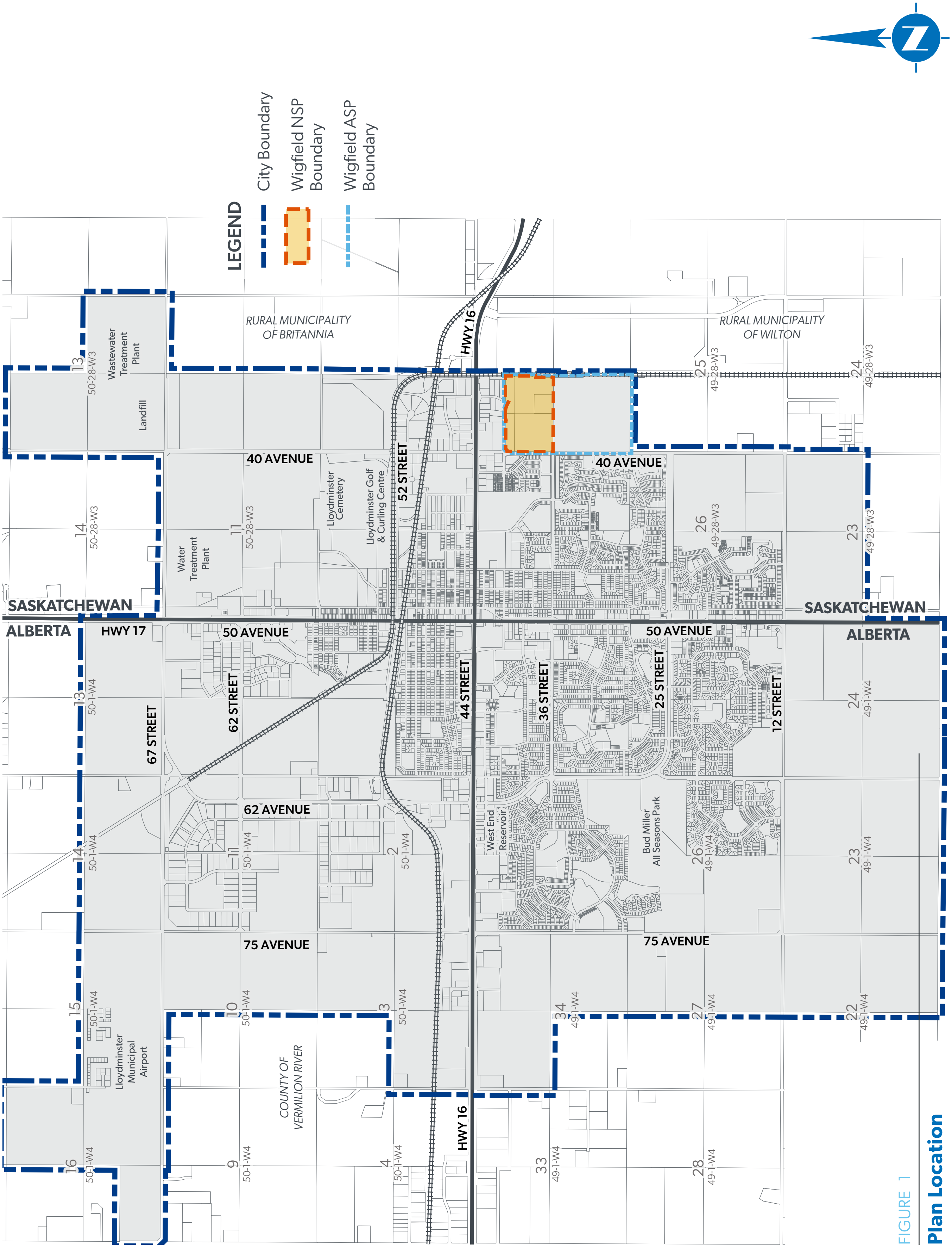


FIGURE 1
Plan Location

02 POLICY & REGULATORY CONTEXT

2.1 OFFICIAL COMMUNITY PLAN (OCP)

The Wigfield NSP falls within the half-mile referral area of the City of Lloydminster within the Lloydminster Planning District Commission (LPDC) Official Community Plan (OCP). The subject lands area adjacent to a Rural Commercial Policy Area.

The purpose of the OCP is to identify and protect future growth areas in the City of Lloydminster and the Rural Municipality of Wilton No. 472 and the Rural Municipality of Britannia No. 502 to provide land use policy which allows for flexibility of choice in land use planning options, and to develop a cooperative administrative structure.

This NSP is consistent with Map 1 Future Land Use Concept of the OCP (found on page 41 of the OCP) and identifies a multi-use walking trail and buffer along the west side of the railway right-of-way.

2.2 MUNICIPAL DEVELOPMENT PLAN (MDP)BYLAW 14-2023

Map 5 Future Land Use Concept of the 2023 Municipal Development Plan identifies the Wigfield NSP lands for future residential and commercial development, which is compatible with the intent of the Wigfield NSP.

The Wigfield NSP supports the **Value of Culture** by upholding the following policies:

4.2.7.1 At the Neighbourhood Structure Plan (NSP) stage, new neighbourhood design shall demonstrate how the proposed trail, sidewalk and bike networks can improve the connectivity of residential areas to the existing and planned cultural and recreational destinations.

4.2.7.2 The City of Lloydminster should improve trail, sidewalk, and bike connections from mature residential areas to existing and planned cultural and recreational destinations.

The Wigfield NSP supports the **Value of Innovation** by upholding the following policies:

4.4.5.1 Trails shall be developed in accordance with the City of Lloydminster's Open Space Master Plan and Trails and Sidewalks Master Plan and improve connectivity between existing and future open spaces.

4.4.5.2 The location of new trails shall improve the connectivity between existing residential areas, neighbourhoods, and city-wide destinations, including school sites, recreation facilities, cultural facilities, and commercial corridors.

The Wigfield NSP supports the **Value of Community Health** by upholding the following policy:

4.5.28 The City of Lloydminster shall work to incrementally expand its parks and open space systems to create an interconnected network of parks and open spaces.

The Wigfield NSP supports the MDP **Value of Initiative** by upholding the following policies:

4.6.18.2 The City of Lloydminster shall pursue diversification of its economic base by planning and coordinating land availability, services, and utility infrastructure for new businesses and expansion of established businesses in various locations based on market needs.

4.6.34 The City of Lloydminster shall continue to promote Lloydminster as a venue of choice for conventions and special events, given its strategic location between Edmonton and Saskatoon and its large inventory of short-term accommodations.

2.3 WIGFIELD AREA STRUCTURE PLAN (ASP)BYLAW 18-2023

The Wigfield ASP informs this NSP. Figure 3 Future Land Use Concept of the Wigfield ASP shows open space, recreation, event facility, and commercial uses for the NSP area. Further, this NSP is prepared in accordance with the policies of the Wigfield ASP, specifically the following:

7.4.1 The City of Lloydminster shall require more comprehensively detailed Neighbourhood Structure Plans to be prepared that provide sufficient engineering analysis with respect to utility infrastructure and transportation needs.

7.4.2 The City of Lloydminster shall require a satisfactory Neighbourhood Structure Plan prior to considering approval of land use amendments, subdivision or development applications for the lands within the ASP boundary.

2.4 LAND USE BYLAW (LUB)BYLAW 05-2016

In accordance with Land Use Bylaw 05-2016, within the Wigfield NSP study area, the existing land use is Urban Transition (UT) District. The proposed use of the land is Recreation (RD) District. The RD District provides for a range of uses consistent with the intent of the proposed development and offers site-specific uses tailored to support this proposal. An application for redistricting is supported by this NSP.

2.5 CITY OF LLOYDMINSTER NEIGHBOURHOOD STRUCTURE PLAN POLICY 610-02

The intent of the Neighbourhood Structure Plan Policy (Policy 610-02) is to provide clarity for the development of detailed planning and analysis associated with undeveloped land up to a maximum of 130 ha in area.

This NSP has been prepared with reference to Policy 610-02.

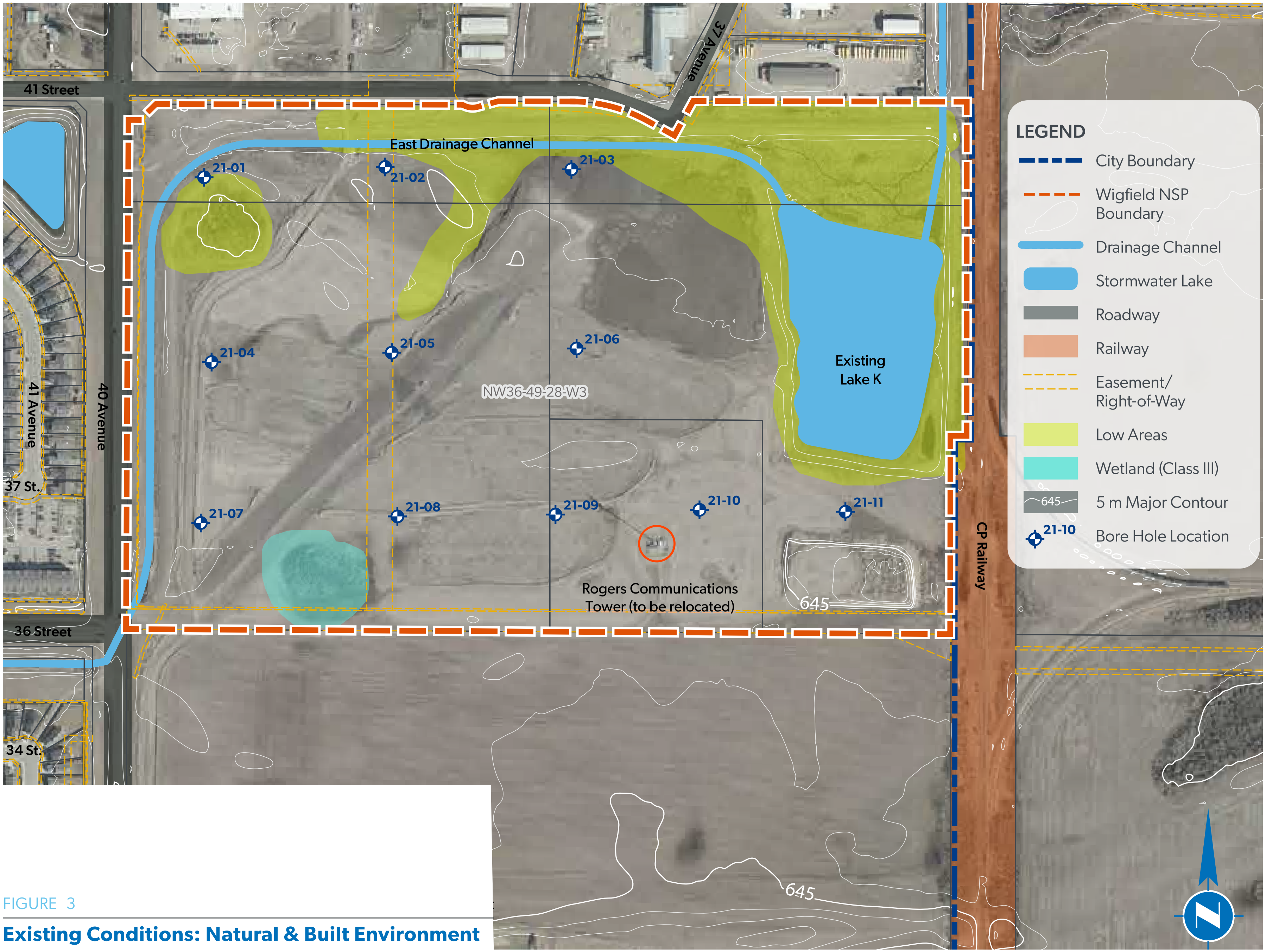


FIGURE 3

Existing Conditions: Natural & Built Environment

03 COMMUNICATION & ENGAGEMENT

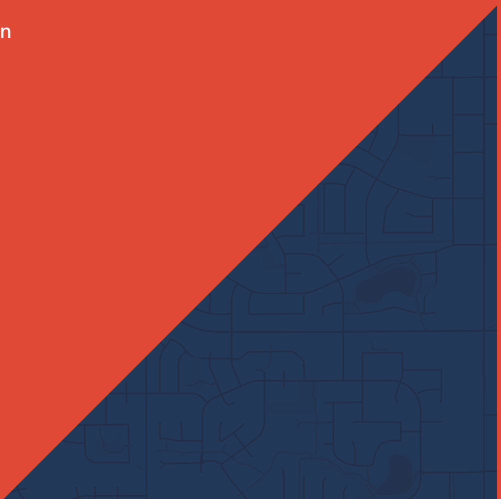
The project for which this NSP was prepared has been informed by public and stakeholder feedback through engagement events. In 2020, the City of Lloydminster began engaging the community on its vision for a modern event facility that could support existing user needs while creating new recreation and entertainment options. Engagement events included open houses, public surveys, information kiosks and interactive tools (Lloydminster Place Event Facility Project Synopsis, current to January 2023). The range of stakeholders, in addition to the general public, the project team engaged with the following:

PRIMARY STAKEHOLDERS

Lloydminster Residents
Lloydminster Junior A Bobcats
Lloydminster Junior B Bandits
Lakeland College Rustlers Female ACAC Hockey Team
Lloydminster Minor Hockey Association
Lloydminster Elite Hockey Division2021/2022
U13 Female Blazers
Lloydminster Youth Council
Lloydminster Skating Club
Hockey Alberta
Border Brutes Lacrosse Club
Lloydminster Curling Club
Border Brutes Lacrosse Club
Lloydminster Extreme Lacrosse
Lloydminster Public School Division
Lloydminster Catholic School Division
Lloydminster Border Blades Speed Skating Club
Lloydminster City Council
Lloydminster Executive Leadership
City of Lloydminster Staff
Adult Hockey Groups
For-Profit Hockey Groups
Inclusion Lloydminster
Lloydminster Slo-Pitch Association
Lloydminster Minor Baseball
Lloydminster Amateur Softball
Lloydminster Minor Ball
Men's Orthodox
Lloydminster Blue Jays
Lloydminster Ladies Fastball

SECONDARY STAKEHOLDERS

Vic Juba Community Theatre
Lloydminster Agricultural Exhibition Association
Lloydminster Public Safety
Fire Services and Emergency Services
Lloydminster Chamber of Commerce
Para Hockey of Canada
Skate Alberta
Border Tribal Council
Little Pine First Nation
Lloydminster Métis Local 76
Métis Nation of Saskatchewan
Moosomin First Nation
Onion Lake Cree Nation
Poundmaker Cree Nation
Saskatchewan Indian Gaming Authority
RM of Britannia No. 502
Lakeland College
RM of Wilton No. 472
Cenovus Energy
Heart of Treaty 6



A number of communication techniques and tools were used to:

- inform, update and gather input,
- provide a variety of engagement opportunities, and
- facilitate meaningful discussions.

The surveys and virtual/in-person open houses were advertised via the following methods:

- Social Media
- On-site Billboard
- Electronic Billboards
- Newspaper
- Email Newsletter
- Hand Delivered Letters to the surrounding commercial areas.

Information shared in the virtual open house included:

- Current approved ASP
- Why the ASP requires amendment
- Draft concepts
- Development opportunities
- Site Context

The first engagement process included an open house and an online survey to collect initial input regarding future event facility experiences, amenities, accessibility, events and uses. Over 640 respondents participated and provided more than 1,300 written comments. The findings of the survey are contained in a 'What We Heard Report' found on the project website at yourvoicelloyd.ca/ypye.

The second round of engagement included community members and residents of surrounding areas in a drop-in style open house hosted at Lloyd Mall. Participants had the opportunity to speak directly with project team leaders and members of Council. A second public survey was made available to participants, the results of which are found in the second 'What We Heard Report' on the project website.

04 ANALYSIS OF EXISTING CONDITIONS

4.1 NATURAL ENVIRONMENT

SOILS/TOPOGRAPHY

According to the Environmental Impact Assessment (EIA) report prepared by ISL Engineering and Land Services Ltd. (see Appendix A), the soils found within the Wigfield NSP area are predominantly Black Loam with Dark Gray and Gray Luvisolic soils. Soils in this class have moderate limitations that reduce the choice of crops or require moderate conservation practices (ISL, 2022).

Most of the plan area is cleared. Topography of the plan area is generally flat with depressional wetland areas, which is likely to change with development (see Figure 2). The lands within the northern portion of the plan area slope gradually to the northeast. Careful stormwater management will be necessary if wetland areas are infilled (ISL, 2022).

It is recommended within the EIA that an erosion and sediment control plan be implemented to account for during and post-construction activities. Further, the Phase 1 ESA undertaken in support of the original Wigfield ASP, prepared in 2012, identified the need for a Phase 2 ESA. SolidEarth Geotechnical Inc. (SolidEarth) undertook a 'limited' Phase 2 ESA in August 2022 to assess the salinity and presence of hydrocarbons near the proposed hotel and event facility sites, which served as the City of Lloydminster's former snow dump (see Appendix B).

Nine boreholes were drilled to depths ranging from 10.4m to 22.5m, and 27 soil samples were submitted for chemical analysis. Three groundwater samples were submitted for routine water analysis.

The results indicated slightly elevated concentrations of sodium in three boreholes in the upper 1.5m. Similarly, slightly elevated concentrations of chloride were detected in the same three boreholes. However, the measured concentrations do not suggest a wide-spread sodium impact on the site (SolidEarth, 2022).

Potential salinity from the snow dump area may have leached into the local groundwater. However, due to the limited groundwater chemistry data the lateral extend of potential salinity impact to the groundwater could not be ascertained (SolidEarth, 2022). SolidEarth recommends further assessment of the site in coordination with the development of Lake K to delineate the extent of sodium and chloride impacts to the groundwater at the site. Salinity impacts need to be delineated as salts can corrode underground utilities and have detrimental effects on soil organisms and plants (SolidEarth, 2022).

GEOTECHNICAL ANALYSIS

SolidEarth undertook a preliminary geotechnical investigation encompassing the plan area in 2021. A more detailed/targeted geotechnical investigation is recommended once site design and site layout details are confirmed. The to-date initiated borehole locations are shown on Figure 3.

The overall conclusion of the geotechnical analysis is that the plan area is suitable for land development, including the installation of underground utilities and infrastructure, with care needed to plan around isolated low-lying areas and some potential for salinity impacts to the near-surface soils within the former snow dump area (SolidEarth, 2021). High-level summaries of discussion around building foundations are found below, with the balance of conclusions found in Appendix C.

BUILDING FOUNDATIONS

Both shallow footing and deep pile foundation systems may be considered to support the proposed structures. Grade-supported floor slabs placed on prepared and improved subgrade or on new engineered fill are also considered feasible (SolidEarth, 2021).

Near surface soils showed some degree of variabilities across the site, which may affect the feasibility of using shallow footings to support the proposed structural elements at some locations of the site. The subsequent detailed design stage(s) will need to address the suitability of shallow footings at specific locations via site-specific geotechnical investigation (SolidEarth, 2021).

Thick and saturated sand deposits were encountered at most of the borehole locations which exhibited seepage and sloughing during drilling. These conditions could pose challenges for some piling options, in particular steel piles and cast-in-place concrete piles (SolidEarth, 2021).

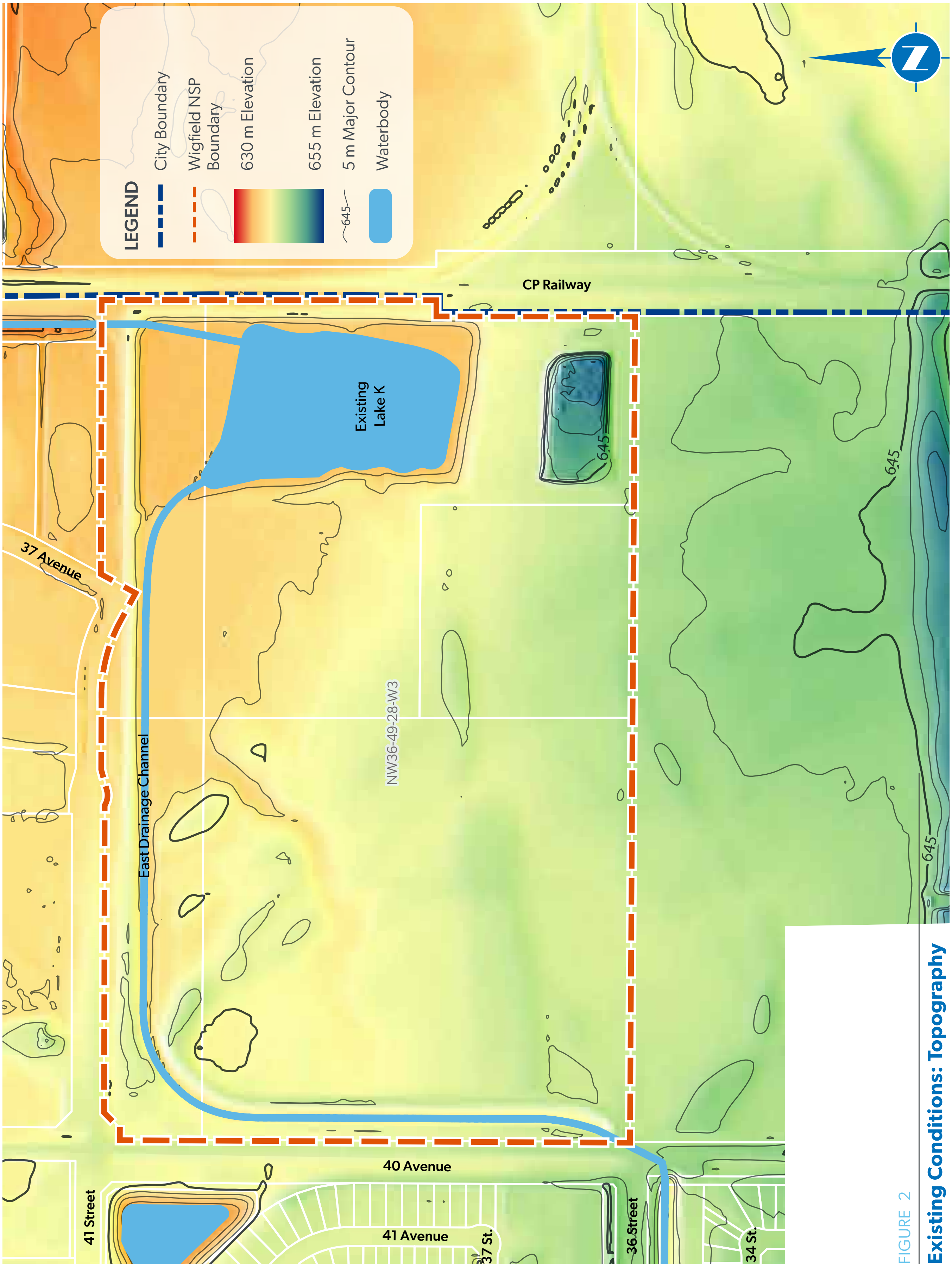


FIGURE 2

Existing Conditions: Topography

VEGETATION

No rare vascular or non-vascular species occurrences are present in the Wigfield NSP area. The nearest historical occurrence (with the 2km study area) is located within city limits of Lloydminster in a developed area and is unlikely to be currently present, given apparent development.

It is recommended within the EIA that nweed species be controlled prior to the commencement of construction and that equipment and vehicles not be parked/stored on noxious weed-infested grounds unless the noxious weeds are first controlled.

WILDLIFE

A search of the Saskatchewan Wildlife database determined that one occurrence of a rare vertebrate animal, and one occurrence of an invertebrate and no occurrences of animal assemblages are located within the Wigfield NSP area. The identified species are not listed in the Saskatchewan Wildlife Species at Risk Regulations (ISL, 2022).

WETLANDS

A field-level assessment was undertaken by Matrix Solutions Inc. (Matrix) in June 2022 to identify and classify potential wetlands (Appendix D). Matrix identified the man-made dugout, which is locally known as Lake K and acts as a stormwater retention pond, located in the northeast corner of the Wigfield NSP area, and a Class III seasonal wetland in the southwestern quadrant of the Wigfield NSP area. Based on the proposed site plan, it is expected that the Class III wetland will be removed, subject to any required provincial approvals.

4.2 BUILT ENVIRONMENT

EXISTING & ADJACENT LAND USE

The Wigfield NSP lands are currently districted Urban Transition (UT) District in the City of Lloydminster's Land Use Bylaw 05-2016 (see Figure 4). In the northeast portion of Wigfield NSP area approximately 4.0 ha (10.0 ac) of land was leased for a radio tower installation (see Figure 3). The lease has since expired, with the City of Lloydminster working with the tower owner to have the facility removed. The lease area is accessed by a gravel road from 40 Avenue which aligns generally with 36 Street to the west of 40 Avenue.

The area immediately north of the Wigfield NSP area bound between 41 Street and 44 Street and 40 Avenue and the City of Lloydminster's eastern boundary is largely developed and commercial and industrial uses, including the Gold Horse Casino.

The Larsen Grove neighbourhood is located west of 40 Avenue, north of 36 Street and south of 44 Street, to the west of the Wigfield NSP area. The Larsen Grove neighbourhood includes low and medium-density residential and commercial land uses.

The Aurora neighbourhood is located west of 40 Avenue and south of 36 Street, to the west of the Wigfield NSP area. Aurora is a low-density residential community, which also includes institutional uses and extensive pedestrian linkages which extend north into Larsen Grove.

The Rural Municipality (RM) of Wilton lies east of the Wigfield NSP area. Agricultural land uses occupy the lands adjacent to the Wigfield NSP areas eastern boundary and the CP Railway in the RM; and, east of there, the Cenovus Energy upgrader site.

The lands south of the Wigfield NSP area are identified for future residential and commercial uses within the Wigfield ASP and are currently undeveloped except for three residences and a dugout.

OIL & GAS INFRASTRUCTURE

A review of the City of Lloydminster's available GIS data revealed there are no oil and gas wells or pipelines within the boundary of the Wigfield NSP area.

TRANSPORTATION NETWORK

ACCESS

Primary access to the Wigfield NSP area is via 36 Street. A proposed secondary access to the proposed recreation and event facility is located at the north end of the site from 41 Street.

ROADS

The existing transportation network which surrounds the Wigfield NSP area is described as:

- 40 Avenue is a two-lane arterial road, going north and south from 44 Street to the City of Lloydminster boundary at 12 Street and agricultural developments to the south.
- 41 Street is a rural/undeveloped two-lane local road east of 40 Avenue and a paved two-lane local road to the west of 40 Avenue. The eastern portion can be accessed from 44 Street via 37 Avenue.
- 37 Avenue is a two-lane local road going north and south from 44 Street to 41 Street.
- 36 Street is a two-lane collector road, extending west from 40 Avenue to 50 Avenue.

TRAILS

There are currently no sidewalks or trails within the Wigfield NSP area. Nearby facilities include a multi-use walking trail on the north side of 36 Street terminating at 40 Avenue, as well as sidewalks within the residential neighbourhoods to the west of 40 Avenue.

RAIL

There is a CP Rail line that runs along the entire eastern boundary of the Wigfield NSP area (see Figure 3). There is no rail access or crossings available to or from the Wigfield NSP area.

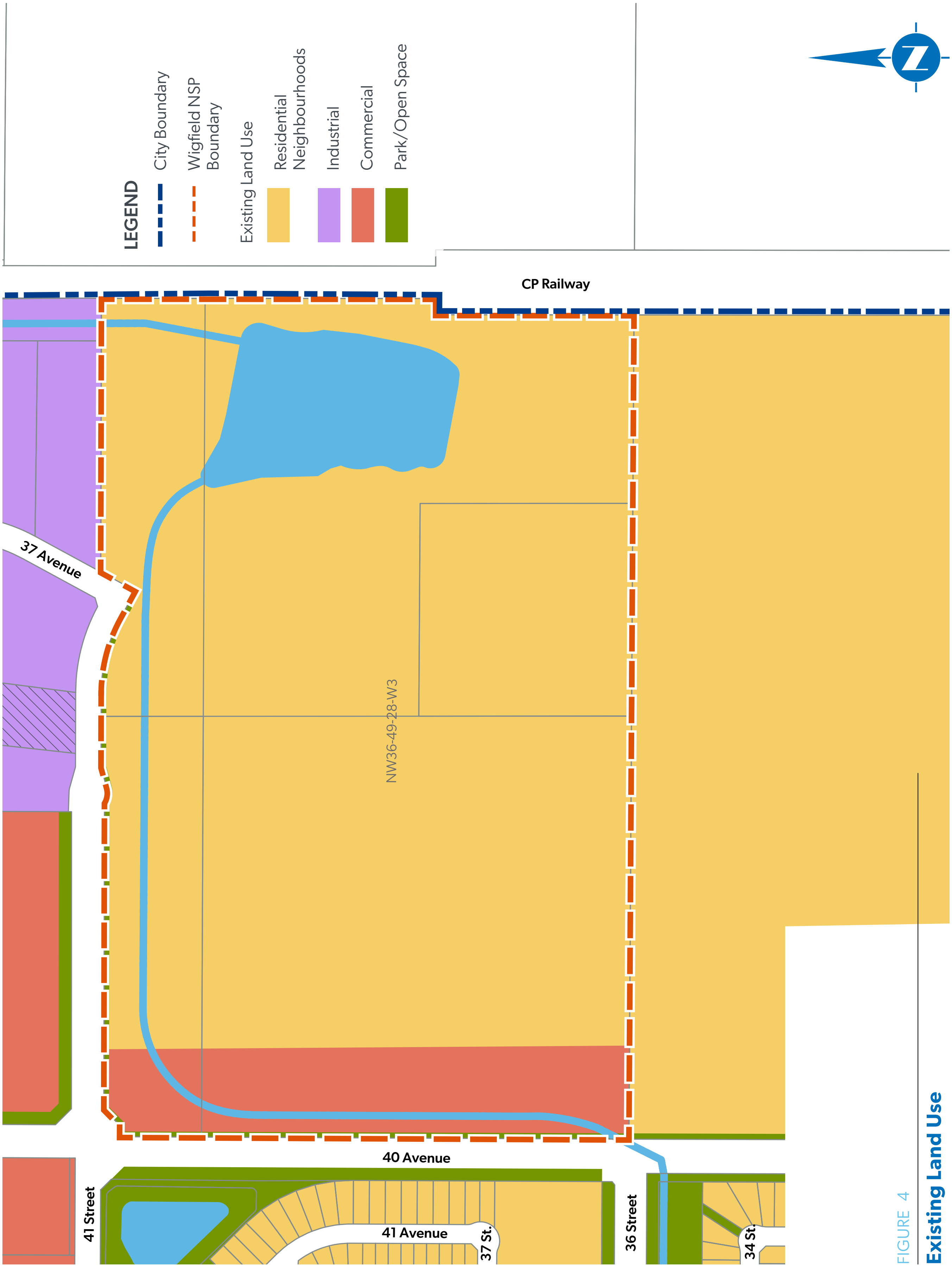


FIGURE 4

Existing Land Use

4.3 EXISTING WATER

The Wigfield NSP area is proposed to be connected to the City of Lloydminster's existing water distribution system. According to preliminary assessments undertaken for the Wigfield NSP Servicing Study prepared by ISL Engineering and Land Services Ltd. (ISL) in 2023 (see Appendix E), the existing water distribution system is considered adequate to support average daily demands and peak hour demands of the proposed development but is not sufficient to support maximum daily demands combined with fire flow requirements (ISL, 2023). Details on the proposed upgrades are discussed within in the Utility Services section.

The City of Lloydminster's existing water system is comprised of the Water Treatment Plant (WTP), the West End Reservoir (WER), and the distribution system. The WTP has an average flow of 11,000m^3/day with a net production capacity of 21,125m^3/day (ISL, 2023). The capacity noted here is derived from the 2016 Water Master Plan and may not accurately represent the City of Lloydminster's actual treatment capacity based on current demands. Therefore, capacity should be confirmed upon completion of the updated Water Master Plan (ISL, 2023).

The WER comprises a 4,545m^3 above-ground reservoir built in 1971 and a 20,201m^3 underground reservoir built in 2006, resulting in a combined capacity of 24,746m^3 (ISL, 2023). The available reservoir capacity is based on the storage summary from the 2016 Water Master Plan and may not reflect the City of Lloydminster's actual available storage based on current demand. Therefore, reservoir capacity should be confirmed upon completion of the updated Water Master Plan (ISL, 2023).

The Wigfield NSP area is undeveloped, and therefore there are minimal water distribution systems within the Wigfield NSP area. Existing water infrastructure is located along 40 Avenue on the west side of the Wigfield NSP area and through existing development along 41 Street and 37 Avenue. There is, however, a 300 mm diameter watermain running through the Wigfield NSP area that connects infrastructure from 36 Street to 41 Street. Additionally, there is an existing 350 mm diameter raw watermain running along 40 Avenue that turns east at 36 Street and continues across the Wigfield NSP area to service the Cenovus Energy upgrader site which is located within the RM of Wilton.

4.4 EXISTING SANITARY

The Wigfield NSP area is proposed to be connected to the City of Lloydminster's existing wastewater collection system. Based on preliminary assessments completed by ISL as part of the Wigfield NSP Servicing Study, in conjunction with the 2016 Sanitary Sewer Master Plan, the East Trunk is already over capacity in some areas under existing conditions without the East Trunk Twin being implemented (ISL, 2023). However, based on the 2016 Sanitary Sewer Master Plan, there remains available capacity in the East Trunk for an estimated additional population of 6,073 people after the Wigfield NSP area is connected, before the East Trunk Twin is required.

As such, the East Trunk Twin is not required as part of servicing the plan area but should be reviewed by the City of Lloydminster to formalize timelines and triggers.

Additional discussion and recommendations are found in the Utility Services section. The remaining capacity within the East Trunk should be confirmed upon completion of the updated Sanitary Sewer Master Plan (ISL, 2023).

4.5 EXISTING STORMWATER

Under existing conditions, stormwater generally drains toward the northeast to a stormwater management facility known locally as Lake K which functions as a wet pond. Lake K connects to Lake N, also a stormwater management facility that functions as a wet pond. Lake N discharges into the East Drainage Channel along the city's east boundary. Upstream of Lake K is the continuation of the East Drainage Channel and a box culvert crossing at the intersection of 36 Street and 40 Avenue, after which the East Drainage Channel continues to Lake J.

There is minimal existing drainage infrastructure within the Wigfield NSP area. Recommendations for upgrades are discussed in the Utility Services section.

05 DEVELOPMENT CONCEPT

The development concept proposes a comprehensive entertainment district for the Wigfield NSP area that includes an event facility, a hotel, four ball diamonds and a pavilion, an outdoor ice rink with a dasher board system, numerous multi-use walking trails, six commercial retail units and a future potential campground and an additional two ball diamonds (see Figure 5).

5.1 LAND USE STATISTICS

The Wigfield NSP area is proposed to be subdivided as shown in Figure 6; however, subdivision approval has not been granted and the exact allocations shown below are subject to change. Land is proposed to be allocated as follows for the broad land use types listed:

Table 1. Land Use Statistics

Land Use Type	Area (ha) hectares	Area (ac) acres	% of GDA
GROSS DEVELOPABLE AREA	**38.78**	**95.83**	**100.0%**
MU (Pond/Drainage Channel)	9.85	24.34	25.40%
MR	3.49	8.62	9.00%
Commercial: Hotel	0.82	2.03	2.11%
Commercial: CRU	2.54	6.28	6.55%
Event Facility	10.41	25.72	26.84%
Future Area	9.77	24.14	25.19%
Road (incl. 0.52 ha 40 Ave Widening)	1.90	4.69	4.90%

It should be noted that Municipal Reserve (MR), which includes the open space around Lake K above the High-Water-Level, is dedicated at 9% of the gross developable area. The shortfall of 1% will be provided by Phase 4 development.

5.2 EVENT FACILITY & HOTEL

The event facility will offer two ice sheets being the Event Arena and the Community Area, with a capacity of approximately 2,000 permanent seats in the Event Arena and approximately 500 permanent seating in the Community Arena. There will also be an outdoor ice rink. The event facility will offer food service and meeting room spaces, and include design features that support inclusivity, diversity and equity, such as designated gender-neutral washrooms and universally accessible shower stalls in change rooms.

A hotel and accompanying parking lot is proposed to the northwest of the event facility.

5.3 PARKING

The City of Lloydminster's Land Use Bylaw 05-2016 could require up to 1,160 parking stalls, depending on how the requirements are interpreted and applied. The development proposes to provide 679 parking stalls. The proponent is undertaking a parking study to determine the appropriate number of parking stalls required under certain scenarios, and how to best understand the relationship between parking and neighborhood land use.

The provision of parking stalls will primarily be by an on-site paved parking lot. Moreover, there is merit in considering the following:

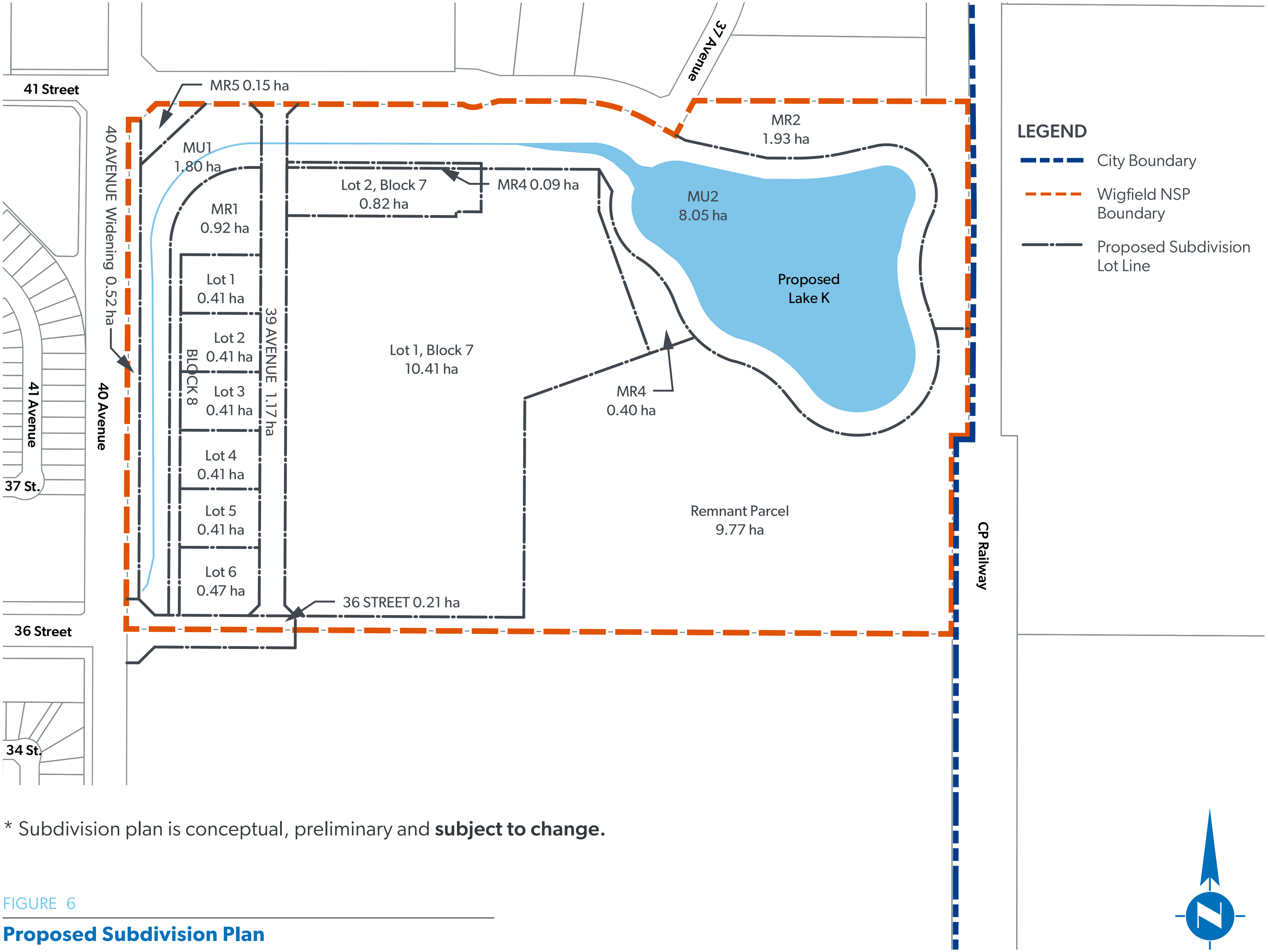
- The request for a 15% parking variance, and the request for a 10% mixed-use development variance
- Requesting a 3-year parking deferral on 226 parking stalls
- Creation of an overflow parking area in Phase 4, which could be used to provide parking space over a specific period to ascertain if additional permanent parking is required.

The parking study was not completed at the time this NSP was prepared, and therefore the outcomes of that study are not contained herein. However, they will be used to inform further parking requirement discussions with the City of Lloydminster. The final parking study will be required to support an application for development.

* Development concept is preliminary, conceptual and **subject to change.**

FIGURE 5

Development Concept



* Subdivision plan is conceptual, preliminary and **subject to change.**

FIGURE 6

Proposed Subdivision Plan

5.4 RECREATION

The development concept proposes four ball diamonds in Phase 3 of the development. The outdoor ice rink and extensive multi-use walking trails provide opportunities for active outdoor recreational activities.

Up to two more ball diamonds and a campground could be developed in the future (Phase 4), subject to NSP amendment approvals.

5.5 COMMERCIAL

Six commercial retail lots are shown in the development concept; however, as development unfolds the configuration and number of commercial lots may change, subject to development approvals. Vehicle-oriented commercial uses such as car washes, drive-in oil change shops and tire shops are not appropriate in this location.

Access to the commercial parcels is via the future 39 Avenue. There is no direct access to the commercial parcels from 40 Avenue due to the presence of the East Drainage Channel. Parking within the commercial parcels should be oriented towards the future 39 Avenue rather than fronting 40 Avenue.

5.6 EMPLOYMENT PROJECTIONS

Using available data, generalized employment projections were estimated for the Wigfield NSP area. Employment projections were calculated using the 2022 Retail Gap Analysis (Fowler Bauld & Mitchell Ltd., 2022), node productivity calculation and the Statistics Canada input-output multipliers:

- Node productivity x estimated CRU square footage = Proposed development productivity
- Proposed development productivity/1,000,000 = productivity multiplier
- Productivity multiplier x jobs multiplier (Stats Can Labour Productivity by business sector industry) = estimated employment projections

Table 2 below summarizes the number of jobs proposed to be created categorized by business sector as proposed by the development concept. Table 2 shows total projected jobs is estimated to be 190 at full build-out, with the majority of jobs, 93, being created in the Food and Beverage business sector. The number of actual jobs created will be contingent upon the final development concept approval, specific business practices, and other forces outside the scope of this NSP.

Table 2. Estimated Employment Projections

BUSINESS SECTOR	Total Jobs (rounded)
Sporting Goods Store	30
Clothing	25
Accommodation	17
Food & Beverage	93
Amusement and Recreation	25
TOTAL	**190**

5.7 OPEN SPACE & RESERVES

The development concept offers a significant are of open space including grassy areas, paved multi-use walking trails, an outdoor ice rink and playing fields. Some of these areas are available for use by the public and can therefore be considered for Municipal Reserve (MR) dedication. As mentioned above, MR dedication makes up 9% of the gross developable land and the remaining 1% will be dedicated at Phase 4 development.

5.8 ARCHITECTURAL DESIGN & LANDSCAPING

The proposed development concept represents a significant development for the City of Lloydminster. As such, a high level of design detail is anticipated on the front facade and grounds surrounding the event facility.

While the event facility will make a strong architectural statement, the architectural designs anticipated for the commercial retail units are anticipated to exhibit a mix of unique and franchise architectural elements that complement the surrounding uses.

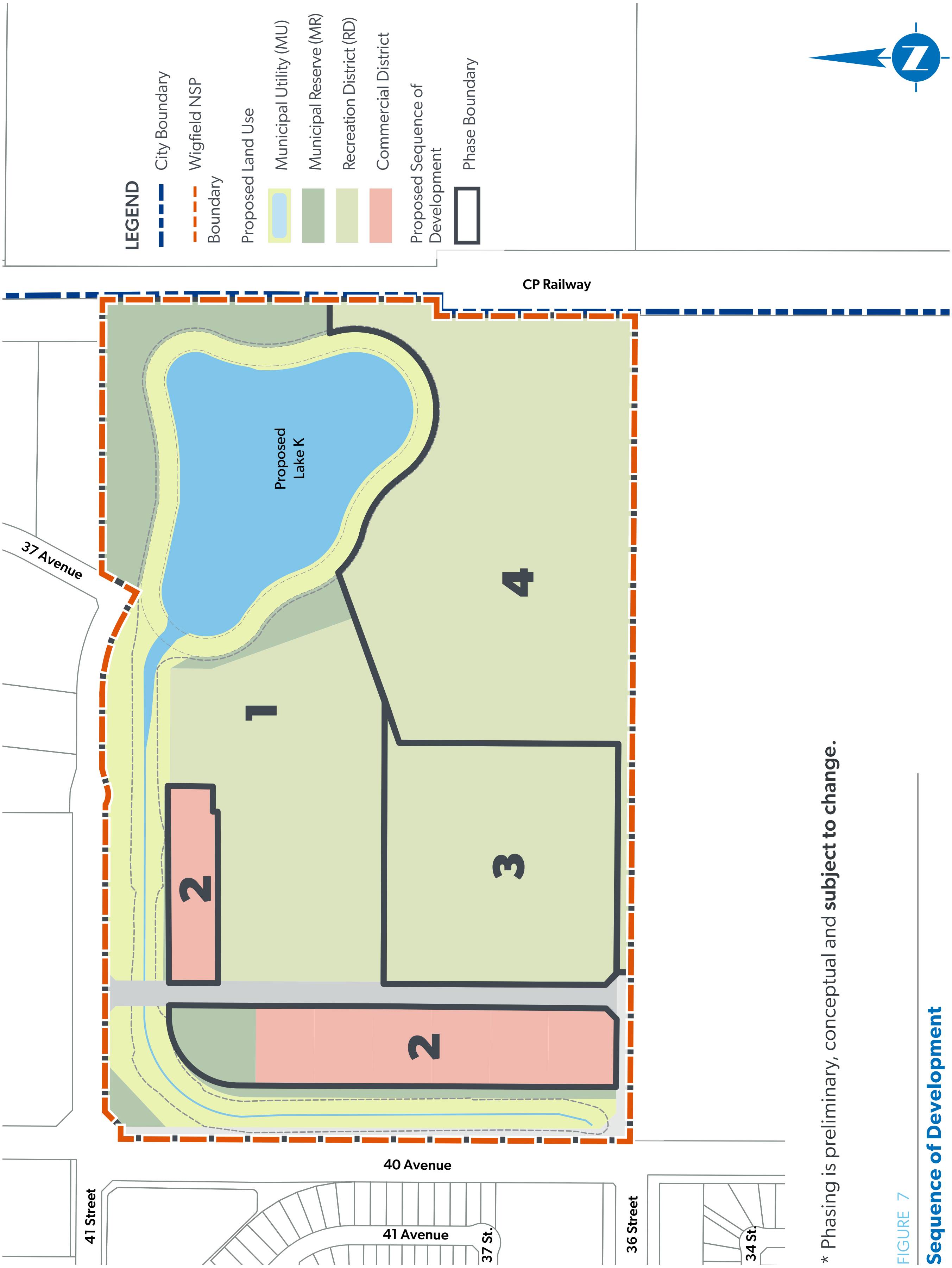
The development will provide landscaping in accordance with the City of Lloydminster's Land Use Bylaw as at the time of development regulations at a minimum. It is expected that native and zone three hardy plant species would be incorporated into the design. Detailed landscaping plans, prepared by a qualified professional, will be provided in support of the development permit application.

5.9 SUBDIVISION & SEQUENCE OF DEVELOPMENT

Refer to Figure 6 for the proposed subdivision layout and Figure 7 for the development phasing.

Phase 1 of development includes the event facility as well as the Lake K and East Drainage Channel ditch improvements. The hotel and commercial areas will form Phase 2 with the ball diamonds forming Phase 3. The final phase of the development concept, Phase 4, has yet to be confirmed but could include an additional two ball diamonds and a campground, as is shown conceptually in Figure 5.

Development timing is subject to market forces and access to funding which are difficult to predict. Changes in phasing may not require an amendment to this NSP if sufficiently supported by market analysis and/or known budgetary constraints.



* Phasing is preliminary, conceptual and **subject to change.**

FIGURE 7

Sequence of Development

06 MUNICIPAL SERVICES

The following sections are informed by the Wigfield NSP Servicing Study prepared by ISL in 2023, the findings of which are summarized and paraphrased below. The purpose of the Servicing Study is to provide a high-level evaluation of the potential future water and wastewater servicing systems in the area as well as stormwater drainage systems. This includes the necessary parameters for the design, including recommendations for water distribution, wastewater collection and stormwater management and conveyance.

Additionally, more detailed site servicing was prepared for the project through the City of Lloydminster's architect, TBD Architects, which is illustrated in Figures 8-10.

6.1 WATER

The water requirements for the proposed development assumed development of all phases. Therefore, this section provides details and recommendations assuming full build out of the NSP area including Phase 4. At time of writing the NSP, Phase 4 was proposed to include two ball diamonds and a campground.

SYSTEM DEMANDS

Consumption rates, or average day demand (ADD), at litres per hectare per day (L/ha/d) were assumed for the three main categories of development based on the City of Lloydminster's Municipal Development Standards (MDS) using blended rates from similar types of uses:

- commercial (20,500L/ha/d),
- event centre (17,750L/ha/d), and
- camping (1,365L/ha/d).

Peak rate factors were applied to the consumption rates (ADD) to account for peak demands: maximum day demand (MDD) at 2x ADD, and peak hour demand at 3x ADD.

FIRE FLOW & VELOCITY

Fire flow protection rates, duration, and storage requirements were based on local and highway commercial use and institutional use, with the more conservative requirement between the two used. Maximum main line flow velocity should not exceed 3.0m/s and be preferably below 2.0m/s, if possible.

WATER TREATMENT PLANT

The 2016 Water Master Plan assumed a population greater than that of the 2021 Federal Census to calculate the maximum day demands for the WTP. Therefore, it is assumed there is existing production capacity in the WTP to serve the Wigfield NSP area in the near term. However, it is recommended that water consumption and the associated WTP production capacity be monitored, and future analysis be completed to support the allocation of capital budget to undertake upgrades to the WTP as development occurs and the demand for production capacity increases (ISL, 2023).

RESERVOIR STORAGE

As with the WTP, the 2016 Water Master Plan assumed a larger population when assessing future capacity of the WER. In considering available capacity to support development of the NSP area, ISL assumed conservative modelling and required fire flows in correlation calculations and arrived at the conclusion that there is sufficient capacity in the WER to accommodate an additional 1,646 people after the connection to the Wigfield NSP area. However, it is recommended that the water demand and associated storage requirements be monitored, and that future analysis be completed to support the allocation of capital budget for the expansion/upgrade of the WER as development occurs and the demand for available storage capacity increases (ISL, 2023).

WATER PIPE NETWORK

ISL undertook an assessment of the existing water distribution system in conjunction with the impacts of the Wigfield NSP area development on existing infrastructure and recommended the following upgrades at a total cost of $1,445,000 to support the development of the Wigfield NSP area:

- 300 mm Watermain Upgrade at a total cost of $595,000
  - The proposed system improvements incorporate water upgrades from 250 mm diameter to 300 mm diameter directly downstream of the Wigfield NSP area along 41 Street (see Figure 8) as well as the installation of a new 300 mm diameter water main connecting 36 Street to 41 Street within the 40 Avenue right-of-way (see Figure 8).
- Pavement Rehabilitation at a total cost of $850,000

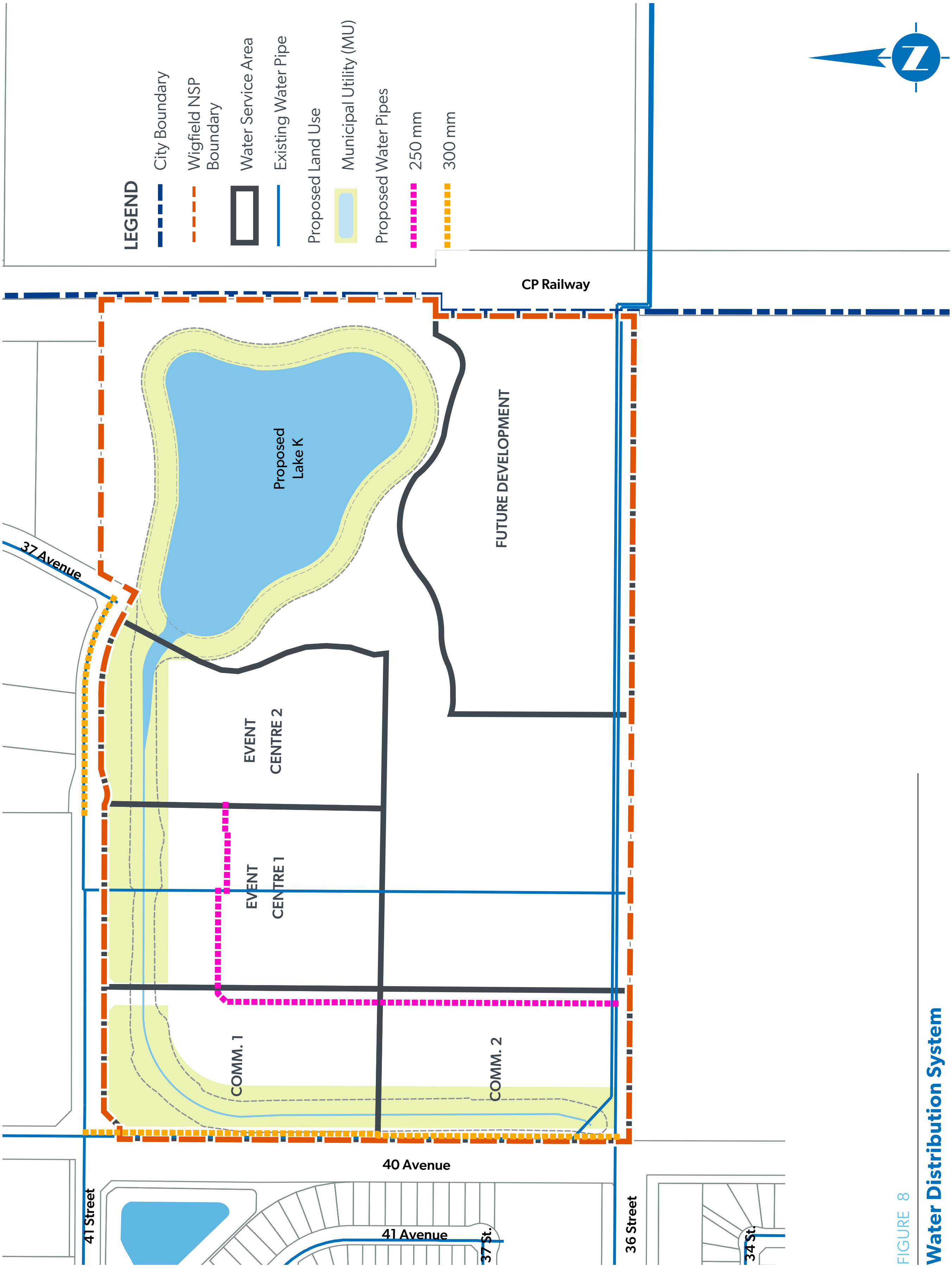


FIGURE 8
Water Distribution System

In addition to the improvements recommended above associated with the existing water distribution system adjacent to the Wigfield NSP area, on-site water servicing was developed by TBD Architects, on behalf of the City of Lloydminster (see Figure 8). The water servicing plan includes three 250 mm diameter waterlines extending from the existing 300 mm diameter watermain: two to service connections for the event facility (one for the main building connection and one for the fire hydrant connection) and one to service the commercial retail lands and the fire hydrants along the future 39 Avenue. The water main within the future 39 Avenue will complete its loop by connecting to the existing 300 mm diameter water main within 36 Street.

The 250 mm diameter water main servicing the commercial retail lands is located within the future 39 Avenue right-of-way. The water main providing service to the event facility, i.e., main building, also supports the individual lot service for the future hotel.

6.2 WASTEWATER

The wastewater requirements for the proposed development assumed development of all phases. Therefore, this section provides details and recommendations assuming full build out of the NSP area including Phase 4. At time of writing the NSP, Phase 4 was proposed to include two ball diamonds and a campground.

SYSTEM DEMANDS

The per capita daily wastewater generation rate, according to the City of Lloydminster's Municipal Development Standards, is 320L/c/d. In the absence of employment densities, ISL applied an area-based wastewater generation rate of 0.2L/s/ha for the commercial and event facility lands. The campground lands were given a wastewater generation rate of 4,800L/d based on 60 campsites.

The peaking factor for non-residential flows, according to the City of Lloydminster's Municipal Development Standards, is 3, which means the peak flow is the non-residential flow rate multiplied by 3.

SYSTEM SIZING AND CONFIGURATION

ISL undertook an assessment of the existing wastewater collection systems in conjunction with the impacts of the Wigfield NSP area development on existing infrastructure and recommended the following upgrades at a total cost of $1,075,000 to support the development of the Wigfield NSP area:

- 900 mm Sanitary Sewer Upgrade at a total cost of $680,000
  - The proposed system improvements incorporate sewer upgrades from 750mm diameter to 900 mm diameter directly downstream of the Wigfield NSP area along 41 Street (see Figure 9).
- Pavement Rehabilitation at a total cost of $395,000

As mentioned above, the Wigfield NSP area is to be services by the existing East Trunk; however, it should be understood that analysis must be completed by the City of Lloydminster to support the allocation of capital budget to the East Trunk Twin as development occurs and available capacity decreases. The Wigfield NSP area can be serviced while imposing minimal impact on the East Trunk; however, future development may be impacted and, as such, should be reviewed in detail.

In addition to the improvements recommended above associated with the wastewater collection system adjacent to the Wigfield NSP area, on-site sanitary servicing was developed by TBD Architects, on behalf of the City of Lloydminster (see Figure 9). The sanitary servicing plan includes three 200 mm diameter sanitary sewers extending from the existing 750 mm diameter sanitary sewer main: one to service the event facility, one to service the commercial retail lands, and one to service the future hotel.

The 200 mm diameter sanitary sewer main in the future 39 Avenue will not connect to the existing 750 mm diameter sanitary sewer main within 36 Street as looping and or overflow capacity is not required.

The 200 mm diameter sanitary sewer main servicing the commercial retail lands is located adjacent to the future 39 Avenue right-of-way.

FIGURE 9

Wastewater Collection System

STORMWATER

As discussed above, there is little existing stormwater infrastructure present within the Wigfield NSP area. However, Lake K has recently been upgraded and there are improvements being made to the existing East Drainage Channel within the Wigfield NSP area. Prior to this work, the culvert crossing at the intersection on 36 Street and 40 Avenue was upgraded to match a 1:100-year flow and now is comprised of a large box culvert. Existing drainage patterns are generally maintained for the Wigfield NSP area under post development conditions: lands west of 40 Avenue will continue to drain northeast to Lake K through the East Drainage Channel and the box culvert crossing, as will the developed lands of the plan area. Lake K in the northeast and the proposed stormwater management facility in the southeast of the plan area will be connected by a future 300 mm diameter storm sewer main which is not considered part of servicing this NSP. Development of Phase 4, i.e., the campground area, must consider the installation of this storm sewer main.

The proposed stormwater servicing developed by TBD Architects, on behalf of the City of Lloydminster, (see Figure 10) collects and conveys stormwater to Lake K via curb and gutter, numerous catch basins, and a gravity stormwater collection system consisting of underground infrastructure which ultimately discharges into Lake K.

As the future 39 Avenue is scheduled to be classified as an urban Collector Road, the road design shall follow the City of Lloydminster's Municipal Development Standards and as such shall contain storm sewer mains and catch basins to collect and convey site surface water to Lake K.

The storm servicing plan includes a mix of 300 mm, 375 mm, 525 mm, 750 mm, 900 mm, 1200 mm diameter storm sewers extending from Lake K to provide service to the event facility parking lot and building, the hotel site, as well as commercial retail lands and the future 39 Avenue.

The storm sewer main proposed to be within the future 39 Avenue will need to extend to the future 36 Street right-of-way in order to provide a connection point to service to this roadway as well as future development to the south of the plan area.

To accommodate the development of the future 39 Avenue and to facilitate the connection of the future 39 Avenue to 41 Street, a crossing of the East Drainage Channel will be required. The crossing is to consist of box culverts sized to the 1:100-year storm event. It is anticipated at this time that this will be managed by two 1800 mm wide by 1200 mm high box culverts.

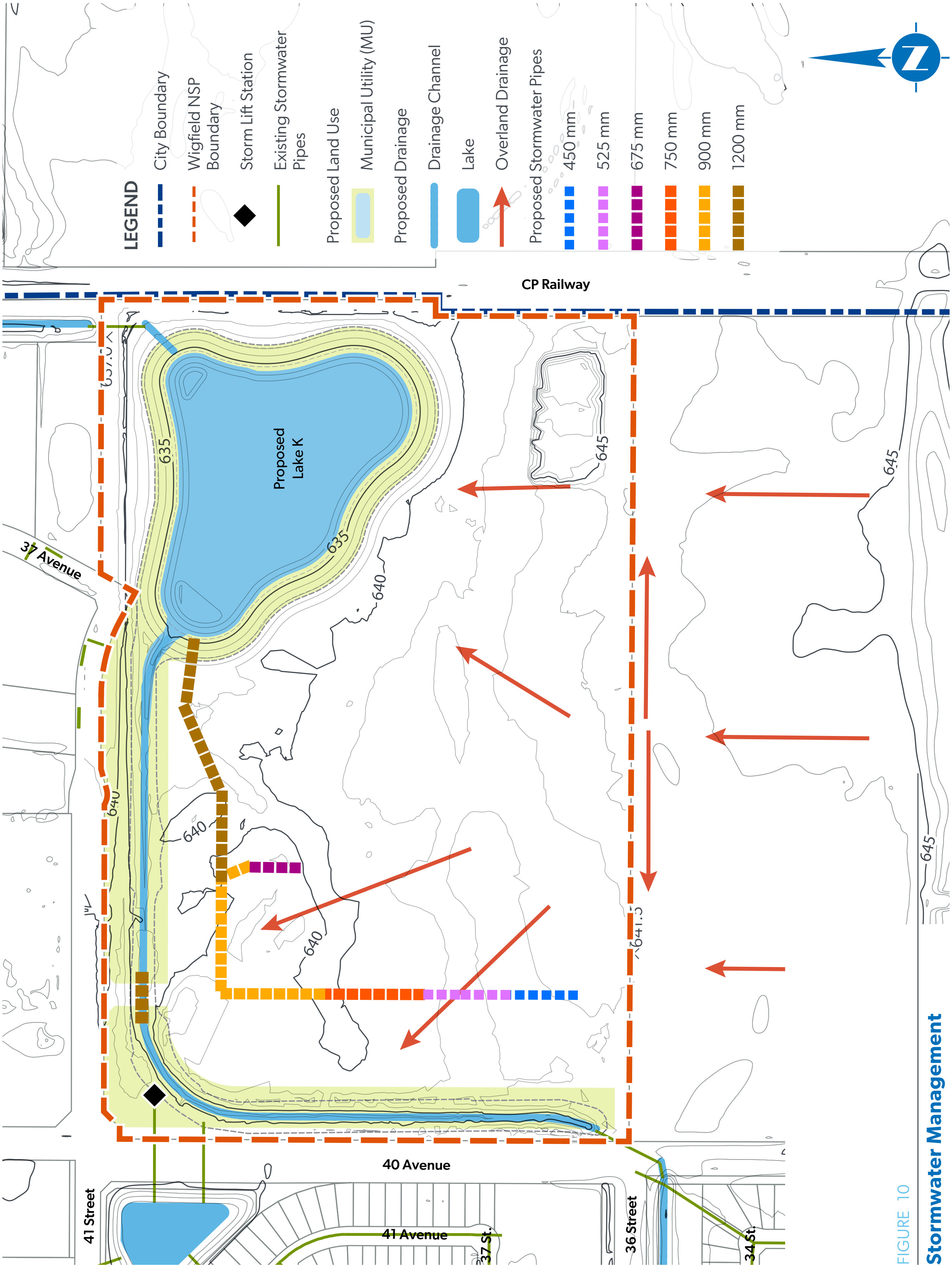


FIGURE 10

Stormwater Management

07 TRANSPORTATION

7.1 ACCESS, INTERNAL CIRCULATION & PARKING

Access to the Wigfield NSP area is proposed to be from 36 Street and 41 Street (see Figure 11). A collector road, future 39 Avenue, will extend south from 41 Street to 36 Street to provide access to the commercial retail lands fronting 40 Avenue as well as to the parking lot of the event facility. From the event facility parking lot access to the hotel and playing fields will be provided. An access to the parking lot associated with the four ball diamonds and pavilion contemplated for Phase 3 is provided from 36 Street at the southern boundary of the Wigfield NSP area. It is understood that the access from 36 Street into Phase 3 will be included as part of the Phase 3 development and, as such, is not contemplated at this time.

There are no internal circulation roads apart from the north-south Collector Road, i.e., future 39 Avenue, as discussed above. Circulation on the event facility site is via the parking lot and a number of multi-use walking trails that wind around and between the event facility, Lake K and the playing fields while providing connectivity to the future 39 Avenue, 36 Street and 41 Street.

The commercial retail lands fronting 40 Avenue have their own parking lots, which shall be oriented to the future 39 Avenue rather than to 40 Avenue. The parking lot for the event facility is expected to also provide parking to the playing fields, in addition to the Phase 3 playing field parking accessed via 36 Street discussed above. As of the writing of this NSP, a parking study was being undertaken by ISL Engineering and Land Services Ltd. to assess the number of parking stalls that ought to be provided to support the proposed event facility and adjacent playing fields. The results of that parking study were not available to be included in this NSP; however, will be presented to the City of Lloydminster upon completion.

In order to provide appropriate access to the Wigfield NSP area, the following roadway improvements are required:

- Upgrade 41 Street to a paved Urban Industrial / Commercial Roadway standard
  - 41 Street between 40 Avenue and approximately 200m east of 40 Avenue
- Develop 36 Street to a paved Urban Industrial / Commercial Roadway
  - 36 Street between 40 Avenue and approximately 100m east of 40 Avenue
  - Being developed to an Urban Industrial / Commercial Roadway, 36 Street will require storm sewer and associated appurtenances, i.e., catch basins to be incorporated to collect surface water as overland drainage will not be permitted.
- Develop 39 Avenue to a paved Urban Industrial / Commercial Roadway
  - 39 Avenue between 36 Street and 41 Street

7.2 TRAFFIC IMPACT ASSESSMENT

A Transportation Impact Assessment (TIA) was prepared by ISL in 2022 (see Appendix F) to provide an overview of the transportation implications anticipated from the proposed development of the Wigfield NSP area and to make recommendations for the internal and surrounding transportation network to support development. The TIA analyzed seven key intersections:

1. Intersection #1: 44 Street (Highway 16) and 37 Avenue
2. Intersection #2: 44 Street (Highway 16) and 40 Avenue
3. Intersection #3: 40 Avenue and 41 Street
4. Intersection #4: 40 Avenue and 36 Street
5. Intersection #5: 36 Street and Multiuse Recreational and Event Facility site access (future)
6. Intersection #6: 40 Avenue and 31 Street
7. Intersection #7: 40 Avenue and 25 Street (future)

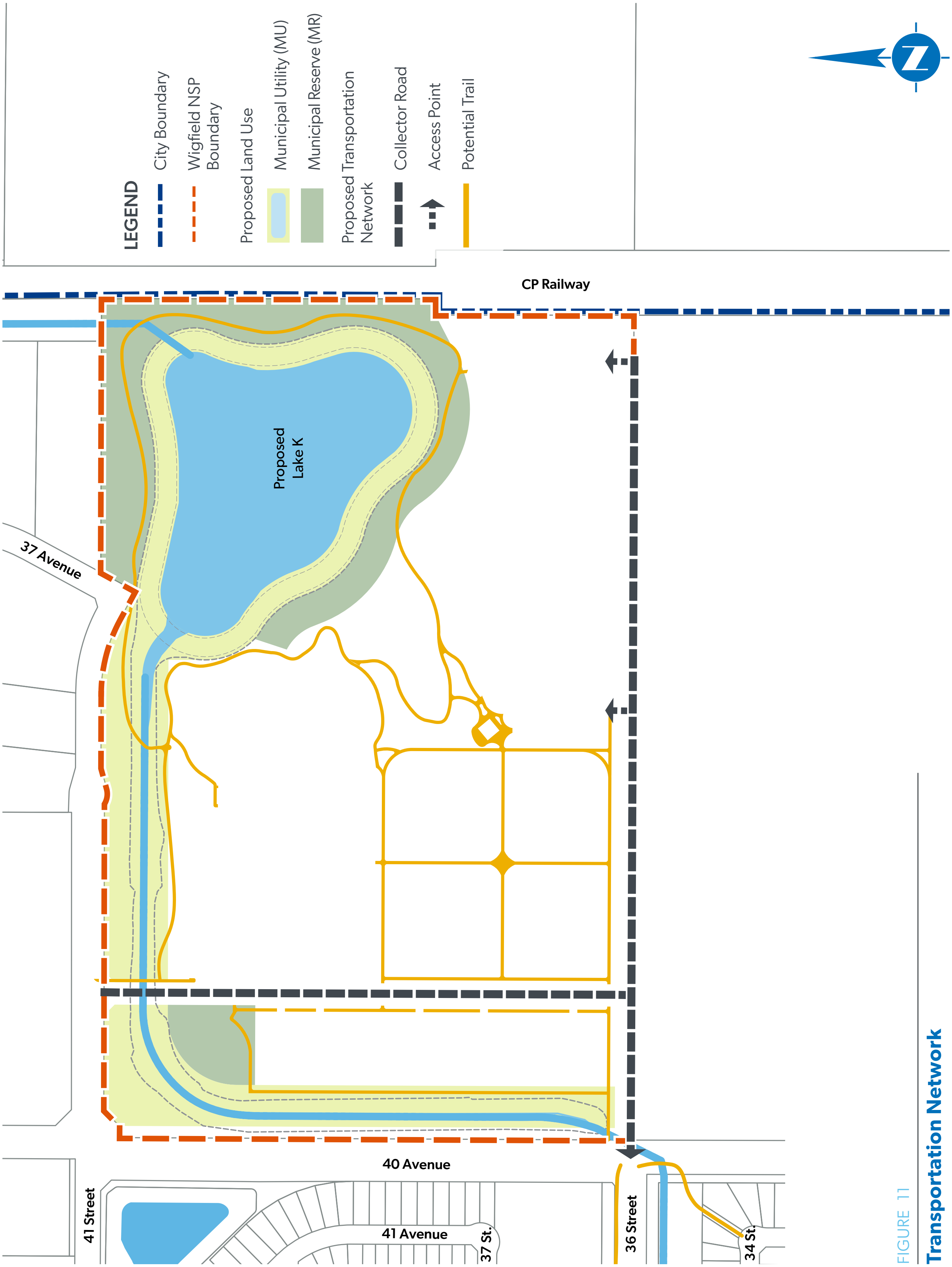


FIGURE 11

Transportation Network

A summary of the findings and recommendations are found below:

OPENING DAY OPERATIONS

The opening day traffic analysis indicates that the proposed development is not expected to have significant impact on the adjacent transportation network. All study intersections are expected to operate at an overall intersection Level of Service (LOS) of C or better on opening day, with the following recommended **intersection improvements**:

- 40 Avenue and 41 Street
    - Add traffic signals to implement a fully signalized intersection which is designed and constructed in accordance with the latest Alberta Transportation requirements and City of Lloydminster practices at the time of development.
    - Southbound approach: upgrade from a shared right-through-left lane to a shared through/right lane with a left turn bay with 70m of storage.
- 40 Avenue and 36 Street
    - Add traffic signals to implement a fully signalized intersection which is designed and constructed in accordance with the latest Alberta Transportation requirements and City of Lloydminster practices at the time of development.
- Future 39 Avenue and 36 Street
    - Add stop control on the southbound leg.
- Future 39 Avenue and 41 Street
    - Add stop control on the northbound leg.

The following improvements not triggered by the proposed development on Opening Day, but improve the overall flow of the transportation network and are therefore provided in the TIA for the City of Lloydminster's consideration:

- 37 Avenue and 44 Street traffic signals:
    - The northbound and southbound left turn movements are expected to operate at LOS E during the PM peak. This would generally trigger consideration for signalization; however, this would likely increase delays for other movements while only benefiting 35 vehicles. It is recommended that the City of Lloydminster maintain the two-way stop control at 37 Avenue and consider the merits of traffic signals should left turning volumes increase or other concerns arise.
- 40 Avenue and 36 Street:
    - Convert the southbound leg to a shared through/right lane and left turn bay. Like 41 Avenue, this would reduce the expected PM peak hour queue from approximately 100m to 75m. Queuing between 36 Street and 41 Street is less of a concern because there is a greater distance between the two streets. The City of Lloydminster may consider adding a left turn bay if delays and queuing become a concern in the future (ISL, 2022).

EVENT SENSITIVITY ANALYSIS

The TIA (ISL, 2022) also provided comment associated with an event sensitivity analysis to understand the impacts of the increased traffic during a major event on the local transportation network. In other words, when there is a major event, at what point will the required infrastructure improvements as identified within the Opening Day scenario, not be sufficient to address the short-term increase in traffic volumes attributable to a major event.

The event sensitivity analysis assumed that major events will typically take place during the evening hours after the average daily afternoon peak hour. It was further assumed that the traffic generated during a major event is based on the number of seats and the number of available parking stalls. A high-level analysis was undertaken assuming 2440, 3500 and 4000 guests and assumed that 10% of the trips generated by a major event were drop-offs. Additionally, the analysis assumed that the surrounding land uses attracted up to 75% of the afternoon peak hour trips at the start of a major event, but only contributed 25% of the trips at the end of the event.

The results of the event sensitivity analysis concluded that the Developer shall prepare a Traffic Management Plan for events where the number of attendees is expected to be greater then 2440 . This is due to the traffic movements at the Opening Day intersections expected to operate at a LOS F as well as long queuing, i.e., greater then 100m, that would impact adjacent intersection operations as a result from the increased volumes of a major event.

The following could be considered to improve traffic flow during an event and included within the Traffic Management Plan:

- 37 Avenue and 44 Street:
    - As in the Opening Day analysis, site generated traffic at this intersection is relatively low. One option is to temporarily prohibit left turning traffic at the intersection to improve traffic flow. In lieu of restricting left turns, traffic would be diverted to 40 Avenue which would impact the other study intersections but would also centralize event related traffic to one corridor.
- 40 Avenue and 44 Street, 40 Avenue and 41 Street, 40 Avenue and 36 Street:
    - Event specific timing plans could be employed to address operational issues at the intersection providing it is possible within the City of Lloydminster's traffic signal hardware and operational programs, including Centracs and Edaptive Module.

- 41 Street and 39 Avenue:
  - Temporarily convert the intersection to a four-way stop. This provides equal opportunity for traffic movements and results in a LOS D or better for all approaches for events with more then 2440 attendees.
  - Some movements are expected to be a LOS F with 3500 or 4000 attendees even as a four-way stop. At this point, a four-way stop with a flag person to direct traffic flow as needed could be considered.

Additionally, the TIA suggests that traffic flow would be generally improved with dedicated turn bays for turning onto and off 41 Street, or 36 Street from 40 Avenue; however, while this improvement is not triggered by the typical Opening Day scenario, it could be implemented by the City of Lloydminster in the future.

ULTIMATE HORIZON TRAFFIC OPERATIONS

The Ultimate Horizon includes the development of the south parcel, as identified within the Wigfield ASP and is expected 55 years into the future. At this stage, the analysis shows that the intersection of 40 Avenue and 44 Street may not be able to accommodate the increased demand, with a Level of Service F during the PM peak, and long delays and queuing are anticipated. All the other intersections are expected to operate within performance thresholds during the AM and PM peaks. The north site access at 41 Street is recommended to be signalized at the Ultimate Horizon.

The Functional Study prepared for 40 Avenue assumed a population horizon of 100,000. This study identified a number of improvements to area roadways that the Wigfield TIA analysis found to be unnecessary, and it is recommended that the City of Lloydminster revisit the population horizon of the 40 Avenue Functional Study.

The following intersection improvements are required to support Ultimate Horizon:

- Future 39 Avenue and 41 Street
  - Add traffic signals to implement a fully signalized intersection which are designed and constructed in accordance with the latest Alberta Transportation requirements and City of Lloydminster practices at the time of development.
- Reduced number of lanes at 25 Street and 40 Avenue, as shown in Exhibit 5.2 (found on page 22 of the TIA, which is found in Appendix F of this NSP).
- Revisit the 40 Avenue Functional Study Ultimate Horizon recommendations. Review the assumptions and inputs for recommended improvements to ensure they are still relevant before moving forward with the improvements.
  - Consider an eastbound right turn auxiliary lane at 40 Avenue and 44 Street to accommodate high estimated turning volumes. The City of Lloydminster may consider reviewing right-of-way requirements plan to either acquire or reserve the additional lands required (ISL, 2022).

7.3 ACCESS MANAGEMENT

The recommended access spacing for the future 39 Avenue from 40 Avenue is summarized below:

- 41 Street and the future 39 Avenue intersection
  - Minimum 100m from 40 Avenue. This provides space for the 90m right turn storage anticipated at the Ultimate Horizon.
- 36 Street and the future 39 Avenue intersection
  - Minimum 60m from 40 Avenue. The turn bay storage anticipated for the Ultimate Horizon is less than 60m.

FUTURE MOBILITY

The TIA makes a number of recommendations regarding future mobility options, excerpted below:

- Ensure high quality active mode connections between the plan area and adjacent neighbourhoods as well as between the neighbourhood zones and the Multiuse Recreational and Event Facility site.
- Ensure high-visibility pedestrian crossings are provided on 40 Avenue based on the Transportation of Canada's Pedestrian Crossing Control Guide.
- Consider local transit services to reduce roadway demand.
- The City of Lloydminster should remove the plan area's designation as a Truck Route Area prior to development as this no longer aligns with the future land use (ISL, 2022).

40 AVENUE: DANGEROUS GOODS AND TRUCK ROUTE

The primary access road to the Wigfield ASP lands is from 40 Avenue, which is currently one of the City of Lloydminster's key Dangerous Goods and Truck Routes as identified within the Dangerous Goods Route and Truck Routes Establishment (ISL 2020). With a proposed change in land use from industrial use to commercial and recreational uses within the Wigfield NSP area, continued use of 40 Avenue as a Dangerous Goods and Truck Route may not be appropriate.

It is recommended that further investigation into the use of 40 Avenue as a Dangerous Goods and Truck Route shall be completed by the City of Lloydminster as development progresses along 40 Avenue south of 41 Street in an effort to identify potential user conflicts and safety challenges.

7.4 TRAILS SYSTEM

The Wigfield NSP area proposes a number of multi-user walking trails that connect to the existing trails system adjacent to the plan area. The surface is proposed to meet the City of Lloydminster's Municipal Development Standards with a minimum 3m wide paved surface. The trails are identified as linear park space and may qualify as Municipal Reserve (MR). Additionally, there is a multi-use walking trail proposed to parallel the East Drainage Channel which will be designated as MR.

08 POLICIES

8.1 SEDIMENTATION CONTROL

The Developer shall provide an erosion and sediment control plan prior to the commencement of construction and ensure that the Developer implements said plan during all applicable phases of construction.

8.2 GEOTECHNICAL ANALYSIS

The Developer shall undertake further assessment of the site in coordination with development of Lake K to delineate the extent of sodium and chloride impacts to the groundwater at the site.

The Developer shall provide a more detailed/targeted geotechnical investigation once site design and site layout details are confirmed.

The Developer shall provide evidence of the suitability of shallow footings at specific locations via site-specific geotechnical investigation at detailed design stage(s), to the satisfaction of the City.

8.3 WEED CONTROL

The Developer shall control invasive, noxious and restricted weed species prior to the commencement of construction and ensure that equipment and vehicles are not parked/stored on weed infested grounds unless the weeds are first controlled.

8.4 WILDLIFE IMPACT MITIGATION

The City of Lloydminster should require the Developer to employ noise abatement equipment during construction to limit the transmission of noise beyond the site that may impact wildlife.

8.5 PARKING

The Developer shall provide the City of Lloydminster with the parking study upon completion.

The City of Lloydminster shall require that on-site parking for the commercial retail lands along the future 39 Avenue be oriented towards the street rather than fronting 40 Avenue.

8.6 LANDSCAPING

The Developer shall provide detailed landscaping plans, prepared by a qualified professional, in support of the development permit application.

8.7 MUNICIPAL RESERVE

The City shall designate the trail along the East Drainage Channel as MR.

8.8 DEVELOPMENT PHASING

The City of Lloydminster may not require an amendment to this NSP for changes in the sequence of development (see Figure 7) if sufficiently supported by market analysis and/or known budgetary constraints.

8.9 SERVICING

The Developer shall upgrade the water distribution system as identified in the ISL Neighbourhood Structure Plan Servicing Study, 2023, found in Appendix E.

The Developer shall upgrade the wastewater collection system as identified in the ISL Neighbourhood Structure Plan Servicing Study, 2023, found in Appendix E.

8.10 TRANSPORTATION NETWORK & MOBILITY

The Developer shall implement the require improvements to the transportation network as identified in the ISL Traffic Impact Assessment, 2022, found in Appendix F.

The Developer shall implement the recommended improvements to improve flow of the transportation network, as identified in the ISL Traffic Impact Assessment, 2022, found in Appendix F.

The Developer shall implement the recommended improvements to improve future mobility, as identified in ISL Traffic Impact Assessment, 2022, found in Appendix F.

09 IMPLEMENTATION, MONITORING & AMENDMENT

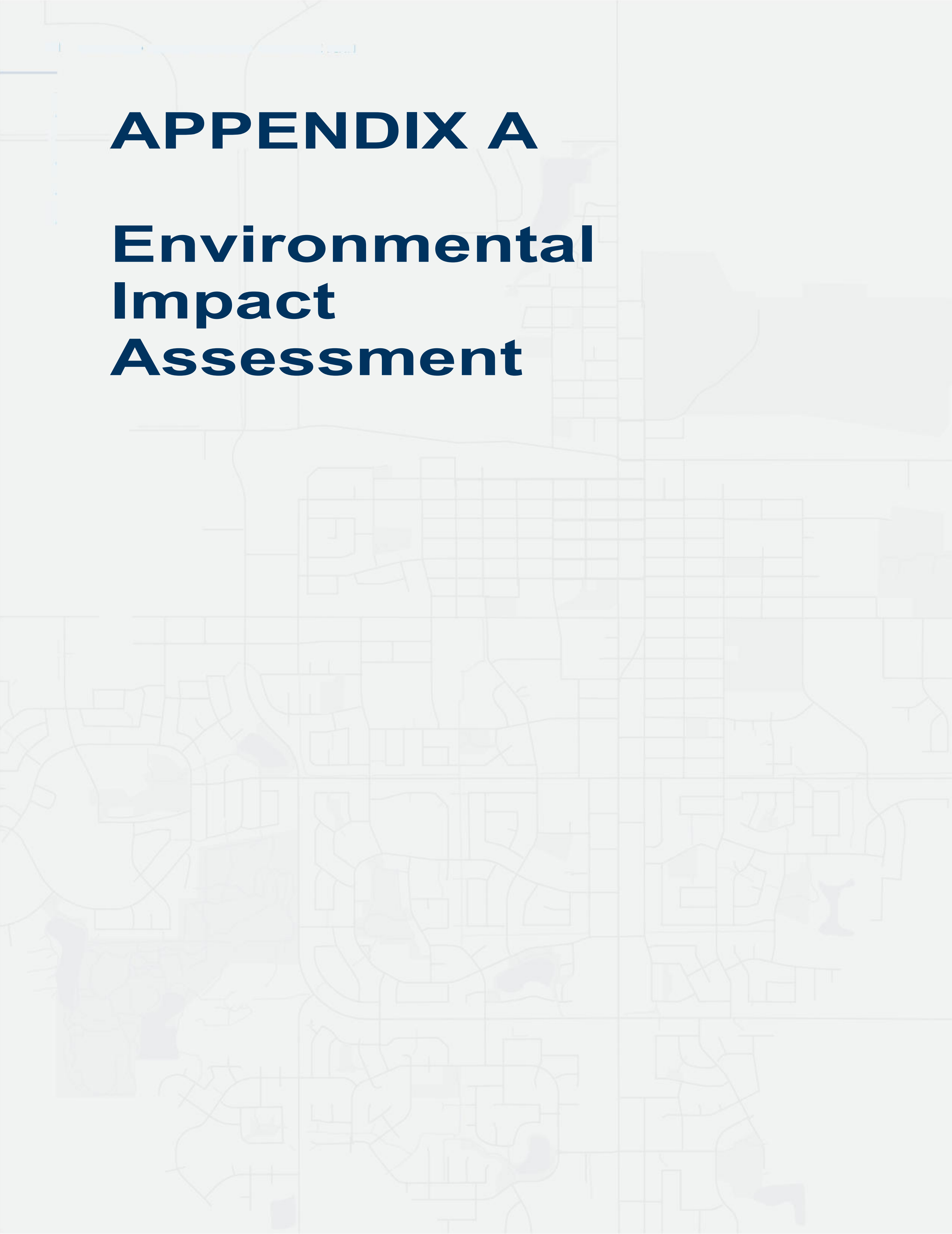
The NSP will be implemented through the redistricting, subdivision and development processes. Administration will monitor the plan for consistency with the Wigfield ASP over time and may recommend amendments as deemed necessary.

Developer-driven amendments may also be requested, with all associated costs of processing said amendments being the responsibility of the developer. All amendment to the NSP will be reviewed and processed in accordance with Policy 610-02.

APPENDICES

APPENDIX A

Environmental Impact Assessment



Desktop Environmental Impact Assessment for the Wigfield ASP Amendment

City of Lloydminster

FINAL REPORT

April 2022

ISL Engineering and Land Services Ltd. Is an award-winning full-service consulting firm dedicated to working with all levels of government and the private sector to deliver planning and design solutions for transportation, water, and land projects.

Proudly certified as a leader in quality management under Engineers and Geoscientists BC's OQM Program from 2014 to 2021.

Table of Contents

APPENDICES

TABLES

FIGURES

1.0 Introduction

1.1 Environmental Impact Assessment Contents

As described in the Municipal Development Plan (MDP) 2013-2032 (Parioplan 2013), an Environmental Impact Assessment (EIA) is required for any proposed development that may have an environmental effect. As this Area Structure Plan (ASP) includes turning primarily agricultural lands into a developed area containing recreational, residential, commercial and industrial infrastructure, an EIA is required.

EIA's may include, but not be limited to:

- A project description including its purpose, alternatives and staging requirements.
- A description of the biophysical development affected e.g., site conditions and topography including natural and man-made constraints to development).
- A prediction of effects that the project may have on the biophysical environment
- Limitations of the study, criteria used in any predictions, and interests consulted
- Recommendations and mitigation measures
- A framework for decision makers to determine the final course of action.

Lloydminster is uniquely positioned as a cross border city, however the Wigfield ASP is located on the Saskatchewan side of the border and relevant Saskatchewan information and legislation is discussed in this report. Notably, the Saskatchewan Water Shed Authority Act (2005) is in force within the jurisdictional boundaries of the City of Lloydminster.

The EIA of the Project (Figure 1.1) uses desktop level analysis to identify potentially sensitive biological and physical features on or adjacent to the Study Area that have potential to be impacted by the Project; the study area is defined as within 2.0 km of the Project footprint (Figure 1.2). Included in this report is baseline environmental conditions pertaining to current land use, existing site conditions, potential vegetation communities, potential wildlife habitat, as well as species and areas of management concern. A field visit was not conducted and as such, historical photography and google streetview taken in summer conditions are used where available.

1.2 Project Description

ISL Engineering and Land Services Ltd. (ISL) has been retained by The City of Lloydminster (The City) to conduct a desktop EIA (Parioplan 2013), as part of the Wigfield ASP amendment (the Project), depicted on Figure 1.1. The amendment is to include accommodations for an Event Arena and consider appropriate adjacent land uses given this. The original Wigfield ASP was conducted by Select Engineering (2014).

The Project is located at NW and SW 36-49-28 W3M. The ASP area is bounded by 40 Avenue on the west, 41 Street on the north and Lloydminster city limits on the south and east. The Wigfield ASP lands are currently agricultural. Within the agricultural area there is a storm water management facility, dugouts and 3 residences. There is an area of disturbance and access road located within the agricultural lands at approximately 36 Street which is described in the Wigfield ASP as a radio tower site (Select 2014). There is an abandoned former sweet gas well described as located within the 40 Avenue right-of-way, and which has been reclaimed (Select 2014). Construction will begin with the event centre, located north of 36 Street.

FIGURE 1.1
PROJECT AREA
WIGFIELD ASP

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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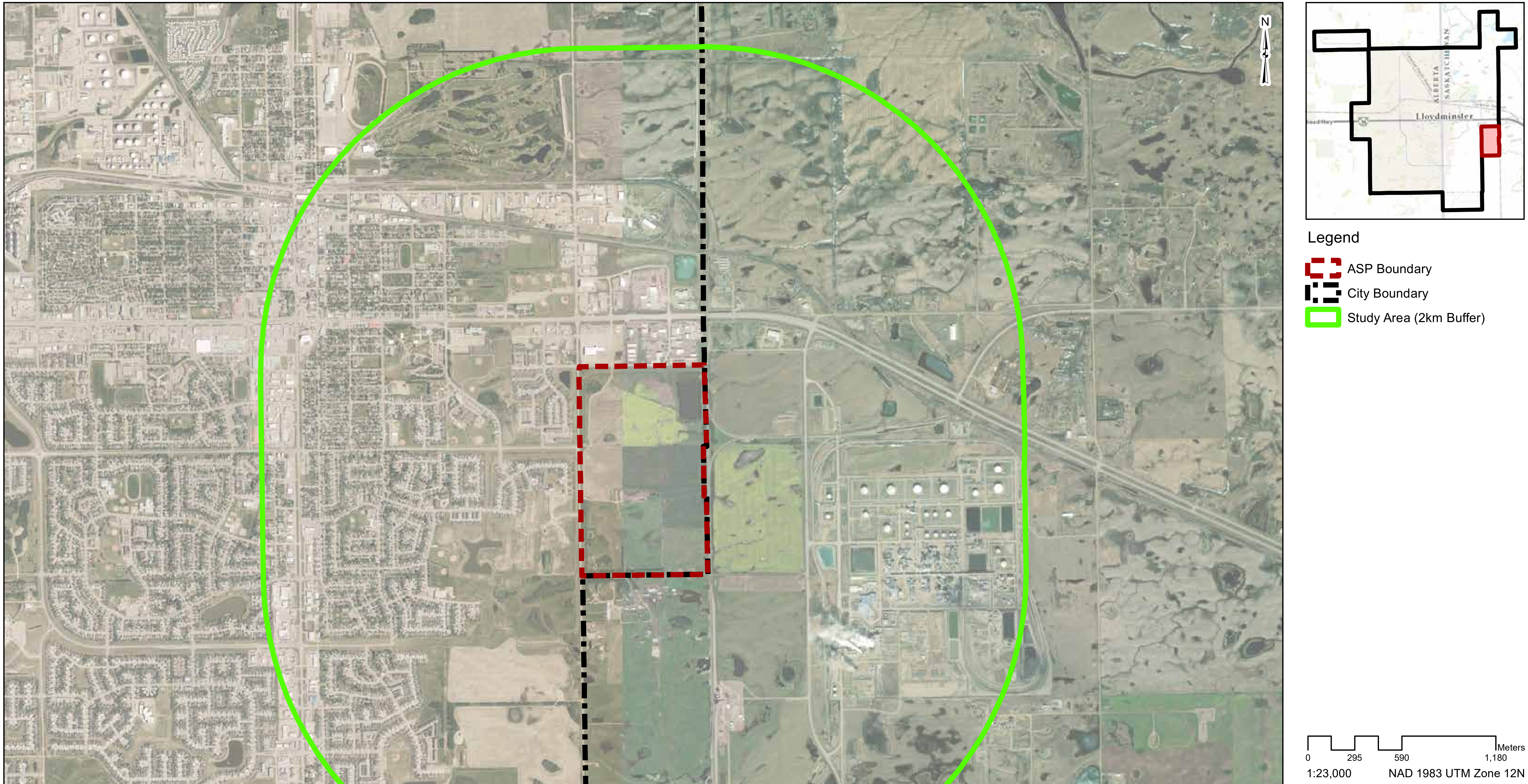

FIGURE 1.2
PROJECT STUDY AREA
WIGFIELD ASP

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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2.0
Biophysical Elements

2.1 Desktop Methodology

Wildlife species and vegetation elements of management concern are any that meet the following criteria:

- Species for which provincial and/or federal restricted activity periods or setback distances exist (Environment and Climate Change Canada 2018);
- Species listed to be of Special Concern, Threatened or Endangered under the *Species at Risk Act* (*SARA*) *(*Government of Canada, 2002) or in the *Wildlife Act* (Government of Saskatchewan 1998)
- Previously identified fish and wildlife species provided by HABISask and listed in the *Wildlife Act* (SK CDC 2022a, Government of Saskatchewan 1983); and
- Rare vegetation species listed on HABISask (SK CDC 2022a).

Additional biophysical elements have been included if thought to be of potential concern given the biophysical elements present or potentially present in the ASP area.

2.1.1 Vegetation

HABISask (Hunting Angling and Biodiversity Information) element occurrence data was reviewed to identify known rare plant and rare ecological community occurrences in the 2km study area of the ASP. For invasive species, iMapInvasives was used to identify any potential concerns with invasive species in the ASP.

2.1.2 Wildlife

ISL conducted a review of the HABISask database for Saskatchewan to determine known species and wildlife protection area occurrences within a 2 km radius in the 2km Study Area.

2.1.3 Fish

To determine the presence of fish, and potential for fish habitat in the ASP area, a review of the HABISask database for Saskatchewan was conducted.

2.1.4 Soil

Saskatchewan Soil Capability classification is interpretive, often based on existing information and not field studies. The Soil Index describes the limitations of soils affecting agricultural use. Classes 1-3 are considered suitable for crops, 4 are considered marginal and 5-7 are suitable as pasture (Shields et al. 1968). The HABISask Database was queried to determine the Soil Index value (Appendix A).

2.1.5 Wetlands

The HABISask database was assessed for potential water features by examining contour lines to gain an understanding of the number, size, and location of potential wetlands. To further identify wetlands, an assessment of historical photographs and satellite imagery was completed.

Wetland Classification

Wetlands are areas where the soil is inundated with water at an ephemeral to permanent time scale, such that the soils become reduced (i.e., hydric) and hydrophytic vegetation is dominant. Based on hydrologic, ecological, and soil (e.g., biogeochemical) properties, wetlands can be further grouped and classified. The methodology used to classify wetlands for the Project was based on the Stewart and Kantrud (1971) Wetland Classification System Please refer to Table 2.1.

Table 2.1: Wetland Classification

System	Class	Type		
		Salinity	Water Permanence[1]	Plant Community Zone
S&K	Class I - Ephemeral ponds	-	Surface water present after snowmelt in most years for only a brief period of time	Low Prairie Zone
S&K	Class II - Temporary ponds	-	Surface water present after snowmelt or heavy rainfall	Wet Meadow
S&K	Class III - Seasonal Ponds	-	Surface water present in growing season, gone by end of the summer	Shallow Wetland
S&K	Class IV - Semi-permanent ponds	-	Surface water present year round in the majority of years unless in drought conditions	Deep Wetland
S&K	Class V - Permanent Ponds	-	Surface water present in all years including drought conditions	Open water
S&K	Class VI - Alkali ponds	High concentration of salts and dominated by salt tolerant plants	Intermittent	Alkaline

1. See Classes discussion by Stewart and Kantrud (1971).

2.2 Results of the Desktop Review

2.2.1 Land Use and Habitat

Ecoregion and Landscape Area

The Aspen Parkland Ecoregion is a mosaic of aspen stands and fescue prairies. Aspen concentration becomes more pronounced as one moves northward in the ecoregion. Typically, the aspen stands will occur in moister areas such as valley bottoms and north facing slopes and hillsides. Fescue dominated grasslands will occur in drier and southward facing slopes (SK CDC 2020). The Project occurs in the Lloydminster Plain Landscape Area (H1). The plain is nearly level, although morainal uplands such as Eagle Hills and valleys such as the Big Gully Coulee occur within the Landscape Area. Most of the Lloydminster Plain is cropland for cereals (Padbury et al. 1998).

Local Habitat

Vegetation within the ASP area is mainly cultivated. Interspersed within is numerous wetlands, and treed areas including treed wetlands. The treed areas are photo interpreted to be dominated by Aspen. The windrow on the Little Pine (south portion) of the ASP is dominated by various species of planted coniferous trees. Photo plates of habitats taken by Google Streetview in September 2018 are provided in Appendix B.

2.2.2 Vegetation

Rare Species

No rare vascular or non-vascular species (i.e., bryophytes or lichens) occurrences are present in the ASP area (SK CDC 2022b). The output from the publicly available database is provided in Appendix C. The nearest historical occurrence (with the 2km Study area) is located within city limits of Lloydminster in a developed area and is unlikely to be currently present given apparent development.

None of the plant species known to occur within the 2km Study Area are listed in the *SARA* public registry, or the *Wildlife Act* and regulations (Government of Canada 2022, Government of Saskatchewan 1998). A listing of rare vascular vegetation species known to occur in the H1-Lloyminster plain is provided in Table 2.2 below.

Table 2.2: Rare Vascular Vegetation Species in the H1- Lloydminster Plain Landscape Area

Common Name	Scientific Name	Provincial Rank[1]	Global Rank[2]
Vascular Plants			
Achnatherum nelsonii ssp. dorei	Columbia Needlegrass	S3	G5T5?
Antennaria dimorpha	Low Pussytoes	S3	G5
Botrychium pallidum	Pale Moonwort	S1	G3
Carex eburnea	Bristle-leaved Sedge	S3	G5
Cirsium drummondii	Short-stemmed Thistle	S3	G5
Corallorhiza striata var. striata	Striped Coral-root	S3	G5T5
Corispermum villosum	Hairy Bugseed	S2	G4?
Cypripedium parviflorum var. makasin	Small Yellow Lady's Slipper	S3	G5T4T5
Danthonia californica	California Oat Grass	S3	G5
Eleocharis elliptica	Slender Spike-rush	S3	G5
Festuca hallii	Plains Rough Fescue	S3	G5

Common Name	Scientific Name	Provincial Rank[1]	Global Rank[2]
Gentiana fremontii	Moss Gentian	S3	G3G4
Geranium carolinianum	Carolina Wild Geranium	S3	G5
Geranium viscosissimum	Sticky Purple Geranium	S2	G5
Lactuca biennis	Tall Blue Lettuce	S3	G5
Lilium philadelphicum var. andinum f immaculata	Immaculate Lily	S1	G5TUQ
Lomatogonium rotatum var. fontanum	Marsh Felwort	S3	G5TNR
Monarda fistulosa var. mollis	Soft Wild Bergamot	S3	G5T5?
Nothocalais cuspidata	Prairie False-dandelion	S3	G5
Piptatherum canadense	Canada Mountain-ricegrass	S3	G4G5
Poa fendleriana ssp. fendleriana	Mutton Grass	S3	G5T5
Potentilla concinna var. concinna	Early Cinquefoil	S2	G5T4G5
Potentilla lasiodonta	Sandhills Cinquefoil	S2	G3
Ranunculus pedatifidus var. affinis	Northern Buttercup	S3	G5T5
Schedonnardus paniculatus	Tumble Grass	S3	G5
Silene menziesii	Menzies' Catchfly	S3	G5
Sisyrinchium septentrionale	Northern Blue-eyed-grass	S3	G4
Viola pedatifida	Crowfoot Violet	S3	G5

Source: Saskatchewan Conservation Data Centre (2022)

1. S1 (Critically Imperiled): Five or fewer occurrences, or especially vulnerable to extirpation due to other factor(s).
   S2 (Imperiled): Twenty or fewer occurrences, or vulnerable to extirpation due to other factor(s).
   S3 (Vulnerable): One hundred or fewer occurrences, or somewhat vulnerable due to other factors, such as restricted range, relatively small population sizes, or other factor(s).
   S4 (Apparently Secure): Uncommon but not rare; potentially some cause for long term concern due to declines or other factors.
   S5 (Secure): Common, widespread, abundant.
   B: Breeding.
   S_S_: Denotes the range of uncertainty about the status rank of the element.
   SNA: Not Applicable because the species or ecosystems is not a suitable target for conservation activities (e.g., introduced species).
   T (Tracked): Current information suggest species is rare or of conservation concern.
   ? (Inexact numeric rank): Denotes inexact numeric rank; this should not be used with any of the Variant Global Conservation Status Ranks or GX or GH.
2. Global (G) ranks are based on species status world-wide and follow a system parallel to Provincial Ranks (Note 1).

Weeds

Plants designated as Prohibited, Noxious or Nuisance in Saskatchewan are listed in Schedule I, II and III of the Ministerial Order for designation of Prohibited, Noxious and Nuisance weed in Accordance with the *Weed Control Act* (Government of Saskatchewan 2010a,b). A search of the iMAPInvasives Database produced no results for within the ASP (Appendix D). Species known to be present are provided listed by the Saskatchewan Conservation Data Centre (2014) and are provided in the table below.

Table 2.3: Weeds in Saskatchewan

Common Name	Scientific Name
Common burdock	*Arctium minus*
Absinthe	*Artemisia absinthium*
Japanese Brome	*Bromus japonicus*
Downy Brome	*Bromus tectorum*
Flowering Rush	*Butomus umbellatus*
Heart-pod Hoarycress	*Cardaria draba*
Nodding Thistle	*Carduus nutans*
Spotted knapweed	*Centaurea stoebe ssp. micranthos*
Canada Thistle	*Cirsium arvense*
Field Bindweed	*Convolvulus arvensis*
Common Hound's-tongue	*Cynoglossum officinale*
Leafy Spurge	*Euphorbia esula*
Baby's-breath	*Gypsophila paniculata*
Dame's Rocket	*Hesperis matronalis*
Common Frogbit	*Hydrocharis morsus-ranae*
Himalayan Balsam	*Impatiens glandulifera*
Field Scabious	*Knautia arvensis*
Kochia	*Kochia scoparia*
Long-stalk Hoarycress	*Lepidium appelianum*
Oxeye Daisy	*Leucanthemum vulgare*
Yellow Toadflax	*Linaria vulgaris*
Purple Loosestrife	*Lythrum salicaria*
Scentless Chamomile	*Matricaria perforata*
Wild Parsnip	*Pastinaca sativa*
European Buckthorn	*Rhamnus cathartica*
Russian Thistle	*Salsola kali*
White Cockle	*Silene latifolia*
Bladder Campion	*Silene vulgaris*
Perrenial Sowthistle	*Sonchus arvensis*
Salt Cedar, Tamarisk	*Tamarix spp.*
Common Tansy	*Tanacetum vulgare*
Common Dandelion	*Taraxacum officinale*

Source: Saskatchewan Conservation Data Centre (2014)

2.2.3 Wildlife

2.2.4 Important Wildlife Habitats

The ASP is not located within or adjacent to any Ramsar wetlands (Bureau of the Convention on Wetlands 2014), World Biosphere Reserves (UNESCO 2015), Western Hemisphere Shorebird Reserves (WHSRN 2019), Important Bird Areas (IBAs) (Bird Studies Canada and Nature Canada 2015), Ducks Unlimited Canada Projects (DUC 2022), Migratory Bird Sanctuaries or National Wildlife Areas (Environment and Climate Change Canada 2021).

The ASP is not located within or adjacent to any provincially-identified parks, ecological reserves, Saskatchewan *Wildlife Habitat Protection Act* (WHPA) lands, Fish and Wildlife Development Fund lands or Agriculture and Agri-Food Canada (AAFC) Community Pasture Program (CPP) lands (AAFC-CPP lands) (SK CDC 2022; Appendix E).

The ASP is within a North American Waterfowl Management Plan (NAWMP) Target Landscape (Government of Saskatchewan 2015). The Saskatchewan Water Security Agency encourages land owners to participate in a voluntary stewardship agreement where conservation is recognized through a certificate of appreciation.

2.2.5 Rare Wildlife Species

A search of the HABISask database determined that one occurrence of a rare vertebrate animal, and one occurrence of an invertebrate and no occurrences of animal assemblages are located within the ASP area. Five additional vertebrate animal occurrences are within the 2km Study Area, approximately 2 km from the ASP (SK CDC 2022) (Appendix C).

The one vertebrate species with a record overlapping ASP is listed on Schedule 1 of the *Species at Risk Act* as Endangered. This species is not listed in the Saskatchewan Wildlife Species at Risk Regulations (Government of Saskatchewan 1983).

2.2.6 Invasive Wildlife Species

Invasive wildlife species as listed by the Saskatchewan CDC are provided in Table 2.4 below.

Table 2.4: Invasive Wildlife Species in Saskatchewan

Common Name	Scientific Name
Rock Pigeon	*Columba livia*
Common Carp	*Cyprinus carpio*
House Sparrow	*Passer domesticus*
Gray Partridge	*Perdix perdix*
Ring-necked Pheasant	*Phasianus colchicus*
Wild Boar	*Sus scrofa*

Source: Saskatchewan Conservation Data Centre (2014)

2.2.7 Fish and Fish Habitat

The ASP area is located in the Southern Fishing Zone (SK CDC 2022) (Appendix F). Potential fish habitat in the ASP area is limited to waterbodies which contain water on a year-round basis and do not freeze to the bed, of which the ASP area contains potential in the Storm Water Management Facility (SWMF) in the north east portion of the ASP. The HABISask Database for Saskatchewan does not contain fisheries data in the ASP, however the absence of data does not equate to an absence of fish (SKCDC 2022).

Although the SWMF is unlikely the contain fish, there is still potential for fish to occur given the presumed depth and size of the waterbody.

2.2.8 Soil

Soils in the H1 Landscape Area are dominantly Black Loam with Dark Gray and Gray Luvisolic soils in heavily treed north facing slopes (Padbury et al. 1998). The soil is classified Index 2 in the Saskatchewan Soil Capability Index (SK CDC 2018). Soils in this class have moderate limitations that reduce the choice of crops or require moderate conservation practices (Shields et al. 1968).

2.2.9 Wetlands

In the ASP, 28 wetland features were desktop identified, delineated, and Classed using current and historical aerial photography and imagery (Appendix G). Wetlands include Marshes and Swamps. Three Artificial features were also identified in the ASP area; dugouts and a SWMF complex (Figure 2.1). Table 2.5 summarizes the results of the desktop historical photograph interpretation within the Area.

Figure 2.1 below illustrates the probable extents and locations of wetlands existing in the ASP currently, based on the combination of current ESRI Imagery and historical photography. Note that one infilled wetland feature is included as it was only recently filled and work appears to be ongoing.

Table 2.5: Desktop Wetland Assessment Results[1]

Wetland Description[1]	S&K Class	Number of Features	Area (ha)
Artificial	-	2	0.5
Disturbed	-	1	0.3
Wetland -SWMF Complex	-	1	6.9
Prairie Pothole Region Wetlands	I	5	0.2
	II	10	2.9
	III	6	3.4
	IV	0	-
	V	0	-
	VI (Alkaline)	0	-
Swamp	-	6	1.7
Total:		**31**	**15.9**

Notes:

1. This table is an estimate of wetland numbers and types based on the most current imagery available and visible presence of potential wetlands in historical photography (Figure 2.1). Fieldwork during the growing season is recommend for confirmation.
2. Wetlands that contain more than one Class are considered complexes. In this case the SWMF is complexed with a mineral wetland (Class III)

Legend

- ASP Boundary

Potential Wetlands (Desktop)

- 🟥 Dugout
- Class I
- Class II
- Class III
- SWMF complex
- now infilled
- swamp

1:5,700

NAD 1983 UTM Zone 12N

FIGURE 2.1
WETLANDS
WIGFIELD ASP

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Date: 2022-05-05 Document: V:\Projects\28059_WigfieldASP\03_EnvReportFigures\Fig2.1_wetlands\28059_Figure_2.1_wetlands.mxd

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3.0
Effects on Biophysical Elements

3.1 Study Limitations

Aerial imagery interpretation is an effective way to identify biophysical features such as wetlands during project planning stages. However, some biophysical features may not be evident on imagery and to be appropriately assessed, fieldwork should be conducted during an appropriate time of the year. Examples include wildlife such as birds, mammals, reptiles, and rare plants.

Pertaining to wetlands, the inconspicuous physical characteristics of some wetlands may have potentially hindered their identification during interpretation due to their small size or often temporary and seasonal occurrence especially on agricultural land. Additionally, Swamp wetlands are particularly difficult to differentiate from wet forest during imagery interpretation. Due to the limitations of imagery interpretation, the wetland location, size, and Class provided in Section 2 above should be used as a guideline for planning purposes only.

The absence of data available in provincial databases does not equate to the absence of species in an assessment area. Databases can only confirm presence of a species at a particular moment at the time of collection.

3.2 Prediction of Effects on Biophysical Elements

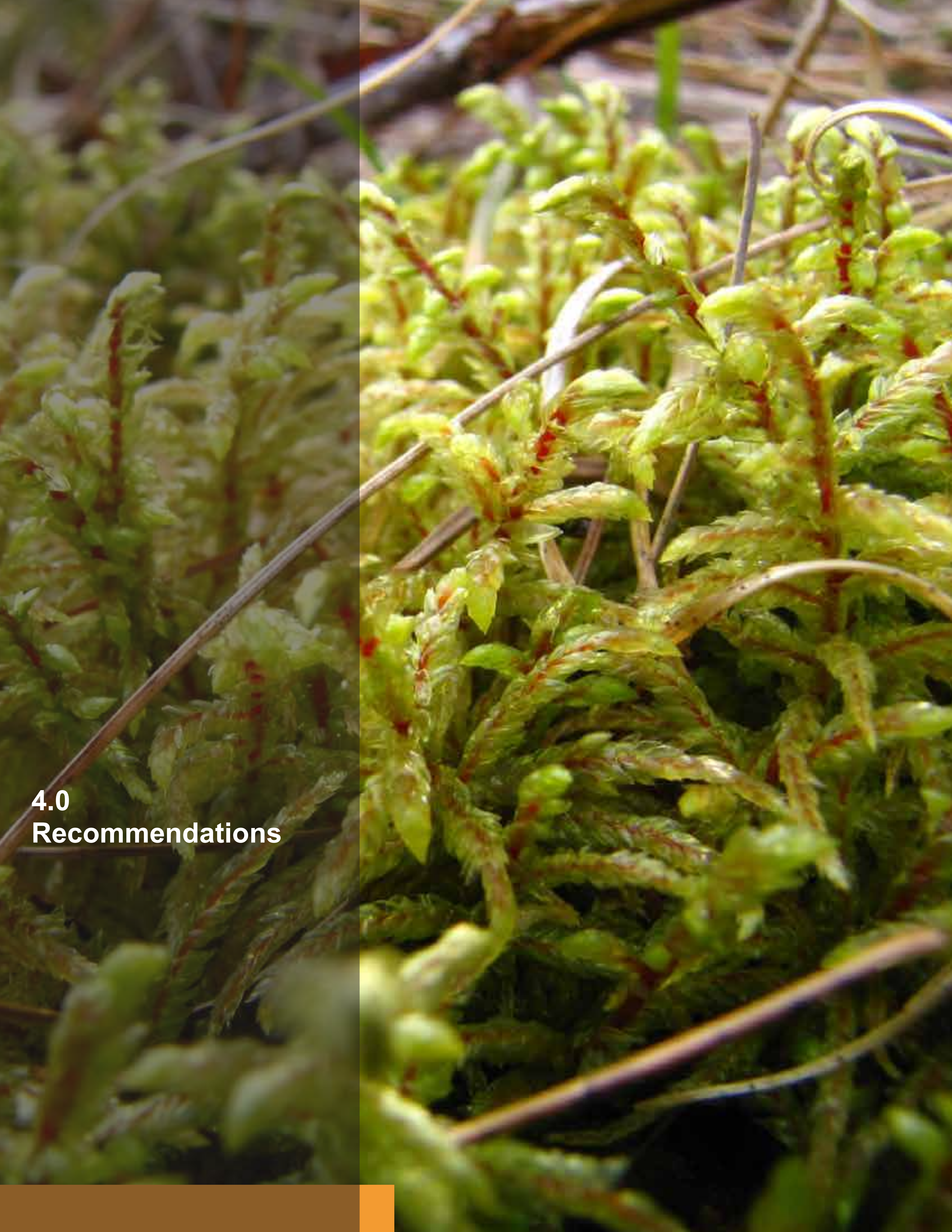
Table 3.1 describes potential impacts that may occur as a result of infrastructure (residential, commercial, industrial and institutional) development within the ASP area.

Table 3.1: Potential Biophysical Effects

Potential Biophysical Impacts of Development in the ASP Area				
Environmental Elements	**Description of Interaction (How, When, Where, Positive, Negative)**	**Type of Potential Impact**	**Mitigation Recommendations**	**Potential Residual Adverse Impact**
Topography	Topography along the ASP Area is generally flat with depressional wetland areas. Topography is likely to change with development.	There is a risk for erosion and sedimentation across the ASP area where vegetation will be stripped. Water management will be critical if wetlands are infilled.	Implement an erosion and sediment control plan and a water management plan.	Loss of natural landscape contours, alteration of surface drainage patterns.
Hydrogeology/ Groundwater	Construction of infrastructure in the ASP area has the potential to interact with groundwater. Groundwater is expected to be a muted representation of surface water and surface water is present in multiple locations in the ASP.	If permanent earthworks occur, this may cause a change in groundwater quality and/or quantity during construction and flow, post construction.	Implement a groundwater monitoring plan, implement erosion and sediment control as well as a spill response plan.	Alteration of groundwater flows, potential for contamination.
Aquatic Resources	Wetlands, a SWMF and dugouts occur within the ASP. Construction has potential to interact with these aquatic resources.	Earthworks may cause a temporary change in surface water quality during construction. Loss of aquatic habitat area may occur.	Flag or fence off waterbodies that are not to be disturbed, include a buffer for protection from sedimentation (e.g., silt fence).	If wetland or waterbodies are infilled, loss of aquatic and shoreline habitat will occur.

Soils	Earthworks will occur during the construction of the Project. Admixing of soils has potential to occur as does erosion and sedimentation. Soils from outside the project may be brought in.	Loss of topsoil, erosion and sedimentation. Potential admixing. It is unknown if soils have contamination issues.	-Implement an erosion and sediment control plan. - Machibroda (2012) recommended a Phase II ESA be conducted. Conduct an Environmental Site Assessment (Phase II) to determine potential contamination issues.	Loss of capability for cultivation, admixing of topsoil with subsoils.
Vegetation	No historical rare plant occurrences overlap the ASP, however some native areas exist and there is low to moderate potential for rare plants. Introduction of soils and dirty construction equipment may result in the introduction or spread of weeds.	Transportation and introduction of weeds. Loss of rare plants or native plants. Loss of native plants and potential habitat for them.	-Prior to construction, manage weeds. Do not park or store vehicles/equipment on infestations and if needed, control weeds prior to use. -Ensure vehicles and soils brought on site are clean and free of weed seeds. -Flag or fence off areas of native vegetation to be retained.	Loss of rare plants, stands of native vegetation, introduction of weeds.
Wildlife and Wildlife habitat	Historical records of vertebrate wildlife and invertebrates are in the area. Potential bird habitat (tree stands and wetlands) exist in the ASP, therefore migratory birds, bats and other wildlife may occur within the ASP and 2 km Study Area.	Construction activities may cause sensory disturbance to wildlife species, causing avoidance. Some wetland and tree/shrub/herbaceous habitat is likely to be removed.	-Follow the recommended timing and setbacks for Species at Risk (if they occur). - There is a record of a Schedule 1 Endangered Species on the *Species At Risk Act* that overlaps the Wigfield ASP. Complete a wildlife field study to determine need for Screening (see 4.1.2). -Complete pre-disturbance wildlife surveys during the migratory bird nesting window or at sensitive periods for bats. Implement all recommendations the wildlife biologist recommends. -Ensure that noise abatement equipment (e.g., mufflers) on machinery is in good working order. Turn off equipment when not in use. Enclose noisy equipment, as needed, to limit the transmission of noise beyond the construction site. -In the event that active nests, dens, burrows, etc. are found during clearing and construction activities, consultation with the appropriate regulator is required. Active nests may be subject to an appropriate buffer until the nest is no longer active or a permit may be granted for removal. -Do not harass or feed wildlife. -Avoid removal of nests and/or nest buffer, wildlife trees, important habitat features such as ungulate browse, or other	Loss of nesting habitat, migratory refuges and foraging habitat.

			habitat features, where practical.	
Fish and Fish Habitat	The ASP occurs in an area with a SWMF that may be altered in the future. If fish are present in the SWMF or in wetlands, loss of aquatic habitat may impact them and their populations.	Construction activities have potential to cause sedimentation. Loss of aquatic habitat area is anticipated with if the SWMF or wetlands occur.	-Conduct fieldwork to determine if fish are present within the SWMF. -Obtain regulatory approvals as per the *Fisheries Act*, if fish are present. -If applicable, follow guidance on screen design found in DFO's Freshwater Intake End-of- Pipe Fish Screen Guideline (DFO 1995). -Monitor to assess sediment release (i.e., turbidity and Total Suspended Solids [TSS]) if required by the applicable regulatory approvals. -If present, fish must be salvaged from within isolated work site and returned to a suitable location -Do not wash equipment or machinery near any waterbody. Control wastewater from construction activities to avoid discharge directly into water -Prohibit fuel storage, refuelling, or servicing of equipment within 100 m of any waterbody, except where secondary containment and/or tertiary containment is provided.	Loss of aquatic habitat, fish mortality.
Species at Risk (COSEWIC, SARA)	One federally listed species (Schedule 1, Endangered) has been previously identified within the 2km Study Area. The ASP does appear to have preferred habitat, however field studies will confirm. Construction activities may cause sensory disturbance to wildlife species, causing avoidance.	Preconstruction surveys will provide appropriate mitigation measures specific for species found.	See wildlife, vegetation and fish and fish habitat, above.	Loss of potential habitat.
Land and Resource Use	The current agricultural cultivation will no longer occur with infrastructure development.	Change in land use and users.	Public consultation will aid in mitigation for concerns over land use changes.	Loss of crop area.



4.0
Recommendations

4.1 Regulatory Framework

All federal, provincial regulations and municipal policies must be adhered to. Provincial regulations that have potential to be applicable in the ASP are described below.. Regulations often change over time, new ones introduced or repealed and requirements may change over time. Fieldwork timed to occur in the growing season prior to ground disturbance will ensure the results are not considered expired by the time of construction.

4.1.1 Federal

Fisheries Act

The provisions of the *Fisheries Act* came into force in August 2019. While guidance documents are still being developed, important changes include the new prohibitions:

- 34.4 (1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish
- 35 (1) No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat
- Harmful Alteration: any change to fish habitat that reduces its long-term capacity to support one or more life processes of fish but does not permanently eliminate the habitat
- Disruption: any change to fish habitat occurring for a limited period of time that reduces its capacity to support one or more life processes of fish
- Destruction: any permanent change of fish habitat, which completely eliminates its capacity to support one or more life processes of fish

Prior to impacts or alteration of the SWMF of connecting waterbodies, conduct a minnow trapping study at approximately to determine if fish are present and if *Fisheries Act* will apply.

Migratory Birds Convention Act

The *Migratory Birds Convention Act (MBCA)* is administered by Environment and Climate Change Canada (ECCC) to ensure protection of migratory birds, their nests, and their eggs. Birds protected by the *MBCA* include waterfowl (such as ducks, geese, and swans), insectivorous birds (such as wrens, robins, shrikes, and woodpeckers), and some nongame birds (such as herons and gulls) (ECCC 2017).

To protect migratory birds, ECCC provides general nesting periods based on geographic location (ECCC 2018). The general nesting period covers the majority of species covered under the *MBCA*; however, it may not be accurate for species that can breed at any time during optimal conditions (*e.g.* crossbill species), or species that may nest earlier or later (ECCC 2018).

The general migratory bird-nesting period for the Project (located within zone B5) is mid-April to late August (ECCC 2018). During this period, construction activities require a pre-construction sweep to avoid disturbance and nest sweeps every 3-7 days where habitat occurs. In the event that nesting migratory birds are identified during the nest sweep, a setback may be identified through consultation with ECCC where feasible, or a permit would be required to remove the nest.

If construction is to occur during the nesting period, mid-April to late August, pre-disturbance mitigation such as nest sweeps will be required to ensure compliance with the *MBCA.* The field wildlife biologist may determine that an extension to this period is warranted based on the species observed during field studies (e.g., owls).

Species at Risk Act

The *Species at Risk Act (SARA)* includes several prohibitions to protect species listed on Schedule 1 of *SARA*. Under Sections 32 and 33 of *SARA*, it is an offence to:

- Kill, harm, harass, capture, or take an individual of a species listed under *SARA* as extirpated, endangered, or threatened
- Possess, collect, buy, sell, or trade an individual of a species listed under *SARA* as extirpated, endangered, or threatened, or any part or derivative of such an individual
- Damage or destroy the residence of one or more individuals of a listed endangered or threatened species or of a listed extirpated species if a recovery strategy has recommended its reintroduction into the wild in Canada

No SARA permit is expected or required for the Project, as no SARA listed species of aquatic habitats are expected to be impacted. The ASP is not located within Federal Lands (e.g., a National Park), and not located within land that is subject to an Emergency Order under *SARA*.

Canada Navigable Waters Act

The *Canada Navigable Waters Act*, administered by Transport Canada, provides protection of navigation on all public navigable waterways in Canada through the Navigation Protection Program (Transport Canada 2021). Regulatory approval is required in scheduled navigable waters, as well as waters that are considered Navigated, where the works risk a substantial interference with navigable.

The SWMF is not considered navigable waters and the *Canada Navigable Waters Act* is not expected to apply to this ASP.

4.1.2 Provincial

Saskatchewan Environmental Assessment Act

The Saskatchewan *Environmental Assessment Act* (EAA) pertains to impacts on the environment from new developments. Development means any project, operation or activity or any alteration or expansion of any project, operation of activity likely to have an effect on rare and unique or endangered features, substantially use a provincial resources, emit pollutants in a manner that is not regulated by another *Act* or regulation, cause widespread public concern or others as listed in Part 1(2(d)) of Chapter E-10.1 of the *Environmental Assessment Act* (Government of Saskatchewan 1980). Due to the recorded occurrence of a *SARA* listed Schedule 1 Endangered wildlife species in the HABISask database and potential presence of habitat (i.e., trees, wetlands) in the ASP area, ISL recommends a wildlife biologist to be hired to conduct field studies in the appropriate season prior to construction, and based on these studies, determine the need to submit a screening to the ministry.

The Saskatchewan Environmental Management and Protection Act and Regulations

To conduct work in or near water, or to discharge with an adverse effect on water, an individual or corporation must obtain an Aquatic Habitat Protection Permit. Work requiring a permit includes: road developments such as culvert or bridge installations; shoreline stabilization; recreational development such as docks, beaches and boat launches; riparian and aquatic vegetation removal; channelization; ditch maintenance; and water use infrastructure such as pumphouses (Saskatchewan Water Security Agency [WSA] 2017). Allow at minimum 12 weeks for Aquatic Habitat Protection Permit processing.

Drainage projects and wetland infilling require a drainage approval. Requirements include: When draining, the proponent must have permission to move water onto, or across, any other person's land to the point of adequate outlet; approval holders will be required to use best practices in design and construction of works to reduce impacts of drainage; approval holders may be required to retain some surface water or storage space for water.

Note that there will not be grandfathering of projects that occurred in the past and all will require an approval in time (WSA 2022).

Saskatchewan Wildlife Habitat Protection Act (WHPA)

The *Wildlife Habitat Protection Act* pertains to crown lands designated as wildlife habitat and ecological lands. The *Act* prohibits lands alteration of designated lands (Government of Saskatchewan 1983). No WHPA lands are in or nearby the ASP.

The Wildlife Act and Wild Species at Risk Regulations

The Saskatchewan *Wildlife Act* determines the protection of wild species considered "designated". The minister can prepare and implement recovery plans for designated species (Government of Saskatchewan 1998). The *Wildlife Act* may be applicable if designated species are discovered prior to construction. The *Wild Species at Risk Regulations* list the species which are designated as extirpated, endangered and threatened (Government of Saskatchewan 1999). A field study should be conducted by a wildlife biologist during the appropriate season prior to construction, to determine if there are designated species using the ASP area.

The Fisheries (Saskatchewan) Act

A new *Fisheries Act* came into force in 2020. A fisheries license is required to obtain or possess fish by any method for scientific purposes (Section 18(1b)). Part 6 of the *Act* designates the Protection of Aquatic Species at Risk, recovery plans, and prohibited activities. Several aquatic species are considered invasive in Saskatchewan and if designated so by a Minister, prohibitions such as importation, buying, selling, transporting, introduction and deposition is prohibited.

A fisheries license will be required to conduct fish studies.

The Weed Control Act

The *Weed Control Act* designates weeds as Prohibited, Noxious or Nuisance. A prohibited weed shall be eradicated while a noxious weed is prohibited from movement by any material, machine, or domestic animal. A ministerial order designates the weed species included (Government of Saskatchewan 2010). A weed survey in the growing season may be beneficial one to two years prior to planned construction. Weed control prior to area development, if needed, is recommended.

4.1.3 Municipal

Lloydminster Municipal Development Plan

Objective 7.1 in the Municipal Development Plan (Parioplan 2013) states an objective "*To identify, conserve and integrate environmentally significant and natural areas into the design of neighbourhoods and other forms of development*".

As per Policy 7.1.1, a biophysical or geotechnical assessment is required prior to subdivision or development. This is to include natural areas and hazard lands and be completed by a qualified consultant. Policy 7.1.3 describes the Protection of Natural Areas through Environmental Reserve dedication, Municipal Reserve dedication, easements, donations and bequests, and acquisition through purchase or land trades. Objective 7.2 further details Environmental Reserve Dedication and Easement.

Policy 7.3.3 describes an Environmental Impact Assessment (EIA), which is required for any proposed development that may have a detrimental environmental effect. The required contents of an EIA are described in Section 1.1.

This report will be included with the ASP amendment and reviewed and approved by the City of Lloydminster.

4.2 Wetland Conservation and Protection

Generally, ISL recommends retention of wetlands that appear more permanent, are large in area, and/or complex wetlands due to the potential landscape hydrologic impact. Typically, the longer water is present, the more likely limited anthropogenic disturbance has occurred. They often contain native plant communities, have high potential for rare species, and are stable wildlife habitat for waterfowl, shorebirds, amphibians, and invertebrate species. Additionally, these basins typically hold more water than other wetlands and may be significant to catchment hydrology. To infill them during development would not only displace this water, but also likely impact the overland flow dynamics, which could lead to flooding and/or spring melt and stormwater management issues.

It should also be noted that less permanent wetlands also provide important wetland functions such as stormwater retention, sediment and nutrient retention, as well as wildlife habitat, however, they occur as smaller features on the landscape within the ASP and the impact of their disturbance is anticipated to be less since the majority of them have been historically disturbed by cultivation. ISL recommends that during design, conservation of these wetlands be considered.

4.2.1 Setbacks and Environmental Reserve

Neither the Government of Saskatchewan nor the City of Lloydminster have mandated setbacks for wetlands. In addition, there is no Policy or Regulation which speaks to setbacks for wetlands in Saskatchewan. However, wetland setbacks are important to consider for development planning. Setbacks provide a buffer of vegetation and help to filter water and other inputs, provide habitat for wildlife, and help protect the wetland from disturbance.

The Saskatchewan Wetland Conservation Corporation makes recommendations for land management around wetlands in a document called *Managing Saskatchewan Wetlands – A Landowner's Guide* (2000). The *Guide* recommends a 10m minimum buffer strip around wetlands be maintained when in cropland. Wider buffers may be recommended if the soil is prone to erosion, salinity is likely or other factors.

ISL recommends that intact wetlands, such as those that are treed or not disturbed by agriculture, be retained as Environmental Reserve and have a 10 m setback buffer applied. This is in accordance with the recommended (not required) best practices described in the *Guide*. Based on recent imagery, the SWMF is the only feature to regularly contain open water and appears as part of a wetland complex and ditch/drainage system. Given the size of this feature and its large water storage capacity, retention is recommended primarily for storm water management purposes. Impacts to other portions of the complex and ditch associated with the SWMF is not recommend until a storm water management plan is completed.

4.3 Recommended Pre-Construction Studies

ISL recommends planning field studies in the appropriate season, prior to the time of ground disturbance. Field information and data collected during fieldwork is generally considered expired 3-5 years from collection. ISL recommends wildlife studies, specifically migratory bird assessments and bat assessments during the appropriate season to assess for protected species and to ensure compliance with federal and provincial legislation. ISL also recommends wetland field studies prior to ground disturbance to provide accuracy in the drainage application and to provide baseline information for water management planning. Additionally, if the SWMF or connected waterbodies are to be disturbed, an assessment for fish presence in the SWMF is recommended to determine if the federal *Fisheries Act* applies. Additional recommendations and options for mitigation at the time of construction are provided in Table 3.1, above. A memorandum or short report detailing the results of these field studies should be produced for the City of Lloydminster.

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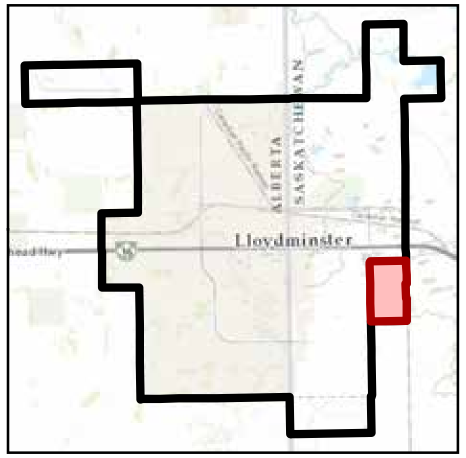
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community



Legend

- ▭ ASP Boundary
- ▭ Wetlands and SWMF
- ▭ 10m Buffer
- ― drainge

1:5,700 NAD 1983 UTM Zone 12N

FIGURE 4.1
WETLANDS AND SWMF RECOMMENDED FOR RETENTION

WIGFIELD ASP

Date: 2022-05-05 Document: V:\Projects\28059_WigfieldASP\03_EnvReportFigures\Fig4.1_RetentionWetlands\28059_Figure_4.1_Retwetlands_v2.mxd

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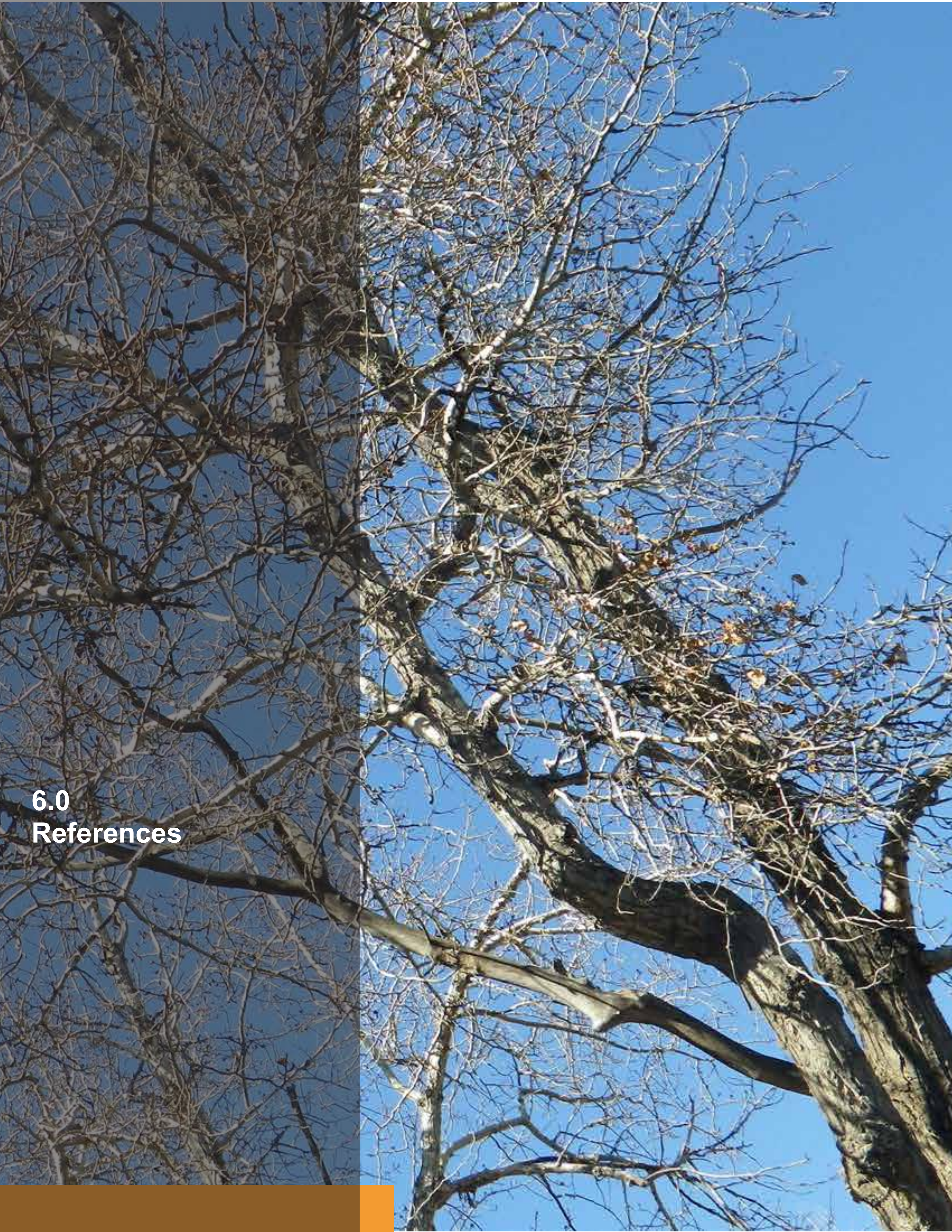
5.0

Decision Making Framework

At the desktop stage, there do not appear to be encumbrances to development that cannot be mitigated for. Fieldwork prior to ground disturbance will provide site and species-specific mitigation and is recommended.

Table 5.1: Decision and Timing Framework

Task	Main Recommendations	Timeframe
Further Biological Assessments?	Recommended, See Section 4.2 and Table 3.1	In the appropriate season, prior to construction
Regulatory Approvals Required?	Yes likely. This is dependent on results of fieldwork at appropriate time of year.	Regulatory planning to follow from the biological field assessment results. Applications for any regulatory approvals should be submitted well prior to construction as application queue times may be many months.
Environmental Reserve and setbacks?	ISL recommends retention of wetlands where possible. Preferably those wetlands that appear most intact and natural. Conduct wetland field assessment to support regulatory applications and stormwater planning. Fieldwork may help refine which wetlands to retain. If wildlife studies determine the presence of rare or at risk species, retention of their habitat may be recommended by the field biologist. ISL recommends retention of the existing SWMF and incorporation into the stormwater planning.	Biophysical fieldwork should occur at the biologically appropriate season prior to construction.



6.0
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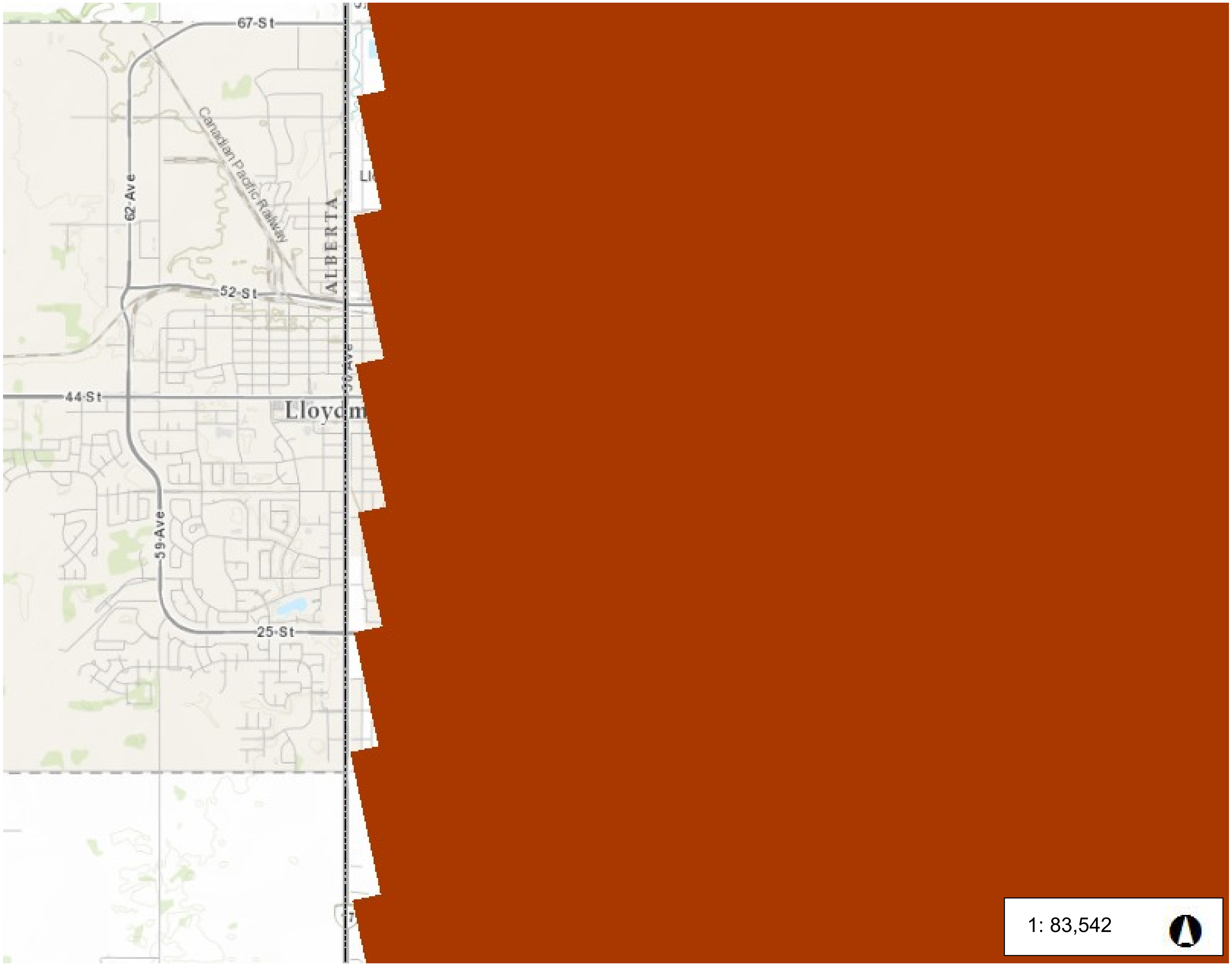
APPENDIX
HABISask Soil Output

A

HABISask- Soils



Legend

⬚ Provincial Boundary

Saskatchewan Soil Capability (

- ■ Class 1
- ■ Class 2
- ■ Class 3
- ■ Class 4
- ■ Class 5
- ■ Class 6
- ■ Class 7
- ■ Organic

Notes

4.2 0 2.12 4.2 Kilometers

WGS_1984_Web_Mercator_Auxiliary_Sphere

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APPENDIX
Photo Plates
B

Plate 1 View east on 40th Avenue north of 36th Street of the Wigfield ASP (Google Streetview, September 2018)

Plate 2 View east on 40th Avenue at 36th Street of the Wigfield ASP (Google Streetview, September 2018)

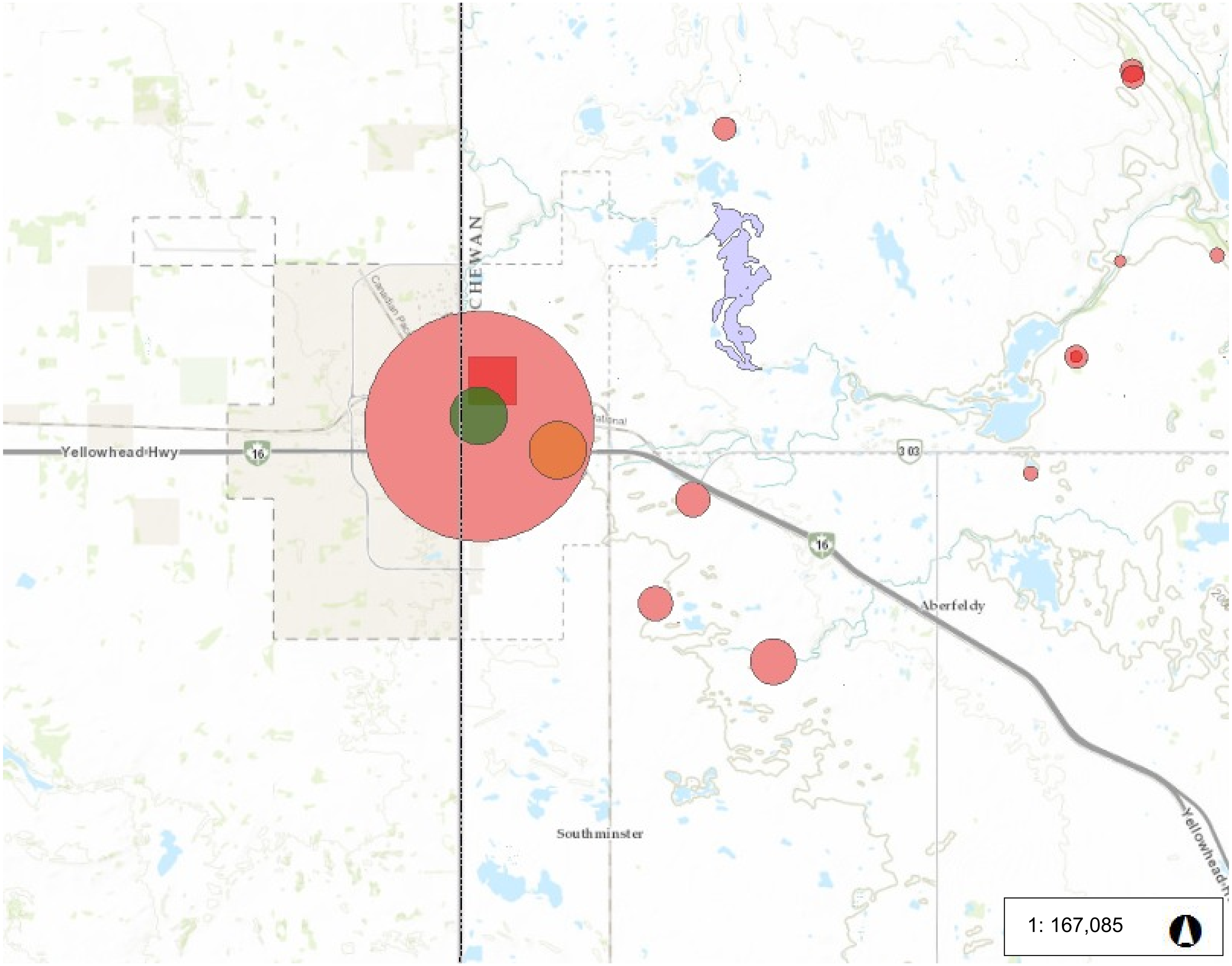
Plate 3 View east on 40th Avenue south of 36th Street of the Wigfield ASP (Google Streetview, September 2018)

Plate 4 View south from the Yellowhead Hwy into the already developed portion of the Wigfield ASP (Google Streetview, September 2018)

APPENDIX
HABISask Rare Species (Public) Output

C

HABISask- Rare and Endangered Species



Legend

- ⬚ Provincial Boundary
- Rare and Endangered Species
  - ■ Vertebrate Animal
  - ■ Invertebrate Animal
  - ■ Animal Assemblage
  - ■ Vascular Plant
  - ■ Nonvascular Plant
  - ■ Other (Botanical)
  - ■ Fungus
- □ National Park
- □ Provincial Park

1: 167,085

8.5 0 4.24 8.5 Kilometers

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Notes

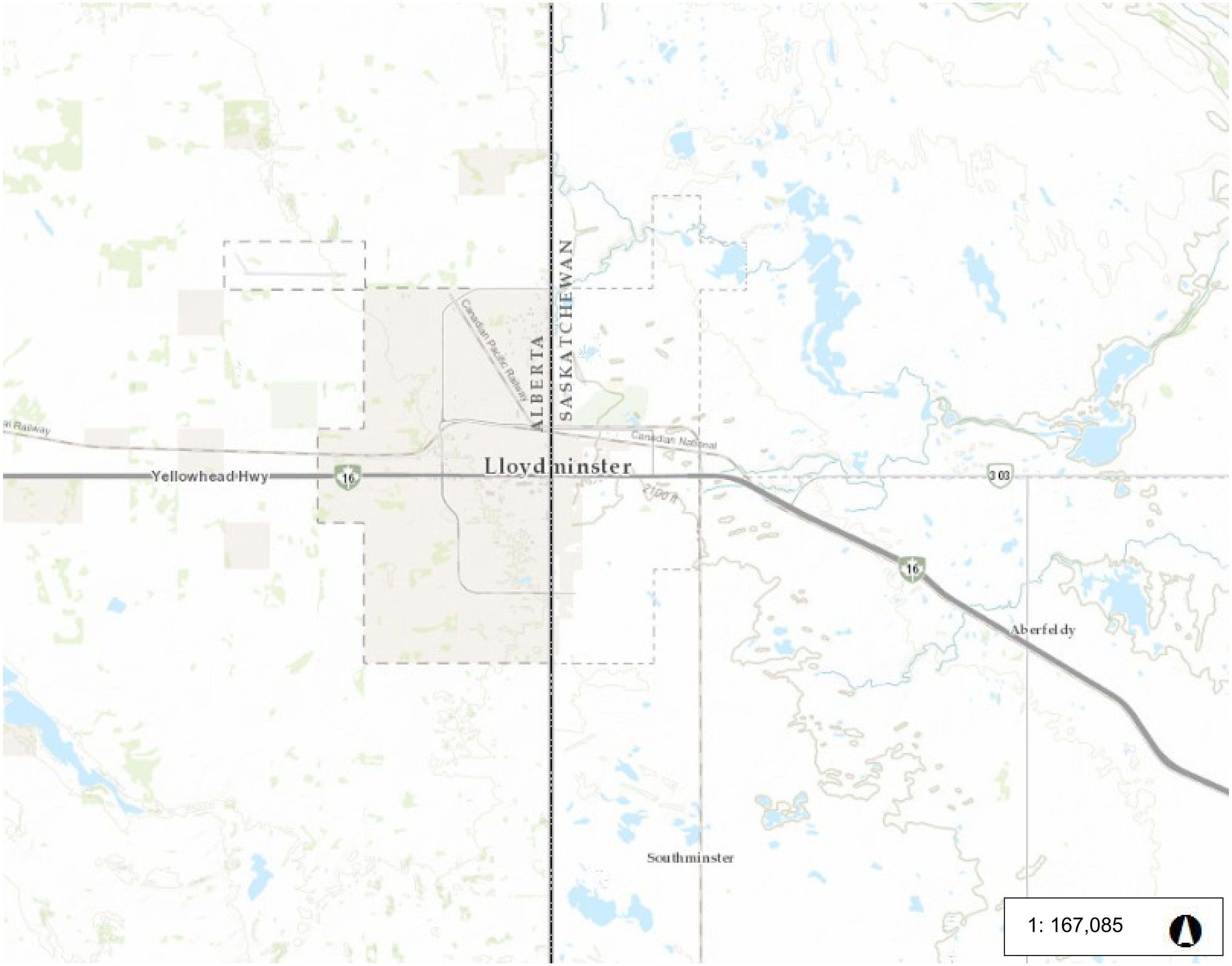
APPENDIX

iMapInvasives Output

D

HABISask
hunting | angling | biodiversity

HABISask- Invasives



Legend

- ● Confirmed Present Species Pc
- — Confirmed Present Species Lir
- 🟩 Confirmed Present Species
- ● Confirmed Present Species Ce
- ☐ Provincial Boundary
- ☐ National Park
- ☐ Provincial Park

Notes

8.5 0 4.24 8.5 Kilometers

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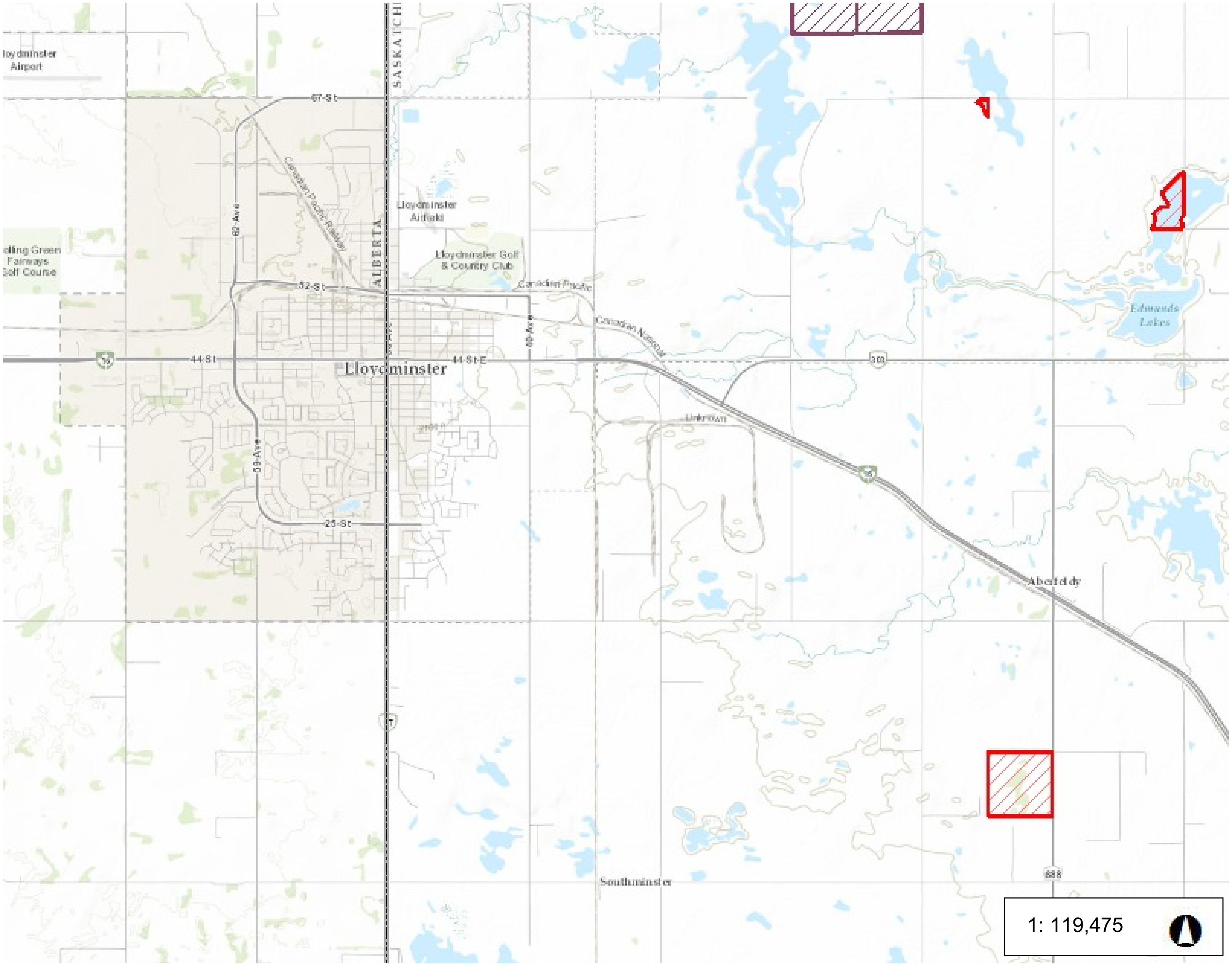
APPENDIX E
HABISask Important Habitat (Public) Output

HABISask- Important Habitat



Legend

- ☐ Provincial Boundary
- ▨ Water Security Agency
- ▨ Game Preserve
- ▨ National Wildlife Area
- ▨ Migratory Bird Sanctuary
- ▨ Conservation Easements
- ▨ Crown Land Subdivisions
- ▨ Ecological Reserves
- Fish and Wildlife Development
  - Managing Jurisdiction
  - 🟪 Ducks Unlimited Canada
  - 🟩 Ducks Unlimited Canada; Nature C
  - 🟫 Government of Saskatchewan, Min
  - 🟦 Nature Conservancy of Canada
  - 🟨 Nature Conservancy of Canada; Sa Federation
  - 🟪 Regina Fish & Game League
  - 🟩 Saskatchewan Pheasants Forever
  - 🟩 Saskatchewan Wildlife Federation
- ▨ Former Federal Pastures
- ▨ Ramsar Wetland
- ▨ Reservior Development Areas
- ▨ Crown Conservation Easemen
- ▨ Protected and Conserved Area
- ☐ National Park
- ☐ Provincial Park

1: 119,475

Notes

6.1 0 3.03 6.1 Kilometers

WGS_1984_Web_Mercator_Auxiliary_Sphere

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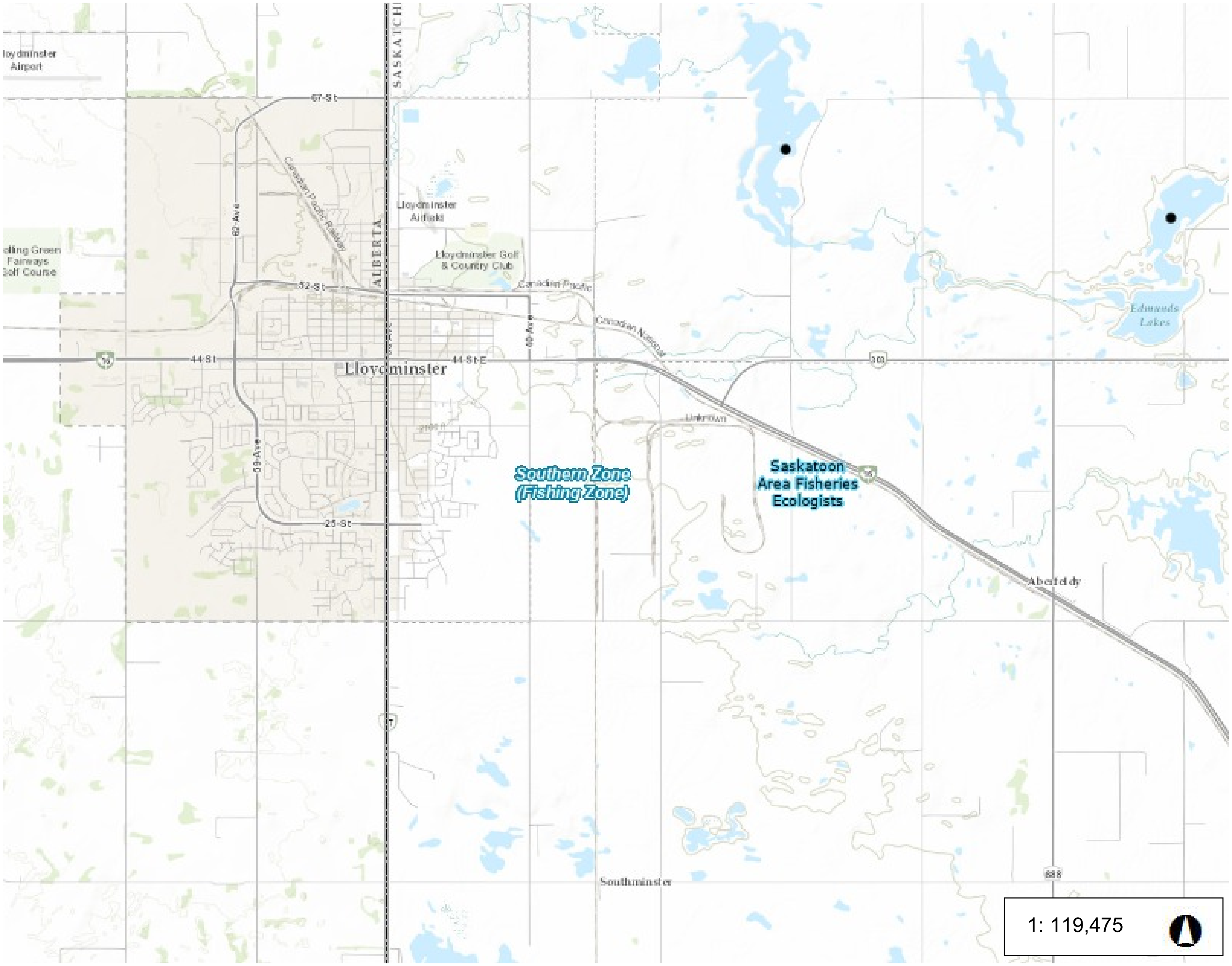
APPENDIX F
HABISask Fisheries Output

HABISask
hunting | angling | biodiversity

HABISask- Fisheries



Legend

- ☐ Provincial Boundary
- ☐ Sport Fish Management Zones
- ☐ Area Fisheries Ecologists
- — Commercial Closures Line
- ▨ Commercial Closures
- — Angling Closures Line
- ▨ Angling Closures
- ● Fisheries - Special Regulations
- ● Fisheries - Species Info
- ● Fisheries - No Lake Info

1: 119,475

Notes

6.1 0 3.03 6.1 Kilometers

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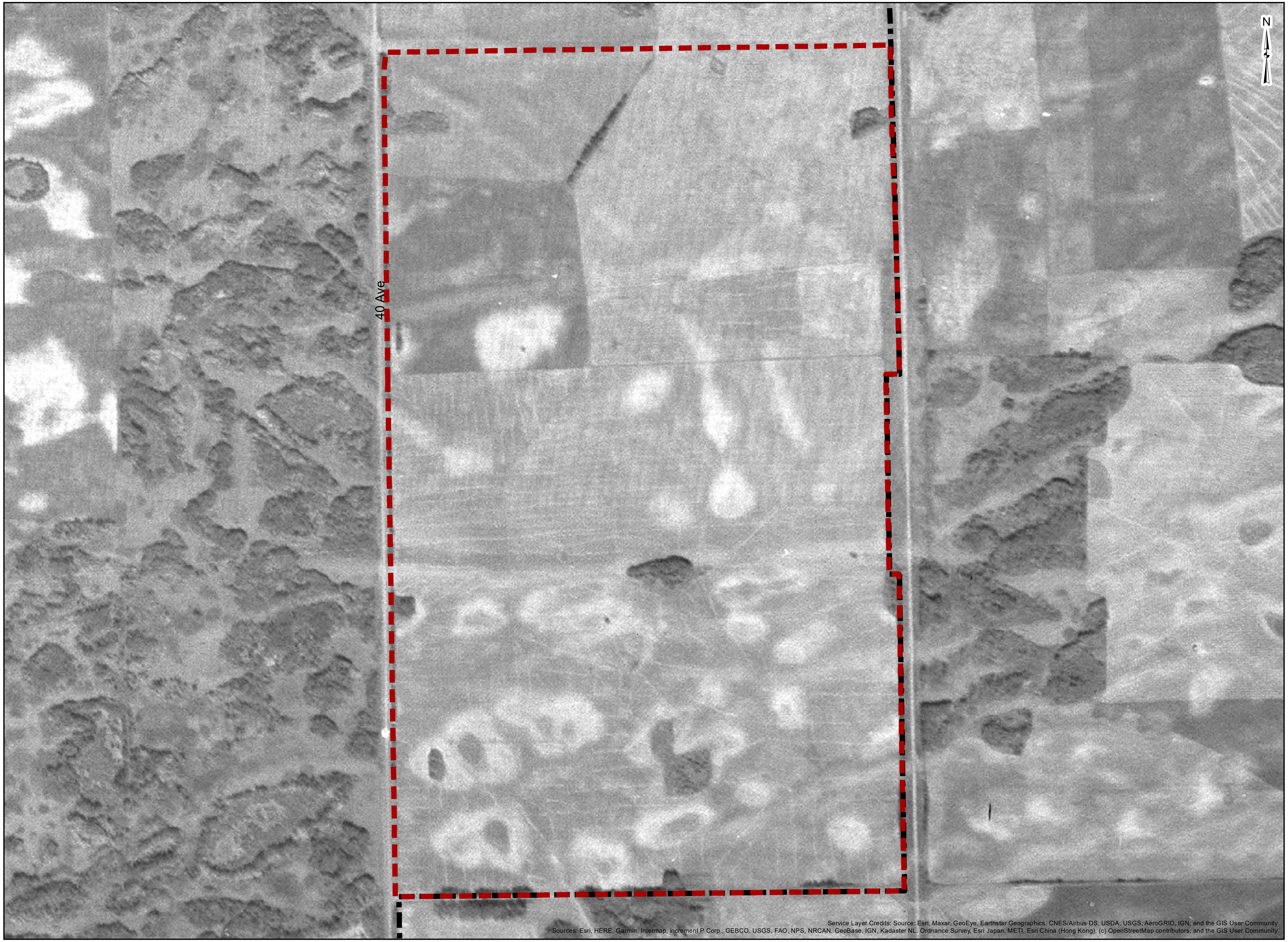
APPENDIX G
Historical Photography



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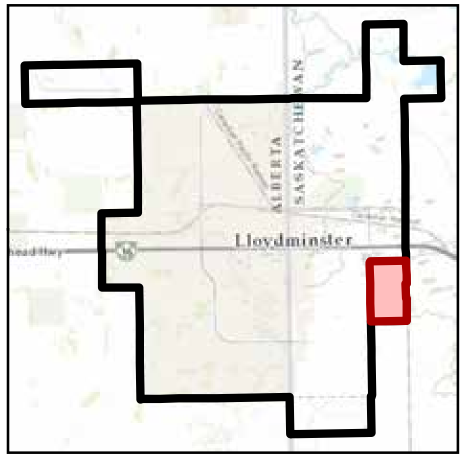

Legend

🟥 ASP Boundary
⬛ City Boundary

1:5,700

NAD 1983 UTM Zone 12N

HISTORICAL PHOTOGRAPHY
1949

WIGFIELD ASP

ISL

LLOYDMINSTER

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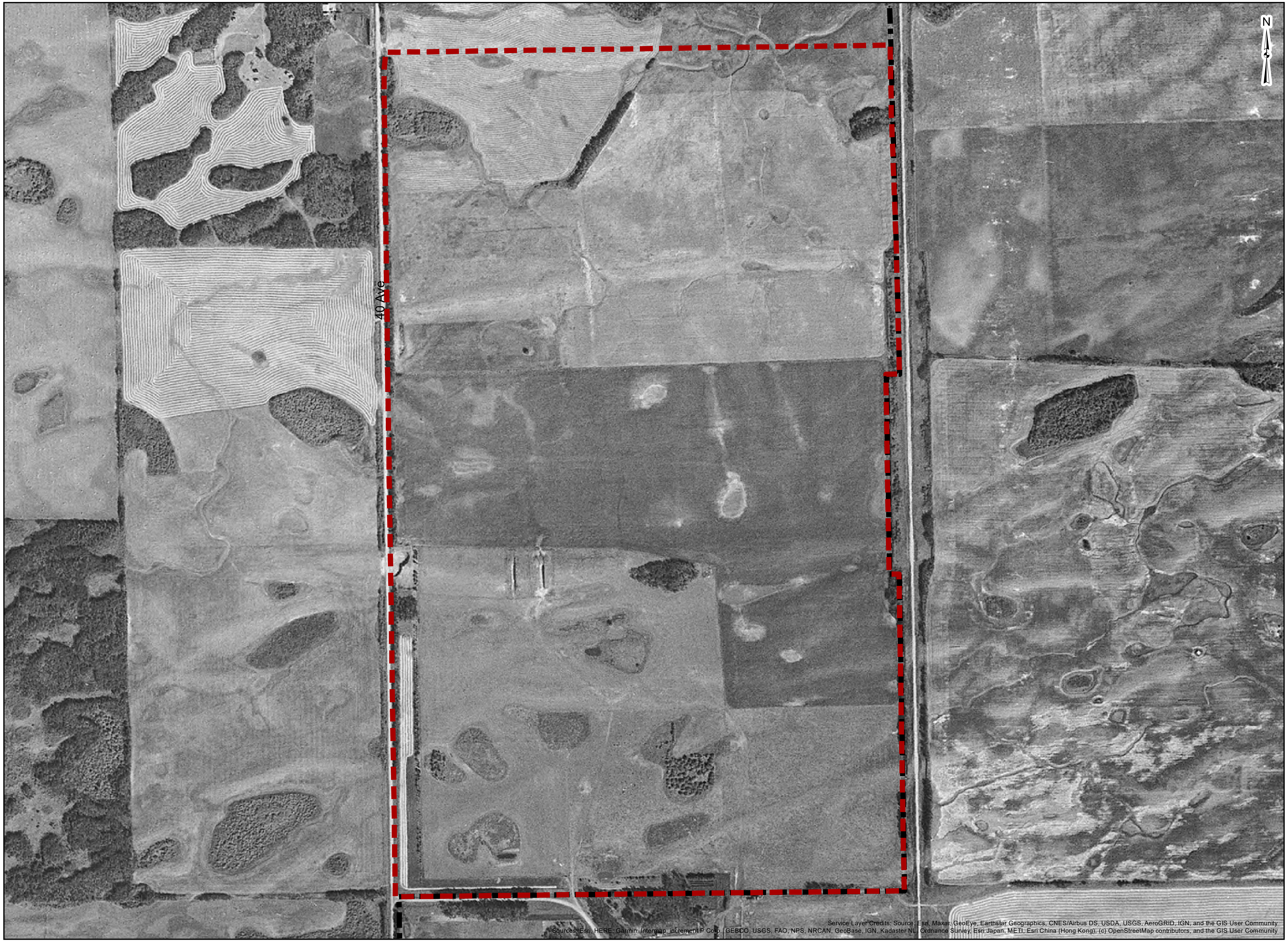

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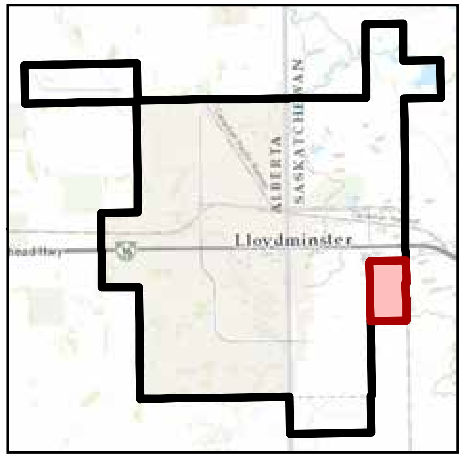

Legend

🟥 ASP Boundary

⬛ City Boundary

0 70 140 280 Meters

1:5,700

NAD 1983 UTM Zone 12N

HISTORICAL PHOTOGRAPHY
1965

WIGFIELD ASP

ISL

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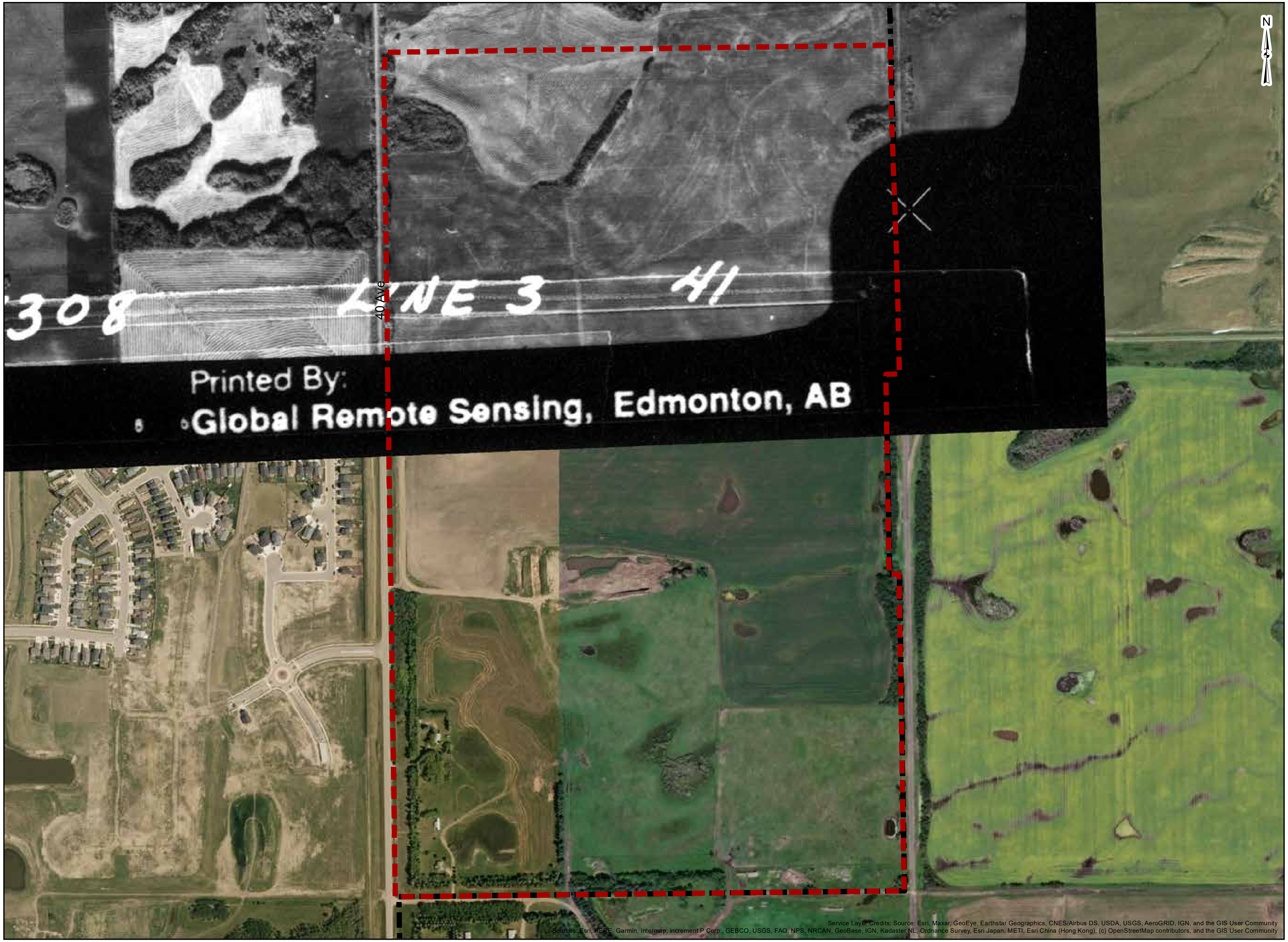

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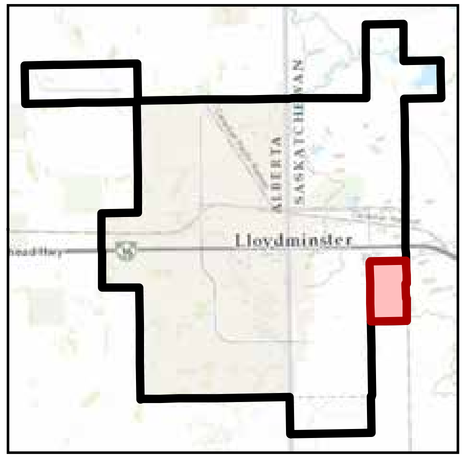

Legend

🟥 ASP Boundary
⬛ City Boundary

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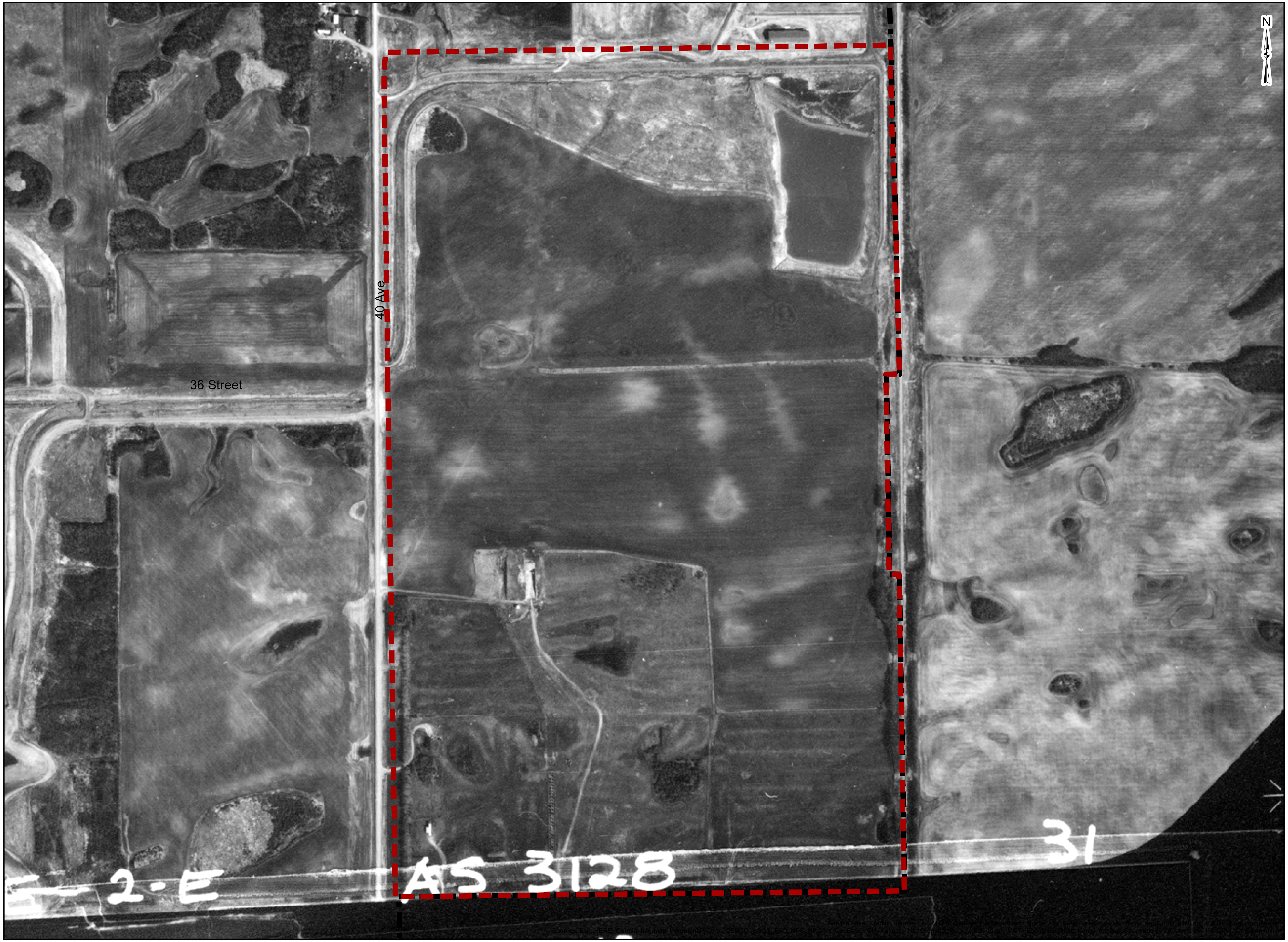
1:5,700 NAD 1983 UTM Zone 12N

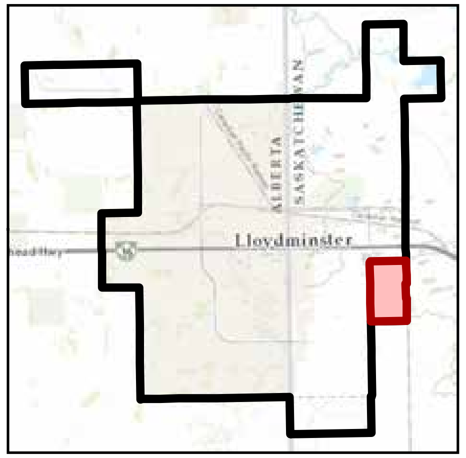
HISTORICAL PHOTOGRAPHY
1971

WIGFIELD ASP

ISL

LLOYDMINSTER





Legend

- ASP Boundary
- City Boundary

0 70 140 280 Meters

1:5,700

NAD 1983 UTM Zone 12N

HISTORICAL PHOTOGRAPHY
1985

WIGFIELD ASP

ISL

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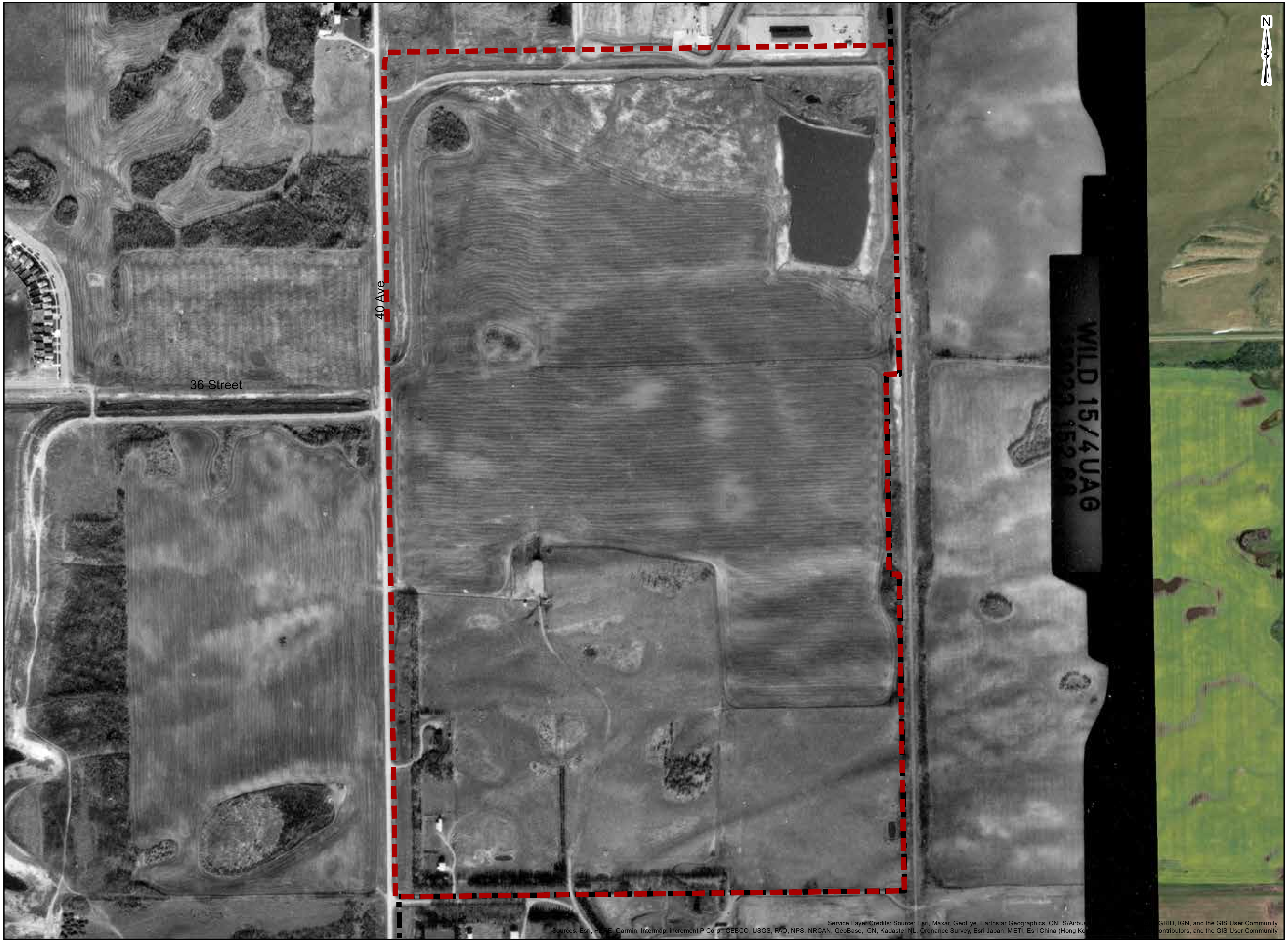

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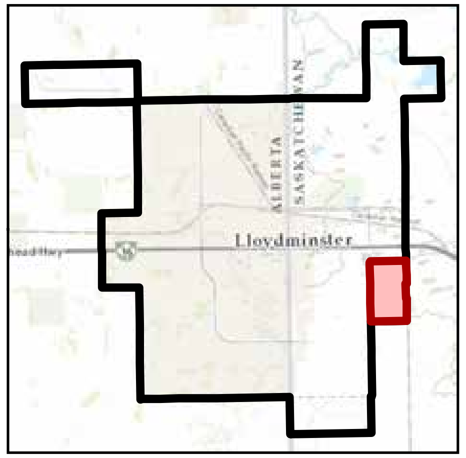

Legend

🟥 ASP Boundary
⬛ City Boundary

0 70 140 280 Meters

1:5,700 NAD 1983 UTM Zone 12N

HISTORICAL PHOTOGRAPHY
1988

WIGFIELD ASP

ISL
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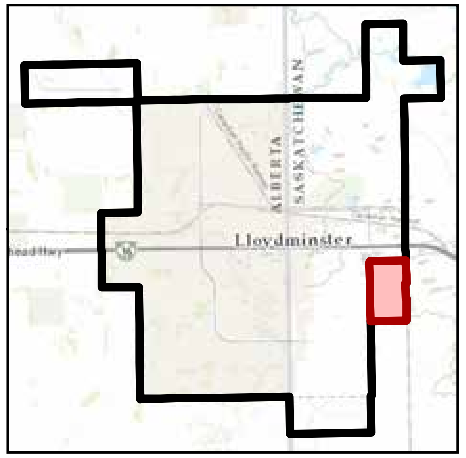
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community



Legend

- ASP Boundary
- City Boundary

0 70 140 280 Meters

1:5,700 NAD 1983 UTM Zone 12N

HISTORICAL PHOTOGRAPHY 1991

WIGFIELD ASP

ISL

LLOYDMINSTER

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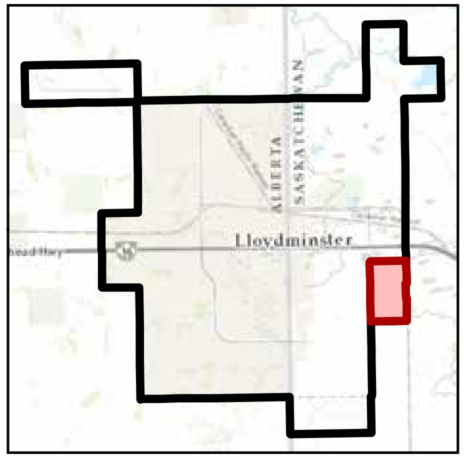

Legend

🟥 ASP Boundary

▨ City Boundary

0 70 140 280 Meters

1:5,700 NAD 1983 UTM Zone 12N

HISTORICAL PHOTOGRAPHY
2000

WIGFIELD ASP

ISL LLOYDMINSTER

Date: 2022-05-05 Document: V:\Projects\28059_WigfieldASP\03_EnvReportFigures\Appendix_HistFigs\28059_HistFigs.mxd

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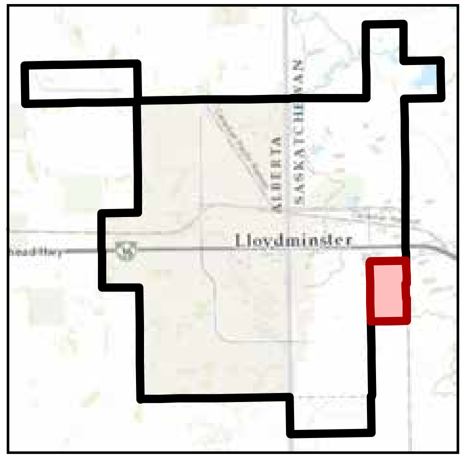

Legend

▭	ASP Boundary
▭	City Boundary

Meters
0 70 140 280

1:5,700 NAD 1983 UTM Zone 12N

HISTORICAL PHOTOGRAPHY
2009

WIGFIELD ASP

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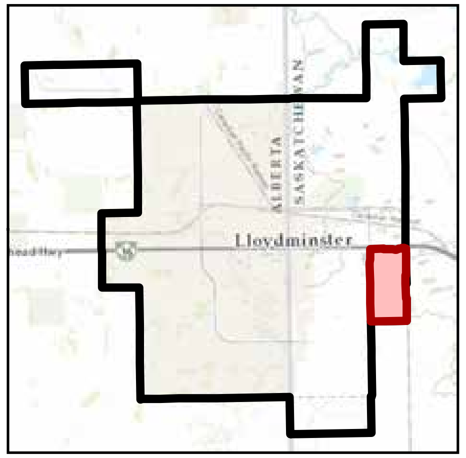

Legend

🟥 ASP Boundary

⬛ City Boundary

0 70 140 280 Meters

1:5,700 NAD 1983 UTM Zone 12N

HISTORICAL PHOTOGRAPHY
2016

WIGFIELD ASP

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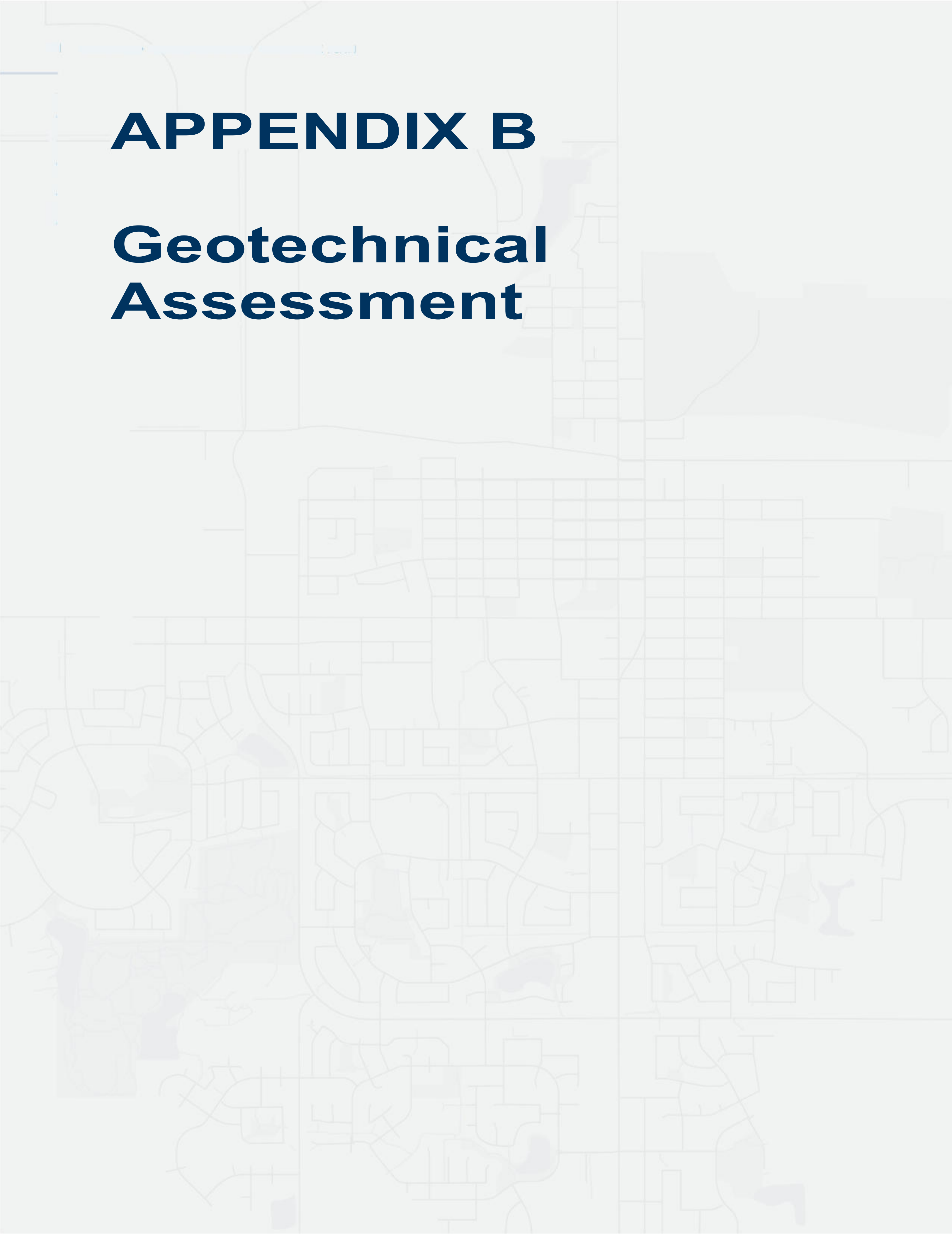
APPENDIX B

Geotechnical Assessment



SolidEarth Geotechnical Inc.
www.solidearth.ca

PRELIMINARY GEOTECHNICAL INVESTIGATION

Proposed Major Events Arena Project
Southeast of 41 Street and 40 Avenue Intersection
City of Lloydminster, Saskatchewan

Prepared for:

City of Lloydminster

Date:

14 December 2021

Project File #: PG21-1603.1000

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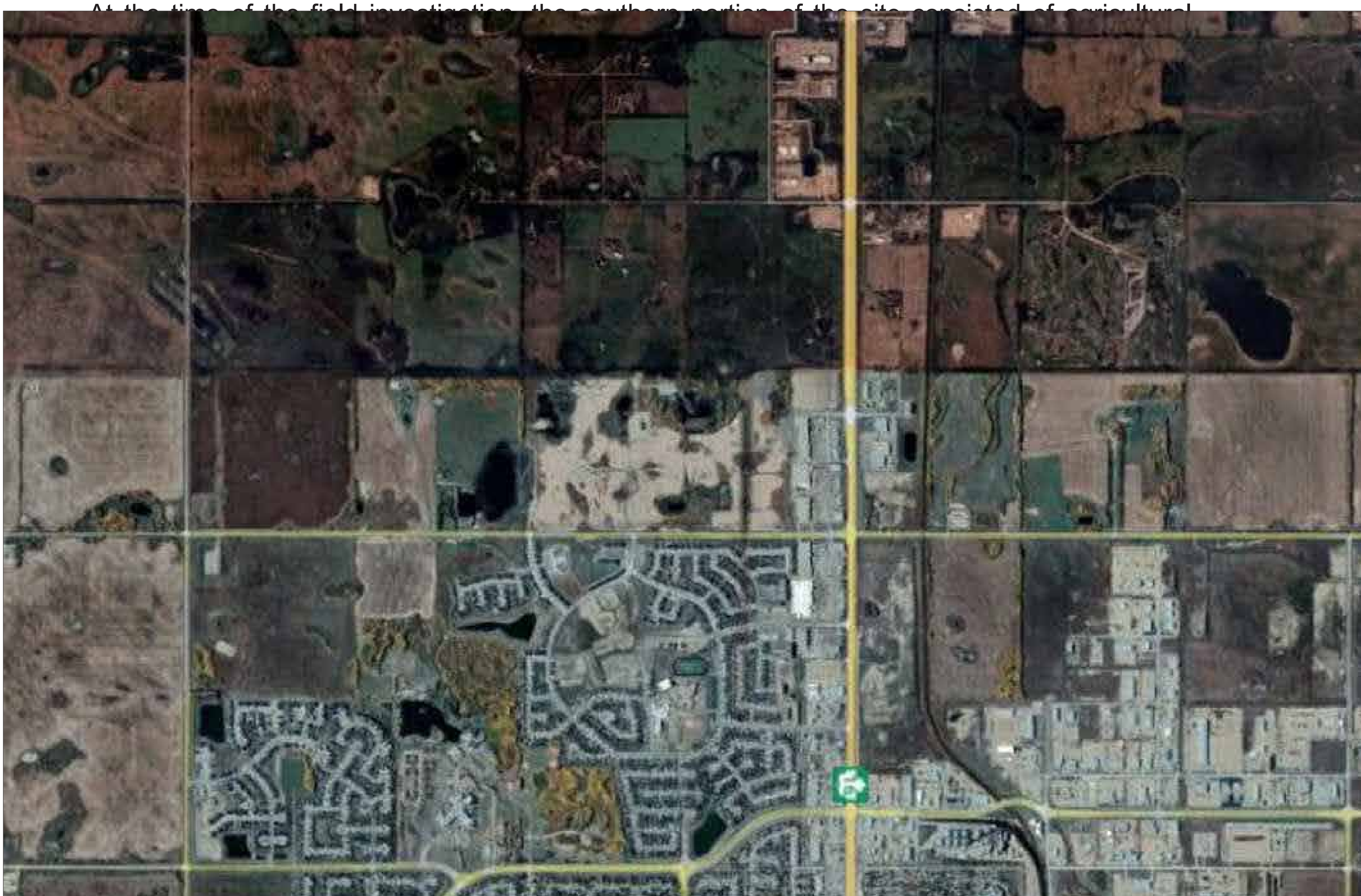
1.0 INTRODUCTION

This report presents the results of the geotechnical investigation conducted for the proposed Major Events Arena Project, located southeast of the intersection of 41 Street and 40 Avenue, in Lloydminster, Saskatchewan. The investigation was carried out by SolidEarth Geotechnical Inc. (SolidEarth) at the authorization of Mr. Joel Turcotte, Director Recreation and Cultural Services of City of Lloydminster (City).

2.0 PROJECT AND SITE DESCRIPTION

Based on information provided to SolidEarth, it was understood that the City is in the planning and design stages for the new Major Events Arena. The project will include, among other elements, an arena/recreational building, sports fields, underground utilities, and paved roadways and parking areas. The site development plan and the location and sizes of the various elements were not available at the time of preparation of this report.

The project site was located on the east side of the City, southeast of the intersection of 41 Street and 40 Avenue. The site was located within the south portion of NW¼ 36-49-28 W3M and was approximately 85 acres. The site was bounded by an agricultural land to the south, railway right-of-way followed by agricultural land to the east, 40 Avenue and commercial properties to the north, and 41 Street followed by a residential subdivision to the west.



As part of the geotechnical investigation, select soil samples were collected from the boreholes advanced within and/or near the snow dump area and submitted for detailed soil salinity and petroleum hydrocarbon analytical chemistry testing. The intention was to assess the potential impact from the historical snow dumping on the near surface soils.

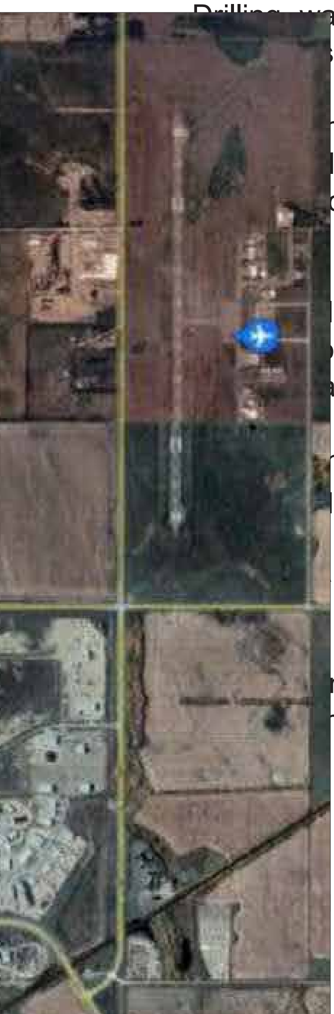
4.0 FIELD AND LABORATORY INVESTIGATION

4.1 GROUND DISTURBANCE AND SAFETY PERFORMANCE

Prior to field drilling, a SolidEarth representative completed internal ground disturbance procedures, which included placing an Alberta One Call, Saskatchewan First Call, and Dig Shaw request. Before starting onsite work, a daily field level hazard assessment was conducted and was communicated with all workers involved during the tailgate meeting. The field work was completed without any near misses or incidents.

4.2 FIELD DRILLING, SAMPLING, AND TESTING

The borehole locations were selected and marked in the field by SolidEarth based on the information provided by the client. The borehole location plan on an aerial photograph is presented as Figure 2.



SolidEarth subcontracted Drilling Solutions Inc. of Sherwood Park, Alberta to drill the boreholes.
as completed using a truck-mounted auger drill rig utilizing 150 mm solid-stem
s flight augers.

nvestigation was undertaken on 23 and 24 November 2021 and consisted of drilling
les (BH21-01 through -11) across the proposed development area. The boreholes
d to approximate depths ranging between 7.3 and 14.9 m below the existing ground

ing, soil samples were collected at approximately 0.75 m intervals along the depth of
les. Pocket penetrometer testing was conducted on selected cohesive soil samples
an indication of the unconfined compressive strength of disturbed soil samples from
Standard Penetration Tests (SPT) were conducted at selected depths (typically
m) to assess the in-situ strength of the soils encountered. The soil sampling and
quences are shown on the borehole logs, Appendix B.

rth geotechnical technologist monitored the drilling operations and logged the
soil samples from the auger cuttings and the SPT samples. The soils were logged
to the Modified Unified Soil Classification System, which is described in the
n of Terms and Symbols in Appendix B. Due to the method by which the soil cuttings
hed to surface, the depths noted on the borehole logs may vary by ± 0.3 m from those

Groundwater seepage conditions were monitored during and immediately following completion of drilling. Slotted standpipe piezometers were installed at most borehole locations at completion of drilling to monitor short term groundwater levels.

Following completion of drilling, the lateral coordinates (northing and easting) of the borehole locations were recorded by the SolidEarth representative using a hand-held GPS unit. These coordinates are shown on the borehole logs.

Select soil samples from the boreholes advanced within and/or near the snow dump area were submitted for soil salinity and petroleum hydrocarbon analytical chemistry testing. The samples were placed directly into laboratory supplied containers, which were immediately placed in chilled coolers for storage and shipment.

4.3 LABORATORY INVESTIGATION

All collected samples were submitted to the laboratory for further examination and testing. The geotechnical laboratory testing conducted included visual examination, determination of the natural moisture content on all collected samples; Atterberg limits, soluble sulphate content and grain size distribution analysis on selected samples. The results of the laboratory testing are presented on the borehole logs, Appendix B.

Selected soil samples were also submitted to ALS Environmental in Edmonton, Alberta for analytical chemistry testing. The following samples were submitted:

- Four (4) soil samples were collected and submitted from BH21-2, BH21-3, BH21-6, and BH21-9 for detailed salinity. All samples were collected from 0.2 mbgs.
- Two (2) soil samples were collected and submitted from BH21-2 and BH21-3 for benzene, toluene, ethylbenzene, and xylene (BTEX), and petroleum hydrocarbon fractions F1 to F4 (F1 – F4). Both samples were collected from 0.2 mbgs.

ALS is certified by the Canadian Association of Analytical Laboratories (CALA). The analytical chemistry reports are presented in Appendix C.

5.0 SUBSURFACE CONDITIONS

The subsurface stratigraphy at the borehole locations generally consisted of topsoil followed by clay till. Sand was encountered interbedded within and/or below the clay till at most borehole locations. A brief summary of the subsurface conditions encountered at the borehole locations is presented below. A detailed description of the subsurface conditions encountered at each borehole location is provided on the borehole logs.

Topsoil/Clay Fill

Topsoil was encountered at the ground surface of the majority of the borehole locations and was between 85 and 275 mm thick.

Clay fill was encountered below the topsoil at the location of BH21-01 and extended to an approximate depth of 1.2 m below the existing ground surface. The clay fill was generally classified as “clay, and silt, and sand, trace gravel”, was stiff, medium plastic, brown, and moist. The moisture content of the clay fill ranged between 9 and 12 percent

It should be noted that the thickness of topsoil/fill across the development areas may vary from what was encountered at the borehole locations.

Clay Till

Clay till was encountered below the topsoil/fill at all borehole locations, and extended to beyond the exploration depths of all boreholes except BH21-03, -07, -08 and -10, which were terminated in sand.

The clay till was generally classified as “clay, and silt, sandy, trace gravel”, was medium plastic, brown to grey, and very moist within the upper 4 to 6 m of soil profile, becoming moist below that depth. The consistency of the clay till was assessed based on the SPT “N” and pocket penetrometer values to be stiff within the upper 2 to 3 m of soil profile, becoming very stiff to hard below that depth.

The natural moisture content of the clay till ranged between 9 and 21 percent, with an average of 15 percent. Liquid and plastic limits of samples of the clay till were in the order of 32 to 38 percent and 10 to 14 percent, respectively. Based on comparison with the plastic limit, it is expected that the average in-situ moisture content of the clay till was near to slightly higher than the optimum moisture content of the soils.

Interbedded Sand/Silt

Relatively thick layers of sand were encountered interbedded within and/or below the clay till at most borehole locations. The top of the sand layers, where encountered, varied across the site and ranged between approximately 1.3 and 4.5 m below the existing ground surface. Similarly, the thicknesses of the sand layers varied across the site and ranged between approximately 1.3 and over 6.9 m thick.

The sand was generally classified as “sand, trace to some silt, trace clay, trace gravel”, was poorly graded, fine to medium grained, brown to grey, and wet to saturated. The sand exhibited seepage and sloughing conditions during drilling. The density of the sand was assessed based on the SPT “N” values to be generally compact to very dense.

A relatively thin layer of silt (approximately 0.7 m thick) was encountered below the sand at an approximate depth of 4.6 m below the existing ground surface of BH21-02. The silt was generally classified as “silt, some clay, some sand”, was non-plastic, grey-brown and very moist.

Clay Shale (Bedrock)

Clay shale (bedrock) was encountered below the clay till at an approximate depth of 14.5 m below the existing ground surface and extended to beyond the exploration depth of BH21-06

The clay shale was generally described as “very weak, massive, and highly weathered”, was high plastic, grey, and very moist, and contained sand and silt seams. The bedrock was very weak in terms of rock classification, and comparable to the consistency of a very stiff to hard cohesive soil.

Groundwater Levels

The groundwater levels measured in the installed piezometers are shown in Table 1. The groundwater levels are expected to fluctuate seasonally depending upon several factors that include the local geology, hydrogeology, and surface infiltration.

6.0 HIGH LEVEL REVIEW OF SITE FEATURES AND GEOTECHNICAL DATA

6.1 SITE DEVELOPMENT CONSIDERATIONS

Review of Aerial Photographs

Aerial photographs of the project site were obtained to determine the historic land features, use, and the changes that occurred in the project area. Aerial photographs were obtained through Google Earth Pro® and the Alberta Environment and Parks (AEP) Air Photo Library. Aerial photographs that were reviewed included the years of 1978, 1991, 2004, 2011, and 2021.

As aerial photographs do not provide a continuous record of site development, it is possible that features of interest may have been present in the study area between the dates of coverage. In addition, photographic quality and scale are variable and may make features difficult to identify or their nature difficult to determine.

In the 1978 aerial photograph, the project area appeared to be mainly undeveloped agricultural land. Localized low areas were suspected near the northwestern corner and near the southern limit of the site.

The 1991 aerial photograph showed the drainage channel (along the western and northern limits of the site), and the SWMP. In addition, evidence of surface soil discolouration was noticed in the north portion of the site, west of the SWMP. The discolouration was suspected to be potentially related to the snow dumping activities (salt staining).

No other evidence of major ground disturbance (excavation, backfill) was noticed within the site in the remaining aerial photographs.

A reproduction of the 1978 and 1991 aerial photographs showing the approximate limits of site are presented as Figure 3 and 4, respectively.

In summary, the review of historical aerial photographs identified:

- No major historical land disturbance within the site (beside the SWMF and channel).
- No extended low areas or sloughs within the site. Localized potential low areas are shown on Figure 3 and 4.
- Potential for salinity impact to the near surface soils within the snow dump area.

Moisture Content of the Near Surface Soils

The near surface moisture contents of the soil (within the upper 1.5 m of soil profile) ranged between 9 and 21 percent, and was anticipated to be higher within the snow dump area. Areas with elevated moisture content in the near surface soils may require additional drying effort during site grading.

Overall Evaluation

In general, the site appeared suitable for land development. The presence of relatively small and isolated low-lying areas will need to be addressed in the planning and design phases but are not anticipated to have any major impact on land development. There is a potential for salinity impact to the near surface soils within the snow dump area.

6.2 BUILDING FOUNDATIONS

Strength of Near Surface Soils

The strength of the near surface soils (within the upper 2 to 3 m of soil profile) showed some degree of variabilities across the site. This variability may affect the feasibility of using shallow footings to support the proposed structural elements at some portions of the site. The suitability of shallow footings at specific locations should be addressed in the detailed design stage by site specific geotechnical investigation once the locations of the project components are finalized.

Presence of Thick and Saturated Sand Deposits

Thick and saturated sand deposits were encountered at the majority of the borehole locations. Seepage and sloughing conditions were encountered from the sand deposits during drilling. These conditions can be challenging for some piling options, particularly driven steel piles and cast-in-place concrete piles.

7.0 PRELIMINARY GEOTECHNICAL ANALYSIS AND RECOMMENDATIONS

It is to be noted that the provided recommendations and considerations should be treated as preliminary only. A detailed geotechnical investigation should be completed once the project components and facility elements sizes and locations are determined.

7.1 FOREWORD

The subsurface soil conditions encountered at the borehole locations were considered suitable for the proposed development. Site grading, installation of underground utilities, and pavement structures were considered feasible.

Both shallow footing and deep pile foundation systems may be considered to support the proposed structures. Grade supported floor slab placed on prepared and improved subgrade or on new engineered fill are also considered feasible.

7.2 SITE GRADING AND EARTHWORKS

7.2.1 Subgrade Preparation and Inspection

During initial site grading, all topsoil should be stripped and removed from the proposed development areas. Topsoil should not be mixed with mineral soils or be used as engineered fill material.

The near surface clayey soils encountered at the borehole locations were classified as medium plastic and were assessed to be generally stiff. The results of the laboratory moisture content testing indicated that the average in-situ moisture content of the clayey soils was near to higher than the optimum moisture content of the soil.

Soft subgrade conditions are not expected to be a major concern but may be encountered at some locations across the site, particularly following snow melt and heavy rain events. Where soft and wet subgrade conditions are encountered, the subgrade should be scarified, air dried, and re-compacted (if good weather conditions prevail) or the soft wet material removed and replaced with drier clay or granular material placed as engineered fill.

All exposed subgrade, following achievement of rough grades (in areas under cut) and prior to placement of engineered fill (in areas under fill) should be inspected by the geotechnical engineer. The inspection may include a proof-roll test to confirm that deflections from construction traffic are minimal. Soft and weak areas identified during inspection, should be strengthened and improved.

In areas where subgrade support is required (apron, slab-on-grade, etc.), it is recommended that the upper 300 mm of the subgrade soil be strengthened/improved. Subgrade strengthening/improvement would include scarifying and re-compacting the subgrade as engineered fill with strict control of moisture content and density. Requirements for engineered fill are discussed below.

7.2.2 Requirement for Engineered Fill

Engineered fill should consist of low to medium plastic clay or well-graded granular material. Silt or sand which is uniformly graded, or which contains more than 10 percent passing the 0.080 mm sieve are not recommended as these materials are generally frost susceptible and are difficult to compact (require strict control of moisture content). All fill soils should be free from any organic materials, contamination, deleterious construction debris, and stones greater than 150 mm in diameter.

The low to medium plastic native clayey soils may be used as engineered fill material. Some moisture conditioning of these soils may be required during construction and will depend on weather conditions at the time of construction.

The sand encountered at the borehole locations was considered “marginal” and is not recommended for engineered fill application. As such, the development of a deep borrow pit and extracting the sand should be avoided.

Engineered fill should be thawed when placed and placed during non-frozen conditions. If winter construction is proposed, SolidEarth can provide additional recommendations once the overall development plan has been finalized.

All engineered fills should be compacted to a minimum of 100 percent of standard Proctor maximum dry density (SPMDD) within the building footprints, and to a minimum of 95 percent of SPMDD within the paved areas. Notwithstanding the above, the upper 300 mm of the subgrade within the paved areas should be compacted to 98 percent of SPMDD.

The fill should be compacted in lift thicknesses of 300 mm (loose) or less, and within two percent of the optimum moisture content or the soil. Engineered fill within the building footprints should extend at least 1 m, or the thickness of the fill, beyond the footprints of the buildings. Fill placement procedures and quality of the fill soils should be monitored by geotechnical personnel. Field monitoring should include compaction testing at regular frequencies.

Even for well compacted fill, some fill settlement under self-weight will occur. Settlement in the order of one to three percent of the fill thickness should be anticipated for engineered fill compacted to between 98 and 95 percent SPMDD. The majority of this settlement is expected to occur within the first year following construction.

7.2.3 Site Drainage

To minimize the potential for water ponding and saturation of the subgrade during and following construction, a minimum grade of two percent (or as directed by the civil design engineer) is recommended at the subgrade level to accommodate surface water runoff away from the development area. The upper 300 mm of backfill around the buildings (where no pavement structure is proposed) should consist of compacted clay to act as a seal against runoff water. The clay should extend a minimum distance of 3 m away from the development area and should be graded at a slope of two percent or more.

It is also recommended that positive surface drainage be provided in the early stages of construction to prevent ponding of water and softening of the subgrade.

7.3 FOUNDATION OPTIONS AND DESIGN CONSIDERATIONS

7.3.1 Foundation Options

Shallow footings based on the native clay till or on new engineered fill may be considered within portions of the site. Deep pile foundations may also be considered. Shallow foundations, where applicable, are expected to be the most economical foundation alternative for this project. Preliminary recommendations for shallow footings and deep pile foundations are provided in this report.

Shallow Footings

As outlined above, the strength of the near surface soils (within the upper 2 to 3 m of soil profile) showed some degree of variability across the site. This variability may affect the feasibility of using shallow footings to support the proposed structural elements at some portions of the site. The suitability of shallow footings at specific locations should be addressed in the detailed design stage by site specific geotechnical investigation once the locations of the project components are finalized.

Pile Foundations

The presence of very dense and saturated sand layers at relatively shallow depth may be challenging for pile foundations. These conditions may result in premature refusal of driven steel piles and casing requirements for cast-in-place (CIP) concrete piles. Continuous flight auger (CFA) concrete piles may be the most favorable pile foundation option.

7.3.2 Foundation Design Method

The current design standard in foundation engineering is based on limit state design. Accordingly, geotechnical recommendations associated with such standard is provided in this letter report.

The *Canadian Foundation Engineering Manual* defines limit states “as conditions under which a structure or its component members no longer perform their intended function”. Limit states are generally classified into two main groups: ultimate limit state and serviceability limit state. Below is a brief discussion on both states.

Ultimate Limit State (ULS)

Ultimate limit states are primarily concerned with collapse mechanisms for the structure and, hence, safety. For foundation design, the ULS consists of: ultimate bearing capacity failure, sliding, overturning, loss of stability, uplift, or large deformation.

The basic foundation design equation using ULS approach is presented as:

$$\Phi R_n \geq \Sigma \alpha_i S_{ni}$$ [1]

where:

ΦR_n - is the factored geotechnical resistance

Φ - geotechnical resistance factor

R_n - the nominal (ultimate) geotechnical resistance determined using unfactored values for geotechnical parameters or performance data (such as pile load test)

$\Sigma \alpha_i S_{ni}$- is the summation of the factored overall load effects for a given load combination condition

α_i - is the load factor corresponding to a particular load

S_{ni} - is a specified load component of the overall load effects (e.g. dead load due to weight of structure or live load due to wind)

$_i$ - represents various types of loads such as dead load, live load, wind load, etc.

Geotechnical resistance factors as provided by the *Canadian Foundation Engineering Manual* for foundations are provided in Table 2. The critical design events and their corresponding load combination and load factors should be assessed and determined by the structural engineer.

Serviceability Limit State (SLS) – Limit States Design

Serviceability limit state is primarily concerned with mechanisms that restrict or constrain the intended use, occupancy, or function of the structure under working loads. For foundation design, SLS are usually associated with:

- excessive foundation movements (e.g. settlement, differential settlement, heave, etc.)
- unacceptable foundation vibrations

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[1] Page 136 of the Canadian Foundation Engineering Manual – 4th Edition, January 2007.

- local damage or deterioration

In general, the SLS criteria can be expressed as follows:

Serviceability Limit ≥ Effect of Service Loads

The soil bearing pressure under SLS conditions is evaluated using un-factored geotechnical parameters (settlement and compressibility properties), such that the bearing pressure does not cause the foundation to exceed the specified serviceability criteria.

The soil-structure interaction and load-deformation characteristics of soils are non-linear and complex and depend on several considerations (e.g., foundations size and configuration, range of movement, etc.). The number of possible combinations is infinite and generic design charts cannot be prepared. Specific design charts under SLS conditions can be provided upon request, once preliminary design requirements have been established.

7.3.3 Preliminary Recommendations for Shallow footings

Footings may suitable for portions of the site but not others. The suitability of shallow footings at specific locations should be addressed in the detailed design stage by site specific geotechnical investigation once the locations of the project components are finalized.

For preliminary design purposes, footings bearing within the native sand/clay till or on new engineered fill may be designed based on un-factored (ultimate) bearing resistance of 200 and 250 kPa for strip and spread footings, respectively. The recommended design values were based on estimated footing total and differential settlements (for footings less than 1 m in width) of less than 25 and 15 mm, respectively. The geotechnical resistance factors outlined in Table 1 should be used in the ULS design scenario. For SLS conditions, the settlement of footings designed with 70 to 80 percent of the factored ULS bearing resistance are expected to be small.

The minimum soil cover for perimeter footings in heated buildings should be 1.5 m. Interior footings of heated buildings may be based at 0.6 m below the underside of the slab. Footings in non-heated buildings or parts of buildings should be provided with 2.5 m of soil cover. Thermal insulation may be used to limit the depth of frost penetration and reduce the thickness of required soil cover.

All footings must comply with the *Saskatchewan Building Code* and *National Building Code of Canada* minimum requirements. The minimum footing width should be 0.6 m regardless of bearing capacity considerations.

Footing excavations should be carried out using excavators with a smooth-edge trimming bucket. Final cleanup of footing subgrade soils by hand methods may be required. No loose, disturbed, remoulded or slough material should be allowed to remain on the foundation bearing surface. Should wet and/or soft soils be encountered at the design footing depth, the footing excavations should be deepened and replaced with engineered fill such that footings bear on competent soils.

Groundwater seepage into the footing excavations is not expected to be a concern during construction. However, if encountered, groundwater seepage could be controlled by a sump and pump dewatering system.

Foundation excavations must be protected from drying, desiccation, rain/snow, freezing, and the ingress of water. Foundation subgrade soils that become frozen, dried, or softened, should be removed and replaced with concrete, or the excavation should be extended to reach soil in an unaffected condition.

Any over-excavation of unsuitable soils could be brought back to design grades using lean-mix concrete (minimum 28-day compressive strength of 5 MPa) or an approved granular engineered fill. Engineered fills should extend laterally 1 m or equal to full depth of fill (whichever is greater) beyond the edge of the footing and be compacted to 100 percent of the SPMDD at moisture content within two percent of the optimum moisture content.

It is recommended that the foundation bearing surface excavation be inspected and approved by a qualified geotechnical engineer prior to concrete placement to confirm soil conditions and bearing capacity.

7.3.4 Preliminary Recommendations for CIP and CFA Piles

CIP concrete pile foundations will likely require casing to maintain a dry and stable hole during construction due to the presence of thick and saturated sand layers. Given the variability in the thickness and depth of the interbedded sand layers, the use of belled piles may be challenging and is not recommended by SolidEarth. As such, only straight-shaft cast-in-place concrete piles are recommended.

CFA piles may be considered as an alternative to CIP concrete piles. CFA piles may be an attractive option as they will not require casing during construction.

CIP concrete and CFA piles should be designed based on skin friction only. The recommended un-factored (ultimate) shaft friction parameters are provided in Table 3. These parameters were based on the soil profiles encountered during drilling and were determined mainly through semi-empirical correlations with the SPT, and moisture content results. Accordingly, a geotechnical resistance factor of 0.4 should be used.

For SLS conditions, piles designed with 70 to 80 percent of the factored ULS parameters are expected to undergo settlement equivalent to approximately 0.2 to 0.5 percent of the pile diameter.

In the design and installation of CIP and CFA piles, the following recommendations should be followed:

- A minimum pile spacing of three (3) pile diameters, centre-to-centre, is recommended for friction piles.
- The minimum recommended shaft diameter is 400 mm for straight shaft.
- Seepage and sloughing conditions should be expected during the installation of the CIP concrete piles, where layers of saturated sand are intercepted by the pile hole. A steel casing should be used to allow for the construction of a dry and clean pile hole. The level of the fresh concrete in the casing should be maintained well above the level of the seepage zones as the casing is withdrawn to offset hydrostatic seepage pressures.
- Piles should be reinforced and be of adequate structural strength to resist compressive and frost uplift forces both during construction and the operational life of the structure.
- The dead weight of the pile may be neglected when calculating the pile vertical load resistance.
- Concrete should be placed in the pile hole in a timely manner. The top part of the pile should be vibrated to reduce potential for voids within the concrete.

7.3.5 Preliminary Recommendations for Driven Steel Pipe Piles

Driven pile foundations were considered suitable for the proposed development but may be challenging where thick and dense layers of sand were encountered. Piles intercepting thick and dense sand may undergo practical refusal in the sand (or significant increase in driving resistance) and may not be able to penetrate to the design depth. Such situations should be assessed by the geotechnical engineer on a case-by-case basis during the pile installation program.

Although cobbles and boulders were not encountered during drilling at any borehole location, this does not rule out the possibility of their existence within the clay till. Intercepting a boulder during pile driving can cause premature refusal of the pile and lower pile capacity. Generally, if boulders are encountered at shallow depth, then excavation and removal of the boulders may be required. Deeper boulders may cause abandoning the pile and replacing it with a pile group with a cap that supports the proposed column.

Based on the subsurface soil conditions encountered, it is anticipated that a soil plug would form if open-ended steel pipe-piles (smaller than 406 mm in diameter) were driven past a depth of approximately 8 m below the ground surface. As a result, the capacity of open-ended steel pipe piles driven to a depth shallower than 8 m should be based solely on skin friction. Deeper piles may be designed using both skin friction and end bearing over the cross-sectional area of the pile tip.

If piles are driven during frozen ground conditions, then pre-boring through the frost zone may be required. The diameter of the pre-bored hole should not exceed 95 percent of the outer diameter of the pile.

The recommended un-factored (ultimate) shaft friction and end bearing parameters are provided in Table 4. These parameters were based on the soil profiles encountered during drilling and were determined mainly through semi-empirical correlations with the SPT and moisture content results. Accordingly, a geotechnical resistance factor of 0.4 should be used.

If piles are driven to practical refusal, the vertical load capacity of steel piles should be limited to the allowable fibre stress of the steel and should be determined by the structural engineer based on current design and building code standards.

The full frictional resistance of a pile (factored ultimate pile capacity) is generally mobilized with pile displacement in the order of 0.5 to 1.0 percent of the pile diameter. The pile head may undergo settlement in the order of 0.5 to 1.0 percent of the pile diameter plus the elastic shortening of the pile, due to the load acting on the pile.

The minimum recommended pile spacing is three pile diameters (centre to centre).

Pile driving analyzer (PDA) testing may be conducted on selected test or production piles to verify pile capacities and the recommended pile parameters. This testing will also allow the use of a geotechnical resistance factor of 0.5 under ULS design conditions, corresponding to a 25 percent increase in the design factored ultimate load resistance of the pile.

PDA testing is generally conducted on a few piles during the design phase (generally selected in critical and key areas) followed by periodic checks during the installation of production piles. The verification testing during the installation of production piles is generally completed at a frequency of approximately five percent of the first 100 piles and one to three percent on the balance. The testing frequency may be adjusted based on the consistency of the observed results.

Installation Considerations

The following installation procedures are recommended for driven steel pipe-piles:

1. Appropriate hammer size and energy should be selected for pile driving to minimize the potential for damage to the pile during driving. The hammer specification generally depends on the size and material of the pile, as well as cushion material and efficiency. Industry practice is to limit hammer energy to the range of 450 to 600 Joules per blow for each square centimeter of pile cross-section. For steel piles less than 300 mm in diameter, typical hammer energies in the order of 25 to 35 kJ per blow are used. For pile sections 300 mm in diameter or greater, typical hammer energies in the range of 40 to 55 kJ per blow are used.

2. The piles should not be driven beyond practical refusal. Industry practice defines practical refusal as 10 to 12 blows per each 25 mm interval for the last 150 mm. This practical refusal criterion may be used as a preliminary guide only. The installation refusal criteria should be established using GRLWEAP once all pile design and hammer specifications become available.
3. Where refusal occurs during pile driving, the potential of heaving of nearby piles should be monitored. The elevations of the tops of piles already installed should be monitored as adjacent piles are driven, in order to determine if heaving of the previously installed piles has occurred. Piles which have heaved must be re-driven to their initial embedment depths.
4. Where groups of piles are to be installed, the piles should be installed starting at the centre with the outer piles installed last.
5. The piles should be free from protrusions or protruding welds, which could create voids in the soil around the pile shaft during installation. If a driving shoe is used, it must not protrude beyond the outside diameter of the pile.
6. Full time monitoring of pile installation by an experienced inspector is recommended to verify that the piles are installed in accordance with design assumptions and that no damage to the piles has occurred. A complete driving record in terms of the number of blows per 250 mm of penetration should be recorded by the inspector for each pile and reviewed during pile installation by a geotechnical engineer.

7.3.6 Uplift Capacity of a Single Pile

The resistance to uplift loads will be provided by shaft friction only (under the depth of frost penetration) and sustained vertical compressive load supported by the pile. For sustained tensile loads (other than those due to frost action) a geotechnical resistance factor of 0.3 should be used in conjunction with the shaft resistance values provided in Tables 3 and 4.

Additional recommendations concerning the resistance of piles against frost action are given in Section 7.3.7 “Frost Considerations for Piles and Grade Beams”.

7.3.7 Frost Considerations for Piles and Grade Beams

Piles supporting components that will be outside the influence of any beneficial heat transfer may be subject to upward frost jacking forces. For those foundation components within the depth of frost penetration, frost jacking pressures are likely to develop along pile shafts, and along the underside and sides of pile caps or grade beams. If not properly resisted, frost uplift forces may cause irrecoverable vertical movement in the pile and may lead to impaired functionality of the structure.

For design purposes, the following may be assumed:

- depth of frost penetration: 1.5 and 2.5 m for heated (with positive heat transfer into the ground) and unheated structures, respectively
- frost uplift pressure of 65 and 100 kPa on the pile shaft applied over a depth of frost penetration for concrete and steel piles, respectively
- a load factor, α, of 1.2 may be used for frost heave forces
- a geotechnical resistance factor, Φ, of 0.8 may be used for ULS condition

To reduce the effects of upward frost forces on pile caps and grade beams, it is recommended that a compressible material, such as “voidform” (or equivalent), be placed between the underside of the pile cap or grade beam and the soil. In such a case, uplift pressure acting on the underside of the pile caps or grade beams may be taken as the crushing strength of the compressible medium. The minimum thickness of the voidform should be 100 mm.

The finished grade adjacent to each pile cap or grade beam should be capped with clay, and sloped away, so that surface runoff is not allowed to infiltrate and collect in the void space. If water is allowed to accumulate in the void space, then full frost heaving pressures will likely occur on the underside of the pile caps and grade beams. Frost forces up to 1800 kPa have been reported in literature and are dependent on the restraints offered by the surrounding soils.

It is to be noted that all piles should be structurally designed to resist frost heave forces if the piles are allowed to freeze during construction.

7.4 GRADE SUPPORTED FLOOR SLAB

Generally, internal grade-supported slabs are expected to exert loads in the order of 10 to 15 kPa on the subgrade. The existing soils encountered at the site or new engineered fill was considered capable of supporting a grade supported concrete floor slab. Some vertical movement in the slab should be expected, however, the magnitude of such movement is expected to be small, provided that the subgrade is prepared and inspected as per the recommendations outlined in Section 7.2 “Site Development Considerations”.

It should be realized that with all slabs-on-grade, heave, settlement, and associated movements of the slab could occur if the moisture content of the subgrade was to change significantly during the lifetime of the structure, if the subgrade was to freeze in the presence of excess moisture, or if the slab was constructed over un-engineered fill. Shrinkage and swell potentials of onsite soils due to moisture change are considered to be relatively low.

If the subgrade became wet during the operational life of the facility, loss of strength and non-uniform support should be anticipated. The potential movement as a result of non-uniform subgrade support could be mitigated with proper subgrade preparation and the use of a free draining base material.

Regardless of the fill requirements, at a minimum, a 200 mm layer of well graded granular base coarse material should be placed directly below the grade-supported slab. The granular material should:

- have no more than 10 percent fines
- have maximum aggregate size of 20 mm
- be uniformly compacted to a minimum of 100 percent of SPMDD at moisture content within two percent of the optimum moisture content

The slab should be structurally designed to carry all anticipated loading. A modulus of subgrade reaction of 25 MPa/m may be used in the design.

The slab should be designed as free floating, but may be anchored to the grade beams at the doorways to reduce the risk of differential movement. Expansion joints should be placed at regular intervals as directed by the structural engineer to reduce random cracking.

Exterior concrete slabs, aprons and sidewalks could be subject to some movements associated with swell and/or frost heave. Subgrade preparation and fill placement for the support of such structures should be controlled in a similar fashion to that placed for the concrete floor slab.

A caulked separation joint should be provided between the building and exterior walkways and aprons. Consideration should also be given to insulating below the slab at exterior doorways.

To reduce the risk of water vapour migration through the floor, installation of a vapour barrier under the slab should be considered. The placement standard and quality of the vapour barrier should be as per current building codes.

7.5 SEISMIC SITE CLASSIFICATION AND PARAMETERS

The 2015 *National Building of Canada* divides sites into six classes (A to F) for seismic response evaluation. This classification is based on the average shear wave velocity, energy-corrected SPT “N” values, or undrained shear strength over the top 30 m of the soil profile.

None of the boreholes advanced during this program were deeper than 14.9 m. However, based on SPT data within the exploration depth and historical information from the general area of the site (which indicates that the soil consistency generally increases with depth), the general area was categorized as Class “C”.

7.6 INSTALLATION OF BURIED UTILITIES

7.6.1 Trench Excavation and Backfill

It is expected that utility lines will be installed to depths of approximately 3 to 4 m below the finished grades. It is expected that the soil conditions within the trench will range from:

- clayey soils at some portions of the site
- clayey soils over the sand within the lower portions of the trench walls and/or base at some portions of the site

Excavations into these clayey soils are expected to be feasible using conventional excavating equipment.

For stability purposes, short term trench excavations in the clayey soils, and above the water table, are expected to be stable with 1 horizontal to 1 vertical (1H:1V) side slopes. Flatter side slopes (up to 3H:1V) or excavation support will be required for deeper excavations, excavations below the water table, and where sand or water seepage is encountered.

The sand encountered at the borehole locations was anticipated to be prone to sloughing. As such, workers should not be allowed in the excavation without proper excavation protection (such as proper side slope inclination, trench box, or shoring).

The degree of excavation stability decreases with time and, therefore, construction should be directed at minimizing the length of time excavations are left open. The excavation should be checked regularly for drying and sloughing of the side slopes and for any tension cracks along top edges of the excavation.

The excavation should extend sufficient distance past the edge of the bottom of the excavation to provide adequate space and protection for the workers. The latest edition of the Construction Safety Regulations of the *Occupational Health and Safety Act of Saskatchewan* should be followed.

Surface grading should be undertaken to prevent surface water from ponding adjacent to or entering the excavation. Stockpiles of materials and excavated soil should be placed away from the crest of the excavation slope by a distance equal to at least half the depth of the excavation. Similarly, wheel loads should be kept back at least 2 m from the crests of the excavation. Larger setback distances should be established for heavy trucks such as those hauling soil or concrete. Greater setbacks, and flatter side slopes, are recommended for excavations that remain open for extended periods of time.

The clay and sand soils excavated from the trenches may be used for trench backfill in the same order and depths encountered. Some moisture conditioning of these soils may be required during construction and will depend on weather conditions at the time.

Trench backfill should be uniformly compacted to a minimum of 98 percent of SPMDD to within 0.3 m of the finished subgrade, and to a minimum of 100 percent of SPMDD for the upper 0.3 m of trench backfill (as per the City of Lloydminster 2020 Municipal Development Standards).

All engineered fill should be compacted in lift thicknesses of 300 mm or less (loose), and within two percent of the optimum moisture content of the soil. Fill placement procedures and quality of the fill soils should be monitored by geotechnical personnel on a full-time basis. Field monitoring should include compaction testing at regular frequencies.

It should be recognized that some settlement of the compacted backfill in the trenches under self-weight will occur. The magnitude and rate of settlement will be dependent on the backfill soil type, the moisture condition of the backfill at the time of placement, thickness of the backfill, drainage conditions, and the initial density achieved during backfilling.

Generally, total settlement of one to three percent of backfill thickness is expected for cohesive soils compacted to between 98 and 95 percent of SPMDD, respectively. Wetter backfill compacted to reduced density standards may be subject to greater settlements. It is expected, however, that the majority of the settlement under self-weight will occur within the first one to two years following construction.

7.6.2 Installation of Underground Utilities

An observational approach combined with local experience with similar subsurface conditions is recommended. It would be desirable for the excavation contractor to be experienced in similar conditions, and/or alternatively to excavate test pits in advance of construction to familiarize field personnel with subsurface conditions. Quality workmanship is essential.

Groundwater should always be kept below the base of the excavation during construction to provide a stable base for pipe placement and manhole installation. Construction equipment should be kept away from the base of the excavation to minimize base disturbance.

If sand is encountered within the base of the excavation, and where accumulated groundwater cannot be practically removed from the base of the excavation, it may be necessary to place a geotextile filter fabric and a layer of washed rock to form a stable base. The use of washed rock allows the material to be placed without the use of compaction effort and thus, with minimal disturbance to the subgrade.

Pipe bedding material and placement standards should be in accordance with the pipe manufacturer’s specification.

7.6.3 Manhole Structures

Good foundation support conditions are expected for manhole bases founded in the clay till/sand. To mitigate the potential for differential settlement of the fill around the manhole barrel, the backfill around the perimeter of the manholes should be compacted to similar standards as the adjacent trench backfill.

Buoyancy of manhole structures should be considered where the invert levels are below the groundwater table. Buoyancy uplift forces are resisted by the weight of the manhole, skin friction along the sides of the manhole and the buoyant weight of soil above any manhole base extending outside the manhole barrel. The stability of the substructures relative to buoyancy pressure can be improved by enlarging the base such that part of the backfill along the circumference may be considered as dead weight. The design groundwater level to be used in the analysis should be established from consideration of the nearest borehole location and should be adjusted for upper bound seasonal water elevations.

7.7 PAVEMENT STRUCTURE

It was understood that asphalt pavement is being considered for this site. It was further understood that only highway legal traffic will be allowed on the pavement structures.

7.7.1 Frost Susceptibility of Soils

Frost heave of the subgrade soils is generally related to the particle size distribution of the soils, moisture content, and the presence of a relatively shallow groundwater table.

The near surface clayey soils encountered at the locations of all boreholes were generally of medium plasticity. The grain size distribution of these soils generally consisted of approximately 24 to 28 percent by weight of clay size particles with the remaining portions as silt, sand and gravel size particles. These soils were generally considered to be moderately to highly susceptible to frost heaving and formation of ice lenses in the presence of water.

The measured groundwater levels at the borehole locations were generally deeper than 1.5 m below the ground surface. The moisture content of the near surface soils was generally higher than the anticipated optimum moisture content of the soil.

Given the above and with proper drainage and surface water management, the risk of frost heaving was considered to be moderate. It is to be noted that poor surface drainage leading to water inundating the subgrade soils will significantly increase the risk level.

Due to the general variability in the soil makeup and groundwater seepage paths in soil deposits, it is not possible to predict with certainty the magnitude of frost heaving at specific locations. It is generally recommended that an observational approach be adopted over the first two winter seasons to identify problematic areas.

Frequently, areas exhibiting the formation of ice lenses and frost heaving during one winter season will exhibit the same during subsequent winter seasons. If areas with problematic frost conditions are observed, then remedial measures may be implemented.

The most suitable remedial measure will have to be assessed on a case by case basis as it depends on the severity of the problem, service/use interruption of the affected area, and the sensitivity of the pavement structure to frost heaving. Remedial measures may include soil replacement, ground insulation, or periodic maintenance (in the case of low use areas).

7.7.2 Surface Water Management Considerations

The performance of the pavement structure will be enhanced to a greater degree with proper management of surface water. It is recommended that adequate slope be provided at the subgrade level, and that the pavement gravel material be properly drained into a positive gravity drainage system. This will reduce the risk of water ponding above the subgrade and potential of softening and/or volume change associated with the presence of excess water.

A minimum grade of two percent is recommended at the subgrade level to accommodate surface water runoff away from the subgrade. The final pavement surface should also be properly sloped to promote surface water runoff away from the paved surface.

Positive drainage away from the pavement surface is particularly important during the spring thaw and snow melt season. If water from melting snow is allowed to remain on the paved surface and subsequently freezes, significant damage to the pavement (and formation of potholes) may be encountered.

7.7.3 Asphalt Pavement Design Section

Recommendations presented in Section 7.1 “Site Development Considerations” regarding subgrade preparation and inspection should be followed. Recommendations presented in this section are based on the assumption that a stable and competent subgrade is achieved prior to the placement of the pavement structure.

The minimum recommended flexible asphalt pavement structure is provided in Table 5. Light duty refers to design traffic of $5x10^4$ Equivalent Single Axle Load (ESAL) and heavy duty refers to design traffic of $1x10^6$ ESAL. The recommended pavement section was based on an expected subgrade Resilient Modulus during spring thaw conditions of 30 to 35 MPa.

The granular base course should be placed in maximum 150 mm thick lifts and uniformly compacted to a minimum of 100 percent of SPMDD at moisture content within two percent of the optimum moisture content. A reduced lift thickness may be required depending on the capability of the compaction equipment available to achieve the required densities.

Asphaltic concrete material and placement requirements should comply with the industry standards and/or the standards of the City of Lloydminster.

It is recommended that locations subjected to heavy static wheel loads, such as at dumpster enclosures, truck/bus stops, or heavy forklift loading/unloading pads, be constructed with concrete pavement instead of flexible asphalt pavement to minimize the potential for rutting, which may occur in asphalt under these service conditions. At a minimum, a 175 mm thick concrete slab underlain by a minimum 150 mm thick layer of granular base course is recommended. The granular base course should be compacted to a minimum of 100 percent of SPMDD at moisture content within two percent of the optimum moisture content of the soil.

8.0 SOIL ANALYTICAL CHEMISTRY TESTING

8.1 REGULATORY FRAMEWORK

A comprehensive land use assessment and selection of applicable environmental regulatory framework were outside the scope of this work. Based on the current land use and subsurface soil conditions encountered, the selected guidelines to assess the analytical chemistry results were:

- The Saskatchewan Environmental Quality Guidelines (SKEQG) (accessed online on 10 December 2021)
- The Canada-Wide Standards for Petroleum Hydrocarbons in Soil (CWS) (January 2008)
- The Canadian Council of Ministers of the Environment, Soil Quality Guidelines for the Protection of Environmental and Human Health (CCME SQG) (Accessed online 10 December 2021)

Based on the project background, it was understood that the Site was to be developed into a commercial development. Accordingly, a commercial land use setting was selected.

The soil samples were collected from the surficial soils at the Site, which were predominantly fine-grained. Accordingly, a fine-grained soil setting was selected.

8.2 RESULTS OF SOIL ANALYTICAL CHEMISTRY TESTING

The results of the soil analytical chemistry testing are presented in Table 6. The analytical chemistry report is presented in Appendix C. A summary of the results is presented below:

- The pH measured in the soil sample collected from BH21-3 at 0.2 m below ground surface was 8.19 and exceeded the upper limit of the SKEQG and CCME SQG.

- The electrical conductivity measured in the soil sample collected from BH21-6 at 0.2 m below ground surface was 6.02 dS/m and exceeded the upper limit of 4 dS/m outlined in the SKEQG and CCME SQG.
- No other exceedances (above any criteria) were detected in any of the parameters tested.

Although no criteria were available for sodium, chloride, and sulphate, the concentrations of these parameters in BH21-6 at 0.2 m below ground surface appeared to be much higher than what was measured at the other borehole locations and generally elevated compared to what one would typically expect in undisturbed soils in similar settings.

9.0 TESTING AND INSPECTION

Recommendations presented in this report may not be valid if site specific investigation are not conducted for major facility elements (to confirm the findings once the site development plan is finalized), if adequate engineering inspection and testing programs during construction are not implemented, or if other building code requirements are not followed. Testing and inspection programs should consist of:

- Full-time monitoring and compaction testing during site grading, subgrade preparation and fill placement
- Design review and full-time installation monitoring of pile foundations
- Design review and bearing inspection for shallow foundations
- Testing for Asphalt and Portland cement concrete as per City of Lloydminster standards.

10.0 CLOSURE

The preliminary recommendations presented in this report are based on the results of soil sampling and testing at 11 borehole locations advanced at the site during this investigation. The provided recommendations and considerations should be treated as preliminary only. A detailed geotechnical investigation should be completed for major facility elements and buildings once the project components are locations are finalized.

Soil conditions by nature can vary across any given site. If different soil conditions are encountered at subsequent phases of this project, SolidEarth should be notified immediately and given the opportunity to evaluate the situation and provide additional recommendations as necessary.

The preliminary recommendations presented in this report should not be used for another site or for a different application at the same site. If the intended application of the site is changed or if the assumptions outlined in this report became invalid, SolidEarth should be notified and given the opportunity to assess if the recommendations presented should be modified.

This report has been prepared for the exclusive use of the City of Lloydminster and their authorized users for the specific application outlined in this report. No other warranties expressed or implied are provided. This report has been prepared within generally accepted geotechnical engineering practices.

Respectfully submitted,
SolidEarth Geotechnical Inc.

Hijazi

Mohamad Hijazi, P.Eng.	Jay Jaber, M.Sc., P.Eng.
Senior Geotechnical Engineer	Senior Geotechnical Engineer
	Managing Director

Figures

properties to the north, and 41 Street followed by a residential subdivision to the west.

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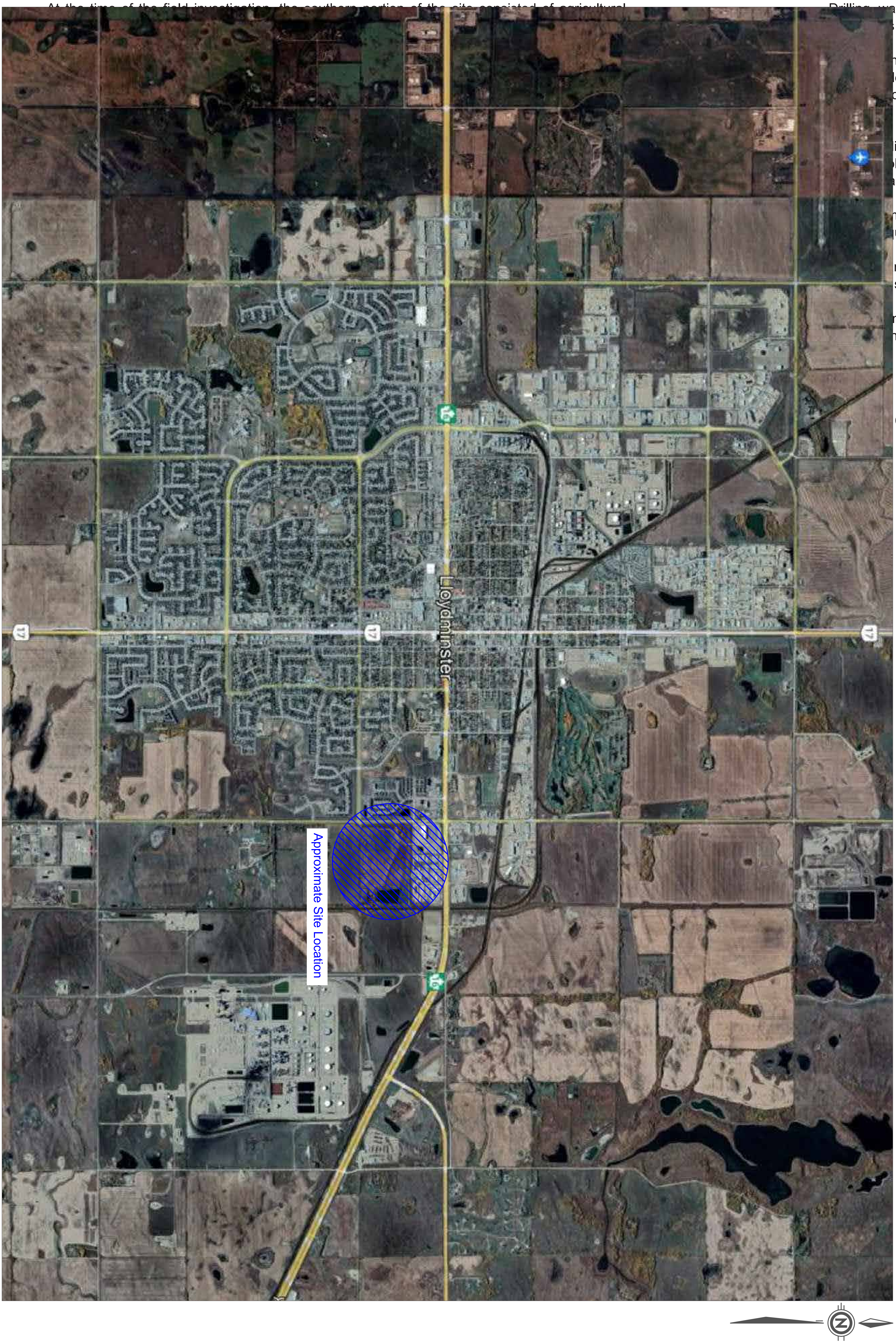


SCALE: NTS
DRAWN BY: MH
FIGURE No.: 1
REVISION No.: 0
DATUM: -
DATE: December 2021
PROJECT No.: PG21-1603.1000
PROJECT NAME: Major Events Arena
Southeast of 41 Street and 40 Avenue Intersection
City of Lloydminster, Saskatchewan
CLIENT:
DRAWING TITLE: Approximate Site Location on an Aerial Photograph

SolidEarth Geotechnical Inc.
5406 52 Avenue, Lloydminster, AB, T9V 2T5

SCALE: NTS	DRAWN BY: MH	FIGURE No.: 2	REVISION No.: 0	PROJECT NAME: Major Events Arena Southeast of 41 Street and 40 Avenue Intersection City of Lloydminster, Saskatchewan
DATUM: -	DATE: December 2021	PROJECT No.: PG21-1603.1000		
SolidEarth Geotechnical Inc. 5406 52 Avenue, Lloydminster, AB, T9V 2T5				DRAWING TITLE: Borehole Location Plan on an Aerial Photograph

CLIENT:

LLOYDMINSTER
Canada's Border City

SCALE: NTS

DRAWN BY: MH

FIGURE No.: 3

REVISION No.: 0

DATUM: -

DATE: December 2021

PROJECT No.: PG21-1603.1000

PROJECT NAME:
Major Events Arena
Southeast of 41 Street and 40 Avenue Intersection
City of Lloydminster, Saskatchewan

DRAWING TITLE:
Approximate Site Limits Shown on a 1978 Aerial Photograph

CLIENT:
LLOYDMINSTER
Canada's Border City

SolidEarth Geotechnical Inc.
5406 52 Avenue, Lloydminster, AB, T9V 2T5

SCALE: NTS
DRAWN BY: MH
FIGURE No.: 4
REVISION No.: 0
DATUM: -
DATE: December 2021
PROJECT No.: PG21-1603.1000

PROJECT NAME:
Major Events Arena
Southeast of 41 Street and 40 Avenue Intersection
City of Lloydminster, Saskatchewan

DRAWING TITLE:
Approximate Site Limits Shown on a 1991 Aerial Photograph

CLIENT:

SolidEarth Geotechnical Inc.
5406 52 Avenue, Lloydminster, AB, T9V 2T5

Tables

Table 1: Measured Groundwater Levels

Borehole ID	Depth of Borehole (mbgs) Note 1	Standpipe Depth (mbgs)	Groundwater Depth (mbgs)	
			Upon Completion of Drilling	On 6 December 2021
BH21-01	7.3	7.3	Dry	4.4
BH21-02	7.3	6.3	2.3	2.1
BH21-03	7.3	NA Note 2	3.0	-
BH21-04	7.3	7.2	3.8	1.4
BH21-05	13.4	13.1	2.7	3.3
BH21-06	14.9	6.4	2.7	- Note 3
BH21-07	7.3	6.4	4.0	3.8
BH21-08	7.3	7.0	5.2	4.7
BH21-09	7.3	7.3	Dry	3.2
BH21-10	7.3	4.9	2.7	3.1
BH21-11	7.3	6.9	Dry	2.9

Note 1: mbgs - metres below the existing ground surface
Note 2: No standpipe piezometer was installed
Note 3: Standpipe was found destroyed

Table 2: Geotechnical Resistance Factors for Foundations

Foundation Type	Loading Condition	Geotechnical Resistance Factor (ULS)
Shallow Foundations	vertical bearing resistance from semi-empirical analysis	0.5
	horizontal resistance against sliding Based on cohesion/adhesion Based on friction	 0.6 0.8
Deep Foundations	resistance to axial load (i) semi-empirical analysis (ii) analysis using static loading test results (iii) analysis using dynamic monitoring results (iv) uplift resistance by semi-empirical analysis (v) uplift resistance using load test results	 0.4 0.6 0.5 0.3 0.4
	resistance to horizontal load	0.5

Table 3: Recommended Unfactored (Ultimate) Shaft Friction Resistance for CIP and CFA Concrete Piles

Depth Below Existing Ground Surface (m)	Soil Type	Un-factored (Ultimate) Shaft Friction (kPa)	
		CIP	CFA
0 to 2	Clay Till	-	-
2 to 8	Clay Till/Sand	40	50
8 to 12	Clay Till/Sand	60	60
Below 12	Clay Till/Sand	80	80

Table 4: Recommended Unfactored (Ultimate) Shaft Friction and End Bearing Resistance for Driven Steel Pipe Piles

Depth Below Existing Ground Surface (m)	Soil Type	Unfactored Shaft Friction Resistance (kPa)	Unfactored End Bearing Resistance (kPa)
0 to 2	Clay Till	-	-
2 to 8	Clay Till/Sand	50	-
8 to 12	Clay Till/Sand	60	1,000
Below 12	Clay Till/Sand	80	1,500

Table 5: Flexible Asphaltic Concrete Pavement Design

Material	Recommended Minimum Thickness (mm)	
	Light Duty ($5x10^4$ ESAL)	Heavy Duty ($1x10^6$ ESAL)
Hot Mix Asphalt	80	120
20 mm Crushed Granular Base Course (City of Lloydminster Type I Base Course)	300	350

Table 6: Results of Groundwater Analytical Chemistry Testing

Parameter	Unit	MDL	SKEQG	CWS	CCME	Monitoring Well ID and Sample Date			
						BH21-2	**BH21-3**	**BH21-6**	**BH21-9**
						0.2 mbgs	**0.2 mbgs**	**0.2 mbgs**	**0.2 mbgs**
Salinity									
pH	--	--	6 - 8	--	6 - 8	7.65	***8.19***	7.62	6.88
calcium	mg/kg	5.0	--	--	--	15.2	17.2	244	28.3
chloride	mg/kg	10	--	--	--	12	85	453	111
conductivity	dS/m	0.010	4	--	4	0.525	1.01	***6.02***	1.31
magnesium	mg/kg	5.0	--	--	--	16.1	33.5	279	33.4
Potassium	mg/kg	5.0	--	--	--	<5.0	<5.0	10.4	<5.0
SAR	--	0.10	12	--	12	2.10	2.12	3.45	2.90
sodium	mg/kg	5.0	--	--	--	37.5	45.2	243	67.1
sulfur (as SO4)	mg/kg	8.0	--	--	--	74.6	63.4	1550	45.4
BTEX, F1 - F4									
benzene	mg/kg	0.0050	--	--	0.0068	<0.0050	<0.0050	--	--
ethylbenzene	mg/kg	0.015	--	--	0.018	<0.015	<0.015	--	--
toluene	mg/kg	0.050	--	--	0.08	<0.050	<0.050	--	--
xylene, m+p-	mg/kg	0.050	--	--	--	<0.050	<0.050	--	--
xylene, o-	mg/kg	0.050	--	--	--	<0.050	<0.050	--	--
xylenes, total	mg/kg	0.075	--	--	2.4	<0.075	<0.075	--	--
BTEX, total	mg/kg	0.10	--	--	--	<0.10	<0.10	--	--
F1 (C6-C10)	mg/kg	5.0	--	320	--	<5.0	<5.0	--	--
F1-BTEX	mg/kg	5.0	--	320	--	<5.0	<5.0	--	--
F2 (C10-C16)	mg/kg	25	--	260	--	<25	<25	--	--
F3 (C16-C34)	mg/kg	50	--	2500	--	<50	<50	--	--
F4 (C34-C50)	mg/kg	50	--	6600	--	<50	<50	--	--
Total PHCs	mg/kg	80	--	--	--	<80	<80	--	--

Notes:

(<) indicates less than analytical method detection limits

mg/kg - milligrams per kilogram | dS/m – Deci-Siemens per metre

1) Saskatchewan Environmental Quality Guidelines, commercial land use, fine-grained soil (Accessed online 10 December 2021)
2) Canada-Wide Standards for Petroleum Hydrocarbons in Soil, commercial land use, fine-grained soils. (January 2008)
3) Canadian Council of Ministers of the Environment, Soil Quality Guidelines, commercial land use, fine-grained soils (Accessed online 10 December 2021)

Appendix A

Site Photographs Taken During the Field Investigation

Photograph 1: Northwest corner of the site looking east at BH21-01

Photograph 2: Southwest corner of the site looking north at BH21-04

Photograph 3: South central portion of the site looking north towards BH21-06

Photograph 4: South portion of the site looking east from BH21-07

Appendix B

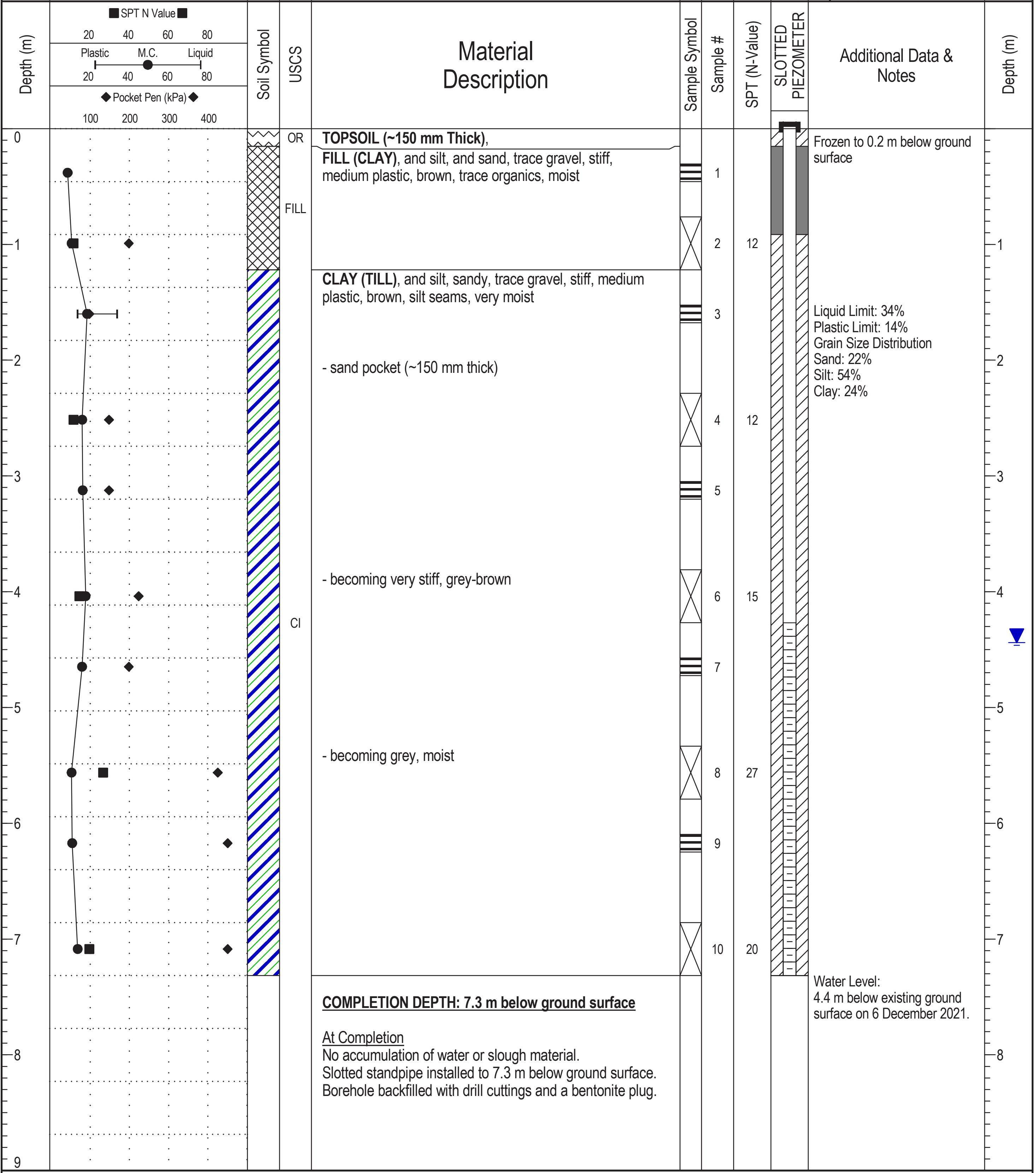
Borehole Logs
Explanation of Terms and Symbols

Project Name: Major Events Arena
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, AB
Northing: 5903296 Easting: 568161
Elevation:

Borehole #: **BH21-01**
Project #: PG21-1603.1000
Logged By: JS / Reviewed By: KJ
Driller: Drilling Solutions Inc.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 23-11-21
Page 1 of 1



Sample #	SPT (N-Value)
1	
2	12
3	
4	12
5	
6	15
7	
8	27
9	
10	20

TOPSOIL (~150 mm Thick),

FILL (CLAY), and silt, and sand, trace gravel, stiff, medium plastic, brown, trace organics, moist

CLAY (TILL), and silt, sandy, trace gravel, stiff, medium plastic, brown, silt seams, very moist

- sand pocket (~150 mm thick)

- becoming very stiff, grey-brown

- becoming grey, moist

COMPLETION DEPTH: 7.3 m below ground surface

At Completion
No accumulation of water or slough material.
Slotted standpipe installed to 7.3 m below ground surface.
Borehole backfilled with drill cuttings and a bentonite plug.

Frozen to 0.2 m below ground surface

Liquid Limit: 34%
Plastic Limit: 14%
Grain Size Distribution
Sand: 22%
Silt: 54%
Clay: 24%

Water Level:
4.4 m below existing ground surface on 6 December 2021.

Sample Symbol	■ Shelby Tube	◻ No Recovery	☒ SPT Test (N)	☰ Grab Sample	▥ Split-Pen	◧ Core
Backfill Symbol	■ Bentonite	⬚ Pea Gravel	▥ Slough	⁘ Grout	▨ Drill Cuttings	⁘ Sand

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Project Name: Major Events Arena
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, AB
Northing: 5903302 Easting: 568311
Elevation:

Borehole #: **BH21-02**
Project #: PG21-1603.1000
Logged By: JS / Reviewed By: KJ
Driller: Drilling Solutions Inc.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 23-11-21
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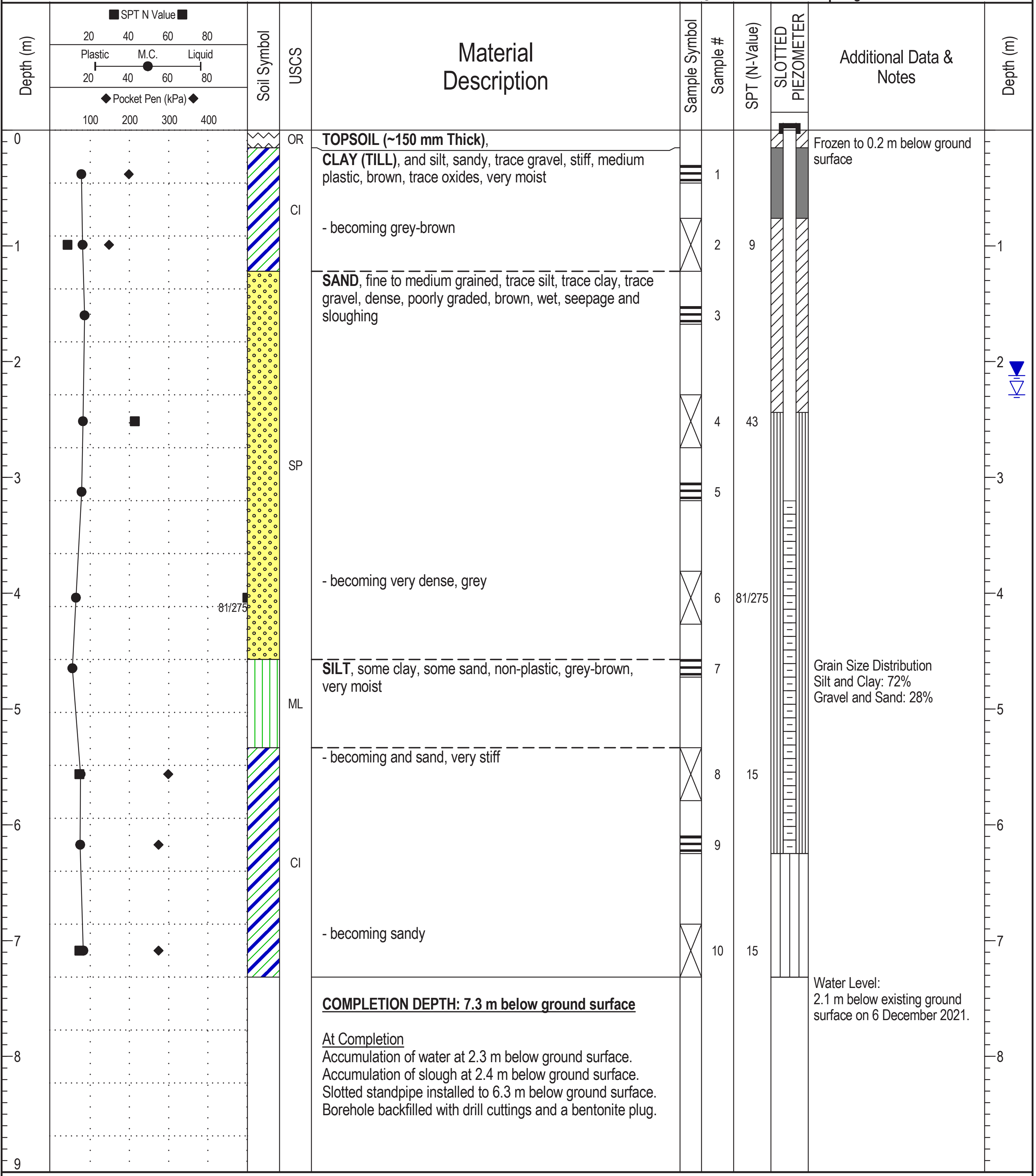

Material Description

TOPSOIL (~150 mm Thick),

CLAY (TILL), and silt, sandy, trace gravel, stiff, medium plastic, brown, trace oxides, very moist

- becoming grey-brown

SAND, fine to medium grained, trace silt, trace clay, trace gravel, dense, poorly graded, brown, wet, seepage and sloughing

- becoming very dense, grey

SILT, some clay, some sand, non-plastic, grey-brown, very moist

- becoming and sand, very stiff

- becoming sandy

COMPLETION DEPTH: 7.3 m below ground surface

At Completion
Accumulation of water at 2.3 m below ground surface.
Accumulation of slough at 2.4 m below ground surface.
Slotted standpipe installed to 6.3 m below ground surface.
Borehole backfilled with drill cuttings and a bentonite plug.

Sample #	SPT (N-Value)
1	
2	9
3	
4	43
5	
6	81/275
7	
8	15
9	
10	15

Additional Data & Notes

Frozen to 0.2 m below ground surface

Grain Size Distribution
Silt and Clay: 72%
Gravel and Sand: 28%

Water Level:
2.1 m below existing ground surface on 6 December 2021.

Sample Symbol: ■ Shelby Tube, ▨ No Recovery, ☒ SPT Test (N), ☰ Grab Sample, ▥ Split-Pen, ▯ Core

Backfill Symbol: ■ Bentonite, ⁘ Pea Gravel, ▥ Slough, ⁘ Grout, ▨ Drill Cuttings, ⁘ Sand

Project Name: Major Events Arena
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, AB
Northing: 5903291 Easting: 568494
Elevation:

Borehole #: **BH21-03**
Project #: PG21-1603.1000
Logged By: JS / Reviewed By: KJ
Driller: Drilling Solutions Inc.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 23-11-21
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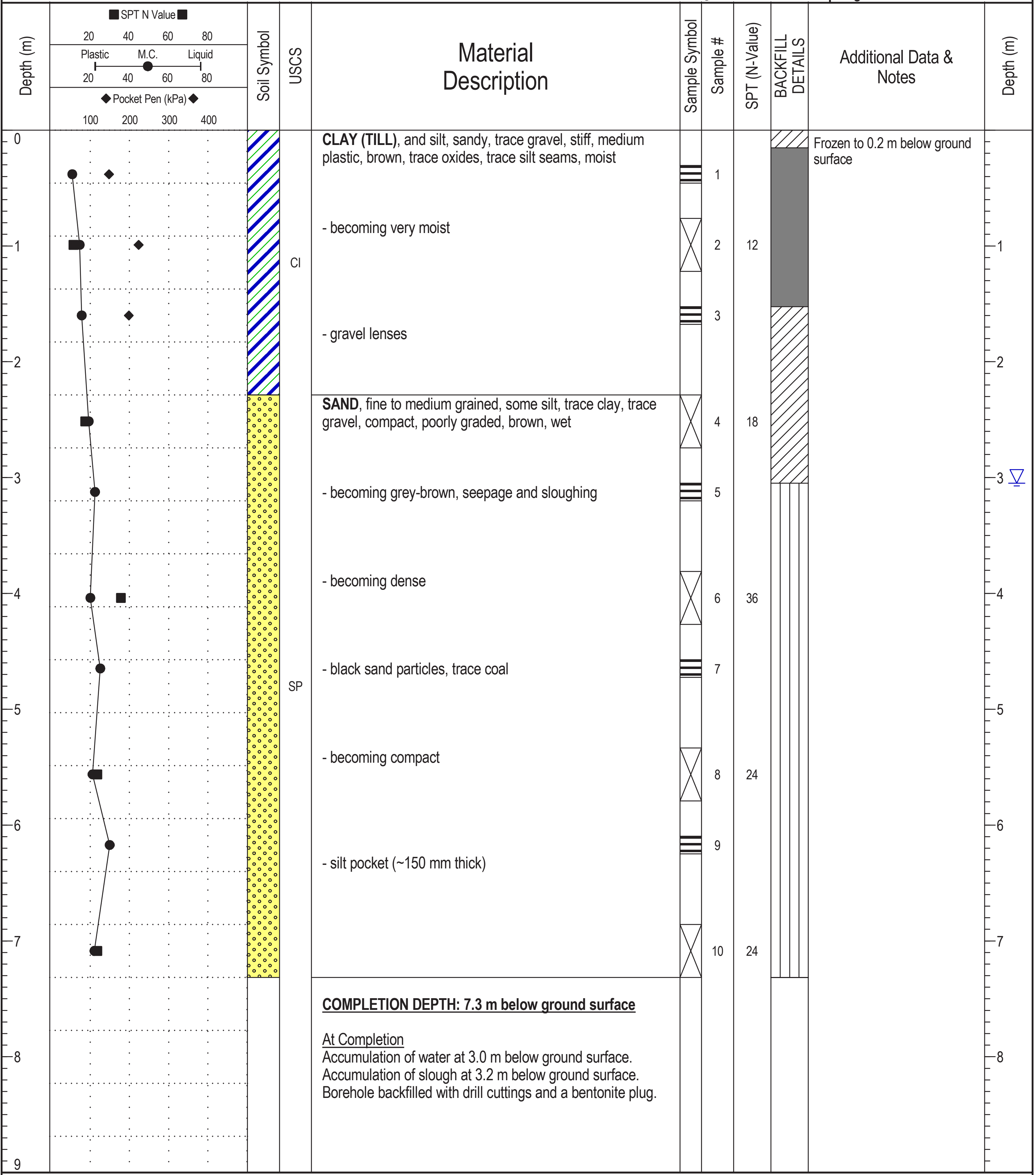

Material Description

CLAY (TILL), and silt, sandy, trace gravel, stiff, medium plastic, brown, trace oxides, trace silt seams, moist

- becoming very moist

- gravel lenses

SAND, fine to medium grained, some silt, trace clay, trace gravel, compact, poorly graded, brown, wet

- becoming grey-brown, seepage and sloughing

- becoming dense

- black sand particles, trace coal

- becoming compact

- silt pocket (~150 mm thick)

COMPLETION DEPTH: 7.3 m below ground surface

At Completion
Accumulation of water at 3.0 m below ground surface.
Accumulation of slough at 3.2 m below ground surface.
Borehole backfilled with drill cuttings and a bentonite plug.

Sample #	SPT (N-Value)
1	
2	12
3	
4	18
5	
6	36
7	
8	24
9	
10	24

Additional Data & Notes

Frozen to 0.2 m below ground surface

Sample Symbol: ■ Shelby Tube; ◪ No Recovery; ☒ SPT Test (N); ☰ Grab Sample; ▥ Split-Pen; ◨ Core

Backfill Symbol: ■ Bentonite; ⬚ Pea Gravel; ▥ Slough; ⁘ Grout; ▨ Drill Cuttings; ⁘ Sand

Project Name: Major Events Arena
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, AB
Northing: 5903113 Easting: 568160
Elevation:

Borehole #: **BH21-04**
Project #: PG21-1603.1000
Logged By: JS / Reviewed By: KJ
Driller: Drilling Solutions Inc.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 23-11-21
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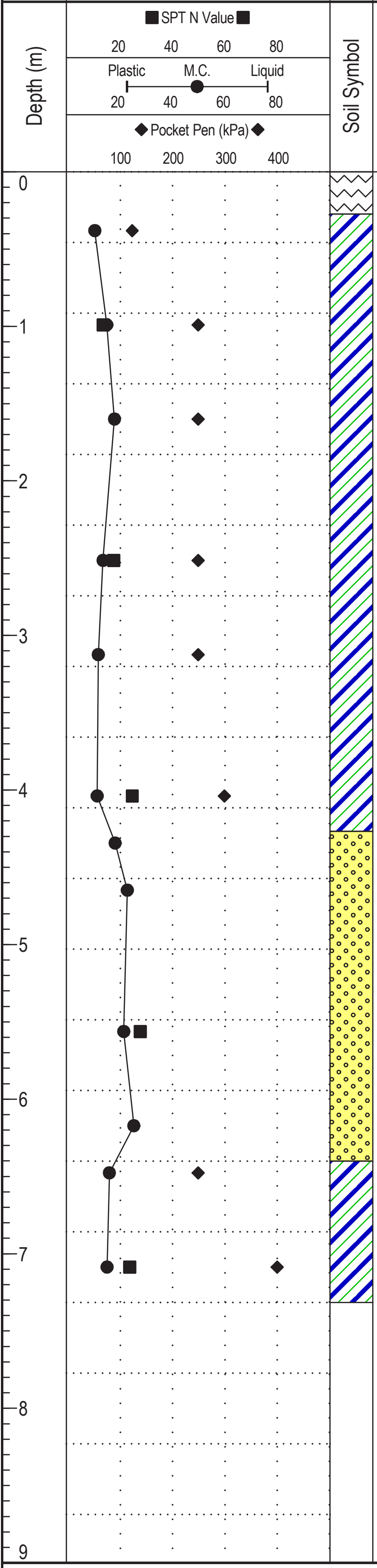
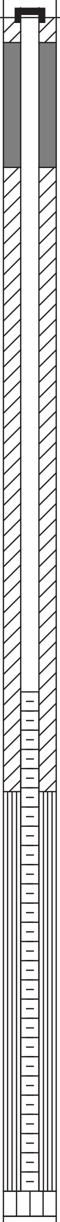


Depth (m)	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	Additional Data & Notes
0	OR	**CULTIVATED SOIL (~275 mm Thick),**				Frozen to 0.2 m below ground surface
	CI	**CLAY (TILL)**, and silt, sandy, trace gravel, stiff, medium plastic, brown, trace silt, moist	Grab Sample	1		
1		- becoming very moist	SPT Test (N)	2	14	
			Grab Sample	3		
2		- becoming grey-brown, very stiff	SPT Test (N)	4	18	
3		- becoming grey	Grab Sample	5		
4			SPT Test (N)	6	25	
	SP	**SAND**, fine to medium grained, some silt, trace clay, trace gravel, compact, poorly graded, grey-brown, wet, seepage and sloughing	Grab Sample	7		
			Grab Sample	8		
5			SPT Test (N)	9	28	
6			Grab Sample	10		
	CI	- becoming and sand	Grab Sample	11		
7			SPT Test (N)	12	24	
		COMPLETION DEPTH: 7.3 m below ground surface				Water Level: 1.4 m below existing ground surface on 6 December 2021.

At Completion
Accumulation of water at 3.8 m below ground surface.
Accumulation of slough at 4.7 m below ground surface.
Slotted standpipe installed to 7.2 m below ground surface.
Borehole backfilled with drill cuttings and a bentonite plug.

SLOTTED PIEZOMETER



Sample Symbol: ■ Shelby Tube ▢ No Recovery ☒ SPT Test (N) ☰ Grab Sample ▥ Split-Pen ◧ Core

Backfill Symbol: ■ Bentonite ⬚ Pea Gravel ▥ Slough ⁘ Grout ▨ Drill Cuttings ⁘ Sand

Project Name: Major Events Arena
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, AB
Northing: 5903121 Easting: 568343
Elevation:

Borehole #: **BH21-05**
Project #: PG21-1603.1000
Logged By: ME / Reviewed By: KJ
Driller: Drilling Solutions Inc.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 24-11-21
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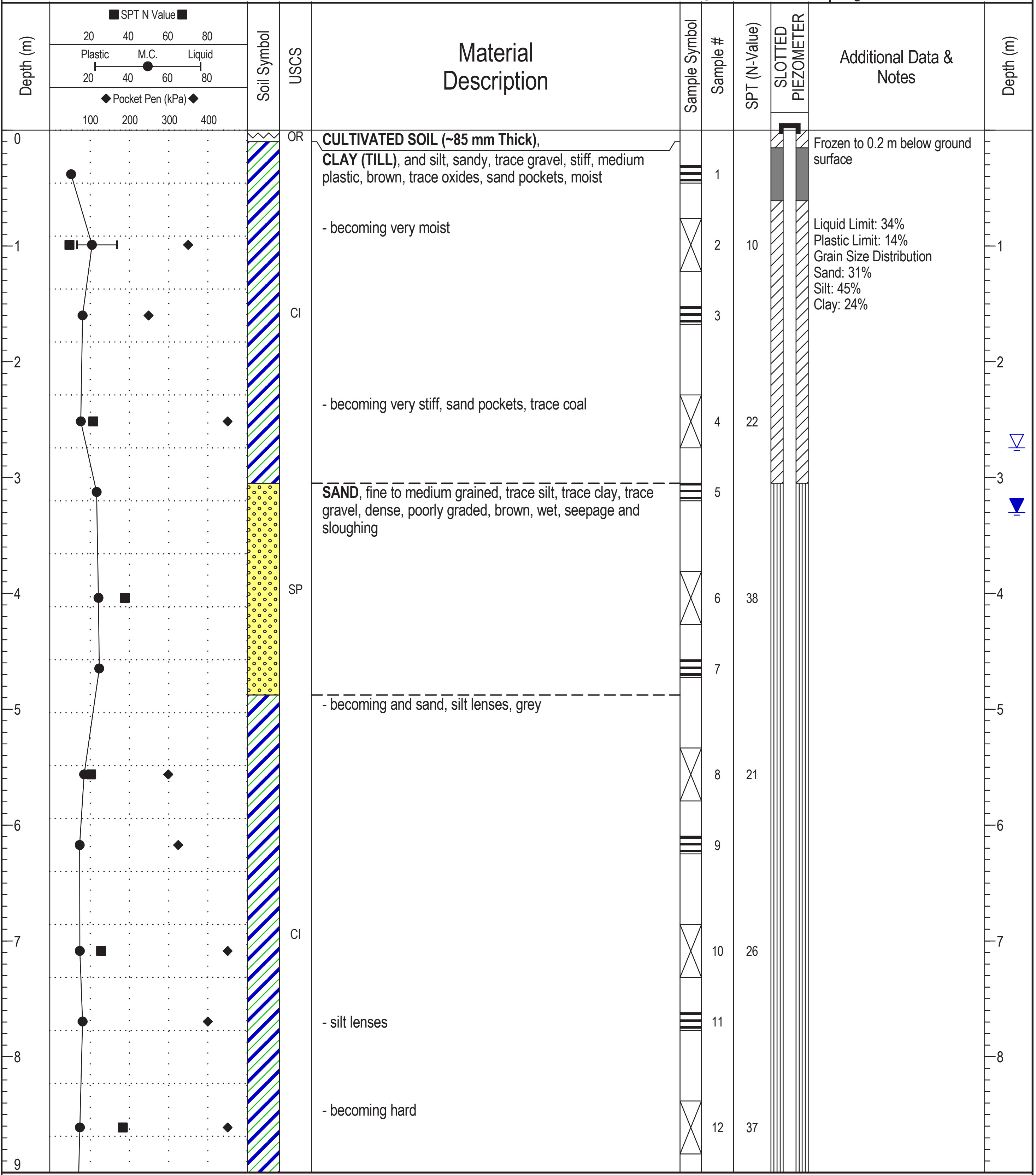


CULTIVATED SOIL (~85 mm Thick),

CLAY (TILL), and silt, sandy, trace gravel, stiff, medium plastic, brown, trace oxides, sand pockets, moist

- becoming very moist

- becoming very stiff, sand pockets, trace coal

SAND, fine to medium grained, trace silt, trace clay, trace gravel, dense, poorly graded, brown, wet, seepage and sloughing

- becoming and sand, silt lenses, grey

- silt lenses

- becoming hard

Sample #	SPT (N-Value)
1	
2	10
3	
4	22
5	
6	38
7	
8	21
9	
10	26
11	
12	37

Frozen to 0.2 m below ground surface

Liquid Limit: 34%
Plastic Limit: 14%
Grain Size Distribution
Sand: 31%
Silt: 45%
Clay: 24%

Sample Symbol ■ Shelby Tube ◪ No Recovery ☒ SPT Test (N) ☰ Grab Sample ▥ Split-Pen ◨ Core

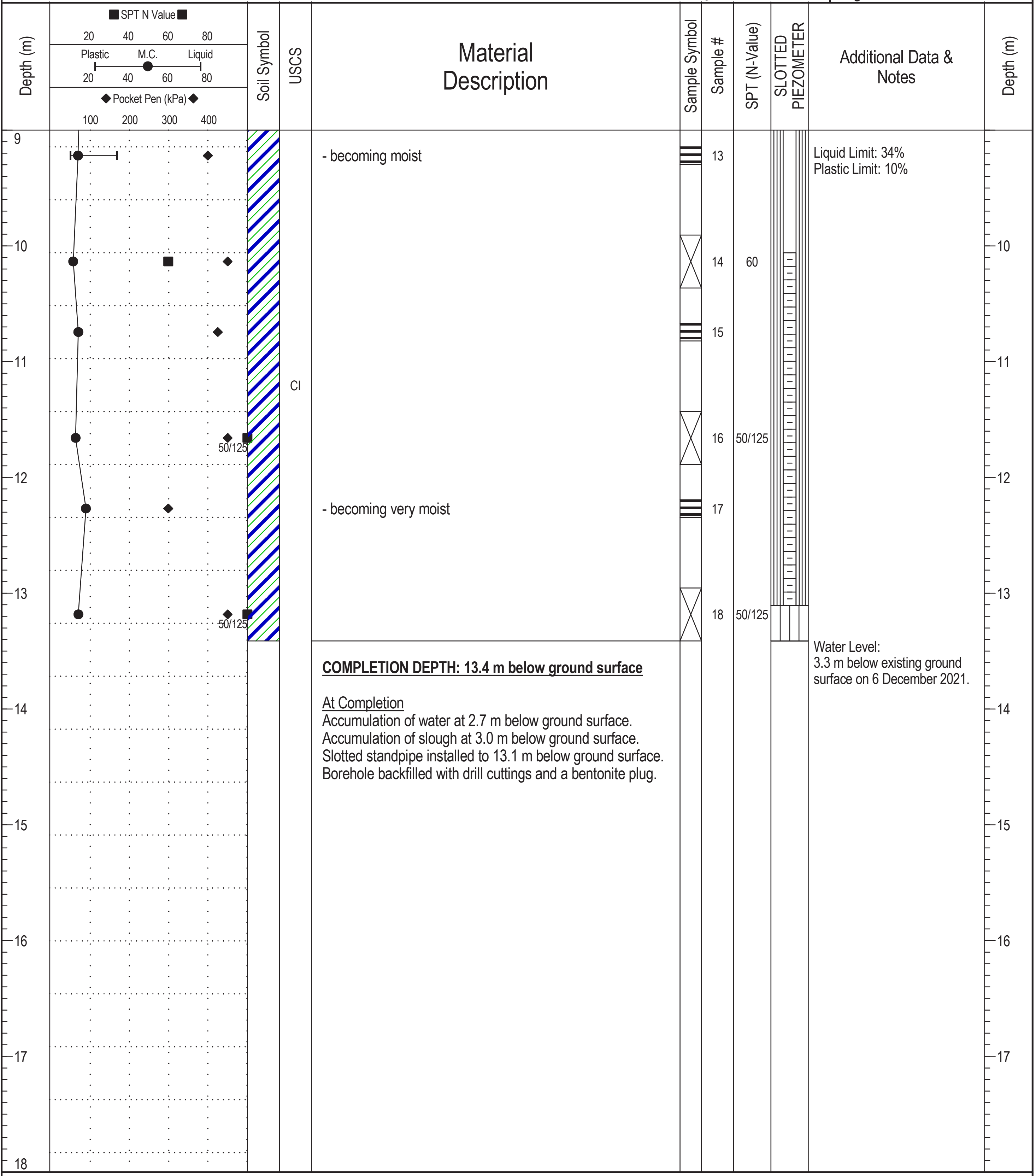
Backfill Symbol ▩ Bentonite ⬚ Pea Gravel ▥ Slough ⁘ Grout ▨ Drill Cuttings ⁘ Sand

Project Name: Major Events Arena
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, AB
Northing: 5903121 Easting: 568343
Elevation:

Borehole #: **BH21-05**
Project #: PG21-1603.1000
Logged By: ME / Reviewed By: KJ
Driller: Drilling Solutions Inc.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 24-11-21



Material Description

- becoming moist

- becoming very moist

COMPLETION DEPTH: 13.4 m below ground surface

At Completion
Accumulation of water at 2.7 m below ground surface.
Accumulation of slough at 3.0 m below ground surface.
Slotted standpipe installed to 13.1 m below ground surface.
Borehole backfilled with drill cuttings and a bentonite plug.

Additional Data & Notes

Liquid Limit: 34%
Plastic Limit: 10%

Water Level:
3.3 m below existing ground surface on 6 December 2021.

Sample Symbol ■ Shelby Tube ◿ No Recovery ☒ SPT Test (N) ☰ Grab Sample ▥ Split-Pen ◨ Core

Backfill Symbol ■ Bentonite ⁙ Pea Gravel ▥ Slough ⁘ Grout ▨ Drill Cuttings ⁙ Sand

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Project Name: Major Events Arena
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, AB
Northing: 5903134 Easting: 568501
Elevation:

Borehole #: **BH21-06**
Project #: PG21-1603.1000
Logged By: ME / Reviewed By: KJ
Driller: Drilling Solutions Inc.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL
Completion Date: 24-11-21
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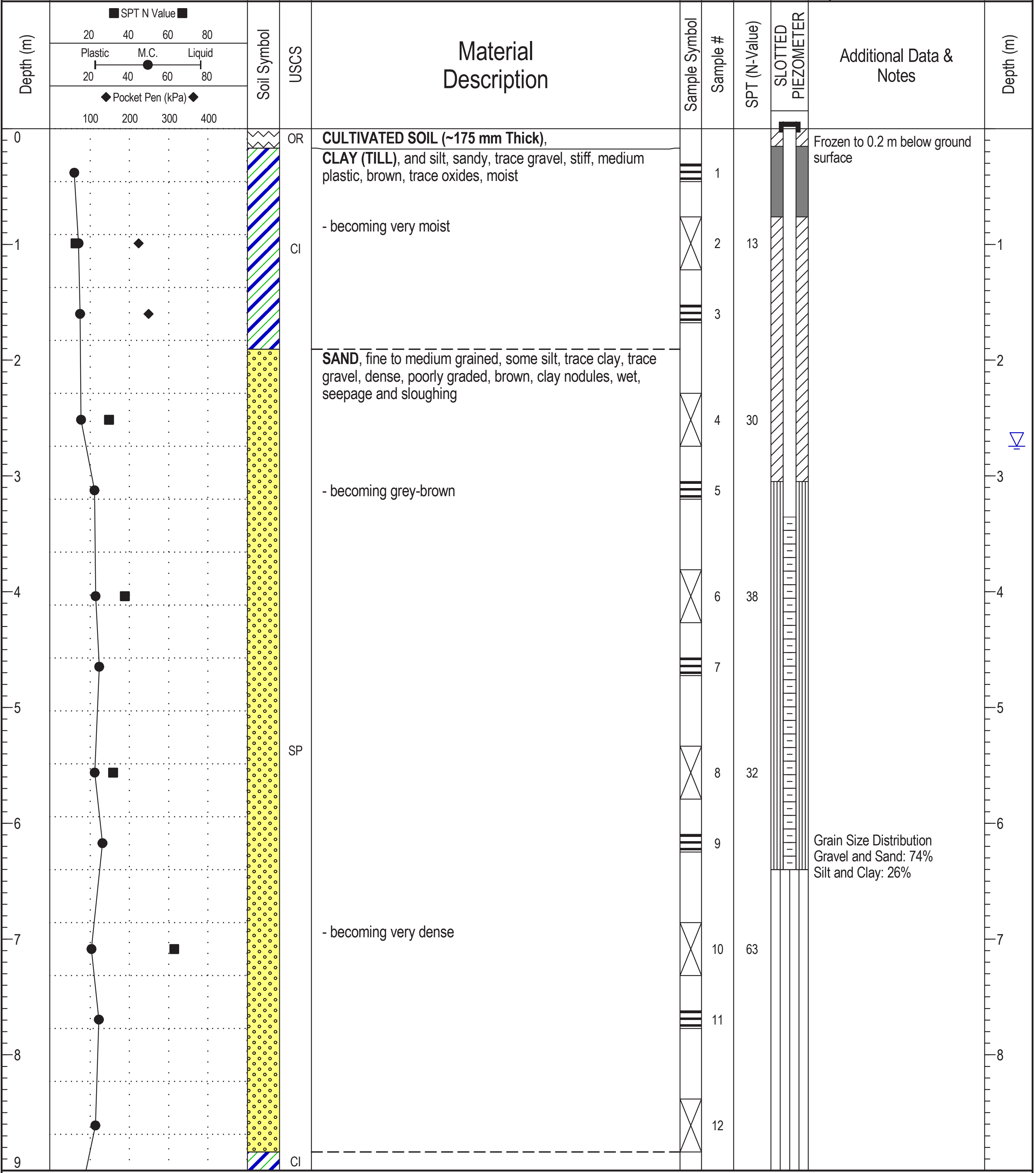

Material Description

CULTIVATED SOIL (~175 mm Thick),

CLAY (TILL), and silt, sandy, trace gravel, stiff, medium plastic, brown, trace oxides, moist

- becoming very moist

SAND, fine to medium grained, some silt, trace clay, trace gravel, dense, poorly graded, brown, clay nodules, wet, seepage and sloughing

- becoming grey-brown

- becoming very dense

Sample #	SPT (N-Value)
1	
2	13
3	
4	30
5	
6	38
7	
8	32
9	
10	63
11	
12	

Additional Data & Notes

Frozen to 0.2 m below ground surface

Grain Size Distribution
Gravel and Sand: 74%
Silt and Clay: 26%

Sample Symbol	■ Shelby Tube	▨ No Recovery	☒ SPT Test (N)	☰ Grab Sample	▥ Split-Pen	◧ Core
Backfill Symbol	▩ Bentonite	⁘ Pea Gravel	▥ Slough	⁘ Grout	▨ Drill Cuttings	⁘ Sand

Project Name: Major Events Arena
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, AB
Northing: 5903134 Easting: 568501
Elevation:

Borehole #: **BH21-06**
Project #: PG21-1603.1000
Logged By: ME / Reviewed By: KJ
Driller: Drilling Solutions Inc.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL
Completion Date: 24-11-21
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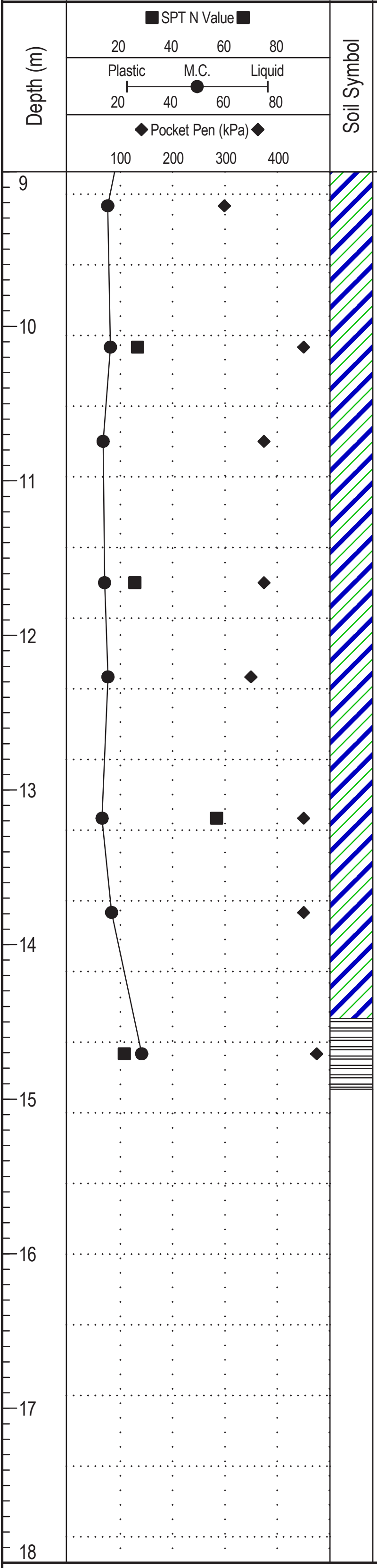

USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	SLOTTED PIEZOMETER	Additional Data & Notes
	- becoming and sand, grey, very stiff	☰	13			
		☒	14	27		
		☰	15			
CI		☒	16	26		
		☰	17			
	- becoming hard	☒	18	57		
	- trace shale	☰	19			
CS	**CLAY SHALE (BEDROCK)**, very weak, massive, silty, trace sand, high plastic, highly weathered, grey, very moist	☒	20	22		
						Water Level: Found to be destroyed on 6 December 2021.

COMPLETION DEPTH: 14.9 m below ground surface

At Completion
Accumulation of water at 2.7 m below ground surface.
Accumulation of slough at 3.0 m below ground surface.
Slotted standpipe installed to 6.4 m below ground surface.
Borehole backfilled with drill cuttings and a bentonite plug.

Sample Symbol	■ Shelby Tube	◻ No Recovery	☒ SPT Test (N)	☰ Grab Sample	▥ Split-Pen	▮ Core
Backfill Symbol	■ Bentonite	⁙ Pea Gravel	▥ Slough	⁘ Grout	▨ Drill Cuttings	⁙ Sand

Project Name: Major Events Arena
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, AB
Northing: 5902965 Easting: 568154
Elevation:

Borehole #: **BH21-07**
Project #: PG21-1603.1000
Logged By: JS / Reviewed By: KJ
Driller: Drilling Solutions Inc.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 23-11-21
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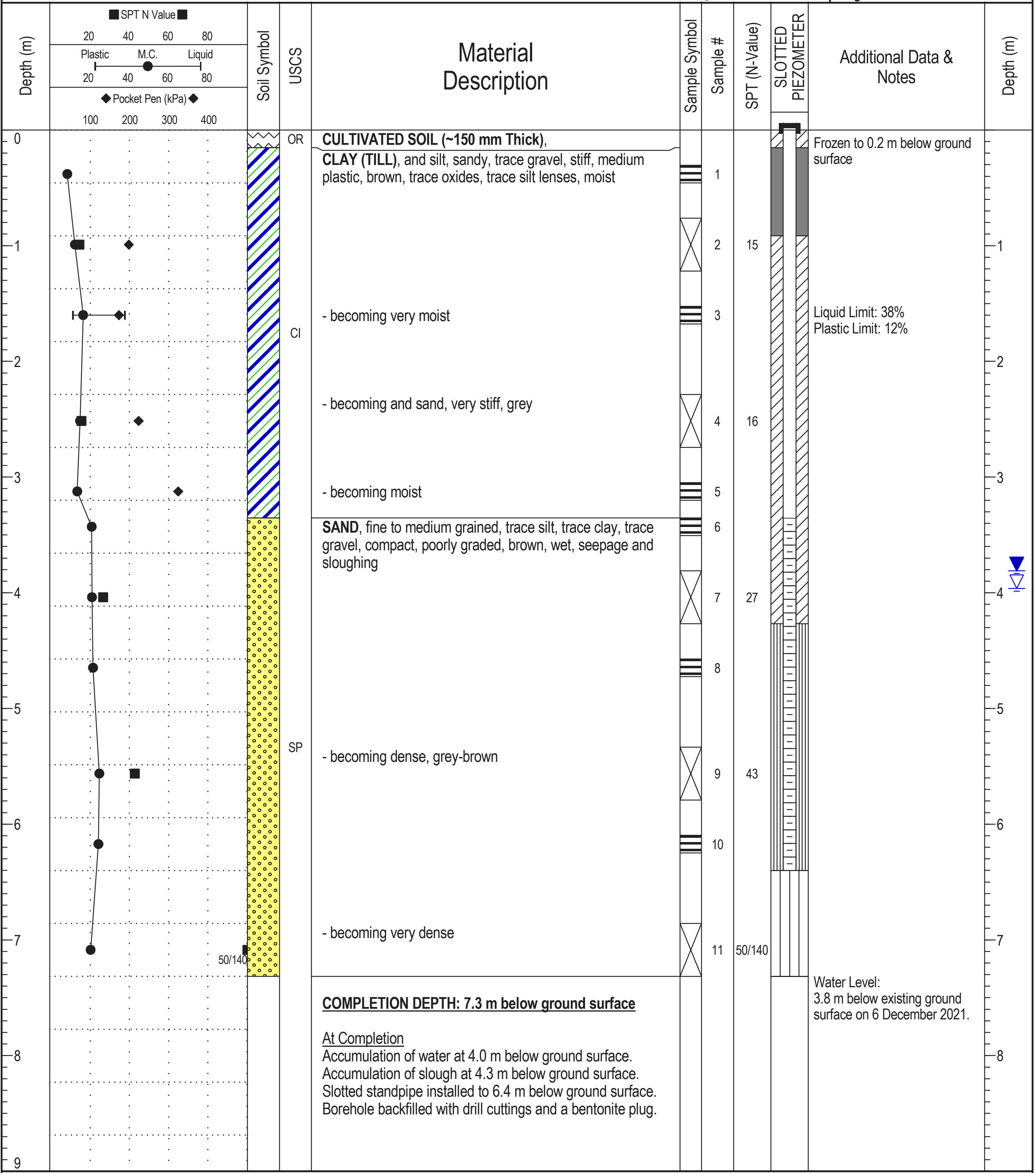

Material Description

CULTIVATED SOIL (~150 mm Thick),

CLAY (TILL), and silt, sandy, trace gravel, stiff, medium plastic, brown, trace oxides, trace silt lenses, moist

- becoming very moist

- becoming and sand, very stiff, grey

- becoming moist

SAND, fine to medium grained, trace silt, trace clay, trace gravel, compact, poorly graded, brown, wet, seepage and sloughing

- becoming dense, grey-brown

- becoming very dense

COMPLETION DEPTH: 7.3 m below ground surface

At Completion
Accumulation of water at 4.0 m below ground surface.
Accumulation of slough at 4.3 m below ground surface.
Slotted standpipe installed to 6.4 m below ground surface.
Borehole backfilled with drill cuttings and a bentonite plug.

Sample #	SPT (N-Value)
1	
2	15
3	
4	16
5	
6	
7	27
8	
9	43
10	
11	50/140

Additional Data & Notes

Frozen to 0.2 m below ground surface

Liquid Limit: 38%
Plastic Limit: 12%

Water Level:
3.8 m below existing ground surface on 6 December 2021.

Sample Symbol: ■ Shelby Tube ▱ No Recovery ☒ SPT Test (N) ☰ Grab Sample ▥ Split-Pen ◨ Core

Backfill Symbol: ■ Bentonite ⬚ Pea Gravel ▥ Slough ⁙ Grout ▨ Drill Cuttings ⁙ Sand

Project Name: Major Events Arena
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, AB
Northing: 5902976 Easting: 568341
Elevation:

Borehole #: **BH21-08**
Project #: PG21-1603.1000
Logged By: ME / Reviewed By: KJ
Driller: Drilling Solutions Inc.
Drill Method: 150 mm Solid Stem Auger

Completion Date: 24-11-21
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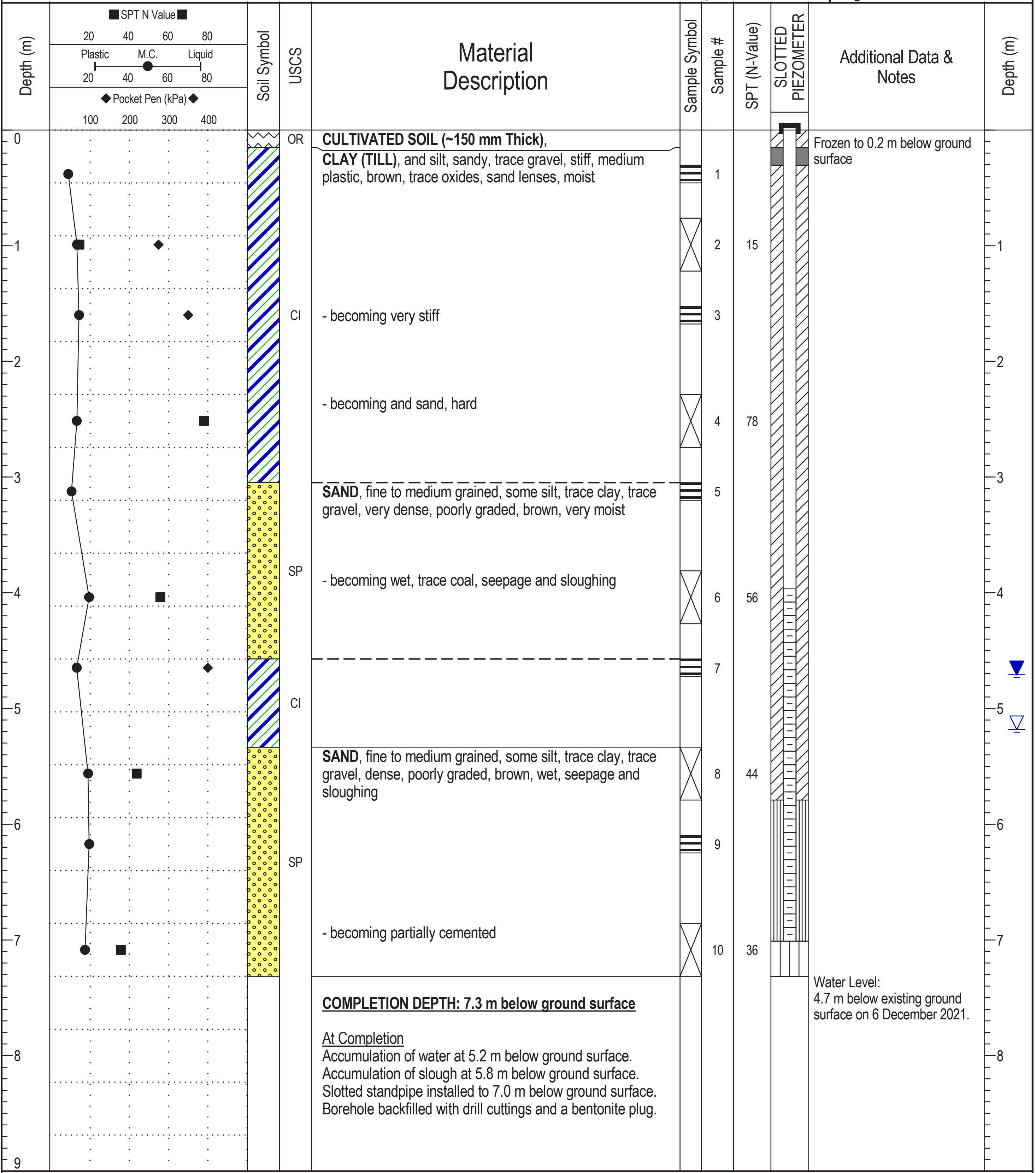

Material Description

CULTIVATED SOIL (~150 mm Thick),

CLAY (TILL), and silt, sandy, trace gravel, stiff, medium plastic, brown, trace oxides, sand lenses, moist

- becoming very stiff

- becoming and sand, hard

SAND, fine to medium grained, some silt, trace clay, trace gravel, very dense, poorly graded, brown, very moist

- becoming wet, trace coal, seepage and sloughing

SAND, fine to medium grained, some silt, trace clay, trace gravel, dense, poorly graded, brown, wet, seepage and sloughing

- becoming partially cemented

COMPLETION DEPTH: 7.3 m below ground surface

At Completion
Accumulation of water at 5.2 m below ground surface.
Accumulation of slough at 5.8 m below ground surface.
Slotted standpipe installed to 7.0 m below ground surface.
Borehole backfilled with drill cuttings and a bentonite plug.

Additional Data & Notes

Frozen to 0.2 m below ground surface

Water Level:
4.7 m below existing ground surface on 6 December 2021.

Sample Symbol: ■ Shelby Tube ▱ No Recovery ☒ SPT Test (N) ☰ Grab Sample ▥ Split-Pen ◨ Core

Backfill Symbol: ■ Bentonite ⬚ Pea Gravel ▥ Slough ⁘ Grout ▨ Drill Cuttings ⁘ Sand

Project Name: Major Events Arena
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, AB
Northing: 5902979 Easting: 568480
Elevation:

Borehole #: **BH21-09**
Project #: PG21-1603.1000
Logged By: ME / Reviewed By: KJ
Driller: Drilling Solutions Inc.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 23-11-21
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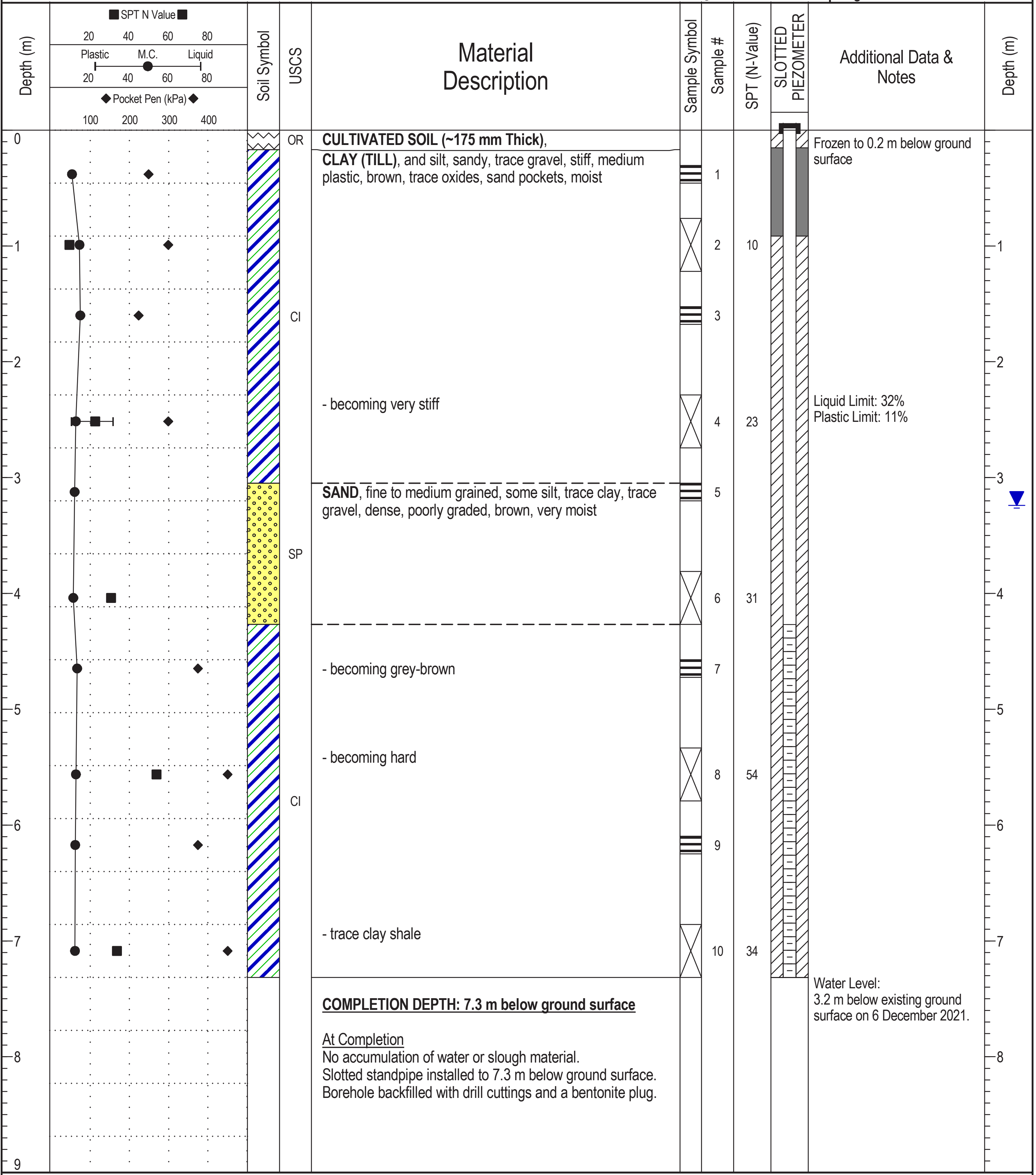

Material Description

CULTIVATED SOIL (~175 mm Thick),

CLAY (TILL), and silt, sandy, trace gravel, stiff, medium plastic, brown, trace oxides, sand pockets, moist

- becoming very stiff

SAND, fine to medium grained, some silt, trace clay, trace gravel, dense, poorly graded, brown, very moist

- becoming grey-brown

- becoming hard

- trace clay shale

<u>**COMPLETION DEPTH: 7.3 m below ground surface**</u>

<u>At Completion</u>
No accumulation of water or slough material.
Slotted standpipe installed to 7.3 m below ground surface.
Borehole backfilled with drill cuttings and a bentonite plug.

Additional Data & Notes

Frozen to 0.2 m below ground surface

Liquid Limit: 32%
Plastic Limit: 11%

Water Level:
3.2 m below existing ground surface on 6 December 2021.

Sample Symbol	■ Shelby Tube	◺ No Recovery	☒ SPT Test (N)	☰ Grab Sample	▥ Split-Pen	◧ Core
Backfill Symbol	■ Bentonite	⁙ Pea Gravel	▥ Slough	⁙ Grout	▨ Drill Cuttings	⁙ Sand

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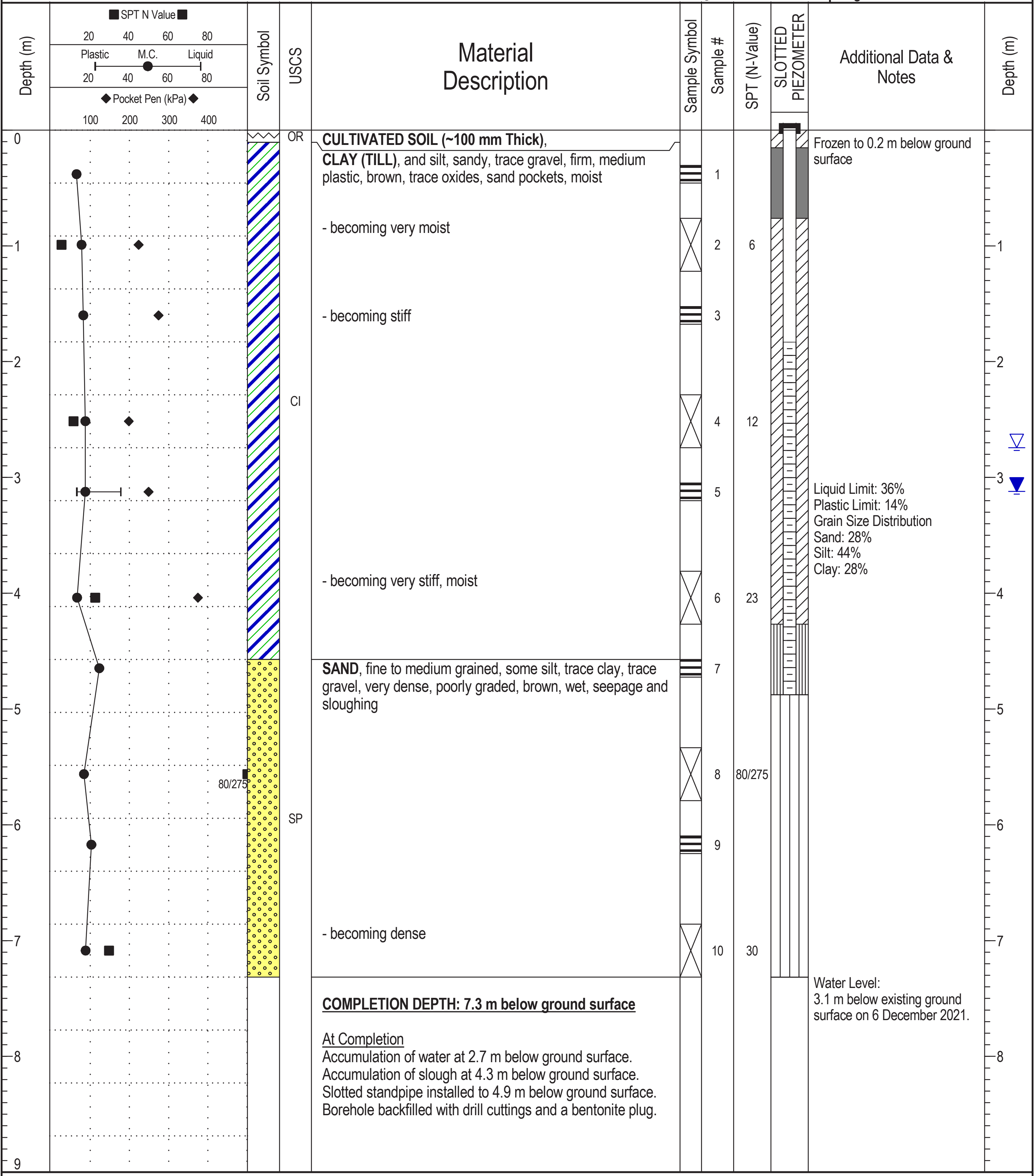
Project Name: Major Events Arena	Borehole #: **BH21-10**	SolidEarth GEOTECHNICAL
Client Name: City of Lloydminster	Project #: PG21-1603.1000	
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, AB	Logged By: ME / Reviewed By: KJ	
Northing: 5902987 Easting: 568618	Driller: Drilling Solutions Inc.	Completion Date: 24-11-21
Elevation:	Drill Method: 150 mm Solid Stem Auger	Page 1 of 1



Material Description

CULTIVATED SOIL (~100 mm Thick),

CLAY (TILL), and silt, sandy, trace gravel, firm, medium plastic, brown, trace oxides, sand pockets, moist

- becoming very moist

- becoming stiff

- becoming very stiff, moist

SAND, fine to medium grained, some silt, trace clay, trace gravel, very dense, poorly graded, brown, wet, seepage and sloughing

- becoming dense

COMPLETION DEPTH: 7.3 m below ground surface

At Completion
Accumulation of water at 2.7 m below ground surface.
Accumulation of slough at 4.3 m below ground surface.
Slotted standpipe installed to 4.9 m below ground surface.
Borehole backfilled with drill cuttings and a bentonite plug.

Sample #	SPT (N-Value)
1	
2	6
3	
4	12
5	
6	23
7	
8	80/275
9	
10	30

Additional Data & Notes

Frozen to 0.2 m below ground surface

Liquid Limit: 36%
Plastic Limit: 14%
Grain Size Distribution
Sand: 28%
Silt: 44%
Clay: 28%

Water Level:
3.1 m below existing ground surface on 6 December 2021.

Sample Symbol	■ Shelby Tube	◸ No Recovery	☒ SPT Test (N)	☰ Grab Sample	▥ Split-Pen	◨ Core
Backfill Symbol	■ Bentonite	⁘ Pea Gravel	▥ Slough	⁘ Grout	▨ Drill Cuttings	⁘ Sand

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Project Name: Major Events Arena
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, AB
Northing: 5902986 Easting: 568759
Elevation:

Borehole #: **BH21-11**
Project #: PG21-1603.1000
Logged By: ME / Reviewed By: KJ
Driller: Drilling Solutions Inc.
Drill Method: 150 mm Solid Stem Auger

Completion Date: 24-11-21
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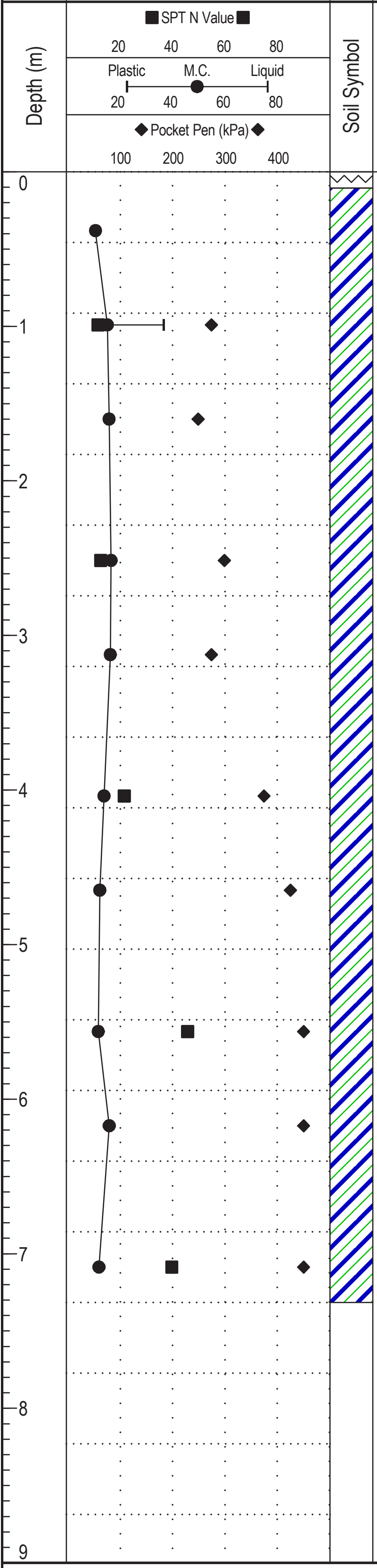
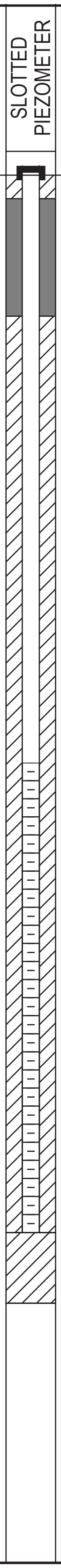


USCS	Material Description
OR	**CULTIVATED SOIL (~100 mm Thick)**,
CI	**CLAY (TILL)**, and silt, sandy, trace gravel, stiff, medium plastic, brown, trace oxides, sand pockets, moist - becoming very moist - becoming very stiff, grey-brown, moist - becoming hard

COMPLETION DEPTH: 7.3 m below ground surface

At Completion
No accumulation of water or slough material.
Slotted standpipe installed to 6.9 m below ground surface.
Borehole backfilled with drill cuttings and a bentonite plug.

Sample Symbol	Sample #	SPT (N-Value)
☰	1	
☒	2	12
☰	3	
☒	4	13
☰	5	
☒	6	22
☰	7	
☒	8	46
☰	9	
☒	10	40



Additional Data & Notes

Frozen to 0.2 m below ground surface

Liquid Limit: 37%
Plastic Limit: 11%

Water Level:
2.9 m below existing ground surface on 6 December 2021.

Sample Symbol	■ Shelby Tube	▨ No Recovery	☒ SPT Test (N)	☰ Grab Sample	▥ Split-Pen	▯ Core
Backfill Symbol	■ Bentonite	⁚ Pea Gravel	▥ Slough	⁘ Grout	▨ Drill Cuttings	⁘ Sand

\\10.0.1.4\SEGDATA_EDM\PROJECTS\GEOTECHNICAL PROJECTS\2021\PG21-1603-COL MAJOR EVENTS ARENA\PHASE 1000-GEOTECHNICAL\PG21-1603.1000 MAJOR EVENTS ARENA.GPJ 21-12-13 01:19 PM (SEG-FINAL)

EXPLANATION OF TERMS & SYMBOLS

The terms and symbols used on the borehole logs to summarize the results of the field investigation and laboratory testing are described on the following two pages.

1. VISUAL TEXTURAL CLASSIFICATION ON MINERAL SOILS

CLASSIFICATION	APPARENT PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	> 200 mm	> 200 mm
Cobbles	75 mm to 200 mm	75 mm to 200 mm
Gravel	4.75 mm to 75 mm	5 mm to 75 mm
Sand	0.075 mm to 4.75 mm	Visible particles to 5 mm
Silt	0.002 mm to 0.075 mm	Non-plastic particles, not visible to naked eye
Clay	< 0.002 mm	Plastic particles, not visible to naked eye

2. TERMS FOR CONSISTENCY & DENSITY OF SOILS

Cohesionless Soils

DESCRIPTIVE TERM	APPROXIMATE SPT "N" VALUE
Very Dense	> 50
Dense	30 to 50
Compact	10 to 30
Loose	4 to 10
Very Loose	< 4

Cohesive Soils

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH	APPROXIMATE SPT "N" VALUE
Hard	>200 kPa	> 30
Very Stiff	100 to 200 kPa	15 to 30
Stiff	50 to 100 kPa	8 to 15
Firm	25 to 50 kPa	4 to 8
Soft	10 to 25 kPa	2 to 4
Very Soft	< 10 kPa	< 2

* SPT "N" Values – Refers to the number of blows by a 63.5 kg hammer dropped 760 mm to drive a 50 mm diameter split spoon sampler for a distance of 300 mm after an initial penetration of 150 mm.

3. SYMBOLS USED ON BOREHOLE LOGS

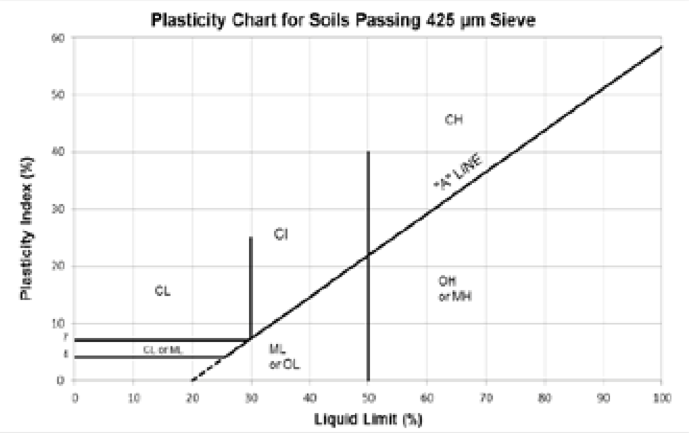
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
N(■)	Standard Penetration Test (CSA A119 1-60)	SO_4	Concentration of Water-Soluble Sulphate
N_d	Dynamic Cone Penetration Test	C_u	Undrained Shear Strength
pp (♦)	Pocket Penetrometer Strength	γ	Unit Weight of Soil or Rock
q_u	Unconfined Compressive Strength	γ_d	Dry Unit Weight of Soil or Rock
w (●)	Natural Moisture Content (ASTM D2216)	ρ	Density of Soil or Rock
w_L	Liquid Limit (ASTM D 4318)	ρ_d	Dry Density of Soil or Rock
w_P	Plastic Limit (ASTM D 4318)	▽	Short-Term Water Level
I_P	Plastic Index	▼	Long-Term Water Level

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75 µm)	**GRAVELS** (MORE THAN HALF COARSE GRAINS LARGER THAN 4.75mm)	CLEAN GRAVELS (LITTLE OR NO FINES)	**GW**	WELL GRADED GRAVELS AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	$C_u = D_{60}/D_{10} > 4$ $C_c = (D_{30})^2/(D_{10} \times D_{60}) = 1$ to 3	
			GP	POORLY GRADED GRAVELS AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		GRAVELS (WITH SOME FINES)	**GM**	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW 'A' LINE I_p LESS THAN 4
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE 'A' LINE I_p MORE THAN 7
	SANDS (MORE THAN HALF COARSE GRAINS SMALLER THAN 4.75mm)	CLEAN SANDS (LITTLE OR NO FINES)	**SW**	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_u = D_{60}/D_{10} > 6$ $C_c = (D_{30})^2/(D_{10} \times D_{60}) = 1$ to 3	
			SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	NOT MEETING ALL GRADATION REQUIREMENTS FOR SW	
		SANDS (WITH SOME FINES)	**SM**	SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW 'A' LINE I_p LESS THAN 4
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE 'A' LINE I_p MORE THAN 7
FINE GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75 µm)	**SILTS** (BELOW 'A' LINE NEGLIGIBLE ORGANIC CONTENT)	$W_L < 50$ %	**ML**	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)	
		$W_L > 50$ %	**MH**	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS		
	CLAYS (ABOVE 'A' LINE NEGLIGIBLE ORGANIC CONTENT)	$W_L < 30$ %	**CL**	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS		
		$30\ \% < W_L < 50$ %	**CI**	INORGANIC CLAYS OR MEDIUM PLASTICITY, SILTY CLAYS		
		$W_L > 50$ %	**CH**	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
	ORGANIC SILTS & CLAYS (BELOW 'A' LINE)	$W_L < 50$ %	**OL**	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
		$W_L > 50$ %	**OH**	ORGANIC CLAYS OF HIGH PLASTICITY		
HIGHLY ORGANIC SOILS			**Pt**	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOUR OR ODOUR, AND OFTEN FIBROUS TEXTURE	
BEDROCK			**BR**	SEE REPORT DESCRIPTION		

Soil Components

Component	Size Range (mm)	Descriptor	% by Weight
Cobbles	> 76	and	> 35
Gravel	76 to 4.75		
Coarse	76 to 19	-y, -ey	35 to 20
Fine	19 to 4.75		
Sand	4.75 to 0.075	some	20 to 10
Coarse	4.75 to 2		
Medium	2 to 0.425	trace	10 to 1
Fine	0.425 to 0.075		
Fines (Silt or Clay)	< 0.075		


Plasticity Chart for Soils Passing 425 µm Sieve

Appendix C

Analytical Chemistry Report

CERTIFICATE OF ANALYSIS

Work Order : **EO2104046**
Client : **SolidEarth Geotechnical Inc.**
Contact : Jay Jaber
Address : 4336 97 Street
Edmonton AB Canada T6E 5R9
Telephone : (780)577-1115
Project : PG21-1603.1000
PO : ----
C-O-C number : SEG21-058
Sampler : JS
Site : COL MAJOR ARENA EVENTS SITE
Quote number : ----
No. of samples received : 4
No. of samples analysed : 4

Page : 1 of 6
Laboratory : Edmonton - Environmental
Account Manager : Dana Brown
Address : 9450 - 17 Avenue NW
Edmonton AB Canada T6N 1M9
Telephone : 7804136472
Date Samples Received : 25-Nov-2021 07:02
Date Analysis Commenced : 25-Nov-2021
Issue Date : 02-Dec-2021 16:30

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance witl FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Alex Drake	Lab Analyst	Inorganics, Edmonton, Alberta
Fahad Husain	Lab Assistant	Inorganics, Edmonton, Alberta
Joan Wu	Lab Analyst	Metals, Edmonton, Alberta
Julian Duarte		Inorganics, Edmonton, Alberta
Kari Mulroy	Lab Supervisor - Environmental	Organics, Edmonton, Alberta
Nina Nykolyuk	Lab Assistant	Inorganics, Edmonton, Alberta
Ping Yeung	Team Leader - Inorganics	Inorganics, Edmonton, Alberta
Ping Yeung	Team Leader - Inorganics	Metals, Edmonton, Alberta
Yan Zhang	Lab Analyst	Organics, Edmonton, Alberta

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.
Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	No Unit
%	percent
dS/m	decisiemens per metre
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
pH units	pH units

>: greater than.

<: less than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical Results

EO2104046-001

Sub-Matrix:**Soil** *Client sample ID:* BH21-2 DEPTH 0.2M

(Matrix: **Soil/Solid)** *Client sampling date / time:* 23-Nov-2021 00:00

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
moisture	----	10.9	0.25	%	E144	-	25-Nov-2021	352436
pH (1:2 soil:CaCl2-aq)	----	7.65	0.10	pH units	E108B	01-Dec-2021	01-Dec-2021	357230
Saturated Paste Extractables								
conductivity, saturated paste	----	0.525	0.010	dS/m	E102	01-Dec-2021	01-Dec-2021	357272
sodium adsorption ratio [SAR]	----	2.10	0.10	-	EC102	-	02-Dec-2021	-
% saturation	----	57.8	1.0	%	E141	01-Dec-2021	01-Dec-2021	357274
calcium, soluble ion content	7440-70-2	26.4	5.0	mg/L	E485	01-Dec-2021	02-Dec-2021	357275
calcium, soluble ion content	7440-70-2	15.2	5	mg/kg	EC485	-	02-Dec-2021	-
magnesium, soluble ion content	7439-95-4	27.8	5.0	mg/L	E485	01-Dec-2021	02-Dec-2021	357275
magnesium, soluble ion content	7439-95-4	16.1	5	mg/kg	EC485	-	02-Dec-2021	-
potassium, soluble ion content	7440-09-7	5.2	5.0	mg/L	E485	01-Dec-2021	02-Dec-2021	357275
potassium, soluble ion content	7440-09-7	<5.0	5	mg/kg	EC485	-	02-Dec-2021	-
sodium, soluble ion content	17341-25-2	64.9	5.0	mg/L	E485	01-Dec-2021	02-Dec-2021	357275
sodium, soluble ion content	17341-25-2	37.5	5	mg/kg	EC485	-	02-Dec-2021	-
chloride, soluble ion content	16887-00-6	20	20	mg/L	E266.Cl	01-Dec-2021	02-Dec-2021	357273
chloride, soluble ion content	16887-00-6	12	12	mg/kg	EC266A.Cl	01-Dec-2021	02-Dec-2021	-
sulfur (as SO4), soluble ion content	14808-79-8	129	6	mg/L	E485	01-Dec-2021	02-Dec-2021	357275
sulfur (as SO4), soluble ion content	14808-79-8	74.6	8	mg/kg	EC485	-	02-Dec-2021	-
Volatile Organic Compounds [BTEXS+MTBE]								
benzene	71-43-2	<0.0050	0.0050	mg/kg	E611A	25-Nov-2021	26-Nov-2021	352358
ethylbenzene	100-41-4	<0.015	0.015	mg/kg	E611A	25-Nov-2021	26-Nov-2021	352358
toluene	108-88-3	<0.050	0.050	mg/kg	E611A	25-Nov-2021	26-Nov-2021	352358
xylene, m+p-	179601-23-1	<0.050	0.050	mg/kg	E611A	25-Nov-2021	26-Nov-2021	352358
xylene, o-	95-47-6	<0.050	0.050	mg/kg	E611A	25-Nov-2021	26-Nov-2021	352358
xylenes, total	1330-20-7	<0.075	0.075	mg/kg	E611A	25-Nov-2021	26-Nov-2021	352358
BTEX, total	----	<0.10	0.1	mg/kg	E611A	25-Nov-2021	26-Nov-2021	352358
Volatile Organic Compounds Surrogates								
bromofluorobenzene, 4-	460-00-4	106	0.10	%	E611A	25-Nov-2021	26-Nov-2021	352358
difluorobenzene, 1,4-	540-36-3	113	0.10	%	E611A	25-Nov-2021	26-Nov-2021	352358
Hydrocarbons								
F1 (C6-C10)	----	<5.0	5.0	mg/kg	E581.F1	25-Nov-2021	26-Nov-2021	352359
F1-BTEX	----	<5.0	5	mg/kg	EC580	-	26-Nov-2021	-
F2 (C10-C16)	----	<25	25	mg/kg	E601.SG	25-Nov-2021	25-Nov-2021	352434
F3 (C16-C34)	----	<50	50	mg/kg	E601.SG	25-Nov-2021	25-Nov-2021	352434
F4 (C34-C50)	----	<50	50	mg/kg	E601.SG	25-Nov-2021	25-Nov-2021	352434
chromatogram to baseline at nC50	----	Yes	-	-	E601.SG	25-Nov-2021	25-Nov-2021	352434
hydrocarbons, total (C6-C50)	----	<80	80	mg/kg	EC581	-	26-Nov-2021	-
Hydrocarbons Surrogates								
bromobenzotrifluoride, 2- (F2-F4 surr)	392-83-6	85.6	1.0	%	E601.SG	25-Nov-2021	25-Nov-2021	352434
dichlorotoluene, 3,4-	97-75-0	118	1.0	%	E581.F1	25-Nov-2021	26-Nov-2021	352359

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2104046-002

Sub-Matrix:**Soil** *Client sample ID:* BH21-3 DEPTH 0.2M -

(Matrix: **Soil/Solid)** *Client sampling date / time:* 23-Nov-2021 00:00

Analytical Results

EO2104046-002

Sub-Matrix:**Soil** *Client sample ID:* BH21-3 DEPTH 0.2M -

(Matrix: **Soil/Solid)** *Client sampling date / time:* 23-Nov-2021 00:00

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
moisture	----	8.52	0.25	%	E144	-	25-Nov-2021	352436
pH (1:2 soil:CaCl2-aq)	----	8.19	0.10	pH units	E108B	01-Dec-2021	01-Dec-2021	357230
Saturated Paste Extractables								
conductivity, saturated paste	----	1.01	0.010	dS/m	E102	01-Dec-2021	01-Dec-2021	357272
sodium adsorption ratio [SAR]	----	2.12	0.10	-	EC102	-	02-Dec-2021	-
% saturation	----	47.7	1.0	%	E141	01-Dec-2021	01-Dec-2021	357274
calcium, soluble ion content	7440-70-2	36.0	5.0	mg/L	E485	01-Dec-2021	02-Dec-2021	357275
calcium, soluble ion content	7440-70-2	17.2	5	mg/kg	EC485	-	02-Dec-2021	-
magnesium, soluble ion content	7439-95-4	70.2	5.0	mg/L	E485	01-Dec-2021	02-Dec-2021	357275
magnesium, soluble ion content	7439-95-4	33.5	5	mg/kg	EC485	-	02-Dec-2021	-
potassium, soluble ion content	7440-09-7	8.1	5.0	mg/L	E485	01-Dec-2021	02-Dec-2021	357275
potassium, soluble ion content	7440-09-7	<5.0	5	mg/kg	EC485	-	02-Dec-2021	-
sodium, soluble ion content	17341-25-2	94.7	5.0	mg/L	E485	01-Dec-2021	02-Dec-2021	357275
sodium, soluble ion content	17341-25-2	45.2	5	mg/kg	EC485	-	02-Dec-2021	-
chloride, soluble ion content	16887-00-6	178	20	mg/L	E266.Cl	01-Dec-2021	02-Dec-2021	357273
chloride, soluble ion content	16887-00-6	85	10	mg/kg	EC266A.Cl	01-Dec-2021	02-Dec-2021	-
sulfur (as SO4), soluble ion content	14808-79-8	133	6	mg/L	E485	01-Dec-2021	02-Dec-2021	357275
sulfur (as SO4), soluble ion content	14808-79-8	63.4	8	mg/kg	EC485	-	02-Dec-2021	-
Volatile Organic Compounds [BTEXS+MTBE]								
benzene	71-43-2	<0.0050	0.0050	mg/kg	E611A	25-Nov-2021	26-Nov-2021	352358
ethylbenzene	100-41-4	<0.015	0.015	mg/kg	E611A	25-Nov-2021	26-Nov-2021	352358
toluene	108-88-3	<0.050	0.050	mg/kg	E611A	25-Nov-2021	26-Nov-2021	352358
xylene, m+p-	179601-23-1	<0.050	0.050	mg/kg	E611A	25-Nov-2021	26-Nov-2021	352358
xylene, o-	95-47-6	<0.050	0.050	mg/kg	E611A	25-Nov-2021	26-Nov-2021	352358
xylenes, total	1330-20-7	<0.075	0.075	mg/kg	E611A	25-Nov-2021	26-Nov-2021	352358
BTEX, total	----	<0.10	0.1	mg/kg	E611A	25-Nov-2021	26-Nov-2021	352358
Volatile Organic Compounds Surrogates								
bromofluorobenzene, 4-	460-00-4	88.5	0.10	%	E611A	25-Nov-2021	26-Nov-2021	352358
difluorobenzene, 1,4-	540-36-3	116	0.10	%	E611A	25-Nov-2021	26-Nov-2021	352358
Hydrocarbons								
F1 (C6-C10)	----	<5.0	5.0	mg/kg	E581.F1	25-Nov-2021	26-Nov-2021	352359
F1-BTEX	----	<5.0	5	mg/kg	EC580	-	26-Nov-2021	-
F2 (C10-C16)	----	<25	25	mg/kg	E601.SG	25-Nov-2021	25-Nov-2021	352434
F3 (C16-C34)	----	<50	50	mg/kg	E601.SG	25-Nov-2021	25-Nov-2021	352434
F4 (C34-C50)	----	<50	50	mg/kg	E601.SG	25-Nov-2021	25-Nov-2021	352434
chromatogram to baseline at nC50	----	Yes	-	-	E601.SG	25-Nov-2021	25-Nov-2021	352434
hydrocarbons, total (C6-C50)	----	<80	80	mg/kg	EC581	-	26-Nov-2021	-
Hydrocarbons Surrogates								
bromobenzotrifluoride, 2- (F2-F4 surr)	392-83-6	86.3	1.0	%	E601.SG	25-Nov-2021	25-Nov-2021	352434
dichlorotoluene, 3,4-	97-75-0	113	1.0	%	E581.F1	25-Nov-2021	26-Nov-2021	352359

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2104046-003

Sub-Matrix:**Soil** *Client sample ID:* BH21-6 DEPTH 0.2M

(Matrix: **Soil/Solid)** *Client sampling date / time:* 24-Nov-2021 00:00

Analytical Results

EO2104046-003

Sub-Matrix:**Soil** Client sample ID: BH21-6 DEPTH 0.2M

(Matrix: **Soil/Solid**) Client sampling date / time: 24-Nov-2021 00:00

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
pH (1:2 soil:CaCl2-aq)	----	7.62	0.10	pH units	E108B	01-Dec-2021	01-Dec-2021	357230
Saturated Paste Extractables								
conductivity, saturated paste	----	6.02	0.010	dS/m	E102	01-Dec-2021	01-Dec-2021	357272
sodium adsorption ratio [SAR]	----	3.45	0.10	-	EC102	-	02-Dec-2021	-
% saturation	----	53.6	1.0	%	E141	01-Dec-2021	01-Dec-2021	357274
calcium, soluble ion content	7440-70-2	456	10.0	mg/L	E485	01-Dec-2021	02-Dec-2021	357275
calcium, soluble ion content	7440-70-2	244	5.4	mg/kg	EC485	-	02-Dec-2021	-
magnesium, soluble ion content	7439-95-4	521	10.0	mg/L	E485	01-Dec-2021	02-Dec-2021	357275
magnesium, soluble ion content	7439-95-4	279	5.4	mg/kg	EC485	-	02-Dec-2021	-
potassium, soluble ion content	7440-09-7	19.4	10.0	mg/L	E485	01-Dec-2021	02-Dec-2021	357275
potassium, soluble ion content	7440-09-7	10.4	5.4	mg/kg	EC485	-	02-Dec-2021	-
sodium, soluble ion content	17341-25-2	454	10.0	mg/L	E485	01-Dec-2021	02-Dec-2021	357275
sodium, soluble ion content	17341-25-2	243	5.4	mg/kg	EC485	-	02-Dec-2021	-
chloride, soluble ion content	16887-00-6	846	20	mg/L	E266.Cl	01-Dec-2021	02-Dec-2021	357273
chloride, soluble ion content	16887-00-6	453	11	mg/kg	EC266A.Cl	01-Dec-2021	02-Dec-2021	-
sulfur (as SO4), soluble ion content	14808-79-8	2900	6	mg/L	E485	01-Dec-2021	02-Dec-2021	357275
sulfur (as SO4), soluble ion content	14808-79-8	1550	8	mg/kg	EC485	-	02-Dec-2021	-

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2104046-004

Sub-Matrix:**Soil** Client sample ID: BH21-9 DEPTH 0.2M

(Matrix: **Soil/Solid**) Client sampling date / time: 23-Nov-2021 00:00

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
pH (1:2 soil:CaCl2-aq)	----	6.88	0.10	pH units	E108B	01-Dec-2021	01-Dec-2021	357230
Saturated Paste Extractables								
conductivity, saturated paste	----	1.31	0.010	dS/m	E102	01-Dec-2021	01-Dec-2021	357272
sodium adsorption ratio [SAR]	----	2.90	0.10	-	EC102	-	02-Dec-2021	-
% saturation	----	48.6	1.0	%	E141	01-Dec-2021	01-Dec-2021	357274
calcium, soluble ion content	7440-70-2	58.3	5.0	mg/L	E485	01-Dec-2021	02-Dec-2021	357275
calcium, soluble ion content	7440-70-2	28.3	5	mg/kg	EC485	-	02-Dec-2021	-
magnesium, soluble ion content	7439-95-4	68.7	5.0	mg/L	E485	01-Dec-2021	02-Dec-2021	357275
magnesium, soluble ion content	7439-95-4	33.4	5	mg/kg	EC485	-	02-Dec-2021	-
potassium, soluble ion content	7440-09-7	6.2	5.0	mg/L	E485	01-Dec-2021	02-Dec-2021	357275
potassium, soluble ion content	7440-09-7	<5.0	5	mg/kg	EC485	-	02-Dec-2021	-
sodium, soluble ion content	17341-25-2	138	5.0	mg/L	E485	01-Dec-2021	02-Dec-2021	357275
sodium, soluble ion content	17341-25-2	67.1	5	mg/kg	EC485	-	02-Dec-2021	-
chloride, soluble ion content	16887-00-6	229	20	mg/L	E266.Cl	01-Dec-2021	02-Dec-2021	357273
chloride, soluble ion content	16887-00-6	111	10	mg/kg	EC266A.Cl	01-Dec-2021	02-Dec-2021	-
sulfur (as SO4), soluble ion content	14808-79-8	93.5	6	mg/L	E485	01-Dec-2021	02-Dec-2021	357275
sulfur (as SO4), soluble ion content	14808-79-8	45.4	8	mg/kg	EC485	-	02-Dec-2021	-

Please refer to the General Comments section for an explanation of any qualifiers detected.

QUALITY CONTROL REPORT

Work Order	: **EO2104046**	Page	: 1 of 7
Client	: SolidEarth Geotechnical Inc.	Laboratory	: Edmonton - Environmental
Contact	: Jay Jaber	Account Manager	: Dana Brown
Address	: 4336 97 Street Edmonton AB Canada T6E 5R9	Address	: 9450 - 17 Avenue NW Edmonton, Alberta Canada T6N 1M9
Telephone	: (780)577-1115	Telephone	: 7804136472
Project	: PG21-1603.1000	Date Samples Received	: 25-Nov-2021 07:02
PO	: ----	Date Analysis Commenced	: 25-Nov-2021
C-O-C number	: SEG21-058	Issue Date	: 02-Dec-2021 16:30
Sampler	: JS		
Site	: COL MAJOR ARENA EVENTS SITE		
Quote number	: ----		
No. of samples received	: 4		
No. of samples analysed	: 4		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits
- Reference Material (RM) Report; Recovery and Acceptance Limits
- Method Blank (MB) Report; Recovery and Acceptance Limits
- Laboratory Control Sample (LCS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Alex Drake	Lab Analyst	Inorganics, Edmonton, Alberta
Fahad Husain	Lab Assistant	Inorganics, Edmonton, Alberta
Joan Wu	Lab Analyst	Metals, Edmonton, Alberta
Julian Duarte		Inorganics, Edmonton, Alberta
Kari Mulroy	Lab Supervisor - Environmental	Organics, Edmonton, Alberta
Nina Nykolyuk	Lab Assistant	Inorganics, Edmonton, Alberta
Ping Yeung	Team Leader - Inorganics	Inorganics, Edmonton, Alberta
Ping Yeung	Team Leader - Inorganics	Metals, Edmonton, Alberta
Yan Zhang	Lab Analyst	Organics, Edmonton, Alberta

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Services number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percentage Difference
# = Indicates a QC result that did not meet the ALS DQO.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test specific).

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Physical Tests (QC Lot: 352436)											
EO2104042-001	Anonymous	moisture	----	E144	0.25	%	32.8	32.6	0.675%	20%	----
Physical Tests (QC Lot: 357230)											
EO2104046-002	BH21-3 DEPTH 0.2M	pH (1:2 soil:CaCl2-aq)	----	E108B	0.10	pH units	8.19	8.30	1.33%	3%	----
Saturated Paste Extractables (QC Lot: 357272)											
EO2104046-002	BH21-3 DEPTH 0.2M	conductivity, saturated paste	----	E102	0.010	µS/cm	1.01 dS/m	1010	0.198%	20%	----
Saturated Paste Extractables (QC Lot: 357273)											
EO2104046-002	BH21-3 DEPTH 0.2M	chloride, soluble ion content	16887-00-6	E266.Cl	20	mg/L	178	183	2.43%	30%	----
Saturated Paste Extractables (QC Lot: 357274)											
EO2104046-002	BH21-3 DEPTH 0.2M	% saturation	----	E141	1.0	%	47.7	52.8	10.0%	20%	----
Saturated Paste Extractables (QC Lot: 357275)											
EO2104046-002	BH21-3 DEPTH 0.2M	calcium, soluble ion content	7440-70-2	E485	5.0	mg/L	36.0	36.5	1.41%	30%	----
		magnesium, soluble ion content	7439-95-4	E485	5.0	mg/L	70.2	71.6	1.93%	30%	----
		potassium, soluble ion content	7440-09-7	E485	5.0	mg/L	8.1	8.4	0.3	Diff <2x LOR	----
		sodium, soluble ion content	17341-25-2	E485	5.0	mg/L	94.7	95.8	1.24%	30%	----
		sulfur (as SO4), soluble ion content	14808-79-8	E485	6	mg/L	133	135	1.12%	30%	----
Volatile Organic Compounds (QC Lot: 352358)											
EO2104046-001	BH21-2 DEPTH 0.2M	benzene	71-43-2	E611A	0.0050	mg/kg	<0.0050	<0.0050	0	Diff <2x LOR	----
		ethylbenzene	100-41-4	E611A	0.015	mg/kg	<0.015	<0.015	0	Diff <2x LOR	----
		toluene	108-88-3	E611A	0.050	mg/kg	<0.050	<0.050	0	Diff <2x LOR	----
		xylene, m+p-	179601-23-1	E611A	0.050	mg/kg	<0.050	<0.050	0	Diff <2x LOR	----
		xylene, o-	95-47-6	E611A	0.050	mg/kg	<0.050	<0.050	0	Diff <2x LOR	----
Hydrocarbons (QC Lot: 352359)											
EO2104046-001	BH21-2 DEPTH 0.2M	F1 (C6-C10)	----	E581.F1	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----
Hydrocarbons (QC Lot: 352434)											
EO2104042-001	Anonymous	F2 (C10-C16)	----	E601.SG	25	mg/kg	<25	<25	0	Diff <2x LOR	----
		F3 (C16-C34)	----	E601.SG	50	mg/kg	<50	<50	0	Diff <2x LOR	----
		F4 (C34-C50)	----	E601.SG	50	mg/kg	<50	<50	0	Diff <2x LOR	----

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 352436)						
moisture	----	E144	0.25	%	<0.25	----
Saturated Paste Extractables (QCLot: 357272)						
conductivity, saturated paste	----	E102	10	µS/cm	<10	----
Saturated Paste Extractables (QCLot: 357273)						
chloride, soluble ion content	16887-00-6	E266.Cl	20	mg/L	<20	----
Saturated Paste Extractables (QCLot: 357275)						
calcium, soluble ion content	7440-70-2	E485	5	mg/L	<5.0	----
magnesium, soluble ion content	7439-95-4	E485	5	mg/L	<5.0	----
potassium, soluble ion content	7440-09-7	E485	5	mg/L	<5.0	----
sodium, soluble ion content	17341-25-2	E485	5	mg/L	<5.0	----
sulfur (as SO4), soluble ion content	14808-79-8	E485	6	mg/L	<6.0	----
Volatile Organic Compounds (QCLot: 352358)						
benzene	71-43-2	E611A	0.005	mg/kg	<0.0050	----
ethylbenzene	100-41-4	E611A	0.015	mg/kg	<0.015	----
toluene	108-88-3	E611A	0.05	mg/kg	<0.050	----
xylene, m+p-	179601-23-1	E611A	0.05	mg/kg	<0.050	----
xylene, o-	95-47-6	E611A	0.05	mg/kg	<0.050	----
Hydrocarbons (QCLot: 352359)						
F1 (C6-C10)	----	E581.F1	5	mg/kg	<5.0	----
Hydrocarbons (QCLot: 352434)						
F2 (C10-C16)	----	E601.SG	25	mg/kg	<25	----
					<25	----
F3 (C16-C34)	----	E601.SG	50	mg/kg	<50	----
F4 (C34-C50)	----	E601.SG	50	mg/kg	<50	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 352436)									
moisture	----	E144	0.25	%	50 %	98.9	90.0	110	----
Physical Tests (QCLot: 357230)									
pH (1:2 soil:CaCl2-aq)	----	E108B	----	pH units	6 pH units	100	97.0	103	----
Saturated Paste Extractables (QCLot: 357272)									
conductivity, saturated paste	----	E102	10	µS/cm	1412 µS/cm	98.6	80.0	120	----
Saturated Paste Extractables (QCLot: 357273)									
chloride, soluble ion content	16887-00-6	E266.Cl	20	mg/L	75 mg/L	102	80.0	120	----
Saturated Paste Extractables (QCLot: 357274)									
% saturation	----	E141	----	%	100 %	105	80.0	120	----
Saturated Paste Extractables (QCLot: 357275)									
calcium, soluble ion content	7440-70-2	E485	5	mg/L	50 mg/L	93.6	80.0	120	----
magnesium, soluble ion content	7439-95-4	E485	5	mg/L	50 mg/L	101	80.0	120	----
potassium, soluble ion content	7440-09-7	E485	5	mg/L	50 mg/L	99.4	80.0	120	----
sodium, soluble ion content	17341-25-2	E485	5	mg/L	50 mg/L	105	80.0	120	----
sulfur (as SO4), soluble ion content	14808-79-8	E485	6	mg/L	150 mg/L	100	80.0	120	----
Volatile Organic Compounds (QCLot: 352358)									
benzene	71-43-2	E611A	0.005	mg/kg	2.5 mg/kg	121	70.0	130	----
ethylbenzene	100-41-4	E611A	0.015	mg/kg	2.5 mg/kg	97.3	70.0	130	----
toluene	108-88-3	E611A	0.05	mg/kg	2.5 mg/kg	112	70.0	130	----
xylene, m+p-	179601-23-1	E611A	0.05	mg/kg	5 mg/kg	124	70.0	130	----
xylene, o-	95-47-6	E611A	0.05	mg/kg	2.5 mg/kg	108	70.0	130	----
Hydrocarbons (QCLot: 352359)									
F1 (C6-C10)	----	E581.F1	5	mg/kg	86 mg/kg	99.0	70.0	130	----
Hydrocarbons (QCLot: 352434)									
F2 (C10-C16)	----	E601.SG	25	mg/kg	576 mg/kg	116	70.0	130	----
					4316 mg/kg	111	70.0	130	----
F3 (C16-C34)	----	E601.SG	50	mg/kg	1184 mg/kg	106	70.0	130	----
F4 (C34-C50)	----	E601.SG	50	mg/kg	904 mg/kg	111	70.0	130	----

Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Soil/Solid**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*Concentration*	*Target*	*MS*	*Low*	*High*	*Qualifier*
Volatile Organic Compounds (QCLot: 352358)										
EO2104046-002	BH21-3 DEPTH 0.2M	benzene	71-43-2	E611A	2.14 mg/kg	2.5 mg/kg	127	60.0	140	----
		ethylbenzene	100-41-4	E611A	1.77 mg/kg	2.5 mg/kg	105	60.0	140	----
		toluene	108-88-3	E611A	2.25 mg/kg	2.5 mg/kg	134	60.0	140	----
		xylene, m+p-	179601-23-1	E611A	4.38 mg/kg	5 mg/kg	130	60.0	140	----
		xylene, o-	95-47-6	E611A	1.93 mg/kg	2.5 mg/kg	115	60.0	140	----

Reference Material (RM) Report

A Reference Material (RM) is a homogenous material with known and well-established analyte concentrations. RMs are processed in an identical manner to test samples, and are used to monitor and control the accuracy and precision of a test method for a typical sample matrix. RM results are expressed as percent recovery of the target analyte concentration. RM targets may be certified target concentrations provided by the RM supplier, or may be ALS long-term mean values (for empirical test methods).

Sub-Matrix: **Soil/Solid**

					Reference Material (RM) Report				
					RM Target	*Recovery (%)*	*Recovery Limits (%)*		
Laboratory sample ID	*Reference Material ID*	*Analyte*	*CAS Number*	*Method*	*Concentration*	*RM*	*Low*	*High*	*Qualifier*
Physical Tests (QCLot: 357230)									
QC-357230-002	RM	pH (1:2 soil:CaCl2-aq)	----	E108B	7.65 pH units	98.2	96.0	104	----
Saturated Paste Extractables (QCLot: 357272)									
QC-357272-003	RM	conductivity, saturated paste	----	E102	6560 µS/cm	84.3	80.0	120	----
Saturated Paste Extractables (QCLot: 357273)									
QC-357273-003	RM	chloride, soluble ion content	16887-00-6	E266.Cl	994 mg/L	87.6	70.0	130	----
Saturated Paste Extractables (QCLot: 357274)									
QC-357274-002	RM	% saturation	----	E141	50.2 %	106	70.0	130	----
Saturated Paste Extractables (QCLot: 357275)									
QC-357275-003	RM	calcium, soluble ion content	7440-70-2	E485	640 mg/L	90.8	70.0	130	----
QC-357275-003	RM	magnesium, soluble ion content	7439-95-4	E485	318 mg/L	96.0	70.0	130	----
QC-357275-003	RM	potassium, soluble ion content	7440-09-7	E485	71.4 mg/L	92.7	70.0	130	----
QC-357275-003	RM	sodium, soluble ion content	17341-25-2	E485	610 mg/L	93.2	70.0	130	----
QC-357275-003	RM	sulfur (as SO4), soluble ion content	14808-79-8	E485	2600 mg/L	93.8	70.0	130	----
Hydrocarbons (QCLot: 352434)									
QC-352434-003	RM	F3 (C16-C34)	----	E601.SG	12844 mg/kg	105	70.0	130	----
QC-352434-003	RM	F4 (C34-C50)	----	E601.SG	1156 mg/kg	92.6	70.0	130	----

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC # SEG21-058

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Report To	
Company:	SolidEarth Geotechnical Inc
Contact:	Jay Jaber or Thomas Feeley
Address:	105 - 4604, 50th Street Cold Lake, Alberta, T9M 1M3
Phone:	780-340-9040 Fax: 780-669-7094
Invoice To	Same as Report ? ☑ Yes ☐ No
Hardcopy of Invoice with Report?	☐ Yes ☐ No
Company:	
Contact:	
Address:	
Phone:	Fax:
Lab Work Order # (lab use only)	E02104046

Report Format / Distribution	
☑ Standard	☑ Other
☑ PDF	☑ Excel ☐ Digital ☐ Fax
Email 1:	Jjaber@solidearth.ca
Email 2:	Tfeeley@solidearth.ca
Email 3:	akhamis@solidearth.ca
Client / Project Information	
Job #:	PG21-1603.1000
PO / AFE:	
LSD:	COL Major Arena Events Site Geotechnical Investigation
Quote #:	
ALS Contact:	Dana Brown
Sampler:	Jesse Squire

Service Requested (Rush for routine analysis subject to availability)

- ● Regular (Standard Turnaround Times - Business Days)
- ○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
- ○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
- ○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT

Analysis Request

Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	BTEX, F1 - F4	Detailed Salinity	Number of Containers
					P		
	BH21-2 Depth 0.2 m	23-Nov-21		Soil	X	X	4
	BH21-3 Depth 0.2 m	23-Nov-21		Soil	X	X	4
	BH21-6 Depth 0.2 m	24-Nov-21		Soil		X	1
	BH21-9 Depth 0.2 m	23-Nov-21		Soil		X	1

Environmental Division
Edmonton
Work Order Reference
EO2104046

Telephone : +1 780 413 5227

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Ti

Failure to complete all portions of this form may delay analysis. Please fill in this form L

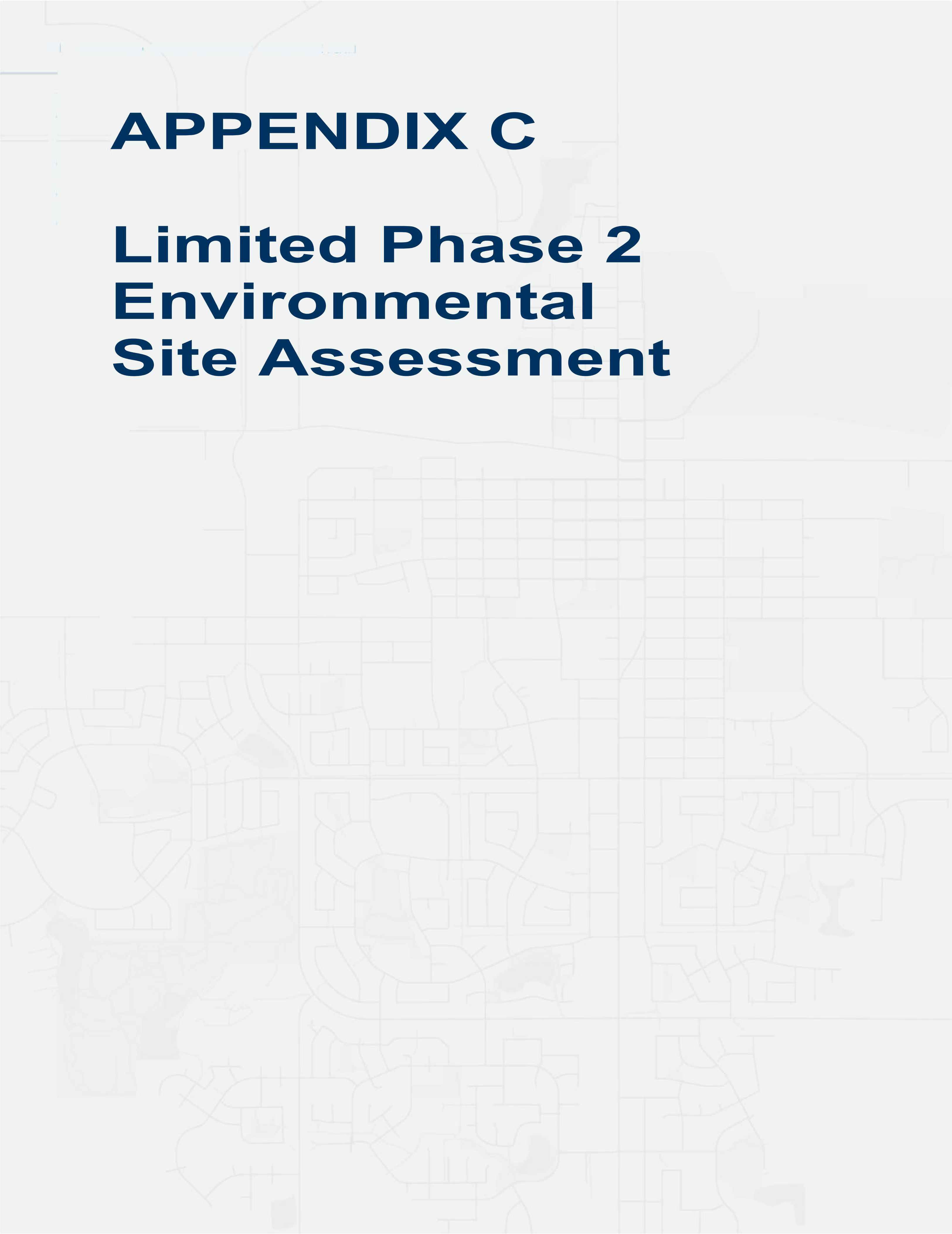
By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided o

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Mo Egal	24-Nov-21		Ron	11/25/21	7:20	18.6 °C				

APPENDIX C

Limited Phase 2 Environmental Site Assessment



SolidEarth Geotechnical Inc.
www.solidearth.ca

LIMITED PHASE II ENVIRONMENTAL SITE ASSESSMENT

Proposed Major Events Site - Arena and Hotel Buildings
Southeast of 41 Street and 40 Avenue Intersection
City of Lloydminster, Saskatchewan

Prepared for:

City of Lloydminster

Date:

30 August 2022

Project File #: PG21-1603.4000

Edmonton : **Tel.: 780.577.1115**
Fax: 780.669.7094
4336 97 Street
Edmonton, AB, T6E 5R9

Cold Lake : **Tel.: 780.545.3545**
Fax: 780.669.7094
#105, 4604 50 Street
Cold Lake, AB, T9M 1S6

Lloydminster : **Tel.: 780.875.2112**
Fax: 780.669.7094
5406 52 Avenue
Lloydminster, AB, T9V 2T5

EXECUTIVE SUMMARY

SolidEarth Geotechnical Inc. (SolidEarth) was commissioned by City of Lloydminster (the City) to complete a Limited Phase II Environmental Site Assessment (Limited Phase II ESA) for a portion of the proposed Major Events Site. Authorization to proceed with the work was received on 15 July 2022.

The Major Events Site was located on the east side of the City, southeast of the intersection of 41 Street and 40 Avenue (within the south and central portions of NW¼ 36-49-28 W3M). The site was located within the south portion of NW¼ 36-49-28 W3M and was approximately 85 acres.

The purpose of this limited Phase II ESA is to assess the presence or absence of salinity and hydrocarbon impact to the near surface soils and groundwater within the arena and hotel buildings footprint (which are close to the historic snow storage area).

Field Activities

The field-drilling program was undertaken between 19 and 21 July 2022 and consisted of drilling nine (9) boreholes (BH22-01 to -07, -15, and -17) to depths of 10.4 to 22.5 m below ground surface (mbgs).

- Twenty-seven (27) soil samples were submitted for analytical chemistry testing for salinity.
- Nine (9) soil samples were submitted for analytical chemistry testing for BTEX, F1 – F4.
- Three (3) groundwater samples were submitted for routine water analysis and BTEX, F1 – F2.

Regulatory Criteria

Based on the land use and subsurface soil conditions encountered, the applicable guidelines to be used were the SEQG Guidelines for commercial land usage and coarse-grained soils.

Findings

SolidEarth identified slight pH exceedances of SEQG Guidelines in several collected and submitted soils samples. No other exceedances of SEQG Guidelines in any of the tested parameters were identified in the submitted soil samples.

The groundwater sample collected and submitted from MW22-04 exceeded SEQG Guidelines for chloride, and the groundwater samples from MW22-04 and MW22-06 exceeded SEQG Guidelines for sodium. Other exceedances were detected, namely, fluoride, nitrite, and manganese. However, these exceedances were also detected in the background monitoring well MW22-15 and were expected to be naturally occurring.

Discussion and Recommendations

Slightly elevated concentrations of sodium were detected in BH22-03, -04, and -05 in the upper 1.5 m compared to those detected in the upper 1.5 m of the background boreholes BH22-15 and -17. However, the measured concentrations were below the SEQG Guidelines.

Similarly, slightly elevated concentrations of chloride were detected in BH22-03, -04, and -05 in the upper 1.5 m compared to those detected in the upper 1.5 m of the background boreholes BH22-15 and -17. Having said that, the measured concentrations were fairly low compared to what is normally observed in salt impacted soil.

Historical operation of the snow dump may have contributed to the measured elevated concentrations of sodium and chloride in the near surface soils. Based on the findings at the borehole locations, the measured concentrations do not suggest wide-spread salt impact to the Site.

Potential salinity from the snow dump area in the north portion of the Site may have leached into the local groundwater, as indicated by the elevated concentrations of chloride in MW22-04 and sodium in MW22-04 and -06 compared to what was measured in the background monitoring well MW22-15. However, due to limited groundwater chemistry data, the lateral extent of potential salinity impact to the groundwater could not be ascertained.

Based on a review of the information described in this report, further assessment is recommended in order to delineate the extent of sodium and chloride impacts to the groundwater at the Site. As the Site is expected to be developed into an arena and hotel, it is no longer expected to serve as a source of salt to the soil and groundwater. However, the potential presence of salinity impacts in the groundwater should be delineated, as salts can have detrimental effects on soil organisms, plants, and can corrode underground utilities.

This should be combined with the development of Lake K (east of the site). The development of Lake K is anticipated to remove the potential source of salinity (where the main snow storage has historically occurred, and snow melt was directed to) as well as potentially impacted near surface soils. It will also affect the groundwater flow and depth in the general area of the Site.

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1.0 INTRODUCTION

SolidEarth Geotechnical Inc. (SolidEarth) was commissioned by City of Lloydminster (the City) to complete a Limited Phase II Environmental Site Assessment (Limited Phase II ESA) for portions of the proposed Major Events Site, located southeast of the intersection of 41 Street and 40 Avenue (within the south and central portions of NW¼ 36-49-28 W3M) in Lloydminster, Saskatchewan (the Site). Authorization to proceed with the work was received on 15 July 2022.

This report provides a brief project description and background, site description, and a summary of activities completed during the current program; summarizes the field observations and laboratory results; analyzes the collected data; provides a discussion of the data in the context of the applicable criteria; and provides recommendations.

2.0 PROJECT DESCRIPTION AND BACKGROUND

Based on information provided to SolidEarth, it was understood that the City is in the detailed design stage for the new Major Events Site. The development will include:

- Arena Facility with an approximate area of 75 x 100 m within the central portion of the site.
- A Hotel Building to the north of the proposed Arena.
- Commercial Retail Units (CRUs) along the western portion of the site.
- Sports fields and a campground within the southern portion of the site.
- Extension of 36 Street along the southern boundary of the Site, in addition to the construction of an internal roadway network.
- Parking lots and underground utility infrastructure to service the development.

SolidEarth completed a Phase I ESA at the Site and presented the findings in a November 2021 report (File #: PG21-1603.2000). The Phase I ESA indicated that the historical usage of the north portion of the Site as a snow storage area presented the potential for elevated concentrations of sodium and chloride. Accordingly, a Phase II ESA was recommended to confirm the presence/absence of impacts at the site.

SolidEarth also complete limited soil sampling during the 2021 initial geotechnical investigation, which included collecting and submitted four (4) soil samples for salinity, and two (2) samples for petroleum hydrocarbon analytical chemistry testing. The findings were presented in the initial “preliminary” geotechnical investigation report (File #: PG21-1603.1000, December 2021).

The purpose of this Limited Phase II ESA is to assess the presence or absence of salinity and hydrocarbon impact to the near surface soils and groundwater within the arena and hotel building footprints (which are close to the historic snow storage area). Depending on the findings, additional assessment of the area may be required and may be interconnected with the area east of the site (proposed Lake K project), where the main snow storage historically occurred.

In addition to the Limited Phase II ESA, a supplemental geotechnical investigation was conducted to assess the subsurface soil and groundwater conditions at selected locations after the Site layout and building locations have been finalized, and to provide detailed geotechnical recommendations for site preparation and grading, building foundation and slab systems, installation of underground utilities, and asphalt pavement structures.

This report presents the results of the Limited Phase II ESA. Discussions and recommendations related to the geotechnical investigation are presented under separate covers.

3.0 SITE DESCRIPTIONS

The Site was located on the east side of the City, southeast of the intersection of 41 Street and 40 Avenue, within the south and central portions of NW¼ 36-49-28 W3M and covered an area of approximately 85 acres. The Site was bounded by agricultural land to the south, a railway right-of-way followed by agricultural land to the east, 41 Street to the north followed by commercial properties to the north, and 40 Avenue to the west followed by a residential subdivision.

The southern portion of the Site consisted of agricultural cropland, while the northern portion was used during the winter season as a snow dump. A stormwater management pond (SWMP) was located in the eastern portion of the Site and a drainage channel existed along the west and north limits. In addition, a telecommunications tower was located within the southern portion of the Site. Topography appeared to be generally sloping downwards from the west to the east.

The location of the Site shown on a 2021 aerial photograph is presented as Figure 1. Photographs showing site conditions that existed at the time of the field investigation are presented in Appendix A.

4.0 SCOPE OF WORK

The scope of work included the following:

1. Utilizing the seven (7) geotechnical boreholes in the arena and hotel building footprints for environmental screening and sampling and completing two (2) boreholes as groundwater monitoring wells.

2. Utilizing two (2) geotechnical boreholes that are away from the historic snow storage area for environmental screening and sampling (as background boreholes) and completing one (1) borehole as a groundwater monitoring well.
3. Collecting and submitting soil samples for analytical chemistry testing for salinity and benzene, toluene, ethylbenzene, xylene and hydrocarbon fractions F1-F4 (BTEX, F1-F4).
4. Collecting and submitting groundwater samples for analytical chemistry testing for routine water and BTEX, F1–F2.
5. Summarizing the findings of field and laboratory programs, as well as providing discussions and recommendations.

Detailed geological and hydrogeological assessment of the area was outside the scope of this program. Also excluded from the scope were a detailed land use assessment and the potential sources and uses of surface and groundwater within the general area of the Site.

5.0 FIELD INVESTIGATION PROGRAM

5.1 SELECTING BOREHOLE LOCATIONS

The borehole locations were selected and marked in the field by SolidEarth based on the proposed development plan, information provided by the City, and the location of historical snow dump areas. As outlined above, all the geotechnical boreholes advanced within the arena and hotel buildings and two (2) boreholes within the southern and western portions of the Site (away from the historical snow dump areas) were selected for environmental screening and testing.

5.2 GROUND DISTURBANCE AND SAFETY PERFORMANCE

Prior to field drilling, a SolidEarth representative completed internal ground disturbance procedures, which included placing an Alberta One Call, Saskatchewan First Call, and Dig Shaw request. Before starting onsite work, a daily field level hazard assessment was conducted and was communicated with all workers involved during the tailgate meeting. The field work was completed without any near misses or incidents.

5.3 DRILLING, SOIL SAMPLING, AND FIELD SCREENING

SolidEarth subcontracted All Service Drilling Ltd. of Nisku, Alberta to drill the boreholes. Drilling was completed using a truck-mounted auger drill rig utilizing 150 mm solid-stem continuous flight augers.

The field investigation was undertaken between 19 and 21 July 2022 and consisted of drilling nine (9) boreholes (BH22-01 to -07, -15, and -17) to depths of 10.4 to 22.5 m below ground surface (mbgs). The locations of the environmental boreholes are shown on Figure 2.

Boreholes BH22-04, -06, and -15 were completed as groundwater monitoring wells. The groundwater monitoring well at BH22-15 was intended to serve as a background well, as it was situated approximately 350 m southwest of the snow dump area.

SolidEarth Environmental and Geotechnical Technologists monitored the drilling operations and logged the recovered soil samples from the auger cuttings. The soils were logged according to the Modified Unified Soil Classification System, which is described in the Explanation of Terms and Symbols in Appendix B. Due to the method by which the soil cuttings were returned to surface, the depths noted on the borehole logs may vary by ± 0.3 m from those recorded.

Soil samples were visually inspected for evidence of environmental contamination including odours, textures, and staining. Soil samples were collected from the auger cuttings along the depth of the boreholes at approximately 0.75 m intervals, with the exception of when suspected evidence of contamination was detected, at which point sampling intervals were more frequent. Collected samples were trimmed to remove the outer 10 to 15 mm to minimize potential cross-contamination, and then split into two specimens.

Select soil specimens were then placed in laboratory supplied 60 ml methanol vials and 125 ml glass jars and stored in chilled coolers for subsequent transport to the laboratory.

5.4 GROUNDWATER MONITORING WELL CONSTRUCTION

The groundwater monitoring wells were constructed using 50 mm diameter PVC solid and machine slotted pipe. In general, 3.0 m of machine slotted pipe was used with approximately 0.3 m of sand placed overtop to form the well screen.

The groundwater monitoring well construction details are shown on the borehole logs, Appendix B, and are summarized in Table 1.

5.5 GROUNDWATER SAMPLING

Prior to conducting groundwater sampling, a SolidEarth representative visited the Site to measure groundwater levels and purge the groundwater monitoring wells. Purging was intended to remove standing water from the well and well space to ensure that representative formation water was being retrieved from the monitoring wells. Approximately three well volumes of standing water were purged, or if the monitoring well was low yielding, it was purged dry. A dedicated bailer was used and was left in the well for subsequent sampling.

Groundwater samples were placed directly into laboratory supplied containers, which were immediately placed in chilled coolers for storage and shipment. Groundwater samples were field filtered and preserved, as required, during sampling.

Purging and sampling of all three groundwater monitoring wells was completed on 3 August 2022.

6.0 SUBSURFACE CONDITIONS

The subsurface stratigraphy at the borehole locations generally consisted of topsoil, followed by clay till, and was underlain by clay shale (bedrock). Sand/silt were encountered interbedded within and/or below the clay till at all borehole locations. A brief summary of the subsurface conditions encountered at the borehole locations is presented below. A detailed description of the subsurface conditions encountered at each borehole location is provided in the borehole logs, Appendix B.

Topsoil

Topsoil was encountered at the ground surface of all-borehole locations and was between 75 and 300 mm thick.

Clay Till

Clay till was encountered below the topsoil at all borehole locations and extended to approximate depths of between 17.7 and 18.7 mbgs at BH22-02 and -05, and to beyond the exploration depths of the remaining boreholes.

The upper portion of the clay till was classified as low to medium plastic clay till and extended to approximate depths ranging between 9.1 and 16.5 m below the existing ground surface. The lower portion of the clay till was classified as high plastic soil.

The low to medium clay till was generally classified as “clay, and silt, sandy, trace gravel”, was brown to grey, and moist to very moist. The high plastic clay till was generally classified as “clay, and silt, trace sand”, was grey, and very moist.

Interbedded Sand/Silt

Relatively thick layers of sand were encountered interbedded within the clay till at all borehole locations. The top of the sand layers, where encountered, varied across the site and ranged between approximately 1.2 and 3.8 m below the existing ground surface. Similarly, the thicknesses of the sand layers varied across the site and ranged between approximately 1.5 and 9.5 m thick.

The sand was generally classified as “sand, some silt, trace clay, trace gravel”, was poorly graded, fine to medium grained, brown to grey, and wet to saturated.

A relatively thin layer of silt (approximately 0.7 m thick) was encountered within and/or below the clay till at BH22-01 location. The silt was generally classified as “silt, some clay, some sand to sandy”, was low plastic, grey and very moist.

Clay Shale (Bedrock)

Clay shale (bedrock) was encountered below the clay till at approximate depths ranging between 17.7 and 18.7 m below the existing ground surface and extended to beyond the exploration depths of BH22-02 and -05.

The clay shale was generally described as “very weak, massive, and highly weathered”, was high plastic, grey, and very moist, and contained sand and silt seams.

7.0 ANALYTICAL LABORATORY TESTING

During the current Limited Phase II ESA, soil and groundwater samples were collected and submitted for analytical chemistry testing for the following parameters:

Soil

- Twenty-seven (27) soil samples were submitted for analytical chemistry testing for salinity.
- Nine (9) soil samples were submitted for analytical chemistry testing for BTEX, F1 – F4.

Groundwater

- Three (3) groundwater samples were submitted for routine water analysis and BTEX, F1 – F2.

All samples were submitted to ALS Environmental in Edmonton, Alberta, using standard chain-of-custody protocol. ALS is certified by the Canadian Association for Laboratory Accreditation Inc. (CALA).

8.0 DATA ANALYSIS

This section presents the criteria used in this assessment and discusses the results of the field measurements and analytical chemistry testing. The results from the initial and current ESAs are presented and discussed.

8.1 ASSESSMENT CRITERIA

8.1.1 General Information

In Saskatchewan, a three-tiered risk-based approach has been adopted for the management and remediation of contaminated sites. The three tiers are:

Tier 1: This tier relies on conservative assumptions regarding land usage, soil conditions, and receptors and requires the least amount of site information.

Tier 2: This tier involves the modification or elimination of specific exposure pathways that may not be active at the subject site. This tier requires a more in-depth understanding of site characteristics than what would be required under a Tier 1 approach.

Tier 3: This approach involves developing site-specific criteria or the completion of a human health and/or ecological risk assessment.

All three tiers were based on the framework developed by the Canadian Council of Ministers of Environment (CCME) and are intended to provide the same level of human health and ecological protection.

8.1.2 Application of Saskatchewan Environmental Quality Guidelines

As specified in the Saskatchewan Environmental Code – *Endpoint Selection Standard* (ESS), the application of Tier 1 endpoints requires minimal site information limited to contaminant delineation, land usage, and soil grain size.

Tier 1 and Tier 2 endpoints are based on conservative assumptions and are not applicable if any of the scenarios outlined below exist at the site. In such a case, a Tier 3 approach is required.

- Volatile contaminants are within 30 centimetres (cm) of the foundation of an occupied building.
- Contaminants are within 10 metres (m) of a surface waterbody.
- The soils at the site are predominantly sands and gravels with a bulk hydraulic conductivity greater than 10^{-3} cm per second.
- The land use does not fit within the four (4) generic land use categories (residential, agricultural, commercial, industrial).
- Groundwater flows to a stagnant water body from which the main route of water loss is by evaporation.
- The contaminant source length or width in groundwater is greater than 10 m.
- Water is used for irrigation or food processing.
- Contaminants are found in fractured bedrock.
- Inorganic contaminants are found in organic soils.
- Rare and/or endangered species reside at or frequent the environmentally impacted site.

Under a Tier 2 endpoint approach, certain pathways may be eliminated or controlled through: (i) engineered controls, (ii) physical controls, or (iii) administrative controls.

A Tier 3 approach is required under certain conditions (listed above) and can be adopted through the completion of a human health or ecological risk assessment and the development of site-specific guideline values.

As no conditions were encountered that precluded the use of the Saskatchewan Environmental Quality Guidelines (SEQG) Tier 1 and/or Tier 2, these criteria were considered applicable.

8.1.3 Land Use Evaluation

Land use determines selection of an environmental endpoint. Land use is affected by current/future land use and current/future zoning.

Based on the current project understanding, the Site was planned for development into an arena and hotel. Accordingly, the SEQG endpoints for commercial land use were selected.

8.1.4 Soil Conditions

SolidEarth identified both fine-grained clay soils as well as sandy soils at the Site. Accordingly, the SEQG Tier 1 endpoints for coarse-grained soils were selected.

8.1.5 Selected Assessment Guidelines

Based on the land use and soil settings encountered, the applicable guidelines to be used were the SEQG endpoints for a commercial land use setting for coarse grained soils (SEQG Guidelines).

8.2 RESULTS OF SOIL FIELD VISUAL AND OLFACTORY SCREENING

During drilling, soil samples were visually inspected for signs of environmental impact including colours, textures, and odours. No unusual odours, textures, or colours were detected in the soils observed during the field drilling program.

During groundwater sampling, no unusual odours or colours were identified in the collected groundwater samples.

8.3 RESULTS OF ANALYTICAL CHEMISTRY TESTING

The results of the analytical chemistry testing of the soil and groundwater samples collected during the current program are presented in Tables 2 to 5. Analytical laboratory reports of the data are presented in Appendix C. The following observations were made:

Soil Results

- The pH levels exceeded the upper limit of the SEQG Guidelines in several soil samples collected from the upper 1.5 m of the soil profile
- The concentrations of BTEX, F1 – F4, in the submitted soil samples were either below the analytical method detection limits or the selected SEQG Guidelines.
- The concentrations of tested salinity parameters, in the submitted soil samples were either below the analytical method detection limits or the selected SEQG Guidelines.
- No SEQG guidelines exist for chloride in soil, however, the concentrations of chloride in the upper 1.5 m of boreholes BH22-03, -04, and -05 (84 to 446 mg/kg) generally appeared to be higher than those observed in the upper 1.5 m of BH22-15 and -17 (<10 mg/kg).
- No clear pattern in EC levels across the Site could be discerned. The EC levels at borehole locations in the arena and hotel area (BH22-01 to -07) were similar to what was measured in boreholes BH22-15 and -17.

Groundwater Results

- The concentrations of chloride in MW22-04 exceeded SEQG Guidelines. The concentrations of chloride in the other two groundwater monitoring wells (including the background well MW22-15) were below SEQG Guidelines.
- The concentrations of sodium exceeded SEQG Guidelines at MW22-04 and MW22-06 but were below SEQG Guidelines at the background well MW22-15.
- The concentrations of fluoride exceeded SEQG Guidelines at all groundwater monitoring well locations.
- The concentrations of nitrite exceeded SEQG Guidelines in MW22-04 and 22-15 but were below SEQG Guidelines in MW22-06.
- The concentrations of manganese exceeded SEQG Guidelines at all groundwater monitoring well locations.
- The concentrations of all other tested salinity parameters were below SEQG Guidelines.
- The concentrations of all tested hydrocarbon parameters were below SEQG Guidelines at all groundwater monitoring well locations.

Groundwater chloride and sodium exceedances have been plotted on Figure 3.

8.4 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

8.4.1 Field Program

All field activities and tasks were completed in accordance with Canadian Council of Ministers of the Environment *Guidance Manual for Environmental Site Characterization in Support of Environment and Human Health Risk Assessment Volume 1 Guidance Manual* (CCME 2016).

The laboratory Quality Control Reports are provided in Laboratory Analytical Chemistry Reports, Appendix C. Based on the review of the laboratory Quality Control Report, no issues were identified. As such, the data presented in the report were considered reliable.

9.0 NATIONAL CLASSIFICATION SYSTEM FOR CONTAMINATED SITES (NCSCS)

The NCSCS is a tool developed by the Canadian Council of Ministers of the Environment (CCME) and enables the classification of sites according to their potential for environmental impact. Its purpose is to aid in the evaluation of contaminated sites. Under the NCSCS, sites can be classified, from high to low priority for action as either Class 1, 2, 3, N, or INS. As per the Saskatchewan Ministry of Environment Impacted Sites Guidance Document, completion of the NCSCS spreadsheet is required at the site assessment stage.

The scope of this Limited Phase II ESA was not intended to delineate contamination; rather, it was meant to identify the presence or absence of contaminants in the areas of proposed development and serve as a foundation for further assessments, if needed. Accordingly, and based on instruction provided in Step 3 of the NCSCS pre-screening spreadsheet, SolidEarth did not proceed through the remainder of the worksheet.

10.0 SUMMARY OF FINDINGS

SolidEarth advanced nine (9) boreholes at the Site and installed three (3) groundwater monitoring wells including one (1) background well. A total of 27 soil samples were submitted for salinity, BTEX, and F1 – F4 analytical chemistry testing and a total of three (3) groundwater samples were submitted for routine water analysis, BTEX, and F1 – F2.

SolidEarth identified slight pH exceedances of SEQG Guidelines in several collected and submitted soils samples. No other exceedances of SEQG Guidelines in any of the tested parameters were identified in the submitted soil samples.

The groundwater sample collected and submitted from MW22-04 exceeded SEQG Guidelines for chloride, and the groundwater samples from MW22-04 and MW22-06 exceeded SEQG Guidelines for sodium. Other exceedances were detected, namely, fluoride, nitrite, and manganese. However, these exceedances were also detected in the background monitoring well MW22-15 and were expected to be naturally occurring.

11.0 DISCUSSION AND RECOMMENDATIONS

Slightly elevated concentrations of sodium were detected in BH22-03, -04, and -05 in the upper 1.5 m compared to those detected in the upper 1.5 m of the background boreholes BH22-15 and -17. However, the measured concentrations were below the SEQG Guidelines.

Similarly, slightly elevated concentrations of chloride were detected in BH22-03, -04, and -05 in the upper 1.5 m compared to those detected in the upper 1.5 m of the background boreholes BH22-15 and -17. Having said that, the measured concentrations were fairly low compared to what is normally observed in salt impacted soil.

Historical operation of the snow dump may have contributed to the measured elevated concentrations of sodium and chloride in the near surface soils. Based on the findings at the borehole locations, the measured concentrations do not suggest wide-spread salt impact to the Site.

Potential salinity from the snow dump area in the north portion of the Site may have leached into the local groundwater, as indicated by the elevated concentrations of chloride in MW22-04 and sodium in MW22-04 and -06 compared to what was measured in the background monitoring well MW22-15. However, due to limited groundwater chemistry data, the lateral extent of potential salinity impact to the groundwater could not be ascertained.

Based on a review of the information described in this report, further assessment is recommended in order to delineate the extent of sodium and chloride impacts to the groundwater at the Site. As the Site is expected to be developed into an arena and hotel, it is no longer expected to serve as a source of salt to the soil and groundwater. However, the potential presence of salinity impacts in the groundwater should be delineated, as salts can have detrimental effects on soil organisms, plants, and can corrode underground utilities.

This should be combined with the development of Lake K (east of the site). The development of Lake K is anticipated to remove the potential source of salinity (where the main snow storage has historically occurred, and snow melt was directed to) as well as potentially impacted near surface soils. It will also affect the groundwater flow and depth in the general area of the Site.

12.0 CLOSURE

This report was based on the conditions encountered and the results of the soil and groundwater sampling at nine (9) borehole locations and three (3) groundwater monitoring well locations advanced at the Site during the current assessment. The findings cannot and should not be extended to other portions of the Site.

The report may assist in reducing, but not eliminating, uncertainty about potential environmental conditions associated with the Site. Due to the limitations stated in the report, different environmental conditions may exist from that which was observed during the completion of this program, or different criteria may apply. Should such a situation arise, SolidEarth should be given the opportunity to review such information and determine if modifications to the findings are warranted.

This report has been prepared for the exclusive use City of Lloydminster and their authorized users for the specific application outlined in this report. No other warranties expressed or implied are provided. This report has been prepared within generally accepted assessment practices.

Thank you for giving us the opportunity to be of service. If you have any questions or require additional information, please feel free to contact our office.

Respectfully submitted,
SolidEarth Geotechnical Inc.

Alex Khamis B.Sc., EP
Environmental Professional

Jay Jaber, M.Sc., P.Eng.
Senior Geo-Environmental Engineer
President

13.0 STATEMENT OF QUALIFICATIONS

Jay Jaber, M.Sc., P.Eng., Senior Geo-Environmental Engineer

Mr. Jay Jaber, M.Sc., P.Eng., is a geo-environmental engineer with over 28 years of engineering consulting experience. He holds a Master's degree in geotechnical engineering from the University of Texas in Austin and is a registered professional engineer in the provinces of Alberta and Saskatchewan.

Mr. Jaber's experience includes: (i) Environmental engineering including environmental site assessment, groundwater monitoring, and remediation and re-development programs; (ii) Geo-environmental engineering including the design of landfill liners and caps, lagoons, and containment systems; (iii) Geotechnical engineering for infrastructure projects including pipeline alignment, roadways, and utilities upgrade projects; (iv) Foundation engineering for bridges, heavy industrial plants, commercial developments, and high rise buildings; (v) Slope stability engineering for deep excavation, embankments over weak soils, and natural slopes; and (vi) Materials engineering and testing for infrastructure, heavy foundations, and roadway projects.

Mr. Alex Khamis, B.Sc., EP, Environmental Professional

Mr. Alex Khamis, B.Sc., EP, is an environmental professional with over nine (9) years of environmental consulting experience. He holds a Bachelor's degree in General Sciences from the University of Alberta in Edmonton and is a registered environmental professional with ECO Canada.

Mr. Khamis's experience includes environmental site assessments (Phase I, II, and III ESAs), remediation programs, groundwater monitoring for landfills, and environmental sampling and testing activities in support of civil construction projects.

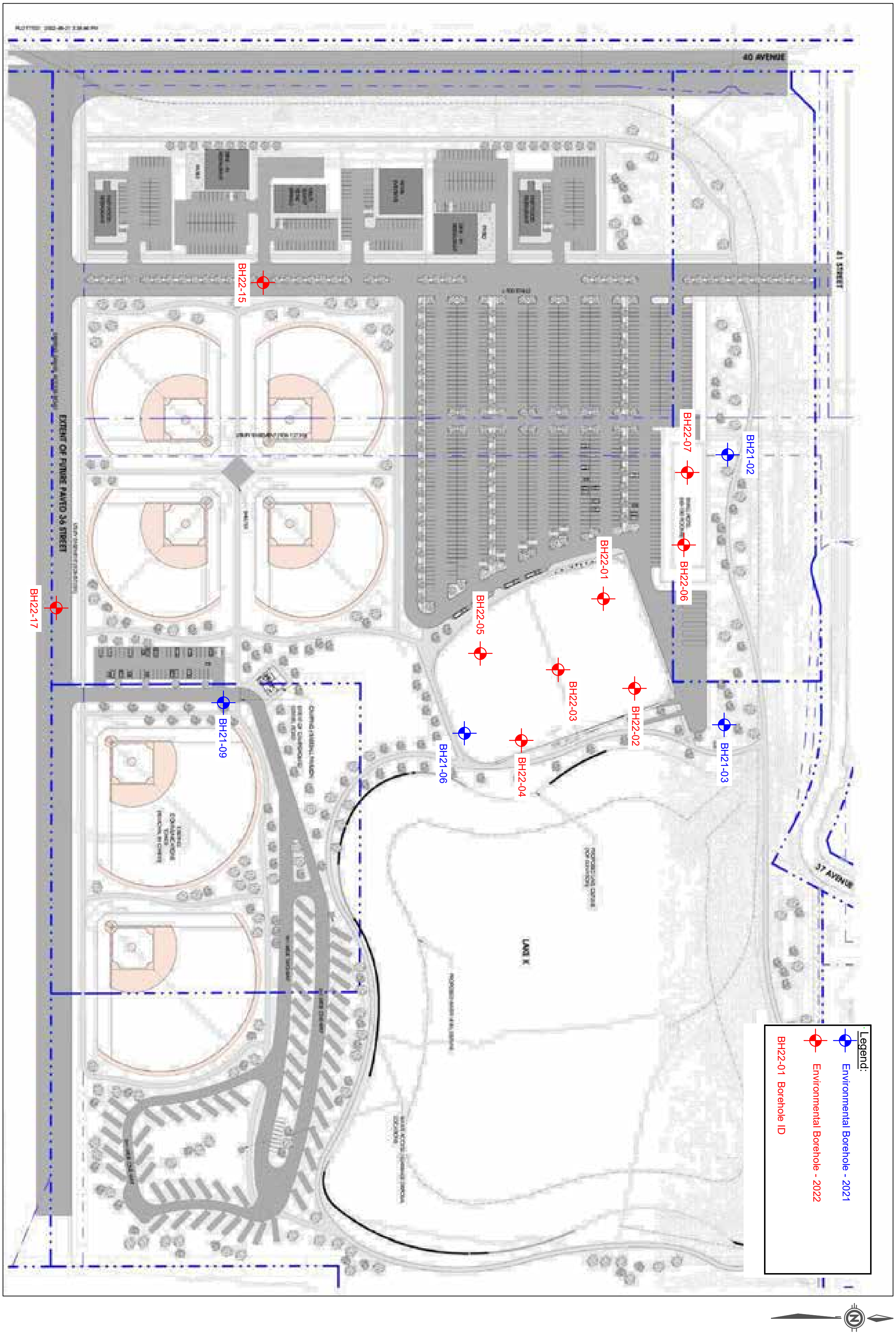
Figures

SCALE: NTS	DRAWN BY: AK	FIGURE No.: 1	REVISION No.: 0	PROJECT NAME: Limited Phase II ESA Proposed Major Events Site - Arena Facility Southeast of 41 Street and 40 Avenue Intersection City of Lloydminster, Saskatchewan
DATUM: -	DATE: August 2022	PROJECT No.: PG21-1603.4000		
				DRAWING TITLE: Key Plan

CLIENT:

SolidEarth Geotechnical Inc.

5406 52 Avenue, Lloydminster, AB, T9V 2T5



SCALE: NTS	DRAWN BY: AK	FIGURE No.: 2	REVISION No.: 0	PROJECT NAME: Limited Phase II ESA Proposed Major Events Site - Arena Facility Southeast of 41 Street and 40 Avenue Intersection City of Lloydminster, Saskatchewan
DATUM: -	DATE: August 2022	PROJECT No.: PG21-1603.4000		

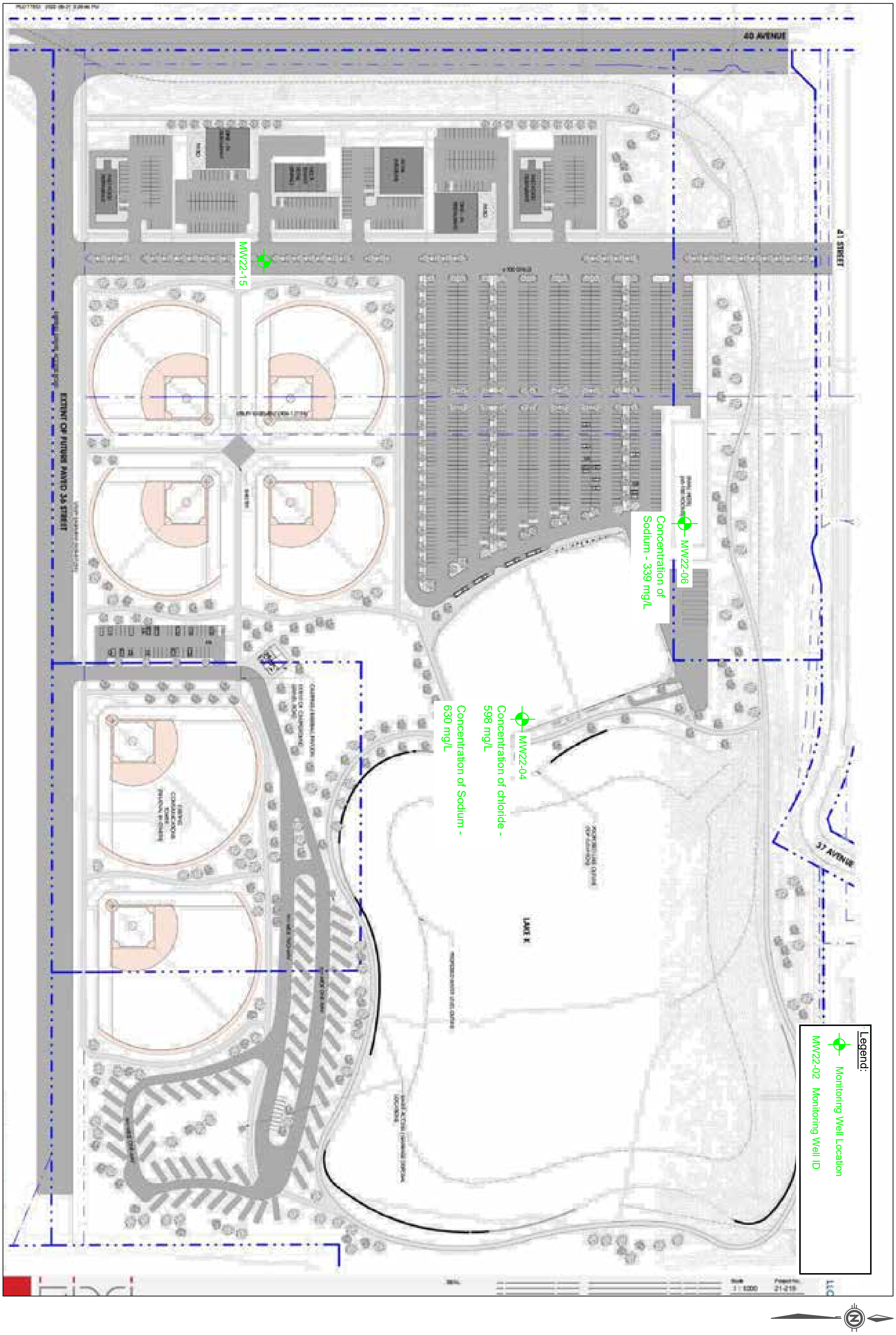
SolidEarth Geotechnical Inc.

5406 52 Avenue, Lloydminster, AB, T9V 2T5

DRAWING TITLE:

Environmental Borehole Plan

CLIENT:



SCALE: NTS	DRAWN BY: AK	FIGURE No.: 3	REVISION No.: 0
DATUM: -	DATE: August 2022	PROJECT No.: PG21-1603.4000	

PROJECT NAME:
Limited Phase II ESA
Proposed Major Events Site - Arena Facility
Southeast of 41 Street and 40 Avenue Intersection
City of Lloydminster, Saskatchewan

CLIENT:

LLOYDMINSTER
Canada's Border City

SolidEarth Geotechnical Inc.
5406 52 Avenue, Lloydminster, AB, T9V 2T5

SolidEarth GEOTECHNICAL

DRAWING TITLE:
Environmental Monitoring Well Plan and Concentrations of Sodium and Chloride

Tables

Table 1 - SolidEarth Groundwater Monitoring Well Construction Details

Limited Phase II ESA
Major Events Arena
Southeast of 41 Street and 40 Avenue
Lloydminster, Saskatchewan

Monitoring Well ID	Installation Date	Borehole Depth (mbgs)	Monitoring Well Screen (m)^{Note1}	Pipe Stickup (m)	Water Level (mbgs)	Northing^{Note2}	Easting^{Note2}
MW22-04	20-Jul-22	4.6	4.6 to 1.6	1.00	3.14	5903170	568514
MW22-06	21-Jul-22	6.1	6.1 to 3.1	1.00	1.61	5903283	568381
MW22-15	22-Jul-22	6.1	6.1 to 3.1	1.00	3.37	5903001	568249

Notes:

mASL - metres above sea level

mbgs - metres below ground surface

1) Monitoring well screen measured from bottom of PVC screen to top of PVC screen/sand pack

2) GPS coordinates collected using handheld Garmin GPS unit accurate to the nearest ±3 m

Table 2 - Summary of Soil Results for Salinity

Parameters	Unit	MDL	CCME	SEQG	Sample ID, Lab ID, Depth, and Date									
					BH22-01, S1, 0.3 M	BH22-01, S2, 0.8 M	BH22-01, S3, 1.5 M	BH22-02, S1, 0.3 M	BH22-02, S2, 0.8 M	BH22-02, S3, 1.5 M	BH22-03, S1, 0.3 M	BH22-03, S2, 0.8 M	BH22-03, S3, 1.1 M	BH22-04, S1, 0.3 M
					21-Jul-22	21-Jul-22	21-Jul-22	19-Jul-22	19-Jul-22	19-Jul-22	21-Jul-22	21-Jul-22	21-Jul-22	20-Jul-22
					EO2205809-001	EO2205809-002	EO2205809-003	EO2205809-004	EO2205809-005	EO2205809-006	EO2205809-007	EO2205809-008	EO2205809-009	EO2205809-010
Physical Tests														
moisture	%	-	-	-	-	-	9.55	-	-	14.8	-	-	13.6	-
pH (1:2 soil:CaCl2-aq)	pH units	-	-	8	8.04	7.98	7.90	7.97	7.73	7.85	7.11	8.19	7.96	8.23
Saturated Paste Extractables														
% saturation	%	-	-	-	45.0	44.9	41.8	49.5	49.6	55.2	54.9	58.6	55.2	52.0
calcium, soluble ion content	mg/kg	-	-	-	30.2	14.5	24.8	203	213	218	12.6	18.2	17.8	7.7
calcium, soluble ion content	mg/L	-	-	-	67.0	32.3	59.4	410	429	395	22.9	31.0	32.2	14.9
chloride, soluble ion content	mg/kg	11	-	-	14	<10	<10	23	<10	22	84	149	89	<10
chloride, soluble ion content	mg/L	20	-	-	30	<20	<20	47	<20	39	153	255	162	<20
conductivity, saturated paste	dS/m	-	-	-	1.38	0.852	0.946	3.63	3.88	4.33	0.883	1.26	0.880	0.567
magnesium, soluble ion content	mg/kg	5	-	-	40.1	18.2	18.7	119	155	211	21.3	27.8	22.8	<5.0
magnesium, soluble ion content	mg/L	-	-	-	89.2	40.6	44.8	241	313	383	38.8	47.4	41.4	5.7
potassium, soluble ion content	mg/kg	5	-	-	<5.0	<5.0	<5.0	9.2	9.3	8.2	<5.0	<5.0	<5.0	<5.0
potassium, soluble ion content	mg/L	10	-	-	<5.0	<5.0	7.5	18.7	18.7	14.8	<5.0	<5.0	<5.0	<5.0
sodium adsorption ratio [SAR]	-	-	12	12	1.72	2.01	1.58	1.13	1.13	1.79	2.76	3.72	2.77	6.82
sodium, soluble ion content	mg/kg	5	-	-	41.2	32.7	27.8	57.9	62.5	115	51.2	82.6	55.8	63.4
sodium, soluble ion content	mg/L	-	-	-	91.6	72.8	66.4	117	126	208	93.3	141	101	122
sulfur (as SO4), soluble ion content	mg/kg	-	-	-	244	114	151	1020	1180	1470	20.9	43.5	24.1	36.6
sulfur (as SO4), soluble ion content	mg/L	-	-	-	542	254	362	2060	2380	2670	38.0	74.3	43.7	70.4

Notes:

mg/kg - milligrams per kilogram

mg/L - milligrams per litre

dS/m - deciSiemens per metre

CCME - Canadian Council of Ministers of the Environment, Soil Quality Guidelines, Commercial Land Use, Coarse-Grained Soils (Accessed online August 2022)

SEQG - Saskatchewan Soil Quality Guidelines, Commercial Land Use, Coarse Grained Soils (Accessed online August 2022)

Exceeds Limit
Result LOR > Limit
Result LOR < Limit

Table 2 - Summary of Soil Results for Salinity

Parameters	Unit	MDL	CCME	SEQG	Sample ID, Lab ID, Depth, and Date									
					BH22-04, S2, 0.8 M	BH22-04, S3, 1.5 M	BH22-05, S1, 0.3 M	BH22-05, S2, 0.8 M	BH22-05, S3, 1.5 M	BH22-06, S1, 0.3 M	BH22-06, S2, 0.8 M	BH22-06, S2, 1.5 M	BH22-07, S1, 0.3 M	BH22-07, S2, 0.8 M
					20-Jul-22	20-Jul-22	20-Jul-22	20-Jul-22	20-Jul-22	21-Jul-22	21-Jul-22	21-Jul-22	21-Jul-22	21-Jul-22
					EO2205809-011	EO2205809-012	EO2205809-013	EO2205809-014	EO2205809-015	EO2205809-016	EO2205809-017	EO2205809-018	EO2205809-019	EO2205809-020
Physical Tests														
moisture	%	-	-	-	-	13.9	-	-	15.4	-	-	12.3	-	-
pH (1:2 soil:CaCl2-aq)	pH units	-	-	8	8.07	8.00	7.22	8.30	8.17	7.93	8.04	7.79	8.13	8.21
Saturated Paste Extractables														
% saturation	%	-	-	-	51.8	55.1	56.5	47.5	50.0	53.7	50.5	50.1	48.9	48.8
calcium, soluble ion content	mg/kg	-	-	-	47.0	59.5	28.9	37.5	44.8	27.7	202	262	191	45.2
calcium, soluble ion content	mg/L	-	-	-	90.7	108	51.2	79.0	89.6	51.6	400	523	391	92.6
chloride, soluble ion content	mg/kg	11	-	-	440	446	407	229	79	<11	<10	<10	<10	<10
chloride, soluble ion content	mg/L	20	-	-	850	809	721	482	158	<20	<20	<20	<20	<20
conductivity, saturated paste	dS/m	-	-	-	3.22	3.48	2.32	3.90	3.54	0.433	2.80	4.08	5.49	2.92
magnesium, soluble ion content	mg/kg	5	-	-	88.1	101	53.0	86.4	87.5	14.7	116	191	214	63.0
magnesium, soluble ion content	mg/L	-	-	-	170	184	93.8	182	175	27.4	229	381	437	129
potassium, soluble ion content	mg/kg	5	-	-	5.7	7.5	5.8	<5.0	<5.0	<5.0	8.9	15.9	7.5	5.5
potassium, soluble ion content	mg/L	10	-	-	11.0	13.6	10.2	<10.0	<10.0	6.2	17.6	31.8	15.4	11.3
sodium adsorption ratio [SAR]	-	-	12	12	3.97	3.94	4.91	7.40	5.99	0.21	0.34	1.07	4.17	6.05
sodium, soluble ion content	mg/kg	5	-	-	144	160	145	248	212	<5.0	17.6	66.1	247	187
sodium, soluble ion content	mg/L	-	-	-	278	290	256	523	423	7.5	34.9	132	505	384
sulfur (as SO4), soluble ion content	mg/kg	-	-	-	229	345	48.1	598	720	29.9	919	1440	1800	717
sulfur (as SO4), soluble ion content	mg/L	-	-	-	443	626	85.1	1260	1440	55.7	1820	2870	3680	1470

Notes:

mg/kg - milligrams per kilogram

mg/L - milligrams per litre

dS/m - deciSiemens per metre

CCME - Canadian Council of Ministers of the Environment, Soil Quality Guidelines

SEQG - Saskatchewan Soil Quality Guidelines, Commercial Land Use, Coarse Gr

Exceeds Limit

Result LOR > Limit

Result LOR < Limit

Table 2 - Summary of Soil Results for Salinity

Parameters	Unit	MDL	CCME	SEQG	Sample ID, Lab ID, Depth, and Date						
					BH22-07, S3, 1.5 M	BH22-15, S1, 0.3 M	BH22-15, S2, 0.8 M	BH22-15, S3, 1.5 M	BH22-17, S1, 0.3 M	BH22-17, S2, 0.8 M	BH22-17, S3, 1.5 M
					21-Jul-22	22-Jul-22	22-Jul-22	22-Jul-22	20-Jul-22	20-Jul-22	20-Jul-22
					EO2205809-021	EO2205809-022	EO2205809-023	EO2205809-024	EO2205809-025	EO2205809-026	EO2205809-027
Physical Tests											
moisture	%	-	-	-	13.4	-	-	13.3	-	-	12.3
pH (1:2 soil:CaCl2-aq)	pH units	-	-	8	8.16	7.77	7.78	7.76	7.71	8.15	7.99
Saturated Paste Extractables											
% saturation	%	-	-	-	49.1	52.9	49.9	49.3	49.0	50.4	50.3
calcium, soluble ion content	mg/kg	-	-	-	19.3	203	95.8	52.8	76.0	94.2	227
calcium, soluble ion content	mg/L	-	-	-	39.4	383	192	107	155	187	452
chloride, soluble ion content	mg/kg	11	-	-	<10	<10	<10	<10	<10	<10	<10
chloride, soluble ion content	mg/L	20	-	-	<20	<20	<20	<20	<20	<20	<20
conductivity, saturated paste	dS/m	-	-	-	2.34	4.25	2.51	1.32	1.86	3.05	6.89
magnesium, soluble ion content	mg/kg	5	-	-	38.2	187	78.8	26.2	97.0	130	486
magnesium, soluble ion content	mg/L	-	-	-	77.8	353	158	53.1	198	259	966
potassium, soluble ion content	mg/kg	5	-	-	<5.0	14.5	11.0	8.1	<5.0	6.3	15.3
potassium, soluble ion content	mg/L	10	-	-	<10.0	27.5	22.1	16.4	9.5	12.5	30.4
sodium adsorption ratio [SAR]	-	-	12	12	7.95	2.25	2.92	2.27	0.92	1.80	3.32
sodium, soluble ion content	mg/kg	5	-	-	184	134	113	56.7	35.8	81.6	275
sodium, soluble ion content	mg/L	-	-	-	374	254	226	115	73.1	162	546
sulfur (as SO4), soluble ion content	mg/kg	-	-	-	530	1520	768	328	583	948	3040
sulfur (as SO4), soluble ion content	mg/L	-	-	-	1080	2880	1540	665	1190	1880	6050

Notes:

mg/kg - milligrams per kilogram

mg/L - milligrams per litre

dS/m - deciSiemens per metre

CCME - Canadian Council of Ministers of the Environment, Soil Quality Guidelines

SEQG - Saskatchewan Soil Quality Guidelines, Commercial Land Use, Coarse Gr

🟥 Exceeds Limit

🟪 Result LOR > Limit

🟪 Result LOR < Limit

Table 3 - Summary of Soil Results for BTEX, F1 - F4

Parameters	Unit	MDL	CCME	SEQG	Sample ID, ALS ID, and Date								
					BH22-01, S3, 1.5 M	BH22-02, S3, 1.5 M	BH22-03, S3, 1.1 M	BH22-04, S3, 1.5 M	BH22-05, S3, 1.5 M	BH22-06, S2, 1.5 M	BH22-07, S3, 1.5 M	BH22-15, S3, 1.5 M	BH22-17, S3, 1.5 M
					21-Jul-22	19-Jul-22	21-Jul-22	20-Jul-22	20-Jul-22	21-Jul-22	21-Jul-22	22-Jul-22	20-Jul-22
					EO2205809-003	EO2205809-006	EO2205809-009	EO2205809-012	EO2205809-015	EO2205809-018	EO2205809-021	EO2205809-024	EO2205809-027
Hydrocarbons													
F1 (C6-C10)	mg/kg	5	240	240	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
F1-BTEX	mg/kg	5	-	240	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
F2 (C10-C16)	mg/kg	25	260	260	<25	<25	<25	<25	<25	<25	<25	<25	<25
F3 (C16-C34)	mg/kg	50	1700	1700	<50	<50	<50	<50	<50	<50	<50	<50	<50
F4 (C34-C50)	mg/kg	50	3300	3300	<50	<50	<50	<50	<50	<50	<50	<50	<50
TEH (C10-C50)	mg/kg	75	-	-	<75	<75	<75	<75	<75	<75	<75	<75	<75
TEH (C16-C50)	mg/kg	75	-	-	<75	<75	<75	<75	<75	<75	<75	<75	<75
Volatile Organic Compounds [Fuels]													
benzene	mg/kg	0.005	0.03	0.078	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
ethylbenzene	mg/kg	0.015	0.082	0.14	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
toluene	mg/kg	0.05	0.37	0.12	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
xylenes, total	mg/kg	0.05	11	1.9	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050

Notes:

mg/kg - milligrams per kilogram

mg/L - milligrams per litre

MDL - method detection limit

CCME - Canadian Council of Ministers of the Environment, Soil Quality Guidelines, Commercial Land Use, Coarse-Grained Soils (Accessed online August 2022)

SEQG - Saskatchewan Soil Quality Guidelines, Commercial Land Use, Coarse Grained Soils (Accessed online August 2022)

Exceeds Limit

Result LOR > Limit
Result LOR < Limit

Table 4 - Summary of Groundwater Results for Salinity

Parameter	Units	MDL	CCME	SEQG	Sample ID, ALS ID, and Date		
					MW22-04	MW22-06	MW22-15
					3-Aug-22		
					EO2206195-001	EO2206195-002	EO2206195-003
Anions and Nutrients							
chloride	mg/L	-	120	120	598	39.0	22.1
fluoride	mg/L	-	0.12	0.12	0.341	0.463	0.395
nitrate (as N)	mg/L	0.1	3	3	<0.100	0.491	0.340
nitrate + nitrite (as N)	mg/L	0.112	-	-	<0.112	0.491	1.20
nitrite (as N)	mg/L	0.05	0.06	0.06	0.076	<0.050	0.860
sulfate (as SO4)	mg/L	-	-	-	2830	2390	1150
Dissolved Metals							
calcium, dissolved	mg/L	-	-		406	510	317
iron, dissolved	mg/L	0.05	0.3	0.3	<0.050	<0.020	<0.020
magnesium, dissolved	mg/L	-	-		434	237	112
manganese, dissolved	mg/L	-	0.2	0.05	0.875	0.632	0.155
potassium, dissolved	mg/L	-	-		11.2	12.6	10.7
sodium, dissolved	mg/L	-	-	200	630	339	125

Table 4 - Summary of Groundwater Results for Salinity

Parameter	Units	MDL	CCME	SEQG	Sample ID, ALS ID, and Date		
					MW22-04	MW22-06	MW22-15
						3-Aug-22	
					EO2206195-001	EO2206195-002	EO2206195-003
Metals							
sodium adsorption ratio [SAR]	-	-	-	-	5.18	3.11	1.54
Physical Tests							
alkalinity, bicarbonate (as HCO3)	mg/L	-	-	-	594	466	523
alkalinity, carbonate (as CO3)	mg/L	1	-	-	<1.0	2.5	<1.0
alkalinity, hydroxide (as OH)	mg/L	1	-	-	<1.0	<1.0	<1.0
alkalinity, total (as CaCO3)	mg/L	-	-	-	487	386	429
conductivity	µS/cm	-	-	-	5810	3830	2350
pH	pH units	-	-	6.5 to 9	7.94	8.30	7.92
Total Dissolved Solids	mg/L	-	-	-	5220	3780	2010

Notes:

ug/L - micrograms per litre

mg/L - milligrams per litre

uS/cm - microSiemens per centimetre

MDL - method detection limit

CCME - Canadian Council of Ministers of the Environment, Freshwater Aquatic Life Guidelines (Accessed online August 2022)

SEQG - Saskatchewan Soil Quality Guidelines, Commercial Land Use, Coarse Grained Soils (Accessed online August 2022)

Exceeds Limit

Result LOR > Limit
Result LOR < Limit

Table 5 - Summary of Groundwater Results for BTEX, F1 - F2

Parameter	Units	MDL	CCME	SEQG	Sample ID, ALS ID, and Date		
					MW22-04	MW22-06	MW22-15
					3-Aug-22		
					EO2206195-001	EO2206195-002	EO2206195-003
Hydrocarbons							
F1 (C6-C10)	µg/L	100	-	2200	<100	<100	<100
F1-BTEX	µg/L	100	-	-	<100	<100	<100
F2 (C10-C16)	µg/L	100	-	1100	<100	<100	<100
Volatile Organic Compounds							
benzene	µg/L	0.5	370	5	<0.50	<0.50	<0.50
ethylbenzene	µg/L	0.5	90	140	<0.50	<0.50	<0.50
toluene	µg/L	0.5	2	21	<0.50	0.54	<0.50
xylenes, total	µg/L	0.5	-	90	<0.50	<0.50	<0.50

Notes:

ug/L - micrograms per litre

mg/L - milligrams per litre

uS/cm - microSiemens per centimetre

MDL - method detection limit

CCME - Canadian Council of Ministers of the Environment, Freshwater Aquatic Life Guidelines (Accessed online August 2022)

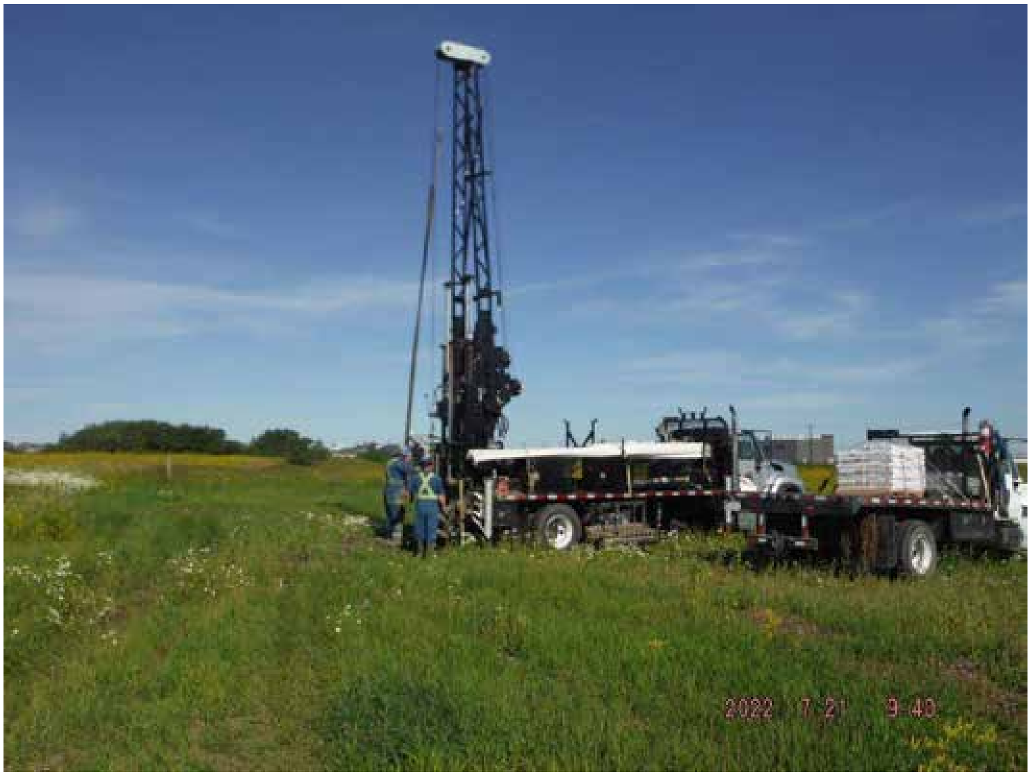
SEQG - Saskatchewan Soil Quality Guidelines, Commercial Land Use, Coarse Grained Soils (Accessed online August 2022)

🟥 Exceeds Limit
🟪 Result LOR > Limit
🟪 Result LOR < Limit

Appendix A

Photographs Taken During Field Activities

Photograph 1: Looking east during the drilling of BH22-02



Photograph 2: Looking west during the drilling of BH22-03

Photograph 3: Looking northwest at MW22-06

Photograph 4: Looking south at MW22-15

Appendix B

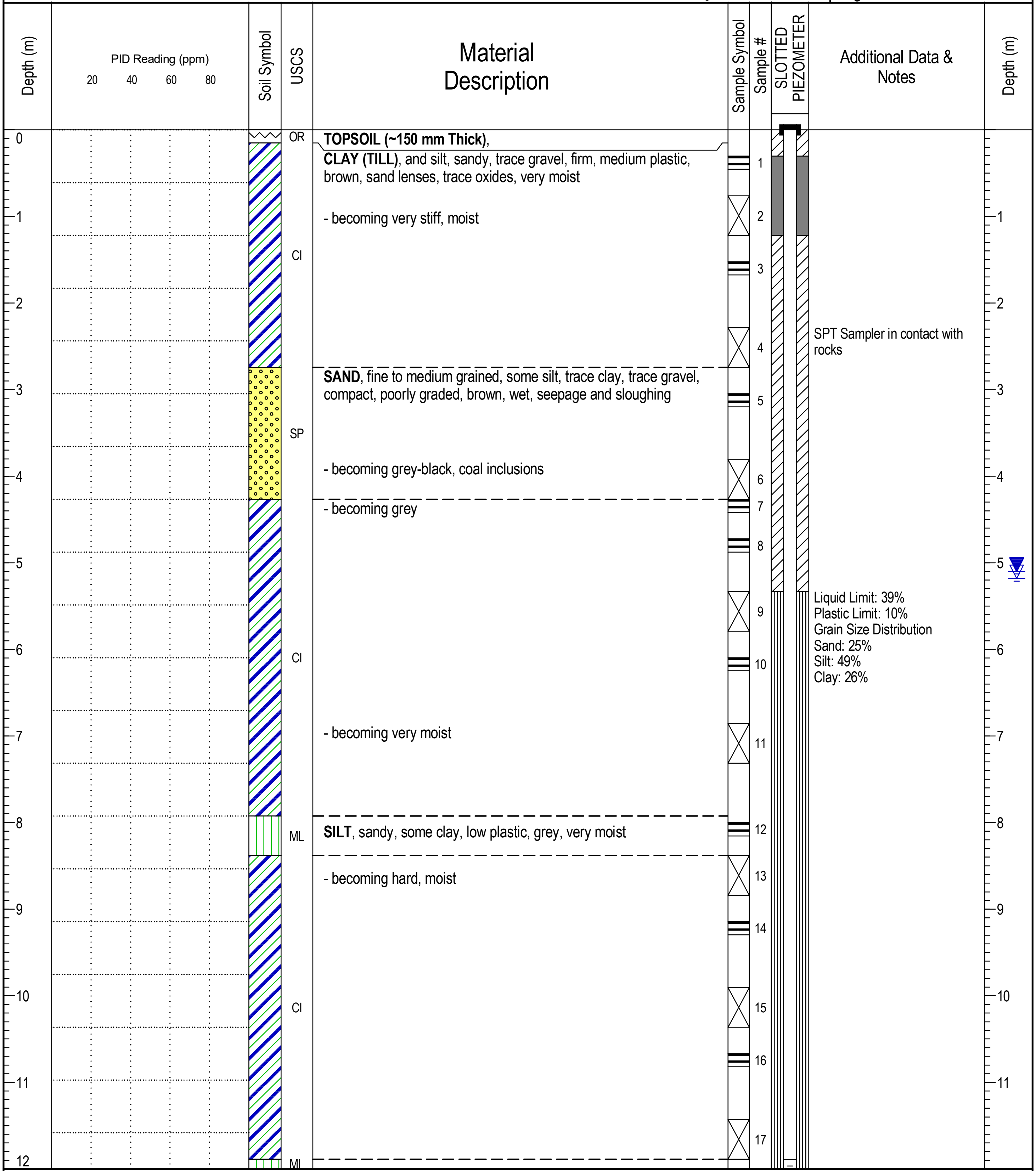
Borehole Logs
Explanation of Terms and Symbols

Project Name: Major Events Site - Arena Facility
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, SK
Northing: 5903229 Easting: 568422
Elevation:

Borehole #: **BH22-01**
Project #: PG21-1603.3000.1
Logged By: PJ / Reviewed By: KJ
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 22-7-21
Page 1 of 2



Material Description

TOPSOIL (~150 mm Thick),

CLAY (TILL), and silt, sandy, trace gravel, firm, medium plastic, brown, sand lenses, trace oxides, very moist

- becoming very stiff, moist

SAND, fine to medium grained, some silt, trace clay, trace gravel, compact, poorly graded, brown, wet, seepage and sloughing

- becoming grey-black, coal inclusions

- becoming grey

- becoming very moist

SILT, sandy, some clay, low plastic, grey, very moist

- becoming hard, moist

Additional Data & Notes

SPT Sampler in contact with rocks

Liquid Limit: 39%
Plastic Limit: 10%
Grain Size Distribution
Sand: 25%
Silt: 49%
Clay: 26%

Sample Symbol	■ Shelby Tube	◪ No Recovery	☒ SPT Test (N)	☰ Grab Sample	▥ Split-Pen	◧ Core
Backfill Symbol	■ Bentonite	⬚ Pea Gravel	▥ Slough	⁘ Grout	▨ Drill Cuttings	⁘ Sand

Project Name: Major Events Site - Arena Facility
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, SK
Northing: 5903229 Easting: 568422
Elevation:

Borehole #: **BH22-01**
Project #: PG21-1603.3000.1
Logged By: PJ / Reviewed By: KJ
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

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Completion Date: 22-7-21
Page 2 of 2

Depth (m)	PID Reading (ppm) 20 40 60 80	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SLOTTED PIEZOMETER	Additional Data & Notes	Depth (m)
12		▥	ML	- becoming some sand	☰	18	▥		
13		▨	CH	- becoming trace sand, high plastic, shale inclusions, very moist	☒	19	▥		13
14		▨			☰	20	▥		14
		▨			☒	21	▥		
15				**COMPLETION DEPTH: 14.9 m below ground surface** At Completion Accumulation of water at 5.2 m below ground surface. Borehole squeezed in at 5.3 m below ground surface. Slotted standpipe installed to 14.9 m below ground surface. Borehole backfilled with drill cuttings and a bentonite plug.				Water Level: 5.1 m below existing ground surface on 3 August 2022.	15
16									16
17									17
18									18
19									19
20									20
21									21
22									22
23									23
24									

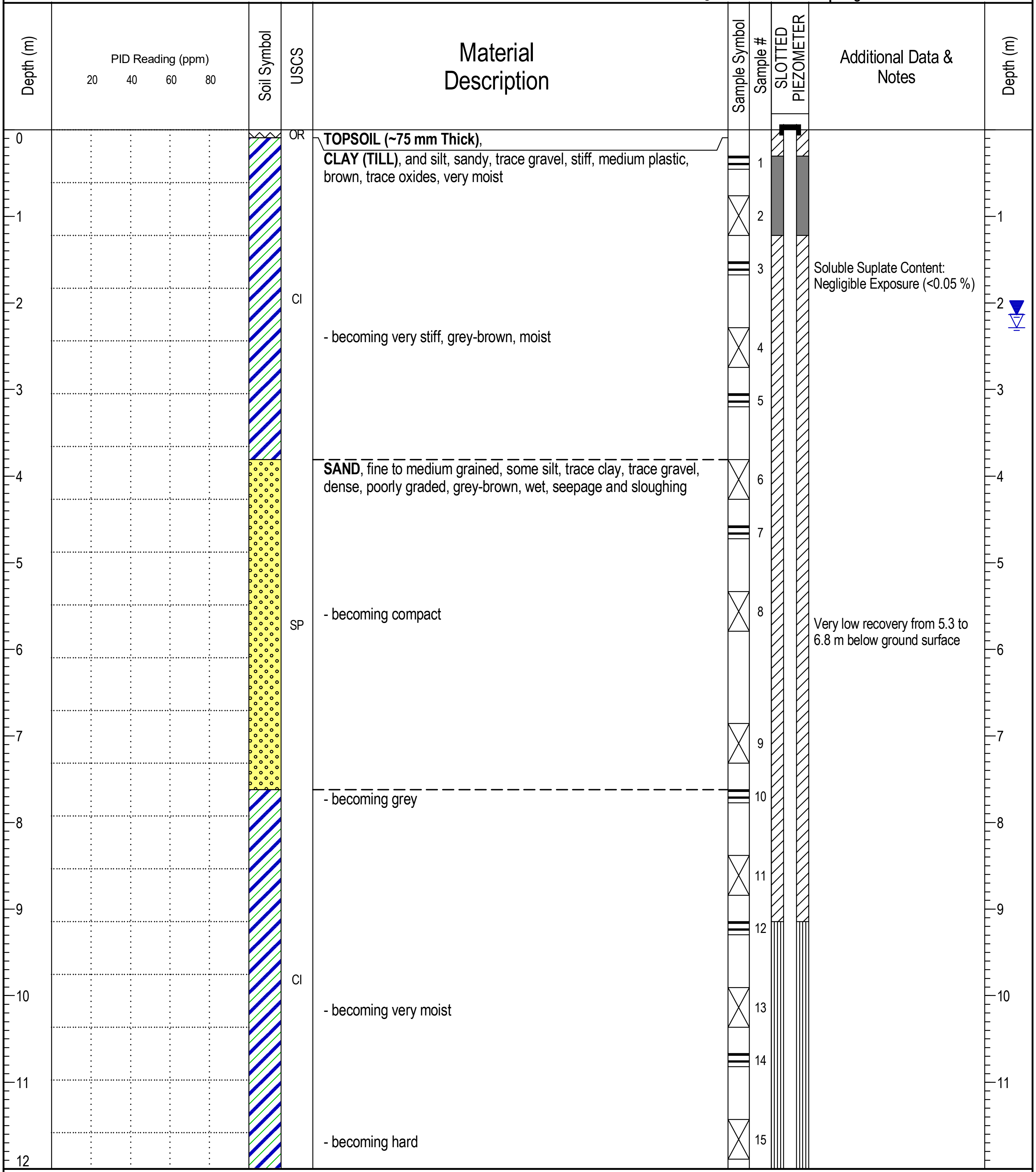
Sample Symbol	■ Shelby Tube	▱ No Recovery	☒ SPT Test (N)	☰ Grab Sample	▥ Split-Pen	◧ Core
Backfill Symbol	■ Bentonite	⁘ Pea Gravel	▥ Slough	⁘ Grout	▨ Drill Cuttings	⁘ Sand

Project Name: Major Events Site - Arena Facility
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, SK
Northing: 5903251 Easting: 568485
Elevation:

Borehole #: **BH22-02**
Project #: PG21-1603.3000.1
Logged By: PJ / Reviewed By: KJ
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 22-7-19
Page 1 of 2



Material Description | Additional Data & Notes

TOPSOIL (~75 mm Thick),

CLAY (TILL), and silt, sandy, trace gravel, stiff, medium plastic, brown, trace oxides, very moist

Soluble Suplate Content: Negligible Exposure (<0.05 %)

- becoming very stiff, grey-brown, moist

SAND, fine to medium grained, some silt, trace clay, trace gravel, dense, poorly graded, grey-brown, wet, seepage and sloughing

- becoming compact

Very low recovery from 5.3 to 6.8 m below ground surface

- becoming grey

- becoming very moist

- becoming hard

Sample Symbol	■ Shelby Tube	▱ No Recovery	☒ SPT Test (N)	☰ Grab Sample	▥ Split-Pen	▮ Core
Backfill Symbol	■ Bentonite	⬚ Pea Gravel	▥ Slough	⁘ Grout	▨ Drill Cuttings	⁘ Sand

Project Name: Major Events Site - Arena Facility
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, SK
Northing: 5903251 Easting: 568485
Elevation:

Borehole #: **BH22-02**
Project #: PG21-1603.3000.1
Logged By: PJ / Reviewed By: KJ
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

Completion Date: 22-7-19
Page 2 of 2

PID Reading (ppm): 20 40 60 80

Depth (m)	USCS	Material Description	Sample #	Additional Data & Notes
12	CI	- becoming moist	16	
		- sand band (coarse grained, ~150 mm thick)		
13			17	
	CH	- becoming trace sand, high plastic, shale inclusions	18	
14				
			19	
15			20	Liquid Limit: 69% Plastic Limit: 17%
16			21	
			22	
17				
	CS	**CLAY SHALE (BEDROCK)**, very weak, massive, some silt, trace sand, high plastic, highly weathered, grey, very moist	23	
18			24	
19			25	
20			26	
		- sandstone inclusions	27	
21		**COMPLETION DEPTH: 21.0 m below ground surface**		Water Level: 2.1 m below existing ground surface on 3 August 2022.
22				
23				
24				

At Completion
Accumulation of water at 2.3 m below ground surface.
Accumulation of slough at 9.1 m below ground surface.
Slotted standpipe installed to 20.4 m below ground surface.
Borehole backfilled with drill cuttings and a bentonite plug.

Sample Symbol: ■ Shelby Tube, ▨ No Recovery, ☒ SPT Test (N), ☰ Grab Sample, ▥ Split-Pen, ◧ Core

Backfill Symbol: ■ Bentonite, ⁘ Pea Gravel, ▥ Slough, ⁘ Grout, ▨ Drill Cuttings, ⁘ Sand

Project Name: Major Events Site - Arena Facility
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, SK
Northing: 5903194 Easting: 568466
Elevation:

Borehole #: **BH22-03**
Project #: PG21-1603.3000.1
Logged By: PJ / Reviewed By: KJ
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

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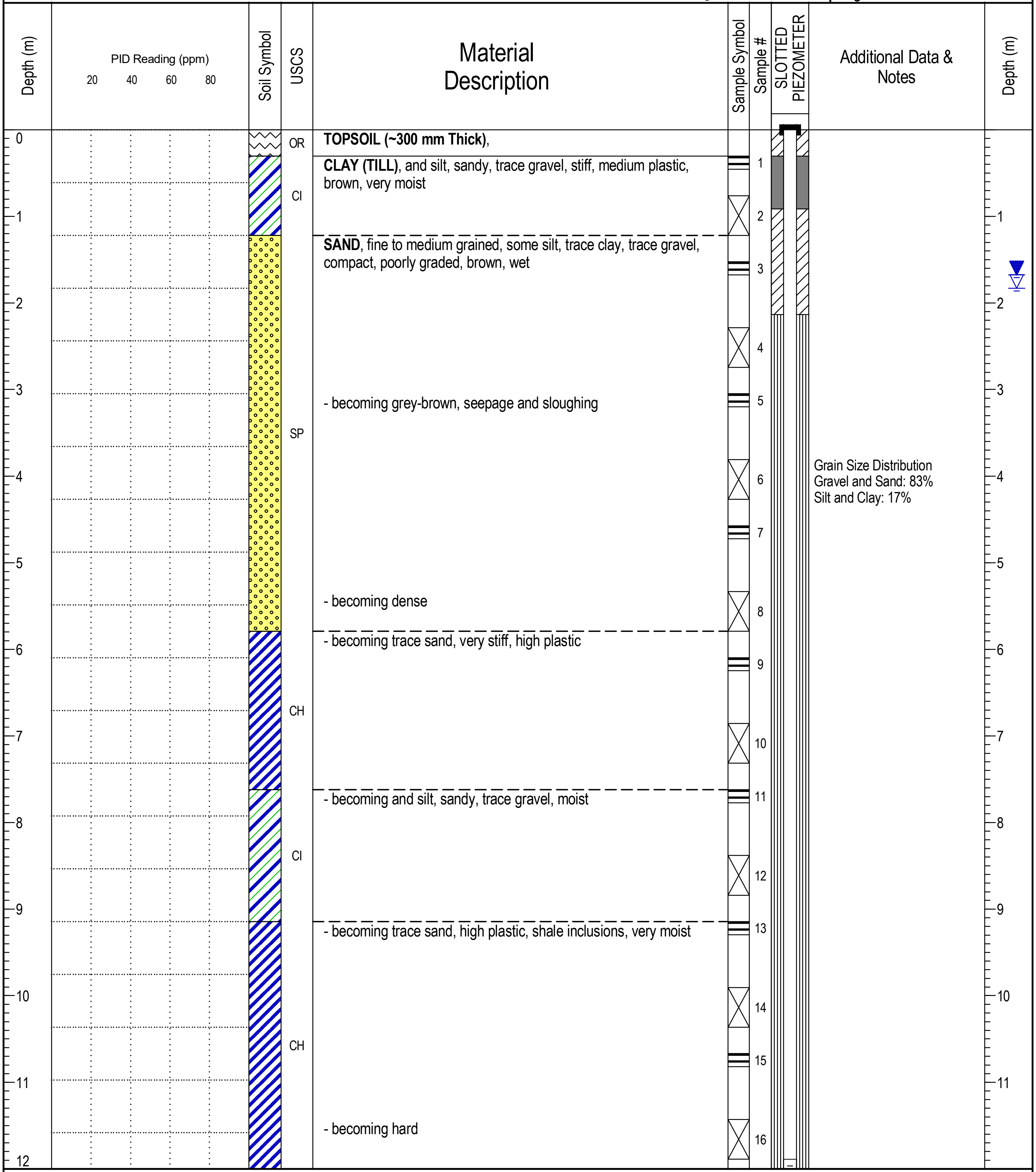
Completion Date: 22-7-21
Page 1 of 2



USCS	Material Description	Additional Data & Notes
OR	**TOPSOIL (~300 mm Thick)**,	
CI	**CLAY (TILL)**, and silt, sandy, trace gravel, stiff, medium plastic, brown, very moist	
SP	**SAND**, fine to medium grained, some silt, trace clay, trace gravel, compact, poorly graded, brown, wet - becoming grey-brown, seepage and sloughing - becoming dense	Grain Size Distribution Gravel and Sand: 83% Silt and Clay: 17%
CH	- becoming trace sand, very stiff, high plastic	
CI	- becoming and silt, sandy, trace gravel, moist	
CH	- becoming trace sand, high plastic, shale inclusions, very moist - becoming hard	

Sample Symbol: ■ Shelby Tube ☐ No Recovery ☒ SPT Test (N) ☰ Grab Sample ▥ Split-Pen ▌ Core

Backfill Symbol: ■ Bentonite ⬚ Pea Gravel ▥ Slough ⁘ Grout ▨ Drill Cuttings ⁘ Sand

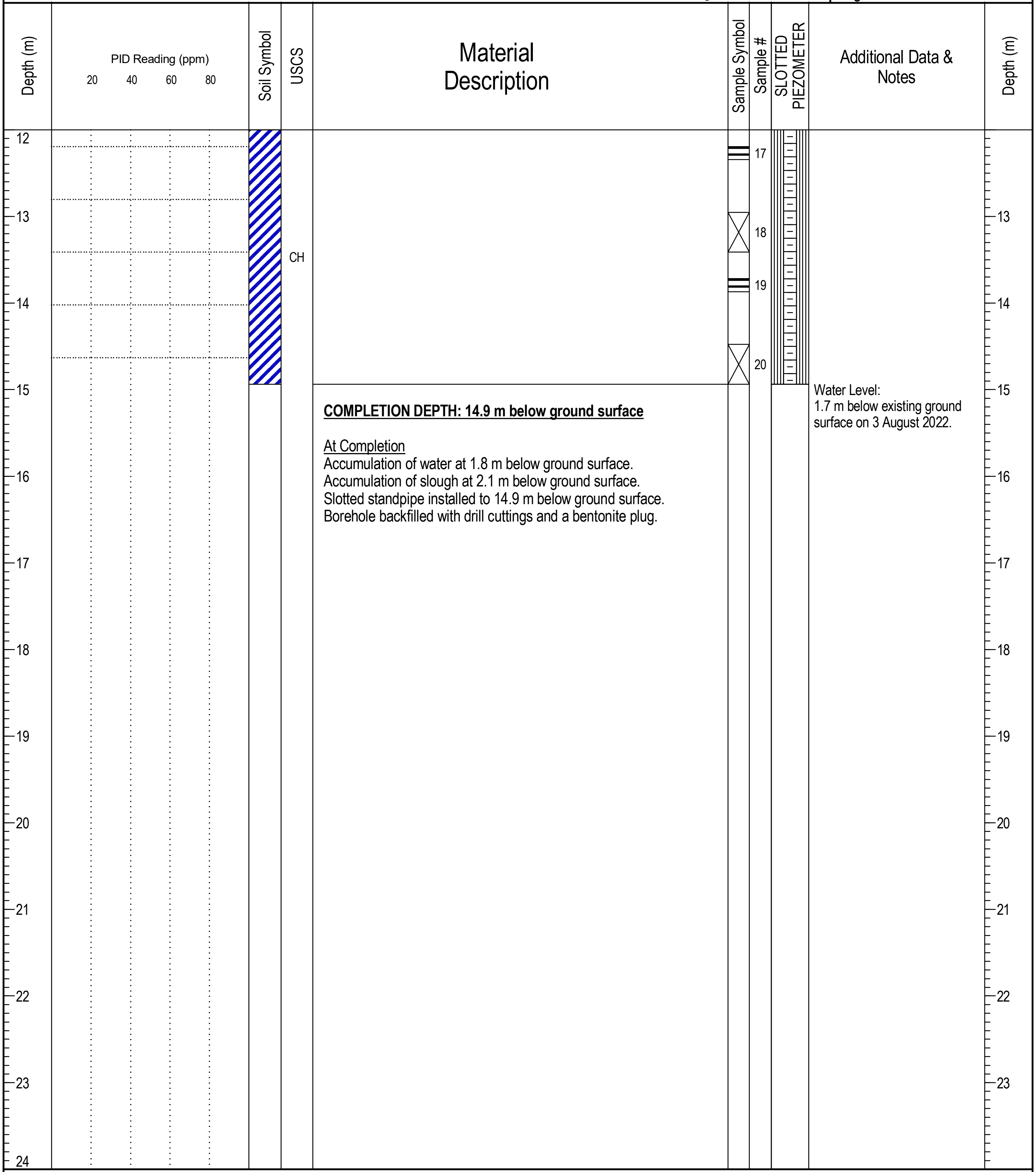
Z:\PROJECTS\GEOTECHNICAL PROJECTS\2021\PG21-1603-COL MAJOR EVENTS ARENA\PHASE 3000-DETAILED GEOTECHNICAL\3000.1 ARENA FACILITY\PG21-1603.3000.1 MAJOR EVENTS SITE-ARENA FACILITY.GPJ 22-08-22 01:06 PM (SEG-ENV-FINAL)

Project Name: Major Events Site - Arena Facility
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, SK
Northing: 5903194 Easting: 568466
Elevation:

Borehole #: **BH22-03**
Project #: PG21-1603.3000.1
Logged By: PJ / Reviewed By: KJ
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 22-7-21
Page 2 of 2



COMPLETION DEPTH: 14.9 m below ground surface

At Completion
Accumulation of water at 1.8 m below ground surface.
Accumulation of slough at 2.1 m below ground surface.
Slotted standpipe installed to 14.9 m below ground surface.
Borehole backfilled with drill cuttings and a bentonite plug.

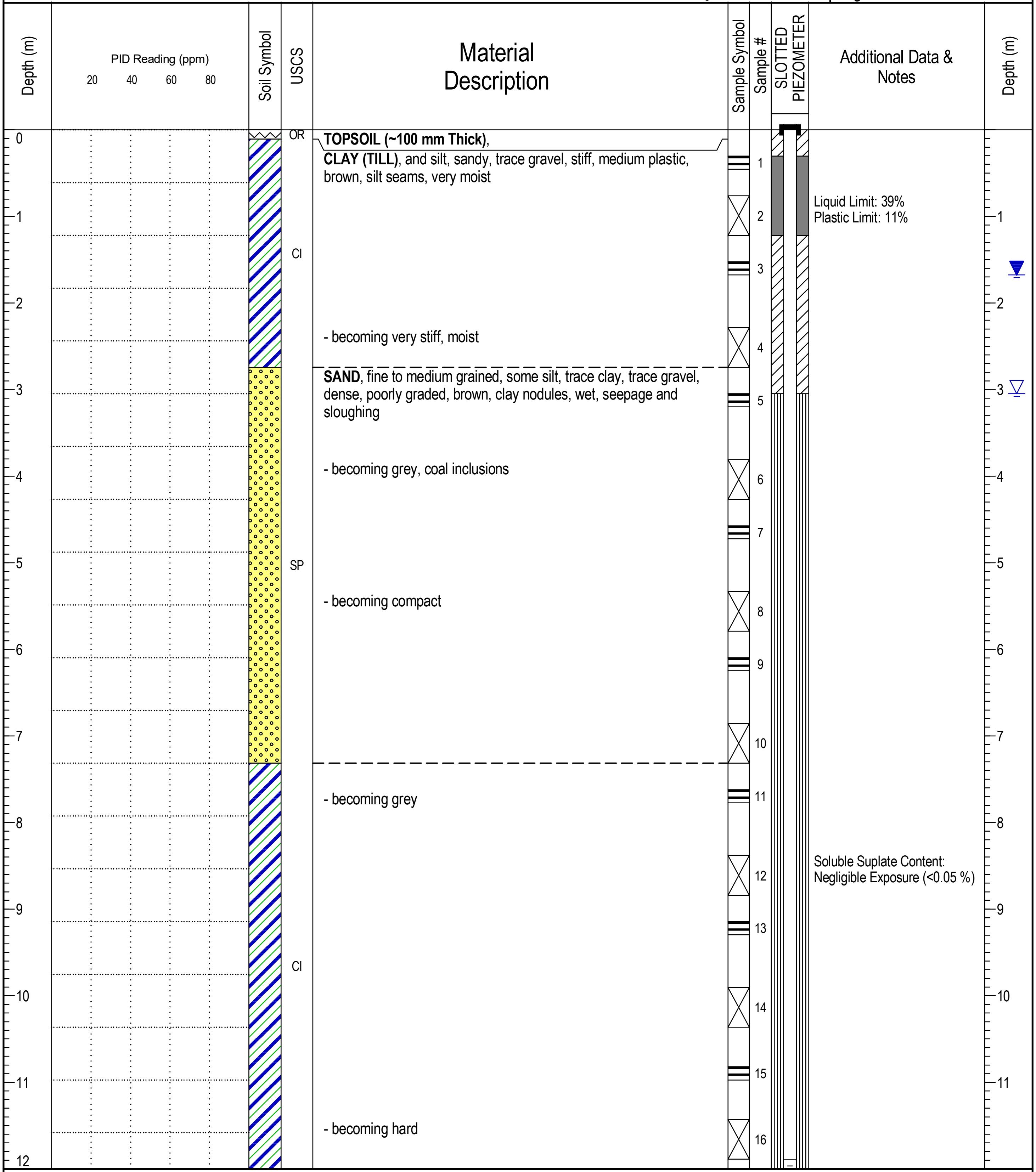
Water Level:
1.7 m below existing ground surface on 3 August 2022.

Sample Symbol	■ Shelby Tube	◿ No Recovery	☒ SPT Test (N)	☰ Grab Sample	▥ Split-Pen	◧ Core
Backfill Symbol	▩ Bentonite	⁙ Pea Gravel	▥ Slough	⁘ Grout	▨ Drill Cuttings	⁙ Sand

Project Name: Major Events Site - Arena Facility
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, SK
Northing: 5903170 Easting: 568514
Elevation:

Borehole #: **BH22-04**
Project #: PG21-1603.3000.1
Logged By: PJ / Reviewed By: KJ
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

Completion Date: 22-7-20
Page 1 of 2



TOPSOIL (~100 mm Thick),

CLAY (TILL), and silt, sandy, trace gravel, stiff, medium plastic, brown, silt seams, very moist

- becoming very stiff, moist

SAND, fine to medium grained, some silt, trace clay, trace gravel, dense, poorly graded, brown, clay nodules, wet, seepage and sloughing

- becoming grey, coal inclusions

- becoming compact

- becoming grey

- becoming hard

Liquid Limit: 39%
Plastic Limit: 11%

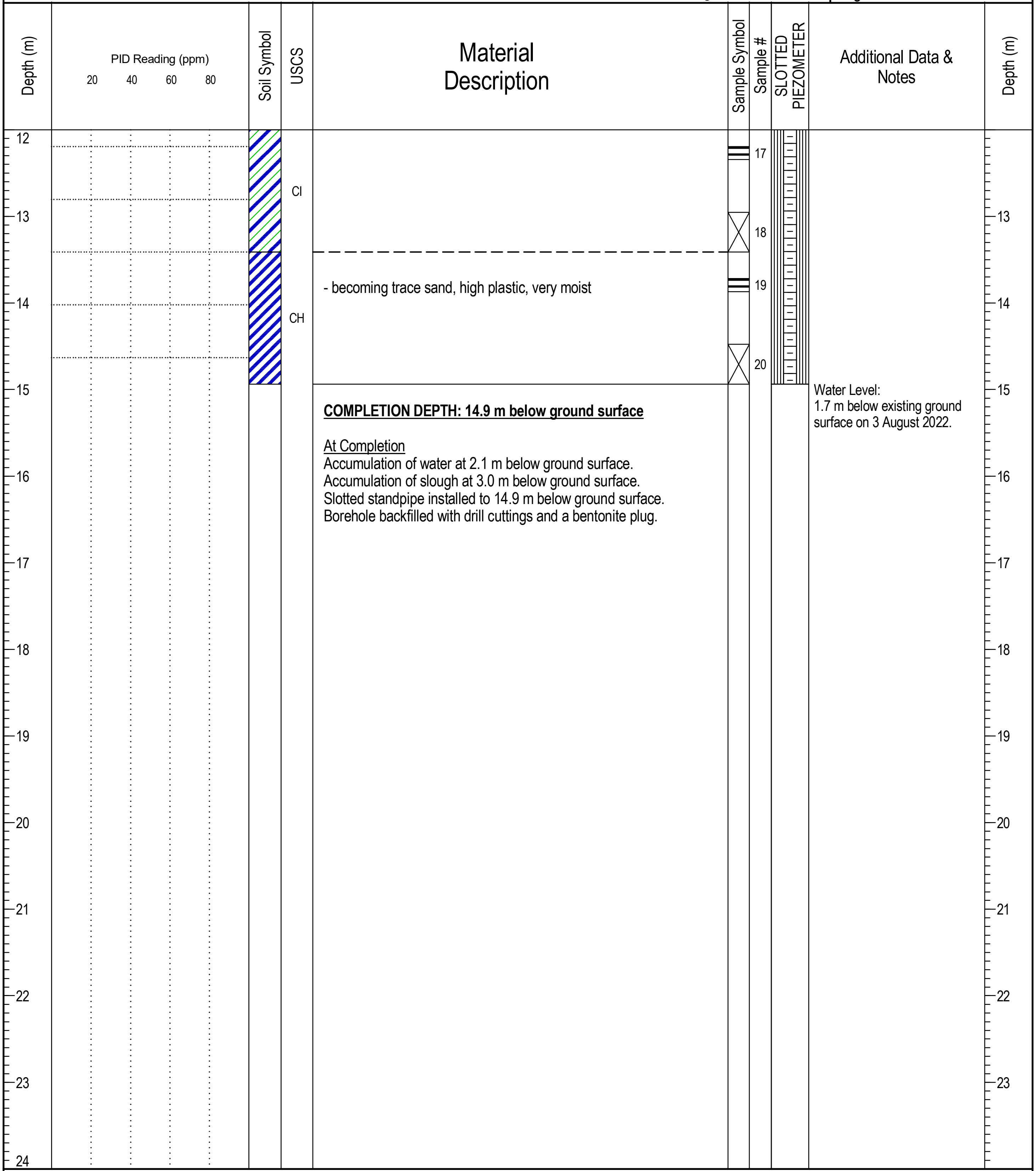
Soluble Suplate Content:
Negligible Exposure (<0.05 %)

Sample Symbol	■ Shelby Tube	▨ No Recovery	☒ SPT Test (N)	☰ Grab Sample	▥ Split-Pen	▮ Core
Backfill Symbol	■ Bentonite	⁚ Pea Gravel	▥ Slough	⁘ Grout	▨ Drill Cuttings	⁘ Sand

Project Name: Major Events Site - Arena Facility
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, SK
Northing: 5903170 Easting: 568514
Elevation:

Borehole #: **BH22-04**
Project #: PG21-1603.3000.1
Logged By: PJ / Reviewed By: KJ
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

Completion Date: 22-7-20
Page 2 of 2



Material Description

- becoming trace sand, high plastic, very moist

COMPLETION DEPTH: 14.9 m below ground surface

At Completion
Accumulation of water at 2.1 m below ground surface.
Accumulation of slough at 3.0 m below ground surface.
Slotted standpipe installed to 14.9 m below ground surface.
Borehole backfilled with drill cuttings and a bentonite plug.

Additional Data & Notes

Water Level:
1.7 m below existing ground surface on 3 August 2022.

Sample Symbol	■ Shelby Tube	▨ No Recovery	☒ SPT Test (N)	☰ Grab Sample	▥ Split-Pen	▌ Core
Backfill Symbol	■ Bentonite	⁚ Pea Gravel	▥ Slough	⁘ Grout	▨ Drill Cuttings	⁘ Sand

Project Name: Major Events Site - Arena Facility
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, SK
Northing: 5903150 Easting: 568444
Elevation:

Borehole #: **BH22-05**
Project #: PG21-1603.3000.1
Logged By: PJ / Reviewed By: KJ
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

Completion Date: 22-7-20
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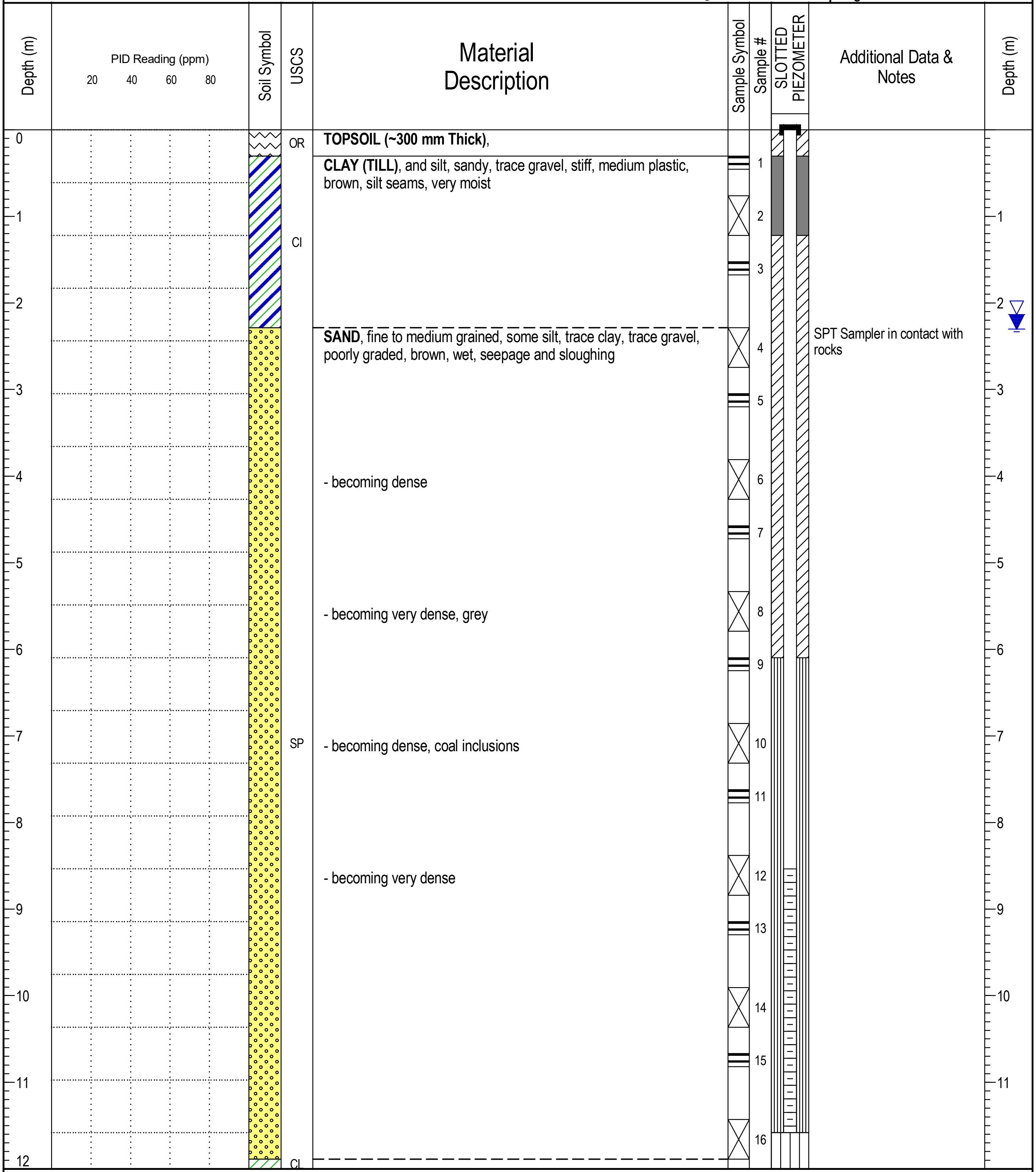

USCS	Material Description	Additional Data & Notes
OR	**TOPSOIL (~300 mm Thick)**,	
CI	**CLAY (TILL)**, and silt, sandy, trace gravel, stiff, medium plastic, brown, silt seams, very moist	
SP	**SAND**, fine to medium grained, some silt, trace clay, trace gravel, poorly graded, brown, wet, seepage and sloughing	SPT Sampler in contact with rocks
	- becoming dense	
	- becoming very dense, grey	
	- becoming dense, coal inclusions	
	- becoming very dense	
CI		

Sample Symbol	■ Shelby Tube	◸ No Recovery	☒ SPT Test (N)	☰ Grab Sample	▥ Split-Pen	◨ Core
Backfill Symbol	■ Bentonite	⁚ Pea Gravel	▥ Slough	⁘ Grout	▨ Drill Cuttings	⁘ Sand

Project Name: Major Events Site - Arena Facility	Borehole #: **BH22-05**
Client Name: City of Lloydminster	Project #: PG21-1603.3000.1
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, SK	Logged By: PJ / Reviewed By: KJ
Northing: 5903150 Easting: 568444	Driller: All Service Drilling Ltd.
Elevation:	Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 22-7-20

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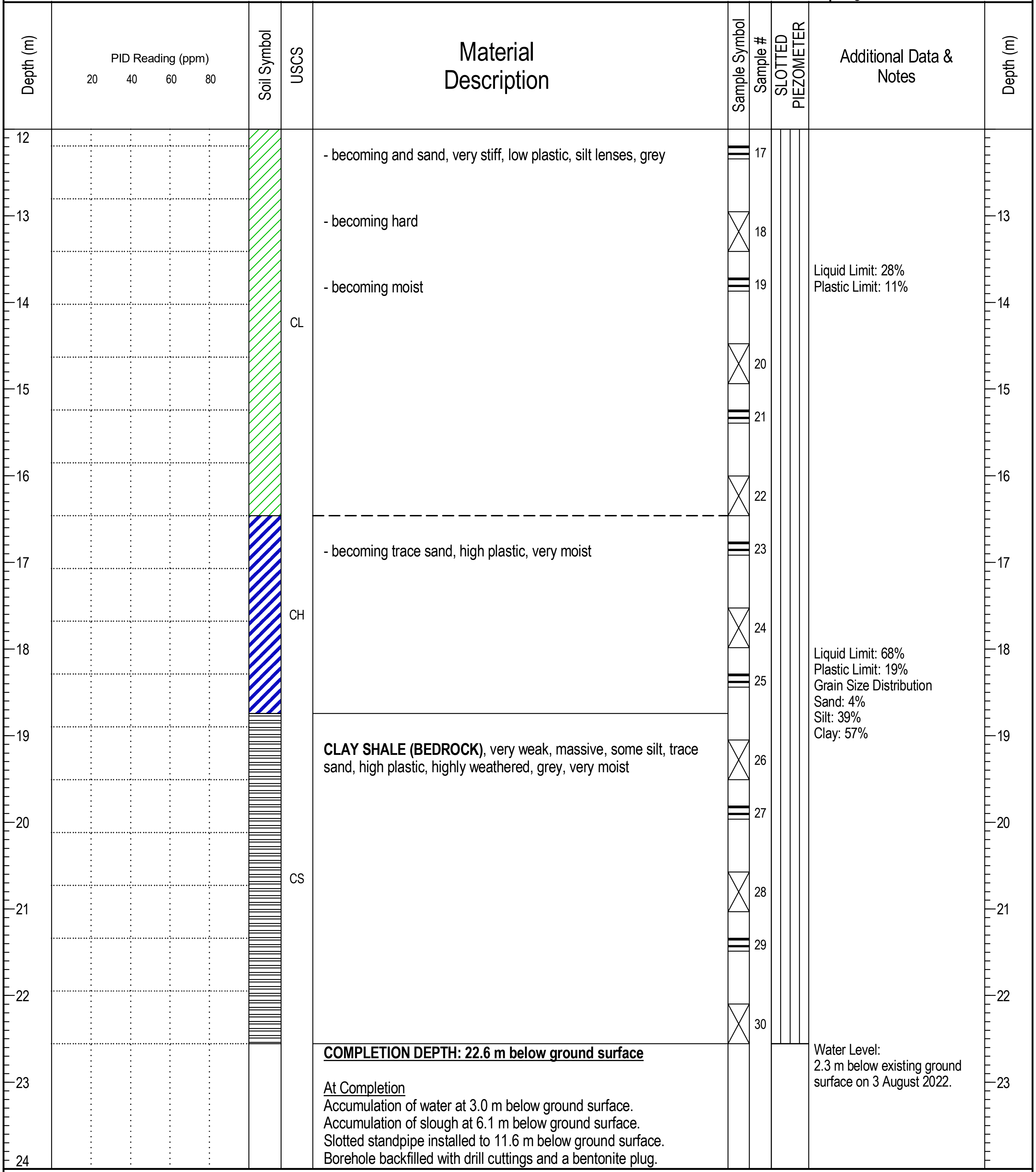

Material Description

Depth (m)	USCS	Material Description	Sample #	Additional Data & Notes
12	CL	- becoming and sand, very stiff, low plastic, silt lenses, grey	17	
13		- becoming hard	18	
14		- becoming moist	19	Liquid Limit: 28% Plastic Limit: 11%
15			20 21	
16			22	
17	CH	- becoming trace sand, high plastic, very moist	23 24	
18			25	Liquid Limit: 68% Plastic Limit: 19% Grain Size Distribution Sand: 4% Silt: 39% Clay: 57%
19	CS	**CLAY SHALE (BEDROCK)**, very weak, massive, some silt, trace sand, high plastic, highly weathered, grey, very moist	26	
20			27	
21			28 29	
22			30	
22.6		**COMPLETION DEPTH: 22.6 m below ground surface**		Water Level: 2.3 m below existing ground surface on 3 August 2022.

At Completion
Accumulation of water at 3.0 m below ground surface.
Accumulation of slough at 6.1 m below ground surface.
Slotted standpipe installed to 11.6 m below ground surface.
Borehole backfilled with drill cuttings and a bentonite plug.

Sample Symbol	■ Shelby Tube	▨ No Recovery	☒ SPT Test (N)	☰ Grab Sample	▥ Split-Pen	◧ Core
Backfill Symbol	■ Bentonite	⬚ Pea Gravel	▥ Slough	⁘ Grout	▨ Drill Cuttings	⁘ Sand

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Project Name: Major Events Site - Hotel Building and CRU's
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, SK
Northing: 5903283 Easting: 568381
Elevation:

Borehole #: **BH22-06**
Project #: PG21-1603.3000.2
Logged By: PJ / Reviewed By: KJ
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL
Completion Date: 22-7-21
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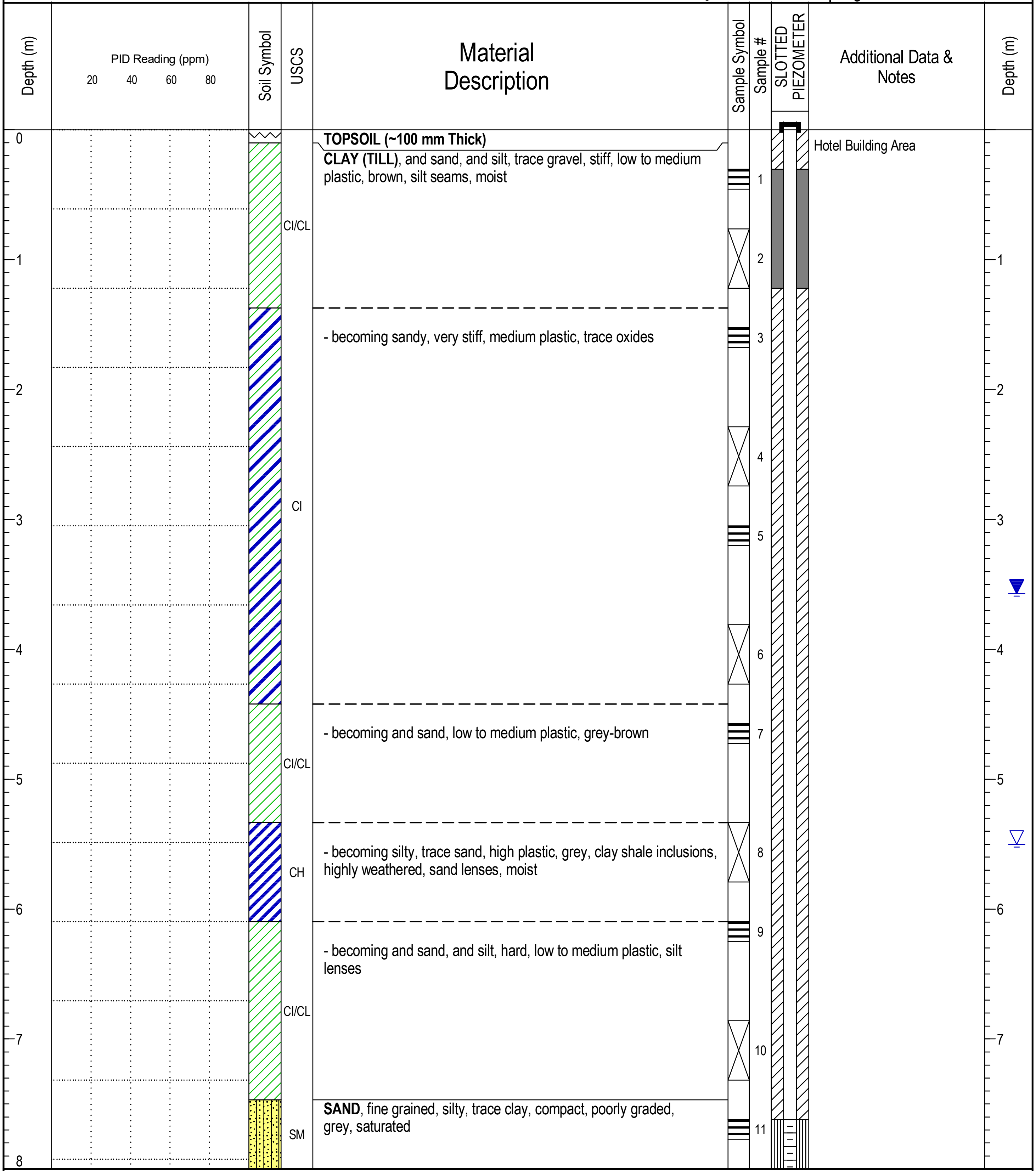


Material Description

TOPSOIL (~100 mm Thick)

CLAY (TILL), and sand, and silt, trace gravel, stiff, low to medium plastic, brown, silt seams, moist

- becoming sandy, very stiff, medium plastic, trace oxides

- becoming and sand, low to medium plastic, grey-brown

- becoming silty, trace sand, high plastic, grey, clay shale inclusions, highly weathered, sand lenses, moist

- becoming and sand, and silt, hard, low to medium plastic, silt lenses

SAND, fine grained, silty, trace clay, compact, poorly graded, grey, saturated

Additional Data & Notes

Hotel Building Area

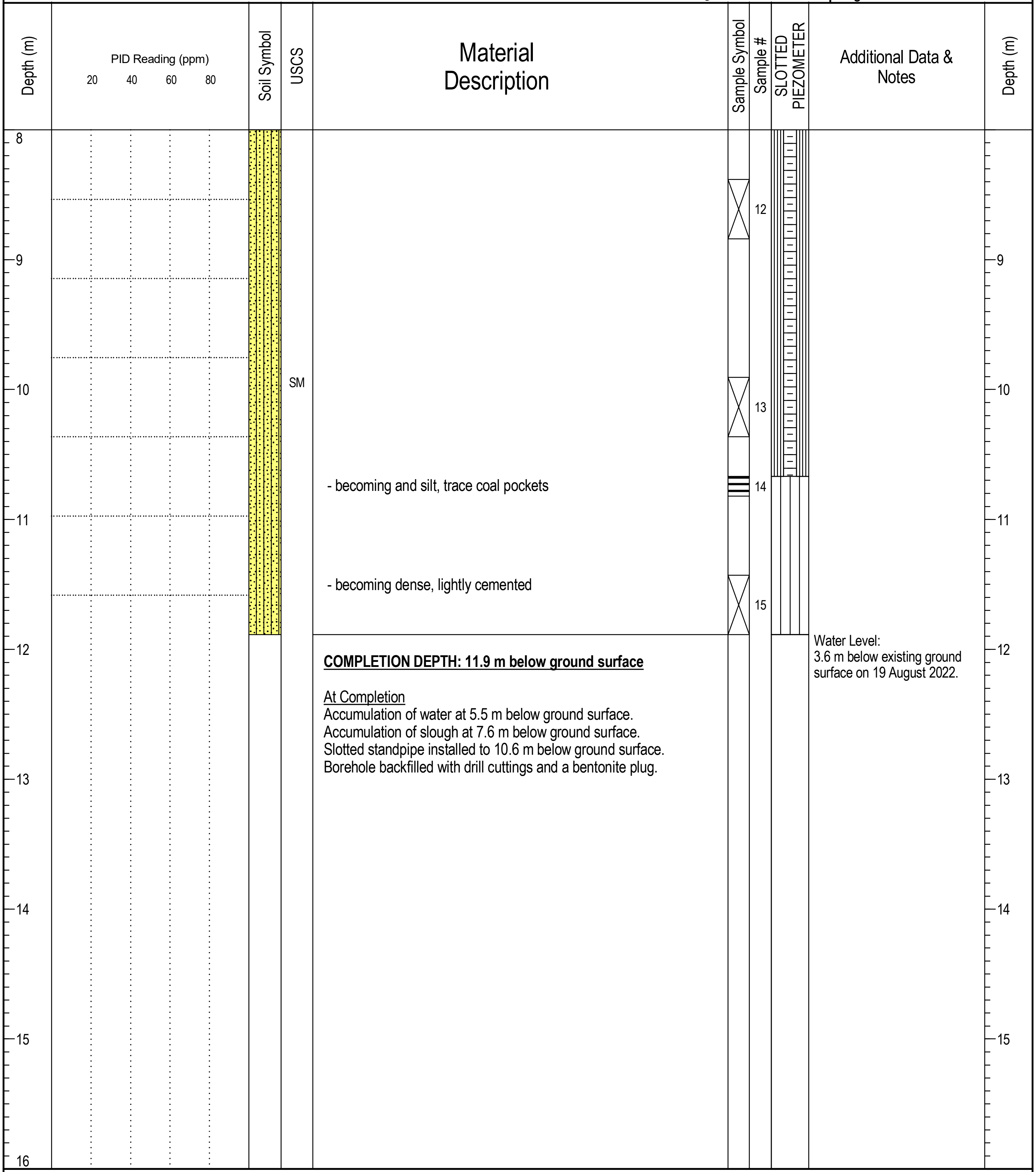
Sample Symbol ■ Shelby Tube ◸ No Recovery ☒ SPT Test (N) ☰ Grab Sample ▥ Split-Pen ◨ Core

Backfill Symbol ■ Bentonite ⬚ Pea Gravel ▥ Slough ⁘ Grout ▨ Drill Cuttings ⁙ Sand

Project Name: Major Events Site - Hotel Building and CRU's
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, SK
Northing: 5903283 Easting: 568381
Elevation:

Borehole #: **BH22-06**
Project #: PG21-1603.3000.2
Logged By: PJ / Reviewed By: KJ
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

Completion Date: 22-7-21
Page 2 of 2



Material Description

- becoming and silt, trace coal pockets

- becoming dense, lightly cemented

COMPLETION DEPTH: 11.9 m below ground surface

At Completion
Accumulation of water at 5.5 m below ground surface.
Accumulation of slough at 7.6 m below ground surface.
Slotted standpipe installed to 10.6 m below ground surface.
Borehole backfilled with drill cuttings and a bentonite plug.

Additional Data & Notes

Water Level:
3.6 m below existing ground surface on 19 August 2022.

Sample Symbol	■ Shelby Tube	▨ No Recovery	☒ SPT Test (N)	☰ Grab Sample	▥ Split-Pen	◧ Core
Backfill Symbol	■ Bentonite	⁙ Pea Gravel	▥ Slough	⁙ Grout	▨ Drill Cuttings	⁙ Sand

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Project Name: Major Events Site - Hotel Building and CRU's
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, SK
Northing: 5903289 Easting: 568338
Elevation:

Borehole #: **BH22-07**
Project #: PG21-1603.3000.2
Logged By: PJ / Reviewed By: KJ
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 22-7-22
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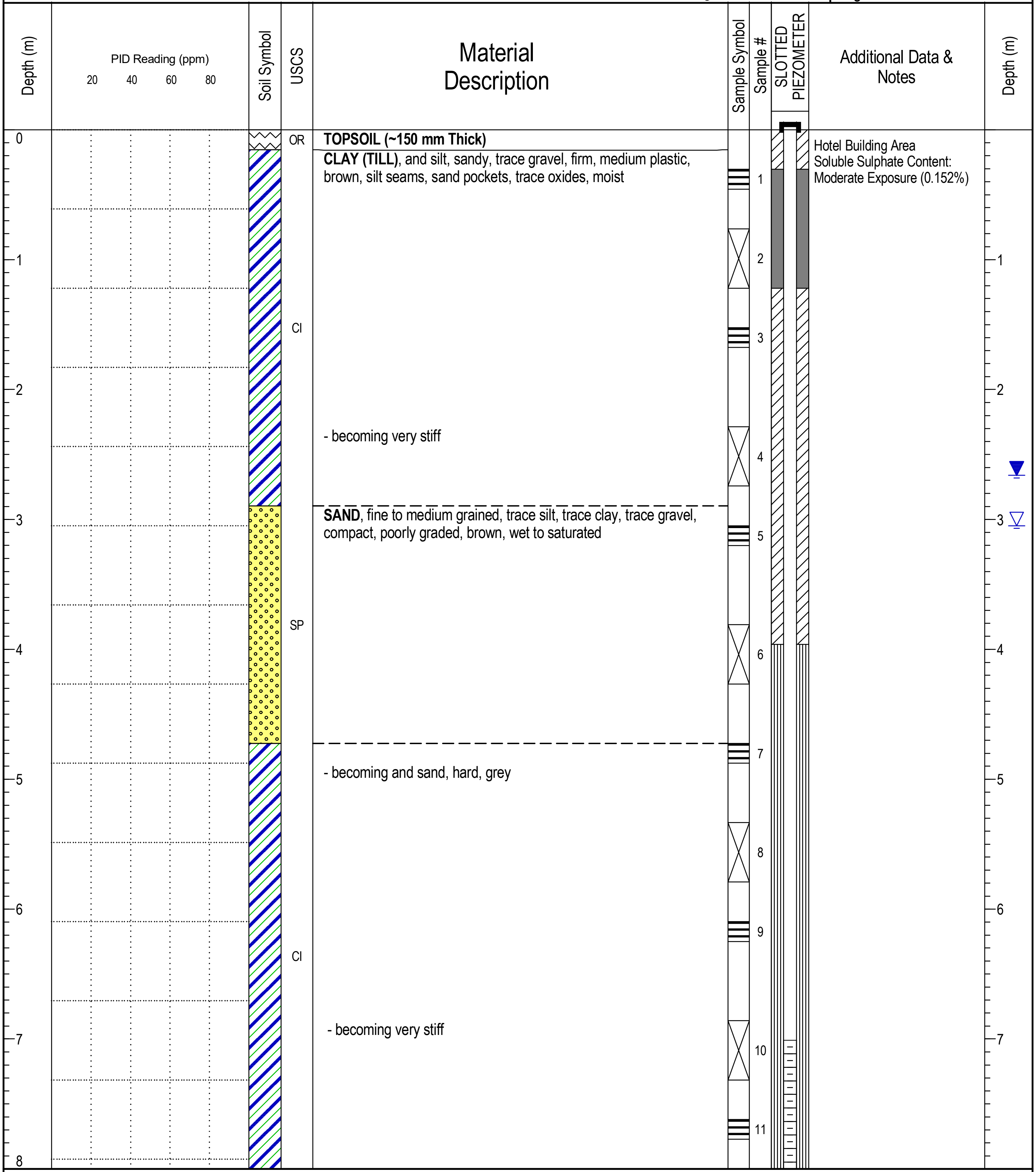

Material Description

TOPSOIL (~150 mm Thick)

CLAY (TILL), and silt, sandy, trace gravel, firm, medium plastic, brown, silt seams, sand pockets, trace oxides, moist

- becoming very stiff

SAND, fine to medium grained, trace silt, trace clay, trace gravel, compact, poorly graded, brown, wet to saturated

- becoming and sand, hard, grey

- becoming very stiff

Additional Data & Notes

Hotel Building Area
Soluble Sulphate Content: Moderate Exposure (0.152%)

Sample Symbol	■ Shelby Tube	◿ No Recovery	☒ SPT Test (N)	☰ Grab Sample	▥ Split-Pen	◧ Core
Backfill Symbol	■ Bentonite	⁚ Pea Gravel	▥ Slough	⁙ Grout	▨ Drill Cuttings	⁙ Sand

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Project Name: Major Events Site - Hotel Building and CRU's
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, SK
Northing: 5903289 Easting: 568338
Elevation:

Borehole #: **BH22-07**
Project #: PG21-1603.3000.2
Logged By: PJ / Reviewed By: KJ
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 22-7-22
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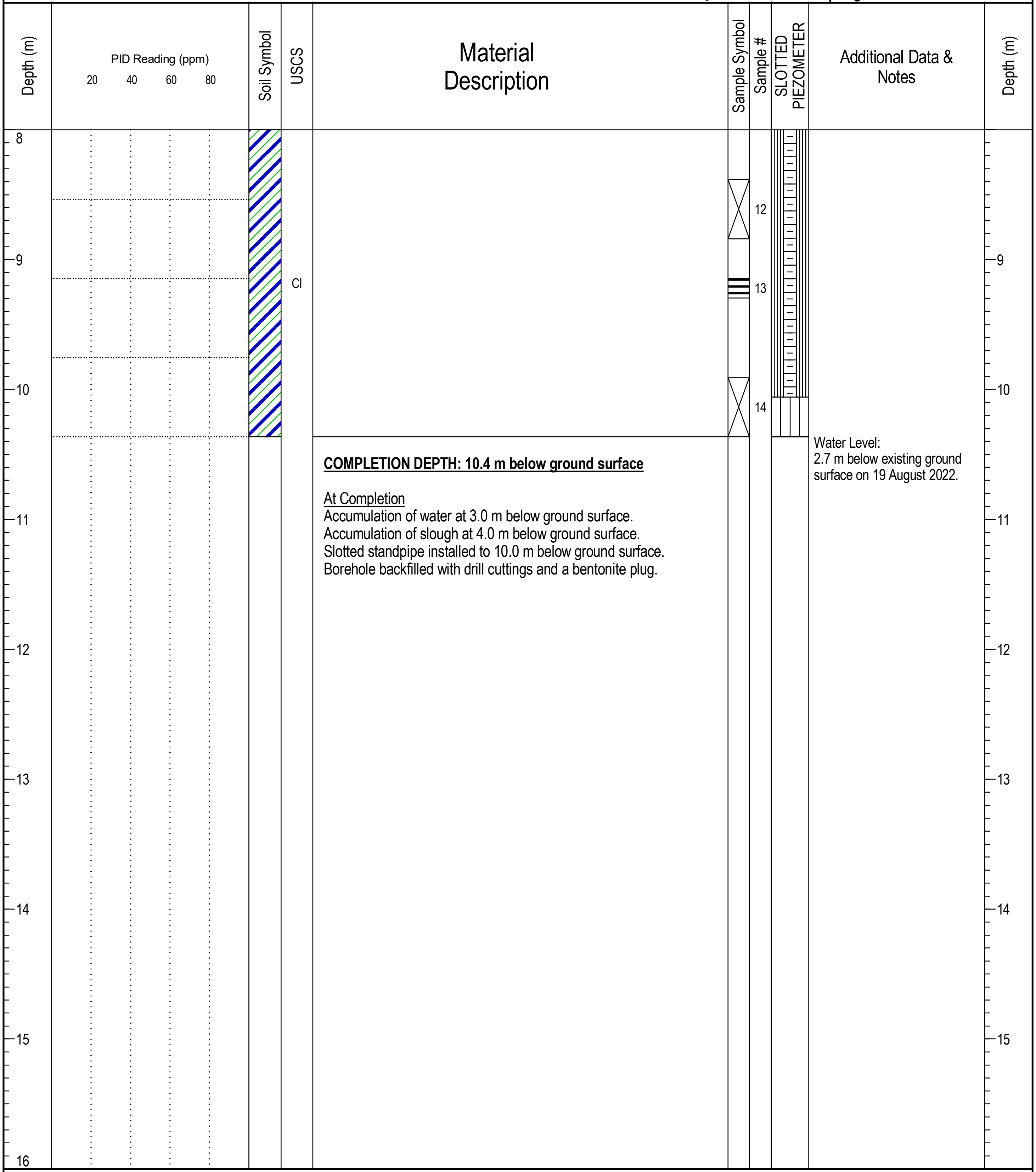

COMPLETION DEPTH: 10.4 m below ground surface

At Completion
Accumulation of water at 3.0 m below ground surface.
Accumulation of slough at 4.0 m below ground surface.
Slotted standpipe installed to 10.0 m below ground surface.
Borehole backfilled with drill cuttings and a bentonite plug.

Water Level:
2.7 m below existing ground surface on 19 August 2022.

Sample Symbol	■ Shelby Tube	▨ No Recovery	☒ SPT Test (N)	☰ Grab Sample	▥ Split-Pen	◧ Core
Backfill Symbol	■ Bentonite	⬚ Pea Gravel	▥ Slough	⁘ Grout	▨ Drill Cuttings	⁘ Sand

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Project Name: Major Events Site - Roadways and Utilities
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, SK
Northing: 5903001 Easting: 568249
Elevation:

Borehole #: **BH22-15**
Project #: PG21-1603.3000
Logged By: PJ / Reviewed By: KJ
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL
Completion Date: 22-7-22
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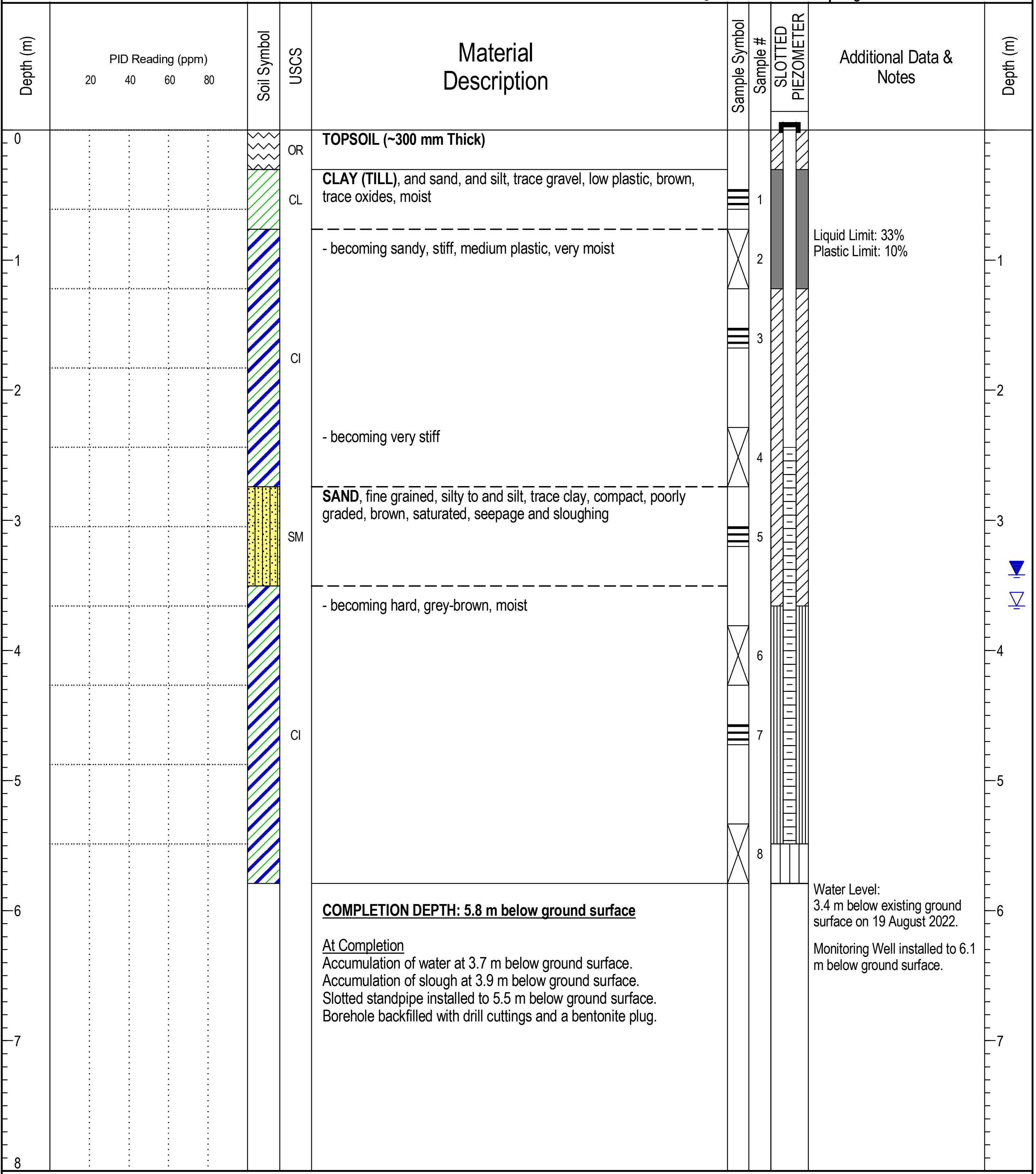

Material Description

TOPSOIL (~300 mm Thick)

CLAY (TILL), and sand, and silt, trace gravel, low plastic, brown, trace oxides, moist

- becoming sandy, stiff, medium plastic, very moist

- becoming very stiff

SAND, fine grained, silty to and silt, trace clay, compact, poorly graded, brown, saturated, seepage and sloughing

- becoming hard, grey-brown, moist

COMPLETION DEPTH: 5.8 m below ground surface

At Completion
Accumulation of water at 3.7 m below ground surface.
Accumulation of slough at 3.9 m below ground surface.
Slotted standpipe installed to 5.5 m below ground surface.
Borehole backfilled with drill cuttings and a bentonite plug.

Additional Data & Notes

Liquid Limit: 33%
Plastic Limit: 10%

Water Level:
3.4 m below existing ground surface on 19 August 2022.

Monitoring Well installed to 6.1 m below ground surface.

Sample Symbol: ■ Shelby Tube, ◪ No Recovery, ☒ SPT Test (N), ☰ Grab Sample, ▥ Split-Pen, ▮ Core

Backfill Symbol: ■ Bentonite, ⬚ Pea Gravel, ▥ Slough, ⬚ Grout, ▨ Drill Cuttings, ⬚ Sand

Project Name: Major Events Site - Roadways and Utilities
Client Name: City of Lloydminster
Site: Southeast of 41 Street and 40 Avenue, Lloydminster, SK
Northing: 5902871 Easting: 568432
Elevation:

Borehole #: **BH22-17**
Project #: PG21-1603.3000
Logged By: PJ / Reviewed By: KJ
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

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Completion Date: 22-7-19
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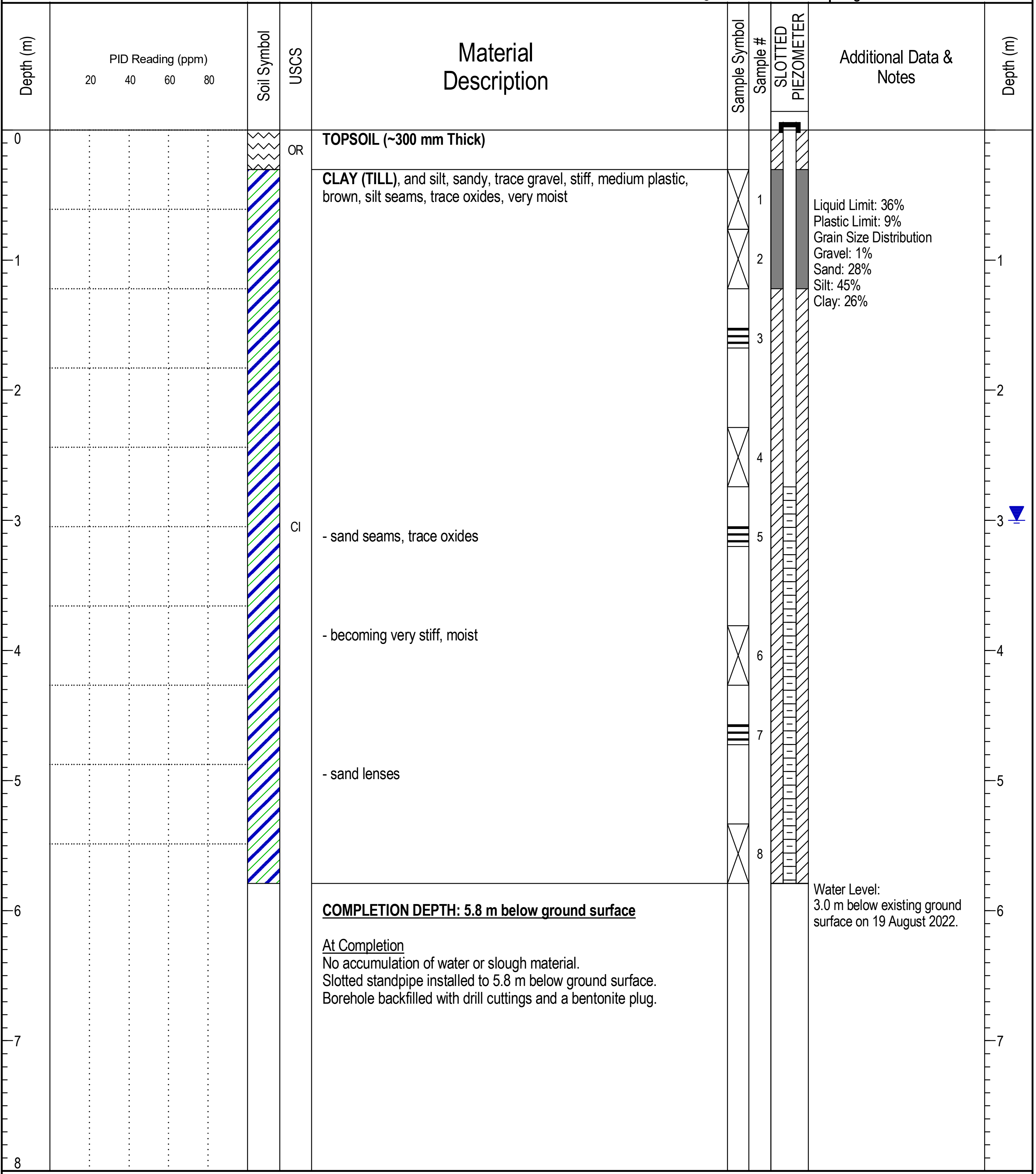

Material Description

TOPSOIL (~300 mm Thick)

CLAY (TILL), and silt, sandy, trace gravel, stiff, medium plastic, brown, silt seams, trace oxides, very moist

- sand seams, trace oxides

- becoming very stiff, moist

- sand lenses

COMPLETION DEPTH: 5.8 m below ground surface

At Completion
No accumulation of water or slough material.
Slotted standpipe installed to 5.8 m below ground surface.
Borehole backfilled with drill cuttings and a bentonite plug.

Additional Data & Notes

Liquid Limit: 36%
Plastic Limit: 9%
Grain Size Distribution
Gravel: 1%
Sand: 28%
Silt: 45%
Clay: 26%

Water Level:
3.0 m below existing ground surface on 19 August 2022.

Sample Symbol	■ Shelby Tube	◺ No Recovery	☒ SPT Test (N)	☰ Grab Sample	▥ Split-Pen	◧ Core
Backfill Symbol	■ Bentonite	⬚ Pea Gravel	▥ Slough	⁘ Grout	▨ Drill Cuttings	⁘ Sand

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SolidEarth Geotechnical Inc.
www.solidearth.ca

EXPLANATION OF TERMS & SYMBOLS

The terms and symbols used on the borehole logs to summarize the results of the field investigation and laboratory testing are described on the following two pages.

1. VISUAL TEXTURAL CLASSIFICATION ON MINERAL SOILS

CLASSIFICATION	APPARENT PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	> 200 mm	> 200 mm
Cobbles	75 mm to 200 mm	75 mm to 200 mm
Gravel	4.75 mm to 75 mm	5 mm to 75 mm
Sand	0.075 mm to 4.75 mm	Visible particles to 5 mm
Silt	0.002 mm to 0.075 mm	Non-plastic particles, not visible to naked eye
Clay	< 0.002 mm	Plastic particles, not visible to naked eye

2. TERMS FOR CONSISTENCY & DENSITY OF SOILS

Cohesionless Soils

DESCRIPTIVE TERM	APPROXIMATE SPT "N" VALUE
Very Dense	> 50
Dense	30 to 50
Compact	10 to 30
Loose	4 to 10
Very Loose	< 4

Cohesive Soils

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH	APPROXIMATE SPT "N" VALUE
Hard	>200 kPa	> 30
Very Stiff	100 to 200 kPa	15 to 30
Stiff	50 to 100 kPa	8 to 15
Firm	25 to 50 kPa	4 to 8
Soft	10 to 25 kPa	2 to 4
Very Soft	< 10 kPa	< 2

* SPT "N" Values – Refers to the number of blows by a 63.5 kg hammer dropped 760 mm to drive a 50 mm diameter split spoon sampler for a distance of 300 mm after an initial penetration of 150 mm.

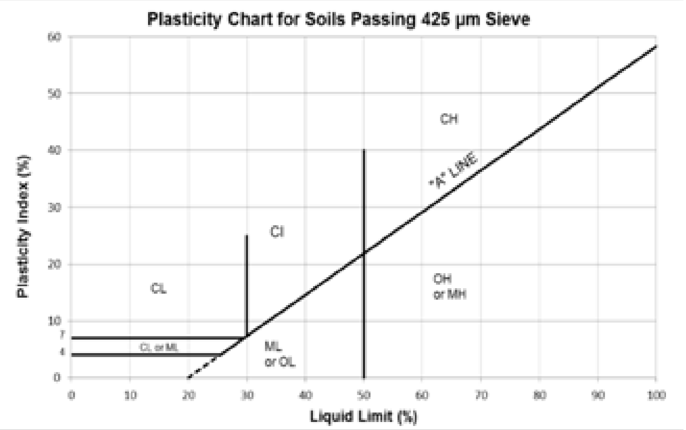
3. SYMBOLS USED ON BOREHOLE LOGS

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
N(■)	Standard Penetration Test (CSA A119 1-60)	SO_4	Concentration of Water-Soluble Sulphate
N_d	Dynamic Cone Penetration Test	C_u	Undrained Shear Strength
pp (♦)	Pocket Penetrometer Strength	γ	Unit Weight of Soil or Rock
q_u	Unconfined Compressive Strength	γ_d	Dry Unit Weight of Soil or Rock
w (●)	Natural Moisture Content (ASTM D2216)	ρ	Density of Soil or Rock
w_L	Liquid Limit (ASTM D 4318)	ρ_d	Dry Density of Soil or Rock
w_P	Plastic Limit (ASTM D 4318)	▽	Short-Term Water Level
I_P	Plastic Index	▼	Long-Term Water Level

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75 µm)	**GRAVELS** (MORE THAN HALF COARSE GRAINS LARGER THAN 4.75mm)	CLEAN GRAVELS (LITTLE OR NO FINES)	**GW**	WELL GRADED GRAVELS AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	$C_u = D_{60}/D_{10} > 4$ $C_c = (D_{30})^2/(D_{10} \text{ x } D_{60}) = 1 \text{ to } 3$	
			GP	POORLY GRADED GRAVELS AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		GRAVELS (WITH SOME FINES)	**GM**	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW 'A' LINE I_p LESS THAN 4
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE 'A' LINE I_p MORE THAN 7
	SANDS (MORE THAN HALF COARSE GRAINS SMALLER THAN 4.75mm)	CLEAN SANDS (LITTLE OR NO FINES)	**SW**	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_u = D_{60}/D_{10} > 6$ $C_c = (D_{30})^2/(D_{10} \text{ x } D_{60}) = 1 \text{ to } 3$	
			SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	NOT MEETING ALL GRADATION REQUIREMENTS FOR SW	
		SANDS (WITH SOME FINES)	**SM**	SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW 'A' LINE I_p LESS THAN 4
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE 'A' LINE I_p MORE THAN 7
FINE GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75 µm)	**SILTS** (BELOW 'A' LINE NEGLIGIBLE ORGANIC CONTENT)	$W_L < 50$ %	**ML**	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)	
		$W_L > 50$ %	**MH**	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS		
	CLAYS (ABOVE 'A' LINE NEGLIGIBLE ORGANIC CONTENT)	$W_L < 30$ %	**CL**	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS		
		30 % $< W_L <$ 50 %	**CI**	INORGANIC CLAYS OR MEDIUM PLASTICITY, SILTY CLAYS		
		$W_L > 50$ %	**CH**	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
	ORGANIC SILTS & CLAYS (BELOW 'A' LINE)	$W_L < 50$ %	**OL**	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
		$W_L > 50$ %	**OH**	ORGANIC CLAYS OF HIGH PLASTICITY		
HIGHLY ORGANIC SOILS			**Pt**	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOUR OR ODOUR, AND OFTEN FIBROUS TEXTURE	
BEDROCK			**BR**	SEE REPORT DESCRIPTION		

Soil Components			
Component	**Size Range (mm)**	**Descriptor**	**% by Weight**
Cobbles	> 76	and	> 35
Gravel	76 to 4.75		
Coarse	76 to 19	-y, -ey	35 to 20
Fine	19 to 4.75		
Sand	4.75 to 0.075	some	20 to 10
Coarse	4.75 to 2		
Medium	2 to 0.425	trace	10 to 1
Fine	0.425 to 0.075		
Fines (Silt or Clay)	< 0.075		



Appendix C

Laboratory Analytical Chemistry Reports

CERTIFICATE OF ANALYSIS

Work Order : **EO2205809**
Client : **SolidEarth Geotechnical Inc.**
Contact : Jay Jaber
Address : 4336 97 Street
Edmonton AB Canada T6E 5R9
Telephone : 780-340-9040
Project : PG21-1603.3000
PO : ----
C-O-C number : SEG 22-038
Sampler : PR
Site : Major Arena Events Center - Detailed Investigation
Quote number : ----
No. of samples received : 27
No. of samples analysed : 27

Page : 1 of 23
Laboratory : Edmonton - Environmental
Account Manager : Dana Brown
Address : 9450 - 17 Avenue NW
Edmonton AB Canada T6N 1M9
Telephone : 7804136472
Date Samples Received : 25-Jul-2022 15:57
Date Analysis Commenced : 26-Jul-2022
Issue Date : 02-Aug-2022 10:49

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance wit FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Fahad Husain	Lab Assistant	Inorganics, Edmonton, Alberta
Jessica Maitland	Lab Assistant	Inorganics, Edmonton, Alberta
Joan Wu	Lab Analyst	Metals, Edmonton, Alberta
Krystal During	Lab Assistant	Organics, Edmonton, Alberta
Ping Yeung	Team Leader - Inorganics	Inorganics, Edmonton, Alberta
Ping Yeung	Team Leader - Inorganics	Metals, Edmonton, Alberta
Shruti Mudliar	Lab Analyst	Inorganics, Edmonton, Alberta
Uyen Munro	Lab Analyst	Organics, Edmonton, Alberta

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.
Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	No Unit
%	percent
dS/m	decisiemens per metre
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
pH units	pH units
t/ha	tonnes per hectare

>: greater than.

<: less than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Qualifiers

Qualifier	*Description*
DLDS	*Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.*
RRV	*Reported result verified by repeat analysis.*

Analytical Results

EO2205809-001

Sub-Matrix: **Soil**
(Matrix: **Soil/Solid**)

Client sample ID: BH22-01, S1, 0.3 M
Client sampling date / time: 21-Jul-2022 11:10

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
pH (1:2 soil:CaCl2-aq)	----	8.04	0.10	pH units	E108B	27-Jul-2022	30-Jul-2022	578849
Saturated Paste Extractables								
conductivity, saturated paste	----	1.38	0.010	dS/m	E102	27-Jul-2022	27-Jul-2022	578832
sodium adsorption ratio [SAR]	----	1.72	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
% saturation	----	45.0	1.0	%	E141	27-Jul-2022	27-Jul-2022	578834
calcium, soluble ion content	7440-70-2	67.0	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
calcium, soluble ion content	7440-70-2	30.2	5	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	89.2	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
magnesium, soluble ion content	7439-95-4	40.1	5	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	<5.0	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
potassium, soluble ion content	7440-09-7	<5.0	5	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	91.6	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sodium, soluble ion content	17341-25-2	41.2	5	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	542	6	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sulfur (as SO4), soluble ion content	14808-79-8	244	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	30	20	mg/L	E266.Cl	27-Jul-2022	29-Jul-2022	578833
chloride, soluble ion content	16887-00-6	14	10	mg/kg	EC266A.Cl	27-Jul-2022	29-Jul-2022	-

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-002

Sub-Matrix: **Soil**
(Matrix: **Soil/Solid**)

Client sample ID: BH22-01, S2, 0.8 M
Client sampling date / time: 21-Jul-2022 11:10

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
pH (1:2 soil:CaCl2-aq)	----	7.98	0.10	pH units	E108B	27-Jul-2022	30-Jul-2022	578849
Saturated Paste Extractables								
conductivity, saturated paste	----	0.852	0.010	dS/m	E102	27-Jul-2022	27-Jul-2022	578832
sodium adsorption ratio [SAR]	----	2.01	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
% saturation	----	44.9	1.0	%	E141	27-Jul-2022	27-Jul-2022	578834
calcium, soluble ion content	7440-70-2	32.3	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
calcium, soluble ion content	7440-70-2	14.5	5	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	40.6	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
magnesium, soluble ion content	7439-95-4	18.2	5	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	<5.0	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
potassium, soluble ion content	7440-09-7	<5.0	5	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	72.8	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sodium, soluble ion content	17341-25-2	32.7	5	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	254	6	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sulfur (as SO4), soluble ion content	14808-79-8	114	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	<20	20	mg/L	E266.Cl	27-Jul-2022	29-Jul-2022	578833

Analytical Results

EO2205809-002

Sub-Matrix:**Soil**

(Matrix: **Soil/Solid)**

Client sample ID: BH22-01, S2, 0.8 M

Client sampling date / time: 21-Jul-2022 11:10

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Saturated Paste Extractables								
chloride, soluble ion content	16887-00-6	<10	10	mg/kg	EC266A.Cl	27-Jul-2022	29-Jul-2022	-

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-003

Sub-Matrix:**Soil**

(Matrix: **Soil/Solid)**

Client sample ID: BH22-01, S3, 1.5 M

Client sampling date / time: 21-Jul-2022 11:10

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
moisture	----	9.55	0.25	%	E144	-	26-Jul-2022	577372
pH (1:2 soil:CaCl2-aq)	----	7.90	0.10	pH units	E108B	27-Jul-2022	30-Jul-2022	578849
Saturated Paste Extractables								
conductivity, saturated paste	----	0.946	0.010	dS/m	E102	27-Jul-2022	27-Jul-2022	578832
sodium adsorption ratio [SAR]	----	1.58	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
% saturation	----	41.8	1.0	%	E141	27-Jul-2022	27-Jul-2022	578834
calcium, soluble ion content	7440-70-2	59.4	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
calcium, soluble ion content	7440-70-2	24.8	5	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	44.8	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
magnesium, soluble ion content	7439-95-4	18.7	5	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	7.5	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
potassium, soluble ion content	7440-09-7	<5.0	5	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	66.4	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sodium, soluble ion content	17341-25-2	27.8	5	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	362	6	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sulfur (as SO4), soluble ion content	14808-79-8	151	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	<20	20	mg/L	E266.Cl	27-Jul-2022	29-Jul-2022	578833
chloride, soluble ion content	16887-00-6	<10	10	mg/kg	EC266A.Cl	27-Jul-2022	29-Jul-2022	-
Volatile Organic Compounds [Fuels]								
benzene	71-43-2	<0.0050	0.0050	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
ethylbenzene	100-41-4	<0.015	0.015	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
toluene	108-88-3	<0.050	0.050	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylene, m+p-	179601-23-1	<0.030	0.030	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylene, o-	95-47-6	<0.030	0.030	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylenes, total	1330-20-7	<0.050	0.05	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
BTEX, total	----	<0.10	0.1	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
Volatile Organic Compounds Surrogates								
bromofluorobenzene, 4-	460-00-4	107	0.10	%	E611A	28-Jul-2022	29-Jul-2022	580210
difluorobenzene, 1,4-	540-36-3	98.9	0.10	%	E611A	28-Jul-2022	29-Jul-2022	580210
Hydrocarbons								
chromatogram to baseline at nC50	n/a	Yes	-	-	E601.SG	26-Jul-2022	27-Jul-2022	577449
F1 (C6-C10)	----	<5.0	5.0	mg/kg	E581.F1	28-Jul-2022	29-Jul-2022	580211
F2 (C10-C16)	----	<25	25	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F3 (C16-C34)	----	<50	50	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449

Analytical Results

EO2205809-003

Sub-Matrix:**Soil** *Client sample ID:* BH22-01, S3, 1.5 M

(Matrix: **Soil/Solid)** *Client sampling date / time:* 21-Jul-2022 11:10

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Hydrocarbons								
F4 (C34-C50)	----	<50	50	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
TEH (C10-C50)	----	<75	75	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
TEH (C16-C50)	----	<75	75	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F1-BTEX	----	<5.0	5	mg/kg	EC580	-	31-Jul-2022	-
Hydrocarbons Surrogates								
bromobenzotrifluoride, 2- (F2-F4 surr)	392-83-6	86.7	1.0	%	E601.SG	26-Jul-2022	27-Jul-2022	577449
dichlorotoluene, 3,4-	97-75-0	101	1.0	%	E581.F1	28-Jul-2022	29-Jul-2022	580211

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-004

Sub-Matrix:**Soil** *Client sample ID:* BH22-02, S1, 0.3 M

(Matrix: **Soil/Solid)** *Client sampling date / time:* 19-Jul-2022 12:30

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
pH (1:2 soil:CaCl2-aq)	----	7.97	0.10	pH units	E108B	27-Jul-2022	30-Jul-2022	578849
Saturated Paste Extractables								
conductivity, saturated paste	----	3.63	0.010	dS/m	E102	27-Jul-2022	27-Jul-2022	578832
sodium adsorption ratio [SAR]	----	1.13	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
% saturation	----	49.5	1.0	%	E141	27-Jul-2022	27-Jul-2022	578834
calcium, soluble ion content	7440-70-2	410	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
calcium, soluble ion content	7440-70-2	203	5	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	241	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
magnesium, soluble ion content	7439-95-4	119	5	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	18.7	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
potassium, soluble ion content	7440-09-7	9.2	5	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	117	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sodium, soluble ion content	17341-25-2	57.9	5	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	2060	12.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sulfur (as SO4), soluble ion content	14808-79-8	1020	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	47	20	mg/L	E266.Cl	27-Jul-2022	29-Jul-2022	578833
chloride, soluble ion content	16887-00-6	23	10	mg/kg	EC266A.Cl	27-Jul-2022	29-Jul-2022	-

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-005

Sub-Matrix:**Soil** *Client sample ID:* BH22-02, S2, 0.8 M

(Matrix: **Soil/Solid)** *Client sampling date / time:* 19-Jul-2022 12:30

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								

Analytical Results

EO2205809-005

Sub-Matrix: **Soil** | Client sample ID: BH22-02, S2, 0.8 M

(Matrix: **Soil/Solid)** | Client sampling date / time: 19-Jul-2022 12:30

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
pH (1:2 soil:CaCl2-aq)	----	7.73	0.10	pH units	E108B	27-Jul-2022	30-Jul-2022	578849
Saturated Paste Extractables								
conductivity, saturated paste	----	3.88	0.010	dS/m	E102	27-Jul-2022	27-Jul-2022	578832
sodium adsorption ratio [SAR]	----	1.13	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
% saturation	----	49.6	1.0	%	E141	27-Jul-2022	27-Jul-2022	578834
calcium, soluble ion content	7440-70-2	429	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
calcium, soluble ion content	7440-70-2	213	5	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	313	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
magnesium, soluble ion content	7439-95-4	155	5	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	18.7	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
potassium, soluble ion content	7440-09-7	9.3	5	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	126	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sodium, soluble ion content	17341-25-2	62.5	5	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	2380	12.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sulfur (as SO4), soluble ion content	14808-79-8	1180	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	<20	20	mg/L	E266.Cl	27-Jul-2022	29-Jul-2022	578833
chloride, soluble ion content	16887-00-6	<10	10	mg/kg	EC266A.Cl	27-Jul-2022	29-Jul-2022	-

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-006

Sub-Matrix: **Soil** | Client sample ID: BH22-02, S3, 1.5 M

(Matrix: **Soil/Solid)** | Client sampling date / time: 19-Jul-2022 12:30

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
moisture	----	14.8	0.25	%	E144	-	26-Jul-2022	577372
pH (1:2 soil:CaCl2-aq)	----	7.85	0.10	pH units	E108B	27-Jul-2022	30-Jul-2022	578849
Saturated Paste Extractables								
conductivity, saturated paste	----	4.33	0.010	dS/m	E102	27-Jul-2022	27-Jul-2022	578832
sodium adsorption ratio [SAR]	----	1.79	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
% saturation	----	55.2	1.0	%	E141	27-Jul-2022	27-Jul-2022	578834
calcium, soluble ion content	7440-70-2	395	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
calcium, soluble ion content	7440-70-2	218	5.5	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	383	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
magnesium, soluble ion content	7439-95-4	211	5.5	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	14.8	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
potassium, soluble ion content	7440-09-7	8.2	5.5	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	208	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sodium, soluble ion content	17341-25-2	115	5.5	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	2670	12.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sulfur (as SO4), soluble ion content	14808-79-8	1470	8	mg/kg	EC485	-	30-Jul-2022	-

Analytical Results

EO2205809-006

Sub-Matrix: **Soil** | *Client sample ID:* BH22-02, S3, 1.5 M

(Matrix: **Soil/Solid**) | *Client sampling date / time:* 19-Jul-2022 12:30

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Saturated Paste Extractables								
chloride, soluble ion content	16887-00-6	39	20	mg/L	E266.Cl	27-Jul-2022	29-Jul-2022	578833
chloride, soluble ion content	16887-00-6	22	11	mg/kg	EC266A.Cl	27-Jul-2022	29-Jul-2022	-
Volatile Organic Compounds [Fuels]								
benzene	71-43-2	<0.0050	0.0050	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
ethylbenzene	100-41-4	<0.015	0.015	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
toluene	108-88-3	<0.050	0.050	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylene, m+p-	179601-23-1	<0.030	0.030	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylene, o-	95-47-6	<0.030	0.030	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylenes, total	1330-20-7	<0.050	0.05	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
BTEX, total	----	<0.10	0.1	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
Volatile Organic Compounds Surrogates								
bromofluorobenzene, 4-	460-00-4	107	0.10	%	E611A	28-Jul-2022	29-Jul-2022	580210
difluorobenzene, 1,4-	540-36-3	90.7	0.10	%	E611A	28-Jul-2022	29-Jul-2022	580210
Hydrocarbons								
chromatogram to baseline at nC50	n/a	Yes	-	-	E601.SG	26-Jul-2022	27-Jul-2022	577449
F1 (C6-C10)	----	<5.0	5.0	mg/kg	E581.F1	28-Jul-2022	29-Jul-2022	580211
F2 (C10-C16)	----	<25	25	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F3 (C16-C34)	----	<50	50	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F4 (C34-C50)	----	<50	50	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
TEH (C10-C50)	----	<75	75	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
TEH (C16-C50)	----	<75	75	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F1-BTEX	----	<5.0	5	mg/kg	EC580	-	31-Jul-2022	-
Hydrocarbons Surrogates								
bromobenzotrifluoride, 2- (F2-F4 surr)	392-83-6	86.5	1.0	%	E601.SG	26-Jul-2022	27-Jul-2022	577449
dichlorotoluene, 3,4-	97-75-0	91.5	1.0	%	E581.F1	28-Jul-2022	29-Jul-2022	580211

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-007

Sub-Matrix: **Soil** | *Client sample ID:* BH22-03, S1, 0.3 M

(Matrix: **Soil/Solid**) | *Client sampling date / time:* 21-Jul-2022 06:50

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
pH (1:2 soil:CaCl2-aq)	----	7.11	0.10	pH units	E108B	27-Jul-2022	30-Jul-2022	578849
Saturated Paste Extractables								
conductivity, saturated paste	----	0.883	0.010	dS/m	E102	27-Jul-2022	27-Jul-2022	578832
sodium adsorption ratio [SAR]	----	2.76	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
% saturation	----	54.9	1.0	%	E141	27-Jul-2022	27-Jul-2022	578834
calcium, soluble ion content	7440-70-2	22.9	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
calcium, soluble ion content	7440-70-2	12.6	5	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	38.8	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
magnesium, soluble ion content	7439-95-4	21.3	5	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	<5.0	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835

Analytical Results

EO2205809-007

Sub-Matrix:**Soil** — *Client sample ID:* BH22-03, S1, 0.3 M

(Matrix: **Soil/Solid)** — *Client sampling date / time:* 21-Jul-2022 06:50

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Saturated Paste Extractables								
potassium, soluble ion content	7440-09-7	<5.0	5	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	93.3	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sodium, soluble ion content	17341-25-2	51.2	5	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	38.0	6	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sulfur (as SO4), soluble ion content	14808-79-8	20.9	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	153	20	mg/L	E266.Cl	27-Jul-2022	29-Jul-2022	578833
chloride, soluble ion content	16887-00-6	84	11	mg/kg	EC266A.Cl	27-Jul-2022	29-Jul-2022	-

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-008

Sub-Matrix:**Soil** — *Client sample ID:* BH22-03, S2, 0.8 M

(Matrix: **Soil/Solid)** — *Client sampling date / time:* 21-Jul-2022 06:50

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
pH (1:2 soil:CaCl2-aq)	----	8.19	0.10	pH units	E108B	27-Jul-2022	30-Jul-2022	578849
Saturated Paste Extractables								
conductivity, saturated paste	----	1.26	0.010	dS/m	E102	27-Jul-2022	27-Jul-2022	578832
sodium adsorption ratio [SAR]	----	3.72	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
% saturation	----	58.6	1.0	%	E141	27-Jul-2022	27-Jul-2022	578834
calcium, soluble ion content	7440-70-2	31.0	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
calcium, soluble ion content	7440-70-2	18.2	5	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	47.4	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
magnesium, soluble ion content	7439-95-4	27.8	5	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	<5.0	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
potassium, soluble ion content	7440-09-7	<5.0	5	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	141	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sodium, soluble ion content	17341-25-2	82.6	5	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	74.3	6	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sulfur (as SO4), soluble ion content	14808-79-8	43.5	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	255	200	mg/L	E266.Cl	27-Jul-2022	29-Jul-2022	578833
chloride, soluble ion content	16887-00-6	149	117	mg/kg	EC266A.Cl	27-Jul-2022	29-Jul-2022	-

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-009

Sub-Matrix:**Soil** — *Client sample ID:* BH22-03, S3, 1.1 M

(Matrix: **Soil/Solid)** — *Client sampling date / time:* 21-Jul-2022 06:50

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								

Analytical Results

EO2205809-009

Sub-Matrix:**Soil**

(Matrix: **Soil/Solid)**

Client sample ID: BH22-03, S3, 1.1 M

Client sampling date / time: 21-Jul-2022 06:50

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
moisture	----	13.6	0.25	%	E144	-	26-Jul-2022	577372
pH (1:2 soil:CaCl2-aq)	----	7.96	0.10	pH units	E108B	27-Jul-2022	30-Jul-2022	578849
Saturated Paste Extractables								
conductivity, saturated paste	----	0.880	0.010	dS/m	E102	27-Jul-2022	27-Jul-2022	578832
sodium adsorption ratio [SAR]	----	2.77	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
% saturation	----	55.2	1.0	%	E141	27-Jul-2022	27-Jul-2022	578834
calcium, soluble ion content	7440-70-2	32.2	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
calcium, soluble ion content	7440-70-2	17.8	5	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	41.4	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
magnesium, soluble ion content	7439-95-4	22.8	5	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	<5.0	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
potassium, soluble ion content	7440-09-7	<5.0	5	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	101	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sodium, soluble ion content	17341-25-2	55.8	5	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	43.7	6	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sulfur (as SO4), soluble ion content	14808-79-8	24.1	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	162	20	mg/L	E266.Cl	27-Jul-2022	29-Jul-2022	578833
chloride, soluble ion content	16887-00-6	89	11	mg/kg	EC266A.Cl	27-Jul-2022	29-Jul-2022	-
Volatile Organic Compounds [Fuels]								
benzene	71-43-2	<0.0050	0.0050	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
ethylbenzene	100-41-4	<0.015	0.015	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
toluene	108-88-3	<0.050	0.050	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylene, m+p-	179601-23-1	<0.030	0.030	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylene, o-	95-47-6	<0.030	0.030	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylenes, total	1330-20-7	<0.050	0.05	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
BTEX, total	----	<0.10	0.1	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
Volatile Organic Compounds Surrogates								
bromofluorobenzene, 4-	460-00-4	101	0.10	%	E611A	28-Jul-2022	29-Jul-2022	580210
difluorobenzene, 1,4-	540-36-3	83.2	0.10	%	E611A	28-Jul-2022	29-Jul-2022	580210
Hydrocarbons								
chromatogram to baseline at nC50	n/a	Yes	-	-	E601.SG	26-Jul-2022	27-Jul-2022	577449
F1 (C6-C10)	----	<5.0	5.0	mg/kg	E581.F1	28-Jul-2022	29-Jul-2022	580211
F2 (C10-C16)	----	<25	25	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F3 (C16-C34)	----	<50	50	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F4 (C34-C50)	----	<50	50	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
TEH (C10-C50)	----	<75	75	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
TEH (C16-C50)	----	<75	75	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F1-BTEX	----	<5.0	5	mg/kg	EC580	-	31-Jul-2022	-
Hydrocarbons Surrogates								
bromobenzotrifluoride, 2- (F2-F4 surr)	392-83-6	85.9	1.0	%	E601.SG	26-Jul-2022	27-Jul-2022	577449
dichlorotoluene, 3,4-	97-75-0	70.5	1.0	%	E581.F1	28-Jul-2022	29-Jul-2022	580211

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-010

Sub-Matrix: **Soil**
(Matrix: **Soil/Solid)**

Client sample ID: BH22-04, S1, 0.3 M
Client sampling date / time: 20-Jul-2022 03:45

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
pH (1:2 soil:CaCl2-aq)	----	8.23	0.10	pH units	E108B	27-Jul-2022	30-Jul-2022	578849
Saturated Paste Extractables								
conductivity, saturated paste	----	0.567	0.010	dS/m	E102	27-Jul-2022	27-Jul-2022	578832
sodium adsorption ratio [SAR]	----	6.82	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
% saturation	----	52.0	1.0	%	E141	27-Jul-2022	27-Jul-2022	578834
calcium, soluble ion content	7440-70-2	14.9	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
calcium, soluble ion content	7440-70-2	7.7	5	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	5.7	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
magnesium, soluble ion content	7439-95-4	<5.0	5	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	<5.0	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
potassium, soluble ion content	7440-09-7	<5.0	5	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	122	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sodium, soluble ion content	17341-25-2	63.4	5	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	70.4	6	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sulfur (as SO4), soluble ion content	14808-79-8	36.6	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	<20	20	mg/L	E266.Cl	27-Jul-2022	29-Jul-2022	578833
chloride, soluble ion content	16887-00-6	<10	10	mg/kg	EC266A.Cl	27-Jul-2022	29-Jul-2022	-

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-011

Sub-Matrix: **Soil**
(Matrix: **Soil/Solid)**

Client sample ID: BH22-04, S2, 0.8 M
Client sampling date / time: 20-Jul-2022 03:45

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
pH (1:2 soil:CaCl2-aq)	----	8.07	0.10	pH units	E108B	27-Jul-2022	30-Jul-2022	578849
Saturated Paste Extractables								
conductivity, saturated paste	----	3.22	0.010	dS/m	E102	27-Jul-2022	27-Jul-2022	578832
sodium adsorption ratio [SAR]	----	3.97	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
% saturation	----	51.8	1.0	%	E141	27-Jul-2022	27-Jul-2022	578834
calcium, soluble ion content	7440-70-2	90.7	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
calcium, soluble ion content	7440-70-2	47.0	5.2	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	170	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
magnesium, soluble ion content	7439-95-4	88.1	5.2	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	11.0	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
potassium, soluble ion content	7440-09-7	5.7	5.2	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	278	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sodium, soluble ion content	17341-25-2	144	5.2	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	443	12.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sulfur (as SO4), soluble ion content	14808-79-8	229	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	850	200	mg/L	E266.Cl	27-Jul-2022	29-Jul-2022	578833

Analytical Results

EO2205809-011

Sub-Matrix: **Soil** *Client sample ID:* BH22-04, S2, 0.8 M

(Matrix: **Soil/Solid**) *Client sampling date / time:* 20-Jul-2022 03:45

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Saturated Paste Extractables								
chloride, soluble ion content	16887-00-6	440	104	mg/kg	EC266A.Cl	27-Jul-2022	29-Jul-2022	-

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-012

Sub-Matrix: **Soil** *Client sample ID:* BH22-04, S3, 1.5 M

(Matrix: **Soil/Solid**) *Client sampling date / time:* 20-Jul-2022 03:45

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
moisture	----	13.9	0.25	%	E144	-	26-Jul-2022	577372
pH (1:2 soil:CaCl2-aq)	----	8.00	0.10	pH units	E108B	27-Jul-2022	30-Jul-2022	578849
Saturated Paste Extractables								
conductivity, saturated paste	----	3.48	0.010	dS/m	E102	27-Jul-2022	27-Jul-2022	578832
sodium adsorption ratio [SAR]	----	3.94	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
% saturation	----	55.1	1.0	%	E141	27-Jul-2022	27-Jul-2022	578834
calcium, soluble ion content	7440-70-2	108	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
calcium, soluble ion content	7440-70-2	59.5	5.5	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	184	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
magnesium, soluble ion content	7439-95-4	101	5.5	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	13.6	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
potassium, soluble ion content	7440-09-7	7.5	5.5	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	290	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sodium, soluble ion content	17341-25-2	160	5.5	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	626	12.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sulfur (as SO4), soluble ion content	14808-79-8	345	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	809	200	mg/L	E266.Cl	27-Jul-2022	29-Jul-2022	578833
chloride, soluble ion content	16887-00-6	446	110	mg/kg	EC266A.Cl	27-Jul-2022	29-Jul-2022	-
Volatile Organic Compounds [Fuels]								
benzene	71-43-2	<0.0050	0.0050	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
ethylbenzene	100-41-4	<0.015	0.015	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
toluene	108-88-3	<0.050	0.050	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylene, m+p-	179601-23-1	<0.030	0.030	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylene, o-	95-47-6	<0.030	0.030	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylenes, total	1330-20-7	<0.050	0.05	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
BTEX, total	----	<0.10	0.1	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
Volatile Organic Compounds Surrogates								
bromofluorobenzene, 4-	460-00-4	122	0.10	%	E611A	28-Jul-2022	29-Jul-2022	580210
difluorobenzene, 1,4-	540-36-3	120	0.10	%	E611A	28-Jul-2022	29-Jul-2022	580210
Hydrocarbons								
chromatogram to baseline at nC50	n/a	Yes	-	-	E601.SG	26-Jul-2022	27-Jul-2022	577449
F1 (C6-C10)	----	<5.0	5.0	mg/kg	E581.F1	28-Jul-2022	29-Jul-2022	580211
F2 (C10-C16)	----	<25	25	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F3 (C16-C34)	----	<50	50	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449

Analytical Results

EO2205809-012

Sub-Matrix: **Soil**
(Matrix: **Soil/Solid)**

Client sample ID: BH22-04, S3, 1.5 M
Client sampling date / time: 20-Jul-2022 03:45

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Hydrocarbons								
F4 (C34-C50)	----	<50	50	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
TEH (C10-C50)	----	<75	75	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
TEH (C16-C50)	----	<75	75	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F1-BTEX	----	<5.0	5	mg/kg	EC580	-	31-Jul-2022	-
Hydrocarbons Surrogates								
bromobenzotrifluoride, 2- (F2-F4 surr)	392-83-6	85.7	1.0	%	E601.SG	26-Jul-2022	27-Jul-2022	577449
dichlorotoluene, 3,4-	97-75-0	116	1.0	%	E581.F1	28-Jul-2022	29-Jul-2022	580211

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-013

Sub-Matrix: **Soil**
(Matrix: **Soil/Solid)**

Client sample ID: BH22-05, S1, 0.3 M
Client sampling date / time: 20-Jul-2022 06:50

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
pH (1:2 soil:CaCl2-aq)	----	7.22	0.10	pH units	E108B	27-Jul-2022	30-Jul-2022	578849
Saturated Paste Extractables								
conductivity, saturated paste	----	2.32	0.010	dS/m	E102	27-Jul-2022	27-Jul-2022	578832
sodium adsorption ratio [SAR]	----	4.91	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
% saturation	----	56.5	1.0	%	E141	27-Jul-2022	27-Jul-2022	578834
calcium, soluble ion content	7440-70-2	51.2	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
calcium, soluble ion content	7440-70-2	28.9	5	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	93.8	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
magnesium, soluble ion content	7439-95-4	53.0	5	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	10.2	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
potassium, soluble ion content	7440-09-7	5.8	5	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	256	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sodium, soluble ion content	17341-25-2	145	5	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	85.1	6	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sulfur (as SO4), soluble ion content	14808-79-8	48.1	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	721	200	mg/L	E266.Cl	27-Jul-2022	29-Jul-2022	578833
chloride, soluble ion content	16887-00-6	407	113	mg/kg	EC266A.Cl	27-Jul-2022	29-Jul-2022	-

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-014

Sub-Matrix: **Soil**
(Matrix: **Soil/Solid)**

Client sample ID: BH22-05, S2, 0.8 M
Client sampling date / time: 20-Jul-2022 06:50

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								

Analytical Results

EO2205809-014

Sub-Matrix:**Soil**
(Matrix: **Soil/Solid)**

Client sample ID: BH22-05, S2, 0.8 M
Client sampling date / time: 20-Jul-2022 06:50

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
pH (1:2 soil:CaCl2-aq)	----	8.30	0.10	pH units	E108B	27-Jul-2022	30-Jul-2022	578849
Saturated Paste Extractables								
conductivity, saturated paste	----	3.90	0.010	dS/m	E102	27-Jul-2022	27-Jul-2022	578832
sodium adsorption ratio [SAR]	----	7.40	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	0.18	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
TGR (sodic)	----	0.34	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
% saturation	----	47.5	1.0	%	E141	27-Jul-2022	27-Jul-2022	578834
calcium, soluble ion content	7440-70-2	79.0	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
calcium, soluble ion content	7440-70-2	37.5	5	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	182	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
magnesium, soluble ion content	7439-95-4	86.4	5	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	<10.0 DLDS,	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
potassium, soluble ion content	7440-09-7	<5.0	5	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	523	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sodium, soluble ion content	17341-25-2	248	5	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	1260	12.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sulfur (as SO4), soluble ion content	14808-79-8	598	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	482	200	mg/L	E266.Cl	27-Jul-2022	29-Jul-2022	578833
chloride, soluble ion content	16887-00-6	229	95	mg/kg	EC266A.Cl	27-Jul-2022	29-Jul-2022	-

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-015

Sub-Matrix:**Soil**
(Matrix: **Soil/Solid)**

Client sample ID: BH22-05, S3, 1.5 M
Client sampling date / time: 20-Jul-2022 06:50

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
moisture	----	15.4	0.25	%	E144	-	26-Jul-2022	577372
pH (1:2 soil:CaCl2-aq)	----	8.17	0.10	pH units	E108B	27-Jul-2022	30-Jul-2022	578849
Saturated Paste Extractables								
conductivity, saturated paste	----	3.54	0.010	dS/m	E102	27-Jul-2022	27-Jul-2022	578832
sodium adsorption ratio [SAR]	----	5.99	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
% saturation	----	50.0	1.0	%	E141	27-Jul-2022	27-Jul-2022	578834
calcium, soluble ion content	7440-70-2	89.6	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
calcium, soluble ion content	7440-70-2	44.8	5.0	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	175	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
magnesium, soluble ion content	7439-95-4	87.5	5.0	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	<10.0 DLDS,	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
potassium, soluble ion content	7440-09-7	<5.0	5.0	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	423	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sodium, soluble ion content	17341-25-2	212	5.0	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	1440	12.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sulfur (as SO4), soluble ion content	14808-79-8	720	8	mg/kg	EC485	-	30-Jul-2022	-

Analytical Results

EO2205809-015

Sub-Matrix: **Soil** — *Client sample ID:* BH22-05, S3, 1.5 M

(Matrix: **Soil/Solid**) — *Client sampling date / time:* 20-Jul-2022 06:50

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Saturated Paste Extractables								
chloride, soluble ion content	16887-00-6	158	20	mg/L	E266.Cl	27-Jul-2022	29-Jul-2022	578833
chloride, soluble ion content	16887-00-6	79	10	mg/kg	EC266A.Cl	27-Jul-2022	29-Jul-2022	-
Volatile Organic Compounds [Fuels]								
benzene	71-43-2	<0.0050	0.0050	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
ethylbenzene	100-41-4	<0.015	0.015	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
toluene	108-88-3	<0.050	0.050	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylene, m+p-	179601-23-1	<0.030	0.030	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylene, o-	95-47-6	<0.030	0.030	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylenes, total	1330-20-7	<0.050	0.05	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
BTEX, total	----	<0.10	0.1	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
Volatile Organic Compounds Surrogates								
bromofluorobenzene, 4-	460-00-4	113	0.10	%	E611A	28-Jul-2022	29-Jul-2022	580210
difluorobenzene, 1,4-	540-36-3	97.6	0.10	%	E611A	28-Jul-2022	29-Jul-2022	580210
Hydrocarbons								
chromatogram to baseline at nC50	n/a	Yes	-	-	E601.SG	26-Jul-2022	27-Jul-2022	577449
F1 (C6-C10)	----	<5.0	5.0	mg/kg	E581.F1	28-Jul-2022	29-Jul-2022	580211
F2 (C10-C16)	----	<25	25	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F3 (C16-C34)	----	<50	50	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F4 (C34-C50)	----	<50	50	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
TEH (C10-C50)	----	<75	75	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
TEH (C16-C50)	----	<75	75	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F1-BTEX	----	<5.0	5	mg/kg	EC580	-	31-Jul-2022	-
Hydrocarbons Surrogates								
bromobenzotrifluoride, 2- (F2-F4 surr)	392-83-6	86.4	1.0	%	E601.SG	26-Jul-2022	27-Jul-2022	577449
dichlorotoluene, 3,4-	97-75-0	82.2	1.0	%	E581.F1	28-Jul-2022	29-Jul-2022	580211

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-016

Sub-Matrix: **Soil** — *Client sample ID:* BH22-06, S1, 0.3 M

(Matrix: **Soil/Solid**) — *Client sampling date / time:* 21-Jul-2022 03:10

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
pH (1:2 soil:CaCl2-aq)	----	7.93	0.10	pH units	E108B	27-Jul-2022	30-Jul-2022	578849
Saturated Paste Extractables								
conductivity, saturated paste	----	0.433	0.010	dS/m	E102	27-Jul-2022	27-Jul-2022	578832
sodium adsorption ratio [SAR]	----	0.21	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
% saturation	----	53.7	1.0	%	E141	27-Jul-2022	27-Jul-2022	578834
calcium, soluble ion content	7440-70-2	51.6	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
calcium, soluble ion content	7440-70-2	27.7	5	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	27.4	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
magnesium, soluble ion content	7439-95-4	14.7	5	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	6.2	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835

Analytical Results

EO2205809-016

Sub-Matrix:**Soil**
(Matrix: **Soil/Solid)**

Client sample ID: BH22-06, S1, 0.3 M
Client sampling date / time: 21-Jul-2022 03:10

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Saturated Paste Extractables								
potassium, soluble ion content	7440-09-7	<5.0	5	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	7.5	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sodium, soluble ion content	17341-25-2	<5.0	5	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	55.7	6	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sulfur (as SO4), soluble ion content	14808-79-8	29.9	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	<20	20	mg/L	E266.Cl	27-Jul-2022	29-Jul-2022	578833
chloride, soluble ion content	16887-00-6	<11	11	mg/kg	EC266A.Cl	27-Jul-2022	29-Jul-2022	-

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-017

Sub-Matrix:**Soil**
(Matrix: **Soil/Solid)**

Client sample ID: BH22-06, S2, 0.8 M
Client sampling date / time: 21-Jul-2022 03:10

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
pH (1:2 soil:CaCl2-aq)	----	8.04	0.10	pH units	E108B	27-Jul-2022	30-Jul-2022	578849
Saturated Paste Extractables								
conductivity, saturated paste	----	2.80	0.010	dS/m	E102	27-Jul-2022	27-Jul-2022	578832
sodium adsorption ratio [SAR]	----	0.34	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
% saturation	----	50.5	1.0	%	E141	27-Jul-2022	27-Jul-2022	578834
calcium, soluble ion content	7440-70-2	400	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
calcium, soluble ion content	7440-70-2	202	5	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	229	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
magnesium, soluble ion content	7439-95-4	116	5	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	17.6	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
potassium, soluble ion content	7440-09-7	8.9	5	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	34.9	5.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sodium, soluble ion content	17341-25-2	17.6	5	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	1820	6	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sulfur (as SO4), soluble ion content	14808-79-8	919	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	<20	20	mg/L	E266.Cl	27-Jul-2022	29-Jul-2022	578833
chloride, soluble ion content	16887-00-6	<10	10	mg/kg	EC266A.Cl	27-Jul-2022	29-Jul-2022	-

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-018

Sub-Matrix:**Soil**
(Matrix: **Soil/Solid)**

Client sample ID: BH22-06, S2, 1.5 M
Client sampling date / time: 21-Jul-2022 03:10

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								

Analytical Results

EO2205809-018

Sub-Matrix:**Soil** — *Client sample ID:* BH22-06, S2, 1.5 M

(Matrix: **Soil/Solid**) — *Client sampling date / time:* 21-Jul-2022 03:10

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
moisture	----	12.3	0.25	%	E144	-	26-Jul-2022	577372
pH (1:2 soil:CaCl2-aq)	----	7.79	0.10	pH units	E108B	27-Jul-2022	30-Jul-2022	578849
Saturated Paste Extractables								
conductivity, saturated paste	----	4.08	0.010	dS/m	E102	27-Jul-2022	27-Jul-2022	578832
sodium adsorption ratio [SAR]	----	1.07	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	27-Jul-2022	29-Jul-2022	-
% saturation	----	50.1	1.0	%	E141	27-Jul-2022	27-Jul-2022	578834
calcium, soluble ion content	7440-70-2	523	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
calcium, soluble ion content	7440-70-2	262	5.0	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	381	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
magnesium, soluble ion content	7439-95-4	191	5.0	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	31.8	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
potassium, soluble ion content	7440-09-7	15.9	5.0	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	132	10.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sodium, soluble ion content	17341-25-2	66.1	5.0	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	2870	12.0	mg/L	E485	27-Jul-2022	29-Jul-2022	578835
sulfur (as SO4), soluble ion content	14808-79-8	1440	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	<20	20	mg/L	E266.Cl	27-Jul-2022	29-Jul-2022	578833
chloride, soluble ion content	16887-00-6	<10	10	mg/kg	EC266A.Cl	27-Jul-2022	29-Jul-2022	-
Volatile Organic Compounds [Fuels]								
benzene	71-43-2	<0.0050	0.0050	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
ethylbenzene	100-41-4	<0.015	0.015	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
toluene	108-88-3	<0.050	0.050	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylene, m+p-	179601-23-1	<0.030	0.030	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylene, o-	95-47-6	<0.030	0.030	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylenes, total	1330-20-7	<0.050	0.05	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
BTEX, total	----	<0.10	0.1	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
Volatile Organic Compounds Surrogates								
bromofluorobenzene, 4-	460-00-4	103	0.10	%	E611A	28-Jul-2022	29-Jul-2022	580210
difluorobenzene, 1,4-	540-36-3	87.9	0.10	%	E611A	28-Jul-2022	29-Jul-2022	580210
Hydrocarbons								
chromatogram to baseline at nC50	n/a	Yes	-	-	E601.SG	26-Jul-2022	27-Jul-2022	577449
F1 (C6-C10)	----	<5.0	5.0	mg/kg	E581.F1	28-Jul-2022	29-Jul-2022	580211
F2 (C10-C16)	----	<25	25	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F3 (C16-C34)	----	<50	50	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F4 (C34-C50)	----	<50	50	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
TEH (C10-C50)	----	<75	75	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
TEH (C16-C50)	----	<75	75	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F1-BTEX	----	<5.0	5	mg/kg	EC580	-	31-Jul-2022	-
Hydrocarbons Surrogates								
bromobenzotrifluoride, 2- (F2-F4 surr)	392-83-6	86.7	1.0	%	E601.SG	26-Jul-2022	27-Jul-2022	577449
dichlorotoluene, 3,4-	97-75-0	106	1.0	%	E581.F1	28-Jul-2022	29-Jul-2022	580211

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-019

Sub-Matrix: **Soil**
(Matrix: **Soil/Solid)**

Client sample ID: BH22-07, S1, 0.3 M
Client sampling date / time: 21-Jul-2022 07:55

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
pH (1:2 soil:CaCl2-aq)	----	8.13	0.10	pH units	E108B	30-Jul-2022	30-Jul-2022	584196
Saturated Paste Extractables								
conductivity, saturated paste	----	5.49	0.010	dS/m	E102	29-Jul-2022	29-Jul-2022	583204
sodium adsorption ratio [SAR]	----	4.17	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	29-Jul-2022	30-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	29-Jul-2022	30-Jul-2022	-
% saturation	----	48.9	1.0	%	E141	29-Jul-2022	29-Jul-2022	583206
calcium, soluble ion content	7440-70-2	391	10.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
calcium, soluble ion content	7440-70-2	191	5	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	437	10.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
magnesium, soluble ion content	7439-95-4	214	5	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	15.4	10.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
potassium, soluble ion content	7440-09-7	7.5	5	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	505	10.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
sodium, soluble ion content	17341-25-2	247	5	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	3680	12.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
sulfur (as SO4), soluble ion content	14808-79-8	1800	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	<20	20	mg/L	E266.Cl	29-Jul-2022	30-Jul-2022	583205
chloride, soluble ion content	16887-00-6	<10	10	mg/kg	EC266A.Cl	29-Jul-2022	30-Jul-2022	-

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-020

Sub-Matrix: **Soil**
(Matrix: **Soil/Solid)**

Client sample ID: BH22-07, S2, 0.8 M
Client sampling date / time: 21-Jul-2022 07:55

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
pH (1:2 soil:CaCl2-aq)	----	8.21	0.10	pH units	E108B	30-Jul-2022	30-Jul-2022	584196
Saturated Paste Extractables								
conductivity, saturated paste	----	2.92	0.010	dS/m	E102	29-Jul-2022	29-Jul-2022	583204
sodium adsorption ratio [SAR]	----	6.05	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	29-Jul-2022	30-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	29-Jul-2022	30-Jul-2022	-
% saturation	----	48.8	1.0	%	E141	29-Jul-2022	29-Jul-2022	583206
calcium, soluble ion content	7440-70-2	92.6	10.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
calcium, soluble ion content	7440-70-2	45.2	5	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	129	10.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
magnesium, soluble ion content	7439-95-4	63.0	5	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	11.3	10.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
potassium, soluble ion content	7440-09-7	5.5	5	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	384	10.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
sodium, soluble ion content	17341-25-2	187	5	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	1470	12.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
sulfur (as SO4), soluble ion content	14808-79-8	717	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	<20	20	mg/L	E266.Cl	29-Jul-2022	30-Jul-2022	583205

Analytical Results

EO2205809-020

Sub-Matrix:**Soil** — *Client sample ID:* BH22-07, S2, 0.8 M

(Matrix: **Soil/Solid**) — *Client sampling date / time:* 21-Jul-2022 07:55

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Saturated Paste Extractables								
chloride, soluble ion content	16887-00-6	<10	10	mg/kg	EC266A.Cl	29-Jul-2022	30-Jul-2022	-

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-021

Sub-Matrix:**Soil** — *Client sample ID:* BH22-07, S3, 1.5 M

(Matrix: **Soil/Solid**) — *Client sampling date / time:* 21-Jul-2022 07:55

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
moisture	----	13.4	0.25	%	E144	-	26-Jul-2022	577372
pH (1:2 soil:CaCl2-aq)	----	8.16	0.10	pH units	E108B	30-Jul-2022	30-Jul-2022	584196
Saturated Paste Extractables								
conductivity, saturated paste	----	2.34	0.010	dS/m	E102	29-Jul-2022	29-Jul-2022	583204
sodium adsorption ratio [SAR]	----	7.95	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	0.20	0.10	t/ha	EC106	29-Jul-2022	30-Jul-2022	-
TGR (sodic)	----	0.66	0.10	t/ha	EC106	29-Jul-2022	30-Jul-2022	-
% saturation	----	49.1	1.0	%	E141	29-Jul-2022	29-Jul-2022	583206
calcium, soluble ion content	7440-70-2	39.4	10.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
calcium, soluble ion content	7440-70-2	19.3	5	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	77.8	10.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
magnesium, soluble ion content	7439-95-4	38.2	5	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	<10.0 DLDS,	10.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
potassium, soluble ion content	7440-09-7	<5.0	5	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	374	10.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
sodium, soluble ion content	17341-25-2	184	5	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	1080	12.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
sulfur (as SO4), soluble ion content	14808-79-8	530	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	<20	20	mg/L	E266.Cl	29-Jul-2022	30-Jul-2022	583205
chloride, soluble ion content	16887-00-6	<10	10	mg/kg	EC266A.Cl	29-Jul-2022	30-Jul-2022	-
Volatile Organic Compounds [Fuels]								
benzene	71-43-2	<0.0050	0.0050	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
ethylbenzene	100-41-4	<0.015	0.015	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
toluene	108-88-3	<0.050	0.050	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylene, m+p-	179601-23-1	<0.030	0.030	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylene, o-	95-47-6	<0.030	0.030	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylenes, total	1330-20-7	<0.050	0.05	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
BTEX, total	----	<0.10	0.1	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
Volatile Organic Compounds Surrogates								
bromofluorobenzene, 4-	460-00-4	95.7	0.10	%	E611A	28-Jul-2022	29-Jul-2022	580210
difluorobenzene, 1,4-	540-36-3	78.8	0.10	%	E611A	28-Jul-2022	29-Jul-2022	580210
Hydrocarbons								
chromatogram to baseline at nC50	n/a	Yes	-	-	E601.SG	26-Jul-2022	27-Jul-2022	577449
F1 (C6-C10)	----	<5.0	5.0	mg/kg	E581.F1	28-Jul-2022	29-Jul-2022	580211
F2 (C10-C16)	----	<25	25	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F3 (C16-C34)	----	<50	50	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449

Analytical Results

EO2205809-021

Sub-Matrix:**Soil** Client sample ID: BH22-07, S3, 1.5 M

(Matrix: **Soil/Solid)** Client sampling date / time: 21-Jul-2022 07:55

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Hydrocarbons								
F4 (C34-C50)	----	<50	50	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
TEH (C10-C50)	----	<75	75	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
TEH (C16-C50)	----	<75	75	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F1-BTEX	----	<5.0	5	mg/kg	EC580	-	31-Jul-2022	-
Hydrocarbons Surrogates								
bromobenzotrifluoride, 2- (F2-F4 surr)	392-83-6	85.5	1.0	%	E601.SG	26-Jul-2022	27-Jul-2022	577449
dichlorotoluene, 3,4-	97-75-0	70.1	1.0	%	E581.F1	28-Jul-2022	29-Jul-2022	580211

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-022

Sub-Matrix:**Soil** Client sample ID: BH22-15, S1, 0.3 M

(Matrix: **Soil/Solid)** Client sampling date / time: 22-Jul-2022 11:30

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
pH (1:2 soil:CaCl2-aq)	----	7.77	0.10	pH units	E108B	30-Jul-2022	30-Jul-2022	584196
Saturated Paste Extractables								
conductivity, saturated paste	----	4.25	0.010	dS/m	E102	29-Jul-2022	29-Jul-2022	583204
sodium adsorption ratio [SAR]	----	2.25	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	29-Jul-2022	30-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	29-Jul-2022	30-Jul-2022	-
% saturation	----	52.9	1.0	%	E141	29-Jul-2022	29-Jul-2022	583206
calcium, soluble ion content	7440-70-2	383	10.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
calcium, soluble ion content	7440-70-2	203	5.3	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	353	10.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
magnesium, soluble ion content	7439-95-4	187	5.3	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	27.5	10.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
potassium, soluble ion content	7440-09-7	14.5	5.3	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	254	10.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
sodium, soluble ion content	17341-25-2	134	5.3	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	2880	12.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
sulfur (as SO4), soluble ion content	14808-79-8	1520	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	<20	20	mg/L	E266.Cl	29-Jul-2022	30-Jul-2022	583205
chloride, soluble ion content	16887-00-6	<10	10	mg/kg	EC266A.Cl	29-Jul-2022	30-Jul-2022	-

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-023

Sub-Matrix:**Soil** Client sample ID: BH22-15, S2, 0.8 M

(Matrix: **Soil/Solid)** Client sampling date / time: 22-Jul-2022 11:30

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								

Analytical Results

EO2205809-023

Sub-Matrix:**Soil** *Client sample ID:* BH22-15, S2, 0.8 M

(Matrix: **Soil/Solid**) *Client sampling date / time:* 22-Jul-2022 11:30

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
pH (1:2 soil:CaCl2-aq)	----	7.78	0.10	pH units	E108B	30-Jul-2022	30-Jul-2022	584196
Saturated Paste Extractables								
conductivity, saturated paste	----	2.51	0.010	dS/m	E102	29-Jul-2022	29-Jul-2022	583204
sodium adsorption ratio [SAR]	----	2.92	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	29-Jul-2022	30-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	29-Jul-2022	30-Jul-2022	-
% saturation	----	49.9	1.0	%	E141	29-Jul-2022	29-Jul-2022	583206
calcium, soluble ion content	7440-70-2	192	5.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
calcium, soluble ion content	7440-70-2	95.8	5	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	158	5.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
magnesium, soluble ion content	7439-95-4	78.8	5	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	22.1	5.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
potassium, soluble ion content	7440-09-7	11.0	5	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	226	5.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
sodium, soluble ion content	17341-25-2	113	5	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	1540	6	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
sulfur (as SO4), soluble ion content	14808-79-8	768	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	<20	20	mg/L	E266.Cl	29-Jul-2022	30-Jul-2022	583205
chloride, soluble ion content	16887-00-6	<10	10	mg/kg	EC266A.Cl	29-Jul-2022	30-Jul-2022	-

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-024

Sub-Matrix:**Soil** *Client sample ID:* BH22-15, S3, 1.5 M

(Matrix: **Soil/Solid**) *Client sampling date / time:* 22-Jul-2022 11:30

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
moisture	----	13.3	0.25	%	E144	-	26-Jul-2022	577372
pH (1:2 soil:CaCl2-aq)	----	7.76	0.10	pH units	E108B	30-Jul-2022	30-Jul-2022	584196
Saturated Paste Extractables								
conductivity, saturated paste	----	1.32	0.010	dS/m	E102	29-Jul-2022	29-Jul-2022	583204
sodium adsorption ratio [SAR]	----	2.27	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	29-Jul-2022	30-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	29-Jul-2022	30-Jul-2022	-
% saturation	----	49.3	1.0	%	E141	29-Jul-2022	29-Jul-2022	583206
calcium, soluble ion content	7440-70-2	107	5.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
calcium, soluble ion content	7440-70-2	52.8	5	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	53.1	5.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
magnesium, soluble ion content	7439-95-4	26.2	5	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	16.4	5.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
potassium, soluble ion content	7440-09-7	8.1	5	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	115	5.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
sodium, soluble ion content	17341-25-2	56.7	5	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	665	6	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
sulfur (as SO4), soluble ion content	14808-79-8	328	8	mg/kg	EC485	-	30-Jul-2022	-

Analytical Results

EO2205809-024

Sub-Matrix: **Soil** — *Client sample ID:* BH22-15, S3, 1.5 M

(Matrix: **Soil/Solid**) — *Client sampling date / time:* 22-Jul-2022 11:30

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Saturated Paste Extractables								
chloride, soluble ion content	16887-00-6	<20	20	mg/L	E266.Cl	29-Jul-2022	30-Jul-2022	583205
chloride, soluble ion content	16887-00-6	<10	10	mg/kg	EC266A.Cl	29-Jul-2022	30-Jul-2022	-
Volatile Organic Compounds [Fuels]								
benzene	71-43-2	<0.0050	0.0050	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
ethylbenzene	100-41-4	<0.015	0.015	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
toluene	108-88-3	<0.050	0.050	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylene, m+p-	179601-23-1	<0.030	0.030	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylene, o-	95-47-6	<0.030	0.030	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylenes, total	1330-20-7	<0.050	0.05	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
BTEX, total	----	<0.10	0.1	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
Volatile Organic Compounds Surrogates								
bromofluorobenzene, 4-	460-00-4	108	0.10	%	E611A	28-Jul-2022	29-Jul-2022	580210
difluorobenzene, 1,4-	540-36-3	96.3	0.10	%	E611A	28-Jul-2022	29-Jul-2022	580210
Hydrocarbons								
chromatogram to baseline at nC50	n/a	Yes	-	-	E601.SG	26-Jul-2022	27-Jul-2022	577449
F1 (C6-C10)	----	<5.0	5.0	mg/kg	E581.F1	28-Jul-2022	29-Jul-2022	580211
F2 (C10-C16)	----	<25	25	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F3 (C16-C34)	----	<50	50	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F4 (C34-C50)	----	<50	50	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
TEH (C10-C50)	----	<75	75	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
TEH (C16-C50)	----	<75	75	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F1-BTEX	----	<5.0	5	mg/kg	EC580	-	31-Jul-2022	-
Hydrocarbons Surrogates								
bromobenzotrifluoride, 2- (F2-F4 surr)	392-83-6	87.5	1.0	%	E601.SG	26-Jul-2022	27-Jul-2022	577449
dichlorotoluene, 3,4-	97-75-0	110	1.0	%	E581.F1	28-Jul-2022	29-Jul-2022	580211

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-025

Sub-Matrix: **Soil** — *Client sample ID:* BH22-17, S1, 0.3 M

(Matrix: **Soil/Solid**) — *Client sampling date / time:* 20-Jul-2022 06:50

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
pH (1:2 soil:CaCl2-aq)	----	7.71	0.10	pH units	E108B	30-Jul-2022	30-Jul-2022	584196
Saturated Paste Extractables								
conductivity, saturated paste	----	1.86	0.010	dS/m	E102	29-Jul-2022	29-Jul-2022	583204
sodium adsorption ratio [SAR]	----	0.92	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	29-Jul-2022	30-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	29-Jul-2022	30-Jul-2022	-
% saturation	----	49.0	1.0	%	E141	29-Jul-2022	29-Jul-2022	583206
calcium, soluble ion content	7440-70-2	155	5.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
calcium, soluble ion content	7440-70-2	76.0	5	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	198	5.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
magnesium, soluble ion content	7439-95-4	97.0	5	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	9.5	5.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207

Analytical Results

EO2205809-025

Sub-Matrix: **Soil** | Client sample ID: BH22-17, S1, 0.3 M
(Matrix: **Soil/Solid**) | Client sampling date / time: 20-Jul-2022 06:50

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Saturated Paste Extractables								
potassium, soluble ion content	7440-09-7	<5.0	5	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	73.1	5.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
sodium, soluble ion content	17341-25-2	35.8	5	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	1190	6	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
sulfur (as SO4), soluble ion content	14808-79-8	583	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	<20	20	mg/L	E266.Cl	29-Jul-2022	30-Jul-2022	583205
chloride, soluble ion content	16887-00-6	<10	10	mg/kg	EC266A.Cl	29-Jul-2022	30-Jul-2022	-

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-026

Sub-Matrix: **Soil** | Client sample ID: BH22-17, S2, 0.8 M
(Matrix: **Soil/Solid**) | Client sampling date / time: 20-Jul-2022 06:50

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
pH (1:2 soil:CaCl2-aq)	----	8.15	0.10	pH units	E108B	30-Jul-2022	30-Jul-2022	584196
Saturated Paste Extractables								
conductivity, saturated paste	----	3.05	0.010	dS/m	E102	29-Jul-2022	29-Jul-2022	583204
sodium adsorption ratio [SAR]	----	1.80	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	29-Jul-2022	30-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	29-Jul-2022	30-Jul-2022	-
% saturation	----	50.4	1.0	%	E141	29-Jul-2022	29-Jul-2022	583206
calcium, soluble ion content	7440-70-2	187	10.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
calcium, soluble ion content	7440-70-2	94.2	5.0	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	259	10.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
magnesium, soluble ion content	7439-95-4	130	5.0	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	12.5	10.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
potassium, soluble ion content	7440-09-7	6.3	5.0	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	162	10.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
sodium, soluble ion content	17341-25-2	81.6	5.0	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	1880	12.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
sulfur (as SO4), soluble ion content	14808-79-8	948	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	<20	20	mg/L	E266.Cl	29-Jul-2022	30-Jul-2022	583205
chloride, soluble ion content	16887-00-6	<10	10	mg/kg	EC266A.Cl	29-Jul-2022	30-Jul-2022	-

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2205809-027

Sub-Matrix: **Soil** | Client sample ID: BH22-17, S3, 1.5 M
(Matrix: **Soil/Solid**) | Client sampling date / time: 20-Jul-2022 06:50

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								

Analytical Results

EO2205809-027

Sub-Matrix:**Soil** — *Client sample ID:* BH22-17, S3, 1.5 M

(Matrix: **Soil/Solid**) — *Client sampling date / time:* 20-Jul-2022 06:50

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
moisture	----	12.3	0.25	%	E144	-	26-Jul-2022	577372
pH (1:2 soil:CaCl2-aq)	----	7.99	0.10	pH units	E108B	30-Jul-2022	30-Jul-2022	584196
Saturated Paste Extractables								
conductivity, saturated paste	----	6.89	0.010	dS/m	E102	29-Jul-2022	29-Jul-2022	583204
sodium adsorption ratio [SAR]	----	3.32	0.10	-	EC102	-	30-Jul-2022	-
TGR (brine)	----	<0.10	0.10	t/ha	EC106	29-Jul-2022	30-Jul-2022	-
TGR (sodic)	----	<0.10	0.10	t/ha	EC106	29-Jul-2022	30-Jul-2022	-
% saturation	----	50.3	1.0	%	E141	29-Jul-2022	29-Jul-2022	583206
calcium, soluble ion content	7440-70-2	452 RRV,	5.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
calcium, soluble ion content	7440-70-2	227	5	mg/kg	EC485	-	30-Jul-2022	-
magnesium, soluble ion content	7439-95-4	966 RRV,	5.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
magnesium, soluble ion content	7439-95-4	486	5	mg/kg	EC485	-	30-Jul-2022	-
potassium, soluble ion content	7440-09-7	30.4 RRV,	5.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
potassium, soluble ion content	7440-09-7	15.3	5	mg/kg	EC485	-	30-Jul-2022	-
sodium, soluble ion content	17341-25-2	546 RRV,	5.0	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
sodium, soluble ion content	17341-25-2	275	5	mg/kg	EC485	-	30-Jul-2022	-
sulfur (as SO4), soluble ion content	14808-79-8	6050 RRV,	6	mg/L	E485	29-Jul-2022	30-Jul-2022	583207
sulfur (as SO4), soluble ion content	14808-79-8	3040	8	mg/kg	EC485	-	30-Jul-2022	-
chloride, soluble ion content	16887-00-6	<20	20	mg/L	E266.Cl	29-Jul-2022	30-Jul-2022	583205
chloride, soluble ion content	16887-00-6	<10	10	mg/kg	EC266A.Cl	29-Jul-2022	30-Jul-2022	-
Volatile Organic Compounds [Fuels]								
benzene	71-43-2	<0.0050	0.0050	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
ethylbenzene	100-41-4	<0.015	0.015	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
toluene	108-88-3	<0.050	0.050	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylene, m+p-	179601-23-1	<0.030	0.030	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylene, o-	95-47-6	<0.030	0.030	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
xylenes, total	1330-20-7	<0.050	0.05	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
BTEX, total	----	<0.10	0.1	mg/kg	E611A	28-Jul-2022	29-Jul-2022	580210
Volatile Organic Compounds Surrogates								
bromofluorobenzene, 4-	460-00-4	109	0.10	%	E611A	28-Jul-2022	29-Jul-2022	580210
difluorobenzene, 1,4-	540-36-3	91.8	0.10	%	E611A	28-Jul-2022	29-Jul-2022	580210
Hydrocarbons								
chromatogram to baseline at nC50	n/a	Yes	-	-	E601.SG	26-Jul-2022	27-Jul-2022	577449
F1 (C6-C10)	----	<5.0	5.0	mg/kg	E581.F1	28-Jul-2022	29-Jul-2022	580211
F2 (C10-C16)	----	<25	25	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F3 (C16-C34)	----	<50	50	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F4 (C34-C50)	----	<50	50	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
TEH (C10-C50)	----	<75	75	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
TEH (C16-C50)	----	<75	75	mg/kg	E601.SG	26-Jul-2022	27-Jul-2022	577449
F1-BTEX	----	<5.0	5	mg/kg	EC580	-	31-Jul-2022	-
Hydrocarbons Surrogates								
bromobenzotrifluoride, 2- (F2-F4 surr)	392-83-6	87.2	1.0	%	E601.SG	26-Jul-2022	27-Jul-2022	577449
dichlorotoluene, 3,4-	97-75-0	105	1.0	%	E581.F1	28-Jul-2022	29-Jul-2022	580211

Please refer to the General Comments section for an explanation of any qualifiers detected.

QUALITY CONTROL REPORT

Work Order	: **EO2205809**	Page	: 1 of 10
Client	: SolidEarth Geotechnical Inc.	Laboratory	: Edmonton - Environmental
Contact	: Jay Jaber	Account Manager	: Dana Brown
Address	: 4336 97 Street Edmonton AB Canada T6E 5R9	Address	: 9450 - 17 Avenue NW Edmonton, Alberta Canada T6N 1M9
Telephone	: 780-340-9040	Telephone	: 7804136472
Project	: PG21-1603.3000	Date Samples Received	: 25-Jul-2022 15:57
PO	: ----	Date Analysis Commenced	: 26-Jul-2022
C-O-C number	: SEG 22-038	Issue Date	: 02-Aug-2022 10:49
Sampler	: PR		
Site	: Major Arena Events Center - Detailed Investigation		
Quote number	: ----		
No. of samples received	: 27		
No. of samples analysed	: 27		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Reference Material (RM) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Fahad Husain	Lab Assistant	Edmonton Inorganics, Edmonton, Alberta
Jessica Maitland	Lab Assistant	Edmonton Inorganics, Edmonton, Alberta
Joan Wu	Lab Analyst	Edmonton Metals, Edmonton, Alberta
Krystal During	Lab Assistant	Edmonton Organics, Edmonton, Alberta
Ping Yeung	Team Leader - Inorganics	Edmonton Inorganics, Edmonton, Alberta
Ping Yeung	Team Leader - Inorganics	Edmonton Metals, Edmonton, Alberta
Shruti Mudliar	Lab Analyst	Edmonton Inorganics, Edmonton, Alberta
Uyen Munro	Lab Analyst	Edmonton Organics, Edmonton, Alberta

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percent Difference
# = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Physical Tests (QC Lot: 577372)											
EO2205809-003	BH22-01, S3, 1.5 M	moisture	----	E144	0.25	%	9.55	9.67	1.23%	20%	----
Physical Tests (QC Lot: 578849)											
EO2205809-001	BH22-01, S1, 0.3 M	pH (1:2 soil:CaCl2-aq)	----	E108B	0.10	pH units	8.04	8.01	0.374%	3%	----
Physical Tests (QC Lot: 584196)											
EO2205640-019	Anonymous	pH (1:2 soil:CaCl2-aq)	----	E108B	0.10	pH units	7.96	7.93	0.378%	3%	----
Saturated Paste Extractables (QC Lot: 578832)											
EO2205809-010	BH22-04, S1, 0.3 M	conductivity, saturated paste	----	E102	10	µS/cm	0.567 dS/m	675	17.4%	20%	----
Saturated Paste Extractables (QC Lot: 578833)											
EO2205809-010	BH22-04, S1, 0.3 M	chloride, soluble ion content	16887-00-6	E266.Cl	20	mg/L	<20	<20	0	Diff <2x LOR	----
Saturated Paste Extractables (QC Lot: 578834)											
EO2205809-010	BH22-04, S1, 0.3 M	% saturation	----	E141	1.0	%	52.0	51.0	2.03%	20%	----
Saturated Paste Extractables (QC Lot: 578835)											
EO2205809-010	BH22-04, S1, 0.3 M	calcium, soluble ion content	7440-70-2	E485	5.0	mg/L	14.9	13.5	1.3	Diff <2x LOR	----
		magnesium, soluble ion content	7439-95-4	E485	5.0	mg/L	5.7	5.8	0.07	Diff <2x LOR	----
		potassium, soluble ion content	7440-09-7	E485	5.0	mg/L	<5.0	<5.0	0	Diff <2x LOR	----
		sodium, soluble ion content	17341-25-2	E485	5.0	mg/L	122	140	14.0%	30%	----
		sulfur (as SO4), soluble ion content	14808-79-8	E485	6	mg/L	70.4	77.3	9.33%	30%	----
Saturated Paste Extractables (QC Lot: 583204)											
EO2205640-019	Anonymous	conductivity, saturated paste	----	E102	10	µS/cm	6.11 dS/m	5840	4.52%	20%	----
Saturated Paste Extractables (QC Lot: 583205)											
EO2205640-019	Anonymous	chloride, soluble ion content	16887-00-6	E266.Cl	20	mg/L	63	57	6	Diff <2x LOR	----
Saturated Paste Extractables (QC Lot: 583206)											
EO2205640-019	Anonymous	% saturation	----	E141	1.0	%	74.1	76.0	2.58%	20%	----
Saturated Paste Extractables (QC Lot: 583207)											
EO2205640-019	Anonymous	calcium, soluble ion content	7440-70-2	E485	10.0	mg/L	380	397	4.41%	30%	----
		magnesium, soluble ion content	7439-95-4	E485	10.0	mg/L	461	472	2.42%	30%	----
		potassium, soluble ion content	7440-09-7	E485	10.0	mg/L	17.2	18.0	0.9	Diff <2x LOR	----
		sodium, soluble ion content	17341-25-2	E485	10.0	mg/L	533	547	2.59%	30%	----
		sulfur (as SO4), soluble ion content	14808-79-8	E485	12.0	mg/L	3800	3920	3.10%	30%	----
Volatile Organic Compounds (QC Lot: 580210)											
EO2205809-003	BH22-01, S3, 1.5 M	benzene	71-43-2	E611A	0.0050	mg/kg	<0.0050	<0.0050	0	Diff <2x LOR	----

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Volatile Organic Compounds (QC Lot: 580210) - continued											
EO2205809-003	BH22-01, S3, 1.5 M	ethylbenzene	100-41-4	E611A	0.015	mg/kg	<0.015	<0.015	0	Diff <2x LOR	----
		toluene	108-88-3	E611A	0.050	mg/kg	<0.050	<0.050	0	Diff <2x LOR	----
		xylene, m+p-	179601-23-1	E611A	0.030	mg/kg	<0.030	<0.030	0	Diff <2x LOR	----
		xylene, o-	95-47-6	E611A	0.030	mg/kg	<0.030	<0.030	0	Diff <2x LOR	----
Hydrocarbons (QC Lot: 577449)											
EO2205809-003	BH22-01, S3, 1.5 M	F2 (C10-C16)	----	E601.SG	25	mg/kg	<25	<25	0	Diff <2x LOR	----
		F3 (C16-C34)	----	E601.SG	50	mg/kg	<50	<50	0	Diff <2x LOR	----
		F4 (C34-C50)	----	E601.SG	50	mg/kg	<50	<50	0	Diff <2x LOR	----
Hydrocarbons (QC Lot: 580211)											
EO2205809-003	BH22-01, S3, 1.5 M	F1 (C6-C10)	----	E581.F1	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Soil/Solid**

Analyte	*CAS Number*	*Method*	*LOR*	*Unit*	*Result*	*Qualifier*
Physical Tests (QCLot: 577372)						
moisture	----	E144	0.25	%	<0.25	----
Saturated Paste Extractables (QCLot: 578832)						
conductivity, saturated paste	----	E102	10	µS/cm	<10	----
Saturated Paste Extractables (QCLot: 578833)						
chloride, soluble ion content	16887-00-6	E266.Cl	20	mg/L	<20	----
Saturated Paste Extractables (QCLot: 578835)						
calcium, soluble ion content	7440-70-2	E485	5	mg/L	<5.0	----
magnesium, soluble ion content	7439-95-4	E485	5	mg/L	<5.0	----
potassium, soluble ion content	7440-09-7	E485	5	mg/L	<5.0	----
sodium, soluble ion content	17341-25-2	E485	5	mg/L	<5.0	----
sulfur (as SO4), soluble ion content	14808-79-8	E485	6	mg/L	<6.0	----
Saturated Paste Extractables (QCLot: 583204)						
conductivity, saturated paste	----	E102	10	µS/cm	<10	----
Saturated Paste Extractables (QCLot: 583205)						
chloride, soluble ion content	16887-00-6	E266.Cl	20	mg/L	<20	----
Saturated Paste Extractables (QCLot: 583207)						
calcium, soluble ion content	7440-70-2	E485	5	mg/L	<5.0	----
magnesium, soluble ion content	7439-95-4	E485	5	mg/L	<5.0	----
potassium, soluble ion content	7440-09-7	E485	5	mg/L	<5.0	----
sodium, soluble ion content	17341-25-2	E485	5	mg/L	<5.0	----
sulfur (as SO4), soluble ion content	14808-79-8	E485	6	mg/L	<6.0	----
Volatile Organic Compounds (QCLot: 580210)						
benzene	71-43-2	E611A	0.005	mg/kg	<0.0050	----
ethylbenzene	100-41-4	E611A	0.015	mg/kg	<0.015	----
toluene	108-88-3	E611A	0.05	mg/kg	<0.050	----
xylene, m+p-	179601-23-1	E611A	0.03	mg/kg	<0.030	----
xylene, o-	95-47-6	E611A	0.03	mg/kg	<0.030	----
Hydrocarbons (QCLot: 577449)						
F2 (C10-C16)	----	E601.SG	25	mg/kg	<25	----
F3 (C16-C34)	----	E601.SG	50	mg/kg	<50	----
F4 (C34-C50)	----	E601.SG	50	mg/kg	<50	----
Hydrocarbons (QCLot: 580211)						
F1 (C6-C10)	----	E581.F1	5	mg/kg	<5.0	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	*CAS Number*	*Method*	*LOR*	*Unit*	*Concentration*	*LCS*	*Low*	*High*	*Qualifier*
Physical Tests (QCLot: 577372)									
moisture	----	E144	0.25	%	50 %	98.8	90.0	110	----
Physical Tests (QCLot: 578849)									
pH (1:2 soil:CaCl2-aq)	----	E108B	----	pH units	6 pH units	100	97.0	103	----
Physical Tests (QCLot: 584196)									
pH (1:2 soil:CaCl2-aq)	----	E108B	----	pH units	6 pH units	100	97.0	103	----
Saturated Paste Extractables (QCLot: 578832)									
conductivity, saturated paste	----	E102	10	µS/cm	1412 µS/cm	98.9	80.0	120	----
Saturated Paste Extractables (QCLot: 578833)									
chloride, soluble ion content	16887-00-6	E266.Cl	20	mg/L	100 mg/L	112	80.0	120	----
Saturated Paste Extractables (QCLot: 578834)									
% saturation	----	E141	----	%	100 %	96.9	80.0	120	----
Saturated Paste Extractables (QCLot: 578835)									
calcium, soluble ion content	7440-70-2	E485	5	mg/L	50 mg/L	102	80.0	120	----
magnesium, soluble ion content	7439-95-4	E485	5	mg/L	50 mg/L	105	80.0	120	----
potassium, soluble ion content	7440-09-7	E485	5	mg/L	50 mg/L	103	80.0	120	----
sodium, soluble ion content	17341-25-2	E485	5	mg/L	50 mg/L	103	80.0	120	----
sulfur (as SO4), soluble ion content	14808-79-8	E485	6	mg/L	150 mg/L	92.9	80.0	120	----
Saturated Paste Extractables (QCLot: 583204)									
conductivity, saturated paste	----	E102	10	µS/cm	1412 µS/cm	99.5	80.0	120	----
Saturated Paste Extractables (QCLot: 583205)									
chloride, soluble ion content	16887-00-6	E266.Cl	20	mg/L	100 mg/L	103	80.0	120	----
Saturated Paste Extractables (QCLot: 583206)									
% saturation	----	E141	----	%	100 %	101	80.0	120	----
Saturated Paste Extractables (QCLot: 583207)									
calcium, soluble ion content	7440-70-2	E485	5	mg/L	50 mg/L	87.6	80.0	120	----
magnesium, soluble ion content	7439-95-4	E485	5	mg/L	50 mg/L	106	80.0	120	----
potassium, soluble ion content	7440-09-7	E485	5	mg/L	50 mg/L	105	80.0	120	----
sodium, soluble ion content	17341-25-2	E485	5	mg/L	50 mg/L	104	80.0	120	----
sulfur (as SO4), soluble ion content	14808-79-8	E485	6	mg/L	150 mg/L	103	80.0	120	----
Volatile Organic Compounds (QCLot: 580210)									
benzene	71-43-2	E611A	0.005	mg/kg	2.5 mg/kg	97.4	70.0	130	----
ethylbenzene	100-41-4	E611A	0.015	mg/kg	2.5 mg/kg	79.8	70.0	130	----

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Volatile Organic Compounds (QCLot: 580210) - continued									
toluene	108-88-3	E611A	0.05	mg/kg	2.5 mg/kg	90.4	70.0	130	----
xylene, m+p-	179601-23-1	E611A	0.03	mg/kg	5 mg/kg	89.8	70.0	130	----
xylene, o-	95-47-6	E611A	0.03	mg/kg	2.5 mg/kg	94.1	70.0	130	----
Hydrocarbons (QCLot: 577449)									
F2 (C10-C16)	----	E601.SG	25	mg/kg	576 mg/kg	116	70.0	130	----
F3 (C16-C34)	----	E601.SG	50	mg/kg	1184 mg/kg	113	70.0	130	----
F4 (C34-C50)	----	E601.SG	50	mg/kg	904 mg/kg	113	70.0	130	----
Hydrocarbons (QCLot: 580211)									
F1 (C6-C10)	----	E581.F1	5	mg/kg	86 mg/kg	88.3	70.0	130	----

Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Soil/Solid**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Volatile Organic Compounds (QCLot: 580210)										
EO2205809-006	BH22-02, S3, 1.5 M	benzene	71-43-2	E611A	1.91 mg/kg	2.5 mg/kg	125	60.0	140	----
		ethylbenzene	100-41-4	E611A	1.50 mg/kg	2.5 mg/kg	98.7	60.0	140	----
		toluene	108-88-3	E611A	1.73 mg/kg	2.5 mg/kg	113	60.0	140	----
		xylene, m+p-	179601-23-1	E611A	3.30 mg/kg	5 mg/kg	108	60.0	140	----
		xylene, o-	95-47-6	E611A	1.75 mg/kg	2.5 mg/kg	115	60.0	140	----

Reference Material (RM) Report

A Reference Material (RM) is a homogenous material with known and well-established analyte concentrations. RMs are processed in an identical manner to test samples, and are used to monitor and control the accuracy and precision of a test method for a typical sample matrix. RM results are expressed as percent recovery of the target analyte concentration. RM targets may be certified target concentrations provided by the RM supplier, or may be ALS long-term mean values (for empirical test methods).

Sub-Matrix:

					Reference Material (RM) Report				
					RM Target	Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method	Concentration	RM	Low	High	Qualifier
Physical Tests (QCLot: 578849)									
	RM	pH (1:2 soil:CaCl2-aq)	----	E108B	7.82 pH units	99.0	96.0	104	----
Physical Tests (QCLot: 584196)									
	RM	pH (1:2 soil:CaCl2-aq)	----	E108B	7.82 pH units	99.0	96.0	104	----
Saturated Paste Extractables (QCLot: 578832)									
	RM	conductivity, saturated paste	----	E102	5970 µS/cm	103	80.0	120	----
Saturated Paste Extractables (QCLot: 578833)									
	RM	chloride, soluble ion content	16887-00-6	E266.Cl	1237 mg/L	100.0	70.0	130	----
Saturated Paste Extractables (QCLot: 578834)									
	RM	% saturation	----	E141	48.3 %	97.6	70.0	130	----
Saturated Paste Extractables (QCLot: 578835)									
	RM	calcium, soluble ion content	7440-70-2	E485	776 mg/L	83.0	70.0	130	----
	RM	magnesium, soluble ion content	7439-95-4	E485	261 mg/L	85.1	70.0	130	----
	RM	potassium, soluble ion content	7440-09-7	E485	111 mg/L	96.0	70.0	130	----
	RM	sodium, soluble ion content	17341-25-2	E485	330 mg/L	91.4	70.0	130	----
	RM	sulfur (as SO4), soluble ion content	14808-79-8	E485	1841 mg/L	85.8	70.0	130	----
Saturated Paste Extractables (QCLot: 583204)									
	RM	conductivity, saturated paste	----	E102	5970 µS/cm	96.8	80.0	120	----
Saturated Paste Extractables (QCLot: 583205)									
	RM	chloride, soluble ion content	16887-00-6	E266.Cl	1237 mg/L	87.7	70.0	130	----
Saturated Paste Extractables (QCLot: 583206)									
	RM	% saturation	----	E141	48.3 %	95.0	70.0	130	----
Saturated Paste Extractables (QCLot: 583207)									
	RM	calcium, soluble ion content	7440-70-2	E485	776 mg/L	82.6	70.0	130	----
	RM	magnesium, soluble ion content	7439-95-4	E485	261 mg/L	85.2	70.0	130	----
	RM	potassium, soluble ion content	7440-09-7	E485	111 mg/L	102	70.0	130	----
	RM	sodium, soluble ion content	17341-25-2	E485	330 mg/L	101	70.0	130	----
	RM	sulfur (as SO4), soluble ion content	14808-79-8	E485	1841 mg/L	93.7	70.0	130	----
Hydrocarbons (QCLot: 577449)									
	RM	F2 (C10-C16)	----	E601.SG	4316 mg/kg	88.0	70.0	130	----

Sub-Matrix:

					Reference Material (RM) Report				
					RM Target	Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	*Reference Material ID*	*Analyte*	*CAS Number*	*Method*	*Concentration*	*RM*	*Low*	*High*	*Qualifier*
Hydrocarbons (QCLot: 577449) - continued									
	RM	F3 (C16-C34)	----	E601.SG	12844 mg/kg	97.3	70.0	130	----
	RM	F4 (C34-C50)	----	E601.SG	1156 mg/kg	87.0	70.0	130	----

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Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

COC Number: ~~21-~~ SEG 22-038

Page 1 of 3

Report To Contact and company name below will appear on the final report

Company: SolidEarth Geotechnical Inc.
Contact: Jay Jaber
Phone: 780-340-9040

Company address below will appear on the final report

Street: 4336 97 Street
City/Province: Edmonton, AB
Postal Code: T6E 5R9

Invoice To Same as Report To ☑ YES ☐ NO
Copy of Invoice with Report ☐ YES ☐ NO
Company:
Contact:

Reports / Recipients

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Merge QC/QCI Reports with COA ☑ YES ☐ NO ☐ N/A
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax jjaber@solidearth.ca
Email 2 Tleeley@solidearth.ca
Email 3 akhamis@solidearth.ca

Invoice Recipients

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax Same as above
Email 2

Turnaround Time (TAT) Requested

☑ Routine [R] if received by 3pm M-F - no surcharges apply
☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum
☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum
☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum
☐ 1 day [F] if received by 3pm M-F - 100% rush surcharge minimum
☐ Same day [E2] if received by 10am M-S - 200% rush surcharge.

Additional fees may apply to rush requests on weekends, statutory holidays and for non-routine tests

Date and Time Required for all E&P TATs:

For all tests with rush TATs requested, please contact your AM to confirm availability.

AFFIX ALS BARCODE LABEL HERE
(ALS use only)

Project Information

ALS Account # / Quote #:
Job #: PG21-1603.3000
PO / AFE:
LSD: Major Arena Events Centre - Detailed Investigation

Oil and Gas Required Fields (client use)

AFE/Cost Center:
PO#
Major/Minor Code:
Routing Code:
Requisitioner:
Location:

ALS Lab Work Order # (ALS use only): EO2205809

ALS Contact: Dana Brown
Sampler: Prarthik

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Salinity	BTEX, F1 - F4	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
1	BH22-01, S1, 0.3 m	21-Jul-22	11:10	Soil	1	R				
2	BH22-01, S2, 0.8 m	21-Jul-22	11:10	Soil	1	R				
3	BH22-01, S3, 1.5 m	21-Jul-22	11:10	Soil	4	R	R			
4	BH22-02, S1, 0.3 m	19-Jul-22	12:30	Soil	1	R				
5	BH22-02, S2, 0.8 m	19-Jul-22	12:30	Soil	1	R				
6	BH22-02, S3, 1.5 m	19-Jul-22	12:30	Soil	4	R	R			
7	BH22-03, S1, 0.3 m	21-Jul-22	6:50	Soil	1	R				
8	BH22-03, S2, 0.8 m	21-Jul-22	6:50	Soil	1	R				
9	BH22-03, S3, 1.1 m	21-Jul-22	6:50	Soil	4	R	R			
10	BH22-04, S1, 0.3 m	20-Jul-22	3:45	Soil	1	R				
11	BH22-04, S2, 0.8 m	20-Jul-22	3:45	Soil	1	R				
12	BH22-04, S3, 1.5 m	20-Jul-22	3:45	Soil	4	R	R			

Environmental Division
Edmonton
Work Order Reference
EO2205809

Telephone : +1 780 413 5227

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?
☐ YES ☐ NO
Are samples for human consumption/ use?
☐ YES ☐ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below
(Excel COC only)

SAMPLE RECEI

Cooling Method: ☐ NONE ☑ ICE ☑ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED
Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO
Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A
INITIAL COOLER TEMPERATURES °C: 5.8
FINAL COOLER TEMPERATURES °C:

SHIPMENT RELEASE (client use)
Time:

INITIAL SHIPMENT RECEPTION (ALS use only)
Received by:
Date: 25-July-22
Time: 12:30pm

FINAL SHIPMENT RECEPTION (ALS use only)
Received by:
Date:
Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

COC Number: ~~24.~~ SEG 22- 038

Page 2 of 3

Report To	Contact and company name below will appear on the final report	
Company:	SolidEarth Geotechnical Inc.	
Contact:	Jay Jaber	
Phone:	780-340-9040	
	Company address below will appear on the final report	
Street:	4336 97 Street	
City/Province:	Edmonton, AB	
Postal Code:	T6E 5R9	
Invoice To	Same as Report To	☑ YES ☐ NO
	Copy of Invoice with Report	☐ YES ☐ NO
Company:		
Contact:		

Reports / Recipients

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Merge QC/QCI Reports with COA ☑ YES ☐ NO ☐ N/A

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax jjaber@solidearth.ca

Email 2 Tfeeley@solidearth.ca

Email 3 akhamis@solidearth.ca

Invoice Recipients

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax Same as above

Email 2

Turnaround Time (TAT) Requested

- ☑ Routine [R] if received by 3pm M-F - no surcharges apply
- ☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum
- ☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum
- ☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum
- ☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum
- ☐ Same day [E2] if received by 10am M-S - 200% rush surcharge.

AFFIX ALS BARCODE LABEL HERE (ALS use only)

Additional fees may apply to rush requests on weekends, statutory holidays and for non-routine tests.

Date and Time Required for all E&P TATs:

For all tests with rush TATs requested, please contact your AM to confirm availability.

Project Information

ALS Account # / Quote #:

Job #: PG21-1603.3000

PO / AFE:

LSD: Major Arena Events Centre - Detailed Investigation

Oil and Gas Required Fields (client use)

AFE/Cost Center:
PO#
Major/Minor Code:
Routing Code:
Requisitioner:
Location:

ALS Lab Work Order # (ALS use only):

ALS Contact: Dana Brown

Sampler: Prarthik

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Salinity		BTEX, F1 - F4	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
13	BH22-05, S1, 0.3 m	20-Jul-22	6:50	Soil	1	R					
14	BH22-05, S2, 0.8 m	20-Jul-22	6:50	Soil	1	R					
15	BH22-05, S3, 1.5 m	20-Jul-22	6:50	Soil	4	R		R			
16	BH22-06, S1, 0.3 m	21-Jul-22	3:10	Soil	1	R					
17	BH22-06, S2, 0.8 m	21-Jul-22	3:10	Soil	1	R					
18	BH22-06 S2, 1.5 m	21-Jul-22	3:10	Soil	4	R		R			
19	BH22-07, S1, 0.3 m	21-Jul-22	7:55	Soil	1	R					
20	BH22-07, S2, 0.8 m	21-Jul-22	7:55	Soil	1	R					
21	BH22-07, S3, 1.5 m	21-Jul-22	7:55	Soil	4	R		R			
22	BH22-15, S1, 0.3 m	22-Jul-22	11:30	Soil	1	R					
23	BH22-15, S2, 0.8 m	22-Jul-22	11:30	Soil	1	R					
24	BH22-15, S3, 1.5 m	22-Jul-22	11:30	Soil	4	R		R			

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

☐ YES ☐ NO

Are samples for human consumption/ use?

☐ YES ☐ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☐ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C

FINAL COOLER TEMPERATURES °C

SHIPMENT RELEASE (client use)

Time:

INITIAL SHIPMENT RECEPTION (ALS use only)

Received by:
Date:
Time:

FINAL SHIPMENT RECEPTION (ALS use only)

Received by:
Date:
Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

COC Number: ~~243~~ SEG 22-038

Page 3 of 3

Report To Contact and company name below will appear on the final report

Company: SolidEarth Geotechnical Inc.
Contact: Jay Jaber
Phone: 780-340-9040

Company address below will appear on the final report

Street: 4336 97 Street
City/Province: Edmonton, AB
Postal Code: T6E 5R9

Invoice To Same as Report To ☑ YES ☐ NO
Copy of Invoice with Report ☐ YES ☐ NO
Company:
Contact:

Reports / Recipients

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Merge QC/QCI Reports with COA ☑ YES ☐ NO ☐ N/A
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax jjaber@solidearth.ca
Email 2 Tfeeley@solidearth.ca
Email 3 akhamis@solidearth.ca

Invoice Recipients

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax Same as above
Email 2

Turnaround Time (TAT) Requested

☑ Routine [R] if received by 3pm M-F - no surcharges apply
☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum
☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum
☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum
☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum
☐ Same day [E2] if received by 10am M-S - 200% rush surcharge.

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(ALS use only)

Additional fees may apply to rush requests on weekends, statutory holidays and for non-routine tests

Date and Time Required for all E&P TATs:

For all tests with rush TATs requested, please contact your AM to confirm availability.

Project Information

ALS Account # / Quote #:
Job #: PG21-1603.3000
PO / AFE:
LSD: Major Arena Events Centre - Detailed Investigation

Oil and Gas Required Fields (client use)

AFE/Cost Center:
PO#
Major/Minor Code:
Routing Code:
Requisitioner:
Location:

ALS Lab Work Order # (ALS use only):

ALS Contact: Dana Brown
Sampler: Prathik

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Salinity		BTEX, F1 - F4	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
25	BH22-17, S1, 0.3 m	20-Jul-22	6:50	Soil	1	R					
26	BH22-17, S2, 0.8 m	20-Jul-22	6:50	Soil	1	R					
27	BH22-17, S3, 1.5 m	20-Jul-22	6:50	Soil	4	R		R			

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?
☐ YES ☐ NO
Are samples for human consumption/ use?
☐ YES ☐ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below
(Excel COC only)

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☐ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED
Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO
Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A
INITIAL COOLER TEMPERATURES °C
FINAL COOLER TEMPERATURES °C

SHIPMENT RELEASE (client use)
Time:

INITIAL SHIPMENT RECEPTION (ALS use only)
Received by:
Date:
Time:

FINAL SHIPMENT RECEPTION (ALS use only)
Received by:
Date:
Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

CERTIFICATE OF ANALYSIS

Work Order : **EO2206195**

Client : **SolidEarth Geotechnical Inc.**

Contact : Jay Jaber

Address : 4336 97 Street
Edmonton AB Canada T6E 5R9

Telephone : 780-340-9040

Project : ----

PO : ----

C-O-C number : SEG22-041

Sampler : AK

Site : ----

Quote number : Groundwater Sampling at Edgerton Lagoon (EQ22-003

No. of samples received : 3

No. of samples analysed : 3

Page : 1 of 6

Laboratory : Edmonton - Environmental

Account Manager : Dana Brown

Address : 9450 - 17 Avenue NW
Edmonton AB Canada T6N 1M9

Telephone : 7804136472

Date Samples Received : 05-Aug-2022 21:02

Date Analysis Commenced : 06-Aug-2022

Issue Date : 13-Aug-2022 14:25

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Alex Drake	Lab Analyst	Inorganics, Edmonton, Alberta
Dan Nguyen	Team Leader - Inorganics	Metals, Edmonton, Alberta
Jessica Maitland	Lab Assistant	Inorganics, Edmonton, Alberta
Kari Mulroy	Lab Supervisor - Environmental	Organics, Edmonton, Alberta
Samantha Mayor	Lab Assistant	Metals, Edmonton, Alberta
Yan Zhang	Lab Analyst	Organics, Edmonton, Alberta

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.
Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	No Unit
%	percent
µg/L	micrograms per litre
µS/cm	Microsiemens per centimetre
meq/L	milliequivalents per litre
mg/L	milligrams per litre
pH units	pH units

>: greater than.

<: less than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Qualifiers

Qualifier	*Description*
DLDS	*Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.*
DLM	*Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).*

Analytical Results

EO2206195-001

Sub-Matrix:**Water**

(Matrix: **Water)**

Client sample ID: MW22-04

Client sampling date / time: 03-Aug-2022 13:00

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
alkalinity, bicarbonate (as HCO3)	71-52-3	594	1.0	mg/L	E290	06-Aug-2022	06-Aug-2022	591259
alkalinity, carbonate (as CO3)	3812-32-6	<1.0	1.0	mg/L	E290	06-Aug-2022	06-Aug-2022	591259
alkalinity, hydroxide (as OH)	14280-30-9	<1.0	1.0	mg/L	E290	06-Aug-2022	06-Aug-2022	591259
alkalinity, total (as CaCO3)	----	487	1.0	mg/L	E290	06-Aug-2022	06-Aug-2022	591259
conductivity	----	5810	1.0	µS/cm	E100	06-Aug-2022	06-Aug-2022	591257
pH	----	7.94	0.10	pH units	E108	06-Aug-2022	06-Aug-2022	591258
solids, total dissolved [TDS], calculated	----	5220	1.0	mg/L	EC103	-	07-Aug-2022	-
Anions and Nutrients								
chloride	16887-00-6	598 DLDS,	2.50	mg/L	E235.Cl	06-Aug-2022	06-Aug-2022	591481
fluoride	16984-48-8	0.341 DLDS,	0.100	mg/L	E235.F	06-Aug-2022	06-Aug-2022	591482
nitrate (as N)	14797-55-8	<0.100 DLDS,	0.100	mg/L	E235.NO3	06-Aug-2022	06-Aug-2022	591478
nitrate + nitrite (as N)	----	<0.112	0.112	mg/L	EC235.N+N	-	07-Aug-2022	-
nitrite (as N)	14797-65-0	0.076 DLDS,	0.050	mg/L	E235.NO2	06-Aug-2022	06-Aug-2022	591479
sulfate (as SO4)	14808-79-8	2830 DLDS,	1.50	mg/L	E235.SO4	06-Aug-2022	06-Aug-2022	591480
Metals								
sodium adsorption ratio [SAR]	----	5.18	0.10	-	EC102A	-	11-Aug-2022	-
Ion Balance								
anion sum	----	85.5	0.10	meq/L	EC101	-	07-Aug-2022	-
cation sum	----	83.7	0.10	meq/L	EC101	-	07-Aug-2022	-
ion balance (APHA)	----	1.06	0.010	%	EC101	-	07-Aug-2022	-
ion balance (cations/anions)	----	97.9	0.010	%	EC101	-	07-Aug-2022	-
Dissolved Metals								
calcium, dissolved	7440-70-2	406	0.250	mg/L	E421	11-Aug-2022	11-Aug-2022	597803
iron, dissolved	7439-89-6	<0.050 DLM,	0.050	mg/L	E421	11-Aug-2022	11-Aug-2022	597803
magnesium, dissolved	7439-95-4	434	0.0250	mg/L	E421	11-Aug-2022	11-Aug-2022	597803
manganese, dissolved	7439-96-5	0.875	0.00050	mg/L	E421	11-Aug-2022	11-Aug-2022	597803
potassium, dissolved	7440-09-7	11.2	0.250	mg/L	E421	11-Aug-2022	11-Aug-2022	597803
sodium, dissolved	7440-23-5	630	0.250	mg/L	E421	11-Aug-2022	11-Aug-2022	597803
dissolved metals filtration location	----	Laboratory	-	-	EP421	-	11-Aug-2022	597803
Volatile Organic Compounds								
benzene	71-43-2	<0.50	0.50	µg/L	E611A	09-Aug-2022	09-Aug-2022	594001
ethylbenzene	100-41-4	<0.50	0.50	µg/L	E611A	09-Aug-2022	09-Aug-2022	594001
toluene	108-88-3	<0.50	0.50	µg/L	E611A	09-Aug-2022	09-Aug-2022	594001
xylene, m+p-	179601-23-1	<0.40	0.40	µg/L	E611A	09-Aug-2022	09-Aug-2022	594001
xylene, o-	95-47-6	<0.30	0.30	µg/L	E611A	09-Aug-2022	09-Aug-2022	594001
xylenes, total	1330-20-7	<0.50	0.50	µg/L	E611A	09-Aug-2022	09-Aug-2022	594001
Volatile Organic Compounds Surrogates								
bromofluorobenzene, 4-	460-00-4	84.4	1.0	%	E611A	09-Aug-2022	09-Aug-2022	594001
difluorobenzene, 1,4-	540-36-3	91.8	1.0	%	E611A	09-Aug-2022	09-Aug-2022	594001
Hydrocarbons								
F1 (C6-C10)	----	<100	100	µg/L	E581.F1	09-Aug-2022	09-Aug-2022	594000
F1-BTEX	----	<100	100	µg/L	EC580	-	10-Aug-2022	-
F2 (C10-C16)	----	<100	100	µg/L	E601	08-Aug-2022	08-Aug-2022	592631
Hydrocarbons Surrogates								
bromobenzotrifluoride, 2- (F2-F4 surr)	392-83-6	101	1.0	%	E601	08-Aug-2022	08-Aug-2022	592631
dichlorotoluene, 3,4-	97-75-0	87.0	1.0	%	E581.F1	09-Aug-2022	09-Aug-2022	594000

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2206195-002

Sub-Matrix: **Water** — *Client sample ID:* MW22-06

(Matrix: **Water**) — *Client sampling date / time:* 03-Aug-2022 12:45

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
alkalinity, bicarbonate (as HCO3)	71-52-3	466	1.0	mg/L	E290	06-Aug-2022	06-Aug-2022	591259
alkalinity, carbonate (as CO3)	3812-32-6	2.5	1.0	mg/L	E290	06-Aug-2022	06-Aug-2022	591259
alkalinity, hydroxide (as OH)	14280-30-9	<1.0	1.0	mg/L	E290	06-Aug-2022	06-Aug-2022	591259
alkalinity, total (as CaCO3)	----	386	1.0	mg/L	E290	06-Aug-2022	06-Aug-2022	591259
conductivity	----	3830	1.0	µS/cm	E100	06-Aug-2022	06-Aug-2022	591257
pH	----	8.30	0.10	pH units	E108	06-Aug-2022	06-Aug-2022	591258
solids, total dissolved [TDS], calculated	----	3780	1.0	mg/L	EC103	-	07-Aug-2022	-
Anions and Nutrients								
chloride	16887-00-6	39.0 DLDS,	2.50	mg/L	E235.Cl	06-Aug-2022	06-Aug-2022	591481
fluoride	16984-48-8	0.463 DLDS,	0.100	mg/L	E235.F	06-Aug-2022	06-Aug-2022	591482
nitrate (as N)	14797-55-8	0.491 DLDS,	0.100	mg/L	E235.NO3	06-Aug-2022	06-Aug-2022	591478
nitrate + nitrite (as N)	----	0.491	0.112	mg/L	EC235.N+N	-	07-Aug-2022	-
nitrite (as N)	14797-65-0	<0.050 DLDS,	0.050	mg/L	E235.NO2	06-Aug-2022	06-Aug-2022	591479
sulfate (as SO4)	14808-79-8	2390 DLDS,	1.50	mg/L	E235.SO4	06-Aug-2022	06-Aug-2022	591480
Metals								
sodium adsorption ratio [SAR]	----	3.11	0.10	-	EC102A	-	12-Aug-2022	-
Ion Balance								
anion sum	----	58.6	0.10	meq/L	EC101	-	07-Aug-2022	-
cation sum	----	60.0	0.10	meq/L	EC101	-	07-Aug-2022	-
ion balance (APHA)	----	1.18	0.010	%	EC101	-	07-Aug-2022	-
ion balance (cations/anions)	----	102	0.010	%	EC101	-	07-Aug-2022	-
Dissolved Metals								
calcium, dissolved	7440-70-2	510	0.100	mg/L	E421	11-Aug-2022	11-Aug-2022	597803
iron, dissolved	7439-89-6	<0.020 DLM,	0.020	mg/L	E421	11-Aug-2022	11-Aug-2022	597803
magnesium, dissolved	7439-95-4	237	0.0100	mg/L	E421	11-Aug-2022	11-Aug-2022	597803
manganese, dissolved	7439-96-5	0.632	0.00020	mg/L	E421	11-Aug-2022	11-Aug-2022	597803
potassium, dissolved	7440-09-7	12.6	0.100	mg/L	E421	11-Aug-2022	11-Aug-2022	597803
sodium, dissolved	7440-23-5	339	0.100	mg/L	E421	11-Aug-2022	11-Aug-2022	597803
dissolved metals filtration location	----	Laboratory	-	-	EP421	-	11-Aug-2022	597803
Volatile Organic Compounds								
benzene	71-43-2	<0.50	0.50	µg/L	E611A	09-Aug-2022	09-Aug-2022	594001
ethylbenzene	100-41-4	<0.50	0.50	µg/L	E611A	09-Aug-2022	09-Aug-2022	594001
toluene	108-88-3	0.54	0.50	µg/L	E611A	09-Aug-2022	09-Aug-2022	594001
xylene, m+p-	179601-23-1	<0.40	0.40	µg/L	E611A	09-Aug-2022	09-Aug-2022	594001
xylene, o-	95-47-6	<0.30	0.30	µg/L	E611A	09-Aug-2022	09-Aug-2022	594001
xylenes, total	1330-20-7	<0.50	0.50	µg/L	E611A	09-Aug-2022	09-Aug-2022	594001
Volatile Organic Compounds Surrogates								
bromofluorobenzene, 4-	460-00-4	81.8	1.0	%	E611A	09-Aug-2022	09-Aug-2022	594001
difluorobenzene, 1,4-	540-36-3	89.4	1.0	%	E611A	09-Aug-2022	09-Aug-2022	594001
Hydrocarbons								
F1 (C6-C10)	----	<100	100	µg/L	E581.F1	09-Aug-2022	09-Aug-2022	594000
F1-BTEX	----	<100	100	µg/L	EC580	-	10-Aug-2022	-
F2 (C10-C16)	----	<100	100	µg/L	E601	08-Aug-2022	08-Aug-2022	592631
Hydrocarbons Surrogates								
bromobenzotrifluoride, 2- (F2-F4 surr)	392-83-6	100	1.0	%	E601	08-Aug-2022	08-Aug-2022	592631
dichlorotoluene, 3,4-	97-75-0	82.9	1.0	%	E581.F1	09-Aug-2022	09-Aug-2022	594000

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

EO2206195-003

Sub-Matrix: **Water**
(Matrix: **Water**)

Client sample ID: MW22-15
Client sampling date / time: 03-Aug-2022 13:15

Analyte	*CAS Number*	*Result*	*LOR*	*Unit*	*Method*	*Prep Date*	*Analysis Date*	*QCLot*
Physical Tests								
alkalinity, bicarbonate (as HCO3)	71-52-3	523	1.0	mg/L	E290	06-Aug-2022	06-Aug-2022	591259
alkalinity, carbonate (as CO3)	3812-32-6	<1.0	1.0	mg/L	E290	06-Aug-2022	06-Aug-2022	591259
alkalinity, hydroxide (as OH)	14280-30-9	<1.0	1.0	mg/L	E290	06-Aug-2022	06-Aug-2022	591259
alkalinity, total (as CaCO3)	----	429	1.0	mg/L	E290	06-Aug-2022	06-Aug-2022	591259
conductivity	----	2350	1.0	µS/cm	E100	06-Aug-2022	06-Aug-2022	591257
pH	----	7.92	0.10	pH units	E108	06-Aug-2022	06-Aug-2022	591258
solids, total dissolved [TDS], calculated	----	2010	1.0	mg/L	EC103	-	07-Aug-2022	-
Anions and Nutrients								
chloride	16887-00-6	22.1 DLDS,	2.50	mg/L	E235.Cl	06-Aug-2022	06-Aug-2022	591481
fluoride	16984-48-8	0.395 DLDS,	0.100	mg/L	E235.F	06-Aug-2022	06-Aug-2022	591482
nitrate (as N)	14797-55-8	0.340 DLDS,	0.100	mg/L	E235.NO3	06-Aug-2022	06-Aug-2022	591478
nitrate + nitrite (as N)	----	1.20	0.112	mg/L	EC235.N+N	-	07-Aug-2022	-
nitrite (as N)	14797-65-0	0.860 DLDS,	0.050	mg/L	E235.NO2	06-Aug-2022	06-Aug-2022	591479
sulfate (as SO4)	14808-79-8	1150 DLDS,	1.50	mg/L	E235.SO4	06-Aug-2022	06-Aug-2022	591480
Metals								
sodium adsorption ratio [SAR]	----	1.54	0.10	-	EC102A	-	12-Aug-2022	-
Ion Balance								
anion sum	----	33.2	0.10	meq/L	EC101	-	07-Aug-2022	-
cation sum	----	30.7	0.10	meq/L	EC101	-	07-Aug-2022	-
ion balance (APHA)	----	3.91	0.010	%	EC101	-	07-Aug-2022	-
ion balance (cations/anions)	----	92.5	0.010	%	EC101	-	07-Aug-2022	-
Dissolved Metals								
calcium, dissolved	7440-70-2	317	0.100	mg/L	E421	11-Aug-2022	11-Aug-2022	597803
iron, dissolved	7439-89-6	<0.020 DLM,	0.020	mg/L	E421	11-Aug-2022	11-Aug-2022	597803
magnesium, dissolved	7439-95-4	112	0.0100	mg/L	E421	11-Aug-2022	11-Aug-2022	597803
manganese, dissolved	7439-96-5	0.155	0.00020	mg/L	E421	11-Aug-2022	11-Aug-2022	597803
potassium, dissolved	7440-09-7	10.7	0.100	mg/L	E421	11-Aug-2022	11-Aug-2022	597803
sodium, dissolved	7440-23-5	125	0.100	mg/L	E421	11-Aug-2022	11-Aug-2022	597803
dissolved metals filtration location	----	Laboratory	-	-	EP421	-	11-Aug-2022	597803
Volatile Organic Compounds								
benzene	71-43-2	<0.50	0.50	µg/L	E611A	09-Aug-2022	09-Aug-2022	594001
ethylbenzene	100-41-4	<0.50	0.50	µg/L	E611A	09-Aug-2022	09-Aug-2022	594001
toluene	108-88-3	<0.50	0.50	µg/L	E611A	09-Aug-2022	09-Aug-2022	594001
xylene, m+p-	179601-23-1	<0.40	0.40	µg/L	E611A	09-Aug-2022	09-Aug-2022	594001
xylene, o-	95-47-6	<0.30	0.30	µg/L	E611A	09-Aug-2022	09-Aug-2022	594001
xylenes, total	1330-20-7	<0.50	0.50	µg/L	E611A	09-Aug-2022	09-Aug-2022	594001
Volatile Organic Compounds Surrogates								
bromofluorobenzene, 4-	460-00-4	84.4	1.0	%	E611A	09-Aug-2022	09-Aug-2022	594001
difluorobenzene, 1,4-	540-36-3	92.4	1.0	%	E611A	09-Aug-2022	09-Aug-2022	594001
Hydrocarbons								
F1 (C6-C10)	----	<100	100	µg/L	E581.F1	09-Aug-2022	09-Aug-2022	594000
F1-BTEX	----	<100	100	µg/L	EC580	-	10-Aug-2022	-
F2 (C10-C16)	----	<100	100	µg/L	E601	08-Aug-2022	08-Aug-2022	592631
Hydrocarbons Surrogates								
bromobenzotrifluoride, 2- (F2-F4 surr)	392-83-6	101	1.0	%	E601	08-Aug-2022	08-Aug-2022	592631
dichlorotoluene, 3,4-	97-75-0	91.6	1.0	%	E581.F1	09-Aug-2022	09-Aug-2022	594000

Please refer to the General Comments section for an explanation of any qualifiers detected.

QUALITY CONTROL REPORT

Work Order : **EO2206195**

Client : SolidEarth Geotechnical Inc.
Contact : Jay Jaber
Address : 4336 97 Street
Edmonton AB Canada T6E 5R9
Telephone : 780-340-9040
Project : ----
PO : ----
C-O-C number : SEG22-041
Sampler : AK
Site : ----
Quote number : Groundwater Sampling at Edgerton Lagoon (EQ22-003
No. of samples received : 3
No. of samples analysed : 3

Page : 1 of 8

Laboratory : Edmonton - Environmental
Account Manager : Dana Brown
Address : 9450 - 17 Avenue NW
Edmonton, Alberta Canada T6N 1M9
Telephone : 7804136472
Date Samples Received : 05-Aug-2022 21:02
Date Analysis Commenced : 06-Aug-2022
Issue Date : 13-Aug-2022 14:23

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Alex Drake	Lab Analyst	Edmonton Inorganics, Edmonton, Alberta
Dan Nguyen	Team Leader - Inorganics	Edmonton Metals, Edmonton, Alberta
Jessica Maitland	Lab Assistant	Edmonton Inorganics, Edmonton, Alberta
Kari Mulroy	Lab Supervisor - Environmental	Edmonton Organics, Edmonton, Alberta
Samantha Mayor	Lab Assistant	Edmonton Metals, Edmonton, Alberta
Yan Zhang	Lab Analyst	Edmonton Organics, Edmonton, Alberta

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percent Difference
# = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Physical Tests (QC Lot: 591257)											
EO2206190-001	Anonymous	conductivity	----	E100	2.0	µS/cm	3740	3780	1.06%	10%	----
Physical Tests (QC Lot: 591258)											
EO2206190-001	Anonymous	pH	----	E108	0.10	pH units	7.92	7.81	1.40%	3%	----
Physical Tests (QC Lot: 591259)											
EO2206190-001	Anonymous	alkalinity, total (as CaCO3)	----	E290	2.0	mg/L	242	254	4.91%	20%	----
Anions and Nutrients (QC Lot: 591478)											
EO2206186-001	Anonymous	nitrate (as N)	14797-55-8	E235.NO3	0.020	mg/L	1.33	1.34	0.315%	20%	----
Anions and Nutrients (QC Lot: 591479)											
EO2206186-001	Anonymous	nitrite (as N)	14797-65-0	E235.NO2	0.010	mg/L	0.016	0.018	0.002	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 591480)											
EO2206186-001	Anonymous	sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L	372	371	0.319%	20%	----
Anions and Nutrients (QC Lot: 591481)											
EO2206186-001	Anonymous	chloride	16887-00-6	E235.Cl	0.50	mg/L	107	107	0.0841%	20%	----
Anions and Nutrients (QC Lot: 591482)											
EO2206186-001	Anonymous	fluoride	16984-48-8	E235.F	0.020	mg/L	0.210	0.207	1.44%	20%	----
Volatile Organic Compounds (QC Lot: 594001)											
EO2206128-006	Anonymous	benzene	71-43-2	E611A	0.50	µg/L	<0.00050 mg/L	<0.50	0	Diff <2x LOR	----
		ethylbenzene	100-41-4	E611A	0.50	µg/L	<0.00050 mg/L	<0.50	0	Diff <2x LOR	----
		toluene	108-88-3	E611A	0.50	µg/L	<0.00050 mg/L	<0.50	0	Diff <2x LOR	----
		xylene, m+p-	179601-23-1	E611A	0.40	µg/L	<0.00040 mg/L	<0.40	0	Diff <2x LOR	----
		xylene, o-	95-47-6	E611A	0.30	µg/L	<0.00030 mg/L	<0.30	0	Diff <2x LOR	----
Hydrocarbons (QC Lot: 594000)											
EO2206128-006	Anonymous	F1 (C6-C10)	----	E581.F1	100	µg/L	<0.10 mg/L	<100	0	Diff <2x LOR	----

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Water**

Analyte	*CAS Number*	*Method*	*LOR*	*Unit*	*Result*	*Qualifier*
Physical Tests (QCLot: 591257)						
conductivity	----	E100	1	µS/cm	1.2	----
Physical Tests (QCLot: 591259)						
alkalinity, total (as CaCO3)	----	E290	1	mg/L	<1.0	----
Anions and Nutrients (QCLot: 591478)						
nitrate (as N)	14797-55-8	E235.NO3	0.02	mg/L	<0.020	----
Anions and Nutrients (QCLot: 591479)						
nitrite (as N)	14797-65-0	E235.NO2	0.01	mg/L	<0.010	----
Anions and Nutrients (QCLot: 591480)						
sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	----
Anions and Nutrients (QCLot: 591481)						
chloride	16887-00-6	E235.Cl	0.5	mg/L	<0.50	----
Anions and Nutrients (QCLot: 591482)						
fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	----
Dissolved Metals (QCLot: 597803)						
calcium, dissolved	7440-70-2	E421	0.05	mg/L	<0.050	----
iron, dissolved	7439-89-6	E421	0.01	mg/L	<0.010	----
magnesium, dissolved	7439-95-4	E421	0.005	mg/L	<0.0050	----
manganese, dissolved	7439-96-5	E421	0.0001	mg/L	<0.00010	----
potassium, dissolved	7440-09-7	E421	0.05	mg/L	<0.050	----
sodium, dissolved	7440-23-5	E421	0.05	mg/L	<0.050	----
Volatile Organic Compounds (QCLot: 594001)						
benzene	71-43-2	E611A	0.5	µg/L	<0.50	----
ethylbenzene	100-41-4	E611A	0.5	µg/L	<0.50	----
toluene	108-88-3	E611A	0.5	µg/L	<0.50	----
xylene, m+p-	179601-23-1	E611A	0.4	µg/L	<0.40	----
xylene, o-	95-47-6	E611A	0.3	µg/L	<0.30	----
Hydrocarbons (QCLot: 592631)						
F2 (C10-C16)	----	E601	100	µg/L	<100	----
Hydrocarbons (QCLot: 594000)						
F1 (C6-C10)	----	E581.F1	100	µg/L	<100	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Water**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	*CAS Number*	*Method*	*LOR*	*Unit*	*Concentration*	*LCS*	*Low*	*High*	*Qualifier*
Physical Tests (QCLot: 591257)									
conductivity	----	E100	1	µS/cm	1412 µS/cm	98.1	90.0	110	----
Physical Tests (QCLot: 591258)									
pH	----	E108	----	pH units	6 pH units	102	97.0	103	----
Physical Tests (QCLot: 591259)									
alkalinity, total (as CaCO3)	----	E290	1	mg/L	500 mg/L	106	85.0	115	----
Anions and Nutrients (QCLot: 591478)									
nitrate (as N)	14797-55-8	E235.NO3	0.02	mg/L	2.5 mg/L	97.9	90.0	110	----
Anions and Nutrients (QCLot: 591479)									
nitrite (as N)	14797-65-0	E235.NO2	0.01	mg/L	0.5 mg/L	92.0	90.0	110	----
Anions and Nutrients (QCLot: 591480)									
sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	101	90.0	110	----
Anions and Nutrients (QCLot: 591481)									
chloride	16887-00-6	E235.Cl	0.5	mg/L	100 mg/L	97.6	90.0	110	----
Anions and Nutrients (QCLot: 591482)									
fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	103	90.0	110	----
Dissolved Metals (QCLot: 597803)									
calcium, dissolved	7440-70-2	E421	0.05	mg/L	50 mg/L	100	80.0	120	----
iron, dissolved	7439-89-6	E421	0.01	mg/L	1 mg/L	98.4	80.0	120	----
magnesium, dissolved	7439-95-4	E421	0.005	mg/L	50 mg/L	97.1	80.0	120	----
manganese, dissolved	7439-96-5	E421	0.0001	mg/L	0.25 mg/L	107	80.0	120	----
potassium, dissolved	7440-09-7	E421	0.05	mg/L	50 mg/L	100	80.0	120	----
sodium, dissolved	7440-23-5	E421	0.05	mg/L	50 mg/L	97.8	80.0	120	----
Volatile Organic Compounds (QCLot: 594001)									
benzene	71-43-2	E611A	0.5	µg/L	100 µg/L	92.4	70.0	130	----
ethylbenzene	100-41-4	E611A	0.5	µg/L	100 µg/L	97.9	70.0	130	----
toluene	108-88-3	E611A	0.5	µg/L	100 µg/L	91.3	70.0	130	----
xylene, m+p-	179601-23-1	E611A	0.4	µg/L	200 µg/L	103	70.0	130	----
xylene, o-	95-47-6	E611A	0.3	µg/L	100 µg/L	99.6	70.0	130	----
Hydrocarbons (QCLot: 592631)									
F2 (C10-C16)	----	E601	100	µg/L	3260 µg/L	112	70.0	130	----

Sub-Matrix: **Water**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Hydrocarbons (QCLot: 594000)									
F1 (C6-C10)	----	E581.F1	100	µg/L	2750 µg/L	102	70.0	130	----

Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Anions and Nutrients (QCLot: 591478)										
EO2206186-001	Anonymous	nitrate (as N)	14797-55-8	E235.NO3	2.44 mg/L	2.5 mg/L	97.7	75.0	125	----
Anions and Nutrients (QCLot: 591479)										
EO2206186-001	Anonymous	nitrite (as N)	14797-65-0	E235.NO2	0.523 mg/L	0.5 mg/L	105	75.0	125	----
Anions and Nutrients (QCLot: 591480)										
EO2206186-001	Anonymous	sulfate (as SO4)	14808-79-8	E235.SO4	ND mg/L	100 mg/L	ND	75.0	125	----
Anions and Nutrients (QCLot: 591481)										
EO2206186-001	Anonymous	chloride	16887-00-6	E235.Cl	ND mg/L	100 mg/L	ND	75.0	125	----
Anions and Nutrients (QCLot: 591482)										
EO2206186-001	Anonymous	fluoride	16984-48-8	E235.F	0.977 mg/L	1 mg/L	97.7	75.0	125	----
Dissolved Metals (QCLot: 597803)										
EO2206143-008	Anonymous	manganese, dissolved	7439-96-5	E421	0.0222 mg/L	0.02 mg/L	111	70.0	130	----
Volatile Organic Compounds (QCLot: 594001)										
EO2206128-013	Anonymous	benzene	71-43-2	E611A	93.0 µg/L	100 µg/L	93.0	50.0	140	----
		ethylbenzene	100-41-4	E611A	84.3 µg/L	100 µg/L	84.3	50.0	140	----
		toluene	108-88-3	E611A	91.0 µg/L	100 µg/L	91.0	50.0	140	----
		xylene, m+p-	179601-23-1	E611A	181 µg/L	200 µg/L	90.6	50.0	140	----
		xylene, o-	95-47-6	E611A	90.3 µg/L	100 µg/L	90.3	50.0	140	----

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC Number: ~~21~~ SEG22-041

Page 1 of 1

Report To — Contact and company name below will appear on the final report

Company: SolidEarth Geotechnical Inc.
Contact: Jay Jaber
Phone: 780-340-9040
Company address below will appear on the final report
Street: 4336 97 Street
City/Province: Edmonton, AB
Postal Code: T6E 5R9

Invoice To

Same as Report To ☑ YES ☐ NO
Copy of Invoice with Report ☐ YES ☐ NO
Company:
Contact:

Project Information

ALS Account # / Quote #:
Job #: PG21-1603.4000
PO / AFE: Major Arena Events Centre - Limited Phase II ESA
LSD:

ALS Lab Work Order # (ALS use only): E02206195

Reports / Recipients

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Merge QC/QCI Reports with COA ☑ YES ☐ NO ☐ N/A
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax jjaber@solidearth.ca
Email 2 Tfeeley@solidearth.ca
Email 3 akhamis@solidearth.ca

Invoice Recipients

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax Same as above
Email 2

Oil and Gas Required Fields (client use)

AFE/Cost Center:
PO#
Major/Minor Code:
Routing Code:
Requisitioner:
Location:

ALS Contact: Dana Brown
Sampler: Alex Khamis

Turnaround Time (TAT) Requested

☑ Routine [R] if received by 3pm M-F - no surcharges apply
☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum
☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum
☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum
☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum
☐ Same day [E2] if received by 10am M-S - 200% rush surcharge.

Additional fees may apply to rush requests on weekends, statutory holidays and for non-routine tests.

Date and Time Required for all E&P TATs:

For all tests with rush TATs requested, please contact your AM to confirm availability.

AFFIX ALS BARCODE LABEL HERE (ALS use only)

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Salinity		BTEX, F1 - F2 (P)	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
	MW22-04	3-Aug-22	13:00	Water	4	R		R			
	MW22-06	3-Aug-22	12:45	Water	4	R		R			
	MW22-15	3-Aug-22	13:15	Water	4	R		R			

Environmental Division
Edmonton
Work Order Reference
EO2206195

Telephone : +1 780 413 5227

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?
☐ YES ☐ NO
Are samples for human consumption/ use?
☐ YES ☐ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

SAMPLE RECEIPT

Cooling Method: ☐ NONE ☐ ICE ☐ ICE
Submission Comments identified on Sample R
Cooler Custody Seals Intact: ☐ YES ☐ N/A
INITIAL COOLER TEMPERATURES °C
8.5

SHIPMENT RELEASE (client use)				INITIAL SHIPMENT RECEPTION (ALS use only)			FINAL SHIPMENT RECEPTION (ALS use only)		
Alex Khamis	A. K	04-Aug-22	Time:	Received by:	Date: Aug 8	Time:	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Appendix D

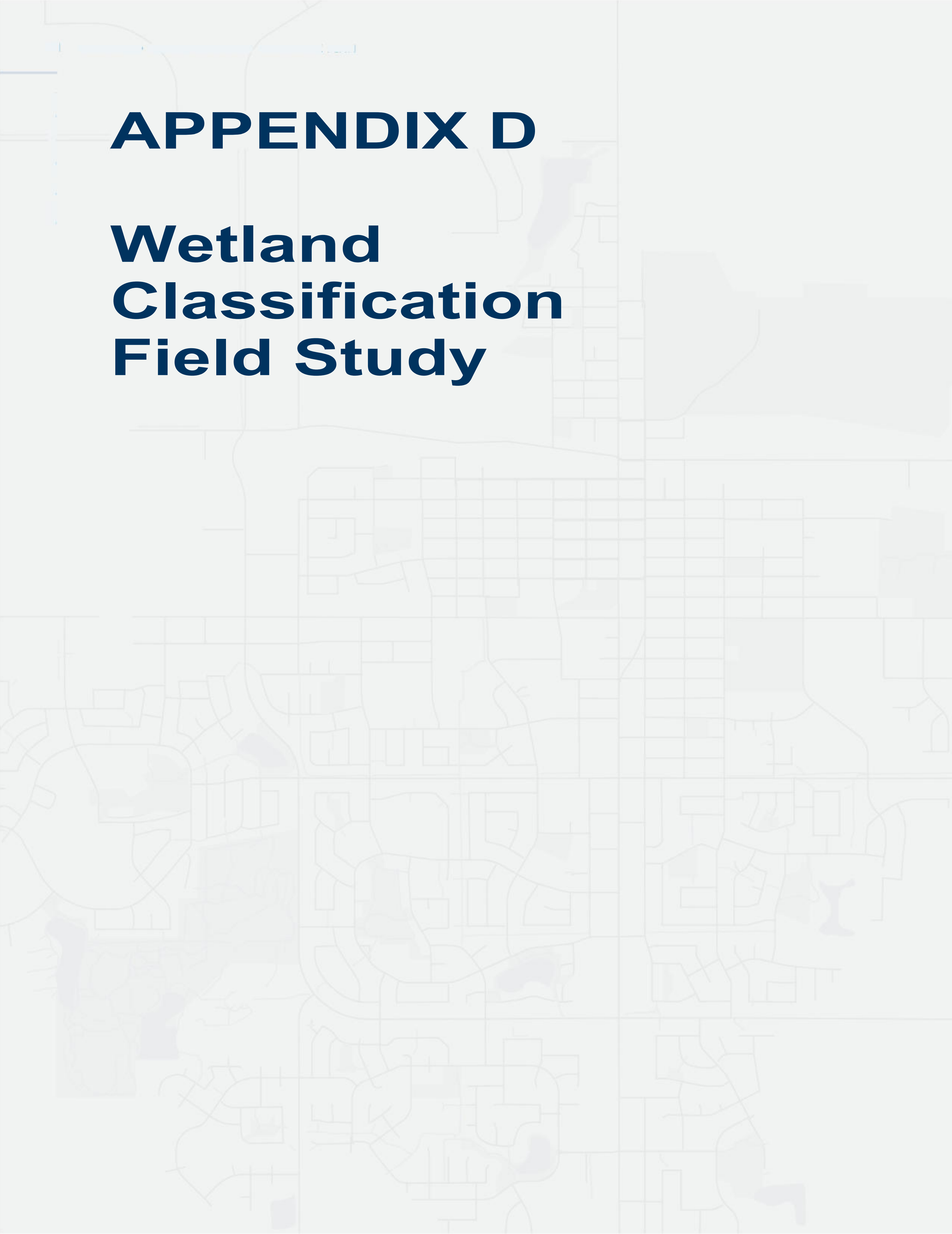
National Classification System for Contaminated Sites Pre-Screening

CCME National Classification System for Contaminated Sites (2008) version 1.3
Pre-Screening Checklist

Question	Response (yes / no)	Comment
1. Are **Radioactive material**, **Bacterial contamination** or **Biological hazards** likely to be present at the site?	No	If yes, do not proceed through the NCSCS. Contact applicable regulatory agency immediately.
2. Are there **no contamination exceedances** (known or suspected)? Determination of exceedances may be based on: 1) CCME environmental quality guidelines; 2) equivalent provincial guidelines/standards if no CCME guideline exists for a specific chemical in a relevant medium; or 3) toxicity benchmarks derived from the literature for chemicals not covered by CCME or provincial guidelines/standards; or 4) background concentration.	No	If yes (*i.e.* , there are no exceedances), do not proceed through the NCSCS.
3. Have **partial/incompleted or no environmental site investigations** been conducted for the Site?	Yes	If yes, do not proceed through the NCSCS.
4. Is there direct and significant evidence of **impacts to humans** at the site, or off-site due to migration of contaminants from the site?	No	If yes, automatically rate the site as Class 1, a priority for remediation or risk management, regardless of the total score obtained should one be calculated.
5. Is there direct and significant evidence of **impacts to ecological receptors** at the site, or off-site due to migration of contaminants from the site?	No	Some low levels of impact to ecological receptors are considered acceptable, particularly on commercial and industrial land uses. However, if ecological effects are considered to be severe, the site may be categorized as Class 1, regardless of the numerical total NCSCS score. For the purpose of application of the NCSCS, effects that would be considered severe include observed effects on survival, growth or reproduction which could threaten the viability of a population of ecological receptors at the site. Other evidence that qualifies as severe adverse effects may be determined based on professional judgement and in consultation with the relevant jurisdiction.
6. Are there indicators of significant **adverse effects in the exposure zone** (*i.e* ., the zone in which receptors may come into contact with contaminants)? Some examples are as follows: -Hydrocarbon sheen or NAPL in the exposure zone -Severely stressed biota or devoid of biota; -Presence of material at ground surface or sediment with suspected high concentration of contaminants such as ore tailings, sandblasting grit, slag, and coal tar.		To answer "yes", two scenarios should be satisfied; (1) there has to be a high probability that receptors will be exposed to the contaminant source in the near future, and (2) the predicted impacts to ecological receptors after exposure must be significant (see question 5). A low probability of exposure resulting in significant impacts, or a high probability of exposure but with only low to moderate effects expected should not result in a Class 1 designation, neither would a low probability of exposure resulting in low-to-moderate effects. If yes, automatically rate the site as Class 1, a priority for remediation or risk management, regardless of the total score obtained should one be calculated.
7. Do measured concentrations of volatiles or unexploded ordnances represent an **explosion hazard**?		If yes, do not proceed through the NCSCS. Do not continue until the safety risks have been addressed. Consult your jurisdiction's occupational health and safety guidance or legislation on exposive hazards and measurement of lower explosive limits.

APPENDIX D

Wetland Classification Field Study



Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

Version 1.0
Matrix 35197-533

August 23, 2022

Katlin Ducherer
CITY OF LLOYDMINSTER
4420 - 50 Ave.
Lloydminster, AB T9V 0W2

Subject: **Classification of Wetlands Located Within NW ¼ 36-049-28 W3M - Wigfield Area Structure Plan**

Dear Katlin Ducherer:

1 INTRODUCTION

The City of Lloydminster (the City) retained Matrix Solutions Inc. to conduct the classification of two wetlands located inside the city limits, within NW ¼ 36-049-28 W3M, associated with the Wigfield Area Structure Plan, which are referred to hereafter as Wetland 2 (W2) and Wetland 3 (W3). The location of W2 and W3 can be referenced on Figure 1. A desktop information review and field visit were conducted in support of the classification. This letter report summarizes the desktop information review and wetland field classification, including methods and wetland classification results.

2 METHODS

2.1 Regulatory

The City, given its unique position along the Alberta and Saskatchewan border, operates under the provincially recognized The Lloydminster Charter (Province of Alberta 2012). As such, activities associated with land development and water management are governed under Saskatchewan regulations (*The Planning and Development Act, 2007* [Government of Saskatchewan 2007] and *The Saskatchewan Watershed Authority Act* [Government of Saskatchewan 2005]). The province of Saskatchewan does not have a wetland policy in place at this time and overall wetland classification is completed using the Stewart and Kantrud (1971) system.

2.2 Desktop Information Review

A desktop analysis of historical aerial imagery using publicly available imagery was completed to classify W2 and W3 according to the Stewart and Kantrud (1971) classification system. Historical precipitation data for the closest station (Lloydminster) were obtained from Alberta Agriculture and Forestry and AgroClimatic Information Service for the period of 1955 to 2021 and were compiled and presented in graphical format to provide climatic context.

2.3 Field Assessment

On June 16, 2022, a Matrix vegetation ecologist visited the wetlands to classify them. Information was collected including presence of water, surrounding land use patterns, and any existing disturbances within the area. Representative photographs of the wetlands were taken. Dominant plant species present at the time of the field visit were identified according to field guides for the area (Lahring 2003, Moss 1996). Wetlands were classified according to the Stewart and Kantrud (1971) classification system.

3 RESULTS

3.1 Weather

Total annual precipitation (mm) was calculated from total monthly values and is presented on Figure A.

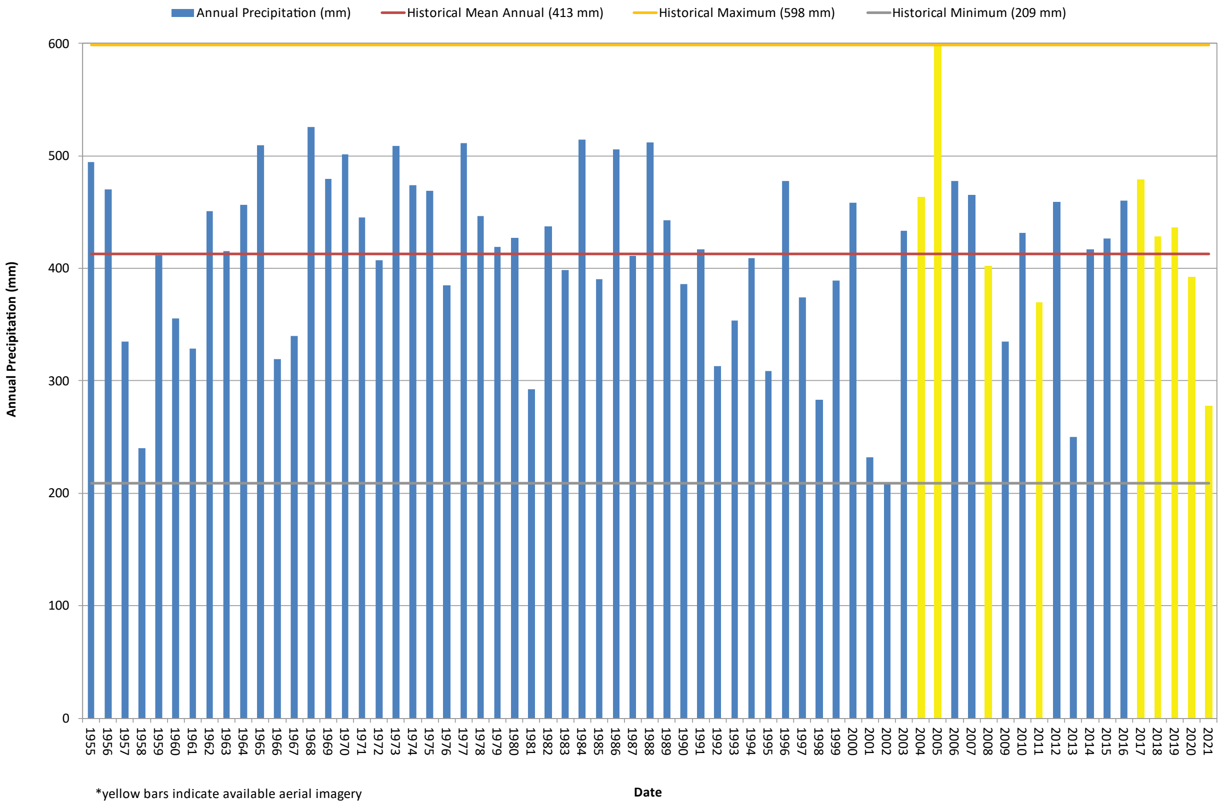


FIGURE A Historical Precipitation Data for 050-01 W4M from 1955 to 2021

3.2 Field Assessment

Descriptions of the wetlands are provided in the following subsections. Representative photographs are provided in Appendix A.

Wetland 2 (Dugout)

Wetland 2 is a dugout and its drainage has been modified by humans. Its shoreline is relatively steep sloped, which is typical of dugouts. It is unknown if the dugout was originally a wetland, but publicly available aerial photographs from as early as 1985 indicate that the dugout was in place.

Wetland 3

No standing water was present at Wetland 3 and dominant wetland vegetation species present were species of dock (*Rumex* sp.), reed canary grass (*Phalaris arundinacea*), spike-rush (*Eleocharis palustris*), cattail (*Typha latifolia*), wheat sedge (*Carex atherodes*), and willow species (*Salix* sp.). Evidence of cattle was observed along the shoreline and within the wetland.

3.3 Wetland Classification

Wetland classifications based on publicly available historical aerial imagery and weather data are presented in Table A. W2 is an anthropogenic dugout, which has surface water present year-round. Based on historical photographs provided by the City taken in 1949 and 1965, the dugout area was primarily upland with an ephemeral drainage and possibly a small wooded swamp (<0.25 ha or 200 m^2). W3 is a seasonal wetland that typically has water present for most of the growing season, but is dry by the end of August.

TABLE A Wetland Classification

Wetland	Class
2	Not a natural wetland
3	Class III (seasonal) wetland

4 CLOSURE

We trust that this letter report suits your present requirements. If you have any questions or comments, please call the undersigned at 403.237.0606.

Yours truly,

MATRIX SOLUTIONS INC.

Aileen Rhodes

Aileen Rhodes, M.Sc., P. Biol.
Principal Environmental Scientist

AR/scw
Attachments

DISCLAIMER

Matrix Solutions Inc. certifies that this report is accurate and complete and accords with the information available during the project. Information obtained during the project or provided by third parties is believed to be accurate but is not guaranteed. Matrix Solutions Inc. has exercised reasonable skill, care, and diligence in assessing the information obtained during the preparation of this report.

This report was prepared for the City of Lloydminster. The report may not be relied upon by any other person or entity without the written consent of Matrix Solutions Inc. and of the City of Lloydminster. Any uses of this report by a third party, or any reliance on decisions made based on it, are the responsibility of that party. Matrix Solutions Inc. is not responsible for damages or injuries incurred by any third party, as a result of decisions made or actions taken based on this report.

CONTRIBUTORS

Name	Job Title	Role
Aileen Rhodes, M.Sc., P. Biol.	Principal Environmental Scientist	Author
Kyle Parkyn, R.T.Ag. (Alberta)	Senior Environmental Technologist	Contributor

VERSION CONTROL

Version	Date	Issue Type	Filename	Description
V1.0	23-Aug-2022	Final	35197-533 Wigfield ASP LR 2022-08-23 final V1.0.docx	Issued to client

REFERENCES

Government of Saskatchewan. 2007. *The Planning and Development Act, 2007*. Chapter P-13.2 of the Statutes of Saskatchewan, 2007 (effective March 21, 2007) as amended by the Statutes of Saskatchewan, 2010, c.E-10.22, c.N-5.2 and c.36; 2012, c.28; 2013, c.C-21.1, c.R-9.11, c.23 and c.32; 2014, c.19; 2015, c.30; 2016, c.P-31.1; 2018, c.27; and 2019, c.8 and c.25. March 21, 2007.

Government of Saskatchewan (Government of Saskatchewan). 2005. *The Saskatchewan Watershed Authority Act*. Chapter S 35.03 of the Statues of Saskatchewan, effective May, 2005, as amended by the Statutes of Saskatchewan, 2006, c.34. Queen's Printer. http://www.qp.gov.sk.ca/documents/english/Chapters/2005/S35-03.pdf

Lahring H. 2003. *Water and Wetland Plants of the Prairie Provinces*. Canadian Plains Research Centre, University of Regina. Regina, Saskatchewan. 2003.

Moss E.H. 1996. *Flora of Alberta*. Second Edition. Revised by John G. Packer. University of Toronto Press. Toronto, Ontario. 1996.

Province of Alberta. 2012. *City of LLoydmister Act, The Lloydminster Charter*. Alberta Regulation 212/2012. Edmonton, Alberta. 2012. https://www.lloydminster.ca/en/living-in-lloydminster/resources/Documents/Lloydminster-Charter.pdf

Stewart R.E. and H.A. Kantrud. 1971. *Classification of Natural Ponds and Lakes in the Glaciated Prairie Region*. Resource Publication 92. Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, United States Department of the Interior. Washington, DC, USA. 1971.

🟥 Wigfield Area Structure Plan Boundary
— Highway
— Road
— Pipeline (Not Field Verified)
┼ Railway

Reference: Data obtained from Altalis © Government of Alberta used under license. GDM midstream and transportation infrastructure data provided by IHS © 2022 used under license. Imagery (2021) Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1:7,000 metres
50 0 50 100
NAD 1983 UTM Zone 12N

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

City of Lloydminster
Wigfield and Northeast Area Structure Plan Zones

Wigfield Area Structure Plan - Wetland Classification

Date:	Project:	Submitter:	Reviewer:
August 2022	35197	K. Parkyn	A. Rhodes

Disclaimer: The information contained herein may be compiled from numerous third party materials that are subject to periodic change without prior notification. While every effort has been made by Matrix Solutions Inc. to ensure the accuracy of the information presented at the time of publication, Matrix Solutions Inc. assumes no liability for any errors, omissions, or inaccuracies in the third party material.

Figure
1

I:\City of Lloydminster\35197\FiguresAndTables\WTM\2022\Report\Figure-1-Wigfield_Area_Structure_Plan_Wetland_Classification.mxd - Tabloid_L - 23-Aug-22, 04:46 PM - dbosak - TID005

APPENDIX A
Site Photographs

*Photographed on
June 16, 2022*

1. Wetland 2: Southeast corner of wetland viewing north

*Photographed on
June 16, 2022*

2. Wetland 2: Southeast corner of wetland viewing northeast

*Photographed on
June 16, 2022*

3. Wetland 3: Central portion of wetland viewing north

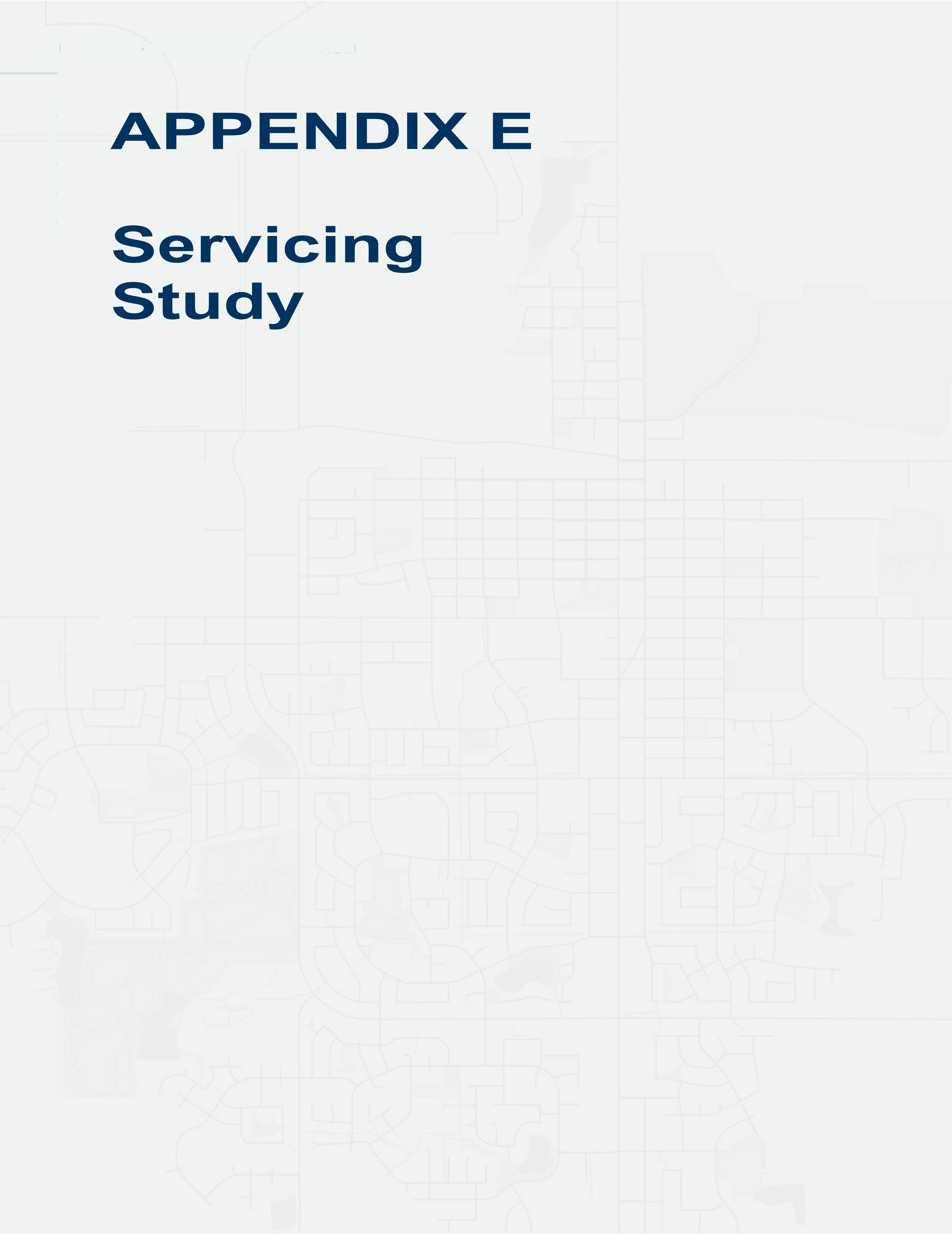
*Photographed on
June 16, 2022*

4. Wetland 2: Central portion of wetland viewing east

Rationale for not proceeding with NCSCS
(document any assumptions, reports, or site-specific information to support selection of "Yes" in Pre-Screening checklist)

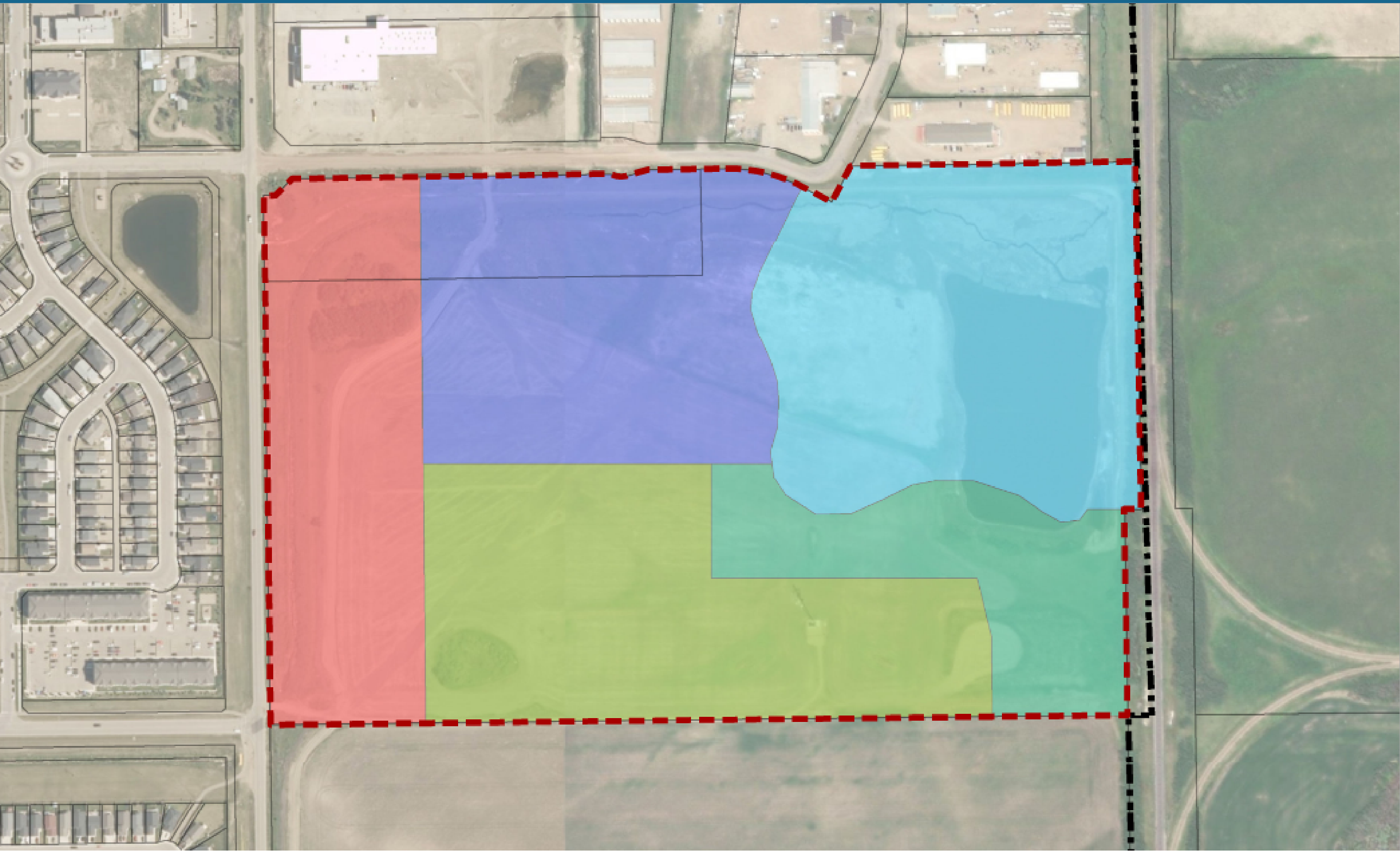
Refer to section 8.0 "8.0NATIONAL CLASSIFICATION SYSTEM FOR CONTAMINATED SITES (NCSCS)". Questions 6 and 7 are not applicable to the Site.

If none of the above applies, proceed with the NCSCS scoring.



APPENDIX E

Servicing Study



Wigfield NSP Servicing Study

City of Lloydminster

Final Report

January 2023

ISL Engineering and Land Services Ltd. Is an award-winning full-service consulting firm dedicated to working with all levels of government and the private sector to deliver planning and design solutions for transportation, water, and land projects.

Proudly certified as a leader in quality management under Engineers and Geoscientists BC's OQM Program from 2014 to 2021.

Integrated Expertise. Locally Delivered.

4015 7 Street SE, Calgary AB T2G 2Y9, T: 403.254.0544 F: 403.254.9186

January 17, 2023

Our Reference: 28059

City of Lloydminster
4420 – 50 Avenue
Lloydminster, AB/SK
T9V 0W2

Attention: Katlin Ducherer – Economic Development Officer

Dear Katlin:

Reference: Wigfield NSP Servicing Study

Enclosed is the final report for the Wigfield Neighbourhood Structure Plan (NSP) Servicing Study. We trust that it meets your expectations.

The key objectives of this project are to review the water, wastewater, and stormwater servicing systems proposed in each associated Master Plan and to recommend servicing systems to accommodate the NSP land use scenario. The Servicing Study will provide the City of Lloydminster (the City) with direction on servicing into more detailed stages of analysis and design for the NSP area in the future. This information will provide solutions for efficient, economic, and sustainable municipal services for the area.

We sincerely appreciate the opportunity to undertake this project on behalf of the City. Should you have any questions or concerns, please do not hesitate to contact the undersigned at 403-254-0544.

Sincerely,

Garnet Dawes, P.Eng., DBIA
Community Development Manager

Corporate Authorization

This document entitled “Wigfield NSP Servicing Study” has been prepared by ISL Engineering and Land Services Ltd. (ISL) for the use of City of Lloydminster. The information and data provided herein represent ISL’s professional judgment at the time of preparation. ISL denies any liability whatsoever to any other parties who may obtain this report and use it, or any of its contents, without prior written consent from ISL.

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Executive Summary

Introduction

The City of Lloydminster (the City) has commissioned ISL Engineering and Land Services Ltd. (ISL) to complete a Servicing Study encompassing water, wastewater, and stormwater infrastructure to support the preparation of the Wigfield Neighbourhood Structure Plan (NSP). The ultimate intent of the Servicing Study is to provide a high-level evaluation of the potential future water and wastewater servicing systems in the area as well as stormwater drainage systems. This includes the necessary parameters for the design, including recommendations for water distribution, wastewater collection, and stormwater management and conveyance.

The Servicing Study represents an investment in the infrastructure and will help support sustainable and cost-effective growth in the Wigfield NSP study area. It should be noted however, that this document is considered a high-level study and is not intended to replace more detailed analyses further into the design process.

The Wigfield NSP area is comprised of approximately 40 ha of land within the City of Lloydminster. The study area is bound by the 41 Street to the north, 36 Street to the south, the City boundary to the east, and 40 Avenue to the west and includes the northwest quarter section of 36-49-26-W3. The setting of the study area, being situated along the City boundary, introduces a number of servicing opportunities and constraints. These opportunities and constraints will be addressed as part of this Servicing Study.

The Water Master Plan, Sanitary Sewer Master Plan, and Stormwater Master Plan were adopted in 2016, 2016, and 2015, respectively. These documents outline how infrastructure systems are to be upgraded or expanded in the City for future development opportunities. The study area is to incorporate commercial, industrial/commercial, industrial, utilities, and open space areas. A sound servicing strategy is useful for both administration and elected officials in carrying out short-term and long-term infrastructure planning and budgeting.

This study follows the previous version of the Wigfield Area Structure Plan (ASP), which was prepared in 2014 by Select Engineering Consultants Ltd. as well as the Wigfield ASP Amendment, which is being finalized by the City. The update to the Wigfield ASP was initiated to accommodate the proposed Event Arena Site as well as commercial and industrial development. The Wigfield NSP was initiated in 2022 to focus on the north portion of the Wigfield ASP area where the proposed Event Arena Site is to be located.

Purpose of Study

Water Servicing

- To recommend systems to provide water servicing for the study area.
- To evaluate the capacity of the existing water distribution system.
- To layout potential water distribution infrastructure based on the 2016 Water Master Plan.
- To provide a framework for future development of detailed water system studies or analysis.

Wastewater

- To recommend systems that will provide wastewater servicing for the study area.
- To layout potential wastewater collection infrastructure based on the 2016 Sanitary Sewer Master Plan.
- To provide a framework for future development of detailed wastewater system studies or analysis.

Stormwater Drainage

- To develop high-level stormwater management strategies to manage increased runoff resulting from future growth.
- To ensure the planned stormwater management system meets regulatory authority requirements.
- To provide a framework for future development of detailed stormwater studies or analysis including, but not limited to, Stormwater Management Reports (SWMRs) to design stormwater management and erosion control measures.

Conclusions and Recommendations

Water Servicing

Conclusions and recommendations for the overall water servicing system for the study area can be summarized as follows:

- The Wigfield NSP area is proposed to be connected to the existing water distribution system.
- Based on preliminary assessments, the existing distribution system is considered adequate under both ADD and PHD conditions; however, it is not considered adequate under MDD+FF conditions.
- A 300 mm watermain connection is recommended along 40 Avenue from 36 Street to 41 Street. It is also recommended that the 200 mm section of watermain along 41 Street be upgraded to 300 mm to match the watermain sections to the west and north of this segment.
- The proposed reservoir storage volume of 592 m^3 for the Wigfield NSP area is based on the SME formula for reservoir storage.
- Based on the 2016 Water Master Plan, there remains available storage capacity within the existing West End Reservoir for an additional population of approximately 1,646 people after the connection of the Wigfield NSP area.
- It is recommended that the currently available capacity of both the reservoir storage and the WTP be evaluated to confirm whether additional upgrades are required to facilitate the proposed Wigfield NSP development and land uses once more detailed employment densities and facility details.
- It is recommended that water consumption and the associated WTP production capacity be monitored and future analysis be completed to support the allocation of capital budget to upgrades to the WTP as development occurs and available production capacity decreases.
- The costs associated with the proposed watermain upgrades is approximately $1.4 million.
- It should be noted that the annual inflation rate is currently almost 7%. The inflation rates seen this year are the highest they have been in 20 years based on the Consumer Price Index (CPI); therefore, the costs provided may increase if this trend continues (Government of Alberta, 2022).

Wastewater Servicing

Conclusions and recommendations for the overall wastewater servicing system for the study area can be summarized as follows:

- The Wigfield NSP area is proposed to be connected to the existing wastewater collection system.
- Based on preliminary assessments the East Trunk is already over capacity in some areas under existing conditions without the East Trunk Twin being implemented.
- Based on the 2016 Sanitary Sewer Master Plan, there remains available capacity in the East Trunk for an additional population of approximately 6,073 people, after the connection of the Wigfield NSP area, before the East Trunk Twin is required.
- The localized downstream upgrades of 750 mm sewer to 900 mm sewer along 41 Street are recommended.
- It is recommended that flows be monitored in the East Trunk and future analysis be completed to support the allocation of capital budget for the East Trunk Twin as development occurs and available capacity decreases.
- It is recommended the timeline and growth triggers for the East Trunk Twin project and other upgrades be reviewed following the completion of the 2022 Sanitary Sewer Master Plan update.
- It is recommended that pipe capacities be reviewed in detail once tie-in locations for services have been determined and more detailed employment densities and facility details are available.
- The costs associated with the proposed wastewater sewer upgrade f is approximately $1.1 million.
- It should be noted that the annual inflation rate is currently almost 7%. The inflation rates seen this year are the highest they have been in 20 years based on the Consumer Price Index (CPI); therefore, the costs provided may increase if this trend continues (Government of Alberta, 2022).

Stormwater Drainage

Conclusions and recommendations for the overall stormwater drainage system in the study area can be summarized as follows:

- The proposed stormwater system consists of pipe connections to and from stormwater management facilities with runoff from the study area being ultimately conveyed to the East Drainage Channel, which discharges to Neale Lake.
- The minor system was sized to the 1:5 year storm event.
- Stormwater management facilities were sized to the 1:100 year storm event.
- The maximum allowable area release rate from proposed stormwater management facilities was limited to 1.5 L/s/ha.
- All stormwater management facilities were sized as wet ponds according to the following additional criteria:
    - Active storage depth was considered to be 1.5 m.
    - Permanent storage depth was considered to be 2.0 m.
    - A freeboard of 0.3 m was applied.
    - Side slopes of 7:1 (H:V) were applied.
- The use of source control Best Management Practices is encouraged to reduce the total runoff volume and enhance stormwater treatment.
- Cost estimates were not prepared for Lake K as this stormwater management facility upgrade/expansion has been completed and was sized to accommodate the Wigfield NSP area.

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FIGURES

ABBREVIATIONS

Abbreviation	Meaning
ADD	Average Day Demand
ADWF	Average Dry Weather Flow
AEPA	Alberta Environment and Protected Areas
ASP	Area Structure Plan
the City	the City of Lloydminster
CT	Contact time
DWF	Dry Weather Flow
FF	Fire Flow
GIS	Geographic Information System
I-I	Inflow-Infiltration
ICI	Industrial, Commercial, Institutional
ISL	ISL Engineering and Land Services Ltd.
MDD	Maximum Day Demand
MDF	Maximum Daily Flow
NSP	Neighbourhood Structure Plan
PDWF	Peak Dry Weather Flow
PHD	Peak Hour Demand
PRV	Pressure Reducing Valve
PWWF	Peak Wet Weather Flow
ROW	Right-of-Way
SME	Saskatchewan Ministry of Environment
SWMF	Stormwater Management Facility
WTP	Water Treatment Plant
WWF	Wet Weather Flow
WWTP	Wastewater Treatment Plant

UNITS

Unit	Meaning
$	dollars
%	percentage
ha	hectares
km	kilometre
kPa	kilopascals
L/p/d	litres per person per day
L/s	litres per second
L/s/ha	litres per second per hectare
m	metres
m^3	cubic metres
mm	millimetres
ha	hectares
km	kilometre

1.0 Introduction

1.1 Authorization

The City of Lloydminster (the City) has commissioned ISL Engineering and Land Services Ltd. (ISL) to complete a Servicing Study encompassing water, wastewater, and stormwater infrastructure to support the preparation of the Wigfield Neighbourhood Structure Plan (NSP). The ultimate intent of the Servicing Study is to provide a high-level evaluation of the potential future water and wastewater servicing systems in the area as well as stormwater drainage systems. This includes the necessary parameters for the design, including recommendations for water distribution, wastewater collection, and stormwater management and conveyance.

The Servicing Study represents an investment in the infrastructure and will help support sustainable and cost-effective growth in the Wigfield NSP study area. It should be noted however, that this document is considered a high-level study and is not intended to replace more detailed analyses further into the design process.

1.2 Background

The Wigfield NSP area is comprised of approximately 40 ha of land within the City of Lloydminster. The study area is bound by the 41 Street to the north, 36 Street to the south, the City boundary to the east, and 40 Avenue to the west and includes the northwest quarter section of 36-49-26-W3. The setting of the study area, being situated along the City boundary, introduces a number of servicing opportunities and constraints. These opportunities and constraints will be addressed as part of this Servicing Study.

The Water Master Plan, Sanitary Sewer Master Plan, and Stormwater Master Plan were adopted in 2016, 2016, and 2015, respectively. These documents outline how infrastructure systems are to be upgraded or expanded in the City for future development opportunities. The study area is to incorporate commercial, industrial/commercial, industrial, utilities, and open space areas. A sound servicing strategy is useful for both administration and elected officials in carrying out short-term and long-term infrastructure planning and budgeting.

This study follows the previous version of the Wigfield Area Structure Plan (ASP), which was prepared in 2014 by Select Engineering Consultants Ltd. as well as the Wigfield ASP Amendment, which is being finalized by the City. The update to the Wigfield ASP was initiated to accommodate the proposed Event Arena Site as well as commercial and industrial development. The Wigfield NSP was initiated in 2022 to focus on the north portion of the Wigfield ASP area where the proposed Event Arena Site is to be located.

1.3 Purpose of Study

The purpose of developing a Servicing Study for the Wigfield NSP area is outlined below.

1.3.1 Water

- To recommend systems to provide water servicing for the study area.
- To evaluate the capacity of the existing water distribution system.
- To layout potential water distribution infrastructure based on the 2016 Water Master Plan.
- To provide a framework for future development of detailed water system studies or analysis.

1.3.2 Wastewater

- To recommend systems that will provide wastewater servicing for the study area.
- To evaluate the capacity of the existing wastewater collection system.
- To layout potential wastewater collection infrastructure based on the 2016 Sanitary Sewer Master Plan.
- To provide a framework for future development of detailed wastewater system studies or analysis.

1.3.3 Stormwater Drainage

- To develop high-level stormwater management strategies to manage increased runoff resulting from future growth.
- To ensure the planned stormwater management system meets regulatory authority requirements.
- To provide a framework for future development of detailed stormwater studies or analysis including, but not limited to, Stormwater Management Reports (SWMRs) to design stormwater management and erosion control measures.

2.0 Study Area

2.1 Location

The Wigfield NSP area lies within the City along the east boundary of the City. The study area is bound by 41 Street to the north, 36 Street to the south, the City boundary to the east, and 40 Avenue to the west and includes the northwest quarter section of 36-49-26-W3. The study area encompasses approximately 40 ha of area and is shown in Figure 2.1.

The study area generally drains toward the northeast. Elevations within the study area range from a high point of approximately 650 m in the southeast to a low point of approximately 640 m in the northeast. The topography of the study area is shown in Figure 2.2 with the minimum elevation of the quarter section shown in Figure 2.3.

The study area is located within the Central North Saskatchewan River, which is part of the Nelson-Churchill (Hudson Bay) continental drainage basin. Within the Central North Saskatchewan River watershed, the study area is situated in Region 05EF, which represents the reach of the Big Gully confluence. A map of the watershed boundaries is shown in Figure 2.4.

2.2 Existing Development

The land use within the study area is currently urban transition. Other land uses surrounding the study area include light and medium industrial as well as direct control (Gold Horse Casino) parcels north of the study area. Figure 2.5 shows the existing land use for the study area. A summary of the existing land use scenario is outlined in Table 2.1.

Table 2.1: Summary of Existing Land Use

Land Use	Area
	ha
Urban Transition	38.78
Total	**38.78**

2.3 Future Development

There are five land uses identified for the Wigfield NSP area, including the event centre, commercial, camping, stormwater management, and sports fields areas in support of the Event Arena. A breakdown of the proposed land use is provided in Table 2.2 as well as shown in Figure 2.6.

Table 2.2: Proposed Land Use

Land Use	Area
	ha
Commercial	6.95
Event Centre	8.31
Stormwater Management	9.92
Camping	4.39
Sports Fields	9.20
Total	**38.78**

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

FIGURE 2.1
STUDY AREA
WIGFIELD NSP
SERVICING STUDY

ISL

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Integrated Expertise. Locally Delivered.

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

— Major Contour - 5 m Interval

— Minor Contour - 1 m Interval

NSP Boundary

City Boundary

Ground Elevation (m)

High : 648.911

Low : 634.016

0 50 100 200 Meters

1:4,000 NAD 1983 UTM Zone 12N

FIGURE 2.2
TOPOGRAPHY
WIGFIELD NSP
SERVICING STUDY

ISL

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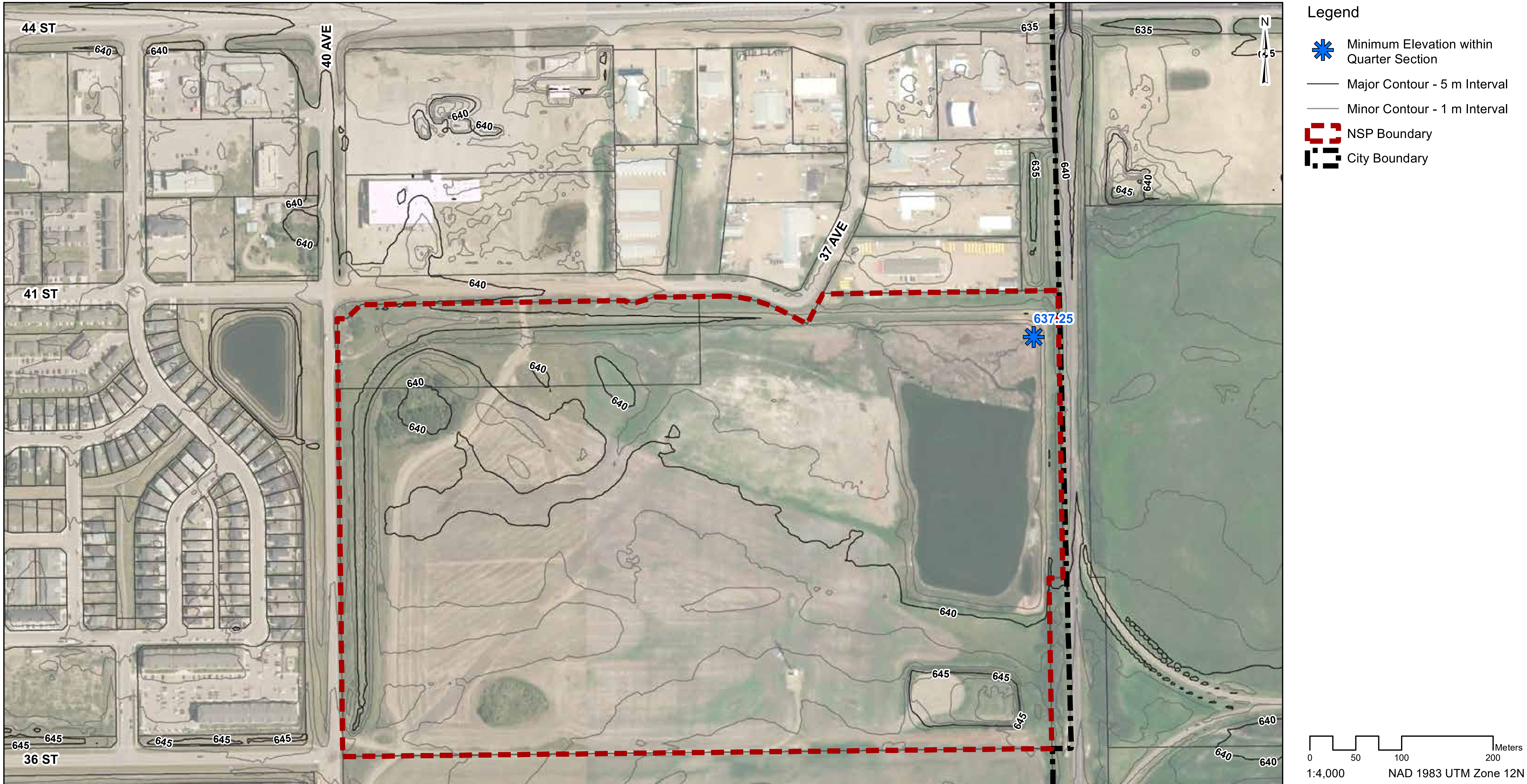

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FIGURE 2.3
MINIMUM GROUND ELEVATION
WIGFIELD NSP
SERVICING STUDY

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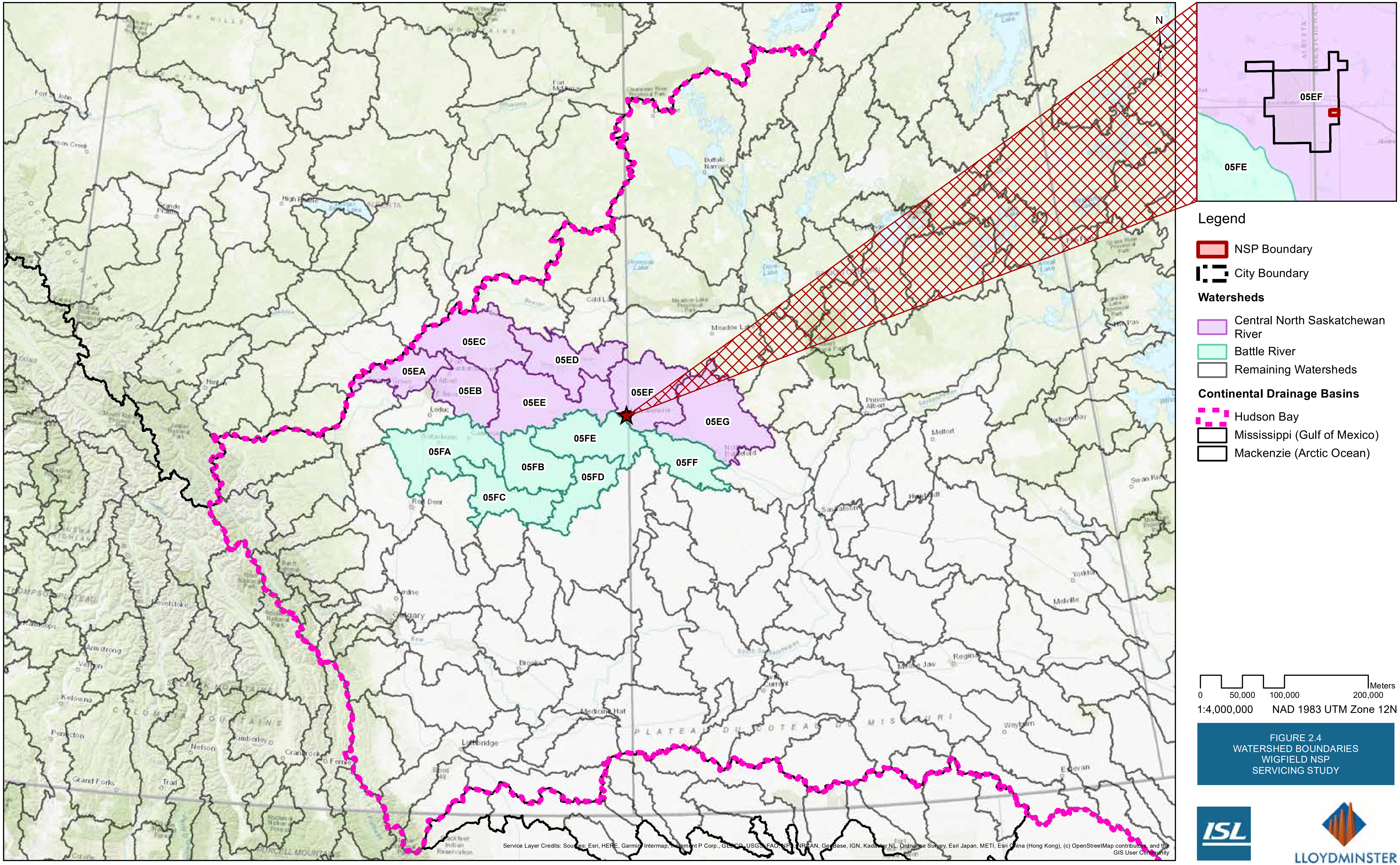

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Legend

🟥 NSP Boundary

▭ City Boundary

Watersheds

🟪 Central North Saskatchewan River

🟩 Battle River

▭ Remaining Watersheds

Continental Drainage Basins

▭ Hudson Bay

▭ Mississippi (Gulf of Mexico)

▭ Mackenzie (Arctic Ocean)

0 50,000 100,000 200,000 Meters

1:4,000,000 NAD 1983 UTM Zone 12N

FIGURE 2.4
WATERSHED BOUNDARIES
WIGFIELD NSP
SERVICING STUDY

ISL

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Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

FIGURE 2.5
EXISTING LAND USE
WIGFIELD NSP
SERVICING STUDY

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FIGURE 2.6
PROPOSED LAND USE
WIGFIELD NSP
SERVICING STUDY

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3.0 Water

3.1 Existing Infrastructure

3.1.1 Existing Water Sources

The City's existing water distribution system is supplied by the North Saskatchewan River. The raw water from the North Saskatchewan River is supplied to the City's existing water treatment plant (WTP), Husky Energy Upgrader, as well as some smaller users. The license for raw water withdrawal is 9,000 acre-feet or approximately 30,500 m^3/day based on gross diversion, with a current average daily demand of approximately 11,000 m^3 (ISL, 2016).

3.1.2 Existing Water Infrastructure

Water Treatment Plant

The existing WTP is northwest of the study area along 67 Street. The WTP is operated from 6:00 am to 11:00 pm except during peak days when it may operate up to 24 hours per day. The WTP has an average flow of 11,000 m^3/day with a net production capacity of 21,125 m^3/day (ISL, 2016).

Reservoir

The City currently stores treated water at the West End Reservoir, along 43 Street west of 62 Avenue, which is comprised of a 4,545 m^3 above ground reservoir built in 1971 and a 20,201 m^3 underground reservoir built in 2006, with a combined capacity of 24,746 m^3. The WTP also has 1,090 m^3 of storage located within the clearwell; however, this volume is not considered part of the overall water system storage capacity (ISL, 2016).

Water Distribution System

The study area is largely undeveloped; therefore, minimal water infrastructure exists within the study area. Existing infrastructure is located along 40 Avenue on the west side of the study area and through existing development along 41 Street/37 Avenue. An existing 300 mm watermain through the study area also connects infrastructure from 36 Street to 41 Street.

An existing 350 mm raw watermain runs along 40 Avenue and through the study area within the 36 Street right-of-way connecting the Husky Energy Upgrader to the City's WTP. A 250 mm watermain connects the City's water distribution system to the Husky Energy Upgrader via an existing 300 mm watermain along 36 Street. The existing water distribution system is shown in Figure 3.1.

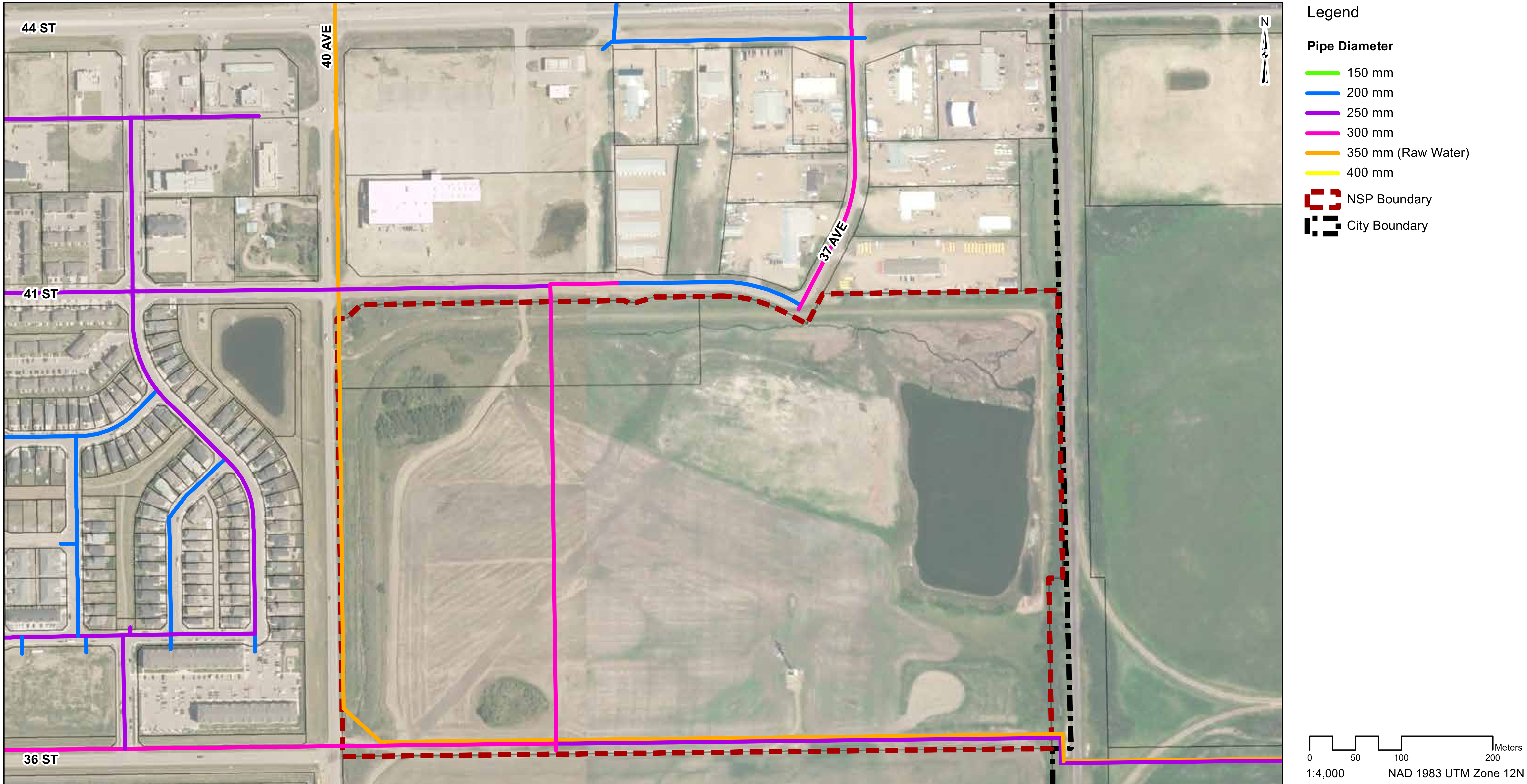


FIGURE 3.1
EXISTING WATER SYSTEM
WIGFIELD NSP
SERVICING STUDY

ISL

LLOYDMINSTER

3.1.3 Existing Capacities

Water Treatment Plant

It was anticipated that a major upgrade to the existing WTP would be required in 2026 based on population projections and the assessment performed as part of the Water Master Plan (ISL, 2016). As much of the study area was considered to be outside of this growth horizon, it was anticipated that an upgrade would be required to facilitate the development of the Wigfield NSP area. However, population growth has not occurred at the rate assumed in the 2016 Water Master Plan; therefore, more details regarding the capacity of the WTP to accommodate the demands of the Wigfield NSP area are provided in Section 3.3.2.

It should be noted that the available WTP capacity is based on the 2016 Water Master Plan; however, this may not accurately represent the City's actual treatment capacity based on current demands. Therefore, it is recommended that this be reviewed following the completion of the 2022 Water Master Plan update.

Reservoir

Based on the projected storage required for 2019, the existing reservoir facility is already over capacity (ISL, 2016). However, population growth has not occurred at the rate assumed in the 2016 Water Master Plan; therefore, preliminary storage requirements for the Wigfield NSP area have been derived and compared to the available capacity and actual population growth rates in Section 3.3.3.

It should be noted that the available reservoir capacity is based on the storage summary presented in the 2016 Water Master Plan; however, this may not accurately represent the City's actual available storage based on current demands. Therefore, it is recommended that this be reviewed following the completion of the 2022 Water Master Plan update.

3.2 Design Criteria

The design criteria used when considering the water servicing network were derived from the City of Lloydminster Municipal Development Standards Section 6 – Water Distribution Systems, Saskatchewan Ministry of Environment's Design Standards, and Alberta Environment and Protected Areas' Standards and Guidelines in addition to the recommendations outlined in the City's 2016 Water Master Plan.

The detailed analysis of the preliminary proposed water distribution network was not completed as part of this Servicing Study as the study area is to be tied-in to the City's existing water distribution network and should be assessed as such to determine overall system impacts.

Although the entire study area was accounted for in the 2016 Water Master Plan there have been notable modifications to the land uses that were applied within the study area, which was assumed to consist of only industrial development. Although this assessment accounts for the change in land use, it is recommended that the network be analyzed further once more detailed population and employment density information is available for the study area.

To further analyze a proposed water distribution system, it is recommended that Bentley's WaterCAD CONNECT Edition or a similar computer model be used. WaterCAD is a powerful analysis tool that hydrodynamically routes flows through the physical distribution system. In this manner, pressure results are obtained, and available fire flow at any location in the water distribution system can be estimated. The network should be assessed under average day demand, peak hour demand, and maximum day demand plus fire flow to analyze the performance of a proposed system.

3.2.1 Water Consumption Rates

The City of Lloydminster Municipal Development Standards stipulate a per capita Average Day Demand (ADD) of 250 L/c/d. As detailed employment densities for the non-residential developments have not been prepared at this stage, area-based water consumption rates for all development types may be utilized. These consumption rates are outlined below in Table 3.1.

Table 3.1: Non-Residential Water Consumption Data

Land Use	Consumption Rate
	L/ha/d
Commercial	20,500
Event Centre	17,750
Camping	1,365

The determination of these consumption rates is based on the City of Lloydminster Municipal Development Standards Section 6 – Water Distribution Systems and is detailed as follows:

- As a detailed classification of the commercial lands has not been outlined, the average consumption rate for local commercial and highway commercial was used.
- As limited details for the event centre area have been outlined, the average consumption rate for local commercial, highway commercial, school institutional, and hospital institutional was used.

No water consumption rates for non-residential camping areas are outlined in the City of Lloydminster Municipal Development Standards Section 6 – Water Distribution Systems. Therefore, it was deemed appropriate to derive a recommended water consumption rate based on corresponding wastewater generation rates stipulated in the Saskatchewan Ministry of Environment's Sewage Works Design Standards and Government of Alberta's Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems. This is due to the relationship that exists between water consumption and sewage generation.

The wastewater generation rate for each camp site stipulated in both of the above noted documents is 80 L/d. With 60 camp sites planned, this results in a wastewater generation rate of 4,800 L/d. The future non-residential water consumption rate was derived by assuming the water rate is 125% (invert of 80%) of the wastewater non-residential generation rate, in accordance with typical expectations. Therefore, the water consumption rate applied for the camping area was 6,000 L/d or 1,365 L/ha/d based on an area of 4.39 ha as outlined in Table 2.2.

3.2.2 Peaking Factors

The following factors are to be used to establish Maximum Day Demand (MDD) and Peak Hour Demand (PHD) for future development:

- Maximum Day Demand – 2.0 x Average Day Demand
- Peak Hour Demand – 3.0 x Average Day Demand

3.2.3 Reservoir Storage Requirements

Reservoir storage volumes were calculated in two manners for comparison purposes: the formulas recommended by Saskatchewan Ministry of Environment (SME) and Alberta Environment and Protected Areas (AEPA).

Saskatchewan Ministry of Environment (Waterworks Design Standard)

$$Volume = ADD\ x\ 2$$

Where,

Volume=Total storage requirement, m^3
ADD=Average Day Demand, m^3

Alberta Environment and Protected Areas (Standards and Guidelines for Municipal Waterworks, Wastewater and Stormwater Drainage Systems)

$$S = A + B + (\text{the greater of } C \text{ or } D)$$

Where,

S=Total storage requirement, m^3
A=Fire storage, m^3
B=Equalization storage (25% of MDD), m^3
C=Emergency storage (minimum of 15% of ADD), m^3
D=Disinfection contact time (CT) storage to meet CT requirements, m^3

3.2.4 Fire Flow Protection Requirements

The 2016 Water Master Plan recommends fire flow requirements for various land use types based on the Fire Underwriters Survey. Table 3.2 below outlines these fire flow rates, durations and storage volumes required for various development types.

Table 3.2: Fire Flow Requirements

Land Use Type	Fire Flow Required	Duration	Fire Storage Required
	L/s	Hours	m^3
Commercial – Local	185	2.5	1,665
Commercial – Highway	225	3.0	2,430
Institutional	225	3.0	2,430

The values for highway commercial and institutional govern for the required fire storage as they are the most conservative. It should be noted that typically fire flow requirements can be reduced by up to 50% for facilities equipped with sprinkler systems (i.e., reduce by 50% and add required sprinkler flow, which is typically 20 L/s to 30 L/s). This reduction is based on the Water Supply for Public Fire Protection (Fire Underwriters Survey, 1999), which states that fire flow may be reduced by up to 50% for facilities with adequately sized and designed automatic fire sprinkler protection systems.

3.2.5 Distribution Pressure Requirements

The future water distribution system is to be assessed using the following criteria based on a variety of standards, including the City's Municipal Development Standards those stipulated by AEPA:

- Normal pressure range in the system under Maximum Day Demand of 350 kPa to 550 kPa.
- Minimum residual pressure in the system under Peak Hour Demand of 273 kPa.
- Maximum pressure allowable before a pressure reducing valve (PRV) is required of 700 kPa.
- Minimum residual pressure in the system under Maximum Day Demand plus Fire Flow of 150 kPa.

3.2.6 Maximum Velocity Requirements

Main line flow velocities should not exceed 3.0 m/s and be preferably below 2.0 m/s if possible, during peak flow conditions and maximum day plus fire flow conditions.

3.3 Proposed Water Distribution System

3.3.1 Water System Demands

Following the determination of the water system design criteria that would be used, the required water demands were derived for each service area as shown in Figure 3.2. The water demands are summarized in Table 3.3.

Table 3.3: Total Water Demands

Service Area ID	Total Water Demands					
	ADD		MDD = 2 x ADD		PHD = 3 x ADD	
	L/s	m^3/d	L/s	m^3/d	L/s	m^3/d
NSP	3.43	296	6.86	592	10.28	888

A detailed breakdown of the calculated water demands for each service area are shown in Table 3.4.

Table 3.4: Water Demand Estimation

Service Area	Area			Residential Population	Water Consumption		Average Day Demand (ADD)				Maximum Day Demand		Peak Hour Demand	
	Residential	Non-Residential	Total		Residential	Non-Residential	Residential	Non-Residential	Total		2 x ADD		3 x ADD	
	ha	ha	ha		L/p/d	L/ha/d	L/s	L/s	L/s	m^3/d	L/s	m^3/d	L/s	m^3/d
Commercial 1	0.00	3.64	3.64	0	250	20,500	0.00	0.86	0.86	75	1.73	149	2.59	224
Commercial 2	0.00	3.32	3.32	0	250	20,500	0.00	0.79	0.79	68	1.58	136	2.36	204
Event Centre 1	0.00	4.45	4.45	0	250	17,750	0.00	0.91	0.91	79	1.83	158	2.74	237
Event Centre 2	0.00	3.86	3.86	0	250	17,750	0.00	0.79	0.79	69	1.59	137	2.38	206
Camping	0.00	4.39	4.39	0	250	1,365	0.00	0.07	0.07	6	0.14	12	0.21	18
Total	**0.00**	**19.66**	**19.66**	**0**			**0.00**	**3.43**	**3.43**	**296**	**6.86**	**592**	**10.28**	**888**

3.3.2 Water Treatment Plant

As outlined within the 2016 Water Master Plan, the WTP experiences an average flow of 10,500 m^3/d and has a net production capacity of 21,800 m^3/d. Based on the existing population of 32,515 in 2014, the average day and maximum day demands were 10,942 m^3 and 21,886 m^3, respectively. This maximum day demand is greater than the net production capacity of the WTP. However, as noted above, the population used to determine these demands is higher than that identified in the 2021 Federal Census and the consumption rate of 250 L/c/d is likely also high. Growth horizon capacity requirements as well as associated upgrades are not discussed in detail in the 2016 Water Master Plan, therefore, it is recommended that water consumption and the associated WTP production capacity be monitored, and future analysis be completed to support the allocation of capital budget to upgrades to the WTP as development occurs and available production capacity decreases.

3.3.3 Reservoir Storage

As previously noted, the West End Reservoir has a combined capacity of 24,746 m^3. An evaluation of the reservoir volume required to service the study area was completed as part of the Servicing Study. This volume of water storage required was determined using the formulas provided by SME and AEPA for comparison. Table 3.5 summarizes the storage requirements.

Table 3.5: Reservoir Storage Requirements

Fire Storage[1]	ADD	MDD	SME Storage[2]	AEPA Storage[3]
m^3	m^3	m^3	m^3	m^3
2,430	296	592	592	2,622

[1] Fire storage required determined based on 225 L/s for 3.0 hours (i.e., commercial/institutional development)
[2] SME storage volume required determined based on the following formula: *ADD x 2*
[3] AEPA storage volume required determined based on the following formula: *Fire Storage + 25% of MDD + 15% of ADD*

It is recommended that the currently available capacity of both the reservoir storage and the WTP be evaluated to confirm whether additional upgrades are required to facilitate the proposed Wigfield NSP development and land uses once more detailed employment densities and facility details are available. This is to be supported by the 2022 Water Master Plan update; therefore, it is recommended that this be revisited following the completion of the 2022 Water Master Plan update.

As the existing West End Reservoir is considered to account for the fire flow required at the 225 L/s flow rate for 3 hours, the more conservative storage requirements for facilitating the Wigfield NSP area only is based on the SME formula. This results in a required storage volume of 592 m^3.

The City's population in 2013 was 31,483 according to the 2013 Municipal Census with the existing population of 32,515 in 2014 being carried forward in the 2016 Water Master Plan based on a growth rate of 3.3%. This can be compared to the 2015 population of 31,377 based on the 2015 Municipal Census and the 2016 population of 31,400 based on the 2016 Federal Census, which indicates an overall drop in population. The 2016 Water Master Plan considered a total population of 38,982 in the 5-year growth horizon (2020) and 44,531 in the 10-year growth horizon (2025). This can be compared to the 2021 census data, which shows a population of only 31,582; therefore, when using the Federal Census data, the population has increased by only 182 people in the last five years.

As outlined in the 2016 Water Master Plan, the West End Reservoir has a total combined storage capacity of 24,746 m^3, with approximately 88%, i.e., 21,886 m^3, of this capacity being used by the existing population. This leaves approximately 2,860m^3 of storage capacity available within the existing reservoir. As the West End Reservoir is considered to account for the fire flow required for the Wigfield NSP area at the 225 L/s flow rate for 3 hours as identified within the City of Lloydminster Municipal Development Standards, the remaining available reservoir capacity is 2,268 m^3. This remaining storage capacity is based on the more conservative storage requirements for facilitating the Wigfield NSP area based on the SME formula, which results in a required fire flow volume requirement of 592 m^3. Therefore, when comparing the approximate available storage capacity and the required fire flow volume requirement for the Wigfield NSP area based on the more conservative SME formula, there remains available storage capacity within the existing West End Reservoir for an additional population of approximately 1,646 people after the connection of the Wigfield NSP area based on correlating the remaining available reservoir capacity of 2,268m^3 to the storage requirement of 5,862 m^3 for the additional 4,254 people as proposed in the 3-year growth horizon as outlined in the 2016 Water Master Plan.

It is recommended that the water demand and associated storage requirements be monitored, and future analysis be completed to support the allocation of capital budget for the expansion/upgrade of the West End Reservoir as development occurs and the available storage capacity decreases.

It should be noted that the 2016 Water Master Plan and associated models are based on a water demand of 250 L/c/d for residential developments, which is high when compared to other municipalities such as the City of Edmonton which specifies 220 L/c/d. Furthermore, it is understood that water conservation over the past number of years has resulted in decreasing water demands, which are evidenced by the City's downward water consumption trend outlined within the 2016 Water Master Plan. Based on discussions with the City and analysis of preliminary water billing data it is likely that the residential water demand is less than 200 L/c/d; it is understood that this is to be reviewed as part of the 2022 Water Master Plan Update. The reduction in the water demand for residential developments from the current 250 L/c/d may have an impact on the available storage capacity assumptions for the West End Reservoir, allowing for additional population growth to occur prior to upgrades being triggered. The analysis contained herein is based on the 250 L/c/d average day demand from the City of Lloydminster's Municipal Development Standards.

3.3.4 Water Pipe Network

The proposed water distribution system for the Wigfield NSP area is to be connected to the City's existing water distribution system. Watermains internal to the development, which are required to service the development area and are expected to be connected to the City's existing system, are the responsibility of the developer. Therefore, the internal network layout has not been developed nor sized at this stage.

As previously noted, it is recommended that a detailed network analysis be completed to assess the adequacy of this system as well as the impacts to the City's existing system once more detailed employment densities and facility details are available.

3.4 Water System Assessment

The City's existing WaterCAD model was used to assess the impacts of the proposed Wigfield NSP development on the existing water distribution system. This model was developed as part of the 2016 Water Master Plan and will be updated as part of the 2022 Water Master Plan update.

In order to assess the impacts of the Wigfield NSP development, the existing water distribution system was assessed under ADD, PHD, and MDD+FF conditions based on the application of the revised land use demands of the proposed Wigfield NSP development. The results of these analyses are shown in Figures 3.2 to 3.4.

The existing water distribution system is adequate under both ADD and PHD conditions. However, as shown in the results in Figure 3.4, the existing water distribution system does not currently meet the fire flow requirements of 225 L/s for highway commercial and institutional as outlined in Section 3.2.4 for the commercial and event centre areas. Therefore, it is recommended that a 300 mm watermain connection be provided along 40 Avenue from 36 Street to 41 Street. It is also recommended that the 200 mm section of watermain along 41 Street be upgraded to 300 mm to match the watermain sections to the west and north of this segment. These proposed upgrades are shown in Figure 3.5.

It should be noted that typically fire flow requirements can be reduced by up to 50% for facilities equipped with sprinkler systems (i.e., reduce by 50% and add required sprinkler flow, which is typically 20 L/s to 30 L/s). Therefore, these upgrades may not be required depending on the implementation of sprinkler systems within the Wigfield NSP development. It should be noted that this scenario was not modelled as this assumption is less conservative and assumes that sprinklers will be implemented across the entire study area.

The existing water distribution system was assessed with the proposed upgrades above implemented with results shown in Figure 3.6 to 3.8. It is recommended these proposed upgrades be reviewed following the completion of the 2022 Water Master Plan update to incorporate any development or projects since the preparation of the 2016 Water Master Plan as well as revisions to future development areas and growth horizons.

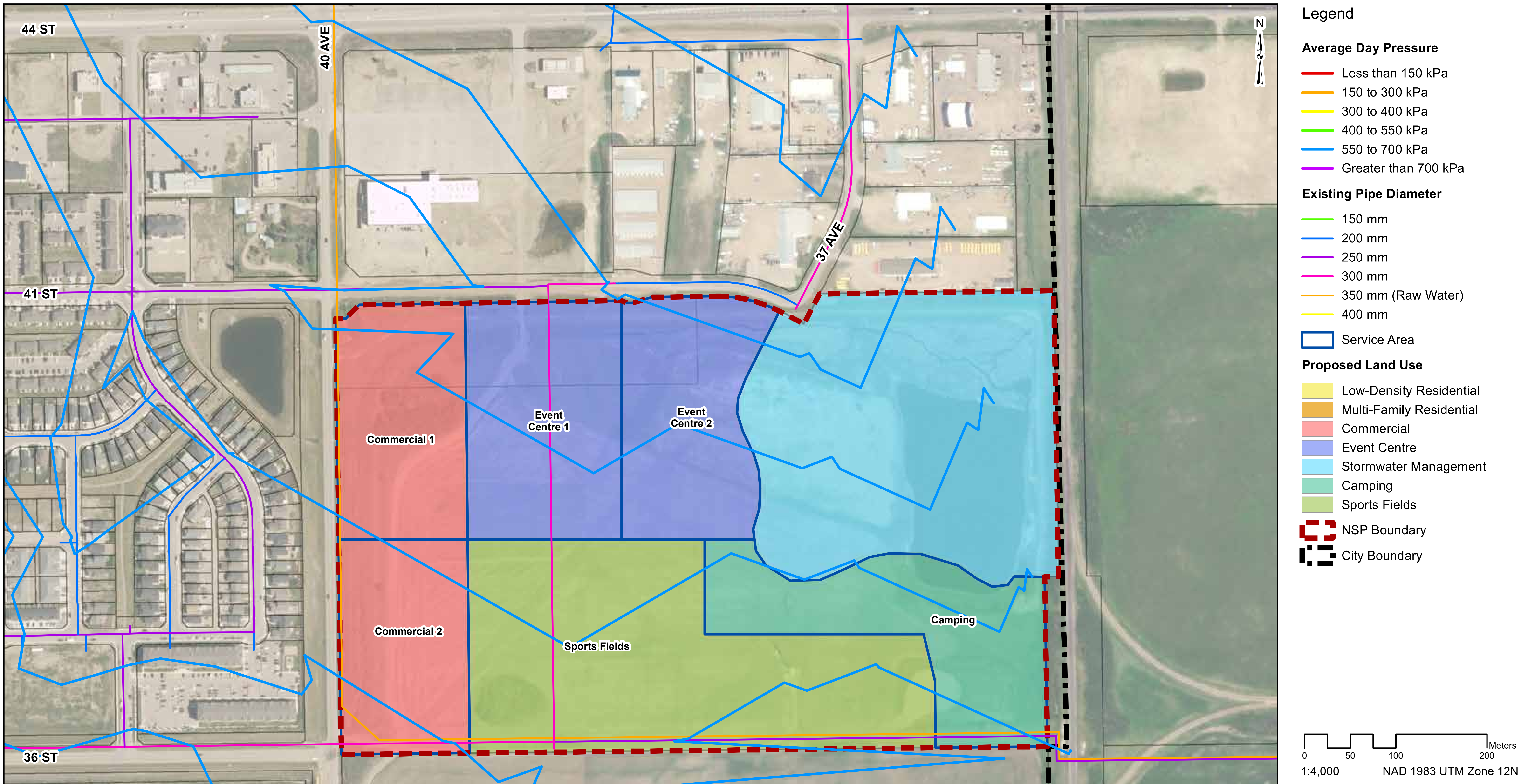
3.5 Cost Estimates

Cost estimates were prepared for the proposed water distribution system upgrades and are summarized in Table 3.6 and provided in detail in Appendix A.

Table 3.6: Summary of Water Servicing Cost Estimates

Item	Sub-Total	Contingency (Rounded)	Engineering (Rounded)	Total (Rounded)
		30%	15%	
300mm Watermain Upgrade	$398,000	$119,000	$78,000	$595,000
Pavement Rehabilitation	$568,000	$170,000	$111,000	$850,000
Total (Rounded)	**$965,000**	**$290,000**	**$190,000**	**$1,445,000**

It should be noted that the annual inflation rate is currently almost 7%. The inflation rates seen this year are the highest they have been in approximately 20 years based on the Consumer Price Index (CPI); therefore, the costs provided may increase if this trend continues (Government of Alberta, 2022).



Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

FIGURE 3.2
EXISTING WATER SYSTEM ASSESSMENT
AVERAGE DAY DEMAND
WIGFIELD NSP
SERVICING STUDY

Date: 2023-01-13 Document: Q:\Projects\28059_WigfieldASP\25_GIS\251_Figures\2_NSP_Servicing\28059_Figure_3.2_Ex_Water_System_ADD.mxd

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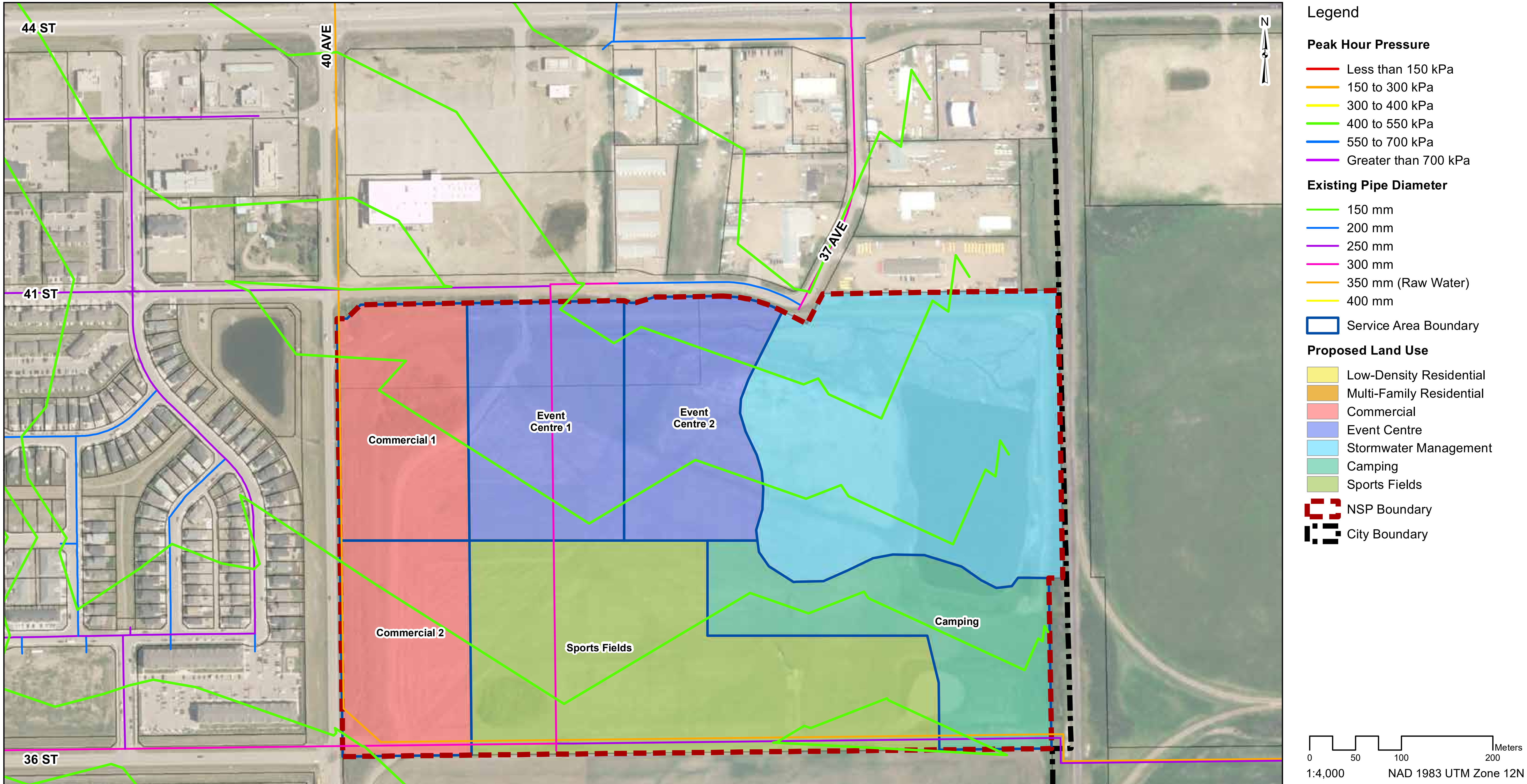

FIGURE 3.3
EXISTING WATER SYSTEM ASSESSMENT
PEAK HOUR DEMAND
WIGFIELD NSP
SERVICING STUDY

ISL

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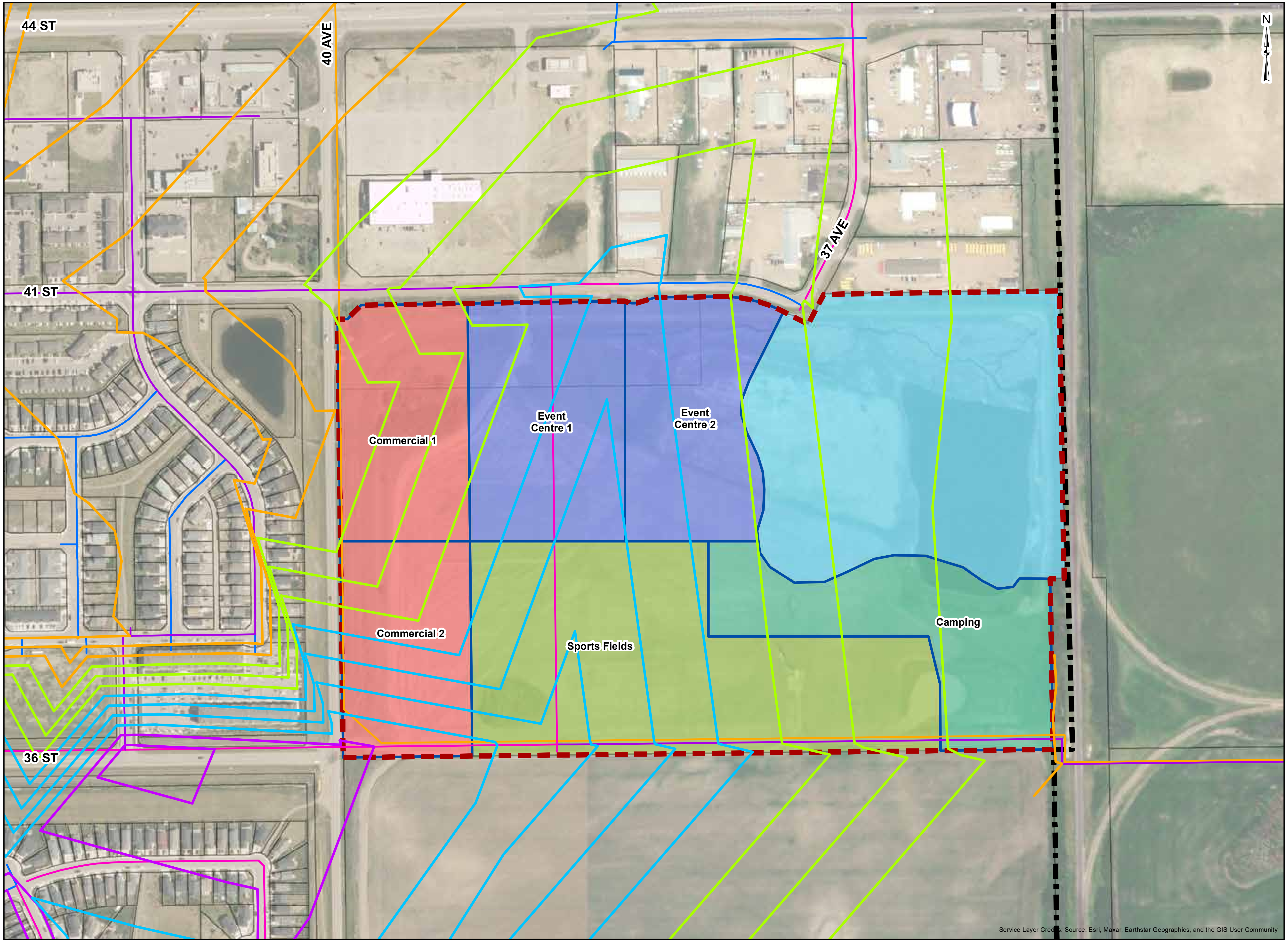

FIGURE 3.4
EXISTING WATER SYSTEM ASSESSMENT
MAXIMUM DAY DEMAND + FIRE FLOW
WIGFIELD NSP
SERVICING STUDY

ISL

LLOYDMINSTER

Date: 2023-01-13 Document: Q:\Projects\28059_WigfieldASP\25_GIS\251_Figures\2_NSP_Servicing\28059_Figure_3.4_Ex_Water_System_MDD+FF.mxd

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Legend

Existing Pipe Diameter

- 150 mm
- 200 mm
- 250 mm
- 300 mm
- 350 mm (Raw Water)
- 400 mm

- Proposed 300mm Watermain
- Service

Proposed Land Use

- Low-Density Residential
- Multi-Family Residential
- Commercial
- Event Centre
- Stormwater Management
- Camping
- Sports Fields

- NSP Boundary
- City Boundary

Note: Sizing of watermains internal to the development to service the development area and connect to the City's existing system are the responsibility of the developer.

0 50 100 200 Meters

1:4,000 NAD 1983 UTM Zone 12N

FIGURE 3.5
PROPOSED WATER SYSTEM
WIGFIELD NSP
SERVICING STUDY

ISL

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Date: 2023-01-13 Document: Q:\Projects\28059_WigfieldASP\25_GIS\251_Figures\2_NSP_Servicing\28059_Figure_3.5_Pr_Water_System.mxd

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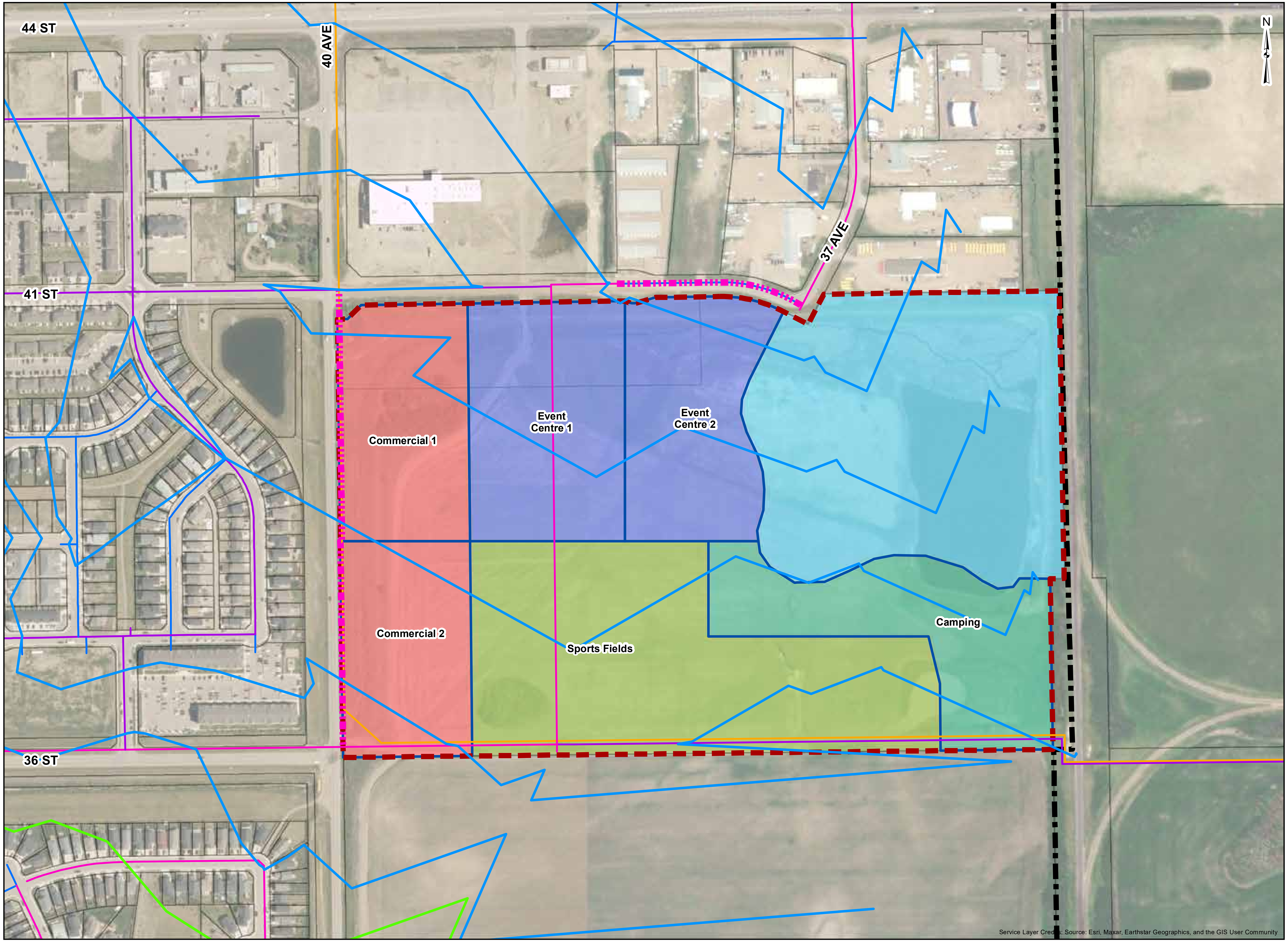

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

Average Day Pressure

- 🟥 Less than 150 kPa
- 🟧 150 to 300 kPa
- 🟨 300 to 400 kPa
- 🟩 400 to 550 kPa
- 🟦 550 to 700 kPa
- 🟪 Greater than 700 kPa

Existing Pipe Diameter

- 🟩 150 mm
- 🟦 200 mm
- 🟪 250 mm
- 🟥 300 mm
- 🟧 350 mm (Raw Water)
- 🟨 400 mm

- ▨ Proposed 300mm Watermain
- ☐ Service Area

Proposed Land Use

- 🟨 Low-Density Residential
- 🟧 Multi-Family Residential
- 🟥 Commercial
- 🟦 Event Centre
- 🟦 Stormwater Management
- 🟩 Camping
- 🟩 Sports Fields
- ☐ NSP Boundary
- ☐ City Boundary

0 50 100 200 Meters

1:4,000 NAD 1983 UTM Zone 12N

FIGURE 3.6
PROPOSED WATER SYSTEM ASSESSMENT
AVERAGE DAY DEMAND
WIGFIELD NSP
SERVICING STUDY

ISL

LLOYDMINSTER

Date: 2023-01-13 Document: Q:\Projects\28059_WigfieldASP\25_GIS\251_Figures\2_NSP_Servicing\28059_Figure_3.6_Pr_Water_System_ADD.mxd

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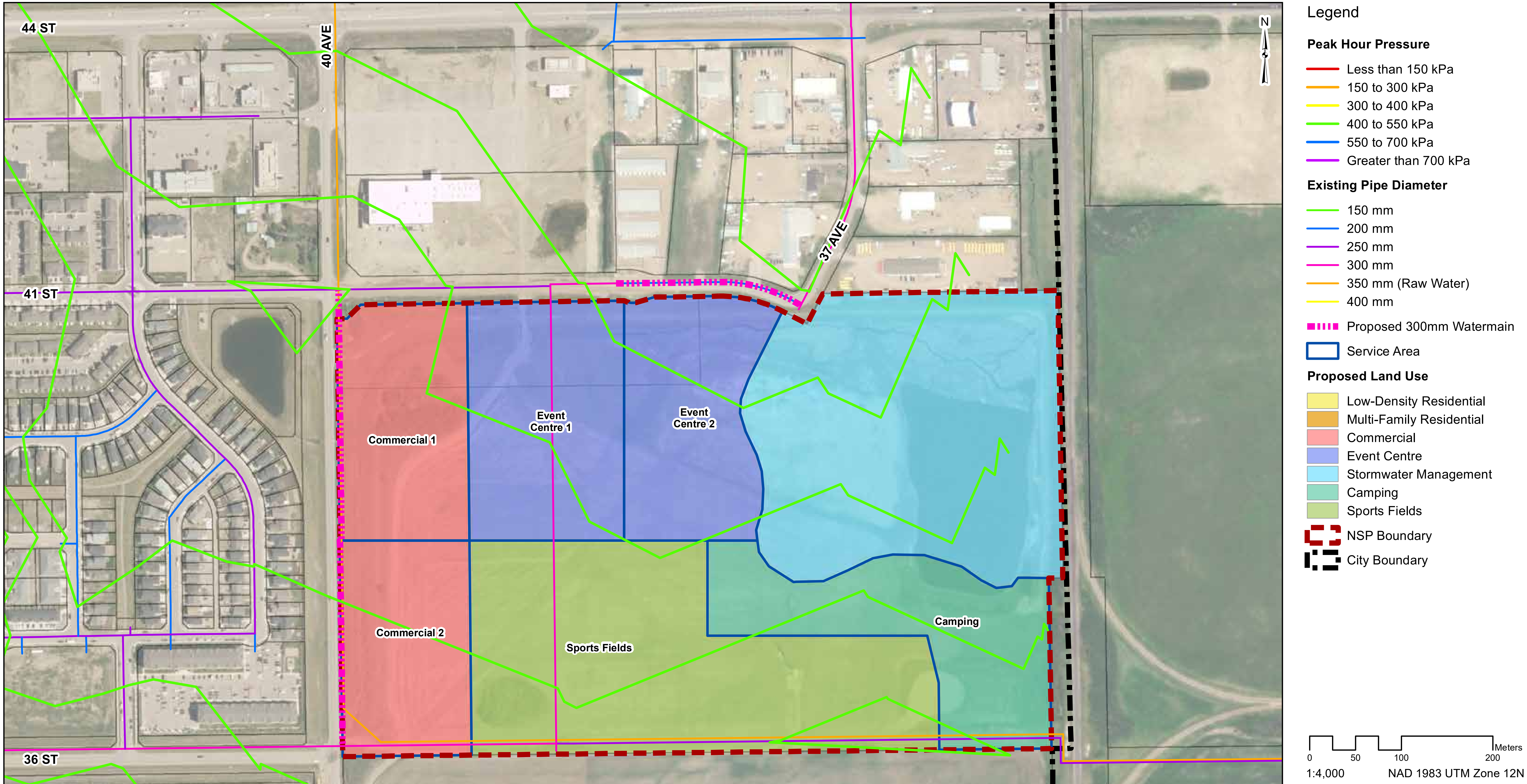

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

FIGURE 3.7
PROPOSED WATER SYSTEM ASSESSMENT
PEAK HOUR DEMAND
WIGFIELD NSP
SERVICING STUDY

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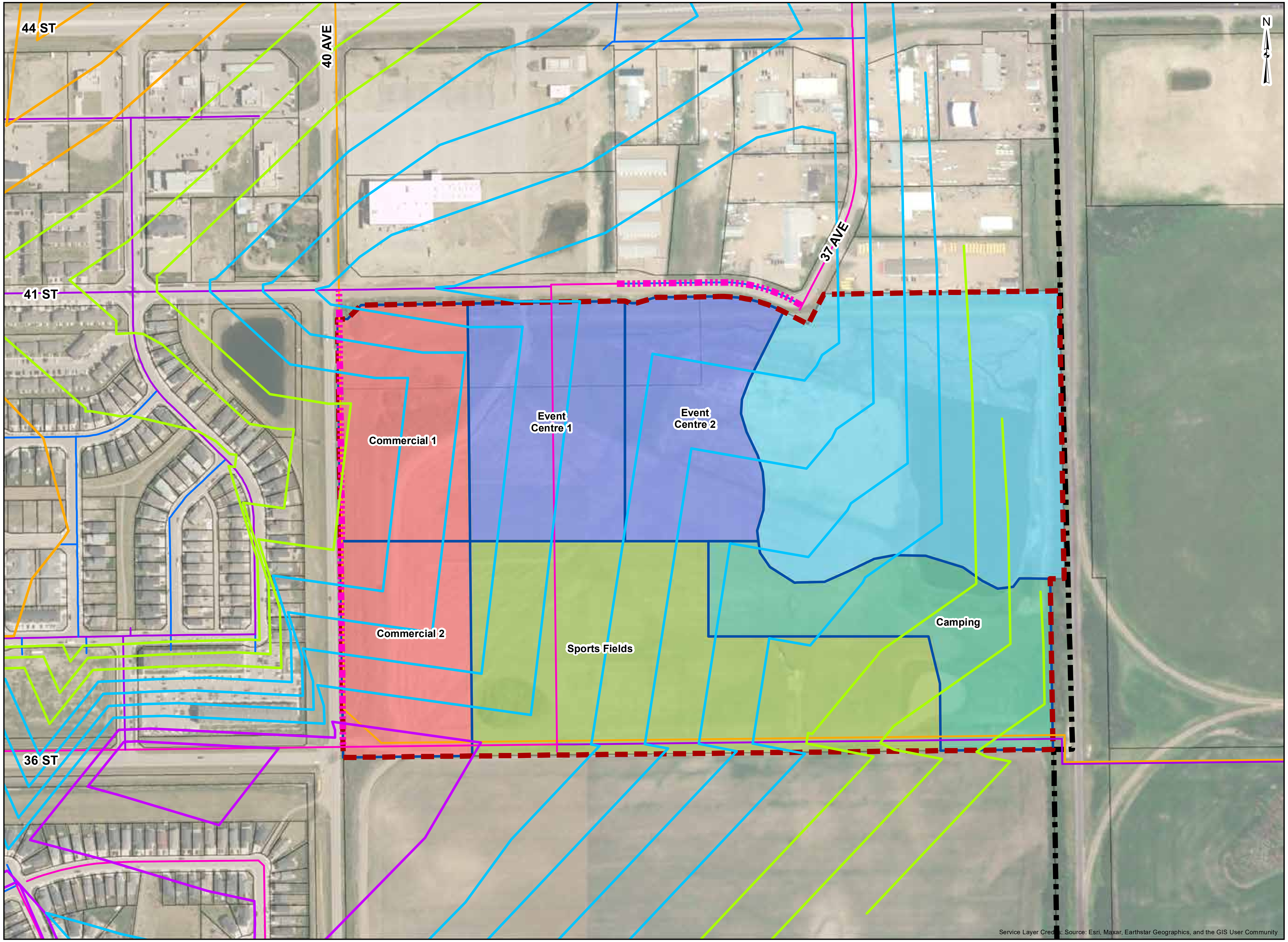
Date: 2023-01-13 Document: Q:\Projects\28059_WigfieldASP\25_GIS\251_Figures\2_NSP_Servicing\28059_Figure_3.7_Pr_Water_System_PHD.mxd



Legend

Available Fire Flow

- Less than 100 L/s
- 100 to 150 L/s
- 150 to 185 L/s
- 185 to 225 L/s
- Greater than 225 L/s

Existing Pipe Diameter

- 150 mm
- 200 mm
- 250 mm
- 300 mm
- 350 mm (Raw Water)
- 400 mm

- Proposed 300mm Watermain
- Service Area

Proposed Land Use

- Low-Density Residential
- Multi-Family Residential
- Commercial
- Event Centre
- Stormwater Management
- Camping
- Sports Fields

- NSP Boundary
- City Boundary

0 50 100 200 Meters

1:4,000 NAD 1983 UTM Zone 12N

FIGURE 3.8
PROPOSED WATER SYSTEM ASSESSMENT
MAXIMUM DAY DEMAND + FIRE FLOW
WIGFIELD NSP
SERVICING STUDY

ISL LLOYDMINSTER

Date: 2023-01-13 Document: Q:\Projects\28059_WigfieldASP\25_GIS\251_Figures\2_NSP_Servicing\28059_Figure_3.8_Pr_Water_System_MDD+FF.mxd

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4.0 Wastewater

4.1 Existing Infrastructure

The existing wastewater system conveys flows to the Wastewater Treatment Plant (WWTP) located north of 67 Street and approximately 800 m east of 40 Avenue. The East Trunk is one of the two primary wastewater trunks in the City, which runs along the east boundary of the City. The wastewater system within the study area and surrounding it are part of the East Trunk system. The existing wastewater system is shown in Figure 4.1.

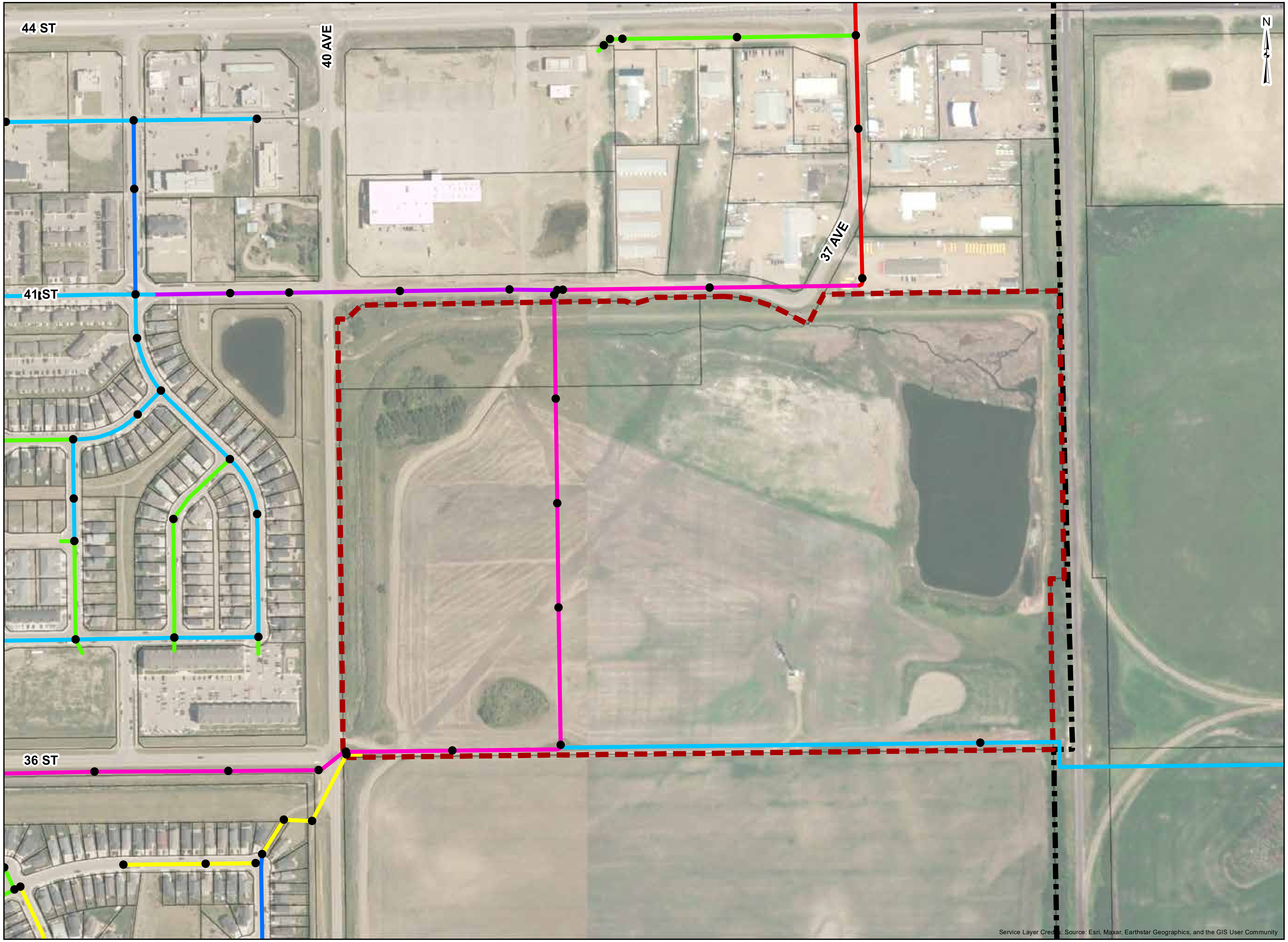
4.1.1 Existing Capacities

Per the 2016 Sanitary Sewer Master Plan (AECOM, 2016), it is understood that there is minimal existing capacity in the East Trunk, as such it was recommended that this trunk be twinned in order to service future development. The existing East Trunk is intended to maintain its service of the current collection area with the exception of the 19 Street Trunk and South Trunk flows in order to accommodate future development in the Wigfield NSP area within the existing East Trunk (AECOM, 2016).

4.2 Design Criteria

The design criteria used when considering the wastewater servicing network were derived from the City of Lloydminster Municipal Development Standards Section 4 – Sanitary Sewer Systems, Saskatchewan Ministry of Environment's Design Standards, and Alberta Environment and Protected Areas' Standards and Guidelines in addition to the recommendations outlined in the City's 2016 Sanitary Sewer Master Plan.

Although the entire study area was accounted for in the 2016 Sanitary Sewer Master Plan there have been notable modifications to the land uses that were applied within the study area, which was assumed to consist of only industrial development. Although this assessment accounts for the change in land use, it is recommended that the network be analyzed further once more detailed population and employment density information is available for the study area.



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Legend

● Existing Manhole

Pipe Diameter

- 200 mm
- 250 mm
- 300 mm
- 375 mm
- 750 mm
- 900 mm
- 1350 mm
- 1200 mm
- NSP Boundary
- City Boundary

0 50 100 200 Meters

1:4,000 NAD 1983 UTM Zone 12N

FIGURE 4.1
EXISTING WASTEWATER SYSTEM
WIGFIELD NSP
SERVICING STUDY

ISL

LLOYDMINSTER

Date: 2023-01-13 Document: Q:\Projects\28059_WigfieldASP\25_GIS\251_Figures\2_NSP_Servicing\28059_Figure_4.1_Ex_Wastewater_System.mxd

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4.2.1 Dry Weather Flow Conditions

The City of Lloydminster Municipal Development Standards stipulate a per capita wastewater generation rate of 320 L/c/d for residential development. As detailed employment densities for non-residential areas have not been prepared at this stage, an area-based wastewater generation rate of 0.2 L/s/ha was applied in accordance with City of Lloydminster Municipal Development Standards. It should be noted that lower contributions for commercial or institutional may be applied on a per case basis at the discretion of the City.

As previously noted, the wastewater generation rate for each camp site stipulated in the Saskatchewan Ministry of Environment's Sewage Works Design Standards and Government of Alberta's Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems is 80 L/d. With 60 camp sites planned, this results in a wastewater generation rate of 4,800 L/d.

4.2.2 Peaking Factors

The peaking factor applied to non-residential flows was 3.0 in accordance with the City of Lloydminster Municipal Development Standards.

4.2.3 Wet Weather Flow Conditions (Inflow-Infiltration)

A constant inflow-infiltration (I-I) allowance of 0.28 L/s/ha was applied to the development area in the study area to simulate wet weather response.

4.3 Proposed Wastewater Collection System

4.3.1 Wastewater System Flows

Following the determination of the wastewater system design criteria that would be used, an estimation of the anticipated sanitary flows was derived for each service area as shown in Figure 4.2. The analysis indicates that the proposed wastewater flows are as follows in Table 4.1.

Table 4.1: Total Wastewater Flows

Service Area ID	Total Wastewater Flows					
	ADWF		PDWF		PWWF	
	L/s	m^3/d	L/s	m^3/d	L/s	m^3/d
Commercial 1	0.73	63	2.18	188	3.20	276
Commercial 2	0.66	57	1.99	172	2.92	252
Event Centre 1	0.89	77	2.67	231	3.92	338
Event Centre 2	0.77	67	2.32	200	3.40	294
Camping	0.06	5	0.17	14	1.40	121
Total	**3.11**	**269**	**9.33**	**806**	**14.83**	**1,282**

A detailed breakdown of the calculated wastewater flows for each service area are shown in Table 4.2.

Table 4.2: Wastewater Flow Estimation

Service Area	Area			Residential Population	Dry Weather Flow Generation Rate		Average Dry Weather Flow				Peaking Factor		Peak Dry Weather Flow		Peak Wet Weather Flow	
	Residential	Non-Residential	Total		Residential	Non-Residential	Residential	Non-Residential	Total		Residential	Non-Residential				
	ha	ha	ha		L/p/d	L/s/ha	L/s	L/s	L/s	m^3/d			L/s	m^3/d	L/s	m^3/d
Commercial 1	0.00	3.64	3.64	0	320	0.20	0.00	0.73	0.73	63	-	3.0	2.18	188	3.20	276
Commercial 2	0.00	3.32	3.32	0	320	0.20	0.00	0.66	0.66	57	-	3.0	1.99	172	2.92	252
Event Centre 1	0.00	4.45	4.45	0	320	0.20	0.00	0.89	0.89	77	-	3.0	2.67	231	3.92	338
Event Centre 2	0.00	3.86	3.86	0	320	0.20	0.00	0.77	0.77	67	-	3.0	2.32	200	3.40	294
Camping	0.00	4.39	4.39	0	320	0.01	0.00	0.06	0.06	5	-	3.0	0.17	14	1.40	121
Total	**0.00**	**19.66**	**19.66**	**0**	**320**	**0.16**	**0.00**	**3.11**	**3.11**	**269**	**-**	**3.0**	**9.33**	**806**	**14.83**	**1,282**

It should be noted that the peak and wet weather flows outlined in the table above are considered to be conservative compared to those resulting from the City's existing XPSWMM model, which was used for assessments and cost estimates. The XPSWMM model results are outlined in Section 4.4.

4.3.2 Wastewater Collection System Sizing and Configuration

No internal sanitary network sizing was completed at this stage as both service areas were intended to be connected to the existing sanitary system and it will be up to the developer to fulfill the intent of the servicing concept presented herein while determining the alignment and sizing of internal sewers to accommodate the sanitary system within future development areas.

Generally, the conveyance system drains from the southwest to northeast. Future pipe sizes are to be determined based on the required minimum design slope to provide a self-cleansing full-pipe velocity, under the derived peak wet weather flows, based on the roughness coefficient (n) of 0.013 in accordance with the City of Lloydminster Municipal Development Standards as presented in Table 4.3.

Table 4.3: Minimum Design Slopes for Sewers

Nominal Pipe Size	Minimum Design Slope	
mm	%	m/m
200	0.40	0.0040
250	0.28	0.0028
300	0.22	0.0022
375	0.15	0.0015
450	0.12	0.0012
525	0.10	0.0010
600 and Larger	0.10	0.0010

If flatter slopes are preferred or required at the detailed design stages, this can be reviewed, though it would have negative repercussions. If this was acceptable, the determined pipe sizes would need to be increased to meet the specified design flows.

4.4 Wastewater System Assessment

Based on the 2016 Sanitary Sewer Master Plan there was adequate capacity for the Wigfield ASP area (with it previously being entirely industrial land use) to be serviced via the existing East Trunk after the implementation of the East Trunk Twin project. Therefore, the Wigfield NSP area is to be connected to the existing wastewater system. The East Trunk Twin project is intended to intercept the flows from the South Trunk and 19 Street Trunk in order to reduce the capacity constraints of the existing East Trunk.

The City's existing XPSWMM model was used to assess the impacts of the proposed Wigfield NSP development on the existing wastewater collection system. For consistency with the 2016 Sanitary Sewer Master Plan, the 25-year storm model was used, and the commercial diurnal pattern was applied for the Wigfield NSP area.

In order to assess the impacts of the Wigfield NSP development, the existing wastewater system was assessed with and without the proposed East Trunk Twin. These assessments are summarized in Figures 4.2 and 4.3, respectively.

Proposed development assessments were run with the Wigfield NSP development flows added to the existing system both with and without the East Trunk Twin for comparison with existing results. These assessments are summarized in Figures 4.4 and 4.5, respectively.

It should be noted that based on the assessments above, sections of the East Trunk remain over capacity with the implementation of the East Trunk Twin with the addition of the Wigfield NSP flows minimally impacting the existing capacity issues.

The proposed wastewater system incorporates proposed sewer upgrades from 750 mm to 900 mm directly downstream of the NSP area along 41 Street. The proposed wastewater system is shown in Figure 4.6. Assessment results for this proposed system are shown in Figure 4.7. It should be noted that this assessment included the East Trunk Twin.

It is recommended that the timeline and growth triggers for the East Trunk Twin project and other upgrade requirements be reviewed following the completion of the 2022 Sanitary Sewer Master Plan update to incorporate development or projects completed since the preparation of the 2016 Sanitary Sewer Master Plan as well as revisions to future development areas and growth horizons. Additionally, it is recommended that pipe capacities be reviewed in detail once tie-in locations for services have been determined in order to address any other potential upgrades required upstream of 41 Street as needed.

4.5 East Trunk Twin Analysis

The modelling assessments contained herein are provided to show the impact of the Wigfield NSP area on the existing sanitary sewer collection system under both existing and proposed conditions; however, these assessments are based on the anticipated growth as outlined within the 2016 Sanitary Sewer Master Plan. Therefore, these assessments are conservative as not all assumed growth areas have been developed and population growth is not occurring at the rate anticipated within the 2016 Sanitary Sewer Master Plan.

The City’s population in 2016 was 31,400 based on the 2016 Federal Census; however, the 2016 Master Plan assumed an existing population of 32,000 since this document was prepared prior to the census. The 2016 Sanitary Sewer Master Plan considered a total population of 38,600 in the 5-year growth horizon (2020) and 44,276 in the 10-year growth horizon (2025). This can be compared to the 2021 census data, which shows a population of only 31,582; therefore, the population has increased by only 182 people in the last five years.

The East Trunk Twin was deemed necessary in the 10-year horizon to accommodate upstream growth as well as to allow for the connection of the Wigfield NSP area to the existing East Trunk. The East Trunk Twin is not triggered in the 5-year horizon; therefore, a population of 38,600 or a minimum increase of 7,018 people from the 2021 Federal Census population of 31,582 can be accommodated by the existing East Trunk. This is based on the conservative assumption that all growth has occurred within the East Trunk catchment as growth specifics for each neighbourhood were not assessed in detail. Based on the equivalent population for commercial/industrial/institutional areas of 48 persons/ha provided in the City's Municipal Development Standards, the Wigfield ASP represents a population of approximately 945 people based on the proposed service area of approximately 19.7 ha. It should be noted that the stormwater management and sports field land use areas have been excluded as these areas were not considered for servicing. Therefore, there remains available capacity in the East Trunk for an additional population of approximately 6,073 people before the East Trunk Twin is required.

It is recommended that flows be monitored in the East Trunk and future analysis be completed to support the allocation of capital budget for the East Trunk Twin as development occurs and available capacity decreases. Also, the 2022 Master Plan Update should account for the allocation of a portion of the trunk capacity to the Wigfield NSP area and away from other lands previously assumed to be serviced by the East Trunk prior to the implementation of the East Trunk Twin.

It should be noted that the 2016 Sanitary Sewer Master Plan and associated models are based on a wastewater generation rate of 360 L/c/d for residential development, which is high compared to other municipalities such as the City of Edmonton which specifies 220 L/c/d. This value was reduced in the City's 2020 Municipal Development Standards to 320 L/c/d; however, this value remains relatively high, as well as higher than the water demand rate specified in the City's Municipal Development Standards, and is to be reviewed as part of the 2022 Sanitary Sewer Master Plan Update. This may have an impact on the available capacity assumptions for the East Trunk, allowing for additional population growth to occur prior to the East Trunk Twin being triggered.

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

Freeboard

- 🟢 Greater than 3.5 m
- 🟡 2.5 to 3.5 m
- 🟠 1.8 to 2.5 m
- 🔴 Less than 1.8 m

Peak Flow Relative to Pipe Capacity

- 🟩 Less than 86%
- 🟨 86% to 100%
- 🟧 100% to 150%
- 🟥 Greater than 150%
- ▭ NSP Boundary
- ▭ City Boundary

0 50 100 200 Meters

1:4,000 NAD 1983 UTM Zone 12N

FIGURE 4.2
EXISTING WASTEWATER SYSTEM
ASSESSMENT - WITHOUT TWINNING
WIGFIELD NSP
SERVICING STUDY

ISL

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Date: 2023-01-13 Document: Q:\Projects\28059_WigfieldASP\25_GIS\251_Figures\2_NSP_Servicing\28059_Figure_4.2_Ex_Wastewater_System_withoutTwin.mxd

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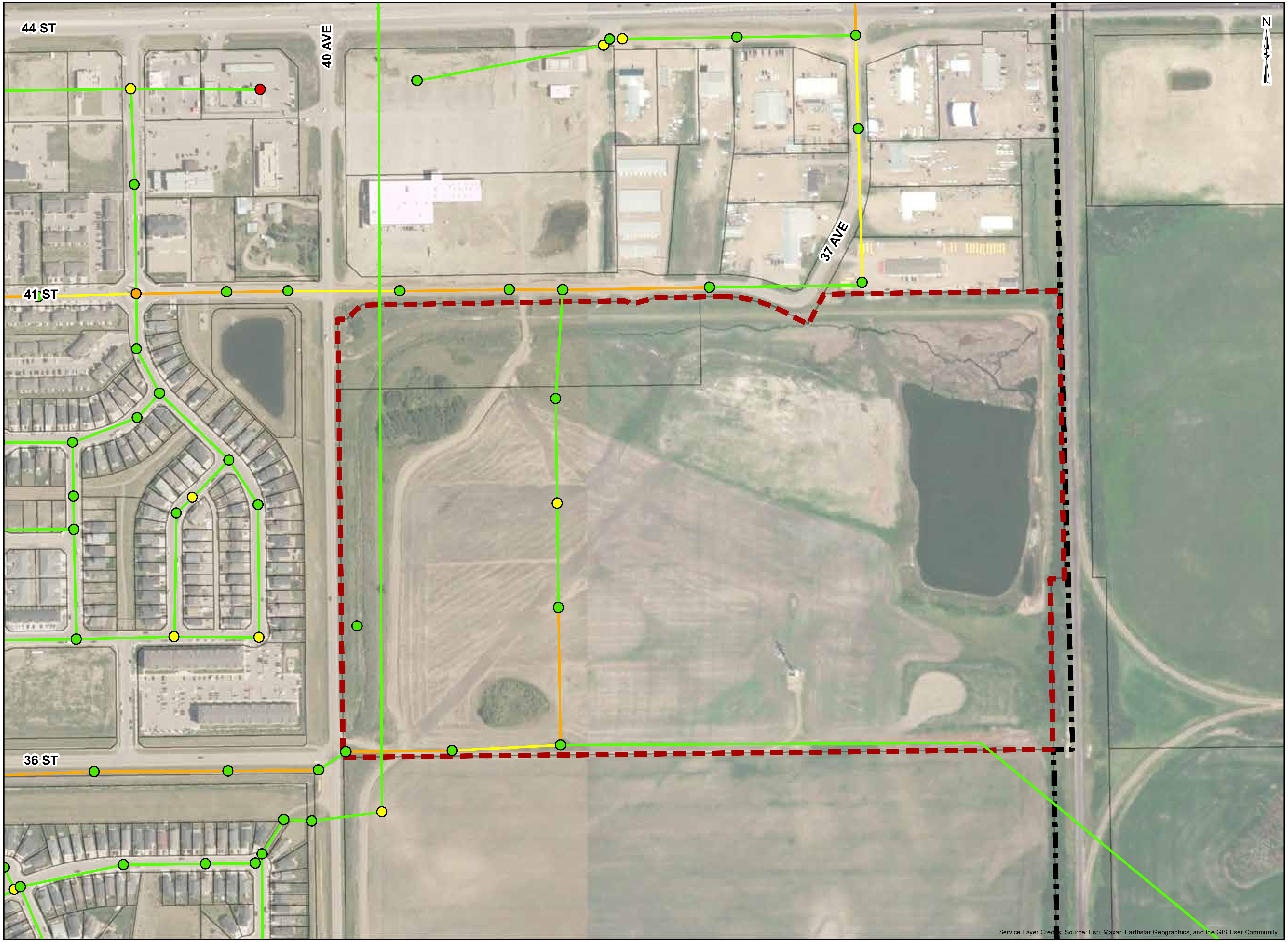

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Legend

Maximum HGL Below Ground Elevation

● Greater than 3.5 m
● 2.5 to 3.5 m
● 1.8 to 2.5 m
● Less than 1.8 m

Peak Flow Relative to Pipe Capacity

— Less than 86%
— 86% to 100%
— 100% to 150%
— Greater than 150%
▭ NSP Boundary
▭ City Boundary

0 50 100 200 Meters

1:4,000 NAD 1983 UTM Zone 12N

FIGURE 4.3
EXISTING WASTEWATER SYSTEM
ASSESSMENT - WITH TWINNING
WIGFIELD NSP
SERVICING STUDY

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Legend

Freeboard

- 🟢 Greater than 3.5 m
- 🟡 2.5 to 3.5 m
- 🟠 1.8 to 2.5 m
- 🔴 Less than 1.8 m

Peak Flow Relative to Pipe Capacity

- — Less than 86%
- — 86% to 100%
- — 100% to 150%
- — Greater than 150%

- ☐ Service Area

Proposed Land Use

- 🟨 Low-Density Residential
- 🟧 Multi-Family Residential
- 🟥 Commercial
- 🟦 Event Centre
- 🟦 Stormwater Management
- 🟩 Camping
- 🟩 Sports Fields
- ☐ NSP Boundary
- ☐ City Boundary

0 50 100 200 Meters

1:4,000 NAD 1983 UTM Zone 12N

FIGURE 4.4
PROPOSED WASTEWATER SYSTEM
ASSESSMENT - WITHOUT TWINNING
WIGFIELD NSP
SERVICING STUDY

ISL

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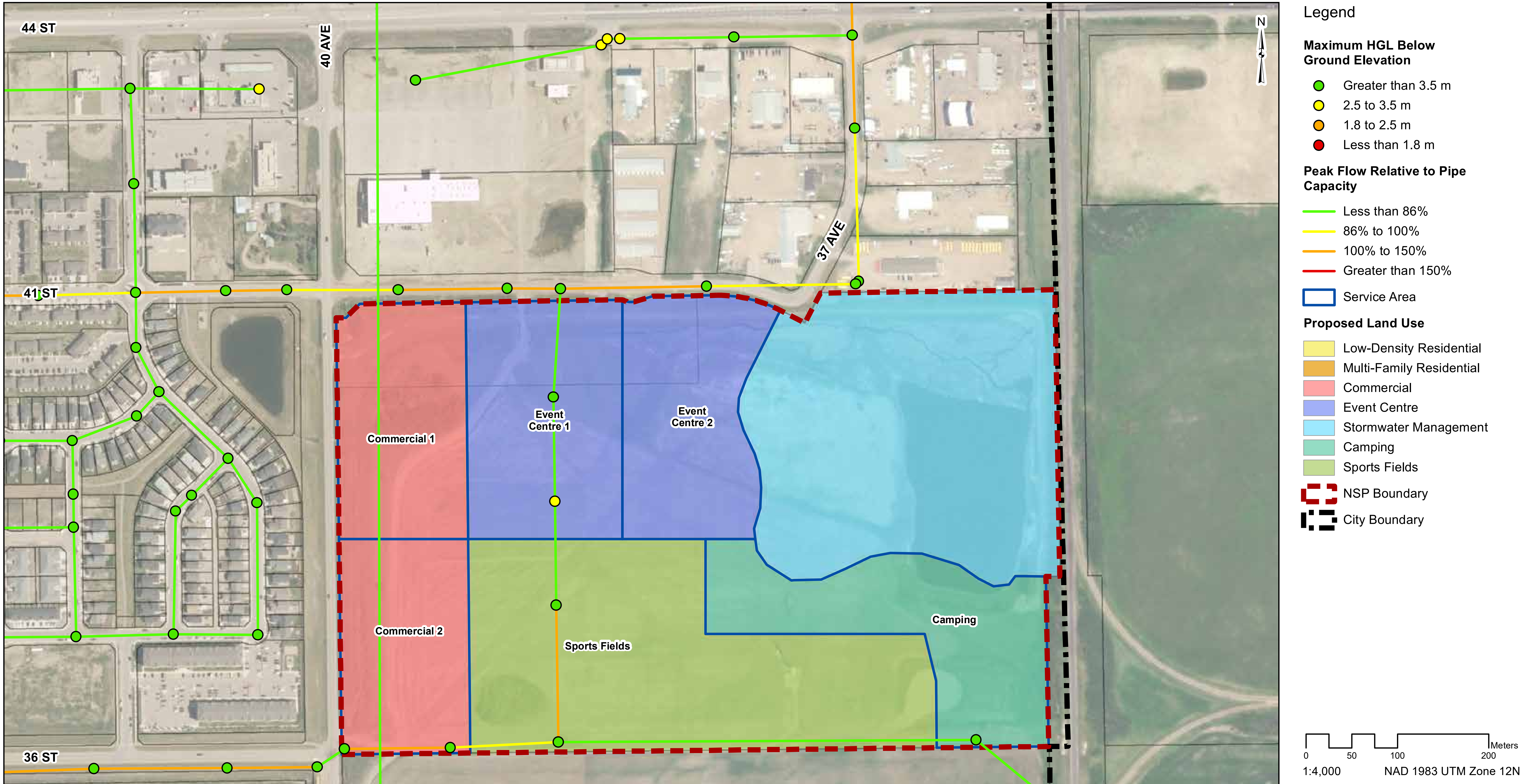
Date: 2023-01-13 Document: Q:\Projects\28059_WigfieldASP\25_GIS\251_Figures\2_NSP_Servicing\28059_Figure_4.4_Pr_Wastewater_System_withoutTwin.mxd



Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

FIGURE 4.5
PROPOSED WASTEWATER SYSTEM
ASSESSMENT - WITH TWINNING
WIGFIELD NSP
SERVICING STUDY

Date: 2023-01-13 Document: Q:\Projects\28059_WigfieldASP\25_GIS\251_Figures\2_NSP_Servicing\28059_Figure_4.5_Pr_Wastewater_System_withTwin.mxd

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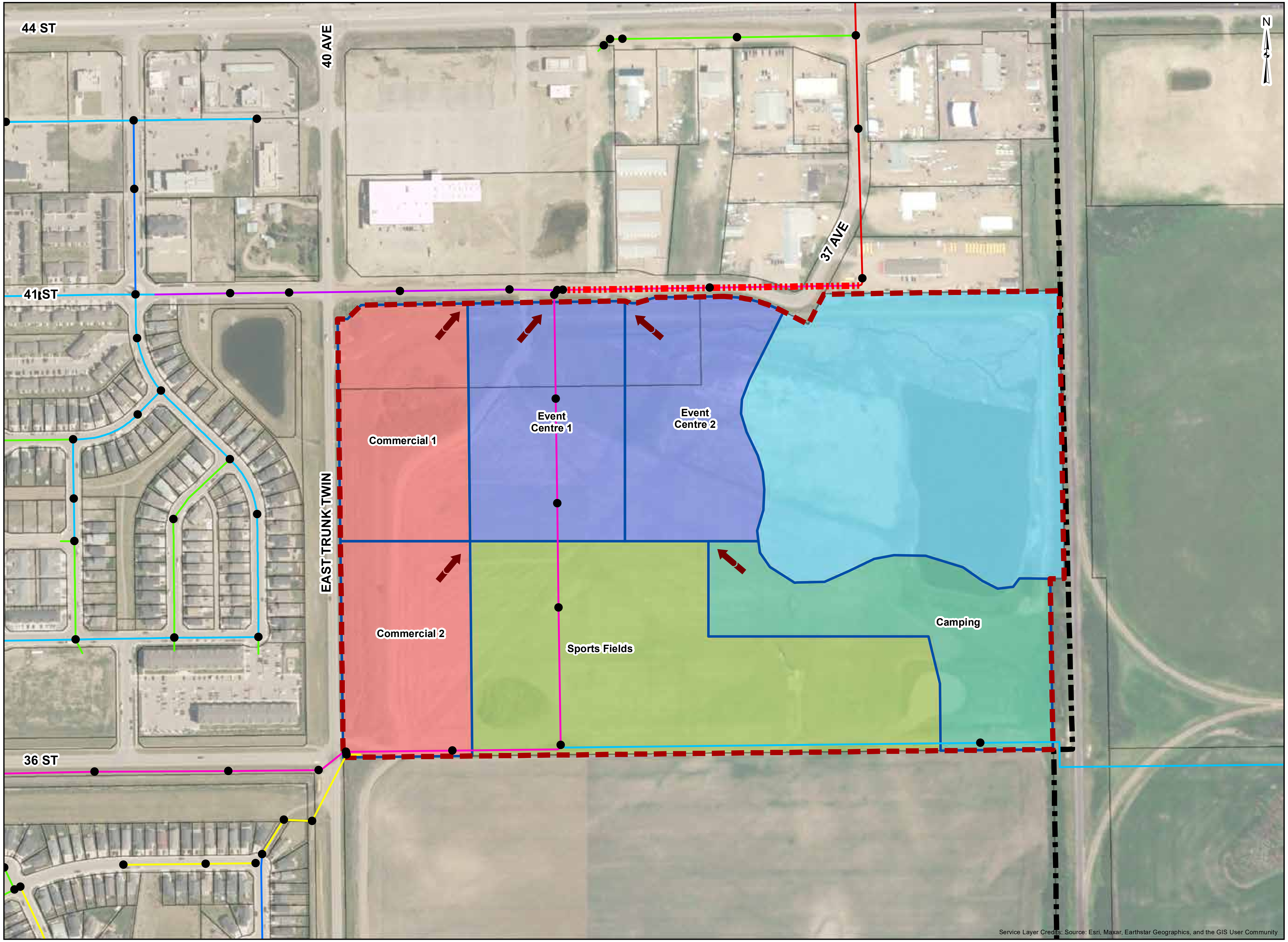

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

● Existing Manhole

Existing Pipe Diameter

— 200 mm
— 250 mm
— 300 mm
— 375 mm
— 750 mm
— 900 mm
— 1350 mm
— 1200 mm

▬ Proposed 900mm Sewer

☐ Service Area

Proposed Land Use

🟨 Low-Density Residential
🟧 Multi-Family Residential
🟥 Commercial
🟦 Event Centre
🟦 Stormwater Management
🟩 Camping
🟩 Sports Fields

▭ NSP Boundary

▭ City Boundary

Note: Sizing of additional sewers internal to the development to service the development area and connect to the City's existing system are the responsibility of the developer.

0 50 100 200 Meters

1:4,000 NAD 1983 UTM Zone 12N

FIGURE 4.6
PROPOSED WASTEWATER SYSTEM
WIGFIELD ASP AMMENDMENT
SERVICING STUDY

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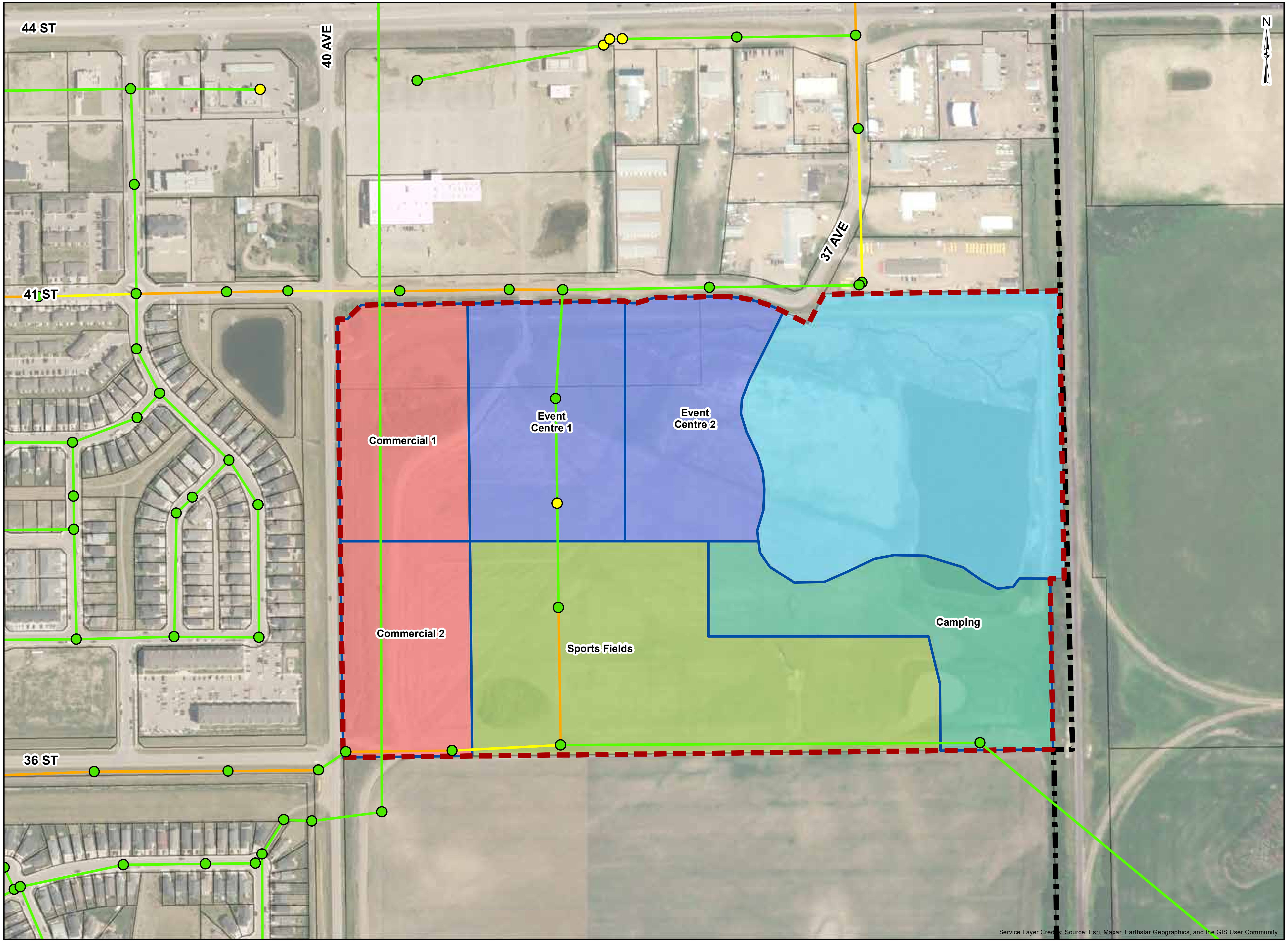

Legend

Maximum HGL Below Ground Elevation

- 🟢 Greater than 3.5 m
- 🟡 2.5 to 3.5 m
- 🟠 1.8 to 2.5 m
- 🔴 Less than 1.8 m

Peak Flow Relative to Pipe Capacity

- Less than 86%
- 86% to 100%
- 100% to 150%
- Greater than 150%

▭ Service Area

Proposed Land Use

- 🟨 Low-Density Residential
- 🟧 Multi-Family Residential
- 🟥 Commercial
- 🟦 Event Centre
- 🟦 Stormwater Management
- 🟩 Camping
- 🟩 Sports Fields

NSP Boundary

City Boundary

0 50 100 200 Meters

1:4,000 NAD 1983 UTM Zone 12N

FIGURE 4.7
PROPOSED WASTEWATER SYSTEM
ASSESSMENT - WITH TWINNING AND UPGRADE
WIGFIELD NSP
SERVICING STUDY

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5.1 Cost Estimates

Cost estimates were prepared for the proposed wastewater collection system and are summarized in Table 4.4 and provided in detail in Appendix A.

Table 4.4: Summary of Wastewater Servicing Cost Estimates

Item	Sub-Total	Contingency (Rounded)	Engineering (Rounded)	Total (Rounded)
		30%	15%	
900mm East Trunk Upgrade	$455,000	$137,000	$89,000	$680,000
Pavement Rehabilitation	$264,000	$79,000	$51,000	$395,000
Total (Rounded)	**$720,000**	**$215,000**	**$140,000**	**$1,075,000**

Although the East Trunk capacity issues directly downstream of the Wigfield NSP area along 41 Street currently exist and are maintained with the implementation of the East Trunk Twin, these have been proposed to be completed for the Wigfield NSP. It is recommended that these upgrades be completed in conjunction with the proposed watermain upgrade along 41 Street to reduce pavement rehabilitation costs.

It should be noted that the annual inflation rate is currently almost 7%. The inflation rates seen this year are the highest they have been in approximately 20 years based on the Consumer Price Index (CPI); therefore, the costs provided may increase if this trend continues (Government of Alberta, 2022).

6.0 Stormwater

6.1 Existing Drainage System

6.1.1 Existing Drainage Patterns

Under existing conditions, stormwater generally drains toward the northeast to a stormwater management facility (SWMF) known as Lake K, which functions as a wet pond. Lake K connects to Lake N, also a SWMF that functions as a wet pond, which discharges to the East Drainage Channel along the city's east boundary (Sameng, 2019). The East Drainage Channel crosses 67 Street and ultimately discharges to Neale Lake.

6.1.2 Existing Drainage Infrastructure

There is minimal existing drainage infrastructure within the study area. A box culvert, completed in 2020, connects the stormwater system to the west across 40 Avenue into the study area where an overland drainage channel conveys flows to Lake K. Lake K is connected to Lake N via culverts and overland drainage channel sections prior to discharge to the East Drainage Channel. The existing stormwater system is shown in Figure 5.1.

Based on the Issued for Tender (IFT) drawings provided for the East Drainage Channel Upgrades (Sameng, 2019), a number of upgrades from Lake J to the channel directly downstream of Lake K are proposed to reduce flooding in the system. This includes the upgrading of the culvert crossing 40 Avenue, which has been completed, the revised connection to the Larsen Grove Stormwater Management Facility, the expansion of Lake K, which is anticipated to be completed in 2022, and the channel upgrades/regrading.

There are likely existing culverts within the study area that are not shown in Figure 5.1, namely crossing 40 Avenue. However, no additional digital information pertaining to roadway culverts was provided; therefore, none are assumed to be located within the study area.

6.2 Design Criteria

The design criteria used to assess the study area was taken from a variety of sources including the City of Lloydminster Municipal Development Standards and the Saskatchewan Ministry of Environment Water Security Agency Stormwater Guidelines. The design criteria selected was then used for input into a XPSWMM model to assess the future stormwater drainage system for the study area.

6.2.1 Unit Area Release Rate

According to the 2015 Stormwater Master Plan, the maximum unit area release rate based on pre-development runoff conditions to be applied to future developments is 1.5 L/s/ha. This rate was utilized to size the SWMFs within the study area.

It should be noted that the January 17, 2019, meeting minutes for the East Drainage Channel Upgrades project notes that the Wigfield area is to have its own SWMF with a release rate of 2.5 L/s/ha. However, the 1.5 L/s/ha above has been utilized at this stage to be conservative as well as for discussion of the release rate impacts and proposed drainage patterns on the upgrades to the East Drainage Channel and Lake K.

The 2015 SMP accounted for the Wigfield ASP development area in the sizing of the proposed Lake K upgrade, with changes to the design proposed in the SMP rationalized in Sameng's design memorandum from February 22, 2019. Therefore, it has been assumed that the storage area and volume required to accommodate the Wigfield NSP development has been accounted for in the proposed Lake K upgrades. However, the storage required to service the Wigfield NSP area is to be confirmed by the City and compared with that required to accommodate the revised land uses proposed in the Wigfield NSP as these differ from those assumed in the 2015 SMP.

The storage required to accommodate the Wigfield NSP area alone is discussed in Section 5.3 for a high-level comparison with that considered in the design of the Lake K upgrades.

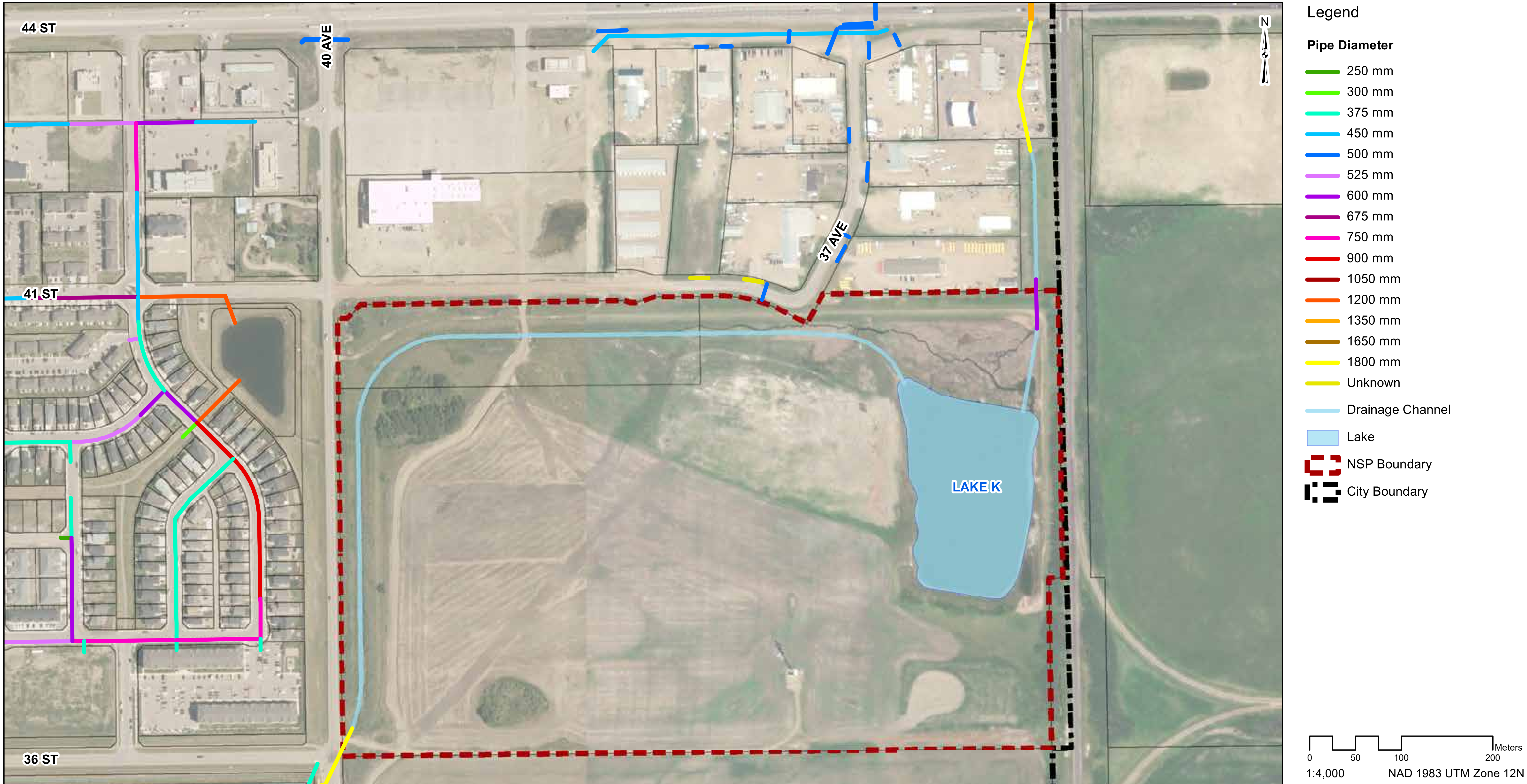

FIGURE 5.1
EXISTING STORMWATER SYSTEM
WIGFIELD NSP
SERVICING STUDY

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6.2.2 Percent Impervious

The design criteria were used along with the proposed land use data for the area, to determine imperviousness for each proposed future catchment of the study area consistent with the existing drainage patterns. Imperviousness data for different land uses is detailed in Table 5.1. The hydrologic data was used to calculate runoff for each area.

Table 5.1: Percent Impervious

Land Use	Percent Impervious
Low-Density Residential	40%
Multi-Family Residential	60%
Commercial	85%
Event Centre	70%
Camping	40%
Sports Fields	10%
Stormwater Management	100%

The determination of these impervious percentages is based on the City of Lloydminster Municipal Development Standards Section 5 – Storm Drainage Systems and is detailed as follows:

- The percent impervious applied for the camping area is based on that provided for residential – low-density (detached/semi-detached) in the City's Municipal Development Standards.
- The percent impervious applied for the camping area is based on that provided for residential – medium-density (townhouse/rowhouse) in the City's Municipal Development Standards.
- As a detailed classification of the commercial lands has not been outlined, the average percent impervious for local commercial and highway commercial was used.
- As limited details for the event centre area have been outlined, the average percent impervious for local commercial, highway commercial, school institutional, and hospital institutional was used.
- The percent impervious applied for the camping area is based on that provided for institutional land uses in the City's Municipal Development Standards.
- The percent impervious applied for the camping area is based on that provided for parks/playgrounds in the City's Municipal Development Standards.

6.2.3 Design Rainfall Events

In determining future development requirements, there are several hydraulic design criteria necessary to conceptualize a future stormwater management system for the study area. The following criteria were utilized to develop the model under proposed conditions:

- New piped (minor system) components were sized using the 1:5 year design storm based on the 4-hour Modified Chicago distribution.
- New stormwater management facilities (SWMF) were sized using a 1:100 year design storm. This was based on the greater of the 4-hour Modified Chicago distribution or the 24-hour Huff distribution.

6.2.4 Runoff Parameters

Several assumptions were made to establish the future model with full development of the necessary stormwater conveyance and storage infrastructure. Slopes are considered to remain constant through future development of the area, thus existing surface data was used to determine these values.

Infiltration is based on the Horton approach using the values outlined in the 2015 Stormwater Master Plan. Table 5.2 summarizes the runoff parameters used in the XPSWMM model.

Table 5.2: Runoff Parameters

Runoff Calculation Parameter		Value
Depression Storage	Impervious Areas	0.75 mm
	Pervious Areas	2.5 mm
Manning's 'n'	Impervious Areas	0.017
	Pervious Areas	0.03
Horton Infiltration	Maximum Infiltration Rate	76.32 mm/hr
	Minimum (Asymptotic) Infiltration Rate	5.69 mm/hr
	Infiltration Decay Rate ('k' value)	0.0011/s

6.3 Proposed Stormwater Drainage System

6.3.1 Proposed Drainage Patterns

Existing drainage patterns are generally maintained for the study area under proposed conditions. The existing development area west of 40 Avenue is to continue draining to the northeast to Lake K with stormwater management for the north service area/catchment being provided by the expanded Lake K. The NSP area is also to continue to drain to Lake K.

The 2015 Stormwater Master Plan (SMP) outlines proposed stormwater management facility (SWMF) locations based on the minimum elevations of each quarter section. As the low point of the south quarter section within the Wigfield ASP boundary is near 40 Avenue and would be surrounded by proposed development, the new SWMF for the south service area of the Wigfield ASP is proposed to be located in the southeast corner of the ASP area. Therefore, the south service area was divided into two catchments by a ridge line running east-west between 31 Street and 36 Street.

In order to avoid potential pumping of the stormwater from the South 1 catchment to the SWMF in the South 2 catchment, it is proposed that stormwater from the South 1 catchment be conveyed to the expanded Lake K facility through the NSP area via the existing drainage channel. The new SWMF in the southeast corner of the ASP area is to control stormwater from the South 2 catchment prior to release and conveyance to Lake K.

Proposed catchments have been delineated as shown in Figure 5.2. The southern Wigfield ASP catchments are also shown as these are proposed to be connected to Lake K. The parameters of these catchments are outlined in Table 5.3.

Table 5.3: Proposed Catchments

Catchment	Area	Percent Impervious
	ha	
North	28.86	84%
South 1	22.74	57%
South 2	36.16	54%
Total	**87.76**	**57%**

6.3.2 Proposed Stormwater Conveyance

For this study area, a stormwater conveyance system providing the overall framework for the ultimate drainage system was developed for the Wigfield ASP area. This system considers proposed SWMF sites and provides surface conveyance linking the ponds to downstream drainage courses.

The south SWMF, located in the southeast corner of the Wigfield ASP area, is connected to Lake K via a 300 mm sewer. It was proposed that the South 1 catchment discharge to the existing drainage channel; however, if this is not possible, flows could be conveyed via a 675 mm sewer to Lake K. If these flows must be controlled to a specified release rate prior to discharge to Lake K, a lift station and forcemain may be required to pump these flows to the proposed SWMF location at the southeast corner of the Wingfield ASP area due to the lack of grade between the low point in the South 1 catchment and the proposed south SWMF location.

The detailed design of the future conveyance system is to be in accordance with the City of Lloydminster Municipal Development Standards Section 5 – Storm Drainage Systems. Sizing of additional sewers and/or localized storage internal to the development to service the development area and connect to the City's existing system are the responsibility of the developer.

The existing downstream system was not assessed in detail; however, the City confirmed that the design of the upgraded downstream infrastructure in association with the Lake K expansion has accounted for the Wigfield ASP area including the Wigfield NSP area.

6.3.3 Proposed Stormwater Management System

In assessing the stormwater management system in the area, SWMFs are proposed to be utilized to control the additional runoff being generated by the new development. Two facilities were proposed for the Wigfield ASP. One was the expansion of Lake K to be integrated into the Wigfield NSP area and the other was a SWMF proposed at the southeast corner of the Wigfield ASP area. The proposed stormwater system is shown in Figure 5.3 with the south catchments’ infrastructure included as it is proposed to connect through the Wigfield NSP area.

It should be noted that the stormwater management facility layout indicated can be revised as development proceeds with facilities being combined as desired to integrate best with the actual development plans of the area or separated into multiple facilities to provide additional community amenity area. This could be accomplished through the use of Staged Master Drainage Plans or Subdivision Stormwater Management Reports that are normally developed to provide a greater level of detail than this study is able to provide as an overall planning document.

Lake K was not assessed in detail; however, the City confirmed that the design of the expansion of Lake K as well as the associated downstream infrastructure has accounted for the Wigfield ASP area including the Wigfield NSP area and its proposed land uses.

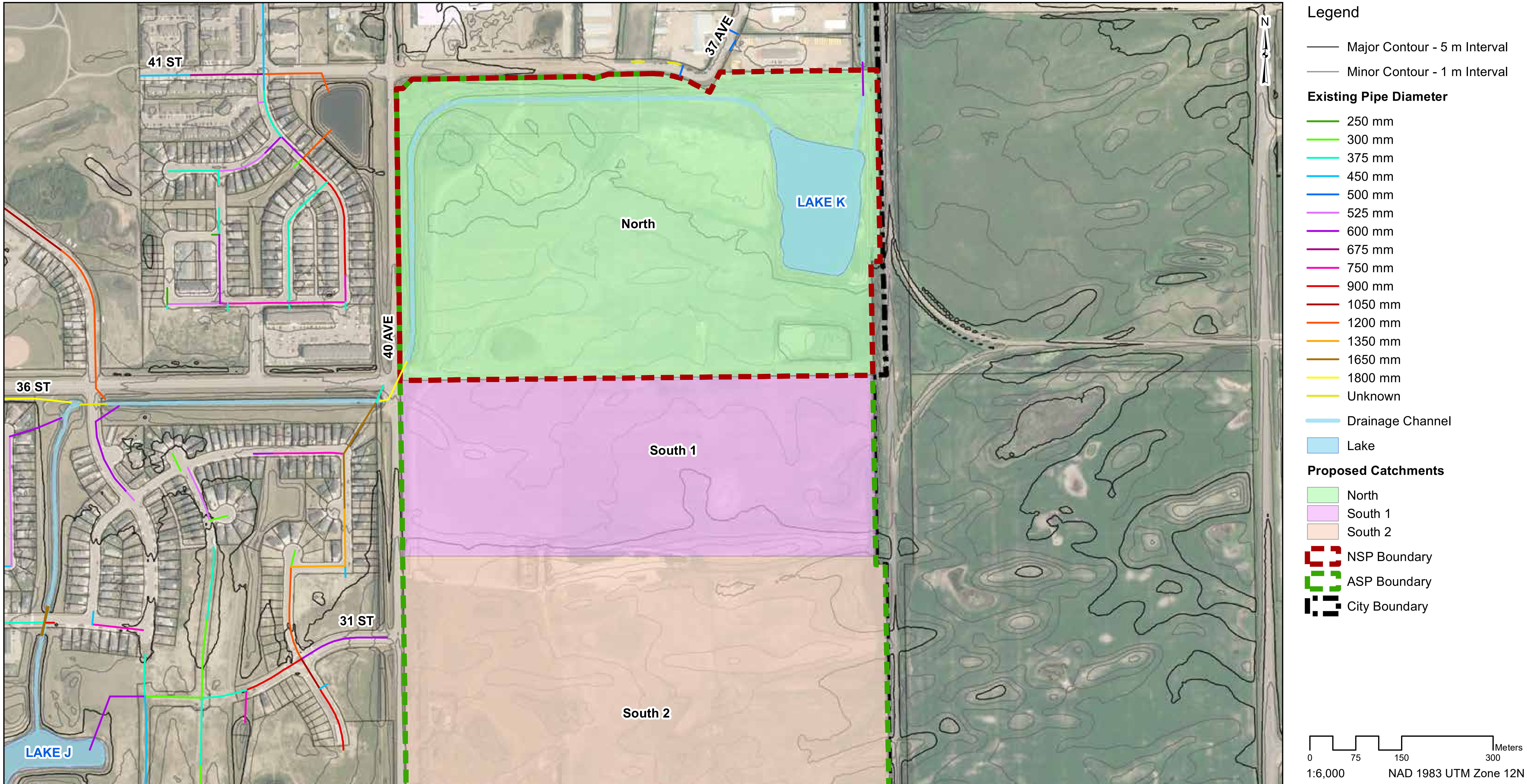

FIGURE 5.2
PROPOSED STORMWATER CATCHMENTS
WIGFIELD NSP
SERVICING STUDY

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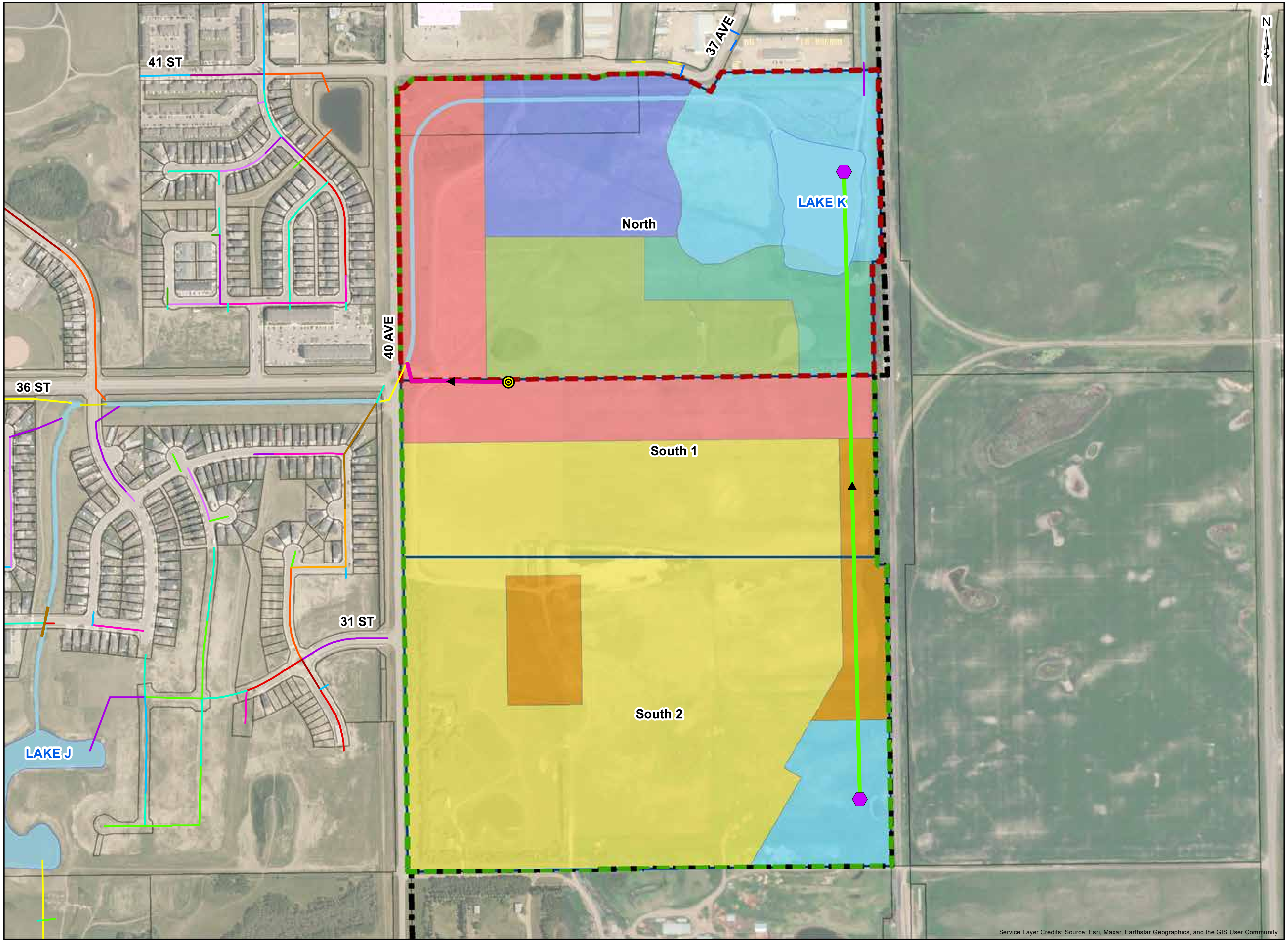

Note: Sizing of additional sewers and/or localized storage internal to the development to service the development area and connect to the City's existing system are the responsibility of the developer.

FIGURE 5.3
PROPOSED STORMWATER SYSTEM
WIGFIELD NSP
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Location

The approximate locations and preliminary sizing of SWMFs is provided in the following section as part of this study. Potential SWMF locations were selected based primarily on the 2015 SMP in additional to existing wetland areas proposed to be converted into SWMFs. Additional considerations included:

- Minimizing the number/size of facilities situated in the core build areas to leverage open spaces and support the densification of development and achieve construction/maintenance economies for the City. This is balanced by the dedication of open space areas.
- Maintaining the existing topography as much as possible to minimize the required re-grading of the study area as well as cut and fill necessary for the facility construction.
- Utilizing existing flow paths and natural drainage courses to minimize the extent of conveyance ditches or storm sewer that would need to be added to link the facilities in the study area.

Sizing

The preliminary sizing of SWMFs was completed using a spreadsheet and validated using the XPSWMM model to determine the active storage volume. This storage volume was based on the proposed land uses.. It should be noted that some localized areas may need to experience regrading to ensure all runoff from the proposed developable area enters one of the proposed stormwater management facilities prior to discharging downstream.

At this stage of development planning, the active storage volume and surface area for the proposed SWMF at Lake K has been sized to accommodate only the proposed development area within the ASP boundary. This was done as no detailed stormwater planning documents were provided for the NSP development area; therefore, this provides a high-level SWMF sizing for the entirety of the ASP boundary. Additionally, this provides the City with a high-level volume and area required in the Lake K expansion to accommodate the Wigfield NSP development compared to existing development west of 40 Avenue.

All ponds have been considered to be constructed as wet ponds at this time to act as community amenities as well as functional stormwater system elements and to accommodate the shallow grade across the site. The following parameters were applied in the sizing of these facilities:

- Active storage volume was based on the 1:100 year storm event.
- Active storage volume was based on the 1.5 L/s/ha release rate.
- Active storage depth was considered to be 1.5 m.
- Permanent storage depth was considered to be 2.0 m.
- A freeboard of 0.3 m was applied.
- Side slopes of 7:1 (H:V) were applied.

The parameters of each of the proposed ponds are summarized in Table 5.4.

It should be noted that the use of synthetic rainfall events has limitations in the overall effectiveness of considering longer periods of rainfall where antecedent moisture conditions may result in increased runoff potential. It is recommended that continuous simulations be utilized in more detailed assessments.

Table 5.4: Stormwater Management Facility Parameters

SWMF ID	Storage Bottom Area		Permanent Volume	Storage Top Area		Storage Volume	Freeboard Top Area		Freeboard Volume	Total Pond Volume
	ha	m^2	m^3	ha	m^2	m^3	ha	m^2	m^3	m^3
North	0.83	8,319	24,857	2.37	23,730	30,200	2.53	25,274	7,479	62,407
South	0.33	3,260	12,444	1.47	14,656	17,880	1.59	15,856	7,792	34,900

The detailed design of the future SWMFs is to be in accordance with the City of Lloydminster Municipal Development Standards Section 5 – Storm Drainage Systems.

6.3.4 Source Control Best Management Practices

Source control practices are becoming of increasing value in terms of stormwater management. A primary focus of these practices is sustainability in the form of pollution prevention strategies. These strategies involve the reduction of runoff volume and rate of flow as well as reduction of overall environmental impact in terms of water quality.

Several LID considerations may be integrated into the future stormwater system to ensure these guidelines are met. Potential source control options are summarized in Table 5.5, below.

Table 5.5: Source Control Practice Table

Source Control Practice	Description	Driving Forces
Stormwater Re-use/ Rainwater Harvesting	Stormwater could be captured in SWMFs or underground storage tanks and used for non-potable uses such as irrigation. This would need to be assessed at the time of development as to whether suitable guidelines for stormwater re-use exist at that stage.	• Potentially significant use of stormwater runoff • Stormwater pollutants retained by storage ponds • Highly applicable to both residential and commercial areas
Bioswales /Vegetated Swales	Stormwater is diverted into surface drainage swales that are vegetated. The net effect is similar to a combination of a grassed swale and an infiltration trench. Significant vegetation is planted to provide additional quality treatment. Subdrains are often installed in soils with infiltration rates below 12.5 mm/hr.	• Provides high amount of volume/rate control • Provides high amount of stormwater pollutant control by retaining pollutants in the swales • Highly applicable to both residential, light commercial, and industrial areas
Absorbent Landscapes	Stormwater runoff is reduced by promoting infiltration into the soil as runoff flows overland. This is often accomplished by designing for significant greenspace. Increased depth of topsoil and reduced soil compaction are also provided for the landscaped areas. This promoted infiltration can allow the soil to work like a sponge to absorb stormwater. Given this technology operates through the promotion of infiltration, soil with a high infiltration rate (low fines content) is recommended. Local geology may limit the effectiveness of this option if a low-permeability soil underlay the added topsoil. A geotechnical report is recommended if this source control is to be implemented.	• Provides high amount of volume/rate control • Highly applicable for low-intensity commercial areas • Somewhat applicable for residential areas • Minimal maintenance required

Source Control Practice	Description	Driving Forces
Green Roofs	Stormwater runoff is reduced by using vegetated roofs. Stormwater is absorbed into soil and is then either evaporated naturally or collected by a subdrain system.	• Works well for roofs of larger buildings (normally commercial and industrial) • Provides high amount of volume/rate control, particularly for small events • Can be used as on-site stormwater control for commercial/industrial areas
Bioretention Areas	Bioretention areas consist of of depressed, landscaped areas utilized to improve water quality, attenuate peak flows to the stormwater minor system, and to reduce overall stormwater volume through promotion of evapotranspiration. Stormwater is absorbed into soil and is then either evaporated naturally or collected by a subdrain system. Plantings are chosen specifically to optimize the uptake of stormwater nutrient loadings (nitrogen, phosphorus) in the geographic location of interest. Municipalities should be mindful that some maintenance of these systems is required when sediment buildup occurs and following the winter frost.	• Works well for most land uses (can be incorporated into parks, roadway medians, parking lots, sidewalk planting strips, etc.) • Can be used as on-site stormwater control for commercial, residential, and industrial areas. • Provides high amount of volume/rate control, particularly for small events • Provides high amount of stormwater pollutant control by retaining pollutants

6.3.5 Cost Estimates

Cost estimates were not prepared for Lake K as this stormwater management facility upgrade/expansion has been completed and was sized to accommodate the Wigfield NSP area based on discussions with the City.

7.0 Conclusions and Recommendations

The objectives of the Wigfield NSP Servicing Study can be largely grouped as follows:

- To review the 2016 Water Master Plan and recommend a distribution system layout. The water servicing system includes water distribution infrastructure.
- To review the 2016 Sanitary Sewer Master Plan and recommend a collection system layout.
- To review the 2015 Stormwater Master Plan and develop high-level stormwater management strategies to manage the increased runoff imposed by the intended future growth areas. This includes stormwater management facilities as well as best management practices to control stormwater runoff release rates, volume, and water quality.

The completed Wigfield NSP Servicing Study will provide a guiding document for future development of the study area that can be used in preparation of future more detailed studies such as Subdivision Servicing Reports, Staged Master Drainage Plans, and Subdivision Stormwater Management Reports.

7.1 Water Servicing

Conclusions and recommendations for the overall water servicing system for the study area can be summarized as follows:

- The Wigfield NSP area is proposed to be connected to the existing water distribution system.
- Based on preliminary assessments, the existing distribution system is considered adequate under both ADD and PHD conditions; however, it is not considered adequate under MDD+FF conditions.
- A 300 mm watermain connection is recommended along 40 Avenue from 36 Street to 41 Street. It is also recommended that the 200 mm section of watermain along 41 Street be upgraded to 300 mm to match the watermain sections to the west and north of this segment.
- The proposed reservoir storage volume of 592 m^3 for the NSP area is based on the SME formula for reservoir storage.
- Based on the 2016 Water Master Plan, there remains available storage capacity within the existing West End Reservoir for an additional population of approximately 1,646 people after the connection of the Wigfield NSP area.
- It is recommended that the currently available capacity of both the reservoir storage and the WTP be evaluated to confirm whether additional upgrades are required to facilitate the proposed NSP development and land uses once more detailed employment densities and facility details.
- It is recommended that water consumption and the associated WTP production capacity be monitored and future analysis be completed to support the allocation of capital budget to upgrades to the WTP as development occurs and available production capacity decreases.
- The costs associated with the proposed watermain upgrade is approximately $1.4 million.
- It should be noted that the annual inflation rate is currently almost 7%. The inflation rates seen this year are the highest they have been in 20 years based on the Consumer Price Index (CPI); therefore, the costs provided may increase if this trend continues (Government of Alberta, 2022).

7.2 Wastewater Servicing

Conclusions and recommendations for the overall wastewater servicing system for the study area can be summarized as follows:

- The Wigfield NSP area is proposed to be connected to the existing wastewater collection system.
- Based on preliminary assessments the East Trunk is already over capacity in some areas under existing conditions without the East Trunk Twin being implemented.
- Based on the 2016 Sanitary Sewer Master Plan, there remains available capacity in the East Trunk for an additional population of approximately 6,073 people, after the connection of the Wigfield NSP area, before the East Trunk Twin is required.
- The localized downstream upgrades of 750 mm sewer to 900 mm sewer along 41 Street are recommended.
- It is recommended that flows be monitored in the East Trunk and future analysis be completed to support the allocation of capital budget for the East Trunk Twin as development occurs and available capacity decreases.
- It is recommended the timeline and growth triggers for the East Trunk Twin project and other upgrades be reviewed following the completion of the 2022 Sanitary Sewer Master Plan update.
- It is recommended that pipe capacities be reviewed in detail once tie-in locations for services have been determined and more detailed employment densities and facility details are available.
- The costs associated with the proposed wastewater sewer upgrade is approximately $1.1 million.
- It should be noted that the annual inflation rate is currently almost 7%. The inflation rates seen this year are the highest they have been in 20 years based on the Consumer Price Index (CPI); therefore, the costs provided may increase if this trend continues (Government of Alberta, 2022).

7.3 Stormwater Drainage

Conclusions and recommendations for the overall stormwater drainage system in the study area can be summarized as follows:

- The proposed stormwater system consists of pipe connections to and from stormwater management facilities with runoff from the study area being ultimately conveyed to the East Drainage Channel, which discharges to Neale Lake.
- The minor system was sized to the 1:5 year storm event.
- Stormwater management facilities were sized to the 1:100 year storm event.
- The maximum allowable area release rate from proposed stormwater management facilities was limited to 1.5 L/s/ha.
- All stormwater management facilities were sized as wet ponds according to the following additional criteria:
  - Active storage depth was considered to be 1.5 m.
  - Permanent storage depth was considered to be 2.0 m.
  - A freeboard of 0.3 m was applied.
  - Side slopes of 7:1 (H:V) were applied.
- The use of source control Best Management Practices is encouraged to reduce the total runoff volume and enhance stormwater treatment.

- Cost estimates were not prepared for Lake K as this stormwater management facility upgrade/expansion has been completed and was sized to accommodate the Wigfield NSP area.

8.0 References

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APPENDIX A
Preliminary Cost Estimates

Table A1: Proposed Water System Cost Estimates

Item	Quantity	Units	Unit Cost	Sub-Total (Rounded)	Contingency (Rounded)	Engineering (Rounded)
					30%	15%
300mm Watermain	710	Metres	$560	$398,000	$119,000	$78,000
Pavement Rehabilitation	710	Metres	$800	$568,000	$170,000	$111,000
			Total (Rounded):	**$965,000**	**$290,000**	**$190,000**

Table A2: Proposed Wastewater System Cost Estimates

Item	Quantity	Units	Unit Cost	Sub-Total (Rounded)	Contingency (Rounded)	Engineering (Rounded)
					30%	15%
900mm Sewer	330	Metres	$1,380	$455,000	$137,000	$89,000
Pavement Rehabilitation	330	Metres	$800	$264,000	$79,000	$51,000
			Total (Rounded):	**$720,000**	**$215,000**	**$140,000**

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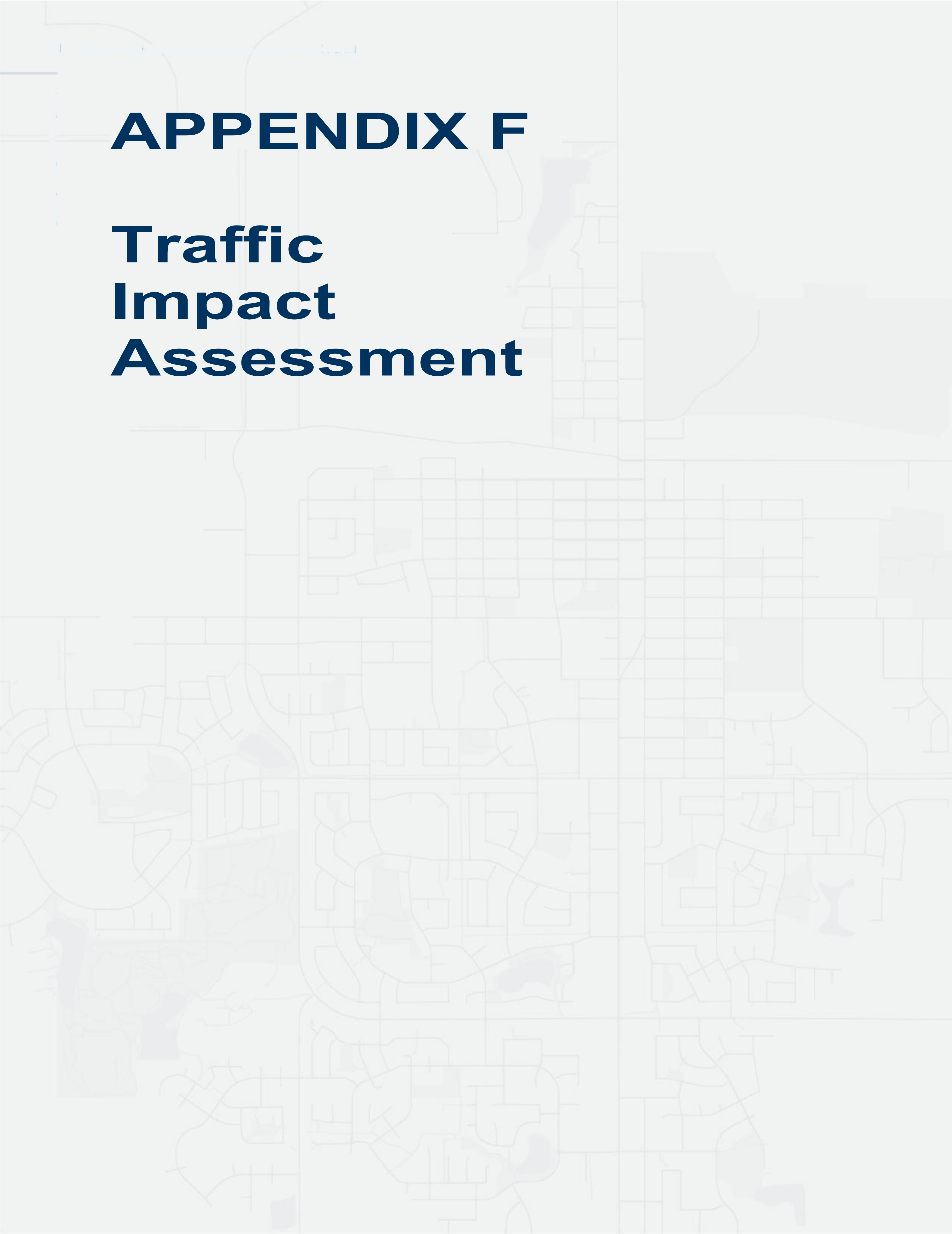
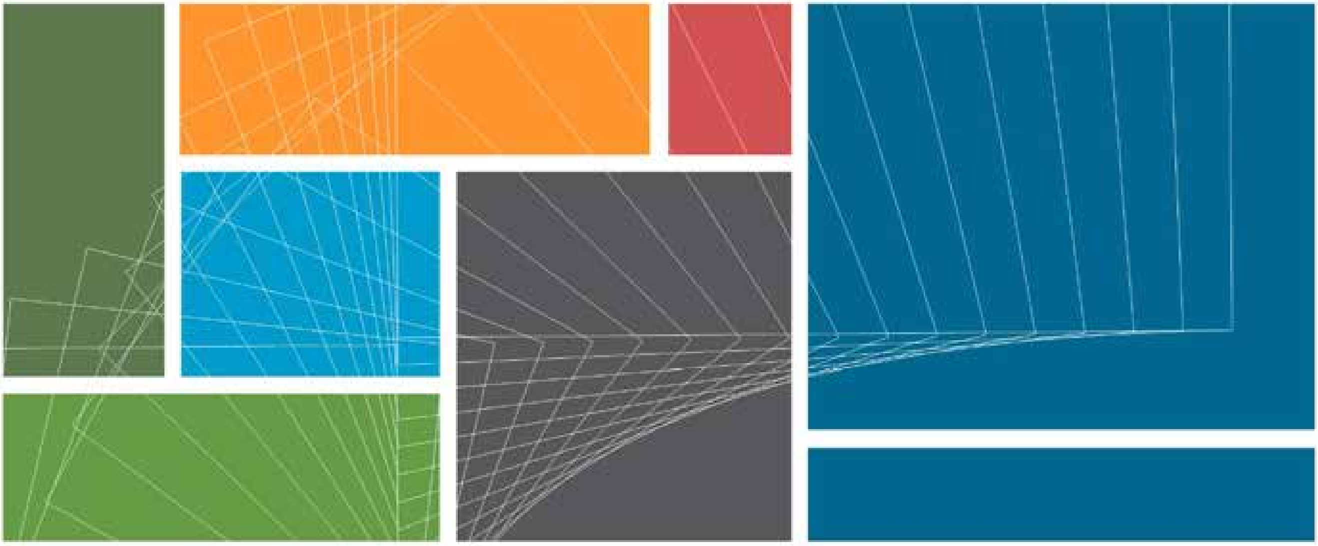
APPENDIX F

Traffic Impact Assessment





City of Lloydminster

Final Report

Wigfield ASP TIA

November 2022

ISL Engineering and Land Services Ltd. Is an award-winning full-service consulting firm dedicated to working with all levels of government and the private sector to deliver planning and design solutions for transportation, water, and land projects.

Proudly certified as a leader in quality management under Engineers and Geoscientists BC's OQM Program from 2014 to 2021.

Corporate Authorization

This document entitled “Wigfield ASP TIA” has been prepared by ISL Engineering and Land Services Ltd. (ISL) for the use of City of Lloydminster. The information and data provided herein represent ISL’s professional judgment at the time of preparation. ISL denies any liability whatsoever to any other parties who may obtain this report and use it, or any of its contents, without prior written consent from ISL.

Daniel Zeggelaar, P.Eng., PTOE, PTP
Project Manager

Table of Contents

APPENDICES

TABLES

EXHIBITS

1.0 Introduction

The original Wigfield (Wigfield) Industrial Area Structure Plan (ASP), prepared in 2014, provided new business and employment opportunities in the City of Lloydminster. The identification of this area for industrial land use was intended to ensure a supply of serviced and accessible industrial lots in the future.

After the approval of the original Wigfield ASP, a number of changes have occurred that require a revised policy direction for the Wigfield area. This report provides an overview of the transportation implications anticipated from the proposed Wigfield ASP land use changes and provides recommendations for the transportation network to support development.

1.1 Site Location

As shown in Exhibit 1.1 – Study Area, the plan area is located at the southeast corner of the City of Lloydminster, in Saskatchewan, adjacent to the Rural Municipality of Wilton No. 472. The Wigfield ASP area is bounded by:

- 40 Avenue and the Larson Grove and Aurora neighbourhoods to the west,
- the Canadian Pacific Railway ROW and industrial development to the east,
- 41 Street and existing commercial and industrial development to the north, and
- The City boundary and agricultural development to the south.

1.2 Scope

The following study provides an overview of the transportation implications anticipated from the proposed Wigfield ASP land uses and provides recommendations for the internal and surrounding transportation network to support development. This TIA includes two study horizons:

- Short Term (Opening Day): 5-year horizon with a City of Lloydminster (the City) population of approximately 35,000.
- Long Term (Ultimate): 55-year horizon with a City population of approximately 100,000.

The study scope includes:

- **Existing Conditions –** Background and existing conditions which may impact the creation of the Wigfield ASP.
  - Existing Roadway Network: internal and external roadway conditions and intersections.
  - Existing Mobility Review: trails and sidewalks, transit, and rail adjacent to and within the subject area.
  - Current and adjacent land uses.
- **Proposed Development –** An overview of future conditions.
  - Future Adjacent Land Uses.
  - Proposed Land Uses.
  - Proposed Roadway Network.
  - Study Intersections.
- **Traffic Volumes –** Anticipated traffic volumes for the short- and long-term horizon.
  - Existing Traffic: current traffic volumes based on traffic counts provided by the City.

Legend

🟥 ASP Boundary

⬛ City Boundary

0 75 150 300 Meters

1:6,000 NAD 1983 UTM Zone 12N

EXHIBIT 1.1
STUDY AREA
WIGFIELD ASP AMMENDMENT
SERVICING STUDY

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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- Background Traffic: Projected traffic volumes for the short- and long-term scenarios without the proposed Wigfield ASP land uses.
  - Site Generated Traffic: Anticipated traffic volumes generated by the proposed land uses.
  - Total Traffic: Total traffic volumes anticipated for the short- and long-term scenarios.
- **Traffic Analysis** – Assessment of traffic operations to understand the implications of the Wigfield ASP on the roadway network in the short- and long-term horizons. The traffic analysis results will inform proposed network improvements and the Wigfield ASP roadway classifications.
- **Event Sensitivity Analysis –** A high-level assessment of traffic operations when an event is hosted at the Multiuse Recreational and Event Facility. The analysis results will provide insight into potential traffic management needs for events.
- **Future Mobility** – A review of non-vehicles transportation within and adjacent to the Wigfield ASP, including trails and sidewalks, rail, and transit.
- **Conclusions and Recommendations**

Study Horizon Determination

The study horizons align with the population horizons as identified within the 40 Avenue Functional Study. The 40 Avenue Functional Study provides four geometric configurations for 40 Avenue based on the population: 35,000; 50,000; 75,000; and 100,000. A linear growth rate of 2.2 percent is applied to the City's Federal 2021 Census population to determine the approximate years corresponding to the 40 Avenue Functional Study population horizons. The 2.2 percent growth rate is from the City of Lloydminster and County of Vermillion River Regional Growth Study completed in 2019. The estimated future population is provided in the table below.

Table 1.1: Estimated City Population by Year

Year	Horizon	Population
2021	-	31,582*
2022	0	32,277
2027	**5**	**35,827**
2032	10	39,768
2037	15	44,143
2042	**20**	**48,998**
2047	25	54,388
2052	30	60,371
2057	35	67,012
2062	**40**	**74,383**
2067	45	82,565
2072	50	91,647
2077	**55**	**101,729**

*From Federal 2021 Census

The short-term five-year horizon represents the “opening day” scenario for the Multiuse Recreational and Event Facility, while the long-term 55-year will be used to confirm the ultimate 40 Avenue configuration from the Functional Study.

2.0 Existing Conditions

2.1 Existing Land Use

The plan area is currently zoned as Urban Transition (UT). Based on the current City's Land Use Bylaws, this district allows for limited agricultural and rural land use activities as the lands await urban development and utility servicing. The lands are currently used for agriculture. The existing land use is shown in Exhibit 2.1.

2.2 Existing Transportation Network

The existing transportation network adjacent to the plan area is shown in Exhibit 2.2 and discussed in the following sections.

2.2.1 Existing Roadway Network

The existing roadway network in the southeast corner of the City is described below:

- **44 Street** is a four-lane divided highway that bisects the City east-west. It is a segment of Highway 16/ Yellowhead Trail extending from British Colombia to Manitoba and is under the City's jurisdiction within the City boundary.
- **40 Avenue** is a two-lane arterial road, going north and south from 44 Street to the City boundary and agricultural development to the south.
- **41 Street** is a rural/undeveloped two-lane local road east of 40 Avenue and a paved two-lane local road to the west. The eastern portion can be accessed from 44 Street via 37 Avenue.
- **37 Avenue** is a two-lane local road going north and south from 44 Street to 41 Street.
- **36 Street** is a two-lane collector road, extending west from 40 Avenue to 65 Street.
- **31 Street** is a two-lane local road extending west from 40 Avenue, currently terminating west of 41 Avenue.

2.2.2 Current Mobility

Sidewalks and Trails

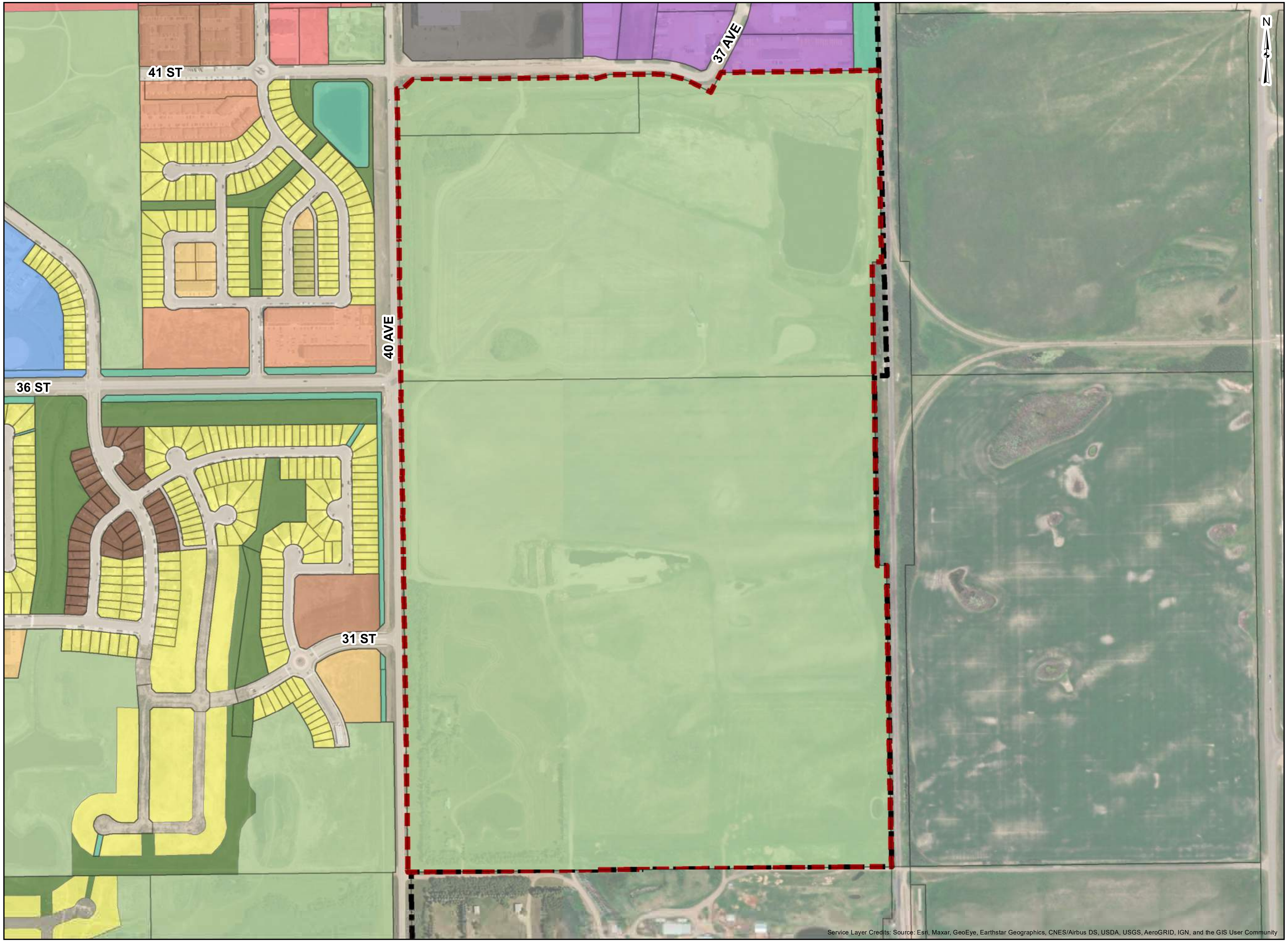
There are currently no sidewalks or trails within or adjacent to the plan area. Nearby facilities include a multi-use path on the north side of 36 Street terminating at 40 Avenue, and sidewalks within the residential neighbourhoods to the west.

Transit

The City does not currently provide public transit.

Rail

Canadian Pacific's single track freight rail line and ROW forms the eastern boundary of the plan area. The track is part of the Lloydminster subdivision with an average of two trains daily based on the most current data from the publicly available Grade Crossing Inventory. Spurs off the main track service industrial businesses to the east. There is currently a grade-separated crossing at 44 Street and an at-grade crossing with passive protection at the southeastern boundary of the plan area.



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Legend

Land Use District

- 🟨 Single-Detached Residential
- 🟩 Semi-Detached Residential
- 🟧 Row House Residential
- 🟧 Medium Density Residential
- 🟫 High Density Residential
- 🟫 Residential Manufactured Home
- 🟥 Central Commercial
- 🟥 Highway Corridor Commercial
- 🟥 Neighbourhood Commercial
- 🟥 Service Commercial
- 🟪 Light Industrial
- 🟪 Medium Industrial
- 🟦 Public Services
- 🟩 Public Utility
- 🟩 Urban Park
- 🟩 Urban Transition
- ⬛ Direct Control
- ASP Boundary
- City Boundary

0 75 150 300 Meters

1:6,000 NAD 1983 UTM Zone 12N

EXHIBIT 2.1
EXISTING LAND USE
WIGFIELD AREA STRUCTURE PLAN
TRAFFIC IMPACT ASSESSMENT

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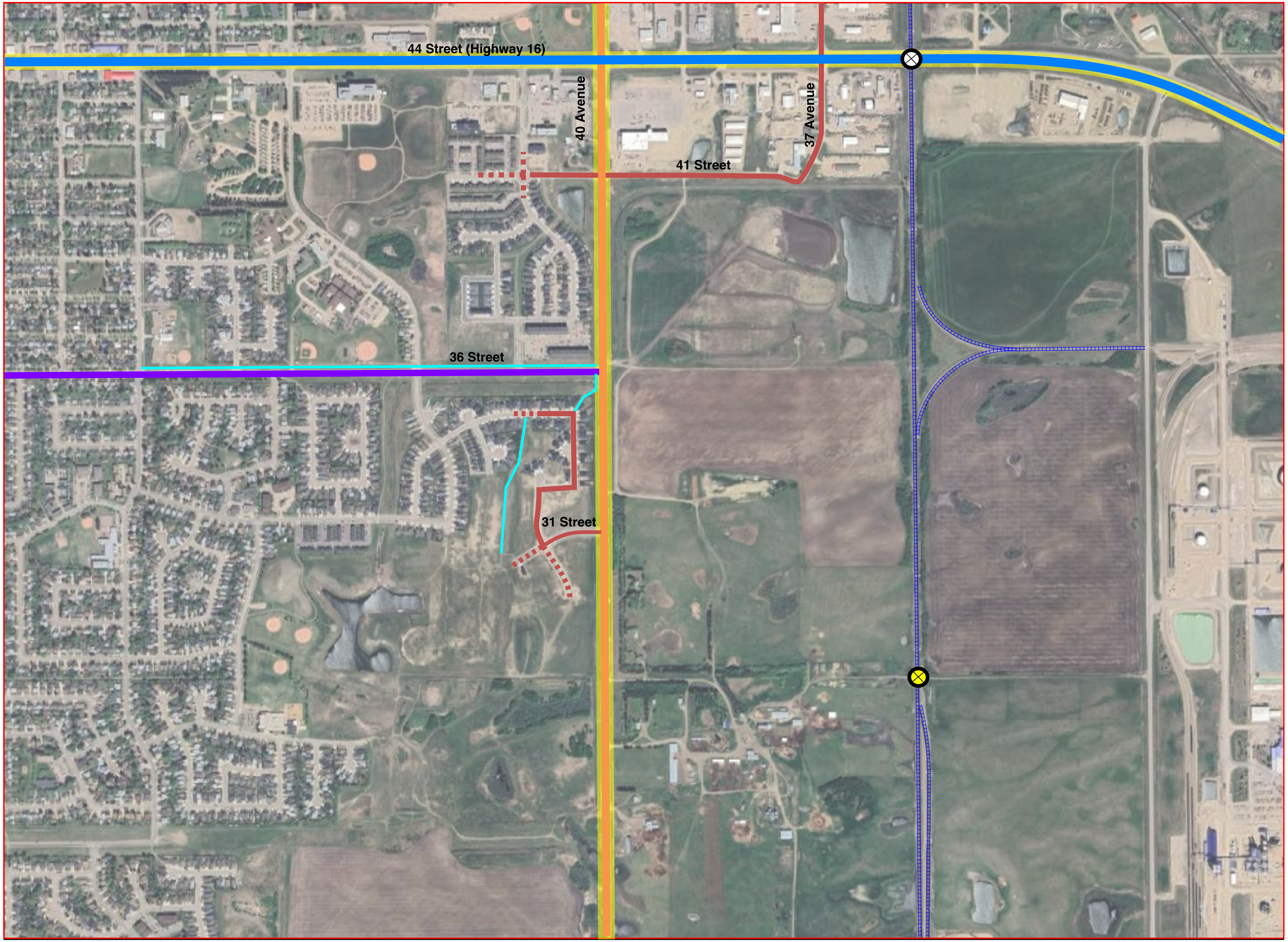

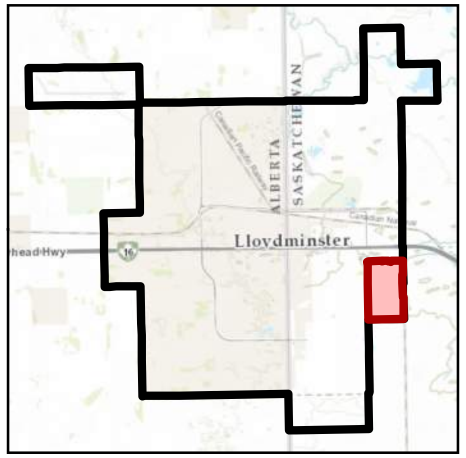

Legend

🟦	Primary Highway Connector
🟧	Arterial Road
🟪	Collector Road
🟥	Local Road
- - -	Continuation of Road
—	Multi-use Path
🟨	Dangerous Goods and Truck Route
╪╪╪	Rail (CP)
⊗	Rail Crossing (at grade)
⊗	Rail Crossing (Grade Separated)

EXHIBIT 2.2
EXISTING TRANSPORTATION NETWORK
WIGFIELD AREA STRUCTURE PLAN
TRAFFIC IMPACT ASSESSMENT

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2.2.3 Dangerous Goods and Truck Routes

44 Street and 40 Avenue are designated Dangerous Goods and Truck Routes. The plan area is currently designated a Truck Route Area, which means that all roads within the area are designated truck routes.

2.3 Adjacent Land Uses

Land uses adjacent to the plan area are as follows:

- North: Gold Horse Casino is located directly north of the plan area. The remaining lands to the north are classified as medium industrial (I1) and light industrial (I2) based on the City's current Land Use map.
- East: Most of the lands are being used by Husky Energy Upgrader for industrial operations. These lands are outside of the City's current boundary.
- South: These lands are outside of the City's current boundary and currently being used for agriculture.
- West: These lands are part of the Larson Grove, Aurora, Wallicefield, and The Willows ASPs. Larson Grove is mostly developed. Aurora appears to be approximately 75% developed while Wallicefield is approximately 50% developed. The Willows remains undeveloped. The undeveloped areas are all adjacent to 40 Avenue. The current land use designations for the western lands include:
  - Residential (R1, R2, R3, R4, R5),
  - Commercial (C2, C3, C5),
  - Public Service (P3), and
  - Urban Transition (UT).

3.0 Proposed Development

3.1 Future Adjacent Land Uses

Future development is mostly planned east of the plan area in the Larson Grove, Aurora, Wallicefield, and The Willows neighbourhoods. The current ASPs indicate these lands are intended for residential neighbourhoods with some commercial and institutional areas.

3.2 Proposed Land Uses

The proposed land uses in the Wigfield ASP update is provided in Exhibit 3.1. The Wigfield ASP includes two distinct areas:

- The Multiuse Recreational and Event Facility site forms the northern portion of the plan area bounded by 36 Street. Proposed land uses include:
  - Commercial along 40 Avenue,
  - Event Centre,
  - Camping,
  - Sports Fields, and
  - Stormwater Management.
- The Residential Neighbourhood is considered the lands south of 36 Street for the purpose of this TIA. Proposed land uses include:
  - Commercial along 36 Street,
  - Low-density residential,
  - Multi-Family residential, and
  - Stormwater Management.

3.3 Proposed Roadway Network

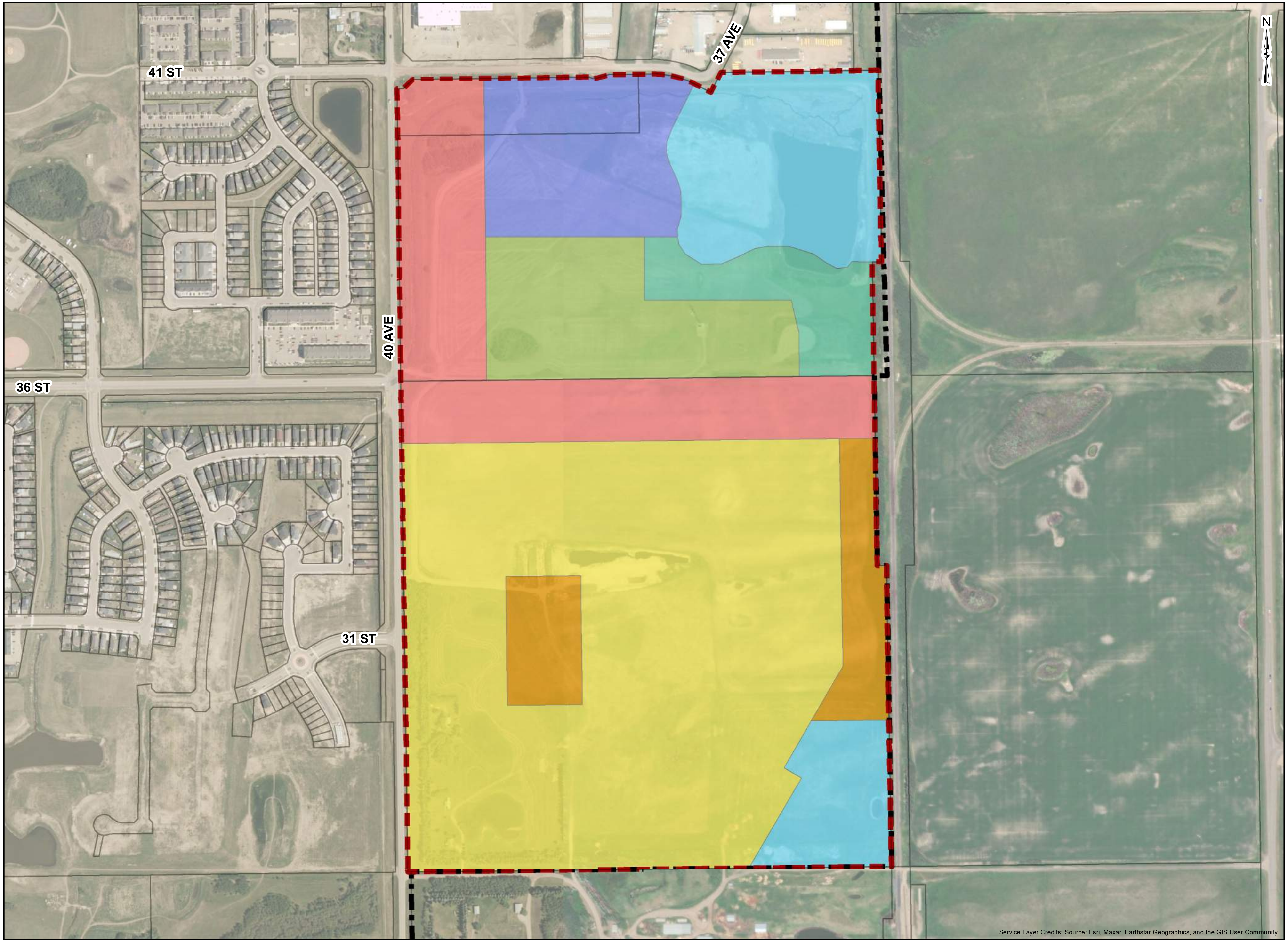
The proposed roadway network is similar to the previous Wigfield ASP completed in 2014 with accesses at the same locations: 36 Street and 31 Street. Unlike the previous Wigfield ASP, the two roads extend east into the plan area and join, making a loop. The Multiuse Recreational and Event Facility area is accessed off 41 Street and 36 Street. No new access on 40 Avenue is proposed.

The proposed roadway network is provided in Exhibit 3.2.

3.4 Proposed Active Modes Network

A highly connected active network is proposed for the plan area. This reflects the change in land use from industrial to residential. Key features include:

- Trails or green space around the entire plan area,
- Trails or green space crossing the plan area east-west and north-south,
- High quality, high visibility crosswalks on 40 Avenue connecting planned trails to the rest of the City's active mode network.
- Several active mode connections to the Multiuse Recreational and Event Facility.



Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

Proposed Land Use

- 🟨 Low-Density Residential
- 🟧 Multi-Family Residential
- 🟥 Commercial
- 🟪 Event Centre
- 🟦 Stormwater Management
- 🟩 Camping
- 🟩 Sports Fields
- ▭ ASP Boundary
- ▭ City Boundary

0 75 150 300 Meters

1:6,000 NAD 1983 UTM Zone 12N

EXHIBIT 3.1
PROPOSED LAND USE
WIGFIELD AREA STRUCTURE PLAN
TRAFFIC IMPACT ASSESSMENT

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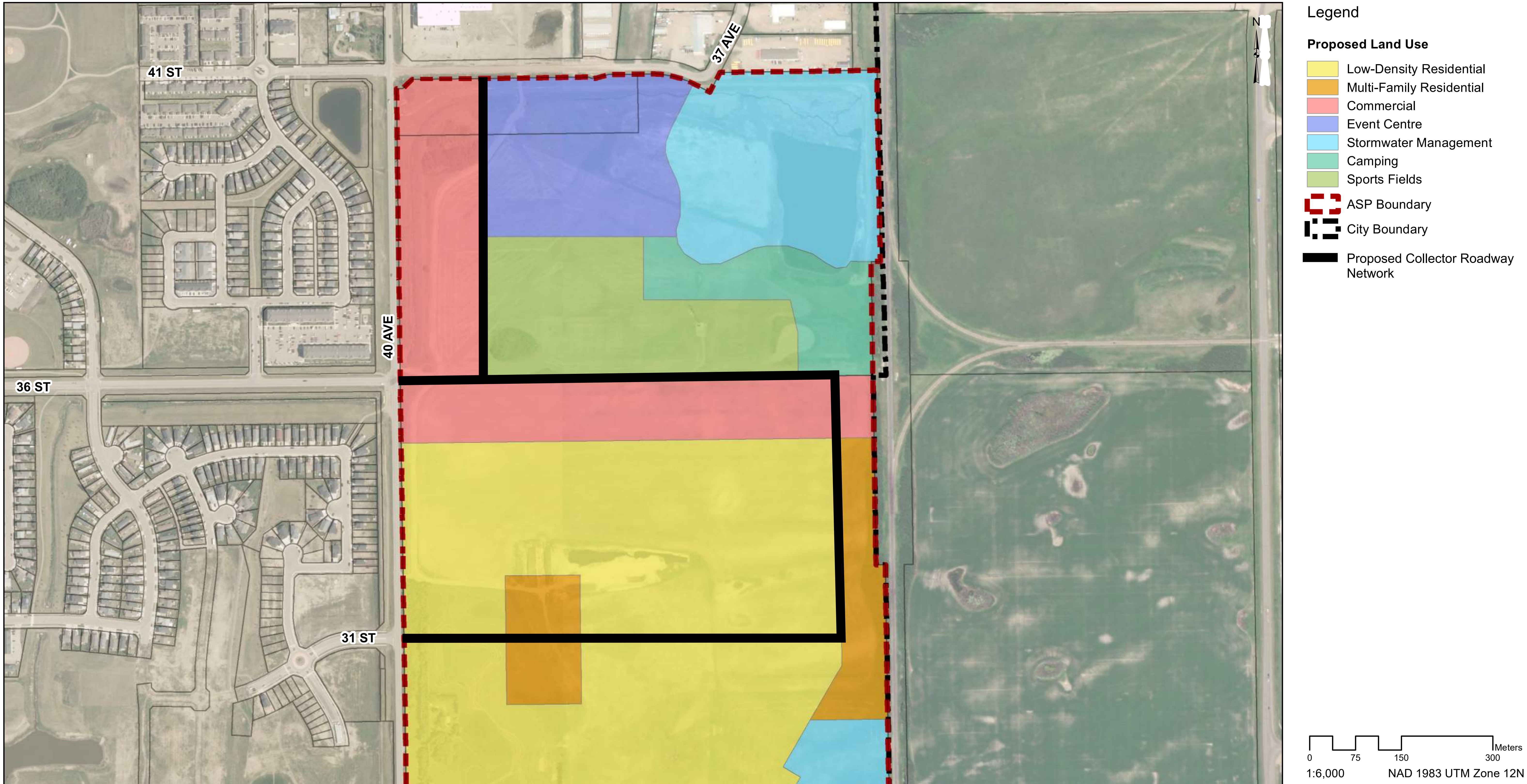

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EXHIBIT 3.2
PROPOSED ROADWAY NETWORK
WIGFIELD AREA STRUCTURE PLAN
TRAFFIC IMPACT ASSESSMENT

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3.5 Study Intersections and Zones

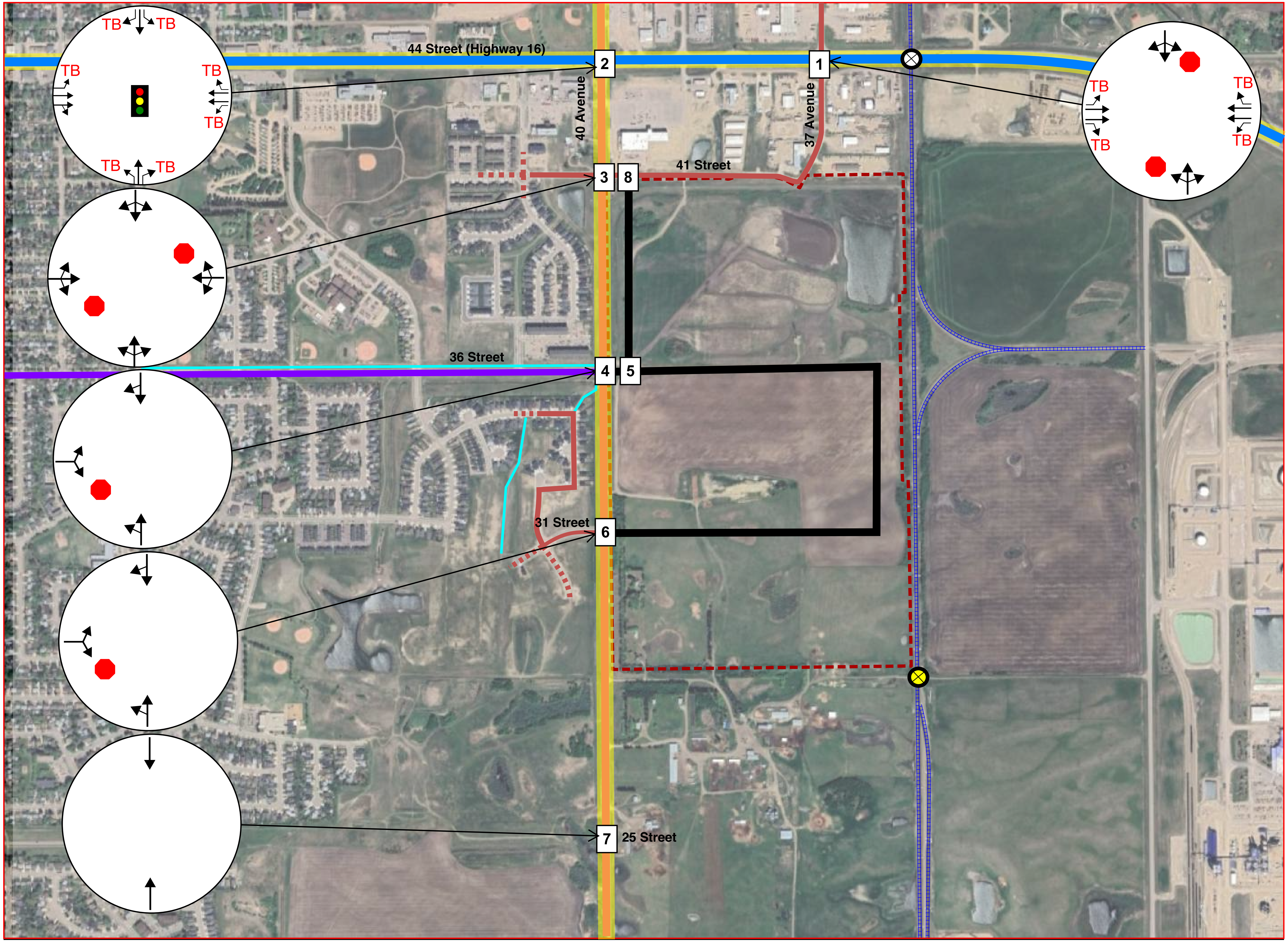
The following intersections were identified as key to the Wigfield ASP's transportation network and will be included in the traffic analysis:

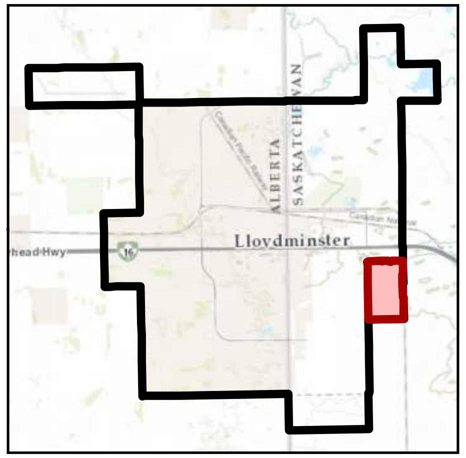
- **Intersection #1:** 44 Street (Highway 16) and 37 Avenue
- **Intersection #2:** 44 Street (Highway 16) and 40 Avenue
- **Intersection #3:** 40 Avenue and 41 Street
- **Intersection #4:** 40 Avenue and 36 Street
- **Intersection #5:** 36 Street and Multiuse Recreational and Event Facility site access (future)
- **Intersection #6:** 40 Avenue and 31 Street
- **Intersection #7:** 40 Avenue and 25 Street (future)
- **Intersection #8:** 41 Street and Multiuse Recreational and Event Facility site access (future)

The study intersections and current geometric configuration are shown in Exhibit 3.3.

The Wigfield ASP area was divided into three zones to simplify calculations and site generated traffic discussions. The zones are shown in Exhibit 3.5 and summarized as:

- Arena: The Multiuse Recreational and Event Facility site lands, accessed from 41 Street and 36 Street west of 40 Avenue.
- Zone 1: The northern residential neighbourhood area. Trips to and from this zone are assumed to primarily use 36 Street. This includes the commercial area, northern multi-family site, and a small portion of single-family homes.
- Zone 2: The southern residential neighbourhood area. Trips to and from this zone are assumed to primarily use 31 Street. This includes most of the single family and multi-family areas.





Legend

- ASP Boundary
- Primary Highway Connector
- Arterial Road
- Collector Road
- Local Road
- Multi-use Path
- Dangerous Goods and Truck Route
- Rail (CP)
- Rail Crossing (at grade)
- Rail Crossing (Grade Separated)
- Proposed Collector Roadway Network
- TB Turn Bay
- Traffic Signal
- ● Stop Control
- # Study Intersection

EXHIBIT 3.3
STUDY INTERSECTIONS, EXISTING GEOMETRIC & TRAFFIC CONTROL
WIGFIELD AREA STRUCTURE PLAN
TRAFFIC IMPACT ASSESSMENT

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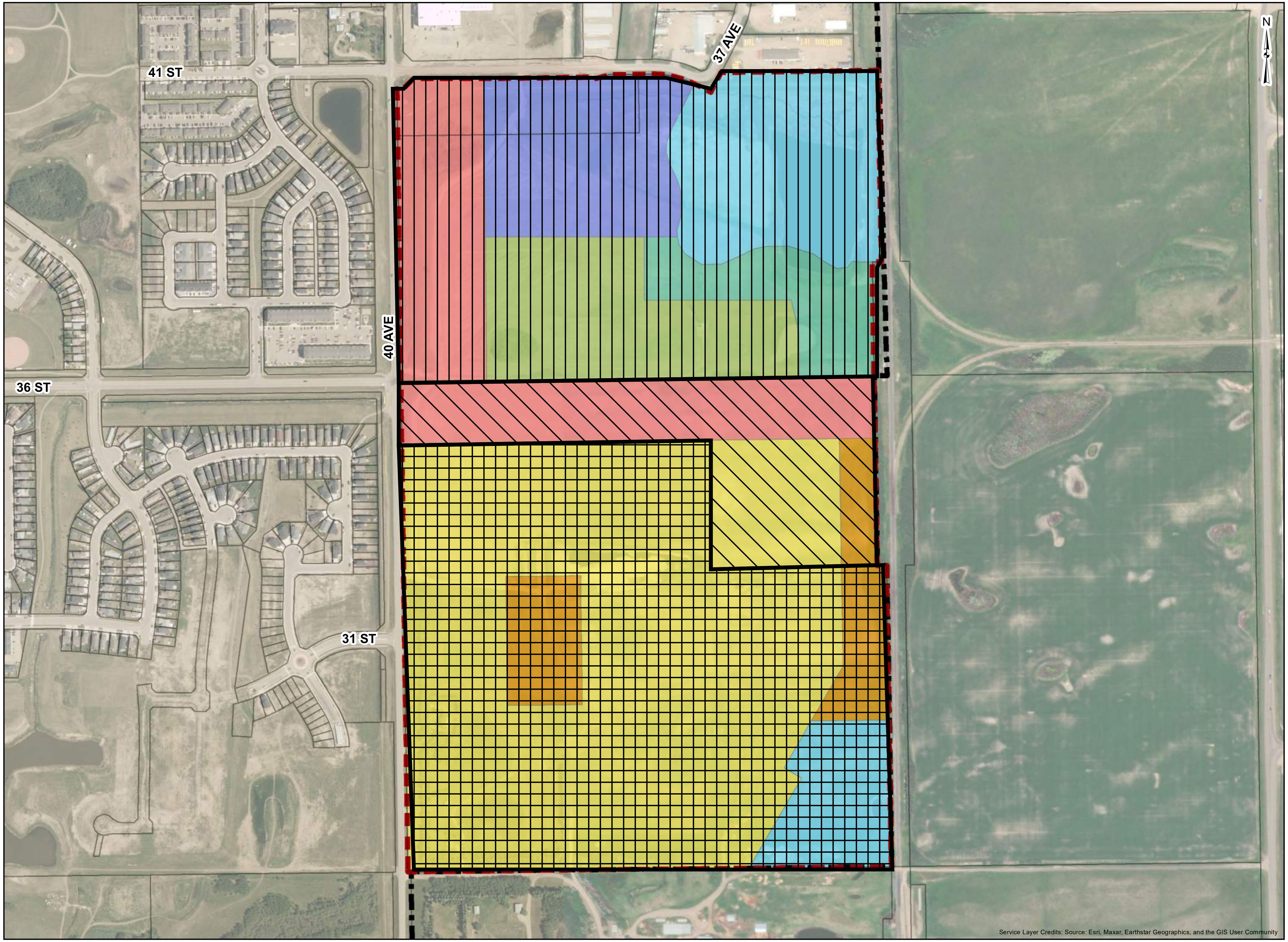

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

Proposed Land Use

- 🟨 Low-Density Residential
- 🟧 Multi-Family Residential
- 🟥 Commercial
- 🟪 Event Centre
- 🟦 Stormwater Management
- 🟩 Camping
- 🟩 Sports Fields
- ▭ ASP Boundary
- ▭ City Boundary
- ▥ Arena Zone
- ▨ Neighbourhood Zone 1
- ▦ Neighbourhood Zone 2

0 75 150 300 Meters

1:6,000 NAD 1983 UTM Zone 12N

EXHIBIT 3.4
TRAFFIC ANALYSIS ZONES
WIGFIELD AREA STRUCTURE PLAN
TRAFFIC IMPACT ASSESSMENT

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4.0 Traffic Volumes

4.1 Existing Traffic Volumes

The existing traffic volumes are based on traffic counts provided by the City. The existing traffic is shown in Exhibit 4.1 and the traffic counts are provided in Appendix A.

4.2 Background Traffic Volumes

The background traffic volumes are based on different sources for the two Scenarios:

- **Opening Day (35,000 population):** A 2.2 percent linear yearly growth rate was applied to through movements on 40 Avenue and 44 Street. This represents expected increases in traffic from the City's growth over five years. Turning movements were not increased. It is assumed that increases in turning movement volume from development will be minimal for the Opening Day scenario.
- **Ultimate (100,000 population):** 2070 total traffic volumes from the 40 Avenue Functional Study were used as the basis for the background traffic volumes. The Functional Study volumes include traffic from adjacent development as well as the casino area. At the time, the Wigfield ASP lands were designated for industrial uses. The ultimate background traffic volumes were calculated by subtracting the traffic entering the Wigfield ASP area from the Functional Study 2070 total traffic volumes.
  - Some adjacent land uses may have been modified since the Functional Study in 2015; however, more recent traffic projections were not available at the time of this TIA.

The background traffic volumes for the Opening Day and Ultimate scenarios are provided in Exhibits 4.2 and 4.3.

4.3 Site Generated Traffic Volumes

The site generated traffic is calculated using the proposed land use for the Wigfield ASP. Each land use has an anticipated trip generation rate that is used to create an estimate of the site generated traffic. The Institute of Transportation (ITE) Engineers Trip Generation Manual (11th Edition) is the main source for this study's trip generation rates. Engineering judgement supplements the ITE manual where needed.

The components of the site generated traffic for the two scenarios are as follows:

- **Opening Day:** This scenario only includes traffic generated by the Multiuse Recreational and Event Facility site. No development is assumed for the residential neighbourhood.
- **Ultimate:** This scenario includes site generated traffic from the Multiuse Recreational and Event Facility site and the residential neighbourhood.

The site generated traffic for the Opening Day and Ultimate scenarios are shown in Exhibit 4.4 and 4.5.

The Multiuse Recreational and Event Facility site land use is based on the most recent concept plan available at the time of this study. This includes:

- Multiuse Recreational and Event Facility – two indoor skating rinks with potential to convert the rinks into event areas. The current plan includes 2440 seats on the event side, 3500 seats on the event side with floor seating, and 500 seats on the community side.
- Six Slo-Pitch diamonds.

- Six commercial (CRU) parcels – Specific businesses have not been confirmed at the time of this TIA. Likely businesses include drive thru, bank, retail, convenience, and restaurant. Expression of interest has been received for a sports equipment store, physiotherapy, and liquor store.
- Recreational Vehicle Park – 40 powered stalls, 16 unpowered.
- One hotel with approximately 100 rooms.

4.3.1 Trip Generation Rates

Trip generation rates are used to estimate the number of trips a land use will produce. Most of the trip rates used for this TIA are from the 11th Edition Trip Generation Manual produced by ITE, an international association of transportation professionals. The following trip generation rates and assumptions were used for this TIA:

- **Multiuse Recreational and Event Facility site:**
  - **Commercial:** The ITE 820 Shopping Centre trip rate is often used when retail types are not defined, however the potential businesses listed are anticipated to generate traffic at much higher rates than ITE's 820 Shopping Centre. The following retail types are assumed:
    - **Sporting Goods Superstore**: ITE trip rate 861.
    - **High-Turnover (Sit-Down) Restaurant**: ITE trip rate 932. The ITE Trip Generation Manual defines this type of restaurant is usually moderately priced and often belongs to a restaurant chain.
    - **Fast-Food Restaurant with Drive-Through Window**: ITE trip rate 934.
    - **Strip Retail Plaza**: ITE trip rate 822. This land use is like the ITE 820 shopping centre but for retail area with less than 40,000 ft^2 of gross floor area.
  - **Multiuse Recreational and Event Facility:**
    - **Typical use:** The ITE 465 Ice Skating Rink. This represents the typical use of the arena for iced skating rinks. The trip rate is reduced to fifteen percent (15%) to represent the anticipated usage outside of the hockey season. This reduction is based on data from the City's other facilities. The ITE Trip Generation Manual does not include trip rates for the AM peak hour. It is assumed that the AM peak hour usage will be like the slo-pitch rate, approximately one eighth of the PM peak hour rate.
    - **Event Scenario**: Trips are correlated with the seating capacity.
  - **Slo-Pitch**: the ITE Trip Generation Manual a trip rate for an outdoor soccer complex (488). For this report, baseball diamonds are assumed to generate the same trips as a soccer field.
  - **Recreational Vehicle Park:** ITE trip rate 416.
  - **Hotel**: ITE trip rate 310.
- **Residential Neighbourhood**:
  - **Residential:** ITE trip rate 210 Single Family Detached.
  - **Multi-Family:** ITE trip rate 215 Single Family Attached. This trip generation rate is used for any single-family housing that shares a wall with an adjoining unit. This can include duplexes and townhouses/rowhouses.
  - **Commercial:**
    - **Shopping Centre:** ITE trip rate 820. The ITE Trip Generation Manual defines a shopping centre as having more than 150,000 ft^2 gross floor area. The three largest commercial areas are close to or greater than this threshold.

- **Shopping Plaza:** ITE trip rate 821. The ITE Trip Generation Manual defines a shopping centre as having between 40,000 and 150,000 ft^2 gross floor area. This land use typically includes a supermarket but could alternatively include home improvement, discount, or other stores.

The trip generation rates are summarized in the table below.

Table 4.1: IASP Trip Generation Rates and Sources

Land Use	Unit	AM			PM			Source
		Rate	In	Out	Rate	In	Out	
Liquor Store	1000 ft^2 GFA	2.08	51%	49%	17	50%	50%	ITE 899
Sporting Goods Superstore	1000 ft^2 GFA	2.05	52%	48%	2.58	46%	54%	ITE 861
High-Turnover (Sit-Down) Restaurant	1000 ft^2 GFA	13.7	57%	43%	16.35	51%	49%	ITE 932
Fast-Food Restaurant with Drive-Through Window	1000 ft^2 GFA	50.57	52%	48%	50.94	51%	49%	ITE 934
Strip Retail Plaza	1000 ft^2 GFA	7.6	50%	50%	13.24	54%	46%	ITE 822
Ice Skating Rink	Rinks	1.04	50%	50%	8.30	62%	38%	ITE 465
Slo Pitch Diamond	Diamonds	1.77	53%	47%	16.9	47%	53%	ITE 488
Campground/Recreational Vehicle Park	Occupied Campsites	0.25	36%	64%	0.41	62%	38%	ITE 416
Hotel	Rooms	0.53	53%	47%	0.6	58%	42%	ITE 310
Single Family Detached Housing	Dwelling Units	0.75	26%	74%	0.99	64%	36%	ITE 210
Single-Family Attached Housing	Dwelling Units	0.55	25%	75%	0.61	62%	38%	ITE 215
Shopping Centre	1000 ft^2 GFA	0.94	62%	38%	3.81	48%	52%	ITE 820
Shopping Plaza	1000 ft^2 GFA	7.06	52%	48%	9.72	49%	51%	ITE 821

GFA = Gross Floor Area

4.3.2 Gross Site Generated Traffic Volume Estimate

A total of 1,067 trips per AM peak hour (in and out) are estimated, with 475 trips inbound and 592 trips outbound. A total of 1,814 trips per PM peak hour (in and out) are estimated, with 977 trips inbound and 837 trips outbound.

The estimated gross site generate traffic by zone is summarized in the table below.

Table 4.2: Gross Trips Generated

Zone	Land Use	AM			PM		
		In	Out	Total	In	Out	Total
Arena	Liquor Store	7	7	14	60	60	120
	Sporting Goods Superstore	7	7	14	8	10	18
	High-Turnover (Sit-Down) Restaurant	55	41	96	58	56	114
	Fast-Food Restaurant with Drive-Through Window	131	121	252	130	125	255
	Strip Retail Plaza	53	53	106	100	85	185
	Ice Skating Rink	1	1	2	10	6	16

Zone	Land Use	AM			PM		
		In	Out	Total	In	Out	Total
	Slo Pitch Diamond	6	5	11	48	54	102
	Campground/Recreational Vehicle Park	5	9	14	14	9	23
	Hotel	28	25	53	35	25	60
1	Single Family Detached Housing	10	27	37	31	17	48
	Single-Family Attached Housing	2	7	9	7	4	11
	Shopping Centre	59	36	95	185	200	385
	Shopping Plaza	33	30	63	43	45	88
2	Single Family Detached Housing	67	190	257	217	122	339
	Single-Family Attached Housing	11	33	44	31	19	50
Total		**475**	**592**	**1067**	**977**	**837**	**1814**

4.3.3 Pass-by

A proportion of the commercial trips generated are assumed to be “pass-by” trips. This is when a vehicle traveling along a roadway makes a stop at an adjacent commercial area on their way to their ultimate destination.

The volume of pass-by trips are removed from the Opening Day and Ultimate background through traffic on 44 Street and 40 Avenue. These pass by trips are then manually assigned onto the transportation network to account for vehicles turning into and out of a commercial area during the peak hour. This reduction only applies to commercial land uses.

Pass-by rates from the ITE 11th Edition Trip Generation Manual Pass-By Tables were used. The Pass-by trip adjustment and rates are summarized in the table below.

Table 4.3: Pass-by Trip Adjustment

Zone	Land Use	Pass-by Rate (%)	AM		PM	
			In	Out	In	Out
Arena	Liquor Store	50	4	4	30	30
	Sporting Goods Superstore	40	3	3	3	4
	High-Turnover (Sit-Down) Restaurant	43	24	18	25	24
	Fast-Food Restaurant with Drive-Through Window	55	72	67	72	69
	Strip Retail Plaza	29	15	15	29	25
1	Shopping Centre	29	17	10	54	58
	Shopping Plaza	40	13	12	17	18

4.3.4 Internal

Internal intersection operations were not assumed for the Wigfield ASP except the Multiuse Recreational and Event Facility access on 36 Street. A ten percent (10%) trip reduction was applied to represent internal trips made by Wigfield ASP residents between Zones 1 and 2. The internal trip reduction is provided in the table below.

Table 4.4: Internal Trip Reduction

Zone	Land Use	AM			PM		
		In	Out	Total	In	Out	Total
1	Single Family Detached Housing	1	3	4	3	2	5
	Single-Family Attached Housing	0	1	1	1	0	1
2	Single Family Detached Housing	7	19	26	22	12	34
	Single-Family Attached Housing	1	3	4	3	2	5

4.3.5 Mode Split

Five percent (5%) of the of vehicle trips were removed to represent the number of trips completed by other modes such as cycling or walking. While most trips are assumed to be by vehicles, it is assumed that a small proportion of residents will walk to work or make purchases in one of the commercial areas. The reduction in vehicle trips to account for the assumed mode split is provided in the table below.

Table 4.5: Mode Split Reduction

Zone	Land Use	AM			PM		
		In	Out	Total	In	Out	Total
Arena	Liquor Store	0	0	0	2	2	3
	Sporting Goods Superstore	0	0	0	0	0	1
	High-Turnover (Sit-Down) Restaurant	2	1	3	2	2	3
	Fast-Food Restaurant with Drive-Through Window	3	3	6	3	3	6
	Strip Retail Plaza	2	2	4	4	3	7
	Ice Skating Rink	0	0	0	1	0	1
	Slo Pitch Diamond	0	0	1	2	3	5
	Campground/Recreational Vehicle Park	0	0	1	1	0	1
	Hotel	1	1	3	2	1	3
1	Single Family Detached Housing	0	1	2	1	1	2
	Single-Family Attached Housing	0	0	0	0	0	0
	Shopping Centre	2	1	3	7	7	14
	Shopping Plaza	1	1	2	1	1	3
2	Single Family Detached Housing	3	9	12	10	5	15
	Single-Family Attached Housing	0	1	2	1	1	2

A five percent (5%) mode split is a conservative estimate. A higher proportion of active mode trips may occur considering the Multiuse Recreational and Event Facility site and plans for high-quality active mode connections to the area. This may result in lower traffic volumes than what is estimated for the Ultimate scenario.

4.3.6 Net Traffic Volumes

The net site generated traffic volumes were calculated by removing the pass-by, internal, and mode split volumes. The proposed land uses are anticipated to generate 717 trips during the AM peak hour (304 in, 418 out) and 1246 trips during the PM peak hour (682 in, 564 out). The net site generated traffic volumes are provided in the tables below.

Table 4.6: Estimated Net Site Generated Traffic Volumes by Zone

Zone	Land Use	AM Trips			PM Trips		
		In	Out	Total	In	Out	Total
Arena	Liquor Store	4	4	7	28	28	57
	Sporting Goods Superstore	4	4	8	5	6	10
	High-Turnover (Sit-Down) Restaurant	29	22	52	31	30	62
	Fast-Food Restaurant with Drive-Through Window	56	51	107	56	53	109
	Strip Retail Plaza	36	36	71	67	57	124
	Ice Skating Rink	1	1	2	9	6	15
	Slo Pitch Diamond	6	5	10	46	51	97
	Campground/Recreational Vehicle Park	5	9	13	13	9	22
	Hotel	27	24	50	33	24	57
1	Single Family Detached Housing	9	23	31	27	14	41
	Single-Family Attached Housing	2	6	8	6	4	10
	Shopping Centre	40	25	64	124	135	259
	Shopping Plaza	19	17	36	25	26	50
2	Single Family Detached Housing	57	162	219	185	105	290
	Single-Family Attached Housing	10	29	38	27	16	43
Total		**304**	**418**	**717**	**682**	**564**	**1246**

Table 4.7: Estimated Net Site Generated Traffic by Area

Area	AM Trips			PM Trips		
	In	Out	Total	In	Out	Total
Multiuse Recreational and Event Facility	168	156	321	287	265	553
Residential Neighbourhood	137	262	397	395	300	693
Total	**304**	**418**	**717**	**682**	**564**	**1246**

4.4 Opening Day and Ultimate Traffic Volumes

The Opening Day and Ultimate traffic volumes were calculated by adding the respective background and site generated volumes and are provided in Exhibits 4.6 and 4.7.

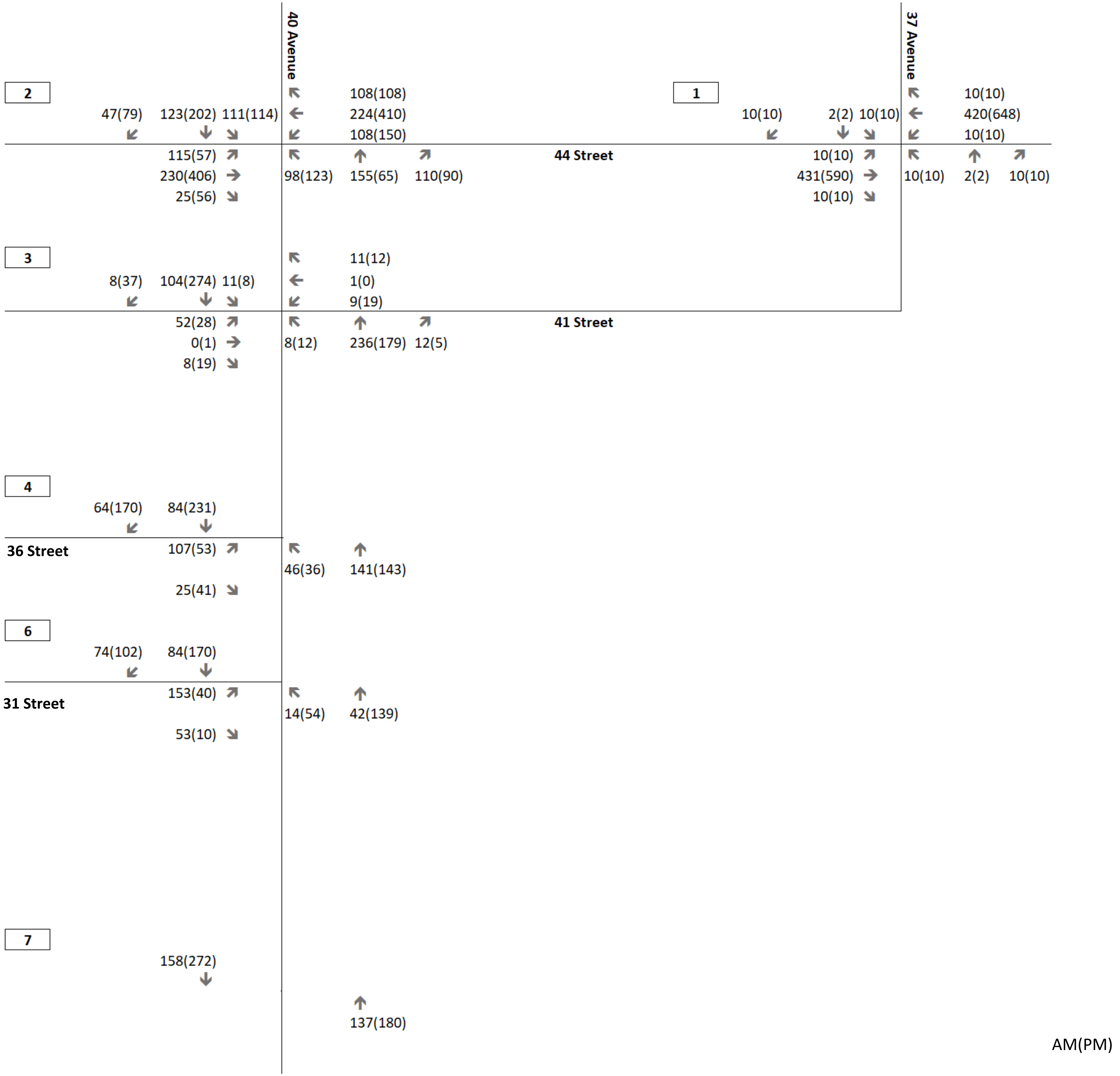

EXHIBIT 4.1
2022 - EXISTING TRAFFIC AM (PM) VOLUMES
WIGFIELD AREA STRUCTURE PLAN
TRAFFIC IMPACT ASSESSMENT

LLOYDMINSTER

Integrated Expertise. Locally Delivered.

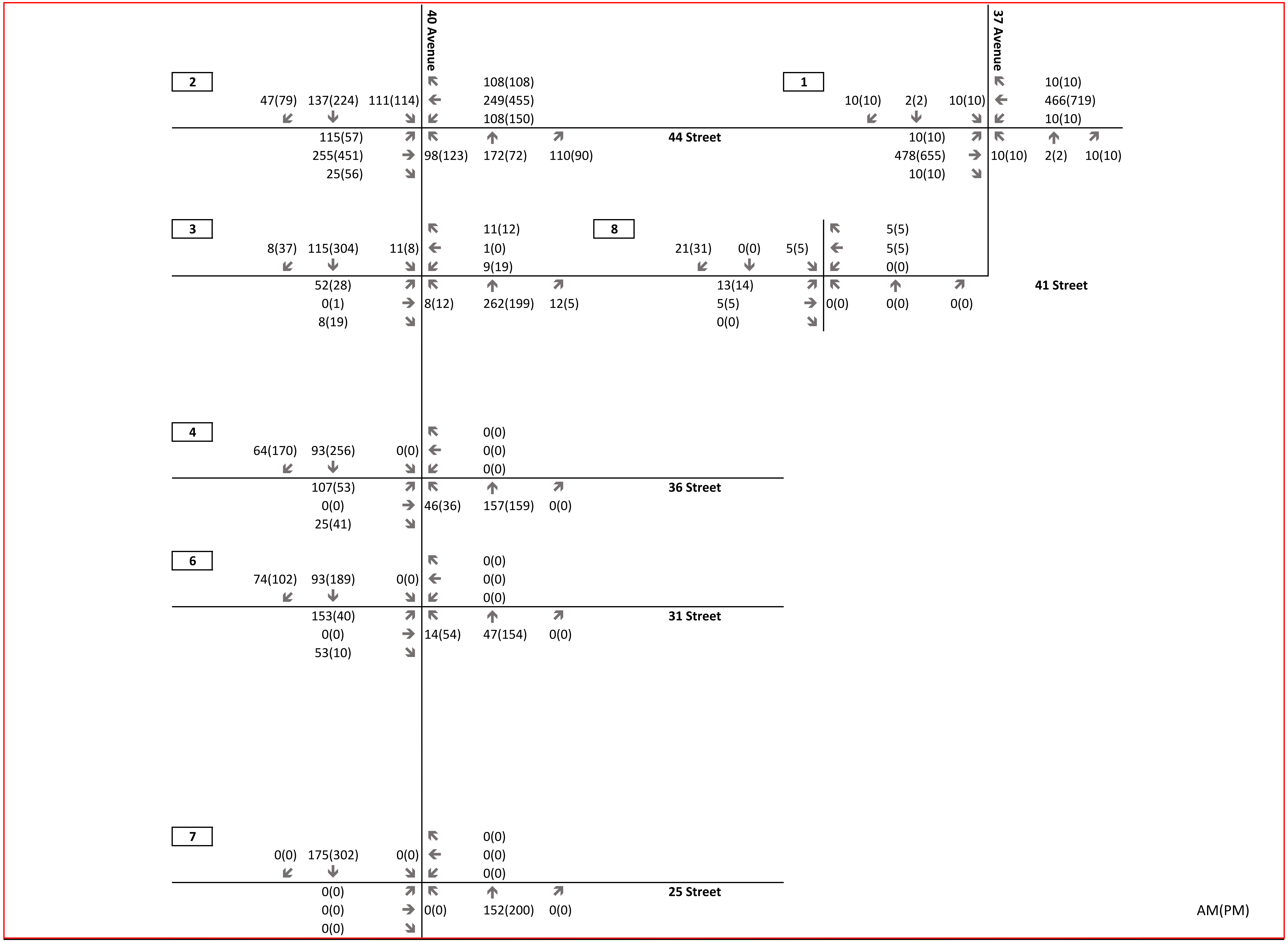

EXHIBIT 4.2
OPENING DAY BACKGROUND
TRAFFIC VOLUMES

WIGFIELD AREA STRUCTURE PLAN
TRAFFIC IMPACT ASSESSMENT

Integrated Expertise. Locally Delivered.

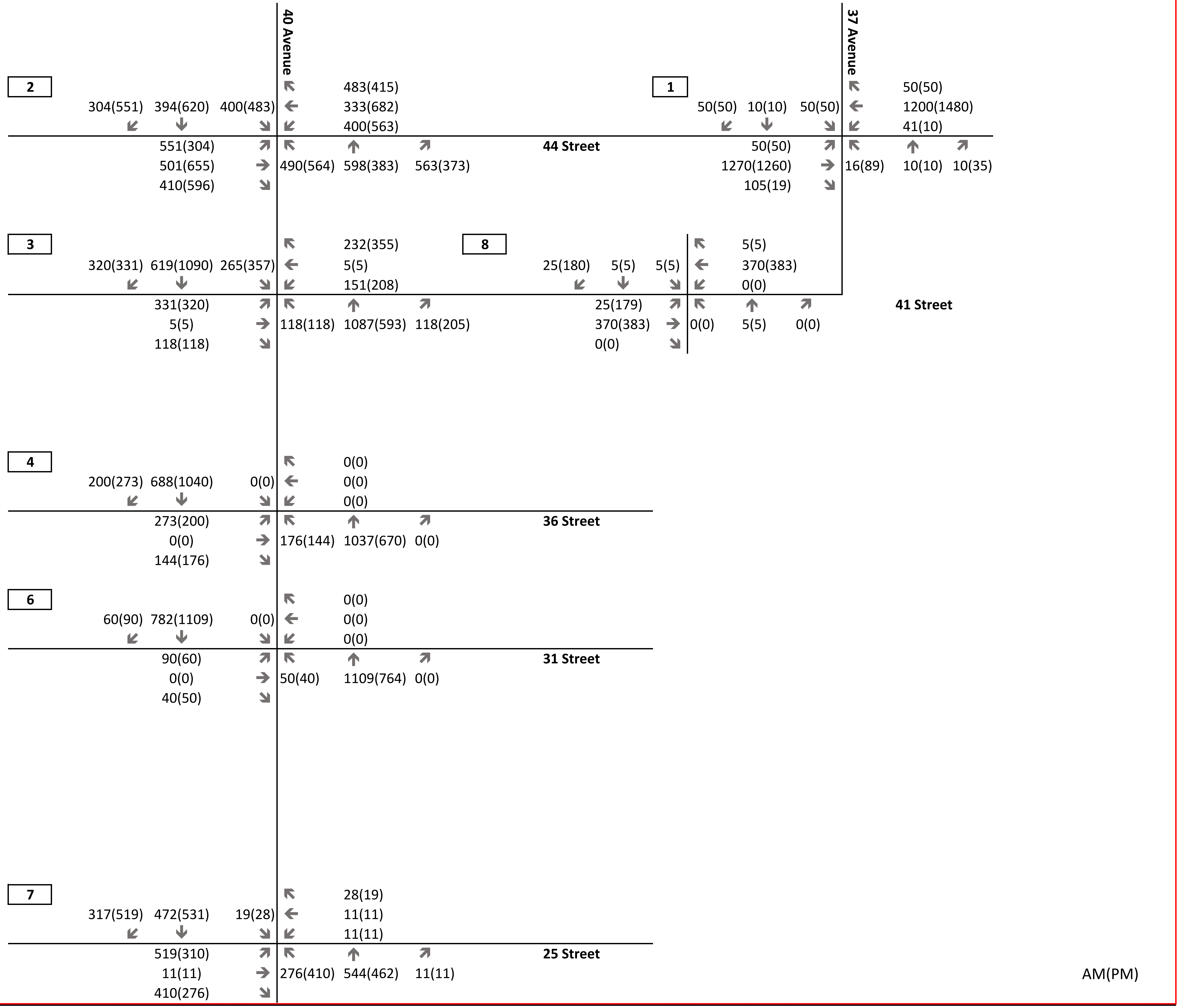

EXHIBIT 4.3
ULTIMATE BACKGROUND
TRAFFIC VOLUMES

WIGFIELD AREA STRUCTURE PLAN
TRAFFIC IMPACT ASSESSMENT

LLOYDMINSTER

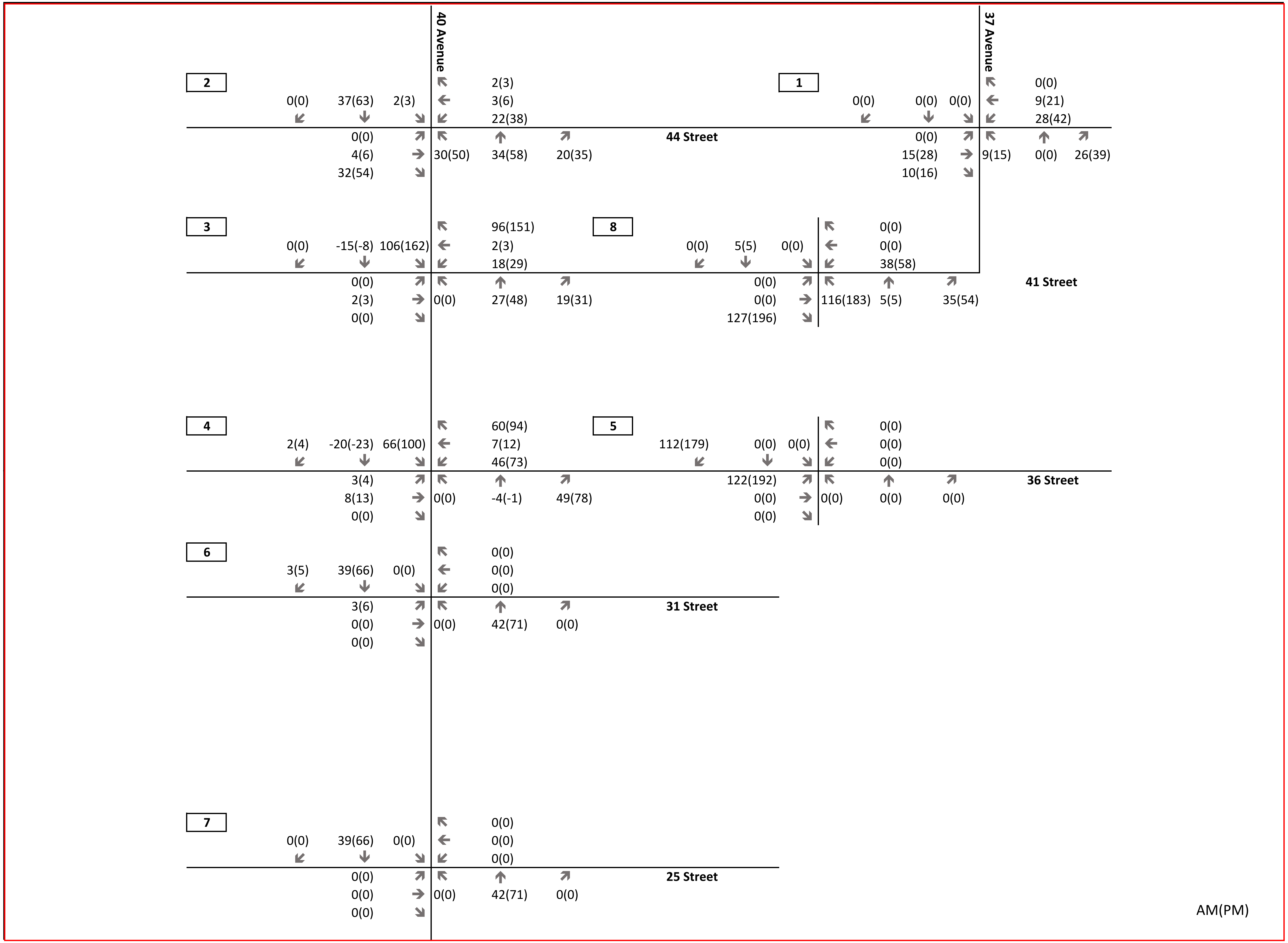

EXHIBIT 4.4
OPENING DAY SITE GENERATED
TRAFFIC VOLUMES

WIGFIELD AREA STRUCTURE PLAN
TRAFFIC IMPACT ASSESSMENT

Integrated Expertise. Locally Delivered.

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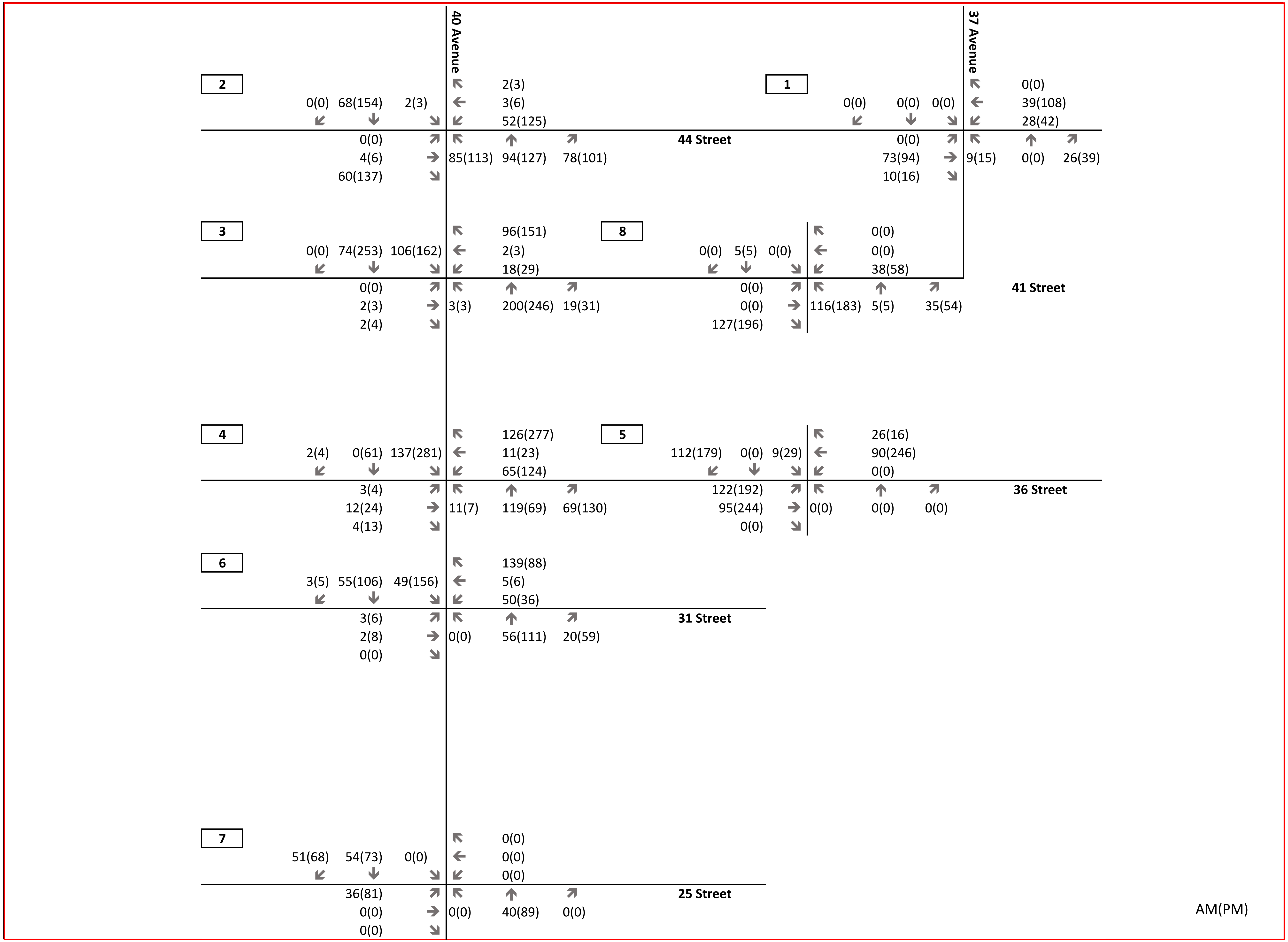

EXHIBIT 4.5
ULTIMATE SITE GENERATED
TRAFFIC VOLUMES

WIGFIELD AREA STRUCTURE PLAN
TRAFFIC IMPACT ASSESSMENT

Date: 2022-06-02 Document: Q:\Projects\28059_WigfieldASP\25_GIS\251_Figures\1_Servicing\28059_Figure_2.1_Study_Area.mxd

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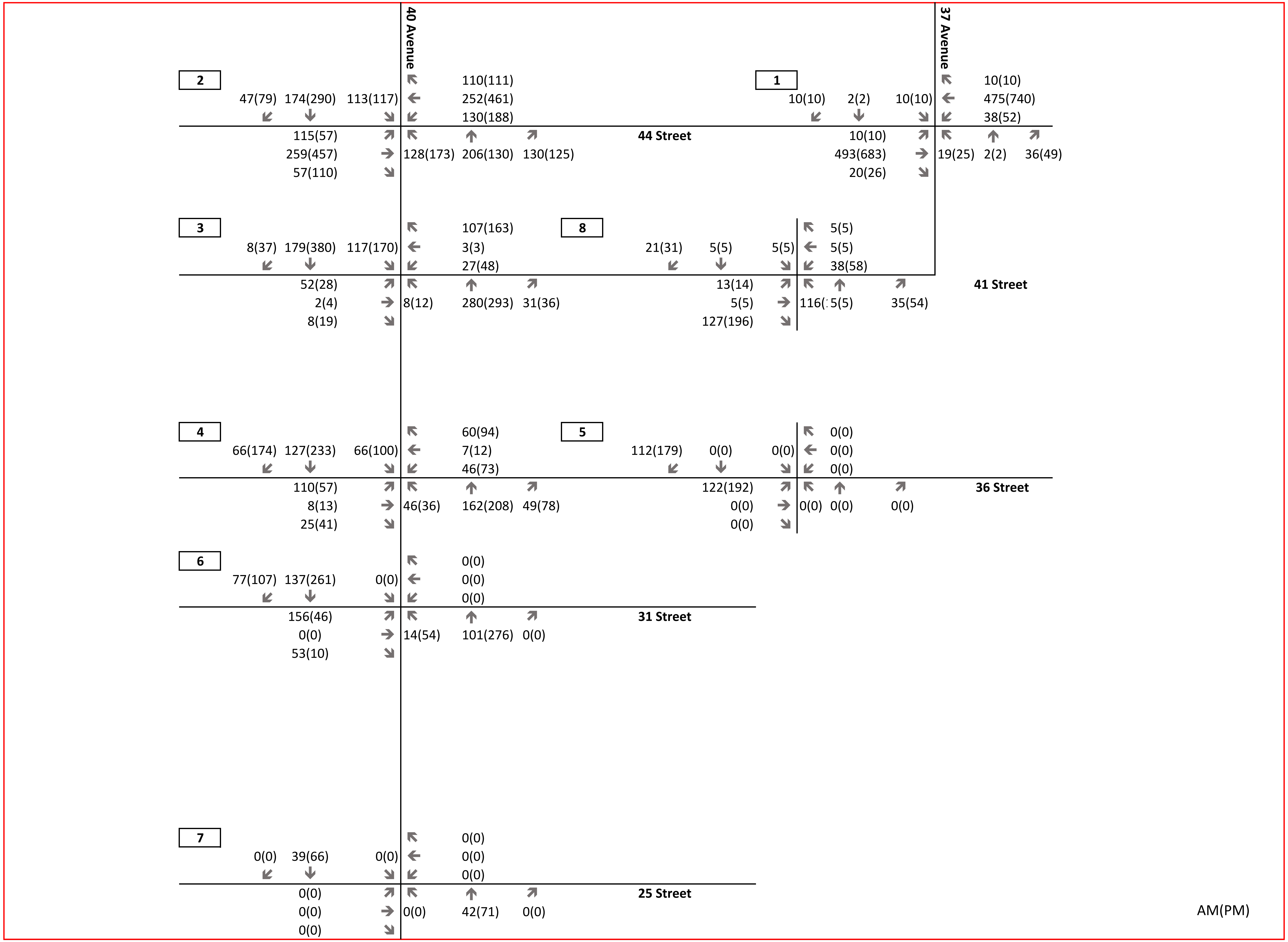

EXHIBIT 4.6
OPENING DAY TOTAL
TRAFFIC VOLUMES

WIGFIELD AREA STRUCTURE PLAN
TRAFFIC IMPACT ASSESSMENT

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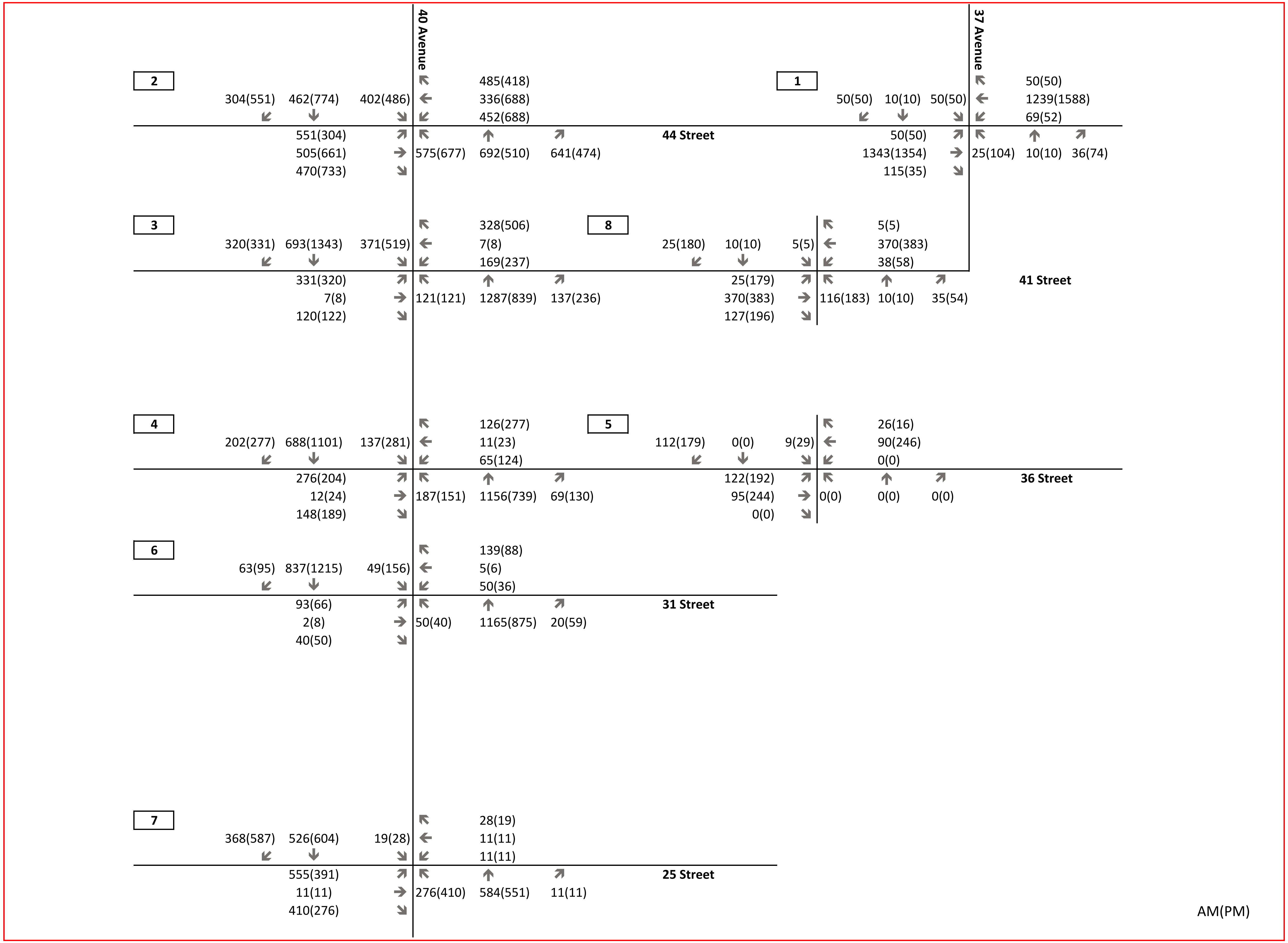

EXHIBIT 4.7
ULTIMATE TOTAL
TRAFFIC VOLUMES

WIGFIELD AREA STRUCTURE PLAN
TRAFFIC IMPACT ASSESSMENT

ISL

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5.0 Traffic Analysis

5.1 Traffic Analysis Methodology

Operational analyses for signalized and unsignalized intersections were performed using Synchro 9. This software is used to evaluate the performance of intersections on the roadway network using the Highway Capacity Manual (HCM) techniques. Using the HCM methodology, intersection performance is categorized by its "Level of Service", or LOS. There are six levels of service as follows:

- LOS A represents the highest level of service, or generally "free flowing conditions"
- LOS F generally represents a "breakdown" or "gridlock" condition in vehicular flow. At signalized intersections drivers will experience waits of two or more cycles.
- Levels of service B, C, D and E are intermediate levels of performance between each extreme
- LOS D reflects "normal" peak hour congestion, generally accepted criterion for design analysis.
- LOS E reflects an intersection or movement experiencing congestion and high delays. It may be accepted for certain movements only (such as low volume or low v/c ratio movements).

Typically, LOS D or better is the accepted standard for peak hour operations of all movements at an intersection. Table 3 shows average delay per vehicle values that correspond with the six service levels.

Table 5.1: LOS Criteria for Signalized and Unsignalized intersections

	Average Delay Per Vehicle (s)	
LOS	Signalized	Unsignalized
A	< 10	< 10
B	10 – 20	10 – 15
C	20 – 35	15 – 25
D	35 – 55	25 – 35
E	55 – 80	35 – 50
F	> 80	> 50

In this study LOS is reported for each intersection movement. This allows for an accurate assessment of each movement's delay, as opposed to averaging delays for approaches or the entire intersection, which can mask specific problem movements.

Synchro also calculates each movement's volume to capacity ratio (v/c). A v/c ratio of 1.0 represents an intersection or movement at full capacity with no ability to accommodate additional traffic. Typically, a v/c ratio of 0.9 or lower for all intersection movements is the accepted standard for peak hour operations. Finally, Synchro also calculates the 95th percentile vehicle queue length for each intersection movement. This allows the determination of left and right turn storage requirements. Use of the 95th percentile vehicle queue length criterion is accepted practice for normal peak hour operation; it means that the queue length is exceeded five percent (5%) of the time.

5.2 Assumed Intersection Geometry

The traffic analysis was completed using the intersection geometry and lane numbers from the following sources:

- **Opening Day:** The existing roadway network conditions. The Opening Day analysis assumes that only the Multiuse Recreational and Event Facility has been developed. No development is assumed for the neighbourhood area. As such, 31 Street is assumed to remain a three-legged stop-controlled intersection with no access into the study area.
- **Ultimate:** the recommended 100,000 population horizon concept plan from the 40 Avenue Functional Study. Recommended deviations from the Functional Study geometry based on the traffic analysis, if any, are discussed in Section 5.3. The intersection of 37 Avenue and 44 Street is not included in the 40 Avenue Functional Study. As such, the intersection is modelled based on its current conditions:
  - Eastbound and Westbound: Two through lanes, one left turn bay, one right turn bay.
  - Northbound and Southbound: A shared left/through/right lane.

The Multiuse Recreational and Event Facility access intersections are assumed to be stop control on the northbound and southbound legs a single shared lane for all movements. The recommended roadway network from the 40 Avenue Functional Study for the 35,000 and 100,000 population horizons are provided in Appendix B. A major improvement for the 100,000 population horizon as recommended in the Functional Study is 4 core lanes on 40 Avenue with signals at all intersections.

5.3 Traffic Analysis Results

The traffic analysis results are summarized and discussed in the sections below. Detailed Synchro reports of the Opening Day and Ultimate traffic analysis are provided in the Appendix C.

5.3.1 Opening Day

The Opening Day traffic analysis results indicate that the Multiuse Recreational and Event Facility site is not anticipated to have a significant impact on the adjacent transportation network. All study intersections are expected to operate at an overall intersection LOS of C or better on Opening Day with the following recommended intersection improvements:

- **40 Avenue and 41 Street (3):**
  - Southbound approach: shared through/right lane with a left turn bay with 70 m of storage.
    - Currently a shared right/through/left. While the southbound approach is expected to operate at LOS B, the 95th percentile queue length indicates that PM peak hour southbound queues may spill back into the casino and commercial access to the north. The recommended left turn bay reduces expected queues from approximately 145 m to 70 m.
  - Traffic signals.
    - Multiple eastbound and westbound movements are expected to operate at LOS E or F during the PM peak hour with the current two-way stop control.
- **40 Avenue and 36 Street (4):**
  - Traffic signals.
    - The eastbound and westbound left turns are expected to operate at LOS E during the PM peak hour with the current two-way stop control.

The Multiuse Recreational and Event Facility accesses (5 and 8) are expected to operate well with stop control on the northbound and southbound legs. Queues are not expected to exceed 20 m during either peak hour.

The Background and Total Opening Day traffic analysis results are summarized in the table below.

Table 5.2: Background and Total Opening Day Traffic Analysis Summary

ID	Intersection	Background		Total	
		Intersection LOS AM(PM)	Traffic Control	Intersection LOS AM(PM)	Traffic Control
1	37 Avenue and 44 Street	A(A)	Two-way stop	A(A)	Two-way stop
2	40 Avenue and 44 Street	B(C)	Signalized	C(C)	Signalized
3	40 Avenue and 41 Street	A(A)	Two-way stop	B(B)	Signalized
4	40 Avenue and 36 Street	B(A)	Two-way stop	B(B)	Signalized
5	36 Street Multiuse Recreational and Event Facility Access	-	-	A(A)	One-way stop
6	40 Avenue and 31 Street	A(A)	One-way stop	A(A)	One-way stop
8	41 Street Multiuse Recreational and Event Facility Access	-	-	A(A)	Two-way stop

Analysis Results Discussion

Some upgrades are not triggered by the proposed development on Opening Day but improve the overall flow of the transportation network. These improvements are provided for the City's consideration:

- 37 Avenue and 44 Street (1) traffic signals:
  - The northbound and southbound left turn movements are expected to operate at LOS E during the PM peak. This would generally trigger consideration for signalization; however, this would likely increase delays for other movements while only benefiting 35 vehicles. Traffic signals are also not warranted using the Transportation Association of Canada's Traffic Signal Warrant Spreadsheet. The intersection receives a warrant score of 28 where the signalization requirement is over 100. It is recommended the City maintain the two-way stop control at 37 Avenue and consider the merits of traffic signals should left turning volumes increase or other concerns arise.
- 40 Avenue and 36 Street (4):
  - Convert the southbound leg to a shared through/right lane and left turn bay. Like 41 Street, this would reduce the expected PM peak hour queue from approximately 100m to 75 m. Queuing between 36 Street and 41 Street is less of a concern because there is a greater distance between the two streets. The City may consider adding a left turn bay if delays and queuing become a concern in the future.

The recommended lane configurations of Opening Day are shown in Exhibit 5.1.

5.3.2 Ultimate Horizon

The Ultimate Horizon analysis results indicate that the intersection of 40 Avenue and 44 Street (2) may not be able to accommodate the increased traffic demand from the proposed Wigfield ASP land uses. The intersection has an overall LOS F during the PM peak hour. Long delays and queues are anticipated. The delays at 40 Avenue and 44 Street (2) also result in northbound and southbound queues over 175 m at 40 Avenue and 41 Street (3). All other intersections are anticipated to operate within the performance thresholds during the AM and PM peak hour with only minor changes to the overall LOS with the following improvements and/or modifications:

- **37 Avenue and 44 Street (1):**
  - Traffic signals.
- **36 Street Multiuse Recreational and Event Facility Access (4):**
  No change from opening day, expected to operate well with a stop sign at the access.
- **40 Avenue and 25 Street (7):**The analysis results indicate that the intersection some lanes included in the 40 Avenue Functional Study 100,000 population horizon concept plan may not be needed. The following lane reductions could be considered by the City:
  - Eastbound: Two left turn bays, one through lane and one shared through/right turn.
    - Concept Plan: Two left turn bays, one through lane, and one right turn bay.
  - Westbound: Shared right/through/left turn lane
    - Concept Plan: one left turn bay and a shared through/right lane.
  - Northbound: Two left turn bays, one through lane, and one shared through/right turn.
    - Concept Plan: Two left turn bays, two through lanes, and one right turn bay.
  - Southbound: One left turn bay, one through lane, and one shared through/left turn lane.
    - Concept Plan: One left turn bay, two through lanes, and one left turn bay.
- **41 Street Multiuse Recreational and Event Facility Access (8):**
  - Traffic signals
    - Several movements are anticipated operate at LOS F with a two-way stop.
  - Eastbound left turn bay and shared through/right lane.
  - Westbound left turn bay and shared through/right lane.

The recommended lane configurations of the Ultimate Horizon are shown in Exhibit 5.2. The Background and Total Ultimate horizon traffic analysis results are summarized in the table below.

Table 5.3: Background (2077) and Total (2077) Traffic Analysis Summary

ID	Intersection	Background (2077)		Total (2077)	
		Intersection LOS AM(PM)	Traffic Control	Intersection LOS AM(PM)	Traffic Control
1	37 Avenue and 44 Street	A(B)	Signalized	A(B)	Signalized
2	40 Avenue and 44 Street	D(D)	Signalized	D(F)	Signalized
3	40 Avenue and 41 Street	C(C)	Signalized	D(D)	Signalized
4	40 Avenue and 36 Street	B(A)	Signalized	B(B)	Signalized
5	36 Street and Multiuse Recreational and Event Facility Access	-	-	A(A)	One-way stop
6	40 Avenue and 31 Street	A(A)	Signalized	B(A)	Signalized
7	40 Avenue and 25 Street	C(C)	Signalized	D(D)	Signalized

ID	Intersection	Background (2077)		Total (2077)	
		Intersection LOS AM(PM)	Traffic Control	Intersection LOS AM(PM)	Traffic Control
8	41 Street and Multiuse Recreational and Event Facility Access	-	-	C(B)	Signalized

*AM(PM)

Analysis Results Discussion

The recommended roadway network for the 100,000 population horizon in the 40 Avenue Functional Study is generally anticipated to be able to accommodate the expected traffic generated by the proposed Wigfield ASP land uses. The intersection of 40 Avenue and 44 Street (2) is the exception, as it is expected to operate at LOS F during the Ultimate PM peak hour. Several factors contribute to the anticipated operational challenges at 40 Avenue and 44 Street:

- **High left turning volumes:** every approach is anticipated to have between 304 vehicles per hour (vph) and 688 vph attempting to turn left during the PM peak hour. The dual left turn bays included in the Functional Study geometry helps to increase the left turning capacity but also increases the time needed for each cycle of the traffic signal. This is because best practice recommends protected only phases for dual left turn lanes as a safety precaution. The addition of protected left turn phases means now a single traffic signal cycle length is shared between eight movements rather than four, leaving less time for through movements.
- **High right turning volumes:** over 700 eastbound vehicles are anticipated to attempt to turn right at 40 Avenue and 44 Street during the PM peak hour. The right turn bay is almost at full capacity and cannot accommodate the high volume.
    - Delays can be significantly reduced by providing a right turn overlap signal. This is a signal that indicates that drivers can complete right turns without coming to a complete stop during a specific left turn phase. This was implemented in the traffic analysis but the eastbound left turn movements remains LOS F.
    - The City could consider changing the eastbound right turn to free flow rather than the yield control included in the Functional Study. This would be achieved by adding an auxiliary or acceleration lane to 40 Avenue south. High-level analysis indicates that the overall intersection LOS would become E with this modification. Obtaining right-of-way for an auxiliary or acceleration lane may be difficult because the area is already developed.
- **Pedestrian clearance times:** each through movement needs to have enough time with a green light (green time) for pedestrians to fully cross the street. This is called the pedestrian clearance time. Wider streets mean more pedestrian clearance time is needed. This can result in some movements having longer green times than is strictly necessary for the vehicles.
    - The Wigfield ASP lands were assumed to be industrial in the 40 Avenue Functional Study and pedestrian timings were not emphasised. More pedestrians are expected to want to cross 40 Avenue now that residential land uses are planned on both sides of the street. Because of this, a higher emphasis on pedestrian safety and comfort was applied to this analysis. Each leg has an assumed five pedestrians crossing during the AM and PM peak hour. This may be conservative and may be revisited when more insights into expected pedestrian behavior is available.

The Ultimate horizon is estimated to be 55 years into the future. It is difficult to capture a truly accurate prediction of transportation behaviors this far into the future. Changes to the way people mode such as introducing local transit routes, a shift to more active modes, an increase in work from home or an increase in trip sharing could have significant implications on this study's findings. The traffic volume estimates could be revisited closer to a certain stage of development to confirm the recommendations from this study are still representative of the future transportation behaviors.

5.4 Event Sensitivity Analysis

The Multiuse Recreational and Event Facility is expected to host events intermittently throughout the year. An event sensitivity analysis was completed to understand the impacts of the increased event traffic on the transportation network.

For this study, events are assumed to occur in the evening past the PM peak hour. Event start and end traffic volumes were estimated to understand the potential impact an event may have on the recommended Opening Day roadway network. The following assumptions were used to develop the event scenario traffic analysis volumes:

- Traffic generated by the Event is assumed based on the number of seats and number of parking stalls. High-level analysis was completed for events with 2440, 3500, and 4000 guests. For each scenario, 10% of event trips are assumed to be drop offs, with vehicles entering then exiting the Multiuse Recreational and Event Facility within the analysis hour.
- The trips generated by the remaining land uses (liquor store, sporting good store, restaurant, retail plaza, RV park, hotel) in the Multiuse Recreational and Event Facility area were reduced to represent the later start and end times for the event, assuming the land uses attracted 75% of the PM peak hour trips during the start of the event and 25% at the end of the event.

The sensitivity analysis results indicate that the City may want to consider some form of traffic management for events over 2440 expected attendees. This is due to traffic movements expected to operate at LOS F with the increased volumes as well as queue lengths over 100 m, which may impact adjacent intersection operations. The following could be considered to improve traffic flow during an event:

- 37 Avenue and 44 Street (1):
  - As in the Opening Day analysis, site generated traffic at this intersection is relatively low. One option is to temporarily prohibit left turning traffic at the intersection to improve traffic flow. Traffic would be diverted to 40 Avenue which would impact the other study intersections but would also centralize event related traffic to one corridor.
- 40 Avenue and 44 Street (2):
  - Event specific timing plans could be employed to address operational issues at the intersection providing it is possible with the City's traffic signal hardware.
- 41 Street Multiuse Recreational and Event Facility Access (3):
  - Temporarily convert the intersection to a four-way stop. This provides equal opportunity for traffic movements and results in LOS D or better for all approaches for events with 2440 attendees.
  - Some movements are expected to be LOS F with 3500 or 4000 attendees even as a four-way stop. At this point, a four-way stop with a flag person to direct traffic flow as needed could be considered.

The 36 Street Multiuse Recreational and Event Facility Access (4) is expected to operate well regardless of the event size. Until development occurs in the neighbourhood zones, the 36 Street access is effectively free-flow because there are no conflicting movements.

Generally, traffic flow would be improved with dedicated turn bays for turning onto or off 41 Street or 36 Street from 40 Avenue. This is not triggered by the typical Opening Day scenario but could be implemented by the City in the future.

The sensitivity analysis results are summarized by LOS F and queues over 100 m in the tables below.

Table 5.4: Event Sensitivity Analysis – Movements with LOS F

ID	Intersection	2440		3500		4000	
		Start	End	Start	End	Start	End
1	37 Avenue and 44 Street	-	NB	-	NB, SB	-	NB, SB
2	40 Avenue and 44 Street	-	-	WBL[1]	SBL[1]	WBL[1]	SBL[1]
3	40 Avenue and 41 Street	-	-	-	-	-	WB[1]
4	40 Avenue and 36 Street	-	-	-	-	SB	-
5	36 Street Multiuse Recreational and Event Facility Access	-	-	-	-	-	-
6	40 Avenue and 31 Street	-	-	-	-	-	-
8	41 Street Multiuse Recreational and Event Facility Access	NB[2]		NB	NB	NB	NB

1: LOS F addressed with changes to the signal timing plan
2: LOS F addressed with four-way stop

Table 5.5: Event Sensitivity Analysis – Movements with Queues over 100 m

ID	Intersection	2440		3500		4000	
		Start	End	Start	End	Start	End
1	37 Avenue and 44 Street	-	-	-	-	-	-
2	40 Avenue and 44 Street	-	-	SBT: 136 m WBT: 120 m	-	SBT: 189 m WBT: 117 m	-
3	40 Avenue and 41 Street	-	-	NB: 146 m SBL: 100 m	WB: 169 m NB: 127 m	NB: 159 m SBT: 161 m	WB: 213 m NB: 201 m
4	40 Avenue and 36 Street	SB: 153 m	WB: 125 m SB: 131 m	NB: 120 m SB: 246 m	WB: 200 m SB: 164 m	EB: 107 m NB: 140 m SB: 154 m	WB: 241 m SB: 201 m
5	36 Street Multiuse Recreational and Event Facility Access	-	-	-	-	-	-
6	40 Avenue and 31 Street	-	-	-	-	-	-
8	41 Street Multiuse Recreational and Event Facility Access	-	NB: 103 m	NB: 139 m	NB: 231 m	NB: 203 m	NB: 352 m

5.5 Recommended Roadway Network

The recommended roadway network for the Opening Day and Ultimate horizons are provided in Exhibit 5.1 and 5.2. The recommended roadway network improvements are summarized below:

Roadway Classifications and improvements:

- 41 Street, 36 Street, and 31 Street classified as a collector roadway within the plan area.

- Upgrade 41 Street to a paved Urban Residential Collector Roadway standard (Drawing 1-101 from the City of Lloydminster Standard Drawings).
  - Traffic on 41 Street for Opening Day is expected to exceed 1000 vehicles per day with the addition of the site generated traffic. This is within the 1000 – 5000 daily volume range for an Urban Collector Road based on Table 3.1 from the City's Municipal Development Standards.

Opening Day Intersection Improvements:

- 40 Avenue and 41 Street (3):
  - Southbound approach: upgrade from a shared right-through-left lane to a shared through/right lane with a left turn bay with 70 m of storage.
  - Traffic signals.
- 40 Avenue and 36 Street (4):
  - Traffic signals.

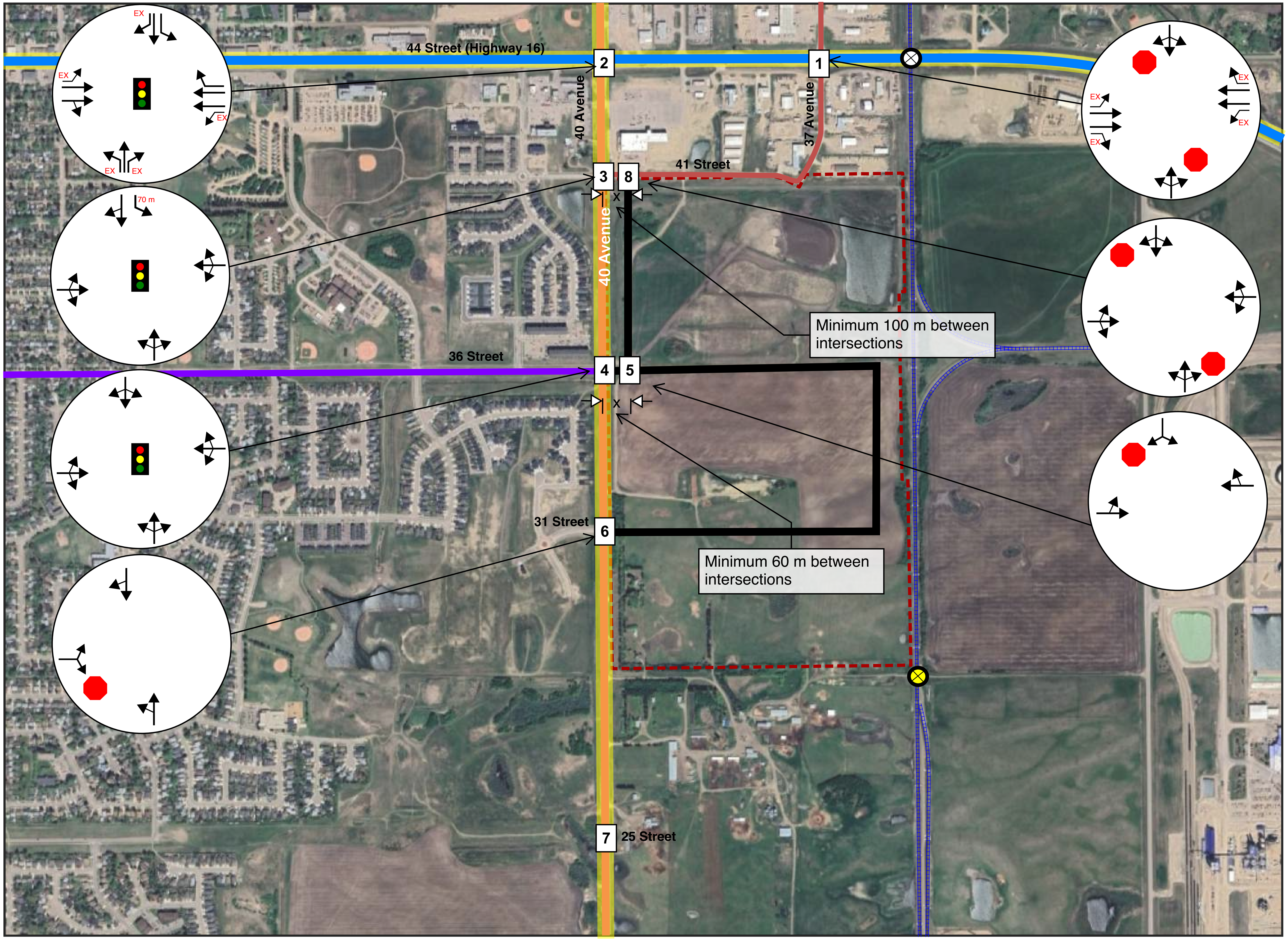
Ultimate Horizon Intersection Improvements:

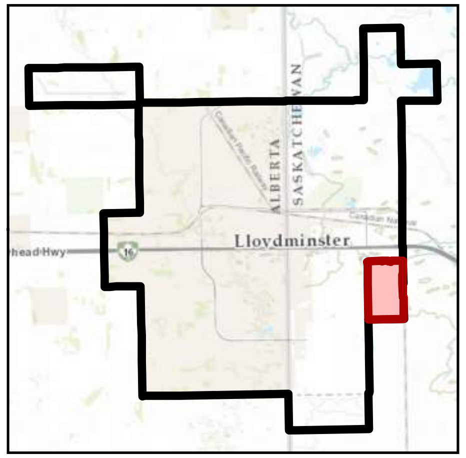
- Modifications to the 40 Avenue Functional Study 100,000 population concept plan:
  - 40 Avenue and 44 Street (2):
    - The City could consider adding an auxiliary lane for the eastbound right turn.
  - 40 Avenue and 25 Street (7):
    - Eastbound: Two left turn bays, one through lane and one shared through/right turn.
    - Westbound: Shared right/through/left turn lane
    - Northbound: Two left turn bays, one through lane, and one shared through/right turn.
    - Southbound: One left turn bay, one through lane, and one shared through/left turn lane.
  - Consider revisiting the 40 Avenue Functional Study 100,000 population concept plan.
    - Some turn bay storage lengths at 44 Street and 40 Avenue (2) and 41 Street and 40 Avenue (3) are not provided. These movements require very long storage bays based on the analysis (+200 m). It is recommended the City revisit the 40 Avenue Functional Study and use the results to inform the storage bay lengths at these locations.
- 37 Avenue and 44 Street (1):
  - Traffic signals.
- 41 Street Multiuse Recreational and Event Facility Access (8):
  - Traffic signals.

Access Management

Access management requirements need to be considered for the Multiuse Recreational and Event Facility. The City's Municipal Development Standards require designs to be in accordance with Transportation Association of Canada's (TAC) Geometric Design Guide. TAC recommends a minimum intersection spacing of 60 m on collector roadways. The access must also provide sufficient space for the westbound right and left turn bay storage at the 40 Avenue and 41 Street / 36 Street intersections. Based on these two criteria, the recommended access spacing for the Multiuse Recreational and Event Facility is summarized below.

- 41 Street: Minimum 100 m from 40 Avenue. This provides sufficient space for the 90m right turn storage anticipated in the Ultimate Horizon.
- 36 Street: Minimum 60 m from 40 Avenue. The turn bay storage anticipated for the Ultimate Horizon is less that 60 m so the minimum TAC spacing is recommended.





Legend

- ASP Boundary
- Primary Highway Connector
- Arterial Road
- Collector Road
- Local Road
- Dangerous Goods and Truck Route
- Rail (CP)
- ⊗ Rail Crossing (at grade)
- ⊗ Rail Crossing (Grade Separated)
- Proposed Collector Roadway Network
- \# m Turn Bay Storage (EX = no change to existing)
- Traffic Signal
- ● Stop Control
- \# Study Intersection

EXHIBIT 5.1

RECOMMENDED OPENING DAY ROADWAY NETWORK

WIGFIELD AREA STRUCTURE PLAN TRAFFIC IMPACT ASSESSMENT

ISL

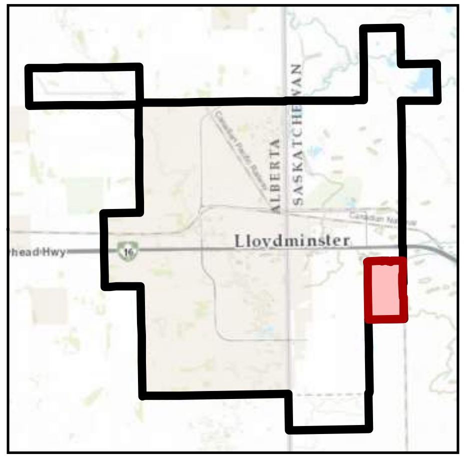
LLOYDMINSTER

Date: 2022-06-02 Document: Q:\Projects\28059_WigfieldASP\25_GIS\251_Figures\1_Servicing\28059_Figure_2.1_Study_Area.mxd

Integrated Expertise. Locally Delivered.

Minimum 100 m between intersections

Minimum 60 m between intersections



Legend

- ASP Boundary
- Primary Highway Connector
- Arterial Road
- Collector Road
- Local Road
- Dangerous Goods and Truck Route
- Rail (CP)
- ⊗ Rail Crossing (at grade)
- ⊗ Rail Crossing (Grade Separated)
- Proposed Collector Roadway Network
- # m Turn Bay Storage (EX = no change to existing, * = additional study recommended)
- 🚦 Traffic Signal
- ● Stop Control
- # Study Intersection

EXHIBIT 5.2

RECOMMENDED ULTIMATE ROADWAY NETWORK

WIGFIELD AREA STRUCTURE PLAN
TRAFFIC IMPACT ASSESSMENT

ISL

LLOYDMINSTER

Date: 2022-06-02 Document: Q:\Projects\28059_WigfieldASP\25_GIS\251_Figures\1_Servicing\28059_Figure_2.1_Study_Area.mxd

Integrated Expertise. Locally Delivered.

6.0 Future Mobility

6.1 Sidewalks and Trails

The Sidewalk and Trails Master Plan recommends a trail along the west side of 40 Avenue up to 31 Street in the medium term and up to 25 Street in the long term. It does not include a recommendation for additional infrastructure on 44 Street east of 40 Avenue nor within the plan area. This is reasonable as the Master Plan was completed prior to the Wigfield ASP update so the area was assumed to be industrial.

It is recommended the City consider revisiting the recommended infrastructure and timelines in Wigfield and the surrounding areas due to the proposed residential land use. Connections to the Multiuse Recreational and Event Facility site may be made a higher priority to make walking or cycling to the Facility a more attractive option.

The plan area doesn't currently include institutional lands. Children will likely attend one of the current or planned schools west of 40 Avenue which means some may need to cross 40 Avenue several times a day. Crossing locations should be well lit to ensure pedestrians remain visible during the winter when the sun rises late and sets early.

6.2 Transit

Future local transit services could help reduce the demand on the roadway network. While none are in place currently, the City is considering the merits of providing transit services and may do so in the future.

6.3 Rail

No documented future rail plans were available at the time of this study.

6.4 Dangerous Goods and Truck Routes

40 Avenue is one of the City's key Dangerous Goods and Truck Routes. This aligned well with the plan area's previous industrial designation. The change to residential neighbourhoods will present some challenges on 40 Avenue as there are now conflicting user priorities. It is important the City maintain the corridor for goods movement, but this must be balanced with ensuring Wigfield remains well connected with the rest of the City.

The City should remove the plan area's designation as a Truck Route Area prior to development as this no longer aligns with the future land use.

7.0 Conclusion and Recommendations

7.1 Conclusion

The following conclusions have been made based on this study:

- **Opening Day Traffic Operations:** the current transportation network is anticipated to be able to accommodate the expected traffic generated by the Multiuse Recreational and Event Facility site with some improvements.
- **Ultimate Traffic Operations:** Most intersections are expected to meet performance thresholds. Significant delays and queuing are expected at 40 Avenue and 44 Street during the PM peak hour. This is primarily due to high right and left turning volumes. The delays at 40 Avenue and 44 Street also impact 41 Street and 40 Avenue, resulting in long queues. It is noted that the Ultimate horizon is likely 55 years into the future and several changes in people's transportation habits may occur between the completion of this study and then.
- **Future Mobility:** previous active mode studies were completed assuming industrial uses for the plan area. These should be revisited to consider the proposed residential land uses to ensure future residents are provided high-quality active mode connections.
- **Dangerous Goods and Truck Routes:** There could be conflicting user priorities on 40 Avenue. Careful consideration should be taken to ensure 40 Avenue is able to balance the needs for goods movement with the adjacent residential neighbourhoods. The Truck Route Area designation does not align with the future land use.

7.2 Recommendations

The recommendations for the Wigfield ASP transportation network are summarized below.

Roadway Classifications and improvements

- 41 Street, 36 Street, and 31 Street classified as a collector roadway within the plan area.
- Upgrade 41 Street to a paved Urban Residential Collector Roadway standard (Drawing 1-101 from the City of Lloydminster Standard Drawings).
  - Traffic on 41 Street for Opening Day is expected to exceed 1000 vehicles per day with the addition of the site generated traffic. This is within the 1000 – 5000 daily volume range for an Urban Collector Road based on Table 3.1 from the City's Municipal Development Standards.

Multiuse Recreational and Event Facility Access Locations

- 41 Street: Minimum 100 m from 40 Avenue.
- 36 Street: Minimum 60 m from 40 Avenue.

Opening Day Intersection Improvements

- 40 Avenue and 41 Street (3):
  - Southbound approach: upgrade from a shared right-through-left lane to a shared through/right lane with a left turn bay with 70 m of storage.
  - Traffic signals.

- 40 Avenue and 36 Street (4):
  - Traffic signals.

Ultimate Horizon Intersection Improvements

- 37 Avenue and 44 Street (1):
  - Traffic signals.
- 40 Avenue and 25 Street (7):
  - Consider reducing number of lanes at 25 Street and 40 Avenue, as shown in Exhibit 5.2.
- 41 Street Multiuse Recreational and Event Facility Access (8):
  - Traffic signals.
- Revisit the 40 Avenue Functional Study 100,000 population concept plan recommendations. Review the assumptions and inputs for recommended improvements to ensure they are still relevant before moving forward with the improvements.
  - Consider an eastbound right turn auxiliary lane at 40 Avenue and 44 Street to accommodate high estimated turning volumes. The City may consider reviewing right-of-way requirements plan to either acquire or reserve the additional lands required.

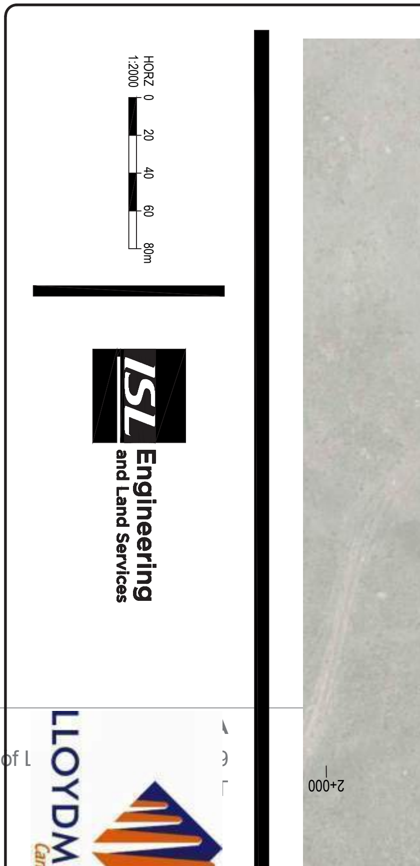
Mobility

- Ensure high quality active mode connections between the plan area and adjacent neighbourhoods as well as between the neighbourhood zones and the Multiuse Recreational and Event Facility site.
- Ensure high-visibility pedestrian crossings are provided on 40 Avenue based on the Transportation of Canada's Pedestrian Crossing Control Guide.
- Consider local transit services to reduce roadway demand.
- The City should remove the plan area's designation as a Truck Route Area prior to development as this no longer aligns with the future land use.

APPENDIX A

Traffic Count Data

J:\13500\13577_Lloydminister_40AveConceptPlan\02_CADD\20_Drafting\202_40 A



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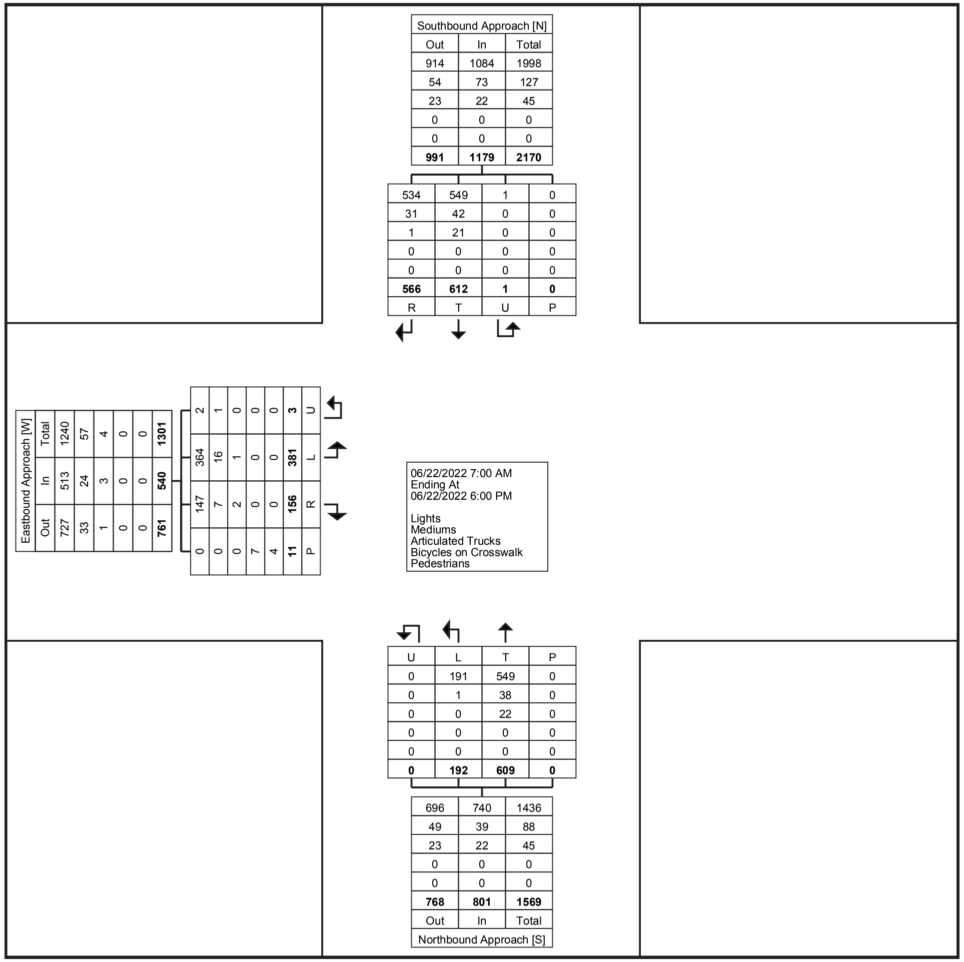
City of Lloydminster
4420-50 Avenue

Lloydminster, Alberta, Canada T9V 0W2
(780) 875-6184 waguinaldo@lloydminster.ca

Count Name: 36 Street and 40 Avenue
Site Code: 3640
Start Date: 06/22/2022
Page No: 3



06/22/2022 7:00 AM
Ending At
06/22/2022 6:00 PM

Lights
Mediums
Articulated Trucks
Bicycles on Crosswalk
Pedestrians

Southbound Approach [N]

Out	In	Total
914	1084	1998
54	73	127
23	22	45
0	0	0
0	0	0
991	**1179**	**2170**

R	T	U	P
534	549	1	0
31	42	0	0
1	21	0	0
0	0	0	0
0	0	0	0
566	**612**	**1**	**0**

Eastbound Approach [W]

Out	In	Total
727	513	1240
33	24	57
1	3	4
0	0	0
0	0	0
761	**540**	**1301**

U	L	R	P
2	364	147	0
1	16	7	0
0	1	2	0
0	0	0	7
0	0	0	4
3	**381**	**156**	**11**

U	L	T	P
0	191	549	0
0	1	38	0
0	0	22	0
0	0	0	0
0	0	0	0
0	**192**	**609**	**0**

Out	In	Total
696	740	1436
49	39	88
23	22	45
0	0	0
0	0	0
768	**801**	**1569**

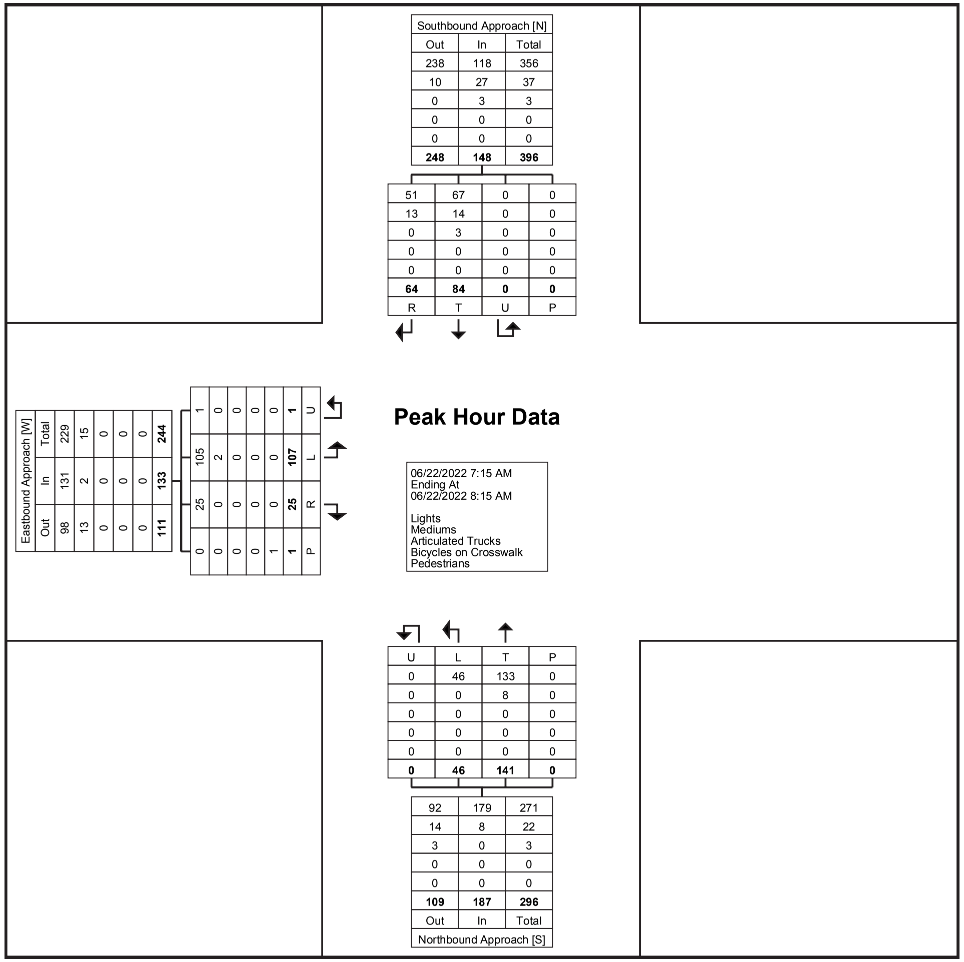
Northbound Approach [S]

Turning Movement Data Plot

City of Lloydminster
4420-50 Avenue

Lloydminster, Alberta, Canada T9V 0W2
(780) 875-6184 waguinaldo@lloydminster.ca

Count Name: 36 Street and 40 Avenue
Site Code: 3640
Start Date: 06/22/2022
Page No: 5



Southbound Approach [N]

Out	In	Total
238	118	356
10	27	37
0	3	3
0	0	0
0	0	0
248	**148**	**396**

51	67	0	0
13	14	0	0
0	3	0	0
0	0	0	0
0	0	0	0
64	**84**	**0**	**0**
R	T	U	P

Eastbound Approach [W]

Out	In	Total
98	131	229
13	2	15
0	0	0
0	0	0
0	0	0
111	**133**	**244**

1	0	0	0	0	**1**	U
105	2	0	0	0	**107**	L
25	0	0	0	0	**25**	R
0	0	0	0	1	**1**	P

Peak Hour Data

06/22/2022 7:15 AM
Ending At
06/22/2022 8:15 AM

Lights
Mediums
Articulated Trucks
Bicycles on Crosswalk
Pedestrians

U	L	T	P
0	46	133	0
0	0	8	0
0	0	0	0
0	0	0	0
0	0	0	0
0	**46**	**141**	**0**

92	179	271
14	8	22
3	0	3
0	0	0
0	0	0
109	**187**	**296**
Out	In	Total

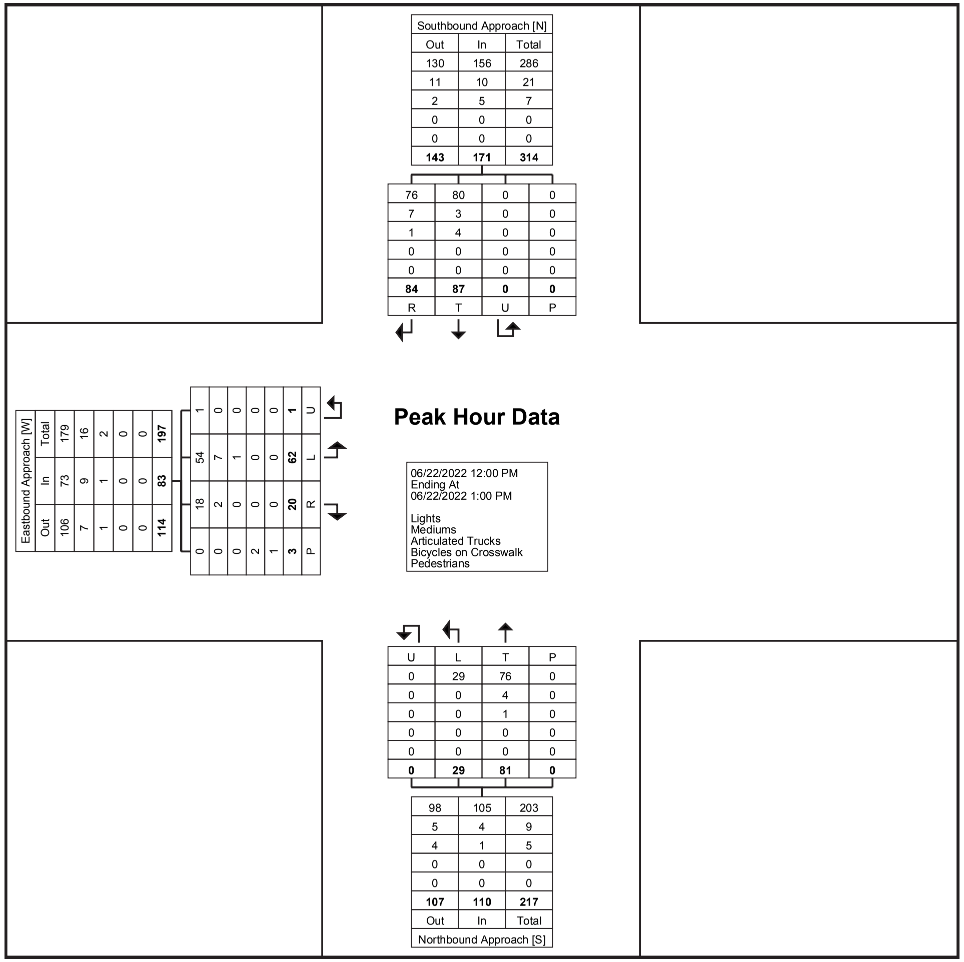
Northbound Approach [S]

Turning Movement Peak Hour Data Plot (7:15 AM)

City of Lloydminster
4420-50 Avenue

Lloydminster, Alberta, Canada T9V 0W2
(780) 875-6184 waguinaldo@lloydminster.ca

Count Name: 36 Street and 40 Avenue
Site Code: 3640
Start Date: 06/22/2022
Page No: 7



Peak Hour Data

06/22/2022 12:00 PM
Ending At
06/22/2022 1:00 PM

Lights
Mediums
Articulated Trucks
Bicycles on Crosswalk
Pedestrians

Southbound Approach [N]

Out	In	Total
130	156	286
11	10	21
2	5	7
0	0	0
0	0	0
143	**171**	**314**

R	T	U	P
76	80	0	0
7	3	0	0
1	4	0	0
0	0	0	0
0	0	0	0
84	**87**	**0**	**0**

Eastbound Approach [W]

Out	In	Total
106	73	179
7	9	16
1	1	2
0	0	0
0	0	0
114	**83**	**197**

U	L	R	P
1	54	18	0
0	7	2	0
0	1	0	0
0	0	0	2
0	0	0	1
1	**62**	**20**	**3**

U	L	T	P
0	29	76	0
0	0	4	0
0	0	1	0
0	0	0	0
0	0	0	0
0	**29**	**81**	**0**

Northbound Approach [S]

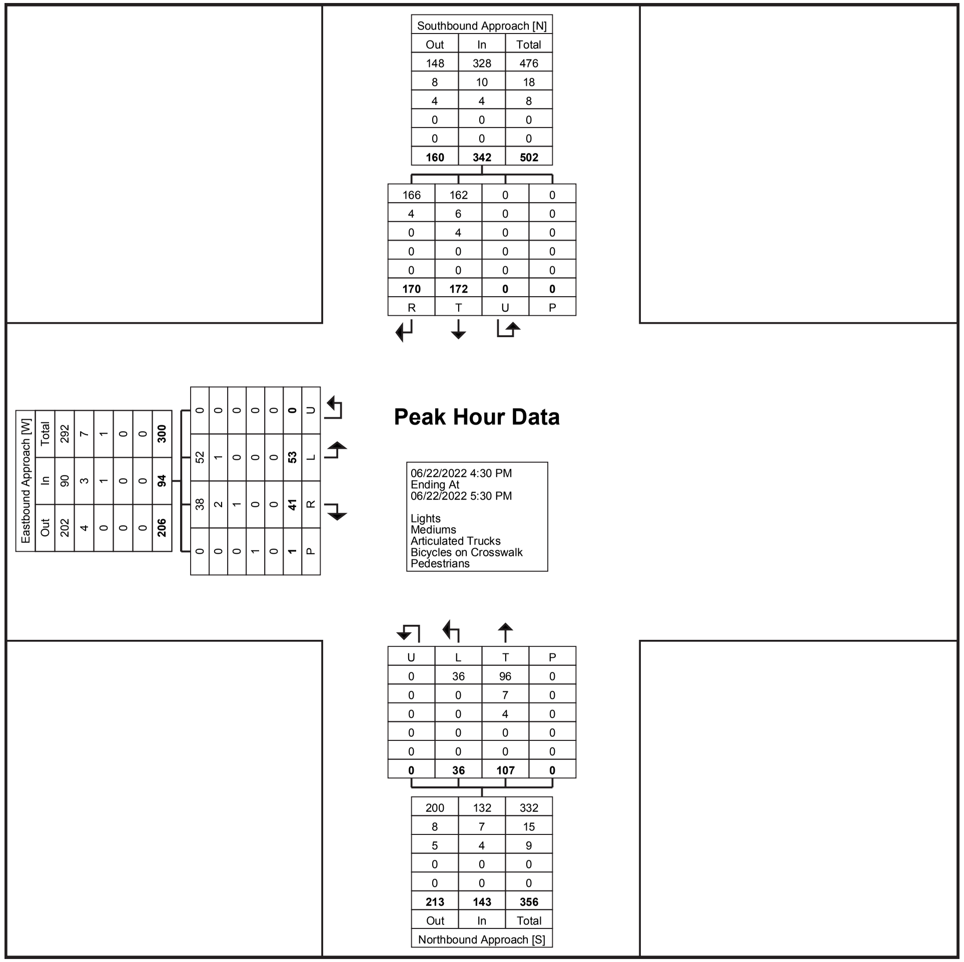
Out	In	Total
98	105	203
5	4	9
4	1	5
0	0	0
0	0	0
107	**110**	**217**

Turning Movement Peak Hour Data Plot (12:00 PM)

City of Lloydminster
4420-50 Avenue

Lloydminster, Alberta, Canada T9V 0W2
(780) 875-6184 waguinaldo@lloydminster.ca

Count Name: 36 Street and 40 Avenue
Site Code: 3640
Start Date: 06/22/2022
Page No: 9



Southbound Approach [N]

Out	In	Total
148	328	476
8	10	18
4	4	8
0	0	0
0	0	0
160	**342**	**502**

R	T	U	P
166	162	0	0
4	6	0	0
0	4	0	0
0	0	0	0
0	0	0	0
170	**172**	**0**	**0**

Eastbound Approach [W]

Out	In	Total
202	90	292
4	3	7
0	1	1
0	0	0
0	0	0
206	**94**	**300**

U	L	R	P
0	52	38	0
0	1	2	0
0	0	1	0
0	0	0	1
0	0	0	0
0	**53**	**41**	**1**

06/22/2022 4:30 PM
Ending At
06/22/2022 5:30 PM

Lights
Mediums
Articulated Trucks
Bicycles on Crosswalk
Pedestrians

U	L	T	P
0	36	96	0
0	0	7	0
0	0	4	0
0	0	0	0
0	0	0	0
0	**36**	**107**	**0**

Out	In	Total
200	132	332
8	7	15
5	4	9
0	0	0
0	0	0
213	**143**	**356**

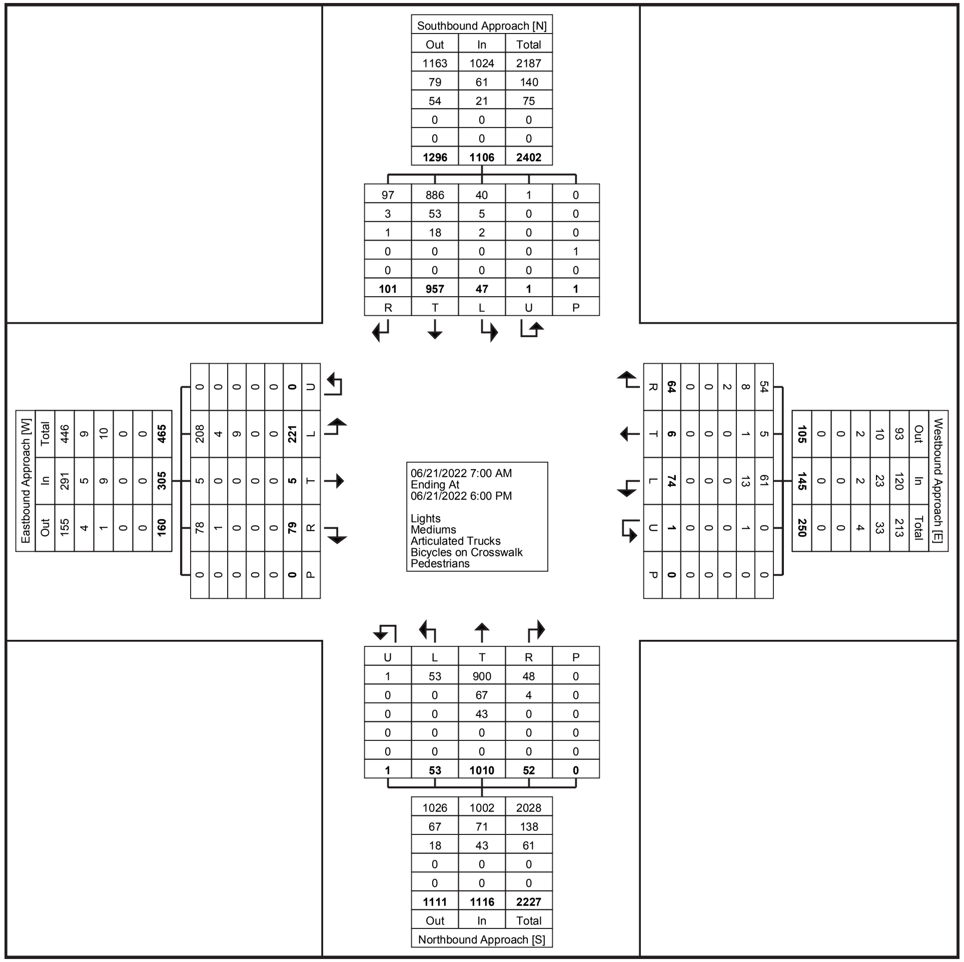
Northbound Approach [S]

Turning Movement Peak Hour Data Plot (4:30 PM)

City of Lloydminster
4420-50 Avenue

Lloydminster, Alberta, Canada T9V 0W2
(780) 875-6184 waguinaldo@lloydminster.ca

Count Name: 41 Street and 40 Avenue
Site Code: 4140
Start Date: 06/21/2022
Page No: 3



06/21/2022 7:00 AM
Ending At
06/21/2022 6:00 PM

Lights
Mediums
Articulated Trucks
Bicycles on Crosswalk
Pedestrians

Southbound Approach [N]

Out	In	Total
1163	1024	2187
79	61	140
54	21	75
0	0	0
0	0	0
1296	**1106**	**2402**

R	T	L	U	P
97	886	40	1	0
3	53	5	0	0
1	18	2	0	0
0	0	0	0	1
0	0	0	0	0
101	**957**	**47**	**1**	**1**

Westbound Approach [E]

Out	In	Total
93	120	213
10	23	33
2	2	4
0	0	0
0	0	0
105	**145**	**250**

R	T	L	U	P
54	5	61	0	0
8	1	13	1	0
2	0	0	0	0
0	0	0	0	0
0	0	0	0	0
64	**6**	**74**	**1**	**0**

Northbound Approach [S]

U	L	T	R	P
1	53	900	48	0
0	0	67	4	0
0	0	43	0	0
0	0	0	0	0
0	0	0	0	0
1	**53**	**1010**	**52**	**0**

Out	In	Total
1026	1002	2028
67	71	138
18	43	61
0	0	0
0	0	0
1111	**1116**	**2227**

Eastbound Approach [W]

Out	In	Total
155	291	446
4	5	9
1	9	10
0	0	0
0	0	0
160	**305**	**465**

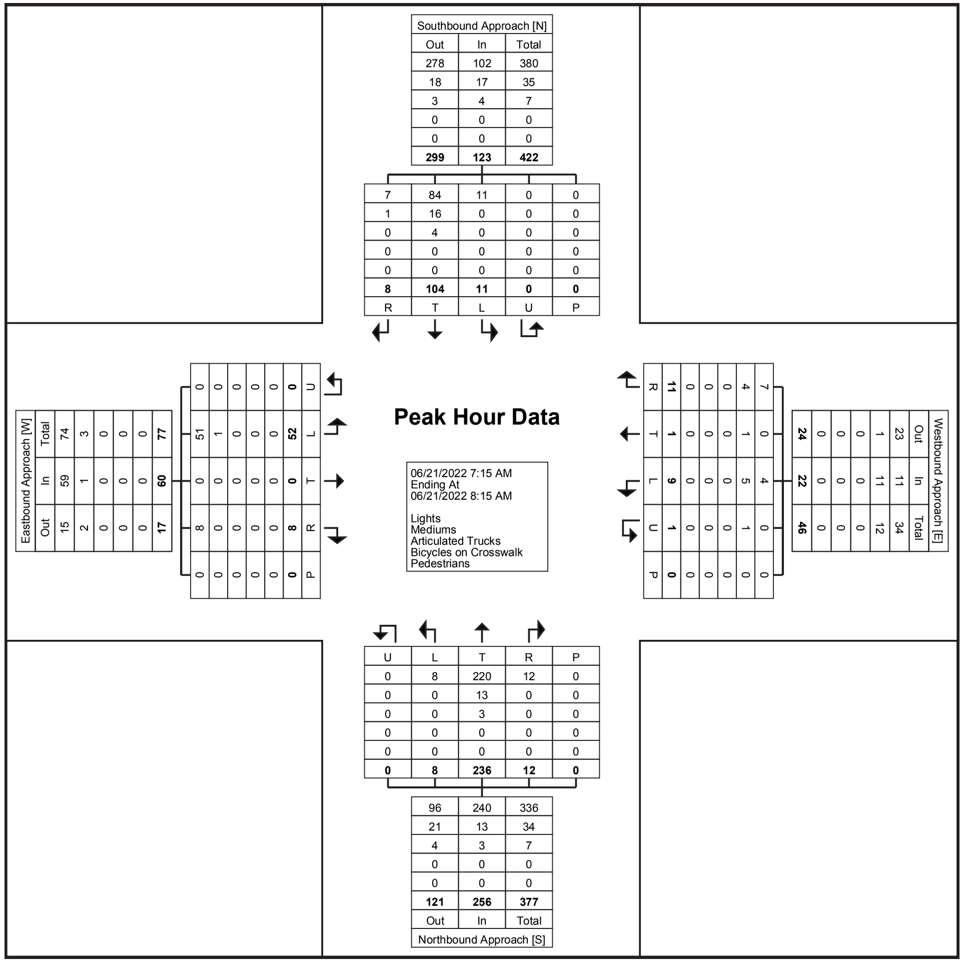
U	L	T	R	P
0	208	5	78	0
0	4	0	1	0
0	9	0	0	0
0	0	0	0	0
0	0	0	0	0
0	**221**	**5**	**79**	**0**

Turning Movement Data Plot

City of Lloydminster
4420-50 Avenue

Lloydminster, Alberta, Canada T9V 0W2
(780) 875-6184 waguinaldo@lloydminster.ca

Count Name: 41 Street and 40 Avenue
Site Code: 4140
Start Date: 06/21/2022
Page No: 5



Southbound Approach [N]

Out	In	Total
278	102	380
18	17	35
3	4	7
0	0	0
0	0	0
299	**123**	**422**

R	T	L	U	P
7	84	11	0	0
1	16	0	0	0
0	4	0	0	0
0	0	0	0	0
0	0	0	0	0
8	**104**	**11**	**0**	**0**

Westbound Approach [E]

Out	In	Total
23	11	34
1	11	12
0	0	0
0	0	0
0	0	0
24	**22**	**46**

R	T	L	U	P
7	0	4	0	0
4	1	5	1	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
11	**1**	**9**	**1**	**0**

Northbound Approach [S]

U	L	T	R	P
0	8	220	12	0
0	0	13	0	0
0	0	3	0	0
0	0	0	0	0
0	0	0	0	0
0	**8**	**236**	**12**	**0**

Out	In	Total
96	240	336
21	13	34
4	3	7
0	0	0
0	0	0
121	**256**	**377**

Eastbound Approach [W]

Out	In	Total
15	59	74
2	1	3
0	0	0
0	0	0
0	0	0
17	**60**	**77**

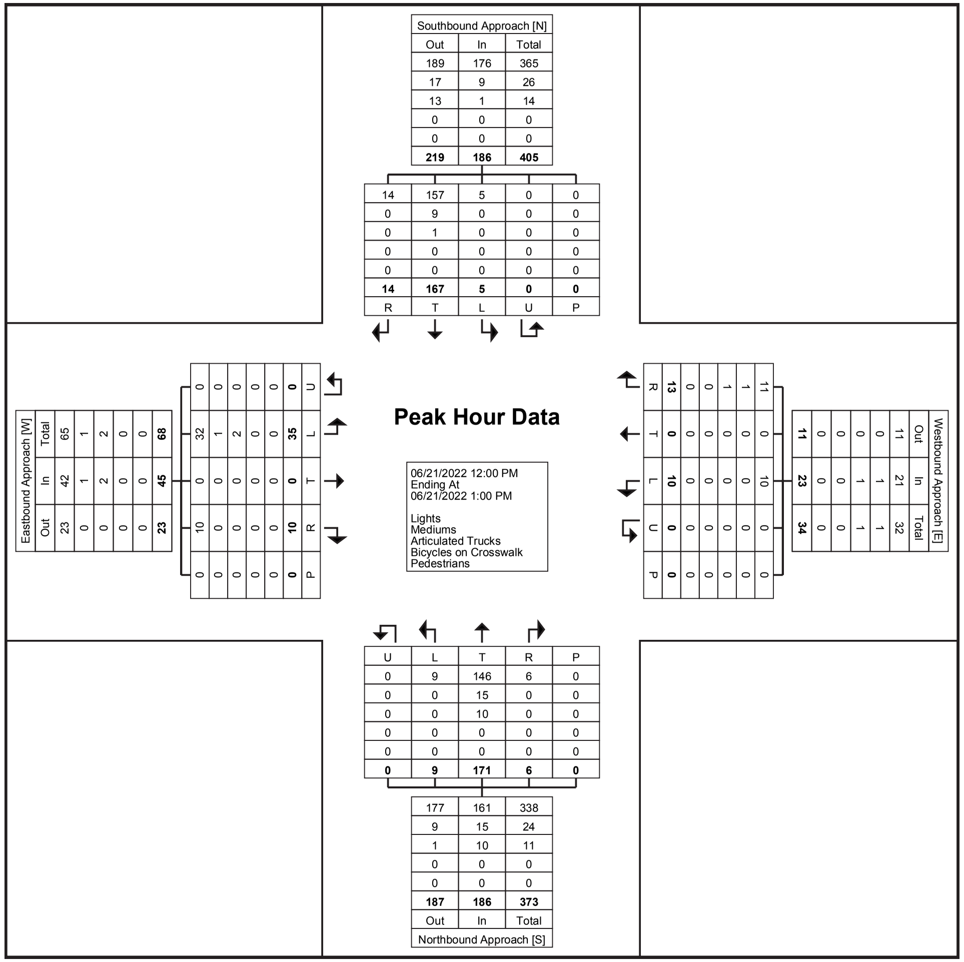
U	L	T	R	P
0	51	0	8	0
0	1	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	**52**	**0**	**8**	**0**

Turning Movement Peak Hour Data Plot (7:15 AM)

City of Lloydminster
4420-50 Avenue

Lloydminster, Alberta, Canada T9V 0W2
(780) 875-6184 waguinaldo@lloydminster.ca

Count Name: 41 Street and 40 Avenue
Site Code: 4140
Start Date: 06/21/2022
Page No: 7



Peak Hour Data

06/21/2022 12:00 PM
Ending At
06/21/2022 1:00 PM

Lights
Mediums
Articulated Trucks
Bicycles on Crosswalk
Pedestrians

Southbound Approach [N]

Out	In	Total
189	176	365
17	9	26
13	1	14
0	0	0
0	0	0
219	**186**	**405**

R	T	L	U	P
14	157	5	0	0
0	9	0	0	0
0	1	0	0	0
0	0	0	0	0
0	0	0	0	0
14	**167**	**5**	**0**	**0**

Westbound Approach [E]

Out	In	Total
11	21	32
0	1	1
0	1	1
0	0	0
0	0	0
11	**23**	**34**

R	T	L	U	P
11	0	10	0	0
1	0	0	0	0
1	0	0	0	0
0	0	0	0	0
0	0	0	0	0
13	**0**	**10**	**0**	**0**

U	L	T	R	P
0	9	146	6	0
0	0	15	0	0
0	0	10	0	0
0	0	0	0	0
0	0	0	0	0
0	**9**	**171**	**6**	**0**

Out	In	Total
177	161	338
9	15	24
1	10	11
0	0	0
0	0	0
187	**186**	**373**

Northbound Approach [S]

Eastbound Approach [W]

Out	In	Total
23	42	65
0	1	1
0	2	2
0	0	0
0	0	0
23	**45**	**68**

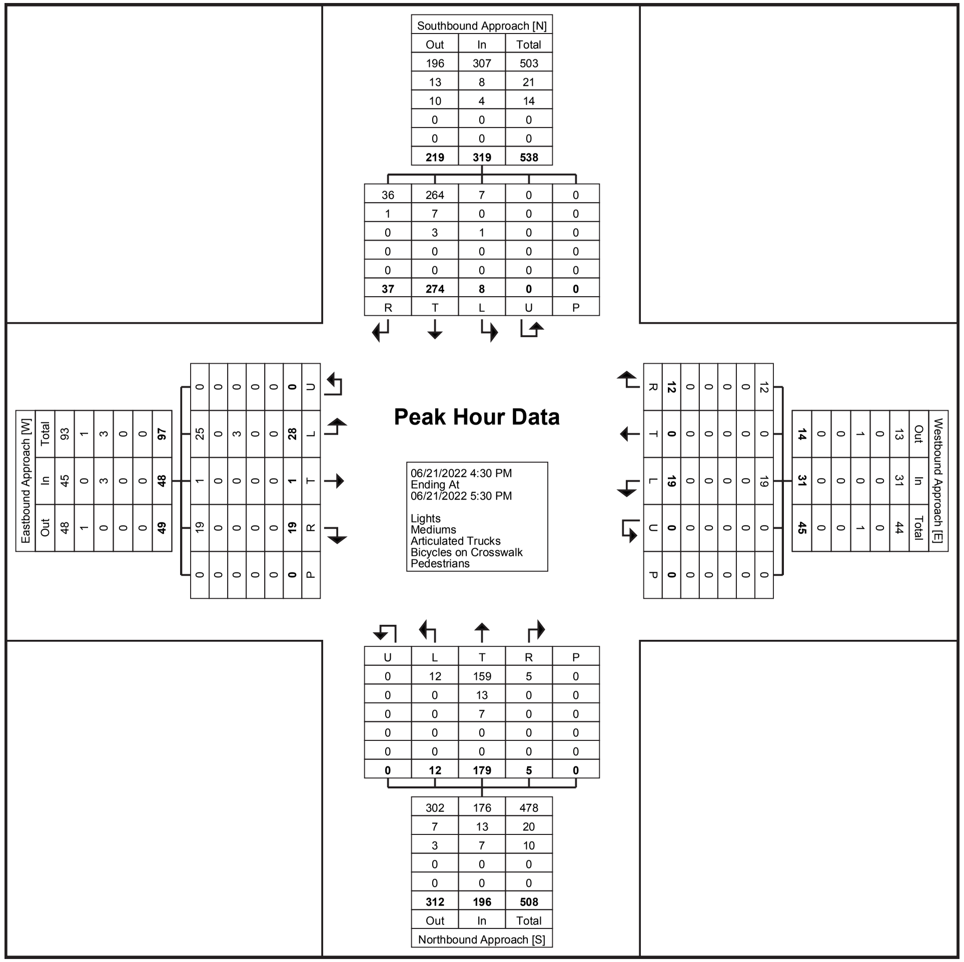
U	L	T	R	P
0	32	0	10	0
0	1	0	0	0
0	2	0	0	0
0	0	0	0	0
0	0	0	0	0
0	**35**	**0**	**10**	**0**

Turning Movement Peak Hour Data Plot (12:00 PM)

City of Lloydminster
4420-50 Avenue

Lloydminster, Alberta, Canada T9V 0W2
(780) 875-6184 waguinaldo@lloydminster.ca

Count Name: 41 Street and 40 Avenue
Site Code: 4140
Start Date: 06/21/2022
Page No: 9



Peak Hour Data

06/21/2022 4:30 PM
Ending At
06/21/2022 5:30 PM

Lights
Mediums
Articulated Trucks
Bicycles on Crosswalk
Pedestrians

Southbound Approach [N]		
Out	In	Total
196	307	503
13	8	21
10	4	14
0	0	0
0	0	0
219	**319**	**538**

36	264	7	0	0
1	7	0	0	0
0	3	1	0	0
0	0	0	0	0
0	0	0	0	0
37	**274**	**8**	**0**	**0**
R	T	L	U	P

Westbound Approach [E]		
Out	In	Total
13	31	44
0	0	0
1	0	1
0	0	0
0	0	0
14	**31**	**45**

12	0	19	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
12	**0**	**19**	**0**	**0**
R	T	L	U	P

U	L	T	R	P
0	12	159	5	0
0	0	13	0	0
0	0	7	0	0
0	0	0	0	0
0	0	0	0	0
0	**12**	**179**	**5**	**0**

302	176	478
7	13	20
3	7	10
0	0	0
0	0	0
312	**196**	**508**
Out	In	Total
Northbound Approach [S]		

Eastbound Approach [W]		
Out	In	Total
48	45	93
1	0	1
0	3	3
0	0	0
0	0	0
49	**48**	**97**

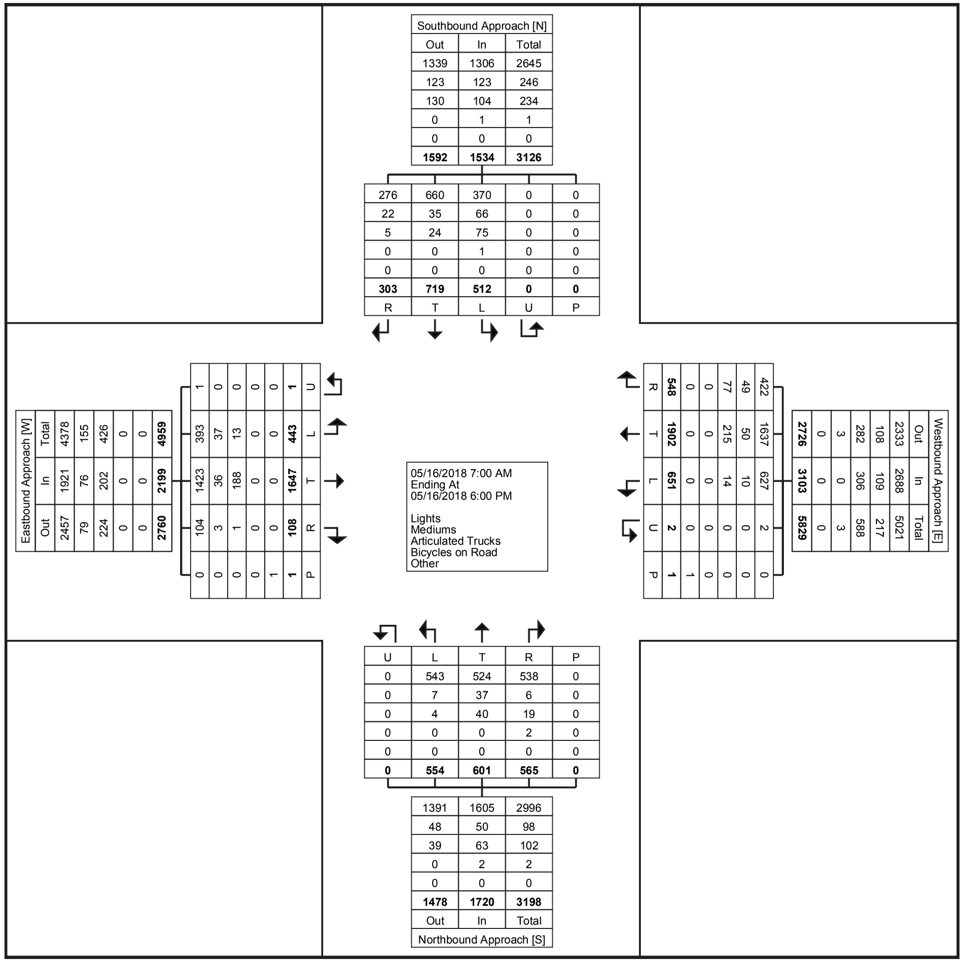
0	25	1	19	0
0	0	0	0	0
0	3	0	0	0
0	0	0	0	0
0	0	0	0	0
0	**28**	**1**	**19**	**0**
U	L	T	R	P

Turning Movement Peak Hour Data Plot (4:30 PM)

City of Lloydminster
4420-50 Avenue

Lloydminster, Alberta, Canada T9V 0W2
(780) 875-6184 waguinaldo@lloydminster.ca

Count Name: 44 Street and 40 Avenue
Site Code: 4440
Start Date: 05/16/2018
Page No: 3



05/16/2018 7:00 AM
Ending At
05/16/2018 6:00 PM

Lights
Mediums
Articulated Trucks
Bicycles on Road
Other

Southbound Approach [N]

Out	In	Total
1339	1306	2645
123	123	246
130	104	234
0	1	1
0	0	0
1592	**1534**	**3126**

R	T	L	U	P
276	660	370	0	0
22	35	66	0	0
5	24	75	0	0
0	0	1	0	0
0	0	0	0	0
303	**719**	**512**	**0**	**0**

Westbound Approach [E]

Out	In	Total
2333	2688	5021
108	109	217
282	306	588
3	0	3
0	0	0
2726	**3103**	**5829**

R	T	L	U	P
422	1637	627	2	0
49	50	10	0	0
77	215	14	0	0
0	0	0	0	0
0	0	0	0	1
548	**1902**	**651**	**2**	**1**

U	L	T	R	P
0	543	524	538	0
0	7	37	6	0
0	4	40	19	0
0	0	0	2	0
0	0	0	0	0
0	**554**	**601**	**565**	**0**

Out	In	Total
1391	1605	2996
48	50	98
39	63	102
0	2	2
0	0	0
1478	**1720**	**3198**

Northbound Approach [S]

Eastbound Approach [W]

Out	In	Total
2457	1921	4378
79	76	155
224	202	426
0	0	0
0	0	0
2760	**2199**	**4959**

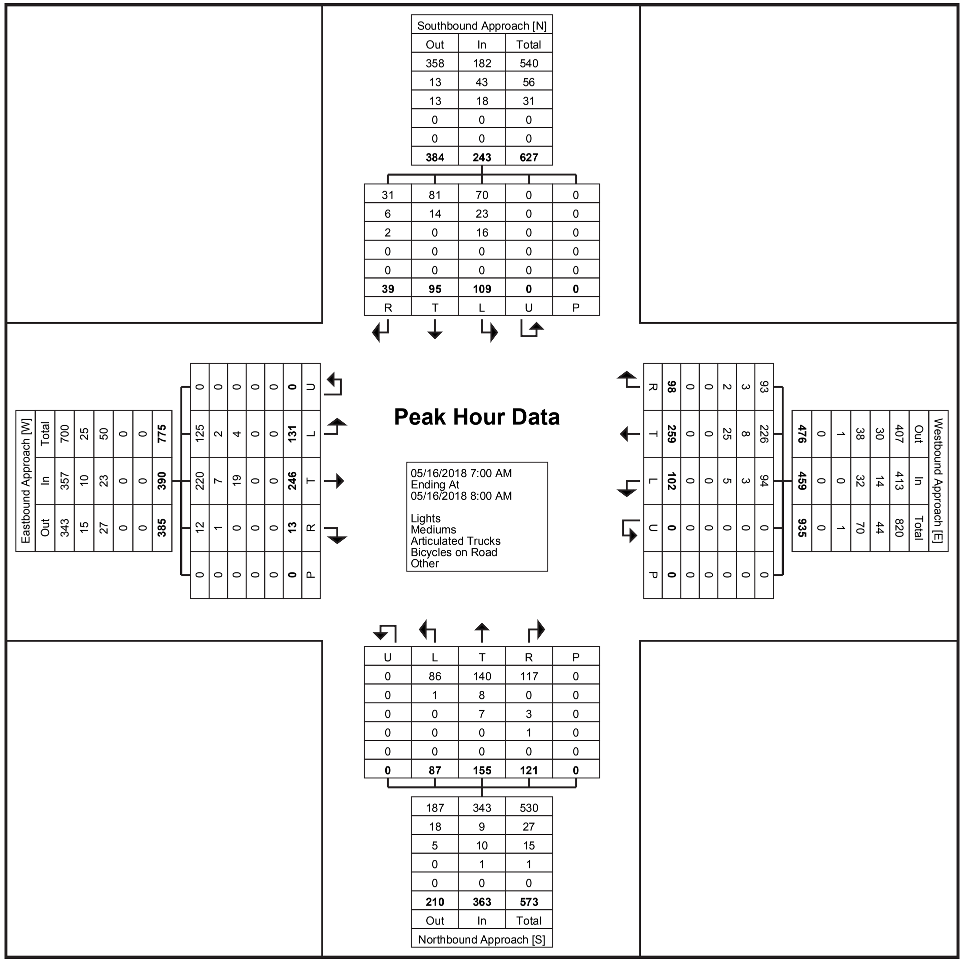
U	L	T	R	P
1	393	1423	104	0
0	37	36	3	0
0	13	188	1	0
0	0	0	0	0
0	0	0	0	1
1	**443**	**1647**	**108**	**1**

Turning Movement Data Plot

City of Lloydminster
4420-50 Avenue

Lloydminster, Alberta, Canada T9V 0W2
(780) 875-6184 waguinaldo@lloydminster.ca

Count Name: 44 Street and 40 Avenue
Site Code: 4440
Start Date: 05/16/2018
Page No: 5



Peak Hour Data

05/16/2018 7:00 AM
Ending At
05/16/2018 8:00 AM

Lights
Mediums
Articulated Trucks
Bicycles on Road
Other

Southbound Approach [N]

Out	In	Total
358	182	540
13	43	56
13	18	31
0	0	0
0	0	0
384	**243**	**627**

R	T	L	U	P
31	81	70	0	0
6	14	23	0	0
2	0	16	0	0
0	0	0	0	0
0	0	0	0	0
39	**95**	**109**	**0**	**0**

Westbound Approach [E]

Out	In	Total
407	413	820
30	14	44
38	32	70
1	0	1
0	0	0
476	**459**	**935**

R	T	L	U	P
93	226	94	0	0
3	8	3	0	0
2	25	5	0	0
0	0	0	0	0
0	0	0	0	0
98	**259**	**102**	**0**	**0**

Northbound Approach [S]

U	L	T	R	P
0	86	140	117	0
0	1	8	0	0
0	0	7	3	0
0	0	0	1	0
0	0	0	0	0
0	**87**	**155**	**121**	**0**

Out	In	Total
187	343	530
18	9	27
5	10	15
0	1	1
0	0	0
210	**363**	**573**

Eastbound Approach [W]

Out	In	Total
343	357	700
15	10	25
27	23	50
0	0	0
0	0	0
385	**390**	**775**

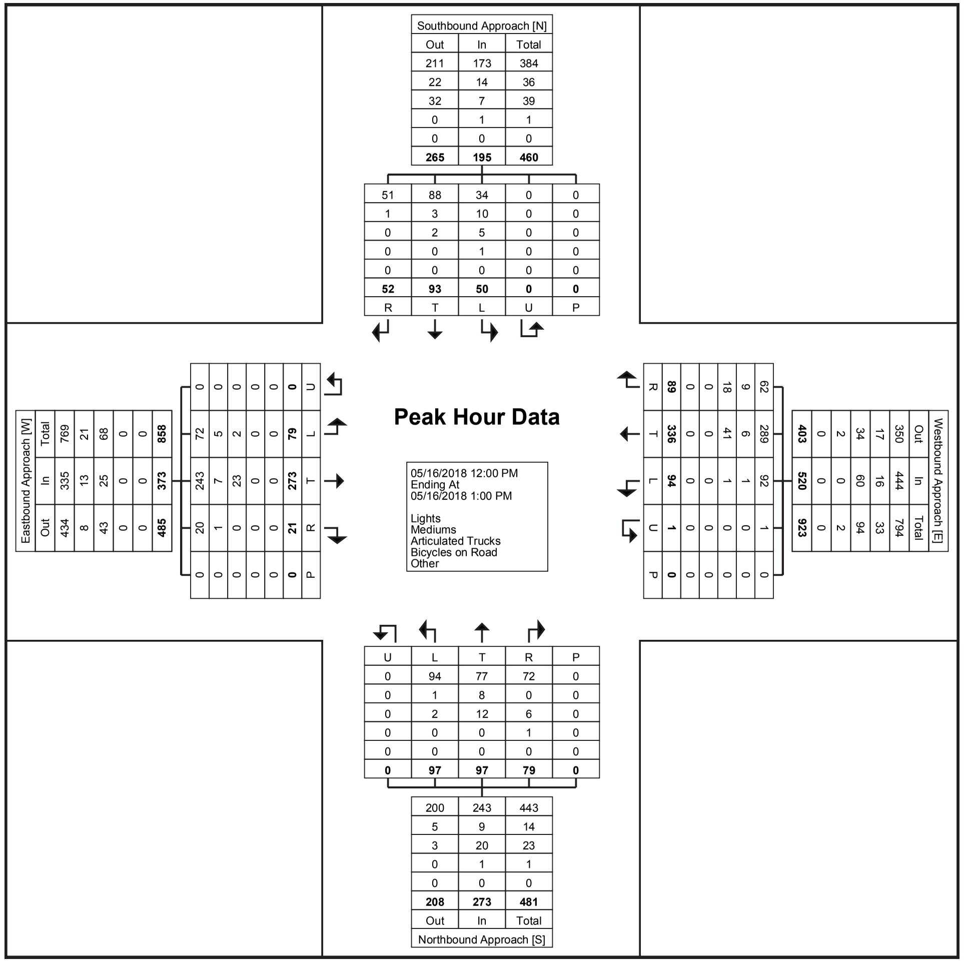
U	L	T	R	P
0	125	220	12	0
0	2	7	1	0
0	4	19	0	0
0	0	0	0	0
0	0	0	0	0
0	**131**	**246**	**13**	**0**

Turning Movement Peak Hour Data Plot (7:00 AM)

City of Lloydminster
4420-50 Avenue

Lloydminster, Alberta, Canada T9V 0W2
(780) 875-6184 waguinaldo@lloydminster.ca

Count Name: 44 Street and 40 Avenue
Site Code: 4440
Start Date: 05/16/2018
Page No: 7



Peak Hour Data

05/16/2018 12:00 PM
Ending At
05/16/2018 1:00 PM

Lights
Mediums
Articulated Trucks
Bicycles on Road
Other

Southbound Approach [N]

Out	In	Total
211	173	384
22	14	36
32	7	39
0	1	1
0	0	0
265	**195**	**460**

R	T	L	U	P
51	88	34	0	0
1	3	10	0	0
0	2	5	0	0
0	0	1	0	0
0	0	0	0	0
52	**93**	**50**	**0**	**0**

Westbound Approach [E]

Out	In	Total
350	444	794
17	16	33
34	60	94
2	0	2
0	0	0
403	**520**	**923**

R	T	L	U	P
62	289	92	1	0
9	6	1	0	0
18	41	1	0	0
0	0	0	0	0
0	0	0	0	0
89	**336**	**94**	**1**	**0**

Eastbound Approach [W]

Out	In	Total
434	335	769
8	13	21
43	25	68
0	0	0
0	0	0
485	**373**	**858**

U	L	T	R	P
0	72	243	20	0
0	5	7	1	0
0	2	23	0	0
0	0	0	0	0
0	0	0	0	0
0	**79**	**273**	**21**	**0**

U	L	T	R	P
0	94	77	72	0
0	1	8	0	0
0	2	12	6	0
0	0	0	1	0
0	0	0	0	0
0	**97**	**97**	**79**	**0**

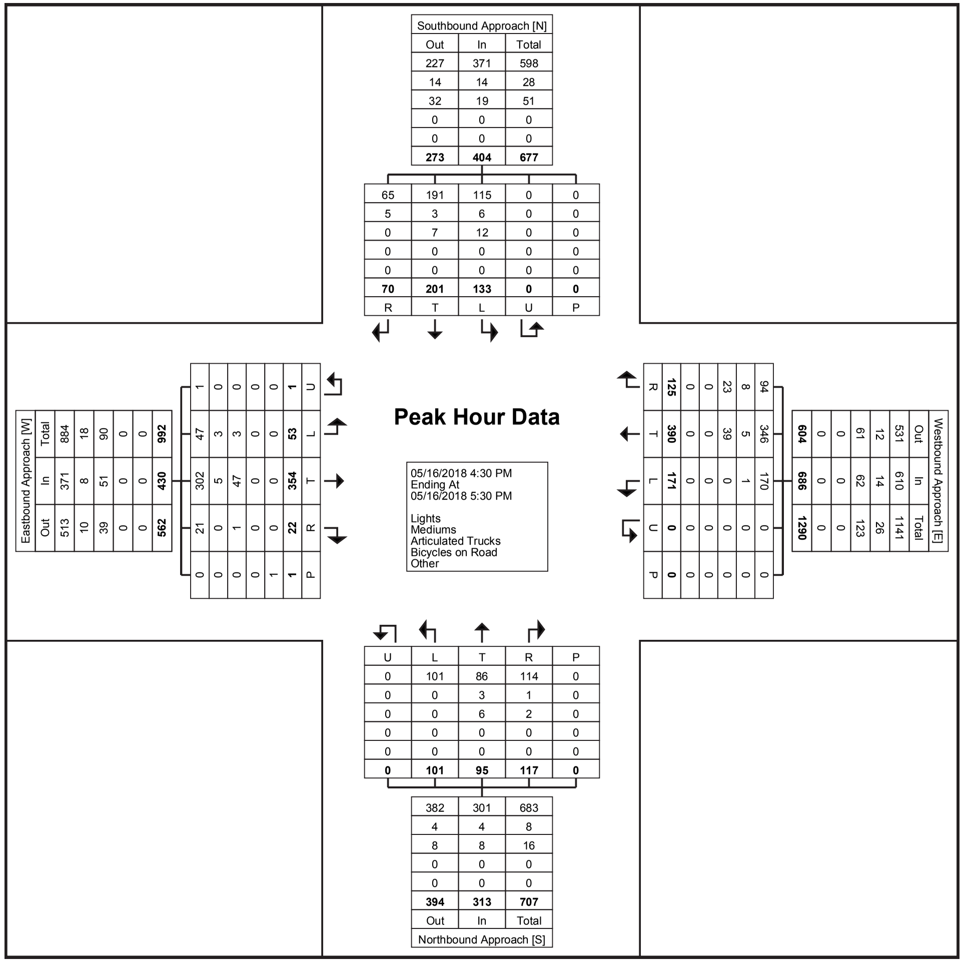
Out	In	Total
200	243	443
5	9	14
3	20	23
0	1	1
0	0	0
208	**273**	**481**

Northbound Approach [S]

Turning Movement Peak Hour Data Plot (12:00 PM)

City of Lloydminster
4420-50 Avenue

Lloydminster, Alberta, Canada T9V 0W2
(780) 875-6184 waguinaldo@lloydminster.ca



05/16/2018 4:30 PM
Ending At
05/16/2018 5:30 PM

Lights
Mediums
Articulated Trucks
Bicycles on Road
Other

Southbound Approach [N]

Out	In	Total
227	371	598
14	14	28
32	19	51
0	0	0
0	0	0
273	**404**	**677**

R	T	L	U	P
65	191	115	0	0
5	3	6	0	0
0	7	12	0	0
0	0	0	0	0
0	0	0	0	0
70	**201**	**133**	**0**	**0**

Westbound Approach [E]

Out	In	Total
531	610	1141
12	14	26
61	62	123
0	0	0
0	0	0
604	**686**	**1290**

R	T	L	U	P
94	346	170	0	0
8	5	1	0	0
23	39	0	0	0
0	0	0	0	0
0	0	0	0	0
125	**390**	**171**	**0**	**0**

U	L	T	R	P
0	101	86	114	0
0	0	3	1	0
0	0	6	2	0
0	0	0	0	0
0	0	0	0	0
0	**101**	**95**	**117**	**0**

Out	In	Total
382	301	683
4	4	8
8	8	16
0	0	0
0	0	0
394	**313**	**707**

Northbound Approach [S]

Eastbound Approach [W]

Out	In	Total
513	371	884
10	8	18
39	51	90
0	0	0
0	0	0
562	**430**	**992**

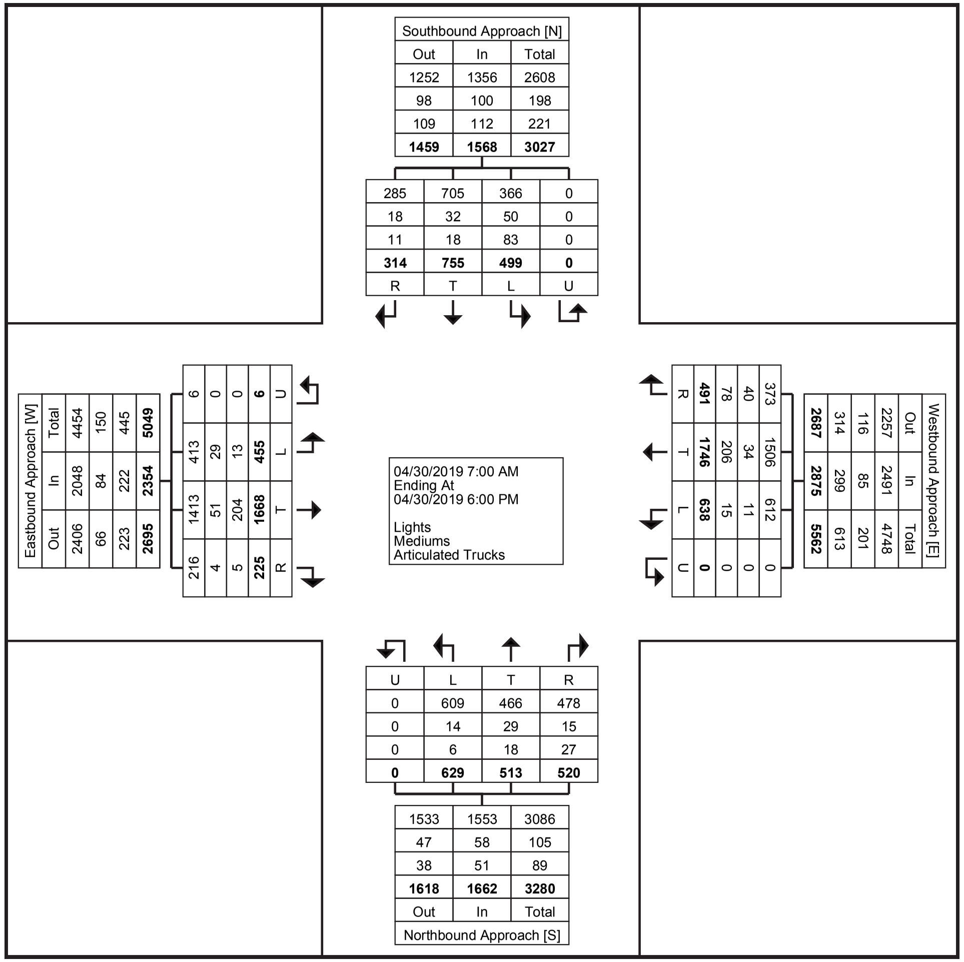
U	L	T	R	P
1	47	302	21	0
0	3	5	0	0
0	3	47	1	0
0	0	0	0	0
0	0	0	0	1
1	**53**	**354**	**22**	**1**

Turning Movement Peak Hour Data Plot (4:30 PM)

City of Lloydminster
4420-50 Avenue

Lloydminster, Alberta, Canada T9V 0W2
(780) 875-6184 bcarriere@lloydminster.ca

Count Name: 44 Street and 40 Avenue
Site Code: 4440
Start Date: 04/30/2019
Page No: 3



Southbound Approach [N]

Out	In	Total
1252	1356	2608
98	100	198
109	112	221
1459	**1568**	**3027**

R	T	L	U
285	705	366	0
18	32	50	0
11	18	83	0
314	**755**	**499**	**0**

Westbound Approach [E]

Out	In	Total
2257	2491	4748
116	85	201
314	299	613
2687	**2875**	**5562**

R	T	L	U
373	1506	612	0
40	34	11	0
78	206	15	0
491	**1746**	**638**	**0**

Northbound Approach [S]

U	L	T	R
0	609	466	478
0	14	29	15
0	6	18	27
0	**629**	**513**	**520**

Out	In	Total
1533	1553	3086
47	58	105
38	51	89
1618	**1662**	**3280**

Eastbound Approach [W]

Out	In	Total
2406	2048	4454
66	84	150
223	222	445
2695	**2354**	**5049**

R	T	L	U
216	1413	413	6
4	51	29	0
5	204	13	0
225	**1668**	**455**	**6**

04/30/2019 7:00 AM
Ending At
04/30/2019 6:00 PM

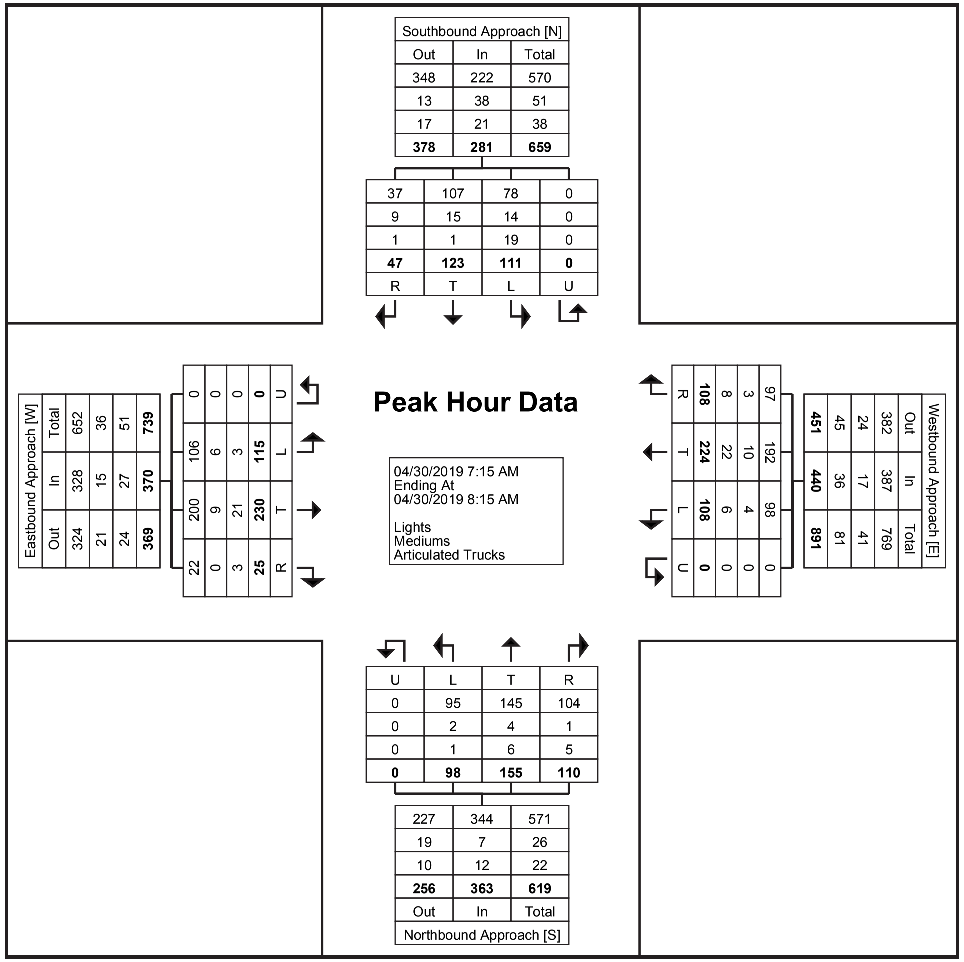
Lights
Mediums
Articulated Trucks

Turning Movement Data Plot

City of Lloydminster
4420-50 Avenue

Lloydminster, Alberta, Canada T9V 0W2
(780) 875-6184 bcarriere@lloydminster.ca

Count Name: 44 Street and 40 Avenue
Site Code: 4440
Start Date: 04/30/2019
Page No: 5



Peak Hour Data

04/30/2019 7:15 AM
Ending At
04/30/2019 8:15 AM

Lights
Mediums
Articulated Trucks

Southbound Approach [N]

Out	In	Total
348	222	570
13	38	51
17	21	38
378	**281**	**659**

R	T	L	U
37	107	78	0
9	15	14	0
1	1	19	0
47	**123**	**111**	**0**

Westbound Approach [E]

Out	In	Total
382	387	769
24	17	41
45	36	81
451	**440**	**891**

R	T	L	U
97	192	98	0
3	10	4	0
8	22	6	0
108	**224**	**108**	**0**

Northbound Approach [S]

U	L	T	R
0	95	145	104
0	2	4	1
0	1	6	5
0	**98**	**155**	**110**

Out	In	Total
227	344	571
19	7	26
10	12	22
256	**363**	**619**

Eastbound Approach [W]

Out	In	Total
324	328	652
21	15	36
24	27	51
369	**370**	**739**

R	T	L	U
22	200	106	0
0	9	6	0
3	21	3	0
25	**230**	**115**	**0**

Turning Movement Peak Hour Data Plot (7:15 AM)

City of Lloydminster
4420-50 Avenue

Lloydminster, Alberta, Canada T9V 0W2
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Count Name: 44 Street and 40 Avenue
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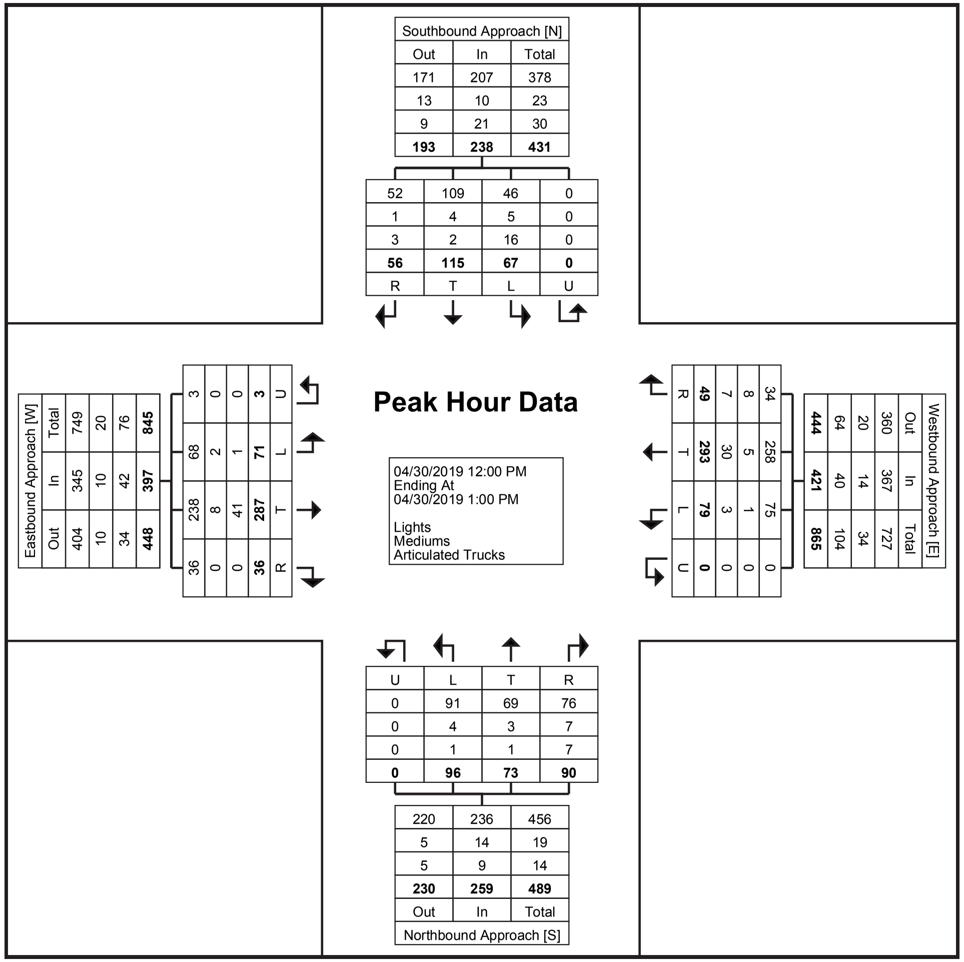
Page No: 7



Peak Hour Data

04/30/2019 12:00 PM
Ending At
04/30/2019 1:00 PM

Lights
Mediums
Articulated Trucks

Southbound Approach [N]

Out	In	Total
171	207	378
13	10	23
9	21	30
193	**238**	**431**

R	T	L	U
52	109	46	0
1	4	5	0
3	2	16	0
56	**115**	**67**	**0**

Westbound Approach [E]

Out	In	Total
360	367	727
20	14	34
64	40	104
444	**421**	**865**

R	T	L	U
34	258	75	0
8	5	1	0
7	30	3	0
49	**293**	**79**	**0**

Northbound Approach [S]

Out	In	Total
220	236	456
5	14	19
5	9	14
230	**259**	**489**

U	L	T	R
0	91	69	76
0	4	3	7
0	1	1	7
0	**96**	**73**	**90**

Eastbound Approach [W]

Out	In	Total
404	345	749
10	10	20
34	42	76
448	**397**	**845**

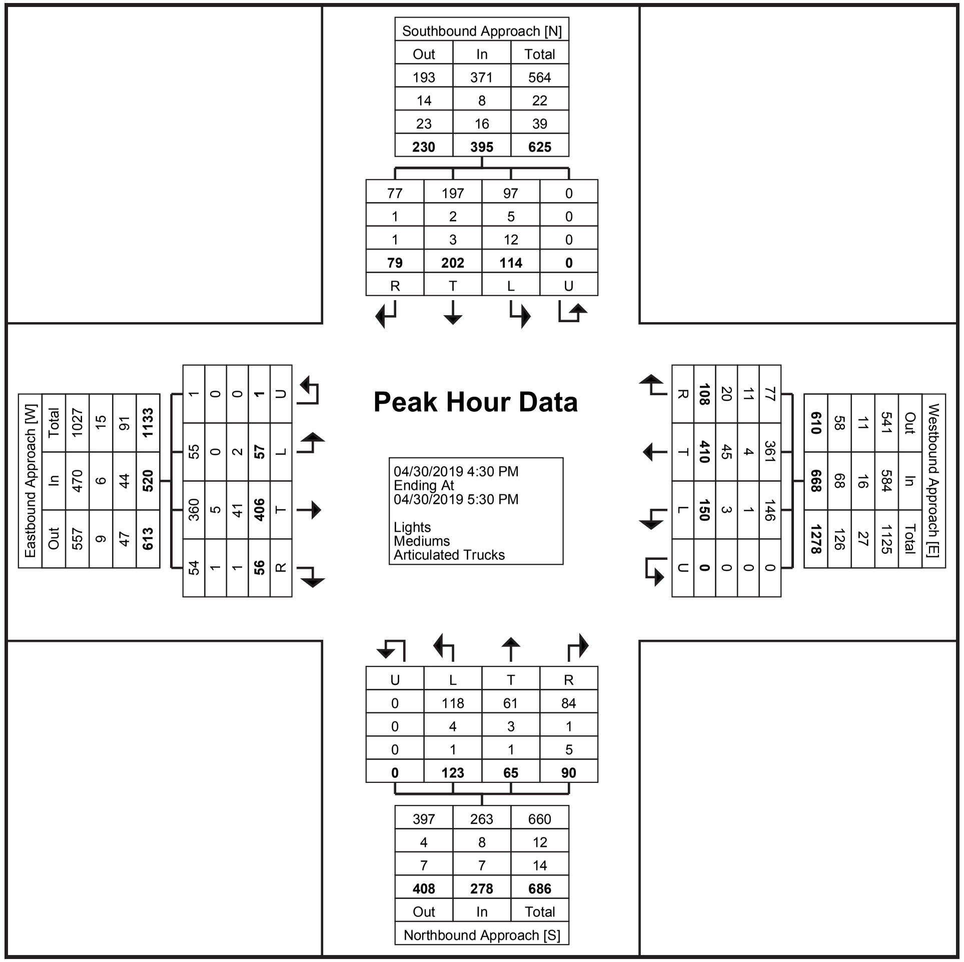
U	L	T	R
3	68	238	36
0	2	8	0
0	1	41	0
3	**71**	**287**	**36**

Turning Movement Peak Hour Data Plot (12:00 PM)

City of Lloydminster
4420-50 Avenue

Lloydminster, Alberta, Canada T9V 0W2
(780) 875-6184 bcarriere@lloydminster.ca

Count Name: 44 Street and 40 Avenue
Site Code: 4440
Start Date: 04/30/2019
Page No: 9



Peak Hour Data

04/30/2019 4:30 PM
Ending At
04/30/2019 5:30 PM

Lights
Mediums
Articulated Trucks

Southbound Approach [N]

Out	In	Total
193	371	564
14	8	22
23	16	39
230	**395**	**625**

R	T	L	U
77	197	97	0
1	2	5	0
1	3	12	0
79	**202**	**114**	**0**

Westbound Approach [E]

Out	In	Total
541	584	1125
11	16	27
58	68	126
610	**668**	**1278**

R	T	L	U
77	361	146	0
11	4	1	0
20	45	3	0
108	**410**	**150**	**0**

Northbound Approach [S]

Out	In	Total
397	263	660
4	8	12
7	7	14
408	**278**	**686**

U	L	T	R
0	118	61	84
0	4	3	1
0	1	1	5
0	**123**	**65**	**90**

Eastbound Approach [W]

Out	In	Total
557	470	1027
9	6	15
47	44	91
613	**520**	**1133**

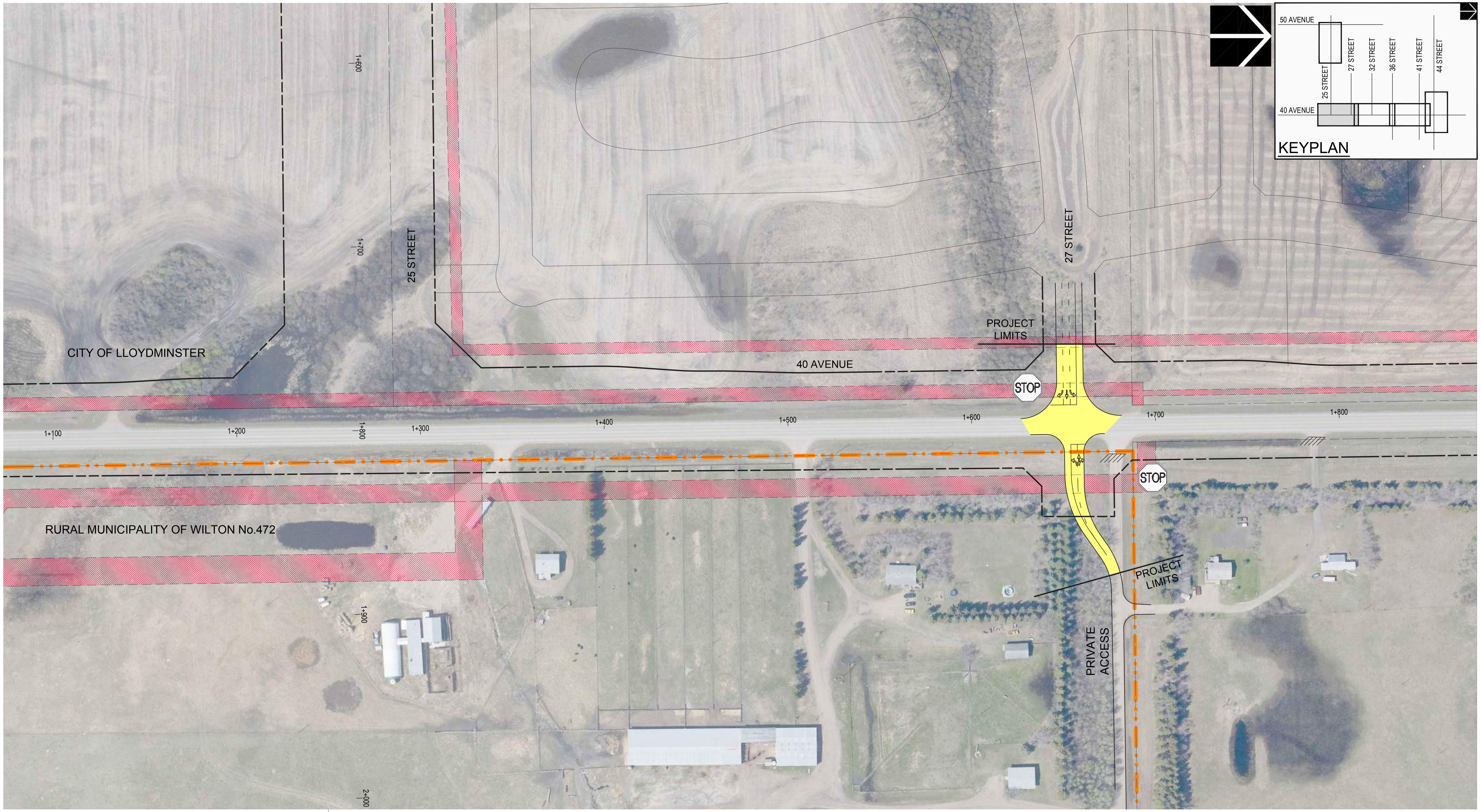
U	L	T	R
1	55	360	54
0	0	5	1
0	2	41	1
1	**57**	**406**	**56**

Turning Movement Peak Hour Data Plot (4:30 PM)

APPENDIX
40 Avenue Functional Study Excerpts
B

35,000 Population Horizon Plans

J:\13500\13577_Lloydminister_40AveConceptPlan\02_CADD\20_Drafting\202_40 Ave Concept\13577-EXHIBIT-35K.dwg - August 30, 2013



HORZ 0 20 40 60 80m
1:2000

ISL Engineering and Land Services

LLOYDMINSTER
Canada's Border City

City of L

Legend

- 🟧 SIDEWALKS
- 🟨 ROADWAY
- 🟩 BERMS
- 🟦 DRAINAGE CHANNEL
- 🟥 EASEMENT
- ▨ POND
- ▨ HIGHWAY COMMERICAL
- ▨ WIGFIELD INDUSTRIAL PARK
- ▨ FUTURE LIGHT INDUSTRIAL
- //// ROAD CLOSURE
- — · · — CURRENT CITY BOUNDARY
- — — — PROPOSED RIGHT-of-WAY
- ● STOP TRAFFIC CONTROL
- 🚶 •🚶• PEDESTRIAN CONTROL

Project 40 AVENUE CONCEPT PLAN

Title 35,000 POPULATION HORIZON

Exhibit No. A2

Date August 30, 2013

J:\13500\13577_Lloydminister_40AveConceptPlan\02_CADD\20_Drafting\202_40 Ave Concept\13577-EXHIBIT-35K.dwg - August 30, 2013

HORZ 0 20 40 60 80m
1:2000

ISL Engineering and Land Services

LLOYDMINSTER Canada's Border City

Legend

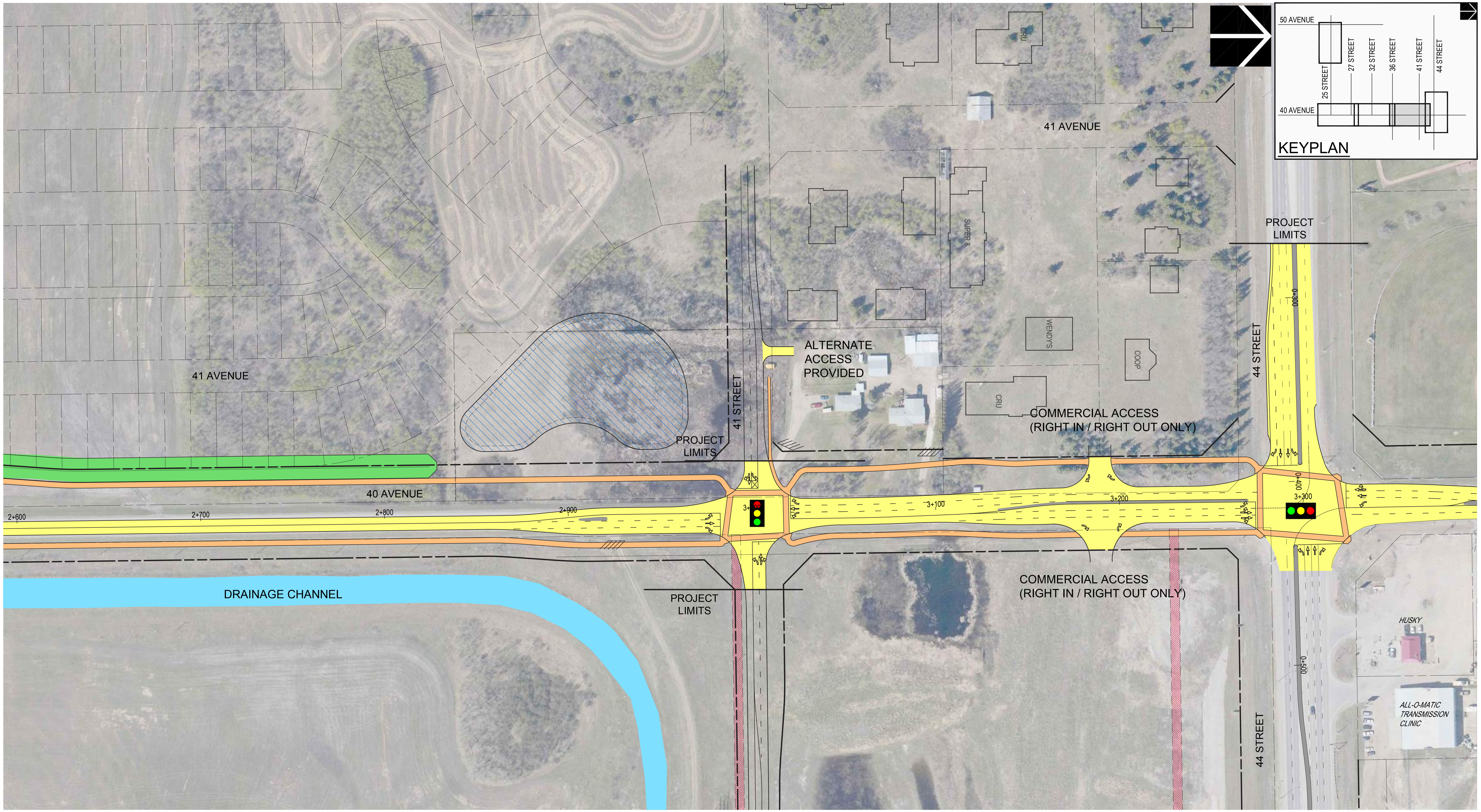
🟧	SIDEWALKS
🟨	ROADWAY
🟩	BERMS
🟦	DRAINAGE CHANNEL
▨	EASEMENT
▨	POND
▨	HIGHWAY COMMERICAL
▨	WIGFIELD INDUSTRIAL PARK
▨	FUTURE LIGHT INDUSTRIAL
////	ROAD CLOSURE
— · —	CURRENT CITY BOUNDARY
— — —	PROPOSED RIGHT-of-WAY
● STOP	TRAFFIC CONTROL
🚶 •🚶•	PEDESTRIAN CONTROL

Project 40 AVENUE CONCEPT PLAN

Title 35,000 POPULATION HORIZON

Exhibit No. A3

Date August 30, 2013



HORZ 0 20 40 60 80m
1:2000

ISL Engineering and Land Services

LLOYDMINSTER
Canada's Border City

Legend

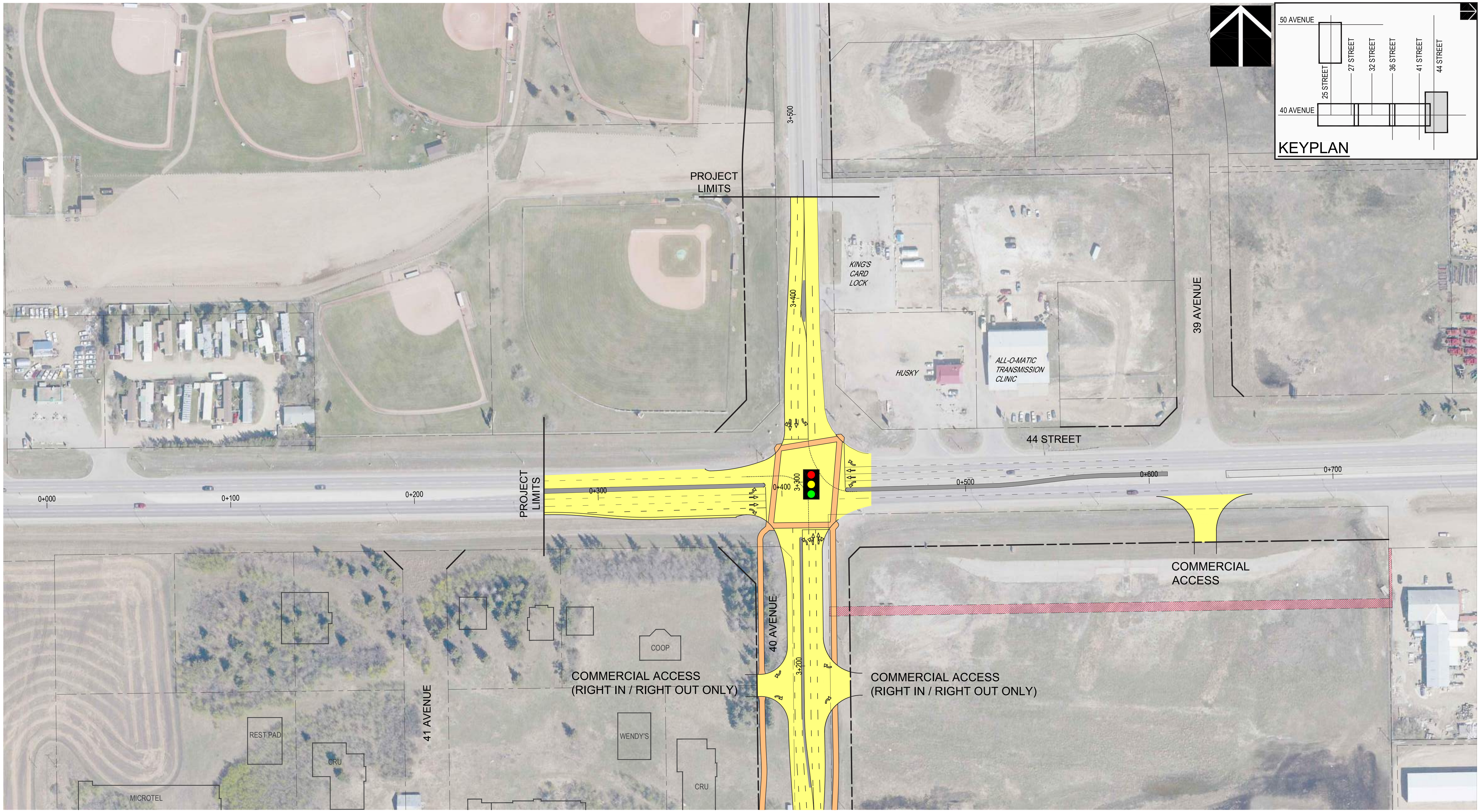
🟧	SIDEWALKS	▨	POND	— · —	CURRENT CITY BOUNDARY
🟨	ROADWAY	▨	HIGHWAY COMMERICAL	— — —	PROPOSED RIGHT-of-WAY
🟩	BERMS	▨	WIGFIELD INDUSTRIAL PARK	STOP	TRAFFIC CONTROL
🟦	DRAINAGE CHANNEL	▨	FUTURE LIGHT INDUSTRIAL	🚶	PEDESTRIAN CONTROL
🟥	EASEMENT	////	ROAD CLOSURE		

Project 40 AVENUE CONCEPT PLAN

Title 35,000 POPULATION HORIZON

Exhibit No. A4

Date August 30, 2013



HORZ 0 20 40 60 80m
1:2000

ISL Engineering and Land Services

LLOYDMINSTER Canada's Border City

Legend

🟧	SIDEWALKS	▨	POND
🟨	ROADWAY	▨	HIGHWAY COMMERICAL
🟩	BERMS	▨	WIGFIELD INDUSTRIAL PARK
🟦	DRAINAGE CHANNEL	▨	FUTURE LIGHT INDUSTRIAL
🟥	EASEMENT	////	ROAD CLOSURE

— • • —	CURRENT CITY BOUNDARY
— — —	PROPOSED RIGHT-of-WAY
🚦 STOP	TRAFFIC CONTROL
🚶 •🚶•	PEDESTRIAN CONTROL

Project 40 AVENUE CONCEPT PLAN

Title 35,000 POPULATION HORIZON

Exhibit No. A5 Date August 30, 2013

100,000 Population Horizon Plans and Profiles

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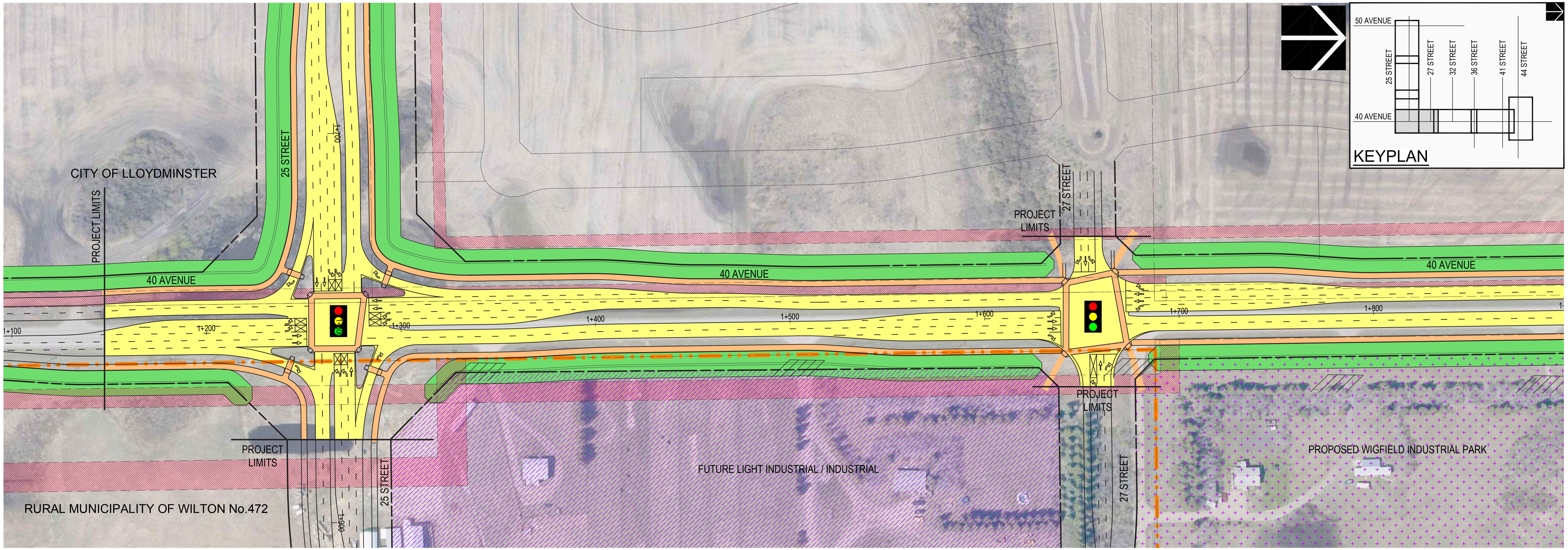

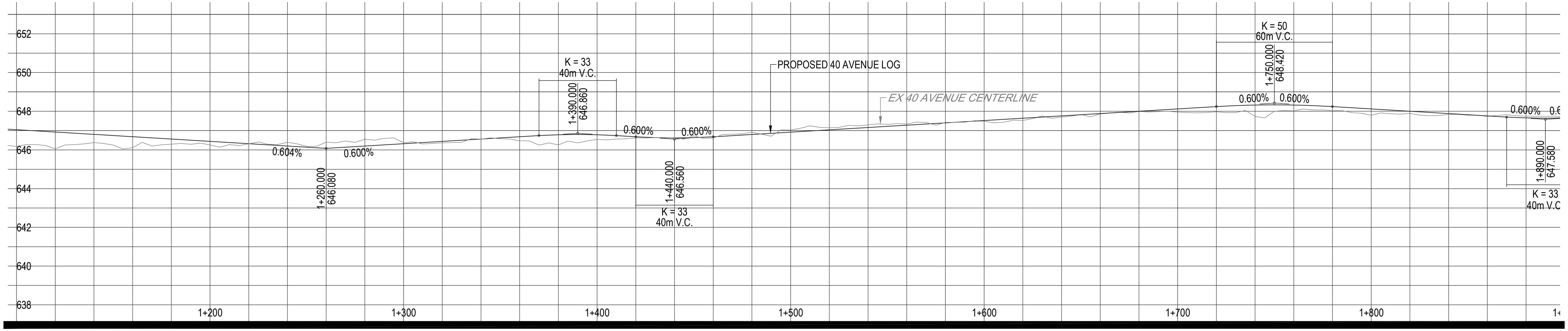

HORZ 1:2000 0 20 40 60 80m
VERT 1:200 0 2 4 6 8m

ISL Engineering and Land Services

LLOYDMINSTER Canada's Border City

Legend

🟧	SIDEWALKS
🟨	ROADWAY
🟩	BERMS
🟦	DRAINAGE CHANNEL
▨	EASEMENT
▨	POND
▨	HIGHWAY COMMERICAL
+ +	WIGFIELD INDUSTRIAL PARK
▨	FUTURE LIGHT INDUSTRIAL
////	ROAD CLOSURE
— · · —	CURRENT CITY BOUNDARY
— — —	PROPOSED RIGHT-of-WAY
🚦 STOP	TRAFFIC CONTROL
🚶 •🚶•	PEDESTRIAN CONTROL

Project 40 AVENUE CONCEPT PLAN

Title ULTIMATE STAGE
(100,000 POPULATION HORIZON)

Exhibit No. C4

Date August 30, 2013

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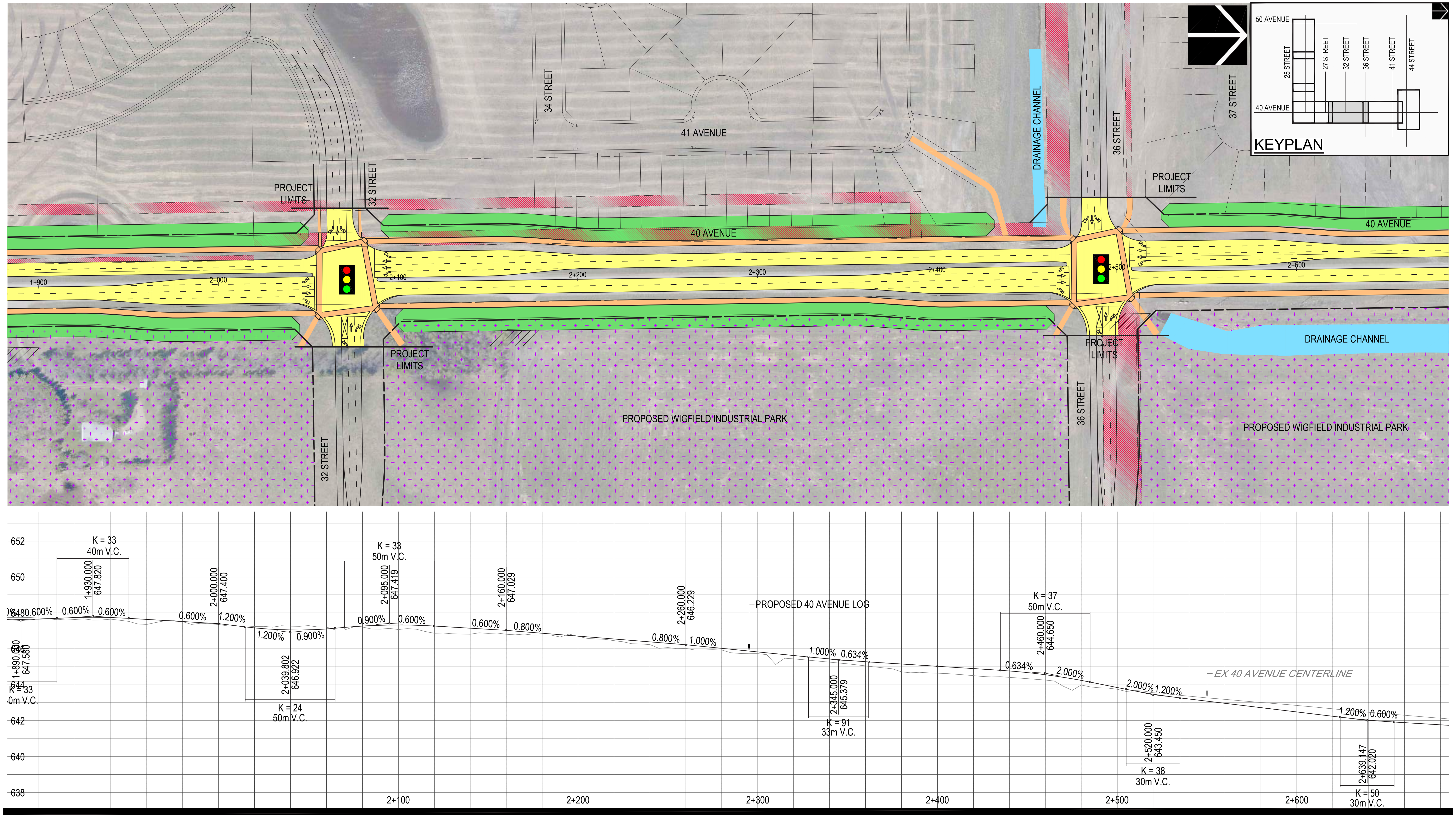

HORZ 1:2000 0 20 40 60 80m
VERT 1:200 0 2 4 6 8m

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LLOYDMINSTER Canada's Border City

Legend

- 🟧 SIDEWALKS
- 🟨 ROADWAY
- 🟩 BERMS
- 🟦 DRAINAGE CHANNEL
- ▨ EASEMENT
- ▨ POND
- ▨ HIGHWAY COMMERICAL
- ▨ WIGFIELD INDUSTRIAL PARK
- ▨ FUTURE LIGHT INDUSTRIAL
- //// ROAD CLOSURE
- — · · — CURRENT CITY BOUNDARY
- — — — PROPOSED RIGHT-of-WAY
- 🚦 STOP TRAFFIC CONTROL
- 🚶 •🚶• PEDESTRIAN CONTROL

Project 40 AVENUE CONCEPT PLAN

Title ULTIMATE STAGE
(100,000 POPULATION HORIZON)

Exhibit No. C5

Date August 30, 2013

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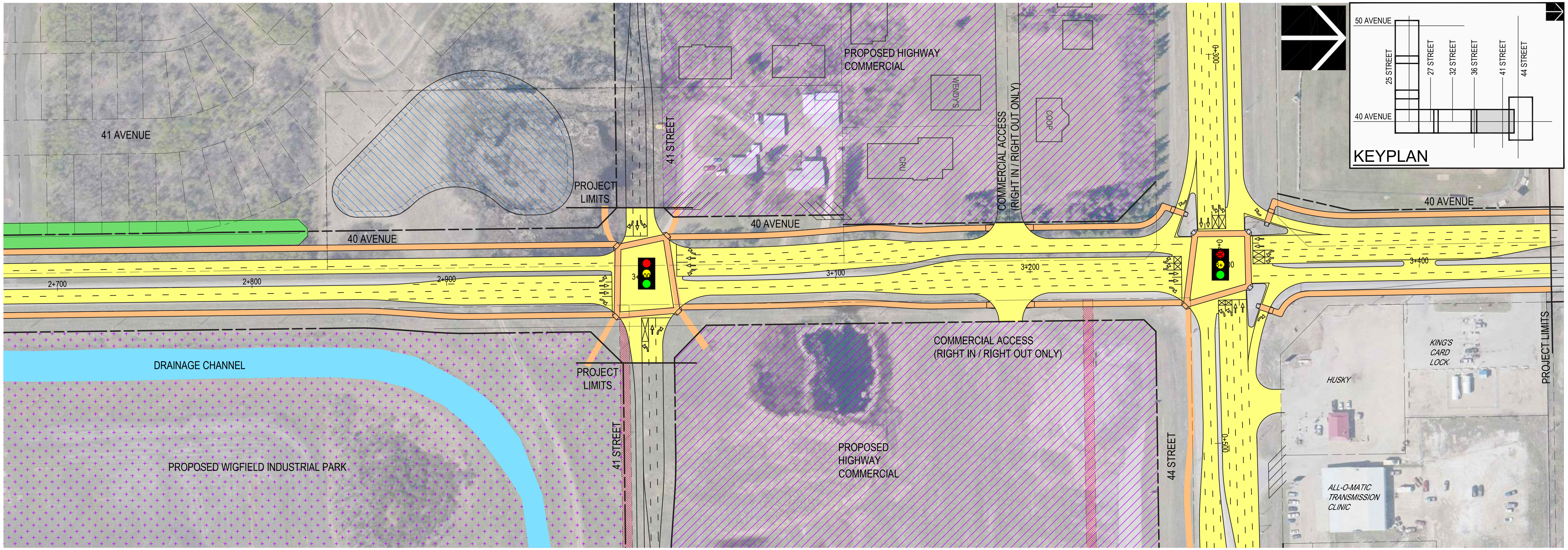

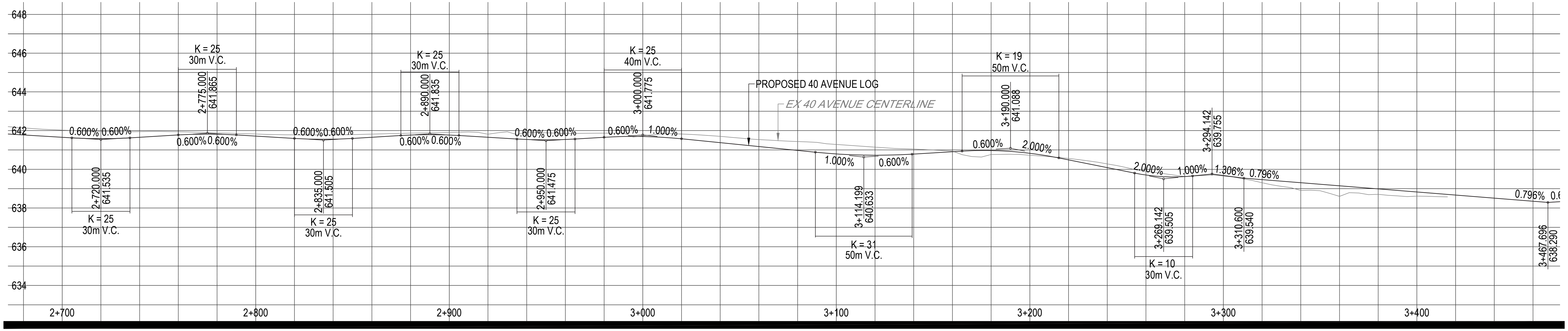

HORZ 0 20 40 60 80m
1:2000
VERT 0 2 4 6 8m
1:200

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LLOYDMINSTER
Canada's Border City

Legend

- SIDEWALKS
- ROADWAY
- BERMS
- DRAINAGE CHANNEL
- EASEMENT
- POND
- HIGHWAY COMMERICAL
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- FUTURE LIGHT INDUSTRIAL
- ROAD CLOSURE
- CURRENT CITY BOUNDARY
- PROPOSED RIGHT-of-WAY
- STOP TRAFFIC CONTROL
- PEDESTRIAN CONTROL

Project 40 AVENUE CONCEPT PLAN

Title ULTIMATE STAGE
(100,000 POPULATION HORIZON)

Exhibit No. C6

Date August 30, 2013

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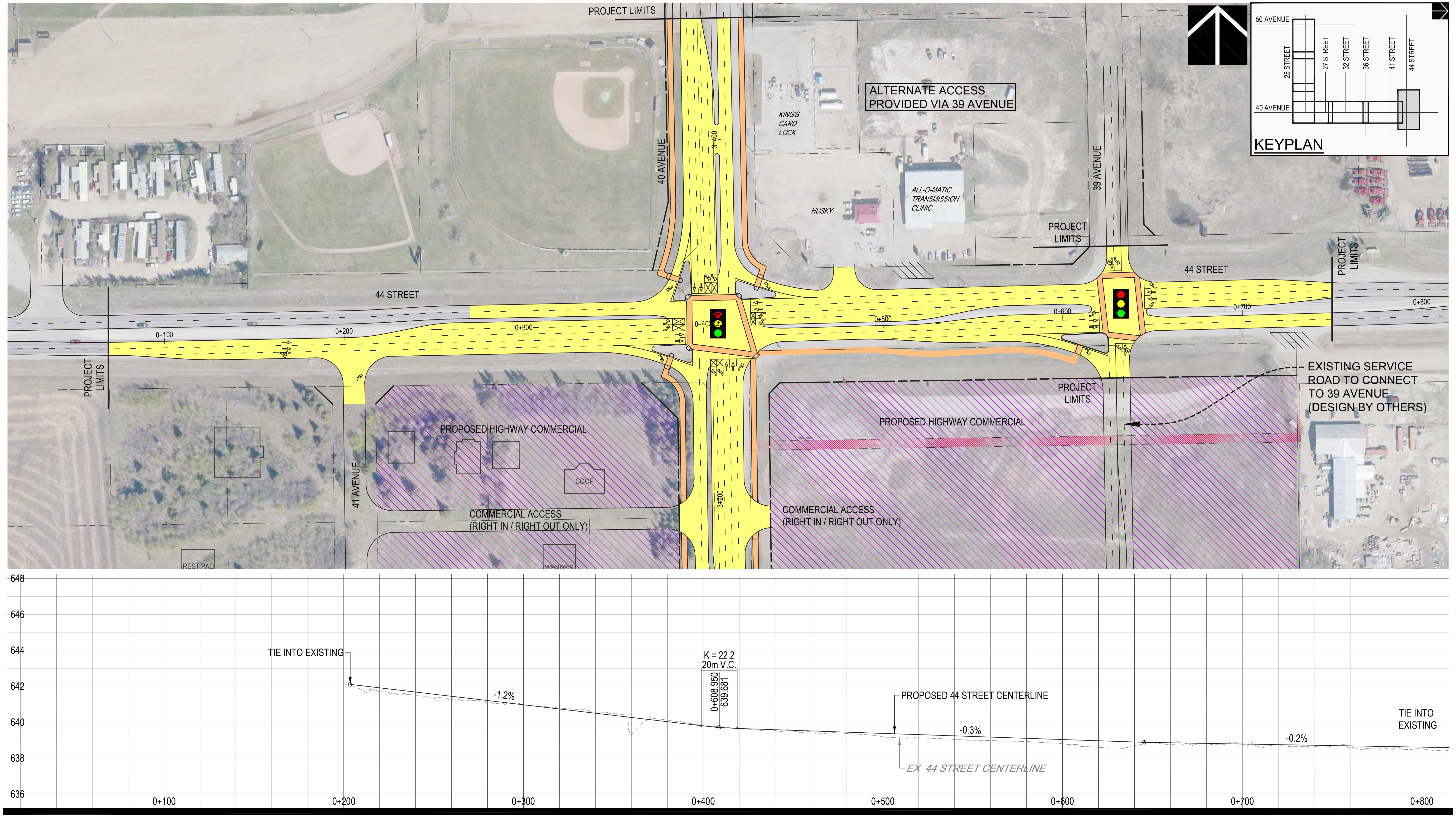

HORZ 0 20 40 60 80m
1:2000
VERT 0 2 4 6 8m
1:200

ISL Engineering and Land Services

LLOYDMINSTER
Canada's Border City

Legend

🟧	SIDEWALKS
🟨	ROADWAY
🟩	BERMS
🟦	DRAINAGE CHANNEL
▨	EASEMENT
▨	POND
▨	HIGHWAY COMMERICAL
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▨	FUTURE LIGHT INDUSTRIAL
////	ROAD CLOSURE
— · · —	CURRENT CITY BOUNDARY
— — —	PROPOSED RIGHT-of-WAY
🚦 STOP	TRAFFIC CONTROL
🚶 •🚶•	PEDESTRIAN CONTROL

Project 40 AVENUE CONCEPT PLAN

Title ULTIMATE STAGE
(100,000 POPULATION HORIZON)

Exhibit No. C7

Date August 30, 2013

APPENDIX
Synchro Report

C

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱		✥			✥	
Traffic Volume (vph)	10	478	10	10	466	10	10	2	10	10	2	10
Future Volume (vph)	10	478	10	10	466	10	10	2	10	10	2	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	180.0		60.0	60.0		130.0	0.0		0.0	0.0		0.0
Storage Lanes	1		1	1		1	0		0	0		0
Taper Length (m)	25.0			25.0			25.0			25.0		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850			0.850		0.938			0.938	
Flt Protected	0.950			0.950				0.978			0.978	
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	0	1728	0	0	1728	0
Flt Permitted	0.950			0.950				0.978			0.978	
Satd. Flow (perm)	1789	3579	1601	1789	3579	1601	0	1728	0	0	1728	0
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		567.2			295.2			164.6			169.3	
Travel Time (s)		34.0			17.7			9.9			10.2	
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
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
Adj. Flow (vph)	11	520	11	11	507	11	11	2	11	11	2	11
Shared Lane Traffic (%)												
Lane Group Flow (vph)	11	520	11	11	507	11	0	24	0	0	24	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Free			Free			Stop			Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 24.8% ICU Level of Service A

Analysis Period (min) 15

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱	↰	↑	↱	↰	↑	↱
Traffic Volume (vph)	115	255	25	108	249	108	98	172	110	111	137	47
Future Volume (vph)	115	255	25	108	249	108	98	172	110	111	137	47
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0		60.0	120.0		300.0	100.0		100.0	100.0		100.0
Storage Lanes	1		1	1		1	1		1	1		0
Taper Length (m)	25.0			25.0			25.0			25.0		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	1.00		0.98	1.00		0.98	1.00		0.98	1.00		0.98
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	1789	1883	1601	1789	1883	1601
Flt Permitted	0.585			0.581			0.650			0.608		
Satd. Flow (perm)	1097	3579	1572	1091	3579	1575	1220	1883	1575	1142	1883	1575
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			182			117			120			182
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		786.6			567.2			287.0			105.8	
Travel Time (s)		47.2			34.0			17.2			6.3	
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
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
Adj. Flow (vph)	125	277	27	117	271	117	107	187	120	121	149	51
Shared Lane Traffic (%)												
Lane Group Flow (vph)	125	277	27	117	271	117	107	187	120	121	149	51
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		6.0			6.0			6.0			6.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	Perm

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Protected Phases		4		3	8		5	2			6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	4	4	4	3	8	8	5	2	2	6	6	6
Switch Phase												
Minimum Initial (s)	10.0	10.0	10.0	7.0	10.0	10.0	7.0	15.0	15.0	15.0	15.0	15.0
Minimum Split (s)	24.0	24.0	24.0	13.0	24.0	24.0	13.0	40.0	40.0	37.0	37.0	37.0
Total Split (s)	27.0	27.0	27.0	13.0	40.0	40.0	13.0	50.0	50.0	37.0	37.0	37.0
Total Split (%)	30.0%	30.0%	30.0%	14.4%	44.4%	44.4%	14.4%	55.6%	55.6%	41.1%	41.1%	41.1%
Maximum Green (s)	21.0	21.0	21.0	7.0	34.0	34.0	7.0	44.0	44.0	31.0	31.0	31.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lead	Lead	Lag			Lag			Lead	Lead	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes			Yes			Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	C-Max	C-Max	C-Max	None	C-Max	C-Max	None	None	None	None	None	None
Walk Time (s)								7.0	7.0	7.0	7.0	7.0
Flash Dont Walk (s)								27.0	27.0	24.0	24.0	24.0
Pedestrian Calls (#/hr)								5	5	5	5	5
Act Effct Green (s)	38.6	38.6	38.6	49.0	49.0	49.0	30.4	29.0	29.0	18.6	18.6	18.6
Actuated g/C Ratio	0.43	0.43	0.43	0.54	0.54	0.54	0.34	0.32	0.32	0.21	0.21	0.21
v/c Ratio	0.27	0.18	0.03	0.18	0.14	0.13	0.23	0.31	0.20	0.51	0.38	0.11
Control Delay	24.0	20.1	0.1	14.7	12.5	3.7	20.8	22.3	3.9	38.2	32.3	0.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.0	20.1	0.1	14.7	12.5	3.7	20.8	22.3	3.9	38.2	32.3	0.5
LOS	C	C	A	B	B	A	C	C	A	D	C	A
Approach Delay		20.0			10.9			16.6			29.5	
Approach LOS		B			B			B			C	
Queue Length 50th (m)	14.7	16.5	0.0	9.5	11.6	0.0	14.2	25.8	0.0	20.8	24.8	0.0
Queue Length 95th (m)	37.9	33.6	0.0	26.0	26.2	10.6	19.3	31.2	8.6	30.7	33.7	0.0
Internal Link Dist (m)		762.6			543.2			263.0			81.8	
Turn Bay Length (m)	120.0		60.0	120.0		300.0	100.0		100.0	100.0		100.0
Base Capacity (vph)	469	1533	777	647	1947	910	456	920	831	393	648	661
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.27	0.18	0.03	0.18	0.14	0.13	0.23	0.20	0.14	0.31	0.23	0.08

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 4:EBTL and 8:WBTL, Start of Green

Natural Cycle: 90

Control Type: Actuated-Coordinated

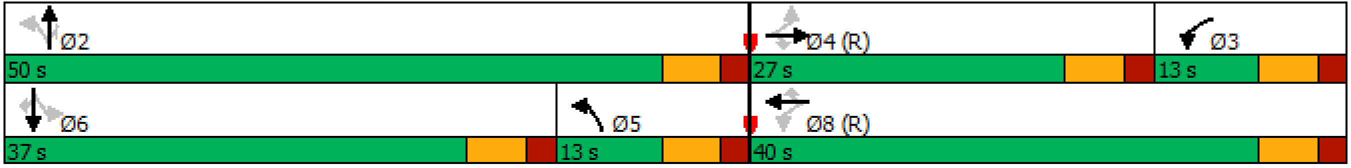
Maximum v/c Ratio: 0.51

Intersection Signal Delay: 18.2 Intersection LOS: B

Intersection Capacity Utilization 64.1% ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 2: Hwy 16 (44 St) & 40 Ave



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↑	↱
Traffic Volume (vph)	52	0	8	9	1	11	8	253	12	11	194	8
Future Volume (vph)	52	0	8	9	1	11	8	253	12	11	194	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0		60.0	60.0		60.0	60.0		60.0	90.0		0.0
Storage Lanes	1		0	1		0	1		0	1		1
Taper Length (m)	25.0			25.0			25.0			25.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	0.99	0.97		0.99	0.97		0.99	1.00		0.99		0.97
Frt		0.850			0.862			0.993				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	1555	0	1789	1580	0	1789	1868	0	1789	1883	1601
Flt Permitted	0.749			0.407			0.626			0.583		
Satd. Flow (perm)	1398	1555	0	761	1580	0	1171	1868	0	1092	1883	1555
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		569			12			4				153
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		224.2			166.6			519.4			287.0	
Travel Time (s)		13.5			10.0			31.2			17.2	
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
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
Adj. Flow (vph)	57	0	9	10	1	12	9	275	13	12	211	9
Shared Lane Traffic (%)												
Lane Group Flow (vph)	57	9	0	10	13	0	9	288	0	12	211	9
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			3.7			6.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2		1	2		1	2		1	2	1
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	Right
Leading Detector (m)	2.0	10.0		2.0	10.0		2.0	10.0		2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6		2.0	0.6		2.0	0.6		2.0	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	Perm

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2			6		6
Detector Phase	4	4		3	8		2	2		6	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Minimum Split (s)	24.0	24.0		10.0	24.0		24.0	24.0		24.0	24.0	24.0
Total Split (s)	24.0	24.0		12.0	32.0		28.0	28.0		28.0	28.0	28.0
Total Split (%)	37.5%	37.5%		18.8%	50.0%		43.8%	43.8%		43.8%	43.8%	43.8%
Maximum Green (s)	18.0	18.0		6.0	26.0		22.0	22.0		22.0	22.0	22.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lead/Lag	Lag	Lag		Lead								
Lead-Lag Optimize?	Yes	Yes		Yes								
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	C-Max
Walk Time (s)	7.0	7.0			7.0		7.0	7.0		7.0	7.0	7.0
Flash Dont Walk (s)	11.0	11.0			11.0		11.0	11.0		11.0	11.0	11.0
Pedestrian Calls (#/hr)	5	5			5		5	5		5	5	5
Act Effct Green (s)	9.5	9.5		11.7	11.7		47.3	47.3		47.3	47.3	47.3
Actuated g/C Ratio	0.15	0.15		0.18	0.18		0.74	0.74		0.74	0.74	0.74
v/c Ratio	0.28	0.01		0.04	0.04		0.01	0.21		0.01	0.15	0.01
Control Delay	25.5	0.0		16.1	8.3		10.6	8.6		9.5	7.6	0.0
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	25.5	0.0		16.1	8.3		10.6	8.6		9.5	7.6	0.0
LOS	C	A		B	A		B	A		A	A	A
Approach Delay		22.1			11.7			8.7			7.4	
Approach LOS		C			B			A			A	
Queue Length 50th (m)	6.6	0.0		1.1	0.1		0.4	14.7		0.4	7.4	0.0
Queue Length 95th (m)	13.3	0.0		2.8	2.5		m3.2	39.7		4.2	34.5	0.0
Internal Link Dist (m)		200.2			142.6			495.4			263.0	
Turn Bay Length (m)	60.0			60.0			60.0			90.0		
Base Capacity (vph)	393	846		237	747		866	1382		807	1393	1190
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.15	0.01		0.04	0.02		0.01	0.21		0.01	0.15	0.01

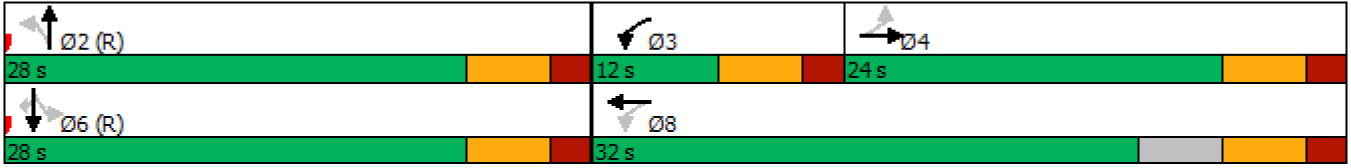
Intersection Summary

Area Type: Other
Cycle Length: 64
Actuated Cycle Length: 64
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.28
Intersection Signal Delay: 9.7 Intersection LOS: A
Intersection Capacity Utilization 38.5% ICU Level of Service A

Analysis Period (min) 15

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: 41 St



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱		↰	↱	
Traffic Volume (vph)	107	25	46	166	147	64
Future Volume (vph)	107	25	46	166	147	64
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0	60.0	60.0			60.0
Storage Lanes	1	0	0			0
Taper Length (m)	25.0		25.0			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	0.99	0.97		1.00	0.99	
Frt		0.850			0.959	
Flt Protected	0.950			0.989		
Satd. Flow (prot)	1789	1601	0	1863	1790	0
Flt Permitted	0.950			0.903		
Satd. Flow (perm)	1773	1555	0	1698	1790	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		27			52	
Link Speed (k/h)	60			60	60	
Link Distance (m)	241.7			126.6	519.4	
Travel Time (s)	14.5			7.6	31.2	
Confl. Peds. (#/hr)	5	5	5			5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	116	27	50	180	160	70
Shared Lane Traffic (%)						
Lane Group Flow (vph)	116	27	0	230	230	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.7			0.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25	15	25			15
Number of Detectors	1	1	1	2	2	
Detector Template	Left	Right	Left	Thru	Thru	
Leading Detector (m)	2.0	2.0	2.0	10.0	10.0	
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	
Detector 1 Size(m)	2.0	2.0	2.0	0.6	0.6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(m)				9.4	9.4	
Detector 2 Size(m)				0.6	0.6	
Detector 2 Type				Cl+Ex	Cl+Ex	
Detector 2 Channel						
Detector 2 Extend (s)				0.0	0.0	
Turn Type	pm+pt	Perm	Perm	NA	NA	

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Protected Phases	7			2	6	
Permitted Phases	4	4	2			
Detector Phase	7	4	2	2	6	
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	
Minimum Split (s)	10.0	24.0	24.0	24.0	24.0	
Total Split (s)	20.0	24.0	40.0	40.0	40.0	
Total Split (%)	31.3%	37.5%	62.5%	62.5%	62.5%	
Maximum Green (s)	14.0	18.0	34.0	34.0	34.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0	
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	C-Max	C-Max	C-Max	
Walk Time (s)		7.0	7.0	7.0	7.0	
Flash Dont Walk (s)		11.0	11.0	11.0	11.0	
Pedestrian Calls (#/hr)		5	5	5	5	
Act Effct Green (s)	10.5	10.4		45.1	45.1	
Actuated g/C Ratio	0.16	0.16		0.70	0.70	
v/c Ratio	0.40	0.10		0.19	0.18	
Control Delay	26.5	9.0		5.9	8.6	
Queue Delay	0.0	0.0		0.0	0.0	
Total Delay	26.5	9.0		5.9	8.6	
LOS	C	A		A	A	
Approach Delay	23.2			5.9	8.6	
Approach LOS	C			A	A	
Queue Length 50th (m)	13.4	0.0		9.2	5.5	
Queue Length 95th (m)	22.8	5.1		25.7	36.5	
Internal Link Dist (m)	217.7			102.6	495.4	
Turn Bay Length (m)	60.0	60.0				
Base Capacity (vph)	503	456		1197	1277	
Starvation Cap Reductn	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	
Storage Cap Reductn	0	0		0	0	
Reduced v/c Ratio	0.23	0.06		0.19	0.18	

Intersection Summary

Area Type: Other

Cycle Length: 64

Actuated Cycle Length: 64

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBT, Start of Green

Natural Cycle: 50

Control Type: Actuated-Coordinated

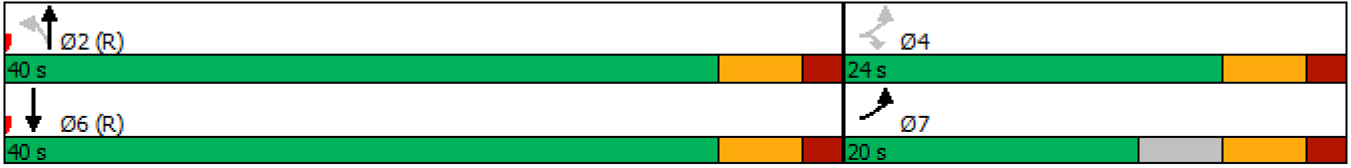
Maximum v/c Ratio: 0.40

Intersection Signal Delay: 11.0 Intersection LOS: B

Intersection Capacity Utilization 47.2% ICU Level of Service A

Analysis Period (min) 15

Splits and Phases:	4: 36 St



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱		↰↑	↑↱	
Traffic Volume (vph)	153	53	14	59	98	74
Future Volume (vph)	153	53	14	59	98	74
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0	60.0	60.0			60.0
Storage Lanes	1	0	0			0
Taper Length (m)	25.0		25.0			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt		0.850			0.942	
Flt Protected	0.950			0.991		
Satd. Flow (prot)	1789	1601	0	1866	1774	0
Flt Permitted	0.950			0.991		
Satd. Flow (perm)	1789	1601	0	1866	1774	0
Link Speed (k/h)	60			60	60	
Link Distance (m)	252.3			793.2	292.1	
Travel Time (s)	15.1			47.6	17.5	
Confl. Peds. (#/hr)	5	5	5			5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	166	58	15	64	107	80
Shared Lane Traffic (%)						
Lane Group Flow (vph)	166	58	0	79	187	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.7			0.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25	15	25			15
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 31.1% ICU Level of Service A

Analysis Period (min) 15

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	⇈	↱	↰	⇈	↱		✥			✥	
Traffic Volume (vph)	10	655	10	10	719	10	10	2	10	10	2	10
Future Volume (vph)	10	655	10	10	719	10	10	2	10	10	2	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	180.0		60.0	60.0		130.0	0.0		0.0	0.0		0.0
Storage Lanes	1		1	1		1	0		0	0		0
Taper Length (m)	25.0			25.0			25.0			25.0		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850			0.850		0.938			0.938	
Flt Protected	0.950			0.950				0.978			0.978	
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	0	1728	0	0	1728	0
Flt Permitted	0.950			0.950				0.978			0.978	
Satd. Flow (perm)	1789	3579	1601	1789	3579	1601	0	1728	0	0	1728	0
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		567.2			295.2			164.6			169.3	
Travel Time (s)		34.0			17.7			9.9			10.2	
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
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
Adj. Flow (vph)	11	712	11	11	782	11	11	2	11	11	2	11
Shared Lane Traffic (%)												
Lane Group Flow (vph)	11	712	11	11	782	11	0	24	0	0	24	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Free			Free			Stop			Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 31.4% ICU Level of Service A

Analysis Period (min) 15

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱	↰	↑	↱	↰	↑	↱
Traffic Volume (vph)	57	451	56	150	455	108	123	72	90	114	227	79
Future Volume (vph)	57	451	56	150	455	108	123	72	90	114	227	79
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0		60.0	120.0		300.0	100.0		100.0	100.0		100.0
Storage Lanes	1		1	1		1	1		1	1		0
Taper Length (m)	25.0			25.0			25.0			25.0		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	1.00		0.98	1.00		0.98	1.00		0.98	1.00		0.98
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	1789	1883	1601	1789	1883	1601
Flt Permitted	0.453			0.439			0.432			0.706		
Satd. Flow (perm)	852	3579	1575	825	3579	1575	811	1883	1576	1324	1883	1574
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			149			117			98			149
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		786.6			567.2			287.0			105.8	
Travel Time (s)		47.2			34.0			17.2			6.3	
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
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
Adj. Flow (vph)	62	490	61	163	495	117	134	78	98	124	247	86
Shared Lane Traffic (%)												
Lane Group Flow (vph)	62	490	61	163	495	117	134	78	98	124	247	86
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		6.0			6.0			6.0			6.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	Perm

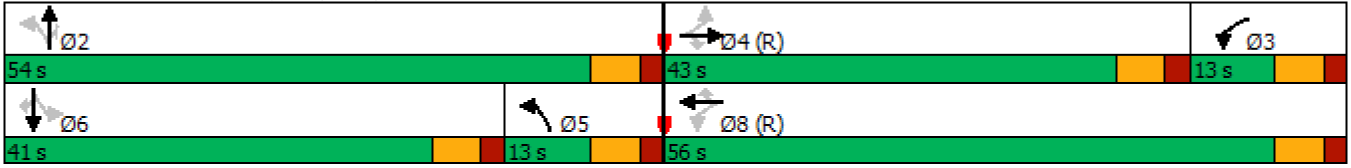
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Protected Phases		4		3	8		5	2			6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	4	4	4	3	8	8	5	2	2	6	6	6
Switch Phase												
Minimum Initial (s)	10.0	10.0	10.0	7.0	10.0	10.0	7.0	15.0	15.0	15.0	15.0	15.0
Minimum Split (s)	43.0	43.0	43.0	13.0	47.0	47.0	13.0	40.0	40.0	41.0	41.0	41.0
Total Split (s)	43.0	43.0	43.0	13.0	56.0	56.0	13.0	54.0	54.0	41.0	41.0	41.0
Total Split (%)	39.1%	39.1%	39.1%	11.8%	50.9%	50.9%	11.8%	49.1%	49.1%	37.3%	37.3%	37.3%
Maximum Green (s)	37.0	37.0	37.0	7.0	50.0	50.0	7.0	48.0	48.0	35.0	35.0	35.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lead	Lead	Lag			Lag			Lead	Lead	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes			Yes			Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	C-Max	C-Max	C-Max	None	C-Max	C-Max	None	None	None	None	None	None
Walk Time (s)	7.0	7.0	7.0		7.0	7.0				7.0	7.0	7.0
Flash Dont Walk (s)	30.0	30.0	30.0		34.0	34.0				28.0	28.0	28.0
Pedestrian Calls (#/hr)	5	5	5		5	5				5	5	5
Act Effct Green (s)	50.0	50.0	50.0	63.0	63.0	63.0	35.0	35.0	35.0	21.9	21.9	21.9
Actuated g/C Ratio	0.45	0.45	0.45	0.57	0.57	0.57	0.32	0.32	0.32	0.20	0.20	0.20
v/c Ratio	0.16	0.30	0.08	0.31	0.24	0.12	0.42	0.13	0.17	0.47	0.66	0.20
Control Delay	22.2	21.0	0.2	16.8	13.2	3.2	33.5	25.0	5.0	43.2	48.3	1.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.2	21.0	0.2	16.8	13.2	3.2	33.5	25.0	5.0	43.2	48.3	1.3
LOS	C	C	A	B	B	A	C	C	A	D	D	A
Approach Delay		19.0			12.4			22.3			38.1	
Approach LOS		B			B			C			D	
Queue Length 50th (m)	7.7	34.4	0.0	15.5	26.1	0.0	22.9	12.9	0.0	25.6	53.2	0.0
Queue Length 95th (m)	21.2	59.6	0.0	35.7	48.6	10.1	31.1	19.6	9.7	37.4	67.3	1.1
Internal Link Dist (m)		762.6			543.2			263.0			81.8	
Turn Bay Length (m)	120.0		60.0	120.0		300.0	100.0		100.0	100.0		100.0
Base Capacity (vph)	387	1628	797	534	2051	952	320	821	742	421	599	602
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.16	0.30	0.08	0.31	0.24	0.12	0.42	0.10	0.13	0.29	0.41	0.14

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 0 (0%), Referenced to phase 4:EBTL and 8:WBTL, Start of Green
Natural Cycle: 110
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.66
Intersection Signal Delay: 21.2 Intersection LOS: C
Intersection Capacity Utilization 87.5% ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 2: Hwy 16 (44 St) & 40 Ave



	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↑	↱
Traffic Volume (vph)	28	1	19	19	0	12	12	245	5	8	388	37
Future Volume (vph)	28	1	19	19	0	12	12	245	5	8	388	37
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0		60.0	60.0		60.0	60.0		60.0	90.0		0.0
Storage Lanes	1		0	1		0	1		0	1		1
Taper Length (m)	25.0			25.0			25.0			25.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	0.99	0.97		0.99	0.97		1.00	1.00		0.99		0.97
Frt		0.857			0.850			0.997				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	1570	0	1789	1555	0	1789	1877	0	1789	1883	1601
Flt Permitted	0.749			0.415			0.483			0.593		
Satd. Flow (perm)	1399	1570	0	776	1555	0	906	1877	0	1110	1883	1555
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		21			353			2				156
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		224.2			166.6			519.4			287.0	
Travel Time (s)		13.5			10.0			31.2			17.2	
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
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
Adj. Flow (vph)	30	1	21	21	0	13	13	266	5	9	422	40
Shared Lane Traffic (%)												
Lane Group Flow (vph)	30	22	0	21	13	0	13	271	0	9	422	40
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			3.7			6.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2		1	2		1	2		1	2	1
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	Right
Leading Detector (m)	2.0	10.0		2.0	10.0		2.0	10.0		2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6		2.0	0.6		2.0	0.6		2.0	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	Perm

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2			6		6
Detector Phase	4	4		3	8		2	2		6	6	6
Switch Phase												
Minimum Initial (s)	10.0	10.0		7.0	10.0		15.0	15.0		15.0	15.0	15.0
Minimum Split (s)	24.0	24.0		13.0	24.0		24.0	24.0		24.0	24.0	24.0
Total Split (s)	24.0	24.0		13.0	34.0		26.0	26.0		26.0	26.0	26.0
Total Split (%)	38.1%	38.1%		20.6%	54.0%		41.3%	41.3%		41.3%	41.3%	41.3%
Maximum Green (s)	18.0	18.0		7.0	28.0		20.0	20.0		20.0	20.0	20.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lead/Lag	Lag	Lag		Lead								
Lead-Lag Optimize?	Yes	Yes		Yes								
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	C-Max
Walk Time (s)	7.0	7.0			7.0		7.0	7.0		7.0	7.0	7.0
Flash Dont Walk (s)	11.0	11.0			11.0		11.0	11.0		11.0	11.0	11.0
Pedestrian Calls (#/hr)	5	5			5		5	5		5	5	5
Act Effct Green (s)	11.6	11.6		13.0	14.2		45.6	45.6		45.6	45.6	45.6
Actuated g/C Ratio	0.18	0.18		0.21	0.23		0.72	0.72		0.72	0.72	0.72
v/c Ratio	0.12	0.07		0.08	0.02		0.02	0.20		0.01	0.31	0.03
Control Delay	21.0	9.8		16.1	0.1		10.3	8.4		10.2	9.6	0.1
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	21.0	9.8		16.1	0.1		10.3	8.4		10.2	9.6	0.1
LOS	C	A		B	A		B	A		B	A	A
Approach Delay		16.3			9.9			8.5			8.8	
Approach LOS		B			A			A			A	
Queue Length 50th (m)	3.2	0.1		2.2	0.0		0.5	11.2		0.3	19.4	0.0
Queue Length 95th (m)	8.2	4.6		4.2	0.0		4.5	45.3		3.5	#76.2	0.0
Internal Link Dist (m)		200.2			142.6			495.4			263.0	
Turn Bay Length (m)	60.0			60.0			60.0			90.0		
Base Capacity (vph)	399	463		272	944		655	1359		803	1363	1168
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.08	0.05		0.08	0.01		0.02	0.20		0.01	0.31	0.03

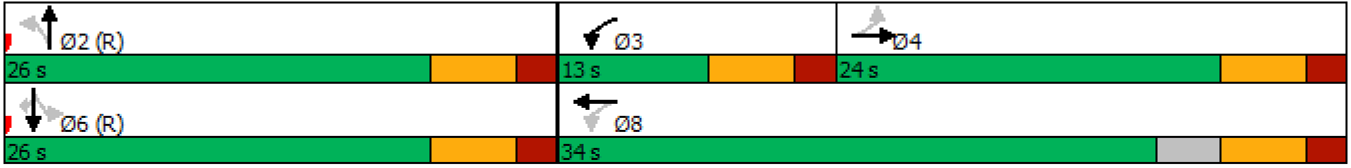
Intersection Summary

Area Type: Other
Cycle Length: 63
Actuated Cycle Length: 63
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 65
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.31
Intersection Signal Delay: 9.2 Intersection LOS: A
Intersection Capacity Utilization 51.9% ICU Level of Service A

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: 41 St



	↗	↘	↖	↑	↓	↙
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱		↰↑	↑↱	
Traffic Volume (vph)	53	41	36	209	256	170
Future Volume (vph)	53	41	36	209	256	170
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0	60.0	60.0			60.0
Storage Lanes	1	0	0			0
Taper Length (m)	25.0		25.0			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	0.99	0.97		1.00	0.99	
Frt		0.850			0.946	
Flt Protected	0.950			0.993		
Satd. Flow (prot)	1789	1601	0	1870	1763	0
Flt Permitted	0.950			0.904		
Satd. Flow (perm)	1777	1558	0	1702	1763	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		45			80	
Link Speed (k/h)	60			60	60	
Link Distance (m)	241.7			126.6	519.4	
Travel Time (s)	14.5			7.6	31.2	
Confl. Peds. (#/hr)	5	5	5			5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	58	45	39	227	278	185
Shared Lane Traffic (%)						
Lane Group Flow (vph)	58	45	0	266	463	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.7			0.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25	15	25			15
Number of Detectors	1	1	1	2	2	
Detector Template	Left	Right	Left	Thru	Thru	
Leading Detector (m)	2.0	2.0	2.0	10.0	10.0	
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	
Detector 1 Size(m)	2.0	2.0	2.0	0.6	0.6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(m)				9.4	9.4	
Detector 2 Size(m)				0.6	0.6	
Detector 2 Type				Cl+Ex	Cl+Ex	
Detector 2 Channel						
Detector 2 Extend (s)				0.0	0.0	
Turn Type	pm+pt	Perm	Perm	NA	NA	

4: 36 St

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Protected Phases	7			2	6	
Permitted Phases	4	4	2			
Detector Phase	7	4	2	2	6	
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	
Minimum Split (s)	10.0	24.0	24.0	24.0	24.0	
Total Split (s)	24.0	24.0	26.0	26.0	26.0	
Total Split (%)	48.0%	48.0%	52.0%	52.0%	52.0%	
Maximum Green (s)	18.0	18.0	20.0	20.0	20.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0	
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	C-Max	C-Max	C-Max	
Walk Time (s)		7.0	7.0	7.0	7.0	
Flash Dont Walk (s)		11.0	11.0	11.0	11.0	
Pedestrian Calls (#/hr)		5	5	5	5	
Act Effct Green (s)	8.9	8.8		36.2	36.2	
Actuated g/C Ratio	0.18	0.18		0.72	0.72	
v/c Ratio	0.18	0.15		0.22	0.36	
Control Delay	16.7	6.2		6.5	6.4	
Queue Delay	0.0	0.0		0.0	0.0	
Total Delay	16.7	6.2		6.5	6.4	
LOS	B	A		A	A	
Approach Delay	12.1			6.5	6.4	
Approach LOS	B			A	A	
Queue Length 50th (m)	4.9	0.0		9.1	14.2	
Queue Length 95th (m)	9.3	4.9		32.2	51.4	
Internal Link Dist (m)	217.7			102.6	495.4	
Turn Bay Length (m)	60.0	60.0				
Base Capacity (vph)	644	589		1233	1300	
Starvation Cap Reductn	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	
Storage Cap Reductn	0	0		0	0	
Reduced v/c Ratio	0.09	0.08		0.22	0.36	

Intersection Summary

Area Type: Other

Cycle Length: 50

Actuated Cycle Length: 50

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBT, Start of Green

Natural Cycle: 50

Control Type: Actuated-Coordinated

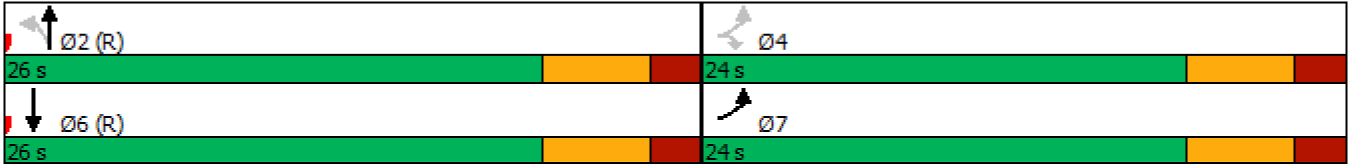
Maximum v/c Ratio: 0.36

Intersection Signal Delay: 7.2 Intersection LOS: A

Intersection Capacity Utilization 54.9% ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 4: 36 St



Opening 35K PM BG
6: 31 St

	↗	↘	↖	↑	↓	↙
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱		↰↑	↑↱	
Traffic Volume (vph)	40	10	54	205	195	102
Future Volume (vph)	40	10	54	205	195	102
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0	60.0	60.0			60.0
Storage Lanes	1	0	0			0
Taper Length (m)	25.0		25.0			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt		0.850			0.954	
Flt Protected	0.950			0.990		
Satd. Flow (prot)	1789	1601	0	1865	1797	0
Flt Permitted	0.950			0.990		
Satd. Flow (perm)	1789	1601	0	1865	1797	0
Link Speed (k/h)	60			60	60	
Link Distance (m)	252.3			793.2	292.1	
Travel Time (s)	15.1			47.6	17.5	
Confl. Peds. (#/hr)	5	5	5			5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	43	11	59	223	212	111
Shared Lane Traffic (%)						
Lane Group Flow (vph)	43	11	0	282	323	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.7			0.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25	15	25			15
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 45.3% ICU Level of Service A

Analysis Period (min) 15

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱		✣			✣	
Traffic Volume (vph)	10	493	20	38	475	10	19	2	36	10	2	10
Future Volume (vph)	10	493	20	38	475	10	19	2	36	10	2	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	80.0		150.0	150.0		80.0	0.0		0.0	0.0		0.0
Storage Lanes	1		1	1		1	0		0	0		0
Taper Length (m)	25.0			25.0			25.0			25.0		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850		0.915			0.938	
Flt Protected	0.950			0.950				0.983			0.978	
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	0	1694	0	0	1728	0
Flt Permitted	0.950			0.950				0.983			0.978	
Satd. Flow (perm)	1789	3579	1601	1789	3579	1601	0	1694	0	0	1728	0
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		581.1			222.2			238.6			271.6	
Travel Time (s)		34.9			13.3			14.3			16.3	
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
Adj. Flow (vph)	11	536	22	41	516	11	21	2	39	11	2	11
Shared Lane Traffic (%)												
Lane Group Flow (vph)	11	536	22	41	516	11	0	62	0	0	24	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Free			Free			Stop			Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 30.9% ICU Level of Service A

Analysis Period (min) 15

Opening Total AM Peak
2: Hwy 16 (44 St) & 40 Ave

10-25-2022

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↑	↱	↰	↑	↱	↰	↑	↱
Traffic Volume (vph)	115	259	57	130	252	110	128	206	130	113	174	47
Future Volume (vph)	115	259	57	130	252	110	128	206	130	113	174	47
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0		120.0	120.0		0.0	100.0		20.0	0.0		100.0
Storage Lanes	1		0	1		1	1		1	1		1
Taper Length (m)	25.0			25.0			25.0			25.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.973				0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	3482	0	1789	3579	1601	1789	1883	1601	1789	1883	1601
Flt Permitted	0.583			0.540			0.578			0.544		
Satd. Flow (perm)	1098	3482	0	1017	3579	1601	1089	1883	1601	1025	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		27				120			141			182
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		786.6			581.1			287.0			335.3	
Travel Time (s)		47.2			34.9			17.2			20.1	
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
Adj. Flow (vph)	125	282	62	141	274	120	139	224	141	123	189	51
Shared Lane Traffic (%)												
Lane Group Flow (vph)	125	344	0	141	274	120	139	224	141	123	189	51
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			6.0			6.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2		1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	2.0	10.0		2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6		2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases		4		3	8		5	2			6	
Permitted Phases	4			8		8	2		2	6		6

Opening Total AM Peak
2: Hwy 16 (44 St) & 40 Ave

10-25-2022

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	4	4		3	8	8	5	2	2	6	6	6
Switch Phase												
Minimum Initial (s)	10.0	10.0		7.0	10.0	10.0	7.0	15.0	15.0	15.0	15.0	15.0
Minimum Split (s)	24.0	24.0		13.0	24.0	24.0	13.0	40.0	40.0	37.0	37.0	37.0
Total Split (s)	27.0	27.0		13.0	40.0	40.0	13.0	50.0	50.0	37.0	37.0	37.0
Total Split (%)	30.0%	30.0%		14.4%	44.4%	44.4%	14.4%	55.6%	55.6%	41.1%	41.1%	41.1%
Maximum Green (s)	21.0	21.0		7.0	34.0	34.0	7.0	44.0	44.0	31.0	31.0	31.0
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lead		Lag			Lag			Lead	Lead	Lead
Lead-Lag Optimize?	Yes	Yes		Yes			Yes			Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	C-Max	C-Max		None	C-Max	C-Max	None	None	None	None	None	None
Walk Time (s)								7.0	7.0	7.0	7.0	7.0
Flash Dont Walk (s)								27.0	27.0	24.0	24.0	24.0
Pedestrian Calls (#/hr)								5	5	5	5	5
Act Effct Green (s)	33.2	33.2		46.2	46.2	46.2	31.8	31.8	31.8	18.8	18.8	18.8
Actuated g/C Ratio	0.37	0.37		0.51	0.51	0.51	0.35	0.35	0.35	0.21	0.21	0.21
v/c Ratio	0.31	0.26		0.24	0.15	0.14	0.32	0.34	0.21	0.57	0.48	0.11
Control Delay	25.4	20.3		15.9	13.1	3.7	22.5	21.9	3.6	41.7	34.4	0.4
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	25.4	20.3		15.9	13.1	3.7	22.5	21.9	3.6	41.7	34.4	0.4
LOS	C	C		B	B	A	C	C	A	D	C	A
Approach Delay		21.7			11.7			16.9			32.1	
Approach LOS		C			B			B			C	
Queue Length 50th (m)	14.7	19.2		11.6	11.8	0.0	18.8	31.6	0.0	21.4	32.2	0.0
Queue Length 95th (m)	37.8	38.7		30.7	26.4	10.7	24.2	37.2	9.3	31.9	41.9	0.0
Internal Link Dist (m)		762.6			557.1			263.0			311.3	
Turn Bay Length (m)	120.0			120.0			100.0		20.0			100.0
Base Capacity (vph)	405	1301		582	1837	880	439	920	854	353	648	670
Starvation Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.31	0.26		0.24	0.15	0.14	0.32	0.24	0.17	0.35	0.29	0.08

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 4:EBTL and 8:WBTL, Start of Green

Natural Cycle: 90

Control Type: Actuated-Coordinated

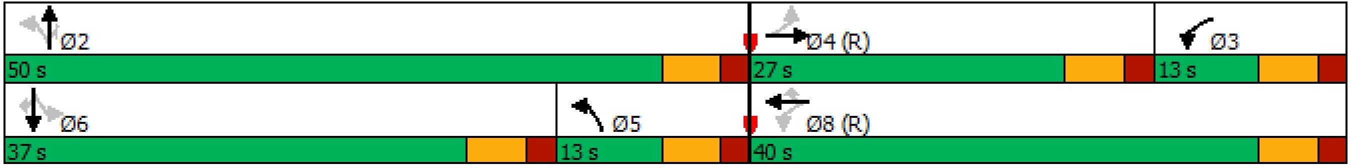
Maximum v/c Ratio: 0.57

Intersection Signal Delay: 19.6 Intersection LOS: B

Intersection Capacity Utilization 61.7% ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 2: Hwy 16 (44 St) & 40 Ave



	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥		↰	↱	
Traffic Volume (vph)	52	2	8	27	3	107	8	280	31	117	179	8
Future Volume (vph)	52	2	8	27	3	107	8	280	31	117	179	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0		60.0	60.0		60.0	60.0		60.0	90.0		0.0
Storage Lanes	0		0	0		0	0		0	1		0
Taper Length (m)	25.0			25.0			25.0			25.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.982			0.894			0.987			0.993	
Flt Protected		0.960			0.990			0.999		0.950		
Satd. Flow (prot)	0	1776	0	0	1667	0	0	1857	0	1789	1870	0
Flt Permitted		0.650			0.924			0.993		0.576		
Satd. Flow (perm)	0	1202	0	0	1556	0	0	1846	0	1085	1870	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		9			116			9			4	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		224.2			222.7			519.4			287.0	
Travel Time (s)		13.5			13.4			31.2			17.2	
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
Adj. Flow (vph)	57	2	9	29	3	116	9	304	34	127	195	9
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	68	0	0	148	0	0	347	0	127	204	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.7			6.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	2.0	10.0		2.0	10.0		2.0	10.0		2.0	10.0	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	2.0	0.6		2.0	0.6		2.0	0.6		2.0	0.6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		

3: 41 St

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	4	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		15.0	15.0		15.0	15.0	
Minimum Split (s)	40.0	40.0		40.0	40.0		33.0	33.0		36.0	36.0	
Total Split (s)	40.0	40.0		40.0	40.0		40.0	40.0		40.0	40.0	
Total Split (%)	50.0%	50.0%		50.0%	50.0%		50.0%	50.0%		50.0%	50.0%	
Maximum Green (s)	34.0	34.0		34.0	34.0		34.0	34.0		34.0	34.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0		0.0	0.0	
Total Lost Time (s)		6.0			6.0			6.0		6.0	6.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Walk Time (s)	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	27.0	27.0		27.0	27.0		20.0	20.0		23.0	23.0	
Pedestrian Calls (#/hr)	5	5		5	5		5	5		5	5	
Act Effct Green (s)		14.9			14.9			53.1		53.1	53.1	
Actuated g/C Ratio		0.19			0.19			0.66		0.66	0.66	
v/c Ratio		0.29			0.39			0.28		0.18	0.16	
Control Delay		25.4			10.2			8.4		8.7	7.6	
Queue Delay		0.0			0.0			0.0		0.0	0.0	
Total Delay		25.4			10.2			8.4		8.7	7.6	
LOS		C			B			A		A	A	
Approach Delay		25.4			10.2			8.4			8.0	
Approach LOS		C			B			A			A	
Queue Length 50th (m)		8.8			4.6			14.8		5.1	8.0	
Queue Length 95th (m)		13.4			13.5			59.4		25.4	34.6	
Internal Link Dist (m)		200.2			198.7			495.4			263.0	
Turn Bay Length (m)										90.0		
Base Capacity (vph)		516			728			1227		719	1241	
Starvation Cap Reductn		0			0			0		0	0	
Spillback Cap Reductn		0			0			0		0	0	
Storage Cap Reductn		0			0			0		0	0	
Reduced v/c Ratio		0.13			0.20			0.28		0.18	0.16	

Intersection Summary

Area Type: Other

Cycle Length: 80

Actuated Cycle Length: 80

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 80

Control Type: Actuated-Coordinated

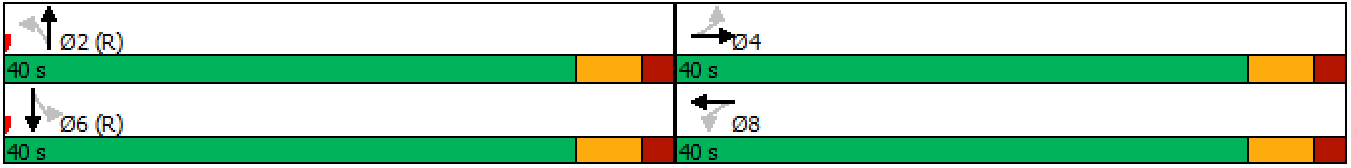
Maximum v/c Ratio: 0.39

Intersection Signal Delay: 9.8 Intersection LOS: A

Intersection Capacity Utilization 54.7% ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 3: 41 St



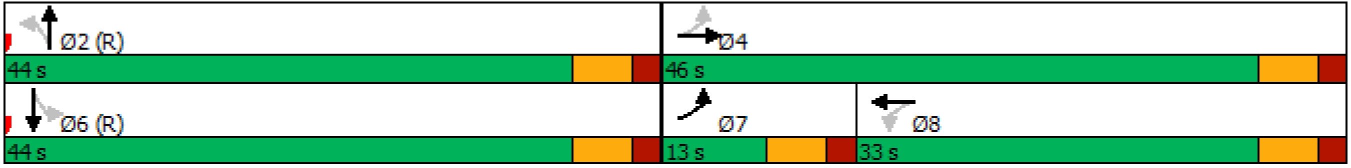
	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣		↰	↱	
Traffic Volume (vph)	110	8	25	46	7	60	46	162	49	66	127	66
Future Volume (vph)	110	8	25	46	7	60	46	162	49	66	127	66
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0		60.0	0.0		0.0	60.0		60.0	60.0		60.0
Storage Lanes	0		0	0		0	0		0	1		0
Taper Length (m)	25.0			25.0			25.0			25.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.977			0.929			0.974			0.949	
Flt Protected		0.963			0.980			0.991		0.950		
Satd. Flow (prot)	0	1772	0	0	1715	0	0	1818	0	1789	1787	0
Flt Permitted		0.706			0.832			0.918		0.615		
Satd. Flow (perm)	0	1299	0	0	1456	0	0	1684	0	1158	1787	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		15			64			16			36	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		241.7			55.6			126.6			519.4	
Travel Time (s)		14.5			3.3			7.6			31.2	
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
Adj. Flow (vph)	120	9	27	50	8	65	50	176	53	72	138	72
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	156	0	0	123	0	0	279	0	72	210	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	2.0	10.0		2.0	10.0		2.0	10.0		2.0	10.0	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	2.0	0.6		2.0	0.6		2.0	0.6		2.0	0.6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8			2			6		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	7	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	7.0	10.0		10.0	10.0		15.0	15.0		15.0	15.0	
Minimum Split (s)	13.0	27.0		27.0	27.0		27.0	27.0		27.0	27.0	
Total Split (s)	13.0	46.0		33.0	33.0		44.0	44.0		44.0	44.0	
Total Split (%)	14.4%	51.1%		36.7%	36.7%		48.9%	48.9%		48.9%	48.9%	
Maximum Green (s)	7.0	40.0		27.0	27.0		38.0	38.0		38.0	38.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0		0.0	0.0	
Total Lost Time (s)		6.0			6.0			6.0		6.0	6.0	
Lead/Lag	Lead			Lag	Lag							
Lead-Lag Optimize?	Yes			Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Walk Time (s)		7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)		14.0		14.0	14.0		14.0	14.0		14.0	14.0	
Pedestrian Calls (#/hr)		0		0	0		0	0		0	0	
Act Effct Green (s)		16.2			16.2			61.8		61.8	61.8	
Actuated g/C Ratio		0.18			0.18			0.69		0.69	0.69	
v/c Ratio		0.63			0.39			0.24		0.09	0.17	
Control Delay		41.5			19.2			6.4		6.3	5.3	
Queue Delay		0.0			0.0			0.0		0.0	0.0	
Total Delay		41.5			19.2			6.4		6.3	5.3	
LOS		D			B			A		A	A	
Approach Delay		41.5			19.2			6.4			5.6	
Approach LOS		D			B			A			A	
Queue Length 50th (m)		24.1			9.3			15.1		3.7	9.3	
Queue Length 95th (m)		40.3			22.6			33.8		10.8	22.7	
Internal Link Dist (m)		217.7			31.6			102.6			495.4	
Turn Bay Length (m)										60.0		
Base Capacity (vph)		585			481			1161		794	1237	
Starvation Cap Reductn		0			0			0		0	0	
Spillback Cap Reductn		0			0			0		0	0	
Storage Cap Reductn		0			0			0		0	0	
Reduced v/c Ratio		0.27			0.26			0.24		0.09	0.17	

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 70
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.63
Intersection Signal Delay: 14.5 Intersection LOS: B
Intersection Capacity Utilization 55.8% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 4: 36 St



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		⇆	
Traffic Volume (vph)	122	0	0	0	0	112
Future Volume (vph)	122	0	0	0	0	112
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.865	
Flt Protected		0.950				
Satd. Flow (prot)	0	1789	1883	0	1629	0
Flt Permitted		0.950				
Satd. Flow (perm)	0	1789	1883	0	1629	0
Link Speed (k/h)		60	60		60	
Link Distance (m)		55.6	585.2		162.5	
Travel Time (s)		3.3	35.1		9.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	133	0	0	0	0	122
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	133	0	0	122	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 20.4% ICU Level of Service A

Analysis Period (min) 15

6: 31 St

	↗	↘	↖	↑	↓	↙
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱		↰↑	↑↱	
Traffic Volume (vph)	156	53	14	101	137	77
Future Volume (vph)	156	53	14	101	137	77
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0	60.0	60.0			60.0
Storage Lanes	1	0	0			0
Taper Length (m)	25.0		25.0			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850			0.951	
Flt Protected	0.950			0.994		
Satd. Flow (prot)	1789	1601	0	1872	1791	0
Flt Permitted	0.950			0.994		
Satd. Flow (perm)	1789	1601	0	1872	1791	0
Link Speed (k/h)	60			60	60	
Link Distance (m)	252.3			794.4	290.7	
Travel Time (s)	15.1			47.7	17.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	170	58	15	110	149	84
Shared Lane Traffic (%)						
Lane Group Flow (vph)	170	58	0	125	233	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.7			0.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25	15	25			15
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 32.4% ICU Level of Service A

Analysis Period (min) 15

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (vph)	13	2	149	33	2	2	128	2	62	2	2	21
Future Volume (vph)	13	2	149	33	2	2	128	2	62	2	2	21
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.877			0.993			0.957			0.885	
Flt Protected		0.996			0.957			0.968			0.996	
Satd. Flow (prot)	0	1645	0	0	1790	0	0	1745	0	0	1660	0
Flt Permitted		0.996			0.957			0.968			0.996	
Satd. Flow (perm)	0	1645	0	0	1790	0	0	1745	0	0	1660	0
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		222.7			370.2			67.4			63.9	
Travel Time (s)		13.4			22.2			4.0			3.8	
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
Adj. Flow (vph)	14	2	162	36	2	2	139	2	67	2	2	23
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	178	0	0	40	0	0	208	0	0	27	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	100		100	100		100	100		100	100		100
Sign Control		Free			Free			Stop			Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 37.1% ICU Level of Service A

Analysis Period (min) 15

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱		✥			✥	
Traffic Volume (vph)	10	683	26	52	740	10	25	2	49	10	2	10
Future Volume (vph)	10	683	26	52	740	10	25	2	49	10	2	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	80.0		150.0	150.0		80.0	0.0		0.0	0.0		0.0
Storage Lanes	1		1	1		1	0		0	0		0
Taper Length (m)	25.0			25.0			25.0			25.0		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850		0.913			0.938	
Flt Protected	0.950			0.950				0.984			0.978	
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	0	1692	0	0	1728	0
Flt Permitted	0.950			0.950				0.984			0.978	
Satd. Flow (perm)	1789	3579	1601	1789	3579	1601	0	1692	0	0	1728	0
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		581.1			222.2			238.6			271.6	
Travel Time (s)		34.9			13.3			14.3			16.3	
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
Adj. Flow (vph)	11	742	28	57	804	11	27	2	53	11	2	11
Shared Lane Traffic (%)												
Lane Group Flow (vph)	11	742	28	57	804	11	0	82	0	0	24	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Free			Free			Stop			Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 39.0% ICU Level of Service A

Analysis Period (min) 15

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↑	↱	↰	↑	↱	↰	↑	↱
Traffic Volume (vph)	57	457	110	188	461	111	173	130	125	117	290	79
Future Volume (vph)	57	457	110	188	461	111	173	130	125	117	290	79
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0		120.0	120.0		0.0	100.0		20.0	0.0		100.0
Storage Lanes	1		0	1		1	1		1	1		1
Taper Length (m)	25.0			25.0			25.0			25.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.971				0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	3475	0	1789	3579	1601	1789	1883	1601	1789	1883	1601
Flt Permitted	0.436			0.334			0.393			0.667		
Satd. Flow (perm)	821	3475	0	629	3579	1601	740	1883	1601	1256	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		31				121			136			182
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		786.6			581.1			287.0			335.3	
Travel Time (s)		47.2			34.9			17.2			20.1	
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
Adj. Flow (vph)	62	497	120	204	501	121	188	141	136	127	315	86
Shared Lane Traffic (%)												
Lane Group Flow (vph)	62	617	0	204	501	121	188	141	136	127	315	86
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			6.0			6.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2		1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	2.0	10.0		2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6		2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	Perm
Protected Phases		4		3	8		5	2			6	
Permitted Phases	4			8		8	2		2	6		6

Opening Total PM Peak
2: Hwy 16 (44 St) & 40 Ave

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	4	4		3	8	8	5	2	2	6	6	6
Switch Phase												
Minimum Initial (s)	10.0	10.0		7.0	10.0	10.0	7.0	15.0	15.0	15.0	15.0	15.0
Minimum Split (s)	24.0	24.0		13.0	24.0	24.0	13.0	40.0	40.0	37.0	37.0	37.0
Total Split (s)	27.0	27.0		13.0	40.0	40.0	13.0	50.0	50.0	37.0	37.0	37.0
Total Split (%)	30.0%	30.0%		14.4%	44.4%	44.4%	14.4%	55.6%	55.6%	41.1%	41.1%	41.1%
Maximum Green (s)	21.0	21.0		7.0	34.0	34.0	7.0	44.0	44.0	31.0	31.0	31.0
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lead		Lag			Lag			Lead	Lead	Lead
Lead-Lag Optimize?	Yes	Yes		Yes			Yes			Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	C-Max	C-Max		None	C-Max	C-Max	None	None	None	None	None	None
Walk Time (s)								7.0	7.0	7.0	7.0	7.0
Flash Dont Walk (s)								27.0	27.0	24.0	24.0	24.0
Pedestrian Calls (#/hr)								5	5	5	5	5
Act Effct Green (s)	29.9	29.9		42.9	42.9	42.9	35.1	35.1	35.1	21.5	21.5	21.5
Actuated g/C Ratio	0.33	0.33		0.48	0.48	0.48	0.39	0.39	0.39	0.24	0.24	0.24
v/c Ratio	0.23	0.52		0.52	0.29	0.15	0.50	0.19	0.19	0.42	0.70	0.17
Control Delay	27.9	26.4		27.1	16.1	4.0	26.5	17.4	3.2	32.0	39.3	0.7
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.9	26.4		27.1	16.1	4.0	26.5	17.4	3.2	32.0	39.3	0.7
LOS	C	C		C	B	A	C	B	A	C	D	A
Approach Delay		26.5			17.1			16.9			31.3	
Approach LOS		C			B			B			C	
Queue Length 50th (m)	7.9	43.6		20.3	27.0	0.0	23.5	17.0	0.0	19.9	53.4	0.0
Queue Length 95th (m)	21.6	71.9		43.0	47.4	10.7	31.8	24.3	9.0	31.4	69.7	0.0
Internal Link Dist (m)		762.6			557.1			263.0			311.3	
Turn Bay Length (m)	120.0			120.0			100.0		20.0			100.0
Base Capacity (vph)	273	1176		390	1707	827	376	920	852	432	648	670
Starvation Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.23	0.52		0.52	0.29	0.15	0.50	0.15	0.16	0.29	0.49	0.13

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 4:EBTL and 8:WBTL, Start of Green

Natural Cycle: 90

Control Type: Actuated-Coordinated

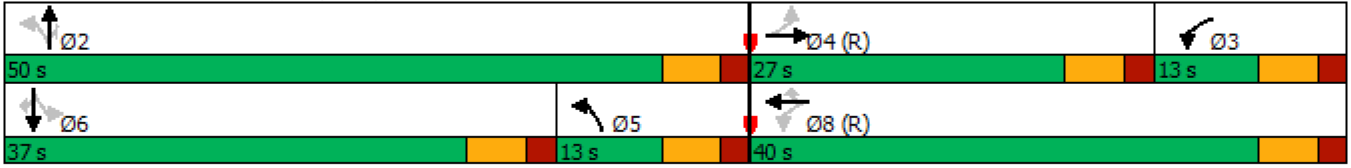
Maximum v/c Ratio: 0.70

Intersection Signal Delay: 22.6 Intersection LOS: C

Intersection Capacity Utilization 71.6% ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 2: Hwy 16 (44 St) & 40 Ave



	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥		↰	↱	
Traffic Volume (vph)	28	4	19	48	3	163	12	293	36	170	380	37
Future Volume (vph)	28	4	19	48	3	163	12	293	36	170	380	37
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0		60.0	60.0		60.0	60.0		60.0	90.0		0.0
Storage Lanes	0		0	0		0	0		0	1		0
Taper Length (m)	25.0			25.0			25.0			25.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.948			0.897			0.986			0.987	
Flt Protected		0.973			0.989			0.998		0.950		
Satd. Flow (prot)	0	1737	0	0	1671	0	0	1853	0	1789	1859	0
Flt Permitted		0.757			0.907			0.982		0.571		
Satd. Flow (perm)	0	1352	0	0	1532	0	0	1824	0	1075	1859	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		21			177			12			10	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		224.2			222.7			519.4			287.0	
Travel Time (s)		13.5			13.4			31.2			17.2	
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
Adj. Flow (vph)	30	4	21	52	3	177	13	318	39	185	413	40
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	55	0	0	232	0	0	370	0	185	453	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.7			6.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	2.0	10.0		2.0	10.0		2.0	10.0		2.0	10.0	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	2.0	0.6		2.0	0.6		2.0	0.6		2.0	0.6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		

Opening Total PM Peak
3: 41 St

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	4	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		15.0	15.0		15.0	15.0	
Minimum Split (s)	27.0	27.0		30.0	30.0		27.0	27.0		27.0	27.0	
Total Split (s)	30.0	30.0		30.0	30.0		30.0	30.0		30.0	30.0	
Total Split (%)	50.0%	50.0%		50.0%	50.0%		50.0%	50.0%		50.0%	50.0%	
Maximum Green (s)	24.0	24.0		24.0	24.0		24.0	24.0		24.0	24.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0		0.0	0.0	
Total Lost Time (s)		6.0			6.0			6.0		6.0	6.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Walk Time (s)	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	14.0	14.0		17.0	17.0		14.0	14.0		14.0	14.0	
Pedestrian Calls (#/hr)	5	5		5	5		5	5		5	5	
Act Effct Green (s)		12.9			12.9			35.1		35.1	35.1	
Actuated g/C Ratio		0.22			0.22			0.58		0.58	0.58	
v/c Ratio		0.18			0.50			0.34		0.29	0.41	
Control Delay		13.1			9.3			9.9		9.7	9.6	
Queue Delay		0.0			0.0			0.0		0.0	0.0	
Total Delay		13.1			9.3			9.9		9.7	9.6	
LOS		B			A			A		A	A	
Approach Delay		13.1			9.3			9.9			9.7	
Approach LOS		B			A			A			A	
Queue Length 50th (m)		3.4			5.6			14.4		8.0	20.7	
Queue Length 95th (m)		8.2			15.9			57.6		30.7	65.8	
Internal Link Dist (m)		200.2			198.7			495.4			263.0	
Turn Bay Length (m)										90.0		
Base Capacity (vph)		553			719			1073		629	1093	
Starvation Cap Reductn		0			0			0		0	0	
Spillback Cap Reductn		0			0			0		0	0	
Storage Cap Reductn		0			0			0		0	0	
Reduced v/c Ratio		0.10			0.32			0.34		0.29	0.41	

Intersection Summary

Area Type: Other

Cycle Length: 60

Actuated Cycle Length: 60

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 60

Control Type: Actuated-Coordinated

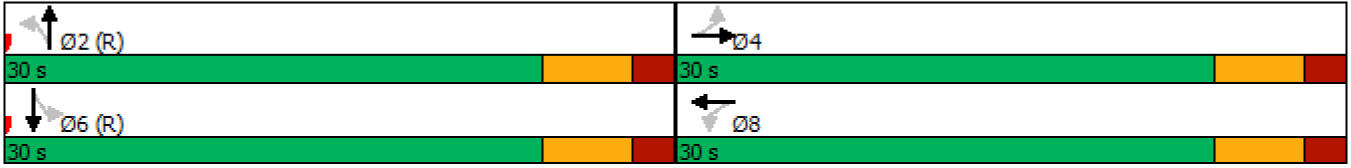
Maximum v/c Ratio: 0.50

Intersection Signal Delay: 9.8 Intersection LOS: A

Intersection Capacity Utilization 68.7% ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 3: 41 St



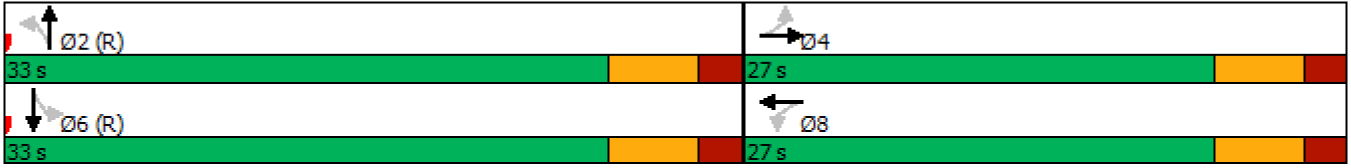
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥		↰	↱	
Traffic Volume (vph)	57	13	41	73	12	94	36	208	78	100	233	174
Future Volume (vph)	57	13	41	73	12	94	36	208	78	100	233	174
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0		60.0	0.0		0.0	60.0		60.0	60.0		60.0
Storage Lanes	0		0	0		0	0		0	1		0
Taper Length (m)	25.0			25.0			25.0			25.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.950			0.929			0.967			0.936	
Flt Protected		0.975			0.980			0.994		0.950		
Satd. Flow (prot)	0	1745	0	0	1715	0	0	1810	0	1789	1763	0
Flt Permitted		0.759			0.838			0.925		0.586		
Satd. Flow (perm)	0	1358	0	0	1466	0	0	1685	0	1104	1763	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		45			102			35			81	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		241.7			55.6			126.6			519.4	
Travel Time (s)		14.5			3.3			7.6			31.2	
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
Adj. Flow (vph)	62	14	45	79	13	102	39	226	85	109	253	189
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	121	0	0	194	0	0	350	0	109	442	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	2.0	10.0		2.0	10.0		2.0	10.0		2.0	10.0	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	2.0	0.6		2.0	0.6		2.0	0.6		2.0	0.6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	4	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		15.0	15.0		15.0	15.0	
Minimum Split (s)	27.0	27.0		27.0	27.0		27.0	27.0		27.0	27.0	
Total Split (s)	27.0	27.0		27.0	27.0		33.0	33.0		33.0	33.0	
Total Split (%)	45.0%	45.0%		45.0%	45.0%		55.0%	55.0%		55.0%	55.0%	
Maximum Green (s)	21.0	21.0		21.0	21.0		27.0	27.0		27.0	27.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0		0.0	0.0	
Total Lost Time (s)		6.0			6.0			6.0		6.0	6.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Walk Time (s)	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	14.0	14.0		14.0	14.0		14.0	14.0		14.0	14.0	
Pedestrian Calls (#/hr)	5	5		5	5		5	5		5	5	
Act Effct Green (s)		12.6			12.6			35.4		35.4	35.4	
Actuated g/C Ratio		0.21			0.21			0.59		0.59	0.59	
v/c Ratio		0.38			0.50			0.35		0.17	0.41	
Control Delay		16.0			14.4			7.9		11.1	10.4	
Queue Delay		0.0			0.0			0.0		0.0	0.0	
Total Delay		16.0			14.4			7.9		11.1	10.4	
LOS		B			B			A		B	B	
Approach Delay		16.0			14.4			7.9			10.5	
Approach LOS		B			B			A			B	
Queue Length 50th (m)		7.9			9.6			13.8		4.2	15.1	
Queue Length 95th (m)		16.2			20.3			42.6		25.9	74.2	
Internal Link Dist (m)		217.7			31.6			102.6			495.4	
Turn Bay Length (m)										60.0		
Base Capacity (vph)		504			579			1009		651	1074	
Starvation Cap Reductn		0			0			0		0	0	
Spillback Cap Reductn		0			0			0		0	0	
Storage Cap Reductn		0			0			0		0	0	
Reduced v/c Ratio		0.24			0.34			0.35		0.17	0.41	

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 55
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.50
Intersection Signal Delay: 10.9 Intersection LOS: B
Intersection Capacity Utilization 67.7% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 4: 36 St



	↗	→	←	↖	↘	↙
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		Y	
Traffic Volume (vph)	192	0	0	0	0	179
Future Volume (vph)	192	0	0	0	0	179
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.865	
Flt Protected		0.950				
Satd. Flow (prot)	0	1789	1883	0	1629	0
Flt Permitted		0.950				
Satd. Flow (perm)	0	1789	1883	0	1629	0
Link Speed (k/h)		60	60		60	
Link Distance (m)		55.6	585.2		162.5	
Travel Time (s)		3.3	35.1		9.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	209	0	0	0	0	195
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	209	0	0	195	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 28.4% ICU Level of Service A

Analysis Period (min) 15

Opening Total PM Peak
6: 31 St

10-25-2022

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱		↰↑	↑↱	
Traffic Volume (vph)	46	10	54	276	261	107
Future Volume (vph)	46	10	54	276	261	107
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0	60.0	60.0			60.0
Storage Lanes	1	0	0			0
Taper Length (m)	25.0		25.0			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850			0.961	
Flt Protected	0.950			0.992		
Satd. Flow (prot)	1789	1601	0	1868	1810	0
Flt Permitted	0.950			0.992		
Satd. Flow (perm)	1789	1601	0	1868	1810	0
Link Speed (k/h)	60			60	60	
Link Distance (m)	252.3			794.4	290.7	
Travel Time (s)	15.1			47.7	17.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	50	11	59	300	284	116
Shared Lane Traffic (%)						
Lane Group Flow (vph)	50	11	0	359	400	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.7			0.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25	15	25			15
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 51.1% ICU Level of Service A

Analysis Period (min) 15

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Volume (vph)	14	2	196	58	2	2	183	2	54	2	2	31
Future Volume (vph)	14	2	196	58	2	2	183	2	54	2	2	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.875			0.996			0.969			0.879	
Flt Protected		0.997			0.955			0.963			0.997	
Satd. Flow (prot)	0	1643	0	0	1791	0	0	1758	0	0	1651	0
Flt Permitted		0.997			0.955			0.963			0.997	
Satd. Flow (perm)	0	1643	0	0	1791	0	0	1758	0	0	1651	0
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		222.7			370.2			67.4			63.9	
Travel Time (s)		13.4			22.2			4.0			3.8	
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
Adj. Flow (vph)	15	2	213	63	2	2	199	2	59	2	2	34
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	230	0	0	67	0	0	260	0	0	38	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Free			Free			Stop			Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 46.6% ICU Level of Service A

Analysis Period (min) 15

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱		✥			✥	
Traffic Volume (vph)	50	1270	105	41	1200	50	16	5	6	50	10	50
Future Volume (vph)	50	1270	105	41	1200	50	16	5	6	50	10	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	180.0		60.0	60.0		180.0	0.0		0.0	0.0		0.0
Storage Lanes	1		1	1		1	0		0	0		0
Taper Length (m)	25.0			25.0			25.0			25.0		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850		0.967			0.939	
Flt Protected	0.950			0.950				0.972			0.978	
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	0	1770	0	0	1730	0
Flt Permitted	0.075			0.058				0.855			0.865	
Satd. Flow (perm)	141	3579	1601	109	3579	1601	0	1557	0	0	1530	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			64			54		7			32	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		262.4			316.2			143.4			113.3	
Travel Time (s)		15.7			19.0			8.6			6.8	
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
Adj. Flow (vph)	54	1380	114	45	1304	54	17	5	7	54	11	54
Shared Lane Traffic (%)												
Lane Group Flow (vph)	54	1380	114	45	1304	54	0	29	0	0	119	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	100		100	100		100	100		100	100		100
Number of Detectors	1	2	1	1	2	1	1	2		1	2	
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru		Left	Thru	
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0		2.0	10.0	
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6		2.0	0.6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8		8	2			6		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	4	4	4	8	8	8	2	2		6	6	
Switch Phase												
Minimum Initial (s)	15.0	15.0	15.0	15.0	15.0	15.0	10.0	10.0		10.0	10.0	
Minimum Split (s)	40.0	40.0	40.0	40.0	40.0	40.0	31.0	31.0		31.0	31.0	
Total Split (s)	81.0	81.0	81.0	81.0	81.0	81.0	69.0	69.0		69.0	69.0	
Total Split (%)	54.0%	54.0%	54.0%	54.0%	54.0%	54.0%	46.0%	46.0%		46.0%	46.0%	
Maximum Green (s)	75.0	75.0	75.0	75.0	75.0	75.0	63.0	63.0		63.0	63.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0		6.0			6.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	None	None	None	None	None	C-Max	C-Max		C-Max	C-Max	
Act Effct Green (s)	68.5	68.5	68.5	68.5	68.5	68.5		69.5			69.5	
Actuated g/C Ratio	0.46	0.46	0.46	0.46	0.46	0.46		0.46			0.46	
v/c Ratio	0.84	0.85	0.15	0.92	0.80	0.07		0.04			0.16	
Control Delay	105.5	39.0	12.9	144.6	38.7	4.8		20.2			19.0	
Queue Delay	0.0	0.1	0.0	0.0	0.0	0.0		0.0			0.0	
Total Delay	105.5	39.1	12.9	144.6	38.7	4.8		20.2			19.0	
LOS	F	D	B	F	D	A		C			B	
Approach Delay		39.5			40.8			20.2			19.0	
Approach LOS		D			D			C			B	
Queue Length 50th (m)	11.2	154.9	9.0	12.8	179.7	0.0		3.7			15.4	
Queue Length 95th (m)	#43.1	163.4	16.0	#40.1	193.5	7.6		10.9			31.1	
Internal Link Dist (m)		238.4			292.2			119.4			89.3	
Turn Bay Length (m)	180.0		60.0	60.0		180.0						
Base Capacity (vph)	70	1789	832	54	1789	827		725			726	
Starvation Cap Reductn	0	34	0	0	0	0		0			0	
Spillback Cap Reductn	0	0	0	0	0	0		0			0	
Storage Cap Reductn	0	0	0	0	0	0		0			0	
Reduced v/c Ratio	0.77	0.79	0.14	0.83	0.73	0.07		0.04			0.16	

Intersection Summary

Area Type: Other

Cycle Length: 150

Actuated Cycle Length: 150

Offset: 35 (23%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 75

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.92

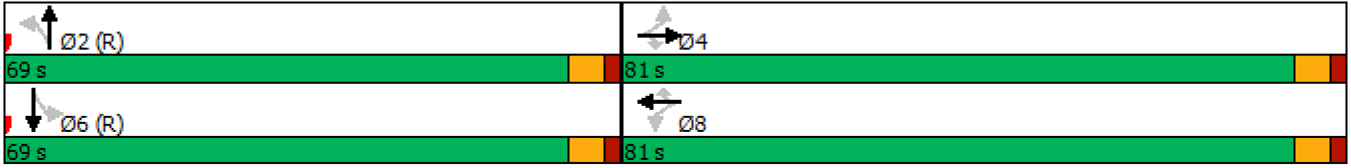
Intersection Signal Delay: 39.1 Intersection LOS: D

Intersection Capacity Utilization 59.9% ICU Level of Service B

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 16: 37 Ave



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↑	↱	↰↰	↑↑	↱	↰↰	↑↑	↱	↰↰	↑↑	↱
Traffic Volume (vph)	551	501	410	400	333	483	490	598	563	400	394	304
Future Volume (vph)	551	501	410	400	333	483	490	598	563	400	394	304
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0		120.0	120.0		120.0	100.0		100.0	100.0		100.0
Storage Lanes	2		1	2		1	2		1	2		1
Taper Length (m)	25.0			25.0			25.0			25.0		
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3471	3579	1601	3471	3579	1601	3471	3579	1601	3471	3579	1601
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	3471	3579	1601	3471	3579	1601	3471	3579	1601	3471	3579	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			65			330			347			109
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		786.6			312.2			156.5			465.2	
Travel Time (s)		47.2			18.7			9.4			27.9	
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
Adj. Flow (vph)	599	545	446	435	362	525	533	650	612	435	428	330
Shared Lane Traffic (%)												
Lane Group Flow (vph)	599	545	446	435	362	525	533	650	612	435	428	330
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		9.0			9.0			9.0			9.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Prot	NA	pm+ov	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	pm+ov
Protected Phases	5	2	3	1	6		3	8		7	4	5
Permitted Phases			2			6			8			4

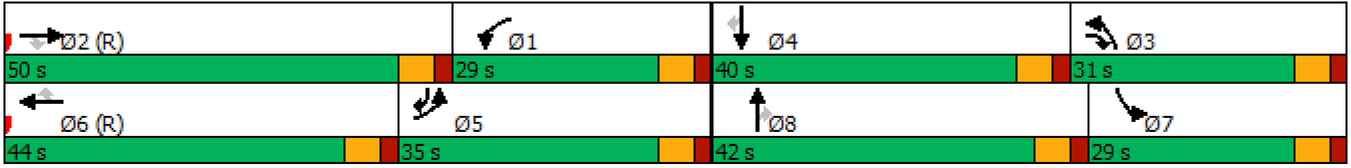
	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	5	2	3	1	6	6	3	8	8	7	4	5
Switch Phase												
Minimum Initial (s)	7.0	15.0	7.0	7.0	15.0	15.0	7.0	10.0	10.0	7.0	10.0	7.0
Minimum Split (s)	13.0	43.0	13.0	13.0	35.0	35.0	13.0	34.0	34.0	13.0	40.0	13.0
Total Split (s)	35.0	50.0	31.0	29.0	44.0	44.0	31.0	42.0	42.0	29.0	40.0	35.0
Total Split (%)	23.3%	33.3%	20.7%	19.3%	29.3%	29.3%	20.7%	28.0%	28.0%	19.3%	26.7%	23.3%
Maximum Green (s)	29.0	44.0	25.0	23.0	38.0	38.0	25.0	36.0	36.0	23.0	34.0	29.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lag	Lead	Lag	Lag	Lead	Lead	Lag	Lead	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max	None	None	C-Max	C-Max	None	Min	Min	None	Min	None
Walk Time (s)		7.0			7.0	7.0		7.0	7.0		7.0	
Flash Dont Walk (s)		30.0			22.0	22.0		21.0	21.0		27.0	
Pedestrian Calls (#/hr)		5			5	5		5	5		5	
Act Effct Green (s)	28.3	47.6	85.4	22.3	41.6	41.6	31.8	34.1	34.1	21.9	24.3	58.6
Actuated g/C Ratio	0.19	0.32	0.57	0.15	0.28	0.28	0.21	0.23	0.23	0.15	0.16	0.39
v/c Ratio	0.92	0.48	0.47	0.84	0.36	0.77	0.73	0.80	0.97	0.86	0.74	0.48
Control Delay	79.1	44.0	19.1	60.2	22.3	14.7	61.2	62.7	53.2	79.2	67.4	23.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	79.1	44.0	19.1	60.2	22.3	14.7	61.2	62.7	53.2	79.2	67.4	23.7
LOS	E	D	B	E	C	B	E	E	D	E	E	C
Approach Delay		50.2			31.8			59.0			59.6	
Approach LOS		D			C			E			E	
Queue Length 50th (m)	95.4	75.2	67.1	72.8	25.1	47.7	78.0	100.3	95.5	68.9	68.7	51.3
Queue Length 95th (m)	#127.3	94.6	113.3	#94.2	41.6	62.5	#119.6	123.9	#176.4	#92.6	81.1	70.6
Internal Link Dist (m)		762.6			288.2			132.5			441.2	
Turn Bay Length (m)	120.0		120.0	120.0		120.0	100.0		100.0	100.0		100.0
Base Capacity (vph)	671	1136	940	532	993	682	735	858	647	532	811	686
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.89	0.48	0.47	0.82	0.36	0.77	0.73	0.76	0.95	0.82	0.53	0.48

Intersection Summary

Area Type: Other
Cycle Length: 150
Actuated Cycle Length: 150
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Green, Master Intersection
Natural Cycle: 130
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.97
Intersection Signal Delay: 50.7 Intersection LOS: D
Intersection Capacity Utilization 77.2% ICU Level of Service D
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 2: Hwy 16 (44 St) & 40 Ave



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↰↑	↱	↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Traffic Volume (vph)	331	5	118	151	5	232	118	1087	118	265	619	320
Future Volume (vph)	331	5	118	151	5	232	118	1087	118	265	619	320
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0		60.0	60.0		60.0	60.0		60.0	90.0		60.0
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (m)	25.0			25.0			25.0			25.0		
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950	0.954		0.950			0.950			0.950		
Satd. Flow (prot)	1700	1707	1601	1789	1883	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.754	0.729		0.380			0.396			0.095		
Satd. Flow (perm)	1349	1304	1601	716	1883	1601	746	3579	1601	179	3579	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			176			252			126			348
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		224.2			386.6			519.4			130.5	
Travel Time (s)		13.5			23.2			31.2			7.8	
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
Adj. Flow (vph)	360	5	128	164	5	252	128	1182	128	288	673	348
Shared Lane Traffic (%)	49%											
Lane Group Flow (vph)	184	181	128	164	5	252	128	1182	128	288	673	348
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			6.0			6.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6

3: 41 St

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	4	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	10.0	10.0	10.0	7.0	10.0	10.0	7.0	15.0	15.0	7.0	15.0	15.0
Minimum Split (s)	45.0	45.0	45.0	13.0	44.0	44.0	13.0	35.0	35.0	13.0	40.0	40.0
Total Split (s)	45.0	45.0	45.0	13.0	58.0	58.0	15.0	50.0	50.0	22.0	57.0	57.0
Total Split (%)	34.6%	34.6%	34.6%	10.0%	44.6%	44.6%	11.5%	38.5%	38.5%	16.9%	43.8%	43.8%
Maximum Green (s)	39.0	39.0	39.0	7.0	52.0	52.0	9.0	44.0	44.0	16.0	51.0	51.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lag	Lag	Lag	Lead			Lag	Lag	Lag	Lead	Lead	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None	None	C-Max	C-Max	None	C-Max	C-Max
Walk Time (s)	7.0	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0
Flash Dont Walk (s)	32.0	32.0	32.0		31.0	31.0		22.0	22.0		27.0	27.0
Pedestrian Calls (#/hr)	5	5	5		5	5		5	5		5	5
Act Effct Green (s)	24.8	24.8	24.8	37.8	37.8	37.8	51.2	51.2	51.2	65.2	65.2	65.2
Actuated g/C Ratio	0.19	0.19	0.19	0.29	0.29	0.29	0.39	0.39	0.39	0.50	0.50	0.50
v/c Ratio	0.72	0.73	0.29	0.62	0.01	0.39	0.35	0.84	0.18	0.77	0.37	0.36
Control Delay	63.5	65.0	3.0	45.6	27.4	5.1	31.1	36.1	9.3	46.5	22.1	3.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	63.5	65.0	3.0	45.6	27.4	5.1	31.1	36.1	9.3	46.5	22.1	3.5
LOS	E	E	A	D	C	A	C	D	A	D	C	A
Approach Delay		48.3			21.1			33.3			22.5	
Approach LOS		D			C			C			C	
Queue Length 50th (m)	50.1	49.3	0.0	35.1	1.0	0.0	17.4	118.5	4.1	55.8	55.7	0.0
Queue Length 95th (m)	67.4	66.8	5.2	46.1	3.6	16.7	46.9	#220.6	23.3	#131.6	89.1	19.2
Internal Link Dist (m)		200.2			362.6			495.4			106.5	
Turn Bay Length (m)	60.0		60.0	60.0		60.0	60.0		60.0	90.0		60.0
Base Capacity (vph)	404	391	603	265	753	791	366	1409	706	374	1795	976
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.46	0.46	0.21	0.62	0.01	0.32	0.35	0.84	0.18	0.77	0.37	0.36

Intersection Summary

Area Type: Other

Cycle Length: 130

Actuated Cycle Length: 130

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 125

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.84

Intersection Signal Delay: 30.1 Intersection LOS: C

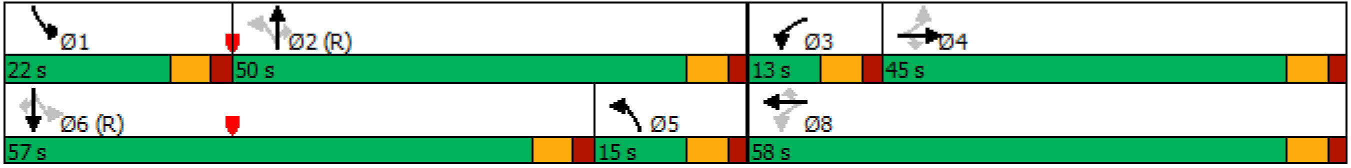
Intersection Capacity Utilization 75.7% ICU Level of Service D

Analysis Period (min) 15

\# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 3: 41 St



	↗	↘	↖	↑	↓	↙
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱	↰	↑↑	↑↑	↱
Traffic Volume (vph)	273	144	176	1037	688	200
Future Volume (vph)	273	144	176	1037	688	200
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0	60.0	60.0			60.0
Storage Lanes	1	0	1			1
Taper Length (m)	25.0		25.0			
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt		0.850				0.850
Flt Protected	0.950		0.950			
Satd. Flow (prot)	1789	1601	1789	3579	3579	1601
Flt Permitted	0.950		0.347			
Satd. Flow (perm)	1789	1601	654	3579	3579	1601
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		157				217
Link Speed (k/h)	60			60	60	
Link Distance (m)	241.7			421.0	519.4	
Travel Time (s)	14.5			25.3	31.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	297	157	191	1127	748	217
Shared Lane Traffic (%)						
Lane Group Flow (vph)	297	157	191	1127	748	217
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.7			6.0	6.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25	15	25			15
Number of Detectors	1	1	1	2	2	1
Detector Template	Left	Right	Left	Thru	Thru	Right
Leading Detector (m)	2.0	2.0	2.0	10.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	2.0	2.0	0.6	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)				9.4	9.4	
Detector 2 Size(m)				0.6	0.6	
Detector 2 Type				Cl+Ex	Cl+Ex	
Detector 2 Channel						
Detector 2 Extend (s)				0.0	0.0	
Turn Type	Perm	Perm	Perm	NA	NA	Perm
Protected Phases				2	6	
Permitted Phases	4	4	2			6

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Detector Phase	4	4	2	2	6	6
Switch Phase						
Minimum Initial (s)	10.0	10.0	15.0	15.0	15.0	15.0
Minimum Split (s)	43.0	43.0	40.0	40.0	35.0	35.0
Total Split (s)	47.0	47.0	83.0	83.0	83.0	83.0
Total Split (%)	36.2%	36.2%	63.8%	63.8%	63.8%	63.8%
Maximum Green (s)	41.0	41.0	77.0	77.0	77.0	77.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	C-Max	C-Max	C-Max	C-Max
Walk Time (s)	7.0	7.0	7.0	7.0	7.0	7.0
Flash Dont Walk (s)	30.0	30.0	27.0	27.0	22.0	22.0
Pedestrian Calls (#/hr)	5	5	5	5	5	5
Act Effct Green (s)	27.4	27.4	90.6	90.6	90.6	90.6
Actuated g/C Ratio	0.21	0.21	0.70	0.70	0.70	0.70
v/c Ratio	0.79	0.34	0.42	0.45	0.30	0.18
Control Delay	63.1	7.6	5.6	3.7	6.7	0.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	63.1	7.6	5.6	3.7	6.7	0.8
LOS	E	A	A	A	A	A
Approach Delay	43.9			4.0	5.4	
Approach LOS	D			A	A	
Queue Length 50th (m)	76.7	0.0	6.7	20.8	20.8	0.0
Queue Length 95th (m)	100.0	16.7	9.7	23.2	29.1	0.0
Internal Link Dist (m)	217.7			397.0	495.4	
Turn Bay Length (m)	60.0	60.0	60.0			60.0
Base Capacity (vph)	564	612	455	2494	2494	1181
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.53	0.26	0.42	0.45	0.30	0.18

Intersection Summary

Area Type: Other

Cycle Length: 130

Actuated Cycle Length: 130

Offset: 6 (5%), Referenced to phase 2:NBTL and 6:SBT, Start of Green

Natural Cycle: 85

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.79

Intersection Signal Delay: 11.1 Intersection LOS: B

Intersection Capacity Utilization 61.6% ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 4:

	↗	↘	↖	↑	↓	↙
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱	↰	↑↑	↑↑	↱
Traffic Volume (vph)	90	40	50	1109	782	60
Future Volume (vph)	90	40	50	1109	782	60
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0	60.0	60.0			60.0
Storage Lanes	1	0	1			1
Taper Length (m)	25.0		25.0			
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt		0.850				0.850
Flt Protected	0.950		0.950			
Satd. Flow (prot)	1789	1601	1789	3579	3579	1601
Flt Permitted	0.950		0.321			
Satd. Flow (perm)	1789	1601	605	3579	3579	1601
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		43				65
Link Speed (k/h)	60			60	60	
Link Distance (m)	252.3			561.3	421.0	
Travel Time (s)	15.1			33.7	25.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	98	43	54	1205	850	65
Shared Lane Traffic (%)						
Lane Group Flow (vph)	98	43	54	1205	850	65
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.7			6.0	6.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25	15	25			15
Number of Detectors	1	1	1	2	2	1
Detector Template	Left	Right	Left	Thru	Thru	Right
Leading Detector (m)	2.0	2.0	2.0	10.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	2.0	2.0	0.6	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)				9.4	9.4	
Detector 2 Size(m)				0.6	0.6	
Detector 2 Type				Cl+Ex	Cl+Ex	
Detector 2 Channel						
Detector 2 Extend (s)				0.0	0.0	
Turn Type	Perm	Perm	Perm	NA	NA	Perm
Protected Phases				2	6	
Permitted Phases	4	4	2			6

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Detector Phase	4	4	2	2	6	6
Switch Phase						
Minimum Initial (s)	10.0	10.0	15.0	15.0	15.0	15.0
Minimum Split (s)	43.0	43.0	40.0	40.0	33.0	33.0
Total Split (s)	47.0	47.0	83.0	83.0	83.0	83.0
Total Split (%)	36.2%	36.2%	63.8%	63.8%	63.8%	63.8%
Maximum Green (s)	41.0	41.0	77.0	77.0	77.0	77.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	C-Max	C-Max	C-Max	C-Max
Walk Time (s)	7.0	7.0	7.0	7.0	7.0	7.0
Flash Dont Walk (s)	30.0	30.0	27.0	27.0	20.0	20.0
Pedestrian Calls (#/hr)	5	5	5	5	5	5
Act Effct Green (s)	16.9	16.9	101.1	101.1	101.1	101.1
Actuated g/C Ratio	0.13	0.13	0.78	0.78	0.78	0.78
v/c Ratio	0.42	0.18	0.11	0.43	0.31	0.05
Control Delay	55.0	12.8	5.4	6.0	2.5	0.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	55.0	12.8	5.4	6.0	2.5	0.2
LOS	E	B	A	A	A	A
Approach Delay	42.2			6.0	2.3	
Approach LOS	D			A	A	
Queue Length 50th (m)	25.7	0.0	4.1	55.7	10.3	0.0
Queue Length 95th (m)	35.4	9.4	12.0	89.0	24.7	0.3
Internal Link Dist (m)	228.3			537.3	397.0	
Turn Bay Length (m)	60.0	60.0	60.0			60.0
Base Capacity (vph)	564	534	470	2783	2783	1259
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.17	0.08	0.11	0.43	0.31	0.05

Intersection Summary

Area Type: Other
Cycle Length: 130
Actuated Cycle Length: 130
Offset: 1 (1%), Referenced to phase 2:NBTL and 6:SBT, Start of Green
Natural Cycle: 85
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.43
Intersection Signal Delay: 6.7 Intersection LOS: A
Intersection Capacity Utilization 57.4% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 6: 31 St

7: 40 Ave & 25 St

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑	↱	↰	↱		↰↰	↑↑	↱	↰	↑↑	↱
Traffic Volume (vph)	519	11	410	11	11	28	276	544	11	19	472	317
Future Volume (vph)	519	11	410	11	11	28	276	544	11	19	472	317
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0		60.0	60.0		60.0	60.0		60.0	60.0		60.0
Storage Lanes	1		1	1		0	2		1	1		1
Taper Length (m)	25.0			25.0			25.0			25.0		
Lane Util. Factor	0.97	1.00	1.00	1.00	1.00	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt			0.850		0.893				0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3471	1883	1601	1789	1682	0	3471	3579	1601	1789	3579	1601
Flt Permitted	0.950			0.750			0.950			0.429		
Satd. Flow (perm)	3471	1883	1601	1413	1682	0	3471	3579	1601	808	3579	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			430		30				76			345
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		293.2			157.4			231.2			229.6	
Travel Time (s)		17.6			9.4			13.9			13.8	
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
Adj. Flow (vph)	564	12	446	12	12	30	300	591	12	21	513	345
Shared Lane Traffic (%)												
Lane Group Flow (vph)	564	12	446	12	42	0	300	591	12	21	513	345
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			8.0			8.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2	1	1	2		1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru		Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0		2.0	10.0	2.0	2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6		2.0	0.6	2.0	2.0	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Prot	NA	Perm	Perm	NA		Prot	NA	Perm	Perm	NA	Perm
Protected Phases	7	4			8		5	2			6	
Permitted Phases			4	8					2	6		6

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	7	4	4	8	8		5	2	2	6	6	6
Switch Phase												
Minimum Initial (s)	7.0	10.0	10.0	10.0	10.0		7.0	15.0	15.0	15.0	15.0	15.0
Minimum Split (s)	13.0	36.0	36.0	36.0	36.0		13.0	33.0	33.0	35.0	35.0	35.0
Total Split (s)	35.0	71.0	71.0	36.0	36.0		23.0	59.0	59.0	36.0	36.0	36.0
Total Split (%)	26.9%	54.6%	54.6%	27.7%	27.7%		17.7%	45.4%	45.4%	27.7%	27.7%	27.7%
Maximum Green (s)	29.0	65.0	65.0	30.0	30.0		17.0	53.0	53.0	30.0	30.0	30.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead			Lag	Lag		Lead			Lag	Lag	Lag
Lead-Lag Optimize?	Yes			Yes	Yes		Yes			Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None		None	C-Max	C-Max	C-Max	C-Max	C-Max
Walk Time (s)		7.0	7.0	7.0	7.0			7.0	7.0	7.0	7.0	7.0
Flash Dont Walk (s)		23.0	23.0	23.0	23.0			20.0	20.0	22.0	22.0	22.0
Pedestrian Calls (#/hr)		5	5	5	5			5	5	5	5	5
Act Effct Green (s)	25.6	42.4	42.4	14.0	14.0		15.7	75.6	75.6	53.9	53.9	53.9
Actuated g/C Ratio	0.20	0.33	0.33	0.11	0.11		0.12	0.58	0.58	0.41	0.41	0.41
v/c Ratio	0.83	0.02	0.55	0.08	0.20		0.72	0.28	0.01	0.06	0.35	0.40
Control Delay	60.9	23.0	5.2	48.9	23.8		65.0	16.6	0.0	16.9	16.2	2.8
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	60.9	23.0	5.2	48.9	23.8		65.0	16.6	0.0	16.9	16.2	2.8
LOS	E	C	A	D	C		E	B	A	B	B	A
Approach Delay		36.1			29.4			32.4			10.9	
Approach LOS		D			C			C			B	
Queue Length 50th (m)	75.4	2.2	3.0	3.1	3.1		40.4	39.9	0.0	1.8	25.2	0.0
Queue Length 95th (m)	94.1	5.1	19.5	8.2	12.6		56.1	75.0	0.0	6.4	62.2	0.0
Internal Link Dist (m)		269.2			133.4			207.2			205.6	
Turn Bay Length (m)	60.0		60.0	60.0			60.0		60.0	60.0		60.0
Base Capacity (vph)	774	941	1015	326	411		459	2081	963	335	1484	865
Starvation Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Reduced v/c Ratio	0.73	0.01	0.44	0.04	0.10		0.65	0.28	0.01	0.06	0.35	0.40

Intersection Summary

Area Type: Other

Cycle Length: 130

Actuated Cycle Length: 130

Offset: 78 (60%), Referenced to phase 2:NBT and 6:SBTL, Start of Green

Natural Cycle: 100

Control Type: Actuated-Coordinated

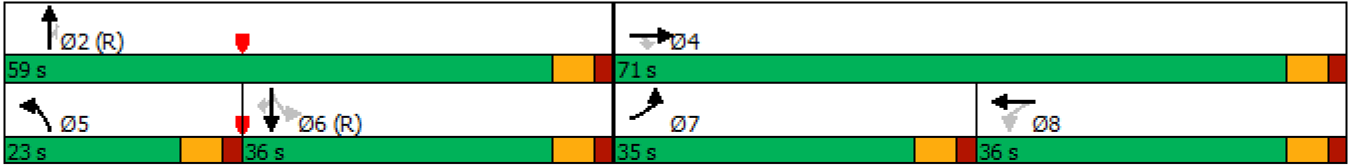
Maximum v/c Ratio: 0.83

Intersection Signal Delay: 27.1 Intersection LOS: C

Intersection Capacity Utilization 64.0% ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 7: 40 Ave & 25 St



	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations			↱			↱		↑↱			↑↱	
Traffic Volume (vph)	0	0	20	0	0	20	0	1630	20	0	1184	20
Future Volume (vph)	0	0	20	0	0	20	0	1630	20	0	1184	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt			0.865			0.865		0.998			0.997	
Flt Protected												
Satd. Flow (prot)	0	0	1629	0	0	1629	0	3571	0	0	3568	0
Flt Permitted												
Satd. Flow (perm)	0	0	1629	0	0	1629	0	3571	0	0	3568	0
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		107.7			109.5			130.5			156.5	
Travel Time (s)		6.5			6.6			7.8			9.4	
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
Adj. Flow (vph)	0	0	22	0	0	22	0	1772	22	0	1287	22
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	22	0	0	22	0	1794	0	0	1309	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			8.0			8.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Free			Free			Free			Free	

Intersection Summary	
Area Type:	Other
Control Type: Unsignalized	
Intersection Capacity Utilization 55.7%	ICU Level of Service B
Analysis Period (min) 15	

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Traffic Volume (vph)	90	5	40	17	5	26	50	1033	12	35	739	60
Future Volume (vph)	90	5	40	17	5	26	50	1033	12	35	739	60
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0		60.0	60.0		60.0	60.0		60.0	60.0		60.0
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (m)	25.0			25.0			25.0			25.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	1883	1601	1789	1883	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.754			0.754			0.340			0.232		
Satd. Flow (perm)	1420	1883	1601	1420	1883	1601	640	3579	1601	437	3579	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			43			28			17			65
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		299.6			269.2			229.6			561.3	
Travel Time (s)		18.0			16.2			13.8			33.7	
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
Adj. Flow (vph)	98	5	43	18	5	28	54	1123	13	38	803	65
Shared Lane Traffic (%)												
Lane Group Flow (vph)	98	5	43	18	5	28	54	1123	13	38	803	65
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			6.0			6.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8		8	2		2	6		6

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	4	4	4	8	8	8	2	2	2	6	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	23.0	23.0	23.0	23.0	23.0	23.0	42.0	42.0	42.0	42.0	42.0	42.0
Total Split (%)	35.4%	35.4%	35.4%	35.4%	35.4%	35.4%	64.6%	64.6%	64.6%	64.6%	64.6%	64.6%
Maximum Green (s)	19.0	19.0	19.0	19.0	19.0	19.0	38.0	38.0	38.0	38.0	38.0	38.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None	C-Max	C-Max	C-Max	C-Max	C-Max	C-Max
Walk Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Act Effct Green (s)	9.8	9.8	9.8	9.8	9.8	9.8	49.9	49.9	49.9	49.9	49.9	49.9
Actuated g/C Ratio	0.15	0.15	0.15	0.15	0.15	0.15	0.77	0.77	0.77	0.77	0.77	0.77
v/c Ratio	0.46	0.02	0.16	0.08	0.02	0.11	0.11	0.41	0.01	0.11	0.29	0.05
Control Delay	31.2	21.4	9.2	22.6	21.4	10.1	1.8	2.4	0.2	2.5	2.3	0.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.2	21.4	9.2	22.6	21.4	10.1	1.8	2.4	0.2	2.5	2.3	0.2
LOS	C	C	A	C	C	B	A	A	A	A	A	A
Approach Delay		24.4			15.6			2.3			2.2	
Approach LOS		C			B			A			A	
Queue Length 50th (m)	11.5	0.6	0.0	2.0	0.6	0.0	1.0	44.1	0.1	0.8	8.9	0.0
Queue Length 95th (m)	22.9	3.0	7.1	6.6	3.0	5.8	m1.8	14.8	m0.0	1.8	11.4	0.3
Internal Link Dist (m)		275.6			245.2			205.6			537.3	
Turn Bay Length (m)	60.0		60.0	60.0		60.0	60.0		60.0	60.0		60.0
Base Capacity (vph)	415	550	498	415	550	487	491	2749	1234	335	2749	1245
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.24	0.01	0.09	0.04	0.01	0.06	0.11	0.41	0.01	0.11	0.29	0.05

Intersection Summary

Area Type: Other
Cycle Length: 65
Actuated Cycle Length: 65
Offset: 63 (97%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 40
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.46
Intersection Signal Delay: 4.0 Intersection LOS: A
Intersection Capacity Utilization 53.5% ICU Level of Service A
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 12: 27 St

Ultimate Background Traffic PM Peak
1: 37 Ave

11-15-2022

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱		✥			✥	
Traffic Volume (vph)	50	1260	19	8	1480	50	89	10	35	50	10	50
Future Volume (vph)	50	1260	19	8	1480	50	89	10	35	50	10	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	180.0		60.0	60.0		180.0	0.0		0.0	0.0		0.0
Storage Lanes	1		1	1		1	0		0	0		0
Taper Length (m)	25.0			25.0			25.0			25.0		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850		0.965			0.939	
Flt Protected	0.950			0.950				0.968			0.978	
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	0	1759	0	0	1730	0
Flt Permitted	0.089			0.135				0.764			0.823	
Satd. Flow (perm)	168	3579	1601	254	3579	1601	0	1389	0	0	1456	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			44			54		21			40	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		262.4			316.2			143.4			113.3	
Travel Time (s)		15.7			19.0			8.6			6.8	
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
Adj. Flow (vph)	54	1370	21	9	1609	54	97	11	38	54	11	54
Shared Lane Traffic (%)												
Lane Group Flow (vph)	54	1370	21	9	1609	54	0	146	0	0	119	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2	1	1	2	1	1	2		1	2	
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru		Left	Thru	
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0		2.0	10.0	
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6		2.0	0.6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2		2	6		6	8			4		

1: 37 Ave

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	2	2	2	6	6	6	8	8		4	4	
Switch Phase												
Minimum Initial (s)	15.0	15.0	15.0	15.0	15.0	15.0	10.0	10.0		10.0	10.0	
Minimum Split (s)	21.0	21.0	21.0	21.0	21.0	21.0	16.0	16.0		16.0	16.0	
Total Split (s)	55.0	55.0	55.0	55.0	55.0	55.0	20.0	20.0		20.0	20.0	
Total Split (%)	73.3%	73.3%	73.3%	73.3%	73.3%	73.3%	26.7%	26.7%		26.7%	26.7%	
Maximum Green (s)	49.0	49.0	49.0	49.0	49.0	49.0	14.0	14.0		14.0	14.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0		6.0			6.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	None	None	None	None	None	C-Max	C-Max		C-Max	C-Max	
Act Effct Green (s)	44.8	44.8	44.8	44.8	44.8	44.8		18.2			18.2	
Actuated g/C Ratio	0.60	0.60	0.60	0.60	0.60	0.60		0.24			0.24	
v/c Ratio	0.54	0.64	0.02	0.06	0.75	0.06		0.41			0.31	
Control Delay	37.8	19.4	0.8	6.0	13.3	1.6		26.6			20.4	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Total Delay	37.8	19.4	0.8	6.0	13.3	1.6		26.6			20.4	
LOS	D	B	A	A	B	A		C			C	
Approach Delay		19.8			12.9			26.6			20.4	
Approach LOS		B			B			C			C	
Queue Length 50th (m)	14.3	193.8	0.4	0.5	77.2	0.0		16.0			9.7	
Queue Length 95th (m)	13.7	27.9	m0.1	2.1	90.7	3.3		34.9			25.2	
Internal Link Dist (m)		238.4			292.2			119.4			89.3	
Turn Bay Length (m)	180.0		60.0	60.0		180.0						
Base Capacity (vph)	109	2338	1061	165	2338	1064		352			382	
Starvation Cap Reductn	0	0	0	0	0	0		0			0	
Spillback Cap Reductn	0	0	0	0	7	0		0			0	
Storage Cap Reductn	0	0	0	0	0	0		0			0	
Reduced v/c Ratio	0.50	0.59	0.02	0.05	0.69	0.05		0.41			0.31	

Intersection Summary

Area Type: Other

Cycle Length: 75

Actuated Cycle Length: 75

Offset: 0 (0%), Referenced to phase 4:SBTL and 8:NBTL, Start of Green

Natural Cycle: 60

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.75

Intersection Signal Delay: 16.7 Intersection LOS: B

Intersection Capacity Utilization 63.0% ICU Level of Service B

Analysis Period (min) 15

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 16: 37 Ave

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↑	↱	↰↰	↑↑	↱	↰↰	↑↑	↱	↰↰	↑↑	↱
Traffic Volume (vph)	304	655	596	563	682	415	564	383	373	483	620	551
Future Volume (vph)	304	655	596	563	682	415	564	383	373	483	620	551
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0		120.0	120.0		120.0	100.0		100.0	100.0		100.0
Storage Lanes	2		1	2		1	2		1	2		1
Taper Length (m)	25.0			25.0			25.0			25.0		
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3471	3579	1601	3471	3579	1601	3471	3579	1601	3471	3579	1601
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	3471	3579	1601	3471	3579	1601	3471	3579	1601	3471	3579	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			65			398			364			109
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		786.6			312.2			156.5			465.2	
Travel Time (s)		47.2			18.7			9.4			27.9	
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
Adj. Flow (vph)	330	712	648	612	741	451	613	416	405	525	674	599
Shared Lane Traffic (%)												
Lane Group Flow (vph)	330	712	648	612	741	451	613	416	405	525	674	599
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		9.0			9.0			9.0			9.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Prot	NA	pm+ov	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	pm+ov
Protected Phases	5	2	3	1	6		3	8		7	4	5
Permitted Phases			2			6			8			4

2: Hwy 16 (44 St) & 40 Ave

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	5	2	3	1	6	6	3	8	8	7	4	5
Switch Phase												
Minimum Initial (s)	7.0	15.0	7.0	7.0	15.0	15.0	7.0	10.0	10.0	7.0	10.0	7.0
Minimum Split (s)	13.0	43.0	13.0	13.0	35.0	35.0	13.0	34.0	34.0	13.0	40.0	13.0
Total Split (s)	35.0	43.0	34.0	33.0	41.0	41.0	34.0	42.0	42.0	32.0	40.0	35.0
Total Split (%)	23.3%	28.7%	22.7%	22.0%	27.3%	27.3%	22.7%	28.0%	28.0%	21.3%	26.7%	23.3%
Maximum Green (s)	29.0	37.0	28.0	27.0	35.0	35.0	28.0	36.0	36.0	26.0	34.0	29.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lead	Lag	Lag	Lag	Lag	Lag	Lead	Lead	Lag	Lead	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max	None	None	C-Max	C-Max	None	Min	Min	None	Min	None
Walk Time (s)					7.0	7.0		7.0	7.0		7.0	
Flash Dont Walk (s)					22.0	22.0		21.0	21.0		27.0	
Pedestrian Calls (#/hr)					5	5		5	5		5	
Act Effct Green (s)	25.8	37.2	73.2	27.0	38.4	38.4	30.0	23.6	23.6	38.2	31.8	57.6
Actuated g/C Ratio	0.17	0.25	0.49	0.18	0.26	0.26	0.20	0.16	0.16	0.25	0.21	0.38
v/c Ratio	0.55	0.80	0.80	0.98	0.81	0.64	0.88	0.74	0.73	0.59	0.89	0.88
Control Delay	60.1	61.1	38.0	85.1	56.2	17.2	73.6	68.2	16.3	53.1	71.8	32.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	60.1	61.1	38.0	85.1	56.2	17.2	73.6	68.2	16.3	53.1	71.8	32.6
LOS	E	E	D	F	E	B	E	E	B	D	E	C
Approach Delay		52.0			56.3			55.8			53.3	
Approach LOS		D			E			E			D	
Queue Length 50th (m)	48.9	111.2	156.2	99.2	106.0	20.8	98.4	66.3	11.3	74.8	107.4	72.5
Queue Length 95th (m)	64.3	136.1	217.5	#137.8	#150.0	69.6	#136.5	81.7	47.3	100.2	131.5	97.5
Internal Link Dist (m)		762.6			288.2			132.5			441.2	
Turn Bay Length (m)	120.0		120.0	120.0		120.0	100.0		100.0	100.0		100.0
Base Capacity (vph)	671	886	814	624	915	705	694	858	660	884	811	713
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.49	0.80	0.80	0.98	0.81	0.64	0.88	0.48	0.61	0.59	0.83	0.84

Intersection Summary

Area Type: Other

Cycle Length: 150

Actuated Cycle Length: 150

Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Green, Master Intersection

Natural Cycle: 140

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.98

Intersection Signal Delay: 54.3 Intersection LOS: D

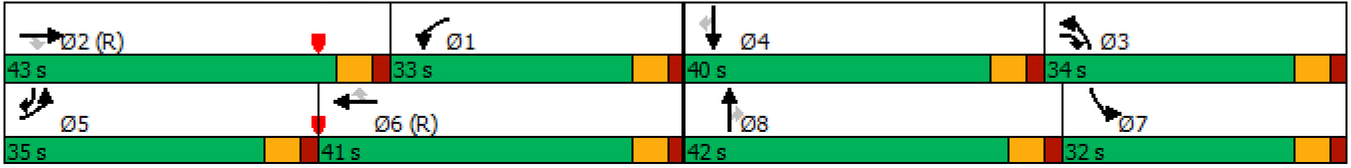
Intersection Capacity Utilization 87.4% ICU Level of Service E

Analysis Period (min) 15

\# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 2: Hwy 16 (44 St) & 40 Ave



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↰↑	↱	↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Traffic Volume (vph)	320	5	118	208	5	355	118	593	205	357	1090	331
Future Volume (vph)	320	5	118	208	5	355	118	593	205	357	1090	331
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0		60.0	60.0		60.0	60.0		60.0	90.0		60.0
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (m)	25.0			25.0			25.0			25.0		
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950	0.954		0.950			0.950			0.950		
Satd. Flow (prot)	1700	1707	1601	1789	1883	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.754	0.729		0.530			0.163			0.265		
Satd. Flow (perm)	1349	1304	1601	998	1883	1601	307	3579	1601	499	3579	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			191			386			223			215
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		224.2			386.6			519.4			130.5	
Travel Time (s)		13.5			23.2			31.2			7.8	
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
Adj. Flow (vph)	348	5	128	226	5	386	128	645	223	388	1185	360
Shared Lane Traffic (%)	49%											
Lane Group Flow (vph)	177	176	128	226	5	386	128	645	223	388	1185	360
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			6.0			6.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6

Ultimate Background Traffic PM Peak
3: 41 St

11-15-2022

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	4	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	10.0	10.0	10.0	4.0	10.0	10.0	7.0	15.0	15.0	7.0	15.0	15.0
Minimum Split (s)	45.0	45.0	45.0	10.0	44.0	44.0	21.0	35.0	35.0	13.0	40.0	40.0
Total Split (s)	45.0	45.0	45.0	10.0	55.0	55.0	21.0	37.0	37.0	28.0	44.0	44.0
Total Split (%)	37.5%	37.5%	37.5%	8.3%	45.8%	45.8%	17.5%	30.8%	30.8%	23.3%	36.7%	36.7%
Maximum Green (s)	39.0	39.0	39.0	4.0	49.0	49.0	15.0	31.0	31.0	22.0	38.0	38.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lead	Lead	Lag			Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None	None	C-Max	C-Max	None	C-Max	C-Max
Walk Time (s)	7.0	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0
Flash Dont Walk (s)	32.0	32.0	32.0		31.0	31.0		22.0	22.0		27.0	27.0
Pedestrian Calls (#/hr)	5	5	5		5	5		5	5		5	5
Act Effct Green (s)	23.4	23.4	23.4	34.6	34.6	34.6	54.2	44.3	44.3	73.4	57.5	57.5
Actuated g/C Ratio	0.20	0.20	0.20	0.29	0.29	0.29	0.45	0.37	0.37	0.61	0.48	0.48
v/c Ratio	0.67	0.69	0.28	0.70	0.01	0.52	0.49	0.49	0.31	0.70	0.69	0.41
Control Delay	55.9	57.7	2.2	50.2	25.0	5.2	20.1	27.9	7.0	21.5	29.2	11.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	55.9	57.7	2.2	50.2	25.0	5.2	20.1	27.9	7.0	21.5	29.2	11.2
LOS	E	E	A	D	C	A	C	C	A	C	C	B
Approach Delay		42.3			21.9			22.2			24.3	
Approach LOS		D			C			C			C	
Queue Length 50th (m)	44.0	44.0	0.0	46.4	0.9	0.0	9.7	56.7	1.0	43.3	112.0	19.2
Queue Length 95th (m)	58.4	58.6	2.7	57.4	3.4	18.9	29.1	107.5	32.6	#97.5	#210.7	59.1
Internal Link Dist (m)		200.2			362.6			495.4			106.5	
Turn Bay Length (m)	60.0		60.0	60.0		60.0	60.0		60.0	90.0		60.0
Base Capacity (vph)	438	423	649	322	768	882	336	1320	731	563	1715	879
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.40	0.42	0.20	0.70	0.01	0.44	0.38	0.49	0.31	0.69	0.69	0.41

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 118 (98%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 120

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.70

Intersection Signal Delay: 25.6 Intersection LOS: C

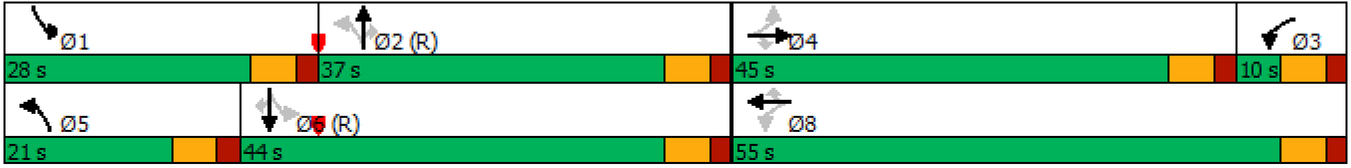
Intersection Capacity Utilization 69.9% ICU Level of Service C

Analysis Period (min) 15

\# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 3: 41 St



	↗	↘	↖	↑	↓	↙
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱	↰	↑↑	↑↑	↱
Traffic Volume (vph)	200	176	144	670	1040	273
Future Volume (vph)	200	176	144	670	1040	273
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0	60.0	60.0			60.0
Storage Lanes	1	0	1			1
Taper Length (m)	25.0		25.0			
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt		0.850				0.850
Flt Protected	0.950		0.950			
Satd. Flow (prot)	1789	1601	1789	3579	3579	1601
Flt Permitted	0.950		0.220			
Satd. Flow (perm)	1789	1601	414	3579	3579	1601
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		86				297
Link Speed (k/h)	60			60	60	
Link Distance (m)	241.7			421.0	519.4	
Travel Time (s)	14.5			25.3	31.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	217	191	157	728	1130	297
Shared Lane Traffic (%)						
Lane Group Flow (vph)	217	191	157	728	1130	297
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.7			6.0	6.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25	15	25			15
Number of Detectors	1	1	1	2	2	1
Detector Template	Left	Right	Left	Thru	Thru	Right
Leading Detector (m)	2.0	2.0	2.0	10.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	2.0	2.0	0.6	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)				9.4	9.4	
Detector 2 Size(m)				0.6	0.6	
Detector 2 Type				Cl+Ex	Cl+Ex	
Detector 2 Channel						
Detector 2 Extend (s)				0.0	0.0	
Turn Type	Perm	Perm	Perm	NA	NA	Perm
Protected Phases				2	6	
Permitted Phases	4	4	2			6

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Detector Phase	4	4	2	2	6	6
Switch Phase						
Minimum Initial (s)	10.0	10.0	15.0	15.0	15.0	15.0
Minimum Split (s)	43.0	43.0	40.0	40.0	35.0	35.0
Total Split (s)	43.0	43.0	77.0	77.0	77.0	77.0
Total Split (%)	35.8%	35.8%	64.2%	64.2%	64.2%	64.2%
Maximum Green (s)	37.0	37.0	71.0	71.0	71.0	71.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	C-Max	C-Max	C-Max	C-Max
Walk Time (s)	7.0	7.0	7.0	7.0	7.0	7.0
Flash Dont Walk (s)	30.0	30.0	27.0	27.0	22.0	22.0
Pedestrian Calls (#/hr)	5	5	5	5	5	5
Act Effct Green (s)	22.0	22.0	86.0	86.0	86.0	86.0
Actuated g/C Ratio	0.18	0.18	0.72	0.72	0.72	0.72
v/c Ratio	0.66	0.53	0.53	0.28	0.44	0.24
Control Delay	54.2	27.4	21.6	4.0	3.1	0.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.2	27.4	21.6	4.0	3.1	0.4
LOS	D	C	C	A	A	A
Approach Delay	41.7			7.2	2.5	
Approach LOS	D			A	A	
Queue Length 50th (m)	51.6	23.6	8.1	6.2	15.6	0.0
Queue Length 95th (m)	65.4	39.8	40.2	24.7	24.0	0.0
Internal Link Dist (m)	217.7			397.0	495.4	
Turn Bay Length (m)	60.0	60.0	60.0			60.0
Base Capacity (vph)	551	553	296	2565	2565	1231
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.39	0.35	0.53	0.28	0.44	0.24

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 8 (7%), Referenced to phase 2:NBTL and 6:SBT, Start of Green

Natural Cycle: 95

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.66

Intersection Signal Delay: 9.9 Intersection LOS: A

Intersection Capacity Utilization 67.3% ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 4:

	↗	↘	↖	↑	↓	↙
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱	↰	↑↑	↑↑	↱
Traffic Volume (vph)	60	50	40	764	1109	90
Future Volume (vph)	60	50	40	764	1109	90
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0	60.0	60.0			60.0
Storage Lanes	1	0	1			1
Taper Length (m)	25.0		25.0			
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt		0.850				0.850
Flt Protected	0.950		0.950			
Satd. Flow (prot)	1789	1601	1789	3579	3579	1601
Flt Permitted	0.950		0.214			
Satd. Flow (perm)	1789	1601	403	3579	3579	1601
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		54				93
Link Speed (k/h)	60			60	60	
Link Distance (m)	252.3			561.3	421.0	
Travel Time (s)	15.1			33.7	25.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	65	54	43	830	1205	98
Shared Lane Traffic (%)						
Lane Group Flow (vph)	65	54	43	830	1205	98
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.7			6.0	6.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25	15	25			15
Number of Detectors	1	1	1	2	2	1
Detector Template	Left	Right	Left	Thru	Thru	Right
Leading Detector (m)	2.0	2.0	2.0	10.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	2.0	2.0	0.6	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)				9.4	9.4	
Detector 2 Size(m)				0.6	0.6	
Detector 2 Type				Cl+Ex	Cl+Ex	
Detector 2 Channel						
Detector 2 Extend (s)				0.0	0.0	
Turn Type	Perm	Perm	Perm	NA	NA	Perm
Protected Phases				2	6	
Permitted Phases	4	4	2			6

	↗	↘	↖	↑	↓	↙
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Detector Phase	4	4	2	2	6	6
Switch Phase						
Minimum Initial (s)	10.0	10.0	15.0	15.0	15.0	15.0
Minimum Split (s)	43.0	43.0	40.0	40.0	33.0	33.0
Total Split (s)	45.0	45.0	75.0	75.0	75.0	75.0
Total Split (%)	37.5%	37.5%	62.5%	62.5%	62.5%	62.5%
Maximum Green (s)	39.0	39.0	69.0	69.0	69.0	69.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	C-Max	C-Max	C-Max	C-Max
Walk Time (s)	7.0	7.0	7.0	7.0	7.0	7.0
Flash Dont Walk (s)	30.0	30.0	27.0	27.0	20.0	20.0
Pedestrian Calls (#/hr)	5	5	5	5	5	5
Act Effct Green (s)	15.7	15.7	96.7	96.7	96.7	96.7
Actuated g/C Ratio	0.13	0.13	0.81	0.81	0.81	0.81
v/c Ratio	0.28	0.21	0.13	0.29	0.42	0.07
Control Delay	46.9	11.5	9.0	6.4	2.5	0.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	46.9	11.5	9.0	6.4	2.5	0.2
LOS	D	B	A	A	A	A
Approach Delay	30.8			6.5	2.3	
Approach LOS	C			A	A	
Queue Length 50th (m)	15.6	0.0	2.0	22.0	13.4	0.0
Queue Length 95th (m)	22.8	9.6	11.3	63.0	31.8	0.7
Internal Link Dist (m)	228.3			537.3	397.0	
Turn Bay Length (m)	60.0	60.0	60.0			60.0
Base Capacity (vph)	581	556	325	2885	2885	1308
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.11	0.10	0.13	0.29	0.42	0.07

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 20 (17%), Referenced to phase 2:NBTL and 6:SBT, Start of Green

Natural Cycle: 85

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.42

Intersection Signal Delay: 5.4 Intersection LOS: A

Intersection Capacity Utilization 51.6% ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 6: 31 St

7: 40 Ave & 25 St

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑	↱	↰	↱		↰↰	↑↑	↱	↰	↑↑	↱
Traffic Volume (vph)	310	11	276	11	11	19	410	462	11	28	531	519
Future Volume (vph)	310	11	276	11	11	19	410	462	11	28	531	519
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0		60.0	60.0		60.0	60.0		60.0	60.0		60.0
Storage Lanes	1		1	1		0	2		1	1		1
Taper Length (m)	25.0			25.0			25.0			25.0		
Lane Util. Factor	0.97	1.00	1.00	1.00	1.00	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt			0.850		0.905				0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3471	1883	1601	1789	1705	0	3471	3579	1601	1789	3579	1601
Flt Permitted	0.950			0.750			0.950			0.468		
Satd. Flow (perm)	3471	1883	1601	1413	1705	0	3471	3579	1601	881	3579	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			300		21				82			564
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		293.2			157.4			231.2			229.6	
Travel Time (s)		17.6			9.4			13.9			13.8	
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
Adj. Flow (vph)	337	12	300	12	12	21	446	502	12	30	577	564
Shared Lane Traffic (%)												
Lane Group Flow (vph)	337	12	300	12	33	0	446	502	12	30	577	564
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			8.0			8.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2	1	1	2		1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru		Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0		2.0	10.0	2.0	2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6		2.0	0.6	2.0	2.0	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Prot	NA	Perm	Perm	NA		Prot	NA	Perm	Perm	NA	Perm
Protected Phases	7	4			8		5	2			6	
Permitted Phases			4	8					2	6		6

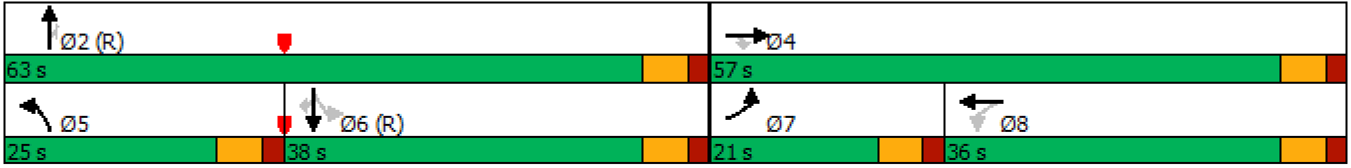
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	7	4	4	8	8		5	2	2	6	6	6
Switch Phase												
Minimum Initial (s)	7.0	10.0	10.0	10.0	10.0		7.0	15.0	15.0	15.0	15.0	15.0
Minimum Split (s)	13.0	36.0	36.0	36.0	36.0		13.0	33.0	33.0	35.0	35.0	35.0
Total Split (s)	21.0	57.0	57.0	36.0	36.0		25.0	63.0	63.0	38.0	38.0	38.0
Total Split (%)	17.5%	47.5%	47.5%	30.0%	30.0%		20.8%	52.5%	52.5%	31.7%	31.7%	31.7%
Maximum Green (s)	15.0	51.0	51.0	30.0	30.0		19.0	57.0	57.0	32.0	32.0	32.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead			Lag	Lag		Lead			Lag	Lag	Lag
Lead-Lag Optimize?	Yes			Yes	Yes		Yes			Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None		None	C-Max	C-Max	C-Max	C-Max	C-Max
Walk Time (s)		7.0	7.0	7.0	7.0			7.0	7.0	7.0	7.0	7.0
Flash Dont Walk (s)		23.0	23.0	23.0	23.0			20.0	20.0	22.0	22.0	22.0
Pedestrian Calls (#/hr)		5	5	5	5			5	5	5	5	5
Act Effct Green (s)	14.6	28.2	28.2	14.0	14.0		19.5	79.8	79.8	54.4	54.4	54.4
Actuated g/C Ratio	0.12	0.24	0.24	0.12	0.12		0.16	0.66	0.66	0.45	0.45	0.45
v/c Ratio	0.80	0.03	0.50	0.07	0.15		0.79	0.21	0.01	0.08	0.36	0.55
Control Delay	66.3	27.2	5.8	43.7	24.2		59.4	10.4	0.0	21.0	18.5	6.5
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.1
Total Delay	66.3	27.2	5.8	43.7	24.2		59.4	10.4	0.0	21.0	18.5	6.7
LOS	E	C	A	D	C		E	B	A	C	B	A
Approach Delay		37.6			29.4			33.0			12.8	
Approach LOS		D			C			C			B	
Queue Length 50th (m)	42.3	2.2	0.0	2.8	2.8		54.6	25.2	0.0	2.7	28.2	4.6
Queue Length 95th (m)	#62.5	5.6	16.5	7.5	10.8		#79.0	51.3	0.0	12.2	76.0	53.1
Internal Link Dist (m)		269.2			133.4			207.2			205.6	
Turn Bay Length (m)	60.0		60.0	60.0			60.0		60.0	60.0		60.0
Base Capacity (vph)	433	800	852	353	442		581	2381	1092	399	1622	1033
Starvation Cap Reductn	0	0	0	0	0		0	0	0	0	0	59
Spillback Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Reduced v/c Ratio	0.78	0.01	0.35	0.03	0.07		0.77	0.21	0.01	0.08	0.36	0.58

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 77 (64%), Referenced to phase 2:NBT and 6:SBTL, Start of Green
Natural Cycle: 100
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.80
Intersection Signal Delay: 25.7 Intersection LOS: C
Intersection Capacity Utilization 67.2% ICU Level of Service C
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 7: 40 Ave & 25 St



Ultimate Total Traffic AM Peak
1: Hwy 16 (44 St) & 37 Ave

11-15-2022

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱		✥			✥	
Traffic Volume (vph)	50	1343	115	69	1239	50	25	10	36	50	10	50
Future Volume (vph)	50	1343	115	69	1239	50	25	10	36	50	10	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	130.0		60.0	60.0		130.0	60.0		0.0	0.0		0.0
Storage Lanes	1		1	1		1	0		0	0		0
Taper Length (m)	30.0			30.0			30.0			30.0		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	1.00		0.99	1.00		0.98		0.99			0.99	
Frt			0.850			0.850		0.932			0.939	
Flt Protected	0.950			0.950				0.983			0.978	
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	0	1707	0	0	1713	0
Flt Permitted	0.197			0.170				0.870			0.820	
Satd. Flow (perm)	371	3579	1578	320	3579	1563	0	1507	0	0	1431	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			115			50		36			48	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		571.8			278.8			154.9			123.0	
Travel Time (s)		34.3			16.7			9.3			7.4	
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	50	1343	115	69	1239	50	25	10	36	50	10	50
Shared Lane Traffic (%)												
Lane Group Flow (vph)	50	1343	115	69	1239	50	0	71	0	0	110	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Number of Detectors	1	2	1	1	2	1	1	2		1	2	
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru		Left	Thru	
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0		2.0	10.0	
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6		2.0	0.6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	2		2	6		6	8			4		
Detector Phase	2	2	2	6	6	6	8	8		4	4	
Switch Phase												
Minimum Initial (s)	15.0	15.0	15.0	15.0	15.0	15.0	10.0	10.0		10.0	10.0	
Minimum Split (s)	21.0	21.0	21.0	21.0	21.0	21.0	16.0	16.0		16.0	16.0	
Total Split (s)	57.0	57.0	57.0	57.0	57.0	57.0	18.0	18.0		18.0	18.0	
Total Split (%)	76.0%	76.0%	76.0%	76.0%	76.0%	76.0%	24.0%	24.0%		24.0%	24.0%	
Maximum Green (s)	51.0	51.0	51.0	51.0	51.0	51.0	12.0	12.0		12.0	12.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0		6.0			6.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	C-Max	C-Max	C-Max	C-Max	C-Max	C-Max	Min	Min		Min	Min	
Act Effct Green (s)	52.5	52.5	52.5	52.5	52.5	52.5		10.5			10.5	
Actuated g/C Ratio	0.70	0.70	0.70	0.70	0.70	0.70		0.14			0.14	
v/c Ratio	0.19	0.54	0.10	0.31	0.50	0.05		0.29			0.45	
Control Delay	6.8	10.4	2.2	9.0	6.1	1.4		34.7			24.5	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Total Delay	6.8	10.4	2.2	9.0	6.1	1.4		34.7			24.5	
LOS	A	B	A	A	A	A		C			C	
Approach Delay		9.6			6.1			34.7			24.5	
Approach LOS		A			A			C			C	
Queue Length 50th (m)	3.8	137.1	2.4	3.1	35.5	0.0		8.1			8.5	
Queue Length 95th (m)	m7.1	m192.1	m7.7	13.5	63.7	3.4		m16.7			26.7	
Internal Link Dist (m)		547.8			254.8			130.9			99.0	
Turn Bay Length (m)	130.0		60.0	60.0		130.0						
Base Capacity (vph)	259	2503	1138	224	2503	1108		271			269	
Starvation Cap Reductn	0	0	0	0	0	0		0			0	
Spillback Cap Reductn	0	0	0	0	0	0		0			0	
Storage Cap Reductn	0	0	0	0	0	0		0			0	
Reduced v/c Ratio	0.19	0.54	0.10	0.31	0.50	0.05		0.26			0.41	

Intersection Summary

Area Type: Other

Cycle Length: 75

Actuated Cycle Length: 75

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Natural Cycle: 50

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.54

Intersection Signal Delay: 9.2 Intersection LOS: A

Intersection Capacity Utilization 74.1% ICU Level of Service D

Analysis Period (min) 60

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Hwy 16 (44 St) & 37 Ave

Ultimate Total Traffic AM Peak
2: 40 Ave & Hwy 16 (44 St)

11-15-2022

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↑	↱	↰↰	↑↑	↱	↰↰	↑↑	↱	↰↰	↑↑	↱
Traffic Volume (vph)	551	522	520	512	508	497	555	667	615	408	476	304
Future Volume (vph)	551	522	520	512	508	497	555	667	615	408	476	304
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0		120.0	120.0		0.0	100.0		100.0	100.0		100.0
Storage Lanes	2		1	2		1	2		1	2		1
Taper Length (m)	30.0			30.0			30.0			30.0		
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00
Ped Bike Factor	0.99		0.98	1.00		0.98	0.99		0.98	0.99		0.98
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3471	3579	1601	3471	3579	1601	3471	3579	1601	3471	3579	1601
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	3449	3579	1572	3454	3579	1570	3451	3579	1569	3453	3579	1571
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			65			298			419			109
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		786.6			571.8			287.0			465.2	
Travel Time (s)		47.2			34.3			17.2			27.9	
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	551	522	520	512	508	497	555	667	615	408	476	304
Shared Lane Traffic (%)												
Lane Group Flow (vph)	551	522	520	512	508	497	555	667	615	408	476	304
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		9.0			9.0			9.0			9.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Prot	NA	pm+ov	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	pm+ov
Protected Phases	5	2	3	1	6		3	8		7	4	5

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases			2			6			8			4
Detector Phase	5	2	3	1	6	6	3	8	8	7	4	5
Switch Phase												
Minimum Initial (s)	7.0	15.0	7.0	7.0	15.0	15.0	7.0	10.0	10.0	7.0	10.0	7.0
Minimum Split (s)	13.0	43.0	13.0	13.0	35.0	35.0	13.0	34.0	34.0	13.0	40.0	13.0
Total Split (s)	33.0	43.0	32.0	35.0	45.0	45.0	32.0	45.0	45.0	27.0	40.0	33.0
Total Split (%)	22.0%	28.7%	21.3%	23.3%	30.0%	30.0%	21.3%	30.0%	30.0%	18.0%	26.7%	22.0%
Maximum Green (s)	27.0	37.0	26.0	29.0	39.0	39.0	26.0	39.0	39.0	21.0	34.0	27.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lead	Lag	Lag	Lag	Lag	Lag	Lead	Lead	Lag	Lead	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max	None	None	C-Max	C-Max	None	Min	Min	None	Min	None
Walk Time (s)		7.0			7.0	7.0		7.0	7.0		7.0	
Flash Dont Walk (s)		30.0			22.0	22.0		21.0	21.0		27.0	
Pedestrian Calls (#/hr)		5			5	5		5	5		5	
Act Effct Green (s)	26.3	41.1	71.2	29.0	43.7	43.7	30.1	34.8	34.8	21.2	25.8	52.1
Actuated g/C Ratio	0.18	0.27	0.47	0.19	0.29	0.29	0.20	0.23	0.23	0.14	0.17	0.35
v/c Ratio	0.91	0.53	0.66	0.76	0.49	0.74	0.80	0.80	0.90	0.83	0.77	0.49
Control Delay	85.2	49.7	29.0	70.0	51.6	31.7	66.7	62.8	37.8	79.9	68.4	14.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	85.2	49.7	29.0	70.0	51.6	31.7	66.7	62.8	37.8	79.9	68.4	14.5
LOS	F	D	C	E	D	C	E	E	D	E	E	B
Approach Delay		55.2			51.3			55.6			58.6	
Approach LOS		E			D			E			E	
Queue Length 50th (m)	87.8	76.4	97.8	77.3	76.0	68.0	82.6	104.0	68.7	63.2	76.3	22.3
Queue Length 95th (m)	#143.0	110.0	#189.3	#116.9	110.7	#156.8	#148.6	142.3	#193.5	#109.7	102.6	44.6
Internal Link Dist (m)		762.6			547.8			263.0			441.2	
Turn Bay Length (m)	120.0		120.0	120.0			100.0		100.0	100.0		100.0
Base Capacity (vph)	625	979	785	671	1043	668	697	930	718	504	811	629
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.88	0.53	0.66	0.76	0.49	0.74	0.80	0.72	0.86	0.81	0.59	0.48

Intersection Summary

Area Type: Other

Cycle Length: 150

Actuated Cycle Length: 150

Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Green, Master Intersection

Natural Cycle: 130

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.91

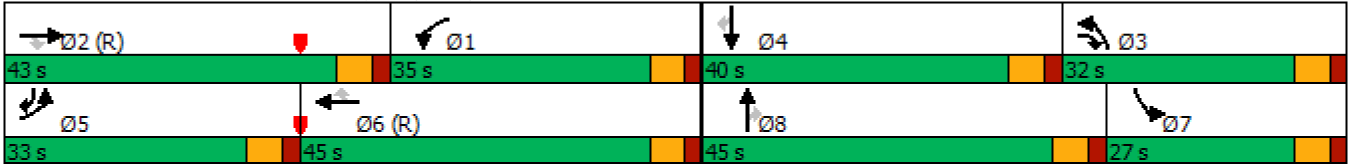
Intersection Signal Delay: 55.0 Intersection LOS: E

Intersection Capacity Utilization 96.8% ICU Level of Service F

Analysis Period (min) 60

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 2: 40 Ave & Hwy 16 (44 St)



	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Traffic Volume (vph)	331	7	120	230	7	279	121	1226	141	379	665	320
Future Volume (vph)	331	7	120	230	7	279	121	1226	141	379	665	320
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0		60.0	60.0		60.0	60.0		60.0	60.0		60.0
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (m)	30.0			30.0			30.0			30.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Ped Bike Factor	1.00		0.98	1.00		0.98	1.00		0.98	1.00		0.97
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	1883	1601	1789	1883	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.753			0.753			0.399			0.167		
Satd. Flow (perm)	1412	1883	1575	1412	1883	1575	749	3579	1573	314	3579	1556
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			149			279			94			320
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		224.2			128.4			519.4			287.0	
Travel Time (s)		13.5			7.7			31.2			17.2	
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	331	7	120	230	7	279	121	1226	141	379	665	320
Shared Lane Traffic (%)												
Lane Group Flow (vph)	331	7	120	230	7	279	121	1226	141	379	665	320
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			6.0			6.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		4			8		5	2		1	6	

3: 41 St & 40 Ave

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	4	4	4	8	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	7.0	15.0	15.0	7.0	15.0	15.0
Minimum Split (s)	45.0	45.0	45.0	44.0	44.0	44.0	21.0	35.0	35.0	13.0	40.0	40.0
Total Split (s)	45.0	45.0	45.0	45.0	45.0	45.0	21.0	45.0	45.0	20.0	44.0	44.0
Total Split (%)	40.9%	40.9%	40.9%	40.9%	40.9%	40.9%	19.1%	40.9%	40.9%	18.2%	40.0%	40.0%
Maximum Green (s)	39.0	39.0	39.0	39.0	39.0	39.0	15.0	39.0	39.0	14.0	38.0	38.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag							Lag	Lag	Lag	Lead	Lead	Lead
Lead-Lag Optimize?							Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None	None	C-Max	C-Max	None	C-Max	C-Max
Walk Time (s)	7.0	7.0	7.0	7.0	7.0	7.0		7.0	7.0		7.0	7.0
Flash Dont Walk (s)	32.0	32.0	32.0	31.0	31.0	31.0		22.0	22.0		27.0	27.0
Pedestrian Calls (#/hr)	5	5	5	5	5	5		5	5		5	5
Act Effct Green (s)	30.7	30.7	30.7	30.7	30.7	30.7	39.0	39.0	39.0	46.3	46.3	46.3
Actuated g/C Ratio	0.28	0.28	0.28	0.28	0.28	0.28	0.35	0.35	0.35	0.42	0.42	0.42
v/c Ratio	0.84	0.01	0.22	0.58	0.01	0.44	0.30	0.97	0.23	0.88	0.44	0.38
Control Delay	58.8	24.7	3.1	39.4	24.7	5.3	30.5	63.6	10.4	58.0	25.1	4.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	58.8	24.7	3.1	39.4	24.7	5.4	30.5	63.6	10.4	58.0	25.1	4.2
LOS	E	C	A	D	C	A	C	E	B	E	C	A
Approach Delay		43.7			20.8			55.8			29.3	
Approach LOS		D			C			E			C	
Queue Length 50th (m)	69.9	1.1	0.0	44.4	1.1	0.0	18.8	141.7	7.0	66.7	55.7	0.0
Queue Length 95th (m)	#113.0	4.7	11.2	73.2	4.7	26.3	37.2	#228.6	25.9	#180.7	93.9	29.8
Internal Link Dist (m)		200.2			104.4			495.4			263.0	
Turn Bay Length (m)	60.0		60.0	60.0		60.0	60.0		60.0	60.0		60.0
Base Capacity (vph)	500	667	654	500	667	738	407	1268	618	430	1505	839
Starvation Cap Reductn	0	0	0	0	0	45	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.66	0.01	0.18	0.46	0.01	0.40	0.30	0.97	0.23	0.88	0.44	0.38

Intersection Summary

Area Type: Other

Cycle Length: 110

Actuated Cycle Length: 110

Offset: 72 (65%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 110

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.97

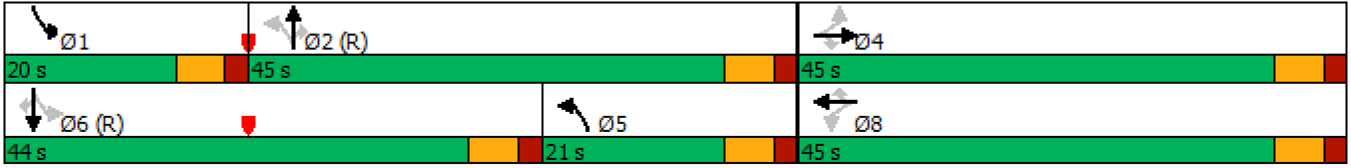
Intersection Signal Delay: 40.2 Intersection LOS: D

Intersection Capacity Utilization 96.0% ICU Level of Service F

Analysis Period (min) 60

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: 41 St & 40 Ave



Ultimate Total Traffic AM Peak
4: 36 Street

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Traffic Volume (vph)	276	11	148	104	6	67	187	1145	66	129	680	207
Future Volume (vph)	276	11	148	104	6	67	187	1145	66	129	680	207
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	80.0		60.0	60.0		60.0	60.0		60.0	60.0		60.0
Storage Lanes	1		0	1		1	1		1	1		1
Taper Length (m)	30.0			30.0			30.0			30.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Ped Bike Factor	1.00		0.98				1.00					0.97
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	1883	1601	1789	1883	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.754			0.750			0.370			0.190		
Satd. Flow (perm)	1415	1883	1576	1413	1883	1601	695	3579	1601	358	3579	1557
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			119			36			63			207
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		241.7			166.9			418.8			519.4	
Travel Time (s)		14.5			10.0			25.1			31.2	
Confl. Peds. (#/hr)	5		5				5					5
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	276	11	148	104	6	67	187	1145	66	129	680	207
Shared Lane Traffic (%)												
Lane Group Flow (vph)	276	11	148	104	6	67	187	1145	66	129	680	207
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			6.0			6.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	35		25	35		25	35		25	35		25
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm

4: 36 Street

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	4	4	4	8	8	8	2	2	2	6	6	6
Switch Phase												
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	15.0	15.0	15.0	15.0	15.0	15.0
Minimum Split (s)	43.0	43.0	43.0	45.0	45.0	45.0	40.0	40.0	40.0	35.0	35.0	35.0
Total Split (s)	47.0	47.0	47.0	47.0	47.0	47.0	43.0	43.0	43.0	43.0	43.0	43.0
Total Split (%)	52.2%	52.2%	52.2%	52.2%	52.2%	52.2%	47.8%	47.8%	47.8%	47.8%	47.8%	47.8%
Maximum Green (s)	41.0	41.0	41.0	41.0	41.0	41.0	37.0	37.0	37.0	37.0	37.0	37.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None	C-Max	C-Max	C-Max	C-Max	C-Max	C-Max
Walk Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Flash Dont Walk (s)	30.0	30.0	30.0	32.0	32.0	32.0	27.0	27.0	27.0	22.0	22.0	22.0
Pedestrian Calls (#/hr)	5	5	5	5	5	5	5	5	5	5	5	5
Act Effct Green (s)	24.8	24.8	24.8	24.8	24.8	24.8	53.2	53.2	53.2	53.2	53.2	53.2
Actuated g/C Ratio	0.28	0.28	0.28	0.28	0.28	0.28	0.59	0.59	0.59	0.59	0.59	0.59
v/c Ratio	0.71	0.02	0.28	0.27	0.01	0.14	0.46	0.54	0.07	0.61	0.32	0.21
Control Delay	38.8	18.6	7.2	24.6	18.3	11.7	19.4	14.8	7.4	33.0	11.4	2.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	38.8	18.6	7.2	24.6	18.3	11.7	19.4	14.8	7.4	33.0	11.4	2.7
LOS	D	B	A	C	B	B	B	B	A	C	B	A
Approach Delay		27.6			19.5			15.1			12.4	
Approach LOS		C			B			B			B	
Queue Length 50th (m)	46.2	1.5	4.0	15.1	0.8	4.3	16.0	55.0	0.0	13.2	29.0	0.0
Queue Length 95th (m)	65.8	4.7	17.3	24.7	3.2	12.5	#65.7	116.0	m11.9	#64.8	68.2	16.6
Internal Link Dist (m)		217.7			142.9			394.8			495.4	
Turn Bay Length (m)	80.0		60.0	60.0		60.0	60.0		60.0	60.0		60.0
Base Capacity (vph)	644	857	782	643	857	748	410	2115	972	211	2115	1005
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.43	0.01	0.19	0.16	0.01	0.09	0.46	0.54	0.07	0.61	0.32	0.21

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 95

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.71

Intersection Signal Delay: 16.2 Intersection LOS: B

Intersection Capacity Utilization 82.5% ICU Level of Service E

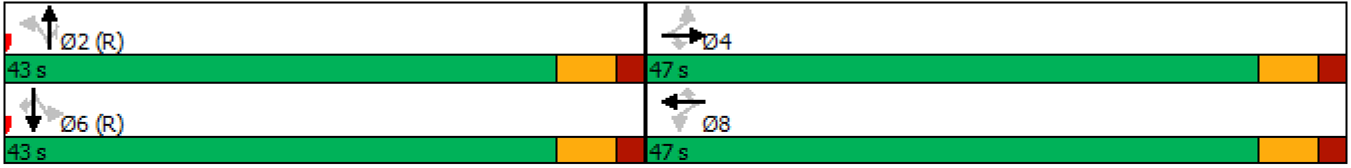
Analysis Period (min) 60

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 4: 36 Street



	↗	→	←	↖	↘	↙
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		Y	
Traffic Volume (vph)	109	96	100	24	8	80
Future Volume (vph)	109	96	100	24	8	80
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.974		0.877	
Flt Protected		0.974			0.995	
Satd. Flow (prot)	0	1834	1834	0	1644	0
Flt Permitted		0.974			0.995	
Satd. Flow (perm)	0	1834	1834	0	1644	0
Link Speed (k/h)		60	60		60	
Link Distance (m)		166.9	484.2		199.3	
Travel Time (s)		10.0	29.1		12.0	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	109	96	100	24	8	80
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	205	124	0	88	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.7	3.7		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	35			25	35	25
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 33.2% ICU Level of Service A

Analysis Period (min) 60

Ultimate Total Traffic AM Peak
6: 31 St

11-15-2022

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Traffic Volume (vph)	156	2	53	50	5	139	50	1165	20	49	819	77
Future Volume (vph)	156	2	53	50	5	139	50	1165	20	49	819	77
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0		60.0	60.0		60.0	60.0		60.0	60.0		60.0
Storage Lanes	1		0	1		1	1		1	1		1
Taper Length (m)	30.0			30.0			30.0			30.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Ped Bike Factor	1.00		0.98				1.00					0.97
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	1883	1601	1789	1883	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.754			0.757			0.321			0.202		
Satd. Flow (perm)	1415	1883	1576	1426	1883	1601	603	3579	1601	380	3579	1556
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			53			36			36			77
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		252.3			554.0			792.9			418.8	
Travel Time (s)		15.1			33.2			47.6			25.1	
Confl. Peds. (#/hr)	5		5				5					5
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	156	2	53	50	5	139	50	1165	20	49	819	77
Shared Lane Traffic (%)												
Lane Group Flow (vph)	156	2	53	50	5	139	50	1165	20	49	819	77
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			6.0			6.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	35		25	35		25	35		25	35		25
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	4	4	4	8	8	8	2	2	2	6	6	6
Switch Phase												
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	15.0	15.0	15.0	15.0	15.0	15.0
Minimum Split (s)	43.0	43.0	43.0	45.0	45.0	45.0	40.0	40.0	40.0	33.0	33.0	33.0
Total Split (s)	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Maximum Green (s)	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None	C-Max	C-Max	C-Max	C-Max	C-Max	C-Max
Walk Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Flash Dont Walk (s)	30.0	30.0	30.0	32.0	32.0	32.0	27.0	27.0	27.0	20.0	20.0	20.0
Pedestrian Calls (#/hr)	5	5	5	5	5	5	5	5	5	5	5	5
Act Effct Green (s)	19.0	19.0	19.0	19.0	19.0	19.0	59.0	59.0	59.0	59.0	59.0	59.0
Actuated g/C Ratio	0.21	0.21	0.21	0.21	0.21	0.21	0.66	0.66	0.66	0.66	0.66	0.66
v/c Ratio	0.52	0.01	0.14	0.17	0.01	0.38	0.13	0.50	0.02	0.20	0.35	0.07
Control Delay	35.6	20.5	6.6	26.1	21.0	22.6	11.5	11.6	3.9	10.4	7.3	2.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	35.6	20.5	6.6	26.1	21.0	22.6	11.5	11.6	3.9	10.4	7.3	2.1
LOS	D	C	A	C	C	C	B	B	A	B	A	A
Approach Delay		28.2			23.5			11.4			7.0	
Approach LOS		C			C			B			A	
Queue Length 50th (m)	26.8	0.3	0.0	7.9	0.8	16.8	3.1	43.2	0.3	2.2	19.4	0.0
Queue Length 95th (m)	35.9	1.7	8.0	13.6	2.9	26.5	m9.1	82.5	m0.7	10.7	51.0	3.2
Internal Link Dist (m)		228.3			530.0			768.9			394.8	
Turn Bay Length (m)	60.0		60.0	60.0		60.0	60.0		60.0	60.0		60.0
Base Capacity (vph)	613	815	712	617	815	714	395	2344	1061	248	2344	1045
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.25	0.00	0.07	0.08	0.01	0.19	0.13	0.50	0.02	0.20	0.35	0.07

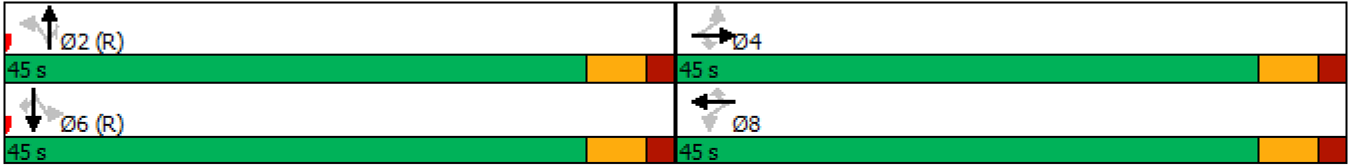
Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 85
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.52
Intersection Signal Delay: 12.1 Intersection LOS: B
Intersection Capacity Utilization 69.2% ICU Level of Service C

Analysis Period (min) 60

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 6: 31 St



	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↱			✥		↰↰	↑↱			↰↑	↱
Traffic Volume (vph)	555	11	410	11	11	28	276	584	11	11	504	356
Future Volume (vph)	555	11	410	11	11	28	276	584	11	11	504	356
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0		60.0	60.0		60.0	60.0		60.0	60.0		60.0
Storage Lanes	1		0	0		0	2		0	0		1
Taper Length (m)	30.0			30.0			30.0			30.0		
Lane Util. Factor	0.97	1.00	1.00	1.00	1.00	1.00	0.97	0.95	0.95	0.95	0.95	1.00
Ped Bike Factor	0.99	0.98			0.99		1.00	1.00			1.00	0.98
Frt		0.854			0.924			0.997				0.850
Flt Protected	0.950				0.989		0.950				0.999	
Satd. Flow (prot)	3471	1582	0	0	1705	0	3471	3566	0	0	3575	1601
Flt Permitted	0.950				0.260		0.950				0.935	
Satd. Flow (perm)	3444	1582	0	0	448	0	3455	3566	0	0	3346	1573
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		311			28			2				356
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		293.2			157.4			231.2			792.9	
Travel Time (s)		17.6			9.4			13.9			47.6	
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	555	11	410	11	11	28	276	584	11	11	504	356
Shared Lane Traffic (%)												
Lane Group Flow (vph)	555	421	0	0	50	0	276	595	0	0	515	356
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			8.0			8.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Number of Detectors	1	2		1	2		1	2		1	2	1
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	Right
Leading Detector (m)	2.0	10.0		2.0	10.0		2.0	10.0		2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6		2.0	0.6		2.0	0.6		2.0	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Prot	NA		Perm	NA		Prot	NA		Perm	NA	Perm
Protected Phases	7	4			8		5	2			6	

7: 40 Ave & 25 St

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases				8						6		6
Detector Phase	7	4		8	8		5	2		6	6	6
Switch Phase												
Minimum Initial (s)	7.0	10.0		10.0	10.0		7.0	15.0		15.0	15.0	15.0
Minimum Split (s)	13.0	33.0		33.0	33.0		13.0	27.0		30.0	30.0	30.0
Total Split (s)	14.0	47.0		33.0	33.0		13.0	43.0		30.0	30.0	30.0
Total Split (%)	15.6%	52.2%		36.7%	36.7%		14.4%	47.8%		33.3%	33.3%	33.3%
Maximum Green (s)	8.0	41.0		27.0	27.0		7.0	37.0		24.0	24.0	24.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0			0.0		0.0	0.0			0.0	0.0
Total Lost Time (s)	6.0	6.0			6.0		6.0	6.0			6.0	6.0
Lead/Lag	Lag			Lead	Lead		Lead			Lag	Lag	Lag
Lead-Lag Optimize?	Yes			Yes	Yes		Yes			Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None		None	None		None	C-Max		C-Max	C-Max	C-Max
Walk Time (s)		7.0		7.0	7.0			7.0		7.0	7.0	7.0
Flash Dont Walk (s)		20.0		20.0	20.0			14.0		17.0	17.0	17.0
Pedestrian Calls (#/hr)		5		5	5			5		5	5	5
Act Effct Green (s)	25.6	38.6			13.4		8.5	39.4			24.9	24.9
Actuated g/C Ratio	0.28	0.43			0.15		0.09	0.44			0.28	0.28
v/c Ratio	0.56	0.49			0.56		0.84	0.38			0.56	0.51
Control Delay	34.6	6.8			42.8		68.7	18.3			37.7	15.6
Queue Delay	0.0	0.0			0.0		0.0	0.0			0.0	0.0
Total Delay	34.6	6.8			42.8		68.7	18.3			37.7	15.6
LOS	C	A			D		E	B			D	B
Approach Delay		22.6			42.8			34.2			28.7	
Approach LOS		C			D			C			C	
Queue Length 50th (m)	44.6	11.3			3.8		~27.1	39.1			53.4	17.5
Queue Length 95th (m)	#127.3	44.7			16.3		#61.9	61.2			78.1	75.3
Internal Link Dist (m)		269.2			133.4			207.2			768.9	
Turn Bay Length (m)	60.0						60.0					60.0
Base Capacity (vph)	986	890			154		329	1563			925	692
Starvation Cap Reductn	0	0			0		0	0			0	0
Spillback Cap Reductn	0	0			0		0	0			0	0
Storage Cap Reductn	0	0			0		0	0			0	0
Reduced v/c Ratio	0.56	0.47			0.32		0.84	0.38			0.56	0.51

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green

Natural Cycle: 90

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.84

Intersection Signal Delay: 28.5 Intersection LOS: C

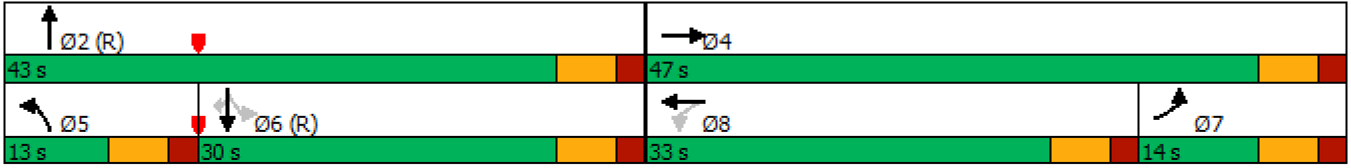
Intersection Capacity Utilization 79.0% ICU Level of Service D

Analysis Period (min) 60

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: 40 Ave & 25 St



Ultimate Total Traffic AM Peak

8: 11-15-2022

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱			✥			✥	
Traffic Volume (vph)	25	370	127	38	370	5	116	5	35	5	5	25
Future Volume (vph)	25	370	127	38	370	5	116	5	35	5	5	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.962			0.998			0.970			0.904	
Flt Protected	0.950			0.950				0.964			0.993	
Satd. Flow (prot)	1789	1812	0	1789	1880	0	0	1761	0	0	1691	0
Flt Permitted	0.390			0.238				0.774			0.972	
Satd. Flow (perm)	735	1812	0	448	1880	0	0	1414	0	0	1655	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		32			1			22			25	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		128.4			452.1			79.4			60.6	
Travel Time (s)		7.7			27.1			4.8			3.6	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	25	370	127	38	370	5	116	5	35	5	5	25
Shared Lane Traffic (%)												
Lane Group Flow (vph)	25	497	0	38	375	0	0	156	0	0	35	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	35		25	35		25	35		25	35		25
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	2.0	10.0		2.0	10.0		2.0	10.0		2.0	10.0	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	2.0	0.6		2.0	0.6		2.0	0.6		2.0	0.6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	15.0	15.0		15.0	15.0		10.0	10.0		10.0	10.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Minimum Split (s)	27.0	27.0		27.0	27.0		27.0	27.0		27.0	27.0	
Total Split (s)	42.0	42.0		42.0	42.0		33.0	33.0		33.0	33.0	
Total Split (%)	56.0%	56.0%		56.0%	56.0%		44.0%	44.0%		44.0%	44.0%	
Maximum Green (s)	36.0	36.0		36.0	36.0		27.0	27.0		27.0	27.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0			0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0			6.0			6.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Walk Time (s)	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	14.0	14.0		14.0	14.0		14.0	14.0		14.0	14.0	
Pedestrian Calls (#/hr)	5	5		5	5		5	5		5	5	
Act Effct Green (s)	25.5	25.5		25.5	25.5			37.5			37.5	
Actuated g/C Ratio	0.34	0.34		0.34	0.34			0.50			0.50	
v/c Ratio	0.10	0.78		0.25	0.59			0.22			0.04	
Control Delay	15.0	29.7		18.3	21.6			11.9			7.3	
Queue Delay	0.0	0.1		0.0	0.0			0.0			0.0	
Total Delay	15.0	29.8		18.3	21.6			11.9			7.3	
LOS	B	C		B	C			B			A	
Approach Delay		29.1			21.3			11.9			7.3	
Approach LOS		C			C			B			A	
Queue Length 50th (m)	2.5	61.2		3.7	41.6			10.5			0.7	
Queue Length 95th (m)	7.2	94.8		7.4	47.4			30.7			7.2	
Internal Link Dist (m)		104.4			428.1			55.4			36.6	
Turn Bay Length (m)												
Base Capacity (vph)	352	886		215	902			718			839	
Starvation Cap Reductn	0	40		0	0			0			0	
Spillback Cap Reductn	0	0		0	0			0			0	
Storage Cap Reductn	0	0		0	0			0			0	
Reduced v/c Ratio	0.07	0.59		0.18	0.42			0.22			0.04	

Intersection Summary

Area Type: Other

Cycle Length: 75

Actuated Cycle Length: 75

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 55

Control Type: Actuated-Coordinated

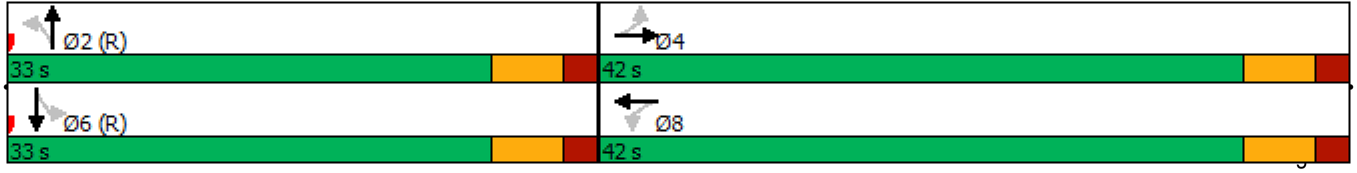
Maximum v/c Ratio: 0.78

Intersection Signal Delay: 23.2 Intersection LOS: C

Intersection Capacity Utilization 57.1% ICU Level of Service B

Analysis Period (min) 60

Splits and Phases: 12:



Ultimate Total Traffic PM Peak
1: Hwy 16 (44 St) & 37 Ave

11-15-2022

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱		✥			✥	
Traffic Volume (vph)	50	1354	35	52	1588	50	104	10	74	50	10	50
Future Volume (vph)	50	1354	35	52	1588	50	104	10	74	50	10	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	130.0		60.0	60.0		130.0	60.0		0.0	0.0		0.0
Storage Lanes	1		1	1		1	0		0	0		0
Taper Length (m)	30.0			30.0			30.0			30.0		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	1.00		0.99	1.00		0.98		0.99			0.99	
Frt			0.850			0.850		0.947			0.939	
Flt Protected	0.950			0.950				0.973			0.978	
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	0	1721	0	0	1713	0
Flt Permitted	0.114			0.164				0.811			0.771	
Satd. Flow (perm)	215	3579	1578	309	3579	1563	0	1429	0	0	1347	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			44			50		37			46	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		571.8			278.8			154.9			123.0	
Travel Time (s)		34.3			16.7			9.3			7.4	
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	50	1354	35	52	1588	50	104	10	74	50	10	50
Shared Lane Traffic (%)												
Lane Group Flow (vph)	50	1354	35	52	1588	50	0	188	0	0	110	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Number of Detectors	1	2	1	1	2	1	1	2		1	2	
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru		Left	Thru	
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0		2.0	10.0	
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6		2.0	0.6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	2		2	6		6	8			4		
Detector Phase	2	2	2	6	6	6	8	8		4	4	
Switch Phase												
Minimum Initial (s)	15.0	15.0	15.0	15.0	15.0	15.0	10.0	10.0		10.0	10.0	
Minimum Split (s)	21.0	21.0	21.0	21.0	21.0	21.0	16.0	16.0		16.0	16.0	
Total Split (s)	57.0	57.0	57.0	57.0	57.0	57.0	18.0	18.0		18.0	18.0	
Total Split (%)	76.0%	76.0%	76.0%	76.0%	76.0%	76.0%	24.0%	24.0%		24.0%	24.0%	
Maximum Green (s)	51.0	51.0	51.0	51.0	51.0	51.0	12.0	12.0		12.0	12.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0		6.0			6.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	C-Max	C-Max	C-Max	C-Max	C-Max	C-Max	Min	Min		Min	Min	
Act Effct Green (s)	51.5	51.5	51.5	51.5	51.5	51.5		11.5			11.5	
Actuated g/C Ratio	0.69	0.69	0.69	0.69	0.69	0.69		0.15			0.15	
v/c Ratio	0.34	0.55	0.03	0.25	0.65	0.05		0.76			0.45	
Control Delay	12.8	7.1	1.2	8.1	8.3	1.4		54.9			24.4	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Total Delay	12.8	7.1	1.2	8.1	8.3	1.4		54.9			24.4	
LOS	B	A	A	A	A	A		D			C	
Approach Delay		7.1			8.1			54.9			24.4	
Approach LOS		A			A			D			C	
Queue Length 50th (m)	2.6	46.0	0.0	2.5	60.2	0.0		33.3			8.5	
Queue Length 95th (m)	13.5	73.9	2.4	9.5	100.2	3.4		m#57.8			27.4	
Internal Link Dist (m)		547.8			254.8			130.9			99.0	
Turn Bay Length (m)	130.0		60.0	60.0		130.0						
Base Capacity (vph)	147	2458	1098	212	2458	1089		259			254	
Starvation Cap Reductn	0	0	0	0	0	0		0			0	
Spillback Cap Reductn	0	0	0	0	0	0		0			0	
Storage Cap Reductn	0	0	0	0	0	0		0			0	
Reduced v/c Ratio	0.34	0.55	0.03	0.25	0.65	0.05		0.73			0.43	

Intersection Summary

Area Type: Other

Cycle Length: 75

Actuated Cycle Length: 75

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Natural Cycle: 60

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.76

Intersection Signal Delay: 10.8 Intersection LOS: B

Intersection Capacity Utilization 69.0% ICU Level of Service C

Analysis Period (min) 60

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Hwy 16 (44 St) & 37 Ave

2: 40 Ave & Hwy 16 (44 St)

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↑	↱	↰↰	↑↑	↱	↰↰	↑↑	↱	↰↰	↑↑	↱
Traffic Volume (vph)	304	661	733	688	688	418	677	510	474	486	774	551
Future Volume (vph)	304	661	733	688	688	418	677	510	474	486	774	551
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0		120.0	120.0		0.0	100.0		100.0	100.0		100.0
Storage Lanes	2		1	2		1	2		1	2		1
Taper Length (m)	30.0			30.0			30.0			30.0		
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00
Ped Bike Factor	1.00		0.98	1.00		0.98	1.00		0.98	0.99		0.98
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3471	3579	1601	3471	3579	1601	3471	3579	1601	3471	3579	1601
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	3454	3579	1572	3457	3579	1570	3458	3579	1569	3448	3579	1571
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			109			380			342			65
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		786.6			571.8			287.0			465.2	
Travel Time (s)		47.2			34.3			17.2			27.9	
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	304	661	733	688	688	418	677	510	474	486	774	551
Shared Lane Traffic (%)												
Lane Group Flow (vph)	304	661	733	688	688	418	677	510	474	486	774	551
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		9.0			9.0			9.0			9.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Prot	NA	pm+ov	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	pm+ov
Protected Phases	5	2	3	1	6		3	8		7	4	5

Ultimate Total Traffic PM Peak
2: 40 Ave & Hwy 16 (44 St) 11-15-2022

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases			2			6			8			4
Detector Phase	5	2	3	1	6	6	3	8	8	7	4	5
Switch Phase												
Minimum Initial (s)	7.0	15.0	7.0	7.0	15.0	15.0	7.0	10.0	10.0	7.0	10.0	7.0
Minimum Split (s)	13.0	43.0	13.0	13.0	35.0	35.0	13.0	34.0	34.0	13.0	40.0	13.0
Total Split (s)	32.0	43.0	33.0	34.0	45.0	45.0	33.0	43.0	43.0	30.0	40.0	32.0
Total Split (%)	21.3%	28.7%	22.0%	22.7%	30.0%	30.0%	22.0%	28.7%	28.7%	20.0%	26.7%	21.3%
Maximum Green (s)	26.0	37.0	27.0	28.0	39.0	39.0	27.0	37.0	37.0	24.0	34.0	26.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lag	Lag	Lag	Lead	Lead	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	Max	None	None	Max	Max	None	Min	Min	None	Min	None
Walk Time (s)		7.0			7.0	7.0		7.0	7.0		7.0	
Flash Dont Walk (s)		30.0			22.0	22.0		21.0	21.0		27.0	
Pedestrian Calls (#/hr)		5			5	5		5	5		5	
Act Effct Green (s)	23.2	37.0	64.0	28.0	41.8	41.8	27.0	37.4	37.4	23.4	33.7	56.9
Actuated g/C Ratio	0.15	0.25	0.43	0.19	0.28	0.28	0.18	0.25	0.25	0.16	0.23	0.38
v/c Ratio	0.57	0.75	0.99	1.06	0.69	0.59	1.08	0.57	0.73	0.90	0.96	0.86
Control Delay	62.6	58.4	81.1	203.5	53.1	10.1	236.4	52.3	21.8	87.4	92.8	35.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	62.6	58.4	81.1	203.5	53.1	10.1	236.4	52.3	21.8	87.4	92.8	35.6
LOS	E	E	F	F	D	B	F	D	C	F	F	D
Approach Delay		69.0			100.7			118.6			73.9	
Approach LOS		E			F			F			E	
Queue Length 50th (m)	45.2	101.4	106.0	~121.8	104.0	9.0	~122.0	74.4	38.5	77.6	127.1	73.8
Queue Length 95th (m)	69.0	143.4	#355.7	#192.4	147.4	67.4	#192.2	107.3	#119.3	#129.2	#202.3	#157.1
Internal Link Dist (m)		762.6			547.8			263.0			441.2	
Turn Bay Length (m)	120.0		120.0	120.0			100.0		100.0	100.0		100.0
Base Capacity (vph)	602	884	739	648	999	712	625	892	648	556	812	670
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.50	0.75	0.99	1.06	0.69	0.59	1.08	0.57	0.73	0.87	0.95	0.82

Intersection Summary

Area Type: Other

Cycle Length: 150

Actuated Cycle Length: 149.7

Natural Cycle: 150

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 1.08

Intersection Signal Delay: 90.3 Intersection LOS: F

Intersection Capacity Utilization 112.2% ICU Level of Service H

Analysis Period (min) 60

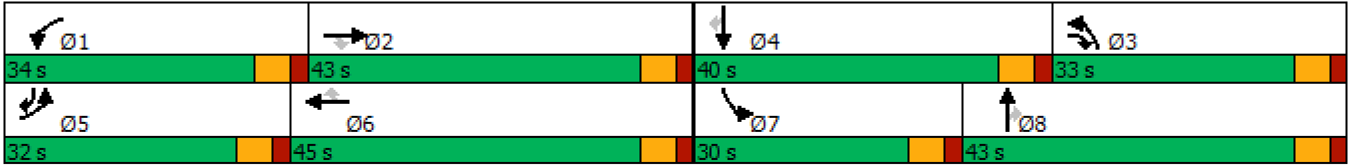
~ Volume exceeds capacity, queue is theoretically infinite.

~ Queue shown is maximum after two cycles.

\# 95th percentile volume exceeds capacity, queue may be longer.

~ Queue shown is maximum after two cycles.

Splits and Phases: 2: 40 Ave & Hwy 16 (44 St)



	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Traffic Volume (vph)	320	8	122	237	8	506	121	839	236	519	1343	331
Future Volume (vph)	320	8	122	237	8	506	121	839	236	519	1343	331
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0		60.0	60.0		60.0	60.0		60.0	60.0		60.0
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (m)	30.0			30.0			30.0			30.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Ped Bike Factor	0.99		0.98	0.99		0.98	1.00		0.98			0.97
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	1883	1601	1789	1883	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.752			0.752			0.175			0.092		
Satd. Flow (perm)	1408	1883	1573	1408	1883	1572	329	3579	1570	173	3579	1552
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			153			479			153			154
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		224.2			128.4			519.4			287.0	
Travel Time (s)		13.5			7.7			31.2			17.2	
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	320	8	122	237	8	506	121	839	236	519	1343	331
Shared Lane Traffic (%)												
Lane Group Flow (vph)	320	8	122	237	8	506	121	839	236	519	1343	331
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			6.0			6.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	

3: 41 St & 40 Ave

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	7.0	10.0	10.0	7.0	10.0	10.0	7.0	15.0	15.0	7.0	15.0	15.0
Minimum Split (s)	21.0	45.0	45.0	21.0	44.0	44.0	21.0	35.0	35.0	13.0	40.0	40.0
Total Split (s)	21.0	45.0	45.0	21.0	45.0	45.0	21.0	40.0	40.0	44.0	63.0	63.0
Total Split (%)	14.0%	30.0%	30.0%	14.0%	30.0%	30.0%	14.0%	26.7%	26.7%	29.3%	42.0%	42.0%
Maximum Green (s)	15.0	39.0	39.0	15.0	39.0	39.0	15.0	34.0	34.0	38.0	57.0	57.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lag	Lead	Lead	Lag	Lead	Lead	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None	None	C-Max	C-Max	None	C-Max	C-Max
Walk Time (s)		7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0
Flash Dont Walk (s)		32.0	32.0		31.0	31.0		22.0	22.0		27.0	27.0
Pedestrian Calls (#/hr)		5	5		5	5		5	5		5	5
Act Effct Green (s)	36.4	15.8	15.8	38.6	17.0	17.0	53.3	42.2	42.2	94.4	77.3	77.3
Actuated g/C Ratio	0.24	0.11	0.11	0.26	0.11	0.11	0.36	0.28	0.28	0.63	0.52	0.52
v/c Ratio	0.81	0.04	0.40	0.57	0.04	0.84	0.54	0.83	0.43	0.86	0.73	0.38
Control Delay	69.7	53.6	6.7	47.6	52.5	23.9	32.4	57.0	23.0	55.2	33.4	14.6
Queue Delay	0.0	0.0	0.0	0.1	0.0	0.8	0.0	0.0	0.0	3.0	0.0	0.0
Total Delay	69.7	53.6	6.7	47.7	52.5	24.7	32.4	57.0	23.0	58.1	33.4	14.6
LOS	E	D	A	D	D	C	C	E	C	E	C	B
Approach Delay		52.3			32.3			47.8			36.4	
Approach LOS		D			C			D			D	
Queue Length 50th (m)	89.1	2.4	0.0	64.5	2.1	22.7	11.8	91.2	6.7	129.0	159.2	29.1
Queue Length 95th (m)	124.3	7.4	14.1	94.7	m5.0	59.1	m47.4	#224.7	m74.3	#259.6	#313.0	84.1
Internal Link Dist (m)		200.2			104.4			495.4			263.0	
Turn Bay Length (m)	60.0		60.0	60.0		60.0	60.0		60.0	60.0		60.0
Base Capacity (vph)	403	489	522	429	489	763	275	1007	551	606	1844	874
Starvation Cap Reductn	0	0	0	10	0	75	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	2	30	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.79	0.02	0.23	0.57	0.02	0.74	0.44	0.83	0.43	0.90	0.73	0.38

Intersection Summary

Area Type: Other

Cycle Length: 150

Actuated Cycle Length: 150

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 150

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.86

Intersection Signal Delay: 40.3 Intersection LOS: D

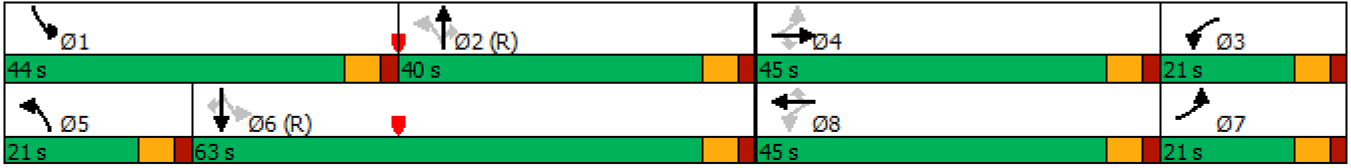
Intersection Capacity Utilization 93.6% ICU Level of Service F

Analysis Period (min) 60

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: 41 St & 40 Ave



Ultimate Total Traffic PM Peak
4: 36 Street

11-15-2022

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Traffic Volume (vph)	204	24	189	124	23	277	151	739	130	281	1101	277
Future Volume (vph)	204	24	189	124	23	277	151	739	130	281	1101	277
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	80.0		60.0	60.0		60.0	60.0		60.0	60.0		60.0
Storage Lanes	1		0	1		1	1		1	1		1
Taper Length (m)	30.0			30.0			30.0			30.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Ped Bike Factor	0.99		0.98									0.97
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	1883	1601	1789	1883	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.742			0.742			0.198			0.308		
Satd. Flow (perm)	1390	1883	1572	1398	1883	1601	373	3579	1601	580	3579	1549
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			189			277			122			174
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		241.7			166.9			418.8			519.4	
Travel Time (s)		14.5			10.0			25.1			31.2	
Confl. Peds. (#/hr)	5		5				5					5
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	204	24	189	124	23	277	151	739	130	281	1101	277
Shared Lane Traffic (%)												
Lane Group Flow (vph)	204	24	189	124	23	277	151	739	130	281	1101	277
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			6.0			6.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	35		25	35		25	35		25	35		25
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	7.0	10.0	10.0	7.0	10.0	10.0	7.0	15.0	15.0	7.0	15.0	15.0
Minimum Split (s)	13.0	43.0	43.0	13.0	45.0	45.0	13.0	40.0	40.0	13.0	35.0	35.0
Total Split (s)	15.0	47.0	47.0	13.0	45.0	45.0	18.0	72.0	72.0	18.0	72.0	72.0
Total Split (%)	10.0%	31.3%	31.3%	8.7%	30.0%	30.0%	12.0%	48.0%	48.0%	12.0%	48.0%	48.0%
Maximum Green (s)	9.0	41.0	41.0	7.0	39.0	39.0	12.0	66.0	66.0	12.0	66.0	66.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lag	Lead	Lead	Lag	Lead	Lead	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None	None	C-Max	C-Max	None	C-Max	C-Max
Walk Time (s)		7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0
Flash Dont Walk (s)		30.0	30.0		32.0	32.0		27.0	27.0		22.0	22.0
Pedestrian Calls (#/hr)		5	5		5	5		5	5		5	5
Act Effct Green (s)	27.4	15.4	15.4	28.3	15.8	15.8	95.0	85.1	85.1	101.4	88.3	88.3
Actuated g/C Ratio	0.18	0.10	0.10	0.19	0.11	0.11	0.63	0.57	0.57	0.68	0.59	0.59
v/c Ratio	0.72	0.12	0.57	0.42	0.12	0.66	0.46	0.36	0.14	0.57	0.52	0.28
Control Delay	68.1	57.9	13.8	52.2	57.0	13.9	16.8	17.1	2.8	15.3	8.7	1.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	68.1	57.9	13.8	52.2	57.0	13.9	16.8	17.1	2.8	15.3	8.7	1.4
LOS	E	E	B	D	E	B	B	B	A	B	A	A
Approach Delay		42.9			27.4			15.2			8.6	
Approach LOS		D			C			B			A	
Queue Length 50th (m)	57.7	7.3	0.0	33.4	7.0	0.0	12.8	55.3	0.0	14.1	32.5	1.4
Queue Length 95th (m)	79.4	15.5	29.5	49.7	15.0	37.1	44.2	76.0	11.4	m51.2	46.8	m6.0
Internal Link Dist (m)		217.7			142.9			394.8			495.4	
Turn Bay Length (m)	80.0		60.0	60.0		60.0	60.0		60.0	60.0		60.0
Base Capacity (vph)	295	514	567	295	489	621	359	2029	960	503	2106	983
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.69	0.05	0.33	0.42	0.05	0.45	0.42	0.36	0.14	0.56	0.52	0.28

Intersection Summary

Area Type: Other

Cycle Length: 150

Actuated Cycle Length: 150

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 115

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.72

Intersection Signal Delay: 16.8 Intersection LOS: B

Intersection Capacity Utilization 73.7% ICU Level of Service D

Analysis Period (min) 60

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 4: 36 Street

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		Y	
Traffic Volume (vph)	192	244	246	16	29	179
Future Volume (vph)	192	244	246	16	29	179
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.992		0.884	
Flt Protected		0.978			0.993	
Satd. Flow (prot)	0	1842	1868	0	1653	0
Flt Permitted		0.978			0.993	
Satd. Flow (perm)	0	1842	1868	0	1653	0
Link Speed (k/h)		60	60		60	
Link Distance (m)		166.9	484.2		199.3	
Travel Time (s)		10.0	29.1		12.0	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	192	244	246	16	29	179
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	436	262	0	208	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.7	3.7		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	35			25	35	25
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 60.0% ICU Level of Service B

Analysis Period (min) 60

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Traffic Volume (vph)	66	8	50	36	6	88	40	875	59	156	1215	95
Future Volume (vph)	66	8	50	36	6	88	40	875	59	156	1215	95
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0		60.0	60.0		60.0	60.0		60.0	60.0		60.0
Storage Lanes	1		0	1		1	1		1	1		1
Taper Length (m)	30.0			30.0			30.0			30.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Ped Bike Factor	0.99		0.98				1.00					0.97
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	1883	1601	1789	1883	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.754			0.752			0.212			0.314		
Satd. Flow (perm)	1412	1883	1572	1416	1883	1601	399	3579	1601	591	3579	1547
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			50			88			59			87
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		252.3			554.0			792.9			418.8	
Travel Time (s)		15.1			33.2			47.6			25.1	
Confl. Peds. (#/hr)	5		5				5					5
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	66	8	50	36	6	88	40	875	59	156	1215	95
Shared Lane Traffic (%)												
Lane Group Flow (vph)	66	8	50	36	6	88	40	875	59	156	1215	95
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			6.0			6.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	35		25	35		25	35		25	35		25
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	4	4	4	8	8	8	2	2	2	6	6	6
Switch Phase												
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	15.0	15.0	15.0	15.0	15.0	15.0
Minimum Split (s)	43.0	43.0	43.0	45.0	45.0	45.0	40.0	40.0	40.0	33.0	33.0	33.0
Total Split (s)	46.0	46.0	46.0	46.0	46.0	46.0	104.0	104.0	104.0	104.0	104.0	104.0
Total Split (%)	30.7%	30.7%	30.7%	30.7%	30.7%	30.7%	69.3%	69.3%	69.3%	69.3%	69.3%	69.3%
Maximum Green (s)	40.0	40.0	40.0	40.0	40.0	40.0	98.0	98.0	98.0	98.0	98.0	98.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None	C-Max	C-Max	C-Max	C-Max	C-Max	C-Max
Walk Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Flash Dont Walk (s)	30.0	30.0	30.0	32.0	32.0	32.0	27.0	27.0	27.0	20.0	20.0	20.0
Pedestrian Calls (#/hr)	5	5	5	5	5	5	5	5	5	5	5	5
Act Effct Green (s)	17.2	17.2	17.2	17.2	17.2	17.2	120.8	120.8	120.8	120.8	120.8	120.8
Actuated g/C Ratio	0.11	0.11	0.11	0.11	0.11	0.11	0.81	0.81	0.81	0.81	0.81	0.81
v/c Ratio	0.41	0.04	0.22	0.22	0.03	0.34	0.12	0.30	0.05	0.33	0.42	0.08
Control Delay	66.1	51.9	14.2	59.0	51.3	12.6	6.5	5.2	1.7	5.0	3.5	0.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	66.1	51.9	14.2	59.0	51.3	12.6	6.5	5.2	1.7	5.0	3.5	0.6
LOS	E	D	B	E	D	B	A	A	A	A	A	A
Approach Delay		44.2			27.2			5.0			3.4	
Approach LOS		D			C			A			A	
Queue Length 50th (m)	20.3	2.4	0.0	10.8	1.8	0.0	1.8	24.9	0.0	5.2	21.5	0.2
Queue Length 95th (m)	33.7	7.4	13.8	20.8	6.2	18.6	11.8	85.0	6.5	14.0	42.7	2.6
Internal Link Dist (m)		228.3			530.0			768.9			394.8	
Turn Bay Length (m)	60.0		60.0	60.0		60.0	60.0		60.0	60.0		60.0
Base Capacity (vph)	376	502	455	377	502	491	321	2881	1300	475	2881	1262
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.18	0.02	0.11	0.10	0.01	0.18	0.12	0.30	0.05	0.33	0.42	0.08

Intersection Summary

Area Type: Other

Cycle Length: 150

Actuated Cycle Length: 150

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 85

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.42

Intersection Signal Delay: 7.0 Intersection LOS: A

Intersection Capacity Utilization 74.6% ICU Level of Service D

Analysis Period (min) 60

Splits and Phases: 6: 31 St

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↱			✥		↰↰	↑↱			↰↑	↱
Traffic Volume (vph)	391	11	276	11	11	19	410	551	11	28	604	587
Future Volume (vph)	391	11	276	11	11	19	410	551	11	28	604	587
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	60.0		60.0	60.0		60.0	60.0		60.0	60.0		60.0
Storage Lanes	1		0	0		0	2		0	0		1
Taper Length (m)	30.0			30.0			30.0			30.0		
Lane Util. Factor	0.97	1.00	1.00	1.00	1.00	1.00	0.97	0.95	0.95	0.95	0.95	1.00
Ped Bike Factor	0.99	0.98			0.99		1.00	1.00			1.00	0.98
Frt		0.856			0.937			0.997				0.850
Flt Protected	0.950				0.987		0.950				0.998	
Satd. Flow (prot)	3471	1586	0	0	1728	0	3471	3566	0	0	3571	1601
Flt Permitted	0.950				0.459		0.950				0.903	
Satd. Flow (perm)	3444	1586	0	0	803	0	3458	3566	0	0	3231	1573
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		276			19			3				587
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		293.2			157.4			231.2			792.9	
Travel Time (s)		17.6			9.4			13.9			47.6	
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	391	11	276	11	11	19	410	551	11	28	604	587
Shared Lane Traffic (%)												
Lane Group Flow (vph)	391	287	0	0	41	0	410	562	0	0	632	587
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			8.0			8.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Number of Detectors	1	2		1	2		1	2		1	2	1
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	Right
Leading Detector (m)	2.0	10.0		2.0	10.0		2.0	10.0		2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6		2.0	0.6		2.0	0.6		2.0	0.6	2.0
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Prot	NA		Perm	NA		Prot	NA		Perm	NA	Perm
Protected Phases	7	4			8		5	2			6	

7: 40 Ave & 25 St

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases				8						6		6
Detector Phase	7	4		8	8		5	2		6	6	6
Switch Phase												
Minimum Initial (s)	7.0	10.0		10.0	10.0		7.0	15.0		15.0	15.0	15.0
Minimum Split (s)	13.0	33.0		33.0	33.0		13.0	27.0		30.0	30.0	30.0
Total Split (s)	13.0	46.0		33.0	33.0		13.0	44.0		31.0	31.0	31.0
Total Split (%)	14.4%	51.1%		36.7%	36.7%		14.4%	48.9%		34.4%	34.4%	34.4%
Maximum Green (s)	7.0	40.0		27.0	27.0		7.0	38.0		25.0	25.0	25.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0			0.0		0.0	0.0			0.0	0.0
Total Lost Time (s)	6.0	6.0			6.0		6.0	6.0			6.0	6.0
Lead/Lag	Lag			Lead	Lead		Lead			Lag	Lag	Lag
Lead-Lag Optimize?	Yes			Yes	Yes		Yes			Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None		None	None		None	C-Max		C-Max	C-Max	C-Max
Walk Time (s)		7.0		7.0	7.0			7.0		7.0	7.0	7.0
Flash Dont Walk (s)		20.0		20.0	20.0			14.0		17.0	17.0	17.0
Pedestrian Calls (#/hr)		5		5	5			5		5	5	5
Act Effct Green (s)	18.7	31.7			13.4		14.6	46.3			25.7	25.7
Actuated g/C Ratio	0.21	0.35			0.15		0.16	0.51			0.29	0.29
v/c Ratio	0.54	0.39			0.30		0.73	0.31			0.68	0.68
Control Delay	38.8	4.1			25.4		47.9	14.2			33.3	7.0
Queue Delay	0.0	0.0			0.0		0.0	0.0			0.0	0.0
Total Delay	38.8	4.1			25.4		47.9	14.2			33.3	7.0
LOS	D	A			C		D	B			C	A
Approach Delay		24.1			25.4			28.4			20.6	
Approach LOS		C			C			C			C	
Queue Length 50th (m)	32.7	1.2			3.7		38.4	31.8			54.3	0.0
Queue Length 95th (m)	#91.0	20.8			12.8		#95.8	56.1			85.2	54.2
Internal Link Dist (m)		269.2			133.4			207.2			768.9	
Turn Bay Length (m)	60.0						60.0					60.0
Base Capacity (vph)	721	858			254		561	1835			923	868
Starvation Cap Reductn	0	0			0		0	0			0	0
Spillback Cap Reductn	0	0			0		0	0			0	0
Storage Cap Reductn	0	0			0		0	0			0	0
Reduced v/c Ratio	0.54	0.33			0.16		0.73	0.31			0.68	0.68

Intersection Summary

Area Type:	Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green

Natural Cycle: 90

Control Type: Actuated-Coordinated

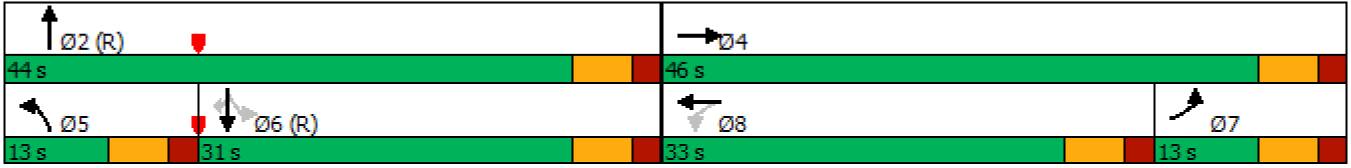
Maximum v/c Ratio: 0.73

Intersection Signal Delay: 24.1	Intersection LOS: C
Intersection Capacity Utilization 79.9%	ICU Level of Service D

Analysis Period (min) 60

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: 40 Ave & 25 St



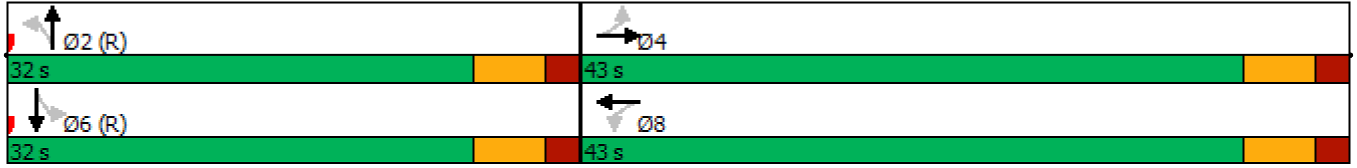
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱			✣			✣	
Traffic Volume (vph)	179	383	196	58	383	5	183	5	54	5	5	180
Future Volume (vph)	179	383	196	58	383	5	183	5	54	5	5	180
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.949			0.998			0.970			0.872	
Flt Protected	0.950			0.950				0.964			0.999	
Satd. Flow (prot)	1789	1787	0	1789	1880	0	0	1761	0	0	1641	0
Flt Permitted	0.410			0.203				0.686			0.993	
Satd. Flow (perm)	772	1787	0	382	1880	0	0	1253	0	0	1631	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		48			1			21			180	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		128.4			452.1			79.4			60.6	
Travel Time (s)		7.7			27.1			4.8			3.6	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	179	383	196	58	383	5	183	5	54	5	5	180
Shared Lane Traffic (%)												
Lane Group Flow (vph)	179	579	0	58	388	0	0	242	0	0	190	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	100		100	100		100	100		100	100		100
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	2.0	10.0		2.0	10.0		2.0	10.0		2.0	10.0	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	2.0	0.6		2.0	0.6		2.0	0.6		2.0	0.6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	15.0	15.0		15.0	15.0		10.0	10.0		10.0	10.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Minimum Split (s)	27.0	27.0		27.0	27.0		27.0	27.0		27.0	27.0	
Total Split (s)	43.0	43.0		43.0	43.0		32.0	32.0		32.0	32.0	
Total Split (%)	57.3%	57.3%		57.3%	57.3%		42.7%	42.7%		42.7%	42.7%	
Maximum Green (s)	37.0	37.0		37.0	37.0		26.0	26.0		26.0	26.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0			0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0			6.0			6.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Walk Time (s)	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	14.0	14.0		14.0	14.0		14.0	14.0		14.0	14.0	
Pedestrian Calls (#/hr)	5	5		5	5		5	5		5	5	
Act Effct Green (s)	29.0	29.0		29.0	29.0			34.0			34.0	
Actuated g/C Ratio	0.39	0.39		0.39	0.39			0.45			0.45	
v/c Ratio	0.60	0.81		0.39	0.53			0.42			0.23	
Control Delay	19.4	23.0		22.6	19.1			17.5			4.1	
Queue Delay	0.0	0.5		0.0	0.0			0.0			0.0	
Total Delay	19.4	23.4		22.6	19.1			17.5			4.1	
LOS	B	C		C	B			B			A	
Approach Delay		22.5			19.6			17.5			4.1	
Approach LOS		C			B			B			A	
Queue Length 50th (m)	21.8	119.7		5.9	41.0			21.5			0.8	
Queue Length 95th (m)	m29.7	m87.1		m14.9	59.4			56.7			17.8	
Internal Link Dist (m)		104.4			428.1			55.4			36.6	
Turn Bay Length (m)												
Base Capacity (vph)	380	905		188	927			580			838	
Starvation Cap Reductn	0	80		0	0			0			0	
Spillback Cap Reductn	0	0		0	0			0			0	
Storage Cap Reductn	0	0		0	0			0			0	
Reduced v/c Ratio	0.47	0.70		0.31	0.42			0.42			0.23	

Intersection Summary

Area Type: Other
Cycle Length: 75
Actuated Cycle Length: 75
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.81
Intersection Signal Delay: 18.8 Intersection LOS: B
Intersection Capacity Utilization 90.0% ICU Level of Service E
Analysis Period (min) 60
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 12:



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