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Canada  
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July 31, 2020  
Wood Project No.: ET200020

Darby Dietz, Superintendent of Public Works Beaver County  
PO Box 140  
Ryley, Alberta TOB 4A0

Dear Mr. Dietz:

**Reference: Lindbrook Estates Subdivision  
Drainage Assessment Report  
Beaver County**

## 1.0 Introduction

Wood Environment & Infrastructure Solutions (Wood) was retained by the Beaver County (County) to complete a drainage assessment for the Lindbrook Estates subdivision. This subdivision is located approximately 60 km southeast of Edmonton. The total study area of the subdivision is approximately 0.70 km<sup>2</sup> (70 ha).

The objective of this study is to assess the existing and historical drainage system and provide suggestions for drainage improvement if required.

## 2.0 Methodology

The following activities were carried out by Wood to assess existing drainage patterns and improvement options.

- Information Review – A background information review was undertaken as part of the drainage assessment. The review included the following:
  - o Review of the National Topographic System (NTS) mapping.
  - o Review of Global Mapper world imagery and Google Earth Pro imagery.
  - o Review of the Canadian Digital Elevation Data derived from the NTS maps.
  - o Review of historical air photos to assess existing and historical drainage pattern.
- Site Assessment – A site assessment was undertaken by Wood on June 20, 2020. Site photos taken during this field visit were reviewed (see Appendix A for site photos). This site visit also provided an overall understanding of the existing drainage pattern. It also provided culvert and ditch conditions.
- Site Survey – A limited site survey was conducted. Natural ditch channel profile in Lot 4, Lot 5 and Lot 6, Block 2 (surveyed site 4), was gathered as well as culverts inlet and outlet elevations

for surveyed sites 1, 2 and 5. See Appendix C for details.

- Discussions with the County – The County provided some information on the overall performance of the existing drainage system which was considered during this assessment.
- Historical Air photo- The historical air photos of 1980, 1993 and 2017 were reviewed to estimate historical drainage path through the area of interest.
- Hydrology – The drainage area of ditches and centerline (CL) culverts was delineated from NTS maps, Canadian Digital Elevation Data using Global Mapper tool, survey data and observed site conditions. The drainage areas were used to determine the design discharge for the ditches and culverts.
- Hydraulic Assessment – The hydraulics of the drainage ditches and CL culverts were assessed for existing conditions for the design discharge. Opportunities to improve drainage was evaluated including vegetation clearing and excavating new ditches. The need for improvement of existing culverts and installation of new culverts was also evaluated based on hydraulic assessment.

### 3.0 Hydrology

As mentioned previously, NTS maps, Canadian Digital Elevation Data, survey data and observed site conditions were used to determine drainage areas. Surveyed information given in Appendix C shows pertinent existing culverts within the subdivision. The drainage areas of ditches and CL culverts were estimated with Global Mapper. This software was also used to determine the drainage areas for the access road culvert assessment. The estimated drainage area at the culvert feeding to the Municipal Reserve (MR) is 0.07 km<sup>2</sup> (7 ha). Based on Wood's assessment, the existing 1-600 mm corrugated steel pipe (CSP) culvert hydraulic opening appears to be adequate for the design flood. For this study, the design flood is a 1:25 year flood event (Q<sub>25</sub>).

### 4.0 Drainage Assessment

The properties of interest in the study area are Lot #18, Lot #24 & Lot #30, 51205 Range Road (RR) 195 (Lindbrook Estates) which are shown on plans included in Appendices. The description of these properties is provided in the table below.

**Table 1. Properties Description**

Address	Legal Land Description
Lot #18	Lot 3, Block 2, Plan 792 0020
Lot #24	Lot 4 (MR), Block 2, Plan 792 0020 (County Owned Municipal Reserve)
Lot #30	Lot 5, Block 2, Plan 7920020
Lot #36	Lot 6, Block 2, Plan 7920020

The overall drainage flow is from north to south through the study area in the subdivision and into Hastings Creek.

## 4.1 Historical Drainage Assessment

The 1980, 1993 and 2017 air photos covering the study area were obtained from Alberta Environment and Parks on July 23, 2020. Air photos were reviewed to assess the drainage path through the study area. The following provides a summary of Wood's review.

**1980 Air Photo:** Figure 1 given in Appendix B, shows the estimated drainage path as of 1980. This shows that drainage pattern is from the north to the internal subdivision road and through a centreline (CL) culvert to the south to MR. The water flows east across the south side of the MR (Lot #24) and across the center of Lot #30 where it flows into the downstream natural drainage channel. The 1980 air photo shows that Lot #30 was not developed at that time to present grades.

**1993 Air Photo:** Figure 2 given in Appendix B, shows the estimated drainage path as of 1993. This figure shows that the drainage pattern is from the north to the internal subdivision road and through a CL culvert to the south to MR. The water then runs southwest across the west side of the MR Lot 4 in Block 2 (Lot #24) and onto Lot 3 in Block 2 (Lot #18). Based on the 1993 air photo, the water then flows to the south side of the MR Lot 4 in Block 2 (Lot #24) and onto Lot 14 and Lot 13 of Block 2 into a pond. If the pond overflows, the water flows east as shown on figure 2, given in Appendix B. The 1993 air photo shows that Lot 5 of Block 2 (Lot #30) was developed before or at the time of the air photo was taken up to present grades and the natural drainage channel path seems to be blocked in Lot 5 due to this development.

**2017 Air Photo:** Figure 3 given in Appendix B, shows the estimated drainage path as of 2017. This figure shows that the drainage pattern is from the north to the internal subdivision road and through a CL culvert to the south to MR. Beyond that there is no well-defined drainage pattern and water is ponded in MR lot 4 Block 2. There is no well defined drainage pattern within the study area and only ponded water are shown.

Figure 4, given in Appendix B, provide a comparison of the drainage path for the years of 1980,1993 and 2017. It also shows options for the proposed drainage ditch to maintain flow from MR Lot 4 of Block 2 into the natural drainage path in Lot 6 and Lot 11 of Block 2.

## 4.2 Existing Drainage System

To understand the existing drainage system in the study area, Wood conducted a site visit and limited survey. The following section describe these activities.

### Wood June 2020 Site visit

Wood, along with the County, carried out Lindbrook Estates site visit on June 20, 2020. Site visit photos are included in Appendix A. Culverts, ditches and 2020 drainage water flood impacted areas were inspected. It was noted that the drainage water from MR Lot 4 in Block 2 (Lot #24) was being pumped to the existing natural drainage path in Lot 6 of Block 2 (Lot #36) through a hose. The historical drainage path from the MR was blocked by the development in Lot 5 of Block 2 (Lot #30). Wood was unable to find any evidence of a culvert/pipe across Lot 5 of Block 2 (Lot #30) to convey drainage water from MR to Lot 6 of Block 2 existing natural drainage path.

### Wood 2020 Survey

Wood conducted a limited survey to better understand the topography of the study area. Five (5) sites were surveyed and their plans and profiles are provided in Appendix C. The following is a brief summary of areas of interest from these surveyed sites.

- Site 5 - Site 5 survey provides the roadway profile and CL culvert inverts draining from north to

- south into MR. The 600mm diameter X 17 m CSP culvert invert elevations are; N Inv 724.28 and S Inv 723.93.
- Site 4 - Site 4 survey provides a plan and profile along the hose (being used for pumping of water) from MR (Lot 4) through Lot 5 into Lot 6 and Lot 11 existing natural drainage path. Site 4 profile shows that the ponded water level in MR is 722.37 and in the natural drainage path in Lot 11 it is 720.29. This provides a slope of 1.7%. The profile also shows high ground between MR (Lot 4) and Lot 5 at an elevation in the order of 723.1, which provides a berm height in the order of 0.9 m between the two properties. The water is currently being held back at the property line between Lot 5 and the MR (Lot 4).

Sites 3, 2 and 1 are shown on plan and profile given in Appendix C.

As shown on the plan given in Appendix D provided by the County, the existing drainage pattern is from the north to the internal subdivision road and through a CL culvert to the south to MR at site 5. Due to 0.9 m high berm between MR (Lot 4) and Lot 5, the water is ponded in MR and backs up across the west side of the MR Lot 4 (Lot #24) and onto Lot 3 (Lot #18). Based on our review of historical air photos, the water should flow east across the south side of the MR Lot 4 (Lot #24) and across Lot 5 (Lot #30) to the existing natural drainage channel in Lot 6. Presently during high flooding due to excessive rains, drainage water is diverted to the existing natural drainage path in Lot 6 through a pump and hose arrangement from where that drainage path runs east to the internal subdivision road again. From there, it runs south through one approach, under the road and down to the cul-de-sac at the south east end of the subdivision before running under Township (TWP) Road 512 and south to the Hastings Creek.

### 4.3 Proposed Drainage Improvements

Based on the 1980 historical air photo review, there was a natural drainage path through Lot 5 to Lot 6 (Block 2). To connect MR (Lot 4, Block 2) to the natural channel in Lot 6 and Lot 11 (Block 2), the following options were considered.

**Option 1:** Construct an open channel ditch from MR (Lot 4) to the natural drainage path in Lot 6 through Lot 5 along historical drainage path.

**Option 2:** Install an 800 mm in diameter CSP across Lot 5 to connect the water from MR to Lot 6.

**Option 3:** Construct an open channel ditch from MR (Lot 4) to the natural drainage path in Lot 6 and Lot 11 along south property line of Lot 4, Lot 5 and Lot 6. This option will result in a longer ditch than Option 1 and significant amount of excavation and impact to adjacent lots.

It is suggested to construct the open channel ditch with a minimum 1 m depth, 2 to 3 m bottom width and 3H:1V side slopes. The open channel ditch should be designed to retain the ordinary high water (1:2 year) in MR (Lot 4). The proposed Option 1 and Option 3 ditches profile and their location is shown in Figure 4 given in Appendix B. Figures 1 and 2 given in Appendix E, provides pertinent environmental land features in the study area.

The drainage system from the surveyed site 2 downstream up to the surveyed site 1 (400 mm in diameter culvert under TWP Road 512) including ditches, CL culverts and approach culverts are not functioning well and should be further investigated. In general, in these areas, clearing, repair of blocked/damaged culverts and clearing and regrading of the ditches is proposed to maintain drainage flow until further drainage

assessment is conducted and suggested drainage improvements are constructed/implemented.

It is recommended to proceed with the detail design of Option 1 (i.e. construct a drainage ditch from MR (Lot 4) to natural drainage path in Lot 6 through Lot 5 along the historical drainage path) since Option 1 would provide the shortest drainage path along the historical natural drainage path with the smallest footprint than Option 3. Option 1 is also preferred over Option 2 since its maintenance would be easier. An agreement with the current landowner would be required for the recommended Option 1.

It is recommended to conduct adequate survey to design this proposed ditch to divert flows from MR Lot 4 through Lot 5 into the natural drainage path in Lot 6. It is also recommended to conduct detailed drainage assessment of the area from surveyed site 2 downstream up to surveyed site 1 (400 mm culvert under TWP Road 512) including ditches, CL culverts and approach culverts.

## 5.0 Closure

If you have any questions about this drainage assessment report, please contact the undersigned at (780) 377-3688 at your earliest convenience.

Respectfully submitted,

**Wood Environment & Infrastructure Solutions  
a Division of Wood Canada Limited**

Prepared by:



Arshed Mahmood, M.Sc., P.Eng.  
Bridge / Water Resources Engineer

Reviewed By:



Claudine Girouard, M.Sc., P.Eng.  
Bridge / Water Resources Engineer



**Appendix A**

**June 20, 2020 Site Visit Photos**

Project Photos

Description

Photo 1

Beaverhill Drive  
looking west in  
vicinity of Lots  
#18, #24 and  
#30.





**Photo 2**

600 mm CSP under Beaverhill Drive culvert inlet draining into MR (Lot #24), surveyed site 5.





**Photo 3**

Looking east along Beaverhill Drive south ditch adjacent to MR (Lot #24).



**Photo 4**

Looking west at pump to divert water from MR (Lot #24) to lot #36 in existing natural drainage ditch (surveyed site 4).



**Photo 5**

Looking east at water hose to divert water from MR (Lot #24) to Lot #36. Hose is installed within Lot #30 (surveyed site 4).



**Photo 6**

Looking southeast at water hose diverting water from MR (Lot #24) to natural channel in Lot #36 (surveyed site 4).



**Photo 7**  
Flooding of lot south of MR (Lot #24).



**Photo 8**

Looking northwest at hose diverting stormwater from lot south of MR to MR.



**Photo 9**

Looking southwest at ditch at surveyed site 2.



**Photo 10**

Looking northeast at ditch at surveyed site 2.





**Photo 11**

Looking at downstream invert (south) at 400 mm CSP culvert at surveyed site 1 under TWP Road 512.



**Photo 12**

Looking south (downstream) of surveyed site 1 culvert under TWP Road 512.



**Photo 13**

Looking north  
(upstream ) of  
culvert under  
TWP Road 512.



**Photo 14**  
Looking east of  
north ditch at  
surveyed site 1  
TWP Road 512.




**Photo 15**

Looking west at north ditch at surveyed site 1 TWP Road 512.

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**Appendix B**

**Drainage Assessment of 1980, 1993 and 2017 Air Photos**

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			QA/QC BY:	DATUM: NAD_1983	TITLE: <b>1980 AERIAL PHOTO DRAINAGE PATTERN</b>
			PROJECTION: UTM_12N	FILE NAME:	FIGURE NO.: FIG. 1



Source: Earth DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Copyright Government of Alberta

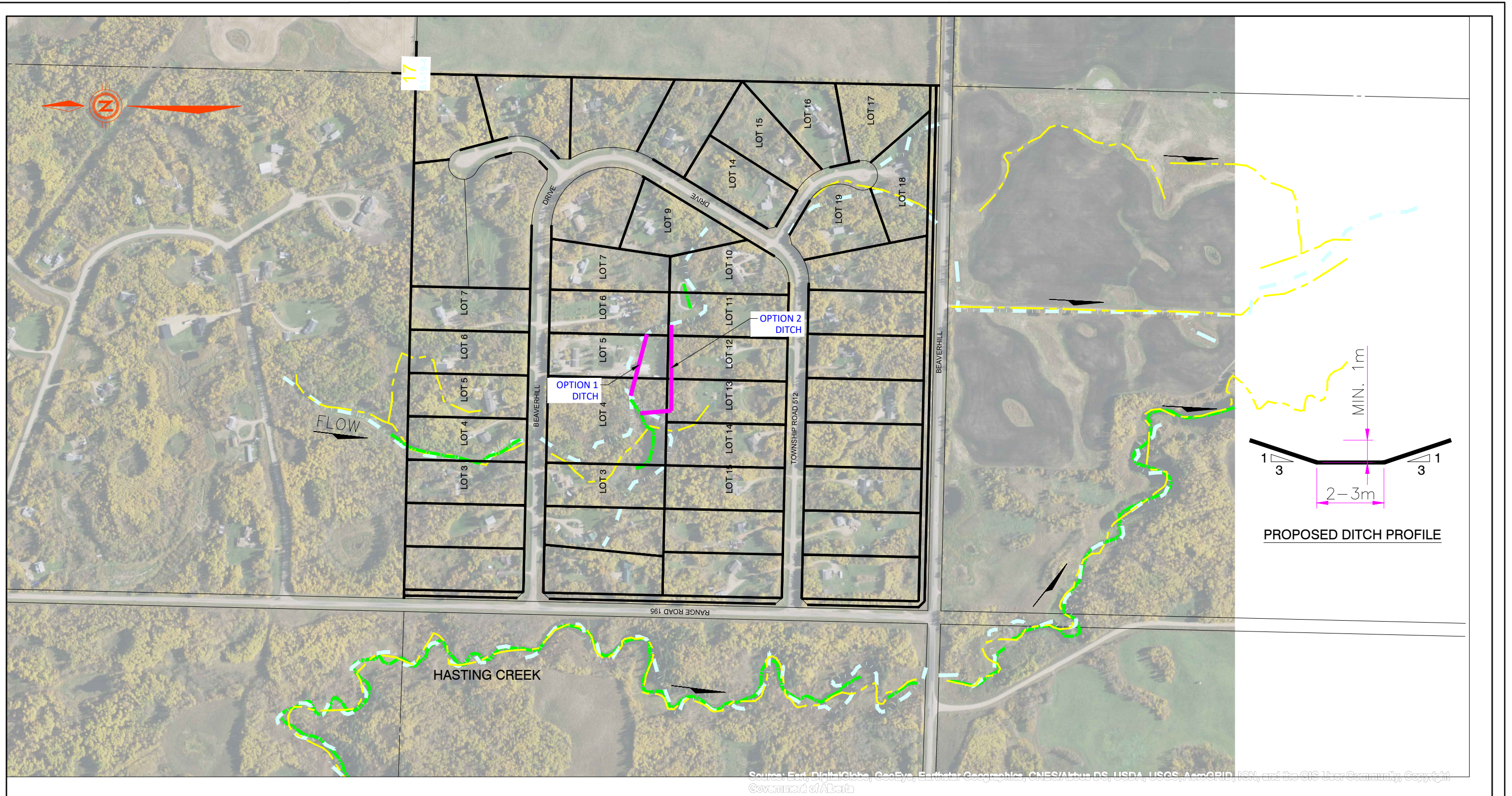
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Source: Earth Data Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Copyright Government of Alberta

<b>LEGEND:</b> DRAINAGE FLOW DIRECTION	CLIENT:  	PREPARED BY: JP	PROJECT: Lindbrook Estates Drainage	DATE: 30-Jul-2020
		NTS		QA/QC BY:
		DATUM: NAD_1983	TITLE: <b>2017 AERIAL PHOTO DRAINAGE PATTERN</b>	FILE NAME:
		PROJECTION: UTM_12N		FIGURE NO.: FIG. 3



Source: Earth Data Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Copyright Government of Alberta

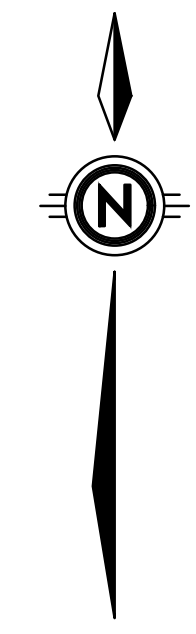
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**Appendix C**

**Wood's July 2020, Surveyed Sites 1, 2, 3, 4 and 5 Plans and Profiles**


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


NOTES / LEGEND

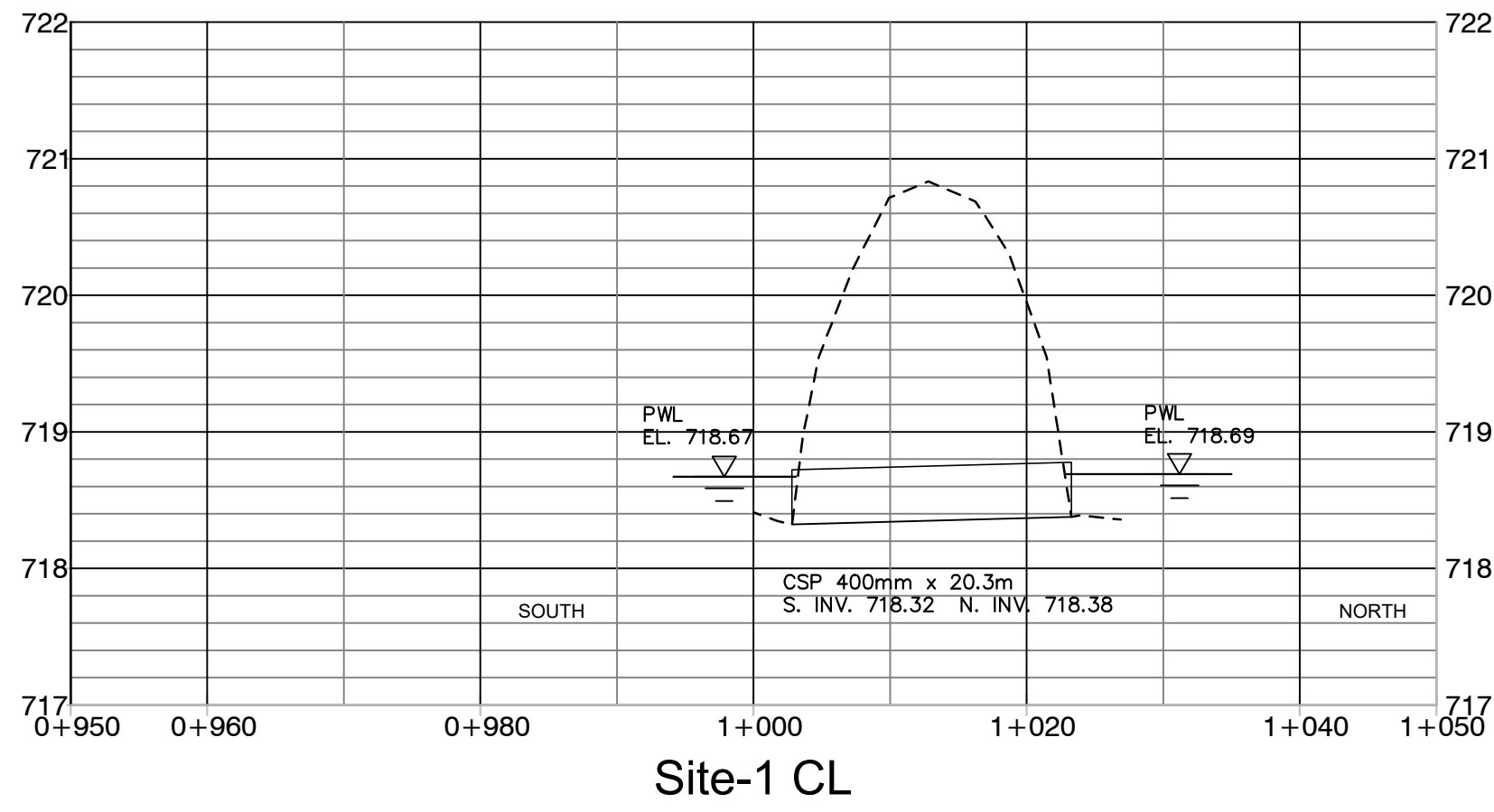
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	WOOD				
NO.	REVISION	DATE	BY	CKD	APPD

PERMIT TO PRACTICE	P.ENG.	
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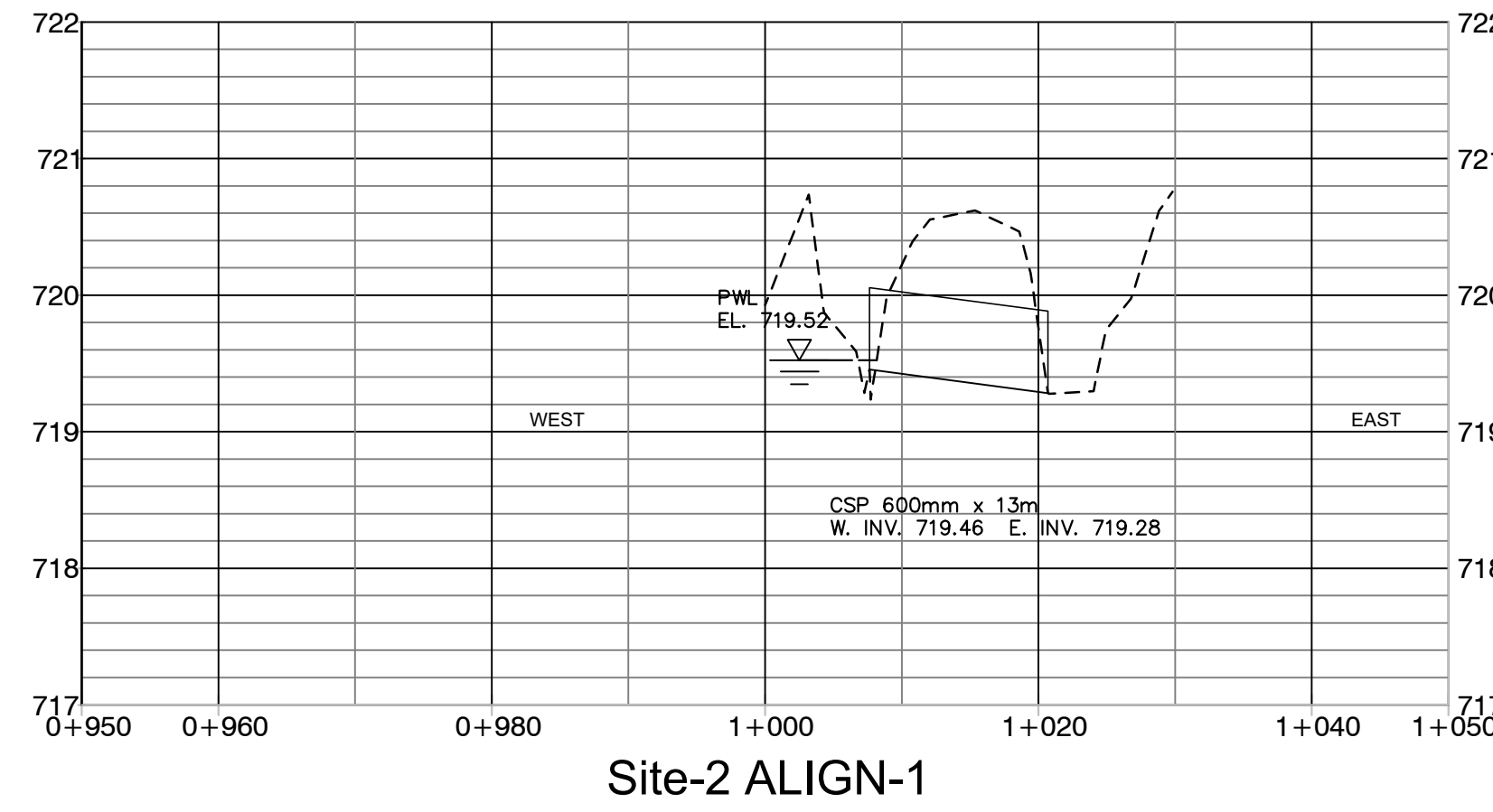

**BEAVER COUNTY**  
**LINDBROOK ESTATES DRAINAGE ASSESSMENT**  
**OVER ALL PLAN**


 PROJECT No. ET20-0020 DWG. No. ET200020-S1 REV 

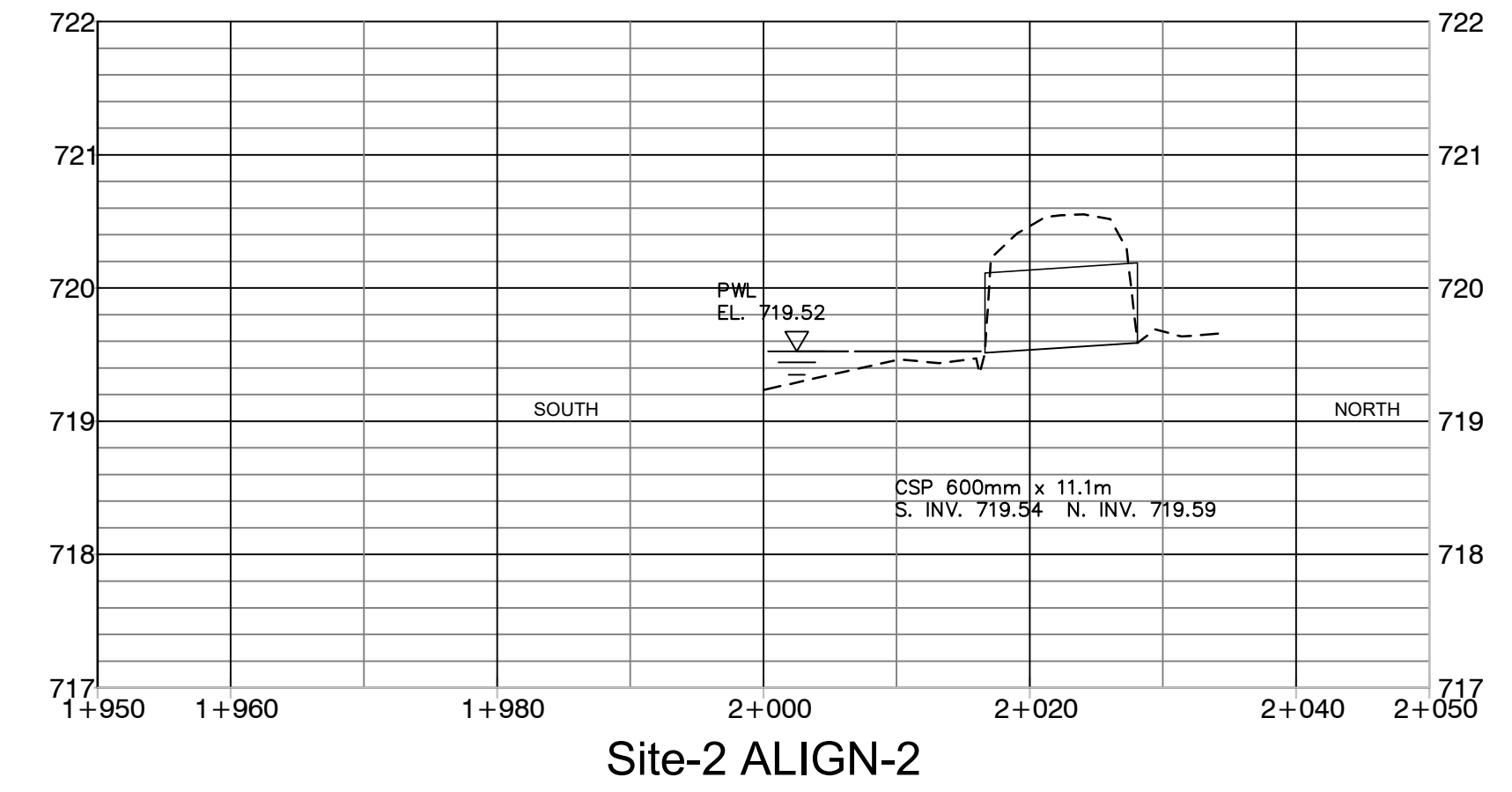
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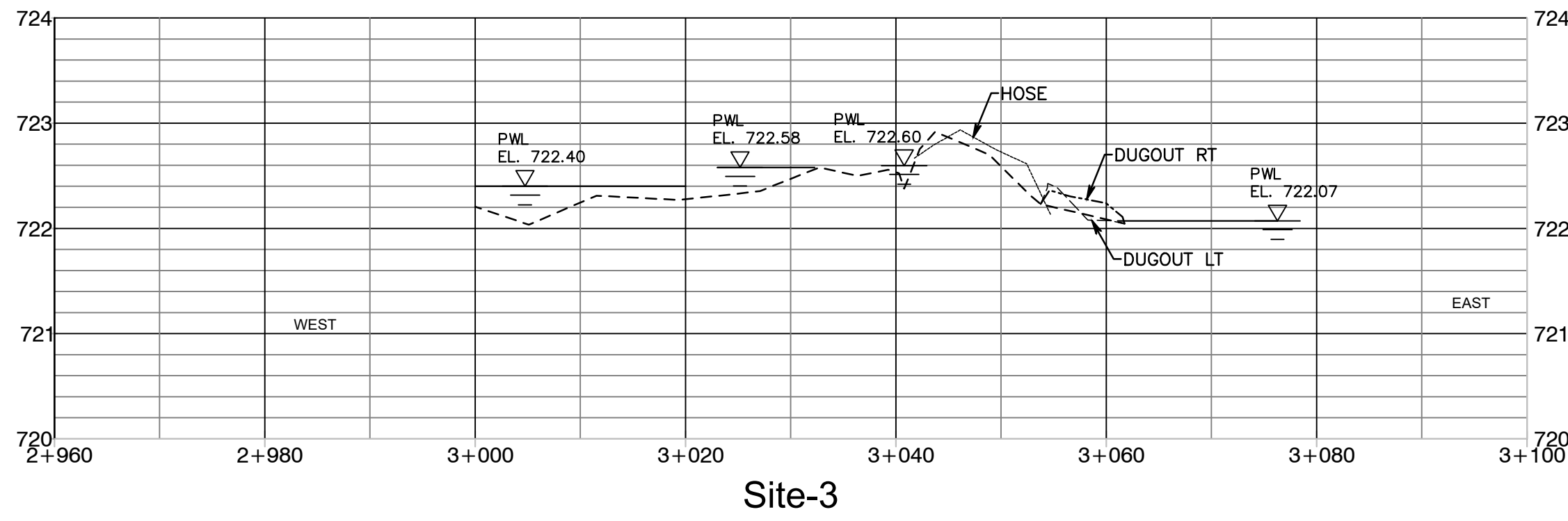
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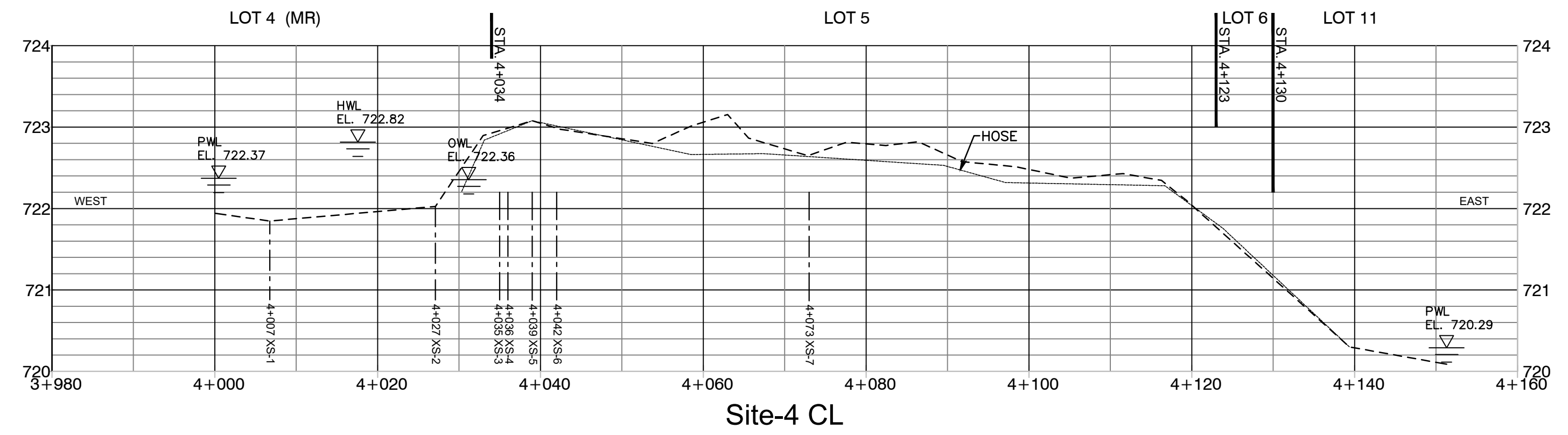
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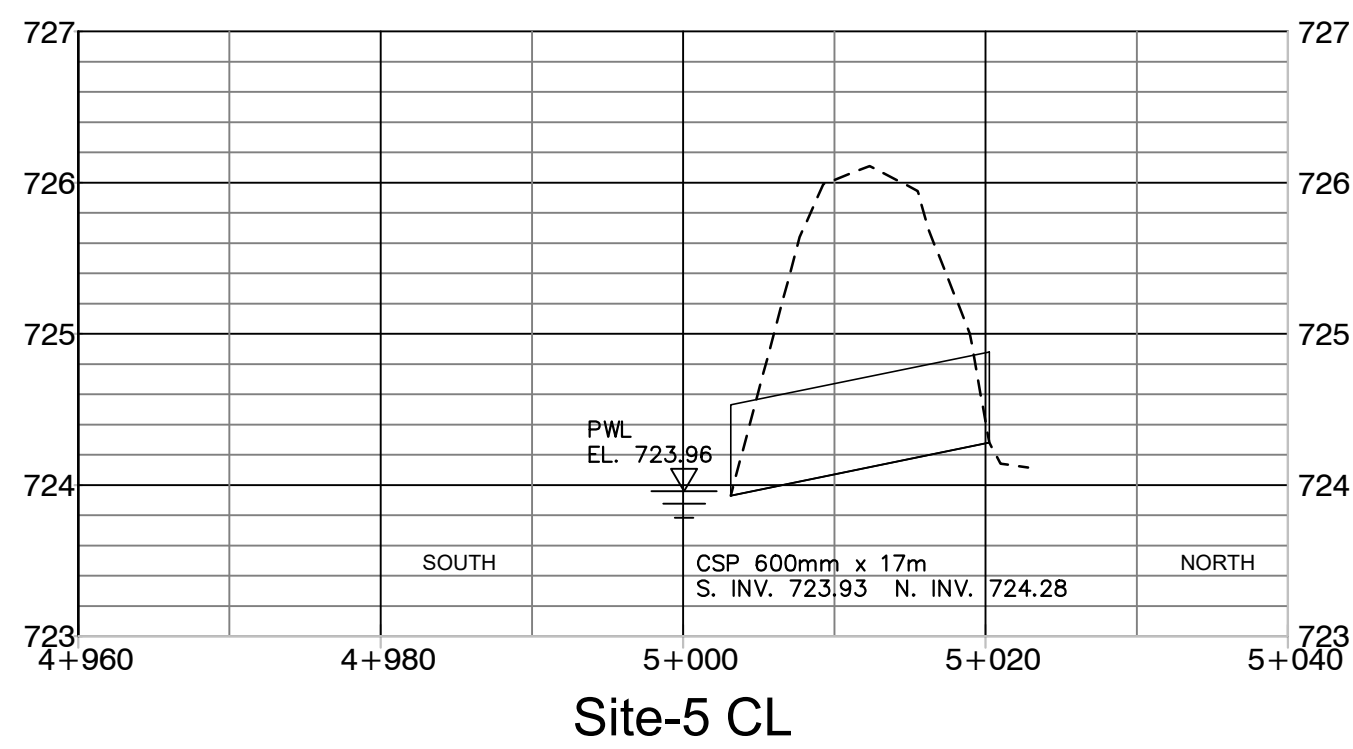
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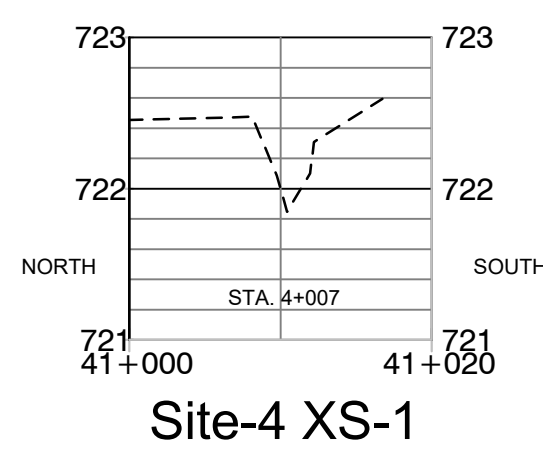
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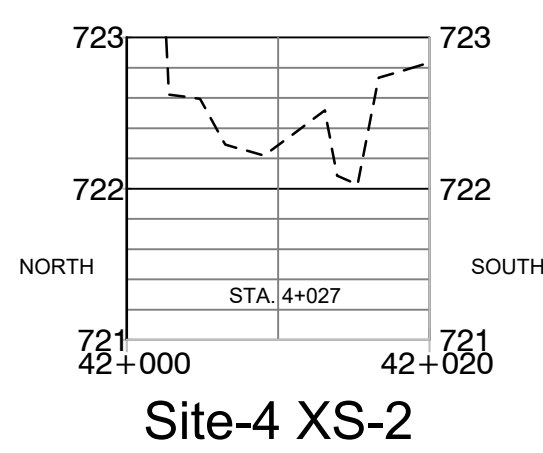
Site-4 CL



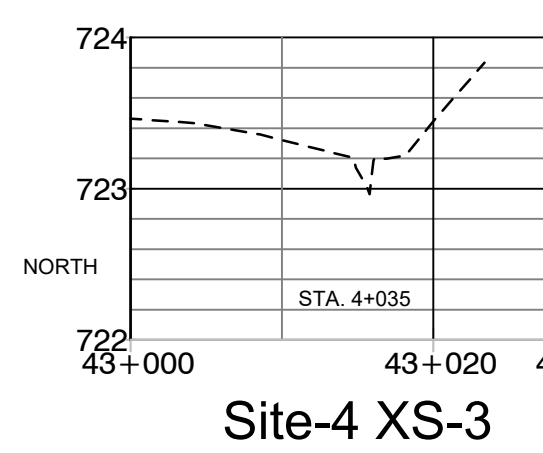
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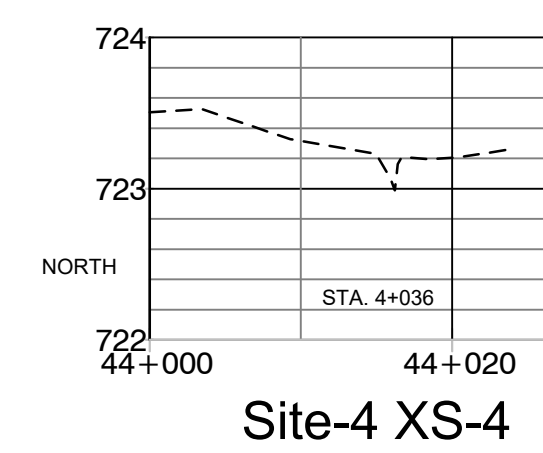
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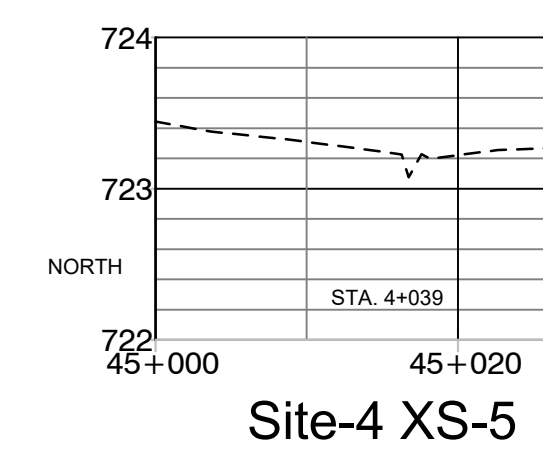
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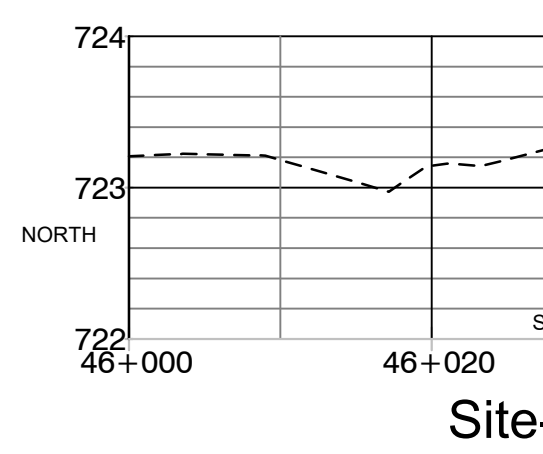
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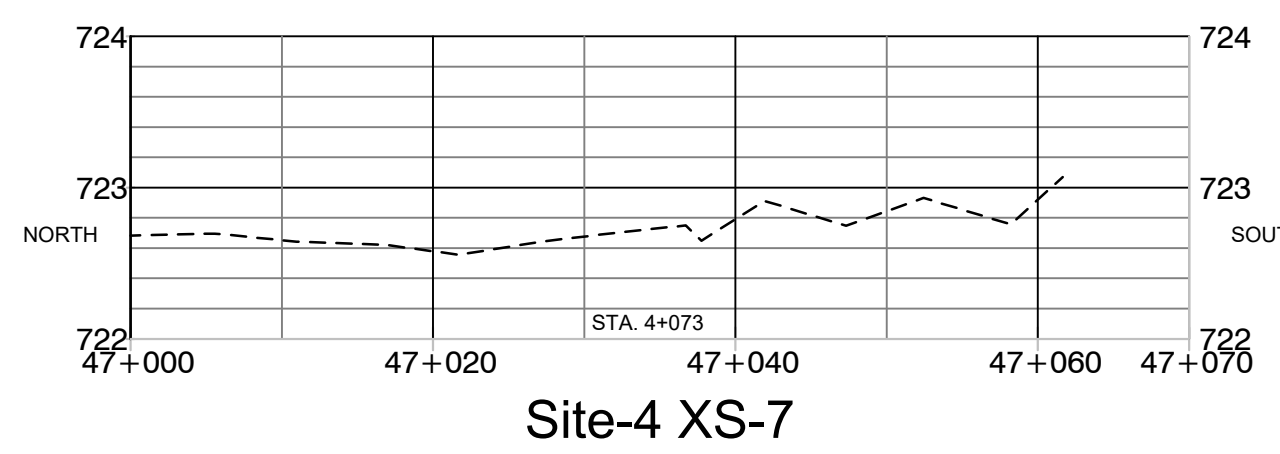
Site-4 XS-4



Site-4 XS-5



Site-4 XS-6



Site-4 XS-7

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NO.	REVISION	DATE	BY	CKD	APPD
PERMIT TO PRACTICE			P.ENG.		
<b>BEAVER COUNTY</b> <b>LINDBROOK ESTATES DRAINAGE ASSESSMENT</b> <b>PROFILES AND CROSS SECTIONS</b>					
PROJECT No. ET20-0020		DWG. NO. ET200020-P1		REV $\Delta$	
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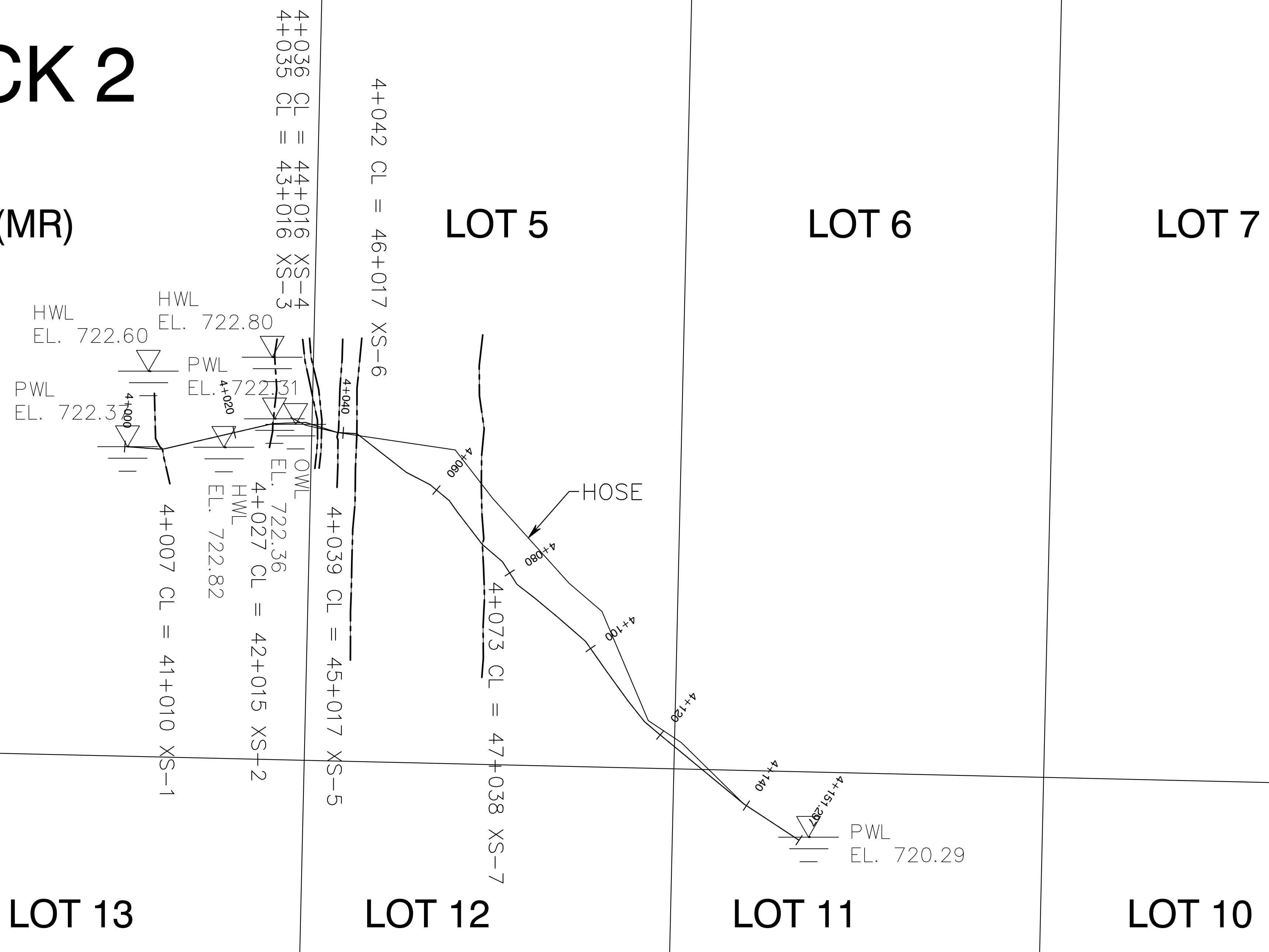
# BLOCK 2

LOT 4 (MR)

LOT 5

LOT 6

LOT 7

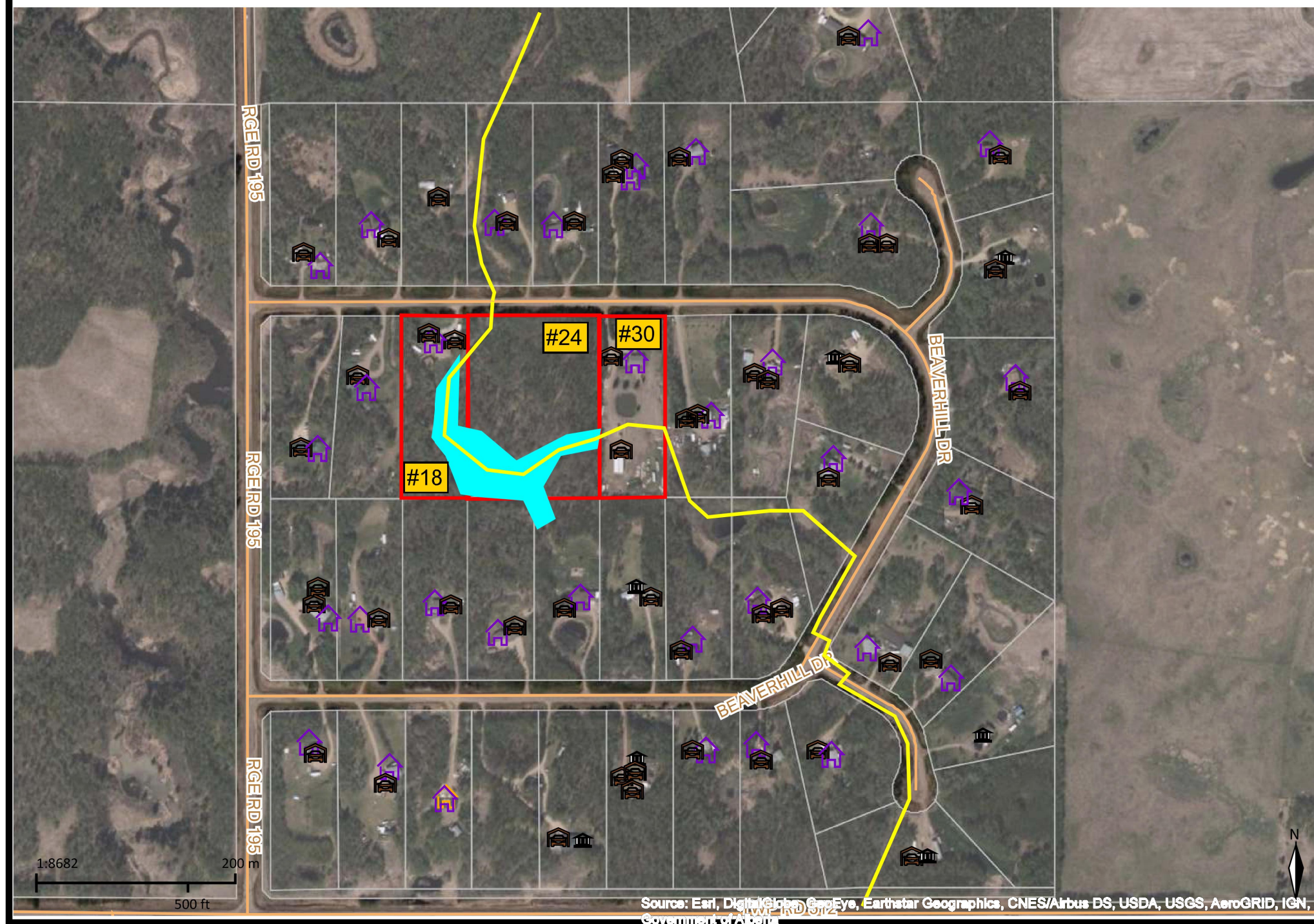




**Appendix D**

**County's Provided Drainage Plan**

# Lindbrook Estates - Drainage Concerns



**LEGEND:**

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			QA/QC BY:				PROJECT NO.:	ET200020
			DATUM:	NAD_1983	TITLE:	<b>LINDBROOK ESTATES DRAINAGE CONCERNS</b>	FILE NAME:	
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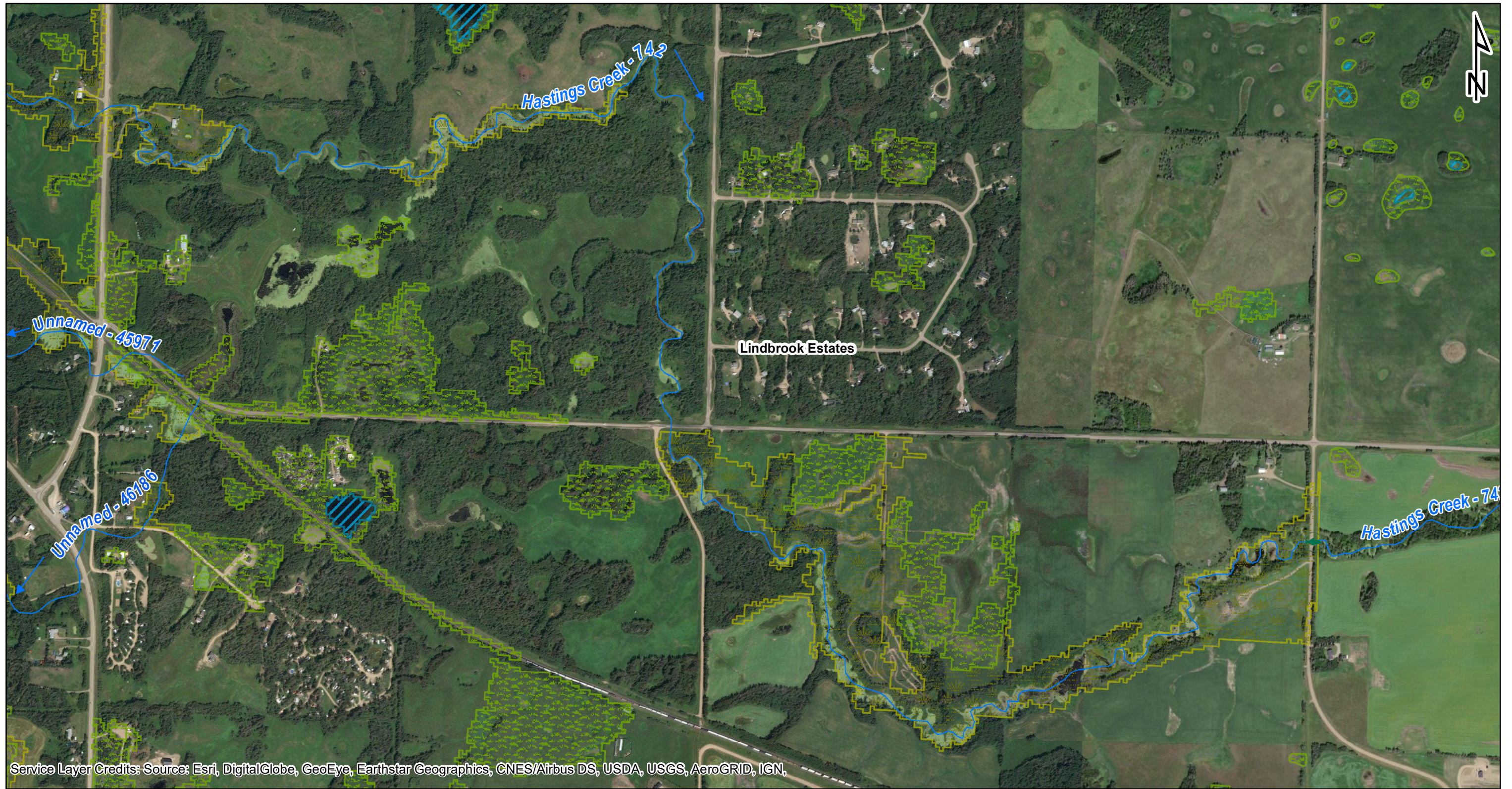


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**Appendix E**

**Study Area Land Environmental Characteristics**

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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN,

<b>LEGEND:</b> Watercourse <b>Alberta Merged Wetland Inventory Class</b> Bog Fen Marsh Open Water Swamp	 <b>1:10,000</b>	CLIENT:  BEAVER COUNTY	PREPARED BY: JP QA/QC BY: AM	PROJECT: <b>Lindbrook Estates Drainage</b>	DATE: 21-Jul-2020 PROJECT NO.: ET200020
			DATUM: NAD_1983 PROJECTION: UTM_12N	TITLE: <b>Preliminary Background Information Review</b>	FILE NAME: Fig1_Background_Drainage.docx FIGURE NO.: Figure 1

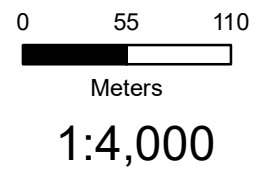


Lindbrook Estates

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN,

**LEGEND:**

- |   |            |
|---|------------|
| Watercourse                                   | Marsh      |
| <b>Alberta Merged Wetland Inventory Class</b> | Open Water |
| Bog   | Swamp      |
| Fen   |            |



CLIENT:	PREPARED BY:	PROJECT:	DATE:
	QA/QC BY:		21-Jul-2020
	JP	<b>Lindbrook Estates Drainage</b>	PROJECT NO.:
	AM		ET200020
	DATUM:		TITLE:
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