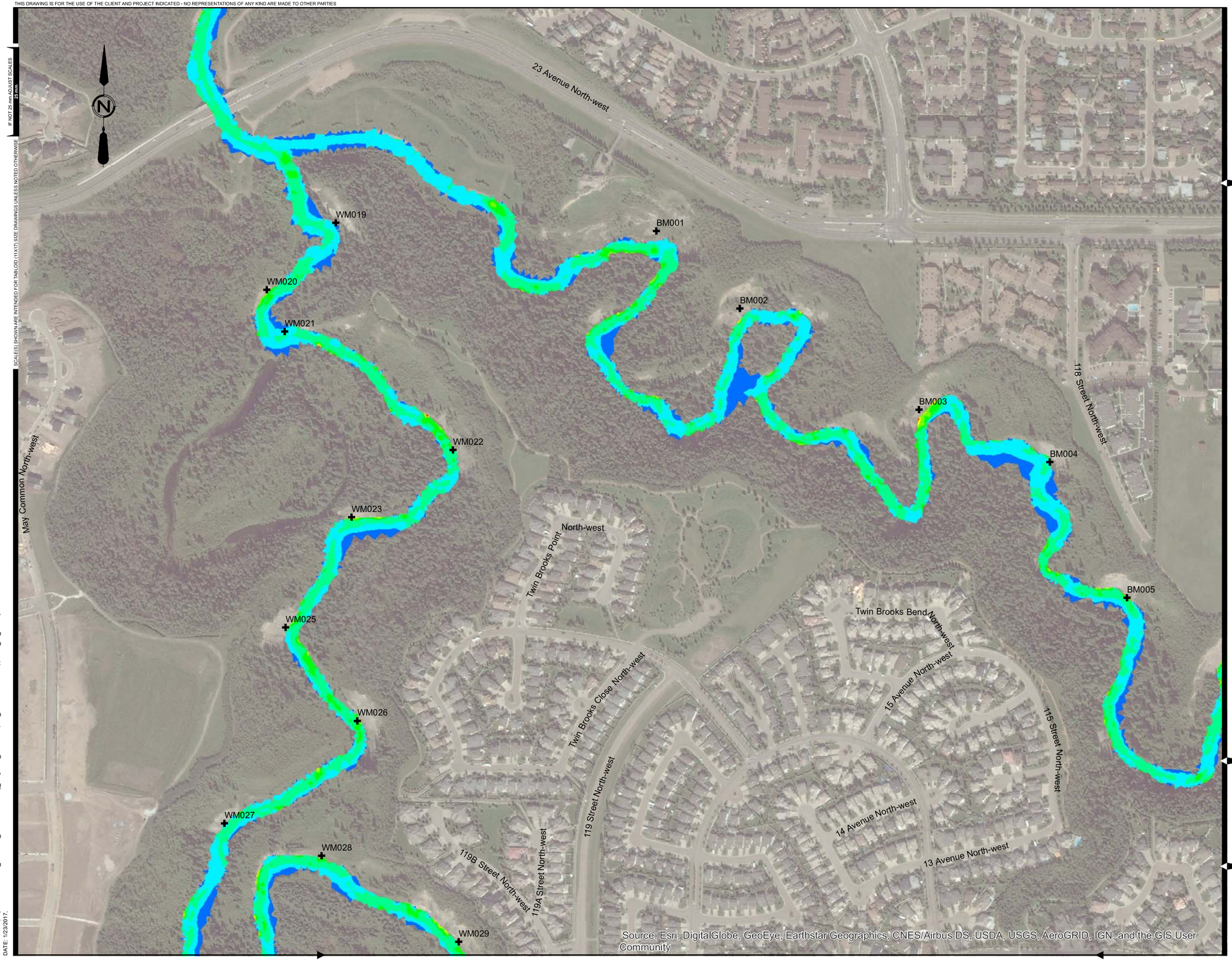


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

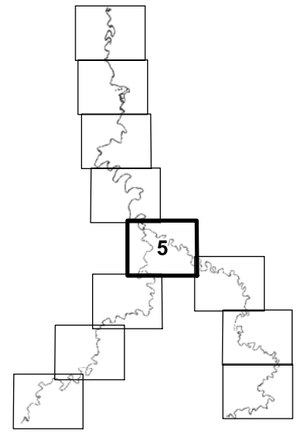
Associated Engineering

Legend:

- Erosion Site

Velocity (m/s)

- >3.5 - 4.0
- >3.0 - 3.5
- >2.5 - 3.0
- >2.0 - 2.5
- >1.5 - 2.0
- >1.0 - 1.5
- >0.5 - 1.0
- >0.0 - 0.5



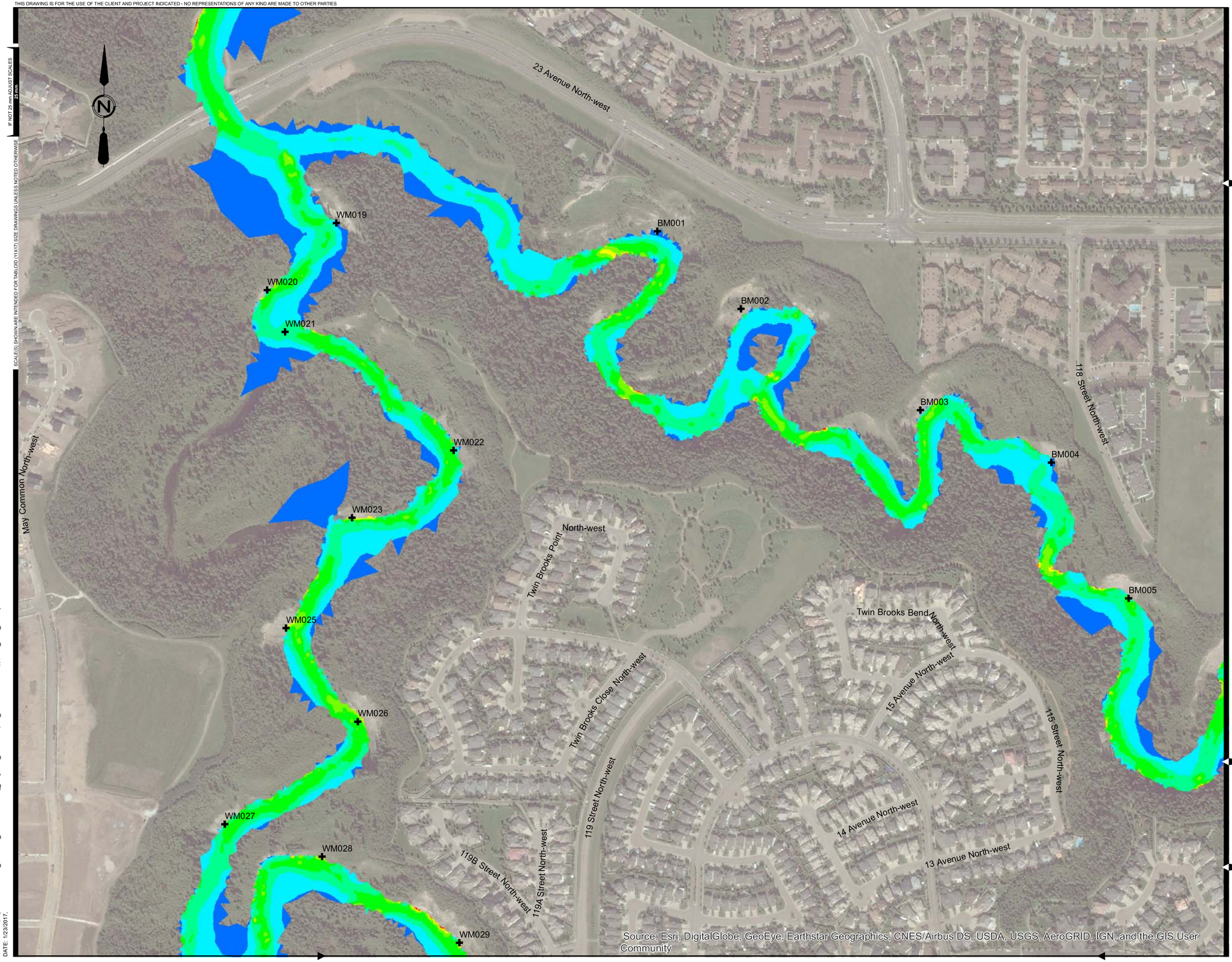
Note: Maps are preliminary and subject to change.

FIGURE No. 4-2

BLACKMUD/WHITEMUD CREEK
WATERSHED MANAGEMENT STUDY

5 YEAR
VELOCITY

AE PROJECT No.	2016-3785
SCALE	1:5,000
APPROVED	
DATE	2017 JANUARY
REV	
DESCRIPTION	ISSUED FOR REPORT



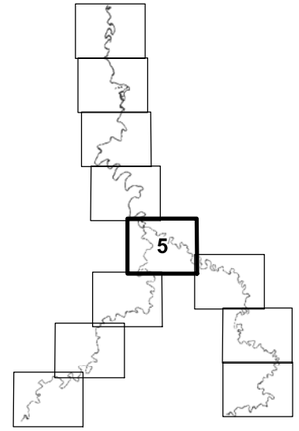
Associated Engineering

Legend:

- Erosion Site

Velocity (m/s)

- >3.5 - 4.0
- >3.0 - 3.5
- >2.5 - 3.0
- >2.0 - 2.5
- >1.5 - 2.0
- >1.0 - 1.5
- >0.5 - 1.0
- >0.0 - 0.5



Note: Maps are preliminary and subject to change.

FIGURE No. 4-3

BLACKMUD/WHITEMUD CREEK
WATERSHED MANAGEMENT STUDY

100 YEAR
VELOCITY

AE PROJECT No.	2016-3785
SCALE	1:5,000
APPROVED	
DATE	2017 JANUARY
REV	
DESCRIPTION	ISSUED FOR REPORT

5 Limitations

The accuracy of the models developed in this task is limited by several assumptions and limitations, principally the following:

- Design flows were estimated from a statistical analysis of limited hydrometric data at three locations (and more recently a fourth location) in the basin having approximately 45 years of data. This was significantly skewed by one single runoff event (1974) and had to be extrapolated to a 1:100 year return period. Furthermore, the historic discharge data have already been impacted by development in the basin. This development impact has increased over the time frame of the monitor data. The design flows presented herein are AE's best estimates based on engineering judgement and the available data.

- Channel cross-sections were developed from LiDAR data, previous studies, and limited topographic survey and may not accurately represent the actual cross-section or the capacity of the channel at low to intermediate flows. The effect of this approximation diminishes at higher flows where a larger portion of the total flow is carried by the floodplain.

- The models are essentially un-calibrated, due to the lack of data required to do so. Some calibration was previously completed in the Flood Hazard Study which provided guidance for the model parameters adopted herein.

Notwithstanding these limitations, the models are deemed to be adequate for planning purposes and for development of an overall water management strategy for the basin. They are no substitute for more detailed site-specific analyses that will be required during implementation of the strategy. They do provide an assessment of baseline hydraulic conditions against which the potential impacts of future development can be measured.

The models are steady-state, based on AE's best estimate of a peak design flow rate for current conditions. The software is capable of fully-dynamic simulation which could be used to simulate flows and water levels using precipitation and weather data from the Edmonton International Airport, to extend the period of recorded flow data, and to better define the interactions between the runoff from urban and rural areas. Ultimately this option is limited by the availability of the required weather data at only one location within a basin of approximately 1,000 km^2 and by the uncertainties involved in rainfall-runoff modelling. In particular, the runoff from snowmelt events in a cold climate, with frozen ground conditions during snowmelt such as occur in Edmonton, is poorly understood and not well simulated with currently available software although some progress has been made in recent years and a practical snowmelt model may soon be available. These limitations provide a severe impediment to improving the estimates that are possible with a steady-state model.

6 Conclusions

The project area creeks were found to have capacity for peak flows that will occur in a 1:2 to 1:5 year return period flood. Localized flooding occurred in the 1:100 year event but was mostly confined to the natural creek floodplains, except in portions of Irvine Creek, Leblanc Canal, Deer Creek, and the glacial spillway valley of Blackmud Creek in the vicinity of Leduc County where extensive overbank flooding occurred. Previous attempts to improve the drainage in these areas had provided capacity for at best the 1:5 year flood.

The majority of the creeks within the basin have complex geometry, are small, lack well defined channels, and have limited channel capacity to convey runoff flows from the existing development. These conditions will constrain future development in the following ways:

- The extent of flooding will constrain development. In some locations along the Blackmud Creek, Irvine Creek, Deer Creek, and Leblanc Canal the flood-risk areas are extensive. The Municipal Government Act empowers municipalities to preserve floodplain areas as Environmental Reserve (land subject to flooding) at the time of development but these powers are not always applied consistently or uniformly. Where extensive overland flooding occurs, it is not always practical to sterilize large areas from development, and these locations should be considered as possible sites for stormwater management ponds or wetlands. A policy for protecting floodplains that recognizes the flood risk and the environment values they create should be developed.

- Along with the extensive flooding, some of the creek channels, in the same locations as above, are too shallow to permit drainage of adjacent development using a conventional underground pipe system. Typically, a depth of 4 m from adjacent land areas to channel bottom is required and in many places this does not exist. Alternatives need to be considered such as:

    - a surface drainage system
    - channel deepening and widening to provide the required capacity (a drainage parkway)
    - a trunk storm sewer system to carry outflows from stormwater management facilities to a safe and reliable discharge point
    - Low-Impact Development standards to reduce the volume and peak runoff rates to pre-development levels

- Erosion issues in Whitemud and Blackmud Creek are understood in only a general way and could be aggravated by increasing runoff volumes and flood peak discharges resulting from further development in the basin. There are no reliable models of the erosion process to give ***quantitative*** estimates of the erosion rates and the impacts of the changing flow regime that will occur with development, but a ***qualitative*** estimate is possible from the model-simulated velocities and shear stresses and morphological principles that relate these hydraulic parameters to the rate of sediment transport.

Existing development in the basin has undoubtedly increased the runoff volume and may have increased peak flows, flood risk, and erosion rates. Some of the older areas were developed before these impacts and the importance of managing stormwater were understood and these older areas discharge directly into the receiving streams without any control. More recent developments have been completed with differing discharge rates in different municipalities and have changed over time for lack of an overall basin water management plan. We have not attempted to quantify these historic impacts but the possibility of further impacts due to anticipated development should be recognized going forward.

Channel velocities in Blackmud and Whitemud Creeks generally increase from upstream to downstream, reflecting the increase in discharge and longitudinal slope, and generally correlate with the bank erosion processes that have been observed. These erosion processes are the results of natural and human influences including previous historic development in the basin since the land was first cleared for agriculture and urban development.

The City of Edmonton has developed and has begun to implement a strategy for erosion control in Whitemud and Blackmud Creek but much work remains to be done. There is significant potential for the existing conditions to worsen if runoff from future development is not adequately managed. Streambank erosion is very sensitive to increases in velocity and flow and could potentially be impacted by development upstream. These potential impacts will be further evaluated in the next phase of this project.

Closure

This report was prepared for the Blackmud/Whitemud Creek Surface Water Management Group to summarize the hydrology and hydraulic modelling results for the Blackmud and Whitemud Creeks.

The services provided by Associated Engineering Alberta Ltd. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,
Associated Engineering Alberta Ltd.

PROFESSIONAL ENGINEER ALBERTA
AKINBOLA GEORGE

May 30, 2017.

Akinbola George, M.A.Sc., P.Eng., PMP
Project Technical Lead

PROFESSIONAL ENGINEER ALBERTA
TONDERAI CHAKANYUKA

May 30, 2017

Tonderai Chakanyuka, MBA, P.Eng., PMP, C.Eng
Project Manager

PROFESSIONAL ENGINEER ALBERTA
LARRY E. BODNARUK

May 30, 2017

Technical Review:
Larry Bodnaruk, P.Eng.

ASSOCIATED ENGINEERING
QUALITY MANAGEMENT SIGN-OFF
Signature:
Date: MAY 30, 2017

APEGA Permit to Practice P 3979

Appendix A - Pilot Model Memo

Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

Date:	April 27, 2017	**File:**	2016-3785.00.E.03.00
To:	Rae-Lynne Spila, P.Eng.		
From:	Tonderai Chakanyuka, MBA, P.Eng, PMP, C.Eng		
Project:	Blackmud/Whitemud Surface Water Management Study		
Subject:	Pilot Model		

MEMO

1 INTRODUCTION

The Blackmud/Whitemud Surface Water Management Group (Group) retained Associated Engineering (AE) to complete a Surface Water Management Study. This study involved hydrologic, hydraulic, hydrogeologic and environmental analyses of the Blackmud and Whitemud Creek basins.

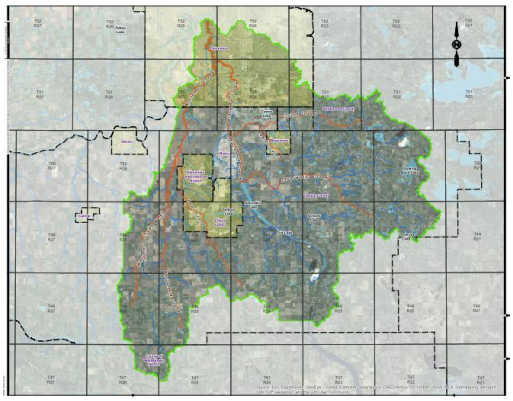


Figure 1-1: Blackmud/Whitemud Creek Basin

A lumped and steady state approach was adopted for the hydrologic and hydraulic modelling phase of the study. This approach required a number of simplifying assumptions compared to a long-term simulation based on a fully dynamic modelling approach. As part of the hydrologic and hydraulic model development, AE developed a pilot model to define the key hydrologic processes, to explore the feasibility of a fully dynamic model, and to try to estimate how conservative the steady-state model would be.

This memo summarizes the pilot model development and simulation results.

2 PILOT MODEL DEVELOPMENT

The extent of the pilot model was the Irvine Creek sub-basin (**Figure 2-1**) which included Irvine Creek and LeBlanc Canal. This sub-basin has a drainage area of approximately 158 km^2 which is about 15% of the entire study basin area. This sub-basin is representative of the hydrology/hydraulic conditions experienced within the basin and was chosen because it experiences the most significant flooding and peak flow attenuation due to routing effects.

Irvine Creek is a tributary of Blackmud Creek located in northeast Leduc County. The Irvine Creek basin includes lands within the Town of Beaumont, the City of Edmonton, Leduc County, and Strathcona County. This area is mostly undeveloped except for the Town of Beaumont. The creek flows in a westerly direction from its upstream point at an unnamed lake east of Highway 21 into Blackmud Creek just south of the intersection of 9th Street and 30th Avenue in Nisku.

Cawes Lake drains into the Irvine Creek watershed in Leduc County but does not have a defined outlet. LeBlanc Canal also drains into Irvine Creek. The canal drains most of the Town of Beaumont, and Town runoff is controlled with a system of stormwater management ponds.

2.1 MODEL SET-UP

Figure 2-2 provides the schematic of the pilot MIKE 11 model. The model consisted of 45 cross-sections on LeBlanc Canal and Irvine Creek over approximately a 7 km reach from the Town of Beaumont to Blackmud Creek. Boundary inflows were generated using PCSWMM for two locations, representing runoff from the Town of Beaumont and from the

upper Irvine Creek basin, upstream of the LeBlanc Canal. The Mike11 model then simulated the routing of this flow through the LeBlanc Canal and Irvine Creek to determine the resulting outflow to Blackmud Creek. It also calculated the water level at each time step at every cross-section in the model.

Cross-sections used within the MIKE 11 model were extracted from the existing Irvine Creek model (Stantec, 2014 Irvine Creek and Cawes Lake Watershed Study) and the 1 m LIDAR data.

Figure 2-3 shows the schematic of the PCSWMM model that was used to generate the boundary inflows. The existing Town of Beaumont PCSWMM model was used to generate an inflow hydrograph to LeBlanc Canal for the 1:100 year, 24 hour design storm event (Huff distribution). The PCSWMM model was expanded to include the Irvine Creek catchment upstream of the Town which was modelled using the following parameters:

Parameter	Value
Ground Slope	Average catchment slope calculated based on LIDAR
Catchment Width	15,000 m
Impervious Area Manning's n	0.015
Pervious Area Manning's n	0.25
Impervious Depression Storage	2 mm
Pervious Depression Storage	5 mm
Percent of Area with Zero Detention	25 %
Maximum Infiltration Rate	75 mm/hr
Minimum Infiltration Rate	5 mm/hr
Decay Constant	4 (1/hr)

Validation of the model for the undeveloped area was completed based on the hydrology assessment carried out for the Blackmud/Whitemud Surface Water Management Study. For this task, basin width was used as a calibration parameter.

For the dynamic model the PCSWMM model was run for the 1:100 year, 24 hour storm duration design storm event (Huff distribution) and the discharge hydrographs were extracted and applied to the Mike 11 pilot model as a time series inflow. For the steady-state model the peak inflows were applied as a steady state boundary inflow at the two inflow nodes.

2.2 MODEL RESULTS

The model results compared a dynamic single-event model to a steady state model for a 1:100 year design storm. This was to determine the impact of flood routing and storage on peak flow and water level within Irvine Creek.

Figure 2-4 compares the routed flow with the dynamic model with those of the steady state model. The results indicated that:

- The peak flow from the urban area coincided with those from the rural area in Irvine Creek. This implies that the peak flows can be added, at least for rainfall events in Irvine Creek.
- The storage and routing effects in Irvine Creek reduce the peak flow by about 5% between the Town of Beaumont and the confluence with Blackmud Creek.

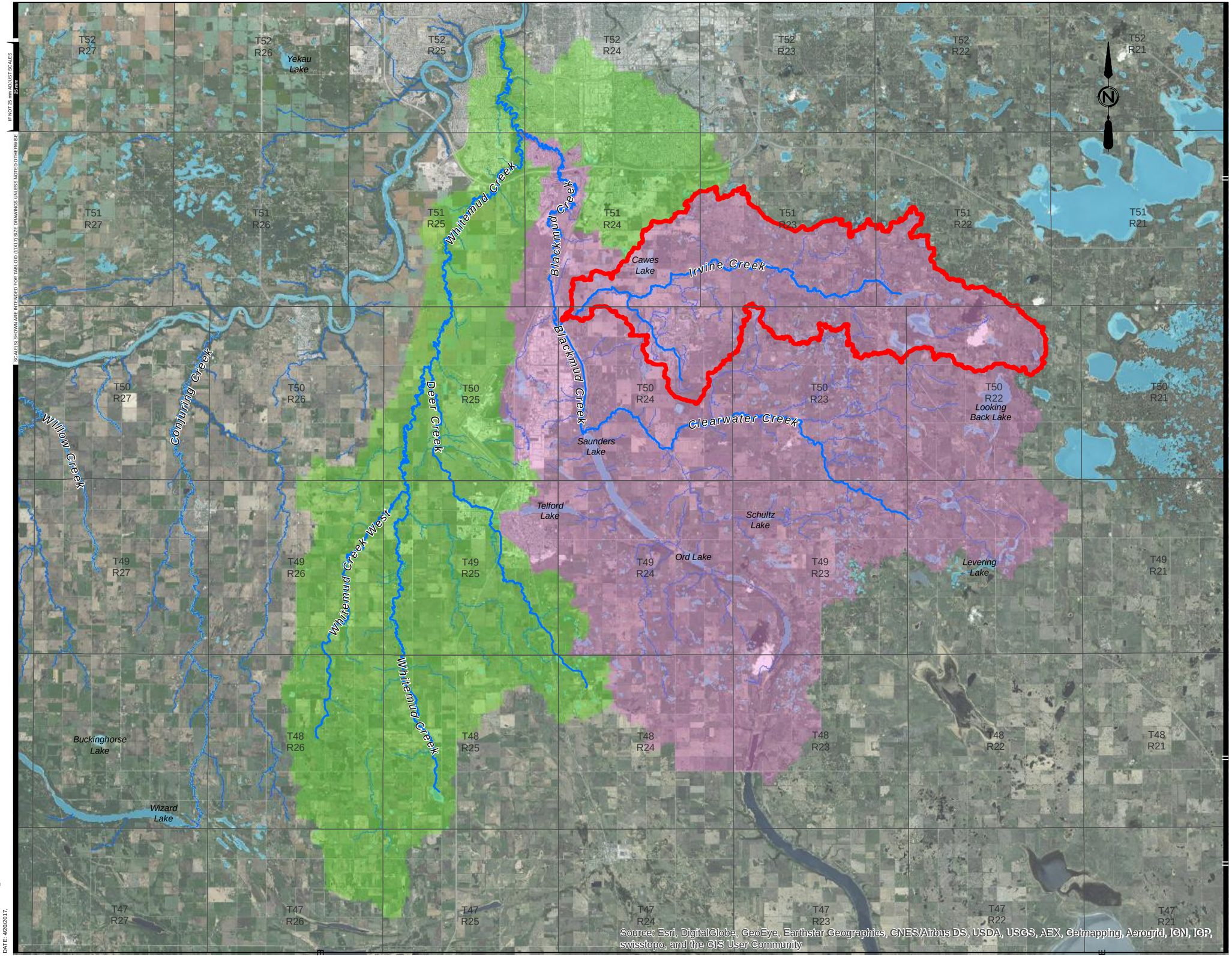
The MIKE11 model required approximately 1 minute to run a 5-day simulation period. Based on this result it is estimated that a dynamic model simulation of the full basin for a 45-year period of recorded flows would require a run time of the order of 30 days. The model run time is affected by the number and spacing of cross-sections, which govern the simulation time step required for stability. The model run time could be reduced by deleting a number of cross-sections, but this would reduce the accuracy of the flood mapping which is a key deliverable of the project and a key consideration in the basin water management plan.

2.3 CONCLUSIONS

The pilot model demonstrated that the urban and rural runoff peaks can be reasonably assumed to coincide, at least for long-duration rainfall events in the Irvine Creek catchment and for urban runoff controlled with stormwater management. Flood storage and routing effects reduced the peak flows by about 5% compared with a steady-state model.

The pilot model also demonstrated that a steady-state model can be made to produce realistic results if appropriate inputs are selected. Also, calibration of the runoff model is required for rural areas and such calibration is hampered by the available flow data at 4 locations and the available precipitation data at only one location. Rainfall varies over relatively short distances and this variability affects our ability to reproduce historic flows.

Finally, the pilot model demonstrated that model run times for a dynamic model would be excessive which limits the practicability of a dynamic model to predict flood levels and extent.



Associated Engineering

Legend:

- Whitemud Creek Watershed
- Blackmud Creek Watershed
- Creek Centreline
- Irvine Creek Sub-basin

FIGURE No. 2-1

BLACKMUD/WHITEMUD CREEK
WATERSHED MANAGEMENT STUDY

PILOT MODEL EXTENT

AE PROJECT No.	2016-3785
SCALE	1:200,000
APPROVED	
DATE	2017 APRIL
REV	
DESCRIPTION	ISSUED FOR REPORT

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DATE: 4/20/2017.

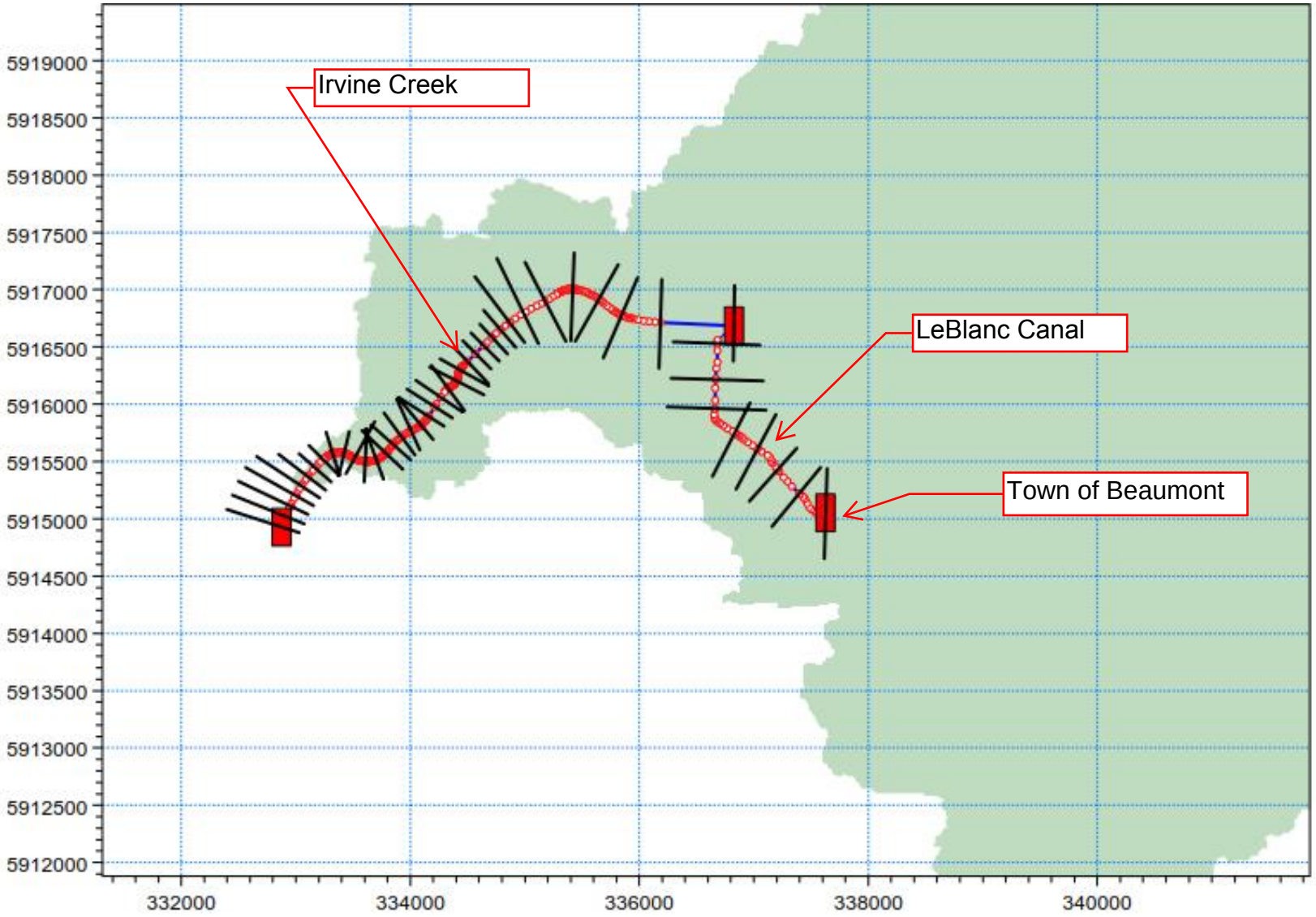
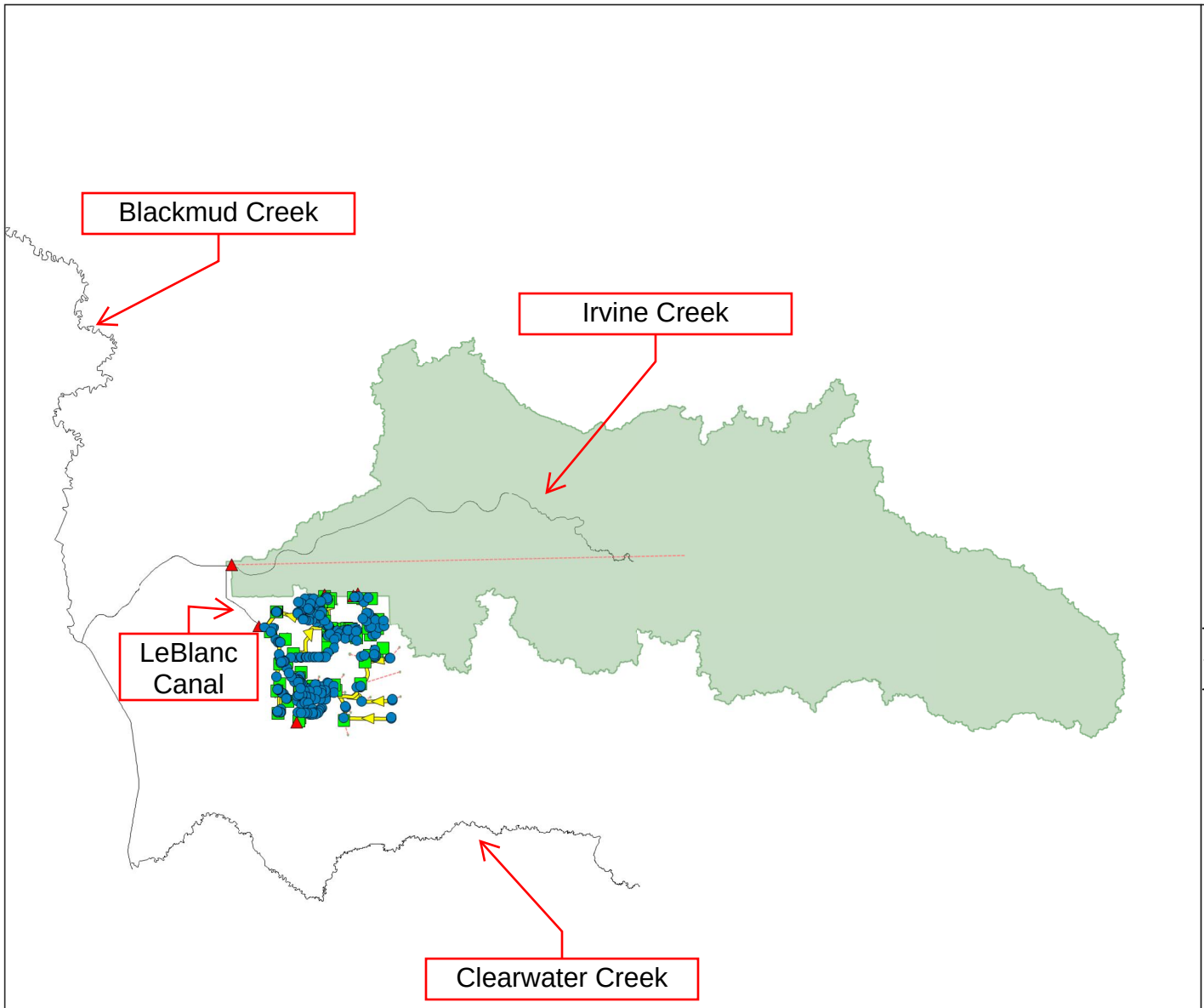


FIGURE No. 2-2

BLACKMUD/WHITEMUD CREEK
WATERSHED MANAGEMENT STUDY

MIKE 11 MODEL SCHEMATIC

AE PROJECT No.	2016-3785
SCALE	
APPROVED	
DATE	2017 APRIL
REV	
DESCRIPTION	ISSUED FOR REPORT



Legend

- Junctions
- Outfalls
- Storages
- Conduits
- Pumps
- Orifices
- Weirs
- Subcatchments

FIGURE No. 2-3

BLACKMUD/WHITEMUD CREEK WATERSHED MANAGEMENT STUDY

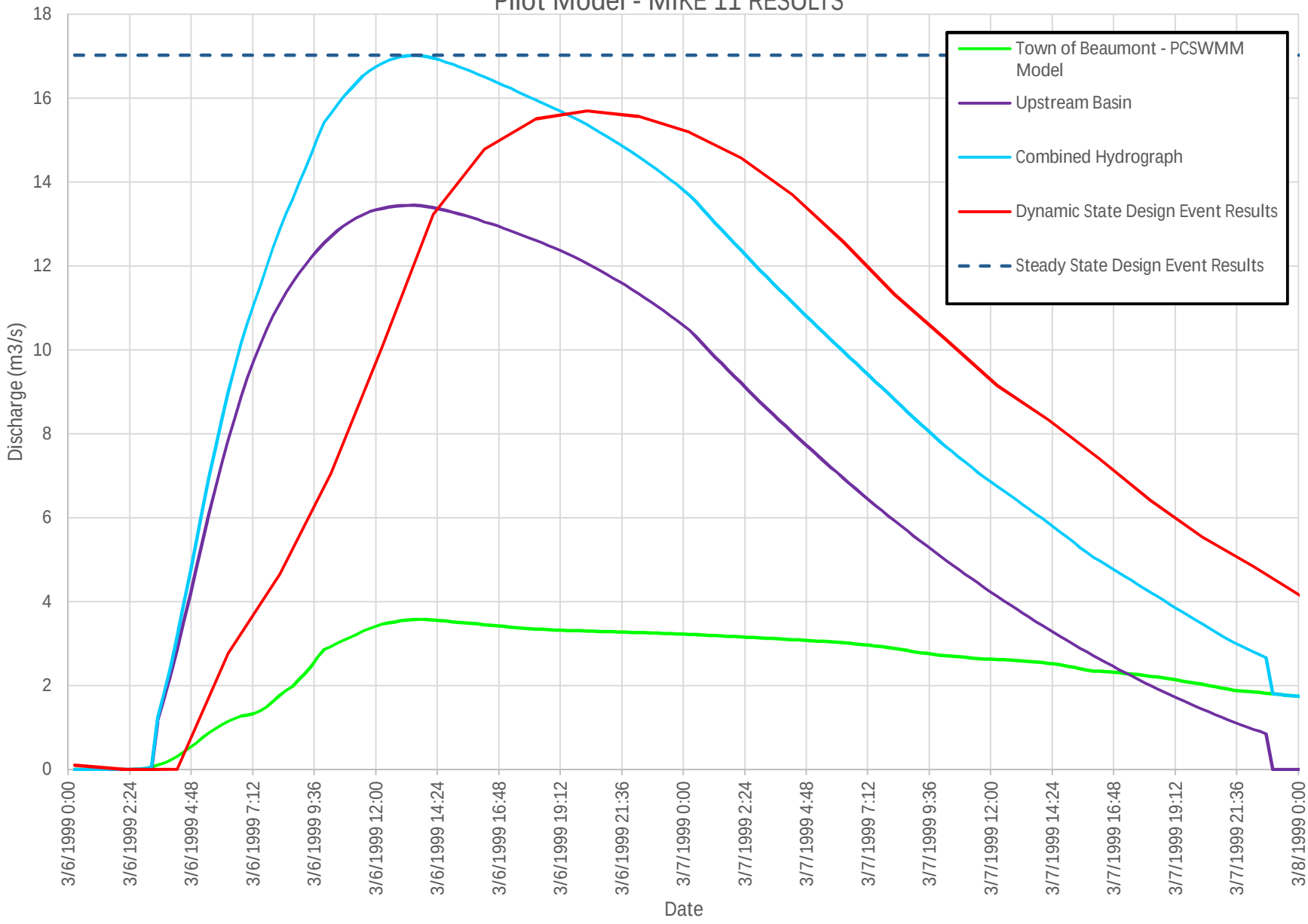
PILOT MODEL SCHEMATIC

AE PROJECT No.	2016-3785
SCALE	
APPROVED	
DATE	2017 APRIL
REV	
DESCRIPTION	

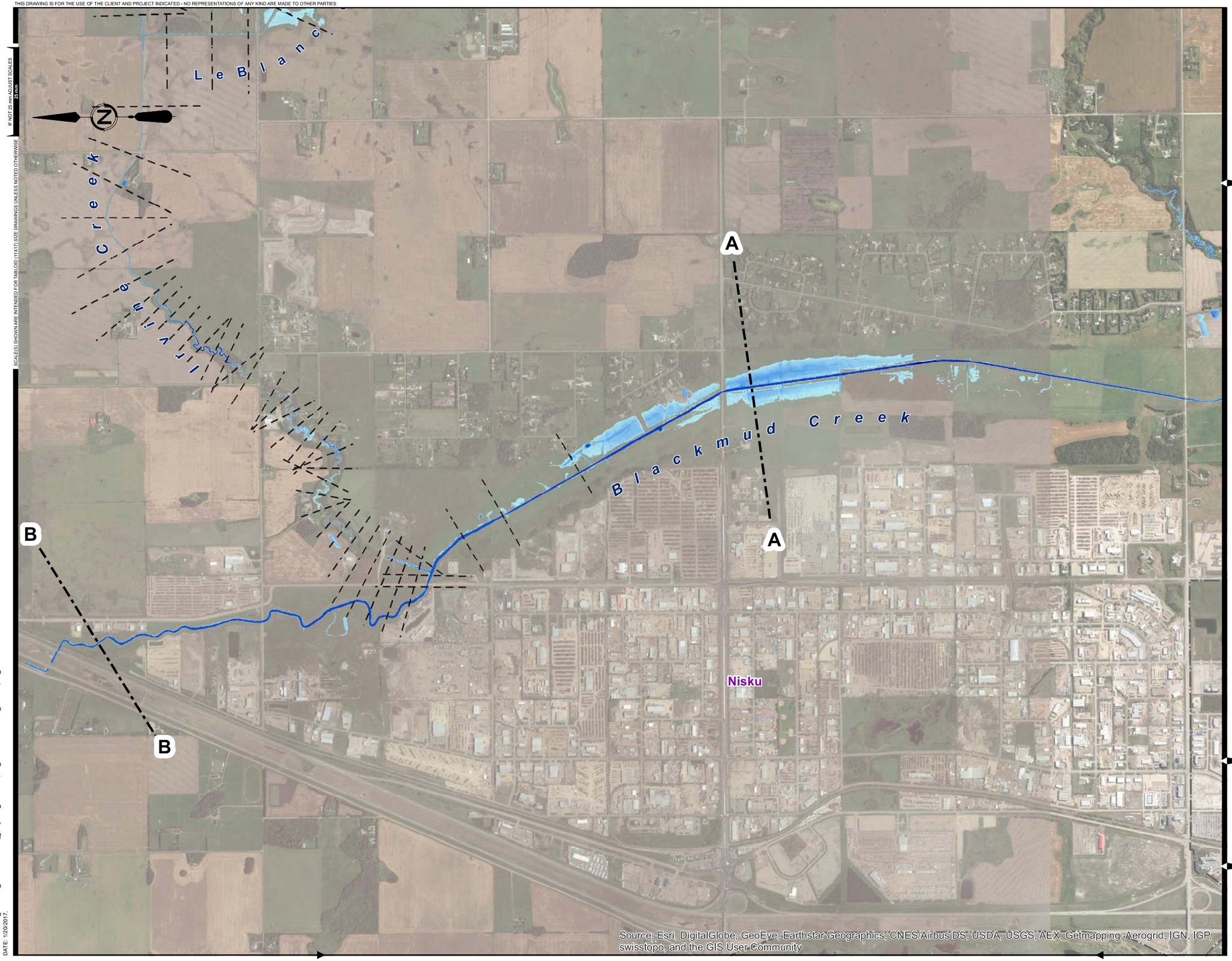
N

5 km

Figure 2-4
Pilot Model - MIKE 11 RESULTS



Appendix B - Flood Maps



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Associated Engineering

Legend:

Water Depth (2 Year)
- High (1.8 m)
- Low (0 m)

Cross Section

Municipal Boundary

FIGURE No. A-1

BLACKMUD/WHITEMUD CREEK
WATERSHED MANAGEMENT STUDY

Blackmud Creek 1:2 Year

AE PROJECT No.	2016-3785
SCALE	1:25,000
APPROVED	
DATE	2017 JANUARY
REV	
DESCRIPTION	ISSUED FOR REPORT

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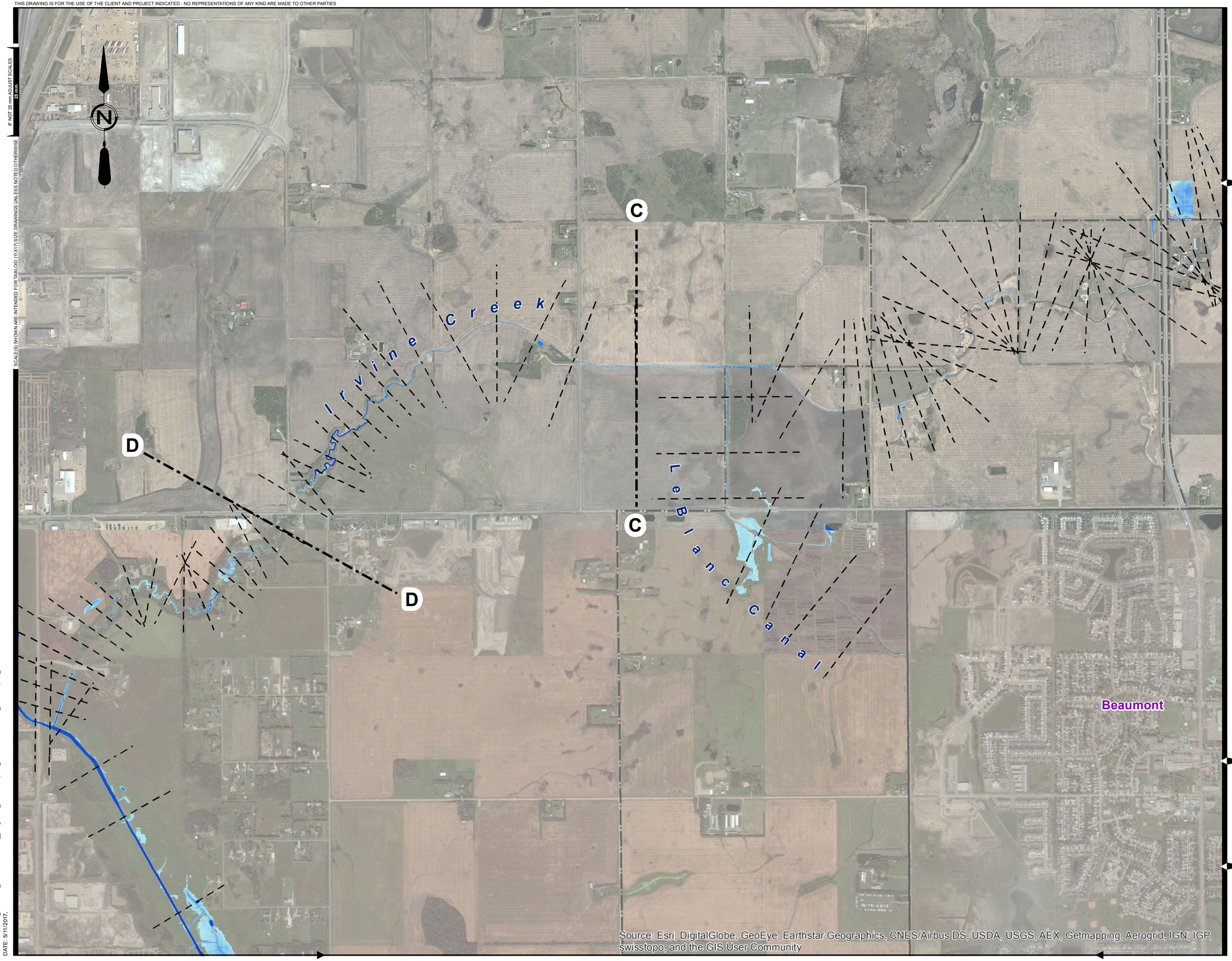

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Associated Engineering

Legend:

Water Depth (2 Year)
- High (1.8 m)
- Low (0 m)

Cross Section

Municipal Boundary

FIGURE No. A-2

BLACKMUD/WHITEMUD CREEK
WATERSHED MANAGEMENT STUDY

Irvine Creek 1:2 Year

AE PROJECT No.	2016-3785
SCALE	1:20,000
APPROVED	
DATE	2017 JANUARY
REV	
DESCRIPTION	ISSUED FOR REPORT

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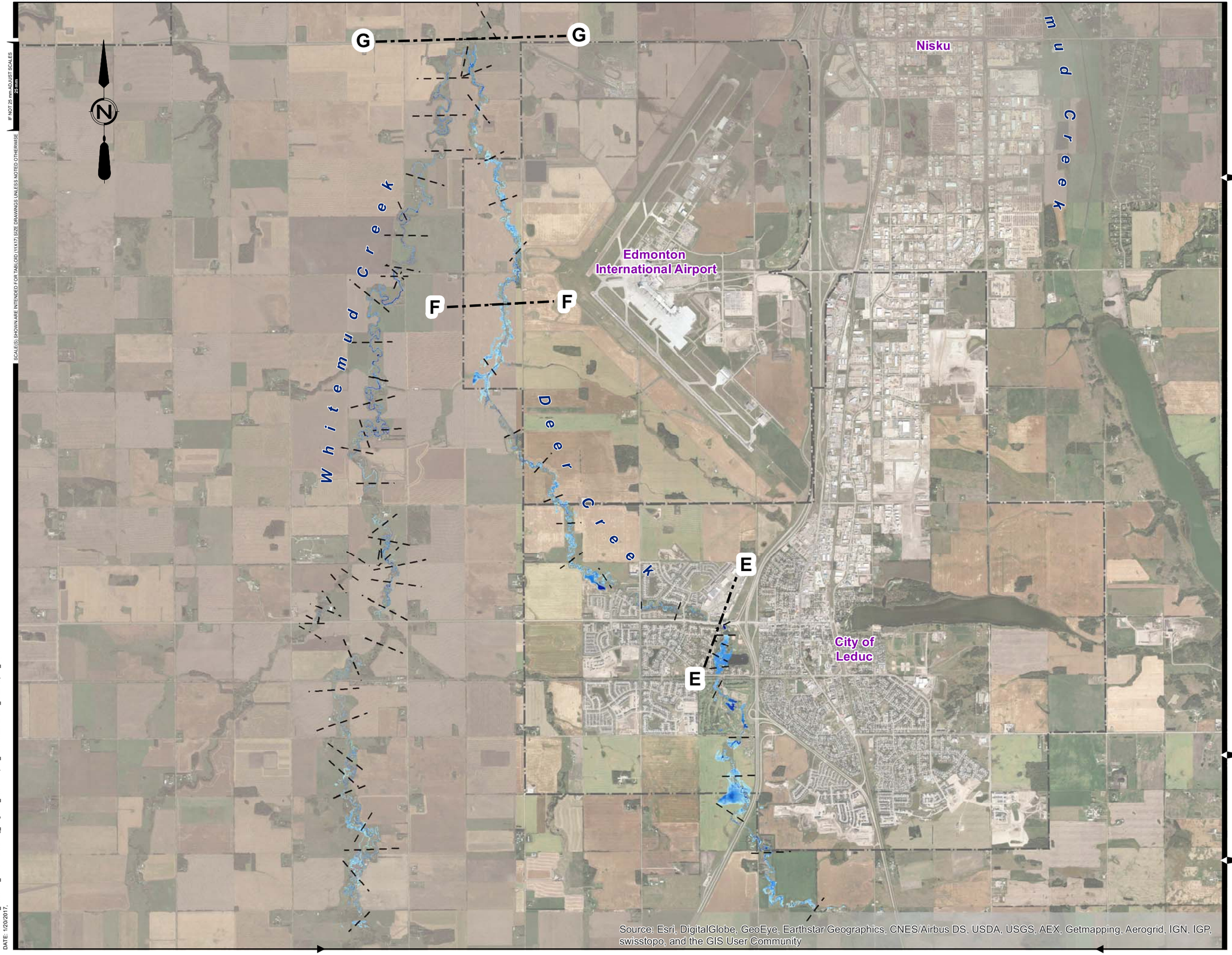

Associated Engineering

Legend:

Water Depth (2 Year)

High (3.1 m)

Low (0 m)

Cross Section

Municipal Boundary

FIGURE No. A-3

BLACKMUD/WHITEMUD CREEK
WATERSHED MANAGEMENT STUDY

Deer Creek 1:2 Year

AE PROJECT No.	2016-3785
SCALE	1:50,000
APPROVED	
DATE	2017 JANUARY
REV	
DESCRIPTION	ISSUED FOR REPORT

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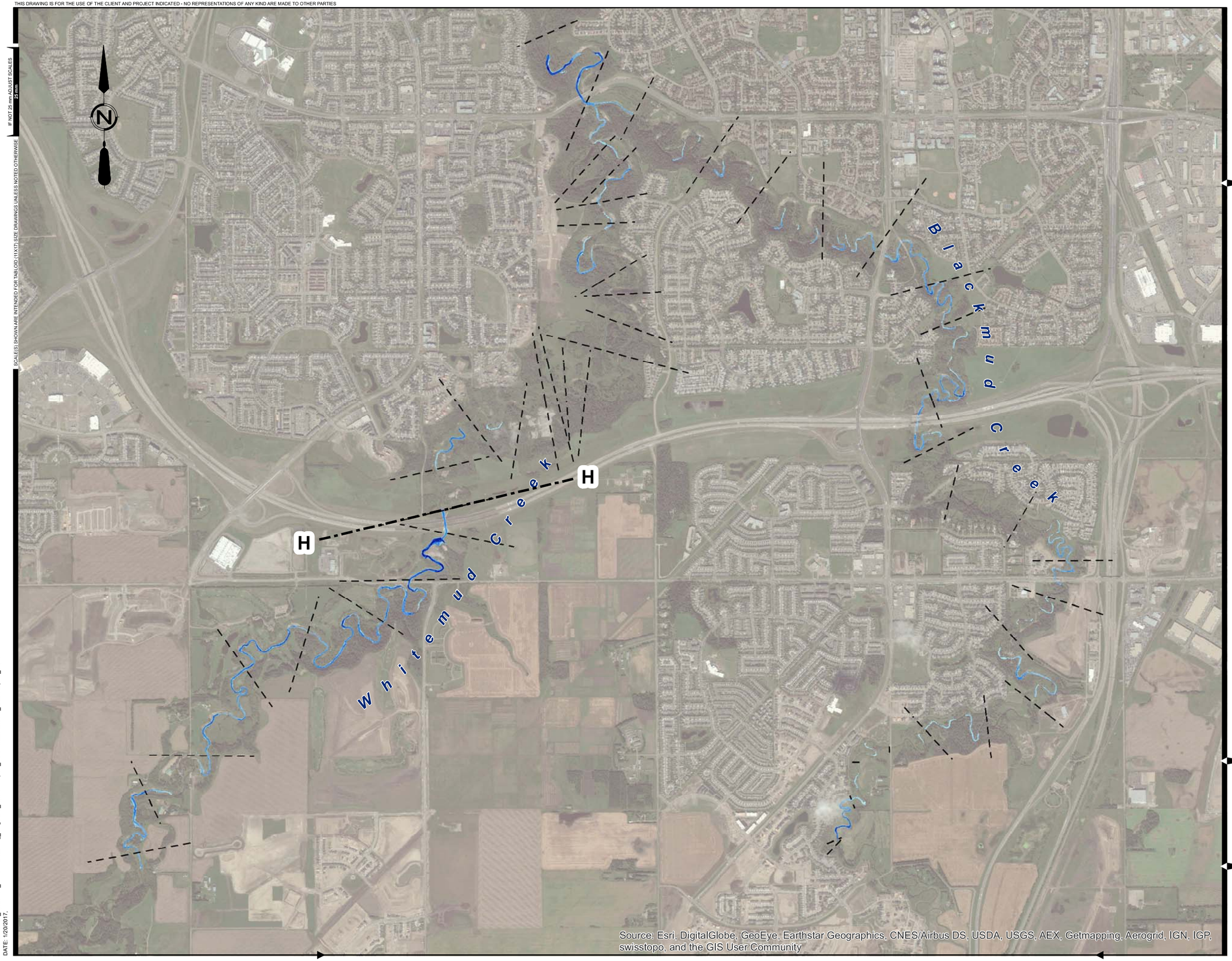

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Associated Engineering

Legend:

Water Depth (2 Year)

High (1.9 m)

Low (0 m)

Cross Section

Municipal Boundary

FIGURE No. A-4

BLACKMUD/WHITEMUD CREEK
WATERSHED MANAGEMENT STUDY

Whitemud Creek 1:2 Year

AE PROJECT No.	2016-3785
SCALE	1:25,000
APPROVED	
DATE	2017 JANUARY
REV	
DESCRIPTION	ISSUED FOR REPORT

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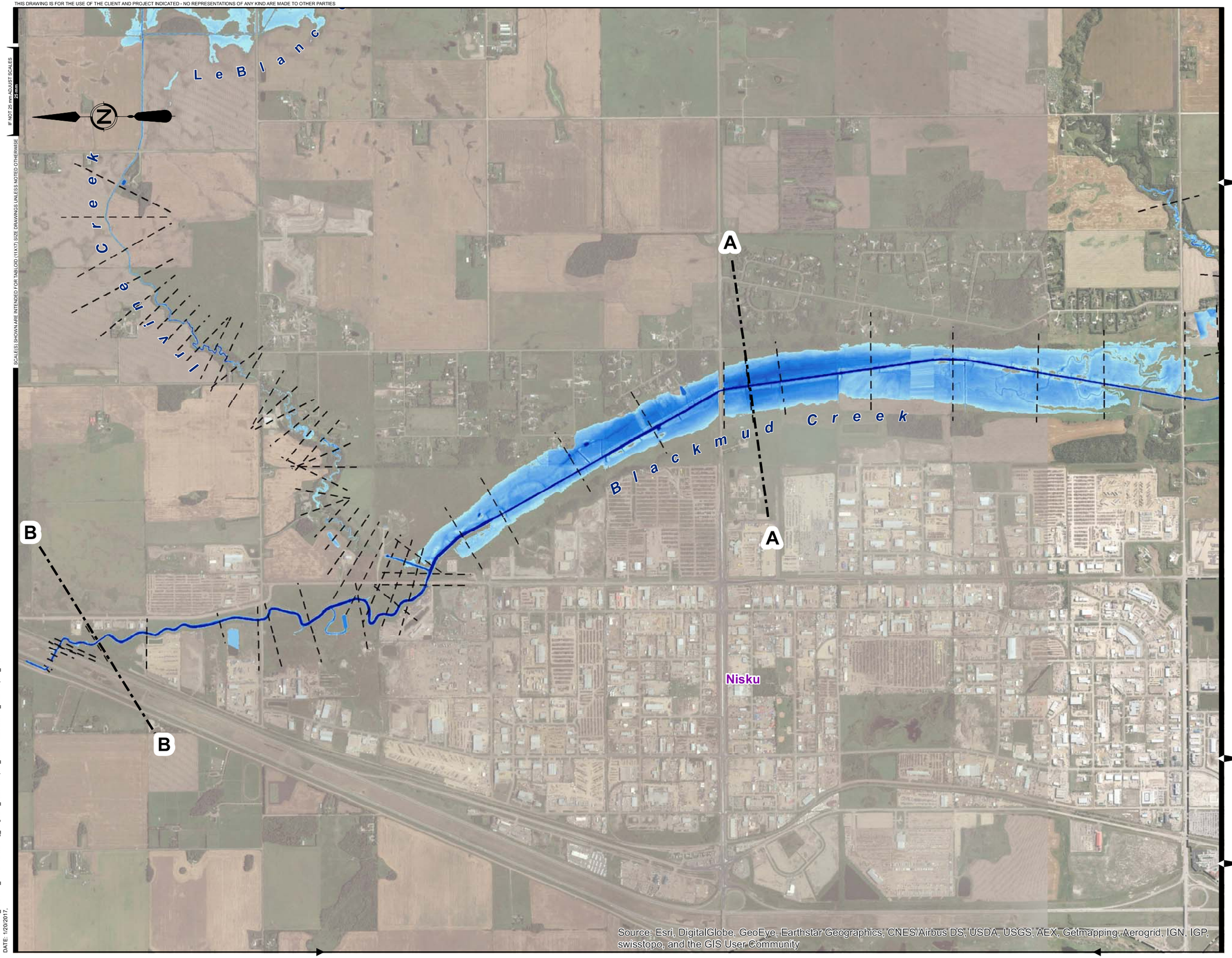

Associated Engineering

Legend:

Water Depth (5 Year)
- High (2.4 m)
- Low (0 m)

Cross Section

Municipal Boundary

FIGURE No. A-5

BLACKMUD/WHITEMUD CREEK
WATERSHED MANAGEMENT STUDY

Blackmud Creek 1:5 Year

AE PROJECT No.	2016-3785
SCALE	1:25,000
APPROVED	
DATE	2017 JANUARY
REV	
DESCRIPTION	ISSUED FOR REPORT

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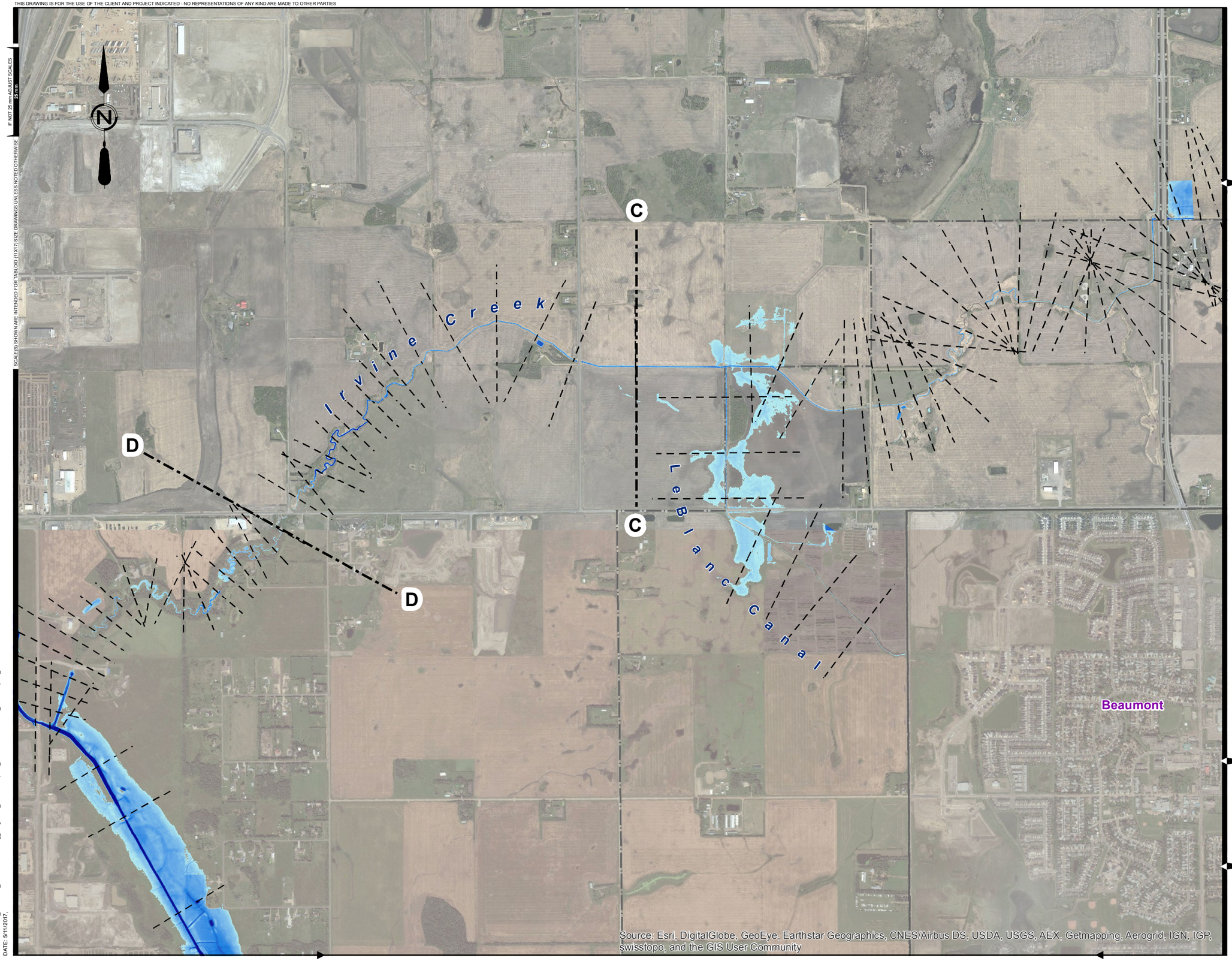


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Associated Engineering

Legend:

Water Depth (5 Year)

High (2.0 m)

Low (0 m)

Cross Section

Municipal Boundary

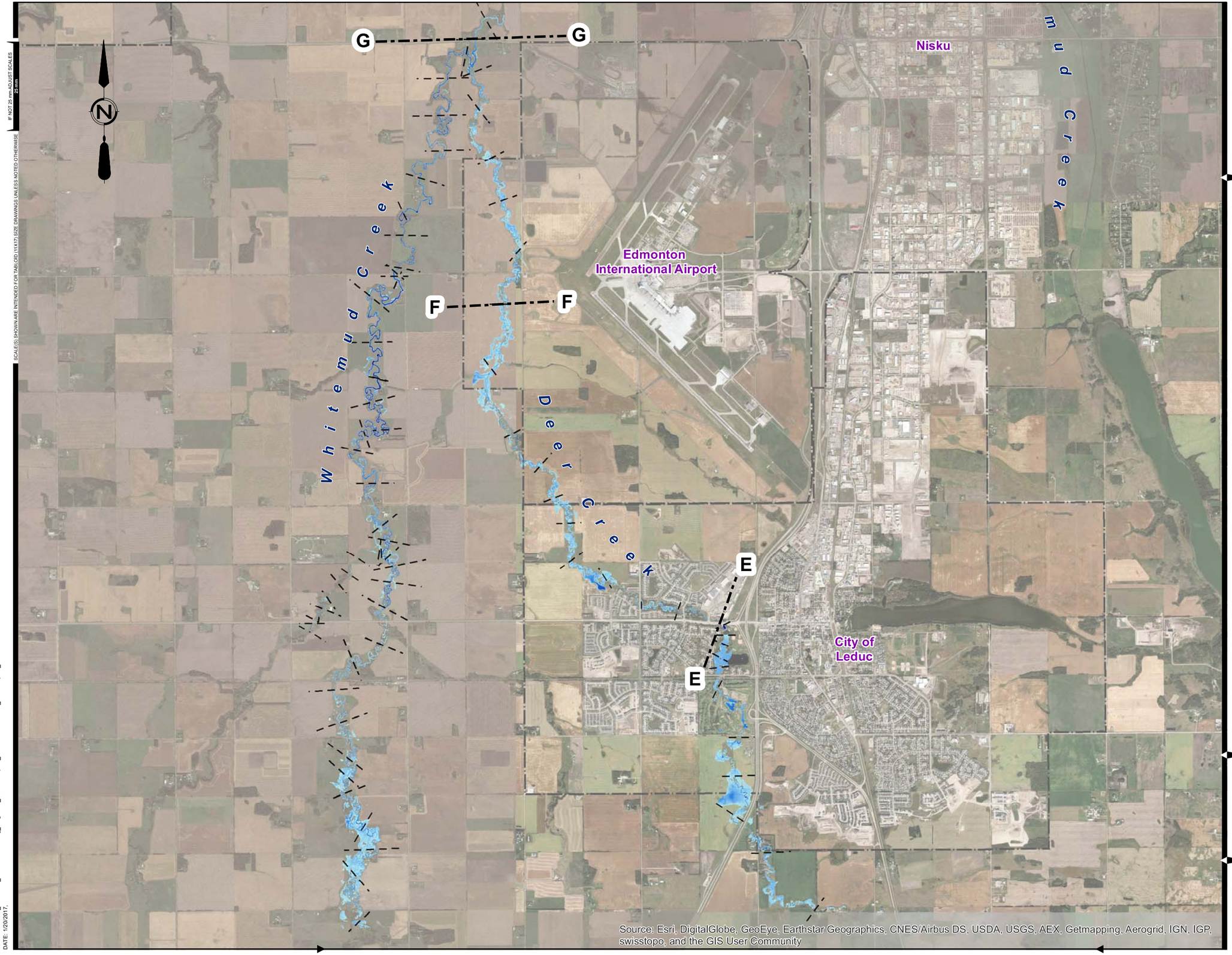
FIGURE No. A-6

BLACKMUD/WHITEMUD CREEK
WATERSHED MANAGEMENT STUDY

Irvine Creek 1:5 Year

AE PROJECT No.	2016-3785
SCALE	1:20,000
APPROVED	
DATE	2017 JANUARY
REV	
DESCRIPTION	ISSUED FOR REPORT

P:\2016378\900_Blackmud_Whitemud\Working_Dwgs\010_GIS\ArcMaps\02_WaterResources\xxx_CreekDepths_v2.mxd
DATE: 5/11/2017,



Associated Engineering

Legend:

Water Depth (5 Year)

High (3.2 m)

Low (0 m)

Cross Section

Municipal Boundary

FIGURE No. A-7

BLACKMUD/WHITEMUD CREEK
WATERSHED MANAGEMENT STUDY

Deer Creek 1:5 Year

AE PROJECT No.	2016-3785
SCALE	1:50,000
APPROVED	
DATE	2017 JANUARY
REV	
DESCRIPTION	ISSUED FOR REPORT

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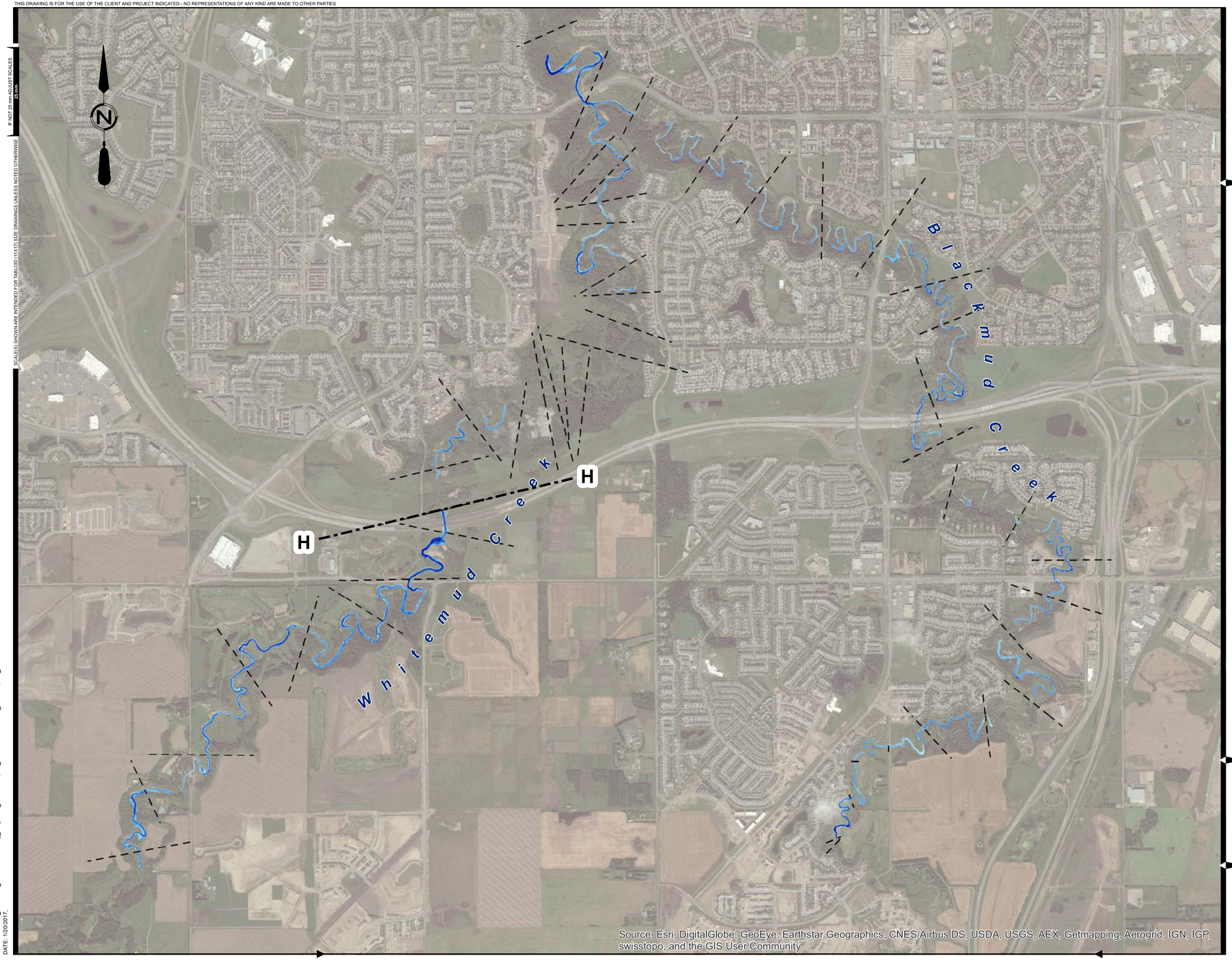


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Associated Engineering

Legend:

Water Depth (5 Year)

High (2.0 m)

Low (0 m)

Cross Section

Municipal Boundary

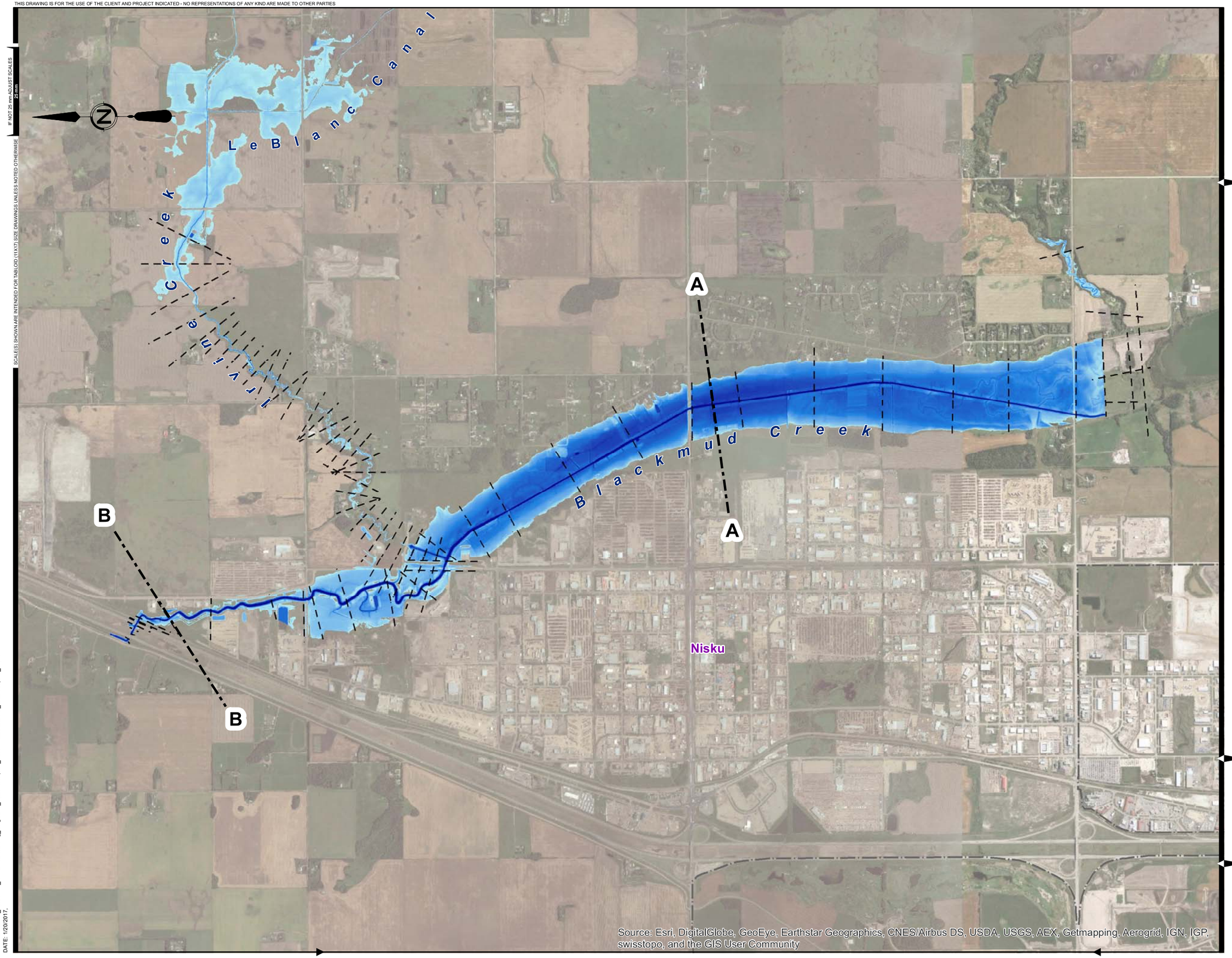
FIGURE No. A-8

BLACKMUD/WHITEMUD CREEK
WATERSHED MANAGEMENT STUDY

Whitemud Creek 1:5 Year

AE PROJECT No.	2016-3785
SCALE	1:25,000
APPROVED	
DATE	2017 JANUARY
REV	
DESCRIPTION	ISSUED FOR REPORT

P:\2016\3785\00_Blackmud_Whitemud\Working_Dwgs\010_GIS\ArcMap\02_WaterResources\xx_Creek\Depths_v2.mxd
DATE: 1/20/2017;



Associated Engineering

Legend:

Water Depth (100 Year)

High (4.1 m)

Low (0 m)

Cross Section

Municipal Boundary

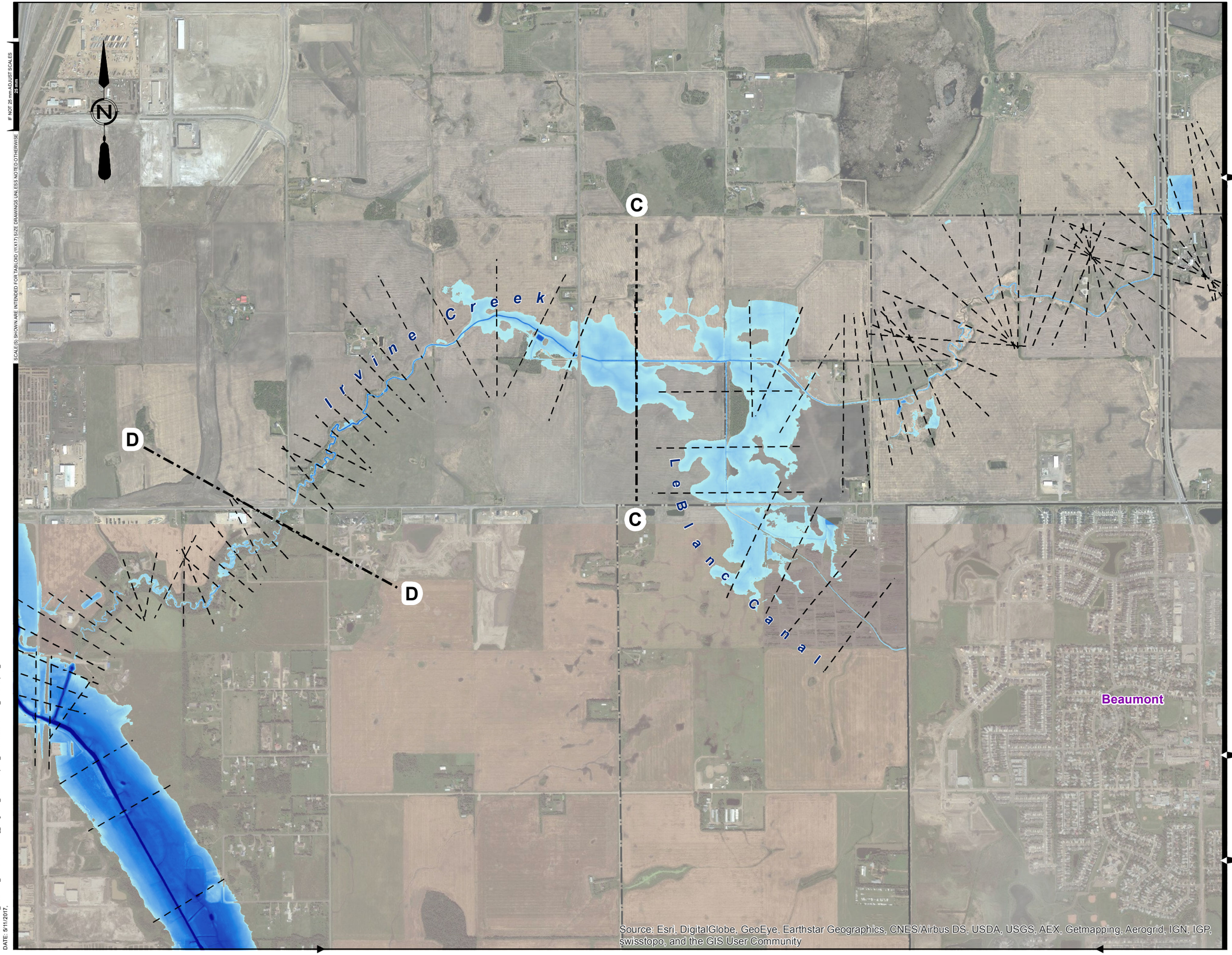
FIGURE No. A-9

BLACKMUD/WHITEMUD CREEK
WATERSHED MANAGEMENT STUDY

Blackmud Creek 1:100 Year

AE PROJECT No.	2016-3785
SCALE	1:30,000
APPROVED	
DATE	2017 JANUARY
REV	
DESCRIPTION	ISSUED FOR REPORT

P:\2016\3785\00_Blackmud_Whitemud\Working_Dwgs\010_GIS\ArcMap\02_WaterResources\xxx_CreekDepths_v2.mxd
DATE: 1/20/2017,



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Associated Engineering

Legend:

Water Depth (100 Year)
- High (3.7 m)
- Low (0 m)

Cross Section

Municipal Boundary

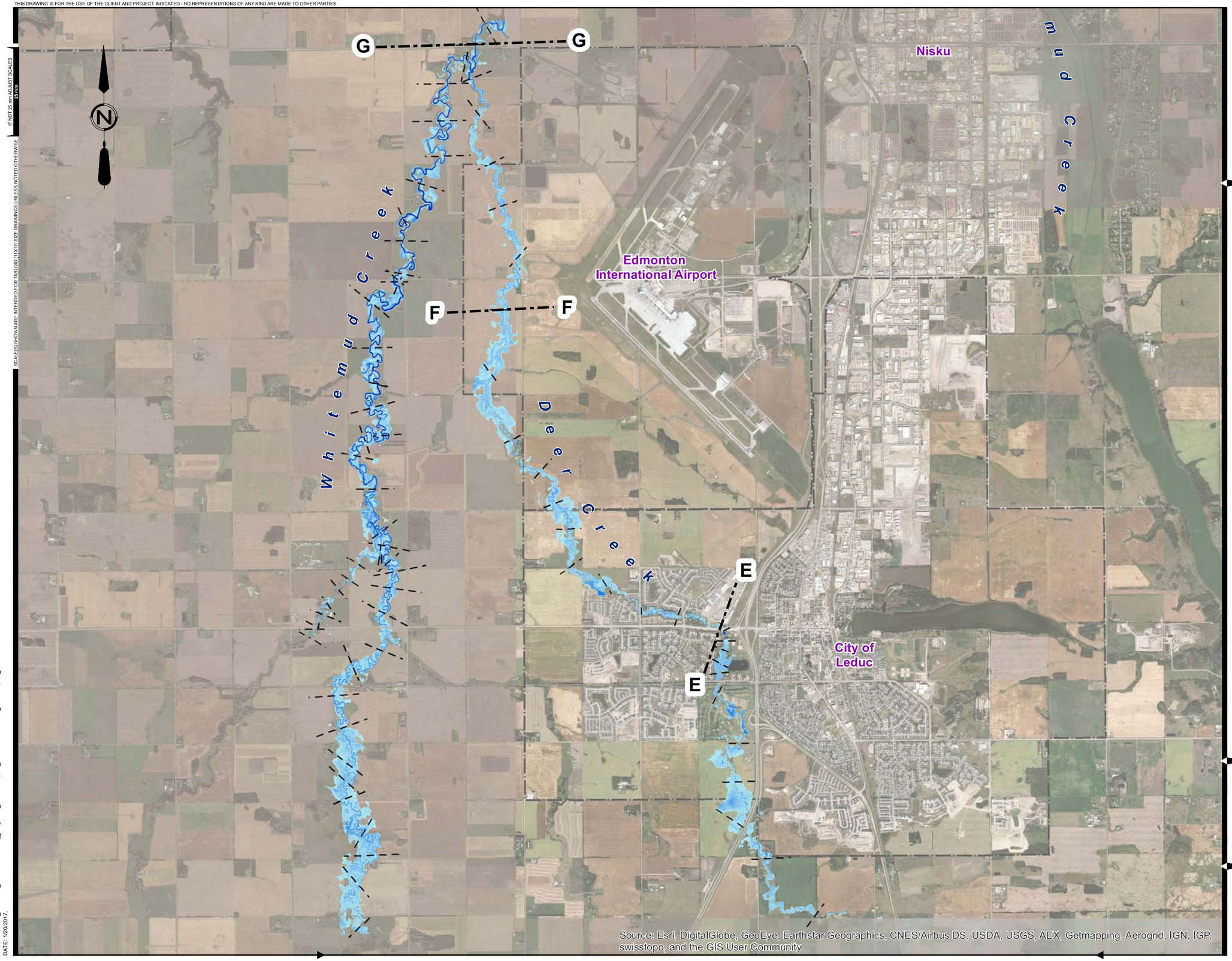
FIGURE No. A-10

BLACKMUD/WHITEMUD CREEK
WATERSHED MANAGEMENT STUDY

Irvine Creek 1:100 Year

AE PROJECT No.	2016-3785
SCALE	1:20,000
APPROVED	
DATE	2017 JANUARY
REV	
DESCRIPTION	ISSUED FOR REPORT

P:\2016\3785\00_Blackmud_Whitemud\Working_Dwgs\010_GIS\ArcMap\02_WaterResources\xxx_CreekDepths_v2.mxd
DATE: 5/11/2017.



Associated Engineering

Legend:

Water Depth (100 Year)

High (4.1 m)

Low (0 m)

Cross Section

Municipal Boundary

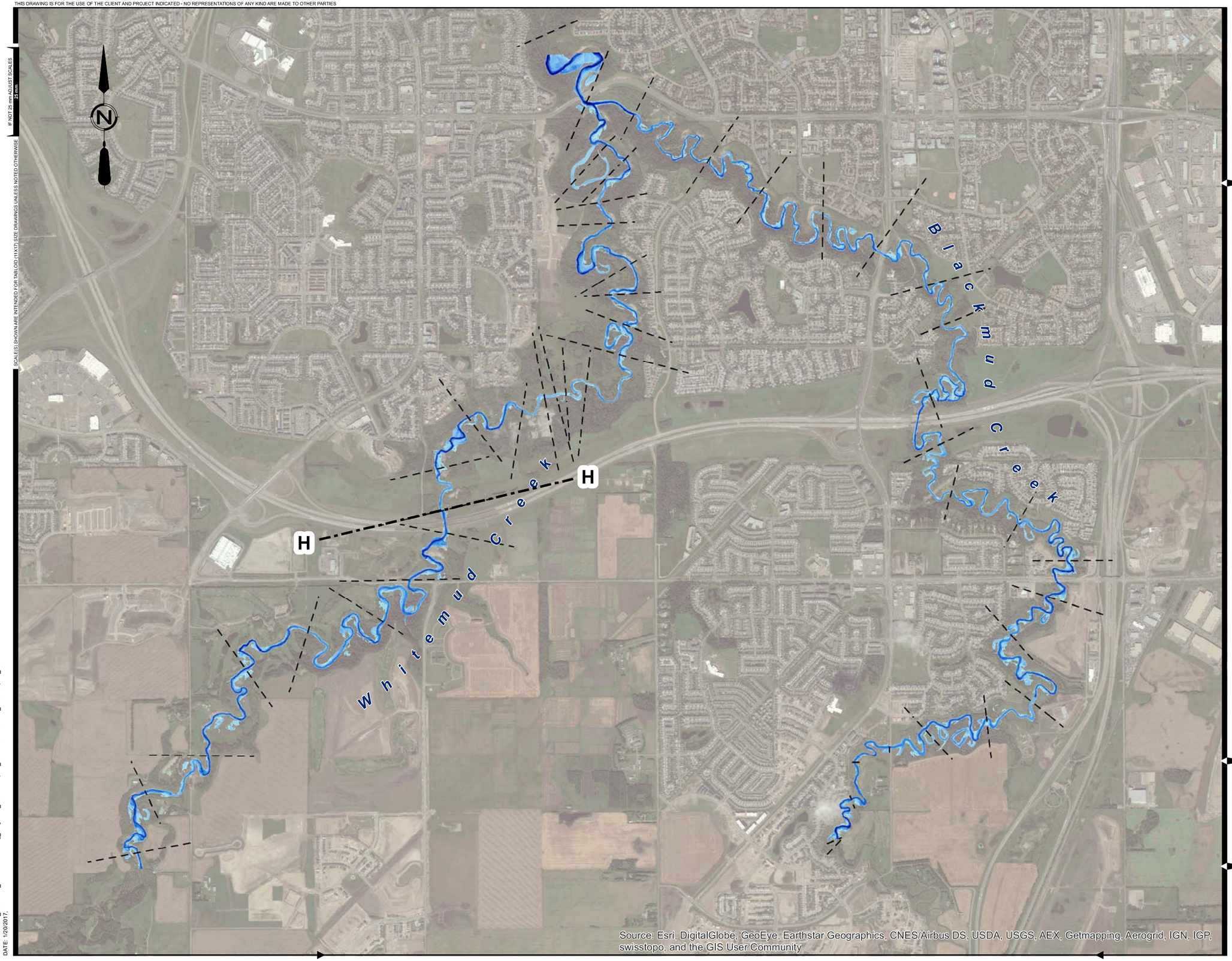
FIGURE No. A-11

BLACKMUD/WHITEMUD CREEK
WATERSHED MANAGEMENT STUDY

Deer Creek 1:100 Year

AE PROJECT No.	2016-3785
SCALE	1:50,000
APPROVED	
DATE	2017 JANUARY
REV	
DESCRIPTION	ISSUED FOR REPORT

P:\2016\3785\00_Blackmud_Whitemud\Working_Dwgs\010_GIS\ArcMap\02_WaterResources\xxx_CreekDepths_v2.mxd
DATE: 1/20/2017;



Associated Engineering

Legend:

Water Depth (100 Year)
- High (4.1 m)
- Low (0 m)

Cross Section

Municipal Boundary

FIGURE No. A-12

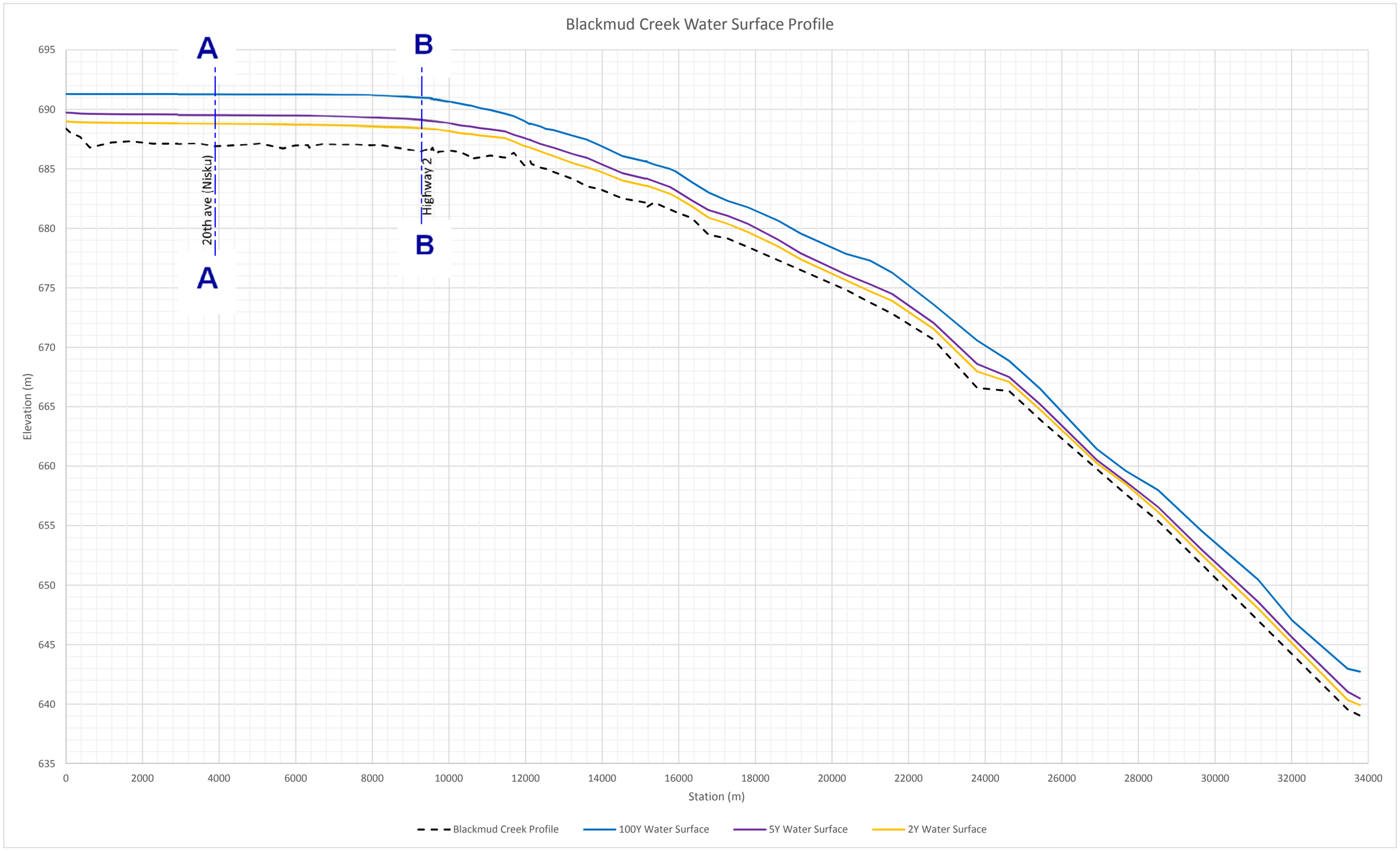
BLACKMUD/WHITEMUD CREEK
WATERSHED MANAGEMENT STUDY

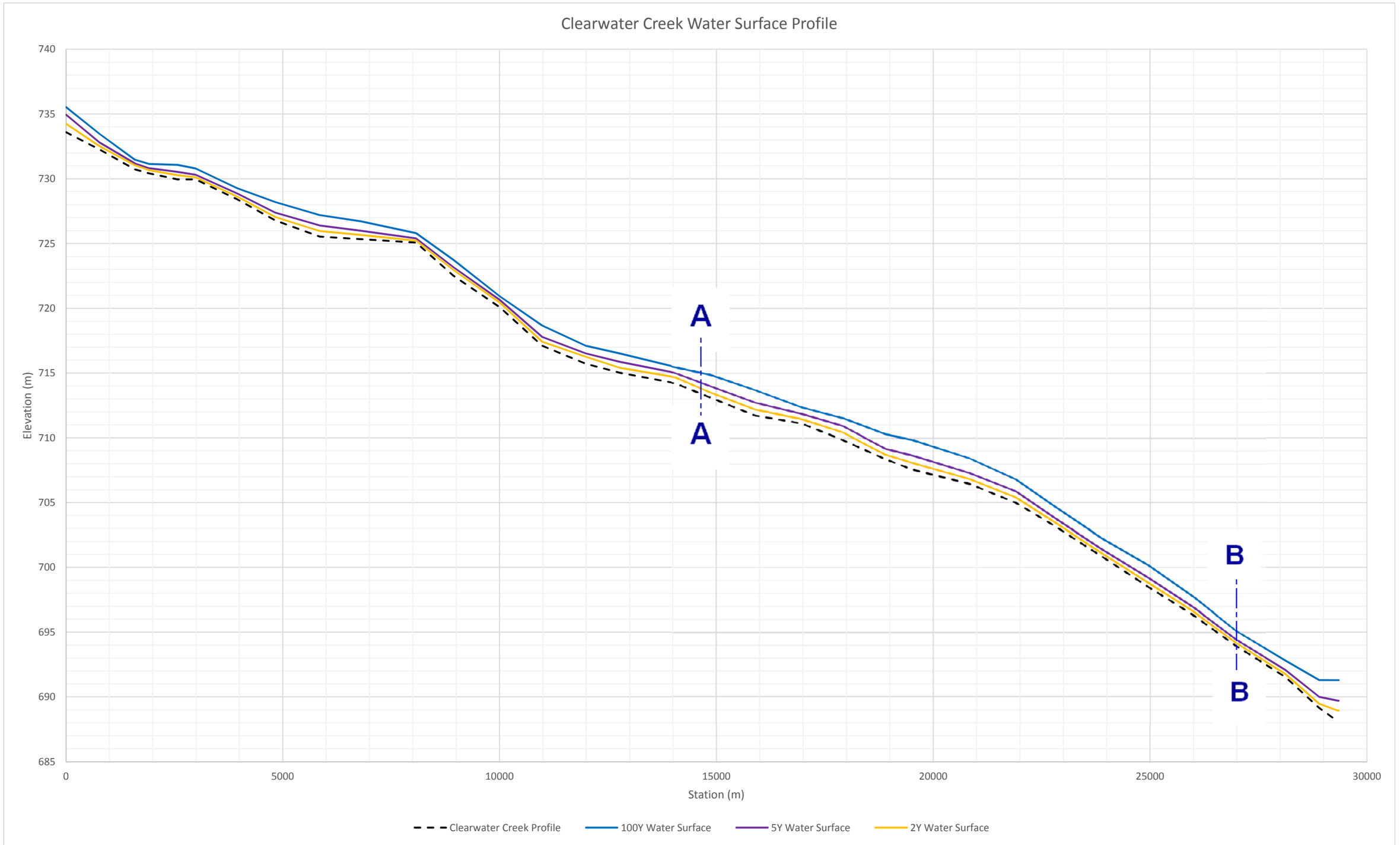
Whitemud Creek 1:100 Year

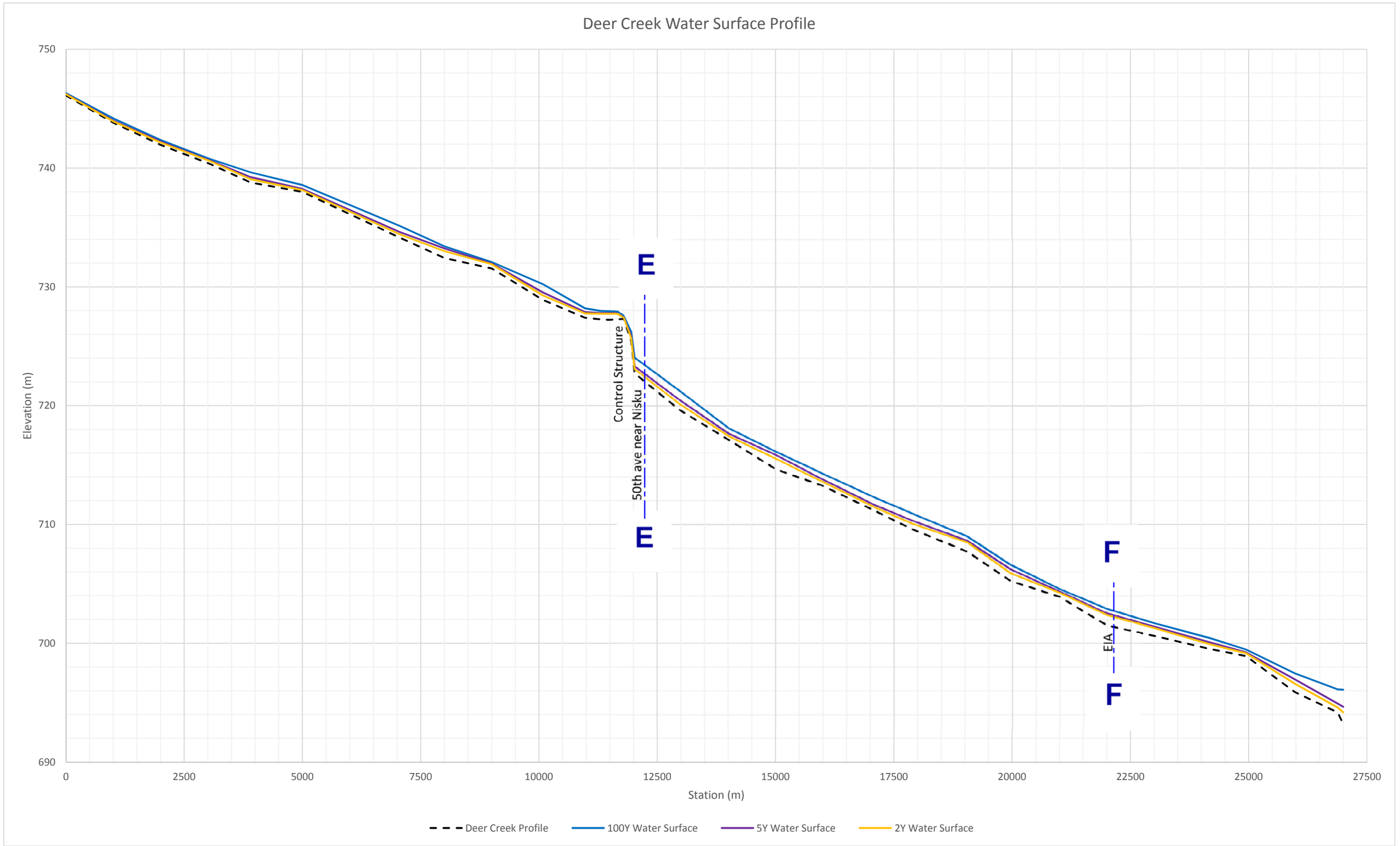
AE PROJECT No.	2016-3785
SCALE	1:25,000
APPROVED	
DATE	2017 JANUARY
REV	
DESCRIPTION	ISSUED FOR REPORT

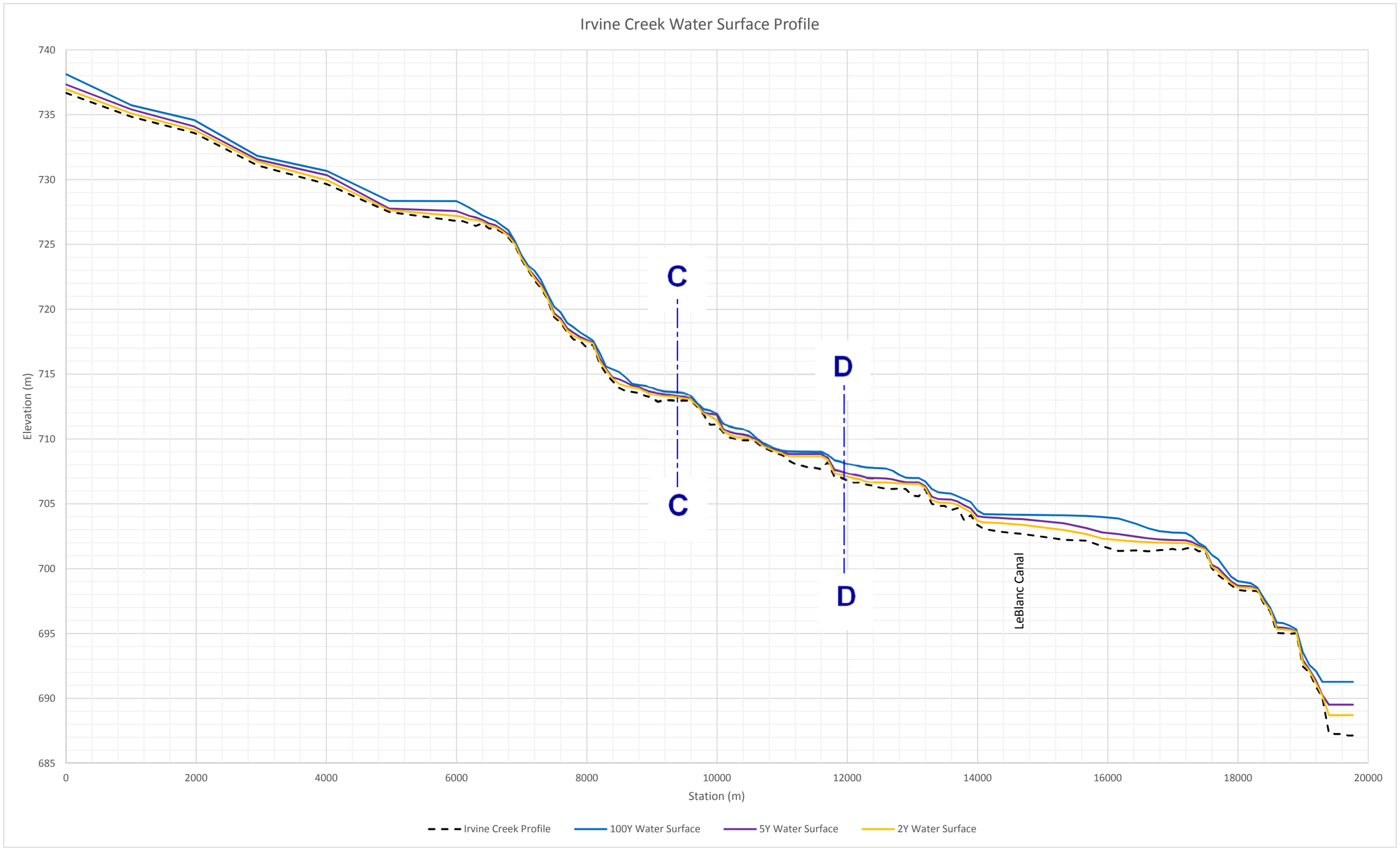
P:\2016\3785\00_Blackmud_Whitemud\Working_Dwgs\010_GIS\ArcMap\02_WaterResources\xxx_CreekDepths_v2.mxd
DATE: 1/20/2017.

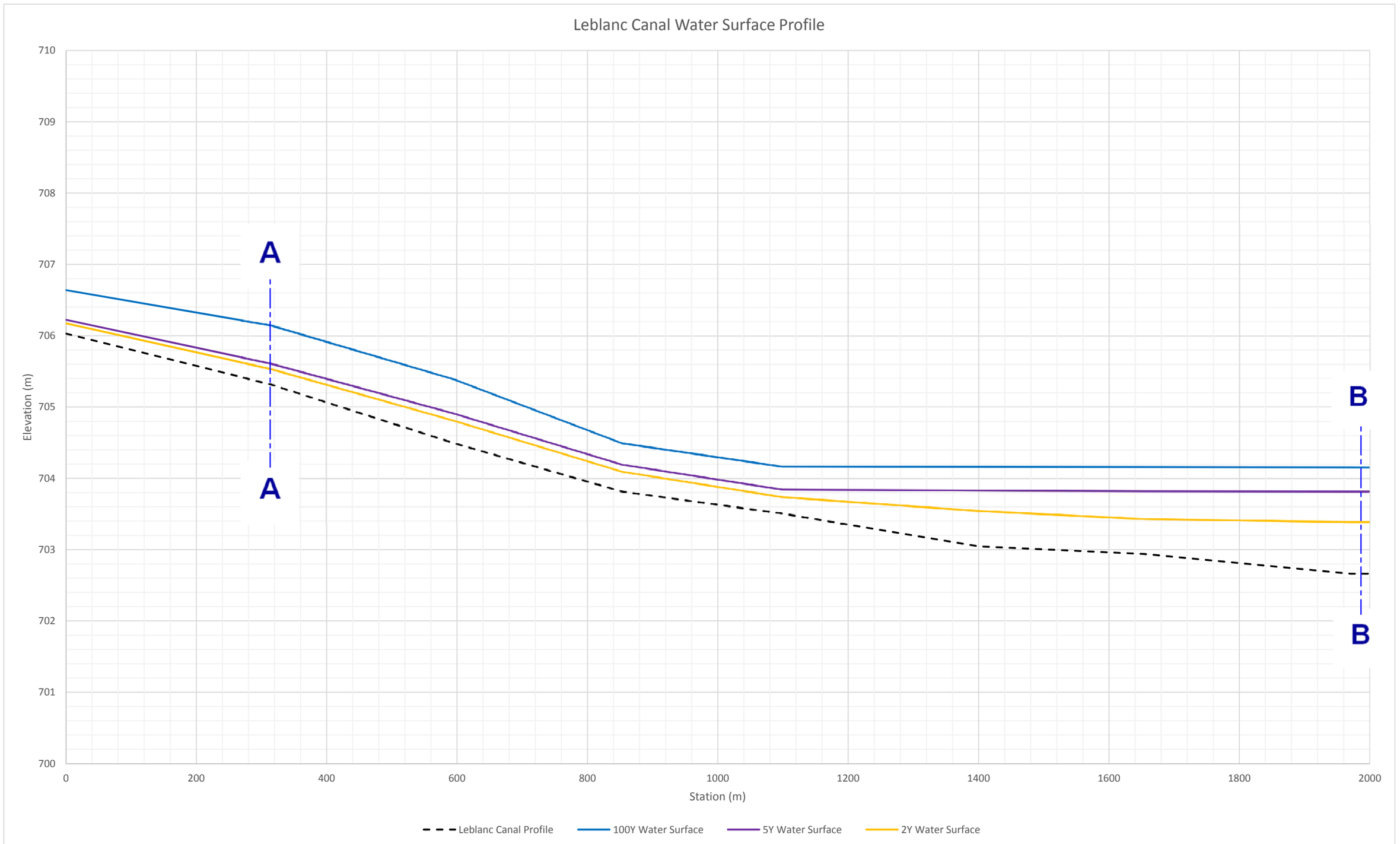
Appendix C - Longitudinal Profiles

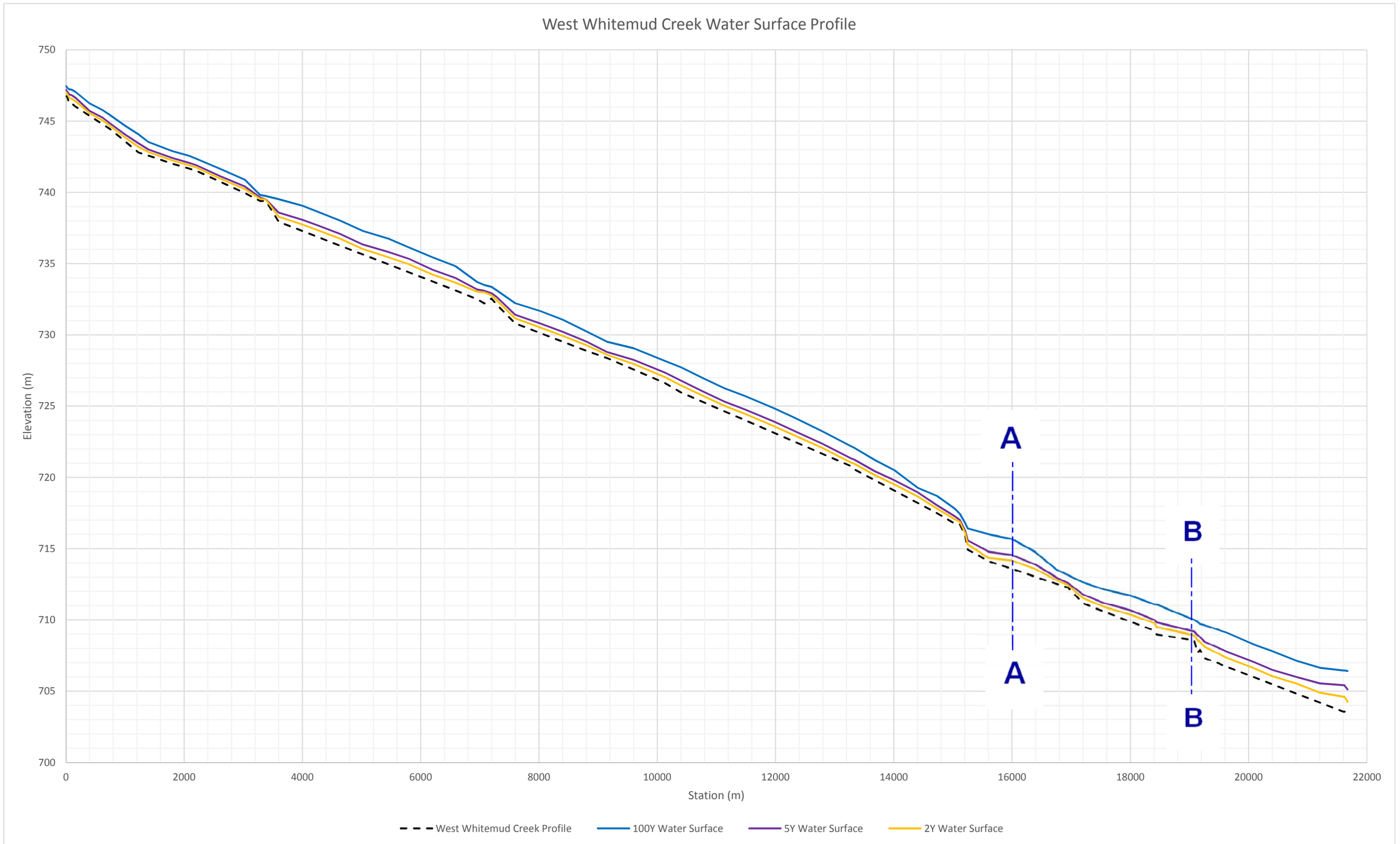

Blackmud Creek Water Surface Profile
A
B
20th ave (Nisku)
Highway 2
A
B
695
690
685
680
675
670
665
660
655
650
645
640
635
Elevation (m)
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
22000
24000
26000
28000
30000
32000
34000
Station (m)
Blackmud Creek Profile
100Y Water Surface
5Y Water Surface
2Y Water Surface

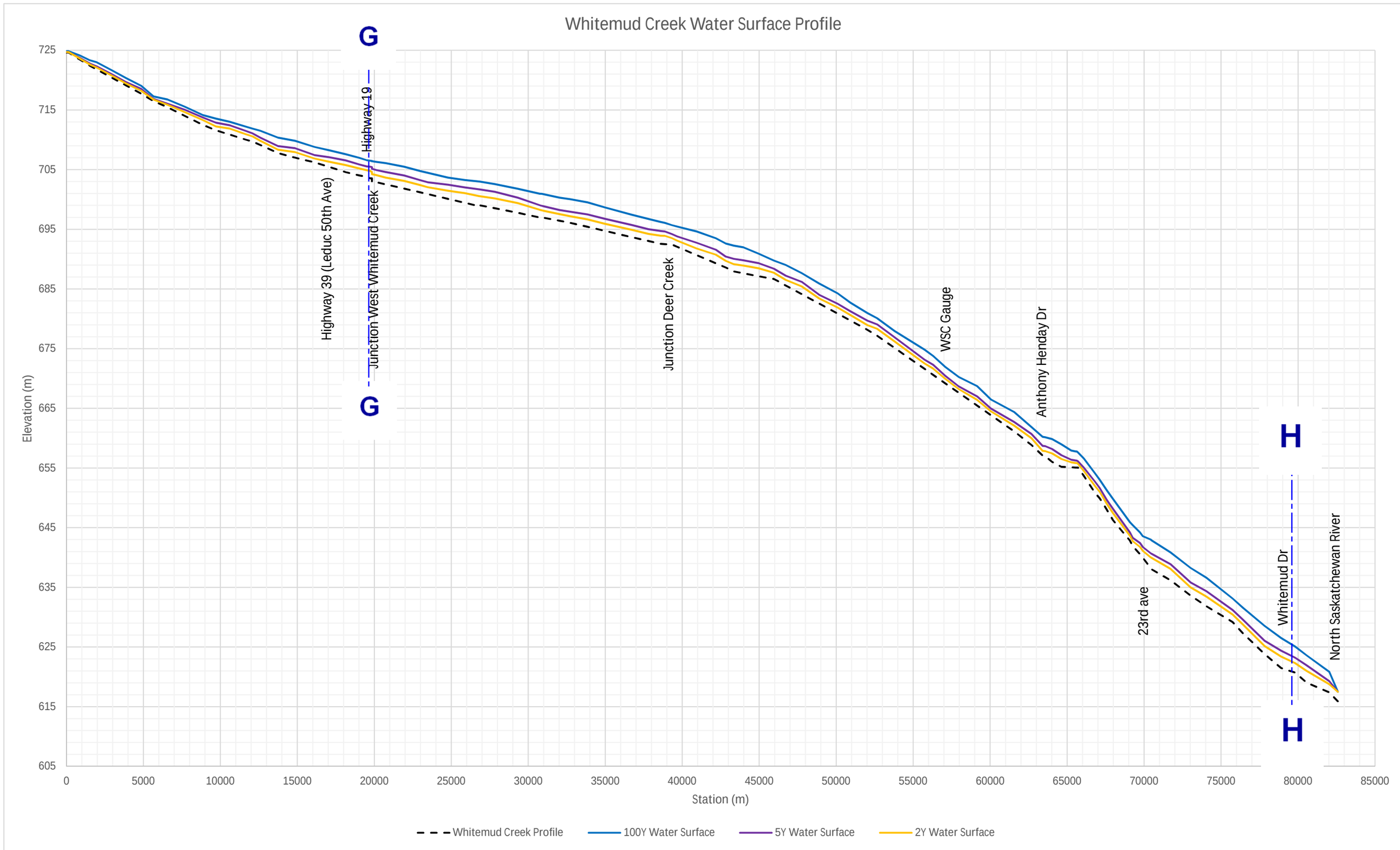

Clearwater Creek Water Surface Profile
740
735
730
725
720
715
710
705
700
695
690
685
Elevation (m)
0
5000
10000
15000
20000
25000
30000
Station (m)
A
A
B
B
Clearwater Creek Profile
100Y Water Surface
5Y Water Surface
2Y Water Surface


Deer Creek Water Surface Profile
Elevation (m)
750
740
730
720
710
700
690
0
2500
5000
7500
10000
12500
15000
17500
20000
22500
25000
27500
Station (m)
E
50th ave near Nisku Control Structure
E
F
EIA
F
Deer Creek Profile
100Y Water Surface
5Y Water Surface
2Y Water Surface


Irvine Creek Water Surface Profile
Elevation (m)
740
735
730
725
720
715
710
705
700
695
690
685
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
Station (m)
C
D
C
D
LeBlanc Canal
Irvine Creek Profile
100Y Water Surface
5Y Water Surface
2Y Water Surface


Leblanc Canal Water Surface Profile
Elevation (m)
710
709
708
707
706
705
704
703
702
701
700
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Station (m)
A
A
B
B
Leblanc Canal Profile
100Y Water Surface
5Y Water Surface
2Y Water Surface


West Whitemud Creek Water Surface Profile
Elevation (m)
750
745
740
735
730
725
720
715
710
705
700
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
22000
Station (m)
A
A
B
B
West Whitemud Creek Profile
100Y Water Surface
5Y Water Surface
2Y Water Surface


Whitemud Creek Water Surface Profile
Elevation (m)
725
715
705
695
685
675
665
655
645
635
625
615
605
0
5000
10000
15000
20000
25000
30000
35000
40000
45000
50000
55000
60000
65000
70000
75000
80000
85000
Station (m)
G
G
Highway 19
Junction West Whitemud Creek
Highway 39 (Leduc 50th Ave)
Junction Deer Creek
WSC Gauge
Anthony Henday Dr
H
H
Whitemud Dr
North Saskatchewan River
23rd ave
Whitemud Creek Profile
100Y Water Surface
5Y Water Surface
2Y Water Surface