



Norman Wells Operations Annual Flowline Integrity and Break-Up Report

October 2019

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ACRONYMS

AANDC	Aboriginal Affairs and Northern Development Canada
BIT	Bear Island Terminal
cm	Centimeters
CER	Canada Energy Regulator
CPF	Central Processing Facility
DoC	Depth of cover
GIT	Goose Island Terminal
GPS	Global Positioning System
ILI	In-Line Inspection
IOR	Imperial Oil Resources
LT	Land Terminal
m³	meters cubed
m	Meters
masl	meters above sea level
MFL	Magnetic flux leakage
N/A	Not applicable
NDE	Non destructive evaluation
NWO	Norman Wells Operations
PM	Preventative Maintenance
RTK	Real Time Kinematic
SLWB	Sahtu Land and Water Board
SSSV	Subsurface Safety Valves

1 INTRODUCTION

Imperial Oil Resources N.W.T. Limited (Imperial) is required by the Sahtu Land and Water Board (SLWB) Water Licence S13L1-007 (Schedule 5, Item 1) and Canada Energy Regulator (CER) Operations Authorization OA1210-001 to annually submit a Flowline Integrity and Break-Up Report no later than October 31st of the year being reported.

Details on the licence requirements for this report and corresponding section within the report can be found in the following concordance table.

Licence Requirement		Section of Report
a)	The results and inspections of the physical condition of each Artificial and Natural Island, including channel erosion, island scour holes and erosion, flowline landfalls, the condition of rip rap and the following information:	Sections 4 & 5
	i. Locations, depth, and volume of channel scour in the vicinity of any Flowline(s)	Section 4
	ii. Locations and magnitude of Artificial Island slope erosion	Section 5
	iii. Locations and severity of Artificial Island rip rap disturbance	Section 5
	iv. Structural integrity of the Artificial Islands, and other related structures	Section 5
	v. Structural integrity of the Natural Islands where it is applicable to project activities	Section 5
b)	The dates and results of Flowline(s) and fuel storage tank integrity tests	Section 6
c)	Details on necessary repair and maintenance work along with a schedule for completing such work prior to the following spring Mackenzie River Break-Up period.	Section 4 & 5

2 2019 BREAK-UP SUMMARY

As per Water Licence S13L1-007, Imperial shall undertake any necessary annual maintenance required to preserve the structural integrity of the islands (Part F, Item 2). In addition, Imperial inspects the riverbeds, channels and banks of the Mackenzie River in the vicinity of the flowline(s). To determine structural integrity of the islands, Imperial conducts an annual artificial island inspection. The results of these surveys are included in this report.

The average water level during the Mackenzie River break-up at Norman Wells is approximately 9 m (44.5 masl) and typically occurs between May 10th and May 15th. In 2019, break-up occurred early the morning of May 14th.

2.1 Annual Inspections

This year's bathymetric survey was completed in July 2019, the results of which are summarized in Section 4 of this report.

The annual artificial island inspection was performed in August 2019 and is summarized in Section 6 of this report.

3 BREAK-UP PREPARATION

Prior to each year's Mackenzie River break-up, a number of essential tasks must be completed. The key items are listed below:

- Spot heavy equipment on Bear and Goose Island
- Service equipment (e.g. compressors, operator trucks, etc.)
- Plug wells (e.g. wireline activity)
- Verify bunker lids and water intake hatch are secured and protected from ice flow
- Install and function test sub surface safety valves (SSSVs)
- Ensure adequate supply of chemical, fuel and potable water on island locations
- Remove equipment from low lying areas
- Inspect Bear Island purge equipment and review purge plan
- Finalize helicopter plans in preparation for ice road closure
- Execute weekly ice profiles
- Close ice road to equipment
- Remove ice road signage
- Monitor river levels and upstream break up conditions

4 2019 BATHYMETRIC SURVEY

The annual bathymetric survey was performed between July 4th and 19th, 2019 by WSP Canada Inc. The purpose of the survey is to:

- Determine the amount of instream cover over Imperial's eight cross river flowline bundles located in the bed of the Mackenzie River
- Monitor the river bed immediately adjacent to eight cross river flowline bundles enabling interception of scour hole movement towards flowline bundles
- Monitor the river bed at the base of the six artificial islands and Bear and Goose causeways for possible erosion or scouring
- Monitor the build-up or movement of the sandbars over the flowline bundles
- Identify any changes in the shape and elevation of the river bed in the areas adjacent to the islands, causeways, and docks

For information on typical bathymetric survey equipment used for the Norman Wells survey, refer to Appendix A.

4.1 Bathymetric Survey Results

The scope of work for the annual bathymetric survey is to measure the elevation of the river bottom for the entire length of each cross-river flowline corridor, and compare to the construction survey elevations of the flowlines to determine the depth of cover along the entire channel. Flagged monitoring sections that have been identified from previous surveys are further examined to determine whether the cover at these locations has decreased or remained constant compared to previous years.

The 2019 cross-river flowline bundle survey results are provided in the following sections. No repair work is currently planned for 2019. Copies of the bathymetric survey drawings can be found in Appendix B.

A specific cross river flowline corridor depth of cover has not been specified for Norman Wells. The corridors are managed on a case by case basis. Cover material is intended to:

- 1) Provide protection against physical impact, and
- 2) Provide protection against failure modes due to pipeline free-span (e.g. vortex induced vibration, bending)

The primary intent of the bathymetric survey is to verify that flowline bundles are not exposed (i.e. depth of cover remains >0m), such that the risks outlined above are reduced to the extent possible. Areas which show relatively low cover (<1.0m) or significant increases or decreases in cover between surveys are flagged for review on an annual basis as monitoring locations.

A summary of the depth of cover measured over the last 4 years is included in Table A in Section 4.1.3, below.

In cases where exposure or near-exposure of the bundle is confirmed, appropriate remedial action is triggered.

Remedial action typically consists of deposition of armoring rock on the pipeline corridor. This armoring rock is sized to be stable during anticipated river flow rates and is not expected to be subject to scour. If armoring material is confirmed to be in place, the flowline corridor is considered to be protected from the risks described above.

4.1.1 Flowline Bundle Profiles

4.1.1.1 Island 1 to Mainland Flowline

The 2019 profile data are consistent with the previous years' surveys and the flowline corridor has adequate cover throughout its entire length, with no sections of the crossing showing less than 1.0 m of cover.

Drawing Number 096-0179-700-801-71 in Appendix B contains the full 2019 Survey results overlayed with previous years' data.

4.1.1.2 Island 2 Mainland Flowline

The 2019 profile data are consistent with the previous years' surveys. Drawing Number 096-0179-700-801-72 in Appendix B contains the full 2019 Survey results overlayed with previous years' data.

Notable results at the monitoring locations include:

- The depth of cover at the monitoring location between Stations 1+575m and 1+594m has increased or remained consistent since 2015.
- Decrease in depth of cover at Station 1+579m compared to the 2018 survey, though higher than the 2016 and 2017 surveys, resulting in a measured depth of cover of 0.9 m.

It is recommended that the section at Station 1+579m remain flagged for future monitoring, and that the section from 1+575m to 1+594m be removed as a monitoring location due to stable depth of cover over the previous five years.

4.1.1.3 Island 3 to Goose Island Flowline

Drawing Number 096-0179-700-801-73 in Appendix B contains the full 2019 Survey results overlayed with previous years' data.

Notable results at the monitoring locations include:

- The monitoring location at Station 0+550m to 0+700m was unable to be surveyed due to rough water conditions. A visual survey was completed in

2017 which confirmed the armoring rock installed in 2015 from Station 0+581m to 0+600m was still in place and that there were no exposures.

- No significant change to the depth of cover compared to previous surveys between Station 1+080m and 1+124m.

It is recommended that the section from 1+080m to 1+124m be removed as a monitoring location due to stable depth of cover over the previous five years.

Low water levels prevented the collection of data at select locations along the Island 3 to Goose Island corridor.

4.1.1.4 Island 3 to Mainland Flowline

The 2019 profile data is consistent with previous years' surveys, and the flowline corridor has adequate cover throughout its entire length, with no sections of the crossing showing less than 1.0 m of cover.

Drawing Number 096-0179-700-801-74 in Appendix B contains the full 2019 Survey results overlayed with previous years' data.

4.1.1.5 Island 4 to Goose Island Flowline

The 2019 profile data is consistent with previous years' surveys and the flowline corridor has adequate cover throughout its entire length, with no sections of the crossing showing less than 1.0 m of cover where measurements were possible. Drawing Number 096-0179-700-801-75 in Appendix B contains the full 2019 Survey results overlayed with previous years' data.

Notable results at the monitoring locations include:

- Data was not able to be collected at the Station 0+357m and 0+475m monitoring locations due to low water levels.
- The depth of cover at the monitoring location between Stations 1+000m and 1+025m has remained consistent since 2015 and showed a slight decrease in 2019 compared to the 2018 survey, returning to 2017 levels.

It is recommended that the section from 0+357m to 0+475m should be probed to determine current depth of cover since bathymetric surveys at this section have not been possible since 2014. Additionally, the section from 1+000m to 1+025m should be removed as a monitoring location due to stable depth of cover over the previous five years.

4.1.1.6 Island 5 to Bear Island Flowline

The 2019 profile data is consistent with previous years' surveys with the exception of a section from 0+830m to the end of the dataset where additional analysis is recommended due to uncertainty in the 2019 survey data. Drawing Number 096-0179-700-801-76 in Appendix B contains the full full 2019 survey results overlayed with previous years' data.

Notable results at the monitoring locations include:

- The monitoring location between Station 0+148.2m and 0+233m was not able to be surveyed due to low water levels.
- Slight decrease in depth of cover at the scour hole at Station 0+344m.
- Slight decrease in depth of cover at section from Station 0+628m to 0+675.
- The depth of cover at the monitoring location between Stations 0+790m to 0+820m has remained consistent since 2015 and showed a slight increase in depth of cover from compared to the 2018 survey
- A large decrease in depth of cover at the section from 0+830m to the end of the data set, which may be due to errors in measurement during the 2019 survey. The measured depth of cover is 0.8m at this location.

It is recommended that the section from 0+790m to 0+820m be removed as a monitoring location due to stable depth of cover over the previous five years. Additionally, the section from 0+830m to the shoreline at Bear Island should be probed to determine confirm whether the 2019 survey results are correct.

4.1.1.7 Island 6 to Bear Island Flowlines

The 2019 profile data is consistent with the previous years' surveys with the exception of a section including the monitoring location at 0+560m to 0+575m, where additional analysis is recommended due to uncertainty in the 2019 survey data.. The flowline corridor has adequate cover throughout its entire length. Drawing Number 096-0179-700-801-77 in Appendix B contains the full 2019 Survey results overlayed with previous years' data.

Notable results at the monitoring locations include:

- The monitoring location between Station 0+125m and 0+205m was not able to be surveyed due to low water levels.
- Continued deposition resulting in increased depth of cover between 0+240m and 0+302.8m.
- A decrease in depth of cover at the section from 0+560m to 0+575, which may be due to errors in measurement during the 2019 survey. The remaining depth of cover is adequate.

It is recommended that the section from 0+245 to 0+355 should be probed to determine confirm the 2019 survey results.

4.1.1.8 Bear Island to Goose Island Flowlines

The 2019 profile data is consistent with the previous years' surveys with the exception of a section including the monitoring location at 0+245m to 0+355m, where additional analysis is recommended due to uncertainty in the 2019 survey data. The flowline corridor has adequate cover throughout its entire length. Drawing Number 096-0179-700-801-78 in Appendix B contains the full 2019 Survey results overlayed with previous years' data.

Notable results at the monitoring locations include:

- Decrease in depth of cover at Station from 0+180m to 0+232m
- A decrease in depth of cover at the section from 0+245 to 0+355, which may be due to errors in measurement during the 2019 survey. The remaining depth of cover is adequate.

It is recommended that the section from 0+245 to 0+355 should be probed to determine confirm whether the 2019 survey results are correct.

4.1.2 Surrounding Areas

The results of the 2019 bathymetric survey for the areas surrounding the artificial island locations, the mainland dock, and the Bear Island to Goose Island causeway are shown in the following sections. No repair work is planned for 2019.

4.1.2.1 Artificial Islands

The 2019 contours are generally consistent with previous year's survey and there are no actions recommended in 2019. Drawing Numbers 096-0179-700-801-79 through 096-0179-700-801-71 in Appendix B contain the full 2019 Survey results.

4.1.2.2 Mainland Dock

The area around the mainland dock was not able to be surveyed in 2019 due to low water levels. There has not been any issues noted at this area in previous years' surveys. It is recommended that the 2020 bathymetric survey is completed as early as safely possible to ensure river depth is sufficient for data collection. Drawing Number 096-0179-700-801-87 in Appendix B contains the 2018 Survey results.

4.1.2.3 Bear Island and Goose Island Causeway

There was a decrease in riverbed elevation from station 0+179 to 0+210 along the causeway, which may be due to errors in measurement during the 2019 survey. Drawing Number 096-0179-700-801-89 in Appendix B contains the full 2019 Survey results.

It is recommended that the abovementioned section be added as a monitoring location to determine whether the lower measurements from the 2019 survey are due to scouring or from a measurement error, and if there is any further scouring in the future.

4.1.3 Summary of Depth of Cover Readings

There were two sections in the 2019 bathymetric survey showing flowline depths of cover below 1.0 m (listed below). There are no areas where pipe has been exposed.

- Mainland to Island 2 – Station 1+579m with a minimum depth of cover of 0.9 m.

- Bear Island to Island 5 – Station 0+830m to 0+851m with a minimum depth of cover of 0.8 m, though this may be due to measurement uncertainty in the 2019 survey

The measured depths of covers at the monitoring locations are shown in Table A: below.

Table A: Summary of Flowline Corridor Depth of Cover

Corridor Name	Start	End	Initial Notification	Reason for Monitoring	Depth of Cover (m)					2019 Scour Volume (m³)	Notes
					2019	2018	2017	2016	2015		
Mainland to Isl 2	1+575	1+594	2014	Low DoC	1.2	1.2	1.0	0.9	-	-	
Mainland to Isl 2	1+579	-	2016	Low DoC	0.9	1.3	0.8	0.8	-	9	
Goose to Isl 3	0+550	0+700	2014	Low DoC	-	-	0.1	0.1	0.9	-	Unable to survey 2019
Goose to Isl 3	1+080	1+124	2016	Not Specified	1.2	1.2	1.2	1.2		-	
Goose to Isl 4	0+357	0+358	2011	Low DoC	-	-	-	-	-	-	Unable to survey 2019
Goose to Isl 4	0+475	0+485	2015	Low DoC	-	1.2	1.4	1.3	1.0	-	Unable to survey 2019
Goose to Isl 4	1+000	1+025	2010	Low DoC	1.8	1.9	1.8	1.8	-	10	
Bear to Isl 5	0+148	0+233	2015	Low DoC	-	1.5	1.3	0.9	0.9	-	Unable to survey 2019
Bear to Isl 5	0+334	0+350	2017	Scouring	1.9	2.1	1.5		1.8	17	
Bear to Isl 5	0+628	0+675	2015	Scouring	1.0	1.1	1.3	1.3	0.9	52	
Bear to Isl 5	0+790	0+820	2014	Scouring	1.5	1.4	1.6	1.4		-	
Bear to Isl 5	0+830	0+851	2019	Scouring	0.8	1.5	1.6	1.4	1.0	30	2019 data uncertainty
Bear to Isl 6	0+125	0+205	2014	Scouring	-	1.7	1.7	1.5	1.4		Unable to survey 2019
Bear to Isl 6	0+240	0+303	2017	Low DoC	1.7	1.5	1.0	-	-		
Bear to Isl 6	0+560	0+575	2019	Scouring	1.4	2.6	2.6	2.6	0.7	58	2019 data uncertainty
Goose to Bear	0+180	0+232	2014	Scouring	1.0*	1.3	1.3	1.7	-	31	*Extrapolated pipe elevation
Goose to Bear	0+245	0+355	2016	Scouring	2.6	3.2	3.4	3.1	-	210	2019 data uncertainty

There were a several locations where the river bottom elevation was not able to be measured during the 2019 bathymetric survey due to low water levels. Although data was unable to be collected at these locations, overall results from 2019 do not indicate an unacceptable risk to any infrastructure. It is recommended that the 2020 bathymetric survey be completed as early as possible after break-up to help ensure there are sufficient water levels to complete the survey at all locations.

5 PROTECTION ASSESSMENT AND MAINTENANCE

5.1 Summary of Protection Assessment and Maintenance

5.1.1 2019 Repairs

Artificial island repairs were completed in February 2019 as per recommendations in the 2018 Artificial Island Inspection Report. Approximately 615 m³ of rip rap and residual limestone was used to repair the artificial islands and Mainland dock as part of this work. Details of the repairs completed are described in the next sections.

5.1.1.1 Island 1

The inspection showed Island 1 to be in good condition; therefore, no maintenance was required in 2019.

5.1.1.2 Island 2

The inspection showed Island 2 to be in good condition; therefore, no maintenance was required in 2019.

5.1.1.3 Island 3

The inspection showed Island 3 to be in good condition; therefore, no maintenance was required in 2019.

5.1.1.4 Island 4

Approximately 98 m³ of combination E rock and residual limestone was placed on the southwest of Island 4 during the winter of 2019.

5.1.1.5 Island 5

Approximately 68 m³ of combination E rock and residual limestone was placed on the southwest of Island 5 during the winter of 2019.

5.1.1.6 Island 6

Approximately 108 m³ of combination E rock and residual limestone was placed on the southwest of Island 6 during the winter of 2019.

5.1.1.7 Mainland Dock

Upstream rock “nose” of the intake rock/block structure was excavated down to the river water level in the winter of 2019. The spoils were added to the remaining upstream

protective structure to replace erosion loss. An additional ~340m³ of combination E rock and Residual Limestone were placed on top of the armored nose upstream of the intake.

5.1.1.8 Goose Island

The inspection showed Goose Island Boat Landing to be in good condition; therefore, no maintenance was required at this location in 2019. In August 2019, erosion was observed to have occurred on the north side of Goose Island, resulting in exposure of flowlines serving a gas injection well. Interim protection work to re-cover the exposed lines was completed in October 2019. Additional protection work is currently being assessed and is expected to be completed in 2019/2020.

5.1.2 2019/2020 Proposed Repairs

The 2019 Artificial Island Inspection was conducted from August 13th to 15th by Wim M. Veldman Consulting and Advisian. The 2019 recommendations put forth by the inspectors form the basis of island repairs to be completed during the 2019/2020 winter season.

5.1.2.1 Island 1

The inspection showed Island 1 to be in good condition; therefore, no immediate repairs are required during the 2019/20 winter period. It is recommended to continue to monitor south side slope for possible future maintenance.

5.1.2.2 Island 2

One area was identified for repair. It is recommended to stabilize a section of the south side slope from gradual loss of rock. It is recommended to fill in an area of approximately 35m x 5m area by placing approximately 175 m³ of Class E material.

5.1.2.3 Island 3

No concerns have been identified with Island 3 riprap. Continued monitoring is recommended.

5.1.2.4 Island 4

One area was identified for repair. Multiple block movement was observed on the north side corner blocks. Adjustment and/or rotation of the blocks is recommended to straighten the blocks or infill gaps with riprap. Evaluation of filling areas around the north side corner blocks apron with riprap is recommended.

5.1.2.5 Island 5

No concerns have been identified with Island 5 riprap. Continue monitoring is recommended.

5.1.2.6 Island 6

No concerns have been identified with Island 6 riprap. Continued monitoring is recommended.

6 FLOWLINE AND FUEL STORAGE TANK INTEGRITY

The operational integrity of all critical equipment is stewarded through Imperial's preventative maintenance program which is derived from OIMS 6.2 Facility Integrity Management System (FIMS). FIMS is the system that identifies critical equipment and sets forth required preventative maintenance programs and frequencies.

6.1 Fuel Storage Tank Integrity Inspections

Table B lists the fuel storage tanks on site, the type and frequency of inspection performed on each tank, along with the results.

Table B: Fuel Storage Tank Integrity Inspections

Tank Name	Type of Inspection	Results
Goose Island Diesel	5 Year External UT	– Last completed 2015; no issues – Next inspection 2020
	1 Month External Visual	– Completed monthly; no issues
Goose Island Gas	5 Year External UT	– Last completed 2015; no issues Next inspection 2020
	1 Month External Visual	– Completed monthly; no issues
Bear Island Gas	5 Year External UT	– Last inspected 2016; no issues Next inspection due in 2021
	1 Month External Visual	– Completed monthly; no issues
Bear Island Diesel	5 Year External UT	– Last inspected 2016; no issues Next inspection 2021
	1 Month External Visual	– Completed monthly; no issues
Mainland Diesel	5 Year External UT	– Installed in 2015 Next inspection due in 2020
	1 Month External Visual	– Completed monthly; no issues
CPF T-103 Diesel	5 Year External Settlement	– Last inspected 2017; no issues Next inspection due in 2022
	5 Year External Visual	– Last inspected 2016; no issues Next inspection due in 2021
	10 Year Internal	– Inspection completed 2016; no issues Next inspection due in 2026
T-104 Emergency Generator Diesel	5 Year External Visual	– Inspection completed 2016; no issues
	10 Year External UT	– Inspection completed 2017; no issues Next inspection due in 2027
Mainland Heating Oil	1 Month External Visual	– Completed monthly; no issues.
CPF Heating Oil Double Wall Tank	1 Month External Visual	– New tank installed in 2018 – Completed monthly; no issues.
Warehouse Heating Oil Double Wall Tank	1 Month External Visual	– New tank installed in 2018 – Completed monthly; no issues.
Mud Plant Heating Oil Double Wall Tank	1 Month External Visual	– New tank installed in 2018 – Completed monthly; no issues.

6.2 Flowline Integrity

Table C lists the flowline integrity inspections completed in 2019, along with the inspection type for each of the flowlines and the inspection results.

Table C: Flowline Integrity Inspections 2019

Flowline Number	Date	Type of Inspection	Results
55 (Island 2 to Mainland)	Sept. 13, 2019 (completed)	In-Line Inspection (ILI)	Magnetic flux leakage (MFL) inspection found external corrosion at onshore sections which was consistent with past ILIs and corrosion growth analysis. No internal corrosion was detected.
60 (Island 1 to Mainland)	July 8, 2019 (completed)	In-Line Inspection (ILI)	MFL inspection found external corrosion at onshore sections which was consistent with past ILIs and corrosion growth analysis. No internal corrosion was detected.
128 (Island 6 to Bear Island)	Sept 4, 2019 (completed)	In-Line Inspection (ILI)	MFL inspection found external corrosion at onshore sections which was consistent with past ILIs and corrosion growth analysis. No internal corrosion was detected.
60 (Island 1 to Mainland)	Sept 3, 2019 (completed)	Verification Dig / Repair	Verification dig on critical external corrosion features at Island 1 from 2012 and 2019 ILI was completed to verify ILI measurements and repair corrosion features.
123 (Island 5 to Bear Island)	August 4, 2019 (completed)	Verification Dig / Repair	Verification dig on critical external corrosion features at Island 5 from 2018 ILI was completed to verify ILI results and repair corrosion features.
Line 65/77 (Goose to Mainland)	Q4 2019 (planned)	U-bolt inspection and repair	Planned inspection to measure the extent of erosion at U-bolt fittings on the mainland section within the utilidor.
Line 450 (Mainland to Goose)	Q4 2019 (planned)	Liner Inspection (onshore section)	Planned non destructive evaluation (NDE) inspections to determine extend of corrosion along onshore section where liner may have been damaged. Testing does not show any issues with the integrity of the liner at the cross-river section of this line.

LIST OF APPENDICES

- Appendix A. Bathymetric Survey Equipment
- Appendix B. Bathymetric Drawings (2019)

Appendix A. Bathymetric Survey Equipment

SURVEY LAUNCH

The survey launches and boat captains for this project were supplied by Imperial. The primary launch (Boat 1) is a 7.3 m aluminum vessel equipped with a 250 hp, 4 stroke Suzuki motor equipped with a propeller (Image J).



Image A: Primary Survey Vessel (Imperial Boat 1)

The survey launch was equipped with the required survey gear and all instruments were interfaced into a central control platform running Hypack navigation and control software (Image K and L).



Image B: Survey Gear



Image C: Survey Gear Inside of Boat 1

In order to survey the river bottom in the shallower water areas between Goose Island, Artificial Islands 3 and 4, and between Bear Island and Island 6, a shallow draft 10.5' inflatable boat was used. The small light weight vessel was well suited for the task and easily transported the WSP crew, Imperial captain, and single beam echo sounder and RTK GPS (Image M).



Image D: 10.5' inflatable boat (Boat 2)

In 2016, the R2Sonic 2020 multibeam system was used for the bathymetric survey at Norman Wells. The high frequency of the R2Sonic 2020 allows for accurate and clean data. In order to accommodate the multibeam system a revised fixed mount was fabricated in 2015. Offsets for the bathymetric sensors including the multibeam, IMU, and GPS antennas were accurately measured using conventional survey technology.

NAVIGATION AND POSITIONING

The GPS RTK (Real Time Kinematic) system utilized for the survey consisted of two Leica dual frequency geodetic quality receivers. The system also included a Pacific Crest radio system consisting of a 35 watt base radio and a rover radio. This system provided real-time horizontal and vertical accuracy to tolerances of 10 mm horizontally and 15 mm vertically.

The base receiver and radio gear were set up on a known control point (control point #7009) in the vicinity of the work area.

Northing = 7,241,611.945

Easting = 599,645.968

Elevation (Geodetic) = 51.668m

SONAR SYSTEM

The R2Sonic is a high quality multibeam sonar capable of producing very dense and accurate bathymetric data. Some of the key features of the R2Sonic 2020 are as follows:

- Over 20 x user selectable frequencies from 200 to 400 kHz
- Focused 1° x 1° beam widths
- 60 kHz signal bandwidth over entire frequency range
- True range resolution of 1.25 cm at all frequencies
- Selectable swath coverage from 10° to 160°
- 1 to 100 meter range

The effective swath width of the R2Sonic system is approximately 3 or 4 times the depth of water. The deeper the water, a larger footprint of the river bottom is covered during any one pass.

In addition to the R2Sonic, a 200 kHz Knudsen 1620 single beam echo sounder was used to survey the shallow waters atop the Goose to Island 3, Goose to Island 4, and Bear to Island 6 flowline bundles. The sounder and the GPS RTK were connected to Hypack software for navigation and data acquisition.

MOTION REFERENCE UNIT

The Applanix Pos MV is considered the highest rated MRU on the market today. This motion reference unit is the ‘benchmark’ for which all MRU’s are compared to. The manufacturer’s claimed accuracy is:

- Roll, Pitch Accuracy 0.02°
- Heading accuracy 0.02°
- Velocity accuracy 0.03m/sec

CALIBRATION, ACCURACY AND DATA VALIDATION

The sonar system must be calibrated for roll, pitch and yaw and the calibration values are entered in the Hypack software. Prior to or during the survey activity, the vessel proceeds to an area where there is both a flat seabed and a rapidly changing seabed to accommodate the 'patch' tests. A preset, pre-configured set of procedures are conducted to gain the calibration values which are used for the remainder of the day.

The accuracy of the final elevations from sounding data is dependent on several factors including:

- the accuracy of the sounder hardware
- speed of the survey launch
- attitude of the survey launch
- river current at time of survey
- wind at time of survey

The digital data produced during the survey was reviewed and checked prior to leaving Norman Wells. It was important to check the quality of the sounding data before leaving the field in case of poor or missing data that would have to be re-surveyed.

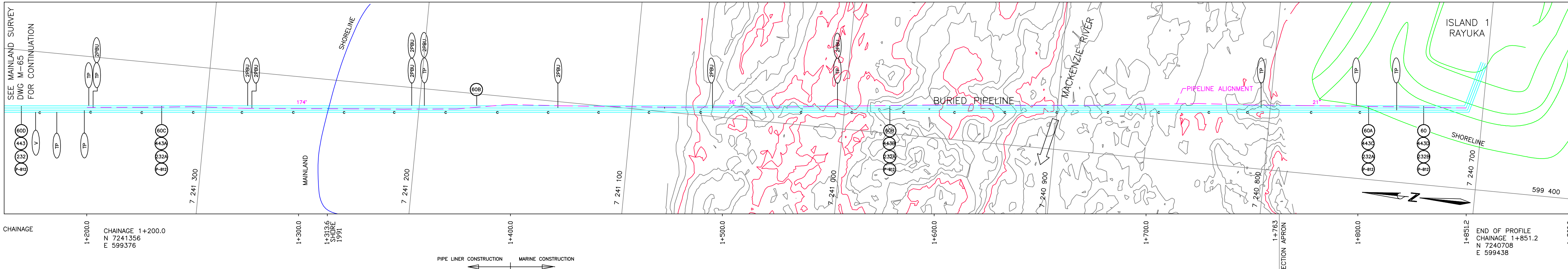
Appendix B. Bathymetric Drawings (2019)

The following bathymetric survey plans were produced:

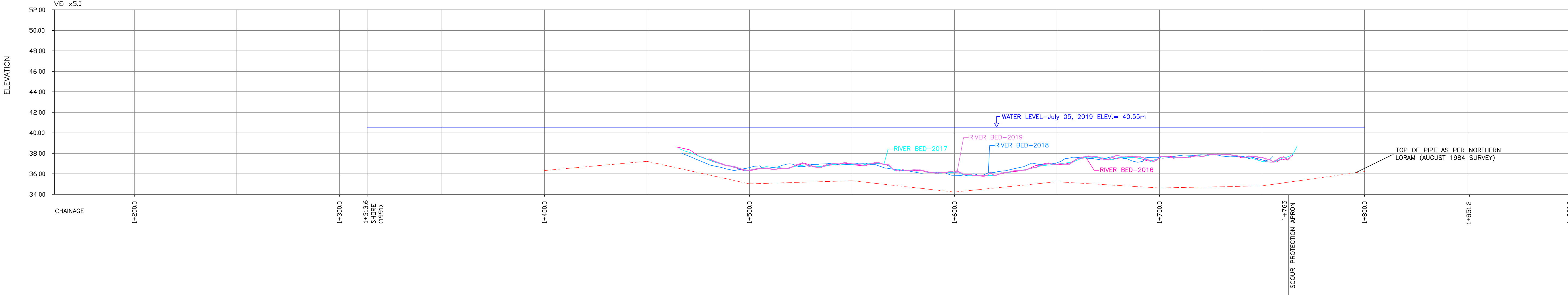
Table D: List of Bathymetric Survey Drawings

Location	Drawing Number
Island 1 to Mainland flowline	096-0179-700-801 71
Island 2 to Mainland flowline	096-0179-700-801 72
Island 3 to Goose Island flowline	096-0179-700-801 73
Island 3 to Mainland flowline	096-0179-700-801 74
Island 4 to Goose Island flowline	096-0179-700-801 75
Island 5 to Bear Island flowline	096-0179-700-801 76
Island 6 to Bear Island flowline	096-0179-700-801 77
Bear Island to Goose Island flowline	096-0179-700-801 78
Island 1 and surrounding area	096-0179-700-801 79
Island 2 and surrounding area	096-0179-700-801 80
Island 3 and surrounding area	096-0179-700-801 81
Island 4 and surrounding area	096-0179-700-801 82
Island 5 and surrounding area	096-0179-700-801 83
Island 6 and surrounding area	096-0179-700-801 84
River Bed and Island Contours	096-0179-700-801 86
Mainland Dock Area	096-0179-700-801 87
Bear Island to Goose Island Causeway	096-0179-700-801 89

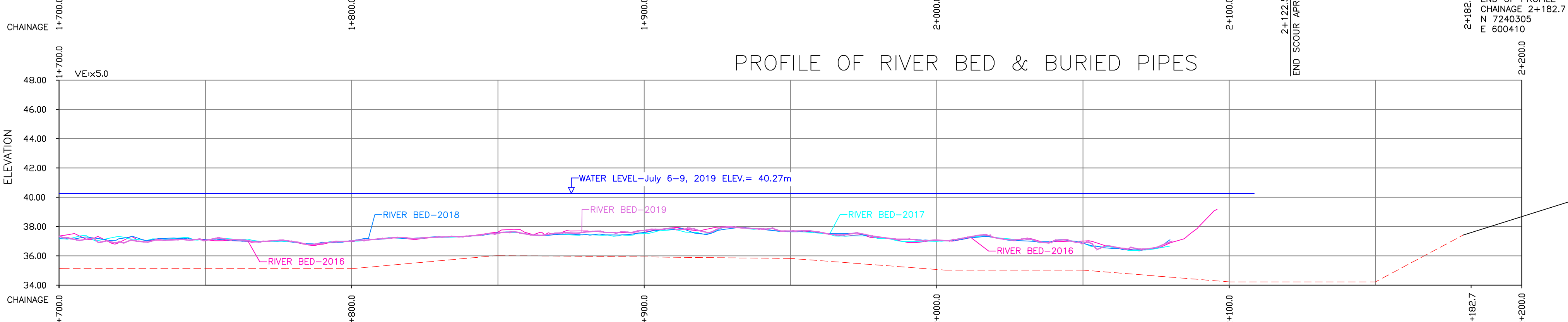
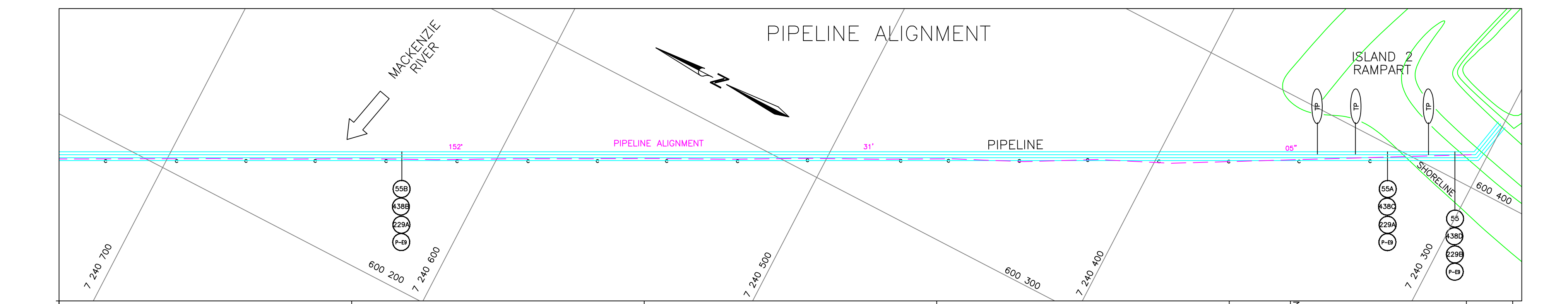
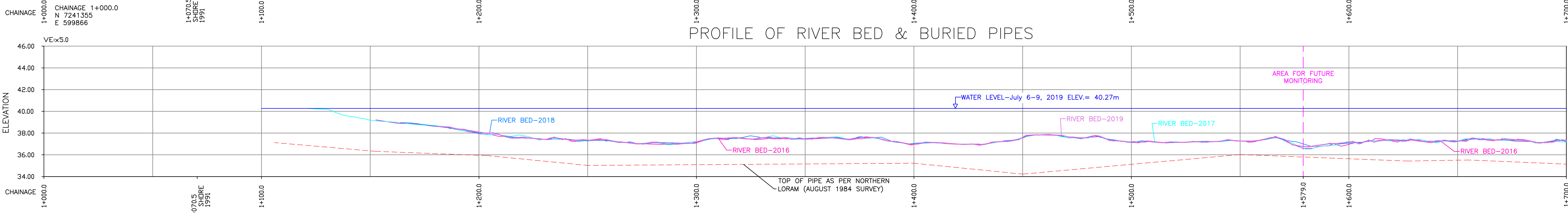
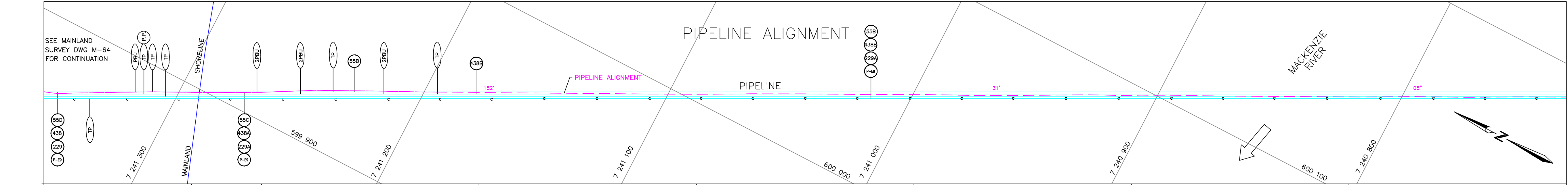
PIPELINE ALIGNMENT



PROFILE OF RIVER BED & BURIED PIPES



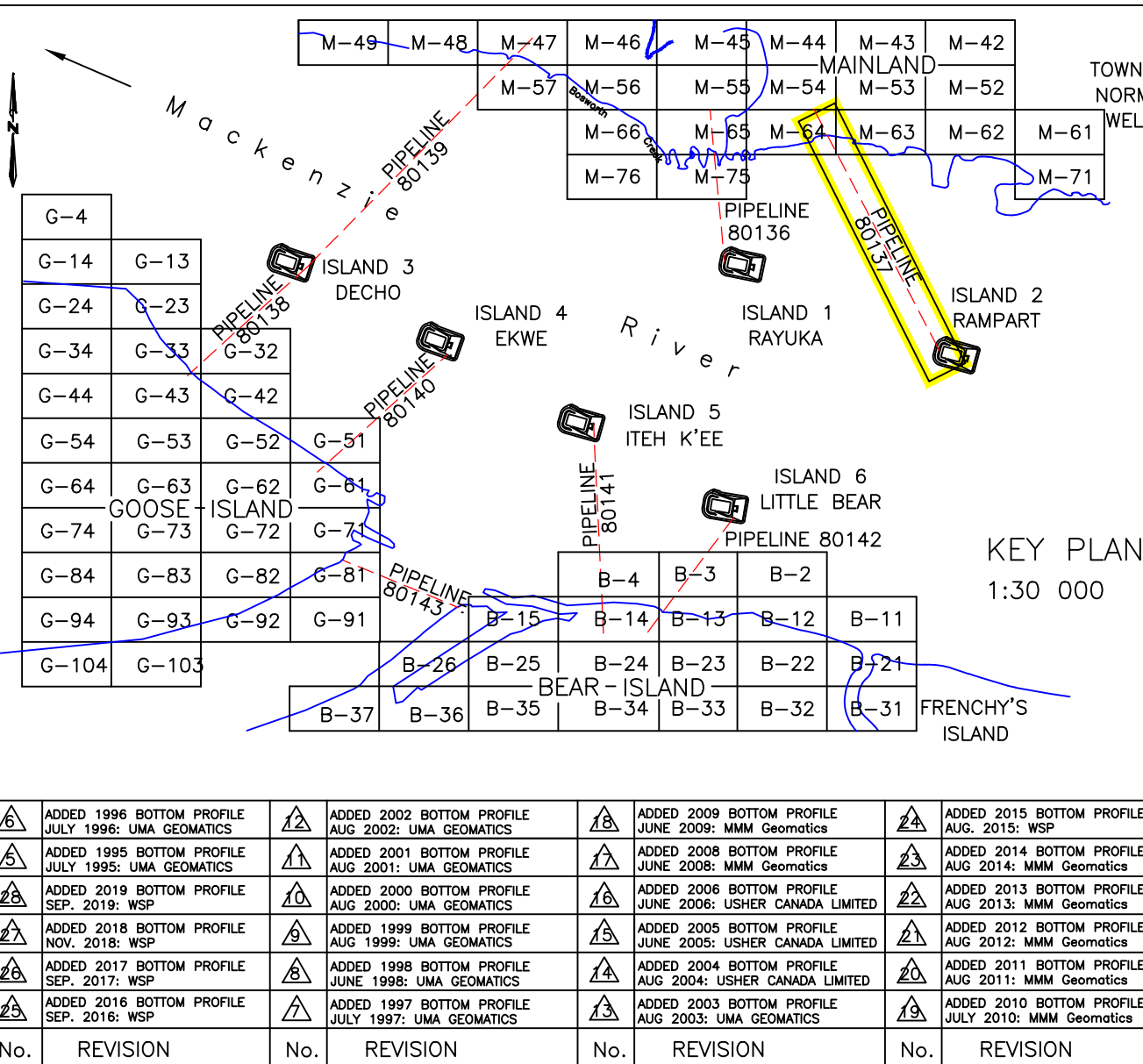
SURVEY CONTROL				No.	SUBSTANCE DESCRIPTION		No.	SUBSTANCE DESCRIPTION		NOTES			
No.	DESCRIPTION	NORTHING	EASTING	ELEV.	MULTIPHASE LIQUIDS					1. RIVER BOTTOM PROFILE FROM 2019 BATHYMETRIC SURVEY PERFORMED JULY 05, 2019.			
1000	REBAR @ N.E. OF ISL. 1	7240711.75	599540.89		60	168.3 OE Is.1 to L.P.T.1, Glycol H.T. 60-60A				2. PIPE PROFILE AND CHAINAGES FROM ESSO DWG. 80054 REV. 8 – TOP OF PIPE AS PER NORTHERN LORAM			
1004	REBAR @ N.W. OF ISL. 1	7240729.21	599459.90		60A	168.3 OE Is.1 to L.P.T.1, Glycol H.T., Conc Coated 60-60A-60B				(TOP OF PIPE PROFILE ELEVATION REDUCED 0.776m IN 2008)			
2	REBAR @ N.E. OF ISL. 2	7240301.75	600511.43		60B	168.3 OE Is.1 to L.P.T.1, Conc Coated 60-60A-60B-60C				3. HORIZONTAL DATUM : NAD27 (SHORAN) – UTM GRID/CM = 129"			
2001	REBAR @ N.W. OF ISL. 2	7240324.34	600431.97		60C	168.3 OE Is.1 to L.P.T.1, Dbl Sect H.T., Conc Coated 60-60A-60B-60C-60D M-75,65,55 H.T.261				4. VERTICAL DATUM – GEODETIC BM 74T016 ELEVATION 60.189			
27	REBAR @ N.W. OF ISL. 3	7240741.90	597423.38		60D	168.3 OE Is.1 to L.P.T.1, Sng Sect H.T. 60-60A-60B-60C-60D-L.P.T.1 M-75,65,55 H.T.261				5. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL			
3000	REBAR @ N.E. OF ISL. 3	7240716.18	597500.36							6. CONTOUR INTERVAL = 0.25 METRES.			
26	REBAR @ N.W. OF ISL. 4	7240387.54	598100.08										
4000	REBAR @ N.E. OF ISL. 4	7240361.98	598175.94		232	88.9 NG (Gas Lift) L.P.T.1 to Is.1 (Buried) 232-232A M-55,65,64							
22	REBAR @ N.W. OF ISL. 5	7240016.98	598734.63		232A	88.9 NG (Gas Lift) L.P.T.1 to Is.1 (Conc Coated) 232-232A-232B M-55,65,64							
5000	REBAR @ N.E. OF ISL. 5	7239993.12	598815.14		232B	88.9 NG (Gas Lift) L.P.T.1 to Is.1 (Buried) 232-232A-232B-L.P.T.1							
21	REBAR @ N.W. OF ISL. 6	7239631.84	599382.56										
6000	REBAR @ N.E. OF ISL. 6	7239616.68	599465.79										
					INJECTION WATER								
					443	88.9 INJ-SW L.P.T.1 to Is.1, Sng Sect H.T., Liner 443-443A M-55,65,75 H.T.262							
					443A	88.9 INJ-SW L.P.T.1 to Is.1, Dbl Sect H.T., Conc Coated, Liner 443-443A-443B M-55,65,75 H.T.262							
					443B	88.9 INJ-SW L.P.T.1 to Is.1, Conc Coated, Liner 443-443A-443B-443C							
					443C	88.9 INJ-SW L.P.T.1 to Is.1, Glycol H.T., Conc Coated, Liner 443-443A-443B-443C-443D							
					443D	88.9 INJ-SW L.P.T.1 to Is.1, Glycol H.T., Liner 443-443A-443B-443C-443D-L.P.T.1							
					ELECTRICAL DESCRIPTION								
					P-B12	4160 H.V. From FS-15KV Switch Gear to Is.1 TR-B7 M-55,65,75							



SURVEY CONTROL				No.	SUBSTANCE DESCRIPTION
No.	DESCRIPTION	NORTHING	EASTING	ELEV.	
1000	REBAR @ N.E. OF ISL. 1	7240711.75	599540.89		55 219.1 OE Is.2 to L.P.T.1, Glycol H.T. 55-55A
1004	REBAR @ N.W. OF ISL. 1	7240729.21	599459.90		55A 219.1 OE Is.2 to L.P.T.1, Glycol H.T., Conc Coated 55-55A-55B M-55A-55B
2	REBAR @ N.E. OF ISL. 2	7240301.75	600511.43		55B 219.1 OE Is.2 to L.P.T.1, Conc Coated 55-55A-55B-55C M-55A-55B-55C
2001	REBAR @ N.W. OF ISL. 2	7240324.34	600431.97		55C 219.1 OE Is.2 to L.P.T.1, Dbl Sect H.T., Conc Coated 55-55A-55B-55C-55D M-55A-55B-55C-55D
27	REBAR @ N.W. OF ISL. 3	7240741.90	597423.38		55D 219.1 OE Is.2 to L.P.T.1, Sng Sect H.T. 55-55A-55B-55C-55D-L.P.T.1 M-55A-55B-55C-55D
3000	REBAR @ N.E. OF ISL.3	7240716.18	597500.36		
26	REBAR @ N.W. OF ISL. 4	7240387.54	598100.08		
4000	REBAR @ N.E. OF ISL. 4	7240361.98	598175.94		229 114.3 NG (Gas Lift) L.P.T.1 to Is.2 (Buried) 229-229A M-55,65,64
22	REBAR @ N.W. OF ISL. 5	7240016.98	598734.63		229A 114.3 NG (Gas Lift) L.P.T.1 to Is.2 (Conc Coated) 229-229A-229B M-55,65,64
5000	REBAR @ N.E. OF ISL. 5	7239993.12	598815.14		229B 114.3 NG (Gas Lift) L.P.T.1 to Is.2 (Buried) 229-229A-229B-L.P.T.1
21	REBAR @ N.W. OF ISL. 6	7239631.84	599382.56		
6000	REBAR @ N.E. OF ISL. 6	7239616.68	599465.79		
					GASLIFT
					114.3 NG (Gas Lift) L.P.T.1 to Is.2 (Buried) 229-229A M-55,65,64
					114.3 NG (Gas Lift) L.P.T.1 to Is.2 (Conc Coated) 229-229A-229B M-55,65,64
					114.3 NG (Gas Lift) L.P.T.1 to Is.2 (Buried) 229-229A-229B-L.P.T.1
					INJECTION WATER
					114.3 INJ-SW L.P.T.1 to Is.2, Sng Sect H.T., Liner 438-438A M-55,65,64 H.T.264
					438A 114.3 INJ-SW L.P.T.1 to Is.2, Dbl Sect H.T., Conc Coated, Liner 438-438A-438B M-55,65,64 H.T.264
					438B 114.3 INJ-SW L.P.T.1 to Is.2, Conc Coated, Liner 438-438A-438B-438C
					438C 114.3 INJ-SW L.P.T.1 to Is.2, Glycol H.T., Conc Coated, Liner 438-438A-438B-438C-438D
					438D 114.3 INJ-SW L.P.T.1 to Is.2, Glycol H.T., Liner 438-438A-438B-438C-438D-L.P.T.1
					ELECTRICAL DESCRIPTION
					P-E9 4160 H.V. From FS-25KV Switch Gear to Is.2 TR-E5 M-54,64

PROFILE ALIGNMENT COORDINATES	
EASTING	NORTHING
599866.000	7241355.000
599867.750	7241350.020
599867.070	7241332.840
599888.830	7241311.060
599900.050	7241288.670
599911.540	7241266.730
599923.760	7241245.240
599935.170	7241222.640
599946.190	7241200.430
599957.710	7241177.750
599968.910	7241155.590
599980.360	7241133.100
599991.630	7241109.940
600002.980	7241088.660
600014.910	7241066.250
600026.790	7241043.290
600038.500	7241019.240
600050.790	7240996.510
600062.340	7240973.070
600073.970	7240950.940
600085.070	7240928.100
600096.790	7240906.500
600108.190	7240884.690
600119.470	7240862.340
600130.870	7240840.070
600142.390	7240817.410
600153.930	7240795.670
600165.200	7240773.220
600176.830	7240751.230
600188.326	7240732.711
600199.801	7240710.940
600211.441	7240688.550
600222.851	7240662.280
600234.411	7240640.240
600245.651	7240617.900
600257.421	7240595.870
600268.931	7240573.770
600280.381	7240551.930
600292.091	7240528.740
600303.921	7240506.690
600315.191	7240484.360
600326.861	7240462.120
600337.481	7240439.550
600349.651	7240417.660
600359.971	7240395.040
600410.000	7240305.000
END CHAINAGE 2+182.7	
Alignment includes Winter 1997 pipe locating data.	

- NOTES
1. RIVER BOTTOM PROFILE FROM 2019 BATHYMETRIC SURVEY PERFORMED JULY 06 TO JULY 09, 2019.
 2. PIPE PROFILE AND CHAINAGES FROM ESSO DWG. 80054 REV. B - TOP OF PIPE AS PER NORTHERN LORAM
(TOP OF PIPE PROFILE ELEVATION REDUCED 0.776m IN 2008)
 3. HORIZONTAL DATUM : NAD27 (SHORAN) - UTM GRID/CM = 129'
 4. VERTICAL DATUM - GEODETIC BM 747016 ELEVATION 60.189
 5. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL
 6. CONTOUR INTERVAL = 0.25 METRES.
- 2016 RIVER BED PROFILE SHOWN AS
- 2017 RIVER BED PROFILE SHOWN AS
- 2018 RIVER BED PROFILE SHOWN AS
- 2019 RIVER BED PROFILE SHOWN AS



LEGEND

UTILIDORS SHOWN

ROADS SHOWN

BURIED PIPES SHOWN

BELOW GROUND POWER, TELEPHONE, & COMMUNICATION SHOWN

VENT SHOWN

TRANSITION POINT

PULL BOX SHOWN

PULL POINT SHOWN

PIPE O/S DIA'S ARE IN MILLIMETERS AND DECIMALS THEREOF

SUBSTANCE/CATEGORY CROSS REFERENCE

SUBSTANCE	CODE	SUBSTANCE	CODE
PROPANE/BUTANE	HV	PRODUCED WATER	SW
CRUDE OIL	CO	FRESH WATER	FW
MULTIPHASE FLUIDS	OE	INJECTION (SW)	INJ-SW
NATURAL/LIFT GAS	NG	INJECTION (FW)	INJ-FW
FUEL GAS	FG	ABANDONED	ABAN
MISCELLANEOUS LIQUIDS	ML	MISCELLANEOUS GASES	MG

Imperial Oil

IMPERIAL OIL RESOURCES

NORMAN WELLS FACILITIES

MAINLAND TO ISLAND 2

SURVEY DRAWING

CONTRACTOR NAME: WSP Surveys (AB)

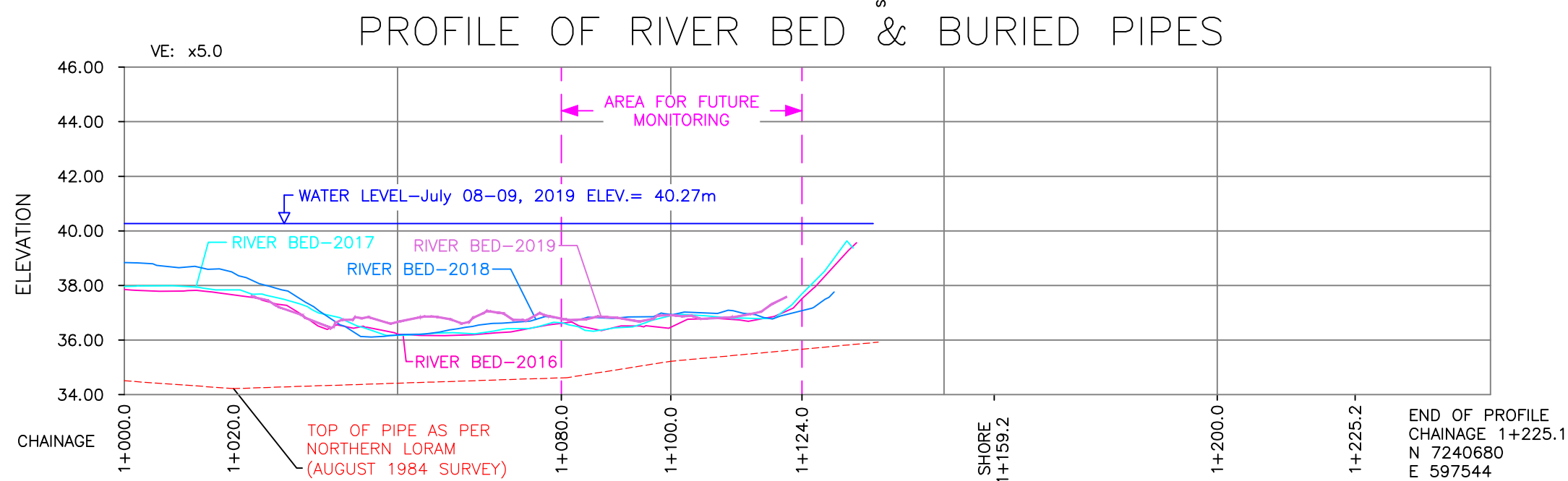
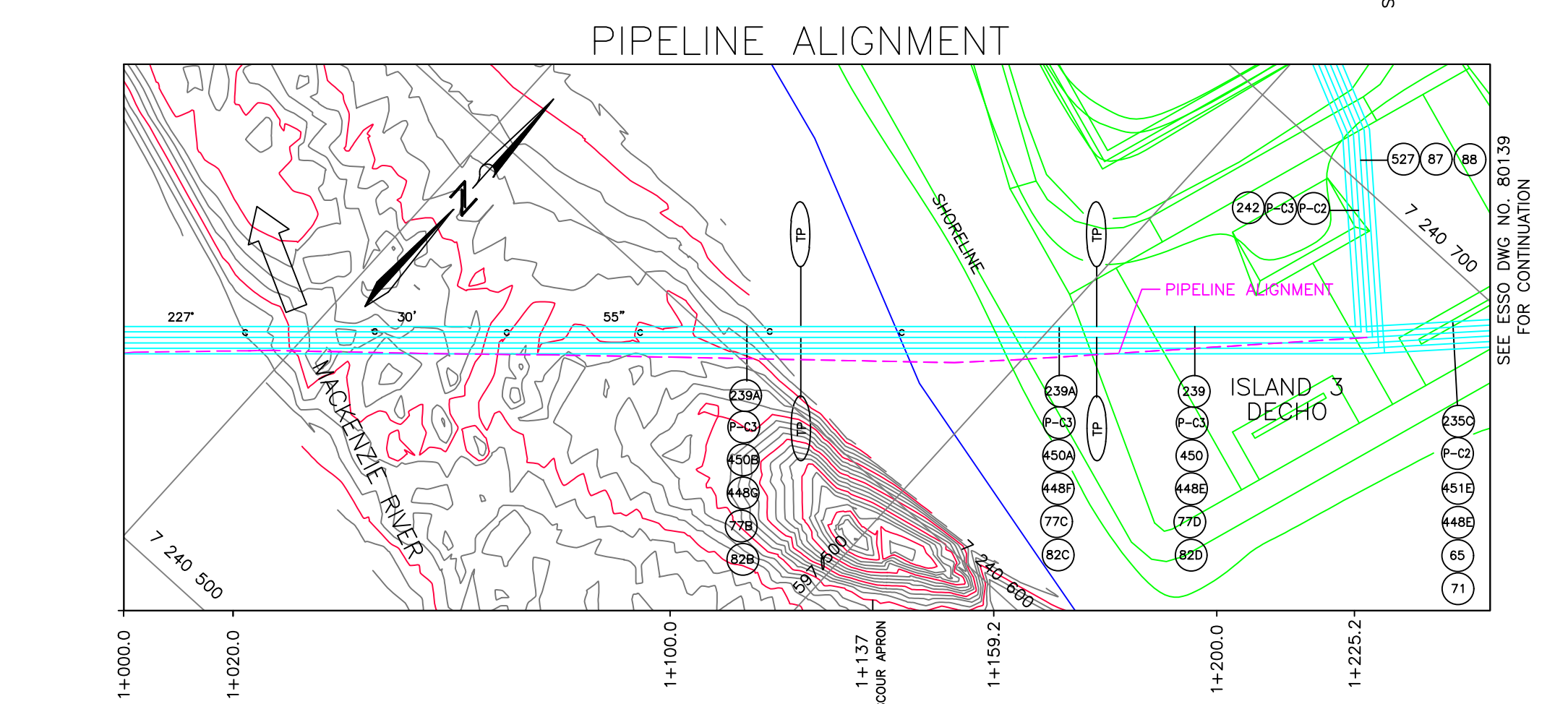
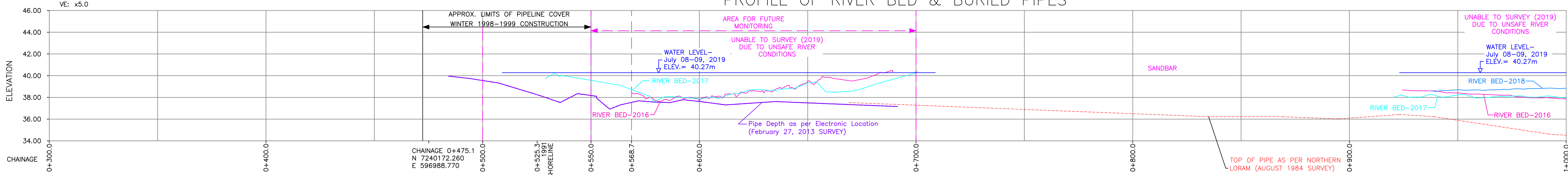
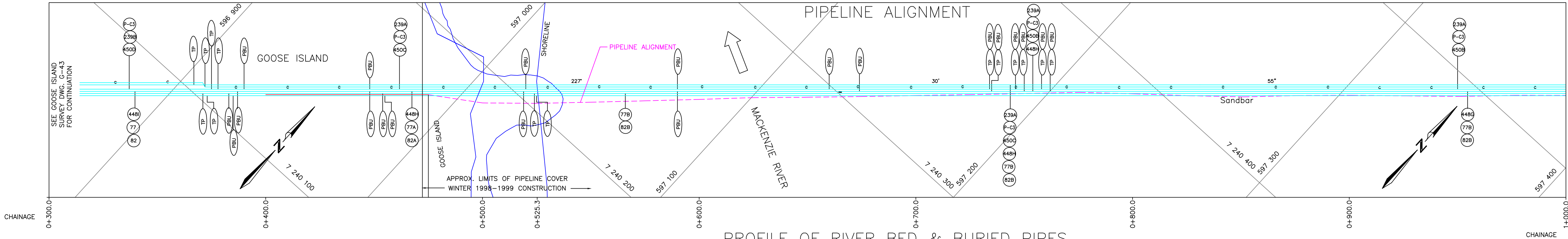
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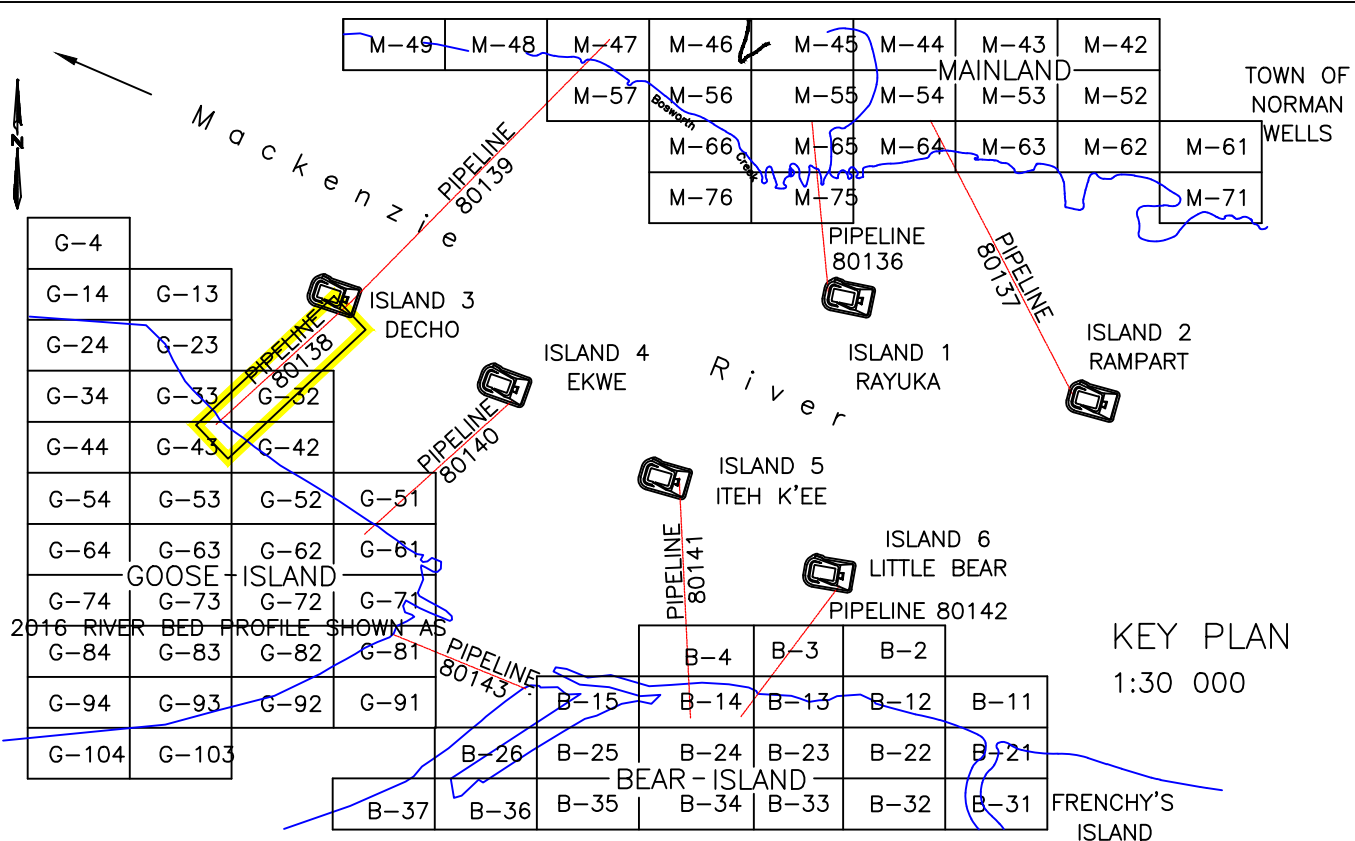
ESSO FILE No.

096-0179-700-801 72



PROFILE ALIGNMENT COORDINATES		
EASTING	NORTHING	
596988.770	7240172.260	START CHAINAGE 0+475.1
597009.800	7240186.220	
597028.480	7240202.910	
597046.630	7240220.110	
597064.660	7240237.340	
597082.730	7240254.650	
597100.870	7240272.040	
597118.990	7240288.930	
597137.310	7240306.010	
597155.620	7240323.290	
597173.860	7240340.390	
597192.100	7240357.130	
597210.340	7240374.010	
597228.580	7240391.010	
597246.820	7240407.940	
597265.060	7240424.870	
597283.300	7240441.770	
597301.540	7240458.730	
597319.780	7240475.370	
597338.020	7240492.060	
597356.260	7240508.800	
597374.500	7240525.540	
597392.740	7240542.280	
597410.980	7240559.020	
597429.220	7240575.760	
597447.460	7240592.500	
597465.700	7240609.240	
597483.940	7240625.980	
597502.180	7240642.720	
597520.420	7240659.460	
597538.660	7240676.200	
597556.900	7240692.940	
597575.140	7240709.680	
597593.380	7240726.420	
597611.620	7240743.160	
597629.860	7240759.900	
597648.100	7240776.640	
597666.340	7240793.380	
597684.580	7240810.120	
597702.820	7240826.860	
597721.060	7240843.600	
597739.300	7240860.340	
597757.540	7240877.080	
597775.780	7240893.820	
597794.020	7240910.560	
597812.260	7240927.300	
597830.500	7240944.040	
597848.740	7240960.780	
597866.980	7240977.520	
597885.220	7240994.260	
597903.460	7241011.000	
597921.700	7241027.740	
597939.940	7241044.480	
597958.180	7241061.220	
597976.420	7241077.960	
597994.660	7241094.700	
598012.900	7241111.440	
598031.140	7241128.180	
598049.380	7241144.920	
598067.620	7241161.660	
598085.860	7241178.400	
598104.100	7241195.140	
598122.340	7241211.880	
598140.580	7241228.620	
598158.820	7241245.360	
598177.060	7241262.100	
598195.300	7241278.840	
598213.540	7241295.580	
598231.780	7241312.320	
598250.020	7241329.060	
598268.260	7241345.800	
598286.500	7241362.540	
598304.740	7241379.280	
598322.980	7241396.020	
598341.220	7241412.760	
598359.460	7241429.500	
598377.700	7241446.240	
598395.940	7241462.980	
598414.180	7241479.720	
598432.420	7241496.460	
598450.660	7241513.200	
598468.900	7241529.940	
598487.140	7241546.680	
598505.380	7241563.420	
598523.620	7241580.160	
598541.860	7241596.900	
598560.100	7241613.640	
598578.340	7241630.380	
598596.580	7241647.120	
598614.820	7241663.860	
598633.060	7241680.600	
598651.300	7241697.340	
598669.540	7241714.080	
598687.780	7241730.820	
598706.020	7241747.560	
598724.260	7241764.300	
598742.500	7241781.040	
598760.740	7241797.780	
598778.980	7241814.520	
598797.220	7241831.260	
598815.460	7241848.000	
598833.700	7241864.740	
598851.940	7241881.480	
598870.180	7241898.220	
598888.420	7241914.960	
598906.660	7241931.700	
598924.900	7241948.440	
598943.140	7241965.180	
598961.380	7241981.920	
598979.620	7241998.660	
599000.000	7242015.400	END CHAINAGE 1+225.1

SURVEY CONTROL				SUBSTANCE DESCRIPTION				SUBSTANCE DESCRIPTION				NOTES			
No.	DESCRIPTION	NORTHING	EASTING	ELEV.	No.	DESCRIPTION		No.	DESCRIPTION			5. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL			
1000	REBAR @ N.E. OF ISL. 1	7240711.75	599540.89		65	273.1 OE Is.3 to C.P.F. Glycol H.T. 87-65-65A		448E	219.1 INJ-FW C.P.F. to G.I.T.4, Gly H.T. 448 to 448F			6. CONTOUR INTERVAL = 0.25 METRES.			
1004	REBAR @ N.W. OF ISL. 1	7240729.21	599459.90		71	355.6 OE Is.3 to C.P.F. Glycol H.T. 88-71-71A		448F	219.1 INJ-FW C.P.F. to G.I.T.4, Conc Coated 448 to 448H G-32,33,43,54						
2	REBAR @ N.E. OF ISL. 2	7240301.75	600511.43		77	273.1 OE GIT 4 to Is.3 Single Sect H.T. 77A-77B G-54,43,33,32 H.T.354		448G	219.1 INJ-FW C.P.F. to G.I.T.4, Conc Coated 448 to 448H G-32,33,43,54 H.T.352			2016 RIVER BED PROFILE SHOWN AS			
2001	REBAR @ N.W. OF ISL. 2	7240324.34	600431.97		77A	273.1 OE GIT 4 to Is.3 Single Sect H.T., Conc Coated, 77A-77B-77C G-54,43,33,32 H.T.354		448H	219.1 INJ-FW C.P.F. to G.I.T.4, Dbl Sect H.T., Conc Coated 448 to 448H G-32,33,43,54 H.T.352			2017 RIVER BED PROFILE SHOWN AS			
27	REBAR @ N.W. OF ISL. 3	7240741.90	597423.38		77B	273.1 OE GIT 4 to Is.3 Conc Coated, 77A-77B-77C-77D G-54,43,33,32		448I	219.1 INJ-FW C.P.F. to G.I.T.4, Sing Sect H.T. 448 to 448I-G.I.T.4 G-32,33,43,54 H.T.352			2018 RIVER BED PROFILE SHOWN AS			
3000	REBAR @ N.E. OF ISL.3	7240716.18	597500.36		77C	273.1 OE GIT 4 to Is.3 Conc Coated, Glycol H.T. 77A-77B-77C-77D		448J	219.1 INJ-FW C.P.F. to G.I.T.4, Sing Sect H.T. 448 to 448J-G.I.T.4 G-32,33,43,54 H.T.352			2019 RIVER BED PROFILE SHOWN AS			
26	REBAR @ N.W. OF ISL. 4	7240387.54	598100.08		77D	273.1 OE GIT 4 to Is.3 Single Sect H.T., Conc Coated, 77A-77B-77C-77D-77E		450A	168.3 INJ-SW Is.3 to G.I.T.4, Gly H.T. 451E-450-450A						
4000	REBAR @ N.E. OF ISL. 4	7240361.98	598175.94		82	355.6 OE GIT 4 to Is.3 Single Sect H.T., Conc Coated, 82A-82B-82C G-54,43,33,32 H.T.353		450B	168.3 INJ-SW Is.3 to G.I.T.4, Conc Coated 450-450A-450B-450C G-32,33,43,54						
22	REBAR @ N.W. OF ISL. 5	7240016.98	598734.63		82A	355.6 OE GIT 4 to Is.3 Single Sect H.T., Conc Coated, 82A-82B-82C G-54,43,33,32 H.T.353		450C	168.3 INJ-SW Is.3 to G.I.T.4, Dbl Sect H.T., Conc Coated 450-450A-450B-450C-450D G-32,33,43,54 H.T.351						
5000	REBAR @ N.E. OF ISL. 5	7239993.12	598815.14		82B	355.6 OE GIT 4 to Is.3 Conc Coated, 82A-82B-82C-82D G-54,43,33,32		450D	168.3 INJ-SW Is.3 to G.I.T.4, Sing Sect H.T. 450-450A-450B-450C-450D G-32,33,43,54 H.T.351						
21	REBAR @ N.W. OF ISL. 6	7239631.84	599382.56		82C	355.6 OE GIT 4 to Is.3 Conc Coated, Glycol H.T. 82A-82B-82C-82D		451E	168.3 INJ-SW C.P.F. to Is.3, Gly H.T. 451-451A-451B-451C-451D-451E-450						
6000	REBAR @ N.E. OF ISL. 6	7239616.68	599465.79		82D	355.6 OE GIT 4 to Is.3 Glycol H.T. 82C-82D-71		527	88.9 INJ-SW 451E Tee to Is.3, Gly H.T. 451E-527-Is.3						
					87	168.3 OE Is.3 to C.P.F. Glycol H.T. 87-65-65A		ELECTRICAL DESCRIPTION							
					88	168.3 OE Is.3 to C.P.F. Glycol H.T. 88-71-71A		P-C2	4160 H.V. From SB-C1 to SB-C2 (Is.3) M-47,57 Refer to Dwg 096-0100-100-006						
					GASLIFT			P-C3	4160 H.V. From SB-C2 (Is.3) to GIT 4 Trans TR-C18 G-54,43,33,32						
					235C	168.3 NG (Gas Lift) C.P.F. to Is.3 (Conc Coated) 235-235A-235B-235C-Is.3		NOTES							
					239	168.3 NG (Gas Lift) Is.3 to GIT 4 (Buried) 235C-239-239A		1. RIVER BOTTOM PROFILE FROM 2019 BATHYMETRIC SURVEY							
					239A	168.3 NG (Gas Lift) Is.3 to GIT 4 (Conc Coated) 239A-239B-239B		PERFORMED JULY 08 TO JULY 09, 2019.							
					239B	168.3 NG (Gas Lift) Is.3 to GIT 4 (Buried) 239A-239B-GIT 4 G-54,43,33,32		2. PIPE PROFILE AND CHAINAGES FROM ESSO DWG. 80054 REV. 8 - TOP							
					242	88.9 NG (Gas Lift) C.P.F. to Is.3 (Buried) 235C-242-Is.3		OF PIPE AS PER NORTHERN LORAM							
								(TOP OF PIPE PROFILE ELEVATION REDUCED 0.776m IN 2008)							
								3. HORIZONTAL DATUM : NAD27 (SHORAN) - UTM GRID/CM = 129'							
								4. VERTICAL DATUM - GEODETIC BM 747016 ELEVATION 60.189							



6	ADDED 1998 BOTTOM PROFILE JULY 1998: UMA GEOMATICS	12	ADDED 2002 BOTTOM PROFILE AUG 2002: UMA GEOMATICS	18	ADDED 2010 BOTTOM PROFILE JULY 2010: MAM GEOMATICS	24	ADDED 2016 BOTTOM PROFILE SEP. 2016: WSP
5	ADDED 1995 BOTTOM PROFILE JULY 1995: UMA GEOMATICS	11	ADDED 2001 BOTTOM PROFILE AUG 2001: UMA GEOMATICS	17	ADDED 2009 BOTTOM PROFILE JUNE 2009: MAM GEOMATICS	23	ADDED 2015 BOTTOM PROFILE AUG. 2015: WSP
4	ADDED 1994 BOTTOM PROFILE JULY 1994: UMA GEOMATICS	10	ADDED 2000 BOTTOM PROFILE AUG 2000: UMA GEOMATICS	16	ADDED 2008 BOTTOM PROFILE JUNE 2008: MAM GEOMATICS	22	ADDED 2014 BOTTOM PROFILE AUGUST 2014: MAM GEOMATICS
27	ADDED 2018 BOTTOM PROFILE NOV. 2018: WSP	9	ADDED 1999 BOTTOM PROFILE AUG 1999: UMA GEOMATICS	15	ADDED 2006 BOTTOM PROFILE AUG 2006: USHER CANADA LIMITED	21	ADDED 2013 BOTTOM PROFILE AUGUST 2013: MAM GEOMATICS
28	ADDED 2017 BOTTOM PROFILE SEP. 2017: WSP	8	ADDED 1998 BOTTOM PROFILE JUNE 1998: UMA GEOMATICS	14	ADDED 2005 BOTTOM PROFILE AUG 2005: USHER CANADA LIMITED	20	ADDED 2012 BOTTOM PROFILE AUGUST 2012: MAM GEOMATICS
29	ADDED 2019 BOTTOM PROFILE SEP. 2019: WSP	7	ADDED 1997 BOTTOM PROFILE JULY 1997: UMA GEOMATICS	13	ADDED 2003 BOTTOM PROFILE AUG 2003: UMA GEOMATICS	19	ADDED 2011 BOTTOM PROFILE AUGUST 2011: MAM GEOMATICS
No.	REVISION	No.	REVISION	No.	REVISION	No.	REVISION

LEGEND

UTILIDORS SHOWN

ROADS SHOWN

BURIED PIPES SHOWN

BELOW GROUND POWER, TELEPHONE, & COMMUNICATION SHOWN

VENT SHOWN

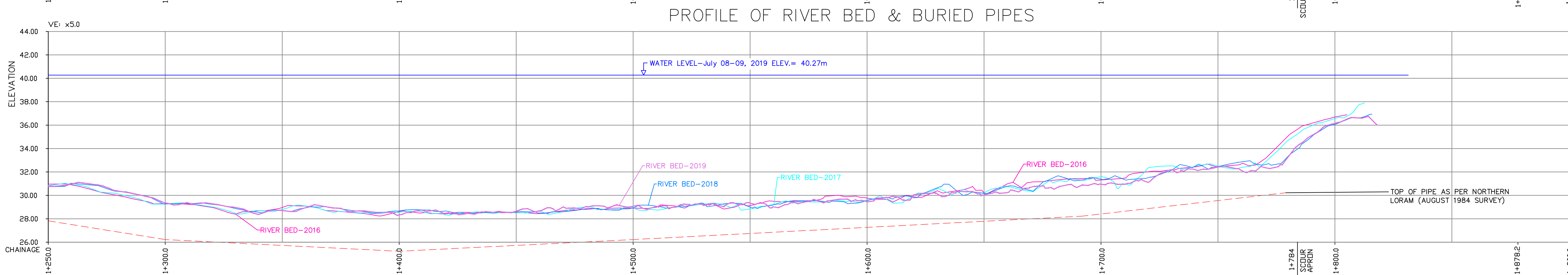
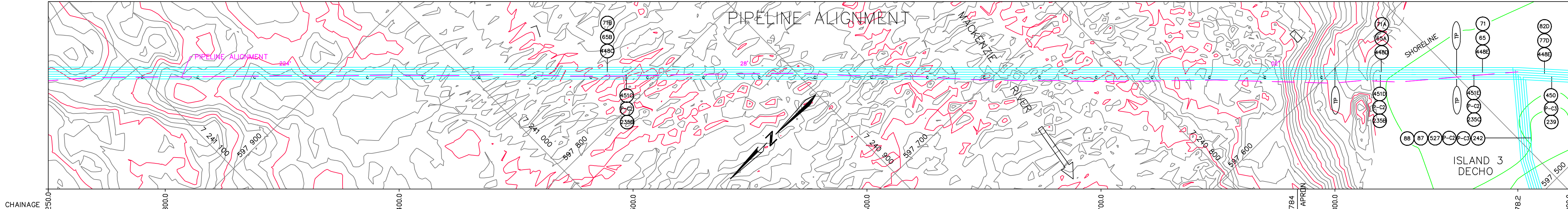
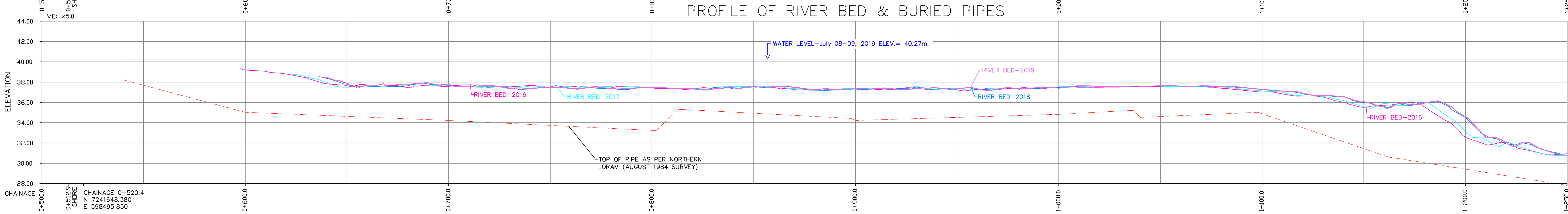
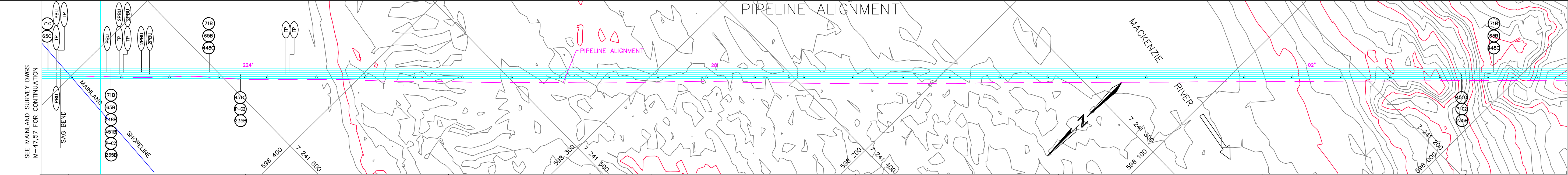
TRANSITION POINT

PULL BOX SHOWN

PULL POINT SHOWN

PIPE O/S DIA'S ARE IN MILLIMETERS AND DECIMALS THEREOF

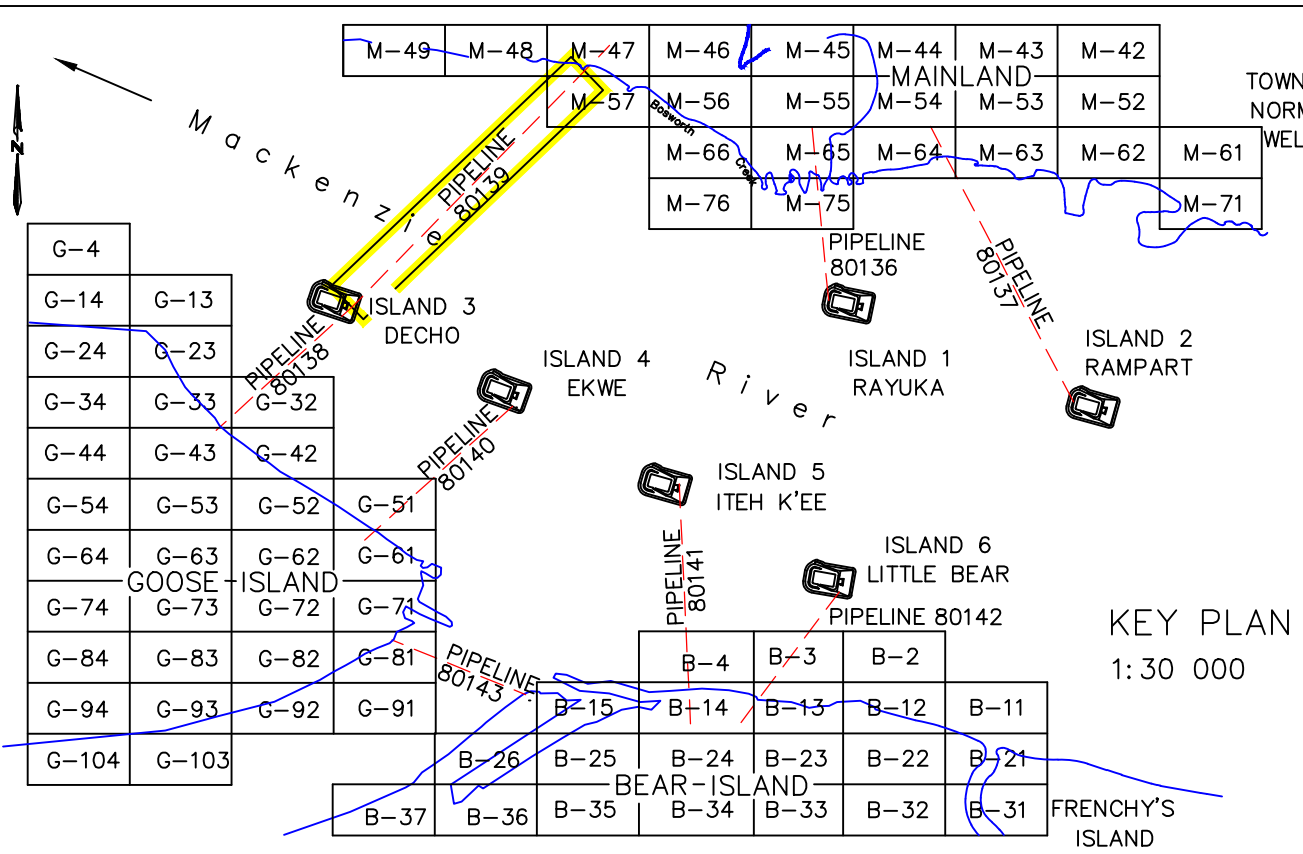
SUBSTANCE/CATEGORY	CROSS REFERENCE
PROPANE/BUTANE	HV
CRUDE OIL	CO
MULTIPHASE FLUIDS	OE
NATURAL/LIFT GAS	NG
FUEL GAS	FG
MISCELLANEOUS LIQUIDS	ML
PRODUCED WATER	SW
FRESH WATER	FW
INJECTION (SW)	INJ-SW
INJECTION (FW)	INJ-FW
ABANDONED	ABAN
MISCELLAN	



PROFILE ALIGNMENT COORDINATES		
EASTING	NORTHING	
598495.850	7241648.380	START CHAINAGE 0+520.4
598475.110	7241628.550	
598457.710	7241608.840	
598438.670	7241592.880	
598403.750	7241557.440	
598385.410	7241540.300	
598367.680	7241522.290	
598349.580	7241504.620	
598332.560	7241487.170	
598314.730	7241469.560	
598280.730	7241433.800	
598262.530	7241416.200	
598226.770	7241380.770	
598192.130	7241345.600	
598175.540	7241327.750	
598156.300	7241308.460	
597982.226	7241130.140	
597971.800	7241117.670	
597949.660	7241094.730	
597932.480	7241077.010	
597913.010	7241056.780	
597897.760	7241041.380	
597881.390	7241024.240	
597863.170	7241006.150	
597846.060	7240988.010	
597827.820	7240970.570	
597811.330	7240953.780	
597793.290	7240934.600	
597776.080	7240916.650	
597758.910	7240898.900	
597742.580	7240883.830	
597723.440	7240864.790	
597705.960	7240849.010	
597690.990	7240834.450	
597686.630	7240829.890	
597668.560	7240810.270	
597651.540	7240794.700	
597632.180	7240774.430	
597595.980	7240738.610	
597588.020	7240729.860	
597583.310	7240725.520	
597576.780	7240719.460	
597544.000	7240680.000	END CHAINAGE 1+878.2

Alignment includes Winter 1997 pipe locating data.

SURVEY CONTROL				No.	SUBSTANCE DESCRIPTION		No.	SUBSTANCE DESCRIPTION		NOTES	
No.	DESCRIPTION	NORTHING	EASTING	ELEV.	MULTIPHASE LIQUIDS		INJECTION WATER		1. RIVER BOTTOM PROFILE FROM 2019 BATHYMETRIC SURVEY PERFORMED JULY 08 TO JULY 09, 2019.		
1000	REBAR @ N.E. OF ISL. 1	7240711.75	599540.89		65	273.1 OE Is.3 to C.P.F. Glycol H.T. 87-65-65A	448E	219.1 INJ-FW C.P.F. to G.I.T. 4, Glycol H.T., 448-448A-448B-448C-448D-448E-448F			
1004	REBAR @ N.W. OF ISL. 1	7240729.21	599459.90		65A	273.1 OE Is.3 to C.P.F. Glycol H.T., Conc Coated 65-65A-65B	451B	168.3 INJ-SW C.P.F. to Is. 3, Dbl Sect H.T., Conc Coated, Liner 451-451A-451B-451C Converted Spare Line H.T.226	2. PIPE PROFILE AND CHAINAGES FROM ESSO DWG. 80054 REV. 8 – TOP OF PIPE AS PER NORTHERN LORAM		
2	REBAR @ N.E. OF ISL. 2	7240301.75	600511.43		65B	273.1 OE Is.3 to C.P.F. Conc Coated 65-65A-65B-65C M-57,47,46	451C	168.3 INJ-SW C.P.F. to Is. 3, Conc Coated Liner 451-451A-451B-451C-451D M-46,47,57 Converted Spare Line			
2001	REBAR @ N.W. OF ISL. 2	7240324.34	600431.97		65C	273.1 OE Is.3 to C.P.F. Sng Sect. H.T. Conc Coated 65-65A-65B-65C-65D M-57,47,46 H.T.224	451D	168.3 INJ-SW C.P.F. to Is. 3, Conc Coated, Gly H.T., Liner 451-451A-451B-451C-451D-451E Converted Spare Line	(TOP OF PIPE PROFILE ELEVATION REDUCED 0.776m IN 2008)		
27	REBAR @ N.W. OF ISL. 3	7240741.90	597423.38		71	355.6 OE Is.3 to C.P.F. Glycol H.T. 88-71-71A	451E	168.3 INJ-SW C.P.F. to Is. 3, Glycol H.T., Liner 451-451A-451B-451C-451D-451E-450 Converted Spare Line	3. HORIZONTAL DATUM : NAD27 (SHORAN) – UTM GRID/CM = 129'		
3000	REBAR @ N.E. OF ISL.3	7240716.18	597500.36		71A	355.6 OE Is.3 to C.P.F. Glycol H.T., Conc Coated 71-71A-71B	450	168.3 INJ-SW Is.3 to GIT 4, Glycol H.T. 451E-450-450A Converted Spare Line	4. VERTICAL DATUM – GEODETIC BM 74T016 ELEVATION 60.189		
26	REBAR @ N.W. OF ISL. 4	7240387.54	598100.08		71B	355.6 OE Is.3 to C.P.F. Conc Coated 71-71A-71B-71C M-57,47,46	527	88.9 INJ-SW 451E Tee to Is.3, Glycol H.T. 451E-527-Is.3	5. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL		
4000	REBAR @ N.E. OF ISL. 4	7240361.98	598175.94		71C	355.6 OE Is.3 to C.P.F. Dbl Sect. H.T. Conc Coated 71-71A-71B-71C-71D M-57,47,46 H.T.223	ELECTRICAL DESCRIPTION		6. CONTOUR INTERVAL = 0.25 METRES.		
22	REBAR @ N.W. OF ISL. 5	7240016.98	598734.63		77D	273.1 OE GIT 4 to Is.3 Glycol H.T. 77C-77D-65	P-C2	4160 H.V. From SB-C1 to SB-C2 (Is.3) M-47,57 Refer to Dwg 096-0100-100-006			
5000	REBAR @ N.E. OF ISL. 5	7239993.12	598815.14		82D	355.6 OE GIT 4 to Is.3 Glycol H.T. 82C-82D-71	P-C3	4160 H.V. From SB-C2 (Is.3) to GIT 4 Trans TR-C18 G-54,43,33,32			
21	REBAR @ N.W. OF ISL. 6	7239631.84	599382.56		87	168.3 OE Is.3 to C.P.F. Glycol H.T. 87-65-65A					
6000	REBAR @ N.E. OF ISL. 6	7239616.68	599465.79		88	168.3 OE Is.3 to C.P.F. Glycol H.T. 88-71-71A					
						GASLIFT			2016 RIVER BED PROFILE SHOWN AS		
					235B	168.3 NG (Gas Lift) C.P.F. to Is.3 (Conc Coated) 235-235A-235B-235C M-46,47,57			2017 RIVER BED PROFILE SHOWN AS		
					235C	168.3 NG (Gas Lift) C.P.F. to Is.3 (Conc Coated) 235-235A-235B-235C-Is.3			2018 RIVER BED PROFILE SHOWN AS		
					239	168.3 NG (Gas Lift) Is.3 to GIT 4 (Conc Coated) 235C-239-239A			2019 RIVER BED PROFILE SHOWN AS		
					242	88.9 NG (Gas Lift) C.P.F. to Is.3 (Buried) 235C-242-Is.3					
						INJECTION WATER					
					448B	219.1 INJ-FW C.P.F. to G.I.T. 4, Dbl Sect H.T., Conc Coated 448-448A-448B-448C M-46,47,57					
					448C	219.1 INJ-FW C.P.F. to G.I.T. 4, Conc Coated 448-448A-448B-448C-448D M-46,47					
					448D	219.1 INJ-FW C.P.F. to G.I.T. 4, Conc Coated, Gly H.T., 448-448A-448B-448C-448D-448E					
					448E	219.1 INJ-FW C.P.F. to G.I.T. 4, Glycol H.T., 448-448A-448B-448D-448E-527					



LEGEND

UTLIDORS SHOWN

ROADS SHOWN

BURIED PIPES SHOWN

BELOW GROUND POWER, TELEPHONE, & COMMUNICATION SHOWN

VENT SHOWN

TRANSITION POINT

PULL BOX SHOWN

PULL POINT SHOWN

PIPE O/S DIA'S ARE IN MILLIMETERS AND DECIMALS THEREOF

SUBSTANCE/CATEGORY CROSS REFERENCE

SUBSTANCE	CODE	SUBSTANCE	CODE
PROPANE/BUTANE	HV	PRODUCED WATER	SW
CRUDE OIL	CO	FRESH WATER	FW
MULTIPHASE FLUIDS	OE	INJECTION (SW)	INJ-SW
NATURAL/LIFT GAS	NG	INJECTION (FW)	INJ-FW
FUEL GAS	FG	ABANDONED	ABAN
MISCELLANEOUS LIQUIDS	ML	MISCELLANEOUS GASES	MG

Imperial Oil

IMPERIAL OIL RESOURCES

NORMAN WELLS FACILITIES

MAINLAND TO ISLAND 3

SURVEY DRAWING

CONTRACTOR NAME: WSP Surveys (AB) Limited Partnership

DATE: 19-09-26

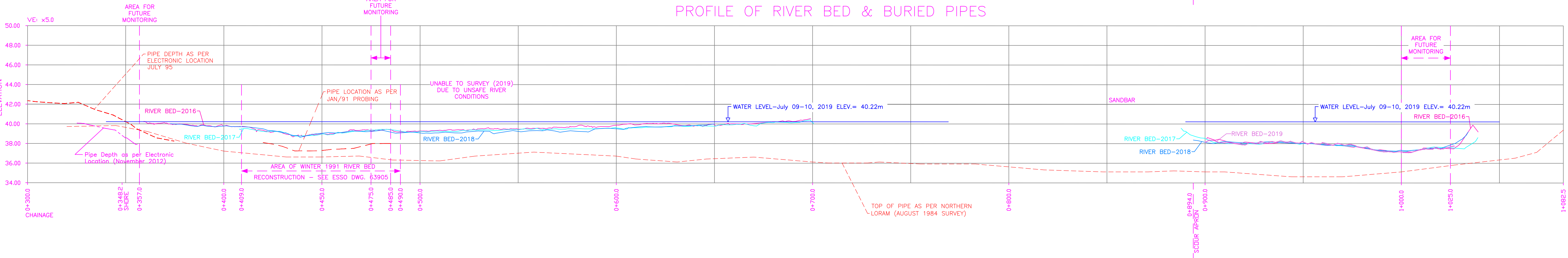
SCALE: H 1:1000 V 1:200

CONTRACTOR DWG NO.: 1199-c

ESSO FILE No.

096-0179-700-801 74

ADDED 1996 BOTTOM PROFILE JULY 1996: UMA GEOMATICS	ADDED 2002 BOTTOM PROFILE AUG 2002: UMA GEOMATICS	ADDED 2009 BOTTOM PROFILE JUNE 2009: UMA GEOMATICS	ADDED 2015 BOTTOM PROFILE AUG 2015: WSP
ADDED 1998 BOTTOM PROFILE JULY 1998: UMA GEOMATICS	ADDED 2001 BOTTOM PROFILE AUG 2001: UMA GEOMATICS	ADDED 2008 BOTTOM PROFILE JUNE 2008: UMA GEOMATICS	ADDED 2014 BOTTOM PROFILE AUG 2014: UMA GEOMATICS
ADDED 2016 BOTTOM PROFILE SEP 2016: WSP	ADDED 2019 BOTTOM PROFILE SEP 2019: WSP	ADDED 2006 BOTTOM PROFILE JUNE 2006: USHER CANADA LIMITED	ADDED 2013 BOTTOM PROFILE AUG 2013: UMA GEOMATICS
ADDED 2018 BOTTOM PROFILE NOV 2018: WSP	ADDED 2020 BOTTOM PROFILE AUG 2020: UMA GEOMATICS	ADDED 2008 BOTTOM PROFILE JUNE 2008: USHER CANADA LIMITED	ADDED 2011 BOTTOM PROFILE AUG 2011: UMA GEOMATICS
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ADDED 2016 BOTTOM PROFILE SEP 2016: WSP	ADDED 1997 BOTTOM PROFILE JULY 1997: UMA GEOMATICS	ADDED 2003 BOTTOM PROFILE AUG 2003: UMA GEOMATICS	ADDED 2002 BOTTOM PROFILE JULY 2002: UMA GEOMATICS
No. REVISION	No. REVISION	No. REVISION	No. REVISION



LEGEND			
UTILIDORS SHOWN _____		_____	
ROADS SHOWN _____		_____	
BURNED PIPES SHOWN _____		_____	
BELOW GROUND POWER, TELEPHONE, & COMMUNICATION SHOWN			
VENT SHOWN _____			
TRANSITION POINT _____			
PULL BOX SHOWN _____			
PULL POINT SHOWN _____			
PIPE O/S DIA.'S ARE IN MILLIMETERS AND DECIMALS THEREOF			
SUBSTANCE/CATEGORY CROSS REFERENCE			
SUBSTANCE	CODE	SUBSTANCE	CODE
PROPANE/BUTANE	HV	PRODUCED WATER	SW
CRUDE OIL	CO	FRESH WATER	FW
MULTIPHASE FLUIDS	OE	INJECTION (SW)	INJ-SW
NATURAL/LIFT GAS	NG	INJECTION (FW)	INJ-FW
FUEL GAS	FG	ABANDONED	ABAN
MISCELLANEOUS LIQUIDS	ML	MISCELLANEOUS GASES	MG



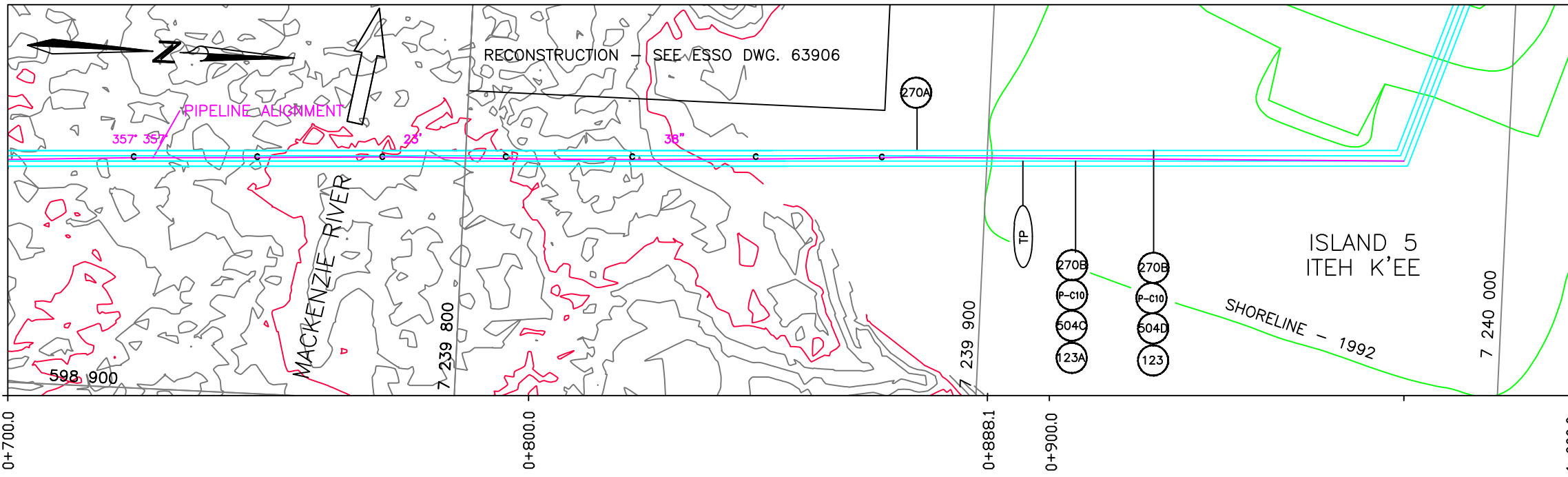
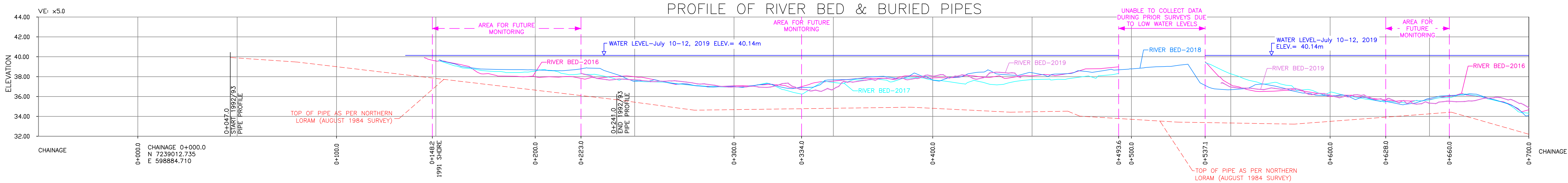
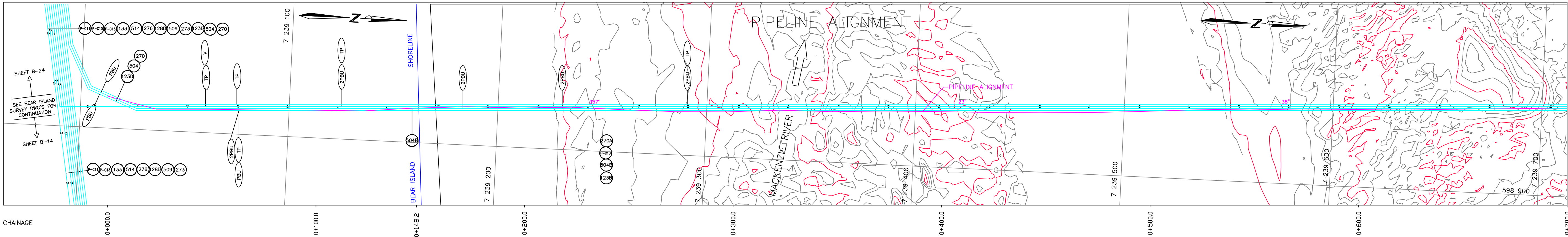
IMPERIAL OIL RESOURCES

NORMAN WELLS FACILITIES

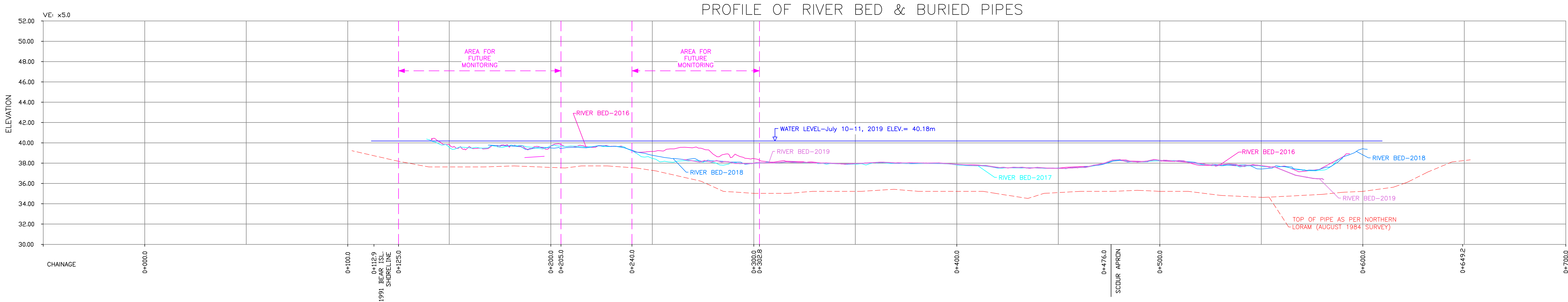
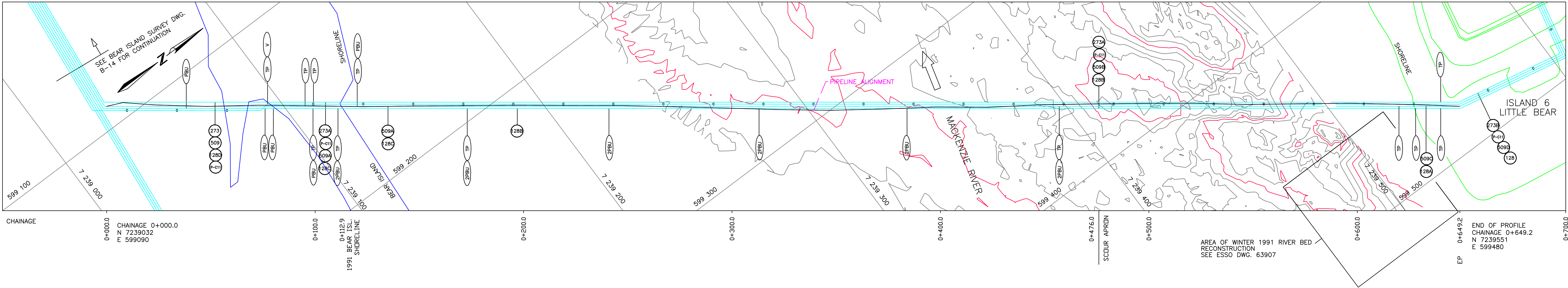
GOOSE TO ISLAND 4

SURVEY DRAWING

CONTRACTOR NAME: WSP Surveys (AB) Limited Partnership	CONTRACTOR DWG NO.: 1200-C
DATE: 19-09-26	ESSO FILE No.
SCALE: H 1:1000 V 1:200	096-0179-700-801 75



PROFILE ALIGNMENT COORDINATES	
EASTING	NORTHING
598884.710	7239012.735
598885.860	7239036.320
598886.710	7239061.550
598887.910	7239085.780
598888.820	7239110.580
598889.050	7239135.440
598890.480	7239160.310
598891.080	7239185.260
598891.060	7239210.410
598892.520	7239235.430
598893.560	7239259.790
598894.320	7239284.800
598895.200	7239310.010
598896.280	7239334.800
598897.790	7239359.970
598898.740	7239384.860
598899.360	7239409.840
598900.610	7239434.770
598901.350	7239459.860
598902.310	7239484.780
598903.570	7239509.940
598904.610	7239535.040
598905.090	7239560.020
598906.320	7239585.090
598907.950	7239610.190
598909.250	7239635.280
598910.400	7239660.400
598911.920	7239685.300
598913.480	7239710.330
598915.363	7239735.330
598917.444	7239760.360
598919.444	7239785.410
598921.444	7239810.250
598923.444	7239835.450
598925.444	7239860.180
598927.444	7239885.080
598929.444	7239909.980
598931.444	7239934.880
598933.444	7239959.780
598935.444	7239984.680
598937.444	7240009.580
598939.444	7240034.480
598941.444	7240059.380
598943.444	7240084.280
598945.444	7240109.180
598947.444	7240134.080
598949.444	7240158.980
598951.444	7240183.880
598953.444	7240208.780
598955.444	7240233.680
598957.444	7240258.580
598959.444	7240283.480
598961.444	7240308.380
598963.444	7240333.280
598965.444	7240358.180
598967.444	7240383.080
598969.444	7240407.980
598971.444	7240432.880
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598981.444	7240557.380
598983.444	7240582.280
598985.444	7240607.180
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598993.444	7240706.780
598995.444	7240731.680
598997.444	7240756.580
598999.444	7240781.480
599001.444	7240806.380
599003.444	7240831.280
599005.444	7240856.180
599007.444	7240881.080
599009.444	7240905.980
599011.444	7240930.880
599013.444	7240955.780
599015.444	7240980.680
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599061.444	7241553.380
599063.444	7241578.280
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599067.444	7241628.080
599069.444	7241652.980
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599073.444	7241702.780
599075.444	7241727.680
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599079.444	7241777.480
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599087.444	7241877.080
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599113.444	7242200.780
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599143.444	7242574.300
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599147.444	7242624.100
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599161.444	7242798.400
599163.444	7242823.300
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599167.444	7242873.100
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599199.444	7243271.500
599201.444	7243296.400
599203.444	7243321.300
599205.444	7243346.200
599207.444	7243371.100
599209.444	7243396.000
599211.444	7243420.900
599213.444	7243445.800
599215.444	7243470.700
599217.444	7243495.600
599219.444	7243520.500
599221.444	7243545.400
599223.444	7243570.300
599225.444	7243595.200
599227.444	7243620.100
599229.444	7243645.000
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599233.444	7243694.800
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599281.444	7244292.400
599283.444	7244317.300
599285.444	7244342.200
599287.444	7244367.100
599289.444	7244392.000
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599405.444	7245836.200
599407.444	7245861.100
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599447.444	7246359.100
599449.444	7246384.000
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599483.444	7246807.300
599485.444	7246832.200
599487.444	7246857.100
599489.444	7246882.000
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599505.444	7247081.200
599507.444	7247106.100
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599511.444	7247155.900
599513.444	7247180.800
599515.444	7247205.700
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599521.444	7247280.400
599523.444	7247305.300</

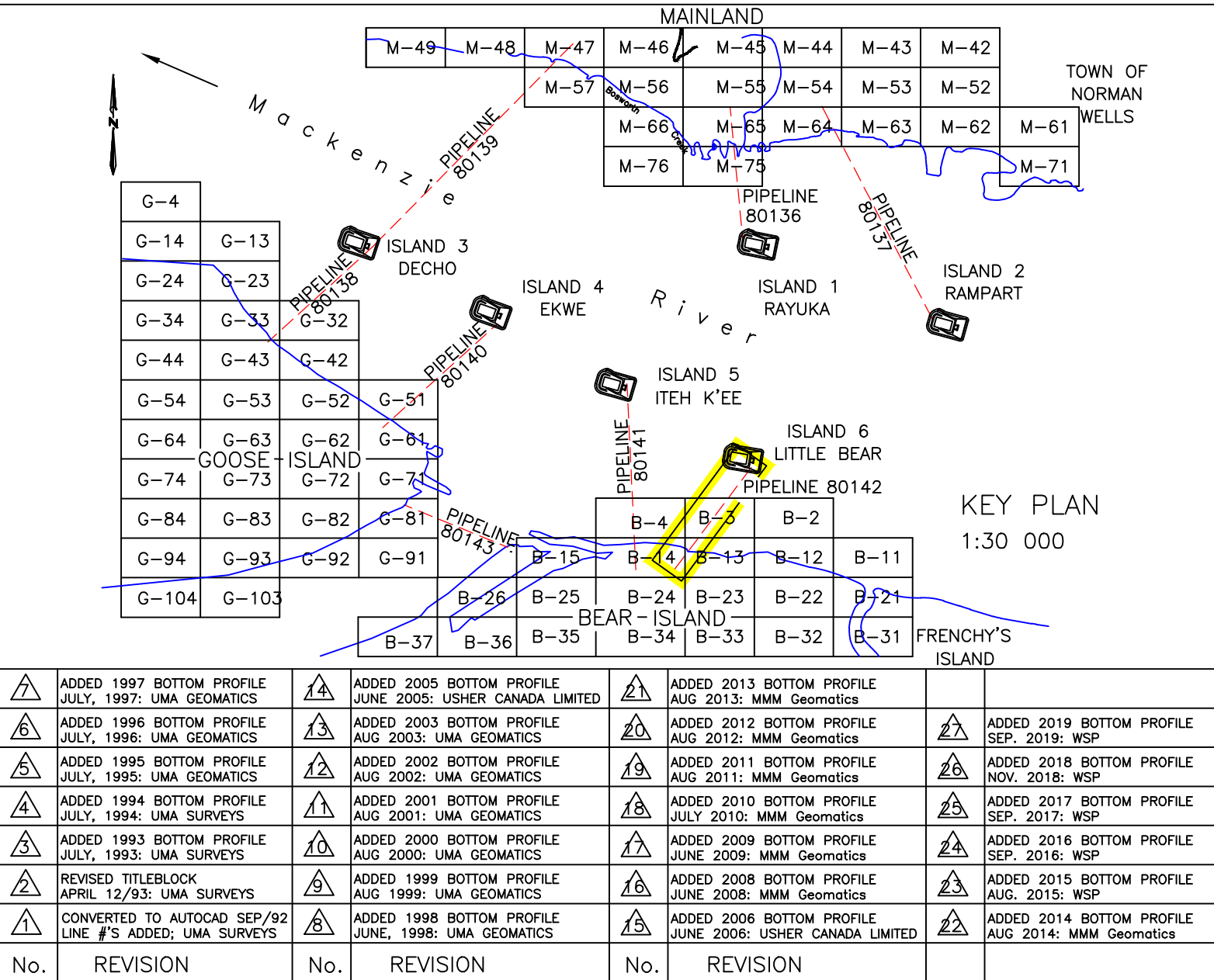


SURVEY CONTROL					No.	SUBSTANCE DESCRIPTION	
No.	DESCRIPTION	NORTHING	EASTING	ELEV.		MULTIPHASE LIQUIDS	
1000	REBAR @ N.E. OF ISL. 1	7240711.75	599540.89		128	168.3 OE Is.6 to BIT 4, Glycol H.T., Conc Coated	128-128A
1004	REBAR @ N.W. OF ISL. 1	7240729.21	599459.90		128A	168.3 OE Is.6 to BIT 4, Glycol H.T., Conc Coated	128-128A-128B
2	REBAR @ N.E. OF ISL. 2	7240301.75	600511.43		128B	168.3 OE Is.6 to BIT 4, Conc Coated	128-128A-128B-128C
2001	REBAR @ N.W. OF ISL. 2	7240324.34	600431.97		128C	168.3 OE Is.6 to BIT 4, Dbl Sect H.T., Conc Coated	128-128A-128B-128C-128D
27	REBAR @ N.W. OF ISL. 3	7240741.90	597423.38		128D	168.3 OE Is.6 to BIT 4, Sng Sect H.T.	128-128A-128B-128C-128D-BIT 4
3000	REBAR @ N.E. OF ISL.3	7240716.18	597500.36			GASLIFT	
26	REBAR @ N.W. OF ISL. 4	7240387.54	598100.08		273	88.9 NG (Gas Lift) BIT 4 to Is.6 (Buried)	273-273A B-25,24,14,13,3
4000	REBAR @ N.E. OF ISL. 4	7240361.98	598175.94		273A	88.9 NG (Gas Lift) BIT 4 to Is.6 (Conc Coated)	273-273A-273B B-25,24,14,13,3
22	REBAR @ N.W. OF ISL. 5	7240016.98	598734.63		273B	88.9 NG (Gas Lift) BIT 4 to Is.6 (Buried)	273-273A-273B-Is.6
5000	REBAR @ N.E. OF ISL. 5	7239993.12	598815.14			INJECTION WATER	
21	REBAR @ N.W. OF ISL. 6	7239631.84	599382.56		509	88.9 INJ-FW BIT 4 to Is.6, Sng Sect H.T.	509-509A B-25,24,14,13,3 H.T.442
6000	REBAR @ N.E. OF ISL. 6	7239616.68	599465.79		509A	88.9 INJ-FW BIT 4 to Is.6, Conc Coated	504-504A-504B B-25,24,14,13,3 H.T.442
					509B	88.9 INJ-FW BIT 4 to Is.6, Conc Coated	509-509A-509B-509C B-25,24,14,13,3
					509C	88.9 INJ-FW BIT 4 to Is.6, Glycol H.T., Conc Coated	509-509A-509B-509C-509D
					509D	88.9 INJ-FW BIT 4 to Is.6, Glycol H.T.	509-509A-509B-509C-509D-Is.6
						ELECTRICAL DESCRIPTION	
					P-C11	4160 H.V. BIT 4 5kV Switch Gear Is.6 Tr-C6	B-25,24,14,13,3

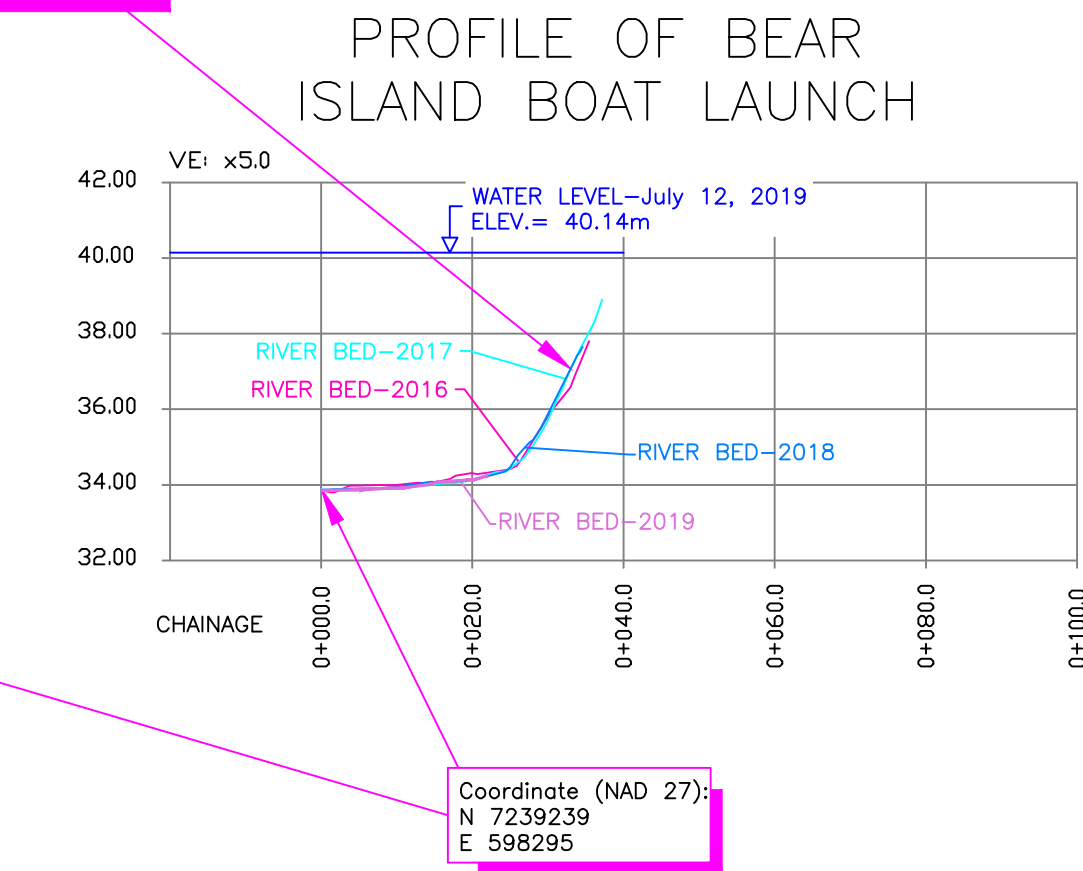
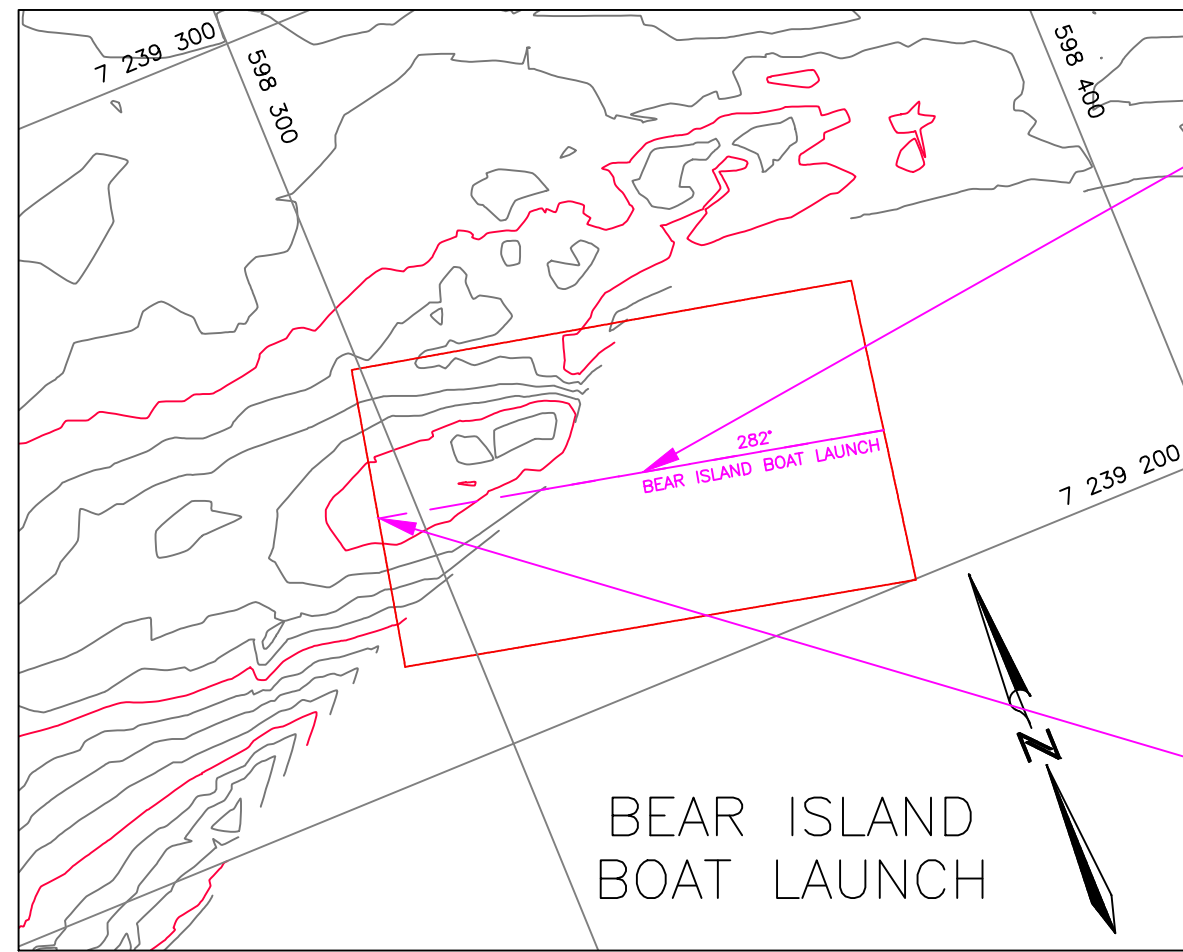
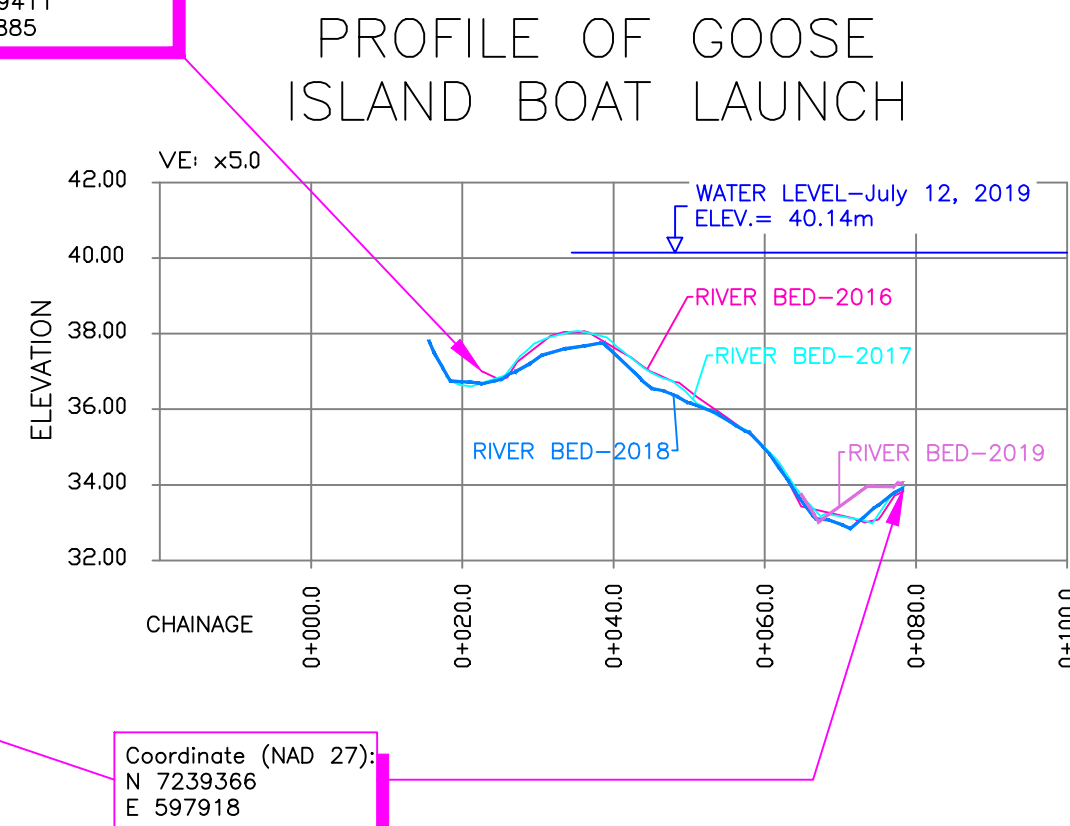
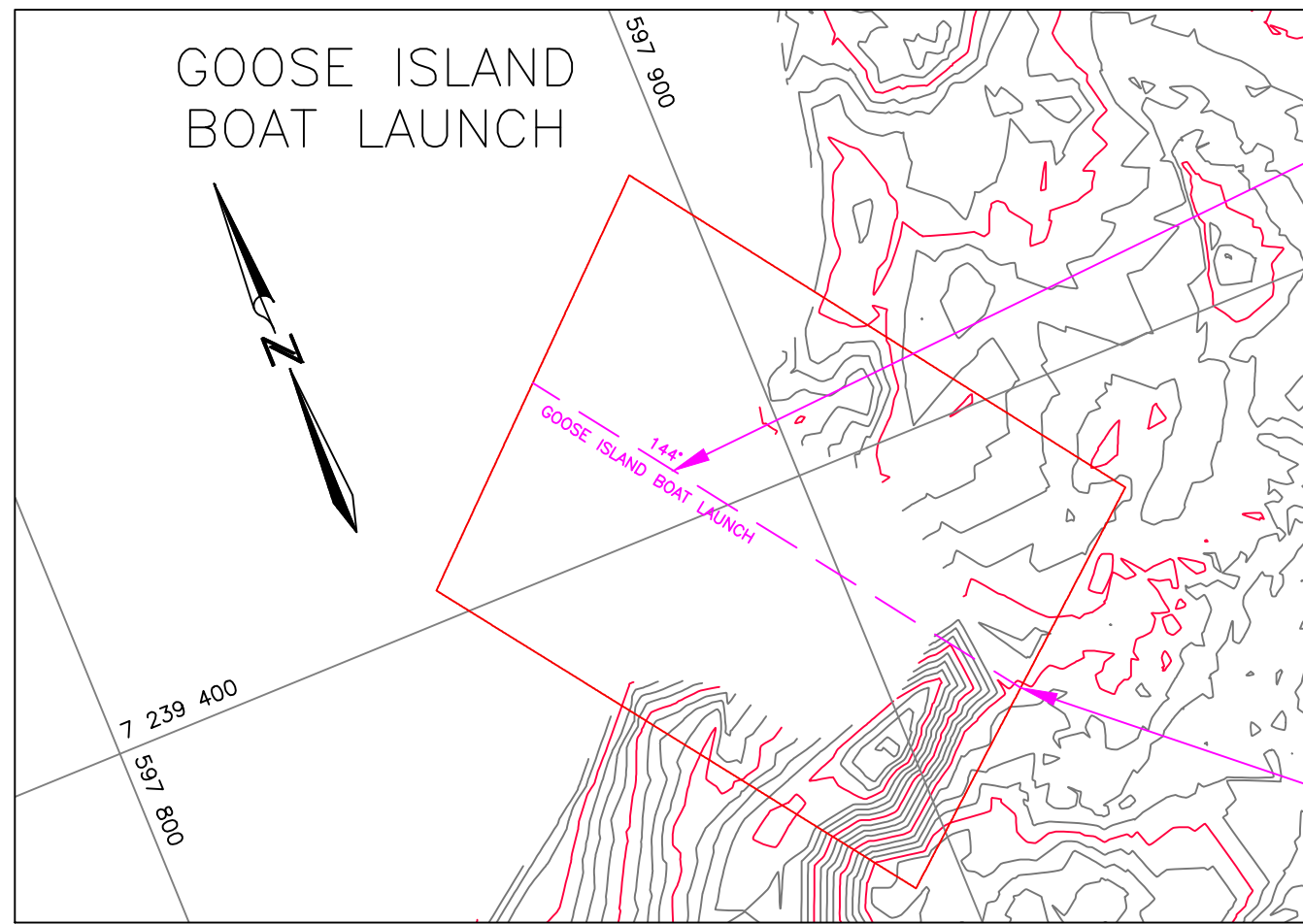
PROFILE ALIGNMENT COORDINATES		
EASTING	NORTHING	
599090.000	7239032.000	START CHAINAGE 0+000.000
599093.250	7239039.250	
599103.320	7239050.850	
599118.870	7239070.340	
599133.430	7239090.700	
599149.930	7239112.080	
599163.950	7239130.100	
599178.670	7239150.250	
599193.510	7239170.290	
599208.340	7239190.310	
599223.420	7239210.200	
599238.330	7239230.020	
599253.750	7239249.580	
599269.330	7239269.230	
599285.010	7239288.900	
599290.520	7239298.040	
599294.190	7239300.800	
599300.310	7239308.730	
599314.720	7239328.900	
599329.050	7239349.520	
599344.090	7239369.280	
599358.010	7239389.800	
599372.550	7239409.930	
599387.300	7239429.980	
599402.270	7239450.020	
599417.930	7239469.890	
599432.740	7239490.140	
599447.530	7239510.210	
599462.960	7239529.870	
599488.430	7239538.780	
599490.000	7239551.000	END CHAINAGE 0+649.2

Alignment includes Winter 1997 pipe locating data.

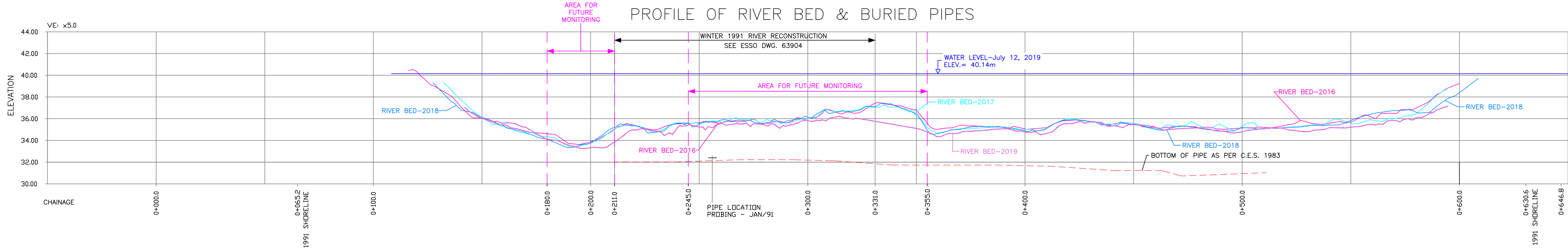
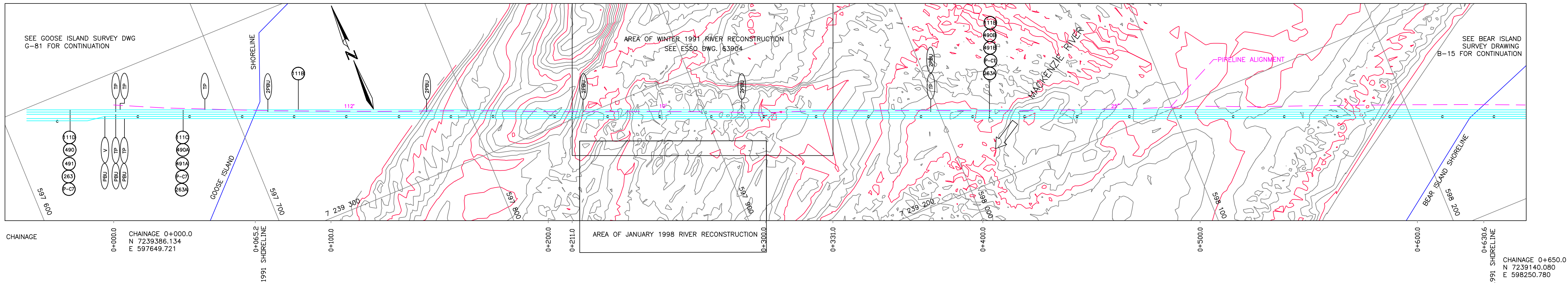
NOTES	
1. RIVER BOTTOM PROFILE FROM 2019 BATHYMETRIC SURVEY	
PERFORMED JULY 10 TO JULY 11, 2019.	
2. PIPE PROFILE AND CHAINAGES FROM ESSO DWG. 80054 REV. 8 - TOP OF PIPE AS PER NORTHERN LORAM	
(TOP OF PIPE PROFILE ELEVATION REDUCED 0.776m IN 2008)	
3. HORIZONTAL DATUM : NAD27 (SHORAN) - UTM GRID/CM = 129°	
4. VERTICAL DATUM - GEODETIC BM 74016 ELEVATION 60.189	
5. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL	
6. CONTOUR INTERVAL = 0.25 METRES.	
LEGEND	
2016 RIVER BED PROFILE SHOWN AS	
2017 RIVER BED PROFILE SHOWN AS	
2018 RIVER BED PROFILE SHOWN AS	
2019 RIVER BED PROFILE SHOWN AS	
No.	REVISION



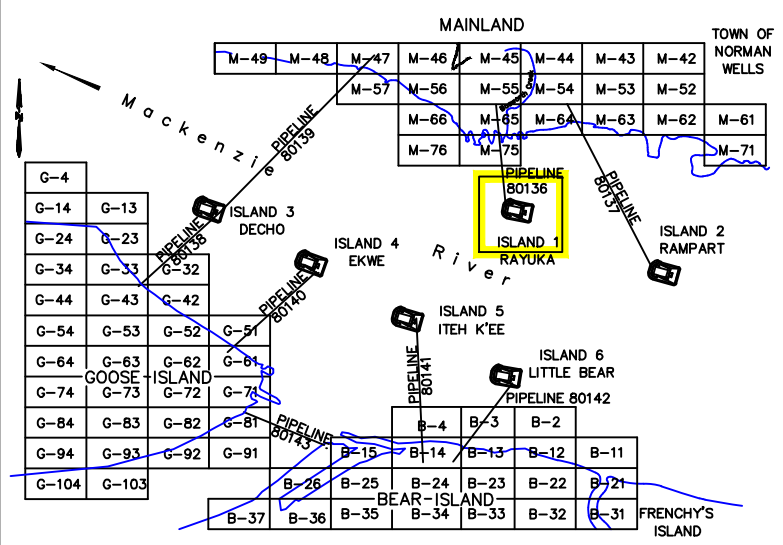
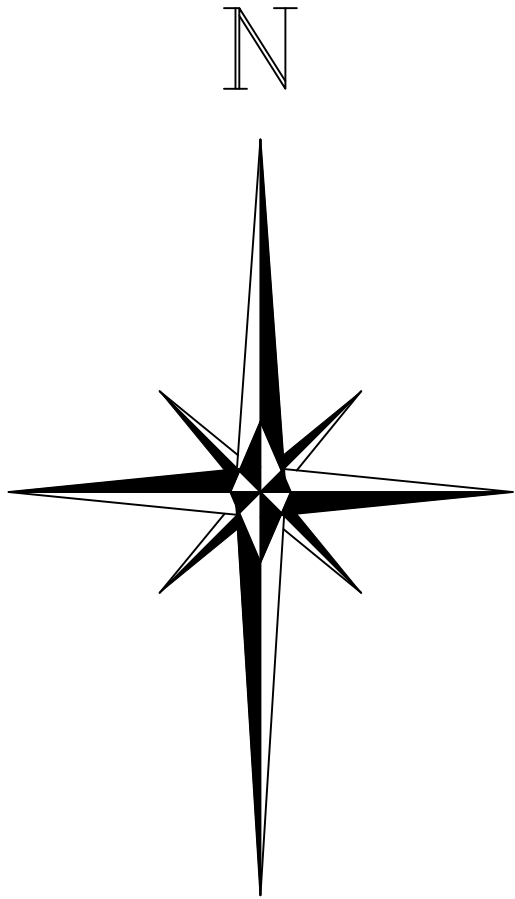
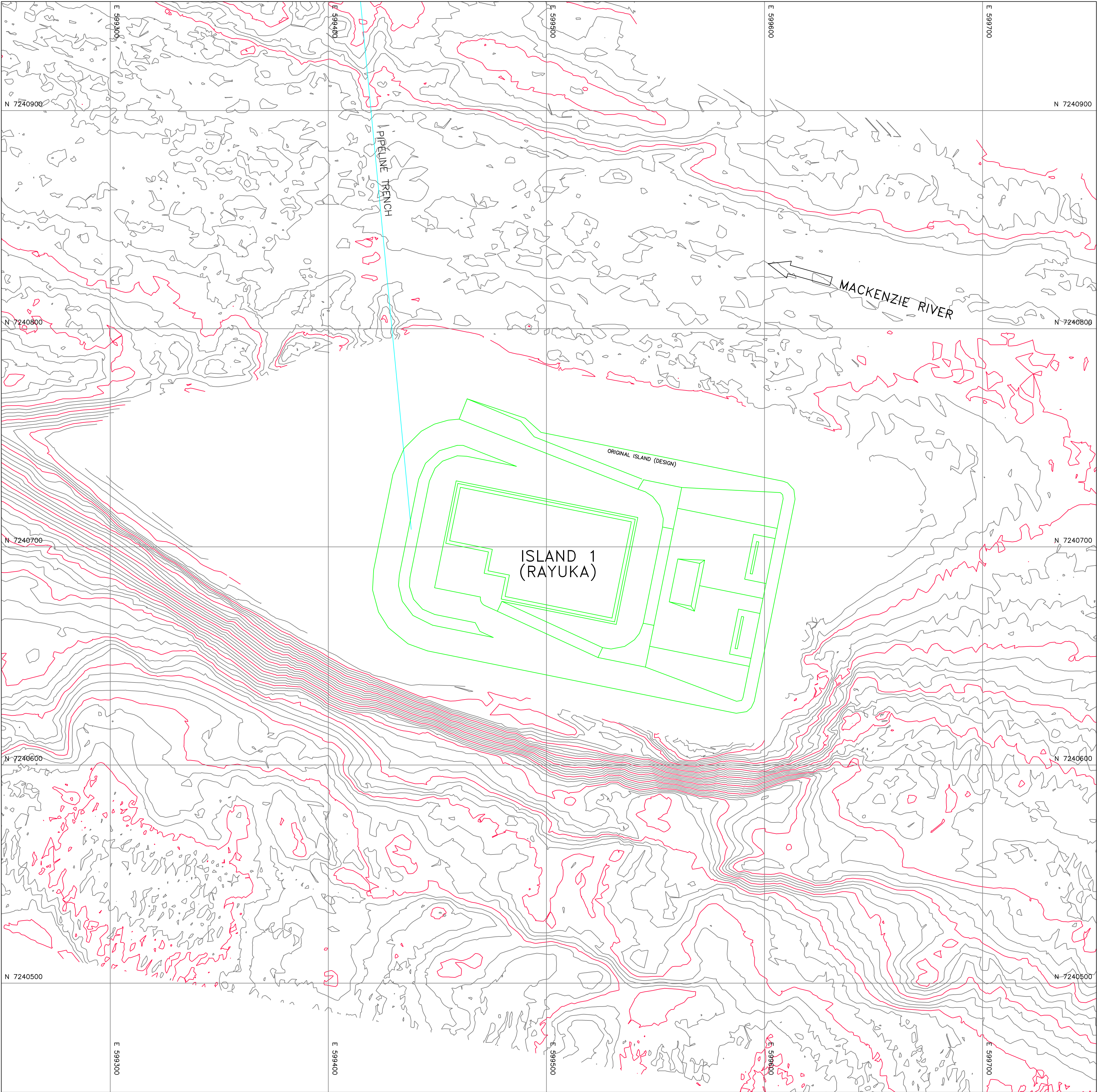
LEGEND			
UTLIDORS SHOWN			
ROADS SHOWN			
BURIED PIPES SHOWN			
BELOW GROUND POWER, TELEPHONE, & COMMUNICATION SHOWN			
VENT SHOWN			
TRANSITION POINT			
PULL BOX SHOWN			
PULL POINT SHOWN			
PIPE O/S DIA'S ARE IN MILLIMETERS AND DECIMALS THEREOF			
SUBSTANCE/CATEGORY CROSS REFERENCE			
SUBSTANCE	CODE	SUBSTANCE	CODE
PROPANE/BUTANE	HV	PRODUCED WATER	SW
CRUDE OIL	CO	FRESH WATER	FW
MULTIPHASE FLUIDS	OE	INJECTION (SW)	INJ-SW
NATURAL/LIFT GAS	NG	INJECTION (FW)	INJ-FW
FUEL GAS	FG	ABANDONED	ABAN
MISCELLANEOUS LIQUIDS	ML	MISCELLANEOUS GASES	MG
 IMPERIAL OIL RESOURCES			
NORMAN WELLS FACILITIES			
BEAR TO ISLAND 6			
SURVEY DRAWING			
CONTRACTOR NAME: WSP Surveys (AB) Limited Partnership		CONTRACTOR DWG No. : 1202-C ESSO FILE No.	
DATE: 19-09-26		096-0179-700-801 77	
SCALE: H 1:1000 V 1:200			



PIPELINE ALIGNMENT



SURVEY CONTROL				No.	SUBSTANCE DESCRIPTION	
No.	DESCRIPTION	NORTHING	EASTING	ELEV.	MULTIPHASE LIQUIDS	
1000	REBAR @ N.E. OF ISL. 1	7240711.75	599540.89		111B	273.1 OE BIT 4 TO GIT 4, Conc Coated 111A-111B-111C B-25,15,80143,G-81,72,73,63,53,54
1004	REBAR @ N.W. OF ISL. 1	7240729.21	599459.90		111C	273.1 OE BIT 4 TO GIT 4, Conc Coated, Dbl Sect H.T. 111A-111B-111C-111D H.T.358 B-25,15,80143,G-81,72,73,63,53,54
2	REBAR @ N.E. OF ISL. 2	7240301.75	600511.43		111D	273.1 OE BIT 4 TO GIT 4, Sng Sect H.T. 111A-111B-111C-111D-111E H.T.358 B-25,15,80143,G-81,72,73,63,53,54
2001	REBAR @ N.W. OF ISL. 2	7240324.34	600431.97		GAS LIFT	
27	REBAR @ N.W. OF ISL. 3	7240741.90	597423.38		263	114.3 NG (Gas Lift) GIT 4 TO BIT 4, (Buried) 263-263A G-54,53,63,73,72,81,80143, B-15,25
3000	REBAR @ N.E. OF ISL. 3	7240716.18	597500.36		263A	114.3 NG (Gas Lift) GIT 4 TO BIT 4, (Conc Coated) G-54,53,63,73,72,81,80143, B-15,25
26	REBAR @ N.W. OF ISL. 4	7240387.54	598100.08		INJECTION WATER	
4000	REBAR @ N.E. OF ISL. 4	7240361.98	598175.94		490	168.3 INJ-FW GIT 4 TO BIT 4, Sng Sect H.T. 490-490A G-54,53,63,73,72,81,80143, B-15,25
22	REBAR @ N.W. OF ISL. 5	7240016.98	598734.63		490A	168.3 INJ-FW GIT 4 TO BIT 4, Dbl Sect H.T., Conc Coated G-54,53,63,73,72,81,80143, B-15,25
5000	REBAR @ N.E. OF ISL. 5	7239993.12	598815.14		490B	168.3 INJ-FW GIT 4 TO BIT 4, Conc Coated G-54,53,63,73,72,81,80143, B-15,25
21	REBAR @ N.W. OF ISL. 6	7239631.84	599382.56		491	168.3 INJ-FW GIT 4 TO BIT 4, Sng Sect H.T. 491-491A H.T.359 G-54,53,63,73,72,81,80143, B-15,25
6000	REBAR @ N.E. OF ISL. 6	7239616.68	599465.79		491A	168.3 INJ-FW GIT 4 TO BIT 4, Dbl Sect H.T., Conc Coated 491-491A-491B H.T.359 G-54,53,63,73,72,81,80143, B-15,25
					491B	168.3 INJ-FW GIT 4 TO BIT 4, Conc Coated 491-491A-491B-491C G-54,53,63,73,72,81,80143, B-15,25
					ELECTRICAL DESCRIPTION	
				P-C7	From GIT 4 5 Kv Switch Gear to Bit 4 5 Kv Switch Gear G-54,53,63,73,72,81,80143, B-15,25	



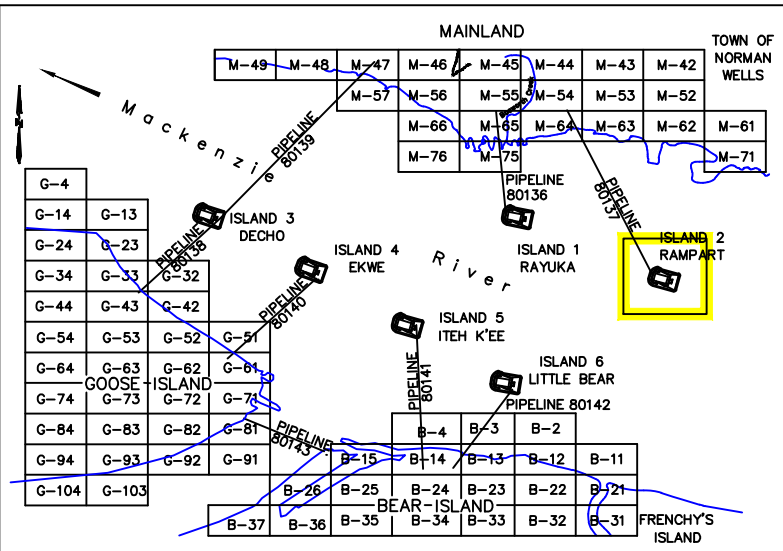
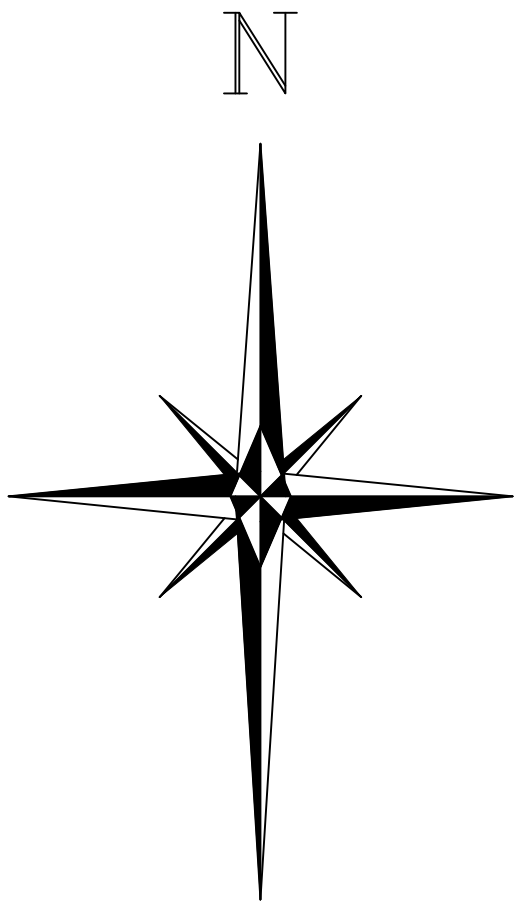
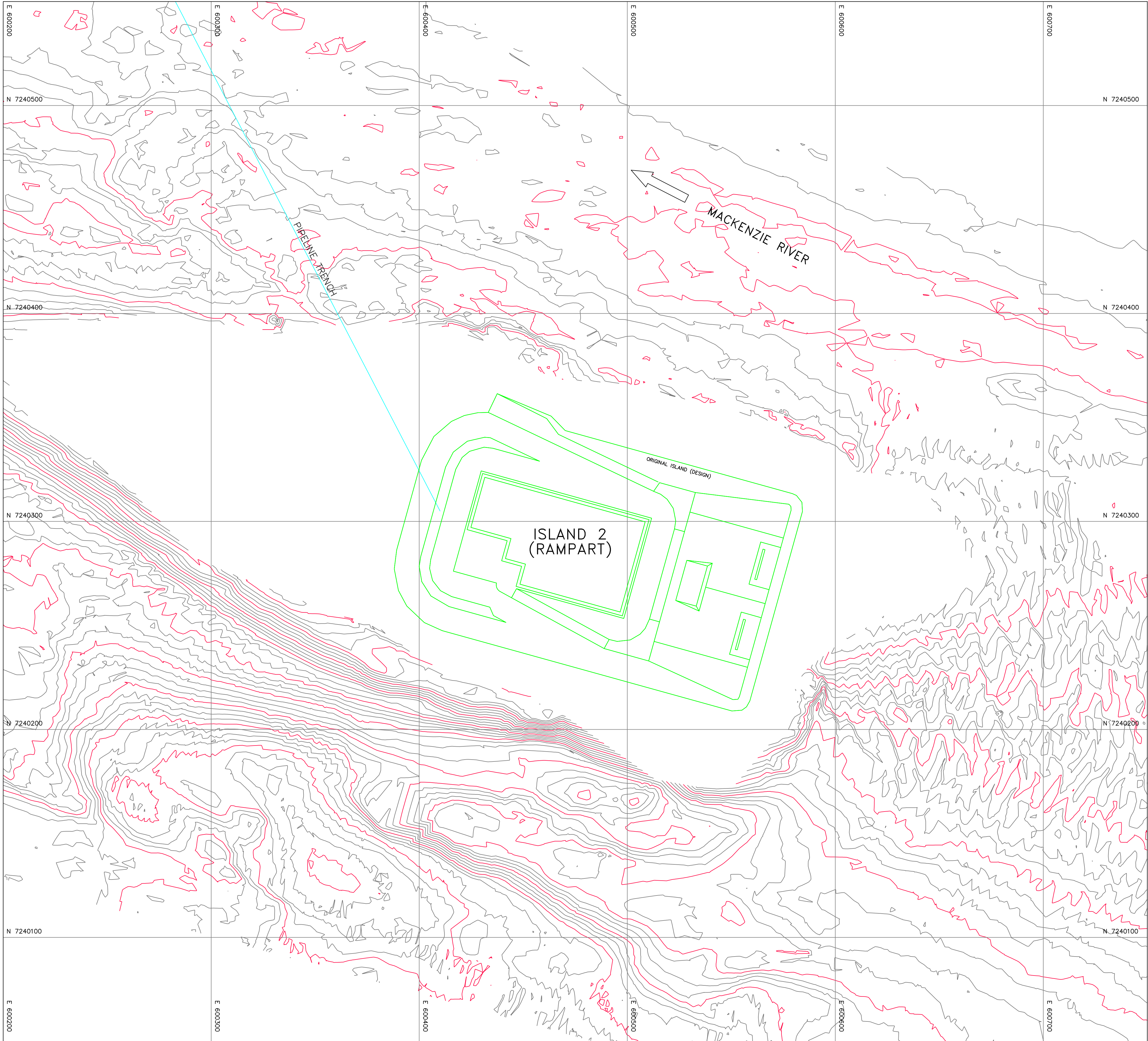
- NOTES**
1. CONTOUR INTERVAL = 0.25 METRES.
 2. BATHYMETRIC SURVEY PERFORMED BETWEEN JULY 05, 2019.
 3. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL.
 4. HORIZONTAL DATUM: NAD27(SHORAN)-UTM GRID/CM = 129°
 5. VERTICAL DATUM: GEODETIC BM 741016
ELEVATION = 60.189m

LEGEND			
	2003 SURVEY CONTOURS AUG 2003: UMA GEOMATICS		2015 SURVEY CONTOURS AUG 2015: WSP
	2002 SURVEY CONTOURS AUG 2002: UMA GEOMATICS		2014 SURVEY CONTOURS AUGUST 2014: MMM Geomatics
	2001 SURVEY CONTOURS AUG 2001: UMA GEOMATICS		2013 SURVEY CONTOURS AUGUST 2013: MMM Geomatics
	2000 SURVEY CONTOURS AUG 2000: UMA GEOMATICS		2012 SURVEY CONTOURS AUGUST 2012: MMM Geomatics
	1998 SURVEY CONTOURS AUG 1998: UMA GEOMATICS		2011 SURVEY CONTOURS AUGUST 2011: MMM Geomatics
	1997 SURVEY CONTOURS AUGUST 1997: UMA GEOMATICS		2010 SURVEY CONTOURS JULY 2010: MMM Geomatics
	2019 SURVEY CONTOURS SEP. 2019: WSP		2009 SURVEY CONTOURS AUGUST 2009: MMM Geomatics
	2018 SURVEY CONTOURS NOV. 2018: WSP		2008 SURVEY CONTOURS JUNE 2008: MMM Geomatics
	2017 SURVEY CONTOURS SEP. 2017: WSP		2007 SURVEY CONTOURS JUNE 2007: USHER CANADA LIMITED
	2016 SURVEY CONTOURS SEP. 2016: WSP		2006 SURVEY CONTOURS AUG 2006: USHER CANADA LIMITED
No.	REVISION	No.	REVISION



NORMAN WELLS FACILITIES
ISLAND 1 & SURROUNDING AREA
SURVEY PLAN

CONTRACTOR NAME: WSP Surveys (AB) Limited Partnership	CONTRACTOR DWG NO. : 1204-C
DATE: 19-09-26	ESSO FILE No.
SCALE: 1:1000	096-0179-700-801 79



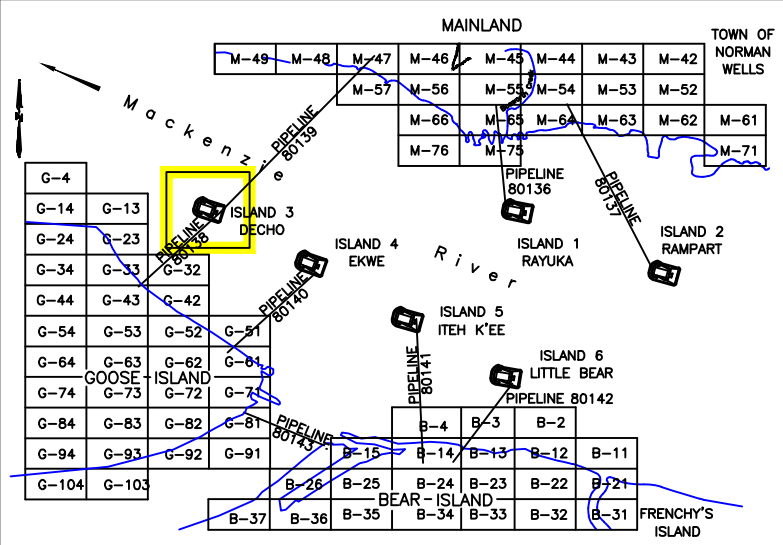
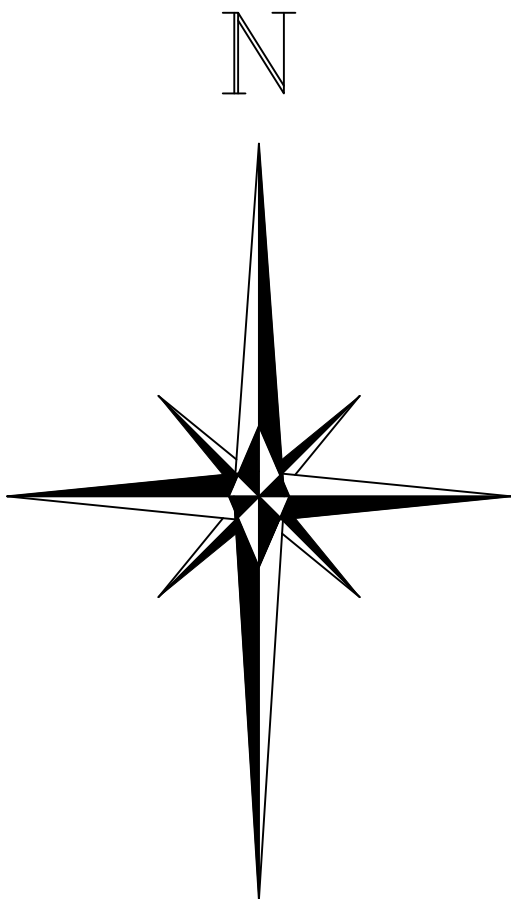
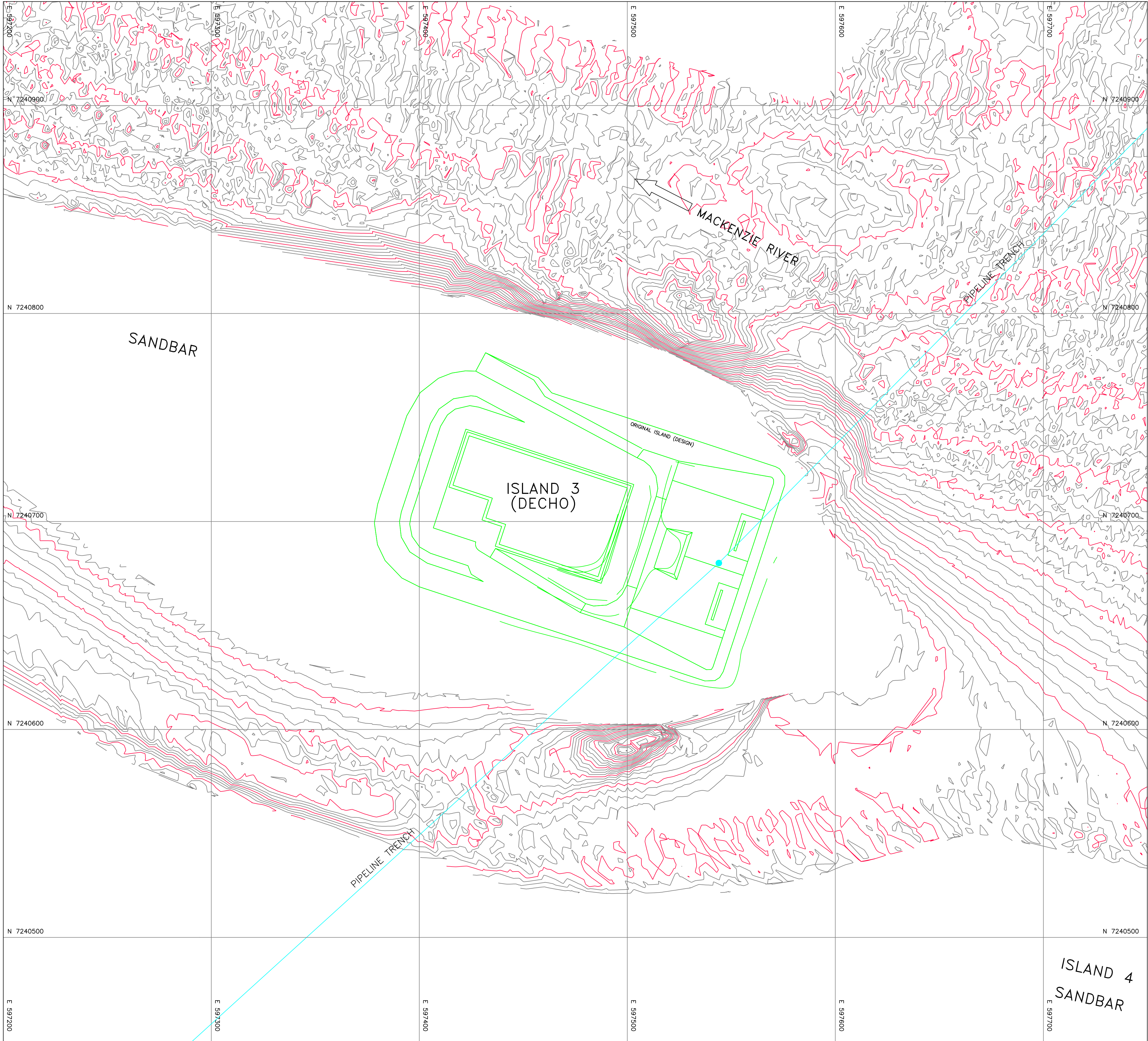
- NOTES**
1. CONTOUR INTERVAL = 0.25 METRES.
 2. BATHYMETRIC SURVEY PERFORMED BETWEEN JULY 06 TO JULY 09, 2019.
 3. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL.
 4. HORIZONTAL DATUM: NAD27(SHORAN)-UTM GRID/CM = 129'
 5. VERTICAL DATUM: GEODETIC BM 741016
ELEVATION = 60.189m

LEGEND	
2003 SURVEY CONTOURS AUG 2003: UMA GEOMATICS	2015 SURVEY CONTOURS AUG 2015: WSP
2002 SURVEY CONTOURS AUG 2002: UMA GEOMATICS	2014 SURVEY CONTOURS AUGUST 2014: MMM Geomatics
2001 SURVEY CONTOURS AUG 2001: UMA GEOMATICS	2013 SURVEY CONTOURS AUGUST 2013: MMM Geomatics
2000 SURVEY CONTOURS AUG 2000: UMA GEOMATICS	2012 SURVEY CONTOURS AUGUST 2012: MMM Geomatics
1998 SURVEY CONTOURS AUG 1998: UMA GEOMATICS	2011 SURVEY CONTOURS AUGUST 2011: MMM Geomatics
1997 SURVEY CONTOURS AUGUST 1997: UMA GEOMATICS	2010 SURVEY CONTOURS JULY 2010: MMM Geomatics
2019 SURVEY CONTOURS SEP. 2019: WSP	2009 SURVEY CONTOURS JUNE 2009: MMM Geomatics
2018 SURVEY CONTOURS NOV. 2018: WSP	2008 SURVEY CONTOURS JUNE 2008: MMM Geomatics
2017 SURVEY CONTOURS SEP. 2017: WSP	2006 SURVEY CONTOURS JUNE 2006: USHER CANADA LIMITED
2016 SURVEY CONTOURS SEP. 2016: WSP	2005 SURVEY CONTOURS JULY 2005: USHER CANADA LIMITED
2004 SURVEY CONTOURS AUG 2004: USHER CANADA LIMITED	
No. REVISION	No. REVISION



NORMAN WELLS FACILITIES
ISLAND 2 & SURROUNDING AREA
SURVEY DRAWING

CONTRACTOR NAME: WSP Surveys (AB) Limited Partnership	CONTRACTOR DWG NO. : 1205-C
DATE: 19-09-26	ESSO FILE No.
SCALE: 1:1000	096-0179-700-801 80



KEY PLAN
1:50 000

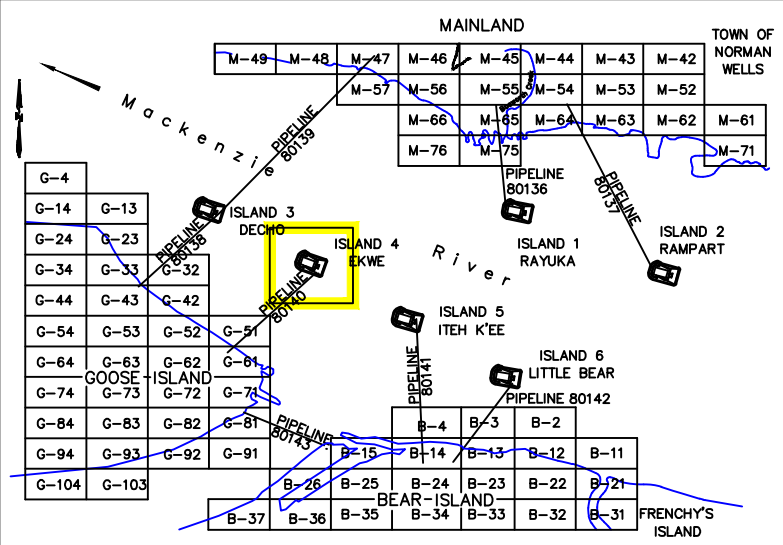
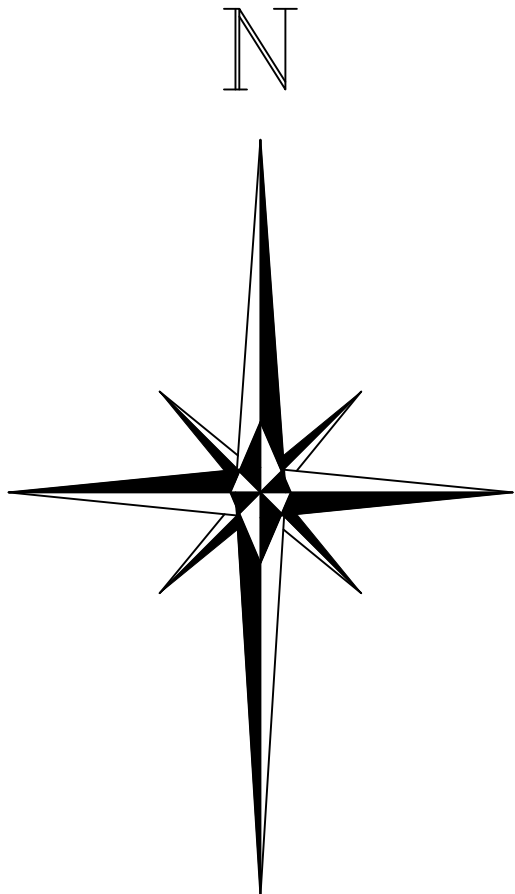
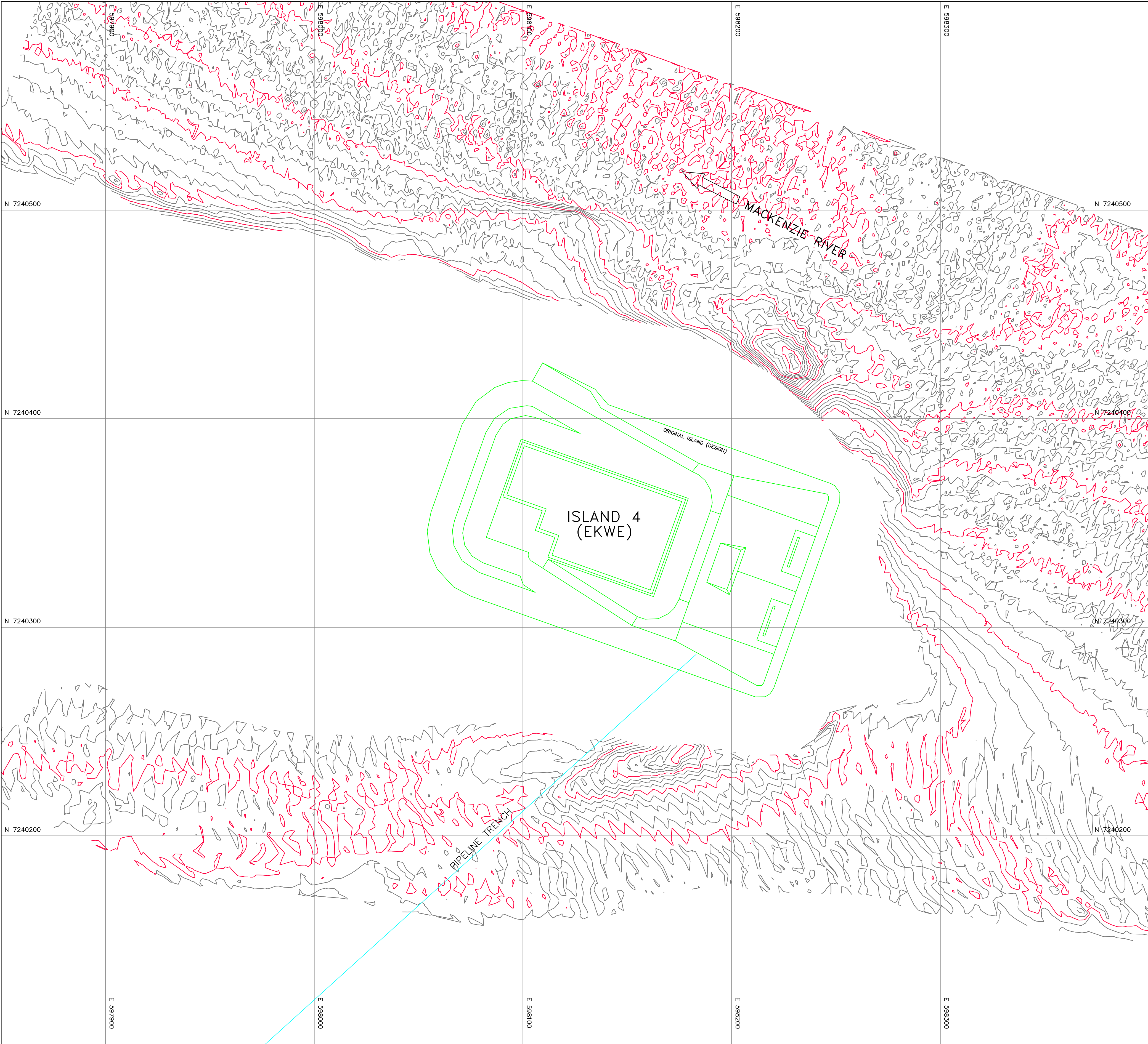
- NOTES
1. CONTOUR INTERVAL = 0.25 METRES.
 2. BATHYMETRIC SURVEY PERFORMED BETWEEN JULY 08 TO JULY 09, 2019.
 3. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL.
 4. HORIZONTAL DATUM: NAD27(SHORAN)-UTM GRID/cm = 129'
 5. VERTICAL DATUM: GEODETIC BM 74T016
ELEVATION = 60.189m

LEGEND			
	2003 SURVEY CONTOURS AUG 2003: UMA GEOMATICS		2015 SURVEY CONTOURS AUG 2015: WSP
	2002 SURVEY CONTOURS AUG 2002: UMA GEOMATICS		2014 SURVEY CONTOURS AUGUST 2014: MAM Geomatics
	2001 SURVEY CONTOURS AUG 2001: UMA GEOMATICS		2013 SURVEY CONTOURS AUGUST 2013: MAM Geomatics
	2000 SURVEY CONTOURS AUG 2000: UMA GEOMATICS		2012 SURVEY CONTOURS AUGUST 2012: MAM Geomatics
	1999 SURVEY CONTOURS AUG 1999: UMA GEOMATICS		2011 SURVEY CONTOURS AUGUST 2011: MAM Geomatics
	1998 SURVEY CONTOURS JUNE 1998: UMA GEOMATICS		2010 SURVEY CONTOURS JULY 2010: MAM Geomatics
	1997 SURVEY CONTOURS AUGUST 1997: UMA GEOMATICS		2009 SURVEY CONTOURS JUNE 2009: MAM Geomatics
	2019 SURVEY CONTOURS SEP. 2019: WSP		2008 SURVEY CONTOURS JUNE 2008: MAM Geomatics
	2018 SURVEY CONTOURS NOV. 2018: WSP		2007 SURVEY CONTOURS JUNE 2007: USHER CANADA LIMITED
	2017 SURVEY CONTOURS SEP. 2017: WSP		2006 SURVEY CONTOURS AUG 2006: USHER CANADA LIMITED
	2016 SURVEY CONTOURS SEP. 2016: WSP		2005 SURVEY CONTOURS JULY 2005: USHER CANADA LIMITED
	2004 SURVEY CONTOURS AUG 2004: USHER CANADA LIMITED		2003 SURVEY CONTOURS AUG 2003: UMA GEOMATICS
No.	REVISION	No.	REVISION



NORMAN WELLS FACILITIES
ISLAND 3 & SURROUNDING AREA
SURVEY DRAWING

CONTRACTOR NAME: WSP Surveys (AB) Limited Partnership	CONTRACTOR DWG No. : 1206-C
DATE: 19-09-26	ESSO FILE No.
SCALE: 1:1000	096-0179-700-801 81



- NOTES
1. CONTOUR INTERVAL = 0.25 METRES.
 2. BATHYMETRIC SURVEY PERFORMED BETWEEN JULY 09 TO JULY 10, 2019.
 3. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL.
 4. HORIZONTAL DATUM: NAD27(SHORAN)-UTM GRID/CM = 129°
 5. VERTICAL DATUM: GEODETIC BM 741016 ELEVATION = 60.189m

LEGEND			
	2003 SURVEY CONTOURS		2015 SURVEY CONTOURS
	2002 SURVEY CONTOURS		2014 SURVEY CONTOURS
	2001 SURVEY CONTOURS		2013 SURVEY CONTOURS
	2000 SURVEY CONTOURS		2012 SURVEY CONTOURS
	1999 SURVEY CONTOURS		2011 SURVEY CONTOURS
	1998 SURVEY CONTOURS		2010 SURVEY CONTOURS
	1997 SURVEY CONTOURS		2009 SURVEY CONTOURS
	2019 SURVEY CONTOURS		2008 SURVEY CONTOURS
	2018 SURVEY CONTOURS		2007 SURVEY CONTOURS
	2017 SURVEY CONTOURS		2006 SURVEY CONTOURS
	2016 SURVEY CONTOURS		2005 SURVEY CONTOURS
	2015 SURVEY CONTOURS		2004 SURVEY CONTOURS
No.	REVISION	No.	REVISION

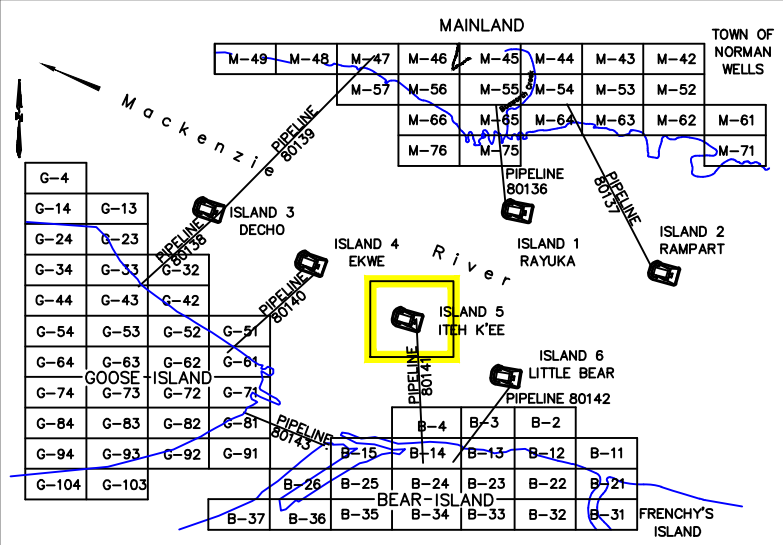
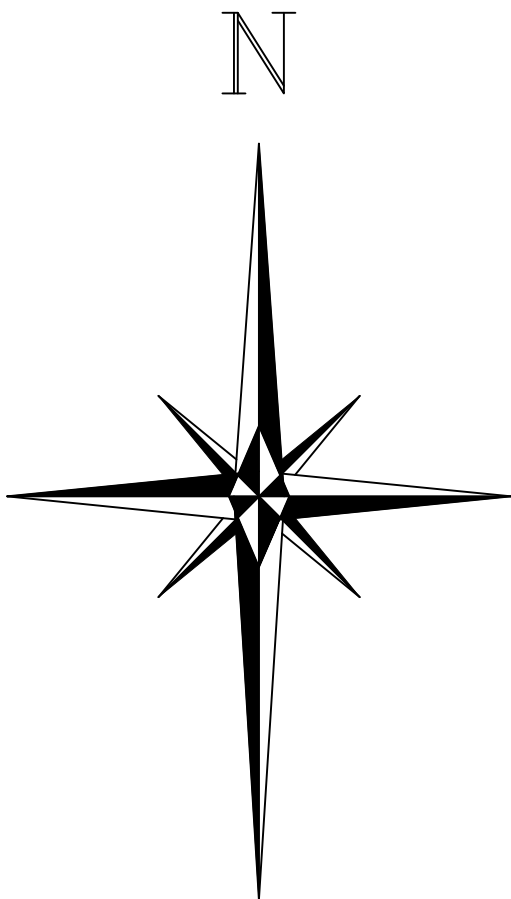
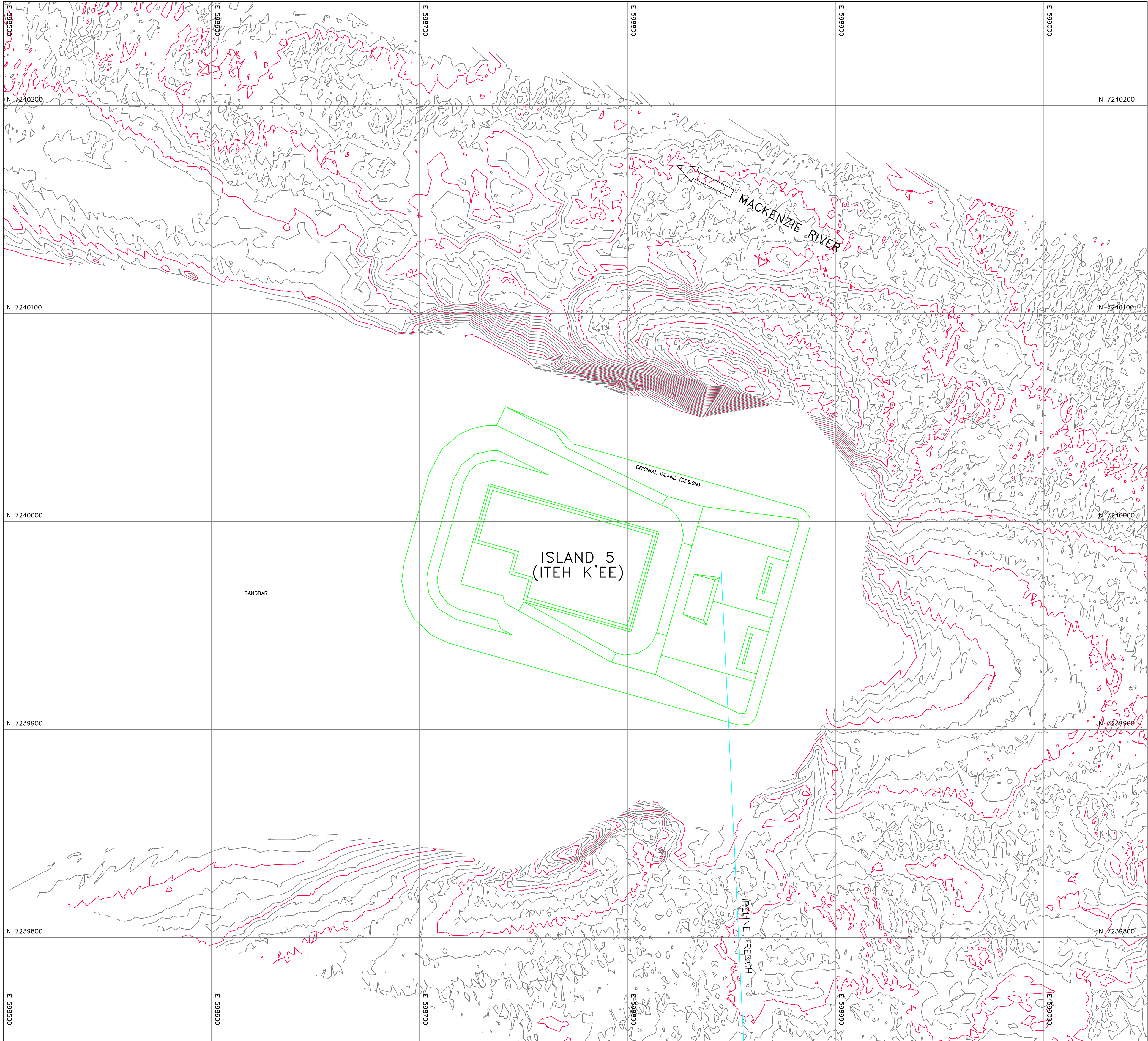
IMPERIAL OIL RESOURCES

NORMAN WELLS FACILITIES

ISLAND 4 & SURROUNDING AREA

SURVEY DRAWING

CONTRACTOR NAME: WSP Surveys (AB) Limited Partnership	CONTRACTOR DWG NO. : 1207-C
DATE: 19-09-26	ESSO FILE No.
SCALE: 1:1000	096-0179-700-801 82



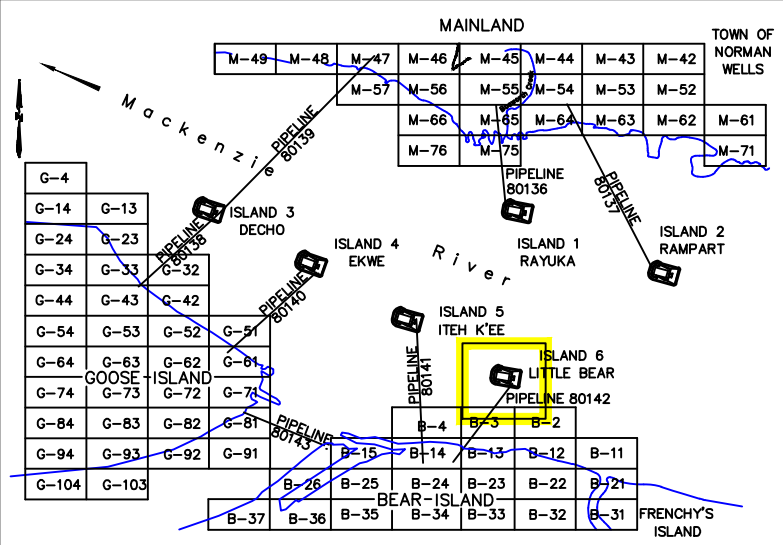
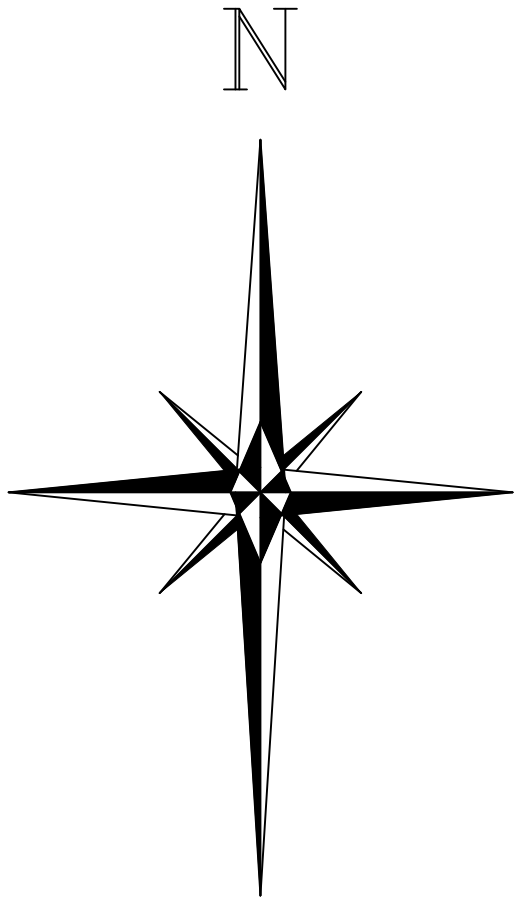
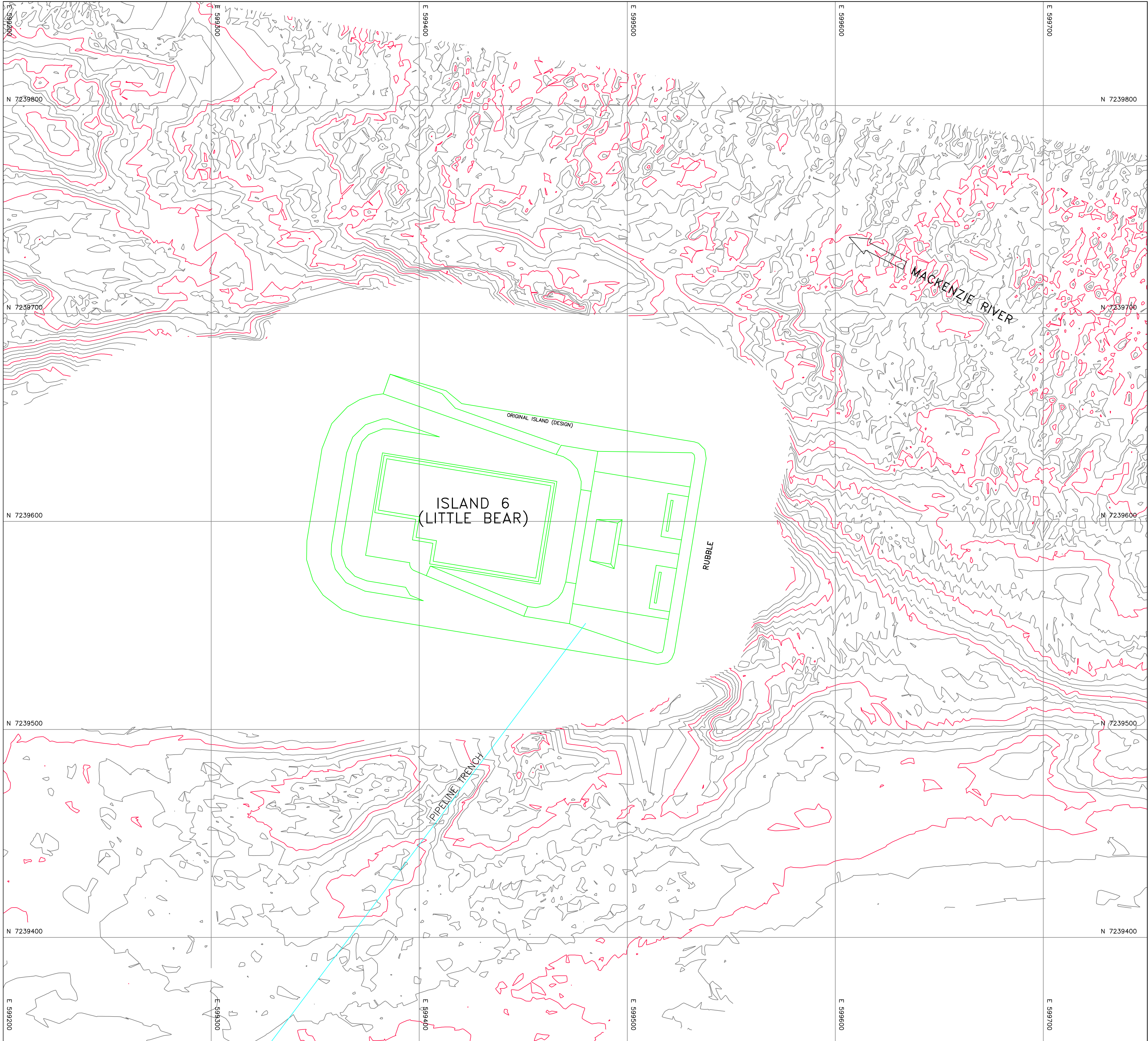
- NOTES**
1. CONTOUR INTERVAL = 0.25 METRES.
 2. BATHYMETRIC SURVEY PERFORMED BETWEEN JULY 10 TO JULY 12, 2019.
 3. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL.
 4. HORIZONTAL DATUM: NAD27 SHORAN-UTM GRID/CM = 129'
 5. VERTICAL DATUM: GEODETIC BM 741016 ELEVATION = 60.189m

LEGEND	
	2003 SURVEY CONTOURS AUG. 2003: UMA GEOMATICS
	2002 SURVEY CONTOURS AUG. 2002: UMA GEOMATICS
	2001 SURVEY CONTOURS AUG. 2001: UMA GEOMATICS
	2000 SURVEY CONTOURS AUG. 2000: UMA GEOMATICS
	1999 SURVEY CONTOURS AUG. 1999: UMA GEOMATICS
	1998 SURVEY CONTOURS JUNE 1998: UMA GEOMATICS
	1997 SURVEY CONTOURS AUGUST 1997: UMA GEOMATICS
	2019 SURVEY CONTOURS SEP. 2019: WSP
	2018 SURVEY CONTOURS NOV. 2018: WSP
	2017 SURVEY CONTOURS SEP. 2017: WSP
	2016 SURVEY CONTOURS SEP. 2016: WSP
	2015 SURVEY CONTOURS AUG. 2015: WSP
	2014 SURVEY CONTOURS AUGUST 2014: MAM Geomatics
	2013 SURVEY CONTOURS AUGUST 2013: MAM Geomatics
	2012 SURVEY CONTOURS AUGUST 2012: MAM Geomatics
	2011 SURVEY CONTOURS AUGUST 2011: MAM Geomatics
	2010 SURVEY CONTOURS JULY 2010: MAM Geomatics
	2009 SURVEY CONTOURS JUNE 2009: MAM Geomatics
	2008 SURVEY CONTOURS JUNE 2008: MAM Geomatics
	2006 SURVEY CONTOURS JUNE 2006: USHER CANADA LIMITED
	2005 SURVEY CONTOURS JULY 2005: USHER CANADA LIMITED
	2004 SURVEY CONTOURS AUG. 2004: USHER CANADA LIMITED
No.	REVISION
No.	REVISION



NORMAN WELLS FACILITIES
ISLAND 5 & SURROUNDING AREA
SURVEY DRAWING

CONTRACTOR NAME: WSP Surveys (AB) Limited Partnership	CONTRACTOR DWG NO. : 1208-C
DATE: 19-09-26	ESSO FILE No.
SCALE: 1:1000	096-0179-700-801 83



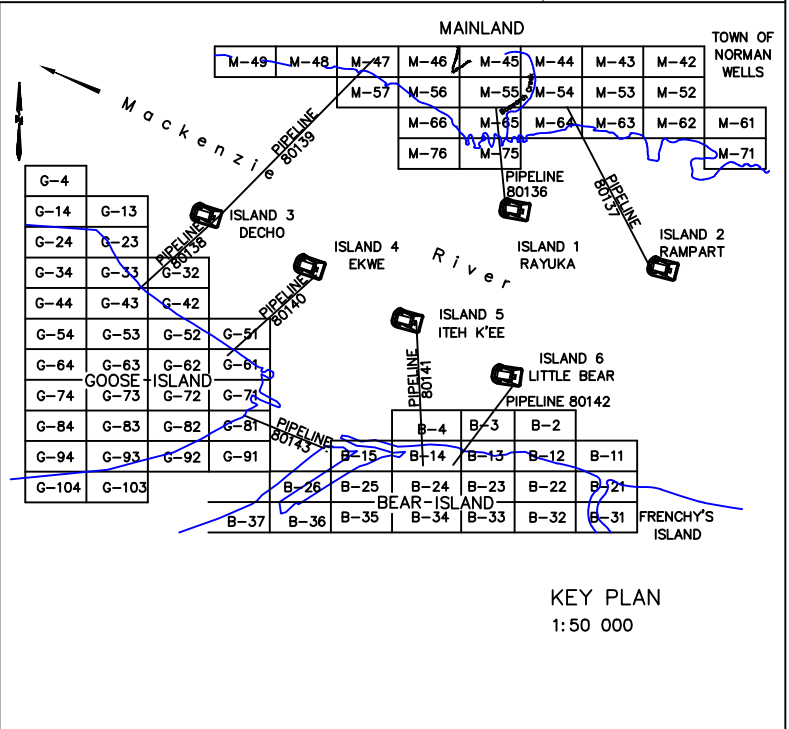
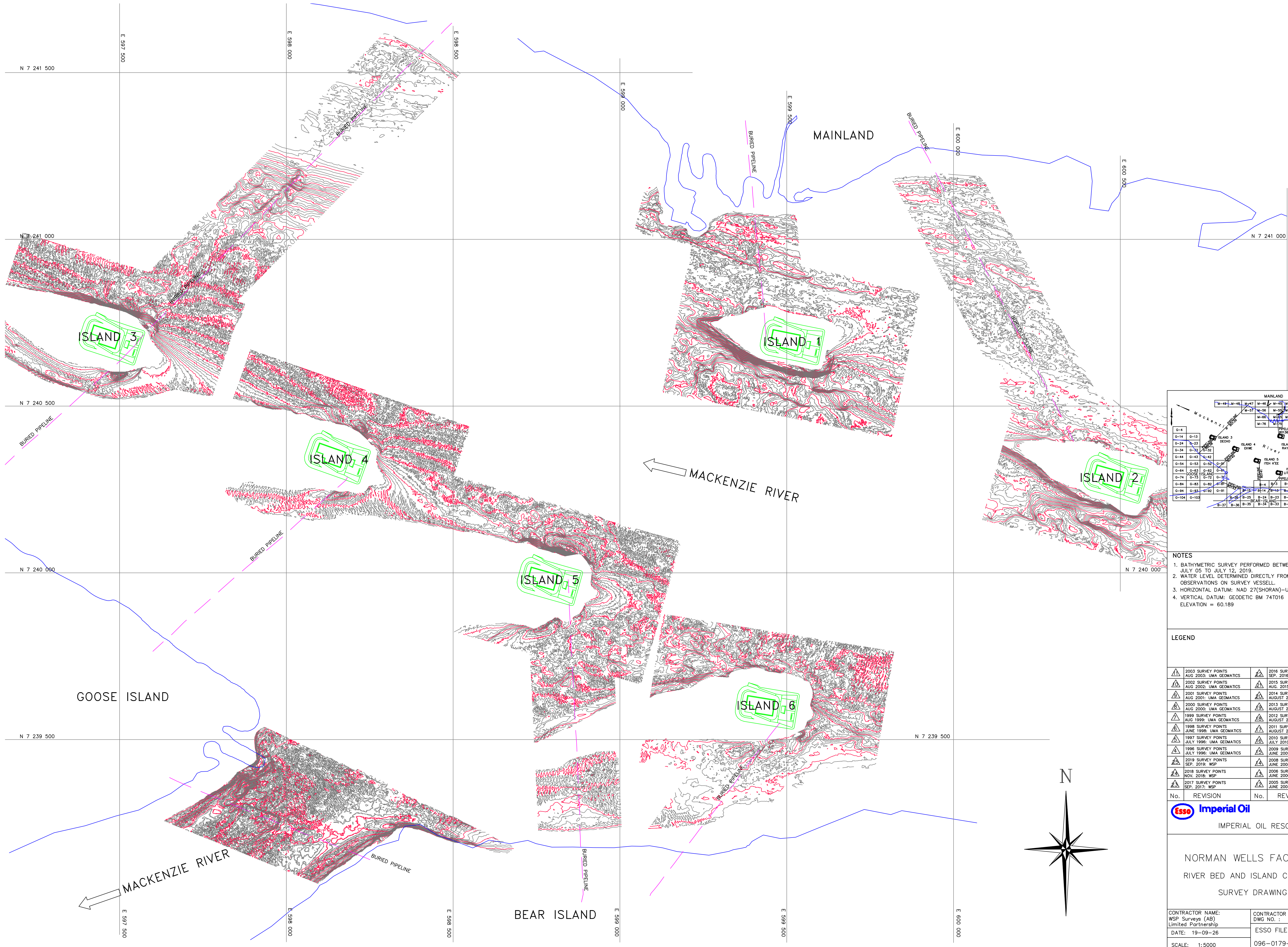
- NOTES**
1. CONTOUR INTERVAL = 0.25 METRES.
 2. BATHYMETRIC SURVEY PERFORMED BETWEEN JULY 10 TO JULY 11, 2019.
 3. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL.
 4. HORIZONTAL DATUM: NAD27(SHORAN)-UTM GRID/CM = 129*
 5. VERTICAL DATUM: GEODETIC BM 741016
ELEVATION = 60.189m

LEGEND			
	2003 SURVEY CONTOURS		2015 SURVEY CONTOURS
	2002 SURVEY CONTOURS		2014 SURVEY CONTOURS
	2001 SURVEY CONTOURS		2013 SURVEY CONTOURS
	2000 SURVEY CONTOURS		2012 SURVEY CONTOURS
	1999 SURVEY CONTOURS		2011 SURVEY CONTOURS
	1998 SURVEY CONTOURS		2010 SURVEY CONTOURS
	1997 SURVEY CONTOURS		2009 SURVEY CONTOURS
	2019 SURVEY CONTOURS		2008 SURVEY CONTOURS
	2018 SURVEY CONTOURS		2007 SURVEY CONTOURS
	2017 SURVEY CONTOURS		2006 SURVEY CONTOURS
	2016 SURVEY CONTOURS		2005 SURVEY CONTOURS
	2015 SURVEY CONTOURS		2004 SURVEY CONTOURS
No.	REVISION	No.	REVISION



NORMAN WELLS FACILITIES
ISLAND 6 & SURROUNDING AREA
SURVEY DRAWING

CONTRACTOR NAME: WSP Surveys (AB) Limited Partnership	CONTRACTOR DWG NO. : 1209-C
DATE: 19-09-26	ESSO FILE No.
SCALE: 1:1000	096-0179-700-801 84



NOTES

1. BATHYMETRIC SURVEY PERFORMED BETWEEN JULY 05 TO JULY 12, 2019.
2. WATER LEVEL DETERMINED DIRECTLY FROM RTK OBSERVATIONS ON SURVEY VESSEL.
3. HORIZONTAL DATUM: NAD 27(SHORAN)-UTM GRID/cm=129'
4. VERTICAL DATUM: GEODETIC BM 74T016
ELEVATION = 60.189

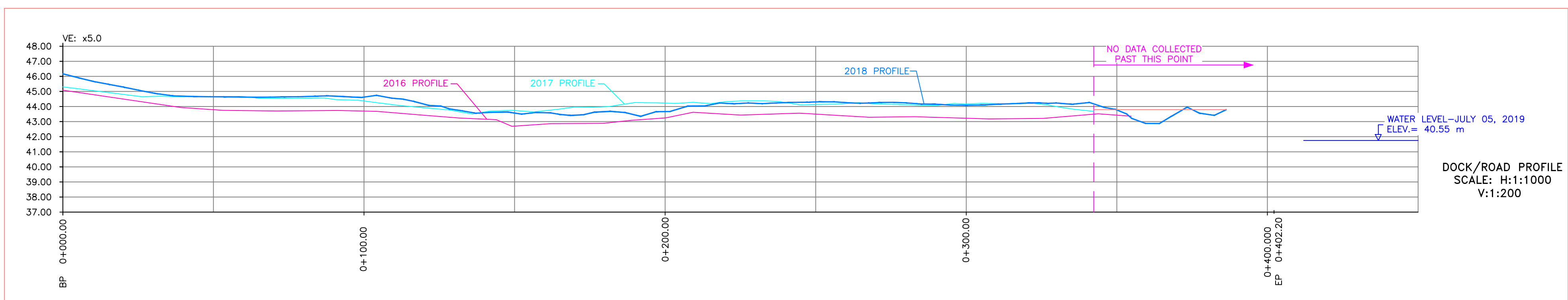
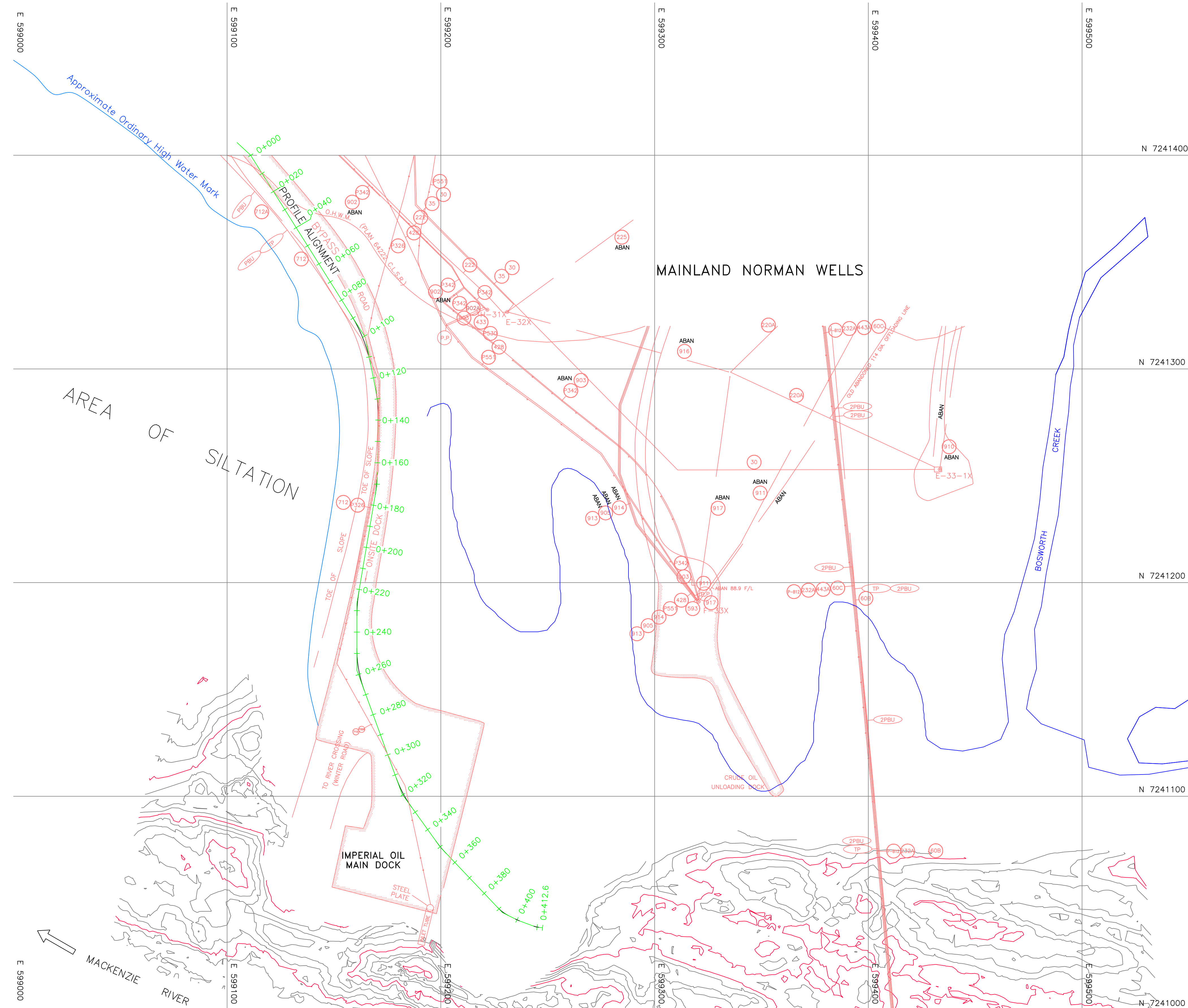
LEGEND	
	2003 SURVEY POINTS
	2002 SURVEY POINTS
	2001 SURVEY POINTS
	2000 SURVEY POINTS
	1999 SURVEY POINTS
	1998 SURVEY POINTS
	1997 SURVEY POINTS
	1996 SURVEY POINTS
	2019 SURVEY POINTS
	2018 SURVEY POINTS
	2017 SURVEY POINTS
	2016 SURVEY POINTS
	2015 SURVEY POINTS
	2014 SURVEY POINTS
	2013 SURVEY POINTS
	2012 SURVEY POINTS
	2011 SURVEY POINTS
	2010 SURVEY POINTS
	2009 SURVEY POINTS
	2008 SURVEY POINTS
	2006 SURVEY POINTS
	2005 SURVEY POINTS

Imperial Oil

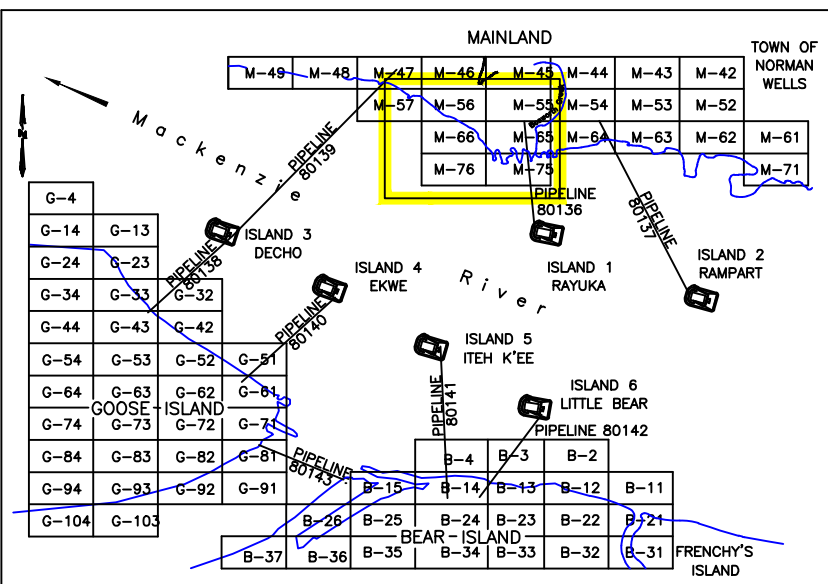
IMPERIAL OIL RESOURCES

NORMAN WELLS FACILITIES
RIVER BED AND ISLAND CONTOURS
SURVEY DRAWING

CONTRACTOR NAME: WSP Surveys (AB) Limited Partnership	CONTRACTOR DWG NO. : 1213-C
DATE: 19-09-26	ESSO FILE No.
SCALE: 1:5000	096-0179-700-801 86



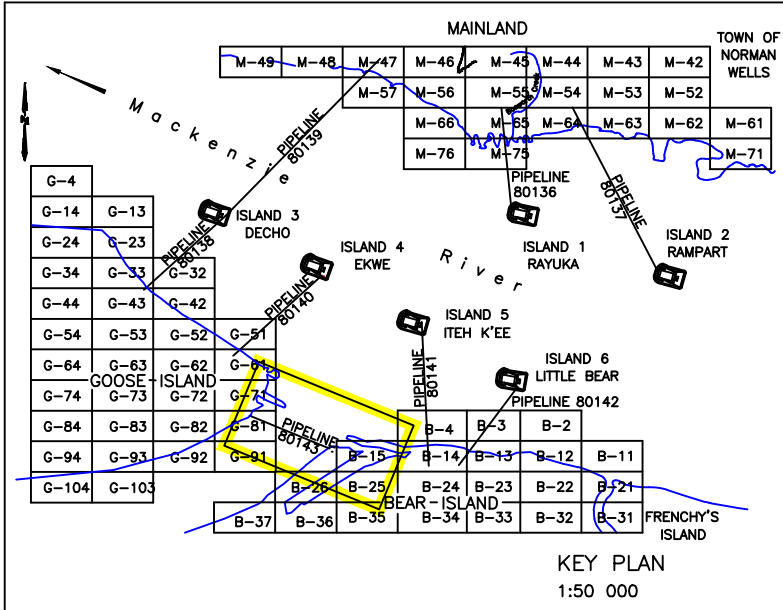
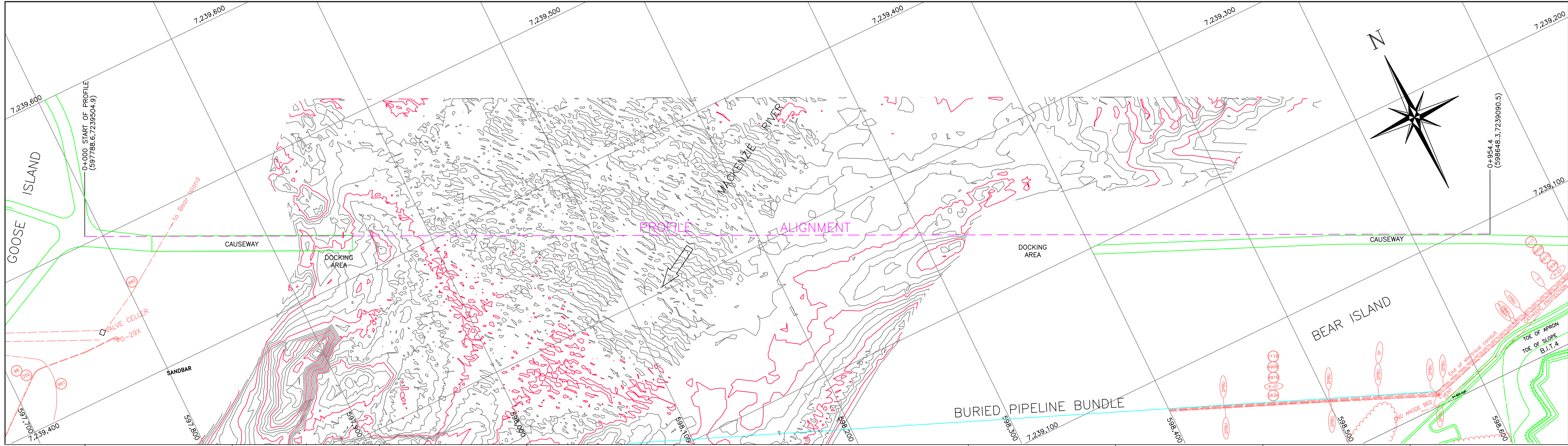
ROAD PROFILE ALIGNMENT COORDINATES	
EASTING	NORTHING
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7241391.394	599116.437
7241381.849	599122.435
7241372.684	599128.195
7241363.396	599134.031
7241353.622	599140.173
7241342.847	599146.944
7241333.305	599152.941
7241323.558	599159.066
7241314.711	599164.625
7241293.559	599168.857
7241283.412	599170.888
7241272.325	599170.857
7241261.930	599170.440
7241251.502	599170.223
7241245.853	599170.105
7241234.977	599168.266
7241223.162	599166.268
7241210.737	599164.167
7241199.388	599162.248
7241190.297	599160.711
7241177.776	599160.711
7241158.998	599160.711
7241148.907	599164.395
7241136.750	599168.832
7241123.265	599173.755
7241111.842	599177.924
7241101.096	599181.847
7241090.336	599189.584
7241076.056	599199.852
7241062.537	599212.701
7241055.395	599219.489
7241045.632	599228.768
7241042.087	599235.774
7241038.802	599244.598
7241038.512	599247.564



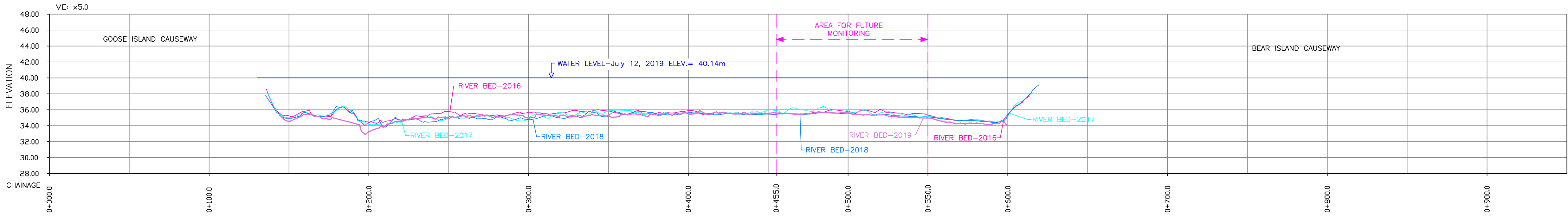
- NOTES
1. CONTOUR INTERVAL = 0.25 METRES.
 2. BATHYMETRIC SURVEY PERFORMED BETWEEN JULY 05, 2019.
 3. WATER LEVEL = 40.55 m (JULY 05, 2019)
 4. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL.
 5. HORIZONTAL DATUM: NAD27(SHORAN)-UTM GRID/CM = 129'
 6. VERTICAL DATUM: GEODETIC BM 747016 ELEVATION = 60.189m
 7. PIPELINE ALIGNMENT SURVEYED BETWEEN JUNE 17 TO JUNE 25, 2017.
- LEGEND
- 2016 ROAD CENTERLINE PROFILE
 - 2017 ROAD CENTERLINE PROFILE
 - 2018 ROAD CENTERLINE PROFILE
 - 2019 ROAD CENTERLINE PROFILE

2004 SURVEY CONTOURS AUG 2004: USHER CANADA LIMITED	2016 SURVEY PROFILE SEP. 2016: WSP
2003 SURVEY CONTOURS/PROFILE AUG 2003: UMA GEOMATICS	2015 SURVEY PROFILE AUG. 2015: WSP
2002 SURVEY CONTOURS/PROFILE AUG 2002: UMA GEOMATICS	2014 SURVEY CONTOURS AUGUST 2014: MMM GEOMATICS
2001 SURVEY CONTOURS/PROFILE AUG 2001: UMA GEOMATICS	2013 SURVEY CONTOURS AUGUST 2013: MMM GEOMATICS
2000 SURVEY CONTOURS/PROFILE AUG 2000: UMA GEOMATICS	2012 SURVEY CONTOURS AUGUST 2012: MMM GEOMATICS
1999 SURVEY CONTOURS/PROFILE AUG 1999: UMA GEOMATICS	2011 SURVEY CONTOURS AUGUST 2011: MMM GEOMATICS
1998 SURVEY CONTOURS/PROFILE JUNE 1998: UMA GEOMATICS	2010 SURVEY CONTOURS AUGUST 2010: MMM GEOMATICS
1997 SURVEY CONTOURS/PROFILE JULY 1997: UMA GEOMATICS	2009 SURVEY CONTOURS JUNE 2009: MMM GEOMATICS
1996 SURVEY CONTOURS/PROFILE JULY 1996: UMA GEOMATICS	2008 SURVEY CONTOURS JUNE 2008: MMM GEOMATICS
2019 SURVEY CONTOURS/PROFILE SEP. 2019: WSP	2018 SURVEY CONTOURS JUNE 2018: WSP
2018 SURVEY CONTOURS/PROFILE SEP. 2017: WSP	2017 SURVEY CONTOURS JULY 2017: WSP
2017 SURVEY CONTOURS/PROFILE SEP. 2017: WSP	2016 SURVEY CONTOURS JULY 2016: WSP
2016 SURVEY CONTOURS/PROFILE SEP. 2016: WSP	2015 SURVEY CONTOURS AUG. 2015: WSP
2015 SURVEY CONTOURS/PROFILE AUG. 2015: WSP	2014 SURVEY CONTOURS AUGUST 2014: MMM GEOMATICS
2014 SURVEY CONTOURS AUGUST 2014: MMM GEOMATICS	2013 SURVEY CONTOURS AUGUST 2013: MMM GEOMATICS
2013 SURVEY CONTOURS AUGUST 2013: MMM GEOMATICS	2012 SURVEY CONTOURS AUGUST 2012: MMM GEOMATICS
2012 SURVEY CONTOURS AUGUST 2012: MMM GEOMATICS	2011 SURVEY CONTOURS AUGUST 2011: MMM GEOMATICS
2011 SURVEY CONTOURS AUGUST 2011: MMM GEOMATICS	2010 SURVEY CONTOURS AUGUST 2010: MMM GEOMATICS
2010 SURVEY CONTOURS AUGUST 2010: MMM GEOMATICS	2009 SURVEY CONTOURS JUNE 2009: MMM GEOMATICS
2009 SURVEY CONTOURS JUNE 2009: MMM GEOMATICS	2008 SURVEY CONTOURS JUNE 2008: MMM GEOMATICS
2008 SURVEY CONTOURS JUNE 2008: MMM GEOMATICS	2007 SURVEY CONTOURS JULY 2007: WSP
2007 SURVEY CONTOURS JULY 2007: WSP	2006 SURVEY CONTOURS JULY 2006: WSP
2006 SURVEY CONTOURS JULY 2006: WSP	2005 SURVEY CONTOURS JULY 2005: USHER CANADA LIMITED

No. REVISION		No. REVISION	
Esso Imperial Oil		IMPERIAL OIL RESOURCES	
NORMAN WELLS FACILITIES		IMPERIAL OIL MAINLAND DOCK	
SURVEY DRAWING		SURVEY DRAWING	
CONTRACTOR NAME: WSP Surveys (AB) Limited Partnership		CONTRACTOR DWG NO. : 1214-C	
DATE: 19-09-26		ESSO FILE No.	
SCALE: 1:2000		096-0179-700-801 87	



- NOTES
1. CONTOUR INTERVAL = 0.25 METRES.
 2. BATHYMETRIC SURVEY PERFORMED BETWEEN JULY 12 TO JULY 12, 2019.
 3. WATER LEVEL = 40.14 m (JULY 12, 2019)
 4. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL.
 5. HORIZONTAL DATUM: NAD27(SHORAN)-UTM GRID/CM = 129°
 6. VERTICAL DATUM: GEODETIC BM 74T016
ELEVATION = 60.189m



PROFILE OF RIVER BED

LEGEND	
—	2016 RIVER BED PROFILE
—	2017 RIVER BED PROFILE
—	2018 RIVER BED PROFILE
—	2019 RIVER BED PROFILE

	2003 SURVEY CONTOURS AUG 2003: UMA GEOMATICS		ADDED 2015 BOTTOM PROFILE AUG. 2015: WSP
	2002 SURVEY CONTOURS AUG 2002: UMA GEOMATICS		ADDED 2014 BOTTOM PROFILE AUG 2014: MMM Geomatics
	2001 SURVEY CONTOURS AUG 2001: UMA GEOMATICS		ADDED 2013 BOTTOM PROFILE AUG 2013: MMM Geomatics
	2000 SURVEY CONTOURS AUG 2000: UMA GEOMATICS		ADDED 2012 BOTTOM PROFILE AUG 2012: MMM Geomatics
	1999 SURVEY CONTOURS AUG 1999: UMA GEOMATICS		ADDED 2011 BOTTOM PROFILE AUG 2011: MMM Geomatics
	1998 SURVEY CONTOURS JUNE 1998: UMA GEOMATICS		ADDED 2010 BOTTOM PROFILE JULY 2010: MMM Geomatics
	1997 SURVEY CONTOURS JULY 1997: UMA GEOMATICS		ADDED 2009 BOTTOM PROFILE JUNE 2009: MMM Geomatics
	ADDED 2019 BOTTOM PROFILE SEP. 2019: WSP		ADDED 2008 BOTTOM PROFILE JUNE 2008: MMM Geomatics
	ADDED 2018 BOTTOM PROFILE NOV. 2018: WSP		2006 SURVEY CONTOURS JUNE 2006: USHER CANADA LIMITED
	ADDED 2017 BOTTOM PROFILE SEP. 2017: WSP		2005 SURVEY CONTOURS JUNE 2005: USHER CANADA LIMITED
	ADDED 2016 BOTTOM PROFILE SEP. 2016: WSP		2004 SURVEY CONTOURS AUG 2004: USHER CANADA LIMITED
No.	REVISION	No.	REVISION



NORMAN WELLS FACILITIES
GOOSE TO BEAR CAUSEWAY
SURVEY DRAWING

CONTRACTOR NAME: WSP Surveys (AB) Limited Partnership	CONTRACTOR DWG No. : 1215-C
DATE: 19-09-26	ESSO FILE No.
SCALE: H 1:1500 V 1:300	096-0179-700-801 89