Geometry Inspection Report prepared for:

Enbridge Energy, Limited Partnership
20" GEOPIG™ Geometry Inspection
NPS20 Line 5 North Straits EAST to Mackinaw

Total Distance: 4.15mi

Pipeline Inspection Date: August 17, 2016

Issue Number: J2008-217 Issue #1

Baker Hughes Pipeline Inspection

4839 – 90th Ave S.E. Calgary, Alberta, Canada, T2C 2S8

Signature Block	Name	Date	Initial
Data Analysis Manager Level III Data Analyst *	Vicky Chan	Sept 15, 2016.	
Analysis Team Lead Level III Data Analyst *	Bruce Zhu	Sept 15, 2016	
Inertial/Caliper Analyst Level II Data Analyst *	Jeremie Choquette	Sept 15, 2016	

* As per ILI PQ 2005

Issue Number	Release Date	Issue Date	Client Data Verified	Description of Changes
J2008-217 - Issue #1	September 15, 2016	Sept 15, 2016		Initial Issue

Note:

This report has been specifically prepared for Enbridge Energy Ltd. Partnership (hereinafter called "Enbridge"). Any use which a third party makes of this report, or any sole reliance on or decisions to be made based on the information contained herein, are the sole responsibility of such third parties. Baker Hughes Pipeline Inspection accepts no responsibility for the damages, if any, suffered by any third party as a result of decisions made or actions based on the information contained in this report.

Information provided herein represents the best efforts of Baker Hughes Pipeline Inspection to evaluate the described lines. Judgements concerning pipe condition are left entirely to Enbridge. All information herein represents only Baker Hughes Pipeline Inspection's opinion of the meaning of the GEOPIG™ information, and shall not be construed as a warranty or guarantee of the structural condition of the pipeline, its fitness for use, or any other condition.

TABLE OF CONTENTS

1 EXECUTIVE SUMMARY 1

2 INSPECTION SUMMARY 2

2.1 Operational Details 2

2.2 Reporting threshold 3

3 SURVEY RESULTS 4

3.1 Chainage 4

3.2 GPS Tie Points 4

3.3 Pipe Anomalies 5

3.4 Bends 6

3.5 Pipeline Movement 6

3.6 Pipe Tally 6

3.7 Plan and Profile 7

4 GEOPIG DESCRIPTION 8

4.1 System Description 8

4.2 Strapdown Inertial Navigation System 8

4.3 Caliper 8

4.4 Other Sensors and Components 9

4.5 Survey Accuracy Specifications 9

5 DATA ANALYSIS PROCEDURES 10

5.1 Chainage 10

5.1.1 Slack Chainage 10

5.1.2 Absolute Chainage 10

5.1.3 Horizontal Chainage 10

5.1.4 Client Chainage 11

5.2 Pipeline Position 11

5.2.1 Tie Points 11

5.2.2 Pipeline Movement 11

5.3 Bending Strain 12

5.3.1 Computation Method 12

5.3.2 Smoothing Curvature Data 14

5.3.3 Interpretation of Bending Strain Data 14

5.4 Pipewall Anomaly Calculation 16

6 BHI SOFTWARE INSTALLATION 17

APPENDICES

Appendix 1. GPS Reference Points
Appendix 2. Pipewall Anomaly Listing
Appendix 3. Internal Diameter Restriction Listing
Appendix 4. Pipeline Movement Listing
Appendix 5. Bend Listing
Appendix 6. Wall Thickness Transitions
Appendix 7. Valves and Tees
Appendix 8. BHI – Enbridge Chainage Correlation Listing
Appendix 9. Pipe Tally Listing
Appendix 10. Plots of Areas of Pipeline Movement
Appendix 11. Plots of Pipeline Plan, Profile, Internal Diameter and Features
Appendix 12. Enbridge ILI Reporting Profile Standard

1 EXECUTIVE SUMMARY

Baker Hughes Pipeline Inspection has successfully completed an inertial geometry survey of Enbridge's 4.15mi NPS20 Oil pipeline, running from St. Ignace to Mackinaw City, Michigan. The successful run was performed on August 17, 2016. The purpose of the inspection was to determine pipeline geometry, which includes plan, profile, bends, weld tally, and pipe wall deformations.

The analysis of the caliper data has identified no dents greater than 2% O.D., and no ovalities greater than 5% O.D. No dents were found greater than 1% O.D., which met the criteria of "Dents in Close Proximity" or "Multiple Apex".

3 internal diameter restrictions, where the I.D. was less than 90% O.D., were identified during the caliper analysis. The largest internal diameter restriction is 17.93in (89.7% O.D.) and located at absolute chainage 21,199.96ft at bend with heavy wall. The internal diameter restriction listing is included in Appendix 3.

The analysis of the inertial data has identified 20 bends with an angle larger than 1.5° and a radius of curvature less than 100D. There are no tight bends of bend radius 5D or less. All bends are listed in Appendix 5.

The line was analyzed for pipeline movements between the current inspection and 2003 GEOPIG™ Inspection. The reporting threshold is to report pipeline movements with differential bending strain exceeding 0.1% and spanning over more than one joint. No areas of pipeline movement, except the launcher and receiver replacements, were found meeting the reporting threshold within this line. The areas of pipeline replacement are listed in Appendix 4 and illustrated in Appendix 10.

Enbridge provided updated GPS coordinates in 2016 for 2 locations along the entire line, consisting of the launch and receive valves. Since the 2005 and 2013 GEOPIG inspections, both the launch and receive areas of the pipeline have been replaced. This information was integrated with the pipe centerline coordinates obtained from the inertial survey, providing a means for locating pipeline anomalies and a foundation for a Geographic Information System (GIS). A listing of the UTM coordinates based on the NAD83 datum is listed in Appendix 1.

One copy of the survey data and the BHI software for viewing is stored on the enclosed DVD. The complete pipeline tally including girth welds, pipe fittings, wall thickness transitions, bends and anomalies can be displayed in BHI's software together with the caliper and inertial data. This information is also available in the Microsoft Excel file "BHI 2016 GEOPIG Survey NPS20 Line 5 North Straits EAST to Mackinaw Issue 1.xls", which is located in the directory "\BHI\NPS20_Line5_NorthStraitsEAST-Mackinaw\2016_GEOPIG_FINAL REPORT Issue #1" on the DVD. Also included on the DVD-ROM is the pipe tally provided in "comma delimited file" (csv) format for ISAS GIS System.

A hard copy of Enbridge ILI Reporting Profile Standard is included in Appendix 13.

2 Inspection Summary

2.1 Operational Details

Baker Hughes Pipeline Inspections has mobilized equipment and a qualified crew to perform in-line inspections of the following system:

BHI Job Number	J2008-217
Pipeline Operator	Enbridge Energy Ltd. Partnership
Segment Name	Line 5 North Straits EAST to Mackinaw
Launch Site	St. Ignace, Michigan
Receive Site	Mackinaw City, Michigan
Pipeline Nominal Diameter	20''
Product	Oil
Section Length	4.15mi
Date of GEOPIG™ Inspection	August 17, 2016
Duration of GEOPIG™ Inspection	37 minutes
Project Manager	Dale Simpson

Table 1. Operational Details

After passing all of the Baker Hughes pre-run inspection procedures, the GEOPIG™ was launched at 9:34 on August 17, 2016. The tool entered the receive trap at 10:11 on August 17, 2016. The GEOPIG™ tool was received in good condition with no apparent damage.

Field analysis indicated that a complete set of Caliper data was collected for the run. All other systems including the odometers and inertial system functioned normally for the entire run.

2.2 Reporting threshold

The reporting criteria are to report

- Dents and wrinkles greater than or equal to 2% of nominal O.D. of the pipeline
- Multi-apex geometric anomalies greater than or equal to 1% O.D.
- Top side geometric anomalies greater than 0.5% O.D. and in close proximity to a dent or geometric anomalies greater or equal than 1% O.D.
- Bottom side geometric anomalies greater than 0.5% O.D. and in close proximity to a dent greater or equal than 2% O.D.
- Ovalities greater than or equal to 5% O.D.
- Areas of pipeline movement with bending strain difference exceeding 0.1% and spanning more than 1 pipe joint

The anomaly size definition varies by feature type and is provided in Section 5.4. Details of the reporting specifications and features definition can be found in Enbridge's Inline Inspection Reporting Profile standard Version 8 included in Appendix 13.

3 SURVEY RESULTS

The GEOPIG™ inertial survey provides pipeline plan, profile and bending strain, allowing one to locate the pipeline in the GPS mapping projection, and to detect pipeline movement between runs. The positional information is derived from the onboard strapdown inertial unit, the odometer readings and the GPS coordinates of selected tie points obtained from a GPS survey.

The caliper survey provides the information on the internal diameter and shape of the pipe, allowing for detection and measurement of pipe wall anomalies (dents, ovalities and wrinkles), wall thickness changes, valves, tees and girth welds.

3.1 Chainage

The GEOPIG™ chainage is the distance measured by the GEOPIG's odometers along the pipeline and is denoted as SCh (slack chainage) on the plots. It starts from 35.89ft at the pig launch trap and ends at 21,778.34ft in the receive trap. A separate client chainage that correlates the GEOPIG™ slack chainage to the Enbridge's As-built chainage has been created. A one-page sample of the BHI – Enbridge chainage correlation listing is included in Appendix 8. The horizontal chainage is also available, and it represents the true horizontal distance of the surveyed pipeline.

3.2 GPS Tie Points

Enbridge provided updated GPS coordinates for 2 locations along the entire line, consisting of the launch and receive valve. Since the 2005 and 2013 GEOPIG inspections, both the launch and receive areas of the pipeline have been replaced. This information was integrated with the pipe centerline coordinates obtained from the inertial survey, providing a means for locating pipeline anomalies and a foundation for a Geographic Information System (GIS). A listing of the UTM coordinates based on the NAD83 datum is listed in Appendix 1.

3.3 Pipe Anomalies

The caliper data was used for detecting and sizing diameter restrictions and pipe wall anomalies, such as ovalities, dents, and wrinkles. The anomaly size definition is provided in Section 5.4.

The analysis of the caliper data has identified no dents greater than 2% O.D., and no ovalities greater than 5% O.D. No dents were found greater than 1% O.D., which met the criteria of "Dents in Close Proximity" or "Multiple Apex". The complete anomaly listing is included in Appendix 2.

Summary of Pipewall Deformations

Deformations		Dents				Ovalities	Inward Wrinkles	Outward Wrinkles
		All (≥ 2%)	≥ 6%	Top of Pipe	On GWD			
Total Number		0	0	0	0	0	0	0
Largest	Size (%OD)							
	Absolute Distance (ft)							

Geometry Feature Severity

Feature Type	Top	Bottom	Max Depth %
Geometry Feature depth d ≥5%	0	0	
Geometry Feature associated with stress risers or welds	0	0	

Wrinkle/Buckle Severity

Feature Type	Top	Bottom	Max Depth %
Wrinkles/Buckles	0	0	
Wrinkles/Buckles across seam welds or girth welds	0	0	

3 internal diameter restrictions, where the I.D. was less than 90% O.D., were identified during the caliper analysis. The largest internal diameter restriction is 17.93in (89.7% O.D.) and located at absolute chainage 21,199.96ft at bend with heavy wall. The internal diameter restriction listing is included in Appendix 3.

3.4 Bends

The analysis of the inertial data has identified 20 bends with an angle larger than 1.5° and a radius of curvature less than 100D. There are no tight bends of bend radius 5D or less. All bends are listed in Appendix 5.

3.5 Pipeline Movement

The line was analyzed for pipeline movements between the current inspection and 2003 GEOPIG™ Inspection. The reporting threshold is to report pipeline movements with differential bending strain exceeding 0.1% and spanning over more than one joint. No areas of pipeline movement, except the launcher and receiver replacements, were found meeting the reporting threshold within this line. The areas of pipeline replacement are listed in Appendix 4 and illustrated in Appendix 10.

Strain Severity

Feature Type	No. of Features	Largest Peak Strain Difference Vertical %	Largest Peak Strain Difference Horizontal %	Largest Peak Strain Difference Total%	GW	Distance (m)	Comments
Pipe Movement	2	N/A	N/A	NA	N/A	N/A	Launch and receive areas replaced since 2005
Largest Movement	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Pipe Movement

Feature Type	No. of Features	Vertical Movement (ft)	Horizontal Movement (ft)	GW	Distance (m)	Comments
Pipe Movement	2	N/A	N/A	N/A	N/A	Launch and receive areas replaced since 2005
Largest Movement	N/A	N/A	N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A

3.6 Pipe Tally

The pipe internal diameter measured by the calipers is used for calculation of pipe wall thickness assuming a constant pipe O.D. The wall thickness transitions were correlated with the listing supplied by Enbridge, and is attached in Appendix 6. The list of valves and tees are included in Appendix 7.

The GEOPIG™ has also detected all the girth welds in the pipeline. They are listed in the worksheet “Weld Log”, which contains the information on the length and start chainage of each pipe joint. The weld log combined with all the other features in the pipeline (valves, tees, wall thickness transitions, anomalies and bends) are listed in the worksheet “Pipe Tally”. A one-page sample of the pipe tally listing is included in Appendix 9.

All the listings included in Appendices 1 to 7 as well as the full pipe tally are available in electronic form in the MS Excel spreadsheet “BHI 2016 GEOPIG Survey NPS20 Line 5 North Straits EAST to Mackinaw Issue 1.xls”.

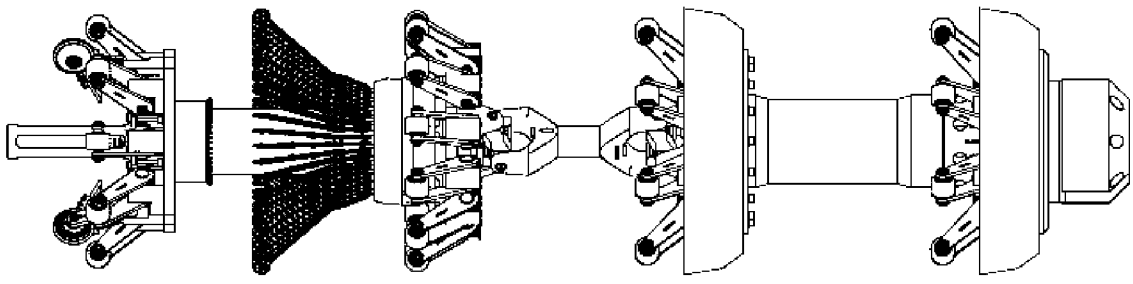
3.7 Plan and Profile

The first plot in Appendix 12 shows the plan, profile, internal diameter and pig velocity, and valves of the entire pipeline. The remaining 3 plots show the pipeline plan, profile, internal diameter and location of selected features, such as valves, tees, and wall thickness transitions at 8,000ft per page.

4 GEOPIG DESCRIPTION

4.1 System Description

The GEOPIG™ is designed to meet a large variety of user requirements using a modular system that integrates a variable number of different sensors. The design of the NPS20 GEOPIG™ consists of two pig carriers, as illustrated bellow.



20" Mechanical Caliper GEOPIG™

A Strapdown Inertial Navigation System is the heart of the GEOPIG™ and delivers position and attitude of the pig along its trajectory within the pipe. Due to the nature of inertial measurements regular "updates" of attitude, position, and velocity are required. External position and attitude are taken from GPS results or alignment sheets.

The GEOPIG™ is suspended in the pipeline by urethane disks at front of the carrier. This restricts the GEOPIG™ to move close and parallel to the pipe centre line. Mechanical calipers are mounted in the middle of the rear carrier and they scan the wall of the pipeline and generate a full picture of the shape of the pipeline. Here the information on dents, ovalities, wrinkles and other features is extracted.

The GEOPIG™ is completed by some other sensors and devices: odometers, which measure the distance travelled, tracking transmitter for location of the GEOPIG™, and finally, storage device and power supply which allow independent operation for long measurement periods.

4.2 Strapdown Inertial Navigation System

The strapdown INS ultimately produces 3-dimensional measurement of inertial acceleration and angular rate directly from orthogonal triads of accelerometers, and single degree of freedom gyros. In the case of a pair of two degree of freedom gyros, a redundant or combined axis measurement is available, and is dealt with appropriately to produce 3 axis orthogonal angular rates. The strapdown accelerometers and gyros are complementary sensors which when coupled deliver the measurements for computing pipeline curvature, orientation of the curvature, and the positioning capability for location of the curvature or other detected features.

4.3 Caliper

One ring of mechanical calipers scans the wall of the pipe. The caliper arms are spaced at precisely machined constant angles around the ring on the pig. An accurate offset was

added to these ranges to give the actual distance from the centre of the carrier to the pipe wall. There are 50 mechanical caliper arms mounted in the middle of the carrier.

4.4 Other Sensors and Components

Other sensors and components integrated in the GEOPIG™ are:

- Odometer wheels providing direct measurements of distance traveled (chainage). Velocity is derived from these time tagged distances.
- Temperature and pressure sensors
- A flash memory system
- Interface electronics
- Batteries
- Micro-processor controllers
- Power management module
- Pig Tracking Module (Electromagnetic)

4.5 Survey Accuracy Specifications

The accuracy of the GEOPIG™ measurements are as follows:

- Pipeline position 1:2,000
- Bending strain +/- 0.02%
- Bend angle +/- 0.1 °
- Anomaly size +/- 0.1”
- Temperature +/- 0.1 Deg C
- Pressure 0.1% or +/- 3 PSI (0.2 BARSG)

5 DATA ANALYSIS PROCEDURES

The primary function of the GEOPIG™ inertial survey is to determine the pipeline plan, profile and bending strain. This is achieved by computing the GEOPIG's trajectory during the run using the data collected by the onboard strapdown inertial unit and the odometers. Due to a tight fit of the GEOPIG™ cups into the pipe the tool rides practically along the pipe centreline. The only exception from this is the deviation of the tool trajectory from the pipe centerline due to serious pipe wall deformations, as well as "smoothing out the corners" over the transition length (equal to the distance between the cups) at the bend boundaries and at the girth welds exhibiting noticeable out-of-straightness, i.e. sudden change of direction due to the weld misalignment. That data it is then rotated into the GPS co-ordinates of the selected tie-points along the line (usually a few km apart) to obtain the desired location accuracy in a given UTM mapping projection.

The following paragraphs outline the methods used for processing the odometer and inertial data in order to obtain the pipeline slack and horizontal chainage, client chainage, pipeline position and bending strain.

5.1 Chainage

The following types of chainages are used for referencing the GEOPIG™ data:

- slack chainage - the distance measured by the GEOPIG's odometers along the pipeline.
- horizontal chainage - the true distance along the pipeline projection on the horizontal plane. Not required by the client in this survey.
- client chainage - the reference system used by the pipeline operator (e.g. station number used on the as-built drawings, or KP location from the ROV survey).

5.1.1 Slack Chainage

The GEOPIG™ slack chainage is the distance measured by the GEOPIG's odometers along the pipeline. It starts from zero at the reducer on the pig launcher and ends at the receive trap. The odometer accuracy is 0.1 %.

The chainage from the first run is used as the baseline for all the subsequent runs. The preliminary chainage from the subsequent runs derived from the odometer data is scaled to match the distance between the girth welds from the baseline survey. Therefore any change of pipeline length between runs, e.g. elongation due to temperature differential, is disregarded.

5.1.2 Absolute Chainage

The GEOPIG™ absolute chainage is the distance along the pipeline corresponding to the upstream edge of defects and the centre of other features, measured from the start of the run. The usage of such distance is as per client specifications.

5.1.3 Horizontal Chainage

The GEOPIG™ horizontal chainage represents the true horizontal distance of the surveyed pipeline. It is computed from the slack chainage by projecting it on the horizontal plane first, and then scaling it to match the horizontal distance based on the GPS co-ordinates (Northing and Easting). The scaling is performed between the same tie-points that are used for rotating the inertial survey data into its final position.

5.1.4 Client Chainage

The purpose of a client chainage is to represent any one-dimensional information used by the client, which could be correlated to the slack chainage. Usually the client chainage corresponds to the chainage shown on the as-builts, or to the chainage recorded during another in-line inspection. It can be incorporated into the data at any time after the DVD is issued to the client.

5.2 Pipeline Position

The pipeline position is provided in terms of Northing, Easting and Height as a function of the chainage, in a selected mapping projection (usually UTM) and a specified datum.

5.2.1 Tie Points

Inertial data is translated, rotated and scaled to the "tie points" with known co-ordinates. Those points are typically selected at traps, valves, welds, bends, wall thickness transitions, or any other pipeline features that can be detected directly or indirectly by the GEOPIG™ sensors. The co-ordinates of those points are usually obtained from GPS survey.

This procedure provides correction for long term drifts that can introduce an absolute position error in the inertial survey over time. By transforming the GEOPIG™ trajectory into the tie points, the Northing, Easting, and Height are obtained for any point along the pipe.

The specified accuracy of the inertial survey is 1:2,000 of the distance from the tie points; therefore for the following sample distances between the tie points the following absolute accuracy is obtained:

Distance Between Tie Points [m]	Absolute Accuracy [m]
20,000	5.0
10,000	2.5
5,000	1.25
3,000	0.75

For example, if the data from two GEOPIG™ run have been tied to the points that are 3km apart, then the allowable error in-between the ties points can reach 0.75m, which corresponds to up to 1.5m difference between two runs. To reduce the relative difference between two runs, a procedure described in the next section is applied, which ensures that the actual pipeline movement is measured with centimeter accuracy. There is practically no difference in the pipeline position between the runs in the areas where the pipeline did not move.

5.2.2 Pipeline Movement

Once preliminary processing has been completed, the data from the current and the previous GEOPIG™ surveys are compared in order to identify the areas of strain differences associated with the pipeline movement. Then the current data is reprocessed using the coordinates of the tie points extracted from the baseline GEOPIG™ survey at 100m intervals, except for the previously determined pipeline movement areas. This procedure improves the accuracy of the local pipeline movement measurement by

reducing the relative error between two runs. A noticeable error would result from the absolute position accumulation error when only the original tie points (from the GPS survey, at about 1km spacing) were used for scaling and rotating the inertial survey data.

5.3 Bending Strain

The bending strain is computed directly from the curvature of the GEOPIG™ trajectory, typically averaged over the distance of three pipe diameters. The specification for the bending strain measurements from the GEOPIG™ survey is +/- 0.02% strain. When the strain difference between two runs is compared that specification is usually exceeded in the originally straight sections of the line, and the accuracy of +/- 0.005% strain is achieved. The following subsections contain the description of the bending strain measurement and general remarks on interpretation of strain data.

5.3.1 Computation Method

There are two main components of the strain tensor in a pipe wall: the longitudinal strain (in the direction of the pipe axis) and the hoop strain (in the circumferential direction). The longitudinal strain is further separated into the axial component and the bending component that changes linearly along the pipe cross-section (see Figure 5.1).

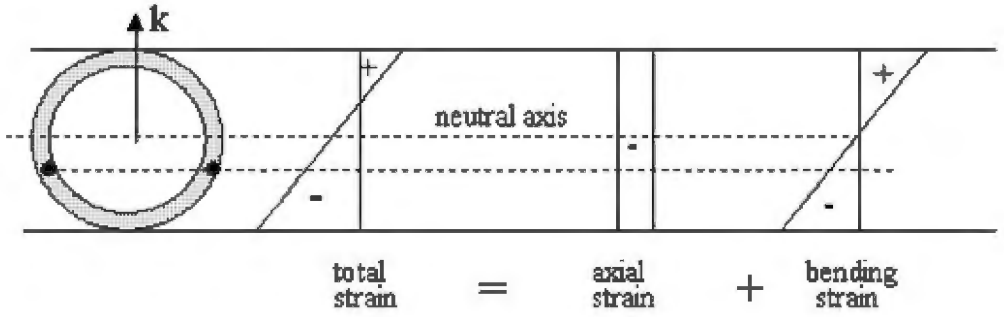


Figure 5.1 Distribution of Axial and Bending Components of Longitudinal Strain in Pipe Cross-section

The bending component of the longitudinal strain at any location in the pipe cross-section can be computed based on the bending strain at two points, e.g. at the top of the pipe (0 o'clock position) and on a right side (3 o'clock position). The bending strain at the bottom of the pipe is called the vertical strain ε_v, because it is induced by bending in the vertical plane (the bending strain at the top of the pipe has the same absolute value, but the opposite sign, i.e. $-\varepsilon_v$). For a similar reason the bending strain on the right side of the pipe is called the horizontal bending strain ε_H (the bending strain on the left side is equal to $-\varepsilon_H$). The maximum bending strain ε in the entire pipe-cross-section is equal to:

$$\varepsilon = \sqrt{\varepsilon_v^2 + \varepsilon_h^2} \,. \qquad (5.1)$$

ENBDNR0000053

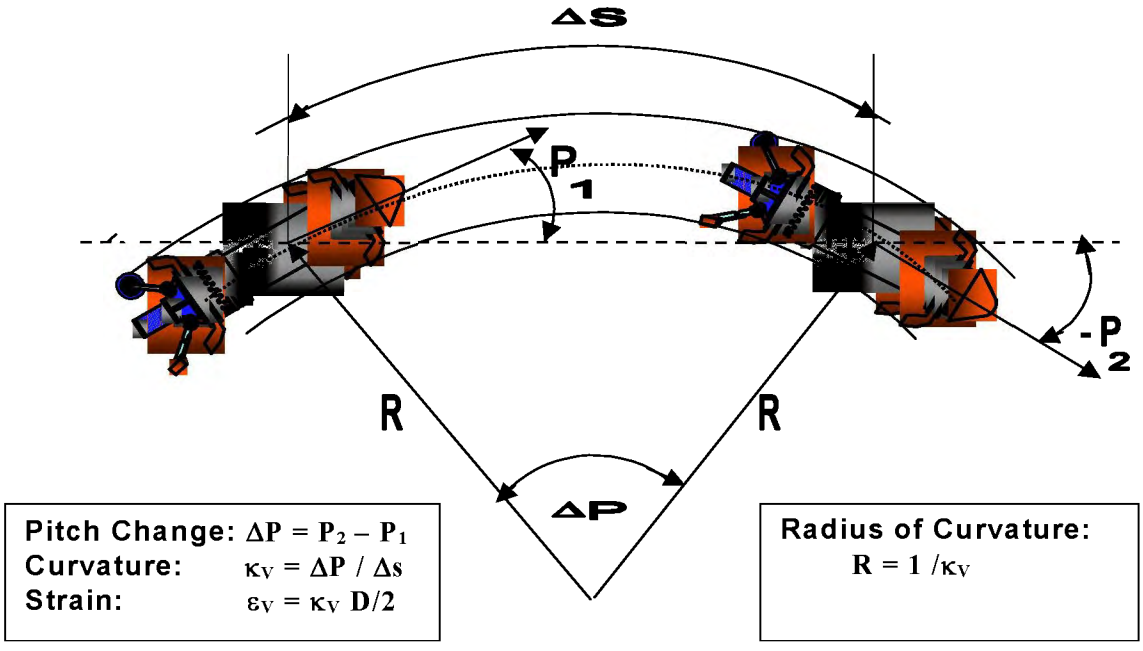


Figure 5.2 Computation of Pipeline Vertical Curvature and Strain from GEOPIG Pitch

Both the vertical and horizontal bending strains are computed from the GEOPIG™ survey using the measurements of the pipe centerline curvature. The curvature of a line in a 3-D space is defined as the change of direction (in radians) over the distance. The distance is measured by the odometers, and the direction of the pipe centerline is computed from the inertial system in terms of azimuth and pitch. The pitch P(s) describes the pipeline tilt with respect to the horizontal plane at chainage s, while the azimuth A(s) specifies the angle between the pipe direction and the north. The horizontal component of the curvature is proportional to the change of the azimuth, and the vertical component is proportional to the change of pitch. The following formulas are used for computation of the pipeline total curvature κ and its vertical κ_V and horizontal κ_h components based on the changes ΔP and ΔA of pitch and azimuth over a distance Δs along the pipe centerline:

$$\kappa = \sqrt{\kappa_v^2 + \kappa_h^2}\,, \qquad \kappa_v = \frac{\Delta P}{\Delta s}, \qquad \kappa_h = -\frac{\Delta A}{\Delta s}\cos(P) \qquad (5.2)$$

The relationship between curvature and bending strain is as follows:

$$\varepsilon = \frac{D}{2}\kappa \qquad \varepsilon_v = \frac{D}{2}\kappa_v \qquad \varepsilon_h = \frac{D}{2}\kappa_h \qquad (5.3)$$

where D is the pipe outside diameter.

The curvature radius is the inverse of the curvature. The BHI software reports strain in percents and the radius of curvature in pipe diameters. Strain is a unitless value that can be expressed in percents by multiplying it by 100%; e.g. 0.45% corresponds to 0.0045 strain.

ENBDNR0000054

5.3.2 Smoothing Curvature Data

The curvature can be computed according to formula (5.2) using the change of azimuth or pitch over the chainage increment as small as the distance between two inertial samples. The inertial data is collected at the rate of 100 samples per second. If the tool travels at the speed of 2 m/s then the distance between two samples is only 2 cm. The raw curvature computed this way would exhibit a significant level of noise, e.g. due to tool vibrations. In order to reduce that noise the curvature is typically averaged over a distance of 3 – 5 pipe diameters, i.e. 2-3m for 20" diameter pipe. For computational efficiency, instead of calculating the actual average, the curvature is computed using formula (5.2), where the increments ΔP and ΔA of pitch and azimuth are taken over a distance of 2m. This is practically equivalent to averaging curvature over the same distance - if the data are equally spaced, i.e. when the tool velocity is stable. The longer is the averaging length the smoother are the results.

Another smoothing technique is a regression line fit to the pitch or azimuth considered as functions of chainage. That method fits a line to all of the pitch values (or azimuth) over a specified length. This is practically equivalent to fitting a circle to all of the points along the GEOPIG™ trajectory over the specified length, but again much more computationally efficient than actually doing it. The radius of that circle is equal to the radius of curvature of the pipeline. The regression line fit produces smoother results than a regular moving average applied over the same length.

When estimating the bending strain induced by pipe-soil interaction, the curvature can be smoothed out over a length longer than 5 pipe diameters, usually over 5 - 10m. This approach significantly reduces the effect of weld misalignment, pipe wall imperfections and tool dynamics on the computed curvature, and at the same time it doesn't underestimate the bending strain induced by pipeline movement. This approach is particularly suited for calculation of strain difference between two runs. However, averaging over too long distance is not proper for computation of curvature of short features, such as bends or buckles. The bending strain of a feature would be underestimated if the feature was shorter than the effective averaging distance, which includes both the length used in curvature computation and the tool length, i.e. the distance between the cups supporting the pig body (i.e. the inertial canister in case of multi-body tools).

5.3.3 Interpretation of Bending Strain Data

The GEOPIG™ measures the total pipeline bending strain at the time of inspection, which includes strain induced during manufacturing, construction and operation. While pipeline is in operation the strain may be caused by the operating conditions (temperature and pressure differential) or by the external forces affecting the pipeline as the results of sea-bottom scouring, sub-sea currents, slope instability, soil settlement and erosion, etc. As the GEOPIG™ measures the total bending strain, including the plastic component induced during the whole history of loading, the current shape of the pipe and its bending strain cannot be fully explained by taking into consideration only the forces acting on the pipe during the inspection, e.g. the gravity, buoyancy and support reaction.

The GEOPIG™ measures the curvature of the pipe centerline with all its imperfections, including the out-of-straightness at welds that is theoretically described by infinite curvature, although it does not correspond to any bending strain in the pipe wall. When such curvature is measured by the GEOPIG™ is obviously not infinite due to the finite

length of the tool and some additional smoothing applied during data processing, but it may still show up as spikes of significant amplitude in the curvature data.

When analyzing the bending strain induced during operation the high residual plastic strain present in the field bends should be disregarded. The main features distinguishing the bending strain induced during operation from the field bends are briefly discussed below. The bending strain in the field bends is usually in the range from 1 to 2% strain and is confined to one pipe joint and is characterized by an abrupt change of strain at the beginning and the end of a bend. The bending strain induced during operation is usually of smaller amplitude, spans more than one pipe joint and undergoes gradual change over longer transition sections.

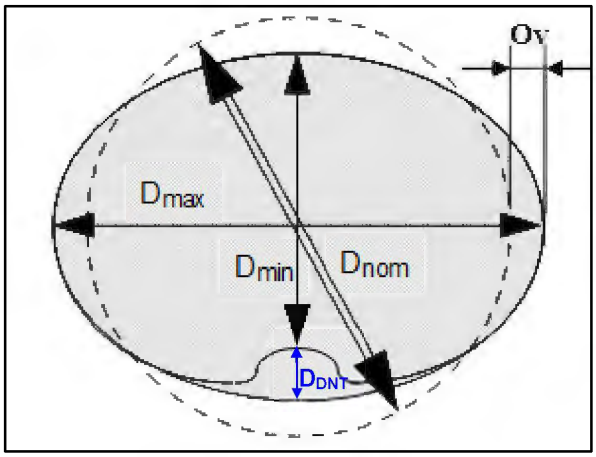
ENBDNR0000056

5.4 Pipewall Anomaly Calculation

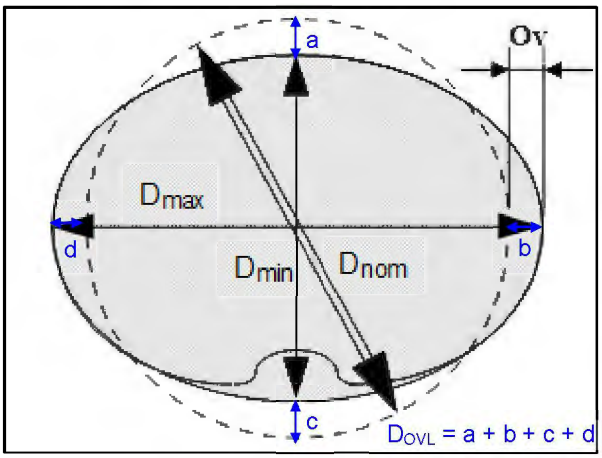
The caliper information is processed to provide the internal shape and diameter of the pipeline. The anomaly size D (depth) is calculated as follows:

For dents: $D_{DNT} = D_{Rstr} - 2*O_V$ without ovality $D_{Rstr} = D_{Nom} - D_{Min}$

$O_V = (D_{Max} - D_{Nom})/2$



For Ovality: $D_{OVL} = D_{Max} - D_{Min}$ CSA Z662



where:

D_{Rstr}	- total diameter restriction
O_V	- pipe ovality
D_{Nom}	- inner nominal pipe diameter
D_{Min}	- inner pipe diameter at the feature
D_{Max}	- inner pipe diameter 90° from the feature

The dent length and width are calculated as the axial distance and the circumferential distance between points of zero radial deflection respectively. The ovality length and width are calculated as the axial distance and the circumferential distance over which the feature depth exceeds 50% of its peak value respectively. A dent with the width larger than its length is called an inward wrinkle. The outward wrinkle is characterized by a local increase of pipe diameter.

6 BHI Software Installation

The report is accompanied by a DVD-ROM containing the BHI display software and the data from the present survey. The data can be viewed using the GeminiView and GeoDisplay programs running in Microsoft Windows operating system. GeminiView is used to display the 3-D view of the pipe and the inner pipe wall shape measured by the calipers. GeoDisplay is used for displaying the inertial, odometer, weld, caliper, and other data bases (if available).

The directory structure on the DVD is as follows:

\BHI\NPS20_Line5_NorthStraitsEAST-Mackinaw\2016_GEOPIG, which contains:

- several subdirectories with the GEOPIG™ data from the run
- environment file 2016_GEOPIG_NPS20_Line5_NorthStraitsEAST-Mackinaw _Issue1.env with the information on the location of the data files from the run. (%RootDir% specifies the path, and %BaseName% - the name)
- configuration file GD.cfg for Geodisplay

\BHI\BHI_Software	with the software stored on two subdirectories:
\GeminiView	with the GeminiView program (GEMINIVIEW.EXE)
\GD	with the GeoDisplay program (GDWIN.EXE)

The entire content of the DVD can be copied to a network drive, or a local hard drive for faster access of the data and the ability to save configurations files with customized displays. The programs can be also stored on the local hard drive while the data is accessed from the DVD or a network drive. In this case only the \BHI_Software subdirectory needs to be copied on the local hard drive.

Geminiview:

To setup the GeminiView program for the first time on a computer:

- Run the setup.exe program in the BHI\BHI_Software\GeminiView directory.

To launch the GeminiView program:

- Double click Geminiview_3.21.exe

Jobs can then be loaded using the File ⇒ Open menu

GeoDisplay:

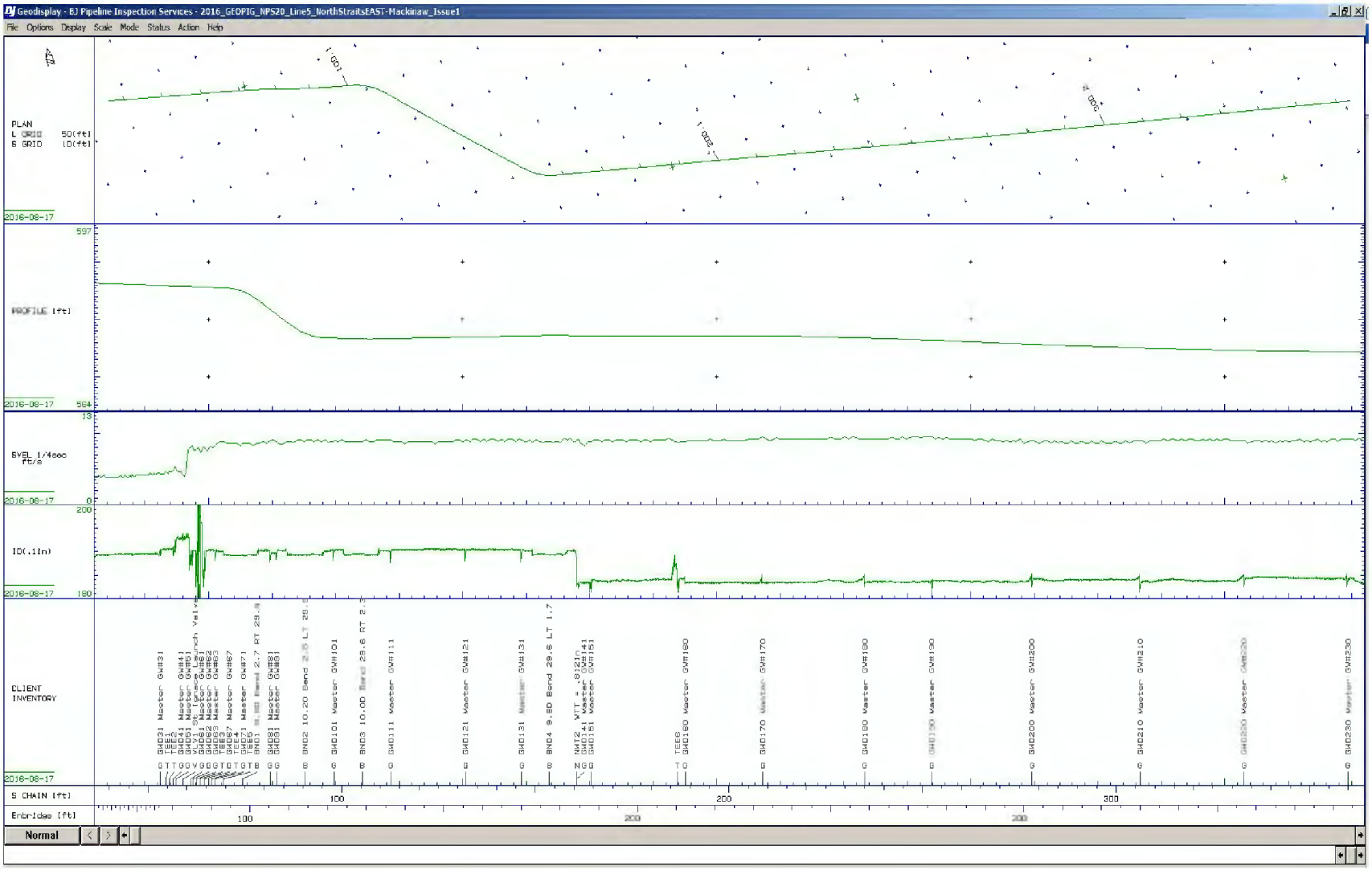
The simplest way to launch GeoDisplay from the DVD is to double click on the application program (GDWIN.EXE) using Windows Explorer.

The recommended way to launch GeoDisplay is to copy the "Geodisplay NPS20_ Line5_NorthStraitsEAST-Mackinaw" icon onto the computer desktop using the procedure outlined below. It is assumed that the subdirectory \BHI\BHI_Software is stored on the **C:** drive, and the data directory \BHI\NPS20_Line5_NorthStraitsEAST-Mackinaw_Issue1 is on the **D:** drive. However, the proper drive letters for the DVD, network or hard drive corresponding to the actual location of those directories have to be used.

1) Go to directory C:\BHI\BHI_Software\GD using the Windows Explorer and drag the shortcut icon "Geodisplay NPS20_ Line5_NorthStraitsEAST-Mackinaw (with the blue and white BHI logo) to the desktop.
2) Right click on this new icon and left click on "Properties".

3) Click on the “Shortcut” tab and make sure the “Target” and “Start in” are set to **C:**\BHI\BHI_Software\GD\GDWIN.exe and **D:** \BHI\NPS20_Line5_NorthStraitsEAST-Mackinaw respectively.
4) Click on the “General” tab and uncheck the “Read-only” box.
5) To start the program, double click on the icon.

Appendix 9. Pipe Tally – Sample Plot



Appendix 11. Plots of Pipeline Plan, Profile, Internal Diameter and Features

Geometry Inspection Report prepared for:

Enbridge Energy, Limited Partnership
20" GEOPIG™ Geometry Inspection
NPS20 Line 5 North Straits WEST to Mackinaw

Total Distance: 4.15mi

Pipeline Inspection Date: August 16, 2016

Issue Number: J2008-216 Issue #1

Baker Hughes Pipeline Inspection

4839 – 90th Ave S.E. Calgary, Alberta, Canada, T2C 2S8

Signature Block	Name	Date	Initial
Data Analysis Manager Level III Data Analyst *	Vicky Chan	Sept 14, 2016	
Analysis Team Lead Level III Data Analyst *	Bruce Zhu	Sept 14, 2016	
Inertial/Caliper Analyst Level II Data Analyst *	Jeremie Choquette	Sept 14, 2016	

* As per ILI PQ 2005

Issue Number	Release Date	Issue Date	Client Data Verified	Description of Changes
J2008-216 - Issue #1	September 14, 2016	Sept 14, 2016		Initial Issue

Note:

This report has been specifically prepared for Enbridge Energy Ltd. Partnership (hereinafter called "Enbridge"). Any use which a third party makes of this report, or any sole reliance on or decisions to be made based on the information contained herein, are the sole responsibility of such third parties. Baker Hughes Pipeline Inspection accepts no responsibility for the damages, if any, suffered by any third party as a result of decisions made or actions based on the information contained in this report.

Information provided herein represents the best efforts of Baker Hughes Pipeline Inspection to evaluate the described lines. Judgements concerning pipe condition are left entirely to Enbridge. All information herein represents only Baker Hughes Pipeline Inspection's opinion of the meaning of the GEOPIG™ information, and shall not be construed as a warranty or guarantee of the structural condition of the pipeline, its fitness for use, or any other condition.

TABLE OF CONTENTS

1 EXECUTIVE SUMMARY 1

2 INSPECTION SUMMARY 2

2.1 Operational Details 2

2.2 Reporting threshold 3

3 SURVEY RESULTS 4

3.1 Chainage 4

3.2 GPS Tie Points 4

3.3 Pipe Anomalies 5

3.4 Bends 6

3.5 Pipeline Movement 6

3.6 Pipe Tally 6

3.7 Plan and Profile 7

4 GEOPIG DESCRIPTION 8

4.1 System Description 8

4.2 Strapdown Inertial Navigation System 8

4.3 Caliper 8

4.4 Other Sensors and Components 9

4.5 Survey Accuracy Specifications 9

5 DATA ANALYSIS PROCEDURES 10

5.1 Chainage 10

5.1.1 Slack Chainage 10

5.1.2 Absolute Chainage 10

5.1.3 Horizontal Chainage 10

5.1.4 Client Chainage 11

5.2 Pipeline Position 11

5.2.1 Tie Points 11

5.2.2 Pipeline Movement 11

5.3 Bending Strain 12

5.3.1 Computation Method 12

5.3.2 Smoothing Curvature Data 14

5.3.3 Interpretation of Bending Strain Data 14

5.4 Pipewall Anomaly Calculation 16

6 BHI SOFTWARE INSTALLATION 17

APPENDICES

Appendix 1. GPS Reference Points
Appendix 2. Pipewall Anomaly Listing
Appendix 3. Internal Diameter Restriction Listing
Appendix 4. Pipeline Movement Listing
Appendix 5. Bend Listing
Appendix 6. Wall Thickness Transitions
Appendix 7. Valves and Tees
Appendix 8. BHI – Enbridge Chainage Correlation Listing
Appendix 9. Pipe Tally Listing
Appendix 10. Pipewall Anomaly Inspection Sheets
Appendix 11. Plots of Areas of Pipeline Movement
Appendix 12. Plots of Pipeline Plan, Profile, Internal Diameter and Features
Appendix 13. Enbridge ILI Reporting Profile Standard

1 EXECUTIVE SUMMARY

Baker Hughes Pipeline Inspection has successfully completed an inertial geometry survey of Enbridge's 4.15mi NPS20 Oil pipeline, running from St. Ignace to Mackinaw City, Michigan. The successful run was performed on August 16, 2016. The purpose of the inspection was to determine pipeline geometry, which includes plan, profile, bends, weld tally, and pipe wall deformations.

The analysis of the caliper data has identified no dents greater than 2% O.D., and 2 ovalities greater than 5% O.D. No dents were found greater than 1% O.D., which met the criteria of "Dents in Close Proximity" or "Multiple Apex". The largest anomaly is a 1.85in (9.2% O.D.) ovality located at absolute chainage 15,478.78ft. The complete anomaly listing is included in Appendix 2.

4 internal diameter restrictions, where the I.D. was less than 90% O.D., were identified during the caliper analysis. The largest internal diameter restriction is 17.31in (86.5% O.D.) and located at absolute chainage 15,478.75ft at an ovality with heavy wall. The internal diameter restriction listing is included in Appendix 3.

The analysis of the inertial data has identified 23 bends with an angle larger than 1.5° and a radius of curvature less than 100D. There are no tight bends of bend radius 5D or less. All bends are listed in Appendix 5.

The line was analyzed for pipeline movements between the current inspection and 2003 GEOPIG™ Inspection. The reporting threshold is to report pipeline movements with differential bending strain exceeding 0.1% and spanning over more than one joint. No areas of pipeline movement, except the launcher and receiver replacements, were found meeting the reporting threshold within this line. The areas of pipeline replacement are listed in Appendix 4 and illustrated in Appendix 11.

Enbridge provided updated GPS coordinates in 2016 for 2 locations along the entire line, consisting of the launch and receive valves. Since the 2005 and 2013 GEOPIG inspections, both the launch and receive areas of the pipeline have been replaced. This information was integrated with the pipe centerline coordinates obtained from the inertial survey, providing a means for locating pipeline anomalies and a foundation for a Geographic Information System (GIS). A listing of the UTM coordinates based on the NAD83 datum is listed in Appendix 1.

One copy of the survey data and the BHI software for viewing is stored on the enclosed DVD. The complete pipeline tally including girth welds, pipe fittings, wall thickness transitions, bends and anomalies can be displayed in BHI's software together with the caliper and inertial data. This information is also available in the Microsoft Excel file "BHI 2016 GEOPIG Survey NPS20 Line 5 North Straits WEST to Mackinaw Issue 1.xls", which is located in the directory "\BHI\NPS20_Line5_NorthStraitsWEST-Mackinaw\2016_GEOPIG_FINAL REPORT Issue #1" on the DVD. Also included on the DVD-ROM is the pipe tally provided in "comma delimited file" (csv) format for ISAS GIS System.

A hard copy of Enbridge ILI Reporting Profile Standard is included in Appendix 13.

2 Inspection Summary

2.1 Operational Details

Baker Hughes Pipeline Inspections has mobilized equipment and a qualified crew to perform in-line inspections of the following system:

BHI Job Number	J2008-216
Pipeline Operator	Enbridge Energy Ltd. Partnership
Segment Name	Line 5 North Straits WEST to Mackinaw
Launch Site	St. Ignace, Michigan
Receive Site	Mackinaw City, Michigan
Pipeline Nominal Diameter	20''
Product	Oil
Section Length	4.15mi
Date of GEOPIG™ Inspection	August 16, 2016
Duration of GEOPIG™ Inspection	21 minutes
Project Manager	Dale Simpson

Table 1. Operational Details

After passing all of the Baker Hughes pre-run inspection procedures, the GEOPIG™ was launched at 11:01 on August 16, 2016. The tool entered the receive trap at 11:22 on August 16, 2016. The GEOPIG™ tool was received in good condition with no apparent damage.

Field analysis indicated that a complete set of Caliper data was collected for the run. All other systems including the odometers and inertial system functioned normally for the entire run.

2.2 Reporting threshold

The reporting criteria are to report

- Dents and wrinkles greater than or equal to 2% of nominal O.D. of the pipeline
- Multi-apex geometric anomalies greater than or equal to 1% O.D.
- Top side geometric anomalies greater than 0.5% O.D. and in close proximity to a dent or geometric anomalies greater or equal than 1% O.D.
- Bottom side geometric anomalies greater than 0.5% O.D. and in close proximity to a dent greater or equal than 2% O.D.
- Ovalities greater than or equal to 5% O.D.
- Areas of pipeline movement with bending strain difference exceeding 0.1% and spanning more than 1 pipe joint

The anomaly size definition varies by feature type and is provided in Section 5.4. Details of the reporting specifications and features definition can be found in Enbridge's Inline Inspection Reporting Profile standard Version 8 included in Appendix 13.

ENBDNR0000066

3 SURVEY RESULTS

The GEOPIG™ inertial survey provides pipeline plan, profile and bending strain, allowing one to locate the pipeline in the GPS mapping projection, and to detect pipeline movement between runs. The positional information is derived from the onboard strapdown inertial unit, the odometer readings and the GPS coordinates of selected tie points obtained from a GPS survey.

The caliper survey provides the information on the internal diameter and shape of the pipe, allowing for detection and measurement of pipe wall anomalies (dents, ovalities and wrinkles), wall thickness changes, valves, tees and girth welds.

3.1 Chainage

The GEOPIG™ chainage is the distance measured by the GEOPIG's odometers along the pipeline and is denoted as SCh (slack chainage) on the plots. It starts from 68.29ft at the pig launch trap and ends at 21,892.66ft in the receive trap. A separate client chainage that correlates the GEOPIG™ slack chainage to the Enbridge's As-built chainage has been created. A one-page sample of the BHI – Enbridge chainage correlation listing is included in Appendix 8. The horizontal chainage is also available, and it represents the true horizontal distance of the surveyed pipeline.

3.2 GPS Tie Points

Enbridge provided updated GPS coordinates for 2 locations along the entire line, consisting of the launch and receive valve. Since the 2005 and 2013 GEOPIG inspections, both the launch and receive areas of the pipeline have been replaced. This information was integrated with the pipe centerline coordinates obtained from the inertial survey, providing a means for locating pipeline anomalies and a foundation for a Geographic Information System (GIS). A listing of the UTM coordinates based on the NAD83 datum is listed in Appendix 1.

3.3 Pipe Anomalies

The caliper data was used for detecting and sizing diameter restrictions and pipe wall anomalies, such as ovalities, dents, and wrinkles. The anomaly size definition is provided in Section 5.4.

The analysis of the caliper data has identified no dents greater than 2% O.D., and 2 ovalities greater than 5% O.D. No dents were found greater than 1% O.D., which met the criteria of "Dents in Close Proximity" or "Multiple Apex". The largest anomaly is a 1.85in (9.2% O.D.) ovality located at absolute chainage 15,478.78ft. The complete anomaly listing is included in Appendix 2.

Summary of Pipewall Deformations

Deformations		Dents				Ovalities	Inward Wrinkles	Outward Wrinkles
		All (≥ 2%)	≥ 6%	Top of Pipe	On GWD			
Total Number		0	0	0	0	2	0	0
Largest	Size (%OD)					9.23		
	Absolute Distance (ft)					15,478.78		

Geometry Feature Severity

Feature Type	Top	Bottom	Max Depth %
Geometry Feature depth d ≥5%	0	0	
Geometry Feature associated with stress risers or welds	0	0	

Wrinkle/Buckle Severity

Feature Type	Top	Bottom	Max Depth %
Wrinkles/Buckles	0	0	
Wrinkles/Buckles across seam welds or girth welds	0	0	

Appendix 10 contains inspection sheets for the two ovalities. There are three inspection sheets per anomaly: a dig sheet showing the position of the feature in a pipe joint together with the adjacent joints, a plot of pipeline plan and profile between the nearest u/s and d/s reference points, and a plot showing 3 views of the anomaly: 3-D view, pipe cross-section and diameter profile. The 3-D view scale is exaggerated 3 times. The pipe diameter profile consists of 25 lines showing the pipe internal diameter at different clock positions measured by the 25 pairs of opposing caliper arms. The clock positions of these caliper arms are colour coded according to the spectrum displayed on the left side of the plot.

4 internal diameter restrictions, where the I.D. was less than 90% O.D., were identified during the caliper analysis. The largest internal diameter restriction is 17.31in (86.5%) and located at absolute chainage 15,478.75ft at an ovality with heavy wall. The internal diameter restriction listing is included in Appendix 3.

3.4 Bends

The analysis of the inertial data has identified 23 bends with an angle larger than 1.5° and a radius of curvature less than 100D. There are no tight bends of bend radius 5D or less. All bends are listed in Appendix 5.

3.5 Pipeline Movement

The line was analyzed for pipeline movements between the current inspection and 2003 GEOPIG™ Inspection. The reporting threshold is to report pipeline movements with differential bending strain exceeding 0.1% and spanning over more than one joint. No areas of pipeline movement, except the launcher and receiver replacements, were found meeting the reporting threshold within this line. The areas of pipeline replacement are listed in Appendix 4 and illustrated in Appendix 11.

Strain Severity

Feature Type	No. of Features	Largest Peak Strain Difference Vertical %	Largest Peak Strain Difference Horizontal %	Largest Peak Strain Difference Total%	GW	Distance (m)	Comments
Pipe Movement	2	N/A	N/A	NA	N/A	N/A	Launch and receive areas replaced since 2005
Largest Movement	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Pipe Movement

Feature Type	No. of Features	Vertical Movement (ft)	Horizontal Movement (ft)	GW	Distance (m)	Comments
Pipe Movement	2	N/A	N/A	N/A	N/A	Launch and receive areas replaced since 2005
Largest Movement	N/A	N/A	N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A

3.6 Pipe Tally

The pipe internal diameter measured by the calipers is used for calculation of pipe wall thickness assuming a constant pipe O.D. The wall thickness transitions were correlated with the listing supplied by Enbridge, and is attached in Appendix 6. The list of valves and tees are included in Appendix 7.

The GEOPIG™ has also detected all the girth welds in the pipeline. They are listed in the worksheet “Weld Log”, which contains the information on the length and start chainage of each pipe joint. The weld log combined with all the other features in the pipeline (valves, tees, wall thickness transitions, anomalies and bends) are listed in the worksheet “Pipe Tally”. A one-page sample of the pipe tally listing is included in Appendix 9.

All the listings included in Appendices 1 to 7 as well as the full pipe tally are available in electronic form in the MS Excel spreadsheet “BHI 2016 GEOPIG Survey NPS20 Line 5 North Straits WEST to Mackinaw Issue 1.xls”.

ENBDNR0000069

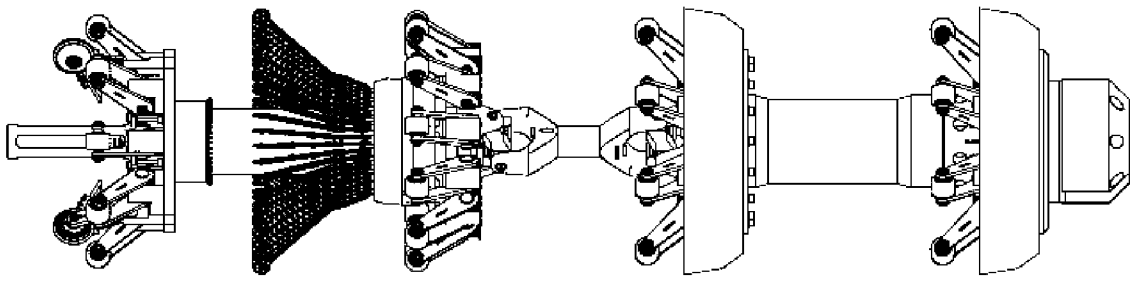
3.7 Plan and Profile

The first plot in Appendix 12 shows the plan, profile, internal diameter and pig velocity, and valves of the entire pipeline. The remaining 3 plots show the pipeline plan, profile, internal diameter and location of selected features, such as valves, tees, anomalies, and wall thickness transitions at 8,000ft per page.

4 GEOPIG DESCRIPTION

4.1 System Description

The GEOPIG™ is designed to meet a large variety of user requirements using a modular system that integrates a variable number of different sensors. The design of the NPS20 GEOPIG™ consists of two pig carriers, as illustrated bellow.



20" Mechanical Caliper GEOPIG™

A Strapdown Inertial Navigation System is the heart of the GEOPIG™ and delivers position and attitude of the pig along its trajectory within the pipe. Due to the nature of inertial measurements regular "updates" of attitude, position, and velocity are required. External position and attitude are taken from GPS results or alignment sheets.

The GEOPIG™ is suspended in the pipeline by urethane disks at front of the carrier. This restricts the GEOPIG™ to move close and parallel to the pipe centre line. Mechanical calipers are mounted in the middle of the rear carrier and they scan the wall of the pipeline and generate a full picture of the shape of the pipeline. Here the information on dents, ovalities, wrinkles and other features is extracted.

The GEOPIG™ is completed by some other sensors and devices: odometers, which measure the distance travelled, tracking transmitter for location of the GEOPIG™, and finally, storage device and power supply which allow independent operation for long measurement periods.

4.2 Strapdown Inertial Navigation System

The strapdown INS ultimately produces 3-dimensional measurement of inertial acceleration and angular rate directly from orthogonal triads of accelerometers, and single degree of freedom gyros. In the case of a pair of two degree of freedom gyros, a redundant or combined axis measurement is available, and is dealt with appropriately to produce 3 axis orthogonal angular rates. The strapdown accelerometers and gyros are complementary sensors which when coupled deliver the measurements for computing pipeline curvature, orientation of the curvature, and the positioning capability for location of the curvature or other detected features.

4.3 Caliper

One ring of mechanical calipers scans the wall of the pipe. The caliper arms are spaced at precisely machined constant angles around the ring on the pig. An accurate offset was

added to these ranges to give the actual distance from the centre of the carrier to the pipe wall. There are 50 mechanical caliper arms mounted in the middle of the carrier.

4.4 Other Sensors and Components

Other sensors and components integrated in the GEOPIG™ are:

- Odometer wheels providing direct measurements of distance traveled (chainage). Velocity is derived from these time tagged distances.
- Temperature and pressure sensors
- A flash memory system
- Interface electronics
- Batteries
- Micro-processor controllers
- Power management module
- Pig Tracking Module (Electromagnetic)

4.5 Survey Accuracy Specifications

The accuracy of the GEOPIG™ measurements are as follows:

- Pipeline position 1:2,000
- Bending strain +/- 0.02%
- Bend angle +/- 0.1 °
- Anomaly size +/- 0.1”
- Temperature +/- 0.1 Deg C
- Pressure 0.1% or +/- 3 PSI (0.2 BARSG)

5 DATA ANALYSIS PROCEDURES

The primary function of the GEOPIG™ inertial survey is to determine the pipeline plan, profile and bending strain. This is achieved by computing the GEOPIG's trajectory during the run using the data collected by the onboard strapdown inertial unit and the odometers. Due to a tight fit of the GEOPIG™ cups into the pipe the tool rides practically along the pipe centreline. The only exception from this is the deviation of the tool trajectory from the pipe centerline due to serious pipe wall deformations, as well as "smoothing out the corners" over the transition length (equal to the distance between the cups) at the bend boundaries and at the girth welds exhibiting noticeable out-of-straightness, i.e. sudden change of direction due to the weld misalignment. That data it is then rotated into the GPS co-ordinates of the selected tie-points along the line (usually a few km apart) to obtain the desired location accuracy in a given UTM mapping projection.

The following paragraphs outline the methods used for processing the odometer and inertial data in order to obtain the pipeline slack and horizontal chainage, client chainage, pipeline position and bending strain.

5.1 Chainage

The following types of chainages are used for referencing the GEOPIG™ data:

- slack chainage - the distance measured by the GEOPIG's odometers along the pipeline.
- horizontal chainage - the true distance along the pipeline projection on the horizontal plane. Not required by the client in this survey.
- client chainage - the reference system used by the pipeline operator (e.g. station number used on the as-built drawings, or KP location from the ROV survey).

5.1.1 Slack Chainage

The GEOPIG™ slack chainage is the distance measured by the GEOPIG's odometers along the pipeline. It starts from zero at the reducer on the pig launcher and ends at the receive trap. The odometer accuracy is 0.1 %.

The chainage from the first run is used as the baseline for all the subsequent runs. The preliminary chainage from the subsequent runs derived from the odometer data is scaled to match the distance between the girth welds from the baseline survey. Therefore any change of pipeline length between runs, e.g. elongation due to temperature differential, is disregarded.

5.1.2 Absolute Chainage

The GEOPIG™ absolute chainage is the distance along the pipeline corresponding to the upstream edge of defects and the centre of other features, measured from the start of the run. The usage of such distance is as per client specifications.

5.1.3 Horizontal Chainage

The GEOPIG™ horizontal chainage represents the true horizontal distance of the surveyed pipeline. It is computed from the slack chainage by projecting it on the horizontal plane first, and then scaling it to match the horizontal distance based on the GPS co-ordinates (Northing and Easting). The scaling is performed between the same tie-points that are used for rotating the inertial survey data into its final position.

5.1.4 Client Chainage

The purpose of a client chainage is to represent any one-dimensional information used by the client, which could be correlated to the slack chainage. Usually the client chainage corresponds to the chainage shown on the as-builts, or to the chainage recorded during another in-line inspection. It can be incorporated into the data at any time after the DVD is issued to the client.

5.2 Pipeline Position

The pipeline position is provided in terms of Northing, Easting and Height as a function of the chainage, in a selected mapping projection (usually UTM) and a specified datum.

5.2.1 Tie Points

Inertial data is translated, rotated and scaled to the "tie points" with known co-ordinates. Those points are typically selected at traps, valves, welds, bends, wall thickness transitions, or any other pipeline features that can be detected directly or indirectly by the GEOPIG™ sensors. The co-ordinates of those points are usually obtained from GPS survey.

This procedure provides correction for long term drifts that can introduce an absolute position error in the inertial survey over time. By transforming the GEOPIG™ trajectory into the tie points, the Northing, Easting, and Height are obtained for any point along the pipe.

The specified accuracy of the inertial survey is 1:2,000 of the distance from the tie points; therefore for the following sample distances between the tie points the following absolute accuracy is obtained:

Distance Between Tie Points [m]	Absolute Accuracy [m]
20,000	5.0
10,000	2.5
5,000	1.25
3,000	0.75

For example, if the data from two GEOPIG™ run have been tied to the points that are 3km apart, then the allowable error in-between the ties points can reach 0.75m, which corresponds to up to 1.5m difference between two runs. To reduce the relative difference between two runs, a procedure described in the next section is applied, which ensures that the actual pipeline movement is measured with centimeter accuracy. There is practically no difference in the pipeline position between the runs in the areas where the pipeline did not move.

5.2.2 Pipeline Movement

Once preliminary processing has been completed, the data from the current and the previous GEOPIG™ surveys are compared in order to identify the areas of strain differences associated with the pipeline movement. Then the current data is reprocessed using the coordinates of the tie points extracted from the baseline GEOPIG™ survey at 100m intervals, except for the previously determined pipeline movement areas. This procedure improves the accuracy of the local pipeline movement measurement by

reducing the relative error between two runs. A noticeable error would result from the absolute position accumulation error when only the original tie points (from the GPS survey, at about 1km spacing) were used for scaling and rotating the inertial survey data.

5.3 Bending Strain

The bending strain is computed directly from the curvature of the GEOPIG™ trajectory, typically averaged over the distance of three pipe diameters. The specification for the bending strain measurements from the GEOPIG™ survey is +/- 0.02% strain. When the strain difference between two runs is compared that specification is usually exceeded in the originally straight sections of the line, and the accuracy of +/- 0.005% strain is achieved. The following subsections contain the description of the bending strain measurement and general remarks on interpretation of strain data.

5.3.1 Computation Method

There are two main components of the strain tensor in a pipe wall: the longitudinal strain (in the direction of the pipe axis) and the hoop strain (in the circumferential direction). The longitudinal strain is further separated into the axial component and the bending component that changes linearly along the pipe cross-section (see Figure 5.1).

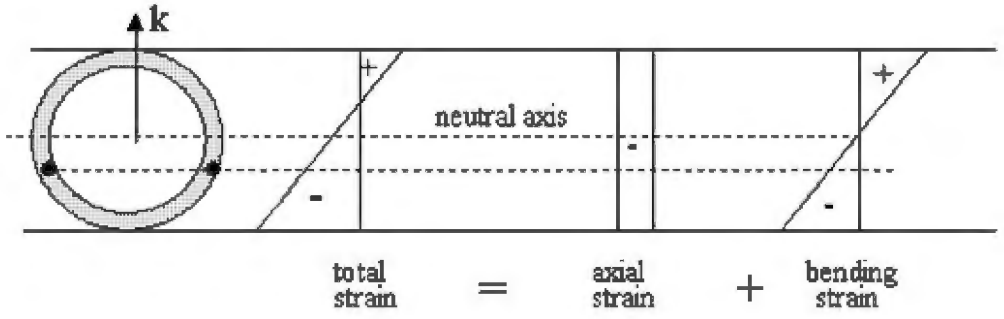


Figure 5.1 Distribution of Axial and Bending Components of Longitudinal Strain in Pipe Cross-section

The bending component of the longitudinal strain at any location in the pipe cross-section can be computed based on the bending strain at two points, e.g. at the top of the pipe (0 o'clock position) and on a right side (3 o'clock position). The bending strain at the bottom of the pipe is called the vertical strain ε_v, because it is induced by bending in the vertical plane (the bending strain at the top of the pipe has the same absolute value, but the opposite sign, i.e. $-\varepsilon_v$). For a similar reason the bending strain on the right side of the pipe is called the horizontal bending strain ε_H (the bending strain on the left side is equal to $-\varepsilon_H$). The maximum bending strain ε in the entire pipe-cross-section is equal to:

$$\varepsilon = \sqrt{\varepsilon_v^2 + \varepsilon_h^2} \,. \qquad (5.1)$$

ENBDNR0000075

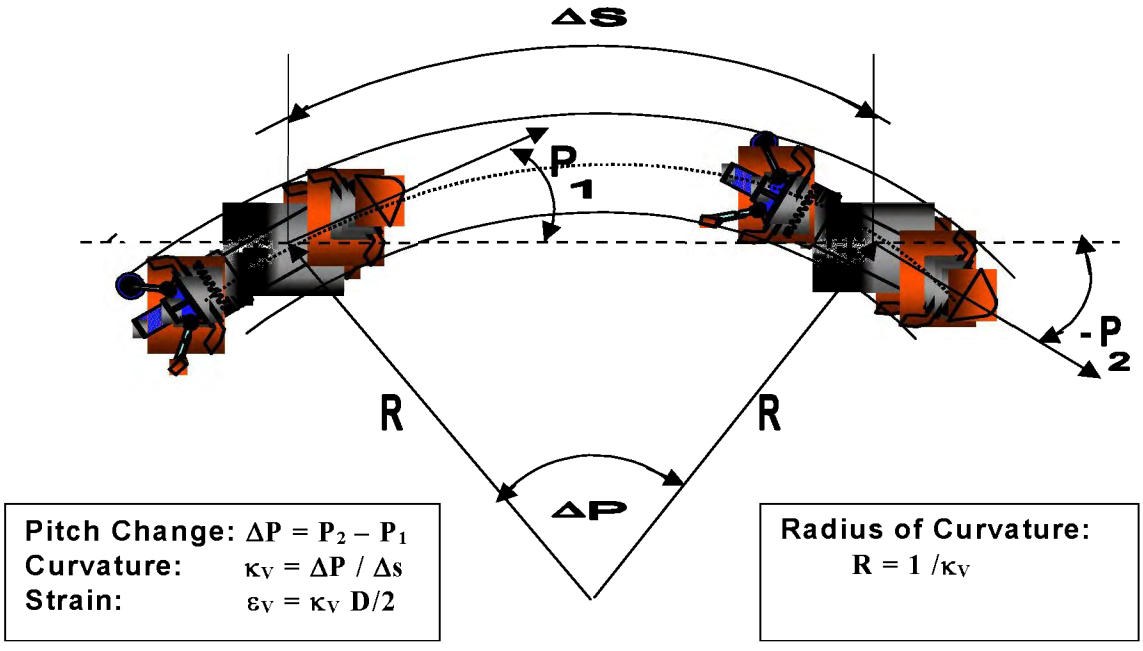


Figure 5.2 Computation of Pipeline Vertical Curvature and Strain from GEOPIG Pitch

Both the vertical and horizontal bending strains are computed from the GEOPIG™ survey using the measurements of the pipe centerline curvature. The curvature of a line in a 3-D space is defined as the change of direction (in radians) over the distance. The distance is measured by the odometers, and the direction of the pipe centerline is computed from the inertial system in terms of azimuth and pitch. The pitch P(s) describes the pipeline tilt with respect to the horizontal plane at chainage s, while the azimuth A(s) specifies the angle between the pipe direction and the north. The horizontal component of the curvature is proportional to the change of the azimuth, and the vertical component is proportional to the change of pitch. The following formulas are used for computation of the pipeline total curvature κ and its vertical κ_V and horizontal κ_h components based on the changes ΔP and ΔA of pitch and azimuth over a distance Δs along the pipe centerline:

$$\kappa = \sqrt{\kappa_v^2 + \kappa_h^2}\,, \qquad \kappa_v = \frac{\Delta P}{\Delta s}, \qquad \kappa_h = -\frac{\Delta A}{\Delta s}\cos(P) \qquad (5.2)$$

The relationship between curvature and bending strain is as follows:

$$\varepsilon = \frac{D}{2}\kappa \qquad \varepsilon_v = \frac{D}{2}\kappa_v \qquad \varepsilon_h = \frac{D}{2}\kappa_h \qquad (5.3)$$

where D is the pipe outside diameter.

The curvature radius is the inverse of the curvature. The BHI software reports strain in percents and the radius of curvature in pipe diameters. Strain is a unitless value that can be expressed in percents by multiplying it by 100%; e.g. 0.45% corresponds to 0.0045 strain.

ENBDNR0000076

5.3.2 Smoothing Curvature Data

The curvature can be computed according to formula (5.2) using the change of azimuth or pitch over the chainage increment as small as the distance between two inertial samples. The inertial data is collected at the rate of 100 samples per second. If the tool travels at the speed of 2 m/s then the distance between two samples is only 2 cm. The raw curvature computed this way would exhibit a significant level of noise, e.g. due to tool vibrations. In order to reduce that noise the curvature is typically averaged over a distance of 3 – 5 pipe diameters, i.e. 2-3m for 20" diameter pipe. For computational efficiency, instead of calculating the actual average, the curvature is computed using formula (5.2), where the increments ΔP and ΔA of pitch and azimuth are taken over a distance of 2m. This is practically equivalent to averaging curvature over the same distance - if the data are equally spaced, i.e. when the tool velocity is stable. The longer is the averaging length the smoother are the results.

Another smoothing technique is a regression line fit to the pitch or azimuth considered as functions of chainage. That method fits a line to all of the pitch values (or azimuth) over a specified length. This is practically equivalent to fitting a circle to all of the points along the GEOPIG™ trajectory over the specified length, but again much more computationally efficient than actually doing it. The radius of that circle is equal to the radius of curvature of the pipeline. The regression line fit produces smoother results than a regular moving average applied over the same length.

When estimating the bending strain induced by pipe-soil interaction, the curvature can be smoothed out over a length longer than 5 pipe diameters, usually over 5 - 10m. This approach significantly reduces the effect of weld misalignment, pipe wall imperfections and tool dynamics on the computed curvature, and at the same time it doesn't underestimate the bending strain induced by pipeline movement. This approach is particularly suited for calculation of strain difference between two runs. However, averaging over too long distance is not proper for computation of curvature of short features, such as bends or buckles. The bending strain of a feature would be underestimated if the feature was shorter than the effective averaging distance, which includes both the length used in curvature computation and the tool length, i.e. the distance between the cups supporting the pig body (i.e. the inertial canister in case of multi-body tools).

5.3.3 Interpretation of Bending Strain Data

The GEOPIG™ measures the total pipeline bending strain at the time of inspection, which includes strain induced during manufacturing, construction and operation. While pipeline is in operation the strain may be caused by the operating conditions (temperature and pressure differential) or by the external forces affecting the pipeline as the results of sea-bottom scouring, sub-sea currents, slope instability, soil settlement and erosion, etc. As the GEOPIG™ measures the total bending strain, including the plastic component induced during the whole history of loading, the current shape of the pipe and its bending strain cannot be fully explained by taking into consideration only the forces acting on the pipe during the inspection, e.g. the gravity, buoyancy and support reaction.

The GEOPIG™ measures the curvature of the pipe centerline with all its imperfections, including the out-of-straightness at welds that is theoretically described by infinite curvature, although it does not correspond to any bending strain in the pipe wall. When such curvature is measured by the GEOPIG™ is obviously not infinite due to the finite

length of the tool and some additional smoothing applied during data processing, but it may still show up as spikes of significant amplitude in the curvature data.

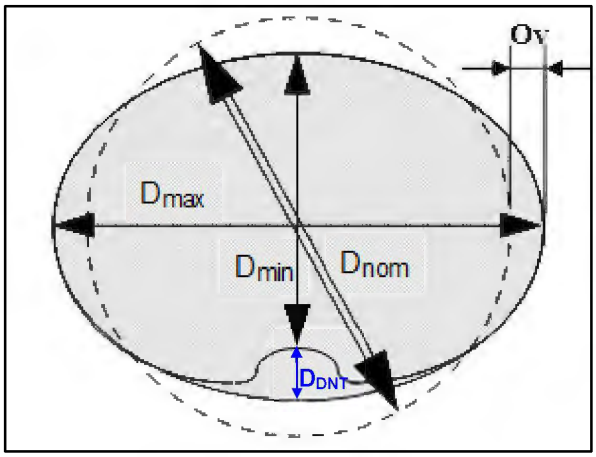
When analyzing the bending strain induced during operation the high residual plastic strain present in the field bends should be disregarded. The main features distinguishing the bending strain induced during operation from the field bends are briefly discussed below. The bending strain in the field bends is usually in the range from 1 to 2% strain and is confined to one pipe joint and is characterized by an abrupt change of strain at the beginning and the end of a bend. The bending strain induced during operation is usually of smaller amplitude, spans more than one pipe joint and undergoes gradual change over longer transition sections.

5.4 Pipewall Anomaly Calculation

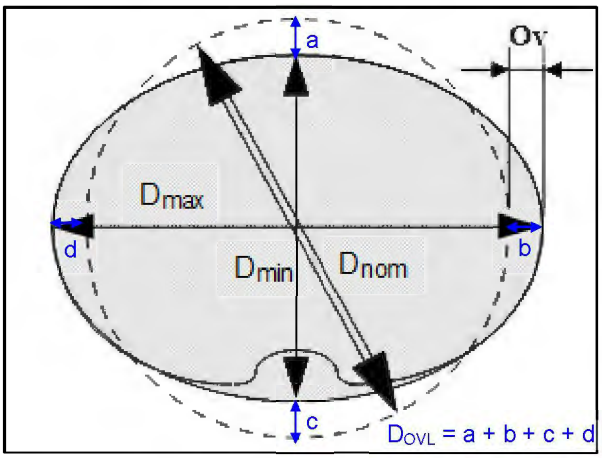
The caliper information is processed to provide the internal shape and diameter of the pipeline. The anomaly size D (depth) is calculated as follows:

For dents: $D_{DNT} = D_{Rstr} - 2*O_V$ without ovality $D_{Rstr} = D_{Nom} - D_{Min}$

$O_V = (D_{Max} - D_{Nom})/2$



For Ovality: $D_{OVL} = D_{Max} - D_{Min}$ CSA Z662



where:

D_{Rstr}	- total diameter restriction
O_V	- pipe ovality
D_{Nom}	- inner nominal pipe diameter
D_{Min}	- inner pipe diameter at the feature
D_{Max}	- inner pipe diameter 90° from the feature

The dent length and width are calculated as the axial distance and the circumferential distance between points of zero radial deflection respectively. The ovality length and width are calculated as the axial distance and the circumferential distance over which the feature depth exceeds 50% of its peak value respectively. A dent with the width larger than its length is called an inward wrinkle. The outward wrinkle is characterized by a local increase of pipe diameter.

6 BHI Software Installation

The report is accompanied by a DVD-ROM containing the BHI display software and the data from the present survey. The data can be viewed using the GeminiView and GeoDisplay programs running in Microsoft Windows operating system. GeminiView is used to display the 3-D view of the pipe and the inner pipe wall shape measured by the calipers. GeoDisplay is used for displaying the inertial, odometer, weld, caliper, and other data bases (if available).

The directory structure on the DVD is as follows:

\BHI\NPS20_Line5_NorthStraitsWEST-Mackinaw\2016_GEOPIG, which contains:

- several subdirectories with the GEOPIG™ data from the run
- environment file 2016_GEOPIG_NPS20_Line5_NorthStraitsWEST-Mackinaw _Issue1.env with the information on the location of the data files from the run. (%RootDir% specifies the path, and %BaseName% - the name)
- configuration file GD.cfg for Geodisplay

\BHI\BHI_Software	with the software stored on two subdirectories:
\GeminiView	with the GeminiView program (GEMINIVIEW.EXE)
\GD	with the GeoDisplay program (GDWIN.EXE)

The entire content of the DVD can be copied to a network drive, or a local hard drive for faster access of the data and the ability to save configurations files with customized displays. The programs can be also stored on the local hard drive while the data is accessed from the DVD or a network drive. In this case only the \BHI_Software subdirectory needs to be copied on the local hard drive.

Geminiview:

To setup the GeminiView program for the first time on a computer:

- Run the setup.exe program in the BHI\BHI_Software\GeminiView directory.

To launch the GeminiView program:

- Double click Geminiview_3.21.exe

Jobs can then be loaded using the File ⇒ Open menu

GeoDisplay:

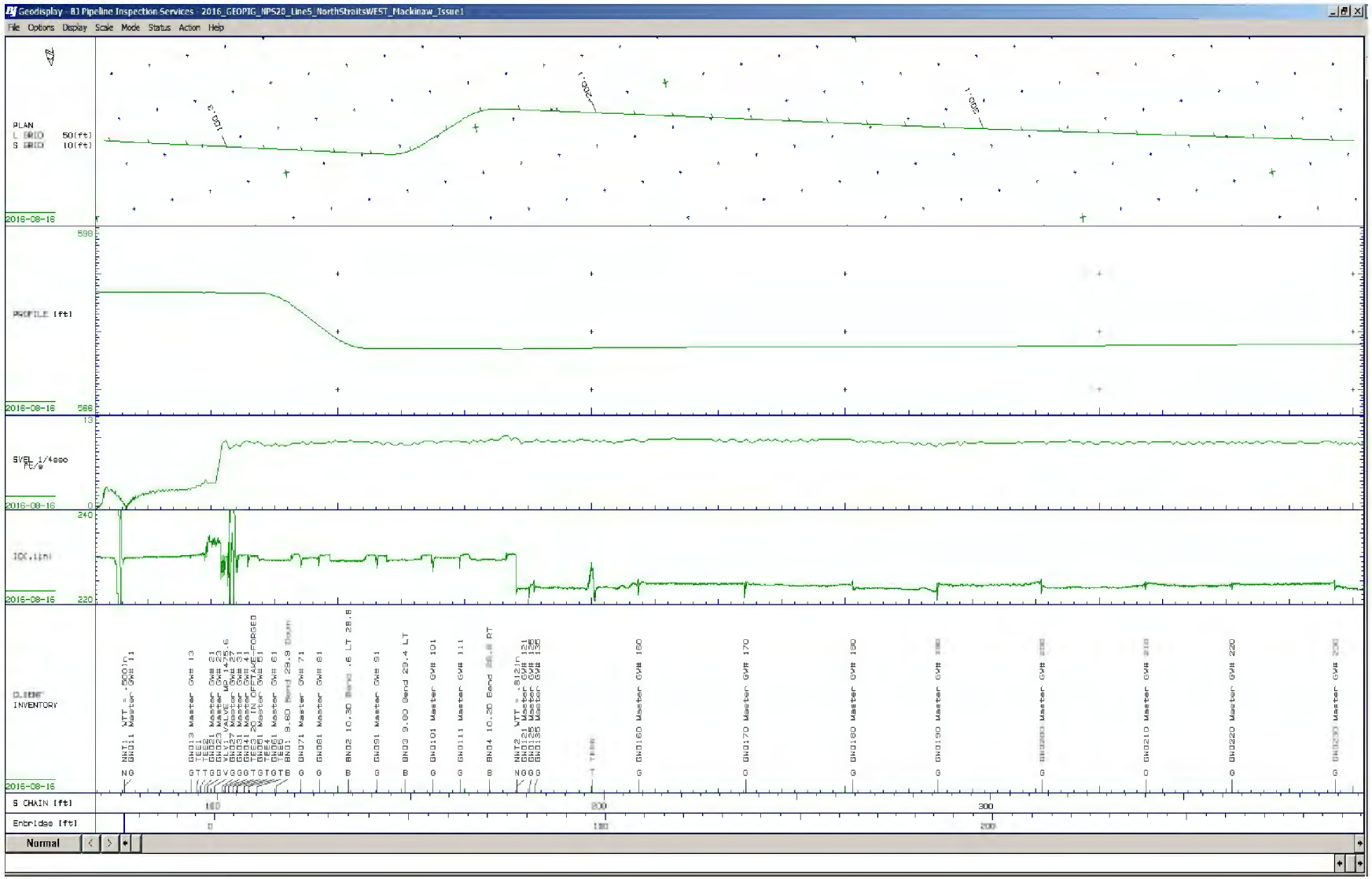
The simplest way to launch GeoDisplay from the DVD is to double click on the application program (GDWIN.EXE) using Windows Explorer.

The recommended way to launch GeoDisplay is to copy the "Geodisplay NPS20_ Line5_NorthStraitsWEST-Mackinaw" icon onto the computer desktop using the procedure outlined below. It is assumed that the subdirectory \BHI\BHI_Software is stored on the **C:** drive, and the data directory \BHI\NPS20_Line5_NorthStraitsWEST-Mackinaw_Issue1 is on the **D:** drive. However, the proper drive letters for the DVD, network or hard drive corresponding to the actual location of those directories have to be used.

1) Go to directory C:\BHI\BHI_Software\GD using the Windows Explorer and drag the shortcut icon "Geodisplay NPS20_ Line5_NorthStraitsWEST-Mackinaw (with the blue and white BHI logo) to the desktop.
2) Right click on this new icon and left click on "Properties".

3) Click on the “Shortcut” tab and make sure the “Target” and “Start in” are set to **C:**\BHI\BHI_Software\GD\GDWIN.exe and **D:** \BHI\NPS20_Line5_NorthStraitsWEST-Mackinaw respectively.
4) Click on the “General” tab and uncheck the “Read-only” box.
5) To start the program, double click on the icon.

Appendix 9. Pipe Tally – Sample Plot



Appendix 12. Plots of Pipeline Plan, Profile, Internal Diameter and Features

GPS Reference Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

BAKER HUGHES

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Comments	Northing (m)	Easting (m)	Height (m)	Latitude (deg.)	Longitude (deg.)
VLV 1	98.16	-0.05	23	0.81	St Ignace Launch Valve	5,078,864.49	674,359.29	178.85	45.84127980	-84.75463148
VLV 2	21,850.59	21,569.53	8621	0.65	Mackinaw Station Receive Valve	5,072,711.65	672,939.58	198.56	45.78629987	-84.77510602

PipeWall Anomaly Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Dist to D/S GWD (ft)	Clock Position h:mm	Depth (in)	Depth (%)	Length (in)	Width (in)	Northing (m)	Easting (m)	Height (m)	Comments
OVL 1	15,478.78	15,259.89	6080	14.21	6.9	1:15	1.846	9.2	42.61	9.07	5,074,485.62	673,174.86	151.45	
OVL 2	15,529.24	15,310.12	6100	17.33	2.9	1:00	1.134	5.7	41.55	9.58	5,074,470.87	673,170.58	153.14	

Minimum Internal Diameter Listing (ID < 90% OD)

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Dist to D/S GWD (ft)	Internal Diameter (in)	Internal Diameter (%OD)	Length (in)	Northing (m)	Easting (m)	Height (m)	Comments
IDR 1	15,478.75	15,259.94	6080	14.18	6.88	17.31	86.5	60.65	5,074,485.61	673,174.86	151.45	At ovality with heavy wall
IDR 2	15,529.34	15,310.10	6100	17.43	2.81	17.81	89.0	41.27	5,074,470.68	673,170.58	153.14	At ovality with heavy wall
IDR 3	20,938.55	20,666.41	8190	15.28	11.29	17.93	89.7	68.74	5,072,865.47	672,797.13	183.95	At bend with heavy wall
IDR 4	21,303.18	21,026.85	8330	16.71	10.16	17.99	90.0	163.18	5,072,760.14	672,784.29	195.23	At bend with heavy wall

PipeLine Movement Listing

Client: Enbridge Energy, Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

BAKER HUGHES

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Largest Strain Difference			Strain Value at Largest Diff.			Pipeline Movement		Start Chainage (ft)	End Chainage (ft)	Length (ft)	Northing (m)	Easting (m)	Height (m)	Comments
			Vert. (%)	Horz. (%)	Total (%)	Vert. (%)	Horz. (%)	Total (%)	Vert. (ft)	Horz. (ft)							
STR 1	115.43	16.64	-4.86	-0.03	4.86	-4.84	-0.03	4.84	-9.25	11.02	77.10	235.74	158.64	5,078,865.64	674,354.52	178.64	Launch area changed since 2005
STR 2	21,780.55	21,499.61	1.22	-5.11	5.25	1.23	-5.12	5.27	-8.43	38.35	21,694.17	21,891.42	197.24	5,072,725.79	672,925.43	196.06	Receive area changed since 2013

Note (1) Chainage and coordinates refer to the location of the peak total strain difference
(2) Peak vert mvmt, peak horz mvmt peak total strain diff may not be at the same location
(3) Positive vertical movements mean the pipe has moved up
(4) Positive horizontal movements mean the pipe has moved left

Bend Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

BAKER HUGHES

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Bend		Azimuth		Pitch		Northing (m)	Easting (m)	Height (m)
					Rad. (D)	Angle (deg.)	Change (deg).	Dir.	Change (deg).	Dir.			
BND 1	115.26	16.47	61	7.15	9.6	29.9	0.2	Right	29.9	Down	5,078,865.63	674,354.56	178.65
BND 2	133.67	34.89	81	7.49	10.3	29.9	0.6	Left	29.9	Up	5,078,866.83	674,349.67	176.11
BND 3	148.65	49.13	91	7.34	9.8	29.4	29.4	Left	0.1	Down	5,078,867.70	674,345.28	175.90
BND 4	170.43	70.57	111	7.62	10.2	29.8	29.8	Right	0.3	Down	5,078,866.17	674,338.83	175.88
BND 5	577.97	479.30	300	15.05	24.9	19.4	19.4	Left	0.3	Up	5,078,893.82	674,217.70	176.25
BND 6	598.90	500.50	310	11.18	25.1	21.6	21.6	Left	0.3	Up	5,078,893.12	674,211.39	176.23
BND 7	625.76	527.47	320	12.86	25.9	23.9	23.9	Left	0.9	Down	5,078,889.23	674,204.24	176.30
BND 8	649.47	551.05	330	11.12	23.2	23.3	23.2	Left	1.4	Up	5,078,883.51	674,199.89	176.33
BND 9	15,422.76	15,204.64	6060	2.79	47.9	7.2	3.1	Left	6.5	Down	5,074,502.35	673,178.04	152.24
BND 10	15,447.90	15,229.48	6070	5.60	48.1	4.4	1.6	Right	4.2	Up	5,074,494.83	673,176.71	151.64
BND 11	15,481.18	15,262.34	6080	16.61	29.7	9.2	5.1	Right	7.7	Up	5,074,484.89	673,174.69	151.48
BND 12	15,529.22	15,309.97	6100	17.31	24.6	6.0	3.1	Left	5.1	Down	5,074,470.92	673,170.59	153.14
BND 13	15,982.25	15,760.16	6280	3.99	45.4	3.0	2.1	Left	2.1	Up	5,074,336.55	673,138.55	153.07
BND 14	20,938.71	20,666.57	8190	15.44	23.6	8.1	0.0	Right	8.1	Down	5,072,865.42	672,797.12	183.96
BND 15	21,176.41	20,901.69	8280	21.30	29.3	4.4	0.3	Right	4.4	Up	5,072,794.92	672,780.50	186.48
BND 16	21,190.21	20,915.21	8290	7.14	30.9	5.1	0.0	Right	5.1	Up	5,072,790.86	672,779.49	186.90
BND 17	21,218.64	20,943.88	8300	11.25	24.4	11.0	10.0	Left	5.2	Up	5,072,782.57	672,777.46	188.45
BND 18	21,251.33	20,976.20	8310	17.69	24.3	18.8	19.5	Left	1.3	Up	5,072,772.97	672,776.89	191.04
BND 19	21,274.87	20,998.76	8320	12.52	23.1	24.2	25.0	Left	2.0	Down	5,072,766.40	672,778.83	193.10
BND 20	21,300.80	21,024.47	8330	14.33	24.5	23.6	22.8	Left	7.7	Down	5,072,760.57	672,783.73	195.10
BND 21	21,323.00	21,046.52	8340	9.65	25.1	15.2	14.1	Left	5.7	Down	5,072,757.42	672,789.62	195.99
BND 22	21,780.83	21,499.89	8531	13.10	9.2	52.3	51.4	Right	11.0	Up	5,072,725.74	672,925.49	196.07
BND 23	21,826.40	21,544.56	8551	13.80	10.0	51.8	51.0	Left	10.7	Down	5,072,713.94	672,932.22	198.44

Wall Thickness Transition Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nominal WT D/S from GWD (in)	Length (ft)	Northing (m)	Easting (m)	Height (m)
GWD 11	75.91	-23.99	0.500	101.64	5,078,862.82	674,366.21	178.87
GWD 121	177.54	77.62	0.812	21,590.19	5,078,866.49	674,336.69	175.87
GWD 8531	21,767.73	21,487.05	0.656	20.26	5,072,727.11	672,921.79	195.99
GWD 8541	21,787.99	21,506.91	0.500	24.61	5,072,724.06	672,926.84	196.38
GWD 8551	21,812.60	21,531.03	0.656	27.37	5,072,717.39	672,929.99	197.75
GWD 8561	21,839.97	21,557.85	0.500	35.64	5,072,712.49	672,936.05	198.58

Valve and Tee Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

BAKER HUGHES

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Comments	Northing (m)	Easting (m)	Height (m)
TEE 1	94.61	-4.70	13	1.36		5,078,864.16	674,360.65	178.85
TEE 2	95.60	-3.68	13	2.35		5,078,864.23	674,360.35	178.85
VLV 1	98.16	-0.05	23	0.81	St Ignace Launch Valve	5,078,864.49	674,359.29	178.85
TEE 3	103.11	4.69	41	0.26	20 IN OFFTAKE-FORGED	5,078,864.83	674,357.89	178.84
TEE 4	107.00	7.94	51	1.84		5,078,865.06	674,356.98	178.84
TEE 5	110.19	11.30	61	2.08		5,078,865.28	674,356.03	178.83
TEE 6	196.18	96.58	135	14.01		5,078,867.85	674,330.93	175.92
TEE 7	21,732.43	21,453.17	8500	15.48		5,072,729.52	672,911.53	196.03
TEE 8	21,737.55	21,457.58	8500	20.60		5,072,729.21	672,912.87	196.02
TEE 9	21,740.32	21,460.29	8500	23.37		5,072,729.02	672,913.69	196.01
TEE 10	21,835.04	21,553.17	8551	22.44		5,072,712.84	672,934.63	198.59
TEE 11	21,836.93	21,555.01	8551	24.33		5,072,712.71	672,935.19	198.59
TEE 12	21,838.94	21,556.98	8551	26.34		5,072,712.56	672,935.78	198.58
TEE 13	21,845.36	21,563.96	8581	0.37		5,072,712.06	672,937.90	198.57
VLV 2	21,850.59	21,569.53	8621	0.65	Mackinaw Station Receive Valve	5,072,711.65	672,939.58	198.56
TEE 14	21,854.92	21,572.63	8643	0.41		5,072,711.42	672,940.52	198.55
TEE 15	21,873.04	21,590.45	8643	18.52		5,072,710.13	672,945.91	198.48
TEE 16	21,874.03	21,591.39	8643	19.52		5,072,710.06	672,946.19	198.47

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD11	75.91	1	Line 5 North Straits WEST - Mackinaw	-23.99	Master GW# 11
GWD21	96.70	1	Line 5 North Straits WEST - Mackinaw	-2.63	Master GW# 21
GWD31	101.95	1	Line 5 North Straits WEST - Mackinaw	2.66	Master GW# 31
GWD41	102.85	1	Line 5 North Straits WEST - Mackinaw	3.57	Master GW# 41
GWD51	105.16	1	Line 5 North Straits WEST - Mackinaw	5.88	Master GW# 51
GWD61	108.11	1	Line 5 North Straits WEST - Mackinaw	9.07	Master GW# 61
GWD71	121.65	1	Line 5 North Straits WEST - Mackinaw	23.09	Master GW# 71
GWD81	126.38	1	Line 5 North Straits WEST - Mackinaw	27.84	Master GW# 81
GWD91	141.31	1	Line 5 North Straits WEST - Mackinaw	41.88	Master GW# 91
GWD101	155.75	1	Line 5 North Straits WEST - Mackinaw	56.14	Master GW# 101
GWD111	162.82	1	Line 5 North Straits WEST - Mackinaw	63.03	Master GW# 111
GWD121	177.54	1	Line 5 North Straits WEST - Mackinaw	77.62	Master GW# 121
GWD125	180.87	1	Line 5 North Straits WEST - Mackinaw	80.70	Master GW# 125
GWD160	209.08	1	Line 5 North Straits WEST - Mackinaw	108.50	Master GW# 160
GWD170	236.67	1	Line 5 North Straits WEST - Mackinaw	136.08	Master GW# 170
GWD180	264.45	1	Line 5 North Straits WEST - Mackinaw	163.51	Master GW# 180
GWD190	286.45	1	Line 5 North Straits WEST - Mackinaw	186.13	Master GW# 190
GWD200	313.37	1	Line 5 North Straits WEST - Mackinaw	212.56	Master GW# 200
GWD210	340.21	1	Line 5 North Straits WEST - Mackinaw	239.49	Master GW# 210
GWD220	362.50	1	Line 5 North Straits WEST - Mackinaw	261.71	Master GW# 220
GWD230	389.12	1	Line 5 North Straits WEST - Mackinaw	288.15	Master GW# 230
GWD240	414.73	1	Line 5 North Straits WEST - Mackinaw	314.25	Master GW# 240
GWD250	441.15	1	Line 5 North Straits WEST - Mackinaw	341.14	Master GW# 250
GWD260	461.54	1	Line 5 North Straits WEST - Mackinaw	361.89	Master GW# 260
GWD270	487.69	1	Line 5 North Straits WEST - Mackinaw	387.89	Master GW# 270
GWD280	514.48	1	Line 5 North Straits WEST - Mackinaw	415.01	Master GW# 280
GWD290	537.15	1	Line 5 North Straits WEST - Mackinaw	437.81	Master GW# 290
GWD300	562.92	1	Line 5 North Straits WEST - Mackinaw	464.13	Master GW# 300
GWD310	587.71	1	Line 5 North Straits WEST - Mackinaw	489.12	Master GW# 310
GWD320	612.90	1	Line 5 North Straits WEST - Mackinaw	514.75	Master GW# 320

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD330	638.35	1	Line 5 North Straits WEST - Mackinaw	539.93	Master GW# 330
GWD340	664.15	1	Line 5 North Straits WEST - Mackinaw	565.72	Master GW# 340
GWD350	671.35	1	Line 5 North Straits WEST - Mackinaw	573.05	Master GW# 350
GWD360	697.89	1	Line 5 North Straits WEST - Mackinaw	599.62	Master GW# 360
GWD370	725.10	1	Line 5 North Straits WEST - Mackinaw	626.69	Master GW# 370
GWD380	752.22	1	Line 5 North Straits WEST - Mackinaw	654.09	Master GW# 380
GWD390	780.41	1	Line 5 North Straits WEST - Mackinaw	682.26	Master GW# 390
GWD400	806.57	1	Line 5 North Straits WEST - Mackinaw	708.75	Master GW# 400
GWD410	831.12	1	Line 5 North Straits WEST - Mackinaw	733.59	Master GW# 410
GWD420	856.66	1	Line 5 North Straits WEST - Mackinaw	759.01	Master GW# 420
GWD430	880.26	1	Line 5 North Straits WEST - Mackinaw	782.84	Master GW# 430
GWD440	907.47	1	Line 5 North Straits WEST - Mackinaw	810.50	Master GW# 440
GWD450	930.65	1	Line 5 North Straits WEST - Mackinaw	834.20	Master GW# 450
GWD460	953.88	1	Line 5 North Straits WEST - Mackinaw	857.68	Master GW# 460
GWD470	981.15	1	Line 5 North Straits WEST - Mackinaw	885.49	Master GW# 470
GWD480	1,000.67	1	Line 5 North Straits WEST - Mackinaw	905.18	Master GW# 480
GWD490	1,026.55	1	Line 5 North Straits WEST - Mackinaw	932.05	Master GW# 490
GWD500	1,049.69	1	Line 5 North Straits WEST - Mackinaw	956.16	Master GW# 500
GWD510	1,077.38	1	Line 5 North Straits WEST - Mackinaw	983.80	Master GW# 510
GWD520	1,102.91	1	Line 5 North Straits WEST - Mackinaw	1,010.24	Master GW# 520
GWD530	1,128.13	1	Line 5 North Straits WEST - Mackinaw	1,035.64	Master GW# 530
GWD540	1,148.60	1	Line 5 North Straits WEST - Mackinaw	1,056.59	Master GW# 540
GWD550	1,174.86	1	Line 5 North Straits WEST - Mackinaw	1,083.11	Master GW# 550
GWD560	1,201.61	1	Line 5 North Straits WEST - Mackinaw	1,109.95	Master GW# 560
GWD570	1,228.19	1	Line 5 North Straits WEST - Mackinaw	1,136.73	Master GW# 570
GWD580	1,251.00	1	Line 5 North Straits WEST - Mackinaw	1,159.75	Master GW# 580
GWD590	1,275.60	1	Line 5 North Straits WEST - Mackinaw	1,184.46	Master GW# 590
GWD600	1,301.52	1	Line 5 North Straits WEST - Mackinaw	1,210.43	Master GW# 600
GWD610	1,322.12	1	Line 5 North Straits WEST - Mackinaw	1,231.39	Master GW# 610
GWD620	1,350.03	1	Line 5 North Straits WEST - Mackinaw	1,258.89	Master GW# 620

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD630	1,374.05	1	Line 5 North Straits WEST - Mackinaw	1,283.07	Master GW# 630
GWD640	1,397.56	1	Line 5 North Straits WEST - Mackinaw	1,307.09	Master GW# 640
GWD650	1,417.58	1	Line 5 North Straits WEST - Mackinaw	1,326.99	Master GW# 650
GWD660	1,444.37	1	Line 5 North Straits WEST - Mackinaw	1,353.78	Master GW# 660
GWD670	1,464.77	1	Line 5 North Straits WEST - Mackinaw	1,374.70	Master GW# 670
GWD680	1,492.18	1	Line 5 North Straits WEST - Mackinaw	1,402.48	Master GW# 680
GWD690	1,516.36	1	Line 5 North Straits WEST - Mackinaw	1,426.74	Master GW# 690
GWD700	1,543.14	1	Line 5 North Straits WEST - Mackinaw	1,453.81	Master GW# 700
GWD710	1,567.43	1	Line 5 North Straits WEST - Mackinaw	1,478.29	Master GW# 710
GWD720	1,594.02	1	Line 5 North Straits WEST - Mackinaw	1,505.03	Master GW# 720
GWD730	1,621.07	1	Line 5 North Straits WEST - Mackinaw	1,532.30	Master GW# 730
GWD740	1,647.31	1	Line 5 North Straits WEST - Mackinaw	1,559.27	Master GW# 740
GWD750	1,673.00	1	Line 5 North Straits WEST - Mackinaw	1,584.75	Master GW# 750
GWD760	1,695.73	1	Line 5 North Straits WEST - Mackinaw	1,607.51	Master GW# 760
GWD770	1,722.37	1	Line 5 North Straits WEST - Mackinaw	1,634.22	Master GW# 770
GWD780	1,750.11	1	Line 5 North Straits WEST - Mackinaw	1,662.02	Master GW# 780
GWD790	1,776.49	1	Line 5 North Straits WEST - Mackinaw	1,688.61	Master GW# 790
GWD800	1,795.06	1	Line 5 North Straits WEST - Mackinaw	1,706.96	Master GW# 800
GWD810	1,821.26	1	Line 5 North Straits WEST - Mackinaw	1,733.10	Master GW# 810
GWD820	1,848.27	1	Line 5 North Straits WEST - Mackinaw	1,760.09	Master GW# 820
GWD830	1,876.46	1	Line 5 North Straits WEST - Mackinaw	1,787.93	Master GW# 830
GWD840	1,903.75	1	Line 5 North Straits WEST - Mackinaw	1,815.16	Master GW# 840
GWD850	1,924.60	1	Line 5 North Straits WEST - Mackinaw	1,836.29	Master GW# 850
GWD860	1,950.45	1	Line 5 North Straits WEST - Mackinaw	1,862.23	Master GW# 860
GWD870	1,978.87	1	Line 5 North Straits WEST - Mackinaw	1,889.93	Master GW# 870
GWD880	2,006.71	1	Line 5 North Straits WEST - Mackinaw	1,917.32	Master GW# 880
GWD890	2,030.08	1	Line 5 North Straits WEST - Mackinaw	1,940.82	Master GW# 890
GWD900	2,055.21	1	Line 5 North Straits WEST - Mackinaw	1,966.20	Master GW# 900
GWD910	2,081.90	1	Line 5 North Straits WEST - Mackinaw	1,992.95	Master GW# 910
GWD920	2,107.03	1	Line 5 North Straits WEST - Mackinaw	2,018.14	Master GW# 920

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD930	2,133.11	1	Line 5 North Straits WEST - Mackinaw	2,044.27	Master GW# 930
GWD940	2,160.29	1	Line 5 North Straits WEST - Mackinaw	2,071.77	Master GW# 940
GWD950	2,185.57	1	Line 5 North Straits WEST - Mackinaw	2,096.78	Master GW# 950
GWD960	2,213.16	1	Line 5 North Straits WEST - Mackinaw	2,124.53	Master GW# 960
GWD970	2,241.49	1	Line 5 North Straits WEST - Mackinaw	2,152.39	Master GW# 970
GWD980	2,269.20	1	Line 5 North Straits WEST - Mackinaw	2,179.88	Master GW# 980
GWD990	2,288.49	1	Line 5 North Straits WEST - Mackinaw	2,199.95	Master GW# 990
GWD1000	2,315.89	1	Line 5 North Straits WEST - Mackinaw	2,227.04	Master GW# 1000
GWD1010	2,343.82	1	Line 5 North Straits WEST - Mackinaw	2,254.80	Master GW# 1010
GWD1020	2,370.95	1	Line 5 North Straits WEST - Mackinaw	2,282.41	Master GW# 1020
GWD1030	2,398.83	1	Line 5 North Straits WEST - Mackinaw	2,309.90	Master GW# 1030
GWD1040	2,426.32	1	Line 5 North Straits WEST - Mackinaw	2,337.15	Master GW# 1040
GWD1050	2,452.35	1	Line 5 North Straits WEST - Mackinaw	2,363.29	Master GW# 1050
GWD1060	2,479.44	1	Line 5 North Straits WEST - Mackinaw	2,390.18	Master GW# 1060
GWD1070	2,506.47	1	Line 5 North Straits WEST - Mackinaw	2,417.26	Master GW# 1070
GWD1080	2,529.50	1	Line 5 North Straits WEST - Mackinaw	2,440.28	Master GW# 1080
GWD1090	2,554.85	1	Line 5 North Straits WEST - Mackinaw	2,465.46	Master GW# 1090
GWD1100	2,580.53	1	Line 5 North Straits WEST - Mackinaw	2,491.28	Master GW# 1100
GWD1110	2,608.25	1	Line 5 North Straits WEST - Mackinaw	2,518.68	Master GW# 1110
GWD1120	2,634.85	1	Line 5 North Straits WEST - Mackinaw	2,545.39	Master GW# 1120
GWD1130	2,661.25	1	Line 5 North Straits WEST - Mackinaw	2,572.18	Master GW# 1130
GWD1140	2,682.76	1	Line 5 North Straits WEST - Mackinaw	2,594.41	Master GW# 1140
GWD1150	2,706.37	1	Line 5 North Straits WEST - Mackinaw	2,618.16	Master GW# 1150
GWD1160	2,729.18	1	Line 5 North Straits WEST - Mackinaw	2,640.81	Master GW# 1160
GWD1170	2,753.94	1	Line 5 North Straits WEST - Mackinaw	2,665.67	Master GW# 1170
GWD1180	2,778.70	1	Line 5 North Straits WEST - Mackinaw	2,690.87	Master GW# 1180
GWD1190	2,802.32	1	Line 5 North Straits WEST - Mackinaw	2,714.90	Master GW# 1190
GWD1200	2,825.38	1	Line 5 North Straits WEST - Mackinaw	2,738.51	Master GW# 1200
GWD1210	2,851.76	1	Line 5 North Straits WEST - Mackinaw	2,765.16	Master GW# 1210
GWD1220	2,877.94	1	Line 5 North Straits WEST - Mackinaw	2,791.68	Master GW# 1220

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD1230	2,896.88	1	Line 5 North Straits WEST - Mackinaw	2,811.72	Master GW# 1230
GWD1240	2,919.35	1	Line 5 North Straits WEST - Mackinaw	2,833.60	Master GW# 1240
GWD1250	2,945.98	1	Line 5 North Straits WEST - Mackinaw	2,860.37	Master GW# 1250
GWD1260	2,967.66	1	Line 5 North Straits WEST - Mackinaw	2,882.74	Master GW# 1260
GWD1270	2,993.33	1	Line 5 North Straits WEST - Mackinaw	2,908.53	Master GW# 1270
GWD1280	3,020.20	1	Line 5 North Straits WEST - Mackinaw	2,935.53	Master GW# 1280
GWD1290	3,046.55	1	Line 5 North Straits WEST - Mackinaw	2,961.68	Master GW# 1290
GWD1300	3,067.78	1	Line 5 North Straits WEST - Mackinaw	2,982.95	Master GW# 1300
GWD1310	3,093.63	1	Line 5 North Straits WEST - Mackinaw	3,008.46	Master GW# 1310
GWD1320	3,120.49	1	Line 5 North Straits WEST - Mackinaw	3,035.49	Master GW# 1320
GWD1330	3,145.87	1	Line 5 North Straits WEST - Mackinaw	3,060.98	Master GW# 1330
GWD1340	3,173.45	1	Line 5 North Straits WEST - Mackinaw	3,088.43	Master GW# 1340
GWD1350	3,199.59	1	Line 5 North Straits WEST - Mackinaw	3,114.82	Master GW# 1350
GWD1360	3,225.39	1	Line 5 North Straits WEST - Mackinaw	3,140.37	Master GW# 1360
GWD1370	3,252.96	1	Line 5 North Straits WEST - Mackinaw	3,168.40	Master GW# 1370
GWD1380	3,279.25	1	Line 5 North Straits WEST - Mackinaw	3,194.91	Master GW# 1380
GWD1390	3,303.54	1	Line 5 North Straits WEST - Mackinaw	3,219.43	Master GW# 1390
GWD1400	3,328.07	1	Line 5 North Straits WEST - Mackinaw	3,243.99	Master GW# 1400
GWD1410	3,355.15	1	Line 5 North Straits WEST - Mackinaw	3,270.81	Master GW# 1410
GWD1420	3,381.91	1	Line 5 North Straits WEST - Mackinaw	3,297.61	Master GW# 1420
GWD1430	3,406.98	1	Line 5 North Straits WEST - Mackinaw	3,322.50	Master GW# 1430
GWD1440	3,435.56	1	Line 5 North Straits WEST - Mackinaw	3,350.66	Master GW# 1440
GWD1450	3,459.84	1	Line 5 North Straits WEST - Mackinaw	3,374.95	Master GW# 1450
GWD1460	3,486.84	1	Line 5 North Straits WEST - Mackinaw	3,401.55	Master GW# 1460
GWD1470	3,508.92	1	Line 5 North Straits WEST - Mackinaw	3,423.55	Master GW# 1470
GWD1480	3,533.14	1	Line 5 North Straits WEST - Mackinaw	3,447.51	Master GW# 1480
GWD1490	3,559.09	1	Line 5 North Straits WEST - Mackinaw	3,473.39	Master GW# 1490
GWD1500	3,587.07	1	Line 5 North Straits WEST - Mackinaw	3,500.97	Master GW# 1500
GWD1510	3,611.48	1	Line 5 North Straits WEST - Mackinaw	3,525.09	Master GW# 1510
GWD1520	3,638.29	1	Line 5 North Straits WEST - Mackinaw	3,551.64	Master GW# 1520

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD1530	3,657.77	1	Line 5 North Straits WEST - Mackinaw	3,571.15	Master GW# 1530
GWD1540	3,682.66	1	Line 5 North Straits WEST - Mackinaw	3,595.80	Master GW# 1540
GWD1550	3,709.69	1	Line 5 North Straits WEST - Mackinaw	3,623.36	Master GW# 1550
GWD1560	3,737.48	1	Line 5 North Straits WEST - Mackinaw	3,650.60	Master GW# 1560
GWD1570	3,765.14	1	Line 5 North Straits WEST - Mackinaw	3,678.05	Master GW# 1570
GWD1580	3,792.02	1	Line 5 North Straits WEST - Mackinaw	3,704.72	Master GW# 1580
GWD1590	3,818.55	1	Line 5 North Straits WEST - Mackinaw	3,730.71	Master GW# 1590
GWD1600	3,843.70	1	Line 5 North Straits WEST - Mackinaw	3,755.57	Master GW# 1600
GWD1610	3,866.50	1	Line 5 North Straits WEST - Mackinaw	3,778.19	Master GW# 1610
GWD1620	3,889.02	1	Line 5 North Straits WEST - Mackinaw	3,800.11	Master GW# 1620
GWD1630	3,917.17	1	Line 5 North Straits WEST - Mackinaw	3,828.27	Master GW# 1630
GWD1640	3,942.91	1	Line 5 North Straits WEST - Mackinaw	3,853.93	Master GW# 1640
GWD1650	3,965.53	1	Line 5 North Straits WEST - Mackinaw	3,876.23	Master GW# 1650
GWD1660	3,990.50	1	Line 5 North Straits WEST - Mackinaw	3,902.08	Master GW# 1660
GWD1670	4,015.30	1	Line 5 North Straits WEST - Mackinaw	3,925.81	Master GW# 1670
GWD1680	4,042.38	1	Line 5 North Straits WEST - Mackinaw	3,952.32	Master GW# 1680
GWD1690	4,068.99	1	Line 5 North Straits WEST - Mackinaw	3,978.55	Master GW# 1690
GWD1700	4,095.98	1	Line 5 North Straits WEST - Mackinaw	4,005.95	Master GW# 1700
GWD1710	4,115.24	1	Line 5 North Straits WEST - Mackinaw	4,024.35	Master GW# 1710
GWD1720	4,141.12	1	Line 5 North Straits WEST - Mackinaw	4,049.96	Master GW# 1720
GWD1730	4,168.12	1	Line 5 North Straits WEST - Mackinaw	4,076.19	Master GW# 1730
GWD1740	4,195.58	1	Line 5 North Straits WEST - Mackinaw	4,103.58	Master GW# 1740
GWD1750	4,224.04	1	Line 5 North Straits WEST - Mackinaw	4,131.58	Master GW# 1750
GWD1760	4,250.05	1	Line 5 North Straits WEST - Mackinaw	4,158.23	Master GW# 1760
GWD1770	4,277.19	1	Line 5 North Straits WEST - Mackinaw	4,184.71	Master GW# 1770
GWD1780	4,304.87	1	Line 5 North Straits WEST - Mackinaw	4,211.86	Master GW# 1780
GWD1790	4,329.96	1	Line 5 North Straits WEST - Mackinaw	4,237.05	Master GW# 1790
GWD1800	4,356.92	1	Line 5 North Straits WEST - Mackinaw	4,263.73	Master GW# 1800
GWD1810	4,384.18	1	Line 5 North Straits WEST - Mackinaw	4,290.82	Master GW# 1810
GWD1820	4,409.49	1	Line 5 North Straits WEST - Mackinaw	4,315.80	Master GW# 1820

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD1830	4,435.71	1	Line 5 North Straits WEST - Mackinaw	4,341.52	Master GW# 1830
GWD1840	4,460.96	1	Line 5 North Straits WEST - Mackinaw	4,366.68	Master GW# 1840
GWD1850	4,481.97	1	Line 5 North Straits WEST - Mackinaw	4,387.27	Master GW# 1850
GWD1860	4,506.52	1	Line 5 North Straits WEST - Mackinaw	4,411.53	Master GW# 1860
GWD1870	4,533.05	1	Line 5 North Straits WEST - Mackinaw	4,437.68	Master GW# 1870
GWD1880	4,559.88	1	Line 5 North Straits WEST - Mackinaw	4,464.16	Master GW# 1880
GWD1890	4,587.02	1	Line 5 North Straits WEST - Mackinaw	4,491.19	Master GW# 1890
GWD1900	4,609.10	1	Line 5 North Straits WEST - Mackinaw	4,512.60	Master GW# 1900
GWD1910	4,636.45	1	Line 5 North Straits WEST - Mackinaw	4,540.07	Master GW# 1910
GWD1920	4,664.02	1	Line 5 North Straits WEST - Mackinaw	4,566.85	Master GW# 1920
GWD1930	4,691.38	1	Line 5 North Straits WEST - Mackinaw	4,593.91	Master GW# 1930
GWD1940	4,718.85	1	Line 5 North Straits WEST - Mackinaw	4,621.08	Master GW# 1940
GWD1950	4,746.70	1	Line 5 North Straits WEST - Mackinaw	4,648.78	Master GW# 1950
GWD1960	4,773.49	1	Line 5 North Straits WEST - Mackinaw	4,675.12	Master GW# 1960
GWD1970	4,800.06	1	Line 5 North Straits WEST - Mackinaw	4,701.27	Master GW# 1970
GWD1980	4,825.83	1	Line 5 North Straits WEST - Mackinaw	4,726.36	Master GW# 1980
GWD1990	4,852.71	1	Line 5 North Straits WEST - Mackinaw	4,753.20	Master GW# 1990
GWD2000	4,874.41	1	Line 5 North Straits WEST - Mackinaw	4,774.63	Master GW# 2000
GWD2010	4,900.51	1	Line 5 North Straits WEST - Mackinaw	4,800.84	Master GW# 2010
GWD2020	4,927.89	1	Line 5 North Straits WEST - Mackinaw	4,827.90	Master GW# 2020
GWD2030	4,954.54	1	Line 5 North Straits WEST - Mackinaw	4,854.22	Master GW# 2030
GWD2040	4,977.59	1	Line 5 North Straits WEST - Mackinaw	4,876.96	Master GW# 2040
GWD2050	5,005.40	1	Line 5 North Straits WEST - Mackinaw	4,904.32	Master GW# 2050
GWD2060	5,031.40	1	Line 5 North Straits WEST - Mackinaw	4,930.35	Master GW# 2060
GWD2070	5,059.54	1	Line 5 North Straits WEST - Mackinaw	4,957.75	Master GW# 2070
GWD2080	5,086.76	1	Line 5 North Straits WEST - Mackinaw	4,984.80	Master GW# 2080
GWD2090	5,113.33	1	Line 5 North Straits WEST - Mackinaw	5,011.46	Master GW# 2090
GWD2100	5,133.88	1	Line 5 North Straits WEST - Mackinaw	5,031.81	Master GW# 2100
GWD2110	5,161.80	1	Line 5 North Straits WEST - Mackinaw	5,059.27	Master GW# 2110
GWD2120	5,187.64	1	Line 5 North Straits WEST - Mackinaw	5,084.76	Master GW# 2120

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD2130	5,212.75	1	Line 5 North Straits WEST - Mackinaw	5,109.82	Master GW# 2130
GWD2140	5,238.95	1	Line 5 North Straits WEST - Mackinaw	5,135.42	Master GW# 2140
GWD2150	5,262.34	1	Line 5 North Straits WEST - Mackinaw	5,159.32	Master GW# 2150
GWD2160	5,290.16	1	Line 5 North Straits WEST - Mackinaw	5,186.47	Master GW# 2160
GWD2170	5,316.80	1	Line 5 North Straits WEST - Mackinaw	5,213.06	Master GW# 2170
GWD2180	5,342.57	1	Line 5 North Straits WEST - Mackinaw	5,238.57	Master GW# 2180
GWD2190	5,367.95	1	Line 5 North Straits WEST - Mackinaw	5,263.59	Master GW# 2190
GWD2200	5,393.09	1	Line 5 North Straits WEST - Mackinaw	5,288.93	Master GW# 2200
GWD2210	5,420.53	1	Line 5 North Straits WEST - Mackinaw	5,315.60	Master GW# 2210
GWD2220	5,447.56	1	Line 5 North Straits WEST - Mackinaw	5,342.78	Master GW# 2220
GWD2230	5,474.84	1	Line 5 North Straits WEST - Mackinaw	5,369.79	Master GW# 2230
GWD2240	5,498.42	1	Line 5 North Straits WEST - Mackinaw	5,393.34	Master GW# 2240
GWD2250	5,525.34	1	Line 5 North Straits WEST - Mackinaw	5,420.30	Master GW# 2250
GWD2260	5,552.46	1	Line 5 North Straits WEST - Mackinaw	5,447.17	Master GW# 2260
GWD2270	5,573.58	1	Line 5 North Straits WEST - Mackinaw	5,468.57	Master GW# 2270
GWD2280	5,599.72	1	Line 5 North Straits WEST - Mackinaw	5,494.60	Master GW# 2280
GWD2290	5,627.00	1	Line 5 North Straits WEST - Mackinaw	5,522.17	Master GW# 2290
GWD2300	5,652.32	1	Line 5 North Straits WEST - Mackinaw	5,547.42	Master GW# 2300
GWD2310	5,679.64	1	Line 5 North Straits WEST - Mackinaw	5,574.91	Master GW# 2310
GWD2320	5,705.53	1	Line 5 North Straits WEST - Mackinaw	5,600.52	Master GW# 2320
GWD2330	5,732.29	1	Line 5 North Straits WEST - Mackinaw	5,627.75	Master GW# 2330
GWD2340	5,759.62	1	Line 5 North Straits WEST - Mackinaw	5,654.49	Master GW# 2340
GWD2350	5,786.35	1	Line 5 North Straits WEST - Mackinaw	5,681.23	Master GW# 2350
GWD2360	5,811.83	1	Line 5 North Straits WEST - Mackinaw	5,706.85	Master GW# 2360
GWD2370	5,838.83	1	Line 5 North Straits WEST - Mackinaw	5,733.70	Master GW# 2370
GWD2380	5,862.87	1	Line 5 North Straits WEST - Mackinaw	5,757.85	Master GW# 2380
GWD2390	5,889.93	1	Line 5 North Straits WEST - Mackinaw	5,784.63	Master GW# 2390
GWD2400	5,910.13	1	Line 5 North Straits WEST - Mackinaw	5,804.90	Master GW# 2400
GWD2410	5,934.64	1	Line 5 North Straits WEST - Mackinaw	5,829.30	Master GW# 2410
GWD2420	5,960.31	1	Line 5 North Straits WEST - Mackinaw	5,854.80	Master GW# 2420

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD2430	5,985.44	1	Line 5 North Straits WEST - Mackinaw	5,879.64	Master GW# 2430
GWD2440	6,007.35	1	Line 5 North Straits WEST - Mackinaw	5,901.22	Master GW# 2440
GWD2450	6,035.20	1	Line 5 North Straits WEST - Mackinaw	5,927.84	Master GW# 2450
GWD2460	6,061.44	1	Line 5 North Straits WEST - Mackinaw	5,954.13	Master GW# 2460
GWD2470	6,088.71	1	Line 5 North Straits WEST - Mackinaw	5,981.18	Master GW# 2470
GWD2480	6,114.50	1	Line 5 North Straits WEST - Mackinaw	6,007.10	Master GW# 2480
GWD2490	6,142.49	1	Line 5 North Straits WEST - Mackinaw	6,034.71	Master GW# 2490
GWD2500	6,168.73	1	Line 5 North Straits WEST - Mackinaw	6,060.76	Master GW# 2500
GWD2510	6,193.87	1	Line 5 North Straits WEST - Mackinaw	6,085.94	Master GW# 2510
GWD2520	6,216.63	1	Line 5 North Straits WEST - Mackinaw	6,108.03	Master GW# 2520
GWD2530	6,244.36	1	Line 5 North Straits WEST - Mackinaw	6,135.24	Master GW# 2530
GWD2540	6,270.87	1	Line 5 North Straits WEST - Mackinaw	6,161.44	Master GW# 2540
GWD2550	6,297.93	1	Line 5 North Straits WEST - Mackinaw	6,188.56	Master GW# 2550
GWD2560	6,326.05	1	Line 5 North Straits WEST - Mackinaw	6,215.82	Master GW# 2560
GWD2570	6,351.89	1	Line 5 North Straits WEST - Mackinaw	6,241.63	Master GW# 2570
GWD2580	6,380.08	1	Line 5 North Straits WEST - Mackinaw	6,269.69	Master GW# 2580
GWD2590	6,407.90	1	Line 5 North Straits WEST - Mackinaw	6,297.48	Master GW# 2590
GWD2600	6,429.38	1	Line 5 North Straits WEST - Mackinaw	6,318.44	Master GW# 2600
GWD2610	6,455.60	1	Line 5 North Straits WEST - Mackinaw	6,344.88	Master GW# 2610
GWD2620	6,482.31	1	Line 5 North Straits WEST - Mackinaw	6,371.35	Master GW# 2620
GWD2630	6,505.83	1	Line 5 North Straits WEST - Mackinaw	6,394.59	Master GW# 2630
GWD2640	6,532.97	1	Line 5 North Straits WEST - Mackinaw	6,421.29	Master GW# 2640
GWD2650	6,559.35	1	Line 5 North Straits WEST - Mackinaw	6,447.47	Master GW# 2650
GWD2660	6,586.23	1	Line 5 North Straits WEST - Mackinaw	6,473.89	Master GW# 2660
GWD2670	6,613.78	1	Line 5 North Straits WEST - Mackinaw	6,500.92	Master GW# 2670
GWD2680	6,641.23	1	Line 5 North Straits WEST - Mackinaw	6,528.05	Master GW# 2680
GWD2690	6,667.94	1	Line 5 North Straits WEST - Mackinaw	6,554.15	Master GW# 2690
GWD2700	6,695.58	1	Line 5 North Straits WEST - Mackinaw	6,581.41	Master GW# 2700
GWD2710	6,723.63	1	Line 5 North Straits WEST - Mackinaw	6,608.80	Master GW# 2710
GWD2720	6,751.84	1	Line 5 North Straits WEST - Mackinaw	6,636.52	Master GW# 2720

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD2730	6,777.38	1	Line 5 North Straits WEST - Mackinaw	6,662.01	Master GW# 2730
GWD2740	6,803.54	1	Line 5 North Straits WEST - Mackinaw	6,687.42	Master GW# 2740
GWD2750	6,824.49	1	Line 5 North Straits WEST - Mackinaw	6,708.21	Master GW# 2750
GWD2760	6,853.12	1	Line 5 North Straits WEST - Mackinaw	6,736.12	Master GW# 2760
GWD2770	6,881.10	1	Line 5 North Straits WEST - Mackinaw	6,763.46	Master GW# 2770
GWD2780	6,907.59	1	Line 5 North Straits WEST - Mackinaw	6,789.83	Master GW# 2780
GWD2790	6,933.13	1	Line 5 North Straits WEST - Mackinaw	6,814.97	Master GW# 2790
GWD2800	6,959.31	1	Line 5 North Straits WEST - Mackinaw	6,840.83	Master GW# 2800
GWD2810	6,982.92	1	Line 5 North Straits WEST - Mackinaw	6,864.00	Master GW# 2810
GWD2820	7,008.00	1	Line 5 North Straits WEST - Mackinaw	6,888.65	Master GW# 2820
GWD2830	7,035.26	1	Line 5 North Straits WEST - Mackinaw	6,915.46	Master GW# 2830
GWD2840	7,062.84	1	Line 5 North Straits WEST - Mackinaw	6,942.69	Master GW# 2840
GWD2850	7,087.55	1	Line 5 North Straits WEST - Mackinaw	6,966.84	Master GW# 2850
GWD2860	7,115.12	1	Line 5 North Straits WEST - Mackinaw	6,993.64	Master GW# 2860
GWD2870	7,140.65	1	Line 5 North Straits WEST - Mackinaw	7,018.89	Master GW# 2870
GWD2880	7,167.13	1	Line 5 North Straits WEST - Mackinaw	7,044.55	Master GW# 2880
GWD2890	7,193.75	1	Line 5 North Straits WEST - Mackinaw	7,070.73	Master GW# 2890
GWD2900	7,220.25	1	Line 5 North Straits WEST - Mackinaw	7,096.68	Master GW# 2900
GWD2910	7,246.90	1	Line 5 North Straits WEST - Mackinaw	7,122.54	Master GW# 2910
GWD2920	7,271.32	1	Line 5 North Straits WEST - Mackinaw	7,146.74	Master GW# 2920
GWD2930	7,299.76	1	Line 5 North Straits WEST - Mackinaw	7,174.61	Master GW# 2930
GWD2940	7,326.65	1	Line 5 North Straits WEST - Mackinaw	7,200.84	Master GW# 2940
GWD2950	7,353.33	1	Line 5 North Straits WEST - Mackinaw	7,227.25	Master GW# 2950
GWD2960	7,381.79	1	Line 5 North Straits WEST - Mackinaw	7,254.90	Master GW# 2960
GWD2970	7,409.56	1	Line 5 North Straits WEST - Mackinaw	7,282.36	Master GW# 2970
GWD2980	7,436.67	1	Line 5 North Straits WEST - Mackinaw	7,308.96	Master GW# 2980
GWD2990	7,464.88	1	Line 5 North Straits WEST - Mackinaw	7,336.39	Master GW# 2990
GWD3000	7,492.12	1	Line 5 North Straits WEST - Mackinaw	7,363.42	Master GW# 3000
GWD3010	7,515.35	1	Line 5 North Straits WEST - Mackinaw	7,386.29	Master GW# 3010
GWD3020	7,541.70	1	Line 5 North Straits WEST - Mackinaw	7,412.44	Master GW# 3020

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD3030	7,568.53	1	Line 5 North Straits WEST - Mackinaw	7,438.42	Master GW# 3030
GWD3040	7,589.28	1	Line 5 North Straits WEST - Mackinaw	7,458.79	Master GW# 3040
GWD3050	7,614.89	1	Line 5 North Straits WEST - Mackinaw	7,484.06	Master GW# 3050
GWD3060	7,641.61	1	Line 5 North Straits WEST - Mackinaw	7,510.14	Master GW# 3060
GWD3070	7,666.12	1	Line 5 North Straits WEST - Mackinaw	7,534.31	Master GW# 3070
GWD3080	7,692.84	1	Line 5 North Straits WEST - Mackinaw	7,560.71	Master GW# 3080
GWD3090	7,720.03	1	Line 5 North Straits WEST - Mackinaw	7,587.36	Master GW# 3090
GWD3100	7,747.98	1	Line 5 North Straits WEST - Mackinaw	7,614.86	Master GW# 3100
GWD3110	7,775.12	1	Line 5 North Straits WEST - Mackinaw	7,641.66	Master GW# 3110
GWD3120	7,800.97	1	Line 5 North Straits WEST - Mackinaw	7,666.93	Master GW# 3120
GWD3130	7,826.81	1	Line 5 North Straits WEST - Mackinaw	7,692.12	Master GW# 3130
GWD3140	7,854.88	1	Line 5 North Straits WEST - Mackinaw	7,719.89	Master GW# 3140
GWD3150	7,881.88	1	Line 5 North Straits WEST - Mackinaw	7,746.15	Master GW# 3150
GWD3160	7,909.08	1	Line 5 North Straits WEST - Mackinaw	7,772.67	Master GW# 3160
GWD3170	7,937.05	1	Line 5 North Straits WEST - Mackinaw	7,799.88	Master GW# 3170
GWD3180	7,948.50	1	Line 5 North Straits WEST - Mackinaw	7,811.16	Master GW# 3180
GWD3190	7,976.10	1	Line 5 North Straits WEST - Mackinaw	7,838.14	Master GW# 3190
GWD3200	8,004.62	1	Line 5 North Straits WEST - Mackinaw	7,866.15	Master GW# 3200
GWD3210	8,031.32	1	Line 5 North Straits WEST - Mackinaw	7,892.26	Master GW# 3210
GWD3220	8,057.70	1	Line 5 North Straits WEST - Mackinaw	7,918.05	Master GW# 3220
GWD3230	8,083.15	1	Line 5 North Straits WEST - Mackinaw	7,943.01	Master GW# 3230
GWD3240	8,110.54	1	Line 5 North Straits WEST - Mackinaw	7,969.88	Master GW# 3240
GWD3250	8,132.68	1	Line 5 North Straits WEST - Mackinaw	7,991.69	Master GW# 3250
GWD3260	8,157.48	1	Line 5 North Straits WEST - Mackinaw	8,016.26	Master GW# 3260
GWD3270	8,182.24	1	Line 5 North Straits WEST - Mackinaw	8,040.42	Master GW# 3270
GWD3280	8,207.95	1	Line 5 North Straits WEST - Mackinaw	8,065.85	Master GW# 3280
GWD3290	8,233.54	1	Line 5 North Straits WEST - Mackinaw	8,090.85	Master GW# 3290
GWD3300	8,260.29	1	Line 5 North Straits WEST - Mackinaw	8,117.38	Master GW# 3300
GWD3310	8,286.13	1	Line 5 North Straits WEST - Mackinaw	8,143.16	Master GW# 3310
GWD3320	8,314.87	1	Line 5 North Straits WEST - Mackinaw	8,170.90	Master GW# 3320

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD3330	8,340.80	1	Line 5 North Straits WEST - Mackinaw	8,196.60	Master GW# 3330
GWD3340	8,369.01	1	Line 5 North Straits WEST - Mackinaw	8,224.45	Master GW# 3340
GWD3350	8,395.53	1	Line 5 North Straits WEST - Mackinaw	8,250.41	Master GW# 3350
GWD3360	8,422.40	1	Line 5 North Straits WEST - Mackinaw	8,277.07	Master GW# 3360
GWD3370	8,450.04	1	Line 5 North Straits WEST - Mackinaw	8,304.04	Master GW# 3370
GWD3380	8,478.32	1	Line 5 North Straits WEST - Mackinaw	8,331.70	Master GW# 3380
GWD3390	8,505.26	1	Line 5 North Straits WEST - Mackinaw	8,358.28	Master GW# 3390
GWD3400	8,527.89	1	Line 5 North Straits WEST - Mackinaw	8,381.16	Master GW# 3400
GWD3410	8,554.69	1	Line 5 North Straits WEST - Mackinaw	8,407.75	Master GW# 3410
GWD3420	8,581.01	1	Line 5 North Straits WEST - Mackinaw	8,433.93	Master GW# 3420
GWD3430	8,607.34	1	Line 5 North Straits WEST - Mackinaw	8,460.16	Master GW# 3430
GWD3440	8,635.28	1	Line 5 North Straits WEST - Mackinaw	8,487.71	Master GW# 3440
GWD3450	8,663.23	1	Line 5 North Straits WEST - Mackinaw	8,515.11	Master GW# 3450
GWD3460	8,686.85	1	Line 5 North Straits WEST - Mackinaw	8,538.38	Master GW# 3460
GWD3470	8,711.45	1	Line 5 North Straits WEST - Mackinaw	8,562.64	Master GW# 3470
GWD3480	8,736.66	1	Line 5 North Straits WEST - Mackinaw	8,587.58	Master GW# 3480
GWD3490	8,761.73	1	Line 5 North Straits WEST - Mackinaw	8,612.19	Master GW# 3490
GWD3500	8,788.78	1	Line 5 North Straits WEST - Mackinaw	8,638.71	Master GW# 3500
GWD3510	8,814.27	1	Line 5 North Straits WEST - Mackinaw	8,664.11	Master GW# 3510
GWD3520	8,839.14	1	Line 5 North Straits WEST - Mackinaw	8,688.83	Master GW# 3520
GWD3530	8,865.66	1	Line 5 North Straits WEST - Mackinaw	8,715.11	Master GW# 3530
GWD3540	8,893.96	1	Line 5 North Straits WEST - Mackinaw	8,742.73	Master GW# 3540
GWD3550	8,918.11	1	Line 5 North Straits WEST - Mackinaw	8,767.27	Master GW# 3550
GWD3560	8,946.11	1	Line 5 North Straits WEST - Mackinaw	8,794.78	Master GW# 3560
GWD3570	8,973.05	1	Line 5 North Straits WEST - Mackinaw	8,821.79	Master GW# 3570
GWD3580	8,998.80	1	Line 5 North Straits WEST - Mackinaw	8,847.52	Master GW# 3580
GWD3590	9,026.37	1	Line 5 North Straits WEST - Mackinaw	8,875.01	Master GW# 3590
GWD3600	9,052.41	1	Line 5 North Straits WEST - Mackinaw	8,900.77	Master GW# 3600
GWD3610	9,078.02	1	Line 5 North Straits WEST - Mackinaw	8,926.49	Master GW# 3610
GWD3620	9,105.56	1	Line 5 North Straits WEST - Mackinaw	8,953.62	Master GW# 3620

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD3630	9,133.07	1	Line 5 North Straits WEST - Mackinaw	8,981.08	Master GW# 3630
GWD3640	9,160.58	1	Line 5 North Straits WEST - Mackinaw	9,008.53	Master GW# 3640
GWD3650	9,187.67	1	Line 5 North Straits WEST - Mackinaw	9,035.77	Master GW# 3650
GWD3660	9,214.62	1	Line 5 North Straits WEST - Mackinaw	9,063.22	Master GW# 3660
GWD3670	9,237.24	1	Line 5 North Straits WEST - Mackinaw	9,084.88	Master GW# 3670
GWD3680	9,264.02	1	Line 5 North Straits WEST - Mackinaw	9,111.60	Master GW# 3680
GWD3690	9,290.96	1	Line 5 North Straits WEST - Mackinaw	9,138.40	Master GW# 3690
GWD3700	9,316.16	1	Line 5 North Straits WEST - Mackinaw	9,163.47	Master GW# 3700
GWD3710	9,343.60	1	Line 5 North Straits WEST - Mackinaw	9,190.57	Master GW# 3710
GWD3720	9,371.51	1	Line 5 North Straits WEST - Mackinaw	9,217.88	Master GW# 3720
GWD3730	9,398.97	1	Line 5 North Straits WEST - Mackinaw	9,245.60	Master GW# 3730
GWD3740	9,425.29	1	Line 5 North Straits WEST - Mackinaw	9,271.44	Master GW# 3740
GWD3750	9,453.20	1	Line 5 North Straits WEST - Mackinaw	9,298.95	Master GW# 3750
GWD3760	9,480.05	1	Line 5 North Straits WEST - Mackinaw	9,325.50	Master GW# 3760
GWD3770	9,507.96	1	Line 5 North Straits WEST - Mackinaw	9,353.50	Master GW# 3770
GWD3780	9,535.82	1	Line 5 North Straits WEST - Mackinaw	9,380.81	Master GW# 3780
GWD3790	9,562.67	1	Line 5 North Straits WEST - Mackinaw	9,407.28	Master GW# 3790
GWD3800	9,590.61	1	Line 5 North Straits WEST - Mackinaw	9,434.73	Master GW# 3800
GWD3810	9,617.88	1	Line 5 North Straits WEST - Mackinaw	9,461.63	Master GW# 3810
GWD3820	9,644.71	1	Line 5 North Straits WEST - Mackinaw	9,488.33	Master GW# 3820
GWD3830	9,669.48	1	Line 5 North Straits WEST - Mackinaw	9,512.71	Master GW# 3830
GWD3840	9,693.98	1	Line 5 North Straits WEST - Mackinaw	9,536.94	Master GW# 3840
GWD3850	9,720.34	1	Line 5 North Straits WEST - Mackinaw	9,563.50	Master GW# 3850
GWD3860	9,748.15	1	Line 5 North Straits WEST - Mackinaw	9,590.75	Master GW# 3860
GWD3870	9,776.03	1	Line 5 North Straits WEST - Mackinaw	9,618.35	Master GW# 3870
GWD3880	9,798.84	1	Line 5 North Straits WEST - Mackinaw	9,640.86	Master GW# 3880
GWD3890	9,825.80	1	Line 5 North Straits WEST - Mackinaw	9,667.20	Master GW# 3890
GWD3900	9,853.47	1	Line 5 North Straits WEST - Mackinaw	9,694.48	Master GW# 3900
GWD3910	9,874.09	1	Line 5 North Straits WEST - Mackinaw	9,714.86	Master GW# 3910
GWD3920	9,901.99	1	Line 5 North Straits WEST - Mackinaw	9,742.40	Master GW# 3920

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD3930	9,929.48	1	Line 5 North Straits WEST - Mackinaw	9,769.62	Master GW# 3930
GWD3940	9,957.11	1	Line 5 North Straits WEST - Mackinaw	9,796.96	Master GW# 3940
GWD3950	9,984.92	1	Line 5 North Straits WEST - Mackinaw	9,824.78	Master GW# 3950
GWD3960	10,010.21	1	Line 5 North Straits WEST - Mackinaw	9,849.39	Master GW# 3960
GWD3970	10,037.50	1	Line 5 North Straits WEST - Mackinaw	9,876.65	Master GW# 3970
GWD3980	10,064.02	1	Line 5 North Straits WEST - Mackinaw	9,902.99	Master GW# 3980
GWD3990	10,091.92	1	Line 5 North Straits WEST - Mackinaw	9,930.44	Master GW# 3990
GWD4000	10,114.29	1	Line 5 North Straits WEST - Mackinaw	9,952.73	Master GW# 4000
GWD4010	10,141.98	1	Line 5 North Straits WEST - Mackinaw	9,980.27	Master GW# 4010
GWD4020	10,166.59	1	Line 5 North Straits WEST - Mackinaw	10,004.82	Master GW# 4020
GWD4030	10,192.72	1	Line 5 North Straits WEST - Mackinaw	10,030.80	Master GW# 4030
GWD4040	10,216.45	1	Line 5 North Straits WEST - Mackinaw	10,054.28	Master GW# 4040
GWD4050	10,241.35	1	Line 5 North Straits WEST - Mackinaw	10,079.05	Master GW# 4050
GWD4060	10,263.89	1	Line 5 North Straits WEST - Mackinaw	10,101.49	Master GW# 4060
GWD4070	10,288.24	1	Line 5 North Straits WEST - Mackinaw	10,125.68	Master GW# 4070
GWD4080	10,315.23	1	Line 5 North Straits WEST - Mackinaw	10,152.69	Master GW# 4080
GWD4090	10,338.99	1	Line 5 North Straits WEST - Mackinaw	10,176.00	Master GW# 4090
GWD4100	10,365.72	1	Line 5 North Straits WEST - Mackinaw	10,202.56	Master GW# 4100
GWD4110	10,393.10	1	Line 5 North Straits WEST - Mackinaw	10,229.81	Master GW# 4110
GWD4120	10,420.82	1	Line 5 North Straits WEST - Mackinaw	10,257.08	Master GW# 4120
GWD4130	10,447.91	1	Line 5 North Straits WEST - Mackinaw	10,284.10	Master GW# 4130
GWD4140	10,474.68	1	Line 5 North Straits WEST - Mackinaw	10,310.57	Master GW# 4140
GWD4150	10,501.04	1	Line 5 North Straits WEST - Mackinaw	10,336.80	Master GW# 4150
GWD4160	10,513.58	1	Line 5 North Straits WEST - Mackinaw	10,349.19	Master GW# 4160
GWD4170	10,533.12	1	Line 5 North Straits WEST - Mackinaw	10,368.68	Master GW# 4170
GWD4180	10,558.20	1	Line 5 North Straits WEST - Mackinaw	10,393.42	Master GW# 4180
GWD4190	10,585.21	1	Line 5 North Straits WEST - Mackinaw	10,419.94	Master GW# 4190
GWD4200	10,612.77	1	Line 5 North Straits WEST - Mackinaw	10,447.54	Master GW# 4200
GWD4210	10,638.77	1	Line 5 North Straits WEST - Mackinaw	10,473.38	Master GW# 4210
GWD4220	10,665.15	1	Line 5 North Straits WEST - Mackinaw	10,499.69	Master GW# 4220

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD4230	10,692.74	1	Line 5 North Straits WEST - Mackinaw	10,526.85	Master GW# 4230
GWD4240	10,714.03	1	Line 5 North Straits WEST - Mackinaw	10,547.77	Master GW# 4240
GWD4250	10,741.29	1	Line 5 North Straits WEST - Mackinaw	10,575.00	Master GW# 4250
GWD4260	10,761.34	1	Line 5 North Straits WEST - Mackinaw	10,594.86	Master GW# 4260
GWD4270	10,786.62	1	Line 5 North Straits WEST - Mackinaw	10,619.98	Master GW# 4270
GWD4280	10,814.01	1	Line 5 North Straits WEST - Mackinaw	10,647.31	Master GW# 4280
GWD4290	10,840.34	1	Line 5 North Straits WEST - Mackinaw	10,673.05	Master GW# 4290
GWD4300	10,868.54	1	Line 5 North Straits WEST - Mackinaw	10,700.86	Master GW# 4300
GWD4310	10,896.15	1	Line 5 North Straits WEST - Mackinaw	10,728.37	Master GW# 4310
GWD4320	10,922.22	1	Line 5 North Straits WEST - Mackinaw	10,754.00	Master GW# 4320
GWD4330	10,949.55	1	Line 5 North Straits WEST - Mackinaw	10,781.10	Master GW# 4330
GWD4340	10,973.03	1	Line 5 North Straits WEST - Mackinaw	10,803.98	Master GW# 4340
GWD4350	11,001.02	1	Line 5 North Straits WEST - Mackinaw	10,831.87	Master GW# 4350
GWD4360	11,026.91	1	Line 5 North Straits WEST - Mackinaw	10,857.29	Master GW# 4360
GWD4370	11,053.55	1	Line 5 North Straits WEST - Mackinaw	10,883.52	Master GW# 4370
GWD4380	11,081.41	1	Line 5 North Straits WEST - Mackinaw	10,911.10	Master GW# 4380
GWD4390	11,105.44	1	Line 5 North Straits WEST - Mackinaw	10,934.74	Master GW# 4390
GWD4400	11,129.27	1	Line 5 North Straits WEST - Mackinaw	10,958.39	Master GW# 4400
GWD4410	11,156.29	1	Line 5 North Straits WEST - Mackinaw	10,985.07	Master GW# 4410
GWD4420	11,183.24	1	Line 5 North Straits WEST - Mackinaw	11,011.64	Master GW# 4420
GWD4430	11,208.56	1	Line 5 North Straits WEST - Mackinaw	11,036.76	Master GW# 4430
GWD4440	11,236.58	1	Line 5 North Straits WEST - Mackinaw	11,064.41	Master GW# 4440
GWD4450	11,262.90	1	Line 5 North Straits WEST - Mackinaw	11,090.71	Master GW# 4450
GWD4460	11,290.69	1	Line 5 North Straits WEST - Mackinaw	11,117.99	Master GW# 4460
GWD4470	11,317.09	1	Line 5 North Straits WEST - Mackinaw	11,144.27	Master GW# 4470
GWD4480	11,341.28	1	Line 5 North Straits WEST - Mackinaw	11,168.37	Master GW# 4480
GWD4490	11,367.17	1	Line 5 North Straits WEST - Mackinaw	11,193.97	Master GW# 4490
GWD4500	11,391.04	1	Line 5 North Straits WEST - Mackinaw	11,217.59	Master GW# 4500
GWD4510	11,418.81	1	Line 5 North Straits WEST - Mackinaw	11,245.23	Master GW# 4510
GWD4520	11,438.22	1	Line 5 North Straits WEST - Mackinaw	11,264.48	Master GW# 4520

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD4530	11,465.83	1	Line 5 North Straits WEST - Mackinaw	11,291.97	Master GW# 4530
GWD4540	11,492.05	1	Line 5 North Straits WEST - Mackinaw	11,317.77	Master GW# 4540
GWD4550	11,518.92	1	Line 5 North Straits WEST - Mackinaw	11,344.57	Master GW# 4550
GWD4560	11,545.79	1	Line 5 North Straits WEST - Mackinaw	11,371.01	Master GW# 4560
GWD4570	11,569.12	1	Line 5 North Straits WEST - Mackinaw	11,393.98	Master GW# 4570
GWD4580	11,595.13	1	Line 5 North Straits WEST - Mackinaw	11,419.74	Master GW# 4580
GWD4590	11,620.07	1	Line 5 North Straits WEST - Mackinaw	11,444.59	Master GW# 4590
GWD4600	11,646.99	1	Line 5 North Straits WEST - Mackinaw	11,471.20	Master GW# 4600
GWD4610	11,675.02	1	Line 5 North Straits WEST - Mackinaw	11,498.84	Master GW# 4610
GWD4620	11,700.27	1	Line 5 North Straits WEST - Mackinaw	11,523.96	Master GW# 4620
GWD4630	11,728.00	1	Line 5 North Straits WEST - Mackinaw	11,551.28	Master GW# 4630
GWD4640	11,754.43	1	Line 5 North Straits WEST - Mackinaw	11,577.53	Master GW# 4640
GWD4650	11,781.38	1	Line 5 North Straits WEST - Mackinaw	11,604.21	Master GW# 4650
GWD4660	11,806.52	1	Line 5 North Straits WEST - Mackinaw	11,628.92	Master GW# 4660
GWD4670	11,829.61	1	Line 5 North Straits WEST - Mackinaw	11,652.17	Master GW# 4670
GWD4680	11,853.00	1	Line 5 North Straits WEST - Mackinaw	11,675.27	Master GW# 4680
GWD4690	11,879.11	1	Line 5 North Straits WEST - Mackinaw	11,701.03	Master GW# 4690
GWD4700	11,906.62	1	Line 5 North Straits WEST - Mackinaw	11,728.53	Master GW# 4700
GWD4710	11,931.46	1	Line 5 North Straits WEST - Mackinaw	11,753.69	Master GW# 4710
GWD4720	11,959.50	1	Line 5 North Straits WEST - Mackinaw	11,781.30	Master GW# 4720
GWD4730	11,982.64	1	Line 5 North Straits WEST - Mackinaw	11,804.11	Master GW# 4730
GWD4740	12,009.18	1	Line 5 North Straits WEST - Mackinaw	11,830.21	Master GW# 4740
GWD4750	12,035.68	1	Line 5 North Straits WEST - Mackinaw	11,856.63	Master GW# 4750
GWD4760	12,063.21	1	Line 5 North Straits WEST - Mackinaw	11,883.51	Master GW# 4760
GWD4770	12,089.46	1	Line 5 North Straits WEST - Mackinaw	11,909.75	Master GW# 4770
GWD4780	12,117.32	1	Line 5 North Straits WEST - Mackinaw	11,937.09	Master GW# 4780
GWD4790	12,144.20	1	Line 5 North Straits WEST - Mackinaw	11,963.56	Master GW# 4790
GWD4800	12,170.55	1	Line 5 North Straits WEST - Mackinaw	11,989.65	Master GW# 4800
GWD4810	12,198.08	1	Line 5 North Straits WEST - Mackinaw	12,016.99	Master GW# 4810
GWD4820	12,225.55	1	Line 5 North Straits WEST - Mackinaw	12,043.59	Master GW# 4820

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD4830	12,251.96	1	Line 5 North Straits WEST - Mackinaw	12,070.16	Master GW# 4830
GWD4840	12,280.15	1	Line 5 North Straits WEST - Mackinaw	12,097.62	Master GW# 4840
GWD4850	12,306.84	1	Line 5 North Straits WEST - Mackinaw	12,124.04	Master GW# 4850
GWD4860	12,332.65	1	Line 5 North Straits WEST - Mackinaw	12,149.86	Master GW# 4860
GWD4870	12,356.52	1	Line 5 North Straits WEST - Mackinaw	12,173.53	Master GW# 4870
GWD4880	12,378.10	1	Line 5 North Straits WEST - Mackinaw	12,194.58	Master GW# 4880
GWD4890	12,404.62	1	Line 5 North Straits WEST - Mackinaw	12,221.16	Master GW# 4890
GWD4900	12,432.23	1	Line 5 North Straits WEST - Mackinaw	12,248.62	Master GW# 4900
GWD4910	12,455.57	1	Line 5 North Straits WEST - Mackinaw	12,271.49	Master GW# 4910
GWD4920	12,482.64	1	Line 5 North Straits WEST - Mackinaw	12,298.25	Master GW# 4920
GWD4930	12,508.95	1	Line 5 North Straits WEST - Mackinaw	12,324.39	Master GW# 4930
GWD4940	12,536.68	1	Line 5 North Straits WEST - Mackinaw	12,351.90	Master GW# 4940
GWD4950	12,564.17	1	Line 5 North Straits WEST - Mackinaw	12,378.97	Master GW# 4950
GWD4960	12,591.53	1	Line 5 North Straits WEST - Mackinaw	12,406.08	Master GW# 4960
GWD4970	12,615.45	1	Line 5 North Straits WEST - Mackinaw	12,429.68	Master GW# 4970
GWD4980	12,642.13	1	Line 5 North Straits WEST - Mackinaw	12,456.12	Master GW# 4980
GWD4990	12,667.83	1	Line 5 North Straits WEST - Mackinaw	12,481.94	Master GW# 4990
GWD5000	12,695.49	1	Line 5 North Straits WEST - Mackinaw	12,509.16	Master GW# 5000
GWD5010	12,717.64	1	Line 5 North Straits WEST - Mackinaw	12,530.93	Master GW# 5010
GWD5020	12,742.53	1	Line 5 North Straits WEST - Mackinaw	12,555.62	Master GW# 5020
GWD5030	12,769.01	1	Line 5 North Straits WEST - Mackinaw	12,581.72	Master GW# 5030
GWD5040	12,794.44	1	Line 5 North Straits WEST - Mackinaw	12,606.87	Master GW# 5040
GWD5050	12,818.78	1	Line 5 North Straits WEST - Mackinaw	12,630.94	Master GW# 5050
GWD5060	12,844.31	1	Line 5 North Straits WEST - Mackinaw	12,656.06	Master GW# 5060
GWD5070	12,869.94	1	Line 5 North Straits WEST - Mackinaw	12,681.13	Master GW# 5070
GWD5080	12,896.32	1	Line 5 North Straits WEST - Mackinaw	12,706.99	Master GW# 5080
GWD5090	12,922.98	1	Line 5 North Straits WEST - Mackinaw	12,733.16	Master GW# 5090
GWD5100	12,947.58	1	Line 5 North Straits WEST - Mackinaw	12,757.73	Master GW# 5100
GWD5110	12,973.90	1	Line 5 North Straits WEST - Mackinaw	12,783.33	Master GW# 5110
GWD5120	13,001.74	1	Line 5 North Straits WEST - Mackinaw	12,810.54	Master GW# 5120

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD5130	13,018.38	1	Line 5 North Straits WEST - Mackinaw	12,826.91	Master GW# 5130
GWD5140	13,044.26	1	Line 5 North Straits WEST - Mackinaw	12,852.69	Master GW# 5140
GWD5150	13,070.06	1	Line 5 North Straits WEST - Mackinaw	12,878.12	Master GW# 5150
GWD5160	13,095.07	1	Line 5 North Straits WEST - Mackinaw	12,902.88	Master GW# 5160
GWD5170	13,122.91	1	Line 5 North Straits WEST - Mackinaw	12,930.31	Master GW# 5170
GWD5180	13,149.82	1	Line 5 North Straits WEST - Mackinaw	12,956.80	Master GW# 5180
GWD5190	13,169.71	1	Line 5 North Straits WEST - Mackinaw	12,976.54	Master GW# 5190
GWD5200	13,196.98	1	Line 5 North Straits WEST - Mackinaw	13,003.33	Master GW# 5200
GWD5210	13,221.29	1	Line 5 North Straits WEST - Mackinaw	13,027.37	Master GW# 5210
GWD5220	13,247.60	1	Line 5 North Straits WEST - Mackinaw	13,053.58	Master GW# 5220
GWD5230	13,275.82	1	Line 5 North Straits WEST - Mackinaw	13,081.73	Master GW# 5230
GWD5240	13,303.09	1	Line 5 North Straits WEST - Mackinaw	13,108.42	Master GW# 5240
GWD5250	13,327.67	1	Line 5 North Straits WEST - Mackinaw	13,133.11	Master GW# 5250
GWD5260	13,354.20	1	Line 5 North Straits WEST - Mackinaw	13,159.39	Master GW# 5260
GWD5270	13,375.66	1	Line 5 North Straits WEST - Mackinaw	13,180.65	Master GW# 5270
GWD5280	13,401.15	1	Line 5 North Straits WEST - Mackinaw	13,205.82	Master GW# 5280
GWD5290	13,426.28	1	Line 5 North Straits WEST - Mackinaw	13,230.72	Master GW# 5290
GWD5300	13,450.47	1	Line 5 North Straits WEST - Mackinaw	13,254.53	Master GW# 5300
GWD5310	13,476.72	1	Line 5 North Straits WEST - Mackinaw	13,280.59	Master GW# 5310
GWD5320	13,503.67	1	Line 5 North Straits WEST - Mackinaw	13,307.45	Master GW# 5320
GWD5330	13,529.15	1	Line 5 North Straits WEST - Mackinaw	13,332.71	Master GW# 5330
GWD5340	13,556.53	1	Line 5 North Straits WEST - Mackinaw	13,359.66	Master GW# 5340
GWD5350	13,584.94	1	Line 5 North Straits WEST - Mackinaw	13,387.67	Master GW# 5350
GWD5360	13,610.21	1	Line 5 North Straits WEST - Mackinaw	13,412.88	Master GW# 5360
GWD5370	13,636.90	1	Line 5 North Straits WEST - Mackinaw	13,439.12	Master GW# 5370
GWD5380	13,664.45	1	Line 5 North Straits WEST - Mackinaw	13,466.04	Master GW# 5380
GWD5390	13,683.19	1	Line 5 North Straits WEST - Mackinaw	13,485.16	Master GW# 5390
GWD5400	13,704.97	1	Line 5 North Straits WEST - Mackinaw	13,506.47	Master GW# 5400
GWD5410	13,728.14	1	Line 5 North Straits WEST - Mackinaw	13,529.10	Master GW# 5410
GWD5420	13,754.37	1	Line 5 North Straits WEST - Mackinaw	13,555.15	Master GW# 5420

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD5430	13,782.36	1	Line 5 North Straits WEST - Mackinaw	13,582.56	Master GW# 5430
GWD5440	13,806.87	1	Line 5 North Straits WEST - Mackinaw	13,606.47	Master GW# 5440
GWD5450	13,832.01	1	Line 5 North Straits WEST - Mackinaw	13,631.15	Master GW# 5450
GWD5460	13,859.19	1	Line 5 North Straits WEST - Mackinaw	13,658.01	Master GW# 5460
GWD5470	13,882.90	1	Line 5 North Straits WEST - Mackinaw	13,681.49	Master GW# 5470
GWD5480	13,905.61	1	Line 5 North Straits WEST - Mackinaw	13,703.87	Master GW# 5480
GWD5490	13,932.33	1	Line 5 North Straits WEST - Mackinaw	13,730.00	Master GW# 5490
GWD5500	13,960.35	1	Line 5 North Straits WEST - Mackinaw	13,757.56	Master GW# 5500
GWD5510	13,987.57	1	Line 5 North Straits WEST - Mackinaw	13,784.62	Master GW# 5510
GWD5520	14,014.58	1	Line 5 North Straits WEST - Mackinaw	13,811.14	Master GW# 5520
GWD5530	14,039.28	1	Line 5 North Straits WEST - Mackinaw	13,835.75	Master GW# 5530
GWD5540	14,067.24	1	Line 5 North Straits WEST - Mackinaw	13,863.23	Master GW# 5540
GWD5550	14,094.92	1	Line 5 North Straits WEST - Mackinaw	13,890.69	Master GW# 5550
GWD5560	14,115.70	1	Line 5 North Straits WEST - Mackinaw	13,911.28	Master GW# 5560
GWD5570	14,141.99	1	Line 5 North Straits WEST - Mackinaw	13,937.29	Master GW# 5570
GWD5580	14,167.34	1	Line 5 North Straits WEST - Mackinaw	13,962.79	Master GW# 5580
GWD5590	14,192.85	1	Line 5 North Straits WEST - Mackinaw	13,988.10	Master GW# 5590
GWD5600	14,219.39	1	Line 5 North Straits WEST - Mackinaw	14,014.33	Master GW# 5600
GWD5610	14,240.81	1	Line 5 North Straits WEST - Mackinaw	14,035.58	Master GW# 5610
GWD5620	14,267.97	1	Line 5 North Straits WEST - Mackinaw	14,062.34	Master GW# 5620
GWD5630	14,293.03	1	Line 5 North Straits WEST - Mackinaw	14,087.18	Master GW# 5630
GWD5640	14,320.73	1	Line 5 North Straits WEST - Mackinaw	14,114.58	Master GW# 5640
GWD5650	14,346.58	1	Line 5 North Straits WEST - Mackinaw	14,140.18	Master GW# 5650
GWD5660	14,373.85	1	Line 5 North Straits WEST - Mackinaw	14,167.13	Master GW# 5660
GWD5670	14,400.38	1	Line 5 North Straits WEST - Mackinaw	14,193.44	Master GW# 5670
GWD5680	14,427.69	1	Line 5 North Straits WEST - Mackinaw	14,220.41	Master GW# 5680
GWD5690	14,454.92	1	Line 5 North Straits WEST - Mackinaw	14,247.43	Master GW# 5690
GWD5700	14,482.80	1	Line 5 North Straits WEST - Mackinaw	14,274.88	Master GW# 5700
GWD5710	14,509.73	1	Line 5 North Straits WEST - Mackinaw	14,301.52	Master GW# 5710
GWD5720	14,531.34	1	Line 5 North Straits WEST - Mackinaw	14,323.13	Master GW# 5720

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD5730	14,557.43	1	Line 5 North Straits WEST - Mackinaw	14,348.67	Master GW# 5730
GWD5740	14,583.91	1	Line 5 North Straits WEST - Mackinaw	14,374.63	Master GW# 5740
GWD5750	14,610.27	1	Line 5 North Straits WEST - Mackinaw	14,400.19	Master GW# 5750
GWD5760	14,632.50	1	Line 5 North Straits WEST - Mackinaw	14,422.37	Master GW# 5760
GWD5770	14,659.65	1	Line 5 North Straits WEST - Mackinaw	14,445.45	Master GW# 5770
GWD5780	14,681.06	1	Line 5 North Straits WEST - Mackinaw	14,470.24	Master GW# 5780
GWD5790	14,708.52	1	Line 5 North Straits WEST - Mackinaw	14,497.27	Master GW# 5790
GWD5800	14,734.72	1	Line 5 North Straits WEST - Mackinaw	14,522.88	Master GW# 5800
GWD5810	14,760.14	1	Line 5 North Straits WEST - Mackinaw	14,547.98	Master GW# 5810
GWD5820	14,788.43	1	Line 5 North Straits WEST - Mackinaw	14,575.86	Master GW# 5820
GWD5830	14,813.32	1	Line 5 North Straits WEST - Mackinaw	14,600.44	Master GW# 5830
GWD5840	14,838.99	1	Line 5 North Straits WEST - Mackinaw	14,625.60	Master GW# 5840
GWD5850	14,865.30	1	Line 5 North Straits WEST - Mackinaw	14,651.78	Master GW# 5850
GWD5860	14,892.49	1	Line 5 North Straits WEST - Mackinaw	14,678.56	Master GW# 5860
GWD5870	14,919.79	1	Line 5 North Straits WEST - Mackinaw	14,705.83	Master GW# 5870
GWD5880	14,946.29	1	Line 5 North Straits WEST - Mackinaw	14,731.95	Master GW# 5880
GWD5890	14,974.98	1	Line 5 North Straits WEST - Mackinaw	14,760.65	Master GW# 5890
GWD5900	15,003.06	1	Line 5 North Straits WEST - Mackinaw	14,788.25	Master GW# 5900
GWD5910	15,030.83	1	Line 5 North Straits WEST - Mackinaw	14,815.82	Master GW# 5910
GWD5920	15,057.37	1	Line 5 North Straits WEST - Mackinaw	14,841.84	Master GW# 5920
GWD5930	15,085.40	1	Line 5 North Straits WEST - Mackinaw	14,869.70	Master GW# 5930
GWD5940	15,112.89	1	Line 5 North Straits WEST - Mackinaw	14,896.98	Master GW# 5940
GWD5950	15,134.37	1	Line 5 North Straits WEST - Mackinaw	14,918.41	Master GW# 5950
GWD5960	15,159.55	1	Line 5 North Straits WEST - Mackinaw	14,943.55	Master GW# 5960
GWD5970	15,179.39	1	Line 5 North Straits WEST - Mackinaw	14,963.03	Master GW# 5970
GWD5980	15,205.87	1	Line 5 North Straits WEST - Mackinaw	14,989.43	Master GW# 5980
GWD5990	15,233.89	1	Line 5 North Straits WEST - Mackinaw	15,017.10	Master GW# 5990
GWD6000	15,260.97	1	Line 5 North Straits WEST - Mackinaw	15,044.06	Master GW# 6000
GWD6010	15,283.80	1	Line 5 North Straits WEST - Mackinaw	15,066.71	Master GW# 6010
GWD6020	15,311.31	1	Line 5 North Straits WEST - Mackinaw	15,093.99	Master GW# 6020

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD6030	15,338.41	1	Line 5 North Straits WEST - Mackinaw	15,120.87	Master GW# 6030
GWD6040	15,365.86	1	Line 5 North Straits WEST - Mackinaw	15,148.15	Master GW# 6040
GWD6050	15,393.56	1	Line 5 North Straits WEST - Mackinaw	15,175.36	Master GW# 6050
GWD6060	15,419.97	1	Line 5 North Straits WEST - Mackinaw	15,201.89	Master GW# 6060
GWD6070	15,442.30	1	Line 5 North Straits WEST - Mackinaw	15,223.95	Master GW# 6070
GWD6080	15,464.57	1	Line 5 North Straits WEST - Mackinaw	15,245.94	Master GW# 6080
GWD6090	15,485.63	1	Line 5 North Straits WEST - Mackinaw	15,266.73	Master GW# 6090
GWD6100	15,511.91	1	Line 5 North Straits WEST - Mackinaw	15,292.61	Master GW# 6100
GWD6110	15,532.15	1	Line 5 North Straits WEST - Mackinaw	15,312.91	Master GW# 6110
GWD6120	15,551.62	1	Line 5 North Straits WEST - Mackinaw	15,332.12	Master GW# 6120
GWD6130	15,577.35	1	Line 5 North Straits WEST - Mackinaw	15,357.80	Master GW# 6130
GWD6140	15,603.57	1	Line 5 North Straits WEST - Mackinaw	15,383.83	Master GW# 6140
GWD6150	15,628.79	1	Line 5 North Straits WEST - Mackinaw	15,408.93	Master GW# 6150
GWD6160	15,655.55	1	Line 5 North Straits WEST - Mackinaw	15,435.47	Master GW# 6160
GWD6170	15,682.25	1	Line 5 North Straits WEST - Mackinaw	15,461.82	Master GW# 6170
GWD6180	15,708.60	1	Line 5 North Straits WEST - Mackinaw	15,488.13	Master GW# 6180
GWD6190	15,735.16	1	Line 5 North Straits WEST - Mackinaw	15,514.58	Master GW# 6190
GWD6200	15,761.42	1	Line 5 North Straits WEST - Mackinaw	15,540.57	Master GW# 6200
GWD6210	15,786.97	1	Line 5 North Straits WEST - Mackinaw	15,565.84	Master GW# 6210
GWD6220	15,814.63	1	Line 5 North Straits WEST - Mackinaw	15,593.47	Master GW# 6220
GWD6230	15,842.68	1	Line 5 North Straits WEST - Mackinaw	15,621.20	Master GW# 6230
GWD6240	15,868.61	1	Line 5 North Straits WEST - Mackinaw	15,647.00	Master GW# 6240
GWD6250	15,895.98	1	Line 5 North Straits WEST - Mackinaw	15,674.17	Master GW# 6250
GWD6260	15,924.08	1	Line 5 North Straits WEST - Mackinaw	15,702.33	Master GW# 6260
GWD6270	15,951.77	1	Line 5 North Straits WEST - Mackinaw	15,729.90	Master GW# 6270
GWD6280	15,978.26	1	Line 5 North Straits WEST - Mackinaw	15,756.19	Master GW# 6280
GWD6290	16,005.13	1	Line 5 North Straits WEST - Mackinaw	15,782.90	Master GW# 6290
GWD6300	16,029.39	1	Line 5 North Straits WEST - Mackinaw	15,807.02	Master GW# 6300
GWD6310	16,056.47	1	Line 5 North Straits WEST - Mackinaw	15,833.58	Master GW# 6310
GWD6320	16,084.99	1	Line 5 North Straits WEST - Mackinaw	15,861.88	Master GW# 6320

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD6330	16,111.79	1	Line 5 North Straits WEST - Mackinaw	15,888.27	Master GW# 6330
GWD6340	16,137.64	1	Line 5 North Straits WEST - Mackinaw	15,914.14	Master GW# 6340
GWD6350	16,164.19	1	Line 5 North Straits WEST - Mackinaw	15,940.15	Master GW# 6350
GWD6360	16,191.61	1	Line 5 North Straits WEST - Mackinaw	15,967.13	Master GW# 6360
GWD6370	16,216.90	1	Line 5 North Straits WEST - Mackinaw	15,992.90	Master GW# 6370
GWD6380	16,236.97	1	Line 5 North Straits WEST - Mackinaw	16,012.27	Master GW# 6380
GWD6390	16,263.56	1	Line 5 North Straits WEST - Mackinaw	16,038.42	Master GW# 6390
GWD6400	16,289.19	1	Line 5 North Straits WEST - Mackinaw	16,063.45	Master GW# 6400
GWD6410	16,316.13	1	Line 5 North Straits WEST - Mackinaw	16,089.98	Master GW# 6410
GWD6420	16,342.03	1	Line 5 North Straits WEST - Mackinaw	16,115.89	Master GW# 6420
GWD6430	16,369.88	1	Line 5 North Straits WEST - Mackinaw	16,143.22	Master GW# 6430
GWD6440	16,397.86	1	Line 5 North Straits WEST - Mackinaw	16,170.70	Master GW# 6440
GWD6450	16,425.28	1	Line 5 North Straits WEST - Mackinaw	16,197.77	Master GW# 6450
GWD6460	16,453.16	1	Line 5 North Straits WEST - Mackinaw	16,225.48	Master GW# 6460
GWD6470	16,476.76	1	Line 5 North Straits WEST - Mackinaw	16,249.05	Master GW# 6470
GWD6480	16,500.90	1	Line 5 North Straits WEST - Mackinaw	16,273.08	Master GW# 6480
GWD6490	16,528.58	1	Line 5 North Straits WEST - Mackinaw	16,300.43	Master GW# 6490
GWD6500	16,550.26	1	Line 5 North Straits WEST - Mackinaw	16,322.12	Master GW# 6500
GWD6510	16,574.58	1	Line 5 North Straits WEST - Mackinaw	16,346.07	Master GW# 6510
GWD6520	16,599.87	1	Line 5 North Straits WEST - Mackinaw	16,371.20	Master GW# 6520
GWD6530	16,619.38	1	Line 5 North Straits WEST - Mackinaw	16,390.71	Master GW# 6530
GWD6540	16,645.75	1	Line 5 North Straits WEST - Mackinaw	16,416.70	Master GW# 6540
GWD6550	16,671.02	1	Line 5 North Straits WEST - Mackinaw	16,441.80	Master GW# 6550
GWD6560	16,695.87	1	Line 5 North Straits WEST - Mackinaw	16,466.41	Master GW# 6560
GWD6570	16,723.98	1	Line 5 North Straits WEST - Mackinaw	16,494.13	Master GW# 6570
GWD6580	16,748.58	1	Line 5 North Straits WEST - Mackinaw	16,518.27	Master GW# 6580
GWD6590	16,774.75	1	Line 5 North Straits WEST - Mackinaw	16,544.37	Master GW# 6590
GWD6600	16,802.28	1	Line 5 North Straits WEST - Mackinaw	16,571.43	Master GW# 6600
GWD6610	16,828.19	1	Line 5 North Straits WEST - Mackinaw	16,597.08	Master GW# 6610
GWD6620	16,852.61	1	Line 5 North Straits WEST - Mackinaw	16,621.46	Master GW# 6620

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD6630	16,880.57	1	Line 5 North Straits WEST - Mackinaw	16,648.88	Master GW# 6630
GWD6640	16,906.80	1	Line 5 North Straits WEST - Mackinaw	16,674.72	Master GW# 6640
GWD6650	16,930.83	1	Line 5 North Straits WEST - Mackinaw	16,698.34	Master GW# 6650
GWD6660	16,952.15	1	Line 5 North Straits WEST - Mackinaw	16,719.48	Master GW# 6660
GWD6670	16,974.47	1	Line 5 North Straits WEST - Mackinaw	16,741.77	Master GW# 6670
GWD6680	16,997.15	1	Line 5 North Straits WEST - Mackinaw	16,764.08	Master GW# 6680
GWD6690	17,021.08	1	Line 5 North Straits WEST - Mackinaw	16,787.92	Master GW# 6690
GWD6700	17,048.65	1	Line 5 North Straits WEST - Mackinaw	16,815.40	Master GW# 6700
GWD6710	17,075.06	1	Line 5 North Straits WEST - Mackinaw	16,841.55	Master GW# 6710
GWD6720	17,099.12	1	Line 5 North Straits WEST - Mackinaw	16,865.28	Master GW# 6720
GWD6730	17,120.42	1	Line 5 North Straits WEST - Mackinaw	16,886.44	Master GW# 6730
GWD6740	17,148.00	1	Line 5 North Straits WEST - Mackinaw	16,913.57	Master GW# 6740
GWD6750	17,175.69	1	Line 5 North Straits WEST - Mackinaw	16,941.13	Master GW# 6750
GWD6760	17,201.66	1	Line 5 North Straits WEST - Mackinaw	16,966.99	Master GW# 6760
GWD6770	17,229.84	1	Line 5 North Straits WEST - Mackinaw	16,994.67	Master GW# 6770
GWD6780	17,257.70	1	Line 5 North Straits WEST - Mackinaw	17,022.12	Master GW# 6780
GWD6790	17,284.36	1	Line 5 North Straits WEST - Mackinaw	17,048.66	Master GW# 6790
GWD6800	17,310.47	1	Line 5 North Straits WEST - Mackinaw	17,074.60	Master GW# 6800
GWD6810	17,337.52	1	Line 5 North Straits WEST - Mackinaw	17,101.69	Master GW# 6810
GWD6820	17,365.18	1	Line 5 North Straits WEST - Mackinaw	17,128.92	Master GW# 6820
GWD6830	17,390.90	1	Line 5 North Straits WEST - Mackinaw	17,155.00	Master GW# 6830
GWD6840	17,417.16	1	Line 5 North Straits WEST - Mackinaw	17,181.22	Master GW# 6840
GWD6850	17,443.60	1	Line 5 North Straits WEST - Mackinaw	17,207.65	Master GW# 6850
GWD6860	17,469.61	1	Line 5 North Straits WEST - Mackinaw	17,233.18	Master GW# 6860
GWD6870	17,496.22	1	Line 5 North Straits WEST - Mackinaw	17,259.61	Master GW# 6870
GWD6880	17,523.21	1	Line 5 North Straits WEST - Mackinaw	17,286.34	Master GW# 6880
GWD6890	17,551.45	1	Line 5 North Straits WEST - Mackinaw	17,314.19	Master GW# 6890
GWD6900	17,578.62	1	Line 5 North Straits WEST - Mackinaw	17,341.39	Master GW# 6900
GWD6910	17,604.71	1	Line 5 North Straits WEST - Mackinaw	17,367.82	Master GW# 6910
GWD6920	17,631.92	1	Line 5 North Straits WEST - Mackinaw	17,394.67	Master GW# 6920

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD6930	17,659.16	1	Line 5 North Straits WEST - Mackinaw	17,420.85	Master GW# 6930
GWD6940	17,686.75	1	Line 5 North Straits WEST - Mackinaw	17,447.89	Master GW# 6940
GWD6950	17,713.27	1	Line 5 North Straits WEST - Mackinaw	17,474.42	Master GW# 6950
GWD6960	17,739.97	1	Line 5 North Straits WEST - Mackinaw	17,500.68	Master GW# 6960
GWD6970	17,766.76	1	Line 5 North Straits WEST - Mackinaw	17,527.23	Master GW# 6970
GWD6980	17,793.92	1	Line 5 North Straits WEST - Mackinaw	17,554.29	Master GW# 6980
GWD6990	17,821.18	1	Line 5 North Straits WEST - Mackinaw	17,580.93	Master GW# 6990
GWD7000	17,848.54	1	Line 5 North Straits WEST - Mackinaw	17,607.86	Master GW# 7000
GWD7010	17,874.94	1	Line 5 North Straits WEST - Mackinaw	17,633.99	Master GW# 7010
GWD7020	17,901.15	1	Line 5 North Straits WEST - Mackinaw	17,659.68	Master GW# 7020
GWD7030	17,928.47	1	Line 5 North Straits WEST - Mackinaw	17,687.04	Master GW# 7030
GWD7040	17,954.21	1	Line 5 North Straits WEST - Mackinaw	17,712.18	Master GW# 7040
GWD7050	17,980.70	1	Line 5 North Straits WEST - Mackinaw	17,738.50	Master GW# 7050
GWD7060	18,005.00	1	Line 5 North Straits WEST - Mackinaw	17,762.82	Master GW# 7060
GWD7070	18,031.25	1	Line 5 North Straits WEST - Mackinaw	17,788.92	Master GW# 7070
GWD7080	18,054.30	1	Line 5 North Straits WEST - Mackinaw	17,811.79	Master GW# 7080
GWD7090	18,080.71	1	Line 5 North Straits WEST - Mackinaw	17,838.15	Master GW# 7090
GWD7100	18,107.68	1	Line 5 North Straits WEST - Mackinaw	17,864.86	Master GW# 7100
GWD7110	18,132.51	1	Line 5 North Straits WEST - Mackinaw	17,889.29	Master GW# 7110
GWD7120	18,159.87	1	Line 5 North Straits WEST - Mackinaw	17,916.24	Master GW# 7120
GWD7130	18,187.92	1	Line 5 North Straits WEST - Mackinaw	17,944.15	Master GW# 7130
GWD7140	18,213.15	1	Line 5 North Straits WEST - Mackinaw	17,968.86	Master GW# 7140
GWD7150	18,239.84	1	Line 5 North Straits WEST - Mackinaw	17,995.40	Master GW# 7150
GWD7160	18,266.80	1	Line 5 North Straits WEST - Mackinaw	18,021.90	Master GW# 7160
GWD7170	18,293.76	1	Line 5 North Straits WEST - Mackinaw	18,048.69	Master GW# 7170
GWD7180	18,315.10	1	Line 5 North Straits WEST - Mackinaw	18,069.85	Master GW# 7180
GWD7190	18,339.96	1	Line 5 North Straits WEST - Mackinaw	18,095.37	Master GW# 7190
GWD7200	18,363.66	1	Line 5 North Straits WEST - Mackinaw	18,118.38	Master GW# 7200
GWD7210	18,391.59	1	Line 5 North Straits WEST - Mackinaw	18,145.34	Master GW# 7210
GWD7220	18,417.00	1	Line 5 North Straits WEST - Mackinaw	18,170.47	Master GW# 7220

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD7230	18,445.09	1	Line 5 North Straits WEST - Mackinaw	18,198.14	Master GW# 7230
GWD7240	18,470.88	1	Line 5 North Straits WEST - Mackinaw	18,223.58	Master GW# 7240
GWD7250	18,498.50	1	Line 5 North Straits WEST - Mackinaw	18,250.75	Master GW# 7250
GWD7260	18,524.14	1	Line 5 North Straits WEST - Mackinaw	18,276.28	Master GW# 7260
GWD7270	18,550.55	1	Line 5 North Straits WEST - Mackinaw	18,302.52	Master GW# 7270
GWD7280	18,579.17	1	Line 5 North Straits WEST - Mackinaw	18,330.70	Master GW# 7280
GWD7290	18,606.81	1	Line 5 North Straits WEST - Mackinaw	18,357.77	Master GW# 7290
GWD7300	18,634.39	1	Line 5 North Straits WEST - Mackinaw	18,385.09	Master GW# 7300
GWD7310	18,658.64	1	Line 5 North Straits WEST - Mackinaw	18,408.85	Master GW# 7310
GWD7320	18,686.46	1	Line 5 North Straits WEST - Mackinaw	18,436.47	Master GW# 7320
GWD7330	18,711.45	1	Line 5 North Straits WEST - Mackinaw	18,461.18	Master GW# 7330
GWD7340	18,737.96	1	Line 5 North Straits WEST - Mackinaw	18,487.54	Master GW# 7340
GWD7350	18,765.24	1	Line 5 North Straits WEST - Mackinaw	18,514.81	Master GW# 7350
GWD7360	18,789.90	1	Line 5 North Straits WEST - Mackinaw	18,539.20	Master GW# 7360
GWD7370	18,815.03	1	Line 5 North Straits WEST - Mackinaw	18,564.30	Master GW# 7370
GWD7380	18,839.88	1	Line 5 North Straits WEST - Mackinaw	18,588.95	Master GW# 7380
GWD7390	18,865.05	1	Line 5 North Straits WEST - Mackinaw	18,613.77	Master GW# 7390
GWD7400	18,891.54	1	Line 5 North Straits WEST - Mackinaw	18,640.20	Master GW# 7400
GWD7410	18,914.08	1	Line 5 North Straits WEST - Mackinaw	18,662.51	Master GW# 7410
GWD7420	18,941.77	1	Line 5 North Straits WEST - Mackinaw	18,689.82	Master GW# 7420
GWD7430	18,968.06	1	Line 5 North Straits WEST - Mackinaw	18,715.92	Master GW# 7430
GWD7440	18,994.61	1	Line 5 North Straits WEST - Mackinaw	18,742.44	Master GW# 7440
GWD7450	19,018.25	1	Line 5 North Straits WEST - Mackinaw	18,766.26	Master GW# 7450
GWD7460	19,045.93	1	Line 5 North Straits WEST - Mackinaw	18,793.74	Master GW# 7460
GWD7470	19,070.81	1	Line 5 North Straits WEST - Mackinaw	18,818.74	Master GW# 7470
GWD7480	19,097.48	1	Line 5 North Straits WEST - Mackinaw	18,844.92	Master GW# 7480
GWD7490	19,123.19	1	Line 5 North Straits WEST - Mackinaw	18,870.31	Master GW# 7490
GWD7500	19,150.95	1	Line 5 North Straits WEST - Mackinaw	18,897.64	Master GW# 7500
GWD7510	19,171.23	1	Line 5 North Straits WEST - Mackinaw	18,917.99	Master GW# 7510
GWD7520	19,197.98	1	Line 5 North Straits WEST - Mackinaw	18,944.71	Master GW# 7520

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD7530	19,223.94	1	Line 5 North Straits WEST - Mackinaw	18,969.93	Master GW# 7530
GWD7540	19,251.02	1	Line 5 North Straits WEST - Mackinaw	18,997.15	Master GW# 7540
GWD7550	19,271.08	1	Line 5 North Straits WEST - Mackinaw	19,016.80	Master GW# 7550
GWD7560	19,298.86	1	Line 5 North Straits WEST - Mackinaw	19,043.99	Master GW# 7560
GWD7570	19,325.49	1	Line 5 North Straits WEST - Mackinaw	19,070.60	Master GW# 7570
GWD7580	19,350.59	1	Line 5 North Straits WEST - Mackinaw	19,095.21	Master GW# 7580
GWD7590	19,377.57	1	Line 5 North Straits WEST - Mackinaw	19,121.98	Master GW# 7590
GWD7600	19,401.98	1	Line 5 North Straits WEST - Mackinaw	19,146.04	Master GW# 7600
GWD7610	19,428.36	1	Line 5 North Straits WEST - Mackinaw	19,172.04	Master GW# 7610
GWD7620	19,451.10	1	Line 5 North Straits WEST - Mackinaw	19,194.38	Master GW# 7620
GWD7630	19,479.69	1	Line 5 North Straits WEST - Mackinaw	19,222.68	Master GW# 7630
GWD7640	19,505.75	1	Line 5 North Straits WEST - Mackinaw	19,248.71	Master GW# 7640
GWD7650	19,534.05	1	Line 5 North Straits WEST - Mackinaw	19,276.27	Master GW# 7650
GWD7660	19,557.33	1	Line 5 North Straits WEST - Mackinaw	19,299.25	Master GW# 7660
GWD7670	19,581.23	1	Line 5 North Straits WEST - Mackinaw	19,322.89	Master GW# 7670
GWD7680	19,608.00	1	Line 5 North Straits WEST - Mackinaw	19,349.26	Master GW# 7680
GWD7690	19,628.64	1	Line 5 North Straits WEST - Mackinaw	19,369.68	Master GW# 7690
GWD7700	19,651.53	1	Line 5 North Straits WEST - Mackinaw	19,392.10	Master GW# 7700
GWD7710	19,674.49	1	Line 5 North Straits WEST - Mackinaw	19,415.24	Master GW# 7710
GWD7720	19,700.70	1	Line 5 North Straits WEST - Mackinaw	19,441.74	Master GW# 7720
GWD7730	19,728.94	1	Line 5 North Straits WEST - Mackinaw	19,468.43	Master GW# 7730
GWD7740	19,751.43	1	Line 5 North Straits WEST - Mackinaw	19,490.87	Master GW# 7740
GWD7750	19,779.17	1	Line 5 North Straits WEST - Mackinaw	19,518.01	Master GW# 7750
GWD7760	19,807.33	1	Line 5 North Straits WEST - Mackinaw	19,545.87	Master GW# 7760
GWD7770	19,832.84	1	Line 5 North Straits WEST - Mackinaw	19,570.99	Master GW# 7770
GWD7780	19,859.24	1	Line 5 North Straits WEST - Mackinaw	19,597.40	Master GW# 7780
GWD7790	19,883.66	1	Line 5 North Straits WEST - Mackinaw	19,621.80	Master GW# 7790
GWD7800	19,910.13	1	Line 5 North Straits WEST - Mackinaw	19,647.93	Master GW# 7800
GWD7810	19,936.53	1	Line 5 North Straits WEST - Mackinaw	19,674.03	Master GW# 7810
GWD7820	19,964.32	1	Line 5 North Straits WEST - Mackinaw	19,701.84	Master GW# 7820

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD7830	19,989.12	1	Line 5 North Straits WEST - Mackinaw	19,726.45	Master GW# 7830
GWD7840	20,016.29	1	Line 5 North Straits WEST - Mackinaw	19,753.51	Master GW# 7840
GWD7850	20,041.72	1	Line 5 North Straits WEST - Mackinaw	19,778.35	Master GW# 7850
GWD7860	20,065.26	1	Line 5 North Straits WEST - Mackinaw	19,801.91	Master GW# 7860
GWD7870	20,092.26	1	Line 5 North Straits WEST - Mackinaw	19,828.61	Master GW# 7870
GWD7880	20,115.49	1	Line 5 North Straits WEST - Mackinaw	19,851.67	Master GW# 7880
GWD7890	20,137.06	1	Line 5 North Straits WEST - Mackinaw	19,873.21	Master GW# 7890
GWD7900	20,163.26	1	Line 5 North Straits WEST - Mackinaw	19,899.46	Master GW# 7900
GWD7910	20,186.95	1	Line 5 North Straits WEST - Mackinaw	19,923.03	Master GW# 7910
GWD7920	20,213.80	1	Line 5 North Straits WEST - Mackinaw	19,949.19	Master GW# 7920
GWD7930	20,240.54	1	Line 5 North Straits WEST - Mackinaw	19,976.17	Master GW# 7930
GWD7940	20,265.94	1	Line 5 North Straits WEST - Mackinaw	20,000.95	Master GW# 7940
GWD7950	20,293.48	1	Line 5 North Straits WEST - Mackinaw	20,028.33	Master GW# 7950
GWD7960	20,320.03	1	Line 5 North Straits WEST - Mackinaw	20,054.28	Master GW# 7960
GWD7970	20,347.21	1	Line 5 North Straits WEST - Mackinaw	20,081.25	Master GW# 7970
GWD7980	20,374.38	1	Line 5 North Straits WEST - Mackinaw	20,108.21	Master GW# 7980
GWD7990	20,402.50	1	Line 5 North Straits WEST - Mackinaw	20,136.01	Master GW# 7990
GWD8000	20,427.70	1	Line 5 North Straits WEST - Mackinaw	20,160.80	Master GW# 8000
GWD8010	20,454.95	1	Line 5 North Straits WEST - Mackinaw	20,187.77	Master GW# 8010
GWD8020	20,481.50	1	Line 5 North Straits WEST - Mackinaw	20,214.11	Master GW# 8020
GWD8030	20,509.52	1	Line 5 North Straits WEST - Mackinaw	20,241.59	Master GW# 8030
GWD8040	20,537.03	1	Line 5 North Straits WEST - Mackinaw	20,268.36	Master GW# 8040
GWD8050	20,563.88	1	Line 5 North Straits WEST - Mackinaw	20,295.16	Master GW# 8050
GWD8060	20,589.40	1	Line 5 North Straits WEST - Mackinaw	20,320.26	Master GW# 8060
GWD8070	20,615.02	1	Line 5 North Straits WEST - Mackinaw	20,345.78	Master GW# 8070
GWD8080	20,641.15	1	Line 5 North Straits WEST - Mackinaw	20,371.64	Master GW# 8080
GWD8090	20,668.83	1	Line 5 North Straits WEST - Mackinaw	20,399.08	Master GW# 8090
GWD8100	20,695.40	1	Line 5 North Straits WEST - Mackinaw	20,425.43	Master GW# 8100
GWD8110	20,722.84	1	Line 5 North Straits WEST - Mackinaw	20,452.61	Master GW# 8110
GWD8120	20,750.09	1	Line 5 North Straits WEST - Mackinaw	20,479.38	Master GW# 8120

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD8130	20,776.20	1	Line 5 North Straits WEST - Mackinaw	20,505.61	Master GW# 8130
GWD8140	20,796.80	1	Line 5 North Straits WEST - Mackinaw	20,526.15	Master GW# 8140
GWD8150	20,820.34	1	Line 5 North Straits WEST - Mackinaw	20,549.51	Master GW# 8150
GWD8160	20,847.46	1	Line 5 North Straits WEST - Mackinaw	20,576.29	Master GW# 8160
GWD8170	20,869.08	1	Line 5 North Straits WEST - Mackinaw	20,597.62	Master GW# 8170
GWD8180	20,896.99	1	Line 5 North Straits WEST - Mackinaw	20,625.21	Master GW# 8180
GWD8190	20,923.27	1	Line 5 North Straits WEST - Mackinaw	20,651.16	Master GW# 8190
GWD8200	20,949.84	1	Line 5 North Straits WEST - Mackinaw	20,677.68	Master GW# 8200
GWD8210	20,976.88	1	Line 5 North Straits WEST - Mackinaw	20,704.53	Master GW# 8210
GWD8220	21,004.15	1	Line 5 North Straits WEST - Mackinaw	20,731.73	Master GW# 8220
GWD8230	21,027.96	1	Line 5 North Straits WEST - Mackinaw	20,755.22	Master GW# 8230
GWD8240	21,052.25	1	Line 5 North Straits WEST - Mackinaw	20,779.44	Master GW# 8240
GWD8250	21,079.06	1	Line 5 North Straits WEST - Mackinaw	20,805.60	Master GW# 8250
GWD8260	21,101.25	1	Line 5 North Straits WEST - Mackinaw	20,827.42	Master GW# 8260
GWD8270	21,128.01	1	Line 5 North Straits WEST - Mackinaw	20,853.74	Master GW# 8270
GWD8280	21,155.11	1	Line 5 North Straits WEST - Mackinaw	20,880.81	Master GW# 8280
GWD8290	21,183.06	1	Line 5 North Straits WEST - Mackinaw	20,908.21	Master GW# 8290
GWD8300	21,207.40	1	Line 5 North Straits WEST - Mackinaw	20,932.04	Master GW# 8300
GWD8310	21,233.64	1	Line 5 North Straits WEST - Mackinaw	20,959.66	Master GW# 8310
GWD8320	21,262.35	1	Line 5 North Straits WEST - Mackinaw	20,986.50	Master GW# 8320
GWD8330	21,286.48	1	Line 5 North Straits WEST - Mackinaw	21,010.13	Master GW# 8330
GWD8340	21,313.34	1	Line 5 North Straits WEST - Mackinaw	21,037.02	Master GW# 8340
GWD8350	21,338.04	1	Line 5 North Straits WEST - Mackinaw	21,061.33	Master GW# 8350
GWD8360	21,365.20	1	Line 5 North Straits WEST - Mackinaw	21,088.56	Master GW# 8360
GWD8370	21,391.61	1	Line 5 North Straits WEST - Mackinaw	21,114.99	Master GW# 8370
GWD8380	21,415.48	1	Line 5 North Straits WEST - Mackinaw	21,138.65	Master GW# 8380
GWD8390	21,434.19	1	Line 5 North Straits WEST - Mackinaw	21,157.54	Master GW# 8390
GWD8400	21,461.85	1	Line 5 North Straits WEST - Mackinaw	21,185.23	Master GW# 8400
GWD8410	21,486.11	1	Line 5 North Straits WEST - Mackinaw	21,208.89	Master GW# 8410
GWD8420	21,511.54	1	Line 5 North Straits WEST - Mackinaw	21,234.08	Master GW# 8420

BHI - Enbridge Chainage Correlation Listing

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Area Number	Enbridge Area Name	Enbridge Chainage (ft)	Description
GWD8430	21,538.27	1	Line 5 North Straits WEST - Mackinaw	21,260.85	Master GW# 8430
GWD8440	21,561.29	1	Line 5 North Straits WEST - Mackinaw	21,283.76	Master GW# 8440
GWD8450	21,584.57	1	Line 5 North Straits WEST - Mackinaw	21,306.63	Master GW# 8450
GWD8460	21,611.86	1	Line 5 North Straits WEST - Mackinaw	21,333.81	Master GW# 8460
GWD8470	21,637.10	1	Line 5 North Straits WEST - Mackinaw	21,358.81	Master GW# 8470
GWD8480	21,662.23	1	Line 5 North Straits WEST - Mackinaw	21,383.50	Master GW# 8480
GWD8490	21,689.92	1	Line 5 North Straits WEST - Mackinaw	21,410.83	Master GW# 8490
GWD8500	21,716.95	1	Line 5 North Straits WEST - Mackinaw	21,437.27	Master GW# 8500
GWD8510	21,743.33	1	Line 5 North Straits WEST - Mackinaw	21,463.13	Master GW# 8510

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 11	75.91	-23.99	11	n/a	0.500	Master GW# 11	5,078,862.82	674,366.21	178.87
GWD 13	93.25	-6.17	13	17.34	0.500	Master GW# 13	5,078,864.06	674,361.07	178.85
TEE 1	94.61	-4.70	13	1.36	0.500		5,078,864.16	674,360.65	178.85
TEE 2	95.60	-3.68	13	2.35	0.500		5,078,864.23	674,360.35	178.85
GWD 21	96.70	-2.63	21	3.45	0.500	Master GW# 21	5,078,864.31	674,360.05	178.85
GWD 23	97.35	-1.97	23	0.66	0.500	Master GW# 23	5,078,864.35	674,359.85	178.85
VLV 1	98.16	-0.05	23	0.81	0.500	St Ignace Launch Valve	5,078,864.49	674,359.29	178.85
GWD 27	101.22	1.93	27	3.86	0.500	Master GW# 27	5,078,864.63	674,358.71	178.85
GWD 31	101.95	2.66	31	0.73	0.500	Master GW# 31	5,078,864.68	674,358.49	178.85
GWD 41	102.85	3.57	41	0.91	0.500	Master GW# 41	5,078,864.75	674,358.22	178.85
TEE 3	103.11	4.69	41	0.26	0.500	20 IN OFFTAKE-FORGED	5,078,864.83	674,357.89	178.84
GWD 51	105.16	5.88	51	2.31	0.500	Master GW# 51	5,078,864.92	674,357.54	178.84
TEE 4	107.00	7.94	51	1.84	0.500		5,078,865.06	674,356.98	178.84
GWD 61	108.11	9.07	61	2.95	0.500	Master GW# 61	5,078,865.13	674,356.67	178.84
TEE 5	110.19	11.30	61	2.08	0.500		5,078,865.28	674,356.03	178.83
BND 1	115.26	16.47	61	7.15	0.500	9.6D Bend 29.9 Down	5,078,865.63	674,354.56	178.65
STR 1	115.43	16.64	61	7.32	0.500	Launch area changed since 2005	5,078,865.64	674,354.52	178.64
GWD 71	121.65	23.09	71	13.54	0.500	Master GW# 71	5,078,866.04	674,352.86	177.83
GWD 81	126.38	27.84	81	4.72	0.500	Master GW# 81	5,078,866.34	674,351.65	177.10
BND 2	133.87	34.89	81	7.49	0.500	10.3D Bend .6 LT 29.9 Up	5,078,866.83	674,349.67	176.11
GWD 91	141.31	41.88	91	14.93	0.500	Master GW# 91	5,078,867.35	674,347.48	175.90
BND 3	148.65	49.13	91	7.34	0.500	9.8D Bend 29.4 LT	5,078,867.70	674,345.28	175.90
GWD 101	155.75	56.14	101	14.44	0.500	Master GW# 101	5,078,867.26	674,343.16	175.90
GWD 111	162.82	63.03	111	7.07	0.500	Master GW# 111	5,078,866.65	674,341.09	175.89
BND 4	170.43	70.57	111	7.62	0.500	10.2D Bend 29.8 RT	5,078,866.17	674,338.83	175.88
GWD 121	177.54	77.62	121	14.73	0.812	Master GW# 121	5,078,866.49	674,336.69	175.87
GWD 125	180.87	80.70	125	3.32	0.812	Master GW# 125	5,078,866.72	674,335.71	175.88
GWD 135	182.17	81.99	135	1.30	0.812	Master GW# 135	5,078,866.81	674,335.32	175.88
TEE 6	196.18	96.58	135	14.01	0.812		5,078,867.85	674,330.93	175.92
GWD 160	209.08	108.50	160	26.91	0.812	Master GW# 160	5,078,868.70	674,327.33	175.95
GWD 170	236.67	136.08	170	27.59	0.812	Master GW# 170	5,078,870.64	674,319.15	175.98
GWD 180	264.45	163.51	180	27.77	0.812	Master GW# 180	5,078,872.60	674,310.91	175.97

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 190	286.45	186.13	190	22.01	0.812	Master GW# 190	5,078,874.16	674,304.38	175.99
GWD 200	313.37	212.56	200	26.92	0.812	Master GW# 200	5,078,876.01	674,296.39	176.02
GWD 210	340.21	239.49	210	26.84	0.812	Master GW# 210	5,078,877.85	674,288.41	176.07
GWD 220	362.50	261.71	220	22.29	0.812	Master GW# 220	5,078,879.36	674,281.78	176.10
GWD 230	389.12	288.15	230	26.62	0.812	Master GW# 230	5,078,881.15	674,273.87	176.13
GWD 240	414.73	314.25	240	25.61	0.812	Master GW# 240	5,078,882.86	674,266.25	176.14
GWD 250	441.15	341.14	250	26.42	0.812	Master GW# 250	5,078,884.62	674,258.38	176.11
GWD 260	461.54	361.89	260	20.39	0.812	Master GW# 260	5,078,885.98	674,252.32	176.12
GWD 270	487.69	387.89	270	26.15	0.812	Master GW# 270	5,078,887.74	674,244.54	176.13
GWD 280	514.48	415.01	280	26.78	0.812	Master GW# 280	5,078,889.57	674,236.58	176.15
GWD 290	537.15	437.81	290	22.67	0.812	Master GW# 290	5,078,891.15	674,229.85	176.19
GWD 300	562.92	464.13	300	25.78	0.812	Master GW# 300	5,078,892.96	674,222.20	176.24
BND 5	577.97	479.30	300	15.05	0.812	24.9D Bend 19.4 LT	5,078,893.82	674,217.70	176.25
GWD 310	587.71	489.12	310	24.79	0.812	Master GW# 310	5,078,893.75	674,214.74	176.25
BND 6	598.90	500.50	310	11.18	0.812	25.1D Bend 21.6 LT	5,078,893.12	674,211.39	176.23
GWD 320	612.90	514.75	320	25.19	0.812	Master GW# 320	5,078,891.41	674,207.49	176.26
BND 7	625.76	527.47	320	12.86	0.812	25.9D Bend 23.9 LT .9 Down	5,078,889.23	674,204.24	176.30
GWD 330	638.35	539.93	330	25.45	0.812	Master GW# 330	5,078,886.40	674,201.66	176.30
BND 8	649.47	551.05	330	11.12	0.812	23.2D Bend 23.2 LT 1.4 Up	5,078,883.51	674,199.89	176.33
GWD 340	664.15	565.72	340	25.80	0.812	Master GW# 340	5,078,879.27	674,198.50	176.41
GWD 350	671.35	573.05	350	7.21	0.812	Master GW# 350	5,078,877.14	674,197.97	176.46
GWD 360	697.89	599.62	360	26.53	0.812	Master GW# 360	5,078,869.28	674,196.04	176.56
GWD 370	725.10	626.69	370	27.21	0.812	Master GW# 370	5,078,861.23	674,194.04	176.63
GWD 380	752.22	654.09	380	27.12	0.812	Master GW# 380	5,078,853.20	674,192.08	176.72
GWD 390	780.41	682.26	390	28.19	0.812	Master GW# 390	5,078,844.84	674,190.07	176.80
GWD 400	806.57	708.75	400	26.17	0.812	Master GW# 400	5,078,837.07	674,188.24	176.83
GWD 410	831.12	733.59	410	24.55	0.812	Master GW# 410	5,078,829.78	674,186.57	176.79
GWD 420	856.66	759.01	420	25.54	0.812	Master GW# 420	5,078,822.18	674,184.84	176.73
GWD 430	880.26	782.84	430	23.61	0.812	Master GW# 430	5,078,815.16	674,183.26	176.68
GWD 440	907.47	810.50	440	27.21	0.812	Master GW# 440	5,078,807.07	674,181.43	176.67
GWD 450	930.65	834.20	450	23.18	0.812	Master GW# 450	5,078,800.18	674,179.86	176.69
GWD 460	953.88	857.68	460	23.24	0.812	Master GW# 460	5,078,793.27	674,178.28	176.67

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 470	981.15	885.49	470	27.27	0.812	Master GW# 470	5,078,785.17	674,176.41	176.65
GWD 480	1,000.67	905.18	480	19.52	0.812	Master GW# 480	5,078,779.38	674,175.04	176.64
GWD 490	1,026.55	932.05	490	25.88	0.812	Master GW# 490	5,078,771.71	674,173.17	176.63
GWD 500	1,049.69	956.16	500	23.14	0.812	Master GW# 500	5,078,764.86	674,171.48	176.57
GWD 510	1,077.38	983.80	510	27.70	0.812	Master GW# 510	5,078,756.67	674,169.45	176.39
GWD 520	1,102.91	1,010.24	520	25.52	0.812	Master GW# 520	5,078,749.13	674,167.54	176.08
GWD 530	1,128.13	1,035.64	530	25.22	0.812	Master GW# 530	5,078,741.68	674,165.67	175.74
GWD 540	1,148.60	1,056.59	540	20.47	0.812	Master GW# 540	5,078,735.63	674,164.16	175.43
GWD 550	1,174.86	1,083.11	550	26.26	0.812	Master GW# 550	5,078,727.88	674,162.20	174.94
GWD 560	1,201.61	1,109.95	560	26.75	0.812	Master GW# 560	5,078,719.99	674,160.19	174.41
GWD 570	1,228.19	1,136.73	570	26.57	0.812	Master GW# 570	5,078,712.15	674,158.22	173.89
GWD 580	1,251.00	1,159.75	580	22.81	0.812	Master GW# 580	5,078,705.41	674,156.55	173.56
GWD 590	1,275.60	1,184.46	590	24.61	0.812	Master GW# 590	5,078,698.13	674,154.77	173.25
GWD 600	1,301.52	1,210.43	600	25.92	0.812	Master GW# 600	5,078,690.44	674,152.96	172.88
GWD 610	1,322.12	1,231.39	610	20.60	0.812	Master GW# 610	5,078,684.33	674,151.55	172.63
GWD 620	1,350.03	1,258.89	620	27.90	0.812	Master GW# 620	5,078,676.04	674,149.65	172.30
GWD 630	1,374.05	1,283.07	630	24.02	0.812	Master GW# 630	5,078,668.91	674,148.03	172.02
GWD 640	1,397.56	1,307.09	640	23.51	0.812	Master GW# 640	5,078,661.92	674,146.46	171.77
GWD 650	1,417.58	1,326.99	650	20.01	0.812	Master GW# 650	5,078,655.96	674,145.13	171.62
GWD 660	1,444.37	1,353.78	660	26.79	0.812	Master GW# 660	5,078,647.99	674,143.35	171.42
GWD 670	1,464.77	1,374.70	670	20.40	0.812	Master GW# 670	5,078,641.92	674,141.99	171.30
GWD 680	1,492.18	1,402.48	680	27.42	0.812	Master GW# 680	5,078,633.77	674,140.16	171.22
GWD 690	1,516.36	1,426.74	690	24.18	0.812	Master GW# 690	5,078,626.58	674,138.54	171.20
GWD 700	1,543.14	1,453.81	700	26.78	0.812	Master GW# 700	5,078,618.61	674,136.72	171.19
GWD 710	1,567.43	1,478.29	710	24.29	0.812	Master GW# 710	5,078,611.40	674,135.04	171.17
GWD 720	1,594.02	1,505.03	720	26.59	0.812	Master GW# 720	5,078,603.51	674,133.21	171.00
GWD 730	1,621.07	1,532.30	730	27.05	0.812	Master GW# 730	5,078,595.49	674,131.30	170.56
GWD 740	1,647.31	1,559.27	740	26.24	0.812	Master GW# 740	5,078,587.73	674,129.45	170.07
GWD 750	1,673.00	1,584.75	750	25.69	0.812	Master GW# 750	5,078,580.12	674,127.62	169.62
GWD 760	1,695.73	1,607.51	760	22.73	0.812	Master GW# 760	5,078,573.39	674,126.00	169.26
GWD 770	1,722.37	1,634.22	770	26.64	0.812	Master GW# 770	5,078,565.51	674,124.11	168.89
GWD 780	1,750.11	1,662.02	780	27.74	0.812	Master GW# 780	5,078,557.30	674,122.12	168.47

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 790	1,776.49	1,688.61	790	26.38	0.812	Master GW# 790	5,078,549.49	674,120.21	168.12
GWD 800	1,795.06	1,706.96	800	18.57	0.812	Master GW# 800	5,078,544.00	674,118.85	167.91
GWD 810	1,821.26	1,733.10	810	26.20	0.812	Master GW# 810	5,078,536.26	674,116.89	167.65
GWD 820	1,848.27	1,760.09	820	27.01	0.812	Master GW# 820	5,078,528.27	674,114.90	167.53
GWD 830	1,876.46	1,787.93	830	28.19	0.812	Master GW# 830	5,078,519.92	674,112.85	167.48
GWD 840	1,903.75	1,815.16	840	27.29	0.812	Master GW# 840	5,078,511.82	674,110.92	167.49
GWD 850	1,924.60	1,836.29	850	20.85	0.812	Master GW# 850	5,078,505.62	674,109.51	167.50
GWD 860	1,950.45	1,862.23	860	25.85	0.812	Master GW# 860	5,078,497.94	674,107.76	167.48
GWD 870	1,978.87	1,889.93	870	28.42	0.812	Master GW# 870	5,078,489.49	674,105.83	167.46
GWD 880	2,006.71	1,917.32	880	27.84	0.812	Master GW# 880	5,078,481.20	674,104.02	167.47
GWD 890	2,030.08	1,940.82	890	23.37	0.812	Master GW# 890	5,078,474.23	674,102.50	167.48
GWD 900	2,055.21	1,966.20	900	25.13	0.812	Master GW# 900	5,078,466.77	674,100.77	167.55
GWD 910	2,081.90	1,992.95	910	26.69	0.812	Master GW# 910	5,078,458.86	674,098.86	167.69
GWD 920	2,107.03	2,018.14	920	25.13	0.812	Master GW# 920	5,078,451.43	674,097.00	167.87
GWD 930	2,133.11	2,044.27	930	26.08	0.812	Master GW# 930	5,078,443.71	674,095.08	168.06
GWD 940	2,160.29	2,071.77	940	27.18	0.812	Master GW# 940	5,078,435.67	674,093.09	168.29
GWD 950	2,185.57	2,096.78	950	25.28	0.812	Master GW# 950	5,078,428.18	674,091.25	168.52
GWD 960	2,213.16	2,124.53	960	27.60	0.812	Master GW# 960	5,078,420.00	674,089.31	168.76
GWD 970	2,241.49	2,152.39	970	28.33	0.812	Master GW# 970	5,078,411.59	674,087.35	169.03
GWD 980	2,269.20	2,179.88	980	27.71	0.812	Master GW# 980	5,078,403.36	674,085.43	169.28
GWD 990	2,288.49	2,199.95	990	19.29	0.812	Master GW# 990	5,078,397.64	674,084.08	169.43
GWD 1000	2,315.89	2,227.04	1000	27.40	0.812	Master GW# 1000	5,078,389.51	674,082.16	169.64
GWD 1010	2,343.82	2,254.80	1010	27.93	0.812	Master GW# 1010	5,078,381.22	674,080.22	169.83
GWD 1020	2,370.95	2,282.41	1020	27.13	0.812	Master GW# 1020	5,078,373.16	674,078.35	170.02
GWD 1030	2,398.83	2,309.90	1030	27.88	0.812	Master GW# 1030	5,078,364.89	674,076.41	170.19
GWD 1040	2,426.32	2,337.15	1040	27.48	0.812	Master GW# 1040	5,078,356.73	674,074.50	170.18
GWD 1050	2,452.35	2,363.29	1050	26.03	0.812	Master GW# 1050	5,078,349.00	674,072.66	170.10
GWD 1060	2,479.44	2,390.18	1060	27.09	0.812	Master GW# 1060	5,078,340.97	674,070.74	170.05
GWD 1070	2,506.47	2,417.26	1070	27.03	0.812	Master GW# 1070	5,078,332.96	674,068.80	170.05
GWD 1080	2,529.50	2,440.28	1080	23.03	0.812	Master GW# 1080	5,078,326.12	674,067.19	170.10
GWD 1090	2,554.85	2,465.46	1090	25.35	0.812	Master GW# 1090	5,078,318.60	674,065.42	170.20
GWD 1100	2,580.53	2,491.28	1100	25.68	0.812	Master GW# 1100	5,078,310.98	674,063.62	170.33

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 1110	2,608.25	2,518.68	1110	27.72	0.812	Master GW# 1110	5,078,302.76	674,061.67	170.45
GWD 1120	2,634.85	2,545.39	1120	26.60	0.812	Master GW# 1120	5,078,294.85	674,059.85	170.61
GWD 1130	2,661.25	2,572.18	1130	26.40	0.812	Master GW# 1130	5,078,287.01	674,058.05	170.73
GWD 1140	2,682.76	2,594.41	1140	21.50	0.812	Master GW# 1140	5,078,280.62	674,056.57	170.80
GWD 1150	2,706.37	2,618.16	1150	23.62	0.812	Master GW# 1150	5,078,273.60	674,054.94	170.83
GWD 1160	2,729.18	2,640.81	1160	22.80	0.812	Master GW# 1160	5,078,266.84	674,053.34	170.82
GWD 1170	2,753.94	2,665.67	1170	24.76	0.812	Master GW# 1170	5,078,259.49	674,051.60	170.79
GWD 1180	2,778.70	2,690.87	1180	24.76	0.812	Master GW# 1180	5,078,252.14	674,049.86	170.77
GWD 1190	2,802.32	2,714.90	1190	23.63	0.812	Master GW# 1190	5,078,245.13	674,048.22	170.73
GWD 1200	2,825.38	2,738.51	1200	23.06	0.812	Master GW# 1200	5,078,238.28	674,046.61	170.67
GWD 1210	2,851.76	2,765.16	1210	26.38	0.812	Master GW# 1210	5,078,230.46	674,044.76	170.59
GWD 1220	2,877.94	2,791.68	1220	26.18	0.812	Master GW# 1220	5,078,222.70	674,042.89	170.48
GWD 1230	2,896.88	2,811.72	1230	18.95	0.812	Master GW# 1230	5,078,217.08	674,041.54	170.36
GWD 1240	2,919.35	2,833.60	1240	22.47	0.812	Master GW# 1240	5,078,210.42	674,039.97	170.23
GWD 1250	2,945.98	2,860.37	1250	26.63	0.812	Master GW# 1250	5,078,202.50	674,038.15	170.08
GWD 1260	2,967.66	2,882.74	1260	21.68	0.812	Master GW# 1260	5,078,196.05	674,036.72	170.02
GWD 1270	2,993.33	2,908.53	1270	25.66	0.812	Master GW# 1270	5,078,188.40	674,035.06	169.90
GWD 1280	3,020.20	2,935.53	1280	26.88	0.812	Master GW# 1280	5,078,180.40	674,033.29	169.75
GWD 1290	3,046.55	2,961.68	1290	26.35	0.812	Master GW# 1290	5,078,172.56	674,031.54	169.64
GWD 1300	3,067.78	2,982.95	1300	21.23	0.812	Master GW# 1300	5,078,166.25	674,030.11	169.55
GWD 1310	3,093.63	3,008.46	1310	25.84	0.812	Master GW# 1310	5,078,158.57	674,028.34	169.45
GWD 1320	3,120.49	3,035.49	1320	26.87	0.812	Master GW# 1320	5,078,150.60	674,026.47	169.28
GWD 1330	3,145.87	3,060.98	1330	25.37	0.812	Master GW# 1330	5,078,143.06	674,024.73	169.09
GWD 1340	3,173.45	3,088.43	1340	27.59	0.812	Master GW# 1340	5,078,134.87	674,022.85	168.77
GWD 1350	3,199.59	3,114.82	1350	26.13	0.812	Master GW# 1350	5,078,127.12	674,021.06	168.33
GWD 1360	3,225.39	3,140.37	1360	25.80	0.812	Master GW# 1360	5,078,119.47	674,019.28	167.87
GWD 1370	3,252.96	3,168.40	1370	27.57	0.812	Master GW# 1370	5,078,111.30	674,017.36	167.36
GWD 1380	3,279.25	3,194.91	1380	26.28	0.812	Master GW# 1380	5,078,103.51	674,015.52	166.91
GWD 1390	3,303.54	3,219.43	1390	24.30	0.812	Master GW# 1390	5,078,096.31	674,013.83	166.62
GWD 1400	3,328.07	3,243.99	1400	24.53	0.812	Master GW# 1400	5,078,089.01	674,012.19	166.48
GWD 1410	3,355.15	3,270.81	1410	27.08	0.812	Master GW# 1410	5,078,080.94	674,010.43	166.41
GWD 1420	3,381.91	3,297.61	1420	26.76	0.812	Master GW# 1420	5,078,072.98	674,008.63	166.37

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 1430	3,406.98	3,322.50	1430	25.07	0.812	Master GW# 1430	5,078,065.54	674,006.90	166.36
GWD 1440	3,435.56	3,350.66	1440	28.58	0.812	Master GW# 1440	5,078,057.05	674,004.92	166.30
GWD 1450	3,459.84	3,374.95	1450	24.27	0.812	Master GW# 1450	5,078,049.83	674,003.29	166.18
GWD 1460	3,486.84	3,401.55	1460	27.00	0.812	Master GW# 1460	5,078,041.80	674,001.51	166.00
GWD 1470	3,508.92	3,423.55	1470	22.08	0.812	Master GW# 1470	5,078,035.23	674,000.02	165.83
GWD 1480	3,533.14	3,447.51	1480	24.22	0.812	Master GW# 1480	5,078,028.04	673,998.36	165.71
GWD 1490	3,559.09	3,473.39	1490	25.95	0.812	Master GW# 1490	5,078,020.33	673,996.59	165.62
GWD 1500	3,587.07	3,500.97	1500	27.98	0.812	Master GW# 1500	5,078,012.01	673,994.71	165.61
GWD 1510	3,611.48	3,525.09	1510	24.41	0.812	Master GW# 1510	5,078,004.75	673,993.05	165.70
GWD 1520	3,638.29	3,551.64	1520	26.82	0.812	Master GW# 1520	5,077,996.78	673,991.21	165.83
GWD 1530	3,657.77	3,571.15	1530	19.48	0.812	Master GW# 1530	5,077,991.00	673,989.87	165.93
GWD 1540	3,682.66	3,595.80	1540	24.89	0.812	Master GW# 1540	5,077,983.60	673,988.15	166.07
GWD 1550	3,709.69	3,623.36	1550	27.03	0.812	Master GW# 1550	5,077,975.58	673,986.27	166.15
GWD 1560	3,737.48	3,650.60	1560	27.78	0.812	Master GW# 1560	5,077,967.32	673,984.37	166.07
GWD 1570	3,765.14	3,678.05	1570	27.67	0.812	Master GW# 1570	5,077,959.08	673,982.59	165.83
GWD 1580	3,792.02	3,704.72	1580	26.87	0.812	Master GW# 1580	5,077,951.07	673,980.91	165.52
GWD 1590	3,818.55	3,730.71	1590	26.53	0.812	Master GW# 1590	5,077,943.17	673,979.17	165.26
GWD 1600	3,843.70	3,755.57	1600	25.15	0.812	Master GW# 1600	5,077,935.72	673,977.37	165.09
GWD 1610	3,866.50	3,778.19	1610	22.80	0.812	Master GW# 1610	5,077,928.98	673,975.67	164.91
GWD 1620	3,889.02	3,800.11	1620	22.52	0.812	Master GW# 1620	5,077,922.32	673,974.04	164.68
GWD 1630	3,917.17	3,828.27	1630	28.16	0.812	Master GW# 1630	5,077,913.97	673,972.06	164.27
GWD 1640	3,942.91	3,853.93	1640	25.73	0.812	Master GW# 1640	5,077,906.35	673,970.26	163.83
GWD 1650	3,965.53	3,876.23	1650	22.62	0.812	Master GW# 1650	5,077,899.65	673,968.66	163.47
GWD 1660	3,990.50	3,902.08	1660	24.98	0.812	Master GW# 1660	5,077,892.24	673,966.92	163.16
GWD 1670	4,015.30	3,925.81	1670	24.80	0.812	Master GW# 1670	5,077,884.87	673,965.25	162.96
GWD 1680	4,042.38	3,952.32	1680	27.08	0.812	Master GW# 1680	5,077,876.82	673,963.42	162.85
GWD 1690	4,068.99	3,978.55	1690	26.62	0.812	Master GW# 1690	5,077,868.92	673,961.58	162.78
GWD 1700	4,095.98	4,005.95	1700	26.98	0.812	Master GW# 1700	5,077,860.91	673,959.67	162.71
GWD 1710	4,115.24	4,024.35	1710	19.27	0.812	Master GW# 1710	5,077,855.20	673,958.31	162.64
GWD 1720	4,141.12	4,049.96	1720	25.87	0.812	Master GW# 1720	5,077,847.52	673,956.51	162.52
GWD 1730	4,168.12	4,076.19	1730	27.00	0.812	Master GW# 1730	5,077,839.50	673,954.64	162.35
GWD 1740	4,195.58	4,103.58	1740	27.47	0.812	Master GW# 1740	5,077,831.35	673,952.75	162.15

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 1750	4,224.04	4,131.58	1750	28.46	0.812	Master GW# 1750	5,077,822.90	673,950.79	161.93
GWD 1760	4,250.05	4,158.23	1760	26.01	0.812	Master GW# 1760	5,077,815.18	673,949.00	161.71
GWD 1770	4,277.19	4,184.71	1770	27.14	0.812	Master GW# 1770	5,077,807.12	673,947.13	161.45
GWD 1780	4,304.87	4,211.86	1780	27.68	0.812	Master GW# 1780	5,077,798.90	673,945.22	161.16
GWD 1790	4,329.96	4,237.05	1790	25.09	0.812	Master GW# 1790	5,077,791.46	673,943.47	160.90
GWD 1800	4,356.92	4,263.73	1800	26.96	0.812	Master GW# 1800	5,077,783.46	673,941.63	160.58
GWD 1810	4,384.18	4,290.82	1810	27.26	0.812	Master GW# 1810	5,077,775.36	673,939.80	160.18
GWD 1820	4,409.49	4,315.80	1820	25.32	0.812	Master GW# 1820	5,077,767.84	673,938.10	159.79
GWD 1830	4,435.71	4,341.52	1830	26.22	0.812	Master GW# 1830	5,077,760.06	673,936.30	159.50
GWD 1840	4,460.96	4,366.68	1840	25.25	0.812	Master GW# 1840	5,077,752.57	673,934.54	159.22
GWD 1850	4,481.97	4,387.27	1850	21.01	0.812	Master GW# 1850	5,077,746.34	673,933.05	159.03
GWD 1860	4,506.52	4,411.53	1860	24.55	0.812	Master GW# 1860	5,077,739.06	673,931.31	158.84
GWD 1870	4,533.05	4,437.68	1870	26.53	0.812	Master GW# 1870	5,077,731.19	673,929.44	158.66
GWD 1880	4,559.88	4,464.16	1880	26.83	0.812	Master GW# 1880	5,077,723.23	673,927.59	158.50
GWD 1890	4,587.02	4,491.19	1890	27.14	0.812	Master GW# 1890	5,077,715.17	673,925.74	158.26
GWD 1900	4,609.10	4,512.60	1900	22.08	0.812	Master GW# 1900	5,077,708.60	673,924.24	158.05
GWD 1910	4,636.45	4,540.07	1910	27.35	0.812	Master GW# 1910	5,077,700.48	673,922.37	157.77
GWD 1920	4,664.02	4,566.85	1920	27.57	0.812	Master GW# 1920	5,077,692.31	673,920.44	157.48
GWD 1930	4,691.38	4,593.91	1930	27.37	0.812	Master GW# 1930	5,077,684.19	673,918.51	157.27
GWD 1940	4,718.85	4,621.08	1940	27.47	0.812	Master GW# 1940	5,077,676.06	673,916.53	157.10
GWD 1950	4,746.70	4,648.78	1950	27.85	0.812	Master GW# 1950	5,077,667.81	673,914.50	156.93
GWD 1960	4,773.49	4,675.12	1960	26.79	0.812	Master GW# 1960	5,077,659.87	673,912.58	156.80
GWD 1970	4,800.06	4,701.27	1970	26.57	0.812	Master GW# 1970	5,077,651.99	673,910.70	156.73
GWD 1980	4,825.83	4,726.36	1980	25.77	0.812	Master GW# 1980	5,077,644.34	673,908.92	156.69
GWD 1990	4,852.71	4,753.20	1990	26.89	0.812	Master GW# 1990	5,077,636.35	673,907.09	156.66
GWD 2000	4,874.41	4,774.63	2000	21.69	0.812	Master GW# 2000	5,077,629.91	673,905.57	156.61
GWD 2010	4,900.51	4,800.84	2010	26.11	0.812	Master GW# 2010	5,077,622.18	673,903.69	156.56
GWD 2020	4,927.89	4,827.90	2020	27.37	0.812	Master GW# 2020	5,077,614.07	673,901.70	156.53
GWD 2030	4,954.54	4,854.22	2030	26.66	0.812	Master GW# 2030	5,077,606.17	673,899.78	156.48
GWD 2040	4,977.59	4,876.96	2040	23.04	0.812	Master GW# 2040	5,077,599.33	673,898.16	156.45
GWD 2050	5,005.40	4,904.32	2050	27.81	0.812	Master GW# 2050	5,077,591.07	673,896.27	156.42
GWD 2060	5,031.40	4,930.35	2060	26.00	0.812	Master GW# 2060	5,077,583.33	673,894.52	156.34

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 2070	5,059.54	4,957.75	2070	28.14	0.812	Master GW# 2070	5,077,574.97	673,892.62	156.25
GWD 2080	5,086.76	4,984.80	2080	27.21	0.812	Master GW# 2080	5,077,566.87	673,890.78	156.18
GWD 2090	5,113.33	5,011.46	2090	26.57	0.812	Master GW# 2090	5,077,558.97	673,888.98	156.17
GWD 2100	5,133.88	5,031.81	2100	20.55	0.812	Master GW# 2100	5,077,552.86	673,887.59	156.19
GWD 2110	5,161.80	5,059.27	2110	27.92	0.812	Master GW# 2110	5,077,544.56	673,885.71	156.21
GWD 2120	5,187.64	5,084.76	2120	25.84	0.812	Master GW# 2120	5,077,536.88	673,883.96	156.21
GWD 2130	5,212.75	5,109.82	2130	25.11	0.812	Master GW# 2130	5,077,529.41	673,882.25	156.18
GWD 2140	5,238.95	5,135.42	2140	26.20	0.812	Master GW# 2140	5,077,521.63	673,880.46	156.16
GWD 2150	5,262.34	5,159.32	2150	23.39	0.812	Master GW# 2150	5,077,514.69	673,878.83	156.12
GWD 2160	5,290.16	5,186.47	2160	27.82	0.812	Master GW# 2160	5,077,506.43	673,876.87	156.04
GWD 2170	5,316.80	5,213.06	2170	26.65	0.812	Master GW# 2170	5,077,498.53	673,874.98	155.97
GWD 2180	5,342.57	5,238.57	2180	25.76	0.812	Master GW# 2180	5,077,490.88	673,873.20	155.95
GWD 2190	5,367.95	5,263.59	2190	25.38	0.812	Master GW# 2190	5,077,483.33	673,871.48	156.06
GWD 2200	5,393.09	5,288.93	2200	25.14	0.812	Master GW# 2200	5,077,475.85	673,869.80	156.12
GWD 2210	5,420.53	5,315.60	2210	27.43	0.812	Master GW# 2210	5,077,467.69	673,867.96	156.10
GWD 2220	5,447.56	5,342.78	2220	27.04	0.812	Master GW# 2220	5,077,459.66	673,866.08	156.08
GWD 2230	5,474.84	5,369.79	2230	27.27	0.812	Master GW# 2230	5,077,451.56	673,864.21	156.10
GWD 2240	5,498.42	5,393.34	2240	23.58	0.812	Master GW# 2240	5,077,444.56	673,862.59	156.11
GWD 2250	5,525.34	5,420.30	2250	26.92	0.812	Master GW# 2250	5,077,436.56	673,860.73	156.10
GWD 2260	5,552.46	5,447.17	2260	27.12	0.812	Master GW# 2260	5,077,428.50	673,858.86	156.10
GWD 2270	5,573.58	5,468.57	2270	21.11	0.812	Master GW# 2270	5,077,422.23	673,857.42	156.10
GWD 2280	5,599.72	5,494.60	2280	26.14	0.812	Master GW# 2280	5,077,414.46	673,855.62	156.09
GWD 2290	5,627.00	5,522.17	2290	27.28	0.812	Master GW# 2290	5,077,406.36	673,853.75	156.04
GWD 2300	5,652.32	5,547.42	2300	25.32	0.812	Master GW# 2300	5,077,398.84	673,852.00	155.98
GWD 2310	5,679.64	5,574.91	2310	27.32	0.812	Master GW# 2310	5,077,390.72	673,850.12	155.88
GWD 2320	5,705.53	5,600.52	2320	25.90	0.812	Master GW# 2320	5,077,383.03	673,848.34	155.75
GWD 2330	5,732.29	5,627.75	2330	26.76	0.812	Master GW# 2330	5,077,375.08	673,846.50	155.60
GWD 2340	5,759.62	5,654.49	2340	27.33	0.812	Master GW# 2340	5,077,366.97	673,844.62	155.43
GWD 2350	5,786.35	5,681.23	2350	26.72	0.812	Master GW# 2350	5,077,359.03	673,842.77	155.23
GWD 2360	5,811.83	5,706.85	2360	25.49	0.812	Master GW# 2360	5,077,351.47	673,841.01	155.05
GWD 2370	5,838.83	5,733.70	2370	27.00	0.812	Master GW# 2370	5,077,343.45	673,839.13	154.87
GWD 2380	5,862.87	5,757.85	2380	24.04	0.812	Master GW# 2380	5,077,336.31	673,837.48	154.73

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 2390	5,889.93	5,784.63	2390	27.06	0.812	Master GW# 2390	5,077,328.28	673,835.62	154.58
GWD 2400	5,910.13	5,804.90	2400	20.20	0.812	Master GW# 2400	5,077,322.28	673,834.23	154.48
GWD 2410	5,934.64	5,829.30	2410	24.51	0.812	Master GW# 2410	5,077,315.00	673,832.54	154.38
GWD 2420	5,960.31	5,854.80	2420	25.66	0.812	Master GW# 2420	5,077,307.37	673,830.78	154.29
GWD 2430	5,985.44	5,879.64	2430	25.13	0.812	Master GW# 2430	5,077,299.91	673,829.05	154.21
GWD 2440	6,007.35	5,901.22	2440	21.91	0.812	Master GW# 2440	5,077,293.40	673,827.55	154.15
GWD 2450	6,035.20	5,927.84	2450	27.86	0.812	Master GW# 2450	5,077,285.12	673,825.64	154.09
GWD 2460	6,061.44	5,954.13	2460	26.23	0.812	Master GW# 2460	5,077,277.33	673,823.83	154.04
GWD 2470	6,088.71	5,981.18	2470	27.27	0.812	Master GW# 2470	5,077,269.23	673,821.96	154.02
GWD 2480	6,114.50	6,007.10	2480	25.79	0.812	Master GW# 2480	5,077,261.56	673,820.20	154.07
GWD 2490	6,142.49	6,034.71	2490	27.99	0.812	Master GW# 2490	5,077,253.24	673,818.31	154.15
GWD 2500	6,168.73	6,060.76	2500	26.24	0.812	Master GW# 2500	5,077,245.44	673,816.54	154.17
GWD 2510	6,193.87	6,085.94	2510	25.15	0.812	Master GW# 2510	5,077,237.96	673,814.82	154.12
GWD 2520	6,216.63	6,108.03	2520	22.76	0.812	Master GW# 2520	5,077,231.20	673,813.26	154.05
GWD 2530	6,244.36	6,135.24	2530	27.73	0.812	Master GW# 2530	5,077,222.97	673,811.34	153.93
GWD 2540	6,270.87	6,161.44	2540	26.50	0.812	Master GW# 2540	5,077,215.09	673,809.53	153.80
GWD 2550	6,297.93	6,188.56	2550	27.06	0.812	Master GW# 2550	5,077,207.05	673,807.68	153.65
GWD 2560	6,326.05	6,215.82	2560	28.12	0.812	Master GW# 2560	5,077,198.70	673,805.77	153.56
GWD 2570	6,351.89	6,241.63	2570	25.84	0.812	Master GW# 2570	5,077,191.01	673,804.02	153.52
GWD 2580	6,380.08	6,269.69	2580	28.19	0.812	Master GW# 2580	5,077,182.63	673,802.13	153.51
GWD 2590	6,407.90	6,297.48	2590	27.83	0.812	Master GW# 2590	5,077,174.35	673,800.25	153.52
GWD 2600	6,429.38	6,318.44	2600	21.48	0.812	Master GW# 2600	5,077,167.97	673,798.79	153.49
GWD 2610	6,455.60	6,344.88	2610	26.21	0.812	Master GW# 2610	5,077,160.18	673,797.00	153.42
GWD 2620	6,482.31	6,371.35	2620	26.71	0.812	Master GW# 2620	5,077,152.24	673,795.18	153.33
GWD 2630	6,505.83	6,394.59	2630	23.52	0.812	Master GW# 2630	5,077,145.25	673,793.57	153.23
GWD 2640	6,532.97	6,421.29	2640	27.14	0.812	Master GW# 2640	5,077,137.19	673,791.72	153.10
GWD 2650	6,559.35	6,447.47	2650	26.37	0.812	Master GW# 2650	5,077,129.35	673,789.90	152.96
GWD 2660	6,586.23	6,473.89	2660	26.89	0.812	Master GW# 2660	5,077,121.37	673,788.05	152.79
GWD 2670	6,613.78	6,500.92	2670	27.55	0.812	Master GW# 2670	5,077,113.19	673,786.15	152.62
GWD 2680	6,641.23	6,528.05	2680	27.45	0.812	Master GW# 2680	5,077,105.04	673,784.25	152.45
GWD 2690	6,667.94	6,554.15	2690	26.71	0.812	Master GW# 2690	5,077,097.11	673,782.41	152.31
GWD 2700	6,695.58	6,581.41	2700	27.64	0.812	Master GW# 2700	5,077,088.90	673,780.51	152.19

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 2710	6,723.63	6,608.80	2710	28.05	0.812	Master GW# 2710	5,077,080.57	673,778.57	152.05
GWD 2720	6,751.84	6,636.52	2720	28.21	0.812	Master GW# 2720	5,077,072.19	673,776.62	151.89
GWD 2730	6,777.38	6,662.01	2730	25.54	0.812	Master GW# 2730	5,077,064.61	673,774.86	151.71
GWD 2740	6,803.54	6,687.42	2740	26.16	0.812	Master GW# 2740	5,077,056.84	673,773.05	151.48
GWD 2750	6,824.49	6,708.21	2750	20.96	0.812	Master GW# 2750	5,077,050.62	673,771.60	151.30
GWD 2760	6,853.12	6,736.12	2760	28.63	0.812	Master GW# 2760	5,077,042.13	673,769.61	151.00
GWD 2770	6,881.10	6,763.46	2770	27.98	0.812	Master GW# 2770	5,077,033.83	673,767.68	150.67
GWD 2780	6,907.59	6,789.83	2780	26.49	0.812	Master GW# 2780	5,077,025.97	673,765.84	150.32
GWD 2790	6,933.13	6,814.97	2790	25.54	0.812	Master GW# 2790	5,077,018.40	673,764.07	149.95
GWD 2800	6,959.31	6,840.83	2800	26.18	0.812	Master GW# 2800	5,077,010.64	673,762.26	149.51
GWD 2810	6,982.92	6,864.00	2810	23.62	0.812	Master GW# 2810	5,077,003.64	673,760.62	149.10
GWD 2820	7,008.00	6,888.65	2820	25.08	0.812	Master GW# 2820	5,076,996.21	673,758.87	148.63
GWD 2830	7,035.26	6,915.46	2830	27.26	0.812	Master GW# 2830	5,076,988.13	673,756.98	148.10
GWD 2840	7,062.84	6,942.69	2840	27.58	0.812	Master GW# 2840	5,076,979.96	673,755.07	147.55
GWD 2850	7,087.55	6,966.84	2850	24.71	0.812	Master GW# 2850	5,076,972.65	673,753.36	147.03
GWD 2860	7,115.12	6,993.64	2860	27.58	0.812	Master GW# 2860	5,076,964.48	673,751.45	146.42
GWD 2870	7,140.65	7,018.89	2870	25.52	0.812	Master GW# 2870	5,076,956.93	673,749.69	145.83
GWD 2880	7,167.13	7,044.55	2880	26.48	0.812	Master GW# 2880	5,076,949.09	673,747.86	145.19
GWD 2890	7,193.75	7,070.73	2890	26.62	0.812	Master GW# 2890	5,076,941.21	673,746.04	144.49
GWD 2900	7,220.25	7,096.68	2900	26.50	0.812	Master GW# 2900	5,076,933.37	673,744.22	143.77
GWD 2910	7,246.90	7,122.54	2910	26.65	0.812	Master GW# 2910	5,076,925.50	673,742.39	142.99
GWD 2920	7,271.32	7,146.74	2920	24.43	0.812	Master GW# 2920	5,076,918.28	673,740.72	142.24
GWD 2930	7,299.76	7,174.61	2930	28.44	0.812	Master GW# 2930	5,076,909.88	673,738.78	141.33
GWD 2940	7,326.65	7,200.84	2940	26.88	0.812	Master GW# 2940	5,076,901.95	673,736.94	140.40
GWD 2950	7,353.33	7,227.25	2950	26.69	0.812	Master GW# 2950	5,076,894.08	673,735.12	139.41
GWD 2960	7,381.79	7,254.90	2960	28.46	0.812	Master GW# 2960	5,076,885.70	673,733.21	138.27
GWD 2970	7,409.56	7,282.36	2970	27.77	0.812	Master GW# 2970	5,076,877.53	673,731.34	137.04
GWD 2980	7,436.67	7,308.96	2980	27.11	0.812	Master GW# 2980	5,076,869.57	673,729.53	135.77
GWD 2990	7,464.88	7,336.39	2990	28.20	0.812	Master GW# 2990	5,076,861.30	673,727.62	134.42
GWD 3000	7,492.12	7,363.42	3000	27.24	0.812	Master GW# 3000	5,076,853.32	673,725.78	133.08
GWD 3010	7,515.35	7,386.29	3010	23.23	0.812	Master GW# 3010	5,076,846.51	673,724.21	131.95
GWD 3020	7,541.70	7,412.44	3020	26.36	0.812	Master GW# 3020	5,076,838.77	673,722.43	130.72

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 3030	7,568.53	7,438.42	3030	26.83	0.812	Master GW# 3030	5,076,830.89	673,720.59	129.56
GWD 3040	7,589.28	7,458.79	3040	20.75	0.812	Master GW# 3040	5,076,824.78	673,719.16	128.72
GWD 3050	7,614.89	7,484.06	3050	25.61	0.812	Master GW# 3050	5,076,817.23	673,717.41	127.79
GWD 3060	7,641.61	7,510.14	3060	26.73	0.812	Master GW# 3060	5,076,809.34	673,715.58	126.96
GWD 3070	7,666.12	7,534.31	3070	24.51	0.812	Master GW# 3070	5,076,802.09	673,713.91	126.23
GWD 3080	7,692.84	7,560.71	3080	26.71	0.812	Master GW# 3080	5,076,794.20	673,712.09	125.40
GWD 3090	7,720.03	7,587.36	3090	27.19	0.812	Master GW# 3090	5,076,786.17	673,710.24	124.48
GWD 3100	7,747.98	7,614.86	3100	27.95	0.812	Master GW# 3100	5,076,777.92	673,708.35	123.50
GWD 3110	7,775.12	7,641.66	3110	27.14	0.812	Master GW# 3110	5,076,769.92	673,706.50	122.51
GWD 3120	7,800.97	7,666.93	3120	25.84	0.812	Master GW# 3120	5,076,762.31	673,704.74	121.48
GWD 3130	7,826.81	7,692.12	3130	25.84	0.812	Master GW# 3130	5,076,754.74	673,702.98	120.20
GWD 3140	7,854.88	7,719.89	3140	28.07	0.812	Master GW# 3140	5,076,746.56	673,701.11	118.54
GWD 3150	7,881.88	7,746.15	3150	27.00	0.812	Master GW# 3150	5,076,738.70	673,699.32	116.88
GWD 3160	7,909.08	7,772.67	3160	27.20	0.812	Master GW# 3160	5,076,730.77	673,697.51	115.30
GWD 3170	7,937.05	7,799.88	3170	27.96	0.812	Master GW# 3170	5,076,722.59	673,695.65	113.78
GWD 3180	7,948.50	7,811.16	3180	11.45	0.812	Master GW# 3180	5,076,719.24	673,694.89	113.19
GWD 3190	7,976.10	7,838.14	3190	27.61	0.812	Master GW# 3190	5,076,711.13	673,693.04	111.92
GWD 3200	8,004.62	7,866.15	3200	28.52	0.812	Master GW# 3200	5,076,702.72	673,691.15	110.77
GWD 3210	8,031.32	7,892.26	3210	26.70	0.812	Master GW# 3210	5,076,694.83	673,689.36	109.86
GWD 3220	8,057.70	7,918.05	3220	26.39	0.812	Master GW# 3220	5,076,687.02	673,687.58	109.16
GWD 3230	8,083.15	7,943.01	3230	25.44	0.812	Master GW# 3230	5,076,679.47	673,685.86	108.70
GWD 3240	8,110.54	7,969.88	3240	27.39	0.812	Master GW# 3240	5,076,671.34	673,684.00	108.39
GWD 3250	8,132.68	7,991.69	3250	22.14	0.812	Master GW# 3250	5,076,664.76	673,682.48	108.27
GWD 3260	8,157.48	8,016.26	3260	24.81	0.812	Master GW# 3260	5,076,657.40	673,680.76	108.15
GWD 3270	8,182.24	8,040.42	3270	24.76	0.812	Master GW# 3270	5,076,650.05	673,679.04	108.10
GWD 3280	8,207.95	8,065.85	3280	25.71	0.812	Master GW# 3280	5,076,642.40	673,677.29	108.15
GWD 3290	8,233.54	8,090.85	3290	25.58	0.812	Master GW# 3290	5,076,634.80	673,675.56	108.19
GWD 3300	8,260.29	8,117.38	3300	26.76	0.812	Master GW# 3300	5,076,626.85	673,673.72	108.20
GWD 3310	8,286.13	8,143.16	3310	25.83	0.812	Master GW# 3310	5,076,619.17	673,671.96	108.15
GWD 3320	8,314.87	8,170.90	3320	28.74	0.812	Master GW# 3320	5,076,610.63	673,670.00	108.01
GWD 3330	8,340.80	8,196.60	3330	25.93	0.812	Master GW# 3330	5,076,602.92	673,668.25	107.87
GWD 3340	8,369.01	8,224.45	3340	28.21	0.812	Master GW# 3340	5,076,594.54	673,666.31	107.69

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 3350	8,395.53	8,250.41	3350	26.52	0.812	Master GW# 3350	5,076,586.67	673,664.46	107.50
GWD 3360	8,422.40	8,277.07	3360	26.87	0.812	Master GW# 3360	5,076,578.69	673,662.60	107.33
GWD 3370	8,450.04	8,304.04	3370	27.64	0.812	Master GW# 3370	5,076,570.48	673,660.74	107.16
GWD 3380	8,478.32	8,331.70	3380	28.28	0.812	Master GW# 3380	5,076,562.07	673,658.86	106.94
GWD 3390	8,505.26	8,358.28	3390	26.94	0.812	Master GW# 3390	5,076,554.06	673,657.08	106.56
GWD 3400	8,527.89	8,381.16	3400	22.64	0.812	Master GW# 3400	5,076,547.33	673,655.61	106.08
GWD 3410	8,554.69	8,407.75	3410	26.80	0.812	Master GW# 3410	5,076,539.37	673,653.87	105.46
GWD 3420	8,581.01	8,433.93	3420	26.32	0.812	Master GW# 3420	5,076,531.56	673,652.13	104.89
GWD 3430	8,607.34	8,460.16	3430	26.33	0.812	Master GW# 3430	5,076,523.74	673,650.35	104.45
GWD 3440	8,635.28	8,487.71	3440	27.94	0.812	Master GW# 3440	5,076,515.45	673,648.43	104.16
GWD 3450	8,663.23	8,515.11	3450	27.96	0.812	Master GW# 3450	5,076,507.15	673,646.50	104.04
GWD 3460	8,686.85	8,538.38	3460	23.62	0.812	Master GW# 3460	5,076,500.14	673,644.86	104.05
GWD 3470	8,711.45	8,562.64	3470	24.60	0.812	Master GW# 3470	5,076,492.83	673,643.17	104.12
GWD 3480	8,736.66	8,587.58	3480	25.21	0.812	Master GW# 3480	5,076,485.33	673,641.46	104.13
GWD 3490	8,761.73	8,612.19	3490	25.07	0.812	Master GW# 3490	5,076,477.88	673,639.78	104.08
GWD 3500	8,788.78	8,638.71	3500	27.05	0.812	Master GW# 3500	5,076,469.83	673,637.98	104.00
GWD 3510	8,814.27	8,664.11	3510	25.49	0.812	Master GW# 3510	5,076,462.25	673,636.27	103.90
GWD 3520	8,839.14	8,688.83	3520	24.87	0.812	Master GW# 3520	5,076,454.85	673,634.58	103.76
GWD 3530	8,865.66	8,715.11	3530	26.52	0.812	Master GW# 3530	5,076,446.97	673,632.77	103.60
GWD 3540	8,893.96	8,742.73	3540	28.30	0.812	Master GW# 3540	5,076,438.56	673,630.86	103.45
GWD 3550	8,918.11	8,767.27	3550	24.15	0.812	Master GW# 3550	5,076,431.38	673,629.24	103.32
GWD 3560	8,946.11	8,794.78	3560	28.00	0.812	Master GW# 3560	5,076,423.05	673,627.36	103.11
GWD 3570	8,973.05	8,821.79	3570	26.94	0.812	Master GW# 3570	5,076,415.04	673,625.58	102.80
GWD 3580	8,998.80	8,847.52	3580	25.75	0.812	Master GW# 3580	5,076,407.38	673,623.88	102.46
GWD 3590	9,026.37	8,875.01	3590	27.56	0.812	Master GW# 3590	5,076,399.19	673,622.03	102.15
GWD 3600	9,052.41	8,900.77	3600	26.04	0.812	Master GW# 3600	5,076,391.45	673,620.27	101.91
GWD 3610	9,078.02	8,926.49	3610	25.61	0.812	Master GW# 3610	5,076,383.84	673,618.52	101.76
GWD 3620	9,105.56	8,953.62	3620	27.54	0.812	Master GW# 3620	5,076,375.67	673,616.61	101.57
GWD 3630	9,133.07	8,981.08	3630	27.51	0.812	Master GW# 3630	5,076,367.50	673,614.71	101.35
GWD 3640	9,160.58	9,008.53	3640	27.51	0.812	Master GW# 3640	5,076,359.33	673,612.82	101.15
GWD 3650	9,187.67	9,035.77	3650	27.10	0.812	Master GW# 3650	5,076,351.29	673,610.94	100.95
GWD 3660	9,214.62	9,063.22	3660	26.94	0.812	Master GW# 3660	5,076,343.29	673,609.09	100.83

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 3670	9,237.24	9,084.88	3670	22.63	0.812	Master GW# 3670	5,076,336.56	673,607.54	100.79
GWD 3680	9,264.02	9,111.60	3680	26.78	0.812	Master GW# 3680	5,076,328.60	673,605.72	100.85
GWD 3690	9,290.96	9,138.40	3690	26.94	0.812	Master GW# 3690	5,076,320.59	673,603.90	101.04
GWD 3700	9,316.16	9,163.47	3700	25.20	0.812	Master GW# 3700	5,076,313.11	673,602.19	101.32
GWD 3710	9,343.60	9,190.57	3710	27.44	0.812	Master GW# 3710	5,076,304.96	673,600.33	101.74
GWD 3720	9,371.51	9,217.88	3720	27.91	0.812	Master GW# 3720	5,076,296.68	673,598.43	102.31
GWD 3730	9,398.97	9,245.60	3730	27.46	0.812	Master GW# 3730	5,076,288.54	673,596.58	103.06
GWD 3740	9,425.29	9,271.44	3740	26.32	0.812	Master GW# 3740	5,076,280.77	673,594.81	103.96
GWD 3750	9,453.20	9,298.95	3750	27.91	0.812	Master GW# 3750	5,076,272.54	673,592.92	105.08
GWD 3760	9,480.05	9,325.50	3760	26.85	0.812	Master GW# 3760	5,076,264.65	673,591.10	106.28
GWD 3770	9,507.96	9,353.50	3770	27.91	0.812	Master GW# 3770	5,076,256.45	673,589.21	107.62
GWD 3780	9,535.82	9,380.81	3780	27.87	0.812	Master GW# 3780	5,076,248.27	673,587.34	109.00
GWD 3790	9,562.67	9,407.28	3790	26.85	0.812	Master GW# 3790	5,076,240.39	673,585.54	110.28
GWD 3800	9,590.61	9,434.73	3800	27.94	0.812	Master GW# 3800	5,076,232.17	673,583.65	111.51
GWD 3810	9,617.88	9,461.63	3810	27.27	0.812	Master GW# 3810	5,076,224.13	673,581.79	112.58
GWD 3820	9,644.71	9,488.33	3820	26.84	0.812	Master GW# 3820	5,076,216.21	673,579.95	113.52
GWD 3830	9,669.48	9,512.71	3830	24.77	0.812	Master GW# 3830	5,076,208.90	673,578.26	114.37
GWD 3840	9,693.98	9,536.94	3840	24.50	0.812	Master GW# 3840	5,076,201.66	673,576.61	115.22
GWD 3850	9,720.34	9,563.50	3850	26.36	0.812	Master GW# 3850	5,076,193.87	673,574.83	116.15
GWD 3860	9,748.15	9,590.75	3860	27.81	0.812	Master GW# 3860	5,076,185.65	673,572.95	117.08
GWD 3870	9,776.03	9,618.35	3870	27.88	0.812	Master GW# 3870	5,076,177.41	673,571.05	117.93
GWD 3880	9,798.84	9,640.86	3880	22.81	0.812	Master GW# 3880	5,076,170.66	673,569.49	118.54
GWD 3890	9,825.80	9,667.20	3890	26.96	0.812	Master GW# 3890	5,076,162.67	673,567.64	119.17
GWD 3900	9,853.47	9,694.48	3900	27.67	0.812	Master GW# 3900	5,076,154.47	673,565.72	119.69
GWD 3910	9,874.09	9,714.86	3910	20.63	0.812	Master GW# 3910	5,076,148.35	673,564.30	120.00
GWD 3920	9,901.99	9,742.40	3920	27.90	0.812	Master GW# 3920	5,076,140.07	673,562.39	120.41
GWD 3930	9,929.48	9,769.62	3930	27.49	0.812	Master GW# 3930	5,076,131.91	673,560.51	120.81
GWD 3940	9,957.11	9,796.96	3940	27.64	0.812	Master GW# 3940	5,076,123.71	673,558.60	121.20
GWD 3950	9,984.92	9,824.78	3950	27.80	0.812	Master GW# 3950	5,076,115.46	673,556.67	121.59
GWD 3960	10,010.21	9,849.39	3960	25.29	0.812	Master GW# 3960	5,076,107.96	673,554.91	121.91
GWD 3970	10,037.50	9,876.65	3970	27.29	0.812	Master GW# 3970	5,076,099.87	673,553.00	122.27
GWD 3980	10,064.02	9,902.99	3980	26.53	0.812	Master GW# 3980	5,076,092.00	673,551.13	122.63

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 3990	10,091.92	9,930.44	3990	27.89	0.812	Master GW# 3990	5,076,083.73	673,549.17	122.93
GWD 4000	10,114.29	9,952.73	4000	22.38	0.812	Master GW# 4000	5,076,077.09	673,547.60	123.07
GWD 4010	10,141.98	9,980.27	4010	27.69	0.812	Master GW# 4010	5,076,068.88	673,545.65	123.16
GWD 4020	10,166.59	10,004.82	4020	24.61	0.812	Master GW# 4020	5,076,061.57	673,543.92	123.19
GWD 4030	10,192.72	10,030.80	4030	26.13	0.812	Master GW# 4030	5,076,053.82	673,542.10	123.19
GWD 4040	10,216.45	10,054.28	4040	23.73	0.812	Master GW# 4040	5,076,046.78	673,540.43	123.17
GWD 4050	10,241.35	10,079.05	4050	24.90	0.812	Master GW# 4050	5,076,039.38	673,538.70	123.14
GWD 4060	10,263.89	10,101.49	4060	22.54	0.812	Master GW# 4060	5,076,032.69	673,537.13	123.10
GWD 4070	10,288.24	10,125.68	4070	24.35	0.812	Master GW# 4070	5,076,025.47	673,535.42	123.02
GWD 4080	10,315.23	10,152.69	4080	26.99	0.812	Master GW# 4080	5,076,017.46	673,533.54	122.85
GWD 4090	10,338.99	10,176.00	4090	23.76	0.812	Master GW# 4090	5,076,010.41	673,531.89	122.65
GWD 4100	10,365.72	10,202.56	4100	26.73	0.812	Master GW# 4100	5,076,002.47	673,530.04	122.40
GWD 4110	10,393.10	10,229.81	4110	27.38	0.812	Master GW# 4110	5,075,994.35	673,528.14	122.16
GWD 4120	10,420.82	10,257.08	4120	27.72	0.812	Master GW# 4120	5,075,986.13	673,526.19	121.94
GWD 4130	10,447.91	10,284.10	4130	27.09	0.812	Master GW# 4130	5,075,978.09	673,524.27	121.79
GWD 4140	10,474.68	10,310.57	4140	26.77	0.812	Master GW# 4140	5,075,970.15	673,522.40	121.73
GWD 4150	10,501.04	10,336.80	4150	26.35	0.812	Master GW# 4150	5,075,962.32	673,520.57	121.75
GWD 4160	10,513.58	10,349.19	4160	12.54	0.812	Master GW# 4160	5,075,958.60	673,519.70	121.80
GWD 4170	10,533.12	10,368.68	4170	19.54	0.812	Master GW# 4170	5,075,952.80	673,518.33	121.86
GWD 4180	10,558.20	10,393.42	4180	25.08	0.812	Master GW# 4180	5,075,945.36	673,516.58	121.96
GWD 4190	10,585.21	10,419.94	4190	27.01	0.812	Master GW# 4190	5,075,937.34	673,514.70	122.12
GWD 4200	10,612.77	10,447.54	4200	27.56	0.812	Master GW# 4200	5,075,929.16	673,512.77	122.29
GWD 4210	10,638.77	10,473.38	4210	26.00	0.812	Master GW# 4210	5,075,921.45	673,510.93	122.45
GWD 4220	10,665.15	10,499.69	4220	26.38	0.812	Master GW# 4220	5,075,913.62	673,509.07	122.53
GWD 4230	10,692.74	10,526.85	4230	27.59	0.812	Master GW# 4230	5,075,905.43	673,507.17	122.57
GWD 4240	10,714.03	10,547.77	4240	21.29	0.812	Master GW# 4240	5,075,899.11	673,505.69	122.62
GWD 4250	10,741.29	10,575.00	4250	27.26	0.812	Master GW# 4250	5,075,891.01	673,503.81	122.74
GWD 4260	10,761.34	10,594.86	4260	20.05	0.812	Master GW# 4260	5,075,885.06	673,502.40	122.83
GWD 4270	10,786.62	10,619.98	4270	25.28	0.812	Master GW# 4270	5,075,877.56	673,500.63	122.91
GWD 4280	10,814.01	10,647.31	4280	27.39	0.812	Master GW# 4280	5,075,869.43	673,498.73	122.96
GWD 4290	10,840.34	10,673.05	4290	26.32	0.812	Master GW# 4290	5,075,861.61	673,496.89	122.97
GWD 4300	10,868.54	10,700.86	4300	28.20	0.812	Master GW# 4300	5,075,853.24	673,494.92	122.98

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 4310	10,896.15	10,728.37	4310	27.61	0.812	Master GW# 4310	5,075,845.04	673,493.01	123.06
GWD 4320	10,922.22	10,754.00	4320	26.07	0.812	Master GW# 4320	5,075,837.30	673,491.21	123.22
GWD 4330	10,949.55	10,781.10	4330	27.33	0.812	Master GW# 4330	5,075,829.19	673,489.30	123.48
GWD 4340	10,973.03	10,803.98	4340	23.48	0.812	Master GW# 4340	5,075,822.22	673,487.67	123.75
GWD 4350	11,001.02	10,831.87	4350	27.98	0.812	Master GW# 4350	5,075,813.91	673,485.74	124.04
GWD 4360	11,026.91	10,857.29	4360	25.90	0.812	Master GW# 4360	5,075,806.22	673,483.96	124.29
GWD 4370	11,053.55	10,883.52	4370	26.64	0.812	Master GW# 4370	5,075,798.31	673,482.13	124.53
GWD 4380	11,081.41	10,911.10	4380	27.86	0.812	Master GW# 4380	5,075,790.03	673,480.24	124.71
GWD 4390	11,105.44	10,934.74	4390	24.03	0.812	Master GW# 4390	5,075,782.88	673,478.63	124.79
GWD 4400	11,129.27	10,958.39	4400	23.83	0.812	Master GW# 4400	5,075,775.79	673,477.04	124.76
GWD 4410	11,156.29	10,985.07	4410	27.02	0.812	Master GW# 4410	5,075,767.76	673,475.24	124.62
GWD 4420	11,183.24	11,011.64	4420	26.95	0.812	Master GW# 4420	5,075,759.74	673,473.44	124.50
GWD 4430	11,208.56	11,036.76	4430	25.32	0.812	Master GW# 4430	5,075,752.21	673,471.75	124.46
GWD 4440	11,236.58	11,064.41	4440	28.02	0.812	Master GW# 4440	5,075,743.87	673,469.86	124.49
GWD 4450	11,262.90	11,090.71	4450	26.32	0.812	Master GW# 4450	5,075,736.05	673,468.06	124.61
GWD 4460	11,290.69	11,117.99	4460	27.79	0.812	Master GW# 4460	5,075,727.79	673,466.18	124.83
GWD 4470	11,317.09	11,144.27	4470	26.40	0.812	Master GW# 4470	5,075,719.95	673,464.40	125.18
GWD 4480	11,341.28	11,168.37	4480	24.19	0.812	Master GW# 4480	5,075,712.77	673,462.76	125.66
GWD 4490	11,367.17	11,193.97	4490	25.89	0.812	Master GW# 4490	5,075,705.09	673,461.01	126.29
GWD 4500	11,391.04	11,217.59	4500	23.86	0.812	Master GW# 4500	5,075,698.03	673,459.37	126.97
GWD 4510	11,418.81	11,245.23	4510	27.78	0.812	Master GW# 4510	5,075,689.83	673,457.46	127.83
GWD 4520	11,438.22	11,264.48	4520	19.41	0.812	Master GW# 4520	5,075,684.09	673,456.13	128.47
GWD 4530	11,465.83	11,291.97	4530	27.60	0.812	Master GW# 4530	5,075,675.94	673,454.24	129.41
GWD 4540	11,492.05	11,317.77	4540	26.23	0.812	Master GW# 4540	5,075,668.20	673,452.44	130.34
GWD 4550	11,518.92	11,344.57	4550	26.86	0.812	Master GW# 4550	5,075,660.29	673,450.59	131.38
GWD 4560	11,545.79	11,371.01	4560	26.88	0.812	Master GW# 4560	5,075,652.37	673,448.75	132.48
GWD 4570	11,569.12	11,393.98	4570	23.32	0.812	Master GW# 4570	5,075,645.50	673,447.17	133.39
GWD 4580	11,595.13	11,419.74	4580	26.01	0.812	Master GW# 4580	5,075,637.82	673,445.41	134.33
GWD 4590	11,620.07	11,444.59	4590	24.94	0.812	Master GW# 4590	5,075,630.44	673,443.71	135.07
GWD 4600	11,646.99	11,471.20	4600	26.92	0.812	Master GW# 4600	5,075,622.46	673,441.87	135.65
GWD 4610	11,675.02	11,498.84	4610	28.04	0.812	Master GW# 4610	5,075,614.14	673,439.96	136.16
GWD 4620	11,700.27	11,523.96	4620	25.24	0.812	Master GW# 4620	5,075,606.65	673,438.24	136.54

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 4630	11,728.00	11,551.28	4630	27.74	0.812	Master GW# 4630	5,075,598.41	673,436.33	136.87
GWD 4640	11,754.43	11,577.53	4640	26.43	0.812	Master GW# 4640	5,075,590.56	673,434.52	137.16
GWD 4650	11,781.38	11,604.21	4650	26.95	0.812	Master GW# 4650	5,075,582.56	673,432.66	137.46
GWD 4660	11,806.52	11,628.92	4660	25.14	0.812	Master GW# 4660	5,075,575.10	673,430.91	137.72
GWD 4670	11,829.61	11,652.17	4670	23.09	0.812	Master GW# 4670	5,075,568.26	673,429.29	137.98
GWD 4680	11,853.00	11,675.27	4680	23.39	0.812	Master GW# 4680	5,075,561.32	673,427.65	138.24
GWD 4690	11,879.11	11,701.03	4690	26.11	0.812	Master GW# 4690	5,075,553.58	673,425.82	138.50
GWD 4700	11,906.62	11,728.53	4700	27.51	0.812	Master GW# 4700	5,075,545.41	673,423.91	138.65
GWD 4710	11,931.46	11,753.69	4710	24.84	0.812	Master GW# 4710	5,075,538.03	673,422.17	138.60
GWD 4720	11,959.50	11,781.30	4720	28.04	0.812	Master GW# 4720	5,075,529.71	673,420.23	138.32
GWD 4730	11,982.64	11,804.11	4730	23.14	0.812	Master GW# 4730	5,075,522.85	673,418.62	138.00
GWD 4740	12,009.18	11,830.21	4740	26.54	0.812	Master GW# 4740	5,075,514.99	673,416.77	137.60
GWD 4750	12,035.68	11,856.63	4750	26.51	0.812	Master GW# 4750	5,075,507.12	673,414.94	137.21
GWD 4760	12,063.21	11,883.51	4760	27.52	0.812	Master GW# 4760	5,075,498.96	673,413.03	136.88
GWD 4770	12,089.46	11,909.75	4770	26.25	0.812	Master GW# 4770	5,075,491.17	673,411.20	136.65
GWD 4780	12,117.32	11,937.09	4780	27.86	0.812	Master GW# 4780	5,075,482.90	673,409.28	136.47
GWD 4790	12,144.20	11,963.56	4790	26.88	0.812	Master GW# 4790	5,075,474.92	673,407.42	136.31
GWD 4800	12,170.55	11,989.65	4800	26.34	0.812	Master GW# 4800	5,075,467.09	673,405.60	136.19
GWD 4810	12,198.08	12,016.99	4810	27.53	0.812	Master GW# 4810	5,075,458.92	673,403.70	136.05
GWD 4820	12,225.55	12,043.59	4820	27.47	0.812	Master GW# 4820	5,075,450.77	673,401.78	135.94
GWD 4830	12,251.96	12,070.16	4830	26.41	0.812	Master GW# 4830	5,075,442.93	673,399.93	135.84
GWD 4840	12,280.15	12,097.62	4840	28.19	0.812	Master GW# 4840	5,075,434.56	673,397.97	135.60
GWD 4850	12,306.84	12,124.04	4850	26.70	0.812	Master GW# 4850	5,075,426.64	673,396.13	135.31
GWD 4860	12,332.65	12,149.86	4860	25.80	0.812	Master GW# 4860	5,075,418.98	673,394.35	135.00
GWD 4870	12,356.52	12,173.53	4870	23.87	0.812	Master GW# 4870	5,075,411.90	673,392.70	134.73
GWD 4880	12,378.10	12,194.58	4880	21.58	0.812	Master GW# 4880	5,075,405.49	673,391.21	134.53
GWD 4890	12,404.62	12,221.16	4890	26.51	0.812	Master GW# 4890	5,075,397.62	673,389.37	134.34
GWD 4900	12,432.23	12,248.62	4900	27.61	0.812	Master GW# 4900	5,075,389.42	673,387.46	134.15
GWD 4910	12,455.57	12,271.49	4910	23.34	0.812	Master GW# 4910	5,075,382.49	673,385.85	134.01
GWD 4920	12,482.64	12,298.25	4920	27.07	0.812	Master GW# 4920	5,075,374.46	673,383.97	133.91
GWD 4930	12,508.95	12,324.39	4930	26.30	0.812	Master GW# 4930	5,075,366.65	673,382.11	133.92
GWD 4940	12,536.68	12,351.90	4940	27.73	0.812	Master GW# 4940	5,075,358.42	673,380.16	134.00

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 4950	12,564.17	12,378.97	4950	27.49	0.812	Master GW# 4950	5,075,350.27	673,378.23	134.14
GWD 4960	12,591.53	12,406.08	4960	27.36	0.812	Master GW# 4960	5,075,342.15	673,376.31	134.30
GWD 4970	12,615.45	12,429.68	4970	23.91	0.812	Master GW# 4970	5,075,335.05	673,374.63	134.45
GWD 4980	12,642.13	12,456.12	4980	26.68	0.812	Master GW# 4980	5,075,327.14	673,372.76	134.56
GWD 4990	12,667.83	12,481.94	4990	25.70	0.812	Master GW# 4990	5,075,319.51	673,370.96	134.55
GWD 5000	12,695.49	12,509.16	5000	27.65	0.812	Master GW# 5000	5,075,311.30	673,369.03	134.53
GWD 5010	12,717.64	12,530.93	5010	22.15	0.812	Master GW# 5010	5,075,304.73	673,367.47	134.49
GWD 5020	12,742.53	12,555.62	5020	24.90	0.812	Master GW# 5020	5,075,297.34	673,365.71	134.42
GWD 5030	12,769.01	12,581.72	5030	26.48	0.812	Master GW# 5030	5,075,289.49	673,363.85	134.33
GWD 5040	12,794.44	12,606.87	5040	25.43	0.812	Master GW# 5040	5,075,281.94	673,362.06	134.20
GWD 5050	12,818.78	12,630.94	5050	24.34	0.812	Master GW# 5050	5,075,274.73	673,360.34	134.07
GWD 5060	12,844.31	12,656.06	5060	25.53	0.812	Master GW# 5060	5,075,267.15	673,358.54	134.01
GWD 5070	12,869.94	12,681.13	5070	25.63	0.812	Master GW# 5070	5,075,259.55	673,356.73	134.02
GWD 5080	12,896.32	12,706.99	5080	26.38	0.812	Master GW# 5080	5,075,251.72	673,354.88	134.14
GWD 5090	12,922.98	12,733.16	5090	26.66	0.812	Master GW# 5090	5,075,243.81	673,353.01	134.30
GWD 5100	12,947.58	12,757.73	5100	24.60	0.812	Master GW# 5100	5,075,236.51	673,351.29	134.44
GWD 5110	12,973.90	12,783.33	5110	26.33	0.812	Master GW# 5110	5,075,228.70	673,349.45	134.57
GWD 5120	13,001.74	12,810.54	5120	27.83	0.812	Master GW# 5120	5,075,220.44	673,347.49	134.66
GWD 5130	13,018.38	12,826.91	5130	16.64	0.812	Master GW# 5130	5,075,215.50	673,346.33	134.73
GWD 5140	13,044.26	12,852.69	5140	25.88	0.812	Master GW# 5140	5,075,207.82	673,344.52	134.81
GWD 5150	13,070.06	12,878.12	5150	25.80	0.812	Master GW# 5150	5,075,200.16	673,342.70	134.92
GWD 5160	13,095.07	12,902.88	5160	25.01	0.812	Master GW# 5160	5,075,192.75	673,340.93	135.08
GWD 5170	13,122.91	12,930.31	5170	27.84	0.812	Master GW# 5170	5,075,184.49	673,338.96	135.24
GWD 5180	13,149.82	12,956.80	5180	26.91	0.812	Master GW# 5180	5,075,176.51	673,337.06	135.39
GWD 5190	13,169.71	12,976.54	5190	19.89	0.812	Master GW# 5190	5,075,170.61	673,335.68	135.52
GWD 5200	13,196.98	13,003.33	5200	27.27	0.812	Master GW# 5200	5,075,162.52	673,333.75	135.72
GWD 5210	13,221.29	13,027.37	5210	24.31	0.812	Master GW# 5210	5,075,155.31	673,332.04	135.89
GWD 5220	13,247.60	13,053.58	5220	26.31	0.812	Master GW# 5220	5,075,147.51	673,330.18	136.05
GWD 5230	13,275.82	13,081.73	5230	28.23	0.812	Master GW# 5230	5,075,139.14	673,328.15	136.18
GWD 5240	13,303.09	13,108.42	5240	27.27	0.812	Master GW# 5240	5,075,131.06	673,326.19	136.29
GWD 5250	13,327.67	13,133.11	5250	24.58	0.812	Master GW# 5250	5,075,123.77	673,324.46	136.41
GWD 5260	13,354.20	13,159.39	5260	26.52	0.812	Master GW# 5260	5,075,115.89	673,322.63	136.53

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 5270	13,375.66	13,180.65	5270	21.46	0.812	Master GW# 5270	5,075,109.52	673,321.13	136.60
GWD 5280	13,401.15	13,205.82	5280	25.49	0.812	Master GW# 5280	5,075,101.96	673,319.33	136.65
GWD 5290	13,426.28	13,230.72	5290	25.13	0.812	Master GW# 5290	5,075,094.50	673,317.56	136.64
GWD 5300	13,450.47	13,254.53	5300	24.20	0.812	Master GW# 5300	5,075,087.32	673,315.87	136.54
GWD 5310	13,476.72	13,280.59	5310	26.25	0.812	Master GW# 5310	5,075,079.53	673,314.03	136.43
GWD 5320	13,503.67	13,307.45	5320	26.96	0.812	Master GW# 5320	5,075,071.54	673,312.13	136.32
GWD 5330	13,529.15	13,332.71	5330	25.47	0.812	Master GW# 5330	5,075,063.98	673,310.35	136.31
GWD 5340	13,556.53	13,359.66	5340	27.38	0.812	Master GW# 5340	5,075,055.85	673,308.45	136.47
GWD 5350	13,584.94	13,387.67	5350	28.41	0.812	Master GW# 5350	5,075,047.41	673,306.49	136.78
GWD 5360	13,610.21	13,412.88	5360	25.27	0.812	Master GW# 5360	5,075,039.91	673,304.75	137.08
GWD 5370	13,636.90	13,439.12	5370	26.69	0.812	Master GW# 5370	5,075,031.99	673,302.90	137.28
GWD 5380	13,664.45	13,466.04	5380	27.55	0.812	Master GW# 5380	5,075,023.81	673,300.99	137.31
GWD 5390	13,683.19	13,485.16	5390	18.75	0.812	Master GW# 5390	5,075,018.25	673,299.68	137.31
GWD 5400	13,704.97	13,506.47	5400	21.77	0.812	Master GW# 5400	5,075,011.78	673,298.18	137.26
GWD 5410	13,728.14	13,529.10	5410	23.17	0.812	Master GW# 5410	5,075,004.90	673,296.57	137.24
GWD 5420	13,754.37	13,555.15	5420	26.23	0.812	Master GW# 5420	5,074,997.11	673,294.76	137.27
GWD 5430	13,782.36	13,582.56	5430	27.99	0.812	Master GW# 5430	5,074,988.80	673,292.81	137.36
GWD 5440	13,806.87	13,606.47	5440	24.51	0.812	Master GW# 5440	5,074,981.52	673,291.11	137.51
GWD 5450	13,832.01	13,631.15	5450	25.14	0.812	Master GW# 5450	5,074,974.05	673,289.38	137.65
GWD 5460	13,859.19	13,658.01	5460	27.18	0.812	Master GW# 5460	5,074,965.98	673,287.50	137.77
GWD 5470	13,882.90	13,681.49	5470	23.72	0.812	Master GW# 5470	5,074,958.94	673,285.85	137.78
GWD 5480	13,905.61	13,703.87	5480	22.71	0.812	Master GW# 5480	5,074,952.20	673,284.26	137.75
GWD 5490	13,932.33	13,730.00	5490	26.72	0.812	Master GW# 5490	5,074,944.27	673,282.38	137.70
GWD 5500	13,960.35	13,757.56	5500	28.02	0.812	Master GW# 5500	5,074,935.96	673,280.41	137.70
GWD 5510	13,987.57	13,784.62	5510	27.22	0.812	Master GW# 5510	5,074,927.89	673,278.49	137.76
GWD 5520	14,014.58	13,811.14	5520	27.01	0.812	Master GW# 5520	5,074,919.87	673,276.61	137.90
GWD 5530	14,039.28	13,835.75	5530	24.70	0.812	Master GW# 5530	5,074,912.54	673,274.89	138.09
GWD 5540	14,067.24	13,863.23	5540	27.96	0.812	Master GW# 5540	5,074,904.23	673,272.96	138.35
GWD 5550	14,094.92	13,890.69	5550	27.67	0.812	Master GW# 5550	5,074,896.02	673,271.04	138.67
GWD 5560	14,115.70	13,911.28	5560	20.79	0.812	Master GW# 5560	5,074,889.86	673,269.60	138.98
GWD 5570	14,141.99	13,937.29	5570	26.28	0.812	Master GW# 5570	5,074,882.07	673,267.79	139.48
GWD 5580	14,167.34	13,962.79	5580	25.35	0.812	Master GW# 5580	5,074,874.55	673,266.05	140.08

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 5590	14,192.85	13,988.10	5590	25.51	0.812	Master GW# 5590	5,074,867.01	673,264.29	140.78
GWD 5600	14,219.39	14,014.33	5600	26.54	0.812	Master GW# 5600	5,074,859.16	673,262.47	141.61
GWD 5610	14,240.81	14,035.58	5610	21.42	0.812	Master GW# 5610	5,074,852.84	673,260.99	142.32
GWD 5620	14,267.97	14,062.34	5620	27.16	0.812	Master GW# 5620	5,074,844.81	673,259.12	143.17
GWD 5630	14,293.03	14,087.18	5630	25.05	0.812	Master GW# 5630	5,074,837.40	673,257.39	143.88
GWD 5640	14,320.73	14,114.58	5640	27.70	0.812	Master GW# 5640	5,074,829.20	673,255.47	144.52
GWD 5650	14,346.58	14,140.18	5650	25.85	0.812	Master GW# 5650	5,074,821.53	673,253.69	144.90
GWD 5660	14,373.85	14,167.13	5660	27.27	0.812	Master GW# 5660	5,074,813.44	673,251.79	145.16
GWD 5670	14,400.38	14,193.44	5670	26.53	0.812	Master GW# 5670	5,074,805.56	673,249.94	145.33
GWD 5680	14,427.69	14,220.41	5680	27.31	0.812	Master GW# 5680	5,074,797.45	673,248.04	145.45
GWD 5690	14,454.92	14,247.43	5690	27.23	0.812	Master GW# 5690	5,074,789.37	673,246.14	145.54
GWD 5700	14,482.80	14,274.88	5700	27.88	0.812	Master GW# 5700	5,074,781.10	673,244.19	145.62
GWD 5710	14,509.73	14,301.52	5710	26.93	0.812	Master GW# 5710	5,074,773.10	673,242.32	145.67
GWD 5720	14,531.34	14,323.13	5720	21.60	0.812	Master GW# 5720	5,074,766.69	673,240.81	145.68
GWD 5730	14,557.43	14,348.67	5730	26.09	0.812	Master GW# 5730	5,074,758.95	673,238.98	145.63
GWD 5740	14,583.91	14,374.63	5740	26.48	0.812	Master GW# 5740	5,074,751.10	673,237.08	145.51
GWD 5750	14,610.27	14,400.19	5750	26.36	0.812	Master GW# 5750	5,074,743.28	673,235.21	145.43
GWD 5760	14,632.50	14,422.37	5760	22.23	0.812	Master GW# 5760	5,074,736.68	673,233.65	145.43
GWD 5770	14,659.65	14,445.45	5770	27.15	0.812	Master GW# 5770	5,074,728.62	673,231.76	145.52
GWD 5780	14,681.06	14,470.24	5780	21.41	0.812	Master GW# 5780	5,074,722.26	673,230.28	145.65
GWD 5790	14,708.52	14,497.27	5790	27.46	0.812	Master GW# 5790	5,074,714.11	673,228.39	145.82
GWD 5800	14,734.72	14,522.88	5800	26.20	0.812	Master GW# 5800	5,074,706.33	673,226.56	145.98
GWD 5810	14,760.14	14,547.98	5810	25.42	0.812	Master GW# 5810	5,074,698.79	673,224.79	146.18
GWD 5820	14,788.43	14,575.86	5820	28.28	0.812	Master GW# 5820	5,074,690.40	673,222.80	146.46
GWD 5830	14,813.32	14,600.44	5830	24.89	0.812	Master GW# 5830	5,074,683.02	673,221.05	146.74
GWD 5840	14,838.99	14,625.60	5840	25.67	0.812	Master GW# 5840	5,074,675.41	673,219.23	147.05
GWD 5850	14,865.30	14,651.78	5850	26.31	0.812	Master GW# 5850	5,074,667.61	673,217.36	147.34
GWD 5860	14,892.49	14,678.56	5860	27.19	0.812	Master GW# 5860	5,074,659.56	673,215.43	147.64
GWD 5870	14,919.79	14,705.83	5870	27.30	0.812	Master GW# 5870	5,074,651.46	673,213.51	147.92
GWD 5880	14,946.29	14,731.95	5880	26.50	0.812	Master GW# 5880	5,074,643.60	673,211.66	148.19
GWD 5890	14,974.98	14,760.65	5890	28.68	0.812	Master GW# 5890	5,074,635.08	673,209.67	148.39
GWD 5900	15,003.06	14,788.25	5900	28.08	0.812	Master GW# 5900	5,074,626.73	673,207.76	148.41

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 5910	15,030.83	14,815.82	5910	27.77	0.812	Master GW# 5910	5,074,618.47	673,205.90	148.36
GWD 5920	15,057.37	14,841.84	5920	26.53	0.812	Master GW# 5920	5,074,610.58	673,204.13	148.34
GWD 5930	15,085.40	14,869.70	5930	28.04	0.812	Master GW# 5930	5,074,602.23	673,202.28	148.32
GWD 5940	15,112.89	14,896.98	5940	27.49	0.812	Master GW# 5940	5,074,594.05	673,200.47	148.36
GWD 5950	15,134.37	14,918.41	5950	21.48	0.812	Master GW# 5950	5,074,587.65	673,199.03	148.40
GWD 5960	15,159.55	14,943.55	5960	25.18	0.812	Master GW# 5960	5,074,580.17	673,197.34	148.48
GWD 5970	15,179.39	14,963.03	5970	19.84	0.812	Master GW# 5970	5,074,574.28	673,195.96	148.63
GWD 5980	15,205.87	14,989.43	5980	26.47	0.812	Master GW# 5980	5,074,566.46	673,193.99	149.03
GWD 5990	15,233.89	15,017.10	5990	28.02	0.812	Master GW# 5990	5,074,558.20	673,191.86	149.49
GWD 6000	15,260.97	15,044.06	6000	27.08	0.812	Master GW# 6000	5,074,550.21	673,189.80	149.95
GWD 6010	15,283.80	15,066.71	6010	22.83	0.812	Master GW# 6010	5,074,543.48	673,188.08	150.38
GWD 6020	15,311.31	15,093.99	6020	27.51	0.812	Master GW# 6020	5,074,535.35	673,186.04	150.88
GWD 6030	15,338.41	15,120.87	6030	27.10	0.812	Master GW# 6030	5,074,527.34	673,184.06	151.28
GWD 6040	15,365.86	15,148.15	6040	27.45	0.812	Master GW# 6040	5,074,519.21	673,182.08	151.64
GWD 6050	15,393.56	15,175.36	6050	27.70	0.812	Master GW# 6050	5,074,511.01	673,180.08	151.99
GWD 6060	15,419.97	15,201.89	6060	26.41	0.812	Master GW# 6060	5,074,503.18	673,178.22	152.26
BND 9	15,422.76	15,204.64	6060	2.79	0.812	47.9D Bend 3.1 LT 6.5 Down	5,074,502.35	673,178.04	152.24
GWD 6070	15,442.30	15,223.95	6070	22.33	0.812	Master GW# 6070	5,074,496.50	673,177.00	151.78
BND 10	15,447.90	15,229.48	6070	5.60	0.812	48.1D Bend 1.6 RT 4.2 Up	5,074,494.83	673,176.71	151.64
GWD 6080	15,464.57	15,245.94	6080	22.27	0.812	Master GW# 6080	5,074,489.84	673,175.73	151.52
IDR 1	15,478.75	15,259.94	6080	14.18	0.812	17.31in Internal Diameter - At ovality with heavy wall	5,074,485.61	673,174.86	151.45
OVL 1	15,478.78	15,259.89	6080	14.21	0.812	9.2% Ovality	5,074,485.62	673,174.86	151.45
BND 11	15,481.18	15,262.34	6080	16.61	0.812	29.7D Bend 5.1 RT 7.7 Up	5,074,484.89	673,174.69	151.48
GWD 6090	15,485.63	15,266.73	6090	21.06	0.812	Master GW# 6090	5,074,483.59	673,174.33	151.61
GWD 6100	15,511.91	15,292.61	6100	26.28	0.812	Master GW# 6100	5,074,475.96	673,172.05	152.56
BND 12	15,529.22	15,309.97	6100	17.31	0.812	24.6D Bend 3.1 LT 5.1 Down	5,074,470.92	673,170.59	153.14
OVL 2	15,529.24	15,310.12	6100	17.33	0.812	5.7% Ovality	5,074,470.87	673,170.58	153.14
IDR 2	15,529.34	15,310.10	6100	17.43	0.812	17.81in Internal Diameter - At ovality with heavy wall	5,074,470.88	673,170.58	153.14
GWD 6110	15,532.15	15,312.91	6110	20.24	0.812	Master GW# 6110	5,074,470.05	673,170.38	153.18
GWD 6120	15,551.62	15,332.12	6120	19.47	0.812	Master GW# 6120	5,074,464.26	673,169.08	153.22
GWD 6130	15,577.35	15,357.80	6130	25.73	0.812	Master GW# 6130	5,074,456.60	673,167.38	153.27
GWD 6140	15,603.57	15,383.83	6140	26.22	0.812	Master GW# 6140	5,074,448.80	673,165.61	153.32

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 6150	15,628.79	15,408.93	6150	25.22	0.812	Master GW# 6150	5,074,441.31	673,163.86	153.32
GWD 6160	15,655.55	15,435.47	6160	26.75	0.812	Master GW# 6160	5,074,433.37	673,161.99	153.27
GWD 6170	15,682.25	15,461.82	6170	26.70	0.812	Master GW# 6170	5,074,425.45	673,160.12	153.24
GWD 6180	15,708.60	15,488.13	6180	26.35	0.812	Master GW# 6180	5,074,417.63	673,158.26	153.25
GWD 6190	15,735.16	15,514.58	6190	26.57	0.812	Master GW# 6190	5,074,409.75	673,156.40	153.29
GWD 6200	15,761.42	15,540.57	6200	26.25	0.812	Master GW# 6200	5,074,401.96	673,154.55	153.36
GWD 6210	15,786.97	15,565.84	6210	25.55	0.812	Master GW# 6210	5,074,394.38	673,152.76	153.42
GWD 6220	15,814.63	15,593.47	6220	27.66	0.812	Master GW# 6220	5,074,386.18	673,150.78	153.43
GWD 6230	15,842.68	15,621.20	6230	28.06	0.812	Master GW# 6230	5,074,377.85	673,148.79	153.43
GWD 6240	15,868.61	15,647.00	6240	25.93	0.812	Master GW# 6240	5,074,370.17	673,146.95	153.41
GWD 6250	15,895.98	15,674.17	6250	27.37	0.812	Master GW# 6250	5,074,362.06	673,144.96	153.41
GWD 6260	15,924.08	15,702.33	6260	28.10	0.812	Master GW# 6260	5,074,353.74	673,142.91	153.34
GWD 6270	15,951.77	15,729.90	6270	27.69	0.812	Master GW# 6270	5,074,345.55	673,140.85	153.24
GWD 6280	15,978.26	15,756.19	6280	26.49	0.812	Master GW# 6280	5,074,337.73	673,138.85	153.09
BND 13	15,982.25	15,760.16	6280	3.99	0.812	45.4D Bend 2.1 LT 2.1 Up	5,074,336.55	673,138.55	153.07
GWD 6290	16,005.13	15,782.90	6290	26.86	0.812	Master GW# 6290	5,074,329.74	673,137.04	153.19
GWD 6300	16,029.39	15,807.02	6300	24.26	0.812	Master GW# 6300	5,074,322.52	673,135.43	153.30
GWD 6310	16,056.47	15,833.58	6310	27.08	0.812	Master GW# 6310	5,074,314.47	673,133.60	153.37
GWD 6320	16,084.99	15,861.88	6320	28.52	0.812	Master GW# 6320	5,074,306.00	673,131.65	153.37
GWD 6330	16,111.79	15,888.27	6330	26.81	0.812	Master GW# 6330	5,074,298.04	673,129.79	153.33
GWD 6340	16,137.64	15,914.14	6340	25.85	0.812	Master GW# 6340	5,074,290.36	673,127.99	153.26
GWD 6350	16,164.19	15,940.15	6350	26.54	0.812	Master GW# 6350	5,074,282.49	673,126.13	153.13
GWD 6360	16,191.61	15,967.13	6360	27.42	0.812	Master GW# 6360	5,074,274.35	673,124.22	152.99
GWD 6370	16,216.90	15,992.90	6370	25.30	0.812	Master GW# 6370	5,074,266.84	673,122.47	152.87
GWD 6380	16,236.97	16,012.27	6380	20.07	0.812	Master GW# 6380	5,074,260.87	673,121.10	152.75
GWD 6390	16,263.56	16,038.42	6390	26.58	0.812	Master GW# 6390	5,074,252.97	673,119.31	152.56
GWD 6400	16,289.19	16,063.45	6400	25.63	0.812	Master GW# 6400	5,074,245.35	673,117.58	152.37
GWD 6410	16,316.13	16,089.98	6410	26.94	0.812	Master GW# 6410	5,074,237.34	673,115.77	152.22
GWD 6420	16,342.03	16,115.89	6420	25.90	0.812	Master GW# 6420	5,074,229.64	673,114.03	152.14
GWD 6430	16,369.88	16,143.22	6430	27.85	0.812	Master GW# 6430	5,074,221.35	673,112.16	152.03
GWD 6440	16,397.86	16,170.70	6440	27.97	0.812	Master GW# 6440	5,074,213.03	673,110.27	151.88
GWD 6450	16,425.28	16,197.77	6450	27.43	0.812	Master GW# 6450	5,074,204.88	673,108.41	151.70

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 6460	16,453.16	16,225.48	6460	27.87	0.812	Master GW# 6460	5,074,196.61	673,106.48	151.53
GWD 6470	16,476.76	16,249.05	6470	23.60	0.812	Master GW# 6470	5,074,189.60	673,104.86	151.43
GWD 6480	16,500.90	16,273.08	6480	24.14	0.812	Master GW# 6480	5,074,182.43	673,103.21	151.32
GWD 6490	16,528.58	16,300.43	6490	27.68	0.812	Master GW# 6490	5,074,174.19	673,101.36	151.16
GWD 6500	16,550.26	16,322.12	6500	21.68	0.812	Master GW# 6500	5,074,167.74	673,099.94	151.11
GWD 6510	16,574.58	16,346.07	6510	24.32	0.812	Master GW# 6510	5,074,160.49	673,098.35	151.06
GWD 6520	16,599.87	16,371.20	6520	25.29	0.812	Master GW# 6520	5,074,152.97	673,096.67	151.01
GWD 6530	16,619.38	16,390.71	6530	19.51	0.812	Master GW# 6530	5,074,147.16	673,095.36	150.95
GWD 6540	16,645.75	16,416.70	6540	26.37	0.812	Master GW# 6540	5,074,139.33	673,093.57	150.83
GWD 6550	16,671.02	16,441.80	6550	25.27	0.812	Master GW# 6550	5,074,131.83	673,091.80	150.69
GWD 6560	16,695.87	16,466.41	6560	24.85	0.812	Master GW# 6560	5,074,124.47	673,090.00	150.65
GWD 6570	16,723.98	16,494.13	6570	28.11	0.812	Master GW# 6570	5,074,116.14	673,087.98	150.70
GWD 6580	16,748.58	16,518.27	6580	24.59	0.812	Master GW# 6580	5,074,108.85	673,086.21	150.77
GWD 6590	16,774.75	16,544.37	6590	26.17	0.812	Master GW# 6590	5,074,101.09	673,084.35	150.87
GWD 6600	16,802.28	16,571.43	6600	27.53	0.812	Master GW# 6600	5,074,092.92	673,082.41	151.00
GWD 6610	16,828.19	16,597.08	6610	25.91	0.812	Master GW# 6610	5,074,085.24	673,080.59	151.15
GWD 6620	16,852.61	16,621.46	6620	24.42	0.812	Master GW# 6620	5,074,077.98	673,078.90	151.30
GWD 6630	16,880.57	16,648.88	6630	27.96	0.812	Master GW# 6630	5,074,069.67	673,076.98	151.48
GWD 6640	16,906.80	16,674.72	6640	26.23	0.812	Master GW# 6640	5,074,061.88	673,075.20	151.63
GWD 6650	16,930.83	16,698.34	6650	24.03	0.812	Master GW# 6650	5,074,054.74	673,073.58	151.75
GWD 6660	16,952.15	16,719.48	6660	21.32	0.812	Master GW# 6660	5,074,048.39	673,072.14	151.82
GWD 6670	16,974.47	16,741.77	6670	22.32	0.812	Master GW# 6670	5,074,041.76	673,070.63	151.90
GWD 6680	16,997.15	16,764.08	6680	22.68	0.812	Master GW# 6680	5,074,035.02	673,069.08	151.93
GWD 6690	17,021.08	16,787.92	6690	23.92	0.812	Master GW# 6690	5,074,027.91	673,067.43	151.92
GWD 6700	17,048.65	16,815.40	6700	27.58	0.812	Master GW# 6700	5,074,019.73	673,065.50	151.86
GWD 6710	17,075.06	16,841.55	6710	26.41	0.812	Master GW# 6710	5,074,011.90	673,063.64	151.82
GWD 6720	17,099.12	16,865.28	6720	24.06	0.812	Master GW# 6720	5,074,004.76	673,061.94	151.82
GWD 6730	17,120.42	16,886.44	6730	21.30	0.812	Master GW# 6730	5,073,998.44	673,060.41	151.83
GWD 6740	17,148.00	16,913.57	6740	27.57	0.812	Master GW# 6740	5,073,990.27	673,058.45	151.87
GWD 6750	17,175.69	16,941.13	6750	27.69	0.812	Master GW# 6750	5,073,982.06	673,056.48	151.93
GWD 6760	17,201.66	16,966.99	6760	25.96	0.812	Master GW# 6760	5,073,974.35	673,054.64	151.92
GWD 6770	17,229.84	16,994.67	6770	28.18	0.812	Master GW# 6770	5,073,965.98	673,052.73	151.95

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 6780	17,257.70	17,022.12	6780	27.86	0.812	Master GW# 6780	5,073,957.67	673,050.96	152.11
GWD 6790	17,284.36	17,048.66	6790	26.66	0.812	Master GW# 6790	5,073,949.72	673,049.27	152.28
GWD 6800	17,310.47	17,074.60	6800	26.11	0.812	Master GW# 6800	5,073,941.93	673,047.61	152.44
GWD 6810	17,337.52	17,101.69	6810	27.06	0.812	Master GW# 6810	5,073,933.87	673,045.88	152.61
GWD 6820	17,365.18	17,128.92	6820	27.66	0.812	Master GW# 6820	5,073,925.63	673,044.08	152.77
GWD 6830	17,390.90	17,155.00	6830	25.72	0.812	Master GW# 6830	5,073,917.98	673,042.34	152.91
GWD 6840	17,417.16	17,181.22	6840	26.26	0.812	Master GW# 6840	5,073,910.18	673,040.53	153.05
GWD 6850	17,443.60	17,207.65	6850	26.44	0.812	Master GW# 6850	5,073,902.34	673,038.67	153.17
GWD 6860	17,469.61	17,233.18	6860	26.01	0.812	Master GW# 6860	5,073,894.63	673,036.81	153.28
GWD 6870	17,496.22	17,259.61	6870	26.61	0.812	Master GW# 6870	5,073,886.75	673,034.88	153.40
GWD 6880	17,523.21	17,286.34	6880	27.00	0.812	Master GW# 6880	5,073,878.75	673,032.94	153.52
GWD 6890	17,551.45	17,314.19	6890	28.23	0.812	Master GW# 6890	5,073,870.37	673,030.95	153.60
GWD 6900	17,578.62	17,341.39	6900	27.17	0.812	Master GW# 6900	5,073,862.30	673,029.07	153.64
GWD 6910	17,604.71	17,367.82	6910	26.10	0.812	Master GW# 6910	5,073,854.55	673,027.31	153.66
GWD 6920	17,631.92	17,394.67	6920	27.20	0.812	Master GW# 6920	5,073,846.46	673,025.47	153.67
GWD 6930	17,659.16	17,420.85	6930	27.24	0.812	Master GW# 6930	5,073,838.36	673,023.61	153.67
GWD 6940	17,686.75	17,447.89	6940	27.59	0.812	Master GW# 6940	5,073,830.17	673,021.71	153.70
GWD 6950	17,713.27	17,474.42	6950	26.52	0.812	Master GW# 6950	5,073,822.29	673,019.86	153.74
GWD 6960	17,739.97	17,500.68	6960	26.70	0.812	Master GW# 6960	5,073,814.37	673,017.98	153.78
GWD 6970	17,766.76	17,527.23	6970	26.79	0.812	Master GW# 6970	5,073,806.42	673,016.09	153.83
GWD 6980	17,793.92	17,554.29	6980	27.16	0.812	Master GW# 6980	5,073,798.36	673,014.20	153.87
GWD 6990	17,821.18	17,580.93	6990	27.27	0.812	Master GW# 6990	5,073,790.26	673,012.32	153.92
GWD 7000	17,848.54	17,607.86	7000	27.36	0.812	Master GW# 7000	5,073,782.14	673,010.43	154.02
GWD 7010	17,874.94	17,633.99	7010	26.40	0.812	Master GW# 7010	5,073,774.29	673,008.63	154.14
GWD 7020	17,901.15	17,659.68	7020	26.21	0.812	Master GW# 7020	5,073,766.50	673,006.86	154.27
GWD 7030	17,928.47	17,687.04	7030	27.33	0.812	Master GW# 7030	5,073,758.38	673,005.00	154.37
GWD 7040	17,954.21	17,712.18	7040	25.73	0.812	Master GW# 7040	5,073,750.73	673,003.22	154.40
GWD 7050	17,980.70	17,738.50	7050	26.49	0.812	Master GW# 7050	5,073,742.86	673,001.39	154.34
GWD 7060	18,005.00	17,762.82	7060	24.30	0.812	Master GW# 7060	5,073,735.65	672,999.69	154.31
GWD 7070	18,031.25	17,788.92	7070	26.25	0.812	Master GW# 7070	5,073,727.86	672,997.88	154.33
GWD 7080	18,054.30	17,811.79	7080	23.05	0.812	Master GW# 7080	5,073,721.01	672,996.28	154.37
GWD 7090	18,080.71	17,838.15	7090	26.40	0.812	Master GW# 7090	5,073,713.17	672,994.44	154.37

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 7100	18,107.68	17,864.86	7100	26.98	0.812	Master GW# 7100	5,073,705.16	672,992.56	154.29
GWD 7110	18,132.51	17,889.29	7110	24.82	0.812	Master GW# 7110	5,073,697.79	672,990.85	154.16
GWD 7120	18,159.87	17,916.24	7120	27.36	0.812	Master GW# 7120	5,073,689.66	672,988.98	154.09
GWD 7130	18,187.92	17,944.15	7130	28.05	0.812	Master GW# 7130	5,073,681.33	672,987.04	154.10
GWD 7140	18,213.15	17,968.86	7140	25.23	0.812	Master GW# 7140	5,073,673.85	672,985.26	154.19
GWD 7150	18,239.84	17,995.40	7150	26.69	0.812	Master GW# 7150	5,073,665.93	672,983.38	154.30
GWD 7160	18,266.80	18,021.90	7160	26.96	0.812	Master GW# 7160	5,073,657.93	672,981.50	154.36
GWD 7170	18,293.76	18,048.69	7170	26.96	0.812	Master GW# 7170	5,073,649.92	672,979.61	154.43
GWD 7180	18,315.10	18,069.85	7180	21.35	0.812	Master GW# 7180	5,073,643.59	672,978.12	154.51
GWD 7190	18,339.96	18,095.37	7190	24.86	0.812	Master GW# 7190	5,073,636.21	672,976.39	154.61
GWD 7200	18,363.66	18,118.38	7200	23.70	0.812	Master GW# 7200	5,073,629.17	672,974.75	154.70
GWD 7210	18,391.59	18,145.34	7210	27.93	0.812	Master GW# 7210	5,073,620.87	672,972.83	154.77
GWD 7220	18,417.00	18,170.47	7220	25.40	0.812	Master GW# 7220	5,073,613.33	672,971.07	154.78
GWD 7230	18,445.09	18,198.14	7230	28.09	0.812	Master GW# 7230	5,073,604.99	672,969.12	154.76
GWD 7240	18,470.88	18,223.58	7240	25.79	0.812	Master GW# 7240	5,073,597.33	672,967.32	154.74
GWD 7250	18,498.50	18,250.75	7250	27.63	0.812	Master GW# 7250	5,073,589.14	672,965.38	154.72
GWD 7260	18,524.14	18,276.28	7260	25.63	0.812	Master GW# 7260	5,073,581.53	672,963.59	154.78
GWD 7270	18,550.55	18,302.52	7270	26.41	0.812	Master GW# 7270	5,073,573.69	672,961.76	154.90
GWD 7280	18,579.17	18,330.70	7280	28.62	0.812	Master GW# 7280	5,073,565.19	672,959.79	155.12
GWD 7290	18,606.81	18,357.77	7290	27.64	0.812	Master GW# 7290	5,073,556.98	672,957.89	155.33
GWD 7300	18,634.39	18,385.09	7300	27.58	0.812	Master GW# 7300	5,073,548.79	672,956.00	155.59
GWD 7310	18,658.64	18,408.85	7310	24.25	0.812	Master GW# 7310	5,073,541.58	672,954.34	155.84
GWD 7320	18,686.46	18,436.47	7320	27.82	0.812	Master GW# 7320	5,073,533.32	672,952.44	156.07
GWD 7330	18,711.45	18,461.18	7330	24.99	0.812	Master GW# 7330	5,073,525.88	672,950.77	156.24
GWD 7340	18,737.96	18,487.54	7340	26.51	0.812	Master GW# 7340	5,073,518.00	672,948.98	156.28
GWD 7350	18,765.24	18,514.81	7350	27.27	0.812	Master GW# 7350	5,073,509.90	672,947.10	156.34
GWD 7360	18,789.90	18,539.20	7360	24.66	0.812	Master GW# 7360	5,073,502.58	672,945.40	156.49
GWD 7370	18,815.03	18,564.30	7370	25.13	0.812	Master GW# 7370	5,073,495.11	672,943.65	156.71
GWD 7380	18,839.88	18,588.95	7380	24.85	0.812	Master GW# 7380	5,073,487.74	672,941.93	157.03
GWD 7390	18,865.05	18,613.77	7390	25.17	0.812	Master GW# 7390	5,073,480.27	672,940.20	157.43
GWD 7400	18,891.54	18,640.20	7400	26.49	0.812	Master GW# 7400	5,073,472.41	672,938.38	157.81
GWD 7410	18,914.08	18,662.51	7410	22.54	0.812	Master GW# 7410	5,073,465.72	672,936.83	158.02

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 7420	18,941.77	18,689.82	7420	27.68	0.812	Master GW# 7420	5,073,457.50	672,934.92	158.16
GWD 7430	18,968.06	18,715.92	7430	26.30	0.812	Master GW# 7430	5,073,449.69	672,933.07	158.24
GWD 7440	18,994.61	18,742.44	7440	26.54	0.812	Master GW# 7440	5,073,441.81	672,931.24	158.41
GWD 7450	19,018.25	18,766.26	7450	23.64	0.812	Master GW# 7450	5,073,434.79	672,929.62	158.66
GWD 7460	19,045.93	18,793.74	7460	27.68	0.812	Master GW# 7460	5,073,426.57	672,927.72	158.92
GWD 7470	19,070.81	18,818.74	7470	24.88	0.812	Master GW# 7470	5,073,419.18	672,926.01	159.11
GWD 7480	19,097.48	18,844.92	7480	26.67	0.812	Master GW# 7480	5,073,411.26	672,924.17	159.23
GWD 7490	19,123.19	18,870.31	7490	25.71	0.812	Master GW# 7490	5,073,403.62	672,922.38	159.26
GWD 7500	19,150.95	18,897.64	7500	27.76	0.812	Master GW# 7500	5,073,395.38	672,920.44	159.24
GWD 7510	19,171.23	18,917.99	7510	20.28	0.812	Master GW# 7510	5,073,389.36	672,919.04	159.22
GWD 7520	19,197.98	18,944.71	7520	26.74	0.812	Master GW# 7520	5,073,381.42	672,917.19	159.23
GWD 7530	19,223.94	18,969.93	7530	25.96	0.812	Master GW# 7530	5,073,373.71	672,915.40	159.23
GWD 7540	19,251.02	18,997.15	7540	27.09	0.812	Master GW# 7540	5,073,365.67	672,913.50	159.26
GWD 7550	19,271.08	19,016.80	7550	20.06	0.812	Master GW# 7550	5,073,359.71	672,912.11	159.28
GWD 7560	19,298.86	19,043.99	7560	27.78	0.812	Master GW# 7560	5,073,351.46	672,910.19	159.31
GWD 7570	19,325.49	19,070.60	7570	26.63	0.812	Master GW# 7570	5,073,343.55	672,908.36	159.35
GWD 7580	19,350.59	19,095.21	7580	25.10	0.812	Master GW# 7580	5,073,336.10	672,906.63	159.39
GWD 7590	19,377.57	19,121.98	7590	26.98	0.812	Master GW# 7590	5,073,328.08	672,904.78	159.46
GWD 7600	19,401.98	19,146.04	7600	24.41	0.812	Master GW# 7600	5,073,320.83	672,903.09	159.51
GWD 7610	19,428.36	19,172.04	7610	26.38	0.812	Master GW# 7610	5,073,313.00	672,901.24	159.58
GWD 7620	19,451.10	19,194.38	7620	22.74	0.812	Master GW# 7620	5,073,306.26	672,899.63	159.64
GWD 7630	19,479.69	19,222.68	7630	28.59	0.812	Master GW# 7630	5,073,297.78	672,897.59	159.67
GWD 7640	19,505.75	19,248.71	7640	26.06	0.812	Master GW# 7640	5,073,290.04	672,895.79	159.71
GWD 7650	19,534.05	19,276.27	7650	28.30	0.812	Master GW# 7650	5,073,281.63	672,893.88	159.81
GWD 7660	19,557.33	19,299.25	7660	23.28	0.812	Master GW# 7660	5,073,274.70	672,892.34	159.92
GWD 7670	19,581.23	19,322.89	7670	23.91	0.812	Master GW# 7670	5,073,267.58	672,890.78	160.11
GWD 7680	19,608.00	19,349.26	7680	26.77	0.812	Master GW# 7680	5,073,259.62	672,889.00	160.28
GWD 7690	19,628.64	19,369.68	7690	20.64	0.812	Master GW# 7690	5,073,253.48	672,887.61	160.43
GWD 7700	19,651.53	19,392.10	7700	22.89	0.812	Master GW# 7700	5,073,246.68	672,886.05	160.63
GWD 7710	19,674.49	19,415.24	7710	22.96	0.812	Master GW# 7710	5,073,239.86	672,884.47	160.87
GWD 7720	19,700.70	19,441.74	7720	26.21	0.812	Master GW# 7720	5,073,232.09	672,882.64	161.19
GWD 7730	19,728.94	19,468.43	7730	28.24	0.812	Master GW# 7730	5,073,223.72	672,880.66	161.63

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 7740	19,751.43	19,490.87	7740	22.50	0.812	Master GW# 7740	5,073,217.06	672,879.06	162.01
GWD 7750	19,779.17	19,518.01	7750	27.74	0.812	Master GW# 7750	5,073,208.84	672,877.10	162.41
GWD 7760	19,807.33	19,545.87	7760	28.16	0.812	Master GW# 7760	5,073,200.48	672,875.14	162.71
GWD 7770	19,832.84	19,570.99	7770	25.51	0.812	Master GW# 7770	5,073,192.90	672,873.39	162.98
GWD 7780	19,859.24	19,597.40	7780	26.40	0.812	Master GW# 7780	5,073,185.07	672,871.59	163.31
GWD 7790	19,883.66	19,621.80	7790	24.42	0.812	Master GW# 7790	5,073,177.82	672,869.91	163.69
GWD 7800	19,910.13	19,647.93	7800	26.47	0.812	Master GW# 7800	5,073,169.97	672,868.06	164.12
GWD 7810	19,936.53	19,674.03	7810	26.41	0.812	Master GW# 7810	5,073,162.15	672,866.20	164.58
GWD 7820	19,964.32	19,701.84	7820	27.78	0.812	Master GW# 7820	5,073,153.93	672,864.21	165.11
GWD 7830	19,989.12	19,726.45	7830	24.80	0.812	Master GW# 7830	5,073,146.60	672,862.41	165.62
GWD 7840	20,016.29	19,753.51	7840	27.17	0.812	Master GW# 7840	5,073,138.57	672,860.45	166.12
GWD 7850	20,041.72	19,778.35	7850	25.43	0.812	Master GW# 7850	5,073,131.05	672,858.57	166.49
GWD 7860	20,065.26	19,801.91	7860	23.54	0.812	Master GW# 7860	5,073,124.09	672,856.85	166.81
GWD 7870	20,092.26	19,828.61	7870	27.01	0.812	Master GW# 7870	5,073,116.09	672,854.94	167.23
GWD 7880	20,115.49	19,851.67	7880	23.23	0.812	Master GW# 7880	5,073,109.19	672,853.40	167.67
GWD 7890	20,137.06	19,873.21	7890	21.57	0.812	Master GW# 7890	5,073,102.77	672,852.04	168.15
GWD 7900	20,163.26	19,899.46	7900	26.19	0.812	Master GW# 7900	5,073,094.97	672,850.42	168.74
GWD 7910	20,186.95	19,923.03	7910	23.69	0.812	Master GW# 7910	5,073,087.92	672,848.90	169.25
GWD 7920	20,213.80	19,949.19	7920	26.85	0.812	Master GW# 7920	5,073,079.95	672,847.12	169.84
GWD 7930	20,240.54	19,976.17	7930	26.74	0.812	Master GW# 7930	5,073,072.03	672,845.27	170.37
GWD 7940	20,265.94	20,000.95	7940	25.39	0.812	Master GW# 7940	5,073,064.50	672,843.48	170.75
GWD 7950	20,293.48	20,028.33	7950	27.54	0.812	Master GW# 7950	5,073,056.34	672,841.51	171.10
GWD 7960	20,320.03	20,054.28	7960	26.55	0.812	Master GW# 7960	5,073,048.48	672,839.59	171.42
GWD 7970	20,347.21	20,081.25	7970	27.18	0.812	Master GW# 7970	5,073,040.44	672,837.62	171.77
GWD 7980	20,374.38	20,108.21	7980	27.17	0.812	Master GW# 7980	5,073,032.39	672,835.69	172.17
GWD 7990	20,402.50	20,136.01	7990	28.12	0.812	Master GW# 7990	5,073,024.05	672,833.72	172.43
GWD 8000	20,427.70	20,160.80	8000	25.20	0.812	Master GW# 8000	5,073,016.56	672,832.01	172.56
GWD 8010	20,454.95	20,187.77	8010	27.25	0.812	Master GW# 8010	5,073,008.45	672,830.19	172.66
GWD 8020	20,481.50	20,214.11	8020	26.55	0.812	Master GW# 8020	5,073,000.55	672,828.40	172.68
GWD 8030	20,509.52	20,241.59	8030	28.02	0.812	Master GW# 8030	5,072,992.23	672,826.48	172.69
GWD 8040	20,537.03	20,268.36	8040	27.51	0.812	Master GW# 8040	5,072,984.05	672,824.60	172.78
GWD 8050	20,563.88	20,295.16	8050	26.84	0.812	Master GW# 8050	5,072,976.08	672,822.75	173.01

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 8060	20,589.40	20,320.26	8060	25.52	0.812	Master GW# 8060	5,072,968.51	672,821.00	173.35
GWD 8070	20,615.02	20,345.78	8070	25.62	0.812	Master GW# 8070	5,072,960.90	672,819.25	173.76
GWD 8080	20,641.15	20,371.64	8080	26.13	0.812	Master GW# 8080	5,072,953.14	672,817.48	174.15
GWD 8090	20,668.83	20,399.08	8090	27.69	0.812	Master GW# 8090	5,072,944.91	672,815.62	174.39
GWD 8100	20,695.40	20,425.43	8100	26.57	0.812	Master GW# 8100	5,072,937.01	672,813.84	174.71
GWD 8110	20,722.84	20,452.61	8110	27.44	0.812	Master GW# 8110	5,072,928.86	672,812.01	175.14
GWD 8120	20,750.09	20,479.38	8120	27.24	0.812	Master GW# 8120	5,072,920.77	672,810.17	175.63
GWD 8130	20,776.20	20,505.61	8130	26.11	0.812	Master GW# 8130	5,072,913.03	672,808.36	176.21
GWD 8140	20,796.80	20,526.15	8140	20.60	0.812	Master GW# 8140	5,072,906.94	672,806.92	176.77
GWD 8150	20,820.34	20,549.51	8150	23.54	0.812	Master GW# 8150	5,072,900.00	672,805.28	177.59
GWD 8160	20,847.46	20,576.29	8160	27.12	0.812	Master GW# 8160	5,072,892.03	672,803.39	178.72
GWD 8170	20,869.08	20,597.62	8170	21.62	0.812	Master GW# 8170	5,072,885.69	672,801.88	179.76
GWD 8180	20,896.99	20,625.21	8180	27.91	0.812	Master GW# 8180	5,072,877.54	672,799.96	181.31
GWD 8190	20,923.27	20,651.16	8190	26.28	0.812	Master GW# 8190	5,072,869.90	672,798.16	182.96
IDR 3	20,938.55	20,666.41	8190	15.28	0.812	17.93in Internal Diameter - At bend with heavy wall	5,072,865.47	672,797.13	183.95
BND 14	20,938.71	20,666.57	8190	15.44	0.812	23.6D Bend 8.1 Down	5,072,865.42	672,797.12	183.96
GWD 8200	20,949.84	20,677.68	8200	26.57	0.812	Master GW# 8200	5,072,862.13	672,796.35	184.26
GWD 8210	20,976.88	20,704.53	8210	27.03	0.812	Master GW# 8210	5,072,854.12	672,794.48	184.84
GWD 8220	21,004.15	20,731.73	8220	27.28	0.812	Master GW# 8220	5,072,846.02	672,792.61	185.21
GWD 8230	21,027.96	20,755.22	8230	23.81	0.812	Master GW# 8230	5,072,838.95	672,790.97	185.44
GWD 8240	21,052.25	20,779.44	8240	24.29	0.812	Master GW# 8240	5,072,831.74	672,789.31	185.62
GWD 8250	21,079.06	20,805.60	8250	26.81	0.812	Master GW# 8250	5,072,823.78	672,787.45	185.79
GWD 8260	21,101.25	20,827.42	8260	22.19	0.812	Master GW# 8260	5,072,817.19	672,785.89	185.96
GWD 8270	21,128.01	20,853.74	8270	26.77	0.812	Master GW# 8270	5,072,809.26	672,783.97	186.13
GWD 8280	21,155.11	20,880.81	8280	27.10	0.812	Master GW# 8280	5,072,801.23	672,782.03	186.31
BND 15	21,176.41	20,901.69	8280	21.30	0.812	29.3D Bend 4.4 Up	5,072,794.92	672,780.50	186.48
GWD 8290	21,183.06	20,908.21	8290	27.96	0.812	Master GW# 8290	5,072,792.96	672,780.01	186.68
BND 16	21,190.21	20,915.21	8290	7.14	0.812	30.9D Bend 5.1 Up	5,072,790.86	672,779.49	186.90
GWD 8300	21,207.40	20,932.04	8300	24.33	0.812	Master GW# 8300	5,072,785.85	672,778.24	187.82
BND 17	21,218.64	20,943.88	8300	11.25	0.812	24.4D Bend 10.0 LT 5.2 Up	5,072,782.57	672,777.46	188.45
GWD 8310	21,233.64	20,959.66	8310	26.25	0.812	Master GW# 8310	5,072,778.16	672,777.07	189.61
BND 18	21,251.33	20,976.20	8310	17.69	0.812	24.3D Bend 19.5 LT 1.3 Up	5,072,772.97	672,776.89	191.04

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 8320	21,262.35	20,986.50	8320	28.70	0.812	Master GW# 8320	5,072,769.82	672,777.55	192.00
BND 19	21,274.87	20,998.76	8320	12.52	0.812	23.1D Bend 25.0 LT 2.0 Down	5,072,766.40	672,778.83	193.10
GWD 8330	21,286.48	21,010.13	8330	24.13	0.812	Master GW# 8330	5,072,763.62	672,780.77	194.08
BND 20	21,300.80	21,024.47	8330	14.33	0.812	24.5D Bend 22.8 LT 7.7 Down	5,072,760.57	672,783.73	195.10
IDR 4	21,303.18	21,026.85	8330	16.71	0.812	17.99in Internal Diameter - At bend with heavy wall	5,072,760.14	672,784.29	195.23
GWD 8340	21,313.34	21,037.02	8340	26.87	0.812	Master GW# 8340	5,072,758.61	672,786.94	195.68
BND 21	21,323.00	21,046.52	8340	9.65	0.812	25.1D Bend 14.1 LT 5.7 Down	5,072,757.42	672,789.62	195.99
GWD 8350	21,338.04	21,061.33	8350	24.70	0.812	Master GW# 8350	5,072,756.32	672,794.07	196.13
GWD 8360	21,365.20	21,088.56	8360	27.16	0.812	Master GW# 8360	5,072,754.54	672,802.16	196.21
GWD 8370	21,391.61	21,114.99	8370	26.41	0.812	Master GW# 8370	5,072,752.85	672,810.03	196.18
GWD 8380	21,415.48	21,138.65	8380	23.87	0.812	Master GW# 8380	5,072,751.28	672,817.13	196.11
GWD 8390	21,434.19	21,157.54	8390	18.71	0.812	Master GW# 8390	5,072,750.03	672,822.70	196.06
GWD 8400	21,461.85	21,185.23	8400	27.66	0.812	Master GW# 8400	5,072,748.15	672,830.92	196.03
GWD 8410	21,486.11	21,208.89	8410	24.26	0.812	Master GW# 8410	5,072,746.47	672,838.13	196.04
GWD 8420	21,511.54	21,234.08	8420	25.42	0.812	Master GW# 8420	5,072,744.72	672,845.68	196.03
GWD 8430	21,538.27	21,260.85	8430	26.73	0.812	Master GW# 8430	5,072,742.88	672,853.62	196.03
GWD 8440	21,561.29	21,283.76	8440	23.02	0.812	Master GW# 8440	5,072,741.30	672,860.46	196.05
GWD 8450	21,584.57	21,306.63	8450	23.28	0.812	Master GW# 8450	5,072,739.73	672,867.38	196.10
GWD 8460	21,611.86	21,333.81	8460	27.29	0.812	Master GW# 8460	5,072,737.88	672,875.50	196.13
GWD 8470	21,637.10	21,358.81	8470	25.24	0.812	Master GW# 8470	5,072,736.17	672,883.00	196.08
GWD 8480	21,662.23	21,383.50	8480	25.13	0.812	Master GW# 8480	5,072,734.46	672,890.47	196.11
GWD 8490	21,689.92	21,410.83	8490	27.69	0.812	Master GW# 8490	5,072,732.55	672,898.70	196.13
GWD 8500	21,716.95	21,437.27	8500	27.04	0.812	Master GW# 8500	5,072,730.66	672,906.72	196.10
TEE 7	21,732.43	21,453.17	8500	15.48	0.812		5,072,729.52	672,911.53	196.03
TEE 8	21,737.55	21,457.58	8500	20.60	0.812		5,072,729.21	672,912.87	196.02
TEE 9	21,740.32	21,460.29	8500	23.37	0.812		5,072,729.02	672,913.69	196.01
GWD 8510	21,743.33	21,463.13	8510	26.38	0.812	Master GW# 8510	5,072,728.82	672,914.55	196.01
GWD 8521	21,758.30	21,477.80	8521	14.97	0.812	Master GW# 8521	5,072,727.76	672,918.99	196.00
GWD 8531	21,767.73	21,487.05	8531	9.43	0.656	Master GW# 8531	5,072,727.11	672,921.79	195.99
STR 2	21,780.55	21,499.61	8531	12.82	0.656	Receive area changed since 2013	5,072,725.79	672,925.43	196.06
BND 22	21,780.83	21,499.89	8531	13.10	0.656	9.2D Bend 51.4 RT 11.0 Up	5,072,725.74	672,925.49	196.07
GWD 8541	21,787.99	21,506.91	8541	20.26	0.500	Master GW# 8541	5,072,724.06	672,926.84	196.38

Pipeline Tally

Client: Enbridge Energy Limited Partnership | Run Date: August 16, 2016 | Projection: UTM | Zone: 16

Project: NPS20 GEOPIG Geometry Inspection | Location: Line 5 North Straits WEST - Mackinaw | Datum: NAD 83 | C.M.: -87

Feature Identifier	Absolute Distance (ft)	Enbridge Chainage (ft)	Nearest U/S GWD	Dist to U/S GWD (ft)	Wall Thickness (in)	Description	Northing (m)	Easting (m)	Height (m)
GWD 8551	21,812.60	21,531.03	8551	24.61	0.656	Master GW# 8551	5,072,717.39	672,929.99	197.75
BND 23	21,826.40	21,544.56	8551	13.80	0.656	10.0D Bend 51.0 LT 10.7 Down	5,072,713.94	672,932.22	198.44
TEE 10	21,835.04	21,553.17	8551	22.44	0.656		5,072,712.84	672,934.63	198.59
TEE 11	21,836.93	21,555.01	8551	24.33	0.656		5,072,712.71	672,935.19	198.59
TEE 12	21,838.94	21,556.98	8551	26.34	0.656		5,072,712.56	672,935.78	198.58
GWD 8561	21,839.97	21,557.85	8561	27.37	0.500	Master GW# 8561	5,072,712.49	672,936.05	198.58
GWD 8571	21,841.36	21,559.22	8571	1.39	0.500	Master GW# 8571	5,072,712.39	672,936.46	198.58
GWD 8581	21,844.99	21,562.77	8581	3.63	0.500	Master GW# 8581	5,072,712.14	672,937.54	198.57
TEE 13	21,845.36	21,563.96	8581	0.37	0.500		5,072,712.06	672,937.90	198.57
GWD 8591	21,847.27	21,565.01	8591	2.28	0.500	Master GW# 8591	5,072,711.98	672,938.21	198.57
GWD 8601	21,848.42	21,566.13	8601	1.15	0.500	Master GW# 8601	5,072,711.89	672,938.55	198.57
GWD 8611	21,849.41	21,567.11	8611	0.99	0.500	Master GW# 8611	5,072,711.82	672,938.85	198.56
GWD 8621	21,849.94	21,567.63	8621	0.54	0.500	Master GW# 8621	5,072,711.79	672,939.00	198.56
VLV 2	21,850.59	21,569.53	8621	0.65	0.500	Mackinaw Station Receive Valve	5,072,711.65	672,939.58	198.56
GWD 8631	21,853.91	21,571.52	8631	3.97	0.500	Master GW# 8631	5,072,711.51	672,940.18	198.55
GWD 8643	21,854.51	21,572.11	8643	0.60	0.500	Master GW# 8643	5,072,711.46	672,940.36	198.55
TEE 14	21,854.92	21,572.63	8643	0.41	0.500		5,072,711.42	672,940.52	198.55
TEE 15	21,873.04	21,590.45	8643	18.52	0.500		5,072,710.13	672,945.91	198.48
TEE 16	21,874.03	21,591.39	8643	19.52	0.500		5,072,710.06	672,946.19	198.47
GWD 8651	21,875.60	21,592.78	8651	21.09	0.500	Master GW# 8651	5,072,709.96	672,946.61	198.47

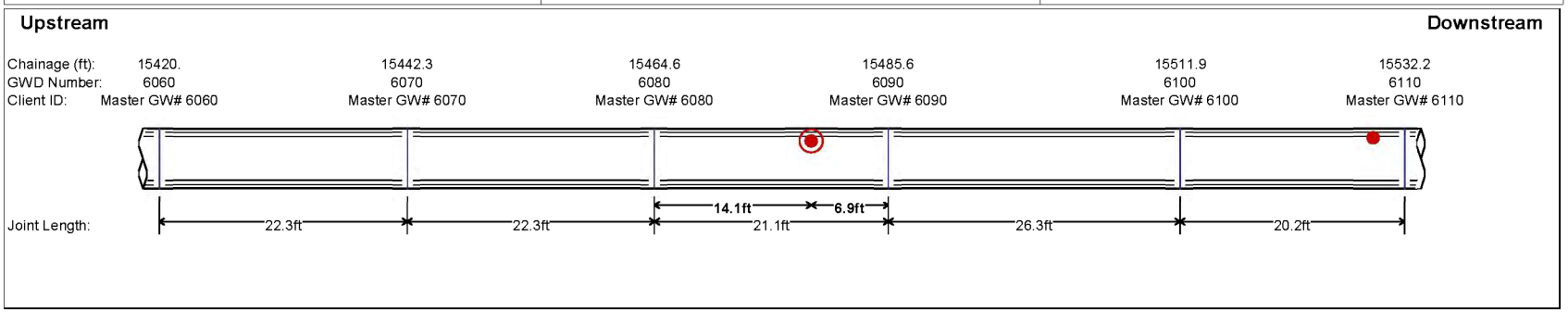
PipeWall Anomaly Inspection Sheet

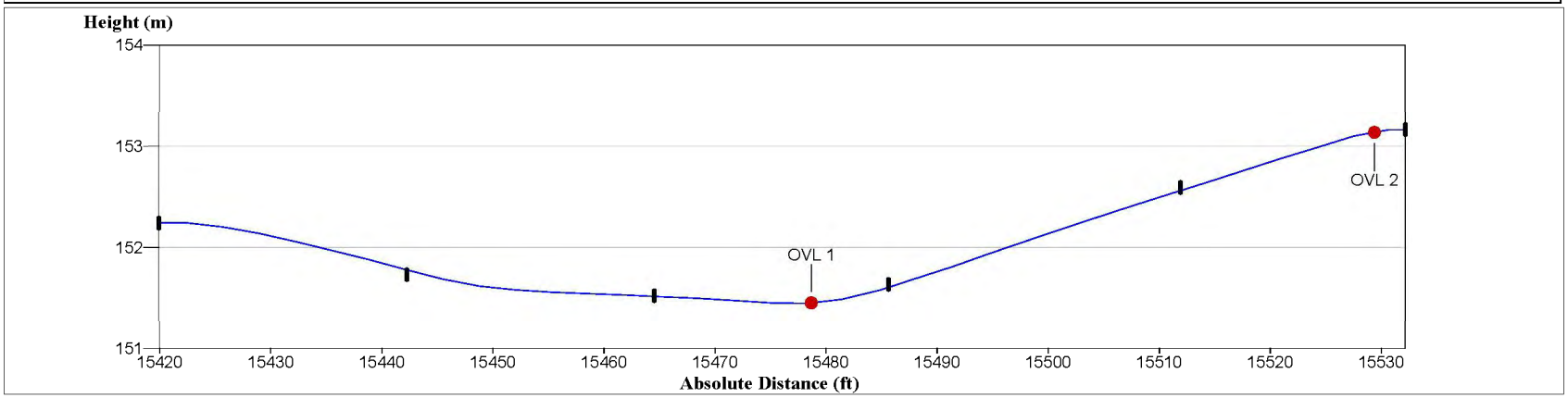
Client:	Enbridge Energy Limited Partnership	Run Date:	August 16, 2016	Projection:	UTM	Zone:	16
Project:	NPS20 GEOPIG Geometry Inspection	Location:	Line 5 North Straits WEST - Mackinaw	Datum:	NAD 83	C.M.:	-87

BAKER HUGHES

Anomaly: **OVL # 1**

Location			Size			Reference Points		
Absolute Distance:	15,478.78	ft	Size Definition:	CSAZ662 Ovality		U/S Weld Number:	6080	
Enbridge Area Number:	1		Depth:	1.846	in	Distance to U/S Weld:	14.21	ft
Enbridge Chainage:	15,259.89	ft	Depth %:	9.2	%OD	Distance to D/S Weld:	6.85	ft
Northing:	5,074,485.62	m	Length:	42.61	in	Joint Length:	21.06	ft
Easting:	673,174.86	m	Width:	9.07	in	U/S Ref.:	St Ignace Launch Valve	
Latitude:	45.80219574	deg.	Clock Position:	1:15	h:mm	Distance to U/S Ref.:	15,379.52	ft
Longitude:	-84.77144519	deg.	Wall Thickness:	0.812	in	D/S Ref.:	Mackinaw Station Receive Valve	
			Comments:			Distance to D/S Ref.:	6,373.10	ft



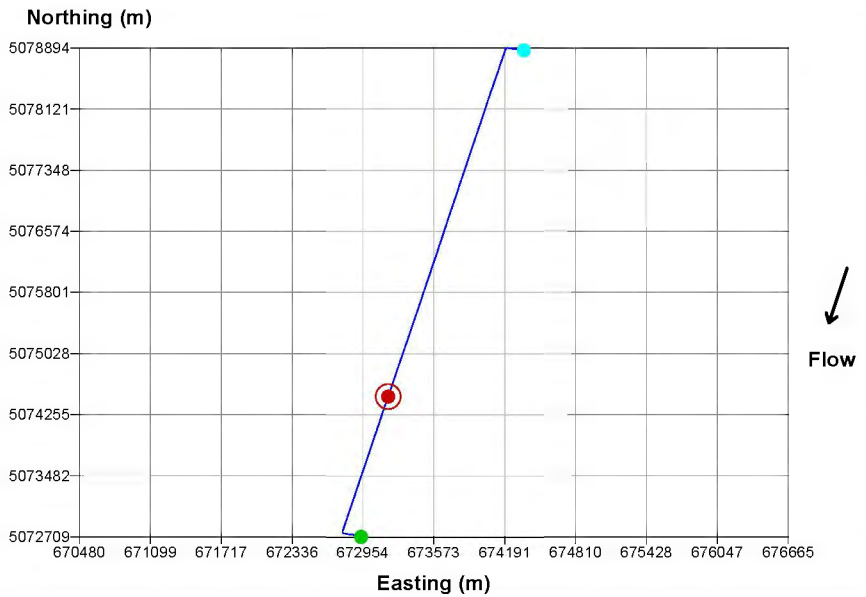


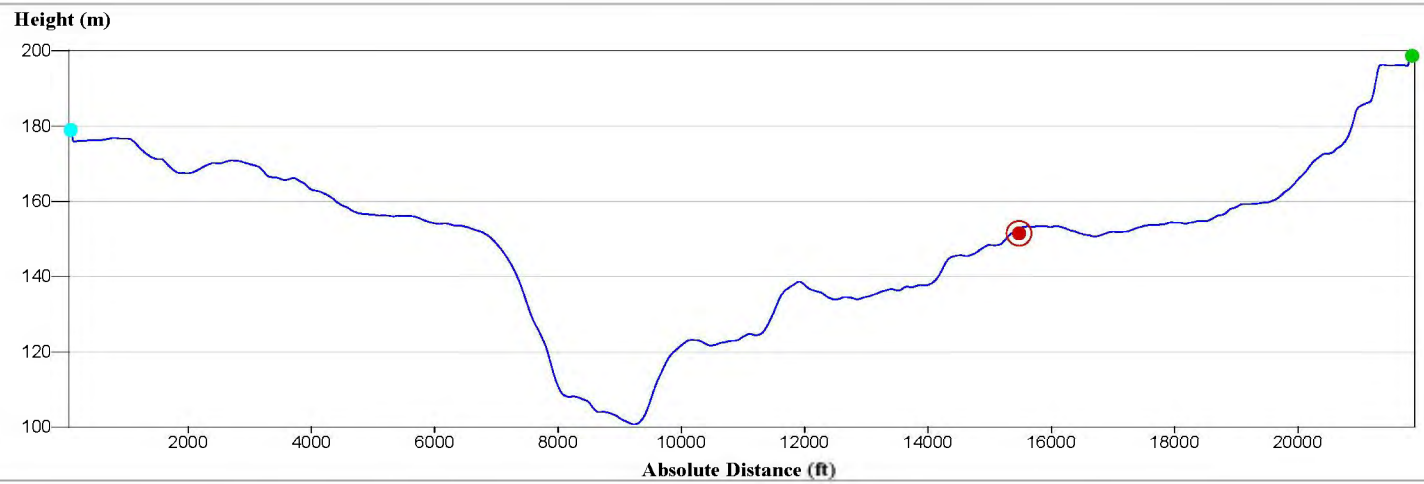
PipeWall Anomaly Inspection Sheet

Client:	Enbridge Energy Limited Partnership	Run Date:	August 16, 2016	Projection:	UTM	Zone:	16
Project:	NPS20 GEOPIG Geometry Inspection	Location:	Line 5 North Straits WEST - Mackinaw	Datum:	NAD 83	C.M.:	-87

Plan and Profile between U/S and D/S Reference Points

Anomaly:	**OVL 1**	
Absolute Distance:	15,476.93	ft
Northing:	5,074,485.62	m
Easting:	673,174.86	m
Height:	151.45	m
U/S Ref.:	St Ignace Launch Valve	
Enbridge Chainage:	-.05	ft
Distance to U/S Ref.:	15,377.67	ft
D/S Ref.:	Mackinaw Station Receive Valve	
Enbridge Chainage:	21,569.53	ft
Distance to D/S Ref.:	6,374.95	ft



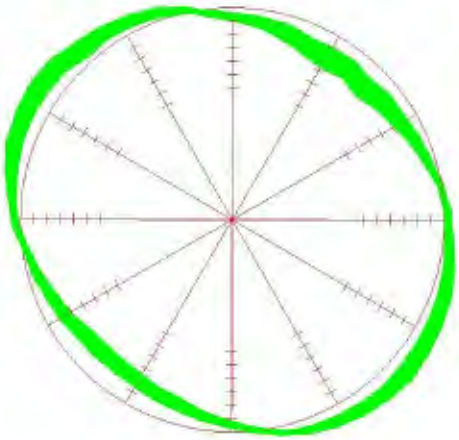


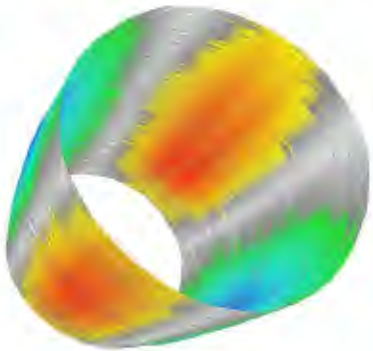
ENBDNR0000150

PipeWall Anomaly Inspection Sheet

Client:	Enbridge Energy Limited Partnership	Run Date:	August 16, 2016	Projection:	UTM	Zone:	16
Project:	NPS20 GEOPIG Geometry Inspection	Location:	Line 5 North Straits WEST - Mackinaw	Datum:	NAD 83	C.M.:	-87

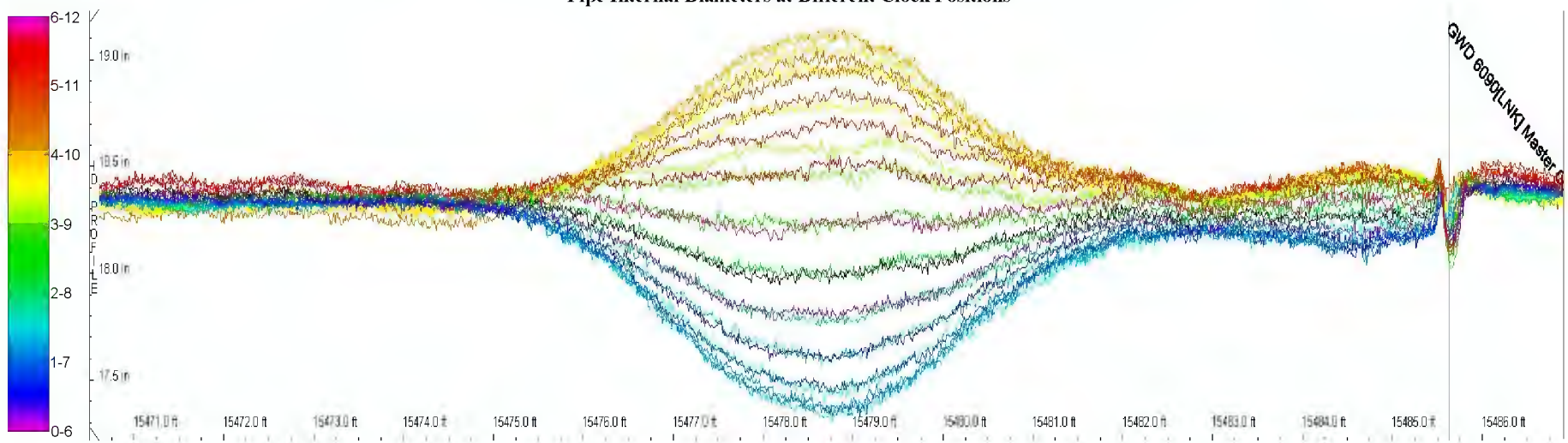
Cross Section View - Each graticule represents 1% OD | **Anomaly Size = 9.2%** | **3D View - Exaggerated 3 times**





O'Clock

Pipe Internal Diameters at Different Clock Positions

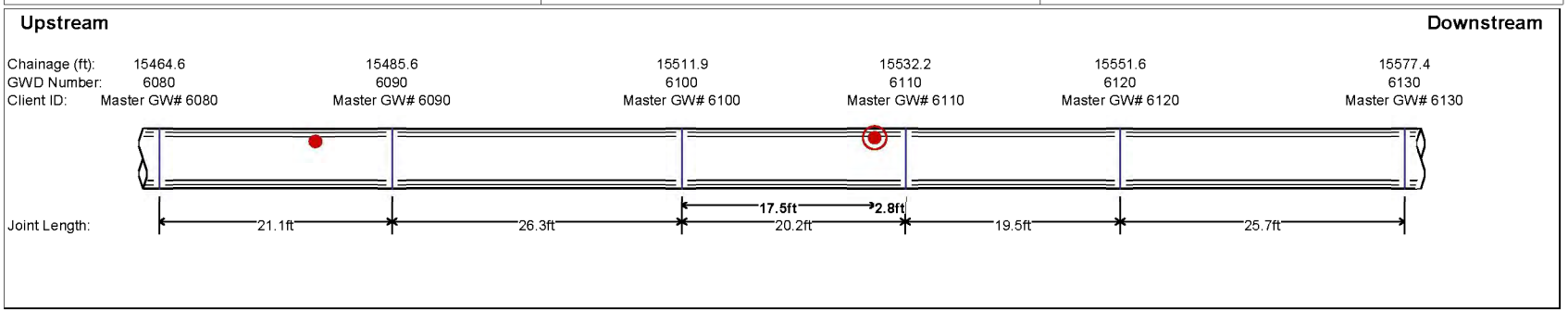


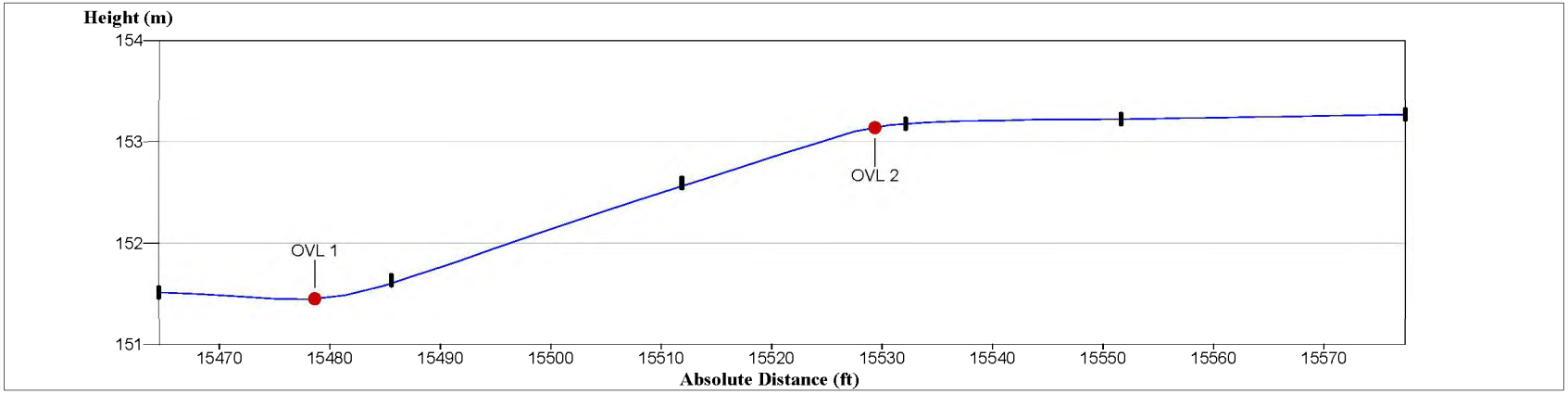
PipeWall Anomaly Inspection Sheet

Client:	Enbridge Energy Limited Partnership	Run Date:	August 16, 2016	Projection:	UTM	Zone:	16
Project:	NPS20 GEOPIG Geometry Inspection	Location:	Line 5 North Straits WEST - Mackinaw	Datum:	NAD 83	C.M.:	-87

Anomaly: **OVL # 2**

Location			Size			Reference Points		
Absolute Distance:	15,529.24	ft	Size Definition:	CSAZ662 Ovality		U/S Weld Number:	6100	
Enbridge Area Number:	1		Depth:	1.134	in	Distance to U/S Weld:	17.33	ft
Enbridge Chainage:	15,310.12	ft	Depth %:	5.7	%OD	Distance to D/S Weld:	2.91	ft
Northing:	5,074,470.87	m	Length:	41.55	in	Joint Length:	20.24	ft
Easting:	673,170.58	m	Width:	9.58	in	U/S Ref.:	St Ignace Launch Valve	
Latitude:	45.80206418	deg.	Clock Position:	1:00	h:mm	Distance to U/S Ref.:	15,429.98	ft
Longitude:	-84.77150557	deg.	Wall Thickness:	0.812	in	D/S Ref.:	Mackinaw Station Receive Valve	
			Comments:			Distance to D/S Ref.:	6,322.65	ft



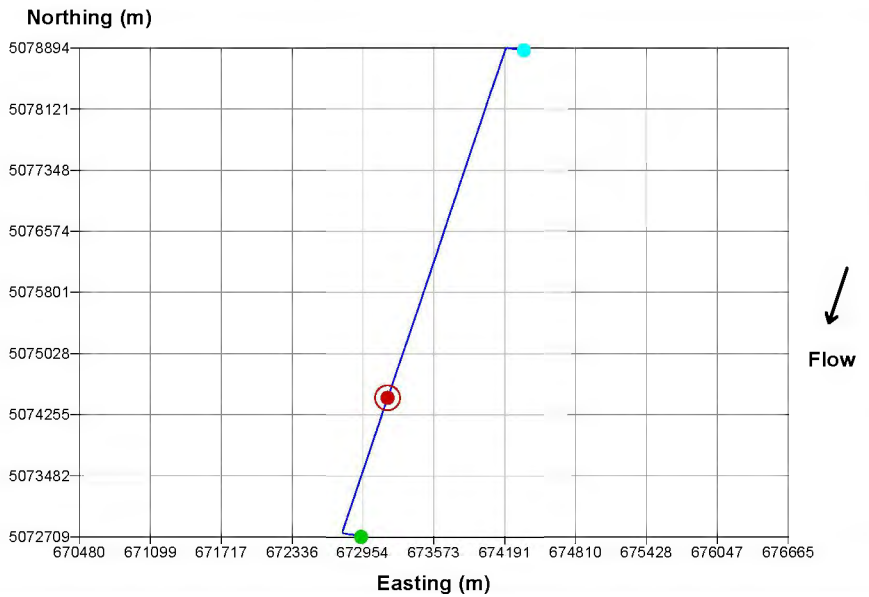


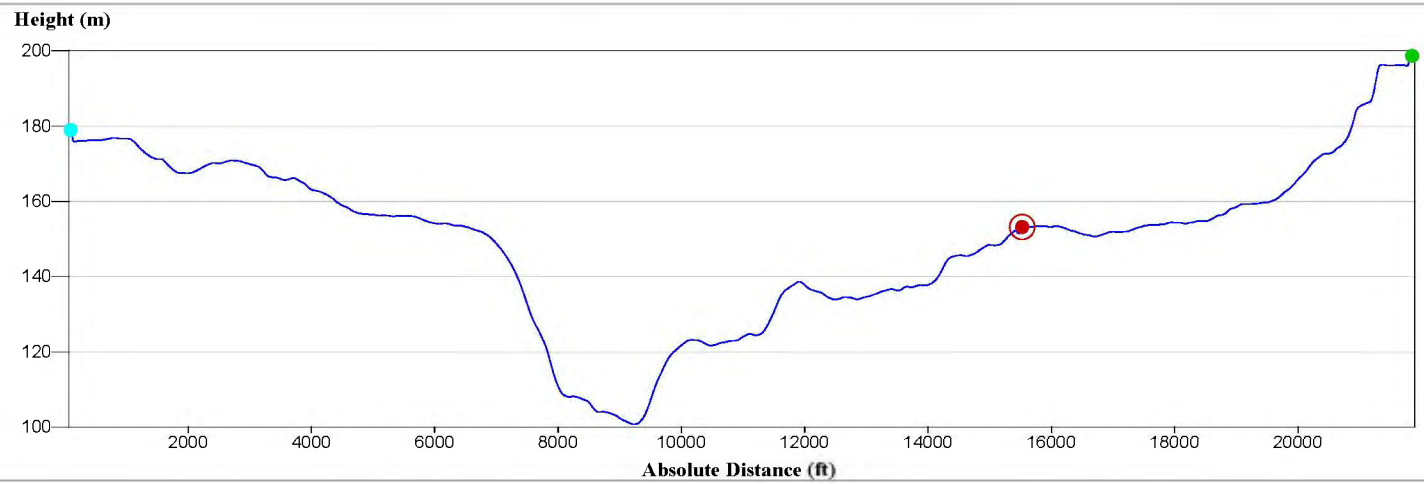
PipeWall Anomaly Inspection Sheet

Client:	Enbridge Energy Limited Partnership	Run Date:	August 16, 2016	Projection:	UTM	Zone:	16
Project:	NPS20 GEOPIG Geometry Inspection	Location:	Line 5 North Straits WEST - Mackinaw	Datum:	NAD 83	C.M.:	-87

Plan and Profile between U/S and D/S Reference Points

Anomaly:	**OVL 2**	
Absolute Distance:	15,527.64	ft
Northing:	5,074,470.87	m
Easting:	673,170.58	m
Height:	153.14	m
U/S Ref.:	St Ignace Launch Valve	
Enbridge Chainage:	-.05	ft
Distance to U/S Ref.:	15,428.38	ft
D/S Ref.:	Mackinaw Station Receive Valve	
Enbridge Chainage:	21,569.53	ft
Distance to D/S Ref.:	6,324.25	ft



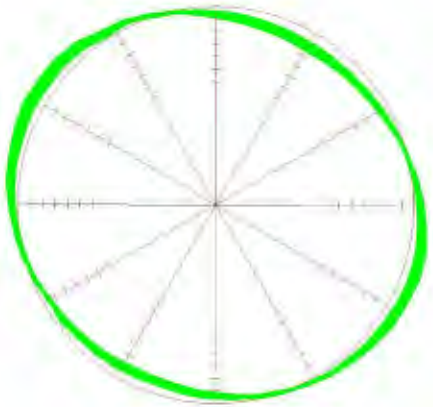


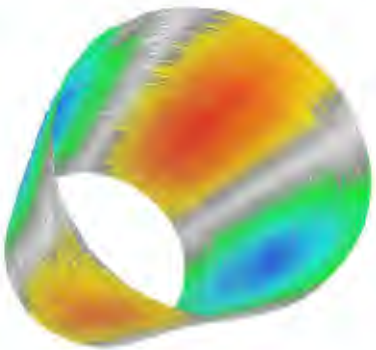
ENBDNR0000153

PipeWall Anomaly Inspection Sheet

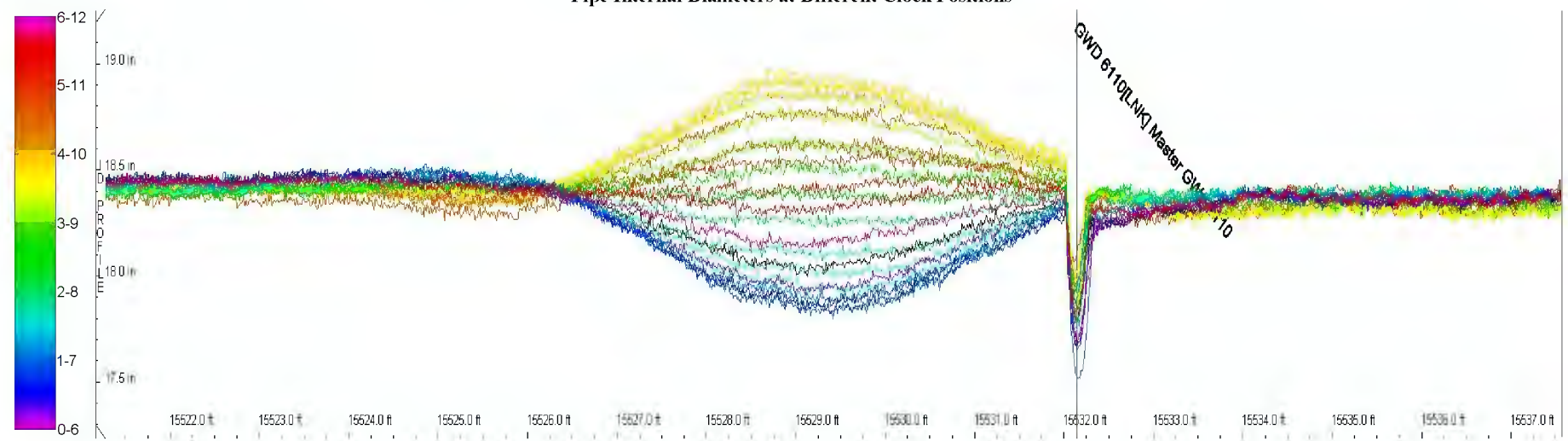
Client:	Enbridge Energy Limited Partnership	Run Date:	August 16, 2016	Projection:	UTM	Zone:	16
Project:	NPS20 GEOPIG Geometry Inspection	Location:	Line 5 North Straits WEST - Mackinaw	Datum:	NAD 83	C.M.:	-87

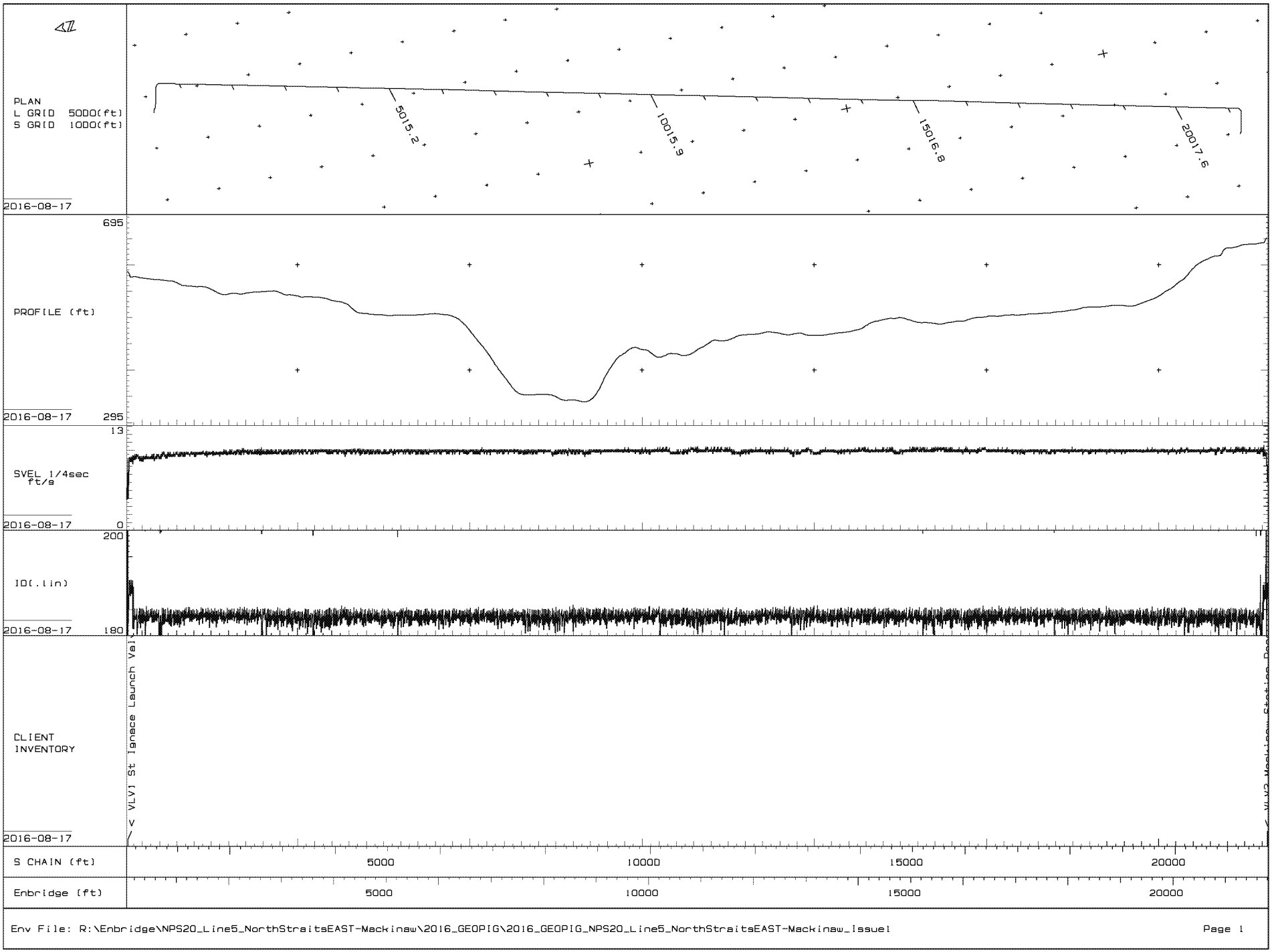
Cross Section View - Each graticule represents 1% OD **Anomaly Size = 5.7%** **3D View - Exaggerated 3 times**

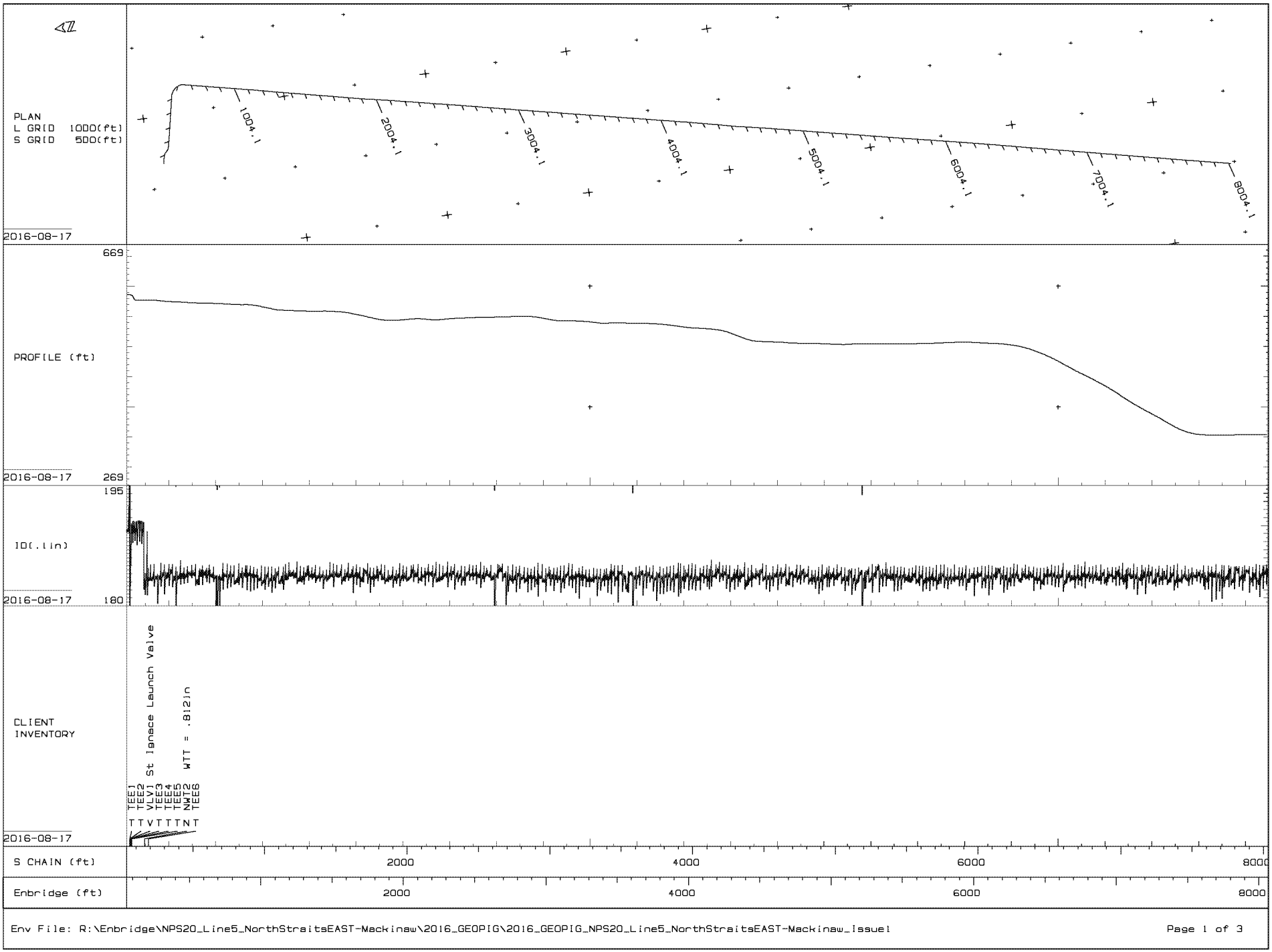




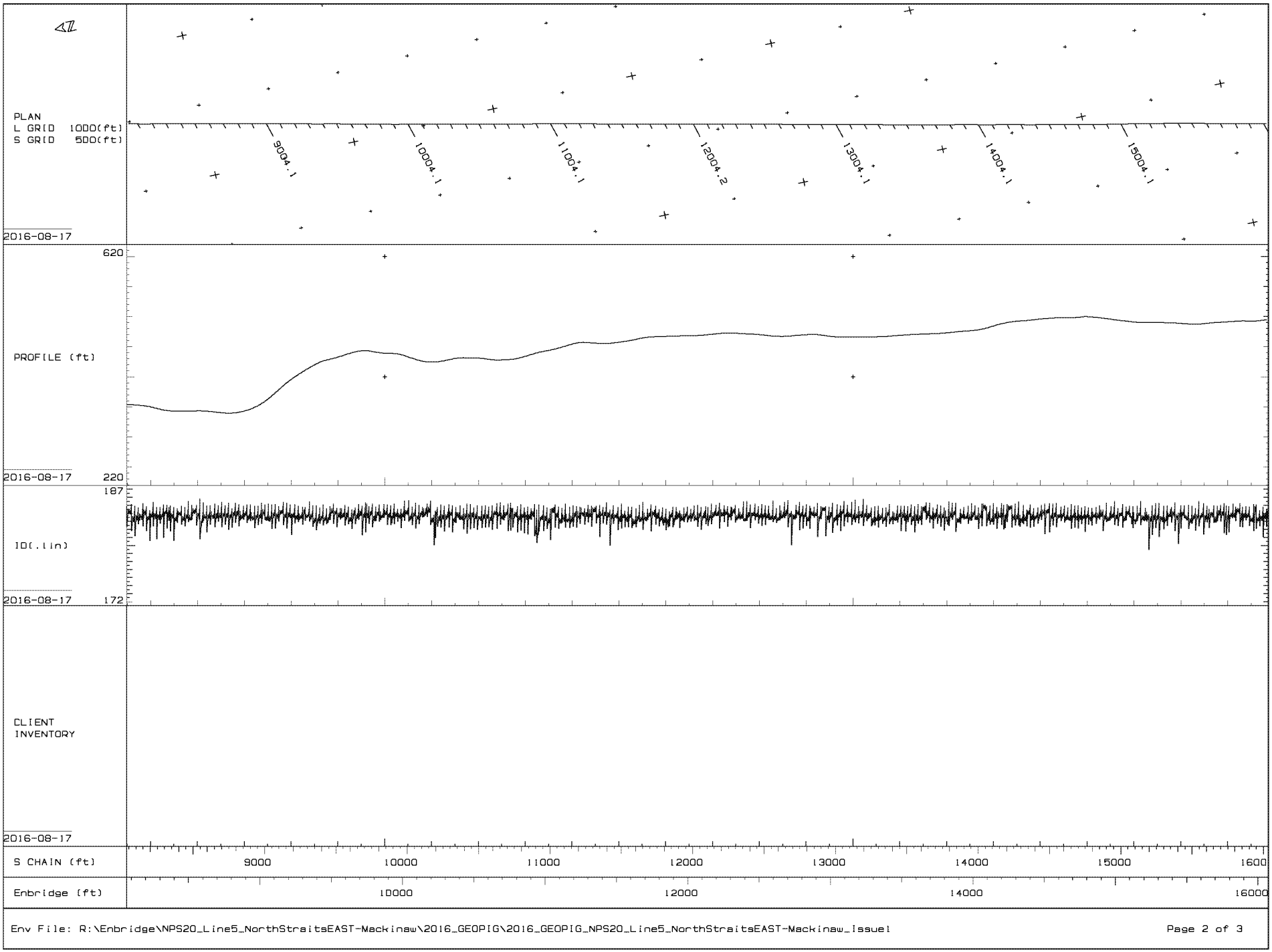
Pipe Internal Diameters at Different Clock Positions



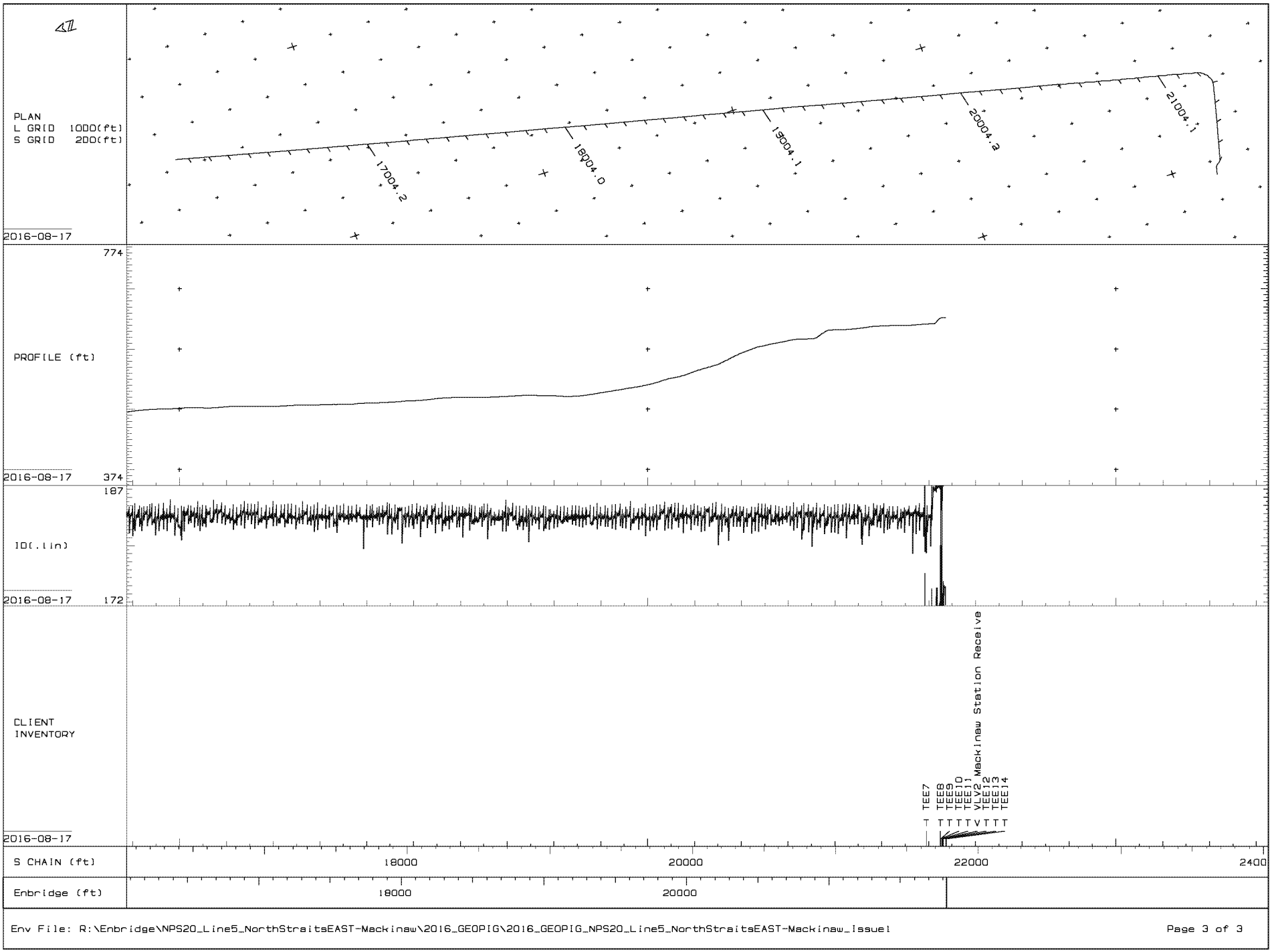

PLAN
L GRID 5000(ft)
S GRID 1000(ft)
2016-08-17
5015.2
10015.9
15016.8
20017.6
695
PROFILE (ft)
2016-08-17
295
13
SVEL 1/4sec
ft/s
2016-08-17
0
200
ID(.lin)
2016-08-17
180
CLIENT
INVENTORY
2016-08-17
< VLV1 St Ignace Launch Val
S CHAIN (ft)
5000
10000
15000
20000
Enbridge (ft)
5000
10000
15000
20000
Env File: R:\Enbridge\NPS20_Line5_NorthStraitsEAST-Mackinaw\2016_GEOPIG\2016_GEOPIG_NPS20_Line5_NorthStraitsEAST-Mackinaw_Issue1
Page 1



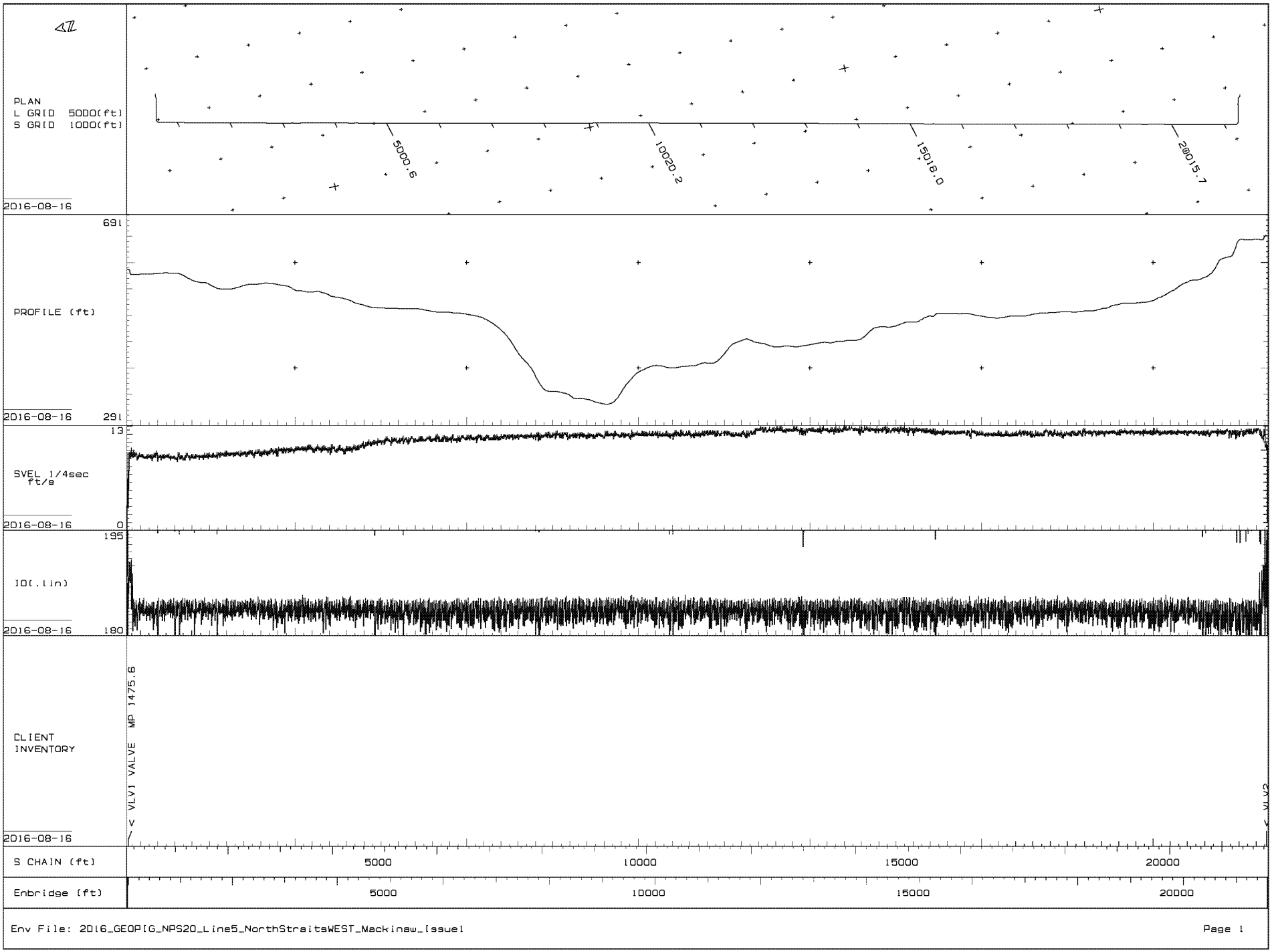
Env File: R:\Enbridge\NPS20_Line5_NorthStraitsEAST-Mackinaw\2016_GEOPIG\2016_GEOPIG_NPS20_Line5_NorthStraitsEAST-Mackinaw_Issue1

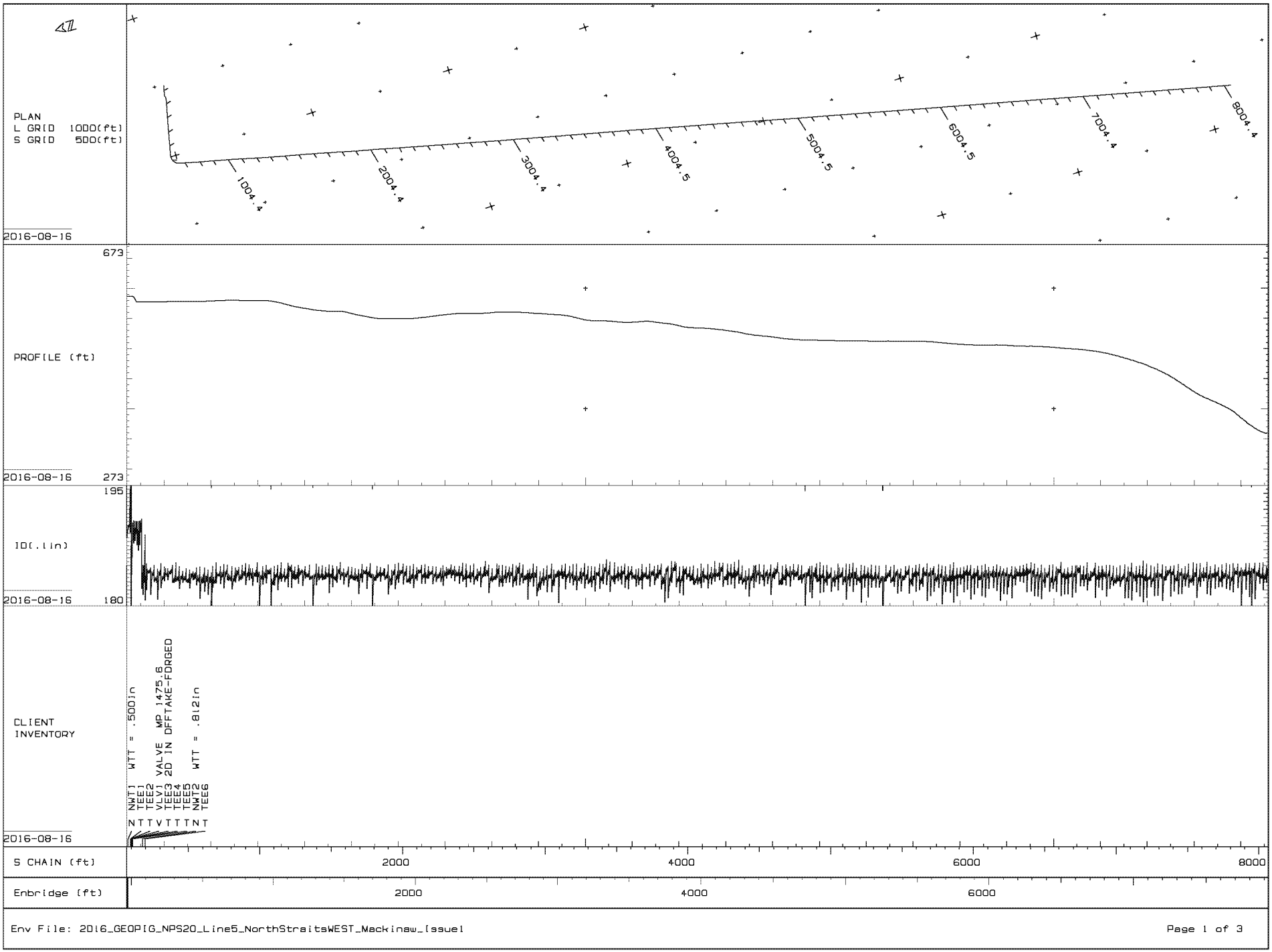


Env File: R:\Enbridge\NPS20_Line5_NorthStraitsEAST-Mackinaw\2016_GEOPIG\2016_GEOPIG_NPS20_Line5_NorthStraitsEAST-Mackinaw_Issue1



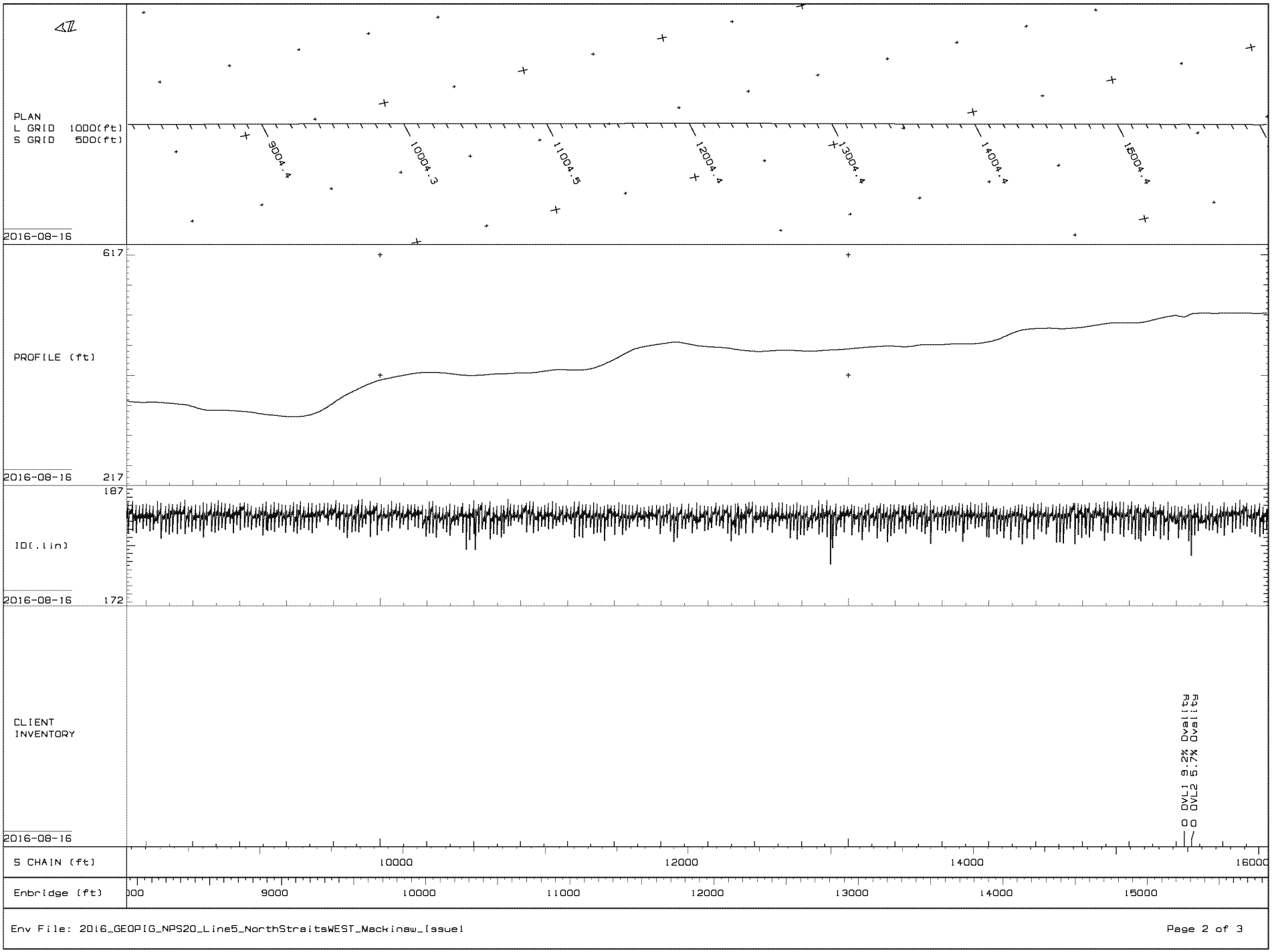
Env File: R:\Enbridge\NPS20_Line5_NorthStraitsEAST-Mackinaw\2016_GEOPIG\2016_GEOPIG_NPS20_Line5_NorthStraitsEAST-Mackinaw_Issue1


PLAN
L GRID 5000(ft)
S GRID 1000(ft)
2016-08-16
5000.6
10020.2
15018.0
20015.7
PROFILE (ft)
691
291
SVEL 1/4sec
ft/s
13
0
IO(.lin)
195
180
CLIENT
INVENTORY
VLV1 VALVE MP 1475.6
VLV2
S CHAIN (ft)
5000
10000
15000
20000
Enbridge (ft)
Env File: 2016_GEOPIG_NPS20_Line5_NorthStraitsWEST_Mackinaw_Issue1
Page 1



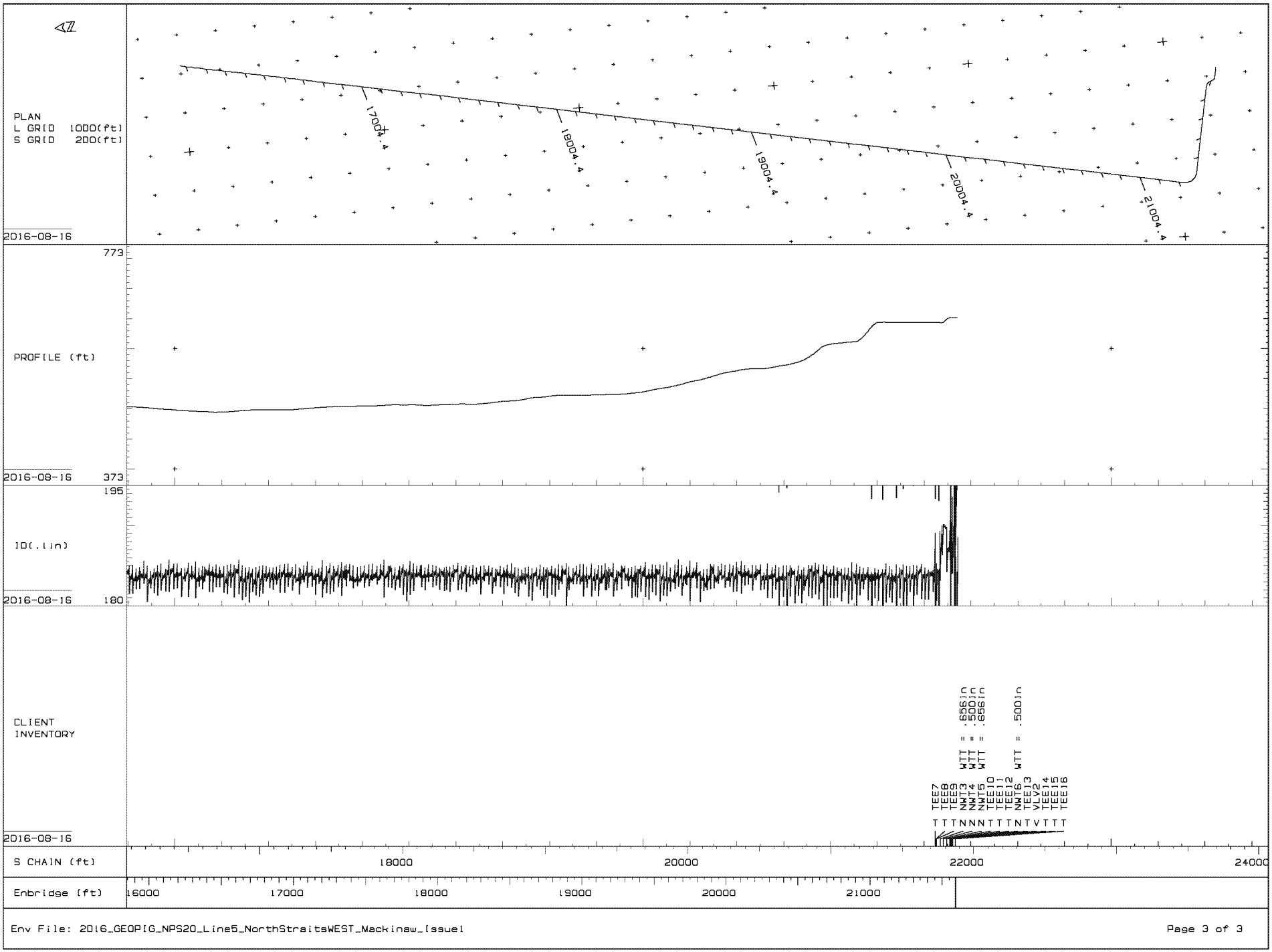
Env File: 2016_GEOPIG_NPS20_Line5_NorthStraitsWEST_Mackinaw_Issue1

ENBDNR0000160



Env File: 2016_GEOPIG_NPS20_Line5_NorthStraitsWEST_Mackinaw_Issue1

ENBDNR0000161


PLAN
L GRID 1000(ft)
S GRID 200(ft)
17004.4
18004.4
19004.4
20004.4
21004.4
2016-08-16
773
PROFILE (ft)
373
2016-08-16
195
ID(.lin)
180
2016-08-16
CLIENT
INVENTORY
TEE7 WTT = .656in
TEE8 WTT = .500in
TEE9 WTT = .656in
NWT3
NWT4
NWT5
TEE10
TEE11
TEE12
NWT6 WTT = .500in
TEE13
VLV2
TEE14
TEE15
TEE16
T T T N N N T T T N T V T T T
2016-08-16
S CHAIN (ft)
16000
18000
20000
22000
24000
Enbridge (ft)
16000
17000
18000
19000
20000
21000
Env File: 2016_GEOPIG_NPS20_Line5_NorthStraitsWEST_Mackinaw_Issue1
Page 3 of 3



Standard

Inline Inspection Reporting Profile Standard

Effective Date: <05/19/2006>

Version #: <8.0>

Version Date: <04/01/2015>

Uncontrolled Copy if Printed

Confidential Business Information – **Internal Use Only – Restricted Distribution**

External Distribution Requires Prior Written Approval by the Law Department

This page intentionally left blank

Confidential Business Information **– Internal Use Only – Restricted Distribution**
External Distribution Requires Prior Written Approval by the Law Department

Document Version Register

Version Number	Version Date	Approved By	Section Number and Title	Details of Version
7.1	06/11/13	Mary Banack		Grandfathered document from external document storage
8.0	04/01/15	Mary Banack		Complete overhaul of document

This page intentionally left blank

TABLE OF CONTENTS

1.0 Purpose 4

2.0 Scope 4

3.0 Standards and Requirements 4

3.1 Regulations, Codes, and Standards 4

3.2 Industry Publications and References 4

3.3 Enbridge Documents/Systems 4

4.0 General 5

5.0 Inspection & Report Identification Information 5

5.1 Electronic Labeling Requirements 5

6.0 Report Delivery 6

7.0 Report Schedule Requirements 6

7.1 Priority Notification Reports 7

7.2 Data Quality Assessments 7

7.2.1 Field DQA 7

7.2.2 Summary DQA 7

7.2.3 Detailed DQA 7

7.3 Draft Pipeline Listing Approval 8

7.4 Final Reports 8

7.4.1 Line Proving 8

7.4.2 Geometry 8

7.4.3 Corrosion Ultrasonics & Magnetic Flux Leakage 8

7.4.4 Crack Ultrasonics 8

7.5 Re-Issued Reports 9

7.5.1 Report Issue Numbering 9

7.6 Report Delivery Extensions 9

7.6.1 Final Report Delivery Extension 9

7.6.2 Re-Issue Report Delivery Extension 9

8.0 Priority Notification Criteria 9
8.1 Geometry & Line Proving 10
8.2 Corrosion Ultrasonics & Magnetic Flux Leakage (MFL) 10
8.3 Crack Ultrasonics 11
8.4 Communication of Priority Notifications 11
9.0 Data Quality Assessment Criteria 12
9.1 Field DQA 12
9.2 Summary DQA 13
9.3 Detailed DQA 13
10.0 Draft Pipeline Listing Approval Criteria 13
11.0 Final Report Criteria 13
11.1 Line Proving Reporting 14
11.2 Geometry Reporting 14
11.3 Corrosion Ultrasonics & Magnetic Flux Leakage Reporting 15
11.4 Crack Ultrasonics Reporting 16
11.5 IMU Reporting 17
12.0 Electronic Listings & Attribute Definitions 18
12.1 Pipeline Listing Reporting Requirements 18
12.2 Inspection Report Identification 19
12.3 Generic Attributes 21
12.4 Geometry Attributes 29
12.5 Metal Loss Attributes 42
12.6 Crack Attributes 48
13.0 Final Report Deliverables 52
13.1 Executive Summary 52
13.2 Vendor Project & Responsible Personnel 52
13.3 Electronic Pipeline Listings 52
13.4 Crack Profiles 52
13.5 Tool Performance Specification 53

ENBDNR0000168

13.6 Viewing Software 53

14.0 Quality System Documentation 53

14.1 Quality Management Process Document(s) 53

14.2 Procedure Document(s) 53

14.3 Personnel Certification & Training Process Document(s) 53

14.4 Proof of Employee Training and Certification Document(s) 54

14.5 Tool Performance Specification 54

14.6 Tool Calibration 54

14.7 Notification/Documented Revision Summary 54

14.8 Record Keeping 55

15.0 Performance 55

16.0 Appendix 55

Appendix A | Report Delivery Extension Request Forms 56

Appendix B | Priority Notification Form 59

Appendix C | Required Attributes For Each Threat/Technology 61

1.0 Purpose

The Reporting Profile Standard provides the mandatory requirements of inline inspection (ILI) reports prepared by ILI vendors. This standard promotes reporting consistency across ILI vendors, improving Enbridge's ability to review and analyze ILI reports and data, leading to the successful management of pipeline threats.

2.0 Scope

This Standard includes reporting requirements and definitions that shall be included and used in all ILI reports submitted to Enbridge LP for all mainline pipelines, as well as, reporting criterion and schedule requirements specific to each ILI technology and pipeline threat (i.e. crack, corrosion, and deformation).

3.0 Standards and Requirements

This document shall comply with relevant Canadian and United States regulations, codes and standards, including:

3.1 Regulations, Codes, and Standards

CSA Z662 Oil and Gas Pipeline Systems

PHMSA CFR Title 49 Part 195 – Transportation of Hazardous Liquids by Pipeline

National Energy Board Onshore Pipeline Regulations

ASME B31.4 Pipeline Transportation Systems for Liquids and Slurries

3.2 Industry Publications and References

API 1160 Managing Systems Integrity for Hazardous Liquid Pipelines

API 1163 In-line Inspection Systems Qualification

ASNT ILI-PQ 2010 In-line Inspection Personnel Qualification and Certification Standard

3.3 Enbridge Documents/Systems

Governance Documents Control Process (IMS-01)

Pipeline Integrity Management System (IMS-09)

PI-85 Regulatory Compliance Procedure

4.0 General

It is important that reports and ILI data received from ILI vendors are properly and consistently communicated to Enbridge; this includes report formats and naming conventions, definitions and labels, data formats, engineering units, decimal places, permissible values, and quality rules.

ILI vendors are expected to understand the requirements of this Reporting Profile Standard. In the event Vendor is not able to meet the requirements of this Standard, Vendor shall notify Enbridge prior to the execution of the inspection. Reports and ILI data received from Vendor that does not abide by this standard shall be not be accepted by Enbridge.

5.0 Inspection & Report Identification Information

The following information shall be clearly indicated on all inspection reports issued to Enbridge.

- Contract number
- Project ID number
- Line number
- Line size (diameter)
- Line segment inspected
- Date tool was launched
- Date tool was retrieved
- Report issue date
- Report issue number
- Report re-issue date (if applicable)
- Lead analyst & certification level
- Checker analyst & certification level
- Analysis & reporting check date

5.1 Electronic Labeling Requirements

Labels for data, CDs, DVDs, and hard drives shall include the following.

Requirements	Example
ILI vendor company name	XYZ Vendor
Disc content	Client data
Line number	Line 5
Start & end trap information	Superior to Iron River
Pipe diameter	30 inch (762 mm)
Line product	Crude Oil Pipeline
Enbridge entity name	Enbridge Pipelines (Lakehead) L.L.C.
Tool type	USCD
Tool launch date	Run date: January 1, 2015
Tool retrieval date	Retrieval date: January 5, 2015
Issue number	Issue #1
Issue date (or re-issue date)	March 1, 2015
Project ID number	123456_78A
Disc number	Disk 1 of 1

The following are the labelling requirements for spreadsheets, word documents & and other electronic files.

Requirements	Example
Line number	Line 5
Start & end trap information	Superior to Iron River
Pipe diameter	30 inch (762 mm)
Enbridge entity name	Enbridge Pipelines (Lakehead) L.L.C.
Tool type	USCD
Tool launch date	Run Start date: January 1, 2015
Tool retrieval date	Run End date: January 5, 2015
Issue number	Issue #1
Issue date (or re-issue date)	March 1, 2015
Project ID number	123456_78A

6.0 Report Delivery

Vendor shall ensure that reports and communications are addressed to the correct Enbridge entity, as specified on the inspection's work order.

Along with or immediately following the final report and any subsequent re-issued reports, Vendor shall issue a Report Delivery Acknowledgement letter electronically or otherwise. Enbridge shall sign and return the letter acknowledging receipt of the report, as well as, the date of receipt.

7.0 Report Schedule Requirements

Reports are to be delivered within the schedule requirements for that particular technology. This is regardless if the technology was run as a stand-alone inspection or in combination with an additional technology. Refer to the individual technology schedule requirements in Table 1, and Sections 7.1 through 7.5.

The calculation of contractual due dates for all report delivery shall start when the tool is received.

Table 1
Summary of Reporting Schedule Requirements

Technology	Priority Notification	Field DQA	Summary DQA	Detailed DQA	Draft Pipeline Listing	Final Report	Re-issue Report(s)
Line Proving	Immediately upon discovery	48 hours after receipt of tool	N/A	N/A	N/A	5 business days after receipt of tool	N/A
Geometry	Immediately upon discovery	48 hours after receipt of tool	7 days after receipt of tool	14 days after receipt of tool	See Section 7.3	60 days after receipt of tool	15 days after request
Corrosion Ultrasonics	Immediately upon discovery	48 hours after receipt of tool	7 days after receipt of tool	14 days after receipt of tool	See Section 7.3	90 days for ≤ 200 km, 30 additional days or fraction thereof for each additional 100 km, to maximum of 150 days after receipt of tool	15 days after request
Magnetic Flux Leakage	Immediately upon discovery	48 hours after receipt of tool	7 days after receipt of tool	14 days after receipt of tool	See Section 7.3	90 days for ≤ 200 km, 30 additional days or fraction thereof for each additional 100 km, to maximum of 150 days after receipt of tool	15 days after request
Crack Ultrasonics	Immediately upon discovery	48 hours after receipt of tool	7 days after receipt of tool	14 days after receipt of tool	See Section 7.3	120 days for ≤ 200 km, 30 additional days or fraction thereof for additional 100 km, to maximum of 150 days after receipt of tool	15 days after request

7.1 Priority Notification Reports

For all technologies, Vendor shall report all priority notification features immediately upon discovery. Criteria for priority notification features are included in Section 8.0 of this Standard.

7.2 Data Quality Assessments

The schedule requirements of each data quality assessment (DQA) are listed below.

7.2.1 FIELD DQA

For all technologies, Vendor shall provide a field DQA report within 48 hours after receipt of the tool. Required content of the field DQA is included in Section 9.1.

7.2.2 SUMMARY DQA

For all technologies, except line proving, Vendor shall provide a summary DQA report within 7 calendar days after receipt of the tool. Required content of the summary DQA is included in Section 9.2.

7.2.3 DETAILED DQA

When recommended by Vendor or requested by Enbridge, Vendor shall provide a detailed DQA report for all technologies, except line proving, within 14 calendar

days after receipt of the tool. Required content of the detailed DQA is included in Section 9.3.

7.3 Draft Pipeline Listing Approval

For all technologies (except for line proving) Vendor shall submit a complete draft of the inspection's Pipeline Listing for Enbridge review and approval. Enbridge approval of the draft Pipeline Listing is required prior to Vendor submission of the final report. Vendor's schedule shall allow a minimum of 10 business days for Enbridge review and approval of the draft Pipeline listing. Vendor's schedule shall also include sufficient time to correct all errors and omissions identified by Enbridge and to re-submit a corrected draft listing for Enbridge review and approval. All identified errors and omissions shall be resolved prior to receiving approval of the draft Pipeline Listing. Required content of the draft Pipeline Listing is included in Section 10.0.

7.4 Final Reports

The delivery requirements for the final report of each technology follow. The required criteria for the final report are included in Section 11.0.

7.4.1 LINE PROVING

Line proving final reports shall be delivered within 5 business days from receipt of inspection tool.

7.4.2 GEOMETRY

Geometry/deformation final reports shall be delivered within 60 calendar days from receipt of inspection tool.

7.4.3 CORROSION ULTRASONICS & MAGNETIC FLUX LEAKAGE

For inspection lengths less than or equal to 200 km, corrosion ultrasonics & magnetic flux leakage (MFL) final reports shall be delivered within 90 calendar days from receipt of inspection tool. For each additional 100 km inspected or fraction thereof, 30 calendar days shall be added to the final report delivery deadline, up to a maximum of 150 calendar days after the receipt of tool.

7.4.4 CRACK ULTRASONICS

For inspection lengths less than or equal to 200 km, crack ultrasonics final reports shall be delivered within 120 calendar days from receipt of receipt of inspection tool. For an additional 100 km inspected or fraction thereof, 30 calendar days shall be added to the final report delivery deadline, up to a maximum of 150 calendar day after the receipt of tool. For inspection lengths greater than 300 km, the final report shall be delivered within 150 calendar days after the receipt of inspection tool.

7.5 Re-Issued Reports

For all technologies, re-issued reports are to be delivered within 15 business days after Enbridge's request for a re-issue report. In cases where re-issued reports may require analysis that cannot be completed within the 15 business day deadline, Vendor shall follow the Report Delivery Extension process in Section 7.6.2.

7.5.1 REPORT ISSUE NUMBERING

The first issue of the final report shall be "Issue 1." Consecutive re-issued reports of the same ILI data shall be clearly identified in consecutive numerical order. The issue date shall also be updated with each re-issued report.

Re-issued reports shall contain an executive summary clearly stating the required revision(s) and reason(s) for the re-issue, such as technical, document editing and/or other.

7.6 Report Delivery Extensions

If Vendor is unable to achieve the final or re-issue reporting schedule requirements in Table 1, and Sections 7.4 and 7.5, Vendor may request a report delivery extension. Report delivery extensions shall be approved by the Manager of Program Execution.

7.6.1 FINAL REPORT DELIVERY EXTENSION

To request an extension, Vendor must submit a completed Final Report Delivery Extension Request form, included in Appendix A, to the Enbridge Program Manager at least 30 calendar days prior to the report's original due date. The extension is granted only after Vendor has received the request form signed by the Manager of Program Execution, within 7 calendar days after the extension request has been submitted.

7.6.2 RE-ISSUE REPORT DELIVERY EXTENSION

To request an extension for a re-issue report, Vendor shall submit a completed Re-Issue Final Report Delivery Extension Request form, included in Appendix A, to the Enbridge Program Manager within 5 calendar days after Enbridge's request for a re-issue report. The extension is granted only after Vendor has received the request form signed by the Manager of Program Execution, within 7 calendar days after the extension request has been submitted.

8.0 Priority Notification Criteria

Vendor shall immediately notify Enbridge of any feature that is believed to be an immediate threat to the pipeline's integrity. This includes, but is not limited to, the Priority Notification Criteria for each technology summarized in Table 2 and detailed in the subsections below. Vendor is to notify Enbridge immediately upon discovery of any and all features that meet the criteria. Vendor

shall ensure a lead analyst is assigned to the effort, and that an analyst is available to collaborate directly with the Enbridge Subject Matter Lead regarding reporting details. The communication protocol is described in Section 8.4.

Table 2
Summary of Priority Notification Criteria

Technology	Priority Notification Criteria	
Line Proving & Geometry	OR	1. Dent or deformation features ≥ 5% OD 2. Priority notification criteria specifically identified in the project work order
Corrosion Ultrasonics & Magnetic Flux Leakage	OR	1. Metal loss features with peak depth ≥ 75% NWT 2. Metal loss feature with an effective area RPR ≤ 0.85 3. Priority notification criteria specifically identified in the project work order
	Corrosion Growth Rate Criteria (upon request only)	
	OR	4. Metal loss features forecasted to reach maximum depth ≥ 75% NWT or actual wall thickness within 365 calendar days 5. Unmatched metal loss features with a depth ≥ 50% NWT or actual wall thickness
Crack Ultrasonics	OR	1. Crack features that meet or exceed the saturation limit of the crack detection tool 2. Crack features ≥ 2.5 mm (0.098 inch), and have been detected on the internal and external pipe surface at the same location; 3. Priority notification criteria specifically identified in the project work order

8.1 Geometry & Line Proving

Enbridge shall be notified immediately upon discovery of any of the geometry/deformation features listed below.

1. Any dents or other deformation features greater than 5% outer diameter (OD) ; OR
2. Any deformation feature that meets or exceeds the criteria for priority notification specifically identified and documented in the project work order.

8.2 Corrosion Ultrasonics & Magnetic Flux Leakage (MFL)

Enbridge shall be notified immediately upon the discovery of any of the metal loss features listed below.

1. Any metal loss feature with a peak depth greater than or equal to 75% of the pipe's nominal wall thickness; OR
2. Any metal loss feature that has an effective area rupture pressure ratio (RPR) less than or equal to 0.85; OR

3. Any metal loss feature that meets or exceeds the criteria for priority notification specifically identified and documented in the project work order (such as metal loss features on Line 3 with a RPR less than or equal to 0.8 shall be reported as priority notifications).

Vendor shall apply the corrosion growth rate (CGR) priority notification criteria 4 and 5 below if specifically requested in the inspection's work order. If Vendor has previous corrosion ultrasonics or MFL data from the past 5 years, or Enbridge has provided previous inspection data, Vendor shall use the 2 data sets and apply the CGR priority notification criteria.

4. Any metal loss feature that is forecasted to reach a maximum depth of 75% or greater, based on a nominal or actual wall thickness, within 365 calendar days of the inspection date. The CGR shall be calculated for all detectable metal loss features using signal-to-signal CGR or box-to-box feature matching comparison; OR

5. Any detected unmatched metal loss feature with a depth of 50% or greater, based on nominal or actual wall thickness.

8.3 Crack Ultrasonics

Enbridge shall be notified immediately upon the discovery of any crack features listed below.

1. Any crack feature that meets or exceeds the saturation limit of the crack detection tool; OR

2. Any crack feature with a depth equal to or greater than 2.5 mm (0.098 inch) and have been detected on the internal and external pipe surface at the same location; OR

3. Any crack feature that meets or exceeds the criteria for priority notification specifically identified and documented in the project work order.

8.4 Communication of Priority Notifications

Upon discovery of features meeting or exceeding the Priority Notification Criteria, Vendor shall immediately notify Enbridge of such features in writing and orally.

Vendor shall orally report priority notifications to the Enbridge Program Manager. If the Enbridge Program Manager does not respond or confirm with Vendor that the oral notification has been received within 1 hour, Vendor shall proceed to notify Enbridge personnel, in the order listed below, until Vendor receives confirmation that the priority notification has been received by Enbridge personnel.

1. Manager, Execution

2. Managers, Mainline Integrity
3. Senior Manager, Program Logistics
4. Senior Manager, Planning Group
5. Director, Integrity Programs

Written notification shall follow the Priority Notification form included in Appendix B. Priority notification feature information shall be reported in an Excel spreadsheet format. For all technologies, priority notification reporting shall include, but is not limited to the following information regarding the feature(s).

- Girth weld numbers
- Absolute distance & distance relative to upstream girth weld
- Orientation start & end, in degrees
- Depth, length & remaining strength calculation (RPR for corrosion features only)
- Distance to the nearest upstream & downstream markers
- Screen shot(s) of the feature(s) from the current ILI data and previous ILI data (if applicable)
- Joint length of the joint with priority notification feature, as well as, five (5) joints immediately upstream & downstream of the joint with priority notification feature
- Long seam orientation of the joint with priority notification feature, as well as, five (5) joints immediately upstream & downstream of the joint with priority notification feature
- All features and feature details, regardless of severity, on the joint with the priority notification feature

Any changes from a reported Priority Notification shall be noted in the Executive Summary of the final report.

9.0 Data Quality Assessment Criteria

Vendor shall submit field and summary DQAs for all inspections. Detailed DQAs are only required when recommended by Vendor or requested by Enbridge.

9.1 Field DQA

For all technologies, except line proving, the field DQA shall confirm that a continuous stream of data was collected during the inspection, that the data meets basic quality requirements, and a summary of the post inspection function test, including:

- Tool cleanliness based on visual inspection,

- Confirmation that adequate power was available and tool was operational,
- Confirmation that all sensors, data storage, odometers, and other mechanical systems operated properly,
- Confirmation that adequate data storage was available, and
- Examination of tool for damage and significant wear.

9.2 Summary DQA

For all technologies, except line proving, the summary DQA shall describe the specification that may be achieved by the inspection. Any impact to probability of detection (POD), probability of identification (POI) and sizing capabilities shall be included in the summary DQA.

Vendor shall provide a recommendation to proceed with analysis, re-run the inspection or complete a detailed DQA.

9.3 Detailed DQA

For all technologies, except line proving, information required in the summary DQA shall be augmented in the detailed DQA. The detailed DQA shall confirm areas of degradation with respect to sensor performance, and detail the POD, POI and sizing capabilities that may be achieved for the areas of degradation.

Vendor shall provide a recommendation to proceed with complete or full data analysis, and/or re-run the inspection.

10.0 Draft Pipeline Listing Approval Criteria

For all technologies, Vendor shall submit a completed electronic draft Pipeline Listing for Enbridge's approval.

Enbridge shall provide the latest version of PipeBook prior to the inspection. Any discrepancies identified by Vendor during data analysis shall be communicated to the Enbridge Program Manager and resolved prior to sending the draft Pipeline Listing for approval.

This approval process is intended to reduce multiple issues of the final deliverables. However, this approval shall not necessarily ensure all data is completely correct. Pipeline Listing and/or final report re-issues may still be requested after the draft Pipeline Listing has been approved.

11.0 Final Report Criteria

Individual reports shall be provided for each technology used on the project unless otherwise stated in the work order. For example, if a "combo" technology, such as a combination MFL and geometry tool, is used to inspect a pipeline, individual reports for the MFL deliverable and the geometry deliverable are required.

11.1 Line Proving Reporting

Line proving reports shall include bend and internal diameter restriction analyses. The bend analysis shall list all of the bends detected and the absolute distance of each detected bend. The bend analysis shall include a summary with the most severe bend, and the closest distance between consecutive bends and the location (absolute distance) of those bends.

The internal diameter restriction analysis shall indicate the total number of internal diameter restrictions on straight pipe and bends. Also, all of the restrictions shall be listed with their absolute distance, distance to upstream girth weld, and internal diameter measurement.

All line proving final reports shall be identified with the attributes in Section 12.2, Inspection Report Identification.

11.2 Geometry Reporting

All restrictions greater than or equal to 2% nominal pipe size (NPS) shall be reported in the final report unless documented otherwise in the work order. Topside geometric anomalies greater than or equal to 0.5% shall be reported, if in close proximity to at least 1 geometric anomaly that is greater than or equal to 1%. All topside dents in close proximity and multiapex dents greater than 1% shall be reported. Bottom side geometric anomalies greater than or equal to 0.5% shall be reported, if in close proximity to at least 1 geometric anomaly that is greater than or equal to 2%. Section 12.4, Geometry Attributes Definitions, includes the criteria for “Topside”, “Dents in Close Proximity” and “MultiApex Dent”.

Vendor shall complete Tables 3 and 4, Geometry Features and Wrinkle/Buckle Severity, in the final report.

Table 3
Geometry Feature Severity

Feature Type	Top	Bottom	Max Depth %
Geometry Feature depth d ≥5%			
Geometry Feature associated with stress risers or welds			

Table 4
Wrinkle/Buckle Severity

Feature Type	Top	Bottom	Max Depth %
Wrinkles/Buckles			
Wrinkles/Buckles across seam welds or girth welds			

11.3 Corrosion Ultrasonics & Magnetic Flux Leakage Reporting

Metal loss features, including corrosion, pipe mill, and other manufacturing related flaws detectable by the technology, shall be reported in the final report unless expressly stated otherwise in the project work order scope of work. All detected geometric anomalies shall be reported.

If a combination corrosion ultrasonic-geometry technology or combination MFL-geometry technology was used, the corrosion ultrasonic or MFL final report shall include geometric anomalies greater than or equal to 0.5%. The final report shall also report dents in close proximity and multiapex dents. Section 12.4, Geometry Attributes Definitions, includes criteria for “Dents in Close Proximity” and “MultiApex Dent”.

Vendor shall provide screenshots for all check valves, complete with the length of the potential valve void. The void length measurement shall start where the valve starts to taper.

Corrosion ultrasonic and MFL final reports, including circumferential magnetic flux leakage (CMFL) reports, shall include Tables 4 and 5 (Wrinkle/Buckle and Corrosion Severity). Only include unsleeved features in Table 5. Additionally, MFL final reports shall include Table 6, Girth Weld Anomaly Severity.

If the corrosion ultrasonic or MFL technology was used in combination with a caliper technology Table 7, Combination Geometry Features Severity, shall be included in the final report.

Table 5
Corrosion Severity

Feature Type	Value	GW	Orientation (°)	Radial Position (Int/Ext)
Worst Depth				
Worst Eff. Area RPR				
Number of Features with Eff. Area ≤ 0.90		N/A	N/A	N/A
Number of Features with Depth ≥ 65%		N/A	N/A	N/A

Table 6
Girth Weld Anomaly Severity

Feature Type	No. of Features	GW	Orientation (°)	Circumferential Length (in/mm)
GW Anomaly		N/A	N/A	N/A
Longest GW Anomaly	N/A			

Table 7
Combination Geometry Features Severity

Feature Type	Top	Bottom	Max Depth %
Geometry Feature depth d ≥5%			
Geometry Feature associated with stress riser, weld, or metal loss			

11.4 Crack Ultrasonics Reporting

The base reporting criteria of 30mm length x 1mm depth shall be used on all crack ultrasonics projects unless expressly stated otherwise within the project work order scope of work. All detected geometric anomalies shall be reported.

The crack reporting criteria is dependent upon the tool speed. All crack features shall be reported using the best achievable criteria up to a maximum of 60 mm in length x 1 mm in depth. The Enbridge Program Manager shall be contacted to validate / confirm the overall criteria obtainable (based on run conditions) prior to data analysis completion.

If a combination crack ultrasonic-geometry technology was used, the crack ultrasonic final report shall include geometric anomalies greater than or equal to 0.5%. The final report shall report dents in close proximity and multiapex dents. Section 12.4, Geometry

Attributes Definitions, includes the criteria for "Dents in Close Proximity" and "MultiApex Dent".

Vendor shall provide Tables 4 and 8, Wrinkle/Buckle and Linear Indications (Crack) Severity, in the final report. Only include unsleeved features in Table 8.

Table 8
Linear Indication (Crack) Severity

Feature Type	Depth > Saturation Limit	Depth 2 mm (or 0.08 inch) to Saturation Limit
Crack-Like Features		
Crack-Field Features		
Notch-Like Features		
Total		

In Table 8, metric values (2 mm) shall be used for inspection where the majority of the pipeline resides in Canada; imperial values (0.08 inch) shall be used when the majority of the pipeline resides in the U.S.

11.5 IMU Reporting

Tables 9 and 10, Strain Severity and Pipe Movement, shall be completed for inspections where inertial measurement unit (IMU) data has specifically been requested in the inspection's work order. If the inspection was performed on Line 21 or the inspection was the first IMU inspection on the pipeline, rather than reporting "Largest Strain Difference" values in Table 9, report "Peak Strain" values. Maximum pipeline movement shall be reported in Table 10; note that the maximum movement may not necessarily coincide with the maximum strain. For Tables 9 and 10, specify all girth welds and absolute distances if the strain feature spans over 1 or more girth welds.

Table 9
Strain Severity

Feature Type	No. of Features	Largest Strain Difference Vertical %	Largest Strain Difference Horizontal %	Largest Strain Difference Total %	GW	Absolute Distance	Comments
Strain		N/A	N/A	N/A	N/A	N/A	Out of xx strain features reported, xx were associated with pipe replacement/re-route
Worst Strain (excluding replacements & re-routes)	N/A		N/A	N/A			
	N/A	N/A		N/A			
	N/A	N/A	N/A				

Table 10
Pipe Movement

Feature Type	No. of Features	Vertical Movement	Horizontal Movement	GW	Absolute Distance	Comments
Pipe Movement		N/A	N/A	N/A	N/A	Out of xx pipe movements reported, xx were associated with pipe replacement/re-route
Largest Movement (excluding replacements & re-routes)	N/A		N/A			
	N/A	N/A				

12.0 Electronic Listings & Attribute Definitions

Electronic general and technology specific reporting requirements follow.

12.1 Pipeline Listing Reporting Requirements

Enbridge shall provide an electronic Pipeline Listing template the most current version of the Reporting Profile Standard, in the form of a MS Excel spreadsheet, to Vendor. The Pipeline Listing template shall contain all feature attribute columns that are to be provided by Vendor. The format of the Pipeline Listing template shall not be modified in anyway, that is, columns and tabs shall not be added, removed, nor rearranged. The same template shall be provided for all technologies; therefore not all columns shall be used for each inspection project. These unused columns shall be left empty; unused columns shall

not be deleted. If the template is not provided, Vendor shall request the electronic Pipeline Listing template from Enbridge.

Note: Any text field permitted within the Pipeline Listing as a permissible value is limited to 256 characters.

Appendix C contains a table that indicates the minimum required Pipeline Listing attributes for each threat/technology. Note that if an attribute in Table C1 has not been identified as required in accordance with Table C1, but Vendor's technology is capable of detecting, identifying, and/or sizing the attribute, the attribute in Table C1 shall be included in the electronic Pipeline Listing.

Vendor shall populate the Pipeline Listing template by increasing girth weld number and absolute distance, in accordance with the PipeBook provided by Enbridge. Imperial units shall be used for inspections where the majority of the pipeline resides in the U.S.; metric units shall be used where the majority of the pipeline resides in Canada. Numeric attributes in the Pipeline Listing include limits to the unit of measure, and number of decimal places that are to be reported.

12.2 Inspection Report Identification

The following report identification attributes shall be included for all inspections.

Country

Country in which the majority of the inspected pipeline resides.

Permissible Values: "CAN" or "US"

End Trap

Call sign (2 or 3 letter abbreviation) of the inspection's receipt trap.

Permissible Values: Select from pull-down menu

File Part

Describes if this file was part of a multi-part file. Format: file_part of total_number_of_files.

Permissible Values: "1of1", "1of2", "2of2", etc.

Issue Comment

Comment to describe the issue number and important comments specific to the issue.

Permissible Values: Text

Issue Date

Date that the inspection report is issued. Format: MM/DD/YYYY.

Permissible Values: Date

Issue Number

Issue number of the inspection report.

Decimal Places: 0 | Permissible Values: Number

Line

Line number which ILI tool was run on. Format: L####X.

Permissible Values: Select from pull-down menu

Nominal Pipe Size

Diameter of pipeline inspected.

Units: inch | Permissible Values: Select from pull-down menu

Project ID

Vendor assigned project identification.

Permissible Values: Text

Run End Date

Date the inspection tool was received. Format: MM/DD/YYYY.

Permissible Values: Date

Run Start Date

Date the inspection tool was launched. Format: MM/DD/YYYY.

Permissible Values: Date

Start Trap

Call sign (2 or 3 letter abbreviation) of the inspections launch trap.

Permissible Values: Select from pull-down menu

Technology

ILI technology type.

Permissible Values: “Caliper”, “CMFL”, “EMAT”, “MFL”, “Phased Array”, “UTCD”, or “UTWM”

Tool Type

Commercial tool name.

Permissible Values: Text

Units

Units of measure for measured values.

Permissible Values: “Metric” or “Imperial”

Vendor

Name of the company that provided the ILI tool.

Permissible Values: Text

12.3 Generic Attributes

The following are attributes that are common to 2 or more technologies.

Absolute Distance

Tool odometer at start of feature (from the beginning of the run).

Units: “m” or “ft” | Decimal Places: 2 | Permissible Values: Decimal

Actual Measured Local Wall Thickness

The local wall thickness measured by the tool in the vicinity of the feature. For ultrasonic technologies only.

Units: “mm” or “inch” | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal greater than 0

Average Wall Thickness

The most frequently measured wall thickness of a pipe joint by the tool. For ultrasonic technologies only.

Units: “mm” or “inch” | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal greater than 0

Degraded Data

For metal loss and geometry features - identifies whether or not signal loss occurred during the detection of the feature which may have led to degraded data; including overspeed, underspeed, sensor failure, debris, rotational, etc.
Y – When signal loss, overspeed, underspeed, sensor failure, debris, poor or excessive tool rotation occurred.
N – When no sensor loss and no degraded data occurred.
For crack features - indicates whether or not the feature area is located within a segment where the reporting specification cannot be met due to deteriorated quality of the ultrasonic data recorded.
Y – When degraded data occurred. Degraded data may be, but is not limited to, debris, speed excursions, coupling loss, electronic failure, etc.
N – When no sensor loss and no degraded data occurred.

Permissible Values: "Y" or "N"

Depth

Specific to each technology. See Section 12.4 through 12.6 below.

Depth Accuracy

Local (or general) tool accuracy for feature detection.

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal greater than 0

Depth Percent Local

Specific to each technology. See Section 12.4 through 12.6 below.

Depth Percent Nominal

Specific to each technology. See Section 12.4 through 12.6 below.

Feature Comment

Vendor provided feature comment. This attribute shall only be used if the feature comment cannot be captured or described with or as part of another available attribute. Vendor shall make efforts to minimize usage of this attribute.

Permissible Values: Text

Feature ID

Vendor assigned unique feature identifier. (Unique to vendor report only.)

Permissible Values: Text

Feature Type

Classification of feature as detected by the tool.

Permissible Values: *Specific to each technology. See Section 12.4 through 12.6 below.*

IMU Reported Elevation

IMU reported elevation of the feature.

Units: "m" | Decimal Places: 2 | Permissible Values: Decimal

IMU Reported Latitude

IMU reported latitude of the feature.

Units: "degrees" | Decimal Places: 6 | Permissible Values: Decimal between -90 & 90

IMU Reported Longitude

IMU reported longitude of the feature.

Units: "degrees" | Decimal Places: 6 | Permissible Values: Decimal between -180 & 180

Interacting with Crack

Indicates whether or not a feature is interacting with a crack as reported by vendor.

Y – When feature interacts with crack.

N – When feature does not interact with crack.

Permissible Values: "Y" or "N"

Interacting with Deformation

Indicates whether or not a feature is interacting with a deformation as reported by vendor.

Y – When feature interacts with deformation.

N – When feature does not interact with deformation.

Permissible Values: "Y" or "N"

Interacting with Manufacturing Defects

Indicates whether or not a feature is interacting with a manufacturing defect as reported by vendor.

Y – When feature interacts with manufacturing defect.

N – When feature does not interact with manufacturing defect.

Permissible Values: "Y" or "N"

Interacting with Metal Loss

Indicates whether or not a feature is interacting with a metal loss as reported by vendor.

Y – When feature interacts with metal loss.

N – When feature does not interact with metal loss.

Permissible Values: "Y" or "N"

Joint Length

Length of the joint (measured from girth weld to girth weld) in which the feature is located. This length is measured from middle of girth weld to middle of girth weld.

Units: "m" or "ft" | Decimal Places: 2 | Permissible Values: Decimal greater than 0

Length

Axial length of feature box (start to end of feature box).

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal greater than 0

Length Accuracy

Local (or general) tool resolution for feature detection.

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal greater than 0

Nominal Pipe Size

Diameter of pipeline inspected, as provided to vendor from Enbridge.

Units: inch | Permissible Values: Number

Nominal Wall Thickness

Nominal wall thickness of the joint, containing the feature, as provided to vendor from Enbridge.

Units: “mm” or “inch” | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal greater than 0

MSP Orientation

Orientation of feature's most severe point (MSP) from 1 to 360 degrees, clockwise from Top Dead Centre (TDC) looking downstream.

Units: “degrees” | Decimal Places: 0 | Permissible Values: Number between 1 & 360

MSP Relative Distance

Distance of the feature’s most severe point from the specified upstream girth weld.

Units: “m” or “ft” | Decimal Places: 2 | Permissible Values: Decimal

Orientation Centre

Orientation of the centre of the feature box from 1 to 360 degrees clockwise from Top Dead Centre (TDC) looking downstream. This attribute only applies to geometric anomalies detected by technologies other than a caliper.

Units: “degrees” | Decimal Places: 0 | Permissible Values: Number between 1 & 360

Orientation End

Circumferential location of trailing edge of feature from 1 to 360 degrees, clockwise from Top Dead Centre (TDC) looking downstream.

Units: “degrees” | Decimal Places: 0 | Permissible Values: Number between 1 & 360

Orientation Start

Circumferential location of leading edge of feature from 1 to 360 degrees, clockwise from Top Dead Centre (TDC) looking downstream.

Units: “degrees” | Decimal Places: 0 | Permissible Values: Number between 1 & 360

Pipe Grade Provided

Pipe grade provided by Enbridge (PipeBook).

Permissible Values: "Grade A25", "Grade A", "Grade B", "X42", "X46", "X52", "X56", "X60", "X65", "X70", "X80", "X90", "X100", or "X120"

Radial Position

Radial position of the feature within the pipe wall.

Internal - Indicates that the feature has been detected on the internal pipe surface only.

External - Indicates that the feature has been detected on the external pipe surface only.

Internal and External - Indicates that the feature(s) has been detected on both the internal and external pipe surfaces at the same location.

Mid-wall – Indicates that the feature has been detected within the pipe wall thickness.

Not decidable – Indicates that the position of the feature could not be determined.

Permissible Values: "Internal", "External", "Internal and External", "Mid-wall", or "Not decidable"

Relative Distance Centre

Distance of the centre of the feature box from the specified upstream girth weld. This attribute only applies to geometric anomalies detected by technologies other than a caliper.

Units: "m" or "ft" | Decimal Places: 2 | Permissible Values: Decimal

Relative Distance End

End distance of the feature from the specified upstream girth weld.

Units: "m" or "ft" | Decimal Places: 2 | Permissible Values: Decimal

Relative Distance Start

Start distance of the feature from the specified upstream girth weld.

Units: "m" or "ft" | Decimal Places: 2 | Permissible Values: Decimal

Relative Position to Girth Weld

Specific to each technology. See Section 12.4 through 12.6 below.

Relative Position to Seam Weld

Specific to each technology. See Section 12.4 through 12.6 below.

Seam Weld Type Detected

Type of seam weld as reported by the vendor. This is the type of weld used to fabricate the pipe joint (the long or spiral seam) and should not be confused with the weld type used to attach 2 separate joints.

ERW/FW – Indicates an electric resistance weld or flash weld

SAW – Indicates a submerged arc weld

DSAW – Indicates a double submerged arc weld

SPIRAL – Indicates a spiral weld

SMLS – Indicates a seamless weld

UNKN – Indicates that the weld type could not be detected or determined by the tool

Permissible Values: "ERW/FW", "SAW", "DSAW", "SPIRAL", "SMLS" or "UNKN"

Seam Weld Orientation End Detected

Ending orientation of the seam weld of the joint containing the feature at the downstream girth weld as measured by the tool from 1 to 360 degrees, clockwise from Top Dead Centre (TDC) looking downstream.

Units: "degrees" | Decimal Places: 0 | Permissible Values: Number between 1 & 360

Seam Weld Orientation End Provided

Ending orientation of the seam weld of the joint containing the feature at the downstream girth weld as provided by Enbridge (PipeBook) from 1 to 360 degrees, clockwise from Top Dead Centre (TDC) looking downstream.

Units: "degrees" | Decimal Places: 0 | Permissible Values: Number between 1 & 360

Seam Weld Orientation Start Detected

Starting orientation of the seam weld of the joint containing the feature at the reference upstream girth weld as measured by the tool from 1 to 360 degrees, clockwise from Top Dead Centre (TDC) looking downstream.

Units: "degrees" | Decimal Places: 0 | Permissible Values: Number between 1 & 360

Seam Weld Orientation Start Provided

Starting orientation of the seam weld of the joint containing the feature at the downstream girth weld as provided by Enbridge (PipeBook) from 1 to 360 degrees, clockwise from Top Dead Centre (TDC) looking downstream.

Units: "degrees" | Decimal Places: 0 | Permissible Values: Number between 1 & 360

Sleeve/Casing ID

Vendor assigned unique sleeve or casing identifier for a single sleeve or casing instance. (Unique to report only.) For casings, a Feature Type of "Casing Start", "Casing End" or "Casing Eccentric" pertaining to the same casing shall have the same ID. For sleeves, a Feature Type of "Sleeve Start" or "Sleeve End" pertaining to the same sleeve shall have the same ID. For casings the identifier shall follow the format C###. For sleeves the format shall be S###.

Permissible Values: C### or S###

Under Sleeve

Indicates whether or not a repair sleeve that covers the full extent of the feature has been detected

Y – When feature is entirely under a repair sleeve.

N – When feature is not or partially not under a repair sleeve.

Permissible Values: "Y" or "N"

Upstream Girth Weld

For metal loss and crack features - Reference upstream girth weld number of the joint containing the start of the feature.

For geometry features - Reference upstream girth weld number of the joint containing the MSP of the feature. If the geometry feature has been detected by a technology other than a caliper, reference upstream girth weld number of the joint containing of the centre of the feature box.

Permissible Values: Decimal | Decimal Places: 0

Width

Circumferential length of feature (start to end of box), measured clockwise from start of feature.

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units

Permissible Values: Decimal greater than 0

12.4 Geometry Attributes

The following are attributes that are specific to geometry technologies. Figures 1 through 7 are presented at the end of this section to supplement the attribute definitions.

Associated With Girth Weld

Indicates whether or not the detectable limit of a geometry feature is located at or crosses a girth weld and affects the curvature of the pipe at the weld.

Permissible Values: "Y" or "N"

Associated With Seam Weld

Indicates whether or not the detectable limit of a geometry feature is located at or crosses a seam weld and affects the curvature of the pipe at the weld.

Permissible Values: "Y" or "N"

Bend Angle

Maximum angle of the bend as measured from a plane in 3 dimensional space (corresponds to the same plane as the bend diameter).

Units: "degrees" | Decimal Places: 0 | Permissible Values: Number

Bend Azimuth Angle

The change in pipe direction angle looking down onto the pipe in the horizontal plane over the length of the bend (see Figure 1).

Units: "degrees" | Decimal Places: 0 | Permissible Values: Number

Bend Azimuth Change Direction

Direction of the bend moving downstream looking down onto the pipe in the horizontal plane.

Permissible Values: "Right" or "Left"

Bend Pitch Angle

The change in pipeline tilt with respect to the horizontal plane over the length of the bend (see Figure 2).

Units: "degrees" | Decimal Places: 0 | Permissible Values: Number

Bend Pitch Direction

Direction of the pitch change moving downstream.

Permissible Values: "Up" or "Down"

Bend Radius

Minimum radius of curvature (2 x radius of curvature) of the bend on a plane in 3-dimensional space (corresponds to same plane as the bend angle).

Units: "OD" | Decimal Places: 1 | Permissible Values: Decimal

CCW_LTR00

The distance from the MSP of the of the geometry feature to the location where the feature has reached 0% peak (MSP) depth, in the counter clockwise transverse direction, on the transverse plane passing through the MSP as determined from the axial profile (see Figure 3). MSP as determined from the axial profile; no post processing removing effects of ovality shall be carried out.

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal

CCW_LTR05

The distance from the MSP of the of the geometry feature to the location where the feature has reached 5% peak (MSP) depth, in the counter clockwise transverse direction, on the transverse plane passing through the MSP as determined from the axial profile (see Figure 3). MSP as determined from the axial profile; no post processing removing effects of ovality shall be carried out.

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal

CCW_LTR50

The distance from the MSP of the of the geometry feature to the location where the feature has reached 50% peak (MSP) depth, in the counter clockwise transverse direction, on the transverse plane passing through the MSP as determined from the axial profile (see Figure 3). MSP as determined from the axial profile; no post processing removing effects of ovality shall be carried out.

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units

Permissible Values: Decimal

Chainage Strain End

The chainage of the end of the reportable strain difference area.

Units: "m" or "ft" | Decimal Places: 2 | Permissible Values: Decimal

Chainage Strain Start

The chainage of the start of the reportable strain difference area.

Units: “m” or “ft” | Decimal Places: 2 | Permissible Values: Decimal

CW_LTR00

The distance from the MSP of the of the geometry feature to the location where the feature has reached 0% peak (MSP) depth, in the clockwise transverse direction, on the transverse plane passing through the MSP as determined from the axial profile (see Figure 3). MSP as determined from the axial profile; no post processing removing effects of ovality shall be carried out.

Units: “mm” or “inch” | Decimal Places: 2 for metric units or 3 for imperial units

Permissible Values: Decimal

CW_LTR05

The distance from the MSP of the of the geometry feature to the location where the feature has reached 5% peak (MSP) depth, in the clockwise transverse direction, on the transverse plane passing through the MSP as determined from the axial profile (see Figure 3). MSP as determined from the axial profile; no post processing removing effects of ovality shall be carried out.

Units: “mm” or “inch” | Decimal Places: 2 for metric units or 3 for imperial units

Permissible Values: Decimal

CW_LTR50

The distance from the MSP of the of the geometry feature to the location where the feature has reached 50% peak (MSP) depth, in the clockwise transverse direction, on the transverse plane passing through the MSP as determined from the axial profile (see Figure 3). MSP as determined from the axial profile; no post processing removing effects of ovality shall be carried out.

Units: “mm” or “inch” | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal

Dent Depth B

Depth of dent-like geometry feature, including the effects of pipe ovality (see Figure 4 (b)).

$$B = D_{NOM} - D_{MIN} - \left(\frac{D_{MAX} - D_{NOM}}{2}\right)$$

Units: “mm” or “inch” | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal

Dent in Close Proximity

Indicates whether or not 2 or more dents are close to each other. If the geometric anomalies were detected by a non-caliper tool use the centre of the feature boxes, rather than the MSPs, in the Y/N definitions below.

Y – When 1 or more topside dent MSPs are within 3 m (10 feet) axial and 60o radial position.

Y – When 2 or more bottom side dents MSPs are within 1.5m (5 feet) axial and 60o radial positions.

N – When neither condition above applies.

Permissible Values: “Y” or “N”

Depth

If feature is a dent or geometric anomaly, report the maximum depth of a geometry feature, excluding the effects of ovality. If feature is a buckle, kink, ripple or wrinkle report Crest-to-Trough height, h. Crest-to-Trough height is the difference between the point of maximum outward deformation and the point of maximum inward deformation of the buckle, kink, ripple or wrinkle (see Figure 5).

Units: “mm” or “inch” | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal for metric or imperial units

Depth Percent Dent

Depth of deformation of a geometry feature at the MSP, excluding the effects of ovality. If feature is a dent, report the depth percent as A/NPS (dent depth A percent). If feature is a wrinkle, report the depth percent as dent depth h/NPS (crest-to-trough height percent).

Units: “$\frac{\%NPS}{100}$” | Decimal Places: 4 | Permissible Values: Decimal between 0 & 1

Depth Percent B

Depth of deformation of a geometry feature at the MSP, including the effects of ovality. Report the depth percent as B/NPS (dent depth B percent). See Figure 6.

Units: "$\frac{\%NPS}{100}$" | Decimal Places: 4 | Permissible Values: Decimal between 0 & 1

DS_LAX00

The downstream axial distance, on the MSP axial plane, from the MSP of the geometry feature to the location where the feature has reached 0% of the peak depth (MSP depth) (see Figure 7).

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal

DS_LAX05

The downstream axial distance, on the MSP axial plane, from the MSP of the geometry feature to the location where the feature has reached 5% of the peak depth (MSP depth) (see Figure 7).

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal

DS_LAX50

The downstream axial distance, on the MSP axial plane, from the MSP of the geometry feature to the location where the feature has reached 50% of the peak depth (MSP depth) (see Figure 7).

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal

Feature Type

Classification of feature as detected by the tool. Feature type may be, 1 of the following.

Dent – Depression causing gross disturbance in curvature of the pipe wall. A feature shall be classified as a dent if the depth is ≥ 2% of the OD.

Geometric anomaly – A depression that causes a disturbance in the curvature of the pipe wall. A feature shall be classified as a geometric anomaly if the depth is < 2% of the NPS, or if the geometric anomaly has been detected by a technology other than a caliper. All geometric anomalies ≥ 1% of the NPS shall be reported. Geometric anomalies ≥ 0.5% shall be reported if they are in close proximity to another dent or geometric anomaly.

Ovality – Out of roundness relative to the nominal circular shape of the pipe; e.g. egg shaped or broadly elliptical. All ovalities ≥ 5% of the NPS shall be reported.

Wrinkle – All other deformations that are not a dent, geometric anomaly and ovality. Buckles, kinks, ripples and wrinkle bends shall all be classified as wrinkles.

Unspecified – This classification shall only be used when ILI tool data limits feature identification.

Internal diameter reduction (IDR) –A significant reduction of the pipe's internal diameter that is not associated with a geometric anomaly.

Bend – A physical pipe configuration that changes the pipe direction.

Permissible Values: "Deformation-Dent", "Deformation-Geometric anomaly", "Deformation-Ovality" , "Deformation-Wrinkle", "Deformation-Unspecified", "Deformation-IDR" or "Bend"

Internal Pipe Pressure at Deformation

The internal pressure of the pipe at the location of the geometry feature. This value shall be reported for all features described in feature type.

Units: "psi" | Decimal Places: 0 | Permissible Values: Number

Largest Strain Difference Horizontal

The horizontal component of total differential bending strain between the current and baseline inspections at the peak total differential bending strain location.

Units: "$\frac{\%}{100}$" | Decimal Places: 4 | Permissible Values: Decimal between 0 & 1

Largest Strain Difference Total

The combined vertical and horizontal components of differential bending strain between the current and baseline inspections at the peak total differential bending strain location.

Units: "$\frac{\%}{100}$" | Decimal Places: 4 | Permissible Values: Decimal between 0 & 1

Largest Strain Difference Vertical

The vertical component of total differential bending strain between the current and baseline inspections at the peak total differential bending strain location.

Units: "$\frac{\%}{100}$" | Decimal Places: 4 | Permissible Values: Decimal between 0 & 1

Maximum ID

The maximum measured inner diameter of the pipe at the location of the feature's MSP.

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal

Minimum Distance of MSP to GW

The minimum distance of the MSP of the geometry feature to the centre of the closest girth weld. If the inspection tool is not capable of detecting the location of the girth weld, the Vendor shall use the girth weld location provided in the baseline PipeBook provided by Enbridge.

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal

Minimum Distance of MSP to LSW

The minimum distance of the MSP of the geometry feature to the centre of the closest seam weld. If the inspection tool is not capable of detecting the location of the seam weld, the Vendor shall use long seam orientation provided in the baseline PipeBook provided by Enbridge.

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal

Minimum ID

The minimum measured inner diameter of the pipe at the location of the feature's MSP.

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal

MultiApex Dent

Indicates whether or not the geometric shape of a dent has more than 1 apex point.

Y – When dent has 2 or more apexes.

N – When dent has only 1 apex.

Permissible Values: "Y" or "N"

Nominal ID

The nominal measured inner diameter of the joint containing feature.

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal

Off Axis

Indicates whether or not the longitudinal axis of a dent is more than 15 degrees from the longitudinal axis of the pipeline.

Y – When longitudinal axis of a dent is more than 15 degrees from the longitudinal axis of the pipeline.

N – When longitudinal axis of a dent is equal to or less than 15 degrees from the longitudinal axis of the pipeline.

Permissible Values: "Y" or "N"

Ovality

Out of roundness relative to the nominal circular shape of the pipe; e.g. egg shaped or broadly elliptical. All ovalities ≥5% of the NPS shall be reported. See Figure 4 (a).

$$Ovality = \frac{(D_{MAX} - D_{MIN})}{(D_{MAX} + D_{MIN}) * \frac{1}{2}}$$

Units: "$\frac{\%NPS}{100}$" | Decimal Places: 4 | Permissible Values: Decimal between 0 & 1

Pipeline Movement Horizontal

The maximum horizontal location difference between the current and the baseline inspection within the start and end chainage range (not necessarily at the peak total differential bending strain location or the vertical movement location).

Units: "m" or "ft" | Decimal Places: 2 | Permissible Values: Decimal

Pipeline Movement Vertical

The maximum vertical location difference between the current and the baseline inspection within the start and end chainage range (not necessarily at the peak total differential bending strain location or the horizontal movement location).

Units: "m" or "ft" | Decimal Places: 2 | Permissible Values: Decimal

Strain Value at Largest Difference Horizontal

The horizontal component of absolute bending strain measured from the current inspection at the peak total differential bending strain location.

Units: "$\frac{\%}{100}$" | Decimal Places: 4 | Permissible Values: Decimal between 0 & 1

Strain Value at Largest Difference Total

The combined vertical and horizontal components of absolute bending strain measured from the current inspection at the peak total differential bending strain location.

Units: "$\frac{\%}{100}$" | Decimal Places: 4 | Permissible Values: Decimal between 0 & 1

Strain Value at Largest Difference Vertical

The vertical component of absolute bending strain measured from the current inspection at the peak total differential bending strain location.

Units: "$\frac{\%}{100}$" | Decimal Places: 4 | Permissible Values: Decimal between 0 & 1

Topside

Indicates whether or not the feature's MSP is between 240 degrees to 120 degrees (topside) or between 120 and 240 degrees (bottom side).

Y – When MSP is between 240 degrees to 120 degrees.

N – When MSP is between 120 and 240 degrees.

Permissible Values: "Y" or "N"

US_LAX00

The upstream axial distance, on the MSP axial plane, from the MSP of the geometry feature to the location where the feature has reached 0% of the peak depth (MSP depth) (see Figure 7).

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal

US_LAX05

The upstream axial distance, on the MSP axial plane, from the MSP of the geometry feature to the location where the feature has reached 5% of the peak depth (MSP depth) (see Figure 7).

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal

US_LAX50

The upstream axial distance, on the MSP axial plane, from the MSP of the geometry feature to the location where the feature has reached 50% of the peak depth (MSP depth) (see Figure 7).

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal

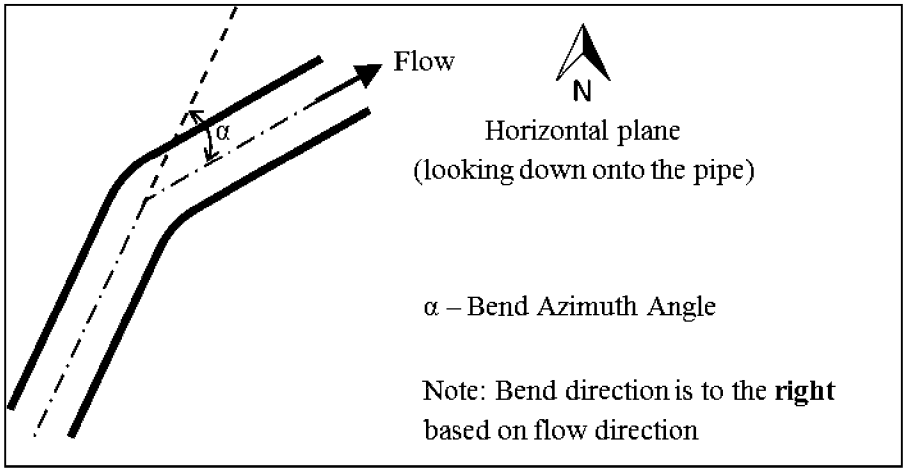


Figure 1 | Bend Azimuth Angle

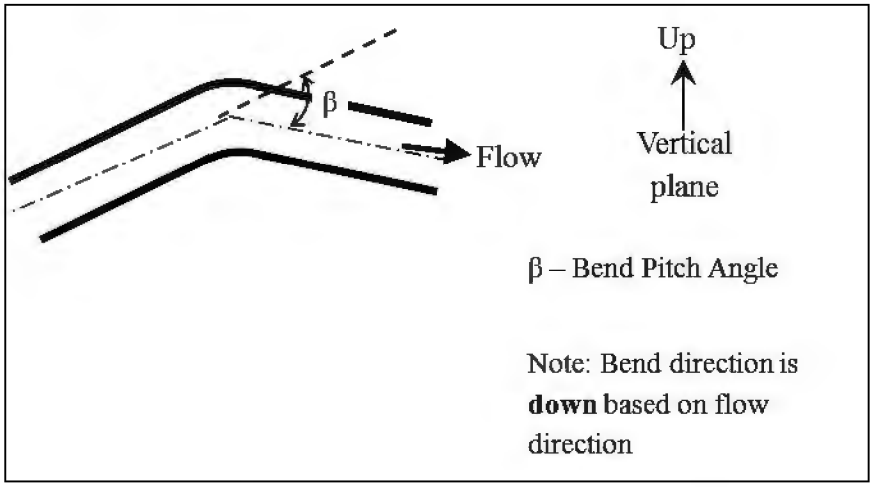


Figure 2 | Bend Pitch Angle

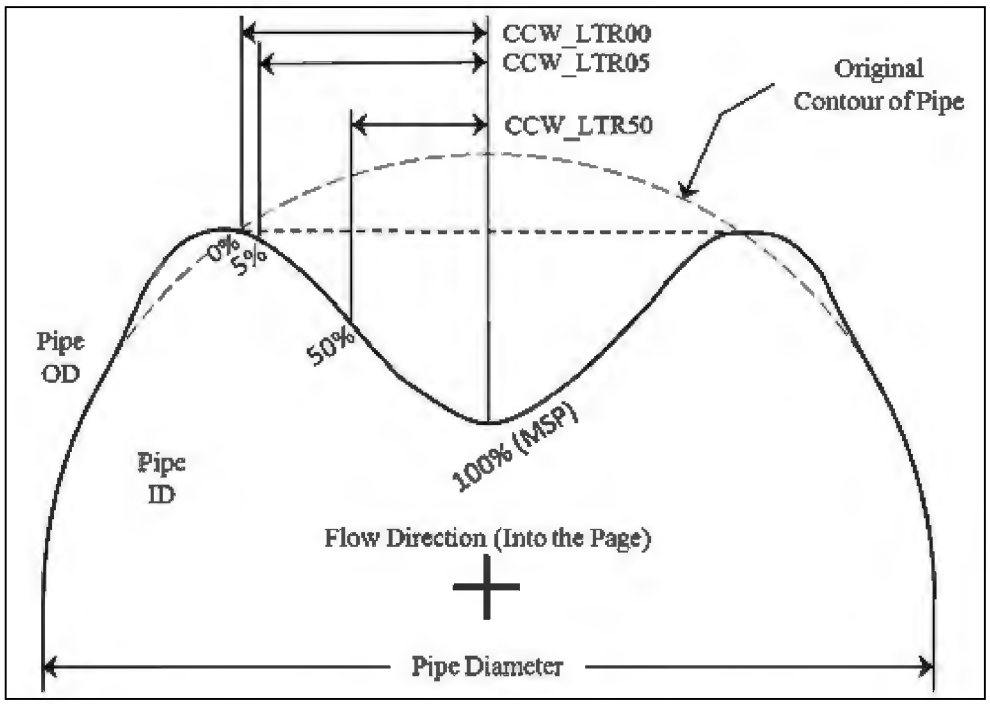


Figure 3 | Example of Transverse Deformation Shape Parameters in the counter clockwise (CCW) direction. Similar nomenclature shall be followed for the clockwise (CW) direction.

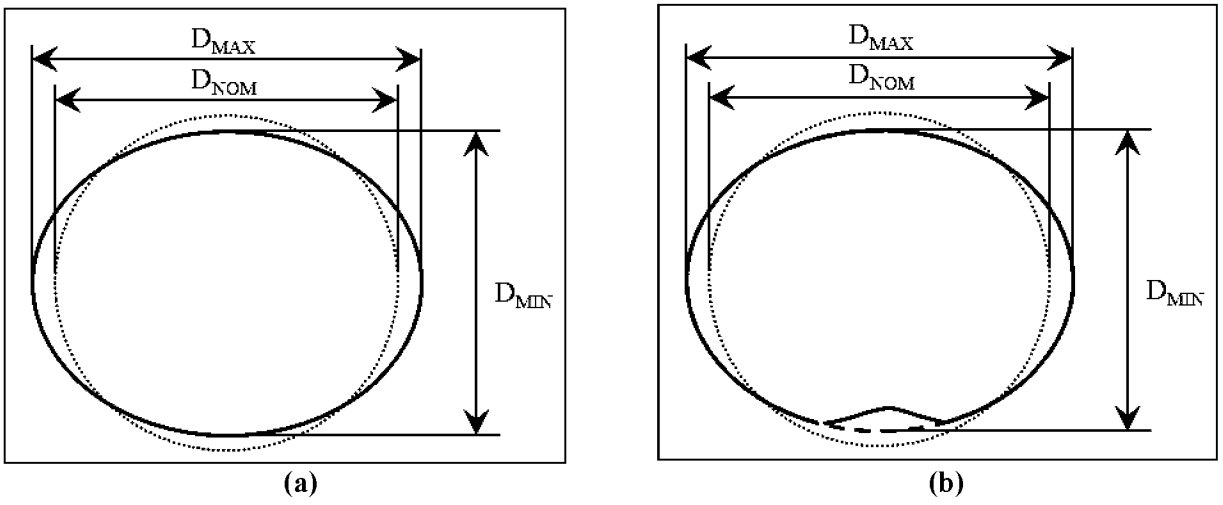


Figure 4 | Parameters used to size ovalities. (a) Ovality associated with a feature that is not a dent or geometry feature. (b) Ovality associated with a dent or geometry feature.

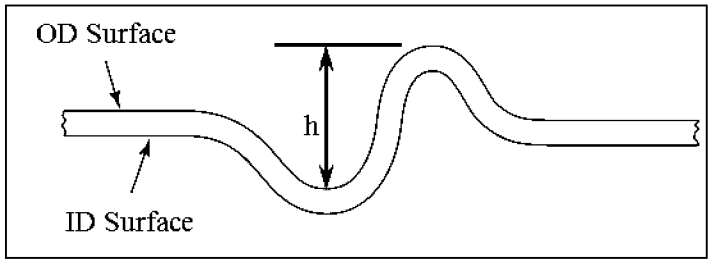


Figure 5 | Longitudinal section of a buckle/ripple/wrinkle, illustrating the corresponding magnitude.

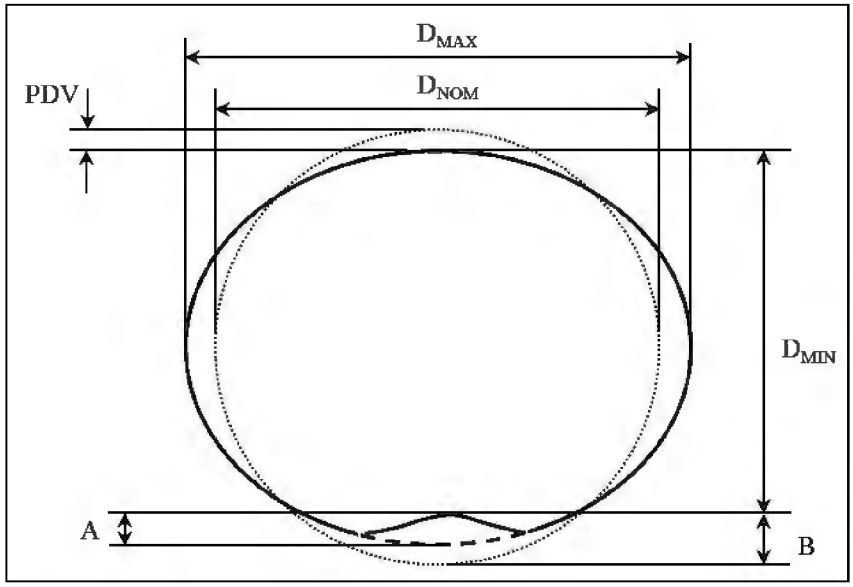


Figure 6 | Cross section of a dent feature with an ovality. Parameters illustrated are used to calculate dent and geometry deformation depth.

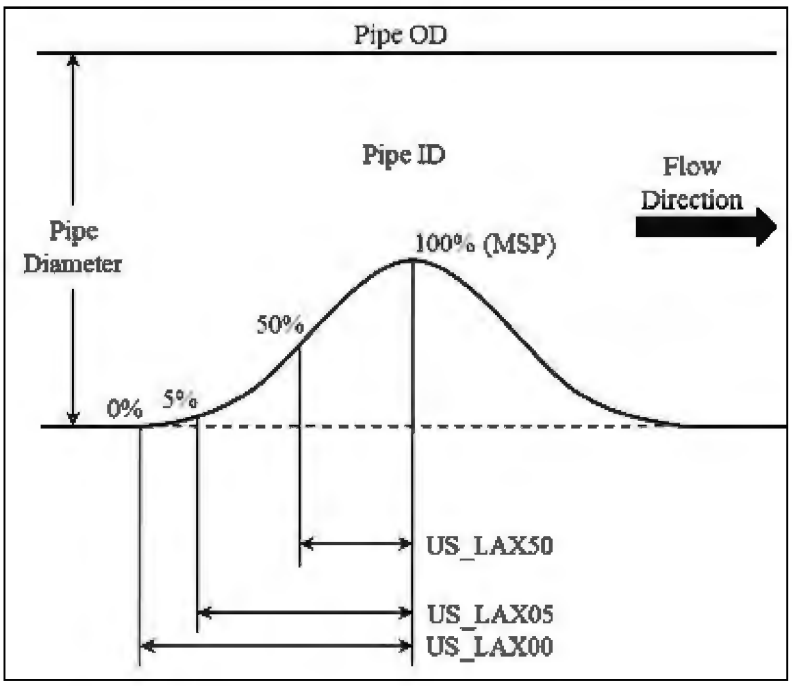


Figure 7 | Example of Axial Shape Parameters, in the upstream (US) direction. Similar nomenclature shall be followed for the downstream (DS) direction.

12.5 Metal Loss Attributes

The following are attributes that are specific to metal loss technologies.

Cluster

Indicates whether or not the anomaly is part of a cluster.

Permissible Values: "Y" or "N"

Cluster ID

Vendor assigned unique cluster ID to group interacting corrosion features.

Permissible Values: Text

Depth

Depth of the feature at the deepest point of the feature with respect to the reference wall thickness. For ultrasonic technologies the reference wall thickness is the local wall thickness. For magnetic flux technologies the reference wall thickness is the nominal wall thickness.

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal

Depth Percent Local

Percent depth of metal loss feature with respect to the local wall thickness.

Units: "$\frac{\%LWT}{100}$" | Decimal Places: 4 | Permissible Values: Decimal between 0 & 1

Depth Percent Nominal

Percent depth of metal loss feature with respect to the nominal wall thickness.

Units: "$\frac{\%NWT}{100}$" | Decimal Places: 4 | Permissible Values: Decimal between 0 & 1

Echo Loss

Specification if echo loss is present on this feature based on Ultrasonic principles.

Y – When echo loss occurred.

N – When no echo loss occurred.

Permissible Values: "Y" or "N"

Echo Loss Rules

If echo loss occurred, this indicates the rule type that triggered the echo loss flag during the mass edit or analysis process.

EL1 – 3P-to-40: This rule is run during the mass edit process. Indicates the presence of 3 pixels of echo loss adjacent to any point within the feature area that has 40% depth or greater. False triggers are not treated as echo loss.

EL2 – 3P-to-MSP: This rule is run during the mass edit process. Indicates the presence of 3 pixels of Echo Loss adjacent to the selected MSP of the feature. False triggers are not treated as echo loss.

EL3 – -20X20-patch: During mass edit, detection square of 20 mm x 20 mm is moved to every possible position within the feature area. If 78.5% of pixels within the detection square are echo loss, the 20X20-patch rule is triggered. False triggers are not treated as echo loss.

ELm – analyst-manual: Indicates that a data analyst has manually judged the influence of the echo loss readings onto the determination of significant points within the defect contour. This flag overrides the automatic rules set during mass edit.

Permissible Values: “EL1”, “EL2”, “EL3”,or “ELm”

Effective Area RPR

Rupture pressure ratio of the feature, calculated using the RSTRENG method, through assessment of river bottom profile.

Decimal Places: 2 | Permissible Values: Decimal

Effective Depth

Effective depth of the feature determined using the RSTRENG method.

Units: “mm” or “inch” | Decimal Places: 2 | Permissible Values: Decimal

Effective Length

Effective axial length of the feature determined using the RSTRENG method.

Units: “mm” or “inch” | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal

Feature Morphology

The dimensional classes association with metal loss features as defined by API 1163. For the definitions below if the pipe wall thickness is less than 10 mm then A is 10, if the wall thickness is greater than or equal to 10 mm then A is equal to the wall thickness. See Figure 8.

Pin hole – indicates that the metal loss feature's width and length are between zero and 1A (e.g. 0 < W < 1A and 0 < L < 1A).

Axial slotting – Indicates that the width of the metal loss feature is between zero and 1A, and its length is equal to or greater than 1A (i.e. 0 < W < 1A and L ≥ 1A).

Circumferential slotting – Indicates that the metal loss feature's width is greater than or equal to 1A and its length is between zero and 1A (i.e. W ≥ 1A and 0 < L < 1A).

Pitting – Indicates the metal loss feature's width and length greater than or equal to 1A and less than 6A, and the feature's length to width ratio is between 0.5 and 2. However, the metal loss feature's width and length are not greater than or equal to 3A (i.e. 1A ≤ W < 6A and 1A ≤ L < 6A and 0.5 < L/W < 2 and not W ≥ 3A and not L ≥ 3A).

Axial grooving – Indicates the width of the metal loss feature is greater than or equal to 1A and less than 3A, and that the length to width ratio is ≥ 2 (i.e. 1A ≤ W < 3A and L/W ≥ 2)

Circumferential grooving – Indicates the metal loss feature's length to width ratio is less than 0.5, and has a length greater than or equal to 1A and less than 3A (i.e. L/W ≤ 0.5 and 1A ≤ L < 3A)

Extended – Indicates the width and length of the metal loss feature is greater than or equal to 3A.

> Permissible Values: "Pin hole", "Axial slotting", "Circumferential slotting", "Pitting", "Axial grooving", "Circumferential grooving" or "Extended"

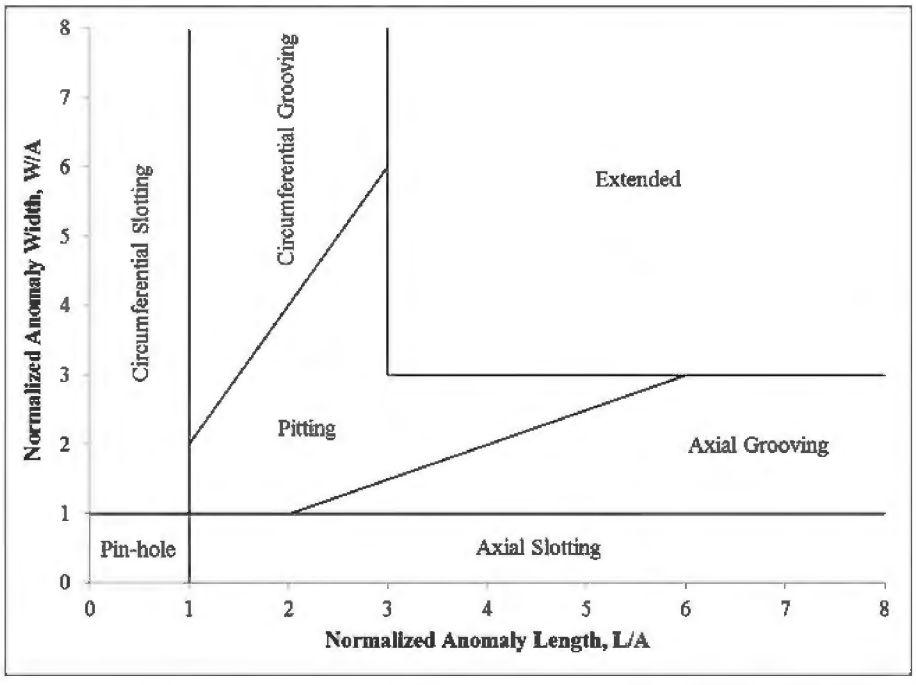


Figure 8 | Metal Loss Feature Morphology

Feature Type

Classification of feature as detected by the tool. Feature type may be, 1 of the following.

Metal loss – Indicates the reduction of wall thickness caused by corrosion or mechanical damage during the manufacturing process or the operation of the pipeline.

Manufacturing defect – Indicates a defect that occurred during the manufacturing process. These abnormalities may include laminations, inclusions, hard spots, slivers, blisters, laps, weld trim, internal coating imperfections, or other features. If the feature has been identified as a Manufacturing defect the following sub classifications follow.

- Lamination - Imperfection or discontinuity with a layered separation that may extend parallel or angular to the pipe wall surface. Laminations are further classified as follows.
    - Sloping – Indicates a continuous lamination that slopes as it approaches both the inner and outer surfaces.
    - Surface breaking – Indicates the lamination extends to either the internal or external surface of the pipe
    - Bulging – Indicates the lamination has caused an extreme bulge, such that a geometry indication has been indicated by the stand-off of the C-Scan

- Inclusion - Particle embedded within the pipe wall. An inclusion may also be intermittent.
- Intermittent – Indicates a non-continuous anomaly.
- Blister - A raised spot on the surface of pipe caused by expansion of gas in a cavity within the pipe wall
- Seam weld anomaly A - Metal loss affecting the seam, not associated with corrosion, that exhibit typical characteristics indicative of linear/crack-like anomalies such as lack of fusion and hook-cracks .
- Seam weld anomaly B - Metal loss affecting the seam, not associated with corrosion, that exhibit a fraction of the characteristics indicative of linear/crack-like anomalies.

Metal object - Any ferrous metal objects that have been detected near to or touching the pipeline.

Deformation – A change in shape of the pipe wall which affects the roundness of the pipe's cross-section or straightness, such as a dent, ripple, wrinkle, buckle, or any other change. If the feature has been identified as Deformation the possible sub classifications follow. Note that deformation identified with ultrasonic corrosion or MFL technologies do not require depth or MSP values.

- Geometric anomaly – See Section 12.4 for definition.
- Ovality - See Section 12.4 for definition.
- Wrinkle - See Section 12.4 for definition.

Casing Eccentric – indicates the tool has detected an area where the casing is touching the pipe.

Sleeve Start – Indicates that the tool has detected the start of a repair sleeve.

Sleeve End - Indicates that the tool has detected the end of a repair sleeve.

Casing Start - Indicates that the tool has detected the start of a casing. Only reported by ultrasonic technologies.

Casing End - Indicates that the tool has detected the end of a casing. Only reported by ultrasonic technologies.

Permissible Values: "Metal loss", "Manufacturing defect- Lamination", "Manufacturing defect- Lamination-Sloping", "Manufacturing defect-Lamination-Surface Breaking", "Manufacturing defect- Lamination-Bulging", "Manufacturing defect- Inclusion", "Manufacturing defect Inclusion-Intermittent", "Manufacturing defect- Blister", "Manufacturing defect- Seam weld anomaly A", "Manufacturing defect- Seam weld anomaly B", "Metal object", "Deformation- Geometric

anomaly", "Deformation-Ovality", "Deformation-Wrinkle", "Casing Eccentric", "Sleeve Start", "Sleeve End", "Casing Start" or "Casing End"

MB31G RPR

Rupture Pressure Ratio of the feature calculation using the modified B31G formula. Also referred to as 0.85dL RPR.

Decimal Places: 2 | Permissible Values: Decimal

Metal Object Proximity

Indicates if a detected ferrous metal object is close to or touching the pipeline, based upon the magnetic signal. This attribute shall only be used when the Feature Type is "Metal Object".

Permissible Values: "Close" or "Touch"

Relative Position to Seam Weld

Indicates whether or not the feature with respect to the seam weld (long seam, spiral weld).

Across weld – Feature is across the seam weld.

Adjacent to weld – Feature is within 25 mm from the centreline of the seam weld.

In weld – Feature is within the seam weld.

Not decidable – Unable to determine the relative position of the feature to the seam weld.

Permissible Values: "Across weld", "Adjacent to weld", "In weld", or "Not decidable"

Relative Position to Girth Weld

Indicates whether or not the feature is interacting with the girth weld.

Across girth weld – Feature is across the girth weld.

Adjacent to weld – Feature is within 25 mm from the centreline of the girth weld.

In weld – Feature is within the girth weld.

Not associated – Feature is more than 25 mm from the centreline of the girth weld.

Permissible Values: "Across girth weld", "Adjacent to weld", "In weld", or "Not associated"

12.6 Crack Attributes

The following are attributes that are specific to crack technologies.

CCW Sensors

Number of counter clockwise sensors that detected a signal from the crack feature.

Decimal Places: 0 | Permissible Values: Number greater than or equal to 0

CW Sensors

Number of clockwise sensors that detected a signal from the crack feature.

Decimal Places: 0 | Permissible Values: Number greater than or equal to 0

Depth

Maximum depth of the feature.

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Number greater than 0

Depth Percent Local

Percent depth of crack feature with respect to local wall thickness.

Units: "$\frac{\%WT}{100}$" | Decimal Places: 4 | Permissible Values: Decimal between 0 & 1

Depth Percent Nominal

Percent depth of crack feature with respect to nominal wall thickness.

Units: "$\frac{\%WT}{100}$" | Decimal Places: 4 | Permissible Values: Decimal between 0 & 1

Depth Range Lower Bound

Vendor reported lower bound of the estimated crack depth range in millimeters or inches. (For example, in the case of 1-2 mm crack the lower bound shall be 1 mm).

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal greater than 0

Depth Range Upper Bound

Vendor reported upper bound of the estimated crack depth range in millimeters or inches. (For example, in the case of 1-2 mm crack the upper bound shall be 2 mm).

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal greater than 0

Feature Type

Classification of feature as detected by the tool.

Crack-like – Discontinuity in the pipe wall in the longitudinal or transverse direction with radially oriented depth.

Crack-field – A cluster of crack-like feature, mainly representative of SCC.

Notch-like – Discontinuity in the pipe wall with a sharp edge in the longitudinal or transverse direction and radially oriented depth (possibly manufacturing related or caused by mechanical damage).

Casing Eccentric – Indicates the tool has detected an area where the casing is touching the pipe.

Sleeve Start – Indicates that the tool has detected the start of a repair sleeve.

Sleeve End - Indicates that the tool has detected the end of a repair sleeve.

Permissible Values: "Crack-like", "Crack-field", "Notch-like", "Casing Eccentric", "Sleeve Start", or "Sleeve End"

Longest Interacting Length

The longest length of linked cracks within a crack field measured in millimeters or inches. Cracks are considered interacting when they are separated by less than specified axial and circumferential distances. These distances are calculated based on the specification in the Canadian Energy Pipeline Association's (CEPA) Recommended Practice for Stress Corrosion Cracking, but are adapted by the vendor based on the capabilities and limitations of the tool. Note that this length may also represent the longest crack indication in a crack field if there are no interacting indications.

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal greater than 0

Minimum Detected Length

Minimum feature length size detectable by the tool at the given tool velocity when the feature was detected.

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal greater than 0

Name of Previous Inspection

The name of the previous crack inspection report performed on the current pipeline.

Permissible Values: Text

Previous Inspection Depth Range Lower Bound

Vendor reported lower bound of the current feature that was reported in the previous crack inspection report. (For example, in the case of a previously reported 1-2 mm crack the lower bound shall be 1 mm.)

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal greater than 0

Previous Inspection Depth Range Upper Bound

Vendor reported upper bound of the current feature that was reported in the previous crack inspection report. (For example, in the case of a previously reported 1-2 mm crack the upper bound shall be 2 mm.)

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal greater than 0

Previous Inspection Feature Type

The feature type, of the current feature, that was reported in the previous crack inspection report.

Permissible Values: Text

Relative Position to Seam Weld

Indicates whether or not the feature with respect to the seam weld (long seam, spiral weld).

Adjacent to weld – Feature is within 20 mm from the centreline of the weld.

Base metal – Feature is greater than 20 mm from the centreline of the weld.

In weld – Feature is within the seam weld.

Not decidable – Unable to determine the relative position of the feature to the seam weld.

Permissible Values: "Adjacent to weld", "Base metal", "In weld", or "Not decidable"

Relative Position to Girth Weld

Indicates whether or not the feature is interacting with the girth weld.

Across girth weld – Feature is across the girth weld.

Adjacent to weld – Feature is between 50 mm and 400 mm from the centreline of the girth weld.

In weld – Feature is within 50 mm from the centreline of the girth weld.

Not associated – Feature is more than 400 mm from the centreline of the girth weld.

Permissible Values: "Across girth weld", "Adjacent to weld", "In weld", or "Not associated"

Remaining Wall Thickness

Measured or calculated remaining wall thickness at most severe point of the feature (local wall thickness minus feature depth).

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal greater than 0

Sensor Lift off

Indicates whether or not a girth weld with a prominent root has reduced the tool's capability in detecting, identifying or sizing the feature.

Y – The tool's capability in detecting, identifying or sizing the feature has been reduced by a girth weld with a prominent root.

N – The tool's capability in detecting, identifying or sizing the feature has not been reduced by a girth weld with a prominent root.

Permissible Values: "Y" or "N"

Single Crack

Indicates the crack like feature is a single crack or intermittent cracks.

Y – Crack like feature is a single crack.

N – Crack like feature is intermittent cracks.

Permissible Values: "Y" or "N"

Tool Velocity

Velocity of the ILI tool when it passed the feature.

Units: "m/s" or "ft/s" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal greater than 0

Width Accuracy

Local (or general) tool accuracy of the feature.

Units: "mm" or "inch" | Decimal Places: 2 for metric units or 3 for imperial units |

Permissible Values: Decimal greater than 0

13.0 Final Report Deliverables

The minimum required deliverables for final reports follow. These deliverables shall be submitted electronically to the Enbridge Program Manager.

13.1 Executive Summary

The final report shall include an Executive Summary, which shall include a summary of the ILI data quality, including comments regarding sensor malfunction, speed excursion, proximity to long seam and girth welds, and wall thicknesses beyond the tool's capabilities. Further, any changes from previously a reported Priority Notification shall be noted in the Executive Summary.

13.2 Vendor Project & Responsible Personnel

The final report shall include the names, signatures, project responsibilities, and qualification level of Vendor personnel involved with the project. Vendor personnel include the project manager, analysts, individuals who performed QA/QC functions, and those responsible for the report's quality assurance and compliance with contract requirements. (Note: if due to data privacy regulations in certain jurisdictions, a general project list, including qualifications that may be cross referenced to specific individuals shall be provided.)

Vendor shall provide the following documentation with each report: Vendor Quality Management Process, Analyst Certification and Training Process documents, and Proof of Certification for each individual involved in the project. Vendor shall include a Notification of Revisions if any of these documents have changed from previously issued versions.

13.3 Electronic Pipeline Listings

The ILI vendor shall provide the completed electronic Pipeline Listing (template discussed in Section 12.1). The Pipeline Listing shall abide to Section 12.0 and all subsections.

13.4 Crack Profiles

For ultrasonic crack inspections, Vendor shall provide a the crack profile for each crack-like, crack-field and notch-like feature listed in the Electronic Pipeline Listing. A MS Excel spreadsheet shall be provided for each crack profile, that is, 1 spreadsheet per crack profile shall be submitted. Each spreadsheet shall include the Inspection Report Identification attributes listed in Section 12.2.

13.5 Tool Performance Specification

The ILI vendor shall consider the excavation information provided by the company and take into consideration the excavation findings. When considered in relation to vendor reports, the vendor shall derive a "Tool Performance and Accuracy" summary based on API 1163 Guideline – Exhibit E as a proposed method.

13.6 Viewing Software

With each final report, Vendor shall provide the viewing software that is required to access, view, and use electronic information.

14.0 Quality System Documentation

The quality system ensures consistent products and services are delivered. The following quality system standards are adopted from API 1163 and/or the Pipeline Operators Forum (latest version June 2012). Activities involved in design, testing, field operations, data analysis, and support services for conducting an ILI fall under the scope of this system.

14.1 Quality Management Process Document(s)

The ILI vendors shall provide documentation which provides an overall summary of the vendor's Quality Management Process as it relates to data acquisition, analysis and reporting. Procedures for all levels of data analysis shall be included.

14.2 Procedure Document(s)

Documentation shall provide guidance on the design, testing, contracting, field operations, data reduction and analysis processes; written procedures for all activities and services necessary to complete a successful ILI. All written procedures and records shall be maintained by each organization, according to their area of responsibility, and made available to Enbridge upon request.

14.3 Personnel Certification & Training Process Document(s)

A list of personnel that shall be deployed for the ILI tool run, data analysis and final report review shall be submitted within the report.

Documentation shall provide a detailed overview of Company Personnel Certification and Training Methodologies and Processes in the areas of Data Acquisition, Analysis and Reporting. Qualifications and Training shall adhere to ASNT ILI-PQ 2010.

14.4 Proof of Employee Training and Certification Document(s)

A document of record of training and certification shall be provided for all individuals involved in the analysis and reporting process in accordance with those identified on the report signature page.

Records of qualification requirements shall be in accordance with ASNT ILI-PQ 2010, and shall be maintained by the individual performing the task. The organization employing the individual shall keep a copy of the qualification record on the file and make available to Enbridge upon request.

14.5 Tool Performance Specification

The vendor shall provide a Defect Detection Specification or Performance and Operating Specification stating the minimum detection and sizing accuracy specific to the project and/or technology used. See API 1163 – Section 7 for guidance. The equipment used in the ILI shall be uniquely identified, and the records maintained so that traceability of the equipment is possible.

14.6 Tool Calibration

Vendor shall provide information regarding the calibration procedure and latest calibration record of the tool. The procedure should give insight into, but not limited to: used calibration features, line pipe material, wall thickness and manufacturing process, too velocity, and date and frequency of calibration. For magnetic tools, the calibration information shall include the tool speed and the measured magnetic field strength value with the position where it was measured. In addition, the Vendor shall supply a definition of which sizing model and revision was used. It can be considered that, for specific applications, specification and/or defect geometries, dedicated tool calibration can be performed (e.g. with spare project pipes) followed by a modified interpretation/sizing model.

14.7 Notification/Documented Revision Summary

A summary shall be provided at the front of the re-issued report identifying any revisions to the above quality documents based on prior releases issued in earlier reports. Understanding what changes have occurred to these documents between reports shall allow Pipeline Integrity personnel to ascertain what process changes take place that may affect the reporting.

This standard is a controlled document within all ILI vendor contracts. Therefore, communication of changes shall be provided, acknowledged and approved by all ILI vendors in accordance with contract requirements.

14.8 Record Keeping

All documentation and information should be maintained such that the inspection can be recreated and easy to access and organized such that there is no confusion regarding the content. Records shall be retained for the time period specified in the contract.

15.0 Performance

Performance of this Standard shall be measured by Vendor compliance to the requirements set out in the Standard.

16.0 Appendix

Appendix A

Report Delivery Extension Request Forms

FINAL REPORT DELIVERY EXTENSION REQUEST FOR:
ENBRIDGE PIPELINES, INC. – PIPELINE INTEGRITY DEPARTMENT

To: <Enbridge Manager of Program Execution>; <Enbridge Execution Program Manager>
Cc: <Line Asset SML>

Subject: Final Report Delivery Extension Request for Line X (XX to XX)

PRIVILEGED AND CONFIDENTIAL

Inspection Details

Vendor		Line	
Tool		Section	
Launch date		Receive date	

Contractual Final Report Due Date	
Requested Final Report Due Date	
Reason for Extension Request	

(Vendor Signature)	
Extension requested by	Date

Completed by Enbridge ☐ Approved ☐ Denied

(Enbridge Signature)	
Extension Approved by (Manager of Program Execution)	Date

Note that Final Report Due Date Extension is only granted after Vendor has received an Enbridge signed copy of this form, within 7 calendar days after the extension request has been submitted.

RE-ISSUE OF FINAL REPORT DELIVERY EXTENSION REQUEST FOR: ENBRIDGE PIPELINES, INC. – PIPELINE INTEGRITY DEPARTMENT

To: <Enbridge Manager of Program Execution>; <Enbridge Execution Program Manager>
Cc: <Line Asset SML>

Subject: Re-issue Final Report Delivery Extension Request for Line X (XX to XX)

PRIVILEGED AND CONFIDENTIAL

Inspection Details

Vendor		Line	
Tool		Section	
Launch date		Receive date	

Final Report Details (This is the report that requires a re-issue)

Final Report Submitted	
Revision of Submitted Report	

Contractual Re-Issue Report Due Date	
Requested Re-Issue Report Due Date	
Reason for Extension Request	

(Vendor Signature)	
Extension requested by	Date

Completed by Enbridge ☐ Approved ☐ Denied

(Enbridge Signature)	
Extension Approved by (Manager of Program Execution)	Date

Note that Re-Issue of Final Report Due Date Extension is only granted after Vendor has received an Enbridge signed copy of this form, within 7 calendar days after the extension request has been submitted

ENBDNR0000224

Appendix B

Priority Notification Form

CONFIDENTIAL PRIORITY NOTIFICATION FOR:
ENBRIDGE PIPELINES, INC. – PIPELINE INTEGRITY DEPARTMENT

To: <Enbridge Program Manager>; pipeline.integrity.priority.notification@enbridge.com

From: ILI Vendor Representative(s)

Subject: PRIORITY NOTIFICATION FOR IMPERATIVE CONDITION ON Line X (XX to XX) – GW XXXX

Importance: High

PRIVILEGED AND CONFIDENTIAL

Please find the attached the dig sheet(s) meeting the priority notification requirements for the *<INSERT TECHNOLOGY>*, ILI Vendor Reference 10XXXX_XXA inspection performed *<INSERT DATE>* on Line X, (XX-XX). The following girth welds have been identified:

1) GW XXXX - <DESCRIBE FEATURE E.G. 85% METAL LOSS FEATURE>
2) GW XXXX - <DESCRIBE FEATURE E.G. 0.85RPR METAL LOSS FEATURE>

We have assigned <ILI VENDOR REPRESENTATIVE> as your contact if you require further information or assistance with these features.

<ILI VENDOR REPRESENTATIVE NAME>
<ILI VENDOR REPRESENTATIVE OFFICE NUMBER>
<ILI VENDOR REPRESENTATIVE CELL NUMBER>

Please confirm receipt of this email using “reply-all” as soon as possible. Do not hesitate to contact me with any questions.

<INSERT AUTOSIGNATURE>

Appendix C

Required Attributes For Each Threat/Technology

Table C1 below indicates the required attributes for each technology/threat that shall be included in the electronic Pipeline Listing. Note that if an attribute has not been identified as required in accordance with Table C1, but Vendor's technology is capable of detecting, identifying, and/or sizing the attribute, the attribute shall be included in the electronic Pipeline Listing.

Table C1: Required Attributes for Each Threat/Technology

Technologies	Caliper	MFL	Ultrasonic	Ultrasonic	Combo MFL-Caliper	Combo MFL-Caliper	Combo UT Metal Loss–UT Crack	Combo UT Metal Loss–UT Crack
Pipeline Listing	**Geometry Listings**	**Metal Loss Listings**	**Metal Loss Listings**	**Crack Listings**	**Metal Loss Listings**	**Geometry Listings**	**Metal Loss Listings**	**Crack Listings**
Generic Attributes (Definitions in Section 12.3)								
Absolute Distance	✓	✓	✓	✓	✓	✓	✓	✓
Actual Measured Local Wall Thickness			✓	✓			✓	✓
Average Wall Thickness			✓	✓			✓	✓
Degraded Data	✓	✓	✓	✓	✓	✓	✓	✓
Depth Accuracy	✓	✓	✓	✓	✓	✓	✓	✓
Feature Comment	✓	✓	✓	✓	✓	✓	✓	✓
Feature ID	✓	✓	✓	✓	✓	✓	✓	✓
Feature Type	✓	✓	✓	✓	✓	✓	✓	✓
IMU Reported GW Elevation	✓ *	✓ *	✓ *	✓ *	✓ *	✓ *	✓ *	✓ *
IMU Reported GW Latitude	✓ *	✓ *	✓ *	✓ *	✓ *	✓ *	✓ *	✓ *
IMU Reported GW Longitude	✓ *	✓ *	✓ *	✓ *	✓ *	✓ *	✓ *	✓ *
Interacting with Crack				✓			✓	✓
Interacting with Deformation		✓	✓	✓	✓		✓	✓
Interacting with Manufacturing Defects		✓	✓	✓	✓	✓	✓	✓
Interacting with Metal Loss						✓		✓
Joint Length	✓	✓	✓	✓	✓	✓	✓	✓
Length	✓	✓	✓	✓	✓	✓	✓	✓
Length Accuracy	✓	✓	✓	✓	✓	✓	✓	✓
Nominal Pipe Size	✓	✓	✓	✓	✓	✓	✓	✓
Nominal Wall Thickness	✓	✓	✓	✓	✓	✓	✓	✓

* Only required if IMU technology included with the inspection.

Technologies	Caliper	MFL	Ultrasonic	Ultrasonic	Combo MFL-Caliper	Combo MFL-Caliper	Combo UT Metal Loss–UT Crack	Combo UT Metal Loss–UT Crack
Pipeline Listing	**Geometry Listings**	**Metal Loss Listings**	**Metal Loss Listings**	**Crack Listings**	**Metal Loss Listings**	**Geometry Listings**	**Metal Loss Listings**	**Crack Listings**
MSP Orientation	✓	✓	✓	✓	✓	✓	✓	✓
MSP Relative Distance	✓	✓	✓	✓	✓	✓	✓	✓
Orientation Centre		✓	✓	✓	✓		✓	✓
Orientation End	✓	✓	✓	✓	✓	✓	✓	✓
Orientation Start	✓	✓	✓	✓	✓	✓	✓	✓
Pipe Grade Provided		✓	✓		✓		✓	
Radial Position		✓	✓	✓	✓		✓	✓
Relative Distance Centre		✓	✓	✓	✓		✓	✓
Relative Distance End	✓	✓	✓	✓	✓	✓	✓	✓
Relative Distance Start	✓	✓	✓	✓	✓	✓	✓	✓
Seam Weld Type Detected				✓		✓		✓
Seam Weld Orientation End Detected		✓	✓	✓	✓	✓	✓	✓
Seam Weld Orientation End Provided	✓	✓	✓	✓	✓	✓	✓	✓
Seam Weld Orientation Start Detected		✓	✓	✓	✓	✓	✓	✓
Seam Weld Orientation Start Provided	✓	✓	✓	✓	✓	✓	✓	✓
Sleeve/Casing ID		✓	✓	✓	✓	✓	✓	✓
Under Sleeve		✓	✓	✓	✓	✓	✓	✓
Upstream Girth Weld	✓	✓	✓	✓	✓	✓	✓	✓
Width	✓	✓	✓	✓	✓	✓	✓	✓
Geometry Attributes (Definitions in Section 12.4)								
Associated With Girth Weld	✓	✓	✓	✓	✓	✓	✓	✓
Associated With Seam Weld	✓	✓	✓	✓	✓	✓	✓	✓
Bend Angle	✓					✓		
Bend Azimuth Angle	✓					✓		

Technologies	Caliper	MFL	Ultrasonic	Ultrasonic	Combo MFL-Caliper	Combo MFL-Caliper	Combo UT Metal Loss–UT Crack	Combo UT Metal Loss–UT Crack
Pipeline Listing	**Geometry Listings**	**Metal Loss Listings**	**Metal Loss Listings**	**Crack Listings**	**Metal Loss Listings**	**Geometry Listings**	**Metal Loss Listings**	**Crack Listings**
Bend Azimuth Change Direction	✓					✓		
Bend Pitch Angle	✓					✓		
Bend Pitch Direction	✓					✓		
Bend Radius	✓					✓		
CCW_LTR00	✓					✓		
CCW_LTR05	✓					✓		
CCW_LTR50	✓					✓		
Chainage Strain End	✓ **					✓ **		
Chainage Strain Start	✓ **					✓ **		
CW_LTR00	✓					✓		
CW_LTR05	✓					✓		
CW_LTR50	✓					✓		
Dent Depth B	✓					✓		
Dent in Close Proximity	✓	✓	✓	✓	✓	✓		
Depth	✓					✓		
Depth Percent Dent	✓					✓	✓	✓
Depth Percent B	✓					✓		
DS_LAX00	✓					✓		
DS_LAX05	✓					✓		
DS_LAX50	✓					✓		
Feature Type	✓	✓	✓	✓	✓	✓		
Internal Pipe Pressure at Deformation	✓					✓		
Largest Strain Difference Horizontal	✓ **					✓ **	✓	✓
Largest Strain Difference Total	✓ **					✓ **		

** Only applicable to strain assessment inspections.

Technologies	Caliper	MFL	Ultrasonic	Ultrasonic	Combo MFL-Caliper	Combo MFL-Caliper	Combo UT Metal Loss–UT Crack	Combo UT Metal Loss–UT Crack
Pipeline Listing	**Geometry Listings**	**Metal Loss Listings**	**Metal Loss Listings**	**Crack Listings**	**Metal Loss Listings**	**Geometry Listings**	**Metal Loss Listings**	**Crack Listings**
Largest Strain Difference Vertical	✓ **					✓ **		
Maximum ID	✓					✓		
Minimum Distance of MSP to GW	✓					✓		
Minimum Distance of MSP to LSW	✓					✓		
Minimum ID	✓					✓		
MultiApex Dent	✓					✓		
Nominal ID	✓					✓		
Off Axis	✓					✓		
Ovality	✓					✓		
Pipeline Movement Horizontal	✓ **					✓ **		
Pipeline Movement Vertical	✓ **					✓ **		
Strain Value at Largest Difference Horizontal	✓ **					✓ **		
Strain Value at Largest Difference Total	✓ **					✓ **		
Strain Value at Largest Difference Vertical	✓ **					✓ **		
Topside	✓	✓	✓	✓	✓	✓	✓	✓
US_LAX00	✓					✓		
US_LAX05	✓					✓		
US_LAX50	✓					✓		
Metal Loss Attributes (Definitions in Section 12.5)								
Cluster								
Cluster ID								
Depth		✓	✓		✓		✓	

Technologies	Caliper	MFL	Ultrasonic	Ultrasonic	Combo MFL-Caliper	Combo MFL-Caliper	Combo UT Metal Loss–UT Crack	Combo UT Metal Loss–UT Crack
Pipeline Listing	**Geometry Listings**	**Metal Loss Listings**	**Metal Loss Listings**	**Crack Listings**	**Metal Loss Listings**	**Geometry Listings**	**Metal Loss Listings**	**Crack Listings**
Effective Area RPR		✓	✓		✓		✓	
Effective Depth		✓	✓		✓		✓	
Effective Length		✓	✓		✓		✓	
Feature Morphology		✓	✓		✓		✓	
Feature Type		✓	✓		✓		✓	
MB31G RPR		✓	✓		✓		✓	
Metal Object Proximity		✓			✓			
Relative Position to Seam Weld		✓	✓		✓		✓	
Relative Position to Girth Weld		✓	✓		✓		✓	
Depth Percent Local		✓	✓		✓		✓	
Depth Percent Nominal		✓	✓		✓		✓	
Echo Loss			✓				✓	
Echo Loss Rules			✓				✓	
Crack Attributes (Definitions in Section 12.6)								
CCW Sensors				✓				✓
CW Sensors				✓				✓
Depth				✓				✓
Depth Percent Local				✓				✓
Depth Percent Nominal				✓				✓
Depth Range Lower Bound								
Depth Range Upper Bound								
Feature Type				✓				✓
Longest Interacting Length				✓				✓
Minimum Detected Length				✓				✓
Name of Previous Inspection				✓				✓
Previous Inspection Depth Range Lower Bound								

Technologies	Caliper	MFL	Ultrasonic	Ultrasonic	Combo MFL-Caliper	Combo MFL-Caliper	Combo UT Metal Loss–UT Crack	Combo UT Metal Loss–UT Crack
Pipeline Listing	**Geometry Listings**	**Metal Loss Listings**	**Metal Loss Listings**	**Crack Listings**	**Metal Loss Listings**	**Geometry Listings**	**Metal Loss Listings**	**Crack Listings**
Previous Inspection Depth Range Upper Bound								
Previous Inspection Feature Type								
Relative Position to Seam Weld				✓				✓
Relative Position to Girth Weld				✓				✓
Remaining Wall Thickness				✓				✓
Sensor Lift off				✓				✓
Single Crack				✓				✓
Tool Velocity				✓				✓
Width Accuracy								

<End of Document>