Oil & Water Don't Mix
Keep Oil Out of the Great Lakes

The Honorable Rick Snyder
Office of the Governor
P.O. Box 30013
Lansing, Michigan 48909

April 13, 2016

Attorney General Bill Schuette
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525 West Ottawa Street
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Lansing, Michigan 48909

Interim Director Keith Creagh
Michigan Department of Environmental Quality ("DEQ")
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Interim Director Bill Moritz
Michigan Department of Natural Resources ("DNR")
Executive Division
P.O. Box 30028
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Re: Recommendation to the State of Michigan to Terminate The 1953 Line 5 Easement with Enbridge

Dear Governor Snyder, Attorney General Schuette, Interim DEQ Director Creagh, and Interim DNR Director Moritz:

Line 5 in the Straits of Mackinac and crossing Great Lakes tributary lakes and streams is an imminent, high-risk infrastructure emergency for the State of Michigan. And yet, it's been two years this month since the State of Michigan launched its initial investigation to determine if Enbridge is in compliance with the 1953 public trust Easement that grants this private corporation limited authority to use the public waters and bottomlands of the Great Lakes for pipeline construction and transport of oil (the "Easement") (see Appendix 1).

In these two years, the undersigned have examined the scientific, logistical, and legal aspects of Enbridge Energy LLP's ("Enbridge") twin, 20-inch Line 5 pipelines in the Mackinac Straits ("Line 5").[1] Based on this examination, it is clear that the State of Michigan has substantial legal and factual cause to terminate the Easement and prohibit the transport of oil through Line 5, protecting the Great Lakes from a catastrophic oil spill. As held by United States and Michigan Supreme Court decisions, easements or occupancy conveyances to private persons or corporations are *always* subject to a continuing and perpetual responsibility of the grantor state. Under these decisions, a public trust

[1] *See* FLOW Report (September 21, 2015) Immediate Enforcement of Easement and Other Actions pp. 18-20 http://flowforwater.org/wp-content/uploads/2015/09/FINAL-FLOW-9-21-15-REPORT-ON-ACTION-PLAN-AND-COMMENTS.pdf

conveyance or easement is revocable and is necessarily subject to modification if the state determines that new circumstances require such a change to protect the public trust.

The State of Michigan is now knowledgeable of the high risks and substantial consequences that a rupture in Line 5 poses to the Straits of Mackinac and the Great Lakes that termination of the Easement is imperative. By this letter, you are put on notice that Enbridge currently is operating in violation of the 1953 Easement with the State of Michigan based on at least the following eight known and ongoing breaches of express terms and conditions:

1. Standard of Care as a Reasonably Prudent Person (Section A)
2. Indemnity Provision (Section J)
3. Pipeline Wall Thickness Provision (Section A (11))
4. Pipeline Exterior Slats and Coating Requirements (Section A (9))
5. Pipeline Minimum Curvature Requirement (Section A (4))
6. Maximum Unsupported Span Provision (Section A (10))
7. Federal Violation of Emergency Oil Spill Response Plan (Section A)
8. State Violation under the Michigan Environmental Protection Action (Section A)

Although it may be that none of these ongoing breaches can be remedied within the Easement's 90-day cure period, the State of Michigan should immediately give written notice of these breaches to demand compliance with and enforce the obligations and liability of Enbridge under the Easement. The State should also put Enbridge on notice that it is in violation of the obligations that are inherent in public trust in the waters, bottomlands, fish, aquatic habitat, and protected uses. Enbridge's continuing and ongoing violations of the 1953 Easement, public trust law, and the Michigan Environmental Protection Act ("MEPA") are more fully described in the attached Memorandum.

Evidence of these violations has continued to mount. In early 2016, Enbridge finally disclosed new information about pipeline dents, 36 cracks and 26 percent loss of pipeline wall thickness in portions of Line 5 in the Straits, calling the integrity of the pipeline's infrastructure and operation into serious question. Just two weeks ago, the University of Michigan released a comprehensive computer modeling study demonstrating that more than 700 miles of shoreline in Lakes Huron and Michigan are potentially vulnerable to an oil spill from Line 5. Moreover, public concern is at a fever pitch; over thirty local units of government, including Mackinac Island and Bois Blanc, and six Native American tribes have recognized the magnitude of this threat, and have accordingly passed resolutions demanding the State of Michigan protect the public interest and restrict the flow of oil in Line 5 to prevent a catastrophic oil spill in the Great Lakes (see Appendix 5). Based on all of this information, the State of Michigan and you as its duly elected public officials have an affirmative legal duty to take immediate action. Such action is needed to address the unacceptably high risk of a catastrophic oil spill in the Great Lakes that would devastate our public drinking waters, our economy, and our *Pure Michigan* way of life.

State officials have advised that the State will not complete its risk or alternative assessments for the Michigan Pipeline Safety Advisory Board to review until June 2017. Given Enbridge's significant easement violations and public trust obligations, we, the undersigned, believe that it is imprudent for the State of Michigan to wait **over a year** until the final risk and alternatives reports are slated for completion. Therefore, we urge the State of Michigan to immediately notify Enbridge in writing that the State is terminating the 1953 Easement (per Section C) on the basis of these multiple breaches of the terms and conditions of the easement and consistent with your legal trustee responsibilities to the citizens of Michigan.

Sincerely,

Dr. Phil Bellfy, Director, Article 32.org

Rev. Deb Hansen, Concerned Citizens of Cheboygan and Emmet County (CCCEC)

Nic Clark, Director, Michigan Clean Water Action

Jane TenEyck, Executive Director, Chippewa Ottawa Resource Authority (CORA)

Wenonah Hauter, Executive Director, Food & Water Watch (F&WW)

Liz Kirkwood, Executive Director, For Love of Water (FLOW)

Anne Zukowski, Board Member, Friends of the Jordan River

Nick Schroeck, Executive Director, Great Lakes Environmental Law Center

Hans Voss, Executive Director, Groundwork Center for Resilient Communities

James Clift, Deputy Director, Michigan Environmental Council (MEC)

Peggy Case, President, Michigan Citizens for Water Conservation (MCWC)

Murtaza Nek, Michigan Coalition Against Tar Sands (MICATS)

Lisa Wozniak, Executive Director, Michigan League of Conservation Voters (MLCV)

Greg Reisig & Ann Rogers, Co-Chairs, Northern Michigan Environmental Action Council (NMEAC)

Karen Martin, Founder, Straits Area of Concerned Citizens for Peace, Justice, and the Environment

David Holtz, Executive Committee Chair, Sierra Club Michigan Chapter

Beth Wallace, Owner and Writer, Surf Great Lakes

Pete Stauffer, Environmental Director, Surfrider Foundation

Bill Latka, Coordinator, TC350.org

Horst Schmidt, President, Upper Peninsula Environmental Coalition (UPEC)

Bill Henne, Chair, Water Air Team Charlevoix (WATCH)

Rachel Hood, Executive Director, West Michigan Environmental Action Coalition (WMEAC)

Hans Cole, Director of Environmental Campaigns and Advocacy, Patagonia

cc: Pipeline Safety Advisory Board
Deputy Attorney General, Carol L. Isaacs
Division Chief, S. Peter Manning
Michigan Agency for Energy, Executive Director, Valerie J.M. Brader

Enclosures.

MEMORANDUM IN SUPPORT OF TERMINATING THE 1953 EASEMENT BETWEEN ENBRIDGE AND THE STATE OF MICHIGAN

This memorandum identifies and summarizes the legal bases for the State of Michigan to terminate the 1953 Easement Agreement with Enbridge, which authorizes the pipeline construction and transport of oil on the public bottomlands of the Straits of Mackinac. Section I details Enbridge's eight known breaches of express terms and conditions of the 1953 Easement with the State of Michigan. Section II articulates the legal authority for the State of Michigan to initiate the legal process to terminate the Easement. Section III emphasizes the State's affirmative public trust legal authority and duty to protect our public water resources over private interests. Finally, section IV concludes that the State must act now to enforce the terms of the Easement given Enbridge's current violations, the age of the pipeline, and new evidence of corrosion and the University of Michigan's study underscoring the extraordinary harm these 63-year-old pipelines pose to the Great Lakes.

I. THE STATE OF MICHIGAN HAS CAUSE TO TERMINATE THE 1953 EASEMENT BECAUSE ENBRIDGE IS OPERATING IN VIOLATION OF EXPRESS TERMS AND CONDITIONS THAT CANNOT BE REMEDIED.

This section summarizes Enbridge's eight known breaches of express terms and conditions of the 1953 Easement with the State of Michigan. Appendix 9 further provides additional detailed information about these easement violations.

The 1953 Easement contains 13 requirements related to the design, material specifications, construction and operation of the Straits pipelines. Section A of the Easement provides, in part, that: "Grantee [Enbridge] shall comply with the following minimum specifications, conditions and requirements, unless compliance therewith is waived or the specifications or conditions modified in writing by the Grantors."

Enbridge currently is operating in violation of the 1953 Easement with the State of Michigan based on at least the following eight known breaches of express terms and conditions:

1. Standard of Care as a Reasonably Prudent Person (Section A)
2. Indemnity Provision (Section J)
3. Pipeline Wall Thickness Provision (Section A (11))
4. Pipeline Exterior Slats and Coating Requirements (Section A (9))
5. Pipeline Minimum Curvature Requirement (Section A (4))
6. Maximum Unsupported Span Provision (Section A (10))
7. Federal Violation of Emergency Oil Spill Response Plan (Section A)
8. State Violation under the Michigan Environmental Protection Action (Section A)

Although none of these breaches can be remedied in the Easement's 90-day period to cure violations, the State of Michigan should immediately give written notice of these breaches to enforce the obligations and liability of Enbridge under the Easement and public trust in the waters, bottomlands, fish and aquatic habitat, ecosystem, and protected uses. When it becomes clear that Enbridge cannot cure these material violations, the State of Michigan's conditional authorization to transport oil in public waters of the Great Lakes should terminate.

1. Violation of the Easement's Reasonable Prudent Person Standard

Section (A) of the Easement states that the grantee Enbridge (predecessor Lakehead Pipe Line Company): "…at all times shall exercise the due care of a reasonably prudent person for the safety and welfare of all persons and of all public and private property, shall comply with all laws of the State of Michigan and of the Federal Government." This "due care" obligation under the Easement extends to "public property," which includes public trust bottomlands, waters of Lake Michigan and Lake Huron, fish and ecosystem resources.

The Merriam-Webster dictionary defines prudence as: "careful good judgment that allows someone to avoid danger or risks."[2] The State of Michigan acknowledges that Enbridge's positions with respect to operation of Line 5 are not reasonable.[3] According to Enbridge, "the existing 61-year-old Straits Pipelines [now 63-years-old] can be operated indefinitely and that it neither has, nor needs to consider, a plan to replace them."[4] On its face, this claim is simply not consistent with the duty to avoid danger and risks, particularly in light of the high-level risk findings of the July 2015 Task Force Report, FLOW's three expert reports, National Wildlife Federation's *Sunken Hazard* report and the University of Michigan's 2016 computer modeling study, which demonstrated that more than 700 miles of shoreline in Lakes Huron and Michigan are potentially vulnerable to an oil spill. Rather, prudence requires the immediate and strict elimination of this type of high risk. Failure to do so on the part of Enbridge is a violation of its covenant and standard of care, and the State has an obligation and the power to enforce this violation under the Easement and public trust law.

Enbridge's actions violate the reasonable and prudent standard to prevent unacceptable harm to public property, private property, and the health and safety of persons by:

(1) withholding critical information essential to evaluating the risks of continued operation of Line 5 and to avoid danger and unacceptable risk;[5]
(2) misrepresenting information about the condition of these aging pipelines (ranging from "excellent"[6] to sections that are corroded up to 26 percent of wall thickness) and downplaying the operation and the high risk and magnitude of harm of a pipeline break in the middle of the Great Lakes; and
(3) failing to comply with the express "minimum [design] specification, conditions, and requirements" of the Easement as detailed in section (2) through (8) below.

Accordingly, the State should immediately give written notice to enforce the obligations and liability of Enbridge under the Easement and public trust in the waters, bottomlands, fish and aquatic habitat, ecosystem, and protected uses.

2. Violation of Easement's Liability Insurance Indemnity Provision

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[2] http://www.merriam-webster.com/dictionary/prudence
[3] Michigan Petroleum Pipeline Task Force Report (July 2015) at p. 47 [hereinafter "Task Force Report."] http://www.michigan.gov/documents/deq/M_Petroleum_Pipeline_Report_2015-10_reducedsize_494297_7.pdf
[4] Task Force Report at p. 47.
[5] Letter from Attorney General to Enbridge (Cynthia Hansen) (March 11, 2016). http://mediad.publicbroadcasting.net/p/michigan/files/201603/MichiganLettertoEnbridge2016.pdf?_ga=1.83754262.1030775807.1458864290
[6] Task Force Report (July 2015) at p.43 "Enbridge has sought to reassure the public and the State that the Straits Pipelines are in 'excellent' condition, present minimal risks, and can reasonably be expected to safely function indefinitely."

Section J (1) of the Easement requires the grantee to "maintain … during the life of the easement … a Comprehensive Bodily Injury and Property Damage Liability policy, bond, or surety, in form and substance acceptable to the Grantor in the sum of at least One Million Dollars ($1,000,000)."

As of July 2015, the State of Michigan confirmed that Enbridge was in violation of Section J(1) of the Easement in its Michigan Petroleum Pipeline Task Force Report. "***To date, Enbridge has not documented that it is in compliance with this requirement.***"[7] As of the date of this letter, Enbridge still has not provided any documentation that it is in compliance with the insurance requirements of the 1953 Easement.

Given $1.2 billion cost associated with Enbridge's breach of Line 6B along the Kalamazoo River, a significantly higher level of protection – beyond Enbridge's $700 million insurance program for its entire system[8] – is necessary and raises serious doubt as to the sufficiency of the protection offered by the 1953 Easement. Liability coverage in the 21st century must include potential costs and losses for natural resource damage and public trust uses. And Enbridge has a legal duty to secure an insurance bond commensurate with the potential damage figure. It is clear, however, that Enbridge has not properly contemplated a worst-case scenario in the Straits to determine its liability for "all public and private property." In short, the State of Michigan should trigger the 90-day notice period because Enbridge has failed to satisfy the liability terms of the Easement. To operate Line 5 without sufficient assurances that these losses can be addressed is neither reasonable nor prudent.

3. Violation of Easement's Pipeline Wall Thickness Requirement

Section A (11) of the Easement states: "The pipe weight shall be not less than one hundred sixty (160) pounds per lineal foot." By incorporating the 1953 Michigan Public Service Commission ("MPSC") Order by reference, this specification translates into 0.812 pipeline wall thickness or schedule 60 seamless pipe (see Appendix 2).[9]

This Easement engineering provision is critical because failure of corrosion and materials, welds, and equipment are the top causes for pipeline ruptures.[10] In 2014, Enbridge's first publicly available document on Line 5, the Operational Reliability Plan ("ORP"),[11] claimed that the Line 5 Straits of Mackinac section of the pipeline had "**No observed corrosion growth**." The ORP, however, did acknowledge annual levels of corrosion for the rest of the 640 miles of Line 5. In February 2016, Enbridge released new data from 2013 inspection reports (predating Enbridge's claims of no corrosion) indicating that the "East Straits" segment of Line 5 on-shore is **corroded in nine areas**

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[7] Task Force Report at p.46.

[8] *Id.*

[9] *See* Appendix 2. The MPSC order requires API 5L grade A Schedule 60 (.812) wall pipe. The 1953 MPSC Order also specifies regarding the pipe intended for use under the Straits of Mackinac: "The 20" schedule 60 (0.812" wall) pipe is API specification 5L Grade A." API specification 5L was first promulgated in 1928 and the pipe used in Line 5 was governed by the 1948 version of API Standard 5LX.

[10] According to PHMSA; *See* http://smartpig.pstrust.org/tag/incidents/.

[11] Enbridge Pipeline Limited Partners, "Operational Reliability Plan: Line 5 and line 5 Straits of Mackinac Crossing," 2014. [hereinafter "Enbridge 2014 ORP"]
https://www.enbridgepartners.com/~/media/7FDCBAC7A8FE4705A2729F3D1B51B6B3.ashx

and in one seven-inch-long spot had **lost 26 percent of its wall thickness to corrosion**.[12] This fact alone constitutes a *per se* violation of the pipeline wall thickness requirement of 0.812 inches.

Enbridge also reported **two dents** on the East Straits pipeline, the largest dent with a width of eight inches and a length of eighteen inches, and **35 circumferential cracks** at the locations where pipe segments are welded together – the girth welds. Despite the metal loss, dents, and cracks, Enbridge concluded: "Our engineering analysis of the pipelines under the Straits of Mackinac tells us these pipes are in **excellent condition, almost as new as when they were built and installed**."[13]

In addition, Enbridge admitted on its website to mill anomalies that suggest the pipelines were never constructed according to the "minimum [design] specification, conditions, and requirements" in Section A of the 1953 Easement.

> In the case of Line 5, which consists of specially manufactured seamless piping for extra strength and safety, some variations in wall thickness result from (and are expected from) the manufacturing process itself.
>
> … The **peak depth of mill anomalies** on the East and West pipelines was **37 and 41 percent of the wall thickness**, respectively. Table 1 below shows the distribution of features for both Straits pipelines, where there were **141 and 294 features identified** by the MFL inspections of the East and West pipelines, respectively.[14]

Enbridge's disclosures suggest that Line 5 in the Mackinac Straits was built at less than a half-inch thick in places, far short of the requirements of the Easement. Yet in the same disclosure, Enbridge simultaneously references the "nearly one-inch-thick walls of Line 5's steel pipe travelling under the Straits."[15] Appendix 9 further details how Line 5 may not comply with API 5L, which articulates the design standard for pipelines, defects, and welding requirements.

In sum, Enbridge's recent admission that the pipe used to construct the Straits sections of Line 5 may not have met the specifications set forth in the 1953 Easement and 1953 MPSC Order violates the Easement. Other requirements in both API 5L and API 1104 may have also been violated and thus must be investigated. As for a remedy, Enbridge cannot cure this defect in the Easement's allocated 90-day period or even in an extended period. This significant and incurable violation must

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[12] Enbridge: Line 5 inspection results: Metal loss/corrosion http://www.enbridge.com/Projects-and-Infrastructure/Public-Awareness/Line-5-Michigan/Safeguarding-the-Great-Lakes/Inspections/Inline-inspection-results/Results-metal-loss-corrosion.aspx

[13] Enbridge website: http://www.enbridge.com/Projects-and-Infrastructure/Public-Awareness/Line-5-Michigan/Safeguarding-the-Great-Lakes/Inspections/Inline-inspection-results/Results-cracking.aspx

[14] Enbridge website: http://www.enbridge.com/Projects-and-Infrastructure/Public-Awareness/Line-5-Michigan/Safeguarding-the-Great-Lakes/Inspections/Inline-inspection-results/Results-metal-loss-corrosion.aspx [emphases added]. As reported by Michigan Radio: "In addition to corrosion, the company says certain parts of the pipelines are not as thick as .812 inches. It says those are places where the pipe thickness varies because the way it was originally manufactured. The depth of these variations in wall thickness are found in both pipelines. On the eastern pipeline, wall thickness reaches .512 inches in some places (or 37% less than the original wall thickness). **And on the western pipeline, wall thickness reaches .479 inches in some places (or 41% less than the original wall thickness**). Mark Brush, "Recently released Enbridge report shows areas of corrosion along Line 5," Michigan Radio, Feb. 5, 2016 http://michiganradio.org/post/recently-released-enbridge-report-shows-areas-corrosion-along-line-5#stream/0 [emphases added].

[15] Enbridge website: http://www.enbridge.com/Projects-and-Infrastructure/Public-Awareness/Line-5-Michigan/Safeguarding-the-Great-Lakes/Inspections/Inline-inspection-results/Results-metal-loss-corrosion.aspx

be addressed immediately before Michigan faces another aging infrastructure crisis threatening drinking water supply for hundreds of thousands of citizens who rely on Lake Michigan and Lake Huron.

4. Violation of Easement's Pipeline Slats and Exterior Coating Requirements

Section A (9) of the Easement requires: "All pipe shall be protected by asphalt primer coat, by inner wrap and outer wrap composed of glass fiber fabric material and one inch by four inch (1" x 4") slats prior to installation." The Engineering and Construction Considerations provides more detail and specifically require that the pipe be entirely wrapped with 1" x 4" wooden slats: " . . . and after attaching 1" X 4" wood slats to the *full circumference of the pipe*, it will be lowered into a previously prepared 'bed' on the floor of the Straits." (see Appendix 3)[16]

The wooden slats wrapped around the Straits sections of Line 5, or "circumferential lagging" as they are called in the industry, fulfilled two important structural functions: (1) protection against abrasion where the pipes rested on the gravel support bed; and (2) protection from excessive stresses if the pipelines encountered a sharp edge such as a large rock or other miscellaneous stresses. Appendix 3's Section 19 labeled Miscellaneous Stresses explains: "Other conditions of load and support have been considered and found to be unimportant. For example, the possibility of concentrated load acting on the pipe is excluded due to the slats and wrapping."[17] In other words, Appendix 3 demonstrates that the circumferential wooden slats wrapped around the circumference of the Straits sections of Line 5 were not a temporary measure to aid the pipe laying operation. Rather they are an integral part of the structure and are intended to be in place throughout the pipelines' entire service life.

Photo A Trudgen Photo of Pipe Stockyard 00010370011.tif

[16] Appendix 3: "Engineering and Construction Considerations for the Mackinac Pipeline Company's Crossing of the Straits of Mackinac" and "Report on the Structural Analysis of the Subaqueous Crossing of the Mackinac Straits," by Dr. Mario G. Salvadori, P. E., Department of Civil Engineering, Columbia University, New York 27, NY, (January 19, 1953) submitted by Mackinac Pipeline Company/Lakehead Pipeline Company to the Michigan Department of Conservation, January, 1953."
http://www.michigan.gov/documents/deq/Appendix_A.2_493980_7.pdf

[17] *Id.* at p. 4 of the "Report on the Structural Analysis of the Subaqueous Crossing of the Mackinac Straits."

Photograph A shows pipe strings being prepared according to the terms of the Easement by wrapping the full circumference of the pipe with 1" x 4" wooden slats. However, additional photographs of the pipeline during the actual construction and installation in 1953 (see below) reveal that the wooden 1" x 4" slats were not properly installed around the full circumference of the pipe as required in the engineering and construction documents. Photograph B, for example, reveals that this pipe was only wrapped with wooden slats on the bottom half when the pipe strings were actually welded together and pulled across the Straits. This photo illustrates a clear violation of the slats requirement in the Easement.[18]

Photo B Trudgen Photo of Pipe String Assembly Welding 0001037005.tif

Recent underwater photographic surveys also show that the circumferential bands used to secure the mandated wooden slats around the circumference of the pipeline have rusted away so that the wooden slats in those areas are missing. Without this protection, it is doubtful that the water barrier coating that protects the steel pipe from external erosion and corrosion still fulfills its function, resulting in the risk of excessive erosion and corrosion on the bottom of the pipe, with subsequent rupture hazard. Accordingly, the failure to maintain this wooden protective layer is a clear violation of the conditions of the Easement, and requires immediate action.

5. Violation of Easement's Pipeline Curvature Requirement

Section A (4) of the Easement states: "The minimum curvature of any section of pipe shall be no less than two thousand and fifty (2,050) feet radius." This stipulation, which applies to both the pipe laying operation and the pipe as it rests on the bottom, was intended to make sure the pipe was not plastically deformed during the pipe laying operation.

When the bending stress applied to a pipe exceeds the steel's yield strength, the pipe is permanently bent, resulting in plastic deformation. Plastic deformation (bending) of the pipe results in residual or "locked in" stresses in the pipe that increase local stress in the pipe beyond what is calculated in the

[18] *See* Appendix 9 for additional photographs.

design basis. This is particularly true as it applies to the girth welds used to join the numerous sections of seamless pipe. Residual stresses can cause unpredictable cracking at bending stresses far less than those intended in the original design. The 2,050-foot radius of curvature requirement limits bending stress to 34 percent of yield strength. If, as demonstrated by the annotated Photo C below, the pipe is allowed to sag to a radius of 278 feet, the bending stress on the pipe as calculated by a simple elastic model becomes 248 percent. A simple elastic model is not applicable at this radius because the stress is much greater than the yield strength of the pipe and the pipe has been plastically deformed.

Calculation of Radius of Curvature During Line 5 Straits Pipelaying Operation

Image, Bruce Trugen 000010370007.tif Taken summer, 1953

Photo C Trudgen Photo Pipelaying Operation as the Pipe was Pulled across the Straits from St. Ignace 000010370007.tif

The clear violation of Section A (4) of the Easement shown in Photo C means that many of the girth welds of the submerged sections of Line 5 have been plastically deformed. Plastic deformation of a weld seam not only makes it more likely to crack at stresses much lower than those that would crack the base metal but also makes the weld more susceptible to corrosion of the deformed areas. This engineering violation also triggers the Easement's termination provision, starting with the 90-day period to cure.

6. Violation of the Easement's Maximum Span Provision

Section A (10) of the Easement provides that: "The maximum span or length of pipe unsupported shall not exceed 75 feet." Documentation from Enbridge to both state agencies – the DEQ and the MPSC – confirms that the unburied portions of the Straits sections of Line 5 have violated this

easement term as early as 2001. In 2001 Enbridge, in what it characterized as an "emergency,"[19] applied for a joint DEQ and U.S. Army Corps of Engineers permit under the Great Lakes Submerged Lands Act ("GLSLA")[20] and the River and Harbors Act "to provide support underneath our pipelines in sections where the pipeline *shows spans unsupported over too great a distance*."[21] Since at least 2001, Enbridge has continued to apply for joint inspection and maintenance permits under the GLSLA and CWA to install more anchor structures on the public bottomlands of the Straits.[22]

In 2014, Enbridge admitted[23] that it was still violating this critical easement provision and filed for its most extensive joint permit from the State of Michigan (under the GLSLA) and the U.S. Army Corps of Engineers (under the Clean Water Act ("CWA")), seeking permission to install 42 additional screw anchors on the bottomlands of the Great Lakes. By November 19, 2014, Enbridge claimed that it had cured the maximum span requirement for both of its twin pipelines: "As you can see, no span length exceeds the seventy-five (75) feet."[24]

Nonetheless, Enbridge's "fix" cannot remedy the decades of untold and unknown stress damage these pipelines have experienced from peak volumetric transport more than 10 times the flow of the Niagara River. Simply adding support to a pipeline that has been damaged by unanticipated stresses does not guarantee pipeline integrity. The Task Force Report commented on this very troubling issue: "Given Enbridge's failure to maintain the legally required intervals for pipeline supports during an apparently extended period of time, and the very significant underwater currents at the Straits, there is a need to analyze the resulting stresses on the pipelines and potential impacts to their integrity."[25] In short, the fact that the line has a long history of being insufficiently supported in hydrodynamic conditions not contemplated in the original design raises serious questions about metal fatigue and locked up stress from plastic deformation. Moreover, failing to disclose the effect of accumulated damage to the pipelines' structural integrity is neither reasonable nor prudent.

In addition, while Enbridge has attempted to cure this easement provision by installing permanent anchor screw supports on 1.03 miles out of 2.1 miles on the east section and 1.02 miles out of 2.3 miles on the west section, Enbridge ***still has left over 50 percent*** of the total unburied sections of

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[19] *See* Appendix 7: Enbridge Letter (Adam Erickson) to MDEQ (John Arevalo), Enbridge Joint Permit Application for Repair Work to be Completed on Crude Oil Transmission Pipelines Located in the Straits of Mackinac: September 14, 2001.

[20] Great Lakes Submerged Lands Act, MCL 324.32501 *et seq.*

[21] *See* Appendix 7.

[22] *See* Appendix 8: Email from Enbridge Jacob Jorgenson to Scott Rasmussen (DEQ) and Gina Nathan (ACE), Nov. 18, 2010. In 2010 after receiving a permit from the DEQ under the GLSLA for additional anchoring structures to support the pipeline, Enbridge notified DEQ that "we do not have the future structure locations determined at this point," "nor the scope of the projects to come…"

[23] Enbridge's June 27, 2014 letter to the State of Michigan
http://www.michigan.gov/documents/deq/Appendix_B.2_493988_7.pdf
State of Michigan's July 24, 2014 letter to Enbridge, "Enbridge's Response acknowledges that at least some portions of the pipelines do not currently meet the Easement's support spacing requirement." "[P]lease consider this letter formal written notice on behalf of the State of Michigan, and pursuant to Condition C. of the Easement, that to date, Enbridge has not fully complied with the 75-foot support spacing requirement contained in Condition A.(1) of the Easement."

[24] *See* Appendix 6: Enbridge's November 19, 2014 Letter and Attachment to Attorney General Schuette and DEQ Director Wyant re: Joint July 24, 2104 State Letter on Easement Violation of Maximum Unsupported Span. http://www.michigan.gov/documents/deq/Appendix_B.4_493991_7.pdf; and Dr. Ed Timm's chart: Unsupported Span Data from Enbridge's November 19, 2014 Letter.

[25] Task Force Report at p.44.

Line 5 without support.[26] The need for additional support structures will remain an ongoing structural problem for Enbridge and trigger ongoing violations because the pipelines will continue to wash out on the original gravel bed due to water currents unaddressed in the original design. Appendix 3 reveals that the maximum current used in the design of the Straits sections of Line 5 was 1.96 knots (2.26 miles per hour). This current value seriously underestimates the true strengths of the currents since washouts and the resultant lack of support were not anticipated to occur.[27] Thus, because over half of the exposed pipelines still rest on the lake bottom without discrete support, new violations of the support requirements in the Easement can occur at any time and exist undetected in the two-year intervals between Enbridge's underwater inspections.

The burden rests with Enbridge to act with due care and demonstrate the structural integrity of the pipe from unsupported spans, and the State has a concurrent affirmative duty to protect our waters from imminent harm. Therefore, the State must notify Enbridge in writing that it has 90 days to substantiate full compliance with the 75-foot support requirement and to disclose all information related to the pipelines' structural integrity from six decades of unanticipated stresses.

7. Violation of Federal Law for Emergency Oil Spill Response Plan

The State granted the Easement to Enbridge's predecessor and its successors subject to a condition specifying that the grantee *"shall comply with all laws … of the Federal Government."*

Enbridge is currently violating the federal Oil Pollution Act ("OPA") because the company is transporting oil through Line 5 in the Straits without a proper oil spill response plan approved by the Secretary of the U.S. Department of Transportation ("the Secretary"). Enbridge cannot prevent a termination because Enbridge itself cannot correct this breach or take remedial action to correct it. The breach can be corrected only by the Secretary, because only he has the authority to approve a spill response plan for a pipeline crossing under navigable waters. The State may therefore invoke its authority under the Easement to terminate the conveyance by giving written notice to Enbridge of this breach.

The Case for Terminating the Easement Under a Federal Violation of Mandatory Pollution Prevention or Reduction Standards and Requirements under the OPA/CWA

In the aftermath of the Exxon *Valdez* oil spill, Congress enacted the OPA in 1990 to amend §311(j) of the CWA and to ensure an effective and immediate response to future oil spills.[28] On February 22, 2016, National Wildlife Federation ("NWF") filed a 60-day notice of intent to sue PHMSA for violations of the Oil Pollution Act, National Environmental Policy Act, and Endangered Species Act in connection with that agency's unauthorized approval of Enbridge's facility response plans ("FRP") for the segments of Line 5 that cross navigable waters.

In October 2015, NWF filed a nationwide lawsuit against the Secretary based on his failure to comply with the OPA by reviewing and, if appropriate, approving spill response plans for pipelines

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[26] *See* Appendix 6.
[27] *See* Appendix 3.
[28] OPA, Pub. L. No. 101-380, § 4202(a)(6) (adding subparagraph (F) to § 311(j)(5), which provides that § 311(j) requires all offshore facilities and certain onshore facilities to prepare a spill response plan, and prohibits them from handling, storing, or transporting oil unless the plan has been reviewed and approved by the President and the plan is followed) (codified at 33 U.S.C. § 1321(j)(5)(F)), § 4202(b)(4)(B) (providing that § 311(j)(5) requires offshore facilities, among others, to prepare a spill response plan), 104 Stat. 484 (1990).

that run in, on, or under inland navigable waters.[29] The Secretary was delegated this duty by the President pursuant to the OPA, and he was required to carry out this duty no later than August 18, 1993. However, the Secretary has so far failed to perform his duty. Consequently, Enbridge has been operating Line 5 to transport oil through the Straits – from August 18, 1993, through the present – contrary to OPA's prohibition against oil transport without a duly approved oil spill response plan.

Enbridge does not have the power either to correct the breach of the requirement that it comply with federal law within 90 days of written notice from the State or take remedial action to correct the breach within 90 days of such notice because only the Secretary has the authority to approve a spill response plan for the Straits section of Line 5.[30] The State may therefore invoke its authority under the Easement to terminate the conveyance by giving written notice to Enbridge of this breach.

Enbridge also cannot prevent termination based on the Easement's provision excusing a failure to comply with a federal law. The terms of this provision would excuse Enbridge only if the company were currently contesting the OPA itself, on constitutional grounds, for example. The Easement would not excuse Enbridge if the company were contesting the application of the law. Regardless, Enbridge is not currently contesting either the OPA itself or its application to the company. Even if initiating a challenge now to the OPA itself would trigger the excuse, the statute of limitations surely must have expired on any such challenge.

8. Violation of State Law under MEPA based on Violation of Federal Water Pollution Standard or Restriction under the OPA/CWA.

The State granted the Easement to Enbridge's predecessor and its successors subject to a condition specifying that the grantee *"shall comply with all laws of the State of Michigan and of the Federal Government."*

The federal OPA/CWA violation of a pollution standard or mandatory requirement identified above also constitutes a *per se* violation of the Michigan Environmental Protection Act ("MEPA"),[31] thus violating state law in violation of the Easement. Because the purpose of the OPA/CWA is a water pollution control standard or restriction designed to protect our water, the public trust, and natural resources from worst-case scenario oil spills and irreparable environmental damage, a violation of this type of statute constitutes a prima facie case under the MEPA.[32] Accordingly, the State of Michigan should invoke its authority to terminate the Easement to transport crude oil because such conduct of Enbridge violates state law under the MEPA, and therefore violates the Easement.

The Case for Terminating the Easement Based on a Violation of State Law under the MEPA

The Michigan Supreme Court has described the MEPA[33] as the State's response to the constitutional mandate under Article 4, § 52.[34] MEPA expressly prohibits any private or public conduct that is

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[29] 33 U.S.C. § 1321 (a)(11) (defining an "offshore facility," in part, as "any facility of any kind located in, on, or under any of the navigable waters of the United States."

[30] The Secretary has yet to answer the complaint NWF filed to force the agency to comply with the OPA. And PHMSA has so far failed to respond to NWF's notice of intent to sue or to give any assurances in the wake of the notice that it would comply with the OPA. Even were the Secretary to immediately commence proceedings to comply with the law, the likelihood that it could review spill response plans and approve Enbridge's plan within ninety days is remote.

[31] Part 17, MCL324.1701 *et seq.*

[32] *Nemeth v. Abonmarche Development, Inc.*, 457 Mich. 16, 576 N.W.2d 641 (Mich. 1998).

[33] MCL 324.1701 *et seq.*

"likely to pollute, impair, or destroy the air, water, or natural resources or the public trust in those resources"[35] unless it can be shown that "there is no feasible and prudent alternative" and that defendant's conduct "is consistent with the promotion of public health, safety and welfare in light of the state's paramount concern for the protection of its natural resources."[36]

MEPA requires State agencies, in the exercise of their regulatory authority and powers,[37] to prevent and minimize to the maximum extent likely harm to water, natural resources, or the public trust. The State, its attorney general, or any person or entity can establish a prima facie case of "likely pollution" under the MEPA Section 1703(1) by proving violations of an air, water, natural resources pollution or impairment standard or requirement in a federal or state law or regulation.[38] For example, in *Nemeth v. Abonmarche Development, Inc.*, the Michigan Supreme Court found that defendants had violated the MEPA based on a violation of the Soil Erosion and Sedimentation Control Act ("SESCA") for soil erosion plan permits.[39] Because the purpose of SESCA was to establish pollution control standards to protect water and soil through the prevention and control of erosion and sedimentation, the Court ruled that a violation of the standards, including soil erosion plans, established a prima facie violation of the MEPA.[40]

One of the OPA provisions establishes federal standards for facility response plans and worst-case scenarios approved by the Secretary in order to prevent or minimize unacceptable risk of water pollution.[41] Offshore facilities like Line 5 "may not handle, store, or transport oil unless" there is an approved facility response plan, and "the facility is operating in compliance with the plan."

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[34] Article 4, § 52 states: "The conservation and development of the natural resources of the state are hereby declared to be of paramount public concern in the interest of the health, safety and general welfare of the people. The legislature shall provide for the protection of the air, water and other natural resources of the state from pollution, impairment and destruction." *State Hwy Comm'n v Vanderkloot*, 392 Mich 159, 182; 220 NW2d 416 (1974) (holding that the legislature is not required "to make specific inclusion of environmental protection provisions in every piece of relevant legislation," including the highway condemnation act); *Genesco, Inc v Michigan Dep't of Environmental Quality*, 250 Mich App 45, 53; 645 NW2d 319 (2002) (same analysis); *Ray v. Mason Co Drain Comm'r*, 393 Mich 294, 304; 224 NW2d 883 (1975); W. Rodgers, Environmental Law § 2.16 at 184 (1977).

[35] MCL 324.1702, 1703, 1705.

[36] *See Ray,* 393 Mich at 304; *Vanderkloot*, 392 Mich at 187-88; Haynes, Jeffrey, Michigan Environmental Protection Act, Michigan Environmental Law Deskbook, 2nd ed. (State Bar of Michigan, 2012).

[37] Case law makes clear that MEPA applies to oil and gas orders, permits, and proposed projects. *West Michigan Environmental Action Council v Natural Resources Comm'n*, 405 Mich 741, 275 NW2d 538 (1979) (denying DNR's decision to grant permit for ten exploratory wells based on likely adverse impacts to pollute, impair, and destroy wildlife); *Anglers of the AuSable v MDEQ*, 283 Mich App 115; 485 Mich 1067, 488 Mich 69 (opinion vacated on rehearing) (the decisions upheld the trial and appellate court holdings that MEPA applies to state department, commission, and other proceedings); *Vanderkloot*, 392 Mich at 187-88.

[38] MCL 324.1702(1). Conduct that is "likely to pollute, impair, or destroy" the environment includes "probable" damage to the environment. *Michigan United Conservation Clubs v. Anthony*, 90 Mich App 99, 105; 280 NW2d 883 (1979). *Nemeth v. Abonmarche Development, Inc.*, 457 Mich. 16, 576 N.W.2d 641 (Mich. 1998). The other two ways to establish a prima facie case include (1) showing that the conduct is likely to pollute etc. or has done so and that there is no feasible or prudent alternative based on scientific and expert evidence, and (2) using an analogous standard like Inland Lakes and Streams Act or Wetlands law, so that the factual violation of one of these other laws shows a prima facie case.

[39] *Nemeth,* 576 N.W.2d at 642**.**

[40] *Id.* at 650-651. State agency water pollution enforcement actions often assert similar MEPA violations. *See, e.g.*, *Michigan v. City of Allen Park*, 501 F Supp 1007, 1014 n 8 (ED Mich 1980); *Attorney General v. John A Biewer Co*, 140 Mich App 1; 363 NW2d 712 (1985); *Attorney General v. Lakes States Wood Preserving, Inc.,* 199 Mich App 149, 151; 501 NW2d 213 (1993).

[41] 33 U.S.C. § 1321(j)(5)(F).

Enbridge, however, is in violation of this OPA standard because it is not operating in compliance with a duly approved offshore facility response plan with a worst-case scenario and risk assessment. Without such a plan, Enbridge's current response plan for Line 5 is legally deficient and poses a substantial threat to the health of the waters, aquatic resources, and public trust uses of Lakes Michigan and Huron. Therefore, Enbridge's violation constitutes a prima facie likely pollution or impairment of water and natural resources or public trust in those resources contrary to § 1703(1) of the MEPA.

Because Enbridge is in violation of this federal pollution standard or requirement that protects navigable waters like the Great Lakes, the State of Michigan can and must assert an independent state claim under the MEPA as well as another easement violation for failing to "comply with all laws of the State of Michigan and of the Federal Government." The State has a duty to prevent likely pollution or degradation of the air and natural resources or public trust.[42] In order to comply with this duty, the State may take direct legal action under the Easement and the MEPA by asking a court to terminate all conduct that is an imminent threat or endangerment, or that is likely to pollute or impair the waters and natural resources or public trust of the State and its citizens.[43]

II. BECAUSE THERE IS NO PLAUSIBLE REMEDY FOR BREACHES THAT THREATEN TO IMPAIR OUR PUBLIC WATERS, THE STATE OF MICHIGAN MUST TERMINATE THE EASEMENT.

Section C provides for termination of the Easement as follows:

> If, after being notified in writing by Grantor of any specified breach of the terms and conditions of this easement, Grantee shall fail to correct said breach within ninety (90) days, or, having commenced remedial actions within such ninety (90) day period, such later time as it is reasonably possible for the Grantee to correct said breach by appropriate action and the exercise of due diligence in the correction thereof.

Enbridge has not been and is not complying with at least eight express terms of the Easement, as described above. The State may therefore invoke its authority under the Easement to terminate the conveyance by giving written notice to Enbridge of these breaches.

Furthermore, Enbridge cannot prevent a termination because Enbridge itself cannot correct these breaches within the 90-day period or take remedial action to correct the breaches. Even if the State were to extend the deadline, Enbridge also cannot correct these breaches because they are material and incurable defects relating to the integrity and current operation of this aging infrastructure and threaten the public trust resources of the Great Lakes.

Accordingly, the Attorney General, DEQ, DNR, and other state agencies or officials, as trustees, should take immediate action to enforce the Easement and to eliminate the risk to these public trust waters, bottomlands, ecosystem, public uses, private property and businesses, and communities and persons in the Straits and northern Lake Michigan and Lake Huron area. The enforcement and other actions described above remain urgent and critical. The violations listed in the above sections (1)

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[42] *Ray*, 393 Mich at 304.

[43] E.g., *Attorney General v. Consumers Power Co*., 202 Mich App 74 (1993); *Attorney General v. Balkema*, 191 Mich App 201 (1991); *Attorney General v. Thomas Solvent*, 146 Mich App 55 (1985); *Attorney General v. Huron County Rd Comm'n.*, 212 Mich App 510 (1995); *People v. Broedell*, 365 Mich 201 (1961); *People v. Babcock*, 38 Mich App 336 (1972).

through (8) call for immediate state legal action independent and separate from the State's Advisory Board process and the agencies' current risk and alternatives analyses of Line 5 in the Straits.

III. THE GREAT LAKES ARE A PUBLIC TRUST AND THE STATE OF MICHIGAN HAS AN AFFIRMATIVE AND CONTINUING LEGAL DUTY TO PROTECT THESE PUBLIC WATER RESOURCES AND USES FOR CURRENT AND FUTURE GENERATIONS.

As Governor, Attorney General of Michigan, and Director of the DEQ and DNR respectively, citizens look to you to exercise prudence and to eliminate the high risk and harm associated with the transport of oil in Line 5's Straits and other water crossings. As noted above, you are the State's primary trustees of these waters, bottomlands, and related natural resources of the Great Lakes,[44] representing some 20 percent of the world's fresh surface water.

The 1953 Easement is necessarily subject to the common law public trust in the bottomlands of the Great Lakes. The Easement explicitly recognizes that Enbridge's use and operations are subject to Act 10's reservation that the state's bottomlands and waters are "held in trust." As such, the Easement is conditional, as described by the courts in the nature of a license, and revocable by the State if subsequent circumstances compel a modification of use or even termination of the Easement to protect the public trust and related health, safety, and welfare. By the very nature of the public trust in these bottomlands and waters, Act 10 did not and cannot grant irrevocable control to Enbridge or any other private entity.[45] Thus, Enbridge cannot claim its easement is "grandfathered," and the State cannot be estopped or prevented in any manner to exercise its authority and comply with its duties to protect the public trust and demand information and compliance with the standards imposed by public trust law.[46] Moreover, this public trust duty requires continuous and complete transparency, disclosure, and accountability on the part of any person or entity that uses or occupies these public trust bottomlands and waters. The State's demand for information disclosure is inherent in the public trust doctrine; anything less than this would shift control of the prevention of harm to the public trust to a private corporation— a direct violation of the public trust.[47]

The high risk and imminent harm from shipping oil through Line 5 under the Straits violate the continuing and supervisory duty imposed by the public trust doctrine and environmental laws that apply to the Great Lakes. The public trust in these waters and environmental standards require the State of Michigan and Enbridge to take immediate action to prevent and minimize harm to the air,

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[44] *Collins v. Gerhardt*, 211 N.W. 2d 115, 118 (Mich. 1926); *People ex rel Director of Conservation v Broedell*, 365 Mich 201, 205 (1961). The DEQ must ensure "the private or public use of those lands and waters will not substantially affect the public use of those lands and waters for hunting, fishing, swimming, pleasure boating, or navigation, or that the public trust in the state will not be impaired by those agreements for use, sales, lease, or other disposition." MICH. COMP. LAWS ANN. § 324.32502; see also R 322.1006.

[45] *Illinois Central R Rd v Illinois*, 146 US 387 (1892). And yet, as noted in the Michigan Petroleum Pipeline Task Force Report: "By not providing the State with actual copies of test results and other State-requested documents, based upon assertions of confidentiality, Enbridge has limited opportunities for independent expert review." (July 2015) p. 44.

[46] *People v Broedell,* 365 Mich at 201.

[47] And yet, as noted in the Michigan Petroleum Pipeline Task Force Report: "By not providing the State with actual copies of test results and other State-requested documents, based upon assertions of confidentiality, Enbridge has limited opportunities for independent expert review." (July 2015) p. 44.

water, natural resources, and public trust in those resources.[48] The State has both the legal authority and affirmative duty to protect these waters and protected trust uses. In short, the transport of oil through Line 5 presents an imminent risk or endangerment of an unacceptable high magnitude of harm and destruction that is irreparable – that is, the harm if a release occurs will be pervasive, in large degree irreparable or irreversible, and persistent.

IV. CONCLUSION

It is clear that Enbridge's twin 63-year-old pipelines located in the heart of the Great Lakes are one of the greatest threats to our water, economy, and *Pure Michigan* way of life. As such, Line 5 is a Michigan and a Great Lakes public trust issue, not a partisan one. Over thirty local units of government, including Mackinac Island and Bois Blanc, have recognized the magnitude of this threat, and have accordingly passed resolutions demanding the State of Michigan protect the public interest and stop the flow of oil in Line 5 to prevent a catastrophic oil spill in the Great Lakes. We have enclosed the list of local government resolutions for your review as Appendix 5.

No elected, appointed or employed official can ignore or be indifferent to the high, perpetual public trust responsibilities and standards that apply to Lake Michigan-Huron and Michigan's navigable waters and aquatic resources. Because the stakes are so high, we urge you, as the state's highest-level trustees, to protect our public trust lands, waters, and uses by taking immediate and responsible action to enforce the terms and conditions of the 1953 Easement with Enbridge.

The time to act is now, given Enbridge's current, ongoing, and multiple easement violations, the age of the pipeline, new evidence of corrosion and material defects, and the extraordinary threat and magnitude of harm these oil pipelines pose to more than 700 miles of shoreline in the Great Lakes. Public trust authority under constitutional, statutory, and common law all require the State of Michigan to enforce the express terms and conditions of the Easement with Enbridge to ensure our common waters are protected for current and future generations.

[48] *Ray*, 393 Mich at 294. The protected public uses, such as navigation, drinking water, fishing, boating, swimming, water-dependent recreation and businesses, are by law paramount and cannot be subordinated. *Obrecht v. National Gypsum Co.*, 361 Mich 399, 412, 415-416, 105 NW2d 143, 149-151 (1960); *Illinois Central R. R.*, 146 US at 453-459.

APPENDICES

Appendix 1: Straits of Mackinac Pipe Line Easement, Conservation Commission of the State of Michigan to Lakehead Pipe Line Company, Inc., April 23, 1953. http://www.michigan.gov/documents/deq/Appendix_A.1_493978_7.pdf

Appendix 2: Michigan Public Service Commission, Opinion and Order, In the matter of the Application of Lakehead Pipe Line Company for approval of construction and operation of a common carrier oil pipeline (Case D-3903-53.1, March 31, 1953). http://www.michigan.gov/documents/deq/Appendix_A.3_493982_7.pdf

Appendix 3: "Engineering and Construction Considerations for the Mackinac Pipeline Company's Crossing of the Straits of Mackinac" and "Report on the Structural Analysis of the Subaqueous Crossing of the Mackinac Straits,"by Dr. Mario G. Salvadori, P. E., Department of Civil Engineering, Columbia University, New York 27, NY, (January 19, 1953) submitted by Mackinac Pipeline Company/Lakehead Pipeline Company to the Michigan Department of Conservation, January, 1953." http://www.michigan.gov/documents/deq/Appendix_A.2_493980_7.pdf

Appendix 4: J. J. McManus, W. L. Pemie, and A. Davies, "HOT APPLIED COAL TAR COATINGS," Allied Chemical Corporation, Plastics Division, Morristown, N. J., Engineering Experiment Station Bulletin 72 (1964): p. 144-156. https://web.anl.gov/PCS/acsfuel/.preprint%20archive/Files/09_4_ATLANTIC%20CITY_09-65_0144.pdf

Appendix 5: List of Communities Resolutions Demanding the State of Michigan to Address the Risk Posed by Line 5 Pipelines in the Straits of Mackinac.

Appendix 6: Enbridge's November 19, 2014 Letter and Attachment to Attorney General Schuette and DEQ Director Wyant re: Joint July 24, 2104 State Letter on Easement Violation of Maximum Unsupported Span. http://www.michigan.gov/documents/deq/Appendix_B.4_493991_7.pdf; and Dr. Ed Timm's chart on Unsupported Span Data from Enbridge's November 19, 2014 Letter.

Appendix 7: Enbridge (Adam Erickson) to MDEQ (John Arevalo), Enbridge Joint Permit Application for Repair Work to be Completed on Crude Oil Transmission Pipelines Located in the Straits of Mackinac, September 14, 2001.

Appendix 8: Permit Application and Email from Enbridge Jacob Jorgenson to Scott Rasmussen (DEQ) and Gina Nathan (ACE), Nov. 18, 2010.

Appendix 9: Additional Information on Easement Violations

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APPENDIX 1

STRAITS OF MACKINAC PIPE LINE EASEMENT

CONSERVATION COMMISSION OF THE STATE OF MICHIGAN

TO

LAKEHEAD PIPE LINE COMPANY, INC.

THIS EASEMENT, executed this twenty-third day of April, A. D. 1953, by the State of Michigan by the Conservation Commission, by Wayland Osgood, Deputy Director, acting under and pursuant to a resolution adopted by the Conservation Commission at its meeting held on February 13, 1953, and by virtue of the authority conferred by Act No. 10, P. A. 1953, hereinafter referred to as Grantor, to Lakehead Pipe Line Company, Inc., a Delaware corporation, of 510 22nd Avenue East, Superior, Wisconsin, hereinafter referred to as Grantee,

W I T N E S S E T H:

WHEREAS, application has been made by Grantee for an easement authorizing it to construct, lay and maintain pipe lines over, through, under and upon certain lake bottom lands belonging to the State of Michigan, and under the jurisdiction of the Department of Conservation, located in the Straits of Mackinac, Michigan, for the purpose of transporting petroleum and other products; and

WHEREAS, the Conservation Commission is of the opinion that the proposed pipe line system will be of benefit to all of the people of the State of Michigan and in furtherance of the public welfare; and

WHEREAS, the Conservation Commission duly considered the application of Grantee and at its meeting held on the 13th day of February, A. D. 1953, approved the conveyance of an easement.

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NOW, THEREFORE, for and in consideration of the sum of Two Thousand Four Hundred Fifty Dollars ($2,450.00), the receipt of which is hereby acknowledged, and for and in consideration of the undertakings of Grantee and subject to the terms and conditions set forth herein, Grantor hereby conveys and quit claims, without warranty express or implied, to Grantee an easement to construct, lay, maintain, use and operate two (2) pipe lines, one to be located within each of the two parcels of bottom lands hereinafter described, and each to consist of twenty inch (20") O D pipe, together with anchors and other necessary appurtenances and fixtures, for the purpose of transporting any material or substance which can be conveyed through a pipe line, over, through, under and upon the portion of the bottom lands of the Straits of Mackinac in the State of Michigan, together with the right to enter upon said bottom lands, described as follows:

> All bottom lands of the Straits of Mackinac, in the State of Michigan, lying within an area of fifty (50) feet on each side of the following two center lines:
>
> (1) Easterly Center Line: Beginning at a point on the northerly shore line of the Straits of Mackinac on a bearing of South twenty-four degrees, no minutes and thirty-six seconds East (S 24° 00' 36" E) and distant one thousand seven hundred and twelve and eight-tenths feet (1,712.8') from United States Lake Survey Triangulation Station "Green" (United States Lake Survey, Latitude 45° 50' 00", Longitude 84° 44' 58"), said point of beginning being the intersection of the center line of a twenty inch (20") pipe line and the said northerly shore line; thence, on a bearing of South fourteen degrees thirty-seven minutes and fourteen seconds West (S 14° 37' 14" W) a distance of nineteen thousand one hundred and forty-six and no tenths feet (19,146.0') to a point on the southerly shore line of the Straits of Mackinac which point is the intersection of the said center line of the twenty inch (20") pipe line and the said southerly shore line; and is distant seven hundred and seventy-four and seven tenths feet (774.7') and on a bearing of South thirty-six degrees, eighteen minutes and forty-five seconds West (S 36° 18' 45" W) from United States Lake Survey Triangulation Station "A. Mackinac West Base" (United States

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Lake Survey, Latitude 45° 47' 14", Longitude 84° 46' 22").

(2) Westerly Center Line: Beginning at a point on the northerly shore line of the Straits of Mackinac on a bearing of South forty-nine degrees, twenty-five minutes and forty-seven seconds East (S 49° 25' 47" E) and distant two thousand six hundred and thirty-four and nine tenths feet (2,634.9') from United States Triangulation Station "Green" (United States Lake Survey, Latitude 45° 50' 00", Longitude 84° 44' 58") said point of beginning being the intersection of the center line of a twenty inch (20") pipe line and the said northerly shore line; thence on a bearing of South fourteen degrees, thirty-seven minutes and fourteen seconds West (S 14° 37' 14" W), a distance of nineteen thousand four hundred and sixty-five and no tenths feet (19,465.0') to a point on the southerly shore line of the Straits of Mackinac which point is the intersection of the said center line of the twenty inch (20") pipe line and the said southerly shore line and is distant one thousand no hundred and thirty-six and four tenths feet (1,036.4') on a bearing of South sixty-three degrees, twenty minutes and fifty-four seconds East (S 63° 20' 54" E) from United States Lake Survey Triangulation Station "A. Mackinac West Base" (United States Lake Survey, Latitude 45° 47' 14", Longitude 84° 46' 22").

TO HAVE AND TO HOLD the said easement unto said Grantee, its successors and assigns, subject to the terms and conditions herein set forth, until terminated as hereinafter provided.

This easement is granted subject to the following terms and conditions:

A. Grantee in its exercise of rights under this easement, including its designing, constructing, testing, operating, maintaining, and, in the event of the termination of this easement, its abandoning of said pipe lines, shall follow the usual, necessary and proper procedures for the type of operation involved, and at all times shall exercise the due care of a reasonably prudent person for the safety and welfare

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of all persons and of all public and private property, shall comply with all laws of the State of Michigan and of the Federal Government, unless Grantee shall be contesting the same in good faith by appropriate proceedings, and, in addition, Grantee shall comply with the following minimum specifications, conditions and requirements, unless compliance therewith is waived or the specifications or conditions modified in writing by Grantor:

(1) All pipe line laid in water up to fifty (50) feet in depth shall be laid in a ditch with not less than fifteen (15) feet of cover. The cover shall taper off to zero (0) feet at an approximate depth of sixty-five (65) feet. Should it be discovered that the bottom material is hard rock, the ditch may be of lesser depth, but still deep enough to protect the pipe lines against ice and anchor damage.

(2) Minimum testing specifications of the twenty inch (20") OD pipe lines shall be not less than the following:

Shop Test----------1,700 pounds per square inch gauge
Assembly Test------1,500 pounds per square inch gauge
Installation Test--1,200 pounds per square inch gauge
Operating Pressure- 600 pounds per square inch gauge

(3) All welded joints shall be tested by X-Ray.

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(4) The minimum curvature of any section of pipe shall be no less than two thousand and fifty (2,050) feet radius.

(5) Automatic gas-operated shut-off valves shall be installed and maintained on the north end of each line.

(6) Automatic check valves shall be installed and maintained on the south end of each line.

(7) The empty pipe shall have a negative buoyancy of thirty (30) or more pounds per linear foot.

(8) Cathodic protection shall be installed to prevent deterioration of pipe.

(9) All pipe shall be protected by asphalt primer coat, by inner wrap and outer wrap composed of glass fiber fabric material and one inch by four inch (1" x 4") slats, prior to installation.

(10) The maximum span or length of pipe unsupported shall not exceed seventy-five (75) feet.

(11) The pipe weight shall not be less than one hundred sixty (160) pounds per linear foot.

(12) The maximum carbon content of the steel, from which the pipe is manufactured, shall not be in excess of .247 per cent.

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(13) In locations where fill is used, the top of the fill shall be no less than fifty (50) feet wide.

(14) In respect to other specifications, the line shall be constructed in conformance with the detailed plans and specifications heretofore filed by Grantee with Lands Division, Department of Conservation of the State of Michigan.

B. Grantee shall give timely notice to the Grantor in writing:

(1) Of the time and place for the commencement of construction over, through, under or upon the bottom lands covered by this easement, said notice to be given at least five (5) days in advance thereof;

(2) Of compliance with any and all requirements of the United States Coast Guard for marking the location of said pipe lines;

(3) Of the filling of said pipe lines with oil or any other substance being transported commerially;

(4) Of any breaks or leaks discovered by Grantee in said pipe lines, said notice to be given by telephone promptly upon discovery and thereafter confirmed by registered mail;

(5) Of the completion of any repairs of said pipe lines, and time of testing thereof, said notice to be given in sufficient time to permit Grantor's authorized representatives to be present at the inspection and testing of the pipe lines after said repairs; and

(6) Of any plan or intention of Grantee to abandon said pipe lines, said notice to be given at least sixty (60) days prior to commencement of abandonment operations.

C. The easement herein conveyed may be terminated by Grantor:

(1) If, after being notified in writing by Grantor of any specified breach of the terms and conditions of this easement, Grantee shall fail to correct said breach within ninety (90) days, or, having commenced remedial action within such ninety (90) day period, such later time as it is reasonably possible for the Grantee to correct said breach by appropriate action and the exercise of due diligence in the correction thereof; or

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(2) If Grantee fails to start construction of the pipe lines authorized herein within two years from date of execution of this instrument; or

(3) If Grantee fails for any consecutive three-year period to make substantial use of said pipe lines commercially and also fails to maintain said pipe lines during said period in such condition as to be available to commercial use within thirty (30) days.

D. Construction of the pipe lines contemplated by this instrument shall not be commenced until all necessary authorization and assent of the Corps of Engineers, United States Army, so far as concerns the public rights of navigation, shall have been obtained.

E. In the event of any relocation, replacement, major repair, or abandonment of either of the pipe lines authorized by this easement, Grantee shall obtain Grantor's written approval of procedures, methods and materials to be followed or used prior to commencement thereof.

F. The maximum operating pressure of either of said pipe lines shall not exceed six hundred (600) pounds per square inch gauge.

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If there is a break or leak or an apparent break or leak in either of said pipe lines, or if Grantor notifies Grantee that it has good and sufficient evidence that there is or may be a break or leak therein, Grantee shall immediately and completely shut down the pipe line involved and said pipe line shall not be placed in operation until Grantee has conducted a shut-in two (2) hour pressure test of six hundred (600) pounds per square inch gauge showing that no substance is escaping from a break or leak in said pipe line.

G. If oil or other substance escapes from a break or leak in the said pipe lines, Grantee shall immediately take all usual, necessary and proper measures to eliminate any oil or other substance which may escape.

H. In the event the easement herein conveyed is terminated with respect to either or both of said pipe lines, or if any part or portion of a pipe line is abandoned, Grantee shall take all of the usual, necessary and proper abandonment procedures as required and approved by Grantor. Said abandonment operations shall be completed to the satisfaction of Grantor within one year after any abandonment of any part or portion of a pipe line; or in event of termination of this easement, within one year thereafter. After the expiration of one year following the termination of this easement, Grantee

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shall at the option of Grantor quit claim to the State of Michigan all of its right, title and interest in or to any pipe line, appurtenances or fixtures remaining over, through, under or upon the bottom lands covered by this easement. Abandonment procedures as used herein include all operations that may be reasonably necessary to protect life and property from subsequent injury.

I. Grantee shall permit Grantor to inspect at reasonable times and places its records of oil or any other substance being transported in said pipe lines and shall, on request, submit to Grantor inspection reports covering the automatic shut-off and check valves and metering stations used in connection with the Straits of Mackinac crossing.

J. (1) Grantee shall indemnify and hold harmless the State of Michigan from all damage or losses caused to property (including property belonging to or held in trust by the State of Michigan), or persons due to or arising out of the operations or actions of Grantee, its employees, servants and agents hereunder. Grantee shall place in effect prior to the construction of the pipe lines authorized by this easement and shall maintain in full force and effect during the life of this easement, and until Grantor has approved completion of abandonment operations, a Comprehensive Bodily Injury and Property Damage Liability policy, bond or surety, in form and substance acceptable to Grantor in the sum of at least One Million Dollars ($1,000,000.00), covering the liability herein imposed upon Grantee.

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(2) Grantee, prior to commencing construction of the pipe lines authorized by this easement, shall provide the State of Michigan with a surety bond in the penal sum of One Hundred Thousand Dollars ($100,000.00) in form and substance acceptable to Grantor, and surety or sureties approved by Grantor, to well, truly and faithfully perform the terms, conditions and requirements of this easement. Said bond shall be maintained in full force and effect during the life of this easement and until Grantor has approved completion of Grantee's abandonment operations. Said bond shall not be reduced in amount except with the written consent of Grantor.

K. Grantee shall within sixty (60) days thereafter notify Grantor in writing of any assignment of this easement.

L. The terms and conditions of this easement shall be binding upon and inure to the benefit of the respective successors and assigns of Grantor and Grantee.

M. All rights not specifically conveyed herein are reserved to the State of Michigan.

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N. Grantee shall not improvise, construct or maintain ship-to-shore or ship-to-pipe line loading or unloading facilities over, through, under or upon any of the bottom lands herein described for the purpose of removing material from or injecting material into said pipe lines.

O. Grantor shall have the right at all reasonable times and places to inspect the pipe lines, appurtenances and fixtures authorized by this easement.

P. It shall not be a breach of the terms and conditions of this easement if for operating or maintenance reasons Grantee shall make use of only one of said pipe lines at a time.

Q. Where provision is made herein that Grantee shall obtain the authorization, approval or consent of Grantor, Grantor agrees that it will not unreasonably withhold the same.

IN WITNESS WHEREOF, the State of Michigan by the Conservation Commission, by Wayland Osgood, Deputy Director, acting pursuant to authority specifically conferred upon him, has caused this instrument to be executed this twenty-third day of April, A.D. 1953.

Signed, Sealed and Delivered
in the Presence of:

/s/ Jane Bower
Jane Bower

/s/ Elizabeth Soule
Elizabeth Soule

STATE OF MICHIGAN
BY THE CONSERVATION COMMISSION

By /s/ Wayland Osgood
Wayland Osgood, Deputy Director, pursuant to resolutions of the Conservation Commission dated February 13, 1953 and July 10, 1951

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STATE OF MICHIGAN)
) ss.
COUNTY OF INGHAM)

On this twenty-third day of April, A.D. 1953, before me, a Notary Public, in and for said county, personally appeared Wayland Osgood, Deputy Director, known by me to be the person who executed the within instrument and who, being duly sworn, deposes and says that he is the duly appointed deputy director of the Conservation Commission and that he executed the within easement under authority specifically conferred upon him by law and by the Conservation Commission at its meetings held on February 13, 1953 and July 10, 1951, and who acknowledged the same to be his free act and deed and the free act and deed of the State of Michigan by the Conservation Commission, in whose behalf he acts.

/s/ C. R. Humphrys
C. R. Humphrys, Notary Public, Ingham County, Michigan
My Commission expires September 20, 1954

Examined and approved 4/23/53
as to legal form and effect:

/s/ R. Glen Dunn
Assistant Attorney General

APPENDIX 2

STATE OF MICHIGAN

BEFORE THE MICHIGAN PUBLIC SERVICE COMMISSION

* * * * *

In the matter of the application of LAKEHEAD PIPE LINE COMPANY, INC. for approval of construction and operation of a common carrier oil pipe line.	D-3903-53.1

At a session of the Michigan Public Service Commission held at its offices in the city of Lansing on the 31st day of March A. D. 1953.

PRESENT: Hon. John H. McCarthy, Chairman
Hon. Maurice E. Hunt, Commissioner
Hon. John M. Veale, Commissioner

OPINION AND ORDER

On the 2nd day of February 1953, the Lakehead Pipe Line Company, Inc. (Lakehead), a Delaware corporation, with its principal office located at 100 W. Tenth Street, City of Wilmington, County of New Castle, Delaware, and with its present Michigan office at 1881 National Bank Building, Detroit, Michigan, a wholly owned subsidiary of Interprovincial Pipe Line Company, a Canadian corporation, filed with this Commission an application requesting approval of the location and construction of a 30" O.D. welded steel pipe line including two 20" O.D. welded steel pipe lines across

the Straits of Mackinac, together with the fixtures and equipment appurtenant thereto for the purpose of carrying and transporting crude oil and petroleum as a common carrier in interstate and foreign commerce, the proposed location of said lines within Michigan being described generally as follows:

> Entering the State of Michigan from the State of Wisconsin at a point near Ironwood, Michigan, thence proceeding in an easterly direction through the counties of Gogebic, Iron, Dickinson, Marquette, Delta, Schoolcraft and Mackinac to a point on the north boundary of the Straits of Mackinac, thence in a southerly direction under said Straits to a point on the south boundary thereof, thence in a southeasterly direction through the counties of Emmet, Cheboygan, Otsego, Crawford, Oscoda, Ogemaw, Arenac and Bay to a point between Saginaw and Bay City, thence in a southeasterly direction through the counties of Tuscola, Lapeer, Sanilac and St. Clair to a point on the international boundary in the St. Clair River, south of the City of Port Huron. (The above route is subject to minor changes after an on-the-ground survey, presently in progress, has been completed).

After due and proper notice, hearing was held on this matter at the offices of the Commission in Lansing, Michigan, on the 20th day of March A. D. 1953. Appearances for intervenors were entered by counsel for Michigan-Ohio Pipeline Company; Township of Denmark, Tuscola County; Tuscola County Drain Commission; and a group of land owners in Bay County along the proposed right-of-way consisting of John G. Zeigler, et al. Representatives were also present from Township Boards, County Road Commissions and from the State Highway

Department.

At the hearing, applicant requested permission to amend its application by inserting the words "operation and maintenance" after the word construction in the final paragraph of the petition, and objection thereto was made by counsel for Denmark Township, Tuscola County.

It appears to the Commission that such amendment would not prejudice any of the parties present at the hearing, and if re-noticed and re-heard would not include any additional parties not having received notice of the instant hearing. It is immediately apparent that the pipe line, if constructed, must be operated and maintained in the same location where constructed, hence such amendment, but makes specific what is otherwise reasonably implied; therefore, the amendment to the application is proper and is hereby received.

The proposed pipe line above described is an extension of an existing pipe line owned and operated by petitioner, Lakehead Pipe Line Company, Inc., as a common carrier, for the transportation of crude oil and petroleum in interstate and foreign commerce from the international boundary between the United States and Canada near Neche, North Dakota, to Superior, Wisconsin.

The sole present source of oil for this pipe line is the Interprovincial Pipe Line Company, which in turn has its source of supply from the Redwater area north of Edmonton,

Alberta, Canada. The Petroleum Administration for Defense has given priority for materials for this pipe line. It appears to this Commission that in times of national emergency delivery of crude oil for joint defense purposes would be greatly enhanced by operation of the proposed pipe line.

The petitioner filed with its petition a map or plat of such proposed pipe line showing the approximate route to be traversed. Upon completion of the pipe line a more detailed map will be filed showing the exact location of the pipe line as laid.

It is not anticipated that any pumping stations will be built in Michigan in 1953, but as the throughput increases according to the present forecast of the petitioner, additional pumping stations will be built in Michigan at or near the following locations:

Watersmeet, Gogebic County
Gulliver, Schoolcraft County
Indian River, Cheboygan County
Bay City, Bay County.

It was represented by the petitioner that the proposed pipe line will be constructed of 30" O.D. x 9/32" high strength expanded, welded pipe. At the discharge of the No. 1 Pump Station at Superior, Wisconsin, there will be a few miles of 5/16" or 11/32" wall pipe. River crossings will be made using 30" x 1/2" wall pipe of the same specification. The Mackinac Straits crossing will consist of two parallel lines

laid approximately 1,000 ft. apart and these lines will be 20" x .812" wall thickness.

It was further represented by the petitioner that the specifications of the pipe to be used are as follows:

30" Pipe will be constructed to API specifications 5LX-52, having a guaranteed minimum yield strength as follows:

1. For thicknesses 3/8" and below, 52,000 psi.
2. Thicknesses 7/16" to 3/8" have 48,000 psi.
3. Thicknesses 1/2" to 7/16", 46,000 psi.

The 20" schedule 60 (.812" wall) pipe is API specifications 5L Grade A.

The joints will be made by welding except where otherwise required as in the case of insulating flanges and certain control valves.

The pipe line will be designed for a normal operating pressure at the pumping stations of 500-550 pounds per square inch except for the first station at Superior, Wisconsin, which may operate at approximately 700 pounds per square inch until station 2 is put into operation.

The minimum mill test pressure is approximately 138% of the maximum allowable working pressure of the pipe in the line. After completion of construction, a test pressure of 740 psig at the outlet of the Superior pumping station will be placed on the line under "no flow" conditions. The minimum test pressures and the allowable working pressures for various diameters and wall thicknesses of pipe to be used are approximately as follows:

Size	Minimum Mill Test Pressures	Maximum Allowable Working Pressures
30" x 1/2"	1242 lbs. per sq. inch	894 lbs. per sq. inch
30" x 11/32"	965 lbs. per sq. inch	695 lbs. per sq. inch
30" x 5/16"	878 lbs. per sq. inch	632 lbs. per sq. inch
30" x 9/32"	790 lbs. per sq. inch	570 lbs. per sq. inch
24" x 5/16"	1097 lbs. per sq. inch	790 lbs. per sq. inch
20" x .812"	1700 lbs. per sq. inch	1200 lbs. per sq. inch

The capacity of the pipe line with no pumping stations in Michigan will be 120,000 barrels per day and when all of the above pumping stations are constructed and in operation the capacity will be 300,000 barrels per day.

The portion of the line that is buried will have a minimum cover of 36" except that in rock the minimum cover will be 24". In rivers, creeks, ditches, ravines and similar locations the minimum cover will be 48".

The entire pipe line will be properly cleaned, primed and coated with a single application of coal tar. The coating will be reinforced by a spiral wrap of glass material and covered by a spiral wrap of special glass outer wrap. Preparations will be made for cathodic protection.

The entire pipe line will be designed in accordance with conservative pipe line practices and under codes applicable to such pipe lines. The presently proposed line and future pump stations will be designed in accordance with the A.S.A. Code for Pressure Piping (Code) where this code is applicable.

The Code provides for two classes of construction for oil transmission pipe lines, namely, Division A and Division B. The Division A requirements allow greater factors of safety and, among other places, are imposed inside cities and villages within the developed residential, business, and industrial areas. In this case the present information does not permit a determination as to whether there would be any Division A construction required, though it is stated that the line is expected to pass within the corporate limits of four cities and villages.

The petitioner, being engaged in interstate and foreign transportation of crude oil and petroleum, must file its tariffs or schedule of rates and charges with the Interstate Commerce Commission. Although the petitioner contemplates providing take-off points for the delivery of crude oil in Michigan, tariffs for any delivery points in the State of Michigan have not yet been determined but when determined and filed with the Interstate Commerce Commission, copies thereof will be supplied to this Commission.

The petitioner has filed its explicit authorized acceptance of the provisions of Act 16, P.A. 1929, as amended.

The Prosecuting Attorney of Tuscola County on behalf of Tuscola County Drain Commissioner, having requested that any grant of authority to applicant contain certain reservations in favor of the County Drain Commissioner, and it appearing to this Commission that such reservations are not

within this Commission's jurisdiction in the matter, but are more properly the subject of negotiation between the parties under other provisions of Act 16, P.A. 1929, as amended, the request hereinbefore mentioned is denied. However, it is recommended that the applicant incorporate the foregoing reservations in its future negotiations with the Drain Commissioners of this state.

Examination of witness T. S. Johnston, President of Lakehead, was of such probative value that the witness agreed to a change in policy employed by agents of the company in obtaining options for right of way. Also, testimony as to the method employed in replacing land drain tile displaced by construction would appear to be reasonable and a conscientious attempt on the part of the petitioner to safeguard private property. While the scope of the examination was in some respects beyond the ordinary jurisdiction of this Commission, we are of the opinion that by reason of statements and correspondence in the file on this matter the applicant intends to operate so as to create a minimum of hardship to the landowners.

Counsel for Denmark Township, Tuscola County and property owners in Bay County moved that the application be denied and in support thereof contended that the proposed project was not in the public interest and that the applicant intended to conduct a private business thereby excluding applicant from the provisions of Act 16, P.A. 1929, as amended. However, the Commission deems these contentions to be without merit and the motions based thereon are hereby denied.

After careful consideration of this matter the Commission FINDS that the petitioner should be authorized to construct, operate and maintain this line as a common carrier as represented by the applicant.

NOW THEREFORE, IT IS HEREBY ORDERED by the Michigan Public Service Commission that the Lakehead Pipe Line Company, Inc. be and the same is authorized to construct, operate and maintain as a common carrier the 30" oil pipe line consisting of approximately 630 miles of 30" O.D. pipe and approximately 10 miles of 20" O.D. pipe (the latter to be used for crossing the Straits of Mackinac), said pipe line to be constructed of the material and over the route as hereinbefore described.

IT IS FURTHER ORDERED that the specifications filed with the petition and presented at the hearing are hereby approved and the said pipe line shall be constructed in accordance therevith; and, in all cases the construction shall be equal to or better than that prescribed for oil transmission pipe lines by the Code for Pressure Piping as approved by the American Standards Association.

IT IS FURTHER ORDERED that detailed information shall be furnished the Commission, prior to actual construction, on the location and character of buildings within 150 feet of the pipe line in all incorporated cities or villages through which the line passes, at which time the Commission will determine whether Division A or Division B construction shall be required at such locations.

IT IS FURTHER ORDERED that the petitioner shall comply in all respects with the provisions of Act 16 of the Public Acts of Michigan for 1929 subject to all the duties and obligations thereby imposed, and with all the rights and privileges by said Act conferred.

IT IS FURTHER ORDERED that the map or plat filed by the petitioner with the Commission be and the same is hereby approved and that within 90 days after the completion of the construction of said line the petitioner shall file a more detailed map showing the exact location of the said pipe line as laid.

The Commission hereby specifically reserves unto itself jurisdiction of this matter and the right to make any other or further orders herein which in its judgment should be hereafter made.

(S E A L)

MICHIGAN PUBLIC SERVICE COMMISSION

/s/ John H. McCarthy
Chairman

By the Commission and
pursuant to its action
of March 31, 1953

S. A. LUND
Its Secretary

/s/ Maurice E. Hunt
Commissioner

STATE OF MICHIGAN

BEFORE THE MICHIGAN PUBLIC SERVICE COMMISSION

* * * * *

In the matter of the application of LAKEHEAD PIPE LINE COMPANY, INC. for approval of construction and operation of a common carrier oil pipe line.	D-3903-53.1

CONCURRING OPINION

Upon consideration of the record in these proceedings and the argument of counsel relating thereto, I concur in the opinion of the Commission that applicant is a common carrier of property and that its operations in Michigan are affected with a public interest. The order therefore, giving applicant the benefit of Act 16, P.A. 1929, as amended, is proper.

This matter is of considerable import to the United States, the Dominion of Canada, the Province of Ontario, and the State of Michigan. Accordingly, I believe some clear expression of broad policy and economic aspects should be made.

Applicant proposes to transport property as a common carrier for hire between two points in the Dominion of Canada, traversing, inter alia, some 630 miles in the State of Michigan. The property to be transported will originate in the Province of Alberta and be delivered to the Province of Ontario. This

transportation will be of great mutual benefit to these provinces. To permit this, the State of Michigan hereby confers upon Canadian citizenry the right to construct and operate the facilities required to perform such transportation, including the right to condemn the property of Michigan citizens.

This action, in my opinion, is justified as a step in the development of proper international, provincial and state trade cooperation. Its import, and similarity to certain other trade problems, should not be overlooked by our Canadian neighbors, particularly by brethern in the Province of Ontario. Therefore, I sign this order with the hope that it will take its place as an integral part of the movement for the freer exchange of trade and transportation facilities by the various governments herein concerned.

(S E A L)

/s/ John M. Veale
John M. Veale, Commissioner

APPENDIX 3

ENGINEERING and CONSTRUCTION CONSIDERATIONS for the MACKINAC PIPELINE COMPANY'S CROSSING of the STRAITS of MACKINAC

The Mackinac Pipeline Company and its Consulting Engineers have placed the greatest importance on the safety factors affecting their pipeline crossing of the Straits of Mackinac.

Early in the planning stages, it was realized that every possible precaution should be taken to insure continuous and uninterrupted service of the pipeline, as a permanent installation for supplying crude oil to the refineries at Sarnia, Ontario. Not only would the construction of such a line be a very costly venture, which would have to be completed during the relatively brief period during late spring and summer when the Straits were not frozen over, but the loss in revenue which would result from any possible break in the line and shutdown in the flow of oil, would be of the most serious importance.

Any precautions which might be taken to prevent this would be fully justified. The seriousness of possible contamination of the Lake waters was considered and every effort has been made to insure that this could not happen.

With this importance associated with the design of the crossing, thorough investigations were made of every conceivable factor affecting the safety of the pipeline. A route was chosen across the narrowest part of the Straits, from Point La Barbe on the St. Ignace side to McGulpin Point just west of Mackinaw City.

For purposes of extra flexibility, extra strength and a greater factor of safety against possible damage, two smaller size lines of extra heavy wall pipe were chosen, operating in parallel and approximately 1300 feet apart.

These two 20" lines will parallel the submarine cable of the Michigan Bell Telephone Company. One will be located approximately 800 feet to the west of the cable and the other approximately 500 feet to the east.

In selecting the exact location for each line, full advantage was taken of the hydrographic survey and test boring information available from the report for the proposed bridge across the Straits. Mr. Glenn Woodruff, who was a consultant on that investigation, was called in, in a consulting capacity to assist in preparing a recommendation for the construction of this crossing.

Echo soundings of the entire Straits' bottom were furnished by the U. S. Lake Survey, Corps of Engineers and U. S. Army.

This method provides a continuous sounding, correct to approximately a half foot, for all of the possible routes. After intensive study of the bottom profiles, plotted from these soundings, the two best routes were chosen for the lines, based on the most even profile, eliminating as many changes of grade or curvature of pipe as possible, in turn, eliminating causes of pipe stress. Sharp "dips" and "humps" were avoided wherever possible, and the relatively few places where these conditions occur, it will be possible to excavate or fill the area

to provide an even bed, within allowable limits of curvature, on which the pipe will rest. Side slopes were avoided, as far as possible, where the pipe might have a tendency to roll. This condition was thoroughly investigated and it was found that a 4 degree or smaller slope would offer no problem, even if the pipe did not sink into the soft bottom material. From discussions with Professors Baier and Landes of the University of Michigan, Departments of Engineering and Geology respectively, it seems quite certain that the material in the deep area is a fairly soft clay material which would permit the pipe to settle into position and probably bury itself, eliminating any possibility of movement.

Extensive investigations were made of ships' anchoring practices in the Straits and it was determined that rarely, if ever, do ships anchor in the Narrows, in the vicinity of the telephone cable and the area where the pipeline will be constructed. In case of a storm or heavy fog, the safer place to anchor would be in one of the sheltered bays or protected areas rather than in the actual Narrows. The telephone cable has never been damaged by ships' anchors, according to our discussion with their engineers, even though it lays unburied and unprotected on the floor of the Straits. As protection against ice packs or other possible damage in the shallow area, it has been decided to bury the lines to a safe depth, from shore out to a point where the water is 40 to 50 feet deep. From that point on, the amount of cover will "taper off" and the lines will lie on the bottom with no cover, in the deeper area.

The pipe itself has been specified to meet certain critical requirements as to a high degree of ductility, extra heavy wall thickness, low carbon content, and very rigid inspection during its manufacture. The pipe will meet the requirements of API Specifications 5L for Grade A Seamless Steel pipe, with the added provisions that the maximum carbon content is to be held to .22 to .24%, the minimum yield strength is to be 30,000 psi and the maximum yield strength is to be 44,000 psi with the pipe having a yield of 30,000 to 34,000 psi selected for installation in the deep unburied portion of the line, because of its higher degree of ductility. The pipe will be 20" O.D. with a wall thickness of .812" and will weigh 166.40 lb. per foot with a weight tolerance of -1.75% per carload lot. It will be given a hydrostatic shop test of 1700 psi. This specification provides the best chemical and physical characteristics for pipe to fit the critical conditions which have been considered in this crossing.

The pipe will be preheated, electric shield-arc welded, X-rayed, and multiple joints welded together on shore will be tested to 1500 psi. After coating with asphalt primer, fiberglass inner wrap and an asbestos felt outer wrap, and after attaching 1" X 4" wood slats to the full circumference of the pipe, it will be lowered into a previously prepared "bed" on the floor of the Straits. It will be protected from excessive curvatures in bending during the laying operation, and will be placed on a bed which will insure spans no greater than those allowable for this particular pipe, and vertical curves within the allowable bending limits. After the lines are completed, they will be given a 1200 psi hydrostatic test, in place.

To take care of the "one chance in a million" that the line may be broken by a sinking ship or some similar accident, automatic shut-off valves have been specified for installation in the upstream piping manifold. These valves will automatically close upon a pressure drop in the line. On the downstream side of the line, check valves will be installed in the manifold preventing back-flow in the line in the event of any possible break.

An extensive study of the structural behavior of the pipe has been made. A copy of the calculations is attached to this report. The study comprises all possible load conditions and every geometric configuration the pipe may take when laid according to the specifications. In each of these conditions, conservative assumptions have been made so that in their overall combination a substantial additional safety factor has been introduced.

The following stresses have been investigated:

1. Hoop stresses or those which tend to burst the pipe.
2. Longitudinal tension or compression stresses.
3. Bending stresses in a horizontal and/or vertical plane.
4. Shear stresses.
5. Torsion stresses.
6. Combination of any or all of the above stresses which produce the maximum critical stresses.

Methods of analysis based upon accepted engineering practice and accepted formulas of the theory of elasticity have been used to determine these stresses.

The stresses mentioned above have been determined for the following loading conditions:

1. Weight of the pipe empty or filled with water or oil taking into account the uplift of the submerged pipe.
2. Outside pressure due to water currents.
3. Interior pressures for operating as well as testing conditions.
4. Bending of the pipe due to the conformation of the line to the bottom of the Straits or trench.
5. Stresses due to oil temperature changes and due to the temperature differential between the oil in the pipe and the water outside.
6. Hydrostatic pressure exerted on the outside of the pipe in case the pipe is empty.

As we follow the calculations attached to this report, we find that first, the lateral pressure of the current on the pipe and the weight of the pipe were determined, computing the resulting bending stresses, under the assumption that certain portions the pipe may span, unsupported over a valley. A table was developed showing the stresses for different span lengths. Then the stresses due to internal pressure, under operating and test conditions, were calculated and added to the stresses due to current and weight. A second table shows these combined stresses. It served to determine the maximum allowable unsupported span over a valley, once the maximum allowable stress had been established. For this condition, the conservative assumption of a beam on simple supports was used, ignoring the favorable influence of span continuity.

The next step was to determine the maximum curvature which the pipe would be permitted to assume in its final position on the bottom. By conforming to the bottom of the Straits or trench, stresses are introduced in the pipe which are similar to those due to bending. This means that the same loading conditions govern the specification of the maximum curvature as were used to determine the maximum unsupported span.

The calculations described in the preceding paragraphs were found sufficient to specify the profile to which the pipe should conform in its final position at the bottom of the Straits. Another series of computations was made to make sure that the pipe would suffer dangerous additional stresses and that it would stay in the position specified. A description of these additional computations and an evaluation of their influence upon the pipe is given in the following paragraphs:

The maximum shear stress was determined for the most unfavorable combination of loading conditions and it was found that these stresses are within the allowable limit specified for the pipe material.

Longitudinal temperature stresses were determined using an assumed temperature differential of 40 degrees F., plus or minus.

An investigation of the lateral displacement of the pipe in any straight run on the bottom, due to thermal buckling, indicates that the induced longitudinal stresses will be relieved due to such lateral displacement.

The ring thermal stresses due to a temperature differential of 30 degrees F between the interior and exterior of the pipe was investigated under the assumption of a thick pipe. These stresses are mainly hoopstresses and have been added to the hoopstresses due to internal pressure. Since the hoopstresses are not governing for the specifications of the profile, these are not affected.

The rolling and sliding effect on the pipe due to sloped banks and the action of the current was considered. The friction was found to be great enough to prevent sliding. The torsional shear and moment values were found to be far short of critical, and effectively prevent the pipe from rolling.

The sliding or lateral movement of a straight run of the pipe on the bottom was investigated for the two conditions of a full pipe and of an empty pipe, due to current. In these calculations no allowance has been made for the favorable fact that the pipe will settle into the top layer of the bottom. Taking this into account, the pipe will not be displaced by the water currents in the Straits.

Another consideration was the possibility of the pipe resting on a sharp edge. The stresses due to this condition are not great and are very localized, hence they do not constitute any hazard for the pipe.

An investigation of the catenary action on a free span was made. This occurs only if the ends of the pipe are prevented from moving towards each other. A reduction of approximately 20% in displacement was derived, which relieves the bending stresses.

The possible vibration induced by pumps or steady current flow were considered and found to be of little consequence.

The factors discussed in this report are believed to be those of the greatest concern in the development of a safe and efficient design. All forseeable conditions, as described, have been carefully investigated, and have been found to satisfy the design criteria and conditions established.

Any possible contamination of the waters, caused by oil spillage from the pipeline crossing is considered remote in comparison to the amount and possibility of spillage from oil tankers.

Letters are attached from Mr. Glenn B. Woodruff, Consulting Engineer, Mr. H. H. Hall, Consulting Engineer (previously, Chief Engineer, Standard Oil Company of California) and Mr. J. M. Evans, Chief Engineer, Standard Oil Company of California, Prof. L. A. Baier, Department of Architecture and Marine Engineering, University of Michigan, and from Prof. M. Salvadori, Professor of Civil Engineering, Columbia University. These men have been consulted on various phases of the investigation and design of the crossing, and have indicated their complete confidence in the safety and soundness of this engineering and construction venture.

Dr. Mario G. Salvadori, P. E.
Consulting Engineer

) West End Avenue
New York 25, N. Y.

Dept. Of Civil Engineer
Columbia University
New York 27, N. Y.

January 19, 1953

REPORT ON THE STRUCTURAL ANALYSIS OF THE SUBAQUEOUS CROSSING OF THE MACKINAC STRAITS.

The 20-inch pipe of thickness 13/16 inch was investigated on the basis of the best available engineering knowledge for a variety of loading and support conditions in order to determine the most unfavorable state of stress during operation and testing.

The maximum stresses thus determined are well within safe limits and the pipe built according to the limitations listed therein is soumd.

The following conditions have been considered in detail in order to specify the limitations recommended at the end of this report and to set up specifications for the materials and the construction of the pipe.

1. Forces due to the Current

Under the action of a recorded current of 1.96 knots, the pipe bends laterally. It is assumed that the pipe will rest on the bottom of the river on two points and will span a valley. The pipe span is assumed simply supported to magnify the existing stresses. The maximum permissible span due to current stresses is thus determined.

2. Stresses due to Vertical Loads

Under the action of its own weight (negative buoyancy) the pipe will bend in the vertical direction when spanning a valley. The pipe is considered full of water or empty and the corresponding maximum valley span is determined under the assumption of simple supports. The favorable influence of continuity of spans is ignored.

Dr. Mario G. Salvadori, P. E.
Consulting Engineer

West End Avenue
New York 25, N. Y.

Dept. Of Civil Engineering
Columbia University
New York 27, N. Y.

3. Combination of Horizontal and Vertical Forces

The stresses due to the current and to the vertical loads are combined to obtain the maximum safe span under both forces, both when the pipe is empty and when it is full.

4. Stresses due to Pressure

The stresses (hoop and longitudinal) due to internal operating and testing pressure were investigated, assuming the pipe to be a thin cylinder and a thick cylinder. The longitudinal stresses were obtained under the assumption of a pipe closed at both ends.

5. Combination of Bending Stresses and Pressure Stresses

The stresses under (3) and (4) were combined in such a way as to obtain the worst possible condition of stress in both tension and compression. The maximum shear stress due to these principal stresses was also determined.

6. Longitudinal Temperature Stresses

A maximum temperature differential of 40° F. was assumed as the basis for the determination of longitudinal stresses due to the prevented expansion of the pipe. This type of stresses is relieved by extension of the pipe due to bending.

7. Critical Length for Thermal Buckling

A temperature increase of 30° F. was assumed to determine the buckling length of pipe under fixed ends and simply supported ends conditions. These spans are longer than the minimum recommended spans.

8. Friction Required to keep Pipe in place during Thermal Expansion

The available friction on the bottom of the river is not capable of preventing the lateral displacement of the pipe due to thermal buckling. Hence the pipe will be displaced laterally and thermal longitudinal stresses will be relieved.

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9. Ring Thermal Stresses

The stresses due to a temperature differential at 30° F. between the oil and the water were investigated under the assumption of a thick pipe. The pipe being thin, these stresses will not be reached.

10. Temperature Increase in Curvature

The increase in curvature due to temperature differentials of the order considered were found negligible. Thus, the corresponding bending stresses may be neglected.

11. Limitations on Curvature

In order to limit the bending stresses in the pipe due to the curvature of the bottom of the river, the minimum allowable curvature is determined and recommended.

12. Collapse of Empty Pipe

Under the assumption of an abnormal condition (due to implosion) which will suddenly empty the pipe, the external pressure is found not to be capable of buckling the pipe. The pipe, hence, will not collapse, due to external pressure, even if empty.

13. Local Buckling Stress

The maximum longitudinal compressive stress is much smaller than the buckling compressive stress for the pipe. Hence, no danger of local buckling is present.

14. Torsional Stresses Due to Slanted Approaches

The pipe does not follow the line of maximum slope on the banks of the river. This condition produces torsional moments and torsional shear stresses. The determination of these stresses under wide conditions proves that they are far from dangerous.

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15. Rolling Tendency

The pipe has a tendency to roll under the action of the current pressure and of the lateral component of its weight on the slanted banks of the river. The available friction is proved to be sufficient to prevent such motion.

16. Lateral Motion of Pipe

Available friction on the full pipe is proved sufficient to prevent the lateral motion of the pipe under the pressure of the current at the bottom of the river. The friction available on the empty pipe may possibly not be sufficient to prevent its lateral motion and a minimum additional negative buoyancy is recommended for the pipe.

17. Knife Edge Cradle Stresses

The possibility of the pipe resting on a sharp edge is considered and the stresses due to this condition, assimilated to a line pressure all around the perimeter of the pipe, are determined. The angle subtended by the knife edge support is varied between 30° and 180°.

18. Catenary Action

The reduction of lateral displacement due to catenary action, under the assumption that the ends of a pipe span be prevented to move one towards the other by friction or other obstacles, is found to be of the order of 20%.

19. Miscellaneous Stresses

Other conditions of load and support have been considered and found to be unimportant. For example, the possibility of a concentrated load acting on the pipe is excluded due to the slats and wrapping.

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20. Twin Pipes

The possibility of two pipes located a few feet apart and connected laterally was briefly considered. It is not felt that the twin pipes would be in a worse state of stress than the single pipe. On the contrary, twin pipes could present a better solution (from a purely structural view point) under various loads and support conditions.

Conclusions

The main recommendations arrived at on the basis of the evaluations outlined above are as follows:

a. The pipe must not be allowed to span a valley of more than 140 feet.

b. The pipe should under no circumstances be bent to a radius of less than 1,750 feet.

c. The pipe, if laid empty, should be weighted down with 20# per linear foot (20# of negative buoyancy) to prevent sliding due to the current. This figure may vary somewhat depending upon local conditions at the bottom of the river.

Calculations

The numerical evidence for the results given above is contained in the report entitled "Calculations for the Subaqeuous Crossings of Mackinac Straits, Saginaw River and St. Clair River", January 10, 1953, which was written under my personal supervision.

Statement

It is my opinion that the pipeline built according to the specification based upon this report and the report referred to under "Calculations" is structurally sound according to the best available engineering knowledge.

M. G. Salvadori

Mario G. Salvadori

New York, January 19, 1953

APPENDIX 4

HOT APPLIED COAL TAR COATINGS

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INTRODUCTION

The very high aromaticity of high temperature coal-tar pitch accounts for many of its unusual physical and chemical properties which make it the preferred raw material for a wide variety of applications. High temperature coal-tar pitch is practically inert to the action of water and neither absorbs or transmits it. High-temperature coal-tar pitch is highly resistant to attack by bacteria and fungi. This property, together with its moisture resistance, make it eminently suitable for roofing; waterproofing; coating of buried steel pipe lines to protect them from corrosion action of wet soil; lining of water pipes, tanks, etc.

COAL-TAR PITCH BASE FOR ENAMELS

Normal coal-tar pitch is somewhat sensitive to changes in temperature. It is comparatively hard and brittle at low temperatures and it tends to soften and flow at high temperatures. It exhibits simple Newtonian flow and is subject to cold flow, i.e., it is deformed by the continued action of a small applied force and in direct proportion to the amount of force applied.

In the early 1930's, a means was found to reduce the susceptibility of coal-tar pitch to temperature change. A "plasticized" pitch was produced by digestion of bituminous coal in coal tar and high boiling coal-tar distillate oils. These plasticized pitches show much reduced susceptibility to temperature changes. They are comparatively soft and are not brittle at low temperatures, and at the same time, they do not soften too readily and flow at high temperatures. In rheological terms, they exhibit complex flow. They can be deformed by the action of strong forces but are to some degree rubbery and resilient and they are very little affected by the action of small forces of the order of 2 to 5 psi which are the estimated order of soil distortion forces at work on a buried, shielded pipe coating. (1)

Figure 1 and Figure 2 summarize pressure deformation tests made by Allied Chemical. These tests were made by immersion of an apparatus, in constant temperature water baths maintained at 77°F and 115°F, in which a weighted $\frac{1}{4}$" diameter blunt monel metal rod rests on a flat dish filled with enamel. These tests show that despite the apparent softness of the plasticized enamel it is more resistant to the action of deforming forces in the low stress range. The tests at 77°F, which can be related to normal temperature conditions of soil forces on buried pipe, show less deformation for the plasticized enamel in the 2 to 5 psi range. The tests at 115°F can be related to deforming forces in handling coated pipe in hot weather or to soil forces on buried pipe in hot line service. The plasticized enamel shows far superior resistance to deformation when deforming forces are comparative light.

HISTORY

Coal-tar coatings have been used for over 100 years to protect ferrous metals against underground corrosion. In 1913, an early form of coal-tar enamel was used in protecting the gates, locks and penstocks of the Panama Canal. Examination after 35 years of service showed them to be in perfect condition. The first application of coal-tar enamel to steel pipe for potable water was made in New York in 1914. At the last count this line was still in operation after over 45 years of service. In the 1930's, AWWA type enamels were used extensively in water lines in many large scale projects particularly in the Far West. These installations are still giving trouble-free service and the coal-tar enamels are virtually unchanged after service of over 30 years. Many excellent general articles have been presented on coal tar enamels. (2,3,4,5,6,7)

MINERAL FILLERS

In the production of coal-tar enamels, usually around 25 to 30% of inert, fine mineral fillers are added to the pitch to improve mechanical strength such as resistance to impact and resistance to deformation from soil forces. Fillers also help to reduce flow at high temperature and tendency to crack at low temperatures.

SPECIFICATIONS

Typical specifications for various grades of coal tar enamels are shown in Table 1. These enamels differ chiefly in the variations in atmospheric or service temperature ranges they will withstand--either from cracking at low temperatures or flow at deformation at high temperatures.

Unplasticized Enamel: A narrow range enamel - exposure range is 30 to 120°F. This grade of enamel is hard and highly resistant to deformation from soil forces. It also has very high resistance to moisture and soil chemicals. It is easy to heat and apply, and is best suited for "over the ditch" application where it will not be subjected to extremes in atmospheric temperatures in storing or rough handling in shipping.

Partially Plasticized: A modified grade to better withstand variations in temperatures. Exposure range is 0 to 140°F. It is a good all-purpose enamel. It is easy to apply and is suitable for either shop coating or over the ditch application.

SPECIFICATIONS

Plasticized Enamels: Regular Grade — A fully plasticized enamel with a wide exposure range of -20 to 160°F. It is resistant to shock and deformation and is less subject to damage in handling. With wide exposure range, it can be stored for long periods without damage to coating from extremes in temperatures.

AWWA Grade: — A fully plasticized enamel with a wide range of -20 to 160°F. It is softer than Regular Grade and is more flexible and better suited for large diameter pipe. It is specifically designed to meet exacting requirements of AWWA. It also finds application on gas and product lines where very low temperatures might be encountered in storage of coated pipe.

Hotline Grade: — A fully plasticized enamel but higher in softening point and harder so as to better withstand high temperature service. Exposure range is 0 to 180°F. It is designed and recommended for:

1. Gas pipelines, at the discharge side of pumping stations where gas enters the pipe at temperatures above 120°F.
2. Warm swampy areas, salt flats, desert beds and other places where excessive soil stress is present.
3. Areas where backfill and trenches are rough, full of stones and other objects which normally penetrate softer coatings.
4. Hot oil lines and lines encapsulating electric cables where temperatures are consistently high most of the time, but do not exceed 180°F or 200°F for short term exposure.

PRIMERS

Primers for the enamels must be capable of application by spraying, rolling, or brushing. They must dry in a reasonalbe period of time and they must give a strong bond with the enamel.

Usually the primers consist of a pitch base, similar to that used in making the enamel, cut back with an aromatic solvent.

There are available quick-drying primers that in addition to developing a strong bond, have the added advantage of very quick-drying properties. These quick-drying primers are chemical as well as conventional coal-tar pitch based primers.

REINFORCEMENT AND OUTER WRAP

It is general coating practice to pull a glass mat into the hot enamel as a reinforcement and the outer side of the coating is protected with a tar saturated asbestos felt.

The glass mat is composed of light weight glass fibers randomly oriented. The sheet is very open and is easily pulled into the hot enamel. This mat acts as a reinforcement for the enamel coating and helps to resist cracking in handling.

The tar saturated asbestos felt outer wrap can be a standard weight of approximately 15 lbs. per 100 sq. ft. or a light weight at 9.0 lbs. per 100 sq. ft. The standard weight has a higher tensile strength than the light weight and is the preferred type. As an added strengthening agent glass fiber can be imbedded into the asbestos felt at spaced intervals (usually $\frac{1}{4}$") across the sheet. The asbestos felt outer wrap is intended to minimize damage when handling the coal-tar coated pipe as well as to protect it from damage during the back filling operation and from soil forces in service.

A Kraft Wrapper is usually applied as a finishing protective cover.

APPLICATION

Coal tar enamel coatings are both mill and field applied. Specifications for enamel coatings systems from simple single enamel coat to multiple enamel coats with glass reinforcement and asbestos shields are shown in Table 2. The severity of service conditions determines the system to be used.

MILL APPLICATION

This application may include interior lining in addition to the exterior coating and wrapping.

The pipe is sand or grit blasted to remove excess rust and mill scale and a coating of primer is applied.

Usually in applying the enamel the pipe moves thru the coating equipment with a rotating motion and the hot enamel is flowed onto the pipe. It is also general practice to pull a glass wrap into the coating as well as to apply an outer protective wrap when applying the hot enamel.

applied by
Interior linings for water lines are centrifugally flowing hot enamel into the pipe while it is rotating at a speed of about 900 lineal ft. per minute.

FIELD APPLICATION

In Field Application, the coating is applied with specialized equipment that rides on the pipe. The pipe is brought to the right of way and "strung" in place; the welders then weld the pipe sections together; the cleaning unit consisting of rotating wire brushes removes mill scale and rust just prior to application of the primer. Following the primer unit is a similar unit where the hot melted coating is applied to the pipe with a glass wrap and a protective outer wrap is applied with the same equipment. The protected pipe is then installed by lowering into the ditch.

MOISTURE ABSORPTION

Minimum moisture absorption is the most important single property that a good coating must have. Minimum moisture absorption goes along with high electrical resistivity. If a coating does not absorb water, it does not become electrically conductive; and therefore, cost of current to protect the pipe cathodically is reasonably low. Minimum moisture absorption is necessary in order to have a continuous strong bond. If a coating absorbs water, and this water gets to the interface between enamel and primer, the bond is destroyed. Minimum moisture absorption is also tied in with resistance to soil chemicals. These soil chemicals are water-borne and will never do any damage unless they penetrate the coating, and this will only be the type of coating which

will absorb water.

Water absorption of coal-tar enamels is extremely low. NACE Committee T-6A on Thermoplastic Coal Tar Base Linings reports that after 6 years immersion, coal-tar enamels, at approximately 100 mils thickness, show an absorption of only 1.7 to 2.3 gms. per square foot or 0.5 to 0.6% by weight.

Water absorption tests at Allied Chemical for a 2-year immersion period show 1.4 gms. per sq. ft. for unplasticized enamel and 3.0 gms. for plasticized enamel. Test results are shown in Figure 3. It will be noted that the absorption curve is levelling out as the time of the test progresses. These tests were made using 316 stainless steel plates which were coated by dipping in hot enamel.

High moisture absorption in time results in the coating becoming electrically conductive, giving rise to high current consumption and high cost for cathodic protection. This high moisture absorption in time results in complete chemical degradation. The high moisture absorption also results in complete loss of bond to the pipe.

Dr. J. O. Harris of Kansas State University determined actual water content by the Dean Stark Method on samples of coal-tar and asphalt enamels removed from active buried pipe lines after up to 29 years service. (9) Analyses of a chart presented in Dr. Harris' paper shows that for 28 coal-tar enamels in the test, service varied from 3 to 29 years with an average of 14.1 years service. The maximum moisture content of all coal-tar enamels was 0.3%. The 19 asphalt enamels in the test varied from 7 to 26 years in service with an average of 13.7 years. The moisture content of the asphalt enamels varied from 3 to 19% with an average of 12.4%.

Dr. Harris' work clearly shows the necessity for long-term water absorption tests for reliable evaluation of pipe coatings.

ELECTRICAL RESISTANCE

High electrical resistance is necessary in the coating so that there will be a minimum amount of current required for cathodic protection. Furthermore, this high electrical resistance must be not only high initially, but must remain high through years of service. Most corrosion engineers and pipeline operators feel that a good coating tested when it is first installed in the ground should test from $\frac{1}{2}$ to 2 megohms per square foot. A generous allowance is made here for some loss of resistivity due to damage in handling prior to laying the pipe, moisture absorption in storage prior to burial, and to damage from burial operations and backfilling. In an excellent article, the IEEE Guide for Selecting Coatings for Pipes of Pipe-Type Cable Systems (10) a comparison is made of bituminous coatings for pipe cable systems. Reinforced Coal-Tar Enamel, Hot-Line Grade, is rated at 1 megohm per square foot when installed and still 1 megohm after 5 years in wet soil. Reinforced asphalt enamel is rated at 1 megohm when installed and 0.1 megohm after 5 years in wet soil. Asphalt mastic is rated at 10 megohm when installed but 0.1 megohm after 5 years in wet soil. In terms of current requirements

for cathodic protection--this would mean that for a mile of 8" pipe, 3 milliamps would be required initially and after 5 years of service, coal tar coated pipe would still require only the same current. The asphalt coatings would require 30 milliamps after 5 years service. (10, 11, 12).

In our own laboratory work, specimens of coated steel are very carefully prepared and are of the proper and specified film thickness. There are no thin spots where felts or glass cut into the coating, no damage from handling or installation in the ground, and true resistivity of the coating itself are determined. In this type of test, initial resistivities are consequently far higher than are obtained in a commercial pipe installation.

Two series of tests were run in Allied's laboratories. In the first series a number of enamels were tested at approximately 3/32 of an inch thickness of coating. The enamels were immersed for one year in N/10 Sodium Chloride solution. Initially all enamels tested well over 1,000 megohms per square foot. Results on coal-tar enamel show very high electrical resistance after the one year immersion period. Test results are shown in Table 3.

In another series of tests in which coal-tar enamels of 2/32 of an inch thickness were subjected to 10 years of continuous immersion in a 5% sodium chloride solution, resistivity was more than 50 megohms per square foot.

Since the resistivity of coal-tar enamels is extremely high, and remains at this high value if the coating is not distorted or damaged, it is the imperfections in the coating and the resistivity of the soil water contained in these imperfections that control the magnitude of the coating resistance that will be measured in the field.

CONTINUOUS STRONG BOND

This is a corollary of the chemical inertness of coal tar pitch. Coal tar pitch shows extremely low moisture absorption, is highly resistant to bacterial deterioration, and highly resistant to soil chemicals. As a result, the coating remains practically unchanged through years of service. No moisture can get through the coating to the pipe and the bond remains firm and strong throughout long years of burial. Coal tar coated pipelines have been dug up after being in service for 20-30 years and more and we find the coating unchanged and the bond strong. The coal tar coating must be laboriously removed and chipped off with a hammer and scrappers.

A Southern Natural Gas line recently dug up and cleaned at the Harvey, Louisiana, yard of the Shamrock Pipe Coating Company is a typical example of coal tar coating which was practically unchanged after 35 years burial. When the enamel was chipped off this pipe, the perfect bond was shown by the fact that, when the coating was removed, the original mill markings on the steel pipe were clearly shown.

RESISTANCE TO SOIL CHEMICALS

Coal tar pitch is almost completely inert to moisture and soil chemicals. Coal tar coatings and coal tar pitch used as pipe coatings and for waterproofing have been dug up after 20-30 and 50 years of service underground. They were found to be practically unchanged. Coal tar pitch does not absorb any appreciable water and is not affected to any appreciable extent by soil bacteria.

The chemical stability of coal tar pitch is due to its aromatic character. The molecular unit of aromatic compounds is the benzene ring. It is a chemical structure of great strength and stability. In the symmetrical benzene ring, three single bonds and three double bonds resonate between the carbon atoms. These structures are called "aromatic rings", and the powerful inter-atomic forces holding them together account for the high stability of coal tar compounds. In the original formation of coal these benzene rings were chemicals united to make large, complex aromatic molecules. In the aromatic molecules comprising coal tar, the chemically inert carbon atoms outnumber hydrogen atoms two to one. It is the high aromatic content of coal tar - over 90% - that gives it great strength and resistance to attack by water or oxygen. Aromatic compounds, as a class of chemicals, have a markedly lower degree of water solubility and affinity for water than aliphatic compounds.

RESISTANCE TO SOLVENT ACTION

Coal tar enamels are substantially insoluble in petroleum products. For oil product lines, this is an important property. In the event of a leak in an oil line, the insolubility of the coal tar enamel coating will assure minimum damage to the coated pipe. This also applies to any pipeline or coated underground steel structure that is in contact with soil contaminated with petroleum products. A nearby foreign pipeline carrying crude or refined petroleum products can contaminate soil near a well-coated line.

RESISTANCE TO SOIL STRESS AND MECHANICAL DAMAGE

Pipe coatings must withstand a reasonable amount of mechanical abuse. If the proper grade of coal tar enamel is used for the conditions to which it must be exposed both prior to burial and after burial; and if it is used in accordance with manufacturer's instructions; and if it is used along with recommended shielding and also reinforcing where it is so specified; then coal tar enamels will not be distorted or damaged and the original coating thickness will be maintained, and the good service expected of a coal tar coating will be obtained.

RESISTANCE TO BACTERIA

Bacteria can feed on many hydrocarbon materials, but coal-tar coatings show no utilization by bacteria. Coal-tar enamel is inert to fungus attack. (13, 14).

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SPECIFICATIONS

TABLE 1

TESTS	METHOD	UN-PLASTICIZED	PARTIALLY PLASTICIZED	PLASTICIZED		
				Regular	AWWA	Hotline
Softening Point, R & B, F.	ASTM D 36	185 - 195	195 - 205	220 - 230	220 min.	250 min.
Penetration: 77 F-100 gms-5 sec 115 F-50 gms-5 sec	ASTM D 5	0 - 2 1 - 8	2 - 7 10 - 25	5 - 10 15 - 25	10 - 20 15 - 55	0 - 5 5 - 15
Filler (ash) %	ASTM D 271	22 - 32	22 - 32	22 - 32	25 - 35	22 - 32
Specific Gravity, 77 F.	ASTM D 71	1.40 - 1.60	1.40 - 1.60	1.40 - 1.60	1.40 - 1.60	1.40 - 1.60
PERFORMANCE TESTS						
High Temperature (1/16" max sag)	AWWA C 203	5 hrs @ 120 F	5 hrs @ 140 F	24 hrs @ 160 F	24 hrs @ 160 F	5 hrs @ 180 F
Low Temperature (no cracks)	AWWA C 203	5 hrs @ 30 F	5 hrs @ 0 F	6 hrs @ -20 F	6 hrs @ -20 F	6 hrs @ 0 F
Peel Test (no peel)	AWWA C 203	80 - 120 F	80 - 140 F	80 - 160 F	80 - 160 F	80 - 180 F
Spark Test 10,000 volts, low amperage, 2/32" coating tkns.	AWWA C 203	no sparks	no sparks	no sparks	no sparks	no sparks
Application Temp. (approx.) F.		400	450	475	475	500

TABLE 2

SYSTEMS	SHOT BLAST	PRIMER	3/32" MIN. ENAMEL	GLASS WRAP	15# ASBESTOS FELT	2/32" ENAMEL	GLASS WRAP	15# ASBESTOS FELT	SEAL COAT OF ENAMEL	60# KRAFT PAPER	ELECTRICAL INSPECTION	SERVICE
Single Coat Single Wrap	●	●	●		●					●	●	Normal Underground Environment
Single Coat Single Wrap	●	●	●	●						●	●	Normal Underground Environment
Single Coat Double Wrap	●	●	●	●	●					●	●	Normal Underground Environment
Double Coat Double Wrap	●	●	●	●		●	●			●	●	Severe Underground Environment - *rocky terrain, corrosive soils, submarine lines, etc.*
Double Coat Triple Wrap	●	●	●	●		●	●	●	●	●	●	Severest Corrosive Environment, *such as river corrosings, etc.*

TABLE 3

ELECTRICAL RESISTIVITY OF SPECIMENS OF ENAMELS

imersed in N/10 Sodium Chloride solution · Wheatstone Bridge, 100 V.

ENAMEL	RESISTIVITY IN MEGOHMS/SQ.FT. 30 DAYS	1 YEAR
Av. of 5 Asphalt Enamels	82,000	less than 0.6
Un-plasticized Coal Tar	200,000	over 200,000
Partially Plasticized Coal Tar	20,000	2,100
Plasticized Coal Tar, Regular Grade	6,000	1,300
Plasticized Coal Tar, Hotline Grade	8,000	1,900
Plasticized Coal Tar, AWWA Grade	1,600	300

FIGURE 1

RHEOLOGICAL DIAGRAM FROM BLUNT ROD PRESSURE DEFORMATION

Test Values at 77°F.

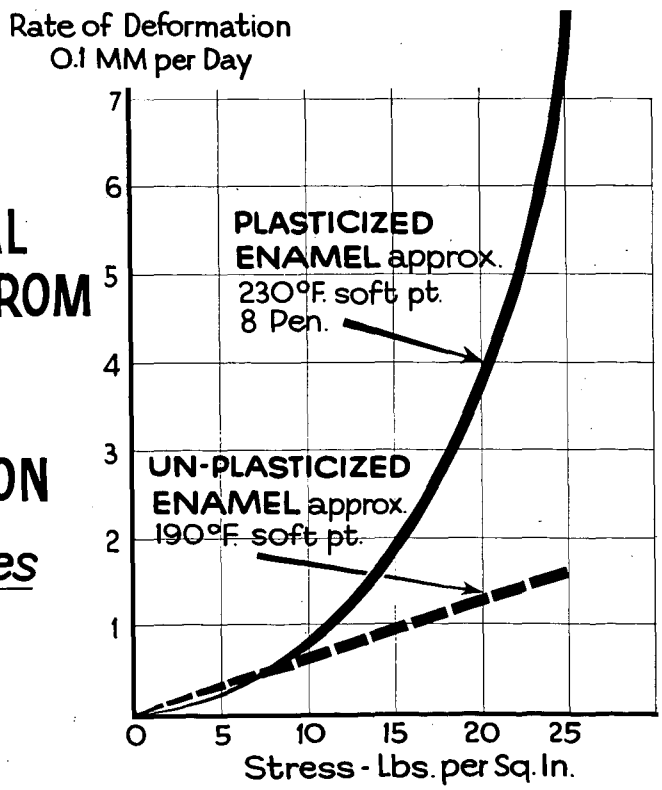


FIGURE 2

RHEOLOGICAL DIAGRAM FROM BLUNT ROD PRESSURE DEFORMATION

Test Values at 115°F

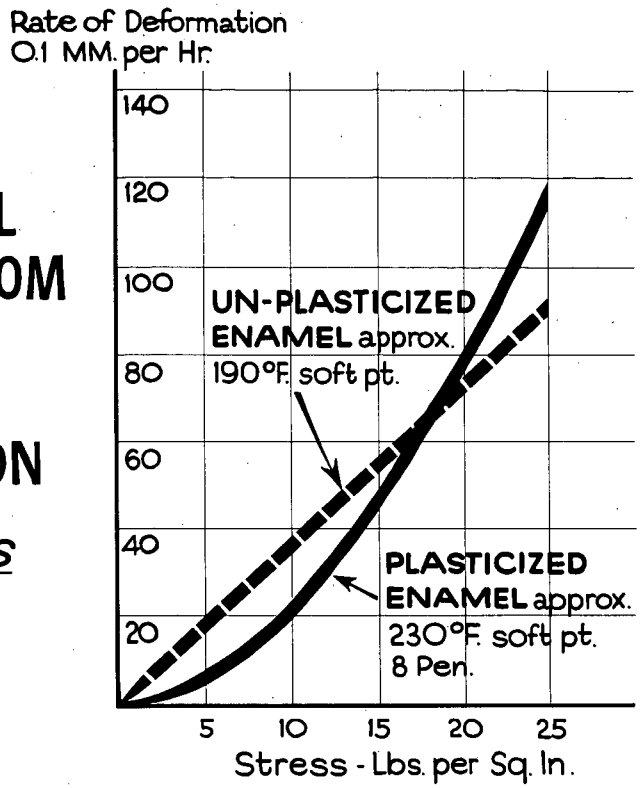
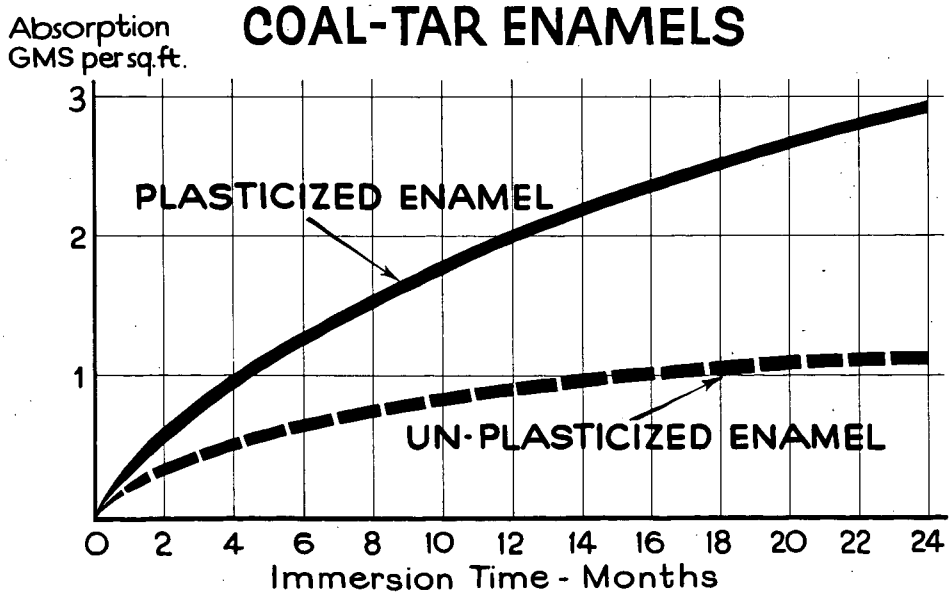


FIGURE 3

WATER ABSORPTION COAL-TAR ENAMELS



Enbridge Line 5 Resolutions adopted as of April 6, 2016

GOVERNMENTAL UNITS

Counties	Cities/Villages	Townships
Alcona	Charlevoix	Alpena
Alger	Cheboygan	Beaugrand
Antrim	East Jordan	Bois Blanc Island
Cheboygan	Mackinac Island	Charlevoix
Chippewa	Mackinaw City	Clark
Emmet	Petoskey	Krakow
Genesee	Rogers City	Mentor
Grand Traverse	Traverse City	Moran
Ingham		Munising
Iosco		Presque Isle
Presque Isle		Tuscarora
Wayne		West Bloomfield

INDIGENOUS NATIONS

Bay Mills Indian Community
Chippewa Ottawa Resource Authority (CORA)
Grand Traverse Band of Ottawa and Chippewa Indians
Little River Bay Band of Ottawa Indians
Little Traverse Bay Bands of Odawa Indians
Nottawaseppi Huron Band of the Potawatomi Indians
Sault Ste. Marie Tribe of Chippewa Indians

OTHER

Les Cheneaux Watershed Council (LCWC)

To look at actual resolution language and for updated lists, please visit:

http://www.oilandwaterdontmix.org/municipal_resolutions
http://www.oilandwaterdontmix.org/tribal_supporters

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Re: Enbridge Line 5 at Straits of Mackinac
Your Joint Letter of July 24, 2014

Dear Messrs. Schuette and Wyant:

I am writing in formal response to the above-referenced letter. As you may know, Enbridge has been hard at work in the Straits of Mackinac reviewing the supports for each of the two 20" pipelines that cross the Straits. Work to install additional supports in the Straits finished September 8, 2014, well within the 90 days required by the easement.

I have enclosed a spreadsheet that reflects the current span lengths for each of the pipelines. As you can see, no span length exceeds seventy-five (75) feet. I have also enclosed a report we received from our contractor that provides more detail about the work done in the Straits. Enbridge will continue to monitor the Straits every month through aerial and land-based inspections and will conduct a detailed underwater visual and side scan sonar survey every two years. That frequency is based on the experience we have garnered over many decades and results in a predictive maintenance model that has confirmed that pipeline spans will not exceed 75 feet.

Enbridge respects the importance of the Straits as a source of commerce, tourism, and natural beauty, and will continue to do what is necessary to help protect that natural resource. Further, Enbridge appreciates the dialog with the State of Michigan in working jointly to protect and enhance the Straits. Enbridge is proud to serve the State of Michigan and provide solutions to some of its energy needs.

If you have any questions about the enclosed, please do not hesitate to contact me to discuss. Thank you again, and we look forward to our continued relationship going forward.

Sincerely,

ENBRIDGE ENERGY, LIMITED PARTNERSHIP
By Enbridge Pipelines (Lakehead) L.L.C.
Its General Partner

Bradley F. Shamla
Vice President, U.S. Operations

Enclosure[s]

C: Leon Zupan
Peter Holran
Cynthia Hansen
Joel Kanvik

Span Identifier	2014 Length	2014 Span Height	2014 Support Length	2012 Length	2010 Length	2007 Length	2006 Length	2005 Length	Touch Down Position and Type (Year Install)	Support Depth	Latitude	Longitude
Southern Exposure Point	NA	NA	NA	NA	NA	NA	NA	NA	Only/Sand	66	45.79740051 N	84.76828612 W
E-75	NA	NA	NA	Silted In	70	69	73	80	NA	NA	NA	NA
									NA	NA	NA	NA
E-74A	50	0.5	240' to Bury	80	61	67	67	71	South/Sand	69	45.79803465 N	84.76803487 W
									North/Anchor (2004)	70	45.79817336 N	84.76798054 W
E-74B South	70	0.5	Shared Touch Down ^	56	109	100			South/Anchor (2004)	70	45.79817336 N	84.76798054 W
									North/Anchor (2010)	71	45.79836191 N	84.76790185 W
E-74B North	47	0.5	Shared Touch Down ^	48					South/Anchor (2010)	71	45.79836191 N	84.76790185 W
									North/Anchor (2006)	70	45.79848622 N	84.76785431 W
E-74C	28	1	Shared Touch Down ^	16	13	14			South/Anchor (2006)	70	45.79848622 N	84.76785431 W
									North/Sand	69	45.79855919 N	84.7678226 W
E-71A	30	0.5	111' to E74C North	76	87	86	86	84	South/Sand	71	45.79885179 N	84.76772027 W
									North/Anchor (2014)	71	45.79893197 N	84.76769084 W
E-71B	49	0.5	Shared Touch Down ^						South/Anchor (2014)	71	45.79893197 N	84.76769084 W
									North/Anchor (2005)	72	45.79906039 N	84.76764254 W
E-72	44	0.5	Shared Touch Down ^	40	40	38	36	48	South/Anchor (2005)	72	45.79906039 N	84.76764254 W
									North/Sand	72	45.79917455 N	84.76759603 W
E-77	37	1	9' to E-72	34	44	52	44	42	South/Sand	72	45.79919654 N	84.76758791 W
									North/Sand	72	45.799292 N	84.76754813 W
E-26	54	1	202' to E77	48	54	45	48	51	South/Clay	76	45.79982164 N	84.76734294 W
									North/Sand	76	45.7999639 N	84.76728235 W
E-25A	38	0.5	42' to E-26	87	91	85	84	96	South/Sand	81	45.80007298 N	84.76724349 W
									North/Anchor (2014)	80	45.80017387 N	84.76720464 W
E-25B	48	0.5	Shared Touch Down ^						South/Anchor (2014)	80	45.80017387 N	84.76720464 W
									North/Sand	79	45.80029924 N	84.76715103 W
E-24	44	0.5	114' to E25B	44	50	45	46	37	South/Sand	81	45.80059751 N	84.76703994 W
									North/Sand	82	45.80071223 N	84.76699755 W
E-23A South	28	0.5	96' to E-24	86	85	81	86	84	South/Sand	83	45.80096148 N	84.76690243 W
									North/Anchor (2014)	85	45.80103603 N	84.76687496 W
E-23A North	58	0.5	Shared Touch Down ^						South/Anchor (2014)	85	45.80103603 N	84.76687496 W
									North/Anchor (2003)	85	45.80118708 N	84.7668158 W
E-23B South	61	0.5	Shared Touch Down ^	66	87	86	90	90	South/Anchor (2003)	85	45.80118708 N	84.7668158 W
									North/Anchor (2012)	84	45.80134576 N	84.76674988 W
E-23B North	31	1	Shared Touch Down ^	26					South/Anchor (2012)	84	45.80134576 N	84.76674988 W
									North/Sand	83	45.80142404 N	84.76671263 W
E-27	63	0.5	78' to E23B North	58	69	65	66	74	South/Sand	82	45.80162764 N	84.76663722 W
									North/Sand	81	45.80179248 N	84.76657389 W
E-28A South	37	1	52' to E-27	70	81	73	74	81	South/Sand	82	45.80193012 N	84.76652267 W
									North/Anchor (2014)	83	45.8020281 N	84.76649157 W
E-28A North	38	1	Shared Touch Down ^						South/Anchor (2014)	83	45.8020281 N	84.76649157 W
									North/Anchor (2005)	83	45.80212884 N	84.76645585 W
E-28B	63	1	Shared Touch Down ^	66	69	65	64	72	South/Anchor (2005)	83	45.80212884 N	84.76645585 W
									North/Sand	81	45.80229567 N	84.76639508 W
E-29	59	1	25' to E28B	60	55	44	63	53	South/Sand	81	45.8023587 N	84.76636855 W
									North/Sand	79	45.80251327 N	84.76631514 W
E-30A	38	1	22' to E29	72	83	82	82	89	South/Sand	78	45.80256885 N	84.76629197 W
									North/Anchor (2014)	77	45.80267125 N	84.76626081 W
E-30B	36		Shared Touch Down ^						South/Anchor (2014)	77	45.80267125 N	84.76626081 W
									North/Sand	76	45.80276442 N	84.76622516 W
E-38	36	1	86 to E-30B	34	45	32	37	46	South/Sand	73	45.80299189 N	84.76614415 W
									North/Sand	72	45.80308618 N	84.76611094 W
E-37	56	1	155' to E-38	54	54	50	54	53	South/Sand	74	45.80349412 N	84.7659669 W
									North/Sand	74	45.80363883 N	84.76590965 W
E-36	50	0.5	12' to E-37	42	41	48	42	34	South/Sand	73	45.80366947 N	84.76589995 W
									North/Sand	73	45.80380204 N	84.76585057 W
E-35A	36	0.5	33' to E-36	60	67	66	67	63	South/Sand	73	45.80389819 N	84.76581718 W
									North/Anchor (2014)	75	45.80399347 N	84.7657808 W
E-35B	36	0.5	Shared Touch Down ^						South/Anchor (2014)	75	45.80399347 N	84.7657808 W
									North/Sand	76	45.80408779 N	84.76574484 W
E-34A	58	1	25' to E35B	58	62	54	61	59	South/Sand	77	45.80415409 N	84.76572209 W
									North/Anchor (2003)	79	45.80430605 N	84.76566353 W
E-34B South	53	1	Shared Touch Down ^	73	80	82	74	75	South/Anchor (2003)	79	45.80430605 N	84.76566353 W
									North/Anchor (2014)	78	45.80444616 N	84.76561487 W
E-34B North	21	1	Shared Touch Down ^						South/Anchor (2014)	78	45.80444616 N	84.76561487 W
									North/Sand	79	45.80450136 N	84.76558981 W
E-33	43	1	109 to E34B North	46	52	47	45	39	South/Sand	82	45.80478655 N	84.76548042 W
									North/Sand	86	45.80490015 N	84.76543833 W
E-32A-A	6		21' to E-33	Silted in	11	17			South/Clay	88	45.80495542 N	84.76541633 W
									North/Anchor (2006)	88	45.80497238 N	84.76541225 W
E-32A South	40	1	Shared Touch Down ^	47	92	89			South/Anchor (2006)	88	45.80497238 N	84.76541225 W
									North/Anchor (2012)	92	45.80507422 N	84.76536839 W
E-32A North	47	1.5	Shared Touch Down ^	40					South/Anchor (2012)	92	45.80507422 N	84.76536839 W
									North/Anchor (2003)	94	45.80519687 N	84.76532216 W
E-32B South	67	1	Shared Touch Down ^	88	87	97	85	79	South/Anchor (2003)	94	45.80519687 N	84.76532216 W
									North/Anchor (2014)	96	45.80537562 N	84.76525738 W
E-32B North	22	1	Shared Touch Down ^						South/Anchor (2014)	96	45.80537562 N	84.76525738 W
									North/Clay	95	45.80543416 N	84.7652347 W
E-31	36	1	22' to E32B North	34	36	42	42	37	South/Clay	95	45.80549271 N	84.76521037 W
									North/Clay	96	45.80558613 N	84.76517358 W
E-39	63	1	58' to E-31	74	83	67	78	66	South/Clay	98	45.80573967 N	84.76511784 W
									North/Sand	98	45.80590475 N	84.76505337 W
E-40A	22	1	370' to E39	85	82	80	90	97	South/Sand	103	45.80688466 N	84.7646828 W
									North/Anchor (2014)	104	45.80694103 N	84.7646623 W
E-40B	60	1	Shared Touch Down ^						South/Anchor (2014)	104	45.80694103 N	84.7646623 W
									North/Sand	104	45.80709655 N	84.76459532 W

E-46	46	1	220' to E40B	86	93	82	72	58	South/Sand	104	45.80767814 N	84.76437691 W
									North/Anchor (2006)	104	45.80780151 N	84.76433045 W
E-45A	58	1	Shared Touch Down ^	53	50	49	62	72	South/Anchor (2006)	104	45.80780151 N	84.76433045 W
									North/Anchor (2014)	104	45.80795517 N	84.76427079 W
E-45B	28	1	Shared Touch Down ^						South/Anchor (2014)	104	45.80795517 N	84.76427079 W
									North/Clay	102	45.80802708 N	84.76423847 W
E-44	45	1	144' to E45B	45	37	33	40	37	South/Clay	100	45.80840536 N	84.76408996 W
									North/Clay	98	45.8085226 N	84.76403879 W
E-43	56	1	67' to E44	54	54	59	54	54	South/Clay	102	45.80870068 N	84.76397628 W
									North/Clay	103	45.80884836 N	84.76391865 W
E-42 South	39	1.5	41' to E43	45	91	97	97	103	South/Clay	103	45.80895719 N	84.76388102 W
									North/Anchor (2012)	103	45.80906046 N	84.76384057 W
E-42 North	46	1.5	Shared Touch Down ^	52					South/Anchor (2012)	103	45.80906046 N	84.76384057 W
									North/Clay	101	45.80917946 N	84.7637909 W
E-41	71	1	130' to E42 North	70	74	77	68	84	South/Clay	98	45.80952345 N	84.76366022 W
									North/Clay	97	45.80971147 N	84.76358754 W
E-47A	45	1	141 to E41	76	75	75	74	75	South/Clay	98	45.81007932 N	84.76344236 W
									North/Anchor (2014)	100	45.81019925 N	84.76339755 W
E-47B	28	1	Shared Touch Down ^						South/Anchor (2014)	100	45.81019925 N	84.76339755 W
									North/Clay	100	45.8102734 N	84.76336643 W
E-48A	55	1.5	20' to E47	48	59	48	55		South/Clay	100	45.81032483 N	84.76334545 W
									North/Anchor (2005)	102	45.81047222 N	84.76329119 W
E-48B South	60	1	Shared Touch Down ^	67	66	82	68		South/Anchor (2005)	102	45.81047222 N	84.76329119 W
									North/Anchor (2014)	101	45.81063345 N	84.7632324 W
E-48B North	14		Shared Touch Down ^						South/Anchor (2014)	101	45.81063345 N	84.7632324 W
									North/Clay	101	45.81066737 N	84.76321778 W
E-79	NA	NA	NA	NA	Filled In	19	13		NA	NA	NA	NA
									NA	NA	NA	NA
E-70	52	1	380' to E48B	53	54	53	47	52	South/Clay	110	45.81167843 N	84.76283521 W
									North/Clay	111	45.81181537 N	84.76278221 W
E-66A South	22	1	3' to E70	22	97	89	97		South/Clay	111	45.81182421 N	84.76277945 W
									North/Anchor (2012)	111	45.81188319 N	84.7627559 W
E-66A North	72	0.5	Shared Touch Down ^	77					South/Anchor (2012)	111	45.81188319 N	84.7627559 W
									North/Anchor (2005)	113	45.81207618 N	84.76267988 W
E-66B	52	1	Shared Touch Down ^	56	89	89	81		South/Anchor (2005)	113	45.81207618 N	84.76267988 W
									North/Clay	113	45.81221358 N	84.76262661 W
E-56A	44	1.5	32' to E66B	45	44	33			South/Clay	113	45.81229737 N	84.76259107 W
									North/Anchor (2006)	114	45.81241142 N	84.76254418 W
E-56B	46	2	Shared Touch Down ^	44	42	48			South/Anchor (2006)	114	45.81241142 N	84.76254418 W
									North/Clay	112	45.81253217 N	84.76250017 W
E-55	46	1	35' to E56B	45	46	41	50	43	South/Clay	113	45.8126226 N	84.76246303 W
									North/Clay	114	45.81274368 N	84.76241929 W
E-54A	57	3	11' to E55	58	62	59	66		South/Clay	114	45.81277307 N	84.76240561 W
									North/Anchor (2005)	121	45.81292344 N	84.76234556 W
E-54B	33	2.5	Shared Touch Down ^	32	37	39	29		South/Anchor (2005)	121	45.81292344 N	84.76234556 W
									North/Grout Bag (2001)	122	45.8130088 N	84.76231479 W
E-53A	44	3	Grout Bags ^	44	38	33	43		South/Grout Bag (2001)	122	45.8130088 N	84.76231479 W
									North/Anchor (2005)	124	45.81312414 N	84.76226755 W
E-53B	60	3	Shared Touch Down ^	57	64	71	63		South/Anchor (2005)	124	45.81312414 N	84.76226755 W
									North/Clay	127	45.8132822 N	84.76221172 W
E-52A	10	2.5	11' toE53B	9	15	14	18		South/Clay	127	45.81330927 N	84.76220265 W
									North/Anchor (2012)	128	45.81333405 N	84.76219074 W
E-52B	8	3	Shared Touch Down ^	8					South/Anchor (2012	128	45.81333405 N	84.76219074 W
									North/Clay	128	45.81335562 N	84.76218435 W
E-49C	51	2	8 to E-52	48	46	36	53	44	South/Clay	129	45.81337589 N	84.76217535 W
									North/Anchor (2004)	133	45.81351091 N	84.76212131 W
E-49B South	42	2	Shared Touch Down ^	86	85	82	87	101	South/Anchor (2004)	133	45.81351091 N	84.76212131 W
									North/Anchor (2014)	136	45.81362344 N	84.76208421 W
E-49B North	45	2	Shared Touch Down ^						South/Anchor (2014)	136	45.81362344 N	84.76208421 W
									North/Anchor (2004)	139	45.81374064 N	84.76203766 W
E-49A South	67	1	Shared Touch Down ^	87	75	93	95	86	South/Anchor (2004)	139	45.81374064 N	84.76203766 W
									North/Anchor (2014)	140	45.81391998 N	84.76197483 W
E-49A North	23	1	Shared Touch Down ^						South/Anchor (2014)	140	45.81391998 N	84.76197483 W
									North/Clay	141	45.81397636 N	84.7619502 W
E-58	62'	3	87 to E49A North	60	51	66	61	61	South/Clay	141	45.81420665 N	84.76187126 W
									North/Clay	144	45.81436938 N	84.76180643 W
E-61A-A	57	3	196' to E58	52	47	59			South/Clay	137	45.81488776 N	84.76160874 W
									North/Anchor (2006)	145	45.81503694 N	84.76155307 W
E-61A	63	4	Shared Touch Down ^	65	61	68	120	129	South/Anchor (2006)	145	45.81503694 N	84.76155307 W
									North/Anchor (2004)	145	45.81520235 N	84.76149042 W
E-61B South	46	4	Shared Touch Down ^	52					South/Anchor (2004)	145	45.81520235 N	84.76149042 W
									North/Anchor (2012)	148	45.81532105 N	84.76144352 W
E-61B North	70	3	Shared Touch Down ^	62	114	113	115	125	South/Anchor (2012)	148	45.81532105 N	84.76144352 W
									North/Anchor (2004)	147	45.81550142 N	84.76137607 W
E-61C South	57	3	Shared Touch Down ^	61	85	90	83	78	South/Anchor (2004)	147	45.81550142 N	84.76137607 W
									North/Anchor (2012)	142	45.81564713 N	84.76132398 W
E-61C North	29	2.5	Shared Touch Down ^	31					South/Anchor (2012)	142	45.81564713 N	84.76132398 W
									North/Clay	139	45.81572031 N	84.76129539 W
E-62	39	1.5	41' to E61C	37	32	29	38	34	South/Clay	135	45.81582864 N	84.76125214 W
									North/Clay	130	45.81593382 N	84.76121499 W
E-63	21	1	9' to E61	18	23	22	22	15	South/Clay	129	45.81595831 N	84.76120677 W
									North/Clay	130	45.81601262 N	84.7611857 W
E-64	49	1	20' to E63	52	47	51	48	52	South/Clay	132	45.81606385 N	84.76116825 W
									North/Clay	132	45.81619121 N	84.76111823 W
E-22A	70	4	38 to E64	76	80	74	76	79	South/Clay	130	45.81629124 N	84.76108022 W
									North/Anchor (2014)	130	45.81647888 N	84.76100317 W
E-22B	7	1	Shared Touch Down ^						South/Anchor (2014)	130	45.81647888 N	84.76100317 W
									North/Clay	130	45.81649739 N	84.76099431 W

E-21	53	0.5	40' to E22	50	43	48	52	51	South/Clay	128	45.81660352 N	84.76095383 W
									North/Clay	129	45.81674293 N	84.7608986 W
E-20	NA	NA	NA	NA	Filled In	23	25		NA	NA	NA	NA
									NA	NA	NA	NA
E-19A South	23	0.5	67 to E21	75	87	76	78	107	South/Clay	133	45.81692151 N	84.76083215 W
									North/Anchor (2014)	136	45.8169808 N	84.76080731 W
E-19A North	60	0.5	Shared Touch Down ^						South/Anchor (2014)	136	45.8169808 N	84.76080731 W
									North/Anchor (2003)	140	45.81714033 N	84.7607472 W
E-19B South	58	1	Shared Touch Down ^	82	75	80	81	73	South/Anchor (2003)	140	45.81714033 N	84.7607472 W
									North/Anchor (2014)	144	45.81729393 N	84.76068901 W
E-19B North	24	0.5							South/Anchor (2014)	144	45.81729393 N	84.76068901 W
									North/Clay	145	45.81735826 N	84.76066463 W
E-18B	22	0.5	33'to E19B North	23	25	22	25	16	South/Clay	148	45.81744163 N	84.76063246 W
									North/Clay	151	45.81749679 N	84.76061139 W
E-18C	15	0.5	6' to E18B	Silted in	16				South/Clay	151	45.81750978 N	84.7606076 W
									North/Clay	154	45.81754778 N	84.760593 W
E-18A	17	0.5	4' to E18C	16	21	22	18	29	South/Clay	154	45.8175558 N	84.76058925 W
									North/Clay	156	45.81759883 N	84.76057257 W
E-17	38	0.5	33' to E18A	39	36	40	31	44	South/Clay	161	45.81768298 N	84.76054041 W
									North/Clay	167	45.81778351 N	84.7605004 W
E-16	42	2.5	58' to E17	38	48	36	38	47	South/Clay	175	45.81793523 N	84.76044082 W
									North/Clay	184	45.81804614 N	84.76039472 W
E-15A	28	1	4' to E16	31	29	25	28		South/Sand	184	45.81805592 N	84.76039102 W
									North/Anchor (2005)	192	45.81812989 N	84.7603635 W
E-15B	50	1	Shared Touch Down ^	52	52	51	47		South/Anchor (2005)	204	45.81812989 N	84.7603635 W
									North/Grout Bag (2001)	203	45.81826147 N	84.76031158 W
E-08A	58	1	Grout Bags ^	56	54	65	56	62	South/Grout Bag (2001)	203	45.81826147 N	84.76031158 W
									North/Anchor (2003)	216	45.81841688 N	84.7602534 W
E-8B	69	2	Shared Touch Down ^	70	71	66	73		South/Anchor (2003)	216	45.81841688 N	84.7602534 W
									North/Anchor (2005)	224	45.81859712 N	84.76018457 W
E-08C/D South	58	3	Shared Touch Down ^	76	39	79	97		South/Anchor (2005)	224	45.81859712 N	84.76018457 W
					20				North/Anchor (2014)	227	45.81875079 N	84.7601283 W
E-08C/D North	18	2	Shared Touch Down ^						South/Anchor (2014)	227	45.81875079 N	84.7601283 W
									North/Sand	227	45.8187984 N	84.76010964 W
E-09	35	0.5	25 to E08C/D North	41	33	33	40	39	South/Sand	229	45.81886442 N	84.76009022 W
									North/Sand	230	45.81895739 N	84.76005737 W
E-10	47	2	72 to E09	52	50	49	44		South/Clay	229	45.81914977 N	84.75998662 W
									North/Clay	230	45.81927332 N	84.75993637 W
E-11	66	2	4' to E10	63	70	74	69		South/Clay	230	45.81928482 N	84.75993198 W
									North/Clay	228	45.819459 N	84.75986295 W
E-12	34	1	58' to E11	39	41	88	81	81	South/Clay	228	45.81963584 N	84.75979216 W
									North/Clay	227	45.81972489 N	84.75975827 W
E-13A	29	1	65' to E12	27	32	40	34	36	South/Clay	228	45.81989427 N	84.75969496 W
									North/Anchor (2004)	230	45.81997078 N	84.75966271 W
E-13B South	58	1	Shared Touch Down ^	56	106	116	112	115	South/Anchor (2004)	230	45.81997078 N	84.75966271 W
									North/Anchor (2010)	228	45.82012417 N	84.75960843 W
E-13B North	57	1	Shared Touch Down ^	56					South/Anchor (2010)	228	45.82012417 N	84.75960843 W
									North/Anchor (2004)	226	45.82027847 N	84.75955349 W
E-13C South	51	1.5	Shared Touch Down ^	48	107	105	99	102	South/Anchor (2004)	226	45.82027847 N	84.75955349 W
									North/Anchor (2010)	225	45.82041043 N	84.75949691 W
E-13C North	52	1.5	Shared Touch Down ^	56					South/Anchor (2010)	225	45.82041043 N	84.75949691 W
									North/Clay	216	45.82055076 N	84.75944415 W
E-3A	27	1	133' to E13C North	87	76	68	90	62	South/Clay	217	45.82090248 N	84.75931622 W
									North/Anchor (2014)	221	45.82097424 N	84.75928534 W
E-3B	53	1	Shared Touch Down ^						South/Anchor (2014)	221	45.82097424 N	84.75928534 W
									North/Anchor (2005)	217	45.82111266 N	84.75922939 W
E-76A/B	58	1	11' to E3B	58	10	18			South/Clay	217	45.82114141 N	84.75921794 W
									North/Clay	217	45.82129123 N	84.75915826 W
E-02A South	15	0.5	238' to E76A/B	76	80	80			South/Sand	218	45.82192295 N	84.75892028 W
									North/Anchor (2014)	218	45.82195983 N	84.75890383 W
E-02A North	55	0.5	Shared Touch Down ^						South/Anchor (2014)	218	45.82195983 N	84.75890383 W
									North/Anchor (2006)	218	45.82210278 N	84.75884748 W
E-02B	26	0.5	Shared Touch Down ^	32	30	33			South/Anchor (2006)	218	45.82210278 N	84.75884748 W
									North/Sand	216	45.82217149 N	84.75882614 W
E-01A South	28	2.5	20' to E02B	81	85	84	88	88	South/Sand	216	45.82222505 N	84.75880875 W
									North/Anchor (2014)	217	45.82229766 N	84.75878027 W
E-01A North	53	2	Shared Touch Down ^						South/Anchor (2014)	217	45.82229766 N	84.75878027 W
									North/Anchor (2003)	217	45.82244184 N	84.7587229 W
E-01B-A South	53	3	Shared Touch Down ^	39	100	96	96	107	South/Anchor (2003)	217	45.82244184 N	84.7587229 W
									North/Anchor (2012)	212	45.82258353 N	84.75866685 W
E-01B-A North	43	2	Shared Touch Down ^	53					South/Anchor (2012)	212	45.82258353 N	84.75866685 W
									North/Anchor (2004)	206	45.82269559 N	84.75862499 W
E-01B-B	48	2	Shared Touch Down ^	82	62	74	68	65	South/Anchor (2004)	206	45.82269559 N	84.75862499 W
									North/Sand	197	45.82282173 N	84.75857538 W
E-04A South	17	1	83' to E-01B-B	84	82	84	101		South/Sand	186	45.82304007 N	84.75848688 W
									North/Anchor (2014)	185	45.82308056 N	84.7584657 W
E-04A North	59	1	Shared Touch Down ^						South/Anchor (2014)	185	45.82308056 N	84.7584657 W
									North/Anchor (2006)	176	45.8232365 N	84.75840367 W
E-04B	19	1	Shared Touch Down ^	20	26	23	101		South/Anchor (2006)	176	45.8232365 N	84.75840367 W
									North/Sand	173	45.82328669 N	84.75838476 W
E-05A South	27	1	37' to E04B	80	75	82	77	74	South/Sand	169	45.82338631 N	84.75834799 W
									North/Anchor (2014)	166	45.82345562 N	84.75831776 W
E-05A North	55	1	Shared Touch Down ^						South/Anchor (2014)	166	45.82345562 N	84.75831776 W
									North/Anchor (2003)	157	45.82360285 N	84.75826104 W
E-05B	67	1	Shared Touch Down ^	65	63	62	57	61	South/Anchor (2003)	157	45.82360285 N	84.75826104 W
									North/Sand	146	45.8237806 N	84.75819081 W
E-06	52	1	228' to E-05B	60	60	76	65	67	South/Sand	116	45.8243827 N	84.75795786 W
									North/Sand	111	45.82452008 N	84.75790456 W

E-07	52	0.5	54' to E06	62	72	74	69	70	South/Sand	104	45.82465949 N	84.75784771 W
									North/Sand	97	45.82479445 N	84.75779612 W
E-65A	62	0.5	458' to E07	64	67	67	59		South/Sand	66	45.82600507 N	84.75733017 W
									North/Anchor (2005)	66	45.82617024 N	84.75726365 W
E-65B	61	1	Shared Touch Down ^	61	60	65	64		South/Anchor (2005)	66	45.82617024 N	84.75726365 W
									North/Sand	66	45.8263332 N	84.75720272 W
Northern Exposure Point	NA	NA	148' to E-65B	NA	NA	NA	NA	NA	Only/Sand	62	45.82672766 N	84.75706154 W

Span Identifier	2014 Length	2014 Span Height	2014 Support Length	2012 Length	2010 Length	2007 Length	2006 Length	2005 Length	Touch Down Position and Type (Year Install)	Support Depth	Latitude	Longitude
Southern Exposure Point	NA	NA	NA	NA	NA	NA	NA	NA	Only/Sand	65	45.79570801 N	84.77389377 W
W-01A	66	2.5	760' to pipe bury	65	79	63	66	71	South/Sand	74	45.79772369 N	84.77314096 W
									North/Anchor (2003)	75	45.79789806 N	84.77307274 W
W-01B South	59	2.5	Shared Touch Down ^	80	79	83	77	80	South/Anchor (2003)	75	45.79789806 N	84.77307274 W
									North/Anchor (2014)	75	45.79805619 N	84.7730173 W
W-01B North	21		Shared Touch Down ^						South/Anchor(2014)	75	45.79805619 N	84.7730173 W
									North/Sand	75	45.79810962 N	84.77299804 W
W-5	71	1	651' to W01B	70	81	83	80	74	South/Sand	75	45.79983894 N	84.77235059 W
									North/Sand	71	45.80002695 N	84.77228089 W
W-77	NA	---	---	Silted In	37	25	24	11	NA	NA	NA	NA
									NA	NA	NA	NA
W-4	12	1	215' to W5	16	13	18	18	14	South/Sand	70	45.8005966 N	84.77206933 W
									North/Sand	70	45.80062778 N	84.77205516 W
W-3	42	1.5	3' to W4	43	39	41	31	22	South/Sand	71	45.8006356 N	84.77205235 W
									North/Sand	71	45.80074826 N	84.77201133 W
W-2A	53	1.5	7' to W3	52	54	54	53		South/Sand	70	45.80076595 N	84.77200487 W
									North/Anchor (2006)	72	45.80090546 N	84.77195411 W
W-2B	12	1.5	Shared Touch Down ^	14	10	10	10		South/Anchor (2006)	72	45.80090546 N	84.77195411 W
									North/Sand	70	45.80093427 N	84.77193985 W
W-6A	40	2	11'to W2B	72	83	82	72	68	South/Clay	70	45.80096456 N	84.7719274 W
									North/Anchor (2014)	70	45.80107298 N	84.77189363 W
W-6B	32		Shared Touch Down ^						South/Anchor(2014)	70	45.80107298 N	84.77189363 W
									North/Clay	72	45.80115633 N	84.77185761 W
W-7	47	2	84' to W6	46	Merged	34	22	33	South/Clay	70	45.8013792 N	84.77176906 W
W-8					50	22	17	23	North/Clay	70	45.80150413 N	84.77171663 W
W-9	51	2.5	40' to W7-8	53	53	65	55	57	South/Clay	66	45.80160803 N	84.77167766 W
									North/Clay	72	45.80174235 N	84.77162408 W
W-11	48	2.5	114' to W-9	52	47	40	46	49	South/Sand	72	45.80204636 N	84.77152015 W
									North/Sand	77	45.80216995 N	84.77145889 W
W-10	66	3	183' to W-11	64	69	63	63	53	South/Sand	79	45.80265731 N	84.77128597 W
									North/Sand	83	45.80283001 N	84.77120879 W
W-12A	35	1.5	133' to W10	43	91	94	95	97	South/Sand	88	45.80318394 N	84.77107992 W
									North/Anchor (2012)	88	45.80327592 N	84.7710389 W
W-12B	56'	1.5	Shared Touch Down ^	46					South/Anchor (2012)	88	45.80327592 N	84.7710389 W
									North/Sand	88	45.80342375 N	84.77098542 W
W-13A	28'	3	65'to W12 North	83	87	90	76	75	South/Sand	86	45.80359866 N	84.7709303 W
									North/Anchor (2014)	90	45.80367382 N	84.77090546 W
W-13B	54		Shared Touch Down ^						South/Anchor (2014)	90	45.80367382 N	84.77090546 W
									North/Sand	91	45.8038143 N	84.7708486 W
W-14	51	1.5	31' to W13	54	51	74	62	48	South/Sand	92	45.803895 N	84.77081842 W
									North/Sand	94	45.80402656 N	84.7707635 W
W-16	40	0.5	24' to W14	44	45	42	48	36	South/Sand	94	45.8040894 N	84.77073743 W
									North/Sand	95	45.80419549 N	84.77069364 W
W-15	37	0.5	260' to W-16	37	38	39	45	37	South/Sand	96	45.80488293 N	84.7704441 W
									North/Sand	97	45.80498015 N	84.77040304 W
W-17				NA	Filled In	23	36	26	NA	NA	NA	NA
									NA	NA	NA	NA
W-18A_A	8	2	162' to W-15	14	15	15	16		South/Sand	105	45.80541373 N	84.77023722 W
									North/Anchor (2006)	106	45.80543625 N	84.77022891 W
W-18A South	42	2.5	Shared Touch Down ^	42	41	100	99		South/Anchor (2006)	106	45.80543625 N	84.77022891 W
									North/Anchor (2010)	113	45.80554847 N	84.7701857 W
W-18A North	55	2	Shared Touch Down ^	55	55				South/Anchor (2010)	113	45.80554847 N	84.7701857 W
									North/Anchor (2004)	117	45.80569713 N	84.77013121 W
W-18B South	62	1	Shared Touch Down ^	82	91	93	87	95	South/Anchor (2004)	117	45.80569713 N	84.77013121 W
									North/Anchor (2014)	120	45.80586207 N	84.77007142 W
W-18B North	24		Shared Touch Down ^						South/Anchor (2014)	120	45.80586207 N	84.77007142 W
									North/Sand	120	45.80592331 N	84.77004434 W
W-20	22'	0.5	48' to W18B	27	47	45	46	49	South/Sand	122	45.80605223 N	84.77000235 W
									North/Sand	122	45.80610853 N	84.76997572 W
W-24A	12	2.5	38' to W-20	17	90	82	86	87	South/Sand	122	45.80620743 N	84.76993569 W
									North/Anchor (2012)	123	45.80623916 N	84.76992226 W
W-24B	70	2	Shared Touch Down ^	69					South/Anchor (2012)	123	45.80623916 N	84.76992226 W
									North/Sand	122	45.80642502 N	84.76984642 W
W-23A	49	0.5	21' to W-24 North	63	63	62	61	68	South/Sand	123	45.80648154 N	84.76982185 W
									North/Anchor (2004)	124	45.80661144 N	84.76977471 W
W-23B	36	1	Shared Touch Down ^	23	57	57	56	56	South/Anchor (2004)	124	45.80661144 N	84.76977471 W
									North/Sand	124	45.80670768 N	84.76973934 W
W-22	30	2	66' to W-23B	33	34	31	37	39	South/Sand	124	45.80688201 N	84.76967483 W
									North/Sand	123	45.80696092 N	84.76964449 W
W-21	51	2	61' to W-22	50	60	58	65	59	South/Sand	124	45.80712413 N	84.76958849 W
									North/Sand	126	45.80725987 N	84.76954174 W
W-25	NA			Silted In	9	30	34	41	NA	NA	NA	NA
									NA	NA	NA	NA
W-26	54	1	226' to W-21	53	66	71	72	64	South/Sand	126	45.8078569 N	84.76930883 W
									North/Sand	128	45.8079986 N	84.76925521 W
W-27	NA		NA	Silted In	12	17	23	19	NA	NA	NA	NA
									NA	NA	NA	NA
W-30	54	1.5	160 to W-26	57	62	62	62	60	South/Sand	130	45.80842054 N	84.76909002 W
									North/Sand	132	45.80856243 N	84.76903767 W
W-28A South	6	3	156' to W-30	70	77	77	84	73	South/Clay	132	45.80897784 N	84.76888725 W
									North/Anchor (2014)	133	45.80899415 N	84.76888196 W
W-28A North	65		Shared Touch Down ^						South/Anchor (2014)	133	45.80899415 N	84.76888196 W
									North/Anchor (2003)	135	45.80916534 N	84.76881592 W
W-28B	59	2	Shared Touch Down ^	67	70	50	58	58	South/Anchor (2003)	135	45.80916534 N	84.76881592 W
									North/Clay	133	45.80932154 N	84.76874888 W
W-28	35	1	15' to W28B	30	34	34	30	28	South/Clay	133	45.80936143 N	84.76873716 W
									North/Clay	133	45.80945076 N	84.76870155 W
W-76				Silted In	20	16	18		NA	NA	NA	NA
									NA	NA	NA	NA
W-31A South	38	0.5	116' to W-28	90	90	89	92	92	Clay	132	45.80975754 N	84.76858567 W
									North/Anchor (2014)	134	45.80985984 N	84.76855131 W
W-31A North	51		Shared Touch Down ^						South/Anchor (2014)	134	45.80985984 N	84.76855131 W
									North/Anchor (2004)	134	45.80999344 N	84.76849255 W
W-31B South	54	0.5	Shared Touch Down ^	78	75	86	83	84	South/Anchor (2004)	134	45.80999344 N	84.76849255 W
									North/Anchor (2014)	135	45.81014042 N	84.7684405 W
W-31B North	25		Shared Touch Down ^						South/Anchor (2014)	135	45.81014042 N	84.7684405 W
									North/Grout Bags (2001)	134	45.81020833 N	84.76841199 W
W-34A	26	0.5	14' to W-31B North	Silted In	17	10	17		South/Sand	134	45.81024645 N	84.76840035 W
									North/Anchor (2006)	134	45.81031762 N	84.76836946 W

W-34B South	64	1	Shared Touch Down ^	64	97	108	110		South/Anchor (2006)	134	45.81031762 N	84.76836946 W
									North/Anchor (2010)	133	45.81048695 N	84.76830706 W
W-34B North	38	1	Shared Touch Down ^	35					South/Anchor (2010)	133	45.81048695 N	84.76830706 W
									North/Sand	130	45.81058605 N	84.76827156 W
W-37A	43	1	37' to W-34B North	79	76	79	101		South/Sand	129	45.81068589 N	84.76823233 W
									North/Anchor (2014)	130	45.8108011 N	84.76819354 W
W-37B	36		Shared Touch Down ^						South/Anchor (2014)	130	45.8108011 N	84.76819354 W
									North/Sand	130	45.81089642 N	84.76815787 W
W-36A	37	1.5	29' to W37	37	38	39	38		South/Sand	127	45.81097249 N	84.76812596 W
									North/Anchor (2006)	127	45.81107112 N	84.76809122 W
W-36B	54	1.5	Shared Touch Down ^	50	51	53	49		South/Anchor (2006)	127	45.81107112 N	84.76809122 W
									North/Grout Bags (2001)	126	45.81121511 N	84.76804264 W
W-35A	27	0.5	Shared Touch Down ^	32	33	25	31	33	South/Grout Bags (2001)	126	45.81121511 N	84.76804264 W
									North/Anchor (2004)	125	45.81128571 N	84.76801092 W
W-35B South	61	0.5	Shared Touch Down ^	79	89	90	90	87	South/Anchor (2004)	125	45.81128571 N	84.76801092 W
									North/Anchor (2014)	121	45.81144798 N	84.76795339 W
W-35B North	24		Shared Touch Down ^						South/Anchor (2014)	121	45.81144798 N	84.76795339 W
									North/Sand	119	45.81150905 N	84.76792436 W
W-38	59	1	68' to W35B	Merged	47	36	31	34	South/Sand	120	45.81168887 N	84.76784301 W
W-39				53	26	27	31	17	North/Anchor (2005)	122	45.81184558 N	84.76778121 W
W-40	45	1	Shared Touch Down ^	44	50	46	44	54	South/Anchor (2005)	122	45.81184558 N	84.76778121 W
									North/Sand	124	45.81196638 N	84.76774431 W
W-41A South	37	1.5	170' to W40	42	90	87	88	87	South/Sand	131	45.8124196 N	84.76757785 W
									North/Anchor (2012)	138	45.8125168 N	84.76753502 W
W-41A North	48	1.5	Shared Touch Down ^	49					South/Anchor (2012)	138	45.8125168 N	84.76753502 W
									North/Anchor (2004)	143	45.8126456 N	84.76748895 W
W-41B	69	1	Shared Touch Down ^	66	73	73	68	65	South/Anchor (2004)	143	45.8126456 N	84.76748895 W
									North/Sand	150	45.81282522 N	84.76741618 W
W-43A	64	2	32 to W-41B	64	63	59	64	68	South/Sand	154	45.81290732 N	84.7673873 W
									North/Anchor (2003)	162	45.81307278 N	84.76732484 W
W-43B	65	2	Shared Touch Down ^	68	67	69	64	62	South/Anchor (2003)	162	45.81307278 N	84.76732484 W
									North/Clay	169	45.81324384 N	84.76726106 W
W-42A	71	1.5	18' to W43B	70	72	67	73	73	South/Clay	169	45.81329129 N	84.76724157 W
									North/Anchor (2003)	168	45.81348091 N	84.76717734 W
W-42B	67	1	Shared Touch Down ^	71	71	77	69	75	South/Anchor (2003)	168	45.81348091 N	84.76717734 W
									North/Sand	164	45.81366089 N	84.76711461 W
W-45	35	0.5	9' to W42B	27	25	27	26	24	South/Sand	163	45.81368538 N	84.76710678 W
									North/Sand	163	45.81377639 N	84.76707143 W
W-46	54	1	50' to W45	44	53	82	82	77	South/Sand	163	45.81390759 N	84.76701534 W
									North/Sand	163	45.81405037 N	84.76696836 W
W-47	41	1.5	150' to W46	37	61	69	67	62	South/Clay	172	45.81444824 N	84.76681747 W
									North/Clay	170	45.81455828 N	84.76677736 W
W-51A	16	1.5	20' to W47	14	14	11	20		South/Clay	170	45.81461201 N	84.76675686 W
									North/Anchor (2006)	170	45.81465648 N	84.7667401 W
W-51B South	58	1	Anchor	82	84	81	80		South/Anchor (2006)	170	45.81465648 N	84.7667401 W
									North/Anchor (2014)	174	45.81481348 N	84.76668449 W
W-51B North	24								South/Anchor (2014)	174	45.81481348 N	84.76668449 W
									North/Clay	172	45.81487608 N	84.76665789 W
W-50	20	0.5	38' to W51B	Filled in	23	18	26	12	South/Clay	172	45.81497406 N	84.76661907 W
									North/Clay	172	45.81502565 N	84.76660073 W
W-49	50	1.5	29' to W50	54	52	61	47	47	South/Clay	172	45.81510113 N	84.76656607 W
									North/Clay	170	45.81523798 N	84.76652427 W
W-48A	54	1	3' to W49	61	57	60	59	63	South/Clay	170	45.81524574 N	84.76652191 W
									North/Anchor (2003)	177	45.81539218 N	84.76646868 W
W-48B	63	1	Shared Touch Down ^	67	79	59	72	66	South/Anchor (2003)	177	45.81539218 N	84.76646868 W
									North/Clay	176	45.81555569 N	84.76639198 W
W-52	59	1	14' to W48B	60	91	61	63	66	South/Clay	175	45.81559247 N	84.76637538 W
									North/Clay	174	45.81574877 N	84.76632003 W
W-53A	69	1	96' to W52	67	77	67	75		South/Clay	169	45.8160056 N	84.76622468 W
									North/Anchor (2005)	169	45.81618886 N	84.76615963 W
W-53B	26	0.5	Shared Touch Down ^	25	31	42	39		South/Anchor (2005)	169	45.81618886 N	84.76615963 W
									North/Clay	170	45.81625886 N	84.76613285 W
W-70 A	42	0.5	109' to W53B	43	114	100	109		South/Clay	172	45.81654866 N	84.76602166 W
									North/Anchor (2010)	175	45.81666162 N	84.76597665 W
W-70 B	36	0.5	Shared Touch Down ^	25					South/Anchor (2010)	175	45.81666162 N	84.76597665 W
									North/Clay	175	45.81675578 N	84.76594127 W
W-69	64	0.5	55' to W70B	70	96	98	81	88	South/Clay	178	45.81690174 N	84.76588593 W
									North/Clay	182	45.81707239 N	84.76582266 W
W-68A South	11	1	105' to W69	77	85	75	83	69	South/Clay	190	45.81735651 N	84.7657183 W
									North/Anchor (2014)	192	45.8173852 N	84.76570621 W
W-68A North	66		Shared Touch Down ^						South/Anchor (2014)	192	45.8173852 N	84.76570621 W
									North/Anchor(2003)	191	45.81756257 N	84.7656429 W
W-68B	62	1	Shared Touch Down ^	60	43	48	41	50	South/Anchor (2003)	191	45.81756257 N	84.7656429 W
									North/Clay	196	45.81772359 N	84.76557989 W
W-71A	26	1	88' to W68B	77	84	81	84	67	SouthClay	217	45.81795369 N	84.76549024 W
									North/Anchor (2014)	224	45.81802422 N	84.76546477 W
W-71B	55		Shared Touch Down ^						South/Anchor (2014)	224	45.81802422 N	84.76546477 W
									North/Anchor (2003)	232	45.81816946 N	84.76541244 W
W-72A South	57	1.5	Shared Touch Down ^	57	105	107	108	108	South/Anchor (2003)	232	45.81816946 N	84.76541244 W
									North/Anchor (2012)	232	45.81831983 N	84.76535345 W
W-72A North	47	1	Shared Touch Down ^	47					South/Anchor (2012)	232	45.81831983 N	84.76535345 W
									North/Anchor (2004)	238	45.81844653 N	84.76530393 W
W-72B South	35	1.5	Shared Touch Down ^	36	100	100	98	99	South/Anchor (2004)	238	45.81844653 N	84.76530393 W
									North/Anchor (2012)	242	45.81854156 N	84.76526921 W
W-72B North	61	1.5	Shared Touch Down ^	61					South/Anchor (2012)	242	45.81854156 N	84.76526921 W
									North/Anchor (2004)	246	45.81870788 N	84.76521301 W
W-72C	54	2	Shared Touch Down ^	59	56	65	52	56	South/Anchor (2004)	246	45.81870788 N	84.76521301 W
									North/Clay	244	45.81885056 N	84.76516087 W
W-75	61	1	19' to W72C	52	77	57	54	44	South/Clay	243	45.81890246 N	84.76513828 W
									North/Clay	241	45.819066 N	84.76508084 W
W-56	57	1	72' to W75	59	67	58	60	61	South/Clay	237	45.81925852 N	84.76501189 W
									North/Clay	238	45.81940715 N	84.76495466 W
W-78				NA	Filled in	16	15		NA	NA	NA	NA
									NA	NA	NA	NA
W-54A	56	1	172' to W56	56	55	53	60		South/Clay	234	45.81986479 N	84.7647835 W
									North/Anchor (2005)	232	45.82001287 N	84.76473484 W
W-54B	51	1.5	26' to W54A	49	88	87	86		South/Clay	232	45.82008325 N	84.76470314 W
									North/Clay	232	45.8202238 N	84.76465785 W
W-57A	43	2.5	65' to W54B	79	77	67	78	75	South/Clay	230	45.82040018 N	84.76459954 W
									North/Anchor (2014)	230	45.8205126 N	84.76455633 W
W-57B	40		Shared Touch Down ^						South/Anchor (2014)	230	45.8205126 N	84.76455633 W
									North/Clay	228	45.82061962 N	84.76451859 W

W-59A-A				Silted In	6	33			NA	NA	NA	NA
									NA	NA	NA	NA
W-59A South	36	2.5	319' to W-57	45	90	91	130		South/Anchor (2006)	221	45.82146702 N	84.76420828 W
									North/Anchor (2012)	221	45.82156234 N	84.76416991 W
W-59A North	53	2.5	Shared Touch Down ^	47					South/Anchor (2012)	221	45.82156234 N	84.76416991 W
									North/Anchor (2003)	219	45.82170276 N	84.76412053 W
W-59B South	41	3	Shared Touch Down ^	52	104	97	100		South/Anchor (2003)	219	45.82170276 N	84.76412053 W
									North/Anchor (2012)	219	45.82180891 N	84.7640712 W
W-59B North	56	3	Shared Touch Down ^	45					South/Anchor (2012)	219	45.82180891 N	84.7640712 W
									North/Anchor (2003)	212	45.82195831 N	84.76401066 W
W-58A South	62	2	Shared Touch Down ^	62	126	132	131		South/Anchor (2003)	212	45.82195831 N	84.76401066 W
									North/Anchor (2010)	207	45.82212511 N	84.76395711 W
W-58A North	70	2.5	Shared Touch Down ^	70					South/Anchor (2010)	207	45.82212511 N	84.76395711 W
									North/Anchor (2003)	190	45.82230838 N	84.7638836 W
W-58B	35	1.5	Shared Touch Down ^	36	38	30	28		South/Anchor (2003)	190	45.82230838 N	84.7638836 W
									North/Clay	183	45.8224028 N	84.76385368 W
W-60A	56	1.5	137' to W58B	58	55	52	60	62	South/Clay	165	45.82276582 N	84.76370893 W
									North/Anchor (2003)	160	45.82291533 N	84.7636541 W
W-60B South	50	2	Shared Touch Down ^	70	90	91	86	89	South/Anchor (2003)	160	45.82291533 N	84.7636541 W
									North/Anchor (2012)	155	45.82304668 N	84.76359861 W
W-60B North	33	2	Shared Touch Down ^	20					South/Anchor (2012)	155	45.82304668 N	84.76359861 W
									North/Clay	148	45.82313538 N	84.76356789 W
W-79				Silted in	15	16			NA	NA	NA	NA
									NA	NA	NA	NA
W-61A	27	1	83' to W60B	72	80	85	79	84	South/Clay	135	45.82335415 N	84.76349054 W
									North/Anchor (2014)	132	45.82342456 N	84.76346306 W
W-61B	45		Shared Touch Down ^						South/Anchor (2014)	132	45.82342456 N	84.76346306 W
									North/Clay	125	45.82354201 N	84.76341513 W
W-62	44	1	351 to W61	46	49	45	44	38	South/Sand	91	45.82447624 N	84.76309011 W
									North/Sand	89	45.82459253 N	84.76304185 W
W-63A	54	1.5	282 to W-62	66	57	49	57	55	South/Sand	78	45.82534041 N	84.76275039 W
									North/Anchor (2004)	78	45.82548661 N	84.7626958 W
W-63B	53	1.5	Shared Touch Down ^	50	54	54	49	51	South/Anchor (2004)	78	45.82548661 N	84.7626958 W
									North/Sand	76	45.8256262 N	84.76264017 W
W-65A	50	1.5	185' to W-63B	77	90	82	86	80	South/Sand	74	45.82611694 N	84.76246404 W
									North/Anchor (2014)	74	45.82624713 N	84.76241517 W
W-65B	26		Shared Touch Down ^						South/Anchor (2014)	74	45.82624713 N	84.76241517 W
									North/Sand	74	45.82631462 N	84.76238826 W
W-64A	18	1	8' to W-65	20	90	89	90	80	South/Sand	73	45.82633776 N	84.76238098 W
									North/Anchor (2012)	73	45.82638189 N	84.76235928 W
W-64B South	29	1	Shared Touch Down ^	71					South/Anchor (2012)	73	45.82638189 N	84.76235928 W
									North/Anchor (2014)	73	45.8264624 N	84.7623333 W
W-64B North	46		Shared Touch Down ^						South/Anchor (2014)	72	45.8264624 N	84.7623333 W
									North/Sand	72	45.82658693 N	84.76228562 W
W-67A	41	2'	98' to W-64N	89	87	89	100	86	South/Sand	72	45.8268466 N	84.76218543 W
									North/Anchor (2014)	72	45.82695668 N	84.762151 W
W-67B	50		Shared Touch Down ^						South/Anchor (2014)	72	45.82695668 N	84.762151 W
									North/Sand	70	45.82708749 N	84.76210055 W
W-66	43	1.5	196' to W-67	67	41	45	45	44	South/Sand	70	45.82760434 N	84.76191151 W
									North/Sand	70	45.82771752 N	84.76186138 W
Northern Exposure Point	NA	NA	100' to W-66	NA	NA	NA	NA	NA	Only/Sand	65	45.82798472 N	84.76176355 W

APPENDIX 6: Unsupported Span Data from Enbridge's November 19, 2014 Letter and Attachment to Attorney General and DEQ Director

	East Span			West Span	
	Southern Exposure Point	2014 Length	45.79740 051N, 84.76828 612W	2014 Length	45.79570 801 N, 84.77389 377 W
1	E-75	0	W-01-A	66	
2		50		59	
3		70		21	
4		47		71	
5		28		0	
6		30		12	
7		49		42	
8		44		53	
9		37		12	
10		54		40	
11		38		32	
12		48		47	
13		44		51	
14		28		48	
15		58		56	
16		61		35	
17		31		55	
18		63		28	
19		37		54	
20		38		51	
21		63		40	
22		59		37	
23		38		0	
24		36		8	
25		36		42	
26		56		55	
27		50		62	
28		36		24	
29		58		22	
30		53		12	
31		21		70	
32		43		49	
33		6		36	
34		40		30	
35		47		51	
36		67		0	
37		22		54	
38		36		0	
39		63		54	
40		22		6	
41		60		65	

42	46	59
43	58	35
44	28	0
45	45	38
46	56	51
47	39	54
48	46	25
49	71	26
50	45	64
51	28	38
52	55	43
53	60	35
54	14	37
55	0	55
56	52	27
57	22	61
58	72	24
59	52	59
60	44	45
61	46	37
62	46	48
63	57	69
64	33	64
65	44	65
66	60	71
67	10	67
68	8	35
69	51	54
70	42	41
71	45	156
72	67	58
73	23	24
74	62	20
75	57	50
76	63	54
77	46	63
78	70	59
79	57	69
80	29	26
81	39	47
82	21	35
83	49	64
84	70	11
85	7	66
86	53	62
87	0	26

88		23		55
89		60		57
90		58		47
91		24		35
92		22		61
93		15		54
94		17		61
95		38		57
96		42		0
97		28		56
98		50		51
99		58		43
100		69		40
101		58		0
102		18		36
103		35		53
104		47		41
105		65		56
106		34		62
107		29		70
108		58		35
109		57		56
110		51		50
111		52		33
112		27		0
113		53		27
114		59		45
115		43		44
116		48		54
117		17		53
118		59		50
119		19		26
120		27		18
121		55		29
122		67		45
123		52		41
124		52		50
125		62		43
126		61		
127	Northern Exposure Point	0	45.82672766 N, 84.75	0

Total Supported Length (feet)	5464	5401
Total Supported Length (miles)	1.03	1.02
Total Unburied Length (miles)	2.1	2.3

APPENDIX 7

Enbridge Energy Company, Inc.
Lake Superior Place
21 West Superior Street
Duluth, MN 55802-2067
www.enbridgepartners.com

Grant P. Henningsen
Supervisor, Civil/Mechanical Engineering
Adam J. Erickson
Engineer
Tel 218 725 0548
Fax 218 725 0564
adam.erickson@enbridge-us.com

ENBRIDGE™

September 14, 2001

Mr. John Arevalo
Michigan Department of Environmental Quality
Gaylord District
2100 West M-32
Gaylord, MI 49735

Re: Enbridge Energy's Joint Permit Application for Repair Work to be Completed on Crude Oil Transmission Pipelines Located in the Straits of Mackinac.

Dear Mr. Arevalo:

As follow-up to our telephone conversation held yesterday regarding the above referenced project, enclosed is a Joint Permit Application for repair work to be conducted on Enbridge's (formerly Lakehead Pipeline) two 20-inch diameter pipelines. We have been in contact with the U.S. Army Corp of Engineers and they will be issuing a permit for this repair work today. They have assigned case number 880161211 to the project. These emergency preventative maintenance repairs must be completed as soon as possible. We are scheduled to begin repair work on Sunday morning, September 16, 2001.

We appreciate your work to expedite the approval process. If you have any questions or comments, please feel free to contact me at (218) 725-0548.

Sincerely,

Adam Erickson

Adam J. Erickson
Engineer

Enclosure: Joint Permit Application
Indications map

c: John Sobojinski – LPL
Grant Henningsen – LPL
Barry Power – LPL

US Army Corps of Engineers (USACE) | Michigan Department of Environmental Quality (MDEQ) DEQ

AGENCY USE		Date Received		
Previous USACE Permit or File Number		Received LWMD/DEQ SEP 17 2001 GAYLOND	Land and Water Management Division, MDEQ File Number	01-24-00466
USACE File Number			*Marina* Operating Permit Number	
			Fee received $	$50.00 #833

- Print in black, blue, or red ink and complete all items in Sections 1 through 9 and those items in Sections 10 through 21 that apply to your proposed project.

1 PROJECT LOCATION INFORMATION

- Refer to your property's legal description for the Township, Range, and Section information, and your property tax bill for your Property Tax Identification Number(s).

Address	Township Name(s)	Township(s)	Range(s)	Section(s)
LAKE MICHIGAN BETWEEN UPPER & LOWER PENINSULA	N/A	39N	3W	N/A

City/Village	County(ies)	Property Tax Identification Number(s)
N/A	N/A	N/A

Name of Waterbody	Project Name or Job Number	Subdivision/Plat	Lot Number	Private Claim
LAKE MICHIGAN	SCN 8122	N/A		

Project types (check all that apply): ☐ private ☐ public/government ☒ industrial ☐ commercial ☐ multi-family ☐ building addition ☐ new building or *structure* ☐ building renovation or restoration ☐ river restoration ☐ single-family ☐ other (explain)

The proposed project is on, within, or involves (check all that apply)

☐ a stream ☐ a pond (less than 5 acres) ☒ a Great Lake or *Section 10 Waters* ☐ a *natural river*
☐ a river ☐ a channel/canal ☐ a designated *high risk erosion area* ☐ a *dam* ☐ a *structure* removal
☐ a ditch or drain ☐ an *inland lake* (more than 5 acres) ☐ a designated *critical dune area* ☐ a wetland ☐ a utility crossing
☐ a *floodway* area ☐ a *100-year floodplain* ☐ a designated *environmental area* ☐ 500 feet of an existing waterbody
☐ a legally established County Drain (date established)

2 DESCRIBE PROPOSED PROJECT AND ASSOCIATED ACTIVITIES, AND THE CONSTRUCTION SEQUENCE AND METHODS

- Attach separate sheets, as needed, including necessary drawings, sketches, or plans.

PROJECT IS TO PROVIDE SUPPORT UNDERNEATH OUR PIPELINES IN SECTIONS WHERE THE PIPELINE SPANS UN-SUPPORTED OVER TOO GREAT A DISTANCE. GROUT BAGS WILL BE PLACED BENEATH THE UNSUPPORTED SECTIONS THEN FILLED WITH GROUT VIA A PUMPING RIG LOCATED ON A BARGE AT THE SURFACE. GROUT HOSES WILL BE CONNECTED BY DIVERS.

3 APPLICANT, AGENT/CONTRACTOR, AND PROPERTY OWNER INFORMATION

- The applicant can be either the property owner or the person or company that proposes to undertake the activity.
- If the applicant is a corporation, both the corporation and it's owner must provide a written document authorizing the agent/contractor to act on their behalf.

Applicant (individual or corporate name)	Agent/Contractor (firm name and contact person)
ENBRIDGE ENERGY LIMITED PARTNERSHIP	
Mailing Address 21 WEST SUPERIOR STREET	Address
City DULUTH State MN Zip Code 55802	City State Zip Code
Daytime Telephone Number with Area Code (218) 725-0548	Daytime Telephone Number with Area Code
Fax (218) 725-0564 E-mail ADAM.ERICKSON@USPL.ENBRIDGE.COM	Fax E-mail

Is the applicant the sole owner of all property on which this project is to be constructed and all property involved or impacted by this project? ☐ No ☒ Yes
(If No, provide a letter signed by the property owner authorizing the agent/contractor to act on his or her behalf or a copy of easements or right-of-ways. If multiple owners, please attach all property owners' names, mailing addresses, and telephone numbers.)

Property Owner's Name (If different from applicant)	Mailing Address
Daytime Telephone Number with Area Code	City State Zip Code

4 PROPOSED PROJECT PURPOSE, INTENDED USE, AND ALTERNATIVES CONSIDERED (Attach additional sheets if necessary)

- The purpose must include any new development or expansion of an existing land use.
- Include a description of alternatives considered to avoid or minimize resource impacts. Include factors such as, but not limited to, alternative construction technologies; alternative project layout and design; alternative locations; local land use regulations and infrastructure; and pertinent environmental and resource issues.
- For utility crossings, include both alternative routes and alternative construction methods.

IN ORDER TO MAINTAIN PIPELINE INTEGRITY & SAFETY - THESE MAINTENANCE REPAIRS CAN WAIT NO LONGER. THIS METHOD OF REPAIR IS THE MOST ENVIRONMENTALLY FRIENDLY METHOD WHICH WE ARE AWARE OF.

US Army Corps of Engineers (USACE) | Michigan Department of Environmental Quality (MDEQ) DEQ

5 LOCATING YOUR PROJECT SITE

- Provide the requested information listed below that will help staff in locating your project site.
- Attach a copy of a map, such as a plat, county, or USGS topographic map, clearly showing the site location and include an arrow indicating the north direction.

Is there an access road to the project? ☐ No ☐ Yes (**If Yes,** type of road, **check all that apply**) ☐ private ☐ public ☐ improved ☐ unimproved

Name of roads at closest main intersection and

Directions from main intersection

Style of house or other building on site ☐ ranch ☐ 2-story ☐ cape cod ☐ bi-level ☐ cottage/cabin ☐ pole barn ☐ none ☐ other (describe)

Color Color of adjacent property house and/or buildings

House number Address is visible on ☐ house ☐ garage ☐ mailbox ☐ sign ☐ other

Street name Fire lane number Lot number

How can your site be identified if there is no visible address?

Provide directions to the project site, with distances from the best and nearest visible landmark and waterbody IT IS LOCATED BETWEEN THE UPPER & LOWER PENINSULA OF MICHIGAN AT THE MACKINAC STRAITS.

Does project cross boundaries of two or more political jurisdictions? (City/Township, Township/Township, County/County, etc.)
☐ No ☐ Yes (If Yes, list jurisdiction names.) UNKNOWN

6 List all other federal, interstate, state, or local agencies authorizations required for the proposed activity, including all approvals or denials received.

Agency	Type approval	Identification number	Date applied	Date approved / denied	If denied, reason for denial
USACE	NATIONWIDE PERMIT	NW03	9-12-01	9-14-01	

7 If a permit is issued, date activity will commence (M/D/Y) 9-15-01 P.E. | Proposed completion date (M/D/Y) 10-15-01

Has any construction activity commenced or been completed in a regulated area? ☒ No ☐ Yes
If Yes, identify the portion(s) underway or completed on drawings or attach project specifications and give completion date(s) (M/D/Y)

Were the regulated activities conducted under a MDEQ permit? ☐ No ☐ Yes
If Yes, list the MDEQ permit number

Are you aware of any unresolved violations of environmental law or litigation involving the property? ☒ No ☐ Yes (**If Yes,** please explain)

8 PUBLIC NOTIFICATION (Attach additional sheets if necessary)

- Complete information for all *adjacent and impacted property owners* and the lake association or established lake board including the contact person's name.
- If you own the adjacent lot, provide the requested information for the first adjacent parcel beyond your property line.

Property Owner's Name	Mailing Address	City	State	Zip Code
N/A				

Name of ☐ Established Lake Board ☐ or Lake Association and the Contact Person's Name	Telephone Number	Mailing Address	City	State	Zip Code

9 APPLICANT'S CERTIFICATION **READ CAREFULLY BEFORE SIGNING**

I am applying for a permit(s) to authorize the activities described herein. I certify that I am familiar with the information contained in this application, that it is true and accurate, and, to the best of my knowledge, is in compliance with the State *Coastal Zone Management Program* and the *National Flood Insurance Program.* I understand that there are penalties for submitting false information and that any permit issued pursuant to this application may be revoked if information on this application is untrue. I certify that I have the authority to undertake the activities proposed in this application. By signing this application, I agree to allow representatives of the MDEQ and the USACE to enter upon said property in order to inspect the proposed activity site and the completed project. I understand that I must obtain all other necessary local, county, state, or federal permits and that the granting of other permits by local, county, state, or federal agencies does **not** release me from the requirements of obtaining the permit requested herein before commencing the activity. I understand that the payment of the application fee does **not** guarantee the issuance of a permit.

- All applicants must complete all the items in Sections 1 through 9 on pages 1 and 2 of this application.
- Complete those items in Sections 10 through 21 that apply to your project. It is necessary to submit only those pages where you have provided information.
- Please list here the application page numbers being submitted and a brief description of other attachments included with your application.

☐ Property Owner
☐ Agent/Contractor
☒ Corporation – Title Enbridge Energy, Limited Partnership Printed Name Adam Erickson Signature Adam Erickson Date 9/19/01

APPENDIX 8

PERMIT APPLICATION

MDNRE / ACE JOINT PERMIT APPLICATION

Straits of Mackinac 2010 Underwater Inspection and Maintenance

August 26, 2010

MDNRE and USACE - Joint Permit Application
Enbridge Pipelines (Lakehead), L.L.C.
Straits of Mackinac Maintenance and Inspection Project, Line 5
Mackinac and Emmet Counties, Michigan

Project Descripton

2 – **Describe proposed project and associated activities, and the construction sequence and methods.**
The purpose of the project will be to perform visual inspection of the existing 20-inch pipelines installed beneath the Straits of Mackinac and install support structures in more than 10 locations along the pipeline. The most of the location of the existing pipelines is shown on the attached site location Figures 1,2,3, & 4 in attachment "FIGURES AND CONTRUCTION TYPICALS".T he work will involve the installation of a helical anchoring system with saddle mounted about the pipeline in each proposed location to increase support; the anchors will be augered directly into the lake bed. The proposed locations for installation of the anchoring structures are provided on the attached map. During the underwater inspection additional location requiring maintenance may be identified. Installation of support structures in these locations would occur during this project. Schematics showing the auguring apparatus and method as well as equipment utilized for installation are included with the attachments.

Work will be conducted from barges and a certified diving contractor will be employed to oversee the installation. Work is scheduled to begin September 17, 2010 and is expected to take 10 days at the minimum with very good weather conditions and up to 30 days with poor weather conditions.

4 – **Proposed project purpose, intended use, and alternative considered.**
In order to maintain pipeline integrity, installation of additional supports to minimize the distance between presently unsupported pipeline spans is necessary. The proposed locations for installation of the anchoring structures are provided on the attached map. Schematics showing the auguring apparatus and method as well as equipment utilized for installation are included with the attachments. The support method is anticipated to incur minimal or no environmental impact. This project is considered pipeline maintenance and is not associated with a new utility installation.

The proposed work is necessary to provide better overall pipeline integrity and safety. Do nothing or the no-build alternative presents a future risk to the pipeline. The no build is not a viable option.

Rasmusson, Scott (DNRE)

From: Jacob Jorgensen [Jacob.Jorgensen@enbridge.com]
Sent: Thursday, November 18, 2010 1:18 PM
To: Scott Rasmusson (DNRE; Gina Nathan (ACE
Cc: Arevalo, John (DNRE); Alina Heydt (Barr; Patsy Bolk; David Hoffman; Jason Pavone
Subject: MDNRE File #10-24-0035-P - Enbridge, Straits of Mackinac

Mr. Rasmusson and Ms. Nathan,

Please find the following information for your file on MDNRE File #10-24-0035-P. Seven screw anchor support assembly installations were completed at the following locations:

West Pipeline Leg
W-18A - Completed at 3:40 PM ON 9-26-10
W-34B - Completed at 3:00 PM ON 9-27-10
W-70 - Completed at 6:40 PM ON 9-29-10
W-58A - Completed at 6:30 PM ON 9-30-10

East Pipeline Leg
E-13C - Completed at 3:35 PM on 10-4-10
E-13B - Completed at 4:11 PM on 10-5-10
E-74B - Completed at 12:15 PM on 10-6-10

We will not be completing the project completion postcard at this time as our preventative work may not be completed. The real-time ROV Inspection in September did not indicate that there were immediate support conditions needing attention that were outside of our original fall 2010 preventative maintenance scope. We will be reviewing the data from the 2010 fall inspection to develop and schedule our future preventative maintenance programs. We do not have the future support locations determined at this point, nor the actual scope of the projects to come at this time, but we will be working towards them in the coming months.

Please let me know if you have any questions or concerns.
Thank you,

Jacob Jorgensen, EIT
Enbridge Energy
Superior Region Engineer
Office: (715) 394-1551
Cell: (218) 248-0808
Fax: (832) 325 5602

Enbridge 24-Hour Emergency Response Number 1-800-858-5253

APPENDIX 9: ADDITIONAL INFORMATION ON EASEMENT VIOLATIONS

Section 3. Additional Information about the Pipeline Wall Thickness Requirement

This revelation of "mill anomalies" is sufficient information on which to form a reasonable belief that the pipe used to construct the Straits sections of Line 5 did not comply with API 5L when the line was constructed and that it is not in compliance with the current version of API 5L. It has not been possible to secure a historical copy of API 5L from 1948, however, the two following sections of API 5L (2004) are believed to be the same as would be found in the 1948 version. The term "mill anomalies" does not appear in API 5L or other applicable standards, so the statement made by Enbridge about dimensional variances in the pipe used in the Straits sections of Line 5 cannot be directly interpreted.

The following sections are from API 5L (2004) describing standards for pipe dimensions and defects.

> 7 Dimensions, Weights, Lengths, Defects, and End Finishes
>
> 7.3 WALL THICKNESS
>
> Each length of pipe shall be measured for conformance to the specified wall thickness requirements. The wall thickness at any location shall be within the tolerances specified in Table 9, except that the weld area shall not be limited by the plus tolerance.

Table 9—Tolerances for Wall Thickness

Size	Type of Pipe	Tolerance[a] (Percent of Specified Wall Thickness)	
		Grade B or Lower	Grade X42 or Higher
≤ $2^7/_8$	All	+ 20.0, – 12.5	+ 15.0, –12.5
> $2^7/_8$ and < 20	All	+ 15.0, – 12.5	+ 15.0, –12.5
≥ 20	Welded	+ 17.5, –12.5	+ 19.5, –8.0
≥ 20	Seamless	+ 15.0, –12.5	+ 17.5, –10.0

[a]Where negative tolerances smaller than those listed are specified by the purchaser, the positive tolerance shall be increased to the applicable total tolerance range in percent less the wall thickness negative tolerance.

> 7.8.14 Other Defects
> Any OD or ID surface imperfection that has a depth greater than 12.5% of the specified wall thickness shall be considered a defect.

Enbridge's admission that the pipe used to construct the Straits sections of Line 5 is inconsistent with the language used in API 5L. This raises the possibility that this pipe did not in fact meet the specifications set forth in the 1953 Easement and the 1953 MPSC Order. It also appears that Line 5 may not be consistent with API Standard 1104 (1999) "Welding of pipelines and Related Facilities." a version of which was in place when Line 5 was constructed. This standard states:

> 7 Design and Preparation of a Joint for Production Welding
>
> 7.2 ALIGNMENT
> The alignment of abutting ends shall minimize the offset between surfaces. For pipe ends of the same nominal thickness, the offset should not exceed 1/8 in. (3 mm). Larger variations

are permissible provided the variation is caused by variations of the pipe end dimensions within the pipe purchase specification tolerances, and such variations have been distributed essentially uniformly around the circumference of the pipe.

Section 4. Additional Information about the Pipeline Slats and Exterior Coating Requirements

Section A (9) of the Easement requires: "All pipe shall be protected by asphalt primer coat, by inner wrap and outer wrap composed of glass fiber fabric material and one inch by four inch (1" x 4") slats prior to installation." An examination of external coating requirements on the Straits sections of Line 5, however, reveals inconsistencies in the related 1953 MPSC Order, the related engineering report, and the 2014 Enbridge report. While the Easement identifies asphalt primer, the MPSC order states coal tar,[49] the engineering report states asphalt primer[50] and the 2014 Enbridge ORP report[51] states it could be either an extract of coal tar or asphalt.[52]
To determine whether the actual coating on Line 5 is consistent with the easement requirements, it is useful to consider a reference from the period when Line 5 was constructed. Exhibit 4[53] provides a thorough explanation of typical field pipeline coating best practices as of 1964:

> In Field Application, the coating is applied with specialized equipment that rides on the pipe. The pipe is brought to the right of way and "strung" in place; the welders then weld the pipe sections together; tile cleaning unit consisting of rotating wire brushes remove mill scale and rust just prior to application of the primer. Following the primer unit is a similar unit where the hot melted coating is applied to the pipe with a glass wrap and a protective outer wrap is applied with the same equipment. The protected pipe is then installed by lowering into the ditch.

This description of the coating technology used on the Straits sections of Line 5 is consistent with photographs showing the equipment used to clean and wrap the pipe before it was strung across the Straits. Photos D and E respectively show the pipe cleaning machine and the pipe wrapping machine used.

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[49] *See* Appendix 2. The Easement language is inconsistent with the 1953 MPSC Order allowing construction of Line 5 by Enbridge's predecessor, the Lakehead Pipe Line Company, which states: "The entire pipe line will be properly cleaned, primed, and coated with a single application of coal tar. The coating will be reinforced by a spiral wrap of glass material and covered by a spiral wrap of special glass outer wrap."
[50] *See* Appendix 3. The Engineering and Construction Considerations for Line 5 articulate these exterior coating system requirements in greater detail, and are not consistent with either the Easement or the MPSC Order: "After coating with asphalt primer, fiberglass inner wrap and an asbestos felt outer wrap, and after attaching 1" x 4" wood slats to the full circumference of the pipe, it will be lowered onto a previously prepared "bed" on the floor of the Straits."
[51] Enbridge's description of the corrosion protective coating system of the Straits sections of Line 5 provides a fourth description that is inconsistent with the other three: "The external coatings on Line 5 is still today recognized as being one of the most successful coating systems applied on pipelines worldwide. The particular material, an extract of coal or asphalt, is highly impermeable to water and is reinforced with a fiber wrapping for added strength." Enbridge 2014 ORP at 12.
[52] It should be noted that coal tar is a product of the destructive distillation of coal while asphalt primer is a petroleum product diluted with a petroleum solvent.
[53] *See* Appendix 4: J. J. McManus, W. L. Pemie, and A. Davies, "HOT APPLIED COAL TAR COATINGS," Allied Chemical Corporation, Plastics Division, Morristown, N. J., Engineering Experiment Station Bulletin 72 (1964): p. 144. https://web.anl.gov/PCS/acsfuel/.preprint%20archive/Files/09_4_ATLANTIC%20CITY_09-65_0144.pdf

Photo D Trudgen Photo of Pipe Cleaning Machine 00010370013.tif

Photo E Trudgen Photo of Pipe Wrapping Machine 00010370012.tif

The machine shown in Photo D uses rotating wire brushes to remove mill scale and rust from welded pipeline stings and the machine shown in Photo E appears prepared to wrap the pipe with two layers of a fabric material followed by what appears to be a paper protective layer. This equipment and other details are exactly like that described in Appendix 4 leading to the conclusion that the Straits sections of Line 5 utilized a coal tar matrix in a glass fiber protected by an outer wrap of paper. This conclusion is not consistent with the language used in either the Easement or Appendix 3 but is consistent with the language used in the 1953 MPSC Order.

Photo F is an enlarged detail from Photo E, featuring a freshly wrapped piece of pipe covered with rust that was not removed by the pipe cleaning machine. This would not have been considered good

practice at the time as noted in Exhibit 4 and applying the coating over rusted pipe would enhance the probability of external corrosion. The body evidence presented above suggests that the coating system applied to the exterior of the Straits sections of Line 5 is not consistent with both the letter and the intent of the Easement.

Photo F Detail from Trudgen Photo of Pipe Wrapping Machine 00010370012.tif

Section 4. Additional Photographic Evidence about the Pipeline Slats Requirements

Photo G Postcard of Line 5 Installation Violating Slats Requirement around Entire Pipeline