Filed: 2020-08-21
Section 101
EB-2020-0160

ONTARIO ENERGY BOARD

IN THE MATTER OF the *Energy Board Act, 1998*, S.O. 1998, c. 15 (Schedule B);

AND IN THE MATTER OF an application by Enbridge Gas Inc. pursuant to Condition 4 from the Ontario Energy Board's Decision and Order, and Section 101 of the *Ontario Energy Board Act, 1998* for authority to construct a work upon, under or over a highway, utility line or ditch in the County of Essex for the purposes of a natural gas pipeline in respect of which the Ontario Energy Board granted leave to construct in EB-2019-0172 to Enbridge Gas Inc.;

ANSWERS OF THE CORPORATION OF THE COUNTY OF ESSEX TO INTERROGATORIES FROM ENBRIDGE GAS INC.

ENBRIDGE – Q # 1
Reference: Response of the County of Essex, Tab 3, Affidavit of William Tape

Preamble: None provided.

Question a): *Please confirm the hoop stress calculation performed by Enbridge/Wood (Ex. B, Tab 1, Sched. 5, Appendix A and B) was performed correctly given the assumptions made.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-01a.), at page 1, a copy of which is attached hereto at **TAB # 1**.

Question b): *How many highway project designs has Dr. Tape completed and for whom and when were these projects completed?*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-01b.), at page 1, a copy of which is attached hereto at **TAB # 1**.

ENBRIDGE – Q # 2
Reference: Response of the County of Essex, Tab 3, Affidavit of William Tape, paragraph 5

Preamble: None provided.

Question a): *Please provide a copy of the retainer letter with the County of Essex and instructions in this matter including the loading information provided by the County of Essex for any analysis.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-02a.), at page 1, a copy of which is attached hereto at **TAB # 1**.

Question b): *Confirm the retainer letter does not include any reference to the decommissioning or abandonment of the existing Enbridge pipeline.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-02b.), at page 1, a copy of which is attached hereto at **TAB # 1**.

Question c): *Please confirm that the letters authored by Dr. Tape may be taken as if given under professional seal.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-02c.), at page 1, a copy of which is attached hereto at **TAB # 1**.

ENBRIDGE – Q # 3
Reference: Response of the County of Essex, Tab 3, Affidavit of William Tape, paragraph 6

Preamble: None provided.

Question a): *How many pipeline projects have you been engaged in as a professional engineer in applying "standards" for construction?*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-03a.), at page 1, a copy of which is attached hereto at **TAB # 1**.

Question b): *Prior to being retained by the County, have you ever reviewed or interpreted CAN/CSA Z662-15 or CAN/CSA Z662-19? If so, explain under what circumstances?*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-03b.), at page 2, a copy of which is attached hereto at **TAB # 1**.

ENBRIDGE – Q # 4
Reference: Response of the County of Essex, Tab 3, Affidavit of William Tape, paragraph 8, Exhibit B, and Exhibit C, page 7 of 8

Preamble: "Based upon our review and in the interest of shielding the County from liability while maintaining a consistent application of policy…"

Question a): *Explain how your "interest of shielding the County from liability" is consistent with your duty as an expert in this proceeding. Please note any differences in these duties.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-04a.), at page 2, a copy of which is attached hereto at **TAB # 1**.

ENBRIDGE – Q # 5
Reference: Response of the County of Essex, Tab 3, Affidavit of William Tape, paragraph 9, and Exhibit C, Page 1, May 7, 2020 letter

Preamble: "…we have undertaken a review of the Enbridge Pipeline vehicle loading analysis date May 1, 2020."

Question a): *Please provide all calculations, memos (including Ms. Kalbol Memo of April 27, 2020) and reports referenced, relied upon and/or created during the vehicle loading analysis review referenced above. In particular, provide all stress analyses performed for the depth of 1.0 metres of cover.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-05a.), at page 2, a copy of which is attached hereto at **TAB # 1**.

Question b): *Please confirm the date on which this review was performed.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-05b.), at page 2, a copy of which is attached hereto at **TAB # 1**.

Question c): *Please identify the "we" being referred to in the quotation.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-05c.), at page 2, a copy of which is attached hereto at **TAB # 1**.

Question d): *What is the typical elevation difference between the edge of pavement and the area directly above the pipeline? Please state the source of this information.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-05d.), at page 2, a copy of which is attached hereto at **TAB # 1**.

Question e): Please provide the source document that requires the shoulder be treated as part of the "travelled portion" of the roadway for interpretation of the TAC *Guidelines for Underground Utility Installations Crossing Highway Rights-of-Way*.

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-05e.), at page 2, a copy of which is attached hereto at **TAB # 1**.

Question f): *Please confirm the area beyond the shoulder is not in your opinion considered part of the "travelled portion".*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-05e.), at page 2, a copy of which is attached hereto at **TAB # 1**.

ENBRIDGE – Q # 6
Reference: Response of the County of Essex, Tab 3, Affidavit of William Tape, paragraph 10(d), and Exhibit C, Page 1, May 7, 2020 letter

Preamble: "it is our understanding that the Country [sic] Road 46 will experience road widening over the course of the pipelines [sic] life placing the proposed service within the driven path."

Question a): *On what information are you relying for the statement that the road will experience widening. Please describe in detail the nature, timing and location of the "widenings". Provide reference documents where available.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-06a.), at page 2, a copy of which is attached hereto at **TAB # 1**.

Question b): *The County of Essex website includes a description, quoted below, and a link to the Capacity Expansion Program (see Attachment #2 or link). Did you review the Capacity Expansion Program?*
"The County's ***Capacity Expansion Program*** *is an aggressive program of road projects planned over the next 20 years with a total value of $380 million. Proposed projects in 2020 cost $28,407,40, including $605,000 for the Centralized Traffic Control System. "*
https://coe-pub.escribemeetings.com/filestream.ashx?DocumentId=13027

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-06b.), at page 2, a copy of which is attached hereto at **TAB # 1**.

Question c:) *Confirm that the attachment referenced in b) shows early works for areas west of Manning Road commencing in 2024 to 2028 and Construction occurring in years 2034 to 2037.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-06c.), at page 2, a copy of which is attached hereto at **TAB # 1.**
Further, the County notes that its publicly available documents are currently quite dated, and the County is in the midst of updating many publicly available documents (including the link above) related to scheduled road improvements.
As the planned improvements to County Road 46 are not readily available in public documents, the County made a point of advising Enbridge repeatedly that improvements to County Road 46 are planned in both the near and longer term.

Question d:) *Confirm that the attachment referenced in b) shows no early works or construction for the remainder of County Road 46 prior to 2037.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-06d.), at page 2, a copy of which is attached hereto at **TAB # 1.**
Again, as in the answer to c) above, the County notes that although the attachment referenced in b) shows no early works or construction on County Road 46 prior to 2037, the County's current plan is to start improvements on County Road 46 in the next 5 to 10 years, and earlier if the need warrants it and the funding is available.
Despite what the document referenced in b) shows, Enbridge was advised repeatedly of the County's plans to improve ounty Road 46, and was advised this would be happening in the near future.

ENBRIDGE – Q # 7
Reference: Response of the County of Essex, Tab 3, Affidavit of William Tape, paragraph 11

Preamble: "I have reviewed and relied upon standards including CAN/CSA Z662-15 and CAN/CSA Z662-19 regarding Oil and Gas Pipeline Systems, the Transportation of Canada ("TAC") relating to the minimum depth of bury for pipelines, load analysis for buried pipes…."
Enbridge agrees that Clause 4, table 4.9 of CAN/CSA Z662-19 would be applicable to transmission pipeline depth of cover requirements when such version is in force, but Enbridge's proposed NPS 6 Windsor Line is a distribution pipeline and CAN/CSA Z662-19 is not yet adopted and in force.

Question a): *Please confirm that CAN/CSA Z662-19 has not yet been adopted by the Technical Standards and Safety Authority.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-07a.), at page 3, a copy of which is attached hereto at **TAB # 1.**

Question b): *Confirm that the "Transportation of Canada ("TAC")" refers to the Transportation Association of Canada.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-07b.), at page 3, a copy of which is attached hereto at **TAB # 1.**

Question c): *To which TAC Guidelines are you referring?*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-07c.), at page 3, a copy of which is attached hereto at **TAB # 1.**

Question d): *Is the TAC a government regulatory authority having the authorization of law to set binding standards? Please provide such authorizing document.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-07d.), at page 3, a copy of which is attached hereto at **TAB # 1.**

Question e): *Explain in detail why Dr. Tape did not refer to Clause 12, table 12.2 of CAN/CSA Z662-15 for the applicable depth of cover requirements which for distribution pipelines is 0.6m in road right of way and under the travelled surface of the road.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-07e.), at page 3, a copy of which is attached hereto at **TAB # 1.**

Question f): *What is the difference between Clause 12, table 12.2 of CAN/CSA Z662-15 and CAN/CSA Z662-19?*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-07f.), at page 3, a copy of which is attached hereto at **TAB # 1.**

ENBRIDGE – Q # 8
Reference: Response of the County of Essex, Tab 3, Affidavit of William Tape, paragraph 12(b), (e), (f), and (k)

Preamble: None provided.

Question a): *Please confirm the reference to "hook stress" is a reference to "hoop stress".*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-08a.), at page 3, a copy of which is attached hereto at **TAB # 1.**

Question b): *Please confirm where you use the term "conservative" it refers to a situation where such loads are unexpected to arise.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-08b.), at page 3, a copy of which is attached hereto at **TAB # 1.**

Question c): *What are the differences between the two versions of the Z662 in the manner in which the calculation of hoop stresses is performed?*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-08c.), at page 3, a copy of which is attached hereto at **TAB # 1.**

Question d): *Please confirm that paragraph (f) only applies to transmission pipelines.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-08d.), at page 3, a copy of which is attached hereto at **TAB # 1.**

Question e): *What analysis did you perform to determine the "hardship on Enbridge" when you prepared your letter? Please provide the analysis.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-08e.), at page 3, a copy of which is attached hereto at **TAB # 1.**

Question f): *Did you update your analysis in accordance with Exhibit B, Tab 1, Schedule 1, Attachment 2, page 1 which showed a distance from edge of pavement of 4.2 metres?*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-08f.), at page 3, a copy of which is attached hereto at **TAB # 1.**

Question g): *If there is no road widening, do you agree that a proposed location of 4.2 metres from edge of pavement is not within the current shoulder of the road?*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-08g.), at page 3, a copy of which is attached hereto at **TAB # 1.**

ENBRIDGE – Q # 9
Reference: Response of the County of Essex, Tab 3, Affidavit of William Tape, paragraph 14, and Exhibit C thereto, page 5

Preamble: "failure to adhere to the TAC recommendations could result in the County being liable for failure to follow best practices. Such legal discussions should obviously be had with the County legal team; however failure to follow guidelines does create a situation of increased risk and liability."

Question a): *Please list all Road Authorities within Ontario that have formally made compliance with TAC an absolute requirement and provide all documents that confirm such adoption by the Road Authority. Please provide confirmation that such adoption is in relation to project running longitudinally within the rights-of-way.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-09a.), at page 4, a copy of which is attached hereto at **TAB # 1.**

Question b): *Please provide the legal analysis or opinion or basis for concluding that the failure to follow the TAC Guidelines in respect of the depth of the pipeline exposes the County to liability for failing to follow best practices.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-09b.), at page 4, a copy of which is attached hereto at **TAB # 1.**

ENBRIDGE – Q # 10
Reference: Response of the County of Essex, Tab 3, Affidavit of William Tape, paragraph 17(e), and (i)

Preamble: None provided.

Question a): *Has Dr. Tape reviewed Enbridge's backfill procedure?*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-10a.), at page 4, a copy of which is attached hereto at **TAB # 1.**

ENBRIDGE – Q # 11
Reference: Response of the County of Essex, Tab 3, Affidavit of William Tape, paragraph 21(a), and (g)

Preamble: "As I had indicated before, the analysis of the Pipeline itself is not in question but rather the application of the TAC Guidelines as the County's standard."

Question a): *Please confirm that had the County of Essex not adopted the TAC Guidelines, that your opinion is the proposal by Enbridge would be acceptable. If not, please explain.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-11a.), at page 4, a copy of which is attached hereto at **TAB # 1.**

Question b): *Please provide the existing and assumed cross-section that you relied upon in making the statements referred to in paragraph (g).*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-11b.), at page 4, a copy of which is attached hereto at **TAB # 1.**

ENBRIDGE – Q # 12
Reference: Response of the County of Essex, Tab 3, Affidavit of William Tape, Exhibit C thereto, page 2

Preamble: "Our assessment includes a review of the documents and the TAC recommendations…"

Question a): *Are "recommendations" binding obligations of design that must in all cases be implemented by a professional engineer?*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-12a.), at page 4, a copy of which is attached hereto at **TAB # 1.**

Question b): *Did you review any of Enbridge's soil or geotechnical reports? If so, please identify which reports and any written analysis not already provided.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-12b.), at page 4, a copy of which is attached hereto at **TAB # 1.**

ENBRIDGE – Q # 13
Reference: Response of the County of Essex, Tab 3, Affidavit of William Tape, Exhibit C thereto, page 3

Preamble: "…TAC's guideline for Underground Utilities Installation (March 2013) states in the forward"

Question a): *Is the above document reference the "Guidelines for Underground Utility Installations Crossing Highway Rights-of-Way" published by the Transportation Association of Canada ("TAC")?*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-13a.), at page 4, a copy of which is attached hereto at **TAB # 1.**

ENBRIDGE – Q # 14
Reference: Response of the County of Essex, Tab 3, Affidavit of William Tape, Exhibit C thereto, page 3

Preamble: The Transportation Association of Canada website, url below, includes in respect of the guideline the following description:
"Guidelines for Underground Utility Installations Crossing Highway Rights-of-Way is intended to assist various road authorities in establishing and administering reasonably uniform criteria for the accommodation of utilities crossing highway (and freeway) rights-of-way."
https://www.tac-atc.ca/en/publications/ptm-uuich-e

Question a): *What investigation have you done to confirm the document applies to pipelines running longitudinally in a roadway rather than crossings? Please provide all correspondence with the TAC in this regard.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-14a.), at page 4, a copy of which is attached hereto at **TAB # 1.**

Question b): *In follow up to the learning of the County's position, Enbridge engaged in the attached correspondence with the Chair of the Committee responsible for the Guidelines for Underground Utility Installations Crossing Highway Rights-of-Way which indicates a potential misinterpretation of the guideline by the County of Essex. (see Attachment #1, a true copy of an email exchange of Scott Walker). Has Dr. Tape or to the knowledge of Dr. Tape, has the County of Essex engaged in correspondence with the TAC in respect of its application of the Guidelines for Underground Utility Installations Crossing Highway Rights-of-Way. If so, please provide.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-14b.), at page 5, a copy of which is attached hereto at **TAB # 1.**

Question c): *Please cite all references to longitudinal pipeline installations included in the TAC Guideline.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-14c.), at page 5, a copy of which is attached hereto at **TAB # 1.**

Question d): *Did you consider section 3.4.3 of the TAC Guideline which states "Care should be taken in utility installations to avoid disturbing existing highway or private drainage facilities."? If so, please provide the documents including such consideration.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-14d.), at page 5, a copy of which is attached hereto at **TAB # 1.**

Question e): *Do you agree that in the TAC Guideline, Figure 4 and Table 1 show the depth of cover (Value C) for longitudinal design as 0.9 metres?*

Response: **S**ee Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-14e.), at page 5, a copy of which is attached hereto at **TAB # 1.**

ENBRIDGE – Q # 15
Reference: Response of the County of Essex, Tab 3, Affidavit of William Tape, Exhibit C thereto, page 3, and Tab 4, *Guidelines for Underground Utility Installations Crossing Highway Rights-of-Way*

Preamble:

Note

Much of this document has been prepared based on *A Guide for Accommodating Utilities Within Highway Right-of-Way*, 2005, published by the American Association of State Highway and Transportation Officials, Washington, D.C.

Used by Permission.

Question a): *Did Dr. Tape review the above referenced document?*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-15a.), at page 5, a copy of which is attached hereto at **TAB # 1.**

Question b): *Did Dr. Tape note in such review the removal of the references to longitudinal installation from the above referenced document in the TAC Guideline? If not, why not.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-15b.), at page 5, a copy of which is attached hereto at **TAB # 1.**

ENBRIDGE – Q # 16
Reference: Response of the County of Essex, Tab 3, Affidavit of William Tape, Exhibit C thereto, page 4

Preamble: None provided.

Question a): *Can you confirm that the Technical Standards and Safety Authority has not yet adopted CAN/CSA Z662-19?*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-16a.), at page 5, a copy of which is attached hereto at **TAB # 1.**

Question b): *On what basis has Dr. Tape concluded that this pipeline is a "transmission line" subject to Table 4.9 and not a "distribution line"?*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-16b.), at page 5, a copy of which is attached hereto at **TAB # 1.**

Question c): *Does Dr. Tape agree that if this pipeline is in fact a distribution line that Table 4.9 is not applicable?*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-16c.), at page 5, a copy of which is attached hereto at **TAB # 1.**

ENBRIDGE – Q # 17
Reference: Response of the County of Essex, Tab 3, Affidavit of William Tape, Exhibit D thereto, page 1

Preamble: None provided.

Question a): *Please provide The National Cooperative Highway Research Program Report 309.*

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-17a.), at page 5, a copy of which is attached hereto at **TAB # 1.**

Question b): Is the British Columbia Ministry of Transportation and Infrastructure Utility Policy Manual 2019, Version 1 binding upon Enbridge or other utilities in Ontario?

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-17b.), at page 5, a copy of which is attached hereto at **TAB # 1.**

Question c): On which prior occasions has the County of Essex relied upon the British Columbia Ministry of Transportation and Infrastructure Utility Policy Manual 2019, Version 1?

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-17c.), at page 5, a copy of which is attached hereto at **TAB # 1.**

ENBRIDGE – Q # 18
Reference: Response of the County of Essex, Tab 3, Affidavit of William Tape, Exhibit D thereto, page 3

Preamble: "The County cannot be reasonably asked to justify every standard on a project by project basis otherwise no work within the ROW could effectively proceed."

Question a): What standards other than the *Guidelines for Underground Utility Installations Crossing Highway Rights-of-Way* has Enbridge requested be justified?

Response: See Letter from Dr. Tape, Re: Response to Queries, dated August 13, 2020, ENB-18a.), at page 6, a copy of which is attached hereto at **TAB # 1.**

ENBRIDGE – Q # 19
Reference: Response of the County of Essex, Tab 2, Affidavit of Jane Mustac, General – no specific reference

Preamble: None provided.

Question a): *Is it the County of Essex' position that Enbridge could agree to the Road User Agreement approved by the County of Essex without seeking approval of the Ontario Energy Board given condition 4 of the Board's Order in the Leave to Construct proceeding?*

Response: Whether or not Enbridge feels that it should have applied to the OEB in light of condition 4 is not a question the County is able to answer. However, the County notes that it has not asked Enbridge, through the Road User Agreement, or otherwise, to alter the route, increase the costs, obtain necessary environmental assessments or otherwise. The County has asked Enbridge to comply with the County's requirements of which Enbridge was aware, well in advance of the OEB issuing its decision in the Leave to Construct proceeding. However, Enbridge chose not to disclose those requirements.
Finally, it is disingenuous of Enbridge to ask this question. Enbridge itself was prepared to enter into the Road User Agreement without advising the OEB, despite condition 4, as long as the County relented on the issue of depth and agreed to a minimum depth of cover of 1.0 metre.

Question b): *Disturbed soils may be found during the installation process and the pipeline will be backfilled as per the recommendations in the geotechnical report and any unsuitable fills/soils encountered will be removed. Does the County have any concerns with the backfill process proposed by Enbridge? If so, please provide where those concerns have been identified.*

Response: It is not clear to the County what the backfill process proposed by Enbridge is. The County has not received a breakdown of Enbridge's backfill procedure or geotechnical report for its review, comment, and/or information.

The County and Enbridge did agree on a backfill procedure, which remains satisfactory to the County, as outlined in the final version of the Road User Agreement approved by County Council.

Question c): *Is the County aware of any specific areas where significant quantities of disturbed material are present?*

Response: No. This is something that would be identified in a geotechnical report. The County has not seen the geotechnical report prepared by Enbridge, and cannot provide further comment until it has.

Question d): *Please confirm that minimizing the impact on agricultural lands and the natural heritage system is a high priority for the County of Essex as set out s.2.11 of the Official Plan.*

Response: Yes. This is one of the factors that the County takes into consideration for land use planning. But this concern is assessed along with other criteria, some of which is conflicting, prior to making a determination on a specific project.

Question e): *If the County wanted a larger pipeline why did it not intervene in the leave to construct proceeding and argue for a larger pipeline?*

Response: The County repeats and relies on the evidence of Jane Mustac found at paragraph 19(m) of her Affidavit.

Question f): *When did the County of Essex adopt the Guidelines for Underground Utility Installations Crossing Highway Rights-of-Way?*

Response: The County Engineer has the discretion to determine what standards and guidelines to consider in making a determination on any project.

Neither the County Engineer nor County Council has ever officially "adopted" any standard or guideline. However, the County Engineer is expected to exercise her discretion in choosing what standards or guidelines to apply to each particular project to ensure that the use, function, and safety of the County road system is protected.

Given the nature of a high pressure pipeline being placed in the travelled portion of County Road 46 travelled portion (i.e. the "clear zone" as defined in the TAC Guidelines and found in section 3.1.2 - Clear Zone), and given the role and function of County Road 46, the County Engineer decided for this

project that the Guidelines for Underground Utility Installations Crossing Highways Rights-of-Way was the appropriate guideline to utilize.

Question g): *What consultation was conducted with Enbridge and other utilities prior to the adoption of the Guidelines for Underground Utility Installations Crossing Highway Rights-of-Way?*

Response: None. Firstly, Enbridge and other utility providers have no decision making role in the determination of the County as to what standards, policies, and procedures the County utilizes with respect to the use of roads under its jurisdiction.
Secondly, the County Engineer has not "adopted" TAC or any other standard and guideline. Again, the County Engineer decides on a project by project basis as to what the appropriate placement of infrastructure in the County's right of way is. In this instance, the TAC Guidelines for Underground Utility Installations Crossing Highway Rights-of-Way was utilized by the County Engineer. This decision was made due to Enbridge insisting on placing the high pressure pipeline in the travelled portion of the roadway (the "clear zone" as defined by TAC) as opposed to closer to the alignment of the existing pipeline not in the travelled portion of the roadway.

Question h): *What research or correspondence has the County done to confirm the Guidelines for Underground Utility Installations Crossing Highway Rights-of-Way applies to situations of longitudinal pipelines within municipal rights-of-way?*

Response: The County has reviewed the Guidelines for Underground Utility Installations Crossing Highway Rights-of-Way. As this is a high pressure pipeline, that Enbridge insists on placing in the travelled portion ("clear zone") of the roadway, the County has determined that the minimum depth of cover should be 1.5 metres.
This determination was not based on this project being a "longitudinal pipeline within a municipal right-of-way". This determination was based on this being a high pressure pipeline in the travelled portion of a roadway that is heavily used by vehicles, agricultural vehicles, and oversized and overweight loads.

Question i): *In the follow up to the learning of the County's position, Enbridge engaged in the attached correspondence with the Chair of the Committee responsible for the Guidelines for Underground Utility Installations Crossing Highway Rights-of-Way which indicates a potential misinterpretation of the Guideline*

by the County of Essex. (see Attachment #1, a true copy of an email exchange of Scott Walker). Has the County of Essex engaged in correspondence with the TAC in respect of its application of the Guidelines for Underground Utility Installations Crossing Highway Rights-of-Way. If so, please provide.

Response: No the County has not engaged in correspondence with TAC with respect to the County's application of the Guidelines. The reference to the TAC Guidelines is only part of the basis for the decision of the County Engineer. No correspondence with TAC was required by the County in reaching its decision.

ENBRIDGE – Q # 20
Reference: Response of the County of Essex, Tab 2, Affidavit of Jane Mustac, No Specific Reference

Preamble: Enbridge understands that the County of Essex has concerns with approval of a depth of 1.0 metre as it may potentially create an assumption of liability.

Question a): *Is the County relying upon a legal memo or opinion in its position that it may attract liability if it permits a depth of cover of 1.0 metre? If so, please provide.*

Response: No. However, the County has been made aware that having guidelines in place, and whether they are followed or ignored, are definitely a factor Court considers in determining the standard of care for negligence. The following are some helpful cases to assist Enbridge in understanding why the County is concerned that Enbridge will not provide a report confirming why it is appropriate for, among other things, the County to deviate from the TAC Guidelines it uses:

(1) See *Deering v. Scugog*, 2010 ONSC 5502 (Sup. Ct.) at para 243 and *Smith v. Safranyos*, 2018 ONCA 760 at paragraph 50.
Where a manual is one respected within the relevant context the court should approach it in the sense that there should be some compelling reason not to follow it in the circumstances and context within which the defendant is operating

(2) See *Cowan v. Hydro One,* 2011 ONSC 6377 (Sup. Ct.) at paragraph 45.
While not determinative, compliance with internal policies and standards will have a place as a factor to be considered in determining whether a defendant has breached its standard of care.

ENBRIDGE – Q # 21
Reference: Response of the County of Essex, Tab 2, Affidavit of Jane Mustac, Paragraph 6

Preamble: The County has provided a partial review of certain elements of the Franchise Agreement. Enbridge understands that the County has identified certain areas of County Road 46 at Concession 8 east to Rochester Townline to be widened.

Question a): *Please provide a copy of the most recent engineering drawings for the County Road 46 road widening(s) referenced above.*

Response: The County is not yet at the design stage, but based on traffic counts and projected growth, during the improvements to County Road 46, the number of lanes will be increased.

Question b): *Please confirm that Enbridge has agreed to install the pipeline at greater than 6.0 metres from edge of pavement where widening has been confirmed as planned within the next 7 to 10 years on County Road 46 from Concession 8 to Rochester Townline which is west of Manning Road towards Windsor for approximately 6.2kms of the pipeline.*

Response: No, the County cannot confirm this. Enbridge has agreed to install the pipeline at greater than 6.0 metres from the edge of pavement from Concession 8 to just east of County Road 19 (approximately 6.2 kilometres of the pipeline). The pipeline continues east along County Road 46 to Rochester Townline. Enbridge has **not** agreed to install that portion of the pipeline greater than 6.0 metres from the edge of pavement along that section of the pipeline.

Construction along the section of roadway between County Road 19 and Rochester Townline will begin as soon as an EA is conducted and funding is in place. If the pipeline is located within 6.0 metres of the existing paved edge of the roadway along any section of County Road 46, prior to road improvements and widening being conducted, the County will require that Enbridge immediately relocate its pipeline at the expense of Enbridge. That is why the County has been forthcoming with its plans to improve County Road 46 and has insisted that Enbridge either install the pipeline at the correct depth or select a different alignment.

Question c): *Please provide any plans for the widening of County Road 46 showing the necessity (direct conflict) of moving or altering the existing NPS 10 pipeline?*

Response: Again, the County is not yet at the design phase. However, given that the existing NPS 10 pipeline is generally in private easements or closer to the property line in the County's right-of-way, away from the edge of the roadway, it is unlikely that the widening of County Road 46 will have a direct impact on the existing NPS 10 pipeline.

The County's concerns with the existing NPS 10 pipeline, is that it is taking up space in a crowded right-of-way, and rather than it being abandoned in place, the space it currently occupies could be utilized by other infrastructure. This is especially concerning to the County for if the NPS 10 pipeline is left in place, there will be areas of County Road 46 that have 3 alignments dedicated to Enbridge, namely (1) the distribution line, (2) the new NPS 6 line, and (3) the old NPS 10 line.

Question d): *Can the County widen County Road by 14 metres to accommodate the additional lanes and shoulder width beyond the current edge of pavement without securing additional lands?*

Response: The County does not have plans to widen the road by 14 metres. It has plans to add a lane of traffic on each side of the road, with a new shoulder.

It is not clear at this time how much land the County will be required to acquire as part of future improvements. The width of the right-of-way varies along County Road 46, and the County's needs will have to be assessed in more detail during the design phase.

Question e): *Has the County procured or approved the procurement of all necessary land rights for the widening?*

Response: No. See the response to d) above.

Question f): Is the County of Essex aware that the Municipality of Chatham-Kent approved a location for the pipeline of approximately 2.5 metres from the edge of pavement along Port Road.

Response: No. The County is also not aware as to whether or not Chatham-Kent has any plans to improve or widen Port Road. Again, the County's issues with the alignments proposed by Enbridge along County Road 46 are that much of the proposed pipeline lies within 6 metres of the current paved edge of the roadway (the travelled portion/clear zone), with

the County knowing that area will be needed for an additional lane of traffic and a new shoulder in the near future.

ENBRIDGE – Q # 22
Reference: Response of the County of Essex, Tab 2, Affidavit of Jane Mustac, Paragraph 7

Preamble: "The transmission and distribution lines of Union Gas are located at various points throughout the County, including along County Road 46"

Question a): *Please confirm the location of the "transmission lines" along County Road 46.*

Response: The County does not distinguish between "transmission" and "distribution" lines. The County looks at the pressure of lines in making its determinations.

Question b): *Please confirm the location of the "distribution lines" along County Road 46.*

Response: See answer to a) above.

Question c): *What criteria is being used by the County of Essex to distinguish between "transmission lines" and "distribution lines"? Please provide the source documents.*

Response: See answer to a) and b) above. The County does not differentiate between "transmission" and "distribution". Its concern is the pressure of any given line.

ENBRIDGE – Q # 23
Reference: Response of the County of Essex, Tab 2, Affidavit of Jane Mustac, Paragraph 9

Preamble: The consultation record that comprised the environmental report in EB-2019-0172, Exhibit C, Tab 6, Schedule 1 (PDF 200 to 205) included letters to the following County of Essex personnel dated February 1, 2019 addressed to:

- Bill King, Manager, Planning Services
- Peter Bziuk, Manager, Design and Construction Services
- Mary Brennan, Director Counsel Services/Clerk

Question a): *Is it the County's position that it received none of these letters prior to May 2019?*

Response: No. The County acknowledges that Stantec wrote to the County advising that it was undertaking an environmental report.

Question b): *Is it the County's position that neither it nor any of its Counsel saw the advertisements for the public information sessions posted in local papers?*

Response: The County cannot confirm whether or not there were advertisements in local papers. But the County has no reason to believe this did not occur.

Question c): *Please provide the correspondence wherein the Essex County informed Stantec of the proposed widening of County Road 46.*

Response: It is standard practice for parties conducting environmental and other reports that impact on County Roads to contact the County to discuss the proposed project and determine whether or not there are future planned improvements. Through a review of the County's records it does not appear that Stantec ever contacted the County for a consultation session.

However, Stantec was retained by Enbridge. At the consultation meeting between the County and Enbridge, which was held prior to Stantec completing the EA, the County advised Enbridge of the proposed widening of County Road 46. As such, although it appears that Stantec was never advised verbally or in writing about the planned improvements to County Road 46, Enbridge was. Enbridge ought to have communicated this to its consultant Stantec, but, for whatever reason, chose not to do so.

Question d): *Please provide the correspondence wherein the County of Essex informed Stantec of the need to comply with TAC Guidelines for Underground Utility Installations Crossing Highway Rights-of-Way.*

Response: The response is the same as in c) above. As Stantec never contacted the County for a consultation session, it appears that Stantec was never advised verbally or in writing about the County's requirements on depth for the proposed alignment in the current or future travelled portion of the road. However, Enbridge was aware of the depth requirements and should have advised its consultant, Stantec, of said requirements.

The County would not have advised Stantec about a "need to comply with TAC Guidelines" in the areas that lie within the travelled portion of the roadway (i.e. the "clear zone" as defined by TAC), as the reference to TAC Guidelines in this project was only part of the County's decision on the issue of depth in the proposed alignment.

Question e): *Please provide the correspondence wherein the County of Essex informed Stantec that the Guidelines for Underground Utility Installations Crossing Highway Rights-of-Way would apply to longitudinal installations.*

Response: See the answer provided in c) and d) above.

ENBRIDGE – Q # 24
Reference: Response of the County of Essex, Tab 2, Affidavit of Jane Mustac, Paragraph 9, and Exhibit B thereto, at page 4

Preamble: In the May 2019 Minutes of meeting, it was noted that Mr. Maisonville expressed concern that County Road 46 would be expanded at some point over the next 20 years.

Question a): *Please confirm that Enbridge has located the pipeline at greater than 6.0 metres from the edge of pavement where there are existing plans for the expansion of County Road 46 between Concession 8 and Rochester Townline.*

Response: No. The statement above is not correct. See the answer provided in 21 b) above. Enbridge has agreed to install the pipeline at greater than 6.0 metres from the edge of pavement from Concession 8 to just east of County Road 19 (approximately 6.2 kilometres of the pipeline). The pipeline continues east along County Road 46 to Rochester Townline. Enbridge has **not** agreed to install that portion of the pipeline greater than 6.0 metres from the edge of pavement along that section of the pipeline.

Question b): *Please confirm that widening of County road 46 is not included in the County of Essex Official Plan, section 2.8.1.1. If this cannot be confirmed, state the reason. A link to the Official Plan is provided below:*
https://www.countyofessex.ca/en/county-government/resources/Documents/Essex_County_Official_PlanACCESSIBLE.pdf

Response: The County of Essex Official Plan was finalized and adopted in April of 2014 and does not include a reference to the widening of County Road 46. Traffic volumes and population projections were not an issue along the County Road 46 corridor in the years leading up to the 2014 Official Plan.

Traffic volumes and population projections have been an issue since in or about late 2015, and it is expected that the next iteration of the Official Plan will address these concerns.

Question c): *Please confirm that widening of County Road 46 is not included in the currently approved Transportation Master Plan 2005 for Essex County.*

Response: The County can confirm that widening of County Road 46 is not included in the Transportation Master Plan 2005. The County can also confirm that the 2005 Master Plan is over 15 years old and requires updating. Again, as per the answer in a) above, traffic problems and population growth have resulted in the County determining that County Road 46 warrants improvements, including widening.

Question d): *Please provide the letter or email or other correspondence to Stantec or Enbridge wherein the County of Essex identified that compliance with the TAC Guidelines for Underground Utility Installations Crossing Highway Rights-of-Way was applicable for road crossings and longitudinal pipeline installations and was applicable to any utility infrastructure within the County of Essex. If such cannot be provided please state why it cannot. In particular, please identify where the County of Essex indicated that the depth of a crossing pipeline (figure 4, table 1) was to be used in respect of a longitudinal pipeline.*

Response: Again the response to this question is the same as the response in 23 c), d), and e) above. Although it is standard practice for parties conducting environmental and other reports that impact on County Roads to contact the County to discuss the proposed project and determine whether or not there are future planned improvements, Stantec never held a consultation session with the County. Through a review of the County's records it does not appear that Stantec ever contacted the County for a consultation session.

However, again, the County held a consultation meeting with Enbridge in advance of Stantec completing its report, at which time Enbridge was advised that if the pipeline was located within 6.0 metres of the existing paved edge of the roadway, that the County would require certain depths be met. Enbridge was also advised at that meeting that the County preferred an alignment that did not locate the pipeline in the current or future travelled portion of the roadway. If Enbridge failed to communicate this information to its consultant, Stantec, it is the responsibility of Enbridge to explain why not. Finally, the TAC Guidelines are not necessarily applicable to "longitudinal pipeline installations" or "to any utility

infrastructure within the County", so this would not have been communicated to Stantec. The TAC Guidelines are being applied by the County because of the proposed pipeline being a high pressure pipeline in the current or future travelled portion of County Road 46. The TAC Guidelines may or may not have been applied by the County if an alignment outside the current or future travelled portion of County Road 46 was utilized by Enbridge.

Question e): *Please confirm that the Guidelines for Underground Utility Installations Crossing Highway Rights-of-Way is not referenced in either the Official Plan or the Transportation Master Plan.*

Response: There are no standards or guidelines referenced in either the Official Plan or the Transportation Master Plan. Standards and guidelines are constantly being updated, and the County utilizes the most up to date standards and guidelines. Further on a project by project basis the County determines which standards and guidelines are applicable. For the project at issue in this matter, the County determined that the TAC Guidelines were the appropriate guidelines to assist the County in making a decision.

ENBRIDGE – Q # 25

Reference: Response of the County of Essex, Tab 2, Affidavit of Jane Mustac, Paragraph 13

Preamble: None provided.

Question a): *With respect to each of the permits identified at paragraph 13, which permits included loads in excess of those analyzed by Enbridge/Wood? Please provide copies of such permits.*

Response: The County is still in the midst of gathering and reviewing the 188 permits issued in 2019 and referenced in the Affidavit of Jane Mustac. Copies of same will be provided when available.

The County's concern is more about the "static" loading analysis used in the Wood report versus the County's "dynamic loading concern and that during the life of the pipe the County will continue to allow more loads (with no maximum weight set) to utilize the County Road 46 corridor.

ENBRIDGE – Q # 26
Reference: Response of the County of Essex, Tab 2, Affidavit of Jane Mustac, Paragraph 14

Preamble: None provided.

Question a): *In respect of the chart provided, expand the chart to add columns and identify for each segment of County Road 46 the year the widening is to take place and the source document authorizing such widening.*

Response: The County is not at the design phase for the planned improvements for County Road 46. County Council has identified the County Road 46 corridor as an essential east/west corridor, that is slated to be widened in the next 5 to 10 years. But there is no strict schedule at this time.

Question b): *Confirm, the Capacity Expansion Program (see Attachment #2 or link below) taken from the County of Essex website, dated October 2019, shows no planned widening activity for County Road 46, even preliminary work, east of Manning Road until at least 2037.*
https://coe-pub.escribemeetings.com/filestream.ashx?DocumentId=13027

Response: The map referenced above was created by Jane Mustac in October of 2019 to show the roads for which EAs have been completed and for which work has been scheduled. This does not mean that work on County Road 46 will not commence until at least 2037. Again the County's stated plans are for improvements to County Road 46 to be completed as soon as there is funding available and the needs warrant it. Further, see the answers to24 b) and 24c) above.

ENBRIDGE – Q # 27
Reference: Response of the County of Essex, Tab 2, Affidavit of Jane Mustac, Paragraph 19(c)

Preamble: None provided.

Question a): *Did the County of Essex issue permits to Enbridge, when requested by Enbridge, that would permit Enbridge the ability to complete preconstruction activities to expedite any portions of the project including daylighting of utilities, entrance permits or any other activities irrelevant to TAC guidelines, depth or abandonment issues? If so, please state when such permits were requested and issued.*

Response: The County issued Enbridge permits to conduct geotechnical work in advance. However, the project was otherwise treated

as 1 project. In order for other permits to be issued, all of the terms for the project have to be agreed and formalized in a Road User Agreement prior to permits being issued.

ENBRIDGE – Q # 28
Reference: Response of the County of Essex, Tab 2, Affidavit of Jane Mustac, Paragraph 19(d)

Preamble: None provided.

Question a): *Please confirm related to the reference in paragraph 19 (d) that the County of Essex regularly issues permits for installation of infrastructure for Enbridge construction of natural gas pipelines throughout Essex County and does not reference any existing or new Road User Agreement in doing so.*

Response: Depending on the nature and size of a project, the County may require only a permit as opposed to a Road User Agreement. During the relatively brief period that Enbridge has been conducting work in the County, only permits have been required, as the scope of work being conducted by Enbridge did not warrant a Road User Agreement. The County has not had a Road User Agreement with Enbridge in the past.

ENBRIDGE – Q # 29
Reference: Response of the County of Essex, Tab 2, Affidavit of Jane Mustac, Paragraph 19(e)

Preamble: None provided.

Question a): *Please confirm related to the reference in paragraph 19(e) for the pipeline installed in 2017 in the County of Essex and Lakeshore the following:*
i. the diameter of the pipeline was NPS 16 and NPS 20
ii. the pipeline was a transmission pipeline;
iii. the number of metres of the pipeline that crossed County Roads;
iv. the number of metres of the pipeline that ran longitudinally in County Roads;
v. the express reference to the obligation to comply the TAC Guidelines for Underground Utility Installations Crossing Highway Rights-of-Way in the permitting documents issued by the County for longitudinal pipeline installations.
vi. Provide a copy of the Road User Agreement for this project and any permit issued by the County for this project.

Response:
i. Correct.
ii. Correct.
iii. Unknown.
iv. None.
v. There was no specific reference to the TAC Guidelines. But this does not mean the TAC Guidelines did not apply. Depths were required for this pipeline in accordance with the TAC Guidelines.
vi. Given that the 2017 project only involved limited crossings of roadways under the County's jurisdiction, a Road User Agreement was not required by the County. This project was dealt with through the County's permitting process only.

Copies of the Permits related to the above referenced project are attached hereto at **TAB # 2.**

ENBRIDGE – Q # 30
Reference: Response of the County of Essex, Tab 2, Affidavit of Jane Mustac, Paragraph 19(e)

Preamble: None provided.

Question a): *Please confirm related to the reference in paragraph 19(e) for the pipeline installed in 2019 in Kingsville the following:*
i. the diameter of the pipeline was NPS 20;
ii. the pipeline was a transmission pipeline;
iii. the number of metres of the pipeline that crossed County Roads;
iv. the number of metres of the pipeline that ran longitudinally in County Roads;
v. the express reference to the obligation to comply the TAC Guidelines for Underground Utility Installations Crossing Highway Rights-of-Way in the permitting documents issued by the County for longitudinal pipeline installations..
vi. Provide a copy of the Road User Agreement for this project and any permit issued by the County for this project.

Response:
i. Correct.
ii. Correct.
iii. Unknown.
iv. None.
v. There was no specific reference to the TAC Guidelines. But this does not mean the TAC Guidelines did not apply. Depths were required for this pipeline in accordance with the TAC Guidelines.
vi. Given that the 2019 Kingsville project only involved limited crossings of roadways under the County's

jurisdiction, a Road User Agreement was not required by the County. This project was dealt with through the County's permitting process only.

Copies of the permits for the project referenced above are attached hereto at **TAB # 3.**

ENBRIDGE – Q # 31
Reference: Response of the County of Essex, Tab 2, Affidavit of Jane Mustac, Paragraph 19(l)

Preamble: None provided.

Question a): *On what information is Ms. Mustac relying in making the statement the CSA/CAN Z662-15 is "outdated".*

Response: The fact that the 2015 CSA Standards have been replaced by the 2019 CSA Standards.

Question b): *Please explain the difference in depth of cover for pipelines between the 2015 and the 2019 version of the CSA/CAN code for distribution lines?*

Response: The County does not apply the CSA Standards and is not in a position to answer this question.
That being said, the County's understanding is that the minimum depth of cover recommended by the 2015 CSA Standards was 0.75 metres, while the 2019 CSA Standards calls for a minimum depth of cover of 1.2 metres. However, this is not a differentiation with which the County is concerned, as the County requires compliance with the more stringent TAC Guidelines that recommend a minimum depth of cover of 1.5 metres.

Question c): *In the CSA/CAN code for the 2015 version, what is the depth of cover for a transmission pipeline? What is the depth of cover for a distribution pipeline?*

Response: The County does not apply the CSA Standards and does not have a copy of the 2015 CSA Standards. As such, Enbridge will have to satisfy itself on this question.
If the County did apply the CSA Standards, which it does not, it would apply the most recent CSA Standards and not outdated CSA Standards.

Question d): *What classification is the Windsor Pipeline and on what basis did you confirm this?*

Response: The County classifies the Windsor Pipeline as a high pressure pipeline.

ENBRIDGE – Q # 32
Reference: Response of the County of Essex, Tab 2, Affidavit of Jane Mustac, Exhibit E thereto, at page 2

Preamble: None provided

Question a): *Given that the County of Essex knew the depth was to be 1.0 metre in general, confirm that the County of Essex did not provide any formal comment in respect of the Environmental Report and did not provide any comment or participate formally in the leave to construct proceeding.*

Response: The County repeats and relies on the evidence of Jane Mustac at paragraph 19(m) of her Affidavit. The County further notes that a minimum depth of 1.0 metre is not a concern, as long as the pipeline is located greater than 6.0 metres from the existing paved edge of the road. Depth is only a concern as Enbridge is insisting on placing the high pressure pipeline in the current or future travelled portion of the roadway (i.e. the "clear zone" as defined by TAC).

ENBRIDGE – Q # 33
Reference: Response of the County of Essex, Tab 2, Affidavit of Jane Mustac, Exhibit I thereto

Preamble: None provided.

Question a): *Given Enbridge's statements that Essex County had concerns about Municipal Consent and that Enbridge only intended to remove the section of the existing pipeline west of Manning Road, why did the County of Essex not participate in the leave to construct proceeding?*

Response: Again, the County repeats and relies on the evidence of Jane Mustac at paragraph 19(m) of her Affidavit. The County further notes that it repeatedly advised Enbridge of what would be required to obtain municipal consent from the County.

ENBRIDGE – Q # 34
Reference: Response of the County of Essex, Tab 2, Affidavit of Jane Mustac, Exhibit J thereto

Preamble: None provided.

Question a): *Confirm that first written mention of a Road User Agreement is in the communications in this Exhibit J – on or about December 10, 2019.*

Response: A review of the County's records indicates that Exhibit J appears to be the first reference to a Road User Agreement. However, the County's position is that the requirement of a Road User Agreement was raised verbally with Enbridge on numerous occasions prior to December of 2019, including at the consultation meeting in may of 2019, and Enbridge never raised any concerns with the County about this requirement.

Question b): *Confirm the date the first draft of the Road User Agreement was delivered.*

Response: The County provided Enbridge with a precedent of its general Road User Agreement on or about February 7, 2020. As per paragraph 15(q) of the Affidavit of Jane Mustac, the draft Road User Agreement with respect to this specific project was first provided to Enbridge on or about April 17, 2020.

ENBRIDGE – Q # 35
Reference: Response of the County of Essex, Tab 2, Affidavit of Jane Mustac, Exhibit M thereto

Preamble: None provided.

Question a): *Please confirm why in respect of the Decommissioning and Removal of Existing Union Gas line that the County Engineer had "sole and absolute discretion" rather than reasonable discretion consistent with the terms of the 1957 Franchise Agreement.*

Response: The "sole and absolute discretion" language is taken from the County's standard Road User Agreement. The precise language could have been negotiated so as not to conflict with the Franchise Agreement, and the County remains willing to do so. However, a fresh By-law will be required to effect this change, and any other changes that may be agreed to during the course of this proceeding before the OEB.

ENBRIDGE – Q # 36
Reference: Response of the County of Essex, Tab 2, Affidavit of Jane Mustac, Exhibit N thereto

Preamble: None provided.

Question a): *Confirm this is the first written reference to the TAC Guidelines for Underground Utility Installations in correspondence between the County of Essex and Enbridge.*

Response: This appears to be the County's first written reference to TAC Guidelines in its correspondence with Enbridge.

Question b): *Is this reference to the Guidelines for Underground Utility Installations Crossing Highway Rights-of-Way or another guideline?*

Response: This is a reference to the TAC Guidelines for Underground Utility Installations.

Question c): *Does Figure 4, Table 1, and Column C of the Guidelines for Underground Utility Installations Crossing Highway Rights-of-Way indicate that the depth of cover for longitudinal pipelines is 1.0 m?*

Response: Yes, that is what is indicated at Figure 4, Table 1, and Column C. However, that 1.0 metre depth is for pipelines that are not in the travelled portion of the roadway. If Enbridge wants to place the pipeline greater than 6.0 metres from the current paved edge of the roadway, the County has no concerns with a minimum depth of 1.0 metre. But, if Enbridge is going to insist on placing the pipeline in the current or future travelled portion of the roadway, the County will continue to insist on a minimum depth of 1.5 metres and takes the positon that the depth indicated in Figure 4, Table 1, Column C does not apply.

Dated: August 21, 2020

JOSEPHINE STARK
LSO # 24691J
DAVID M. SUNDIN
LSO # 60296N
McTAGUE LAW FIRM LLP
Barristers & Solicitors
455 Pelissier Street
Windsor, Ontario N9A 6Z9
(T) 519-255-4356
(F) 519-255-4384
(E) dsundin@mctaguelaw.com
LAWYERS FOR THE INTERVENOR,
THE CORPORATION OF THE COUNTY
OF ESSEX

TAB # 1

HADDAD MORGAN & ASSOCIATES LTD
CONSULTING ENGINEERS

August 13, 2020

The Corporation of the County of Essex
360 Fairview Avenue West
Essex, Ontario
N8M 1Y6

McTague Law Firm LLP
455 Pelissier Street
Windsor, Ontario
N9A 6Z9

Attention: Ms. Jane Mustac, P. Eng, County Engineer
Ms. Krystal Kalbol, P.Eng., Manager, Transportation Planning & Development
Mr. David M. Sundin

RE: RESPONSE TO QUERIES RELATED TO APPLICATION BY ENBRIDGE TO THE ONTARIO ENERGY BOARD
Our Project No.: 20-163

It is with pleasure we offer our response to the various inquires made by all parties below.

ENB-01

a.) We reviewed the calculations in general, but as noted in our documentation, have no grounds to challenge the calculation process of another Professional Engineer. This being said we cannot formally confirm if any arithmetic errors occurred.
b.) Our office, with myself involved, have undertaken many projects in the public right-of-way which includes road reconstruction, highway structure replacement and rehabilitation. These projects have occurred in many of the municipalities within the County of Essex, inclusive of work for the County of Essex directly.

ENB-02

a.) Attached are the documents supplied to our office. No formal proposals have been submitted to, or signed by the County of Essex.
b.) There has been no discussion to date about the decommissioning or abandonment of the existing pipeline.
c.) The documents as issued from our office can be considered as being submitted under professional seal.

ENB-03

a.) Each subdivision, road reconstruction, or site design undertaken by myself, and/or my office is in following with industry standards for construction. As such we regularly, as part of our usual professional duties, follow through with these standards.

b.) Our office has limited experience with the Z662 Standard, however, read in the same manner as other standards, which we apply daily given the wide range of standards offered by CSA, their implementation can be understood.

ENB-04

a.) It is our duty as Professional Engineers to protect the public at large, however, it is also our duty to protect our clients from risk and liabilities. Should an event occur in the presence of a failure to comply with an accepted industry guideline it would suggest responsibility in some part falls to the County of Essex. As such, a Professional Engineer is critical for us to identify risks, where possible, and advise that industry practices are regularly followed as a shield from liability.

ENB-05

a.) Please find attached the calculations provided to us for our review. As noted in ENB-01 response, we have no reason to disbelieve, or challenge the computational abilities of another licensed Professional Engineer, or more to the point, the ability to perform said calculations. However, we do ask if other conditions which may/will occur are being considered in varying soil conditions?
b.) This review took place the week of May 4, 2020.
c.) The reference "we" speaks to the Engineering office of Haddad, Morgan and Associates Ltd.
d.) There is no defined "typical" as this is not the consistent location. For example, in urban residential environment the gas service would be more consistently between back and curb and the property line. As such, guidelines such as TAC are followed in an effort to establish norms to ensure proper right of way management and to avoid future conflicts.
e.) The travel portion would consist of the typical travel lanes and the shoulder itself.

ENB-06

a.) The specifics of road widening were conveyed to our office during discussions with the County on this file. Specific time lines and final design values are best asked of the County.
b.) We have not reviewed this particular document as it was not viewed as relevant to the current issue at hand. Based on the various correspondence received between Enbridge and the County of Essex, it appears to be accepted that road widening is a future plan for this particular Right of Way.
c.) This is a question best asked of the County themselves as it is outside our scope.
d.) This is a question best asked of the County themselves as it is outside our scope.

ENB-07

a.) The acceptance of adopting a standard by TSSA is a question best asked of TSSA. Irrespective of TSSA acceptance, the Canadian Standards Association has seen fit to update the standard, noting that Standards are written in collaboration with a cross-section of industry to establish best practices.
b.) Correct, TAC is the acronym for Transportation Association of Canada.
c.) The TAC guidelines referenced in our documents are the TAC Guidelines themselves, TAC – Guidelines for Underground Utility Installations Crossing Highway Rights-of-Way (TAC 2013), and TAC Management of Utilities in and Adjacent to the Public Right-of-Way: Survey of Practices (TAC 2008).
d.) The Transportation Association of Canada is a not-for-profit national technical association. It is not our belief that they have a direct ability to mandate law. From TAC's website "The Transportation Association of Canada (TAC) is a not-for-profit, national technical association that focusses on road and highway infrastructure and urban transportation. Our mission is to work together to share ideas, build knowledge, promote best practices, foster leadership, and encourage bold transportation solutions.". Their presence and function to industry is similar to the Canadian Standards Association who publish guidelines/standards which Governing bodies may adopt.
e.) Our office applied Clause 4 "Design" as these early clauses tend to set the tone of the standard in general. Given it falls under "Design" such values should be strongly considered and not omitted, this the most stringent condition should be assessed.
f.) As we have updated files to the 2019 Version, our copy of the 2015 Version is not readily available. If you have a copy of these two versions please share to avoid long delays in pulling archived items.

ENB-08

a.) Correct, we apologize for the typo.
b.) Incorrect, conservative meaning the more stringent of conditions, or those that reduce overall risk. This does not preclude their potential to exist.
c.) Again, I reference back to our comment to ENB-07(f).
d.) Please clarify the reference to "paragraph (f)" as stated in the comment.
e.) There was no analysis of this type performed. The initial costs would reasonably be expected to increase by some definable value as a result of a moderate depth increase; however, the focus of defining one's location in the right-of-way is as much for the protection of the public and the County as it is for Enbridge. By defining where the gas line would be in the right-of-way the County can take measures to avoid future interferences and issues that may result in risk to the Enbridge plant.
f.) Please clarify, the referenced attachment does not appear to be consistent with the question asked.
g.) If the road were not to be widened and thus the proposed pipeline would sit outside the shoulder width of the road this statement would be correct.

ENB-09

a.) The request to confirm this will take several months in order to contact each potential municipality and request their level of application of the TAC guidelines. In the current condition, the County has made clear on this file and past projects which we have worked with them that the TAC standards are to be adhered to.

b.) Fundamentally, failure to follow industry standards and practices, such as TAC and CSA Standards, while not illegal, could create grounds to argue liability in the event of an unfortunate occurrence. If the County only accepts Enbridge's recommendation and allows this to proceed, and some event occurs resulting in legal action, the County would not be able to defend itself with the argument of adherence to industry accepted standards.

ENB-10

a.) No, Enbridge's backfill procedure has not been reviewed as backfill is not the issue at hand. It is the focus of the County and our recommendation that they adhere to the standards to TAC to ensure proper levels of safety while ensuring proper right-of-way management.

ENB-11

a.) If the County of Essex did not have defined policies such as adherence to TAC this statement would be correct provided all other applicable standards of the day are adhered to. In such a situation, Enbridge would have to solely exercise to due diligence to ensure conformance to all approval agencies and compliance to all standards and codes.

b.) All conceptual considerations of our office are based on assumed 3% cross fall on the road with anticipation of a longitudinal pitch for movement of water. No formal cross-section was developed.

ENB-12

a.) Recommendations are not binding but failure to follow them, much like failure to follow a non-binding CSA Standard would be a failure by the Engineer professionally. It is incumbent on an Engineer to ensure that all efforts are made to apply standards and failing to do so should be justifiable.

b.) No soils report was included in the documents provided, only reference thereto.

ENB-13

a.) I believe the question is asking if the comment references "TAC – Guidelines for Underground Utility Installations Crossing Highway Rights-of Way", if this interpretation is correct the answer would be yes.

ENB-14

a.) The Association was not contacted, and as with any guideline and standard it is interpreted based on figures and verbiage. Keep in mind that there are several cross roads as well which will be "crossed". It is appropriate to interpret the intent and not simply apply semantics to verbiage.

b.) At this point I am unaware of any correspondence between the County and the Transportation Association.
c.) The TAC guidelines speak to pipelines in the right-of-way and the term crossing can be interpreted as crossing through (which it crosses through the right-of-way as it enters and exits as some point).
d.) This statement by TAC is reasonable in that it would be a focus to avoid damage to private drainage and the existing highway, but such statements do not negate the current proposal at hand and must work well with long term plans for the proposed road expansions when such funds become available.
e.) We agree with this statement and in the current condition such a proposal may apply but it fails to address the long-term plans as Enbridge is unlikely to relocate or reconstruct such a significant piece of infrastructure in the foreseeable future. As such, consideration must be given to referencing it relative to edge of pavement (future edge of pavement).

ENB-15

a.) Our office did not review the American Association of State Highway and Transportation documents as TAC was able to define it clearly for their purposes.
b.) As noted above, the TAC standard was reviewed only. Note that given the clarity on our interpretation of the TAC Document, this further scrutiny was not deemed necessary.

ENB-16

a.) As noted in an alternate response, I would suggest such a question is best directed to TSSA. Moreover, as previously noted in an earlier response, the adoption by TSSA is not as key as to note that the authors of the standard felt it prudent to update the standard. Had such earlier values been considered still reasonable no need for increase would have been warranted.
b.) It is our understanding from discussion with the County that this line is for the transmission of goods through the corridor in question. More specifics would be needed to fully appreciate the most appropriate definition of the line. This being said, in the absence of all data and in order to avoid further delays the more stringent case must be realized. Irrespective of the definition the governing values proposed by the County are not focused on the definition of transmission versus Distribution.
c.) I would direct you to the answer to "B".

ENB-17

a.) The document has been attached.
b.) No, the British Columbia standard is not binding, as noted in our response it is simply a means of defining a solution. As noted, in the absence of a clear definition of such matters in Ontario we must review what other reasonable actions and guidelines are followed outside of this area in regions that can be compared. As British Columbia has a clearly defined standard and is within the same Country it is reasonable to look to their standards for Guidance.
c.) I am unaware of any situation similar to this that would warrant such a comparison. The focus was, and still is, to define best practices.

ENB-18

a.) The request was to Justify the TAC guidelines, or more specifically, justify the adoption of these guidelines. To the point being made in our responses, if the County or any Road Authority must justify each and every decision in length debate no work in the interest of the public could occur.

EP-Essex-3

a.) There is no formal engagement letter for this file. Our office was directed to provide a review of documents and an opinion as relates to the existing standards.

EP-Essex-4

a.) We are unaware if additional geotechnical works have been undertaken or will be.

EP-Essex-5

a.) The document referenced are guidelines, however, as is typically in many standards unless enforced by some act of legislation or other mandate they still act as a guideline in that failure to comply with them has no set consequence, such as investigation of licensing, or other legal ramification.
b.) This statement is correct, we are referencing the TAC guidelines.
c.) At this time, we are unaware of any legislation that mandates the application of the guidelines. Such actions are decided by each Road Authority individually as a means of following best practices and ensuring proper right-of-way management.

EP-Essex-6

a.) The documents referenced are one in the same, I refer you to our response to EP-Essex-5 (a).
b.) As noted in EP-Essex-5 (a), given that some standards are not mandated by act of legislation, in certain circumstances, a standard is functionally a guideline in these conditions. Both Guidelines and Standards are developed by committees representing industry with the intent to define best practice with the most current knowledge base.
c.) TAC Guidelines, as they are not by the Canadian Standards Association are not standards.

EP-Essex-7

a.) It is our suggestion that if an alternate path for the line can be defined that moves it away from the location of concern for the County while meeting the desired depths of Enbridge such solutions would be ideal. However, if Enbridge insists on retaining the proposed location it would be appropriate for the County to maintain its insistence that the guidelines be followed.
b.) As noted above, consideration may be given to considering opportunity to locating it outside the definable driving paths (outside the shoulders) or locating it on a parallel right-of-way not anticipated to experience significant long-term geometric change.

EP-Essex-8

a.) The statement made by Enbridge is that there is no risk to the County. Such comments cannot be reasonably made as it is fully expected that in the event of any negative event in the right-of-way would immediately result in the engagement of the County in both response and any resulting legal involvement such as statements of claim where appropriate, as they are the Road Authority and charged with the responsibility to ensure public safety and property management of the right-of-way.

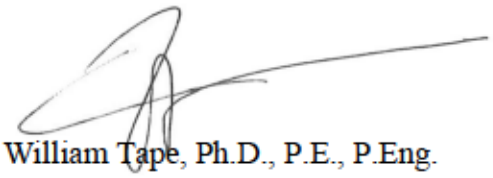
EP-Essex-9

a.) The comment is not intended to suggest that no weighting be placed on the Geotechnical Report. Rather, it is noted that a geotechnical investigation is a very localized assessment of soil, functionally it is looking at a road map through a straw. As such, this report can only offer a snap shot of what was seen but may or may not reflect what is found on a larger scale. As is common in these reports the Geotechnical Engineer notes the need for field review during construction to ensure what was observed is consistent with what is actually found.

We trust the above, and attached meets the needs of the various parties at this time.

Your truly,

Haddad Morgan and Associates Ltd.



William Tape, Ph.D., P.E., P.Eng.

Corporation of the County of Essex
360 Fairview Avenue West, Suite 315, Essex, ON N8M 1Y6
Phone: 519-776-6441, ext. 1316
TTY: 1-877-624-4832
Website: www.countyofessex.ca
Email: kkalbol@countyofessex.ca

April 27, 2020

MEMO

To: Jane Mustac
From: Krystal Kalbol

Re: Enbridge Gas Inc., Windsor Line Project, Location and Depth of Cover

Enbridge Gas Inc. proposes to install approximately 29 kilometers of a 6 NPS gas unencased pipeline with a design pressure of 3,450 kPa at a proposed depth of cover of 750 mm at various locations within the County Road 46 corridor as identified below:

- A horizontal distance ranging from 9.7 to 8.2 meters from the edge of pavement within the Town of Tecumseh (approximately 6 kms); and
- A horizontal distance ranging from 6.0 to as close as 2.1 meters from edge of pavement within the Town of Lakeshore (approximately 23 kms).

This key corridor functions as a Class 2 arterial road, is a major truck route and accommodates an Average Annual Daily Traffic (AADT) of up to 12,000 vehicles per day (vpd) with 5% consisting of heavy truck traffic. The traffic volume along this corridor has been increasing at a rate of up to approximately 15% annually over the last couple of years and growth is expected to continue.

Based on the role and function of the roadway, the platform that is considered utilized and protected as the travelled portion can encompass up to 6.0 meters from the existing edge of pavement for safety purposes, to meet roadway maintenance requirements, to accommodate oversize and/or overload permits and to allow for future expansion of the shoulder and/or travelled lanes.

Since the existing right of way is under the jurisdiction of the County of Essex, the requirements for location and installation of all utilities within this corridor follow provincial standards and guidelines. These guidelines continue to protect the

roadway use, maintenance standards, integrity of the roadway and future improvements. The design portion of these guidelines are considered minimum criteria.

The following outlines key guidelines according to the Transportation Association of Canada (TAC), Guidelines for Underground Utility Installation Crossing Highway Rights-of-Way. The following excerpts identify some of the requirements that are applicable:

- Section 3.2.3 entitled Highway and Utility Responsibilities identifies *that "the utility should be responsible to ensure that their installations are properly designed, installed, operated and maintained including depth, clearances and separation between facilities, and the work is in accordance with the road authority's utility accommodation guidelines and standards".*
- Section 3.3.1 entitled Later Adjustment and Interference identifies that *"new utility installations should be located to minimize the need for later adjustment to accommodate future highway improvements and to permit servicing such installations with minimum interference to highway traffic".*
- Section 3.4.5 entitled Traffic Control identifies that *"Traffic controls for utility construction and maintenance operations should conform to the road authority's requirements. Any utility construction or maintenance operation should be planned with full regard to safety, and interference with highway traffic should be kept to an absolute minimum".*
- Section 4.1.8 entitled Underground Utility Cover stresses that *"the minimum utility cover depths should be as specified hereafter (see Table 1 and Figure 4) for each utility installation type…Utility installations should conform to all conditions described in columns A, B, C and D of Table 1. The minimum utility cover depths specified by a road authority may be greater when installed within freeway rights-of-way".*
- Section 4.3.1 entitled Encasements states that *"Pipeline encasement should be mandatory for bridge approaches, freeways and interchange ramps crossings. Casings should consist of a pipe or other separate structure*

around and outside the carrier pipe and should be designed to support the dead loads of the highway and superimposed loads thereon, including that of construction machinery. The strength of the casing should, as a minimum, equal the structural capacity of drainage culverts in the area and should be composed of durable materials designed to meet the conditions to which it may be subjected".

- Table 1 - Minimum Cover Depth For Underground Installations Crossing Highways (and Freeways) mandates that the minimum depth for an **unencased** new high pressure gas or liquid petroleum pipelines (>680 kPa) below pavement surface is 1500 mm and that the minimum depth below ground elevation is 1000 mm. The depth can be reduced with **encasement** to 1200mm below pavement surface and the minimum depth below ground elevation to 900mm.

Based on these provincial guidelines, and the nature of the proposed pipeline, the installation would be required to be installed at the below required depths:

- With a minimum depth of cover of 1.0 meters where the horizontal distance from the edge of pavement is in excess of 6.0 meters (ground elevation); and
- With a minimum depth of cover of 1.5 meters where the horizontal distance from the edge of pavement is located at and/or closer than 6.0 meters (pavement surface).

Utilities can be accommodated on highway rights-of-way when such use and occupancy do not adversely affect highway safety, construction, maintenance or operations. In this respect, guidelines outlining safe and rational practices for accommodating utilities within highway rights-of-way are of valuable assistance to the road authorities to protect the safety, integrity, maintenance standards and future improvements within key corridors.

If specific site conditions do not practically allow for these guidelines to be met, compromises may be made based on sound and reasonable engineering judgement. If a guideline cannot be met due to the existing conditions, it shall be well-justified by a Qualified Professional Engineer, documented and accepted by County Staff.

Should you require further information, please contact me by email at kkalbol@countyofessex.ca or by phone at 519-776-6441 extension 1316.

Regards,

Krystal Kalbol, P.Eng
Manager, Transportation Planning & Development

Enbridge Pipeline Vehicle Loading Analysis

Proposed NPS 6 Windsor Line along County Road 46, County of Essex Ontario

Introduction:

Enbridge is proposing to replace the existing NPS 10 Windsor Line with a new NPS 6 pipeline. The pipeline will be installed within the road allowance parallel to roads for approximately 64 kms between Chatham-Kent and The County of Essex. There was a concern about the stress of the pipeline in its proposed location as it is likely to be exposed to vehicle loading including but not limited to superloads, particularly on County Road 46 in the County of Essex as the pipelines proposed alignment is within approximately 2m of road edge in some locations. The following analysis will provide results of a load assessment on this new pipeline under vehicle loading conditions to meet the Enbridge's design and operating requirements and those of CSA Z662-15 and to determine the max allowable axle load that can be accepted by the pipeline. Analysis considers the hoop stress due to internal pressure and those imposed on it by the soil and vehicle loading.

Assumptions:

- Basis for axle load will be the Ministry of Transportation Ontario (MTO) legal axle load limit of 9000kgs per axle.
- Superload is considered a vehicle weighing more than 120000kgs, from MTO, A Guide to Oversize/Overweight Vehicles and Loads in Ontario, but is limited to max axle load of 9000kgs per axle.
- Vehicle axle load is to be positioned directly vertical over the pipeline. This arrangement will create the maximum loading for this condition.
- An imbalance factor of 10% which increases the wheel load of the axle to allow for consideration of illegal loads and an impact factor of 1.5 was used to simulate vehicles driving on uneven surface over the pipeline.
- Analysis will consider tired vehicles only, which will simulate the maximum ground pressure over the pipeline. Other vehicles, such as those that ride on tracks generally disperse their weight over a larger area and therefore have a lower ground pressure values than those of tired vehicles.
- Assume the pipeline is backfilled only with the native material found within the road allowance, which is known to be ordinary clay. This is considered a conservative assumption as compacted granular fill over and/or around the pipeline would bear more of the vehicle loading than clay and transfer less to the pipeline.

Pipeline Design Parameters:

Outside Diameter (OD): NPS 6 (168.3mm)
Wall Thickness: 4.8mm
Material: Gr. 359, Cat. I, HFERW seam, CSA Z245.1-18 steel pipe
Specified Minimum Yield Strength: 359 MPa
Cover Depth: 100cm
Max Op Temp: 20C degree
Max Op Pressure: 3450 kPa
Min Install Temp: 0C degree
Content: Sweet Natural Gas
Pipeline design to meet the requirements of Clause 12, of CSA Z661-15
During vehicle loading pipeline shall operate at less than 85% SMYS

Live Loads To Calculate:

1. MTO road legal limit or 9000kgs per axle. See analysis equipment label SHL.
2. 5 x MTO road legal limit or ~45000kgs per axle. See analysis equipment label 5xSHL
3. 10 x MTO road legal limit or ~90000kgs per axle, to simulate a maximum pipeline loading. See analysis equipment label 10xSHL

Results:

In all live load cases the results display that the pipeline operates below allowable stress limits under the proposed design conditions for the pipeline located near or under the travelled portion of the roadway. This includes a superload.

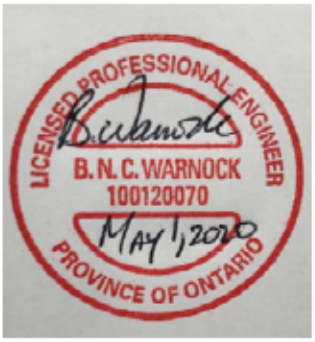
The results of the analysis meet the requirements of the Transportation Association of Canada (TAC) Guidelines For Underground Utilities Crossing Highway Right-Of-Ways.

Results for the 9000kgs and ~45000kgs per axle load considered the impacts of fluctuating hoop stresses or fatigue loading. This can be assumed to represent the case of loads sustained by regular vehicle traffic over the roadway and pipeline.

Results for the ~45000kgs per axle analysis displays an allowable loading factor of safety of 5 over what could be expected the normal vehicle use along the roadway.

Results for the ~90000kgs per axle analysis display a near maximum loading that can be accepted by the pipeline. In this case if a superload were to be overweight or given a permit to operate an axle load at greater than 9000kgs up to ~90000kgs per axle the pipeline is robust enough to carry that extreme load.

Analysis performed by Blair Warnock, P.Eng, Senior Pipeline Design Engineer, Enbridge Inc.



Pipelines Crossed by Equipment on Tires

Location:						
Description & Purpose	NPS 6 Windsor LIne - Oversize Vehicle Load Analysis					
Province	ON	Permanent crossing? Yes		Type	3rd Party	
Equipment:				Tire or ground bearing pressure, psi | kPa	110 | 758	
Label	SHL			Distance between axles in set, in | cm	48 | 122	
Description	MTO limit of 9000kgs/axle under Fatigue/Cyclic loading			Axle gauge, ft | m	6.0 | 1.83	
Axle Load, lb | kg	19,841 | 8,998			Impact Factor	1.5	
# axles in set	3			Imbalance Factor	10%	
Line(s) to be crossed:						
Line Name	6WL					
OD, in | cm	6.625 | 16.8					
Wall thickness, in | mm	0.189 | 4.8					
Pipe grade, ksi | MPa	52 | 359					
Pressure, psi | kPa	500 | 3447					
Long seam type	ERW					
Installation:						
Depth of cover, in | cm	39 | 100					
Installation type	Settled					
Bottom Reaction Angle, deg	60					
Trench or bore width, in | cm	7 | 17					
Soil Unit Weight, pcf | kg/m^3	120 | 1922					
Soil Type	4					
Modulus of soil reaction E', psi | kPa	250 | 1724					
Slab or Matting:	no slab					
Slab thickness, in | cm						
Impact Factor on slab or mat						
Slab material						
Slab width across pipe, ft | m						
Slab length along pipe, ft | m						
odulus of subgrade reaction k, pci | MPa/m						
Maximum Hoop Stress, % SMYS:						
Calculated	26.3%					
Allowable	85%					
Fluctuating Hoop Stress, psi | MPa:						
Calculated	4.2 | 28.7					
Allowable	20 | 138					
Requirements / Notes:	Axle load for analysis of ~9000 kgs or MTO Road Legal Axle limit. Results show pipeline still remains below maximum allowable hoop stress limit and max allowable fluctuating hoop stress limit, which considers fatigue or cyclic loading which can be assumed to be representative of continuous vehicle traffic over the pipeline/roadway.					
Analyzed by:	BNW 4/17/2020					

Pipelines Crossed by Equipment on Tires

Location:

Description & Purpose	NPS 6 Windsor LIne - Oversize Vehicle Load Analysis
Province	ON
Permanent crossing?	Yes
Type	3rd Party

Equipment:

Label	SHLx5	Tire or ground bearing pressure, psi | kPa	110 | 758
Description	5 x MTO limit of 9000kgs/axle under Fatigue/Cyclic loading	Distance between axles in set, in | cm	48 | 122
Axle Load, lb | kg	99,000 | 44,898	Axle gauge, ft | m	6.0 | 1.83
# axles in set	1	Impact Factor	1.5
		Imbalance Factor	10%

Line(s) to be crossed:						
Line Name	6WL					
OD, in | cm	6.625 | 16.8					
Wall thickness, in | mm	0.189 | 4.8					
Pipe grade, ksi | MPa	52 | 359					
Pressure, psi | kPa	500 | 3447					
Long seam type	ERW					
Installation:						
Depth of cover, in | cm	39 | 100					
Installation type	Settled					
Bottom Reaction Angle, deg	60					
Trench or bore width, in | cm	7 | 17					
Soil Unit Weight, pcf | kg/m^3	120 | 1922					
Soil Type	4					
Modulus of soil reaction E', psi | kPa	250 | 1724					
Slab or Matting:	no slab					
Slab thickness, in | cm						
Impact Factor on slab or mat						
Slab material						
Slab width across pipe, ft | m						
Slab length along pipe, ft | m						
odulus of subgrade reaction k, pci | MPa/m						
Maximum Hoop Stress, % SMYS:						
Calculated	50.5%					
Allowable	85%					
Fluctuating Hoop Stress, psi | MPa:						
Calculated	19.4 | 133.7					
Allowable	20 | 138					

Requirements / Notes: Axle load for analysis of ~45000kgs or ~5 x MTO Road Legal Axle limit of 9000kgs. Results show pipeline still remains below maximum allowable hoop stress limit and max allowable fluctuating hoop stress limit, which considers fatigue or cyclic loading which can be assumed to be representative of continuous vehicle traffic over the pipeline/roadway.

Analyzed by: BNW 4/17/2020

Pipelines Crossed by Equipment on Tires

Location:

Description & Purpose	NPS 6 Windsor LIne - Oversize Vehicle Load Analysis
Province	ON
Permanent crossing?	No
Type	3rd Party

Equipment:

Label	SHLx10	Tire or ground bearing pressure, psi | kPa	110 | 758
Description	10 x MTO limit of 9000kgs/axle assumed Super Load	Distance between axles in set, in | cm	157 | 400
Axle Load, lb | kg	198,000 | 89,796	Axle gauge, ft | m	19.7 | 6.00
# axles in set	1	Impact Factor	1.5
		Imbalance Factor	10%

Line(s) to be crossed:		
Line Name	6WL	
OD, in | cm	6.625	16.8
Wall thickness, in | mm	0.189	4.8
Pipe grade, ksi | MPa	52	359
Pressure, psi | kPa	500	3447
Long seam type	ERW	
Installation:		
Depth of cover, in | cm	39	100
Installation type	Settled	
Bottom Reaction Angle, deg	60	
Trench or bore width, in | cm	7	17
Soil Unit Weight, pcf | kg/m^3	120	1922
Soil Type	4	
Modulus of soil reaction E', psi | kPa	250	1724
Slab or Matting:	no slab	
Slab thickness, in | cm		
Impact Factor on slab or mat		
Slab material		
Slab width across pipe, ft | m		
Slab length along pipe, ft | m		
odulus of subgrade reaction k, pci | MPa/m		
Maximum Hoop Stress, % SMYS:		
Calculated	77.1%	
Allowable	85%	
Fluctuating Hoop Stress, psi | MPa:		
Calculated	N/A	N/A
Allowable	20	138

Requirements / Notes: Axle load for analysis of ~90000kgs or ~10 x MTO Road Legal Axle limit of 9000kgs. Results show pipeline still remains below maximum allowable hoop stress limit. This load is considered to represent a superload or over weight vehicle permitted load.

Analyzed by: BNW 4/17/2020

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NATIONAL COOPERATIVE
HIGHWAY RESEARCH PROGRAM REPORT

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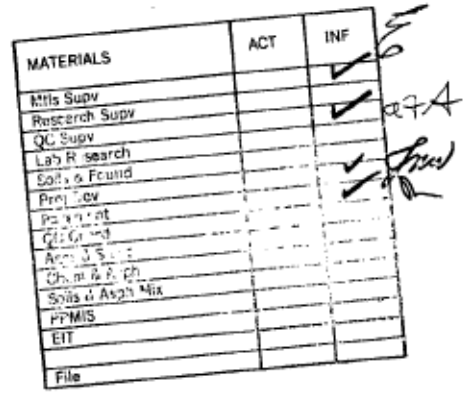
PROTECTION OF PIPELINES THROUGH HIGHWAY ROADBEDS



MATERIALS	ACT	INF
Mtls Supv		✓
Research Supv		✓
QC Supv		
Lab Research		✓
Soils & Found		✓
Proj Dev		
Pavement		
Geology		
Aggr & Soils		
Chem & Petr		
Soils & Aggr Mix		
PPMIS		
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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM REPORT **309**

PROTECTION OF PIPELINES THROUGH HIGHWAY ROADBEDS

R. A. KOENIG JR. and J. P. TAYLOR
Wilbur Smith Associates
Falls Church, Virginia

RESEARCH SPONSORED BY THE AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS IN COOPERATION WITH THE FEDERAL HIGHWAY ADMINISTRATION

AREAS OF INTEREST:

Facilities Design
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TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL
WASHINGTON, D.C.

JULY 1988

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

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NCHRP REPORT 309

Project 15-9 FY '85

ISSN 0077-5614

ISBN 0-309-04606-8

L. C. Catalog Card No. 88-51016

Price $8.00

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Published reports of the

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

are available from:

Transportation Research Board
National Research Council
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Printed in the United States of America

FOREWORD

By Staff
Transportation
Research Board

This report provides a summary of information on protection of pipeline crossings of highways and contains guidelines for use by highway officials in determining the desired type of protection for specific circumstances. These guidelines take into account factors such as pipe location and design, construction methods, required cover, consequences of failure, corrosion protection, and future highway widening and construction. The guidelines may be used to assist states in formulating policies on pipeline crossings. The report should be of interest to highway department personnel dealing with utilities and right-of-way, as well as to individuals with utility companies who must prepare requests for pipeline crossings.

Existing policies for pipeline protection are extremely varied. Many state highway and transportation agencies require that pipelines through highway roadbeds be encased. This policy is predicated on the expectation that as a result of encasement: (1) the pipeline is protected from associated loading; (2) in the event of pipeline rupture, liquids would be discharged out of the ends of the casing, protecting the integrity of the roadbed; and (3) ruptured pipelines could be conveniently removed from the casing and new pipe reinstalled. In other cases, improved pipe designs and strengths, together with the problems and costs of the use of casings with cathodic protection systems, lend support to the fact that encasement is not always the best alternative to pipeline protection.

No comprehensive national standards exist for underground pipeline protection for highway crossings or for conditions warranting encasement or nonencasement. In 1983 research was completed under NCHRP Project 20-7, Task 22, and a report was prepared entitled "Encasement of Pipelines Through Highway Roadbeds." That report documented the state of the art of pipeline encasement on a national basis. Although it is recognized that pipelines in highway right-of-way should be protected to a greater degree than normal "line" pipe, encasement is only one of several currently available means of providing increased protection.

The research conducted under NCHRP Project 15-9 and presented in this report includes a thorough review of the literature and information pertaining to pipeline crossings, updating that presented in the previously mentioned report. The review covers various state policies, AASHTO's publications, *A Guide for Accommodating Utilities Within Highway Right-of-Way* and *Policy on the Accommodation of Utilities on Freeway Rights-of-Way,* federal pipeline regulations, and policies developed by the pipeline industry. Pipeline failures are summarized.

Based on this research, guidelines for the protection of pipelines through highway roadbeds were developed and are presented. These guidelines are intended to assist

highway officials in reviewing requests for approval of pipeline crossings of highways. Factors that need to be considered include:

- Location
- Method of construction
- Depth of cover
- Consequences of pipeline failure
- Corrosion
- Carrier pipe design
- Future highway widening and construction.

With these factors in mind, as well as the possible causes of failures, a matrix of protective measures, including encasement, is included. Each of these protective measures is discussed.

These guidelines can be adapted for local conditions by the various state highway departments to formulate or update policies governing pipeline crossings. Highway officials and utility industry personnel are cautioned that the guidelines are general in nature and based on evolving practice. Accordingly, each pipeline crossing should be treated and analyzed as a unique situation.

CONTENTS

ACKNOWLEDGMENTS

Wilbur Smith Associates, BTML Division, Consulting Engineers, located in Falls Church, Virginia, prepared this report under NCHRP Project 15-9. Principal Investigator for the project was Raymond A. Koenig, Jr., and the Assistant Investigator was John P. Taylor, P.E.

Many state transportation departments, utility company officials, staffs from government agencies at the federal and state level, trade associations and independent agencies contributed to the information included in this report. Because of the number of responses and the limited scope of the study, it was impossible to include data received from each source in the final report. Both to those who recognize their input directly in this report, and those who do not, gratitude is expressed.

Special acknowledgment is given to Mr. Frank E. Fulton, Chief, Pipeline Safety Enforcement Division, U.S. Department of Transportation, Mr. H. M. Shepherd, Petroleum Engineer, National Transportation Safety Board, Dr. T. D. O'Rourke, School of Civil and Environmental Engineering, Cornell University, Mr. V. A. Yarborough, Colonial Pipeline Company, and other utility and highway officials who contributed to this study.

PROTECTION OF PIPELINES THROUGH HIGHWAY ROADBEDS

SUMMARY

Utility accommodation policies for pipelines crossing highways have not changed significantly since the previous research of NCHRP Project 20-7, Task 22, "Encasement of Pipelines Through Highway Roadbeds," was prepared in March 1983. However, there does appear to be a growing awareness and acceptance of the fact that encasement of pipelines for highway crossings is not always the best alternative for providing protection for pipelines or highways. State highway agencies appear to be more amenable to allowing utility crossings of highways without encasement. Recent research on utility crossings of railroads has application to highway crossings in the use of alternatives to encased crossings. Recent catastrophic failures of pipelines at highway crossings highlight the potential problems of encased pipelines.

While these developments have been going on, there have been no guidelines available to assist highway agency personnel in the approval of proposed pipeline crossings of highways. This research project (NCHRP Project 15-9) has developed guidelines based on current practices and available information concerning pipeline crossings of highways. These guidelines will assist highway agency personnel in approving proposed pipeline crossings of highways by utilities. The factors that are presented for consideration in the guidelines are:

- Vertical and horizontal location of the pipe.
- Allowable construction methods.
- Required cover.
- An assessment of consequences of pipeline failure.
- Corrosion protection.
- Carrier pipe design.
- Future highway widening and construction.

The methods of providing additional protection are also discussed with suggestions for using appropriate protection methods in different circumstances.

CHAPTER ONE

INTRODUCTION AND RESEARCH APPROACH

THE PROBLEM

In 1981, research was conducted addressing the need for encasing pipelines under highways. The research was sponsored under NCHRP Project 20-7, Task 22, entitled "Encasement of Pipelines Through Highway Roadbeds" (*1*). The objective of that research was to develop procedures for determining the need for pipeline encasement at highway crossings based on:

(1) a review of literature on pipeline design and performance, (2) limited stress analyses of underground pipelines, and (3) an evaluation of field experience by highway, railroad, and utility agencies of encased and uncased pipelines.

The study was completed in 1982 and the final report accepted by NCHRP in 1983. The final report contained a review of existing regulations concerning pipeline crossings including those of the U.S. DOT Office of Pipeline Safety, and referenced 42 related publications in the bibliography. The report contained the results of a survey of state highway departments, utility companies, and pipeline operators regarding their encasement practices. This survey also revealed problems encountered with the use of casings, particularly with regard to cathodic protection systems. A discussion of warrants for providing increased protection at pipeline crossings was included in the report as well as procedures for limited stress analyses for design of both encased and uncased pipeline crossings.

The study concluded that pipelines in highway and railroad rights-of-way should be protected to a greater degree than normal "line" pipe. Encasement is only one of several currently available alternatives to provide such increased protection. Local conditions must be taken into account in selecting a protection method including the nature of the facility being crossed, the nature of the crossing pipeline, the nature of the soil through which the pipeline passes, population of areas immediately adjacent to the right-of-way, and impacts of pipeline failure.

The conclusions contained in the report also summarized the reasons or warrants for providing protection at a highway/pipeline crossing. The various methods of providing additional protection applicable to these warrants were discussed. Encasing or placing a sleeve was shown to be appropriate in some instances, but sleeves have not been successful in facilitating the removal of carrier pipe and can interfere with cathodic protection devices. The potential problems of cathodic protection and other causes of failure should be considered during design. The report stated "each crossing and protective method has its own unique considerations and limitations, all of which must be thoroughly evaluated for each crossing application."

Since the completion of the final report for NCHRP Project 20-7, Task 22, methods for protecting pipelines crossing highway rights-of-way have continued to receive attention. While the safety of the highway using public and utility owners is of paramount importance, the potential cost savings are great if certain installations can be made without encasement. Such issues as: the effectiveness of known corrosion protection; the lack of data on failure rates and the consequences of failures; unknown maintenance and installation costs; and the impact of the types of materials being transported have all been raised. These issues reveal the lack of accepted guidelines to follow in deciding if additional protection is necessary for a pipeline crossing a highway, and, if necessary, the kind of protection. The objective of NCHRP Project 15-9 is to develop guidelines for pipeline protection through roadbeds.

RESEARCH APPROACH

In order to accomplish the objective of this research project, the research was conducted in four phases or tasks: (1) further data collection for failure rates and maintenance costs; (2) the assessment of the consequences of failure on highway and utility activities; (3) the development of guidelines for selecting pipeline protection; and (4) the presentation of information in a summary report.

The following chapters and appendixes include findings, analysis of the problem, and conclusions related to the development of the guidelines for pipeline protection through highway roadbeds. The guidelines appear as Appendix A, entitled "Guidelines for the Protection of Pipelines Through Highway Roadbeds."

CHAPTER TWO

FINDINGS

BACKGROUND

Research conducted as part of NCHRP Project 20-7, Task 22, resulted in a large body of documents related to the encasement of pipelines crossing railroad and highway roadbeds. Those documents included state highway agency specifications and regulations, related research, and input from utility and industry groups. The documents were reviewed during the conduct of NCHRP Project 15-9. They provided the basis for further investigation and data gathering to meet the objective of this project, the development of guidelines for pipeline protection through roadbeds.

In particular, the previously collected information was reviewed for industry material and state regulations that may have been updated since 1982. States that had previously allowed uncased pipeline crossings were identified so that further information on the performance of uncased crossings could be requested, as well as, costs and changes in practices related to these crossings. Utility and industry groups that had provided invaluable information in Project 20-7, Task 22, were identified as potential sources for further or updated information. A brief literature search of the Transportation Research Information System (TRIS) database was conducted to ascertain if any recent research had been conducted related to pipeline crossings of highways.

Requests for information were sent to 13 states and responses were received from 9. One of two utility operators and five of nine industry groups responded to requests for information. Unsolicited information was received from another source in

response to a notice concerning the project that appeared in *TR News* (*2*). Phone queries and interviews with the National Transportation Safety Board and the U.S. DOT Office of Pipeline Safety personnel were also conducted.

INFORMATION UPDATE

AASHTO and Federal pipeline safety information analyzed and reviewed in NCHRP Project 20-7, Task 22, was found to be unchanged. No revisions were planned for Federal standards governing transportation of gas and hazardous liquids contained in Title 49 of the Code of Federal Regulations (*3*).

The state transportation departments chosen from which to request additional information for this study were not randomly selected. Rather, states that had provided useful information in the previous study were again asked to provide information. These states generally have large networks of natural gas or petroleum transmission pipelines within their borders. These states thus have more experience with the problem of hazardous material pipelines crossing highways. State responses to requests for information included the following:

- Georgia responded to questions concerning the use of concrete-coated steel pipe crossings by stating that approximately 120 had been installed ranging in size from 10 in. to 36 in. with no known problems after almost 15 years of service. A potential problem for this method of protection was noted in that a field procedure would be needed to apply concrete coating if road widening occurred. For existing steel casings requiring road widening, split casings can be placed around the carrier and welded to the existing casing to provide a continuously encased crossing. Georgia permits all types of pipelines to be placed across highways without a casing when lines are placed by the open trench method ahead of highway construction. A savings of approximately $700,000 was realized for three major pipelines crossing I-675 near Atlanta using this procedure.
- Pennsylvania allows noncased crossings of utilities when certain conditions and precautions are satisfied. These conditions vary depending on the class of highway and the type of utility. Each pipeline crossing of a highway must be individually designed by the utility for that location and requires approval of the state DOT. An interesting requirement for various pipeline crossings without casing is that "an acceptable scheme for future repairs or replacement of the facility without open cutting of the pavement or shoulder" must be provided with the utility request for approval. The state has not encountered any problems with the noncased crossings that have been installed. These have only been in use a short period of time but because of the higher class or thicker pipe used, a life expectancy in excess of 100 years is anticipated. Noncased installations are noted as being less expensive than cased crossings and offer the advantage of being easier to relocate or adjust if the facility is affected by highway construction.
- Kentucky still permits unencased crossings and noted there have been more problems with encased pipelines, including three recent pipeline explosions at highway crossings.
- Mississippi was in the process of updating or revising Standard Operating Procedures related to utility crossings. When the Highway Department is constructing a highway across an existing transmission pipeline, the utility company is asked to consider placing a longitudinally reinforced concrete protective pad instead of placing split encasement around the existing pipe. Another alternative is to replace the existing pipe with a thicker wall pipe across the proposed highway. Figure A-9 from Appendix A is an example of a protective pad used in Mississippi for a pipeline crossing.
- Texas contacted their District Offices and provided a summary of responses about failures of pipelines in encasement as compared to noncased lines. The summary is presented in Table 1. There is only a slight difference in the total number of failures in cased versus uncased crossings and failure is not defined. However, cathodic protection appears to be a major cause of failure for cased pipeline crossings.
- West Virginia allows uncased pipeline crossings of highways for natural gas when certain criteria have been met. The State notes that the cost savings from using uncased crossings for natural gas pipelines is a benefit to both the utility companies and the rate paying public. The State also allows exceptions to its normal policy requiring encasement as follows:

  a. Under municipal sections where not possible or practical.
  b. Copper or steel pipe 1¼ in. or less nominal diameter.
  c. Plastic pipe, meeting requirements of ASTM, D2513, Type 2306, 1¼ in. or less nominal diameter.
  d. Cast or ductile iron gravity flow sewer pipe, mechanical, "push on", or flanged type joint meeting ANSI Specifications A21.6, A21.10, A21.11, A21.51, or Federal Specifications WW-P-421c, and AWWA Specifications C106, 110, 111, and 151, and of a thickness class capable of resisting the anticipated live and dead loads.
  e. Rigid plastic gravity flow sewer pipe capable of resisting the anticipated live and dead loads.
  f. Concrete sewer pipe.

- Tennessee and Alabama both allow uncased crossings while requiring additional protective measures including the use of higher factors of safety in the design, construction and testing than normally required for cased construction. Tennessee is not aware of any problems occurring with uncased crossings. Uncased crossings are generally less expensive to install and appear to be more trouble free.

Table 1. Summary of reported pipeline crossing failures in Texas Highway Department districts.

Failures Occurring in Pipelines	Uncased	Cased
Number of Districts reporting	23	23
Number reporting failures	11	13
Type of failed lines		
Water	5	1
Water and Oil	3	1
Oil	2	4
Aviation Fuel	1	-
Gas	-	4
Gas and Water	-	1
Petroleum	-	1
Propane Gas	-	1
Causes of Failure		
Age and Installation	7	5
Corrosion	1	-
Damage by this Department	1	-
Damage by other Utility	1	-
Cathodic Protection	-	5
Unknown	1	3

Utility and industry group responses to requests for additional information provided some relevant data. Colonial Pipeline Company reported that they had installed 1,720 uncased road crossings in 10 states since 1972 ranging in diameter from 8 in. to 40 in. with no leaks, problems, or any other failures. They stated that maintenance costs have been negligible.

The American Water Works Association pipe and pipe installation manuals were virtually unchanged as they related to crossings from the previous study. The American Petroleum Institute's Recommended Practice 1102 (*4*) remains unchanged from the previous study.

RECENT DEVELOPMENTS

While the TRIS literature search revealed no new references on pipeline crossings of highways and railroads, responses from the American Gas Association, the U.S. DOT Office of Pipeline Safety (OPS), and the National Transportation Safety Board (NTSB) recommended some highly relevant sources. These included a report on a program being conducted by Cornell University for the Gas Research Institute (GRI) on "Practices for Pipeline Crossings at Railroads" (*5*). The "Pipeline Accident Report, Texas Eastern Gas Pipeline Company Ruptures and Fires at Beaumont, Kentucky on April 27, 1985 and Lancaster, Kentucky on February 21, 1986" (*6*) by the National Transportation Safety Board and transcripts of hearings (*7*) and related documents associated with the investigations of the accidents contained much valuable information. A program of pipeline inspection initiated as a result of these accidents also revealed valuable information.

The GRI research program has produced two reports (*5, 8*) that provide valuable information related to highway crossings. Although the reports focus on railroad crossings, much of the information is relevant to highways. Of particular interest was the information on design and construction methods for pipeline crossings, foreign practices, a review of catastrophic crossing failures, and corrosion control contained in the reports. Significant findings and recommendations of the report include the following:

- In the United Kingdom and the Federal Republic of Germany, gas pipeline regulations allow uncased pipeline crossings at railroads.
- The option to use thicker wall carrier pipes in lieu of casings at crossings is allowed in a 1984 revision of the British Institution of Gas Engineers recommendations and is also being considered in Canada for incorporation into industry specifications.
- The investigations of pipeline failures within casings at crossings by the NTSB indicate that casings can lead to potentially unsafe conditions. A review of NTSB accident reports shows that problem areas include atmospheric as well as galvanic corrosion control and longitudinal pipeline stresses due to carrier pipe flexure inside the casing.
- Casings have not successfully withstood the forces that occurred when transmission natural gas pipelines have failed within the casing.
- Poor bedding conditions can create additional ring bending stresses in a casing or in an uncased carrier pipe, and these stresses are not decreased with pressurization.
- Carrier settlement outside the casing and inadequate spacing of insulators inside the casing can combine to create a condition of contact between the casing and the carrier as well as substantial longitudinal bending stress in the carrier.
- The carrier pipe may be exposed to atmospheric corrosion as a result of its isolation from the casing and the circulation of air through vents attached to the casing.
- Casings can reduce or eliminate the effectiveness of cathodic protection.
- The problems associated with cathodic protection are compounded by difficulties in securing and interpreting meaningful measurements at cased crossings. The introduction of a casing creates a more complicated electrical system than would generally prevail for uncased pipe.

The NTSB Pipeline Accident Report on the Beaumont and Lancaster, Kentucky, natural gas pipeline explosions (*6*) contains information on both accidents, the investigations into the accidents, and recommendations related to the causes of each. The Beaumont accident occurred in carrier pipe within a casing under a state highway. The Lancaster explosion occurred in a section of pipeline near, but outside of, the casing near another state highway. Points of interest about both accidents from the Executive Summary of the *Accident Report* are noted in the following paragraphs:

- On April 27, 1985, natural gas under 990 psig ruptured the No. 10 pipeline of the Texas Eastern Gas Pipeline Company system. The rupture was in an area weakened by atmospheric corrosion that was located within the pipeline's casing under Kentucky State Highway 90 near Beaumont, Kentucky. The ensuing fire killed five persons in a house located north of the rupture, injured three persons as they fled from their houses located south of the rupture, and destroyed substantial amounts of property.
- On February 21, 1986, natural gas under 987 psig ruptured the No. 15 pipeline of the Texas Eastern Gas Pipeline system. The rupture was in an area weakened by galvanic corrosion and was located south of Kentucky State Highway 52 near Lancaster, Kentucky. The force of the escaping gas and the ensuing fire injured three persons as they fled from their houses, resulted in the evacuation of 77 other persons, and destroyed substantial amounts of property.
- The National Transportation Safety Board determined that the probable cause of the pipeline accident near Beaumont, Kentucky, was the unsuspected and undetected atmospheric corrosion of Texas Eastern Gas Pipeline Company's 30-in.-diameter pipeline in a casing under State Highway 90. Contributing to the accident was the failure of the pipeline industry and of the U.S. DOT Office of Pipeline Safety to recognize the need for, and to require the use of, in-line corrosion detection techniques for identifying and monitoring the existence and severity of corrosion in casings and other areas shielded from corrosion protection.
- The probable cause of the pipeline accident near Lancaster, Kentucky, was the failure of the Texas Eastern Gas Pipeline Company to fully investigate the extent and severity of previously detected and inspected corrosion-caused damage and to replace the damaged segment of pipeline before its failure. Contributing to the accident was the lack of gas company guidelines for its personnel for further inspection and the shut down or reduction in line pressure when corrosion damage on its pipelines is detected.
- As a result of its investigations of these accidents, the Safety Board issued recommendations to: upgrade the qualifications

and training of gas company employees; require complete inspections for corrosion-caused damage of buried pipelines that have been excavated; require periodic affirmation through inspections and tests of the maximum allowable operating pressure of pipelines; require periodic inspections for corrosion damage of pipelines installed in vented casings; require changes in pipelines to facilitate use of in-line inspection equipment; and provide additional and more specific guidance on corrosion control practices and corrosion monitoring procedures.

Investigations into these pipeline failures also included a public hearing on the Beaumont accident in October 1985 (*7*). This hearing explored the reasons for using casings for pipeline crossings and the adverse effects the use of casings may have. While pipeline industry organizations declined to participate, testimony from gas company, state, federal, and railway industry representatives was given. Some relevant points of this testimony included in the report are:

- The gas company representatives stated that many sections of pipe had been removed from casings when pipe was being relocated because of road construction and other activities. Inspection of the removed pipe sections showed that the pipe was in good condition with only minor areas of corrosion. Furthermore, minor leakage of gas has been the only result experienced due to corrosion of pipe installed within casings; no major ruptures had ever been experienced before these accidents by the gas company.
- The representative of the OPS stated that he knew of no statistics on pipeline failures directly applicable for assessing the effect, if any, casings may have on the overall safety of buried pipelines. However, from the records of OPS there is no indication that the failure of pipelines that are encased has resulted in a significant threat to public safety. The OPS does not require the casing of pipelines for crossing road or for any other reason; however, if a casing is used, the OPS regulations incorporate specific actions which must be taken (49 CFR 192.323 and 192.467 (c)).
- Representatives of the Federal Highway Administration (FHWA), DOT, and the American Association of State Highway and Transportation Officials (AASHTO) commented that before 1959 the Federal Government and most of the States favored the use of casings for pipeline crossings under highways. Since 1959 there has been no policy specifically requiring the use of casing. Instead, the policy has been to leave the decision concerning the use of casings up to the individual State Highway Departments.
- The representative of the Kentucky State Highway Department concurred with the FHWA and AASHTO representatives. He stated that Kentucky had a policy in the 1950's which generally required the casing of pipeline crossings under highways. However, this policy was changed to allow the uncased crossing of pipelines where heavier pipe wall and improved insulating coatings were used. The change in policy came about because pipeline companies have been able to demonstrate that the heavier wall pipelines could safely withstand the forces imposed by the highway and vehicular traffic and in so doing the pipeline could be better protected against corrosion within the highway right-of-way.
- The representative of the American Railway Engineering Association (AREA) stated that it endorses the casing of pipelines crossing under railroads to protect against damaging the railroad should the pipe leak or rupture. While individual railroads are not mandated to follow this policy, in practice, most railroads do require the use of casings for pipelines crossing their rights-of-way. The representative further stated that by following good construction and inspection practices, operators of pipelines should experience no problems as a result of these casings.

A detailed review of the transcripts of the October 1985 hearings on the accidents conducted by the NTSB (*7*) was also made. Of interest was:

- The testimony concerning the detection of corrosion from currently used testing methods. Testimony described the difficulty in interpreting readings of pipe to soil potential to determine if pipes were shorted, were shielded, or active corrosion was present within casings.
- The AREA representative cited an example of a pipeline failure under a railroad and roadway in Mississippi where the roadway collapsed, but the railroad did not because the pipeline under the railroad was cased. He also stated that not using casings would, in effect, be an experiment.
- The U.S. DOT OPS representative discussed statistics related to gas transmission incidents recorded by his organization. Of 7,192 incidents of gas transmission lines (for all lines, not only highway crossings) between 1970 and 1982, 54 were attributed to corrosion in a road right-of-way. Although records do not indicate if pipelines were or were not encased, he felt the majority were probably encased. An incident is a leak, requiring reporting to the OPS, which caused death or serious injury or property damage greater than $50,000, but many of the incidents were reported under the older criteria of $5,000 in property damage. He stated that while the OPS is neutral on whether casings should be required or not, engineering judgment should be used and casing may be desirable in some locations.
- The Kentucky Department of Highways representative stated that the Department now allows utility companies to decide if casings are required or not. However, most District Engineers insist on casings.

As a result of the accidents in Kentucky involving the Texas Eastern Gas Pipeline Company, a program to check all pipelines of the company in Kentucky was initiated. This survey used a lina-log device to check for corrosion in pipelines. This device is placed in a pipe section and travels in the gas. By taking electromagnetic readings, it can detect corrosion in the line. The corrosion survey of three pipelines in Kentucky revealed that for 364 cased pipelines crossings, 26 were shorted and 20 were corroded. For the corroded crossings, 5 were replaced, 7 were filled or scheduled to be filled with a dielectric filler, and all were scheduled for more frequent monitoring.

CHAPTER THREE

INTERPRETATION, APPRAISAL, AND APPLICATION

Despite evidence suggesting that encasing pipelines with steel casing may not be the most appropriate protection for all pipelines crossing highways, many agencies continue to require such protection. The wording of AASHTO's *A Guide for Accommodating Utilities Within Highway Right-of-Way* (*9*) calls for encasement or an alternate means of providing the same degree of protection afforded by encasement. Many state highway agencies, in adopting the wording of the *AASHTO Guide,* have thus made encasement the first choice for most pipeline crossing situations. When a highway official is faced with the decision to approve or disapprove a utility's proposed pipe crossing, encasement would appear to be the best or most conservative means of providing protection.

The *AASHTO Guide* was based on experience and practices of almost 30 years ago. Since then, improvement have been made in the methods of providing protection for pipelines crossing highways. More experience has been gained in the problems of encasement and alternatives to it. A need exists, therefore, to provide information related to pipeline protection for highway crossings to highway officials. The intent of this project is to develop guidelines for pipeline protection through highway roadbeds that will provide such needed information. The guidelines for the protection of pipelines through highway roadbeds are contained in Appendix A.

The guidelines have been developed based on research for this project and that of NCHRP Project 20-7, Task 22. The guidelines give highway officials factors to consider in approving a proposed pipeline crossing of a highway and descriptions of currently available methods of providing pipeline protection. The guidelines avoid the requirement of encasement as the first choice for a pipeline crossing, but consider encasement as one of several different alternatives.

The guidelines have been kept general in nature and do not go into details of design or construction. Because the design and construction of a pipeline crossing is usually the responsibility of the utility, such information would not normally be required by highway officials. These guidelines in Appendix A have been kept as concise as possible to give the highway official a brief "tool" to assist in the approval of proposed pipeline crossings.

These guidelines are not intended as the definitive work on pipeline protection for highway roadbeds because of their general nature and the fact that the methods of protection are based on current practice. Protection methods will no doubt change and improve. These guidelines should therefore be used with an understanding of when they were developed and their limited intent.

CHAPTER FOUR

CONCLUSIONS AND SUGGESTED RESEARCH

The guidelines proposed in Appendix A are intended as a useful aid for highway officials in approving or disapproving proposed utility crossings of highways. They are based on available information and practices and provide highway officials a rational approach to decision-making. The guidelines are general enough so that they can and should be modified and adapted for local use. They can also be updated or modified as protection methods change. Over time, research should be conducted to ensure the validity of these guidelines and to modify them, as necessary, based on evolving practice.

APPENDIX A

GUIDELINES FOR THE PROTECTION OF PIPELINES THROUGH HIGHWAY ROADBEDS

INTRODUCTION

Utility and transportation networks have long shared common rights-of-way and will continue to do so as both networks continue to grow. As these networks intersect at common rights-of-way, problems often arise when construction, maintenance, and operations of one network affect the operations of the other network. Because of the importance of both highway and pipeline networks to the public, it has been recognized that they should be protected from each other. Pipeline crossings should minimize the utilities' interference with traffic and highway operations. Highway maintenance, repair and expansion operations should also be taken into account as they affect utility operations.

Each highway agency has the responsibility to maintain the right-of-way of highways under its jurisdiction to preserve the operational safety, integrity, and function of the highway facility. Highway agencies derive their authority to designate and to control the use made of right-of-way acquired for public highway purposes from state laws or regulations. Because the safety, integrity, and function of a highway can be affected by the manner in which utilities cross the highway, states have regulated the crossing of pipelines through highway roadbeds. States must comply with the requirements of the AASHTO *Policy on the Accommodation of Utilities on Freeway Rights-of-Way* (*10*) for pipelines crossing Interstate and other Federal-Aid freeways. This policy requires that crossings maintain the safety and integrity of the highway. Many states also follow AASHTO's *A Guide for Accommodating Utilities Within Highway Right-of-Way* (*9,* hereinafter referred to as the *AASHTO Guide*) for highways under their jurisdiction. This guide provides recommendations on the crossing of highways by various utilities and was first approved in 1969. Much of the wording of the guide is from an American Society of Civil Engineers (ASCE) study and related research done in the late 1950's and early 1960's (*11*).

Utilities may also be granted permission to install their lines and facilities on the right-of-way of public roads and streets. Such authorization or permission also depends on state laws and regulations. Utilities additionally depend on franchises, local laws, and ordinances to install their lines. Natural and other gas and hazardous liquid pipelines must also comply with Title 49, Transportation, *Code of Federal Regulations* (*3,* hereinafter referred to as CFR), which require additional precautions for pipelines crossing highways.

While utilities are usually responsible for the design of pipelines crossing highways, highway agencies are responsible for review and approval of the utilities' proposed crossing with respect to the location of the utility facilities to be installed and the manner of installation. Conflicts can arise over the design of pipeline crossings and the degree of additional protection required.

It should be noted that relatively few incidents of pipeline failure have occurred in the past three decades since the Interstate System was started and utility policies began to be established for highway rights-of-way. Available interstate pipeline system leak and incident data do not identify the cause or frequency of leaks or incidents at crossing locations, but it is believed to be a fairly minor problem. There is no national database of interstate pipeline incidents from which to draw conclusions about water or sewer line crossings of highways, but this is also believed to be a minor problem. Isolated reports of incidents of water main breaks or dig-ups can be found, but there is not a comprehensive database of water line or sewer line failures. Four catastrophic failures of encased petroleum and natural gas pipelines, however, have occurred at highway crossings which resulted in the loss of life and property.

Summary of Guidelines

In order to alleviate potential conflicts regarding the protection of pipelines at crossings, it is the intent of these guidelines to assist highway agencies in reviewing and approving such crossings. These guidelines outline the factors that should be considered in approving proposed pipeline crossings of highways and discuss appropriate protection methods for various situations. Each crossing should be evaluated as the unique situation that it is, and these guidelines will assist highway agencies in that evaluation.

Factors that should be considered for each pipeline crossing situation will vary. However, the following factors should be taken into account in approving protection measures:

- Pipeline size.
- Operating pressures.
- Nature of the transported material.
- Road classification and the probable causes and consequences of leakage for the road.
- Carrier pipe design.
- Required cover.
- Vertical and horizontal location of the pipe.
- Allowable construction methods.
- Corrosion protection.
- Future highway widening and construction.

Also, an understanding of the available protection methods is desirable in providing protection for pipeline crossings. Methods in use include: protective slabs, cradles or walls, encasement pipes or sleeves, concrete encasement, thickened wall pipe, tunnels or galleries, cathodic protection, and leak-proof joints.

For each of these protection measures, there will be advantages and disadvantages. Costs for construction and maintenance of different equal alternatives will often govern the selection of the most appropriate alternative.

Application

The guidelines apply to all public and private utilities in pipelines, including but not limited to water, gas, oil, petroleum products, steam, sewage, drainage, irrigation, and similar facilities that are to be located, adjusted, or relocated to cross rights-of-way of highways under the jurisdiction of highway agencies.

Scope

These guidelines are provided for use by highway agencies in regulating the design and methods for installing, adjusting, accommodating, and maintaining pipeline utilities crossing highway rights-of-way. They do not alter current regulations or authority for installing utilities, nor do they determine financial responsibility for replacing or adjusting utilities. They are merely guidelines intended to assist highway authorities in preserving the safe operation and integrity of highway systems.

Where laws or orders from public authorities, including state highway authorities, industry or governmental codes, prescribe a higher degree of protection than recommended by these guidelines, the higher degree of protection should be provided. These guidelines supplement, but do not alter, the provisions of the AASHTO *Policy on the Accommodation of Utilities Within Freeway Rights-of-Way.*

DEFINITION OF TERMS

Following are definitions for terms used in this guide:

Cap—rigid structural element surmounting a pipe, conduit, casing, or gallery.
Carrier—pipe directly enclosing a transmitted fluid (liquid or gas).
Casing—a larger pipe enclosing a carrier.
Clear zone—that roadside border area, starting at the edge of the traveled way, available for use by errant vehicles.
Coating—material applied to or wrapped around a pipe.
Cover—depth of fill over top of pipe, conduit, casing, or gallery to grade of roadway or ditch.
Cradle—rigid structural element below and supporting a pipe.
Encasement—structural element surrounding a pipe.
Flexible pipe—a plastic, fiberglass, or metallic pipe having a large ratio of diameter to wall thickness which is designed for diametric deflection greater than 3 percent.
Gallery—an underpass for two or more utility lines.
Grout—a cement mortar or a slurry of fine sand.
Highway, street, or road—a general term denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way.
Jacket—encasement by concrete poured around a pipe.
Normal—crossing at a right angle.
Pavement structure—the combination of subbase, base course, and surface course placed on a subgrade to support the traffic load and distribute it to the subgrade.
Pipe—a tubular product made as a production item for sale as such. Cylinders formed from plate in the course of the fabrication of auxiliary equipment are not pipe as defined here.
Pressure—relative internal pressure in psig (pounds per square inch gauge).
Right-of-Way—a general term denoting land, property, or interest therein, usually in a strip, acquired for or devoted to transportation purposes.
Rigid pipe—pipe designed for diametric deflection of less than 1 percent.
Roadway—the portion of a highway, including shoulders, for vehicular use. A divided highway has two or more roadways.
Slab, floating—slab between, but not contacting, pipe or pavement.
Sleeve—encasement structure of steel or concrete.
Traveled way—the portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes.
Trenched—installed in a narrow open excavation.
Untrenched—installed without breaking ground or pavement surface, such as by jacking or boring.
Vent—appurtenance to discharge gaseous contaminates from casing.
Walled—partially encased by concrete poured alongside the pipe.

CONSIDERATIONS FOR PIPELINES CROSSING HIGHWAYS

The following general considerations are suggested for the location, selection of protection and design of pipeline installations crossing highway rights-of-way:

Location

Pipelines should be located to minimize the need for later adjustment to accommodate future highway improvements and to permit servicing such lines with minimum interference to highway traffic.

To the extent feasible and practicable, pipeline crossings of the highway should cross on a line generally normal to the highway alignment. Such alignment should present the least disturbance to the roadbed by being the shortest crossing distance.

The location of above-ground appurtenances for pipelines within the highway right-of-way limits should conform with the clear zone policies applicable for the system, type of highway, and specific conditions for the particular highway section involved. The depth of cover for pipelines under ditches should be adequate to protect the pipeline from ditch maintenance and repair activities.

In all cases, full consideration should be given to the measures, reflecting sound engineering principles and economic factors, necessary to preserve and protect the safety of highway traffic, its maintenance efficiency, and the integrity and visual quality of the highway.

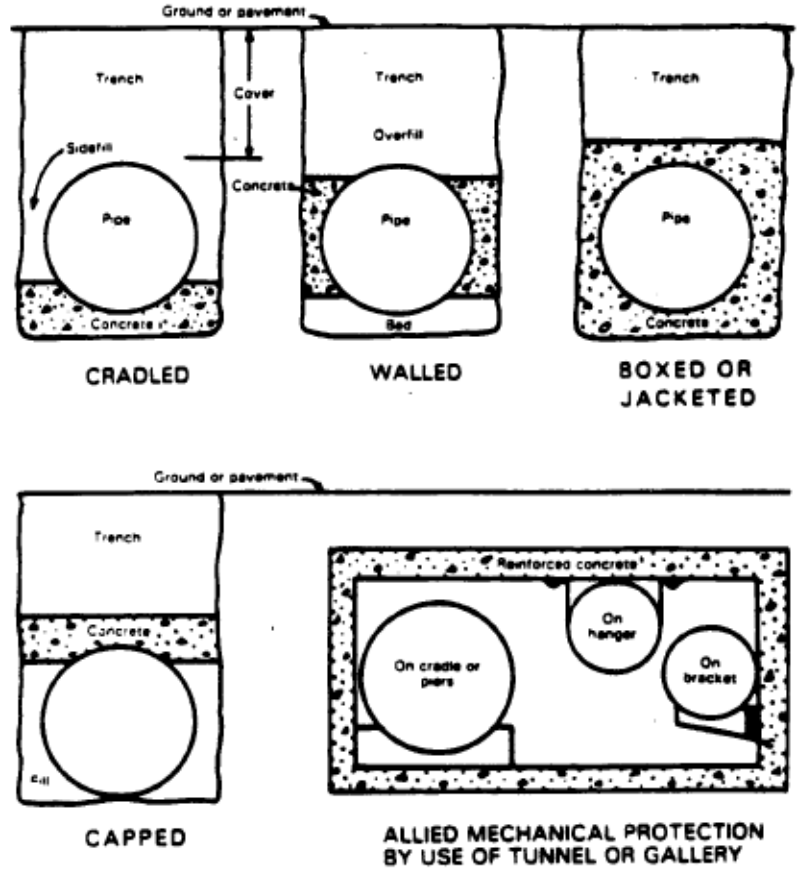


Figure A-1. Trenched protective measures. (From Ref. 9, by permission)

Construction Method to be Used

Whether the pipeline crossing is built using trenched or untrenched construction techniques helps determine the method of protection provided. Trenched construction is installing the pipe in a narrow, open excavation while untrenched is jacking or boring the pipe without breaking the ground or pavement.

Methods of providing protective measures for trenched construction are shown in Figure A-1 and for untrenched in Figure A-2. Trenched construction provides more options for protective measures; however, it is often impractical to use. Traffic is disrupted during construction. The pavement is cut and the subgrade is disturbed, which often leads to later settlement and pavement damage. As a result, many highway agencies prohibit

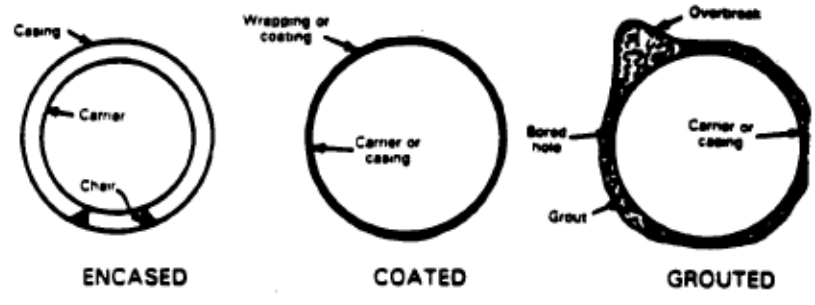


Figure A-2. Untrenched protective measures. (From Ref. 9, by permission)

Table A-1. Trenchless construction methods. (From Ref. 5)

Method	Lining Type and Range of Internal Diameter, in. (mm)	Length of Drive, ft (m)	Suitable Ground Conditions	Steering and Accuracy, in. (mm)	Surface Access (Pit Length × Width), ft (m)[b]
Pipe jacking with remotely controlled tunneling and excavation shields	Jacked pipe 12 to 36 (300 to 900)	Max to date 400 (120)	All except rock and large boulders. Excavation shields are designed to limit ground movements.	Steerable; typical accuracy ± 1 (25).	20 × 7 (6 × 2) launch pit; 10 × 7 (3 × 2) reception pit.
Pipe jacking with auger borer	Jacked pipe 6 to 36 (150 to 900)	Up to 330 (100), often less	All except hard rock and boulders. Risk of ground movement in soft clay and loose sand with obstructions.	At best accuracy about ± 2 (50), but decrease with distance.	10 × 7 (3 × 2) launch pits; 7 × 7 (2 × 2) reception pit.
Percussive moling	Pulled plastic or steel pipe 2 to 8 (50 to 200)	Max 230 (70), but typically 100 (30)	Not suitable for very soft ground or rock. Can break up small boulders. Minimum heave at depths greater than 10 × pipe diameter.	No control once launched. Best accuracy ± 4 (100) in 100 ft (30 m).	7 × 5 (2 × 1.5) launch pit; 5 × 5 (1.5 × 1.5) reception pit.
Horizontal drilling	Steel pipe 2 to 36 (50 to 200)	Max 4200 (1300)	Can be used in most soils.	Steerable by use of special drilling tools. Turning radius controlled by pipe diameter.	Drilling normally from surface-mounted rig.
Pipe ramming	Driven steel pipe 2 to 36 (50 to 200)	Max 200 (60)	All except rock and boulders. May be able to chisel soft rock. May cause heave in clay and dense sand.	Little control once drive started. Best accuracy ± 4 (100).	16 × 5 (5 × 1.5) launch pit; 5 × 5 (1.5 × 1.5) reception pit.
On-line replacement	Plastic pipe 4 to 16 (100 to 400)	Max to date about 300 (100).	Suitable for most soils.	Uses existing pipe as pilot tunnel.	7 × 5 (2 × 1.5) launch pit; 5 × 5 (1.5 × 1.5) reception pit.

[a]Adapted from report prepared by Binnie and Partners, 1985.

[b]Dimensions for launching and receiving pits are generally minimum required dimensions. Larger dimensions are commonly used to expedite construction processes.

the use of trenched construction except in specific situations.

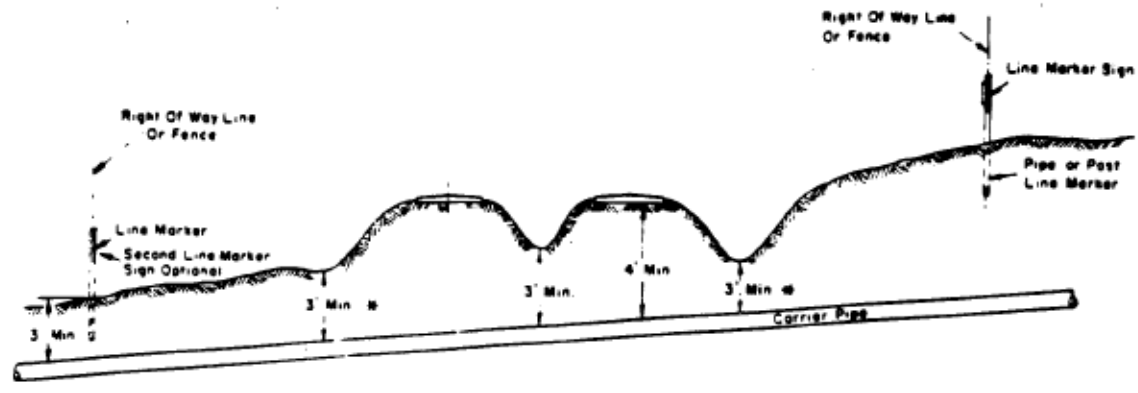
Untrenched construction has the advantage of not disrupting traffic or breaking the pavement surface. Table A-1 presents various untrenched construction methods and associated characteristics. Jacking or ramming techniques can cause damage to the pipe or the pipe's protective coating. Casing pipe, jacking pipe, thickened wall pipe, grouting, or precast concrete coverings may be used to prevent or mitigate such damage. Drilling or boring may also cause damage to protective coatings, and precast concrete coverings can be used to protect the carrier pipe. Suitable ground conditions for each type of untrenched construction are given in Table A-1. Because of the potential for damage to the carrier pipe during untrenched construction, additional protective measures for crossings may be warranted even if other warrants for protection do not exist.

Cover

The depth of cover for a pipeline crossing is most critical at the low points of the highway section. Because these are usually the bottoms of longitudinal ditches, such points are very likely to be subject to frequent maintenance operations including ditch cleaning, widening, or deepening. Scour may also increase the depth of unpaved ditches. Damage from maintenance activities is one of the most frequent causes of pipeline failure. The depth of cover is therefore a determining factor in whether additional protection is required for a pipeline. The greater the depth of cover, the less critical the need for additional protection. Figure A-3 shows a typical highway cross section and recommended minimum cover depths for petroleum pipelines. These cover depths are recommended by the American Petroleum Institute and comply with the Federal regulations for hazardous liquids.

Suggested controls for cover of pipelines are also contained in the *AASHTO Guide.* These controls include the recommendation that depth of cover be established by each highway agency based on engineering and safety factors, the product carried, and the maximum working or test pressures for the pipelines. The *AASHTO Guide* also recommends that pipelines be rerouted or protected if minimum cover cannot be obtained because of other utilities, water table, local ordinances, or similar reasons.

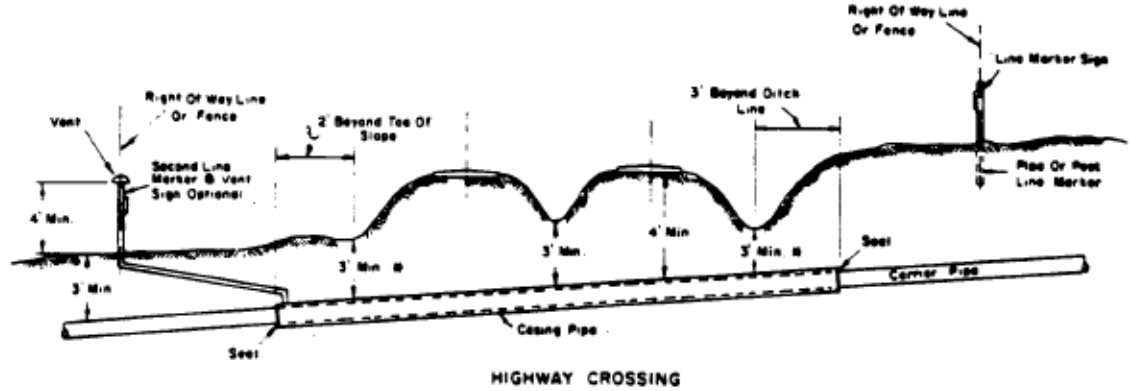
Gas pipelines must comply with the safety standards and specifications of both the CFR and state regulatory bodies. Required CFR minimum depths of cover for gas pipelines are 30 in. in Class I locations in normal soil; 18 in. in consolidated rock; 36 in. in Class II, Class III, Class IV, and ditch locations in normal soil; and 24 in. in consolidated rock. Classes are determined based on the proximity of a pipe to buildings or structures, with Class I locations being the most remote from populated areas or buildings. Federal codes for minimum cover depths for all liquids are the same as the API recommended depths of cover shown in Figure A-3.



HIGHWAY CROSSING

*For pipelines transporting LPG this dimension shall be 4' min.

EXAMPLE OF
UNCASED CROSSING INSTALLATIONS



HIGHWAY CROSSING

*For pipelines transporting LPG this dimension shall be 4' min.

EXAMPLE OF
CASED CROSSING INSTALLATIONS

Figure A-3. Critical dimensions—depth of cover. (Dimensions for petroleum pipelines from API Recommended Practice 1102)

Assessment of Consequences of Pipeline Failure

An assessment of the potential consequences of the failure of a pipeline at a particular crossing will aid in approving appropriate methods of protection for that pipeline. The assessment should include the following steps: (1) classify the materials being transported, (2) identify causes and consequences of failure, (3) evaluate if additional protection is required for the crossing, and (4) if additional protection is required, identify appropriate protection methods.

Step 1—Classify Material Being Transported

The material should be classified as either hazardous or nonhazardous. Hazardous materials for pipeline crossings are flammable, corrosive, or toxic. Such materials, if spilled, cause loss of life or serious injury, property damage, or environmental contamination. It is critical to know whether or not a material is hazardous in assessing the consequences of a pipeline failure. Special Federal or State regulations may apply to the transport of hazardous materials that must be complied with. Federal regulations covering pipelines are in Title 49 of the *Code of Federal Regulations,* Part 192—Transportation of Natural and Other Gas by Pipelines: Minimum Federal Safety Standards, and Part 195—Transportation of Hazardous Liquids by Pipeline. Part 192 requires that different design factors be used for various crossing situations for the steel pipe design formula. The design factor in the design formula decreases for a pipeline crossing a highway, which results in the requirement for lower pressure or greater wall thickness than pipe not at a crossing. Part 195 requires that pipes at highways be installed to ade-

quately withstand dynamic forces expected by anticipated traffic loads. Accounting for traffic loads generally increases the pipe pressure, which results in a need for thicker pipe.

The pressure of materials being transported is also important. Pressures of 1000 psig or more may be found in natural gas or petroleum transmission pipelines. Transmission pipelines carry large volumes of materials from supply or source points to localized distribution systems. Distribution pipelines are generally lower pressure and smaller pipes that are used to provide products to consumers. Natural gas pressure in distribution piping may be as low as 0.25 psig. Lower pressures can also be found in water, sanitary sewer, or other pipelines. In addition to transmission or distribution pipelines, collector systems are also used. Collector systems for natural gas or petroleum products draw materials into collection or storage points for further refining, storage, and transmission. Collector pipe system pressure and sizes vary, depending on the volume of materials being transported.

Step 2—Identify Causes and Consequences of Pipeline Failure at Crossing Site

Pipelines may fail at highway crossings, although the frequency of such failures is low. From records of catastrophic failures and available information from pipeline operators and highway agencies, pipeline crossing failures are most likely caused by:

- Damage of pipelines from construction or maintenance operations.
- Corrosion leading to leakage or rupture.
- Differential settlement of crossing pipe relative to line pipe resulting in increased pipe stresses or failure of corrosion protection systems.
- Pressure surges that overstress pipes.

Because of the frequency of roadside and highway maintenance and construction operations, the likelihood of damage to pipelines from such operations is relatively high and is the most common cause of pipeline failure. Operations such as ditch cleaning and reshaping, installation of additional utilities or drainage structures or road widening or realignment occur near pipelines crossing highways. Pipelines can be struck or dug up during excavations or be overstressed from heavy construction vehicle loads.

Corrosion damage occurs in metal pipes when moisture and oxygen come into contact with metallic surfaces. The electrical properties of soil also affect corrosion. Metal pipes are usually protected from corrosion by coatings and cathodic protection systems. The CFR requires both coatings and cathodic protection for natural gas and hazardous liquid pipelines. Coatings, however, may be damaged during coating application, pipe installation, maintenance, or repair. Cathodic protection systems may be defeated by short circuits, shielding, or loss of current. Corrosion can lead to a loss of pipe thickness and thus reduced stress capacity.

Differential settlement occurs when a pipeline in a highway embankment settles at a rate different from that of the pipeline in adjacent areas. Differential settlement can induce stresses in pipes and cause pipe bending. Pipe bending can cause short circuits in cathodic protection systems if metal sleeves are used for pipeline protection (see Fig. A-4).

Pressure surges in pipelines can overstress pipelines and cause failures. While pressure surges are unlikely to overstress pipe

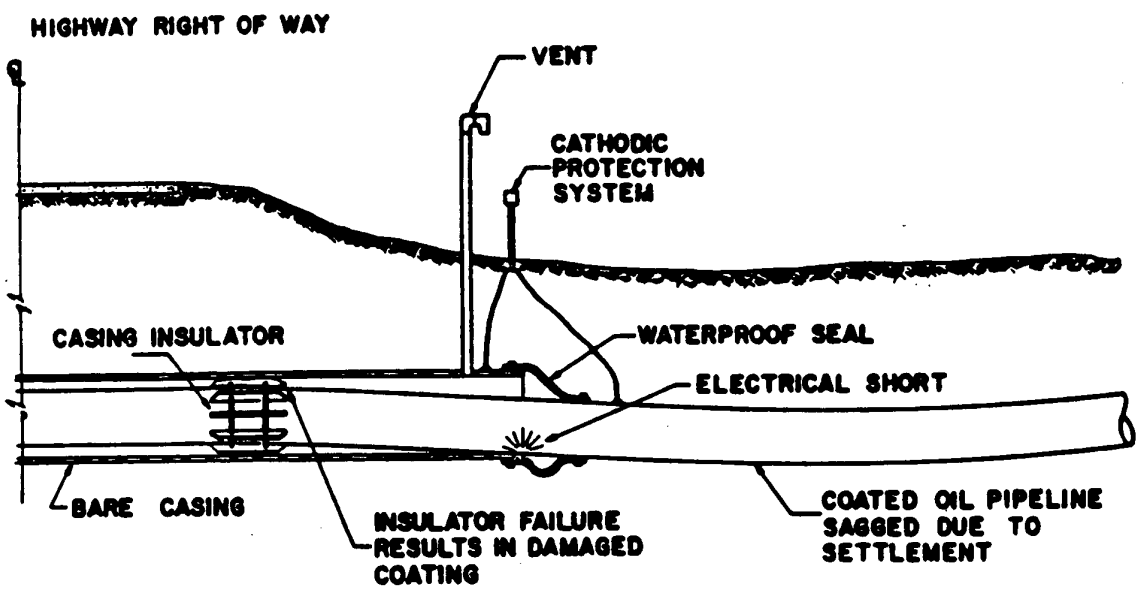


Figure A-4. Differential settlement of cased crossing and resulting short circuit. (From Ref. 12)

in good condition, pipe that has been previously damaged, corroded, or stressed from settlement may fail because of a pressure surge.

When any of the foregoing causes of failure are possible at a particular crossing site, the outcome of a failure occurring should be evaluated. There are many outcomes or consequences that may result from a pipeline failure at a highway crossing, but the most probable consequences are: the loss of pavement subgrade of highway embankment because of release of materials being transported, contamination of the highway and adjacent areas because of spill or release of materials, and fire or explosion if flammable materials are released from the pipeline.

These consequences will vary in severity depending on the type, volume, and pressure of the material in the pipeline and the location of the pipeline. For example, slow water leaks may lead to pavement damage requiring future repairs to the highway, while a water main break may wash out the road and damage property necessitating emergency repairs. A break in a petroleum products pipeline may: destroy the subgrade and pavement of the road making it impassable; contaminate adjacent ditches and surface water; and ignite, endangering life and property. Loss of the utility service may also be a serious consequence of a pipeline failure.

Step 3—Evaluate if Additional Protection is Required

The next step in assessing the consequences of pipeline failure at a crossing site is to evaluate if additional protection is required. This evaluation should be based on the type of materials being transported and the potential causes and consequences of failure at a site. The CFR requires a variation in the design formula for steel pipe for natural and other gases at a highway crossing and requires traffic loadings be accounted for in the design of hazardous liquid pipeline crossings. These additional requirements generally result in the need for thicker pipe, which may be sufficient for a particular crossing site, and no other protection may be necessary. Similarly, no additional protection may be necessary for nonhazardous liquids at a particular low volume road crossing site, and normal line may be allowed.

Step 4—If Additional Protection is Required for a Crossing, Identify Appropriate Protection Methods

When additional protection is warranted for a pipeline crossing of a highway, it is usually the responsibility of the utility to select and design the protection method. Highway agencies are then responsible for the review and approval of the proposed crossing. Highway officials involved in the review process should approve appropriate protection methods for a particular situation. Protection methods include: protective slabs, cradles or walls, encasement pipes, concrete encasement (includes grouting, boxing, or jacketing), thickened wall pipe, tunnels or galleries, cathodic protection, and leak-proof joints.

Suggested protection measures for the potential causes and consequences of a pipeline crossing failure are graphically presented in Figure A-5.

In order to use Figure A-5, the causes of pipeline crossing failure for a site should be identified in the first column of the matrix labeled "Causes". Probable consequences of failure for each selected cause should then be selected from the second or "Consequence" column. For each cause and consequence selected as valid for a particular crossing, appropriate "Protection" methods are marked in the third section of the matrix. Any crossing situation may result in several combinations of causes, consequences, and appropriate protection methods. Some protection measures will be appropriate for multiple combinations of causes and consequences and will thus be more appropriate for a site. However, the allowed method of construction, location, and cover may preclude the use of certain protection methods.

For example, a natural gas pipeline crossing is proposed for a highway in a cut section. Settlement is not anticipated as a problem. Because of the utility's equipment and operating procedures, pressure surges are also not considered a potential cause of failure. Accordingly, "Damage" and "Corrosion" are selected in the causes column as shown in Figure A-6. If pipeline failure occurred, a fire, explosion, or destruction of the roadbed could occur. These consequences are selected. Because the highway cannot be closed during construction of the pipeline, untrenched construction methods must be used. With this in mind, appropriate untrenched protection methods are found in the "Protection" block. Appropriate protection methods for the described situation would include encasement pipe, concrete encasement, thickened wall pipe or cathodic protection. In this situation, cathodic protection would be required because of the requirements of the CFR. Encasement pipe, thickened wall pipe, concrete encasement, or a combination of these methods would be appropriate to provide protection in addition to the cathodic protection required by the CFR. Because damage from construction or maintenance activities is the most common cause of pipeline crossing failures, encasement pipe or concrete encasement would be preferable over thickened wall pipe alone. If other factors, such as soil conditions, are not a problem for this proposed crossing, a utility's request to use encasement pipe, thickened wall pipe, concrete encasement, or a combination of methods should be approved.

Corrosion

Corrosion can be a serious problem for buried metallic pipes. Corrosion can eventually lead to pipe failure by reducing the wall thickness of pipes and, thus, reducing their capacity to handle stresses. Because pipes are buried, detecting corrosion damage is difficult. Failure of corrosion protection measures can be minimized, however, by ensuring their proper installation during construction. The following should be considered in relation to corrosion of metal pipelines crossing highways:

- The CFR requires that both natural gas and hazardous liquid steel pipelines be covered with protective coatings and cathodically protected.
- Coatings for steel pipelines damaged during manufacture or installation should be repaired prior to backfilling.
- Because coatings damaged during jacking or boring operations cannot be repaired, soil conditions must preclude coating damage. If this is not the case, additional carrier pipe protection will be required. Uncoated steel casing pipe, special coatings of tough durable materials or concrete-coated carrier pipe can be used in difficult soil conditions to avoid damage to protective carrier pipe coatings.

CAUSES	CONSEQUENCES			PROTECTION							
	Embankment/ Subgrade Loss	Spill	Fire or Explosion	Floating Slab or Cap	Cradle or Wall	Encasement Pipes	Concrete Encasement	Thickened Wall Pipe	Tunnel or Gallery	Cathodic Protection	Leak-Proof Joints
Damage from Construction or Maintenance Activities	●			●		●	●		●		
		●		●		●	●		●		
			●	●		●	●		●		
Corrosion (metal pipes only)	●						●	●		●	
		●					●	●		●	
			●				●	●		●	
Settlement	●				●	●	●	●			●
		●			●		●	●			●
			●		●		●	●			●
Pressure Surge	●					●		●			●
		●						●			●
			●					●			●

Figure A-5. Identify causes, consequences, and suitable protective measures for pipelines crossing highways.

• If steel casing pipe is used, casing and carrier pipe must be cathodically protected as a unit or the pipes must be electrically isolated. Electrical isolation is provided, as shown in Figure A-7, by insulators. Electrical isolation can be defeated if: insulators are damaged or not spaced properly during insertion of the carrier in the casing; differential settlement causes short circuits; or water acting as an electrolytic solution is present in the carrier/casing spacing.

Design

The utility is responsible for the design of the pipeline crossing the highway rights-of-way. The highway agency is responsible for review and approval of the utility's crossing proposal. The highway agency review should include the measures to be taken to preserve the safe and free flow of traffic, structural integrity of the roadway, ease of highway maintenance, appearance of the highway, and the integrity of the utility facility.

Utility installations under the right-of-way of state highways should, as a minimum, meet the following design requirements:

1. Water lines should conform with the current applicable specifications of the American Water Works Association.
2. Pressure pipelines should conform with the currently applicable sections of the Standard Code of Pressure Piping of the American National Standards Institute; Title 49 CFR, Parts 192, 193, and 195; and applicable industry codes.

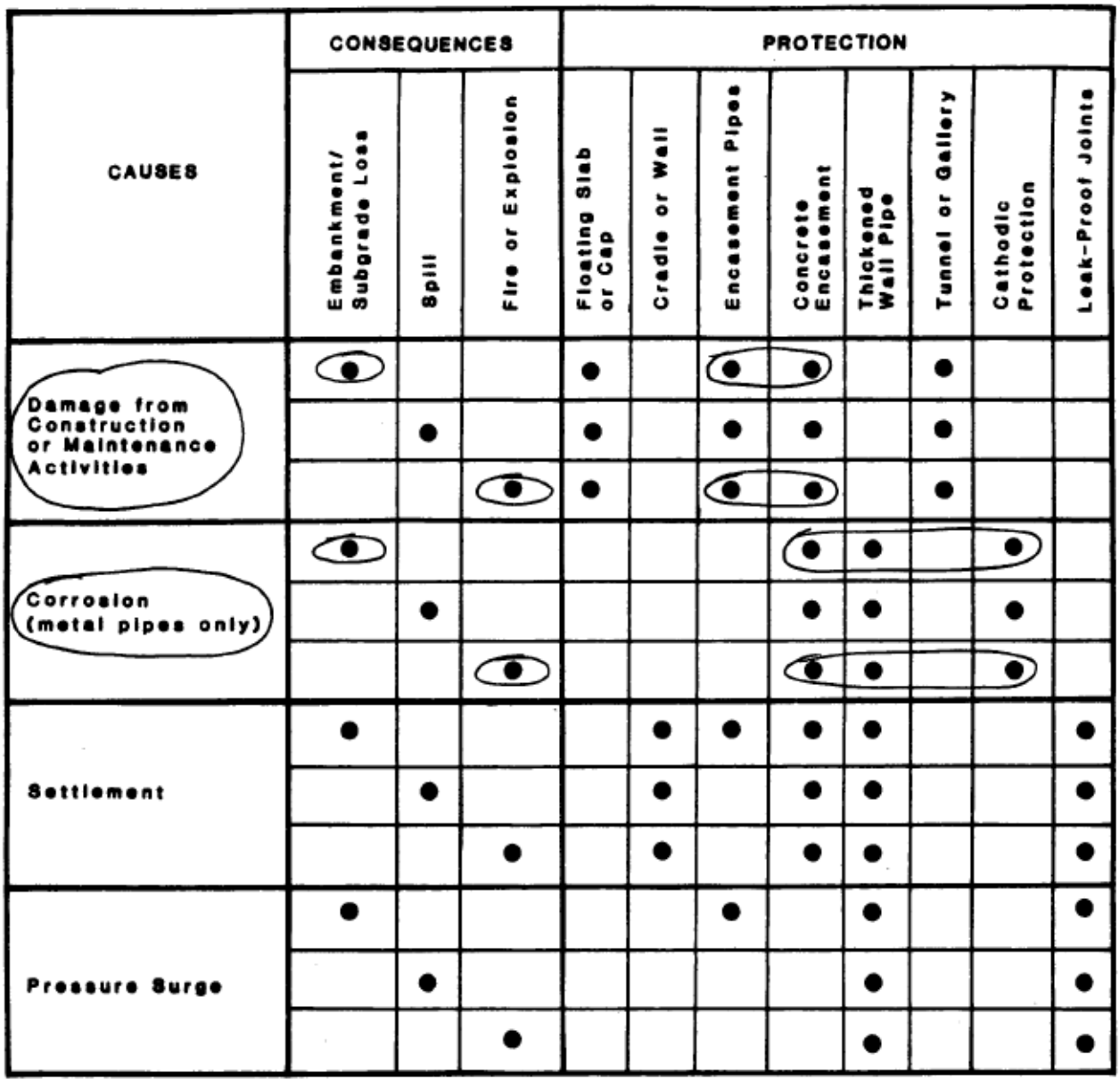


Figure A-6. Example to identify causes, consequences, and suitable protective measures for a highway crossing.

3. Liquid petroleum pipelines should conform with the currently applicable recommended practice of the American Petroleum Institute for pipeline crossings under railroads and highways.

4. Any pipeline carrying hazardous materials shall conform to the rules and regulations of the U.S. Department of Transportation governing the transportation of such materials.

Specific provisions of these requirements are given in Table A-2.

All utility installations under highway rights-of-way should be of durable materials designed for long service life expectancy and relatively free from routine servicing and maintenance. Utility installations should have at least the service life of the highway they are crossing, which is usually in the 20-year to 30-year range.

On new installations or adjustments to existing utility lines, provisions should be made for known or planned expansion of the utility. Such provisions should be planned so as to minimize hazards and interference with highway traffic when additional underground lines are installed at some future date.

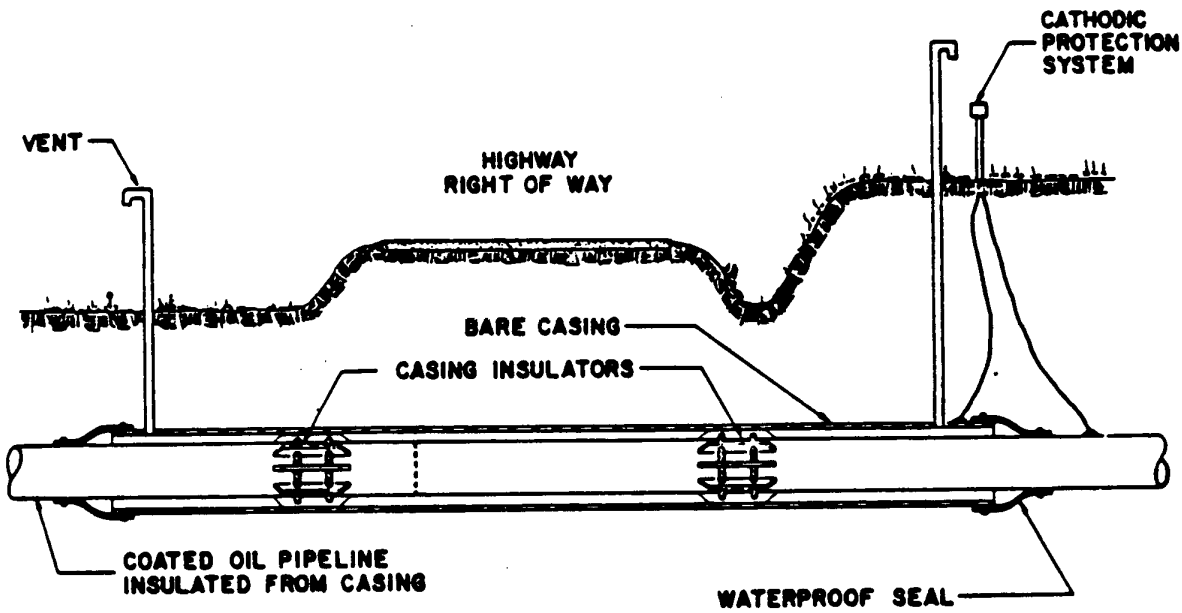


Figure A-7. Pipeline in casing under highway right-of-way. (From Ref. 1)

Table A-2. Applicable standards.

A.	Water Lines
	1. Section of AWWA C600-82, Standard for Installation of Gray Ductile Cast Water Mains and Appurtenances - Summary
	2. Section 7-2 of AWWA M23, PVC Pipe Design and Installation Manual - Summary
	3. Chapter 6, 10, and 11 of AWWA M11, Steel Pipe - A Guide for Design and Installation
	4. Page 70-73 from AWWA M9. Concrete Pressure Pipe Manual - Summary
B.	Gas Pipelines
	1. Title 49, Code of Federal Regulation, Part 192 "Transportation Federal Safety Standards"
	2. ANSI/ASME B31. 8-1982, "Gas Transmission and Distribution Piping Systems"
	3. "ASME Guide for Gas Transmission and Distribution Piping Systems - 1983"
C.	Liquid Petroleum Pipelines
	1. ANSI/ASME B31. 4-1979, "Liquid Petroleum Transportation Pipeline Crossing Railroads and Highways", API Recommended Practice 1102
	2. Title 49, Code of Federal Regulations, Part 195, "Transportation of Hazardous Liquids by Pipelines"
D.	Cathodic Protection - the National Association of Corrosion Engineers (NACE) "Recommended Practice, Control of External Corrosion in Underground or Submerged Metallic Piping Systems", NACE Standard RP-01-69.

Future Widening and Construction

Anticipating future highway widening may not always be possible. If it is known that a highway will be widened in the future, however, pipeline protection should be provided to account for such widening. Situations arise when highway widening is planned for an existing pipeline crossing site where no provisions were made in the protective measures for future widening. A decisions is then required on whether to extend the pipeline protection in the same manner that exists; modify the entire crossing; modify only the pipeline under the widening; or widen the roadway without modifying the crossing. The utility's recommendations for pipeline protection of the widening should be reviewed by the highway agency. The same factors used for a new crossing evaluation should be used in a widening evaluation. The costs of modifying or replacing the existing crossing should also be considered.

Future repair, replacement, or maintenance of pipelines should be a factor in a utility's crossing application. Distribution pipelines are more likely to be modified to provide new service. Casing pipes, tunnels, or galleries may be beneficial in such situations to facilitate modifications or expansions. Transmission mains, on the other hand, cannot be easily taken out of service and are generally larger in physical size. Pipeline operators usually do not remove and replace transmission pipes crossing highways. Instead, they generally bore or jack a new crossing and abandon the old crossing. For such crossings, using an encasement pipe sleeve for the sole purpose of facilitating future removal and replacement is inappropriate.

PROTECTIVE MEASURES

The previous section of these guidelines discussed factors to

consider in the selection of methods for providing additional pipeline protection at highway crossings. Various means of providing such protection were also mentioned including encasement pipes, concrete encasement, cathodic protection, cradles or walls, protective slabs, thickened wall pipe, tunnels or galleries or leakproof joints. A description of these methods and important characteristics of each are noted below.

Sleeves

Sleeves are encasement pipes, tunnels, or galleries for carrier pipes under highways. The longer pipe, tunnels, or galleries are used under highway crossings in many situations and are appropriate for a variety of transported materials, consequences, and potential damage causes. Steel, reinforced concrete, plastic or cast iron encasement pipes may be used with either trenched or untrenched construction. Steel pipes are predominantly used in untrenched construction. Galleries of precast or cast-in-place concrete require trenched construction, while tunneling is a specialized method of untrenched construction.

Encasement pipes have been used extensively for pipeline crossing protection. Steel pipes are suitable for untrenched construction, as shown in Table A-1, which describes various untrenched construction methods. Encasement is especially useful when jacked or bored installations of coated carrier pipes may cause damage to the carrier pipe coating.

Some controversy exists over the use of encasement for highway crossings as many highway agencies require their use or the provision of suitable equal protection as recommended in the *AASHTO Guide.* Many pipeline operators believe casings are unnecessary or less suitable than other protection methods for certain situations. Pipeline operators' objections to casing use have been because of the higher cost of casing and problems with cathodic protection systems of steel casing pipes. More recent experience with uncased crossings, rather than the information originally incorporated in the *AASHTO Guide,* suggests encasement is often not the best alternative for pipeline protection of highway crossings.

When encasement pipe is used for a pipeline crossing, several points must be considered. These are:

- Rigid versus flexible casing—flexible metal casing may cause loss of support to pavements. Rigid cast iron or reinforced concrete casings, however, are not customary practice for use with steel carrier pipes that are usually used for high pressure gases or required by Federal regulations for hazardous liquids.
- Internal diameter of casing—must be large enough to facilitate installation of carrier pipe and prevent external loads from being transmitted to the carrier pipe. API recommends that the casing pipe should be at least two nominal pipe sizes larger than the carrier pipe (*4*). AWWA recommends that the casing pipe for ductile-iron carrier pipe be 6 to 8 in. larger than the outside diameter of pipe bells (*13*). AWWA also recommends an inside clearance of at least 2 in. greater than the maximum outside diameter of pipe bells, skids, or cradle runners.
- Cathodic protection—metal casing pipes can defeat cathodic protection systems for carrier pipes and lead to corrosion and failure of the carrier pipe.
- Casing seals—ends of casing pipes should be sealed to prevent flowing water and debris from entering the annular space between the casing and the carrier pipe. Foam filled annular spaces can also protect the space and prevent water from flowing.

Tunnels or galleries provide many of the advantages of encasement pipes. They protect carrier pipes from loads and in case of leakage convey materials from underneath the highway traveled way.

Even though tunnels and galleries are often relatively more expensive than other protection methods, they do offer some advantages. For example, several utilities can be placed in a tunnel or gallery. If there are no conflicts with placing different utilities in close proximity to one another, the need for multiple easements, construction, and maintenance activities can be combined in a single crossing. Also, tunnels or galleries can be constructed to allow an increase in utility sizes, the addition of utilities in a crossing, or as a means of inspecting the utilities in the crossing.

Concrete Encasement

Concrete encasement provides additional protection suitable for many crossing situations. Encasement methods using concrete include grouting, boxing, capping, and jacketing.

Grouting along with jacketing are the only concrete encasement methods suitable for untrenched construction. When boring or jacking is used with pipe, there is often a space between the carrier pipe and adjacent soil. This space can be filled with grout by pumping grout material into the space or void. When the grout hardens, it provides additional protection from corrosion and loads around the carrier pipe and helps prevent settling of the carrier pipe and the highway subgrade. The grout does not protect pipe coatings from damage during installation when it is placed after the pipe is bored or jacked. Because placing grout is not a precise operation, the grout may not cover all such damaged areas.

Boxing is the placing of concrete around the entire carrier pipe. This method provides full protection from dig-ups, loadings, settlement, and corrosion. Trenched construction is required.

Jacketing is the placing of concrete around the pipe prior to boring or jacking. Many configurations are possible for jacketing. An example of a design developed and used in numerous highway crossings is shown in Figure A-8. In this example, thicker wall pipe is coated with a double coat of asphalt or coal tar. Primer, enamel, and fiberglass wrapping may also be used as insulation. A 1-in. thick concrete jacket reinforced with wire mesh is applied outside the asphalt or coal tar coating. The pipe is then placed by boring, keeping the annular space between the pipe and hole to a minimum. The space is then filled with urethane foam to prevent water channelization along the pipeline and to mitigate the potential for settlement around the pipe.

Partial Concrete Encasement

Cradling is the placing of a slab as a base for pipe. This method does not provide full protection from dig-ups, loadings, or corrosion, but it does provide protection from settlement damage. Because the method is used with trenched construction, pipe coating damage is minimized.

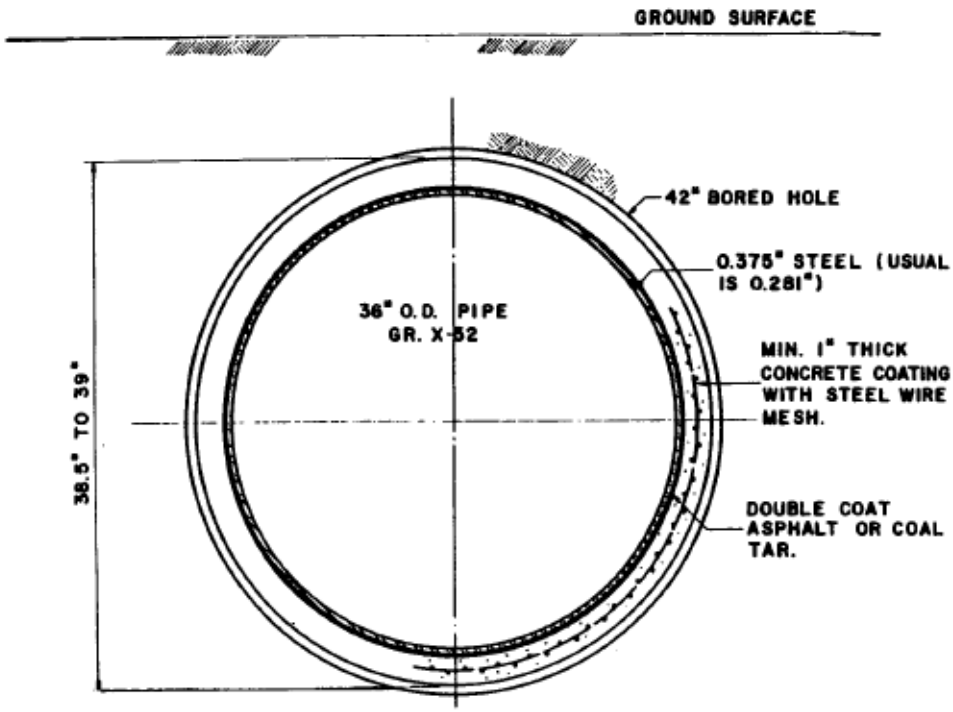


Figure A-8. Jacketed pipeline crossing. (From Ref. 12)

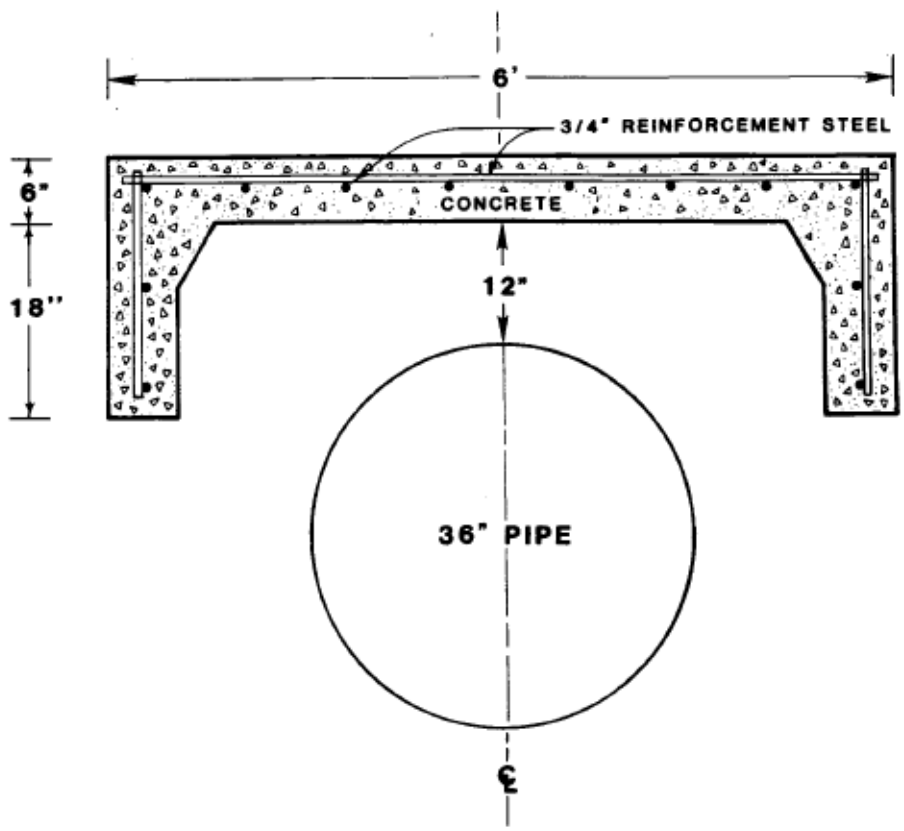


Figure A-9. Protective slab.

Walling is the placing of concrete on the sides of pipe in contact with the pipe. This provides more protection than cradling from dig-ups and corrosion, but not full protection that other methods provide.

Concrete Protective Slabs

Capping is the placing of a slab in contact with the top of the pipe. This method provides good protection from loadings and dig-ups.

A protective slab is similar to a concrete cap. However, the slab is not in contact with the carrier pipe and "floats" above the pipe. The slab can be precast or cast in place. An example of a protective slab is shown in Figure A-9. Such slabs do not provide protection from corrosion or settlement, but they provide excellent protection from loads or dig-ups by construction or maintenance equipment. Trenched construction is required.

These methods may be used for protection of the pipeline in the area between the traveled way and the right-of-way limit, even if trenched construction is not allowed in the traveled way. The slab or cap would thus provide protection from dig-ups in the area most likely to be damaged by construction or maintenance work. Damage to the roadway pavement can be eliminated and traffic disruption limited during construction.

Cathodic Protection

Cathodic protection systems are devised to reverse the natural flow of current from the pipeline to the soil. This natural current strips electrons from metallic atoms of the pipeline and corrosion results. In a cathodic protection system, a direct current from the surrounding soil to the metallic surface is introduced. This direct current can be from sacrificial anodes that are usually an alloy of zinc or magnesium, spaced along the pipe and connected to each other by lead wires. Such a system is known as a galvanic system for the galvanic couple formed between the anode and metal pipe which causes current to flow. Another means of introducing a current is called an impressed or induced current system. Low voltage direct current is either converted from conventional alternating current by a rectifier or supplied by a battery. Current flows from anode materials through the soil to the surface of the metallic pipe. Current is then collected from the pipe surface by wires that carry it back to the rectifier or battery. Figure A-10 illustrates an induced or impressed system.

In addition to requiring cathodic protection for metallic pipelines, the CFR requires periodic testing of these systems to ensure their proper functioning. Rectifiers must be inspected every 2 months and systems tested at least once a year, but at intervals not exceeding 15 months. If tests indicate any deficiencies in the system, remedial corrective action is required.

In addition to cathodic protection systems, coatings and wrapping are used to prevent corrosion of metallic surfaces. The CFR requires that an external protective coating:

- Is designed to mitigate corrosion of the buried or submerged component.
- Has sufficient adhesion to the metal surface to prevent underfilm migration of moisture.
- Is sufficiently ductile to resist cracking.
- Has enough strength to resist damage due to handling and soil stress.
- Supports any supplemental cathodic protection.

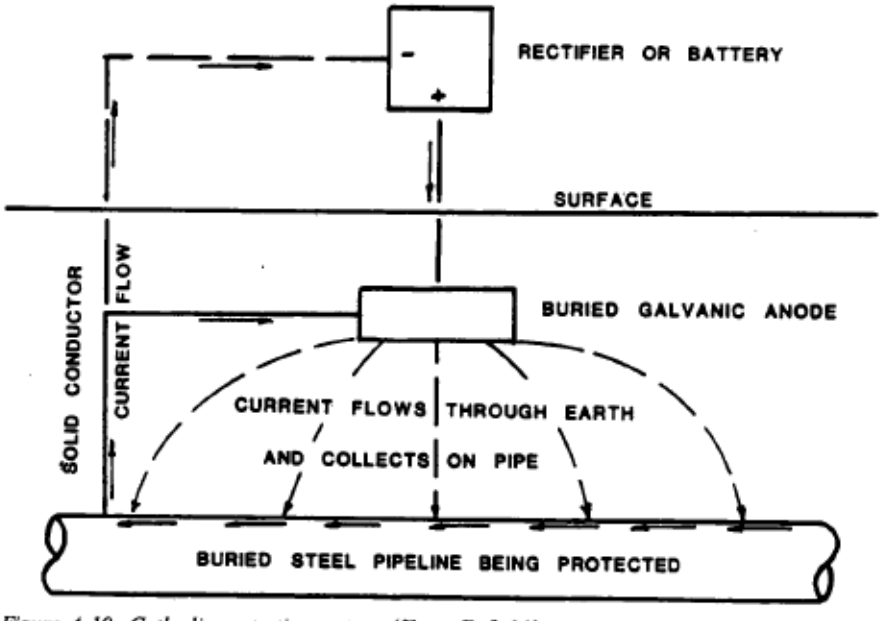


Figure A-10. Cathodic protection system. (From Ref. 14)

A wide variety of suitable coatings and wrappings is recommended by the AWWA for different applications. API recommends that coating and cathodic protection comply with ANSI/ASME B31.4 Code. Natural gas pipeline coatings must also comply with criteria specified in Title 49 of the CFR Part 192. Hazardous liquid pipeline coatings must comply with criteria specified in Title 49 of the *Code of Federal Regulations,* Part 195. The National Association of Corrosion Engineers (NACE) specifies detailed criteria for selection, testing, installation, and materials for pipeline coatings in their "Recommended Practice, Control of External Corrosion in Underground or Submerged Metallic Piping Systems," *NACE Standard RP-01-69.*

Thickened Wall Carrier Pipe

Using pipe at highway crossings with thicker walls than for cross country or normal line pipe provides additional protection for both the utility and highway. Thickened wall pipe can satisfy CFR requirements to account for dynamic traffic forces in hazardous liquid pipeline crossing design. The use of required design factors in equations for natural and other gas pipelines crossing highways will result in an increase in pipe wall thickness over cross country pipe.

Thickened wall pipe not only satisfies Federal requirements for hazardous liquid or natural gas pipelines, but also offers greater protection for all pipelines. Thickened wall pipe offers additional protection from the loss of section caused by corrosion; pressure surges; settlement stresses; and construction loads.

If thickened wall pipe is used, however, there may be an increase in the pipe rigidity over adjacent thinner walled pipe. There is some concern that this increased rigidity could affect the live load transfer to the pipe. Girth weld thicknesses will increase for thickened wall pipe with the potential for substandard welds. Because of these concerns, an alternative to thickened wall pipe is the use of higher grade steel pipe for highway crossings. Pipes of higher grade steel can provide greater strength than normal line pipe of a lesser grade steel.

Leak-Proof Joints

Pipeline joints are subject to failure because of improper welds, corrosion, or stresses. Testing of welds by nondestructive methods is required by the CFR in all highway rights-of-way for hazardous liquid and natural gas pipelines. Hydrostatic testing is also required for hazardous liquid pipelines. Such tests should ensure leak proof joints at welded sections.

Leak proof joints are also available for cast iron, concrete, or other pipe materials. The use of such joints and appropriate testing during construction can provide the additional protection required at pipeline crossings.

APPENDIX B

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TAB # 2

WORK PERMIT

Permit No.	Date
W - 14 - 2	2014 03 31
yy No.	yyyy mm dd

TYPE OF PERMIT

- ☐ Single Event Permit
- ☒ Blanket Permit

MUNICIPAL CONSENT REQUIRED

- ☐ No
- ☒ Yes Consent No. _____ Date _____

CONTACT INFORMATION

Proponent:	Union Gas Limited		
Street Address:	750 Richmond Street		
City, Province, Postal Code:	Chatham	Ontario	N7M 5J5
Contact Name, Position:	George Adams		
Work Phone, Work Fax:	519-436-2460 x76962		
Cell Phone, Email:	519-359-9953	GAdams@uniongas.com	
Contractor:	Aecon Utilities		
Street Address:	20 Carlson Court, Suite 800		
City, Province, Postal Code:	Toronto	Ontario	M9W 7K6
Contact Name, Position:	Marius Wyszomirski	Estimating & Controls Manager	
Work Phone, Work Fax:	416-423-4157 ext. 3350	416-423-0233	
Cell Phone, Email:	416-432-2650	MWyszomirski@aecon.com	

LOCATION AND DESCRIPTION OF WORK

County Road No.:	25, 27, 22, 31	Intersecting Road: (if applicable)	N/A
Municipal No.:	N/A	Municipality:	Lakeshore
Project Limits:	From: N/A	To:	N/A
Scheduled Dates:	May 2014 – November 2014		

Description of Work:

Underground road crossings.

Excavation:

- ☐ Roadway
- ☒ Boulevard
- ☐ Sidewalk/Bicycle Lane
- ☐ Shoulder
- ☐ Curb and Gutter
- ☐ None

Length: Varies m	Width: Varies m	Depth: Varies m

WORK PERMIT

Permit No.	Date
W - 14 - 2 (yy / No.)	2014 03 31 (yyyy mm dd)

ASSOCIATED DRAWINGS

Drawing Names: PL 126 – 01 to PL126 -12, PL126 – RC2, PL 126 – RC6, PL 126 – RC7 – SC8, PL126 – RC8 – SC10, PL126 – RC10

Prepared By: Matt Waddick, Union Gas

Date: March 20, 2014

TRAFFIC PROTECTION PLAN (in accordance with Ontario Traffic Manual Book 7, current revision)

☒ Yes a traffic plan is required ☐ No a traffic plan is NOT required

Typical Traffic Layout: Lane closure and flagging, as required. Plans to follow.

Road Closure: ☐ Full ☒ Lane ☐ None

INSURANCE

Amount of Proponent Insurance	$5,000,000 Commercial General Liability, $1,000,000 Automobile	Certificate No.	SPE-2013-113-UGL	Exp. Date	May 1, 2014
Amount of Contractor Insurance	$2,000,000 Commercial General Liability, $2,000,000 Automobile, $8,000,000 Umbrella	Certificate No.	2013-140-AU	Exp. Date	JULY 1, 2014

CONDITIONS

This permit is conditional upon the Proponent and the Contractor signing below and agreeing to the conditions list on this permit application as well as any other conditions that may be relevant to the work, including but not limited to any federal, provincial, and/or municipal act, regulation, or guideline.

PROPONENT (PRINT): George Adams, P. Eng. POSITION: Senior Construction Project Manager

SIGNATURE: George Adams DATE: Mar 20, 14

CONTRACTOR (PRINT): Marius Wyszomirski POSITION: Estimating & Controls Manager

SIGNATURE: DATE: MARCH 20, 2014

FOR OFFICE USE ONLY

PERMIT APPROVED BY (PRINT): DALE MYER POSITION: ENG. TECH.

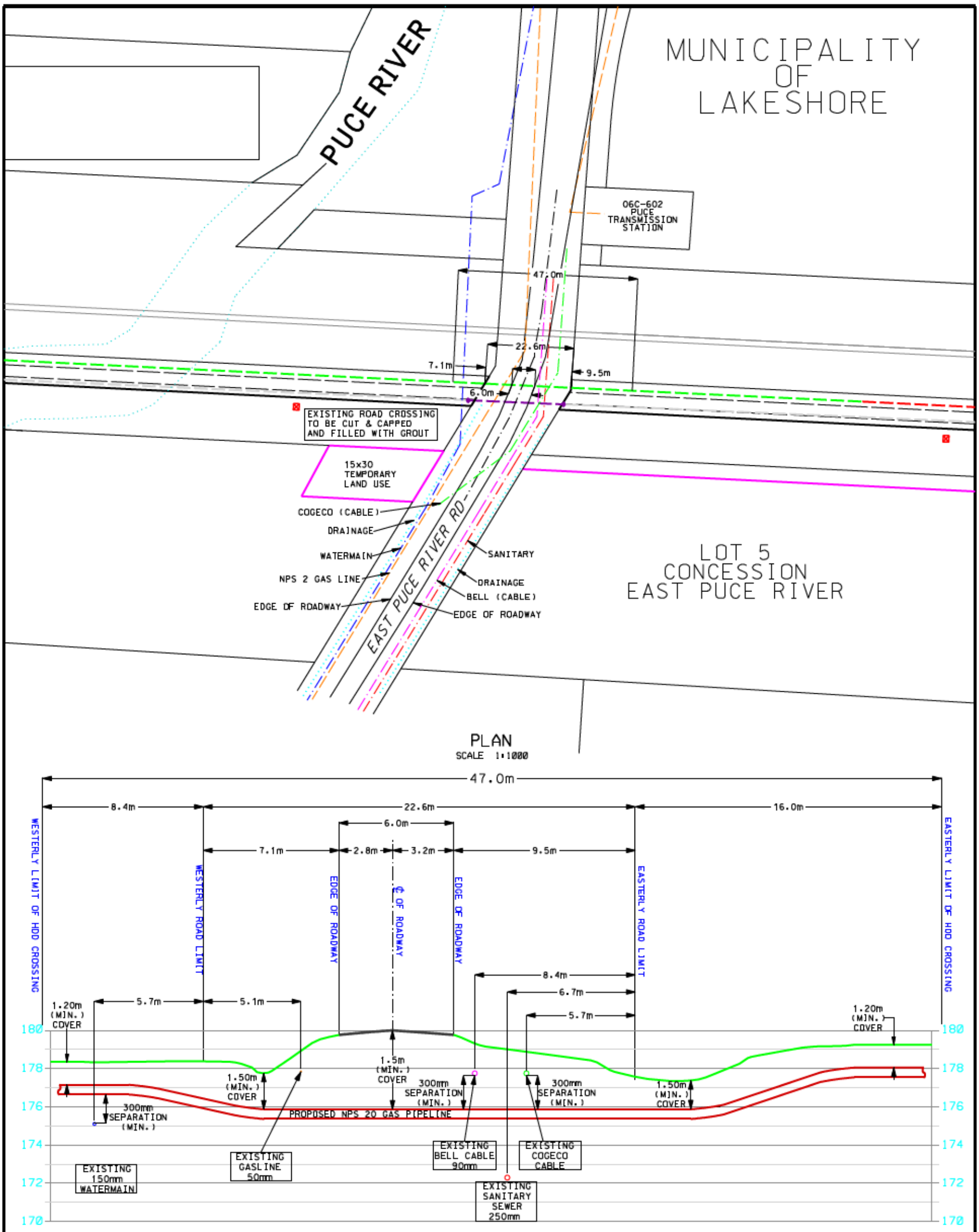
SIGNATURE: DATE: MARCH 31 2014

ADDITIONAL CONDITIONS OF APPROVAL

FEE/DEPOSIT RECORD

FEE:	$150.00	RECEIPT No.	26187	AMOUNT OF REFUND:	
DEPOSIT:	$0.00	DATE:	May 26/14	REFUND ISSUED BY:	
TOTAL RECEIVED:	$150.00	RECEIVED BY:	L. Hodge		

REV 12/2011



REVISIONS

NO.	DATE	BY	APP'D	REMARKS
01	2013-11-27	MJW		MUNICIPAL REVIEW

uniongas
A Spectra Energy Company

PANHANDLE NPS 16 REPLACEMENT PROJECT
EAST PUCE RIVER RD CROSSING - NPS 20
MUNICIPALITY OF LAKESHORE

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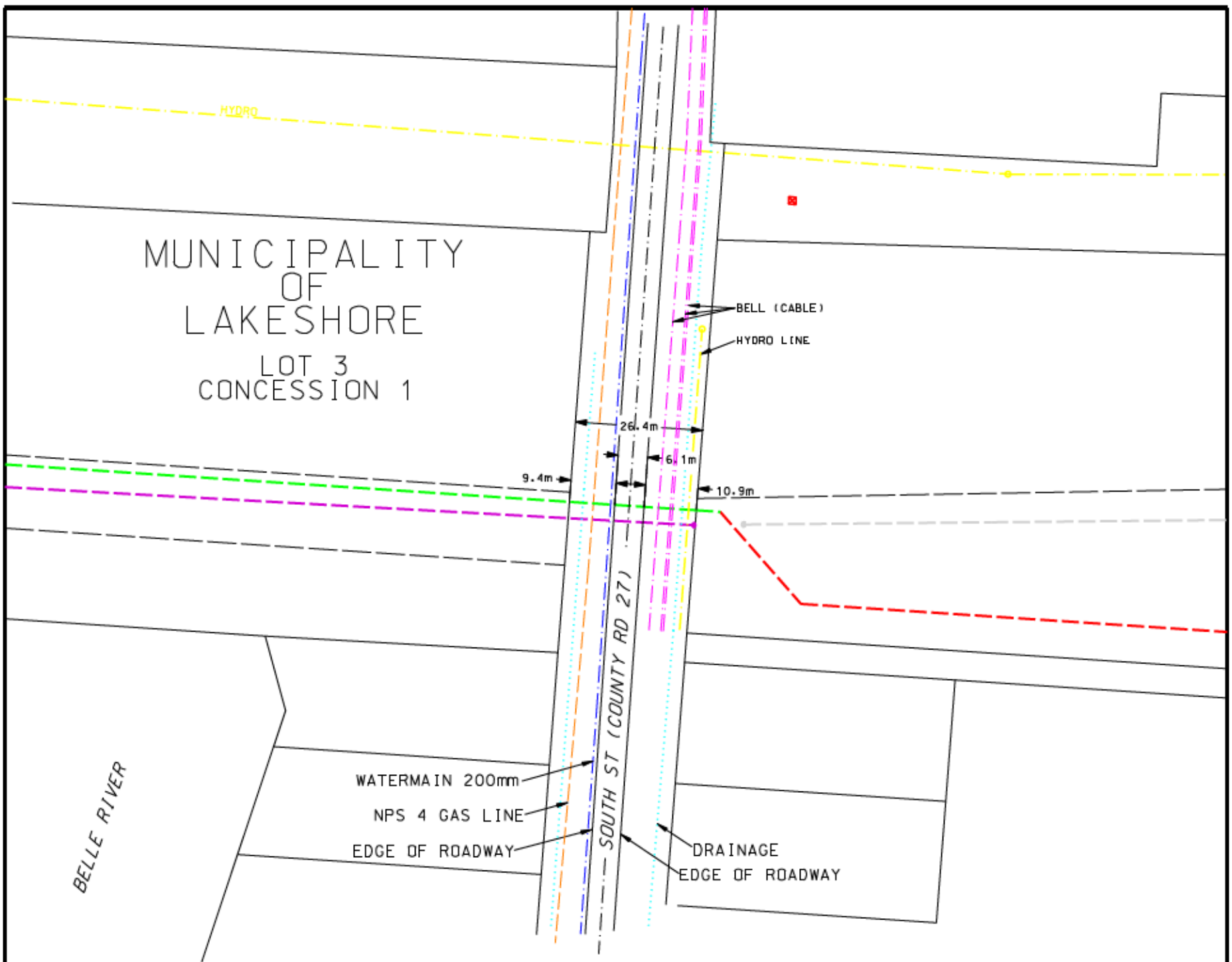

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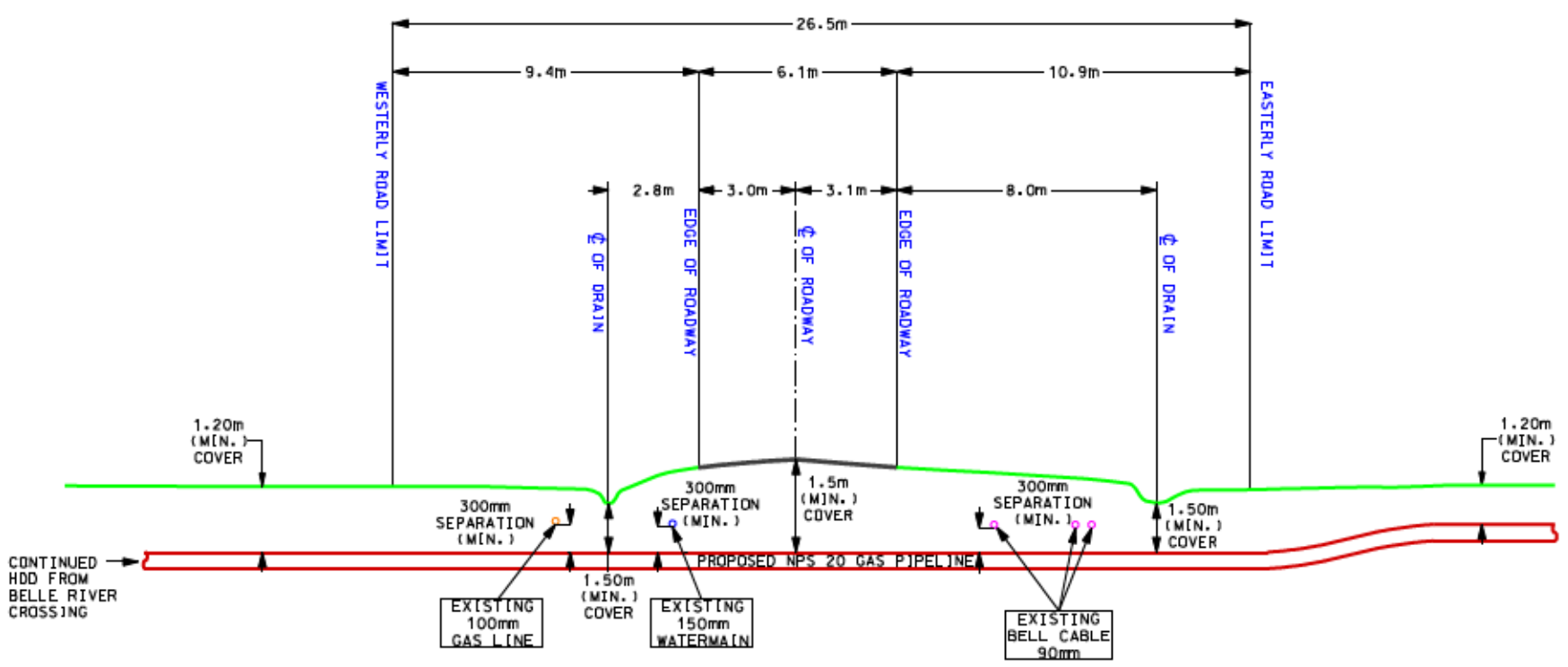

SOUTH ST (COUNTY RD 27) ROAD CROSSING
PROFILE
SCALE HOR. 1:200
VERT 1:200

METHOD OF INSTALLATION: HORIZONTAL DIRECTIONAL DRILL

GENERAL NOTE:
1. HYDRO & COGECO CABLES ABOVE GRADE
2. ALL UTILITIES TO BE FIELD LOCATED AND HYDROEXCAVATION TO BE USED WHEN NECESSARY
3. NO FIELD ELEVATIONS AVAILABLE FOR SOUTH ST

REVISIONS

NO.	DATE	BY	APP'D	REMARKS
01	2013.11.27	MJW		MUNICIPAL REVIEW

uniongas
A Spectra Energy Company

PANHANDLE NPS 16 REPLACEMENT PROJECT
SOUTH ST (COUNTY RD 27) CROSSING - NPS 20
MUNICIPALITY OF LAKESHORE

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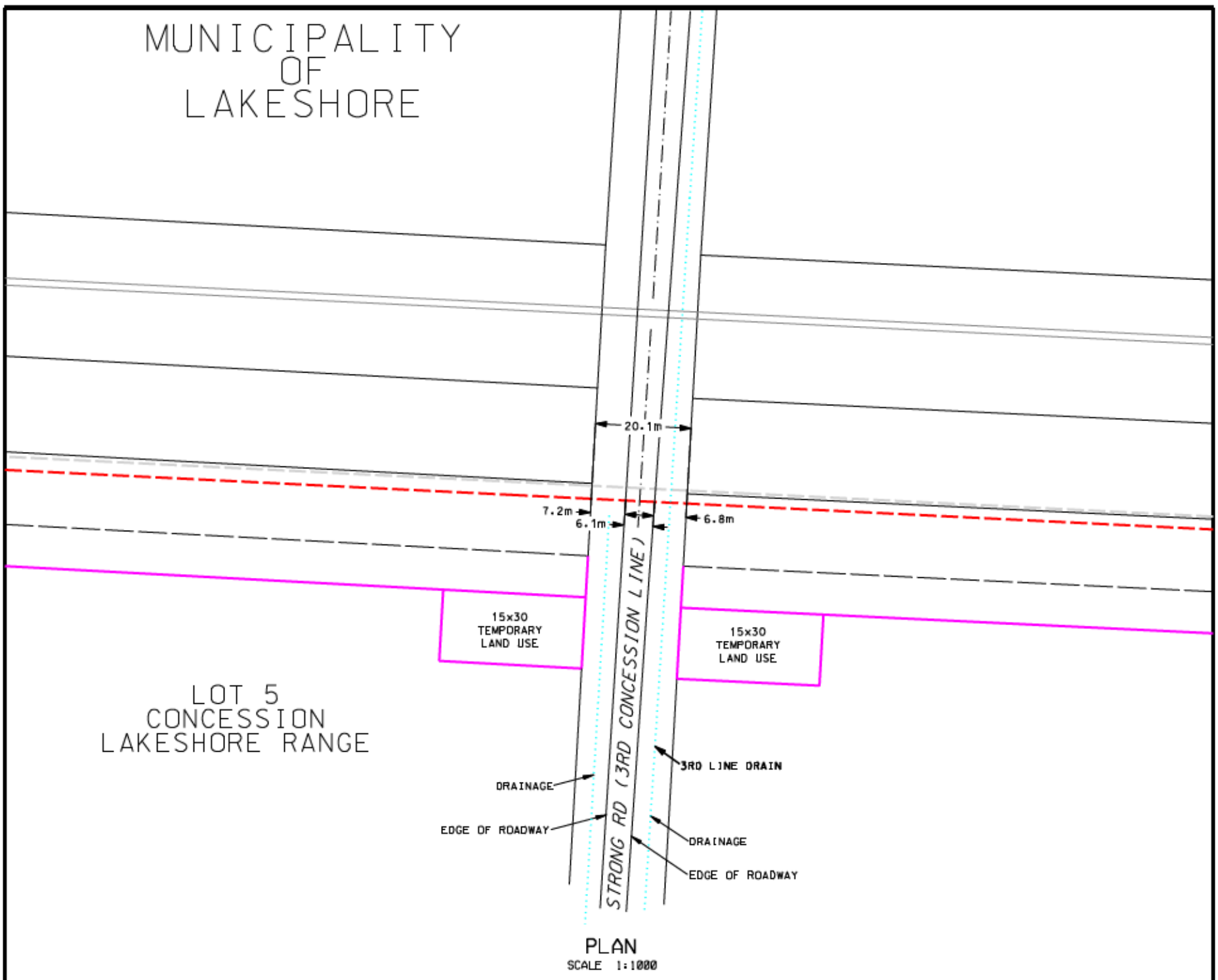

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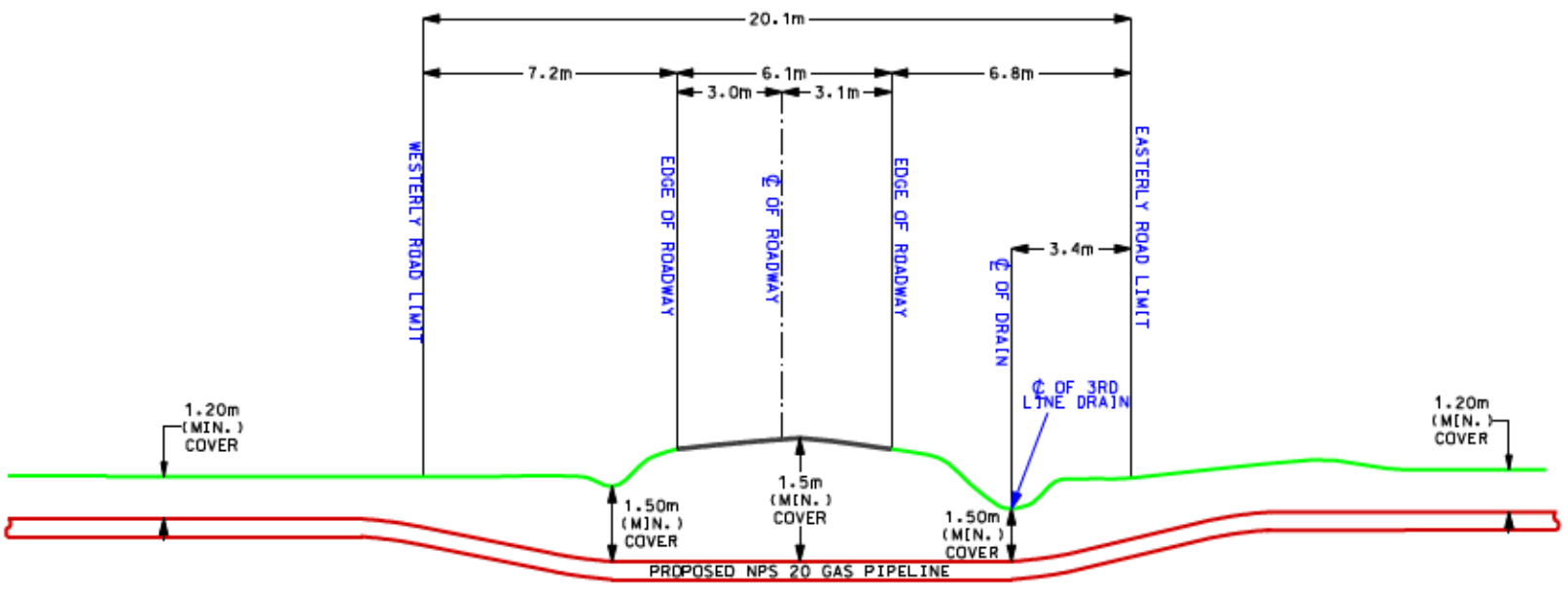


STRONG RD (3RD CONCESSION LINE)

PROFILE

SCALE HOR. 1:200
VERT 1:200

METHOD OF INSTALLATION: OPEN CUT

GENERAL NOTE:
1. HYDRO & CODECO CABLES ABOVE GRADE
2. ALL UTILITIES TO BE FIELD LOCATED AND HYDROVAC TO BE USED WHEN NECESSARY
3. NO FIELD ELEVATIONS AVAILABLE FOR STRONG RD.
4. ALL CULVERTS, END WALL TREATMENT AND TILE DRAINS REMOVED DURING ARE TO BE RESTORED TO MATCH EXISTING CONDITIONS
5. RESTORE ALL OPEN DRAINS TO MATCH ORIGINAL GRADE AND CONTOUR CONDITIONS

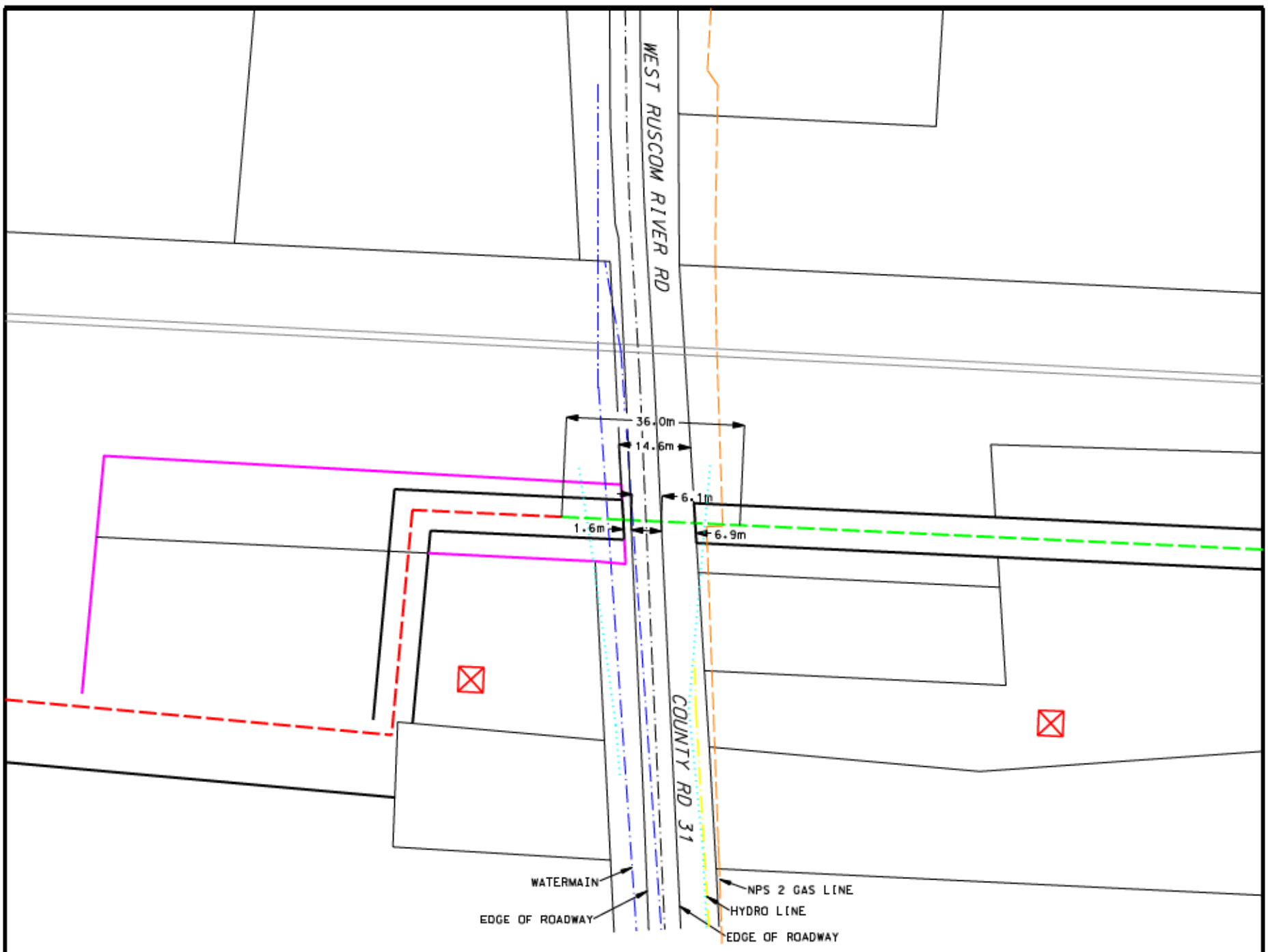
REVISIONS

NO.	DATE	BY	APP'D	REMARKS
01	2013-11-27	MJW		MUNICIPAL REVIEW

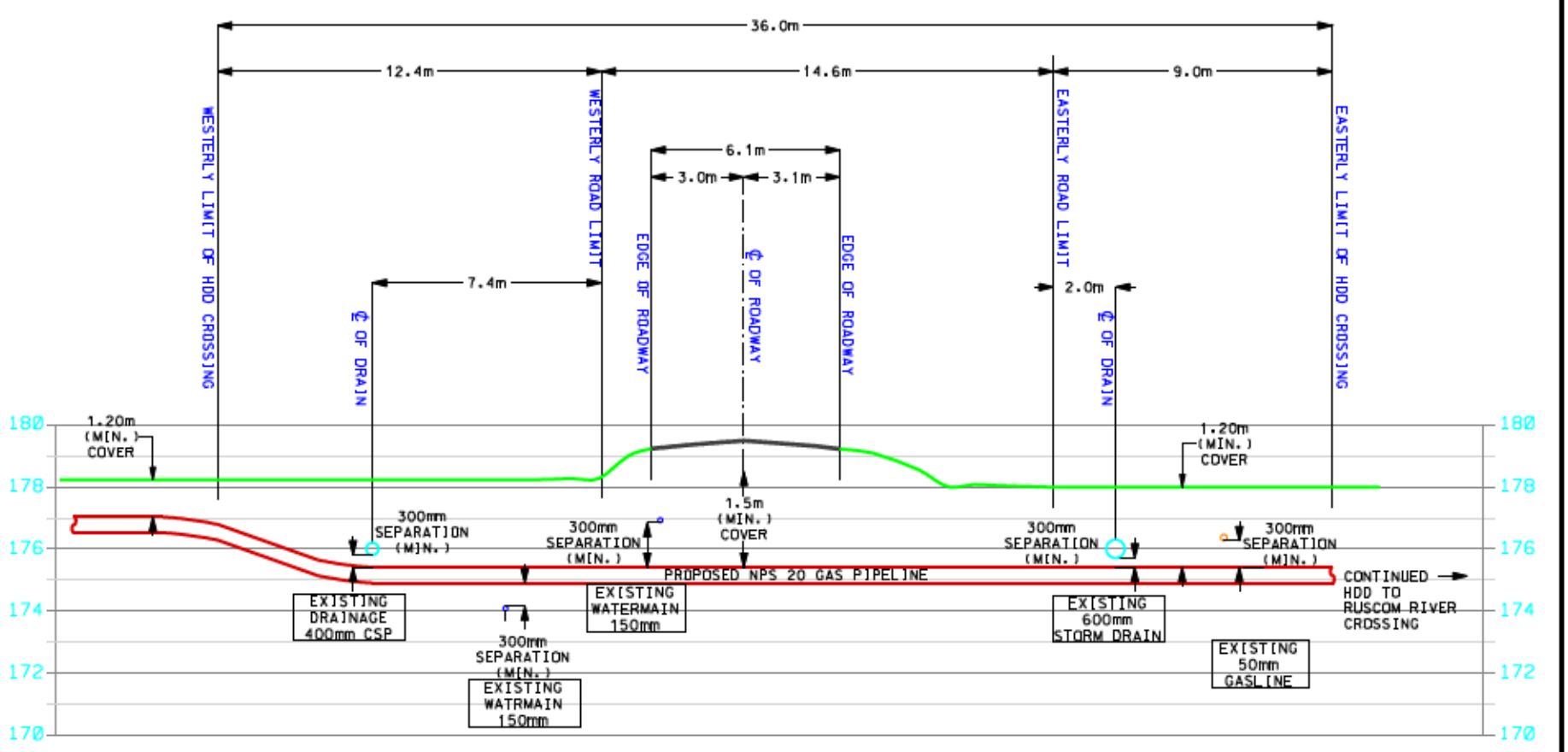
uniongas
A Spectra Energy Company

PANHANDLE NPS 16 REPLACEMENT PROJECT
STONG RD CROSSING - NPS 20
MUNICIPALITY OF LAKESHORE

DRAWN BY	M. WADDICK	DATE	2013-11-26	SCALE 1-1	PLOT SPEC. 1:1
CHECKED BY	KEK	DATE	2013-11-26	AC/DRAW CODE	PL126-RC8.DGN
APPROVED BY		DATE		JOB NO.	
SIZE	DRAWER	SHEET		DRAWING NO.	
B	N/A	1 OF 1		PL126-RC8	



PLAN
SCALE 1:1000



WEST RUSCOM RIVER ROAD CROSSING

PROFILE

SCALE HOR. 1:200
VERT 1:200

METHOD OF INSTALLATION: HORIZONTAL DIRECTIONAL DRILL

GENERAL NOTE:
1. ALL UTILITIES TO BE FIELD LOCATED AND HYDROEXCAVATION TO BE USED WHEN NECESSARY

REVISIONS

NO.	DATE	BY	APP'D	REMARKS
01	2013-11-27	MJW		MUNICIPAL REVIEW

uniongas
A Spectra Energy Company

PANHANDLE NPS 16 REPLACEMENT PROJECT
WEST RUSCOM RIVER RD CROSSING - NPS 20
MUNICIPALITY OF LAKESHORE

DRAWN BY	M. WADDICK	DATE	2013-11-26	SCALE 1-1	PLOT SPEC. 1:1
CHECKED BY	KEK	DATE	2013-11-26	AC/DRAW CODE	PL126-RC10.DGN
APPROVED BY		DATE		JOB NO.	
SIZE B	DRAWER N/A	SHEET 1 OF 1		DRAWING NO.	PL126-RC10

TAB # 3

County of Essex

ENTRANCE
& OTHER MISCELLANEOUS WORKS
PERMIT

Permit No.				Date		
E -	2019	-	008	2019	02	11
	yyyy		No.	yyyy	mm	dd

APPLICATION IS HEREBY MADE TO (CHECK ONE OF THE FOLLOWING TO PROPOSED WORK)

- ☐ CONSTRUCT AN UNPAVED ENTRANCE
- ☐ CONSTRUCT A PAVED ENTRANCE
- ☐ CONSTRUCT CURBS, CUT CURBS
- ☐ PAVE AN EXISTING ENTRANCE
- ☐ CHANGE THE DESIGN OF AN ENTRANCE
- ☐ CHANGE THE LOCATION OF AN ENTRANCE
- ☐ CHANGE THE CLASSIFICATION OF AN ENTRANCE
- ☒ OTHER **Bore utilities under road**

DESCRIPTION AND LOCATION OF PROPERTY
(EXACT LOCATION OF NEW ENTRANCE MUST BE STAKED OUT)

LOT No:		ROAD No:	14	LOCATION:	1680m east of CR 27
REG. PLAN:		SIDE OF ROAD:	North & South	MUNICIPALITY:	Kingsville
CONC:		ROAD NAME:	County Road 14		

CONDITIONS

It is understood that all works will be constructed, altered, maintained or operated at the expense of the undersigned and that work must not be begun before a permit has been issued by the County Engineer. The issuance of a permit by the Engineer does not relieve the holder of the responsibility of complying with relevant bylaws, municipal regulations, and requirements of other regulatory agencies.

All works must be completed in accordance with the requirements of the County of Essex before the expiry date shown on the form or the deposit will be forfeited. Any defective conditions must be corrected to the satisfaction of the County Engineer who may, in the interest of the protection of the public, direct immediate repairs or removal of the works by County forces at the expense of the Applicant.

Each entrance or miscellaneous works must be designed, constructed, and maintained in a manner that prevents surface water from the entrance and/or the adjoining property from being discharged onto the roadway.

NAME OF OWNER:	Enbridge Gas	PHONE NO. (HOME)	226-229-0544
ADDRESS: (STREET, CITY, PROV., POSTAL CODE)	50 Keil Drive North	PHONE NO. (WORK)	
	Chatham, Ontario, N7M 5M1		jodonohue@uniongas.com

FORM TO BE COMPLETED TO THIS LINE BY APPLICANT

DEPOSIT RECORD

FEE:	$150.00	On Line		
DEPOSIT:				
TOTAL RECEIVED:	$150.00			

County of Essex

ENTRANCE
& OTHER MISCELLANEOUS WORKS
PERMIT

Permit No.			Date		
E - 2019 - 008			2019	02	11
yyyy		No.	yyyy	mm	dd

APPROVAL & INSTRUCTIONS (EXISTING ROADSIDE DRAINAGE SYSTEM AND REMARKS)

☐ MUNICIPAL DRAIN: (NAME) _____

☐ ROAD DITCH: (PIPE REQUIRED)

PIPE LENGTH _____ PIPE DIAMETER _____ PIPE MATERIAL _____

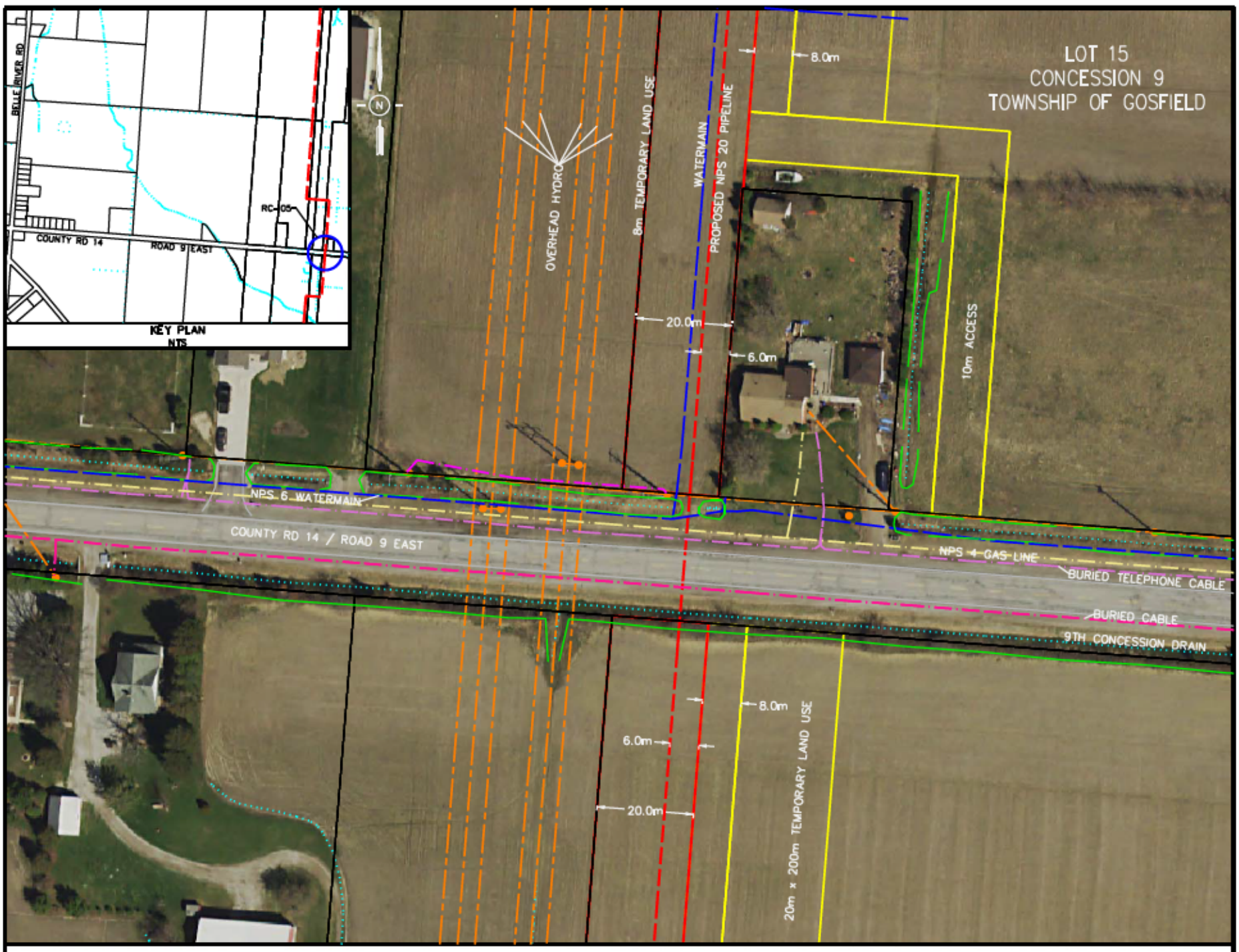
☐ TILE OR SEWER ☐ CURB AND GUTTER

Additional Conditions/Remarks:
Bore gas pipeline under County Road 14 for Union gas as per drawing PL1876-RC-05
Traffic management during construction as per Ontario Traffic Manual – Book 7

Permit Approved by (Print): Kris Kretschmann

Signature: Kris Kretschmann

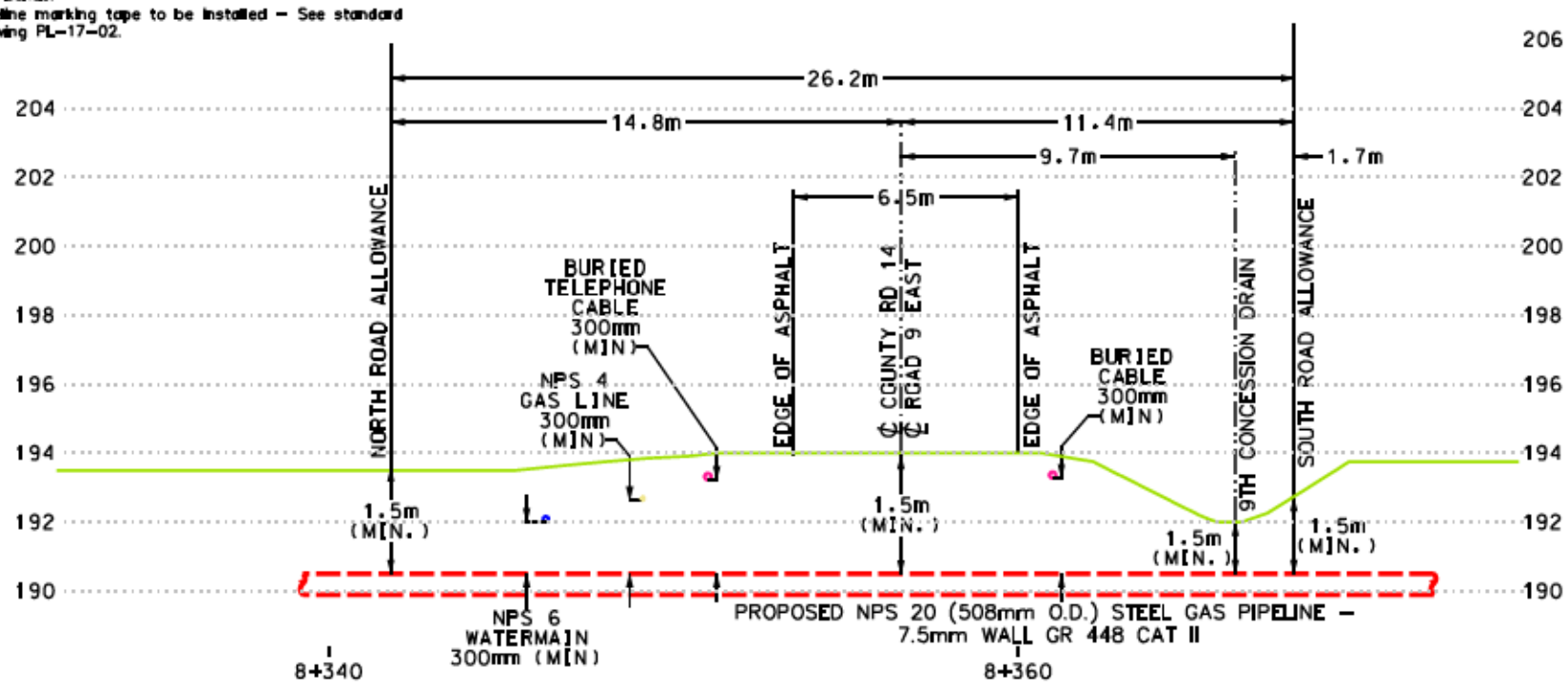
Date: February 11, 2019



PLAN SCALE 1:1000

GENERAL NOTES:

1) All utilities to be field located and Hydrovacexcavation is to be used when necessary.
2) Restore all roadside swales to match pre-construction conditions.
3) Roadway to be restored to match existing surface conditions including grades, standard compaction, and granular shoulder restoration.
4) All grassed areas in the existing right-of-way to be restored with topsoil and hydroseed as required.
5) Bends shall not be installed within 7m of top of bank.
6) Bends shall not be installed within 15m of road allowance.
7) Pipe elevation under watercourse shall remain constant between sag bends.
8) Pipeline marking tape to be installed - See standard drawing PL-17-02.



GROUND PROFILE ALONG CENTERLINE OF PROPOSED NPS 20 KINGSVILLE PIPELINE

SCALE HOR. 1:200
SCALE VER. 1:200

INSTALLATION METHOD: TRENCHLESS

REVISIONS

NO.	DATE	BY	APP'D	REMARKS
A	2018:08:31	MJW	DTL	ISSUED FOR PERMIT

uniongas
An Enbridge Company

NPS 20 KINGSVILLE TRANSMISSION REINFORCEMENT PROJECT
2019 CONSTRUCTION - TOWN OF KINGSVILLE
COUNTY RD 14 / ROAD 9 EAST CROSSING

DRAWN BY: MATT WADDICK	DATE: 2018:08:31	SCALE: AS SHOWN	PLOT SPEC.: 1:1
CHECKED BY:	DATE:	AC/DRAW CODE: PL1876-RC-05_A.dgn	
APPROVED BY:	DATE:	FILE REVISION DATE:	
SIZE: B	DRAWER: N/A	SHEET: 1 of 1	DRAWING NO.: PL1876-RC-05

County of Essex

ENTRANCE
& OTHER MISCELLANEOUS WORKS
PERMIT

Permit No.			Date		
E - 2019 - 005			2019	02	11
yyyy		No.	yyyy	mm	dd

APPLICATION IS HEREBY MADE TO (CHECK ONE OF THE FOLLOWING TO PROPOSED WORK)

- ☐ CONSTRUCT AN UNPAVED ENTRANCE
- ☐ CONSTRUCT A PAVED ENTRANCE
- ☐ CONSTRUCT CURBS, CUT CURBS
- ☐ PAVE AN EXISTING ENTRANCE
- ☐ CHANGE THE DESIGN OF AN ENTRANCE
- ☐ CHANGE THE LOCATION OF AN ENTRANCE
- ☐ CHANGE THE CLASSIFICATION OF AN ENTRANCE
- ☒ OTHER **Bore utilities under road**

DESCRIPTION AND LOCATION OF PROPERTY
(EXACT LOCATION OF NEW ENTRANCE MUST BE STAKED OUT)

LOT No:		ROAD No:	8	LOCATION:	680m east of CR 27
REG. PLAN:		SIDE OF ROAD:	North & South	MUNICIPALITY:	Lakeshore & Kingsville
CONC:		ROAD NAME:	County Road 8		

CONDITIONS

It is understood that all works will be constructed, altered, maintained or operated at the expense of the undersigned and that work must not be begun before a permit has been issued by the County Engineer. The issuance of a permit by the Engineer does not relieve the holder of the responsibility of complying with relevant bylaws, municipal regulations, and requirements of other regulatory agencies.

All works must be completed in accordance with the requirements of the County of Essex before the expiry date shown on the form or the deposit will be forfeited. Any defective conditions must be corrected to the satisfaction of the County Engineer who may, in the interest of the protection of the public, direct immediate repairs or removal of the works by County forces at the expense of the Applicant.

Each entrance or miscellaneous works must be designed, constructed, and maintained in a manner that prevents surface water from the entrance and/or the adjoining property from being discharged onto the roadway.

NAME OF OWNER:	Enbridge Gas	PHONE NO. (HOME)	226-229-0544
ADDRESS: (STREET, CITY, PROV., POSTAL CODE)	50 Keil Drive North	PHONE NO. (WORK)	
	Chatham, Ontario, N7M 5M1		jodonohue@uniongas.com

FORM TO BE COMPLETED TO THIS LINE BY APPLICANT

DEPOSIT RECORD

FEE:	$150.00	Cheque		
DEPOSIT:				
TOTAL RECEIVED:	$150.00			

County of Essex

ENTRANCE
& OTHER MISCELLANEOUS WORKS
PERMIT

Permit No.			Date		
E - 2019 - 005			2019	02	11
yyyy		No.	yyyy	mm	dd

APPROVAL & INSTRUCTIONS (EXISTING ROADSIDE DRAINAGE SYSTEM AND REMARKS)

☐ MUNICIPAL DRAIN: (NAME) _____

☐ ROAD DITCH: (PIPE REQUIRED) _____

PIPE LENGTH PIPE DIAMETER PIPE MATERIAL

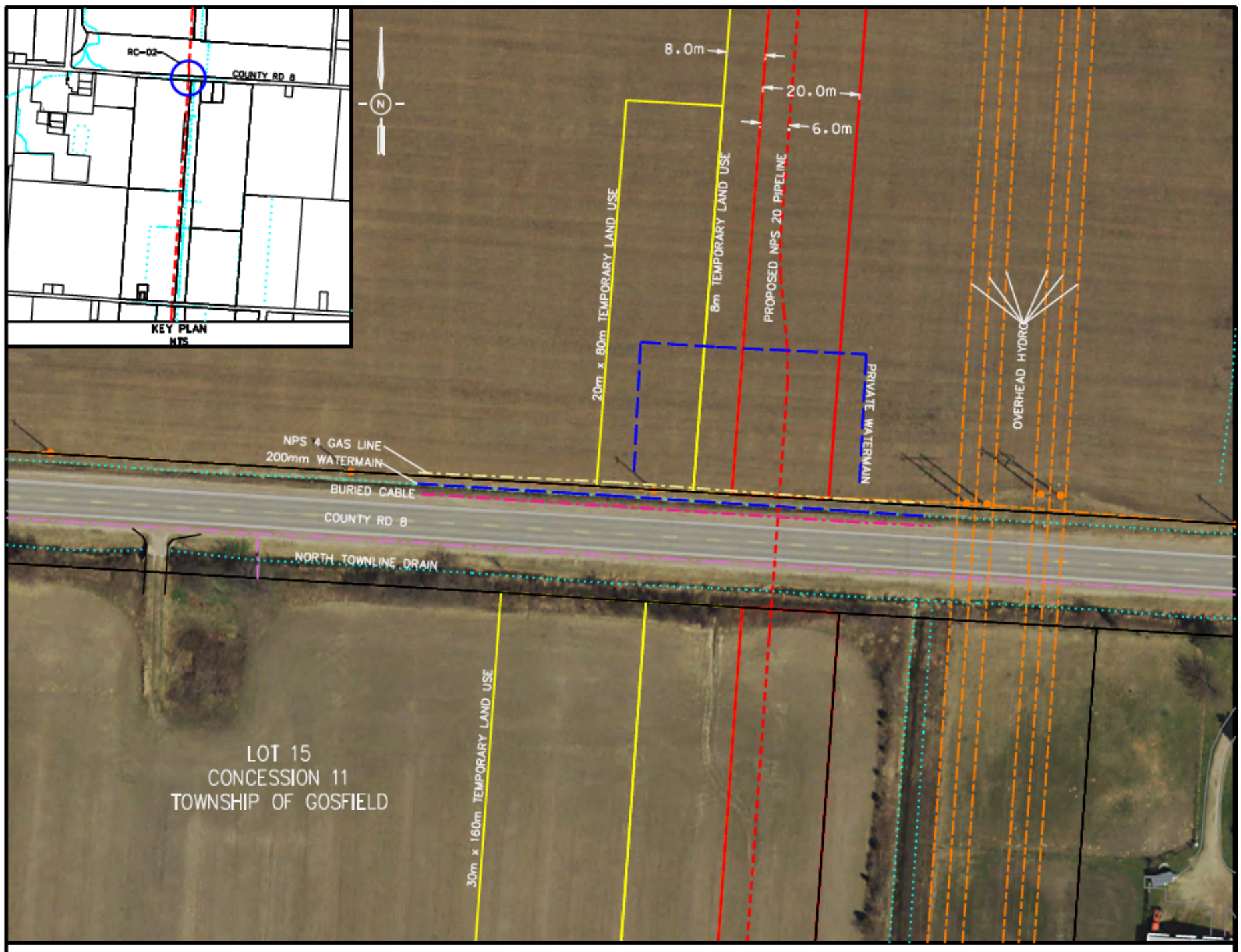
☐ TILE OR SEWER ☐ CURB AND GUTTER

Additional Conditions/Remarks:
Bore gas pipeline under County Road 8 for Union gas as per drawing PL1876-RC-02
Traffic management during construction as per Ontario Traffic Manual – Book 7

Permit Approved by (Print): Kris Kretschmann

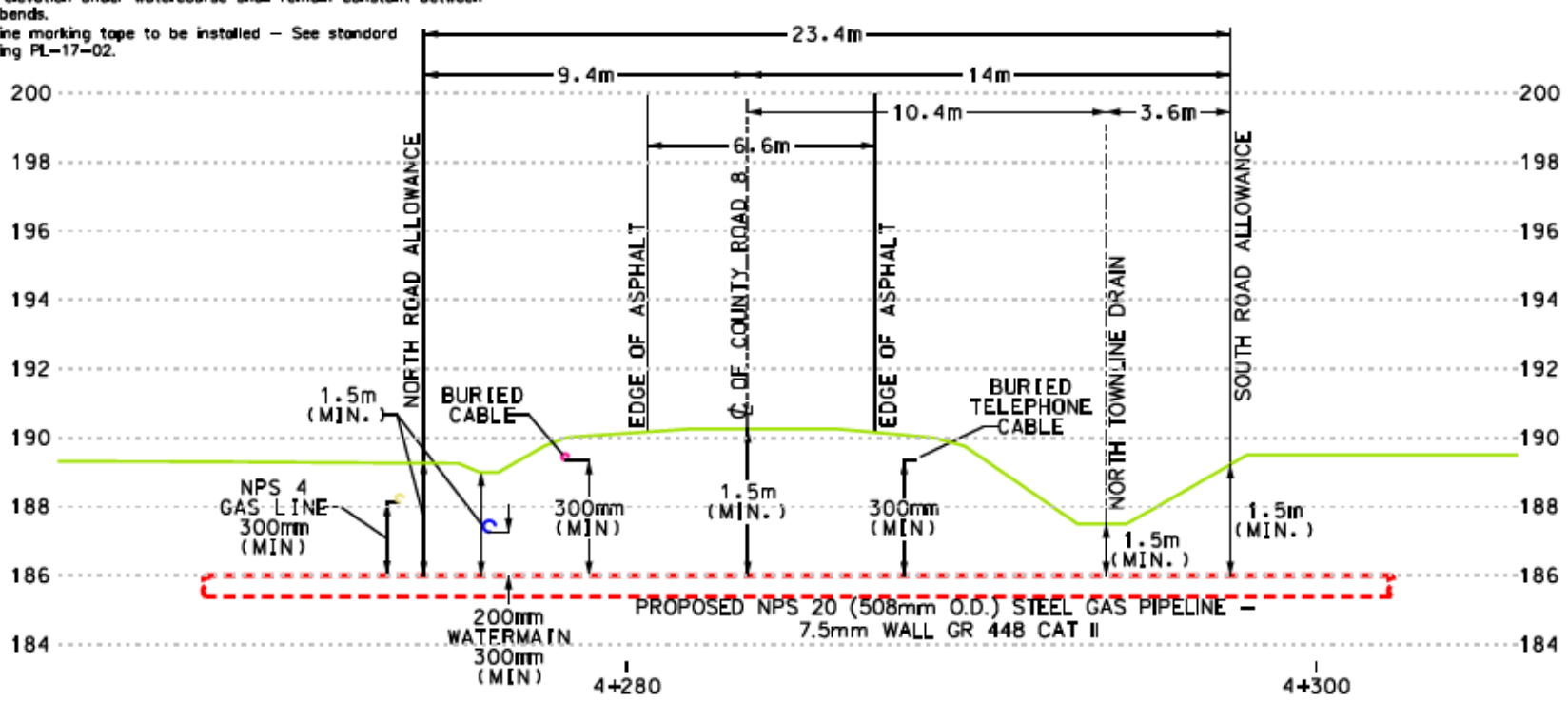
Signature: Kris Kretschmann

Date: February 11, 2019



PLAN SCALE 1:1000

GENERAL NOTES:
1) All utilities to be field located and Hydrovacexcavation is to be used when necessary.
2) Restore all roadside swales to match pre-construction conditions.
3) Roadway to be restored to match existing surface conditions including grades, standard compaction, and granular shoulder restoration.
4) All grassed areas in the existing right-of-way to be restored with topsoil and hydroseed as required.
5) Bends shall not be installed within 7m of top of bank.
6) Bends shall not be installed within 15m of road allowance.
7) Pipe elevation under watercourse shall remain constant between sag bends.
8) Pipeline marking tape to be installed – See standard drawing PL-17-02.



GROUND PROFILE ALONG CENTERLINE OF PROPOSED NPS 20 KINGSVILLE PIPELINE

SCALE HOR. 1:200
SCALE VER. 1:200

INSTALLATION METHOD: TRENCHLESS

REVISIONS

NO.	DATE	BY	APP'D	REMARKS
A	2018:08:31	MJW	DTL	ISSUED FOR PERMIT
B	2018:09:14	MJW	DTL	ISSUED FOR BID 2
C	2018:11:07	MJW	DTL	ISSUED FOR BID 3

uniongas
An Enbridge Company

NPS 20 KINGSVILLE TRANSMISSION REINFORCEMENT PROJECT
2019 CONSTRUCTION – TOWN OF KINGSVILLE
COUNTY ROAD 8 CROSSING

DRAWN BY: MATT WADDICK	DATE: 2018:08:31	SCALE: AS SHOWN	PLOT SPEC.: 1:1
CHECKED BY:	DATE:	AC/DRAW CODE: PL1876-RC-02_B.dgn	
APPROVED BY:	DATE:	FILE REVISION DATE: 2018:11:07	
SIZE: B	DRAWER: N/A	SHEET: 1 of 1	DRAWING NO.: PL1876-RC-02

County of Essex

ENTRANCE
& OTHER MISCELLANEOUS WORKS
PERMIT

Permit No.			Date		
E - 2019 - 006			2019	02	11
yyyy		No.	yyyy	mm	dd

APPLICATION IS HEREBY MADE TO (CHECK ONE OF THE FOLLOWING TO PROPOSED WORK)

- ☐ CONSTRUCT AN UNPAVED ENTRANCE
- ☐ CONSTRUCT A PAVED ENTRANCE
- ☐ CONSTRUCT CURBS, CUT CURBS
- ☐ PAVE AN EXISTING ENTRANCE
- ☐ CHANGE THE DESIGN OF AN ENTRANCE
- ☐ CHANGE THE LOCATION OF AN ENTRANCE
- ☐ CHANGE THE CLASSIFICATION OF AN ENTRANCE
- ☒ OTHER **Bore utilities under road**

DESCRIPTION AND LOCATION OF PROPERTY
(EXACT LOCATION OF NEW ENTRANCE MUST BE STAKED OUT)

LOT No:		ROAD No:	18	LOCATION:	225m west of Highway #3
REG. PLAN:		SIDE OF ROAD:	North & South	MUNICIPALITY:	Kingsville
CONC:		ROAD NAME:	County Road 18		

CONDITIONS

It is understood that all works will be constructed, altered, maintained or operated at the expense of the undersigned and that work must not be begun before a permit has been issued by the County Engineer. The issuance of a permit by the Engineer does not relieve the holder of the responsibility of complying with relevant bylaws, municipal regulations, and requirements of other regulatory agencies.

All works must be completed in accordance with the requirements of the County of Essex before the expiry date shown on the form or the deposit will be forfeited. Any defective conditions must be corrected to the satisfaction of the County Engineer who may, in the interest of the protection of the public, direct immediate repairs or removal of the works by County forces at the expense of the Applicant.

Each entrance or miscellaneous works must be designed, constructed, and maintained in a manner that prevents surface water from the entrance and/or the adjoining property from being discharged onto the roadway.

NAME OF OWNER:	Enbridge Gas	PHONE NO. (HOME)	226-229-0544
ADDRESS: (STREET, CITY, PROV., POSTAL CODE)	50 Keil Drive North	PHONE NO. (WORK)	
	Chatham, Ontario, N7M 5M1		jodonohue@uniongas.com

FORM TO BE COMPLETED TO THIS LINE BY APPLICANT

DEPOSIT RECORD

FEE:	$150.00	On Line		
DEPOSIT:				
TOTAL RECEIVED:	$150.00			

County of Essex

ENTRANCE
& OTHER MISCELLANEOUS WORKS
PERMIT

Permit No.			Date		
E - 2019 - 006			2019	02	11
yyyy		No.	yyyy	mm	dd

APPROVAL & INSTRUCTIONS (EXISTING ROADSIDE DRAINAGE SYSTEM AND REMARKS)

☐ MUNICIPAL DRAIN: (NAME) _____

☐ ROAD DITCH: (PIPE REQUIRED)

PIPE LENGTH _____ PIPE DIAMETER _____ PIPE MATERIAL _____

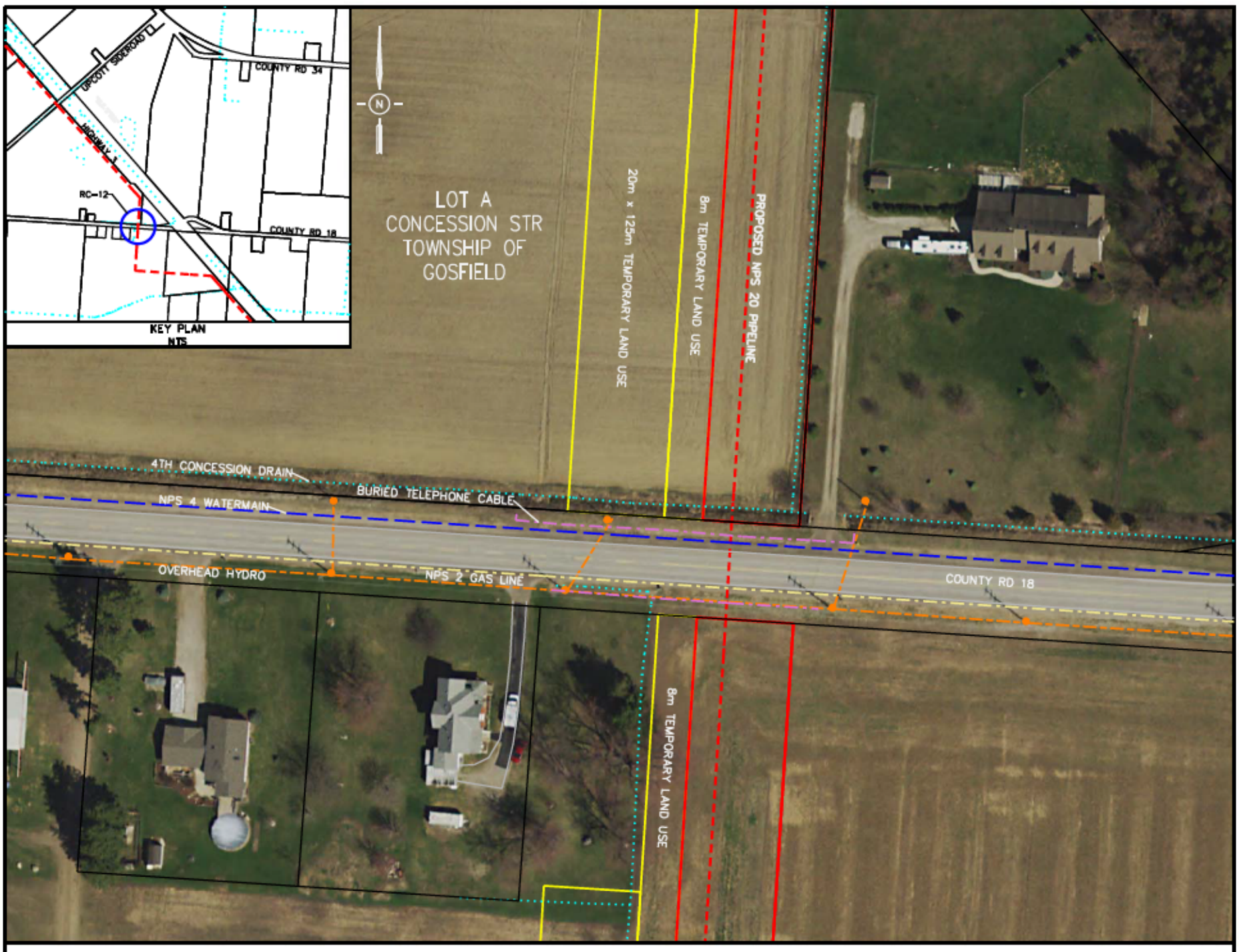
☐ TILE OR SEWER ☐ CURB AND GUTTER

Additional Conditions/Remarks:
Bore gas pipeline under County Road 18 for Union gas as per drawing PL1876-RC-12
Traffic management during construction as per Ontario Traffic Manual – Book 7

Permit Approved by (Print): Kris Kretschmann

Signature: Kris Kretschmann

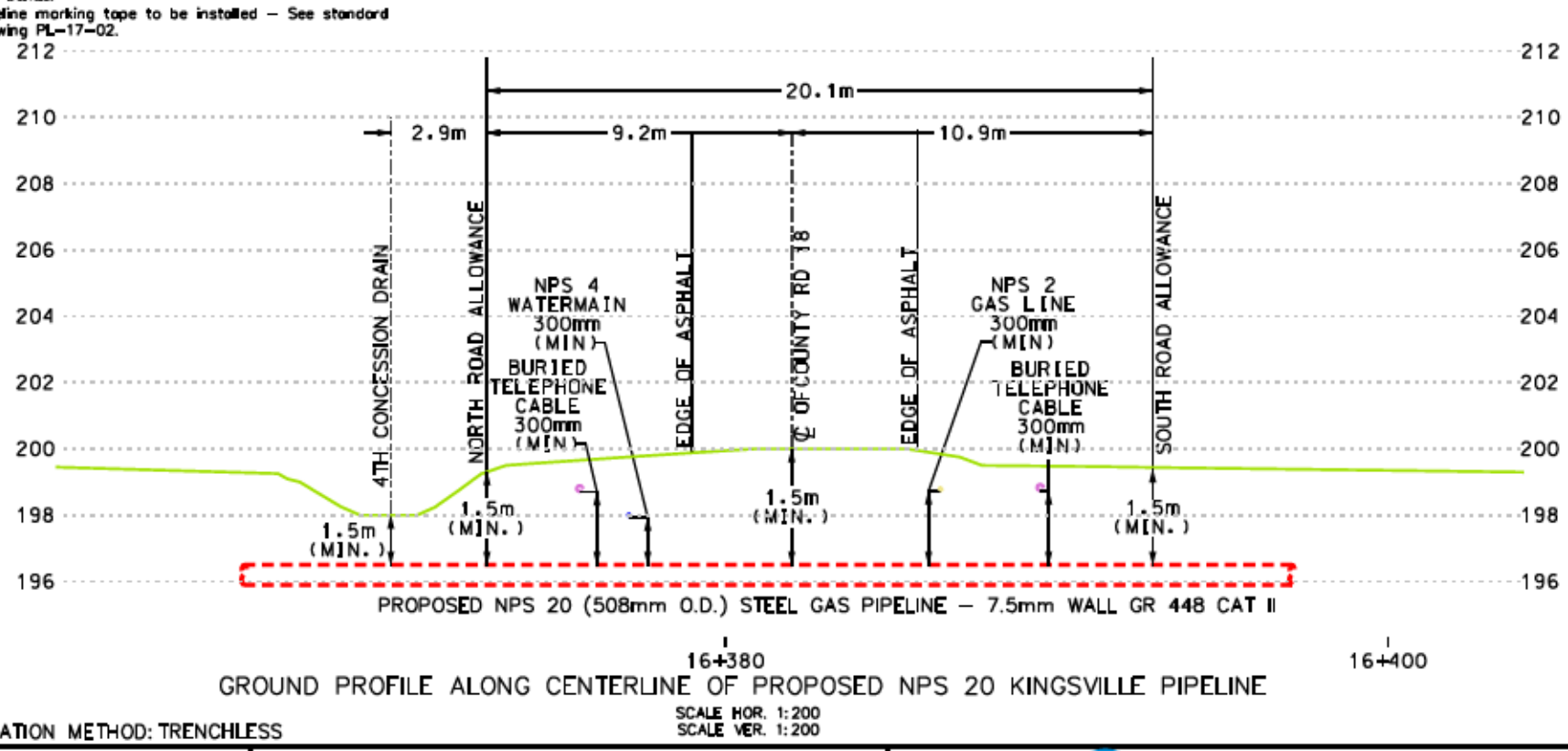
Date: February 11, 2019



PLAN SCALE 1:1000

GENERAL NOTES:

1) All utilities to be field located and Hydrovacexcavation is to be used when necessary.
2) Restore all roadside swales to match pre-construction conditions.
3) Roadway to be restored to match existing surface conditions including grades, standard compaction, and granular shoulder restoration.
4) All grassed areas in the existing right-of-way to be restored with topsoil and hydroseed as required.
5) Bends shall not be installed within 7m of top of bank.
6) Bends shall not be installed within 15m of road allowance.
7) Pipe elevation under watercourse shall remain constant between sag bends.
8) Pipeline marking tape to be installed – See standard drawing PL-17-02.



GROUND PROFILE ALONG CENTERLINE OF PROPOSED NPS 20 KINGSVILLE PIPELINE

SCALE HOR. 1:200
SCALE VER. 1:200

INSTALLATION METHOD: TRENCHLESS

REVISIONS

NO.	DATE	BY	APP'D	REMARKS
A	2018:08:31	MJW	DTL	ISSUED FOR PERMIT
B	2018:09:14	MJW	DTL	ISSUED FOR BID 2
C	2018:11:07	MJW	DTL	ISSUED FOR BID 3

uniongas
An Enbridge Company

NPS 20 KINGSVILLE TRANSMISSION REINFORCEMENT PROJECT
2019 CONSTRUCTION – TOWN OF KINGSVILLE
COUNTY RD 18 CROSSING

DRAWN BY: MATT WADDICK	DATE: 2018:08:31	SCALE: AS SHOWN	PLOT SPEC.: 1:1
CHECKED BY:	DATE:	AC/DRAW CODE: PL1876-RC-12_C.dgn	
APPROVED BY:	DATE:	FILE REVISION DATE: 2018:11:07	
SIZE: B	DRAWER: N/A	SHEET: 1 of 1	DRAWING NO.: PL1876-RC-12

County of Essex

ENTRANCE
& OTHER MISCELLANEOUS WORKS
PERMIT

Permit No.			Date		
E - 2019 - 007			2019	02	11
yyyy		No.	yyyy	mm	dd

APPLICATION IS HEREBY MADE TO (CHECK ONE OF THE FOLLOWING TO PROPOSED WORK)

- ☐ CONSTRUCT AN UNPAVED ENTRANCE
- ☐ CONSTRUCT A PAVED ENTRANCE
- ☐ CONSTRUCT CURBS, CUT CURBS
- ☐ PAVE AN EXISTING ENTRANCE
- ☐ CHANGE THE DESIGN OF AN ENTRANCE
- ☐ CHANGE THE LOCATION OF AN ENTRANCE
- ☐ CHANGE THE CLASSIFICATION OF AN ENTRANCE
- ☒ OTHER **Bore utilities under road**

DESCRIPTION AND LOCATION OF PROPERTY
(EXACT LOCATION OF NEW ENTRANCE MUST BE STAKED OUT)

LOT No:		ROAD No:	34	LOCATION:	1280m east of CR 29
REG. PLAN:		SIDE OF ROAD:	North & South	MUNICIPALITY:	Kingsville
CONC:		ROAD NAME:	County Road 34		

CONDITIONS

It is understood that all works will be constructed, altered, maintained or operated at the expense of the undersigned and that work must not be begun before a permit has been issued by the County Engineer. The issuance of a permit by the Engineer does not relieve the holder of the responsibility of complying with relevant bylaws, municipal regulations, and requirements of other regulatory agencies.

All works must be completed in accordance with the requirements of the County of Essex before the expiry date shown on the form or the deposit will be forfeited. Any defective conditions must be corrected to the satisfaction of the County Engineer who may, in the interest of the protection of the public, direct immediate repairs or removal of the works by County forces at the expense of the Applicant.

Each entrance or miscellaneous works must be designed, constructed, and maintained in a manner that prevents surface water from the entrance and/or the adjoining property from being discharged onto the roadway.

NAME OF OWNER:	Enbridge Gas	PHONE NO. (HOME)	226-229-0544
ADDRESS: (STREET, CITY, PROV., POSTAL CODE)	50 Keil Drive North	PHONE NO. (WORK)	
	Chatham, Ontario, N7M 5M1		jodonohue@uniongas.com

FORM TO BE COMPLETED TO THIS LINE BY APPLICANT

DEPOSIT RECORD

FEE:	$150.00	On Line		
DEPOSIT:				
TOTAL RECEIVED:	$150.00			

County of Essex

ENTRANCE
& OTHER MISCELLANEOUS WORKS
PERMIT

Permit No.			Date		
E - 2019 - 007			2019	02	11
yyyy		No.	yyyy	mm	dd

APPROVAL & INSTRUCTIONS (EXISTING ROADSIDE DRAINAGE SYSTEM AND REMARKS)

☐ MUNICIPAL DRAIN: (NAME) _____

☐ ROAD DITCH: (PIPE REQUIRED)

PIPE LENGTH _____ PIPE DIAMETER _____ PIPE MATERIAL _____

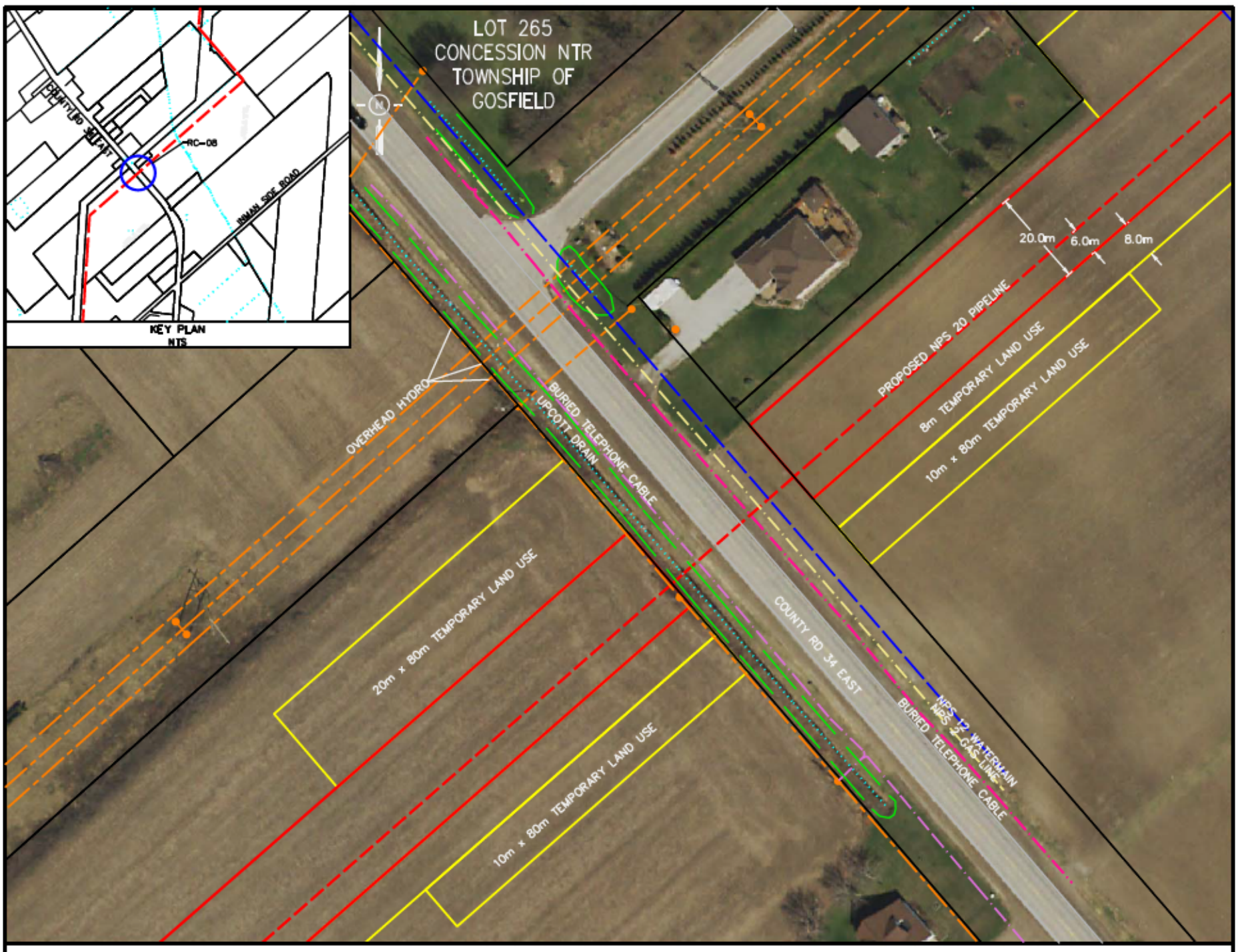
☐ TILE OR SEWER ☐ CURB AND GUTTER

Additional Conditions/Remarks:
Bore gas pipeline under County Road 34 for Union gas as per drawing PL1876-RC-08
Traffic management during construction as per Ontario Traffic Manual – Book 7

Permit Approved by (Print): Kris Kretschmann

Signature: Kris Kretschmann

Date: February 11, 2019

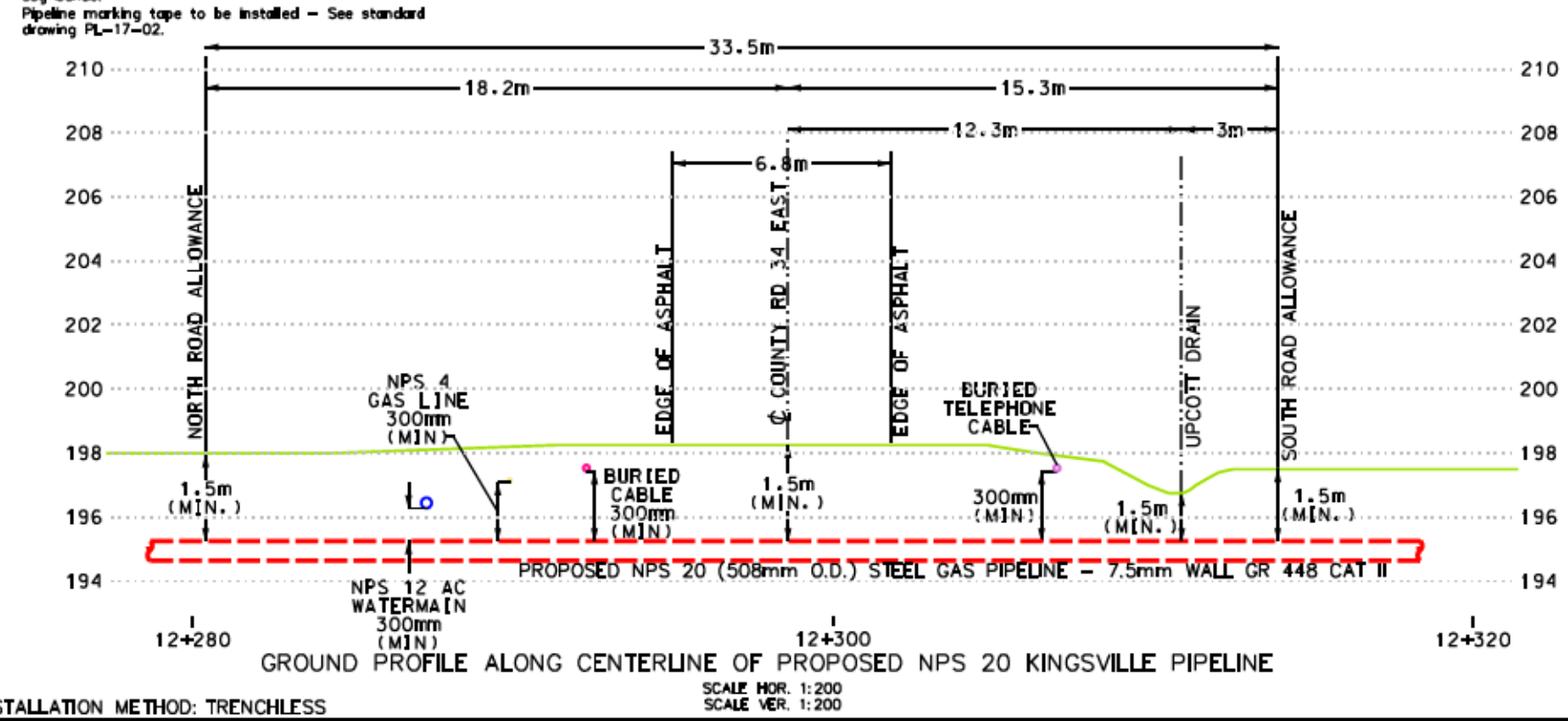


GENERAL NOTES:

1) All utilities to be field located and Hydrovacexcavation is to be used when necessary.
2) Restore all roadside swales to match pre-construction conditions.
3) Roadway to be restored to match existing surface conditions including grades, standard compaction, and granular shoulder restoration.
4) All grassed areas in the existing right-of-way to be restored with topsoil and hydroseed as required.
5) Bends shall not be installed within 7m of top of bank.
6) Bends shall not be installed within 15m of road allowance.
7) Pipe elevation under watercourse shall remain constant between sag bends.
8) Pipeline marking tape to be installed – See standard drawing PL-17-02.

PLAN SCALE 1:1000

NOTE:
MUNICIPALITY ASBUILTS IDENTIFY WATERMAIN MATERIAL AS ASBESTOS CEMENT



GROUND PROFILE ALONG CENTERLINE OF PROPOSED NPS 20 KINGSVILLE PIPELINE

SCALE HOR. 1:200
SCALE VER. 1:200

INSTALLATION METHOD: TRENCHLESS

REVISIONS

NO.	DATE	BY	APP'D	REMARKS
A	2018:08:31	MJW	DTL	ISSUED FOR PERMIT

uniongas
An Enbridge Company

NPS 20 KINGSVILLE TRANSMISSION REINFORCEMENT PROJECT
2019 CONSTRUCTION – TOWN OF KINGSVILLE
COUNTY RD 34 EAST CROSSING

DRAWN BY: MATT WADDICK	DATE: 2018:08:31	SCALE: AS SHOWN	PLOT SPEC.: 1:1
CHECKED BY:	DATE:	AC/DRAW CODE: PL1876-RC-08_A.dgn	
APPROVED BY:	DATE:	FILE REVISION DATE:	
SIZE: B	DRAWER: N/A	SHEET: 1 of 1	DRAWING NO.: PL1876-RC-08