SCOTT PETRIE LLP
LAW FIRM

Barry R. Scott, LL.B., ACCI., FCCI.
Jeffrey A. Bell, B.A.(Hons.),B.Ed., LL.B.
E. Glenn Hines, B.Sc., LL.B.
Wayne A. Petrie, B.A., LL.B. (Associated)
Ian S. Wright, B.A., LL.B.
John D. Goudy, B.A.(Hons.), LL.B., B.C.L.
Erin M. Naylor, B.PAPM., LL.B.
A. David Brander, B.A., LL.B (1953-2011)

Suite 200 - 252 Pall Mall Street
London, Ontario N6A 5P6
Telephone: 519 433-5310
Facsimile: 519 433-7909

Ext 236
e-mail: jgoudy@scottpetrie.com

January 9, 2015

VIA RESS ELECTRONIC FILING

Attention: Kirsten Walli, Board Secretary
Ontario Energy Board
2300 Yonge Street
27th Floor
Toronto, ON M4P 1E4

Dear Madam Secretary:

RE: Union Gas Ltd. – Dawn Parkway 2016 Expansion Project – OEB File No. EB-2014-0261
GAPLO Written Evidence Statement

We are the lawyers for the Gas Pipeline Landowners of Ontario ("GAPLO") in the above noted proceeding. Please find enclosed GAPLO's Written Evidence Statement.

Yours truly,

SCOTT PETRIE LLP
LAW FIRM

John D. Goudy

Encl.

EB-2014-0261

ONTARIO ENERGY BOARD

IN THE MATTER OF the *Ontario Energy Board Act, 1998*, S.O. 1998, c. 15, Schedule B, and in particular, S.36 thereof;

AND IN THE MATTER OF the *Ontario Energy Board Act, 1998*, S.O. 1998, c. 15, Schedule B, and in particular, S.90(1) thereof;

AND IN THE MATTER OF the *Ontario Energy Board Act, 1998*, S.O. 1998, c. 15, Schedule B, and in particular, S.91 thereof;

AND IN THE MATTER OF an Application by Union Gas Limited for an Order or Orders for approval of recovery of the cost consequences of all facilities associated with the development of the proposed Lobo C Compressor/Hamilton-Milton Pipeline project;

AND IN THE MATTER OF an Application by Union Gas Limited for an Order or Orders granting leave to construct natural gas pipelines and ancillary facilities in the City of Hamilton, City of Burlington, and the Town of Milton, and leave to construct a compressor and ancillary facilities in the Municipality of Middlesex Centre.

GAPLO WRITTEN EVIDENCE STATEMENT

January 9, 2015

---

1. The Gas Pipeline Landowners of Ontario ("GAPLO") is a voluntary organization of landowners directly affected by Union Gas Limited ("Union") pipelines and associated facilities. GAPLO has approximately 120 active members across Ontario including Karen Hewitt, a landowner whose lands are directly affected by the proposed Hamilton to Milton NPS 48 Pipeline.

2. As set out in GAPLO's intervention request letter, GAPLO and its members have an interest in ensuring that Union's construction methodologies and environmental protection measures are held to the highest standards by the Board. GAPLO and its members also have

an interest in ensuring that the form of landowner agreement to be approved by the Board pursuant to Section 97 of the *Ontario Energy Board Act* satisfactorily addresses, *inter alia*, the accommodation of farming practices and issues related to pipeline abandonment.

3. In reviewing Union's application for the Hamilton to Milton NPS 48 Pipeline Project, GAPLO was disappointed to see that Union is proposing to step back from important improvements that were made previously to its form of easement agreement and to its construction methodology, initially in connection with the Strathroy to Lobo NPS 48 Pipeline (EB-2005-0550)[1].

4. GAPLO's intervention in this proceeding is focused on re-establishing those important improvements for the current project and beyond. The reasons behind the changes made by Union for the Strathroy to Lobo NPS 48 Pipeline remain valid in the present context, and Hamilton to Milton landowners (whether members of GAPLO or not) deserve the same treatment by Union and the Board.

EASEMENT AGREEMENT

5. For the current project, Union has reverted to the form of easement agreement that was used immediately prior to the Strathroy to Lobo NPS 48 Pipeline Project[2]. That form of agreement omits two important changes that were agreed upon by Union and GAPLO and accepted by the Board in its Section 97 decision in EB-2005-0550[3]:

a. The replacement in Clause 1 of the phrase "*Transferor and Transferee hereby agree that nothing herein shall oblige Transferee to remove the Pipeline from the Lands as part of Transferee's obligation to restore the Lands*" with "*As part of the Transferee's obligation to restore the Lands upon surrender of its easement, the Transferee*

[1] EB-2005-0550, Decision and Order dated June 12, 2006; EB-2005-0550 Settlement Agreement between GAPLO-Union (Strathroy-Lobo) and Union Gas Limited dated May 9, 2006 (see **Attachment 1**); Transcript of EB-2005-0550 Receipt of Settlement Proposal, May 9, 2006 (see **Attachment 2**).

[2] Union Pre-filed Evidence, Exhibit "A", Tab 13, Schedule 3

[3] EB-2005-0550, Decision and Order dated June 12, 2006, page 9; Union Form of Easement for Strathroy to Lobo NPS 48 Pipeline (see **Attachment 3**); This form of easement agreement was also proposed by Union and approved by the Board in connection with the NPS 36 Pipeline in EB-2007-0633 (see excerpt from Union Pre-filed Evidence at **Attachment 4**); EB-2007-0633, Decision and Order dated October 19, 2007, page 7.

agrees at the option of the Transferor to remove the Pipeline from the Lands. The Transferee and the Transferor shall surrender the easement and the Transferee shall remove the Pipeline at the Transferor's option where the Pipeline has been abandoned. The Pipeline shall be deemed to be abandoned where: a) corrosion protection is no longer applied to the Pipeline, or, b) the Pipeline becomes unfit for service in accordance with Ontario standards. The Transferee shall, within 60 days of either of these events occurring, provide the Transferor with notice of the event. Upon removal of the Pipeline and restoration of the Lands as required by this agreement, the Transferor shall release the Transferee from further obligations in respect of restoration. This provision shall apply with respect to all Pipelines in the Dawn-Trafalgar system on the Transferor's Lands."; and,

b. The addition of the following language at the end of Clause 3: "*The Transferee further agrees to make reasonable efforts at its own expense to accommodate changes in land use on lands adjacent to the easement for the purpose of ensuring the Pipeline is in compliance with all applicable regulatory requirements in connection with any such change in use.*"

6. Of the two omissions from the form of easement agreement proposed by Union in this proceeding, the omission of the additional abandonment language is of primary concern to pipeline landowners. Given that Ontario has virtually no requirements in place for pipeline abandonment, Union's proposed language is designed to have the effect of avoiding any removal of abandoned pipelines in the future regardless of landowner preference.

7. In response to GAPLO's interrogatories related to pipeline abandonment, Union suggested the following:

a. "*Union does not anticipate the need to ever abandon this line. However, when abandoning pipelines, Union complies with all applicable codes and regulations*"[4];

b. "*There should be no adverse effects if the pipeline is decommissioned and abandoned in compliance with legislation, regulations, codes and guidelines*"[5]; and,

c. "*No. Union will not agree to amend the provisions of the easement. Union will comply with any applicable TSSA requirements with respect to abandonment of pipelines*."[6]

8. Union does not provide any support for its suggestion that compliance with legislation, regulations, codes and guidelines will mean that there will be no adverse effects from pipeline abandonment in place. Possible adverse effects such as ground subsidence/collapse, residual contamination and the creation of water conduits are well known to pipeline companies and landowners[7].

9. Union also does not provide details of the currently applicable legislation, regulations, codes and guidelines, including applicable TSSA (Technical Standards and Safety Authority) requirements. As noted above, Ontario has virtually nothing in place to deal with the abandonment of pipelines, leaving pipeline companies more or less free to choose their own preferred methods of abandonment. The TSSA has published a "Pipeline Abandonment Checklist" that is nothing but a series of questions for pipeline companies[8].

10. Ontario legislation does require compliance by pipeline companies with the CSA Standard Z662-11, but that standard provides only three brief sub-sections on pipeline abandonment[9]. Decisions about how a pipeline is to be abandoned (in place or removed) are

[4] Union Response to GAPLO IR 1.16(a).
[5] Union Response to GAPLO IR 1.16(b).
[6] Union Response to GAPLO IR 1.16(f),(g) and (h).
[7] See, for example, National Energy Board Pipeline Abandonment Physical Issues Committee – Key Abandonment Issues Summary (**Attachment 5**) and Det Norske Veritas Pipeline Abandonment Scoping Study prepared for the National Energy Board (**Attachment 6**). Of note, both of these documents were created after the completion of the EB-2005-0550 proceeding.
[8] TSSA Pipeline Abandonment Checklist (see **Attachment 7**).
[9] CSA Z662-11, Section 10.16.

left entirely to the pipeline company, and there is no requirement for public participation or even landowner participation in the pipeline abandonment process.

11. While Union did not address pipeline abandonment in its current application, Union's Environmental Management Manual included as part of the Environmental Assessment for the 2006 Hamilton to Milton NPS 48 Pipeline did state that, "Abandonment plans will be developed after consulting with regulatory authorities, and receipt of approvals where necessary. All environmental and socioeconomic issues associated with abandonment or decommissioning options will be considered."[10]

12. Again, Union's plans for future pipeline abandonment as disclosed in 2006 do not include landowner involvement in the decision-making process, or even landowner consultation. Also, GAPLO is aware of no current requirements in Ontario for approvals for pipeline abandonment.

13. In the absence of a regulatory regime for pipeline abandonment in Ontario, Union's proposed easement agreement abandonment language is designed to prevent pipeline removal on abandonment. Landowners deserve to have the option of pipeline removal on abandonment, and the language in the easement agreement to be approved by the Board in this proceeding should reflect that.

14. The other omission from Union's easement agreement of concern to GAPLO and its members is Union's retraction of its commitment to make reasonable efforts at its own expense to accommodate changes in land use adjacent to the pipeline easement. The proximity of the Hamilton to Milton pipeline route to the 401 Highway and to large urbanized centres makes this commitment even more important in the present context than it was in the Strathroy to Lobo context.

15. At least as far back as 1991, Union has been made aware by landowners of the development potential of properties along the Hamilton to Milton section. In the Environmental

[10] Union Response to GAPLO IR 1.22, Attachment 1, 2006 EA, Section 4.12, Adobe Page 339.

Assessment prepared in April, 1991 for the Hamilton to Milton section, Acres International Limited reported that: "Nine landowners stressed that the pipeline would affect the immediate development potential of their land and it would subsequently lose its value. A further nine landowners thought that their land had subdivision potential sometime in the future."[11]

16. The Board should protect a landowner's ability to develop the lands along the Hamilton to Milton Pipeline corridor in the future by requiring Union to restore its commitment to facilitating future changes in land use in the form of easement agreement.

INDEPENDENT CONSTRUCTION MONITOR

17. In the area of pipeline construction methodology, Union has taken a major step backwards from the Strathroy to Lobo NPS 48 Pipeline by refusing to agree to the appointment of an Independent Construction Monitor ("CMT").[12] Union appears to imply that, as no significant issues with Union's construction practices were identified by the CMT in the Strathroy to Lobo NPS 48 Pipeline construction (according to Union), there would be no need to have a CMT in place for future constructions.

18. Union's position fails to acknowledge that the CMT position was established for past pipeline constructions in order to address a history of problems faced by landowners, failures by contractors to follow proper construction procedures, and damage to the environment.[13] An absence of significant issues during the construction of the Strathroy to Lobo NPS 48 Pipeline is not an indication of the absence of a need for the CMT position; it is an indication of the important role played by the CMT in ensuring that Union's contractors performed appropriately.

[11] Union Response to GAPLO IR 1.22, Attachment 1, 1991 EA, Adobe Page 453.
[12] Union Response to GAPLO IR 1.5.
[13] EB-2005-0550 Written Evidence of Ian Goudy (see **Attachment 8**); EB-2005-0550 Written Evidence of Rick Kraayenbrink (see **Attachment 9**).

19. This is actually reflected in Union's statement to the Board in its May 11, 2009 letter that, "the primary role that [the CMT] was to undertake during construction of the Strathroy Lobo pipeline was that of a compliance monitor."[14]

20. Also, it should be noted that the weather and soil conditions for the construction of the Strathroy to Lobo NPS 48 Pipeline were close to ideal, with the result that the potential for construction problems was reduced. The Strathroy to Lobo CMT noted in its report that: "it was clear to the CMT during the project that the standard procedures for construction and clean-up used by Union Gas were adequate in 2007 for many of the 46 properties (not including properties owned by Union Gas) within the ROW, especially since the sandy soil types along the ROW and the weather during the 2007 construction season were very conducive to construction activities."[15]

21. However, the CMT also noted: "Under these near ideal construction conditions, it was also clear to the CMT that at least seven (15%) of landowners were not satisfied with the standard procedure used by Union Gas and were willing to advocate for themselves. These landowners told members of the CMT they felt they were either mislead during the pre-construction interview process, or their concerns were not addressed to their satisfaction, or promises made were not fulfilled during the construction and clean-up phases of the work."[16]

22. The CMT position is important to ensure proper execution of construction methodology by Union's contractors, especially where affected landowners do not extensive knowledge of pipeline construction. In its final report, the Strathroy to Lobo CMT made a number of recommendations about landowner education, to which Union responded with the following: "Union understands that these recommendations result from discussions between the Monitor and various parties regarding construction practices including the options that a landowner has regarding construction on their properties and concerns regarding their understanding of the

[14] Union Response to GAPLO IR 1.5, Attachment 1.
[15] Cordner Science Final Report dated December 18, 2008, page 16 (see report excerpt at **Attachment 10**).
[16] Cordner Science, *supra* at page 16.

options available to them. These recommendations are most likely as a result of the above noted Communications recommendations in that Cordner is likely not aware and did not participate in any of the pre-construction negotiations between Union and the various landowner negotiating committees (GAPLO-Strathroy/Lobo and Bartlett Group) during which these matters were discussed. As well Union has suggested to landowners that if they have any questions regarding any of the terms of the Letter of Understanding or construction practices that they should seek the advice of GAPLO or other experts that are available to them. Union does not believe that Cordner knows or understands the knowledge of construction practices that GAPLO has developed."[17]

23. The involvement of an independent construction monitor in the proposed Hamilton to Milton NPS 48 Pipeline construction will be all the more important because GAPLO does not have a significant presence along the affected pipeline route[18]. Union does not appear to have provided for any landowner representation in the oversight of construction for the current project. For the Strathroy to Lobo NPS 48 Pipeline construction, Alan Wood acted as landowner representative on behalf of GAPLO and its members.

24. Union has also not included as part of its current project application a copy of any Letter of Understanding to be used with landowners. Union and GAPLO agreed upon the form of Letter of Understanding to be used for the Strathroy to Lobo NPS 48 Pipeline construction[19], which included provision for the independent construction monitor, and GAPLO is proposing that the same form of Letter of Understanding be made a requirement of approval by the Board of the Hamilton to Milton NPS 48 Pipeline project.

---

[17] Union Response to GAPLO IR 1.5, Attachment 1.

[18] Union does confirm, though, that the Integrity Dig Agreement as endorsed by Union and GAPLO (see **Attachment 11**) applies to the land along the Hamilton to Milton section (see Union Response to GAPLO IR 1.30(c)).

[19] Letter of Understanding for Landowners on the Proposed NPS 48 Strathroy-Lobo Project (see **Attachment 12**); This form of Letter of Understanding was also used by Union in connection with the NPS 36 Pipeline in EB-2007-0633 (see excerpt from Union Pre-filed Evidence at Attachment 4 above).

CUMULATIVE EFFECTS ASSESSMENT

25. Union's decision to step back from previous commitments about pipeline abandonment, facilitation of future development of lands, and the use of an independent construction monitor during pipeline construction, indicates a choice to ignore the historical reasons behind the advancements in construction and landowner relations that Union has made over several decades.

26. The cumulative effects assessment undertaken by Stantec Consulting Ltd. ("Stantec") on behalf of Union also reflects this choice. Stantec did not include consideration of the adjacent Union pipelines and pipeline easements in its analysis of cumulative effects of the proposed project, in spite of clear direction to do so in the *OEB Environmental Guidelines for the Location, Construction and Operation of Hydrocarbon Pipelines and Facilities in Ontario*.[20]

27. In response to one of GAPLO's interrogatories related to the cumulative effects assessment, Union states that: "No landowner concerns have been addressed regarding soil damage or crop loss from any previous pipeline construction activities in the Hamilton to Milton pipeline corridor. Considering that the oldest of the three existing pipelines was constructed nearly 60 years ago, Union would expect negligible, if any, residual soil damage or crop loss."[21]

28. However, Union has been made aware of these cumulative effects of its past construction projects. In the Environmental Assessment prepared in April, 1991 for the Hamilton to Milton Corridor, Acres International Limited cited major concerns raised by affected landowners:

a. "Six landowners reported changes in grade or some effect on drainage such that they now have wet areas where the land does not dry out as quickly in the spring";

b. "Six landowners reported some adverse effects on crops, including lower yields and not growing specialty crops over the pipeline easement";

[20] *OEB Environmental Guidelines for the Location, Construction and Operation of Hydrocarbon Pipelines and Facilities in Ontario*, 6th Edition 2011, pages 44 et ff.
[21] Union Response to GAPLO IR 1.28(d).

c. "Poor separation of topsoil was discussed by 3 landowners";

d. "Increased stoniness was mentioned by 2 landowners"; and,

e. "Two landowners were upset with activities of the construction crew".[22]

29. In 2006, Stantec prepared an Environmental Assessment for the Hamilton to Milton section and noted the following cumulative effects resulting from an expanding pipeline corridor:

a. "Soil compaction/structure concerns, leading to reduced crop yields, as similar areas are reworked during repetitive construction activities (e.g., the work area for the 1st line is often used as the spoil area for the next line). Historically, when the 1957 pipeline was installed, little or no restoration work was carried out after pipe installation. However, construction practices have vastly improved since then (including wet soils shut-down policy, top soil stripping and clean-up practices) and crop reduction has been lessened (ESG, 1998)";

b. "Increase in the easement widths can place limitations on the options for which the land can be used (e.g., loss of building potential)";

c. "Ongoing inconvenience to landowners during construction activities by successive pipeline installation and their maintenance"; and,

d. "Fragmentation/nibbling of woodlots such that the size is reduced to such an extent it has little ecological importance and often there is a loss of the linkage between natural areas."[23]

30. Although Union's Soil/Crop Monitoring Program has not included the Hamilton to Milton section specifically[24], crop yield loss of up to 40% has been identified by Union in locations along the nearby Milton to Parkway NPS 48 section[25]. No data was provided for crop yields over the pipelines constructed by Union Gas prior to the 1970s before Union had implemented

[22] Union Response to GAPLO IR 1.22, Attachment 1, 1991 EA, Adobe Page 452.
[23] Union Response to GAPLO IR 1.22, Attachment 1, 2006 EA, Section 6.1, Adobe Page 131.
[24] Union Response to GAPLO IR 1.28(f).
[25] *Pipeline Construction and Impacts on Agricultural Lands: A Historical Review of the Union Gas Soil/Crop Monitoring Program*, ESG International, July, 1998, Table 4, Adobe Page 18 (see **Attachment 13**).

any of the improvements to construction practices cited in its interrogatory response to GAPLO[26].

31. As a condition of approval of the current project, Union should be required to complete a cumulative effects assessment that includes consideration of the adjacent pipelines (including residual soil damage and crop yield loss) and the overall impact of the further expansion of the Hamilton to Milton corridor, including the effect that multiple pipelines within the corridor will have on future abandonment activities.

DEPTH OF COVER MONITORING PROGRAM

32. Union has advised GAPLO that it is, "in the process of preparing a Standard Operating Practice for depth of cover and will file this document in confidence with the Board once complete."[27] GAPLO is requesting that the Board make it a condition of approval of the current project that Union prepare the Standard Operating Practice for depth of cover and that it be provided to GAPLO and all landowners along the Hamilton to Milton section.

33. It is GAPLO's understanding that a written procedure to address depth of cover has been a regulatory requirement in Ontario since as early as 2008[28], and Union has suggested no rationale for maintaining confidentiality over its proposed Standard Operating Practice. Landowners have a direct and immediate interest in knowing how Union monitors depth of cover over its pipelines and how it will remedy specific situations of insufficient depth of cover.

PROPOSED CONDITIONS OF APPROVAL

34. To summarize, GAPLO will be requesting that the Board impose the following as conditions of approval of the Hamilton to Milton NPS 48 Pipeline:

[26] Union Response to GAPLO IR 1.28(f).
[27] Union Response to GAPLO IR 1.2(a).
[28] TSSA Oil and Gas Pipeline Systems Code Adoption Document FS-121-08 dated January 14, 2008 (see **Attachment 14**); TSSA Oil and Gas Pipeline Systems Code Adoption Document Amendment FS-196-12 dated November 1, 2012 (see **Attachment 15**).

a. That the form of agreement that Union has offered or will offer to affected landowners will be the form of easement agreement approved by the Board in EB-2005-0550; and,

b. That Union will use the Letter of Understanding filed by Union with the Board in EB-2005-0550 for the current project, including provision for the appointment of an independent construction monitor for the construction.

35. GAPLO has also identified two steps that the Board should require Union to take immediately and prior to any further consideration by the Board of Union's application:

a. Union should be required to complete and file in this proceeding a cumulative effects assessment that includes consideration of the adjacent pipelines (including residual soil damage and crop yield loss) and the overall impact of the further expansion of the Hamilton to Milton corridor, including the effect that multiple pipelines within the corridor will have on future abandonment activities; and,

b. Union should be required to prepare and file in this proceeding its proposed Standard Operating Practice for depth of cover.

36. This written evidence statement was prepared under the direction of Ian Goudy, Rick Kraayenbrink and Alan Wood.

January 9, 2015

ONTARIO ENERGY BOARD

IN THE MATTER OF the *Ontario Energy Board Act*, 1998, S.O. 1998, c.15, Schedule B, and in particular, s.90(1) thereof;

AND IN THE MATTER OF an Application by Union Gas Limited for an Order or Orders granting leave to construct a natural gas pipeline and ancillary facilities in the Township of Strathroy-Caradoc and in the Township of Middlesex Centre, all in the County of Middlesex.

SETTLEMENT AGREEMENT

Subject to the approval of the Ontario Energy Board, GAPLO-Union (Strathroy-Lobo) and Union Gas Limited, by their solicitors, hereby agree to settle the issues between them in this proceeding in accordance with the Agreed Partial Mitigation Measures in Schedule 1 attached hereto. Landowner agreements shall be amended accordingly.

Dated at Toronto, Ontario
this 9th day of May, 2006.

Paul G. Vogel
Counsel for GAPLO-Union
(Strathroy-Lobo)

Glenn Leslie
Counsel for Union Gas Limited

Schedule 1
GAPLO-UNION (STRATHROY-LOBO) v. UNION GAS
EB-2005-0550

PIPELINE IMPACTS
-and-
RESIDUAL EFFECTS
(Cumulative and Non-cumulative)

IMPACTS	EFFECTS	AGREED PARTIAL MITIGATION MEASURES
Agricultural production and operations • **Soil mixing** • **Drainage** • **No freeze zone**	• Decreased production/ crop maturation/ quality/whole farm price • Loss of drainage system efficiency • Limitations on higher value crops/specialty crops • Operational interference • Income loss • Decreased rental value • Diminished land value	• **WSSD – LOU and Schedules 1 and 5 to LOU to be modified as necessary:** An independent construction monitor shall be appointed by GAPLO-Union (Strathroy-Lobo), the Company and Ontario Energy Board Staff. The monitor shall be on site continuously to monitor construction with respect to all issues of concern to landowners and to be available to landowners and the Company at all times. The monitor shall file interim and final reports with the OEB. The joint committee shall be composed of one GUSL landowner, one other landowner and three representatives of the Company; WSSD issues shall be decided by the Joint Committee with assistance of the construction monitor as required. Where construction activities are undertaken by the Company in wet soil conditions (as determined by the monitor), the Company shall pay to the landowner 150% of disturbance and crop loss damage compensation on the area affected by the activities (area also to be determined by the construction monitor).The 150% payment applies only once to any one area; on areas where the 150% payment is applied, the landowner forfeits the right to top-up of crop loss damages under the LOU. The 150% payment does not affect the landowner's right to topsoil replacement where crop loss exceeds 50%.
• **Equipment size/cultivation depth**	• Decreased efficiency/increased headlands • Increased compaction, crop loss, costs	• **Depth of Cover – to replace the last sentence in Section 1(g) of the LOU -** If the Company, acting reasonably, determines in consultation with the landowner and drainage expert that it is necessary to increase the depth of the pipeline to accommodate facilities such as drainage, processes such as deep tillage, heavy farm equipment or land use changes, Union will provide for additional depth of cover. At the request of the landowner, the Company shall undertake a depth of cover survey of the Pipeline, and shall

IMPACTS	EFFECTS	AGREED PARTIAL MITIGATION MEASURES
		provide its findings to the landowner. Where it is determined that cover over the Pipeline is less than three feet, Union shall restore depth of cover to three feet with the importation of topsoil or by lowering the pipe.
• **Stones**	• Annual stone-picking • Equipment damage	• **Stone Picking Practice – Sections 1(k) and 1(m) to be modified as necessary – the second last sentence of Section 1(k) shall read** – Stones 50 mm (2") in diameter and larger will be picked by hand and/or with a mechanical stone picker. – **Section 1(m) last two sentences are replaced with** – If requested by the landowner, the Company will return in the year following construction and chisel plough or cultivate to the depth of the topsoil. When necessary to accommodate planting schedules, the landowners should perform cultivating and/or chisel ploughing themselves at the Company's expense, provided the need for this work has been agreed upon in advance (see Schedule of Rates attached). The Company shall, at a time satisfactory to the landowner, pick stones 50 mm (2") or larger in diameter by hand and/or with a mechanical stone picker in each of the first two years following construction. The Company shall, at a time satisfactory to the landowner, return to pick stones 50 mm (2") or larger in the following years where there is a demonstrable need.
• **Construction access**	• Interference with agricultural access • Aggravation of WSSD damage	• Maximum open trench 6 km.
• **Maintenance and repair interference/ damage**	• Ongoing operational interference/loss of productive time and damage from maintenance and repair operations	• **Damage from pipeline operation** – The Integrity Dig Agreement shall apply to all integrity and maintenance operations on whole Dawn-Trafalgar system.

IMPACTS	EFFECTS	AGREED PARTIAL MITIGATION MEASURES
• **Cyst Nematode**	• Contamination risk	• **Cyst Nematode – at Section 8 of the LOU** – In consultation with the landowner, the Company agrees to sample all agricultural easements along the pipeline route of this project, before construction, and any soils imported to the easement lands for the presence of soy bean cyst nematode (SCN) and provide a report of test results to the landowner. In the event the report indicates the presence of SCN, the Joint Committee will work with OMAFRA and the University of Guelph to develop a best practices protocol to handle SCN when detected and will employ the most current best practice at the time of construction. The Company will also test for SCN whenever it is conducting post-construction soil tests.
• **Construction impact disputes**	• Forum for landowner consultation on WSSD and efficient dispute resolution required	• **Joint Committee – LOU and Schedule 1 to LOU to be modified as necessary** – An independent construction monitor shall be appointed by GAPLO-Union (Strathroy-Lobo), the Company and Ontario Energy Board Staff. The monitor shall be on site continuously to monitor construction with respect to all issues of concern to landowners and to be available to landowners and the Company at all times. The monitor shall file interim and final reports with the OEB. The joint committee shall be composed of one GUSL landowner, one other landowner and three representatives of the Company. The Company will pay to the GUSL landowner member of the Joint Committee at his or her direction a total payment of $10,000 plus G.S.T. as an honorarium for participation on the committee. • **Assignment of the LOU – sentence to be added at the end of Section 11 of LOU** – The Company shall not assign this agreement without prior written notice to the landowner and, despite such assignment, the Company shall remain liable to the landowner for the performance of its responsibilities and obligations in this agreement.
Land use • **Agricultural**	• prevent construction/expansion existing facilities • restrict development intensive livestock/permitted uses • location limitations / inconvenience / costs	• **Easement Agreement: future use – To be inserted after Clause 3 of the easement agreement** - The Transferee further agrees to make reasonable efforts at its own expense to accommodate changes in land use on lands adjacent to the easement for the purpose of ensuring the Pipeline is in compliance with all applicable regulatory requirements in connection with any such change in use.

IMPACTS	EFFECTS	AGREED PARTIAL MITIGATION MEASURES
	• use interference with remaining lands • whole farm income loss • diminished whole farm land value	
• **Non-agricultural**	• sterilize land – greenspace • limit development options/increase costs • diminish quality of life • whole property income loss • whole property diminished land value	• **Easement Agreement: future use – To be inserted after Clause 3 of the easement agreement** - The Transferee further agrees to make reasonable efforts at its own expense to accommodate changes in land use on lands adjacent to the easement for the purpose of ensuring the Pipeline is in compliance with all applicable regulatory requirements in connection with any such change in use.
Socio-economic • **social/ psychological**	• loss of control over property/environment • violation of personal space • depression/anxiety • loss of enjoyment • diminished quality of life • loss of identification with community • lifetime challenge financially, emotionally and physically	

IMPACTS	EFFECTS	AGREED PARTIAL MITIGATION MEASURES
• **time loss**	• operational interference • production and income loss • family life disturbance	
• **health and safety**	• vulnerability/danger/risk • operational restrictions • decreased self-worth • liability	• **Depth of Cover – to replace the last sentence in Section 1(g) of the LOU** - If the Company, acting reasonably, determines in consultation with the landowner and drainage expert that it is necessary to increase the depth of the pipeline to accommodate facilities such as drainage, processes such as deep tillage, heavy farm equipment or land use changes, Union will provide for additional depth of cover. At the request of the landowner, the Company shall undertake a depth of cover survey of the Pipeline, and shall provide its findings to the landowner. Where it is determined that cover over the Pipeline is less than three feet, Union shall restore depth of cover to three feet with the importation of topsoil or by lowering the pipe.
• **abandonment risks**	• liability • environmental contamination • safety • land use restrictions	• **Abandonment – to replace the last sentence in Clause 1 of the Easement Agreement, and Section 6.3 of the LOU to be modified as necessary** – As part of the Transferee's obligation to restore the lands upon surrender of its easement, the Transferee agrees at the option of the Transferor to remove the pipeline from the Lands. The Transferee and the Transferor shall surrender the easement and the Transferee shall remove the Pipeline at the Transferor's option where the Pipeline has been abandoned. The Pipeline shall be deemed to be abandoned where: a) corrosion protection is no longer applied to the Pipeline, or, b) the Pipeline becomes unfit for service in accordance with Ontario standards. The Transferee shall, within 60 days of either of these events occurring, provide the Transferor with notice of the event. Upon removal of the Pipeline and restoration of the Lands as required by this agreement, the Transferor shall release Transferee from further obligations in respect of restoration. This provision shall apply with respect to all Pipelines in the Dawn-Trafalgar system on the Transferor's lands.

ONTARIO ENERGY BOARD

FILE NO.: **EB-2005-0550**

VOLUME: **Receipt of Settlement Proposal**

DATE: **May 9, 2006**

BEFORE: **Cynthia Chaplin** **Presiding Member**

Ken Quesnelle **Member**

EB-2005-0550

THE ONTARIO ENERGY BOARD

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

AND IN THE MATTER OF an Application by Union Gas Limited, pursuant to subsection 90(1), for an Order or Orders granting leave to construct natural gas pipeline and ancillary facilities in the Township of Strathroy-Caradoc in the Township of Middlesex Centre in the County of Middlesex.

Hearing held at 2300 Yonge Street,
25th Floor, West Hearing Room,
Toronto, Ontario, on Tuesday,
May 6, 2006, commencing at 1:30 p.m..

Receipt of Settlement Proposal

B E F O R E:

CYNTHIA CHAPLIN PRESIDING MEMBER

KEN QUESNELLE MEMBER

A P P E A R A N C E S

DONNA CAMPBELL	Board Staff
GLENN LESLIE	Union Gas
PAUL VOGEL JOHN GOUDIE	GAPLO Union Strathroy-Lobo
BARBARA BODNAR	Enbridge Gas Distribution

I N D E X O F P R O C E E D I N G S

Description	Page No.
Appearances	1
Submissions by Mr. Leslie	2
Submissions by Mr. Vogel	4
Submissions by Ms. Campbell	5
Questions from the Board	13
--- Whereupon the hearing adjourned at 1:55 p.m.	15

E X H I B I T S

Description	Page No.

NO EXHIBITS ENETERED DURING THIS HEARING

U N D E R T A K I N G S

Description	Page No.

NO UNDERTAKINGS ENTERED DURING THIS HEARING

Tuesday, May 6, 2006

--- Upon commencing at 1:30 p.m.

MS. CHAPLIN: Please be seated. Good afternoon, everyone. The Board is sitting today in the matter of application EB-2005-0550, submitted by Union Gas Limited for an order or orders granting leave to construct a natural gas pipeline and ancillary facilities in the Township of Strathroy-Caradoc and in the Township of Middlesex Centre, all in the County of Middlesex.

The parties to this proceeding have recently ended a settlement conference and earlier today filed a settlement proposal reflecting the participants' positions. The purpose of today's hearing is for the Board to receive a settlement proposal and to rule on its acceptability.

My name is Cynthia Chaplin, and I will be the presiding member in this hearing, and joining me on the panel is Board member Mr. Quesnelle.

May I have appearances, please?

APPEARANCES:

MR. LESLIE: Good afternoon. My name is Glenn Leslie. I am counsel to Union Gas.

MS. CHAPLIN: Good afternoon, Mr. Leslie.

MR. VOGEL: Good afternoon, Madam Chair. My name is Paul Vogel. I am counsel for GAPLO Union Strathroy-Lobo, one of the intervenors. With me is Mr. John Goudy, my co-counsel.

MS. CHAPLIN: Thank you, Mr. Vogel. Would anyone else like to --

MS. BODNAR: Barbara Bodnar for Enbridge Gas Distribution.

MS. CHAPLIN: Thank you.

MS. CAMPBELL: Donna Campbell for the Ontario Energy Board, and I am assisted by Zora --

MS. CRNOJACKI: Crnojacki.

MS. CAMPBELL: Thank you.

MS. CHAPLIN: Thank you, Ms. Campbell.

Before we begin, are there any preliminary matters before we turn to the settlement proposal, Ms. Campbell?

MS. CAMPBELL: I don't believe there are any.

MS. CHAPLIN: Okay, thank you. Perhaps we will begin with Mr. Leslie, if you want to present the settlement proposal.

SUBMISSIONS BY MR. LESLIE:

MR. LESLIE: Yes, thanks very much. As the Board knows, I believe, as a result of discussions over the last couple of days, we have reached an agreement with the GAPLO landowners, which you have. This agreement deals with the issues that were raised by GAPLO in these proceedings. We also have an agreement with them on compensation, which is a separate matter.

But the agreement you have deals with the issues that were raised in these proceedings. The agreement contemplates -- I will just mention one aspect of it. It contemplates the appointment of a construction monitor, and that -- the idea there was to really do something similar to what had been done in an earlier case. It is EBL-0234.

This is a variation on that theme, but that was where we got the idea from.

There were criteria used in that case. They're appendix C to the decision. I simply wanted to say that it was our expectation, I guess, that those criteria would be used in this case, as well.

The agreement does contemplate the participation of Board Staff in the appointment of that individual.

I should probably advise the Board that there are a number of other landowners who are not represented by Mr. Vogel. I can tell the Board that with respect to those landowners, to the extent that they have not signed agreements or agreed to, the only issues relate to compensation. There are no issues relating to the proposal as it relates to the pipeline or the application that is before you.

Board Staff have given us their proposed conditions of approval and they are acceptable.

Finally, I guess my understanding was that we had been advised, through Board Staff, that it would not be necessary for Union to have either of the two panels that we planned to have available, if there had been a hearing, testify or appear, and it was also my understanding that the Board, subject to reviewing the agreement and being satisfied with it, would be in a position to issue a decision on the application before you. I would ask you to do that as soon as possible.

There are reasons set out in the evidence, but,

briefly, it is a matter of satisfying the people who contracted with us that we are going ahead, and there is also a need to order pipe relatively soon.

I think that is all I have. Thank you very much.

MS. CHAPLIN: Okay. Thank you, Mr. Leslie. Mr. Vogel do you have any additional comments?

SUBMISSIONS BY MR. VOGEL:

MR. VOGEL: No, Madam Chair. I think it is the basis of the settlement you have in schedule 1 attached to the settlement agreement. You will see there that with respect to the impacts and the effects of the proposed pipeline construction, that we have been able to resolve at least partial mitigation measures with respect to some of those impacts and effects. And, as you are aware, as a result of the decision at Issues Day, compensation structure and compensation issues are not before you here.

So it appears that we have been successful in resolving whatever could be resolved, by way of partial mitigation measures, to address part of the impacts and effects which will be created by this proposed pipeline construction.

MS. CHAPLIN: Thank you. Before I turn to Ms. Campbell, is there any other comments? Ms. Campbell, does Board Staff have any comments or questions?

SUBMISSIONS BY MS. CAMPBELL:

MS. CAMPBELL: I have a handful of comments and questions concerning the form itself.

The first thing that I would like to know is I am

going to ask Mr. Leslie -- I alerted him to the fact that this question would be asked. I am wondering if Union is in a position to advise the Panel of the cost impact of the steps that are contained in the schedule 1 attached to the settlement agreement.

MR. LESLIE: Yes. It is roughly a quarter of a million dollars.

MS. CAMPBELL: Thank you.

MS. CHAPLIN: Just because I don't have the number on the top of mind, what is that roughly as a percentage of the total project?

MR. LESLIE: It would be less than 1 percent, I would think. It is $50 million project.

MS. CHAPLIN: Thank you very much.

MR. LESLIE: Sorry, the 50 is for pipe. It is a $100 million project.

MS. CHAPLIN: Thank you.

MS. CAMPBELL: The next question that I have, it is really a clarification. I notice that the manager of facilities is here to make sure that I get this right. In the opening paragraph, if everybody would look under WSSE, there is the statement that an independent construction monitor shall be appointed by GAPLO Union, the company and Ontario Energy Board staff.

I simply wish to confirm that the Energy Board's involvement is in assisting in the appointment of the monitor, but no one from the Board will be going into the field to check on the monitor.

However, the Board will be receiving the reports that are referenced in the upper third of that paragraph. In other words, the sentence I'm referring to, "The monitor shall file interim and final reports with the OEB." So I wish to clarify that and ensure that that is everybody's understanding while we're in the room.

MR. VOGEL: That's correct, Ms. Campbell.

MR. LESLIE: Yes, that is correct.

MS. CAMPBELL: Thank you.

MR. LESLIE: I think Mr. McKay played this role the last time it was done.

MS. CAMPBELL: Yes. And he is here to make sure it is pretty defined, so I think we have justified it. The other issue that I raised before the Panel came into the room has to do with the timing of the filing of the reports. No one had actually -- at least I haven't and I hadn't heard it discussed in my hearing, and I am assuming no one else has turned their mind to the actual filing of the report, and what we were discussing -- and Mr. Vogel seemed to be amenable to this. I haven't discussed it with Mr. Leslie -- was those reports, the -- that particular report by the independent construction monitor on the issues in that paragraph would be filed -- sorry, and the other issues on which the independent construction monitor's report, those reports would come in at the same time as the reports that Union generally files, the other reports that Union must file.

I appreciate I haven't discussed this with Union, so I

am going to ask Mr. Leslie if he could canvas his clients and determine if that is appropriate.

MR. LESLIE: Apparently last time they were on a slightly different schedule, that is the monitor's reports were filed at a different time than post-construction reports. But I don't see any reason why that couldn't be coordinated, if that was important.

MS. CAMPBELL: This is probably a question that is more theoretical than anything right now because nobody knows how much they're going to file. Any concept of reporting times you are thinking of?

MR. VOGEL: I don't think the -- probably our best contemplation at this point in time is that the construction monitor would file reports as per the draft conditions of approval, timing for Union. Subject to, I suppose, the monitor having the discussion to file reports at other times if the monitor thought that was appropriate.

MS. CAMPBELL: How does that sound?

MR. LESLIE: That's fine.

MS. CAMPBELL: Okay.

All right. I just had something raised with me and I just want to clarify it to make sure, so that everybody's concerns in the room are addressed. Just to confirm the limited role of Board Staff, probably because this is someone who would be affected by this. The limited role of Board Staff, in that if there is a dispute, that the dispute would be dealt with by the joint committee and not by the Board.

MR. VOGEL: That's correct. The contemplation -- the joint committee is established as a dispute resolution mechanism.

MS. CAMPBELL: Right.

MR. VOGEL: I think the schedule 1 provides for the joint committee to do its work in consultation with the monitor. So that is the contemplated forum in which disputes would be resolved.

MS. CAMPBELL: Thank you. My next question comes from page 3, construction impact disputes.

It is under joint committee LOU. So the first point beside construction impact disputes. And it is the second sentence from the top and I asked this question of Mr. Vogel before we started. I just would like you to explain to the panel how the one other landowner would be appointed.

MR. VOGEL: Oh, the make-up of the joint committee includes two landowners, one of whom is a Gaplo-Union representative. As Mr. Leslie has indicated to you, Madam Chair, there are other landowners who don't belong to Gaplo-Union, so there is provision on the joint committee for those other landowners to also be represented by one of the non-Gaplo-Union landowners.

I presume that that landowner would be appointed by Union consulting with the other non-Gaplo landowners, and determining an appropriate representative.

MS. CAMPBELL: There is also reference to a honorarium to be paid. Does the other landowner get an honorarium

also, is that the subject of --

MR. LESLIE: That is our expectation. Mr. Vogel didn't negotiate that, but we assume that if we paid one, we would probably pay the other.

MS. CAMPBELL: Okay, thank you.

My next question arises from page 4. It has the heading socio-economic and there are two bullet points, one on page 4, social/psychological; the second at the top of Page 5, time loss.

There is nothing under the agreed partial mitigation measures. I am correct, am I, that because it is blank that means there are no agreed partial mitigation measures for these topics?

MR. VOGEL: That's correct, Ms. Campbell.

MS. CAMPBELL: Can you explain to the Panel the purpose of filing the form with the empty column.

MR. VOGEL: Well, the schedule itself, I think the panel is familiar with the form as it has evolved through the course of this hearing, identifies construction impacts and effects from the proposed pipeline construction, residual effects and cumulative effects, some of which are at least addressed in part now through the agreed partial mitigation measures, and the schedule simply, I think, summarizes the prefiled evidence from Gaplo with respect to what those effects are. To the extent they're being dealt with in this hearing, indicates what the agreed partial mitigation measures are.

MS. CAMPBELL: I guess I didn't phrase my question

particularly well.

If there is no agreed partial mitigation measure that can be taken, why is it included in this form?

MR. VOGEL: I think for the sake of completeness. I mean that's the way the hearing is resolved.

MR. VOGEL: Those are the impacts and effects identified in the evidence, and to the extent that we have been able to develop agreed mitigation measures, that's the subject of a settlement agreement in this proceeding.

MS. CAMPBELL: Right. So do I take it the fact that it is blank means that it is dealt with by compensation only? Those are compensatory matters as opposed to matters in which mitigation measures can be taken in part or in whole?

MR. VOGEL: If they were to be addressed, they would be addressed through compensation.

MS. CAMPBELL: Okay.

MR. VOGEL: That's correct.

MR. LESLIE: It may be important to understand how this document evolved. I don't know, but I mean the first two columns have always been there. Previously there were two other columns. One was what Mr. Vogel was proposing and the fourth column had to do with compensation.

For purposes of this afternoon, what Mr. Vogel, after talking to us, was to condense the second -- the third and fourth column into what you now see in the agreed partial mitigation measures so that you knew what we agreed to deal with the issues.

The first two columns are really just what was there in the first place.

MR. VOGEL: As I think I explained in my opening remarks, Madam Chair, as a result of the determination at issues day that compensation structure is not in issue this proceeding. We have not addressed compensation structure in the context of this proceeding. And therefore, what we are presenting to you today is the extent that we have been able to agree on the partial mitigation measures for the identified impacts and effects.

MS. CHAPLIN: So perhaps just for our purposes, could I kind of summarize that as -- I guess the way that the Panel is looking at it is: What represents the settlement is in fact what appears in the third column?

MR. LESLIE: That is right.

MS. CHAPLIN: That is in effect the settlement agreement. To the extent there is information in the first two columns, that is the rationale or the underlying – and to the extent there is nothing in the agreed column for those two categories, nothing turns on the fact that there is something there in the first two columns, really, it is not part of the settlement?

MR. LESLIE: I think that is right. There is another agreement dealing with compensation that is material to your understanding.

MR. VOGEL: But the fact they appear in the first two columns and there is nothing beside them in the third column would simply indicate, in my submission to you, that

they are not being addressed here through partial mitigation measures. I think that is what you can take from this schedule.

MS. CHAPLIN: Okay. Thank you.

MS. CAMPBELL: So I take it, then, that the parties are content -- although these issues are not being addressed by this document at all -- to leave it there? That is really my real question.

MR. VOGEL: We are content in the context of the proceeding as it was structured at issues day, to proceed on the basis of this settlement because these are the issues which were capable of settling in the context of this proceeding.

MS. CAMPBELL: Okay. I have one other question -- two, actually. Well, it can be said in one but it has two parts to it.

This has to do with simply completing the record. There is reference in here to amendments to the letter of understanding and amendments to the easement. Is it the intention of the parties to file an amended form of the easements and an amended letter of understanding? They are part of the pre-filed evidence already, and that simply why I'm asking.

MR. LESLIE: No, but that certainly can be done.

MS. CAMPBELL: Well, the Panel has to approve the form of an easement.

MR. LESLIE: I frankly hadn't thought about it, but you are right, they have to prove the form of the easement,

and that means that the changes that are contemplated by this document would have to be in an easement that was in evidence and we will look after that, yes.

MS. CAMPBELL: Thank you. Do you intend to amend and file a letter of understanding? The reason I am asking is simply you have already pre-filed it, so if you could do that also, because this document makes reference to it, also.

MR. LESLIE: Yes, of course.

MS. CAMPBELL: Thank you. Those are my questions.

MS. CHAPLIN: Thank you. Mr. Quesnelle?

QUESTIONS FROM THE BOARD:

MR. QUESNELLE: Board Staff has basically covered off anything I have, so I am satisfied. I don't have anything else, Madam Chair.

MS. CHAPLIN: Thank you. Ms. Campbell, can you confirm that intervenors have been given notice of this settlement, and have there been any comments or...

MS. CAMPBELL: No, no. Last night I indicated, by e-mail, that it was likely that a settlement proposal on some or all of the issues would be tendered before the Board today. I optimistically had said 9:30 or shortly thereafter. I expanded the definition of "shortly thereafter", but there has been no response and no indication, that I am aware of, that anyone seeks to come and address you on this.

MS. CHAPLIN: And save and aside for this settlement agreement, is it your understanding -- are there any other

outstanding issues in this proceeding? Is there any requirement, from your perspective, for Union's panels to appear for any further evidence to be heard?

MS. CAMPBELL: I am pausing for effect, just to make everybody nervous.

No. No, there isn't.

MS. CHAPLIN: One moment, please.

[Board Panel confers]

MS. CHAPLIN: Thank you. The Panel has conferred and we are -- we accept the settlement as it has been presented, and bearing in mind Mr. Leslie's comments, we will issue a decision and order as soon as practical, after receiving the amended agreements.

Are there any final matters? Mr. Leslie, Ms. Campbell?

MS. CAMPBELL: No. I would just like to thank the parties for their persistence over the last two-and-a-half days. I have only been privy to some of it, but I must say that the Board Staff is certainly content with the proposal that was put forward and commends the parties for their efforts.

MS. CHAPLIN: Thank you.

MR. LESLIE: Thank you for your patience.

MS. CHAPLIN: Oh, well, that was easy for us.

The Board would also like to thank the parties for the hard work they obviously put in and the cooperative approach they took. We would like to thank Board Staff for the contributions you made to the settlement, and also we

would like to thank the reporters for remaining on call for such an extended period of time. We do appreciate their flexibility.

If we have nothing further, we are adjourned and we will issue the decision in due course. Thank you very much.

--- Whereupon hearing the adjourned at 1:55 p.m.

EASEMENT FOR TRANSMISSION PIPELINE

WHEREAS the Transferor is the owner in fee simple of those lands and premises more particularly described as

(hereinafter called the "Transferor's lands").

WHEREAS the Transferee is the owner in fee simple of those lands and premises (hereinafter called the "Transferee's lands") situate, lying and being in the geographic Township of Dawn, now Township of Dawn-Euphemia, in the County of Lambton and Province of Ontario and being composed of the west half (w1/2) of Lot Number 25 in the 2nd Concession of the said Township.

The Transferor (and the Mortgagee) do hereby GRANT, CONVEY, TRANSFER AND CONFIRM unto the Transferee, its successors and assigns, to be used and enjoyed as appurtenant to all or any part of the lands of the Transferee's lands the right, liberty, privilege and easement on, over, in, under and/or through a strip of the Transferor's lands more particularly described in Box 5 of page one of this Schedule (hereinafter referred to as the "Lands") to survey, lay, construct, maintain, inspect, patrol, alter, remove, replace, reconstruct, repair, move, keep, use and/or operate one pipe line for the transmission of pipeline quality natural gas as defined in The Ontario Energy Board Act S.O. 1998 (hereinafter referred to as the "Pipeline") including therewith all such buried attachments, equipment and appliances for cathodic protection which the Transferee may deem necessary or convenient thereto, together with the right of ingress and egress at any and all times over and upon the Lands for its servants, agents, employees, those engaged in its business, contractors and subcontractors on foot and/or with vehicles, supplies, machinery and equipment for all purposes necessary or incidental to the exercise and enjoyment of the rights, privileges and easement hereby granted. The Parties hereto mutually covenant and agree each with the other as follows:

1 In consideration of the sum of
00/100 DOLLARS ($) of lawful money of Canada (hereinafter called the "Consideration"), which sum is payment in full for the rights and interest hereby granted and for the rights and interest, if any, acquired by the Transferee by expropriation, including in either or both cases payment in full for all such matters as injurious affection to remaining lands and the effect, if any, of registration on title of this document and where applicable, of the expropriation documents, subject to Clause 12 hereof to be paid by the Transferee to the Transferor at least 30 days prior to the exercise by the Transferee of any of its rights hereunder other than the right to survey, the rights, privileges and easement hereby granted shall continue in perpetuity or until the Transferee, with the express written consent of the Transferor, shall execute and deliver a surrender thereof . Prior to and following such surrender Transferee shall remove all debris as may have resulted from the Transferee's use of the Lands from the Lands and in all respects restore the Lands to it's previous productivity and fertility so far as is reasonably possible, save and except for items in respect of which compensation is due under Clause 2 hereof. ***As part of the Transferee's obligation to restore the lands upon surrender of its easement, the Transferee agrees at the option of the Transferor to remove the Pipeline from the Lands. The Transferee and the Transferor shall surrender the easement and the Transferee shall remove the Pipeline at the Transferor's option where the Pipeline has been abandoned. The Pipeline shall be deemed to be abandoned where: a) corrosion protection is no longer applied to the Pipeline, or, b) the Pipeline becomes unfit for service in accordance with Ontario standards. The Transferee shall, within 60 days of either of these events occurring, provide the Transferor with notice of the event. Upon removal of the Pipeline and restoration of the Lands as required by this agreement, the Transferor shall release the Transferee from further obligations in respect of restoration. This provision shall apply with respect to all Pipelines in the Dawn-Trafalgar system*** **on** ***the Transferor's Lands.***

2. The Transferee shall make to the Transferor (or the person or persons entitled thereto) due compensation for any damages to the Lands resulting from the exercise of any of the rights herein granted, and if the compensation is not agreed upon by the Transferee and the Transferor, it shall be determined by arbitration in the manner prescribed by the Expropriations Act, R.S.O. 1990, Chapter E-26 or any Act passed in amendment thereof or substitution therefore. Any gates, fences, municipal drains, and tile drains interfered with by the Transferee shall be restored by the Transferee at its expense as closely as reasonably possible to the condition and function in which they existed immediately prior to such interference by the Transferee and in the case of tile drains, such restoration shall be performed in accordance with good drainage practice.

3. The Pipeline (including attachments, equipment and appliances for cathodic protection but excluding valves, take-offs and fencing installed under Clause 9 hereof) shall be laid to such a depth that upon completion of installation it will not obstruct the natural surface run-off from the Lands nor ordinary cultivation of the Lands nor any tile drainage system existing in the Lands at the time of installation of the Pipeline nor any planned tile drainage system to be laid in the Lands in accordance with standard drainage practice, if the Transferee is given at least thirty (30) days notice of such planned system prior to the installation of the pipeline; provided that the Transferee may leave the pipeline exposed in crossing a ditch, stream, gorge or similar object where approval has been obtained from the Ontario Energy Board or other Provincial Board or authority having jurisdiction in the premises. The Transferee agrees to make reasonable efforts to accommodate the planning and installation of future tile drainage systems following installation of the pipeline so as not to obstruct or interfere with such tile installation. ***The Transferee further agrees to make reasonable efforts at its own expense to accommodate changes in land use on lands adjacent to the easement for the purpose of ensuring the Pipeline is in compliance with all applicable regulatory requirements in connection with any such change in use.***

4. As soon as reasonably possible after the construction of the Pipeline, the Transferee shall level the Lands and unless otherwise agreed to by the Transferor, shall remove all debris as may have resulted from the Transferee's use of the Lands therefrom and in all respects restore the Lands to its previous productivity and fertility so far as is reasonably possible, save and except for items in respect of which compensation is due under Clause 2 hereof.

5. The Transferee shall indemnify the Transferor for any and all liabilities, damages, costs, claims, suits and actions which are directly attributable to the exercise of the rights hereby granted, except to the extent of those resulting from the gross negligence or willful misconduct of the Transferor.

6. In the event that the Transferee fails to comply with any of the requirements set out in Clause 2, 3, or 4 hereof within a reasonable time of the receipt of notice in writing from the Transferor setting forth the failure complained of, the Transferee shall compensate the Transferor (or the person or persons entitled thereto) for any damage, if any, necessarily resulting from such failure and the reasonable costs if any, incurred in the recovery of those damages.

7. Except in case of emergency, the Transferee shall not enter upon any lands of the Transferor, other than the Lands, without the consent of the Transferor. In case of emergency the right of entry upon the Transferor's lands for ingress and egress to and from the Lands is hereby granted. The determination of what circumstances constitute an emergency, for purposes of this paragraph is within the absolute discretion of the Transferee, but is a situation in which the Transferee has a need to access the pipeline in the public interest without notice to the Transferor, subject to the provisions of paragraph 2 herein. The Transferee will, within 72 hours of entry upon such lands, advise the

Transferor of the said emergency circumstances and thereafter provide a written report to Transferor with respect to the resolution of the emergency situation.

8. The Transferor shall have the right to fully use and enjoy the Lands except for planting trees over a six (6) metre strip centered over the Pipeline, and except as may be necessary for any of the purposes hereby granted to the Transferee, provided that without the prior written consent of the Transferee, the Transferor shall not with mechanical equipment or explosives excavate, drill, install, erect or permit to be excavated, drilled, installed or erected in, on, over or through the Lands any pit, well, foundation, pavement, building, mobile homes or other structure or installation. Notwithstanding the foregoing the Transferee upon request shall consent to the Transferor erecting or repairing farm fences, constructing or repairing his tile drains and domestic sewer pipes, water pipes, and utility pipes and constructing or repairing his lanes, roads, driveways, pathways, and walks across, on and in the Lands or any portion or portions thereof, provided that before commencing any of the work referred to in this sentence the Transferor shall (a) give the Transferee at least three (3) clear days notice in writing pointing out the work desired so as to enable the Transferee to evaluate and comment on the work proposed and to have a representative inspect the site and/or be present at any time or times during the performance of the work, (b) shall follow the instructions of such representative as to the performance of such work without damage to the Pipeline, (c) shall exercise a high degree of care in carrying out any such work and, (d) shall perform any such work in such a manner as not to endanger or damage the Pipeline as may be required by the Transferee.

9. The rights, privileges and easement herein granted shall include the right to install, keep, use, operate, service, maintain, repair, remove and/or replace in, on and above the Lands any valves and/or take-offs subject to additional agreements and to fence in such valves and/or take-offs and to keep same fenced in, but for this right the Transferee shall pay to the Transferor (or the person or persons entitled thereto) such additional compensation as may be agreed upon and in default of agreement as may be settled by arbitration under the provisions of The Ontario Energy Board Act, S.O. 1998, or any Act passed in amendment thereof or substitution therefore. The Transferee agrees to make all reasonable efforts to locate such facilities adjacent to lot lines and public road allowances. The Transferee shall keep down weeds on any lands removed from cultivation by reason of locating any valves and/or take-offs in the Lands.

10. Notwithstanding any rule of law or equity and even though the Pipeline and its appurtenances may become annexed or affixed to the realty, title thereto shall nevertheless remain in the Transferee.

11. Neither this Agreement nor anything herein contained nor anything done hereunder shall affect or prejudice the Transferee's rights to acquire the Lands or any other portion or portions of the Transferor's lands under the provisions of The Ontario Energy Board Act, S.O. 1998, or any other laws, which rights the Transferee may exercise at its discretion in the event of the Transferor being unable or unwilling for any reason to perform this Agreement or give to the Transferee a clear and unencumbered title to the easement herein granted.

12. The Transferor covenants that he has the right to convey this easement notwithstanding any act on his part, that he will execute such further assurances of this easement as may be requisite and which the Transferee may at its expense prepare and that the Transferee, performing and observing the covenants and conditions on its part to be performed, shall have quiet possession and enjoyment of the rights, privileges and easement hereby granted. If it shall appear that at the date hereof the Transferor is not the sole owner of the Lands, this Indenture shall nevertheless bind the Transferor to the full extent of his interest therein and shall also extend to any after-acquired interest, but all

moneys payable hereunder shall be paid to the Transferor only in the proportion that his interest in the Lands bears to the entire interest therein.

13. In the event that the Transferee fails to pay the consideration as hereinbefore provided, the Transferor shall have the right to declare this easement canceled after the expiration of 15 days from personal service upon the Secretary, Assistant Secretary or Manager, Lands Department of the Transferee at its Executive Head Office in Chatham, Ontario, (or at such other point in Ontario as the Transferee may from time to time specify by notice in writing to the Transferor) of notice in writing of such default, unless during such 15 day period the Transferee shall pay the said consideration; upon failing to pay as aforesaid, the Transferee shall forthwith after the expiration of 15 days from the service of such notice execute and deliver to the Transferor at the expense of the Transferee, a valid and registerable release and discharge of this easement.

14. All payments under these presents may be made either in cash or by cheque of the Transferee and may be made to the Transferor (or person or persons entitled thereto) either personally or by mail. All notices and mail sent pursuant to these presents shall be addressed to the Transferor at and to the Transferee at Union Gas Limited, 50 Keil Drive North, Chatham, Ontario N7M 5M1, Attention: Manager, Lands or to such other address in either case as the Transferor or the Transferee respectively may from time to time appoint in writing.

15. The rights, privileges and easement hereby granted are and shall be of the same force and effect as a covenant running with the land and this Indenture, including all the covenants and conditions herein contained, shall extend to, be binding upon and enure to the benefit of the heirs, executors, administrators, successors and assigns of the Parties hereto respectively; and, wherever the singular or masculine is used it shall, where necessary, be construed as if the plural, or feminine or neuter had been used, as the case may be. The Transferee shall not assign this agreement without prior written notice to the Transferor and, despite any such assignment, the Transferee shall remain liable to the Transferor for the performance of its responsibilities and obligations hereunder.

16. The Transferor hereby acknowledges that this transfer will be registered electronically and the Transferor hereby authorizes the Transferee to complete the registration of this transfer.

17. The Mortgagee on Mortgage/Charge Number , in consideration of the sum of Two Dollars ($ 2.00) the receipt whereof is hereby acknowledged, joins herein for the purpose of consenting hereto and agrees to the easement hereby granted and covenants that the Transferee shall have quiet possession of the rights, privileges and easements hereby granted. The Mortgagee certifies that the Mortgagee is at least eighteen years old.

(Name of Mortgagee)
Witness:

(Per: _____

Date of Signature _____

(Per: _____

Date of Signature _____

“ I/We have authority to bind the corporation ”

Municipality of Chatham-Kent

Province of Ontario

DECLARATION REQUIRED UNDER
SECTION 50 OF THE PLANNING
ACT, R.S.O. 1990, as amended

I, Beverly Howard Wilton, of the Municipality of Chatham-Kent, in the Province of Ontario.

DO SOLEMNLY DECLARE THAT

1. I am Manager, Lands Department of Union Gas Limited, the Transferee in the attached Grant of Easement and as such have knowledge of the matters herein deposed to.

2. The use of or right in the land described in the said Grant of Easement is being acquired by Union Gas Limited for the purpose of a hydrocarbon transmission line within the meaning of part VI of the Ontario Energy Board Act , 1998.

AND I make this solemn declaration conscientiously believing it to be true and knowing that it is of the same force and effect as if made under oath, and by virtue of The Canada Evidence Act.

DECLARED before me at the)
)
Municipality of Chatham-Kent,)
) _____
in the Province of Ontario)
)
this day of , 2005)
)

A Commissioner, etc.

SECTION 6

LAND MATTERS

NPS 36 Pipeline

68. The proposed NPS 36 pipeline connects to the 156 Compressor Station at Lot 31, Concession 1, Dawn-Euphemia Township, and runs southerly to Dawn in Lot 26, Concession 2, Dawn-Euphemia Township.

69. Union requires approximately 6.0 hectares of permanent easement for the proposed pipeline. Section 6-Schedule 1 lists the names and addresses of all affected landowners and the dimensions of the permanent easements required. As of the date of filing, Options for the four permanent easements have been obtained.

70. Union's Grant of Easement form which is attached as Section 6-Schedule 2 is the form developed following the EB-2005-0550 Strathroy-Lobo TFEP hearing.

71. Union will require approximately 2.0 hectares of temporary easement for the proposed construction. The affected landowners and dimensions of temporary easement are also outlined in Section 6-Schedule 1. Union will employ the Temporary Land Use Agreement form previously approved by the Board and used by Union in the past on pipeline projects. These agreements are for a period of two years. This period allows Union an opportunity to return following construction to perform further clean-up work as required.

72. At the conclusion of construction, Union will seek a Full and Final Release from each of the directly affected landowners. This Release covers any compensation for actual damages resulting from the pipeline construction.

73. Union will also use a Letter of Understanding ("LOU") between Union and landowners for the project, and specifically the form of the LOU employed in the Strathroy-Lobo project referred to in paragraph 70. The LOU outlines compensation, damage mitigation, clean-up, and restoration policies to be implemented for the project. It also constitutes a framework for

individual landowner negotiations. The LOU is structured so that common concerns can be addressed in a consistent and mutually-acceptable fashion.

74. The LOU provides a benchmark for individual negotiations for land rights. If necessary, updates or site-specific reports by mutually-acceptable appraisers will be paid for by Union to resolve questions of land values.

75. During individual negotiations with affected landowners, property-specific matters of compensation for land rights and anticipated damages, as well as site-specific mitigation measures will be settled. These measures are documented in the LOU.

Well Drilling, Roads and Gathering Lines

76. Drilling of wells, construction of roadways, and construction of gathering pipelines within the DSA will be undertaken pursuant to existing Storage Lease Agreements with the landowners.

77. In the 156 Pool, wells will be drilled on the Ronald and Richard Clubb, Adelle Stewardson and Frank and Martha Wilson properties. The 59-85 Pool wells will be drilled on properties owned by Eunice Aitken and Lisa Pleau and Union Gas Limited. The location of wells can be found in Section 4-Schedules 1 and 2. Copies of the Storage Lease Agreements for these landowners can be found at Section 6-Schedule 3.

78. Permanent all-weather roadways are required to accommodate vehicular traffic to the existing and proposed well locations and will be used on an ongoing basis during and following construction. These access roads will be used where possible for construction and maintenance of the gathering pipelines in order to minimize environmental disturbance. The location of the access roads is shown in Section 6-Schedule 4.

79. Letters of Acknowledgement stating that there is no objection to the commencement of drilling of the wells and construction of the permanent all-weather access roads in the locations proposed have been presented to each landowner. Signed Letters of Acknowledgment have been received from all landowners and are included as Section 6-Schedule 4.

Province of Ontario

Schedule

Form 5 — Land Registration Reform Act

Additional Property Identifier(s) and/or Other Information

This is an Easement in Gross

EASEMENT FOR TRANSMISSION PIPELINE

WHEREAS the Transferor is the owner in fee simple of those lands and premises more particularly described as (herinafter called the "Transferor's lands").

WHEREAS the Transferee is the owner in fee simple of those lands and premises (hereinafter called the "Transferee's lands") situate, lying and being in the geographic Township of Dawn, now Township of Dawn-Euphemia, in the County of Lambton and Province of Ontario and being composed of the west half (w1/2) of Lot Number 25 in the 2nd Concession of the said Township.

The Transferor (and the Mortgagee) do hereby GRANT, CONVEY, TRANSFER AND CONFIRM unto the Transferee, its successors and assigns, to be used and enjoyed as appurtenant to all or any part of the lands of the Transferee's lands the right, liberty, privilege and easement on, over, in, under and/or through a strip of the Transferor's lands more particularly described in Box 5 of page one of this Schedule (hereinafter referred to as the "Lands") to survey, lay, construct, maintain, inspect, patrol, alter, remove, replace, reconstruct, repair, move, keep, use and/or operate one pipe line for the transmission of pipeline quality natural gas as defined in The Ontario Energy Board Act S.O. 1998 (hereinafter referred to as the "Pipeline") including therewith all such buried attachments, equipment and appliances for cathodic protection which the Transferee may deem necessary or convenient thereto, together with the right of ingress and egress at any and all times over and upon the Lands for its servants, agents, employees, those engaged in its business, contractors and subcontractors on foot and/or with vehicles, supplies, machinery and equipment for all purposes necessary or incidental to the exercise and enjoyment of the rights, privileges and easement hereby granted. The Parties hereto mutually covenant and agree each with the other as follows:

1. In consideration of the sum of 00/100 DOLLARS ($) of lawful money of Canada (hereinafter called the "Consideration"), which sum is payment in full for the rights and interest hereby granted and for the rights and interest, if any, acquired by the Transferee by expropriation, including in either or both cases payment in full for all such matters as injurious affection to remaining lands and the effect, if any, of registration on title of this document and where applicable, of the expropriation documents, subject to Clause 12 hereof to be paid by the Transferee to the Transferor at least 30 days prior to the exercise by the Transferee of any of its rights hereunder other than the right to survey, the rights, privileges and easement hereby granted shall continue in perpetuity or until the Transferee, with the express written consent of the Transferor, shall execute and deliver a surrender thereof . Prior to and following such surrender Transferee shall remove all debris as may have resulted from the Transferee's use of the Lands from the Lands and in all respects restore the Lands to it's previous productivity and fertility so far as is reasonably possible, save and except for items in respect of which compensation is due under Clause 2 hereof. As part of the Transferee's obligation to restore the lands upon surrender of its easement, the Transferee agrees at the option of the Transferor to remove the Pipeline from the Lands. The Transferee and the Transferor shall surrender the easement and the Transferee shall remove the Pipeline at the Transferor's option where the Pipeline has been abandoned. The Pipeline shall be deemed to be abandoned where: a) corrosion protection is no longer applied to the Pipeline, or, b) the Pipeline becomes unfit for service in accordance with Ontario standards. The Transferee shall, within 60 days of either of these events occurring, provide the Transferor with notice of the event. Upon removal of the Pipeline and restoration of the Lands as required by this agreement, theTransferor shall release the Transferee from further obligations in respect of restoration. This provision shall apply with respect to all Pipelines in the Dawn-Trafalgar system on the Transferor's Lands.

2. The Transferee shall make to the Transferor (or the person or persons entitled thereto) due compensation for any damages to the Lands resulting from the exercise of any of the rights herein granted, and if the compensation is not agreed upon by the Transferee and the Transferor, it shall be determined by arbitration in the manner prescribed by the Expropriations Act, R.S.O. 1990, Chapter E-26 or any Act passed in amendment thereof or substitution therefor. Any gates, fences, municipal drains, and tile drains interfered with by the Transferee shall be restored by the Transferee at its expense as closely as reasonably possible to the condition and function in which they existed immediately prior to such interference by the Transferee and in the case of tile drains, such restoration shall be performed in accordance with good drainage practice.

FOR OFFICE USE ONLY

Additional Property Identifier(s) and/or Other Information

3. The Pipeline (including attachments, equipment and appliances for cathodic protection but excluding valves, take-offs and fencing installed under Clause 9 hereof) shall be laid to such a depth that upon completion of installation it will not obstruct the natural surface run-off from the Lands nor ordinary cultivation of the Lands nor any tile drainage system existing in the Lands at the time of installation of the Pipeline nor any planned tile drainage system to be laid in the Lands in accordance with standard drainage practice, if the Transferee is given at least thirty (30) days notice of such planned system prior to the installation of the pipeline; provided that the Transferee may leave the pipeline exposed in crossing a ditch, stream, gorge or similar object where approval has been obtained from the Ontario Energy Board or other Provincial Board or authority having jurisdiction in the premises. The Transferee agrees to make reasonable efforts to accommodate the planning and installation of future tile drainage systems following installation of the pipeline so as not to obstruct or interfere with such tile installation.
The Transferee further agrees to make reasonable efforts at its own expense to accommodate changes in land use on lands adjacent to the easement for the purpose of ensuring the Pipeline is in compliance with all applicable regulatory requirements in connection with any such change in use.

4. As soon as reasonably possible after the construction of the Pipeline, the Transferee shall level the Lands and unless otherwise agreed to by the Transferor, shall remove all debris as may have resulted from the Transferee's use of the Lands therefrom and in all respects restore the Lands to its previous productivity and fertility so far as is reasonably possible, save and except for items in respect of which compensation is due under Clause 2 hereof.

5. The Transferee shall indemnify the Transferor for any and all liabilities, damages, costs, claims, suits and actions which are directly attributable to the exercise of the rights hereby granted, except to the extent of those resulting from the gross negligence or willful misconduct of the Transferor.

6. In the event that the Transferee fails to comply with any of the requirements set out in Clause 2, 3, or 4 hereof within a reasonable time of the receipt of notice in writing from the Transferor setting forth the failure complained of, the Transferee shall compensate the Transferor (or the person or persons entitled thereto) for any damage, if any, necessarily resulting from such failure and the reasonable costs if any, incurred in the recovery of those damages.

7. Except in case of emergency, the Transferee shall not enter upon any lands of the Transferor, other than the Lands, without the consent of the Transferor. In case of emergency the right of entry upon the Transferor's lands for ingress and egress to and from the Lands is hereby granted. The determination of what circumstances constitute an emergency, for purposes of this paragraph is within the absolute discretion of the Transferee, but is a situation in which the Transferee has a need to access the pipeline in the public interest without notice to the Transferor, subject to the provisions of paragraph 2 herein. The Transferee will, within 72 hours of entry upon such lands, advise the Transferor of the said emergency circumstances and thereafter provide a written report to Transferor with respect to the resolution of the emergency situation.

8. The Transferor shall have the right to fully use and enjoy the Lands except for planting trees over a six (6) metre strip centered over the Pipeline, and except as may be necessary for any of the purposes hereby granted to the Transferee, provided that without the prior written consent of the Transferee, the Transferor shall not with mechanical equipment or explosives excavate, drill, install, erect or permit to be excavated, drilled, installed or erected in, on, over or through the Lands any pit, well, foundation, pavement, building, mobile homes or other structure or installation. Notwithstanding the foregoing the Transferee upon request shall consent to the Transferor erecting or repairing farm fences, constructing or repairing his tile drains and domestic sewer pipes, water pipes, and utility pipes and constructing or repairing his lanes, roads, driveways, pathways, and walks across, on and in the Lands or any portion or portions thereof, provided that before commencing any of the work referred to in this sentence the Transferor shall (a) give the Transferee at least three (3) clear days notice in writing pointing out the work desired so as to enable the Transferee to evaluate and comment on the work proposed and to have a representative inspect the site and/or be present at any time or times during the performance of the work, (b) shall follow the instructions of such representative as to the performance of such work without damage to the Pipeline, (c) shall exercise a high degree of care in carrying out any such work and, (d) shall perform any such work in such a manner as not to endanger or damage the Pipeline as may be required by the Transferee.

FOR OFFICE USE ONLY

Additional Property Identifier(s) and/or Other Information

9. The rights, privileges and easement herein granted shall include the right to install, keep, use, operate, service, maintain, repair, remove and/or replace in, on and above the Lands any valves and/or take-offs subject to additional agreements and to fence in such valves and/or take-offs and to keep same fenced in, but for this right the Transferee shall pay to the Transferor (or the person or persons entitled thereto) such additional compensation as may be agreed upon and in default of agreement as may be settled by arbitration under the provisions of The Ontario Energy Board Act, S.O. 1998, or any Act passed in amendment thereof or substitution therefor. The Transferee agrees to make all reasonable efforts to locate such facilities adjacent to lot lines and public road allowances. The Transferee shall keep down weeds on any lands removed from cultivation by reason of locating any valves and/or take-offs in the Lands.

10. Notwithstanding any rule of law or equity and even though the Pipeline and its appurtenances may become annexed or affixed to the realty, title thereto shall nevertheless remain in the Transferee.

11. Neither this Agreement nor anything herein contained nor anything done hereunder shall affect or prejudice the Transferee's rights to acquire the Lands or any other portion or portions of the Transferor's lands under the provisions of The Ontario Energy Board Act, S.O. 1998, or any other laws, which rights the Transferee may exercise at its discretion in the event of the Transferor being unable or unwilling for any reason to perform this Agreement or give to the Transferee a clear and unencumbered title to the easement herein granted.

12. The Transferor covenants that he has the right to convey this easement notwithstanding any act on his part, that he will execute such further assurances of this easement as may be requisite and which the Transferee may at its expense prepare and that the Transferee, performing and observing the covenants and conditions on its part to be performed, shall have quiet possession and enjoyment of the rights, privileges and easement hereby granted. If it shall appear that at the date hereof the Transferor is not the sole owner of the Lands, this Indenture shall nevertheless bind the Transferor to the full extent of his interest therein and shall also extend to any after-acquired interest, but all moneys payable hereunder shall be paid to the Transferor only in the proportion that his interest in the Lands bears to the entire interest therein.

13. In the event that the Transferee fails to pay the consideration as hereinbefore provided, the Transferor shall have the right to declare this easement canceled after the expiration of 15 days from personal service upon the Secretary, Assistant Secretary or Manager, Lands Department of the Transferee at its Executive Head Office in Chatham, Ontario, (or at such other point in Ontario as the Transferee may from time to time specify by notice in writing to the Transferor) of notice in writing of such default, unless during such 15 day period the Transferee shall pay the said consideration; upon failing to pay as aforesaid, the Transferee shall forthwith after the expiration of 15 days from the service of such notice execute and deliver to the Transferor at the expense of the Transferee, a valid and registerable release and discharge of this easement.

14. All payments under these presents may be made either in cash or by cheque of the Transferee and may be made to the Transferor (or person or persons entitled thereto) either personally or by mail. All notices and mail sent pursuant to these presents shall be addressed to the Transferor at and to the Transferee at Union Gas Limited, 50 Keil Drive North, Chatham, Ontario N7M 5M1, Attention: Manager, Lands or to such other address in either case as the Transferor or the Transferee respectively may from time to time appoint in writing.

15. The rights, privileges and easement hereby granted are and shall be of the same force and effect as a covenant running with the land and this Indenture, including all the covenants and conditions herein contained, shall extend to, be binding upon and enure to the benefit of the heirs, executors, administrators, successors and assigns of the Parties hereto respectively; and, wherever the singular or masculine is used it shall, where necessary, be construed as if the plural, or feminine or neuter had been used, as the case may be. The Transferee shall not assign this agreement without prior written notice to the Transferor and, despite any such assignment, the Transferee shall remain liable to the Transferor for the performance of its responsibilities and obligations hereunder.

FOR OFFICE USE ONLY

Province of Ontario

Schedule
Form 5 — Land Registration Reform Act

Additional Property Identifier(s) and/or Other Information

16. The Mortgagee in Mortgage/Charge Number , in consideration of the sum of Two Dollars ($2.00) the receipt whereof is hereby acknowledged, joins herein for the purpose of consenting hereto and agrees to the easement hereby granted and covenants that the Transferee shall have quiet possession of the rights, privileges and easements hereby granted. The Mortgagee certifies that the Mortgagee is at least eighteen years old.

_____
(Name of Mortgagee)

Witness:

(Per: _____

Date of Signature _____

(Per: _____

Date of Signature

"I/we have authority to bind the corporation."

FOR OFFICE USE ONLY

Additional Property Identifier(s) and/or Other Information

Municipality of Chatham-Kent

Province of Ontario

DECLARATION REQUIRED UNDER
SECTION 50 OF THE PLANNING
ACT, R.S.O. 1990, as amended

I, Beverly Howard Wilton, of the Municipality of Chatham-Kent, in the Province of Ontario.

DO SOLEMNLY DECLARE THAT

1. I am Manager, Lands Department of Union Gas Limited, the Transferee in the attached Grant of Easement and as such have knowledge of the matters herein deposed to.

2. The use of or right in the land described in the said Grant of Easement is being acquired by Union Gas Limited for the purpose of a hydrocarbon transmission line within the meaning of part VI of the Ontario Energy Board Act , 1998.

AND I make this solemn declaration conscientiously believing it to be true and knowing that it is of the same force and effect as if made under oath, and by virtue of The Canada Evidence Act.

DECLARED before me at the
Municipality of Chatham-Kent,
in the Province of Ontario
this day of , 2005

A Commissioner, etc.

FOR OFFICE USE ONLY

Attachment 5

National Energy Board | Office national de l'énergie

Canada

National Energy Board

Pipeline Abandonment Physical Issues Committee - Key Abandonment Issues Summary

1. Ground Subsidence
2. Prevention of Pipeline Collapse Under Railways and Roads
3. Additional Abandonment Issues
4. Post-Abandonment Issues

Potential Abandonment Knowledge Gaps

1. Ground Subsidence

There is a valid assumption that if a pipeline is left in the ground with no cathodic protection that it will deteriorate over time and potentially cause a surface disturbance in the form of ground subsidence. The gaps in knowledge on this topic include:

- How does a pipe collapse mechanism occur?
- What are contributing factors to pipe collapse (corrosion rates, size of pipes etc.)?
- What are the regional effects of soil conditions on structural failure of buried pipe (moisture, consolidation, porosity, climate etc.)?
- Does subsidence occur over a very long time and if so will it be noticeable on the ground surface?
- Is there a relationship between farm machinery and pipe collapse in fields?
- What is the potential for subsurface animal habitat being established and causing settlement?
- In what situations should the removal of pipeline or abandonment-in-place be given priority?
- What would be the best means of removing various sizes of pipe and what would be the estimated reclamation needs?
- Is there any low cost means of filling pipelines?

2. Prevention of Pipeline Collapse Under Railways and Roads

The options available for abandoning a pipeline under a road or railway include removing the pipe, filling it and leaving it as is. Gaps in knowledge include:

- The degree of subsidence of replacement material that occurs if a pipe is removed versus settlement from corrosion of a pipeline remaining in place.
- What are the tolerance for settlement under a transportation corridor and the recommended approach for different magnitudes of roads and railways?
- What design considerations should be incorporated in new designs to accommodate abandonment under transportation corridors?
- If filling is to occur what is the recommended procedure?
    - The types of fill material that could be used and their effectiveness.
    - If filling a pipeline is to occur should it be throughout the right of way?
- There is a lack of knowledge on the effects of pipe deterioration under a corridor depending on:
    - vehicle loading by type and frequency,
    - use of pipe sleeves,
    - the type of surface on the road, and
    - the size of pipe.
- The amount of increased corrosion due to factors such as vibration and drainage.

3. Additional Abandonment Issues

The period for abandonment is normally from the end of a pipe's useful life to the point where the owner has completed all required work to make the pipeline meet abandonment requirements. Typically all above ground facilities are removed and water crossings are to be dealt with in a fashion that prevents pipes from floating or becoming avenues for contamination (plugging is recommended). However, the following gaps in knowledge for this phase include:

a. Pipe Cleanliness

- What is an acceptable level of pipe cleanliness?
- Need research to identify all potential contaminants and quantify acceptable levels.
    - Run pigs and then measure residue.

- Measure residue on abandoned pipe.
- Accelerate internal coating decomposition.

- Is conventional cleaning procedure acceptable?

b. Right of Way Contamination

Some contamination is expected at pump stations, compressor stations, tank farms and documented spills. The NEB will determine the acceptable risk through the public hearing process and then clean up will be to standards of the day for that jurisdiction. Gaps in knowledge are:

- Given that the degree of clean up is dependent on land use;
  - Can a cross-Canada standard be arrived at to apply to all pipelines for remediation under each land use?
  - What if land use changes?
  - What assurance is there that crops will not be affected?
  - What assurance is there that agricultural workers would not be affected?
  - Is a change in standards retroactive?
- Is it possible to have the clean up exceed minimum requirements?
- What is the risk to groundwater and soil from undetected leaks?
- What would be the anticipated natural degradation of contaminants?
- How to document that contamination was cleaned up?
  - facilitates environmental assessments and land transfers.
- What are the effects of external pipe coating degradation?

4. Post-Abandonment Issues

Following physical pipeline abandonment work the pipeline enters a post-abandonment phase that lasts until either the pipeline is removed or there are no further issues. Issues of ground subsidence and transportation corridor protection have already been identified. There have been concerns expressed relating to liability, financial responsibility and jurisdiction. These are generally beyond the scope of the committee. However, some relate to being able to address physical issues. Other physical issues and potential gaps in knowledge include the following:

- The location and maintenance of records regarding the residual pipeline equipment.

- The means of ensuring signage, pipe locates and ongoing monitoring occurs.
- The mechanism to ensure land title retains the ROW when necessary. (preferred regulatory jurisdiction)
- Means of dealing with unforeseen contaminants found after abandonment (this is related to the NEB initiative to address financial issues through companies setting aside funds).
- Potential for frost heave of pipes when not in use under different soil conditions.
- What criteria should be in place for creation of a road over an abandoned pipeline?
- What approach is recommended where a land use change means a development or house is to be put over a pipeline?
- How to determine the optimum location for pipeline plugs to prevent pipelines from becoming water conduits (potentially carrying contaminated water and causing erosion).

Date Modified: 2011-10-28

DET NORSKE VERITAS

PIPELINE ABANDONMENT SCOPING STUDY

NATIONAL ENERGY BOARD (NEB)

Report No.: EP028844
Reg No.: ENACA855
November 2010

Table of Contents

EXECUTIVE SUMMARY **1**

1 INTRODUCTION **2**

2 APPROACH **2**

3 BACKGROUND **3**

3.1 PAST STUDIES 3

4 RESULTS OF LITERATURE REVIEW **8**

4.1 CODES AND STANDARDS 8
4.2 ENVIRONMENTAL & LAND USE 9
4.3 GEOTECHNICAL 24
4.4 ENGINEERING 28

5 RECOMMENDATIONS FOR FURTHER STUDIES **33**

5.1 ENVIRONMENTAL & LAND USE 33
5.2 GEOTECHNICAL 45
5.3 ENGINEERING 50

6 REFERENCES **52**

APPENDIX A - REVIEW OF RELEVANT PIPELINE CODES **74**

APPENDIX B - ALTERNATIVE RETIREMENT OPTION MATRICES **83**

EXECUTIVE SUMMARY

Det Norske Veritas (DNV) together with TERA ENVIRONMENTAL CONSULTANTS and BGC ENGINEERING INC. were contracted by the National Energy Board (NEB) to conduct a literature review regarding the current understanding worldwide with respect to the physical/technical issues associated with onshore pipeline abandonment and use the results of the literature review to critically analyze and identify gaps in current knowledge, and make recommendations as to potential future research projects that could help to fill those gaps.

The project team conducted the literature review based on more than 100 key words applicable to pipeline abandonment. Various combinations of these key words were used to search for published information dealing with issues associated with pipeline abandonment. More than 430 abstracts of published papers were reviewed and these were narrowed down to 83 relevant documents, which were obtained for more detailed reviews by the subject matter experts (SMEs). In addition, various standards from North America, South America, Australia, Europe, and the United Kingdom were reviewed for requirements specific to pipeline abandonment.

Based on the review of these documents by the SMEs, this report outlines the current level of knowledge regarding issues related to pipeline abandonment; identifies the knowledge gaps and, in Section 5, outlines additional research topics that could be completed in order to address the knowledge gaps. Topics recommended for additional study include:

Recommended Study	Estimated Cost
Detection of Residual Contamination	$140,000
Risk Assessment	$50,000
Decomposition of Pipe Materials	$25,000
Cleaning Methods and Disposal of Cleaning Fluids	$200,000
Abandonment under Water Bodies	$350,000
Pipeline Exposure Data from Existing Records	$50,000
Buoyancy Effects on Pipeline Exposure	$75,000
Standard Pipeline Products List	$25,000
Frost Heave Effects on Pipeline Exposure	$50,000/yr.
Evaluation of Previous Pipeline Abandonment programs	$100,000 plus $25,000/yr.
Collapse of Soil Under Various Conditions	$300,000
Validation of Culvert Failure Model for Abandoned Pipelines	$40,000
Validation of Structural Integrity Models	$30,000

1 INTRODUCTION

On July 6, 2010, the National Energy Board (NEB) issued a Request for Proposal (RFP) for the completion and submission of a pipeline abandonment study. The RFP indicated that a multi-stakeholder Pipeline Abandonment Physical Issues Committee wished to address specific gaps in knowledge or other issues related to the physical aspects of onshore pipeline abandonment related to both landowner and industry interests. This would include but not be limited to studies or research related to:

- Ground subsidence and frost heave;
- Soil and groundwater contamination;
- Pipe cleanliness;
- Road, railway and utility crossings;
- Water crossings;
- Erosion; and
- Creation of conduits.

The objectives of this project were to conduct a literature review regarding the current understanding worldwide with respect to the physical/technical issues associated with onshore pipeline abandonment and use the results of the literature review to critically analyze and identify gaps in current knowledge, and make recommendations as to potential future research projects that could help to fill those gaps.

Det Norske Veritas (DNV) partnered with TERA ENVIRONMENTAL CONSULTANTS and BGC ENGINEERING INC. to submit a proposal in response to the RFP and on 4, August 2010, the project team was awarded the contract.

2 APPROACH

To conduct the literature review, subject matter experts (SMEs) in Engineering, Environmental, and Geotechnical issues identified the keywords that were used to conduct the literature searches. Additional keywords were also provided by members of the NEB's Pipeline Abandonment Physical Issues Subcommittee. Based on the keyword list, titles of papers and related abstracts were identified through the literature searches. The literature searches were performed using two search engines; Engineering Village and Science Direct. Engineering Village searches all areas of engineering and includes the article abstract databases COMPENDEX and NTIS. Science Direct is a product of Elsevier B. V. and contains over 10 million articles and book chapters in the fields of science, technology, and medicine. Subject matter experts reviewed the results of the literature searches and identified specific references they considered to be potentially relevant to the study. The identified papers were then obtained and the SMEs reviewed the papers applicable to their subject area.

DNV provided overall project management as well as the SMEs to address the Engineering issues identified for the project. TERA provided SMEs to address the Environmental issues. BGC provided SMEs to address the Geotechnical issues. Land Management issues were addressed by all SMEs as applicable.

This report outlines the results of the literature review, identifies knowledge gaps, and provides scoping for further studies and research on physical abandonment issues related to onshore pipelines in Canada.

3 BACKGROUND

3.1 Past Studies

Pipeline abandonment has been a topic of discussion in the Canadian oil and gas industry for over 25 years. This summary is taken from the NEB's Land Matters Consultation Initiative, Stream 4 – Pipeline Abandonment - Physical Issues, and is based on three previous studies undertaken in 1985, 1996, and 1997.

In 1985, NEB staff reviewed technical, environmental, and financial issues associated with pipeline abandonment (the 1985 NEB Staff Paper). In 1996, the Pipeline Abandonment Steering Committee, a collaboration of the NEB, Alberta Energy Utilities Board (EUB), Canadian Energy Pipeline Association (CEPA) and Canadian Association of Petroleum Producers (CAPP), developed a discussion paper (the 1996 Discussion Paper) that examined the physical and technical issues associated with abandonment. In particular, this latter paper provides a template for abandonment planning and implementation. In 1997, the same collaboration examined legal issues relating to abandonment (the 1997 Legal Paper).

In addition, as part of the process of developing the 1996 Discussion Paper, the Pipeline Abandonment Steering Committee commissioned four reviews of specific technical issues. The reviews examine trace pipeline contaminants, corrosion, pipeline related subsidence and environmental issues respectively and are also referenced herein.

Physical and technical issues of retirement and reclamation can be organized into six principal sections:
1. Retirement options;
2. Engineering issues;
3. Land use considerations;
4. Environmental issues;
5. Post-abandonment; and
6. Principles for pipeline abandonment.

1. Retirement Options

Three approaches to pipeline retirement are possible:
a) Removal
b) Abandonment in-place
c) Reuse of facilities

Pipeline Retirement Option Matrix - a key factor influencing the choice of retirement options is present and future land use. This is reflected in the Table below, which provides a matrix adapted from the 1985 paper.

Retirement Option Matrix[1] (from PADP 1996)

Land Use		Pipeline Diameter			
		60.3 to 203 mm (2" – 8")	273 to 550 mm (10" to14")	406 to 550 mm (16" – 20")	610 to 1219 mm (24" to 48")
Agricultural	Crop	A	R	R	R
	Crop (with depth of cover considerations)	R	R	R	R
	Pasture (inc. native prairie & rangeland)	A	R	R	R
Non-Agricultural	Rock	A	A	A	A^+
	Till	A	A	A	A^+
	Cohesive Soil	A	A	A	A^+
	Granular Soil	A	A	A	A^+
	Wetlands	A^+	A^+	A^+	A^+
Urban	Suburban	A	A	A^+	A^+
	Park	A	A	A^+	A^+
	Urban	A	A^+	S	S
	Industrial	A	A^+	S	S
Crossings	River	A	A^+	A^+	A^+
	River Approaches	A	S	S	S
	Rail	A	A^+	A^+	A^+
	Road	A	A^+	A^+	A^+
	Secondary Road	A	A	A^+	A^+
	Pipeline	A	S	S	S
	Sewer	A	A	A^+	A^+
	Cable	A	A	A^+	A^+

1

Option	Description
A	Abandon in-place recommended
A^+	Abandon in-place with special treatment to prevent ground subsidence.
R	Remove pipe
S	Site-specific evaluation recommended

Note: CEPA and NEB have developed updated Retirement Option Matrices which are included Appendix B of this report.

2. Engineering Issues

a) Corrosion

The 1996 Discussion Paper and an associated corrosion study examined the causes and timing of corrosion associated with abandoned pipelines. The Corrosion Study suggested that, while coating defects affect less than one percent of the length of most pipelines, corrosion will eventually result in random perforations throughout the length of the pipeline.

b) Pipeline collapse

As the pipe becomes pitted with corrosion, it will eventually collapse. Collapse may have few consequences for small-diameter pipes (6"/168 mm or less). However, collapse of large diameter pipes can lead to subsidence, which in environmentally or geo-technically sensitive areas would require back-filling and restoration. Given the non-uniform nature of the corrosion process, it is unlikely that significant lengths of pipeline will collapse at any one time.

The 1985 NEB Staff Paper suggests options for managing concerns for large diameter pipeline collapse that includes developing a tool to collapse a line prior to abandonment and/or filling a line, or at least critical sections of it (e.g. stream crossings, under railways), with a liquid that can solidify (e.g. cement).

3. Land Use Considerations

As the previously referred to reviews have concluded, land use is the most important factor to consider when determining whether to remove a pipeline section or abandon it in place. Of particular concern are sensitive areas, including:

- Native prairie;
- Parks and ecological reserves;
- Unstable or highly erodible slopes;
- Water crossings
- Areas susceptible to wind erosion;
- Irrigated land; and,
- Road, railway, and other utility crossings.

The pipeline industry must manage these issues and land use in general within three types of land rights: easement; fee simple; and leasehold lands.

4. Environmental Issues

Both the 1985 NEB Staff Paper and the 1996 Discussion Paper examine the environmental issues associated with pipeline retirement. The 1996 report is based, in part, on a review of environmental issues for pipeline retirement commissioned by the Pipeline Abandonment Steering Committee.

a) Soil and groundwater contamination
The Committee also commissioned a study to examine the types and quantities of contaminants that could be released from pipelines abandoned in-place.
Potential sources of contamination that were identified include:
• Substances in the hydrocarbon stream;
• Pipe treatment chemicals;
• Pipeline coatings and their degradation products;
• Historical leaks and spills of product not cleaned up to current standards;
• Pump and compressor lubricants, some of which could contain PCBs from past use.

Contamination risks are arguably greatest for pipelines abandoned in-place. The pipe will eventually be perforated by corrosion, allowing contaminants to migrate into the surrounding environment. Potential also exists for corroded pipe to act as a water conduit, transporting any contaminants present to other points along the pipeline. The cleanliness of the pipe is an important factor relating to potential soil and/or groundwater contamination from abandoned pipe. The 1996 Discussion Paper indicates that the question of "how clean is clean" remains to be answered.

b) Soil resources
Where pipe is to be removed, the erosion issues will be similar to those associated with installation.
Abandonment in-place can lead to erosion in two ways. Corrosion perforated pipe can conduct water along the right-of-way to exit the pipeline in new locations. Later, as the pipeline collapses, resultant soil subsidence can create water conduits able to intercept and channel drainage along the right-of-way, potentially, at much greater velocities than natural drainage patterns would allow.
To examine ground subsidence risks for abandoned pipelines the Pipeline Abandonment Steering Committee commissioned both a geotechnical study and a survey of pipeline companies. Neither the industry survey nor follow-up discussions identified any instances of observed subsidence. However, the Committee recommended that a field observation program be put into place that would allow tolerance criteria to be developed. This remains to be done.

c) Creation of water conduits
The potential for pipelines to create water conduits as a result of abandonment creates risks of unnatural drainage and unwanted transport of materials that can include eroded soils and contaminants. Some potential exists for water movement in un-compacted, back-filled trench material that may remain after the pipe has been removed. However, the greatest concern relates to pipelines abandoned in place.
The 1996 Discussion Paper identifies measures such as pipeline plugs and trench breakers for managing the risk of undue water mobility. The material suggests that this issue is understood and manageable.

d) Pipeline water crossings
Even after pipeline retirement, water crossings remain a key environmentally sensitive location on pipeline rights-of-way. While the water quality, fisheries and geomorphology issues associated with pipeline water crossings are well documented, most work is primarily from the point of view of pipeline installation.
Pipes abandoned in-place at water-crossings could contaminate surrounding water as corroded pipe fails and/or the pipe could be exposed. Pipe can be exposed in streams by stream bank erosion and migration, scouring of the stream channel and by other similar erosion mechanisms. Pipes may be exposed in still waters and wetlands because of pipe buoyancy if control mechanisms (e.g. concrete saddle weights) fail.

5. Post-Retirement
The 1996 Discussion Paper provides a concise template for retirement planning together with information on addressing the principal technical and environmental issues. A major issue identified was the responsibility for monitoring and maintenance. The 1997 Legal Paper examines legal issues associated with retirement and focuses much of its attention on the issue of ongoing responsibility for the retired pipeline right-of-way. The Legal Working Group concluded that "*in the absence of an express provision to impose conditions which would continue after the abandonment order comes into effect, [*the NEB concluded*] that it has no authority to attach conditions subsequent to an abandonment order"*. In response, to the extent that it has had to address the retirement, the Board has adopted an approach that requires regulated pipelines to satisfy conditions precedent before a retirement can take effect.

6. Summary of Outstanding Issues
a) How clean is clean?
The 1996 Discussion Paper identifies the lack of allowable threshold criteria for contaminants as a gap.

b) Corrosion and its effects
A better understanding of the rate of corrosion in various soil types and the effects of corrosion on surrounding soil is required. Also, the actual collapse mechanism of a retired pipeline failing due to corrosion is not known hence its effect on subsidence remains unknown.

c) Practical experience with pipeline related soil subsidence.
While the Pipeline Abandonment Committee undertook an industry survey in 1996, looking for examples of pipeline related soil subsidence, the responses provided little information. In response, the Paper recommended that a field investigation program be undertaken that could lead to the development of tolerance criteria for pipeline related soil subsidence.

d) Retirement of facilities at water crossings
Knowledge surrounding the impact of corrosion on water surrounding an abandoned-in place pipeline as well as the impacts of pipe exposure in a water crossing needs to be assessed.

e) The exact nature of the Board's jurisdiction and approach to retirement going forward. Responsibility for enforcing responses to problems that may occur on retired pipeline rights-of-way that was previously federally regulated appears uncertain. There may be steps that can be taken to clarify this gap.

4 RESULTS OF LITERATURE REVIEW

4.1 Codes and Standards

DNV has reviewed the code recommendations regarding pipeline abandonment, or "permanent de-commissioning" as it is known in the UK, from a variety of countries, including Canada and the United States, the United Kingdom, Australia and South America (Argentina and Chile, although no guidance is given in either of these codes). Full details, including quotations taken directly from codes, where applicable, are presented in Appendix A.

Essentially, no significant differences have been found between the various standards; all give general guidance on what pipeline operators must consider without going into detail. The majority of the standards reviewed stipulate that "the decision to abandon a section of piping, in place or through removal, shall be made on the basis of an assessment that includes consideration of current and future land use and the potential for safety hazards and environmental damage to be created by ground subsidence, soil contamination, groundwater contamination, erosion, and the creation of water conduits" or words to similar effect (the quotation is taken from CSA Z662-07).

CSA Z662-07 states, similar to most of the codes reviewed, that piping that is abandoned in place shall be:

(a) Emptied of service fluids;

(b) Purged or appropriately cleaned or both;

(c) Physically separated from any in-service piping; and

(d) Capped, plugged, or otherwise effectively sealed.

and that records shall be maintained of all piping that is abandoned in place. Such records shall include locations and lengths for each pipe diameter and where practical, burial depth.

Both ANSI/ASME B31.4 and B31.8 have very similar clauses.

With respect to UK standards, DNV has reviewed the national standard for gas pipelines, as well as the relevant ISO, European and national pipeline "standard" (the "standard" is in fact a British Standard "Published Document" as ISO and (on a hierarchal basis) European standards must be used in preference to British Standards). However, the authors have learnt that ISO and European standards are often regarded as overly generic, and companies will therefore invoke the requirements of all three "standards". Appendix A demonstrates that the requirements of

both the ISO and BS EN standards are very sparse, but more details are given in PD 8010-2004; again, the guidance is similar to the North American standards, although pipeline cover is stipulated, together with the need to consider using filler materials in certain abandoned sections. The standard for gas pipelines, IGEM TD/1/Version 5, within the UK gives more detail, including:

- Considerations of alternative uses for the (to be abandoned pipeline),
- Filling with inert gas if necessary,
- Land use and legal/landowner considerations,
- Future maintenance of the pipeline, e.g. to prevent possible collapse,
- The need for line markers, and
- The removal of short, above ground sections.

Finally, the Australian national standard AS 2885.3 has been reviewed, which is similar in outline to TD/1, although it states that line markers are not required after abandonment. It is the only standard reviewed which states that cathodic protection systems may need to be continued and the system maintained after pipeline abandonment. The standard also states that, before abandoning the pipeline, landowner releases for the completed abandonment must be obtained and the pipeline operator should relinquish the easement where no future or continuing use of the easement is proposed.

4.2 Environmental & Land Use

This Section presents a summary of the key documents forming the foundation of this report and a synopsis of all relevant documents discovered by the literature search completed as described in Section 2.

This section is structured to address the nine specific environmental components identified below:

- Detection of Residual Contamination
- Environmental Standards
- Risk Assessment
- Conduit Effect
- Decomposition of Pipe Material
- Cleaning Methods and Disposal of Fluids
- Disposal of Pipe Material
- Abandonment in Sensitive Ecological Areas
- Abandonment under Water Bodies

These topics were identified by the committee to address contamination remediation, reclamation, and protection of sensitive ecological areas. From an understanding of the past studies summarized in Section 3 and by careful review by subject matter experts (SMEs) of the subsequent literature, it is believed that the list of topics is comprehensive.

For each of the nine topics, the information gleaned by the SMEs is presented in the following sub-headings:

a) *Background Information* - The key background documents (Section 3) are well known to the National Energy Board (NEB) Pipeline Abandonment Physical Issues Committee so this sub-section is not intended to summarize those reports but rather present the key observations relevant to each of the 9 specific environmental components.

b) *Recent Findings* - This sub-section builds from the key background documents drawing on the information found in the literature review.

The purpose of this report is to identify the current state of knowledge with respect to pipeline abandonment and recommend to the NEB Pipeline Abandonment Physical Issues Committee, studies, research or tasks intended to fill knowledge gaps. The environmental recommendations are presented in Section 5.1. These have been developed by the SMEs from an understanding of the key background documents, this literature review and practical knowledge of current practice in the pipeline industry. In most instances, the authors have not attempted to suggest a priority for these tasks. We feel the NEB committee is better positioned to decide priorities.

The literature search discovered 83 documents that appeared relevant to onshore pipeline abandonment. Specifically, 36 appeared to have environmental themes. All of these are listed in Section 6 and any that offered discussion or recommendations that the environmental SMEs deemed meaningful are mentioned in this section.

4.2.1 Detection of Residual Contamination

Background Information

A number of different contaminants were identified as having the potential to be present in pipelines; however, the concern is the quantity of residual contaminants left in the interior of the pipeline at abandonment. Methods for analyzing levels of *known* contaminants in soil and water as a result of spills are well established. However, developing a methodology for accurately measuring the presence and quantity of contaminants remaining in a section of abandoned pipeline remain unclear.

A review of literature indicates that it was possible for polychlorinated byphenyls (PCBs) to have entered pipelines and peripheral facilities through the use of PCBs in lubricants at some point in the history of a pipeline system. Despite the cessation of use of PCBs for over 20 years, they can persist in the environment due to their chemical stability. Measurements of PCB concentrations along gas pipelines were not lending themselves to accurate conclusions, in part because there is no systematic protocol for ensuring comparable results. Consequently, proper management of

PCBs is difficult because estimations with respect to PCB concentrations along remaining pipelines cannot be produced. Estimating PCB concentrations is also made difficult due to the lack of information on PCB dynamics within pipeline systems.

Another potentially harmful substance present in both oil and gas pipelines is naturally occurring radioactive material (NORM). During the production process, NORM flows with the oil, gas, and water mixture and can accumulate in scale, sludge and scrapings within a pipeline. It can also form a thin film on the interior surfaces of gas processing equipment and vessels. The level of NORM accumulation can vary substantially from one facility to another depending on the geological formation, operational, and other factors.

As of 1996, little research had been done in terms of the development of guidelines for the testing and handling of NORM. In general, contaminant testing would be more efficient if the types and volumes relative to different pipeline products and locations within the distribution system were better understood.

The clean up of any spills, leaks, or contaminated sites must be conducted in accordance with prevailing regulatory requirements. Any pipeline failure resulting in a release of liquid having a volume greater than 1.5 m^3 must be reported by the pipeline operator pursuant to the NEB *Onshore Pipeline Regulations 1999* (OPR). Spills, as a result of pipeline failures and facility operation activities, are also reported to provincial regulators such as the Alberta Energy Resources and Conservation Board, Saskatchewan Energy and Resources and the British Columbia Oil and Gas Commission. Guidelines and procedures for managing spills and contaminated sites have also been established by federal and provincial regulators. However, very little information can be gathered regarding the occurrence of spills following the abandonment of pipelines as very few examples of abandonment projects exist in Canada (CEPA 2007).

Recent Findings

While conducting pipeline removal, Yukon Pipelines Limited collected soil samples every 100m along the pipeline for visual observations and organic vapour monitoring (Roblin 2006).

An example of a monitoring program set in place as part of a pipeline abandonment operation using *in-situ* biological degradation of certain contaminants is provided from the Schoonebeek Oilfield, Netherlands (Kant *et al.* 2010). It was found that, depending on the progress of the degradation process, the monitoring scheme was reconsidered and adjusted at regular intervals, and if disappointing remediation results occurred, a selected remediation alternative would be considered.

In 2008, the International Association of Oil and Gas Producers (IAOGP) released NORM guidelines specific to the oil and gas industry. Mentioned in the report is that NORMs can be either directly measured or assessed in a laboratory. In Canada, guidelines are present that cover NORM detection and handling procedures, as well as limits and exemption levels for the various radionuclides that may occur (Health Canada 2000). In the absence of national regulations,

current international practice will also provide such guidelines (International Atomic Energy Association [IAEA] 2010).

In a 1991 study entitled *Gas Research Institute* (GRI) *Pipeline Research Program* (Linz *et al.* 1991), the authors state that sampling and analytical procedures commonly used for PCBs by electric utilities and other industries do not apply well to gas pipelines. Further, the authors state that negotiations were ongoing at the time between the gas industry and the United States Environmental Protection Agency (EPA) regarding both development of a statistical model to use for system characterization, and a methodology or systematic protocol to quantify residual pipe contamination. At the time, the GRI was also conducting a method development task (to establish procedural methodology) using an assortment of contaminant types. In addition, GRI was studying the partitioning of PCB within different soil and water types. The study mentions that the EPA is moving toward a liquid sample based "moving average" approach as opposed to the expensive and time consuming 1% incidence approach for statistical analysis of PCB concentrations in pipelines.

In a study entitled *The TSCA PCB Regulations and Their Effect on Pipeline Removal and Abandonment Programs* (La Shier 1989), the author mentions the need for further development of statistical analysis techniques for measuring PCB concentrations in pipelines. A sound statistical model is needed because PCB concentrations vary considerably throughout the pipeline system.

A study was conducted regarding the statistical analysis of PCB data from natural gas pipelines, which aimed to further establish both a sound sample method and an understanding of statistical distribution of PCBs along pipelines (Bishop *et al.* 1990). However, due to the limited size and scope of the study, the authors felt it was "imprudent" to draw definitive conclusions regarding the implications of their results.

4.2.2. Environmental Standards

Background Information

The National Contaminated Sites Remediation Program (NCSRP) was administered through bilateral agreements between the federal government and participating provincial/territorial environment departments with the aim of developing a consistent, scientifically defensible and cost-effective assessment and remediation plan for contaminated sites (NCSRP 1993, Canadian Council of Ministers of the Environment (CCME) 2006). Canada-wide standards for soil quality guidelines have since been developed and are well established by the CCME at the closing stages of the NCSRP in 1995 (CCME 1999a). Generic guidelines have been derived to protect human health and key ecological receptors that sustain normal activities on four land use categories: agricultural, residential/parkland, commercial, and industrial. Generic land use scenarios are envisioned for each category based on how the land is used and on how sensitive and dependent the activity is on the land. Sensitivity to contamination increases among ecological or human

health components most dependent on land use activities (*i.e., agricultural and residential/parkland).*

Recent Findings

CCME's environmental soil quality guidelines were derived through the determination of the threshold level of effects for maintaining important ecological functions associated with specific land uses. Direct exposure to soil is the primary derivation procedure for environmental quality guidelines regarding residential/parkland, commercial, and industrial land uses. The Canadian soil quality guidelines have been derived specifically for protection of the ecological receptors in the environment and/or for the protection of human health associated with the identified land uses. Human health soil quality guidelines provide concentrations of contaminants in soil at or below which no appreciable human health risk is expected. The protection of human health takes into account the daily background exposure from air, water, soil, food, and consumer products. Indirect exposure pathways resulting from contaminated soils were also considered during the derivation of human health guidelines. In the case of agricultural land use, another derivation procedure is used based on soil and food ingestion (CCME 2006). CCME has established its Policy for the Management of Toxic Substances (1998) for the purpose of putting in place a results-based, accelerated action plan that all jurisdictions can utilize, and provides opportunity for public and stakeholder participation.

The CCME has several specific documents that aid in appropriate management and remediation of contaminated sites associated with the oil and gas industry.

The Canada-Wide Standards for Petroleum Hydrocarbons in Soil (PHC CWS) uses a three-tiered approach as a remedial standard for contaminated soil and subsoil occurring in four land use categories. The first tier is the direct adoption of Canadian soil quality guidelines (numerical limits [CCME 2007]) while the second tier allows limited modification of Canadian soil quality guidelines by setting site-specific objectives. The third tier uses risk assessment procedures to establish remediation objectives at contaminated sites on a site-specific basis (CCME 2008).

The Canadian Soil Quality Guidelines for carcinogenic and other polycyclic aromatic hydrocarbons (PAHs) contain recent scientific information on the chemical and physical properties of potentially carcinogenic and other commonly analyzed un-substituted PAHs, a brief review of sources and emissions in Canada, the expected environmental fate, and the toxicological significance of these PAHs to soil microbial processes, plants, animals and humans (CCME 2010).

The Canadian Soil Quality Guidelines for polychlorinated biphenyls (PCBs) contain guidelines for the protection of environmental health, but also recognizes a need for remediation guidelines as interim management objectives for persistent bio-accumulative substances in soils (CCME 1999b).

The Canadian Soil Quality Guidelines for benzene, toluene, ethylbenzene and xylene (BTEX) contain guidelines for the protection of environmental health (CCME 2004).

CCME has adopted a three-tired approach for dealing with contaminated site assessment and remediation. The first tier is the direct adoption of Canadian soil quality guidelines. However, the fact that some sites might present particular conditions (*e.g.*, high natural background concentrations, complex mixtures of contaminants, or unusual exposure scenarios) must also be considered. For these sites, the second tier allows limited modification of Canadian soil quality guidelines by setting site specific objectives. Finally, the third tier uses risk assessment procedures to establish remediation objectives at contaminated sites on a site-specific basis.

In July 2010, the NEB introduced the Draft Remediation Process Guide. This Guide describes the way a company can demonstrate that a contaminated site associated with an NEB regulated facility has met remediation criteria. This Guide applies to NEB-regulated facilities under the *National Energy Board Act* (NEB Act) and the *Canada Oil and Gas Operations Act* (COGOA). At a minimum this Guide applies to:

- Remediation of residual contamination in soil and groundwater to an appropriate standard;
- Remediation of all spill sites whether the spill is reportable or not;
- Off-site contamination remediation; and
- Historic contamination events.

The NEB accepts remediation criteria established by the province or territory where the remediation site is located as a baseline but requires the use of CCME standards if the criteria are more stringent. Remediation criteria must be selected based on the type of soil and land use. Typical land use categories are industrial, commercial, residential, parkland, and agricultural. Justification for the use of particular criteria must be provided.

Provincial governments have adopted the CCME standards with some provinces using the CCME guidelines as a platform from which further directives and guidelines have been established. For example, Alberta includes natural areas as an additional land use category (AENV 2009).

In a case study of the 1996 abandonment of a Yukon Pipelines Limited pipeline stretching from Whitehorse to Skagway, contaminated soils were compared with CCME criteria, and groundwater samples were compared with both the Yukon Contaminated Site Regulation and CCME drinking water criteria.

The Canadian Guidelines for the Management of NORM have been developed by the NORM Working Group, a working group of the Federal Provincial Territorial Radiation Protection Committee (FPTRPC), representing the interests of provincial and territorial regulators and includes affected industries in the petroleum production, fertilizer manufacturing and metal recycling industry sectors. With the support and encouragement of Health Canada and the Canadian Nuclear Safety Commission, the Canadian Guidelines set out principles and procedures for the detection, classification, handling, and material management of NORM in Canada, and also include guidance for compliance with federal transportation regulations. These

Guidelines provide the framework for the development of more detailed NORM management practices and guidelines by regulatory authorities, affected industries and specific workplaces.

4.2.3 Risk Assessment

Background Information

Conducting risk assessments for abandoned pipelines is a key procedure that should be implemented to ensure protection of ecological receptors and/or for the protection of human health. To start, abandoning a pipeline in-place must be weighed against the environmental impact of removal, and should be site specific (PADP 1996).

Components considered in a site-specific risk assessment are largely related to environmental variables that may jeopardize pipeline integrity, causing stress and/or corrosion related cracks and eventual disintegration, facilitating contamination release, water displacement, point source erosion and subsidence. Although assessment of risks associated with pipeline abandonment includes external environmental variables affecting pipeline integrity, it is the potential damage that toxic substances, if released, may have on particular receptors.

To begin a risk assessment, a field study of residual contaminants in pipelines prepared for abandonment should be conducted. The study should include the determination of the nature and quantity of residual contaminants for the range of operating conditions and products typically found in Alberta (Thorne *et al.* 1996). A risk management plan should then be developed and include factors such as: type of contaminants, differences in product, pipeline construction, operating conditions and environmental sensitivity, and lack of detailed information (Thorne *et al.* 1996).

As mentioned in Section 4.2.2, Canada-wide standards for soil quality guidelines have been developed and are well established by the CCME. The soil quality guidelines provide concentrations of contaminants in soil at or below which no appreciable human health risk is expected. The protection of human health takes into account the daily background exposure from air, water, soil, food, and consumer products. Indirect exposure pathways resulting from contaminated soils, such as contaminated groundwater, contaminated meat, milk, and produce, infiltration into indoor air, and wind erosion resulting in deposition on neighbouring property were also considered during the derivation of human health guidelines.

Recent Findings

The Canadian Energy Pipeline Association (CEPA) recognizes that a risk-based, comprehensive site specific assessment is essential in determining appropriate abandonment procedures for specific pipelines (2007). However, CEPA also states that a risk-based decision process to support the required site-specific assessments has not yet been developed. In addition, the lack of environmental baseline data (*e.g.* interactions and pathways of specific contaminants released in different soil and groundwater systems) makes restoration requirements difficult to assess

(Sookdeo 2002). Furthermore, ongoing controversies pertaining to the definition of pipeline cleanliness specifications must be resolved in order to develop such a decision process (CEPA 2007). Although it is evident there are many issues to be resolved in order to develop a robust and comprehensive risk assessment approach, key considerations that should be included in any risk assessment are listed by the authors of *Decision Procedures for Pipeline Rehab* (Hodgdon *et al.* 1991). They state that risk analysis is a flexible technique that can include:

- Management assessment of risk whereby management has sufficient data and information to reach the decision that risks exist and action is necessary;
- Comparative risk assessment whereby the risks in several segments of a pipeline system are developed on a comparative basis in order to assign priorities to the segments for budget and scheduling purposes; and
- A risk analysis that determines the probabilities and seriousness of risk at a specific site.

In addition to the above recommendations, much insight can be collected from recent experiences and investigations into the matter:

The authors of *Oilfield Abandonment and Soil Restoration in the Netherlands, Experience for the Future* (Kant et al. 2010) discuss risk assessment and subsequent remediation techniques used on a large oilfield abandonment project in the Netherlands. In the Netherlands, soil-risks can be modelled in a semi-quantitative manner as a result of the establishment of Soil Protection Guidelines (based on long term collection of data) that ensure permit conditions are uniform. This allowed remediation measures to be attuned to the actual risks of residual contamination. For example, if conditions permitted, slightly contaminated soil was left or put back. This "fit for use approach, or function-oriented remediation approach, whereby pollutant concentrations in soil and groundwater were remediated to levels associated with land use, proved practical and cost effective, allowing resources to focus on areas of greatest over-all risk without compromising risks of lesser significance or immediacy. In general, however, the preferred approach (though more costly) would be multifunctional remediation, whereby all contaminated sites are remediated so that no risks exists no matter what the land use.

The authors of *Use of Risk-Based Business Approach for Characterization of Environmental Remediation Liabilities in Upstream Oil and Gas Production Facilities* (Connor et al. 2008) discuss a Risk-Based Corrective Action (RBCA) risk classification system for characterization of site conditions. This system, discussed in detail in the paper, is designed to characterize site conditions and risk distribution in terms of the magnitude and immediacy of the risks posed, thereby facilitating development of a corrective action program schedule and budget designed to address imminent concerns in the near-term and non-imminent concerns over the long-term. This RBCA risk classification system could be adopted for pipeline abandonment, used to distinguish between necessary immediate actions and actions that can be postponed until later depending on the type of monitoring information gathered or other non-immediate characteristics of the risk (e.g. location, subsidence etc).

Government Directives and Guidelines

The NEB Draft Remediation Process Guide recognizes that not all contaminated sites accommodate typical remediation approaches; for example, in the following situations:

- National criteria for a contaminant does not exist;
- Remediation to guideline-based criteria is not feasible for the targeted land use;
- Guideline-based objectives do not seem appropriate given the site specific conditions, (i.e. recovery of the contaminant is too deep or otherwise unfeasible to access) so a risk assessment is necessary to establish site specific objectives;
- Receptors of concern have been identified; or there is significant public concern, as determined by the lead agency.

In these situations, the Guide recommends a risk management approach be followed. This involves the selection and implementation of a risk control strategy based on site specific objectives. Monitoring and evaluation of the strategy's effectiveness is required. The CCME approach is recommended. Risk management may include direct remedial actions or other strategies that reduce the probability, intensity, frequency or duration of exposure to contamination through soil, water or air/vapour pathways. The latter may include controls such as zoning designations, land use restrictions or orders. The decision to select a particular risk-based strategy will be informed by risk assessment information.

Alberta Environment incorporates site-specific risk assessment (SSRA) guidance and remedial objectives in its *Tier 2 Soil and Groundwater Remediation Guidelines* (2009). Mentioned in the Tier 2 document is that in all instances, site specific remediation objectives will require use of procedures, protocols, and monitoring that are acceptable to Alberta Environment. Where there are no clear guidance documents that have been accepted by Alberta Environment, discussion with Alberta Environment will be necessary prior to acceptance of final Tier 2 SSRA remediation objectives. Site-specific risk assessment may be triggered by a number of conditions, including situations in which Tier 1 and/or Tier 2 pathway and receptor exclusion and guideline adjustment approaches are either precluded by technical or policy factors or where site specific risk assessment is clearly demonstrated to offer the same level of protection as the Tier 1 objectives. The guideline continues, addressing the basis and considerations for SSRAs, implementation of site-specific remediation objectives and identification of conditions/restrictions associated with SSRA. The guidelines also cover the roles of, and approaches to, exposure control, circumstances precluding exposure control and requirements for exposure control.

In 2004, Health Canada released a document entitled *Federal Contaminated Site Risk Assessment in Canada.* This document was released to standardize guidance for consistent assessments on federal contaminated sites. These cover hydrocarbon related contamination rather extensively, and could be considered in the oil and gas abandonment and remediation process. These preliminary quantitative risk assessment (PQRA) guidelines are different from more complex site-specific risk assessments (SSRA). Nevertheless, the two assessments are not

independent and can in fact work together to produce a more accurate, precise, realistic, reliable, and defensible quantification of risks (Health Canada 2004). Health Canada is currently working on a guidance manual for conducting SSRAs which will be published when the work is complete.

4.2.4 Conduit Effect

Background Information

For in-place abandonment of pipelines, the conduit effect refers to the migration and discharge of water through the pipeline resulting from perforations caused by excessive corrosion or outside forces. Modern pipeline coatings provide substantial protection; however, an estimated 1% of external pipeline surfaces are not coated (Webster 1995). Furthermore, coatings may be improperly installed, defective or damaged from either construction or natural activities.

Significant environmental impacts have the potential to occur resulting from the conduit effect. The level of cleanliness within the pipe will determine the magnitude of the potential impacts resulting from point-source leaks along the damaged pipeline. It has been suggested that water displacement and flow as a result of perforations could lead to drainage of wetlands, or flooding of low lands. In addition, if abandoned pipelines are not completely cleaned, it has also been suggested that water within the pipeline may accumulate excessive contaminant loads, depositing them near sensitive areas (*e.g. wetlands, watercourses etc)* or in surrounding soils and groundwater (PADP 1996). In addition it has been suggested that any water discharge has the potential to cause subsurface erosion resulting in ground instability and surface subsidence.

In order to inhibit the transfer of water through a pipeline, it has been suggested that plugs could be installed at an appropriate spacing and along certain terrain features to ensure that changes in surface and ground water conditions will not result in water flow (H.R. Heffler Consulting Ltd. *et al.* 1995, PADP 1996,). When identifying plug locations, one should consider pipeline access and the resulting effects of the ground disturbance (PADP 1996). Furthermore, water discharge points should be created along slopes to reduce excessive erosion and flooding of low areas where the pipeline flattens out (PADP 1996).

The flow and displacement of water may also occur through uncompacted materials along a trench where pipeline was removed (Roblin 2006). Sediment packing, as well as installation of trench breakers and subdrains are appropriate mitigation measures (PADP 1996, Thorne *et al.* 1996, Roblin 2006).

Recent Findings

When discussing the environmental impacts and mitigation measures associated with the conduit effect, CEPA, in their 2007 report, stated that no new information was collected. Putting negative impacts aside, positive research has been done exploring pipelines abandoned in-place as conduits for alternative applications.

In a publication entitled: *Use of Abandoned Pipeline to Transport Sediment to Marshes* (Coates 1994), the author argues abandoned pipelines have the potential to be used for nourishment of existing marshes by transport of freshwater with nutrients and finer sediments. The author also considers the utilization of pipelines to transport sediment to restore marshes as technically feasible.

In a publication entitled: *Multiproduct Pipe Transport Conversion of Abandoned Single Product Pipelines* (Davis et al. 2005), the author presents a methodology for creating and controlling multiple pipelines that are installed within a larger outside diameter (O.D.) line. One benefit of this is reduced construction related environmental damages.

In a publication entitled: *Contractors' Concept of Optical Fibre in Sewers of Abandoned Pipelines* (Welch 2004) the application of pipelines as conduits for optical fibre cables is explored. Benefits of this application include fewer construction related nuisances to the public, reduced impact to the environment and safer, more compact utility corridors.

4.2.5 Decomposition of Pipe material

Background Information

Pipelines bodies consist of 97 to 99% iron by weight, followed by 0.5 to 2.0% manganese, 0.5 to 1.0% copper, nickel, molybdenum, chromium and carbon. Trace elements (less than 0.1%) are sulphur, phosphorus, tin, lead, bismuth and arsenic. The types of material associated with pipelines coatings are coal tar, enamel, polyethylene tape, asbestos, asphalt, high density polyethylene and fusion bonded epoxy. Presently, polyethylene and fusion bonded epoxy are the most widely used coatings. Pipeline coatings used in the 1950's and 1960's included blown bitumen or coal-tar pitch covered by glass-fibre cloth, bituminized paper, hessian, or asbestos felt. In Alberta, asbestos felt wrap was used into the early 1970's (Thorne *et al.* 1996).

Metals released from the pipeline body from corrosion corrode to a state of lower environmental mobility, and are generally not considered a potential environmental threat. Carcinogenic PAHs present in coal tar enamel was one of the leading causes of an industry switch to polyethylene. Polyethylene is considered safe to work with, and does not produce toxic leachates (Thorne *et al.* 1996).

Ground subsidence resulting from excessive deterioration and subsequent pipeline collapse is little understood, as of 1996 no data on the phenomenon was currently available. There are many uncertainties in predicting subsidence. For example, temporal relationships of pipeline degradation and how the magnitude and impact such degradation will influence subsidence is poorly understood. Nevertheless, it is improbable that a sudden collapse will lead to a depression of the soil cover as deep as the pipe diameter over an extended length of the pipeline (Geo-Engineering Ltd. 1996). Any subsidence is likely to be localized and intermittent.

Recent Findings

There is limited new information regarding the impacts of contaminant release resulting from pipeline decomposition. One study on subsea in-place abandonment found that, since PAH is not very water soluble; it will become a major environmental hazard only when organisms feed on particulate material (Scandpower Risk Management Inc. 2004). This could be an environmental concern in wetter areas for onshore pipeline abandonment.

In its 2007 report, CEPA concluded that pipelines of diameters greater than 12 inches will still be within tolerable ranges of subsidence, and that pipeline structural integrity would be retained for decades, if not centuries. CEPA still recognizes, however, that considerable work is needed to validate subsidence risks resulting from corrosion.

4.2.6 Cleaning methods and disposal of cleaning fluids

Background Information

The most critical determinant for ensuring pipe cleanliness is effective pigging (PADP 1996, Thorne *et al.* 1996). Preferably, in-place abandoned pipelines should be cleaned free of solids or any waxy build up (PADP 1996). However, studies have shown that significant quantities of contaminants may be left in abandoned pipelines as a result of poor pigging operations. A number of factors influence the efficacy of pigging operations such as pipeline configuration (*e.g.* bends and doglegs), pig type and proper pig use. Even with effective pigging, PCBs and NORMs have been identified as remaining in a limited number of gas transmission lines (Thorne *et al.* 1996).

Regarding disposal, all waste materials and contaminated soils must be handled, stored and disposed in accordance with approved waste management procedures. Properly engineered containment and storage equipment, proper labelling, proper disposal processes with respect to local regulations and effective spill contingency plans should be used (PADP 1996). In general, small quantities of pigging waste are usually accepted by oilfield waste disposal companies, often without conducting detailed chemical analysis (Thorne *et al.* 1996). Asbestos containing coating is removed through a high pressure water jet method, and the water used is collected, filtered and, if associated with coal tar wrap, tested for PAHs, PCBs, and chlorides. In 1996, disposal guidelines for NORMs were not yet established, and PCB disposal guidelines were currently being investigated (Thorne *et al.* 1996).

Recent Findings

Pipelines abandoned in-place should be cleaned to meet all applicable guidelines and regulatory requirements (CEPA 2007). A substantial amount of information now exists pertaining to proper detection, handling and disposal of NORMs, PCBs, and PAHs. Fluids removed from the pipeline should be discharged into tanks to allow settling and proper testing. Though there are many guidelines and standards pertaining to cleaning and proper disposal of pipelines and associated

fluids, defining cleanliness, specifically in terms of land use, remain unclear (CEPA 2007). Past studies do provide insight, however, into innovative procedures for disposal and cleaning of pipelines and their related products:

The authors of *Oilfield Abandonment and Soil Restoration in the Netherlands, Experience for the Future* (Kant et al. 2010), discuss new techniques used for dealing with residual substances collected as a result of cleaning procedures. The substances were stored at temporary storage locations where they were then assessed and transported to qualified processing plants. These plants would then work to reduce the toxicity of contaminants via techniques such as anaerobic benzene degradation, land farming, in-situ chemical oxidation and aerobic biodegradation.

The authors of *Innovative Methodology for Cleaning Pipes: Key to Environmental Protection* (Buzelin *et al.* 2008), describe a successful new methodology using chemicals to remove paraffin and asphaltene. It involved the flushing of a chemical product composed of diesel, isopropane, benzene and naphthalene. This method was applied for subsea pipes that were unable to be successfully pigged to meet contaminant levels below Brazilian standards. Such an approach may be viable as a secondary cleaning procedure, ensuring areas along the line unable to be effectively pigged (doglegs, slopes etc) can still be cleaned effectively.

4.2.7 Disposal of pipe material

Background Information

There was no information covering proper disposal of pipeline and pipeline materials recovered from the background readings (PADP 1996, Thorne *et al.* 1996, H.R. Heffler Consulting Ltd. *et al.* 1995).

Recent Findings

In Alberta, waste pipe not containing any hazardous substances can typically be recycled as scrap metal. If the pipe does contain hazardous materials it can either be cleaned to an acceptable standard and recycled, or disposed of at an approved landfill (Swanson *et al.* 2010). If NORMs or PCBs are detected beyond acceptable levels even after thorough cleaning, then disposal should be in accordance with their respective established guidelines (Sections 1.1.2 and 2.2). As an example, in the U.S. no selling or reusing of pipe still containing >50ppm of PCB is permitted, and must be either cleaned to an acceptable level approved by the EPA, or disposed of at an approved incinerator (La Shier 1989).

With respect to pipeline coating materials, specifically coal tar wrap, wrapping the pipe with plastic wrap before removing it from the trench will help reduce flaking and deposition of the material onto the ground (Swanson *et al.* 2010). In a 1996 document entitled: *Utility Manages to Work with Asbestos in Coal-Tar Pipe Wrap* (Falise), research conducted into the health effects of removing coal tar wrap laden with asbestos came to several important conclusions:

- Without the use of power tools or burning apparatus, the non-friable nature of coal tar wrap ensured that its disturbance and removal did not release hazardous amounts of free asbestos into the air;
- The use of special personal protective devices during distribution activities involving wrap removal is unnecessary;
- No extraordinary labeling, packaging or disposal methods are required; and
- Scrap pipe, with the wrap still intact, can be disposed of in a construction debris landfill.

As an alternative to disposal or recycling, pipe cleaned to acceptable standards can be utilized in a number of ways: as bridge guards, support along shorelines, piers for buildings, bridge supports, road foundations, casings, culverts, corrals and cattle guards, centre posts and columns for fence/barns, flag poles etc (Howell 2010).

4.2.8 Abandonment in sensitive ecological areas

Background Information

Sensitive areas such as national and provincial parks, ecological reserves and regionally significant environmentally sensitive areas should be subject to in-place abandonment. In-place abandonment is also the preferred option for native grasslands, forests, wetlands and muskeg. As indicated in the PADP 1996, removal of pipelines in sensitive areas will cause unnecessary disturbances, particularly in muskeg and wetland environments. In wetlands, it is recommended that abandoned pipe be either filled with water or perforated to allow natural invasion of water, with plugs installed along the pipe to prevent drainage and/or contamination (H.R. Heffler Consulting Ltd. *et al.* 1995). In-place abandonment may require some level of activity (*e.g.* spot excavations), and associated impacts such as erosion and slope instability should be mitigated (PADP 1996).

In addition, in-place abandonment should be considered along unstable slopes where, over time, the pipe may act as a structural support, and its removal would damage slope integrity. Removal along slopes could also lead to extensive and expensive remediation requirements (PADP 1996).

Recent Findings

Abandonment in-place along sensitive areas and unstable slopes remains the preferred action (CEPA 2007). However, removal may be the best option in northern areas where soil, groundwater and temperature conditions encourage extensive frost heaving, potentially resulting in surface exposure of the pipeline (Mackay *et al.* 1979). If, for a number of reasons, removal is the only viable option, several mitigation measures provided in the following case studies may be utilized:

In *A Case Study from Abandonment of a Southern Alberta Pipeline* (Swanson *et al.* 2010), clearing, where absolutely necessary, was conducted by hand. To minimize disturbance in treed areas, pipeline segments were cut and pulled from one or both sides of a stand. Furthermore, disturbances in forested areas were mitigated through the use of small, maneuverable bobcats. In native prairie, large pieces of sod were salvaged from the right-of-way and replaced as soon as possible following pipe removal.

In A *Case Study of the Yukon Pipelines Limited* (Roblin 2006), removal in sensitive areas was monitored by a qualified professional, and work crews carried spill cleanup kits. Pipe buried in standing water of wetlands was cut, tested and plugged at both ends. It was then pulled out from the area at one end. One large section of pipe was removed in winter to minimize disturbance to the wetland. Soil samples were taken every 100 meters along the pipeline for visual observations and organic vapour monitoring.

When considering abandonment options in sensitive areas, factors such as burial depth and cleanliness of the pipe should be considered. In frost sensitive northern areas the discontinuation of pipelines may interrupt surface water-ground water interactions, leading to ponding, erosion and channeling along the right of way, whether the pipeline is left in-place or removed (Van Everdingen 1979).

To abandon an NEB regulated pipeline, Section 50 of the OPR states: “An application made by a company under section 74 of the NEB Act for leave to abandon a pipeline or a section of one shall include the rationale for the abandonment and the measures to be employed in the abandonment.”

The NEB will consider the application and approve (or deny) by issue of a Certificate with conditions. The Certificate will not be valid until the conditions are satisfied.

Given this process, it seems reasonable that each project-specific application will examine the land use and environmental implications for the entire system and propose environmental mitigation measures that satisfy the NEB. The environmental threat of an abandoned pipeline seems similar to that of the operating pipeline. The consequences of leaks are removed but the risk of other physical phenomena such as river scour, channel migration, floods, right-of-way erosion, landslides, etc., continue.

The process of removing a buried pipeline may create as much or more environmental disturbance as pipeline installation. Most pipelines are likely to be abandoned in place except where current or reasonably foreseeable land use dictates removal. During abandonment, site-specific study will identify appropriate environmental protection measures.

4.2.9 Abandonment under water bodies

Background Information

In general, in-place abandonment is the preferred approach for pipelines abandonment under water bodies (PADP 1996). Left in-place, the pipeline should be as clean as possible, and caps

and plugs should be strategically positioned to mitigate contamination threats from trace materials along the rest of the line. If the pipeline has the potential to float it should be either perforated, with caps and plugs in place to protect from contaminants, or filled with concrete. If the line is to be removed through excavation, mitigation measures will be identical to those used in initial construction. Removing the pipeline may be required if threats of future exposure from excessive erosion seem likely (PADP 1996). It may even be prudent to remove the pipe at sag bends under threat of exposure from horizontal channel migration (Heffler Consulting Ltd. *et al.* 1995).

Recent Findings

Limited new information was acquired regarding pipeline abandonment under water bodies. In *A Case Study from Abandonment of a Southern Alberta Pipeline* (Swanson *et al.* 2010), they found that, during abandonment, the 273 mm O.D. pipeline segments could be successfully pulled from watercourses. The study also mentions the Alberta floods in 2005, where numerous creaks flooded their banks, leaving a number of pipelines exposed. Sudden exposure of pipe as a result of such scenarios, or from gradual erosion, could pose hazards for water recreation (*e.g.* obstruction, hydrology changes etc).

4.3 Geotechnical

The geotechnical section of this report presents a discussion of geohazards or "natural hazards," and focuses on the two most active natural hazard types; geotechnical (soil or slope related) and hydrotechnical hazards (surface water related). Other types of natural hazards are discussed as appropriate. Section 6 presents a summary of the key documents forming the foundation of this report. The relevant issues are summarized in Section 3. In this section a summary of key findings from the relevant literature and experience is presented.

The literature search yielded 16 documents that were geohazard-related; however, none particularly addressed geohazards for onshore pipeline abandonment. Some papers detailed characteristics of geohazards and a few were related directly to geohazard management. To supplement these sources, the book Geohazard Management in Pipeline Geo-Environmental Design and Geohazard Management, published by the American Society of Mechanical Engineers, was consulted as a reference.

A natural hazard, depending on the nature of the hazard and the scale of the occurrence and the prior condition of the right of way and pipeline can result in the following:

- No significant effect on the pipeline (i.e. a 0.5 m surface slide occurs but the pipeline is buried 4 m deep),
- Pipeline exposure (i.e. concentrated flows occur and erode 1.5 m of soil from a slope and the pipeline was buried 1 m deep), and

- Puncture of the pipeline (i.e. a large scale landslide occurs and breaks the pipeline).

As a consequence of other factors (such as pipeline removal or corrosion) the collapse of the pipeline and the surrounding soil can also occur. The collapse failure mode is not thought to be caused by a natural hazard, but by other factors leading to a condition where the soil has a void to collapse into. Soil collapse is a consequence for some land use, and could lead to other types of consequences.

Information regarding the mechanism of pipeline collapse is scarce, excepting the 1996 Geo-Engineering study (Geo-Engineering (MST) 1996) completed for the NEB. More information exists on the occurrence of exposure and puncture, almost no information is specifically for abandoned pipelines, while most information comes out of integrity work related to active pipelines.

The main geohazard concerns were identified in Section 3.1, Past Studies. These have been broadly categorized into those that could cause pipeline exposure and/or puncture, or conditions where collapse could occur. Each is associated with unique concerns in terms of land use and/or environmental consequences.

In addition, each of pipeline exposure, puncture and collapse is then a leading factor for the development of the next stage of degradation. For example, the exposure of a pipeline can increase the probability of pipeline puncture from geohazards, corrosion and outside forces. This relationship of each condition enhancing the likelihood of the next occurring is not specifically addressed in this section, although Event Trees relating causes and consequences could be developed to aid in understanding of these types of scenarios (Discussed in Section 5.1.3). To develop general guidance on pipeline abandonment, both the direct consequence of the geohazard, and the further effects that can be linked to the initial hazard, should be considered, such as is shown in Table 2: Retirement Options Matrix.

The understanding of these topics was developed based on a review of the past studies summarized in Section 3, and by careful review of literature and knowledge gained by experience of our subject matter experts (SMEs).

General Comments on Geohazards

Geohazard occurrences are largely spatially controlled. They are concentrated at: rivers, slopes, water bodies, crossings and other distinct locations. Geohazards are all principally controlled by local factors such as soil type, access to moisture and local temperature/insulation effects. Thus, any abandonment plan must review geohazards at distinct locations. Forty distinct geohazards (Rizkalla et al. 2008) are categorized for assessment as part of management of hazards for active pipeline integrity. The types of geohazards present on a particular pipeline are a function of the natural attributes of the right of way and are thought to largely persist once product is no longer flowing in the pipeline; the differences are related to the consequences.

Geohazards can be categorized in to the following general headings (after Rizkalla et al. 2008):

1. Mass movements (geotechnical)
2. Hydrotechnical
3. Seismic
4. Surface or subsurface soil erosion (normally associated with slopes)
5. Freezing
6. Thawing of permafrost
7. Geochemical
8. Volcanic
9. Others (normally associated with unique geological settings; volcanic activity, Karst, desert conditions)

The most active geohazards for typical pipelines are; hydrotechnical, surface or subsurface erosion and geotechnical (Leir 2009). Hydrotechnical hazards are associated with channelized flow of streams and rivers. The mechanism of erosion varies with river energy and the soil through which the river flows and can manifest as scour, channel degradation, bank erosion, stream encroachment and avulsion. Surface erosion of the ground varies with rainfall, channelization of local water, soil types, slope and vegetation. Geotechnical hazards are associated with various types of earth/mass movements, which vary with soil types, groundwater and changes to either the groundwater or the loading of the slope.

4.3.1 Exposure

Understanding of issue and existing information

In order to provide context for the likelihood of pipeline exposure following abandonment, an examination of the occurrence of pipeline exposure due to geohazards on active pipelines was used as a proxy. It can be expected that the rates of exposure could be higher for an abandoned pipeline due to the lack of maintenance or active visual inspections, eventual loss of buoyancy control where installed and frost heave of pipe without product within the pipeline. Pipeline exposure in an area where buoyancy control is needed is thought to be controlled by the failure of the control measures, if no other action is taken. No literature was found on the potential for frost heave to expose an abandoned pipeline, but culverts and pipelines with product near ambient temperature could be considered a proxy for further study.

The effects of pipeline exposure are threefold; interference with land use, degradation of the pipe or coating, and becoming a cause for further degradation by puncture/collapse.

Based on reviews of various pipeline systems in Western Canada (Leir 2009), the annual pipeline exposures/impact rates for active pipelines was: 1.4 exposures/impacts per 1,000 km of pipe. Of these exposures/impacts, 1.2 were due to hydrotechnical hazards and 0.2 due to surface

erosion/geotechnical hazards (Leir 2009 groups surface erosion/geotechnical hazards as geotechnical hazards).

The main hydrotechnical hazard types include (Leir 2009): scour, degradation, bank erosion, encroachment and avulsion. Scour occurs in channels that are deepened where water flow becomes concentrated by obstacles in the stream; therefore, locally increasing erosion and reducing the depth of cover over a pipeline. Degradation, which is probably the most common hydrotechnical hazard leading to pipeline exposure, is the natural lowering of the channel bed that occurs when sediment supply is decreased or the erosive capacity of the stream is enhanced. Vertical erosion rates are estimated at an average 20-30 mm per year when typical flow regimes and storm events are considered together. When this erosive force is focused on the horizontal migration of the stream, bank erosion occurs, most often on the outside curve of the channel. If pipelines run parallel to a river or stream, encroachment may occur should the stream migrate to intersect the pipeline. Again, this is common at the outside curve of bends. Finally, stream avulsion can lead to pipeline exposure when the existing channel is abandoned for another route, one that intersects the pipeline. Avulsion occurs most often on debris flow fans or as a result of flooding within flat floodplains. The rate of pipeline exposure due to these hazards should not be affected by abandonment of the pipeline or the filling/plugging of the pipeline.

Surface water erosion includes erosion of the backfill directly above the pipeline or of other areas on the right of way that were cleared or disturbed for pipeline installation. The occurrence of this mode of exposure is thought to be generally increased upon abandonment, since the inspection will be reduced or eliminated. If the pipeline is removed from a slope by excavation, re-establishment of vegetation will be required to reduce the amount of erosion on the slope.

Furthermore, wind erosion and deposition can reduce or increase the cover thickness over pipelines. The effects of wind erosion are enhanced where topography is more pronounced depending on soil texture and where vegetative cover is thin.

Mass movements can sometimes result in pipeline exposure (although they normally would result in development of strain and puncture of the pipeline), especially at river banks or if the soil flows from around the pipeline. The rate of exposure is unlikely to be changed by abandonment.

4.3.2 Puncture

Understanding of issue and existing information

Similar to pipeline exposure, an estimate of the occurrence of puncture during abandonment can be estimated by the rate of pipeline failure due to geohazards. In an active pipeline, the internal product pressure has the effect of provided a bursting pressure, which may decrease the likelihood of a puncture without product as compared to an abandoned line. The effects of the puncture are much less significant without the possibility of liquid or gas product leaks or ruptures. However, a puncture would allow water access into and out of the pipeline, which in turn may produce flow in the pipe (and potentially a pathway for residual contamination or water

flow) and internal corrosion. In Canada, the annual rate of pipeline failure due to geohazards is between 5.4 to 1.6 x 10^{-3} per 1,000 km of installed pipelines (Rizkalla et al. 2008). These statistics indicate that geohazards are much more likely to result in pipeline exposure rather than puncture.

The geohazard that causes most of the punctures is mass movement (landslide, debris flows or rockfall) due to overstressing of the pipeline. Although the rate of pipeline failure is much less for geohazards than other failure mechanisms, the cost of a failures due to geohazards is high (Porter et al. 2004) due to the significance of the individual events. Following abandonment, the consequences of a puncture resulting from geohazards should be about the same as for other causes of puncture.

4.3.3 Collapse

Understanding of issue and existing information

Complete pipeline collapse is not typically encountered in active pipelines, and is unlikely to result from a geohazard.

If external loading exceeds the pipe capacity, at crossings or due to corrosion of the pipe reducing its load carrying capacity, the pipe could collapse. If the pipeline is removed from the ground, or completely corroded a void would be created within the ground, which could collapse. These two scenarios create a conduit in the soil, or permit the above soil to collapse into the void. The 1996 (Geo-Engineering 1996) study undertaken for the NEB outlined the potential effects of voids and the resulting surface effects.

There have been studies conducted in attempt to determine the effects of pipeline collapse on the ground surface and establish whether significant subsidence will result, a significant subsidence is one that would result in damages to person and property. A 1996 report prepared for the Pipeline Abandonment Committee by Geo-Engineering (M.S.T.) LTD. modelled conditions wherein significant soil cover collapse would be observed. The results of the study concluded that it is improbable that substantial subsidence would occur simultaneously over a long stretch of pipe and the likely scenario would be slow loss of ground into a perforated pipe. The study also concluded that, depending on soil bulking factor and for a 1 m depth of burial, 300 mm diameter voids are the maximum size that would result in little or no subsidence. The study also indicated that more research is required with regards to soil-pipeline interaction and the effects of time on the system. It is expected that, in the long term, any pipeline left in place would eventually degrade to the point that a void exists in the ground.

4.4 Engineering

4.4.1 External Corrosion

Data from Literature

Very little information was found in the literature on the topic of external corrosion of abandoned pipelines and the inevitable collapse of these pipelines as the external corrosion progresses. On the other hand, there is a fair amount of data on underground corrosion that is useful in the assessment of this issue. The National Bureau of Standards [now referred to as the National Institute of Standards and Technology (NIST)] funded extensive research on this topic in the 1950's and this work is summarized in a report that is currently available through NACE International [Romanoff 1957]. In this research, coated and uncoated coupons of a number of different steels were exposed under freely corroding conditions in soils throughout of the United States. While it is difficult to summarize the large body of work in this report, some of the significant findings include:

- Soil corrosivity increases with decreasing pH
- Soil corrosivity increases with decreasing resistivity
- Pitting rates follow a power law, with an exponent that is generally near 0.5 and varies with soil properties

With respect to soil resistivity, Table 2 shows that soils having resistivities less than 1000 ohm-cm are generally considered to be very corrosive, while soils having resistivities greater than 10,000 ohm-cm are considered to be essentially not corrosive.

Table 1. Soil Corrosivity vs Soil Resistivity [Beavers, 1998]

Soil Resistivity, Ω-cm	**Corrosivity**
0-1000	Very Corrosive
1000-2000	Corrosive
2000-10,000	Mildly Corrosive
> 10,000	Progressively Less Corrosive

The California State Department of Transportation [Anon 1993] performed an analysis of data from perforated culverts and observed a similar correlation between soil corrosivity and the pH and resistivity of the soil. They developed an algorithm relating these factors to the time of perforation of a 52 mil culvert:

Years to Perforation = $13.97[\text{Log}_{10}R - \text{Log}_{10}(2160-2490\text{Log}_{10}pH)]$

A linear corrosion rate was recommended by the authors for extrapolation to thicker culverts. This assumption is questionable, albeit conservative, if the culverts perforate by pitting, which is likely, because the power law exponent for pitting is generally less than one. Figures 1 and 2 show the predictions for perforation of a pipeline, by corrosion, for various soil resistivities and

wall thicknesses. The most striking conclusion from this analysis is that the predicted perforation times are very long, > 50 years, for even moderate pipe wall thicknesses. This prediction does not appear to be consistent with pipeline industry experience in which pitting perforations are seen in much shorter time periods for pipelines with inadequate or no cathodic protection.

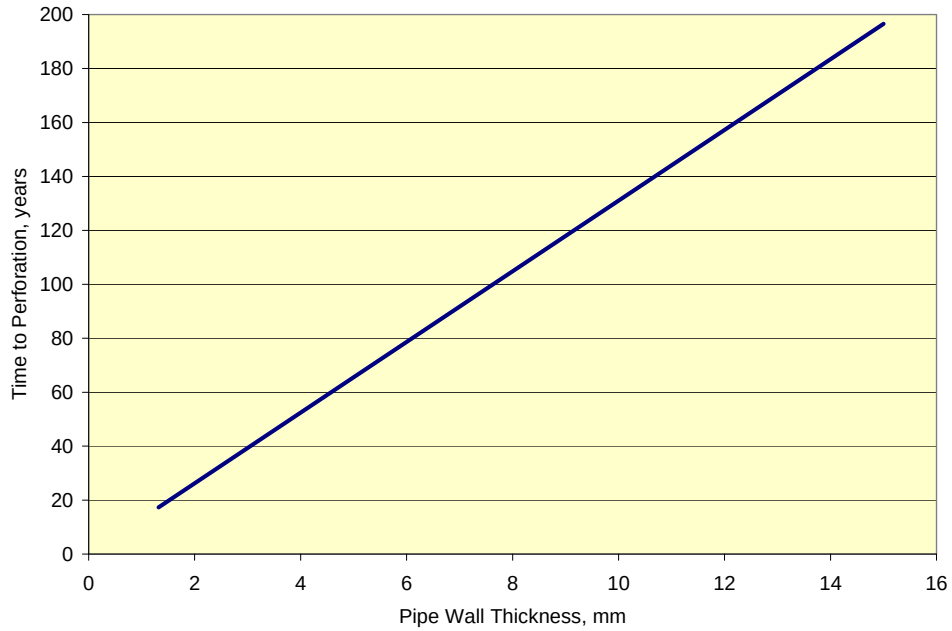


Figure 1. Time to perforation as a function of pipe wall thickness for a soil resistivity of 1000 ohm-cm and a soil pH of 7.

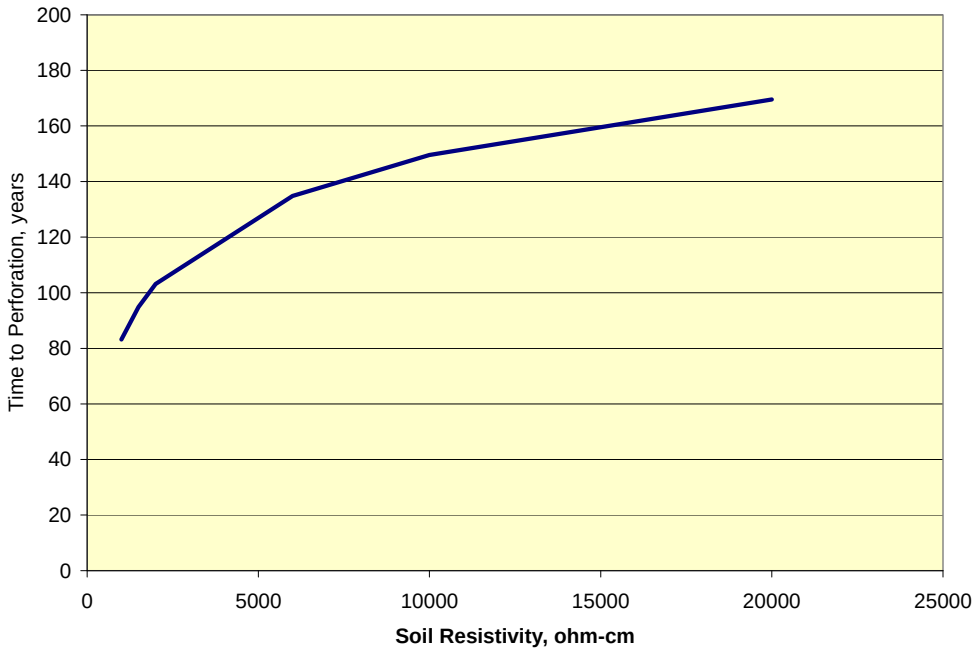


Figure 2. Time to perforation as a function of soil resistivity for a pipe wall thickness of 6.35 mm and a soil pH of 7.

While the time to perforation predictions from the culvert model appear to be unreasonably long for typical pipeline wall thicknesses, the parameters used in the model appear to be sound based on the extensive body of underground corrosion data. Therefore, a reasonable path forward is to analyze the underground corrosion data available in the literature to optimize the model for general corrosion of the thicker pipeline steels. This model could then be incorporated with an actual collapse model (described below) to predict the time to collapse from external corrosion as a function of soil properties and pipeline dimensions.

Once through-wall perforations occur in an abandoned pipeline, the pipeline is likely to fill with groundwater. This could promote internal corrosion that could ultimately contribute to pipeline collapse. While no data were found on this topic in the literature, the mechanism of aqueous corrosion, along with related literature, were used to evaluate this issue. Two cases were considered; complete filling of the pipeline with groundwater (Case 1), such as in a swamp, and partial filling (Case 2). For Case 1, it was assumed that the pipe fills with aerated groundwater. Since the solubility of oxygen in water is low (< 8 ppm), the oxygen in a pipeline will be consumed rapidly for typical corrosion rates. For example, the oxygen in a 24-inch diameter pipeline will be consumed in around one week at a corrosion rate of about 0.1 mm/y. After the oxygen is consumed, the corrosion rate will drop to negligibly low values. Anaerobic bacteria may accelerate the corrosion rate somewhat, but significant damage would not be expected based on measured corrosion rates for deep steel pilings (Beavers 1998), or buried subsea artifacts (J A.

Beavers, G. H. Koch, and W. E. Berry, "Corrosion of Metals in Marine Environments," Metals and Ceramics Information Center, MCIC Report 86-50, 1986) Furthermore, resupply of oxygen in the pipeline would be very limited unless there were a large number of large holes present in the pipeline.

Case 2 is somewhat more problematic in that the oxygen in the vapor space in a partially filled pipeline could promote continuous internal corrosion of the pipeline under aerated conditions. The most severe corrosion would likely occur at the liquid air interface where the water volume was small, because of the associated large air volume. However, under these conditions, the corrosion would be localized to the bottom of the pipe and the resulting collapse would be minimal.

The conclusion of this analysis is that external corrosion of abandoned pipelines is likely to be the largest contributor to ultimate collapse.

4.4.2 Structural Integrity

Data from Literature

No information was found in the literature on the topic of structural integrity of abandoned pipelines and on methods for assessing their collapse when external corrosion reaches a critical value. On the other hand, API 579-1/ASME FFS-1 provides methods for assessing the fitness for service of pipe with general or local metal loss and external pressure loading that could be applied to abandoned pipelines with external pressure loading from soil. Paragraph A.4.4 in Annex A of this standard provides equations for calculating allowable thickness, maximum pressure, and stress on cylindrical shells subject to external pressure. Paragraph B1.4 in Annex B1 of this standard provides guidelines for performing stress analysis to protect against collapse from buckling.

The methods in API 579-1/ASME FFS-1 may not be directly applicable to pipeline abandonment as written because they were developed for application to pressure vessels and piping in operating facilities. A detailed review and evaluation of these methods is needed to assess their applicability to pipeline abandonment issues.

5 RECOMMENDATIONS FOR FURTHER STUDIES

Based on the assessment of the literature reviewed as outlined in Section 4 above, this section recommends various research projects which could be conducted to address the knowledge gaps identified for pipeline abandonment issues.

5.1 Environmental & Land Use

5.1.1 Detection of Residual Contamination

In the opinion of the SMEs, testing protocols (both field and laboratory) for hydrocarbon contaminants (and other reasonably foreseeable elements) in soil and/or groundwater is quite well established. An area of deficiency relates to practical methods to measure the extent of residual hydrocarbons inside a segment of buried pipeline.

While there are well known practices for testing and managing PCBs, a protocol for PCB detection within a buried pipeline is not readily available.

Similarly, standard practices for detection of NORM and handling/disposal of NORM-contaminated material is relatively well known in some areas of petroleum industry activities. However, this is a potential hazard that is not well documented in connection with pipeline abandonment.

Recommendations made during the previous abandonment studies continue to be valid. These recommendations include:

- Estimation of the quantities of contaminants that might be released by an abandoned pipeline (Thorne *et al.* 1996).
- Research contaminant types and volumes relative to different pipeline products and locations within the distribution system (Thorne et al. 1996).
- Research the systematic protocols for PCB swab testing (Thorne et al. 1996).
- Review study conducted by US Institute of GAS Technology on trace contaminants in natural gas (Thorne et al. 1996).
- Investigate statistical analysis approaches for determining PCB concentrations throughout a pipeline (La Shier 1989).
- Research EPA findings on development of an appropriate methodology to quantify residual pipe contamination and development of a statistical model for PCB characterizations (*e.g.* "moving average" approach) (Linz 1991).

- Research the use of swab tests to develop surrogate contaminants that are representative of the residual contaminant load of various types of pigged and cleaned pipe in order to reduce assessment risk and cost (Thorne et al. 1996).
- Research PCB physical and chemical characteristics in natural gas environment as they are yet unstudied (Linz et al. 1991).
- Transport of PCBs as a component of various pipeline fluids is not well known (Linz *et al.* 1991).
- Research study by GRI and NIST into predicting PCB migration the physical/chemical controls that influence it (Linz *et al.* 1991).
- Research soil/water PCB partitioning study conducted by GRI and Battelle Pacific Northwest Laboratories (Linz *et al.* 1991).

Current Recommendations:

Develop practical testing protocols to accurately quantify residual contaminants remaining inside a section of buried pipe following standard cleaning procedures. The purpose of developing standard sampling protocols is twofold: for one, the chosen methodology would serve to provide an accurate representation of the nature, extent and distribution of contaminants along the pipeline; secondly, such a universal approach would provide user-friendly guidelines for companies, and ensure consistent sampling results. Such standard protocols would be developed to determine the initial likelihood of PCB and NORM contamination in the pipeline. In doing so, NORMs and/or PCBs would either be included or excluded from further testing.

Scope:

Standard testing protocols should be developed in consideration of standard practices for detection of hydrocarbons, PCBs and NORMs in pipelines. In order to integrate these contaminants into a standard testing protocol, three separate studies should be conducted:

- Methods to accurately quantify residual hydrocarbons along an abandoned pipeline.
- Develop standard practices for detection of PCBs where suspected in abandoned pipelines.
- Standard practices for detection of NORM-contaminated pipe. (This study could be limited to the pipelines regulated by the NEB. Past experience suggests that NORM contamination in oilfield pipe, fittings and tanks is more likely to be found in upstream oil and gas activities than in the transmission and distribution systems regulated by the NEB).

Expected Results:

In recommending further research into the environmental effects of pipeline abandonment, the development of a standard testing protocol takes precedence. Many decisions regarding the management and handling of abandoned pipeline hinge on the efficacy and accuracy of contaminant testing. For example, establishing a standard testing protocol may lead to:

- An accurate indication of the potential concentrations of contaminants to be transported down a section of abandoned pipeline as a result of the conduit effect;
- A greater understanding of the nature, extent and distribution of contaminants, which is the first step in developing formal risk assessment tools modelling the fate and effects of detected contaminants in an abandoned pipeline;
- Consistent results, allowing statistical studies of such results to be compiled from various abandonment projects and, over time, lead to the development of a contaminant database with the establishment of categories of expected residual contaminants based on the pipeline product and locations along the pipeline system;
- Greater support for providing an indication of effective cleaning methods; and
- Guidance for decision making on locations for pipeline abandonment in-place.

Length of Time to Conduct Research:

1 year of field work to conduct research on a representative sample of pipeline types and sizes would be required.

Types of Organizations to Conduct Research:

Oil and gas pipeline operating companies to donate segments of pipeline to conduct an assortment of sampling techniques.

Environmental consultants to provide direction on appropriate locations for sampling.

Accredited environmental laboratories to conduct analysis.

Expected Costs

Costs associated with developing a practical and accurate sampling method for hydrocarbon related contaminants are estimated at $100,000.

Costs associated with developing a practical and accurate detection method for residual PCBs in pipelines are estimated at $15,000.

Costs associated with developing a practical and accurate detection, handling and disposal procedure for NORMs are estimated at $25,000.

Standard Pipeline Products List

Background

Liquid petroleum products can consist of a complex mixture of paraffinic, cycloparaffinic and aromatic hydrocarbons covering carbon chains ranging from C1 to C60+. The composition varies depending on the source of crude and/or the refining process. Some products can contain minor amounts of sulphur, nitrogen and oxygen compounds as well as trace amounts of heavy metals such as nickel, vanadium and lead. Natural gas is a complex combination of hydrocarbons consisting of saturated aliphatic hydrocarbons predominately consisting of methane and ethane but such that constituent composition may vary.

Recommendation:

Initiate a study to identify compounds to be tested for in soil and water as a result of a pipeline leak at the abandonment phase.

Scope

A review of products shipped through NEB regulated pipeline systems. The study should include a thorough review of the Material Safety Data Sheets (MSDS) for all products shipped as well as for products that could enter the pipeline as a result of the operation and at abandonment of the pipeline system.

Expected Result

The development of a standard list compounds expected to be found as a result of a pipeline leak. The research should determine the extent to which the list can be applied to abandoned pipelines. A detailed review and evaluation of the list is needed to assess the applicability to pipeline abandonment issues.

Project Duration

The study could be completed within one month.

Types of Organizations that Could Conduct the Research

This study could be conducted by environmental consultants in cooperation with pipeline operating companies.

Expected Cost of the Research

The proposed study is expected to cost approximately $25,000.00

5.1.2 Environmental Standards

Current Recommendations:

In SMEs opinion, further enhancements of the current standards on soil and groundwater quality are beyond the scope of issues that warrant effort by the Pipeline Abandonment Physical Issues Committee (pipeline abandonment committee).

Ultimately, standards for pipeline abandonment could be proposed but currently there is insufficient practical experience in accurately measuring the presence and quantity of contaminants remaining in a section of abandoned pipeline to consider general or specific environmental standards at this time. It is recommended that NEB regulated pipelines use CCME standards to assess remediation success.

5.1.3 Risk Assessment

Recommendations made during the previous abandonment studies continue to be valid. These recommendations include:

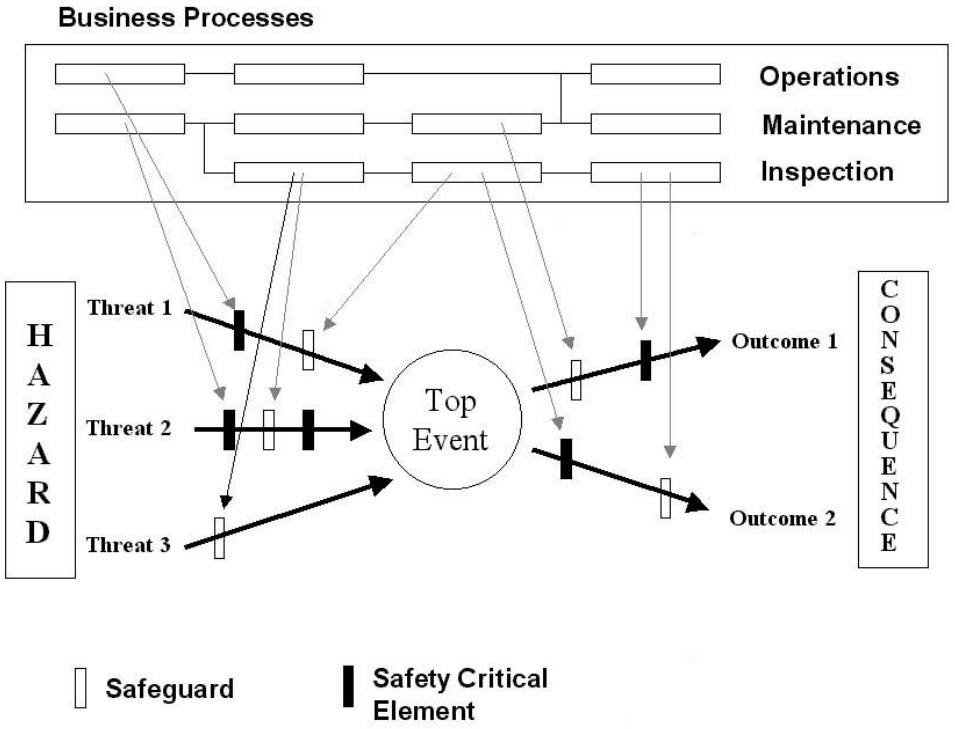
- Research and refine land use categories as part of the development of the risk based site specific assessment process (CEPA 2007).
- Research the impacts of new treatment chemicals being marketed for use in the oil and gas industry, particularly as they relate to pipeline abandonment in-place (Thorne *et al.* 1996).
- Further research into contaminant properties and their potential environmental impacts (Thorne *et al.* 1996).

Current Recommendations:

Background

Given the variability of potential causes of pipeline collapse and the consequences that vary with location and other local environmental factors, it is suggested that an event and consequence analysis be used as a tool to identify scenarios and consequences related to pipeline abandonment.

One method which may be adapted to pipeline abandonment is the Bow-Tie analysis illustrated below. In the centre of the diagram is the ‘Top Event’ or process hazard. To the left are the barriers or safeguards that aim to prevent the top event from occurring, to the right are all the safeguards that aim to mitigate the potential consequences from the top event.



Safeguards can be varied in nature from personnel with relevant experience, to training, to operational procedures, and so forth. Using this approach it is critical to know the status of each safeguard in real time to support decision making.

It can readily be seen that by analyzing all potential top events and quantifying all potential outcomes for all types of losses a picture of the risk exposure at any point in time can be built up. Safeguards to the left of the top event affect the likelihood that the event will take place, in Quantitative Risk Assessment (QRA) terms, the frequency of the event. Those to the right impact the potential consequences of an event and can increase or reduce the severity of a top event.

Objective and Scope

The objective of this research would be to identify the various scenarios and related consequences of pipeline abandonment events and identify potential consequences of those events.

Expected Result

The research would determine the potential risk exposure for various events and outline potential safeguards to reduce the frequency and/or consequences of a particular event.

Project Duration

The project could be completed within three months.

Types of Organizations that Could Conduct the Research
This research could be conducted by risk consultants.

Expected Cost of the Research
The proposed research is expected to cost approximately $50,000.

5.1.4 Conduit Effect

No examples of an abandoned pipeline acting as a conduit for water movement were found in the literature review. The potential for a pipe abandoned in place to become a conduit for water movement was discussed in Section 3.9 of the PADP 1996. If the abandoned pipeline is clean, the potential environmental risks could be related to draining wetlands or, conversely, flooding inappropriate land areas or to transport soil material inside the pipe to a down slope location where it may escape and cause impacts. If the pipe is not clean there may be a risk of transporting contaminants.

In order to address these potential issues, it is assumed that the abandoned pipe would be segmented at appropriate locations. Both the CAPP 2002 Guidelines document and the CEPA 2007 Pipeline Abandonment Assumptions document refer to Table 3-1 of the PADP 1996 for determining the appropriate locations where segmentation and plugs are recommended which remain valid today. Impermeable materials such as concrete, polyurethane foam or soil are still reasonable materials to create plugs in the pipe.

In the case of pipeline removal, water pathways through the uncompacted pipeline trench material must be prevented or interrupted. The principles governing the locations of trench breakers are the same as those governing the locations of plugs for pipelines abandoned in place.

The occurrence of the conduit effect on the outside of an abandoned pipeline is not seen as being any different than for an operating pipeline. If it was not an issue previously it should not be an issue when the line is abandoned in place.

No additional studies are recommended with respect to the potential conduit effect although this issue could be monitored as part of the study recommended in section 5.2.4 below.

5.1.5 Decomposition of Pipe material

Recommendations made during the previous abandonment studies continue to be valid. These recommendations include:

- Quantification of subsidence threats for large diameter pipelines, and the possible development of algorithms to model structural collapse of pipelines (CEPA 2007).

- Study leaching potential of coal tar coatings, and identification of the specific PAHs that may be released into the environment from the degrading coatings (Thorne *et al.* 1996).
- The potential environmental risks from asbestos left in-place should be further assessed (Thorne *et al.* 1996).
- Inspect a representative number of abandoned lines to observe rates of corrosion, internal contamination from pipeline residues, structural integrity and soil contamination (H.R. Heffler Consulting Ltd. *et al.* 1995).
- In a 1974 document entitled: Recent Developments in the Use of Mine Waste of Subsidence Control (Allen *et al.*), the authors describe the effectiveness of using sediment slurries for hydraulic filling of abandoned mines. Perhaps further research could be conducted into the applications of this technique for in-place pipeline abandonment.

Current Recommendations:

The mechanism, rates and effects of pipe corrosion warrants engineering study while considering contamination of soil or groundwater by pipe coatings and their degradation products is worthy of consideration. While not likely to be widespread or dramatic, it should not be ignored. A study of the leaching potentials of pipe coatings (especially older materials such as coal tar coatings) is warranted. Consideration should be given to the environmental and human health effects of the chemicals, the rate and nature of chemical decomposition, potential for soil and groundwater transport and recommendations leading toward improved abandonment/disposal practices.

Scope:

Study leaching potential and associated human health and environmental effects of the contaminants released from coal tar coatings. A theoretical understanding of the potential for leached contaminants to move through various soil and groundwater regimes, as well as the human and environmental consequences of such contamination, should be established. Concurrently, laboratory testing of the structural integrity and the rate and nature of chemical decomposition of coal tar coatings under simulated field conditions should be undertaken.

Expected Results:

A greater understanding of the nature and rate of coal tar wrap decomposition, dispersal of leached chemicals in the surrounding environment and the potential human and environmental effects of leached contaminants will contribute to the development of formal risk assessment models with respect to identifying the fate and effects of detected contaminants in an abandoned

pipeline with coal tar coating; and the establishment of safe handling and disposal procedures / recycling options for pipelines coated with coal tar wrap.
An understanding of soil and groundwater mechanisms suggests that solution and transport of metal ions in the environment resulting from corroding pipe is worthy of thought, but is almost certainly not likely to be a widespread issue. The SMEs suggest this is a topic that can be deferred for future consideration.

Length of Time for Research:

3 – 6 months

Types of Organizations to Conduct Research:

Charter Coating, of Calgary Alberta, is an example of a company able to perform external coating evaluation tests, and is capable of undertaking integrity tests on coal tar coating to determine the rate of coating decomposition.

Analyzing the dynamics of decomposed coatings in soil and groundwater, and the associated human and environmental effects, should be undertaken by a company or companies specializing in environmental chemistry and human health.

Expected Costs:

Costs associated with undertaking integrity tests on coal tar coatings is estimated at $15,000.00

Costs associated with the study of leaching potential of coal tar coatings, and identification of contaminants that may be released into the environment from the degrading coatings is estimated at $10,000.00.

5.1.6 Cleaning methods and disposal of cleaning fluids

Recommendations made during the previous abandonment studies continue to be valid. These recommendations include:

- If pipe is going to be reused for alternative purposes, further research should be conducted in order to determine the appropriate cleanliness requirements for the intended use (Thorne *et al.* 1996).
- The development of a pigging report including information on types and quantities of pipeline scale (Thorne *et al.* 1996).
- The evidence which regulatory authorities will accept as being sufficient proof of cleanliness in terms of the residual volume of contaminants requires adequate definition (Thorne *et al.* 1996).

- There is currently insufficient data available to make a reasonable estimate of the maximum volume of contaminants that may remain in a pigged line (H.R. Heffler Consulting Ltd. *et al.* 1995).
- Adequate standards of cleanliness should be attained through accepted test procedures. Testing water slugs pushed through the line could prove a useful technique (H.R. Heffler Consulting Ltd. *et al.* 1995).
- Cleanliness parameters should be established through the development of a model recommending appropriate levels of cleanliness for abandonment (H.R. Heffler Consulting Ltd. *et al.* 1995)

Current Recommendations:

To the best of our knowledge, no published reports or field trials of pipe cleaning are available. Although such a study is recommended, it is suggested it be led by qualified engineers and pipeline operators.

Scope:

An engineer led study should be undertaken to determine effective cleaning methods in an attempt to determine cleanliness parameters for either abandoning pipeline in place, or removing sections for reuse or disposal.

Expected Results:

The development of cleanliness standards following determination of effective cleaning procedures and establishment of an accurate and acceptable sampling protocol are expected to assist in:

- Establishing safe handling and disposal methods for pipelines;
- Providing an indication of the effectiveness of cleaning operations along a given length of pipeline;
- Removing the obscurity in determining "how clean is clean" and streamline the abandonment process in a safe and responsible manner;
- Determining the environmental suitability of the cleaning compounds;
- Handling and disposal of wax, waste petroleum products, spent cleaning compounds, etc;

- The environmental safety of all practices (risk of spills, emergency preparedness, worker and public health, etc); and
- Developing achievable cleanliness standards for pipe to be abandoned in place or removed for reuse or disposal.

Length of Time for Research:

1 -2 years

Types of Organizations to Conduct Research:

Pipeline operating companies;

Materials Engineers;

Companies specializing in environmental chemistry and human health.

Expected Costs:

Costs for developing such standards are estimated at $150,000 to $200,000. The costs associated with undertaking this research result from both the necessity to involve a range of expert knowledge and opinion and the extensive period of time potential required to establish collective agreement on what contamination levels constitute a clean pipe.

5.1.7 Disposal of pipe material

Current Recommendations:

Until standards have been developed to determine acceptable concentrations of residual contaminants, recommendations for reuse and/or disposal studies cannot be made. Current options for disposal of pipe materials include complying with the requirements of a government approved landfill.

5.1.8 Abandonment under water bodies

NEB regulated pipelines are found under all types of water bodies; streams, lakes, irrigation canals, and others. (No consideration has been given in this report to offshore pipelines, although onshore pipelines crossing a large lake employing marine lay methods are quite feasible.) Water

saturated soil; such as muskeg or flood irrigated lands, could be included in this discussion as well.

Again, it is assumed that most pipelines under any water body will be abandoned in place – after due consideration by way of Certificate approval. In this case, the environmental implications are related to loss of buoyancy control (*i.e.* pipe flotation) or exposure by other means. As well, since most streams are located at the bottom of a slope, the risk of surface erosion or the implications of material transport and discharge via the buried pipe acting as a conduit need to be recognized.

There will however be instances where the risk of abandonment in place dictates special treatment. Cutting and capping the pipe at each side of the water body will be warranted in some cases, as will removal of some or all of the pipe in anticipation of stream bed scour or lateral channel migration. In other cases the pipe section under the water body could be filled with cement as a permanent way to prevent flotation. This is likely to be used in special cases but it has to be admitted that, a cement filled pipe section that is exposed, could be a barrier to fish movement or to human use and enjoyment of a stream.

Removal of the underwater section of a pipeline seems a last resort since this practice could result in significant disturbance to the stream. Since this is likely to be a very infrequent practice, no comprehensive studies are suggested. There have been a few cases where a length of buried pipe has been pulled from the ground with essentially no surface disturbance, other than the locations where the pipe has to be exposed at each end necessitating land disturbance and reclamation at those locations. If successful, this technique would be especially attractive at watercourse crossings.

Current Recommendations:

It is recommended that an engineered led study to investigate techniques to remove sections of buried pipeline resulting in little to no surface disturbance with respect to abandonment under water bodies as well as sensitive ecological areas.

Scope:

Engineering field tests to determine the diameter and length of pipelines and the extent to which they can be pulled from the ground should be conducted.

Potential environmental effects associated with pulling pipe from underneath water bodies for consideration include alterations of stream hydrology as a result of subsidence and structural instability of the bed and bank complex. Potential environmental effects associated with pulling pipe from beneath sensitive ecological areas and wetlands for consideration include subsidence and terrain instability, as well as channeling of surface and subsurface water along the trench and associate subsidence and/or erosion.

Expected Results:

Recognizing the potential environmental effects associated with pulling pipe from under water bodies and sensitive ecological areas could lead to:

- The establishment of mitigation measures in response to such effects; and
- The establishment of best-practices for abandoning a section of pipeline under a water body or sensitive ecological area.

Length of Time for Research:

1-3 years to conduct field tests at a variety of locations with various diameters and lengths of pipeline.

Types of Organizations to Conduct Research:

Pipeline operating companies in cooperation with environmental consultants.

Expected Costs:

$200,000 - $350,000

5.2 Geotechnical

5.2.1 Compile Exposure Data from NEB and ERCB Records

Background

Leir, 2009 provided information related to pipeline exposure of active pipelines. NEB and ERCB records should be examined to provide an expanded database of the rate of exposure for active pipelines and their locations.

Objective and Scope

The objective of the proposed research is to expand the database by compiling an updated list of exposure instances. Using GIS and NEB/ERCB records, correlate exposures with hydrotechnical, geotechnical and wind erosion hazards (this would include third party damages due to reduced depth of cover) where possible.

Expected Result

This can help guide the committee to understand the sites most at risk due to exposure, and where exposure is unlikely.

Project Duration
It is expected that this data review work (depending on the quality and amount of data) could be completed within 3 months.

Types of Organizations that Could Conduct the Research
This type of work may be done internally by NEB or ERCB staff, or alternatively it could be completed by consultants working for these organizations.

Expected Cost of the Research
The proposed research is expected to cost approximately $50,000.

5.2.2 Examine Buoyancy Effects on Pipeline Exposure Rates

Background
A geohazard that is thought to have the potential to significantly increase the rate of exposure post-abandonment is loss of buoyancy control. Liquid pipelines depend on the weight of the product to, in part, control buoyancy. Once the pipeline is abandoned, this additional weight will be removed. For gas pipelines, buoyancy control is installed and maintained during the active phase of the pipeline use. Degradation of these control measures is likely to result in exposure if the initial conditions persist. When considering the need for this study, abandonment measures such as removal of the pipeline, installation of interior weight and puncture of the line should be considered as alternatives.

Objective and Scope
The objective of the proposed research is to study the longevity of different buoyancy control measures.

Expected Result
The results of the research will be to develop a model that could be used to predict the potential for and the timing of exposure of abandoned pipelines due to lack of or loss of buoyancy control.

Project Duration
The project can be completed within six months.

Types of Organizations that Could Conduct the Research
This research could be conducted by a University as part of a multi-year research project or could be completed by a consulting engineering firm specializing in design of buoyancy control
Expected Cost of the Research
The proposed research is expected to cost approximately $75,000 if completed by a consultant.

5.2.3 Examine Frost Heave Effects on Pipeline Exposure Rates

Background

Frost heave also has the potential to result in pipeline exposure. Once the warm product is removed, heave of the pipeline could begin to occur. The rate and importance of this mechanism is thought to depend on soil type and available moisture. No information was encountered in the literature pertaining to this geohazard and its ability to expose a pipeline once abandoned. The literature on performance of culverts could be used as a proxy but also studies could be completed on active pipelines with product near ambient temperatures or suspended pipelines. The studies could take three forms; laboratory testing of soils for frost heave properties, field measurement of heave rates in a single winter and across multiple seasons, and examination of the long term performance of pipelines that are suspended or operating at ambient temperatures.

Objective and Scope

The objective of the proposed research is to understand the mechanism of heaving of abandoned pipelines. A laboratory study could be undertaken to examine, under multiple freeze thaw cycles, the interaction of growing ice under the pipeline against resistance forces above the pipeline. This type of work has been conceived many times for cold gas pipelines, but only a limited amount of information is in the public domain, and testing of the abandonment case was not found in the literature.

The laboratory scale work should be compared to results of field studies of pipelines with product at ambient temperatures or for suspended pipelines. The field scale study would be used to determine the effect of frost on long segments of pipe, versus local frost heave effects that could be determined in the laboratory. The study should include installation of markers on the pipeline and a regular program of surveying the markers. Survey stations should be set-up in a number of different terrains and soil moisture conditions. Thermistors should be installed to monitor the development of the frost front at these stations.

An examination of pipelines operating for a long period at ambient temperatures or where operations have been suspended, should offer a good perspective on the performance of abandoned pipelines.

Expected Result

The laboratory results of the research will be to develop a numerical model to determine the effects of different soil types and moisture conditions on the potential for an abandoned pipeline to become jacked out of the ground by frost action. The result of this lab study would not be definitive, but give general guidance.
The field study of suspended pipelines or ambient temperature product pipeline would provide real scale information related to local frost heave effects on a long section of pipeline.

Project Duration
The project would have to be completed as part of a multi-year effort.

Types of Organizations that Could Conduct the Research
This research could be conducted by a University as part of a multi-year research project or a multi-year effort of pipeline examination and surveys.

Expected Cost of the Research
The proposed research is expected to cost approximately $50,000 per year.

5.2.4 Evaluate Success of Previous Pipeline Abandonment Programs

Background
Pipelines have previously been abandoned in Alberta and other jurisdictions. A review of the approved plans could be conducted to gain a general understanding of the approaches taken. Then, if site visits were conducted to determine the effectiveness of activities, valuable information could be obtained on post-abandonment conditions and performance of various abandonment procedures.

Objective and Scope
The objective of the proposed research is to compile "real time" information with respect to actual procedures used for pipeline abandonment. The scope of the project could cover any abandoned pipelines under NEB or ERCB jurisdiction. A report could be assembled detailing the approaches taken for each site and could include the study of the current ground surface effect of pipelines that are abandoned in place; the study of the current ground surface effects of pipelines that have been removed; and the selection of segments of pipelines that have been abandoned in place, remove them, and observe ground surface changes.

Expected Result
The results of the research will provide a better understanding of the effects of actual abandonment procedures.

Project Duration
The project could be conducted over a number of years, but in each year will only require about 1 month of effort and result in a summary report of observations.

Types of Organizations that Could Conduct the Research
This research could be conducted by a consultant or pipeline operating company.

Expected Cost of the Research

The proposed research is expected to cost approximately $100,000 to initially set up the monitoring stations, and then approximately $25,000 for each year the project is run. It is also assumed that $100,000 would be spent during the fifth year to assess the data collected over each five year cycle.

5.2.5 Collapse of soil under different void sizes, soil types and depth of cover

Background

The mechanism of soil collapse could be studied in three ways;

- examine already pulled pipelines to determine actual collapse and magnitude of the resulting surface effect,
- create voids in soil and accelerate the collapse (this study should examine different pipe sizes, soil types, depths of burial and moisture conditions), and
- Complete model studies using centrifuges.

Objective and Scope

The first item could be part of the study of existing abandoned pipelines, and involve setting up survey points for multiple year studies to examine the eventual collapse of the soil into the void.

The second study could be to set up a test area with a known soil type and moisture, install a pipeline and compact the soil, later remove the pipe and monitor the collapse depth and timing. Loading by different types of equipment could also be examined in this experimental set-up.

The third suggestion is very similar to that of the second, except that with the use of a centrifuge would allow control of the soil used, pipeline diameters and depth of cover. The tests are conducted on a small scale basis and the centrifuge is used to determine the long term effect.

Expected Result

The results of the research will be to develop a model to determine the effects of different soil types and moisture conditions on the potential for soil collapse once a pipeline is pulled out or fails due to corrosion.

Project Duration

The project could be conducted over a number of years.

Types of Organizations that Could Conduct the Research

This would be best undertaken as a university research project or it could be undertaken by a consultant and a commercial testing program at a university centrifuge.

Expected Cost of the Research

The proposed research is expected to cost approximately $200,000 to $300,000

5.3 Engineering

5.3.1 Validation of Culvert Failure Model for Abandoned Pipelines

Background

The California State Department of Transportation has developed a model for culvert failure from corrosion, which is based on field data for the time to perforation of culverts in various soils in California. The model is very simplistic, incorporating soil pH and resistivity, but is reasonable based on extensive research on the topic over the past century. However, the model has not been validated for thicker structures, such as underground pipelines. Estimates of penetration depth versus time for pipelines are needed, for incorporation in plastic instability models, in order to determine the time of collapse for these structures.

Objective and Scope

The objective of the proposed research is to validate the Culvert Failure Model for the thicker shell walls associated with abandoned pipelines. The scope of work will be to analyze the extensive underground corrosion data available in the literature and use relevant data to optimize the Culvert Failure Model for general corrosion of the thicker pipeline steels. This model could then be incorporated with an actual collapse model to predict the time to collapse as a function of soil properties and pipeline dimensions.

Expected Result

The results of the research will be a validated prediction model for penetration versus time of abandoned pipelines, as a function of soil properties.

Project Duration

The project can be completed within six months.

Types of Organizations that Could Conduct the Research

This research could be conducted by contract research organizations, government laboratories, or universities with extensive experience in underground corrosion of corrodible structures.

Expected Cost of the Research

The proposed research is expected to cost approximately $40,000.

5.3.2 Structural Integrity

Background

API 579-1/ASME FFS-1 provides methods for assessing the fitness for service of pipe with general or local metal loss and external pressure loading that could be applied to abandoned pipelines with external pressure loading from soil.

Objective and Scope

The methods in API 579-1/ASME FFS-1 may not be directly applicable to pipeline abandonment as written because they were developed for application to pressure vessels and piping in operating facilities. The review should include evaluating whether the fitness-for-service assessment procedures can be tailored directly to pipeline abandonment issues.

Expected Result

The research would determine the extent to which they can be applied to abandoned pipelines. A detailed review and evaluation of these methods is needed to assess their applicability to pipeline abandonment issues.

Project Duration

The project could be completed within two months.

Types of Organizations that Could Conduct the Research

This research could be conducted by contract research organizations with professional engineers familiar with API 579-1/ASME FFS-1 and pipeline fitness for service issues.

Expected Cost of the Research

The proposed research is expected to cost approximately $30,000.

6 REFERENCES

5,000 KM ROW CP SURVEY ANALYSIS AND THE POTENTIAL ADVANTAGES OF THE -100 MV POLARIZATION CRITERION FOR THE CP OF AGED COATING OIL AND GAS PIPELINES IN GULF AND NORTH OF MEXICO
Canto, J.1, 7; De La Escalera, L.M. Martinez1, 7; Rivera, H.1, 7; Godoy, A.1, 7; Andrade, C.G. Lopez2; Betancourt, E. Rodríguez3; Albaya, H.C.4; Pesce, Norberto5; Ascencio, J.A.6; Martinez-Gomez, L.6 Source: NACE - International Corrosion Conference Series, p 080691-080698, 2008, Corrosion 2008

A 10-BIT, 40 MSAMPLES/S LOW POWER PIPELINE ADC FOR SYSTEM-ON-A-CHIP DIGITAL TV APPLICATION
Francke, Johannes1; Yang, Huazhong1; Luo, Rong1 Source: Proceedings of the International Semiconductor Conference, CAS, v 2, p 421-424, 2006.

A 34-IN PIPELINE REPAIR AND UPGRADE OFFSHORE SICILY
Balducci, S.1; Gerola, A.1; Ellis, R.1; Abboni, A.2 Source: Pipeline World, n 8, p 11-14, April 2005

A DESIGN APPROACH FOR "SELF-LIFTING" METHOD TO ELIMINATE SEVERE SLUGGING IN OFFSHORE PRODUCTION SYSTEMS
Tengesdal, J.; Thompson, Leslie; Sarica, Cem Source: Proceedings - SPE Annual Technical Conference and Exhibition, p 1549-1554, 2003

A PROTOCOL FOR THE DERIVATION OF ENVIRONMENTAL AND HUMAN HEALTH SOIL QUALITY GUIDELINES. Canadian Council of Ministers of the Environment. 2006. xxix + 186 pp.

ABANDON AND RECOVERY WIRE ROPE TORSION PREDICTION
Haan, Joost Den1; Krutzen, Martijn P.M.2 Source: Proceedings of the International Conference on Offshore Mechanics and Arctic Engineering - OMAE, v 2006, 2006, Proceedings of 25TH International Conference on Offshore Mechanics and Arctic Engineering, OMAE 2006

ABANDONED, CORRODED LINE REHABILITATED FOR NITROGEN SERVICE.
Kipin, Peter Source: Pipeline and Gas Journal, v 207, n 2, p 34, 37, 40, Feb 1980

ABANDONMENT AND RECOVERY SOLUTION OF SUBMARINE PIPELINES.
Datta, T.K. Source: Applied Ocean Research, v 4, n 4, p 247-252, Oct 1982

ABANDONMENT OF CHEVRON PLATFORMS HAZEL, HILDA, HOPE AND HEIDI
Basavalinganadoddi, Chandrashekar1; Mount II, Paul B.1 Source: Proceedings of the International Offshore and Polar Engineering Conference, p 468-477, 2004.

AFRICA-ITALY PIPELINE PROGRESSES THROUGH WORK OF SOPHISTICATED BARGE.
Mulcahy, Michael Source: Sea Technology, v 21, n 10, p 14-15, 17, Oct 1980

AGGREGATE RESOURCES INVENTORY PROGRAM.
Anon Source: Miscellaneous Paper - Ontario Geological Survey, p 111-114, 1983

AIR SEALS
Mitchell, Donald W. Source: Session Papers - American Mining Congress Coal Convention, p 49-54, 1991

ALBERTA PIPELINE ENVIRONMENTAL STEERING COMMITTEE. A MODEL FOR COOPERATIVE RESOLUTION OF ISSUES
Brocke, Larry K.1; Kuipers, Fred1 Source: Proceedings of the International Pipeline Conference, IPC, v 2, p 1319-1323, 1996

ALBERTA TIER 2 SOIL AND GROUNDWATER REMEDIATION GUIDELINES. ALBERTA ENVIRONMENT. 2009. iv + 76 pp + Appendices

ANALYSIS OF THE FAILURE OF THE MINTE CREEK CULVERT
Ayala, L.; Brown, E. Source: Destructive water: water-caused disasters, their abatement and control. Proc. international conference, California, 1996, n 239, p 353-360, 1997

AN ASSESSMENT OF SAFETY, RISKS AND COSTS ASSOCIATED WITH SUBSEA PIPELINE DISPOSALS. Skandpower Risk Management Inc. 2004. ii + 46 pp.

AN OVERVIEW OF ENVIRONMENTAL ISSUES PERTAINING TO ABANDONMENT OF AN NEB-REGULATED PIPELINE: A CASE STUDY OF THE YUKON PIPELINES LIMITED ABANDONMENT
Roblin, Katherine E.1 Source: Proceedings of the Biennial International Pipeline Conference, IPC, v 1, p 409-424, 2007, Proceedings of the ASME International Pipeline Conference 2006, IPC 2006

AN UPDATE ON THE COST OF DECOMMISSIONING IN THE GULF OF MEXICO, 2003-2008
Kaiser, Mark J.1; Dodson, Richard2; Foster, Matthew2 Source: International Journal of Oil, Gas and Coal Technology, v 2, n 2, p 89-120, 2009

APPLICATION OF LEARNINGS FROM THE ASSESSMENT OF CATHODIC PROTECTION AND COATINGS ON A RECOVERED MARINE PIPELINE END TERMINATION
Walsh, Michael1; Gibson, Grant T.1; Dupre, Michael H.2; Partridge, Paul E.3 Source: NACE - International Corrosion Conference Series, p 061061-0610616, Corrosion 2006

APPLIED USE OF HIGH RESOLUTION IMAGERY FOR HUMAN SAFETY AND ENVIRONMENT IN SOUTH SUMATRA, INDONESIA
Terry, Sarah1, 5; Soofi, Khalid A.2; Kwenandar, Yuli3, 4; Mcintosh, Bill3, 4 Source: 2005 International Oil Spill Conference, IOSC 2005, p 11334-11338.

BALANCED DESIGN AND FINITE-ELEMENT ANALYSIS OF CULVERTS
Allgood, J.R.; Takahashi, S.K. Source: Highway Research Record, n 413, p 45-56, 1972

BARTOLO WATER PIPELINE REHABILITATION STUDY.
Doyle, Albert A.1; Bayles, Thomas E.1; Jochem, Timothy C.1; Schrock, B.Jay1 Source: ASCE, p 184-192, 1988

BROOKS AQUEDUCT
Manz, David H.1; Loov, Robert E.1; Webber, Jim1 Source: Canadian journal of civil engineering, v 16, n 5, p 684-692, Oct 1989

BUDGET PREPARATION FOR A GAS DISTRIBUTION RENEWAL PROJECT.
Ahmad, Hayat1 Source: Pipe line industry Houston, Tex., v 68, n 6, p 33-34, Jun 1988

BUILDING UP THE WEST-TO-EAST NATURAL GAS TRANSMISSION PROJECT AS A HIGH RELIABILITY SYSTEM
Wu, Zongji1 Source: Tianranqi Gongye/Natural Gas Industry, v 22, n 6, p 1-5+1, 2002.

CALIFORNIA AQUEDUCT FOUNDATION REPAIR USING MULTIPLE GROUTING TECHNIQUES
Wehling, Timothy M.1; Rennie, David C.1 Source: Geotechnical Special Publication, n 120 II, p 893-904, 2003

CANADA-WIDE STANDARDS FOR PETROLEUM HYDROCARBONDS (PHC) IN SOIL. Canadian Council of Ministers of the Environment. 2008. 8 pp.

CANADIAN GUIDELINES FOR THE MANAGEMENT OF NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM). HEALTH CANADA. 2000. First Edition. 47 pp.

CANADIAN SOIL QUALITY GUIDELINES – CARCINOGENIC AND OTHER POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) (Environmental and Human Health Effects). Canadian Council of Ministers of the Environment. 2010. xx + 215 pp.

CANADIAN SOIL QUALITY GUIDELINES FOR THE PROTECTION OF ENVIRONMENTAL AND HUMAN HEALTH – ETHYLBENZENE. Canadian Council of Ministers of the Environment. 2004. 9 pp.

CANADIAN SOIL QUALITY GUIDELINES FOR THE PROTECTION OF ENVIRONMENTAL AND HUMAN HEALTH – POLYCHLORINATED BIPHENYLS (TOTAL). Canadian Council of Ministers of the Environment. 1999b. 11 pp.

CANADIAN SOIL QUALITY GUIDELINES FOR THE PROTECTION OF ENVIRONMENTAL AND HUMAN HEALTH. Summary Tables. Canadian Council of Ministers of the Environment. 2007. 6 pp.

CAPPING TECHNIQUES FOR ABANDONED WELLS OF GAS STORAGE
Zhang, Ping1, 2; Liu, Shiqiang1; Zhang, Xiaohui1; Liu, Jianmei1; Xue, Qingxiang1 Source: Tianranqi Gongye/Natural Gas Industry, v 25, n 12, p 111-114+16, December 25, 2005

CARING FOR THE ENVIRONMENT WORLDWIDE
Monk, David1 Source: Petroleum Review, v 43, n 508, p 248-250, May 1989

CASE HISTORY OF USING AN INTEGRATED ASSET MODEL FOR DEPLETION PLANNING OF A TIGHT GAS RESERVOIR, NORTHEAST THOMPSONVILLE FIELD, JIM HOGG AND WEBB COUNTIES, TEXAS
Schott, David W.1; Abacioglu, Yafes1; Moran, Mark J.1; Stein, Michael H.1; Scattergood, Joseph2 Source: Proceedings - SPE Annual Technical Conference and Exhibition, p 2951-2959, 2004.

CCME POLICY STATEMENT FOR THE MANAGEMENT OF TOXIC SUBSTANCES. Canadian Council of Ministers of the Environment. 1998. 3 pp.

CHALLENGES OF WASTE MANAGEMENT IN ENVIRONMENTALLY DEVELOPING COUNTRIES
Paton, Wendy1; Fletcher, Paul1 Source: Society of Petroleum Engineers - 9th International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production 2008 - "In Search of Sustainable Excellence", v 2, p 1068-1075, 2008.

CHALLENGES OF WASTE MANAGEMENT IN ENVIRONMENTALLY DEVELOPING COUNTRIES
Paton, Wendy1; Fletcher, Paul1 Source: Society of Petroleum Engineers - 9th International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production 2008 - "In Search of Sustainable Excellence", v 2, p 1068-1075.

CHARACTERISTICS OF ULTRA-DEEPWATER PIPELAY ANALYSIS
Choi, H.S.1; Jo, H.J.1 Source: Proceedings of the Annual Offshore Technology Conference, v 3, p 11-16, 1999

CLEANUP OF FORMER MGP SITES: COMMUNITY EXPOSURE, RESPONSIBLE PARTY LIABILITY, AND OPTICAL REMOTE SENSING
Minnich, Timothy R.1; Scotto, Robert L.1 Source: Proceedings of the Air and Waste

Management Association's Annual Meeting and Exhibition, p 2723-2733, 2004, Proceedings of the A and WMA's 97th Annual Conference and Exhibition; Sustainable Development: Gearing up for the Challenge

COMPACTION CONTROL TO MINIMIZE SETTLEMENT OF FILL SUPPORTING A SHOPPING CENTER
Newman, F.Barry1; Mazzella, Samuel G.1 Source: ASTM Special Technical Publication, n 1384, p 149-155, 2000

COMPUTER AND PLANNING OF CHP/DH SYSTEMS.
Roslund, Stefan1 Source: District Heating Assoc, Carterham, 1983
Conference: District Heating Association - District Heating '83, Fifth National Conference: Planning for CHP Heat. Sponsor: District Heating Assoc, Carterham, Engl

CONCRETE RECYCLING USES STANDARD CRUSHING EQUIPMENT.
ROBERTSON, JOSEPH L. Source: ROCK PROD, V 85, N 9, p 45-46, 48, 50, Sep 1982

CONTRACTORS' CONCEPT OF OPTICAL FIBER IN SEWERS OR ABANDONED PIPELINES
Welch, Michael C.1 Source: New Pipeline Technologies, Security, and Safety, v 1, p 749-752, 2003

CONVERSION OF THE ABANDONED POTASH MINE 'WILHELMINE-CARLSGLUCK' IN HULSEN/VERDEN, WEST GERMANY, TO CRUDE OIL STORAGE.
Klemme, Jobst Source: In Situ, v 3, n 2, p 121-146, 1979

CORROSION OF METALS IN MARINE ENVIRONMENTS
J A. Beavers, G. H. Koch, W. E. Berry, Source: Metals and Ceramics Information Center, MCIC Report 86-50, 1986

COUNTING THE COST OF NORTH SEA JUNK
Foxwell, David Source: Engineer, v 280, n 7240-7241, p 17-18, Mar 9 1995

DEACTIVATION AND DISPOSAL OF A PIPELINE POTENTIALLY CONTAMINATED WITH URANIUM HEXAFLUORIDE (UF6) AT THE DEPARTMENT OF ENERGY (DOE) SAVANNAH RIVER SITE (SRS)
Santos, Joseph K.1; Reynolds II, John M.2 Source: 2005 ANS Topical Meeting on Decommissioning, Decontamination, and Reutilization, v 2005, p 375-378

DECISION PROCEDURES FOR PIPELINE ABANDONMENT. Hodgdon, A.M. and P.C. Wright. 1991. Oil and Gas Journal. (87)32: 40 - 52.

DECISION PROCEDURES FOR PIPELINE REHAB
Wright, Paul C.1; Hodgdon, Arthur M.1 Source: Oil and Gas Journal, v 87, n 32, Aug 7 1989

DECOMMISSIONING - CONSIDERING ALL THE OPTIONS
Terdre, Nick Source: Petroleum Review, v 57, n 681, p 12-15, October 2003

DECOMMISSIONING COST FUNCTIONS IN THE GULF OF MEXICO
Kaiser, Mark J.1; Pulsipher, Allan G.1; Byrd, Robert C.2 Source: Journal of Waterway, Port, Coastal and Ocean Engineering, v 129, n 6, p 286-296, November/December 2003

DECOMMISSIONING MARINE PIPELINES
Lissaman, Jack1; Palmer, Andrew1 Source: Pipes and Pipelines International, v 44, n 6, p 35-43, Nov-Dec 1999

DECOMMISSIONING PROCESS PLANT FACILITIES
Phillips, Louis T.1 Source: Chemical Engineering Progress, v 98, n 12, p 68-73, December 2002

DESIGN ROBUSTNESS SAVES MARCO POLO OIL SCR DURING ITS INSTALLATION
Mekha, Basim B.1; O'Sullivan, Enda2; Nogueira, Andre3 Source: Proceedings of the International Conference on Offshore Mechanics and Arctic Engineering - OMAE, v 1 B, p 867-874, 2004, Proceedings of the 23rd International Conference on Offshore Mechanics and Arctic Engineering - 2004 Volume 1 Part B: Offshore Technology

DETECTING AND IMAGING HARD-TO-FIND ABANDONED WELLS AND PIPELINES
Gochioco, Lawrence M.1; Ruev Jr., Fred1 Source: Leading Edge (Tulsa, OK), v 25, n 3, p 358-361, March 2006

DETERMINATION OF ENVIRONMENTAL LIABILITIES AND DEVELOPMENT OF A FACILITY CLOSURE PLAN FOR A STATE OIL AND GAS COMPANY
Sookdeo, Nigel1 Source: Proceedings - SPE Annual Technical Conference and Exhibition, p 581-590, 2002

DEVELOPMENT OF PROCESSES AND EQUIPMENT MAKES WORK SAFER, MORE ECONOMICAL. RE/DECOMMISSIONING PETROCHEMICAL PIPELINES
Powers, Marvin D.1 Source: Pipeline and Gas Journal, v 217, n 3, p 26-31, Mar 1990

DREDGING, TRENCHING AND ROCK PLACEMENT WORKS FOR THE SAKHALIN-1 PROJECT, RUSSIAN FAR EAST
Athmer, Joep; Gijzel, Teus Source: Terra et Aqua, n 105, p 3-17, December 2006

EDEN PARK FEEDER REPLACEMENT
Arnette, Patrick J.1; Weber, Russell A.1 Source: Proceedings of the 2006 Pipeline Division Specialty Conference - Pipelines 2006: Service to the Owner, v 211 40854, p 53, 2006, Proceedings of the 2006 Pipeline Division Specialty

EFFECTS OF RIGHT-OF-WAY CONSTRUCTION THROUGH FOREST INTERIOR HABITAT ON BIRD AND SMALL MAMMAL POPULATIONS AND RATES OF NEST

PREDATION
Chmielewski, A. Source: NCASI Technical Bulletin, n 781 I, p 84-85, 1999

EFFECTS OF SLURRY BACKFILLING - LESSONS LEARNED
Faddick, Robert R.1 Source: Geotechnical Special Publication, n 21, p 95-104, 1988

EMERGENCY ABANDONMENT OF 78" CMP AT BLUE LAKES TROUT FARM
Anon Source: Proceedings of the ASCE Pipeline Division Specialty Congress - Pipeline Engineering and Construction, p 943-953, Pipelines 2004, What's on the

EMISSIONS RETROFIT TECHNOLOGIES FOR A FAMILY OF LARGE-BORE SPARK-GAS ENGINES
Gillette, Allen D.1 Source: Proceedings of the American Gas Association, Operating Section, p 44-53, 1995

ENHANCED GAS RECOVERY AND CO2 SEQUESTRATION BY INJECTION OF EXHAUST GASES FROM COMBUSTION OF BITUMEN
Sim, Steve S. K.1; Brunelle, Patrick2; Turta, Alex T.1; Singhal, Ashok K.1 Source: Proceedings - SPE Symposium on Improved Oil Recovery, v 2, p 905-914, 2008, 16th SPE/DOE Improved Oil Recovery Symposium 2008 - "IOR: Now More Than Ever."

ENVIRONMENTAL CONSIDERATIONS FOR PIPELINE ABANDONMENT: A CASE STUDY FROM ABANDONMENT OF A SOUTHERN ALBERTA PIPELINE. Swanson, J.M., T. Kunicky and Pete Poohkay. 2010. Proceedings of the 8th International Pipeline Conference. 7 pp.

ENVIRONMENTAL ISSUES CONCERNING PIPELINE ABANDONMENT. H.R. Heffler Consulting Ltd. and TERA Environmental Consultants (Alta) Ltd. 1995. A report for: Pipeline Abandonment Environmental Working Group. 22 pp.

ENVIRONMENTAL MANAGEMENT PROCESS FOR MAJOR PROJECTS
Krishna, Paul1; Moynihan, Kelly1; Callon, Doug1 Source: Society of Petroleum Engineers - International Petroleum Technology Conference 2009, IPTC 2009, v 3, p 1623-1633

EQUILIBRIUM OF OFFSHORE CABLES AND PIPELINES DURING LAYING.
Pedersen, P.Terndrup Source: International Shipbuilding Progress, v 22, n 256, p 399-408, Dec 1975

EXPERIMENTAL STUDY AND NUMERICAL ANALYSIS OF SEISMIC RESPONSE OF EMBEDDED LARGE-SPAN CORRUGATED STEEL CULVERT
Che, Ailan1; Takahiro, Iwatate2; Ge, Xiurun1 Source: Yanshilixue Yu Gongcheng Xuebao/Chinese Journal of Rock Mechanics and Engineering, v 25, n SUPPL. 2, p 4052-4058, October 2006.

DRAKE F-76, IN SITU ABANDONMENT OF A HIGH ARCTIC OFFSHORE COMPLETION AND FACILITIES
Duguid, Alan; McBeth, Ray Source: Journal of Canadian Petroleum Technology, v 39, n 5, p 33-40, May 2000

FEDERAL CONTAMINATED SITE RISK ASSESSMENT IN CANADA – PART 1: GUIDANCE ON HUMAN HEALTH PRELIMINARY QUANTITATIVE RISK ASSESSMENT (PQRA). Health Canada. 2004. Contaminated Sites Program. 41 pp.

FIELD MEASUREMENTS AND ANALYSIS OF A LARGE-DIAMETER FLEXIBLE CULVERT
Byrne, P.M.1; Srithar, T.1; Kern, C.B.1 Source: Canadian geotechnical journal, v 30, n 1, p 135-145, Feb 1993

FILLING ABANDONED MINES WITH FLUIDIZED BED COMBUSTION ASH GROUT
Gray, Donald D.1; Reddy, Thirupathi P.1; Black, D.Courtney1; Ziemkiewicz, Paul F.1 Source: ASTM Special Technical Publication, n 1331, p 180-193, May 1998

FILLING ABANDONED UNDERGROUND FACILITIES WITH CLSM FLY ASH SLURRY
Naik, Tarun R.1; Ramme, Bruce W.1; Kolbeck, Henry J.1 Source: Concrete International, v 12, n 7, p 19-25, Jul 1990

FIT FOR PURPOSE
Healy, J.1; Weigold, G.2 Source: Hydrocarbon Engineering, v 11, n 3, p 113-116, March 2006

FLOW ASSURANCE IN MULTIPHASE ENVIRONMENTS
Forsdyke, I.N.1 Source: Proceedings - SPE International Symposium on Oilfield Chemistry, p 267-276, 1997

GARDEN BANKS 388 ABANDONMENT - TECHNICAL ASPECTS COVERING PIGGING AND FLUSHING OPERATIONS
MacLeod, R.B.1; Pierson, J.M.1 Source: Proceedings of the Annual Offshore Technology Conference, v 3, p 585-589, 2000

GAS EXTRACTION VIA BOREHOLES IN ABANDONED MINING AREAS
Schlüter, Ralph1; Kaminski, Michael2 Source: Gluckauf: Die Fachzeitschrift fur Rohstoff, Bergbau und Energie, v 142, n 1-2, p 30-36+4, January 23, 2006

GAS GATHERING IN THE CENTRAL NORTH SEA.
Stern, Jonathan1 Source: Pipes and Pipelines International, v 33, n 1, p 7-12, Jan-Feb 1988

GAS RESEARCH INSTITUTE PIPELINE PCB RESEARCH PROGRAM
Linz, David G.1; Woodyard, John P.1 Source: Proceedings of the American Gas Association, Operating Section, p 369-372, 1991

GEOTECHNICAL ASPECTS OF TERRAIN SUBSIDENCE AFTER PIPELINE ABANDONMENT. Geo-Engineering Ltd. 1996. Prepared for the Pipeline Abandonment Committee. 7 pp + Appendix.

GRAVEL-PACK ISOLATION SQUEEZE FOR PLUG-DOWN RECOMPLETION
Fleming, J.J.; Boyd, S.R.; Wolverton, D.M. Source: SPE Reservoir Engineering (Society of Petroleum Engineers), n A, p 711-714, 2000

GUIDANCE MANUAL FOR DEVELOPING SITE SPECIFIC SOIL QUALITY REMEDIATION OBJECTIVES FOR CONTAMINATED SITES IN CANADA. Canadian Council of Ministers of the Environment. 1999a. National Contaminated Sites Remediation Program. 30 pp.

GUIDELINES FOR PIPELINE ABANDONMENT APPLICATIONS IN ALBERTA (DRAFT)
Canadian Association of Petroleum Producers, January 2002.

GUIDELINES FOR THE MANAGEMENT OF NATURALLY OCCURRING RADIOACTIVE MATERIAL (NORM) IN THE OIL AND GAS INDUSTRY. International Association of Oil and Gas Producers. 2008. 42 pp.

HDD UTILITY TUNNEL TO PEDDOCKS ISLAND - FORT ANDREWS
McHugh, K.E.1; Gabriel, P.F.1 Source: Pipelines 2007: Advances and Experiences with Trenchless Pipeline Projects - Proceedings of the ASCE International Conference on Pipeline Engineering and Construction, p 48, 2007.

HESS CREEK THERMAL EROSION TEST SITE FROZEN CUT SLOPE SURFACE TREATMENTS
Rooney, J.W.1; Condo, A.C.1 Source: Canadian Soc for Civil Engineering, p 1129-1149, 1984

HISTORY OF A WET GAS TRANSPORTATION PIPELINE FROM DESIGN THROUGH TO DECOMMISSIONING
Starsmore, R.P. Source: Pipes and Pipelines International, v 35, n 4, p 11, Jul-Aug 19

HORIZONTAL DIRECTIONAL BORE RELOCATES 15 EXISTING LINES.
Halderman, Ron1 Source: Pipe line industry Houston, Tex., v 67, n 1, p 25-26, Jul 1987

HOW RISKY WERE MY OLD PLATFORMS?
Marshall, Peter W.1 Source: Proceedings of the International Conference on Offshore Mechanics and Arctic Engineering - OMAE, v 2, p 511-520, 2007.

IDENTIFICATION AND ASSESSMENT OF TRACE CONTAMINANTS ASSOCIATED WITH OIL AND GAS PIPELINES ABANDONED IN PLACE
Thorne, Wendy E.R.1; Basso, Anne C.1; Dhol, Sukhvinder K.1 Source: Proceedings of the International Pipeline Conference, IPC, v 2, p 1263-1270, 1996

IMPACTS OF THE ALAMEDA CORRIDOR TRANSPORTATION PROJECT IN METROPOLITAN LOS ANGELES
Ripaldi, Carl Peter1 Source: SPE/EPA Exploration & Production Environmental Conference, p 555-559, 1999

IMPACTS OF THE ALAMEDA CORRIDOR TRANSPORTATION PROJECT IN METROPOLITAN LOS ANGELES
Ripaldi, Carl Peter1 Source: SPE/EPA Exploration & Production Environmental Conference, p 555-559, 1999

IMPLEMENTATION OF ISO-14000 STANDARDS IN ROUTINE ENVIRONMENTAL MANAGEMENT OF OIL AND GAS FIELDS BY MEANS OF GIS AND REMOTE SENSING
Jellema, Jan; Tchistiakov, Alexei Source: Journal of Canadian Petroleum Technology, v 41, n 9, p 11-15, September 2002

IMPLEMENTATION OF ISO-14000 STANDARDS IN ROUTINE ENVIRONMENTAL MANAGEMENT OF OIL AND GAS FIELDS BY MEANS OF GIS AND REMOTE SENSING
Jellema, Jan; Tchistiakov, Alexei Source: Journal of Canadian Petroleum Technology, v 41, n 9, p 11-15, September 2002

INERT GAS APPLICATIONS IN NATURAL GAS STORAGE: STUDIES IN THE MICHIGAN STRAY SANDSTONE
Nowaczewski, Stephen F.1 Source: Proceedings of the Annual ACM-SIAM Symposium on Discrete Algorithms, p 541-566, 2001, 2001 Operating Section Proceedings, American Gas Association

IN-HOUSE DESIGN REDUCES COST OF VALVE RETIREMENT/UPGRADING.
Ahmad, Hayat Source: Pipe Line Ind, v 47, n 3, p 53-56, Mar 1978

INNOVATIVE DESIGN FOR DIVERSION
Sundaram, A.V.1 Source: Waterpower '91: A New View of Hydro Resources, p 1049-1058, 1991

INNOVATIVE METHODOLOGY FOR CLEANING PIPES-KEY TO ENVIRONMENTAL PROTECTION
Buzelin, Luiz Otávio Soranço1; De Campos Lima, Cláudio Benevenuto1 Source: Society of

Petroleum Engineers - 9th International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production 2008 - "In Search of Sustainable Excellence", v 2, p 730-738, 2008, Society of Petroleum Engineers - 9th International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production 2008 - "In Search of Sustainable Excellence"

INNOVATIVE REUSE OF DRYDOCKS AS CONTAINED DISPOSAL SITES
Graham, Todd1; Ueda, Emily2 Source: Ports 2010: Building on the Past, Respecting the Future - Proceedings of the 12th Triannual International Conference, p 621-630, 2010, Ports 2010: Building on the Past, Respecting the Future - Proceedings of the 12th Triannual International Conference

INNOVATIVE USES OF CONTROLLED LOW STRENGTH MATERIAL (CLSM) IN COLORADO
Hook, William1; Clem, Don A.1 Source: ASTM Special Technical Publication, n 1331, p 137-150, May 1998

INSPECTION OF COKE-OVEN GAS PIPELINE STATE TO DETERMINE PROSPECTS OF ITS FURTHER OPERATION
Kichenko, B.V.; Majstrenko, V.V.; Molyavko, G.A.; Kolosov, G.I.; Skripchenko, N.P. Source: Koks i Khimiya, n 11, p 37-39, Nov 1992

INSTALLED PIPE, ESPECIALLY PRE-1970, PLAGUED BY PROBLEMS
Kiefner, John F.1 Source: Oil and Gas Journal, v 90, n 32, p 45-51, Aug 10 1992

ISSUES ARISING FROM THE WESTHAVEN TRAGEDY CONCERNING FISHING GEAR AND PIPELINE INTERACTIONS
Side, J.1 Source: Underwater Technology, v 24, n 1, p 3-9, 1999

LAGGAN & TORMORE - DEVELOPMENT OF TWO NEW DEEPWATER GAS CONDENSATE FIELDS AND ASSOCIATED GAS EXPORT INFRASTRUCTURE
Cutler, Jeremy1 Source: Society of Petroleum Engineers - Offshore Europe Oil and Gas Conference and Exhibition 2009, OE 2009, v 1, p 364-376.

LESSONS LEARNED FROM MAGNOLIA THRU-TUBING RECOMPLETIONS USING COILED TUBING
Fleming, Gavin1; Marti, Srinagesh K.1; Kartika, Ign1 Source: Coiled Tubing and Well Intervention Conference and Exhibition 2009, p 308-321

LINK OF HISTORICAL PROPORTIONS SQUEEZES INTO VERMONT SITE
Cho, Aileen Source: ENR (Engineering News-Record), v 258, n 11, p 17-19, March 19, 2007

LIVE BY SATELLITE AND OTHER EVENTS AT WASTE MANAGEMENT '04
Zacha, Nancy J. Source: Radwaste Solutions, v 11, n 3, p 48-52, May/June 2004

LIVE INSERTION: A PUSH IN THE RIGHT DIRECTION.
Thompson, Alan1 Source: Gas engineering and management, v 28, n 5, May 1988

LONGEST CONDUIT
Soukup, R.J.1 Source: American Society of Mechanical Engineers, Petroleum Division (Publication) PD, v 6, p 1-5, 198

LOUISIANA IS LOSING CRITICAL REEF HABITAT AND JOB OPPORTUNITIES
Kolian, Steve1; Walker, Allen2 Source: Sea Technology, v 45, n 10, p 31-34, October 2004

MANAGING ABANDONMENT, DECOMMISSIONING, REMEDIATION AND RESTORATION THROUGHOUT THE E&P LIFECYCLE
Hoffmann, Rob1; Strong, Jim1 Source: Society of Petroleum Engineers - SPE International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production 2010, v 3, p 1970-1975.

MANAGING GIS AND SPATIAL DATA TO SUPPORT EFFECTIVE DECISION MAKING THROUGHOUT THE PIPELINE LIFECYCLE
Van Wyngaarden, Robert1; Vanderwal, Mel1 Source: Proceedings of the Biennial International Pipeline Conference, IPC, v 1, p 503-508, 2006

MATHEMATICAL MODELLING OF SAND WAVE MIGRATION AND THE INTERACTION WITH PIPELINES
Morelissen, Robin1; Hulscher, Suzanne J.M.H.1; Knaapen, Michiel A.F.1; Németh, Attila A.1; Bijker, Romke1 Source: Coastal Engineering, v 48, n 3, p 197-209, June 2003

MERCURY IN NATURAL GAS - DECONTAMINATION PROCESS FOR PIPELINES AND PLANT COMPONENTS DURING FIELD ABANDONMENT
Mussig, Von S.1 Source: Erdoel Erdgas Kohle/EKEP, v 111, n 5, 3pp, May 1995

MERCURY POROSIMETRY. AN INAPPROPRIATE METHOD FOR THE MEASUREMENT OF PORE SIZE DISTRIBUTIONS IN CEMENT-BASED MATERIALS
Diamond, Sidney1 Source: Cement and Concrete Research, v 30, n 10, p 1517-1525, October 2000

METHOD TO SOLVE THE PROBLEM OF ABANDON/RECOVERY OPERATION OF A PIPELINE.
Aranha, J.A.P.; de Lima, J.; Cruz, J.J.; Ielo, V.C.F. Source: Offshore Structures Engineering, v 4, p 189-222, 1982

MONITORING THE MECHANICAL INTEGRITY OF CASING IN PRODUCTION OR INJECTION WELLS
Bigelow, E.L.1 Source: American Society of Mechanical Engineers, Petroleum Division (Publication) PD, v 68, p 247-259, 1995, Offshore and Arctic Operations 1995

MULTIPRODUCT PIPE TRANSPORT CONVERSION OF ABANDONED SINGLE PRODUCT PIPELINES
Davis, C.1; Fagan, J.1 Source: Proceedings - SPE Annual Technical Conference and Exhibition, p 2605-2611, 2005

NATIONAL CONTAMINATED SITES REMEDIATION PROGRAM. 1993. 1992 - 1993 Annual Report. Canadian Council of Ministers of the Environment. Website: http://www.ccme.ca/assets/pdf/pn_1002_e.pdf. Accessed: November 2010.

NATURAL HAZARD AND RISK MANAGEMENT FOR SOUTH AMERICAN PIPELINES
Porter, Michael1; Savigny, K. Wayne1 Source: Proceedings of the International Pipeline Conference, IPC, v A, p 861-869, 2002

NEW EUROPEAN AND GERMAN LAW REGARDING ABNORMAL OCCURRENCES - SEVESO IN THE GAS INDUSTRY
Evers, Ch.1 Source: Gaswaerme International, v 48, n 3, p 201-204, March 1999

NEW STANDARDS FOR OIL AND GAS PIPELINE
Source: Pipeline World, n 6, p 27, December 2004

NEW TECHNIQUE TO ELIMINATE SEVERE SLUGGING IN PIPELINE/RISER SYSTEMS
Sarica, Cem1; Tengesdal, Jarl O.1 Source: Proceedings - SPE Annual Technical Conference and Exhibition, v PI, p 633-641, 2000

NORTH SEA OPERATORS TACKLING PLATFORM ABANDONMENT PROBLEMS
Knott, David Source: Oil and Gas Journal, v 93, n 12, 7pp, Mar 20 1995

NOVEL TECHNIQUE FOR OPENHOLE ABANDONMENT SAVES RIG TIME - A CASE HISTORY
Chong, King K.1; Butterfield Jr., Charles A.1; Conwell, Russell P.2 Source: SPE - Asia Pacific Oil and Gas Conference, p 1019-1025, 2000.

NW EUROPE'S OFFSHORE OPERATORS FILLING IN DEVELOPMENT PUZZLE
Knott, David Source: Oil and Gas Journal, v 94, n 46, Nov 11 1996

OILFIELD ABANDONMENT AND SOIL RESTORATION IN THE NETHERLANDS, EXPERIENCES FOR THE FUTURE
Kant, Aad1; Oranjewoud, N.V.1 Source: Society of Petroleum Engineers - SPE International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production 2010, v 3, p 1837-1847, 2010, Society of Petroleum Engineers - SPE International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production 2010

ONSHORE, OFFSHORE USE OF HIGH-PRESSURE PIPELINE ISOLATION PLUGS FOR OPERATING PIPELINE CONSTRUCTION, MAINTENANCE
Parrott, Ralph1; Tveit, Edd1 Source: Pipeline and Gas Journal, v 232, n 1, p 30-35, January 2005

ONSHORE PIPELINE REGULATIONS. NATIONAL ENERGY BOARD. 1999. Website: http://laws.justice.gc.ca/PDF/Regulation/S/SOR-99-294.pdf.

ON-SITE REMEDIATION OF ORGANICALLY IMPACTED SOILS ON OILFIELD PROPERTIES
Hildebrandt, W.W.1; Wilson, S.B.1 Source: Proc 90 Calif Reg Meet, p 401-406 20061, 1990, Proc 90 Calif Reg Meet

OPTIMIZING GAS FIELD PERFORMANCE TO INCREASE GAS PRODUCTION RATES AND RESERVES
Stein, M.H.1; Venturini, G.J.2; Avasthi, S.M.2 Source: SPE Latin American and Caribbean Petroleum Engineering Conference Proceedings, v 2, p 646-659.

PIPE JACKING IN DIFFICULT URBAN WATERFRONT CONDITIONS
Castro, Rafael C.1; Muindi, Tennyson M.2; Hughes, Geoffrey3; Albert, Philip H.4 Source: Pipelines 2007: Advances and Experiences with Trenchless Pipeline Projects - Proceedings of the ASCE International Conference on Pipeline Engineering and Construction, p 30, 2007.

PIPELINE ABANDONMENT, A DISCUSSION PAPER ON TECHNICAL AND ENVIRONMENTAL ISSUES
Pipeline Abandonment Steering Committee, 1996

PIPELINE ABANDONMENT ASSUMPTIONS
Prepared for the Terminal Negative Salvage Task Force of the Canadian Energy Pipeline Association. (DRAFT) September 2006 – April 2007

PIPELINE CORROSION EVALUATION. Webster, R.D. 1995. Topical Report, Corrpro Canada Inc. 12 pp.

PIPELINE GEO-ENVIRONMENTAL DESIGN AND GEOHAZARD MANAGEMENT
Chapter 6: Geohazard Management. Edited by Moness Rizkalla, ASME, 2008.

PIPELINE OPERATORS UNDER USING POTENTIAL PIPELINE REHABILITATION. Howell, D. 2010. Oil and Gas Journal. January 11, 2010: 56 - 59.

PIPELINE PCB RESEARCH PROGRAM - GAS RESEARCH INSTITUTE. Linz, D.G. and J.P. Woodyard. 1991. Proceedings of the American Gas Association, Operating Section 1991: 369 - 372.

PIPELINE SAFETY FROM A UK LEGAL PERSPECTIVE
Fisher, Alan1 Source: Pipes and Pipelines International, v 42, n 1, 8pp, Jan-Feb 1997

PIPELINES SAFETY REGULATIONS
Bugler, J.C.1 Source: Institution of Chemical Engineers Symposium Series, n 139, p 525-535, 1995

PLASTIC BUCKLING OF TUBES IN PURE BENDING.
Calladine, C.R.1 Source: Cambridge Univ Press, p 111-124, 1983

PLASTIC PIPE INSERTION.
Diskin, Joe1 Source: Pipeline and Gas Journal, v 214, n 5, p 22-23, May 1987

PLUGGING AND ABANDONING MULTILATERAL HORIZONTAL CBM WELLS FOR SAFE MINE THROUGH OPERATIONS
Suhy, Thomas E.1 Source: SPE Eastern Regional Meeting, p 197-205, 2009, SPE Eastern Regional Meeting 2009

PORTLAND PIPELINE PROVIDES REHABILITATION CHALLENGE
Anon Source: Public Works, v 127, n 13, p 51-52, Dec 1996

POTENTIAL INTERACTIONS BETWEEN PIPELINES AND TERRAIN IN A NORTHERN ENVIONMENT.
van Everdingen, R.O. Source: Technical Bulletin - Canada, Inland Waters Directorate, n 114, 1979

PREDICTABLE PROGRAMMING ON A PRECISION TIMED ARCHITECTURE
Lickly, Ben1; Liu, Isaac1; Patel, Hiren D.1; Kim, Sungjun2; Lee, Edward A.1; Edwards, Stephen A.2 Source: Embedded Systems Week 2008 - Proceedings of the 2008 International Conference on Compilers, Architecture and Synthesis for Embedded Systems, CASES'08, p 137-146.

PREDICTION MODEL FOR DECOMMISSIONED OFFSHORE PIPELINES
Bijker, R.1; Chen, Z.1 Source: Proceedings of the International Offshore and Polar Engineering Conference, v 2, p 143-146, 2001

PREPARING FOR DECOMMISSIONING OF THE HEATHER FIELD
Hustoft, R.1; Gamblin, R.1 Source: Offshore Europe Conference - Proceedings, p 135-147, 1995

PROJECT DELAYS
Westwood, Adam1 Source: Refocus, v 6, n 5, p 14, September/October 2005

PUMPED-SLURRY BACKFILLING OF INACCESSIBLE MINE WORKINGS FOR SUBSIDENCE CONTROL.

Whaite, Ralph H.; Allen, Alice S. Source: Information Circular - United States, Bureau of Mines, n 8667, 1975

QUALITY OF THE BOTTOM SEDIMENT PRIOR TO DREDGING IN THE GOLDEN HORN OF ISTANBUL
Kinaci, C.1; Inanc, B.2; Aydin, A.F.1; Yuksel, E.1; Sevimli, M.F.1; Arikan, O.1; Topacik, D.1 Source: Journal of Environmental Science and Health - Part A Toxic/Hazardous Substances and Environmental Engineering, v 39, n 2, p 365-374, 2004

RADIATION PROTECTION AND THE MANAGEMENT OF RADIOACTIVE WASTE IN THE OIL AND GAS INDUSTRY. International Atomic Energy Association. 2010 xii + 204 pp.

REALIZING THE POTENTIAL OF COST EFFECTIVE SEWER REPLACEMENT IN CHURCHILL BOROUGH
Blenko, Andrew W.1 Source: Pipelines 2002 - Beneath Our Feet: Challengers and Solutions - Proceedings of the Pipeline Division Specialty Conference, p 50, 2002, Pipelines 2002 - Beneath Our Feet: Challengers and Solutions - Proceedings of the Pipeline Division Specialty Conference

RECENT DEVELOPMENTS IN THE USE OF MINE WASTE FOR SUBSIDENCE CONTROL.
Allen, Alice S.; Anderson, Carl W. , p 213-221, 1974
Conference: Miner Waste Util Symp, 4th, Proc, May 7, 1974 - May 8, 1974

RECLAMATION OF NATIONAL ENERGY BOARD REGULATED PIPELINE RIGHTS OF WAY - A LIFE CYCLE APPROACH
Lien, Kent1 Source: Proceedings of the International Pipeline Conference, IPC, v B, p 1419-1424, 2002
Conference: Proceedings of the 4th International Pipeline Conference, September 30, 2002 - October 3, 2002 Sponsor: ASME
Publisher: American Society of Mechanical Engineers

REDEVELOPMENT OF THE ABANDONED DUTCH ONSHORE SCHOONEBEEK OILFIELD WITH GRAVITY ASSISTED STEAM FLOODING
Jelgersma, Frank1 Source: International Petroleum Technology Conference 2007, IPTC 2007, v 3, p 1617-1621.

RE-ENGINEERING EXISTING PIPELINES IN WESTERN CANADA
Hallihan, Michael F.1 Source: Proceedings of the Biennial International Pipeline Conference, IPC, v 1, p 973-980, 2007, Proceedings of the ASME International Pipeline Conference 2006, IPC 2006

RESEARCH ON THE CRITERION OF INSTABILITY OF THE HIGH-FILL SOFT ROADBED

Liu, Chun-Yuan1; Gong, Wen-Yi1; Li, Xiao-Ying1; Shi, Jin-Na1 Source: Geotechnical Special Publication, n 197, p 243-248, 2009, Slope Stability, Retaining Walls, and Foundations

RISK MANAGEMENT: LESSONS FROM SIX CONTINENTS
Nielsen, Kris R.1 Source: Proceedings of the ASCE Pipeline Division Specialty Congress - Pipeline Engineering and Construction, p 179-188, 2004

ROLE OF GEOTECHNICAL INVESTIGATION FOR DIRECTIONALLY DRILLED RIVER CROSSINGS
Barlow, J.Peter1; Cavers, Drummond S.1 Source: Proceedings of the International Pipeline Conference, IPC, v 2, p 1229-1235, 1996

SAFETY AND LOSS MANAGEMENT SYSTEM FOR PIPELINES
Abes, Jake1 Source: Proceedings of the Biennial International Pipeline Conference, IPC, v 1, p 981-988, 2007, Proceedings of the ASME International Pipeline Conference 2006, IPC 2006 ISBN-10: 0791842614

SECURING PIPELINE APPROVALS IN ATOUGH REGULATORY ENVIRONMENT
Buszynski, Mario E.1 Source: Proceedings of the Biennial International Pipeline Conference, IPC, v 1, p 425-430, 2007, Proceedings of the ASME International Pipeline Conference 2006, IPC 2006

SEISMIC ANALYSIS OF LARGE-DIAMETER FLEXIBLE UNDERGROUND PIPES
Davis, C.A.1; Bardet, J.P.1 Source: Journal of Geotechnical and Geoenvironmental Engineering, v 124, n 10, p 1005-1015, Oct 1998

SEVERE SLUGGING ATTENUATION FOR DEEPWATER MULTIPHASE PIPELINE AND RISER SYSTEMS
Tengesdal, J; Sarica, Cem; Thompson, Leslie Source: Proceedings - SPE Annual Technical Conference and Exhibition, p 1489-1501, 2002

SIGNIFICANT DECOMMISSIONING SUCCESS AT A SELLAFIELD URANIUM PURIFICATION PLANT
Prasser, Jane1; Eilbeck, Mark1 Source: 2005 ANS Topical Meeting on Decommissioning, Decontamination, and Reutilization, v 2005, p 173-179, 2005

SIX WAYS TO IMPROVE OFFSHORE PRODUCTION OPERATIONS.
Snyder, Robert E. Source: World Oil, v 185, n 1, 6 p between p 79 and 90, Jul 1977

SLURRY BACKFILLING OF AN UNDERGROUND COAL MINE
Brown, Adrian1; Murphy, James1; Bartell, Henry1 Source: Geotechnical Special Publication, n 21, p 76-94, 1988

SLURRY BACKFILLING OF MINE VOIDS IN HANNA, WYOMING.
Faddick, Robert R.1; Eby, William R.1 Source: University of Kentucky, Office of Engineering Services, (Bulletin) UKY BU, p 209-213, 1986

SLURRY BACKFILLS - USEFUL AND VERSATILE.
Balsamo, Nina1 Source: Public Works, v 118, n 4, p 58-60, Apr 1987

SOLID WASTES SHREDDER FACILITIES IN THE U. S. AND CANADA.
DeZeeuw, Richard E.; Haney, Emil B.; Wenger, Robert B. Source: Solid Wastes Management Refuse Removal Journal, v 19, n 4, 8 p between p 22 and 79, Apr 1976

SOME ABIOTIC CONSEQUENCES OF THE CANOL CRUDE OIL PIPELINE PROJECT, 35 YEARS AFTER ABANDONMENT.
Kershaw, G.Peter Source: Natl Acad Press, p 595-600, 1983
Conference: Proceedings - Permafrost, 4th International Conference. Sponsor: NAS, Polar Research Board, Washington, DC, USA

STATISTICAL ANALYSIS OF PCB DATA FROM NATURAL GAS PIPELINES. Bishop, M.K. and D.L. Lewis. 1990. Gas Research Institute. vi + 74 pp.

STATISTICS OF A LARGE CORROSION CONTROL PROGRAM IN LAKE MARACAIBO
Benedict, Risquet L.1 Source: Materials Performance, v 28, n 5, p 18-24, May 1989

STINGRAY SYSTEM INCLUDES REMOTE CONTROL OF OFFSHORE COMPRESSOR STATION.
Ewing, Robert C. Source: Oil and Gas Journal, v 74, n 18, May 3 1976

STRUCTURAL SOLUTIONS FOR TREATING URBAN STORM WATER RUNOFF
Hunt, Bill Source: Water Resources Research Institute News of the University of North Carolina, n 13, p 11-12, 1999

STUDY OF INTEGRATED OIL-FIELD PIPELINES NETWORK SYSTEM BASED ON GIS SPATIAL DATA SHARING PLATFORM
Fan, Wenyou1; Xie, Banghua1; Meng, Xin2 Source: Proc. International Conference on Pipelines and Trenchless Technology 2009, ICPTT 2009: Advances and Experiences with Pipelines and Trenchless Technology for Water, Sewer, Gas, and Oil Applications, v 361, p 1113-1121.

STUDY OF RESERVOIR-INDUCED EARTHQUAKE OF THREE GORGES PROJECT
Chen, Deji1; Wang, Yongxi2; Zeng, Xinping1 Source: Yanshilixue Yu Gongcheng Xuebao/Chinese Journal of Rock Mechanics and Engineering, v 27, n 8, p 1513-1524, August 2008

STUDY ON DYNAMIC RESPONSE OF EMBEDDED LONG SPAN CORRUGATED STEEL CULVERTS USING SCALED MODEL SHAKING TABLE TESTS AND NUMERICAL ANALYSES
Che, Ai-Lan1; Iwatate, Takahiro2; Ge, Xiu-Run1 Source: Journal of Zhejiang University: Science, v 7, n 3, p 430-435, March 2006

STUDY ON THE UNSTABLE GEOLOGICAL FACTORS OF OIL GAS SUBMARINE PIPELINE IN SHALLOW SEA SHELF AREA
Xu, Yongchen1; Wu, Jianzheng1; Zhu, Longhai1; Wang, Nan1 Source: Proc. International Conference on Pipelines and Trenchless Technology 2009, ICPTT 2009: Advances and Experiences with Pipelines and Trenchless Technology for Water, Sewer, Gas, and Oil Applications, v 361, p 281-295, 2009.

SUBSEA HIPPS: A WAY TO DEVELOP HIGH-PRESSURE SUBSEA FIELDS
Patni, Sandeep1; Davalath, Janardhan1 Source: SPE Production and Facilities, v 20, n 2, p 155-159, May 2005

SUBSEA PIPELINE INTERVENTION WITH COILED TUBING FROM A SUPPLY VESSEL
Pepin, Alexandre1; Spadaro, Angelo1 Source: Coiled Tubing and Well Intervention Conference and Exhibition 2009, p 197-201, 2009.

SUGGESTED IMPROVEMENTS IN DESIGNING SOIL-STEEL STRUCTURES
Kennedy, John B.1; Laba, Jan T.1 Source: Transportation Research Record, n 1231, p 96-104, 1989

SWELLABLE PACKERS PROVIDE A BROWNFIELD WATER MANAGEMENT SOLUTION IN OPEN AND CASED HOLE - CASE HISTORIES INCLUDING STRADDLES, PLUGS, SLIMHOLE SIDETRACKS AND TESTING IN CORRODED CASING
Al Douseri, Khaled M. M.1; Barnes, Chris2; Young, Dustin2; Smith, Peter E.2; Halliburton2 Source: Society of Petroleum Engineers - Offshore Europe Oil and Gas Conference and Exhibition 2009.

TECHNICAL AND ENVIRONMENTAL CONSIDERATIONS FOR DEVELOPMENT OF PIPELINE ABANDONMENT STRATEGIES. CANADIAN ENERGY PIPELINE ASSOCIATION. 2007. Prepared for the Terminal Negative Salvage Task Force of the Canadian Energy Pipeline Association. v + 85 pp.

TECHNOLOGY AND INNOVATIONS CONTRIBUTE TO SAFETY AND EFFICIENCY IN STORM DISASTER RECOVERY
Mailey, J.F.1 Source: Society of Petroleum Engineers - 9th International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production 2008 - "In Search of Sustainable Excellence", v 1, p 462-477.

THE CITY OF GALVESTON, TEXAS' 1890 WATER LINE A HISTORY AND STUDY OF ITS REHABILITATION
Miller, Bethany1; Ortega, Rafael1; Wade, Brandon2 Source: Proceedings of the Pipeline Division Specialty Conference, p 411-420, 2005, PIPELINES 2005: Optimizing Pipeline Design, Operations, and Maintainance in Today's Economy

THE GEOPHYSICAL TOOLBOX: A PRACTICAL APPROACH TO PIPELINE DESIGN AND CONSTRUCTION
Henderson, J.1; Bowman, M.1; Morrissey, J.1 Source: Proceedings of the 5th Biennial International Pipeline Conference, IPC, v 1, p 283-290, 2004,

THE GEOPHYSICAL TOOLBOX: A PRACTICAL APPROACH TO PIPELINE DESIGN AND CONSTRUCTION
Henderson, J.1; Bowman, M.1; Morrissey, J.1 Source: Proceedings of the Biennial International Pipeline Conference, IPC, v 1, p 283-290, 2004,

THE HYDROGEOLOGICAL PROBLEMS OF DISUSED MINES IN OLGIATE MOLGORA (LC)
Longoni, L.1; Papini, M.1 Source: WIT Transactions on the Built Environment, v 102, p 43-52, 2008, Underground Spaces: Design, Engineering and Environmental Aspects

THE RHUM FIELD: A SUCCESSFUL HP/HT GAS SUBSEA DEVELOPMENT (CASE HISTORY)
Brown, Alastair1; Farrow, Chris1; Cowie, Jim2 Source: Offshore Europe Conference - Proceedings, p 457-463.

THE SMITH RANCH URANIUM PROJECT
Stout, R. Mark; Stover, Dennis E. Source: Proceedings of the Annual Symposium - Energy for Sustainable Development: World Nuclear Association, p 111-124.

THE TSCA PCB REGULATIONS AND THEIR EFFECT ON PIPELINE REMOVAL AND ABANDONMENT PROGRAMS. La Shier, R. 1989. American Gas Association, Operating Section: 379 - 381.

THE UPTAKE OF IRON-55 BY MARINE SEDIMENT, MACROALGAE, AND BIOTA FOLLOWING DISCHARGE FROM A NUCLEAR POWER STATION
Warwick, P.E.1; Cundy, A.B.2; Croudace, I.W.1; Bains, M.E.D.3; Dale, A.A.3 Source: Environmental Science and Technology, v 35, n 11, p 2171-2177, June 1, 2001

THE USE OF THE RUST DATABASE TO INVENTORY, MONITOR, AND ASSESS RISK FROM UNDERSEA THREATS
Overfield, Mike L.1; Symons, Lisa C.1 Source: Marine Technology Society Journal, v 43, n 4, p 33-40, Winter 2009

TRENCHLESS TECHNOLOGY APPLIED TO DEGRADED GRAVITY CONCRETE OUTFALL SEWER TO AVOID COLLAPSE
Abraham, Ronald1; Sanyu, Bakari2 Source: Proceedings of Pipelines Congress 2008 - Pipeline Asset Management: Maximizing Performance of Our Pipeline Infrastructure, v 321, 2008, Proceedings of Pipelines Congress 2008 - Pipeline Asset Management: Maximizing Performance of Our Pipeline Infrastructure

TSCA PCB REGULATIONS AND THEIR EFFECT ON PIPELINE REMOVAL AND ABANDONMENT PROGRAMS (89-DT-61)
LaShler, Richard Source: American Gas Association, Operating Section, Proceedings, p 379, 1989

TSCA PCB REGULATIONS AND THEIR EFFECT ON PIPELINE REMOVAL AND ABANDONMENT PROGRAMS (89-DT-61)
LaShler, Richard Source: American Gas Association, Operating Section, Proceedings, p 379, 1989

TSCA PCB REGULATIONS AND THEIR EFFECT ON PIPELINE REMOVAL AND ABANDONMENT PROGRAMS (89-DT-61)
LaShler, Richard Source: American Gas Association, Operating Section, Proceedings, p 379, 1989

UNDERGROUND HAZARDOUS WASTE DISPOSAL: A DYNAMIC ALTERNATIVE TO CURRENT HAZARDOUS WASTE MANAGEMENT
Mavropoulos, A.1; Menegaki, M.2; Kaliampakos, D.2 Source: Waste Management and the Environment II, p 159-168, 2004, Waste Management and the Environment II

UPDATE ON NEW PCB RULEMAKING
Levine, Phyllis B.1 Source: Proceedings of the American Gas Association, Operating Section, p 246-248, 1995

UPLIFT OF OBJECTS BY AN UPFREEZING ICE SURFACE.
Mackay, J.Ross; Burrous, C. Source: Canadian geotechnical journal, v 16, n 3, p 609-613, Aug 1979.

USE OF ABANDONED PIPELINE TO TRANSPORT SEDIMENT TO MARSHES
Coates Jr., Charles H.1 Source: International Conference on Dredging and Dredged Material Placement, v 2, p 1101-1110, 1994

USE OF CONTROLLED LOW-STRENGTH MATERIALS IN IOWA.
Larsen, Ronald L.1 Source: Concrete International, v 10, n 7, p 22-23, Jul 1988

USE OF RISK-BASED BUSINESS APPROACH FOR CHARACTERIZATION OF ENVIRONMENTAL REMEDIATION LIABILITIES IN UPSTREAM OIL AND GAS PRODUCTION FACILITIES
Connor, John A.1; Ravishankar, Krish2; Mejia, Juan Carlos3 Source: Society of Petroleum Engineers - 9th International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production 2008 - "In Search of Sustainable Excellence", v 2, p 1135-1156.

UTILITY MANAGES TO WORK WITH ASBESTOS IN COAL-TAR PIPE WRAP. Falise, M.J. 1996. Pipeline and Gas Journal. 223(4): 68 - 70.

VERTICAL CONNECTION SYSTEM FOR FLEXIBLE PIPES: OFFSHORE TESTS AND PIONEER INSTALLATION
Nagle, F.J.M.1; da Silva, J.E.Mendonca1; Costa, L.A.G.1; Capllonch, R.W.1 Source: Proceedings of the Annual Offshore Technology Conference, v 3, p 509-514, 1993, Construction & Installation/Field Drilling & Development Systems

VIDEO AND SONAR INSPECTION GUIDES REHABILITATION OF THE CORONADO TRANSBAY SEWER FORCE MAIN
Alex, Elmer1; Solomon, Marc1; Walton, Ed2; Witt, Maggie1; Gornall, Jason1 Source: Pipelines 2009: Infrastructure's Hidden

WHAT ABOUT RISK? THE CASE FOR RISK-BASED CLEANUP AT THE FORMER GUADALUPE OIL FIELD
Garcia, Gonzalo1 Source: Proceedings - SPE Annual Western Regional Meeting, p 772, 1997, A New Dawn in the Old West

APPENDIX A - REVIEW OF RELEVANT PIPELINE CODES

A1. INTRODUCTION

In this Appendix, DNV has reviewed the findings of relevant standards from Canada, the USA, the United Kingdom, Australia, and Argentina. The actual requirements of the different standards reviewed are quoted directly.

A2. Canadian Standard CSA Z662-07 Oil and Gas Pipeline Systems

Pipeline abandonment is considered in Clause 10.17 of the above standard. The guidance provided (as with all standards reviewed) is highly generic.

10.17 Abandonment of piping

10.17.1

The decision to abandon a section of piping, in place or through removal, shall be made on the basis of an assessment that includes consideration of current and future land use and the potential for safety hazards and environmental damage to be created by ground subsidence, soil contamination, groundwater contamination, erosion, and the creation of water conduits.

10.17.2

Piping that is abandoned in place shall be:

(a) Emptied of service fluids;

(b) Purged or appropriately cleaned or both;

(c) Physically separated from any in-service piping; and

(d) Capped, plugged, or otherwise effectively sealed.

10.17.3

Records shall be maintained of all piping that is abandoned in place. Such records shall include locations and lengths for each pipe diameter and where practical, burial depth.

Note: Operating companies should consider maintaining all pertinent records related to the abandoned piping.

A3. Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids, American Society of Mechanical Engineers, ASME B31.4-2006

Pipeline abandonment is considered within section 457 of the code as follows:

457 ABANDONING A PIPING SYSTEM

In the event of abandoning a piping system, it is required that:
(a) Facilities to be abandoned in place shall be disconnected from all sources of the transported liquid, such as other pipelines, meter stations, control lines, and other appurtenances
(b) Facilities to be abandoned in place shall be purged of the transported liquid and vapor with an inert material and the ends sealed".

The stipulations are less than those of CSA Z662-07; little consideration is given to environmental protection, and the keeping of records after abandonment is not mentioned.

A4. Gas Transmission and Distribution Piping Systems, American Society of Mechanical Engineers, ASME B31.8-2006

Pipeline abandonment is considered within section 851 of the code as follows:

851.8 Abandoning of Transmission Facilities

Each operating company shall have a plan in its operating and maintenance procedures for abandoning transmission facilities. The plan shall include the following provisions:

(a) Facilities to be abandoned shall be disconnected from all sources and supplies of gas such as other pipelines, mains, crossover piping, meter stations, control lines, and other appurtenances.

(b) Facilities to be abandoned in place shall be purged of gas with an inert material and the ends shall be sealed, except that:

(c) After precautions are taken to determine that no liquid hydrocarbons remain in the facilities to be abandoned, then such facilities may be purged with air. If the facilities are purged with air, then precautions must be taken to determine that a combustible mixture is not present after purging. (See para. 841.275.)

A5. Steel Pipelines and Associated Installations for High Pressure Gas Transmission, Institution of Gas Engineers and Managers, IGEM/TD/1/Ed. 5, 2010 (U.K. Standard)

Pipeline abandonment, or permanent de-commissioning as per the term within the code, is considered within section 12.9.6:

12.9.6 Permanent de-commissioning of pipelines, sections of pipelines and associated installations

12.9.6.1 General

A pipeline, pipeline section or associated installation that is no longer to be used for the conveyance of gas shall be taken out of service, with all hazardous fluids removed and the following options considered:

- Use the asset for another purpose or
- Remove the assets or
- Leave the asset in-situ, but rendered permanently safe.

Note: This may involve removing components, for example valves, and capping open ends so as to leave all sections gas tight.

The following factors shall be taken into account when deciding on the most appropriate option:

- Public safety
- Environmental protection
- Future land use
- Legal duties and residual liabilities
- Practical difficulties and financial considerations
- Maintenance requirements, for example to prevent corrosion of the pipeline leading to pipe wall collapse or becoming a channel for the conveyance of water or gases.

12.9.6.2 For assets left in-situ, consideration shall be given to residual liabilities with the owner or operator of the assets, which may remain in perpetuity.
Note: There may be a continuing duty to monitor the condition of the pipeline and a requirement for maintenance or remedial action, for example to ensure that the pipeline route remains safe and without danger as a result of decommissioning.

12.9.6.3 Taking an asset out of service
The following steps shall be taken when taking an asset out of service:

- Consider dismantling and removal – recommended for all above ground sections but economic considerations may limit this option to short sections of buried pipeline.
- Clear and purge the pipeline of any flammable gases, vapours, or residues
- Physically separate from other parts of the system and isolate from all possible sources of gas.
- If appropriate, fill remaining pipeline sections with non hazardous material, for example by grouting, especially large diameter pipelines at road and rail crossings or at other locations sensitive to subsidence.
  Note: Practical and economic considerations may limit this to short sections of buried pipeline.
- Where it is not practicable to fill a large diameter pipeline section with grout, charge with an inert gas and seal permanently the vent and fill points. Leakage tests should be carried out and pressures checked periodically and re-charged as necessary.

12.9.6.4 Identification of permanently de-commissioned buried pipelines left in-situ

The pipeline or pipeline sections shall be identified by suitable markers.

12.9.6.5 Records of permanently de-commissioned assets left in-situ

Records of permanently de-commissioned assets left in-situ shall be maintained.

A6. Code of Practice for Pipelines, British Standards Published Document (PD) 8010-2:2004,

Part 1: Steel Pipelines on Land

Pipeline abandonment is considered within Section 14 of the code:

14.1 Arrangements for Abandonment

NOTE Attention is drawn to the Pipe-lines Act 1962(11), Regulation 25 in respect of pipeline abandonment, and to the Pipelines Safety Regulations 1996 (12) in respect of general duties to preserve safety throughout the lifetime of the pipeline (including abandonment).

Pipeline systems planned to be abandoned should be decommissioned in accordance with 13.2.4 and disconnected from other parts of the pipeline system remaining in service.

A pipeline should be deemed to be disused when it has been abandoned or when the owners cease to inspect it regularly and are no longer prepared to maintain it in an operable condition.

When the owners are no longer prepared to maintain a disused pipeline in an operable condition they should take precautions to prevent the pipeline from becoming a source of danger or nuisance or having an undesirable effect on any watercourses.

Before being abandoned, the pipeline should be completely disconnected at both ends and if necessary divided into sections. All open ends should be capped and sealed. In certain areas, e.g. those subject to subsidence or where heavy external loads can occur, it can be necessary to close the pipeline at both ends and to fill the abandoned line with a suitable filler.

Where an abandoned pipeline cannot be made safe by this method, it should be removed. In all cases where the fluid conveyed is deemed to be an environmental or safety hazard, or could become so after contact with the soil, the fluid should be completely removed from the pipeline.

The pipeline section being abandoned should always be emptied and then cleaned to ensure that no toxic material remains within the pipe.

All above-ground sections of the pipeline system should be removed to not less than 900 mm (36 in) below ground level. Backfilling and land reinstatement should be carried out in accordance with 10.12.14 and 10.12.15.

14.2 Records

A record should be kept by the owners of a pipeline to indicate that they have taken the necessary precautions. A record plan showing the size and depth of the pipeline and its location related to the surface features should also be prepared and a copy given to the owners and occupiers of the land concerned.

A7. Petroleum and Natural Gas Industries - Pipeline Transportation Systems, ISO 13623

13.5 Pipeline systems planned to be abandoned shall be decommissioned in accordance with 13.2.4 and disconnected from other parts of the pipeline system remaining in service.

Abandoned pipeline sections shall be left in a safe condition.

13.2.4 Consideration should be given to decommission pipelines planned to be out of service for an extended period. The removal of fluids shall be in accordance with 13.3.7.

Decommissioned pipelines, except when abandoned, shall be maintained and cathodically protected.

13.3.7.3 Venting and flaring

Hazards and constraints which should be considered when planning to vent or flare are:

- Asphyxiating effects of vented gases;
- Ignition of gases by stray currents, static electricity or other potential ignition sources;
- Noise level limits;
- Hazard to aircraft movements, particularly helicopters in the vicinity of offshore installations and terminals;
- Hydrate formation;
- Valve freezing;
- Embrittlement effects on steel pipework.

13.3.7.4 Draining

Liquids may be pumped, or pigged, out of a pipeline using water or an inert gas. Hazards and constraints which should be considered when planning to drain include:

- Asphyxiating effects of inert gases;
- Protection of reception facilities from overpressurization;
- Drainage of valve cavities, “dead legs”, etc.;
- Disposal of pipeline fluids and contaminated water;
- Buoyancy effects if gas is used to displace liquids;

- Compression effects leading to ignition of fluid vapour;
- Combustibility of fluids at increased pressures;
- Accidental launch of stuck pigs by stored energy when driven by inert gas.

13.3.7.5 Purging

Hazards and constraints which should be considered when preparing for purging include:

- Asphyxiating effects of purge gases;
- Minimizing the volume of flammable or toxic fluids released to the environment;
- Combustion, product contamination or corrosive conditions when reintroducing fluids.

A8. Pipelines – Gas and Liquid Petroleum. Part 3: Operations and Maintenance, Australian Standard AS 2885.3-2001

8.10 ABANDONING A PIPELINE

8.10.1 General

When a pipeline is to be abandoned, an abandonment plan, including an environmental rehabilitation plan, shall be compiled and approved. The sequence of decision making required to develop and implement the plan should be in accordance with Figure 8.10.1. When a pipeline is abandoned, it shall be disconnected from all sources of hydrocarbons that may be present in other pipelines, processing plant, meter stations, control lines and other appurtenances, and shall be purged of all hydrocarbons and vapour with a nonflammable fluid. Disposal of the purging fluid shall meet all relevant environmental and safety requirements.

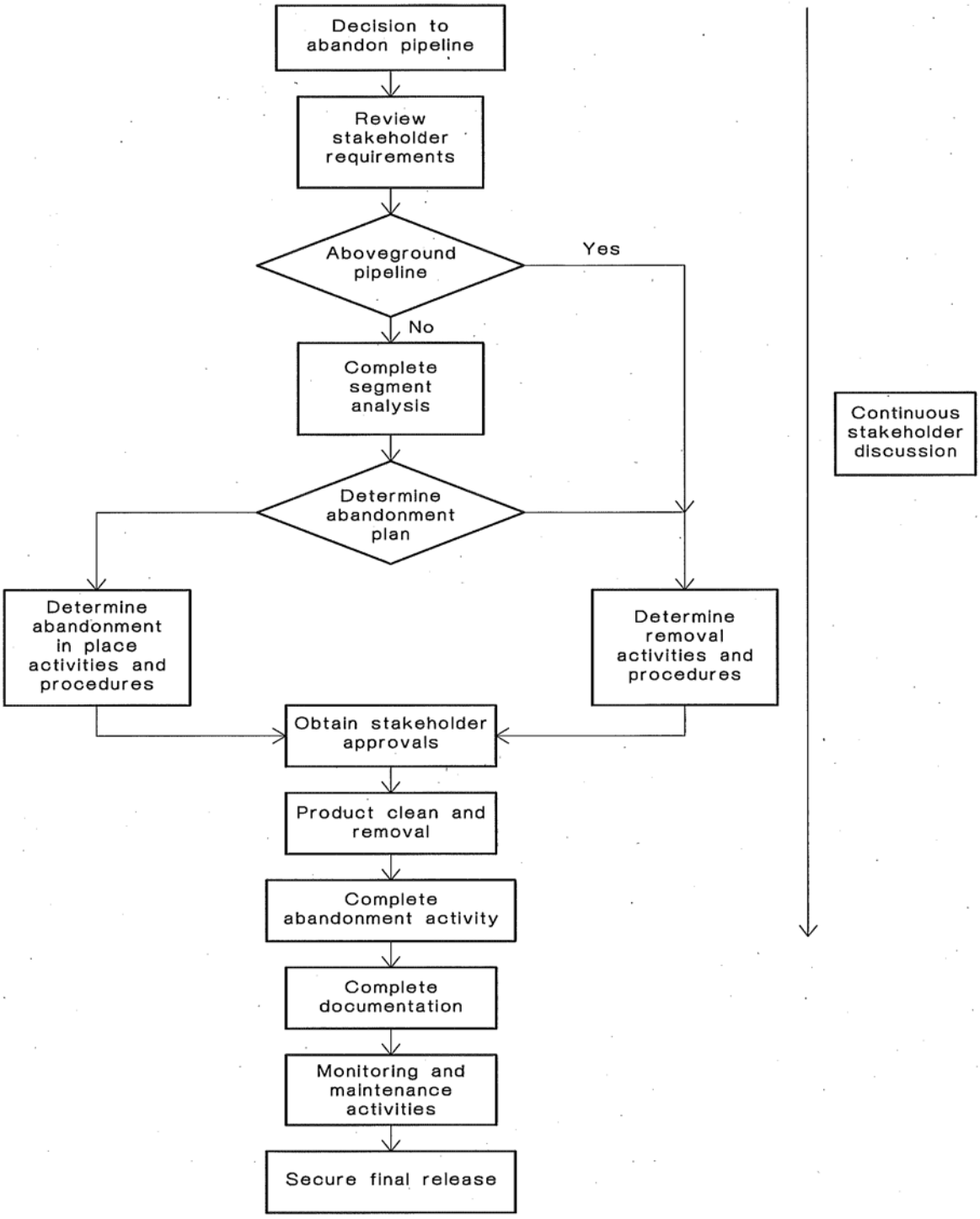


FIGURE 8.10.1 PIPELINE ABANDONMENT FLOW CHART

8.10.2 Abandonment in place

When abandonment in place is approved, the pipeline section shall be abandoned in such a way to ensure that ground subsidence and the risk of contamination of the soil or ground water are minimized.

Where cathodic protection is applied, to prevent the eventual collapse of the pipeline, the responsibility for maintenance of the system shall remain with the pipeline operator and appropriate records shall be kept.

NOTE: Consideration should be given to filling the abandoned pipeline with an inert substance.

8.10.3 Abandonment by removal

When abandonment by removal is approved, the removal of the pipeline section shall meet all relevant safety, and environmental requirements. The requirements for pipeline removal shall be considered as similar to pipeline construction, and shall comply with the relevant requirements of Clause 9.4.3 and AS 2885.1.

8.11 ABANDONMENT OF ABOVE-GROUND PIPELINES

Above-ground pipelines shall be abandoned by removal of the pipeline.

8.12 ADDITIONAL REQUIREMENTS FOR ABANDONMENT

When a pipeline is abandoned, the following additional requirements shall be completed:

(a) The cutting of all buried pipelines at a minimum of 750 mm below natural surface or at the pipeline depth, whichever is the lesser.
(b) The removal of all buildings, fences and equipment.
(c) The removal of all signage associated with the pipeline on completion of the post abandonment maintenance period.
(d) Except where cathodic protection is required in accordance with Clause 8.10.2, the cathodic protection system including buried cables, impressed current units, power lines, solar arrays and batteries are to be removed. Anode and earthing beds are to be disconnected at 600 mm below the natural surface level.
(e) All interference mitigation bonds with third party structures to be removed, that is the pipeline has to be mechanically and electrically disconnected from all other structures.
(f) Obtaining landowner releases for the completed abandonment.
(g) The relinquishing of the easement where no future or continuing use of the easement is proposed.

8.13 ABANDONMENT RECORDS

Where abandonment in place is approved, on completion of the abandonment of the pipeline section in situ, as executed drawings, complying with AS 1100.401, identifying and locating sections of the abandoned pipeline, shall be prepared as part of the relinquishment procedure.

These records shall be made publicly available to prevent possible mistakes in identifying an abandoned pipeline as an operational pipeline.
Records of approved changes of operating conditions, all engineering investigations and work carried out in connection with any change in the operating conditions shall be maintained until the pipeline is abandoned or removed.

A9. Normas Argentinas Mínimas De Seguridad Para El Transporte y Distribución de Gas Natural y Otros Gases Por Cañerías, ENARGAS (1993)

This code (in Spanish) has been reviewed but no reference to pipeline abandonment was found. DNV also has a draft copy of an Argentine code for transporting liquid hydrocarbons, but again no reference was found in relation to pipeline abandonment.

APPENDIX B – ALTERNATIVE RETIREMENT OPTION MATRICES

Retirement Option Matrix
From NEB document A1S0C1 Revisions to Preliminary Base Case Assumptions 4 March 2010

Physical Assumption by Land Use and Facility For the Purpose of Estimating Preliminary Cost Estimates					
Land Use		**Pipeline Diameter**			**Above-Ground Facilities**
		2" to 12" 60.3 to 323.9mm	14" to 24" 355.6 to 610 mm	>26" >660 mm	
Agri-cultural	Cultivated	A: 80% (R: 20%)	A: 80% (R: 20%)	A: 80% (R: 20%)	R
	Cultivated with special features	R	R	R	R
	Non Cultivated	A: 80% (R: 20%)	A: 80% (R: 20%)	A: 80% (R: 20%)	R
Non-Agri-cultural	Existing Developed Lands	A	A	A	R
	Prospective future development	R	R	R	R
	No future development Anticipated (e.g. forest)	A: 80% (R: 20%)	A: 80% (R: 20%)	A: 80% (R: 20%)	R
Other	Environmentally Sensitive Areas	A	A	A	R
	Roads & Railways	A+	A+	A+	R
	Water Crossings	A	A	A	R
	Other Crossings (Utilities)	A	A+	A+	R

Legend: A = Abandon in place,
A+ = Abandon in place with special treatment (e.g. fill with granular material),
R = Removal

Retirement Option Matrix
From CEPA Pipeline Abandonment Options, 2007

Land Use		Pipeline Diameter		
		2" to 12" 60.3 to 323.9mm	14" to 24" 355.6 to 610 mm	>26" >660 mm
Agricultural	**Cultivated**	A	A	A
	Cultivated with special features (depth of cover considerations)	R	R	R
	Non Cultivated (Native Prairie, Rangeland, Pasture)	A	A	A
Non-Agricultural	**Existing Developed Lands** (Commercial, Industrial, Residential)	A	A	A
	Prospective future development (Commercial, Industrial, Residential)	R	R	R
	No future development anticipated (e.g. Forest areas)	A	A	A
Other Areas	**Environmentally Sensitive Areas**	A	A	A
	Roads & Railways	A+	A+	A+
	Water Crossings	A	A	A
	Other Crossings (Utilities)	A	A+	A+

Each box in the matrix represents the primary option for pipeline abandonment for each of the land use categories. It is recognized that there will always be a certain amount of pipe that will be removed or abandoned in place for each of the categories based on site specific assessments, but the primary option is the one listed in the matrix. As well, it is recognized that further development is

needed to further refine land use categories. This development will occur as part of the development of the risk based site specific assessment process.

The three recommended options available in the matrix are described below.

Primary Pipeline Abandonment Options

Abandonment Option	Description
A	pipeline is abandoned in place
A^+	pipeline is abandoned in place with special treatment to prevent potential ground subsidence (e.g., fill pipe with concrete)
R	pipeline is removed

At the initial stages of any pipeline abandonment project, site specific assessments will be necessary and will probably determine that a combination of abandonment options be performed for the various land use categories. In doing so, pipeline companies may determine a percentage split between the primary option in the matrix and any potential secondary option. For example, the matrix recommends that all diameter ranges of pipelines be abandoned in place for a cultivated land use category. However, when the time arrives to initiate an actual abandonment project for this land use category, there is a reasonable likelihood that a small amount of pipe will require removal or abandon with special treatment after the completion of site specific assessments. A similar approach can be applied for the other land use categories.

PIPELINE ABANDONMENT CHECKLIST

PLANNING

1. Has subsidence been considered for pipelines having a diameter greater than 323.9 mm (12 inches)?
2. Has the pipeline company notified the landowners and proper authorities (municipalities, MOE, MTO, MNR, etc.) of the abandonment?
3. Have abandonment procedures for crossings been agreed upon by utilities (road, railway, pipelines, etc.) and authorities responsible for rivers and streams crossed by the pipeline?
4. Has consideration been given to the effect of drainage in the area surrounding the abandoned pipeline , which may act as a conduit for ground water after the pipe is perforated by corrosion?
5. Has consideration been given to the removal of all the aboveground facilities?
6. Has consideration been given to any hazards posed to people, equipment, wildlife or livestock by any apparatus left in place above or underground?

IMPLEMENTATION

1. Has the abandoned pipeline been physically isolated from the live pipeline?
2. Has the pipeline been drained of all fluids and adequately cleaned to prevent ground water contamination from hydrocarbon residue on the pipe wall after the pipe is perforated by corrosion?
3. Have all aboveground facilities been removed and has consideration been given to removing underground facilities such as anode beds and tanks?

LIABILITY/RISK MANAGEMENT

1. Does the pipeline company have a contingency plan to remedy any contamination caused by the abandoned pipeline?
2. Has consideration been given to conducting post-abandonment surveillance programs?
3. Has consideration been given to maintaining signage after the pipeline is abandoned?
4. Has consideration been given to providing a locate service after the pipeline is abandoned?

EB 2005-0550

ONTARIO ENERGY BOARD

IN THE MATTER OF the *Ontario Energy Board Act*, 1998, S.O. 1998, c.15, Schedule B, and in particular, s.90(1) thereof;

AND IN THE MATTER OF an Application by Union Gas Limited for an Order or Orders granting leave to construct a natural gas pipeline and ancillary facilities in the Township of Strathroy-Caradoc and in the Township of Middlesex Centre, all in the County of Middlesex.

GAPLO-UNION (STRATHROY-LOBO)

WRITTEN EVIDENCE OF IAN GOUDY

March 31, 2006

March 31, 2006

My parents' land at the north-half of Lots 21 and 22 in the former London Township, which was first farmed by my mother's family in the 1840's, was expropriated in 1957 for a 26" natural gas pipeline. Union Gas drew up the agreement it offered, which talked of ingress and egress, full and final release, and Union's right to set the compensation level. The landowner was told if you try to fight this you will risk losing what is on the table, and if you put up a big enough fight you may lose your farm. We were expropriated.

With that construction, woodlots were cleared; the trench was dug; the pipeline installed; the trench filled; easement leveled; and, drains repaired. A lot of this work was done in very wet conditions because of construction took place in the late fall. At the time, I thought it was interesting to watch all of this large equipment driving through mud over top of their tracks. When one piece of equipment would get stuck they would just bring something larger in. At the time we did not have any idea of how much damage was being caused to our soils.

The following year (1958), the easement surface was very irregular because of the subsidence and erosion resulting from the construction. When we finally tilled the easement, we began to see an excess of stone on the easement lands as well as a distinct difference of soil colour on and off easement. When we planted a crop on this easement, we immediately realized something terrible had happened to the productivity of these soils. In some areas there was no yield at all. Also, we now constantly had to pick stones on the easement, and we had to go much slower with our equipment or we risked destroying it.

The woodlot that was cleared in 1957 remained a wasteland until 1991 when the 48" line was built. This was because of the location of the pipeline and the restriction of establishing woodlot on the easement. The compensation my parents received for the 1957 construction project and easement damages was something less than $1000.00 in total. I was ten years old when that line went through.

In 1964, my parents were notified that a second pipeline was to be built on our property. This line would be 34" in diameter and be built using the same methods as the 26" line. Once again expropriation took place and the pipeline was built. I remember the extreme frustration my father experienced in trying to have things done better that time. His efforts were to no avail. More woodlot was cleared creating more wasteland. The damage to the soils was a repeat of 1957 construction – in other words, a doubling of the damage. I can recall that some neighbors put up opposition to the construction, and were threatened by the police with arrest if they persisted. People were upset, but didn't seem to have any rights or recourse. I was seventeen years old when the second line went through.

In 1976, Stuart O'Neil and Peter Lewington took Interprovincial Pipelines to court over topsoil damage and won their case. This ruling indicated I.P.L. was obligated to pay $10,000.00 per acre for complete topsoil replacement on their farms. This development came about only after a number of year's preparation and considerable personal financial risk to both landowners. That decision became a precedent for much of what followed afterward.

In 1974, I took over my family's farm from my parents. In 1979, word came that a third pipeline, 42" in diameter would be built on the easement. With evidence from the O'Neil and Lewington case, I appeared at the OEB hearing in London. We requested that total easement top soil stripping take place to prevent further damage to what had occurred on the 26" and 34" lines. The OEB agreed to this and so this was an option in the agreement. The land and compensation damage was increased to about $2,200.00 per acre. I disagreed with the crop loss compensation and so once again our land was expropriated. In 1984, after spending much time and legal expense in trying to improve the crop loss compensation, I was finally forced to accept what I was originally offered. We learned some lessons about top soil stripping from this construction for future construction. We learned that you must segregate all three horizons of soil, and that the displaced soil from the pipe must be removed to prevent crowning of the soil over the pipeline. Other measures to protect the topsoil from erosion and subsidence after construction were also needed. There was some improvement in this construction over the previous constructions. After this construction I had made up my mind that if another pipeline ever came I would push even harder for our rights. I was thirty-three years old when the third line was constructed.

Shortly after this, I decided I needed an outlet for the drains in the back part of our property. This drain would have cost me around $600.00 to install, but because of the wall effect of the pipelines there was no way of getting the water from one side to the other. I had a meeting with a Union Gas representative and one of their lawyers on site to explain the problem. At that meeting I was told that because my parents had never indicated in 1957 we would need a drain through that area Union was not responsible. We ended up applying for a municipal drain, which cost close to $7,000.00 to install

Around 1990, Union notified us again that they were going to build a fourth line 48" in diameter. By this time the government had introduced intervenor funding. A landowners' group was formed to go to the OEB hearing collectively and argue the issues of compensation issues and damage. Although I agreed with many of the group's issues, I thought that the argument should be put forward that our properties had suffered enough already, and maybe Union should be required to find another route. I hired my own lawyer and ended up participating in a fairly extensive hearing. Once again, as with the third construction and the O'Neil and Lewington case, this was very time consuming and was a big personal financial risk. Because of that hearing, there were improvements made on compensation, treatment of the easement, woodlots, and drainage in comparison to what we experienced with the previous pipelines. A lot of this came about through our access to legal and expert support, and intervenor funding. This was the first Union Gas

pipeline for which our property was not expropriated. I was forty-three years old when the fourth pipeline went through.

Our property also has the two Lake Huron to London water pipelines, which dissect the Union lines. These pipes measure 56" outside diameter. When the most recent line was built, Ecological Services (now Stantec) was the environmental firm the Ontario Clean Water Agency used to monitor the construction. Because OCWA could not operate equipment over the Union Gas easement, the water line had to be bored underneath the gas lines. A construction that would normally have taken only a few days ended up taking more than two months in some of the wettest conditions possible. This unfortunate situation end up impacting properties both sides of the Union easement all the way to the concession roads on the north and south. A situation arose during this period resulting from Ecological Services inaction during wet weather and wet soil conditions. An irate machine operator put my life in some considerable danger.

In the mid to late 90s a new issue arose for pipeline landowners. This issue concerned the repair and maintenance of the pipelines. When the pipelines were originally built, Union Gas land agents indicated these pipelines would last forever. We are now finding out that some pipes are starting to corrode and require maintenance. It upset many landowners, including me, to think that now Union would be back to open the easement up again. Once again we as landowners had to mobilize and so we formed the Gas Pipeline Landowners of Ontario (GAPLO). With a lot of time and effort we were able to work out the Integrity Dig Agreement with Union Gas. This agreement has served as one of the very few bright spots in pipeline landowner relations on the issue of repair and maintenance of pipelines.

More recently new issues have come to light. These issues have to do with abandonment and talk of restrictions of mobile equipment over top of these pipelines. The wording is a little stronger on NEB controlled pipelines, but restrictions are still a real concern to the landowners on the Dawn-Trafalgar pipeline corridor. It is because of these issues that once again we, as landowners, feel we have to speak up to protect our rights.

Having pipeline easements and pipelines running through your property like we do is a never-ending challenge financially, emotionally and physically, which I am sure most people do not realize. And those challenges are ones that we didn't ask for, but we have to respond at our own expense. I think it is very clear that if it had not been for the persistence and sacrifice of many landowners over the years, we would still see pipelines being built the way the original pipelines were built. I am now 59 years old.

Ian Goudy

ONTARIO FUEL BOARD

IN THE MATTER OF The Gas Pipe Lines Act, Statutes of Ontario (1951) 15 George VI, Chapter 30, as amended,

AND IN THE MATTER OF an Application by Union Gas Company of Canada, Limited, to the Ontario Fuel Board for approval of the Board to deposit in the proper Registry Office a copy of the Certificate of Public Convenience and Necessity granted by the Board to the Company under date of June 12, 1957 and a plan and description of land which the Company desires to acquire by expropriation under the above-mentioned Act for the construction, maintenance and operation of its line and upon, under or over which the Company desires to construct, lay, carry or place its line.

NOTICE OF HEARING

The Ontario Fuel Board hereby appoints Wednesday, the 25th day of September, 1957, at 10:00 o'clock in the forenoon, Daylight Saving Time, at the County Council Chambers, County Building, City of London, in the County of Middlesex, and Province of Ontario for hearing of the Application, a copy of which is hereunto attached, and all persons interested therein.

Further particulars may be obtained at the office of the Applicant, the Solicitors for the Applicant, Messrs. McNevin, Gee & O'Connor Chatham, Ontario, or this Board.

DATED at Toronto this 11th day of September, 1957.

ONTARIO FUEL BOARD

"A. R. Crozier"

"W. R. Howard"

IN THE MATTER OF The Gas Pipe Lines Act, Statutes of Ontario, (1951) 15 George VI, Chapter 30, as amended,

AND IN THE MATTER OF an Application by Union Gas Company of Canada, Limited to the Ontario Fuel Board for approval of the Board to deposit in the proper Registry Office a copy of the Certificate of Public Convenience and Necessity granted by the Board to the Company under date of June 12, 1957 and a plan and description of land which the Company desires to acquire by expropriation under the above mentioned Act for the construction, maintenance and operation of its line and upon, under or over which the Company desires to construct, lay, carry or place its line.

-: APPLICATION :-

TAKE NOTICE that Union Gas Company of Canada, Limited has applied to the Ontario Fuel Board pursuant to Section 4 of The Gas Pipe Lines Act, Statutes of Ontario (1951) 15 George VI, Chapter 30, as amended, for approval of the Board to deposit in the proper Registry Office a duly attested copy of the Certificate of Public Convenience and Necessity issued by the Board to the Company under date of June 12, 1957 together with a duly attested and signed plan and description of certain lands in which the Company desires to acquire by expropriation under the said Act a limited estate, right or interest, a copy of which plan and description and a definition of which limited estate, right or interest are hereunto attached.

DATED at Chatham, Ontario this 12th day of September, 1957.

Union Gas Company of Canada, Limited

By McNevin, Gee & O'Connor,
Barristers, etc.,
Bank of Montreal Bldg.,
CHATHAM, Ontario,

Its Solicitors Herein.

TO:- Margaret Florence Goudy
Joseph E. Needham

re:- parts
Lot 21 & 22; Concession 9
Township of London
County of Middlesex

IN THE MATTER OF The Gas Pipe Lines Act, Statutes of Ontario (1951) 15 George VI, Chapter 30, as amended,

AND IN THE MATTER OF a plan and description of land required by Union Gas Company of Canada, Limited in connection with the establishment of a pipeline for the transmission of gas between a point in Lot #25, in the 2nd Concession of the Township of Dawn, in the County of Lambton and the Townline Road between the Counties of Halton and Peel, with certain branch lines therefrom, pursuant to Certificate of Public Convenience and Necessity dated the 12th day of June, 1957, granted by the Ontario Fuel Board.

DEFINITION OF
ESTATE, RIGHT or INTEREST REQUIRED

A right, liberty and easement in perpetuity on, over, along, in, under and through a strip of land Sixty Feet (60') in perpendicular width as set forth in the attached description dated the 5th day of September , 1957 signed by J. D. Barnes , O.L.S. and attested by the seal of Union Gas Company of Canada, Limited under the hands of its proper signing officers in that behalf hereunto attached as Schedule "A" and made part hereof, and, as shown within the "red"border on the attached plan dated the 5th day of September , 1957 signed by J. D. Barnes , O.L.S. and attested by the seal of Union Gas Company of Canada, Limited under the hands of its proper signing officers in that behalf, which plan forms part and parcel of such description and is hereunto attached as Schedule "B", for all or any of the purposes of ingress and egress at any time or times with or without vehicles, machinery, plant and equipment and of surveying, laying, constructing, maintaining, inspecting, patrolling, altering, removing, replacing, reconstructing, repairing, moving, keeping, using and operating a buried pipeline for the transmission of gas (together with all buried attachments, appliances for cathodic protection, equipment and appurtenances necessary thereto) including the right along such strip of land to leave exposed any pipeline with its said appurtenances in crossing any ditch, stream or gorge, and, including the right to make temporary openings in any fence or tile drain along or across such strip of land for any of the purposes aforesaid, but expressly excluding the right to fence in all or any part of such strip of land except to restore any fence interfered with; subject to the aforesaid purposes and rights, RESERVING to the landowner from time to time or person or persons entitled thereto, the right to fully use, occupy and enjoy such strip of land, except as to any excavating, drilling, installing or erecting therein or thereon of any pit, well, foundation, building or other structure or installation apart from installing lanes, roads, driveways, pathways and walks without interference with the said pipeline and apart from constructing, repairing, using and operating farm or domestic tile drains in and constructing, repairing and keeping fences in and on such strip of land, without interfering with the said pipeline. THE WHOLE TO BE subject to items (i) to (iv) inclusive of the terms and conditions set forth in the Certificate of Public Convenience and Necessity granted by the Ontario Fuel Board to Union Gas Company of Canada, Limited the 12th day of June, 1957.

D. H. 152

SCHEDULE A

ALL AND SINGULAR that certain parcel or tract of land and premises, situate, lying and being in the Township of London, in the County of Middlesex, in the Province of Ontario, and being composed of Part of Lots 21 and 22, Concession 9, in the said Township and which said parcel of land containing by admeasurement Five and One hundred and Forty-eight one-thousandths acres (5.148 ac.) be the same, more or less, being a strip of land sixty feet (60') in perpendicular width, which Centre Line and Centre Line produced of the said strip of land is located as follows:

BEARINGS are ASTRONOMIC and are referred to the meridian through the south-west corner of Lot 1, Concession 5, Township of London:

COMMENCING at a point in a post and wire fence being the line between Lots 22 and 23, distant Thirty feet (30') measured northerly thereon from its intersection with the southerly limit of the north half of Lot 22, and said point of commencement being also distant Two thousand, One hundred and Thirty feet (2130') measured southerly thereon from the north-west corner of Lot 22, Concession 9:

THENCE North Sixty-eight degrees, Twenty-two minutes, Thirty seconds, East (N68°22'30"E) a distance of One hundred and Four and Twenty-eight one-hundredths feet (104.28') to a point, said point being distant Thirty feet (30') measured northerly at right angles from the line between the north and south half of Lot 22:

THENCE North Sixty-eight degrees, Thirty-two minutes, East (N68°32'E) a distance of Five hundred and Eighty-four and Nine-tenths feet (584.9') to a point said point being distant Thirty feet (30') measured northerly at right angles from the line between the north and south halves of Lot 22:

THENCE North Sixty-eight degrees, East (N68°00'E) a distance of Four hundred and Ninety-seven and Forty-two one-hundredths feet (497.42') to a point said point being distant Thirty feet (30') measured northerly at right angles from the line between the north and south halves of Lot 22:

THENCE North Sixty-eight degrees, Thirty-five minutes, Thirty seconds, East (N68°35'30"E) a distance of

Cont.

Continued

Five hundred and Forty-four and Fifty-three one-hundredths feet (544.53') to a point said point being distant Thirty feet (30') measured Northerly at right angles from the line between the north and south halves of Lot 22;

THENCE North Sixty-eight degrees, Nineteen minutes, East, (N68°19'E) a distance of Two hundred and Thirty-six and Four-tenths feet (236.4') more or less, to a point in a post and wire fence being the line between Lots 21 and 22, distant Thirty feet (30') measured northerly thereon from the northerly limit of the north half of Lot 22, and said point being also distant Two thousand, One hundred and Forty-three and Five-tenths feet (2143.5') measured southerly thereon from the northwest corner of Lot 21, Concession 9;

THENCE North Sixty-eight degrees, Nineteen Minutes, East, (N68°19'E) a distance of One thousand, Five hundred and Thirteen and eighty-one one-hundredths feet (1513.81') to a point, said point being distant Thirty feet (30') measured northerly at right angles from the line between the north and south halves of Lot 21;

THENCE North Sixty-eight degrees, Five minutes, Thirty seconds, East, (N68°05'30"E) a distance of Two hundred and Fifty-six and Seven one-hundredths feet (256.07') to a point said point being distant thirty feet (30') measured northerly at right angles from the line between the north and south halves of Lot 21 and said point also being distant Five and Seven one-hundredths feet (5.07') measured South Sixty-six degrees, Forty-six minutes, West,

Cont.

SCHEDULE A

(S66°46'W) a distance of Two hundred and Eighty-nine and Ninety-three one-hundredths feet (289.93') measured South Sixty-eight degrees, Five minutes, Thirty seconds, West (S68°05'30"W) from a point in the easterly limit of Lot 21, distant Two thousand, One hundred and Thirty-eight and Seventy-three one-hundredths feet (2138.73') measured South Twenty-one degrees, Fourteen minutes, Thirty seconds, East (S21°14'30"E) thereon from the north-east corner of Lot 21, Concession 9:

The herein described parcel of land shown outlined in red on a plan of survey, dated the 5th day of September, 1957, in the City of Toronto, certified as correct by J. D. Barnes, Ontario Land Surveyor, is attached hereto as Schedule B.

J. D. Barnes

J. D. Barnes, O. L. S.

The estate, right or interest required is as per attached definition.

UNION GAS COMPANY OF CANADA, LIMITED

"T. Weir"

"SEAL"

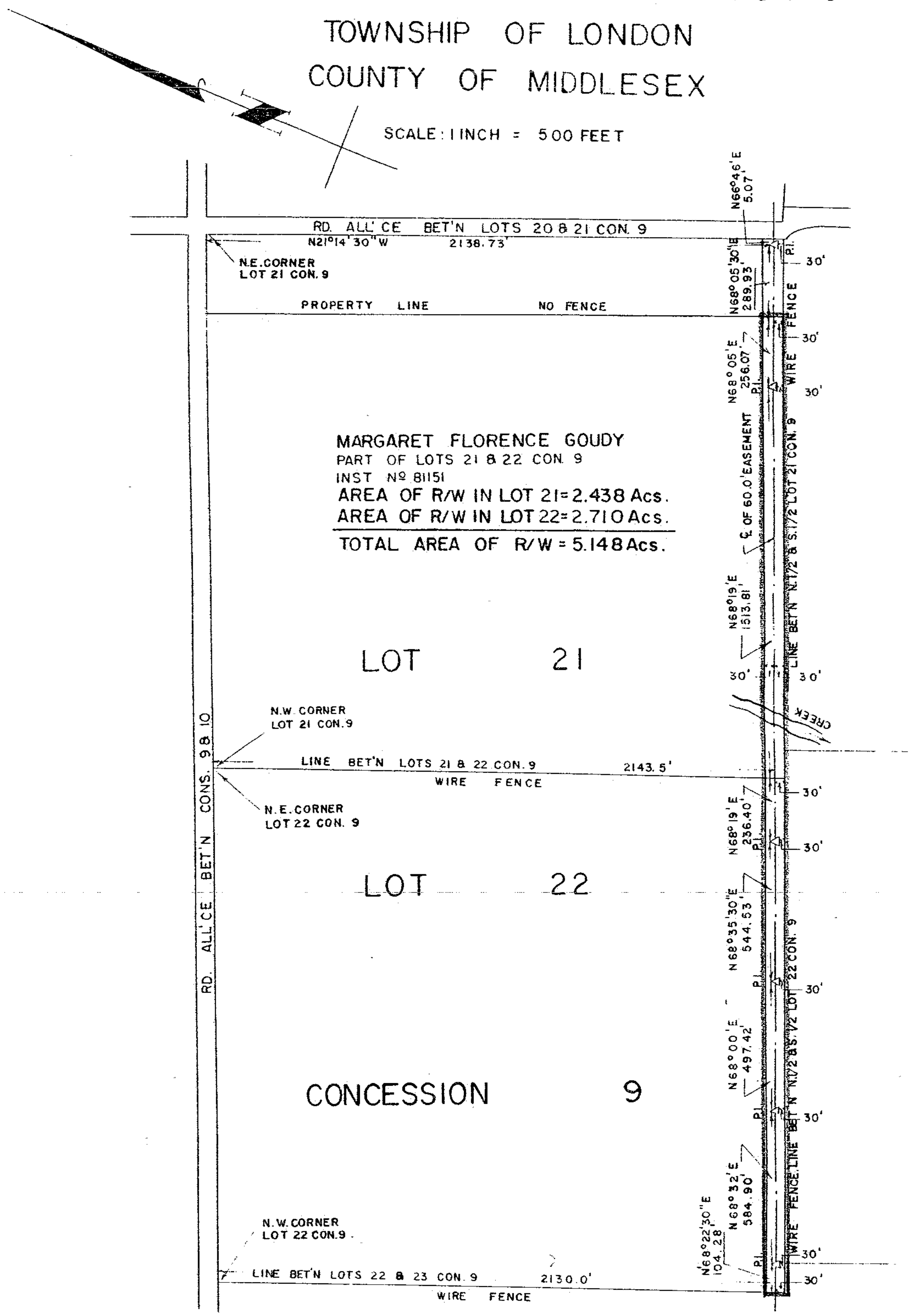
"J. W. S. McOuat"

Assistant Secretary

SCHEDULE "B"

PLAN SHOWING
PART OF LOTS 21 AND 22 CONCESSION 9
TOWNSHIP OF LONDON
COUNTY OF MIDDLESEX

SCALE: 1 INCH = 500 FEET



THE ESTATE, RIGHT OR INTEREST REQUIRED IS AS PER ATTACHED DEFINITION.

UNION GAS COMPANY OF CANADA LIMITED

Vice-President & General Manager

Assistant Secretary

NOTE:
BEARINGS HEREON ARE ASTRONOMIC AND ARE REFERRED TO THE MERIDAN THROUGH THE SOUTH-WEST CORNER OF LOT 16 CONCESSION 5 TOWNSHIP OF LONDON

"SEAL"

DATED: SEPT. 5, 1957
TORONTO, ONTARIO.

O.L.S.
HERBERT L. COONS
ONTARIO LAND SURVEYOR

DHL-1

THE ONTARIO ENERGY ACT

R.S.O. 1960, Chapter 122

Notice of Registration of Order Authorizing Expropriation

To [illegible] Lorence Boudy, [illegible], [illegible].
.....
.....
.....
.....
.....
.....
.....
.....

TAKE NOTICE that pursuant to Section 13 (4) of The Ontario Energy Act, Ontario Natural Gas Storage and Pipelines Limited did on the 5th day of [illegible], 196[illegible] register as No. [illegible] in the Registry Office for the County of [illegible], a certified copy of an Order of the Ontario Energy Board dated the 4th day of [illegible], 196[illegible] authorizing the said Company to expropriate the land as set forth in the description and plan and defined in the definition of estate, right or interest required, copies of which are attached to the Notice of Expropriation bearing even date herewith and served upon you herewith pursuant to Section 5 (1) of The Expropriation Procedures Act, 1962-63.

DATED at Chatham, Ontario this 1[illegible] day of [illegible], 196[illegible].

ONTARIO NATURAL GAS STORAGE AND PIPELINES LIMITED

by McNevin, Gee & O'Connor

McNevin, Gee & O'Connor

its Solicitors herein.

FORM 1

The Expropriation Procedures Act, 1962-63

(Section 5 (1))

NOTICE OF EXPROPRIATION

To Margaret Florence Boudy, R.R.#3, Ilderton, Ontario.
.....

.....

.....
(Registered Owner)

TAKE NOTICE:

1. That Ontario Natural Gas Storage and Pipelines Limited did, on the 5th day of June, 1964, register as No. [illegible] in the Registry Office for the County of Middlesex (No. 25) a plan of expropriation in accordance with The Expropriation Procedures Act, 1962-63, and that the land defined therein is vested in Ontario Natural Gas Storage and Pipelines Limited for its use.

2. Attached hereto is a copy of the portion of the plan of expropriation of your land, together with a copy of the description thereof and a copy of the definition of the estate, right or interest required.

3. That, under The Expropriation Procedures Act, 1962-63, Ontario Natural Gas Storage and Pipelines Limited will be notifying you of the amount of compensation it is willing to pay for the land expropriated and the damages resulting therefrom and that, if you are not satisfied with the offer, you are entitled to have the compensation determined by a Board of Arbitration upon your making application to it.

4. That for any further information respecting this matter you may communicate with Ontario Natural Gas Storage and Pipelines Limited at Gas Building, 48 Fifth Street, Chatham, Ontario.

DATED at Chatham, Ontario, this 12th day of June, 1964.

ONTARIO NATURAL GAS STORAGE AND PIPELINES LIMITED

by McNevin, Gee & O'Connor,

McNevin, Gee & O'Connor,

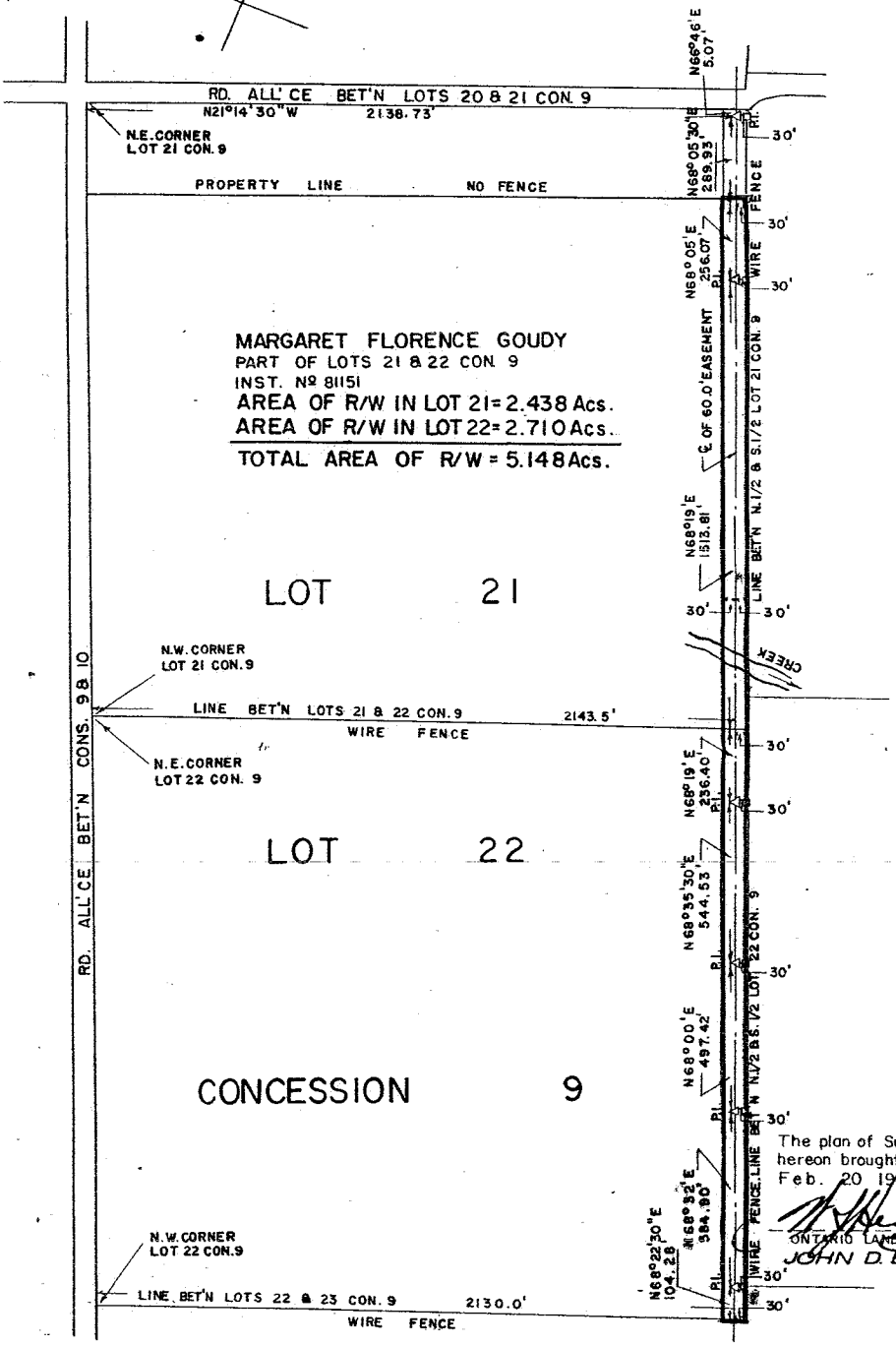
its Solicitors and Agent Herein.

SCHEDULE "B"

PLAN SHOWING

PART OF LOTS 21 AND 22 CONCESSION 9
TOWNSHIP OF LONDON
COUNTY OF MIDDLESEX

SCALE: 1 INCH = 500 FEET



The plan of Survey shown hereon brought up to date Feb. 20 1964

ONTARIO LAND SURVEYOR
JOHN D. BARNES

THE ESTATE, RIGHT OR INTEREST REQUIRED IS AS PER ATTACHED DEFINITION.

ONTARIO NATURAL GAS STORAGE AND PIPELINES LIMITED

President & General Manager

Secretary

NOTE:
BEARINGS HEREON ARE ASTRONOMIC AND ARE REFERRED TO THE MERIDAN THROUGH THE SOUTH-WEST CORNER OF LOT 16 CONCESSION 5 TOWNSHIP OF LONDON
-□- DENOTES 1" SQ. & 2' LONG IRON BAR

DATED: SEPT. 5, 1957
TORONTO, ONTARIO.

O.L.S.
HERBERT L. COONS
ONTARIO LAND SURVEYOR

SCHEDULE "A"

ALL AND SINGULAR that certain parcel or tract of land and premises situate, lying and being in the Township of London, in the County of Middlesex, in the Province of Ontario, and being composed of Part of Lots 21 and 22, Concession 9, in the said Township, and which said parcel of land containing by admeasurement five and one hundred and forty-eight one-thousandths acres (5.148 ac.) be the same more or less, and being a strip of land sixty feet (60.0') in perpendicular width, which centre line and centre line produced of the said strip of land is described as follows:

BEARINGS HEREIN are astronomic and are referred to the meridian through the South-West corner of Lot 16, Concession 5, Township of London;

COMMENCING at a point in the interior of Lot 21, Concession 9, said point being in the Westerly limit of the lands as described in Registered Instrument No. 53681, and distant thirty feet (30.0') measured Northerly at right angles from the line between the North and South halves of Lot 21, and which said point may be located as follows:

STARTING at the North-East corner of Lot 21, Concession 9;

THENCE South twenty-one degrees, fourteen minutes, thirty seconds East (S21°14'30"E) along the Easterly limit of Lot 21, two thousand, one hundred and thirty-eight and seventy-three one-hundredths feet (2,138.73');

THENCE South sixty-six degrees, forty-six minutes West (S66°46'W) five and seven one-hundredths feet (5.07');

THENCE South sixty-eight degrees, five minutes, thirty seconds West (S68°05'30"W) two hundred and eighty-nine and ninety-three one-hundredths feet (289.93') to the said point of commencement;

THENCE SOuth sixty-eight degrees, five minutes West (S68°05'W) two hundred and fifty-six and seven one-hundredths feet (256.07') to a point distant thirty feet (30.0') measured Northerly at right angles from the line between the North and South halves of Lot 21;

THENCE South sixty-eight degrees, nineteen minutes West (S68°19'W) one thousand, five hundred and thirteen and eighty-one one-hundredths feet (1,513.81') to a point in a wire fence being the line between Lots 21 and 22, Concession 9, distant thirty feet (30.0')

measured Northerly at right angles from the line between the North and South halves of Lot 21, said point of intersection also being distant two thousand, one hundred and forty-three and five-tenths feet (2,143.5') measured Southerly thereon from the North-West corner of Lot 21, Concession 9;

THENCE South sixty-eight degrees, nineteen minutes West (S68°19'W) two hundred and thirty-six and forty one-hundredths feet (236.40') to a point distant thirty feet (30.0') measured Northerly at right angles from the line between the North and South halves of Lot 22;

THENCE South sixty-eight degrees, thirty-five minutes, thirty seconds West (S68°35'30"W) five hundred and forty-four and fifty-three one-hundredths feet (544.53') to a point distant thirty feet (30.0') measured Northerly at right angles from the line between the North and South halves of Lot 22;

THENCE South sixty-eight degrees, zero minutes, West (S68°00'W) four hundred and ninety-seven and forty-two one-hundredths feet (497.42') to a point distant thirty feet (30.0') measured Northerly at right angles from the line between the North and South halves of Lot 22;

THENCE South sixty-eight degrees, thirty-two minutes West (S68°32'W) five hundred and eighty-four and ninety one-hundredths feet (584.90') to a point distant thirty feet (30.0') measured Northerly at right angles from the line between the North and South halves of Lot 22;

THENCE South sixty-eight degrees, twenty-two minutes, thirty seconds West (S68°22'30"W) one hundred and four and twenty-eight one-hundredths feet (104.28') to the intersection with a wire fence being

the line between Lots 22 and 23, distant thirty feet (30.0') measured Northerly at right angles from the line between the North and South halves of Lot 22, said point of intersection also being distant two thousand, one hundred and thirty feet (2,130.0') measured Southerly along the line between Lots 22 and 23, from the North-West corner of Lot 22, Concession 9.

The herein described parcel of land bounded on the West by a wire fence being the line between Lots 22 and 23, and on the East by the Westerly limit of the lands as described in Registered Instrument No. 53681, as shown outlined in red on a copy of a Plan of Survey, prepared by Herbert L. Coons, Ontario Land Surveyor, dated September 5th, 1957, brought up to date by John D. Barnes, Ontario Land Surveyors, dated February 20th, 1964, in the City of Toronto, certified as correct by W. J. Hughes, O.L.S., is attached hereto as Schedul B.

April 27, 1964

Certified Correct: W. J. Hughes, O.L.S.

The estate, right or interest required is as per attached definition.

ONTARIO NATURAL GAS STORAGE AND PIPELINES LIMITED

_____

President and General Manager

_____

Secretary

DEFINITION OF ESTATE, RIGHT OR INTEREST REQUIRED

A right, liberty and easement in perpetuity on, over, along, in, under and through a strip of land sixty feet (60') in perpendicular width as shown within the red border on the attached copy of a plan dated the 20th day of January, 1964, signed by W. J. Hughes O.L.S., hereunto attached as Schedule "B" for all or any of the purposes of ingress and egress by Ontario Natural Gas Storage and Pipelines Limited, its successors and assigns, its and their servants, workmen, employees, agents, contractors and subcontractors and those engaged in its and their business, at any time and from time to time either on foot and/or with vehicles, machinery, supplies and equipment and of surveying, laying, constructing, maintaining, inspecting, patrolling, altering, removing, replacing, reconstructing, repairing, moving, keeping, using and operating in, through, along and under such strip of land in such location or locations as the Company may decide, a buried pipeline for the transmission of gas (together with all such buried attachments and equipment and attachments and appliances for cathodic protection which the Company may deem necessary or convenient thereto) including the right along such strip of land to leave exposed any pipeline with its said appurtenances in crossing a ditch, stream, gorge or similar object where approval thereto has been obtained from the appropriate Provincial Authority having jurisdiction in such matters, and, including the right to make temporary openings in any fence or tile drain along or across such strip of land for any of the purposes aforesaid, but expressly excluding the right to fence in all or any part of such strip of land except to restore any fence interfered with; SUBJECT TO THE AFORESAID PURPOSES AND RIGHTS, RESERVING to the landowner from time to time or person or persons entitled thereto, the right to fully use, occupy and enjoy such strip of land except as may be necessary for any of the purposes aforesaid and except (without the prior written consent of the Company) as to any excavating, drilling, installing or erecting therein or thereon of any pit, well, foundation, pavement, building or other structure or installation apart from installing, constructing, repairing, keeping, using and operating lanes, roads, driveways, pathways, walks, farm or domestic tile drains, domestic sewer pipes, domestic water pipes and domestic utility pipes and fences in and on such strip of land without interfering with the said pipeline, provided that prior to commencing any such installation, construction or repair the landowner shall (a) give the Company at least five (5) clear days' notice in writing pointing out the work desired so as to enable the Company to have a representative inspect the site and/or be present at any time or times during the performance of the work, (b) follow the instructions of such representative as to the performance of such work without damage to the said pipeline and, (c) exercise a high degree of care in carrying out any such work.

DHL -1[illegible]2

The Expropriation Procedures Act, 1962-63

Section 8 (1)

Offer in Full Payment of the Compensation for Land Expropriated

To [illegible]argaret Florence [illegible]oudy, [illegible]. 3, Alderton, Ontario.
.....

.....

.....

.....

.....

.....

.....

.....

(Registered Owner)

TAKE NOTICE:

1. That Ontario Natural Gas Storage and Pipelines Limited hereby offers to pay to you the sum of [illegible] Sixty-three Cents ($ 00.63) in full payment of the compensation for all interests in the land as described and defined in the Notice of Expropriation bearing even date herewith and served upon you herewith.

2. That this notice is given pursuant to Section 8 (1) of The Expropriation Procedures Act, 1962-63.

DATED at Chatham, Ontario this [illegible]th day of [illegible], 19[illegible].

ONTARIO NATURAL GAS STORAGE AND PIPELINES LIMITED

by McNevin, Gee & O'Connor

McNevin, Gee & O'Connor

its Solicitors and Agent Herein.

DHL-192

The Expropriation Procedures Act, 1962-63

Section 18

Offer of Payment of 50% of Estimated Compensation for Land Expropriated

To Margaret Florence Moudy, R.R.#3, Alderton, Ontario.
.....
.....
.....
.....
.....
.....
.....
.....
(Registered Owner)

TAKE NOTICE:

1. That Ontario Natural Gas Storage and Pipelines Limited hereby offers to pay to you the sum of Three hundred Dollars and Thirty-two Cents---------- ($300.32) being a sum of not less than 50 per cent of the amount estimated by the Company as the compensation for all interests in the land as described and defined in the Notice of Expropriation bearing even date herewith and served upon you herewith, and that such sum, if accepted, shall be applied in partial payment of any compensation that may subsequently be agreed upon or determined.

2. That this notice is given pursuant to Section 18 of The Expropriation Procedures Act, 1962-63.

DATED at Chatham, Ontario, this 12th day of June, 1964.

ONTARIO NATURAL GAS STORAGE AND PIPELINES LIMITED

by McNevin, Gee & O'Connor,

its Solicitors and Agent Herein.

DHL-102

The Expropriation Procedures Act, 1962-63

Section 19

Notice of Possession

To [illegible] Florence Coudy, [illegible], [illegible]erton, [illegible]rio.
.....
.....
.....
.....
.....
.....
.....
.....
(Registered Owner)

TAKE NOTICE:

1. That on the 24th day of June, 1964, Ontario Natural Gas Storage and Pipelines Limited requires possession of the land as described and defined in the Notice of Expropriation bearing even date herewith and served upon you herewith.

2. That this notice is given pursuant to Section 19 of The Expropriation Procedures Act, 1962-63.

DATED at Chatham, Ontario this 24th day of June, 1964.

ONTARIO NATURAL GAS STORAGE AND PIPELINES LIMITED

by McNevin, Gee & O'Connor
McNevin, Gee & O'Connor

its Solicitors and Agent Herein.

ONTARIO ENERGY BOARD

IN THE MATTER OF the *Ontario Energy Board Act*, 1998, S.O. 1998, c.15, Schedule B, and in particular, s.90(1) thereof;

AND IN THE MATTER OF an Application by Union Gas Limited for an Order or Orders granting leave to construct a natural gas pipeline and ancillary facilities in the Township of Strathroy-Caradoc and in the Township of Middlesex Centre, all in the County of Middlesex.

GAPLO-UNION (STRATHROY-LOBO)

WRITTEN EVIDENCE OF RICK KRAAYENBRINK

March 31, 2006

I own and farm properties described as Part of Lot 26, Concession 2 and Part of Lot 26 and Part of the road allowance between Concessions 1 & 2, Registered Plan No. 24, Moore Township, Lambton County, designated as Parts 1 -10, Plan 25R1585 in the Land Registry Office for the Registry Division of Lambton (No. 25).

On my property, there are three existing Union Gas lines running north and south. In addition, there is a Vector line running east and west. There are also three TransCanada lines running east and west. This makes seven lines on the property. From the perspective of potential liability and safety, I am concerned that no landowner would want to buy this property. With the addition of each line, there is a larger percentage of land being damaged. In addition, the development potential of this land is diminished. One cannot construct buildings on top of the pipelines. The more pipelines there are, the less likely it is that industry will be interested in the farm for development. The particular difficulty with the three Union Gas lines is that the railway is due west of the route. Any railway spur to be constructed on the farm to provide access to it would have to go over the three Union pipelines. This would only be feasible if the lines were buried deep enough and if the thickness of the pipe were sufficient. However, the pipelines are not buried deeply enough nor is the thickness of the pipe sufficient to allow for commercial development over top of the line. Commercial development on this property is a likelihood given its location. It is close to industry and it is close to a railway, the St. Clair River and a major highway. In order to develop the property, a railway spur would be a necessity so that industry would have access to the railway. If my land is now industrial land because of multiple pipelines, I should be compensated for industrial land. The same goes for Strathroy -Lobo.

Working the land on this farm properly with three Union lines, one Vector line and three Trans Canada lines has been a challenge. The three Union lines run north-south, the one Vector and three Trans Canada lines run east-west. The Vector and Trans Canada lines cause loss of production because of crossing regulations. We are afraid of crossing the three Union lines with a loaded grain buggy which weighs 60,000 lbs because of the thin walled pipe and the depth of cover. With farm equipment getting larger and heavier pipes in the rural area should be thicker than that in the urban area because of heavy equipment. Are our lives not as valuable as that of the urban people?

I have a 12 inch Union Gas line which I believe was installed in the 1960's. The 24 inch Union Gas line was installed in 1989 and the 20 inch in 2002. I knew the 12 inch line was in the property when we bought it in 1997. However, it was only some time after our purchase that we found out that we had the 24 inch line in production with the gas flowing. In 2001, we discovered that the line was unregistered. We have our own tiling equipment and use it on the farm. The fact that, for a time, we had no idea the line was there, had the potential to kill a number of people. The 20 inch line was the only Union line put in while we owned the land. We reluctantly came to an agreement with Union Gas on that line because a hearing was too expensive and letting them expropriate would mean losing all control. When we signed the agreement with Union we lost most of our control anyways.

With respect to the construction of new Union Gas lines, like that being proposed in Strathroy-Lobo, I am very concerned about soil impacts. I would very much like to see all the soil stripped with a high hoe rather than with a bulldozer. This would mean that there would be less compaction of the subsoil. This would mean that drainage would be better due to there being less compaction. This

method of stripping was used by Vector on my property and on other properties and I saw that this worked very well even though it was an especially wet summer.

In order to ensure that construction methods and procedures are fair to the landowners, I believe that a Joint Committee is necessary. I was a landowner representative on the Vector line when it was installed. The Committee was very important in ensuring that construction was done according to the Letter of Understanding (LOU). Ron Kerr, the other landowner representative, and I met with the Project Manager on a daily basis, and this worked very well. As stated above, the Vector line was installed during one of the wet test summers in history and there were many situations which arose that made it difficult for Vector to abide by the LOU. There were situations where the committee members asked the landowners for their opinion and this was of great assistance in getting the job done. I have found in my dealings with landowners that it is easier to resolve problems with them when it is other landowners who speak to them about problems that arise. With the Joint Committee in place, it was a team effort to get the line in.

The Joint Committee proposed by Union Gas in its current LOU is too restricted. A Joint Committee would not mean that Union would lose control over its construction schedule and procedures. The Committee would be made up of one landowner representative, one Union Gas representative and a neutral third party environmentalist. This structure provides a good balance and means that sometimes a landowner gets his or her way and sometimes the landowner is overruled. This was the setup for the Vector pipeline. I've attached to this statement excerpts from the Vector LOU about the "Construction Liaison Committee" and WSSD.

With respect to the separation distance between subsoil and topsoil during construction, Union must ensure that it uses enough temporar y land to keep these soils separate even if it means they must remove trees. Although it is understood by landowners that the trees are in an environmentally sensitive area, it is my position that trees will regenerate in a shorter time than the time it w ould take to remediate the topsoil if there were to be mixing. I believe that Union Gas has done its calculations for land required by assuming that landowners only want the trench area stripped. From experience, I know that there is not enough room to allow for full easement stripping while maintaining an adequate separation distance between topsoil and subsoil of one metre. The impact of having subsoil and topsoil mixed, even if inadvertently, cannot be overstated. I personally would not want the remediation that Union Gas has indicated as the answer to all the landowners' problems, but would rather have prevention. The soil is our lifeblood. Union could alleviate the potential problems of soil mixing by placing a row of large bales between the tops oil pile and the subsoil pile.

Another issue that I wish to address is pre-construction tiling. Pre-construction tiling is a very important factor in this construction. All low -lying areas require a stone pit so that when there is a large amount of rain , the rain will flow away. The advantage to a stone pit is that it works 24 hours a day. With a stone pit in place, the soil will dry much more quickly and will not saturate which in turn will mean less compaction. Pre-tiling must be done on both sides of the topsoil piles where the tile will not be damaged by construction activities. Installing pre-construction tile will mean there will be a lot less delay for the construction crew as the soil will then dry more quickly. I strongly believe that putting in pre-construction tiling would save Union Gas thousands and perhaps

tens of thousands of dollars on dewatering crews if there is any large rainfall during construction which there may well be given that Union Gas appears to be intending to construct in the fall. Post-construction tiling should then be done on the easement and temporary work area.

During construction, traffic should remain on the trench line. This is an important point as this will eliminate a lot of compaction to the soil that othe rwise would result. It will also prevent equipment from crushing existing tile that is in the ground. If this is not avoided, flooding may again become a problem given that crushed tile will not be operating properly. Common sense will allow exceptions to this rule such as if an ambulance has to get down if someone is hurt. In addition, I understand that some workers are expensive and it is cheaper to have them travel on the trench line in a bus to save on travelling time. However, if this is going to be done, the bus should have terra tires on it. When I travel on my own land, I use some of the supply of terra tires that I keep in my shed for exactly that reason. I believe that Union Gas should accord the land the same respect the landowners give it. Pick up trucks on the easement cause a lot of compaction and, therefore, Union Gas should use all-terrain vehicles during construction.

Landowners are also concerned about the proposed depth of cover for this pipeline. I grow and harvest grain. The approximate weight of a loaded grain buggy is five times the weight of a high hoe per square inch. My concern about this is that on a federally regulated pipeline, I am not allowed to drive a high hoe over the line as the high hoe is considered to be too h eavy. Although driving a grain buggy over the lines is not an every day occurrence, it is something that sometimes does need to be done. Farmers do not want to be in a position where we are not allowed to drive over the pipelines with our heavy farm equ ipment.

The average weight of my loaded grain buggy is 23.1 pounds per square inch with the tires on it that I have on it (up to 60,000 pounds). Sugar beet harvesters used in Southwestern Ontario can weigh approximately the same. The average weight of a high hoe, in comparison, I understand to be approximately 4.6 pounds per square inch. I am most concerned that the depth of cover proposed for the Strathroy-Lobo line is insufficient to support the great weights that sometim es are driven over the lines. Landowners are concerned for their safety and that of their families each and every time they must cross one of the lines with heavy machinery. This concern becomes even more of a concern in respect of the older lines and as farm equipment gets heavier and heavier. Landowners also are concerned about not being allowed in the future to travel across these pipelines with their heavy farm equipment.

I also make use of deep tillage equipment such as a disc ripper and para - plough in my farming operations to loosen compacted soil, improving overall drainage and crop yield. Normally, I operate this equipment down to a maximum depth of twenty inches, but deep tillage may go even deeper. Pipelines must be installed deep enough to accommodate modern farming pr actices safely.

Another issue that needs to be addressed is that of construction vehicles parking on both sides of the road. It is essential that farmers are able to get from one field to the next and in order to do so, they must be able to drive the wide farm machinery down the road. If construction vehicles park on both sides of the road, which I have seen them do on other occasions, farmers am not able to pass by on the road as there is not enough room to get around. I have no objection to there being parking areas at each road crossing on the land with proper construction methods.

After construction, it is vital that the land be restored to its pre -construction grade. In order to ensure that the grade is what it was prior to construction, the use of GPS technology is essential. Returning the land to its original grade is important to ensure that water will flow from any low spots and will either run off the field or into stone pits. If this is not done on this soil, flooding will occur. GPS technology gives topographic readings that can pinpoint the grade no matter what point is picked. This technology is not very expensive and what is gained in accuracy is worth it. Using GPS would ensure that the grade is restored to its pre - construction state and in the long run, I believe it would save Union Gas money by allowing them to avoid flooding problems that would otherwise result from failing to return the land to grade after construction.

I believe that Union Gas must understand that when they con struct pipelines, they have a great impact on the soil productivity and fertility. Mitigation, in a lot of cases, is not a sufficient answer to the problems. Prevention of problems at the outset should be the goal. I believe that prevention would be cos t-effective for both landowners and Union Gas in the long run.

If Union intends, despite landowners' concerns, to construct during wet weather, it should pay different compensation for working in dry conditions than it does for working in wet conditions. Working in wet soils should be compensated at two or three times the rate for working in dry weather. On my farm, Union's construction crews didn't abide by the WSSD. Wet Soil Shutdown is supposed to be a routine part of "Union's normal management pro cess for pipeline construction activities." On my farm, they had dozers and stringer trucks full of mud. The rolling harrows of the cultivators they used were full of mud. They were para -

ploughing wet soil, which compacted the soil even more instead of reducing it. The para-plough is a dry soil tool.

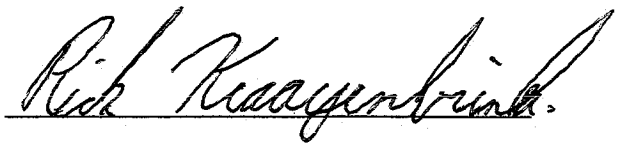
The eventual abandonment of the pipeline is of great concern to me and all pipeline landowners. As pipelines have aged, we have become, as landowners, very aware of issues resulting from the degradation of the pipe. The abandonment issue must be dealt with in the easement agreement so that there is some certainty for landowners at the outset. If pipes are left in the ground upon abandonment, they could corrode and cause problems with water movement, there could be blow outs and there could very well be environmental problems from the leaching of contaminants that are left in the pipe. Our greatest concern is knowing at the outset who will be responsible for these pipes. It is vitally important that the company accept responsibility up front for abandonment and that there be a fund established for remedial action upon abandonment. In the attached agreement between CN and Union Gas, Union agreed to remove its pipe from the ground on 90 days' notice. Landowners should have that same option.

Liability is also a concern for landowners. As there is no financial benefit to us having a pipeline on the property, it is important to know the exact extent to which we are indemnified by the company. We need to know by whom we are indemnified, whether the indemnification will be effective if the company changes hands and the implications of any trade agreements on our liability. As landowners we do not feel that we should have any liability for these pipelines given that we have not asked that they be installed on our properties.

Union Gas' pipelines have had a significant impact on my life. I still think about the unregistered pipeline which endangered my family. And the process

needs to be changed. It's impossible to negotiate a fair deal with the threat of expropriation hanging over your head. To have even a slim chance to get a fair deal, landowners have to get together, and that takes time and money. In my case, we had to hire a lawyer at our own expense in order to explain our options. The hearing process is expensive, too, and not just in terms of money. Landowners have to devote a lot of time to a pipeline project that isn't theirs.

Union Gas seems to rely heavily on what has been done "historically" in order to justify what is being proposed now in Strathroy-Lobo. I would simply point out that what has been done "historically" has caused many problems for landowners and this should never be the justification for what will be done now or in the future. Times and knowledge have changed and Union Gas should be willing to change with the times. No leave to construct should be granted until Union presents a fair easement agreement, a fair LOU and a fair compensation package. And Union Gas should be responsible for all of the costs incurred by the landowners in dealing with the pipeline including hearing costs, lawyer costs, expert consultant costs, landowner time, etc.



Rick Kraayenbrink

March 31, 2006

Vector Pipeline Project
Landowner Letter of Understanding
May 6, 1999

20) The Company agrees to make reasonable efforts to locate above ground facilities adjacent to lot lines and public road allowances. The acquisition and rights of first refusal to re-acquire above ground facility lands will be negotiated between individual landowner(s) and the Company.

21) The Company agrees that construction equipment used for the purpose of topsoil replacement will not be located off the easement or temporary working space and will be designed to minimize soil compaction and draw the topsoil from the stockpile or windrow onto the easement and temporary work space.

22) The Company agrees to instruct its employees and contractors to park vehicles and equipment off the traveled portion and on one side of any road used during construction. Company inspectors will monitor parking during construction to ensure this practice is maintained.

B. Landowner Relations Program

1) Prior to construction the Company shall undertake interviews with individual landowners to identify and determine any site specific details including the location of water wells, septic systems, existing and planned drain tiles and drain mains, access roads, field access crossing locations and other issues which may be of concern during construction.

2) The Company shall notify all landowners of the scheduled start of construction a minimum of 1 week prior to the contractor moving equipment onto the permanent easement and temporary working areas.

3) During construction and restoration, the Company agrees to implement a landowner complaint tracking system.

4) The Company will also establish a three-member committee, referred to as the Vector Construction Liaison Committee ("VCLC"), that will be used to facilitate the resolution of disputes between landowners and the Company **during and following construction** that directly result from construction and restoration activities.

5) The VCLC will comprise of the following individuals: (1) the Project Chief Inspector; (2) the Project Environmental Inspector; and (3) a GAPLO-Vector appointed landowner representative. GAPLO-Vector recognizes that its appointed representative shall use all reasonable efforts to be available to address matters pertaining to the VCLC. Upon being appointed, the GAPLO-Vector representative shall notify the Company of the name and the telephone number(s) of one (1) alternate landowner representative who will be contacted by the Company in the event that the appointed landowner representative cannot be contacted or is otherwise unavailable. So as to ensure continuity and expedited resolution of matters concerning the VCLC, the alternate landowner representative shall remain as the VCLC landowner representative for the purposes of addressing the specific matter before the VCLC. Vector shall make reasonable efforts to contact all members of the VCLC, **including the alternate VCLC landowner representative if the appointed landowner representative is unavailable**, should a committee decision be required. In the event any member of theVCLC can not be contacted or is otherwise unavailable, the issue before the VCLC shall be resolved by the remaining VCLC members.

6) In the event that a dispute arises between a landowner and the Company and such dispute cannot be resolved to the mutual satisfaction of the parties through discussion or referral to the VCLC, the Company will consider retaining a mutually satisfactory independent consultant to assist in the resolution of the particular dispute.

7) The Company agrees to provide remuneration to the VCLC landowner representative for participation in VCLC proceedings at a rate of $75 per hour.

8) Should an emergency arise during the construction or operation of the pipeline, the Company agrees to notify any affected landowner within 72 hours following emergency access to that landowner's property and provide a written report on how the emergency situation was resolved.

C. Soil Studies & Testing

1) The Company agrees to carry out pre and post-construction compaction, soil fertility and soybean cyst nematode sampling and testing at locations both on and immediately adjacent to the temporary work space or easement in an undisturbed location.

Vector Pipeline Project
Landowner Letter of Understanding
May 6, 1999

SCHEDULE "A"

VI. Wet Weather Shut-Down Procedure

This procedure applies to all pipeline construction projects supervised by Vector. The objective of this procedure is to conserve and protect soil in agricultural areas from long-term damage and consequential crop losses. Movement of heavy construction equipment on the pipeline right-of-way during wet soil conditions may cause excessive compaction and rutting. This procedure is in place to suspend or minimize construction activity during these periods and shall remain in effect over the entire construction and clean-up periods. In some special situations, other wet soil operating procedures may be employed, subject to the approval of the landowner.

1) At least 30 minutes before the commencement of construction on days where there is the possibility that wet weather may cause soil damage if construction activities proceeds, members of the VCLC will assess the right-of-way soil conditions and determine whether right-of-way conditions are too wet such that soil damage would result if construction were to proceed.

2) In the event a majority of the VCLC determines that soil damage would result if construction were to proceed that day, the Chief Inspector will immediately notify the Project Manger and the Pipeline Contractor of such determination. The Chief Inspector will further ensure that the Pipeline Contractor has promptly ceased all of the affected construction activity.

3) It is recognized that a majority of the VCLC may determine that certain activities can continue without causing soil damage. This may include restricting movement on the right-of-way to wide tracked equipment, bored crossings, welding etc.

4) If rain commences after construction has started, the VCLC will closely monitor right of way soil conditions. In the event a majority of the VCLC determines that construction should be stopped, the Chief Inspector will immediately notify the Project Manger and the Pipeline Contractor of such determination. The Chief Inspector will further ensure that the Pipeline Contractor has promptly ceased all of the affected construction activity.

[redacted]

PERMISSION is hereby given by CN TRANSACTIONS INC. (hereinafter called the "CN") to UNION GAS LIMITED (hereinafter called the "Licensee") to enter upon for all purposes relating to the construction and thereafter the use and maintenance of a 24" pipeline for he conveyance of gas, (hereinafter referred to as the "pipeline") along the Right of Way of the Railway in the Township of Moore, County of Lambton and Province of Ontario, in the location identified as Parts 3, 6 and 8 on Registered Reference Plan No. 25R-5094, attached as Schedule "A" hereto and to use and occupy Parts 1, 4, 5 and 7 shown on the said plan for access to parts 3, 6 and 8 during the period of construction, and for continued access and the storage of construction materials for a period of one year after the completion of construction. SUCH PERMISSION IS GIVEN SUBJECT TO THE FOLLOWING TERMS AND CONDITIONS:

THE LICENSEE AGREES:

1. At its own risk and expense, to use and maintain the pipeline to the satisfaction of CN and in compliance with all orders, rules and regulations of the National Transportation Agency or other authority of competent jurisdiction now or hereafter in force applicable thereto.

2. Before commencing any major repairs or renewals of the service pipelines, to give to the local Superintending Officer of CN at least seventy-two (72) hours' prior notice in writing to enable the CN to send an Inspector to supervise the said work and to pay the wages of the said Inspector including his expenses while so engaged, on demand from CN.

3. Not at any time to obstruct CN's tracks nor to interfere, in any way, with the usefulness or safety for railway purposes of the CN's tracks and lands. Should CN at any time or from time to time desire to construct other tracks under the service pipelines or to make any alterations to its existing tracks, at its own risk and expense to perform any work of strengthening, rebuilding or altering the pipeline as may be required by CN.

4. To indemnify and save harmless CN from all loss and expense incurred by CN and from and against all claims and demands, loss, costs, damages, actions, suits or other proceedings by whomsoever made, brought or prosecuted (and the Licensee hereby waives as against CN all claims or whatsoever nature or kind) in any manner arising by reason of the constructions, existence, maintenance or use of the pipeline, save and except to the extent that any action, suit, claim, demand, direct loss, costs, damages and expenses arises from the gross negligent acts or omissions

Received Time Mar. 26. 8:32PMmployees and agents.

5. All persons entering upon the premises of CN for any purpose connected with this License shall do so at the risk of the Licensee and CN shall not be liable for any injury, loss or damage howsoever caused to such persons while on the said premises and to indemnify CN against all claims that may be made by reason of any such injury, loss or damage, save and except to the extent that any such injury, direct loss or damage arises from the gross negligent acts or omissions of CN, its servants, employees and agents.

6. To pay to CN, for the privileges herein granted, the sum of TWO THOUSAND AND SEVENTY THREE DOLLARS ($2,073.00) per annum, payable in advance on the First day of June, in each year during the first five years hereof, the first of such payments to become due and payable on the First day of June, One Thousand Nine Hundred and Eighty-nine.

PROVIDED that the license fee payable hereunder shall be subject to review at the end of the fifth and at the end of each successive five years during the continuance hereof and set at a rate which, in the opinion of CN, is fair and equitable and shall be payable in like manner.

7. The pipeline and facilities and all appurtenances thereof while on CN premises shall at all times be at the risk of the Licensee in respect of loss or damage from whatsoever cause arising, whether due to the negligence of CN, its employees or otherwise.

8. Not to assign or sublicense this License nor any right or privilege hereunder without the consent in writing of CN.

AND MUTUALLY AGREE:

9. This License shall be in effect from the First day of June, One Thousand Nine Hundred and Eight-Nine until terminated by either party hereto on giving to the other party not less than Ninety (90) days' written notice. Such notice may be given by addressing same to the Licensee at 50 Keil Drive N., Chatham, Ontario, N7M 5M1, and to CN addressing same to its Regional Manager, Real Estate Services, Suite 920, 277 Front Street West, Toronto, Ontario, M5V 2X4.

10. Upon the termination of this License in any manner, the Licensee shall forthwith, at its own risk and expense, remove the service pipelines from the premises of the Railway and restore the said premises affected by such removal to a condition satisfactory to CN. Should the Licensee default in so doing, CN may perform the said work or removal at the risk and expense of the Licensee.

DATED at Toronto, Ontario, as of the First day of June, One Thousand, Nine Hundred and Eighty-Nine.

Witness:

CN TRANSACTIONS INC.

Regional Manager

Cordner Science

Agricultural and Environmental Consultants

FINAL REPORT

Construction Monitor Services
NPS 48 Strathroy Lobo Pipeline Project
Union Gas Limited

Prepared for: The Construction Monitor Committee of the Union Gas Limited NPS 48 Strathroy Lobo Pipeline Project

Submitted to: Construction Monitor Committee
Zora Crnojacki, Ontario Energy Board
Gerry Mallette, Union Gas Limited
Alan Wood, Landowner Representative

Prepared by: Dr. Jane Sadler Richards PAg
Cordner Science
34050 Maguire Road, RR 2
Ailsa Craig, ON N0M 1A0
Tel: 519-293-1190
Fax: 519-293-1199
Email: janesr@cordnerscience.com

Stephen G. Redmond PAg CCA
Redmond Agronomic Services

Alan McCallum CCA
McCallum Agronomic Services

Date: 18 Dec 08

Table of Contents

1 EXECUTIVE SUMMARY 1

2 LIST OF RECOMMENDATIONS 3

3 INTRODUCTION 8

3.1 Background And Scope Of Work 8
3.2 Purpose 8
3.3 Objectives 8

4 METHODS 9

4.1 Construction Monitor Services 9
4.1.1 Construction Monitor Team (CMT) 9
4.2 Communications Protocol 9
4.3 On-Site Monitoring 10
4.3.1 Approach 10
4.3.2 Methods 10
4.3.3 Record Of On-Site Observations 11
4.4 On-Site Data Collection 12
4.5 Reports 12
4.5.1 Daily Report 12
4.5.2 Weekly Report 12
4.5.3 Wet Soil Shutdown Report 12
4.5.4 Contact Report 12
4.5.5 Final Report 13

5 RESULTS 13

5.1 Construction Monitor Services 13
5.2 Communications 13
5.3 On-Site Observations 13
5.4 On-Site Data 13
5.4.1 Precipitation 13
5.4.2 Post Construction Soil Compaction 15
5.5 Reports 15
5.5.1 Log Of Daily Reports 15
5.5.2 Log Of Weekly Reports 16
5.5.3 Log Of Wet Soil Shutdown Reports 16
5.5.4 Log Of Contact Reports 16
5.5.5 Final Report 16

6 DISCUSSION AND RECOMMENDATIONS 16

6.1 Organization Of Operations Into A Construction Phase And A Remediation Phase 16
6.2 Construction Monitor Services 22
6.2.1 Team Approach To Construction Monitor Services 22
6.2.2 Construction Monitor Committee 22
6.3 Communications 23

6.4 On-Site Observations – General 25
6.4.1 Documents 25
6.4.2 Pre-Construction Meetings Between Lands Agent And Landowners 30
6.4.3 Participation Of On-Site Construction Monitor In Weekly Landowner/Union Gas Meetings 31
6.4.4 Management of Unique Landowner Needs and Sensitive Lands 31
6.4.5 Risk Management On Properties With Soybean Cyst Nematode 32
6.4.6 Partial Strip Versus Full Strip Of Topsoil 33
6.4.7 Stone Picking 35
6.4.8 Seeding For Vegetative Cover 36
6.4.9 Depth Of Topsoil 36
6.4.10 Depth Of Pipeline Soil Cover 36
6.4.11 Timing Of Subsoiling And Tile Drainage Installation 37
6.4.12 Timing Of Clean-Up 37
6.5 On-Site Observations – Single Property 38
6.5.1 Property #016 38
6.5.2 Property #026 39
6.5.3 Property #051 39
6.5.4 Timeline Summary For Example Properties On The NPS 48 Strathroy Lobo Pipeline Project 41
6.6 On-Site Data 42
6.6.1 Rainfall And Soil Moisture Content 42
6.6.2 Soil Compaction 42
6.7 Reporting Structure 43
7 CONCLUSION 43
APPENDIX A: STATEMENT OF WORK 44
APPENDIX B: REFERENCE DOCUMENTS 46
APPENDIX C: COMMUNICATIONS PROTOCOL 47
APPENDIX D: REPORT FORMS 50
APPENDIX E: LOG OF DAILY REPORTS
APPENDIX F: LOG OF WET SOIL SHUTDOWN REPORTS
APPENDIX G: LOG OF CONTACT REPORTS

LIST OF TABLES

Table 5.1: Monthly Rainfall (July - November, 2007) Along The NPS 48 Strathroy Lobo Pipeline ROW Compared To Normal Rainfall From Strathroy – Mullifarry Weather Station, Environment Canada 13
Table 5.2: Rainfall Events (July - November, 2007) Along The NPS 48 Strathroy Lobo Pipeline ROW 14
Table 5.3: Wet Soil Shutdown Events (July 2007 - November 2008) Along The NPS 48 Strathroy Lobo Pipeline ROW 15
Table 6.1: CMT List Of Concerns Regarding The LOU 26

1 EXECUTIVE SUMMARY

Union Gas Limited constructed three natural gas pipelines prior to 1990 within a corridor in southwestern Ontario stretching from the Dawn Compressor Station, near Sarnia, to the Trafalgar Compressor Station on the western edge of Mississauga. The Union Gas Limited (Union Gas) NPS 48 Strathroy Lobo Pipeline Project, which is discussed in this report, represented one of the final construction components of a fourth pipeline within this corridor. The Strathroy Lobo section of the pipeline stretches 18 km from the Strathroy Gate near the town of Strathroy to the Lobo Compressor near the village of Lobo, Ontario. Construction occurred in 2007 and clean-up was completed in 2008.

A Construction Monitor Committee (CMC), consisting of one representative of the Ontario Energy Board (OEB), Union Gas and the landowners was formed. The CMC determined the need for Construction Monitor services for the duration of the Union Gas Limited NPS 48 Strathroy Lobo Pipeline Project. These services were provided by a Construction Monitor Team (CMT). The purpose of the Construction Monitor services was to observe and report on construction activities to provide a review of several operations of interest to landowners and the Ontario Energy Board. The objectives of the Construction Monitor services were:

1. To observe impacts of construction on the land, including right-of-way (ROW) preparation, trenching, backfill and clean-up operations as well as wet soil shutdown (WSS) events;
2. To review construction activities for compliance with the OEB Conditions of Approval, Letters of Understanding (LOU) agreed to between landowners and Union Gas;
3. To review all specific construction commitments included in Union Gas's construction contract;
4. To respond to specific requests by landowners or the Committee within 24 hours while maintaining limited contact with landowners on a day-to-day basis; and
5. To prepare and deliver a series of activity reports in a timely manner to the appropriate persons.

The Construction Monitor services were provided by a team of three independent consultants with over 65 years of combined experience in various professional roles in agriculture, research, consulting and environmental monitoring. The CMT included: Dr. Jane Sadler Richards PAg, Cordner Science, Ailsa Craig, ON; Alan McCallum, CCA, McCallum Agronomic Services, Iona Station, ON; and Stephen Redmond, Redmond Agronomic Services, PAg, CCA, Lucan, ON.

The approach used by the CMT relied on the daily observations, notes and photographs made by the on-site Construction Monitor to assess and report on the 'impacts of construction on the land'. The pipeline construction work was observed from a practical perspective i.e., *What are the options for minimizing the impacts on the land given this is a construction site?* The approach did not include a review of every document related to the

construction project and development/completion of multiple checklists based on a comparison of 'what was printed in the documents and what was done during construction'. Also, the approach did not include a review of the financial details of individual landowner contracts or calculations of topsoil storage and expanded work areas, re-imbursement for use of other property or any other financial matters between Union Gas and the landowner. The CMT was authorized to observe activities, review documents, respond to requests and report their findings. The CMT was not authorized to decide when wet soil shutdown was required or to initiate contact with landowners.

The CMT recognized Union Gas took positive steps to address the impacts of construction, remediate affected lands and improve landowner relations during the NPS 48 Strathroy Lobo Pipeline Project. The CMT recognized the difficulties experienced by those landowners who contacted the CMT when construction of the pipeline did not occur as they anticipated. The CMT concluded more work is required to balance the need to construct new pipeline with the need to mitigate the impacts of construction on the land through which the pipeline is built. However, the CMT observed good will amongst individuals on a daily basis, which suggested continued progress is possible. The recommendations in this report provide direction for positive change in the future. These recommendations may be particularly important when construction conditions are not as ideal as those experienced during the NPS 48 Strathroy Lobo Pipeline Project.

During the course of this project, the CMT was convinced by their combined experiences that a different approach to the organization of operations associated with pipeline construction is required to improve the balance between corporate pipeline and landowner interests. The primary recommendation of the CMT is that:

> *future pipeline construction projects should be divided into two distinct phases i.e., Construction Phase and Remediation (formerly called Clean-up) Phase, which have clearly defined and separate objectives and budgets.*

The benefits of this approach are powerful:

1. The pipeline contractor could continue to focus on what they do best i.e., construct high quality pipelines.

2. The clean-up contractor could develop a focus that is remediation-centred, and has the capacity to address the needs of <u>each</u> property and landowner <u>every day</u> and <u>every time</u> they interact.

3. The overall cost of clean-up in time, effort, and damaged good will, could be reduced if more focus was placed on successful land remediation and minimizing the risk of failure of related structures and practices.

The primary recommendation and 38 additional recommendations are fully discussed in the report.

2 LIST OF RECOMMENDATIONS

Primary Recommendation, NPS 48 Strathroy Lobo Pipeline Project:

1. *The CMT recommends future pipeline construction projects should be divided into two distinct phases i.e., Construction Phase and Remediation (formerly called Clean-up) Phase, which have clearly defined and separate objectives and budgets.*

The following concepts should be integrated into the objectives and requirements of the Remediation Phase:

- A clearly defined set of objectives and budget that focus on maximizing the effectiveness and efficiency of land remediation efforts. (This would be similar to the current Construction Phase engineering requirement to "perfect" the installation of the pipeline.)
- The Remediation Phase would begin with pre-construction landowner meetings, land clearing, and drainage tile interruption, and continue as soon as backfilling of the trench begins.
- The contractor would appoint a Remediation Foreman, approved by the landowners or their representative(s), to oversee all remediation activities. The responsibilities and budgets of the Construction Foreman and the Remediation Foreman should complement each other and not overlap. This should allow each foreman to focus on achieving the best possible outcome for their phase of the work and improve the balance between meeting the interests of the pipeline company and the interests of the landowners.
- The independent Soils Inspector for construction should continue to act as the soils specialist for replacement of topsoil as this physical step in the Remediation Phase is linked to the procedures initiated during topsoil stripping in the Construction Phase.
- An experienced independent agronomist holding a current Certified Crop Advisor (CCA) designation should be contracted to oversee all agronomic aspects of remediation. The Remediation Foreman and the CCA may or may not be the same person.
- The CCA must be current with all Best Management Practices (BMPs) used in crop production including use of new equipment, conservation tillage systems, fertility practices, etc. The CCA would consult with each landowner and determine, prior to land remediation (i.e., clean-up), what equipment, materials and techniques are required to rehabilitate the unique features of each property.

- The CCA should discuss with each landowner the option to overwinter the topsoil pile and replace the topsoil on the field in the year following construction. If construction is delayed by wet weather, a decision could be made with the landowner to minimize the use of large dozers and hi-hoe equipment and/or move the work and resources into the following year.
- The CCA would also consult with each landowner on other issues such as tile drainage prior to topsoil replacement, acceptance of lower quality topsoil for subsidence areas and the stone picking requirement for each property.
- A distinct Remediation Phase, with a separate budget, would provide the Foreman/CCA with the flexibility to source tillage and seeding equipment for specialized clean-up procedures from the landowners themselves or other local suppliers. This would minimize the use of construction contractor preferred equipment and perhaps decrease the cost of clean-up by allowing landowners to perform more secondary tillage operations.
- The roles of the Lands Agent, Soils Inspector, CCA, and Construction Monitor should be revised to ensure they are complementary within the organizational structure of the project.

Additional Recommendations (listed in discussion order):

2. *A checklist for each property to standardize the process of documenting observations for each property and to list key steps in pipeline construction and clean-up could be developed.* The checklist should be completed by the on-site Monitor. It also should provide additional documented assurance that each property was observed regularly, consistently and during key activities.
3. *The CMC should appoint a communications coordinator to ensure all requests from the CMT to the CMC are responded to not only on a day-to-day basis but also when the CMC needs to meet to prepare a joint response.* The role of communications coordinator could rotate on a one or two month basis amongst CMC members.
4. *If the CMT role is not modified to allow them to communicate directly with landowners along the pipeline, then a clear mandate must be given to the CMC Landowner Representative or their delegate to communicate issues regarding individual lands to each affected landowner within a specified time frame.*
5. *The Communications Protocol should be updated and used by the CMT during future pipeline projects.*
6. *Two-way discussions between the on-site Monitor and pipeline staff should continue to provide the CMT with the best opportunity to understand construction and clean-up activities in progress.*

7. *The Contact Reporting system should be maintained for future projects and the CMT should have the discretion to forward copies of a Contact Report to all third parties mentioned or involved in the discussion, issue or site meeting – including the affected landowner(s).* The Contact Report could be enhanced to include landowner contacts initiated by the CMT to advise them of potential items they may want to follow-up on with regard to impacts of the construction and clean-up activities on their land. This would allow the CMT to identify potential action items, shift the responsibility for follow-up to the parties involved and eliminate the need for the CMC Landowner Representative to contact affected landowners.
8. *Surveys involving all parties in the pipeline project could be used to measure changes in levels of communication, knowledge and satisfaction regarding respective roles, responsibilities and procedures during the project.*
9. *The same Lands Agent should represent Union Gas during both the pre-construction meetings with landowners and the on-site construction and remediation work.* This should enhance relationships and communications between parties.
10. *The on-site Lands Agent should have a computer and email access to improve general communications and to assist the CMT with effective communication between Union Gas and landowners.*
11. *Documents involving landowner interests should be reviewed to eliminate inconsistencies and streamlined for ease of transfer of information from negotiated terms to a working list of commitments that can be updated as work progresses.*
12. *A procedure for timely update and distribution of the Line List (or applicable sections) to those involved including the affected landowner(s) would improve communications.*
13. *It is essential to maintain flexibility in the field to make alternative or additional verbal commitments between Union Gas and the landowner to accommodate changing field conditions or unforeseen circumstances. Changes in commitments, however, must be documented and circulated to affected parties within 24 hrs of discussion.*
14. *The clean-up procedure document should clearly identify what practices will occur on each type of land (i.e., field crop, forage crop, pasture, natural lands, woodlots) and on each section of the ROW (i.e., working area, trench area, storage area).*
15. *Exceptions to the standard procedure should be identified in each document.*
16. *An education program aimed at ensuring landowners have enough information to make informed decisions on construction and remediation options for their land must be provided.*
    For example, the education program could include a factsheet explaining the procedures used in pipeline construction. This factsheet would outline the steps the Contractor will take to prepare the area for construction, the steps required for the installation of the pipeline and the clean-up procedures involved. The

factsheet could be used in the pre-construction meeting to review the construction activities in relation to an individual landowner's property. This would allow each landowner to visualize the construction on their property and help them indicate any special needs related to their properties. Another factsheet could be developed to provide Union Gas and landowners with relevant information on Best Management Practices (BMPs) related to land management options during and after pipeline construction.

17. *Landowners could be provided with the option to hire a consulting agrologist e.g., CCA, to attend an education program on their behalf so the consultant can make recommendations to the landowner on what construction and remediation options are best suited for their land.*

18. *A minimum of two one-on-one landowner meetings should be held during the pre-construction period.* For example, the first meeting could be used to view educational materials, including visuals such as a video of construction and remediation (i.e., clean-up) practices, and to initiate discussions on how the project could affect the landowner's property and operations. A second meeting could be used to review construction and remediation practices again, to answer questions/concerns arising from the first meeting, and to discuss/confirm specific requirements for construction and remediation on each property.

19. *At each pre-construction meeting, the topics, arrangements and action items arising from the meeting must be documented in writing and everyone attending the meeting must initial and receive a copy of the record of the meeting before they leave.*

20. *The timing and methods used to negotiate financial compensation should be examined to ensure financial concerns do not distract the parties from construction and remediation concerns.*

21. *The on-site Monitor should attend the weekly Union Gas/landowner meetings on a regular basis.* This would improve the CMT's understanding of issues and their communication with the parties.

22. *A list of action items and responsibilities for follow-up could be prepared and updated at each weekly meeting to track the status and resolution of concerns.* Action notes could be circulated by email to those involved including off-duty members of the CMT.

23. *Unique landowner needs and sensitive lands should be identified as soon as possible in the project to ensure adequate and timely follow-up.*

24. *Plans for rehabilitating each property should include consideration of BMPs.*

25. *Significant improvement in the effectiveness and efficiency of the equipment wash procedures could be achieved with the establishment of an industrial-sized, dedicated wash station.*

26. *Landowners should be provided with agronomic information and/or consultation before making a decision to allow a partial strip rather than a full strip of topsoil on their lands during construction.*

27. *A factsheet could be developed to provide appropriate agronomic information on each choice.*
28. *The specifications and procedures for stone picking should be revised to allow flexibility to adjust the requirements relative to natural soil conditions.*
29. *Timely seeding on a property-by-property basis should be required rather than seeding all or a group of properties after construction is completed.*
30. *Consistency of depth of topsoil across each property should be confirmed.*
31. *Notification procedures should be reviewed to require Union Gas and landowners to contact each other within a specified timeframe when one party has new information about depth of soil cover over a pipeline.* This information could provide assurances to both Union Gas and landowners that adequate soil cover remains in place or, more importantly, alert both Union Gas and landowners that adequate cover is not in place and that steps must be taken by the landowner to minimize risks until adequate soil cover can be re-established by Union Gas.
32. *Landowners should be provided with agronomic information and/or consultation before making a decision to allow tile drainage installation soon after subsoil/topsoil rehabilitation.*
33. *A factsheet could be developed to provide appropriate agronomic information on available choices.*
34. *Consideration should be given to recognizing and accommodating differences in contractor/landowner priorities in any timelines included in contract and/or landowner agreements.*
35. *The contractor should keep equipment and work crews at full strength to the end of the project so that clean-up proceeds as quickly as possible.*
36. *An analysis of the timelines required for both construction and clean-up activities may help in the allocation of time and resources between the two phases on a pipeline project i.e., construction and remediation.*
37. *Consideration should be given to establishing a method for scientifically documenting specific soil conditions on those days when it is difficult to visually assess the need for a wet soil shutdown.*
38. *A review of the objectives, and the scientific and statistical methods available to assess the agronomic effectiveness of remediation procedures should be conducted.*
39. *Maximum use of innovations in electronic technology should improve the efficiency of daily report preparation in the future.*

3 INTRODUCTION

3.1 BACKGROUND AND SCOPE OF WORK

Union Gas Limited constructed three natural gas pipelines prior to 1990 within a corridor in southwestern Ontario stretching from the Dawn Compressor Station, near Sarnia, to the Trafalgar Compressor Station on the western edge of Mississauga. The Union Gas Limited (Union Gas) NPS 48 Strathroy Lobo Pipeline Project, which is discussed in this report, represented one of the final construction components of a fourth pipeline within this corridor. The Strathroy Lobo section of the pipeline stretched 18 km from the Strathroy Gate near the town of Strathroy to the Lobo Compressor near the village of Lobo, Ontario. Construction occurred in 2007 and clean-up was completed in 2008.

Landowner experiences with previous Union Gas construction projects regarding construction procedures; activity under wet soil conditions; and communications between Union Gas, the pipeline contractor and landowners involved in the projects, gave rise to significant discussions between Union Gas and the landowners along the Strathroy Lobo section of the pipeline. A Construction Monitor Committee (CMC), consisting of one representative of the Ontario Energy Board (OEB), Union Gas and the landowners was formed. The CMC determined the need for Construction Monitor services for the duration of the Union Gas Limited 48" Strathroy Lobo Pipeline Project. These services were provided by a Construction Monitor Team (CMT). The approach and methods used by the Construction Monitor Team (CMT) were based on the description of the Construction Monitor role provided by the CMC during the consultant selection process (Appendix A).

This content of this report follows direction similarly provided by the CMC (Appendix A):

> A final report generally summarizing all reports shall be provided at the end of the contract term. The report shall contain at a minimum, recommendations in respect to the following:
> - Communications with landowners and the Committee.
> - Potential construction activity improvements.
> - Reporting requirements.

3.2 PURPOSE

The purpose of the Construction Monitor services was to observe and report on construction activities to provide a review of several operations of interest to landowners and the Ontario Energy Board.

3.3 OBJECTIVES

1. To observe impacts of construction on the land, including right-of-way (ROW) preparation, trenching, backfill and clean-up operations as well as wet soil shutdown (WSS) events;
2. To review construction activities for compliance with the Ontario Energy Board (OEB) Conditions of Approval, Letters of Understanding (LOU) agreed to between landowners and Union Gas;

3. To review all specific construction commitments included in Union's construction contract;
4. To respond to specific requests by landowners or the Committee within 24 hours while maintaining limited contact with landowners on a day-to-day basis; and
5. To prepare and deliver a series of activity reports in a timely manner to the appropriate persons.

4 METHODS

4.1 CONSTRUCTION MONITOR SERVICES

4.1.1 Construction Monitor Team (CMT)

The Construction Monitor services were provided by a team of three independent consultants with over 65 years of combined experience in various professional roles in agriculture, research, consulting and environmental monitoring. The CMT was coordinated by Dr. Jane Sadler Richards PAg, Cordner Science, agricultural and environmental consultants, Ailsa Craig, ON. Dr. Sadler Richards also was an active on-site Monitor. The other members of the CMT were Alan McCallum, CCA, McCallum Agronomic Services, Iona Station, ON and Stephen Redmond, Redmond Agronomic Services, PAg, CCA, Lucan, ON.

The CMT received project and safety training from Union Gas prior to the commencement of construction activities. Union Gas provided several documents to the CMT members for their review and ongoing reference (Appendix B).

4.2 COMMUNICATIONS PROTOCOL

The CMT developed procedures to ensure the three-person rotation worked effectively and efficiently (Appendix C). The overall goal was to develop clear, concise and transparent communications between the CMT members, and between the CMT and the CMC.

In summary the responsibilities of the CMT members were to:
- maintain open and regular verbal and written communications within the CMT and the CMC;
- complete, distribute and file communications documentation in a timely, organized and secure manner; and
- conduct regular 'check backs' on communication documents to ensure that action items were followed up and issues were addressed.

CMT members communicated as follows:
- each member maintained a field notebook that included communication and personal notes with observations of construction activities; and information related to photographs and/or videos taken on-site;
- when necessary, the on-site Monitor phoned other CMT members and provided a brief summary or comment on the day's activities and future items to consider;

- all report documents were created and transmitted by email generally at the end of each day, to enable other CMT members and the CMC to understand construction progress and issues as they developed; and
- an original, signed copy of each report was filed in the Cordner Science office at Ailsa Craig, ON.

4.3 On-Site Monitoring

4.3.1 Approach

The approach used by the CMT relied on the daily observations, notes and photographs made by the on-site Monitor to assess and report on the 'impacts of construction on the land'.

The pipeline construction work was observed from a practical perspective i.e., *What are the options for minimizing the impacts on the land given this is a construction site?*

The approach did not include a review of every document related to the construction project and development/completion of multiple checklists based on a comparison of 'what was printed in the documents and what was done during construction'. Also, the approach did not include a review of the financial details of individual landowner contracts or calculations of topsoil storage and expanded work areas, re-imbursement for use of other property or any other financial matters between Union Gas and the landowner.

4.3.2 Methods

The on-site Monitor arrived at the Union Gas field office in the morning between 6:30 and 7:30 am. They received a copy of the Daily Working Schedule, which listed the operations and where they would occur along the pipeline. Casual discussions with other inspectors often occurred at this time.

The on-site Monitor then traveled to various locations along the pipeline during the day to observe the work as it progressed. The on-site Monitor may have referred to documents provided by Union Gas during training sessions or during ongoing work (Appendix B) to provide specifics related to each property e.g., property number and owner, request for whole or partial stripping of easement. However, the on-site Monitor relied mainly on the Line List provided by Union Gas, which summarized the specific land-related agreements made with each landowner (not including financial agreements) in the Letter of Understanding (LOU) and the results of the landowner interviews conducted several months prior to the work and recorded on the Union Gas [landowner] Interview Sheet. The on-site Monitor regularly noted items to continue to check on as the work progressed. This information was passed on to the other Monitors on the team by email or telephone if they were scheduled to be there when the follow-up was required.

Wet conditions on the right-of-way (ROW) resulted in a full or partial wet soil shutdown (WSS). The CMT was not involved in WSS decisions. The on-site Monitor reviewed the revised Daily Working Schedule and decided how best to spend their time for the day. Ongoing operations were often monitored more closely for impacts during wet soil conditions, paper work was caught up, or discussions with landowners/other monitors/pipeline workers may have occurred. Occasionally, the on-site Monitor returned to their home office to do paper work or other unrelated work and returned later in the day to assure themselves that activity on the pipeline occurred as planned during the WSS and to look for impacts related to wet soil conditions.

The on-site Monitor had unrestricted access (within safety limitations) to the pipeline construction site when observing land-related operations. The on-site Monitor regularly commented on or discussed activities with key workers e.g., Lands Agent, Soils Inspector, as appropriate, to ensure they (i.e., the on-site Monitor) thoroughly understood the activities in progress and/or the thinking behind decisions to conduct work in a certain way. This type of communication often provided an opportunity for those present to review the actual activities and the pros and cons of the options that were available for conducting or communicating about the work. The objectives of the on-site Monitor were to fully understand the construction options, to assure themselves that the option chosen for completing the work was reasonable under the construction circumstances and to assure themselves that impacts on the land were minimized as much as practical. The outcome was a record of observed work, conditions related to real or potential impacts on the land and, on occasion, an opinion related to a situation e.g., "soils were wet/were dry in the expanded work area where the tie-in was completed". This information was documented in a series of reports i.e., Daily Report, Contacts Report, Wet Soil Shutdown Report and Weekly Report.

The on-site Monitor was invited on a few occasions (i.e., less than 20) by Union Gas, the CMC Landowner Representative, or individual landowners to attend Tue morning Landowner Liaison Meetings, on-site discussions between the Lands Agent and a landowner, and to speak to a tour group from the Ontario Energy Board. These contacts and related follow-up were documented in the Contacts Reports along with other significant discussions with key workers regarding pipeline activities.

4.3.3 Record Of On-Site Observations

Each member of the CMT kept personal notes regarding observations, conversations and photographs/videos of on-site conditions. These notes were used to prepare subsequent project reports. The notebooks and photographs/videos were filed by date and key word at Cordner Science and remain part of the project record.

4.4 On-Site Data Collection

The CMT mandate was to observe activities and impacts on the land; not to collect data. Data representing daily rainfall along the pipeline and soil compaction on the ROW were collected by the Soils Inspector (Stantec Consulting) on behalf of Union Gas. Manual rainfall gauges were placed at the following locations: Field Office (Strathroy); Saxton Rd (SF #2); Abredeen Rd. (SF #6); Komoka Rd (SF #8); and Nairn Rd (SF #11). After soil tillage procedures were completed, a hand-held soil penetrometer was used by the Soils Inspector to obtain data on resistance to soil penetration, which is an indicator of soil density and structure. This information may be used to assess soil compaction.

4.5 Reports

All reports were transmitted electronically by email, generally at the end of each day, to the CMT and the CMC representatives from Union Gas and the landowners. The CMC representative from the Ontario Energy Board (OEB) received the Weekly Report, which summarized daily activities. Paper copies of each report were signed and filed at Cordner Science.

4.5.1 Daily Report

Each day the on-site Monitor created a daily report using a template (Appendix D) that listed the construction activities and progress occurring on various properties. The daily report also included a brief summary of weather, soil conditions and major events that occurred throughout the day.

4.5.2 Weekly Report

The on-site Monitor on Saturday i.e., at the end of each week, prepared a Weekly Report using a template (Appendix D) that summarized the construction activity for the week, as well as the weather and contacts made during the week.

4.5.3 Wet Soil Shutdown Report

If rainfall created wet soil conditions such that a wet soil shutdown (WSS) event occurred, then the on-site Monitor prepared a WSS report using a template (Appendix D) that documented the time of the WSS, the persons involved in the WSS decision, the construction activities suspended and the construction activities that were allowed to proceed.

4.5.4 Contact Report

Verbal discussions between the CMT and others on the construction-site regarding relevant activities, whether by phone or in person, were documented by the on-site Monitor. These discussions were formally documented in a daily Contacts Report using a template (Appendix D) that detailed the date and time of the discussion, the persons in attendance, whether the discussion was by phone or a physical meeting, subject and points of discussion, decisions made and action items required.

4.5.5 Final Report

The CMT was directed to complete a final report as follows (Appendix A):

A final report generally summarizing all reports shall be provided at the end of the contract term. The report shall contain at a minimum, recommendations in respect to the following:

- *Communications with landowners and the Committee;*
- *Potential construction activity improvements; and*
- *Reporting requirements.*

5 RESULTS

5.1 Construction Monitor Services

The Construction Monitor services were delivered as agreed with the CMC. No concerns or complaints about the approach or conduct of the CMT members were brought to the attention of the CMT. Union Gas regularly invited the on-site Monitor to be present during landowner discussions. Individual landowners involved in discussions with Union Gas regularly expressed their thanks to the on-site Monitor for their presence during the discussions.

5.2 Communications

No concerns or complaints about the communications between the CMT members or between the CMT and CMC were brought to the attention of the CMT.

5.3 On-Site Observations

Each CMT member maintained a raw data file including personal notebooks and photographs or videos. Approximately 1000 photographs/videos showing various aspects of the construction work were taken by the CMT in 2007 and 2008.

5.4 On-Site Data

5.4.1 Precipitation

5.4.1.1 Monthly Rainfall

Table 5.1 illustrates the total rainfall that occurred during the July 6 to November 16, 2007 construction period compared to the normal rainfall for Strathroy, ON.

Table 5.1: Monthly Rainfall (July - November, 2007) Along The NPS 48 Strathroy Lobo Pipeline ROW Compared To Normal Rainfall From Strathroy – Mullifarry Weather Station, Environment Canada

Month	2007 Rainfall (mm)	Normal Rainfall (mm)	% of Normal
Jul	30.2	71.7	42
Aug	99.0	82.1	121
Sep	32.8	89.8	37
Oct	58.2	67.4	86

Month	2007 Rainfall (mm)	Normal Rainfall (mm)	% of Normal
Nov	60.8*	77.6	78

* Note: 23.4 mm of rainfall were recorded during the first 16 days of November when clean-up activities were in progress on the ROW.

Construction on the Union Gas NPS 48 Strathroy Lobo Pipeline Project benefited from below average rainfall during July, September, October and November, 2007. Rainfall was above average in August, 2007. Precipitation data were not available for the periods from February 28 to March 8, 2007 and from April 14 to May 7, 2007.

5.4.1.2 Rainfall Events

The individual rainfall events shown in Table 5.2 represent the approximate amounts of rainfall recorded at the five rain gauges established along the 18 km pipeline ROW. Amounts varied from the Strathroy Compressor station to the Nairn Road near the Lobo Compressor Station and provided an indication of the pattern of rainfall encountered by the contractor during the construction period from July 6 to November 16, 2007. In general, one or two significant rainfall events occurred along the ROW each month.

Table 5.2: Rainfall Events (July - November, 2007) Along The NPS 48 Strathroy Lobo Pipeline ROW

Date	Rainfall (mm)	Date	Rainfall (mm)	Date	Rainfall (mm)	Date	Rainfall (mm)	Date	Rainfall (mm)
Jul 9	< 0.2	Aug 2	2 - 5	Sep 10	14 - 18	Oct 2	5 - 6	Nov 1	< 0.2
Jul 12	< 0.2	Aug 7	20 - 24	Sep 11	8 - 9	Oct 6	1	Nov 6	4 - 5
Jul 14	2 - 3	Aug 9	6 - 11	Sep 12	3 - 6	Oct 9	< 0.2	Nov 7	10 - 18
Jul 17	1 - 2	Aug 19	6	Sep 14	3 - 4	Oct 10	< 0.2	Nov 14	< 0.2
Jul 18	6 - 26	Aug 20	9 - 12	Sep 15	1 - 2	Oct 11	< 0.2		
Jul 19	1 - 2	Aug 23	15 - 20	Sep 22	< 0.2	Oct 12	< 0.2		
		Aug 24	1 - 2	Sep 26	2 - 4	Oct 18	0.5 - 3		
		Aug 25	10 - 14	Sep 28	4 - 14	Oct 19	< 0.2		
						Oct 27	10 - 12		

5.4.1.3 Wet Soil Shutdown Events

The various rainfall events (Table 5.2) required a decision by Union Gas to continue construction activities if the impact on the landowner's soil was negligible or to implement a full or partial wet soil shutdown to prevent construction vehicles from tracking through soils causing rutting or soil compaction.

Table 5.3 lists the dates of the full or partial WSS events and indicates the time a decision was made to limit construction activities. A 6:30 am WSS usually indicated a rainfall event that occurred overnight or late the previous day. A WSS event that

occurred later in the morning or during the work day normally reflected weather and soil conditions that continued to deteriorate, thus requiring a WSS.

Table 5.3: Wet Soil Shutdown Events (July 2007 - November 2008) Along The NPS 48 Strathroy Lobo Pipeline ROW

Date	Shutdown P- Partial F-Full		Time of Shutdown	Date	Shutdown P- Partial F-Full		Time of Shutdown
Jul 19/07	P		6:30 am	Oct 23/07	P		6:30 am
Aug 7/07	P		10:00 am	Oct 24/07	P		6:30 am
Aug 8/07	P		7:00 am	Oct 27/07	P		6:30 am
Aug 9/07	P		8:30 am	Nov 1/07	P		6:30 am
Aug 20/07		F	6:30 am	Nov 7/07		F	6:30 am
Aug 21/07	P		6:30 am	May 8/08	P		7:00 am
Aug 23/07	P		8:00 am	May 12/08		F	7:00 am
Aug 24/07	P		8:00 am	May 14/08	P		12:00 pm
Aug 25/07	P		6:30 am	May 15/08		F	7:00 am
Aug 27/07	P		6:30 am	May 16/08	P		7:00 am
Sep 10/07	P		6:30 am	May 17/08	P		8:00 am
Sep 11/07	P		6:30 am	May 22/08		F	7:00 am
Sep 12/07	P		6:30 am	May 31/08		F	7:00 am
Sep 15/07	P		7:30 am	Jun 2/08	P		7:00 am
Sep 26/07	P		10:30 am	Jun 3/08		F	7:00 am
Sep 28/07	P		7:00 am	Sep 30/08		F	5:30 pm
Oct 2/07	P		6:30 am	Oct 1/08	P		7:00 am

A total of 26 partial WSS events and 8 full WSS events occurred during the construction period. This represented less than 20% of available construction days where wet soils limited construction activities.

5.4.2 Post Construction Soil Compaction

Penetrometer data for only six properties were provided to the CMT despite repeated assurances all data would be available for review. The CMT anticipated the information could be used to confirm the minimum depth of tillage i.e., to the depth of the soil probe, and that soil within the ROW on a property was disturbed during clean-up to alleviate soil compaction due to construction activities. The CMT was unable to complete this assessment.

5.5 Reports

5.5.1 Log Of Daily Reports

A total of 173 Daily Reports were created for the construction and clean-up activities on the Union Gas Limited NPS 48 Strathroy Lobo Pipeline Project. One group of reports was written for the tree cutting and brush burning activities that occurred from February 28 to March 8, 2007. A second group of reports was written for the

pipeline construction activities that occurred from July 6 to November 16, 2007. A third group of reports was written for the final clean-up activities from May 5 to October 7, 2008. A log of Daily Reports is found in Appendix E.

5.5.2 Log Of Weekly Reports

A total of 29 Weekly Reports were written for the construction and clean-up activities from February 28, 2007 to October 7, 2008. The Weekly Reports included information compiled from the Daily, Contact and Wet Soil Shutdown Reports. Almost all of the information appearing in these latter reports was included in the Weekly Reports because the CMC member representing the Ontario Energy Board (OEB) received only the Weekly Reports and the CMT wanted to ensure the OEB member was fully aware of activity associated with the project. A log of Weekly Reports is not provided in this Final Report as the information is redundant. The reports are on file with Cordner Science.

5.5.3 Log Of Wet Soil Shutdown Reports

Rainfall events resulted in a total of 33 wet soil shutdown (WSS) decisions during pipeline construction activities from July 6, 2007 to October 7, 2008. A log of WSS Reports is found in Appendix F.

5.5.4 Log Of Contact Reports

Communication with various personnel and stakeholders on the project resulted in a total of 87 Contact Reports. A log of Contact Reports is found in Appendix G.

5.5.5 Final Report

A draft final report was submitted to the CMC on February 29, 2008. The final report i.e., this document, was completed in December, 2008 at the end of the contract term for Construction Monitor services.

6 DISCUSSION AND RECOMMENDATIONS

6.1 Organization Of Operations Into A Construction Phase And A Remediation Phase

During the course of this project, the CMT was convinced by their combined experiences that a different approach to the organization of operations associated with pipeline construction is required to improve the balance between corporate pipeline and landowner interests. The following discussion and recommendations summarize the experiences and thinking of the CMT in this regard.

Discussion:

Three lines of thinking lead to the idea that a new approach to the organization of construction operations is required.

First, it was clear to the CMT during the project that the standard procedures for construction and clean-up used by Union Gas were adequate in 2007 for many of

the 46 properties (not including properties owned by Union Gas) within the ROW, especially since the sandy soil types along the ROW and the weather during the 2007 construction season were very conducive to construction activities. Under these near ideal construction conditions, it was also clear to the CMT that at least seven (15%) landowners were not satisfied with the standard procedures used by Union Gas and were willing to advocate for themselves. These landowners told members of the CMT they felt they were either mislead during the pre-construction interview process, or their concerns were not addressed to their satisfaction, or promises made were not fulfilled during the construction and clean-up phases of the work.

After observing the NPS 48 Strathroy Lobo Pipeline Project, the CMT concluded there were two divergent views of pipeline work.

1. It appeared to the CMT that, notwithstanding the very positive approach exercised by Union Gas personnel in trying to resolve landowner issues, the corporate view or perspective was focused on high quality pipeline construction. Also, it appeared to the CMT that Union Gas and its contractor installed the 48" pipeline with considerable expertise and precision. The early success of the pipe-testing procedure was proof of the quality of work and professionalism involved in all aspects of the pipeline construction.

2. It appeared to the CMT the landowner's view or perspective was focused on minimizing the impacts of construction, receiving adequate compensation for the impacts of construction, long-term land rehabilitation and returning to normal farm operation as soon as possible. These sentiments were expressed to the CMT by landowners and/or the Lands Agent at various times during the project.

3. It was apparent to the CMT that these two divergent views played a role in how issues were addressed by both parties.

Second, the following table was provided to the CMT by Union Gas to describe operations during the project:

OPERATONS					
Clearing		Pipework		Water Crossing	
Stripping		Trenching		Drain Tile Repair	
Grading		Backfilling		Access/Culv/Bridge	
Fencing		Boring		Erosion Control	
Stringing		Road Xing		Clean-up	
Bending		Rail Xing		Other	

Often the terms construction or clean-up were used by workers to describe the general nature of the work in progress on a day-to-day basis. Construction involved activities including: clearing, stripping, grading, stringing, bending, pipework, trenching, backfilling, boring, crossings (road, rail, water), access (roads, culverts, bridges) and erosion control (filter fences, etc.). Clean-up activities started after

backfilling and involved grading, fencing, drain tile repair and clean-up (rock picking, take-down of erosion control structures, subsoiling, cultivation, seeding, etc.). The CMT observed that construction activities were very focused on achieving the main objective of constructing a working pipeline to meet quality specifications within budget and by a specified date. Clean-up activities were less focused and regularly adjusted to fit in amongst the priorities of construction activities. As a result, equipment, size of work crew, timing and/or budget were not always best suited to meeting land remediation objectives. Also, while the construction documents provided to the CMT were considered 'final' and contained sections related to clean-up procedures, a clean-up document entitled Clean-up Procedure Package was less well prepared and was provided mid-way through the project. The first section was labeled 'draft' and the remaining sections were a compilation of sections from the construction documents previously received by the CMT. The CMT did not receive a finalized Clean-up Procedure Package during the project.

The following provide examples of poor decision-making and workmanship relative to meeting land remediation objectives during clean-up:

Example 1: A landowner believed they had requested a survey of their property (#027) prior to construction to ensure the original character and shape of the steep slopes on the property could be re-established after construction. The pre-construction survey was not done due to an apparent miscommunication during the pre-construction meeting and very little effort was made by the contractor to document the 'before' conditions so they could be re-established 'after' construction. Several attempts at re-shaping the property were made before the landowner was satisfied with the work. In the meantime, the landowner felt isolated and 'in the wrong' for insisting that the contractor continue re-shaping the land until the slopes met their expectations. The contractor did not appear to be sensitive to the landowner's perspective i.e., the landowner did not want their land 'improved' by the construction of gentler slopes; they wanted their land returned to the way it was before construction. The negotiating challenges faced by the Lands Agent and the extra expense incurred by the contractor could have been avoided with more focus on this landowner's perspective, needs and the overall objective of satisfactory land rehabilitation.

Example 2: Approximately 90 to 100 loads of topsoil were trucked onto property #038 in spring 2008 to address soil subsidence after construction over the 48" pipeline. This topsoil contained foreign material (a battery cable, pieces of plastic and concrete were observed by the CMT) and large lumps of subsoil-like clay. The landowners for properties #037 and #038 strongly resisted Union Gas's position that the material was acceptable for spreading on agricultural land. However, as listed in the LOU, the landowners should have had the opportunity to 'approve' the source of this topsoil before it was purchased and trucked on-site.

Union Gas and the contractor did not appear to be sensitive to the landowners' perspective i.e., the landowners wanted quality topsoil on their properties to minimize the long term impacts of construction on crop yields and field management practices. During on-site meetings, the CMT heard these landowners say they were concerned that poor or different topsoil conditions along the ROW would either negatively affect crop yields in years to come if the ROW was managed the same as the rest of the field, or they would have to use a different land management strategy just for the ROW in order to ensure a good crop yield on the ROW. In either case, the landowners were concerned they would lose time and/or money due to the presence of the pipeline. Union Gas's position that landowners would be compensated for any future need for additional fertilizer, extra time and/or yield loss put the onus on the landowners to pursue this option. These landowners wanted the problem dealt with up front in the best way possible to minimize the risk of having to deal with it at a later date. The negotiating challenges faced by Union Gas and the extra expense incurred by the contractor could have been avoided with more focus on the landowners' perspective, needs and the overall objective of satisfactory land rehabilitation.

Example 3: The push to complete the clean-up procedures in the fall of 2007 resulted in a decision to seed the steep slope on property #034 in November 2007. This was done in an effort to establish some vegetative growth to help stabilize the soil even though it was very late in the season to do so. (The work should have been done at least a month earlier.) The ATV broadcast seeder used to seed this slope traveled up and down the slope creating compacted areas under the tire tracks that subsequently eroded over the winter. In fall 2008, general labourers spent many hours adding topsoil to the eroded channels on this slope and then re-seeding it in an attempt to re-establish the grass. The extra expense incurred by the contractor could have been avoided with more focus on the overall objective of satisfactory land rehabilitation.

Example 4: A Brillion grass seeder was brought onto one property (#013) to re-seed a large area in 2008 where the fall 2007 attempt to establish a grass mixture had failed. This specialized piece of equipment should have been available for the entire clean-up procedure in 2007 and 2008 as many areas required grass seeding. It appeared to the CMT that while satisfactory equipment was used during the construction phase of the project it was not always used during the clean-up phase of the work. The extra expense incurred by the contractor to re-seed property #013 could have been avoided if there was more focus on the overall objective of satisfactory land rehabilitation.

Example 5: A grass waterway was constructed across the full easement on property #037. This waterway was shaped with a dozer during the final stages of clean-up in

fall 2008. Workmanship during the final key step in construction of this critical erosion control structure was considered sub-standard by the CMT. Fertilizer was incorporated across the grass waterway structure with a field cultivator and the grass was seeded with an ATV spreader without any attempt to roll or firm the cultivated topsoil before or after seeding. The lack of good seed-to-soil contact will probably result in very poor or no establishment of a vegetative cover. Without cover the waterway will be prone to soil erosion due to water moving across the unprotected constructed channel.

It is anticipated by the CMT that the onus will be on the landowner to follow-up with Union Gas in the future to ask for additional remediation work on this important erosion control structure. The potential extra time, effort and expense incurred by Union Gas and the contractor when rebuilding a failed structure, and the potential extra time, effort and expense incurred by the landowner when identifying the problem, contacting Union Gas and ensuring the problem is fixed appropriately could be avoided with more focus on the overall objective of satisfactory land rehabilitation.

Third, the CMT believes the circumstances outlined in the above two lines of thinking could be substantially addressed if there is a clear separation in the management of operations associated with construction and clean-up objectives.

The benefits of this approach are powerful:

1. The pipeline contractor could continue to focus on what they do best i.e., construct high quality pipelines.

2. The clean-up contractor could develop a focus that is remediation-centred, and has the capacity to address the needs of <u>each</u> property and landowner <u>every day</u> and <u>every time</u> they interact.

3. The overall cost of clean-up in time, effort, and damaged good will could be reduced if more focus was placed on successful land remediation and minimizing the risk of failure of related structures and practices.

<u>Primary Recommendation, NPS 48 Strathroy Lobo Pipeline Project:</u>

1. *The CMT recommends future pipeline construction projects should be divided into two distinct phases i.e., Construction Phase and Remediation (formerly called Clean-up) Phase, which have clearly defined and separate objectives and budgets.*

The following concepts should be integrated into the objectives and requirements of the Remediation Phase:

- A clearly defined set of objectives and budget that focus on maximizing the effectiveness and efficiency of land remediation efforts. (This would be similar to the current Construction Phase engineering requirement to "perfect" the installation of the pipeline.)

- The Remediation Phase would begin with pre-construction landowner meetings, land clearing, and drainage tile interruption, and continue as soon as backfilling of the trench begins.

- The contractor would appoint a Remediation Foreman, approved by the landowners or their representative(s), to oversee all remediation activities. The responsibilities and budgets of the Construction Foreman and the Remediation Foreman should complement each other and not overlap. This should allow each foreman to focus on achieving the best possible outcome for their phase of the work and improve the balance between meeting the interests of the pipeline company and the interests of the landowners.

- The independent Soils Inspector for construction should continue to act as the soils specialist for replacement of topsoil as this physical step in the Remediation Phase is linked to the procedures initiated during topsoil stripping in the Construction Phase.

- An experienced independent agronomist holding a current Certified Crop Advisor (CCA) designation should be contracted to oversee all agronomic aspects of remediation. The Remediation Foreman and the CCA may or may not be the same person.

- The CCA must be current with all Best Management Practices (BMPs) used in crop production including use of new equipment, conservation tillage systems, fertility practices, etc. The CCA would consult with each landowner and determine, prior to land remediation (i.e., clean-up), what equipment, materials and techniques are required to rehabilitate the unique features of each property.

- The CCA should discuss with each landowner the option to overwinter the topsoil pile and replace the topsoil on the field in the year following construction. If construction is delayed by wet weather, a decision could be made with the landowner to minimize the use of large dozers and hi-hoe equipment and/or move the work and resources into the following year.

- The CCA would also consult with each landowner on other issues such as tile drainage prior to topsoil replacement, acceptance of lower quality topsoil for subsidence areas and the stone picking requirement for each property.

- A distinct Remediation Phase, with a separate budget, would provide the Foreman/CCA with the flexibility to source tillage and seeding equipment for specialized clean-up procedures from the landowners themselves or other local suppliers. This would minimize the use of construction contractor preferred equipment and perhaps decrease the cost of clean-up by allowing landowners to perform more secondary tillage operations.

- The roles of the Lands Agent, Soils Inspector, CCA, and Construction Monitor should be revised to ensure they are complementary within the organizational structure of the project.

6.2 CONSTRUCTION MONITOR SERVICES

6.2.1 Team Approach To Construction Monitor Services

Discussion:

The use of a team of three independent agricultural consultants was unique to Union Gas and the historical provision of Construction Monitor services. In general the CMT members felt the team approach was very effective and added value to the Monitor services. The CMT focused on maintaining a professional relationship with all Union Gas Inspectors and Contractor employees.

Strengths:

- An experienced professional was on-site each day. This promoted consistent, high quality monitoring; a continuous ability to interact knowledgeably with other professionals; and an enhanced understanding of rationales behind decisions.
- The team approach provided a forum for three professionals with different areas of specialty to come together (by phone or meeting) to discuss and reach a consensus of opinion and approach regarding construction activities, site conditions and potential impacts on the land.

Challenges:

2. The consistency in documentation of observations and level of communication by three individuals was an ongoing challenge.

Recommendation:

2. *A checklist for each property to standardize the process of documenting observations for each property and to list key steps in pipeline construction and clean-up could be developed.* The checklist should be completed by the on-site Monitor. It also should provide additional documented assurance that each property was observed regularly, consistently and during key activities.

6.2.2 Construction Monitor Committee

Discussion:

The CMT reported directly to the CMC. Jane Sadler Richards, CMT, and Gerry Mallette, CMC, were the designated lead contacts. This arrangement worked very well to resolve day-to-day concerns and questions. However, the CMT did not

receive feedback for those items requiring follow-up by the CMC as a whole or by the Landowner Representative of the CMC. This resulted in uncertainty about how best to effect two-way communications between the CMT and the CMC as a whole. For example:

a) An email was sent to the CMC on September 25, 2007 with a request to review and confirm or modify the approach and methods used by the CMT to monitor the work on the pipeline. A Committee response in writing was requested. No return communication from the CMC as a whole was received. Jane Sadler Richards later followed up by telephone with the Union Gas and Landowner Representatives and received their individual verbal comments on the approach and methods.
b) The CMT was not sure whether reported items of potential concern to individual landowners were communicated to affected landowners by the CMC Landowner Representative. No return communication from the CMC was received with regard to these potential action items. For example, on May 23, 2008 (see Daily Report) the CMT reported six piles of stones were unloaded in a landowner's bush by the contractor's field crew. These stones should have been transported to the closest road access point for removal from the property. The CMT received no verification this observation was communicated by the CMC Landowner Representative to the affected landowner. Since the stone piles in the bush were not removed, the CMT assumed the landowner remained unaware of the incident.

Recommendations:

3. *The CMC should appoint a communications coordinator to ensure all requests from the CMT to the CMC are responded to not only on a day-to-day basis but also when the CMC needs to meet to prepare a joint response.* The role of communications coordinator could rotate on a one or two month basis amongst CMC members.
4. *If the CMT role is not modified to allow them to communicate directly with landowners along the pipeline, then a clear mandate must be given to the CMC Landowner Representative or their delegate to communicate issues regarding individual lands to each affected landowner within a specified time frame.*

6.3 COMMUNICATIONS

Discussion:

The Communication Protocol (Appendix C) used between CMT members worked well during the project.

Communications between the CMT and Union Gas and its contractors were very positive. Management and workers were highly responsive to comments and questions made by the CMT. For example, the CMT and Soils Inspector regularly discussed soil-related procedures. The CMT gained a better understanding of why certain construction and clean-up practices were used and the Soils Inspector

gained a better understanding of why the CMT was questioning or concerned about impacts on the land. These discussions lead to a mutual respect for each others point of view. Clarification provided by the Soils Inspector and Lands Agent was crucial to the work performed by the CMT. Without it the CMT would have made several comments in the daily report records that were not necessary.

In general, the CMT Contact Reports were used to document discussions between the on-site Monitor and other workers or landowners involved in the pipeline project. These reports were a very important component of the Communications Protocol because they were used by the CMC and the CMT to stay abreast of ongoing discussions and the resolution of issues. The CMT Contact Reports were sometimes used to document specific issues and discussions resulting from construction and clean-up procedures. For example, a series of Contact Reports (see 4 and 5Oct07) documented several site meetings held at property #027 to address the re-shaping of the steep slopes and stream banks on this land. The on-site Monitor was invited by the landowner to attend these meetings due to the sensitivity of this issue. Copies of the Contact Reports were provided to the Lands Agent and the landowner for their reference.

Three different Lands Agents were used during this project: the first in the pre-construction meetings; the second during construction and clean-up in 2007; and the third during clean-up in 2008. This situation sometimes lead to a significant disconnect in communications between the Lands Agent and a landowner. For example, a disagreement regarding the scope of clean-up activities at properties #052 and #054 developed between the contractor and the landowners. Resolution cost Union Gas and the landowners extra time and money. In the opinion of the CMT, the disagreement had a negative impact on the land because field work was delayed until late fall and by then working conditions were less than ideal. The landowners understood they had the option to stop work until spring but one of them indicated to the CMT that he just wanted the work done so the issue would go away and he could get back to normal operations.

During construction and clean-up in 2007, the Lands Agent did not have a laptop computer or email access, which hindered efficient communications with the CMT especially related to updates to the line list (see section 6.4 On-site Observations - General).

Recommendations:

5. *The Communications Protocol should be updated and used by the CMT during future pipeline projects.*
6. *Two-way discussions between the on-site Monitor and pipeline staff should continue to provide the CMT with the best opportunity to understand construction and clean-up activities in progress.*
7. *The Contact Reporting system should be maintained for future projects and the CMT should have the discretion to forward copies of a Contact Report to all third parties mentioned or involved in the discussion, issue or site meeting – including*

the affected landowner(s). The Contact Report could be enhanced to include landowner contacts initiated by the CMT to advise them of potential items they may want to follow-up on with regard to impacts of the construction and clean-up activities on their land. This would allow the CMT to identify potential action items, shift the responsibility for follow-up to the parties involved and eliminate the need for the CMC Landowner Representative to contact affected landowners.

8. *Surveys involving all parties in the pipeline project could be used to measure changes in levels of communication, knowledge and satisfaction regarding respective roles, responsibilities and procedures during the project.*
9. *The same Lands Agent should represent Union Gas during both the pre-construction meetings with landowners and the on-site construction and remediation work.* This should enhance relationships and communications between parties.
10. *The on-site Lands Agent should have a computer and email access to improve general communications and to assist the CMT with effective communication between Union Gas and landowners.*

6.4 On-Site Observations – General

Observations by the CMT were based on activities along the ROW, and interaction with Union Gas, the construction contractor and landowners who were on-site to view or approve the work. The CMT regularly observed Union Gas and its contractors completing the pipeline project on properties without obvious landowner intervention. However, since the role description for the CMT did not allow the CMT to initiate contact with landowners, there was no opportunity to determine the level of landowner satisfaction with the performance of the company relative to the landowners' expectations. During the course of the pipeline project, the CMT regularly observed practices that met or exceeded the CMT's performance expectations with regard to construction impacts, clean-up and rehabilitation of the land. Pipeline workers relied on project documents for guidance, and their training and experience to perform their duties. There were exceptions, however, where Union Gas and/or its contractors did not meet the CMT's or a landowner's expectations.

6.4.1 Documents

Discussion:

Four documents were important to meeting agreements between Union Gas and landowners:

1. Letter of Understanding (LOU)
2. Union Gas [landowner] Interview Sheet
3. Line list
4. Clean-up Procedure (draft)

Also, alternative or additional verbal arrangements by Union Gas and landowners were made and revised on a daily basis as the work progressed.

1. Letter of Understanding

A review of the Letter of Understanding (LOU) suggested:

- The LOU document is a product of years of pipeline construction and agricultural land rehabilitation.
- The LOU document provides a common framework for negotiation of compensation and services between the company and individual landowners.
- The information in the LOU is complex and could overwhelm some landowners, especially those with no experience in pipeline construction.
- The LOU includes negotiation to establish financial compensation for the Land Rights and Damages outlined in Appendix "A": Settlement of the LOU. During this project, the CMT heard this negotiation occurred during the pre-construction meeting between the Lands Agent and the landowner. The CMT is concerned that, at least for some landowners, the focus of the pre-construction meetings may have centred on financial compensation without sufficient focus on construction impacts and remediation options.
- Specific concerns regarding items in the LOU are listed below.

Table 6.1: CMT List Of Concerns Regarding The LOU

Section 1: Pipeline Construction Procedures in Letter of Understanding (LOU)	CMT Concern
Section 1 of the LOU regularly uses the phrase 'at the request of the landowner' …	No educational program or materials were provided to the CMT to indicate landowners were sufficiently well informed about why they might request or not request a specified procedure.
a) …The Company will strip topsoil from over the pipeline trench and adjacent subsoil storage area. …	These words were inconsistent with the Line List which stated 'ditch and spoil side'. Inconsistency in terminology can cause confusion, especially for those who do not work in the pipeline industry.
a) …The Company will strip topsoil across the entire width of the easement at the request of the landowner…	No educational program or materials were provided to the CMT to indicate landowners were sufficiently well informed about why they might choose or not choose a full strip of topsoil on their property. The CMT had particular concerns about the advisability of partial stripping and the potential impact of this procedure on the land (see section 6.4.7).
(e) Whenever possible, all vehicles and equipment will travel on the trench line.	No process to direct vehicle traffic over the trench line was evident on-site.
(h) At the request of the landowner topsoil will be over-wintered and replaced the following year.	No educational program or materials were provided to the CMT to indicate landowners were sufficiently well informed about why they might choose or not choose to over-winter their topsoil.
(l) At the request of the landowner, the Company agrees to retain an independent consultant to carry out tests along the pipeline to monitor soils and crop productivity. As part of this testing, a soil specialist will conduct comparative compaction testing of the subsoils and NPK	The CMT was on-site during every day of construction and remediation. They were not aware of the presence of any independent consultant conducting tests along the pipeline. Best practice suggests the consultant would be on-site before, during and after construction to obtain test data (following a BACI design i.e., before vs after, control vs impact). The CMT concluded none of the 46 landowners requested an independent consultant before or during the

Section 1: Pipeline Construction Procedures in Letter of Understanding (LOU)	CMT Concern
(nitrogen, phosphorus, potassium) testing and testing of pH levels on and off the easement after construction. Global positioning System (GPS) equipment may be used to identify all test locations. The Company further agrees to implement all commercially reasonable measures, where recommended by the soil specialist to remediate the soil.	project. This suggested the landowners were not sufficiently well informed about why and when they might choose or not choose to have a consultant test their lands. Item (l) takes a 'wait and see' approach to remediation and puts the onus on the landowner to pursue Union Gas to exercise this option, especially if the landowner waits until after construction is completed. It is not clear whether the 'independent consultant' and the 'soil specialist' are the same or different persons. If testing is initiated after construction is completed, this type of issue may take months or years to resolve since field data are collected on a seasonal basis. A proactive approach to agricultural land remediation suggests measures required to remediate soil fertility for optimum crop production e.g., application of macro-nutrients (N-P-K) to boost soil fertility in the year following construction, should be taken to offset the risk that remediation procedures were not as effective as expected. Finally, this item creates potential conflicts with item (bb) listed below.
(m) After topsoil replacement, the topsoil will be tilled (see section k) and stones picked. If requested by the landowner, the Company will cultivate the topsoil or make compensating arrangements with the landowner to perform such work. The request by the landowner must be made during the pre-construction interview in order to be coordinated with the construction process. After cultivation the Company will pick stones again. If requested by the landowner, the Company will return in the year following construction and chisel plough or cultivate to the depth of the topsoil. When necessary to accommodate planting schedules, the landowners should perform cultivating and/or chisel ploughing themselves at the Company's expense, provided the need for this work has been agreed upon in advance (see Schedule of Rates attached).	No educational program or materials were provided to the CMT to indicate landowners were sufficiently well informed about why they might request or not request this procedure. Also, the request must be made during the pre-construction interview [CMT assumed this meant the pre-construction meeting with the Lands Agent] before the landowner has had sufficient time to consider all the options available to them.
(o) subsection 5. Other areas recommended by the drainage consultant. ... In areas where topsoil has been stripped, and at the request of the landowner, the company will complete post-construction tile installation and repairs prior to topsoil replacement.	No educational program or materials were provided to the CMT to indicate landowners were sufficiently well informed about why they might request or not request this procedure.
(s) The landowner will execute a	The CMT did not have the mandate or the information to

Section 1: Pipeline Construction Procedures in Letter of Understanding (LOU)	CMT Concern
Clean-up Acknowledgement when he/she is satisfied with the clean-up operations described in Paragraph 1. (h) through (q). ...	review if or how signing the Clean-up Acknowledgement affected landowner requests for construction and remediation (i.e., clean-up) procedures, or the links, if any, with financial compensation.
(x) The Company's Landowner Complaint Tracking system shall be available to landowners for the proposed construction.	The CMT did not ask and Union Gas did not offer to provide the CMT with access to this information. The CMT was not aware of any complaints beyond those documented in the reports in the appendices of the final report.
(y) The Company shall pay the costs of independent consultants satisfactory to both the landowner and the Company to resolve site specific disputes involving affected lands on a binding basis concerning the following: ... [Topics related to: topsoil, compensation for specialty crops, and resolution of future crop claims.]	No educational program or materials were provided to the CMT to indicate landowners were sufficiently well informed about why they might request or not request this procedure.
(bb) Any imported topsoil shall be natural, cultivated, medium loam, neither clay or sandy in nature, capable of heavy agricultural growths and be from a source approved by the landowner.	No educational program or materials were provided to the CMT to indicate landowners were sufficiently well informed about why they might request or not request this procedure. The CMT participated in one situation (see section 6.1, example 2. properties #037 and 038) where this clause of the LOU was referenced. It was clear to the CMT that the Union Gas representatives and their contractor, and the landowners were not 'sufficiently well informed' about clause (bb). The CMT concluded that, although topsoil was trucked onto the pipeline on a regular basis during the project, no landowner had challenged the quality of the topsoil nor exercised their right to approve the source.

2. Union Gas [landowner] Interview Sheet

The Union Gas [landowner] Interview Sheet appeared to record changes from the initial interview held during the project Environmental Assessment (E.A.) and additional information regarding individual properties. The wording in the Union Gas [landowner] Interview Sheet introduced some inconsistencies in terminology e.g., the term 'topsoil stripping' indicated in Part B: Lands Agent Pre-Construction Check List was different than in either the LOU or the Line List i.e., the options listed were 'ditch and working side' or 'full easement', respectfully, which caused confusion during the project.

Also, the lack of detail in the Union Gas [landowner] Interview Sheet may have created confusion for landowners about Union Gas's commitments. For example the landowner of property #027 felt Union Gas had agreed to rehabilitate the steep slopes on their property. The landowner believed a survey of the slopes was 'promised' during a pre-construction meeting but this survey did not occur and the documents provided to the Lands Agent during construction did not reference a survey of the slopes on the property.

3. Line List

A list of property-specific Union Gas/landowner understandings and/or action items related to construction activities (called the Line List) was provided to the CMT. It was understood that the Line List was generated by the Lands Agent from the pre-construction meeting and subsequent follow-up. However, the CMT observed on several occasions that the Line List was incomplete or inaccurate. Also, it was apparent that, as construction progressed, changes to the Line List were verbally agreed to between the Lands Agent and a landowner but not always updated on the Line List. The CMT discussed this situation with Union Gas and improvements to the process were made immediately. However, the CMT continued to find it challenging to remain up-to-date with individual landowner requirements or requests and often relied on the Lands Agent to verbally communicate changes or landowner concerns.

4. Clean-up Procedures (draft 07.08.17)

The CMT was provided with a draft clean-up procedure for reference during on-site monitoring (see also section 6.1). It appeared to the CMT that the focus of clean-up procedures was to move as quickly as possible to complete the entire project in the construction year to maximize use of available equipment and avoid the expense of significant clean-up efforts in the year following construction. As clean-up procedures carried on until November 16, 2007 this increased the risk of soil compaction, especially since clean-up on properties more prone to compaction were left until the end of the 2007 program.

The CMT also observed dozers working on the storage area as soil was moved from and to the ROW. Rehabilitation of storage areas consisted of cultivation of soil surface after soil piles were moved per the draft Clean-up procedures. The potential for compaction due to dozer activity when stripped topsoil was piled and again when excess subsoil was removed and topsoil was replaced on the ROW, was not known.

Recommendations:

11. *Documents involving landowner interests should be reviewed to eliminate inconsistencies and streamlined for ease of transfer of information from negotiated terms to a working list of commitments that can be updated as work progresses.*
12. *A procedure for timely update and distribution of the Line List (or applicable sections) to those involved including the affected landowner(s) would improve communications.*
13. *It is essential to maintain flexibility in the field to make alternative or additional verbal commitments between Union Gas and the landowner to accommodate changing field conditions or unforeseen circumstances. Changes in commitments, however, must be documented and circulated to affected parties within 24 hrs of discussion.*
14. *The clean-up procedure document should clearly identify what practices will occur on each type of land (i.e., field crop, forage crop, pasture, natural lands, woodlots) and on each section of the ROW (i.e., working area, trench area, storage area).*
15. *Exceptions to the standard procedure should be identified in each document.*
16. *An education program aimed at ensuring landowners have enough information to make informed decisions on construction and remediation options for their land must be provided.*
    For example, the education program could include a factsheet explaining the procedures used in pipeline construction. This factsheet would outline the steps the Contractor will take to prepare the area for construction, the steps required for the installation of the pipeline and the clean-up procedures involved. The factsheet could be used in the pre-construction meeting to review the construction activities in relation to an individual landowner's property. This would allow each landowner to visualize the construction on their property and help them indicate any special needs related to their properties. Another factsheet could be developed to provide Union Gas and landowners with relevant information on Best Management Practices (BMPs) related to land management options during and after pipeline construction.
17. *Landowners could be provided with the option to hire a consulting agrologist e.g., CCA, to attend an education program on their behalf so the consultant can make recommendations to the landowner on what construction and remediation options are best suited for their land.*

6.4.2 Pre-Construction Meetings Between Lands Agent And Landowners

Discussion:

A Lands Agent for Union Gas met with landowners several months prior to construction to discuss activities related to the pipeline project and to identify and address landowner concerns. The CMT heard comments from landowners during the course of the project that what the landowner envisioned during the pre-construction meetings did not always match the reality they faced during construction and clean-up.

Recommendations:

18. *A minimum of two one-on-one landowner meetings should be held during the pre-construction period.* For example, the first meeting could be used to view educational materials, including visuals such as a video of construction and remediation (i.e., clean-up) practices, and to initiate discussions on how the project could affect the landowner's property and operations. A second meeting could be used to review construction and remediation practices again, to answer questions/concerns arising from the first meeting, and to discuss/confirm specific requirements for construction and remediation on each property.
19. *At each pre-construction meeting, the topics, arrangements and action items arising from the meeting must be documented in writing and everyone attending the meeting must initial and receive a copy of the record of the meeting before they leave.*
20. *The timing and methods used to negotiate financial compensation should be examined to ensure financial concerns do not distract the parties from construction and remediation concerns.*

6.4.3 Participation Of On-Site Construction Monitor In Weekly Landowner/Union Gas Meetings

Discussion:

Occasionally the on-site Monitor was invited by Union Gas or the Landowner Representative to attend the weekly landowner/Union Gas meeting to discuss the progress of construction activity along the ROW. These meetings were very informative and assisted the CMT in understanding the concerns and current issues of each party. The CMT observed that while items of concern were discussed and a course of action agreed to at each meeting there was no review of the status of a running list of previous concerns.

Recommendations:

21. *The on-site Monitor should attend the weekly Union Gas/landowner meetings on a regular basis.* This would improve the CMT's understanding of issues and their communication with the parties.
22. *A list of action items and responsibilities for follow-up could be prepared and updated at each weekly meeting to track the status and resolution of concerns.* Action notes could be circulated by email to those involved including off-duty members of the CMT.

6.4.4 Management of Unique Landowner Needs and Sensitive Lands

Discussion:

The CMT observed the occasional landowner or property that required heightened attention to communications and/or follow-up to ensure landowner requests/expectations were met. The CMT also observed that some landowner requests did not meet agricultural Best Management Practices (BMPs).

For example, one landowner with a very unique pasture and creek on the ROW (#027) requested the steep slopes of the pasture be recreated after the pipeline

trench was backfilled. The communication of this request was not passed on effectively to the contractor and subsequently the landowner required several slopes to be re-graded with a bulldozer to return them to their original grade and shape. Better identification of the special needs of this property and landowner, along with timely communication amongst all parties, would have improved the relationship between Union Gas and the landowner, and saved the expense of moving equipment back to the site to work on the slopes.

This property also included a low slope, cattle crossing through the creek that was difficult to return to its original condition with the construction materials used by the contractor. However, the cattle crossing through the creek was not considered an agricultural BMP by the CMT. Consultation with the landowner and tenant farmer during the pre-construction meeting may have identified an alternative system for providing access and/or water for the cattle and may have eliminated the need to rebuild the cattle crossing.

Recommendations:

23. Unique landowner needs and sensitive lands should be identified as soon as possible in the project to ensure adequate and timely follow-up.

24. Plans for rehabilitating each property should include consideration of BMPs.

6.4.5 Risk Management On Properties With Soybean Cyst Nematode

Discussion:

The Union Gas NPS 48 Strathroy Lobo pipeline ROW crossed several properties with detected levels of soil-borne soybean cyst nematodes. This pest can cause a significant negative impact on crop yield when present in soil where soybeans are grown. It was incumbent on Union Gas to minimize the risk of transfer of this pest from one property or field to the next due to construction activity.

During the course of construction activities, all members of the CMT observed and discussed amongst themselves and with Union Gas i.e., the Soils Inspector, the efforts to minimize the risk of transfer of soybean cyst nematodes from one location to another. It was agreed the risk of transfer could not be eliminated due to

uncontrollable factors such as: human (ATV and/or farm equipment) and animal movement across the ROW; and wind-blown topsoil. Risk was minimized, however, by: stripping all of the infected topsoil from the ROW and separating it from the ROW using a filter fence to control the movement of soil by water erosion onto the ROW; controlling the movement of construction equipment on and off the affected portions of the ROW; controlling the transfer of soil on worker boots; removing mud/soil and then rinsing construction equipment with a chlorine solution; and rinsing affected roadways with a chlorine solution.

Recommendations:

25. *Significant improvement in the effectiveness and efficiency of the equipment wash procedures could be achieved with the establishment of an industrial-sized, dedicated wash station.*

6.4.6 Partial Strip Versus Full Strip Of Topsoil

Discussion:

During the course of construction activities, all members of the CMT observed and discussed amongst themselves and with Union Gas, i.e., the Soils Inspector, the impacts of partial versus full topsoil stripping on the land.

In the opinion of the CMT there are several advantages to a full topsoil stripping of the ROW when considering potential impacts on the land:

- Prevents deep rutting of the topsoil in the working (also called travel) area of the ROW when moist or wet soil conditions are encountered;
- Prevents mixing of topsoil with subsoil due to construction traffic;
- Eliminates compaction of the topsoil by allowing construction traffic to occur on the subsoil; and
- Improves potential crop growth conditions in the following years because the subsoil is rehabilitated first in a separate step by deep ripping or subsoiling and then the topsoil is replaced and rehabilitated in a separate step by subsoiling and cultivating. This combination of steps should provide the best opportunity to

effectively rehabilitate topsoil and subsoil after construction activities. It is recognized, however, that soil and weather conditions have a significant impact on the potential success of these rehabilitation efforts.

Recommendations:

26. Landowners should be provided with agronomic information and/or consultation before making a decision to allow a partial strip rather than a full strip of topsoil on their lands during construction.

27. A factsheet could be developed to provide appropriate agronomic information on each choice.

6.4.7 Stone Picking

Discussion:

Specifications for the Union Gas NPS 48 Strathroy Lobo Pipeline Project required that the clean-up procedure remove all stones greater than two inches in diameter from the surface of the subsoil and the topsoil. This specification was too restrictive and exceeded normal stone picking practices for this agricultural area.

Recommendations:

28. The specifications and procedures for stone picking should be revised to allow flexibility to adjust the requirements relative to natural soil conditions.

6.4.8 Seeding For Vegetative Cover

Discussion:

Several pasture and grass areas along the ROW required seeding to provide vegetative cover to control soil erosion. Several of these areas had steep slopes where establishment of vegetative cover was critical prior to winter to prevent soil erosion during runoff in winter and the spring of 2008. These properties could have been given a higher priority for clean-up and seeding to allow some growth of vegetation before the cold weather in late fall.

Recommendations:

29. Timely seeding on a property-by-property basis should be required rather than seeding all or a group of properties after construction is completed.

6.4.9 Depth Of Topsoil

Discussion:

Topsoil is extremely important to agricultural productivity. Therefore the post-construction uniformity of depth of topsoil on the ROW could affect the post-construction uniformity of crop growth. The CMT observed that topsoil was spread back over exposed subsoil on the ROW by competent operators. The general objective for topsoil depth was approximately 8" (20 cm) after spreading. It appeared that actual depth of topsoil was not systematically checked for each property and there were no data to support the widespread achievement of this objective. Also, it was understood by the CMT there were no plans to check the depth of topsoil in 2008 after the topsoil settled over winter. Therefore there was no way to confirm the consistency of post-construction depth of topsoil for each property.

Recommendations:

30. Consistency of depth of topsoil across each property should be confirmed.

6.4.10 Depth Of Pipeline Soil Cover

Discussion:

Adequate soil cover over existing pipelines is extremely important to maintaining the safety of agricultural workers using farm machinery over pipelines and to maintaining the integrity of the pipeline system. Soil erosion by wind, water and tillage could decrease the anticipated depth of soil cover over a pipeline and increase the risk of farm machinery e.g., tillage equipment, hitting the pipeline. The CMT learned that both Union Gas and landowners are very interested in knowing when the depth of soil cover over a pipeline is approaching or has reached a depth that could increase the risk of accidents for agricultural workers and the pipeline.

Recommendations:

31. *Notification procedures should be reviewed to require Union Gas and landowners to contact each other within a specified timeframe when one party has new information about depth of soil cover over a pipeline.* This information could provide assurances to both Union Gas and landowners that adequate soil cover remains in place or, more importantly, alert both Union Gas and landowners that adequate cover is not in place and that steps must be taken by the landowner to minimize risks until adequate soil cover can be re-established by Union Gas.

6.4.11 Timing Of Subsoiling And Tile Drainage Installation

Discussion:

The CMT observed an overlap of 'best practice' objectives between rehabilitation of compacted subsoil/topsoil and installation of tile drainage on the ROW. Deep ripping and subsoiling of subsoil was required to relieve soil compaction due to construction activities before topsoil was replaced on the ROW. However, best practice for the installation of tile drainage lines suggests that tile lines should be laid on a solid bed of subsoil for best long term drainage results. Tiling soon after rehabilitation of subsoil/topsoil meant the tile lines could be laid in disturbed subsoil that could settle unevenly over time and cause the tile lines to 'undulate' rather than lie flat in the subsoil. This situation, if it occurred, could compromise the effectiveness of the tile lines under certain field conditions e.g., when free flow of drained water is impeded by undulations in the tile lines.

Recommendations:

32. *Landowners should be provided with agronomic information and/or consultation before making a decision to allow tile drainage installation soon after subsoil/topsoil rehabilitation.*
33. *A factsheet could be developed to provide appropriate agronomic information on available choices.*

6.4.12 Timing Of Clean-Up

Discussion:

At the end of the construction/growing season the weather can become unsettled very quickly. This effectively decreases the number of days when soil moisture conditions are good to ideal for completing clean-up tasks e.g., subsoiling, cultivating stone picking, seeding of vegetative cover. However, when given the choice of working in moist to wet conditions in fall versus moist to wet conditions in spring, landowners will generally consent to continued work in the fall. There are various agronomic reasons for this decision. In the fall the subsoil may be dryer than in the spring and therefore there is less potential for soil compaction due to fall work. In the fall there are generally fewer tasks competing for resources and more time available to do the work than in the spring. In the fall, the possibility exists that soil compaction, caused by working in moist to wet soil conditions, could be alleviated by frost action during the winter months. The CMT observed during the project that pressure to complete clean-up tasks as soon as possible was not maintained by the contractor toward the end of the project. The CMT noted that timely pipe-laying was

particularly important to the contractor while timely clean-up was particularly important to the landowner.

Recommendations:

34. Consideration should be given to recognizing and accommodating differences in contractor/landowner priorities in any timelines included in contract and/or landowner agreements.

35. The contractor should keep equipment and work crews at full strength to the end of the project so that clean-up proceeds as quickly as possible.

6.5 On-Site Observations – Single Property

The CMT created an extensive report (Appendices E, F, G) and photographic record of activities on each property along the ROW. Summaries of construction and clean-up activities for three example properties (#016, #026 and #051) were created from these reports.

6.5.1 Property #016

Construction activity began on July 4, 2007 at property #016 when the access ramp was installed off Walker Line. On July 7th a grader established the topsoil depth and topsoil was stripped on July 9th. A crew moved on-site the next day and began to install the dewatering equipment to lower the water table of this property. Compaction of the subsoil was observed from the dewatering process as excess water from drilling well points was laying on the soil surface.

On July 24th pipe stringing occurred and a dozer was used to level out the ruts made by the pipe trucks in the soft subsoil. From July 26th to 30th the pipe bending, end preparation, welding and coating operations took place and on August 1st the property was used as a staging area for the bore hole under the CNR railway line.

On August 3rd a problem occurred with the CNR bore hole and the hole was enlarged causing excess water in the large trench area. This water was not removed by the dewatering points and subsequently was pumped onto the soil surface between the spoil pile and the topsoil storage area on the north side of the ROW. The water began to flow eastward between the two piles of soil and a berm was constructed to stop the water from flowing the length of the property.

On August 8th the open-cut trench across McEvoy Road was constructed allowing the 48" pipe to be installed along the entire length of property #016. The tie-in process continued for several days and on August 15th backfilling of the trench and removal of the dewatering well points began from the CNR crossing to McEvoy Road. On August 20th a pump was used to help dry out the low lying areas of the property. On August 22nd the subsoil was graded and on August 28th and 29th the topsoil was pulled across the ROW. On September 7th, 8th and 13th the ROW was subsoiled to mitigate compaction from construction activities, and cultivation and clean-up of the ROW were performed on September 22nd.

On May 13th and 14th, 2008, additional topsoil was trucked to property #016 to mitigate soil subsidence over the trench line.

4 Aug 07

14 Aug 07

7 Aug 07

28 Sep 07

Timeline Summary (#016):
Topsoil stripping to trench backfilling = 43 days (July 4th to August 16th)
Clean-up = 35 days (August 20th to September 22nd, 2007 and May 13th to 14th, 2008)

Landowner Interaction (#016):
This property was used as a staging area for the CNR bore hole and considerable construction traffic occurred under wet conditions as dewatering efforts required the transfer of excess water out of the deep trench. Despite problems that delayed construction of the 48" pipe on this property and the need for additional topsoil in the spring of 2008, the CMT was not aware of any landowner concerns and no site meetings to discuss issues were requested.

6.5.2 Property #026

Construction activity on property #026 began on July 11, 2007 when stumps along the Henderson Drain were removed, erosion control measures were added and the topsoil was stripped on the ROW. From July 27th to August 3rd the pipe stringing,

end preparation, welding and coating operations were completed and the dewatering well points were installed. The dewatering pumps were started on August 4th and pipe trenching took place from August 10th to 13th. The pipe was laid in the trench on August 17th and backfilling occurred on August 18th. On August 27th preparations were made for the open cut crossing of the Henderson Drain and the crossing was completed on August 28th. The tie-ins to the 48" pipe on both sides of the drain were made on August 29th and on August 30th the dewatering well points were removed.

On September 1st the area of the pipeline directly under the high voltage hydro lines was protected with concrete patio stones and all backfilling was completed on this property. From September 4th to 18th the subsoil was graded, topsoil was pulled and deep tillage completed. On September 25th the topsoil was deep tilled and grading occurred on October 4th. The flume in the Henderson drain was removed on October 9th and the fence on the property was repaired on October 30th. The following year on May 24, 2008, the bridge crossing the Henderson Drain was replaced.

Timeline Summary (#026):
Topsoil stripping to trench backfilling = 38 days (July 11th to August 18th)
Open-cut crossing of Henderson Drain with tie-ins = 3 days (August 28th to 30th)
Clean-up (including fence installation) = 56 days (September 4th to October 30th)

Landowner Interaction (#026):
All requests for bridge re-building and storage of extraneous material from the open-cut drain crossing were handled by the Lands Agent. The CMT was not aware of any landowner concerns and no site meetings to discuss issues were requested.

6.5.3 Property #051

Construction activity on property #051 began on April 30, 2007 as the property's fence line was used to access the ROW with a rubber tired backhoe for location of field tiles on adjoining land. Topsoil stripping began on July 20th followed by grading of the subsoil on July 27th.

On August 1st pipeline stringing took place. The pipe bending, end preparation, welding and coating occurred from August 10th to 14th. Trenching began on August 27th and the pipe was lowered into the trench on September 8th. From September 13th to 19th the trench was backfilled, leveled, extraneous material was removed from the site, the municipal drain was reconnected and other existing small tiles were repaired.

From October 5th to 17th the stones on the surface of the exposed subsoil were picked. On October 22nd the tile drainage contractor presented the final drawings for tile drain repairs and improvements to alleviate water from exposed artesian springs. On this date significant discussions also occurred about the deep tillage procedure to alleviate the effects of compaction caused by construction and the potential impacts on the placement and proper operation of drainage tile. At the request of the landowner, the topsoil was left in its storage position on the south side of the ROW

until spring 2008. On November 10, 2007 a fence was installed between property #051 and #052.

In 2008 the clean-up procedures continued on property #051. From May 26th to 30th the new tile drains were installed along the 48" pipeline, subsoil was leveled and topsoil was pulled across the ROW. The field was deep-ripped or subsoiled with a para-till machine both on the subsoil and again after the topsoil was pulled. A field cultivator provided the final leveling of the ROW and a final pick of stones was completed before the tenant farmer planted the field to white beans.

10 Aug 07

30 Aug 07

12 Sep 07

12 Sep 07

21 Sep 07

16 Oct 07

16 Oct 07

30 Oct 07

Timeline Summary (#051):
Topsoil stripping to trench backfilling = 60 days (July 20th to September 19th)
Clean-up = 237 days (October 5, 2007 to May 30, 2008)

Landowner Interaction (#051):
Several site meetings were held with the landowner to discuss construction and clean-up issues. The landowner contacted the CMT on September 7, 2007 to discuss concerns about free flowing water from springs in the trench on property #051. On September 12, 2007 the area used for storage of topsoil on the property was identified as a problem and this was communicated to the CMT through the CMC Landowner Representative.

On October 22 a site meeting was held to discuss drainage plans for fall 2007 and the landowner communicated her request to leave topsoil over the winter and replace it in spring 2008 when new tiles bordering the 48" pipeline were installed. This request was previously made during the pre-construction interview.
This landowner was also concerned about follow-up contact with the Union Gas Lands Agent attending the pre-construction meeting and commented that a reply about compensation for construction activities was not received.

6.5.4 Timeline Summary For Example Properties On The NPS 48 Strathroy Lobo Pipeline Project

The following summarizes the timelines, unique features and landowner concerns for the above example properties:

Property #	Construction Activities (days elapsed)	Clean-up Activities (days elapsed)	Unique Features and Landowner Concerns Documented by the CMT
016	43	33	CNR crossing and McEvoy/Walker Line intersection CMT was not aware of any landowner concerns
026	41	56	Henderson Drain crossing and Hydro tower line CMT was not aware of any landowner concerns
051	60	237	Artesian springs in trench area CMT was aware of significant landowner concerns, which required several site meetings. It was decided to replace topsoil on the ROW in spring 2008.

A review of the Daily and Contact reports for individual properties provided a summary of the timelines for construction and clean-up activities associated with the NPS 48 Strathroy Lobo Pipeline Project. The example properties show that construction (topsoil stripping to backfilling) varied from 41 to 60 days while the time required for all clean-up activities on a property ranged from 33 days to 237 days. Sensitive features played a role in the length of time required to complete construction and clean-up; however the unique needs of the landowner also determined the duration of the project on an individual property.

Recommendations:

36. *An analysis of the timelines required for both construction and clean-up activities may help in the allocation of time and resources between the two phases on a pipeline project i.e., construction and remediation.*

6.6 On-Site Data

6.6.1 Rainfall And Soil Moisture Content

Discussion:

The method of collection of rainfall data appeared to be adequate for the purposes of the project. Decisions on wet soil shutdown (WSS) were based on amount of rainfall and a visual assessment of soil conditions by the Soils Inspector. On-site observations made by the CMT generally supported the WSS decisions made by the Soils Inspector. It should be noted, however, that decisions regarding when and when not to implement a WSS provide an opportunity for contentious debate. There are methods available to assess moisture conditions in the field. Having this information available could be helpful in resolving issues associated with decisions on WSS.

Recommendations:

37. *Consideration should be given to establishing a method for scientifically documenting specific soil conditions on those days when it is difficult to visually assess the need for a wet soil shutdown.*

6.6.2 Soil Compaction

Discussion:

The penetrometer data were obtained from within the ROW and immediately after deep tillage when the soil was at its 'fluffiest'. The penetrometer data would be more useful if it were collected using a BACI design i.e., before vs after and control vs impact, notwithstanding the instrument's limitations under compacted or 'settled' soil conditions.

Recommendations:

38. *A review of the objectives, and the scientific and statistical methods available to assess the agronomic effectiveness of remediation procedures should be conducted.*

6.7 Reporting Structure

Discussion:

One to two hours per day were spent preparing various reports related to the on-site Monitor service. The CMT streamlined this process as much as possible during the course of the construction work.

Recommendations:

39. *Maximum use of innovations in electronic technology should improve the efficiency of daily report preparation in the future.*

7 CONCLUSION

The CMT recognized Union Gas took positive steps to address the impacts of construction, remediate affected lands and improve landowner relations during the NPS 48 Strathroy Lobo Pipeline Project. The CMT recognized the difficulties experienced by those landowners who contacted the CMT when construction of the pipeline did not occur as they anticipated. The CMT concluded more work is required to balance the need to construct new pipeline with the need to mitigate the impacts of construction on the land through which the pipeline is built. However, the CMT observed good will amongst individuals on a daily basis, which suggested continued progress is possible. The recommendations in this report provide direction for positive change in the future. These recommendations may be particularly important when construction conditions are not as ideal as those experienced during the NPS 48 Strathroy Lobo Pipeline Project.

Appendix A: Statement Of Work

The following information was provided by the Construction Monitor Committee (CMC) during the consultant selection process:

CONSTRUCTION MONITOR ROLE DESCRIPTION

Accountability
The Construction Monitor (Monitor) is accountable to and reports directly to the Construction Monitor Committee (Committee).

Scope
The Monitor shall observe and report on pipeline construction activities for the 2007 Union Gas Limited (Union) 48" pipeline from Strathroy to Lobo. Observation shall be limited to impacts of construction on the land, including right-of-way preparation, trenching, backfill and clean-up operations as well as Wet Soil Shutdown (WSS) events. The Monitor shall review construction activities for compliance with the Ontario Energy Board (OEB) Conditions of Approval, Letters of Understanding (LOU) agreed to between landowners and Union Gas and all specific construction commitments included in Union's construction contract.

The WSS practice is defined in the LOU. The Monitor does not have the authority to decide when WSS is required. When requested by an authorized representative of the Joint Committee (composed of landowner and Union Gas representatives) the Monitor shall render an opinion of whether or not construction work took place in wet soil conditions as defined in the LOU.

The Monitor shall limit contact with landowners to situations where a specific request is made by the landowner or the Committee. When a request is received, the Monitor shall respond within 24 hours. The Monitor shall be present on the construction work site and will be subject to the safety program established by the pipeline contractor, including safety training and qualification prior to entering the work site.

Deliverables
Reports shall be completed in accordance with the sample documents attached hereto. Such reports shall not be subjected to review or editing by any member of the Committee or their sponsor organizations prior to submission. Daily reports shall be submitted simultaneously and directly to the GAPLO and Union Gas Committee members. Weekly reports shall be submitted simultaneously and directly to all members of the Committee. A final report generally summarizing all reports shall be provided at the end of the contract term. The report shall contain at a minimum, recommendations in respect to the following:

- Communications with landowners and the Committee.
- Potential construction activity improvements.
- Reporting requirements.

The Monitor shall verbally report any violations of conditions, landowner agreements or specifications immediately to the Union Gas inspector on-site and in writing to the Chief Inspector and to members of the Committee as soon as possible.

Qualifications
1. Graduate of a recognized Community College or University with a background in environmental sciences or engineering or technology.
2. Experience with heavy construction, preferably in pipeline construction.
3. Knowledge and experience with soil characteristics and agricultural practices.

4. Proven ability to understand and interpret technical and legal specifications and permits. The 48" Strathroy Lobo project will require familiarity with:
   a. The OEB Conditions of Approval
   b. Contents of the construction contract including
      i. General Conditions of the Contract
      ii. Construction Specifications
      iii. Construction Drawings
      iv. Special Landowner Requirements
      v. Environmental Permits and the Environmental Construction Plan
   c. Environmental Assessment
5. Excellent communications skills and interpersonal skills exhibiting tact and diplomacy.
6. Ability to provide independent judgement so that an unbiased third party viewpoint is maintained.

Equipment

The Monitor shall have the following equipment available and operable at all times:

- Pickup truck with four wheel drive capability.
- Insurance in accordance with Section 17 of the Master Services Agreement.
- Laptop computer and printer.
- Digital still image and video capture equipment. Film still image equipment.
- Cell phone with message service.
- Personal protection safety equipment (hard hat, safety boots, eye protection, safety vest).

Term and Hours

Term: Nominal February to December 2007

Hours: As required, not to exceed 10 hours per day, 6 days per week.

Appendix B: Reference Documents

No.	Document Title and Contents	Source
1	Ontario Energy Board Decision and Order EB-2005-0550 re an Application by Union Gas Limited to construct natural gas pipeline ▪ includes Appendix A: Conditions of Approval	Ontario Energy Board web site
2	Union Gas Limited Trafalgar Facilities Expansion Program 2007 Construction NPS 48 Strathroy Lobo Facilities Agreement ▪ Schedule 1 – General Conditions ▪ Schedule 2 – Technical Specifications and Drawings ▪ Schedule 3 – Special Instructions ▪ Schedule 4 – Price Schedule ▪ Addenda	Union Gas
3	NPS 48 Strathroy Lobo Pipeline Construction Contract Schedule 3 Appendix C – Line List with Landowner Commitments; called 'the Line List' ▪ Summarized the list of commitments to the landowner as listed in their Letter of Understanding (LOU) ▪ Summarized landowner answers/requests during pre construction interview	Union Gas; updated verbally by the Lands Agent, or as hand written changes or as a formal revision; copied to each CMT member
4	Union Gas [landowner] Interview Sheet	A landowner
5	Construction Monitor Services Contract NPS 48 Strathroy Lobo Pipeline Construction 2007 / 2008 Between Union Gas Limited and Cordner Science	Union Gas/Cordner Science
6	Daily working schedule ▪ Listed daily operations and location of work	Union Gas from Banister Construction; available daily
7	Aerial photographs (Drawing K041-01 to 03) ▪ Showed property boundaries, numbers and landowner names	Union Gas
8	Map of access points to ROW ▪ Kickoff to SF12	Union Gas
9	Clean-up procedure package (draft 17Aug07) ▪ Documented procedure re soils, special instructions, construction specifications and equipment allowances	Union Gas
10	Pipeline Drawings (Drawing K172 series) ▪ Construction alignment sheets and detail drawings ▪ Crossing drawings	Union Gas; updated once
11	List of property owners and property descriptions	Union Gas
12	Contact List ▪ Names and cell numbers of key persons	Union Gas; updated as needed
13	Efile templates for various reports ▪ Daily, Contacts, Wet Soil Shutdown, Weekly Reports	Union Gas; revised by CMT
14	List of tackifying locations on ROW ▪ Locations identified as needing hydro-mulching to hold blowing sand/soil to control blowing sand/soil	Union Gas
15	Gantt chart of work timelines	Union Gas
16	Incident Notification and Review Guidelines ▪ Re safety incidents	Union Gas
17	Union Gas Limited Major Projects Group Inspector Training & Orientations Pipeline Projects	Union Gas
18	2007 Pocket Ontario OH&S Act & Regulations Consolidated Edition	Union Gas
19	Approved Safety Guide For Pipeline Construction in Canada Issued by Pipe Line Contractors Assoc of Canada 2006	Union Gas
20	Pipeline Lifeline Prepared by the Pipeline Contractors Assoc of Canada	Union Gas

Appendix C: Communications Protocol

CORDNER SCIENCE

Communications Procedure

Construction Monitor Team
NPS 48 Strathroy Lobo Pipeline Construction
2007 / 2008

Revision Number: 0

Reason for Revision:

Effective Date: _____

Submitted By: _____

Jane Sadler Richards
Title: Monitor Supervisor, Construction Monitor Team

Approval Date: _____

Approved By: _____

(Name)
Title: _____

Contents:

1.0 PURPOSE
2.0 SCOPE
3.0 GENERAL
4.0 RESPONSIBILITIES
5.0 PROCEDURE
- 5.1 VERBAL COMMUNICATIONS
- 5.2 WRITTEN COMMUNICATIONS
- 5.3 DAILY REPORT
- 5.4 WEEKLY REPORT
- 5.5 WET SOIL SHUTDOWN REPORT
- 5.6 HEALTH AND SAFETY REPORT
- 5.7 DOCUMENT FILING

1.0 PURPOSE

The purpose of this document is to outline procedures that the Construction Monitor Team (CMT) will use to ensure the three person rotation works effectively and efficiently. The overall goal is to develop communications that are clear, concise, transparent and timely amongst the CMT members, and between the CMT and the Construction Monitor Committee (CMC).

2.0 SCOPE

This Communications Procedure provides an outline of how verbal and written communications, and related supporting documentation, should be conducted by the CMT.

The Communications Procedure is a 'living document' that will be used on a daily basis by the CMT. As such, it may be revised from time-to-time to reflect ongoing 'best practices' related to communications in the context of this project.

3.0 GENERAL

The CMT provides on-site monitoring of the construction activities related to the NPS 48 Strathroy Lobo Pipeline Construction 2007 / 2008.

4.0 RESPONSIBILITIES

Each member of the CMT is responsible for:

- maintaining open and regular verbal and written communications with members of the CMT and CMC;
- completing, distributing and filing communications documentation in a timely, organized and secure manner; and
- conducting regular 'check backs' on communications documents to assure themselves that follow-up promised or required by them has been addressed.

The CMC is responsible for:

- ensuring that communications from the CMT are responded to in a timely manner, which should allow the CMT to function effectively and efficiently.

5.0 PROCEDURE

Each CMT member will maintain and keep readily available a Field Notebook that includes a hard copy of all communications outlined below.

5.1 Verbal Communications

Verbal discussions, whether by phone or in person, should be documented by the on-site member of the CMT or by the member initiating the call if neither person is on-site. Written documentation of verbal communications should include the following, if applicable:

- Date and time of discussion
- Person initiating the call
- Type of discussion (verbal/in person)
- Parties involved
- Subject of discussion
- Points of discussion
- Decision(s) made, if any
- Action(s) required, if any
- Cross reference(s) to other items (map point, photo, etc.), if any
- Initials of person and date discussion was documented

Each CMT member is required to carry a cell phone with key phone numbers encoded in the system while at the work site or 'on call'.

The CMT member on-site on any given day is required to phone the two other CMT members to provide a brief summary/comment on the day's activities and future items to consider. This practice should remain in place until it is apparent that the communications procedure is working

smoothly, at which time the necessity for a daily verbal debriefing may be re-evaluated and modified.

5.2 Written Communications

Emails or other written communications should indicate the following:

- Date and time of discussion
- Parties involved
- Subject of discussion
- Points of discussion
- Decision(s) made, if any
- Action(s) required, if any
- Cross reference(s) to other items (map point, photo, etc.), if any

ALL emails or other written communications related to the functions of the CMT must be sent directly or copied to the other two members of the CMT as applicable.

5.3 Daily Report

At the end of each work day, the on-site Monitor shall:

- complete the Construction Monitor Contacts Report and insert the related communications documents as listed in the previous sections;
- complete the Construction Monitor Daily Report;
- email a copy of the Daily Report to the CMT and CMC; and
- print, sign, date and insert a copy of the report in the Field Notebook.

5.4 Weekly Report

At the end of each work week, the on-site Monitor shall:

- complete the Construction Monitor Weekly Report;
- email a copy of the Weekly Report to the CMT and CMC; and
- print, sign, date and insert a copy of the report in the Field Notebook.

5.5 Wet Soil Shutdown Report

When wet soil shutdown is ordered, the on-site Monitor shall:

- complete the Construction Monitor Wet Soil Shutdown Report;
- email a copy of the Wet Soil Shutdown Report to the CMT and CMC; and
- print, sign, date and insert a copy of the report in the Field Notebook.

5.6 Health and Safety Report

When an accident/incident occurs that, in the opinion of the on-site Monitor, represents a health and safety concern to CMT members, a report including the following items should be prepared:

- Date and time of incident
- Parties involved
- Nature of incident
- Potential effects on the work
- Action(s) taken, if any
- Notification(s) given to whom
- Signature of report author and date

All accidents, injuries, property damage or negative environmental impacts should be reported to the CMT lead as soon as possible.

NOTE: Give first aid and seek medical attention as required.
NOTE: This report is in addition to normal company and government worker safety procedures.

5.7 Document Filing

A copy of all communications and reports will be maintained by each CMT member in their Field Notebook to provide ongoing reference to previous communications and follow-up. JSR will replace original communications (e.g., write ups of verbal discussions, signed reports) with copies at regular intervals and the originals will be kept on file at the Cordner Science office.

Appendix D: Report Forms

UNION GAS LIMITED STRATHROY TO LOBO NPS 48 PIPELINE CONSTRUCTION MONITOR DAILY REPORT

Date		**Contractor Name**	Cordner Science
Report No.		**Monitor Name**	

LOCATION			
County	Middlesex	Township	Middlesex Centre
Conc		Lot	
From Station	Strathroy	To Station	Lobo

Landowner #s & Names					
SF	Kickoff	Today	SF	6	Today
na			25		
1			26		
2			27		
3			28		
4			SF	7	Today
SF	1	Today	29		
5			30		
6			31		
7			32		
8			33		
9			34		
SF	2	Today	SF	8	Today
10			35		
11			37		
12			38		
SF	3 Bone Yard	Today	41		
13			na		
14			SF	9	Today
15			45		
16			46		
SF	4	Today	47		
18			SF	10	Today
19			48		
20			49		
21			50		
SF	5	Today	51		
22			52		
23			54		
24			SF	11	Today
			na		
			SF	12	Today

Road/Rail/Water Crossings	none

WEATHER (Temperature/Rainfall/ Comment)		Today	
		Forecast	

OPERATONS					
Clearing		Pipework		Water Crossing	
Stripping		Trenching		Drain Tile Repair	
Grading		Backfilling		Access/Culv/Bridge	
Fencing		Boring		Erosion Control	
Stringing		Road Xing		Clean-up	
Bending		Rail Xing		Other	

PHOTOGRAPHY						
Photographs	Yes		No		Identifiers	
Camcorder	Yes		No		Identifiers	

COMMENTS

No. & Property	Pics	Notes

Other Comments – date

Monitor's Signature

UNION GAS LIMITED STRATHROY TO LOBO NPS 48 PIPELINE CONSTRUCTION MONITOR WEEKLY REPORT

Date		**Contractor Name**	Cordner Science
Report No.		**Monitor Name**	

WEEK OF

Monday, (month, day, year) to Sunday , (month, day, year)

WEATHER	Date(d/m/y)	Temp. (°C)	Comment
Mon			
Tue			
Wed			
Thu			
Fri			
Sat			

CONDITIONS ON THE RIGHT-OF-WAY

Day(s)	Comments
Mon	
Tue	
Wed	
Thu	
Fri	
Sat	

CONSTRUCTION PROGRESS TO DATE

WET SOIL SHUTDOWN

ANTICIPATED CONSTRUCTION IN SENSITIVE AREAS

SUMMARY OF CONSTRUCTION INSPECTION DAILY REPORTS

Date	Report #	Pics	Location	Operation
Mon,				
Tue,				
Wed,				
Thu,				
Fri, 1				
Sat,				

SUMMARY OF CONTACTS AND LANDOWNERS OR MONITOR CONCERNS

Date	Name	File # / Agency	Concerns / Action	Resolved

SUMMARY OF CONTACTS AND LANDOWNERS OR MONITOR CONCERNS				
Date	Name	File # / Agency	Concerns / Action	Resolved
			-	

SUMMARY RE UNION'S MONITORING PROGRAMS

ADDITIONAL MONITOR COMMENTS

DISTRIBUTION:
CMC AND CMT

_____
Monitor's Signature

UNION GAS LIMITED STRATHROY TO LOBO NPS 48 PIPELINE CONSTRUCTION WET SOIL SHUTDOWN REPORT

Date		**Contractor Name**	Cordner Science
Report No.		**Monitor Name**	

LOCATION			
County	Middlesex	Township	Strathroy-Caradoc and Middlesex Centre
Conc		Lot	
From Station	Strathroy	To Station	Lobo

DECISION TO SUSPEND WORK

Time _____ By _____ Of _____

All Activities Shut Down? _____ No _____

Suspended Operations and / or Locations of Work Today	
Continuing Operations and Locations of Work Today	

RAINFALL INFORMATION:

WEATHER REPORT	
Source:	
Yesterday's Rainfall	
Today's Weather	
Tomorrow's Forecast	

GROUND CONDITIONS / GENERAL COMMENTS

_____

Monitor's Signature

UNION GAS LIMITED STRATHROY TO LOBO NPS 48 PIPELINE CONSTRUCTION MONITOR CONTACT REPORT

Date:	**Contractor Name:**
Report No.:	**Monitor Name:**

SUMMARY OF CONTACTS (Attach Separate Records of Telephone / Discussion as needed.)

Name	File # / Agency	Concern / Action / Comment

Monitor's Signature

uniongas
A Spectra Energy Company

October 21, 2010

GAPLO-Union
c/o Ian Goudy
22303 Wonderland Rd. N.
R.R.#3
Ilderton, ON N0M 2A0

Dear Mr. Goudy

RE: GAPLO-Union Gas Limited
Pipeline System Integrity Dig Agreement

LETTER OF ENDORSEMENT
by and between Union Gas Limited ("Union") and GAPLO-Union ("GAPLO")

Union and GAPLO agree that the form of Pipeline System Integrity Dig Agreement (the **"Agreement"**) attached to this letter is the form that will be utilized for integrity digs undertaken by Union up to December 31, 2015.

The Agreement is endorsed subject to the following conditions:

(a) Land use values for the purposes of Addendum C-2 are to be determined by base line appraisal conducted by qualified appraisal professionals and will be paid on a Regional basis. These regions will be Lambton, Middlesex, Oxford, Waterloo and Hamilton Counties/Regions. Appraisals are to be completed in the year of and prior to any dig occurring in any of the Regions by an appraiser satisfactory to both Union and GAPLO and with the appraisal reports to be provided to both Union and GAPLO;

(b) The interest rate to be used for the purposes of calculating one-time crop loss payments in Addendum C-3 for digs conducted in 2008-2010 are:

i. 2008 – 3.0%
ii. 2009 – 2.2%
iii. 2010 – 2.0%

(c) For digs conducted after 2010, the interest rate is to be as provided in Addendum C-3 and approved by both Union and GAPLO.

Agreed to, accepted and endorsed this 31st day of October, 2010.

Signed on behalf of Union

Mark A. Murray,
Manager, Regulatory Projects and Lands Acquisition

Signed on behalf of GAPLO

For Internal Use Only
Lands File No.:
Cheque No.:
Project:
Acct No.:

Dig:
Owner:

PIPELINE SYSTEM INTEGRITY DIG AGREEMENT

In consideration of the sum of One Dollar ($1.00) of lawful money of Canada now paid by the Company to the Owner (the receipt of which is hereby acknowledged) and the further rents, covenants and agreements hereinafter reserved and contained the parties hereby agree as follows:

This Agreement is between Union Gas Limited (the **"Company"**) and (**"Owner"**), owner of PIN: ; Insert Legal Being Part of the PIN

The Owner hereby grants to the Company, its servants, agents, employees, contractors and sub-contractors and those engaged in its and their business, the right on foot and/or with vehicles, supplies, machinery and equipment at any time and from time to time during the term of this Agreement to enter upon, use and occupy a parcel of land (the **"said lands"**) as designated on the sketch attached hereto and made a part hereof the said lands providing access to or being immediately adjacent to and abutting the lands subject to an existing easement agreement in favour of the Company and a dig site within the lands subject to the Company's easement, and mutually agreed to prior to entry for the purpose of exposing the Company's gas transmission pipeline to enable inspection, repair, replacement, reconstruction or maintenance of the existing NPS diameter gas transmission pipeline, and appurtenances on the afore-mentioned easement including, without limiting the generality of the foregoing, the right to make temporary openings in any fence along or across the said lands and to remove any other object therein or thereon interfering with the free and full enjoyment of the right hereby granted and further including the right of surveying and placing, storing, levelling and removing earth, dirt, fill stone, debris of all kinds, pipe, supplies, equipment, vehicles and machinery and of movement of vehicles, machinery and equipment of all kinds. It is acknowledged that the access lands will be used for the movement of the Company's equipment, supplies and personnel only and the areas of temporary land use for topsoil storage will be used for that purpose only. The Company will ensure that any aggregate or fill stone will not be intermixed with soils and such material will only be used or placed within the dig site area(s).

This Agreement is granted upon the following understandings:

(a) The rights hereby granted terminate on the 31st day of December, 20__; the actual use of the land shall be from the beginning of construction until December 31st of the year following construction. The Company shall make to the person entitled thereto due compensation for any physical damages resulting from the exercise of the rights hereby granted and if that compensation is not agreed upon it shall be determined in the manner prescribed by section 100 of The Ontario Energy Board Act, 1998, S.O. 1998, Chapter 15, Sched. B, as amended or any Act passed in amendment thereof or substitution therefor;

(b) After the completion of any pipeline repair and maintenance work conducted on the said lands, the Company at its own expense unless otherwise agreed to by the Owner, will remove construction debris from the said lands and restore the said lands to their former state so far as is reasonably practicable, save and except for items in respect of which compensation is due under paragraph (a) and the Company will also restore any tile, gates and fences interfered with as a result of the Company's repair and maintenance work within or around the said lands to their original performance. Any actual crop loss in any year in excess of the level of compensation provided in Addenda C-1, C-2, C-3, D-1 or D-2 hereof will be paid by the Company upon receipt of satisfactory proof of such loss.

(c) It is further agreed that the Company shall assume all liability, including environmental liability, and obligations for any and all loss, damage or injury, (including death) to persons or property that would not have happened but for this indenture or anything done or maintained by the Company hereunder or intended so to be and the Company shall at all times indemnify and save harmless the Owner from and against all such loss, damage or injury and all actions, suits, proceedings, costs, charges, damages, expenses, claims or demands arising therefrom or connected therewith provided that the Company shall not be liable under this Paragraph to the extent to which such loss, damage or injury is caused or contributed to by the gross negligence or default of the Owner, its servants or agents.

(d) Addenda A, B-1, B-2, C-1, C-2, C-3, D-1, D-2 and E attached hereto and made a part hereof are for the specific purpose of addressing matters of construction practices and compensation relating to the Company's pipeline repair and maintenance dig program (Addenda B-1, B-2, C-1, C-2, C-3, D-1 and D-2 hereinafter being referred to collectively as the **"Compensation Addenda"**). Compensation payments as set out in Addenda B-1 and B-2 selected and initialled as accepted by the Owner and approved by the Company shall be binding on the parties hereto. It is further understood that due to the investigative nature of the repair and maintenance program, information will become known during the Company's activities and the actual dig area(s) within the lands subject to the Company's easement and temporary land use area(s) for topsoil storage adjacent to the dig sites may need to extend beyond the lands as set out on the sketch attached hereto. The Company shall notify the Owner if such extension will occur and it is agreed and understood that all of the terms and conditions and matters of compensation as may be applicable and which are set out herein shall apply to any such lands. No additional lands shall be used for access to the dig site beyond the lands set out on the sketch attached hereto without the Owners written consent.

The Company and the Owner agree and acknowledge that this agreement is specific to the purposes hereof, being the exposure, inspection, repair, replacement, reconstruction or maintenance of the Company's gas transmission pipeline(s), and nothing contained herein shall be treated as a precedent in any future easement(s).

The Company and the Owner agree to perform the covenants on its part herein contained.

DATED this day of _____, 20__.

_____
Owner

_____
Owner

Address:

_____

_____

UNION GAS LIMITED

_____
Per:

I have authority to bind the Corporation

ADDENDUM "A"
PIPELINE SYSTEM INTEGRITY DIG AGREEMENT

1) Repair and Maintenance Program:

This agreement provides for the use of the specific portions of the Owners lands as set out on the sketch attached hereto and does not replace or amend the rights granted to the Company under it's permanent easement agreements affecting the lands of the Owner.

2. Pipeline Construction Procedures:

a) The Company will use boundary stakes to identify both the dig area and access area;

b) The normal or expected time period to complete an INVESTIGATIVE DIG, being the initial exposure, examination and in place repair of the pipeline is 3 to 4 working days. In wet weather conditions and in recognition of the Company commitment to its wet soils shut down provisions set out in Section 7 of this Addendum and in Addendum "E", it is acknowledged that more working time could be required.

The construction season for purposes of this agreement shall be from June 1st to September 15th inclusive annually. The late or early compensation as set out in Addenda D-1 or D-2 hereto shall apply to any work other than restoration work undertaken by the Company outside of the construction season.

c) The equipment used to undertake the pipeline repair and maintenance work will be equipment with a ground pressure of 20 psi or less such as tracked and wide-tired vehicles. Appropriate farm equipment will be used for clean-up operations. Travel to and from any dig site will be restricted for vehicles which may exceed a 20 psi ground pressure including trucks as required for movement of personnel and supplies.

Should 10 feet or more of pipeline replacement be required the anticipated additional equipment which would be required which may exceed the 20 psi ground pressure includes:

tracked sidebooms (or equivalent)
welding rigs
dump trucks

All sites at which 10 feet or more of replacement pipeline is installed will be considered "REPLACEMENT DIG" sites for purposes of this agreement and in particular for purposes of compensation as set out in the Compensation Addenda hereto. Work at such replacement sites will require more than time to complete than a basic dig (5 to 7 working days).

d) In the area of the digs, either investigative or replacement, the Company will completely strip the topsoil from the existing easement as indicated on the attached drawing, utilizing a temporary land use area ("TLU") for topsoil storage. Compensation for any dig site will be based upon a minimum one-half (1/2) acre site.

e) The Company does not recommend that the topsoil be stripped on the access roadway on agricultural lands. However, should the Owner request stripping of the access for a REPLACEMENT DIG site, the access area will be stripped to a width no greater than 15 feet allowing equipment to travel on subsoil. The top-soil will be stored on TLU adjacent to the access and subject to agreement with the Owner to the contrary, the TLU will be restricted to an area of 12 feet in width adjacent to the access roadway. All TLU for topsoil storage will be compensated at the rates set out in the Compensation Addenda hereto and all topsoil storage areas will be outside of the lands subject to the easement for the pipeline being exposed for the purposes of this agreement.

f) The Company will ensure all its standard construction practices as registered with the Fuels Safety Division of the Technical Standards and Safety Authority and environmental mitigation measures will be followed to ensure a proper repair and clean-up.

g) Unless there is an agreement with the Owner to the contrary and the Company is not required to haul away subsoil from the dig site, all dig site land will be returned to original grade and construction will be undertaken to avoid the creation of crowns over the dig areas. It is further understood however, that if the Company imports fill (such as sand) to be placed around a pipe, excess sub-soil will be removed from the said lands if such removal is required in order to achieve a return to original grade. In location(s) within a dig area where a crown remains after clean-up of greater than 50mm (2 inches), the topsoil will be stripped and excess subsoil removed. If required, the area will then be subsoiled and stones picked. The topsoil shall then be replaced over the area using a dozer and the area will be levelled with the surrounding area. If required, the area will be chisel plowed and stones picked to the satisfaction of the Chief Inspector in consultation with the Owner.

h) The year following construction, if subsidence or erosion occurs to a depth of greater than 50 mm (2 inches) or where surface drainage is adversely affected, the Company shall be

responsible for importing topsoil to repair any such subsidence or erosion. The imported topsoil is to;

i) be natural, cultivated, medium loam, neither clay nor sandy in nature, capable of sustaining heavy agricultural growths,

ii) be from a source approved by the Company after consultation with the Owner.

i) In accordance with standard Company practice, the disturbed area will be cultivated and stones will be picked as required.

j) Based on existing tile plans, the Company will repair and restore all field drainage systems and municipal drainage systems to their original performance. **The Company shall make best efforts to avoid existing tile systems.** The Company shall notify the Owner or his/her designate when tile repairs are completed and all repairs are to be inspected and approved by the Owner or his/her designate prior to backfilling, where practicable. Should the depth of the soil be limited or such other conditions exist so as to place exiting tile systems at risk of damage resulting from the pipeline repair and maintenance work of the Company, additional soil or wood or steel mats will be used to protect the tile system(s).

All tile repairs are guaranteed by the Company. If additional tile work is required due to the construction activity, the Company will employ a qualified tile contractor to make the necessary installation(s) and/or repairs. New tile installations are guaranteed by the Company.

k) The Company shall repair or replace fences which are damaged by pipeline repair and maintenance work.

l) The Owner will not execute a final clean-up approval until he/she is satisfied with the clean-up described above. It is suggested that any tenant(s) who are affected by construction accompany the Owner to inspect the clean-up prior to execution of the clean-up approval.

3) Trees:

The Company will take steps to avoid any tree removal while completing its pipeline repair and maintenance work. However, should it be necessary to remove a tree or trees to perform the work or gain access to the site, the Company's standard tree replacement policy will be followed. If, however, a tree in excess of 6 feet in height is removed, a 6 to 8 foot replacement tree will be supplied. The Company will warranty such trees for a period of 3 years following planting.

4) Specialty Crops

Damages to specialty crops, i.e. tobacco, produce, registered seed variety, will be reviewed and compensation negotiated on a site specific basis and paid on a yearly basis as a specialty crop rotation.

Damages to non-annual crops such as alfalfa or pasture will be negotiated for total losses and will be restored to production.

NOTE: Duplicate crop damage payments will not be made if the Owner is already being paid under another existing program of the Company, i.e. Soil Restoration Program.

If the Company and Owner cannot agree on the compensation to be paid for a specialty crop or non-annual crop, such compensation shall be determined at the Company's expense by a jointly-retained, independent and qualified consultant satisfactory to both parties.

5) Results of the Pipeline Repair and Maintenance Dig:

The Owner will be advised in a brief letter report of the Company's findings and the method of corrective action, if any, undertaken. The report will include the Company's analysis and the data used in that analysis.

6) Soil Testing

The Company undertakes to do soil testing according to the following:

a) Compaction testing will be completed of the soils in the disturbed area during clean-up both on and off easement and the results will be provided to the Owner.

b) If compaction tests indicate residual compaction, remedial work to alleviate such compaction will be undertaken. Unless there is an agreement between the Company and the Owner to the contrary, work undertaken to alleviate compaction shall be performed prior to the return of topsoil to the affected area(s).

c) The soils in the disturbed area and any soils imported to make repairs will be tested for soy bean

cyst nematoade and a report will be provided to the landowner.

d) At the request of the Owner and with the agreement of the Company, soil testing for fertility of soils within the affected area(s) shall be undertaken, at the Company's expense, by a jointly-retained independent and qualified consultant satisfactory to both of the parties hereto. The Company shall be responsible for the implementation of all commercially reasonable recommendations as may be made by such consultant for the purpose of rehabilitation of soils directly and adversely affected by the Company's activities hereunder.

7) Wet Soils Shutdown

Except in the case of an emergency requiring immediate action, the Company will follow its wet soils practice as set out in Addenda "E" hereto during repair or maintenance work on agricultural lands. Some of the considerations in the practice are:

a) extent of surface ponding;

b) extent and depth of rutting;

c) surface extent and location of potential rutting and compaction (ie. can traffic be re-routed within the said lands around wet area(s));

d) type of equipment and nature of the construction operations proposed for that day.

e) In the event that repair and maintenance work is carried out in wet soils, the wet soils compensation as set out in Addendas D-1 or D-2 hereto shall be payable for the dig site, access and topsoil storage areas. If the Owner and Company can not agree upon the payment of wet soils compensation as provided herein, the Company will arrange, at it's expense, for an independent third party consultant satisfactory to the parties hereto to attend and make a determination as to the payment of wet soils compensation, and the Owner and the Company agree to be bound by his determination.

8) Cover Crops

Upon completion of a pipeline repair and maintenance dig and at the request of the Owner, the Company shall establish a cover crop on the said lands. The type of cover crop established shall reflect the commercially reasonable wishes and direction of the Owner.

9) Survival

With respect to the provisions of Article 2(j) concerning the Company's obligation for repairing and/or installing new tiles, those provisions shall survive the termination of this agreement, provided that the tiles repaired or installed by the Company have not been altered, moved, repaired, adjusted or removed by the Owner, unless otherwise agreed to in writing by Company and the Owner. The provisions of this agreement respecting soil restoration shall survive the termination of this agreement, provided that the Owner notifies the Company's Manager, Lands within five years of the termination date of the Owners' requirement for remedial work. Should the Owner require performance in the form of remedial work associated with soil restoration in the area(s) affected by this agreement, the Owner must notify the Company's Manager, Lands before any restoration work is undertaken. In the event of such remedial work, the Owner shall be compensated for crop loss in accordance with the Compensation Addenda hereto, provided that duplicate crop damage payments will not be made to the extent that the Owner has already been paid under this or another existing program of the Company.

ADDENDUM "B-1"[1]

PIPELINE SYSTEM INTEGRITY DIG AGREEMENT COMPENSATION

Property (File) No: _____ Landowner(s) _____

The parties to this Repair and Maintenance Agreement dated the _____ day of _____, 20__, in consideration of making this settlement have summarized below all the obligations, damages and compensation arising from and for the required land rights and repair and maintenance construction across the Landowner(s)' property, namely part of Lot _____, Concession _____, Township of _____.

(Check all applicable items of compensation)

INVESTIGATIVE DIG (access typically not stripped)

( ) Temp. Land Use and Damages for access (off easement)	____ acs x $	/ acre	=	_____
( ) Damages for access (on easement)	____ acs x $	/ acre	=	_____
( ) Temp. Land Use and Damages for topsoil storage (off easement)	____ acs x $	/ acre	=	_____
( ) Damages for topsoil storage (on easement)	____ acs x $	/ acre	=	_____
( ) Damages for dig site	____ acs x $	/ acre	=	_____ *
	Sub-Total 1			_____

Note: * minimum payment based on a 0.5 acre site

Initialled to indicate acceptance by Owner(s): _____ _____

Initialled to indicate approval by Union Gas Limited: _____ _____

REPLACEMENT DIG (access likely to be stripped)

( ) Temp. Land Use and Damages for access (off easement)	____ acs x $	/ acre	=	_____
( ) Damages for access (on easement)	____ acs x $	/ acre	=	_____
( ) Temp. Land Use and Damages for topsoil storage (off easement)	____ acs x $	/ acre	=	_____
( ) Damages for topsoil storage (on easement)	____ acs x $	/ acre	=	_____
( ) Damages for dig site	____ acs x $	/ acre	=	_____ *
Sub Total				_____
Less investigative payment already made				(_____)
	Sub-Total 2			_____

Note: * minimum payment based on a 0.5 acre site

Initialled to indicate acceptance by Owner(s): _____ _____

Initialled to indicate approval by Union Gas Limited: _____ _____

[1] Per acre compensation as provided in this Addendum B-1 has been calculated in accordance with compensation values set out in Addenda C-1 and C-2.

ACTIVITIES IN WET SOILS / LATE OR EARLY ACTIVITIES

( ) See Addendum B-2.

GORED AREAS AND EXTRA HEADLAND AREAS OR **LANDS OCCUPIED OR INACCESSIBLE FOR A 2ND YR**

( )	Crop Damages	____ acs x $ 700.00 / acre =	_____
( )	Disturbance Damages	____ acs x $ 525.00 / acre =	_____
		Sub-Total 3	_____

Initialled to indicate acceptance by Owner(s): _____ _____

Initialled to indicate approval by Union Gas Limited: _____ _____

NOTE: Applicable payment to be inserted appropriate to an investigative dig and adjusted for the eventual use. Minimum payments required to be remitted at signing.

TOTAL (Sub-totals 1 to 3): _____

Initialled to indicate acceptance by Owner(s): _____ _____

Initialled to indicate approval by Union Gas Limited: _____ _____

ADDENDUM "B-2"[1]

PIPELINE SYSTEM INTEGRITY DIG AGREEMENT COMPENSATION

Property (File) No: _____ Landowner(s) _____

The parties to this Repair and Maintenance Agreement dated the _____ day of _____, 20__, in consideration of making this settlement have summarized below all the obligations, damages and compensation arising from and for the required land rights and repair and maintenance construction across the Landower(s)' property, namely part of Lot _____, Concession _____, Township of _____.

NOTE: The Company acknowledges that if dig work proceeds in wet soils, or earlier or later than the agreed to construction season it must remit the following additional 50% payment of the agreed to Damage Payments herein.

(Check all applicable items of compensation)

INVESTIGATIVE DIG (access typically not stripped)

( ) Temp. Land Use and Damages for access (off easement)	____ acs x $	/ acre	=	_____
( ) Damages for access (on easement)	____ acs x $	/ acre	=	_____
( ) Temp. Land Use and Damages for topsoil storage (off easement)	____ acs x $	/ acre	=	_____
( ) Damages for topsoil storage (on easement)	____ acs x $	/ acre	=	_____
( ) Damages for dig site	____ acs x $	/ acre	=	_____ *

Sub-Total 1 _____

Note: * minimum payment based on a 0.5 acre site

Initialled to indicate acceptance by Owner(s): _____ _____

Initialled to indicate approval by Union Gas Limited: _____ _____

REPLACEMENT DIG (access likely to be stripped)

( ) Temp. Land Use and Damages for access (off easement)	____ acs x $	/ acre	=	_____
( ) Damages for access (on easement)	____ acs x $	/ acre	=	_____
( ) Temp. Land Use and Damages for topsoil storage (off easement)	____ acs x $	/ acre	=	_____
( ) Damages for topsoil storage (on easement)	____ acs x $	/ acre	=	_____
( ) Damages for dig site	____ acs x $	/ acre	=	_____ *

Sub Total _____

Less investigative payment already made (_____)

Sub-Total 2 _____

Note: * minimum payment based on a 0.5 acre site

Initialled to indicate acceptance by Owner(s): _____ _____

Initialled to indicate approval by Union Gas Limited: _____ _____

TOTAL (Sub-totals 1 to 2): _____

Initialled to indicate acceptance by Owner(s): _____ _____

Initialled to indicate approval by Union Gas Limited: _____ _____

---

[1] Per acre compensation as provided in this Addendum B-2 has been calculated in accordance with compensation values set out in Addenda D-1 and D-2.

ADDENDUM C -1

PIPELINE SYSTEM INTEGRITY DIG COMPENSATION

Payment Summary - Rates Per Acre

ON EASEMENT - NORMAL CONSTRUCTION

	Access NOT Stripped	Access Stripped	Investigative/Replacement Dig Site (Stripped) (Note: Always on Easement)	Top Soil Storage (Note: Top Soil Storage Never Stripped)
Land Use	$0.00	$0.00	$0.00	$0.00
Disturbance Damage	$1,050.00	$2,100.00	$2,625.00	$525.00
One Time Crop Loss (1)	50% of One Time Crop Loss	100% of One Time Crop Loss	125% of One Time Crop Loss	$700.00
Total	$	$	$	$ 1,225.00

1 - calculated as per Addendum C-3

ADDENDUM C-2

Payment Summary - Rates Per Acre

PIPELINE SYSTEM INTEGRITY DIG COMPENSATION

OFF EASEMENT - NORMAL CONSTRUCTION

	Access NOT Stripped	Access Stripped	Top Soil Storage (Note: Top Soil Storage Never Stripped)
Land Use (1)	100% of Land Use value	100% of Land Use value	50% of Land Use value
Disturbance Damage	$1,050.00	$2,100.00	$525.00
One Time Crop Loss (2)	50% of One Time Crop Loss	100% of One Time Crop Loss	$700.00
Total	$	$	$

1 - compensation for land use wil be determined by base line appraisal conducted by qualified appraisal professionals and will be paid on a regional basis. Those regions will be Lambton, Middlesex, Oxford, Waterloo and Hamilton counties/regions.

2 - calculated as per Addendum C-3

ADDENDUM C-3

PIPELINE SYSTEM INTEGRITY DIG AGREEMENT COMPENSATION

ONE-TIME CROP LOSS PAYMENT

First year crop loss @ 100%		$700.00
Second year crop loss @ 75%		525.00
Third year crop loss @ 56.3%		394.10
Fourth year crop loss @ 42.2%		295.40
Fifth year crop loss @ 31.6%		221.20
Sixth year crop loss @ 23.7 %		165.90
SUB-TOTAL	$	2,301.60
Present Value of Future loss @ 23.7% compensation for one-time crop loss will be based on a gross return of $700.00 per acre with future loss to be calculated on an annual basis based on the average of the interest rates posted on May 1st by the Royal Bank of Canada and the Canadian Imperial Bank of Canada for a five year GIC.	$	(to be calculated) [1]
Allowance for additional fertilizer	$	300.00
Stonepicking	$	200.00
TOTAL ONE-TIME CROP LOSS PAYMENT PER ACRE	**$**	

[1] Example of calculation of Present Value of Future Loss

- Assume interest rate of 2%
- $165.90 (Sixth year payment) divided by 2% = $8,295.00

ADDENDUM D-1

Payment Summary - Rates Per Acre

PIPELINE SYSTEM INTEGRITY DIG COMPENSATION

ON EASEMENT - WET/LATE/EARLY CONSTRUCTION[1]

	Access NOT Stripped	Access Stripped	Investigative/Replacement Dig Site (Stripped) (Note: Always on Easement)	Top Soil Storage (Note: Top Soil Storage Never Stripped)
Land Use	$0.00	$0.00	$0.00	$0.00
Disturbance Damage	$525.00	$1,050	$1,312.50	$262.50
One Time Crop Loss [2]	25% of One Time Crop Loss	50% of One Time Crop Loss	62.5% ofOne Time Crop Loss	$350.00
Total	$	$	$	$612.50

[1] Compensation as provided in this Addendum D-1 is in addition to compensation as provided in Addendum C-1 and is payable pursuant to the provisions of Addendum A, para. 2(b) and para. 7(e).

[2] Calculated as per Addendum C-3

ADDENDUM D - 2

PIPELINE SYSTEM INTEGRITY DIG COMPENSATION

Payment Summary - Rates Per Acre

OFF EASEMENT - WET/LATE/EARLY CONSTRUCTION[1]

	Check all Applicable	Access NOT Stripped	Check all Applicable	Access Stripped	Check all Applicable	Top Soil Storage (Note: Top Soil Storage Never Stripped)
Land Use (1)	( )	n/a	( )	n/a	( )	n/a
Disturbance Damage	( )	$525.00	( )	$1,050.00	( )	$262.50
One Time Crop Loss (2)	( )	25% of One Time Crop Loss	( )	50% of One Time Crop Loss	( )	$350.00
Total		$		$		$

(1) Compensation as provided in this Addendum D-2 is in addition to compensation as provided in Addendum C-2 and is payable pursuant to the provisions of Addendum A, para. 2(b) and para. 7(e).

(2) Calculated as per Addendum C-3

ADDENDUM "E"

TO PIPELINE SYSTEM INTEGRITY DIG AGREEMENT

Property (File) No Landowner(s):

The following sets out the Wet Soils Shutdown practice of Union Gas Limited for pipeline construction, repair and maintenance on agricultural lands.

While constructing, repairing or performing maintenance work ("construction activities") on pipelines during the normal construction period (June 1st to September 15th) Union's senior inspectors inspect right-of-way conditions each day before construction activities commence for that day. If, in the judgment of these inspectors, the right-of-way conditions on agricultural lands are such that construction would have an adverse affect on the soils due to wet soils conditions, the contractor is prohibited from starting construction activities. The wet soil shutdown restriction would be in effect until, in the judgment of Union's chief inspector, the soils would have sufficiently dried to the extent that commencing construction activities would have no adverse affects on the soils.

Wet soils shutdown is a routine part of Union's normal management process for pipeline construction activities. In recognition of this, Union budgets for and includes in contract documents, provisions for payment to the pipeline contractors for wet soils shutdown thereby removing any potential incentive for the contractor to work in wet conditions.

In addition, Union's inspection staff is responsible for ensuring that construction activities do not occur during wet soils shutdown. This would include shutting down construction activities if soils became wet during the day.

It should, however, be recognized that there may be situations when construction activities cannot be carried out during the normal construction period due to delays in project timing and it may become necessary to work in wet conditions in the spring or fall of the year (after September 15th and before May 31st) . When this situation cannot be avoided, additional mitigation measures are put in place to minimize resulting damages. Union will authorize work in wet soils conditions only when all other reasonable alternatives have been exhausted.

LETTER OF UNDERSTANDING FOR LANDOWNERS ON THE PROPOSED NPS 48 STRATHROY-LOBO PROJECT

INTRODUCTION

It is the policy of Union Gas Limited ("the Company") that landowners affected by its pipeline projects be dealt with on a consistent basis that is fair to both parties. This Letter of Understanding represents the Company's commitment to that objective by providing a common framework within which negotiations for this project can take place. Union will therefore observe the following guidelines in its dealings with landowners on the NPS 48 Strathroy-Lobo Project ("the project").

CONTENTS

The following matters are addressed in this Letter of Understanding and its appendices and schedules all of which form a part hereof.

		Page
1.	Pipeline Construction Procedures	2
2	Liability	7
3.	Water Wells	7
4.	Land Rights	8
	4.1 Easements	8
	4.2 Temporary Land Use Agreements	8
5.	Damage Payments	9
	5.1 Disturbance Damages	9
	5.2 Construction Damages	9
	(a) Crop Damages	9
	(b) Woodlots and Hedgerows	12
	(c) General Matters for Damages	13
6.	Post-Construction and Pipeline Operations Issues	13
	6.1 Weed and Brush Control in Non-Cultivated Lands	13
	6.2 Damages from Pipeline Operations	13
	6.3 Abandonment	14
	6.4 Depth of Cover	***14***
	6.5 Stonepicking	***14***
7.	Gored Land	14
8.	Testing for Soybean Cyst Nematode	14
9.	***Independent Construction Monitor***	***14***.
10.	Insurance	15
11.	Compensation Levels	15
12.	Assignment	15
13.	Appendix "A" Compensation Settlement	16
14.	Appendix "B" Other Site Specific	17
15	Schedule 1 – Landowner Relations & Terms Of Reference of Joint Committee	18
16.	Schedule 2 Woodlot Evaluation	19
17.	Schedule 3 - Aesthetic Tree Evaluation	20
18.	Schedule 4 - Schedule of Rates for Work Performed by Owners of Land	21
19.	Schedule 5 Wet Soils Shutdown	22

1. PIPELINE CONSTRUCTION PROCEDURES

Prior to construction, Union's project manager or designated agent shall visit with each affected landowner to review the timing of construction and discuss site specific issues and implementation of mitigation and rehabilitation measures in accordance with the provisions of this agreement.

(a) Prior to installing the pipeline in agricultural areas, the Company will strip topsoil from over the pipeline trench and adjacent subsoil storage area. All topsoil stripped will be piled adjacent to the easement and temporary land use areas in an area approximately 10 metres (33') in width. The topsoil and subsoil will be piled separately and Union will exercise due diligence to ensure that topsoil and subsoil are not mixed. If requested by the landowner, topsoil will be ploughed before being stripped to a depth as specified by the landowner.

The Company will strip topsoil across the entire width of the easement at the request of the landowner, provided also that a temporary right to use any necessary land for topsoil storage outside the easement is granted by the landowner.

Further, if the landowner so requests the Company will not strip topsoil with the topsoil/subsoil mix being placed on the spoil side of the easement on top of the existing topsoil.

At the request of a landowner a mulch layer will be provided between the existing topsoil and the stripped topsoil pile in situations where a crop is not present.

At the landowners request, separation of distinct subsoil horizons such as blue and yellow clays shall be performed. Blue clays will be removed from the easement lands.

(b) The Company agrees to stake the outside boundary of the work space which will include easement, temporary work room, or topsoil storage areas. Where topsoil is to be stored off easement, the stakes will not be removed during the stripping operation. The stakes will be located at 30 metre (98.4 foot) intervals prior to construction. The intervals or distance between stakes may decrease as deemed necessary in order to maintain sight-lines and easement boundaries in areas of sight obstructions, rolling terrain or stream and road crossings. The Company will restake the easement limit for post construction tile work at the request of the landowner.

(c) On present and proposed agricultural lands, the Company will undertake appropriate survey techniques to establish pre-construction and post-construction grades with the view to restoring soils to pre-construction grade as reasonably practicable.

(d) The company will ensure all construction practices and appropriate environmental mitigation measures will be followed to ensure a proper clean up.

(e) Whenever possible, all vehicles and equipment will travel on the trench line.

(f) ***The Company will not open more than 6.0 km. of trench line at a time.***

(g) The Company will install the pipeline with a minimum of 1.2 metres of coverage. ***If the Company, acting reasonably, determines in consultation with the landowner and drainage expert that it is necessary to increase the depth of the Pipeline to accommodate facilities such as drainage, processes such as deep tillage, heavy farm equipment or land use changes, Union will provide for additional depth of cover.***

(h) At the request of the landowner topsoil will be over-wintered and replaced the following year. In these circumstances the Company will replace the topsoil such that the easement lands are returned to surrounding grade.

(i) During trench backfilling the Company will remove any excess material after provision is made for normal trench subsidence. The landowner shall have the right of first refusal on any such excess material. If trench subsidence occurs the year following construction, the following guidelines will be observed :

(i) 0 to 4 inches - no additional work or compensation.

(ii) Greater than 4 inches - the Company will strip topsoil, fill the depression with subsoil and replace topsoil. If it is cost effective the Company will repair the settlement by filling it with additional topsoil.

If mounding over the trench persists the year following construction, the following guidelines will be observed :

(i) 0 to 4 inches - no additional work or compensation.

(ii) Greater than 4 inches the Company will strip topsoil, remove excess subsoil and replace topsoil

(iii) Should adequate topsoil depth be available, the mound can be levelled at the request of the Landowner

If the construction of the pipeline causes a restriction of the natural surface flow of water, due to too much or not enough subsidence, irrespective of the 4" level stated above, the Company will remove the restriction by one of the methods described above.

(j) If following over-wintering of the topsoil, return to grade and the establishment of a cover crop, there is identifiable subsidence in excess of 2 inches the Company will restore the affected area to grade with the importation of topsoil.

(k) The Company will also pick stones prior to topsoil replacement. The subsoil will be worked with a subsoiling implement, as agreed by the Company and the Landowner Committee. After topsoil replacement, the topsoil will be tilled with an implement(s) as agreed by the Company and the Landowner Committee. ***Stones 50 mm (2") in diameter and larger will be picked by hand and/or with a mechanical stonepicker.*** The subsoil on the easement will be tilled again as above.

(l) At the request of the landowner, the Company agrees to retain an independent consultant to carry out tests along the pipeline to monitor soils and crop productivity. As part of this testing, a soil specialist will conduct comparative compaction testing of the subsoils and NPK (nitrogen, phosphorus, potassium) testing and testing of PH levels on and off easement after construction. Global Positioning System (GPS) equipment may be used to identify all test locations. The Company further agrees to implement all commercially reasonable measures, where recommended by the soil specialist to remediate the soil.

(m) After the topsoil replacement, the topsoil will be tilled (see section k) and stones picked. If requested by the landowner, the Company will cultivate the topsoil or make compensating arrangements with the landowner to perform such work. This request by the landowner must be made during the pre-construction interview in order to be co-ordinated with the construction process. After

cultivation, the Company will pick stones again. ***If requested by the landowner, the Company will return in the year following construction and chisel plough or cultivate to the depth of the topsoil. When necessary to accommodate planting schedules, the landowners should perform cultivating and/or chisel ploughing themselves at the Company's expense, provided the need for this work has been agreed upon in advance (see Schedule of Rates attached).***

(n) All subsoils from road bores will be removed.

(o) The Company will repair and restore all field drainage systems and municipal drains impacted by construction to their original performance and will be responsible for remedy, in consultation with the landowner, of any drainage problem created by the existence of the pipeline. The Company will be responsible for any defects in the integrity and performance of tile installed or repaired in conjunction with construction, operation or repair, provided the defects are caused by the company's activities, faulty materials or workmanship. The Company guarantees and will be responsible forever for the integrity and performance of such tile as well as any other drain tile or municipal drain compromised by the company's activities, including future maintenance operations and problems caused by the company's contractors, agents or assigns. Where the landowner, acting reasonably, believes that there may be a drainage problem arising from the company's operations, the company will perform an integrity check on any tile construction/repair crossing the pipeline, and repair any deficiencies to the landowner's satisfaction.

All installations may be inspected by the landowner or his/her designate prior to backfilling where practicable. The company will provide the landowner or his/her designate advance notice of the tile repair schedule.

The company will retain the services of a qualified independent drainage consultant. The consultant will work with landowners to develop plans and installation methods and, if the plan is implemented, the consultant will certify that the construction accords with the plan. If prior to construction the company is provided with these plans prepared by the drainage consultant and approved in writing by the landowner, the company will install tile along the pipeline in the following situations:

1. In areas of numerous random tiles or systematic tiles that cross the pipeline easement, the Company will install header tiles (interceptor drains) adjacent to the easement as laid out in the plans. The downstream end of cut tile will be plugged. Such work will occur as soon as practicable, but prior to topsoil stripping operations. Any intercepted drains will be connected or plugged. The company will attempt to minimize the number of tile crossing the pipeline easement.

2. In areas where drainage problems will be created as a result of the easement, the drainage consultant will develop a tile plan to mitigate these impacts provided that the landowner is agreeable to any works required for this installation.

3. Should the pipeline construction program clear lands adjacent to existing pipelines and as a result create a newly cleared area large enough to farm, the company will, at the request of the landowner, develop a tile plan to drain the said area. The Company will install the tile in the newly cleared area, and install a drainage outlet that will enable the implementation of the said tile plan provided the cost of such work does not exceed the present value of the net crop revenue from the said area. The

present value shall be calculated using the same crop value and discount rate used in the one time crop loss compensation calculation. The net crop revenue shall be derived by reducing the crop value by a negotiated input cost. The Company will accept drainage design solutions that include the use of a motorized pump, if the landowner releases the Company from all future operation and maintenance responsibilities for said pump. The Company will accept drainage design solutions that include outlet drains crossing adjacent properties, if the landowner obtains necessary easements or releases fully authorizing said crossings.

4. Drainage laterals will be installed after construction of the pipeline to provide easement drainage. Lateral and cross-easement tiles will be installed in the construction year as weather permits.

5. Other areas recommended by the drainage consultant.

If random tiles are encountered during construction they will be staked and capped, unless temporary piping is installed to maintain flow.

The Company will do the following to accommodate planned and future drainage systems in the Company's drainage and pipeline design. The Company will incorporate any professionally designed drainage plans obtained by the landowner for future installation. If the landowner intends to install or modify a drainage system but has not yet obtained professionally designed plans, the Company will hire a drainage consultant to develop an Easement Crossing Drainage Plan in consultation with the landowner.

In areas where topsoil has been stripped, and at the request of the landowner, the company will complete post-construction tile installation and repairs prior to topsoil replacement.

The installation of tile shall be performed by a licensed drainage contractor. The company will consult with the landowner committee and mutually develop a list of acceptable tile drainage contractors to be used during construction. Header tiles will be installed using a trench method to ensure that all field tile are located and connected as required by the tile plan.

The company will provide the landowner with the most recent specifications concerning tile support systems for existing tile across the trench. The method of support will be agreed upon between the landowner and the company's drainage consultant during the pre-construction visit.

The company will provide the landowner with a copy of as-built drainage plans.

(p) Company will, unless otherwise agreed to with the landowner, ensure any water which may accumulate on the easement during construction will be released into an open drain or ditch, but not in a tile drain. This may, however, be accomplished through the installation of temporary tile. The Company will provide the landowner with a proposed temporary tiling plan for review. If the Company pumps into an existing tile with the landowner's permission, the water will be filtered.

(q) The Company shall replace or repair any fences which are damaged by pipeline construction in a good and workmanlike manner. In addition, the Company will reset any survey monuments which are removed or destroyed during pipeline construction.

(r) It is understood that the Company is required to adhere to all of the conditions set out in the Leave to Construct Order of the Ontario Energy Board and that the foregoing are additional undertakings that the Company has agreed upon with the landowners on the project. A copy of the conditions will be mailed to each landowner as soon as it is available.

(s) The landowner will execute a Clean-up Acknowledgment when he/she is satisfied with the clean-up operations described in Paragraph 1, (h) through (q). It is suggested that any tenant(s) who are affected by construction accompany the landowner to inspect the clean-up prior to execution of the Clean-up Acknowledgment. The Landowner Committee will be provided, for review, the form of documents required for landowner execution.

(t) Where private water or utility lines are planned to be interrupted, the Company will supply temporary service to the affected landowners prior to service interruption. In the case of accidental interruption, temporary services will be provided by the Company at the earliest possible opportunity.

(u) Where requested by the landowner, the Company will leave plugs for access across the trench to the remainder of the landowner's property during construction. Following construction, the Company shall ensure that the landowner shall have access across the former trench area and easement. Upon request of the landowner, the Company shall create a gravel base on filter fabric across the plug(s) and will remove same at the further request of the landowner.

(v) The Company, including its employees, agents, contractors and sub-contractors, will not use any off-easement culverts incorporated into Municipal Drains to provide access to the easement. Further, the Company will not use any laneway or culvert of the landowner without the landowner’s prior written consent. In the event of such use, the Company will, at its own expense, repair any damage and compensate the landowner accordingly. The Company agrees to monitor and maintain private driveways that cross the easement for a period of 18 months after construction.

(w) The Company agrees that construction activities will not occur over the off-easement areas without the written permission of the landowner. The Company agrees that it will pay for damages caused by construction/operations activities in the event that such off easement damages occur.

(x) The Company’s Landowner Complaint Tracking system shall be available to landowners for the proposed construction.

(y) The Company shall pay the costs of independent consultants satisfactory to both the landowner and the Company to resolve site specific disputes involving affected lands on a binding basis concerning the following:

(i) The need for topsoil importation as in Clauses 1 i) hereof, respecting the existence of identifiable subsidence,

(ii) The need for topsoil importation as in Clause 1 (z) hereof, respecting the establishment of crop losses in excess of 50%,

(iii) The establishment of levels of compensation for specialty crops as in clause 5.2 hereof.

(iv) resolution of future crop loss claims under s.5.2 (a) hereof.

In addition, in the event that a dispute arises between a landowner and the Company and such dispute cannot be resolved to the mutual satisfaction of the parties through discussion or referral to the joint committee established pursuant to Para. 1(d)(d) and Schedule 1 hereof, the Company may retain a mutually satisfactory independent consultant to assist in the resolution of the particular dispute.

(z) The Company will import 3 inches of topsoil to remedy any areas affected by construction that have crop losses in excess of 50 % in the fifth year following construction to be distributed in accordance with the following protocol regardless of the cause of the loss and without prejudice to the landowner's continuing right to compensation for losses in excess of those compensated for.

(i) The Company will regrade the total width of the easement, including the designated area to level any ruts;

(ii) The Company will import a quantity of topsoil equivalent to three (3) inches times the total area of the Land experiencing greater than 50% crop loss (the "affected area").The topsoil will be of a quality described in subsection (bb), dry and tested for the presence of soybeans cyst nematode;

(iii) The Company will spread the imported topsoil uniformly over the affected area to a maximum depth of three (3) inches on the affected area or as otherwise agreed to by the Landowner and the Company in a manner so as to not adversely affect the natural drainage of the Land or adversely impact on normal farming operations .

Alternatively, at the option of the landowner, if there is greater than 50% crop loss after five years, Union will retain an independent soils consultant satisfactory to both parties to develop a prescription to rectify the problem. This may include the importation of topsoil.

(aa) The Company will perform compaction testing on and off the easement before and after topsoil replacement and provide the results to the landowner. Unless there is an agreement to the contrary, the Company will remediate any residual compaction in the subsoil prior to return of topsoil.

(bb) Any imported topsoil shall be natural, cultivated, medium loam, neither clay or sandy in nature, capable of heavy agricultural growths and be from a source approved by the landowner.

(cc) The Company will provide a copy of this Letter of Understanding and the environmental reports to the construction contractor.

(dd) The Company agrees to implement one joint committee for the NPS 48 Strathroy-Lobo Project under the terms of reference agreed to in Schedule 1 hereof.

(ee) The Company will ensure suitable passage and land access for agricultural equipment during construction.

2 LIABILITY

The Company will be responsible for damages to property, equipment, and loss of time resulting from construction operations, and will pay for repairs or replacement costs. The Company will be responsible, and indemnify the landowner from any and all liabilities, damages, costs, claims, suits and actions except those resulting from the gross negligence or willful misconduct of the landowner.

3. WATER WELLS

To ensure that the quality and quantity (i.e. static water levels) of well water is maintained, a pre, during and post construction monitoring program will be implemented for all drilled wells within 100 metres of the proposed pipeline, for all dug wells within 100 metres and for any other wells recommended by the Company's hydrogeology consultant. All samples will be taken by the Company's environmental personnel and analyzed by an independent laboratory. Their report will be made available to the landowner on or before the filing of the final post-construction monitoring report.

Should a well be damaged (quantity and/or quality) from pipeline installation/operations, a potable water supply will be provided and the water well shall be restored or replaced as may be required.

4. LAND RIGHTS

Land rights required for the pipeline construction include permanent interests such as pipeline easements (i.e. a limited interest in the affected lands) and may also include temporary land use agreements. The Company agrees that it will not surrender any of its permanent rights or be released from any of its obligations in the easement lands unless an agreement to the contrary has been made with the landowner. In making payment for land rights directly to the registered owner of the affected lands, the owner is responsible to ensure his/her tenant is aware of the terms of the easement or temporary land use agreement and this Letter of Understanding.

Consideration for land rights will be based on appraised market value of the affected lands. In determining the appraised market value, independent accredited real estate appraisers are retained by the Company who must observe the standards established by the Appraisal Institute of Canada. If agreement on the consideration for land rights cannot be reached, the Company will pay for a second report by a qualified appraiser who is chosen by the landowner provided the appraiser and the terms of reference for the appraisal report are mutually acceptable to the landowner and the Company. If consideration for land rights still cannot be agreed upon, the matter would be determined at a compensation hearing and the Company's offers would not prejudice either parties' presentation at the hearing.

4.1 EASEMENTS

Pipeline easements convey a limited right in an owner's land for the construction, operation, maintenance and repair of a pipeline. The owner retains title to the right-of-way lands with a

restricted right to use the easement. The Company will pay a consideration for easements based upon 100% of the appraised market value of the lands required which includes a premium as an incentive for settlement. Payments for easements will be made in one lump-sum or will be amortized over 10 years using the current Canada Savings Bond (CSB) rate, at the option of the landowner.

4.2 TEMPORARY LAND USE AGREEMENTS

Consideration is also paid for temporary use of landowners' property required in connection with the project. This lump sum payment for use of these lands is based upon 50% of the appraised market value for agricultural lands. Payment for Disturbance damages will also be made on the basis of 50 percent of the values described in 5.1 below and Appendix "A" hereto. The Comparative Crop Option and One Time Payment with Cover Crop Option 5.2 below is available for temporary land use lands in agricultural areas. For non-agricultural or development lands, an annual payment is offered based on the market value multiplied by the current CSB rate. Temporary land use will be required for at least a two year period, being the year of construction and the following year to allow for clean-up and restoration activities. Should activities extend beyond the two year period, payment will be negotiated on an annual basis. Although every effort will be made by the Company to identify temporary land use areas required, in certain instances either before or during construction, additional temporary land use may be identified and compensation will be as outlined above. Temporary land use payments do not include those lands used for top soil storage adjacent to the right-of-way which is compensated on the following basis:

(a) *minimum area equivalent to 36% of the easement area (payable before construction)*:

(i) 50% of appraised market value for agricultural land

(ii) disturbance damages (as a component of easement disturbance damages as described in s.5.1 and Appendix "A" hereto)

(iii) crop loss (100% damages for crop destroyed during construction and future loss "as incurred" in accordance with s.5.2(a) and Appendix "A" hereto)

(b) *additional topsoil storage in excess of 36% of easement area (payable after construction)*:

(i) (as above)

(ii) actual area of topsoil storage x 50% of appraised market value of agricultural land minus disturbance payment for topsoil storage paid in easement disturbance prior to construction

(iii) (as above)

5. DAMAGE PAYMENTS

Compensation for damages can be grouped under two headings, namely, Disturbance Damages, which are paid at the time easements and temporary land use agreements are executed, and Construction Damages, which are paid either before or after construction is completed. Disturbance and Construction damage payments will apply to both easement and temporary land use and will be based upon the areas of the proposed pipeline easement and temporary land use.

5.1 DISTURBANCE DAMAGES

Disturbance Damages are intended to recognize that pipeline construction will result in some unavoidable interference with active agricultural operations and certain other uses of affected lands. This may include lost time due to negotiations and construction, inconvenience to the farming

operations, restricted headlands, interrupted access, extra applications of fertilizer, temporary storage of top soil off easement. Other land uses may qualify for Disturbance Damages which are site-specific in nature and recognize the particular circumstances of the use being interfered with. Union will negotiate with the affected owner to address these site-specific issues.

5.2 CONSTRUCTION DAMAGES

(a) CROP DAMAGE

There are two options available to landowners for compensation of crop damage. A Comparative Crop Program, or a One Time Payment program with a Cover Crop Option. These are described below.

OPTION ONE: Comparative Crop Program

In the "Comparative Crop Program" the Company will monitor crop yields on and off right-of-way to compensate for any reduction in yield which is attributable to the pipeline construction and any related effects (i.e. thermal effect) and will follow a damage claim settlement program as follows:

First Year (Construction Year) - Pay 100% of crop damage on all permanent and temporary easements, topsoil storage areas, gored areas and adjoining affected lands.

Second to Fifth Year - The crop loss compensated applies only to easements and temporary land use areas. It will be based on results obtained from a consulting agronomist retained by the Company; any other testing must be approved by the Company . The agronomist will determine any difference in crop yields on and off the easement/temporary land use areas (percent crop loss) and the Company will compensate for such crop losses at prevailing rates.

Sixth Year - In the sixth year, at the landowner's discretion in consultation with the Company, the" Comparative Crop Program " may remain in effect, or the landowner may offer to accept a lump sum payment from the Company, and the landowner will sign a Full and Final Release. The lump sum payment will be the sixth year percent crop loss plus net present value of future years' losses. Net present value of future years' losses will be based on the percent crop loss in the sixth year multiplied by the average price per acre on crops grown in the prior six (6) year period divided by the current CSB rate. For example:

$$\text{Present Value} = \frac{\text{Payment}}{\text{Interest}} \qquad \text{Thus, Lump Sum} =$$

$$\text{(Sixth Year \% Crop Loss)} +$$

$$\frac{\text{(\% Crop Loss x Average Crop Price Per Acre x Acreage)}}{\text{CSB Rate}}$$

Example: 20% crop loss over 1 acre area; average crop price $300/acre

$$(.20 \times \$300.00 \times 1.0) + \frac{.20 \times \$300.00 \times 1.0}{.105} = \$631.43 \text{ (Lump Sum Payment)}$$

It is understood and agreed that landowners will use good farming practices in the cultivation of their lands to mitigate any ensuing damages to the best of their ability. The Company will provide crop restoration recommendations following the completion of construction to assist landowners in rehabilitating the affected lands and will compensate them for any expenses over and above normal farm management of the easement while carrying out these recommendations. Where a landowner

has followed these recommendations to the best of their ability, and is still participating in the "Comparative Crop Program " the Company will, at its expense, retain agricultural specialists to offer advice and assistance in restoration procedures.

If the landowner chooses the Comparative Crop Program, the Company will also monitor and compensate for any decrease in the price obtained for the whole field crop as a result of differences in grade, quality, condition or moisture content between the crop on the whole Dawn-Trafalgar right-of-way and the crop off right-of-way but this provision shall not apply if the One Time Payment Program is chosen.

Pasture Lands - If the affected lands are being used for pasture, the landowner may wish to select the following option in lieu of the 5 year crop monitoring described above. Any unbroken pasture area involved will be reseeded by the Company or on mutual agreement, by the landowner who will be compensated for the reseeding. Pasture area will be paid at 100% loss for a two year term, being the construction year and the year following construction to allow the affected area to establish growth. At the end of the two year period, if the pasture has been established, a Full and Final release will be requested from the landowner. If the pasture has not yet been established, compensation will continue to be paid at 100% loss until such time as the pasture has been established, at which time a Full and Final Release will be signed by the landowner.

OPTION TWO: One Time Payment With Cover Crop Option

As an alternative to the foregoing damage programmes, the Company will offer landowners a one-time settlement on the area of the permanent easement and temporary land use areas, for a Full and Final Release on future crop loss, trees, stone picking beyond the year following construction, cover crops, inspection, consulting time and general damages of any nature whatsoever. Payment is normally made after construction but can be made at the time easement agreements are executed. Notwithstanding that the landowner will have executed a Full and Final Release for crop damages either before or after construction, should productivity loss exceed the percentages paid through the "One Time" Program in any year following construction and the landowner has not been (or is not being) compensated for crop loss under the terms of an existing crop loss compensation program with the Company, the Company will reimburse the landowner for the difference calculated by applying the percentage loss to the landowner's actual gross return in the year and deducting the compensation received for that year under the " One Time " program. It will be incumbent upon any landowner making this type of claim to advise the company in sufficient time to allow for investigation of the matter and completion of the required samplings**.** Alternatively, at the option of the Landowner, upon provision of advance notice to the Company to permit opportunity for inspection, GPS data may be utilized to establish yield reductions for the purpose of any applicable " top up ", provided that the Company is not responsible for installing GPS units or survey equipment if necessary. In the event that the landowner selects this option, the landowner must provide all necessary GPS documentation related to the entire farm field in question, including, but not limited to, maps, computer print-outs and formula to determine field averages.

Example Third year crop loss under "One Time" Program = 50%.

Actual crop loss following investigation and sampling = 60%.

Difference payable to landowner - 10%).

For any land used outside the permanent easement, the Company will pay 100% damages for any crops destroyed during the construction year and pay damages for future crop loss on an "as incurred" basis.

This option does not apply to specialty crops. Damages to specialty crops, i.e. tobacco, produce, registered seed variety, will be reviewed and compensation negotiated on a site specific basis and paid on a yearly basis as a specialty crop rotation.

In addition to the one time payment, the landowner may request a cover crop rehabilitation program for cultivated lands. Under this program the landowner will plant alfalfa/sweet clover or other restoration crops approved by the Company on the easement and his/her normal crop in the remainder of the field for up to three years. The initial cost of tillage and planting will be paid by the Company as determined by "Economics Information", published by the Ministry of Agriculture and Food. The cost of seed planted over the easement will be compensated upon presentation of an invoice for same. This cover crop program does not apply for tobacco crops.

(b) WOODLOTS AND HEDGEROW TREES

All woodlots and hedgerow trees to be cut will be appraised by a qualified forester retained by the Company. The forester will contact the landowner before entry on their property. Copies of appraisal reports will be made available to affected landowners and payment will be made in accordance with the reports.

If requested by the landowner, evaluation of trees in woodlots will be based on the accepted practice as outlined on Schedule 1 hereto.

The evaluation of trees for aesthetic values, will be carried out by qualified professionals according to standard principles as outlined in Schedule 2 hereto. Compensation for trees evaluated in this manner shall be set out in Appendix "B" to this document.

Union reserves the right to use trees for which it has paid compensation. At the landowner's request, any remaining logs will be cut into 10 foot (3.05 metre) lengths, lifted and piled adjacent to the easement.

As an alternative to the forester's appraisal, the landowner may accept "Option Two: One Time Payment" (see page 13) in lieu of the woodlot evaluation.

Tree plantations (Christmas trees and nursery stock) will be appraised separately.

Prior to the start of construction, the following options will be discussed with the landowner, and the most appropriate option selected:

Option 1: The land will be completely cleared for construction with all stumps and brush removed so that the land can be cultivated.

Option 2: At Union's expense, all vegetation on the construction area will be cut with brush cutters or sprayed regularly so that brush or trees will not grow again.

Option 3: Union will maintain a 6 metre strip over the pipeline which will be kept clear by cutting the brush or spraying. The remainder of the easement will be allowed to reforest naturally or can be reforested by the landowner.

The Company has established a policy to replant twice the area of trees to those which are cleared for pipeline projects. Landowners whose woodlots are to be cleared may apply in writing to the Company should they wish to participate in this programme. Tree seedlings will be replanted on the right-of-way or within the landowner's property using species determined in consultation with the landowner. Replanting must be done in accordance with the Company's policies regarding tree planting on easements so that a 6 metre strip centred on the pipeline is left open for access to the pipeline.

For hedgerows the Company will implement the following practice: If a tree in excess of six (6) feet is removed a six (6) foot replacement tree will be supplied; if a tree less than six (6) feet in height is removed, a similar sized tree will be supplied. The Company will warrantee such trees for a period of three years following planting, provided the landowner waters the tree as appropriate after planting.

The only exception to the non-planting of the 6 metre strip is that with permission, trees may be planted as a crop (nursery stock), provided that no tree is permitted to grow higher than 2 metres in height, and the species are of a shallow rooting variety. The use of hydraulic spades within the 6 metre strip is prohibited.

(c) GENERAL MATTERS FOR DAMAGES

As damage payments are made directly to the registered landowner, the landowner is responsible for making any compensation to his/her tenant for any matters included in the damage payment from the Company.

The Landowner(s) in consideration of this settlement, covenants and represents that this settlement and the relevant easement agreement or option for easement, as the case may be will be made known to any occupant, tenant or lessee of their lands.

Where damage settlements cannot be negotiated, the Company or the landowner may apply to the Board of Negotiation or Ontario Municipal Board to settle unresolved claims. It is further understood and agreed that the landowner's executing our easement, is without prejudice to his/her position in negotiation of damages following construction of the pipeline and the aforementioned settlement arrangements will be in full effect.

6. POST-CONSTRUCTION AND PIPELINE OPERATIONS ISSUES

6.1 WEED AND BRUSH CONTROL IN NON-CULTIVATED AREAS

The pipeline easement through woodlots will be brushed out on a regular basis either within a 6 metre strip centred over the pipeline or across the full width of easement which was initially cleared for construction. The width of clearing will be discussed with landowners prior to work commencing.

At the choice of the landowner, the easement can be replanted with trees provided no planting takes place within a 6 metre strip centred over the pipeline. Landowners are reminded that the company must be notified five days prior to any excavation taking place on the easement and that such excavation must be under the direction of a Company inspector, in accordance with the easement agreement.

The Company will work with the Landowner to ensure that weeds are controlled along the pipeline. Weeds will be sprayed or cut after discussion with the landowner. The Landowner will be provided with a contact name in the event that concerns are experienced with weeds.

6.2 DAMAGES FROM PIPELINE OPERATIONS

Prior to scheduled excavation for maintenance work, top soil shall be stripped and piled separately from subsoil.

Pipeline maintenance shall be scheduled to accommodate crop planting, growing and harvesting, however, in the event maintenance work results in crop damage, Union shall negotiate crop damage settlements.

Any work on existing pipelines will be carried out using current practices.

The Integrity Dig Agreement shall apply to all integrity and maintenance operations on the whole Dawn-Trafalgar system.

6.3 ABANDONMENT

Upon the abandonment of the pipeline ***(as determined by the Easement)*** , the affected lands shall be returned as close as possible to its prior use and condition with no ascertainable changes in appearance or productivity as determined by acomparison of the crop yields with adjacent land where no pipeline was installed, provided that there shall be no additional compensation for crop loss to the landowner under the Comparative Crop Program 5.2 (a) OPTION ONE or the One-Time Payment with Cover Crop OPTION TWO but without prejudice to any continuing right of the landowner to " top up " compensation pursuant to the provisions of Section 5.2 (a) hereof.

The Company, in consultation with the landowner or third parties as required, will determine a reasonable and appropriate course of action to rectify any deficiencies.

6.4 DEPTH OF COVER

At the request of the landowner, the Company shall undertake a depth of cover survey of the Pipeline, and shall provide its findings to the landowner. Where it is determined that cover over the Pipeline is less than three feet, The Company shall restore depth of cover to three feet with the importation of topsoil or by lowering the pipe.

6.5 STONEPICKING

The Company shall, at a time satisfactory to the landowner, pick stones 50 mm (2") or larger in diameter by hand/or with a mechanical stone picker in each of the first two years following construction. The Company shall, at a time satisfactory to the landowner, return to pick stones 50 mm (2") or larger in the following years where there is a demonstrable need.

7. GORED LAND

The Company agrees to pay landowners the 100 % annual crop loss component as provided In the One Time Payment with Cover Crop Option hereof, or in the case of specialty crops as provided in Clause 5.2 hereof for agricultural lands rendered not useable as a result of the construction of the pipeline and clean-up following construction.

8. TESTING FOR SOY BEAN CYST NEMATODE

In consultation with the landowner, the Company agrees to sample all agricultural easements along the pipeline route of this project, before construction, and any soils imported to the easement lands for the presence of soy bean cyste nematode (SCN) and provide a report of test results to the landowner. In the event the report indicates the presence of SCN, the Joint Committee will work with OMAFRA and the University of Guelph to develop a best practices protocol to handle SCN when detected and will employ the most current best practice at the time of construction. The Company will also test for SCN whenever it is conducting post-construction soil tests.

9. INDEPENDENT CONSTRUCTION MONITOR

An independent construction monitor shall be appointed by GAPLO-Union (Strathroy – Lobo), the Company and Ontario Energy Board Staff. The monitor shall be on site continuously to

monitor construction with respect to all issues of concern to landowners, and shall be available to the landowners and the Company at all times. The monitor shall file interim and final reports with the Ontario Energy Board.

10. INSURANCE

Upon request by the landowner, the Company will provide insurance certificates evidencing at least five million dollars in liability insurance coverage.

11. COMPENSATION LEVELS

The levels of compensation applicable to your property are set out in Appendix "A" and are based upon the criteria set out above. Kindly sign the second copy of this Letter of Understanding and initial all Appendices to indicate your acceptance of our arrangements.

12. ASSIGNMENT

All rights and obligations contained in this agreement shall extend to, be binding upon, and enure to the benefit of the heirs, executors, administrators, successors and assigns of the parties hereto respectively; and wherever the singular or masculine is used it shall, where necessary, be construed as if the plural, or feminine or neuter had been used, as the case may be.

The Company shall not assign this agreement without prior written notice to the landowner and, despite such assignment, the Company shall remain liable to the landowner for the performance of its responsibilities and obligations in this agreement.

Yours very truly,
UNION GAS LIMITED

_____
Manager, Lands Department

_____

Dated at _____, Ontario this _____ day

of_____,20_____.

Witness:

(
(_____
(Landowner
(
(
(_____
(Landowner

NPS 48 STRATHROY-LOBO Pipeline

APPENDIX "A": SETTLEMENT

Property No. _____, Landowner(s): _____

The parties to this Letter of Understanding dated the ___ day of _____, 2003, in consideration of making this settlement have summarized below all the obligations, claims, damages and compensation arising from and for the required land rights and the pipeline construction across the Landowner(s)' property, namely _____.

(Check all applicable items of compensation)

Yes	No				
		LAND RIGHTS			
[ ]	[ ]	(a)	Easement @	$	per acre.
[ ]	[ ]	(b)	Temporary Land Use @	$	per acre.
[ ]	[ ]	(c)	Topsoil Storage Land Use @	$	per acre. (36% Easement Area)
[ ]	[ ]	(d)	Topsoil Storage Land Use @	$	per acre (for area exceeding 36% of Easement Area) Determined and Payable after construction
		DAMAGES			
[ ]	[ ]	(a)	Disturbance @	$	per acre of easement.
[ ]	[ ]	(b)	Disturbance @	$	per acre of Temporary Land Use
[ ]	[ ]	(c)	Disturbance		As outlined in s.4.2 for Topsoil Storage Area exceeding 36 % of Easement Area Determined and Payable after construction
		(d)	Crops		
[ ]	[ ]	Comparative Crop Program:		(See section 5.2(a))	
[ ]	[ ]	One Time Payment @		$	per acre of easement.
[ ]	[ ]	One Time Payment @		$	per acre of Temporary Land Use
[ ]	[ ]	Cover Crop Program:		(See section 5.2(a) –	typically decision made after construction
[ ]	[ ]	Top Soil Storage		Measured Crop Damage per acre (100% loss in year of construction) If and as incurred in years after construction	
		OTHER (IN LIEU OF " ONE TIME ")			
[ ]	[ ]	(d)	Pasture Lands @	(See OPTION ONE –	Comparative Crop Program)
[ ]	[ ]	(e)	Woodlots	(See section 5.2(b))	

OBLIGATIONS

[ ] a) This Letter of Understanding.

[ ] [ ] b) Attached as Appendix "B" any other special requirements or compensation issues.

Initialled for identification by owner(s): _____. _____.

Approval (Union Gas Limited): _____. _____.

NPS 48 STRATHROY-LOBO Pipeline

APPENDIX "B" SETTLEMENT

Property No.:_____ , Landowner(s):

SCHEDULE 1

Landowner Relations and Terms of Reference of Joint Committee

In addition to Wet Soils Shutdown issues, the Joint Committee's purpose is to:

i) provide a mechanism to address issues/concerns that arise during and following construction including concerns related to wet soil shutdown decisions made by the Company;

ii) provide a brief overview of issues/concerns raised during and following construction; and,

iii) consider which items should be included in a Post Construction Report.

The objective of the Joint Committee is to provide:

i) a vehicle to address issues/concerns which arise during and following construction;

ii) deal with any unforeseen circumstances which may arise during or following construction; and,

iii) an opportunity for landowners to comment on how Union might improve future construction practices.

In reviewing the foregoing, the types of issues which may be addressed are as follows:

i) landowner concerns that arise during and following construction;

ii) unusual or unanticipated impacts of the construction process which show up only after construction is completed;

iii) methods of anticipating and avoiding these circumstances in the future; and,

iv) review of ongoing construction practices and procedures which in the view of the landowners might be improved in future construction.

Duration of the Joint Committee

i) The Joint Committee shall be formed during the year of construction in advance and prior to the commencement of construction. The landowners shall be responsible for recruiting the landowner members and advising the Company thereof. The Committee shall continue for a period of two (2) years from the date of commencement of construction and so long thereafter as the Committee determines is necessary.

Committee Make-Up

i) Members shall be affected landowners, and appropriate representatives of the Company. **The Joint Committee shall be composed of one GUSL landowner, one other landowner and three representatives of the Company;**

Payment to Landowner members

i) The Company will pay to the ***GUSL landowner member of the Joint Committee at his or her direction a total payment of $ 10,000 plus G.S.T. and the same amount to the other landowner member*** as an honorarium for their participation on the committee.

SCHEDULE 2

WOODLOT EVALUATION

At the time of signing of the Letter of Understanding the landowners with woodlots will be given 3 options.

1. take a one time full and final for the total easement.

2. take a one time full and final for that portion of the easement in agricultural land, and have the woodlot evaluated separately.

3. take the crop monitoring program and have the woodlot evaluated separately.

Woodlots will be assessed in the following manner:

A forestry consultant will cruise the woodlot to determine the amount of volume which could be harvested on a periodic basis from the woodlot under sustained yield management.

This volume will then be determined on an annual basis.

Current sale prices will then be given to this volume to determine an annual amount which could be harvested from the woodlot.

This value will then be present valued using the same formula as the one time payment option.

SCHEDULE 3

AESTHETIC TREE EVALUATION

The following procedure would be followed where a landowner wishes to have trees on his property evaluated for aesthetic values.

During discussions for the Letter of Understanding, the landowners would identify the trees he wishes to have evaluated for aesthetic purposes.

Union would contract a qualified person to complete an evaluation of the trees.

The landowners would be paid the evaluated price for the trees in addition to other payments.

If trees are less than 5 inches in diameter replacement of the trees may be considered in lieu of a payment.

If the landowner disagrees with Unions evaluation a second evaluation may be completed using the same criteria as the original evaluation.

EVALUATION CRITERIA

A four part evaluation criteria will be completed for aesthetic trees:

Tree Value	=	Basic Value	x	Species Rating	x	Condition Rating	x	Location Rating

Basic value is estimated without consideration of condition, species or location. It is calculated by multiplying the cross-sectional area of the tree trunk by an assigned value per square inch of trunk area. (in 1983 this value was $22.00)

Species rating is a percentage rating based on the relative qualities of the tree species.

Condition rating is a percentage rating based on the health of the tree.

Location rating is a percentage rating based on the location of the tree.

SCHEDULE 4

Schedule of Rates for Work
Performed by Owners of Land

Typically all work will be done by the Company. In the event that landowners perform work on behalf of the Company, at the Companys' expense, the company will remunerate the landowner in accordance with the following;

1.	Stonepicking	- $10.00 per hour/per person picking by hand
		- $45.00 per hour for use of tractor and wagon
2.	Chisel Plowing	- $70.00 per hour
3.	Cultivation	- $50.00 per hour
4.	Tile Inspection	- $20.00 per hour *

* Payment for Tile Inspection is for those hours spent inspecting tile at the request of the contractor.

SCHEDULE 5

Wet Soils Shutdown

The following sets out the Wet Soils Shutdown practice of Union Gas Limited for pipeline construction, repair and maintenance on agricultural lands.

Wet Soils Shutdown issues shall be decided by the Joint Committee with the assistance of the construction monitor as required.

While constructing the Company's pipeline the Company's senior inspectors inspect right-of-way conditions each day before construction activities commence for that day. If, in the judgment of these inspectors ***or other Company representatives and other members of the Joint Committee with the assistance of the construction monitor***, the right-of-way conditions on agricultural lands are such that construction would have an adverse affect on the soils due to wet soils conditions, the contractor is prohibited from starting construction activities. The inspectors***/other Company representatives and other members of the Joint Committee with the assistance of the construction monitor*** shall consider the extent of surface ponding, extent and depth of rutting, surface extent and location of potential rutting and compaction (i.e, can traffic be re-routed within the easement lands around wet area(s)) and the type of equipment and nature of construction proposed for that day. The wet soil shutdown restriction would be in effect until, in the judgment of ***the Company representatives and other members of the Joint Committee with the assistance of the construction monitor***, the soils would have sufficiently dried to the extent that commencing construction activities would have no adverse affects on the soils.

Wet soils shutdown is a routine part of Union's normal management process for pipeline construction activities. In recognition of this, Union budgets for and includes in contract documents, provisions for payment to the pipeline contractors for wet soils shutdown thereby removing any potential incentive for the contractor to work in wet conditions.

In addition, Union's inspection staff ***and the Joint Committee with the assistance of the construction monitor are*** responsible for ensuring that construction activities do not occur during wet soils shutdown. This would include shutting down construction activities if soils became wet during the day.

It should, however, be recognized that there may be situations when construction activities cannot be carried out during the normal construction period due to delays in project timing and it may become necessary to work in wet conditions in the spring or fall of the year. ***Where construction activities are undertaken by the Company in wet soil conditions (as determined by the monitor),*** additional mitigation measures ***may be*** put in place to minimize resulting damages. Mitigation measures may, where appropriate, be developed by Union on a site specific basis and may include avoiding certain areas, full easement stripping, geotextile roads, the use of swamp mats, or the use of other specialized equipment where deemed appropriate by Union. Union will authorize work in wet soils conditions only when all other reasonable alternatives have been exhausted.

Where construction activities are undertaken by the Company in wet soil conditions (as determined by the monitor),the Company shall pay to the landowner 150 % of disturbance and crop loss damage compensation on the area affected by the activities (area also to be determined by the construction monitor). The 150 % payment applies only once to any one area; on areas where the 150 % payment is applied, the landowner forfeits the right to top-up of crop loss damages under the L.O.U.. The 150 % payment does not affect the landowner's right to topsoil replacement where crop loss exceeds 50 % in the fifth year following construction.

PIPELINE CONSTRUCTION AND IMPACTS ON AGRICULTURAL LANDS: A HISTORICAL REVIEW OF THE UNION GAS SOIL/CROP MONITORING PROGRAM

ENVIRONMENTAL CONSULTING · ECOTOXICITY TESTING · ENVIRONMENTAL TECHNOLOGIES

PIPELINE CONSTRUCTION AND IMPACTS ON AGRICULTURAL LANDS: A HISTORICAL REVIEW OF THE UNION GAS SOIL/CROP MONITORING PROGRAM

Prepared for:

Union Gas Limited
50 Keil Drive North
Chatham, Ontario
N7M 5K1

Prepared by:

V. Alder, E.E. Mackintosh and E. Mozuraitis
ESG International
361 Southgate Drive
Guelph, Ontario
N1G 3M5

G97202
July, 1998

Approved by: [signature]
Date: 9/07/98

TABLE OF CONTENTS

1. INTRODUCTION 1

2. HISTORICAL PERSPECTIVE 3
2.1 Dawn-Trafalgar Pipeline System 3
2.2 Pipeline Construction Practices 5
2.3 Crop and Soil Monitoring Programs 7

3. IMPACTS OF PIPELINE CONSTRUCTION ON CROP YIELDS 9
3.1 Dawn-Kerwood Pipeline Loop 9
3.2 Data Variability 9
3.2.1 Climate 9
3.2.2 Crop Type 9
3.2.3 Farm Management Practices 11
3.2.4 Construction Practices 11
3.3 Crop Yield Trends 12
3.3.1 General 12
3.3.2 Variation in Crop Yield Across the Easement 12
3.3.3 Variations in Crop Yield Over Time 14
3.3.4 Impact of Subsoiling Practices 16

4. EFFECTS OF CONSTRUCTION ON SOIL PROPERTIES 17
4.1 Soil pH and Calcium Carbonate Levels 17
4.2 Soil Organic Matter Levels 19
4.3 Soil Fertility Levels 19
4.4 Soil Bulk Density 20

5. CONCLUSIONS 22

6. LIST OF REPORTS 24
6.1 Monitoring and Research Reports, Dawn-Kerwood Pipeline Loop 24
6.2 Monitoring Reports, Other Loops 24
6.3 Other References 25

TABLES

1. Pipeline Loops Constructed Since 1975 on the Trafalgar System 3
2. Average Crop Yield 10
3. Variation in Average Soybean Yield (% of Control) by Property - NPS 42 Strathroy/Lobo 11
4. Average Crop Yield On Easement by Construction Activity 14

Average On Easement Crop Yield by Construction Activity for the NPS 42 and 48 Pipelines 14
6. Average Soil pH and Calcium Carbonate Levels for Each Sample Location 17
Average Soil Organic Matter Levels in Relation to Easement Location 19
Average Soil Fertility Levels in Relation to Easement Location 19

FIGURES

Trafalgar Pipeline System Corridor 2
2. Typical Cross-Section for Construction of NPS 48 Pipelines 4
Typical Easement Layout for Trafalgar Pipeline System 6
General Crop Yield Trends for NPS 42/48 pipelines constructed from 1975-1994 13
Impact of Subsoiling on Crop Yields over the Trench Line (NPS 42 Dawn to Kerwood) 15
6. Soil Associations along the Trafalgar Pipeline System Corridor 18
Average Soil Bulk Density Levels by Easement Area, NPS 48 St. Mary's to Beachville (expressed as % of control) 21

APPENDICES

A General Sampling Design for Crop Monitoring Programs

1. INTRODUCTION

The Union Gas Trafalgar System extends from the Dawn Compressor Station in Lambton County to the Trafalgar Compressor Station in the Regional Municipality of Peel (Figure 1). The system contains two to four pipelines: a 26 inch diameter pipeline constructed in 1957; a 34 inch diameter pipeline constructed from 1964 to 1970; a 42 inch diameter pipeline constructed from 1974 to 1989; and a 48 inch diameter pipeline which began construction in 1990.

The pipeline primarily crosses prime agricultural lands in Lambton, Middlesex and Oxford Counties and Waterloo Region and, to a lesser extent, in the eastern section through Hamilton-Wentworth and Halton Regions. Consequently, many of the environmental issues that have surfaced during construction focus on mitigation and restoration of agricultural lands.

A crop monitoring program was initiated by Union Gas in 1976 on the Dawn/Kerwood pipeline loop as a means of being able to assess the level of crop damage for payment of compensation packages to farmers. The program has been expanded over time to include: research into techniques for improving restoration of agricultural lands; refinement of crop sampling design for improved measurements; and the inclusion of soil monitoring. Significant changes have also been made to pipeline construction techniques on agricultural lands, since the initial construction of the NPS 42 Dawn/Kerwood pipeline loop.

Union Gas has developed a substantial soil/crop monitoring database since 1976 and it is the purpose of this report:

1) to provide a historical documentation of the program;

2) to assess, to the extent possible, the impact that changes in pipeline construction practices have had on restoration of agricultural lands; and

3) to develop conclusions, based on the existing database, with respect to ongoing construction practices and soil/crop monitoring programs.

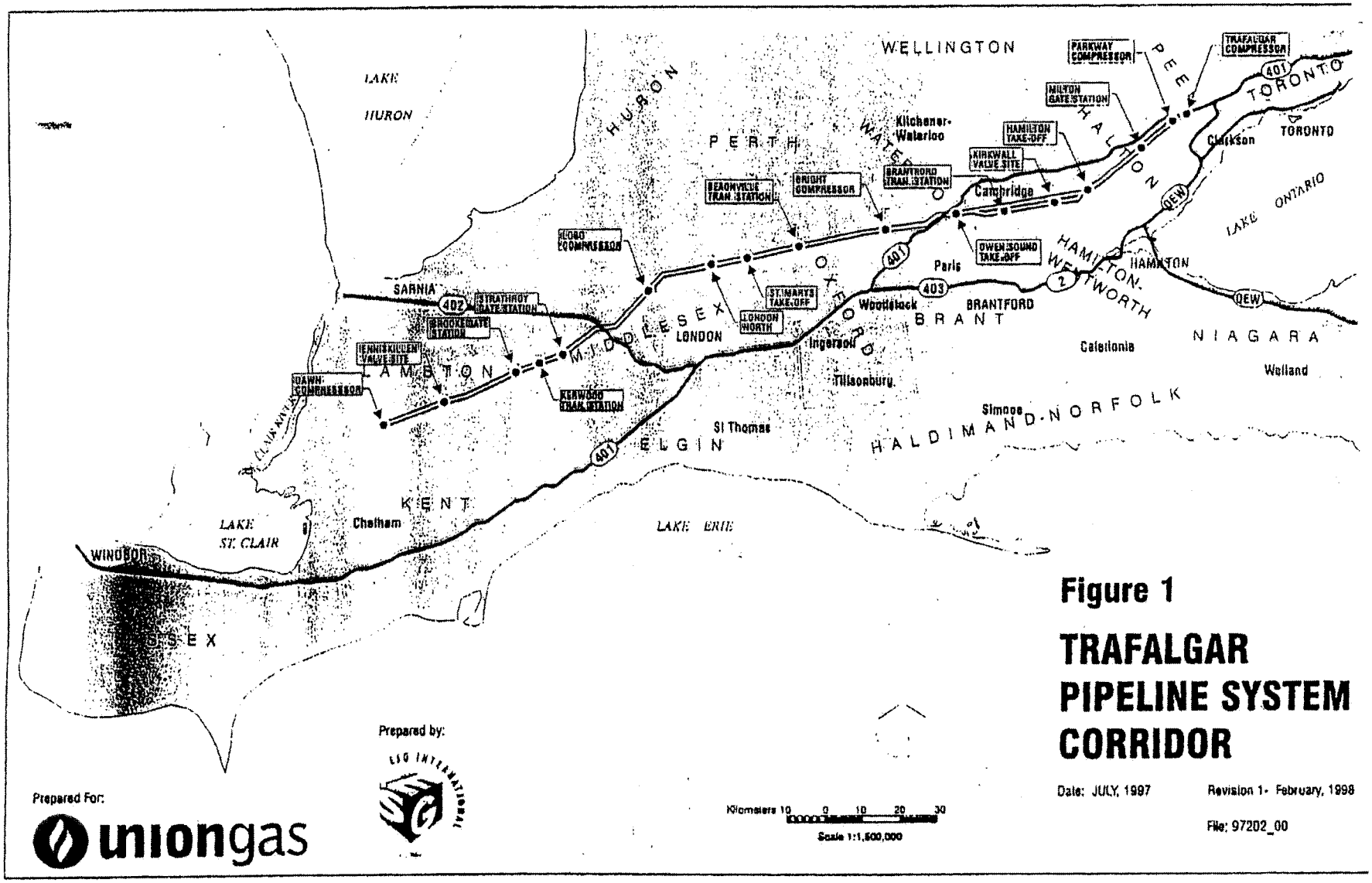


Figure 1

TRAFALGAR PIPELINE SYSTEM CORRIDOR

Date: JULY, 1997 Revision 1- February, 1998

File: 97202_00

2. HISTORICAL PERSPECTIVE

2.1 Dawn-Trafalgar Pipeline System

The Dawn-Trafalgar pipeline easement includes two to four existing pipelines, NPS 26, 34 and 42 and a fourth NPS 48, that is in various stages of construction. Construction of the NPS 42 and 48 pipelines has been undertaken in stages (or by construction loop) as outlined in Table 1. The choice and length of the construction loop is determined by gas demand and related engineering design parameters.

A typical cross-section of an easement used in construction of the pipelines is shown in Figure 2. There are exceptions, of course, but for the majority of the line, this diagram can be used.

Table 1. Pipeline Loops Constructed Since 1975 on the Trafalgar System

Pipe Diameter (inches)	Pipeline Loop	Year of Construction	Type of Monitoring/Years
42	Dawn/Enniskillen	1975	• crop (1976-80); Brooke/Kerwood started in 1977 • crop (1981-1985) • studies completed on soil restoration program (1981-1984) and crop sampling program (1988-1990) • soil restoration program (1983-present)
42	Enniskillen/Brooke	1975	
42	Brooke/Kerwood	1976	
42	Lobo/London	1979	• crop (1981-1985)
42	London/St.Mary's	1981	• crop (1982-1986)
42	Kerwood/Strathroy	1982	• crop (1983-1987)
42	Bright/Owen Sound	1982	• crop (1983-1987)
42	St.Mary's/Beachville	1984	• none
42	Owen Sound/Brantford	1985	• none
42	Brantford/Kirkwall	1988	• none
42	Strathroy/Lobo	1989	• crop (1991, 93, 95)
42	Beachville/Bright	1989	• crop (1991, 93, 95)
48	Kirkwall/Hamilton	1990	• soil (1991) • crop (1993, 95)
48	Lobo/St.Mary's	1991	• soil (1993) • crop (1993, 95)
48	Milton/Parkway	1991	• soil (1993) • crop (1993, 95, 97)
48	St.Mary's/Beachville	1993	• soil (1995) • crop (1995, 97)
48	Enniskillen/Brooke	1994	• soil (1996) • crop (1996)
48	Bright/Owen Sound	1996	• studies to be started in 1998

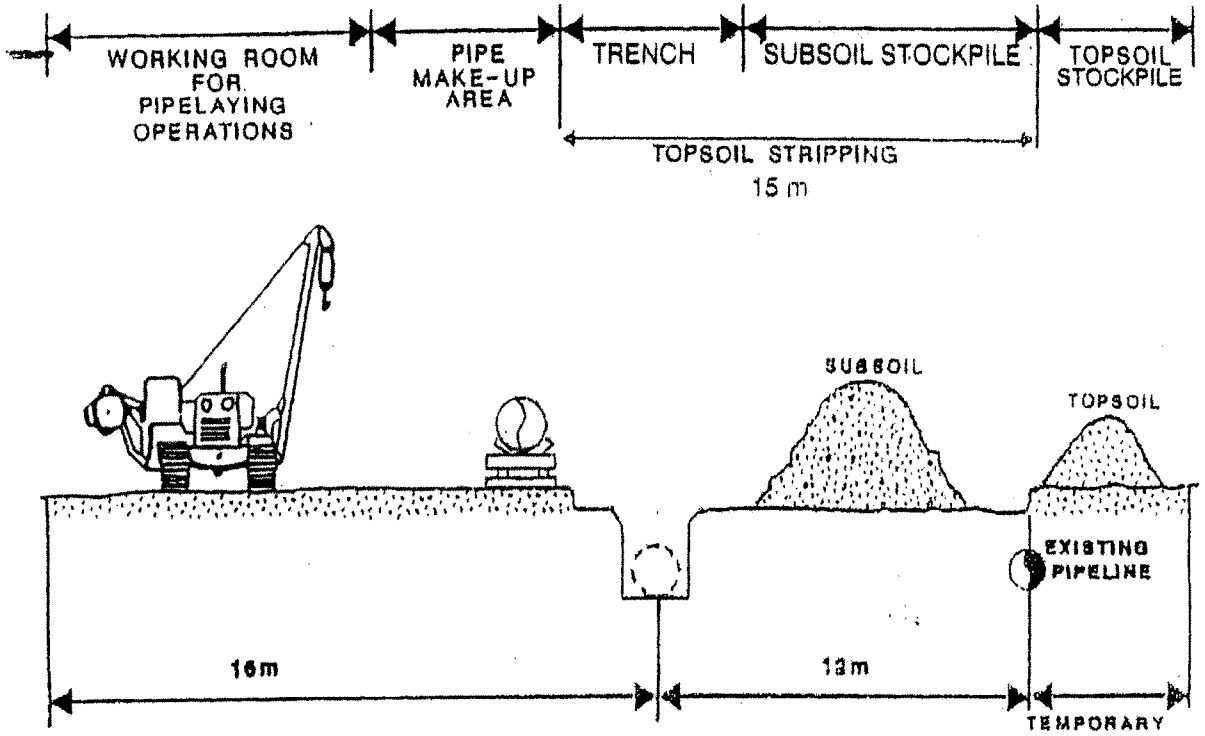


Figure 2

TYPICAL CROSS-SECTION OF AN EASEMENT FOR CONTRUCTION OF NPS 48 PIPELINES

Prepared For: uniongas

Prepared by:

Date: JULY, 1997 Revision 1- February, 1998

File: 97202_03

GAPLO 283

Each successive construction easement is overlapped with the previous easement so that the spoil area of the NPS 48 is usually located over the workspace and trench area of the NPS 42. A typical plan view of the Dawn to Trafalgar easement is shown in Figure 3. The area of easement overlap is where cumulative effects impacts are observed.

2.2 Pipeline Construction Practices

In 1976, the Ontario Energy Board issued its first set of guidelines and these have since undergone several revisions (fourth edition, 1995). Environmental construction practices and post-construction compliance monitoring used on all the construction loops since 1976 follow the OEB guidelines, Union Gas specifications, and recommendations arising from the environmental assessment.

Numerous changes have been made to pipeline construction and cleanup practices since 1976 as a result of: improvements to equipment and construction techniques, feedback from farmers and farm groups, and evaluation of results obtained from the soil/crop monitoring program. The more important changes have been as follows:

- **Wet Soil Shutdown** - Formerly called wet weather shutdown, Union Gas implemented a policy on wet soil shutdown on the NPS 42 Lobo/London pipeline loop in 1979. It involves suspending most construction activities on the pipeline easement as a result of wet soil conditions that may lead to excessive rutting or impacts on soil properties.
- **Trench Line Management** - There are two main construction activities addressed under trenchline management, subsidence over the trench and location of stringing trucks. Crowning the trench to offset subsidence of soil backfilled around the pipe was initiated in 1979. Further amendments to this practice were made in 1993 and involve hauling away excess trench materials as opposed to feathering the material over the spoil pile side of the trench. Rerouting the stringing trucks over the trench line was implemented as a standard practice in 1989. Up to that time, stringing trucks used the workspace or the trench area for travel.
- **Soil Construction Inspection** - A topsoil conservation inspector is responsible for agronomic aspects of topsoil conservation, such as topsoil removal based on soil horizon depth rather than uniform depth, and appropriate stockpiling and topsoil replacement to its original location. In addition, the soil inspector addresses issues of easement compaction.
- **Construction Clean Up** - Clean up includes construction activities related to soil tillage for ameliorating soil compaction on easement, stone picking and repair of tile drainage, among others. During the 1980s, most tillage operations were completed using a chisel plough to a depth of 15-20 cm. The use of subsoilers on easement was limited. In 1993, subsoiling was introduced as a standard construction clean up practice. As well, the environmental inspectors also inspected the clean up operations in greater detail using soil penetrometers or related equipment to assess soil compaction.

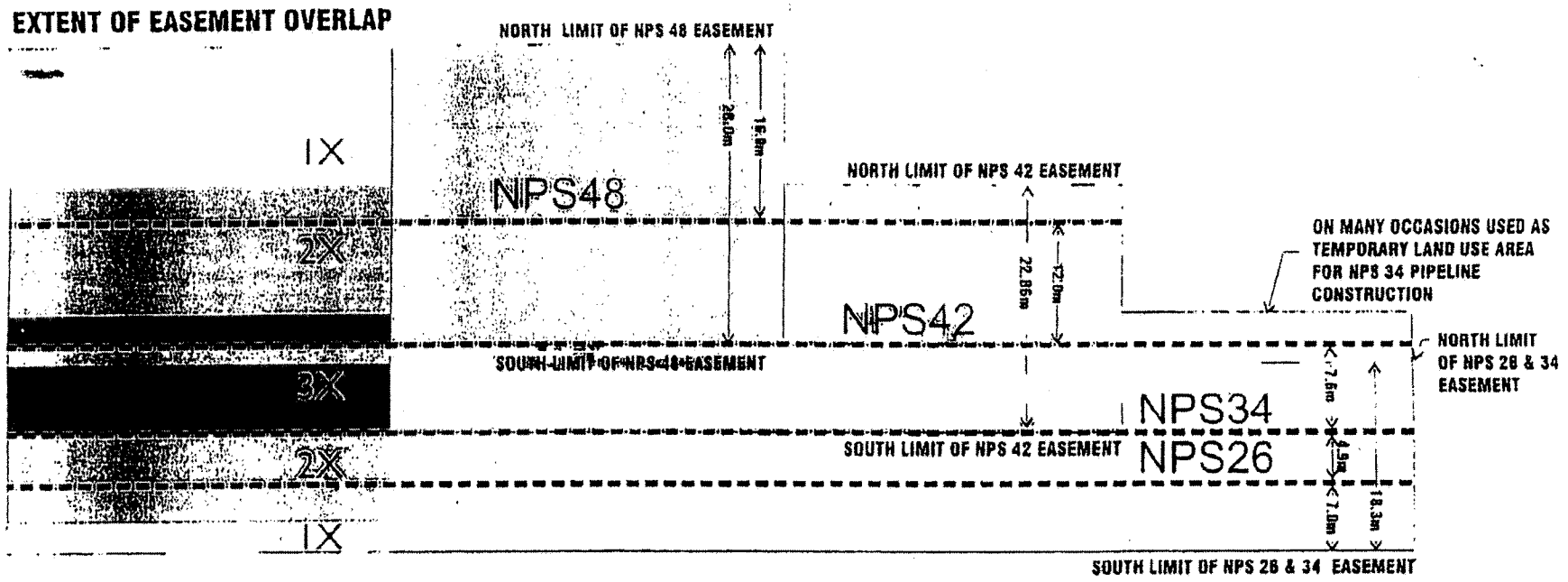


Figure 3

TYPICAL EASEMENT LAYOUT** FOR TRAFALGAR PIPELINE SYSTEM

**SITE VARIATIONS DO OCCUR

Prepared For: uniongas

Prepared by: ESG INTERNATIONAL

PROJECT NORTH

Date: JULY, 1997 Revision 2 - March 1998 File: 97202_02

- **Post Construction Mitigation** - This included activities primarily related to growing green manure crops such as red clover and alfalfa in years following construction. This is a voluntary program and was first offered to the farmers in 1984. Compensation is paid to the farmer to grow the green manure crops on easement.

During the same period, payment to the contractor allocated by Union increased from 15% of the contract for backfilling and cleanup in 1979, to 15% for cleanup alone from 1981 to 1984 and 25% for cleanup in 1985.

2.3 Crop and Soil Monitoring Programs

The Union Gas crop monitoring program began in 1976 following construction of the NPS 42 Dawn/Kerwood pipeline. Construction of the Dawn-Kerwood section actually began in 1974, however, due to technical problems with the pipe and field welding construction on the Dawn/Enniskillen loop was post-poned until 1975. Construction on the Dawn/Enniskillen and the Enniskillen/Brooke valve loops were completed in the fall of 1975. Wet weather resulted in adverse conditions during construction, post-construction cleanup and soil restoration. This resulted in significant loss of topsoil due to mixing, severe soil compaction and degradation of soil structure across the easement. The section of the line from the Brooke Valve to Kerwood Transmission Station was constructed in 1976 under more ideal weather and soil conditions.

Initial crop monitoring results collected in 1976 showed average on-easement crop yields ranging from 18-49 percent of the control depending on crop type. Crop yields gradually improved over the period to 1980 but still remained low (Table 2). As a result of these losses Union Gas undertook a three year soil restoration research program in fall, 1981. The purpose of the research program was three fold:

1) to determine the limiting soil conditions along the easement that were adversely impacting crop yield;

2) to assess the effectiveness of subsoiling and green manure crops on ameliorating crop yield losses; and

3) to recommend a soil restoration program for implementation along the Dawn-Kerwood easement to ameliorate adverse crop impacts.

The study resulted in a recommendation to subsoil the easement and implement a green manure program. A majority of the farmers along the easement accepted the subsoiling program which was completed in the fall of 1984. Although a crop compensation program was included as part of the green manure program, only a limited number of farmers actively implemented the trials due to the crop rotation system in usage at the time (i.e., corn/soybean/winter wheat).

Without the benefits of the green manure crops used in association with subsoiling, the improvements in crop yield from subsoiling lasted about 1-3 years. The green manure program remained in place for the farmers on the Dawn/Kerwood section until 1993 when it was replaced with a Soil Restoration Program. This program is a voluntary, ten year program that consists of compensating the farmers for taking the Union Gas easement out of general field crop production and planting to green manure crops. The program is

midway through the ten year cycle and has been implemented by approximately 25 to 30 farmers.

Crop monitoring data was collected on a five year program for loops constructed from 1976-1982 (Table 1). The Dawn to Kerwood loop contains 10 years of data (i.e., 2 five year programs). Crop monitoring data was changed to a 1, 3 and 5 year program following construction in 1989. As well, the sampling design for crop monitoring was also modified as a result of detailed field studies (ESP, 1990). A comparison of the field sampling procedures pre- and post-1989 is contained in Appendix A. The main modifications made to the sampling procedures consisted of increasing the minimum number of field replications from about 3 to 6 and subsampling the easement as work space, trench area and spoil area. The width of the area in workspace, trench and spoil pile is then used to calculate the average yield for the entire easement.

Throughout the crop monitoring program yield information on easement has always been expressed as a percentage of the off easement control sample. A control site, paired with each on easement sample, was located 10 m off easement in the farm field.

Although detailed soil information was collected on the Dawn/Kerwood Loop during the research study in 1981-84, routine collection of soil information did not begin until 1991 during construction of the Kirkwall/Hamilton Loop. Site information has also been collected on a farm-to-farm basis to address individual farmer concerns.

3. IMPACTS OF PIPELINE CONSTRUCTION ON CROP YIELDS

3.1 Dawn-Kerwood Pipeline Loop

The NPS 42 Dawn/Brooke pipeline was constructed in 1974-75 under adverse climatic and soil conditions which have not been repeated since. In this respect, the crop yield data provides a good indication of the magnitude of potential crop yield losses under worst case scenarios (Table 2), and as well, provides some guidance as to the long term residual impacts that can be expected from construction under adverse conditions. Average crop yields on easement for the first five years were 48 per cent and for the second 5 years still remained at 72 per cent of the control (Table 2). These levels are substantially below average crop yields for all remaining pipeline loops. This contrasts dramatically with results obtained for the NPS 48 Enniskillen/Brooke section of the Dawn/Kerwood loop constructed in 1994. Construction of this section occurred under what is considered as "normal present day construction practices" and average crop yields obtained from the 1 year after crop monitoring were 98 percent of the control.

3.2 Data Variability

Although the crop monitoring program to date contains some 21 years of data, there is a wide range in crop performance on easement within any given year along the pipeline loops.

3.2.1 Climate

Data from the field crop monitoring program are subject to the same yearly variations in climate that impacts upon overall farm yields. Indeed, under extreme moisture deficits or surplus, crop yields are impacted to a greater extent on easement due to modifications in water holding capacity that occur as a result of soil compaction and/or degradation of soil structure (see Section 4.4).

3.2.2 Crop Type

The common crop rotation program grown throughout most of the prime agricultural areas usually consists of some combination of cash cropping with corn, soybeans and cereals, particularly winter wheat.

Results obtained from the Dawn/Kerwood crop monitoring program during the period 1976-85 suggested that soybeans suffered greater crop loss than corn and winter wheat on the fine textured clay soils.

More recent yield data does not support this initial observation along the entire easement, although it is apparent that crop maturity immediately over the trench area is delayed. It is particularly evident and troublesome in the case of soybeans which can remain green over the trench for some time after the adjacent crop has ripened which leads to problems with harvesting timeliness.

Table 2. Average Crop Yield for Whole Easement (expressed as percent of control) for All Crops by Pipeline Loop

Pipeline Loop	Year Constructed/ Diameter	Year Program Started	Year 1		Year 2		Year 3		Year 4		Year 5		Average
			Average Yield	Range	Average Yield	Range	Average Yield	Range	Average Yield	Range	Average Yield	Range	
Dawn/Enniskillen	1975/NPS 42	1976	32	*	41	*	48	*	54	*	65	*	48
Dawn/Kerwood	1975/NPS 42	1981	72	12-97	69	23-100	74	24-116	75	41-96	72	26-116	72
Lobo/London	1979/NPS 42	1981	83	32-136	76	37-100	74	27-122	81	47-95	81	60-102	79
London/St.Mary's	1981/NPS 42	1982	78	38-100	80	60-102	85	60-99	82	54-92	86	65-100	83
Kerwood/Strathroy	1981/NPS 42	1983	77	52-99	83	33-118	78	46-97	86	56-108	80	49-92	81
Bright/Owen Sound	1982/NPS 42	1983	80	51-103	78	42-105	80	57-92	81	60-103	78	45-100	80
Beachville/Bright	1989/NPS 42	1991	82	48-99	--	--	78	68-94	--	--	83	78-88	81
Strathroy/Lobo	1989/NPS 42	1991	78	49-104	--	--	81	59-99	--	--	85	70-100	81
Kirkwall/Hamilton	1990/NPS 48	1991	*	*	--	--	94	77-121	--	--	79	79	91
Lobo/St.Mary's	1991/NPS 48	1993	90	63-136	--	--	86	32-116	--	--	86	62-102	88
Milton/Parkway	1991/NPS 48	1993	105	83-129	--	--	77	58-106	--	--	92	82-108	93
St.Mary's/Beachville	1993/NPS 48	1995	87	76-100	--	--	83	44-107	--	--	--	--	85
Enniskillen/Brooke	1994/NPS 48	1996	98	84-115	--	--	--	--	--	--	--	--	98

* data not available

-- program changed to 1, 3, 5 year after crop monitoring

\reports\97\table3.202

3.2.3 Farm Management Practices

Management practices vary considerably from farm to farm and these have a major impact on the response of crop yields on easement. Table 3 shows the variation in crop yield obtained on four different farms in 1993. Such variations are typical for the easement

Table 3. Variation in Average Soybean Yield (% of Control) by Property - NPS 42 Strathroy/Lobo

Property	Workspace	Trench Line	Spoil Side	Total Easement
1	103	76	79	87
2	75	50	51	59
3	96	98	80	88
4	80	57	73	73

and are further illustrated in Table 2 which shows the range in yield for any given year and pipeline loop.

3.2.4 Construction Practices

Continuous changes to and improvements in construction and cleanup practices have occurred throughout the duration of the crop monitoring program. A number of these changes are referred to in Section 2.2. Due to the large number of variables involved in determining annual crop yield it is impossible to attribute or allocate percentage improvements in crop yield to any one specific construction practice. However, it is clearly evident that average crop yields on easement have gradually improved (see Section 3.3) over the past twenty years. A considerable amount of this improvement must rest with the changes in construction practice (e.g., implementation of wet soil shutdown policy and, in particular, in construction cleanup). As an example, average on easement crop yields (Table 2) for NPS 48 spreads constructed in the 1990s is about 89 per cent as compared to the NPS 42 constructed in the 1970/80s which is about 77 per cent. These differences are statistically significant at P less than 0.001.

The benefit accrued from changes in policies and practices is evident from direct comparisons of crop yield data obtained from construction of the NPS 42 and 48 pipelines. The NPS 48 Lobo/St. Mary's Loop (constructed in 1991) has an average on-easement yield of 88 percent based on the 1 and 3 year after crop monitoring program (Table 2). The comparable NPS 42 loops are the Lobo/London and London/St. Mary's constructed in 1979 and 1981 respectively. The average on easement crop yield obtained from averaging the respective 5 year programs is 81 per cent. The average crop yields are statistically significantly higher (P less than .05) for the more recently constructed NPS 48 Lobo/St. Mary's than for either of the NPS 42 Lobo/London and London/St. Mary's pipeline loops. Overall changes made in construction practices from 1979/81 to 1991 are a major factor contributing to these improvements. A more significant improvement was noted for the NPS 48 Enniskillen/Brooke loop although that observation is limited to the first year after monitoring program (see Section 3.1).

3.3 Crop Yield Trends

3.3.1 General

The overall improvement in on easement crop yields for corn, soybeans and winter wheat during the period 1976 to 1997 is shown in Figure 4. The data show a clear trend toward higher crop yields on easement and a reduction in impacts related to pipeline construction over time. Fit of a straight line through the data indicates an increase of 0.83 per cent per year over the period 1976 to 1997.

Due to the number of variables that impact on crop yield, it is difficult to ascribe an actual per cent to any one factor. However, one would expect that the impact of climate would average out over time. Similarly, farm management and crop rotation practices have changed in response to new innovations and research results. Here too, the relative impact of these practices on the control and on easement yields could be expected to act in a similar direction. This primarily leaves the changes to pipeline construction and clean up practices (Section 2.2) as the major factor influencing the overall yield trends.

A more detailed breakdown of average yields and the related range in crop yield is shown for each construction loop in Table 2. As discussed in Section 3.2.4, there is a significant improvement in on easement crop yields for construction loops built in the 1990s as compared to those constructed from 1976 to 1989.

3.3.2 Variation in Crop Yield Across the Easement

Prior to 1989, on easement yields were measured by sampling across the easement; hence, an average crop yield for the entire easement was obtained. Crop sampling design was modified in 1991 to correspond with the construction activity on easement (i.e. work space, trench area and spoil area (Figure 2)). Average crop yield for the workspace, trench and spoil areas are 91, 81 and 84 per cent of the control, respectively (Table 4). Clearly, the trench and spoil pile areas are the most impacted by construction activities. The trench area is the most impacted since the soils are compacted over the pipe to minimize subsidence and they are not subsoiled during construction clean up.

While not always the case, the spoil area is often the work space and trench line area of the previous construction easement. The reduced crop yield on the spoil area would thereby be related to residual impacts associated with the construction activities and clean up practices used on the work space of the previous construction easement (see Section 4.4).

Table 5 presents the same data as contained in Table 4 but recalculated to compare the results for the NPS 42 and 48 pipelines.

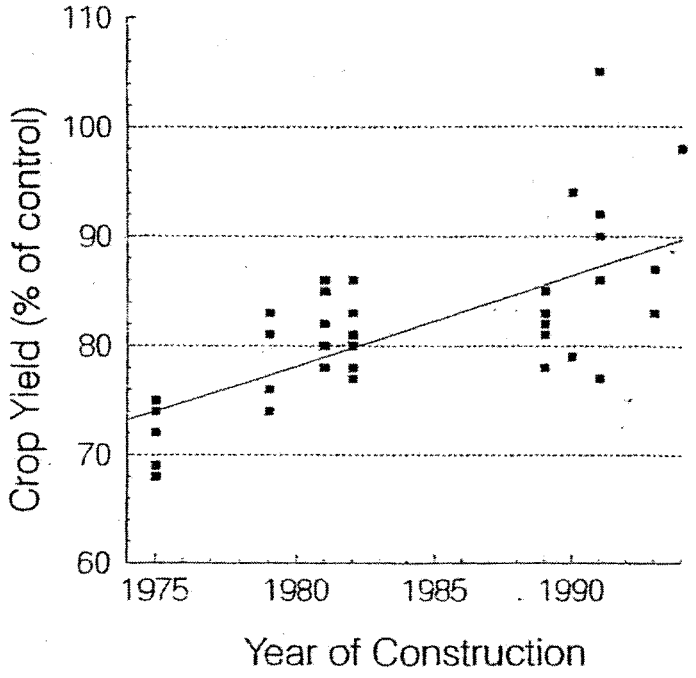


Figure 4. General Crop Yield Trends for NPS 42/48 Pipelines Constructed from 1975 - 1994.

Table 4. Average Crop Yield On Easement by Construction Activity (expressed as % control for all crop/properties)

Construction Loop	Year Constructed/ Diameter	Year Sampled	Spoil Area	Trench Area	Workspace	Whole Easement *
Strathroy-Lobo	1989/NPS 42	1991	--	73	80	78
		1993	76	77	90	81
		1995	82	80	92	85
Beachville-Bright	1989/NPS 42	1991	--	79	83	82
		1993	77	75	81	78
		1995	84	63	90	83
Kirkwall-Hamilton	1990/NPS 48	1993	98	92	90	94
		1995	80	59	82	79
Lobo-St.Mary's	1991/NPS 48	1993	90	89	91	90
		1995	83	86	91	86
		1997	85	85	86	86
Milton-Parkway	1991/NPS 48	1993	93	111	115	105
		1995	72	60	85	77
		1997	82	92	101	92
St.Mary's-Beachville	1993/NPS 48	1995	81	74	96	87
		1997	78	71	90	83
Enniskillen-Brooke	1994/NPS 48	1996	94	103	102	98
Average			85	84	91	87

* calculated using width of respective easement areas

Table 5. Average On Easement Crop Yield by Construction Activity for the NPS 42 and 48 Pipelines (% of control for all crops)

	Spoil Area	Trench Area	Workspace	Whole Easement
NPS 42	79	75	85	81
NPS 48	86	86	93	89

Average crop yields show significant improvements on all areas of the easement of the NPS 48 over the NPS 42 pipeline.

3.3.3 Variations in Crop Yield Over Time

Further reference to Table 2 suggests that the average crop yield for any particular construction easement does not change markedly over the duration of the sampling program. Consequently, modifying the crop sampling program from a continuous 5 year program to a 3 year one consisting of 1, 3, 5 year after sampling provides one with a reliable set of data with cost savings.

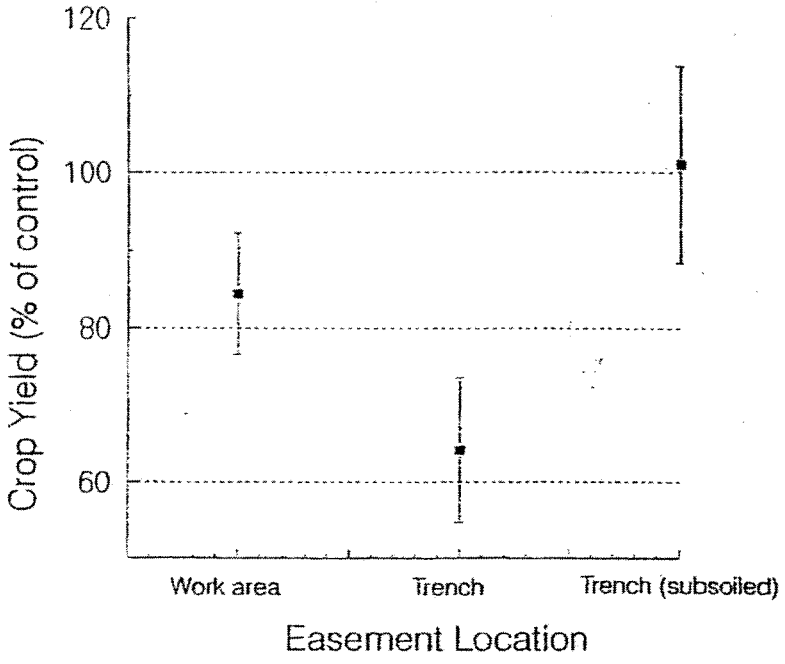


Figure 5. Impact of Subsoiling on Crop Yields over the Trench Line (NPS 42 Dawn to Kerwood).

3.3.4 Impact of Subsoiling Practices

Research undertaken during the soil restoration program from 1981 to 1984 demonstrated that significant benefits could be accrued from subsoiling the NPS 42 pipeline easement over the trench area (Figure 5). The Dawn-Kerwood loop is constructed in fine textured clay soils. During trenching operations in 1975, soil structure, which is critical to the productivity of these soils, was destroyed and, as well, the subsoil was highly compacted as a result of backfilling the trench area under wet, late fall construction conditions. These conditions restrict water and air movement through the soil and also reduce root penetration.

The practice of subsoiling over the trench area was evaluated on twelve farms. Crop yield for cereal, corn and soybean improved considerably in the year following the subsoiling operation from an average of 64 per cent to 101 per cent. Subsequent interviews with farmers suggested that the beneficial impacts of subsoiling lasted up to 3 years. This is consistent with research done elsewhere on soils with comparable impacts.

Subsoiling loosens the soil and allows water, air and root penetration. Penetration of roots, particularly when using deep rooted green manure crops such as alfalfa, help promote structure redevelopment and the maintenance of soil pores with depth.

Subsoiling was also included as a standard practice in construction clean up during the 1990s. The noticeable improvements in average on easement crop yields for construction loops completed in the 1990s (Table 2) also suggest that inclusion of subsoiling as a standard practice in the construction clean up program has been beneficial.

4. EFFECTS OF CONSTRUCTION ON SOIL PROPERTIES

Monitoring of soil properties during the 1 year after crop sampling program was implemented in 1991. With some exceptions, the sampling includes characterization of topsoil pH, fertility levels, soil organic matter, calcium carbonate levels and soil bulk density. The easement is subsampled in the same manner as for the crop sampling design. Similarly, a control off easement is sampled 10 m perpendicular from the easement edge.

The general soil conditions found along the pipeline corridor are shown in Figure 6. Fine textured, clay soils are common in Lambton and Middlesex Counties and the Regions of Halton and Peel. Clay loam to loam soils are more common in Oxford and Brant Counties, while coarse textured soils are found in the Region of Waterloo. Shallow soils to bedrock occur in the Region of Hamilton-Wentworth.

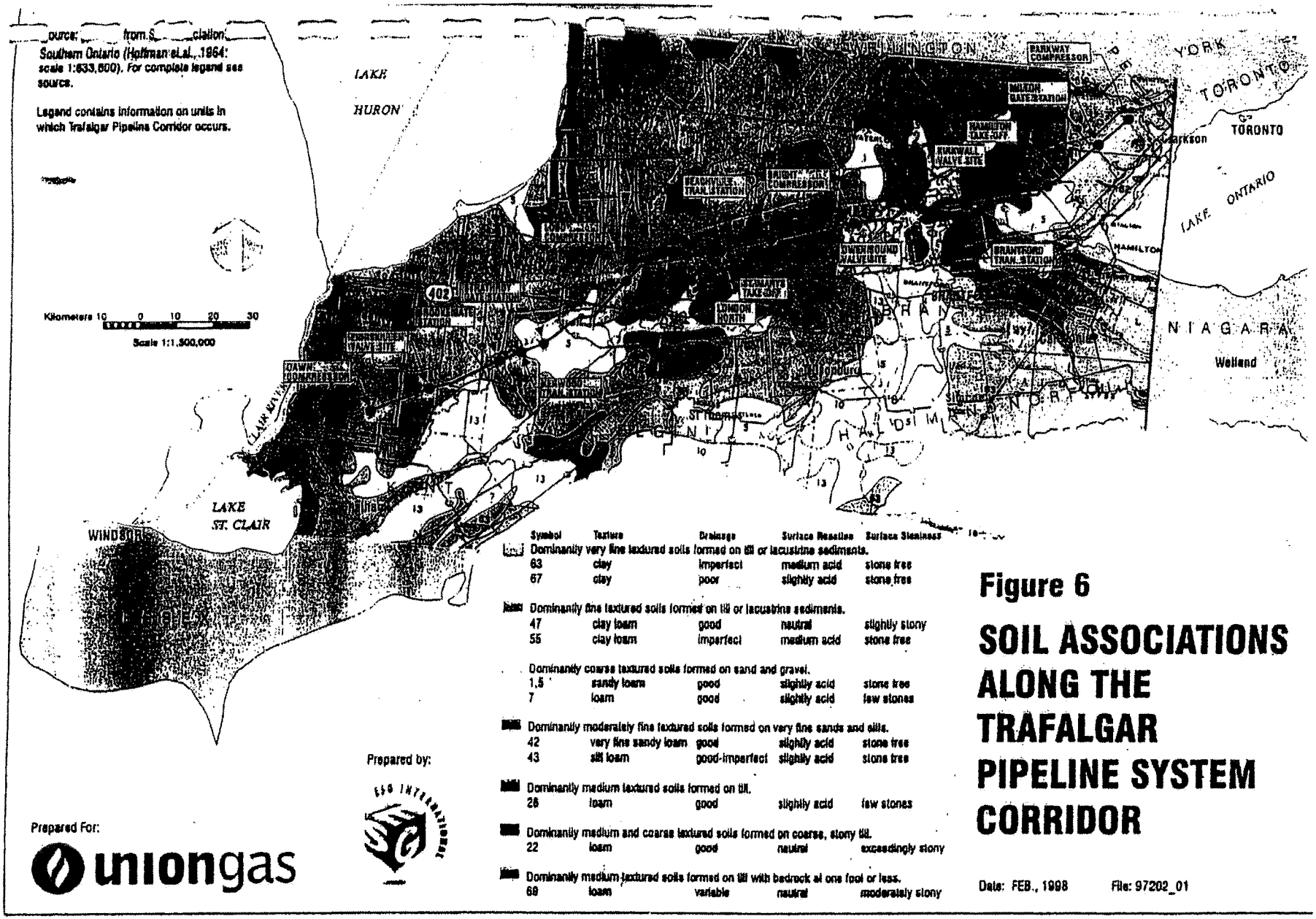
4.1 Soil pH and Calcium Carbonate Levels

As a result of construction activities, soil pH and calcium carbonate levels are normally higher on easement as compared to the control, in particular for the trench and spoil pile areas. The workspace values are more similar to the control which is also consistent with observations from the crop yield data (i.e. construction impacts are greatest for the trench and spoil pile areas).

On the Lobo-St. Mary's line, sampling of carbonates below the plow layer revealed even more substantially elevated levels on the trench and spoil side than was evident in the topsoil samples (Table 6). The trenching operation results in the mixing of the B and C horizons which is used to backfill the trench; hence, the high levels of calcium carbonates.

Table 6. Average Soil pH and Calcium Carbonate Levels for Each Sample Location (average for all properties)

Pipeline Loop	NPS 48 (Year Constructed)	Soil depth (cm)	Spoil Pile		Trench		Workspace		Control	
			pH	$CaCO_3$ equiv. (%)	pH	$CaCO_3$ equiv. (%)	pH	$CaCO_3$ equiv. (%)	pH	$CaCO_3$ equiv. (%)
Kirkwall-Hamilton	1990	0-15	–	–	7.7	11.4	7.7	11.6	7.6	7.9
Lobo-St.Mary's	1991	0-15	7.8	9.0	7.8	9.0	7.7	4.8	7.5	2.6
		15-30	–	19.1	–	17.5	–	6.9	–	4.9
Milton-Parkway	1991	0-15	7.5	3.3	7.5	3.1	7.2	1.4	6.5	0.7
St.Mary's-Beachville	1993	0-15	7.6	4.8	7.7	4.7	7.1	1.5	6.5	1.3
Enniskillen-Brooke	1994	0-20	7.7	4.9	7.7	5.4	7.3	2.5	6.9	2.3



Symbol	Texture	Drainage	Surface Reaction	Surface Stoniness
Dominantly very fine textured soils formed on till or lacustrine sediments.				
63	clay	imperfect	medium acid	stone free
67	clay	poor	slightly acid	stone free
Dominantly fine textured soils formed on till or lacustrine sediments.				
47	clay loam	good	neutral	slightly stony
55	clay loam	imperfect	medium acid	stone free
Dominantly coarse textured soils formed on sand and gravel.				
1,5	sandy loam	good	slightly acid	stone free
7	loam	good	slightly acid	few stones
Dominantly moderately fine textured soils formed on very fine sands and silts.				
42	very fine sandy loam	good	slightly acid	stone free
43	silt loam	good-imperfect	slightly acid	stone free
Dominantly medium textured soils formed on till.				
26	loam	good	slightly acid	few stones
Dominantly medium and coarse textured soils formed on coarse, stony till.				
22	loam	good	neutral	exceedingly stony
Dominantly medium textured soils formed on till with bedrock at one foot or less.				
69	loam	variable	neutral	moderately stony

Figure 6

SOIL ASSOCIATIONS ALONG THE TRAFALGAR PIPELINE SYSTEM CORRIDOR

Date: FEB., 1998 File: 97202_01

GAPLO 297

4.2 Soil Organic Matter Levels

The standard construction practice for handling topsoil on the NPS 42 and 48 pipelines involves stripping and stockpiling topsoil from over the trench line and spoil pile areas. Topsoil may also be stripped from the entire easement at the request of individual farmers or in extremely wet areas with poorly drained soils.

Stripping, stockpiling and reapplication of topsoil inevitably results in some dilution of topsoil (Table 7). Soil organic matter levels for control sample areas adjacent to the easement average 4 per cent and range from 3.8 to 5.0 per cent. Organic matter levels are lower on the spoil and trench areas than the workspace. Average values are 80, 83 and 92 per cent of the control, respectively. The spoil area for the NPS 48 is the workspace/trench area for the previously constructed NPS 42 pipeline. The significantly lower organic matter levels on the spoil area (77 per cent) as compared to the trench area (91 per cent) for the NPS 48 Enniskillen/Brooke loop is obviously related to the problems encountered during construction of the NPS 42 pipeline in 1974/75.

4.3 Soil Fertility Levels

Soil fertility levels were determined using standard available P and K procedures for recommending fertilizer applications. Measured levels of soil test P and K do not appear to be affected as a result of pipeline construction (Table 8); often, the levels are higher than those of the control.

Table 7. Average Soil Organic Matter Levels in Relation to Easement Location (expressed as % of control for all properties sampled)

Pipeline Loop	NPS 48 (Year constructed)	On Easement Location		
		Spoil Area	Trench Area	Work Area
Kirkwall-Hamilton	1990	–	82	83
Lobo-St.Mary's	1991	89	90	100
Milton-Parkway	1991	81	76	90
St.Mary's-Beachville	1993	72	76	96
Enniskillen-Brooke	1994	77	91	92
Average		80	83	92

Table 8. Average Soil Fertility Levels in Relation to Easement Location (expressed as % of control for all properties sampled)

Pipeline Loop	NPS 48 (Year constructed)	Available P			Available K		
		Spoil	Trench	Work Area	Spoil	Trench	Work Area
Kirkwall-Hamilton	1990	–	101	84	–	94	85
Lobo-St.Mary's	1991	105	112	106	98	96	102
Milton-Parkway	1991	113	135	94	104	105	98
St.Mary's-Beachville	1993	101	110	100	91	100	100
Enniskillen-Brooke	1994	117	146	103	97	97	91
Average		109	121	97	98	98	95

4.4 Soil Bulk Density

Average soil bulk density levels are highest over the trench area and lowest over the workspace (Figure 7). Comparable values for the spoil area are intermediate between the two. The higher bulk density levels over the trench line relate to construction activities. To minimize subsidence, soil is backfilled and compacted in successive layers over the pipe. Further, the trench area is not subsoiled, thus, leaving a highly compacted layer that limits root penetration. Residual soil compaction is also observed on the spoil area of the NPS 48 pipelines, in spite of the fact that there are minimal construction activities on this part of the easement. However, clean up of the NPS 42 workside (the spoil area for the NPS 48) was mainly confined to the topsoil layer so that soil compaction which occurred at greater depths was not necessarily mitigated. Even still, these residual levels are low and generally less than 10 per cent. Standard construction practices on the NPS 48 pipeline include deep tillage or subsoiling of the workspace.

Amelioration of soil compaction on the work space during clean up appears to be quite effective as average bulk density levels are only 5-6 per cent higher than the control.

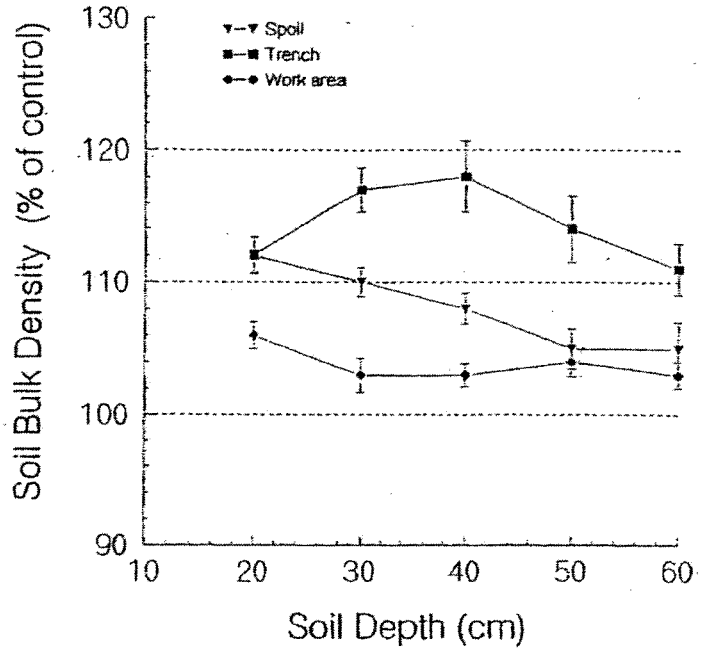


Figure 7. Average Soil Bulk Density Levels by Easement Area, NPS 48 St. Marys to Beachville (expressed as % of control).

5. CONCLUSIONS

The Dawn to Trafalgar pipeline system consists of at least two pipelines throughout its length, an NPS 26 and 34. In addition, a third or fourth line consisting of NPS 42 and 48 lines has been installed in several sections. The length of the pipeline is approximately 220 km. The pipeline largely passes through prime agricultural lands, with the exception of lands in the eastern section of the system where shallow depth to bedrock is encountered.

Since construction began on the NPS 42 in 1974/75, Union Gas has developed one of the most comprehensive databases available to assess the impacts of pipeline construction on agricultural lands.

The purpose of this report is to provide a historical documentation of this soil/crop monitoring program and to assess, to the extent possible, the impact that changes in pipeline construction practices have had on the restoration of agricultural lands.

Due to the large number of variables inherent in field studies of this nature, it is impossible to assign actual quantitative values in terms of improved crop yield performance to specific changes in pipeline construction and clean up practices during the period. However, the data clearly show a set of trends that are helpful in reaching some conclusions with respect to the past and establishing future direction.

1. Average crop yields on easement have shown a significant improvement from the initial crop yield data collected in 1976 to 1997 (Figure 4). These improvements reflect major changes made to pipeline construction practices over this period including implementation of wet soil shutdown policies and improved construction clean up practices, among others.

2. Average crop yield levels expressed as a percent of control for the NPS 48 and NPS 42 construction loops are 91 and 80 per cent, respectively (Table 2). Clearly, construction and clean up practices used on the NPS 48 pipeline have led to significant improvements in crop yield performance as compared to NPS 42 construction.

3. The impact of pipeline construction varies on easement depending on the construction activity. Both crop yield and soil data indicate that the greatest residual impact of construction on agricultural land occurs immediately over the trench area, followed by the spoil pile area and is least for the workspace. Average crop yield levels for all crops and properties sampled over the trench area, spoil pile and workspace areas are 81, 84 and 91 per cent, respectively (Table 4). The low values for the spoil pile area represents a cumulative (or residual) impact as the spoil pile areas are usually located on the workspace of the previous construction easement. Corresponding crop yields for the workspace are on average greater than 91 per cent of the control; indeed, for the NPS 48 construction average crop yield is 93 per cent of control.

4. The trench and spoil pile area consistently show elevated levels of residual soil compaction as compared to the workspace (Figure 7). Similarly, soil pH and calcium carbonate levels are higher (Table 6) and soil organic matter levels are

lower (Table 7) compared to the workspace. There is no indication that soil test phosphorus and potassium levels are impacted as a result of construction, and that therefore fertilizer application recommendations would differ on and off easement.

5. Analysis of the data supports changing the crop yield sampling frequency from the 5 year program to a 3 year program consisting of 1, 3 and 5 year after yield measurements.

6. Although the data are limited, inclusion of subsoiling as an ongoing component of construction clean up appears to be improving overall crop yield performance on easement.

6. LIST OF REPORTS

6.1 Monitoring and Research Reports, Dawn-Kerwood Pipeline Loop

Ecological Services for Planning (ESP), Robinson Merritt de Vries (RMdV), Smith Hoffman (SH). January, 1982. Rehabilitation of Agricultural Lands, Dawn-Kerwood Loop Pipeline.

_____, February 1982. Rehabilitation of Agricultural Lands, Dawn-Kerwood Loop Pipeline. Executive summary.

_____, January 1983. Rehabilitation of Agricultural Lands, Dawn-Kerwood Loop Pipeline. Interim Report.

_____, February 1983. Rehabilitation of Agricultural Lands, Dawn-Kerwood Loop Pipeline. Executive summary.

_____, January 1984. Rehabilitation of Agricultural Lands, Dawn-Kerwood Loop Pipeline. Technical Report.

_____, January 1984. Rehabilitation of Agricultural Lands, Dawn-Kerwood Loop Pipeline. Executive summary.

Ecological Services for Planning Ltd. (ESP), February 1984. Agricultural Rehabilitation, Dawn-Kerwood Loop Pipeline (Detailed soil and crop analyses). 1983.

ESP, RMdV, SH. February 1985. Rehabilitation of Agricultural Lands, Dawn-Kerwood Loop Pipeline.

ESP, August, 1990. Crop Monitoring Program, Dawn-Kerwood.

6.2 Monitoring Reports, Other Loops

ESP. June, 1980. Union Gas Pipeline: Lobo-London Loop Evaluation of Agricultural Rehabilitation Practices.

ESP. September, 1980. Evaluation of Soil Restoration Lobo-London Loop Pipeline.

ESP. May, 1992 (revised Sept. 1992). Field Crop Monitoring, 1991. NPS 42 Pipelines: Lobo-Strathroy and Beachville-Bright Loops.

ESP. June, 1992. Soil Monitoring - Kirkwall to Hamilton NPS 48 Pipeline Loop.

ESP. May, 1994. 1993 Crop Monitoring. NPS 42 Strathroy-Lobo and Beachville-Bright.

ESP. May, 1994. 1992-93 Soil and Crop Monitoring. NPS 48 Milton to Parkway Pipeline.

ESP. May, 1994. 1993 Crop Monitoring. NPS 48 Kirkwall-Hamilton.

ESP. December, 1995. 1995 Crop Monitoring. NPS 48 Kirkwall to Hamilton.

ESP. January, 1996. 1995 Crop Monitoring. NPS 42 Strathroy to Lobo and Beachville to Bright.

ESP. January, 1996. 1995 Crop Monitoring. NPS 48 Milton to Parkway Pipeline.

ESP. January, 1996. 1995 Soil and Crop Monitoring. NPS 48 St. Mary's to Beachville.

Ecoplans Ltd. December, 1996. Enniskillen to Brooke NPS 48 Pipeline. Soil and Crop Monitoring Program. Phase One.

Gore & Storrie Limited. December 1995. NPS 48 Lobo Compressor Station to St. Mary's Valve Site, Three Year Post-Construction Crop Monitoring Report.

Gore & Storrie Limited. November, 1995. NPS 48 Lobo Compressor Station to St. Mary's Valve Site, Post Construction Soil and Crop Monitoring Report.

Robinson, Merritt & deVries Limited. 1980. Comparative Crop Evaluation Program. Union Gas 42" Line Right of Way. Dawn Compressor Station to the Kerwood Valve.

6.3 Other References

Adams, R.B. January 22, 1990. Union Gas Ltd. Memorandum to R.R. Bryant Re: Construction Practices.

Broadwith, Hughes & Associates Ltd. August 1980. Union Gas Pipeline: Lobo-London Loop. Assessment of Rehabilitation for Agriculture and Economic Loss to Farmers.

Hoffman, D.W., B.C. Matthews and R.E. Wicklund. 1964. Soil Associations of Southern Ontario. Report No. 30 of the Ontario Soil Survey. Canada Department of Agriculture, Ontario Department of Agriculture. Contains one colour map scale 1:633,600.

Union Gas Ltd., MacLaren Plansearch Inc., Ecological Services for Planning Ltd., and Ontario Energy Board and Pe Ben Pipelines (1979) Inc. July 1985. An Environmental Performance Audit of Selected Pipeline Projects in Southern Ontario. Report to Environment Canada.

APPENDIX A

GENERAL SAMPLING DESIGN FOR CROP MONITORING PROGRAMS

Table 1. General Sampling Design for Crop Monitoring Programs

	Sampling Period	
	1976-1982	1989-1996
Sample location	whole easement, control	trench line, work side, spoil side, and control
Replication	3	3 - 6
Plot size	all crops: 1 crop row x 23 m (75') easement	corn: 2 rows x 4.5 to 6 m (depending on row width) for area = 9 m^2 soybeans & cereals: 1 to 4 rows (depending on row width) of 4 to 6 m for area = 4 m^2
Yield measurement	corn: cobs husked and weighed in field; soybeans & cereals: whole plant weight in field	corn: subsample 10 ears dried shelled and weighed; soybeans & cereals: whole plant weight in field
Result	all crops: percent difference in weights on and off easement	corn: grain yield (kg/ha) for each of the easement locations and off easement; soybeans & cereals: whole plant weight for each easement location and off easement all crops: percent difference for each easement location and for easement overall by weighting on- easement locations according to the width they occupy within the easement

\reports\97\ubcrop.202

Fuels Safety Program	Ref. No.: FS-121-08	Rev. No.:
Oil and Gas Pipeline Systems Code Adoption Document - Amendment	Date: January 14, 2008	Date:

IN THE MATTER OF:
THE TECHNICAL STANDARDS AND SAFETY ACT, 2000,
***S.O. 2000, c. 16* (the "Act")**

- and -

ONTARIO REGULATION 210/01 (Oil and Gas Pipeline Systems)
made under the Act

and

ONTARIO REGULATION 223/01 (Codes and Standards Adopted by Reference)
made under the Act

Subject: Amendments to the Oil and Gas Pipeline Systems Code Adoption Document adopted by reference as part of Ontario Regulation 210/01 (Oil and Gas Pipeline Systems)
Sent to: Gaseous Fuels Advisory Council, Pipeline RRG, Posted on TSSA's Web-Site

The Director of Ontario Regulation 210/01 (Oil and Gas Pipeline Systems) pursuant to section 8 of Ontario Regulation 223/01 (Codes and Standards Adopted by Reference) hereby provides notice that the Oil and Gas Pipeline Systems Code Adoption Document published by the Technical Standards & Safety Authority and dated June 1, 2001, as amended, is amended as follows:

All sections of the Code Adoption Document (Sections 1 to 5) are revoked and replaced with the following:

Section 1

REFERENCE PUBLICATIONS

(1) The reference publications as set forth herein are approved by the Director and adopted as part of this Document and the standards, procedures and requirements therein, as applicable to this Document, shall be complied with by operating companies as well as anyone engaged in the design, construction, erection, alteration, installation, testing, operation or removal of a pipeline, for the transmission of oil or gas or the distribution of gas.

Government of Ontario

Technical Standards & Safety Act, 2000, Ontario Regulation 220/01 (Boilers and Pressure Vessels)

Canadian Standards Association

Service Regulators for Natural Gas, CSA 6.18-02

Section 2

GENERAL REQUIREMENTS

2. (1) The Standards issued by the Canadian Standards Association entitled Oil and Gas Pipeline Systems Z662-07 and CSA Z276-07 Liquefied Natural Gas (LNG) – Production, Storage and Handling and the standards, specifications, codes and publications set out therein as reference publications insofar as they apply to the said Standards are adopted as part of this Document, with the following changes to the CSA-Z662-07 Standard:

(2) Clause **1.2** is amended by adding the following item:

(h) pipelines that carry gas to and from a well head assembly of a designated storage reservoir.

(3) Clause **1.3** is amended by adding the following items:

(p) digester gas or gas from landfill sites
(q) multiphase fluids
(r) gathering lines
(s) offshore pipeline systems
(t) oil field steam distribution pipeline systems oil field water services
(u) carbon dioxide pipeline systems.

(4) Clause **4.1.7** is revoked and the following substituted:
4.1.7 Subject to prior review by the Director, it shall be permissible for steel oil and gas pipelines to be designed in accordance with the requirements of Annex C, provided that the designer is satisfied that such designs are suitable for the conditions to which such pipelines are to be subjected.

(5) Clause **7.10.3.2** is revoked and the following substituted:
7.10.3.2 For HVP and for sour service pipeline systems, all butt welds shall be inspected by radiographic or ultrasonic methods, or a combination of such methods, for 100% of their circumferences, in accordance with the requirements of clause 7.10.4.

(6) Clause **10.5.10** is amended by adding the following clauses:
10.5.10.7 Operating companies shall inform agencies to be contacted during an emergency, including the police and fire departments about the hazards associated with its pipelines.

10.5.10.8 Operating companies shall prepare an emergency response plan and make it available to local authorities.

(7) Clause **10.6** is amended by adding the following clause:
10.6.5 Right-of-Way Encroachment

10.6.5.1 It shall be prohibited to install patios or concrete slabs on the pipeline right-of-way or fences across the pipeline right-of-way unless written permission is first obtained from the operating company.

10.6.5.2 It shall be prohibited to erect buildings including garden sheds or to install swimming pools on the pipeline right-of-way. Storage of flammable material and dumping of solid or liquid spoil, refuse, waste or effluent, shall be also forbidden.

10.6.5.3 Operating companies shall be allowed to erect structures required for pipeline system operation purposes on the pipeline right-of-way.

10.6.5.4 No person shall operate a vehicle or mobile equipment except for farm machinery and personal recreation vehicles across or along a pipeline right-of-way unless written permission is first obtained from the operating company or the vehicle or mobile equipment is operated within the travelled portion of a highway or public road.

10.6.5.5 Operating companies shall develop written procedures for periodically determining the depth of cover for pipelines operated over 30% of SMYS. Such written procedures shall include a rationale for the frequency selected for such depth determinations. Where the depth of cover is found to be less than 60 cm in lands being used for agriculture, an engineering assessment shall be done in accordance with clauses 10.14.2 and 10.14.6 and a suitable mitigation plan shall be developed and implemented to ensure the pipeline is adequately protected from hazards.

(8) Clause **10.14.2** is amended by adding the following clauses:

10.14.2.6 The Director may require operating companies or a person to submit a design, specification, program, manual, procedure, measure, plan or document to the Director if:

a) the operating company or person makes an application to the Director under Section 18.(1) 1, 18.(1) 3 and 16.(6) of Ontario Regulation 210/01 (Oil and Gas Pipeline Systems), or

b) the Director has reasons to believe that the design, construction, operation or abandonment of a pipeline, or any part of a pipeline is or may cause,

i. a hazard to the safety of the public or to the employees of the operating company,

ii. an adverse effect to the environment or to property, or

iii. the Director wishes to assess the operating company's pipeline integrity management program.

10.14.2.7 For the protection of the public, the pipeline and the environment, an operating company shall develop a pipeline integrity management program for steel pipelines with a MOP of 30% or more of the SMYS. The pipeline integrity management program shall contain:

a) a management system;

b) a working records management system;

c) a condition monitoring program, and

d) a mitigation program.

10.14.2.8 When developing the pipeline integrity management program, an operating company shall consider CAN/CSA-Z662-07, Oil and Gas Pipeline Systems, Annex N, Guidelines for Pipeline Integrity Management Programs.

(9) Clause **10.14.3.1** is revoked and the following substituted:

10.14.3.1 Prior to a change in service fluid, including sweet to sour, the operating company shall conduct an engineering assessment to determine whether it would be suitable for the new service fluid. The assessment shall include consideration of the design, material, construction, operating, and maintenance history of the pipeline system and be submitted to the Director for approval.

(10) Clause **10.16.1.2** is amended by adding the following items:

(e) maintain warning signs and markers along the pipeline right-of-way;
(f) maintain existing fences around above ground pipeline facilities; and
(g) empty tanks and purge them of hazardous vapours.

(11) Clause **12.4.11.1** is renumbered as clause **12.4.11.1.1**. Clause **12.4.11** is amended by adding the following clauses:

12.4.11.1.2 All new and replacement natural gas service regulators shall comply with the requirements of CSA 6.18-02 standard, Service Regulators For Natural Gas, including the Drip and Splash Test contained in Appendix A of the said Standard. Where a regulator – meter set installation or supplemental protective devices as providing equivalent protection against regulator vent freeze up passes a successful test in accordance to Appendix C of the said Standard, the requirements of Appendix A (Drip and Splash Test) and those contained in Clause 14.15 (Freezing Rain Test) of the Standard are waived. Evidence of test made in accordance with Appendix C, shall be kept by the operating Company as permanent records.

12.4.11.1.3 Regulator-meter set configurations shall be included in the operating company's operating and maintenance procedures.

(12) Clause **12.4.15.6** is amended by replacing the reference to CAN/CSA-B149.1 to "Table 5.2 of B149.1S1-07 Supplement No. 1 to CAN/CSA-B149.1-05, Natural Gas and Propane Installation Code".

(13) Clause **12.10.11** is amended by adding the following clauses:

12.10.11(e) For polyethylene piping installed in Class 1 and Class 2 location, the upgraded maximum operating pressure shall not exceed the design pressure calculated in accordance with the requirements of Clause 12.4.2.1; and

12.10.11(f) For polyethylene piping installed in Class 3 and Class 4 location, the upgraded maximum operating pressure shall not exceed the design pressure calculated in accordance with the requirements of clause 12.4.2.1 with a combined design factor and temperature derating factor (F x T) of 0.32.

(14) Clause **12.10.13.1** is revoked and the following substituted:

12.10.13.1.1 The Director may require operating companies or a person to submit a design, specification, program, manual, procedure, measure, plan or document to the Director if:

a) the operating company or person makes an application to the Director under subsection 18.(1) 2 of Ontario Regulation 210/01 (Oil and Gas Pipeline System),
b) the Director has reasons to believe that the design, construction, operation or abandonment of a pipeline, or any part of a pipeline is or may cause,
i. a hazard to the safety of the public or to the employees of the operating company,
ii. an adverse effect to the environment or to property, or
iii. the Director wishes to assess the operating company's integrity management program.

12.10.13.1.2 Operating companies shall establish effective procedures for managing the integrity of pipeline systems with a MOP less than 30% of SMYS (Distribution Systems) so that they are suitable for continued service. The integrity management program shall contain:

a) a management system;
b) a working records management system;
c) a condition monitoring program, and
d) a mitigation program.

When developing the integrity management program, an operating company shall consider Annex M, Guidelines for Gas Distribution System Integrity Management Programs.

This program and implementation plan shall be completed no later than April 30, 2008.

Section 3

POLYETHYLENE PIPE CERTIFICATION

3. (1) Polyethylene piping and fittings that are used in a polyethylene gas pipeline shall be certified by a designated testing organization accredited by the Standards Council of Canada as conforming to the CAN/CSA-B137.4-05. Polyethylene Piping Systems for Gas Services.

Section 4

WELDER QUALIFICATION

4.(1) Welds shall not be made in any steel pipe that forms or is intended to form a part of a steel oil or gas pipeline or a component of a steel pipeline unless the welder is qualified to make the weld in accordance with the requirements of the CSA Z662-07 Standard adopted under section 2 of this document and is the holder of the appropriate authorization issued under Ontario Regulation 220/01 (Boilers and Pressure Vessels), made under the *Technical Standards & Safety Act, 2000.*

Section 5

5.(1) Where there is a conflict between a standard, specification, code or publication adopted in this document, this document shall prevail.

(2) Any person involved in an activity process or procedure to which this document applies, shall comply with this document.

(3) The above amendments to the Oil and Gas Pipeline Code Adoption Document are effective on March 31, 2008.

Dated at Toronto this 26th. day of March, 2008.

_____

John Marshall
Statutory Director
Ontario Regulation 210/01 (Oil and Gas Pipeline Systems)
made under the *Technical Standards & Safety Act, 2000*

Fuels Safety Program	Ref. No.: **FS-196-12**	Rev. No.:
OIL AND GAS PIPELINE SYSTEMS CODE ADOPTION DOCUMENT AMENDMENT	Date: **November 1, 2012**	Date:

IN THE MATTER OF AN AMENDMENT TO THE

Oil and Gas Pipeline Systems Code Adoption Document

adopted as part of Ontario Regulation 210/01 (Oil and Gas Pipeline Systems)
by section 8(1) of Ontario Regulation 223/01 (Codes and Standards Adopted by Reference)
made under the *Technical Standards and Safety Act, 2000,* S.O. 2000, c. 16

The Director for the purposes of O. Reg. 210/01 (Oil and Gas Pipeline Systems), under authority of section 36(3)(a) of the *Technical Standards and Safety Act, 2000,* S.O. 2000, c. 16 (the "Act"), hereby amends the Oil and Gas Pipeline Systems Code Adoption Document published by the Technical Standards and Safety Authority and dated June 1, 2001, as amended, as follows:

1. **All sections of the Oil and Gas Pipeline Systems Code Adoption Document (Sections 1 to 5) are revoked and replaced with Sections 1 to 5 of this document.**

Section 1

CODES ADOPTED BY REFERENCE

1. The Director hereby adopts and requires all persons to whom O. Reg. 210/01 (Oil and Gas Pipeline Systems) applies to comply with the standards, procedures and other requirements of the following codes and regulations:
   (a) **CSA Z662-11 (Oil and Gas Pipeline Systems)**, published by the Canadian Standards Association, as amended by Section 2 of this document;
   (b) **CSA Z246.1-09 (Security Management for Petroleum and Natural Gas Industry Systems)**, published by the Canadian Standards Association; and
   (c) **CSA Z276-11 (Liquefied Natural Gas (LNG) - Production, Storage and Handling)**, published by the Canadian Standards Association.

Section 2

AMENDMENTS TO CSA Z662-11 (OIL AND GAS PIPELINE SYSTEMS)

2. For the purposes of compliance with this Code Adoption Document, CSA-Z662-11 (Oil and Gas Pipeline Systems) shall be deemed to be amended as follows:

(1) Clause **1.2** is amended by adding the following item:

(h) pipelines that carry gas to and from a well head assembly of a designated storage reservoir.

(2) Clause **1.3** is amended by adding the following items:

(p) digester gas or gas from landfill sites
(q) multiphase fluids
(r) gathering lines
(s) offshore pipeline systems
(t) oil field steam distribution pipeline systems oil field water services
(u) carbon dioxide pipeline systems.

(3) Clause **3.2** is amended by renumbering the existing clause as 3.2.1 and adding the following clause:

3.2.2

Natural gas distributors shall incorporate into the procedures for managing the integrity of pipeline systems required in clause 3.2.1 an action plan that includes:

(a) a description of the steps taken or that will be taken to mitigate the potential of penetration of sewer lines by a natural gas pipeline during trenchless installation;
(b) a program that raises stakeholder awareness of the potential safety issues that could arise when attempting to clear a blocked sewer service line beyond the outside walls of a building; and
(c) an assessment of potential risks and a plan to mitigate these risks.

(4) Clause **4.1.8** is deleted and substituted with the following:

4.1.8

Steel oil and gas pipelines may be designed in accordance with the requirements of Annex C, provided that such designs are suitable for the conditions to which such pipelines are to be subjected, and provided that the design has been reviewed and approved by the Director prior to installation or use.

(5) Clause **4.3.4** is amended by adding the following clauses:

4.3.4.9 High consequence areas

4.3.4.9.1 Definitions

The following definitions apply to the remainder of clause 4.3.4:

Assessment means the use of testing techniques set out in this section to ascertain the condition of a covered pipeline segment.

Covered segment or ***Covered pipeline segment*** means a segment of oil or gas transmission pipeline located in a high consequence area. The terms “oil”, “gas” and “transmission" are defined in O. Reg. 210/01. For the purpose of this document, transmission lines include only lines with an MOP of 30% or more of the SMYS.

High consequence area means

(a) for a gas transmission pipeline, an area defined as:
  (i) a Class 3 location under CSA Z662-11, Clause 4.3.3;
  (ii) a Class 4 location under Clause 4.3.3;
  (iii) any area in a Class 1 or Class 2 location where the potential impact radius is greater than 200 metres and the area within the potential impact circle contains 20 or more buildings intended for human occupancy; or
  (iv) any area in a Class 1 or Class 2 location where the potential impact circle contains an *identified site*; and

(b) for an oil pipeline, an area containing:
  (i) a *commercially navigable waterway,* which means a waterway where a substantial likelihood of commercial navigation exists;
  (ii) a *high population area,* which means an urbanized area, as defined and delineated by the latest Statistics Canada Census, that contains 50,000 or more people or has a population density of at least 385 people per square km;
  (iii) an *other populated area,* which means a place, as defined and delineated by the latest Statistics Canada Census, that contains a concentrated population, such as an incorporated or unincorporated city, town, village, or other designated residential or commercial area; or

(iv) an *unusually sensitive area,* as defined in company's pipeline integrity management program.

Identified site means, for Class 1 and Class 2 locations, any of the following areas:

(a) an outside area or open structure that is occupied by 20 or more persons on at least 50 (not necessarily consecutive) days in any 12 month period. Examples include but are not limited to, beaches, playgrounds, recreational facilities, camping grounds, outdoor theaters, stadiums, recreational areas near a body of water, and areas outside a rural building such as a religious facility;

(b) a building that is occupied by 20 or more persons at least five (not necessarily consecutive) days a week for at least 10 (not necessarily consecutive) weeks in any 12 month period. Examples include, but are not limited to, religious facilities, office buildings, community centers, general stores, 4-H facilities, sporting and entertainment facilities; or

(c) a facility occupied by persons who are confined, are of impaired mobility, or would be difficult to evacuate. Examples include but are not limited to hospitals, prisons, schools, day-care facilities, retirement facilities and assisted-living facilities.

Potential impact circle, for natural gas or *HVP pipelines systems*, is a circle of radius equal to the potential impact radius (PIR).

Potential impact radius **(PIR)** means the radius of a circle within which the potential failure of a pipeline could have significant impact on people or property, determined by the following formula:

$$r = 0.00313 \text{ times square root of } (pd^2)$$

where:

r is the radius of the circular area surrounding the point of failure in metres (m)

p is the MOP of the pipeline in kPa

d is the nominal diameter of the pipeline in mm

NOTE: 0.00313 is the factor for natural gas based on conversion from a formula used in GRI-00/0189. This number will vary for other gases depending upon their heat of combustion. An operator transporting gas other than natural gas shall refer to ASME/ANSI B31.8 S for the formula to calculate the potential impact radius.

4.3.9.2 Identification of high consequence areas

(a) *General*. Operating companies shall identify which segments of its oil and gas transmission pipeline system are in high consequence areas. The operator must

describe in its integrity management program the method used to establish high consequence areas, including the determination of the potential impact radius.

(b) *Identified sites.* The operator shall identify identified sites by

(i) using information the operator has obtained from routine operation and maintenance activities; and

(ii) obtaining information about locations that are likely to meet the criteria for identified sites from public officials with safety or emergency response or planning responsibilities (such as officials from local emergency planning response agencies or from municipal planning departments).

(c) *Identified sites – where public officials cannot assist*. If the public officials mentioned above indicate that they do not have the necessary information or are otherwise unable to identify potential identified sites, the operator shall use the following methods, as appropriate, to identify potential identified sites:

(i) the presence of signs, public notices, flags or other markings that suggest that the area may become an identified site in the future; and

(ii) the existence of publicly available information, including online and at local land registry offices, that suggests the area may become an identified site in the future.

(d) *Newly identified high consequence areas*. When an operator obtains information suggesting that the area around a pipeline segment not previously identified as a high consequence area could constitute a high consequence area, the operator shall evaluate whether the area indeed constitutes a high consequence area. If the segment is determined to constitute a high consequence area, it must be incorporated into the operator's baseline assessment plan as a high consequence area within one year from the date the area is identified.

4.3.4.10 Operator's responsibility to implement this clause

4.3.4.10.1

An operator of a covered pipeline segment shall develop and follow a written program (part of the pipeline system integrity management program (IMP)) that contains all the elements described in the IMP and that addresses the risks on each covered transmission pipeline segment.

4.3.4.10.2 *Implementation standards*

An operator may use an equivalent standard or practice to a standard or practice required by clause 4.3.4 only when the operator demonstrates in its Integrity Management Program that the alternative standard or practice provides an equivalent level of safety to the public and property.

4.3.4.11 Risk assessment

The operator shall conduct a risk assessment that follows Annex B Guidelines for risk assessment of pipelines falling within the scope of CSA Z662-11 for each covered

segment. The risk assessment shall include the high consequence areas and determine if additional preventive or mitigation measures are needed.

The operator shall prioritize the covered pipeline segments according to the risk.

4.3.4.12 Remediation

For each covered segment, the operator shall develop and establish measures to prevent or reduce the probability of an incident and to limit the potential consequences thereof.

These measures shall include conducting a risk analysis of the pipeline segment to identify additional measures to enhance public safety or environmental protection. Such measures may include, but are not limited to:

(a) establishing shorter inspection intervals;

(b) installing emergency flow restricting devices (remote operated valves, check valves and automatic shut off valves, as applicable);

(c) modifying the systems that monitor pressure or detect leaks, as applicable;

(d) providing additional training to personnel on response procedures;

(e) conducting drills with local emergency responders; and

(f) adopting other management controls.

Evacuation procedures shall take into consideration the PIR.

For oil pipeline segments located in high consequence areas, the operating company shall provide the Ontario Ministry of Natural Resources (MNR) and the Ontario Ministry of Environment (MOE) an opportunity to comment on the company's contingency plan for leaks or spills and shall address any comments provided by MOE or MNR.

(6) Clause **7.10.3.2** is deleted and substituted with the following:

7.10.3.2

For HVP and for sour service pipeline systems, all butt welds shall be inspected by radiographic or ultrasonic methods, or a combination of such methods, for 100% of their circumferences, in accordance with the requirements of clause 7.10.4.

(7) Clause **10.3.7.1** is deleted and substituted with the following:

10.3.7.1

Prior to a change in service fluid, including from non-sour service to sour service, the operating company shall conduct an engineering assessment to determine whether the pipeline systems would be suitable for the new service fluid. The assessment shall include consideration of the design, material, construction, operating, and maintenance history of the pipeline system and shall be submitted to the Director for approval.

(8) Clause **10.3** is amended by adding the following clause:

10.3.10

For the protection of the pipeline, the public and the environment, the operating company shall develop a pipeline integrity management program for steel pipelines with an MOP of 30% or more of the SMYS that complies with the applicable requirements of clause 3.2 of CSA Z662-11. The integrity management program shall include the following items:

(a) a management system;

(b) a working records management system;

(c) a condition monitoring program, and

(d) a mitigation program.

(9) Clause **10.5.2** is amended by adding the following clauses:

10.5.2.6 Emergency communication meetings

The operator of a transmission pipeline shall conduct meetings with local authorities, inviting police, firefighting authorities, Ontario Ministry of Transportation (MTO), Ministry of Natural Resources (MNR), Ministry of the Environment (MOE), local conservation authorities and TSSA, to explain to the authorities the characteristics of the pipeline system the operator operates, the type of fuels being transported and the typical behaviour of these fuels in case of uncontrolled escapes or spills and the capabilities and the coordination required to respond to pipeline emergencies.

These meetings shall be conducted at intervals not exceeding five years at locations that ensure the key stakeholders can attend. The meetings shall be prioritized so as to correspond to the operating company's prioritization of the covered pipeline segments according to the risk.

10.5.2.7

Operating companies shall prepare an emergency response plan and make it available on request to the authorities referred to in clause 10.5.2.6.

(10) Clause **10.6** is amended by adding the following clause:

10.6.5 Right-of-way encroachment

10.6.5.1

No person shall install patios or concrete slabs on the pipeline right-of-way or fences across the pipeline right-of-way unless written permission is first obtained from the operating company.

10.6.5.2

No person shall erect any building (including garden sheds) or install swimming pools on the pipeline right-of-way, and no person shall deposit or store any flammable material, solid or liquid spoil, refuse, waste or effluent on the pipeline right-of-way.

10.6.5.3

Notwithstanding the above, operating companies may erect structures required for purpose of pipeline system operation on the pipeline right-of-way.

10.6.5.4

No person shall operate a vehicle or mobile equipment except for farm machinery or personal recreation vehicles across or along a pipeline right-of-way unless written permission is first obtained from the operating company or the vehicle or mobile equipment is operated within the travelled portion of a highway or public road in the pipeline right-of-way.

10.6.5.5

Operating companies shall develop written procedures for periodically determining the depth of cover for pipelines operated over 30% of SMYS. Such written procedures shall include a rationale for the frequency selected for such depth determinations. Where the depth of cover is found to be less than 60 cm in lands being used for agriculture, an engineering assessment shall be done in accordance with clause 3.3 and a suitable mitigation plan shall be developed and implemented to ensure the pipeline is adequately protected from hazards.

(11) Clause **10.15.1.2** is amended by adding the following items:

(e) maintain warning signs and markers along the pipeline right-of-way;
(f) maintain existing fences around above ground pipeline facilities; and
(g) empty tanks and purge them of hazardous vapours within 60 days of deactivation.

(12) Clause **12.4.11.1** is renumbered as clause **12.4.11.1.1**. Clause **12.4.11** is amended by adding the following clauses:

12.4.11.1.2

All new and replacement natural gas service regulators shall comply with the requirements of CSA 6.18-02 (R2008) (Service Regulators for Natural Gas), published by the Canadian Standards Association, including the Drip and Splash Test contained in Appendix A of the said standard. Where a regulator-meter set installation or supplemental protective devices provides equivalent protection against regulator vent freeze up passes a successful test in accordance with Appendix C of the said standard, the requirements of Appendix A (Drip and Splash Test) and those contained in clause

14.15 (Freezing Rain Test) of the standard are waived. Evidence of tests completed in accordance with Appendix C of the standard shall be retained by the operating company as permanent records.

12.4.11.1.3

Regulator-meter set configurations shall be included in the operating company's operating and maintenance procedures.

(13) Clause **12.4.15.6** is revoked and substituted with the following:

12.4.15.6

Where regulator failure would result in the release of gas, open ends of the vents shall be located where the gas can escape freely into the atmosphere and away from any openings in the buildings. Clearances from building openings shall be commensurate with local conditions and the volume of gas that might be released, but shall not be less than those set out in the following table:

Clearance from service regulator vents discharge (m)

Column:	I	II	III	IV
Building opening	0.3	1	3	1
Appliance vent outlet	0.3	1	1	1
Moisture exhaust duct (dryers)	1	1	1	1
Mechanical air intake	1	3	3	3
Appliance air intake	0.3	1	3	3
Source of ignition	0.3	1	1	3

Column I applies to natural gas regulators certified under CSA 6.18 standard, incorporating an OPCO system and with a limited relief of 1.5 m^3/h.

Column II applies to natural gas regulators certified under CSA 6.18 standard (if within the scope of the standard) with a relief capacity up to 55 m^3/h.

Column III applies to natural gas regulators with a relief capacity over 55 m^3/h.

Column IV applies to propane regulators.

Where regulators might be submerged during floods, either a special anti-flood-type breather vent fitting shall be installed or the vent line shall be extended above the height of the expected flood waters.

(14) Clause **12.10.11** is amended by adding the following items:

(e) For polyethylene piping installed in Class 1 and Class 2 locations, the upgraded maximum operating pressure shall not exceed the design pressure calculated in accordance with the requirements of Clause 12.4.2; and

(f) For polyethylene piping installed in Class 3 and Class 4 locations, the upgraded maximum operating pressure shall not exceed the design pressure calculated in accordance with the requirements of clause 12.4.2 with a combined design factor and temperature derating factor (F x T) of 0.32, unless the operating company conducts an engineering assessment to determine whether it would be suitable for the existing polyethylene piping to be operated at the new pressure. The assessment shall include consideration of the design, material, construction, operating, and maintenance history of the pipeline system and be submitted to the Director for approval.

(15) Clause **12.10** is amended by adding the following clause:

12.10.16

Operating companies shall establish effective procedures for managing the integrity of pipeline systems with an MOP less than 30% of SMYS (Distribution Systems) so that they are suitable for continued service, in accordance with the applicable requirements of clause 3.2 of CSA Z662-11.

Section 3

POLYETHYLENE PIPE CERTIFICATION

3. Polyethylene piping and fittings that are used in a polyethylene gas pipeline shall be certified by a designated testing organization accredited by the Standards Council of Canada as conforming to CAN/CSA-B137.4-09 (Polyethylene Piping Systems for Gas Services).

Section 4

WELDER QUALIFICATION

4. Welds shall not be made in any steel pipe that forms or is intended to form a part of a steel oil or gas pipeline or a component of a steel pipeline unless the welding procedures have been approved and the welder is qualified to make the weld in accordance with the requirements of CSA-Z662-11 (Oil and Gas Pipeline Systems) and is the holder of the appropriate authorization issued under O. Reg. 220/01 (Boilers and Pressure Vessels) made under the Act.

Section 5

MISCELLANEOUS

5.

(1) Where there is a conflict between a standard, specification, code or publication adopted in sections 1, 2, 3 or 4 of this document, this document prevails.

(2) Any reference to "Director" in a code amended by this document means the Director for O. Reg. 210/01 (Oil and Gas Pipeline Systems).

(3) Any person involved in an activity, process or procedure to which this document applies shall comply with this document.

(4) Except as provided below, this Code Adoption Document amendment is effective **November 1, 2012**.

(5) Notwithstanding Section 5(4), the following parts of the Code Adoption Document are effective **March 1, 2013**:

(a) Section 1(b), which adopts CSA Z246.1-09 (Security Management for Petroleum and Natural Gas Industry Systems); and

(b) Section 2(5), which adds clause 4.3.4.9 (re high consequence areas) to clause 4.3.4. of CSA Z662-11 (Oil and Gas Pipeline Systems).

SIGNED this 31st day of August, 2012

_____

John Marshall
Director for O. Reg. 210/01, appointed under authority of section 4(1) of the Act

Technical Standards and Safety Authority
14th Floor - Centre Tower
3300 Bloor St. West
Toronto, Ontario M8X 2X4

This document was developed in consultation with the
Gaseous Fuels Advisory Council and the Pipeline Risk Reduction Group