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December 19, 2014

Via Email
Original via Mail

British Columbia Utilities Commission
6th Floor, 900 Howe Street
Vancouver, BC
V6Z 2N3

Attention: Ms. Erica M. Hamilton, Commission Secretary

Dear Ms. Hamilton:

Re: FortisBC Energy Inc. (FEI or the Company)

Application for a Certificate of Public Convenience and Necessity (CPCN) for Approval of the Lower Mainland Intermediate Pressure (IP) System Upgrade (LMIPSU) Projects

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Pursuant to sections 45 and 46 of the *Utilities Commission Act* (the Act), FEI applies (the Application) to the British Columbia Utilities Commission (the Commission) for a CPCN to construct and operate two IP pipeline segments in the Lower Mainland of British Columbia that will replace the existing pipeline segments.

In particular, FEI seeks approval under sections 45 and 46 of the Act to:

1. Construct and operate a new Nominal Pipe Size (NPS) 30 IP pipeline operating at 2070 kPa between Coquitlam Gate Station and East 2nd & Woodland Station to upgrade and replace an existing NPS 20 IP pipeline operating at 1200 kPa (Coquitlam Gate IP Project[1]); and

2. Construct and operate a new NPS 30 IP pipeline operating at 1200 kPa between Fraser Gate Station and East Kent & Elliott Street to upgrade and replace an existing NPS 30 IP pipeline (Fraser Gate IP Project).

[1] In some Appendices completed by third parties and in some public information documents completed early in the planning phase, the Coquitlam IP Project was referred to as the Metro IP Project.

FEI also seeks Commission approval for related deferral accounts pursuant to sections 59 to 61 of the Act.

Requests for Confidential Treatment of Certain Appendices

To support the Application, FEI has filed several appendices, with the following ones being filed confidentially in accordance with the Practice Directive of the British Columbia Utilities Commission regarding Confidential Filings.

- Appendix A-11 Design Basis Memorandum
- Appendix A-12 Wall Thickness Selection Report
- Appendix A-13 Engineering Drawings – Coquitlam Gate Station
- Appendix A-14 Engineering Drawings – East 2nd and Woodland Station
- Appendix A-15 Engineering Drawings – IP/DP District Stations
- Appendix A-16 Engineering Drawings – IP/IP Interface Stations
- Appendix A-21 FEI Risk Register
- Appendix A-22 Estimate Preparation Plan
- Appendix A-23 Basis of Estimate
- Appendix A-24 Pipeline Estimate
- Appendix A-25 Stations Estimate
- Appendix A-26 Civil Estimate
- Appendix A-27 WorleyParsons – Cost Risk Analysis
- Appendix D-4-2 Email to Tsleil-Waututh First Nation July 15, 2014
- Appendix D-4-3 Response from Tsleil-Waututh First Nation July 15, 2014
- Appendix D-4-4 Email from Tsleil-Waututh First Nation August 20, 2014
- Appendix D-4-5 Email to-from Tsleil-Waututh First Nation August 27, 2014
- Appendix D-4-6 Email to-from Tsleil-Waututh First Nation Confirming November 5, 2014 Meeting
- Appendix D-5-2 Email to-from Squamish Nation July 15, 2014
- Appendix E Financial Schedules

In addition, certain portions of Appendix B-3: Socio-Economic Overview Assessment have been redacted as the redacted portions are not related to this Application and contain commercially sensitive information. Certain portions of Appendix C-2: Summary of Public Consultation Activities have also been redacted to remove personal information.

Should parties that choose to register in the review of this Application require access to some or all of the information filed confidentially, FEI has provided in Appendix G-3 a proposed Undertaking of Confidentiality to be executed before confidential information may be released to registered parties under the strict terms of the undertaking. FEI has no objection to providing certain confidential information to its customary and routine intervener groups representing customer interests. Should FEI have concerns with or object to releasing confidential information to any other registered party, FEI requests the opportunity to file comment.

FEI respectfully requests that the Commission hold the above listed documents confidential, and believes that such information should remain confidential even after the regulatory process for this Application is completed. Below, FEI will outline the reasons for keeping the information confidential.

Appendices A-11 through A-16 and Appendix A-21

The engineering documents should be kept confidential on the basis that they contain sensitive technical information pertaining to the Company's assets. In particular, they identify vulnerable points on the Company's natural gas delivery system. FEI believes that there is a reasonable expectation that the release of such information can potentially jeopardize the safety and security of the Company's system.

Appendices A-22 through A-27

The Cost Estimates should be kept confidential on the basis that they contain capital cost estimates for the Projects, and FEI will be going to the market for competitive bids for the materials and construction work. If the estimated costs for the material and construction work are disclosed, it can be reasonably expected that FEI's negotiating position may be prejudiced. For instance, the bidding parties with knowledge about the estimated costs may use the estimate costs as a reference for their bidding. Because there are limited contractors due to high demand in the market in recent years, FEI's negotiating position may be further prejudiced if the bidders know about the Company's estimated costs for materials and construction work.

Further, in Appendices A-23, A-24 and A-27 FEI has redacted certain sections and tables where the redacted information does not pertain to either the Coquitlam Gate IP or the Fraser Gate IP Projects.

Appendices D-4-2 through D-4-6 and Appendix D-5-2

Correspondence with the Squamish Nation and the Tsleil-Waututh First Nation should be kept confidential on the basis that these First Nations have expressed concerns regarding the public disclosure of correspondence with FEI. A description of the nature of the correspondence still appears in the publicly filed Application.

Appendices E-1 through E-3

The financial schedules contain the cost estimates for the Projects and of other alternatives. The information should be kept confidential for the same reasons provided above with respect to Cost Estimates.

FEI proposes that information requests relating to these confidential appendices be filed separately from other information requests, with a copy circulated only to FEI and other parties that have signed Undertakings of Confidentiality. This process will ensure that confidential information is not inadvertently disclosed.

If further information is required, please contact the undersigned.

Sincerely,

FORTISBC ENERGY INC.

Original signed:

Diane Roy

Attachments

cc (email only): BCOAPO
BCSEA
CEC

FortisBC Energy Inc.

Application for a Certificate of Public Convenience and Necessity for the Lower Mainland Intermediate Pressure System Upgrade Projects

Volume 1 - Application

December 19, 2014

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1. APPLICATION

1.1 SUMMARY OF APPROVALS SOUGHT

FortisBC Energy Inc. (the Company or FEI), pursuant to sections 45 and 46 of the *Utilities Commission Act* (the Act), applies to the British Columbia Utilities Commission (BCUC or the Commission) for a Certificate of Public Convenience and Necessity (CPCN) to construct and operate two Intermediate Pressure (IP) pipeline segments in the Lower Mainland of British Columbia that will replace the existing pipeline segments (the Application). In particular, FEI seeks approval under sections 45 and 46 of the Act to:

1. Construct and operate a new Nominal Pipe Size (NPS) 30 IP pipeline operating at 2070 kPa between Coquitlam Gate Station and East 2nd & Woodland Station to upgrade and replace an existing NPS 20 IP pipeline operating at 1200 kPa (Coquitlam Gate IP Project[1]); and
2. Construct and operate a new NPS 30 IP pipeline operating at 1200 kPa between Fraser Gate Station and East Kent Avenue & Elliott Street to upgrade and replace an existing NPS 30 IP pipeline (Fraser Gate IP Project).

These two replacements are collectively referred to as the "Projects", and individually referred to as the "Project" as the context requires. The estimated capital cost for the Projects in As spent dollars, including Allowance for Funds Used During Construction (AFUDC) and including abandonment / demolition costs, is $263.664 million, consisting of $245.557 million for the Coquitlam Gate IP Project and $18.107 million for the Fraser Gate IP Project.

FEI is also seeking Commission approval under sections 59-61 of the Act for deferral treatment of costs for preparing this Application, and therefore requests a new deferral account, entitled the "LMIPSU Application Costs deferral account". The LMIPSU Application costs would be included in Rate Base and amortized over a three year period commencing January 1, 2016. The Application costs include expenses for legal review, consultant costs[2], Commission costs and Commission approved intervener costs, and forecast costs to support the hearing process. The LMIPSU application costs will be recorded in a Non-Rate Base deferral account on a net-of-tax basis attracting a weighted average after tax cost of capital (WACC) return until December 31, 2015. The balance of the LMIPSU Application Costs deferral account as at December 31, 2015, is forecast to be $1.047 million.[3]

[1] In some Appendices completed by third parties and in some public information documents completed early in the planning phase, the Coquitlam Gate IP Project was referred to as the Metro IP Project; however the Metro IP includes both the Coquitlam Gate IP system and the Fraser Gate IP system whereas the Coquitlam Gate IP Project only includes the Coquitlam IP system.

[2] For assistance in answering information requests.

[3] Approximately $1.387 million on a before tax basis, this includes $80 thousand financing charges at the Company's weighted average cost of capital.

Also under sections 59-61 of the Act, FEI is further seeking approval from the Commission to record in a new deferral account, entitled the "LMIPSU Project Development account", project development costs that cover expenses for project management, engineering, and consultants' costs for assessing the potential design and alternatives and associated costs prior to Commission approval of the Projects. The LMIPSU Project Development costs would be included in Rate Base and FEI will begin to amortize these costs over three years starting January 1, 2016. The LMIPSU Project Development costs will be recorded in a Non-Rate Base deferral account on a net-of-tax basis attracting a weighted average after tax cost of capital (WACC) return until December 31, 2015. The balance in this account at December 31, 2015, is forecast to be $2.004 million.[4]

1.2 *EXECUTIVE SUMMARY*

FEI is applying to the Commission to construct and operate two IP pipeline segments in the Lower Mainland of British Columbia that will replace the existing pipeline segments.

The Coquitlam Gate IP pipeline portion of these Projects will install approximately 20 kilometres of NPS 30 Coquitlam Gate IP pipeline operating at 2070 kPa and extending from Coquitlam Gate station (Coquitlam Gate) at Mariner Way & Como Lake Avenue in Coquitlam to East 2nd & Woodland Drive in Vancouver (2nd & Woodland) (Coquitlam Gate IP pipeline). This pipeline will replace an existing NPS 20 pipeline operating at 1200 kPa that is nearing the end of its service life as evidenced by the increasing frequency of gas leaks resulting from non-preventable active corrosion. It has been determined, based on field observations during pipeline excavations and leak responses that failure of the field-applied coating installed at the time of original construction is resulting in corrosion at the welds.

The Fraser Gate IP pipeline portion of the these projects will replace a short 0.5 kilometre section of the existing Fraser Gate IP pipeline (1200 kPa NPS 30 IP) between Fraser Gate station in Vancouver and East Kent Avenue & Elliott Street with a 1200 kPa NPS 30 IP pipeline that meets FEI's seismic criteria for critical facilities to be resistant to a 1:2475-year event.

The Coquitlam Gate IP pipeline and the Fraser Gate IP pipeline are both a critical part of the gas supply to Metro Vancouver. They are part of FEI's Metro IP system which currently operates at 1200 kPa, and interconnect at the 2nd & Woodland district station. The majority of gas delivered into the Metro IP system is currently supplied through the Fraser Gate station. The Metro IP system is an inter-connected system that supports more than 210,000 customers in the Metro Vancouver communities of Vancouver, Burnaby, Coquitlam, Port Moody, Port Coquitlam, West Vancouver and the District and City of North Vancouver.

The two gate stations, Coquitlam Gate and Fraser Gate, are primarily supplied by FEI transmission pressure (TP) pipelines which originate at Huntingdon Station in Abbotsford and

[4] The December 31, 2015 pre-tax balance in this account, including AFUDC, is forecast to be $2.639 million. Approximately 95% of the development costs are expected to be attributable to the Coquitlam Gate IP project and 5% attributable to the Fraser Gate IP project.

run to Nichol Valve Station in Surrey where the pipelines diverge to flow west to Fraser Gate station and north to Coquitlam Gate station and beyond, including additional areas of Coquitlam, Squamish, Whistler, the Sunshine Coast and Vancouver Island. A secondary supply to Coquitlam is a smaller TP pipeline originating at Livingston Gate station in Langley and serving the communities of Maple Ridge, Pitt Meadows and Port Coquitlam, before terminating at Coquitlam Gate. Figure 1-1 provides an overview of FEI's Coastal Transmission System in the Lower Mainland. Figure 1-2 shows a geographical representation of the Lower Mainland IP and TP systems.

Figure 1-1: FEI Coastal Transmission System (CTS)

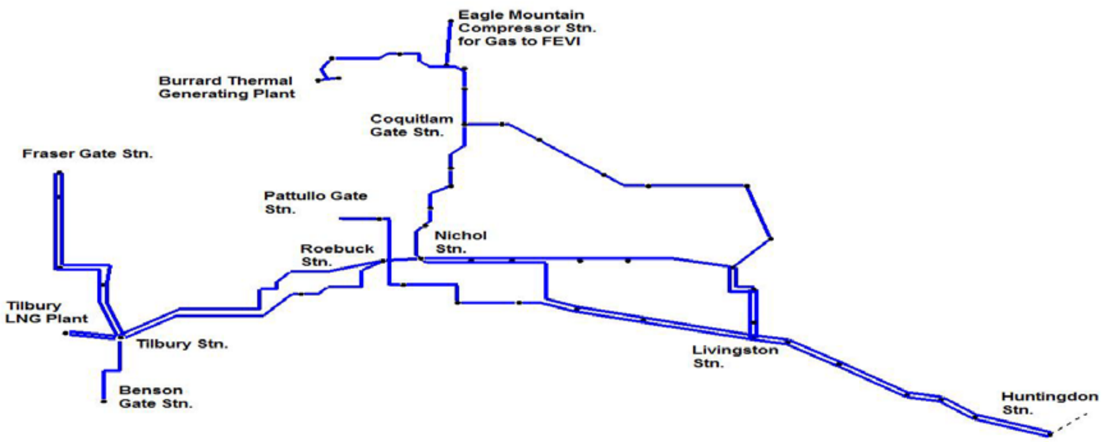
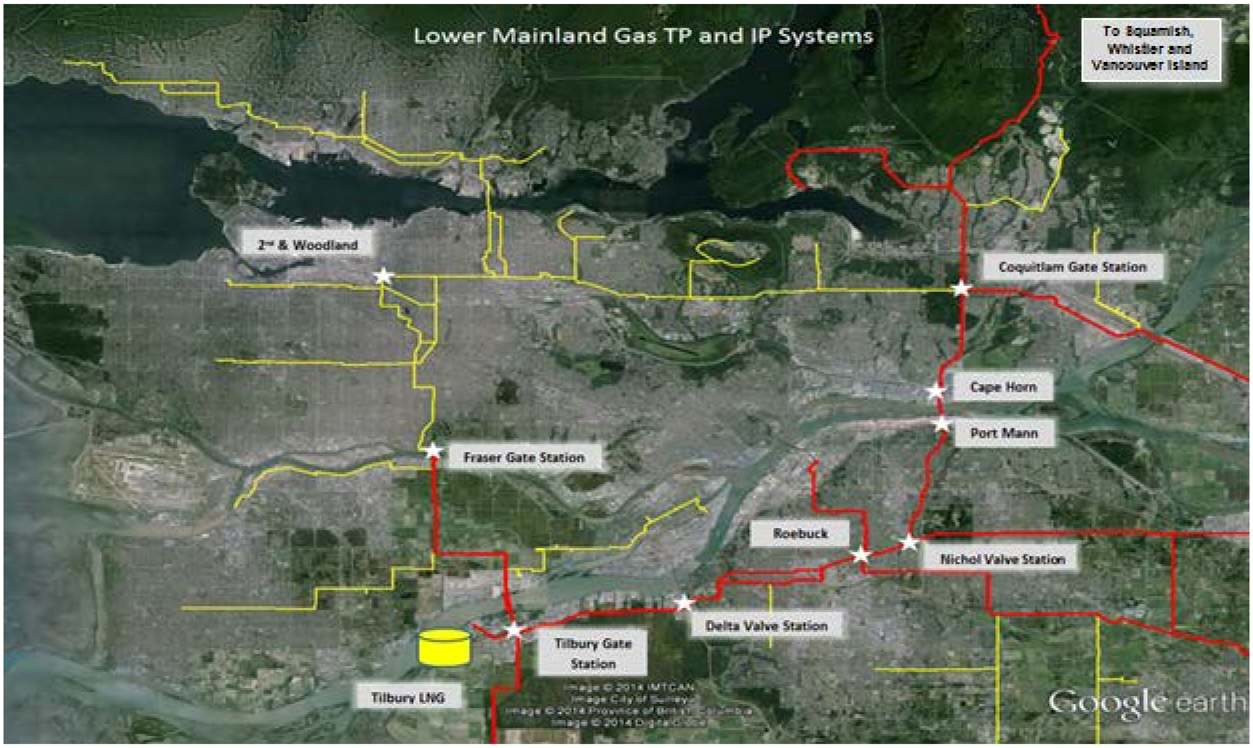


Figure 1-2: Aerial View of the Lower Mainland IP and TP Systems



Source: FEI data overlaid on Google Earth mapping

TP pipelines operating at greater than 2070 kPa

IP pipelines operating from 700 kPa to 2070 kPa

The purpose of the Coquitlam Gate and Fraser Gate IP pipelines is to transport natural gas in a bi-directional corridor to supply numerous district stations along the route. The district stations in-turn feed the distribution system serving residential customers, commercial customers and large industrial customers in the Metro Vancouver communities.

The Lower Mainland is situated in a seismically active area. Seismic studies that have been conducted in recent years indicate that the section of the Fraser Gate IP pipeline between Fraser Gate station and the corner of East Kent Avenue & Elliott Street does not meet FEI's seismic criteria[5]. FEI's seismic criteria aligns with both the 2005 Building Code of Canada and FEI's understanding of the minimum criteria applied by other critical utility infrastructure operators in the Lower Mainland. At the present time, a full-bore rupture of the Fraser Gate IP pipeline due to a seismic event could result in significant public safety and economic consequences and would require the complete shutdown of the pipeline. The Fraser Gate IP pipeline is a major supply source of natural gas serving customers in Vancouver, Burnaby and the North Shore. In the event the Fraser Gate IP pipeline is shut down, up to 171,000

[5] This criteria, which is documented in FEI's design standard DES-09-02 and included as Appendix A-28, is consistent with the design and construction of the two pipelines under the South Fraser River which was approved through BCUC order C-2-09 in 2009.

customers could be without a natural gas supply for up to three weeks. FEI estimates that the economic impact to the general public, customers and the Company of a failure of the Fraser Gate IP pipeline could be in excess of $320 million (section 4.1.2.3). FEI considers the safety and economic consequences posed by the possible pipeline failure as warranting mitigation.

To address the identified seismic vulnerability and mitigate potential consequences, the Company recommends replacement of approximately 500 metres of NPS 30 pipeline operating at 1200 kPa and extending from Fraser Gate at the 2700 block of East Kent Avenue to the corner of East Kent Avenue & Elliott Street with a pipeline constructed in accordance with FEI's seismic criteria which require critical facilities to be resistant to a 1:2475-year event at a cost of $18.107 million (As spent dollars, including AFUDC). This is further discussed in section 4.2 below.

The proposed Fraser Gate IP Project will:

- Achieve seismic resistance to a 1:2475 year event;
- Mitigate the safety risk posed by the pipeline as a result of seismic vulnerability;
- Mitigate the economic risk posed by the pipeline as a result of seismic vulnerability; and
- Consider constructability, operational and safety factors, such as routing constraints, proximity to adjacent utilities and appropriate construction techniques, limiting interruption of flow of gas during construction and commissioning and allowing sufficient space to work around existing piping and components.

Ongoing operations and studies demonstrate that the NPS 20 Coquitlam Gate IP pipeline is experiencing increasing incidences of non-preventable leaks due to corrosion. Since 1987 this pipeline has experienced 15 leaks, seven of which occurred in 2013. Quantitative reliability analysis (see Appendix A-1) concludes that the annual leak frequency could increase by 370 percent by 2033.

The safety risk associated with operation of this pipeline is currently being managed through mitigation measures such as odorization, leak detection (frequent leak surveys), and leak response. However, FEI has determined that leak prevention cannot be effectively managed through maintenance activities on this pipeline and has therefore assessed the pipeline as nearing the end of its service life. As a result of its assessments, FEI has concluded that replacement of this pipeline is the most appropriate solution to prevent future leaks.

FEI believes that continued long-term operation of the pipeline in its current state, in the absence of a replacement plan, could result in the British Columbia Oil and Gas Commission (OGC) finding that FEI has failed to comply with the *British Columbia Oil and Gas Activities Act* and Canadian Standards Association Standard CSA-Z662-11.

In addition to the integrity related risk associated with the Coquitlam Gate IP pipeline, FEI also recognizes other capacity related constraints on the Metro IP system:

1. Operational Flexibility: Over time and with growth in demand on the system, there has been an erosion of the operational flexibility required to facilitate planned work on the Fraser Gate IP pipeline; and
2. System Resilience: The Fraser Gate IP pipeline and the Coquitlam Gate IP pipeline are identified as single point of failure pipelines at the present time; if either pipeline fails, there is no alternate supply capacity sufficient to provide year round system resiliency to mitigate potential consequences that could occur as a result of unplanned outages.

For a significant part of the service life of the Metro IP system, there has been a level of capacity to allow operational flexibility in the system so that during warmer periods, the system could be supported for some period without its primary supply, Fraser Gate station. This allowed an operational window to interrupt the supply from Fraser Gate station to facilitate planned work that requires isolation of the flow. Over time and with growth in demand on the system, this capacity has eroded such that the existing NPS 20 Coquitlam Gate IP pipeline cannot be relied on to support the Metro IP System throughout the year without some support from Fraser Gate station, through the Fraser Gate IP pipeline. The current Metro IP system lacks the capacity to provide a level of operational flexibility to facilitate planned outages for work, such as the replacement of the section of the Fraser Gate IP pipeline to address seismic concerns without the installation of a bypass.

At the present time the existing Fraser Gate IP pipeline and Coquitlam Gate IP pipeline are not capable of providing security of supply to the customers normally served by each other under design day conditions. Due to lack of capacity on the Coquitlam Gate IP pipeline, these pipelines can be considered to be single point of failure pipeline segments. Failure of the NPS 30 pipeline at the Fraser Gate outlet would result in loss of service to up to 171,000 customers. Loss of the NPS 20 pipeline at the Coquitlam Gate outlet would result in loss of service to up to 41,000 customers. The economic impact to the general public, customers and the Company of a failure of the Fraser Gate IP pipeline or the Coquitlam Gate IP pipeline could be approximately $320 million or $64 million respectively. An increase in capacity of the Coquitlam Gate IP pipeline as part of the necessary pipeline replacement to address the identified non-preventable corrosion leaks will alleviate this issue. Further, as discussed in sections 3.1.3.4 and section 3.2.3.2, a quantitative risk assessment calculates a reduction in economic risk in the range of $2.5 million per year associated with providing a fully resilient Metro IP system through increasing the capacity of the Coquitlam Gate IP pipeline as proposed in the Application and in conjunction with the construction of the Cape Horn to Coquitlam TP loop (shown in Figure 1.3). The Cape Horn to Coquitlam TP loop is planned to be constructed as further described in section 1.3.

The need to replace the existing pipeline for integrity reasons has created an opportunity for FEI to evaluate and mitigate system risks in a cost-effective manner. The replacement of the Coquitlam Gate IP pipeline provides a unique, and appropriately timed, one-time opportunity to restore operational flexibility and provide resiliency to the Metro IP system through an increase in pipeline capacity in the Coquitlam Gate IP pipeline.

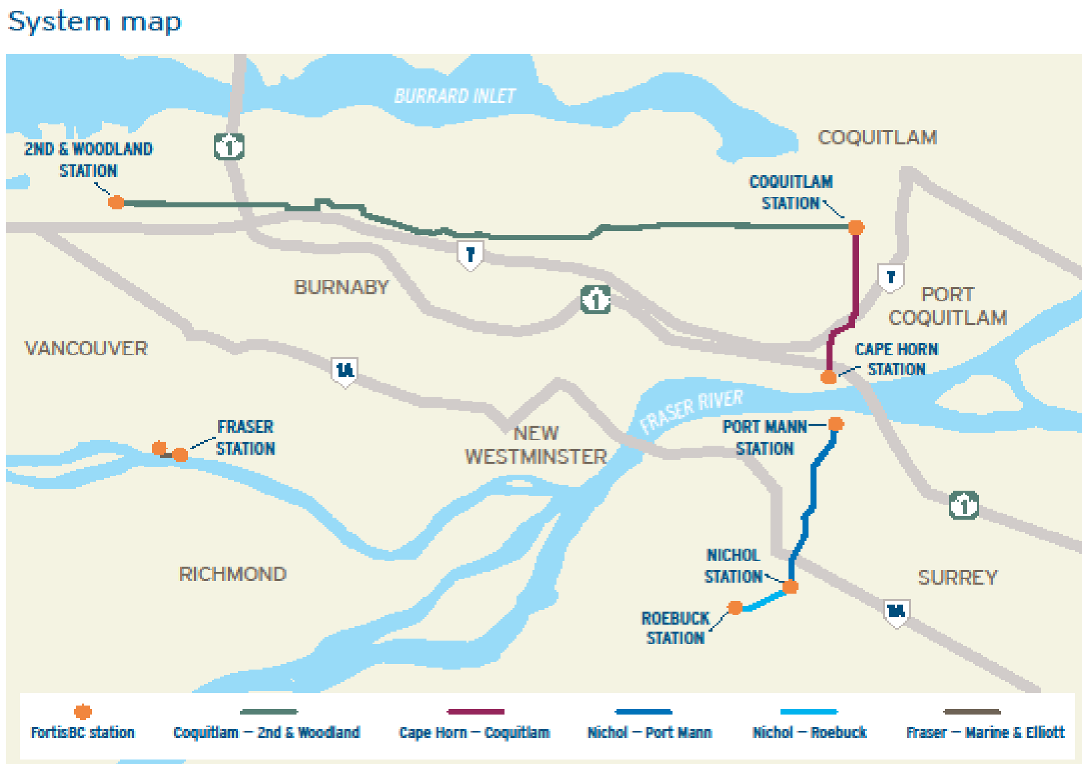
In order to eliminate the identified non-preventable corrosion risks associated with the Coquitlam Gate IP pipeline and address other capacity related constraints, FEI has evaluated a number of alternatives and has identified the preferred alternative to address the objectives identified for the Projects. The only solution which meets all of the stated objectives is replacement of the the existing NPS 20, 1200 kPa Coquitlam Gate IP pipeline with a NPS 30 pipeline operating at 2070 kPa at a cost of $245.557 million (As spent dollars, including AFUDC and abandonment / demolition). This is further discussed in section 3.2 of this Application.

The proposed Coquitlam Gate IP Project will:

- Eliminate the elevated reliability, safety and regulatory risk posed by the existing Coquitlam Gate IP pipeline as a result of the known corrosion mechanism and resulting unacceptable projected leak frequency;
- Provide sufficient operational flexibility to permit planned maintenance and repair of the Fraser Gate IP pipeline;
- Provide full system resilience in conjunction with the Cape Horn to Coquitlam TP pipeline reinforcement, to fully supply the Coquitlam Gate IP pipeline and the Fraser Gate IP pipeline from either the Fraser Gate station or the Coquitlam Gate station on any day of the year and therefore reduce the potential consequences of a failure upstream, at, or downstream of either gate station; and
- Consider constructability, operational and safety factors, such as routing constraints, proximity to adjacent utilities and appropriate construction techniques, limiting interruption of flow of gas during construction and commissioning and allowing sufficient space to work around existing piping and components.

The two IP pipeline replacement Projects as proposed, in conjunction with other planned TP pipeline looping projects (identified as Cape Horn-Coquitlam, Nichol-Port Mann and Nichol-Roebuck in Figure 1-3) that have been identified as being required for either capacity and/or security of supply purposes and that are expected to be constructed as described in section 1.3, will significantly improve the resiliency of the natural gas system in the Lower Mainland. See Figure 1-3 for a high level view of the proposed IP projects and the planned TP projects.

Figure 1-3: High level view of Projects



Specifically, the proposed Coquitlam Gate IP Project will eliminate the reliability and safety risk as a result of the known corrosion mechanism and resulting unacceptable projected leak frequency, provide sufficient operational flexibility to permit planned maintenance and repair of the Fraser Gate IP pipeline and provide full system resilience in conjunction with the planned Cape Horn to Coquitlam TP pipeline reinforcement further described in section 1.3.

The proposed Fraser Gate IP Project will mitigate the safety risk and consequence to customers associated with the pipeline as a result of seismic vulnerability and meet seismic resistance to a 1:2475 year event.

Together, the two IP pipeline Projects will improve system integrity and safety, allow for full system resiliency and reduce the risk of gas supply disruption to up to approximately 171,000 customers residing in the Lower Mainland in the event of a failure of existing pipelines.

While each of the individual Projects noted above is a stand-alone project that is justified on its own merits in this CPCN, and can be constructed independently of the other Project, FEI has grouped the two Projects into this one CPCN due to the fact that they are related, complement one another and will provide regulatory and construction efficiencies if they are addressed at the same time.

A summary of the total forecast capital costs, and 2019 average cost of service, is as follows:

- Total Capital Cost (As-spent dollars) excluding AFUDC but including abandonment and demolition cost is $250.216 million (including AFUDC the As spent cost is $263.664 million), and
- 2019 Average Cost of Service Impact - $0.130 / GJ.

For a typical FEI residential customer consuming 95 GJ per year in 2019, this would equate to approximately $12 per year and reflects an approximate increase of 3.39% on delivery margin or an approximate increase of 1.3% on the burner tip.[6]

The following table summarizes the total forecast capital and deferred costs for the projects:

Table 1-1: Summary of Forecast Capital & Deferred Costs ($millions)

Particular	2014$	As-Spent	AFUDC	Tax Offset	Total
Total Capital Cost	219.677	250.216	13.448		**263.664**
LMIPSU Development Cost	2.441	2.442	0.197	(0.635)	**2.004**
LMIPSU Application Cost	1.307	1.307	0.080	(0.340)	**1.047**
Total	**223.425**	**253.965**	**13.725**	**(0.975)**	**266.715**

Table 5-1 in section 5 presents a detailed summary of the costs by project and Table 5-2 provides the financial impacts associated with the completion of each of the two IP pipeline Projects, as well as a summary of the combined rate impacts. Both tables are based on detailed schedules for each pipeline segment as included in Appendix E-1.

The Company has identified a number of Project stakeholders, including residents, businesses, government entities and First Nations. Communications and consultations with the stakeholders with respect to the Projects have already taken place, and as outlined in section 7 (Public Consultation) FEI continues to consult with stakeholders regarding routing, the Project schedule, temporary construction space, Rights of Way (ROW), and public safety. Another series of public information sessions is planned prior to start of construction, with the goal of informing residents and the public about construction activities, traffic issues and mitigation strategies.

FEI is committed to continuing consultation with Project stakeholders and will continue to ensure that, as the Projects progress; stakeholders are kept informed and have ways to provide feedback to the Company.

The Projects will not involve Crown Land or any First Nations treaty land. However, during the preliminary stage of considering alternatives, as further explained in section 8 of this Application, the Company has informed First Nations about the Company's plan to construct

[6] Approximate burner tip impact calculated based on a Residential customer's annual bill of $922 as of January 1, 2015

pipelines in Coquitlam, Burnaby and Vancouver. The OGC will be the Crown agency responsible for First Nations consultation. FEI will work with the OGC if any further First Nation consultation is required.

Environmental, archeological and socio-economic assessments have been completed and conclude that the impacts associated with the Projects are expected to be minimal and can be mitigated through the implementation of standard best management practices and mitigation measures.

Based on the information summarized above and provided in this Application, FEI believes it has demonstrated that the Projects are in the public interest and should be approved.

1.3 FEI 2014-2018 PBR APPLICATION AND FEU 2014 LONG TERM RESOURCE PLAN

The Projects were discussed in section 4.7.2 (pages 250 to 252) in FEI's Application for Approval of a Multi-Year Performance Based Ratemaking Plan for 2014 through 2018 as anticipated CPCNs. The Projects were also described in the FEU[7] 2014 Long Term Resource Plan (LTRP) (section 5.2) which was accepted by Commission Order G-189-14.

In the LTRP, the FEU submitted that system reinforcements were needed in the Lower Mainland portion of FEI's natural gas delivery system to address long-term requirements for both system sustainment and capacity constraints. FEI plans to move forward with the reinforcement of the Coastal Transmission System including looping the NPS 20 TP pipeline between the Cape Horn Valve Station and Coquitlam Gate Station with a NPS 36 TP pipeline in the future for the reasons described in section 5 and Appendix D-1 of the LTRP.

The Cape Horn to Coquitlam TP loop once constructed, provides the necessary pipeline capacity to the Coquitlam Gate IP pipeline which will provide full resiliency to the Metro IP system. It would allow for continued gas service to all customers in the event of an interruption to the gas supplied by either of the existing IP pipelines. This will allow for planned or unplanned maintenance and repair of the Fraser Gate IP pipeline at any time of the year and without significant service disruption. Until the Cape Horn to Coquitlam TP loop is constructed, sufficient operational flexibility will exist to permit planned maintenance and repair of the Fraser Gate IP pipeline during warmer times of the year (further described in section 3.1.2.3.1).

[7] FEU refers to FortisBC Energy Utilities comprised of FortisBC Energy Inc., FortisBC Energy (Vancouver Island) Inc. and FortisBC Energy (Whistler) Inc. As of January 1, 2015 these utilities will all be referred to collectively as FEI per Commission Order G- 21-14 approving FortisBC Energy Utilities Common Rate, Amalgamation and Rate Design Application.

1.4 *Requested Regulatory Review of CPCN Application*

The Company's Performance Based Ratemaking (PBR) Plan for the period 2014 to 2019 (approved by Order G-138-14) provides that FEI will apply for a CPCN for the years 2014 and 2015 for projects in excess of $5 million in capital expenditures. Given that the current estimated capital cost for each segment of the Projects exceeds the established threshold, FEI is thus applying to the Commission for a CPCN for the two Projects.

The information presented in this Application accords with the guidelines set out in the Commission's *2010 Certificates of Public Convenience and Necessity Application Guidelines* (the Guidelines). Draft Procedural and Draft Final Orders are included in Appendix G.

FEI believes that a written hearing process, with a workshop to provide an overview of the Projects, and two rounds of Information Requests from the Commission and interveners, provides for an appropriate and efficient review for the Application. However, the routing component of the Coquitlam Gate IP pipeline may temporarily impact certain residents and/or communities and therefore be of particular interest; FEI would be agreeable to an oral hearing limited to routing, if the Commission believes this would be of value.

The Projects are of a nature that falls within the traditional natural gas infrastructure construction, are required for safety and reliability and are primarily confined to private property and municipal property such as streets and parking lots. It is anticipated that traffic flows will be impacted during construction and mitigation measures will be put in place. It is also anticipated that there will be no impact to First Nations during the construction and operation of these pipelines.

FEI proposes the following regulatory timetable in Table 1-2 below:

Table 1-2: Proposed Regulatory Timetable

ACTION	DATE (2015)
BCUC Issues Procedural Order	Monday, January 5
FEI Publishes Notice by the Week of	Monday, January 12
Intervener and Interested Party Registration and Confirmation if Attending Workshop	Monday, January 26
Workshop	Tuesday, February 3
Commission and Intervener Information Request No. 1	Thursday, February 12
FEI Response to Information Requests No. 1	Thursday, March 12
Commission and Intervener Information Request No. 2	Thursday, April 2
FEI Response to Information Requests No. 2	Monday, April 27
Limited Scope Oral Hearing – Routing (If required)	Thursday, May 7
FEI Written Final Submission	Thursday, May 21

ACTION	DATE (2015)
Intervener Written Final Submission	Thursday, May 28
FEI Written Reply Submission	Thursday, June 4

2. APPLICANT

2.1 *NAME, ADDRESS AND NATURE OF BUSINESS*

FEI is a company incorporated under the laws of the Province of British Columbia and is a wholly-owned subsidiary of FortisBC Holdings Inc., which, in turn, is a wholly-owned subsidiary of Fortis Inc. FEI maintains an office and place of business at 16705 Fraser Highway, Surrey, British Columbia, V4N 0E8.

FEI is the largest natural gas distribution utility in British Columbia and provides sales and transportation services to residential, commercial, and industrial customers in more than 100 communities throughout British Columbia. FEI's distribution network delivers gas to more than eighty percent of the natural gas customers in British Columbia.

FEI is regulated by the BCUC.

2.2 *FINANCIAL CAPABILITY*

FEI is capable of financing the Projects. FEI has credit ratings for senior unsecured debentures from DBRS[8] and Moody's Investors Service of A and A3 respectively.

2.3 *TECHNICAL CAPABILITY*

FEI has designed and constructed a system of integrated high, intermediate and low-pressure pipelines and operates more than 42,200 kilometres of natural gas transmission and natural gas distribution mains and service lines in British Columbia. FEI's transmission and distribution infrastructure serves approximately 840,000 customers in British Columbia. As noted in section 1.3, amalgamation will take effect January 1, 2015 and FEI will include the customers of FortisBC Energy (Vancouver Island) Inc. and FortisBC Energy (Whistler) Inc. for a total of approximately 950,000 customers.

The Projects will be managed by a team from the Company. Figure 3-8 in section 3 provides the organization chart of the Project team for both Projects. FEI retained WorleyParsons Canada Services Ltd. (WorleyParsons), an experienced pipeline engineering firm, to undertake the initial pipeline and station engineering for these Projects.

FEI will employ a qualified contractor for the detailed design and construction of the Projects, which is discussed further in sections 3.3.7.1 and 3.3.7.2 and sections 4.3.7.1 and 4.3.7.2 respectively of the Application.

[8] Formerly Dominion Bond Rating Service

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3. COQUITLAM GATE IP

3.1 PROJECT JUSTIFICATION

3.1.1 Project Description

The Coquitlam Gate IP pipeline portion of this Project involves the installation of approximately 20 kilometres of NPS 30 Coquitlam Gate IP pipeline operating at 2070 kPa and extending from Coquitlam Gate station (Coquitlam Gate) at Mariner Way & Como Lake Avenue in Coquitlam to East 2nd & Woodland Drive in Vancouver (2nd & Woodland) (Coquitlam Gate IP pipeline). This pipeline will replace an existing NPS 20 pipeline operating at 1200 kPa that is nearing the end of its expected service life as evidenced by the increasing frequency of gas leaks resulting from non-preventable active corrosion.

3.1.2 Project Need

In this section, FEI will discuss the main justifications for the Coquitlam Gate IP Project.

3.1.2.1 A Primary Source of Gas Supply to Metro Vancouver

The existing Coquitlam Gate station to 2nd & Woodland station pipeline is a NPS 20 steel IP pipeline, approximately 20 kilometres in length, and was installed in 1958. The pipeline is a critical part of the gas supply to Metro Vancouver. It is part of FEI's Metro IP system which currently operates at 1200 kPa.

The Metro IP system is supplied through two pipelines, the Coquitlam Gate IP pipeline, a NPS 20 IP (1200 kPa) pipeline originating at Coquitlam Gate station, and the Fraser Gate IP pipeline, a NPS 30 IP pipeline (1200 kPa) originating at Fraser Gate station. These two pipelines interconnect at the 2nd & Woodland district station in Vancouver. The majority of gas delivered into the Metro IP system is currently supplied through the Fraser Gate station. The Metro IP system is an inter-connected system that supports more than 210,000 customers in the Metro Vancouver communities of Vancouver, Burnaby, Coquitlam, Port Moody, Port Coquitlam, West Vancouver and the District and City of North Vancouver.

The two gate stations, Coquitlam Gate and Fraser Gate, are primarily supplied by FEI transmission pressure (TP) pipelines which originate at Huntingdon Station in Abbotsford and run to Nichol Valve Station in Surrey where the pipelines diverge to flow west to Fraser Gate station and north to Coquitlam Gate station and beyond, including additional areas of Coquitlam, Squamish, Whistler, the Sunshine Coast and Vancouver Island. A secondary supply to Coquitlam is a smaller TP pipeline originating at Livingston Gate station in Langley and serving the communities of Maple Ridge, Pitt Meadows and Port Coquitlam, before terminating at Coquitlam Gate. Figure 3-1 provides an overview of FEI Coastal Transmission System in the

Lower Mainland. Figure 3-2 shows a geographical representation of the Lower Mainland IP and TP systems.

Figure 3-1: FEI Coastal Transmission System (CTS)

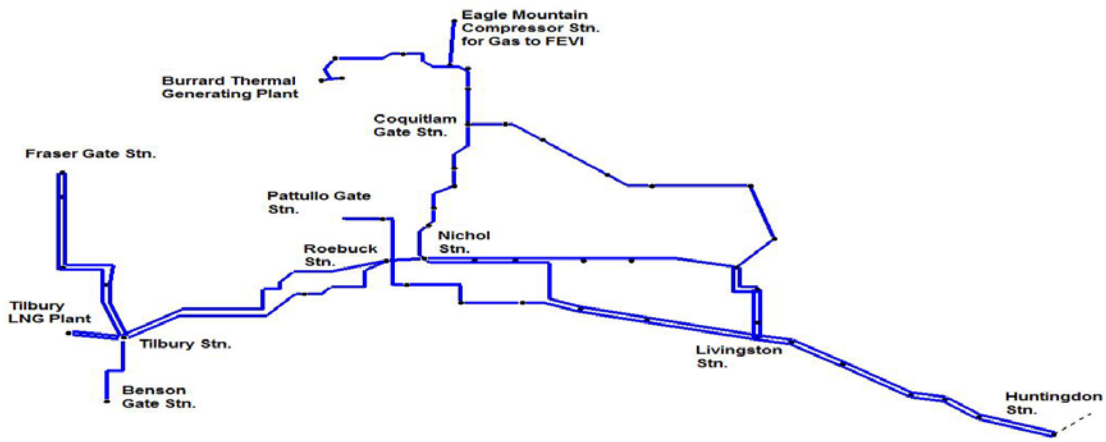
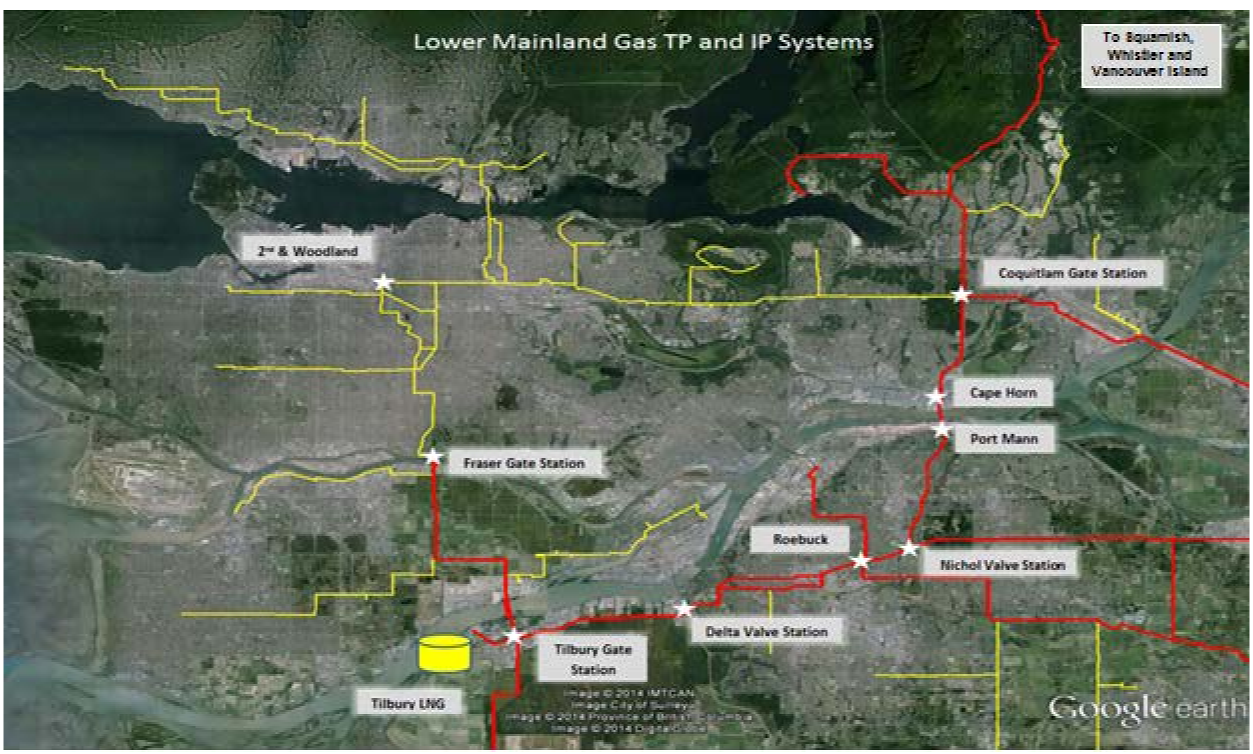


Figure 3-2: Aerial View of the Lower Mainland IP and TP Systems



Source: FEI data overlaid on Google Earth mapping

- TP pipelines operating at greater than 2070 kPa
- IP pipelines operating from 700 kPa to 2070 kPa

The purpose of the Coquitlam Gate and Fraser Gate IP pipelines is to transport natural gas in a bi-directional corridor to supply numerous district stations along the route. The district stations in-turn feed the distribution system serving residential customers, commercial customers and large industrial customers in the Metro Vancouver communities.

3.1.2.2 A Safety and Regulatory Concern

The Coquitlam Gate IP pipeline has experienced a number of leaks since 1987. The failure mechanism, corrosion beneath disbonded field-applied coating at girth welds (further described below), is non-preventable. Due to current active corrosion on this pipeline, the leak frequency is expected to escalate over time.

The pipeline is a steel pipeline, constructed of material and to the standards that were in place in 1958. The external coating of the pipe body (excluding girth weld regions) is a factory-applied coal tar enamel, and the construction girth welds are field coated with coal tar enamel. Despite appearing similar in name, the two coating systems (factory-applied and field coated) have performed dissimilarly over time. Long-term coating performance is primarily influenced by the application procedure (including ambient conditions at the time of application), which is recognized as being more controllable in a factory environment.

Proactive corrosion management of buried steel pipelines is achieved primarily through external coatings in conjunction with cathodic protection (CP). Cathodic protection is the application of an electrical current to the pipeline to minimize the natural corrosion tendency of buried steel. As pipe coatings may degrade over time or suffer construction or third party damage, CP is applied as a secondary defense against corrosion. Industry experience recognizes that although CP is being applied to a pipeline, corrosion may still occur due to CP shielding. Disbonded coatings, large rocks, or foreign structures are examples of situations where "CP shielding" can occur, preventing the CP current from reaching the pipeline and possibly resulting in corrosion.

Since 1987 the Coquitlam Gate IP pipeline has experienced 15 instances of leaks due to corrosion, seven of which occurred in 2013. A further leak occurred in 2014 before the filing of this Application. Leaks on this pipeline will continue, and as shown in the "FEI -508 MM IP Pipeline Quantitative Reliability Assessment Report" completed by Dynamic Risk Assessment Systems (DRAS) (see Appendix A-1), are predicted to escalate to a rate of 3.7 times the 2013 rate by 2033. All recorded leaks have occurred under the field-applied coating located at construction girth welds. It has been determined, based on field observations of leaks and pipeline excavations, that the thick field-applied coating is disbonding from the pipe surface in such a way that "CP shielding" is occurring. Due to the shielding of the cathodic protection current, the CP cannot effectively mitigate corrosion growth and prevent leaks on the Coquitlam Gate IP pipeline.

FEI evaluated several above ground techniques used to locate areas of ineffective coating and determined that they were ineffective at locating the coating disbondment that was leading to corrosion damage. As such, FEI is unable to determine where coating failure has occurred and where corrosion which may lead to failure is likely to exist.

The safety risk associated with operation of this pipeline that includes an increasing leak occurrence and risk of gas migration and accumulations in public areas is currently being managed through mitigation measures such as odourization, leak detection (more frequent leak surveys), and leak response. However, as further described below, FEI has determined leaks cannot be prevented through maintenance activities on this pipeline and has therefore assessed the pipeline as nearing the end of its service life. As a result of its assessments, FEI has concluded that replacement of this pipeline is the most appropriate solution to prevent future leaks.

FEI's replacement plan also considers the obligations as a permit holder under the BC Oil and Gas Activities Act (OGAA), which in sections 37 (1) and 37(3) state:

> *"A permit holder and a person carrying out an oil and gas activity must prevent spillage"*

> *"A person who is aware that spillage is ... likely to occur must make reasonable efforts to prevent or assist in containing or preventing the spillage."*

FEI believes that continued long-term operation of the pipeline in its current state, in the absence of a replacement plan, could result in the OGC finding that FEI has failed to comply with a provision of the OGAA.

On Oct 30, 2013, after the 7th reported leak that year, the OGC issued order 2013-25 (see Appendix A-2) requiring FEI to:

1. On or before December 1, 2013 complete and submit to the Oil and Gas Commission:

- *a. An engineering assessment of Pipeline Project 1045*[9]
- *b. An estimate of the volume of gas lost during the most recent leak;*
- *c. Records of the closed interval surveys of the cathodic protection system for the past five years, and;*
- *d. A map of the subject pipeline that shows all failure locations over the past five years.*

2. Complete leak surveys on the subject pipeline at a minimum of once per week.

3. Submit the information required in Item 1 electronically to the Commission

The reasons given for the order are as follows:

- *i. Fortis BC is the operator responsible for the subject pipeline.*
- *ii. The subject pipeline has experienced seven leaks to date in 2013, two leaks in 2012, and six leaks prior to that.*
- *iii. Fortis BC has identified external corrosion as the cause.*
- *iv. I am of the opinion that the subject pipeline may pose a risk to public safety and the environment.*

9 Project 1045 was a reference used by the OGC for the Coquitlam Gate IP pipeline.

FEI's engineering assessment submitted in response to the OGC issued order 2013-25 identified pipe replacement as an integral part of FEI's plan to maintain compliance with the OGAA.

FEI's response to OGC order 2013-25 is included in Appendix A-3. A summary is provided below.

- Due to the coating failure mechanism causing apparent shielding of the cathodic protection (CP) system, it has been deemed unlikely that cathodic protection will mitigate corrosion growth and prevent future leaks.
- Options to address this systemic issue are limited. In-line inspection is not a viable option due to low operating pressures and the expected presence of inside diameter restrictions. With consideration to the cause of leaks, extent of leaks, expected increase in leak frequency, and lack of effective prevention methods, FEI has determined that pipe replacement is the most appropriate mitigation method.
- Replacement meets the requirements of Canadian Standards association (CSA) Z662 Section 12.10.2.3 (d) which states "Where the condition of distribution or service lines, as indicated by leak records or visual observation, deteriorates to the point where they should not be retained in service, they shall be replaced, reconditioned, or abandoned". Replacement also meets the requirements of the BC Oil and Gas Activities Act Section 37 (3) which states "A person who is aware that spillage is occurring or likely to occur must make reasonable efforts to prevent or assist in containing or preventing the spillage".
- In response to observed leak frequencies, FEI increased leak survey frequency of the subject pipeline to quarterly on March 4, 2013. This frequency was further increased to weekly on August 22, 2013. To facilitate leak survey, vegetation control frequencies have also been increased over some segments.
- To support optimal leak response for the subject pipeline, FEI has implemented the following measures:
    - Pretested pipe and stopple equipment have been acquired to facilitate leak repair during cold weather conditions if a bypass is needed to maintain service to customers.
    - Bypass sizing requirements have been assessed to expedite repair planning.
    - Repair sleeves have been manufactured and are being stored for use on the subject pipeline.
- Leak response documentation specific to the subject pipeline has been developed to facilitate decisions by "on-call managers" who may be responding to leaks identified during evenings, weekends, or holidays.

- With the operating practices identified above, FEI does not anticipate the subject pipeline becoming inoperable. Safety risk is being managed through odourization, leak detection, and leak response.
- FEI has assessed that the subject pipeline is suitable for continued service for the short term, and is being operated in accordance with the requirements of CSA Z662-11.
- FEI's replacement plan for the subject pipeline, appropriately addresses FEI's requirement as a Permit Holder under Section 37 (1) (a) of the BC Oil and Gas Activities Act to "prevent spillage".

The OGC replied to FEI on December 18, 2013 that they had received and reviewed FEI's response to order 2013-25.

3.1.2.3 An Operational Flexibility and System Resiliency Opportunity

FEI recognizes the existing Coquitlam Gate IP pipeline requires replacement in order to mitigate future gas leaks resulting from non-preventable active corrosion. In addition to the integrity related risk associated with the Coquitlam Gate IP pipeline, FEI also identified other capacity related constraints on the Metro IP system that warrant consideration in the selection of a prudent replacement solution:

1. Operational Flexibility: Over time and with growth in demand on the system there has been an erosion of the operational flexibility required to facilitate planned work on the Fraser Gate IP pipeline; and
2. System Resilience: The Fraser Gate IP pipeline and the Coquitlam Gate IP pipeline are identified as single point of failure pipelines at the present time, if either pipeline fails, there is no alternate supply capacity sufficient to provide year round system resiliency to mitigate potential consequences that could occur as a result of unplanned outages.

3.1.2.3.1 LIMITED CAPACITY TO PROVIDE OPERATIONAL FLEXIBILITY

For a significant part of the service life of the Metro IP system, there has been sufficient capacity to provide operational flexibility in the system such that during warmer periods, the system could be supported for some period without the primary supply from Fraser Gate station. This allowed FEI an operational window to interrupt the supply from Fraser Gate station to facilitate planned work on the Fraser Gate IP pipeline that requires isolation of the flow. Over time and with growth in demand on the system, this operational flexibility has been eroded such that currently the existing NPS 20 Coquitlam Gate IP pipeline cannot be relied on to support the Metro IP System at any time of year without some support from Fraser Gate station, through the Fraser Gate IP pipeline.

Operational flexibility is the ability to isolate a section of pipeline as required for planned or scheduled maintenance without impacting supply to customers. Operational flexibility can be improved by adding pipeline loops or providing multiple sources of supply within a system.

Using inline valves is the preferred method for isolating pipeline segments for maintenance purposes. Once the pipeline is isolated, natural gas can be purged from the segment and the pipeline can be modified or replaced. When the gas supply downstream of the isolated segment is not sufficient to maintain pressure to customers, a permanent or temporary bypass must be installed around the isolated segment in order to maintain supply to these customers while repair or replacement work is carried out. This is achieved by installing temporary valves (stopple fittings) and bypass piping of sufficient size to meet the downstream load requirements at the time of the work. Stopple fittings are fittings permanently welded to the pipe, which allows a hole in the pipe to be created through which a mechanical plug is inserted into the existing pipeline to stop the flow of gas. Bypass piping is attached to these fittings to divert the flow around the isolated section. Once flow is achieved in the bypass piping, the plug is inserted into the existing pipeline, stopping the flow of gas. The line can then be purged of gas and repairs or replacements completed. Once the piping is repaired or replaced the plug is removed allowing the flow back into the repaired or replaced segment of pipe. The bypass is then isolated and removed.

Both the Coquitlam Gate IP and Fraser Gate IP pipelines are large diameter pipelines which have long segments located within busy roadways. Stopple and bypass operations are major undertakings from a financial and time/effort perspective and require significant planning and engineering. Excavations on these large pipelines, required for stopple/bypass operations, are significant as the pipe is often buried at depths exceeding 2 metres. Other infrastructure in the roadway such as water, sewer, power, cable, and telephone can complicate installation of stopple fittings, bypass piping, and installation of shoring cages to make excavations safe. Routing of bypass piping is often difficult in these confined urban areas. Fittings welded to pipelines result in a loss of depth of cover and may require extension of bypass lengths to ensure minimum depth of cover is achieved. Interruptions due to excavations and bypass routing can have major and extended impacts on traffic and local access.

Maintenance work is typically scheduled to minimize the need for bypasses. The period of time where isolation can be achieved without installation of bypasses is typically called the maintenance window. This period of time varies for most segments depending on the time of year (system load). At some time in the future, FEI expects there to be maintenance required on the Fraser Gate IP pipeline, including pipe segment replacement due to integrity issues such as corrosion or river crossing erosion, seismic upgrades, and valve/fitting replacements. It should be expected that over the operating life of the pipeline that sections of pipelines will require renewal due to mechanisms such as corrosion. Pipeline modifications are often required to meet outside requests such as pipe lowering or relocations for road work. Scheduling these maintenance activities can be difficult depending on the urgency of the request and the time of year. Delays to these maintenance projects may occur as a result of a lack of operational flexibility.

In the past all segments on the Coquitlam IP and Fraser Gate IP had maintenance windows where work could be carried out without the need for bypass. Over time, due to load growth, this maintenance flexibility has been eroded such that the pipeline segments immediately downstream of the Fraser Gate station require bypass piping to be installed at all times of the year, and pipeline segments downstream of Coquitlam Gate will require bypass piping to be installed in winter conditions. Over time, the operational flexibility will continue to erode, making routine maintenance more complicated and costly to perform, with increasing impact on the public.

The replacement of the existing Coquitlam Gate IP pipeline with an enhanced capacity pipeline will provide FEI the ability to create an extended operational window to facilitate planned maintenance.

The need to replace the existing Coquitlam Gate IP pipeline for integrity reasons has created a unique, one-time opportunity for FEI to restore operational flexibility to facilitate planned work. For example the increased capacity from Coquitlam would allow for the Fraser Gate IP Project (described in section 4.1) to be completed in a more cost effective and efficient manner compared to the current Metro IP system.

3.1.2.3.2 LIMITED CAPACITY TO PROVIDE RESILIENCY

FEI and its predecessor companies have been providing natural gas service to the residents and businesses of British Columbia safely and reliably for over 50 years. In that time the Company has seen an increase in the number of customers in the Lower Mainland, Vancouver Island and the Sunshine Coast, reaching approximately 700,000. The supply of natural gas is vital in meeting the energy needs of the province on a continuous basis. Over time, the increasing number of customers and increasing demand for natural gas supply has resulted in the erosion of the system capacity necessary for operational flexibility within the Metro IP system and has reduced the overall resiliency of the natural gas delivery system. The erosion of system resiliency has increased the risk associated with possible unplanned system outages.

Resiliency[10] provides the ability to isolate a section of pipeline on an emergency basis without impacting supply to customers. Like operational flexibility, system resiliency is achieved by having pipeline loops or multiple sources of supply within a system.

Unlike operational flexibility where temporary bypass piping can be used to prevent downstream supply shortfalls during planned maintenance, emergency repairs must be conducted by shutting in a section of pipeline using the inline valves as quickly as possible to minimize the potential impact of escaping gas. Where insufficient supply downstream of the isolated segment exists, customers will be interrupted.

Examples of events that could result in emergency shut downs include: third party damage (punctures), corrosion leaks, equipment failure and geotechnical, hydrotechnical or seismic failures.

[10] Resiliency is defined in the Glossary of Terms as the ability to rebound quickly in case of equipment failure. Also see the Appendix A-5 and A-6 where resiliency has been discussed by consultants in other jurisdictions or proceedings.

The importance of resiliency in the natural gas industry was outlined in Dr. Stephen Flynn's report for Union Gas in support of the Parkway West project (see Appendix A-6, Page 1 of 15).

> *"When a company provides an essential service to the public, its responsibilities extend beyond ensuring that its facilities, systems, and networks are safe, secure, and adequately maintained. As the aftermath of Superstorm Sandy has made clear, when something as important to a community as energy is at stake, the hard and soft infrastructures that supply a critical service must be made resilient. Resilient infrastructure, in turn, should have: (1) designed features that allow it to withstand disruptive events, (2) redundancies that allow continuity of essential function during disruptive events even when individual parts fail, and (3) the capacity to rapidly restore essential functions in the face of major disruptive events.*
>
> *Constructing resilient systems requires making upfront investments for addressing possible future contingencies. As such it serves a purpose that is analogous to insurance. Infrastructure that is built to ride out and bounce back from predictable and unpredictable shocks lowers the risk of catastrophic economic consequences. Beyond that, it also mitigates the risk of loss of life and suffering in the face of natural and man-made disruptive events."*

Both the Federal Government and the US organization, the National Infrastructure Advisory Council (NIAC), identify the energy sector as a critical or lifeline sector.

In 2009 the Federal Government published its "National Strategy for Critical Infrastructure" (see Appendix A-7-1). It states on page 2, that the "*Goal of the National Strategy for Critical Infrastructure is to build a safer, more secure and more resilient Canada".* The document classifies critical infrastructure in ten sectors; Energy and Utilities is one of these sectors.

In 2013 NIAC, which provides the President of the United States with advice on the security and resilience of the critical infrastructure sectors, published a report: "Strengthening Regional Resilience Report and Recommendations November 21, 2013" (see Appendix A-7-2). It states on page 14 that:

> *"the term lifeline sector generally refers to a sector that provides indispensable services that enable the continuous operation of critical businesses and government functions, and would risk human health and safety or national and economic security if compromised or not promptly restored (see Exhibit 5). These sectors provide the most essential services that underlie a regional economy. They are distinguished from life support sectors, such as emergency services and public health, which are indispensable for public safety and health in specific localities. While different stakeholders may define lifeline sectors differently, there is widespread agreement across security and resilience literature that the following four sectors fit the characteristics of lifeline sectors for every region and event.*
>
> - *Energy (oil, natural gas and electricity)*

- *Transportation (rail, aviation, highway, transit and marine)*
- *Communications (and supporting IT)*
- *Water (potable water and wastewater)"*

The Federal Government's Action Plan for Critical Infrastructure (see Appendix A-8, page 3) states that owners and operators of critical infrastructure need to manage the risk to their critical infrastructure.

The Federal Government's National Strategy for Critical Infrastructure (see Appendix A-7-1) indicates that when a facility has been identified as critical, the owner of the facility should take additional steps to ensure that the facility is always available. The document states on page 2, that:

> *"The National Strategy is based on the recognition that enhancing the resiliency of critical infrastructure can be achieved through the appropriate combination of security measures to address intentional and accidental incidents, business continuity practices to deal with disruptions and ensure the continuation of essential services, and emergency management planning to ensure adequate response procedures are in place to deal with unforeseen disruptions and natural disasters."*

As noted above in section 1.2, the Fraser Gate IP and the Coquitlam Gate IP pipelines, forming the Metro IP system, provide a critical source of gas supply to more than 210,000 customers in Coquitlam, Burnaby, Vancouver and the North Shore. Currently, supply from the Fraser Gate station is required at all times of the year to meet the Metro IP system customer requirements. Therefore, any interruption of supply downstream of the Nichol Valve station will result in customer outages on the Metro IP system. Under winter conditions the outages are particularly significant and under design conditions up to 171,000 customers in the system could be left unsupported should the supply through the Fraser Gate station be interrupted, leaving only Coquitlam Gate station to provide supply. Similarly, up to 41,000 customers would not be supported through Fraser Gate station should the supply through Coquitlam Gate station be interrupted.

As a result, the Fraser Gate IP pipeline and the Coquitlam Gate IP pipeline are identified as single point of failure pipelines because if either pipeline fails, there is no alternate supply to serve all of the customers currently served by the other pipeline segment.

An alternate supply in the context of pipelines means that there is more than one source of gas that will enable continued service to customers if one of the sources is unavailable. This is typically provided by a loop (two or more pipelines operating between two fixed points) or back-feed (gas supplied to the area from another source). An alternate supply, when designed and built into the TP or IP system, will increase reliability, operational flexibility and resiliency of the system. Lack of backup capacity of certain pipelines can mean that for pipelines with no alternate supply (single point of failure pipelines), there is no efficient way to isolate stations or pipeline segments for in-service repair, replacement or reconfiguration for an alternate feed without adversely impacting supply to customers.

As further described in section 3.1.3.3, an economic impact study shows that a gas supply interruption as a result of an unplanned failure of the Fraser Gate IP pipeline could be in the order of three weeks and the economic impact to the general public, customers and the Company could be in excess of $320 million (see Appendix A-5, Page 5, Table ES-2a "Reference Case "As Is" Economic Consequences", line item IP-Segment 1). The economic impact to the general public, customers and the Company as a result of a failure of the Coquitlam Gate IP pipeline could be in the range of $64 million (see Appendix A-5, Page 5, Table ES-2b "Reference Case "Residual" Economic Consequences") and the gas supply interruption could be in excess of five days.

A quantitative risk assessment study (see Appendix A-10 page 17) indicates that the operational risk[11] reflective of select portions of today's Metro IP system is estimated to be $3.054 million/year. It concludes that the operational risk reduction associated with a potential Coquitlam Gate IP pipeline upgrade and a Cape Horn to Coquitlam TP loop installation to be approximately $2.456 million/year which is the difference between the $3.054 million/year risk associated with today's system and the remaining risk of $598 thousand/year following completion of the Projects.

To address infrastructure resilience, FEI attempts to ensure the availability and reliability of its critical assets in three ways: maintaining existing assets, providing alternate supplies and ensuring timely recovery in the event of failure. The following is a description of how each applies to the proposed Coquitlam Gate IP Project.

- Maintenance of existing IP pipelines: FEI has an Integrity Management Program and currently employs industry standard failure prevention measures on its IP systems, such as cathodic protection and seismic surveys. However, given the particular failure mechanism identified on the Coquitlam Gate IP as discussed in the OGC Order Response included as Appendix A-3, and the seismic issues discussed in Appendix A-4, FEI cannot ensure the availability, reliability and integrity of the Coquitlam Gate IP pipelines without the change contemplated by the replacement.
- Alternate Supply: An alternate supply in the context of pipelines means that there is more than one source of gas that will enable continued service to the customers if one of the sources is cut off. An alternate supply is typically provided by a loop or back-feed. The proposed Coquitlam Gate IP pipeline replacement, in conjunction with increased capacity supplied by the planned construction of the Cape Horn to Coquitlam TP loop (described in section 1.3) provides the opportunity to install the necessary pipeline capacity to supply gas to all customers in the event of an interruption to the gas supplied

[11] Operational risk is a measure of loss-of-service impact, and is defined as the sum of the quantitative risk value of each pipeline section per year of operation, based on failure frequency per year and financial cost per event associated with the loss-of-service.

by either of the existing pipelines. This will allow for planned or unplanned maintenance and repair of the Metro IP system.

- Timely Recovery: FEI has systems in place to respond to and recover from operational events. These include remote monitoring, emergency spare parts, 24/7 on call coverage and mutual aid association resource agreements. However, repair and recovery from a failure requiring a pipeline shut-in and blowdown to repair of either the Fraser Gate IP pipeline or the Coquitlam Gate IP pipeline with loss of line pack would exceed the required timeframe to ensure the continuity of natural gas supply.

FEI believes it is prudent to take advantage of the opportunity to replace the existing Coquitlam Gate IP pipeline with a solution which would install the capacity necessary to both restore the system operational flexibility that natural growth has eroded over time, and provide increased system resilience.

As further outlined below in section 3.2, FEI has evaluated alternatives that can provide operational flexibility to address planned system work, as well as alternatives that can provide full system resiliency to mitigate potential consequences that could occur as a result of credible unplanned outage scenarios.

3.1.3 Studies

FEI engaged a number of third party experts and internal staff to conduct studies and reviews to assess the need and justification for the Coquitlam Gate IP pipeline project. A list of the studies and assessments, which included a pipeline quantitative reliability assessment, a loss of supply assessment, an economic consequence of failure study, a quantitative risk assessment, and a seismic study, are summarized below.

3.1.3.1 Pipeline Quantitative Reliability Assessment

FEI retained Dynamic Risk Assessment Systems Inc. (DRAS) in 2013 to provide a quantitative reliability assessment of the Coquitlam Gate IP pipeline. The assessment was undertaken as a result of the increased number of leaks that FEI had experienced on this pipeline. Excavation based assessment data completed by FEI served as the basis of the reliability analysis, which focused solely on the most plausible threat, the external corrosion.

The analysis showed that while the probability of rupture was insignificant, *"the probability of failure by leak increases by a factor of 3.7 through the period 2013 – 2033".* (Appendix A-1, page 4 of 15)

3.1.3.2 Loss of Supply Assessment

As a means to determine the potential number of customers impacted by the loss of specific pipeline segments, FEI undertook a study utilizing hydraulic models from its System Capacity Planning group. It shows that loss of service to the Fraser Gate IP system could impact up to

171,000 customers and a loss of service to the Coquitlam Gate IP system could impact up to 41,000 customers (see Appendix A-9).

3.1.3.3 Economic Consequence of Failure Study

FEI retained HJ Ruitenbeek Resource Consulting Limited in 2014 to undertake an economic consequence analysis of hypothetical natural gas interruptions in the Lower Mainland. The study shows that the economic impact on the general public, customers and the Company caused by a failure on certain segments of FEI's TP and IP pipelines resulting in interrupted service to the customers served by the Fraser Gate IP and Coquitlam Gate IP would be in the range of $320 million and $64 million respectively (see Appendix A-5, Page 5, Table ES-2a "Reference Case As Is Economic Consequence", line item IP-Segment 1).

3.1.3.4 Quantitative Risk Assessment

FEI retained DRAS in 2014 to provide a quantitative risk assessment associated with a number of Lower Mainland System Upgrade projects that were under consideration. In order to establish the risk benefit associated with carrying out certain projects, the Quantitative Risk Assessment was performed to determine the change in risk between a "Base Case" (no capacity increase) and "After" project completion with increased capacity in both the TP system and the IP system.

The study notes that *"The potential annual operational risk reduction associated with replacing the existing Coquitlam NPS 20 IP pipeline operating at 1200 kPa with an NPS 30 IP pipeline operating at 2070 kPa and the addition of capacity at Coquitlam Gate Station achieved by looping the NPS 20 Transmission Pressure (TP) pipeline between the Cape Horn Valve Station and Coquitlam Gate Station with a NPS 36 TP pipeline is estimated to be $2.456 million per year."* (See Appendix A-10 at page 1)

3.1.3.5 Seismic Study Fraser Gate Station IP

FEI retained D.G. Honegger Consulting to conduct a Site-Specific Seismic Vulnerability Assessment of the Fraser Gate IP Pipeline in 2012. The study identified the section of pipeline from Fraser Gate along East Kent Avenue as being susceptible to a seismic event and assessed the level of pipeline vulnerability for the Fraser Gate IP pipeline. The Site-Specific Seismic Vulnerability Assessment of the Fraser Gate IP pipeline report, dated February 2013, is attached as Appendix A-4. A summary of the findings is listed below:

> *"Ground displacement hazards estimated by Golder for a return period of 2,475 years for the portion of the pipeline along East Kent Avenue South include lateral spread displacement of 1.6 m toward the river and settlement of 0.03 m. The corresponding lateral spread displacement for a return period of 475 years was estimated to be 0.3 m."* (See Appendix A-4, page 2)
>
> *"The allowable compression strain for pressure integrity is 1.8% based upon the relationship between the ratio of wall thickness to pipe diameter in PRCI guidelines*

(Honegger and Nyman, 2004). Based upon these strain limits, the horizontal displacement capacity is approximately 0.5 m, which is greater than the 475-year displacement estimate but well below the 2,475-year displacement estimate of 1.6 m." (See Appendix A-4, page 3).

In order to replace the section of pipeline between Fraser Gate and East Kent Avenue & Elliott without the possibility of impacting service to up to 171,000 customers served by Fraser Gate, the capacity of the Coquitlam Gate IP pipeline must be increased or a bypass installed.

3.1.4 Technical Feasibility

The Projects' technical feasibility is borne out through the engineering, construction and operational details presented in the following sections. FEI retained WorleyParsons Canada Services Ltd. (WorleyParsons), an experienced engineering firm, to undertake the pipeline and station engineering and constructability analysis for the Coquitlam Gate IP Project.

In section 3.2, FEI evaluates Coquitlam Gate IP Project alternatives and selects the alternative that best meets the project objectives, including constructability, operational, and safety factors.

In section 3.3, FEI examines the technical requirements of the Coquitlam Gate IP Project. Various route options are also evaluated and a preferred option is selected based on technical and non-technical criteria. This approach ensures that the preferred project alternative and preferred route alignment are technically feasible.

3.1.5 Project Justification Conclusion

The Coquitlam Gate IP pipeline is a major natural gas supply source to Metro Vancouver. The pipeline, as part of the Metro IP system, is also connected to the Fraser Gate IP pipeline. Together they serve over 210,000 customers in Metro Vancouver.

The Coquitlam Gate IP pipeline has been assessed as being near the end of its service life due to an unacceptable projected frequency of gas leaks resulting from non-preventable active corrosion. Engineering assessments have concluded that leak prevention cannot be effectively managed by maintenance activities and therefore the existing pipeline must be replaced.

For a significant part of the service life of the Metro IP system, there has been a level of capacity to allow operational flexibility in the system so that during warmer periods, the system could be supported for some time without support of the primary supply, the Fraser Gate station. This allowed an operational window to interrupt the supply from the Fraser Gate station to facilitate planned work requiring isolation of the flow. Over time and with growth in demand on the system, this capacity has eroded such that the existing NPS 20 Coquitlam Gate IP pipeline cannot currently be relied upon to support the Metro IP system at any time of year without some support from the Fraser Gate station, through the Fraser Gate IP pipeline. The current IP system lacks the capacity to provide a level of operational flexibility to facilitate planned outages. As noted in section 3.1.2.3, increasing the capacity on the Coquitlam Gate IP pipeline will allow for an operational window to replace the section of the Fraser Gate IP pipeline between Fraser Gate and East Kent Avenue & Elliott to mitigate seismic vulnerabilities.

In addition, at the present time, the Coquitlam Gate IP and the Fraser Gate IP pipelines lack sufficient capacity to supply all customers currently being served if supply through one of the two is interrupted, thereby making both pipelines single points-of-failure within the Metro Vancouver delivery area. If a major failure occurs on the Coquitlam Gate to 2nd & Woodland pipeline or the TP pipelines serving Coquitlam Gate station during design conditions it is possible that up to 41,000 customers served by that pipeline system could be impacted, and potentially experience a prolonged period of gas service outage. The economic impact to the general public, customers and the Company due to a loss of service to the Coquitlam Gate IP could be in the range of $64 million.

If a major failure occurs on the Fraser Gate to 2nd & Woodland pipeline or the TP pipelines serving the Fraser Gate station during design conditions, due to the current lack of capacity to supply the Fraser Gate to 2nd & Woodland load from the Coquitlam Gate IP pipeline, it is possible that up to 171,000 customers served by that pipeline system could be impacted, and potentially experience a prolonged period of gas service outage as described in section 4.1.2.3. The economic impact to the general public, customers and the Company due to a loss of service to the Fraser Gate IP pipeline could be in excess of $320 million.

Increasing the capacity of the Coquitlam Gate IP pipeline to achieve full resiliency to the Metro IP system allows for mitigation of the estimated economic impacts associated with loss of service as well as provides an operational risk reduction of approximately $2.456 million per year.

The need to replace the existing pipeline for integrity reasons has created an opportunity for FEI to evaluate and mitigate other system constraints in a cost effective manner. The replacement of the Coquitlam Gate IP pipeline provides a unique, one-time opportunity to prudently restore operational flexibility and provide resiliency to the Metro IP system through an increase in pipeline capacity in the Coquitlam Gate IP pipeline.

3.2 *ALTERNATIVE SOLUTIONS*

This section describes:

- The objectives and requirements that the Company will meet with the alternatives considered;
- The alternatives considered and evaluated by the Company; and
- The preferred alternative selected by the Company.

As described below, the only solution which meets the stated objectives is replacement of the existing NPS 20, 1200 kPa Coquitlam Gate IP pipeline with a NPS 30 pipeline operating at 2070 kPa at a cost of $245.557 million ((As-spent) including AFUDC and abandonment / demolition).

3.2.1 Objectives and Requirements

The Coquitlam Gate IP pipeline has reliability, safety, and regulatory risks because of non-preventable pipeline corrosion and an unacceptable projected frequency of gas leaks. The capacity of the pipeline is not sufficient to backfeed the Fraser Gate IP pipeline to provide operational flexibility or resiliency to the Metro IP system. Thus, the objectives of the Coquitlam Gate IP Project are to:

1. Eliminate the elevated reliability, safety and regulatory risk (including the BC Oil and Gas Activities Act) posed by the existing Coquitlam Gate IP pipeline as a result of the known corrosion mechanism (i.e. corrosion beneath field applied coating at girth welds) and resulting unacceptable projected leak frequency (Pipeline Risk);
2. Provide sufficient operational flexibility to permit planned maintenance and repair of the Fraser Gate IP pipeline (Operational Flexibility);
3. Provide full system resilience in conjunction with the Cape Horn to Coquitlam TP pipeline reinforcement, to fully supply the Coquitlam Gate IP pipeline and the Fraser Gate IP pipeline from either the Fraser Gate station or the Coquitlam Gate station on any day of the year and therefore reduce the potential consequences of a failure upstream, at, or downstream of either gate station (System Resiliency); and
4. Address constructability, operational and safety factors, such as routing constraints, proximity to adjacent utilities and appropriate construction techniques, limiting interruption of flow of gas during construction and commissioning and allowing sufficient space to work around existing piping and components (Constructability).

For each alternative discussed below, the Company considered the advantages and disadvantages of the alternative in light of the objectives and requirements discussed above. Further, while some of the alternatives were constructible, where they did not sufficiently meet key objectives the Company considered these alternatives to be not feasible. Operational flexibility allowing for planned maintenance and repair is a critical requirement for continued safe, reliable and essential service to customers.

3.2.2 Alternatives Description

As part of its assessment of the Coquitlam Gate IP Project, FEI evaluated several alternatives.

The following alternatives, including preliminary capital cost screening, are discussed in further detail below. A table comparing the alternatives ability to meet the Coquitlam Gate IP Project objectives is presented below in section 3.2.3.1. FEI prepared capital costs to the AACE Class 4 level for the feasible alternatives considered, and an AACE Class 3 level estimate for the preferred alternative which are shown below in section 3.2.3.2.

- Alternative 1 - Do nothing (Status quo of continuing ongoing integrity and leak management).
- Alternative 2 - Rehabilitate the existing NPS 20 Coquitlam Gate IP operating at 1200 kPa in place;
- Alternative 3 - Replace (in-kind) the existing NPS 20 Coquitlam Gate IP operating at 1200 kPa with a NPS 20 pipeline operating at 1200 kPa;
- Alternative 4 - Replace the existing NPS 20 Coquitlam Gate IP operating at 1200 kPa with a NPS 24 pipeline operating at 2070 kPa.
- Alternative 5 - Replace the existing NPS 20 Coquitlam Gate IP operating at 1200 kPa with a NPS 36 pipeline operating at 1200 kPa;
- Alternative 6 - Replace the existing NPS 20 Coquitlam Gate IP operating at 1200 kPa with a NPS 30 pipeline operating at 2070 kPa (preferred alternative); and
- Alternative 7 - Replace the existing NPS 20 Coquitlam Gate IP operating at 1200 kPa with a NPS 42 pipeline operating at 1200 kPa.

Alternative 1 involves operating and maintaining the underground asset in its current form without rehabilitating, upgrading or replacing the pipe. Ongoing increased integrity and leak management would not address the current pipeline concerns, and would only mitigate some of the risk associated with leaks on the Coquitlam Gate IP pipeline until a more permanent solution could be implemented.

Alternatives 2 through 7 listed above were selected for evaluation because they provide a range of industry standard pipeline diameters which could potentially deliver the necessary capacity to meet the objectives and requirements. This determination is based on the criteria that the pipeline design will use the Company's current standard for IP pipeline operating pressures. The alternatives also considered the criteria that, at a minimum, the pipeline design capacity had to meet forecasted design degree day load (i.e. peak demand) for the 20 year planning period.

3.2.2.1 Alternative 1 - Do Nothing (Status Quo of Continuing Ongoing Integrity and Leak Management)

Pipeline integrity management is an ongoing requirement of pipeline operation. However, in recent years, the Coquitlam Gate IP pipeline has required incremental activities beyond what is typical for an IP pipeline.

Integrity excavations and inspections were performed in 2011, 2012 and 2013 at selected locations along the pipeline. This was done to better understand the cause of the documented corrosion leaks, and to determine if any indirect methods such as above-ground cathodic-protection surveys were capable of detecting areas of coating damage and significant corrosion. In addition to excavations, this pipeline has been subject to increased leak detection surveys. Whereas FEI's standard leak survey frequency for IP systems is annual, the Coquitlam Gate IP pipeline has been subject to weekly leak surveys since August 2013 as a result of the increased incidence of leaks. As expected, based on the results of the integrity excavations, corrosion leaks have continued to occur and FEI has deemed them non-preventable through maintenance.

This alternative would require ongoing regular integrity management activities and increased leak inspections.

Advantages:

- Leak surveys can be, and have been, implemented more frequently with relative ease to determine the occurrence of leaks more quickly, and therefore effect repair sooner; and
- Requires no initial capital expenditure.

Disadvantages:

- Leak surveys are reactive, not proactive, and will only identify existing leaks;
- Leak surveys, no matter how frequent, cannot predict future leak locations;
- The alternative is not an accepted long-term operating practice for management of potential safety risks to the public, plant, property and FEI personnel;
- The risk of future pipeline leaks remains high;
- The risk to reliability of supply during a leak repair remains high;
- The risk of disruption to the general public, local residents or businesses due to construction impacts from repair activities along the pipeline route remains high;
- The alternative does not enhance the operational flexibility of the Metro IP system; and
- The alternative does not enhance the resiliency of the Metro IP system.

This alternative will not address the reliability, safety, or regulatory concerns associated with the unacceptable projected frequency of gas leaks and may eventually put FEI in a position where it is no longer able to "prevent spillage",[12] "remedy the cause or source of the spillage", or "contain and eliminate the spillage", each of which is required of a Permit Holder under Section 37 (1) of the BC Oil and Gas Activities Act. Further, FEI has committed to replacement of the pipeline as an integral part of its response to OGC Order 2013-25. Not undertaking pipe replacement could result in the OGC finding that FEI has failed to comply with a provision of the OGAA. As the

[12] Under the BC Oil and Gas Activities Act, spillage is defined as escaping, leaking, or spilling of natural gas.

alternative does not meet any of the objectives of the Project or the OGC requirements, FEI has concluded that this is not a feasible alternative.

3.2.2.2 Alternative 2 - Rehabilitate the Existing Coquitlam Gate IP Pipeline Operating at 1200 kPa

This alternative has a capital cost estimate of $154 million in 2014 dollars as determined below.

Rehabilitation of the existing pipeline would involve proactively excavating each girth weld location along the pipeline, inspecting for corrosion and repairing where necessary. It should be noted that there are approximately 1,700 girth welds along the pipeline. Unfortunately, there are no technical methods to identify girth weld locations from above ground, and consequently multiple digs may be required to locate each weld. Furthermore, some sections of the pipeline have increased depth of cover resulting in welds which are unusually deep and hence would be extremely difficult to access. Once a girth weld had been exposed an assessment would be conducted and necessary repairs would occur. Subsequent to the repair, the pipeline girth weld, together with the adjacent pipe body, would be tested, inspected and recoated, the trench backfilled and the street or landscape refurbished as necessary.

Based on an average cost of approximately $92,200 per site (using average actual dig and repair costs from 2011-2013) and 1,667 digs (based on a dig every 12 metres of the 20,000 metre pipeline) the Company has estimated that the cost associated with this alternative could be approximately $154 million.

Advantages:

- The work could be scheduled over several construction seasons;
- No new running line would be required (except where inability to inspect due to depth would require a new section of pipeline to be installed), and
- It has one of the lowest capital costs compared to other alternatives.

Disadvantages:

- There are no methods to identify and locate girth weld locations from above ground, therefore, multiple digs and extensive excavation may be required to locate a girth weld;
- Direct inspection of the welds can only assess the pipeline condition over a very short length of pipeline at the weld location;
- It does not adequately mitigate potential safety risks to the public, plant, property and FEI personnel as a result of corrosion leaks with potential gas migration and accumulation until all of the pipeline welds have been exposed for inspection and evaluation;
- It does not enhance the operational flexibility of the Metro IP system;

- It does not enhance resiliency of the Metro IP system; and
- There are significant construction constraints associated with the urban nature of certain sections of this pipeline.

This alternative does not fully mitigate potential future pipeline corrosion leaks because only the pipeline at each weld location would have been exposed for inspection, evaluation and repair. The estimated cost of this alternative is in the range of $154 million, with minimal potential benefits compared to the other long term strategy solutions, is very high. This alternative, while it is constructible, does not provide operational flexibility or system resiliency, or fully address pipeline risk. Consequently FEI has concluded that this is not a feasible alternative.

3.2.2.3 Alternative 3 - Replace (in-kind) the Existing Coquitlam Gate IP Pipeline Operating at 1200 kPa with a New NPS 20 Pipeline Operating at 1200 kPa

This alternative has an AACE Class 4 Project Capital Cost Estimate $142.162 million in 2014 dollars.

This alternative involves the replacement of the Coquitlam Gate IP pipeline with a new IP pipeline. The new pipeline would be similar to the existing pipe in terms of diameter and pressure. Because the pipeline capacity would not change, Coquitlam Gate station would not require any infrastructure upgrades (such as pipe, valves and equipment). Also, the pipeline would connect directly with each of the intermediate offtake points along the pipeline route and with the NPS 30 Fraser Gate IP pipeline at East 2nd & Woodland station.

Advantages:

- This approach would replace the entire length of the existing pipeline with new pipe and would therefore reduce the probability of leaks;
- It would significantly reduce the risk of future corrosion related gas leaks;
- It would significantly reduce safety risks to the public, plant, property and FEI personnel as a result of leaks with potential gas migration and accumulation;
- It would minimize the risk of supply interruption to customers served by the Coquitlam Gate IP pipeline as a result of leaks;
- Due to common operating pressure, the pipeline would interface directly with the existing IP system and not require additional IP/IP interface stations; and
- It has one of the lowest capital costs compared to other alternatives.

Disadvantages:

- It does not provide sufficient operational flexibility to permit planned maintenance and repair of the Fraser Gate IP pipeline;

- It does not provide operational flexibility to the Metro IP system;
- It does not enhance resiliency of the Metro IP system;
- It does not mitigate the Metro IP system security of supply issues; and
- There are significant construction constraints associated with urban pipeline installation projects.

As discussed in section 3.1.2.3 the Company believes operational flexibility allowing for planned maintenance and repair is a critical requirement for continued safe, reliable and essential service to customers. This alternative does not provide the increased capacity necessary to facilitate planned outages for system work or provide system resiliency, therefore FEI has assessed this alternative not to be a prudent alternative, and consequently, not feasible.

3.2.2.4 Alternative 4 - Replace the Existing Coquitlam Gate IP Pipeline Operating at 1200 kPa with a NPS 24 Pipeline Operating at 2070 kPa

This alternative has an AACE Class 4 Project Capital Cost Estimate $175.004 million in 2014 dollars[13].

Instead of replacing the existing Coquitlam Gate IP pipeline in-kind, the same approach as outlined for that alternative could be adopted to replace the existing pipeline in its entirety with new larger diameter pipe (NPS 24) operating at an increased pressure (2070 kPa). Installing a larger capacity pipeline would result in some operational flexibility and resiliency for the Metro IP system. However, the level of increased capacity provided is insufficient to supply back feed capability for a Fraser Gate IP outage during the colder days of winter.

The capacity of a NPS 24 pipeline would be greater than the existing NPS 20 pipeline (larger diameter and higher operating pressure); therefore, upgrades would be necessary at Coquitlam Gate station to mechanical, civil and electrical infrastructure (pipe, valves, equipment and controls etc.) to facilitate the higher gas throughput from the TP network. Also, the pipeline would not connect directly with each of the intermediate offtake points along the pipeline route and with the NPS 30 Fraser Gate IP pipeline at East 2nd and Woodland station. Instead, shorter lateral offtake pipes would be upgraded for the higher pressure and longer lateral offtakes would be connected via small form factor buried IP/IP pressure regulating vault stations. At East 2nd and Woodland a new IP/IP pressure regulating station would be required to interface the NPS 24 Coquitlam Gate IP pipeline with the NPS 30 Fraser Gate IP pipeline.

Advantages:

- This approach would replace the entire length of the existing pipeline with new pipe and would therefore reduce the probability of leaks;

[13] The equivalent As-spent cost including abandonment/demolition cost but excluding AFUDC is $202.481 million: AFUDC of $11.054 million with the total cost being $213.535 million.

- It would significantly reduce the risk of future corrosion related gas leaks;
- It would significantly reduce safety risks to the public, plant, property and FEI personnel as a result of leaks with potential gas migration and accumulation;
- It would minimize the risk of supply interruption to customers served by the Coquitlam Gate IP pipeline as a result of leaks;
- It has the third lowest capital cost compared to other alternatives; and
- It would provide operational flexibility to permit planned maintenance and repair of the Fraser Gate IP pipeline with minimum risk of customer service interruption by avoiding the use of a bypass.

Disadvantages:

- There are significant construction constraints associated with urban pipeline installation projects;
- Due to the higher operating pressure, the pipeline would interface indirectly with the existing IP system via additional IP/IP pressure reducing stations, creating a more complex system to operate;
- It would require a significant upgrade to Coquitlam Gate station to facilitate the higher pipeline capacity compared to the NPS 20 in-kind pipeline and the NPS 36 pipeline; and
- It does not provide full resiliency to the Metro IP system during mid-winter or design day conditions.

Although the level of increased capacity provided is insufficient to supply backfeed capability for a Fraser Gate IP outage during the colder days of winter (it does not provide full system resiliency), this alternative meets the other objectives. Therefore, on this basis, the Company investigated this alternative further.

3.2.2.5 Alternative 5 - Replace the Existing Coquitlam Gate IP Pipeline Operating at 1200 kPa with a NPS 36 Pipeline Operating at 1200 kPa

This alternative has an AACE Class 4 Project Capital Cost Estimate $205.448 million in 2014 dollars[14].

Instead of replacing the existing Coquitlam Gate IP pipeline in-kind, the same approach as outlined for that alternative could be adopted to replace the existing pipeline in its entirety with new larger diameter pipe (NPS 36) operating at the current 1200 kPa. Installing a larger capacity pipeline would result in some operational flexibility and resiliency for the Metro IP system and mitigate risk of outage to 123,500 of the 171,000 customers served by the Fraser Gate IP pipeline. However, even with the increased capacity due to the larger pipe diameter, it

[14] The equivalent as-spent cost including abandonment/demolition cost but excluding AFUDC is $238.178, AFUDC of $12.309 million with the total cost being $250.487 million.

does not provide sufficient back feed capability during a Fraser Gate IP outage during the colder days of winter.

The capacity of a NPS 36 pipeline would be greater than the existing NPS 20 pipeline (larger diameter); therefore, upgrades would be necessary at Coquitlam Gate station to mechanical, civil and electrical infrastructure (pipe, valves, equipment and controls etc.) to facilitate the higher gas throughput from the TP network. However, the pipeline would connect directly with each of the intermediate offtake points along the pipeline route and with the NPS 30 Fraser Gate IP pipeline at East 2nd & Woodland station without the need to install any interface pressure reduction stations.

Advantages:

- This approach would replace the entire length of the existing pipeline with new pipe and would therefore reduce the probability of leaks;
- It would significantly reduce the risk of future corrosion related gas leaks;
- It would significantly reduce safety risks to the public, plant, property and FEI personnel as a result of leaks with potential gas migration and accumulation;
- It would minimize the risk of supply interruption to customers served by the Coquitlam Gate IP pipeline as a result of leaks;
- Due to common operating pressure the pipeline would interface directly with the existing IP system and not require additional IP/IP interface stations;
- It would provide sufficient operational flexibility to permit planned maintenance and repair of the Fraser Gate IP pipeline with minimum risk of customer service interruption by avoiding the use of a bypass; and
- It would supply the backfeed capacity to provide operational flexibility and some resiliency for the Metro IP system and mitigate risk of outage to 123,500 of the 171,000 customers served by the Fraser Gate IP pipeline.

Disadvantages:

- There are significant construction constraints associated with urban pipeline installation projects;
- The larger diameter implies greater constraints in terms of planning, engineering, routing and construction associated with a NPS 36 pipeline installation than with the preferred NPS 30 pipeline project;
- It would require a significant upgrade to Coquitlam Gate to facilitate the higher pipeline capacity compared to the NPS 20 in-kind pipeline;
- It has the highest cost of the feasible alternatives; and

- It does not provide full resiliency to the Metro IP system and could result in a loss of supply to approximately 47,500 customers during the colder days of winter.

Since this alternative provides some operational flexibility and resiliency it has been included as an alternative in the financial analysis.

3.2.2.6 Alternative 6 - Replace the Existing Coquitlam Gate IP Pipeline Operating at 1200 kPa with a NPS 30 Pipeline Operating at 2070 kPa

This alternative has an AACE Class 3 Project Capital Cost Estimate $201.282 million in 2014 dollars[15].

Instead of replacing the existing Coquitlam Gate to 2nd & Woodland pipeline in-kind, a similar approach as outlined above could be adopted to replace the existing pipeline in its entirety with new larger diameter pipe operating at a higher pressure with sufficient capacity to establish full Metro IP system resiliency.

The capacity of a NPS 30 pipeline would be greater than the existing NPS 20 pipeline (larger diameter and higher operating pressure). Therefore, upgrades would be necessary at Coquitlam Gate to mechanical, civil and electrical infrastructure (pipe, valves, equipment and controls etc.) to facilitate the higher gas throughput from the TP network. Also, the pipeline would not connect directly with each of the intermediate offtake points along the pipeline route and with the NPS 30 Fraser Gate IP pipeline at East 2nd and Woodland station. Instead, shorter lateral offtake pipelines would be upgraded for the higher pressure, and longer lateral offtakes would be connected via small form factor buried IP/IP pressure regulating vault stations. At East 2nd and Woodland a new IP/IP pressure regulating station would be required to interface the new NPS 30 Coquitlam Gate IP pipeline with the existing NPS 30 Fraser Gate IP pipeline.

Advantages

- This approach would replace the entire length of the existing pipeline with new pipe and would therefore reduce the probability of leaks;
- It would significantly reduce the risk of future corrosion related gas leaks;
- It would significantly reduce safety risks to the public, plant, property and FEI personnel as a result of leaks with potential gas migration and accumulation;
- It would minimize the risk of supply interruption to customers served by the Coquitlam Gate IP pipeline as a result of leaks;
- It delivers the level of backfeed capacity considered necessary to provide operational flexibility and full system resiliency; and
- It provides the backfeed capacity to permit ongoing planned and unplanned maintenance and repair of the Fraser Gate IP pipeline (if required).

[15] The equivalent As-spent cost including abandonment/demolition cost but excluding AFUDC is $232.985 million, AFUDC of $12.572 million with the total cost being $245.557 million.

Disadvantages

- There are significant construction constraints associated with urban pipeline installation projects;
- Due to the higher operating pressure the pipeline would interface indirectly with the existing IP system via additional IP/IP pressure reducing stations, creating a more complex system to operate;
- It would require a significant upgrade to Coquitlam Gate station to facilitate the higher pipeline capacity compared to the NPS 20 in-kind pipeline and the NPS 36 pipeline, and
- It has a higher cost than Alternative 4 (replacement with a NPS 24 2070 kPa IP pipeline).

This alternative provides a solution that meets all of the stated objectives and therefore has been included as an alternative in the financial analysis.

3.2.2.7 Alternative 7 - Replace the Existing Coquitlam Gate IP Pipeline Operating at 1200 kPa with a NPS 42 Pipeline Operating at 1200 kPa

Instead of replacing the existing Coquitlam Gate IP pipeline in-kind, the same approach as outlined above could be adopted to replace the existing pipeline in its entirety with a new larger diameter pipe (NPS 42) operating at the same pressure. Installing a larger capacity pipeline would provide similar back feed capability compared to the preferred alternative, for example, full Metro IP system supply security.

The capacity of a NPS 42 pipeline would be greater than the existing NPS 20 pipeline (larger diameter); therefore, upgrades would be necessary at Coquitlam Gate station to mechanical, civil and electrical infrastructure (pipe, valves, equipment and controls etc.) to facilitate the higher gas throughput from the TP network. However, the pipeline would connect directly with each of the intermediate offtake points along the pipeline route and with the NPS 30 Fraser Gate IP pipeline at East 2nd and Woodland station without any interface pressure reduction stations.

A constructability analysis, completed as part of the pipeline routing process identified prohibitive construction constraints associated with the installation of NPS 42 pipeline along the more densely developed sections of the route. Consequently, FEI concluded that this alternative is not feasible and as a result no cost estimates were prepared.

This alternative has been assessed as not a feasible alternative because of the construction constraints associated with the installation of an NPS 42 pipeline along the densely developed sections of the route identified during a constructability analysis that was completed as part of the pipeline routing process.

3.2.3 Alternatives Evaluations

The Company conducted a non-financial evaluation of the seven alternatives discussed above and a financial evaluation of the three alternatives that were considered feasible. The cost estimate for Alternative 2 was prepared by FEI based on average unit cost per repair and an estimated number of leak repairs and weld replacements. FEI engaged WorleyParsons Canada to prepare preliminary pipeline routing and engineering, construction planning, scheduling and AACE Class 3 estimates for Alternative 6 and Class 4 cost estimates for Alternatives 3, 4 and 5. No cost estimate was prepared for Alternative 7 due to constructability constraints. WorleyParsons Canada was selected based on proven experience and technical capabilities in developing AACE cost estimates for large diameter pipeline projects of this scale and magnitude.

3.2.3.1 Non-Financial Considerations

The Company considered the advantages and disadvantages of each alternative based on non-financial and financial factors. The discussion in section 3.2.2 explains the advantages and disadvantages of each alternative. The following table summarizes each alternative considered. The objectives and requirements discussed in section 3.2.1 are used as the main criteria for the evaluation and for the summary, as these criteria reflect the Company's objectives to adopt a solution that will address the issues identified in section 3.1 of the Application. These issues include: risks associated with the pipeline being a single point-of-failure, safety and reliability concerns associated with gas leaks, financial and non-financial consequences associated with an outage, and compliance with current codes, standards and operating requirements. Table 3-1 provides a Non-Financial comparison of the seven alternatives considered.

Table 3-1: Coquitlam Gate IP Project Non-Financial Comparison

Alternatives		Objectives/Requirements				Overall Assessment
		Reduce Pipeline Risk	Provide Sufficient Operational Flexibility	Provide Full System Resiliency	Constructible	
1	Do Nothing	Does not meet Objective	Does not meet Objective	Does not meet Objective	Not Applicable	Not Feasible
2	Rehabilitate Existing NPS 20	Partially meets Objective	Does not meet Objective	Does not meet Objective	Meets Objective	Not Feasible
3	Replace Existing NPS 20 in kind	Meets Objective	Does not meet Objective[1]	Does not meet Objective	Meets Objective	Not Feasible
4	Replace with NPS 24 at 2070 kPa	Meets Objective	Meets Objective	Does not meet Objective[3]	Meets Objective	Feasible
5	Replace with NPS 36 at 1200 kPa	Meets Objective	Meets Objective	Does not meet Objective[4]	Meets Objective	Feasible
6	Replace with NPS 30 at 2070 kPa	Meets Objective	Meets Objective[2]	Meets Objective[2]	Meets Objective	Feasible
7	Replace with NPS 42 at 1200 kPa	Meets Objective	Meets Objective	Meets Objective	Does not meet Objective	Not Feasible

(green)	Meets objective/feasible
(yellow)	Partially meets objective
(red)	Does not meet objective/not feasible

Notes:

(1) Requires a bypass any time maintenance or repair is required.
(2) Meets objective 365 days of the year.
(3) Under this alternative, a failure upstream, at, or downstream of the Fraser Gate Station during mid-winter conditions will impact up to 171,000 customers that could result in an economic impact in excess of $320 million.
(4) Under this alternative, a failure upstream, at, or downstream of the Fraser Gate Station during mid-winter conditions will impact up to 47,500 customers that could result in significant economic impact.

Objectives/Requirements:

1. Pipeline Risk: Eliminate the elevated reliability, safety and regulatory risk posed by the existing Coquitlam Gate IP pipeline as a result of the known corrosion mechanism and resulting unacceptable projected leak frequency.

2. Operational Flexibility: Provide sufficient operational flexibility to permit planned maintenance and repair of the Fraser Gate IP pipeline.

3. System Resiliency: Provide the ability/flexibility in conjunction with the Cape Horn to Coquitlam TP pipeline reinforcement, to fully supply the Coquitlam Gate IP system and the Fraser Gate IP system from either the Fraser Gate Station or the Coquitlam Gate Station on any day of the year, and therefore reduce the potential consequences of a failure upstream, at, or downstream of either gate station.

4. Constructability of the proposed alternative including operation and safety concerns.

The non-financial analysis shows that of the alternatives assessed; only Alternative 6 provides a solution that meets all of the stated objectives. Replacement with the NPS 30 2070 kPa IP alternative is constructible and eliminates the elevated reliability, safety and regulatory risk posed by the existing Coquitlam Gate IP pipeline as a result of the known corrosion mechanism and resulting unacceptable projected leak frequency. It also provides the necessary operational flexibility to facilitate planned outages and resiliency to mitigate the risks and consequences associated with unplanned outages.

Alternative 3 is constructible and meets the objectives of eliminating the elevated reliability, safety and regulatory risk posed by the existing Coquitlam Gate IP pipeline as a result of the known corrosion mechanism and resulting unacceptable projected leak frequency. FEI recognizes the existing Coquitlam Gate IP pipeline requires replacement due to an unacceptable projected frequency of gas leaks resulting from non-preventable active corrosion. The need to replace the existing Coquitlam Gate IP pipeline for integrity reasons has created a unique one-time opportunity for FEI to achieve operational flexibility and resiliency in a cost effective manner. Replacing the existing NPS 20 in kind (Alternative 3) does not restore any of the operational flexibility or system resiliency that has been eroded over time as a result of customer and demand growth; therefore, FEI has deemed this alternative not to be prudent or viable and has not included it as an alternative in the financial analysis.

Alternative 4 is constructible and meets the objectives of eliminating the elevated reliability, safety and regulatory risk posed by the existing Coquitlam Gate IP pipeline as a result of the known corrosion mechanism and resulting unacceptable projected leak frequency. This alternative also provides some operational flexibility and system resiliency for a portion of the year. However, under this alternative, a failure upstream, at, or downstream of the Fraser Gate Station during colder winter day conditions, will result in outages to customers that could have an economic impact in excess of $320 million. Since this alternative provides some operational flexibility and resiliency it has been included as an alternative in the financial analysis.

Alternative 5, similar to Alternative 4, is constructible and meets the objectives of eliminating the elevated reliability, safety and regulatory risk posed by the existing Coquitlam Gate IP pipeline as a result of the known corrosion mechanism and resulting unacceptable projected leak frequency. This alternative also provides operational flexibility for a portion of the year. This alternative provides an additional degree of system resiliency above Alternative 4, in that a failure upstream, at, or downstream of the Fraser Gate Station would only result in outage and resulting economic impact for up to 47,500 of the 171,000 customers served by this pipeline. Since this alternative provides more operational flexibility and resiliency (compared to Alternative 4), and better meets the Project objectives and requirements, it has been included as an alternative in the financial analysis.

3.2.3.2 Financial Considerations

The financial evaluation considers both the capital cost[16] and the present value of increased operating costs associated with additional stations and increased pressure. FEI also undertook a financial operational risk evaluation which was added to the financial evaluation to determine the preferred alternative.

The financial analysis was completed for those alternatives that meet a significant portion of the Project objectives and requirements by the non-financial technical analysis. For purposes of evaluation, the capital cost estimates for the alternatives were developed to an AACE Class 4 level of project definition and are stated in 2014 dollars. The capital cost estimate for the NPS 30 pipeline was developed to an AACE International Recommended Practice No. 17R-97 Class 3 level of project definition.

The following Table 3-2 provides a summary of the financial comparison.

Table 3-2: Coquitlam Gate IP Project Financial Comparison

	Alternative 4 Install NPS 24 pipeline at 2070 kPa	Alternative 5 Install NPS 36 pipeline at 1200 kPa	Alternative 6 Install NPS 30 pipeline at 2070 kPa
AACE Estimate Accuracy	***Class 4***	***Class 4***	***Class 3***
Total Direct Capital Cost excl. AFUDC & includes Abandonment / Demolition (2014$millions)	175.004	205.448	201.282
Total Direct Capital Cost excl. AFUDC (As-spent $millions)	202.481	238.178	232.985
AFUDC (as spent $millions)	11.054	12.309	12.572
Total As-spent includes Abandonment / Demolition & AFUDC ($millions)	213.535	250.487	245.557
Annual incremental gross O&M (2014$millions)	0.055	0.020	0.055
Levelized Rate Impact – 60 Yr. ($ / GJ)	0.087	0.103	0.101
PV Incremental Cost of Service – 60 Yr. ($millions))	259.659	306.480	300.513

[16] Includes project management, engineering, permits, materials procurement, construction, commissioning and contingency. For purposes of comparing alternatives, the development costs and application costs have been excluded from the capital costs in Table 3-2. These costs are the same in Alternative 4, 5 and 6 and are fully amortized before 2019 and do not impact the 2019 and 60 year average Levelized rate impact..

As shown in the above table, Alternative 4 (NPS 24 at 2070 kPa) is the least expensive compared to the other feasible alternatives with a total estimated capital cost of $202.481 million. The pipeline materials and construction costs are the largest components of the capital costs comprising 80 percent to 90 percent of the total. Therefore, the NPS 24, with the smallest diameter, is the least expensive pipeline to construct because of increased construction productivity and lower pipe steel costs. Detailed financial schedules for Alternative 4 are included in Confidential Appendix E-2-1.

Alternative 6 (NPS 30 at 2070 kPa) and Alternative 5 (NPS 36 at 1200 kPa) have similar capital cost estimates at $232.985 million and $238.178 million respectively. However since Alternative 5 has a higher cost and does not offer the system resilience of Alternative 6, no further analysis has been undertaken. Detailed financial schedules for Alternatives 6 and 5 are included in Confidential Appendices E-1-1 and E-2-2, respectively.

In addition to the financial evaluation, a calculation of the present value of operational risk was conducted on Alternatives 4 and 6 to determine the differential between the two alternatives in terms of a 60 year levelized cost when the impact of an operational risk reduction was taken into account. The present value of the operational risk was added to the present value of the cost of service to provide an overall present value comparison, which is summarized in Table 3-3 below. Operational risk is a measure of loss-of-service impact, and is defined as the sum of the quantitative risk value of each pipeline section per year of operation, based on failure frequency per year and financial cost per event associated with the loss-of-service. The calculation of the annual risk reduction associated with the Project is included in Appendix A-10. There is no operational risk reduction during design day calculations for Alternative 4. Only Alternative 6 can provide 100 percent operational risk reduction.

Table 3-3: Coquitlam Gate IP Project Financial and Operational Risk Comparison

		Alternative 4 Install NPS 24 pipeline at 2070 kPa	Alternative 6 Install NSP 30 pipeline at 2070 kPa
1	Operational Risk Reduction (%)	0	100
2[17]	Remaining Operational Risk (2014$millions / year)	2.456	0
3	PV Remaining Operational Risk – 60 Yr[18] ($millions)	38.880	0
4	PV Incremental Cost of Service – 60 Yr ($millions)	259.659	300.513
5	PV Remaining Operational Risk + PV Incremental Cost of Service –60Yr ($millions)	298.539	300.513

[17] See section 3.1.3.4.

[18] PV Remaining Operational Risk – 60 Year was derived by applying the formula for the present value of an annuity to the annual remaining operational risk of $2.456 million using FEI's after tax weighted average cost of capital of 6.14%; PV = $2.456 x $[(1 – (1 + k)^{-n}) / k]$ Where k = 6.14% and n = 60 years.

As demonstrated in Table 3-3 above, the difference in operational risk reduction for Alternative 6 compared to Alternative 4 is 100 percent.

Referring to line 3 of Table 3-3, the benefit of the PV operational risk differential for a 60 year period utilizing the Company's 6.14 percent WACC for Alternative 6 compared to Alternative 4, was calculated to be $38.880 million.

Referring to line 5 of Table 3-3, where the 60 year PV Incremental Cost of Service and PV Operational Risk are added, Alternative 6 is $1.974 million more than Alternative 4. Based on an incremental cost of $.014 per GJ and an average annual consumption of 95GJ per residential customer, the annual cost difference between the two alternatives would be $1.33 per customer.

In summary, when taking into account the reduction in operational risk provided by Alternative 6 compared to Alternative 4, and that Alternative 6 is the only alternative which meets all of the stated objectives FEI has selected Alternative 6 as the preferred alternative.

3.2.4 Conclusion – Preferred Alternative

Through the financial and non-financial evaluation of various alternatives, the Company has determined that Alternative 6 (NPS 30 at 2070 kPa) is the preferred alternative and that it will satisfy all the objectives and requirements outlined in section 3.2.1 above.

Of the seven alternatives considered, the following three are the only viable alternatives that allow the Company to meet some or all of the Project objectives and requirements:

- Alternative 4: install a NPS 24 pipeline operating at 2070 kPa;
- Alternative 5: install a NPS 36 pipeline operating at 1200 kPa; and
- Alternative 6: install a NPS 30 pipeline operating at 2070 kPa.

Each of these alternatives will mitigate the reliability, safety and regulatory risk posed by the existing NPS 20 Coquitlam Gate IP pipeline as a result of the known corrosion mechanism and unacceptable projected leak frequency. These alternatives also present practical pipeline replacement solutions that are constructible using modern standard pipeline installation techniques. However, only Alternative 6 meets all of the Coquitlam Gate IP Project objectives and requirements.

Alternative 6 has a capital cost that is $32.022 million (as-spent dollars) greater than Alternative 4 (NPS 24 at 2070 kPa). Alternative 4, similar to Alternative 6, would mitigate the integrity risks associated with the existing NPS 20 pipeline leaks. However, Alternative 4 would not fully meet the Coquitlam Gate IP Project objectives and requirements in terms of reliability, operational flexibility or resiliency of the current Metro IP system.

An analysis of the PV of the 60 year cost of service shows that Alternative 4 is $40.854 million less than Alternative 6 and that the differential in terms of a 60 year Levelized Rate Impact between the two is $0.014 per GJ. Based on an average annual consumption of 95 GJ per residential customer, this would result in an annual cost difference between the two alternatives of $1.33 per customer.

While financial considerations have a role when selecting the preferred alternative, one of the primary objectives of the Projects together is the elimination of both Fraser Gate IP and the Coquitlam Gate IP as single point-of-failure pipelines, and to improve overall system resilience through increased system reliability, flexibility, and redundancy. As noted in the Non-Financial and Financial comparison discussion, Alternative 6 is the alternative that meets all the objectives.

By reducing all of the operational risk, improving operational flexibility, and increasing system resiliency, for a relatively small incremental cost over Alternative 4, Alternative 6 is considered the most prudent and is a cost-effective solution when all factors are considered. On this basis, it has been selected as the preferred alternative.

3.3 *PROJECT DESCRIPTION*

In this section, FEI will describe the proposed Coquitlam Gate IP pipeline replacement in more detail, including information on components, schedule, resources requirements, and risks and management.

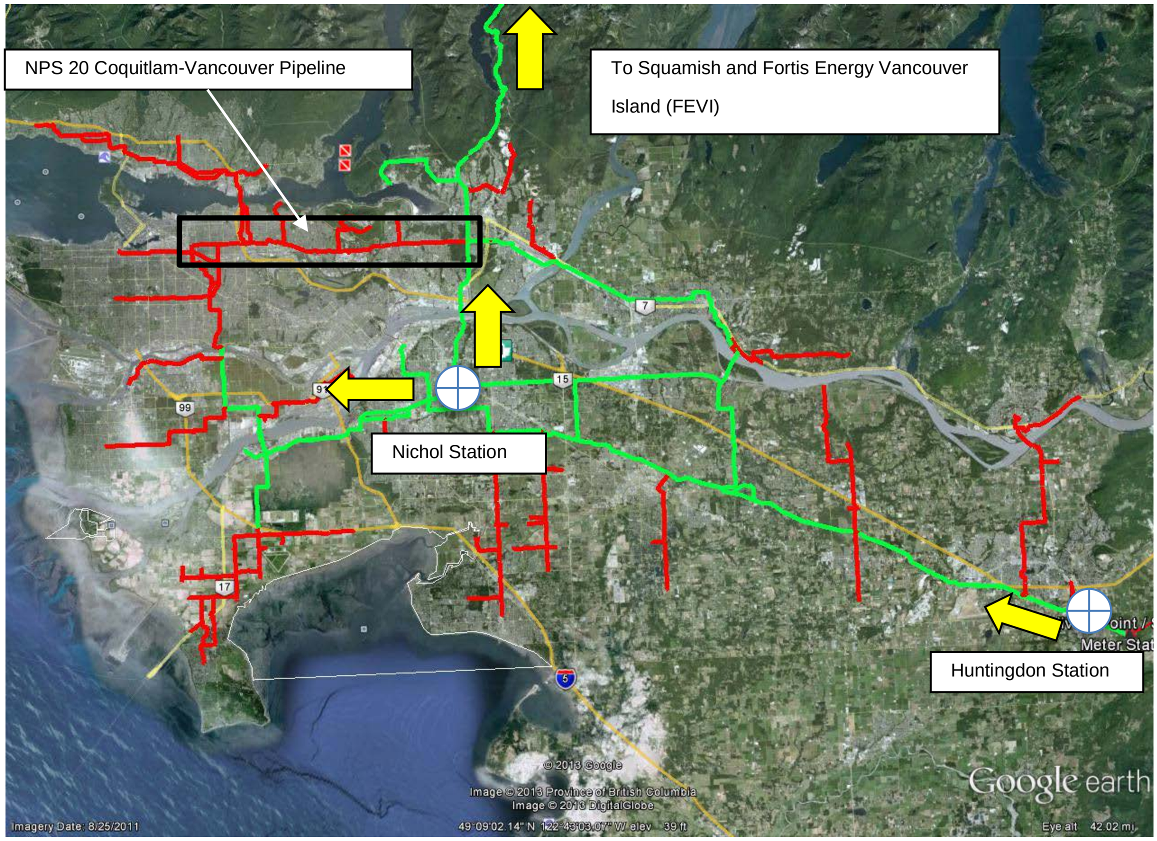
3.3.1 Introduction

The FEI system, which supplies natural gas to the Lower Mainland and Vancouver Island, is presented in Figure 3-3. It comprises TP and IP pipelines which are illustrated as green (TP) and red (IP) for clarity. The TP pipelines have dedicated Right of Way (ROW) easements which are located within shared utility corridors, and the IP pipelines, which operate at lower pressure, are generally located within road allowances.

The Coquitlam and Fraser Gate stations are the two interface points between the TP pipeline network and the lower pressure IP pipeline network which distributes gas throughout Metro Vancouver.

The existing NPS 20 Coquitlam Gate IP pipeline, which has experienced integrity issues as previously described in section 3.1, is also highlighted in Figure 3-3. This pipeline extends from Coquitlam Gate located at Como Lake & Mariner Way in Coquitlam to East 2nd & Woodland in Vancouver and is approximately 20 km in length. The Coquitlam Gate IP Project will involve the replacement of the existing NPS 20 IP pipeline which operates at 1200 kPa with a new NPS 30 IP pipeline which will operate at 2070 kPa.

Figure 3-3: Coquitlam Gate IP Project FEI Lower Mainland Gas Supply Network



Source: FEI data overlaid on Google Earth mapping

TP pipelines operating at greater than 2070 kPa

IP pipelines operating from 700 kPa to 2070 kPa

3.3.2 Project Components

The project scope will include the design, routing, construction and commissioning of a new NPS 30 IP pipeline and associated facilities (stations). The main project components include:

- NPS 30 IP pipeline that will operate at a Maximum Operating Pressure (MOP) of 2070 kPa;
- Pipeline design in accordance with CSA Z662 Section 12 for 'Gas Distribution Systems' to operate at hoop stresses of less than 30 percent of the specified minimum yield strength of the line pipe;
- Upgrades to the Coquitlam Gate station to facilitate the larger IP pipeline flow capacity and operating pressure;

- Upgrades to East 2nd & Woodland Station to interface the NPS 30 IP pipeline with the existing Fraser Gate IP network; and
- Interface with the existing IP network at a number of supply offtakes en-route from Coquitlam through Burnaby to the terminus at East 2nd & Woodland in Vancouver.

The pipeline will be constructed and installed predominantly within existing road allowance, as transportation corridors provide the most feasible alignment opportunities within a dense urban environment.

3.3.3 Basis of Design and Engineering

3.3.3.1 Standards and Specifications

The design, construction and operation of FEI natural gas pipelines and stations are conducted in accordance with British Columbia Oil and Gas Commission regulations and the Canadian Standards Association (CSA) Standard Z662 "Oil and Gas Pipeline Systems". The Coquitlam Gate IP Project, comprising both pipelines and stations, will be developed in accordance with all applicable statutory codes and standards including FEI's internal standards.

Table 3-4 lists the applicable industry standards and specifications for the project.

Table 3-4: Applicable Industry Standards and Specifications

Document	Description
CSA Z662-11	Oil and Gas Pipeline Systems
CSA Z245.1-07	Steel Pipe
CSA Z245.11-09	Steel Fittings
CSA Z245.12-09	Steel Flanges
CSA Z245.20-10	External Fusion Bond Epoxy Coating for Steel Pipe
CSA C22.3 No. 6	Principles and Practices of Electrical Coordination Between Pipelines and Electric Supply Lines
CAN/CSA-G40.21-04	Specification for Structural Quality Steels
API RP 1102-2007	Steel Pipelines Crossing Railroads and Highways, 7th Edition
TC E-10	Government of Canada, Transport Canada: Standards Respecting Pipeline Crossings Under Railways
CPR 2.39	Pipeline and Cable Installations Within Railway Right of Ways
OCC-1-2005	Recommended practice for Control of External Corrosion on Buried or Submerged Metallic Piping Systems

Other applicable documents are listed in the Design Basis Memorandum (DBM) (see Confidential Appendix A-11).

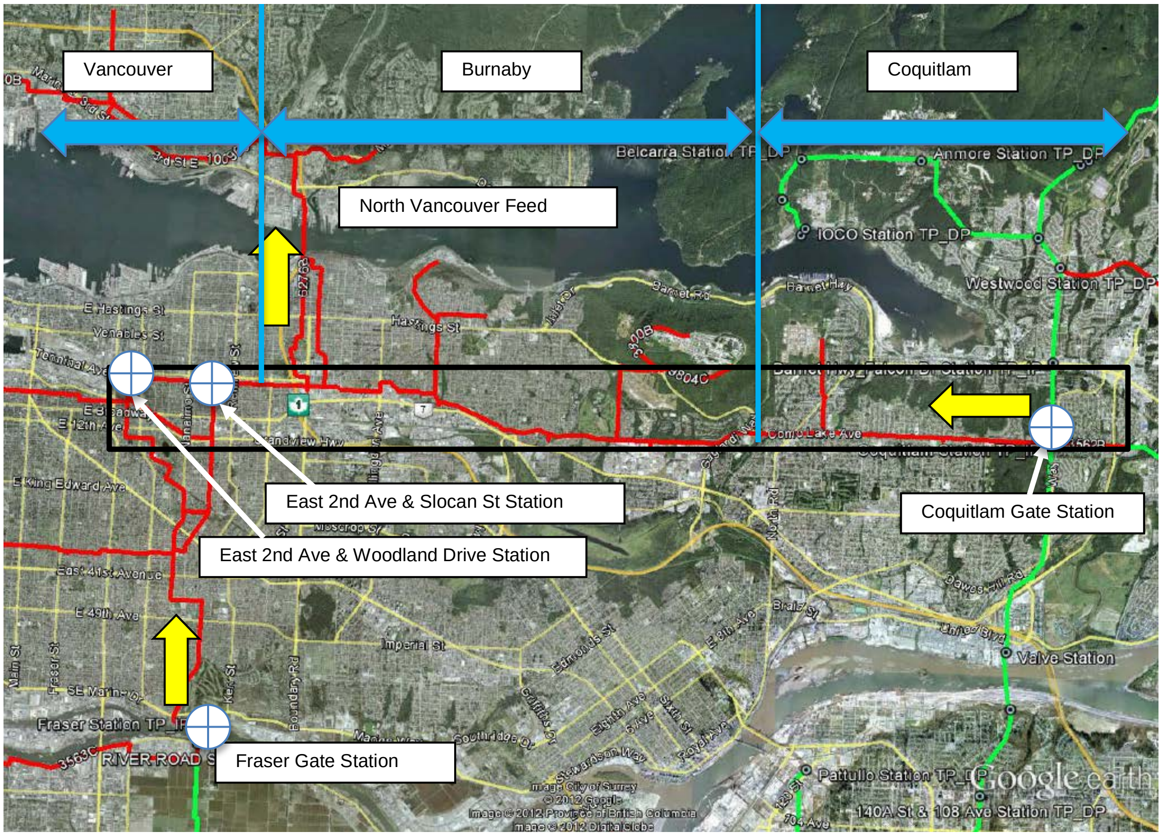
3.3.3.2 Process Description

As previously described in section 3.1.2, Coquitlam Gate station is the interface station between the TP network and the existing NPS 20 Coquitlam Gate IP pipeline which extends approximately 20 km from Coquitlam to Vancouver. Gas which enters Coquitlam Gate station from the TP network is filtered and cleaned. It is then heated to ensure the temperature is maintained above the dew point temperature, preventing harmful hydrate formation during the pressure reduction process. Next, the pressure of the gas is reduced from 4020 kPa to 1200 kPa through pressure regulators, and finally the gas is metered prior to entry to the NPS 20 IP pipeline.

The Coquitlam Gate IP pipeline is the ‘backbone’ of the east to west IP distribution network which supplies district stations and single point of use industrial customers connected along the route corridor from Coquitlam to Vancouver (see Figure 3-4). The Fraser Gate IP pipeline is the ‘backbone’ of the south to north IP distribution network. Both pipelines interconnect in Vancouver at East 2nd & Woodland and East 2nd & Slocan Street stations. This interconnectivity facilitates a balanced gas flow between both pipelines, especially in the event of a disruption to normal flow regimes.

For example, if Coquitlam Gate station, or the Coquitlam Gate IP pipeline, experiences an outage then gas will flow from Fraser Gate IP pipeline into the Coquitlam Gate IP pipeline or, conversely, if Fraser Gate Station, or the Fraser Gate IP pipeline experiences an outage, gas will flow from the Coquitlam Gate IP pipeline into the Fraser Gate IP pipeline. However, the capacity of the existing Coquitlam Gate IP pipeline is not sufficient to supply all customers connected to the Fraser Gate IP pipeline in the event of an outage on the Fraser Gate IP pipeline. The capacity of the Coquitlam Gate IP pipeline is also insufficient to allow sufficient gas to flow from the Fraser Gate IP pipeline to supply all connected customers in the event of an outage at Coquitlam Gate in mid-winter conditions, although it does have that ability in warmer months of the year. In effect, the NPS 20 Coquitlam Gate IP pipeline is a restriction in the ‘backbone’ of the current Coquitlam Gate IP system and the Fraser Gate IP system preventing full resiliency.

Figure 3-4: Coquitlam Gate IP Pipeline



Source: FEI data overlaid on Google Earth mapping

TP pipelines operating at greater than 2070 kPa

IP pipelines operating from 700 kPa to 2070 kPa

3.3.3.2.1 NEW NPS 30 IP PIPELINE

The proposed NPS 30 Coquitlam Gate IP pipeline will operate at 2070 kPa and replace the existing smaller diameter NPS 20 Coquitlam Gate IP pipeline which operates at 1200 kPa. The NPS 30 pipeline will provide a greater capacity network 'backbone' pipeline to flow gas along the east to west corridor to East 2nd & Woodland station and into the Fraser Gate IP pipeline network. In the event of an outage at Fraser Gate station, or along the NPS 30 Fraser Gate IP pipeline, the Coquitlam Gate IP pipeline will be sufficient to flow gas from Coquitlam Gate station along the east-west corridor and into the Fraser Gate IP pipeline to meet the gas needs of the entire IP network connected customers. Conversely, in the event of a disruption to normal operation of Coquitlam Gate station, or the Coquitlam Gate IP pipeline, gas will flow from the Fraser Gate IP network back through the Coquitlam Gate IP pipeline to meet the gas needs of the entire IP network. To meet the NPS 30 Coquitlam Gate IP design parameters in terms gas flow rate and pressure it will also be necessary to upgrade the existing Coquitlam Gate station.

3.3.3.2.2 COQUITLAM GATE STATION

As noted previously, natural gas enters Coquitlam Gate station from the TP network at 4020 kPa. The existing station is designed for the gas flow capacity and MOP of the NPS 20 Coquitlam Gate IP pipeline. As the NPS 30 Coquitlam Gate IP pipeline capacity will be greater (a combination of higher gas flow rate and MOP), the Coquitlam Gate station infrastructure will need to be upgraded accordingly. Upgrades to mechanical, civil and electrical and controls infrastructure will be required and will involve the installation of larger equipment and pipework. However, the station will continue to provide the same functionality in terms of gas processing, namely, filtration, metering, heating and pressure regulation of the gas entering from the TP network prior to entry into the Coquitlam Gate IP pipeline. The main differences between the upgraded station and the existing station are a higher outlet pressure of 2070 kPa (instead of 1200 kPa) and a higher gas flow rate.

3.3.3.2.3 INTEGRATION WITH EXISTING GAS DISTRIBUTION SYSTEM

There are a number of IP lateral offtakes along the route of the existing Coquitlam Gate IP pipeline which supply gas to district regulating stations and industrial customers between Coquitlam and Vancouver. These IP laterals are smaller diameter lines which connect the district stations and industrial customers to the Coquitlam Gate IP pipeline. The district stations lower the gas pressure from 1200 kPa to 420 kPa. They comprise pressure regulating equipment located in 1.2 metre deep below ground compact vaults which are accessed for operation and maintenance via hydraulically actuated access doors located on the surface. The lengths of the IP laterals connecting the district stations and industrial customers vary depending on the proximity to the Coquitlam Gate IP pipeline. It will be necessary to interface the proposed NPS 30 Coquitlam Gate IP pipeline with each of these laterals such that gas supply is maintained without interruption during construction, commissioning and long term operation of the pipeline.

District stations and industrial customers, which are located in proximity to the existing Coquitlam Gate IP pipeline and connected by relatively short IP laterals, will undergo station and lateral pipeline upgrades to meet the higher MOP of the proposed Coquitlam Gate IP pipeline. In situations where the district stations or industrial load is located remotely, and connected via a longer IP lateral, then a new station will be constructed at the interface between the Coquitlam Gate IP pipeline and the existing IP laterals to reduce the pressure from the Coquitlam Gate IP pipeline MOP of 2070 kPa to the lateral line MOP of 1200 kPa. This solution is more cost effective and will result in a lower overall impact by avoiding the cost and construction associated with unnecessarily replacing the existing longer lateral pipelines with a new pipeline through congested urban neighbourhoods. These IP/IP pressure reduction stations will comprise pressure regulating equipment housed in a compact underground vault similar to the existing district stations.

A total of five new IP/IP pressure reduction stations would be located along the Coquitlam Gate IP pipeline route to connect the following longer IP laterals:

- Clarke Road & Robinson Street station lateral (also serves Petro Canada);

- University Drive East & Tower Road station lateral (also serves Simon Fraser University);
- Springer Avenue & Empire Drive station lateral (also serves Chevron Canada);
- North Shore lateral; and
- East 2nd Avenue & Slocan Street station lateral (also interconnects with Fraser Gate IP).

There are four district stations connected by shorter laterals that currently reduce the pressure from 1200 kPa to distribution pressure (DP) of 420 kPa. The short interconnecting laterals will be replaced with new pipe to suit the proposed NPS 30 Coquitlam Gate IP pipeline pressure of 2070 kPa and the stations will require upgrading to reduce the pressure from the higher Coquitlam Gate IP pipeline pressure of 2070 kPa to 420 kPa. The four district stations include:

- Poirier Street & Grover Avenue station;
- Broadway & Underhill Avenue station;
- Bainbridge Avenue & Broadway station; and
- Springer Avenue & Broadway station.

3.3.3.2.4 INTERFACE WITH EXISTING FRASER GATE IP PIPELINE

The terminus of the proposed NPS 30 Coquitlam Gate IP pipeline will be East 2nd & Woodland station where the existing NPS 20 Coquitlam Gate IP pipeline interfaces directly with the Fraser Gate IP pipeline as both IP pipelines have a common MOP. Since the proposed NPS 30 Coquitlam Gate IP pipeline will operate at a higher MOP, it will be necessary to construct an IP/IP pressure control station to regulate the pressure from 2070 kPa to 1200 kPa. This station will be larger and more complex compared to the new IP/IP stations required to interface with the longer IP laterals along the route. The East 2nd & Woodland station will comprise pipeline pigging and gas filtration, metering and pressure regulation to facilitate gas flow from the NPS 30 Coquitlam Gate IP pipeline to the Fraser Gate IP pipeline. The East 2nd & Woodland station will also comprise pressure regulation from 1200 kPa to 420 kPa to facilitate gas supply to the local distribution network. The proposed station infrastructure will be constructed above ground within the confines of an existing FEI owned site at East 2nd & Woodland Drive. The mechanical and electrical equipment, especially noise generating equipment, will be situated within engineered buildings to ensure any noise emissions are limited to specified levels at or below minimum requirements for the urban location. The buildings will also be architecturally designed to meet City of Vancouver's planning requirements in terms of neighbourhood aesthetics. A final measure of neighbourhood screening will involve extension of the mature trees which exist along three sides of the site to the fourth side to ensure that any visual impacts are minimized.

3.3.3.2.5 BI-DIRECTIONAL CAPABILITY

The East 2nd & Woodland Station, in addition to facilitating gas flow from the proposed NPS 30 Coquitlam Gate IP pipeline to the Fraser Gate IP pipeline (forward flow regime), will also include facilities to provide automatic reverse flow capabilities (reverse flow regime) to flow gas from the Fraser Gate IP pipeline to the Coquitlam Gate IP pipeline. This bi-directional flow capability will ensure the NPS 30 Coquitlam Gate IP pipeline is fully integrated into the overall Coquitlam Gate IP system and the Fraser Gate IP system and provides flexibility in achieving full resiliency of the Metro IP system. Thus, if gas from Fraser Gate station, or the Fraser Gate IP pipeline, is disrupted, the system can be shut in and gas will flow from Coquitlam Gate IP pipeline through East 2nd & Woodland Station into the Fraser Gate IP pipeline to supply all customers.

Also, if the gas flow from Coquitlam Gate station, or through the Coquitlam Gate IP pipeline, is disrupted, there exists the capability for gas to flow in the opposite direction from Fraser Gate IP pipeline network back through the East 2nd & Woodland Station along the Coquitlam Gate IP pipeline to supply all customers.

3.3.3.3 Pipeline

3.3.3.3.1 DESIGN PARAMETERS

The Coquitlam Gate IP pipeline and lateral pipeline upgrade main design parameters are listed in Table 3-5.

Table 3-5: Coquitlam Gate IP Pipeline Specification Details

Details	Values
Pipeline Length	19,700 m
Pipeline Outside Diameter/Nominal Pipe Size)	762 mm/NPS 30
Maximum Operating Pressure (MOP)	2,070 kPa (300psi)
Pipeline Material Grade/Specified Minimum Yield Strength (SMYS)	359 MPa (X52)
Maximum Hoop Stress (as a % of SMYS)	<30%
Pipeline Buried Depth (min)	1.2m to top of pipe
Design Temperature	50 degC
Pipe External Coating	Fusion Bonded Epoxy (FBE)

As detailed in section 3.3.3.2.3 some of the existing IP/DP district stations which are located in proximity to the existing Coquitlam Gate IP pipeline and connected by relatively short IP lateral pipelines, will undergo station and lateral pipeline upgrades to suit the higher MOP of the proposed Coquitlam Gate IP pipeline. These laterals will be constructed to the same pipe specification as detailed in Table 3-5. The diameter and approximate lengths of these laterals are detailed in Table 3-6.

Table 3-6: Coquitlam Gate IP Lateral Pipeline Details

Lateral Details	Length (m)	Diameter (NPS)
Poirier Street & Grover Avenue Station Lateral	80	6
Broadway & Underhill Avenue Station Lateral	160	6
Bainbridge Avenue & Broadway Station	150	4
Springer Avenue & Broadway Station	50	6

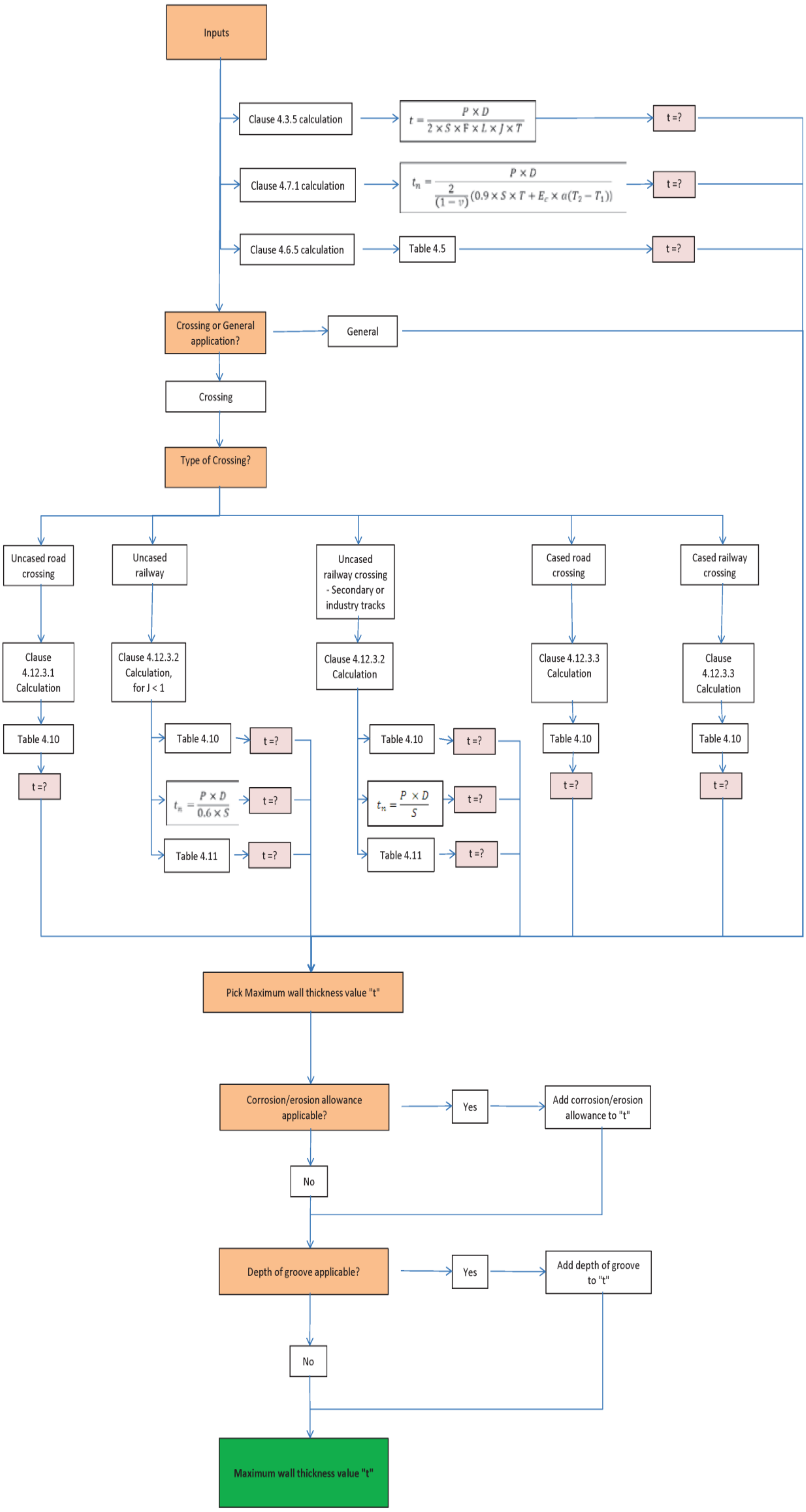
3.3.3.3.2 PIPE SPECIFICATION

The pipe specification process for the proposed pipeline follows accepted industry practices, and meets all relevant code requirements, specifically those in CSA Z662-11 Oil and Gas Pipeline Systems. The wall thickness selection criteria for the NPS 30 Coquitlam Gate IP pipeline are based on several factors outlined in CSA Z662-11. The wall thickness selection is based on the following:

- CSA Z662-11 Section 12 hoop stress requirements. Section 12 requires that the hoop stress of the pipeline is less than 30 percent of the specified minimum yield strength;
- Consideration of any proposed crossings (road or rail, cased or uncased) and minimum wall thickness requirements for the specific crossing type; and
- Consideration of pipe thinning during the induction bending process.

Figure 3-5 outlines the process used to determine the minimum wall thickness.

Figure 3-5: Wall Thickness Selection Flow Chart[19]



[19] Source: WorleyParsons Canada Service Ltd.

Consideration was given to selecting a consistent wall thickness in order to better accommodate pipeline pigging operations, ease constructability (through minimization of transition pieces and welds), and to maximize cost saving opportunities during the pipe production.

The steel grade selection and the wall thickness selection is an iterative process as both wall thickness and steel grade are values required during the hoop stress calculation. During the steel grade selection, consideration was given to selecting a higher grade of steel as this allows for the hoop stress requirements to be met while selecting the optimum pipe wall thickness. This has the following advantages:

- Shorter girth welding times;
- Improved handling times and processes due to lighter weight; and
- Decreased transportation and handling costs due to lighter weight.

In addition, consideration was given to selecting a grade of steel that allows for future repairs to be completed by the Company using qualified weld procedures.

Based on the preliminary design that was completed, the selected wall thickness and steel grade are 11.1 mm and Grade 359 respectively. During detailed design, further stress analysis will be completed to validate the pipe wall thickness and grade selection.

The pipe material grade and wall thickness selection is detailed in the Wall Thickness Selection Report attached in Confidential Appendix A-12.

3.3.3.3.3 LOCATION AND RUNNING LINE

The existing Coquitlam Gate IP pipeline traverses approximately 20 km in an east-west alignment from Como Lake & Mariner Way in Coquitlam to East 2nd & Woodland Drive in Vancouver. The proposed NPS 30 Coquitlam Gate IP pipeline will, based on the selected preferred route option, adopt a similar but parallel alignment for most of the route through Coquitlam, Burnaby and Vancouver. The detailed running line is presented in the route selection process in section 3.3.4.

3.3.3.3.4 BLOCK VALVES

There are a number of block valves installed along the existing Coquitlam Gate IP pipeline. They serve as a means to isolate individual sections of the pipeline and stop the flow of gas to that section, if required during normal operation and maintenance or in case of emergencies. If two or more of these valves are closed simultaneously, the resulting pipeline ‘shut-in’ stops the flow of gas through the section of pipeline. The existing block valves sectionalize the pipeline such that shut-in of a section should not isolate the gas supply to a district station or larger single point load. However, in some segments between isolation valves, district stations could be removed from service. If a district station was removed from service, the low pressure distribution system in the immediate vicinity would be adequately interconnected such that the isolated station load could be temporarily supported from surrounding district stations without loss of gas supply.

The proposed NPS 30 Coquitlam Gate IP pipeline design has nine block valves allowed for at each of the lateral offtake points. This sectionalization generally follows the current pipeline operating philosophy whereby the pipeline can be sectionalized without removing the gas supply to a connected supply point. The final requirement, in terms of number of block valves for pipeline operation and maintenance, will be determined during the detailed design phase via Hazard Identification (HAZID) and Hazardous Operation (HAZOP) studies. The proposed Coquitlam Gate IP pipeline block valve sectionalization is illustrated in Figure 3-6 and detailed in Table 3-7.

Figure 3-6: Proposed NPS 30 Coquitlam Gate IP Block Valve Sections

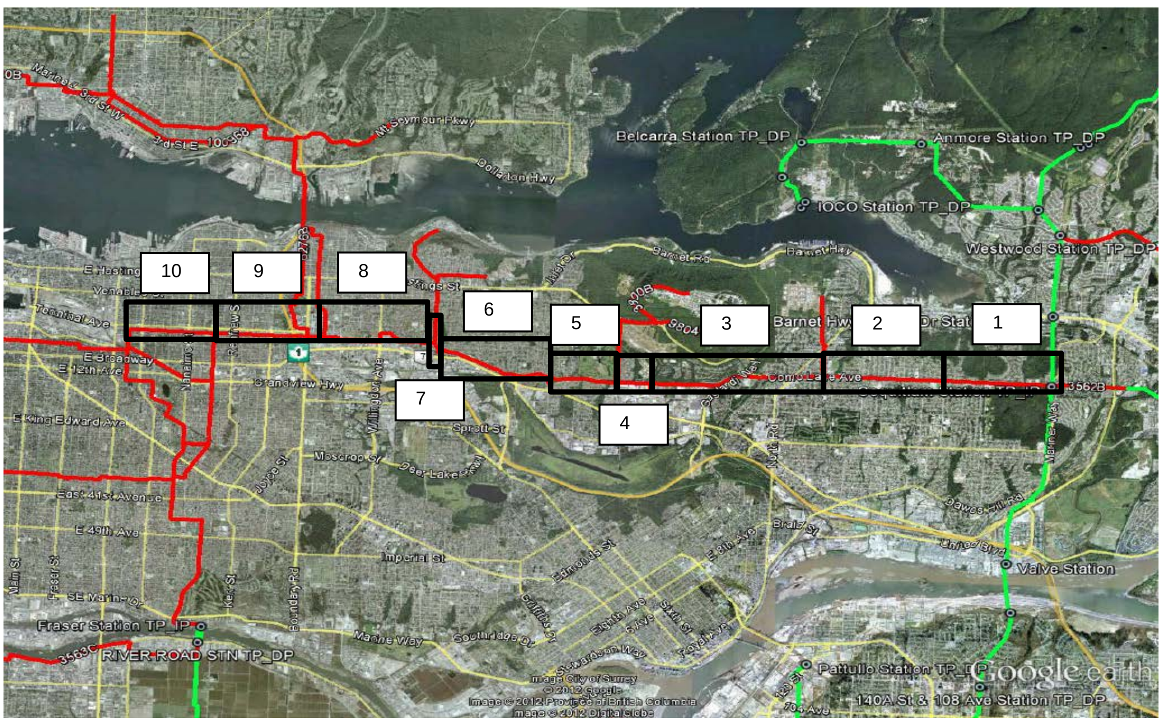


Table 3-7: Proposed NPS 30 Coquitlam Gate IP Sectionalization

Segment	Location
1	Como Lake Ave. & Mariner Way to Como Lake Ave. & Poirier Street
2	Como Lake Ave. & Poirier St. to Como Lake Ave. & Robinson St.
3	Como Lake Ave. & Robinson St. to Broadway & Underhill Ave.
4	Broadway & Underhill Ave. to Broadway & Arden Ave.
5	Broadway & Arden Ave. to Broadway & Bainbridge Ave.
6	Broadway & Bainbridge Ave. to Broadway & Springer Ave.
7	Broadway & Springer Ave. to Springer Ave. & Halifax St.

Segment	Location
8	Springer Ave. & Halifax St. to Graveley St. and Ingleton Ave.
9	Graveley St. & Ingleton Ave. to East 1st Ave. & Slocan St.
10	East 1st Ave. & Slocan St. to East 2nd Ave. & Woodland Drive

3.3.3.3.5 IN-LINE INSPECTION

In-line inspection (ILI) is a process which utilizes the pipeline gas flow and pressure characteristics to propel an inspection tool within the pipeline. There are a number of types of in-line inspection tools that can be used to detect and size a variety of pipeline anomalies, including corrosion and existing mechanical damage. To facilitate ILI, the pipeline design must incorporate certain features and mechanical components including:

- Pipeline bends with radii at least 3 to 5 times the pipeline diameter;
- Full bore mainline block valves to permit unrestricted passage;
- Launcher at the pipeline inlet for tool insertion and to control the propulsion through the pipeline; and
- Receiver at the pipeline outlet to receive the in-line inspection tool.

FEI has determined that due to the longevity of steel pipelines, it is appropriate to design the Coquitlam Gate IP pipeline with future ILI capability. This will enable the cost effective and targeted mitigation of specific pipeline hazards (i.e. corrosion) over the service life of the new asset.

3.3.3.3.6 CORROSION PROTECTION

Coating Protection

External coatings provide the first level of defence against external corrosion of buried steel piping, and are required by the CSA Z662 standard. Coating protection involves the application of a layer of factory applied corrosion resistant material to the outside of the pipe after manufacture and prior to delivery for construction. There are different coating materials available depending on the specific requirements. Fusion Bonded Epoxy (FBE) has been selected as the most appropriate coating for the Coquitlam Gate IP pipeline replacement. FBE material is a high quality durable, industry accepted coating and has been selected due to the pipeline's urban location and the following requirements:

- Due to the potential presence of hydrocarbons along the route alignment corridor the costing must be resistive to hydrocarbon deterioration;
- Due to the highly constrained working area during construction requiring multiple pipe handling scenarios the coating must resist mechanical damage during construction and installation; and

- Due to the urban pipeline location the coating must be resistive to mechanical damage after installation and backfill to minimize future excavations for damage repair.

Cathodic Protection

Cathodic protection is generally regarded as a secondary defense against external corrosion, used in conjunction with coatings. It is also a requirement of the CSA Z662 standard. Corrosion control of the Coquitlam Gate IP pipeline will be achieved via the protective external coating described previously and an impressed current cathodic protection system. Cathodic protection of the existing Coquitlam Gate IP pipeline is supplied via an impressed current cathodic Protection (CP) system, comprising rectifiers and deep anode beds. These are located at 2nd Avenue & Skeena Street and at Underhill Drive & Broadway. To facilitate cathodic protection system management and its effective performance, the existing pipeline is separated into two sections via an electrical isolation fitting installed at 2nd Avenue & Boundary Road. The impressed current system located at 2nd Avenue & Skeena Street was originally installed in 1964 and had replacement anode beds installed in 1976 and 1994. This impressed current system now provides protection to the Coquitlam Gate IP pipeline from 2nd Avenue & Boundary Road to 2nd Avenue & Woodland Street. The impressed current system located at Underhill Drive & Broadway was installed in 1989, with a replacement anode bed installed in 2003. This impressed current system provides protection to the Coquitlam Gate IP pipeline from 2nd Avenue and Boundary to Coquitlam Gate station. It is expected that the existing CP system could be used to provide protection to the new Coquitlam Gate IP pipeline; this will be confirmed during detailed design.

3.3.3.3.7 INTEGRITY MONITORING

Similar to the existing pipeline, the integrity of the new Coquitlam Gate IP pipeline will be managed within FEI's Integrity Management Program (IMP). The IMP is a corporate-level management system for identifying and mitigating hazards to the system that have the potential to result in failure with significant consequences. Activities include:

- Monitoring of the cathodic protection system in accordance with CSA Z662, CGA OCC-1, and industry practice. These monitoring programs are established and documented within Company standards; and
- Third-party damage prevention activities, including a permits & inspection process and public safety awareness programs.

3.3.3.4 Stations (Facilities)

To facilitate integration of the NPS 30 Coquitlam Gate IP pipeline at 2070 kPa MOP into the existing IP network at 1200 kPa MOP, station upgrades will be required. The specific upgrades are detailed in the following sections.

3.3.3.4.1 COQUITLAM GATE STATION

The required upgrades to the existing Coquitlam Gate station are listed below and presented in greater detail on the engineering drawings attached in Confidential Appendix A-13.

- Remove the existing pressure control system consisting of filtration, heating, metering, and control/regulation along with associated piping (the existing system is not designed to handle the new gas flow rates through the station to the NPS 30 Coquitlam Gate IP pipeline);
- Remove the existing mechanical equipment: gas heat exchanger and glycol boiler system, filter vessels, and equipment and piping associated with the existing pressure reduction system;
- Remove the existing pressure letdown building which includes deconstruction of the below-ground building foundation;
- Remove the existing glycol boiler system building;
- Remove the existing instrumentation building;
- Install a new TP/IP pressure control system TP 4020 kPa to IP 2070 kPa consisting of filtration, heating, metering and control/regulation (suitable for the new gas flow rates);
- Install a new IP/IP pressure control system IP 2070 kPa to IP 1200 kPa consisting of filtration, heating, metering and control/regulation;
- Install a new heat exchanger for the TP/IP pressure control system;
- Install a boiler building housing three glycol boiler systems for the heat exchangers;
- Install a new pig launcher;
- Install a building for the TP/IP pressure control system;
- Relocate the existing storage building to the southwest corner of the plot plan;
- Install a new instrumentation building; and
- Relocate the uninterruptable power supply system, standby generator, and instrument air system.

3.3.3.4.2 EAST 2ND AND WOODLAND STATION

The required upgrades at East 2nd & Woodland station are listed below and presented in greater detail on the engineering drawings attached in Confidential Appendix A-14.

- Install a new pig receiver;
- Remove the existing below ground regulator vault;
- Remove the existing below ground filter vault;
- Remove the existing storage building;

- Remove or abandon in place (as required) the existing NPS 16 pipeline;
- Install a new IP/IP pressure control system consisting of filtration, metering, and control/regulation (suitable for the new gas flow rates);
- Install a new pressure control system to allow for reverse flow from the Fraser Gate IP pipeline (1200 kPag) to the Coquitlam Gate IP pipeline (2070 kPag design but operates at 1200 kPag during reverse flow);
- Install a common building for the pressure control systems within the enclosed fenced boundary at East 2nd & Woodland site;
- Install an acoustic enclosure for the pig receiver;
- Install a new sump for draining of the filters; and
- Install an instrument air system.

3.3.3.4.3 IP/DP DISTRICT STATIONS

As detailed in section 3.3.3.2.3 some existing IP/DP district stations, which are located in proximity to the existing Coquitlam Gate IP pipeline and connected by relatively short IP lateral pipelines, will undergo station and lateral pipeline upgrades to suit the higher MOP of the proposed Coquitlam Gate IP pipeline. The required upgrades to existing IP/DP district Stations are listed below and presented in greater detail on the engineering drawings attached in Confidential Appendix A-15.

- Upgrade IP/DP pressure regulating stations at four locations along the Coquitlam Gate IP pipeline consisting of filtration, metering and pressure letdown; and
- The existing IP/DP station equipment is installed in underground vaults. The upgraded equipment will also be installed in underground vaults of similar size and in the same location as the existing vault stations.

3.3.3.4.4 IP/IP INTERFACE STATIONS

As detailed in section 3.3.3.2.3 where an existing IP/DP district station or IP industrial load is located remotely, and connected via a longer IP lateral to the Coquitlam Gate IP pipeline, a new IP/IP station will be constructed at the interface between the Coquitlam Gate IP pipeline and the existing IP lateral to reduce the pressure from 2070 kPa to the lateral line MOP of 1200 kPa. This solution is more cost effective and will result in a lower overall impact by avoiding the cost and construction associated with unnecessarily replacing the existing longer lateral pipelines with a new pipeline through congested urban neighbourhoods. These IP/IP pressure reduction stations will comprise pressure regulating equipment housed in a compact underground vault similar to the existing district stations. The required IP/IP interface station upgrades are listed below and presented in greater detail on the engineering drawings attached in Confidential Appendix A-16.

- Provision of IP/IP Pressure Letdown System at five locations along the Coquitlam Gate IP pipeline consisting of filtration, metering and pressure control/letdown; and
- Install underground vaults for each IP/IP Pressure Letdown System. The final location of the vaults will depend on the interface location between the existing lateral and the NPS 30 Coquitlam Gate IP pipeline, the inlet and outlet pipe configuration. The exact location will be confirmed during the detailed design and routing phase.

3.3.3.4.5 RTU/SCADA AND COMMUNICATION

New Remote Telemetry Units (RTU) and Supervisory Control and Data Acquisition (SCADA) systems will be installed at Coquitlam Gate and East 2nd & Woodland stations including communications hardware and Uninterruptible Power Supplies (UPS). Communications with the FEI Control Centre will be via cellular phone and telephone line for redundant communications. All field instruments including fire and gas detectors, Emergency Shut Down (ESD) valves will be wired to the new RTU/SCADA systems. The programming and configuration of these systems will be executed by FEI Electrical & Controls (E&I) group.

3.3.3.5 Operations and Maintenance Activities

The NPS 30 Coquitlam Gate IP pipeline will operate at a higher pressure than the existing NPS 20 pipeline. The IP/IP interface stations that will be required to connect the proposed Coquitlam Gate IP pipeline with the lower pressure IP network will be of similar design and include similar equipment and warrant identical operating procedures as the numerous district pressure let down stations currently operated by the Company. In effect, the Coquitlam Gate IP pipeline, after commissioning, will be operated and maintained in accordance with the Company's current proven standards and procedures for IP pipelines and stations.

3.3.3.6 Pipeline Right-of-Way and Valve Locations

The existing Coquitlam Gate IP pipeline is located within road allowance. The proposed NPS 30 Coquitlam Gate IP pipeline preferred route option is detailed in section 3.3.4. The majority of this alignment will also be located within road allowance which will not require permanent ROW. However, there is a short section of the route alignment, approximately 70 m, which will require new land and access rights. The pipeline block valves will be integrated in the pipeline and, therefore, their locations will be generally dictated by the pipeline route alignment and the location of the lateral offtake connections. The quantity of valves required and their exact location will be determined during the detailed design phase as outlined in section 3.3.4.8.

3.3.3.7 Other Utilities

The proposed location of the Coquitlam Gate IP pipeline within road allowance through developed urban areas will accordingly result in the pipeline being installed in proximity to existing adjacent utilities. Data acquired during the routing process indicates the following utility infrastructure and services will be encountered along the pipeline route:

- Electrical power (BC Hydro);
- Telecommunications (TELUS, Shaw);
- Traffic signal infrastructure;
- Street lighting;
- Sanitary sewer;
- Storm drainage;
- Potable water; and
- Natural gas (FEI).

Major stakeholders including BC Hydro, Metro Vancouver (formally Greater Vancouver Regional District), TransLink, Ministry of Transportation and Infrastructure and the municipalities of Vancouver, Burnaby and Coquitlam have already been contacted by the Project team regarding these utilities. Further liaison with all stakeholders combined with onsite investigations will address stakeholders concerns, impact assessment and mitigation during detailed design and engineering.

3.3.3.8 Abandonment Process

The existing NPS 20 Coquitlam Gate IP pipeline will be abandoned in place once the new pipeline is in service. It is not possible to abandon or remove the existing NPS 20 IP pipeline prior to installation and commissioning of the new NPS 30 IP pipeline in its entirety. Supply must be maintained to all customers. Therefore, to minimize the risk of supply interruption from either a corrosion leak or damage caused by the parallel construction of the new NPS 30 IP pipeline, the ability to isolate and repair a section of the existing NPS 20 IP pipeline and backfeed from either the Fraser Gate or Coquitlam Gate stations must be maintained.

In accordance with CSA Z662-11 and the Company's internal standards, the pipeline will be abandoned in the following stages:

- Emptied of service fluids;
- Purged and appropriately cleaned;
- Physically separated from any in-service piping;
- Cut and capped below grade; and
- No longer cathodically protected or maintained according to normal maintenance schedules.

The pipeline will be sectioned into shorter segments, and all open ends plugged or sealed with watertight closures in order to minimize potential gas or water migration. Sections of the abandoned pipe may be filled with a structural grout to prevent pipeline collapse and ensure the integrity of nearby drainage systems or other infrastructure. All recorded data pertaining to the abandoned pipeline, including location and depth of cover, will be maintained on file.

3.3.4 Route Selection Process

The routing process for the NPS 30 Coquitlam Gate IP pipeline follows industry practice and specific consideration is given to the recommendations of CSA Z662-11 Oil and Gas Pipeline Systems which is the standard specification for the design, construction, operation, and maintenance of Canadian pipelines.

3.3.4.1 Routing Objectives

The route selection process adopted for this project, which is described in the following sections, is based on a typical approach to routing a pipeline between fixed start and end points and any intermediate off take points. However, the process has been tailored to meet the specific requirements and objectives of the urban location of the Coquitlam Gate IP pipeline. This is necessary due to the unique challenges associated with the densely populated urban location, land use, terrain, infrastructure, local permits and regulations, environment, and archeology. However, all pipelines are generally routed to connect between a start point and an end point. This common characteristic is no different in the case of the Coquitlam Gate IP pipeline, and the final route selected must be:

- Safe (to construct and to operate);
- Environmentally acceptable - the route must have a minimum negative impact on the environment;
- Practical – the pipeline route should permit as much of the pipeline as possible to be constructed using modern standard pipeline construction techniques whilst minimizing the use of non-standard or higher risk techniques; and
- Economic – the route should meet the project's economic objectives, without compromising safety and the environment whilst minimizing local economic impact on communities that the pipeline passes through, and have the smallest footprint feasible (ideally the shortest distance between pipeline start and end points).

3.3.4.2 Routing Process within Project Phases

Pipeline routing is an iterative process which starts with a wide 'corridor of interest' and then narrows down to a more defined route at each design stage as more data is acquired, resulting in a final alignment. The ultimate goal is to achieve a safe, environmentally acceptable, constructible (practical) and economic route. This is achieved by following a staged routing and design process.

The first stage involves the identification of one or more pipeline corridors which are located and geographically sized to encapsulate sufficient area in which all feasible route options can be identified. One or more pipeline corridors may initially be selected so as to adequately avoid key constraints and obstacles. This stage is the first step of the preliminary planning and design phase of the project.

The second stage, after one or more corridors has been identified, involves gathering available data pertaining to feasible route options within the corridor. The alignments of the route options are then further refined through desktop analysis and feedback from engagement and consultation with stakeholders, landowners and the community. The route options are then evaluated against established criteria and the preferred alternative is selected.

Stage one and two have been completed and the selected route alignment (preferred alternative) is presented later in this section.

The third and final stage involves completion of detailed routing and engineering on the selected preferred alternative, which is a preliminary route alignment, to achieve a fully engineered and defined pipeline route. The data required to achieve this level of project definition is gathered from further stakeholder and public consultation, comprehensive site investigations and detailed engineering. This fully informed design process will deliver a safe, environmentally acceptable, and constructible pipeline.

3.3.4.3 Route Corridor Identification

The initial step in the routing process defines a broad area of search between the two fixed start and end points of the pipeline; that is, one or more possible pipeline corridors. The corridor selection process is based on a desktop study of key constraints, whilst ensuring as much as possible that any corridor selected is practical and feasible and is not likely to create significant problems at a later stage in the routing process or the project lifecycle.

The geographic limits within which the pipeline route selection takes place are defined by identifying the start and end point of the pipeline and any intermediate fixed points. An ideal 'straight line' route of interest is then straddled across these points so that key issues and constraints affecting the selection of the route can be plotted and assessed. The width of the corridor depends upon the nature of the terrain traversed, current infrastructure development, likely future development growth and the degree of complexity expected with regard to environmental, engineering and constructability aspects. Natural and existing and planned manmade constraints to routing within the area of interest defined by the corridor are identified.

The existing NPS 20 Coquitlam Gate IP pipeline starts at Coquitlam Gate station and terminates at East 2nd & Woodland station in Vancouver. There are also a number of lateral offtakes along the route of the existing pipeline. These laterals distribute gas to large load centres and single point industrial customer loads; these must also connect to the proposed NPS 30 Coquitlam Gate IP replacement pipeline to maintain continuity of service and avoid any supply disruption during construction.

This requirement to interface with specific existing gas system network nodes, whilst avoiding the construction of significant additional pipeline infrastructure to connect the new pipeline to the existing network, provided the fundamental route constraints which established the initial route assessment corridor for the Coquitlam Gate IP Project. Thus, the first step in the routing process established a route assessment corridor which was largely based on the existing NPS 20 IP pipeline route alignment which exists within the following roadways through Coquitlam, Burnaby and Vancouver:

- Coquitlam – Como Lake Avenue;
- Burnaby East – Broadway;
- Burnaby West – Springer Avenue, Halifax Street, Brentlawn Drive, and 2nd Avenue; and
- Vancouver – East 2nd Avenue.

The existence of other feasible corridors was also investigated. However, in Coquitlam and Burnaby in particular, there are very limited contiguous routes along residential streets other than the Como Lake Avenue and Broadway transportation corridors. Also, the existing NPS 20 Coquitlam Gate IP pipeline is closely aligned to a direct east-west orientation, with East 2nd & Woodland station only 600 m north of Coquitlam Gate station. In addition, there are several north-south orientated obstacles that constrain the current pipeline and channel it along the current route. These include:

- Mundy Lake Park;
- Como Lake Park;
- Miller Park;
- East Grove Park/Stoney Creek;
- Maple Grove Park;
- Burnaby Mountain;
- Beecher Park;
- Burnaby Lake Park;
- Eagle Creek Ravine Park;
- Charles Rummel Park; and
- Burnaby Mountain Golf Course.

The fixed end points at Coquitlam Gate station and East 2nd & Woodland station are key network infrastructure nodes and do not offer any opportunities for relocation without massive and prohibitive IP and DP system modifications. The existing NPS 20 Coquitlam Gate IP pipeline route is very efficient in its routing length. A perfect straight line pipeline route between Coquitlam station and East 2nd & Woodland station would be 18,710 m in length; the existing NPS 20 pipeline length is 19,450 m in length.

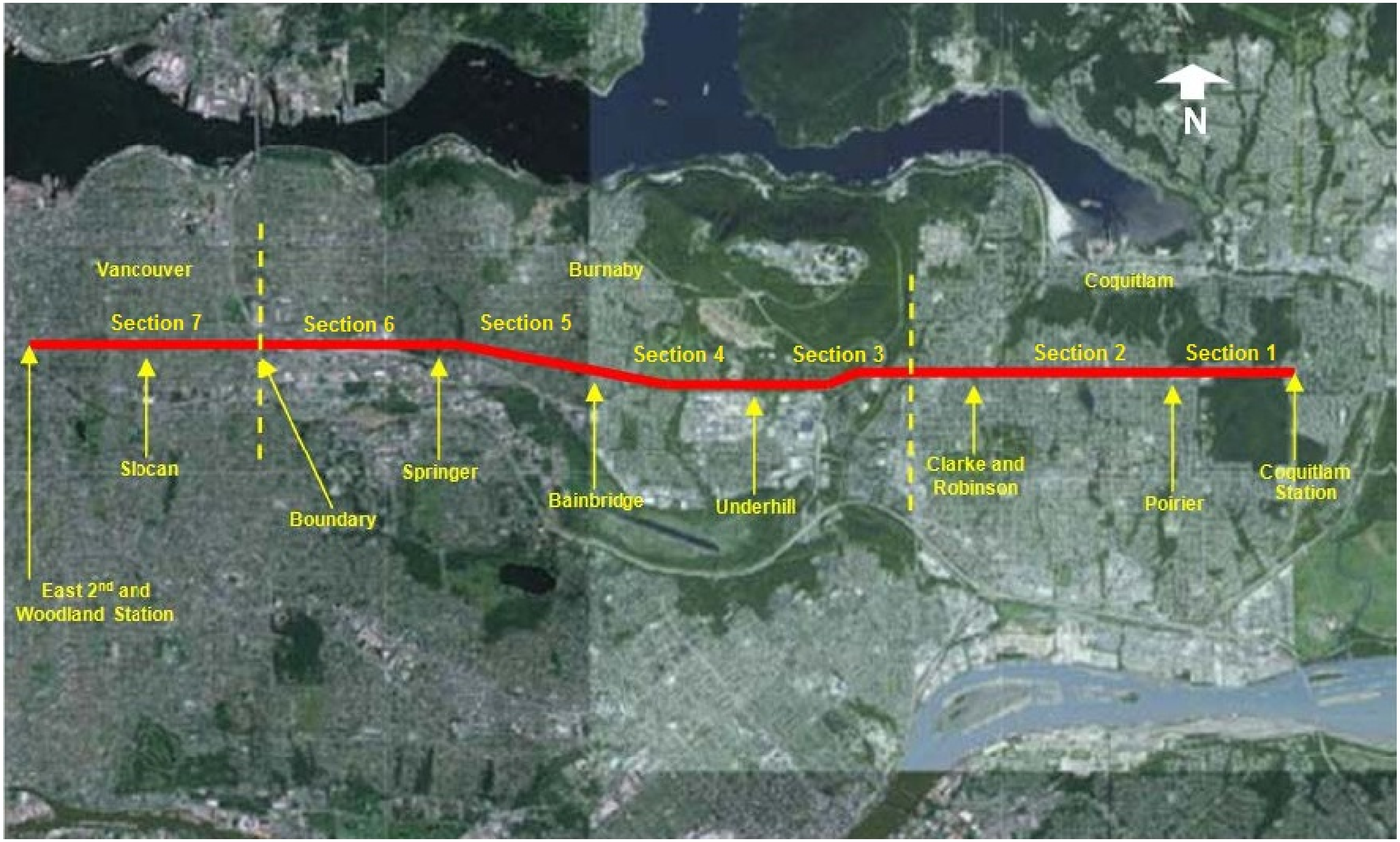
The selected corridor width extends on either side of the existing pipeline alignment to ensure all feasible route options are captured. The corridor width included potential route options around perceived routing obstacles along the existing NPS 20 Coquitlam Gate IP pipeline alignment on which the assessment corridor focussed. The information pertaining to key constraints including geological and above and below ground man-made infrastructure features was obtained from municipality and major stakeholder feedback, online sources, cartographic and engineering and environmental desktop constraint surveys. As a result, the key constraints and obstructions were identified and avoided as much as possible.

3.3.4.4 Route Options Considered

Following the establishment of a route corridor, various desktop studies including available online data, information gathered through liaison with major stakeholders and an onsite visual appraisal was used to identify feasible alternative route alignments within the selected route corridor.

Feasible route options depend on the identification of routing constraints and obstacles with the aim of avoidance where possible of areas of potential construction difficulty, safety hazards, whilst minimizing community, stakeholder and environmental impacts. The route options are determined through examination of aerial photography, mapping data, and onsite crossing point vantage surveys, environmental constraint studies and major crossing constraint assessments. To aid analysis of the route options identified, the routing corridor was subdivided into sections based on the separation distance between each of the lateral offtake points. This resulted in the following corridor sectionalization and the feasible routes determined within each corridor section. The feasible route options are illustrated on route option maps included in Appendix A-17. A summary map of the seven route option sections is presented in the following Figure 3-7 below.

Figure 3-7: Coquitlam Route Corridor Section Map



As part of the route option assessment process traffic analysis studies were conducted in Coquitlam, Burnaby and Vancouver to ensure any displaced traffic could be accommodated (see Appendices A-18-1 to A-18-6). A street tree assessment in the Woodland Area of Vancouver was also completed (see Appendix A-19) to assist in minimizing the impact on trees in that area.

3.3.4.4.1 SECTION 1: COMO LAKE AVENUE & MARINER WAY TO POIRIER STREET

This corridor section extends from Coquitlam station at Mariner Way & Como Lake Avenue to Poirier Street in Coquitlam. The following feasible route options are identified and illustrated on the route option map in section 4.1 of Appendix A-17.

- **Route Option 1:** From Como Lake Avenue at Mariner Way west to Como Lake Avenue at Poirier Street.
- **Route Option 2:** From Como Lake Avenue at Mariner Way west to Como Lake Avenue at Montrose Street, south on Montrose Street to Regan Avenue, and west on Regan Avenue to Poirier Street, then north on Poirier Street to Como Lake Avenue.

3.3.4.4.2 SECTION 2: POIRIER STREET TO ROBINSON STREET

This section extends from Poirier Street to Robinson Street in Coquitlam. The following feasible route options are identified and illustrated on the route option map in section 4.2 of Appendix A-17.

- **Route Option 1:** From Como Lake Avenue at Poirier Street west to Como Lake Avenue at Robinson Street.
- **Route Option 2:** From Como Lake Avenue at Poirier Street west to Como Lake Avenue at Schoolhouse Street, south on Schoolhouse Street to Grover Avenue, west on Grover Avenue to MacIntosh Street, south on MacIntosh Street to Regan Avenue, and west on Regan Avenue to Robinson Street.
- **Route Option 3:** From Como Lake Avenue at Poirier Street north along Poirier Street, Harbour Drive and Gatensbury Street to St. George Street, west on St. George Street to Clark Road, and south on Clarke Road to Robinson Street.

3.3.4.4.3 SECTION 3: ROBINSON STREET TO UNDERHILL AVENUE

This section extends from Robinson Street in Coquitlam to Underhill Avenue in Burnaby. The following feasible route options are identified and illustrated on the route option map in section 4.3 of Appendix A-17.

- **Route Option 1:** From Como Lake Avenue at Robinson Street west to Broadway at Gaglardi Way, south west along Gaglardi Way to Broadway, then west along Broadway to Broadway at Underhill Avenue.

- **Route Option 2:** From Como Lake Avenue south on Robinson Street west on Smith Avenue, south on Fairview Street, west on Cottonwood Avenue, south on Whiting Way, west on Perth Avenue, south on North Road, west on Cameron Street and East Lake Drive, and north on Underhill Ave to Broadway.
- **Route Option 3:** From Clarke Road at Robinson St west on Chapman Ave to North Rd and continuing west on Pipeline Trail crossing Gaglardi Way to west on Transmountain Trail and south on Underhill Ave to Como Lake Avenue.

3.3.4.4.4 SECTION 4: UNDERHILL AVENUE TO BAINBRIDGE AVENUE

This section extends from Underhill Avenue to Bainbridge Avenue in Burnaby. The following feasible route options are identified and illustrated on the route option map in section 4.4 of Appendix A-17.

- **Route Option 1:** From Broadway at Underhill Avenue to Broadway at Bainbridge Avenue along Broadway.
- **Route Option 2:** From Broadway at Underhill Avenue west along Broadway to lake City Way, south on Lake City Way and east on Lougheed Highway and north on Bainbridge Avenue to Broadway.
- **Route Option 3:** From Broadway at Underhill Avenue north on Underhill Avenue, west on Shellmont Street and Greystone Drive and then south on Philips and Duthie Avenue to Broadway at Bainbridge Avenue.

3.3.4.4.5 SECTION 5: BAINBRIDGE AVENUE TO SPRINGER AVENUE

This section extends from Bainbridge Avenue to Springer Avenue in Burnaby. The following feasible route options are identified and illustrated on the route option map in section 4.5 of Appendix A-17.

- **Route Option 1:** From Broadway at Bainbridge Avenue to Broadway at Springer Avenue along Broadway.
- **Route Option 2:** From Broadway south on Bainbridge Avenue, west on Lougheed Hwy, and north on Springer Avenue to Broadway.
- **Route Option 3:** From Broadway at Bainbridge Avenue, west on Broadway to Cliff Avenue, north on Cliff Avenue, west on Halifax Street, south on Holdom Avenue to Broadway, and west on Broadway to Springer Avenue.

3.3.4.4.6 SECTION 6: SPRINGER AVENUE TO BOUNDARY ROAD

This section extends from Springer Avenue to Boundary Road in Burnaby. The following feasible route options are identified and illustrated on the route option map in section 4.6 of Appendix A-17.

- **Route Option 1:** From Broadway at Springer Avenue, north on Springer Avenue, west on Halifax Street, west on Ridgelawn Drive and the lane north of Brentwood Town Center, west on Halifax Street, north west on Douglas Road and west on Graveley Street to Boundary Road.
- **Route Option 1a:** From Broadway at Springer Avenue, north on Springer Avenue, west on Halifax Street, west on Ridgelawn Drive and the lane north of Brentwood Town Center, north on Willingdon Avenue, west on Graveley Street to Boundary Road.
- **Route Option 2:** From Broadway at Springer Avenue, north on Springer Avenue, west on Halifax Street, west on Ridgelawn Drive, south on Beta Avenue, west on Dawson Street, north on Madison Avenue and Douglas Road, and west on Graveley Street to Boundary Road.
- **Route Option 3:** From Broadway at Springer Avenue, north on Springer Avenue, west on Halifax Street, north on Delta Avenue, west on Highlawn Drive and Midlawn Drive, south on Fairlawn Drive, west on Brentlawn Drive, Graveley Street to Boundary Road.
- **Route Option 3a:** From Broadway at Springer Avenue north on Springer Avenue, west on Halifax Street, north on Delta Avenue, west through Brentwood School, Brentwood Park and Midlawn Drive, south on Fairlawn Drive, west on Brentlawn Drive, Graveley Street to Boundary Road.

3.3.4.4.7 SECTION 7: BOUNDARY ROAD TO EAST 2ND AND WOODLAND DRIVE (TERMINUS)

This section extends from Boundary Road to East 2nd at Woodland Drive in Vancouver. The following feasible route options are identified and illustrated on the route option map in section 4.7 of Appendix A-17.

- **Route Option 1:** West on Graveley Street from Boundary Road, south to East 1st Avenue, west on East 1st Avenue to Woodland Drive, south on Woodland Drive to East 2nd Avenue.
- **Route Option 1a:** West on Graveley Street from Boundary Road, south to East 1st Avenue, west on East 1st Avenue to Kamloops Street, south on Kamloops, west on East 3rd Avenue to Woodland Drive.
- **Route Option 1b:** West on Graveley Street from Boundary Road, south to East 1st Avenue, west on East 1st Avenue to Slocan Street, south on Slocan, west on East 2nd Avenue to Woodland Drive.
- **Route Option 2:** West on Graveley Street from Boundary Road, south to East 1st Avenue, west on East 1st Avenue to Windermere Street, south on Windermere Street to East 3rd Avenue, west on East 3rd Avenue to east 2nd and Woodland Drive.
- **Route Option 3:** West on Graveley Street from Boundary Road, south to East 1st Avenue, west on East 1st Avenue to Windermere Street, north on Windermere Street, west on Graveley Street, south on Woodland Drive to East 2nd Avenue.

3.3.4.5 Assessment of Route Options

Following the identification of feasible route options, a series of selection criteria was established to evaluate and select a preferred route option. The assessment process comprised both quantitative and qualitative elements that analysed the relative impact of each route option with respect to the selection criteria.

3.3.4.5.1 EVALUATION CRITERIA

The key principles and considerations taken into account when evaluating the route options are listed and defined in Table 3-8:

Table 3-8: Pipeline Route Evaluation Criteria Definitions

Category 1: Community and Stakeholder Criteria	
Health and Safety	Considers the risks to the community, stakeholders, employees, and contractors during construction of the pipeline.
Socio-Economic	Considers the effect of the Project on the cultural values, economic well-being, and daily life for local stakeholders and citizens during construction of the pipeline.
Land Ownership and Use	Considers the number of landowners, existing and future plans for land usage and development, easement width, ability to acquire and maintain access rights necessary for construction and operation of the pipeline, the amount of land that is necessary for construction and the effect on local residents.
Category 2: Environmental Criteria	
Ecology	Considers the impact during construction of the pipeline to the environment including environmentally sensitive areas along the project site.
Cultural Heritage	Considers the impact during construction of the pipeline to known archaeology and culturally sensitive areas at the Project site.
Human Environment	Considers the impact of the Project to the human environment including noise, local emissions, aesthetics, nuisance factor and the short and long term visual effect that may be observed by residents and visitors in the project area.

Category 3: Technical Criteria	
Engineering	Considers the engineering and design effort to meet all statutory codes and regulations to result in the optimum pipeline system.
Construction	Considers the existing above and below ground constraints in terms of pipeline construction activities, pipe laying productivity, requirement for non-standard higher risk construction techniques and construction footprint.
Operation	Considers long term impacts including those to employees and contractors to maintain the pipeline integrity and complete maintenance and repairs. Also considers impacts to adjacent development and third party land ownership and use.
System Interface	Considers the challenges with interfacing the new pipeline and facilities into the existing gas distribution system infrastructure.
Adjacent Infrastructure	Considers the potential impacts on adjacent (existing and planned) facilities and buried/above ground utility infrastructure and risk to longevity and safe operation of the gas pipeline and facilities from adjacent infrastructure.
Natural Hazards	Considers the vulnerability during operation of the pipeline and built facilities to natural hazards including seismic impacts, ground contamination, tree root encroachment etc.
Category 4: Cost	
Cost	Considers the least cost project solution that meets community, environmental, and technical criteria while cognisant of impacts to the rate base.

3.3.4.5.2 DATA INPUT

FEI analyzed the route options against the Community and Stakeholder, Environmental and Technical evaluation criteria in terms of relative impact level. The evaluation criteria were given a weighted score as outlined in Table 3-9, in order to quantify the relative merits of each option. Data which informed the evaluation process was based on the FEI project team expert opinion and quantitative data from the routing and constructability analysis.

The rankings were prepared using criteria for evaluation that are generally consistent with those put forth with previous projects. Consistent with FEI's corporate culture of conducting business in a safe and environmentally responsible manner, a high weighting was afforded to those evaluation criteria associated with the health, safety and environment. In consideration of the urban nature of the pipeline route location, health and safety, community (socio-economic), environment (human), constructability and operational considerations are the main factors guiding the choice of pipeline routes and were given the highest weighting. Land ownership and use, engineering, and other factors, such as locations of intermediate offtake points relative to end users along the pipeline route were also considered.

FEI also prepared costs estimates for each route option and analyzed the relative cost impact of each route option. The construction costs and materials costs are the largest components of the overall cost estimate. The material costs are driven by the length of each route option. In addition to the length, the construction costs are also driven by the type of construction required to build the pipeline and the construction productivity achieved (i.e. time and resources to construct the pipeline route option). The cost estimate analysis considered five types of construction that will be required to install the pipeline through the different areas encountered in the urban environment:

1. Open areas of roadways with no utility crossings have the least construction constraints and therefore the highest productivity;
2. Areas of roadway with less frequent utility crossings are the next level of construction productivity;
3. Areas where only water service connections need to be crossed are the next productive;
4. Areas where the gas pipeline must be pulled into an excavated trench under a high density of utility connections which cross over the trench and cannot be disconnected are the next productive; and
5. Trenchless construction is the least productive.

Table 3-9: Pipeline Route Evaluation Weighting[20]

Criteria	Weighting	Evaluation
Community and Stakeholder Criteria Weighting		
Health and Safety	15	Assessment of the construction zone environment, nature of the planned construction activities and proximity to vulnerable entities.
Socio-Economic	15	Roadway usage impacts, number of intersections impacted, number of commercial accesses impacted etc.
Land Ownership and Use	5	Property directly impacted during construction and nature of impacts.
Sub-total:	***35***	
Environmental Criteria Weighting		
Ecology	5	Natural and environmentally sensitive areas impacted.
Cultural heritage	5	Culturally sensitive areas impacted.
Human Environment	15	Nature and proximity of sensitive receptors, residential accesses impeded etc.
Sub-total:	***25***	

[20] Please see the criteria definitions in Table 3-8.

Criteria	Weighting	Evaluation
Technical Considerations Weighting		
Engineering	5	Areas of construction difficulty requiring engineering solutions identified.
Construction	10	Type of construction required, pipe installation productivity quantified, length of pipeline and overall construction footprint etc.
Operation	10	Areas of potential operational difficulty identified.
System Interface	5	Complexity of interface and length of pipeline laterals quantified.
Adjacent infrastructure	5	Type of adjacent infrastructure, proximity and spacing, planned infrastructure, using wider road allowance to maximize proximity etc.
Natural Hazards	5	Preliminary evaluation of the surrounding natural and man-made environment and potential hazards along the route corridor.
Sub-total:	***40***	
Total	**100**	
Cost		Calculated cost of each route option based on length, construction type and productivity.

The pipeline will traverse Coquitlam, Burnaby and Vancouver municipalities. Each municipality provided utility data pertaining to water, storm and sanitary sewers and property boundaries. Some electrical data for street lighting and traffic controls were also provided. Due to the age of some older infrastructure, certain data relating to some water and sewer connections was missing. In addition, information was acquired from municipal on-line mapping databases which was used to assess the interaction between utilities including proximity, alignment and spacing. Municipal planning databases and planning documents were also consulted to determine proposed utility and roadway projects along the route corridor and assess potential conflicts. Data was also collected for other natural gas and electricity utilities. This data included above ground and buried electrical power infrastructure locations, centre line of power lines and individual power lines for higher voltage.

Base traffic modelling and preliminary traffic management reviews were completed for the route corridor through Coquitlam, Burnaby and Vancouver. Traffic impact assessments were also completed for Lougheed Highway and 1st Avenue as understanding the potential construction impacts to traffic in these areas is deemed critical at this stage of the routing process. During the detailed routing and design stages, further detailed traffic impact assessments will be completed as required in consultation with each municipality. The studies and findings are included in Appendix A-18-1 to A-18-6 in the following report structure:

- Base Traffic Modelling Report;
- Preliminary Traffic Management Review for Coquitlam, Burnaby and Vancouver;

- 1st Avenue Traffic Impact Assessment; and
- Lougheed Highway Traffic Impact Assessment.

A Street Tree Impact Assessment in the Woodlands area of Vancouver was also completed and is included Appendix A-19.

3.3.4.5.3 ROUTE OPTIONS SCORING AND RANKING

The route options identified in each route corridor section were scored, relative to each other, using the route evaluation criteria:

- Community and stakeholder impacts (Health and Safety, Socio-Economic, Land Ownership and Use);
- Environmental impacts (Ecology, Cultural, and Human); and
- Technical considerations (Engineering, Construction, Operations, System Interface, Adjacent Utilities, Natural Hazards).

A five point ranking score was used. A route option that would result in a very high negative impact for a given criteria scored least and was given a one (1). However, this score is designed for exceptional circumstances and, therefore, not normally applicable. A route option that would result in a high negative impact (poor choice) for a given criteria scored low and was given a two (2). A route option that would result in a moderate impact (good choice) for a given criteria scored average and was given a three (3). A route option that would result in a low impact (better choice) for a given criteria scored above average and was given a four (4). A route option that would result in very low impact (best choice) for a given criteria scored highest and was given a five (5). The scoring is outlined in Table 3-10.

Table 3-10: Route Evaluation Scoring

Score	Impact Evaluation
5	Very low (negligible) impact, best choice
4	Low impact, better choice
3	Moderate impact, good choice
2	High negative impact, poor choice
1	Very high negative, (unacceptable) impact, unviable choice

The cumulative weighted score for each route option was tabulated and the route options were then ranked. The alignment that scores highest will deliver a safe, environmentally acceptable and constructible pipeline route subject to cost and overall economic viability.

To ensure an economic route is selected, cost estimates were prepared for each route option. Cost is primarily driven by construction productivity and length. Therefore, reducing the length of pipeline to be constructed by selecting the shortest route option, for the same type of construction, minimizes total cost. However, the least cost route might not be the most suitable and, whilst cost is important to selecting an economic route, the selected route should strike a balance between least cost and minimum overall impact.

In addition to the non-financial route evaluation criteria, each route option was also ranked according to cost and the rankings compared. This helped to ensure that the selected preferred alignment meets the project's economic objectives, without compromising safety or the environment while minimizing the overall pipeline footprint and local impact on the communities that the pipeline passes through.

3.3.4.6 Conclusion – Selected Route Option

The overall objective of the routing process is to select the route option that minimizes potential impacts on the community, stakeholders and environment whilst meeting safety requirements, and identifying a constructible and economic route. The result is the preferred Coquitlam Gate IP pipeline route option which is presented here in summary and in detail in the Route selection Report (see Appendix A-17).

The routing process identified a route corridor between Coquitlam Gate station and East 2^{nd} & Woodland station. The corridor was sectionalized into seven sections based on the locations of lateral offtakes from the existing NPS 20 Coquitlam Gate IP pipeline. Twenty four route options (ranging from two to five for each section) within the corridor were evaluated. This approach helped to identify feasible alternatives while ensuring routing efficiency in interfacing with the existing IP network was maintained.

The selected preferred route aligns closely with the existing NPS 20 Coquitlam Gate IP pipeline. The relative position of the selected route to the existing IP pipeline is detailed in the Table 3-11.

Table 3-11: Coquitlam Gate IP Project Selected Pipeline Route Details

Section	Existing NPS 20 Coquitlam IP route	Proposed NPS 30 Coquitlam IP route	Relative Position
1	Como Lake Avenue	Como Lake Avenue	Parallel in same road
2	Como Lake Avenue	Como Lake Avenue	Parallel in same road
3	Como Lake Avenue and Broadway	Como Lake Avenue and Broadway	Parallel in same road
4	Broadway	Broadway	Parallel in same road
5	Broadway	Broadway	Parallel in same road
6	Springer Avenue, Halifax Street, Brentlawn Drive, Lane adjacent to Brentwood Town Centre, Halifax Street, 2^{nd} Avenue	Springer Avenue, Halifax Street, Highlawn Drive, Brentlawn Drive, Graveley Street	Parallel Street (offset one to two streets north)
7	East 2^{nd} Avenue	East 1^{st} Avenue	Parallel Street (offset one street north)

The routing analysis determined that for the initial 70 percent of the route corridor (between Como Lake Avenue & Mariner Way in Coquitlam and Broadway & Springer Avenue in Burnaby) the optimum alignment for the replacement NPS 30 Coquitlam IP pipeline is parallel to the existing NPS 20 IP pipeline and within the same roadway.

However, due to various constraints, none of the route options that were parallel to the existing NPS 20 IP pipeline and within the same roadway, between Broadway & Springer Avenue in Burnaby and East 2nd & Woodland in Vancouver, were selected as the preferred route option.

Section 1 to 5: Mariner Way (Coquitlam) to Springer Avenue (Burnaby):

The routing analysis determined that for the initial approximately 70 percent of the route corridor, between Como Lake Avenue & Mariner Way in Coquitlam and Broadway & Springer Avenue in Burnaby, the optimum alignment for the replacement NPS 30 Coquitlam IP pipeline is parallel to the existing NPS 20 IP pipeline within the same roadway. In arriving at this determination a number of alternatives were considered; however, due to the disjointed road layout north and south of the main Como Lake Avenue and Broadway traffic corridors none of the alternatives to the north or south of the main Como Lake Avenue and Broadway traffic corridors were viable to form an efficient contiguous parallel pipeline route within the assessment corridor.

Section 6: Springer Avenue to Boundary Road:

Between Broadway & Springer Avenue in Burnaby and the pipeline terminus at East 2nd Avenue & Woodland Drive in Vancouver, FEI was challenged to find an efficient route through this area during the routing process. Through Burnaby, in particular the Brentwood area of west Burnaby, light industrial, commercial and high and low density residential development, segmented and interspersed with an erratic road layout, resulted in a number of route options to consider. The existing NPS 20 Coquitlam Gate IP pipeline follows an efficient and direct alignment through this area. It is not possible to remove the existing pipeline or install another pipeline parallel in some of the same roads due to lack of space caused by the density of adjacent buried utilities.

Lougheed Highway was considered as a potential route option to avoid Brentwood Town Centre. As the pipeline construction would close 2 to 3 lanes in one direction during construction, a traffic impact assessment was completed for Lougheed Highway and is included in Appendix A-18-5. The analysis determined that the total closure of all west bound lanes did not appear feasible as there were no suitable continuous parallel routes for traffic to detour and the resulting traffic disruption would be prohibitively severe. The reduction of all lanes to single lanes in each direction would result in significant deterioration in traffic performance because there were no alternative routes with sufficient spare capacity to absorb the volume of traffic that would be displaced.

Preliminary consultation with the City of Burnaby also confirmed that extended lane closures on Lougheed Highway in the Brentwood area would likely not be permitted unless there were no other feasible route options. The main concern was the significant traffic impacts to the arterial street network in the area from pipeline construction work reducing traffic lanes; especially at the intersection of Willingdon Avenue & Lougheed Highway which is at capacity during peak hours. This could necessitate night work which would be highly disruptive to residents in the vicinity. Furthermore, any work along the arterial street system could also divert traffic onto local residential streets which would create undesirable longer term impacts if commuters find that shortcutting through local streets to be preferable. In addition to the potential traffic impacts, the presence of numerous buried utilities, Sky Train support structures, elevated guide way and Brentwood elevated Sky Train station would present significant construction constraints which further ruled this out as an option during the initial options screening process. See section 3.3.4.7 for further information on the potential Lougheed Highway route option.

The routing analysis determined that the optimum alignment for the replacement NPS 30 IP pipeline in the section is parallel to the existing pipeline but offset by one to two blocks north. The route option through Brentwood School and Brentwood Park is not viable due to the challenges associated with acquiring land and access rights or temporary construction workspace through the school property. Both route options adjacent to Brentwood Town Center ranked third and fourth out of the five route options analyzed.

A route option south of Lougheed Highway was considered but the additional length and larger construction footprint, higher cost and greater relative impacts in terms of health and safety and socio-economic, resulted in the lowest rank for this route option.

Section 7: Boundary Road to Woodland Drive:

Within the final section of route corridor through Vancouver from Boundary Road to East 2nd Avenue & Woodland Drive the road layout is conducive to straight contiguous route alignments. The feasible route options presented two significant constraints in the form of major short term traffic disruption (socio-economic impact) from construction on East 1st Avenue (see Appendix A-18-6) and major long term visual and aesthetic impacts (human environment) from potential tree canopy damage to a worst case scenario of complete removal of established trees along the avenues parallel to East 1st Avenue (see Appendix A-19). Preliminary traffic analysis indicated that prudent traffic management in the form of advanced warning, signage and lane closure would mitigate the traffic impacts and force traffic to temporarily use surplus capacity available on Hastings Street and Broadway. Thus, the routing analysis found East 1st Avenue to be the optimum alignment to construct the replacement NPS 30 Coquitlam IP pipeline.

3.3.4.7 Further Analysis of Lougheed Highway

Lougheed Highway, a major thoroughfare through the City of Burnaby, was identified and evaluated as a route option in corridor Sections 4 and 5. Due to traffic concerns, construction constraints and utility congestion, a route option through Section 6 was ruled out during the preliminary screening and not evaluated using FEI's Pipeline Route Evaluation Criteria.

The Lougheed Highway option in Section 4 was determined as not being viable due to excessive cost. The option on Lougheed Highway through Section 5 was less expensive and scored favourably against the preferred option on Broadway in most criteria except socio-economic. However, due to traffic disruption from multiple lane closure during construction, the Lougheed Highway option scored lower. This resulted in the Lougheed Highway option in Section 5 ranking second to the preferred Broadway option. As noted above, in Section 6 through the Brentwood area of Burnaby, Lougheed Highway was not considered as a route option due to significant anticipated traffic disruption, construction constraints and utility congestion.

As part of the ongoing consultation with the City of Burnaby, at a meeting between FEI and the City on November 27, 2014, the City suggested that FEI reconsider routing the NPS 30 Coquitlam Gate IP pipeline in the Brentwood area of Burnaby along Lougheed Highway.

The City of Burnaby indicated that traffic impacts along Lougheed Highway should not be considered as a major issue when assessing route feasibility. The City stated that if a mutually agreeable route alignment can be determined along Lougheed Highway in Section 5 and Section 6, between approximately Bainbridge Avenue and Boundary Road, the City would support the route.

As a result of the feedback from the City, FEI, in conjunction with the City of Burnaby and in consultation with other stakeholders such as Translink, B.C. Hydro and MoTI, will conduct further analysis to determine if a route option along Lougheed Highway in Section 5 and 6 is feasible. It is anticipated that this analysis will be completed by early 2015. If the analysis shows that a route option along Lougheed Highway is technical feasible, constructible, that traffic issues can be managed with reasonable efforts and that the route option scoring and cost is comparable to the current preferred route alignment options, FEI will submit a revised route evaluation for the sections of route corridor through Burnaby to the BCUC for consideration.

3.3.4.8 Design and Approval of Final Route [Detailed Design Phase]

The previously described routing process stages (stage 1 and 2) have been completed to bring the Project to the necessary stage of development for completion of an AACE Class 3 estimate. A preferred pipeline route option was selected resulting in a preliminary alignment. The detailed information which was gathered during completion of stage 1 and 2 of the routing process will form the basis of the next stage of the project design process which is final route design and approval.

The next and final stage of the routing process will involve detailed field investigation of the route and the environment in which the pipeline is to be constructed. Topographical, geotechnical, and soil resistivity field surveys will be carried out as necessary. Pipeline detailed engineering, geotechnical engineering, and environmental specialist review, with appropriate approvals from landowners and stakeholders will inform the selection of locations for accesses, station sites, cathodic protection sites and main line valve sites.

The geotechnical data collected will also inform the pipeline engineering detailed design. Any refinements to the selected preliminary route alignment and final locations for any facilities along the pipeline route will then be made. Any reroutes will be detailed and documented during detailed design.

Municipalities, stakeholders and any third parties will be contacted to obtain further details of any known or expected development or encroachment along the route, the location of underground obstructions, pipelines, services and structures and all other pertinent data.

Further consultations will be held during route finalization with major stakeholders impacted and any other appropriate organizations, landowners, third parties, etc.

Stakeholder, local jurisdiction and government approval will be obtained in accordance with statutory requirements.

The outcome of the final stage of the routing process will comprise a confirmed pipeline route and complete list of the affected landowners and stakeholders which will facilitate preparation of the construction scope of work and detailed construction execution plans.

3.3.5 Construction, Installation and Commissioning

It is intended that the Coquitlam Gate IP pipeline will be constructed by one pipeline construction contractor beginning in the summer season of 2018. The Project is expected to be completed with five separate construction crews due to congestion and proximity of obstacles impeding the work zones as a result of working in a built up urban area. Final cleanup will be completed as the construction progresses.

3.3.5.1 Methods of Construction

The construction of the NPS 30 IP pipeline from Coquitlam Gate to East 2nd & Woodland will traverse areas including arterial traffic routes, residential streets, green areas and streams which will present different construction challenges and constraints and require specific construction techniques. A number of urban and suburban standard pipeline construction techniques that will facilitate safe pipeline construction are outlined in the following sections.

3.3.5.1.1 STOVE PIPE METHOD

This technique involves installing one joint of pipe at a time. The welding, weld inspection and coating activities are all performed in the open trench. At the end of each day, after the pipe is installed, the trench is backfilled and/or covered with steel plates. This mode of pipeline construction is slow and tailored for areas where space is limited; it will be implemented along certain constrained sections of the Coquitlam Gate IP pipeline.

3.3.5.1.2 DRAG SECTION METHOD

This technique involves the trenching, installation and backfill of a prefabricated length of pipe containing several pipe joints pulled into the trench all in one day. At the end of each day, after the pipe is installed, the trench is backfilled and/or covered with steel plates or timber mats. This method and the 'in-street' method described in the next section will be the most common construction techniques utilized to construct the Coquitlam Gate IP pipeline.

3.3.5.1.3 IN STREET METHOD

In street construction is a combination of the two methods described above. Sufficient trench is excavated to allow the contractor to ensure that there will be no alignment changes required due to unknown obstacles. To provide the contractor with a starting point for the following day, a short section of trench is not backfilled but is covered with steel plates.

3.3.5.1.4 TYPICAL CROSS COUNTRY METHOD

Cross-country pipeline construction is typically accomplished with several distinct crews performing their specialized tasks traveling along a significant length of pipeline right-of-way. Each crew conducts the individual tasks of clearing, grading, stringing, bending, welding, lowering in, tying in, backfilling and cleaning up one at a time. The Coquitlam Gate IP pipeline construction will be executed to suit the particular requirements of the urban location by implementing the construction methods previously described. There are very limited sections which could be constructed using typical cross-country construction methods; however, reconfiguring the construction crews from the urban construction setup would be inefficient and cost prohibitive.

3.3.5.1.5 TRENCHLESS INSTALLATION

Sections of the Coquitlam IP pipeline will require installation requiring methods other than traditional open cut; three trenchless techniques have been identified for this requirement.

Horizontal Directional Drilling (HDD)

HDD is a trenchless crossing technique that is frequently selected where suitable subsurface geology exists. The HDD process involves drilling an opening, or small diameter bore, usually approximately 50 percent larger than the gas pipe, from one side of the crossing to the other side. The gas pipe is then inserted into the prepared opening. The HDD drilling process is executed from ground level at either side of the crossing area. Prior to setup of the HDD equipment some surface preparation (i.e. tree removal and grading) may be necessary. The HDD equipment is setback sufficiently from the edge of the trenchless zone so as to minimize any potential impact. The drill enters the ground at an angle (approximately 8 to 20 degrees) and extends from ground level adopting a curved "u-shape" profile beneath the ground and exits at ground level on the opposite side of the crossing. The completed bore (hole) is then cleaned and prepared for insertion of the gas pipeline. The new pipeline is then pulled into the prepared hole to complete the installation of the new gas pipeline.

The main disadvantage of HDD is construction risks presented by unforeseen underground conditions. While mitigated with sub-surface investigations, there always remains the possibility of significant drilling challenges with these unforeseen conditions. This is inherent with any underground construction.

Direct Pipe

Direct Pipe is a relatively new trenchless technology which has been assessed by the Company's pipeline engineering consultant as a potentially viable trenchless technique that, similar to HDD, could be used to install the new gas pipeline and reduce the risk presented by challenging sub-surface conditions. Direct Pipe is a hybrid of HDD and Microtunneling trenchless techniques.

In a Microtunnel project the first step would involve the construction of two shafts, one for jacking and one for receiving, aligned on each side of the crossing. The jacking shaft would be larger and deeper than the receiving shaft to accommodate the Microtunnel drill. The Microtunnel drill travels underground from the jacking shaft to the receiving shaft. Precast concrete sections, similar to large diameter concrete pipes, would be inserted behind the Microtunnel drilling machine as it advances through the ground. The Microtunnelling drill is located at the front of the pipe sections, or casings, and advanced through the ground by the hydraulic rams of the jacking station located in the launch shaft. The gas pipeline would then be threaded into the formed concrete lined tunnel.

Direct Pipe, similar to Microtunnelling utilizes a drill to excavate an underground opening or tunnel in which the new pipeline would be installed. However, unlike Microtunnelling, Direct Pipe does not require the construction of complicated and expensive jacking shafts; instead, the gas pipeline is attached directly to the back of the drill and is jacked forward by a surface mounted 'thruster' that grabs the pipeline and moves the pipe and drill forward together. Also, HDD and traditional Microtunnelling forms a bore, or opening, significantly larger in diameter than the gas pipeline, and the opening is stabilized during the drilling process by filling the annulus with a special fluid which balances the underground pressures and prevents collapse of the drilled hole. The Direct Pipe process forms a more efficient opening which is approximately 1 inch wider than the gas pipeline only. This minimizes the material that needs to be excavated and allows for a faster and more efficient trenchless drilling process.

Direct Pipe offers many of the same advantages afforded by the HDD and Microtunnelling in terms of avoiding larger open cut excavations and having less environmental impact. However, Direct Pipe has unique capabilities which facilitate the installation of large diameter pipeline with a smaller equipment layout footprint compared to HDD which make it particularly suited to urban locations. Direct Pipe is more sensitive to the length of the crossing and equipment sizing and selection than HDD; it can install approximately 1000m of NPS 30 to NPS 36 pipe, which is longer than that afforded by Microtunnelling, but HDD can install significantly more.

Trust Bore Pipe Jacking

Thrust boring, or auger boring, is a jack and bore drilling method, similar to microtunnelling, and typically used for installing steel pipe casing beneath an existing surface. Thrust boring is typically performed by placing an auger equipped with a cutting head inside a steel pipe. The auger is then attached to the rotation shaft of a thrust boring machine. Steel pipe casing, if used, is typically installed in 6 metre lengths so an entry pit at least 11 metres long is required to accommodate the combined length of the pipe and thrust boring machinery. The thrust boring machine is capable of drilling in a variety of ground conditions from sand through to reasonably hard rock making it a dependable and economical way of drilling. Auger boring can be effectively used to install pipe sections with a maximum combined length of approximately 70 metres.

An exit pit is usually dug on the opposite end of the work area although it is not always required.

Once the final section of casing has reached the exit pit the auger and cutting bit assembly is removed. After the thrust boring machinery has been detached from the steel pipe the carrier pipe or conduits are installed through the casing. Any remaining space within the casing is usually then filled with grout. Once the installed pipe work is connected to existing or new infrastructure both the entry and exit pits can be backfilled. Thrust boring can be used for:

- Railways;
- Roads; and
- Structures.

Thrust boring generally works best in soils that are located above the groundwater table. When groundwater is present during a boring operation, special dewatering measures must be taken to prevent the steel pipe casing from being flooded with water.

3.3.5.2 Construction Activities

The Coquitlam Gate IP pipeline construction is divided into three phases, each with its own activities: pre-construction, construction and post-construction.

3.3.5.2.1 PRE-CONSTRUCTION

Surveying

In addition to the surveying completed during the detailed design and routing various surveys will also be completed by the pipeline contractor prior to the commencement of onsite construction activities, these surveys will include:

- Geotechnical studies;
- Ground penetrating radar; and
- Underground line sweep by the pipeline contractor.

Pipe and Materials Stockpiling

Prior to construction start, the long lead materials including line pipe, induction bends and other large pipe fittings, large bore valves and other larger and more complex stations equipment will be received from various suppliers. These items are usually pre-ordered to ensure arrival prior to construction start and therefore mitigate construction delays. These materials will have to be stored in a manner to facilitate safe handling and avoid damage. In advance of material delivery, a specific storage and lay down area will be established by FEI in which to store materials prior to construction and also allow the contractor to take ownership of them and mobilize to site during pipeline construction.

Site Clearing and Preparation

There are some shorter sections of the route where the pipeline would be installed in non-paved areas of road allowance. In these areas, it may be necessary to remove small trees and brush prior to top soil removal and stockpiling for future reclamation.

3.3.5.2.2 CONSTRUCTION

Asphalt Handling

The existing road paving asphalt will have to be removed prior to trench excavation. The asphalt will have to be cut, loaded and transported to a disposal site. After construction restoration of all asphalt, roadways, sidewalks and pathways shall be in accordance with the standards and specification of each municipality.

Soil Handling

In areas where there is no asphalt, only topsoil, the top layer of organic material will be stripped and stored onsite. Sub soil, or the soil beneath the top layer of asphalt or organic material, will be excavated and removed off site for disposal. Any portions of the excavated materials that are found to be contaminated will be tested, properly contained and hauled to a disposal site. Engineered materials will be imported and used to backfill around the pipe as it is installed. Topsoil replacement and any re-vegetation shall be in accordance with municipal and environmental requirements.

Pipe Haul and Stringing

Individual lengths of pipe are brought in from stock pile sites and laid out end-to-end in suitable lengths to suit the site location and construction zone configuration.

Trenching

Once the position of the pipeline alignment is confirmed onsite and the centreline clearly marked, a trench is dug along the centre line and prepared for pipe installation. The equipment used to dig the trench varies depending on the type of soil.

Bending and Welding

Individual lengths of pipe are bent to fit the trench profile using a hydraulic bending machine. Welders join the pipes together using manual welding technologies. Welding shacks are placed over the joint to prevent the wind from affecting the weld. The welds are then inspected and certified by X-ray or ultrasonic methods.

Non-Destructive Testing

All welds will be non-destructively inspected for 100 percent of their circumferential length. Girth welds joining the pipe will be inspected using approved radiographic procedures prior to coating the weld joints. Quality assurance/quality control (QA/QC) records will be kept for each weld including welders qualification numbers and pipeline GPS coordinate locations for each weld.

Girth Weld Coating

The pipes arrive at the construction site pre-coated, however the welded joints must be coated at the site. The girth welds will be coated to prevent corrosion. The coating materials will be selected in accordance with FEI engineering standards to ensure the integrity of the coating is suitable to withstand handling during construction and also any contaminants that might come into contact with the pipeline in the future. The coating materials, methodology and procedures will be reviewed and approved by FEI and a qualified third party inspector will monitor the coating application and record the QA/QC.

Lowering-In

The welded pipeline is lowered into the trench using bulldozers with special cranes called side booms.

Installing valves and fittings

Valves and other fittings are installed after the pipeline is in the trench. The valves are used once the line is operational to shut off or isolate part of the pipeline.

Backfill and Padding

Backfilling of the pipeline trench will follow directly after the pipeline has been lowered in. At specific locations extra deep ditch and sand padding may be required. The backfill material will be compacted as it is installed to ensure the final trench construction is robust and will not settle after construction and as a result of surface loading from traffic or other activities; this is particularly important where the pipeline will be installed in road allowance.

3.3.5.2.3 POST CONSTRUCTION

Testing

After the pipeline has been welded, non-destructively tested and backfilled, as per CSA Z662-11 requirements, it will be filled with water and pressurized to a minimum of 1.4 times the maximum operating pressure for approximately 8 hours to test the pipe strength and ensure there are no leaks. The pressure test will be completed to FEI procedures and standards. The test water will be sourced from an adjacent potable source such as a water hydrant. Prior to disposal the water will be tested for suspended solids or contaminants and the test results will dictate the disposal method.

Drying

After successful completion of the pipeline pressure test and removal and disposal of the test water the pipeline will be dried to remove all remnants of the test water. Foam swabs, propelled by compressed air, will be passed through the pipeline to remove any water pooled at the low points; however, this method will leave a very thin layer of water on the inner pipe wall surface. To remove this moisture super dry air will be passed through the pipeline to absorb this water until a final dew point of -40 degrees Celsius is achieved. This means that the water remaining in the pipeline is less than the normal miniscule level of moisture in the natural gas the pipeline will ultimately transport.

Clean-Up and post-Construction Restoration

The final step is to reinstate the pipeline construction workspace and remove any temporary facilities.

3.3.5.3 Construction Plan and Execution

The construction work will entail taking temporary occupation of sections of roadway which will vary in length depending on the specific site configurations. FEI expects that a number of construction crews will build the pipeline between spring to autumn 2018. The work zones will likely then move in an east to west direction. At any one time, it is therefore expected that there will be a number of work zones in effect. Due to the nature of the work, the work zones will be occupied on a 24 hour basis with limited, if any, potential to restore traffic lanes during peak commuter travel times, however, FEI and the Company’s contractor will work with municipalities to manage traffic delays and inform local residents and businesses of temporary traffic delays.

3.3.5.4 Construction Management

3.3.5.4.1 NOISE CONTROL

The construction site is located close to businesses and residents in Coquitlam, Burnaby and Vancouver. Noise monitoring and control will comply with local guidelines. As outlined in the

Socio-Economic study (Appendix B-3), all construction activities will be carried out in compliance with municipal noise by-laws with respect to construction equipment usage. As stipulated in respective noise by-laws, no construction activities will occur on statutory holidays, Sundays or at night, without applicable by-law exemptions. General noise control measures will be implemented during construction, including but not limited to:

- Scheduling construction at noise-sensitive locations during non-sensitive times, to limit disruption to sensitive receptors, including wildlife;
- Maintaining equipment prior to use and ensuring equipment is in good working order;
- Using noise abatement equipment including mufflers that are in good working order;
- Turning off equipment when not in use;
- Enclosing noisy equipment and use noise barriers, where warranted, to limit the transmission of noise beyond the construction site;
- Locating stationary equipment, such as compressors and generators, away from noise receptors;
- Replacing or repairing equipment parts generating excessive noise;
- Informing truck drivers and mobile equipment operators that the use of engine retarder brakes will not be permitted in previously identified noise-sensitive locations;
- Maintaining access roads to limit vehicle noise and noise from vibration; and
- Advising municipalities and the community of construction periods.

3.3.5.4.2 SAFETY AND SECURITY

Construction site safety and security will be maintained during the course of the installation including all working and non-working hours inclusive of weekends. A comprehensive safety plan will be developed by the pipeline contractor in compliance with FEI standards, WorkSafeBC regulations, and the requirements of other impacted stakeholders.

3.3.5.4.3 TRAFFIC CONTROL

A major portion of the Coquitlam Gate IP pipeline will be constructed within road right of way which will result in associated impacts to traffic including transit, pedestrian and cycling modes. Since the alignment passes through Coquitlam, Burnaby and Vancouver as well as through the Highway 1 and 1st Avenue interchange areas that fall under the jurisdiction of the Ministry of Transportation and Infrastructure (MoTI). Highway Use Permits will need to be prepared and submitted to the respective road agencies for approval.

The construction work will entail taking temporary occupation of sections of road which will vary in length depending upon the specific site conditions and road configuration. FEI expects that a number of construction crews working concurrently will build the pipeline between spring to autumn 2018. The construction crews are expected to work concurrently in the following four areas:

- Como Lake Avenue route in Coquitlam and Burnaby;
- Broadway route in east Burnaby;
- Broadway route in west Burnaby; and
- East 1st Avenue in Vancouver.

The work zones in each area listed above will then move in an east to west direction. At any one time, it is therefore expected that there will be a number of work zones in effect. Due to the nature of the work, the work zones will be occupied on a 24 hour basis with limited, if any, potential to restore traffic lanes during peak commuter travel times. As outlined in the Socio-Economic Study, Traffic Management Plans will be prepared in consultation with the local municipalities to assist in maintaining traffic flow (including for transit and school buses). These will conform to municipal requirements for traffic management during construction. Where appropriate, efforts will be made to limit construction during peak traffic periods and to stage construction so as to reduce the impacted areas of the road rights-of-way. FEI and the Company's contractor will work with municipalities to manage traffic delays and inform local residences and businesses of temporary traffic delays as appropriate. Clean-up and restoration of roadways will be undertaken immediately upon completion of construction to support the commencement of regular traffic flow.

Designated parking areas may be established for construction crews to help manage parking congestion in residential areas. The contractor will be encouraged to transport construction staff to site from a central collection point via bus or other method to reduce the potential of parking issues and traffic congestion from arising.

FEI will also establish construction monitoring programs that include processes to promptly respond to construction complaints.

3.3.5.4.4 ENVIRONMENTAL MANAGEMENT

FEI plans to employ the services of an Environmental Inspector to be present during the construction of the pipeline. The Environmental Inspector will be familiar with pipeline construction techniques and applicable guidelines and standards.

As outlined in the Socio Economic Study, the Environmental Inspector will provide inspection of contractor environmental mitigation measures and respond to any environmental issues that may develop during the pipeline construction.

The primary objective of environmental inspection is to determine compliance with pertinent environmental legislation, regulations, industry standards, and project permit conditions, including any notification requirements or conditions set by the regulator.

The purpose of environmental monitoring during construction is to oversee the natural and social environments to determine any adverse effects and to verify that the construction site is returned to pre-construction conditions as soon as possible.

The purpose of post-construction monitoring is to ascertain the success of the restoration effort and mitigation measures.

3.3.6 Project Schedule

Conceptual engineering has been substantially completed, and construction is proposed to be undertaken, in 2018. Specific milestone activities are estimated in Table 3-12.

Table 3-12: Coquitlam Gate IP Project Schedule Milestones

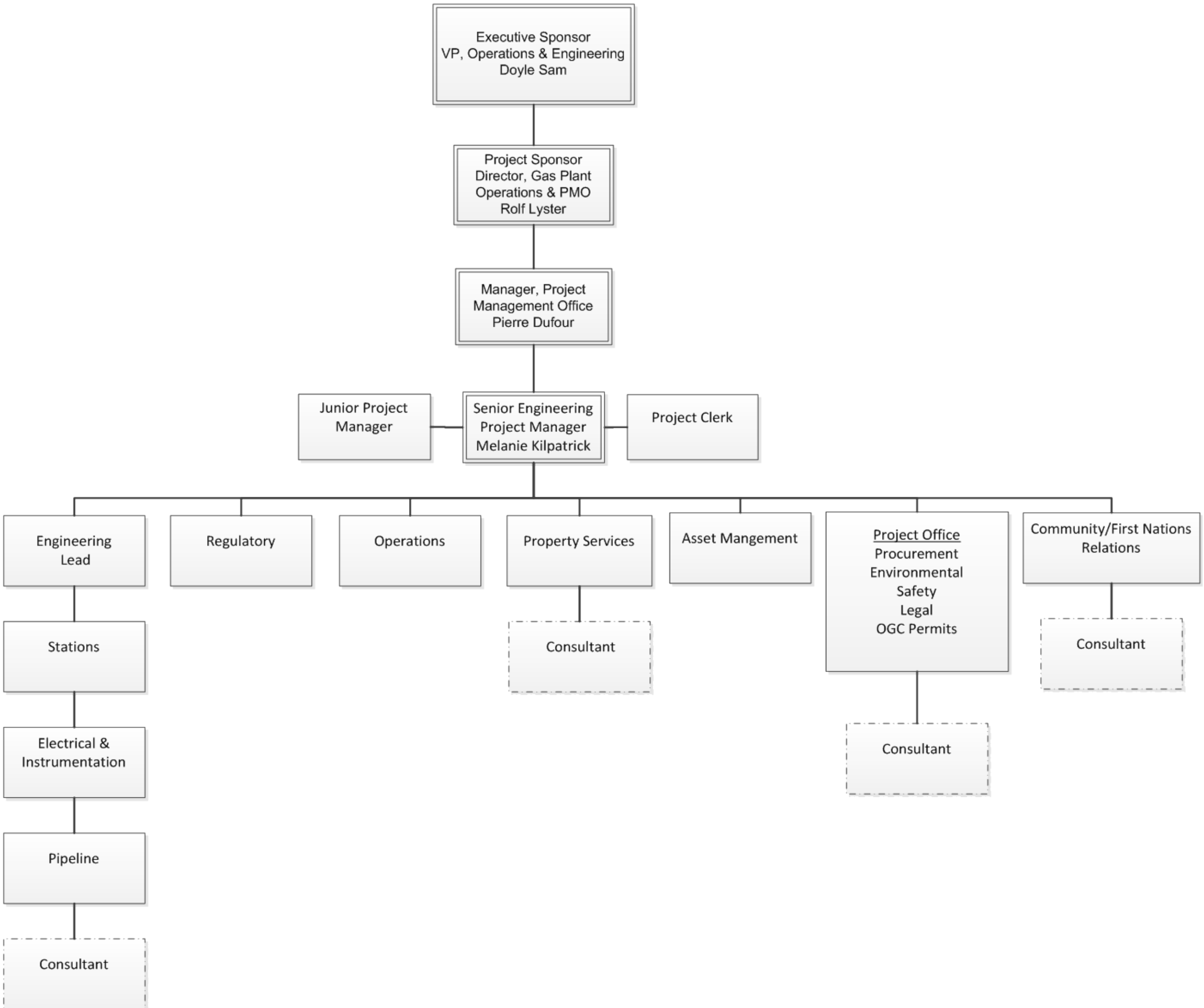
Activity	Date
Concept Development	Completed
CPCN Preparation	July 2013 – Dec. 2014
CPCN Filing	Dec. 2014
CPCN Approval	Q3 2015
Start Detailed Engineering, material specification and contract development	Oct. 2015
Materials Tendering and Orders Placed	Aug. 2016
Award Contractor	June 2017
Submit OGC Application	Sept. 2017
OGC Pipeline Approval	Jan. 2018
Materials Delivery	Mar. 2018
Construction Start	April 2018
In Service	Nov. 2018
Restoration	June 2019

A more detailed project schedule is attached as Appendix A-20-1.

3.3.7 Resource Requirements

A FEI Project Manager will manage the Project and implement the execution plan for each phase of the Project. Figure 3-8 outlines the functional organization chart for management of this Project.

Figure 3-8: Project Functional Organization Chart



The Executive Sponsor for the execution of the Project is Doyle Sam, P.Eng, Executive Vice-President, Operations and Engineering. The Project Manager is Melanie Kilpatrick, P.Eng. FEI will set up a project team that will include personnel from FEI and assistance from third parties with expertise in additional areas.

3.3.7.1 Design and Quality Control

The pipeline and facilities (stations) engineering will be undertaken by a specialized pipeline engineering consultant with the necessary experience and skills to complete the detailed routing and engineering for the Coquitlam Gate IP pipeline to the highest standards and to meet the Project objectives and requirements. Any specialized services required for environmental management, geotechnical investigation and analysis, and construction inspection will be contracted to individuals and companies possessing the demonstrated skills and experience to complete the work. These individuals and companies will ensure that public and worker safety, quality workmanship and environmental compliance are maintained throughout the Project.

FEI operating personnel will ensure all facilities conform to FEI standards and industry practices and are efficiently placed into operation upon completion of construction.

3.3.7.2 Construction Services

FEI will issue an Expression of Interest to identify potential prime construction contractors and pre-qualify selected contractors prior to the release of the tender documents. The construction will be subject to a competitive tender. At the close of the procurement process, FEI will select the final successful Contractor based on capability, safety, schedule and cost. FEI will select the bid that provides the best overall value.

3.3.7.3 Materials

FEI will arrange a competitive bid process to procure all materials and will award to the bidders that provide the best value.

3.3.8 Other Applications for Approval

3.3.8.1 BC Oil and Gas Commission

The construction and operation of the Project are governed by the Oil and Gas Activities Act and subject to the OGC regulation. The Project requires a Pipeline Application and numerous Facility Applications. FEI plans to file the Applications by Q3 - 2017. OGC Applications are a significant process with considerable technical scrutiny on the Project by the OGC. Public and First Nations consultation, land and access rights, archaeological requirements, design reviews, environmental permits/approvals for work in and around fish bearing streams are all components of the Applications. Each component must receive OGC approval prior to the start of construction, a significant regulatory process in addition to the CPCN approval by the BCUC. The current schedule assumes a four month approval period and it is expected that the OGC permits can be obtained to meet the Project schedule.

3.3.8.2 Municipal Permits

Pipeline construction within the City of Coquitlam, City of Burnaby and City of Vancouver will require municipal permits to ensure construction and installation meets municipal bylaws and guidelines. FEI is currently in the process of identifying all required municipal permits and will acquire them prior to commencing construction. The terms and conditions outlined in these permits and approvals will be adhered to during the construction of the project.

3.3.8.3 Ministry of Transportation and Infrastructure (MoTI) Permits

Highway 1 and 1st Avenue interchange areas under the jurisdiction of the Ministry of Transportation and Infrastructure (MoTI). Highway Use Permits will need to be prepared and submitted for approval

3.3.8.4 Other Pending or Anticipated Applications/Conditions

A qualified environmental professional working in conjunction with the Company's Environmental Affairs group will assist the Project in identifying permits/approvals required and in the development of an Environmental Protection Plan including an Environmental Emergency Preparedness and Response Plan for the Project.

The Project is not expected to require an Environmental Assessment Certificate pursuant to the British Columbia Environmental Assessment Act or require a screening under the Canadian Environmental Assessment Act, 2012.

Agency notifications, permits or approvals are anticipated under, but not limited to, the Fisheries Act, Species at Risk Act, Water Act, and Heritage Conservation Act.

As indicated above in section 3.3.3.6, the Coquitlam Gate IP project may involve the acquisition of new land and access rights for an approximate 70 metres of the proposed route alignment between Boundary Road and Highway No.1. FEI will finalize any new land and access right negotiations once approval of this Application is received.

3.3.9 Risk Analysis and Management

FEI conducted a risk assessment of the Project to determine the technical and non-technical risks associated with various interrelated LMSU projects including the Coquitlam Gate IP pipeline and the Fraser Gate IP pipeline projects (see Confidential Appendix A-21). The risk assessment identified and qualitatively analyzed the risk drivers.

The risk assessment adopted a formal approach and established a risk management framework which will be updated throughout the project lifecycle. The risk assessment outputs (risk register and treatment plan) contributed to the development of a project contingency amount which is summarized in section 3.4.1.4.3.

The risk assessment was initiated early in the Project scoping phase to ensure the project team had sufficient time to properly manage the risks. To ensure a robust risk assessment the following were referred to for guidance:

- AACE IR No. 62R-11 *"Risk Assessment: Identification and Qualitative Analysis"* (Rev. May 11, 2013); and
- AACE IR No. 63R-11 *"Risk Treatment"; and*

- International Standard, ISO 31000:2009, "*Risk Management- Principles and guidelines*".

3.3.9.1 Risk Identification Planning

FEI and WorleyParsons completed the project risk workshop in January 2014. The purpose as noted was to determine the technical and non-technical risks associated the projects. The workshop was held at the Company's offices and was facilitated by WorleyParsons risk specialists using proprietary process, and procedures specifically tailored to large linear construction projects.

The workshop was attended by the full project team comprising Subject Matter Experts (SMEs) in all main project disciplines.

The first stage of the workshop established the context for the workshop in terms of:

- Key project success factors;
- Major project stakeholders (internal and external); and
- Risk likelihood and consequence scales.

The project team identified key success factors, and major stakeholders. Prior to identifying the risks the Project team also determined appropriate categories and scales of likelihood and consequence (probability and impact) relevant to the project. The resulting information regarding success factors, stakeholders and the risk likelihood matrix is shown in the risk register document. This information facilitated qualitative analysis of the identified risks.

3.3.9.2 Risk Register and Action Plan

The risk workshop provided the discussion forum and opportunity for the multi-disciplinary project team to identify and discuss the project risks. The risk facilitator filtered risks from non-risk items (other issues and concerns etc.) and recorded risk descriptions from the SMEs.

The risk workshop identified a number of risks which are tabulated in the risk register document in Confidential Appendix A-21. In addition to recording the risks, any existing controls and safeguards to deal with the identified risks were also recorded. This information formed the basis of the risk analysis and risk treatment plan. Once the risks were identified, a qualitative analysis was completed to prioritize or rank the risks so that the project team could focus on treatments, action plans and recommendations. The first step involved the workshop participants applying a likelihood category and consequence to each risk identified which facilitated risk scoring, ranking and presentation in a risk map. The risk map identifies the basis of the risk score criteria which depends on the selected likelihood and consequence. The Risk Map showing the unmitigated risk ranking before treatment is included in the risk register.

The second step required the workshop participants to propose suitable measures to reduce the risk probability or consequence (risk treatment plans) for the risks that were ranked as extreme or high. To further support the treatment plan, the ability of the proposed measures to influence the risk score was also stated.

The results of the workshop show that none of the project risks were rated with a consequence rating of 5 (Catastrophic) together with a likelihood of A (Almost certain) or B (Likely). With the treatment plan, of the three project risks that were rated with a consequence rating of 5 and a likelihood of C (Moderate), two were reduced to a likelihood of D (unlikely) and one was reduced to consequence of 4 (Major) with a likelihood of D. As a result of the treatment plan, the number of risks rated as extreme was reduced from 11 to 4, and the number rated as high was reduced from 42 to 34. These details are presented in the full risk register in Confidential Appendix A-21.

3.4 *PROJECT COST ESTIMATE*

The Company prepared the Project cost estimate based on AACE Class 3 specifications, in accordance with the CPCN Guidelines. This section discusses:

- The Project cost estimate details; and
- The financial impacts.

3.4.1 Cost Estimate Details

The total capital cost of the Project, filed confidentially in Appendix E-3-1 is forecast to be $245.557 million in as spent dollars (including AFUDC of $12.572 million and abandonment/demolition costs of $4.172 million)[21].

The Coquitlam Gate IP Project is larger in scale and more complex in detail compared to projects typically undertaken by the Company. To provide the necessary expertise FEI engaged WorleyParsons to assist with project engineering and estimating services and develop the pipeline routing, design and construction planning to the necessary level of project definition as prescribed by the AACE recommended practices. This collaborative approach ensured the estimating, forecasting, control and other processes used for the Project represent industry best practice.

This section will address the following:

- Estimate preparation plan;
- Basis of Estimate;

[21] Of the total $245.557 million dollars, $228.813 million of capital and $12.455 million of AFUDC is charged to Gas Plant in Service; $4.172 million abandonment / demolition costs plus $0.117 million of AFUDC is charged to Negative Salvage Deferral Account. The total AFUDC charged to Gas Plant in Service and to Negative Salvage Deferral Account is $12.572 million.

- Cost estimate validation, and
- Project capital costs estimate details.

3.4.1.1 Estimate Preparation Plan

The Estimate Preparation Plan, attached in Confidential Appendix A-22, was prepared to provide an outline for the development of the pipeline capital cost. It details the responsibilities of WorleyParsons and FEI, and explains how the estimate was to be developed and reviewed for final delivery. This document details:

- The class and accuracy of the estimate;
- Estimate information;
- Estimate responsibility overview;
- Quality assurance; and
- Pipeline estimate.

The AACE Class 3 cost estimate is a quantity-based estimate, achieved through material take-offs (MTOs) provided by WorleyParsons pipeline and facilities engineering groups. These quantities serve as the foundation to which costs and labour rates were applied to develop the direct field costs. Allowances were added to account for any quantity and costing shortfalls to derive a total direct field costs value. Indirect costs, construction management along with a deliverables based engineering estimate were added to the cost estimate. Other components added to the cost estimate to arrive at a total installed capital cost estimate are spares, start-up and commissioning costs, and contingency.

Throughout the development of the Class 3 and Class 4 estimates prepared for the alternatives analysis in Table 3-2 the following AACE International Recommended Practices were referenced for guidance:

- AACE IR 10S-90 *"Cost Engineering Terminology"* Rev. Jan 14 1014;
- AACE IR 17R-97 *"Cost Estimate Classification System"* (Rev. November 29, 2011); and
- AACE IR 46R-11 *"Required Skills and Knowledge of Project Cost Estimating*" (Rev. January 16, 2013).

The capital cost estimate comprises input from FEI with regard to 'Owner's costs' and input from WorleyParsons regarding materials and construction. The respective inputs and the main cost components are detailed below.

FEI estimate responsibilities (owner costs) include:

- Project management;

- Engineering oversight;
- Permits and approvals;
- Property and right of way;
- Owners inspection:
    - Construction inspectors;
    - Non-destructive testing;
    - Pipeline caliper pig runs;
    - Pipeline ILI runs; and
- Pipeline tie-In and commissioning.

WorleyParsons estimate responsibilities include:

- Engineering, procurement and construction management services;
- Pipeline and stations indirect construction costs;
- Pipeline and stations direct construction costs;
- Construction sub-contracts; and
- Pipeline and stations materials costs.

3.4.1.2 Basis of Estimate

The Basis of Estimate is attached in Confidential Appendix A-23. This document details:

- Estimate background:
    - Purpose and objective of the estimate;
- Basis of estimate:
    - Extent of the estimate;
    - Key qualifications;
    - Assumptions of the cost estimate;
    - Exclusions of the cost estimate;
- Quantity derivation and cost basis:
    - Bulk material and plant equipment cost basis;
    - Labour rates;
    - Contractors indirects;
    - Estimate allowances;

- Other costs and indirects;
- Engineering, procurement and construction management services;
- Commissioning, handover and close out costs;
- Freight;
- Owners costs;
- Spare parts;
- Escalation assessment;
- Market forces assessment;
- Contingency; and
- Estimate options.

3.4.1.2.1 PIPELINE, FACILITIES AND CIVIL ESTIMATES

The pipeline, facilities (stations) and civil works AACE class 3 estimates are outlined in Confidential Appendices A-24, A-25, and A-26. These documents presents the following details with respect to estimate scope, procurement, estimate basis, construction and engineering assumptions and project execution risks:

- Direct and indirect costs;
- Estimate pricing;
- Construction costs:
  - Labour costs;
  - Direct labour;
  - Employer contributions;
  - Productivity;
  - Equipment (bills of materials); and
  - Other construction costs.
- Unit price items, engineering and materials costs;
- Owners costs;
- Work breakdown structure;
- Construction:
  - Detailed construction assumptions;
  - Watercourse crossings;
  - Materials;

- Mobilization and demobilization (equipment);
- Maintenance and services;
- Key sub-contracts; and
- Construction and productivity assumptions.

- Design assumptions, exclusions and exceptions:
  - Roads;
  - Utilities and foreign pipelines;
  - Watercourse;
  - Trenchless crossings;
  - Bedding and padding;
  - Buoyancy control;
  - Induction bends;
  - Pig Traps;
  - Valves; and
  - Routing.

3.4.1.3 Cost Estimate Validation

Cost estimate quality assurance (QA) and validation were completed as follows:

- A series of internal WorleyParsons reviews including peer reviews, squad checks, document quality checks, cold eye reviews and signed calculation cover sheets;
- Ongoing validation reviews involving both WorleyParsons and FEI team members throughout the estimate development process, to confirm that the estimate assumptions are still valid and that the procurement and construction strategies remain unchanged;
- Review of the construction methodology and Unit Price Items (UPIs) with FEI; and
- Senior management review by WorleyParsons.

3.4.1.4 Project Capital Cost Estimate Details

The cost estimate is based on an AACE Class 3 level of Project definition and design, and the individual cost elements consist of historical costs, non-binding quotations and projections. The expected accuracy of the cost estimate is +30 percent to -20 percent.

The cost estimate is based on the most recent studies and information currently available to FEI and an estimated in-service date for the Project of October, 2018. The estimate excludes GST but includes 7 percent PST on materials. FEI, as a GST registrant, is entitled to recover the

GST it pays on its taxable purchases. As such, the tax does not represent a net cost to the Company. 2014 market prices have been used for the material supply and construction contracts.

3.4.1.4.1 PROJECT EXECUTION COST ESTIMATE SUMMARY

The Project total installed cost, including direct and indirect costs, is presented in Confidential Appendix E-3-1. The estimated capital cost of $232.985 million plus actual AFUDC (As-spent) will be used as the control budget until replaced by more detailed estimates, and cost reports will conform at a minimum to the level of detail as set out in Confidential Appendix E-3-1[22]. LMIPSU Development and LMIPSU Application deferred costs will be tracked separately and will be reported on as well.

3.4.1.4.2 ESCALATION

An escalation rate of 4.5 percent per annum is used based on the ten year average escalation rates from Statistics Canada for industrial construction and line pipe from 2002 to 2012.

3.4.1.4.3 PROJECT CONTINGENCY AND MONTE CARLO ANALYSIS

FEI conducted a risk analysis of the project and has used the results of the analysis in determining the contingency.

The project contingency strategy used guidance from:

- AACE IR No. 40R-08 *"Contingency Estimating – General Principles"*;
- AACE IR No. 66R-11 *"Selecting Probability distribution Functions for Use in Cost and Schedule Risk Simulation Models"* (Rev. August 24, 2012); and
- WorleyParsons Guideline 002-000-PMW-266 (015251) PDP-0011 *"Cost Risk Analysis Guideline"* (Rev. March 6, 2013).

A two step approach was used to determine the Project contingency. The first step involved the use of predetermined guidelines to evaluate a single contingency value which was applied to the base cost estimate. This contingency was based on the expert opinion of the FEI and WorleyParsons engineering team combined with detailed knowledge of the project scope and risks. A flat percentage contingency was selected and applied to the estimate base cost (see Confidential Appendix A-23 – Basis of Estimate).

The second step involved a combined 'estimate risk assessment workshop' (different from the project risk workshop described in section 3.3.9.1) and 'quantitative risk analysis'. The workshop was led by a WorleyParsons facilitator and lead estimator. The quantitative risk analysis using the Monte Carlo method was conducted using @Risk software. The WorleyParsons Cost Risk Analysis report is attached in Confidential Appendix A-27. The Project

[22] Appendix E-3-1 includes an estimate of AFUDC of $12.572 million. Actual AFUDC will vary.

team SMEs identified risk ranges and probabilities regarding critical line items in the estimate. These risk ranges and probabilities informed the Monte Carlo simulation analysis to determine the range of the total Project estimate. This provided a distribution of probabilities (levels of confidence) which the Project estimate would not exceed. The P10/P90 risk range and the P50 value, results in an accuracy range of -16.3 percent /+ 21.7 percent which is in line with the AACE Class 3 Cost Estimate level of accuracy. The outcome of the first contingency step established a contingency amount. The second step confirmed the selection of a prudent contingency amount which was validated through selection of the Monte Carlo P50 value.

3.4.1.4.4 ESTIMATE EXCLUSIONS

The cost estimates exclude First Nations Capacity Funding and Accommodation Costs as no such costs are anticipated at this time.

4. FRASER GATE IP

4.1 *PROJECT JUSTIFICATION*

4.1.1 Project Description

The Fraser Gate IP pipeline Project involves the replacement of approximately 500 metres of NPS 30 pipeline operating at 1200 kPa and extending from Fraser Gate station at the 2700 block of East Kent Avenue to the corner of East Kent Avenue & Elliott Street. This pipeline will replace the section of the existing NPS 30 pipeline which does not meet FEI's seismic criteria of resistance to a 1:2475 year event.

4.1.2 Project Need

In this section, FEI will discuss the justification for the Fraser Gate IP Project:

4.1.2.1 Pipeline vulnerability to a 1:2475 Seismic Event

FEI's Integrity Management Program (IMP) provides a comprehensive and systematic approach to managing risks associated with hazards to the FEI pipeline system assets. Through implementation of the IMP, effective prevention, monitoring and mitigation activities for those hazards are implemented. The IMP is a management system, and therefore includes elements related to performance management and continual improvement.

One activity within the FEI IMP is Seismic Hazard Management. The objective of this activity is to maintain pressure integrity such that failure of identified assets will not pose a hazard to the public immediately following ground displacements during an earthquake with a 1:2475 return period. FEI undertakes periodic reviews of existing assets. These reviews are completed at a level of detail appropriate to the assessed hazard.

Given an identified seismic vulnerability on a segment of the Fraser Gate IP pipeline (i.e. vulnerable to failure due to less than 1:2475 year seismic induced ground movement), FEI engaged DGHC in 2012 to produce a Site Specific summary report to capture the level of pipeline vulnerability and to recommend necessary follow-on study or mitigation measures for the Fraser Gate IP pipeline. This Summary of Site-Specific Seismic Vulnerability Assessment of the Fraser Gate IP pipeline report, dated Feb 2013, is attached as Appendix A-4.

CSA Z662, Oil and Gas Pipeline Systems, the governing technical code for the subject pipeline, requires that anticipated seismic loading be part of the design criteria for any oil or gas pipeline. In accordance with this code and consistent with industry practice, the FEI seismic design guideline DES-09-02, which is attached as Appendix A-28, requires an assessment of potential seismic risks and that the pipeline design be sufficient to withstand anticipated seismic loadings for a seismic event with a return period of 1:2475 years (2.5 percent probability of exceedance over 50 years) [23]. FEI's seismic criteria aligns with both the 2005 Building Code of Canada and FEI's understanding of the minimum criteria applied by other critical utility infrastructure operators in the Lower Mainland.

4.1.2.2 Consequences of Failure of the Fraser Gate IP Pipeline (Safety)

The safety concern associated with the identified seismic vulnerability of the Fraser Gate IP pipeline is influenced by factors such as the predicted pipeline failure mode and population density. A widely referenced methodology for estimating the threat within the immediate vicinity of a pipeline failure location is outlined in the following paper: "A Model for Sizing High Consequence Areas Associated with Natural Gas Pipelines, Gas Research Institute (GRI), 2000". This model estimates a hazard area radius of 83 metres for this pipeline.

The Fraser Gate IP pipeline is located in an urban area. A review of the East Kent Avenue in the vicinity of the pipeline shows that there are residential dwellings along the north side of the roadway. A full-bore rupture of the pipeline resulting from a seismic event could therefore result in significant public safety issues.

4.1.2.3 Consequences of Failure of the Fraser Gate IP Pipeline (Economic)

In addition to the safety concern noted above, the potential consequence of large-scale service impacts to up to 171,000 customers and the economic loss resulting from failure of the Fraser Gate IP pipeline due to a seismic event is an additional driver for this Project.

FEI estimates that the economic impact (see Appendix A-5) to the general public, customers and the Company of a failure of the Fraser Gate IP pipeline could be in excess of $320 million.

The Fraser Gate NPS 30 IP pipeline is the primary source of gas supply to Vancouver, Burnaby and the North Shore, serving approximately 171,000 customers. The pipeline section that relates to the Fraser Gate IP Project, extends from Fraser Gate at the 2700 Block of East Kent Avenue towards the corner of East Kent Avenue and Elliott Street. This segment of the pipeline was constructed and commissioned in 1958. It is part of FEI's System which operates at 1200 kPa and connects with the Coquitlam Gate to 2nd & Woodland pipeline at 2nd & Woodland in Vancouver. An overview of the FEI Coastal Transmission System in the Lower Mainland and a geographical representation of the Lower Mainland IP and TP systems are shown in Figures 3-1 and 3-2. Natural gas is received from the Tilbury valve assembly and continues to flow north through Fraser Gate station to the 2nd and Woodland station to end points at Vancouver, Burnaby and the North Shore.

Rapid Loss of Natural Gas Supply to Customers

At the present time, the failure of the non-redundant Fraser Gate IP pipeline due to a seismic event can lead to the complete shutdown of the pipeline. If the Fraser Gate IP pipeline is

[23] This criteria, which is documented in FEI's design standard DES-09-02 and included as Appendix A-28, is consistent with the design and construction of the two pipelines under the South Fraser River which was approved through BCUC order C-2-09 in 2009.

shutdown, customers downstream of Fraser Gate station could suffer a very rapid loss of natural gas supply. As an example, it is estimated that should a complete outage of gas flow occur there is less than one hour of line pack during a peak winter day.

Critical Customer Impact - Economic and Financial

An outage of the Fraser Gate IP pipeline due to a seismic event could result in loss of service to up to 171,000 customers for a prolonged period of time.

As earlier described in section 3.1.3.3, an economic impact study shows that a gas supply interruption as a result of an unplanned failure of the Fraser Gate IP pipeline could be in the order of three weeks and the economic impact to the general public, customers and the Company could be in excess of $320 million (see Appendix A-5, Page 5, Table ES-2a "Reference Case "As Is" Economic Consequences", line item IP-Segment 1).

4.1.2.4 Operational Flexibility and System Resiliency

The Fraser Gate IP pipeline and the Coquitlam Gate IP pipeline are identified as single point of failure pipelines because if either pipeline fails, there is no alternate supply or redundant pipeline to serve all of the customers currently served by the other pipeline segment. For more details on operational flexibility and system resiliency see section 3.1.2.3.

4.1.3 Studies

FEI engaged a number of third party experts and internal staff to conduct studies and reviews to assess the need and justification for the Fraser Gate IP Project. A list of the studies and assessments, which included a seismic study, a loss of supply assessment, and an economic consequence of failure study, are summarized below.

4.1.3.1 Seismic Study Fraser Gate Station IP

FEI retained D.G. Honegger Consulting to conduct a Site-Specific Seismic Vulnerability Assessment of the Fraser gate IP pipeline in 2012. The study identified the section of pipeline from Fraser Gate station along East Kent Avenue as being susceptible to a seismic event, assessed the level of pipeline vulnerability and recommended mitigation measures for the Fraser Gate IP pipeline. The Site-Specific Seismic Vulnerability Assessment of the Fraser Gate IP pipeline report, dated February 2013, is attached as Appendix A-4. A summary of the findings is listed below:

> *"Ground displacement hazards estimated by Golder for a return period of 2,475 years for the portion of the pipeline along East Kent Avenue South include lateral spread displacement of 1.6 m toward the river and settlement of 0.03 m. The corresponding lateral spread displacement for a return period of 475 years was estimated to be 0.3 m."* (See Appendix A-4, page 2)

"The allowable compression strain for pressure integrity is 1.8% based upon the relationship between the ratio of wall thickness to pipe diameter in PRCI guidelines (Honegger and Nyman, 2004). Based upon these strain limits, the horizontal displacement capacity is approximately 0.5 m, which is greater than the 475-year displacement estimate but well below the 2,475-year displacement estimate of 1.6 m." (See Appendix A-4, page 3)

4.1.3.2 Loss of Supply Assessment

As a means to determine the potential number of customers impacted by the loss of specific pipeline segments, FEI undertook a study utilizing hydraulic models from its System Capacity Planning group. It shows that loss of service to the Fraser Gate IP system could impact up to 171,000 customers (see Appendix A-9).

4.1.3.3 Economic Consequence of Failure Study

FEI retained HJ Ruitenbeek Resource Consulting Limited in 2014 to undertake an economic consequence analysis of hypothetical natural gas interruptions in the Lower Mainland. The study shows that the economic impact on the general public, customers and the Company caused by a failure on certain segments of the Company's TP and IP pipelines that interrupted service to the customers served by the Fraser Gate IP would be approximately $320 million (see Appendix A-5, Page 5, Table ES-2a "Reference Case As Is Economic Consequence", line item IP-Segment 1).

4.1.4 Technical Feasibility

The Project's technical feasibility is borne out through the engineering, construction and operational details presented in the following sections. FEI retained WorleyParsons Canada Services Ltd. (WorleyParsons), an experienced pipeline engineering firm, to undertake the pipeline engineering and constructability analysis for this Project.

In section 4.2, FEI evaluates project alternatives and selects the alternative that best meets the project objectives, including constructability, operational, and safety factors.

In section 4.3, FEI examines the technical requirements of the Project. Various route options are also evaluated and a preferred option is selected based on technical and non-technical criteria. This approach ensures that the preferred project alternative and preferred route alignment are technically feasible.

4.1.5 Conclusion of Justification

The Fraser Gate IP pipeline is a major natural gas supply source to Vancouver, Burnaby and the North Shore, serving approximately 171,000 customers.

The Fraser Gate IP Project is required since the pipeline has been assessed as being vulnerable to failure due to a less than 1:2475 year seismic-induced ground movement event.

The Fraser Gate IP pipeline is located in an urban area. A review of East Kent Avenue in the vicinity of the pipeline shows that there are residential dwellings along the north side of the roadway. Using the "Model for Sizing High Consequence Areas Associated with Natural Gas Pipelines", Gas Research Institute (GRI) 2000, an estimated hazard area radius of 83 metres for this pipeline was calculated. A full-bore rupture of the pipeline resulting from a seismic event could therefore result in significant public safety issues.

If a failure occurs on the Fraser Gate IP pipeline due to a seismic event, it is possible that up to 171,000 customers served by that pipeline system could be impacted, and potentially experience a prolonged period of gas service outage as described in section 4.1.2.3 above. The economic impact to the general public, customers and the Company due to a loss of service to the Fraser Gate IP pipeline could be in excess of $320 million.

The risk posed by the Fraser Gate IP pipeline is driven by the seismic concerns and by the Consequence-of-Failure factors including potential safety issues, possible complete shutdown of the pipeline for an extended repair period and the impact to service to customers in Vancouver, Burnaby, and the North Shore. FEI considers that the magnitude of potential safety issues, service interruption, business and economic losses, warrants mitigation. As such, the Company is proposing the Fraser Gate IP Project to mitigate the potential safety risk and economic consequences associated with failure of the Fraser Gate IP pipeline between the Fraser Gate station to East Kent & Elliot due to a seismic induced earth movement event.

FEI assessments conclude that a pipeline constructed in accordance with FEI's Seismic standard would mitigate the identified seismic vulnerability and potential consequences.

4.2 *ALTERNATIVE SOLUTIONS*

This section will describe:

- the objectives and requirements that the Company will meet with the alternatives considered;
- the alternatives considered and evaluated by the Company; and
- the preferred alternative selected by the Company.

4.2.1 Objectives and Requirements

As noted above, the Fraser Gate IP pipeline has been identified as vulnerable to failure due to a less than 1:2475 year seismic-induced ground movement. Thus, the objectives of any alternative considered are to:

- Achieve FEI's seismic criteria of resistance to a 1:2475 year event;
- Mitigate the safety risk posed by the pipeline as a result of seismic vulnerability;
- Mitigate the economic risk posed by the pipeline as a result of seismic vulnerability; and
- Address constructability, operational and safety factors, such as routing constraints, proximity to adjacent utilities and appropriate construction techniques, limiting interruption of flow of gas during construction and commissioning and allowing sufficient space to work around existing piping and components.

For each alternative discussed below, the Company considered the advantages and disadvantages of the alternative in light of the above objectives and requirements. While both alternatives were possible, one of them did not meet key objectives therefore the Company considered this alternative to be not feasible. Seismic resistance to a 1:2475 year event is a requirement for continued safe, reliable and essential service to customers.

4.2.2 Alternatives Description

To achieve the objectives and requirements outlined above, FEI considered two alternatives, and selected the upgrade of a 500 metre segment of NPS 30 pipe, installed on the south side of East Kent Avenue as the preferred alternative, based on an evaluation of both financial and non-financial factors. The following alternatives were considered to be the only available alternatives, and are discussed below:

- Alternative 1 - Do nothing; and
- Alternative 2 – Existing pipeline abandonment, and upgraded replacement. Replace a segment of NPS 30 pipeline from Fraser Gate to the corner of East Kent Avenue & Elliott Street with a higher grade of steel and thicker pipe wall to mitigate the seismic risk. This is the only alternative that will provide the required seismic resistance.

4.2.2.1 Alternative 1 - Do Nothing

This alternative will prolong the risk associated with the pipeline's vulnerability to failure due to less than 1:2475 year seismic-induced ground movement. The alternative does not meet any of the objectives of the project, thus the "do nothing" approach or maintaining the status quo is not acceptable.

4.2.2.2 Alternative 2 - Pipeline Replacement

Project Capital Cost Estimate $14.855 million (Class 3 - 2014 dollars, excluding AFUDC)[24].

[24] The As-spent cost excluding AFUDC is $17.231 million; AFUDC is forecast to be $0.876 million, for a total capital cost of $18.107 million.

This alternative involves the replacement of the existing Fraser Gate IP pipeline with a new NPS 30 IP pipeline from the outlet of Fraser Gate station to the corner of East Kent Avenue & Elliott Street (approximately 500 m in length). The pipe design, material selection, construction and testing will ensure the upgraded pipeline will meet the Company's seismic design objective to maintain pressure integrity and not pose a hazard to the public following ground displacements during a major earthquake. This alternative was identified in the DGHC Site-Specific Report (see Appendix A-4) for improving the pipeline response to a seismic event to comply with the Company's seismic standard.

While the only technically viable alternative that meets the Project objectives is a pipeline replacement, as part of the analysis, several route options were investigated. The route selection process is outlined in section 4.3.4.

Advantages:

- This alternative meets the Company's seismic standard requirements;
- Would significantly reduce safety risks to the public, property and FEI personnel as a result of a less than 1:2475 year seismic event;
- Would minimize the risk of supply interruption and economic consequences to customers served by the Fraser Gate IP pipeline as a result of a less than 1:2475 year seismic event; and
- The route optimizes constructability, operational and safety factors.

Disadvantages:

- Higher costs than Alternative 1 - Do Nothing; and
- Construction impacts associated with urban pipeline installation projects.

4.2.3 Alternative Evaluations

The company conducted a non-financial evaluation of the alternatives discussed above and a financial evaluation of the alternative identified as meeting the Company's Objectives and Requirements. A Class 3 estimate was prepared for the preferred alternative.

4.2.3.1 Non-Financial Considerations

The Company considered the advantages and disadvantages of each alternative based on non-financial factors noted above. The following table summarizes each alternative considering the objectives and requirements discussed in section 4.2.1. The main criteria for the evaluation and for the summary are the Company's objectives to build a pipeline that will address concerns identified in section 4.1 of the Application, such as removing from service the section of pipeline that is vulnerable to a 1:2475 year seismic induced ground movement event, mitigating the safety and economic risk posed by the pipeline, and satisfying current codes, standards and operating requirements. Table 4-1 provides a Non-Financial comparison of the alternatives considered.

Table 4-1: Fraser Gate IP Project Non-Financial Comparison

Pipeline Solution		Objectives/Requirements				Overall Assessment
		Achieve Seismic Criteria [1]	Mitigate the Safety Risk [2]	Mitigate the Economic Risk[3]	Constructability, Operation and Safety[4]	
1	Do Nothing	Does not meet Objective	Does not meet Objective	Does not meet Objective	Not Applicable	Not Feasible
2	Pipeline Replacement	Meets Objective	Meets Objective	Meets Objective	Meets Objective	Feasible

Notes:

(1) Achieve FEI's seismic criteria of resistance to a 1:2475 year event.

(2) Mitigate the safety risk posed by the pipeline as a result of seismic issues.

(3) Mitigate the economic risk posed by the pipeline as a result of seismic issues.

(4) Addresses constructability, operational and safety factors, such as routing constraints, proximity to adjacent utilities and appropriate construction techniques, limiting interruption of flow of gas during construction and commissioning and allowing sufficient space to work around existing piping and components.

4.2.3.2 Financial Considerations

The only technically viable alternative that meets the Project objectives is a pipeline replacement however, as part of the analysis, three route options were investigated. The preferred route option that was selected based on technical and capital cost considerations is Route Option 1.

Route Option 1 is located within East Kent Avenue South from Fraser Gate station to Elliott Street (south of the existing rail lines). This route option has the highest route ranking and the lowest capital cost estimate. The route selection process is outlined in section 4.3.4.

The financial evaluation of the preferred alternative consists of the following components, and its impact on the levelized rates and incremental cost of service:

- Capital costs, estimated by an independent engineering firm; and
- Present value of operating costs.

FEI evaluated the incremental cost of service, cash flow and rate impacts associated with Alternative 2 – Route Option 1 over a 60 year period. The 60 year time horizon was chosen to be consistent with the assumed useful life of the assets. The incremental cost of service estimates are based on FEI's currently approved capital structure, cost of capital and tax treatment.

The following table provides a summary of the financial evaluation conducted.

Table 4-2: Fraser Gate IP Project Financial Analysis

	Alternative 2 – Route Option 1 – East Kent Ave South
Estimate Accuracy	Class 3
Total Direct Capital Cost excl. AFUDC (2014 $millions)	14.855
Total Direct Capital Cost excl. AFUDC (As-spent ($millions)	17.231
AFUDC (as spent ($millions)	0.876
Total As-spent ($millions)	18.107
Annual Gross O&M (2014 $millions)	0.001
Levelized Rate Impact $ / GJ – 60 Yr.	0.007
PV Incremental Cost of Service – 60 Yr. ($millions)	21.654

4.2.4 Conclusion – Preferred Alternative

Through the financial and non-financial evaluation, the Company has determined that the upgrade of a segment of NPS 30 pipeline from Fraser Gate station to the corner of East Kent Avenue & Elliott Street (Alternative 2- Route Option 1) is the preferred alternative. This alternative will remove from service the section of pipeline that is vulnerable to a 1:2475 year seismic induced earth movement event. It will reduce the probability of pipeline failure which, in turn, will reduce the safety risk, the loss of gas supply risk and economic risk to approximately 171,000 customers. The preferred alternative will satisfy all the objectives and requirements outlined in section 4.2.1 above.

4.3 *PROJECT DESCRIPTION*

In this section, FEI will describe the Fraser Gate IP Project component of the proposed Project in more detail, including information on project components, project schedule, resources requirement, and project risks and management.

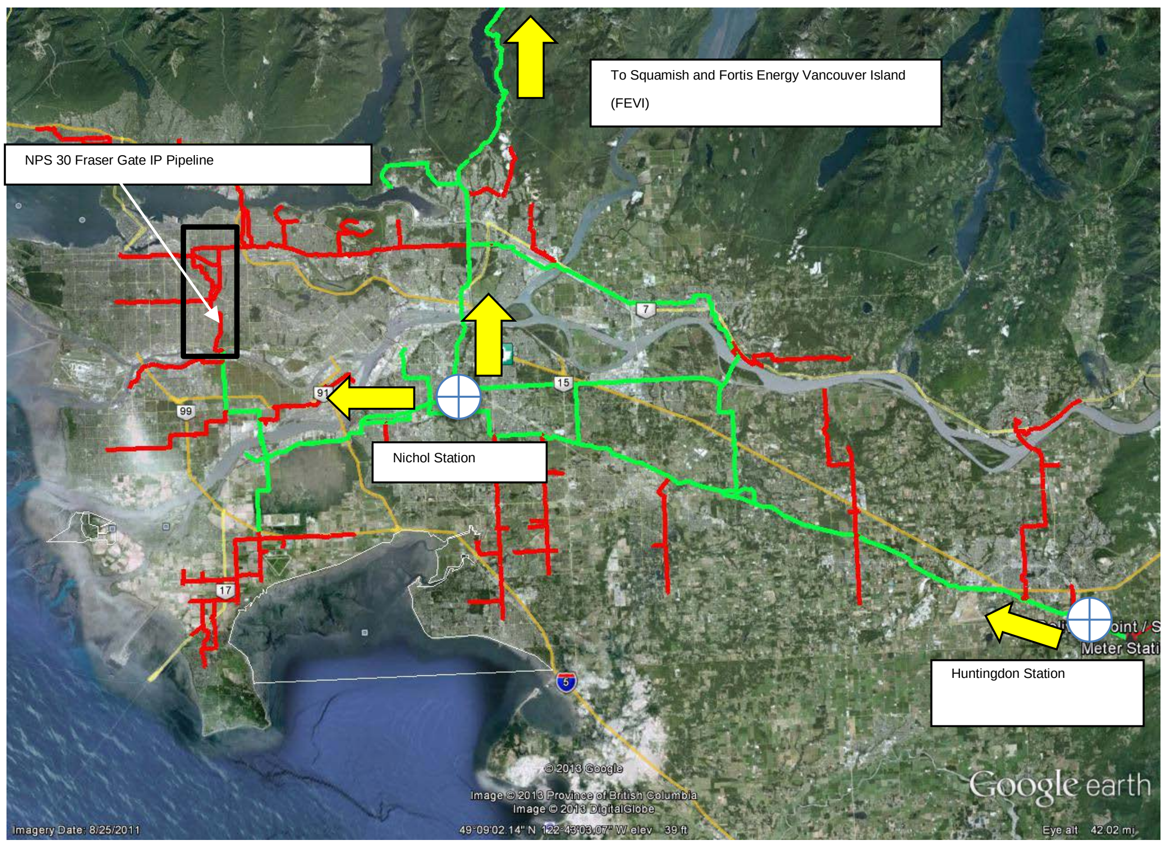
4.3.1 Introduction

The FEI system, which supplies natural gas to the Lower Mainland and Vancouver Island, is presented in Figure 4-3. It comprises TP and IP pipelines which are illustrated as green and red for clarity. The TP pipelines have dedicated Right of Way (ROW) easements which are located within shared utility corridors, and the IP pipelines, which operate at lower pressure, are generally located within road allowances.

The Coquitlam Gate and Fraser Gate stations are the two interface points between the TP pipeline network and the lower pressure IP pipeline network which distributes gas throughout Metro Vancouver.

The existing NPS 30 Fraser Gate IP pipeline, which is vulnerable to a seismic event as previously described, is also highlighted in Figure 4-1. This pipeline extends from Fraser Gate station (located on East Kent Avenue in Vancouver), to East 2nd & Woodland station in Vancouver. The pipeline length in question extends from the outlet of Fraser Gate along East Kent Avenue. This component of the Project will involve upgrading a section of the existing NPS 30 Fraser Gate IP pipeline which operates at 1200 kPa with a new NPS 30 pipe (strengthened to address the seismic vulnerabilities) which will continue to operate at 1200 kPa.

Figure 4-1: Fraser Gate IP Project FEI Lower Mainland Gas Supply Network



Source: FEI data overlaid on Google Earth mapping

TP pipelines operating at greater than 2070 kPa

IP pipelines operating from 700 kPa to 2070 kPa

4.3.2 Project Components

The project scope will include the design, routing, construction and commissioning of 500 metres of new NPS 30 pipeline. The main project components include:

- The NPS 30 Fraser Gate IP pipeline that will operate at a Maximum Operating Pressure (MOP) of 1200 kPa;
- The pipeline will be designed in accordance with CSA Z662 Section 12 for 'Gas Distribution Systems' to operate at hoop stresses of less than 30 percent of the specified minimum yield strength of the line pipe; and
- The pipeline design will follow the FEI Seismic Design Guideline (DES-09-02).

The pipeline will be constructed and installed predominantly within existing road allowance as transportation corridors provide the most feasible alignment opportunities within a dense urban environment.

4.3.3 Basis of Design and Engineering

4.3.3.1 Standards and Specifications

The design, construction and operation of FEI natural gas pipelines and stations is conducted in accordance with British Columbia Oil and Gas Commission regulations and the Canadian Standards Association (CSA) Standard Z662-11 "Oil and Gas Pipeline Systems". The Fraser Gate IP Project will be developed in accordance with all applicable statutory codes and standards including FEIs internal standards.

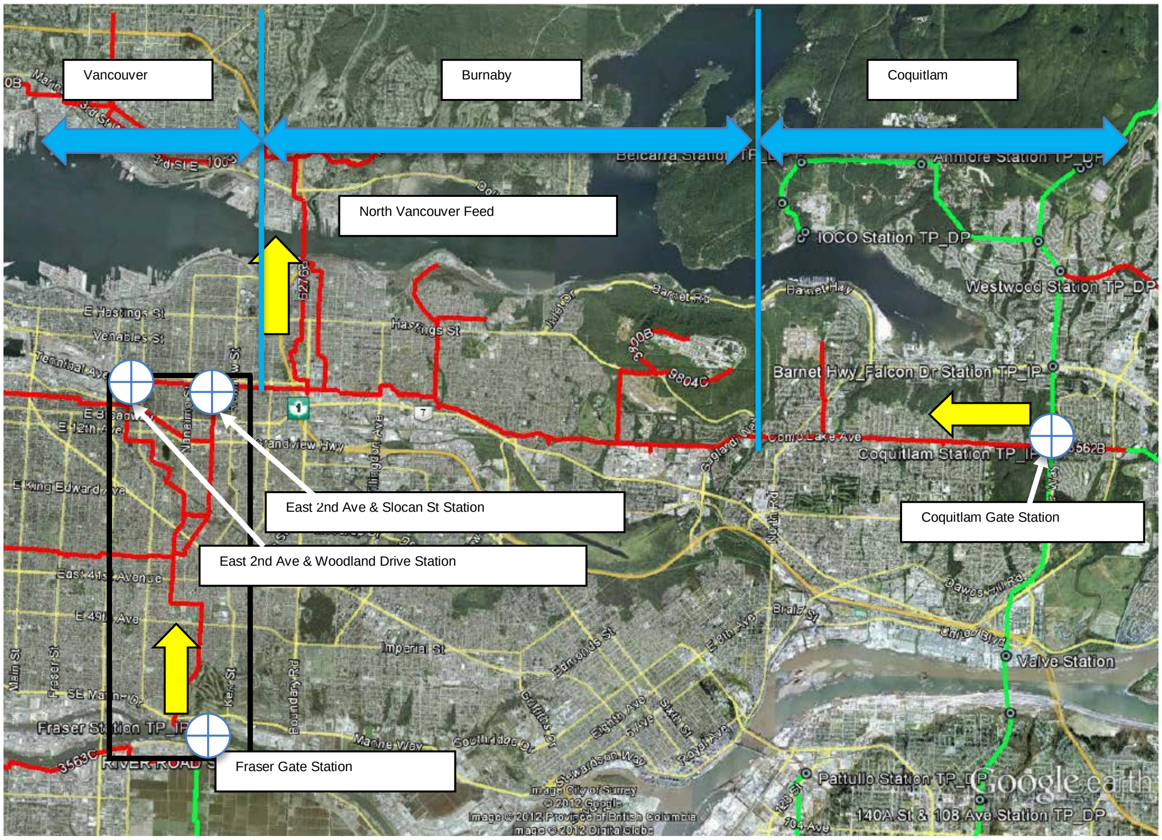
Please refer to section 3.3.3.1 for a list of applicable industry standards and specifications for the Fraser Gate IP Project.

4.3.3.2 Process Description

As previously described, Fraser Gate station is the interface station between the TP network and the existing NPS 30 Fraser Gate IP pipeline which extends from the Fraser River to Vancouver. Gas which enters Fraser Gate station from the TP network is filtered and cleaned; it is then heated to ensure the temperature is maintained above the dew point temperature preventing hydrate formation during the pressure reduction process. Next the pressure of the gas is reduced from 4020 kPa to 1200 kPa through the pressure regulators, and finally the gas is metered prior to entry to the NPS 30 Fraser Gate IP pipeline.

The Fraser Gate IP pipeline is the 'backbone' of the south to north gas distribution network which supplies numerous district stations and single point of use industrial customers situated along the route corridor within Vancouver (see Figure 4-2). The Coquitlam Gate IP pipeline is the 'backbone' of the east to west IP distribution network. Both interconnect in Vancouver at East 2nd & Woodland Drive and East 2nd & Slocan Street stations. This interconnectivity facilitates a balanced gas flow between both pipelines, especially in the event of a disruption to normal flow regimes.

Figure 4-2: Fraser Gate IP Pipeline



Source: FEI data overlaid on Google Earth mapping

- TP pipelines operating at greater than 2070 kPa
- IP pipelines operating from 700 kPa to 2070 kPa

4.3.3.2.1 NEW NPS 30 FRASER GATE IP PIPELINE

The proposed NPS 30 Fraser Gate IP pipeline will operate at 1200 kPa and replace the existing NPS 30 pipeline for approximately 500m starting at the outlet of Fraser Gate station. The proposed upgrade of the Fraser Gate IP pipeline will provide additional security of supply to the pipeline network by removing the section of pipeline with seismic vulnerabilities from the system.

4.3.3.2.2 FRASER GATE STATION

The existing Fraser Gate station was previously upgraded in 1997 to mitigate the seismic vulnerabilities of the station, but the pipeline along East Kent Avenue was not identified as requiring mitigation at that time. Subsequent seismic investigations in the area determined that the existing Fraser Gate IP pipeline is vulnerable to a 1:2475 year seismic event.

4.3.3.2.3 INTERFACE WITH EXISTING MARINE AND ELLIOTT DISTRICT STATION

The Marine & Elliott district station is the first location where the existing NPS 30 Fraser Gate IP pipeline serves the distribution pressure system in the area. As the MOP of the Fraser Gate IP pipeline will not change, no upgrades are required at the Marine & Elliott district station.

4.3.3.3 Pipeline

4.3.3.3.1 DESIGN PARAMETERS

The Fraser Gate IP pipeline main design parameters are listed in Table 4-3.

Table 4-3: Fraser Gate IP Pipeline Specification Details

Details	Values
Pipeline Length	500 m
Pipeline Outside Diameter/Nominal Pipe Size)	762 mm / NPS 30
Maximum Operating Pressure (MOP)	1,200 kPa (175 psi)
Pipeline Material Grade/Specified Minimum Yield Strength (SMYS)	483 MPa (X70)
Maximum Hoop Stress (as a % of SMYS)	<30%
Pipeline Buried Depth (min)	1.2 metre to top of pipe
Design Temperature	50°C
Pipe External Coating	Fusion Bonded Epoxy (FBE) under layer with 90mm negative buoyancy Concrete outer layer

4.3.3.3.2 PIPE SPECIFICATION

Please refer to section 3.3.3.3.2 for additional information on the pipe selection methodology.

Based on the preliminary design that was completed, the selected wall thickness and steel grade are 11.1 mm and Grade 483 respectively. As this replacement is required to mitigate seismic vulnerabilities of the existing pipeline, the steel grade was increased to a higher grade than what is required for hoop stress. During detailed design, further seismic and stress analysis will be completed to validate the pipe wall thickness and grade selection.

The pipe material grade and wall thickness selection is detailed in the Wall Thickness Selection Report attached in Confidential Appendix A-12.

4.3.3.3.3 LOCATION AND RUNNING LINE

The existing NPS 30 Fraser Gate IP pipeline traverses approximately 500 metres in an east-west alignment from the outlet of the Fraser Gate to the corner of East Kent Avenue & Elliott Street.

4.3.3.3.4 Block Valves

The proposed 500 metre replacement on the Fraser Gate IP pipeline does not impact any isolation valves. All existing valves will remain in service.

4.3.3.3.5 In-Line Inspection

The existing Fraser Gate IP pipeline is not designed to accommodate in line inspections (ILI). This project will replace a small portion of the NPS 30 Fraser Gate IP pipeline which will not result in a piggable pipeline. However, the section of new pipeline that will be installed will be designed to accommodate ILI should it become feasible at some point in the future.

4.3.3.3.6 Corrosion Protection

Coating Protection

External coatings provide the first level of defense against external corrosion of buried steel piping, and are required by CSA Z662. Coating protection involves the application of a layer of factory applied corrosion resistant material to the outside of the pipe after manufacture and prior to delivery for construction. There are different coating materials available depending on the specific requirements. Concrete has been selected as the most appropriate coating for the Fraser Gate IP pipeline replacement. This coating is comprised of an anti-corrosion coating layer, a 90mm layer of reinforced concrete, and an outer wrap. Concrete coating has been selected due to the close proximity of the proposed pipeline route to the Fraser River and the high water table levels during flooding and the potential for soil liquefaction in a seismic event. The concrete is a high quality, durable, industry accepted coating and has been selected due to the pipelines urban location and the following requirements:

- Due to the potential presence of hydrocarbons along the route alignment corridor the coating must be resistive to hydrocarbon deterioration;
- Due to the highly constrained working area during construction requiring multiple pipe handling scenarios the coating must resist mechanical damage during construction and installation; and
- Due to the urban pipeline location the coating must be resistive to mechanical damage after installation and backfill to minimise future excavations for damage repair.

Cathodic Protection

Cathodic protection of the existing NPS 30 Fraser Gate IP pipeline is supplied via an impressed current cathodic protection (CP) system, comprising rectifiers and deep anode beds. These are located at No 7 Road and Vulcan Way in Richmond. The impressed current system has been applying CP to the pipeline since its installation. Replacement anode beds were most recently installed in 1984. This impressed current system provides protection to the NPS 30 Fraser Gate IP pipeline from Fraser Gate station to East 37th Avenue and Nanaimo Street. It is expected that the existing CP system could be used to provide protection to the new Fraser Gate IP pipeline; however this will be confirmed during detailed design.

4.3.3.3.7 INTEGRITY MONITORING

Similar to the existing pipeline, the integrity of the new Fraser Gate IP pipeline will be managed within FEI's Integrity Management Program (IMP). The IMP is a corporate-level management system for identifying and mitigating hazards to the system that have the potential to result in failure with significant consequences. Activities include:

- Monitoring of the cathodic protection system, in accordance with CSA Z662, CGA OCC-1, and industry practice. These monitoring programs are established and documented within company standards; and
- Third-party damage prevention activities, including a permits & inspection process and public safety awareness programs.

4.3.3.4 Stations (Facilities)

No design upgrades, modifications, and replacements of stations are required as part of the 500 metre replacement of the NPS 30 Fraser Gate IP pipeline.

4.3.3.5 Operations and Maintenance Activities

FEI's proposal is to construct and operate a NPS 30 IP pipeline which operates at the same pressure as the existing pipeline, and no stations will be impacted by this replacement. After commissioning, the Fraser Gate IP pipeline will be operated and maintained in accordance with the Company's current proven standards and procedures for IP pipelines and stations.

4.3.3.6 Pipeline Right-of-Way and Valve Locations

The existing NPS 30 Fraser Gate IP pipeline is located within existing road allowances. The proposed NPS 30 Fraser Gate IP pipeline preferred route option is detailed in section 4.3.4. The majority of this alignment will be located within road allowance, while a small portion of the proposed pipeline route may fall within Gladstone Park or neighbouring properties either of which will require new land and access rights. FEI will finalize new land and access right negotiations once approval of this Application is received.

4.3.3.7 Other Utilities

The proposed location of the Fraser Gate IP pipeline within road allowance through developed urban areas will accordingly result in the pipeline being installed in proximity to existing adjacent utilities. Data acquired during the routing process indicates the following utility infrastructure and services will be encountered along the pipeline route:

- Electrical power (BC Hydro)

- Telecommunications (TELUS, Shaw)
- Traffic signal infrastructure
- Street lighting
- Sanitary sewer
- Storm drainage
- Potable water
- Natural gas (FEI)

Major stakeholders including BC Hydro, Metro Vancouver (formally GVRD), TransLink, Ministry of Transportation and Infrastructure and the City of Vancouver have already been contacted by the Project team regarding these utilities. Further liaison with all stakeholders combined with onsite investigations will address stakeholders concerns during detailed design and engineering.

4.3.3.7.1 ABANDONMENT PROCESS

The existing NPS 30 IP pipeline will be abandoned in place once the new pipeline is in service. See section 3.3.3.8 for additional information regarding the abandonment process.

4.3.4 Route Selection Process

The routing process for the NPS 30 Fraser Gate IP pipeline follows industry practice, and specific consideration was given to the recommendations of CSA Z662-11 Oil and Gas Pipeline Systems which is the standard specification for the design, construction, operation, and maintenance of Canadian pipelines.

4.3.4.1 Routing Objectives

The route selection process adopted for this project, which is described in the following sections, is based on a typical approach to routing a pipeline. However, the process has been tailored to meet the specific requirements and objectives of the urban location of the Fraser Gate IP pipeline. This is necessary due to the unique challenges associated with the densely populated urban location, land use, terrain, existing infrastructure, local permits and approvals, regulations, environment, and archaeology. The final route selected must be safe, environmentally acceptable, practical and economic.

Please refer to section 3.3.4.1 for additional information regarding the routing objectives.

4.3.4.2 Routing Process within Project Phases

Pipeline routing is an iterative process which, in the case of the Fraser IP, starts with a wide ‘corridor of interest’ and then narrows down to a more defined route at each design stage as more data is acquired, resulting in a final alignment. Identification of a pipeline corridor has been completed, and feasible route options within the corridor have been identified. The route options have been evaluated against established criteria and a preferred route option has been selected and is presented later in this section. The final stage in the routing process involves completion of detailed routing and engineering of the selected preferred alternative, based on further stakeholder and public consultation, comprehensive site investigations and detailed engineering.

Please refer to section 3.3.4.2 for additional detail on the routing process.

4.3.4.3 Route Corridor Identification

The proposed Fraser Gate IP pipeline replacement is limited to the vicinity of the north arm of the Fraser River due to specific seismic vulnerabilities of the existing pipeline in this area. The limited extent of the pipeline scope provided the fundamental route constraints which established the initial route assessment corridor area for the Fraser Gate IP pipeline project. Thus, the first step in the routing process established a route assessment corridor based on the existing NPS 30 IP pipeline route alignment which exists within East Kent Avenue.

The selected corridor width extends on either side of the existing pipeline alignment to ensure all feasible route options are captured. The corridor width included potential route options around perceived routing obstacles along the existing Fraser Gate IP pipeline alignment. The information pertaining to the key constraints, including geological and above and below man-made infrastructure features, was obtained from municipality and major stakeholder feedback, online sources, cartographic, engineering, and environmental desktop constraint surveys. As a result the key constraints and obstructions were avoided as much as possible.

Please refer to section 3.3.4.3 for additional details on the route corridor development.

4.3.4.4 Route Options Considered

Following the establishment of a route corridor, various desktop studies including available online data, information gathered through liaising with major stakeholders, and an onsite visual appraisal was used to identify feasible alternative route alignments within the selected route corridor.

Feasible route options depend on the identification of routing constraints and obstacles with the aim of avoidance where possible of areas of potential construction difficulty, safety hazards, whilst minimizing community, stakeholder, and environmental impacts. The route options are determined through examination of aerial photography, mapping data, and onsite crossing point vantage surveys, environmental constraint studies and major crossing constraint assessments. The feasible route options are illustrated in Figure 4-3.

4.3.4.5 Assessment of Route Options

Following the identification of feasible route options, a series of selection criteria was established to evaluate and select a preferred alternative. The assessment process comprised both quantitative and qualitative elements that analysed the relative impact of each route option with respect to the selection criteria.

4.3.4.5.1 EVALUATION CRITERIA

The key principles and considerations taken into account when evaluating the route options are listed and defined in Table 3-8.

4.3.4.5.2 DATA INPUT

The criteria weightings applied to the Fraser Gate IP pipeline are generally consistent with the weightings for the Coquitlam Gate IP pipeline and those put forth with previous FEI projects. Consistent with FEI's corporate culture of conducting business in a safe and environmentally responsible manner, a high weighting was afforded to those evaluation criteria associated with health, safety, and environment. In consideration of the urban nature of the pipeline location (and broadly similar to that of the Coquitlam Gate IP pipeline), health and safety, community (socio-economic), environment (human), constructability and natural hazards considerations are the main factors guiding the choice of pipeline route and were given the highest weighting. Please refer to Table 4-3 for the full list of criteria weightings.

Please refer to section 3.3.4.5.2 for additional information on the evaluation criteria development and cost estimate preparation.

4.3.4.5.3 ROUTE OPTIONS SCORING AND RANKING

The route options identified were scored, relative to each other, using the route evaluation criteria. Please refer to section 3.3.4.5.3 for additional details regarding the route option scoring and ranking.

4.3.4.6 Preferred Route Options Selection

Three route options were identified for the Fraser Gate IP pipeline replacement in the East Kent Avenue area. Route Option 1 is routed in East Kent Avenue South roadway from Fraser Gate station to Elliott Street including a short section within Gladstone Park (to the south of the existing rail line).

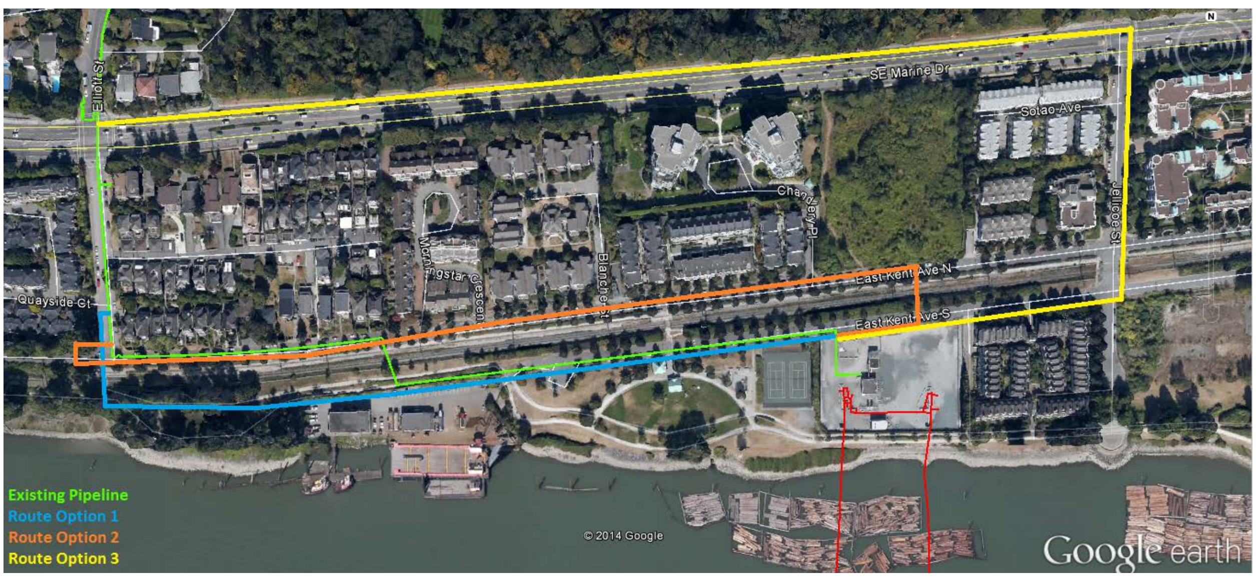
Route Option 1 parallels the existing Fraser Gate IP pipeline in East Kent Avenue South. However, at the western end of East Kent Avenue South the existing pipeline crosses beneath the existing rail line to adopt an alignment on East Kent Avenue North to Elliott Street. At this crossing location there is a very high density of existing utilities in East Kent Avenue North (including the existing NPS 30 Fraser Gate IP pipeline), residential accesses, a grade elevation difference between East Kent Avenue North and South and a commercial business adjacent to the south of the rail line. These constraints would result in significant construction challenges with installing the proposed NPS 30 IP pipeline crossing at this location. The optimum location for Route Option 1 to cross beneath the existing rail line, and connect to the existing IP network, was identified further west where a direct alignment from south of the rail line will connect to the existing IP system in Elliott Street and thereby avoid the utility congestion and space restrictions on East Kent Avenue North and result in a constructible crossing.

Route Option 2 is located within East Kent Avenue North from Fraser Gate station to Elliott Street (to the north of the existing rail lines). The high density of existing utilities, including the existing Fraser Gate IP pipeline, within this roadway would not provide enough space to install the proposed NPS 30 replacement pipeline using open trench methods. Furthermore, open trench pipeline construction along this section of East Kent Avenue North would isolate access to a number of residential housing developments with no alternative access or lane access. Therefore, trenchless pipe installation would be the only feasible method to install the proposed NPS 30 IP pipeline on this route.

Route Option 3 travels north from the existing Fraser Gate station, east on Kent Avenue to Jellicoe Street, and then west along Marine Drive to the intersection of Marine Drive and Elliott Street.

Route Option 1 and 2 are approximately 540 metres long and Option 3 is significantly longer at 1,000 metres.

Figure 4-3: Fraser Gate IP Replacement Route Options



Source: FEI data overlaid on Google Earth mapping

4.3.4.6.1 COMMUNITY AND STAKEHOLDER IMPACTS

Health and Safety

The route options considered would involve pipeline construction in proximity to houses, road users and commercial accesses, with potential risk to the health and safety of local residents, general public and construction personnel. Route Option 1 would involve pipeline construction on East Kent Avenue South which would require temporary closure of a public park and other leisure amenities in the vicinity and would, therefore, result in a relatively isolated construction zone. This would help mitigate potential health and safety risk to the general public during construction. Route Option 2 would involve pipeline construction on East Kent Avenue North in closer proximity to houses, condo developments and road users. Route Option 3 would involve pipeline construction on two lane residential streets and also on South East Marine Drive which is a multi-lane highly trafficked commuter route. Route Option 1 and 2 are significantly shorter compared to Route Option 3 and Route Option 1 would present the least health and safety risk. Route Option 2 would position the construction in closer proximity to houses and the general public which would present greater health and safety risk. Route Option 3, due to its location, significant additional length and longer construction timelines would present the highest potential risk to the general public, stakeholders, employees and contractors.

- Route Option 1: low impact, better route choice (4)
- Route Option 2: moderate impact, good route choice (3)
- Route Option 3: high impact, poor route choice (2)

Socio-Economic

Route Option 1 would involve pipeline construction on East Kent Avenue South which would negatively impact limited local traffic movement and one commercial access. However, access would remain open to properties on the north side of East Kent Avenue. To mitigate the impact to the commercial access on the south side of east Kent Avenue site specific construction planning and construction staging would be implemented. Route Option 2 would require construction on East Kent Avenue North which is a well-travelled residential and cyclist commuter route providing local access to many home and condo developments. In order to maintain access to these homes a segment of East Kent Avenue North would need to be converted from a recreational green space to a through road and a 600 m trenchless pipeline installation section would be required. If the recreational space on East Kent Avenue North cannot be converted to a through road, a longer trenchless installed section would be required in order to maintain access. Due to the restrictions to residential parking and access, and commuter delays on the cycle route on East Kent Avenue North, Route Option 2 would result in a higher impact. Route Option 3 would require closure of multiple lanes along a section of South East Marine Drive to construct the pipeline. The resulting traffic impacts would have a significant negative impact to the economic well being and daily life for local stakeholders, commuters and residents in the area and result in the highest impact route choice.

- Route Option 1: low impact, better route choice (4)
- Route Option 2: moderate impact, good route choice (3)
- Route Option 3: high impact, poor route choice (2)

Land Ownership and Use

Route Option 1 would involve temporary construction through a municipal park and privately owned land. Pipeline access rights would be required through these areas which would limit future development along the pipeline route, resulting in a potentially high impact to land ownership and use. Route Option 2 would require the temporary conversion of an existing recreational green space into roadway to allow for access to homes to be maintained. Route Option 3 would be wholly constructed within roadway, and have a low impact on land ownership and use. Route Option 2 and 3, compared to Option 1, would involve installation of the pipeline primarily within municipal roadway and would have less impacts in terms of land ownership and land use. However, Route Option 2 would temporarily impact on existing recreational green space on East Kent Avenue North. This would have a moderate short term impact on land use.

- Route Option 1: high impact, poor route choice (2)
- Route Option 2: moderate impact, good route choice (3)
- Route Option 3: low impact, better route choice (4)

4.3.4.6.2 ENVIRONMENTAL IMPACTS

Ecology

Route Option 1 is located directly adjacent to the north bank of the Fraser River and would also traverse Gladstone Park. The proximity of Route Option 1 to the river would increase the potential for spills, sediment runoff or other potential negative environmental impacts. It is likely that the portion of Route Option 1 located in the park would also require some vegetation and tree removal.

Route Option 2 would be located parallel to Route Option 1, but further removed from the Fraser River and separated by an existing rail line. The increased distance to the Fraser River would help to mitigate the risk of spills etc. negatively impacting the river. However, the construction on this alignment would also negatively impact existing trees. Furthermore, this route option would be installed using trenchless construction techniques which present additional risks of inadvertent drilling fluid releases both vertically and laterally during construction.

Route Option 3 would be situated the furthest from the Fraser River with least potential to negatively impact the river. In addition to potential direct environmental impacts, the likelihood of finding contaminated sites during pipeline construction in an urban neighbourhood is a major consideration; the Environmental Constraints Study identified four potential sites in this area which would impact Route Options 1 and 2 equally. Since Route Option 3 does not parallel

Route Options 1 and 2 or the four identified potentially contaminated sites, this route option may result in less potential to encounter contaminated material during construction.

- Route Option 1: high impact, poor route choice (2)
- Route Option 2: high impact, poor route choice (2)
- Route Option 3: low impact, better route choice (4)

Cultural Heritage

All route options would have negligible impacts to archaeological or culturally significant sites. No known sites are present on any of the route options, at this time.

- Route Option 1: very low impact, best route choice (5)
- Route Option 2: very low impact, best route choice (5)
- Route Option 3: very low impact, best route choice (5)

Human Environment

Route Option 1 would involve pipeline construction along East Kent Avenue South and a short section of a public park. Option 2 would involve pipeline construction along East Kent Avenue North and adjacent to a cycle path. Route Option 3 would also impact some residential streets but would quickly move from the residential areas into a more heavily trafficked transportation corridor as it progresses north from the Fraser Gate station. Due to the closer proximity to homes and businesses, Route Options 1 and 2 would have a greater impact on human environment in terms of noise, heavy vehicle movement and nuisance factors than Route Option 1.

- Route Option 1: high impact, poor route choice (2)
- Route Option 2: high impact, poor route choice (2)
- Route Option 3: moderate impact, good route choice (3)

4.3.4.6.3 TECHNICAL CONSIDERATIONS

Engineering

Route Options 2 and 3, because of the location, length and construction techniques required would present more routing and design challenges than would be required for Route Option 1. Route Option 2 would involve extensive site investigations to support the detailed design of a compound curve trenchless pipe installation. Furthermore, Route Option 2 would require rerouting of a significant number of existing buried utilities and service connects prior to construction which would significantly complicate the routing and design effort required at this location. Route Option 3 would require an additional 500 m of pipeline including a trenchless crossing from the south side to the north side of South East Marine Drive which would result in additional engineering considerations.

- Route Option 1: low impact, better route choice (4)
- Route Option 2: high impact, poor route choice (2)
- Route Option 3: moderate impact, good route choice (3)

Construction

Route Options 1 and 3 would, due to the lower density of subsurface utilities encountered within municipal roadway, achieve similar construction productivity. Route Option 1 would include a section of the pipeline within an existing park which would also minimize potential construction constraints. Route Option 2 would present significant construction challenges including a high density of existing utilities which would require relocation prior to pipeline construction. Each of these route options would involve a shorter bored crossing under the existing rail line. However, Route Option 2 would also require the use of trenchless construction technique to install the pipeline in East Kent Avenue North which would involve constrained equipment setup and logistical challenges to safely execute the construction process while minimizing negative impact to local road users and access. Route Option 3 would have the same level of construction productivity as Route Option 1; it is, however, approximately twice as long as Option 1 which would result in the longest construction timeline and largest overall construction impact footprint.

- Route Option 1: low impact, better route choice (4)
- Route Option 2: high impact, poor route choice (2)
- Route Option 3: moderate impact, good route choice (3)

Operation

Route Options 1 and 3 would install the pipeline at approximately 1.2 metres of cover to the top of the pipeline. As a result, both of these options would be readily accessible in the future should excavation of the pipeline be required for maintenance purposes. However, the location of Route Option 3 would present challenges in terms of traffic management should the pipeline on South West Marine Drive require excavation. Due to the density of utilities in East Kent Avenue North, Route Option 2 would install the pipeline at significant depth below the existing surface utilities which would result in access limitations for operation and maintenance purposes.

- Route Option 1: better route choice (4)
- Route Option 2: poor route choice (2)
- Route Option 3: good route choice (3)

System Interface

All three route choices would require deep excavations and complex tie in procedures to tie the proposed pipeline into the existing system.

- Route Option 1: high impact, poor route choice (2)
- Route Option 2: high impact, poor route choice (2)
- Route Option 3: high impact, poor route choice (2)

Adjacent Utilities

Route Options 1 and 3 would encounter a similar density of adjacent buried utilities within the paved sections of roadway on each route option alignment. However, the current routing analysis indicates that there is sufficient space to install the proposed NPS 30 IP pipeline with sufficient offset to the adjacent utilities. Route Option 3 rated lower than Route Option 1 because Route Option 3 is approximately twice as long. Route Option 2 would, however, be located on east Kent Avenue North which contains a very high level of existing sub surface utilities and which would require rerouting and relocation of the existing utilities to complete the pipeline construction and installation.

- Route Option 1: low impact, better route choice (4)
- Route Option 2: high impact, poor route choice (2)
- Route Option 3: moderate impact, good route choice (3)

Natural Hazards

The detailed design and final geotechnical analysis have not yet been completed; preliminary engineering indicates that all three route options will meet the Company's geotechnical and seismic standard requirements. Route Option 1 would be located within the seismic ground displacement zone and would meet FEI's seismic criteria of maintaining pressure integrity during a 1:2475 seismic event. Route Options 2 and 3 would be located outside of the ground displacement zone for the majority of the pipeline route. A small portion of both pipeline route options would be within the ground displacement zone at the exit of Fraser Gate station, and both route options would meet FEI's seismic criteria at this location.

- Route Option 1: moderate impact, good route choice (3)
- Route Option 2: low impact, better route choice (4)
- Route Option 3: low impact, better route choice (4)

4.3.4.6.4 COST

Route Option 1 is estimated to be the lowest cost route option; it would require significantly less trenchless construction compared to Option 2 and deliver higher construction productivity and is half as long as Route Option 3. A preliminary screening estimate was completed for Route Option 2 which provided a cost estimate approximately 12 percent higher than Route Option 1. This is primarily due to the construction challenges associated with the non-standard trenchless construction and high density of existing buried utilities that would have to be relocated to accommodate pipe installation, and construction risks associated with long trenchless pipeline installations. The preliminary screening estimate for Route Option 3 provided a cost estimate approximately 113 percent higher than Route Option 1. Route Option 3 is the most expensive route option as it is over twice as long as Route Options 1 and 2 resulting in the additional construction costs.

4.3.4.7 Selected Preferred Route Option

The relative impact scoring of these route options in Table 4-4 reflects the impacts and considerations outlined in the previous sections. The total scores for Route Option 1, 2 and 3 are 335, 270 and 295 respectively.

Table 4-4: Fraser Gate IP Pipeline Route Options Screening Matrix

Fraser IP Route Selection

Option		**1**		**2**		**3**	
Length (m)		**540**		**600**		**1050**	
Impact and Vulnerability Considerations	**Weight**	**East Kent Avenue South**		**East Kent Avenue North**		**Jellicoe Street + Marine Drive**	
		Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
Community/Stakeholder							
Health and Safety	15	4	60	3	45	2	30
Socio-Economic	15	4	60	3	45	2	30
Land Ownership and Use	5	2	10	3	15	4	20
Environmental							
Ecology	5	2	10	2	10	4	20
Cultural Heritage	5	5	25	5	25	5	25
Human Environment	15	2	30	2	30	3	45
Engineering/Technical							
Pipeline Engineering/Design	5	4	20	2	10	3	15
Pipeline Construction	10	4	40	2	20	3	30
Pipeline Operation	5	4	20	2	10	3	15
System interface	5	2	10	2	10	2	10
Adjacent Utilities	5	4	20	2	10	3	15
Natural Hazards	10	3	30	4	40	4	40
Totals	**100**		**335**		**270**		**295**
Ranking		**1**		**3**		**2**	
Relative Cost		**100%**		**112%**		**213%**	
Cost Ranking		**1**		**2**		**3**	

The overall objective of the routing process is to select the route option that minimizes potential impacts on the environment and community while meeting safety requirements, and identifying an economic route.

The routing process identified a route corridor between Fraser Gate station and Elliott Street, and assessed 3 route options within the corridor. The route options evaluation resulted in the selection of a preferred route along East Kent Avenue South (see Appendix A-29 for a detailed map).

Route Option 2 is located within East Kent Avenue North, from Fraser Gate station to Elliott Street (north of the existing rail lines). As outlined in Table 4-4, Route Option 2 rated much lower than Route Option 1 (270 versus 335) in the route ranking analysis. This is primarily due to the high density of existing third party utilities that would have to be relocated to accommodate pipe installation, the need for construction in close proximity to houses and commercial establishments and the level of traffic disruption that would occur during the project execution. As a result of the higher cost and lower route option rankings, no further financial analysis was completed on Route Option 2.

Route Option 3 travels north from the existing Fraser Gate station, east on Kent Avenue to Jellicoe Street, and then west along Marine Drive to the intersection of Marine Drive and Elliott Street. As outlined in Table 4-4. Route Option 3 rated lower than Route Option 1 (295 versus 335) in the route ranking analysis. This is primarily due to the additional pipeline length creating a longer construction window resulting in prolonged community and stakeholder impacts compared to Route Option 1. In addition to the community and stakeholder impacts, Route Option 3 would involve construction on South East Marine Drive, a heavily trafficked transportation corridor, which would result in greater traffic disruption compared to Route Option 1 (which would involve pipeline construction activities along a residential street and short section of park space). As a result of the higher cost and lower route option rankings, no further financial analysis was completed on Route Option 3.

Route Option 1, the preferred route, is located within East Kent Avenue South and a short section of park, from Fraser Gate station to Elliott Street (south of the existing rail lines). This route option has the highest route ranking and the lowest cost estimate.

4.3.4.8 Design and Approval of Final Route [Detailed Design Phase]

The previously described routing process stages (stage 1 and 2) have been completed to bring the Project to the necessary stage of development for completion of an AACE Class 3 estimate. A preferred pipeline route option was selected resulting in a preliminary alignment. The detailed information which was gathered during completion of stage 1 and 2 of the routing process will form the basis of the next stage of the project design process which is final route design and approval.

Please refer to section 3.3.4.8 for additional information on the detailed design phase.

4.3.5 Construction, Installation and Commissioning

It is intended that the Fraser Gate IP pipeline will be constructed with the Coquitlam Gate IP Project by one pipeline construction contractor beginning in the summer of 2018. Final cleanup will be completed as the construction progresses.

4.3.5.1 Methods of Construction

The construction of the NPS 30 IP pipeline replacement from Fraser Gate station to Elliott Street will traverse areas including traffic routes, residential streets, green areas and rail road crossings which will present different construction challenges and constraints and require specific construction techniques. A number of urban and suburban standard pipeline construction techniques that will facilitate safe pipeline construction are outlined in section 3.3.5.1.

The construction techniques that are currently expected on the Fraser Gate IP pipeline are as follows:

- In Street Method; and
- Trenchless Installation.

For additional details on these pipeline construction methods, please refer to section 3.3.5.1.

4.3.5.2 Construction Activities

The Fraser Gate IP pipeline construction is divided into three phases, each with its own activities: pre-construction, construction and post-construction.

The construction activities currently planned for the Fraser Gate IP pipeline are as follows:

- Pre-Construction:
  - Surveying;
  - Pipe and Materials Stockpiling; and
  - Site Preparation.
- Construction:
  - Asphalt Handling;
  - Soil Handling;
  - Pipe Haul and Stringing;
  - Trenching;
  - Bending and Welding;
  - Non-Destructive Testing;
  - Girth Weld Coating;
  - Lowering-In; and
  - Backfill and Padding.
- Post-Construction:

- o Testing;
- o Drying;
- o Tie-In (between the new replacement pipeline and the existing Fraser Gate IP infrastructure); and
- o Clean-Up and Post-Construction Restoration.

For additional details on these construction activities, please refer to section 3.3.5.2.

4.3.5.3 Construction Plan and Execution

The construction work will entail taking temporary occupation of sections of East Kent Avenue South. A single construction crew will build the pipeline between spring and autumn 2018. Due to the nature of the work, the work zone will be occupied on a 24 hour basis which will result in some access restrictions and impact the use of leisure amenities in the vicinity and Gladstone Park. The pipeline construction operations will be staged and executed to minimize potential impacts to any local commercial accesses.

4.3.5.4 Construction Management

4.3.5.4.1 NOISE CONTROL

The construction site would be located in proximity to residential developments on East Kent Avenue North. Noise monitoring and control will comply with local guidelines. Please refer to section 3.3.5.4.1 for additional noise control information.

4.3.5.4.2 SAFETY AND SECURITY

Construction site safety and security will be maintained during the course of the construction including all working and non-working hours inclusive of weekends. A comprehensive safety plan will be developed by the pipeline contractor in compliance with FEI standards, WorkSafeBC regulations, and the requirements of other impacted stakeholders.

4.3.5.4.3 TRAFFIC CONTROL

The Fraser Gate IP pipeline replacement preferred alignment would not have a significant impact to traffic since the alignment is mainly routed within a cul-de-sac. Local traffic will be impacted along East Kent Avenue South, and a small segment of Elliott Drive will be closed to complete the tie in to the existing pipeline. This closure will not significantly impact traffic or access as alternate routes are readily available. Traffic control measures will be implemented in accordance with FEI standards, WorkSafeBC regulations, and the requirements of other impacted stakeholders.

4.3.5.4.4 ENVIRONMENTAL MANAGEMENT

FEI plans to employ the services of an Environmental Inspector to be present during the construction of the pipeline. The Environmental Inspector will be familiar with pipeline construction techniques and applicable guidelines and standards. Please refer to section 3.3.5.4.4 for additional information on Environmental Management.

4.3.6 Project Schedule

Conceptual development has been substantially completed and construction is proposed to be undertaken starting in 2018. Specific milestone activities are estimated in Table 4-5.

Table 4-5: Fraser Gate IP Project Schedule Milestones

Activity	Date
Conceptual Development	Completed.
CPCN Preparation	July 2013 – Dec 2014
CPCN Filing	Dec. 2014
CPCN Approval	Q3. 2015
Start of Detailed Engineering, materials specification and contract development	Oct. 2015
Materials Tendering and Orders Placed	Aug. 2016
Submit OGC Application	Sept. 2017
OGC Pipeline Approval	Jan. 2018
Award Contractor	June 2017
Materials Delivery	March 2018
Construction Start	July 2018
In Service	Nov. 2018
Restoration	June 2019

A more detailed schedule is attached as Appendix A-20-2.

4.3.7 Resource Requirements

A FEI Project Manager will manage the Project and implement the execution plan for each phase of the Project. Please refer to section 3.3.7 for additional information and Figure 3-8 provides the functional organization chart for management of this Project.

4.3.7.1 Design and Quality Control

The pipeline engineering will be undertaken by a specialized pipeline engineering consultant with the necessary experience and skills to complete the detailed routing and engineering for the Fraser Gate IP pipeline replacement to the highest standards and to meet the Project objectives and requirements. Any specialized services required for environmental management, geotechnical investigation and analysis, and construction inspection will be contracted to individuals and companies possessing the demonstrated skills and experience to complete the work. These individuals and companies will ensure that public and worker safety, quality workmanship and environmental compliance are maintained throughout the Project.

FEI operating personnel will ensure all facilities conform to FEI standards and industry practices and are efficiently placed into operation upon completion of construction.

4.3.7.2 Construction Services

FEI will issue an Expression of Interest to list potential prime construction contractors and pre-qualify selected contractors prior to the release of the tender documents. The construction will be subject to a competitive tender. At the close of the procurement process, FEI will select the final successful Contractor based on capability, safety, schedule and cost. FEI will select the bid that provides the best overall value.

4.3.7.3 Materials

FEI will arrange a competitive bid process to procure all materials and will award to the bidders that provide the best value.

4.3.8 Other Applications for Approval

4.3.8.1 BC Oil and Gas Commission

The construction and operation of the Project are governed by the Oil and Gas Activities Act and subject to the OGC regulation. The Project requires a Pipeline Application. FEI plans to file the Pipeline Application in September 2017. A Pipeline Application is a significant process with considerable technical scrutiny on the Project by the OGC. Public and First Nations consultation, land or access rights, archaeological requirements, design reviews, environmental permits/approvals for work in and around fish bearing streams are all components of the Pipeline Application. Each component must receive OGC approval prior to the start of construction, a significant regulatory process in addition to the CPCN approval by the BCUC. Since the proposed pipeline will generally follow the existing pipeline route, the current schedule assumes a five month approval period.

4.3.8.2 Municipal Permits

Pipeline construction within the City of Vancouver will require municipal permits to ensure construction and installation meets municipal bylaws and guidelines. FEI is currently in the process of identifying all required municipal permits and will acquire them prior to commencing construction. The terms and conditions outlined in these permits and approvals will be adhered to during the construction of the Project.

4.3.8.3 Other Pending or Anticipated Applications/Conditions

A qualified environmental professional working in conjunction with the Company's Environmental Affairs group will assist the Project in identifying permits/approvals required and in the development of an Environmental Protection Plan including an Environmental Emergency Preparedness and Response Plan for the Project.

The Project is not expected to require an Environmental Assessment Certificate pursuant to the British Columbia Environmental Assessment Act or require a screening under the Canadian Environmental Assessment Act, 2012.

Agency notifications, permits or approvals are anticipated under, but not limited to, the Fisheries Act, Species at Risk Act, Water Act, and Heritage Conservation Act. Notifications, permits or approvals may also be required from the Agricultural Land Commission and City of Vancouver. The terms and conditions outlined in these permits and approvals will be adhered to during the construction of the Project.

As indicated above, the Fraser Gate IP project will involve the acquisition of new land and access rights for the proposed route alignment from municipal or private property owners. FEI will finalize new land and access right negotiations once approval of this Application is received.

4.3.9 Risk Analysis and Management

FEI conducted a risk assessment of the Project that identified and quantitatively analyzed the risk drivers. The risk assessment adopted a formal approach and established a risk management framework which, as part of an integrated Project Execution Plan will be updated throughout the project lifecycle. The risk assessment outputs (risk register and treatment plan) contributed to the development of a project contingency amount which is summarized in section 4.4.1.4.3.

Please refer to section 3.3.9 for additional information regarding the Risk Assessment process.

4.4 *PROJECT COST ESTIMATE*

The Company prepared the Project cost estimate based on AACE Class 3 specifications, in accordance with the CPCN Guidelines. This section discusses the Project cost estimate details.

4.4.1 Cost Estimate Details

The total capital cost of the Project, the details of which are filed confidentially in Appendix E-3-2, is estimated to be $18.107 million in as spent dollars (including AFUDC).

To provide the necessary expertise FEI engaged WorleyParsons to assist with project engineering and estimating services and to develop the pipeline routing, design and construction planning to the necessary level of project definition as prescribed by the AACE recommended practices. This collaborative approach ensured the estimating; forecasting, control and other processes used for the Project represent industry best practice. This section will address the following:

- Estimate preparation plan;
- Basis of Estimate;
- Cost estimate validation; and
- Project capital costs estimate details.

4.4.1.1 Estimate Preparation Plan

The Estimate Preparation Plan, attached in Confidential Appendix A-22, was prepared to provide an outline for the development of the pipeline capital cost. It details the responsibilities of WorleyParsons and FEI, and explains how the estimate was to be developed and reviewed for final delivery.

Please refer to section 3.4.1.1 for additional information on the Estimate Preparation Plan.

4.4.1.2 Basis of Estimate

The Basis of Estimate is attached in Confidential Appendix A-23. Please refer to Section 3.4.1.2 for additional information.

4.4.1.2.1 PIPELINE AND CIVIL ESTIMATES

The pipeline and civil works AACE class 3 estimates are outlined in Confidential Appendices A-24, and A-26. Please refer to section 3.4.1.2.1 for additional information on these estimates.

4.4.1.3 Cost Estimate Validation

Cost estimate quality assurance (QA) and validation were completed as follows:

- A series of internal WorleyParsons reviews including peer reviews, squad checks, document quality checks, cold eye reviews and signed calculation cover sheets;
- Ongoing validation reviews involving both WorleyParsons and FEI team members throughout the estimate development process, to confirm that the estimate assumptions are still valid and that the procurement and construction strategies remain unchanged;
- Review of the construction methodology and Unit Price Items (UPIs) with FEI; and
- Senior management review by WorleyParsons.

4.4.1.4 Project Capital Cost Estimate Details

This cost estimate is based on an AACE Class 3 level of Project definition and design, and the individual cost elements consist of historical costs, non-binding quotations and projections. The expected accuracy of the cost estimate is +30 percent to -20 percent.

Cost estimates are based on the most recent studies and information currently available to FEI and an in-service date of October 2018. The estimate excludes GST but includes 7 percent PST on materials. FEI, as a GST registrant, is entitled to recover the GST it pays on its taxable purchases. As such, the tax does not represent a net cost to the Company. 2014 market prices have been used for the material supply and construction contracts.

4.4.1.4.1 PROJECT EXECUTION COST ESTIMATE SUMMARY

The Project total installed cost, including direct and indirect costs, is presented in Confidential Appendix E-3-2.[25] The estimated capital cost of $17.231 million plus actual AFUDC (As-spent) will be used as the control budget until replaced by more detailed estimates. Cost reports will conform at a minimum to the level of detail as set out in Confidential Appendix E-3-2. Deferred Development and LMIPSU Application costs will be tracked separately and will be reported on as well.

4.4.1.4.2 ESCALATION

An escalation rate of 4.5 percent per annum is used based on the ten year average escalation rates from Statistics Canada for industrial construction and line pipe from 2002 to 2012.

4.4.1.4.3 PROJECT CONTINGENCY AND MONTE CARLO ANALYSIS

A two step approach was used to determine the Project contingency. The first step involved the use of predetermined guidelines to evaluate a single contingency value which was applied to the base cost estimate. This contingency was based on the expert opinion of the FEI and WorleyParsons engineering team combined with detailed knowledge of the project scope and risks. A flat percentage contingency was selected and applied to the estimated base cost (see Confidential Appendix A-23 – Basis of Estimate).

The second step involved a combined ‘estimate risk assessment workshop’ (different from the project risk workshop described in section 3.3.9.1) and ‘quantitative risk analysis’. The workshop was led by a WorleyParsons facilitator and lead estimator. The quantitative risk analysis using the Monte Carlo method was conducted using @Risk software. The WorleyParsons Cost Risk Analysis report is attached in Confidential Appendix A-27. The Project team SMEs identified risk ranges and probabilities regarding critical line items in the estimate. These risk ranges and probabilities informed the Monte Carlo simulation analysis to determine the range of the total Project estimate. This provided a distribution of probabilities (levels of confidence) which the Project estimate would not exceed. The P10/P90 risk range and the P50 value, results in an accuracy range of -21.1 percent /+ 28.9 percent which is in line with the AACE Class 3 Cost

[25] Appendix E-3-2 includes an estimate of AFUDC of $0.876 million. Actual AFUDC will vary.

Estimate level of accuracy. The outcome of the first contingency step established a contingency amount. The second step confirmed the selection of a prudent contingency amount which was validated through selection of the Monte Carlo P50 value.

Please refer to section 3.4.1.4.3 for additional details on how contingency was developed.

4.4.1.4.4 ESTIMATE EXCLUSIONS

The cost estimates exclude First Nations Capacity Funding and Accommodation Costs as no such costs are anticipated at this time.

5. PROJECT COSTS AND ACCOUNTING TREATMENT

5.1 SUMMARY OF CAPITAL COSTS, INCREMENTAL COST OF SERVICE AND AVERAGE LEVELIZED COST

Details of the Coquitlam Gate IP Project capital costs can be found in Confidential Appendix E-1-1, Schedule 6, and in Confidential Appendix E-3-1. Fraser Gate IP Project costs can be found in Confidential Appendix E-1-2, Schedule 6, and in Confidential Appendix E-3-2.

Based on the Projects' costs, Table 5-1 presents a summary of the total forecast project costs and Table 5-2 presents the financial impacts associated with the completion of each of the two IP pipeline Projects as well as a summary of the combined rate impacts. Both tables are based on detailed schedules for each pipeline segment as included in Confidential Appendices E-1-1 and E-1-2. The impact to customer rates in 2019 (when the asset enters rate base) is approximately $0.130 per GJ and levelized over the 60 year analysis period is approximately $0.108 per GJ. For a typical FEI residential customer consuming an average 95 GJ per year, in 2019, this would equate to approximately $12.35 per year. The annual impact to customers from the Coquitlam Gate IP Project in 2019 would be approximately $11.60 per year and from the Fraser Gate IP Project would be approximately $0.75 per year.

Table 5-1: Summary of Forecast Capital and Deferred Costs ($millions)

Particular	2014$	As-Spent	AFUDC	Tax Offset	Total
Coquitlam Gate IP Project	201.282	228.813	12.455		**241.268**
Fraser Gate IP Project	14.855	17.231	0.876		**18.107**
Total Addition to Plant	216.137	246.044	13.331		**259.375**
Abandonment/Demolition Costs[26]	3.540	4.172	0.117		**4.289**
Total Projects Capital Cost	219.677	250.216	13.448		**263.664**
LMIPSU Development Cost	2.441	2.442	0.197	(0.635)	**2.004**
LMIPSU Application Cost	1.307	1.307	0.080	(0.340)	**1.047**
Total	**223.425**	**253.965**	**13.725**	**(0.975)**	**266.715**

[26] Abandonment and demolition costs will be charged to the Negative Salvage Deferral Account in accordance with BCUC Order G-44-12

Table 5-2: Financial Analysis of the Projects Reinforcements

AACE Class 3	Coquitlam Gate IP	Fraser Gate IP	Combined[27]
Total Charged to GPIS ($millions)	241.268	18.107	259.375
Abandonment / Demolition Costs ($millions)[28]	4.289	--	4.289
Total Capital Costs including Abandonment / Demolition ($millions)	245.557	18.107	263.664
2019 Rate Impact ($ / GJ)	0.122	0.008	0.130
Levelized Rate Impact 60 Years ($ / GJ)	0.101	0.007	0.108
Levelized Incremental Revenue Requirement ($millions)[29]	18.971	1.315	20.286
Incremental Revenue Requirement PV 60 Years ($millions)	300.513	21.654	322.167
Net Cash Flow NPV 60 Years ($millions)	2.365	0.303	2.668
2019 Incremental Rate Base ($millions)	242.250	17.937	260.187

5.2 *ACCOUNTING TREATMENT*

Consistent with FEI's treatment of CPCNs, the capital costs of these two projects will be held in Work in Progress Attracting AFUDC until January 1 of the year following when they are in service. The projects are planned to be in service in October, 2018. On January 1, 2019 the projects costs will be transferred to Gas Plant in Service accounts and included in the Company's Rate Base.

5.2.1 Negative Salvage

Abandonment/demolition costs related to the existing 20" Coquitlam Gate IP pipeline, and Coquitlam Gate station will be charged to FEI's existing Negative Salvage Deferral Account in accordance with the approved treatment of these costs as approved in Order G-44-12. The abandonment / demolition costs are forecast to be $3.540 million (2014 dollars) or in as-spent dollars to be $4.289 million (including AFUDC of $0.117 million). These costs are identified in Confidential Appendix E-3-1.

Charges for abandonment and demolition costs as well as the negative salvage provision are shown in Confidential Appendix E-1-1 Schedule 9 for the Coquitlam Gate IP Project and in Confidential Appendix E-1-2, Schedule 9 for the Fraser Gate IP Project (there are no abandonment or demolition costs for the Fraser Gate IP Project).

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27 Numbers in rows may not add exactly due to rounding.

28 Abandonment and demolition costs will be charged to the Negative Salvage Deferral Account in accordance with BCUC Order G-44-12.

29 Levelized Rate Impact for 60 Years x 187,832 TJ / 1,000; The volume of 187,832 TJ is from FEI's compliance filing for Common Rates, dated October 31, 2014, Appendix A, Schedule 5, Column 2, Row 28 (Total Non-Bypass Sales and Transportation Service Volumes.

5.2.2 LMIPSU Application Costs

FEI is seeking Commission approval under Sections 59-61 of the Act for deferral treatment of the LMIPSU Application costs.[30] The Application costs include expenses for legal review, consultant costs[31], Commission costs and Commission approved intervener costs and are based on a written/oral hearing process. FEI is seeking approval to add these costs to a new deferral account, the LMIPSU Application Costs account, attracting the weighted average cost of capital until it enters rate base on January 1, 2016. FEI proposes a three year amortization period starting in 2016. The December 31, 2015 net-of-tax balance in the LMIPSU Application Costs deferral account is forecast to be $1.047 million as set out in the following Table 5-3.

Table 5-3: Forecast Deferred Regulatory Application Costs ($millions)

Particulars	As-Spent
Application Costs	1.307
WACC Return	0.080
Total Before Tax Offset	1.387
Tax Offset	(0.340)
Total	**1.047**
Annual Amortization for 3 Years	0.349

5.2.3 LMIPSU Development Costs

FEI is seeking Commission approval under Sections 59-61 of the Act for deferral treatment of the LMIPSU Development costs.[32] Development costs are related to charges for project management, engineering, and consultants' costs for assessing the potential design and alternatives and associated costs prior to Commission approval of the Projects. FEI is seeking Commission approval for a deferral account, the LMIPSU Development Costs account, attracting the weighted average cost of capital until it enters rate base on January 1, 2016. In consideration of the amortization period of similar deferral accounts in FEI and the forecast rate impact of this proposed account, FEI proposes a three year amortization period starting in 2016.[33]

[30] Deferral treatment of development and application costs is consistent with the treatment of development costs in recent FEI CPCNs such as the Application for a Certificate of Public Convenience and Necessity to Construct and Operate a Transmission Pressure Pipeline Crossing of the Muskwa River for the Fort Nelson Service Area (Order G-2-14) and Application for a Certificate of Public Convenience and Necessity for the Huntingdon Station Bypass (Order G-6-14)

[31] For assistance in answering information requests.

[32] Deferral treatment of development and application costs is consistent with the treatment of development costs in recent FEI CPCNs such as the Application for a Certificate of Public Convenience and Necessity to Construct and Operate a Transmission Pressure Pipeline Crossing of the Muskwa River for the Fort Nelson Service Area (Order G-2-14) and Application for a Certificate of Public Convenience and Necessity for the Huntingdon Station Bypass (Order G-6-14)

[33] Please note that FEI would agree to a BCUC determination to include development deferral costs in capital costs charged to Gas Plant in Service which would have a substantially longer amortization; however, in this

The pre-tax development costs are forecast to be $2.639 million. Of this amount, 95 percent is attributable to the Coquitlam Gate IP Project and 5 percent is attributable to the Fraser Gate IP Project.[34] The Development costs allocated by project are detailed in the following table:

Table 5-4: Forecast Deferred Development Costs ($millions)

Projects	Allocation	As-Spent	WACC return	Total Before Tax Offset	Tax Offset	Total	Annual Amorti-zation
Coquitlam Gate IP Project	95%	2.320	0.187	2.507	(0.603)	1.904	0.635
Fraser Gate IP Project	5%	0.122	0.010	0.132	(0.032)	0.100	0.033
Total	**100%**	**2.442**	**0.197**	**2.639**	**(0.635)**	**2.004**	**0.668**

As shown in Table 5-4 above, the December 31, 2015 net-of-tax balance in the LMIPSU Development Costs deferral account is forecast to be $2.004 million.

circumstance the increase in costs to customers over the life of the project may not offset the short term rate impact.

[34] Allocation is based on the relative length of IP pipeline segments replaced.

6. OVERVIEW OF ENVIRONMENTAL, ARCHAEOLOGICAL AND SOCIO-ECONOMIC ASSESSMENTS AND PROVINCIAL GOVERNMENT ENERGY OBJECTIVES

FEI has assessed the environmental, archaeological and socio-economic impacts from the Projects. Based on the assessments undertaken for the Projects, the Projects are expected to have minimal environmental and archaeological impacts. These impacts can be mitigated through the implementation of standard best management practices.[35] Any risk to Project construction timelines and costs as a result of encountering contaminated soil or groundwater can be minimized through additional investigations. The areas surrounding fish-bearing streams have been provisionally assessed as having high archaeological potential and therefore an Archaeological Impact Assessment (AIA) has been recommended for these areas.

The socio-economic report indicates the Projects have the potential to result in a net positive impact to residents and businesses through the creation of additional employment and economic "spin-offs" for local business owners. Improving the long-term natural gas supply to the area also has positive economic benefits. Any short-term disruption effects of the Projects are expected to be temporary and generally minor should the recommended mitigation measures be implemented. No long term negative effects are expected to result.

6.1 *ENVIRONMENTAL ASSESSMENT*

FEI retained Dillon Consulting (Dillon)[36] to conduct a preliminary environmental assessment of the Projects.

The assessment is based on both a desktop review of available information and initial field investigations. The assessment was undertaken to identify and describe the potential impacts to the biophysical environment from the Projects and to provide a basis for the completion of detailed assessments and preparation of environmental management plans to be completed once Commission approval of this Application is received and prior to construction commencement. The assessment reviewed four segments of pipeline, only two of which are pertinent to this CPCN Application:

- Fraser Gate IP pipeline Replacement; and
- Coquitlam Gate IP pipeline Replacement.

Based on this preliminary assessment, the environmental risk of the Projects is low and any potential environmental impacts from the Projects can be mitigated through standard environmental protection and mitigation measures.

[35] Best management practices as defined by Dillon in its Report Appendix B-1, Table 21, pp. 60-64.
[36] Dillon is a multi-discipline consulting firm that has provided planning, engineering, environmental sciences and management services to the private and public services since 1946.

6.1.1 Preliminary Environmental Assessment

The results of the work undertaken by Dillon are outlined in the FEI – Lower Mainland Natural Gas System Upgrades: Metro Vancouver Reinforcements Environmental Overview Assessment report (Environmental Overview Assessment), a copy of which is attached as Appendix B-1. The assessment included the following areas:

- Current Land Use;
- Soils and Surficial Geology;
- Contaminated Sites;
- Natural Environment; and
- Species at Risk.

The Environmental Overview Assessment identified natural features that could potentially be impacted by the Projects' construction as well as areas of potential contamination that could impact the Projects' construction, costs and timelines. These potential impacts are summarized below.

The Environmental Overview Assessment identifies significant natural features such as fish, wildlife, and terrestrial habitat along the two IP pipeline segments that could be impacted during construction. The Environmental Overview Assessment also identifies ways to minimize the impacts through implementation of standard best management practices. These natural features can be summarized into the following categories:

- Watercourses crossed by or in close proximity to the pipeline alignments;
  - Fraser Gate IP Replacement – 1; and
  - Coquitlam Gate IP Replacement – 15;
- Parks/conservation areas crossed by or in close proximity to the pipeline alignments;
  - Fraser Gate IP Replacement – 2; and
  - Coquitlam Gate IP Replacement – 16;
- Species at risk potentially found on or in close proximity to the pipeline alignments;
  - Fraser Gate IP Replacement – 2; and
  - Coquitlam Gate IP Replacement – 9.

Table 21 of the Environmental Overview Assessment (Appendix B-1, page 60-64) identifies proposed best management practices to minimize impacts to the significant natural features.

In addition, the report identified locations with a high potential of encountering soil or groundwater contamination within the Projects' areas which may impact Project construction, costs and timelines. These areas of high potential are called Areas of Potential Environmental Concern (APECs). The Environmental Overview Assessment recommended that low risk APECs be managed during construction but medium-high risk APECs should have further assessment through the use of subsurface soil and water investigation prior to construction. The APECs found within each pipeline segment are as follows:

- Fraser Gate IP Replacement – 1 low risk APEC and 1 medium to high risk APEC; and
- Coquitlam Gate IP Replacement – 5 low risk APECs and 9 medium to high risk APECs.

FEI will be undertaking further assessment of medium to high risk APECs during the detailed engineering phase of the Projects to minimize the risk of these APECs on the Project costs and timelines. On pages 65 to 66, the Environmental Overview Assessment (Appendix B-1) summarizes that:

- There is a high potential for encountering soil or groundwater contamination within the Projects' areas;
- There is a requirement for regulatory permitting due to the potential for impacts to the natural environment with regards to vegetation and fish habitat;
- The Projects' activities in natural areas should take place during the window of least risk, (i.e. fisheries window or bird nesting window) to minimize any potential impact; and
- The potential environmental impacts associated with the Projects can be avoided or mitigated by following applicable provincial and federal guidelines and through the application of standard best management practices and mitigation measures.

Table 21 (pages 60 to 64) in the Environmental Overview Assessment report (Appendix B-1) outlines the relevant best management practices and mitigation measures to minimize and avoid potential effects of the Projects on the natural environmental features within the pipeline route. Examples of best management practices and mitigation measures are:

- Ground and surface water management;
- Minimizing vegetation removal;
- Erosion and sediment controls;
- Adherence to fish and bird timing windows;
- Soil handling procedures; and
- Spill response procedures.

FEI will follow the best management practices and mitigation measures applicable to the IP pipeline replacements during construction.

Based on the preliminary environmental assessment work completed by Dillon, the Projects will likely require provincial permitting/authorization under the Environmental Management Act and the Water Act, and potentially federal permitting/authorization under the Fisheries Act and the Species at Risk Act. Upon Commission approval of this Application, FEI will undertake a Detailed Environmental Assessment to confirm permitting requirements and apply for the required permits accordingly.

6.1.2 Further Plans

Environmental constraints and potential environmental impacts related to the Projects will be further documented during the Detailed Environmental Assessment, which will include vegetation, fish and wildlife and their habitat, and surface/ground water resources. A major component of the Detailed Environmental Assessment will be further assessments through the use of subsurface soil and water investigation of the medium to high risk APEC sites.

Site specific mitigation strategies will be developed to offset any potential negative impacts associated with the Projects or from the environment on the Projects. All required environmental permits and approvals for the Projects will be identified and applied for during the detailed engineering phase of the Projects.

Detailed environmental specifications will be prepared as part of the Project tendering process to ensure that contractors are aware of the Projects' environmental requirements in addition to FEI's internal environmental standards. An Environmental Management Plan specific to the Projects will be developed by successful contractors prior to commencement of the Projects. Environmental monitoring will be undertaken during all sensitive aspects of the work program and the designated environmental monitor will have "stop work authority" in the event that works underway have the potential to impact the natural environment.

6.2 *ARCHAEOLOGY*

An Archaeological Overview Assessment (AOA) (Appendix B-2) of the Projects was undertaken by Stantec Consulting Ltd. (Stantec)[37] to assess the potential for archaeological and/or cultural heritage resources within the Projects area and to determine the requirements for an AIA prior to ground disturbing activities.

The AOA is based on a desktop review of available information and a preliminary field reconnaissance (PFR) of the entire area of the Projects. The AOA reviewed four segments of pipeline, only two of which are pertinent to this CPCN:

- Fraser Gate IP Project; and
- Coquitlam Gate IP Project.

[37] Stantec is a multi-discipline consulting firm that has provided a variety of professional services including archaeological, planning, engineering, and environmental services since 1954.

The AOA concluded that, for the two segments noted above, the majority of each Project is considered to have low archaeological potential due to the amount of previous disturbance by development activities. The areas surrounding fish-bearing streams have been provisionally assessed as having high archaeological potential and therefore an AIA has been recommended for these areas. A detailed AIA will be undertaken once Commission approval of this Application is received and prior to construction of the Projects.

6.2.1 Archaeological Overview Assessment

As noted above, the results of the work undertaken by Stantec are outlined in the AOA.

The report indicates that with respect to the Coquitlam Gate IP Replacement and the Fraser Gate IP Replacement:

- There are no recorded archaeological sites within 500 metres of the area of the Projects;
- Most of the area of the Projects was evaluated as having low archaeological potential and therefore not requiring any further archaeological assessment; and
- Four unnamed creek crossings at the south base of Burnaby Mountain have a high archaeological potential, and therefore require an AIA.

Based on the preliminary AOA, a permit will be required under the Heritage Conservation Act in order to undertake a detailed AIA of the above mentioned areas.

6.2.2 Further Plans

Potential archaeological and cultural impacts associated with the four areas of high archaeological potential will be further assessed during the AIA, which will be undertaken once approval of this Application from the Commission is obtained and prior to construction. A subsurface testing program will be undertaken, where required, within these four areas, as part of the AIA, to further identify sensitive areas. The AIA will provide a detailed assessment to allow for development of site specific mitigation strategies to offset any potential impacts associated with the Projects. All archaeological permits will be obtained during the detailed engineering phase of the Projects.

Detailed archaeological specifications will be prepared as part of the Projects' tendering process to ensure that contractors are aware of the Projects' archaeological requirements. As described above, a Project specific Environmental Management Plan, including protection of archaeological and cultural resources, will be developed by the successful contractors prior to commencement of the Projects. If required, archaeological monitoring will be undertaken during all sensitive aspects of the work program and the designated archaeological monitor will have "stop work authority" in the event that works underway have the potential to impact archaeological or cultural resources.

6.3 *SOCIO-ECONOMIC ASSESSMENT*

FEI also retained Dillon to undertake a socio-economic impact assessment study (see Appendix B-3) of the proposed routes for five pipeline sections, only two of which are pertinent to this CPCN application:

- Fraser Gate IP Project; and
- Coquitlam Gate IP Project.

The socio-economic report indicates the Projects have the potential to result in a net positive impact to residents and businesses through the creation of additional employment and economic spinoffs for local business owners. Improving the long-term natural gas supply to the area also has positive economic benefits. Any short-term disruption effects of the Projects are expected to be temporary and generally minor should the recommended mitigation measures be implemented. No long term negative effects are expected to result.

6.3.1 Socio-Economic Overview

The study found that, for the most part, the proposed routes for the pipeline sections are within existing road rights-of-way. Land uses adjacent to the Projects' sections are largely urban and include residential (high to low density), commercial, institutional (i.e. schools, churches), parks/open space, recreation (i.e. golf courses).

An inventory of the different business, commercial, and industrial areas along the Projects' routes, identified that large malls, small retail clusters, service stations, and commercial strips were the most prevalent. Potential effects to business activity during construction will include general disturbances, delays to road traffic, access impacts, and loss of on-street parking. Dillon indicated that construction activities also have the potential to disturb nearby residents and users of recreation space/institutions and that construction noise has the potential to dissuade people from using outdoor living space for a period of time.

The potential for cumulative effects was reviewed. The construction of the Projects could potentially overlap with Kinder Morgan's construction of the Trans Mountain Expansion Pipeline project, which will cross the Coquitlam Gate IP pipeline section in one location between Lake City Way and Underhill Avenue along Broadway in Burnaby. Dillon recommends that FEI consult with Kinder Morgan in order that any cumulative effects are recognized and managed appropriately. FEI is maintaining ongoing contact with Kinder Morgan to ensure that:

- both project teams are fully informed of respective project progress and development;
- should there be a possibility of construction overlap, risks are identified and mitigation measures are put in place; and
- cumulative effects are recognized and managed appropriately.

The study makes several recommendations (based on industry best practices and applicable requirements of local regulations) to mitigate, manage and minimize potential, adverse effects and to monitor Projects' impacts as construction proceeds. Recommendations include compliance with municipal noise bylaws and limiting traffic access restrictions to businesses and residents as much as possible. The report also suggests that a Traffic Management Plan can address temporary disturbances to vehicular traffic that will, for short periods of time, reduce areas of residential and commercial on-street parking. Proposed mitigation activities to minimize any negative effects are contained in Section 3 of the report. Construction and Monitoring recommendations are outlined in Section 5 of the report.

Dillon also determined the construction of the Projects has the potential for positive employment impacts and will contribute to the local economy in the Lower Mainland, BC, Canada, and outside Canada, concluding that new jobs may be generated during the construction period. It also found economic spin-offs will be created, such as increased demand for local hospitality services (hotels and restaurants for employees working on the construction sites, etc.). FEI estimates the economic benefits (see Table 6-1) of the two upgrades will be as follows:

Table 6-1: Potential Economic Benefits

Coquitlam Gate IP *($millions – 2014 dollars)*

Cost ($000)	Lower Mainland	All BC (except Lower Mainland)	Canada (except BC)	Outside Canada	Sub-Total
Materials		1.722		32.713	34.435
Construction	107.404		46.030		153.434
Owner	13.412				13.412
Sub-Totals	**120.816**	**1.722**	**46.030**	**32.713**	**201.281**

Fraser Gate IP *($millions – 2014 dollars)*

Cost ($000)	Lower Mainland	All BC (except Lower Mainland)	Canada (except BC)	Outside Canada	Sub-Total
Materials		0.097		1.847	1.944
Construction	7.978		3.419		11.397
Owner	1.515				1.515
Sub-Totals	**9.493**	**0.097**	**3.419**	**1.847**	**14.856**

The study concludes that with the adoption of the recommendations outlined in the socio-economic report, the Projects are not expected to have any negative, long-term effects on the socio-economic conditions in the study area. There are expected to be some positive socio-economic benefits to the regional area and the province resulting from the Projects. Additionally

FEI will work with municipalities, community associations and local stakeholders to identify needs and suggestions on meaningful remediation projects after construction is complete.

6.3.2 Future Plans

FEI will continue to work with the local stakeholders, agencies and the public to effectively understand and address any impacts the Projects may have on the community as further described in section 7 of the Application. Once the proposed Projects are approved the Company will develop construction plans to minimize the impact that construction activities might have in the Projects area.

6.4 *PROVINCIAL GOVERNMENT ENERGY OBJECTIVES*

The Provincial government's energy objectives are defined in Section 1 of the UCA. Based on the results of the socio-economic report (Appendix B-3), FEI expects that the Projects will support the following British Columbia energy objective found in Section 2(k) of the Clean Energy Act:

> *to encourage economic development and the creation and retention of jobs*

The socio-economic report determined the construction of the Projects has the potential for positive employment impacts and will contribute to the local economy in the Lower Mainland, BC, Canada, and outside Canada, concluding that new jobs may be generated during the construction period. It also found economic spin-offs will be created, such as increased demand for local hospitality services.

6.5 *CONCLUSION*

Environmental, archaeological and socio-economic studies have been undertaken for the Projects.

The Environmental Overview Assessment concluded that any environmental impacts associated with the Projects are expected to be minimal and can be mitigated through the implementation of standard best management practices and mitigation measures. The report also identified APECs that can be managed either during construction (low risk APECs) or through further investigations prior to construction (medium to high risk APECs). Further investigation of medium to high risk APECs will be undertaken once Commission approval of this Application is received and prior to construction of the Projects.

The AOA concluded that the majority of the Projects are considered to have low archaeological potential due to the amount of previous disturbance by development activities. The areas surrounding fish-bearing streams have been provisionally assessed as having high archaeological potential and therefore an AIA has been recommended for these areas. An AIA will be undertaken once Commission approval of this Application is received and prior to construction of the Projects.

The Socio Economic study concludes that, with the adoption of the recommendations outlined in the Socio-Economic report, the Projects are not expected to have any negative, long-term effects on the socio-economic conditions in the study area. Positive socio-economic benefits to the regional area, the province and beyond are expected to result from the Projects. Additionally FEI will further work with municipalities, community associations and local stakeholders to identify needs and suggestions on meaningful remediation projects after construction is complete.

During construction, FEI will follow the best management practices and mitigation measures applicable to the IP pipeline replacements and as determined appropriate by a Qualified Environmental Professional or a Professional Archaeologist.

In summary, any potential environmental, archaeological, or socio-economic impacts associated with the Projects are expected to be minimal and can be mitigated through the implementation of standard best management practices and mitigation measures.

7. PUBLIC CONSULTATION

7.1 INTRODUCTION

The Projects are designed to deliver continued safe and reliable supply of natural gas to FEI customers in the Lower Mainland, one of the most densely populated areas serviced by FEI. Residents, businesses, commuters, transit operators, and companies that move goods stand to be disrupted by any construction in road rights of way or neighborhoods. Other challenges facing the Projects due to the high density include: development planned for preferred routes; limited space around and within route corridors; construction fatigue on the part of residents and businesses disrupted by public works projects over the past few years; irregular street layout; and opposition to the removal of the tree canopy or any work that would impact green space.

As noted in section 6, the Projects are expected to create additional employment and economic benefits for local business owners. Improvement of the long-term natural gas supply to the area is also expected to provide positive economic benefits. Any short-term disruptive effects of the Projects are expected to be temporary and generally minor with the implementation of the recommended mitigation measures. No long term negative effects are expected to result.

Public consultation and communication are integral components of FEI's project development process. FEI recognizes that the public expects meaningful consultation and engagement, and its knowledge and interest in energy issues and pipelines is fairly high. These factors significantly influenced the creation of the Communications and Consultation plan (see Appendix C-1).

The plan and activities that have occurred to date with respect to the Projects are provided in this section, which is organized as follows:

- An overview of the public consultation plan;
- A list of stakeholders for the Projects;
- A summary of consultation activities to date (see Appendix C-2) and input received; and
- Ongoing consultation plans.

The Company has also engaged First Nations communities and leadership in the area. This is discussed separately in section 8.

7.2 COMMUNICATIONS AND CONSULTATION PLAN

The focus of the Company's public Communication and Consultation Plan is to ensure that residents, land owners, community stakeholders and other interested and affected parties are informed about the Projects, have access to information regarding the Projects, and are encouraged to provide input that is considered as part of the decision-making process. FEI's main goal for public consultation has been to create a dialogue with interested parties, explain the need for the Projects, present FEI's preferred Alternatives for the Projects, consider other options where possible, and ensure that interested parties are made aware that FEI must consider environmental impacts, constructability, and rate impacts resulting from the Projects in making a final decision.

Issues raised by stakeholders in each community in which work is planned, as well as operational issues with stakeholders (such as municipal permitting for use of roads and rights of way, and anticipated impacts to the public and neighbourhoods) and regulatory approvals have been or will be addressed by FEI. FEI held informal and formal meetings with various levels of government, business organizations, and other stakeholders as part of its public consultation. Activities included:

1. Communication regarding the Projects with the pertinent government agencies at the federal, provincial, municipal and regional levels;
2. Communication regarding the Projects with local residents; and
3. Meetings, presentations and conversations with stakeholders.

It should be noted that FEI was considering upgrades to five sections of pipeline when consultation began, however of these five projects only the two IP pipelines are the subject of this CPCN Application. Some of the materials created for the consultation process may reference all five proposed sections, however, only the IP pipeline related material is relevant to this Application.

7.2.1 Pre-consultation

Prior to the public consultation for the Projects, research was undertaken to identify communication and consultation objectives, impacted parties, and key issues.

7.2.1.1 Communication and Consultation Objectives

FEI identified a number of communication and consultation objectives as part of the public consultation for the Projects including:

- Create awareness of the pipeline upgrades, specifically within communities directly impacted by construction;
    - Ensure balanced and objective information is provided to all stakeholders regarding the upgrades;
    - Provide opportunity for public feedback; and
    - Address stakeholder concerns or provide explanations when unable to do so;
- Support Company values of safety, environmental commitment, and customer value; and

- Ensure FEI meets communication and consultation requirements as established by its regulators.

7.2.1.2 Identification of Projects Stakeholders other than First Nations

Included within the Company's Communication and Consultation plan dated March 2014 (Appendix C-1) FEI has identified key stakeholders. Each of the following groups or individuals was approached by email, telephone or letter, informing them about the Projects. The Projects Team met with those with concerns, queries or seeking more information.

1. Residents and businesses neighboring the Projects corridor, and commuters that may be impacted by the Projects
2. Community associations and organizations, including:
    a. Burquitlam Community Association;
    b. Ranch Park Community Association;
    c. Oakdale Neighbourhood Association;
    d. South East Coquitlam Ratepayers Association;
    e. Mundy Park Community Association;
    f. North East Burnaby Community Association;
    g. Burnaby North Community Association;
    h. Hastings Sunrise Community Policing Office;
    i. Grandview Woodland Area Council; and
    j. Frog Hollow Neighbourhood House.

3. Organizations representing business and commerce, including:
    a. Austin Heights Business Improvement Association;
    b. Burnaby Board of Trade;
    c. North Road Business Improvement Association;
    d. Burnaby Heights Merchants Association;
    e. Brentwood Town Centre Mall;
    f. Lougheed Town Centre Mall;
    g. Commercial Drive Business Improvement Association;
    h. Hastings North Business Improvement Association;
    i. Vancouver Board of Trade;
    j. Hastings Crossing Business Improvement Association; and

   k. Tri Cities Chamber of Commerce.

4. Municipal and regional governments – Mayor, Council, City Manager and/or staff within the following:
   a. City of Vancouver;
   b. City of Burnaby;
   c. City of Coquitlam;
   d. City of Port Coquitlam; and
   e. Regional District of Metro Vancouver.

5. Provincial government:
   a. BC Ministry of Energy & Mines;
   b. Members of the Legislative Assembly;
   c. Suzanne Anton, Liberal MLA Vancouver Fraserview, Minister of Justice and Attorney General;
   d. Shane Simpson, NDP MLA, Vancouver Hastings;
   e. Jenny Kwan, NDP MLA, Vancouver Mount Pleasant;
   f. Linda Reimer, Liberal MLA, Port Moody Coquitlam;
   g. Selina Robinson, NDP MLA, Coquitlam Maillardville;
   h. Richard Lee, Liberal MLA, Burnaby North; and
   i. Jane Shin, NDP MLA, Burnaby Lougheed.

6. Federal government:
   a. Members of Parliament;
   b. Kennedy Stewart, NDP MP, Burnaby-Douglas;
   c. Libby Davies, NDP MP, Vancouver East; and
   d. Finn Donnelly, NDP MP, New Westminster-Coquitlam.

7. Other utilities:
   - BC Hydro;
   - BC Hydro (Metro North Project); and
   - Kinder Morgan Canada (Trans Mountain).

7.2.1.3 Issues Identification

The Project team identified key concerns expected to be raised by landowners, residents, businesses, and other community stakeholders that would potentially be impacted by the Projects. The Project team then gathered information to address concerns, explain how proposed routes were determined and how the Company planned to mitigate any impacts during construction.

The anticipated concerns are listed below:

1. **Route selection:** FEI will be prepared to outline the regulatory and operational criteria behind the proposed pipeline route and how alternative routes were considered.
2. **Traffic disruption:** Land owners, residents and businesses are expected to request specific and detailed information about how access to their homes and businesses would be disrupted by construction and what measures FEI would utilize to mitigate impact. The Project team will prepare maps of the proposed route and prepare members to discuss in detail which homes, businesses and roadways would require changes to access. The Project team would reinforce, during these discussions, that detailed information would be available only after detailed engineering work is complete.
3. **Public consultation process:** Given the extent of the Projects, FEI expects many resident groups, neighbourhood associations, advocates for the environment and individuals to scrutinize the extent to which public consultation was carried out. The Project team's efforts to be transparent and accountable to all those impacted by the Projects – as well as those seeking to provide input – will be available for review by stakeholders.
4. **Impact to the environment:** FEI will be prepared to speak to how the Projects will be guided by municipal by-laws and will seek to minimize the impact of construction on the environment.
5. **Legacies:** FEI will be prepared to outline how it plans to work with municipalities, community associations and residents to identify local needs and accept suggestions on meaningful remediation projects after construction is complete.
6. **Coordination of work, safety of pipelines:** FEI will establish good communication processes and coordinate work to ensure stakeholders are adequately informed and that disruption to residents, land owners, businesses and the public is mitigated.
7. **Business opportunities:** Area businesses and municipalities are expected to seek out ways they could work with and supply FEI as the Projects move forward.

7.2.1.4 Development of Messaging

As these upgrades intersect various municipal boundaries, traversing through scores of neighbourhoods, communities and public spaces such as schools, community centres and hospitals, FEI anticipated that the associated issues along with the level of public interest and engagement would vary widely across the region. The communications approach and information methods (fact sheets, information boards, etc.) were designed to:

- include information specific to each community, neighbourhood or business area;
- provide information and consultation to a broad spectrum of stakeholders due to the financial impact on ratepayers;
- include information for stakeholders about how routing decisions were reached and which alternatives were considered; and
- be consistent and integrated, recognizing that communications activities are not performed in isolation and stakeholders may receive information from more than one source.

The following key messages were developed and refined, then used to create collateral information that included a fact sheet (Appendix C-3), story boards (Appendix C-4), a web page about the upgrade Projects and a script for Contact Centre staff (Appendix C-5) who would be responding to customer and public queries.

- FEI is upgrading its Lower Mainland pipeline system to ensure customers continue to have reliable access to natural gas.
- In 2013, FEI identified integrity and related security of supply issues with regard to a section of the Fraser IP pipeline and the Coquitlam IP pipeline. Specifically:
    - The Coquitlam IP pipeline is reaching 56 years in service, is experiencing an increased frequency of corrosion leaks, and is approaching the end of its service life; and
    - The Fraser IP pipeline is currently seismically vulnerable.

- These Projects will involve the installation of approximately 20.5 kilometres of Intermediate Pressure pipeline. The upgrades will:
    - Replace 20 kilometres of NPS 20 IP pipeline with a NPS 30 pipeline between Coquitlam and Vancouver (called the "Coquitlam IP pipeline") which is over 50 years old and now approaching end of service life. This is required to provide security of supply to customers in Coquitlam, Burnaby and Vancouver; and
    - Replace 500 metres of NPS 30 IP pipeline with a seismic strengthened NPS 30 pipeline in Vancouver between Fraser Gate and the corner of East Kent Avenue & Elliott Street (called the "Fraser IP pipeline") to increase seismic resistance to current standards.

- FEI will consult and engage with stakeholders to ensure the public understands the reasons for the upgrades, the alternatives that were considered and what mitigation measures are planned to deal with any potential environmental impacts of the Projects. Additionally, stakeholder engagement will aim to create awareness around the community benefits of the upgrades, including local economic benefits as well as legacy projects. FEI is committed to meeting or exceeding rigorous safety standards and trains its employees to work to these high safety standards.

7.3 *SUMMARY OF CONSULTATIVE ACTIVITIES AND INPUT RECEIVED AND ADDRESSED*

FEI recognized at the outset of planning for the Projects that the proposed upgrades would be undertaken at a time when public interest in energy issues and pipelines is fairly high and that the public has an expectation for meaningful consultation and engagement.

The Company's objective was to address specific issues raised by stakeholders in each community in which the planned work is being undertaken, as well as operational issues with stakeholders, such as municipal permitting for use of roads, and use of rights of way, anticipated impacts to the public and neighbourhoods and regulatory approvals.

The concerns that most often arose at stakeholder meetings were largely anticipated; a listing follows along with the rationale, solutions or options presented by the Project Team.

- **Route selection:** Several people consulted by FEI questioned how the route was selected, and sought an explanation as to why the Coquitlam Gate IP pipeline could not be constructed on the same street as the existing line.
    - FEI outlined the regulatory and operational criteria behind the proposed pipeline route and how alternative routes were considered and then deemed feasible or not, based on encroaching urban development and confined construction areas. Safety requirements, location of other underground utilities, environmental protection and disruption to local residents were also considered during route alignment. The proposed route also minimizes potential impacts on the environment and communities.

- **Traffic disruption:** Land owners and residents sought specific information about how access to their homes and businesses would be disrupted by construction and the measures FEI planned to utilize to mitigate impact.
    - FEI will develop a traffic management plan. Once construction begins, the Project team will work with the municipalities to ensure signage is posted to notify residents and commuters of upcoming construction. This information will also be disseminated via advertisements, updates to the media and on FEI's website so that the public is aware of work schedules and can adjust their schedules, as needed.

- **Business opportunities:** Several business groups and municipalities – including the Surrey Board of Trade, Burnaby Board of Trade, Hastings Crossing Business Association and City of Coquitlam - asked FEI to establish a process that would identify opportunities for local businesses and contractors, including creation of a skills inventory of interested contracting opportunities to provide to the general contractor.
    - FEI created the registry and committed to sharing information with the general contractor, once selected.

- **Impact to the environment:** A number of community groups, residents and municipalities expressed concern about trees that FEI would remove during construction, how they would be replaced and generally the impact of construction on green space. Several people questioned why the existing pipeline would remain in ground (as opposed to being removed during construction).
    - Construction crews will be guided by municipal bylaws. The Project team is working with municipalities to map out trees slated for removal during construction, and replacement once work is complete.
    - Based on the complex underground network of utilities around the existing gas lines, and the requirement to maintain the existing NPS 20 IP pipeline operation during construction, the optimal approach is to abandon the gas line in place. The Projects will see retired sections from the pressurized gas network disconnected after the new NPS 30 IP pipeline is constructed, commissioned and fully operational. The abandonment work will be carried out in accordance with proper standards and procedures.

- **Public consultation process:** the catchment area for consultation was challenged, as was the time in which stakeholders could provide input on this stage of the process.
    - FEI outlined in letters, stakeholder meetings and public information sessions of its plan to inform land owners, residents, stakeholders and interested parties about the proposed upgrade, the regulatory process, and how they could provide input.

- **Legacies:** FEI will work with municipalities, community associations and local stakeholders to identify community needs and suggestions on meaningful remediation projects after construction is complete.
    - FEI's objective is to create these legacies as part of repair and restoration work to boulevards and pavement impacted during construction.

- **Coordination of work, safety of pipelines:** Stakeholders who routinely access rights of way to carry out work expressed the need for good communication processes to ensure work was well coordinated and that disruption to land owners, residents, and the public is mitigated.

- Protocols have been created with other stakeholders whose work will intersect with the Projects.

Discussions with stakeholders, governments, associations and individuals helped inform and develop messaging for the public information sessions, a process also guided by the socio-economic report prepared by Dillon Consulting; it concluded that there were no potential impacts to the public that could not be successfully mitigated.

7.3.1 Consultation with the Public and Feedback Received

FEI identified, engaged, and solicited feedback from the public and affected parties near the Projects and provided them with updated information on the proposed work plan. Consultation undertaken involved:

1. Residents located within 200 metres of the intermediate pressure pipeline upgrades were mailed a notice in May 2014 outlining the scope of the proposed Projects and inviting them to a series of public information sessions (Appendix C-6).
2. Advertisements with respect to the public information sessions were placed in two daily newspapers with circulation throughout BC and in community newspapers in the Projects' area (Appendix C-7). They ran for two to three weeks before the session took place in the community.
3. FEU's 950,000 natural gas customers received information about the Projects via Quick Connect, an insert in their monthly invoice in September 2014 (Appendix C-8). Additionally, customers who signed up for The Conserver (Appendix C-9), an electronic newsletter, received an article on the Projects. In each, FEI outlined the parameters of and justification for the Projects, proposed start of construction, and the potential impact to rates. The Company also laid out the next steps with regards to the regulatory process and provided information on how customers could contact the BCUC or the Company.

7.3.1.1 Public Information Sessions and Feedback Received

In early 2014, after consulting with companies who have expertise and knowledge of industry leading practices in public consultation, FEI determined it would host a series of five information sessions spaced out across the four communities. As stated above, FEI had been considering upgrades to five sections of pipeline when consultation began, and is now proceeding with the two IP pipelines as part of this CPCN Application. Letters that included detailed information about the five sections and the public information sessions were mailed to 8,000 residents within 200 metres of the existing pipelines in May 2014. The letter is attached as Appendix C-6. Community, municipal and government stakeholders who had already been consulted by the

Project team, as well as those who had declined offers of a meeting, were invited to the community information sessions. The invitation is attached as Appendix C-10-1. Given that the proposed upgrades ran along major roadways and thoroughfares relied upon by commuters and commercial vehicles, FEI also advertised the sessions in nine community newspapers and two daily newspapers with province-wide circulation; the advertisements included as Appendix C-7 appeared twice each in each community paper, and once in each daily newspaper.

Key messages were refined then used to create collateral information that included a fact sheet (Appendix C-3), story boards (Appendix C-4), a web page about the upgrade Projects and a script for Contact Centre staff (Appendix C-5) who would be responding to customer and public queries. A map prepared by the Engineering group also became part of the Projects' collateral inventory (Appendix C-11).

Project team employees assigned to staff the public information sessions received training in order to optimize their interaction with attendees, and to assist them in terms of discussing the Projects with the public, customers, as well as land and business owners.

Following is a summary of each session and its outcome:

Table 7-1: Summary of Public Information Sessions

Date	Community	Response
May 27, 2014	Coquitlam Poirier Sports and Leisure Complex, 633 Poirier Street	*Attendees: 17 total including business owners, land owners, interested parties, representatives from the City of Coquitlam and Chamber of Commerce, and a representative of Kinder Morgan.* Attendees inquired as to why the work is required; FEI provided a brief justification for the Project, reassuring residents that the existing pipeline is being operated safely and that industry practice would continue to be followed. Detailed routing, the potential impacts on residential areas and the proposed mitigation measures were also provided, as was the impact on rates. City of Coquitlam representatives were on hand to gauge public input and seek more information about the alignment between construction windows on Como Lake Avenue. The Chamber of Commerce made inquiries about the impact to businesses in the construction areas. FEI provided the details and the measures FEI would take to mitigate impacts.
June 3, 2014	Coquitlam Executive Plaza Hotel, 405 North Road	*Attendees: 13 total, most describing themselves as individuals or landowners; MLA Jane Shin; two people from the City of Burnaby; a person representing Kinder Morgan; and three employees of FEI.* Several residents from Highlawn Drive attended and expressed concern about a construction Project so soon after the installation of a water main which had disrupted their neighbourhood for months. They received information about how the proposed route was selected, efforts to mitigate impact on residents (dust, debris, access by the disabled). This group suggested the line be re-routed through a park and school in the neighbourhood. FEI contacted the Burnaby School District and presented the residents' proposal. The district staff rejected the proposal. Residents of

Date	Community	Response
		Highlawn Drive were invited to a follow up meeting which was held on October 7, 2014 (Appendix C-12). Other attendees questioned why FEI would not remove the existing pipe and expressed concerns about traffic congestion, access to businesses and commercial properties on North Road during construction, and impact to businesses overall. The Project Team explained that because of the complex underground network of utilities around the existing gas lines, and the requirement to maintain the existing NPS 20 IP pipeline operation during construction, the optimal approach is to abandon the gas line in place for which there are specific standards and procedures. The Project Team also presented outlines of the traffic plan to mitigate impacts on properties and businesses. A representative from Kinder Morgan suggested that FEI coordinate crossings with their existing or new line. FEI's Project team has met with Kinder Morgan and established an ongoing communications framework as Kinder Morgan finalizes its routing plan.
June 4, 2014	Burnaby Confederation Community Centre, 4585 Albert Street	*14 attendees including a representative from the City of Burnaby.* A resident of Highlawn Drive raised concerns about dust, loss of trees, and general disruption of the neighbourhood. Noting the selected route runs along a recently installed water main, some attendees asked whether the line could be installed along Lougheed or another commercial road instead of a residential street. At the meeting FEI committed to inquire with the City of Burnaby Parks Department as well as the Burnaby School District. District staff rejected the proposal. Additional routing alternatives in this area were evaluated and a preferred route determined. FEI followed up with the Highlawn residents at a scheduled meeting on October 7, 2014.
June 24, 2014	Vancouver Trout Lake Community Centre, 3360 Victoria Drive	*16 attendees including residents of Surrey and Burnaby.* Project team members explained the route selection process and outlined that a traffic consultant would be retained to assess existing traffic conditions, perform traffic modelling to determine potential traffic impacts from construction and to plan mitigation measures to reduce the disruption during the Project. Attendees also raised concerns about the impact to trees along the route, and access to pedestrian walkways during construction. The Project team assured attendees there will be minimal net impact on the tree canopy. One individual contacted the FEI Project team with concerns about the timing of the Vancouver public information session. He felt that the 6 to 9 pm timeframe would not allow for residents of the west side of the city to attend if they were not comfortable with travelling or driving at night, which he is not. He declined to provide contact information.

Not all attendees signed in or provided FEI with contact information for follow up.

Detailed information on the number of residents and businesses who contacted FEI and their comments and concerns is contained within Appendix C-2.

7.3.1.2 Public Feedback from Highlawn Residents

A number of residents of Highlawn Drive in Burnaby approached Project team members, at public sessions held in June 2014, to express concerns over the pipeline route from Broadway and Springer to Boundary. The residents stated that the neighbourhood was inconvenienced during installation of a water main in 2013. The residents requested a reconsideration of FEI's proposed pipeline route; several people suggested the pipeline be re-routed through a park and school in the neighbourhood, while others opined it run along Lougheed Highway or another commercial road instead of a residential street.

FEI contacted the Burnaby School District and presented the residents' proposal. The Secretary Treasurer informed FEI that the Board of Education of School District No. 41 (Burnaby) believes that placing the gas pipeline on or in proximity to any school, particularly an elementary school, is inappropriate, and was strongly opposed to the rerouting option presented.

In an attempt to address the concerns of these residents the Project team examined the feasibility of installing the pipeline to the south of Lougheed Highway through light industrial, commercial and densified urban neighbourhood. This alignment, the longest, would involve two major trenchless crossings of Lougheed Highway in addition to pipeline construction along highly trafficked feeder routes and areas comprising light industrial and commercial enterprises. It was deemed not feasible because of the traffic disruption and increased costs. Another option looked at installing the pipeline in a lane adjacent to Brentwood Mall's north property line, where an NPS 20 IP pipeline currently exists. This option was deemed not feasible due to insufficient space in the alley within which to construct a second large diameter pipeline.

FEI invited Highlawn Drive residents to a meeting on October 7, 2014 to communicate the results of the review; letters were direct mailed to 59 homeowners and residents of Highlawn Drive, Midlawn Drive, Beta Avenue, and Delta Avenue (see Appendix C-12) and marked 'Important Information Enclosed'.

A total of 28 people attended the meeting where the Project team spoke to the alternative routes examined, the criteria against which they were evaluated, and how FEI selected its preferred route (see Appendix C-13 for a copy of the power point presentation). Residents appeared to be dissatisfied with the selection process and outcome, and informed FEI that they would be seeking redress through a number of avenues.

FEI received a request from a representative of the Highlawn Drive residents on October 16, 2014 seeking detailed information with respect to the route selection process including evaluation reports, a traffic impact study and construction specifications. FEI proposed a meeting with the representative to present detailed information relating to all of the topics noted.

At the meeting held October 29, 2014, residents were provided with our traffic studies, routing matrix, and criteria and weighting system utilized for route selection. They asked questions regarding:

- FEI's contracting practices;

- General landowner relations during construction;
- Construction practices;
- Operating practices;
- Whether FEI funded interveners (the group wants to engage its own traffic consultant);
- Whether FEI has other pipelines at 300 MOP along roads elsewhere in the Lower Mainland; and
- What the pipeline markings along the right of way would look like.

Burnaby North MLA Richard T. Lee hosted another meeting between FEI and Highlawn residents, at their request, on October 31, 2014. After being briefed by the Project team and Highlawn group, MLA Lee suggested Highlawn residents take the opportunity to oppose the gas line by appearing before Burnaby City Council, which they did on November 3, 2014. After hearing residents' concerns, Council voted to ask staff to meet with FEI and report back, and requested the Project team present to Council. FEI was invited to a meeting with Council and senior staff on November 24, 2014 where the FEI route selection process and construction practices for the Burnaby west area was reviewed.

Council asked FEI to update Council on the project in the near future. All correspondence with the representatives of the Highlawn Drive residents is contained in Appendix C-14.

7.3.1.3 Public Feedback Outside of the Public Information Sessions

As stated above, FEI began consultations with individual residents and land owners in November 2013 with letters to the residents and land owners directly affected by the proposed pipeline upgrades. One property owner contacted FEI requesting information about the Projects and had questions about how FEI would access their property. In response, FEI provided general information about the Projects and a commitment that the Company would provide adequate notification prior to entering the property owner's land. Residents and land owners in this group received updated information and an invitation to attend public information sessions in a letter mailed in May 2014. It should be noted that FEI was considering upgrades to five sections of pipe when these letters were mailed out, and is now proceeding with the two IP pipelines as part of the CPCN Application.

As noted above in section 7.3.1, FEU also distributed information about the Projects to its 950,000 natural gas customers via Quick Connect (Appendix C-8). Additionally, customers who signed up for The Conserver (Appendix C-9), an electronic newsletter, received an article on the Projects. FEI has not received any feedback or comments from customers.

7.3.2 Consultation with Government

7.3.2.1 Municipal and Regional Governments

FEI has kept municipal and regional engineering departments apprised with regard to decisions on routing, detailed work, and traffic plans. Beginning in September 2013, those representatives were briefed regarding the criteria for route selection, plans for traffic management, noise and environmental mitigation. The communication and consultation plan was outlined and it was deemed appropriate in terms of reaching those impacted. FEI indicated to regional and municipal governments that it will coordinate work across the region to mitigate disruption and duplication, and to keep the appropriate departments up to date as the Projects move forward.

Table 7-2: Summary of Municipal and Regional Government Consultation

Municipality	Summary of discussion, issues raised	Next steps/follow up
Coquitlam	The Project team presented to Council on November 25, 2013 and met with the Utility Program Manager on November 27, 2013; the Infrastructure Management Division on January 28, 2014; and Engineering, Traffic and Parks staff on June 16, 2014. Discussions centered on opportunities for local businesses and contractors, the impact on rates, how disruption to traffic would be mitigated, overall mitigation and the potential for expropriation.	Working with staff to identify alignment for new pipe and permit conditions.
	Joint meeting with staff from Burnaby, Coquitlam and Vancouver on September 4, 2013 raised questions about whether existing pipeline would be abandoned, and if FEI would pay for a dedicated municipal resource to process application.	When questioned about pipeline abandonment at subsequent meetings with these municipalities and other stakeholders, FEI explained that the existing Coquitlam Gate IP pipeline will be abandoned in place once the new pipeline is in service. This work will be carried out in accordance with CSA Z662-11 and the Company's internal standards. Further, FEI noted that municipalities do not process applications for pipeline abandonment.
Burnaby	Met with Leif Bjorseth, Assistant Director Engineering and Development Services on January 27, 2014; Planning and Building staff on February 4, 2014; the Director of Engineering and Deputy City Manager on May 1, 2014; Mr. Bjorseth again on May 6, 2014; and Mayor Derek Corrigan on May 20, 2014. To review details of pipeline routing and general engineering issues.	Reviewed details of pipeline routing and general engineering issues.

Municipality	Summary of discussion, issues raised	Next steps/follow up
	City staff requested FEI import trench material and install the pipe at least two metres below surface, and encouraged FEI to pursue a bike path legacy. In response, FEI confirmed it would import engineered trench backfill material and that the pipe will be installed according to minimum pipeline depth of cover specifications.	Opportunities for bike path legacies will be discussed as the Project moves into the completion and remediation phase.
	FEI invited Highlawn Drive residents to a meeting to discuss the route selection and consultation process. The group requested Mr. Bjorseth from the City attend. Mr. Bjorseth agreed to be present but only as an observer.	FEI met with Mr. Bjorseth on October 27, 2014 to update him on FEI's ongoing discussions with the Highlawn Drive residents at his request. FEI met with Highlawn Drive residents on October 29, 2014 to review route selection and the public consultation process. Mr. Bjorseth attended as an observer.

Municipality	Summary of discussion, issues raised	Next steps/follow up
	At the request of the City, FEI appeared before Council and senior staff during a meeting that preceded its regular Council meeting, on November 24, 2014.	Route selection process and construction practices for the Burnaby west area were reviewed. Council asked FEI to update Council on the project in the near future.
	FEI met with Engineering and Planning staff on November 27, 2014 to follow up on the meeting with Council and senior staff.	Engineering and Planning staff suggested that FEI reconsider routing the Project in Burnaby along Lougheed Highway, possibly from Bainbridge to Boundary Road, and suggested FEI should not consider traffic impacts as a major issue when assessing route feasibility. FEI agreed to conduct further analysis, in conjunction with the City of Burnaby and in consultation with other stakeholders such as Translink, B.C. Hydro and MoTI, and report back to City Council before the end of January 2015.
	FEI met with representatives of the Highlawn Residents group on December 5, 2014.	FEI updated residents with regards to direction provided by the City.
	At the request of the City, FEI appeared before Council and senior staff during a meeting that preceded its regular Council meeting, on December 8, 2014.	Council members received an update from City staff and FEI on the route feasibility work that would be undertaken, with a commitment to report back before the end of January 2015.
Port Coquitlam	Although the Project route does not enter this municipality, MP Finn Donnelly suggested FEI consult with this community as commuters who reside here may be impacted. Mayor Greg Moore requested during a meeting March 21, 2014 that, to the extent possible, work be coordinated with other municipal and regional governments.	Will provide updates as Project proceeds.

Municipality	Summary of discussion, issues raised	Next steps/follow up
Vancouver	Met with the Manager, Utilities Management Branch and Streets Director on May 14, 2014 where questions and concerns were raised about routing, how construction would proceed, traffic modelling and trenchless construction.	A follow up meeting was held on June 4, 2014 where the Chief Engineer indicated that he was satisfied concerns had been addressed. The Chief Engineer will update the City Manager and Mayor Gregor Robertson. Traffic studies are underway and preliminary reports are expected later in 2014. FEI plans to share these reports with municipalities before construction begins.
	Met with a Director from the Parks Department about impact on trees on May 23, 2014.	FEI has made several attempts to arrange a meeting with the Parks Department, in order to share the arborist report. A meeting has not been scheduled at time of this submission.
Metro Vancouver	Identified need for a contract to determine operating and contact requirements when FEI work intersects with Metro Vancouver's during a meeting with staff February 11, 2014.	FEI and Metro Vancouver have established a notification protocol.

7.3.2.2 Provincial Government Agencies and Elected Representatives

FEI consulted the following Members of the Legislative Assembly of British Columbia:

Table 7-3: Summary of Provincial Consultation

Name	Summary of discussion, issues raised	Next steps/follow up
Suzanne Anton, Liberal MLA, Vancouver Fraserview, Minister of Justice and Attorney General	No issues or concerns were expressed during a meeting on January 24, 2014.	Provided with information sheets and an invitation to the community info session, as requested, in order for constituency staff to respond to public inquiries. No further follow up required.
Shane Simpson, NDP MLA, Vancouver Hastings	Met March 14, 2014. Mr. Simpson urged FEI to go beyond open house formats for community consultation, and suggested the Project team also consult Grandview Woodlands Area Council and Frog Hollow Neighbourhood House.	No follow up required.

Name	Summary of discussion, issues raised	Next steps/follow up
Jenny Kwan, NDP MLA, Vancouver Mount Pleasant	No issues or concerns were raised during the meeting on May 20, 2014. Ms. Kwan committed to providing contact information for local organizations that FEI could invite to community information meetings. She would like to be kept apprised of any legacy ideas as the Project moves into the completion and remediation phase.	FEI will apprise of any legacy ideas as the Project moves into the completion and remediation phase.
Linda Reimer, Liberal MLA, Port Moody Coquitlam	No issues or concerns were raised during meeting on November 25, 2013. Ms. Reimer will advise FEI if community brings issues to her attention.	No follow up required.
Selina Robinson, NDP MLA, Coquitlam Maillardville	No issues or concerns were raised during a meeting on August 29, 2013.	No follow up required.
Richard Lee, Liberal MLA, Burnaby North	No issues or concerns were raised during a meeting on November 29, 2013.	No follow up required.
Jane Shin, NDP MLA, Burnaby Lougheed	No issues or concerns were raised during a meeting February 7, 2014. Offered to act as liaison with Korean-language business owners and interested groups, including the Consulate General of the Republic of South Korea merchants seeking compensation for disruption to business, etc. Ms. Shin also offered to assist in developing a workshop with groups who have previously opposed the Kinder Morgan pipeline.	Ms. Shin facilitated a presentation to the Consulate General and other groups on March 7, 2014. No additional follow up required.

FEI provided the staff of the Ministry of Energy and Mines with updates about the Projects during regularly scheduled meetings. The staff raised no concerns, and informed FEI that further consultation with other provincial stakeholders was not necessary.

7.3.2.3 Federal Government Representatives

FEI consulted the following Members of Parliament:

Table 7-4: Summary of Federal Government Consultation

Name	Summary of discussion, issues raised	Next steps/follow up
Kennedy Stewart, NDP MP, Burnaby-Douglas	During a meeting on January 8, 2014, Mr. Stewart informed FEI he was satisfied the Project serves domestic customers and agrees with rationale for upgrading existing pipeline. He suggested that it was important for FEI to get support from Burnaby's Mayor.	Followed up on June 3, 2014 after meeting with Burnaby's Mayor, who accepted FEI's need to upgrade the Coquitlam Gate IP pipeline which is nearing the end of its service life. No further follow up required.
Libby Davies, NDP MP, Vancouver East	Declined two requests for a meeting with her office.	No follow up required.
Finn Donnelly, NDP MP, New Westminster-Coquitlam	During a meeting on February 14, 2014, Mr. Donnelly questioned whether abandoned pipe could be used to house fibre optic cables. He provided feedback on public consultation process, and suggested several additional groups to consult including City of Port Coquitlam.	Followed up with City of Coquitlam regarding fibre optic network at a meeting held September 4, 2014. FEI included Port Coquitlam in consultations and a meeting was held March 21, 2014. Invited Mr. Donnelly to public engagement events. No further follow up required.

7.3.3 Business Groups and Community Associations

In developing the communication and consultation plan, FEI identified a number of business groups and community associations to engage; others were suggested and identified during discussions with other stakeholders. The result is a robust consultation with groups that represent and speak for the communities and commercial interests that may be affected by the Projects.

Specific information about how construction will disrupt access to streets, homes and business was sought, along with how FEI plans to mitigate the impact. FEI committed to providing detailed information closer to the start of construction.

The following groups were consulted:

Table 7-5: Summary of Business Groups & Community Associations Consultation

Group	Summary of discussion, issues raised	Next step/follow up
Tri Cities Chamber of Commerce	At a meeting on February 20 2014, FEI reviewed the impact of the Project on businesses and communicated opportunities for businesses and contractors. Suggested FEI meet with the Mayor of Port Coquitlam.	FEI met with the Mayor March 21, 2014. No further follow up required.

Group	Summary of discussion, issues raised	Next step/follow up
Burnaby Board of Trade	At a meeting on February 4, 2014, FEI presented details of the Project, information on how First Nations were consulted, and discussed procurement opportunities for local contractors. The Burnaby Board of Trade requested FEI build a skills matrix to catalogue those interested in providing services to FEI.	A skills matrix has been developed, cataloguing those interested in providing services to FEI.
	FEI offered to host a workshop or seminar to help FEI inform members.	Workshop held May 14, 2014. No further follow up required.
Commercial Drive Business Improvement Association	At a meeting on February 6, 2014, the Commercial Drive Business Improvement Association (BIA) offered advice on the consultation process and suggested FEI also consult with the Grandview Woodlands Area Council. The BIA also provided advice on how to reach residents whose second language is English. Suggested sponsorship opportunities for FEI to build community support however, these fell outside of the scope of FEI's Community Investment Program.	As requested, followed up outcome of FEI's discussion with the Grandview Woodlands Area Council. No further follow up required.
North Road Business Improvement Association	At a meeting on March 5, 2014, the North Road Business Improvement Association advised FEI on how best to engage the Korean business community through the group's newsletter. No concerns or issues were raised.	No follow up required.
Burnaby Heights Merchants Association	At a meeting on April 4, 2014 the Burnaby Heights Merchants Association expressed concerns about the impact to Hastings Street merchants during construction. FEI advised there would be traffic detours for commercial and residential traffic.	No follow up required.
Hastings North Business Improvement Association	Even though members will not be impacted by construction, FEI consulted with this group on January 7, 2014.	
	They suggested additional groups to consult including: Grandview Woodlands Area Council, Frog Hollow Neighbourhood House and school parent advisory councils.	The Project consulted with the Grandview Woodlands Area Council and the Frog Hollow Neighbourhood House, however, it did not consult with parent advisory councils because the school district would share information about the Project with parents as appropriate.

Group	Summary of discussion, issues raised	Next step/follow up
Hastings Crossing Business Improvement Association	Even though members will not be impacted by construction, FEI consulted with this group on February 26, 2014. Would like FEI to consider how best to procure services locally.	A skills matrix has been developed, cataloguing those interested in providing services to FEI.
Burquitlam Community Association	During a meeting on January 9, 2014 the Burquitlam Community Association did not express concerns, however they did have questions about pipeline integrity, planning, regulatory approval and communicating with businesses. FEI provided the necessary information.	Added to mailing list for Project updates.
Oakdale Neighbourhood Association	Questions regarding pipeline integrity, planning process and impact on rates were raised at a meeting held on February 20, 2014. FEI provided the necessary information.	No follow up required.
Hastings Sunrise Community Policing	On a meeting held on January 7, 2014, FEI laid out the stakeholders and groups we had engaged with and planned to consult. There were no issues raised regarding the Project.	No follow up required.
Grandview Woodlands Area Council	During a telephone call on February 13, 2014, this group expressed opposition to pipelines of any type or size. Declined offer of a meeting.	FEI provided a Project map and fact sheet via email.
Frog Hollow Neighbourhood House	At a meeting held on April 7, 2014, the Frog Hollow Neighbourhood House expressed concern about traffic disruption, impact to tree inventory and community legacies. The Project team assured attendees there will be minimal impact to the tree canopy and laid out the traffic plan to mitigate disruption to residents.	Legacies will be discussed as the Project moves into the completion and remediation phase. Frog Hollow Neighbourhood House followed up on June 11, 2014 to suggest possible enhancements to Clinton Park on 1st Avenue, which will be considered as the Project concludes.

Stakeholders who asked to be included on FEI's mailing list were further updated at this stage of the public consultation process (see Appendix C-10-2).

7.3.4 Other Parties

FEI recognized at the outset of planning for the pipeline upgrade that coordinating access to rights of way with other utilities and stakeholders was integral to the Projects' success. To that end the Project team met with and consulted BC Hydro, BC Hydro's *Metro North Project* and Kinder Morgan to discuss joint use of rights of way and Project timing. All partners agreed to coordinate work where possible and keep one another appraised as Projects planning progresses.

7.4 CONSULTATION PLAN GOING FORWARD

FEI is committed to continuing consultation with Project stakeholders and will continue to ensure that, as the Projects progress, they are kept informed and have ways to provide feedback.

A comprehensive Communications Plan will be developed prior to the start of construction and will detail the methods FEI will utilize to keep customers, residents, land owners, business owners and other interested parties informed about access and accommodation issues, services and goods required, timelines and opportunities to connect with FEI. Communication and Consultation methods include:

- Emails to stakeholders who have signed up (web portal will permit connections as the Projects proceed);
- Stories on FEI's website;
- Letter drop offs;
- Articles and stories in the media – both proactive and reactive;
- Meetings on request; and
- Presentations on request.

7.5 CONCLUSION – SUFFICIENCY OF THE CONSULTATION PROCESS

FEI believes that the communication plan and the public consultation activities to the time of filing have been sufficient, appropriate and meet the requirements of the CPCN Guidelines with respect to the Projects. In particular, consultation and communication with land owners, residents, and businesses directly affected by the Projects and with the municipalities of Coquitlam, Burnaby, and Vancouver has been both useful and productive, and has been incorporated into FEI's plans for the Projects. FEI will continue to consult with stakeholders regarding route issues, the schedule for the Projects, temporary construction space, right of way, plans to mitigate traffic disruption, tree replacement, and public safety. Another series of public information sessions is planned prior to start of construction, with the goal of informing residents and the public about construction activities, traffic issues and mitigation strategies.

It is FEI's intent that good relationships with residents, land owners, businesses and other stakeholders will be maintained through all phases of the Projects. FEI will minimize the Projects' impact, maintain the schedule for the Projects and preserve the Company's good relationships with stakeholders.

FEI is committed to continuing consultation with stakeholders and will continue to work with known stakeholders and affected parties to ensure that they are informed and engaged as the Projects progress.

8. FIRST NATIONS CONSULTATION

8.1 INTRODUCTION

FEI has identified that the Projects are located within traditional territories of the Coast Salish Peoples, in particular, the Tsleil-Waututh First Nation, Squamish Nation, Kwikwetlem First Nation, Stó:lō, Musqueam Indian Band, Semiahmoo First Nation and Tsawwassen First Nation. The Projects do not cross any First Nations reserve lands. The potential impact of the Projects on First Nations' rights and title will be limited. FEI commenced its communication regarding the Projects with these First Nations in October 2013, and evidence of engagement is current to December 4, 2014.

In this section, FEI describes its approach and plan with respect to First Nations engagement regarding the potential impacts on the established or asserted Aboriginal rights and title in the context of these Projects. More specifically, FEI outlines the Company's approach to identification and engagement of potentially impacted First Nations, summarizes early engagement activities and feedback from the respective First Nations, and details the Company's First Nations engagement plan going forward. FEI also outlines the OGC's First Nations consultation process, in consideration that the OGC is one of the Crown agencies responsible for First Nations consultation, and, if necessary, accommodation of First Nations' interests.

8.2 ENGAGEMENT APPROACH

8.2.1 Overview of Approach

FEI's goal is to be a corporate leader in developing and building mutually beneficial working relationships with First Nations communities. To this end, FEI has developed and adopted a Statement of Aboriginal Principles[38]. FEI is committed to building effective First Nation relationships and to have the structure, resources and skills necessary to maintain these relationships. In order to achieve this commitment, the actions of the Company and its employees are guided by these principles throughout the First Nations engagement in these Projects.

Although the duty to consult rests with a Crown agency in a specific project, FEI recognizes that it may be responsible for conducting discussions with the identified First Nations groups under the responsible Crown agency's process. FEI's discussions or engagement must be specific to each First Nation and has to be thorough, timely, and meaningful. The appropriate level of engagement will depend on the strength of the claim and the significance of the potential impact of a project on the rights and interests of the particular First Nation being engaged.

[38] "Statement of Principles" http://www.fortisbc.com/About/OurCommitments/AboriginalRelations/Pages/Statement-of-Principles.aspx.

FEI is committed to working with the First Nations that may potentially be affected by the Projects to ensure that they:

- Are informed about the Projects and the associated alternatives;
- Are aware of the potential adverse and beneficial impacts of the Projects on the First Nations' interests; and
- Are provided with opportunities to provide input to the Projects, through FEI's engagement activities and also the Commission's regulatory review process itself if the First Nation should decide to participate.

Where appropriate, FEI will, together with the Crown agencies responsible for First Nation consultation, identify methods to avoid or mitigate potential impacts on those First Nations' interests, and, where appropriate, discuss and develop options for accommodation.

8.2.2 Documentation and Notification

To ensure opinions, perspectives and concerns are respected and meaningfully considered, FEI keeps records of correspondence and communications with identified First Nations. A detailed record of FEI's interactions with First Nation groups in the context of these Projects is contained in the First Nations Engagement Log (Appendix D-1). This record is contemporaneous and updated to the date of the filing of this Application.

To initially introduce the Projects to First Nations, FEI identified First Nations (see section 8.3) and provided them with an introductory letter, which is included in Appendix D-2. Further documentation on the Projects has been and will be provided to the First Nations if appropriate.

FEI will inform each First Nation that they can register to participate in the regulatory review of this Application before the BCUC as part of the CPCN filing notifications.

8.3 IDENTIFICATION OF FIRST NATIONS WITH ASSERTED CLAIMS IN PROJECTS AREA

Through 2013 to mid-2014, FEI identified seven First Nations whose rights and title may be impacted by the Projects. The nations and/or tribal groups who were initially identified in 2013 through Q1 of 2014 include: Tsawwassen First Nation, Semiahmoo First Nation, Stó:lō, Musqueam Indian Band, and Kwikwetlem First Nation. After further consideration of the potentially affected traditional territories, Tsleil-Waututh Nation and Squamish Nation were also identified as First Nations with interests in the region. The complete identification was based on the following resources:

- Discussions with the First Nations;
- A review of the Provincial iMAPBC consultative database;

- Provincial Heritage Conservation Act permit applications; and
- Experience working with the First Nations in the Projects area.

The following subsections describe the identification of the First Nations who may have a potential interest in the Projects area.

8.3.1 Stó:lō

The general area of the Projects location is within the asserted traditional territory of the Stó:lō people. There are two tribal councils representing some but not all of the Stó:lō peoples in the region. The Sto:lo Nation Tribal Council and the Sto:lo Tribal Council. There are also Stó:lō bands that do not belong to either council. The People of the River Referrals office (PRRO) was "formed on June 12th, 2012, as a virtual office of technical staff from Stó:lō Nation (Stó:lō Research and Resource Management Centre), Stó:lō Tribal Council, and the Ts'elxweyeqw Tribe. The PRRO provides administrative, research, and technical support throughout the referrals review process to several Stó:lō Communities within S'ólh Téméxw."[39] There are 14 Stó:lō First Nations participating in the PRRO, including Chawathil First Nations, Cheam First Nations, Leq'a:mel First Nations, Scowlitz First Nations, Shz'ow'hamel First Nation, Skawahlook First Nations, Sumas First Nations and the Ts'elxweyeqw Tribe, which signed on behalf of the Aitchelitz Band Shxwha:y Village, Skowkale First Nations, Soowahlie First Nations, Squiala First Nations, Tzeachten First Nation and Yakweakwioose First Nation.

Please see Appendix D-3 for a June 14, 2014, BC Government news release which discusses the funding extension and support from the BC Government for the PRRO.

8.3.2 Kwikwetlem First Nation

The Kwikwetlem First Nation (KFN) has two reserves in Metro Vancouver. Reserve #1 is in close proximity to the mouth of Coquitlam River that drains into the Fraser River and is 6.5 acres. Reserve #2 is in Port Coquitlam, further up Coquitlam River and is 202 acres in size.

Based in part on a review of the KFN's Heritage Policy, which describes and maps KFN's traditional territory, as well as provides protocol for conducting work in the region, FEI has determined that the Projects are located within the KFN's asserted traditional territory.

8.3.3 Tsawwassen First Nations

The Tsawwassen First Nation (TFN) lands are adjacent to the South Arm of the Fraser River and just north of the international boundary with the United States at Point Roberts, Washington. Effective April 3, 2009, the TFN entered into a comprehensive tri-partite agreement with the federal and provincial governments which provided for the transfer of land and self-

[39] "People of the River Referrals Office" http://www.srrmcentre.com/referrals.html

government jurisdiction to TFN. The TFN reclaimed 1789 acres of land and have direct control and ownership of said land. The TFN traditional territory is comprised of 2,471,000 acres of the south-west quadrant of Metro Vancouver and the Salish Sea.

Based on a review of the documents on the BC Treaty Commission website,[40] including a statement of intent map, FEI has determined that the Projects are located within the TFN's asserted traditional territory.

8.3.4 Semiahmoo First Nation

The Semiahmoo First Nation (SFN) have one reserve which is approximately 319 acres, located between the boundary of White Rock, British Columbia and the Canada-United States boundary, and the Peace Arch Provincial Park in the southern portion of Metro Vancouver.

The SFN's traditional territory spans both sides of the Canada-United States border. Through review of documents which speak to Semiahmoo traditional territory (e.g. brief to the Cohen Commission, March 10, 2010), FEI has determined that the Projects are located within SFN's asserted traditional territory.

8.3.5 Musqueam Indian Band

The main community of the Musqueam Indian Band (MIB) is Reserve #2, in the Point Grey area of Vancouver. Reserve #2 constitutes three separate reserves of approximately 628 acres. The Projects do not cross Musqueam lands, but FEI has determined that the Projects are located within the MIB's asserted traditional territory.

8.3.6 Tsleil-Waututh First Nation

The Tsleil-Waututh First Nation (TWN) has traditional territory that covers approximately 247 acres, with its main reserve centred on Burrard Inlet within Metro Vancouver. TWN has a stewardship policy and a consultative area map posted on its website.

Based on FEI's review of these documents, FEI has determined that the Projects cross TWN asserted traditional territory and the territory displayed in its consultative boundaries map.

8.3.7 Squamish Nation

The traditional territory of the Squamish Nation (SN) covers 1483 acres in south west British Columbia.

The SN has developed the Xay Temixw Land Use Plan, which includes management objectives and land use zoning, and describes the community's goals for the forests and wilderness located in the SN traditional territory.

[40] "Tsawwassen First Nations" http://www.bctreaty.net/nations/tsawwassen.php.

Based on the review of the Xay Temixw Land Use Plan, FEI has determined that the Projects are located within the asserted traditional territory of the SN.

8.4 *ENGAGEMENT ACTIVITIES*

FEI began engagement activities in October 2013, which included one or both of:

- Sending a letter, fact sheet, and/or a map (or a combination thereof) which introduced the Projects (please see Appendix D-2 and C-3); and
- Holding a meeting with the First Nation to provide an overview of the Projects.

A complete log of these activities with respect to the identified First Nations in connection with these Projects is attached as Appendix D-1. The following provides a description of some of the key engagement activities to the date of the filing of the Application.

Meetings were held and letters sent to First Nations between October 2013 and July 2014. These discussions and letters provided a general overview of the Projects, including the potential route, the rationale for the Projects, as well as requesting a response as to whether the First Nation would like to be further consulted. FEI will continue to consult with any First Nations who's claimed traditional territory overlaps with the Projects' potential routes to keep them informed of major Project developments, and to work together to address potential impacts of the Projects on the exercise of their asserted rights or title, and other concerns.

8.4.1 Stó:lō

FEI sent a letter to the People of the River Referral office on March 5, 2014 (see Appendix D-2) to introduce the Projects. FEI has previously met with the PPRO to discuss its process, and it stated that it will respond to FEI if it feels that the referral (the letter, map, etc.) impacts the rights and title of the Stó:lō people. No response has been received from the PRRO.

8.4.2 Kwikwetlem First Nation

On October 8, 2013, FEI staff held an initial meeting with Kwikwetlem First Nations. This meeting preceded formal letters to other First Nations since the Company was interested in investigating the possibility of entering into an economic partnership with KFN to utilize a portion of its reserve land as part of the preparation and work-zone associated with the Projects. The KFN traditional territory overlaps with the Projects, as do a number of other First Nations' traditional territories. However, the KFN's Reserve land is located in close proximity to the Projects. These discussions explained the Projects, the general route, and what might be required from FEI with regards to workspace. Follow-up with KFN took place on July 22, 2014. At that time FEI stated that the Projects are still in the planning stage, but the Company had no further details to share with respect to economic opportunities.

8.4.3 Tsawwassen First Nations

FEI sent a letter to the TFN on March 5, 2014 (see Appendix D-2). No response has been received from the TFN.

8.4.4 Semiahmoo First Nation

FEI sent a letter to the SFN on March 5, 2014 (see Appendix D-2). No response has been received from the SFN.

8.4.5 Musqueam Indian Band

FEI sent a letter to the MIB on March 5, 2014 (see Appendix D-2). No response has been received from the MIB.

8.4.6 Tsleil-Waututh First Nations

FEI sent a letter (see Appendix D-4-1) as well as an email (see Confidential Appendix D-4-2) to the TWN on July 15, 2014. A written response from TWN, dated July 15, 2014, was received by FEI, which included TWN's Stewardship Policy, an invoice for work required for TWN to review the Projects, and an outline of next steps (see Confidential Appendix D-4-3). FEI paid the invoice and on August 20, 2014, TWN sent an email requesting more detailed maps as well as shape files. TWN also provided FEI with a list of possible dates to meet and discuss the Projects (see Confidential Appendix D-4-4). FEI forwarded the requested shape files to TWN via an email on Aug 27, 2014 (see Confidential Appendix D-4-5). FEI and TWN have arranged for a meeting to discuss the Projects on November 5, 2014 (see Confidential Appendix D-4-6). FEI provided TWN with an overview of the rationale for the LMSU project, the routing, and some of the potential construction methods. TWN requested to a copy of the archaeology reports and any environmental management reports once they are complete. TWN also requested to be kept informed of contracting opportunities related to the Projects.

8.4.7 Squamish Nation

FEI sent a letter (see Appendix D-5-1) as well as an email (see Confidential Appendix D-5-2) to SN on July 15, 2014. SN requested a more detailed map (see Confidential Appendix D-5-2). More detailed mapping was sent to SN on July 16, 2014 (see Appendix D-5-3). No further communication has been received from SN with regards to the Projects.

8.5 ONGOING AND FUTURE FIRST NATIONS CONSULTATION

8.5.1 OGC Process Regarding First Nations Consultation

The OGC is a Crown agency responsible for First Nations consultation, and, if necessary, accommodation of First Nations' interests. The OGC's First Nations consultation process, as documented in its Pipeline Permit Application Manual[41], Pipeline Operations Manual[42], and Facilities Application and Operations Manual[43] can be found on the OGC website.

Under the OGC process, FEI as the Projects proponent is responsible for conducting preliminary discussions with the identified First Nations, and for providing documentation, such as Projects descriptions, maps and drawings to First Nations to facilitate the OGC process. FEI's engagement activities that have taken place since the early, preliminary stage of Projects consideration, as detailed the First Nations Engagement Log (Appendix D-1), will be forwarded to the OGC for its consideration when FEI files its application with the OGC.

FEI's continued consultation efforts will be in concert with the OGC's efforts as outlined in the OGC's manual. FEI will also continue to:

- Provide timely information and updates regarding the Projects and the regulatory process where appropriate;
- Provide timely and comprehensive responses to any questions, concerns or requests for information regarding the Projects; and
- Engage in discussions to further identify any potential impacts of the Projects on aboriginal interests, and seek to avoid, mitigate or accommodate any potential impacts if necessary.

8.5.2 BCUC Process Regarding First Nations Consultation

FEI will ensure that First Nations are aware that they can participate in the BCUC process, including registering to intervene in proceedings. FEI will inform First Nations that they can register to participate in the regulatory review of this Application before the BCUC as part of the CPCN filing notifications.

8.6 SUFFICIENCY OF FEI'S ENGAGEMENT PROCESS WITH FIRST NATIONS TO DATE

The Projects do not cross First Nations reserve land. The Projects do cross the traditional territories of a number of First Nations, however the Projects' route will follow in existing roads, right-of-ways, and pre-disturbed land.

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41 https://www.bcogc.ca/content/pipeline-permit-application-manual.
42 https://www.bcogc.ca/content/pipeline-operations-manual.
43 https://www.bcogc.ca/industry-zone/documentation/Facilities.

The potential of the Projects to impact First Nations interests is confined to impacts on archaeological sites (if any) from construction activities associated with the pipeline upgrades. FEI retained Stantec Consulting Ltd. to conduct an archaeological overview assessment (AOA) (Appendix B-2: Archaeological Overview Assessment: Metro Vancouver Reinforcements Vancouver, Burnaby, Coquitlam and Surrey BC) to assess the potential for archaeological and/or cultural heritage resources within the Projects area. The AOA concluded that for the Coquitlam Gate IP and Fraser Gate IP Projects:

- There are no recorded archaeological sites within 500m of the area of the Projects;
- Most of the Projects area was evaluated as having low archaeological potential therefore not requiring any further archaeological assessment; and
- Four areas along the Coquitlam IP pipeline segment, associated with unnamed, fish bearing watercourses, have a high archaeological potential, therefore require an Archaeological Impact Assessment (AIA).

See section 6.2 and Appendix B-2 for the Archaeological Overview Assessment Report and discussion.

The First Nations with any potential interests in the general area of the Projects have been identified as noted above and have been provided with, and will be continued to be provided with, information on the Projects. No significant concerns have been raised as of December 4, 2014. Any concerns will be addressed by the Company as necessary.

Accordingly, FEI believes that the level of First Nations engagement undertaken at this stage of the Projects is appropriate. It is FEI's intention and regular practice to continue liaising with First Nations as the Projects progress. Additionally, FEI's continued consultation efforts will be in concert with the OGC's efforts as part of the OGC application process.

9. CONCLUSION

9.1 OVERVIEW

FEI is applying to the Commission to replace the approximately 20 kilometre long existing 1200 kPa NPS 20 IP pipeline (Coquitlam Gate IP) between Coquitlam Gate Station and the East 2nd & Woodland Station with a 2070 kPa NPS 30 IP pipeline, and also to replace a short 0.5 kilometre section of the existing 1200 kPa NPS 30 IP pipeline (Fraser Gate IP) between Fraser Gate Station and East Kent Avenue & Elliott Street with a 1200 kPa NPS 30 IP pipeline.

The Coquitlam Gate IP Project as proposed eliminates the identified non-preventable corrosion risks associated with the existing Coquitlam Gate IP pipeline and addresses other capacity related constraints and the Fraser Gate IP Project will mitigate the identified seismic vulnerability and associated consequences.

9.2 FRASER GATE IP PROJECT

As described fully in the Application, the Fraser Gate IP pipeline has been assessed as being vulnerable to failure due to a 1:2475 year seismic induced ground movement event and FEI believes the potential safety issues and the potential impact and consequence to up to 171,000 customers warrants mitigation.

To mitigate the identified seismic vulnerability and potential consequences, the Company recommends replacement of approximately 500 metres of NPS 30 pipeline with a pipeline constructed in accordance with FEI's seismic criteria. The estimated capital cost for the Fraser Gate IP Project in As spent dollars, including AFUDC is $18.107 million.

The only technically viable alternative that meets the Project objectives is a pipeline replacement however, as part of the analysis, the routing process identified a route corridor between Fraser Gate station and Elliott Street, and assessed three route options within the corridor.

The route options evaluation resulted in the selection of a preferred route along East Kent Avenue South. Route Option 1, the preferred route, is located within East Kent Avenue South and a short section of park, from Fraser Gate station to Elliott Street (south of the existing rail lines). This route option has the highest route ranking and the lowest cost estimate.

Route Option 2 is located within East Kent Avenue North, from Fraser Gate station to Elliott Street (north of the existing rail lines). This Route Option rated much lower than Route Option 1 (270 versus 335) in the route ranking analysis. This is primarily due to the high density of existing third party utilities that would have to be relocated to accommodate pipe installation, the need for construction in close proximity to houses and commercial establishments and the level of traffic disruption that would occur during the project execution.

Route Option 3 travels north from the existing Fraser Gate station, east on Kent Avenue to Jellicoe Street, and then west along Marine Drive to the intersection of Marine Drive and Elliott Street. Route Option 3 rated lower than Route Option 1 (295 versus 335) in the route ranking analysis. This is primarily due to the additional pipeline length creating a longer construction window resulting in prolonged community and stakeholder impacts compared to Route Option 1.

The overall objective of the routing process was to select the route option that minimizes potential impacts on the community, stakeholders and environment while meeting safety and construction requirements in an economical manner. FEI has determined that Route option 1, located within East Kent Avenue South from Fraser Gate station to Elliott Street (to the south of the existing rail lines) is the preferred route.

The proposed Fraser Gate IP Project will:

- Achieve FEI's seismic criteria of resistance to a 1:2475 year event;
- Mitigate the safety risk posed by the pipeline as a result of seismic vulnerability;
- Mitigate the economic risk posed by the pipeline as a result of seismic vulnerability; and
- Address constructability, operational and safety factors, such as routing constraints, proximity to adjacent utilities and appropriate construction techniques, limiting interruption of flow of gas during construction and commissioning and allowing sufficient space to work around existing piping and components.

9.3 *COQUITLAM GATE IP PROJECT*

Ongoing operations and studies demonstrate that the NPS 20 Coquitlam Gate IP pipeline is experiencing an increasing incidence of non-preventable leaks due to corrosion. Since 1987 this pipeline has experienced 15 leaks, seven of which occurred in 2013. Leaks on the Coquitlam Gate IP pipeline are expected to continue and a quantitative reliability analysis predicts that the annual leak frequency could escalate to a rate of 3.7 times the 2013 rate by 2033.

The safety risk associated with operation of this pipeline is currently being managed through mitigation measures such as odourization, leak detection (frequent leak surveys), and leak response. However, FEI has determined that leak prevention cannot be effectively managed through maintenance activities on this pipeline and has therefore assessed the pipeline as nearing the end of its service life. As a result of its assessments, FEI has concluded that replacement of this pipeline is the most appropriate solution to prevent future leaks. FEI believes that continued long-term operation of the pipeline in its current state, in the absence of a replacement plan, could result in the OGC finding that FEI has failed to comply with a provision of the OGAA.

FEI recognizes the existing Coquitlam Gate IP pipeline requires replacement in order to mitigate future gas leaks resulting from non-preventable active corrosion. In addition to the integrity related risk associated with the Coquitlam Gate IP pipeline, FEI also identified other capacity related constraints on the Metro IP system that warrant consideration in the selection of a prudent replacement solution:

1. Operational Flexibility: Over time and with growth in demand on the system there has been an erosion of the operational flexibility required to facilitate planned work on the Fraser Gate IP pipeline; and
2. System Resilience: The Fraser Gate IP pipeline and the Coquitlam Gate IP pipeline are identified as single point of failure pipelines at the present time, if either pipeline fails, there is no alternate supply capacity sufficient to provide year round system resiliency to mitigate potential consequences that could occur as a result of unplanned outages.

The replacement of the Coquitlam Gate IP pipeline provides a unique, one-time opportunity to prudently restore operational flexibility and provide resiliency to the Metro IP system through an increase in pipeline capacity in the Coquitlam Gate IP pipeline at an appropriate time.

To eliminate the elevated reliability, safety and regulatory risk posed by the existing Coquitlam Gate IP pipeline as a result of the known corrosion mechanism, and address other capacity related constraints, FEI has evaluated a number of alternatives based on non-financial and financial factors.

The non-financial aspects of each alternative considered are summarized in Table 9.1.

Table 9-1: Coquitlam Gate IP Project Non-Financial Comparison

Alternatives		Objectives/Requirements				Overall Assessment
		Reduce Pipeline Risk	Provide Sufficient Operational Flexibility	Provide Full System Resiliency	Constructible	
1	Do Nothing	Does not meet Objective	Does not meet Objective	Does not meet Objective	Not Applicable	Not Feasible
2	Rehabilitate Existing NPS 20	Partially meets Objective	Does not meet Objective	Does not meet Objective	Meets Objective	Not Feasible
3	Replace Existing NPS 20 in kind	Meets Objective	Does not meet Objective	Does not meet Objective	Meets Objective	Not Feasible
4	Replace with NPS 24 at 2070 kPa	Meets Objective	Meets Objective	Does not meet Objective	Meets Objective	Feasible
5	Replace with NPS 36 at 1200 kPa	Meets Objective	Meets Objective	Does not meet Objective	Meets Objective	Feasible
6	Replace with NPS 30 at 2070 kPa	Meets Objective	Meets Objective	Meets Objective	Meets Objective	Feasible
7	Replace with NPS 42 at 1200 kPa	Meets Objective	Meets Objective	Meets Objective	Does not meet Objective	Not Feasible

(green)	Meets objective/feasible
(yellow)	Partially meets objective
(red)	Does not meet objective/not feasible

The non-financial analysis shows that:

- Alternative 6 is the only alternative that provides a solution that meets all of the stated objectives.
- Alternative 4 meets the objectives of eliminating the elevated reliability, safety and regulatory risk and also provides some operational flexibility and system resiliency for a portion of the year. Since this alternative provides some operational flexibility and resiliency it was included as an alternative in the financial analysis.
- Alternative 5 meets the objectives of eliminating the elevated reliability, safety and regulatory risk and also provides operational flexibility for a portion of the year. Since this alternative provides some operational flexibility and resiliency it was included as an alternative in the financial analysis.

The financial evaluation consists of the estimated capital cost and operating cost and their impact on the levelized rates and incremental cost of service.

The cost estimates represent the estimated total cost of each alternative including project management, engineering, permits, materials procurement, and construction and commissioning. The following Table 9-2 provides a summary of the financial evaluation conducted.

Table 9-2: Coquitlam Gate IP Project Financial Comparison

	Alternative 4 Install NPS 24 pipeline at 2070 kPa	Alternative 5 Install NPS 36 pipeline at 1200 kPa	Alternative 6 Install NPS 30 pipeline at 2070 kPa
AACE Estimate Accuracy	***Class 4***	***Class 4***	***Class 3***
Total Direct Capital Cost excl. AFUDC & includes Abandonment / Demolition (2014$millions)	175.004	205.448	201.282
Total Direct Capital Cost excl. AFUDC (As-spent $millions)	202.481	238.178	232.985
AFUDC (as spent $millions)	11.054	12.309	12.572
Total As-spent includes Abandonment / Demolition & AFUDC ($millions)	213.535	250.487	245.557
Annual incremental gross O&M (2014$millions)	0.055	0.020	0.055
Levelized Rate Impact – 60 Yr. ($ / GJ)	0.087	0.103	0.101
PV Incremental Cost of Service – 60 Yr. ($millions))	259.659	306.480	300.513

Increasing the capacity of the Coquitlam Gate IP pipeline to achieve full resiliency to the Metro IP system allows for mitigation of the estimated economic impacts associated with loss of service as well as provides an operational risk reduction of approximately $2.456 million per year.

A calculation of the present value of operational risk was conducted on Alternatives 4 and 6 since Alternative 5 has a higher cost and does not offer the system resilience of Alternative 6. This was completed to determine the differential between the two alternatives in terms of a 60 year Levelized cost when the impact of risk reduction was taken into account. The present value of the operational risk was added to the present value of the cost of service to provide an overall present value comparison, which is summarized in Table 9-3. Operational risk is defined as the sum of the quantitative risk value of each pipeline section per year of operation, based on failure frequency per year and financial cost per event.

Table 9-3: Coquitlam Gate IP Project Financial and Operational Risk Comparison

		Alternative 4 Install NPS 24 pipeline at 2070 kPa	Alternative 6 Install NSP 30 pipeline at 2070 kPa
1	Operational Risk Reduction (%)	0	100
2[44]	Remaining Operational Risk (2014$millions / year)	2.456	0
3	PV Remaining Operational Risk – 60 Yr[45] ($millions)	38.880	0
4	PV Incremental Cost of Service – 60 Yr ($millions)	259.659	300.513
5	PV Remaining Operational Risk + PV Incremental Cost of Service –60Yr ($millions)	298.539	300.513

In summary, when taking into account the reduction in operational risk provided by Alternative 6 compared to Alternative 4, and that Alternative 6 is the only alternative which meets all of the stated objectives FEI has selected Alternative 6 as the preferred alternative. The estimated capital cost for the Coquitlam Gate IP Project in As spent dollars, including AFUDC and abandonment / demolition costs is $245.557 million.

FEI evaluated a number of route options using a detailed route selection process. The overall objective of the routing process was to select the route option that minimizes potential impacts on the community, stakeholders and environment while meeting safety and construction requirements in an economical manner. The result is the preferred Coquitlam Gate IP pipeline route option which is presented in Table 9-4 relative to the existing pipeline route.

Table 9-4: Coquitlam Gate IP Project Selected Pipeline Route

Section	Existing NPS 20 Coquitlam IP route	Proposed NPS 30 Coquitlam IP route	Relative Position
1	Como Lake Avenue	Como Lake Avenue	Parallel in same road
2	Como Lake Avenue	Como Lake Avenue	Parallel in same road
3	Como Lake Avenue and Broadway	Como Lake Avenue and Broadway	Parallel in same road
4	Broadway	Broadway	Parallel in same road
5	Broadway	Broadway	Parallel in same road
6	Springer Avenue, Halifax Street, Brentlawn Drive, Lane adjacent to Brentwood Town Centre, Halifax Street, 2nd Avenue	Springer Avenue, Halifax Street, Highlawn Drive, Brentlawn Drive, Graveley Street	Parallel Street (offset one to two streets north)

44 See section 3.1.3.4.

45 PV Remaining Operational Risk – 60 Year was derived by applying the formula for the present value of an annuity to the annual remaining operational risk of $2.456 million using FEI's after tax weighted average cost of capital of 6.14%; PV = $2.456 x $[(1 – (1 + k)^{-n}) / k]$ Where k = 6.14% and n = 60 years.

Section	Existing NPS 20 Coquitlam IP route	Proposed NPS 30 Coquitlam IP route	Relative Position
7	East 2nd Avenue	East 1st Avenue	Parallel Street (offset one street north)

9.4 LMIPSU PROJECTS SUMMARY

A summary of the total forecast capital costs for the Projects, and 2019 average cost of service, is as follows:

- Total Capital Cost (As-spent dollars) excluding AFUDC but including abandonment and demolition cost is $250.216 million (including AFUDC the As spent cost is $263.664 million), and
- 2019 Average Cost of Service Impact - $0.130 / GJ.

For a typical FEI residential customer consuming 95 GJ per year in 2019, this would equate to approximately $12 per year and reflects an approximate increase of 3.39% on delivery margin or an approximate increase of 1.3% on the burner tip.[46]

The following Tables 9-5 and 9-6 summarize the total forecast capital and deferred costs for the Projects and the approximate average burner tip rate impacts:

Table 9-5: Summary of Forecast Capital & Deferred Costs ($millions)

Particular	2014$	As-Spent	AFUDC	Tax Offset	Total
Total Capital Cost	219.677	250.216	13.448		**263.664**
LMIPSU Development Cost	2.441	2.442	0.197	(0.635)	**2.004**
LMIPSU Application Cost	1.307	1.307	0.080	(0.340)	**1.047**
Total	**223.425**	**253.965**	**13.725**	**(0.975)**	**266.715**

Table 9-6: Summary of Approximate Rate Impacts ($/GJ)

Approximate Rate Impact	2019	60 Year Levelized Average
Coquitlam Gate IP Project	0.122	0.101
Fraser Gate IP Project	0.008	0.007
Total	**0.130**	**0.108**

[46] Approximate burner tip impact calculated based on a Residential customer's annual bill of $922 as of January 1, 2015

The Company has engaged the public and First Nations since the early stages of the Projects, and will continue to do so during future phases of the Projects.

The Company has identified a number of Project stakeholders, including residents, businesses and government entities. Communications and consultations with the stakeholders with respect to the Projects have already taken place, and as outlined in section 7 (Public Consultation) FEI continues to consult with stakeholders regarding route issues, the schedule for the Projects, temporary construction space, right of way, and public safety. Another series of public information sessions is planned prior to start of construction, with the goal of informing residents and the public about construction activities, traffic issues and mitigation strategies.

FEI is committed to continuing consultation with Project stakeholders and will continue to ensure that, as the Projects progress, they are kept informed and have ways to provide feedback to the Company.

The Projects will not involve Crown Land or any First Nations treaty land. However the Company has communicated with First Nations about the Projects and the Company's plans for the Projects. The OGC will be the Crown agency responsible for First Nations consultation. FEI will work with the OGC if any further First Nations consultation is required.

The Projects are primarily confined to private property, and municipal property such as streets, parking lots, etc. It is anticipated that traffic flows will be impacted during construction however appropriate mitigation measures will be put in place to address this issue.

The Environmental Overview Assessment concluded that any environmental impacts associated with the Projects are expected to be minimal and can be mitigated through the implementation of standard best management practices and mitigation measures.

The Archaeological Overview Assessment concluded that the majority of the Projects are considered to have low archaeological potential due to the amount of previous disturbance by development activities. The areas surrounding fish-bearing streams have been provisionally assessed as having high archaeological potential and therefore an AIA has been recommended for these areas. An AIA will be undertaken once BCUC approval of this Application is received and prior to construction of the Projects.

The Socio-Economic study concludes that, with the adoption of the recommendations outlined in the Socio-Economic report, the Projects are not expected to have any negative, long-term effects on the socio-economic conditions in the study area. Positive socio-economic benefits to the regional area, the province and beyond are expected to result from the Projects.

During construction, FEI will follow the best management practices and mitigation measures applicable to the Intermediate Pressure pipeline replacements and as determined appropriate by a Qualified Environmental Professional or a Professional Archaeologist.

In summary, any potential environmental, archaeological, or socio-economic impacts associated with the Projects are expected to be minimal and can be mitigated through the implementation of standard best management practices and mitigation measures.

The Company has concluded that the Projects as proposed are the most prudent solutions to the concerns identified by FEI regarding the Coquitlam Gate IP pipeline and the Fraser Gate IP pipeline and therefore, believes the Projects as proposed are in the public interest and should be approved.