PNG PACIFIC NORTHERN GAS

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Via E-File and E-mail

October 9, 2020

B.C. Utilities Commission
Suite 410 - 900 Howe Street
Vancouver, BC V6Z 2N3

File No.: 4.2 (2020)

Attention: Marija Tresoglavic
Acting Commission Secretary

Dear Ms. Tresoglavic:

Re: Pacific Northern Gas Ltd.
Application for a Certificate of Public Convenience and Necessity for the Salvus to Galloway Gas Line Upgrade Project

Accompanying please find the application by Pacific Northern Gas Ltd. (PNG) to the British Columbia Utilities Commission (BCUC) for approval of a Certificate of Public Convenience and Necessity (CPCN), pursuant to Sections 45 and 46 of the *Utilities Commission Act*, for net capital expenditures of approximately $84.8 million to upgrade the Salvus to Galloway segment of the PNG Western Transmission Gas Line (Project) (the Application).

The Project scope includes the following:

- Repairs to the highest-risk metal loss features and dents;
- Line lowering activities in high-risk areas;
- Two valve site installations deemed essential for future strategic system isolation; and
- Mitigation of one very-high risk geohazard.

PNG submits that the Project represents an appropriate balance of mitigating risks associated with metal loss, dents and geohazards while managing customer rate impacts associated with the Project. Successful execution of the Project will will ensure the continued provision of safe and reliable natural gas service to the northwest coastal region of British Columbia.

PNG notes that parties registered as Interveners in the PNG-West 2020-2021 Revenue Requirements Application and the PNG and Pacific Northern Gas (N.E.) Ltd. 2019 Consolidated Resource Plan proceedings have been copied on this Application.

Request for Confidential Treatment of Certain Appendices

PNG has filed the following appendices confidentially pursuant to Section 18 of the BCUC's Rules of Practice and Procedure regarding confidential documents:

- Appendix C – BGC 2019 Report - 2019 Preliminary Geohazard Assessment
- Appendix D – BGC 2020 Report - 2020 Geohazard Mitigation Plan
- Appendix E – Dynamic Risk - MP 311-MP 364 ILI Response Prioritization
- Appendix F – Skystone - NPS 8 Mainline Above Ground Survey Indirect Inspection Report
- Appendix I – Lauren - Upgrade Feasibility Report
- Appendix K – Lauren - Basis of Estimate
- Appendix L – Revay - Quantitative Cost Risk Assessment
- Appendix M – Lauren - Risk Registry
- Appendix N – Financial Analysis

PNG respectfully requests that the BCUC treat the above listed documents as confidential and to remain confidential after the regulatory process is completed. PNG provides the following reasons for treating the information as confidential.

<u>Appendices C, D, E, F, I, K, L, and M</u>

Appendices C, D, E, F, I, K, L and M are engineering documents that include cost estimates and identify pipeline system and Project risks, and also contain sensitive information relating to PNG's assets.

PNG submits that these appendices should be kept confidential on the basis that should the Application be approved, PNG expects to seek competitive bids for the materials and construction work required to execute the Project. Disclosure of the estimated cost details for the material and construction work would prejudice PNG's negotiating position and competitive tendering processes.

PNG also believes the appendices should be kept confidential as the information contained in the documents is sensitive from an operational standpoint and if disclosed could negatively impact PNG's ability to operate the system in a safe and reliable manner. PNG notes that it is industry standard practice for pipeline and utility operators not to provide specific detailed risk information in public forums on a non-confidential basis, but rather to summarize the salient issues in the body of applications.

Appendix N

Appendix N includes cost estimates, containing capital cost estimates for the Project. Again, PNG submits that this appendix should be kept confidential on the basis that should the Application be approved, PNG expects to seek competitive bids for the materials and construction work required to execute the Project, and disclosure of the estimated costs for the material and construction work would prejudice PNG's negotiating position and competitive tendering processes.

PNG believes it has struck a reasonable balance of providing the necessary facts and analysis in the body of the Application, while providing confidential appendices for consideration by the BCUC and selected interveners undertaking due process.

Access to Confidential Information for Interveners

Consistent with Section 24 of the BCUC's Rules of Practice and Procedure regarding requests for access to confidential documents, PNG believes it is appropriate that parties wishing access to confidential information must submit a request electronically to the BCUC, with a copy to PNG, that explains the reason(s) for the request and a statement describing how access to the information pertains to their participation in the proceeding. If a request is granted, the requesting party must sign and file with PNG and the BCUC a Declaration and Undertaking form before receiving a copy of the confidential information. PNG has no objection to providing confidential information to its customary and routine intervener groups representing customer interests. However, PNG requests that the BCUC provide it with the opportunity to file comments on any objections or concerns that it may have, should any other registered parties seek access to confidential information.

Please direct any questions regarding this letter to my attention.

Yours truly,

Original on file signed by:

Verlon G. Otto

cc: Leigha Worth (BCPIAC) – BCOAPO (ed@bcpiac.org)
Irina Mis (BCPIAC) – BCOAPO (imis@bcpiac.org)
Bill Andrews – BCSEA-SCBC (wjandrews@shaw.ca)
Tom Hackney – BCSEA-SCBC (thackney@shaw.ca)

PACIFIC NORTHERN GAS LTD.

PNG-WEST SERVICE AREA

Application for a Certificate of Public Convenience and Necessity for the Salvus to Galloway Gas Line Upgrade Project

October 9, 2020

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1 Application

1.1 Approvals Sought

Pacific Northern Gas Ltd. (PNG) hereby applies to the British Columbia Utilities Commission (BCUC) for a Certificate of Public Convenience and Necessity (CPCN) for the Salvus to Galloway Gas Line Upgrade Project (Project) (the Application), pursuant to sections 45 and 46 of the *Utilities Commission Act* (UCA). As described herein, the Project involves the undertaking of significant remediation of the Salvus to Galloway section of the PNG Western Transmission Gas Line in order to align with current regulatory requirements and to ensure the continued safe, reliable delivery of natural gas to PNG customers. Project activities are focused on works necessary to repair metal loss (corrosion) and dent anomalies along the pipeline segment, increasing depth of cover in high risk areas, improving pipeline right of way access, as well as addressing geohazards that have been determined to be cost effective to remediate. The Project has an estimated capital cost of approximately $84.8 million in as-spent dollars ($80.6 million in 2020 dollars) to be incurred over a three-year period, between 2021 and 2023.

As outlined in this Application, PNG submits that the proposed Project is a necessary and cost-effective solution to address existing compliance deficiencies relating to applicable pipeline standards and to ensure the continued provision of safe, reliable natural gas service to PNG's customers in the Prince Rupert and Port Edward areas, and that it is therefore in the public interest. A draft BCUC order detailing the approval sought is appended to this Application as Appendix A.

1.2 Executive Summary

1.2.1 Introduction

PNG owns and operates the Western Transmission Gas Line. The Western Transmission Gas Line has been providing safe and reliable transportation and utility service for over 50 years and presently serves over 20,400 residential, commercial, and industrial customers in twelve communities and surrounding areas.

Figure 1-1 illustrates the Salvus to Galloway section of the Western Transmission Gas Line.

Figure 1-1: Salvus to Galloway Section of PNG Western Transmission Gas Line

The western-most part of the pipeline system, from Terrace to Prince Rupert, traverses extremely rugged and challenging mountainous and river valley terrain, resulting in geotechnical and hydrotechnical challenges (collectively, geohazards) throughout the pipeline route. These geohazards are not typical of those faced by pipelines outside of this difficult topography and terrain.

The ongoing challenges have been heightened by the vintage of the original pipeline system and the accepted design and construction specifics for this pipeline segment when originally constructed in 1968. This resulted in a higher risk of physical damage and failure, complexity of maintenance and repair, and existing and resultant less than desirable conditions that “must be lived with”. PNG has managed these conditions and outcomes as best possible in an environment with limited market opportunities for natural gas in the Prince Rupert area for the past 30 years. The status quo, however, is no longer acceptable, resulting in the Project proposed herein.

1.2.2 Project Justification

The objective of the proposed Project is to remediate the Salvus to Galloway pipeline segment as a necessary and cost-effective solution to address existing compliance deficiencies relating to applicable pipeline standards and to ensure the continued provision of safe, reliable natural gas service to PNG's customers in the Prince Rupert and Port Edward areas.

Following a 20-plus year period where PNG deferred certain maintenance and integrity management practices in order to operate within an economic circumstance void of significant industrial customers, PNG must now look to undertake projects and investment that allow for the significant repair and upgrade of aged assets in order to safeguard the integrity and safety of its pipeline system. This is of utmost priority for the Salvus to Galloway pipeline segment that has been identified as being susceptible to high hazard and risk associated with threats such as corrosion, mechanical damage, and geohazards.

1.2.3 Alternative Analysis and Recommended Solution

PNG believes that it is in the public interest to upgrade the existing Salvus to Galloway pipeline segment, rather than undertaking more elaborate options to supply the Prince Rupert and Port Edward areas.

PNG undertook a multi-step process to identify and screen potential options to ensure reliable service to the Prince Rupert and Port Edward communities. The first step included a detailed screening of options to eliminate non-viable alternatives, giving consideration to a variety of factors including integrity management, project execution and financial impacts. Following the screening analysis PNG determined that the Upgrade Pipeline alternative was the only option that had an acceptable balance of cost, the ability to comply with applicable codes and regulations in a timely manner, and could also meet the capacity and timing needs for future RECAP customers.

The next step involved PNG identifying four sub-options to the Upgrade Pipeline alternative with varying degrees of scope and timing for the associated pipeline repairs and reinforcement that could be undertaken. PNG conducted a systematic evaluation of these potential sub-options for the Upgrade Pipeline alternative and selected Upgrade Alternative 2 (UA 2) as its recommended alternative to proceed into the construction phase. This preferred alternative includes:

- Repairs to the highest-risk, compliance-based, metal loss features and dents;
- Line lowering activities in high-risk areas;
- Two valve site installations deemed essential for future strategic system isolation; and

- Mitigation of one very high-risk, complex geohazard (Lachmach to Debris Slides, MP 347 – 350).

The solution will cost-effectively mitigate the selected pipeline integrity issues and hazards in accordance with the *Oil and Gas Activities Act*, the associated Pipeline Regulation, and CSA Z662, the standard governing the design, construction, operation, and maintenance of natural gas pipelines. This option will rectify all immediate and high priority metal loss features and dents and address geohazards on a risk-adjusted basis.

1.2.4 Project Costs and Rate Impact

The total cost of the Project (as-spent dollars) is $84.76 million, which includes a 20% contingency and 5% management reserve to reflect the risks associated with the Project. The Project work will be undertaken over a three-year period, between 2021 and 2023. Table 1-1 provides the expected total and annual Project expenditures.

Table 1-1: Project Completion and In-service (Project Years 2021-2023) – As-spent Dollars

(As-spent $)	Estimated Project Completion Dates			
Asset Class	**2021**	**2022**	**2023**	**Total**
Land Rights (BCUC 461)	1,839	3,451	1,203	**6,493**
Transmission Mains (BCUC 465)	24,841,027	44,175,968	15,737,982	**84,754,976**
Total	**24,842,866**	**44,179,418**	**15,739,185**	**84,761,469**
% of Total Project	29%	52%	19%	**100%**

In June 2020, PNG initiated the RECAP auction to assess the demand for, and value of, capacity on the Western Transmission Gas Line. As a result of the RECAP, PNG has entered into long term contracts for a total of 65 MMSCFD. While PNG has executed Transportation Service Agreements (TSAs) to support 65 MMSCFD of new contract demand, PNG recognizes that there is inherent risk associated with development projects such as those underlying the RECAP demand, including the requirement to obtain BCUC approval of CPCNs for incremental capital expenditures, as well as other regulatory approvals.

Given the materiality of the potential revenues associated with these incremental RECAP volumes, PNG has given consideration to the expected impact on average delivery rates of the Project, both alone and in combination with potential incremental demand from RECAP at both 30 MMSCFD and 65 MMSCFD. On a standalone basis (without any RECAP revenues or costs), PNG anticipates that the Project will increase residential delivery rates for PNG-West customers by approximately 11% once fully implemented. However, under both the 30

MMSCFD and 65 MMSCFD RECAP scenarios the RECAP revenues are expected to more than offset the entire cost of service impact of the Project over the average initial 20-year term of the RECAP TSAs.

1.2.5 Environmental and Archaeological Evaluation

As part of project development, PNG commissioned comprehensive environmental and archaeological studies and assessments to evaluate the potential for environmental and archaeological impacts that may arise from the Project work. PNG has concluded that the Project is expected to have minimal irreversible or deleterious environmental and archaeological impact. Identified potential impacts can and will be mitigated through implementation of best management practices. PNG will continue its investigations through the pre-construction phase to get a more fulsome understanding of the potential risk to various species and habitats, which will help to minimize any impacts to the environment and resultantly to project cost and timelines.

As the Project proceeds through the detailed engineering phase, environmental constraints and archaeological potential will be further assessed and identified. This work will inform the development of site-specific mitigation plans to address potential impacts associated with project work. PNG will obtain required environmental and archaeological permits prior to commencement of project work. Project activities will be governed by permit conditions and purpose-built management plans and will be guided by the direction of qualified professionals. Where appropriate, PNG will undertake environmental and archaeological monitoring during work activities and will engage Indigenous communities for archaeological and cultural values preservation monitoring during work in sensitive areas.

1.2.6 Consultation and Engagement

Key components of PNG’s project development process include early consultation and engagement with Indigenous communities, identified stakeholders, and the general public and maintaining two-way communication with affected and interested parties.

Public and Stakeholder Engagement

PNG undertook robust communication and engagement activities for the Project that included two virtual information sessions, print, radio and digital ads, email notifications, and virtual meetings with individual key stakeholders.

PNG will continue to engage with stakeholders and the public as the Project advances and will maintain open dialogue with all interested parties. Communication with stakeholders will continue throughout the construction phases of the Project on matters such as schedule/timelines, construction spaces, and also on potential impacts to natural gas service. PNG is committed to addressing all questions, concerns or issues raised and to working with stakeholders to minimize project impacts.

Indigenous Consultation and Engagement

PNG identified six potentially impacted Indigenous communities and proactively engaged with each of them on the proposed Project. The purpose of engagement activities was to provide an overview of the maintenance and integrity repair works proposed to be undertaken, discuss projected permitting, consultation, and Project opportunities. Engagement activities included communication and discussion with representatives from each Indigenous community's respective land and resource management departments, including the offer of a Project overview presentation by PNG.

As the Project develops and moves throughout the various project stages, PNG will continue to work with Indigenous communities to ensure they are consulted, engaged and kept informed of Project developments and that they have an opportunity to comment on updated environmental and archaeological management plans as they are developed.

1.2.7 British Columbia's Energy Objectives and PNG's Long Term Resource Plan

PNG confirms that the Salvus to Galloway Upgrade Project was identified in PNG's most recent resource plan, its 2019 Consolidated Resource Plan. PNG also confirms that the Project supports British Columbia's energy objective of encouraging economic development and the creation of jobs. The Project is expected to create employment opportunities and contribute to the economies in the north western and north eastern regions of British Columbia.

1.2.8 Conclusion

PNG submits that the proposed Project to remediate the Salvus to Galloway pipeline segment through identified upgrades is necessary to ensure continued safe, reliable gas service to its customers in the northwest coastal region of British Columbia and is in the public interest. PNG respectfully requests that the BCUC approve the Project as described in the Application.

1.3 Proposed Regulatory Process

In this Application, PNG is seeking approval for $84.8 million in capital expenditures to remediate the Salvus to Galloway section of its Western Transmission Gas Line. PNG is hopeful that it will obtain BCUC approval for the Project no later than June 30, 2021, in order to accommodate the Project schedule presented in Section 6.4.1, as well as enable PNG to meet anticipated new customer contractual obligations as noted in Section 4.3.

PNG submits that a written hearing process with two rounds of information requests from the BCUC and registered interveners should allow for an appropriate and efficient review of the Application. In this regard, PNG has provided a proposed regulatory timetable in Table 1-1 below. PNG remains open to other regulatory processes and actions that may facilitate an expeditious and efficient review, including an oral component, such as the possibility of a workshop with BCUC Commissioners and interveners where PNG would provide an overview of the Application.

Table 1-2: Proposed Regulatory Timetable

ACTION	DATE
BCUC Procedural Notice	Week of October 19, 2020
PNG publishes Public Notice	Week of November 2, 2020
Intervener and Interested Party Registration	Thursday, November 19, 2020
BCUC Information Request No. 1	Tuesday, November 24, 2020
Intervener Information Request No. 1	Tuesday, December 1, 2020
PNG response to Information Request No. 1	Thursday, January 7, 2021
BCUC and Intervener Information Request No. 2	Tuesday, January 26, 2021
PNG response to Information Request No. 2	Thursday, February 25, 2021
PNG Final Argument	Wednesday, March 11, 2021
Intervener Final Argument	Thursday, March 25, 2021
PNG Reply Argument	Thursday, April 8, 2021

1.4 Organization of the Application

The Application provides detailed information in support of the Project in accordance with the guidelines set out in the BCUC's 2015 Certificate of Public Convenience and Necessity Application Guidelines (CPCN Guidelines).

The remainder of the Application is organized into the following sections:

- Section 2 provides an overview of the Applicant and provides information on PNG's financial and technical capabilities to undertake the Project;
- Section 3 establishes context for the Application and provides information on the history of PNG and its Western Transmission Gas Line, the regulatory environment and on PNG's integrity management activities;
- Section 4 provides the justification for the Project;
- Section 5 describes the alternatives considered, the criteria for evaluating alternatives, and the technical and financial evaluation of each of the alternatives;
- Section 6 provides a detailed description of the Project, including construction, design, resource planning and management and schedule, as well as setting out a risk analysis and potential project impacts;
- Section 7 provides the cost estimate, the assumptions upon which the financial analysis is based and the rate impacts;
- Section 8 provides an overview of the Project environment, including a discussion of the environmental and socio-economic impacts the Project may have and PNG's plans to mitigate those impacts;
- Section 9 discusses PNG's public consultation and communication efforts regarding the Project and PNG's engagement with Indigenous communities potentially impacted by the Project; and
- Section 10 describes how the Project supports British Columbia's energy objectives and its inclusion within PNG's most recent long-term resource plan.

2 Applicant

2.1 Name, Address and Nature of Business

PNG is a company formed under the laws of British Columbia and is a wholly-owned subsidiary of TriSummit Utilities Inc. (TSU, formerly AltaGas Canada Inc. (ACI)), the owner of a number of Canadian utilities and renewable power infrastructure. TSU is in turn owned by TriSummit Cycle Inc. (TCI, formerly PSPIB Cycle Investments Inc.), an entity in which the Public Sector Pension Investment Board (PSP) indirectly holds an 80% interest and in which the Alberta Teachers' Retirement Fund Board (ATRF) indirectly holds a 20% interest.

PNG maintains an operating office at 2900 Kerr Street in Terrace, British Columbia, and its head office is located at Suite 750, 888 Dunsmuir Street, Vancouver, British Columbia.

PNG provides natural gas transmission, distribution and sales services to approximately 20,400 residential, commercial and industrial customers located in communities in north western British Columbia via its PNG-West division. The PNG-West division's transmission pipeline connects with the Enbridge Inc. (previously Spectra Energy Corp.) pipeline system near Summit Lake, British Columbia and extends to the west coast of British Columbia at both Prince Rupert and Kitimat. The PNG-West division owns and operates approximately 1,050 kilometres of transmission pipeline, including 592 kilometres of mainline transmission pipeline and the remaining lateral transmission lines extending into the various communities served by PNG, the most significant being dual lines extending approximately 57 kilometres from Terrace to Kitimat.

There are five compressor units that can be used to maintain pressure on the PNG-West division's transmission pipeline system: two located at Summit Lake and one each at Vanderhoof, Burns Lake and Telkwa. The sustainable capacity of the transmission pipeline system, with the present compressor and looping configuration, is approximately 3,260 10^3m^3 per day (115 MMSCFD). However, the pipeline has been operating at approximately 30% of its sustainable capacity since early 2000.

PNG also owns and operates natural gas distribution facilities in the PNG-West division including approximately 950 kilometres of distribution mains and 690 kilometres of service lines to deliver gas from its transmission pipeline system to homes and businesses in Prince Rupert, Port Edward, Kitimat, Terrace, Smithers, Telkwa, Houston, Burns Lake, Fraser Lake, Fort St. James and Vanderhoof. In addition, the PNG-West division operates a propane vapour distribution system serving approximately 130 customers in the town of Granisle.

PNG is the parent company of Pacific Northern Gas (N.E.) Ltd. (PNG(NE)), also a natural gas distribution utility, providing sales and transportation services to approximately 21,000 residential, commercial and industrial customers in the north eastern British Columbia communities of Fort St. John, Dawson Creek, and Tumbler Ridge. PNG and PNG(NE) are both regulated by the BCUC.

The layout of the PNG-West and PNG(NE) transmission and distribution assets are illustrated in Figure 2-1 that follows.

Figure 2-1: Overview of PNG and PNG(NE) Natural Gas Pipeline Systems

2.2 Financial Capability

PNG is capable of financing the Project either directly, or indirectly, through its association with TSU, its parent company. At this time, PNG anticipates securing financing for the Project from TSU at rates commensurate with those available in the financial markets. DBRS Limited currently rates TSU as BBB (high) with a Stable trend and PNG is rated BBB (low) with a Stable trend. PNG is currently evaluating borrowing durations and associated interest rates to determine the most cost-effective approach to finance the capital expenditures required for the Project. In this regard, PNG expects to file an application with the BCUC in November 2020 seeking approval of the underlying financing arrangements to be contingent upon BCUC approval of the Project.

2.3 Technical Capability

PNG has the technical capability to coordinate and oversee the necessary remediation activities identified for the Project. PNG has many years of experience with constructing, operating and maintaining natural gas transmission and distribution systems, high pressure infrastructure, and in providing safe, secure and reliable gas service to its customers. In addition to the resources available internally, PNG has engaged Lauren Services and a number of other external service providers with a wide array of expertise to assist with engineering, design, procurement and construction activities.

2.4 Company Contacts

All notices and other communications in connection with this Application should be directed to:

Verlon Otto, Director Regulatory Affairs
Pacific Northern Gas Ltd.
Suite 750, 888 Dunsmuir Street
Vancouver, British Columbia V6C 3K4
Tel: 604-697-6218
Fax: 604-697-6210
E-mail: votto@png.ca

And copied to PNG's alternate contact:

Gordon Doyle, Vice President Regulatory Affairs, Legal & Gas Supply
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Fax: 604-697-6210
E-mail: gdoyle@png.ca

2.5 Legal Counsel

All notices and other communications in connection with this Application should also be directed to legal counsel engaged by PNG on this matter at:

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Vancouver, British Columbia V7Y 1B3

Tel: 604-661-1722
Fax: 604-661-9349
E-mail: lherbst@farris.com

3 History and Context of Application

3.1 Introduction

PNG and its wholly-owned subsidiary PNG(NE) own and operate approximately 1,200 kilometres of high-pressure pipelines, of which approximately 1,050 kilometres make up the PNG Western Transmission Gas Line. As illustrated in Figure 3-1, the Western Transmission Gas Line is comprised of main stem, loops, and laterals extending from the R1 Compressor Station at Summit Lake, 50 kilometres northeast of Prince George in the northern interior, to Prince Rupert and Kitimat on the north west coast. The Western Transmission Gas Line has been providing safe and reliable transportation and utility service for over 50 years and presently serves over 20,400 residential, commercial, and industrial customers in twelve communities and surrounding areas.

Figure 3-1: PNG Western Transmission Gas Line

The western most part of the pipeline system, from Terrace to Prince Rupert, traverses extremely rugged and challenging mountainous and river valley terrain, resulting in geotechnical and hydrotechnical challenges (collectively, geohazards) throughout the pipeline route. These geohazards are not typical of those faced by pipelines outside of this difficult topography and terrain. The ongoing challenges are heightened by the vintage of the original pipeline system and the fact that design and construction practices were different when the original Transmission Gas Line from Summit Lake to Prince Rupert was constructed in 1968. For all these reasons, the pipeline faces integrity threats that require intervention as well as risks that require mitigation in environmentally sensitive and habitat rich areas with varying degrees of access challenges. Despite these challenges, in general, the pipeline system from Summit Lake to Terrace, and Terrace to Kitimat, has been reasonably well maintained, with regularly executed integrity investigation, assessment, and repair campaigns in the years following in-line inspection (ILI) programs. With the exception of discrete areas of extreme terrain and complex access and constructability challenges, such as tight valleys and wide watercourses, the pipeline system has seen limited interruption from failure.

One pipeline segment of particular challenge and concern is the Mile Post (MP) 311.15 to MP 362.5 portion of the Western Transmission Gas Line from the Highway 16 West Salvus highway maintenance yard (Salvus) adjacent the Skeena and Kasiks Rivers 50 kilometres southwest of Terrace to the Galloway Pressure Regulating Station (Galloway) in the Port Edward area approximately 9 kilometres southeast of Prince Rupert. The challenge and compromises made to build this pipeline segment in this difficult terrain were identified in a post-construction 1969 Pipeline Inspection Report[1] where it is noted that the section to Prince Rupert experienced the greatest construction difficulties. Access was difficult and the area was referred to as “difficult pipeline country”. As a result, this section had the poorest standard of construction of any on the Western Transmission Gas Line. The 1969 Pipeline Inspection Report identifies that most of the pipe was laid on the surface and left hanging in many places, over long stretches; trenches were not backfilled; and in some locations the pipeline was run along creek bottoms with no scour protection. The environment and construction practices resulted in acknowledgment that this pipeline segment had a higher risk of physical damage from geohazards and that it would not be practical to undertake the work to place all sections of the pipe in a backfilled trench and that the existing conditions must be “lived with”. PNG has managed these conditions and outcomes as best possible in an environment with limited market opportunities for natural gas in the Prince Rupert area for the past 30 years.

This Salvus to Galloway pipeline segment is now subject to even greater risk of rupture and loss of service due to pipeline integrity issues related to overall physical condition and external forces imposed by geohazards. Figure 3-2 illustrates the Salvus to Galloway section of the Western Transmission Gas Line.

[1] Inspection of Pacific Northern Gas Pipeline from Summit Lake to Prince Rupert Report, April 21 and 22, 1969, RM Hardy and Associates Ltd.

Figure 3-2: Salvus to Galloway Section of PNG Western Transmission Gas Line

Through PNG's risk management processes, expert studies, operational experience and institutional knowledge, PNG has confirmed that the Salvus to Galloway section of pipeline is of considerably higher risk than the rest of the Western Transmission Gas Line and that it requires immediate remediation. In recent years, PNG has carried out additional in-depth technical studies in this area, which has further revealed the degree of pipeline integrity defects that are of concern and require intervention.

To allow for further investigation into the condition of the Salvus to Galloway segment PNG has sought BCUC approval for funding to conduct additional studies in this region, both in the 2018-2019 Revenue Requirements Application and, more recently, in the 2020-2021 Revenue Requirements Application. Given its history and degree of apparent risk, the Salvus to Galloway segment of pipeline is a particular focal point in the ongoing PNG segment-based risk assessment program designed to assess risk at a line-by-line, section-by-section, and threat-by-threat degree of granularity, in order to comply with the requirements of the British Columbia Oil and Gas Commission (BC OGC) and Canadian Standards Association (CSA) standard Z662, Oil and Gas Pipeline Systems (CSA Z662), which is the standard governing the design, construction, operation, and maintenance of natural gas pipelines, as further described in Section 3.4 of this Application.

Given the above, and the ongoing evolution and mounting rigour of codes, standards, best practices and regulatory requirements associated with pipeline design, construction, operations, maintenance, overall safety and loss management, and the timely prioritization of compliance related integrity threat intervention and risk mitigation, PNG proposes to upgrade and remediate the Salvus to Galloway pipeline segment. Upon obtaining the required regulatory approvals from the BCUC and the BC OGC, PNG will undertake work to address the highest priority integrity issues as required by the applicable codes and standards, improving reliability of service, and reducing overall pipeline risk.

To provide further context for the need for the Project proposed by PNG in this Application, the following sections provide additional information on the history of PNG and the regulation of the Western Transmission Gas Line, as well as on PNG's integrity management planning and activities, and industry changes impacting PNG.

3.2 History of PNG and the Western Transmission Gas Line

In its over 50-year history, PNG has gone through numerous ownership changes and has seen significant changes to its customer base. PNG was incorporated under the laws of British Columbia in 1965 as a wholly-owned subsidiary of Westcoast Transmission Company Limited (now Enbridge Inc.). To fund the construction of a gas transmission pipeline in northwest British Columbia, PNG issued common and preferred shares to the public and converted to a public company in 1968.

On December 5, 1966, PNG received approval from the then Public Utilities Commission of British Columbia for the construction and operation of a natural gas system extending from Summit Lake near Prince George to Prince Rupert (the Western Transmission Gas Line). The Western Transmission Gas Line was constructed in 1968 in accordance with the *Pipe Line Act* from a point 50 kilometres north of Prince George at Summit Lake on Enbridge Inc.'s Westcoast Energy pipeline system, west through to Prince Rupert and Kitimat on the British Columbia west coast. Following completion of the Western Transmission Gas Line, PNG developed gas distribution services in the adjacent communities. In 1982, PNG expanded its pipeline system to provide service to a methanol production facility constructed in Kitimat.

In 2000, a major company reorganization was undertaken in response to liquidity issues created when PNG's largest customer, the methanol company in Kitimat, closed for a one-year period. Savings were realized through downsizing and consolidation of responsibilities for operations and maintenance personnel. In November 2005, the methanol plant closed permanently, resulting in the loss of PNG's largest customer.

In December 2003, Tricor Acquisition (STP) Inc., a subsidiary of Tricor Pacific Capital Inc., acquired PNG's common shares held by Westcoast Energy Inc. In April 2005, all of the common shares of PNG owned by Tricor were sold and PNG became widely held.

In December 2011, PNG was acquired by AltaGas Ltd. of Calgary, Alberta, an energy infrastructure business with a focus on natural gas, power and regulated utilities.

In October 2018, AltaGas Ltd. spun off its Canadian utility and renewable energy assets, including PNG, as part of a new public company, ACI. ACI successfully completed its initial public offering and sale of common shares and was listed on the Toronto Stock Exchange.

In March 2020, ACI was acquired by TCI, an entity in which PSP indirectly holds an 80% interest and in which ATRF indirectly holds a 20% interest. On April 1, 2020 ACI changed its name to TSU.

3.3 Regulation of the Western Transmission Gas Line

As a pipeline operator with pipelines operating over 700 kPa, PNG is regulated by the BC OGC, a Crown agency of the Province of British Columbia established in 1998. The BC OGC's mandate is to regulate oil and gas activities and pipelines in British Columbia that do not cross provincial boundaries.

The BC OGC reviews most oil and gas pipeline and facility applications for projects on provincial and private lands. The rules pertaining to pipelines in British Columbia are defined in the provincial *Oil and Gas Activities Act* and applicable CSA standards, most notably CSA Z662. In the event of a pipeline rupture, the BC OGC has the authority to carry out an investigation and possibly levy administrative penalties and fines if the pipeline operator is deemed culpable.

The BC OGC also requires companies to periodically test, inspect, and monitor pipelines to ensure compliance with regulatory standards. In addition, it also requires companies to carry out integrity management programs to ensure pipelines are fit for service. The BC OGC also conducts pipeline construction inspections and uses a risk-based model for inspecting and assuring compliance of operational pipelines. PNG is required to update and periodically submit its Integrity Management Plan (IMP) to the BC OGC for audit and review. BC OGC audits are conducted on a regular 4-5 year frequency as part of the Pipeline and Facilities Compliance Assurance Protocol Program.

In 2011, the BC OGC issued an order (General Order 2011-03; see Appendix B) related to a failure on the Salvus to Galloway segment of PNG's Western Transmission Gas Line. The order directed PNG to undertake a variety of actions, including: implement a vegetation clearing program in accordance with CSA Z662; perform an engineering assessment of the pipeline and develop a hazard mitigation program; assess the hazards and develop a mitigation program related to existing girth welds; amend the IMP to incorporate the actions noted above; and consider pipeline relocation alternatives.

PNG made the necessary changes to its IMP, which continued to guide integrity management action on the West Transmission Gas Line until more recent updates and activity improvements were instituted in 2018 onwards. PNG also responded to the direction for examination of the relocation of the pipeline and (1) indicated that no viable alternatives were identified for the relocation of the Terrace to Prince Rupert segment that are physically and economically practical and, further, (2) alternative means of delivering gas service to Prince Rupert come with their own inherent risk and using them is not warranted or economic.

Recent industry pipeline incidents in North America have resulted in a greater regulator focus on aged infrastructure. Recently, the BC OGC initiated a compliance review related to assets greater than 50 years of age. Given the age of the PNG Western Transmission Gas Line it is part of this review. This is inclusive of the Salvus to Galloway pipeline segment. The BC OGC intends to assess overall pipeline condition and CSA Z662 integrity-based compliance through review of historical operating records associated with ILI, subsequent direct assessment and repair, failures and associated emergency repairs, geotechnical evaluations, in-service pressure testing, cathodic protection sufficiency, fitness for service, and engineering assessments. In response to the BC OGC initiative, PNG formulated an action plan for document aggregation and transfer, resulting in the submission of over 1,000 individual files chronicling 20-plus years of historical records and data.

3.4 Integrity Management Planning

Under the direction of the BC OGC, PNG first undertook to develop and implement a formalized and documented IMP in 2009, with the initial IMP adopted in 2011. Following a BC OGC audit that identified shortcomings in PNG's existing IMP, a subsequent update to the IMP was performed in 2014-2015 with the intent of more completely aligning with the requirements of CSA Z662, in particular, the IMP was updated for shortcomings related to PNG's risk assessment and management practices. Included was addressing the fact that PNG's risk identification, assessment, mitigation, and management processes did not directly and independently focus on each of the individual threats identified in American Society of Mechanical Engineers (ASME) B31.8S Managing System Integrity of Gas Pipelines, including external corrosion, mechanical damage, and risk from natural forces such as geohazards, and did not apply focus or assessment on a pipeline segment-by-segment basis.

From 2015 onwards, PNG has continued to update its IMP and associated program documents and has diligently sought to improve its overall understanding of the requirements of the IMP and overarching safety and loss management in terms of various program applications as they pertain to BC OGC and CSA Z662 compliance. Specifically, PNG's IMP addresses the requirements of the following sections of CSA Z662, the standard governing the design, construction, operation, and maintenance of natural gas pipelines that pertain to inspection, maintenance and monitoring, threat and hazard identification and mitigation, risk assessment and management, and repairs:

- Section 3.2 – Risk Management;
- Section 3.3 – Pipeline System Integrity Management;
- Section 10 – Operating, Maintenance, and Upgrading;
- Annex A – Safety and Loss Management System;
- Annex B – Guidelines for Risk Assessment of Pipeline Systems; and
- Annex N – Guidelines for Pipeline System Integrity Management Programs.

This update to integrity management planning is inclusive of requirements pertaining to pipeline imperfections and defect assessment, natural forces such as geohazards, depth of cover, and right of way maintenance. PNG's current IMP and associated Safety and Loss Management System (SLMS) were most recently internally assessed for conformance against CSA Z662 and updated in 2020. The updated IMP and associated practices are currently subject to a BC OGC audit that is scheduled for completion before the end of 2020.

In 2019, PNG and the BC OGC resumed discussions on PNG's risk identification, assessment, mitigation, and management processes, the need for application on a pipeline segment-to-segment basis, and the previous deficiency findings of the 2014 IMP audit. PNG responded by providing a corrective action project plan that committed the utility to improving risk assessment and management processes and to developing a semi-quantitative segment-based risk assessment methodology and risk model for the entire PNG system, with initial implementation in 2020 and mandatory quarterly progress reporting to the BC OGC. The resultant methodology and model would align with PNG's risk assessment program and processes adopted in 2020, giving consideration to static and dynamic data, environmental conditions, consequences to the environment, business continuity, and safety of operation, employees, and the public, and incorporate the following:

- Inventory of all pipelines and associated physical and operational attributes;
- Hazard / threat identification and prioritization;
- Risk analysis and evaluation for mitigated and unmitigated risks;
- Identification of risk reduction and control measures; and
- Identification of reassessment considerations.

Associated work continues to progress on this initiative with the initial implementation stage projected for December 2020.

In support of integrity management and the IMP, PNG has expanded its team of integrity-focused staff and has supported the teams development, supplemented by expanded use of external subject matter experts in the fields of integrity management and associated industry best practice, and the increased visibility of the IMP to senior management and the company executive. PNG's actively evolving and maturing approach to integrity management is well aligned with mounting industry, regulator, public, and stakeholder pressures related to pipeline system integrity management and expectations for continuous improvement. These pressures stem from the interest garnered by recent integrity-related industry incidents in North America and associated regulator inquiries, many of which focus on the implications of deferred inspection and maintenance, historical sub-standard construction practices, environmentally-induced corrosion and cracking, and environmentally-induced loading resulting from geohazard presence as further described in Section 4 of this Application.

PNG has taken incremental steps towards improving its integrity management practices by requesting, justifying, and receiving approval for significant increases in both operating and maintenance and capital expenditures related to integrity management and risk mitigation. This is well documented within PNG's two most recent revenue requirements applications to the BCUC and associated responses to information requests on these applications, as well as within the documented results of the PNG Annual Risk Reviews and the subsequent Annual Pipeline Risk Mitigation Reports that have been filed with the BCUC in support of the noted recent revenue requirements applications.

In recognition of the condition of PNG's aging transmission system, PNG has made significant increases in its system betterment expenditures over the past 7 years. As an example of this, whereas in 2015 PNG spent $2.6 million on system betterment, this amount has increased to forecast amounts of $10.2 million and $13.0 million for 2020 and 2021, respectively.

3.5 Historical Pipeline Integrity Activities

Since the construction of the Western Transmission Gas Line in 1968, it has been documented that the line, and in particular the Salvus to Galloway pipeline segment, faced significant integrity risks. The discussion that follows provides a brief overview of historical concerns, incidents of pipeline review and repair, and ILI activity conducted on the segment.

3.5.1 Original Construction

As described previously, the 80 kilometre Salvus to Galloway pipeline segment was constructed by Westcoast Transmission Company Limited as part of the original Prince Rupert Transmission Mainline in the late 1960s, and given the remoteness and ruggedness of the acquired right of way from Salvus to Galloway, that project faced considerable construction challenges. It is possible that acceptable construction practices of the day, and lesser appreciation for pipeline lifecycle risk and management contributed considerably to the pipeline segment being exposed to significantly higher risk and integrity management cost than most others within the natural gas transmission industry. This has been documented through the reporting of independent third-party subject matter experts within the industry.[2]

[2] Whitepaper IPC2016-64085: "Updated Estimates of Frequencies of Pipeline Failures Caused by Geohazards" by Porter, Ferris, Leir, Leach and Haderspock and presented at the 11th International Pipeline Conference (IPC2016) gives PNG Western Transmission Gas Line special mention as having an annual failure frequency of about 0.45 per 1000 kilometres compared to an average of 0.03 per 1000 kilometres for Canada/USA.

3.5.2 Incidents of Review and Repair

In the first 20 years of operation, the Salvus to Galloway pipeline segment experienced at least 15 recorded significant repair or section replacement projects and it has been noted in previous reviews that (due to expected dents, corrosion, low depth of cover, and exposure concerns) future line relocation, upgrading, and lowering works should be anticipated. This was all prior to the first ILIs in the mid-1990s.

In 1991, an internal PNG technical report (1991 Report) identified risks that were related to the original design, construction, and commissioning, operating and maintenance history, pipeline physical characteristics, and geohazards. Particular matters of note included the facts that the pipeline segment traversed extremely difficult terrain, that there was limited-to-no access for heavy equipment for repair and risk mitigation work purposes, and that historically there were limited funds available for upgrading the pipeline in risky areas. The 1991 Report also noted that to mitigate the impacts of these challenges PNG had historically operated the line at a reduced operating pressure equating to an effective design factor of 50% rather than the normal practice of operating at an 80% design factor. On one hand, this operational decision, which continues to be followed, may have mitigated some of the potential adverse impacts associated with the condition of the pipeline. Conversely, if PNG could have operated as originally intended, at the higher design factor, PNG would not have had to absorb losses to operational flexibility, line pack, and resiliency.

Since 1991, PNG has experienced at least 35 additional pipeline incidents along the Salvus to Galloway segment, one of which, as noted previously, resulted in an order from the BC OGC (General Order 2011-03, see Appendix B). In this time, PNG has endeavoured to continue a reasonable level of integrity management of the pipeline, including regular inspection, monitoring, and maintenance activities. Given the original pipeline construction, sustained access challenges, and environmental sensitivities there has been high cost associated with each instance of mitigation and repair for both proactively planned and emergency responses. With the subsequent loss of some of its largest industrial customers, PNG managed certain activities such as right of way vegetation management, pipeline anomaly investigation and repair, and geohazard mitigation with a view to make prudent maintenance decisions in consideration of the potential for increased costs, the lower volume and operating pressures of this pipeline segment, the financial capacity of PNG, and the potential for adverse rate impacts on customers already subject to very high delivery rates.

3.5.3 In-Line Inspections

The first ILI of the Salvus to Galloway segment of the Prince Rupert NPS 8 transmission mainline was conducted in 1993. Results led to a dent and corrosion-focused integrity inspection and repair campaign under which at least sixteen repair projects in independent locations along the Salvus to Galloway pipeline segment were carried out.

In 2007, an additional ILI using global positioning system (GPS), caliper, and axial magnetic flux leakage technologies was completed for the purpose of further identifying deformation and metal loss integrity concerns. As a result of mounting access and permitting complexities and associated cost escalation in an extremely customer rate-pressured environment (due to the loss of large industrial customers at the time), limited investigation, assessment, and repair were conducted following the 2007 ILI run.

In 2018, a further ILI run was completed utilizing industry-leading survey and tool tracking technologies for the purposes of optimizing accuracy and precision of pipeline anomaly location, severity, interaction, and overall integrity threat information returned from the ILI tool. The ILI tool platform included industry-leading geospatial data, deformation measurement, and helical magnetic flux leakage technologies for the purposes of identifying dents, axially- and circumferentially-oriented features such as corrosion, gouges, long seam and pipe body linear defects; and effectively conducting a multi-threat discrimination survey, all of which contribute equally to meeting the identified purposes of the ILI run.

3.6 Industry Changes

While pipeline safety and integrity have always been important to PNG, it is important to recognize that changes occurring in the industry are heightening the need to address aging infrastructure and ensure integrity management in complete accordance with CSA Z662 and evolving industry standard practice. There have been significant integrity-related pipeline ruptures in North America, such as the rupture on the Enbridge Inc. transmission pipeline near Prince George in 2018, the Pacific Gas & Electric incident in San Bruno, California in 2010, and the Olympic Pipeline rupture in Washington State in 1999. These and other incidents have caused the industry to increase its rigour around pipeline integrity, including the associated regulatory changes discussed previously. There have also been technological advances in pipeline inspection, such as electromagnetic acoustic transducer (EMAT) equipped ILI, which are driving the industry to learn more about pipeline defects and how to repair them in a more systematic and proactive fashion. In addition, software applications have become more sophisticated, enabling more comprehensive risk assessments from the underlying data.

Further, the public and regulators expect that pipeline operators such as PNG be responsive to such changes to reduce the risk of further pipeline incidents. Pipeline systems across North America are aging, and PNG is not immune to the natural degradation of such systems which, without proactive risk management plans, elevates the risks. With aging infrastructure, utility and pipeline operators have had to respond with risk-adjusted approaches to address deteriorating assets.

3.7 Summary

Following a 20-plus year period where PNG deferred certain maintenance and integrity management practices in order to operate within an economic circumstance void of significant industrial customers, PNG must now look to undertake projects and investment that allow for the significant repair and upgrade of aged assets in order to safeguard the integrity and safety of its pipeline system. Further, the combination of heightened regulations, industry incidents, aging infrastructure, new technology options, and overall elevated public expectations, as well as its own commitment to safety and reliability, have placed PNG in a situation where it must respond to the aforementioned issues relating to the integrity of its pipeline system.

This is of utmost priority for the Salvus to Galloway pipeline segment that has been identified as being susceptible to high hazard and risk associated with threats such as corrosion, mechanical damage, and geohazards. As described in this Application, the proposed Project to remediate the Salvus to Galloway pipeline segment is a necessary and cost-effective solution address existing compliance deficiencies relating to applicable pipeline standards and to ensure the continued provision of safe, reliable natural gas service to PNG's customers in the Prince Rupert and Port Edward areas.

4 Project Need and Justification

4.1 Introduction

The objective of the proposed Project is to remediate the Salvus to Galloway pipeline segment as a necessary and cost-effective solution to address existing compliance deficiencies relating to applicable pipeline standards and to ensure the continued provision of safe, reliable natural gas service to PNG's customers in the Prince Rupert and Port Edward areas.

Following a 20-plus year period where PNG deferred certain maintenance and integrity management practices in order to operate within an economic circumstance void of significant industrial customers, PNG must now look to undertake projects and investment that allow for the significant repair and upgrade of aged assets in order to safeguard the integrity and safety of its pipeline system.

This is of utmost priority for the Salvus to Galloway pipeline segment. With advances in technology and pipeline assessment methodologies, as well as a stronger understanding of the geohazard risks that the Salvus to Galloway segment is subject to, PNG has identified that this pipeline segment is susceptible to high hazard and risk associated with threats including corrosion, mechanical damage, and geohazards.

In the sections that follow PNG provides background on the Salvus to Galloway pipeline segment and provides information on the main drivers for the Project, establishing why the status quo is no longer acceptable and why the proposed Project to mitigate risk and more fully restore system integrity is required.

4.2 Geographic Location, Topography and Terrain

The PNG Western Transmission Gas Line traverses extremely challenging mountainous and river valley terrain across and through the Nechako Plateau and the Skeena, Hazelton and Coast Mountain Ranges as it makes its way from its point of commencement 50 kilometres northeast of Prince George to its terminus 9 kilometres southeast of Prince Rupert on British Columbia's west coast.

The approximate 80 kilometre Salvus to Galloway segment of the Western Transmission Gas Line traverses a particularly challenging landscape, commencing at sea level in the Skeena River and Kasiks River valley bottoms before rising to a height of 900 metres as the pipeline ascends to the summit of a razor-thin mountain ridgeline and pipe tunnel (the Razorback) before dropping elevation abruptly on its way to and through the Khyex River valley and a return to sea level at Work Channel. The pipeline then continues its serpentine path through the Prudhomme Summit and a series of interlinking lakes before reaching Morse Basin and re-joining a parallel path with Highway 16 at the Galloway terminus. Figure 4-1 below provides a representation of the pipeline route and topography.

The entirety of the Salvus to Galloway pipeline segment is in remote terrain. Presently the majority of the pipeline right of way has no established access. As a result, while there is reduced public safety risk resulting from a pipeline rupture, there is significantly greater complexity (including environmental constraints and worker safety considerations) when attempting to access the pipeline for either proactive or reactive response, inspection, monitoring, and repair.

Figure 4-1: Topography of the Salvus to Galloway Pipeline Segment

Photos 4-1 and 4-2 illustrate the typical terrain encountered along the pipeline corridor, as well as risk and presence of pipeline exposure resulting from hydrotechnical conditions and past construction practice.

Photo 4-1: Pipeline Terrain

Photo 4-2: Pipeline Terrain, Hydrology, and Exposed Pipe

Note exposed pipeline (yellow) in stream.

4.3 Infrastructure Criticality

The PNG Western Transmission Gas Line is considered critical infrastructure as it is the only source of natural gas supply to the northwest coast of British Columbia, providing service to the communities of Prince Rupert and Port Edward and the surrounding region in Coast Tsimshian territory. PNG supplies over one petajoule of natural gas annually to approximately 3,000 industrial, commercial, and residential customers in this area. The pipeline provides fuel gas for operations associated with the export of grain, coal, propane, wood pellets, and other rapidly growing and strategic needs associated with Canada's third largest export port. The pipeline currently provides fuel supply for BC Hydro's emergency backup generating facilities at Galloway Rapids, supporting sustained electric power supply to the Prince Rupert and Port Edward areas during both planned powerline maintenance and emergency response situations. In addition, the region also has a number of Indigenous communities that have long-term economic development opportunities tied to having a secure and reliable natural gas pipeline to serve the area.

PNG has been actively trying to attract and attach new customer load to its Western Transmission Gas Line in an effort to increase the base over which its costs are allocated and to reduce existing customer rates, all else held equal.

In June 2020, PNG conducted a fair, transparent and competitive process for the allocation of reactivated capacity (RECAP) on the Western Transmission Gas Line to assess the demand for and value of available capacity on the pipeline system, and to accommodate that demand to the extent that it is economically viable and in the public interest. Interested parties could either bid for firm transportation service (TSA) or bid to reserve transportation capacity (TRA). PNG had five parties express interest in participating in the RECAP bid process, with three of those parties participating in the auction and making a combined total of five bids with overall requested volume of 163.0 MMSCFD for delivery to the Prince Rupert, Terrace and Kitimat interconnection locations. A summary of the bids received is provided in Table 4-1.

Table 4-1: RECAP Bid Summary

Bid #	Interconnection Location	Requested Capacity MMSCFD	Bid Type[1]
1	Prince Rupert	22.5	TSA
2	Prince Rupert	10.0	TSA
3	Prince Rupert	22.5	TSA
4	Terrace	20.0	TSA
5	Kitimat	88.0	TRA
	Total	163.0	

[1] TSA = Transportation Service Agreement; TRA = Transportation Reservation Agreement

Following the RECAP bid evaluation process, PNG offered two parties TSAs totalling 65 MMSCFD (45 MMSCFD at Prince Rupert and 20 MMSCFD Terrace) and offered the other party a TRA for 13 MMSCFD at Kitimat. PNG continues discussions with the party offered the TRA for 13 MMSCFD, while the two parties offered TSAs have executed the agreements. PNG anticipates seeking BCUC approval of a planned CPCN application for additional interconnection infrastructure and related capital costs, as well as approval of the underlying contracts associated with the incremental RECAP load.

While meeting incremental load from RECAP customers is not the driver of the Project, without the work described in Section 6 of this Application, PNG would be unable to reliably meet the demand related to the RECAP loads. Consequently, the Project will also allow PNG to operate the Western Transmission Gas Line at pressures required to serve RECAP customers in a safe and reliable manner.

4.4 Potential for Loss of Service

Unless the work proposed as part of this Project is undertaken, there is a potential for loss in service to customers served beyond the Salvus to Galloway pipeline segment. The specific work that PNG has identified as necessary along this pipeline segment to ensure the continued safe, reliable delivery of natural gas to its customers focuses on addressing the following critical matters:

- Geohazard mitigation;
- Repairs to address pipeline integrity issues;
- Depth of cover; and

- Access management.

4.4.1 Geohazard Risk and Management

Within the context of the pipeline industry, geohazards comprise a subgroup of natural hazards associated with geotechnical, hydrotechnical, tectonic, snow and ice, and geochemical processes that can adversely affect the safety and cost of construction and operations, threaten the integrity of pipeline systems and associated infrastructure, and impact the environment.[3] A list of geohazards commonly affecting onshore pipeline systems is provided in Table 4-2.

Table 4-2: Common Geohazards Affecting Onshore Pipelines

Hazard Class	Hazard Type
Geotechnical	Frost Heave Thaw Settlement Rock Fall, Slide, Creep Earth Slide, Creep, Flow Debris Slide Ground Subsidence
Hydrotechnical	Debris Flow Scour Accretion and Deposition Channel Degradation and Migration Encroachment Avulsion
Snow and Ice Hazards	Avalanche Ice Fall
Erosion Hazards	Surface Water Erosion Groundwater Erosion

The presence, threat, and impact of geohazards are more pronounced in mountainous and river valley terrain such as that traversed by the PNG Western Transmission Gas Line and are most evident for the Salvus to Galloway pipeline segment, as evidenced by the geohazard-related incident history provided in Table 4-3.

[3] Whitepaper IPC2016-64085: "Updated Estimates of Frequencies of Pipeline Failures Caused by Geohazards" by Porter, Ferris, Leir, Leach and Haderspock and presented at the 11th International Pipeline Conference (IPC2016) provides an overview of geohazard classifications.

Table 4-3: Salvus to Galloway Geohazard Incident History Since 1972

Geohazard Type	Ruptures	Total Incidents
Landslide	1	3
Rock Fall or Slide	3	10
Debris Slide or Flow	5	15
River Erosion / Hydrotechnical	–	8
Total	9	36

As a result of the number of pipeline incidents related to rock slides, debris flow and other geohazards, PNG undertook geohazard-specific inventory and risk assessment studies across the Salvus to Galloway pipeline corridor through 2018-2019 to better understand the magnitude of geohazard risk along the corridor. The results of this work can be found in Appendix C, the BGC Engineering Inc. (BGC) 2019 Preliminary Geohazard Assessment, NPS 8 Mainline Pipeline from Salvus to Galloway Rapids report (BGC 2019 Report), and Appendix D, the BGC 2020 Development Support for Geohazard Mitigation Plan, NPS 8 Mainline Pipeline from Salvus to Galloway report (BGC 2020 Report), which have been filed in support of this Application on a confidential basis. These studies identified the prominent presence of geotechnical, hydrotechnical, rockslide, rock fall, avalanche, debris flow, debris slide, and glaciomarine landslide threats. These threats, in conjunction with the legacy pipeline condition, original construction methods, and documented incident event history informed an assignment of the industry accepted hazard indicator Probability of Failure (PoF) and relative hazard rating for each of the identified geohazard locations. Table 4-4 lists the values for PoF and hazard rating generally accepted industry wide and used by numerous pipeline operators in Canada and the United States. PoFs greater than 1×10^{-3} are typically considered to exceed acceptable risk tolerance.[4]

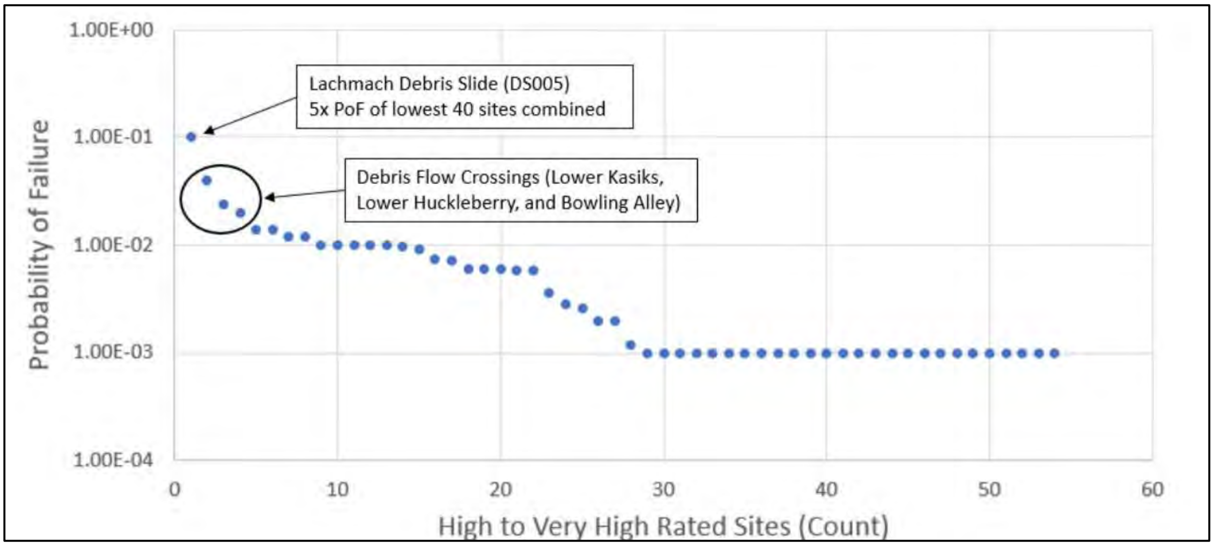
Table 4-4: Probability of Failure (PoF) Range and Hazard Rating

Hazard Rating	PoF Range
Very High	$> 1 \times 10^{-2}$
High	1×10^{-3} to 1×10^{-2}
Medium	1×10^{-4} to 1×10^{-3}
Low	1×10^{-5} to 1×10^{-4}
Very Low	$< 1 \times 10^{-5}$

[4] Appendix C - BGC 2019 Report (Confidential), Section 5.0, p. 16

In total, 322 geohazard sites along the Salvus to Galloway segment were inventoried and rated as part of the 2018-2019 assessment work.[5] In total, high and very high hazard ratings were identified at 56 geohazard sites along the segment. As illustrated in Figure 4-2 that follows,[6] of the 56 high and very high hazard rated sites, it was determined that a small quantity of specific geohazard sites had PoF values orders higher than the aggregate sum of all remaining high and very high rated sites. This information was used as an input to the subsequent determination of geohazard risk.

Figure 4-2: Prioritized Geohazard Sites Based on PoF Rating



4.4.1.1 Geohazard Risk Estimation and Cost/Benefit of Mitigation

Risk to the Salvus to Galloway pipeline segment from the 56 high and very high rated geohazard sites was estimated by multiplying the associated PoF value and an assigned pipeline incident specific consequence that takes into account the operational impacts of a pipeline failure.[7] Making use of PNG's corporate risk matrix as a basis,[8] a second related matrix was developed in order to estimate consequence based on the effort required to access a site after an incident, the complexity of repair, and the associated time and cost to PNG.[9]

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[5] A geohazard site is defined as a location subject to a pre-defined level of geotechnical and/or hydrotechnical threat.
[6] Appendix D - BGC 2020 Report (Confidential), Figure 2.1, p.7
[7] Appendix C - BGC 2019 Report (Confidential), Section 4.2, p. 9
[8] Appendix D - BGD 2020 Report (Confidential), Appendix D, Table D.1
[9] Ibid., Table D.3

Figure 4-3 provides the resulting risk estimation, with sites distributed across the low to extreme range, noting that those ‘unacceptable’ or ‘extreme’ exceed PNG’s pre-defined risk tolerance.

Figure 4-3: Risk Estimation for Prioritized Geohazard Sites

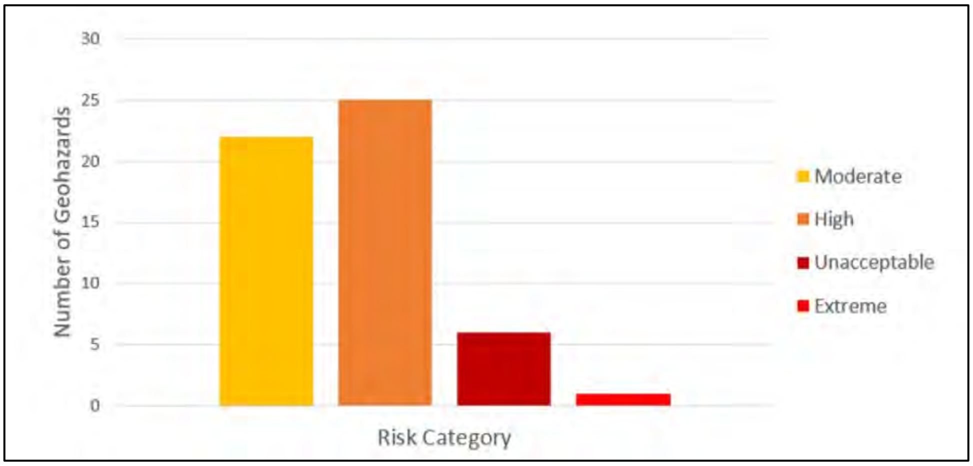
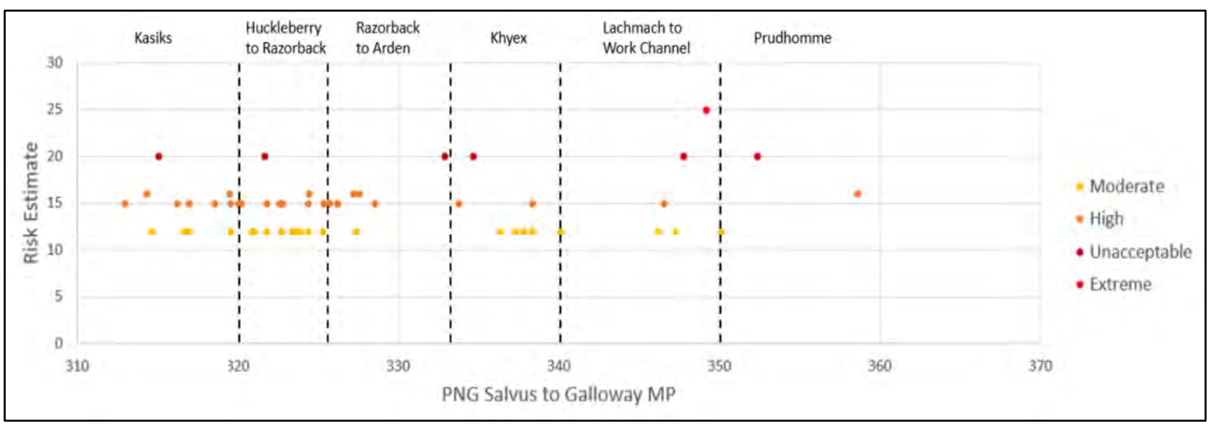


Figure 4-4 provides risk distribution information for prioritized geohazard sites from a risk estimate magnitude, quantity, and physical location across the Salvus to Galloway pipeline segment.

Figure 4-4: Risk Distribution for Prioritized Geohazard Sites



Conscious of the need to strike a prudent balance between risk mitigation, avoidance, and associated cost, PNG sought to define a way for identifying those geohazard risks whose immediate mitigation benefit outweighed the cost associated with a potential rupture and necessary future repairs, both short term and across the expected pipeline life. As a result, BGC introduced the concept of cost-benefit ratio (CBR), where any risk with a CBR < 1.0

indicates it is financially prudent to mitigate this risk versus incurring a future, emergent, and unplanned repair as a result of an incident.[10] Table 4-5 provides resultant CBR values for the 56 risk-estimated geohazard sites.

Table 4-5: Geohazard Sites Prioritized by Cost-Benefit Ratio

Cost Group: Site, MP (geohazard type)[1]	Combined PoF	Cost-Benefit Ratio
48.2: Lachmach Debris Slides, MP 347 - 350 (DS)	1.10E-01	0.5
14.1: Unnamed Debris Flow, MP 321.7 (DF)	2.40E-02	1.2
2: Kasiks, MP 314 - 315 (DF, RF, RS)	5.10E-02	1.6
40: Khyex River, MP 334.64 (HT)	1.40E-02	1.6
32: Bowling Alley, MP 326 - 328 (DF, HT, RF, RS)	7.18E-02	1.7
53: Prudhomme Debris Slides, MP 352 - 353 (DS)	1.00E-02	1.7
38: Arden Creek, MP 332.85 (HT)	1.20E-02	2.5
10.1: Kasiks River Encroachment, MP 319 (HT)	1.00E-02	2.9
39: Arden Creek, MP 333.72 (HT)	9.10E-03	3.1
29: Upper Huckleberry, MP 325 - 326 (DF, RS)	1.05E-02	4.3
14.2: Lower Huckleberry, MP 321 - 322 (DF, HT, RF, RS)	3.47E-02	5.8
26: Upper Huckleberry, MP 323 - 324 (HT, RF, RS)	1.40E-02	8.3
10.2: Kasiks, MP 319 (RS, RF)	2.00E-03	9.5
54: Analog Creek, MP 358.55 (HT)	1.00E-02	10.2
13: Kasiks River Crossing, MP 320 (HT)	1.98E-03	11.3
52: Fortune Creek Encroachment, MP 350.09 (HT)	9.60E-03	12.9
44: Khyex, MP 338 - 339 (RF, RS)	2.00E-03	16.4
46: Moss Creek, MP 340.09 (HT)	5.90E-03	17.6
5: Kasiks, MP 316 - 319 (DF, RF, RS)	5.00E-03	17.7
1: Kasiks, MP 312 - 313 (RS)	1.00E-03	19.5
37: Razorback to Arden, MP 328 - 330 (RS)	1.00E-03	25.0
48.1: Lachmach to Work Channel, MP 346 - 347 (DF, DS)	2.00E-03	38.1
42: Khyex, MP 337 - 338 (DF, HT)	3.60E-03	38.3
47: Lachmach to Work Channel, MP 346 (HT)	2.80E-03	39.2
41: Khyex, MP 336.4 (HT)	1.00E-03	71.4

[1] Geohazard types are abbreviated as follows: DF = debris flow / flood; DS = debris slide; HT = hydrotechnical; RF = rock fall; RS = rock slide

[10] Ibid., Section 5, p.24

4.4.1.2 Non-Financial Drivers for Geohazard Mitigation – Regulatory Requirements

The requirement to identify and manage pipeline integrity risks including geohazards is specified in CSA Z662 within: Section 3 Safety and Loss Management; Section 10.3 Integrity of Pipeline Systems; Annex A Safety and Loss Management System; Annex B Guidelines for Risk Assessment of Pipeline Systems; and Annex N Guidelines for Pipeline System Integrity Management Systems.

In direct association with the requirements of CSA Z662, the identification, monitoring, and mitigating of risk of natural hazards and external force such as geohazards is a requirement under the *Oil and Gas Activities Act*, Pipeline Regulation Section 7, and the BC OGC Integrity Management Plan Compliance Assurance Protocol. Under the purview of the BC OGC it is expected that risk is mitigated to As Low As Reasonably Practicable.

4.4.2 Pipeline Mechanical Condition

As noted previously, the first ILI of the Salvus to Galloway pipeline segment of the Prince Rupert NPS 8 transmission mainline was conducted in 1993, which resulted in at least sixteen independent repair projects along the pipeline segment. In 2007, an additional ILI was completed; however, as explained earlier, limited investigation, assessment, and repair were conducted following the run. In 2018, a further ILI run was completed utilizing industry leading survey and tool tracking technologies.

Results of the 2007 and 2018 ILIs are presented in Table 4-6. There were significant increases in the identified quantities of both metal loss (corrosion) and dent anomalies. The increases are assumed to be indicative of the fact that the level of detection improved from 2007 to 2018 due to evolving inspection technology, of the ongoing threat (from which repercussions were felt over an additional 11 years) to the pipeline from external forces (rock fall, debris flows, etc.), and of corrosion growth of anomalies over the period.

Table 4-6: Metal Loss and Dent Features: 2007 and 2018 In-line Inspections

	Number of Identified Anomalies	
In-line Inspection Year	**Metal Loss**	**Dents**
2007	5,870	169
2018	6,822	711

Given the need for repairs identified in the post-1993 ILI inspections, the lack of a repair campaign following the 2007 ILI program, and the results of the 2018 ILI run (including the reinforcement of the evidence of ongoing threat from corrosion growth and geohazard related mechanical damage), and the increasing regulatory requirements associated with inspection and risk mitigation, as well as its own commitment to safety and reliability, PNG seeks to undertake the proposed Project to directly assess, repair, and mitigate risk of both corrosion and dents in compliance with regulation and what is now industry accepted practice. PNG engaged Dynamic Risk Assessment Systems Inc. (Dynamic Risk) to undertake engineering work to assess and prioritize such metal loss features and dents. The Dynamic Risk findings are provided in Appendix E, the Dynamic Risk NPS 8, MP 311 - MP 364 Mainline Inline Inspection Response Prioritization memo, which has been filed in support of this Application on a confidential basis.

4.4.2.1 Metal Loss Features – External Corrosion

Corrosion imperfections and their treatment requirements are described in CSA Z662-19, Clause 10.10.2, and additionally within the following supplementary technical resources for defect assessment and response criteria:

- American Petroleum Institute (API) 579 – Fitness For Service;
- ASME B31G – Manual for Determining The Remaining Strength of Corroded Pipelines;
- ASME B31.8 – Gas Transmission & Distribution Piping Systems; and
- British Standards Institute (BSI) BS 7910 – Guide to Methods for Assessing Acceptability of Flaws in Metallic Structures.

As specified within CSA Z662-19, Clause 10.10.2.1, corrosion defect assessment requires that corrosion areas be thoroughly cleaned and inspected so that their dimensions can be measured accurately. Per CSA Z662-19, Clauses 10.10.2.2 – 10.2.2.5, to effectively conduct a corrosion area defect assessment, the following must be determined:

- Presence of cracks;
- Interaction with the seams of the pipe or in areas of low toughness;
- Interaction with dents;
- Area depth and length; and
- Failure pressure.

For those areas determined to contain defects, repair shall be made using a method acceptable to CSA Z662-19, Section 10.

Following the 2018 ILIs, results were analysed against ASME B31G, B31G modified, and RSTRENG[11] by the ILI vendor integrity team and independent subject matter experts to identify areas of potential defect and to prioritize those potential defects in accordance with their relative severity and consequence of failure. The resulting prioritization identified 12 corrosion area groupings requiring immediate response based on their impact to pipeline safe maximum operating pressure and an inability to safely operate to the limit of PNG's licensed operating pressure of 1,354 psig. Given locational proximity to these 12 immediate response groupings and/or prioritized dents described in Section 4.4.2.2, 190 additional corrosion groupings were prioritized for inspection on the same pipe joints already identified for inspection, allowing for confirmation of baseline data for the purposes of future corrosion growth rate determination in accordance with CSA Z662 engineering assessment criteria and for the incremental improvement in pipeline integrity resulting from suppression of associated corrosion at these locations.[12]

In 2019 to 2020, PNG set out to perform investigative digs on easily accessible, high priority corrosion sites for the purposes of ILI validation and to further inform future investigation and defect assessment requirements. Of the six sites investigated, all were determined to contain defects requiring repair. Two locations were found to have complex interaction between

[11] RSTRENG is used to calculate the strength of the remaining thickness of pipes
[12] Appendix E - Dynamic Risk NPS 8, MP 311 - MP 364 Mainline Inline Inspection Response Prioritization memo

interlinking corrosion clusters and dents and were repaired at time of investigation through application of abutted pressure containing steel sleeves.

One additional site was excavated and a leak was discovered adjacent to the intended assessment area. At the leak site corrosion and cracking were found to be interacting within the heat affected zone of a girth weld. This location was repaired temporarily with a leak clamp while plans were developed for a permanent repair. Photo 4-3 illustrates the pipe condition in proximity to the leak location.

Photo 4-3: Pipe Condition at Leak Location

In addition to the corrosion-related leak identified in 2020, the Salvus to Galloway pipeline segment was subject to a corrosion-related through wall pipeline failure in 2018 at MP 313.4. The cause was determined to be external corrosion growth on an unprotected girth weld, where no girth weld coating had been applied during original construction and the girth weld was determined to be defective. Photo 4-4 and Photo 4-5 illustrate the pipeline as-found condition at the location of the rupture. Photo 4-6 and Photo 4-7 illustrate the pipeline condition found under the intact sleeve and jacketing of an adjacent ‘exemplary’ pipe section and weld. These recent failures give clear indication of the need for a focused external corrosion risk mitigation integrity investigation and repair campaign.

Photo 4-4: Pipe Body Condition at MP 313.4 Weld Failure

Photo 4-5: Pipe Body and Weld Condition at MP 313.4 Weld Failure

Photo 4-6: 'Exemplary' Pipe and Coating As-found

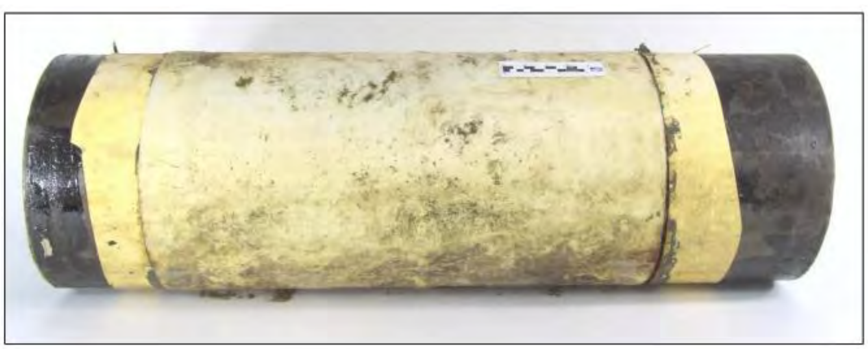
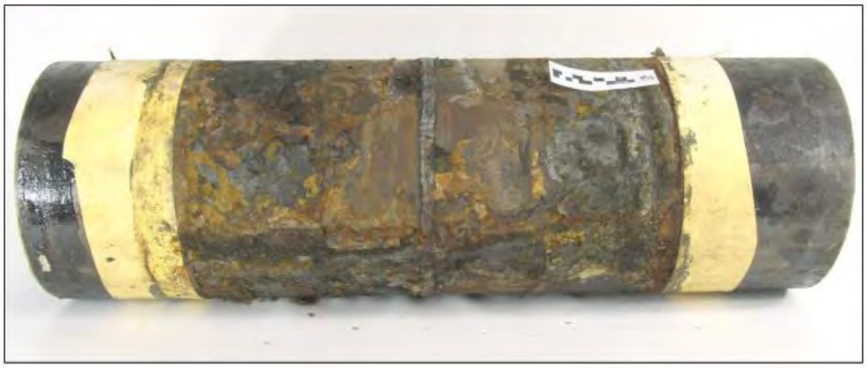


Photo 4-7: 'Exemplary' Pipe with Jacketing Removed



4.4.2.2 Dents

Dents and their categorization and treatment are described in CSA Z662-19, Clause 10.10.4, with Clause 10.10.4.1 stating that dents shall be inspected using methods capable of determining the location of the dent relative to pipe welds, the depth and shape of the dent, and the presence of stress concentrators. The definition of dents as defects requiring investigation is as per Clause 10.10.4.2 and states that dents in pipe of the Salvus to Galloway diameter that meet prescribed criteria shall be considered defects unless determined by an engineering assessment to be acceptable, and that pipe containing such defects shall be repaired using an acceptable repair method.

CSA Z662-19, Clause 10.10.4 also states that special consideration and concern should be given for dents susceptible to sharp rock impact and in areas of geotechnical hazard and surface loading.

Based on the prescribed criteria, in conjunction with the dent-related data and data analyst integrity assessment from the 2018 ILI run, and the post-run anomaly assessment and prioritization conducted by Dynamic Risk, it has been determined that 116 dents on the Salvus to Galloway pipeline segment require immediate investigation and response. Those dents have been given prioritization definitions based on listed industry standard assessment criteria as per Table 4-7 and are referred to in later sections of this Application.

Table 4-7: Dent Prioritization Definitions

	Feature Type	Criteria 1	Criteria 2	Criteria 3	Criteria 4
Immediate	Metal Loss	FPR ≤ 1.1	-	-	-
Immediate	Dent	Crossing Long Seam	Strain > 4%	Rerounded	With metal loss
Immediate	Dent	With Metal Loss	Strain > 6%	Top 2/3 of pipe	-
Immediate	Dent	Rerounded	Strain > 6%	-	-
Priority 1	Metal Loss	1.1 < FPR ≤ 1.25	-	-	-
Priority 1	Dent	Crossing Long Seam	Strain > 2%	Depth > 6 mm	-
Priority 1	Dent	With Metal Loss	Fails ASME B31G (Level 0 Evaluation)	-	-
Priority 1	Dent	>6% % of OD Restriction	Strain > 6%	-	-
Priority 2	Dent	"High Severity" Dent in the TDW's "Dent Prioritization Report".	Not Included as Immediate or Priority 1 Location	-	-
Priority 3	Dent	Length to Depth Ratio (L/d) Less than 20	Strain > 6%	-	-

Timeline requirements for dent assessment and management are defined within industry standard guidance and regulation documents such as Pipeline and Hazardous Materials Safety Administration (PHMSA) 49 CFR Part 192 and 195, ASME B31.8S, API 1160, and the pending API 1183. In general, there are 60 and 180 day evaluation and remediation criteria, with maximum response timelines of 365 days for dents identified as defects. Given the time that has passed since the completion of the 2018 ILI run, PNG is effectively offside of these timeline requirements. This circumstance is considered to be unavoidable given the nature and extent of the remediation required and was a precursor to the planning and advancement of the proposed Project.

4.4.3 Depth of Cover

As identified in CSA Z662-19, Clause 4.11, pipeline cover shall be sufficient to protect the pipeline against external loads, scour, and third-party damage, with a minimum cover requirement in remote locations of 0.60 metres. This increases to a minimum of 1.20 metres for water course crossings. Minimum values are to be assessed against risk posed by external threats, with cover being increased in areas of geotechnical and hydrotechnical activity, or in areas of prevalent third-party activity, in order to maintain the integrity and safe operation of the pipeline.

Industry best practice documents such as the Canadian Energy Pipeline Association (CEPA) Watercourse Crossings guidelines identify the fact that hydrotechnical hazards associated with watercourse erosion are typically the most common and most active geohazards affecting operating onshore pipelines, with these hazards most commonly avoided through the installation of crossings of adequate depth. Low depth of cover can result in increased risk of exposure due to scour, channel degradation, avulsion, bank erosion, or encroachment. Once exposed, the pipeline becomes susceptible to failure from debris impact, hydraulic loading, or vortex induced vibration.

When considering the risk to pipelines from geohazards such as rockslide and debris slide, mechanical cover provided by adequate burial depth is typically the primary form of pipeline protection against impact, denting, and subsequent rupture. Most dents resulting from external interference are located on the top half of the pipeline and are most prominent in areas of insufficient cover.

As first identified in the post-construction inspection as per the 1969 Pipeline Inspection Report and later documented in various internal PNG reports, much of the Salvus to Galloway pipeline segment was constructed with insufficient cover. Many sections of the pipeline were laid on surface with no cover. Water course crossings were made with insufficient cover to protect against scour and subsequent damage from stream material transport; and a number of spans were constructed above ground with inadequate design and construction considerations for protection against external forces and debris resulting from rock fall, landslides, and debris flows, for example. These conditions were primary contributors to many of the historic pipeline incidents and failures that resulted from geohazard activity and other external threats such as vegetation overgrowth and windfall.

As part of preliminary works associated with the proposed Project, independent studies conducted in 2018 and 2019 by Skystone International LP, Chartwell Consultants Ltd., and BGC identified over 100 locations of complete pipe exposure demonstrating evidence of external coating damage from both UV degradation and mechanical damage. On an 11.5 kilometre section chosen for depth of cover assessment given existing access feasibility for ground traverse, 179 locations were found to have depth of cover measurements below those required by CSA Z662.[13]

While the entire pipeline section could not be directly assessed due to vegetation density, watercourses, and access constraints at the time of study, it is believed that (given the prevalence and distribution of historic events across the entire 80 kilometre pipeline section,

[13] Appendix F - Skystone International LP - NPS 8 Mainline Above Ground Survey Indirect Inspection Report (Confidential), p.17

and the relatively uniform terrain), this concentration of depth of cover issues is representative of that for the entirety of Salvus to Galloway. Given this, while it is not considered feasible to address all legacy depth of cover issues, depth of cover sufficiency is proposed to be addressed in the highest risk areas of exposed pipelines and in locations where other integrity upgrade works such as direct assessment, corrosion and dent repairs, and geohazard mitigations are undertaken.

4.4.4 Access Management

While CSA Z662 and associated integrity risk management practices require pipeline rights of way to provide for ready access for maintenance, inspection, and emergency response, the remoteness, terrain complexities, and environmental sensitivities and environmental value-related challenges along the Salvus to Galloway corridor do not allow for this. The existing right of way only converges with Highway 16 in three locations along the Salvus to Galloway corridor's 80 kilometre length, providing the only existing opportunities for overland access to the right of way. While providing access points to the pipeline right of way, these sparsely distributed access points do not significantly improve overall pipeline access from a maintenance, inspection, or emergency response perspective given the terrain, extent of vegetation, and distribution and quantity of water course crossings.

Given the significant remoteness of the pipeline, and an environment which includes spawning and rearing habitats for many salmon and other aquatic and terrestrial species, it is not conducive to the degree of disturbance typical of road building. Improvements to vehicle access have been negligible since the original 1960s construction of the segment. As a result, historic access has been performed on a once-in, once-out basis for those limited areas capable of tracked equipment access and the majority of access has been restricted to high-cost, higher-risk helicopter use.

Intended overland access via tracked equipment in areas involving stream crossings, both on right of way and on temporary work spaces not covered in existing operating permits, must be authorized as a 'Change In and About a Stream' as defined in Section 11 of the *Water Sustainability Act*. Obtaining authorization includes a resource intensive process of collecting, analyzing and classifying field data to determine if water courses are fish bearing and identifying the potential for harm to fish and fish habitat as a result of conventional, non-permanent, and intrusive crossing mechanisms.

While it will not be viable to improve access to a level consistent with less remote pipelines constructed in the present day, the Project would improve access to a degree deemed reasonable and of high value and benefit given the existing constraints. The right of way will be cleared of vegetation, and locations for permanent crossings of larger streams via installation of bridges or permanent fords will be identified. This will allow for improved use of the existing right of way and strategically identified and permitted temporary workspaces for the purposes of select physical constraint bypass. This will be accompanied by the identification and permitting of logistically critical equipment and material-staging areas for work efficiency improvement and incident management and response. It is anticipated that all crossings will be matted or constructed fords and that overland access through areas of soft ground will rely extensively on access matting. It is proposed that one permanent bridge be installed across the Kloiya River, significantly improving access to the currently highly remote right of way area to the backside of Prudhomme Lake. This will significantly improve overland access to the Prudhomme Summit, where the construction of a shoo-fly road is proposed. Construction of this shoo-fly will create a linkage between the Prudhomme and Lachmach areas, resulting in the future ability for continuous linear traverse of appreciable areas of the overall right of way that are currently discontinuous in terms of access. In turn, this will significantly improve inspection, monitoring, maintenance, and emergency response capability.

4.5 Illustrative Examples of Legacy Construction and Maintenance, Geohazard and Corrosion Effects

Photos 4-8 through 4-12 illustrate the results of the original pipeline construction and legacy maintenance that have been further pronounced by the remote and rugged mountainous terrain in a region with challenges from geohazards, high precipitation and watercourse concerns. These historic practices are now being outpaced by changes in governing standards, acts, and regulations including, but not limited to, CSA Z662, the *Oil and Gas Activities Act* and Pipeline Regulation, and ASME B31.8S. Technological changes in inspection technology, such as advanced EMAT equipped ILI tools, have further illuminated the seriousness of pipeline defects.

Photo 4-8: Pipeline Legacy – Exposure, Coating Degradation, and Geohazard Threat

Photo 4-9: Pipeline Legacy – Exposure, Coating Degradation, and Geohazard Threat

Photo 4-10: Pipeline Legacy – Aging Infrastructure Repairs Needed

Photo 4-11: Pipeline Legacy – Exposure and Extent of Vegetation Overgrowth

1 **Photo 4-12: Pipeline Legacy – Exposed Pipe with Ultraviolet Degradation**

Photos 4-13 and 4-14 provide examples of impacts of various geohazard incidents along the Salvus to Galloway pipeline segment.

Photo 4-13: Debris Slide Resulting in 700' Replacement (1992)

Photo 4-14: Debris Flow Related Line Failure at Girth Weld (2010)

Photo 4-15 provides an example of a corrosion-related failure on the Salvus to Galloway pipeline segment.

Photo 4-15: Corrosion Related Failure at MP 322.7 (1993)

4.6 Project Justification Conclusion

Safe and reliable gas delivery and the safety of the public, employees, and the environment are core values and top priorities of PNG. This is reflected in the PNG's business objectives and strategies and is integral in the prioritization of its resources. This same safe and reliable gas delivery, safety consciousness, and focus on environmental stewardship are key expectations of PNG's customers and other stakeholders.

PNG's ability to safely and reliably operate its Western Transmission Gas Line, including the Salvus to Galloway pipeline segment, are critical to PNG being able to continue to meet the needs of existing customers, and equally critical to the attachment of new industrial customers in the Prince Rupert and Port Edward areas, including meeting the capacity and timing requirements of RECAP customers as described in Section 4.3. As such, the Salvus to Galloway pipeline segment is considered critical regional infrastructure for the Prince Rupert, Port Edward, and the Coast Tsimshian territories for both ongoing and long term economic development and associated opportunities, including those directly and indirectly related to the needs and activities of Canada's third-largest port and its export of domestic goods to overseas markets.

As identified in the preceding discussion, PNG has an IMP and associated programs to meet the requirements of CSA Z662 and the BC OGC regulations. The IMP includes requirements associated with managing the risk of and addressing pipeline threats such as corrosion and dents from natural force such as weather-related events and geohazards, and the need for access management for the purposes of routine inspection, repair, and emergency response. While PNG has endeavoured to prudently manage the balance between integrity management expenditures and customer rate impacts following the loss of significant customer loads over the last 20 years, this has resulted in the deferral of certain integrity management activities in areas of complex access, permitting, and environmental constraint where costs per unit of effort are higher than on other areas of the PNG system. In these remote areas, including and most notably Salvus to Galloway, integrity activity has been predominantly focused on and limited to monitoring and performing repairs under emergent and unplanned conditions. The degradation has been further pronounced by the legacy construction practices, as well as the remote and rugged mountainous terrain in a region with challenges from geohazards, high precipitation, and watercourse concerns.

PNG submits that it can no longer continue with the status quo and that the proposed Project to mitigate risk and more fully restore system integrity is required. With advances in technology and pipeline assessment methodologies to validate and confirm the gravity of the dents and metal loss on the Salvus to Galloway pipeline segment, as well as a stronger understanding of the geohazard risks that the Salvus to Galloway segment is subject to, PNG further submits that time is of the essence to address the identified pipeline integrity concerns so as to ensure the provision of safe, reliable gas service to its customers, as well as to ensure compliance with applicable industry and regulatory codes and standards.

5 Description and Evaluation of Alternatives

5.1 Introduction

In coming to the conclusion to submit this Application for the Project to upgrade the existing Salvus to Galloway pipeline infrastructure, PNG considered a number of alternatives and applied evaluation criteria with financial and non-financial factors to identify the most prudent path forward. This section provides additional information on this process, including:

- A discussion of the alternatives considered and the results of a preliminary screening leading to the identification of four viable sub-alternatives;
- A discussion of the advantages and disadvantages of each viable alternative; and
- An evaluation of the alternatives using a weighted scoring system based on three criteria:
  1) Pipeline Integrity and Asset Management;
  2) Project Delivery, Operational Assurance and Stakeholder Impact; and
  3) Financial and Customer Impacts.

Subject matter experts assisted in developing the approach to scoring and validated the evaluation to ensure the selected alternative was the optimal solution.

The evaluation demonstrated that the best solution for customers is the upgrade, repair and refurbishment of the existing Salvus to Galloway pipeline segment to address the pipeline integrity concerns, address regulatory compliance deficiencies and provide long term safe, cost-effective, and reliable natural gas service.

5.2 Alternatives Considered

PNG considered several alternative approaches to addressing the Salvus to Galloway pipeline integrity concerns and to ensure long-term compliance with codes, standards and regulations. In the initial phase of this exercise, PNG considered the ability of the alternative to address pipeline integrity at a level of costing and reliability that was technically and commercially viable. In particular, PNG considered cost, the ability to comply with applicable codes, standards and regulations, project timing, and the ability for the alternative to meet long-term capacity and reliability needs.

The four alternatives that were identified for screening were:

1) Status Quo;
2) Replace Pipeline;
3) Upgrade Pipeline; and
4) Deactivate Pipeline and Utilize Alternative Gas Supply.

5.2.1 Alternative 1 - Status Quo

The Status Quo alternative is to continue to operate the pipeline in its current state. As described in Section 4, the Status Quo is not a viable option as this would result in PNG not being in compliance with CSA Z662, its own IMP, nor industry accepted risk levels for corrosion, dents, or geotechnical hazards.

The Status Quo alternative therefore does not comply with the stated project objective of compliance and meeting long-term capacity and reliability needs.

5.2.2 Alternative 2 - Replace Pipeline

As a second alternative, PNG considered replacing the entire 80 kilometre section of pipeline from Salvus to Galloway with a new pipeline. This concept included constructing a new pipeline using the existing alignment and widening the right of way to accommodate the new pipeline, recognizing the routing limitations in this remote, environmentally sensitive, and mountainous area of northern British Columbia. However, some rerouting would be required to minimize geohazard risks.

Replacing the 80 kilometre Salvus to Galloway pipeline segment is not economically viable given the high cost of replacement and the associated impact on PNG customer rates. Construction of a new NPS 8 pipeline in this remote and mountainous terrain is estimated to cost in excess of $420 million (as-spent dollars). PNG engaged Innovative Pipeline Projects Ltd. (IPPL) to prepare a screening level cost estimate (see Appendix G), which validated PNG's cost concerns. To put this option in perspective, the entire rate base of PNG-West for 2020 has an approximate value of $152 million; clearly PNG customers would experience significant rate shock in the event that this option were to be pursued. This is simply not a competitive option.

Further, the time frame required to undertake such a replacement of the pipeline is expected to be far greater than for the other alternatives, as new rights-of-way would be required resulting in the need for significantly greater archaeological and environmental study, consultation and engagement, and permitting processes.

While this alternative met the objectives of ensuring pipeline integrity and code compliance and the ability to accommodate future load growth, the alternative posed significant challenges with time to complete the project and the associated costs. Given the unfavourable financial and schedule aspects, including extremely high project costs, permitting challenges, timelines and environmental impacts, PNG rejected the Replace Pipeline alternative and has not carried it forward as a viable alternative. This conclusion is consistent with PNG's 2011 evaluation of the feasibility of relocating the pipeline segment in response to the BC OGC General Order 2011-03, as previously described in Section 3.3.

5.2.3 Alternative 3 - Upgrade Pipeline

The Upgrade Pipeline alternative includes capital repairs to selected segments of the 80 kilometre section of pipeline between Salvus and Galloway, including areas of extensive corrosion, dents and geohazards. This alternative is focused on the mitigation of selected identified pipeline integrity issues and on the mitigation of selected hazards to address compliance deficiencies with the *Oil and Gas Activities Act* and associated Pipeline Regulation, and CSA Z662, the formative oil and gas pipeline standard on which the BC OGC regulation is based. This alternative is focused on rectifying all immediate and high-priority metal loss features and addressing dents and geohazards on a risk-adjusted basis. The compliance specifics associated with these integrity defects and threats are documented in Sections 3 and 4.

The Upgrade Pipeline alternative would mitigate the risks of pipeline ruptures and leaks. It would also transition the pipeline into an improved condition from an asset management perspective to enable continued safe and reliable supply to the northwest coastal region of British Columbia. Further, this alternative would address compliance with the applicable codes and standards and is seen as a feasible risk-adjusted option. However, PNG expects some continued residual pipeline integrity risk, as only the highest priority corrosion features, dents or geohazards would be addressed. From a project management perspective, the alternative could be completed in time for future industrial load and demand growth anticipated over the next 3 to 4 years.

In the context of the aforementioned points, and PNG's further evaluation later in Section 5.5, PNG has recommended proceeding with the Upgrade Pipeline alternative as its path forward on the basis that cost estimates are in a reasonable range and that the applicable codes, standards and regulations would be satisfied. Additionally, the necessary works can be completed to meet demand growth from RECAP, and will address long-term capacity and reliability needs, as described in Section 4.3.

The final scope of the Upgrade Pipeline alternative warranted further evaluation of sub-alternatives that would include varying degrees of the following:

- Pipe integrity prioritizations and response selection;
- Geohazard identification, classification, and mitigation alternative selection;
- Areas of access improvement; and
- Other improvements for pipeline reliability and operability.

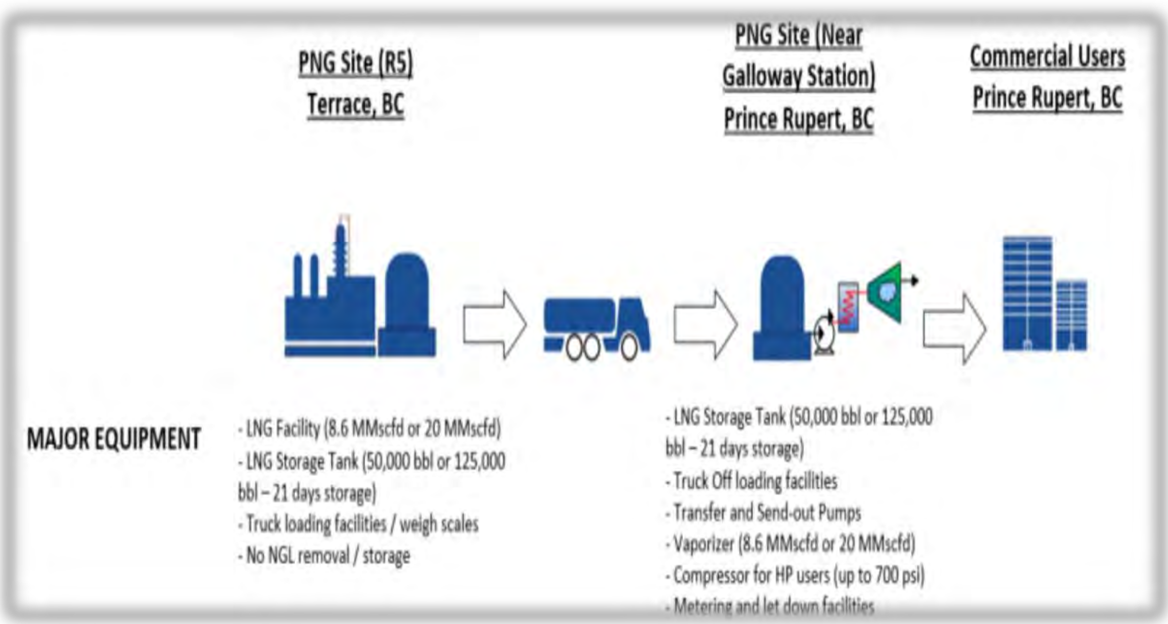
In consideration of the wide scope spectrum of potential upgrade solutions, with the assistance of Lauren Services PNG developed four sub-options that vary with respect to the scope, schedule, costs and degree of risk management. The four sub-options or upgrade alternatives are addressed further in Section 5.5. In all four cases, PNG is ultimately focused on extending the life of the current NPS 8 pipeline segment through repairs and refurbishment. The timeframe required to complete the upgrades is anticipated to be between 3 and 5 years, depending on the final breadth of the scope of upgrades undertaken. While undertaking repairs, PNG would build more permanent access points to the right of way and would also address vegetation management issues that are present. The estimated costs for the developed upgrade alternatives for the Salvus to Galloway pipeline segment range between $65 million and $280 million (as-spent dollars) depending on the final scope of the upgrades.

5.2.4 Alternative 4 - Deactivate Pipeline and Supply with LNG

As a final alternative, PNG gave consideration to deactivating the pipeline between Terrace and Prince Rupert and serving existing and future prospective customers in the communities of Prince Rupert and Port Edward with liquefied natural gas (LNG). For the purpose of this analysis, PNG determined that it would require a secure source of supply, over which it had control, in the region. PNG reviewed the concept of owning, operating and constructing a facility in the Terrace area, with the feedstock being natural gas delivered on PNG's Western Transmission Gas Line. The project concept contemplated liquefaction and storage facilities in Terrace, trucking LNG to Prince Rupert, and lastly a site in Prince Rupert to vaporize, store, compress, and meter the natural gas for distribution in the Prince Rupert and Port Edward region.

PNG engaged Solaris Management Consultants Inc. to develop a high level cost estimate of this alternative for screening purposes (see Appendix H). Indications are that capital expenditure for infrastructure required to supply the area with LNG would cost between $235 million and $364 million (as-spent dollars).[14] In addition to these significant capital costs, PNG anticipates a significant operating cost to address ongoing operations – much higher than operating the pipeline – including the addition of several operators, maintenance costs, and electricity costs to liquefy and cool natural gas. Figure 5-1 that follows illustrates the envisioned operational requirements for implementing an LNG supply solution under this scenario.

Figure 5-1: Key Features of Deactivate Pipeline (DP) and Supply with LNG Alternative



This option was rejected for numerous reasons. First, recognizing that PNG's RECAP auction was intended to grow transportation service to the Prince Rupert and Port Edward region, this

[14] Appendix H - Solaris Management Consultants Inc., PNG LNG Concept Evaluation, p.10

alternative was considered inconsistent with PNG's long-term goal of providing reliable gas service to the region as under this model PNG would not be able to meet its long-term obligations.

While the alternative would address the pipeline integrity issues (as PNG would no longer rely on the Salvus to Galloway pipeline segment), new operational challenges would be introduced with LNG facilities operating in base load operation, which is not conventional when pipeline options are available. This alternative would introduce new challenges with respect to security of supply as PNG would be relying on the transportation of LNG from Terrace to Prince Rupert by truck, often in extremely adverse weather and road conditions. The alternative would also have much greater public exposure to risk from PNG operations than is currently the case. While the existing pipeline is routed through remote, uninhabited areas, the LNG operations would be located in closer proximity to the public and would involve significant LNG tanker traffic on public roads already appreciably challenged by commodity export-related traffic volumes. These aspects of the alternative introduce greater public safety risk than the existing pipeline. Further, as noted previously, decommissioning the Salvus to Galloway pipeline segment and relying on LNG would also limit PNG's ability to meet future growth in demand, particularly large industrial growth.

5.3 Alternatives Evaluation Methodology

PNG applied a multi-criteria analysis involving a weighted-scoring methodology to evaluate the performance of each alternative scope in relation to three sets of evaluation criteria. In addition to the weighted score computed for each alternative, PNG internal subject matter experts validated the appropriateness of the outcomes. The components of the evaluation methodology are described in the discussion that follows.

5.3.1 Evaluation Criteria

The following evaluation criteria were applied in evaluating the identified approaches to addressing the Salvus to Galloway pipeline integrity concerns and to ensure long-term compliance with codes, standards and regulations:

1) Pipeline Integrity and Asset Management:

   a) Prevention of leaks;

   b) Prevention of ruptures;

   c) Asset management and lifecycle optimization; and
   d) Foundational technical solution.
2) Project Delivery, Operational Assurance and Stakeholder Impact:
   a) Project delivery;
   b) Environmental;
   c) Lands and right of way considerations;
   d) Consultation and engagement;
   e) Operational;
   f) System capacity and reliability; and
   g) Socio-economic benefit.
3) Financial and Customer Impact:
   a) Net present value (NPV) of incremental annual revenue requirement (over 70 years post completion); and
   b) Rate impact.

Each criterion is described in the sections below.

5.3.1.1 Pipeline Integrity and Asset Management

For each alternative, PNG considered the following factors within the category of Pipeline Integrity and Asset Management:

- Prevention of Leaks: Prevents transmission pipeline leaks due to corrosion, dents or geohazard threats. PNG assessed leaks as a significant safety and reliability issue. PNG assumed that a leak could be repaired, without incurring natural gas service loss to downstream customers;
- Prevention of Ruptures: Prevents transmission pipeline ruptures due to corrosion, dents or geohazard threats, and the potential consequences of a natural gas

transmission pipeline rupture as discussed in Section 4. PNG assessed ruptures as a significant safety and reliability issue and assumed that if a rupture occurred, all downstream customers would not have service for an extended period of time;

- Asset Management and Lifecycle Optimization: Proactive decisions can be based on asset condition over the lifecycle of the pipeline. Potential hazards can be addressed in a preventative manner versus responding to a rupture or leak; and
- Foundational Technical Solution: Provides integrity and asset management solution for the long term, without needing to revert to another alternative.

5.3.1.2 Project Delivery, Operational Assurance and Stakeholder Impact

In evaluating alternatives, PNG also considered factors relating the strength of Project Delivery, Operational Assurance and Stakeholder Management. PNG considered an analysis period of 73-75 years in its assessment which includes three to five years for project execution, from 2021 to 2023-2025, 65 years post-construction for lifecycle operation, and 5 years for the amortization of remaining net assets. The categories of Project Delivery, Operational Assurance and Stakeholder Impact were assessed on a sliding scale according to the descriptions below:

- Project Delivery: Degree of difficulty relating to scope, cost, schedule, Environment, Health and Safety and quality for the project;
- Environmental: Degree to which environmental and archaeological impacts are minimized (i.e. Aquatic Species and Habitats, Water Quality and Quantity, Terrestrial Species and Habitats, Species at Risk, GHG Emissions, etc.);
- Lands and Right of Way: Degree of difficulty associated with temporary and/or permanent land rights as well as lifecycle impacts (i.e. landowners, new rights of way, project workspace, etc.);
- Consultation and Engagement: Degree of complexity with engaging Indigenous communities and stakeholders (i.e. general public and customers, British Columbia provincial government agencies, federal agencies, municipal and regional governments);

- Operational: Degree of complexity in operating the selected project considering factors such as resources, maintenance requirements, equipment and tools, operational hazards, etc.;
- System Capacity and Reliability: Ability for PNG to meet current and future system capacity needs and reliable gas service to customers. PNG considered that its pipeline asset is of strategic importance to future economic developments in northwestern British Columbia, and also the interplay with PNG's RECAP initiative; and
- Socio-economic Benefit: Degree to which the project creates positive impacts to the region through job creation during construction of the project as well as the use of hospitality and other local services.

5.3.1.3 Financial and Customer Impact

The 70-year post-construction analysis period was chosen based on the currently approved depreciation rate of the Transmission Main pipeline at 1.54% (or 65 years) since the majority of the capital expenditures are tracked under the Transmission Main pipeline asset, as well as an additional 5-year period to amortize any remaining net plant assets from ongoing maintenance capital.

PNG undertook a financial evaluation of long-term rate impacts through an analysis of the present value of the incremental revenue requirement, as well as the delivery rate impact the year after construction is completed and the assets are placed into service based on the estimated capital cost and operating cost for each alternative. For a fair net present value comparison, future incremental sustainment capital and operating expenditures over the 65-year operational period for each alternative was included.

5.3.2 Methodology for Scoring and Weighting

PNG scored each alternative on an overall basis on a range from 0 to 5 based on their consistency with the definitions for each of the Evaluation Criteria as defined above. For the financial and customer impact criteria scoring, PNG scored the alternatives as described in Table 5-1.

Table 5-1: Criteria for Overall Financial Scoring

Score	Description
0	No detailed cost estimate was prepared for the alternative if it is technically not feasible or it is screened out on a technical and cost basis.
1	The alternative is over 100% higher than the alternative with the lowest net present value (NPV) of incremental revenue requirement and the lowest incremental rate impact.
2	The alternative is 50% to 100% higher than the alternative with the lowest NPV of incremental revenue requirement and the lowest incremental rate impact.
3	The alternative is 20% to 50% higher than the alternative with the lowest NPV of incremental revenue requirement and the lowest incremental rate impact.
4	The alternative is 5% to 20% higher than the alternative with the lowest NPV of incremental revenue requirement and the lowest incremental rate impact.
5	The alternative with the lowest NPV of incremental revenue requirement (average over the entire analysis period) and those alternatives that are within 5% of the alternative with the lowest NPV of incremental revenue requirement and the lowest incremental rate impact.

The financial evaluation scoring system compares the NPV of the incremental revenue requirement relative to the alternative with the lowest NPV of incremental revenue requirement. For example, the alternative with its NPV of incremental revenue requirement and rate impact only 5% higher than the alternative with the lowest NPV of incremental revenue requirement was not given the same weighting as the alternative with a NPV of incremental revenue requirement that is over 100% higher than the alternative with the lowest NPV of incremental revenue requirement.

Tables 5-2 through 5-5 illustrate the weightings applied when scoring the alternatives.

Table 5-2: Overall Weighting of Evaluation Criteria

Evaluation Criteria	Weight
Pipeline Integrity and Asset Management	40%
Project Delivery, Operational Assurance and Stakeholder Impact	20%
Financial and Customer Impacts	40%

Table 5-3: Weightings within Pipeline Integrity and Asset Management

Pipeline Integrity and Asset Management	Weight
Prevention of Leaks (small release, no loss of service)	25%
Prevention of Ruptures (major release, loss of service)	45%
Proactive Asset Management and Lifecycle Optimization	15%
Foundational Technical Solution	15%

Table 5-4: Weightings within Project Delivery, Operational Assurance and Stakeholder Impact

Project Delivery, Operational Assurance and Stakeholder Impact	Weight
Project Delivery	20%
Environmental	15%
Lands and Right of Way	10%
Consultation and Engagement	15%
Operational	10%
System Capacity & Reliability	25%
Socio-economic Benefit	5%

Table 5-5: Weightings within Financial and Customer Impact

Financial and Customer Impact	Weight
NPV of Incremental Annual Revenue Requirement (65 years)	80%
Rate Impact	20%

5.3.3 Management and Subject Matter Expert Review

In evaluating the alternatives, PNG involved its internal subject matter experts to review and assess potential scores and issues in the multi-criteria analysis. This group included senior management, engineering, operations, regulatory, finance and consultants. PNG engaged in several sessions to discuss the issues, advantages and disadvantages, in order to ensure the that the solutions were assessed with the appropriate management and technical judgement.

5.4 Preliminary Screening Conclusion

At the initial screening stage, PNG was able to eliminate the following options: 1) Status Quo, 2) Replace Pipeline, and 4) Deactivate Pipeline and Supply with LNG. The Status Quo is simply not a viable option given the pipeline integrity risk and lack of compliance with codes, standards and regulations. The Replace Pipeline option is cost prohibitive and would require an extended period of time to construct. The Deactivate Pipeline and Supply with LNG is also cost-prohibitive and it does not provide the operational reliability, long-term capacity or meet the timelines required by PNG.

The Upgrade Pipeline alternative was selected because it was considered to be the only option that had an acceptable balance of cost, ability to comply with applicable codes and regulations in a timely manner, and that could also meet the capacity and timing needs for future RECAP customers. The Upgrade Pipeline alternative provides a solution that meets PNG's long-term capacity and reliability needs.

While the Upgrade Pipeline alternative was the only option that passed the preliminary screening analysis, PNG has determined that there are sub-options to this alternative with varying degrees of scope and timing for the associated pipeline repairs and reinforcement that could be undertaken. In Section 5.5 that follows, PNG presents a systematic evaluation of these potential sub-options for the Upgrade Pipeline alternative.

5.5 Further Evaluation – Upgrade Pipeline Alternatives

In the previous section PNG presented its rationale for eliminating all alternatives other than the Upgrade Pipeline alternative. As noted previously, for the Upgrade Pipeline solution PNG has identified four variations for capital repairs of the 80 kilometre section of pipeline to address the extensive corrosion, dents, geohazards and related necessary pipeline repairs. These sub-alternatives or Upgrade Alternatives (UA) are referred to as UA 1, UA 2, UA 3, and UA 4, and are summarized in Table 5-6 and described more fully in the sections that follow.

Table 5-6: Upgrade Pipeline – Description of Sub-alternatives

	UA 1 **Upgrade Alternative 1** **Metal Loss / Dent** **Capex**	**UA 2** **Upgrade Alternative 2** **Metal Loss / Dent** **Capex +** **Very High Risk Sites**	**UA 3** **Upgrade Alternative 3** **Metal Loss / Dent** **Capex +** **Very High Risk +** **Hydro/Geohazards in Area**	**UA 4** **Upgrade Alternative 4** **All Capex Identified in High Risk Sites** **Multi-year Program**
Scope	• All ranked Metal Loss Features (MLF) will be exposed and repaired • All immediate /Priority 1 dents exposed and repaired • Priority 2 dents exposed assessed. • Engineering assessment with Finite Element Analysis (FEA) used to reduce quantity of required repairs. Presents risk of cost uncertainty. • Priority 3 dents exposed and repaired ▪ FEA conducted on Priority 3 dents with opportunity for cost savings • Strategic access improvements	• All items in UA 1 plus: • Repair treatment of all Priority 2 dents with use of FEA for potential repair avoidance and opportunity for cost reduction • Mitigation of very high-risk geohazard sites with Cost Benefit Ratio (CBR) ≤ 1.0 – Refer to Tables 4-4 and 4-5 • Line lowering in high risk areas • Includes 2 block valve site installations	• All items in UA 2 plus: • Mitigation of geohazards sites with CBR ≤ 2.0 – Refer to Tables 4-4 and 4-5 • Additional line lowering	• All items in UA 3 plus: • Mitigation of all remaining high/very high geohazards • All remaining line lowering
Cost Estimate (As-spent $)	$65.1 million (Class 4)	$84.8 million (Class 3)	$147.3 million (Class 4)	$279.8 million (Class 4)
Schedule	3 Years	3 Years	3-5 Years	3-5 Years
Risk	Highest ⟷			Lowest

As illustrated, each sub-alternative presented can be considered to build on the prior sub-alternative (i.e. UA 2 includes all of the work identified for UA 1 plus some additional scope items, UA 3 includes all of the work identified for UA 2 plus some further scope items, and UA

4 includes all of the work identified for UA 3 plus some additional scope items). Following the initial screening and selection of the Upgrade Pipeline alternative, all of UA 1, UA 2, UA 3 and UA 4 were deemed feasible; however, the final project definition required further evaluation of these sub-alternatives to produce a practical and appropriate project scope while still meeting all project objectives. PNG applied a second level of assessment to evaluate the four viable Upgrade Pipeline alternatives as per the discussion that follows.

5.5.1 Upgrade Alternative 1 (UA 1)

This option focused on repairs to the highest risk metal loss features and dents as defined as defects in CSA Z662 which include all immediate, P1, and P3 dents. In addition, pipeline anomalies not expected to meet codes, standards and regulations (defects) based on returned in-line inspection data and subsequent evaluation (P2 dents) would be exposed, directly assessed (including FEA), and repaired as required. PNG did not include any geohazards or additional scope for line lowering or line break valve additions.

5.5.1.1 Metal Loss and Dents

In UA 1, PNG would apply several methods to address metal loss and dents identified from its ILI runs, as there are several allowable assessment and repair methods to comply with CSA Z662. PNG included a combination of the following: 1) Sleeve Repair (pressure containing and compression); 2) Pipe Replacement; and 3) Engineering Assessment (Finite Element Analysis (FEA)).

1) Sleeve Repair

Sleeve repairs consist of installing external sleeves in the area of a pipeline defect. Repair sleeves are steel or composite reinforcements, welded or wrapped, on top of the defect. Each repair sleeve is unique, must be designed per CSA Z662 (Section 10) and associated repair treatment typically will include the following activities: design repair sleeves; procure sleeves; expose and excavate existing piping; investigative works to confirm sleeve installation requirements; install sleeve; perform Non-Destructive Examination (NDE); coating; backfill; and clean-up. Sleeve Repair options include: steel reinforcement repair sleeves; steel pressure-containment repair sleeves; composite reinforcement repair sleeves; and steel compression reinforcement repair sleeves.

Repair sleeves are considered by CSA Z662-19 Section 10 as permanent repairs and negate the need for pipeline outages incurred as a result of pipeline cut-out replacement alternatives, therefore reducing service disruption.

2) Pipe Replacement

Pipeline replacement work would focus on replacing pipe sections where defects have been identified. This option would require line isolation and blow-down of line pack between existing sectionalizing valves or the use of line stops with a bypass line depending on whether an acceptable outage can be taken without affecting service to downstream customers. Pipe replacement includes the following activities: procure pipe; either take an outage of the mainline (including depressurization via flaring or venting) or install line stops and bypass if required; pressure test and dry new piping; excavate existing piping; remove and replace pipe segment; tie-in pipe; perform NDE; coating; backfill; purge pipeline system; and clean-up.

3) Finite Element Analysis

Metal loss features can be easily assessed for safe maximum operating pressure given anomaly size and degree of pipe wall thinning. Dents, however, cannot be similarly assessed and per CSA Z662 must be repaired unless deemed acceptable by an engineering assessment, typically consisting of FEA. FEA of dents typically assess dent depth, length to depth ratio, strain, corrosion features, and other stress concentrators that may be present. FEA can also use operational history to assess historic pressure cycling and estimate remaining life. A dent proven acceptable by engineering assessment could provide an opportunity for cost savings to the project by avoiding potentially unnecessary repair costs. FEA work consists of: selecting an appropriate FEA vendor; selecting dents suitable for FEA; utilizing existing ILI data and/or field-collected dimensional information to perform FEA and make a decision on repair necessity; and schedule repair if required based on FEA results.

5.5.1.2 Geohazards

UA 1 does not include conducting any immediate geohazard mitigation activities. PNG would monitor and react as necessary to the geohazard risk into the future versus proactively mitigating the risk to the pipeline. Working with BGC, PNG has developed a cost/benefit ratio

(CBR)[15] analysis and under UA 1 the risk of any potential failures due to geohazards even where the CBR is below 1.0[16] have been assessed as acceptable.

5.5.1.3 Other Risks

As part of the scope of UA 1, PNG would provide some strategic access improvements but would not build any additional valve sites or conduct any line lowering work for shallow pipe.

5.5.1.4 UA 1 Summary – Integrated Scope

Through the use of risk assessment tools, engineering analysis and a project-specific decision tree,[17] PNG determined a scope of work that includes a combination of sleeve repairs, pipe replacement, and FEA engineering assessment for probable repair deferral. PNG would not pursue any further work to increase the number of valves on the system or to address geohazard risk. Table 5-7 provides a summary of advantages and disadvantages of pursuing UA 1.

Table 5-7: UA 1 Advantages and Disadvantages

UA 1	Advantages	Disadvantages
Pipeline Integrity and Asset Management	• Rectifies all metal loss and dent anomalies defined as defects under CSA Z662 • Marginally improves right of way access for emergency response and routine inspection, maintenance and monitoring	• Risk of more dents needing repair may be identified during engineering assessment and/or field-based direct assessment • Higher risk of pipeline failure compared to UA 2 after project completion • Does not address any depth of cover issues • Not proactive from an asset management perspective due to lack of geohazard mitigation
Project Delivery, Operational Assurance and	• Lowest environmental and stakeholder impact as work requires no pipeline re-routing	• Higher risk of outage due to failure from not addressing geohazard scope • Highest risk of unplanned pipeline failures causing supply disruption

[15] A cost/benefit ratio (CBR) is estimated by dividing the estimated cost of a geohazard mitigation by the total benefit of performing the same mitigation. A CBR greater than 1.0 shows that the costs of performing a mitigation outweigh the benefits, and thus may not be beneficial if performed, where a CBR of less than 1.0 identifies mitigations that have a benefit that exceeds the cost to perform.
[16] Appendix D - BGC 2020 Report (Confidential), Section 5, p.24
[17] Appendix I - Lauren Services - PNG Salvus to Galloway Upgrades Feasibility Report (Confidential)

UA 1	Advantages	Disadvantages
Stakeholder Impact	• Lowest risk option from a project planning and execution perspective	• No additional block valves and does not increase operational flexibility in the case of a pipeline incident • Creation of only temporary accesses results in more complex future access planning compared to all other upgrade alternatives
Financial and Customer Impact	• Lowest capital cost option and lowest rate impact in short-term	• Continued risk of pipeline failure could result in increased operating costs and/or insurance premiums • Does not address geohazards that may be cost-effective to remediate

5.5.2 Upgrade Alternative 2 (UA 2)

This option focused on repairs to the highest-risk metal loss features and dents similar to UA 1, plus included allowance for the repair treatment of all P2 dents, resulting in cost avoidance opportunity should repair of any such anomalies be avoided by FEA. All pipeline defects that did not meet codes, standards and regulations would be exposed and repaired. Unlike UA 1, PNG included: geohazard mitigations that fell below a CBR of 1.0 (i.e. deemed beneficial over the analysed period); additional scope for line lowering; and some new valve sites to increase operational flexibility and improve risk management.

5.5.2.1 Metal Loss and Dents

UA 2 included 100% of the scope of UA 1, plus cost and resource allowance for enacting repair treatment of all P2 dents. FEA-based engineering critical assessment of ILI identified dents that do not meet the base criteria of CSA defects as per Clause 10.10.4.2 of CSA Z662-19 but have other characteristics resulting in high prioritization (Priority 2 dents) is planned to be conducted as an opportunity to reduce costs by negating the need for repairs should results of the FEA be favourable.

5.5.2.2 Geohazards

As noted previously, in conjunction with BGC PNG developed a risk assessment tool that assesses geohazards on a PoF and CBR basis. In UA 2, PNG would effectively complete all geohazard repairs where the CBR is less than 1.0, making proactive mitigation a cost-favourable and financially prudent decision. The BGC 2020 Report utilized a risk model to determine the probability of failure (that is, PoF) of certain sites along the right of way, and

PNG has worked with BGC and Lauren Services to determine the costs of such a repair and outage. Certain key sites emerged as critically important to repair and other sites were deemed to be acceptable to monitor for the foreseeable future. As a result, UA 2 includes one very high risk geohazard repair, that being 48.1: Lachmach Debris Slides, MP 347 – 350, which has a PoF of 1.0×10^{-1} and a CBR of 0.5. For the remainder of the sites PNG would monitor the geohazard risk into the future rather than proactively mitigating risk to the pipeline. As described earlier, the risk of any potential failures due to geohazards where the CBR is greater than 1 has been established as acceptable.

5.5.2.3 Other Risks

Under UA 2, PNG would provide some strategic access improvements, including one permanent access bridge located at Kloiya Creek to ensure more immediate access to a remote section of the right of way. Furthermore, two additional valve sites for operational flexibility and risk management improvement would be installed and PNG would also conduct line lowering at areas deemed as high risk to further address non-conformance with CSA Z662 prescribed minimum depths of cover.

5.5.2.4 UA 2 Summary – Integrated Scope

In summary, under UA 2 PNG would expand the scope of the dent repairs to reduce the overall risk level associated with the Project. UA 2 also includes the mitigation of one very high risk geohazard site where the CBR is less than 1.0. In addition, PNG would conduct line lowering works in high-risk areas in order to further mitigate risk of geohazards by providing improved protection and degree of separation for external threats. There would be two additional valve sites installed to further enable maintenance work and security of supply. Table 5-8 provides a summary of advantages and disadvantages of UA 2.

Table 5-8: UA 2 Advantages and Disadvantages

UA 2	Advantages	Disadvantages
Pipeline Integrity and Asset Management	• Addresses dents defined as defects under CSA Z662 and rectifies dents where rectification would be considered industry best practice based on ILI information • Reduced risk of pipeline failure compared to UA 1	• Does not include all high risk area depth of cover mitigation • Does not include mitigation of high and very high geohazards with CBR > 1.0

UA 2	Advantages	Disadvantages
	• Includes depth of cover mitigation in highest risk areas • Two additional block valves increase operational flexibility in the case of a pipeline incident or planned maintenance • Increased pipeline reliability by mitigating geohazards with a CBR < 1.0	
Project Delivery, Operational Assurance and Stakeholder Impact	• Low environmental and stakeholder impact as work requires no pipeline re-routing • Greater execution certainty compared to UA 1 due to more defined project scope related to dents thus minimizing potential for increased costs and schedule impacts due to unplanned work • Greater execution certainty relative to UA 3 as geohazard mitigation in UA 2 does not require a reroute	• Higher risk of geohazard related incidents compared to UA 3 given limited geohazard scope • Creation of primarily temporary accesses results in more complex future access planning compared to UA 4
Financial and Customer Impact	• Addresses geohazards that are cost-effective (CBR < 1.0) to remediate	• Continued risk of pipeline failure could result in increased insurance premiums and repair costs

5.5.3 Upgrade Alternative 3 (UA 3)

The UA 3 option includes all of the aforementioned work that would be done in UA 2. However, PNG would expand the scope of work to include more geohazard site repairs to reduce the overall risk level. The scope includes all of the “very high” and “high” geohazards work with a CBR < 2.0. Additional sites identified for this alternative are listed in Table 5-9. PNG would also include additional line lowering works in medium risk areas under UA 3.

Table 5-9: UA 3 Additional Geohazard Repair Sites

Identified Geohazard	Combined PoF	CBR
14.1: Unnamed Debris Flow, MP 321.7 (DF)	2.40E-02	1.2
2: Kasiks, MP 314 - 315 (DF, RF, RS)	5.10E-02	1.6
40: Khyex River, MP 334.64 (HT)	1.40E-02	1.6
32: Bowling Alley, MP 326 - 328 (DF, HT, RF, RS)	7.18E-02	1.7
53: Prudhomme Debris Slides, MP 352 - 353 (DS)	1.00E-02	1.7

5.5.3.1 UA 3 Summary – Integrated Scope

Table 5-10 provides a summary of advantages and disadvantages of UA 3.

Table 5-10: UA 3 Advantages and Disadvantages

UA 3	Advantages	Disadvantages
Pipeline Integrity and Asset Management	• Addresses dents defined as defects under CSA Z662 and rectifies dents where rectification would be considered industry best practice based on ILI information • Includes depth of cover mitigation in high and medium risk areas • Decreased residual risk compared to UA 2 due to increased number of high risk geohazard mitigations	• Does not include the degree of integrity mitigations such as armouring and extensive line lowering included within UA 4 • Does not mitigate all 56 high risk geohazards whose mitigation is contemplated in UA 4
Project Delivery, Operational Assurance and Stakeholder Impact	• Lower environmental and stakeholder impact vs UA 4	• Increased environmental and stakeholder impact compared to UA 2 • Creation of primarily temporary accesses results in more complex future access planning compared to UA 4 • More complex execution compared to UA 2 given required rerouting
Financial and Customer Impact	• Lower cost and rate impact versus UA 4	• Continued risk of pipeline failure could result in increased insurance premiums and repair costs

5.5.4 Upgrade Alternative 4 (UA 4)

This option includes all of the aforementioned work that would be done in UA 3. However, for UA 4 PNG would also include mitigation of all remaining high and very high geohazards to reduce residual risk to a medium level (PoF defined as $<10^{-3}$ per year). In total, 56 geohazard sites would be mitigated, including additional mitigation solution options such as atypical site designs and significant rerouting.

Additionally, permanent access would be constructed throughout the line, including bridge or culvert crossings of all streams. Project scope would also increase the amount of line lowering to include low-risk sites.

5.5.4.1 UA 4 Summary – Integrated Scope

Table 5-11 provides a summary of advantages and disadvantages of UA 4.

Table 5-11: UA 4 Advantages and Disadvantages

UA 4	Advantages	Disadvantages
Pipeline Integrity and Asset Management	• Addresses dents defined as defects under CSA Z662 and rectifies dents where rectification would be considered industry best practice based on ILI information • Addresses all known locations of exposed pipe with line lowering and/or armouring • Lowest residual risk to pipeline • Addresses all 56 high-risk or greater geohazards • Significantly increases pipeline access capability along it entire length	
Project Delivery, Operational Assurance and Stakeholder Impact	• Least residual operational risk due to increased geohazard mitigations • Permanent access allows for easier access to respond to future emergencies	• Most complex project execution • Highest environmental and stakeholder impact as work requires the most pipeline rerouting • Permanent access plan has higher cost and environmental and stakeholder impact
Financial and Customer Impact		• Highest cost option and highest rate impact

5.6 Scoring of Alternatives

5.6.1 Alternative Scoring - Financial Evaluation

PNG has scored all alternatives, including the four Upgrade Pipeline sub-alternatives, using the methodology discussed in Section 5.3. The results of the financial scoring are presented in Table 5-12.

Based on the results of the financial analysis as presented in Table 5-12, UA 1 and UA 2 have NPVs within 10% at $84 million and $92 million, respectively. The next closest alternative with respect to NPV is UA 3 which at $146 million is in excess of 50% greater than the NPV of UA 2. UA 1 has the lowest rate impact at 12% followed by UA 2 at 16%. The difference in rate impact between UA 1 and UA 2 compared to the smaller difference in NPV between these two options can be attributed to UA 1 having lower upfront cost but requiring greater maintenance expenditures throughout the life of the asset. This results in a greater difference in rate impact compared to the difference in NPV as the rate impact is measured over a shorter term than the NPV analysis. Given the longer-term assessment view and value of information provided by the NPV relative to the rate impact, the proportional contribution of NPV to the financial scoring was set considerably higher than that of rate impact.

Table 5-12: Financial Evaluation of Alternatives

Alternative	Description	NPV ($million)	Rate Impact[1]
Replace Pipeline[2]	$452.3M (As-spent $) Replacement of Salvus to Galloway portion of pipeline with new pipeline	$325	102%
LNG Options:			
LNG: Option A[3]	$235.2M (As-spent $) LNG facility in Terrace with Regasification facility in Prince Rupert (at Galloway Station) with 8.6 MMscf/d capacity	$232	61%
LNG: Option B[3]	$363.6M (As-spent $) LNG facility in Terrace with Regasification facility in Prince Rupert (at Galloway Station) with 20 MMscf/d capacity	$488	126%
Upgrade Options:			
UA 1	$65.1M (As-spent $) capital spend. Includes an estimate of future maintenance capital.	$84	12%
UA 2	**$84.8M (2020 $) capital spend. Includes an estimate of future maintenance capital.**	**$92**	**16%**
UA 3	$147.3M (As-spent $) capital spend. Includes an estimate of future maintenance capital.	$146	27%
UA 4	$279.8M (As-spent $) capital spend. Includes an estimate of future maintenance capital.	$233	52%

Notes:

[1] The rate impact is calcuated as the Cost of Service increase relative to the 2021 Cost of Service in the 2020 - 2021 Revenue Requirements Application once construction is completed and assets are placed into service.

[2] High-level analysis conducted to eliminate this option as economically viable. The capital cost estimate is considered Class V (-20%/+50%). No operating expenses and only minimal maintenance capital costs were included.

[3] High-level analysis was conducted to eliminate this option as economically viable. Replacement costs of LNG facilities upon end of useful life were calculated at half the inflated initial costs (a using a 2.68% annual inflation rate based on the average annual increase in Statistics Canada's Infrastructure Construction Price Index). Operating and maintenance costs were estimated based on 8-10 additional employees for labour, power costs and $1-$2 million annually for other operating costs. Trucking costs were not included, however PNG anticipates these would be significant.

5.6.2 Alternative Scoring - Overall

As noted previously, PNG evaluated the identified pipeline remediation options, including the four Upgrade Alternatives (UA 1, UA 2, UA 3, and UA 4), based on the scoring criteria and weightings described in Section 5.3. Table 5-13 that follows provides a summary of the resultant weighted-average overall scorings in consideration of all criteria.

Table 5-13: Summary of Weighted-average Scoring of Alternatives

Alternative	Total Score	Pipeline Integrity and Asset Management					Project Execution, Operational Assurance and Stakeholder Impact								Financial and Rates		
		Sub-Total	Prevention of Leaks (small release, no loss of service)	Prevention of Ruptures (major release, loss of service)	Management and Lifecycle Optimization	Foundational Technical Solution	Sub-Total	Project Delivery	Environmental	Lands & Right of Way	Consultation and Engagement	Operational	System Capacity & Reliability	Socio-economic benefit	Sub-Total	Present Value (PV) of Incremental Annual Revenue Requirement	Rate Impact
		40%	25%	45%	15%	15%	20%	20%	15%	10%	15%	10%	25%	5%	40%	80%	20%
Status Quo	**0.37**	-	0	0	0	0	***1.85***	3	2	2	3	3	0	0	-	0	0
Replace Pipeline	**2.97**	***5.00***	5	5	5	5	***2.85***	1	2	2	1	5	5	5	***1.00***	1	1
UA 1	**3.42**	***1.70***	2	2	1	1	***3.70***	4	4	5	5	2	3	2	***5.00***	5	5
UA 2	**3.67**	***3.15***	3	3	3	4	***4.45***	5	5	5	5	3	4	3	***3.80***	4	3
UA 3	**2.73**	***3.23***	3	3	3.5	4	***3.60***	4	4	3	3	3	4	3	***1.80***	2	1
UA 4	**2.59**	***4.00***	4	4	4	4	***2.95***	2	3	2	2	4	4	4	***1.00***	1	1
Deactivate Pipeline	**2.36**	***4.25***	5	5	3	2	***1.30***	2	1	1	1	1	1	3	***1.00***	1	1

As demonstrated in Table 5-13, UA 2 had the highest overall score of 3.67 among the Upgrade Alternatives, with the highest score in the Project Execution, Operational Assurance and Stakeholder Impact categories. UA 1 had the next highest total score at 3.42, and while it had the highest score under Financial impacts, it was appreciably lower than UA 2 with respect to its scores in both the Integrity and Asset Management and Project Execution, Operational Assurance, and Stakeholder Impact categories.

5.7 Preferred Alternative Conclusion

PNG believes that it is in the public interest to upgrade the existing NPS 8 Salvus to Galloway pipeline segment, rather than undertaking more elaborate options to supply the Prince Rupert and Port Edward areas. PNG has completed rigorous analysis over a two-year period that has been validated and supplemented by the work of third-party experts.[18] PNG has conducted a detailed screening of options to eliminate non-viable alternatives, giving consideration to a variety of factors including integrity management, project execution and financial impacts.

Based on the analysis above, PNG has selected UA 2 as its recommended alternative to proceed into the construction phase. This alternative includes capital repairs of selected segments of the 80 kilometre section of pipeline, including areas of extensive corrosion, dents

[18] Dynamic Risk Assessment Systems Inc., BGC Engineering Inc., Skystone International LP, Lauren Services, Solaris Management Consultants Inc., Innovative Pipeline Projects Ltd., Khtada Environmental Services Ltd., Chartwell Consulting Services Ltd., Roy Northern Land and Environmental Ltd., Revay and Associates, and Strait Projects Ltd.

and geohazards. The solution is expected to cost-effectively rectify all immediate and high priority metal loss features and dents and address geohazards on a risk-adjusted basis, and thereby addressing compliance deficiencies with the *Oil and Gas Activities Act*, the associated Pipeline Regulation, and CSA Z662.

The multi-criteria analysis has demonstrated that UA 2 is the preferred option for PNG, with a score of 3.67 out of 5.0. The summary of advantages and disadvantages further corroborates that UA 2 is the optimal solution for PNG and is in the public interest. While UA 2 does not generate the highest score from an Integrity and Asset Management perspective, PNG has developed a prudent, practical and cost-effective approach to manage integrity risk and ongoing compliance with codes, standards and regulations. PNG is keenly aware of the high cost of work in this challenging terrain in its service territory and of potential rate impacts, and believes UA 2 strikes an appropriate balance of mitigating risks associated with metal loss, dents and geohazard risks while managing rate impacts associated with the Project. PNG is well-positioned to execute and deliver the Project and the solution is appropriate from an Operational Assurance and Stakeholder Impact point of view.

6 Project Description

6.1 Introduction

The Project proposed in this Application involves repairing sections of the NPS 8 pipeline between Salvus and Galloway on PNG's Western Transmission Gas Line, following the scope of Alternative UA 2 as described in Section 5. The scope of the Project includes:

- Repairs to the highest risk metal loss features and dents;
- Line lowering activities in high risk areas;
- Two valve site installations deemed essential for future strategic system isolation; and
- Mitigation of one very high risk geohazard (Lachmach to Debris Slides, MP 347 – 350).

PNG notes that the evaluation of the best course of action has been under development since 2017, and that the specific scope for the Project as outlined in this Application will be executed from 2021 to 2023.

6.2 Basis of Design and Engineering

PNG engaged Lauren Services to prepare a Design Basis Memorandum (Appendix J) to summarize the physical environment, operating conditions, design requirements, and methodologies for pipeline and civil design of the front-end engineering and design (FEED) phase of the Project. The sections that follow provide a description of the various project design requirements.

6.2.1 Standards and Specifications

The design and construction of the pipeline upgrades will be in accordance with the *Oil and Gas Activities Act* and will meet or exceed the minimum requirements of CSA Z662-19, applicable PNG Standard Practice Instructions (SPIs) and other standards and codes referenced herein and summarized in Table 6-1.

Table 6-1: Applicable Pipeline Standards and Guidelines

Standard	Description
CSA Z662-19	Oil and Gas Pipeline Systems (2019)
CSA Z245.1-18	Steel Pipe
CSA Z245.11-17	Steel Fittings
CSA Z245.12-17	Steel Flanges
CSA Z245.15-17	Steel Valves
CSA Z245.20-18	External Fusion Bond Epoxy Coating for Steel Pipe
CSA Z245.21-18	External Polyethylene Coating for Pipe
CSA Z245.30-18	Field Applied External Coatings for Steel Pipeline Systems
	CEPA Watercourse Management Recommended Practices (1st Edition)

6.2.2 Pipeline Specification and Design Criteria

Pipeline replacement segments will meet the CSA Z245.1-18 specification, with design meeting the requirements of CSA Z662-19. All new piping used in remediation and repair work will be NPS 8 to match the current pipeline diameter. Minimum design parameters for new pipe are as provided in Table 6-2.

Table 6-2: Pipeline Upgrade Design Parameters

Item	Value
Pipe Size (OD):	219.1 mm
Minimum Pipe Wall Thickness:	General Locations – 5.2 mm Stations Location – 8.2 mm
Specified Minimum Yield Strength:	359 MPa
Maximum Operating Pressure (MOP):	9,335 kPag (1,354 psig)
Location Factor	General – 0.9 Stations – 0.625
Design Factor	0.8
Joint Factor	1.0
Temperature Factor	1.0
Flange Rating:	PN 100 (ANSI 600)
Minimum Depth of Cover	General – 0.6 m Crossings (other than rail) – 1.2 m
Corrosion Allowance:	None
Design Temperature:	-29° C minimum (above grade) -5° C minimum (below grade) 40° C maximum (above grade)
Installation Temperature:	0° C
Maximum Operating Temperature:	50° C

CSA Z662 defines class locations as a geographical area classified according to its approximate population density and other characteristics. The pipeline within the Project scope bounds is presently entirely in a Class 1 location with 10 or fewer developments within proximity to the right of way. Taking a conservative approach, PNG will select and design materials and pressure testing specifications for a CSA Z662 Class 2 location, which allows for consistent materials to be used through the Project and capacity for future development near the right of way. This is a design decision that results in negligible difference in cost relative to Class 1 location requirements.

6.2.2.1 Bends

Bends will meet the minimum requirements of CSA Z662 and CSA Z245.11 (for induction bends only) and shall be of suitable radius for pigging and internal inspection (ILI) of the pipeline.

Field bends will be used where possible to account for points of inflection on the right of way. Shop fabricated induction bends will be used for valve sites and locations where space constraints impede the use of field bends. Mitred bends will not be used.

6.2.2.2 Block Valves

Block valves will be installed for the purposes of maintenance and operation flexibility. Specific locations will be determined during detailed design and will be selected based on a balance of accessibility, terrain-based risk, and optimization of operational flexibility from a system resilience and emergency response perspective.

All valves will comply with CSA Z662 and CSA Z245.15 with a pressure rating of PN100 (ANSI 600). Mainline isolating valves shall be full bore in order to maintain pipeline ILI capability.

Blowdown valves will be installed in conjunction with new block valves in order to afford for depressurization of pipeline sections between valves. Blowdown assemblies shall be sized to allow for the section to be depressurized rapidly during emergency situations. Locations of the block valves and associated blowdown assemblies shall be such that the gas can be vented or flared to the atmosphere without undue hazard. Overall, assemblies will be designed and constructed in consideration of future incorporation of pump-across compressors for the purposes of minimizing future gas loss volumes to the atmosphere related to pipeline section maintenance.

Valves will be manually operated with provisions for remote or automatic shutdown functionality in the future.

6.2.2.3 Corrosion Control

Corrosion control will be performed by a combination of external coating, cathodic protection, and mechanical protection as required and specified by CSA Z662. Applicable standards referenced in Section 6.2.1 will be adhered to for coating selection, application, and testing of both new and repaired existing pipeline coatings.

New pipe and existing coating repairs will be in accordance with PNG SPI 8-5 – Painting and Coating. In general, new pipe will be externally coated with fusion bonded epoxy or YJ2K™.

Pipe mechanical protection will be installed where pipe or pipe coatings may be damaged by backfill or bedding materials make-up, trench properties, or the presence of threat from external environmental forces such as geotechnical or hydrotechnical activity (rock fall, rock slide, debris flow) that can impact the pipeline over the operational life. Typical means of mechanical protection are as listed in Table 6-3 below.

Table 6-3: Pipe Mechanical Protection

Location	Frequency
Mechanical Shield	Industry Standard polyethylene weave pipeline external wrap products such as Rock Guard or Tuff-N-Nuff will be used in areas where suitable backfill cannot be used or imported, or in steep terrain or sensitive areas where additional pipeline protection is required.
Rock-free Initial Backfill	When possible and economically viable, a sufficient amount of rock free material, either native or imported, will be placed over and around the pipeline to prevent rock damage by subsequent fill of native soils. The amount and type of initial fill will be site specific to account for concerns related to drainage, bearing strength, etc. Large rocks or boulders found during trench excavation will be discarded or placed on the side of the right of way.
Rock Jacket	Shop applied Rock Jacket™ (or equivalent concrete-type external coating) will be applied to pipe installed in rock blasted trench or areas of large angular fill to protect the pipeline from the native rock fill and bedding conditions.

The existing Western Transmission Gas Line has an impressed current cathodic protection system that will continue to protect the sections to be upgraded as part of the Project. Location-specific cathodic protection enhancements such as additional test posts and/or rectifiers will be installed based on the recommendations of Skystone International Inc., the corrosion protection and prevention consultant selected for the Project.

6.2.2.4 Transition Pieces

Transition pieces will be used at connections where internal offset of the pipeline wall thickness is greater than 2.4 mm, as required by CSA Z662.

6.2.2.5 Welding and Non-destructive Examination

Welding and non-destructive examination (NDE) on the pipeline will be performed by qualified personnel in accordance with CSA Z662-19 Clause 7 and PNG SPIs. Weld procedures and NDE will be reviewed and approved as part of Project quality and inspection and test plans.

All new and exposed legacy welds along the pipeline shall be subjected to NDE for 100% of their length using radiographic or ultrasonic methods. The results of the NDE will be verified to be acceptable prior to coating and backfill. A detailed material conformance log will be kept and will include material test report data, applicable weld procedures, and company specifications. This conformance log will be provided to the contractor(s) prior to construction, upkept by the contractor(s) throughout Project execution; and will be audited by PNG.

6.2.2.6 Pressure Testing

Prior to commissioning, any new pressure containing materials will be pressure tested in accordance with CSA Z662 and PNG SPIs to verify pipe integrity using water or air as the test medium. The test medium will be considered on a case-by-case, location-by-location basis.

6.2.2.7 Pipeline Repair Methodology

Pipeline anomalies, including metal loss features and dents, will be repaired by acceptable methods per CSA Z662 Table 10.2, with the preferential repair method being pipe replacement via cut-out. Based on project-specific reviews, including consideration of terrain, available line-pack, and customer impacts resulting from cut-out related outages, sleeve repairs have been selected for repairs where cut-outs are not deemed feasible based on the balance of integrity-risk reduction, constructability, environmental constraints, and costs. Acceptable repair sleeve methods include steel pressure-containing sleeves or steel compression sleeves and will be installed by qualified personnel.

Engineering critical assessment incorporating FEA shall be used to verify potential repair avoidance opportunities for high-priority dents identified by the most recent ILI data analysis but not meeting the definition of a defect under CSA Z662. Any opportunities realized through completion of FEA will reduce both cost and resource expense on the Project.

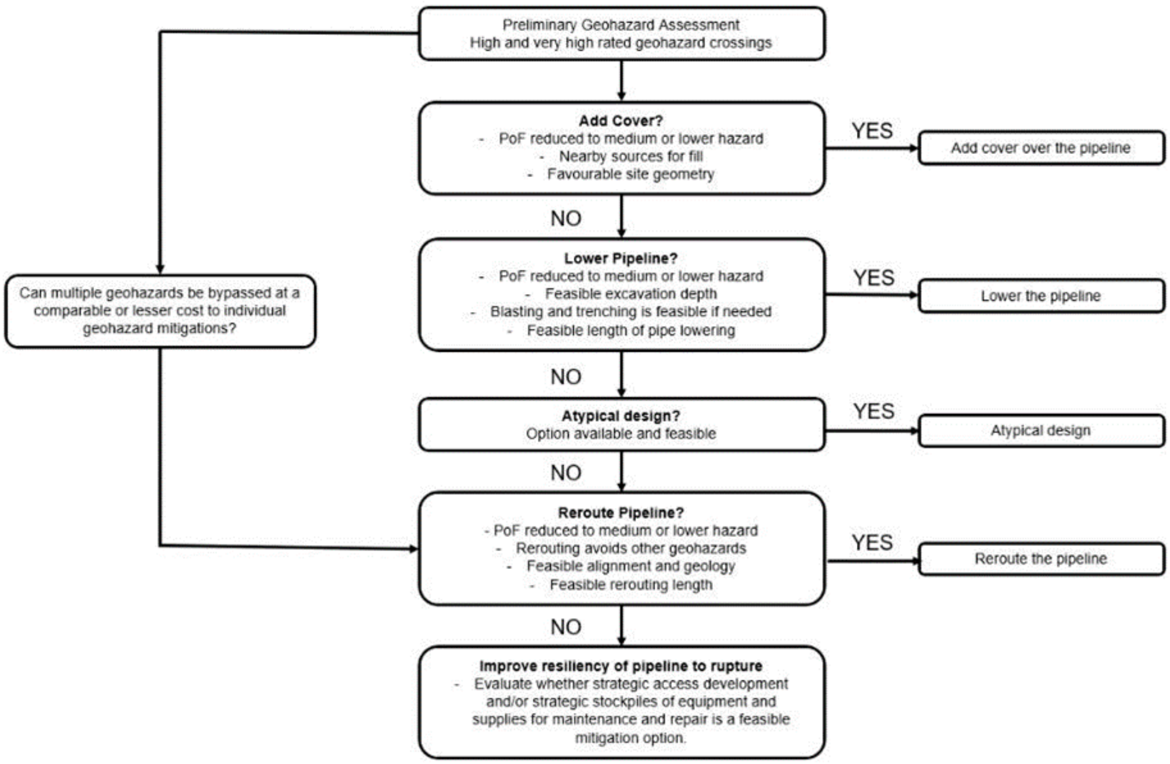
6.2.3 Geohazard Mitigation – Lachmach River Area Debris Slides

In the Project, PNG proposes to mitigate geohazard risk associated with debris slide areas in the Lachmach River area. These debris slide hazards have the highest PoF of all geohazards inventoried and assessed by BGC, with a PoF value of $1.10E^{-01}$ and a CBR of 0.5 as previously discussed in Section 4.4.1.1. The pipeline is located close to the toe of debris slide prone slopes, within the typical slide deposition zone. The pipeline is at or near surface, covered by a small earthen roach. As a result, the pipeline is exposed to impacts from moving debris, even in the deposition zone where erosion and scour would not normally be expected.

Mitigation design development will be as presented in Figure 6-1 in accordance with the mitigation options hierarchy flow chart developed by BGC.[19] For debris slides such as those in the Lachmach River area, PoF-reduction based mitigation will be achieved via line lowering, increased cover, moving as far from the slide source as possible, increasing pipe wall thickness, and adding external mechanical protection such as concrete coating to improve impact resistance.

[19] Appendix D, BGC 2020 Report (Confidential), Fig. 3-1, p.9

Figure 6-1: Geohazard Mitigation Options Hierarchy Flowchart

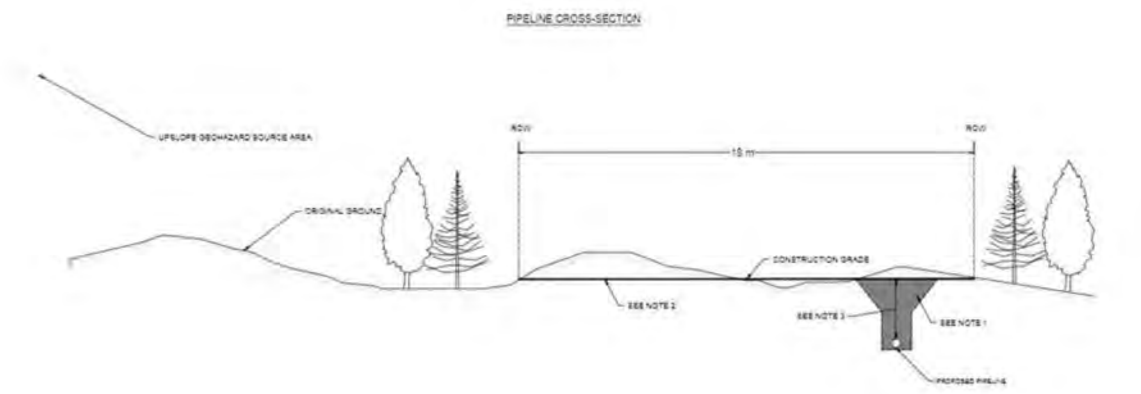


Depth of cover will be increased to 1 metre or greater to conform with the target depth of cover assignment provided by BGC for debris slide hazards where the pipeline is located in the deposition zone,[20] noting that even modest increases in burial depth into native soil can significantly reduce probability of failure. Furthermore, the pipeline will be relocated into a new trench on the east side of the existing right of way with careful regrading, where possible, to promote debris deposition that will be less dangerous than otherwise.

PNG will follow typical hazard mitigation design methods at debris slide crossings as provided by BGC and depicted in the following cross section representation in Figure 6-2.

[20] Appendix D, BGC 2020 Report (Confidential), Table 3-3, p. 13

Figure 6-2: Typical Line Lowering, Relocation, and Regrading Mitigation on Flat Terrain



6.3 Project Cost Estimate

In conjunction with Lauren Services, PNG developed the Project cost estimate to an Association for the Advancement of Cost Engineering International (AACE International) Class 3 definition level using AACE International Recommended Practices Nos. 18R-97 and 97R-18 as guides. The cost estimate was reviewed and validated by Lauren Services. PNG engaged Lauren Services to assist with and provide engineering and estimating services for the Project and to develop the design and construction planning to the necessary level of project definition as prescribed by the AACE International recommended practices. This collaborative approach ensured that PNG was able to develop an estimate that reflects leading practices in estimating and forecasting. The discussion that follows provides further details on the cost estimate.

6.3.1 Project Cost Estimate Details and Summary

The capital cost estimate for the Project is forecast at $84.8 million in as-spent dollars ($80.6 million in 2020 dollars) which represents a P85 confidence level. The Project cost estimates for materials and labour were developed based on 2020 prices. PNG has made use of an inflation factor of 2.68% which is consistent with the Infrastructure Construction Price Index.[21] The capital cost estimate includes the applicable British Columbia Provincial Sales Tax (PST) of

[21] Statistics Canada: https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1810002201

7% for materials purchases. PNG has not included Federal Goods and Services Tax (GST) in its estimate, as PNG is a GST registrant and is entitled to recover GST paid.

Lauren Services was engaged to prepare a Basis of Estimate for the Project, including the detailed work breakdown structure and the associated AACE Class 3 total installed cost estimate of $84.8 million, including direct and indirect costs, contingency, and management reserve. The Basis of Estimate has been appended as Appendix K, which has been submitted on a confidential basis. The Project cost estimate will be used as the control budget and will be refined following certain critical project stages such as contractor and materials procurement. The performance of the Project against the control budget will be tracked through implementation of a project-specific cost control and reporting plan. Details of this plan will be developed through the activities of the Project Management Office (PMO).

A summary of the Project capital budget is provided in Table 6-4 that follows.

Table 6-4: Project Cost Summary

Cost Element *($ millions)*	**As-spent $**	**2020 $**
Indirect Costs:		
Engineering and Project Development	$ 1.25	$ 1.19
Permitting (Lands, Environmental, Archaeological)	2.02	1.92
S2G Project and Construction Management	8.55	8.13
	11.82	11.24
Direct Costs:		
Procurement	0.90	0.86
Construction (Equipment and Labor)	54.55	51.90
	55.45	52.75
Subtotal	67.27	63.99
Contingency (20%)	13.45	12.80
Subtotal including Contingency	80.73	76.79
Management Reserve (5%)	4.04	3.84
Total Capital Cost	**$ 84.76**	**$ 80.63**

6.3.2 Quantitative Risk Analysis and Project Contingency

Risk identification, quantitation, and response selection have been performed with guidance from the AACE Total Cost Management Framework and Recommended Practices 41r-08, 57r-09, and 63r-11.

The Project cost estimate includes a contingency of 20%, as well as a management reserve of 5%. These provisions are based on PNG's current understanding of the Project's risk profile. The contingency value was established as an output from the assessment of defined scope cost estimate probabilistic risk, whereas the management reserve has been established to provide allowance for any potential changes to project scope or unforeseen events.

In an effort to develop a comprehensive project quantitative risk analysis, PNG and Project partners conducted a number of risk workshops to identify and explore all potential project risks, their probability of occurrence, and impact to the Project. Revay and Associates were engaged to facilitate the process and to develop a risk model in @Risk software in order to complete a stochastic (Monte Carlo) analysis. The range of minimum, most likely, and maximum probabilistic cost were modelled as a Trigen distribution to reflect the 10% to 90% confidence ranges. The resultant model outputs and analysis are provided in Appendix L, submitted on a confidential basis. As noted previously, as a result of this analysis PNG has selected a P85 confidence level and associated contingency to establish the control budget for the Project.

6.3.2.1 Contingency

As previously noted, PNG has included a 20% provision for contingency in the Project cost estimate. PNG believes its approach to contingency is consistent with the BCUC CPCN Guidelines and the following AACE International Recommended Practices' definition for contingency:

> Contingency – An amount added to an estimate to allow for items, conditions, or events for which the state, occurrence, and/or effect is uncertain and that experience shows will likely result, in aggregate, in additional costs.[22]

As previously described, PNG has selected a P85 confidence level and associated contingency to establish the control budget for the Project. Given the project-related complexities associated with access, environmental sensitivities, weather constraints, geotechnical and hydrotechnical activity, potential for customer impact, and the unknowns of an aged pipeline asset across a multi-year project execution schedule, a high potential for worst case risk scenarios for the pre-defined project scope is considered to be reasonably likely.

[22] AACE International Recommended Practice No. 10S-90, Cost Engineering Terminology, p. 27

PNG recognizes that a P85 amount is on the higher side of the typically acceptable range. The analysis of PNG and Revay and Associates suggests that a contingency with a confidence level high in the acceptable range would be appropriate for this Project for three reasons:

1) The Project scope is unique and challenging (pipeline remediation);

2) The Project location is difficult with many unknowns and uncertainties (difficult terrain and geohazards, stakeholder, environmental, and permitting complexities); and

3) This type of project is not one that is commonly undertaken in the given conditions.

Should the need to access contingency arise, the Senior Project Manager will be responsible for accessing contingency within the approved project budget.

6.3.2.2 Management Reserve

As previously noted, PNG's contingency is exclusive of necessary management reserve which has been set at 5%. PNG believes its approach to management reserve is consistent with the BCUC CPCN Guidelines and the following AACE International Recommended Practices' definition for management reserve:

> Management Reserve – An amount added to an estimate to allow for discretionary management purposes outside of the defined scope of the project, as otherwise estimated. May include amounts that are within the defined scope, but for which management does not want to fund as contingency or that cannot be effectively managed using contingency.[23]

As described by Revay and Associates, the contingency analysis did not include extraordinary risk or major marketplace changes. PNG recognizes that a P85 amount is on the higher side of the typically acceptable range. The analysis of PNG and Revay and Associates suggests that a contingency with a confidence level high in the acceptable range would be appropriate given the uniqueness and challenges presented by the Project, with Revay and Associates stating that this approach would be in line with best practices. Due to the remoteness, uncertainty, and uncommon nature of the Project, PNG believes that the discretion provided by a management reserve is necessary to address unconsidered scope items whilst already in this

[23] Ibid., p. 72

challenging region of British Columbia. Further, the management reserve will address unknown project-related risks that may materialize during project implementation that have high consequence but a low likelihood of occurring.

In terms of physically accessing funding established for the management reserve during project execution, PNG's process will involve formal documentation of requests to the Executive Sponsor for additional funding that detail the additional scope or conditions that have materialized. The Project's baseline costs will only be increased upon formal approval by the Executive Sponsor, authorizing the Senior Project Manager to complete the identified necessary work.

6.3.3 Basis of Estimate

As noted previously, the Basis of Estimate for the Project prepared by Lauren Services is appended in support of this Application as confidential Appendix K. The Basis of Estimate documents the following inputs used in the development of the Project cost estimate:

- Estimate background;
- Purpose and objective of the estimate;
- Basis of estimate;
- Scope of the estimate;
- Assumptions;
- Material and equipment cost basis;
- Labour rates;
- Contractor indirect costs;
- Estimate allowances;
- Other costs and indirect costs;
- Engineering services; and
- Freight.

6.3.4 Validation Process for Cost Estimate

The cost estimate was developed with the support of Lauren Services and a purpose-built project cost estimating team comprised of the following applicable subject matter experts in their respective disciplines identified in Table 6-5.

Table 6-5: Subject Matter Experts Used in Development of Cost Estimate

Company	Subject Matter
BGC Engineering Inc.	Geohazard inventory, hazard identification, risk assessment, alternatives cost/benefit analysis, and risk mitigation conceptual design
Chartwell Consultants Ltd.	Access management and improvement development
Dynamic Risk Assessment Systems Inc.	Pipeline integrity and ILI response
Khtada Environmental Services Limited	Aquatic and terrestrial habitat assessments, environmental constraints analysis, stream identification and classification, and environmental related permitting
Lauren Services	Pipeline engineering
McElhanney Consulting Services Ltd.	Survey
Revay and Associates Ltd.	Quantitative risk analysis
Roy Northern Land and Environmental Ltd.	Archeological reviews and permitting
Strait Projects Ltd.	Construction execution

Scopes for each estimating activity were reviewed and defined through a series of estimating workshops in order to ensure there were no gaps in estimating details and no duplication. Each specialist estimate developed was reviewed independently by Lauren Services and PNG and was also subject to a comprehensive review by Revay and Associates as part of the quantitative risk analysis (see confidential Appendix L). Lauren Services performed internal reviews of the estimate including independent reviews by peers outside the Project team. The estimate was also reviewed with PNG throughout the development and at each milestone date to ensure a complete and accurate estimate was developed.

6.4 Project Development and Execution Schedule

6.4.1 Project Schedule

Project FEED has been completed and detailed design, permitting, and execution planning are in various degrees of development.[24] Construction is proposed to be undertaken starting in

[24] Appendix K – Lauren Services, Basis of Estimate (Confidential)

2021. Specific project activities and their respective milestone dates are summarized in Table 6-6. The anticipated project schedule is based on receiving BCUC project approval by June 30, 2021 and an assumed construction start in the third quarter of 2021. Typically, for the given project location, in-field construction activities correspond to aquatic and terrestrial habitat-related least risk timing windows which generally occur in summer months. Construction is planned for each of 2021, 2022, and 2023.

Table 6-6: Project Schedule

Activity	Timeline		
Project Planning			
FEED	Completed		
Indigenous and Stakeholder Consultation	Ongoing		
CPCN Preparation	January 2020 – October 2020		
CPCN Regulatory Review	October 2020 – June 2021		
Project Execution	**2021 Construction**	**2022 Construction**	**2023 Construction**
Engineering Detailed Design	September 2020 - January 2021	September 2021 – December 2021	September 2022 – December 2022
Contractor Selection and Award	October 2020 - January 2021	October 2021 - January 2022[1]	October 2022 - January 2023[1]
Materials Tendering / Orders Placed	January 2021 – August 2021	January 2022 – March 2022	January 2023 – March 2023
Submit OGC Application	December 2020	August 2021	August 2022
OGC Pipeline Approval	March 2021	January 2022	January 2023
Award Contractor (or Extend)	April 2021	April 2022[1]	April 2023[1]
Materials Delivery	March 2021	March 2022	March 2023
Construction Start	July 2021	May 2022	May 2023
In Service	November 2021	November 2022	November 2023
Restoration	September – November 2021	September – November 2022	September – November 2023

[1] If necessary.

6.4.2 Contractor Selection and Award

Pipeline construction work will be performed by pre-qualified contractors who have the experience and resources to safely and efficiently complete the Project. Potential contractors will be identified and engaged early to ensure they have sufficient time to establish beneficial partnerships and joint ventures with local and Indigenous businesses and service providers prior to the competitive bidding process. The contractors will be evaluated, and work awarded, based on predetermined weighted criteria, including such factors as capability, safety, schedule, cost and local resource and Indigenous community affiliation. Contracts will be developed in consideration of the balance between upfront, committed cost, and risk ownership.

Depending on the results of the tendering process, one or more construction contracts will be awarded.

6.4.3 Engineering Detailed Design

The detailed engineering design will be completed using a services contract for the complete design and development of bid and construction packages. Bid packages will be developed throughout 2020 and into 2021. Detailed design activities will be performed prior to each construction phase.

The engineering design activities will be completed by a consulting engineering firm acceptable to PNG.

6.4.4 Procurement and Manufacturing

Long-lead items will be purchased at the appropriate time prior to construction. The materials expected to fall into this category include:

- Mainline pipe and bends (external coating, concrete coating and bare);
- Valves and fittings; and
- Mechanical protection.

6.4.5 Mobilization

Due to the nature of work, the extent and quantity of mobilization efforts will be based on the number of crews required for each discrete scope aspect (i.e. ILI repairs, geohazard repairs, block valve installations) across a given project phase. Site mobilization is expected to start immediately following CPCN approval and to continue through 2023 as required per the Project schedule.

6.4.6 Fabrication

Block valve assemblies will be shop fabricated while mainline cut-out repair sections will be fabricated at lay-down areas near the various project sites. Transportation to the installation sites will be by truck, tracked pipe and equipment carrier, or where vehicle access is not feasible, by helicopter.

6.4.7 Site Installation

The duration of construction at each of the repair or installation sites will vary depending upon a number of factors including access limitations for crews, equipment and materials, weather, effective daily work hours available, and, in the case of repairs, the extent of damage found. The expected construction timeframe for the entire Project is from July 2021 to November 2023.

6.4.8 Land Acquisition

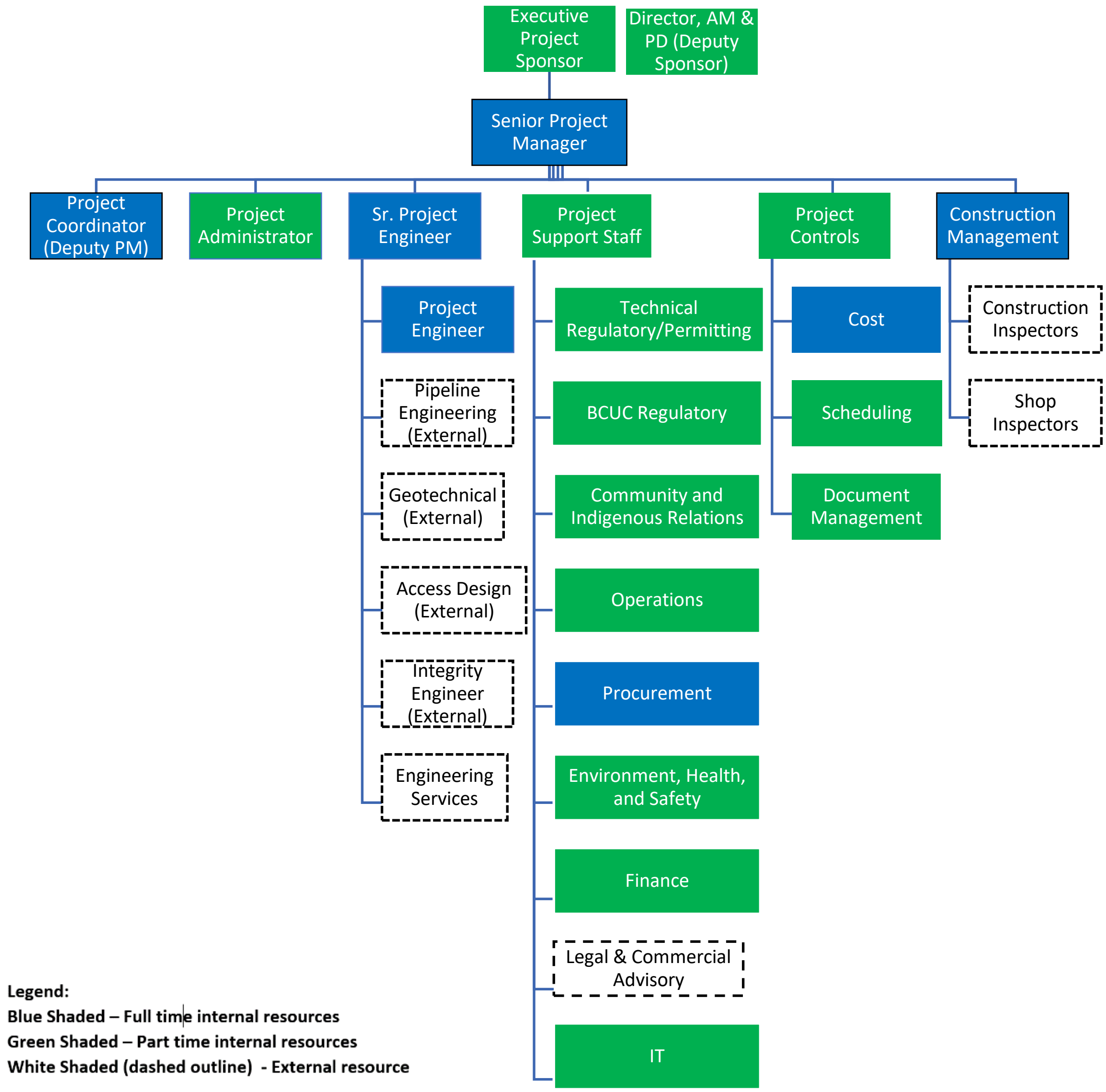
The Project is not anticipated to require any new permanent right of way but will require valve site-related surface rights on existing right of way and temporary construction working space and access rights. PNG will develop a land management plan to assess the requirements and to prioritize the required permitting and agreements. PNG will leverage existing relationships, internal resources, and work with experienced land agents to conduct negotiations and execute agreements as required.

6.5 Project Team and Project Management

Figure 6-3 outlines the anticipated functional organizational chart specific to the management of the Project. The Executive Sponsor of the Project is the Senior Vice President, Operations and Engineering. The core leadership of the Project will be comprised of the Executive Sponsor, the Director of Asset Management & Project Delivery and the Senior Project Manager.

The Project organization will be formally structured into a PMO that will oversee typical functions of the Project. The PMO will ensure the execution of key project activities such as: planning; development; management of resources; management of engineering; reporting; stakeholder and Indigenous relations; human resources; project estimating, cost and schedule reporting and management; procurement; scope control; risk management; environmental, health and safety; and quality management. The team will adhere to a project management and governance structure outlined in a Project Management Plan (PMP) to ensure project objectives are met.

Figure 6-3: Proposed Project Team and Organizational Structure



6.6 Project Impacts

6.6.1 Environmental

Work on the Project will adhere to the requirements of an Environmental Management Plan (EMP). All work will be done in accordance with PNG's Environmental Standard Practice Procedures and project-specific measures as identified by Qualified Environmental

Professionals (QEPs). Project work will be performed in the identified least-risk timing windows as much as possible or with additional prescriptive mitigative measures as required. To mitigate the impact to the environment, key elements of the EMP will include:

- Environmentally sensitive areas will be clearly identified prior to construction. Locations of these areas will be identified to all project staff by mapping, site flagging or discussion during a pre-construction meeting.
- Construction practices will be subject to restriction and additional environmental protocols within environmentally sensitive areas.
- Clearing and grubbing activities will not proceed closer than 50 metres to any watercourse and/or waterbody prior to marking the limits of these areas or as deemed by the contract designs/drawings.
- Clearing or grubbing activities will be conducted to protect vegetation outside of the Project footprint with the exception of danger trees, which will be removed with minimal disturbance to surrounding vegetation.
- The Project area is in a location with numerous stream crossings of the existing PNG right of way. The Project is not expected to require any new stream crossings; however, equipment will need to cross streams in order to gain access to the Project site. Prior to the work commencing, appropriate crossing techniques and associated mitigations will be determined with guidance from environmental professionals. Typical crossing methods include culverts, bridges, or temporary fords.
- All work will be undertaken and completed in such a manner as to prevent the release of silt, sediment or sediment-laden water, or any other deleterious substances into any ditch, watercourse, drainage or environmental sensitive area. Ground disturbance will be minimized in areas adjacent to any watercourse, or environmentally sensitive area.

6.6.2 Cultural

Based on previous archaeological work and ethnographic information, it is expected that the following archaeological site types may be found within the Project area:

- Subsurface and surface scatters of stone artifacts and/or animal remains;

- Shell middens;
- Cultural depressions, including house pits and cache pits;
- Culturally modified trees;
- Fish traps;
- Historic structures (e.g. cabins);
- Trails;
- Rock art; and
- Human burials.

As described further in Section 8.3, PNG engaged Roy Northern Land and Environmental (Roy Northern) to undertake a Preliminary Field Reconnaissance (PFR) and Archaeological Overview Assessment (AOA) for potential archaeological impacts of the Project. Potential archaeological impacts identified will be further assessed by PNG during the Archaeological Impact Assessment (AIA) process. Results from the AIA process will be used to develop site-specific mitigation plans to address any potential impacts associated with project work. PNG will also provide detailed archaeological specifications, including PNG's Chance Find Procedure, to those working on the Project. Where appropriate, PNG will engage Indigenous communities for archaeological work and cultural values preservation monitoring during work in sensitive areas.

6.6.3 Socio-economic

In developing the Project, PNG assessed the overall impact of the Project from a socio-economic perspective and believes that the Project will have positive economic impacts to the region through the creation of employment opportunities related to project construction and the use of local hospitality services.

In planning the project-related work, PNG intends to mitigate the impact to customers by avoiding outages through the use of line pack and LNG, if needed, to provide system support while undertaking repairs. Once the Project is complete, customers will experience improved reliability of natural gas service. Given the remoteness of the Project work, local disruption is expected to be minimal and is not expected to have negative impacts to residents or businesses in the region.

The Project is not expected to require any re-routing with all work being done in the existing right of way (thus minimizing impacts on surrounding areas). Some laydown areas will be required for materials; those areas will be selected to minimize environmental and cultural impacts and will be restored when project work is completed.

PNG believes there will be positive employment impacts from the Project and is committed to providing employment and training opportunities to local businesses and communities. Pipeline construction work will be performed by prequalified contractors who have the experience and resources to safely and efficiently complete the required activities. Contractors will be selected based on a predetermined weighted criteria that includes consideration of local Indigenous community involvement and the offering of work opportunities and partnerships to qualified Indigenous workers and businesses. Potential contractors will be identified and engaged early to ensure any partnerships, joint ventures, or other business arrangements can be established prior to the competitive bidding process.

On an overall basis, PNG anticipates that the Project will have positive socio-economic impacts for the areas in the vicinity of the Project, as well as the Province's Peace region. Employment opportunities related to the Project are expected to provide a number of direct and spin off socio-economic benefits to the region. PNG will continuously monitor project impacts throughout construction and will seek to mitigate any potential negative impacts that may arise.

6.6.4 Safety and Security

In line with PNG's regular course of business, maintaining safe and secure operations on the Project will be a top priority, with related results being used as one of many measures of overall project success. Ensuring the safety and security of the public, PNG personnel, contractors, natural gas service, the environment, equipment, materials, and property will be of paramount consideration during project planning, resourcing, and execution.

Safety and security hazard and risk considerations on the Project will be those typical of pipeline construction, with the added elements associated with rugged remote terrain and inclement weather. Equipment operation, excavation safety, materials handling, lifting, hoisting, and rigging, welding, cutting and grinding, pressure testing, working on uneven terrain, geohazard exposure, working near water, danger trees, and off-road, barge, and helicopter transport will be pipeline construction specific safety focal points. Access and egress complexities, communications reliability, and response capability for emergency responders will be considerations that arise given project remoteness.

All works will be subject to stringent project-specific plans focused on health, safety, security, environment, and quality. This will be inclusive of PNG SPIs and Contractor Management Program policies, procedures, and due diligence documentation, as well as supplementary Health, Safety, Security, Environment & Quality (HSSEQ) programs and plans furnished by contractors and built out by the PNG PMO. The PMO will have both full-time and part-time project and construction management resources and focused HSSEQ management, inclusive of field resources overseeing site execution activities.

Security hazard and risk on the Project are considered to be relatively low given the general lack of work site accessibility. Theft, sabotage, vandalism, and uncontrolled public access to an industrial work site are aspects to be considered and controlled.

While the large majority of the work is highly remote and with limited to no direct land-based access, any existing or developed access points to the project-related portions of the PNG right of way and temporary work spaces will have adequate controls in place. This may include a combination of entry point security personnel and roving inspection. Remote locations with active work sites, including equipment and materials laydowns and storage areas, will be monitored at regular frequencies. Security measures have been identified as an opportunity for local and Indigenous employment.

A more complete list of safety and security related hazards and risks will be developed by the PNG PMO, construction contractors and third-party support service providers as part of detailed work planning.

6.7 Permits Required

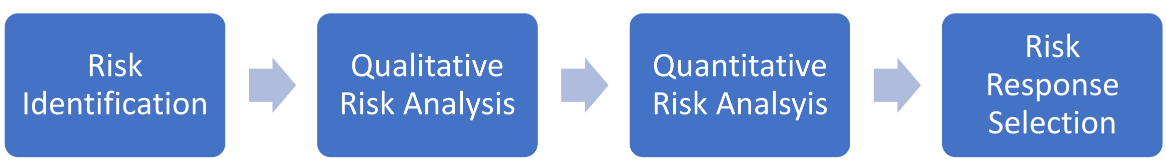
High-pressure pipeline segments operating in British Columbia at pressures greater than 700 kPa are regulated by the BC OGC under the *Oil and Gas Activities Act*. The pipeline segment between Salvus and Galloway that is the subject of this Application is not trans-boundary or trans-provincial and is therefore under the regulatory authority of the BC OGC. More generally, the following permits are expected to be required for the Project:

- BCUC
  - Certificate of Public Convenience and Necessity
- BC OGC
  - Notice of Intent (Replacement in Kind)
  - Section 11 Approval for Changes In and About a Stream
  - License of Occupation
  - Master License to Cut
- DFO
  - *Federal Fisheries Act* Authorization
- Heritage Conservation Act
  - 12.2 Heritage investigation Permit
  - Site Alteration Permit
- BC Parks
  - BC Parks Use Permit for works within the Khyex Conservancy

6.8 Project Risks

In general, PNG's risk analysis for the Project was as per the process illustrated in Figure 6-4.

Figure 6-4: Project Risk Review Process



6.8.1 Risk Identification and Qualitative Analysis

A risk register was created through a series of workshops undertaken in 2020 where all project risks, probabilities, impacts, potential mitigations, and post-mitigation residual risks were identified and examined in association with eight identified risk categories: Stakeholder; Environment; Land; Regulatory; Construction; Procurement; Engineering; and Project Management. The Risk Registry created for the Project is included with this Application as confidential Appendix M. Table 6-7 that follows provides a summary of major identified project risks as taken from the Risk Registry.

Risk registers from similar past projects, lessons learned, and interviews with people with historical working knowledge in the area were also examined as part of the project-specific risk identification activities. For reference, PNG's risk matrix has been incorporated into the Risk Registry that is appended as confidential Appendix M.

Table 6-7: Project Risk Summary

Item	Risk Title	Risk Description	Mitigation Strategy
1	Unable to identify and engage Indigenous communities	Due to complexity of Indigenous communities involved, unable to engage all Indigenous communities, leading to delays in permit approvals.	▪ Engage Indigenous communities early in FEED to identify stakeholder concerns. ▪ Utilize experienced land and community agents to identify and engage all stakeholders prior to permit submission.
2	Stakeholder demands are not achievable	Stakeholder demands may be in excess of available project budget and or schedule constraints.	▪ Engage stakeholders early in FEED to identify stakeholder concerns. ▪ Conduct cost-benefit analysis of solutions and decisions.
3	Unable to acquire temporary work space (TWS) beyond existing permit in Khyex Conservancy	Unable to acquire TWS and/or permanent right of way for proposed work/reroutes resulting in reroute and further negotiations.	▪ Engage BC Parks early. ▪ Adapt construction plans to what is accepted in permit. ▪ Reduce or eliminate TWS in the conservancy.
4	Unable to achieve required depth of cover	Unknown as to whether rock blasting for the ditch can be managed, and obtaining desired design depth may not be possible or require rework.	▪ Terrain mapping performed in FEED. ▪ Perform as much field reconnaissance as possible in high risk areas prior to construction to determine if any indications of bedrock. ▪ Follow company blasting specifications. ▪ Rock hammering may be used as last resort in short sections. ▪ Assume high percentage of rock in planning and estimating. ▪ Plan for other mitigations other than deeper cover or accept higher risk.
5	Access difficulties during integrity work	Challenges due to remote locations of existing pipeline, integrity work to be performed on the existing system may require high cost (helicopter mobilization or access road building).	▪ Capital cost estimate to include contingency for access challenges. ▪ Develop a project access plan.

Item	Risk Title	Risk Description	Mitigation Strategy
6	Additional depth of cover (DOC) as designed not achievable	DOC may not be achievable because of site conditions (bed rock, type of soil, etc.) or will take longer timeframe to achieve DOC.	▪ Confirm DOC requirements. ▪ Consider risk vs. reward for costs of blasting deeper on untravelled surfaces. ▪ Have contractor review sites as soon as possible and potentially obtain geotechnical investigations.
7	Geotechnical hazard event	Risk of a geohazard event (rock fall, debris flow, etc.) endangers worker safety.	▪ Review forecasted and recent/current precipitation and ground conditions. ▪ As part of geohazard management plan, geotechnical engineer on site monitoring conditions during construction. ▪ Include in contractor safety program.
8	Lack of understanding of tolerance for system outages	Lack of definition regarding the tolerance for system downtime could result in insufficient time for tie-ins.	▪ Perform gas conservation studies and plan outages with PNG Operations to ensure outage times are sufficient. ▪ Ensure the construction execution plan matches outage plan.
9	Regulatory approval delay – BC OGC	Due to variable approval window of BC OGC, there is a threat that permit approvals are delayed which could result in schedule slippage.	▪ Initiate communications, engagement, and consultation with BC OGC, project stakeholders, and Indigenous communities early to advise them of the plan prior to submitting applications. ▪ Submit application early and utilize experienced regulatory consultant to ensure application is complete to reduce the number of information requests from regulator. ▪ Optimize the number of applications based on project scope. ▪ Clarify with archaeological specialist how overarching archaeological permit application affects BC OGC applications.

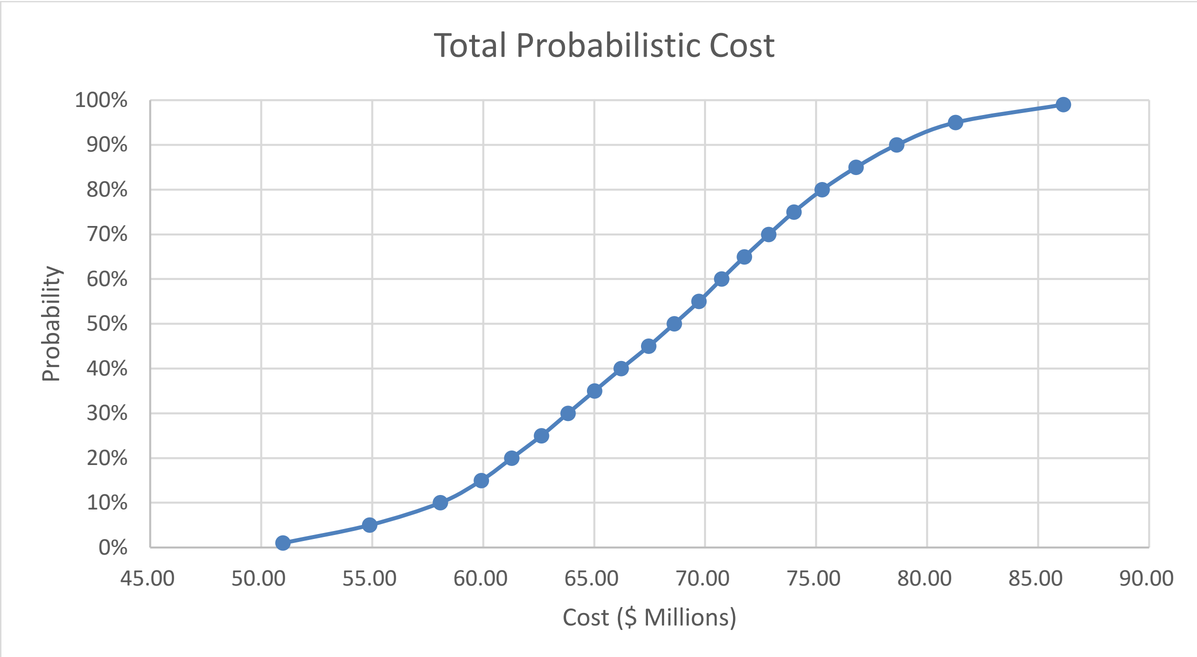
Item	Risk Title	Risk Description	Mitigation Strategy
9	Regulatory approval delay – BCUC	Given the nature and scope of the Project, there is a risk that CPCN approval is delayed which could result in schedule slippage.	▪ Initiate communications, engagement, and consultation with BCUC and project stakeholders early to advise them of the plan. ▪ Submit application early and utilize experienced subject matter experts to ensure application is complete to reduce the number of information requests.
10	Archeological permit delays	Archeological permit not received in time for planned construction.	▪ Early engagement with affected Indigenous communities. ▪ Apply for archaeological permit as early as possible. ▪ Include enough buffer area to avoid amendments or changes to application. ▪ Schedule construction around the most likely permit receipt time. ▪ Practice avoidance if possible, utilize existing right of way as much as possible. ▪ Chance Find and Cultural Resource Protection Plan.
11	DFO permit delays	DFO permit not received in time for planned construction.	▪ Apply for DFO permit early in the process. ▪ Discuss with environmental on permitting plan on request for review (30 days) vs. authorization process (60 and 90 days).
12	Disturbance to fisheries	Pipeline crosses multiple fish bearing watercourses with possible negative impact due to construction activities.	▪ Select suitable crossing methods and site practices as guided by QEPs, Construction Environmental Management Plan (CEMP), and industry best practice. ▪ Schedule outside high-risk windows based on environmental assessment.

Item	Risk Title	Risk Description	Mitigation Strategy
13	Disturbance to species at risk	Pipeline crosses multiple water crossings with a potential to interact with marine species at risk, dependent on watercourse crossing method.	▪ Select suitable crossing methods based on environmental assessment for pipeline and equipment (aerial or trenchless). ▪ Project-specific CEMP and PNG Environmental Protection Plan (EPP). ▪ Construct in isolation of flow and fish and amphibians whenever possible. ▪ Strong restrictions to work in certain areas.
14	Increased erosion due to vegetation removal	Clearing of right of way may cause erosion of exposed surfaces resulting in undesirable water and sediment runoff to adjacent lands and watercourse.	▪ Erosion control with reclamation and drainage control by contractor. ▪ Contractor to follow requirements of EPP. ▪ Rationalize areas of manual vs. machine brushing. ▪ Write a prescription for riparian management during clearing. ▪ Environmental inspection and monitoring during construction.
15	Unexpected presence of fish	Fish studies to identify fish in areas where they were not expected.	▪ Perform fish studies as early as possible. ▪ Assume fish are everywhere. ▪ Perform gradient analysis.
16	Park Use Permit (PUP) not defined or received	PUP in Khyex Conservancy does not cover area needed for Project and PUP amendment not received in time for planned construction.	▪ Engage BC Parks and BC OGC early in 2020 and perform permitting as early as possible.

6.8.2 Quantitative Cost Risk Analysis

A quantitative cost risk analysis was conducted for the selected project alternative following the qualitative analysis for the four identified project alternatives initially considered. Cost estimate uncertainty ranges, including maximum, likely and minimum (maximum: 90% confidence; minimum: 10% confidence) were collected for each of the components in the cost estimate during a series of risk workshops held in the first quarter of 2020. A model was created using @Risk software to conduct a stochastic (Monte Carlo) analysis. The cost estimate ranges were modelled as a Trigen distribution to reflect the 0% and 99% confidence ranges. Figure 6-5 illustrates the probabilistic curve for the selected alternative. Refer to the Monte Carlo analysis included in confidential Appendix L.

Figure 6-5: Total Probabilistic Project Cost



6.9 Project Description Conclusion

The preceding discussion identifies and describes in detail key elements of the proposed Project. PNG has undertaken a rigorous multi-year analysis and the appropriate underlying developmental work to support this Application. Further, PNG has provided detailed appendices containing comprehensive information with respect to engineering, cost estimating, schedule, permitting, project impacts, project management and other necessary resources, most of which have been informed and validated by subject matter experts and third-party reports. Lastly, the Application also demonstrates that an appropriate level of work has been completed to date on risk identification and associated mitigation plans should the identified risks materialize.

7 Project Costs, Accounting Treatment and Rate Impacts

7.1 Introduction

As described in Section 6.3, PNG has developed the Project cost estimate to the AACE International Class 3 definition level. The cost estimate includes PST on the materials and as the Project spans multiple years, reflects inflation of 2.68% annually, which as noted previously is consistent with the Infrastructure Construction Price Index. The Project cost estimate is developed at a P85 confidence level and includes a 20% contingency and a 5% management reserve. The Project cost is forecast at $84.8 million in as-spent dollars ($80.6 million in 2020 dollars). Table 7-1 that follows replicates Table 6-4 provided in Section 6.3 of this Application and provides a summary of the Project capital budget.

Table 7-1: Project Cost Summary

Cost Element *($ millions)*	**As-spent $**	**2020 $**
Indirect Costs:		
Engineering and Project Development	$ 1.25	$ 1.19
Permitting (Lands, Environmental, Archaeological)	2.02	1.92
S2G Project and Construction Management	8.55	8.13
	11.82	11.24
Direct Costs:		
Procurement	0.90	0.86
Construction (Equipment and Labor)	54.55	51.90
	55.45	52.75
Subtotal	67.27	63.99
Contingency (20%)	13.45	12.80
Subtotal including Contingency	80.73	76.79
Management Reserve (5%)	4.04	3.84
Total Capital Cost	**$ 84.76**	**$ 80.63**

PNG has undertaken a financial analysis of the Project over a 65-year period. Table 7-2 that follows provides a summary of the initial 7 years of the analysis. The full details of the financial analysis are presented in Appendix N, submitted on a confidential basis.

Table 7-2: Summary Financial Analysis

Salvus to Galloway - Alternative 1 - Base Case for 65 years	2021E	2022E	2023E	2024E	2025E	2026E	2027E
Cost of Service							
Depreciation of utility plant	-	382,194	1,061,870	1,304,009	1,304,009	1,304,009	1,304,009
Tax on depreciation	-	141,359	392,747	482,305	482,305	482,305	482,305
Amortization of Net Salvage	-	76,434	212,360	260,785	260,785	260,785	260,785
Tax on Amortization of Net Salvage	-	28,270	78,544	96,455	96,455	96,455	96,455
Interest on utility plant	192,135	797,103	1,399,432	1,518,520	1,489,629	1,460,738	1,431,847
Return on equity on utility plant	548,717	2,063,117	3,348,294	3,633,226	3,564,102	3,494,977	3,425,852
Tax on return on equity	202,950	763,070	1,238,410	1,343,796	1,318,229	1,292,663	1,267,096
CCA Tax Reduction	(1,102,584)	(2,607,633)	(2,443,973)	(2,015,612)	(1,854,366)	(1,706,020)	(1,569,541)
Property Tax	-	-	-	-	-	-	-
Total Ratebase Items	(158,783)	1,643,914	5,287,684	6,623,483	6,661,147	6,685,911	6,698,807
Operating Costs		-	-	-	-	-	-
TOTAL COST OF SERVICE	**(158,783)**	**1,643,914**	**5,287,684**	**6,623,483**	**6,661,147**	**6,685,911**	**6,698,807**
Utility Plant - Total							
Balance (bop)	**0**	**24,842,865**	**69,022,283**	**84,761,468**	**84,761,468**	**84,761,468**	**84,761,468**
Utility Additions							
461 - Land rights	1,839	3,451	1,203	-	-	-	-
465 - Transmission mains	24,841,027	44,175,967	15,737,981	-	-	-	-
Balance (eop)	**24,842,865**	**69,022,283**	**84,761,468**	**84,761,468**	**84,761,468**	**84,761,468**	**84,761,468**
Add: Acc. Depreciation	-	(382,194)	(1,444,065)	(2,748,074)	(4,052,083)	(5,356,092)	(6,660,102)
Add: Acc. Amortization of Net Salvage Value	-	(76,434)	(288,794)	(549,578)	(810,363)	(1,071,148)	(1,331,932)
Less: Reduction of Net Salvage Value	-	-	-	-	-	-	-
Average Rate Base	12,421,433	46,703,260	75,796,132	82,246,213	80,681,419	79,116,625	77,551,831
Ending Net Rate Base	19,874,660	68,563,655	83,028,610	81,463,816	79,899,022	78,334,228	76,769,434
465 - Transmission Mains - rate							
Acc. Amortization of Net Salvage Value - bop	-	-	76,434	288,794	549,578	810,363	1,071,148
Amortization of Net Salvage	-	76,434	212,360	260,785	260,785	260,785	260,785
Acc. Amortization of Net Salvage Value - eop	-	76,434	288,794	549,578	810,363	1,071,148	1,331,932
Assumptions:							
Annual Inflation	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Annual Infrastructure Construction Price Escalation	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%
Infrastructure Construction Price Escalation (2020 = base year)	102.7%	105.4%	108.3%	111.2%	114.1%	117.2%	120.4%
2021 Application - Cost of Service	42,248,182	42,248,182	42,248,182	42,248,182	42,248,182	42,248,182	42,248,182
Year-over-year Change		4.3%	8.6%	3.2%	0.1%	0.1%	0.0%

7.2 Accounting Treatment

7.2.1 Treatment of Capital Costs

The Project proposes to undertake remediation along the 80 kilometre Salvus to Galloway pipeline. Consequently, the Project will consist of multiple discrete undertakings on specific pipeline segments which are scheduled to be placed into service as each undertaking is completed. PNG will transfer the associated capital costs of each asset or undertaking that has been placed into service into the appropriate plant asset account and include the amounts in PNG's rate base for the year the asset is placed into service, in accordance with PNG's historical practice for capital projects undertaken and completed within a calendar year. Also, in accordance with PNG's established practice, depreciation of project costs will commence in the year following the year the asset is placed into service.

PNG anticipates that the majority of the capital will be placed into the BCUC 465 Transmission Mains account with a small remaining amount of capital in the BCUC 461 Land Rights account. The tables that follow illustrate the anticipated classification and timing of project capital expenditures, with Table 7-3 illustrating the spending profile on an as-spent, inflated basis and Table 7-4 illustrating the spending profile for uninflated costs denominated in 2020 dollars.

Table 7-3: Project Completion and In-service (Project Years 2021-2023) – As-spent $

(As-spent $)	**Estimated Project Completion Dates**			
Asset Class	**2021**	**2022**	**2023**	**Total**
Land Rights (BCUC 461)	1,839	3,451	1,203	**6,493**
Transmission Mains (BCUC 465)	24,841,027	44,175,968	15,737,982	**84,754,976**
Total	**24,842,866**	**44,179,418**	**15,739,185**	**84,761,469**
% of Total Project	29%	52%	19%	**100%**

Table 7-4: Project Completion and In-Service (Project Years (2021-2023) – 2020 $

(in 2020 $)	**Estimated Project Completion Dates**			
Asset Class	**2021**	**2022**	**2023**	**Total**
Land Rights (BCUC 461)	1,791	3,273	1,112	**6,175**
Transmission Mains (BCUC 465)	24,192,192	41,898,399	14,536,708	**80,627,300**
Total	**24,193,983**	**41,901,672**	**14,537,820**	**80,633,475**
% of Total Project	30%	52%	18%	**100%**

7.2.2 Net Salvage

The provision for net salvage related to project costs will be recorded to PNG's existing Net Salvage Deferral Account in accordance with the accounting treatment established as per

BCUC Orders G-151-18 and G-221-18. The net salvage provision for the Project is forecast to be approximately $17.0 million (as-spent) as calculated by applying the 20% net salvage rate (BCUC Account 465 Transmission mains) on $84.8 million. The minimal amount of capital for Land Rights has no applicable net salvage rate.

7.2.3 AFUDC on Work in Progress

Given the nature of the Project, with multiple discrete undertakings, PNG expects that the majority of the Project capital will be placed into service in the year that the capital is spent. However, if capital expenditures are carried over into a future period, in accordance with PNG's established practice, the expenditures will attract an Allowance for Funds Used During Construction (AFUDC) at PNG's after-tax weighted average cost of capital.

When project capital costs are placed into service and transferred to rate base, PNG will record a return on capital based on an average annual rate base at PNG's approved return on equity. The average rate base will also incur interest expense at PNG's cost of debt.

7.3 Rate Impacts

As described in Section 4.3, in June 2020 PNG initiated the RECAP auction to assess the demand for, and value of, capacity on the Western Transmission Gas Line. As a result of the RECAP auction, two proponents entered into contracts for a total of 65 MMSCFD. While PNG has executed Transportation Service Agreements (TSAs) to support 65 MMSCFD of new contract demand, PNG recognizes that there is inherent risk associated with development projects such as those underlying the RECAP demand, including the requirement to obtain BCUC approval of CPCNs for incremental capital expenditures as well as other regulatory approvals.

Based on the foregoing, and given the materiality of the potential revenues associated with these incremental RECAP volumes, PNG has given consideration to the expected impact on average delivery rates of the Project, both alone and in combination with potential incremental demand from RECAP, and has provided the following three rate-impact scenarios for the Project:

1) Rate impacts associated with the Project excluding RECAP costs and revenues;

2) Rate impacts of the Project including all costs and revenues related to the entire 65 MMSCFD RECAP volumes; and

3) Rate impacts of the Project including the costs and revenues associated with the smaller of the two RECAP proponents' load of 30 MMSCFD.

7.3.1 Rate Impact of Project Alone

On a standalone basis, PNG anticipates that the Project will increase the total cost of service to PNG-West customers by approximately 16% once fully implemented. This result and the anticipated average rate impacts for residential customers is illustrated in Tables 7-5 and 7-6, below. As shown, PNG's residential customers would see a delivery rate increase of approximately $2.23/GJ relative to rates proposed for 2021 in PNG's 2020-2021 Revenue Requirements Application, which is equivalent to an annual bill increase of $152 or 11.2%.

Table 7-5: Rate Impact of the Project

	2021E	2022E	2023E	2024E	2025E	2026E	2027E
Cost of Service ($)							
2021 Revenue Requirements Application	42,248,182	42,248,182	42,248,182	42,248,182	42,248,182	42,248,182	42,248,182
Salvus to Galloway	(158,783)	1,643,914	5,287,684	6,623,484	6,661,147	6,685,911	6,698,807
Total	42,089,399	43,892,096	47,535,866	48,871,666	48,909,329	48,934,093	48,946,989
Revenue Deficiency/(Sufficiency) ($)							
Salvus to Galloway Project	(158,783)	1,643,914	5,287,684	6,623,484	6,661,147	6,685,911	6,698,807
CAGR Relative to 2021 Rates		4.3%	6.3%	5.1%	3.8%	3.1%	2.5%
Year over Year Rate Increase	**-0.4%**	**4.3%**	**8.3%**	**2.8%**	**0.1%**	**0.1%**	**0.0%**
Residential delivery rates ($/GJ)	12.68	13.23	14.32	14.73	14.74	14.74	14.75

Table 7-6: Summary of Cost and Rate Impact

Cost Impacts	
Capital Cost ($2020)	$80,633,475
Average Annual Impact on Cost of Service[1]	$6,442,899
Average Rate Impacts	
Incremental cost of service (per GJ)[1]	$2.23
Residential usage/year (GJ)[2]	68.3
Impact to annual residential bill	$152
Average change to 2021[2] residential bill	11.2%

[1] Over first 20 years of service

[2] Based on 2021 as per 2020-2021 Revenue Requirements Application

7.3.2 Rate Impact of Project plus 65 MMSCFD RECAP Scenario

Under a scenario where the Project is completed and 65 MMSCFD of RECAP demand is also realized, PNG's cost of service will initially increase relative to the forecast 2021 cost of service (as per the PNG 2020 - 2021 Revenue Requirements Application). However, by 2023 PNG forecasts that the margin generated from the incremental 65 MMSCFD RECAP demand will more than offset the incremental cost of service. Further, PNG expects the incremental margin from the incremental 65 MMSCFD to more than offset the entire cost of service impact of the Project in the average initial 20-year term of the RECAP TSAs.

As illustrated in Table 7-7, in the absence of any other cost of service adjustments or changes in revenues, PNG's analysis indicates that with both the Project and the realization of 65 MMSCFD in RECAP volumes residential delivery rates will decline by approximately a cumulative 44% from 2021 and 2025.

PNG will plan for its future revenue requirement applications to include rate impact mitigation proposals that reflect PNG's cost of service and revenues at the time those applications are filed, therefore future revenue requirements applications will not reflect the reductions in rates illustrated in Table 7-7. This is discussed in additional detail in Section 7.3.4.

Table 7-7: Rate Impact of the Project plus RECAP Volumes of 65 MMSCFD

	2021E	2022E	2023E	2024E	2025E	2026E	2027E
RECAP Revenue	**-**	**852,506**	**12,343,726**	**24,370,404**	**30,056,127**	**29,838,886**	**29,939,060**
Cost of Service							
2021 Revenue Requirements Application	42,248,182	42,248,182	42,248,182	42,248,182	42,248,182	42,248,182	42,248,182
Salvus to Galloway	(158,783)	1,643,914	5,287,684	6,623,484	6,661,147	6,685,911	6,698,807
RECAP	-	33,766	1,084,999	946,820	4,664,359	4,056,342	4,312,079
Total	42,089,399	43,925,863	48,620,865	49,818,486	53,573,688	52,990,435	53,259,068
Revenue Deficiency/(Sufficiency)							
Salvus to Galloway Project	(158,783)	1,643,914	5,287,684	6,623,484	6,661,147	6,685,911	6,698,807
RECAP Margin	-	(818,740)	(11,258,727)	(23,423,584)	(25,391,768)	(25,782,544)	(25,626,981)
Total	(158,783)	825,174	(5,971,043)	(16,800,100)	(18,730,621)	(19,096,633)	(18,928,174)
CAGR Relative to 2021 Rates		2.0%	-7.3%	-15.5%	-13.6%	-11.3%	-9.4%
Year over Year Rate Increase		**2.0%**	**-15.8%**	**-29.9%**	**-7.6%**	**-1.6%**	**0.7%**
Residential delivery rates ($/GJ)	12.68	12.93	10.89	7.64	7.06	6.95	7.00

7.3.3 Rate Impact of Project plus 30 MMSCFD RECAP Scenario

Similar to the 65 MMSCFD RECAP scenario, under a scenario where the Project is completed and 30 MMSCFD of RECAP demand is realized, PNG's cost of service will initially increase relative to the forecast 2021 cost of service. However, by 2023 PNG forecasts that the margin generated from the incremental 30 MMSCFD RECAP demand will more than offset the incremental cost of service. Further, PNG expects the incremental margin from the incremental 30 MMSCFD to more than offset the entire cost of service impact of the Project in the average initial 20-year term of the RECAP TSAs.

As illustrated in Table 7-8, in the absence of any other cost of service adjustments or changes in revenues, PNG's analysis indicates that with both the Project and the realization of 30 MMSCFD in RECAP volumes residential delivery rates will decline by approximately a cumulative 12% from 2021 and 2025.

Once again, PNG notes that its future revenue requirement applications will include rate impact mitigation proposals that reflect PNG's cost of service and revenues at the time those applications are filed and will <u>not</u> reflect the reductions in rates illustrated in Table 7-8. As previously noted, this is discussed in further detail in Section 7.3.4.

Table 7-8: Rate Impact of the Project plus RECAP Volumes of 30 MMSCFD

	2021E	2022E	2023E	2024E	2025E	2026E	2027E
RECAP Revenue	-	-	2,113,652	10,568,258	12,681,910	12,983,074	13,167,848
Cost of Service							
2021 Revenue Requirements Application	42,248,182	42,355,682	42,031,611	42,358,967	42,248,182	42,248,182	42,248,182
Salvus to Galloway	(158,783)	1,643,914	5,287,684	6,623,484	6,661,147	6,685,911	6,698,807
RECAP	-	-	(181,957)	664,826	888,763	905,331	929,570
Total	42,089,399	43,999,596	47,137,338	49,647,276	49,798,092	49,839,424	49,876,560
Revenue Deficiency/(Sufficiency)							
Salvus to Galloway Project	(158,783)	1,643,914	5,287,684	6,623,484	6,661,147	6,685,911	6,698,807
RECAP Margin	-	-	(2,295,609)	(9,903,433)	(11,793,147)	(12,077,743)	(12,238,277)
Total	(158,783)	1,643,914	2,992,075	(3,279,949)	(5,132,000)	(5,391,832)	(5,539,470)
CAGR Relative to 2021 Rates		3.9%	3.5%	-2.7%	-3.2%	-2.7%	-2.3%
Year over Year Rate Increase		**3.9%**	**3.1%**	**-13.9%**	**-4.8%**	**-0.7%**	**-0.4%**
Residential delivery rates ($/GJ)	12.68	13.18	13.58	11.70	11.14	11.06	11.02

7.3.4 Future Rate Impact Mitigation

A primary objective of PNG is to minimize significant fluctuations in rates and to provide customers with rate stability. While not the subject of this Application, PNG provides the following high level description of opportunities to smooth the rate impacts that will arise as a result of the combination of significant project capital costs and the potential for incremental margin from RECAP revenues. As events unfold and certainty is obtained, PNG will refine strategies and make an application in future revenue requirements submissions for their approval.

7.3.4.1 Project Development Period / Pre-RECAP Revenues

PNG is mindful of the rate impacts of project costs in the development period and may apply to the BCUC for approval of a new deferral account, if considered necessary, to defer some or all of the incremental cost of service associated with the Project in its initial years to mitigate rate volatility. PNG would seek amortization of this new deferral account in future revenue requirements applications following the realization of RECAP volumes and the associated revenues.

In addition, prior to commencement of RECAP customer projects and receipt of RECAP revenues, PNG may seek approval of a rate smoothing deferral account similar to those approved by the BCUC in past revenue requirements applications should such a mechanism be necessary to help mitigate volatility in customer rates.

7.3.4.2 Post-RECAP Revenues

PNG notes that in Order G-35-20, the decision on PNG's RECAP application, the BCUC approved the establishment of the Large Volume Industrial Deferral Account (LVIDA) proposed by PNG to capture a portion of the revenues from shippers contracting for RECAP capacity. PNG's stated intent for the LVIDA is to: manage the inherent uncertainty related to the RECAP outcome; avoid volatility in customer rates by systematically managing expected rate decreases; have the ability to avoid rate shock as contracts eventually expire; and provide flexibility to manage any unforeseen circumstances that may arise in the future. The BCUC agreed with PNG that the RECAP process has the potential for future rate volatility due to the timing of associated revenues and costs and therefore the BCUC approved establishment of the LVIDA as a mechanism to benefit ratepayers by way of rate smoothing, mitigating future rate volatility and the potential for rate shock.

PNG is also mindful that the rate impact of project costs extends beyond the initial terms established under the TSAs entered into as part of the RECAP. Given the potential for volatility in customer rates arising from project costs, initial RECAP revenues, and RECAP revenues beyond the initial TSA terms, PNG anticipates seeking BCUC approval in future revenue requirements applications to amortize the LVIDA as a mechanism to provide rate stability.

7.3.4.3 Mitigation of Rate Volatility

In Table 7-9 and Table 7-10 that follow, PNG provides illustrative examples of how the identified deferral accounts may be utilized to manage rate volatility under various RECAP scenarios. PNG reiterates that the information presented in these tables is illustrative in nature and that the nature of deferral accounts and their additions and amortization will be addressed in future applications to the BCUC.

Project plus RECAP Volumes of 65 MMSCFD

In Table 7-9, PNG illustrates a scenario where the Project is completed and 65 MMSCFD of RECAP volume is secured. For the purpose of this example, PNG has chosen a constant annual rate increase of 1.8%, which is slightly below PNG's expected inflation rate of 2.0%.

For this scenario, PNG illustrates the use of the rate smoothing mechanism to mitigate rate impacts during the three-year period that project costs are incurred and RECAP demand ramps up. This example also illustrates that excess RECAP revenue above the RECAP cost of service will be captured in the LVIDA for future amortization, to provide flexibility in avoiding rate shock if and when the RECAP contracts expire, and to mitigate rate impacts of unforeseen circumstances in the future. This scenario does not anticipate use of a new project-specific deferral account during the development period. PNG notes that the use of all three mechanisms may be necessary to manage rate changes over time.

PNG further notes that other factors will have an impact on customer rates in the near future, including the full amortization of the LNG Option Fee deferral account,[25] an increase in provision from the continued phase-in of negative salvage and the expiry of the LDS#2 contract.

Table 7-9: Mitigation of Rate Impacts: Project plus RECAP Volumes of 65 MMSCFD

	2021E	2022E	2023E	2024E	2025E	2026E	2027E
Revenue Deficiency/(Sufficiency)							
Project Costs	(158,783)	1,643,914	5,287,684	6,623,484	6,661,147	6,685,911	6,698,807
RECAP Margin	-	(818,740)	(11,258,727)	(23,423,584)	(25,391,768)	(25,782,544)	(25,626,981)
Rate Smoothing Deferral	-	(1,100,000)	(3,991,803)	5,075,902	-	-	-
Project-specific Deferral	-	-	-	-	-	-	-
Less Additions to LVIDA		818,740	11,258,727	14,200,000	22,051,410	23,260,153	23,980,521
Total	(158,783)	543,914	1,295,880	2,475,802	3,320,789	4,163,520	5,052,348
CAGR Relative to 2021 Rates		1.7%	1.7%	1.7%	1.7%	1.7%	1.7%
Year over Year Rate Increase	**-0.4%**	**1.7%**	**1.7%**	**1.7%**	**1.8%**	**1.8%**	**1.8%**
Residential delivery rates ($/GJ)	12.68	12.89	12.90	12.90	12.91	12.91	12.91
LVIDA Balance (including WACD Interest)		**818,740**	**12,101,138**	**26,507,221**	**49,224,827**	**73,791,755**	**99,894,956**

[25] The LNG Partners Option Fee Payment deferral account is an interest-bearing deferral account that was initially established under BCUC Order G-174-08 to track the receipt of option fee payments received from customers to secure future transportation capacity on PNG Western Transmission Gas Line.

Project plus RECAP Volumes of 30 MMSCFD

In Table 7-10, PNG illustrates a scenario where the Project is completed and 30 MMSCFD of RECAP volume is secured. Once again, PNG has chosen a constant annual rate increase of 1.8% for this scenario.

In this scenario, PNG illustrates the use of the rate smoothing mechanism to mitigate rate impacts during the three-year period that project costs are incurred and RECAP demand ramps up. This example also illustrates that excess RECAP revenue above the RECAP cost of service will be captured in the LVIDA for future amortization, to provide flexibility in avoiding rate shock if and when the RECAP contracts expire, and to mitigate rate impacts of unforeseen circumstances in the future. In addition, this scenario also illustrates the use of a new project-specific deferral account during the development period. PNG notes that the use of all three mechanisms may not be necessary to manage rate changes over time.

PNG reiterates that there are other factors that will have an impact on customer rates in the near future, including the full amortization of the LNG Option Fee deferral account, an increase in provision from the phase-in of negative salvage and the expiry of the LDS#2 contract.

Table 7-10: Mitigation of Rate Impacts: Project plus RECAP Volumes of 30 MMSCFD

	2021E	2022E	2023E	2024E	2025E	2026E	2027E
Revenue Deficiency/(Sufficiency)							
Project Costs	(158,783)	1,643,914	5,287,684	6,623,484	$6,661,147	$6,685,911	$6,698,807
RECAP Margin	-	-	(2,295,609)	(9,903,433)	(11,793,147)	(12,077,743)	(12,238,277)
Rate Smoothing Deferral	-	107,500	(216,571)	110,785	-	-	-
Project-specific Deferral	-	(1,150,740)	(3,701,379)	(4,636,439)	(4,662,803)	3,247,192	3,249,563
Less Additions to LVIDA		-	2,295,609	10,000,000	12,754,430	6,502,766	7,513,522
Total	(158,783)	600,674	1,369,735	2,194,398	2,959,627	4,358,127	5,223,615
CAGR Relative to 2021 Rates		1.8%	1.8%	1.8%	1.8%	1.8%	1.8%
Year over Year Rate Increase	**-0.4%**	**1.8%**	**1.8%**	**1.8%**	**1.8%**	**1.8%**	**1.8%**
Residential delivery rates ($/GJ)	12.68	12.86	13.10	13.33	13.57	13.82	14.07
LVIDA Balance (including WACD interest)			**2,295,609**	**12,335,220**	**25,342,108**	**32,495,006**	**41,006,521**

PNG cautions that the results presented in Table 7-9 and Table 7-10 are for illustrative purposes only. PNG will bring forward a comprehensive strategy to provide rate stability in future revenue requirements applications which will reflect all cost of service items and revenues at the time of submission.

8 Environment and Archaeology

8.1 Introduction

In developing the Project, PNG has investigated and assessed the potential for environmental and archaeological impacts that may arise from the Project work and has concluded that the Project is expected to have minimal irreversible or deleterious environmental and archaeological impact. Identified potential impacts can and will be mitigated through implementation of best management practices. PNG will continue its investigations through the pre-construction phase to get a better understanding of the potential risk to various species and habitats, which will help to minimize any impacts to the environment and resultantly to project cost and timelines. The Project work areas were assessed for archaeological potential and an AIA has been recommended for some sites. PNG will carefully consider the AIA as recommended and obtain requisite permitting for associated activities.

8.2 Environment

PNG contracted Khtada Environmental Services (Khtada) to undertake an environmental analysis of the Salvus to Galloway pipeline alignment and to produce an Environmental Constraints Report (ECR, see Appendix O). Khtada is a partnership between Metlakatla Development Corporation (an independent business arm of Metlakatla First Nation) and Triton Environmental Consulting, a western Canadian environmental services firm with considerable work experience and project expertise in the project-related geographic areas and ecosystems.

In developing the assessment, Khtada undertook a desktop review of both published and unpublished technical reports. This review was further informed by Khtada's prior experience in providing environmental services to PNG in the area over the past 15 years.

Khtada's analysis and the resultant ECR are intended to:

- Characterize in general terms the environmental setting and sensitivities along the pipeline alignment between the Salvus Valve and the Galloway Station;
- Summarize relevant environmental background information available for the area;
- Identify environmental regulatory requirements in the context of conceptual pipeline remediation activities;

- Determine constraints integrating environmental sensitivities and regulatory requirements; and
- Recommend additional environmental studies to be completed to facilitate short- and long-term planning and permitting objectives.

As detailed in the ECR, all work will be done in accordance with PNG's Environmental Standard Practice Procedures and with applicable project-specific measures as identified by the appropriate Qualified Environmental Professionals (QEPs). On this basis:

- Work will be performed in least risk timing windows as much as possible. Any instances requiring work outside of these least risk windows will have additional mitigations implemented through the guidance of QEPs.
- Environmentally sensitive areas will be clearly identified by QEPs prior to commencement of construction activities. Locations of these areas will be identified to all project staff by mapping, site flagging and/or discussion during pre-construction meetings. Onsite, full-time environmental monitors will be utilized to ensure conformance.
- All work will be undertaken and completed in such a manner so as to prevent the release of silt, sediment or sediment-laden water, or any other deleterious substances into any ditch, watercourse, drainage or environmental sensitive area.
- Construction practices within environmentally sensitive areas will be subject to restriction and additional environmental protocols.

8.2.1 Environmental Constraints

Methods for scoping the analysis supporting the ECR have been based on the Guideline for the Selection of Valued Components and Assessment of Potential Effects (2013) prepared by the British Columbia Environmental Assessment Office. Environmental Components (ECs) are defined as features of the natural environment that are normally considered to possess ecological importance by project proponents, Indigenous groups, government agencies, the public and other stakeholders. Khtada selected the following ECs for review based on their regional experience, the spatial and temporal scope of the Project and anticipated project-environment interactions:

- Aquatic species and habitats;
- Water quality and quantity;
- Terrestrial species and habitats;
- Species at risk; and
- Administrative boundaries and requirements.

Table 8-1 that follows provides a description of the ECs selected and the rationale for inclusion in the assessment.

Table 8-1: Summary of Environmental Components

Environmental Component	Scope	Rationale for Inclusion
Aquatic Species and Habitats	• Anadromous and resident fish • Fish habitat	• Pipeline infrastructure is located within fish habitat and proposed work may result in changes to that habitat through physical works or mechanisms involving water quantity and quality.
Water Quality and Quantity	• Classifiable streams • Classifiable wetlands • Non-classified drainages (NCDs)	• Pipeline infrastructure is located within watercourses considered as 'Streams' under the Water Sustainability Act and works affecting Streams are regulated activities.
Terrestrial Species and Habitats	• Migratory and non-migratory avian species and habitats	• Brushing and clearing, and the noise and visual impacts that result has the potential to disturb or displace avian species either through impact to active nests, mortality, or changes in behaviour.
	• Mammalian wildlife and habitats	• Brushing, clearing, and equipment operation have the potential to disturb or displace mammalian species, and access improvements and development of infrastructure have the potential to impact their habitat.
	• Amphibians and amphibian habitat	• Pipeline infrastructure is located within wetlands and adjacent upland areas used by amphibians for foraging and breeding, and changes to these features from access and pipeline repair works may impact these habitats.

Environmental Component	Scope	Rationale for Inclusion
	• Plants and ecosystems of conservation concern	• Brushing and clearing have the potential to destroy rare plants or impact listed ecosystems through vegetation removal or alteration mechanisms.
Species at Risk	• Species identified under Schedule 1 of the Species at Risk Act	• Clearing, and infrastructure development may disturb or displace wildlife species at risk or result in loss of their habitat.
Administrative	• Provincial Parks and Protected Areas • Federal Lands • Legally designated special management areas	• Activities within certain administrative areas have special management and permitting considerations.

8.2.2 Summary of Environmental Components by Segment

A detailed screening of project-specific ECs was undertaken by breaking down the Project work to address four pipeline segments: 1) Salvus to Razorback; 2) Razorback to Lachmach; 3) Lachmach to Prudhomme Summit; and 4) Prudhomme to Summit to Galloway. Making use of web-based resources, technical reports and recent on-the-ground experience in the Project area, an assessment was made as to whether a specific EC was expected to be present in each particular pipeline segment (yes, no, potential or unknown), and whether there are regulations protecting each particular EC. A summary of the screening can be found in Table 4 of the ECA. The discussion that follows provides an overview of key ECs for each pipeline segment.

8.2.2.1 Segment 1: Salvus to Razorback

The Kasiks River is located in proximity to the Salvus to Razorback segment and supports a number of fish species. The Kasiks watershed supports various spawning areas across the various parts of the river. For example, chinook salmon and steelhead trout spawn in the uppermost reaches of the river while chum salmon spawn in the mid-lower Kasiks River.

A number of terrestrial species and habitat are also present in the Salvus to Razorback segment. These include ungulate winter range for moose and mountain goats, wetland habitat for amphibians and rare and endangered plant species, beaver dams in wetlands in the lower Kasiks River and likely migration, forage and nesting habitat for a wide variety of identified species such as the grizzly bear and the wolverine.

8.2.2.2 Segment 2: Razorback to Lachmach

The pipeline in Segment 2 from Mile Post 326.41 (Razorback) to 336.8 (lower Khyex River) is located within the Khyex Conservancy, a 4,100 hectare tract of Crown land established in 2008 to protect old growth forests and documented Indigenous community traditional use sites located in the area.

As indicated, the Khyex River extends into Segment 2 and supports various fish species including providing their spawning environment. Species include chum salmon spawning in the lower Khyex River at the confluence of larger tributaries, as well as steelhead which are suspected to spawn primarily in the lower 400m of Chasm Creek. Coho – the most abundant species – are found widely disbursed within the Khyex River, as well as in Arden Creek, which is also present in this segment.

A number of terrestrial species and habitat are also present in the Razorback to Lachmach segment. These include ungulate winter range for moose and mountain goat as well as critical habitat for marbled murrelet. Habitat for amphibians and rare and endangered plant species is present in Segment 2 as well, and beaver dams in wetlands in the lower Khyex River have also been observed. Given the remoteness of the area it is likely the area provides migration, forage and nesting habitat for a wide variety of identified species such as the grizzly bear and the wolverine.

8.2.2.3 Segment 3: Lachmach to Prudhomme Summit

From the Khyex Valve, Segment 3 of the pipeline joins the Antigonish Creek watershed and traverses an upper bench. Antigonish Creek is known to contain pink and coho salmon, as well as various species of trout, sculpin and stickelback. The pipeline crosses into the Lachmach watershed containing Lachmach Creek, a major salmon spawning stream. The pipeline follows Lachmach Creek to its confluence, briefly parallels Work Chanel, and then crosses and parallels Fortune Creek, which is known to contain various salmon, cutthroat trout, dolly varden and sculpin. The pipeline deviates to an elevated bench and tributaries that are inaccessible to fish until the pipeline crosses Upper Fortune Creek.

The first 5 kilometres alongside Antigonish Creek are identified as either moose or mountain goat ungulate winter range. Critical habitat for marbled murrelet has been identified throughout the segment. The pipeline in this segment also crosses numerous small wetlands that may provide amphibian habitat and increases the likelihood of the presence of rated and endangered plant species. Beaver dams were also present in wetlands and, given the remoteness of the area, it is likely the area provides migration, forage and nesting habitat for a wide variety of identified species such as the grizzly bear and the wolverine.

8.2.2.4 Segment 4: Prudhomme Summit to Galloway Station

From Prudhomme Summit, the pipeline traverses the north side of Prudhomme Creek, Prudhomme Lake and Taylor Lake. Various salmon and trout have been observed in Prudhomme Lake, with spawning chinook and coho found in Prudhomme Creek upstream of the lake. The pipeline crosses the Kloiya Dam and follows a lower bend of the Kloiya River. Spawning salmon have been noted at the crossing during field studies.

Critical marbled murrelet habitat has been identified throughout Segment 4, particularly in the area west of Prudhomme Summit. The pipeline crosses numerous small wetlands that may provide amphibian habitat and increased likelihood of rare and endangered plant species. Similar to the other segments, beaver dams were observed in the right of way and, given the remoteness of this pipeline segment, the area likely provides migration, forage and nesting habitat for a wide variety of identified species such as the grizzly bear and the wolverine.

Prior to reaching the Galloway Station, Segment 4 traverses through Kloiya Bay, a District of Port Edward protected area.

8.2.3 Future Environmental Work

As the detailed design phase of the Project advances, PNG will continue to assess and document ECs and potential environmental impacts related to the Project. As potential impacts are identified, PNG will develop site-specific mitigation plans in conjunction with QEPs to minimize any potential impacts to the environment as a result of the Project.

PNG will ensure that both PNG and external contractors are aware of the Project’s environmental requirements as well as PNG’s internal environmental policies and standards. Where appropriate, PNG will include the environmental specifications as part of the tendering package for work to be done for the Project. PNG will also require contractors to provide site-specific Environmental Management Plans prior to commencement of work activities for the Project. In addition, PNG will ensure that environmental monitoring conducted by qualified personnel is in place for work activities in and around identified sensitive areas, an activity that is projected to directly include the involvement of project-impacted Indigenous communities.

8.2.4 Regulatory Requirements

PNG has identified a number of key regulatory permitting requirements and processes at both the federal and provincial level that will be required for work related to the Project. These are summarized in the discussion that follows.

8.2.4.1 Federal Regulatory Requirements

Federal approval by the Impact Assessment Agency of Canada (formerly the Canadian Environmental Assessment Agency) is not required, as proposed activities will not involve construction or operation of a new pipeline segment over 40 kilometres in length (Regulations Designating Physical Activities SOR/2012-147). However, the following federal permitting processes are expected to apply to the Project:

- *Species at Risk Act* – There are several identified species that are listed in the *Species at Risk Act* that could potentially be impacted by the Project; most notable is the presence of the marbled murrelet in the area. However, field assessments are required to confirm the modelled habitat. PNG may be required to receive authorization under Section 73 of the *Species at Risk Act* before conducting project activities. The expected timing of receiving authorization is 90 days from the filing of an application.

- *Fisheries Act* – Activities involving interface with fish and fish habitat are subject to the provisions of the *Fisheries Act* and require an assessment by a QEP to determine if Department of Fisheries Office (DFO) review is required and what permitting pathway would be appropriate. The QEP would prepare key deliverables and liaise with the DFO on behalf of PNG throughout the process. The three permitting pathways with the highest likelihood of being triggered by the Project are: 1) Request for Review; 2) Application for a Fisheries Act Authorization under normal circumstances; and 3) Application for a Fisheries Act Authorization under emergency circumstances.[26]

8.2.4.2 Provincial Regulatory Requirements

A provincial Environmental Assessment Certificate under the British Columbia *Environmental Assessment Act* will not be required as the Project does not involve replacing or extending a natural gas transmission pipeline segment for a length greater than 60 kilometres (BC

[26] A description of each process can be found on page 23 of Environmental Constraint Analysis included as Appendix O to this Application

Reviewable Projects Regulation, B.C. Reg. 26/2019). However, the following provincial permitting processes are expected to apply to the Project:

- *BC Oil and Gas Commission* – High-pressure pipelines operated at or greater than 700 kPa in British Columbia are regulated by the BC OGC under the British Columbia *Oil and Gas Activities Act* and Pipeline Regulation. Further, as the pipeline segment between Salvus and Galloway is not transboundary or trans-provincial it is under the regulatory authority of the BC OGC. As the entity responsible for oversight of oil and gas operations in British Columbia, the BC OGC has the authority to issue permits related to works on oil and gas infrastructure. The BC OGC requires demonstrated consultation with potentially impacted Indigenous nations, as well as engagement with landowner and/or rights holders. In addition, engineering, design and other technical information are required to support the permit applications. Each activity permit requires specific information related to the activity and can be applied for on an individual basis or as multiple submissions made at one time. PNG expects that numerous work activities related to the Project will require BC OGC permitting. PNG will ensure that applications are made in a timely manner and that it adheres to all regulations.

- *BC Parks* – As described previously, Segment 2 of the pipeline is routed within the boundary of the Khyex Conservancy. BC Parks states that conservancies provide for a wider range of low impact, compatible economic opportunities than Class A parks. However, economic activities must not restrict, prevent or hinder the conservancy from meeting its intended purpose of maintaining biological diversity and natural environments. PNG has an existing Park Use Permit that provides PNG with the authority to undertake work related to the Project in permitted areas. Pending final work plans, PNG may be required to amend the existing permit and will do so in conjunction with BC Parks, as necessary. Should an amendment be required, PNG estimates that it could take between six months and one year to obtain depending on the nature of the activities and outcome of public and Indigenous consultation.

8.2.5 Land Use

Several federal First Nations Reserve lands intersect with or are situated in close proximity to the pipeline right of way or access routes in the Project area. These include Kasika No. 72, Kasiks River No. 29, Ksagwisgwas No. 63, Khyex No. 64, and Khyex No. 8. PNG notes that the pipeline is routed through Kasika No. 72 and Khyex No. 8. Cabins are located along the Kasiks

River and are believed to belong to recreational users, suggesting that the valley has important recreational value. The pipeline does not interfere with these potential users.

Government-sanctioned documents may also impose environmental constraints on a project, depending on the scope. These can include Ministerial Orders (i.e. Ungulate Winter Range, Species at Risk identified through the Identified Wildlife Management Strategy) or land use planning and management guidelines and objectives (i.e. North Coast Land Use Management Plan, Great Bear Rainforest Land Use Objectives). PNG will adhere to all applicable directives as outlined in government sanctioned documents, as required.

8.2.6 Future Activities

As the Project proceeds through the detailed engineering phase, ECs will be further assessed and identified. This work will inform the development of site-specific mitigation plans to address potential impacts associated with project work. PNG will apply for required environmental permits prior to commencement of project work. PNG will also provide environmental specifications to contractors. In addition, where appropriate, PNG will undertake environmental monitoring while undertaking work activities in environmentally sensitive areas.

8.3 Archaeology

Roy Northern was engaged by PNG to undertake a desktop archaeology review of the Project footprint (September 2019), as well as preliminary field reconnaissance of select study areas of the Salvus to Galloway pipeline right of way (October 2019). These two study methods assessed the Project site for areas of archaeological and cultural potential. The desktop review and PFR report indicated that areas of archaeological potential exist within the Project footprint and an AIA is recommended to be completed before any clearing or other land remediation activities are undertaken in the identified areas. Work on the AIA commenced in August 2020.

8.3.1 Archaeological Overview Assessment

As noted, PNG engaged Roy Northern to conduct an AOA, which is a desktop archaeology review of the Project footprint (Appendix P). The intent of this review was to:

- Examine the Project area and evaluate the potential for archaeological sites; and
- Provide recommendations on the need for, and scope of, further archaeological work.

A review of the Provincial Heritage Register indicates that five recorded archaeological sites are located within, or near, the Project area. An additional desktop source (Beynon 1953 in Inglis 1974) revealed a sixth potential archaeological site, a traditional village potentially located at the confluence of the Khyex and Skeena Rivers.

Further, PNG engaged Roy Northern to conduct preliminary field studies in select areas of the Project corridor. The Preliminary Field Reconnaissance Report (Appendix Q) identified areas with archaeological potential within the discrete areas examined. PNG anticipates that further field reconnaissance activities will be undertaken.

The recommended AIA will require a Section 12.2 Heritage Inspection Permit to be issued by the BC Archaeology Branch. Roy Northern currently holds a valid Section 12.2 Permit on behalf of PNG which allows for AIAs for various pipeline developments and replacements, as well as other ancillary developments such as workspaces, log decks, sumps, borrow pits, access roads, and any other necessary facilities provided that individual project footprints are no larger than one hectare in area or 2 kilometres in length (within a 5 meter right of way).

In February 2020, Roy Northern applied to the BC Archaeology Branch for a Section 12.2 permit to specifically address the requirements of the Project. Indigenous community reviews have been completed and the application is currently under final review by the BC Archaeology Branch.

No further archaeological work is recommended for those portions of the Project area that are considered to have low archaeological potential. However, in order to address the possibility of unanticipated discovery of archaeological sites during remediation activities associated with the pipeline, PNG will follow its Chance Find Procedures as well as those of affected Indigenous communities. Based on previous archaeological work and ethnographic information, it is expected that archaeological site types which may be found within the Project area include:

- Subsurface and surface scatters of lithic (stone) artifacts and/or faunal (animal) remains;
- Shell middens;
- Cultural depressions, including house pits and cache pits;
- Culturally Modified Trees;

- Fish traps;
- Historic structures (i.e. cabins);
- Trails;
- Rock art;
- Human burials; and
- Assessment of archaeological potential and overlap with known archaeological sites.

8.3.2 Indigenous Community Participation

The following Indigenous communities were identified as part of the AOA and Section 12.2 permitting process:

- Kitselas
- Kitsumkalum
- Lax Kw'alaams
- Metlakatla
- Gitxaala
- Gitga'at

PNG has contacted all of the identified Indigenous communities regarding the Project, either by telephone, e-mail, in-person meetings, or a combination of these methods. The identified Indigenous communities were provided background information on the Project and consulted on ancestral remains procedures specific to the Section 12.2 permit application. In addition, Roy Northern engaged Indigenous communities as part of their preliminary field reconnaissance work, with the Kitsumkalum First Nation providing a cultural monitor for some of the field study activities.

Following receipt of the Section 12.2 permit, further field reconnaissance activities can be undertaken to flag areas of archaeological potential and to determine site-specific mitigations and avoidances.

8.3.3 Future Activities

Potential archaeological impacts identified in the AOA desktop review and the Preliminary Field Reconnaissance Report will be further assessed by PNG as part of the AIA process. Results from the AIA process will be used to develop site-specific mitigation plans to address any potential impacts associated with project work. PNG will also provide detailed archaeological specifications, including PNG's Chance Find Procedure, to contractors working on the Project site. Where appropriate, PNG will engage Indigenous communities for archaeological and cultural monitoring during work in sensitive areas.

9 Consultation and Engagement

9.1 Introduction

Key components of PNG's project development process include early consultation and engagement with Indigenous communities, other key stakeholders, and the general public, and maintaining two-way communication with affected and interested parties. PNG's Salvus to Galloway Communication and Engagement Plan (see Appendix R) was created to provide a framework and guide for Indigenous and public engagement, communication and related efforts. The plan identifies Indigenous communities and other key stakeholders who may have an interest in the Project, and lists potential issues and provides an overarching approach to consultation and communication with respect to the Project. PNG engaged identified stakeholders who may potentially be impacted by the Project through direct mail notifications, phone calls and e-mails. PNG offered to meet with a number of stakeholders, including local governments, and followed up on any requests for further information on the Project. In addition, PNG created regional public awareness of the Project through print, radio and social media and two virtual public information sessions. PNG has committed to engage with all identified stakeholders throughout the Project.

As described in Section 9.4 of this Application, PNG commenced a focused effort to engage and consult with Indigenous communities potentially impacted by the Project in late-2019. Initial engagement with Indigenous leaders and communities was primarily through e-mail notification and, given the COVID-19 pandemic situation, follow-up discussions were primarily conducted over the telephone and through video conference. Follow-up engagement with affected Indigenous communities typically consisted of PNG presentation by video conference of a project overview and allowing for discussion of any questions or concerns. PNG notes that to date no issues have been raised by Indigenous communities in regard to the Project that remain outstanding. PNG will continue to consult and engage with the communities throughout the development and execution phases of the Project.

9.2 Communication and Engagement Objectives

Underpinning the communication and engagement on the Project are PNG's corporate values of: 1) commitment to the environment, health and safety; 2) providing its customers with safe and reliable energy; 3) commitment to the communities it serves; and 4) accountability for its actions.

PNG also strives to ensure it meets the regulatory requirements related to communication and consultation which include:

- Identifying and engaging with potentially impacted and interested parties;
- Identifying issues and concerns raised during the engagement process, as well as the actions PNG is taking or plans to take to address identified issues;
- An overall evaluation as to the sufficiency of PNG's engagement prior to the filing of the CPCN Application; and
- Plans for ongoing communication and engagement throughout the Project.

As part of the Communication and Engagement Plan for the Project, PNG identified a number of key objectives to guide engagement including building and maintaining beneficial and respectful relationships with Indigenous communities, other stakeholders and the general public. Fulfilling these objectives ensures an open, transparent and honest engagement process where participants are engaged early and understand how their input is considered in decision making. Furthermore, the engagement process has and are intended to continue to ensure that PNG informs stakeholders and others of how factors such as environmental impacts, constructability, rate impacts and any social impacts of the Project are considered.

As the public is diverse, PNG committed to using multiple communication and engagement channels to reach the widest audience possible and ensured that people were able to receive information in a preferred manner, through cost-effective channels. This included print, radio, digital and website/phoneline-based information sharing ranging from newspaper coverage to virtual information sessions.

PNG engaged Indigenous communities to identify how they would like to participate in the Project process and began the discussions as to how they would meaningfully contribute to the planning, provide input and participate in economic activities through the construction phase of the Project.

9.3 Public Engagement

9.3.1 Potentially Affected Stakeholders

In the development of the Communication and Engagement Plan for the Project, PNG identified key stakeholders and assessed the potential impact of the Project to each stakeholder. This assessment guided the planned extent of engagement and the selection of an appropriate medium for communication to the stakeholders. PNG initiated its engagement with stakeholders taking this assessment into consideration.

The following public stakeholders have either already been engaged by PNG or will be engaged as the Project advances though its various phases:

- General Public – residents, businesses, industrial customers, RECAP customers as well as landowners that will be directly impacted by the Project;
- British Columbia Provincial Government Agencies – BC OGC; BC Parks; Ministry of Forests, Lands, Natural Resource Operations and Rural Development; Ministry of Environment; Ministry of Transportation & Infrastructure; and Ministry of Energy, Mines and Petroleum Resources.
- Federal Agencies – Transport Canada and Department of Fisheries and Oceans.
- Municipal and Regional Governments – City of Prince Rupert and District of Port Edward.

As identified earlier, Indigenous communities have also been identified as important key stakeholders. Activities focused on these communities are addressed in Section 9.4 – Consultation and Engagement with Indigenous Communities.

9.3.2 Engagement Approach

PNG proactively engaged those stakeholders anticipated to be most impacted by the Project and notified/informed those who may have an interest in it. In its approach to public engagement, PNG aimed to ensure that stakeholders including customers, land owners, local governments and other interested and potentially impacted parties were informed of the Project early in the process, had access to information, and were aware of the multiple channels available to provide their feedback so it could be considered in PNG's project planning and execution. This approach follows the best practices as set out by the

International Association of Public Participation (IAP2). The IAP2 Public Participation Spectrum outlines five levels of participation guided by a stakeholder's level of project impact, as illustrated in Table 9-1.

Table 9-1: IAP2 Public Participation Spectrum of Engagement

Inform	Consult	Involve	Collaborate	Empower
Information Sharing	Consultation		Active Participation	
Sharing information to build awareness	Testing ideas or concepts to build knowledge	Collaborating to develop solutions	Sharing decision making	Delegating decision making

As context for the planned engagement, the proposed Project is a required safety and reliability upgrade taking place on an existing gas line in a designated right of way in a remote area. Therefore, no new landowners will be impacted. The Project's location in a remote area minimizes concerns for traffic impacts. Although impacts on rates could be a point of interest for customers, PNG is looking to mitigate this challenge by adding further industrial loads to significantly offset the cost of the upgrade. Given this situational analysis, PNG engaged stakeholders and the public at the Inform / Consult / Involve levels on the IAP2 spectrum, specific to the perceived impact on each stakeholder.

9.3.3 Key Issues and Risks

PNG identified a number of key issues and potential project impacts for customers, industry and other stakeholders, as well as the general public. Issue identification and potential impact assessment was used to determine the level of communication and participation required for each stakeholder group. The key issues and project impacts PNG identified were:

- Environmental Impacts (fish habitat, water crossings and proximity to water bodies, site clearing and sensitive habitat);
- Construction Impacts (noise disturbances, traffic/road disruptions);
- Customer Service Impacts (such as disruption of natural gas service); and
- Customer Rate Impacts (potential rate increases).

9.3.4 Impact Levels

The level of community impact is the effect that a specific action, decision or project will have on the community or stakeholder. PNG proactively engaged those most likely to be impacted by the Project and notified those who may have an interest in the Project.

Based on PNG's assessment, public participation activities for the Project include the Inform, Consult and Involve levels of the IAP2 Public Participation Spectrum. PNG used the key issues and impacts identified in Section 9.3.3 to classify stakeholders into three tiers, or levels of the IAP2 Spectrum:

- Tier 1 – High Impact Potential (IAP2 Level: Involve)
- Tier 2 – Moderate Impact Potential (IAP2 Level: Consult)
- Tier 3 – Low Impact Potential (IAP2 Level: Inform)

9.3.5 Engagement Strategies by Tier

Using the tier classification described previously, PNG developed communications and engagement strategies for each tier, as appropriate:

- Tier 1 Strategies:
    - Notification letter mailed directly to landowners including Project Fact Sheet;
    - E-mails including notification letter and Project Fact Sheet;
    - Two virtual community information sessions (webinars); and
    - Local and/or regional government meetings.
- Tier 2 Strategies:
    - E-mails including notification letter and Project Fact Sheet; and
    - Two virtual community information sessions (webinars).
- Tier 3 Strategies:
    - E-mails including notification letter and Project Fact Sheet; and

- Two virtual community information sessions (webinars).

9.3.6 Communications Materials to Support Engagement

PNG used a number of two-way communications channels to share project information with the public and to receive input. Channels included two virtual information sessions; Facebook posts where the public posted comments or questions regarding the Project; and a project e-mail and telephone line for the public to ask questions. During the virtual information sessions potential suppliers/contractors who were interested in providing services to the Project were directed to the registry for contractors, suppliers and employment listed on the project page established on PNG's website, png.ca.

PNG's Facebook page provides an opportunity for PNG to share project information for public review, and the public can post questions on the page for PNG to consider and/or to post a response. Topics of interest raised by the public to date include: impact to rates; the need to have pipelines be in good condition and not be left too long for maintenance/repairs; support for getting the work done safely and transparently; support for the Project and for PNG; support for pipeline jobs; support for using local workers; working with Indigenous communities; environmental management; and a number of non-project related topics such as the carbon tax and fracking.

The Project e-mail address has received communications from suppliers expressing interest in being considered for the Project, as well as communications from the public seeking details on the size and pressure of the pipeline.

Additional information on each of the communication channels is provided in the discussion that follows. In addition, copies of engagement materials have been included as Appendix S.

News Release

PNG issued a news release to announce the Project to local media on July 30, 2020. The *Prince Rupert Northern View* and the *Terrace Standard* ran articles on August 5, 2020 based on the release and follow-up calls to PNG. Also, CFTK-TV based in Terrace inquired about the news release, though ended up not covering the story.

Project Fact Sheet

A Project Fact Sheet was sent to all identified stakeholders in Table 9-2, above, as well as the Indigenous communities identified in Section 9.4.1. The fact sheet outlined the need for and scope of the proposed Project and included a description of the Project location, timeline, work activities, required permits, natural gas service during construction and PNG's approach to Indigenous and community engagement. The Project Fact Sheet was sent out beginning July 30, 2020.

PNG Website

In late July, 2020, PNG added a projects section to its external website and a specific page for the proposed Project (png.ca/projects/s2ggasline). The Project page provides project details including its location, timelines and next steps, and public engagement information including information on two virtual information sessions, the Project e-mail address and phone number, as well as a registry for suppliers. The site serves as a hub for all communications activities, including social media, paid ads and steps like the news release which was issued to generate coverage in the local media. All of these items contained a link to the Project webpage to provide audiences with more information.

Over the months of August 2020 and September 2020, the page received 1,590 visitors that on average each spent 3.3 minutes on the page reviewing the content and some returned multiple times as the page had a total of 2,004 visits. Additionally, 88 visitors downloaded the more detailed factsheets. Increases in traffic to the page were driven by and coincided with the timing of PNG's Facebook posts and digital ads placed in the *Terrace Standard* and the *Prince Rupert Northern View*. These occurred over a three-week period to help create awareness for the August 19 and August 26 public information sessions.

PNG will make use of the Project webpage over the course of the Project, adding information as needed to reflect project updates and topics of interest to PNG's customers and the community.

Project E-mail / Phone Line

The Project e-mail address and phone line went live on July 30, 2020 and were designed to support two-way communication with the public and to receive and respond to questions. The Project e-mail address and phone line have been used by suppliers looking to register their services with the Project, including an Indigenous supplier who learned about the Project through the newspaper advertisement, as well as by members of the public to ask questions. The Project e-mail address and phone line will remain active throughout the Project.

Social Media

PNG has three social media accounts: Facebook, Linked-In and Twitter. PNG posted numerous project-related posts to each of these platforms that were designed to create awareness about the Project and to drive visitors to the Project webpage for more information about the Project and the two virtual information sessions. Of particular note is the performance of the Facebook posts between August 5 and September 30, 2020, which reached over 56,750 people in the PNG service territory (given the multiple posts some people may have been reached more than once). PNG shared *Prince Rupert Northern View* / *Terrace Standard* news articles regarding the proposed Project announcement on its social media sites, which garnered the most engagement of all PNG's project-focused Facebook posts, generating 140 "likes", 4 "sad" and 34 "shares". Following social media posts, page views on the Project webpage spiked upwards.

Paid Media Print (Newspaper)

In order to reach a broad spectrum and demographic of the community, PNG also placed ads in the weekly print editions of the *Prince Rupert Northern View* and the *Terrace Standard*, with ads run on August 6, 13, and 21, 2020. The ads shared information about the Project and instruction on how to participate in the two virtual information sessions. A phone number was provided for readers who did not have computer access.

Paid Media Digital (Newspaper)

To further create and sustain awareness of the two virtual information sessions on the Project, PNG invested in paid digital media including ads on the homepages of the *Prince Rupert Northern View* and the *Terrace Standard*. The investment to run ads on the homepage for three weeks was the same cost as a paid print placement for one week and facilitated a combined reach of approximately 14,500 people.

Virtual Information Sessions

PNG traditionally has open houses where community members are welcome to meet with the Project team in person. In light of the COVID-19 pandemic and the need for physical distancing, PNG felt a virtual format was the safest and most appropriate path forward. The virtual sessions were designed to address the wide range of methods people receive information and are comfortable engaging. This means that someone seeing a print ad or a digital ad could participate by phone; phone and computer; or just computer. Each virtual session consisted of a 25-minute presentation by the Project leads followed by an opportunity for the public to ask questions. The sessions were held on August 19 and 26, 2020 from 6:30 pm to 7:30 pm with 10 members of the public participating on August 19 and 11 members participating on August 26.

Radio

To further create awareness in the region about the Project, PNG purchased ad space on CFNR FM, British Columbia's only Indigenous Nation radio station. The station is popular with local Indigenous communities and non-Indigenous residents in Prince Rupert, Terrace, Kitimat and many smaller communities in the area and is considered to have a larger local reach than CBC radio. Beginning in September 2020, PNG invested in running 3, 30-second ads per day over a period of 30 days. The brief, information-focused ad was delivered in the style of a public service announcement that described the location and need for the Project and PNG's commitment to safety and public engagement. Listeners were encouraged to go to the PNG website and provide feedback. As a result of the ad, traffic to the Project webpage spiked during the first week of the 30-day campaign.

Bill Message

Beginning with September 2020 customer billings, all residential and small commercial customers in the PNG-West service territory will receive a bill message informing them of the Project and directing them to the Project webpage for more information and ways to participate in the engagement process.

9.3.7 Description of Engagement to Date

Tier 1, Tier 2 and Tier 3 stakeholders were contacted by e-mail and provided with a project notification letter and a copy of the Project Fact Sheet.

PNG invited all Tier 1 stakeholders for a meeting to further discuss the Project. The City of Prince Rupert and the District of Port Edward were the only Tier 1 stakeholders to take up the offer to meet with PNG. Presentations were made to the District of Port Edward on September 4, 2020, and the City of Prince Rupert on September 29, 2020, which provided PNG an opportunity to address questions from these stakeholders. PNG sent follow-up e-mails to the remaining Tier 1 stakeholders further offering to set up a meeting to discuss the Project.

Offers were made to meet with Tier 2 and Tier 3 stakeholders should they be interested in an opportunity to learn more about the Project. PNG received several e-mail replies from these stakeholder group members expressing they had no questions regarding the Project. PNG also extended an invitation to these stakeholder groups to attend the two virtual information sessions to learn more about the Project.

PNG will continue to make itself available to meet with any stakeholder should any further questions arise as the Project advances.

9.3.8 Issues and Concerns Raised

PNG identified, engaged, and solicited feedback from stakeholders and the general public and provided them with project information and opportunities for discussion. At this time, there are no outstanding issues or concerns that were raised with PNG. The discussion that follows provides an overview of stakeholder feedback provided to date.

PNG received eight acknowledgement e-mails in response to its notification letters. These e-mails were from Transportation Canada, Ridley Terminals, BC Hydro, North Coast Regional District, CN Rail, the BC Ministry of Energy, Mines and Petroleum Resources, the Department of Fisheries and Oceans, and the office of local MLA Jennifer Rice. In summary, these stakeholders all acknowledged the Project but did not raise any questions or concerns.

In addition, PNG received five e-mails in response to the notification letters asking questions or requesting additional information or meetings.

- Enbridge Inc. asked about increased capacity, which was answered via e-mail.
- Coast Mountain Regional District requested additional maps and plans of the pipeline route which were provided.

- The Prince Rupert Chamber of Commerce offered to help with communications for the Project by adding information to their weekly newsletter.
- The BC Ministry of Environment requested a meeting with PNG. This meeting will be held via video-conference on September 23, 2020.
- The District of Port Edward raised concerns regarding the potential of cost impacts to customers, noting that the region already pays some of the highest natural gas prices in the province. PNG provided information via e-mail and also met with the District and provided a project presentation which included a discussion on mitigation strategies for rate impacts. These strategies include future prospective opportunities for regional development which will result in greater system utilization and increased gas volumes transported, both of which are means of mitigating costs of necessary regulation-based repairs and associated impacts on customer rates.

As noted, on September 29, 2020, PNG met with the City of Prince Rupert and made a presentation on the Project and answered questions mainly regarding potential outages related to project work. PNG informed the City of Prince Rupert that the Project plan will look to minimize outages and advised that it will keep the City of Prince Rupert informed as the Project progresses.

To date, PNG received one other expression of concern (from a member of the general public) through the dedicated project e-mail address. The concern was regarding increases to the pipeline diameter or twinning the pipeline to increase capacity. PNG clarified the pipeline diameter remains the same (8 inches) and that the Project does not include twinning the pipeline, but rather repairing and replacing existing sections, as required.

In addition to issues or concerns raised, PNG received thirteen vendor submission forms from various companies expressing an interest in providing construction services for the Project. Due to the high volume of interest from prospective vendors, PNG created a Vendor Supply Form on the Project webpage to provide vendors with a simple and easy way to register their interest. One submission received included an offer from a landowner for PNG to use their private land on Prudhomme Lake as a staging area or a workcamp.

9.3.9 Overview of Sufficiency of Public Engagement

At the time of filing this Application, PNG believes that the communication and engagement plan and the engagement activities for the proposed Project have been sufficient and reasonable and meet the requirements established in the BCUC CPCN Guidelines.

PNG will continue to engage with stakeholders and the general public as the Project advances and will maintain open dialogue with all interested parties. Communication will continue throughout the construction phases of the Project on matters such as schedule/timelines, construction spaces, and also on potential impacts to natural gas service or possible traffic disruptions. PNG is committed to addressing all questions, concerns or issues raised and to working with stakeholders to minimize project impacts.

9.4 Consultation and Engagement with Indigenous Communities

9.4.1 Potentially Affected Indigenous Communities

PNG considered all Indigenous communities whose traditional territories overlap the Project footprint to be potentially impacted by the proposed Project. PNG's review and evaluation identified six Indigenous communities, all of Tsimshian ancestry, including:

- Gitga'at First Nation
- Gitxaala Nation
- Kitselas First Nation
- Kitsumkalum First Nation
- Lax Kw'alaams Band
- Metlakatla First Nation

9.4.2 Consultation and Engagement Approach

PNG proactively engaged with each Indigenous community identified as being potentially impacted by the Project. Engagement activities included communication and discussion with representatives from each Indigenous community's respective land and resources departments, including the offer of a presentation by PNG to provide a project overview. The purpose of the engagement was to provide a high-level overview of the maintenance and integrity works that are planned to be carried out as part of the proposed Project.

The communications and discussions focused on the following matters:

- History of PNG as a company, its service areas and its existing pipeline systems;
- Explanation of why the Project work is required, including safety of the pipeline, reliability of service, addressing geohazard risks and compliance with standards and provincial regulations;
- Anticipated project timeline, commencing Fall 2020 and with construction phases through to 2023;
- Project background and anticipated work activities, including access management, integrity digs, pipeline repairs, geohazard mitigations, installation of temporary and permanent streams crossings, right of way clearing and development of staging and laydown areas;
- Google Earth overview of the Project plan and layout highlighting the four project sections, access constraints for crews and equipment, locations of significant waterways and terrain features, and conservancy areas;
- Overview of work completed to date and scheduling of planned works, including the timing of entry into the four project sections;
- Environmental remediation activities;
- Overview of PNG's engagement principles, specifically an open, transparent and honest engagement process that shares information on a timely basis and that seeks input from affected parties; and
- Opportunities for involvement of Indigenous community-owned businesses whose services can be procured to assist in the pipeline upgrade works.

The Indigenous communities were encouraged and given the opportunity to ask clarification and technical questions during the overview presentation. PNG had subject matter experts including professional engineers available to answer questions. An electronic copy of the presentation was provided to each Indigenous community to share with their governing councils and band members, if desired. In addition to questions asked during the presentation, the communities' representatives were encouraged to subsequently review the material and follow up with PNG on any further questions or concerns.

PNG also committed to the Indigenous community representatives that consultation and engagement would be an ongoing process, including direct engagement on specific permits authorized by the BC OGC.

9.4.3 Description of Consultation and Engagement to Date

Preliminary engagement with affected Indigenous communities began in 2019. This engagement consisted of phone calls and face-to-face meetings where PNG's future plans to carry out necessary upgrade works on the pipeline between Salvus and Galloway were explained. This was an early introduction to the proposed Project to prompt Indigenous communities to begin thinking about any potential impacts to their rights within their respective territorial overlap with the Project. Much of the early engagement coincided with archaeological works that were planned in some of the identified higher priority upgrade and maintenance sections of the pipeline.

Following the COVID-19 shutdowns in early-to-mid 2020, project notification letters were sent to identified Indigenous communities on July 30, 2020. The letters included the Project Fact Sheet providing a high-level description of the Project as well as PNG contact information. This was followed up with a formal presentation to Indigenous communities who expressed interest in taking up this opportunity (as described in Section 9.4.2). Copies of materials related to Indigenous community engagement for the Project are included for reference as Appendix T.

9.4.4 Issues and Concerns Raised

PNG identified, engaged, and solicited feedback from the Indigenous communities and provided them with project information and opportunities for discussion. Table 9-3 that follows provides a summary of PNG's engagement efforts with Indigenous communities to date.

1 **Table 9-2: Indigenous Community Engagement Activities and Issues**

Indigenous Community	Summary of Discussion / Issues Raised / Notes of Interest	Next Steps / Follow-up
Gitga'at	Gitga'at is notification only. An offer by PNG to the community to take part in a project presentation has not been responded to.	PNG will continue to reach out to the community for engagement.
Gitxaala	Early engagement on the proposed project occurred in relation to archaeological work. In September 2020, a formal virtual presentation was given to the community. Questions were raised specific to what integrity works were going to be carried out. The community would like to be involved in the review and comment of all plans. Concern expressed over BC OGC handling of permits that should be dealt with by DFO. The community expressed interest in working on the Project.	PNG will continue to engage and provide updates and forward environmental-related assessment information ahead of permitting stages. Project Fact Sheet and Project Overview presentation sent in electronic format to the community. PNG discussed contracting opportunities and committed to meeting with the community once the scope of work has been defined.
Kitselas	In late 2019 to early 2020, the community was informally introduced to the Project through telephone conversations and e-mails. This introduction coincided with early archaeological work associated with the Project. In August 2020, a formal virtual presentation was given to the community. Questions were raised largely around what permits would be applied for and associated agencies. Questions around timeframes for work to be carried out in the various sections were also asked. The community emphasized the need to consider mountain goat interactions with helicopter use. Kitselas acknowledges that the Project is a required upgrade to an existing pipeline.	PNG will continue to engage and provide updates and forward environmental-related assessment information ahead of permitting stages. PNG will seek guidance from regulatory agencies on helicopter use as it pertains to goat habitat. PNG has identified procurement opportunities and is in discussion with the community on such. A meeting with Wai Wah representatives was held on September 17, 2020 to discuss opportunities. Project Fact Sheet and Project Overview presentation sent in electronic format to the community for further review and comment, as applicable.

Indigenous Community	Summary of Discussion / Issues Raised / Notes of Interest	Next Steps / Follow-up
	Kitselas expressed interest in working on the Project via their environmental company, Wai Wah.	
Kitsumkalum	In late 2019 to early 2020, the community was informally introduced to the Project through phone conversations and e-mails. This introduction coincided with early archaeological work associated with the Project. In August 2020, a formal virtual presentation was given to the community. The community acknowledged the necessity of the Project and the fact works are largely being carried out on previously disturbed ground. Concern expressed over any new access roads/structures as they could lead to increased hunting pressure in the area. General questions on pipeline characteristics were raised. Kitsumkalum offered suggestions on how they could assist the Project economically.	PNG will continue to engage and provide updates and forward environmental-related assessment information ahead of permitting stages. PNG emphasized increased access is a concern, but structures will be temporary and rehabilitated. PNG wishes to work with Kitsumkalum on business opportunities and held a meeting on September 25, 2020 with the Band Office employment and training coordinator. Project Fact Sheet and Project Overview presentation sent in electronic format to the community for further review and comment, as required.
Lax Kw'alaams	In late 2019 to early 2020, the community was informally introduced to the Project through phone conversations and e-mails. This introduction coincided with early archaeological work associated with the Project. In August 2020, a formal virtual presentation was given to the community. The community emphasized that the Project was not going through a full environmental review. As such, they wish to review all environmental-related information and plans as they are created for comparison against their own land use plan and values. Specific areas of concerns were provided. The community subsequently provided documents on valued species and their land use plan. A comprehensive list of	PNG will continue to engage and provide updates and forward environmental-related assessment information ahead of permitting stages. This information will be evaluated against the values and land use plans provided by the community. PNG commits to finding mitigation opportunities wherever possible. PNG has identified procurement opportunities and is in discussion with the community on such. A preliminary meeting was held with representatives on September 28, 2020. Project Fact Sheet and Project Overview presentation sent in

Indigenous Community	Summary of Discussion / Issues Raised / Notes of Interest	Next Steps / Follow-up
	questions was also forwarded to PNG pertaining to environmental management.	electronic format to the community for further review and comment, as applicable.
Metlakatla	In late 2019 to early 2020, the community was informally introduced to the Project through phone conversations and e-mails. This introduction coincided with early archaeological work associated with the Project. In August 2020, a formal virtual presentation was given to the community. Questions were raised specific to characteristics of the existing pipeline. Concerns over environmental factors were expressed, including streams, access and the need for QEPs on site. The community would like to see all assessments. The community suggested follow up with Treaty team where Treaty Lands overlap the existing pipeline. On September 9, 2020 the community sent an e-mail with questions pertaining to stream works planned for fall 2020.	PNG will continue to engage and provide updates and forward environmental-related assessment information ahead of permitting stages. PNG has identified procurement opportunities and is in discussion with the community on such. PNG will be meeting with Metlakatla Treaty team at a later date. Project Fact Sheet and Project Overview presentation sent in electronic format to the community for further review and comment, as applicable. PNG is following up on stream-related questions and anticipates no further issues.

PNG considers that there are no substantive outstanding issues or concerns related to engagement with Indigenous communities at the time of application. The Indigenous communities engaged to date all recognize the importance of the proposed Project in ensuring a reliable supply of gas to local communities. PNG committed to continuing engagement on environmental impacts of the Project ahead of permit applications when more detailed information is available. PNG will work with the individual communities to accommodate and mitigate any concerns, where possible.

PNG observes that several of the Indigenous communities expressed an interest in how they could assist with project activities. PNG notes that, to date, crews from the various Indigenous communities have been involved in pre-project archaeological and environmental works. Going forward, PNG will endeavour to employ environmental monitors from the Indigenous communities and is committed to identifying and helping to provide other local contracting opportunities to Indigenous community-owned and affiliated businesses.

9.4.5 Overview of Sufficiency of Indigenous Community Consultation and Engagement Process to Date

Early in project development, PNG identified Indigenous communities whose traditional territories overlap the Project footprint and engaged the communities to allow them to have a better understanding of the Project, potential impacts associated with the Project and provided an opportunity for input. This process also provided PNG a better understanding of the interests and concerns of Indigenous communities in the Project area.

PNG has ensured that all Indigenous communities were notified of the Project and were provided an opportunity to meet with PNG to discuss the Project and their interests and concerns. Following discussion, if further detail was requested, PNG followed up and provided the requested information. Some requests either required greater detail than was available at the time or were of an ongoing nature as the Project advances; however, PNG committed to provide the information as it becomes available. PNG also agreed to inform all identified Indigenous communities of PNG's filing of this Application.

As the Project develops and moves throughout the various project stages, PNG will continue to work with Indigenous communities to ensure they are kept informed of project developments. Indigenous communities will also have opportunities to comment on impacts during Consultation and Notification aspects of the BC OGC permitting process, including commenting on updated environmental and archaeological management plans.

10 British Columbia Energy Objectives and Long Term Resource Plan

10.1 Introduction

As required by section 46 (3.1) of the UCA, the BCUC's evaluation of a CPCN must consider:

(a) the applicable of British Columbia's Energy Objectives,

(b) the most recent long-term resource plan filed by the public utility under section 44.1, and

(c) the extent to which the application for the certificate is consistent with the applicable requirements under sections 6 and 19 of the *Clean Energy Act*.

Sections 6 and 19 of the *Clean Energy Act* are related to electricity and are not applicable to the Application. As such, PNG gives no further consideration to requirement (c).

10.2 British Columbia Energy Objectives

In reviewing the applicability of the British Columbia Energy Objectives contained in section 2 of the *Clean Energy Act*, PNG has determined that only objective (k) is relevant to the Project. Objective (k) is "to encourage economic development and the creation and retention of jobs." PNG has described in Section 6.6.3 how the Project will provide local employment as well as positive benefits to the local and provincial economy during the construction phase. As described in Section 4.3, the Project will support the connection of new large industrial customers including those who were successful proponents in PNG's RECAP process, which in turn will also provide employment benefits to the local and provincial economies.

10.3 Long Term Resource Plan

On October 31, 2019, PNG filed its 2019 Consolidated Resource Plan (2019 CRP) with the BCUC. The 2019 CRP was prepared in accordance with the BCUC's Resource Planning Guidelines for Regulated Utilities (Resource Planning Guidelines) issued on December 15, 2003. The Salvus to Galloway remediation work that is the subject of this Application was identified in Section 9.4, Repairs and Betterment, of the 2019 CRP. In particular, the 2019 CRP notes that repairs are required to sections of the Prince Rupert eight-inch pipeline traversing treacherous mountainous terrain in environmentally sensitive areas between Salvus and Galloway. PNG submits that the Project remains consistent with the 2019 CRP.

APPENDICES

Appendix A – Draft BCUC Order

Appendix B – BC OGC Order 2011-03

Appendix C – BGC 2019 Report - 2019 Preliminary Geohazard Assessment (Confidential)

Appendix D – BGC 2020 Report - 2020 Geohazard Mitigation Plan (Confidential)

Appendix E – Dynamic Risk - MP 311-MP 364 ILI Response Prioritization (Confidential)

Appendix F – Skystone - NPS 8 Mainline Above Ground Survey Indirect Inspection Report (Confidential)

Appendix G – IPPL - Prince Rupert Upgrade Report and Basis of Estimate

Appendix H – Solaris - Terrace to Prince Rupert LNG Concept Evaluation

Appendix I – Lauren - Upgrade Feasibility Report (Confidential)

Appendix J – Lauren - Design Basis Memorandum

Appendix K – Lauren - Basis of Estimate (Confidential)

Appendix L – Revay - Quantitative Cost Risk Assessment (Confidential)

Appendix M – Lauren - Risk Registry (Confidential)

Appendix N – Financial Analysis (Confidential)

Appendix O – Khtada - Environmental Constraints Report

Appendix P – Roy Northern - Archaeological Overview Assessment

Appendix Q – Roy Northern - Preliminary Field Reconnaissance

Appendix R – Communications and Engagement Plan

Appendix S – Public Engagement Materials

Appendix T – Indigenous Community Engagement Materials

Appendix A – Draft BCUC Order

DRAFT

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ORDER NUMBER
G-xx-21

IN THE MATTER OF
the *Utilities Commission Act*, R.S.B.C. 1996, Chapter 473

and

Pacific Northern Gas Ltd.
Application for a Certificate of Public Convenience and Necessity
for the Salvus to Galloway Upgrade Project

BEFORE:
????????, Commissioner
????????, Commissioner

on June ??, 2021

ORDER

WHEREAS:

A. On October 9, 2020, Pacific Northern Gas Ltd. (PNG) submitted an application to the British Columbia Utilities Commission (BCUC) pursuant to sections 45 and 46 of the *Utilities Commission Act* (UCA), seeking approval of a Certificate of Public Convenience and Necessity (CPCN) for the Salvus to Galloway Upgrade Project (Application);

B. By Order G-XX-20 dated XX, the BCUC established a regulatory timetable for the review of the Application which consisted of intervener registration and two rounds of information requests (IR), as well as a timetable for the filing of PNG and intervener written final submissions and PNG's reply submission; and

C. The BCUC has reviewed the evidence in this proceeding and finds that the approval sought in the Application is in the public interest and that a CPCN be issued to PNG for the Salvus to Galloway Upgrade Project.

DRAFT

NOW THEREFORE pursuant to sections 45 and 46 of the *Utilities Commission Act* and for the reasons set out concurrently with this order, the British Columbia Utilities Commission orders as follows:

1. A CPCN is granted to PNG for the Salvus to Galloway Upgrade Project.

2. PNG is directed to comply with all the directives outlined in the decision issued concurrently with this order.

DATED at the City of Vancouver, in the Province of British Columbia, this xx day of June 2021.

BY ORDER

????????
Commissioner

Appendix B – BC OGC Order 2011-03

IN THE MATTER of an October 10, 2010 pipeline rupture which occurred on a natural gas transmission pipeline between Terrace and Prince Rupert British Columbia, owned by Pacific Northern Gas Limited (PNG)

GENERAL ORDER 2011-03

1 Under Section 49(1)(b) of the *Oil and Gas Activities Act*, I hereby order PNG to:

a) Develop and implement a program for clearing the existing pipeline right of way of trees and other vegetation in accordance with the requirements of *CSA Z662 Oil and Gas Pipeline Systems;*

b) Perform an engineering assessment of the entire pipeline to determine where the hazards of discontinuous pipe support and exposed pipe surfaces may or do exist and develop and implement a hazard mitigation program for these hazards;

c) Develop hazard assessment and mitigation methodologies to manage and further assess the hazards imposed by the quality of existing girth welds as determined by the ACUREN report entitled *8" NPS Pipe Failure Investigation Prince Rupert Mainline* and dated December 21, 2010;

d) Amend their integrity management program to incorporate, as appropriate, the program developed under paragraph 1(a), the engineering assessment required under paragraph 1(b) and the hazard assessment and mitigation programs required under paragraph 1(b) and 1(c);

e) Consider and identify pipeline re-location alternatives; and

f) Respond to the Commission by April 15, 2011 summarizing what has been completed, what is still outstanding, and a timeline for completion of all requests.

2 This order takes effect at the time and date of issuance.

3 This order shall remain in effect for the remainder of the pipeline's operating lifespan.

Ken Paulson, P.Eng
Chief Engineer and Deputy Commissioner
Oil and Gas Commission

DATED AT the City of Victoria, in the Province of British Columbia, this 8th day of February 2011 at 4 pm.

RATIONALE FOR ORDER

I have made this Order for the pipeline after having considered:

- The probability that a loss of product may create a risk to public safety, damage the environment and result in the waste of petroleum and natural gas resources.
- Failure to identify and mitigate the cause of the loss of product and implement corrective measures may result in a reoccurrence of the pipeline failure incident.
- Failure to ensure that the pipeline is fit for continuous service may compromise the pipeline and lead to further failures of the line.

Ken Paulson, P.Eng
Chief Engineer and Deputy Commissioner
Oil and Gas Commission

February 8, 2011.

Appendix C – BGC 2019 Report - 2019 Preliminary Geohazard Assessment (Confidential)

Appendix D – BGC 2020 Report - 2020 Geohazard Mitigation Plan (Confidential)

Appendix E – Dynamic Risk - MP 311-MP 364 ILI Response Prioritization (Confidential)

Appendix F – Skystone - NPS 8 Mainline Above Ground Survey Indirect Inspection Report (Confidential)

Appendix G – IPPL - Prince Rupert Upgrade Report and Basis of Estimate

Pacific Northern Gas Ltd.

Prince Rupert Pipeline Upgrade

Basis of Estimate and Report

NPS 8 Replacement Ripeline

Salvus to Galloway

Document Number:

C	2020-Sep-26	Issued to Client	AJG	DFJ			
Rev.	**Issue Date (YYYY-Mmm-DD)**	**Issue**	**By**	**Checked**	**Approved**	**Project Manager**	**Client**

REVISION HISTORY SUMMARY

Rev.	Brief Description of Change	Revised By	Effective Date
Rev A	▪ Issued for Review		
Rev B	▪ Issued for Review	AJG	

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Note that the accuracy of the associated cost estimate is dependent upon the various underlying assumptions, inclusions, and exclusions described herein. Actual project costs may differ, and can be significantly affected by factors such as changes in the external environment, the manner in which the project is executed and controlled, and other factors that may impact the estimate basis or otherwise affect the project. Estimate accuracy ranges are only assessments based upon the cost estimating methods and data employed in preparing the estimate, and are not a guarantee of actual project costs.

1.0 Project Overview and Purpose

Pacific Northern Gas Ltd. (PNG) engaged Innovative Pipeline Projects Ltd. (IPP) for a feasibility study to consider potential pipeline upgrades on the Prince Rupert pipeline leg, and then develop cost estimates for such upgrades.

A primary concern for PNG is understood to be the pipeline interval from Salvus to Galloway Rapids, where the existing pipeline has current geo-hazard issues, together with shallow depth of cover concerns and a significant number of pipe wall anomalies. PNG is developing options and conducting an assessment of alternatives to alleviate these concerns. One option is to consider the feasibility of replacing this interval of the pipeline with a new NPS 8 pipeline, and IPP was retained to study this option. This study also considered and developed preliminary prices for some additional pipeline section options for future consideration. In each case, the new pipeline would follow the existing ROW and would be placed beside the existing pipeline. The pipeline route is shown in Figure 1.1 below.

Figure 1.1, Prince Rupert Pipeline

2.0 Project Scope

The project assigned to IPP consists of a new NPS 8 pipeline from Salvus to Galloway Rapids, for the study option to replace the existing pipeline, with the existing pipeline remaining in service until the new pipeline installation is completed and commissioned. An ANSI 600 pipeline system is anticipated, with an operating pressure in the order of 9,930 kPag. The length of this interval of pipeline is approximately 86 km

The IPP scope on this assignment was a pipeline feasibility study with the deliverable being a capital cost estimate approaching AACE Class 5 standard, with an expected accuracy range of -20% to +50%. Compression is not included in the IPP work scope.

In addition, IPP studied and made preliminary capital cost estimates on other sections of the Prince Rupert pipeline leg, and conducted a preliminary assessment of costs for pipeline sections in the NPS 16 size immediately downstream from the Prospective future Terrace R5 compressor station and immediately downstream from a prospective future compressor station at Salvus, for future consideration. The results of these additional studies are included in this report.

IPP reviewed the route on desktop and categorized the route by terrain type for cost estimating purposes. IPP utilized a Base Lay factored estimate methodology to determine the anticipated construction costs for the new pipeline. Additionally, IPP drew on knowledge from other recent IPP projects in the NPS 8 and NPS 16 sizes to provide estimate costs for the major materials such as pipe and valves, and for pre-construction costs such as land, environmental, engineering and owner's costs, to develop the overall capital cost.

3.0 ESTIMATE RESULTS AND SUMMARY CONCLUSIONS

A summary table of the estimate results is provided is Table 3.1.

Table 3.1: TIC Costs Summary, Salvus to Galloway Rapids, NPS 8

SUMMARY of COSTS			
WBS	**DESCRIPTION**		**TOTAL COST**
	Base Lay Price		$ 93,402,050
	Miscellaneous Early Works		$ 69,350,000
	Incremental Lump Sums		$ 44,585,000
	Unit Price Items		$ 14,010,308
	Extra Work (out of scope)		$ 9,340,205
	Third Party Field Support Charges		$ 19,450,533
	Pre-Construction Project Costs for NPS 8 pipeline		$ 15,942,000
	Other Miscelaneous Project Costs		$ 32,534,200
	Owner's Internal Costs		$ 23,889,144
	SUB-TOTAL		**$ 322,503,440**
	Contingency	20.00%	$ 59,722,859
	Escalation, per Statistics Canada Infrastructure Escalation Index	2.68%	$ 8,044,441
	AFUDC		
	SUB-TOTAL		**$ 67,767,300**
	TOTAL PROJECT (AACE Class 5+, -20% to +50%)		**$ 390,270,740**

These capital costs represent our estimate of the Total Installed Costs (TIC) for an NPS 8 replacement pipeline from Salvus to Galloway Rapids. No compressor station costs included. The TIC includes an allowance for Owner's costs and include an overall contingency allowance of 20%.

The costs were developed from estimates for two pipeline sections between Salvus and Galloway Rapids, and these estimates are provided in Appendix A.

As part of the study, other options were also explored and priced. The preliminary cost estimates for these additional options are provided in Appendix B. These other option estimates are for the following scenarios:

a) Terrace to Dasque Creek, NPS 16 pipeline

b) Dasque Creek to Salvus, NPS 8 pipeline

c) Salvus to Khyex River, NPS 16 pipeline

4.0 ESTIMATE METHODOLOGY AND COST BASIS

The general approach to the current cost estimate for the Prince Rupert Pipeline Upgrade, reflective of the current early level of project definition, is as follows:

- The pipeline construction cost estimate is based on a Unit Price style estimate, which includes developing a Base Lay Price together with Unit Price Items and Lump Sum items. The Base Lay Price is the base cost of construction the pipeline through the project terrain, before consideration for special features such as major crossings and valve assemblies (the Lump Sum items), and before consideration of additional cost items such as removal of trench rock and pipe padding (the Unit Price Items).

- The Base Lay price was determined by drawing on previous experience with estimating and actual construction pricing for reasonably similar pipeline projects completed in north/central Alberta and north east BC during the past few years.

- The terrain and conditions assumed for the reference case Base Lay Price will be typical summer construction, gently rolling, with full right of way width available, agricultural and light bush mixture, light to moderate grade, with good access to and along the right of way. For construction cost estimating purposes, the pipeline route is segmented by terrain type, and predetermined factors are assigned to each terrain type to reflect the incremental construction costs for each terrain type as the difficulty increases. The factors are applied to the reference case Base Lay Price (the price applicable to easiest terrain and conditions), to arrive at the Base Lay Price applicable to each interval classification.

- Considerations applied in developing the factors for each terrain type or unique construction challenge include: topographical relief, right of way width restrictions associated with terrain, summer or winter construction, number of crossings, expected production rates, access and workforce accommodation.

- Pipeline material cost estimates were based on cost knowledge from recent other pipeline projects with NPS 8 and NPS 16 pipe sizes. The included material estimates reasonably reflect the major equipment and materials that will be required to complete the project.

- Pipeline services (engineering, survey, NDE, etc.) are estimated from previous experiences on similar sized projects and adjusted for terrain.

5.0 Estimate Classification

In line with AACE Recommended Practice No. 97R-18 – Cost Estimate Classification System for Pipeline Infrastructure, the present cost estimate for the Salvus to Galloway Rapids pipeline is viewed as approaching a Class V, based on the level of engineering development (under 1%). The accuracy range is considered to be -20% on the low side and +50% on the high side, noting that an overall contingency amount of 20% has already been included in the estimate.

6.0 Design Basis

This estimate was prepared with the following basis for the engineering design:

- The NPS 8 pipe is ANSI 600 rated, designed for an operating pressure in the order of 9,930 kPag.
- Internal inspection tool senders and receivers are included at either end of the pipeline. The receiver sites are assumed to be equipped for local operation only and no provisions have been included for remote operation or SCADA communications at this stage.
- The pipe wall thicknesses were calculated assuming: generally Class 1 location, 60°C maximum design temperature, 5°C minimum installation temperature during summer, -5°C minimum installation temperature during fall and early winter.

7.0 Construction Estimate Assumptions

The following describes the general construction related assumptions for the cost estimate:

- Logging and clearing is assumed to be completed by local and/or First Nation contractors, either in a previous season or early in the same season as pipeline construction;
- The pipeline construction contracts will be competitively bid, and will be based on a conventional build-up of Base Lay Price per metre of length, together with Lump Sum Prices for identified special items (such as major river crossings, and valve assemblies), and Unit Price Items for elements known to be present but difficult for a construction contractor to quantify at time of bid (such as trench rock, topsoil stripping quantities, and trench plugs).
- The pipeline contractor would be Prime over access and clearing operations, also providing access and operational support, access along the right of way including temporary bridges at water crossings and crossing ramps across buried facility crossings, power line guards etc., and project signage;

- Any salvage on private land would be provided to landowner , decked off right of way for landowners in tree lengths, and not to be cut into firewood by the clearing or pipeline contractors;

- 2 Camps for workforce accommodation have been included in the pipeline portions between Salvus and Galloway Rapids.

- PNG will organize the necessary approvals required for the transport of merchantable wood from the right of way to the end user. Removal costs are included in this estimate;

- Adequate work space will be available for safe and efficient execution of the work;

- There will be space for roll back storage during construction, allowed for during the footprint development;

- There is no allowance for additional pipeline length or construction length due to reroutes;

- An allowance has been added to the horizontal length of pipe needed for the route to provide for the "horizontal to slack" measurement increment, plus for surplus pipe, scrap pipe as a result of unusable pups, and security pipe. No contingency has been included for pipe lost in event of a failed HDD;

- The summer construction season is assumed to start August 1;

- Owner, land acquisition costs, and environmental study and inspection costs to be verified by PNG. Provisional cost allowances have been entered in the estimate, for completeness;

- The right of way footprint recommended for construction is 15 m in width for the NPS 8 pipeline size, to allow for efficient construction progress. An additional 10% to 15% of extra work space is assumed to be available as discreet "push-outs" at selected locations to allow for: staging areas, surplus soil storage, HDD entry/exist sites, laydown area for HDD/bores drag sections;

- No delays associated with Environmental restrictions after close of the migratory bird restriction period have been allowed for in this estimate;

- Cost of designed HDD crossings are based on recent estimates for drills of similar diameter and length;

- A conventional approach is assumed for the installation of water course crossings: those where water flow is manageable by mechanical means would be trenched, with flowing water isolated from the construction disturbance (e.g. flumed or pumped bypass); larger crossings would be installed by trenchless methods;

- Assumed that typical pipeline construction practices are applied – a normal use of access mats is included, for access alone, and a mat allowance also for mats to provide a dead air space when working above the existing adjacent pipeline;

Note: There may be a risk of much higher use of mats (e.g. if a really wet summer occurs and the decision is to push forward and use mats for access), the order of magnitude is difficult to predict. As part of the risk assessment, the potential for a wet summer should be considered, and a mat strategy should be established in preparation for this eventuality (purchase mats, lease mats or daily rental of mats are options to consider).

- Normal ground disturbance practices would be allowed within facility sites (as opposed to 100% hydro vac for any excavations within facility sites);
- Assumed no contaminated soils will be encountered at facility sites or along the right of way, thus, no allowance included for disposal and replacement with clean material;
- Assumed a reasonable summer construction season (typical weather conditions from July 15 through to Nov 15);
- Pipe will be stockpiled – assumed previously disturbed sites available for stockpiling;
- The NPS 8 pipe is planned to be triple random length (average length 18 m,);
- No unusual stress related design restrictions included (e.g. the use of screw anchors in wetlands/muskeg to prevent pipe upheaval, would be an additional restriction);
- Other than those pipeline crossings included in designed HDD drills, the installation of all other pipeline crossings are included in the Base Lay price;
- An allowance has been included for mud management and disposal (extensive early planning required);
- Water for construction needs and hydro test water would be available within 5 km of the right of way (i.e. fill line can be constructed to water source, as opposed to any need for hauling of water);
- Contractor to supply Construction field offices and field office supplies (photocopiers, internet, office supplies etc.) and heated washrooms for PNG use with hot and cold running water;
- PNG would supply caliper tool and technician (allowance included in Estimate);
- Final cleanup would be completed during the same season as completion of pipeline construction;
- PNG would contract a specialized reclamation contractor to do the right of way seeding (Mainline contractor responsible for bar ditches, creek banks and problematic slopes in Base Lay Price);

7.1 Logging and Clearing

The following are the assumptions and considerations for logging, clearing, disposal of debris, and removal of logs from the right of way:

- Applied $125/m3 for timber salvage;
- Applied a blended rate of $15,000/ha for either mulching or pile and burn for this estimate;
- Assumed an average of $2,500 per load for trucking merchantable wood to end user;

7.2 Base Lay Cost

The Base Lay Price (BLP) was applied to the full length of the proposed pipeline loops. Lump Sum prices (outlined in Section 7.3) and Unit Price Item pricing (outlined in Section 7.4) are incremental to the Base Lay Price. The following is a high level overview of the Work included in the Base Lay:

- Mobilization and demobilization is typically included in the BLP. However, due to the remote location of this project from the available pipeline contractors, an additional separate line item has been entered for this cost, as our existing BLP cost data is based on projects that are not so remote;
- access preparation, clearing and/or clearing support;
- Living out allowance (LOA) is included for the summer spreads, and camp costs are incremental to the LOA;
- management, identification and excavation of buried facilities;
- mats for crossings;
- right of way preparation/grading;
- hauling from stockpile, stringing of pipe, and other materials;
- trenching;
- pipe bending;
- welding;
- weld joint supply and coating application;
- lowering-in, backfilling;
- trenchless crossings (not identified as Lump Sums);

- HDD support (workspace preparation, pipe delivery and weld up, pipe handling into the drilled hole, clean-up) for any Owner drills The cost of all drills is in this estimate; Base Lay Price payment through the HDD interval represents compensation for HDD support;
- crossing of all pipelines and utilities;
- crossings of wetlands, streams and watercourses (not identified as Lump Sums);
- all tie-in welds;
- installation of test leads and CP posts;
- installation of warning signs;
- hydrostatic testing;
- filling, dewatering and drying (methanol wash);
- support in running of Owner supplied caliper tool;
- final tie-ins;
- clean up (machine and final);
- post construction final clean-up the following year if required.

The BLP for construction was premised on BLP rates experienced by IPP personnel on recently completed projects in central and northern Alberta and northeast BC, which were constructed by both CLAC and Non-union contractors in similar settings for pipe diameters similar to PNG Pince Rupert Upgrade contemplated diameters, also influenced by recent estimate prices derived from recent actual cost experiences, and BLPs derived or factored from other recent projects. The NPS 8 Base Case is representative of typical CLAC/Union contractor pricing while the NPS 16 Base Case is representative of typical Non-union pricing, summarized as follows:

- NPS 8 pipeline, reference BLP (price for easiest terrain): $280/m
- NPS 16 pipeline, reference BLP (price for easiest terrain): $675/m

Subsequent to establishing the reference BLP, a high level desk top assessment was carried out on terrain conditions to characterize each pipeline section. The following factors were applied to the Base Cost to reflect each terrain classification. Refer to the table below for a summary of Base Lay factors for various terrain classifications, applied to the Prince Rupert pipeline route as such terrain was encountered.

Table 7.2.1, Base Lay Factors, Salvus to Galloway Rapids

Terrain Type	Factor
Typical Northern Alberta/BC summer/fall green area construction/good access, gently rolling, light to moderate grade, no cross drainage channels, good access for rubber tired equipment, no restrictions associated with work space, trench holds up and no high water table, minimal rock and no significant water crossings (no work space restriction)	1.0
Rolling to choppy, moderate grade, moderate side-hill	1.5
Rolling to choppy, steeper slopes, heavier grade, some side-hill, reduced access for rubber tired vehicles, some rock consideration	2.0
Heavy grade, reduced work space, restricted access, steep side hill, grade rock consideration	2.75
Very difficult terrain conditions, very heavy grade, steep slopes, heavy side-hill, deep cross drainages/ravines, grade and ditch rock consideration, narrow work space, no access other than along right of way	4.0
Significant congestion/reduced work space, tight with river, toe of mountain, proximity to powerline and may need to work over top of existing pipeline (use of dead air space), may be future operating concerns	4.0
Pipeline Contractor support and pipe install, for Tunnel/Aerial or HDDs	1.5
Cable crane or steep slope crew with limited access	10.0

For the Salvus to Galloway Rapids interval, the Base Lay Factor averaged 3.88._

7.3 Lump Sum Items

Lump sum items are typically larger river crossings, any complex crossing with some potential risk involved, valve assemblies and fabricated assemblies. The following items were included as estimated lump sum values and are incremental to the Base Lay Price:

- The HDD of major rivers such as the Khasiks and the Khyex rivers crossings
- For the NPS 8 pipeline, assembly and installation of receivers and launchers for internal inspection tool runs, at the start and end of the pipeline;
- An allowance has been included to activate, improve, and deactivate access roads to support clearing and pipeline construction;
- An allowance for drilling fluid management/handling and disposal has been included (further work required in subsequent project development stages, for a mud disposal and management plan to be able to refine these costs);
- No cleaning stations have been allowed for – equipment would arrive on site clean in accordance with project Specifications and this cost would be included in the Base Lay Price.

7.4 Unit Price Items

Unit Price Items (UPIs) consist of items that are typically difficult to quantify prior to construction, but are expected, and are priced on a unit basis during the bid phase, to shelter the construction contractor from quantity risk while ensuring that the owner only pays for the quantities actually encountered during construction. UPIs typically include items such as topsoil stripping, trench rock, trench plugs and sub-terrain drains for ground water management. Quantities will be agreed on between Manager and Contractor as these items are encountered during construction.

A UPI allowance of 15% of the Base Lay cost was applied.

7.5 Extra Work Allowance

Typically, there will be some amount of additional work that arises that was not anticipated at time of bid and is outside the Contractors "Scope of Work". This is compensated as Extra Work by way of the Change Order process, in addition to all other compensation identified in the preceding paragraphs. To account for this anticipated extra work, a value of 5 to 10% is generally applied (depending on the value of the project) to the Base Lay Price and treated as Out of Scope Work (percentages are based on previous experience and depending on the value of the project). IPP has applied 10% to the project average base lay price, for this preliminary estimate.

8.0 MATERIALS

With the limited amount of engineering input, the estimate does not include an exhaustive list of the required materials anticipated to be required to complete the project. For the purpose of assisting with the project overall total installed cost estimate, the representative cost of materials has been drawn from knowledge on recent other IPP projects in the NPS 8 and NPS 16 diameters (includes aspects such as heavy-wall pipe content, coating, transportation and handling, and fabrication costs).

9.0 Other Support Costs

Cost estimates for the following construction support services were based on recent project costs and/or budgetary estimates;

- Survey costs include preliminary, engineering, legal, and construction survey (with as-built data, including pipe log, and depth of cover);
- Construction Management and field inspection services (excluding environmental inspection, land matters, and safety). Field inspection includes inspection of clearing and inspection of pipe stockpiling);
- Non Destructive testing (NDT) services;
- Caliper pig services, to detect dents and ovality only (this is not a multi-function ILI suited to a baseline run) ; and
- CP/AC Mitigation.

For completeness of the estimate, "place holder" pricing has also been provided for the following significant elements which we are aware of, have observed pricing on other projects, but do not have specific detailed pricing expertise:

- A provisional allowance has been entered for environmental studies, environmental protection plan and environmental inspection during construction, for completeness of the capital cost estimate.
- Provisional allowances have been entered for Land Costs, Land Acquisition Agents, stakeholder relations and First Nations consultation;
- A provisional allowance of 8% of the project capital cost has been entered for Owner's Internal Costs (Owner's project costs other than the third party project services identified and costed elsewhere in this estimate) ;
- A provisional allowance has been entered for Contingency. A risk assessment on the major components of this estimate would be expected to yield some elements with higher variability (such as construction cost), and other elements of lower variability (such as engineering and inspection). For this early stage of project development, with a substantial +/- range to the estimate, a contingency of 20% has been proposed and applied.
- A provisional allowance has been entered for Escalation. The current Statistics Canada Infrastructure Escalation Index rate of 2.68% per annum has been applied to construction costs occurring after the first year of construction activity.

10.0 EXCLUSIONS

The following items were the major exclusions from this capital cost estimate:

- Facility Costs (Compressor Station upgrades), including design, materials and construction;
- Cost of project approval by local authorities, if any;
- Initial fill of catalysts, chemicals, lubricants, and fuels;
- Pipeline first fills, i.e. line fill;
- Pipeline commissioning;
- Disposal of contaminated soil or other toxic materials encountered on the route;
- Project financing costs;
- Import duties, taxes, and tariffs if any, and
- Event driven risks including risks associated with currency fluctuations.

11.0 EXCEPTIONS

N/A

12.0 RISKS/OPPORTUNITIES

12.1 Risks

An early consideration of high level risks identified the following:

- Management of sediment run-off during construction, when constructing in close proximity to the Skeena, the Kasiks and the Khyex rivers in particular, and in the vicinity of many other fish bearing streams
- Heavy rain and wet snow conditions could have a significant adverse effect on schedule
- Constructing through some very challenging terrain conditions (tight valleys either side of the Razorback and over the Razorback) and in close proximity to pristine fish bearing streams
- Geo hazards in the tight valley conditions between Salvus and the mouth of Khyex River
- Managing environmental sensitivities based on project commitments, and escalated regulatory expectations being experienced on other current pipeline projects in BC.

- Management of sediment controls and right of way erosion incidents between construction seasons, and post construction, could be very expensive
- Availability of skilled workforce in a heated market place
- Potential cost increase to most facets of construction during a heated market

12.2 Opportunities

During early engineering stages of this project, IPP would recommend that the project team revisit in more detail the initial assessment of the needs for tunnels, cable crane systems, barge landings and barging to the project, at various locations. Some of these unusual components also require use of heavy lift helicopters and an extensive geotechnical program, all of which costs are included in these preliminary estimates.

12.3 14.1 Pipeline Separation Considerations

In studying this pipeline route, safe spacing of the new pipeline in proximity to the existing pipeline is a consideration in this restricted mountain terrain. On a prior pipeline construction project in the mountains of BC, which also had significant space limitations, we closely considered this situation and examined NEB data and records on gas pipeline failures, to determine typical crater displacements and shapes. The study concluded that within 7 m spacing, the new pipe at similar depth of cover could be expected to be partly expose by and adjacent pipeline rupture, and vice versa.

For preliminary planning purposes, given the Prince Rupert pipeline replacement scenario, where the old pipeline would be a risk to the new pipeline only during construction, and when the new pipeline is placed in service the parallel section of old line is then taken out of service, the provisional hierarchy of spacings used for planning and costing purposes in this study, is as follows:

1. 9 m spacing is a typical industry routine secure spacing for a gas pipeline.
2. 7 m to 9 m spacing is deemed acceptable with no additional protections
3. At less than 7 m spacing, use heavy-wall pipe.
4. At less than 5 m spacing, use heavy wall pipe and extra depth of cover.
5. 3 m from side wall of existing pipe to nearest side-wall of new trench is the closeness limit for mechanical trenching, and in this proximity the elevation of the top of the new pipeline is to be below the bottom of the old pipeline.

13.0 CONTINGENCY

IPP has provided a base cost estimate, including the Direct Field Cost, the Construction Indirect Cost and the Engineering Cost and other support service costs. A provisional allowance of 20% contingency has been proposed, and included in this preliminary estimate.

14.0 RECONCILIATION

No previous class estimate has been prepared for this project scope of work; therefore, no reconciliation is necessary at this stage.

Attachment A

Cost estimates

Salvus to Galloway Rapids, NPS 8 Pipeline

PNG, Prince Rupert Upgrade, Class V Capital Cost Estimate

Segment 1, Salvus (MP311.1) to Khyex R. (MP340.8), NPS 8 replacement pipe, Sep 26 2020

A	Estimated Base Lay Cost				
Item / WBS	**Description**	**Factor**	**Length (m)**	**Value**	**Notes**
	Blended base lay price	1	47,740	$67,119,150	$280/m reference base case
	Slack length addition	0.0125	0		$1,406/m average BLP
	Premium for winter construction (add 12%)	0.12	0		
	Allowance for re-routes		0		
			Sub Total, Base Lay Price	**$67,119,150**	

B	Miscellaneous Early Works				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**
	Project Mob/Demob Allowance	1	LS	$750,000	for travel distance
	Helicopter support for early works	1	LS	$8,280,000	4hrs x 180d x ($4000 + $7500)
	Access Road Upgrade and development	1	LS	$3,000,000	reactivation. multi seasons
	Camp site development /cleanup	1	LS	$250,000	could be barge based
	Allowance for camp	1	LS	$25,000,000	
	Stockpiles, Development Allowance	2	LS	$200,000	1 in Terrace industrial space
	Barge landings	3	LS	$450,000	allow @150,000 each
	Barge services, 10 months x25d/mo.	10	mo	$2,500,000	$10,000/d ave., $20,000 peak
	pipe transport and stockpile	49000	m	$735,000	
	Security on stockpile, for 2 seasons	580	days	$1,450,000	2 x 145d x 2 seasons
	Timber harvest logging, 20 km	5600	m3	$700,000	8 loads/km @ 35 m3/load
	Timber trucking	160	loads	$400,000	8 loads/km x 25 km
	clear/grubb/dispose, 32 km x 15 m wide	53	ha	$1,060,000	add 10% for EWS
	mulching, 25 km x 15 m wide	30	ha	$450,000	
	Prime Contractor support to access & clear	22	km	$440,000	40 km cleared
	Geotech/coring program (heli premium)	6	holes	$540,000	Kasiks & Khyex crossings
	Sub Total, Miscellaneous Early Works			**$46,205,000**	

C	Incremental Lump Sums				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**
	Khasiks HDD	650	m	$1,300,000	$2,000/m for location
	Bridge for Kasiks to support construction	1	each	$1,500,000	
	Cable crane setup/operate/service/remove	2	each	$18,000,000	Razor, East side & West side
	Khyex trenchless crossing	650	m	$1,300,000	$2,000/m for location
	Bridge for Khyex to support construction	1	each	$2,000,000	
	Casing allowance for drills, includes casing	120	m	$144,000	subsurface likely cobble
	Mud management and disposal from HDDs	2	each HDD	$280,000	allowance only
	Geohazard allow., avalanche chutes/drains	1	each	$2,500,000	allowance only
	Environ. controls, silt fence/filters/catchments			$2,500,000	allowance only
	Highway Crossing	0	m	$0	
	Railway crossings	0		$0	
	FSR Roads	0		$0	
	Assumed water course/wetland crossings	20	each	$3,500,000	dam & pump
	AC Mitigation (paralleling high voltage lines)	500	m	$12,500	
	install Pigging faciliites each end of loop	2	each	$250,000	with expanding site and fence
	install 2 prefabricated Valve Assemblies	2	each	$250,000	
	2 Site development/fencing and access road	2	each	$200,000	
	access mats for dead air space (buy)	500	each	$500,000	includes cleaning and trucking
	Allowance for 100 access mats, rent	100		$150,000	$10/d x 120 d + truck + clean
			Sub Total, Lump Sums	**$34,386,500**	

D	Unit Price Items				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**
	Incremental Unit Price (cost/m) Items	1	LS	$10,067,873	estimate 15% of BLP
			Sub Total, Unit Price Items	**$10,067,873**	

E	Extra Work (out of scope)				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**

PNG, Prince Rupert Upgrade, Class V Capital Cost Estimate

Segment 1, Salvus (MP311.1) to Khyex R. (MP340.8), NPS 8 replacement pipe, Sep 26 2020

	Forced Account Items (out of scope work)	1	LS	$6,711,915	estimate 10% of Base Lay Price
			Sub Total, Extra Work	**$6,711,915**	
F	**Third Party Field Support Charges**				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**
	Survey (engineering, legal, construction)	48		$1,912,000	
	Owner's Sweep	32	days	$111,533	assume 1.5 kms per day
	Ground Penetrating Radar (in swamp)	1	LS		allowance only
	CM/Inspection, 2 seasons	48	km	$3,346,000	budgetary estimate
	Inspection on access and clearing	1	LS	$750,000	
	NDT	48	km	$1,673,000	
	Caliper tool	1	LS	$80,000	allowance only
	Infra red scan if any burning	1	LS	$50,000	Oveflight + develop data
	Seeding and reclamation of work space	121	ha	$1,210,000	1
	Reclamation after Contractor warranty	48	km	$1,195,000	Allowance
			Sub Total, Field Support	**$10,327,533**	
	Interim Total, All Construction Costs (per all above Subtotals):			**$174,817,971**	
G	**Pre-Construction Project Costs for NPS 16 pipe**				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**
	Land and Stakeholder Relations	48	km	$2,640,000	$55,000/km
	Environmental & Regulatory, to approvals	48	km	$960,000	use $20,000/km for terrain
	Engineering (c/w HDD, CP and Geotech)	48	km	$1,632,000	use $34,000/km for terrain
	Pipe Material, Mainline, FBE/ARO coated	50	km	$2,975,000	$59,500/km prior 8" project
	Pipe handling, storage & caps	50	km	$325,000	estimate from previous data
	Mainline Block Valve assemblies, fabricated	2	each	$100,000	
	Pig Trap assemblies, fabricated	2	each	$170,000	
	1nduction Bends manufacture	25	each	$50,000	estimate one every 2 km
	Sub Total, Pre-Construction Project Costs			**$8,852,000**	
H	**Other Miscelaneous Project Costs**				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**
	CP Installation	48	km	$177,600	
	Environmental Inspection	48	km	$336,000	10% of CM & Inspection
	Tunnel at Razorback (potential)	450	m	$31,500,000	field evaluate to try to avoid
		Sub Total, Other Miscelaneous		**$32,013,600**	
	Sub-Total, All costs before Owner's Costs and Contingency			**$215,683,571**	
	Owner's Internal Costs (estimate 8% of TIC)			**$17,254,686**	
	Contingency (estimate 20% of TIC)			**$43,136,714**	20% of TIC for a Class 5 estimate
	Escalation (2.68% p.a. on construction, years 2 & 3)			**$5,622,146**	20% yr 1; 40% yr 2; 40% yr 3
	Segment 1, 48 km, Total Cost			**$281,697,117**	$5,900,652
					TIC per km

Notes :

1) No allowance included for marine clay
2) Third party field costs have been elevated to reflect expected slow production
3) All "Pre-Construction" costs derived from data on other recent projects of similar diameter

PNG, Prince Rupert Upgrade, Capital Cost Estimate (Class 5, max +/-)

Segment 2, Khyex (MP 340.8) to Galloway Rapids (MP364.5), NPS 8 replacement pipe, Sep 26 2020

A — Estimated Base Lay Cost

Item / WBS	Description	Factor	Length (m)	Value	Notes
	Blended base lay price	1	38,100	$26,282,900	$280/m reference base case
	Slack length addition	0.0125	0		$690/m average BLP
	Premium for winter construction (add 12%)	0.12	0		
	Allowance for re-routes		0		
			Sub Total, Base Lay Price	**$26,282,900**	

B — Miscellaneous Early Works

Item / WBS	Description	Quantity	Unit	Value	Comment
	Project Mob/Demob Allowance	1	LS	$750,000	for travel distance
	Helicopter support for early works	1	LS	$1,440,000	6hrs x 60d x ($4000)
	Access Road Upgrade and development	1	LS	$1,500,000	reactivation. multi seasons
	Camp site development /cleanup	1	LS	$250,000	may re-use Salvus site
	Allowance for camp	1	LS	$15,000,000	small camp, up to 150 people
	Stockpiles, Development Allowance	1	LS	$100,000	expect Rupert industrial site
	Barge landings	0	LS	$0	
	Barge services, 10 months x25d/mo.	0	mo	$0	
	pipe transport and stockpile	39000	m	$585,000	
	Security on stockpile, for 2 seasons	100	days	$250,000	
	Log Clear and haul logs	15	km	$2,325,000	15 km x (15 m ROW + 15%EWS)
	Prime Contractor support to access & clear	15	km	$675,000	15 km cleared
	Geotech/coring program (heli premium)	3	holes	$270,000	test holes at Lachmach R
	Sub Total, Miscellaneous Early Works			**$23,145,000**	

C — Incremental Lump Sums

Item / WBS	Description	Quantity	Unit	Value	Comment
	Lachmach R. HDD	650	m	$1,300,000	assume $2000/m
	Casing allowance for drill, includes casing	60	m	$72,000	subsurface likely cobble
	Bridge on Lachmach to support construction	1	each	$1,500,000	
	Mud management and disposal from HDDs	60	m	$36,000	allowance only
	water crossings, allowance	25	each	$3,750,000	by-pass and open-cut
	Geohazard allow., avalanche chutes/drains	1	each	$250,000	allowance only
	Environmental controls for run-off	38	km	$1,520,000	silt fence, waddles, catchments
	Highway Crossings	240	m	$288,000	3 crossings, 80 m each
	Railway crossings	0	each	$0	
	FSR Roads	1	each	$50,000	
	AC Mitigation (paralleling high voltage lines)	6300	m	$157,500	25 km abutted to powerline
	install Pigging faciliites each end of loop	2	each	$250,000	with expanding site and fence
	install prefabricated Valve Assemblies	2	each	$250,000	
	Site development/fencing and access road	2	each	$200,000	
	access mats for dead air space (buy)	500	each	$500,000	includes cleaning and trucking
	Allowance for access mats, rent	50		$75,000	$10/d x 120 d + truck + clean
			Sub Total, Lump Sums	**$10,198,500**	

D — Unit Price Items

Item / WBS	Description	Quantity	Unit	Value	Comment
	Incremental Unit Price (cost/m) Items	1	LS	$3,942,435	estimate 15% of BLP
			Sub Total, Unit Price Items	**$3,942,435**	

E — Extra Work (out of scope)

Item / WBS	Description	Quantity	Unit	Value	Comment
	Forced Account Items (out of scope work)	1	LS	$2,628,290	estimate 10% of Base Lay Price
			Sub Total, Extra Work	**$2,628,290**	

F — Third Party Field Support Charges

PNG, Prince Rupert Upgrade, Capital Cost Estimate (Class 5, max +/-)

Segment 2, Khyex (MP 340.8) to Galloway Rapids (MP364.5), NPS 8 replacement pipe, Sep 26 2020

Item / WBS	Description	Quantity	Unit	Value	Comment
	Survey (engineering, legal, construction)	38		$1,900,000	premium for terrain
	Owner's Sweep	38	days	$133,000	assume 1.0 kms per day
	Ground Penetrating Radar (in swamp)	1	LS	$100,000	allowance only
	CM/Inspection	38	km	$3,800,000	budgetary estimate
	Inspection on access and clearing	1	LS	$750,000	
	NDT	38	km	$1,330,000	
	Caliper tool	1	LS	$50,000	allowance only
	Infra red scan if any burning	1	LS	$15,000	Oveflight + develop data
	Seeding and reclamation of work space	38	km	$285,000	1
	Reclamation after Contractor warranty	38	km	$760,000	Allowance
		Sub Total, Field Support		$9,123,000	
	Interim Total, All Construction Costs (per all above Subtotals):			$75,320,125	
G	Pre-Construction Project Costs for NPS 8 pipe				
Item / WBS	Description	Quantity	Unit	Value	Comment
	Land and Stakeholder Relations	38	km	$2,090,000	$55,000/km
	Environmental & Regulatory, to approvals	38	km	$760,000	use $20,000/km for terrain
	Engineering (c/w HDD, CP and Geotech)	38	km	$1,292,000	use $34,000/km for terrain
	Pipe Material, Mainline, FBE/ARO coated	40	km	$2,380,000	$59,500/km prior 8" project
	Pipe handling, storage & caps	40	km	$260,000	estimate from previous data
	Mainline Block Valve assemblies, fabricated	2	each	$100,000	
	Pig Trap assemblies, fabricated	2	each	$170,000	
	1nduction Bends manufacture	19	each	$38,000	estimate one every 2 km
	Sub Total, Pre-Construction Project Costs			$7,090,000	
H	Other Miscelaneous Project Costs				
Item / WBS	Description	Quantity	Unit	Value	Comment
	CP Installation	38	km	$140,600	
	Environmental Inspection	38	km	$380,000	10% of CM & Inspection
		Sub Total, Other Miscelaneous		$520,600	
	Sub-Total, All costs before Owner's Costs, Contingency and Escalation			$82,930,725	
	Owner's Internal Costs (estimate 8% of TIC)			$6,634,458	
	Contingency (estimate 20% of TIC)			$16,586,145	20% of TIC for a Class 5+ estimate
	Escalation (2.68% p.a. on construction, years 2 & 3)			$2,422,295	20% yr 1; 40% yr 2; 40% yr 3
	Segment 2, 38 km, Total Cost			$108,573,623	$2,849,701
					TIC per km

Notes :

1) No allowance included for marine clay
2) Third party field costs have been elevated to reflect expected slow production
3) All "Pre-Construction" costs derived from data on other recent projects of similar diameter

Attachment B

Cost estimates

Other Pipeline Segments Considered and Estimated

PNG, Prince Rupert Upgrade, Class V Capital Cost Estimate

Segment 3, Terrace (MP273.5) to Dasque Cr. (MP290.0), NPS 16 replacement pipe, Sep 26 2020

A	Estimated Base Lay Cost				
Item / WBS	**Description**	**Factor**	**Length (m)**	**Value**	**Notes**
	Blended base lay price	1	26,550	$32,815,800	$675/m reference base case
	Slack length addition	0.0125	0		
	Premium for winter construction (add 12%)	0.12	0		
	Allowance for re-routes		0		
			Sub Total, Base Lay Price	**$32,815,800**	

B	Miscellaneous Early Works				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**
	Project Mob/Demob Allowance	1	LS	$750,000	Incremental for distance
	Helicopter support for early works	1	LS	$360,000	3hrs x 30d x $4000
	Access Road Upgrade and development	1	LS	$500,000	reactivation. multi seasons
	Camp site development /cleanup	1	LS	$200,000	could be barge based
	Allowance for small camp (up to 150 people)	1	LS	$15,000,000	
	Stockpile Development Allowance	1	LS	$100,000	Terrace industrial space
	Barge landings (allowed for 5 @150,000 each)	0	LS	$0	
	Barge services, 10 months x25d/mo.	0	mo	$0	$10,000/d ave., $20,000 peak
	pipe transport and stockpile	27500	m	$550,000	
	Security on stockpile, for 2 seasons	180	days	$450,000	90 d x 2 seasons
	Timber harvest logging, 20 km	5600	m3	$700,000	8 loads/km @ 35 m3/load
	Timber trucking	160	loads	$400,000	8 loads/km x 25 km
	clear/grubb/dispose, 22 km x 15 m wide	36	ha	$720,000	add 10% for EWS
	mulching, 25 km x 15 m wide	30	ha	$450,000	
	Prime Contractor support to access & clear	22	km	$440,000	40 km cleared
	Geotech/coring program (heli premium)	4	holes	$360,000	Lakelse
			Sub Total, Miscellaneous Early Works	**$20,980,000**	

C	Incremental Lump Sums				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**
	Lakelse HDD (600 metres x $3,500/m)	750	m	$2,625,000	
	Drain/fan complex (MP 289)	5	each	$250,000	Assume open cut
	Dasque suspended xing (allowed 150 m)	0	m	$0	
	Casing allowance for drills	80	m	$120,000	subsurface likely cobble
	Mud management and disposal from HDDs	1	m	$200,000	allowance only
	Geohazard allowance for avalanch chutes	0	each	$0	allowance only
	Highway Crossing at MP 274, HD Bore	80	m	$80,000	
	Railway crossings	0		$0	no railway
	FSR Roads (assumed open cut in BLP)	0		$0	
	Assumed 5 water course/drain crossings	5	each	$250,000	incremental to Base Lay
	AC Mitigation (paralleling high voltage lines)	15000	m	$375,000	
	install Pigging faciliites each end of loop	2	each	$500,000	with expanding site and fence
	install 1 prefabricated Valve Assemblies	1	each	$125,000	
	1 Site development/fencing and access road	1	each	$100,000	
	access mats for dead air space (buy)	0	each	$0	includes cleaning and trucking
	Allowance for 100 access mats, rent	100		$150,000	$10/d x 120 d + truck + clean
			Sub Total, Lump Sums	**$4,775,000**	

D	Unit Price Items				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**
	Incremental Unit Price (cost/m) Items	1	LS	$4,922,370	estimate 15% of BLP
			Sub Total, Unit Price Items	**$4,922,370**	

PNG, Prince Rupert Upgrade, Class V Capital Cost Estimate

Segment 3, Terrace (MP273.5) to Dasque Cr. (MP290.0), NPS 16 replacement pipe, Sep 26 2020

E	**Extra Work (out of scope)**				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**
	Forced Account Items	1	LS	$3,281,580	estimate 10% of Base Lay Price
		Sub Total, Extra Work		**$3,281,580**	
F	**Third Party Field Support Charges**				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**
	Survey, engineering, legal, construction	27		$1,350,000	
	Owner's Sweep	18	days	$63,000	assume 1.5 kms per day
	CM/Inspection, 2 seasons	27	km	$3,510,000	budgetary estimate
	Inspection on access and clearing	1	LS	$450,000	
	NDT	27	km	$1,080,000	
	Caliper tool	1	LS	$75,000	allowance only
	Infra red scan if any burning	1	LS	$10,000	Oveflight + develop data
	Seeding and reclamation of work space	1	LS	$90,000	Allowance
	Reclamation after Contractor warranty	1	LS	$90,000	Allowance
		Sub Total, Field Support		**$6,718,000**	
	Interim Total, All Construction Costs (per all above Subtotals):			**$73,492,750**	
G	**Pre-Construction Project Costs for NPS 16 pipe**				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**
	Land and Stakeholder Relations	27	km	$2,092,500	$77,500/km
	Environmental & Regulatory, to approvals	27	km	$675,000	use $25,000/km for terrain
	Engineering (c/w HDD, CP and Geotech)	27	km	$1,215,000	use $45,000/km for terrain
	Pipe Material, Mainline	27.5	km	$4,226,750	$153,700/km
	Pipe handling, storage & caps	27.5	km	$519,750	
	Mainline Block Valve assemblies, fabricated	1	each	$300,000	
	Pig Trap assemblies, fabricated	2	each	$600,000	
	1nduction Bends manufacture	15	each	$150,000	estimate one every 2 km
		Sub Total, Pre-Construction Project Costs		**$9,779,000**	
H	**Other Miscelaneous Project Costs**				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**
	CP Installation	27	km	$99,900	
	Environmental Inspection	27	km	$351,000	10% of CM & Inspection
		Sub Total, Other Miscelaneous		**$450,900**	
	Sub-Total, All costs before Owner's Costs and Contingency			**$83,722,650**	
	Owner's Internal Costs (estimate 8% of TIC)			**$6,697,812**	
	Contingency (estimate 20% of TIC)			**$16,744,530**	20% of TIC for a Class 5 estimate
	Escalation (2.68% p.a. on construction, years 2 & 3)			**$2,363,527**	20% yr 1; 40% yr 2; 40% yr 3
	Segment 3, 27 km, Total Cost			**$109,528,519**	

Notes :

1) No allowance included for marine clay
2) Third party field costs have been elevated to reflect expected slow production
3) All Pre-Construction costs derived from data on other recent projects of similar diameter

PNG, Prince Rupert Upgrade, Capital Cost Estimate (Class 5, max +/-)

Segment 4, Dasque (MP 290.0) to Salvus (MP311.1), NPS 8 replacement pipe, Sep 26 2020

Item / WBS	Description	Factor	Length (m)	Value	Notes
A	**Estimated Base Lay Cost**				
	Blended base lay price	1	34,000	$29,485,121	$280/m reference base case
	Slack length addition	0.0125	0		$867/m average BLP
	Premium for winter construction (add 12%)	0.12	0		
	Allowance for re-routes		0		
			Sub Total, Base Lay Price	**$29,485,121**	

Item / WBS	Description	Quantity	Unit	Value	Comment
B	**Miscellaneous Early Works**				
	Project Mob/Demob Allowance	1	LS	$750,000	for travel distance
	Helicopter support for early works	1	LS	$8,280,000	4hrs x 180d x ($4000 + $7500)
	Access Road Upgrade and development	1	LS	$3,000,000	reactivation. multi seasons
	Camp site development /cleanup	1	LS	$400,000	could be barge based
	Allowance for camp	1	LS	$20,000,000	
	Stockpiles, Development Allowance	2	LS	$400,000	haul to island
	Barge landings	5	LS	$750,000	allow @150,000 each
	Barge services, 10 months x25d/mo.	10	mo	$2,500,000	$10,000/d ave., $20,000 peak
	pipe transport and stockpile	34500	m	$517,500	
	Security on stockpile, for 2 seasons	365	days	$912,500	2 x 145d x 2 seasons
	Log Clear and haul logs	20	km	$3,500,000	20 km x (15 m ROW + 15%EWS)
	Prime Contractor support to access & clear	20	km	$660,000	40 km cleared
	Geotech/coring program (heli premium)	16	holes	$1,440,000	Kasiks & Khyex crossings
			Sub Total, Miscellaneous Early Works	**$43,110,000**	

Item / WBS	Description	Quantity	Unit	Value	Comment
C	**Incremental Lump Sums**				
	Dasque aerial x-ing	150	m	$2,250,000	$2,000/m for location
	expansion loops (one each side of aerial)	2	each	$350,000	
	2 tunnels at pinched off noses	675	m	$40,500,000	
	2 Skeena backchanels HDDs	5000	m	$5,000,000	assume 2,500 m each
	3 Skeena HDDs, geometry & substrate issues	3000	m	$6,375,000	assume 1000 m each
	Casing allowance for drills, includes casing	600	m	$720,000	subsurface likely cobble
	Mud management and disposal from HDDs	8000	m	$1,760,000	allowance only, island premium
	Geohazard allow., avalanche chutes/drains	1	each	$1,200,000	allowance only
	Highway Crossing	0	m	$0	
	Railway crossings	0		$0	
	FSR Roads	0		$0	
	Assumed water course/drain crossings	15	each	$750,000	dam & pump
	AC Mitigation (paralleling high voltage lines)	25000	m	$625,000	25 km abutted to powerline
	install Pigging faciliites each end of loop	2	each	$250,000	with expanding site and fence
	install prefabricated Valve Assemblies	4	each	$500,000	
	Site development/fencing and access road	4	each	$400,000	
	access mats for dead air space (buy)	1000	each	$1,000,000	includes cleaning and trucking
	Allowance for 100 access mats, rent	200		$300,000	$10/d x 120 d + truck + clean
			Sub Total, Lump Sums	**$61,980,000**	

Item / WBS	Description	Quantity	Unit	Value	Comment
D	**Unit Price Items**				
	Incremental Unit Price (cost/m) Items	1	LS	$4,422,768	estimate 15% of BLP
			Sub Total, Unit Price Items	**$4,422,768**	

Item / WBS	Description	Quantity	Unit	Value	Comment
E	**Extra Work (out of scope)**				
	Forced Account Items (out of scope work)	1	LS	$2,948,512	estimate 10% of Base Lay Price

PNG, Prince Rupert Upgrade, Capital Cost Estimate (Class 5, max +/-)

Segment 4, Dasque (MP 290.0) to Salvus (MP311.1), NPS 8 replacement pipe, Sep 26 2020

			Sub Total, Extra Work	**$2,948,512**	
F	**Third Party Field Support Charges**				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**
	Survey (engineering, legal, construction)	34		$1,700,000	
	Owner's Sweep	34	days	$119,000	assume 1.0 kms per day
	Ground Penetrating Radar (in swamp)	1	LS		allowance only
	CM/Inspection, 2 seasons	34	km	$4,930,000	budgetary estimate
	Inspection on access and clearing	1	LS	$1,500,000	
	NDT	34	km	$1,360,000	
	Caliper tool	1	LS	$150,000	allowance only
	Infra red scan if any burning	1	LS	$25,000	Oveflight + develop data
	Seeding and reclamation of work space	31	ha	$314,600	1
	Reclamation after Contractor warranty	12	km	$300,000	Allowance
			Sub Total, Field Support	**$10,398,600**	
	Interim Total, All Construction Costs (per all above Subtotals):			**$152,345,001**	
G	**Pre-Construction Project Costs for NPS 8 pipe**				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**
	Land and Stakeholder Relations	34	km	$1,870,000	$55,000/km
	Environmental & Regulatory, to approvals	34	km	$680,000	use $20,000/km for terrain
	Engineering (c/w HDD, CP and Geotech)	34	km	$1,156,000	use $34,000/km for terrain
	Pipe Material, Mainline, FBE/ARO coated	35	km	$2,082,500	$59,500/km prior 8" project
	Pipe handling, storage & caps	35	km	$227,500	estimate from previous data
	Mainline Block Valve assemblies, fabricated	4	each	$200,000	
	Pig Trap assemblies, fabricated	2	each	$170,000	
	1nduction Bends manufacture	17	each	$34,000	estimate one every 2 km
	Sub Total, Pre-Construction Project Costs			**$6,420,000**	
H	**Other Miscelaneous Project Costs**				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**
	CP Installation	34	km	$125,800	
	Environmental Inspection	34	km	$493,000	10% of CM & Inspection
			Sub Total, Other Miscelaneous	**$618,800**	
	Sub-Total, All costs before Owner's Costs and Contingency			**$159,383,801**	
	Owner's Internal Costs (estimate 8% of TIC)			**$12,750,704**	
	Contingency (estimate 20% of TIC)			**$31,876,760**	20% of TIC for a Class 5+ estimate
	Escalation (2.68% p.a. on construction, years 2 & 3)			**$4,899,415**	20% yr 1; 40% yr 2; 40% yr 3
	Segment 4, 34 km, Total Cost			**$208,910,681**	$6,144,432
					TIC per km

Notes :

1) No allowance included for marine clay
2) Third party field costs have been elevated to reflect expected slow production
3) All "Pre-Construction" costs derived from data on other recent projects of similar diameter

PNG, Prince Rupert Upgrade, Class V Capital Cost Estimate

Segment 1, Salvus (MP311.1) to Khyex R. (MP340.8), NPS 16 replacement pipe, Sep 26 2020

A	Estimated Base Lay Cost				
Item / WBS	**Description**	**Factor**	**Length (m)**	**Value**	**Notes**
	Blended base lay price	1	47,740	$161,999,961	$675/m reference base case
	Slack length addition	0.0125	0		$3,207/m average BLP
	Premium for winter construction (add 12%)	0.12	0		
	Allowance for re-routes		0		
			Sub Total, Base Lay Price	**$161,999,961**	

B	Miscellaneous Early Works				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**
	Project Mob/Demob Allowance	1	LS	$750,000	for travel distance
	Helicopter support for early works	1	LS	$8,280,000	4hrs x 180d x ($4000 + $7500)
	Access Road Upgrade and development	1	LS	$3,000,000	reactivation. multi seasons
	Camp site development /cleanup	1	LS	$250,000	could be barge based
	Allowance for camp	1	LS	$25,000,000	
	2 Stockpiles, Development Allowance	1	LS	$200,000	1 in Terrace industrial space
	Barge landings (allowed for 5 @150,000 each)	3	LS	$450,000	allow for 3 @150,000 each
	Barge services, 10 months x25d/mo.	10	mo	$2,500,000	$10,000/d ave., $20,000 peak
	pipe transport and stockpile	49000	m	$980,000	
	Security on stockpile, for 2 seasons	580	days	$1,450,000	2 x 145d x 2 seasons
	Timber harvest logging, 20 km	5600	m3	$700,000	8 loads/km @ 35 m3/load
	Timber trucking	160	loads	$400,000	8 loads/km x 25 km
	clear/grubb/dispose, 32 km x 15 m wide	53	ha	$1,060,000	add 10% for EWS
	mulching, 25 km x 15 m wide	30	ha	$450,000	
	Prime Contractor support to access & clear	22	km	$440,000	40 km cleared
	Geotech/coring program (heli premium)	6	holes	$540,000	Kasiks & Khyex crossings
			Sub Total, Miscellaneous Early Works	**$46,450,000**	

C	Incremental Lump Sums				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**
	Khasiks HDD	650	m	$2,600,000	$4,000/m for location
	Bridge for Kasiks to support construction	1	each	$1,500,000	
	Cable crane setup/operate/service/remove	2	each	$18,000,000	Razor, East side & West side
	Khyex trenchless crossing	650	m	$2,600,000	$4,000/m for location
	Bridge for Khyex to support construction	1	each	$2,000,000	
	Casing allowance for drills, includes casing	120	m	$180,000	subsurface likely cobble
	Mud management and disposal from HDDs	2	m	$350,000	allowance only
	Geohazard allow., avalanche chutes/drains	1	each	$2,500,000	allowance only
	Environ. controls, silt fence/filters/catchments			$2,500,000	allowance only
	Highway Crossing	0	m	$0	
	Railway crossings	0		$0	
	FSR Roads	0		$0	
	Assumed water course/wetland crossings	20	each	$3,500,000	dam & pump
	AC Mitigation (paralleling high voltage lines)	500	m	$12,500	
	install Pigging faciliites each end of loop	2	each	$500,000	with expanding site and fence
	install 2 prefabricated Valve Assemblies	2	each	$500,000	
	2 Site development/fencing and access road	2	each	$350,000	
	access mats for dead air space (buy)	500	each	$500,000	includes cleaning and trucking
	Allowance for 100 access mats, rent	100		$150,000	$10/d x 120 d + truck + clean
			Sub Total, Lump Sums	**$37,742,500**	

D	Unit Price Items				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**
	Incremental Unit Price (cost/m) Items	1	LS	$24,299,994	estimate 15% of BLP
			Sub Total, Unit Price Items	**$24,299,994**	

PNG, Prince Rupert Upgrade, Class V Capital Cost Estimate

Segment 1, Salvus (MP311.1) to Khyex R. (MP340.8), NPS 16 replacement pipe, Sep 26 2020

E	Extra Work (out of scope)				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**
	Forced Account Items (out of scope work)	1	LS	$16,199,996	estimate 10% of Base Lay Price
			Sub Total, Extra Work	**$16,199,996**	
F	Third Party Field Support Charges				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**
	Survey (engineering, legal, construction)	48		$2,390,000	
	Owner's Sweep	32	days	$111,533	assume 1.5 kms per day
	Ground Penetrating Radar (in swamp)	1	LS		allowance only
	CM/Inspection, 2 seasons	48	km	$6,214,000	budgetary estimate
	Inspection on access and clearing	1	LS	$750,000	
	NDT	48	km	$1,912,000	
	Caliper tool	1	LS	$150,000	allowance only
	Infra red scan if any burning	1	LS	$50,000	Oveflight + develop data
	Seeding and reclamation of work space	121	ha	$1,210,000	1
	Reclamation after Contractor warranty	20	LS	$1,800,000	Allowance
			Sub Total, Field Support	**$14,587,533**	
	Interim Total, All Construction Costs (per all above Subtotals):			**$301,279,985**	
G	Pre-Construction Project Costs for NPS 16 pipe				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**
	Land and Stakeholder Relations	48	km	$3,720,000	$77,500/km
	Environmental & Regulatory, to approvals	48	km	$1,200,000	use $25,000/km for terrain
	Engineering (c/w HDD, CP and Geotech)	48	km	$2,160,000	use $45,000/km for terrain
	Pipe Material, Mainline	50	km	$7,685,000	$153,700/km
	Pipe handling, storage & caps	50	km	$945,000	
	Mainline Block Valve assemblies, fabricated	2	each	$600,000	
	Pig Trap assemblies, fabricated	2	each	$600,000	
	1nduction Bends manufacture	25	each	$250,000	estimate one every 2 km
		Sub Total, Pre-Construction Project Costs		**$17,160,000**	
H	Other Miscelaneous Project Costs				
Item / WBS	**Description**	**Quantity**	**Unit**	**Value**	**Comment**
	CP Installation	48	km	$177,600	
	Environmental Inspection	48	km	$624,000	10% of CM & Inspection
	Tunnel at Razorback (potential)	450	m	$31,500,000	field evaluate to try to avoid
			Sub Total, Other Miscelaneous	**$32,301,600**	
	Sub-Total, All costs before Owner's Costs and Contingency			**$350,741,585**	
	Owner's Internal Costs (estimate 8% of TIC)			**$28,059,327**	
	Contingency (estimate 20% of TIC)			**$70,148,317**	20% of TIC for a Class 5 estimate
	Escalation (2.68% p.a. on construction, years 2 & 3)			**$9,689,164**	20% yr 1; 40% yr 2; 40% yr 3
	Segment 1, 48 km, NPS 16 size, Total Cost			**$458,638,393**	$9,607,004
					TIC per km

Notes :

1) No allowance included for marine clay
2) Third party field costs have been elevated to reflect expected slow production
3) All "Pre-Construction" costs derived from data on other recent projects of similar diameter

Appendix H – Solaris - Terrace to Prince Rupert LNG Concept Evaluation

Pacific Northern Gas Ltd.	LNG CONCEPT EVALUATION	SOLARIS MANAGEMENT CONSULTANTS INC.

Project: LNG Concept Evaluation **Job No.:** TBD

Location: Terrace and Prince Rupert **Doc. No.:** PNG_LNGConcept_2020_08_18

Rev	Date (dd-mmm-yyyy)	Status	Prepared by	Checked by	Approved by
A	19-Aug-2020	Issued for Information	TIP	BGO	MJH
B	03-Sep-2020	Issued for Information	TIP	BGO	MJH

PACIFIC NORTHERN GAS

LNG CONCEPT EVALUATION

Prepared by:

Solaris Management Consultants Inc.

Project:	LNG Concept Evaluation	**Job No.:**	TBD
Location:	Terrace and Prince Rupert	**Doc. No.:**	PNG_LNGConcept_2020_08_18

REVISION HISTORY

DATE	PAGE / SECTION	DESCRIPTION
03-Sep-2020	Section 1.3	Include estimated power consumption rates in Tables 1 and 2
03-Sep-2020	Section 3.0	Revise Risks and Opportunities section as per client comments.

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DISCLAIMER

This report is conceptual in nature and represents the work of Solaris Management Consultants Inc. (Solaris-MCI), performed to recognized engineering principles and practices appropriate for conceptual engineering work and the terms of reference provided by Solaris-MCI's contractual customer, Pacific Northern Gas (the Customer). This report may not be relied upon for detailed implementation or any other purpose not specifically identified within this report. This report is confidential and prepared solely for the use of the Customer. The contents of this report may not be relied upon by any party other than the Customer, and neither Solaris-MCI, their sub-consultants nor their respective employees assume any liability for any reason, including, but not limited to, negligence, to any other party for any information or representation herein. The extent of any warranty or guarantee of this report or the information contained therein in favor of the Customer is limited to the warranty or guarantee, if any, contained in the contract between the Customer and Solaris-MCI.

1.0 INTRODUCTION

1.1 Project Location and Overview

Pacific Northern Gas Ltd (PNG) is evaluating the development of a LNG facility to process and liquefy natural gas and transport the LNG via a virtual pipeline to a downstream greenfield facility site near the industrial park on PNG's R5 site in Terrace, British Columbia, Canada.

The proposed facility will be capable of producing either:

- Option 1 – 100,000 gpd (This equates to approximately 8.6 MMscfd of feed gas required and does not include shrinkage for fuel gas)
- Option 2 – 250,000 gpd (This equates to approximately 20 MMscfd of feed gas required and does not include shrinkage for fuel gas)

of LNG on a continuous basis.

The design concept involves a vendor standardized gas processing package and LNG liquefaction facility with an LNG storage tank. The LNG will be pumped from the storage tank to fill LNG ISO containers that will be transported by truck from the facility to Prince Rupert.

The facility at Prince Rupert will be located at a site near PNG's Galloway Station where these LNG ISO Containers will be off-loaded into another LNG storage tank of similar size. This Prince Rupert facility will have the appropriate equipment to pump, vaporize and compress the natural has for PNG's HP and LP users in Prince Rupert.

Please see the LNG system schematic below:

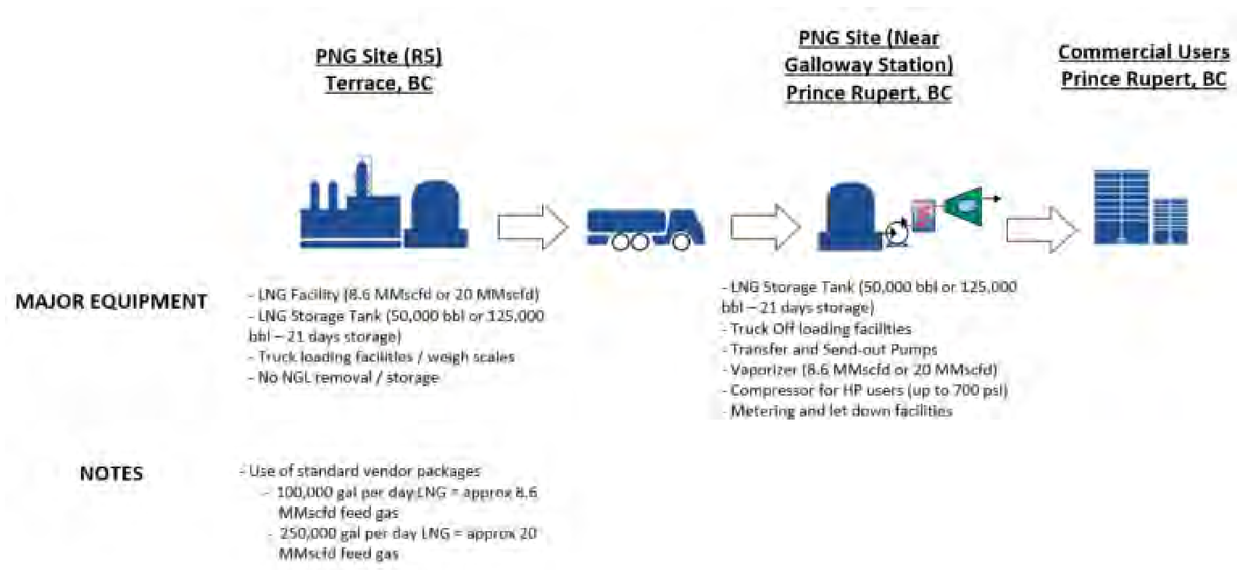

Figure 1: Proposed PNG LNG System Schematic

1.2 Key Assumptions

The following assumptions were made for this concept evaluation:

- LNG equipment is based on standardized vendor packages with the following design criteria:
  - 100,000 gallons per day Mixed Refrigerant System
  - 250,000 gallons per day Mixed Refrigerant System
- Mixed Refrigerant technology is assumed over Nitrogen Cycle
  - Experience has shown costs are relatively comparable between the two technologies, however power consumption is approximately 20-30% more for the Nitrogen cycle. Please note that other technology selection criteria should be evaluated in subsequent project phases.
- Gas analysis is based upon previous PNG projects conducted by Solaris in which case the gas is lean enough that NGL removal is not required. Therefore, NGL removal and storage has not been included in the cost estimate. This may be re-evaluated at subsequent phases of the project.
- 3 weeks storage capacity at both Terrace (R5) and Prince Rupert (Galloway) sites.
- Vaporizer and Compressor sized to be approximately the feed gas flowrate.
- 40 ft. Intermodal LNG ISO Containers used for transport.
- LNG Storage Tank assumed to be single or double containment. Full containment LNG tank considered, but deemed not necessary for this evaluation. This may be re-evaluated at subsequent phases of the project.
- OPEX costs are not included in this concept evaluation, including transport.
- Pipeline tie-in for feed gas to the LNG plant is relatively close to the facility and will not require a long inlet pipeline.

1.3 Major Equipment and Systems

The LNG facility will comprise of inlet facilities, gas treatment, liquefaction, LNG storage, boil-off gas handling, LNG trailer loading and all associated balance of plant items such as utilities, fire suppression system, civil works, etc.

These systems are widely available from multiple vendors at the proposed capacities.

In summary, the Terrace (R5) facility comprises of the following main processes and utility units.

Estimated power consumption rates have been included in order to gauge OPEX costs.

Table 1: Main Processes and Utility Units – Terrace (R5)

Unit Name	Description	Option 1		Option 2	
		Estimated Equip Costs	Estimated Power Consumption	Estimated Equip Costs	Estimated Power Consumption
Pipeline Interface System	Pipeline tie in, droplet/solids removal facilities, metering system, and overpressure protection (OPP) system.	$2.0 MM	0 kW	$3.0 MM	0 kW
Inlet Compression System	Compression of inlet feed gas to optimal liquefaction pressure. (TBC – but included in cost estimate)	$1.0MM	220 kW	$1.5 MM	552 kW
Mercury Removal System	Mercury removal based on a robust and non-regenerable Adsorbents bed (TBC). Required to protect liquefaction equipment.	$24.0 MM (Included in above pricing)	0 kW	$37.0 MM (Included in above pricing)	0 kW
Acid Gas Removal System	CO_2, H_2S and some sulphur components removed by using standard amine technology and design.		102 kW		255 kW
Molecular Sieve Dehydration System	Deep dehydration by regenerable molecular sieve beds.		40 kW		100 kW
Liquefaction System	Liquefaction by vendor technology using single mixed refrigerant cycle or nitrogen cycle (TBC).		3,098 kW (SMR technology)		7,744 kW (SMR technology)
Refrigerant Unloading, Storage and Make-up System	Make-up supply facilities for refrigerants. Methane, Ethane, Propane, Iso-Butane, Pentane, and Nitrogen will be supplied in required quantity and quality (as dictated by LNG vendor) to be used for refrigerant cycle. Storage vessels, compressors, and make up pumps, and truck loading facilities will be required.	$2.6MM	50 kW	$4.0 MM	125 kW
Boil-Off Gas Compression System	Compression of boil-off gas (BOG) from the liquefaction process, buffer storage, ISO container pre-cooling and loading process.	$1.0MM	108 kW	$1.5 MM	270 kW
Fuel Gas System	Inlet gas from inlet pipeline. This system will be comprised of a fuel gas filter, fuel gas heater, and redundant pressure let down stations.	$0.5 MM	0 kW	$0.6 MM	0 kW

Unit Name	Description	Option 1		Option 2	
		Estimated Equip Costs	Estimated Power Consumption	Estimated Equip Costs	Estimated Power Consumption
Associated Utility Systems	All required utility systems, e.g. instrument air, drain systems (LNG, Mixed Refrigerant, Amine), water treatment, flare or inert gas systems, thermal oxidizer, electric heating systems, process and utility heat mediums systems, etc.	$10 MM	750 kW	$15.0 MM	1875 kW
LNG Storage Tank	LNG Storage Tank will act as buffer storage when the facility needs to turn up or turndown its production. Sizing is approximately 50,000 bbls (Option 1) or 125,000 bbls (Option 2)	$24.0 MM (Installed cost)	18 kW	$42.0 MM (Installed cost)	45 kW
LNG Truck Loading	Weigh scales and 2 truck-loading facilities to load ISO containers with LNG. Includes 2 loading pumps.	$0.7 MM	36 kW	$1.0 MM	90 kW
ISO Container Inspection and Handling	ISO container certification, repair, and staging facilities for transport to the Prince Rupert (Galloway) facility. This area will include office, warehouse/shop, nitrogen facilities for purging, transport trucks, and reach stackers	$3.5 MM	40 kW	$4.5 MM	100kW
Fire Suppression System	Fire protection pumps and associated equipment.	$0.75 MM	200 kW	$1.25 MM	500 kW
Control Room, Warehouse, Communications	Used for operations and equipment storage. Electric building heaters.	$0.5 MM	150 kW	$0.5 MM	150 kW
Power Supply and backup power generation	Substation led by BC Hydro. Backup power will be from standby diesel generator.	$3.0 MM	0.5 MW Backup	$3.5 MM	1.0 MW Backup
TOTAL EQUIPMENT COST (excluding LNG Storage Tank)		$49.6 MM	Total Estimated Power Consumption = 4,812 kW (SMR Technology)	$73.4MM	Total Estimated Power Consumption = 11,806 kW (SMR Technology)
TOTAL INSTALLED COST of Equipment (excluding LNG Storage Tank)		$123.9 MM (Install factor = 2.5)		$183.4 MM (Install factor = 2.5)	
TOTAL INSTALLED COST of LNG Storage Tank		$24.0 MM		$42.0 MM	
TOTAL INSTALLED COST of Project		$147.9 MM		$225.4 MM	

In summary, the Prince Rupert (Galloway) facility comprises of the following main processes and utility units.

Table 2: Main Processes and Utility Units – Prince Rupert (Galloway)

Unit Name	Description	Option 1		Option 2	
		Estimated Equip Costs	Estimated Power Consumption	Estimated Equip Costs	Estimated Power Consumption
Boil-Off Gas Compression System	Compression of boil-off gas (BOG) from the LNG storage, ISO container un-loading process.	$1.0MM	108 kW	$1.5 MM	270 kW
Fuel Gas System	Inlet gas from inlet pipeline (TBC). This system will be comprised of a fuel gas filter, fuel gas heater, and redundant pressure let down stations.	$0.5 MM	0 kW	$0.6 MM	0 kW
Associated Utility Systems	All required utility systems, e.g. instrument air, drain systems (LNG), flare or inert gas systems, electric heating systems, process and utility heat mediums systems, etc.	$5.0 MM	500 kW	$7.5 MM	1250 kW
LNG Storage Tank	LNG Storage Tank will act as buffer storage when the facility needs to turn up or turndown its production. Sizing is approximately 50,000 bbls (Option 1) or 125,000 bbls (Option 2)	$24.0 MM (Installed cost)	18 kW	$42.0 MM (Installed cost)	45 kW
LNG Truck Un-Loading	Truck un-loading facilities to transfer LNG from ISO containers to LNG storage tank. Includes 2 pumps.	$0.7 MM	36 kW	$1.0 MM	90 kW
Pumps and Vaporizer	Vaporizer used to warm up LNG to a gaseous state. Assumed vaporizer sizing matches LNG inlet feed gas flowrate (i.e. 8.6 MMscfd and 20 MMscfd). PHM used in vaporizer.	$4.0 MM	50 kW	$7.0 MM	125 kW
Sales Gas Compressor	Sales gas compressor will be used to increase pressure of sales gas to 700 psig for PNG's HP users	$1.0MM	1,177 kW	$1.5 MM	2,942 kW
Metering and pressure let down stations	Metering facilities used for production accounting and pressure let down stations to regulate supply pressure to desired conditions.	$0.6 MM	0 kW	$0.8 MM	0 kW
Fire Suppression System	Fire protection pumps and associated equipment.	$0.75 MM	160 kW	$1.25 MM	400 kW
Control Room, Warehouse, Communications	Used for operations and equipment storage. Electric building heaters.	$0.5 MM	150 kW	$0.5 MM	150 kW

Unit Name	Description	Option 1		Option 2	
		Estimated Equip Costs	Estimated Power Consumption	Estimated Equip Costs	Estimated Power Consumption
Power Supply and backup power generation	Substation led by BC Hydro. Backup power will be from standby diesel generator.	$2.0 MM	0.5 MW Backup	$2.5 MM	0.75 MW Backup
TOTAL EQUIPMENT COST (excluding LNG Storage Tank)		$16.1 MM	Total Estimated Power Consumption = 2,199 kW	$24.1 MM	Total Estimated Power Consumption = 5,272 kW
TOTAL INSTALLED COST of Equipment (excluding LNG Storage Tank)		$40.1 MM (Install factor = 2.5)		$60.4 MM (Install factor = 2.5)	
TOTAL INSTALLED COST of LNG Storage Tank		$24.0 MM		$42.0 MM	
TOTAL INSTALLED COST of Project		$64.1 MM		$102.4 MM	

2.0 COST ESTIMATE SUMMARY

The total installed cost estimate for the entire project is summarized in Table 3 below:

Table 3: Terrace (R5) and Prince Rupert (Galloway) – Total Installed Cost Estimate for the Entire Project

Site Location	Option 1 (100,000 gpd, 8.6 MMscfd feed gas)	Option 2 (250,000 gpd, 20.0 MMscfd feed gas)
Terrace (R5)	TIC: $147.9 MM	TIC: $225.4 MM
Prince Rupert (Galloway)	TIC: $64.1 MM	TIC: $102.4 MM
TOTAL AACE Class 5 TIC (+50% / -20%) ($CAD)	(-20%: $169.6 MM) $212.0 MM (+50%: $318.0MM)	(-20%: $262.2 MM) $327.8 MM (+50%: $491.7 MM)

3.0 RISKS AND OPPORTUNITIES

The proposed PNG LNG project comes with many inherent risks surrounding the following topics:

- Technical
- Economic
- Environmental
- Commercial
- Operational
- Political

Many details will have to be identified and addressed in subsequent project phases. However, here are examples of general risks associated to LNG projects that should be addressed early on in the project life cycle:

- Liquefaction design/redundancy and contractual flexibility in terms of problems at the plant (i.e. plant availability and on-time%)
- Generally, the reliability of an LNG plant vs. a pipeline is likely much lower. The LNG supply chain will involve more components such as the LNG facility itself, trucking, compression, and vaporization.
- The design and construction of LNG facilities is also subject to considerable local and international design standards and regulations when compared to a pipeline and associated compressor stations.
- Increased level of safety and quality management to address LNG specific operating issues.
- Vendor price escalation and variability on multiple types of equipment. Much of the main LNG process equipment may be fabricated outside of Canada and therefore subject to currency exchange rate fluctuation and tariffs.
- Impurities produced from LNG facility operations need to be addressed due to issues of heightening environmental policies and regulations.
- Risk of LNG spills, vapour cloud, dispersion, ignition, and emergency response.
- Warm and cold start-up times to be aligned with baseload operation.
- Many new contracts models to be developed, risk of default from multi-party value chain.
- Risk of schedule delays and cost-over runs during construction. Project execution plan and contracting strategy to be established early in the project in order to mitigate these risks.
- Possible limitations to future expansion. Pre-investment strategy to be evaluated.
- Increased stakeholder complexity with multiple locations in semi-urban areas.
- Insurance premiums
- Security risk management plan

Specifically, here are a few examples of risks and opportunities associated to a PNG LNG facility in Terrace and Prince Rupert:

- Due to the size of the equipment, this area makes it easy for equipment transport by truck or barge into Port Edward. Logistics modelling is recommended to optimize production, storage, and transportation designs.
- Regulatory applications to the BC Oil and Gas Commission (OGC) a relatively clear in the OGC's LNG Facility Permit Application and Operations Manual. However, proper execution during public consultation and first nations engagement is highly recommended especially if proposed facility location is near town sites.
- Trucking risks are also a concern as potential competing projects may increase the volume of truck traffic on Highway 16 to Prince Rupert.
- Competing projects, such as LNG Canada, in the area will also cause a strain on labour supply.
- Weather risks during construction and operation (i.e. Highway 16 subject to road closures in winter, less reliability)
- Risk of facility siting and layout issues as there is no site actually identified yet (only proxy). New land required in Terrace and Prince Rupert area. A Quantitative Risk Assessment (QRA) and Siting Study will be required as part of the BC OGC LNG Facility Application.
- Reliability and redundancy of power supply and associated costs is also a risk due to the exposure to BC Hydro supply and labour rates. BC Hydro service contracts are also subject to planned and unplanned outages.
- Lack of operating experience in the service area. Therefore, additional expertise and systems need to be established within PNG. Additional employees and training will be required.

4.0 CLOSING REMARKS

The concepts contained in this LNG facility evaluation are relatively high level and based upon Solaris' experience in LNG and natural gas processing. The intent is to assist PNG stakeholders in the key decisions they will have to make in undertaking a project of this nature.

Any of these ideas identified can be discussed or analyzed in further detail should PNG require.

Appendix I – Lauren - Upgrade Feasibility Report (Confidential)

Appendix J – Lauren - Design Basis Memorandum

DESIGN BASIS MEMORANDUM

Salvus to Galloway Upgrades

Pacific Northern Gas Ltd.

Doc No: PNG006-011_02_4100_001

Rev	Date	Description	By	Checked	Approved
C	Sep 30, 2020	Re-Issued for FEED	Jhonatan Díaz	Alvin Kwan	Graham Pavlik
B	March 26, 2020	Issued for FEED	Jhonatan Díaz	Alvin Kwan	Graham Pavlik
A	December 18, 2019	Issued for Review	Jhonatan Díaz	Alvin Kwan	Graham Pavlik

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1.0 INTRODUCTION

1.1. Background

The Pacific Northern Gas Ltd. (PNG) Prince Rupert Mainline transmission pipeline transports gas from Summit Lake, BC to Port Edward near Prince Rupert, BC.

PNG is proposing to conduct infrastructure upgrades to repair and replace sections along an 80 km segment of the eight-inch (219.1 mm) diameter Prince Rupert Mainline, the westerly most segment of PNG's West Transmission Gas line. The proposed work will take place from the Salvus maintenance yard to the Galloway pressure regulating station.

PNG has requested Lauren Services ("Lauren") to provide Project Management and Engineering services to support the FEED portion of the project. The project goal is to:

- Ensure the continued safety of the pipeline and reliability of natural gas service
- Enhance pipeline stability by addressing geotechnical risks from landslide, rockfall, avalanche, and washout; and
- Ensure long-term reliable energy supply to thousands of residential, commercial, and industrial customers throughout the communities we serve in the Prince Rupert and Port Edward region.

During the FEED portion of the work, Class 3 cost estimates on selected alternative(s) are to be developed in order to support a Certificate of Public Convenience and Necessity (CPCN) application to the British Columbia Utilities Commission (CPCN).

Construction is expected to occur between 2021 and 2023.

1.2. Purpose

The purpose of this Design Basis Memorandum is to summarize the physical environment, operating conditions, design requirements, and methodologies for pipeline and civil design of the FEED phase of the Salvus to Galloway remediation project. The Project will be designed and constructed in accordance with federal, provincial and municipal regulations, client specifications, and industry codes and standards as defined in this document.

1.3. Pipeline Locations

The Mainline section of interest runs between Salvus Station and Galloway Station, spanning an approximate length of approximately 80 km (50 miles) and divided in 4 sections:

- Salvus to Razorback (MP 311-326)
- Razorback to Lachmach (MP 326-340)
- Lachmach to Prudhomme Summit (MP 340-352)
- Prudhomme Summit to Salvus (MP 352-361).

Salvus Station is located approximately 54 km west of Terrace, BC. Galloway station is located approximately 12 km southeast of Prince Rupert, BC.

Locations of the main features for the pipeline section between Salvus and Galloway can be summarized (from upstream to downstream) and generally from east to west, as follows:

Table 1 – Locations of Main Pipeline Sections – Salvus to Galloway

Location	MP	Nearest Town
Salvus Facility	311	Approx. 54 km West of Terrace BC
One-night creek Block Valve	323	Approx. 66 km West of Terrace BC
Razorback	326	Approx. 70 km West of Terrace BC
Bowling Alley	327	Approx. 70 km West of Terrace BC
Khyex River Valve Site	340	Approx. 32 km South East of Prince Rupert BC
Lachmach Valve Site	344	Approx. 32 km South East of Prince Rupert BC
Prudhomme Summit	352	Approx. 18 km South East of Prince Rupert BC
Galloway Facility	361	Approx. 12 km South East of Prince Rupert BC

Figure 1 – Pipeline Route Salvus to Galloway

Table 2 – Project Segments – Salvus to Galloway

Project Segment	Location	MP	Approximate KM Distance
1	Salvus to Razorback	311-326	24
2	Razorback to Lachmach	326-340	22.5
3	Lachmach to Prudhomme Summit	340-352	19
4	Prudhomme Summit to Galloway Station	352-361	14.5

1.4. Definitions

- **Class Location** - a geographical area classified according to its approximate population density and other characteristics that are considered when designing and pressure testing piping to be located in the area.
- **Company** – Pacific Northern Gas Ltd.
- **CSA Z662** – CSA Z662-19 Oil and Gas Pipeline Systems
- **ILI Priority** – Immediate, P1, P2, or P3 as defined by Dynamic Risk for prioritization of ILI sites based on industry best practices.
- **Isolating valve** — a valve for isolating laterals, stations, pressure-relieving installations, and other facilities.
- **Mainline, the** – PNG's pipeline travelling from Summit Lake to Ridley Terminal in Prince Rupert BC.
- **Sectionalizing valve**— a valve for isolating a segment of a pipeline.
- **Owner** – The project owner, Pacific Northern Gas Ltd.
- **Engineer** – The engineering consultant, Lauren Services
- **Specifications** – Codes, Regulations, and Specifications as listed in Compliance Matrix
- **Contractor** — the prime contractor and any subcontractors engaged in work covered by this document.

1.5. Acronyms

- **AOP** – Areas of Potential
- **ASME** – American Society of Mechanical Engineers
- **BCOGC** – British Columbia Oil and Gas Commission
- **CCC –** Continuous Concrete Coating/ Concrete Compressor Coating
- **CIPS** – Closed Interval Potential Survey
- **CP** – Cathodic Protection
- **CSA** - Canadian Standards Association
- **DBM** – Design Basis Memorandum
- **DFBE** – Dual Fusion Bond Epoxy (pipe coating)
- **FBE** – Fusion Bonded Epoxy (pipe coating)
- **FEED** – Front End Engineering and Design
- **GIS** – Geographical Information System
- **ILI** – Inline Inspection
- **mm** - millimetres
- **MOP** – Maximum Operating Pressure
- **MTR** – Manufacturing Test Reports
- **NOP** – Normal Operating Pressure
- **NPS** – Nominal Pipe Size
- **OD** – Outside Diameter
- **PFR** – Preliminary Field Reconnaissance

- **PNG** – Pacific Northern Gas
- **ROW** – Right of Way
- **SMYS** – Specified Minimum Yield Strength
- **TWS** – Temporary Workspace
- **WT** – Wall Thickness

2.0 DESIGN CODES, STANDARDS, AND SPECIFICATIONS

The design and construction of the pipeline will be in accordance with the Oil and Gas Activities Act (“OGAA”). In general, the pipeline will meet or exceed the system requirements of CSA Z662-19 Oil and Gas Pipeline Systems, applicable PNG Standard Practice Instructions, and other standards and codes referenced herein.

Refer to the Appendix A - PNG006-011_02_6000_006_Compliance Matrix for the applicable industry codes, standards, and Company specifications.

3.0 SURVEY, ENVIRONMENT, LAND, AND ARCHAEOLOGY

3.1. Survey

A desktop level study has been performed by CWL in Terrace, BC to identify affected landowners based on the potential new ROW and line work. A detailed survey will be performed where TWS is required to complete the Work.

Detailed surveying to identify utilities, other buried pipelines, and extents of crossings has not been performed and will be performed during later phases of the project.

Detailed surveys will be performed at locations of particular interest along the pipeline alignment (temporary workspaces, licenses of occupation, valve/riser sites, HDDs, bores, wetlands, slope instability, congested areas, etc.) to identify potential interferences and assist with detailed design at these sites.

The following deliverables will be provided by supporting teams:

- Preliminary Construction Plans (or similar mapping used for route review)
- Final Construction Plans and OGC maps for permit application
- Elevation profiles
- Identification of crossings
- Line list on final route.

During detailed design and construction, the following activities will be conducted:

- Mapping
- Obtain line work on all known property owners
- Conduct ground truthing
- Survey existing pipeline (validate as-built data)
- Line sweep
- Construction survey
- Conduct as-build survey.

Sites expected to require detailed survey will be determined once all temporary workspace has been identified.

3.2. Environmental Considerations

Khatada Environmental Services (KES) was engaged to provide desktop and field studies and attend planning meetings with PNG, Lauren, and other contractors/consultants to scope project Environmental requirements. KES provided, or will provide, input on the following:

- Classify watercourses
- Summarize the desktop study environmental baseline information available for the four identified infrastructure segments
- Identify permitting pathways required to obtain environmental regulatory approvals to move the segment(s) into the construction phase
- Identify information required to make regulatory and permit submissions and scope the fieldwork required
- Attend routing meetings to communicate environmental constraints associated with each option
- Attend risk identification and scheduling workshops to identify individual segment risks and to review the schedule with the project team
- Perform aquatics, terrestrial, and wildlife assessments
- Prepare and submit DFO applications.

See Khtada Environmental Constraints Analysis Rev 1 dated April 2, 2020.

3.3. Lands and Regulatory

All works related to access and temporary workspace will be applied for as required by the BC Oil and Gas Commission.

3.4. Archaeology

Roy Northern Land Consultants (Roy Northern) were engaged to assist the project team to identify project risks and the following:

- Assess the archaeological resource potential located within the project area
- Conduct Preliminary Field Reconnaissance
- Identify the need and scope of further field studies
- Conduct Site File Search of the records held by the Archaeology Branch of the BC Ministry of Forests, Lands and Natural Resource Operations (MFLNRO)
- Develop a property line list
- Identify expected activities for land acquisition and regulatory applications.

Based on the archaeology desktop studies, Roy Northern has recommended the following:

- Obtain a Section 12.2 Heritage Conservation Act Heritage Inspection Permit as soon as possible
- A targeted Preliminary Field Reconnaissance (PFR) be conducted by a professional archaeologist, focusing on areas of potential (AOP) be conducted to narrow down and eliminate AOPs, and revisit previously recorded archaeological sites within and adjacent to the proposed development
- A 10% sample of low potential terrain is subject to PFR on the way to and from the 19 identified AOPs
- A permitted subsurface testing program will be conducted by a professional archaeologist in the AOPs that remain following the PFR
- It is strongly recommended that relevant Indigenous Nations be involved in the PFR and subsequent subsurface testing, as their capacity allows

The above recommendations must be met prior to the commencement of any development-related activities that will, or have the potential to, result in the felling of trees and/or the disturbance of the ground surface.

3.5. Stakeholder and Indigenous Nations Consultation

PNG has performed the following consultation items:

- Develop a public consultation plan
- Develop a list of project stakeholders (i.e. landowners, PNG, etc.)
- Engage Indigenous Nations communities and leadership in the area
- Develop a summary of consultation activities and input received.

Indigenous Nations with any potential interests in the general area of the Project have been identified, engaged with early, informed of the scope of the current proposed Project, and will continue to be engaged where appropriate during the Project construction.

The following First Nations were identified as part of the AOA and Section 12.2 permitting process:

- Kitselas
- Kitsumkalum
- Lax Kw'alaams
- Metlakatla
- Gitxaala
- Gitga'at

4.0 CURRENT SYSTEM DESIGN AND OPERATION

4.1. PNG Service Area

Pacific Northern Gas Ltd. owns and operates a natural gas transmission and distribution system in west-central British Columbia and through its subsidiary Pacific Northern Gas (N.E.) Ltd. owns and operates natural gas distribution systems and a gas processing plant in the province's northeast. This includes approximately 3000 km of distribution mains and services pipelines and 1200 km of transmission pipelines. PNG is a wholly owned subsidiary of AltaGas Ltd.

Figure 2 – PNG Service Area

4.2. Salvus to Galloway Route Description

The Salvus to Galloway section of PNG's Mainline pipeline is approximately 80 kilometers (50 miles) long and carries natural gas west towards Prince Rupert. Starting at Salvus station, which contains sending and receiving barrels, the pipeline runs parallel to the Kasiks River until reaching a block valve site known as One Night Creek Block Valve (MP 323). This block valve site is located approximately 20 km (12 miles) west from the Salvus station.

Next, the pipeline traverses a mountain and through a tunnel known as Razor Back and goes down into a U-shaped glacial valley known as the Bowling Alley. Exiting the Bowling Alley, the pipeline runs parallel to Arden Creek and subsequently the Khyex River. Upon reaching the mouth of the Khyex River, there is another valve site known as Khyex River Valve (MP 340). The valve site is located 47 km from the Salvus station, and it is the only automated valve site in this section of the Mainline.

The next valve site, known as Lachmach valve site (MP 344), is located 6.5 km (4 miles) west of the Khyex River valve site. The pipeline runs in close proximity to the Work Channel Road until reaching the work channel. Then, the pipeline reaches Prudhomme Summit at MP 350 (62 km west of Salvus) before ultimately reaching the Galloway station at MP 361 (80 km west of Salvus). Like the Salvus station, the Galloway station also contains sending and receiving barrels along with a heater and filter.

Figure 3 – Salvus to Galloway Route and Main Features

5.0 GEOTECHNICAL DESIGN

5.1. Geohazard Mitigations

BGC Engineering Inc. (BGC) has been retained for categorizing, prioritizing, and designing of mitigations, for all geo-hazards on the project. All geo-hazards have been identified as being low to very high risk based on a calculated probability of failure. Geo-hazards include, but are not limited to:

- Debris Slides
- Landslides
- Hydrotechnical
- Rock falls / rockslides
- Encroachments.

Refer to BGC Final Preliminary Geohazard Assessment, NPS 8 Mainline Report and BGC Geohazard Mitigation Plan Development Report for details.

5.2. Geotechnical Investigation

Detailed geotechnical information to be used for structural design is not known at this time and investigations will not be performed for this phase of the project. For FEED, conservative assumptions regarding geotechnical information will be made based on available information.

6.0 PIPELINE DESIGN

6.1. Routing

It is not expected the current routing of the Mainline will be altered significantly although minor reroutes may be used. If modifications to the routing are required, it will be discussed with Owner at a later stage of the Project and applied for and consulted on as required with the regulator.

6.2. Class Location

The scope of this project is not to change or update any existing class location designations. The project areas are mostly Class 1 locations. Lauren has selected materials and pressure testing specifications for CSA Z662 Class 2 as a conservative approach for this level of the project as it would have negligible effects on costs. This can be further refined during detailed design.

6.3. Pipeline Design Criteria Summary

Pipeline replacements will be designed to meet the criteria stated in Table 3.

Table 3 – Design Conditions

Item	Value
Pipe Size (OD):	219.1mm
Pipe Wall Thickness:	See Section 6.6
Line Pipe Yield Strength:	See Section 6.6
Pipe Joint Length:	12 m Nominal (DRL)
Pipe Manufacturing Process:	SMLS
Maximum Operating Pressure (MOP):	9,335 kPag (1354 psig)
Flange Rating:	PN 100 (ANSI 600)
Corrosion Allowance:	none
Ambient Temperature:	-29° C minimum (above grade)
	-5° C minimum (below grade)
	40° C maximum (above grade)
Installation Temperature:	0 °C
Maximum Operating Temperature:	50°C

6.4. Pipe Sizing

All new piping used in remediation and repair work will be NPS 8 to match the current Mainline diameter. No further line sizing analyses will be performed as this is considered a maintenance project.

6.5. Elevation Profile

The preliminary pipeline elevation profile is based on QGIS data and as shown on the alignment sheets. Table 4 shows the high and low points of each pipeline segment:

Table 4 – Pipeline Elevation Profile

Location	Nearest MP	Elevation, m (approx.)
Salvus Facility	311	10
One-night creek Block Valve	323	225
Razorback	326	676 (upstream) 681 (downstream)
Arden Creek/Khyex River	334	8
Khyex River Valve	340	23
Lachmach valve	344	87
Prudhomme Summit	352	350
Galloway Facility	361	53

6.6. Wall Thickness (WT)

Design wall thickness calculations were performed based on CSA Z662 for sweet natural gas service. The recommended minimum wall thickness for each application can be summarized in Table 5:

Table 5 – Recommended Minimum Wall Thicknesses

Pipe Size	Class Location	Application[1]	Min. Material Grade (MPa)	Selected Wall Thickness	Pipe Category
219.1 mm OD	Class 1 and 2	General	359	5.2 mm	II
	Class 1 and 2	Other	359	8.2 mm (STD)	II
	Class 1 and 2	Stations	359	8.2 mm (STD)	II

1 – Application as defined in CSA Z662

Refer to Appendices for reference calculations.

6.7. Minimum Depths of Cover and Clearances

Minimum cover requirements are based on CSA Z662 as well as local and federal regulations. Table 6 outlines the minimum cover and clearance requirements. Selected cover will be based on recommendations from geotechnical design for mitigation of geohazard but at no time will be less than that stated herein.

Table 6 – Cover and Clearance for Sweet Gas Pipeline above 700 kPa Operating Pressure

Location	Class Location	Cover for buried pipelines, minimum, m		Reference
		Normal Excavation (m)	Rock excavation requiring blasting or removal (m)	
General	Any	0.60	0.60	CSA Z662
Right-of-way (road or railway)	Any	0.75	0.75	CSA Z662
Below travelled surface (road)*	Any	1.20	1.20	CSA Z662
Crossings of railway rights-of-way	Below base of rail: 3.05 m Below bottom of ditches or ground surface: 1.83 m 762 cm to 1524 cm from centerline of nearest track: 1.83 m Over 1524 cm from centerline of nearest track: 1.52 m			TC-E10
Water crossing	Any	1.20‡	0.60	CSA Z662
Drainage or irrigation ditch invert	Any	0.75	0.60	CSA Z662
Clearance From	**Class Location**	**Min. Clearance for buried pipelines, (mm)**		**CSA Z662**
Underground structures and utilities (conduits, cables, and other pipelines)	Any	300		CSA Z662
Drainage tile	Any	50		CSA Z662

Note: This Table combines the most stringent requirements of CSA Z662 and TC E-10.

‡ Reduced cover, but no less than 0.6m, may be used if analysis demonstrates that the potential for erosion is minimal.

6.8. Crossings

6.8.1. General

Crossings will be designed to meet the requirements of CSA Z662 and all applicable local and federal regulations. Refer to Compliance Matrix for a list of Acts and Regulations applicable to crossings including, but not limited to, water and rail crossings.

6.8.2. Crossing Methods

The following crossing methodologies may be considered for this project during detailed design phases:

- Open Cut
- Horizontal Directionally Drilled (HDD) Crossings
- Aerial Crossings.

6.9. Bends

Bends will meet the minimum requirements of CSA Z662 and CSA Z245.11 (for induction bends only) and shall be of suitable radius for pigging and internal inspection (ILI) of the pipelines. In general, the field bends will be the preferred bend method unless space constraints or design warrants the use of induction bends.

Field bends will be the preferred bend method up to points of inflection of 50 degrees unless space constraints or design warrants the use of fabricated bends such as 90-degree risers or large points of inflection throughout the right-of-way. Field bends will have a maximum bend angle of 25 degrees per pipe joint (1.5 degrees per nominal pipe OD) with a maximum of 2 adjacent bends. Minimum tangent length for field bends and fabricated bends are 1.8 m and 1.0 m respectively.

6.10. Valves

The following sections describe the requirements for different valve types. All valves will comply with CSA Z662 and CSA Z245.15 with a pressure rating of PN100 (ANSI 600). Mainline isolating and sectionalizing valves shall be full bore capable of having pigging equipment passing through them unimpeded.

6.10.1. Sectionalizing Valves

The existing mainline pipeline system already has sectionalizing valves in accordance with CSA Z662; the maximum distances between sectionalizing valves are as follows:

Table 7 – Maximum spacing of sectionalizing valves, km

Maximum valve spacing, km			
Class 1 location	Class 2 location	Class 3 location	Class 4 location
NR	25	13	8
Note: distances may be adjusted by up to 25% based upon factors such as operational, maintenance, access, and system design considerations			

It is expected sectionalizing valves will be installed between Salvus and Galloway stations to assist with operational and maintenance flexibility. Their locations and specifications will be determined at a later phase of the project but will be based on ease of access and benefits to operational flexibility.

6.10.2. Blowdown valves

Blowdown valves will be installed where new pipeline block valves are installed to blow down the sections of transmission lines between sectionalizing valves. Blowdowns shall be sized to allow for the section to be blown down rapidly during emergency situations. Locations of blowdown valves shall be such that the gas can be blown to the atmosphere without undue hazard.

6.10.3. Ball Valves

Mainline isolation valves will be full bore, ball valves.

6.10.4. Plug valves

Plug valves are considered superior to ball valves for throttling applications and will be used for bypass and venting applications where full bore valves are not required.

6.10.5. Check Valves

If required, check valves will be swing type. Mainline check valves shall be full bore and piggable.

6.10.6. Valve Operators / Actuators

Valve operators/actuators for any of the new valve sites will be considered based on site access, engineering and design, and budget.

6.11. Pigging Facilities (Sending and Receiving)

No pigging facilities will be installed.

6.12. Corrosion Control

6.12.1. General

Table 8 identifies the minimum corrosion control measures:

Table 8 – Corrosion Control Methods

Location of Piping	Corrosion Control Methods
Buried Piping	• Externally coated in accordance with SPI 8-6 Painting and Coatings • Continuous cathodic protection installed within one year of operation
Above Ground Piping	• Externally coated in accordance with SPI 8-6 Painting and Coatings

6.12.2. Protective Coatings

The following standards will be adhered to for coating selection, application, and testing (holiday):

- PNG Standard Practice Instructions
- Z245.20 Series-14 Plant-applied external coatings for steel pipe
- Z245.20-14 Plant-applied external fusion bond epoxy coating for steel pipe.

Table 9 identifies coating methods to be used:

Table 9 – Coating Selection Methodology

Application	Coating Type[1]
Mainline Pipeline – Buried	FBE/Yellow Jacket/Rock Jacket*
Open Cut Crossings	FBE/Yellow Jacket
Above Ground Piping	Painted
Bored or HDD Crossings	N/A
Buoyancy Control (Water Crossings)	CCC
Rock Blasted Trench	Rock Jacket™
Aerial Crossings	Painted

* Final coating selection will be based on site conditions and constructability reviews

6.12.3. Pipe Mechanical Protection

Pipe mechanical protection will be installed where required due to backfill material containing rocks or other material that can damage the pipe or pipe coating. Also, per the geotechnical survey, additional mechanical protection measures may be used at locations considered to be Very High and High Geohazard risk zones. Table 10 shows the mitigations to be taken to protect the pipe and pipe coating from damage:

Table 10 – Pipe Mechanical Protection

Location	Frequency
Mechanical Shield	Industry Standard products such as Rock Guard or Tuff-N-Nuff will be used in areas where suitable backfill cannot be used or imported or in steep terrain or sensitive areas where additional pipeline protection is required.
Rock-free initial backfill	When possible and economically viable, a sufficient amount of rock free material, either native or imported, will be placed over and around the pipeline to prevent rock damage by subsequent fill of native soils. The amount and type of initial fill will be site specific to account for concerns related to drainage, bearing strength, etc. Large rocks or boulders found during trench excavation will be discarded or placed on the side of the ROW.
Rock Jacket	Shop applied Rock Jacket ™ (or equivalent) will be applied to pipe installed in rock blasted trench to protect the pipeline from the native rock fill.

6.12.4. Painting & Insulation

All painting and insulation will comply with Company Specifications.

6.13. Cathodic Protection

The existing Prince Rupert Mainline has an impressed current CP system with a rectifier PN-15-ICCP near Prince Rupert BC.

Skystone International has been retained to perform CIPS and DOC studies along the entire existing pipeline route. Recommendations will be made for locations of new test posts and rectifiers to be installed to enhance the current CP system.

Refer to Skystone PNG NPS 8 Inch Indirect Inspection Report Rev2.0 dated January 6, 2020.

6.14. Locations in close proximity to electrical transmission lines

Not Applicable.

6.15. Right – of – Way (ROW) and Temporary Workspace (TWS)

The repair and replacement work will take place in the existing ROW; no ROW can be used until a proper survey has been completed.

TWS will be required for access and storing of materials throughout the Project. Refer to Appendix for details of the assumed TWS.

6.16. Stress Analysis

Detailed stress analysis has not been performed for the FEED. Conservative assumptions have been made for pipe lengths, bends, installation temperature, operating temperature, etc. Preliminary calculations for hoop and longitudinal stresses due to thermal growth have been performed and show the selected pipe grades and wall thicknesses are enough. Additional calculations will be performed to determine the following:

- Maximum unsupported pipe spans
- Maximum depth/span ratio for line lowering without cutting the pipeline (see section 6.17)
- Rerouted segments as required.

A detailed analysis must be performed at later stages of the Project to confirm design is in accordance with allowable stresses in CSA Z662, including:

- Maximum allowable freely supported spans for axially restrained sections
- Minimum required flexibility in partially or fully unrestrained sections
- Maximum allowable support spacings for stress design of unrestrained sections; and
- Maximum allowable cold-sprung reactions on equipment attached to flexible piping.

6.17. Stress Analysis – Line Lowering

A study was conducted to determine the maximum depth/span ratio for line lowering without cutting the pipeline. The calculated allowable bending stress and available stress for roping were calculated using API Recommended Practice 1117. While the calculation shows that is possible to lower the pipeline while in service, it is not recommended due to significant safety and operational risks of lowering an operating pipeline. Furthermore, due to lack of records and standards when the pipeline was constructed, a proper engineering assessment for material qualification/ acceptance per CSA Z662 clause 5.8 cannot be completed.

Line lowering, if required for the project, will include pipe replacement.

6.18. Buoyancy Control

Where the pipeline crosses any watercourse or any locations where the buoyancy of the pipeline may be affected, buoyancy control will be achieved by using pipeline weights, concrete coated pipe, or other means as applicable. The calculation results show that the existing pipe (NPS 8, wall thickness of 5.2 mm or less) is buoyant and evidence from the field confirms its buoyancy. Thus, buoyancy controls using geotextile bag weights installed approximately every 16 m. If new pipe is installed with a WT of 8.2 mm and/or the pipe in placed under cohesive soil, buoyancy controls can be discussed with the Company.

Refer to Appendix for Reference Calculations.

6.19. Signage and Pipeline Marking

Pipeline markings will be installed in accordance with CSA Z662 and PNG SPI 8-6 Pipeline Marking.

6.20. Pressure Control and Over-Pressure Protection

All existing pressure control and over-pressure protection on the Mainline will be utilized and new materials will be rated for the maximum output of the compressor system(s). It is not anticipated any new pressure control or over-pressure protection on the Mainline will be required.

6.21. Pipeline Venting and/or Flaring

Per the BCOGC Flaring and Venting Reduction Guideline, venting of gas is typically allowed to reduce the duration of system outages and related impacts. During planned outages or maintenance activities, PNG may wish to utilize mobile flaring or incinerating equipment to reduce emissions if the work can be completed within allowable outage windows.

During detailed design a Gas Conservation Plan as well as dispersion modeling shall be performed to determine the optimal pipeline evacuation practice and shall consider releases and impacts to nearby structures. The Gas Conservation Plan shall include consideration of operational flexibility while minimizing impact on the environment. The methodology shall consider the following:

- Lost gas cost
- Impact on environment
- Acceptable outage times, if any
- Contingencies for longer than anticipated outage periods such as LNG delivery trucks
- Depressurization (pump down compressors, mobile incineration, venting, etc.).

Design of new block valve stations will include connections for mobile flaring, incineration, or compression equipment.

6.22. Isolation, Gas Conservation, and tie-ins

An initial Outage Plan and Gas Conservation Study was performed for this phase of the project. Refer to PNG006-011_09_4000_01_101 for details.

During detailed design, the outage and gas conservation plan shall be finalized to determine the most desirable method for evacuating the pipeline. The methodology shall consider the following:

- Lost gas cost
- Impact on environment
- Acceptable outage times, if any
- Contingencies for longer than anticipated outage periods such as LNG delivery trucks
- Depressurization (pump down compressors, mobile incineration, venting, etc.).

6.23. Materials

Materials that will be used for the Project will comply with Canadian standards or acceptable US standards and PNG SPI's. All materials shall be in accordance with the description in PNG's piping specification C1A Rev 0.

6.23.1. Pipe Fittings and Flanges

All pipe, fittings and flanges will comply with Canadian standards or acceptable US standards and PNG SPI's including the following:

- CSA Z245.1-18 Steel Pipe
- CSA Z245.11-17 Steel Fittings
- CSA Z245.12-17 Steel Flanges
- CSA Z245.15-17 Steel Valves.

6.23.2. Transition Pieces

Transition pieces will be made of pipe and will be used at connections where internal offset of the pipeline wall thickness is greater than 2.4 mm as required by CSA Z662.

6.23.3. Gaskets and Bolts

Gaskets will be in accordance with CSA Z245.12 for dimensions and bolting patterns. Spiral wound 316SS (graphite filled – non-asbestos) gaskets will be used for all applications along the pipeline. Bolts and nuts will be in accordance with ASME B16.15.

6.24. Pipeline Construction

Pipeline construction will be in accordance with CSA Z662 and Lauren Pipeline General Construction Specifications.

6.25. Welding and NDE

Welding and non-destructive examination on the pipeline will be performed in accordance CSA Z662 Clause 7 and PNG Standard Practice Instructions using qualified personnel and procedures.

100% of welds along the pipeline shall be subject to NDE using radiographic methods during construction. The results of the NDE will be verified to be acceptable prior to backfill.

A detailed material conformance log shall be kept and will include MTR data, applicable weld procedures, and Company specifications. This list will be provided to the contractor prior to construction.

6.26. Pressure Testing

6.26.1. Pressure Test Design

Prior to commissioning, any new pressure containing materials will be pressure tested in accordance with CSA Z662 and SPI 8-9-2 Testing Pipelines Operating Above 700 kPa using water as the test medium.

The strength and leaks tests will meet the following minimum requirements:

Table 11 – Strength and Leak Test Pressures

Class Location	Strength Test			Leak Tests		
	Test Basis	Minimum Test Pressure	Maximum (Liquid Medium)	Minimum	Minimum Test Pressure	Maximum
1 or 2 – General	1.25 x MOP	11,670 kPa	Lesser of 0.2% deviation on a P-V plot and 110% of the SMYS of the pipe	110% MOP	10,270 kPa	Lesser of 100% SMYS and the Maximum Strength Test Pressure
1 or 2 - piping in compressor stations*, gas pressure-regulating stations, and gas measuring stations, or **3 or 4**	1.4 x MOP	13,069 kPa	Lesser of 0.2% deviation on a P-V plot and 110% of the SMYS of the pipe	110% MOP	10,270 kPa	Lesser of 100% SMYS and the Maximum Strength Test Pressure

Pressure testing of pipe and fabricated assemblies that are fully exposed and accessible during the test will be required to only need to undergo a 1-hour strength test with a visual leak test immediately following the test. Components which cannot be visually inspected shall be tested per CSA Z662, Section 8.

6.27. ILI Prioritization and Remediation Measures

ILI features, including dents and metal loss features have been assessed by Dynamic Risk as summarized in NPS 8, MP 311 - MP 364 Mainline Inline Inspection Response Prioritization report, dated Sep 25, 2020. Features have been prioritized as Immediate to Priority 3 as summarized as follows:

Table 12 – Anomaly Prioritization Criteria

Priority Level	Feature Type	Criteria 1	Criteria 2	Criteria 3	Criteria 4
Immediate	Metal Loss	FPR ≤ 1.1	-	-	-
Immediate	Dent	Crossing Long Seam	Strain > 4%	Re-rounded	With metal loss
Immediate	Dent	With Metal Loss	Strain ≥ 6%	Top 2/3 of pipe	-
Immediate	Dent	Re-rounded	Strain ≥ 6%	-	-
Priority 1	Metal Loss	1.1 < FPR ≤ 1.25	-	-	-
Priority 1	Dent	Crossing Long Seam	Depth ≥ 6 mm	-	-
Priority 1	Dent	With Metal Loss	Fails ASME B31G (Level 0 Evaluation)	-	-
Priority 1	Dent	≥ 6 % of OD Restriction	Strain ≥ 6%	-	-
Priority 2	Dent	"High Severity" Dent in the TDW's "Dent Prioritization Report".	Not addressed as Immediate, or Priority 1 Location	-	-
Priority 3	Dent	Length to Depth Ratio (L/d) Less than 20	Strain > 6%	-	-

A number of remediation measures will be considered for this project. All remediation measures will be in accordance with CSA Z662-19 Table 10.2. These include, but are limited to the following:

- Pressure containing sleeves
- Compression sleeves
- Pipe replacements
- Pipeline lowering
- Pipeline rerouting.

Based on the decision tree PNG006-011_09_4000_01_103_Decision Tree established with Company, remediation technique was selected for each ILI location and summarized in the PNG006-011_09_4000_01_001_Project Database. This can be summarized as follows:

Table 13 – Remediation Technique

Segment	ILI Features	Remediation Location	No. Cut-outs	No. Sleeves
1. Salvus to Razorback (Kasiks/Huckleberry) (MP311-326)	1-36	1-32	7	26
2. Razorback to Lachmach (Bowling Alley/Khyex) (MP326-340)	36-49	32-49	3	14
3. Lachmach to Prudhomme Summit (MP340-352.1)	50-70	50-72	1	21
4. Prudhomme Summit to Galloway (MP352.5-361)	70-93	73-100	0	28

Since the Mainline has been operating at a normal operating pressure (NOP) of 980 psi, an engineering assessment must be performed prior to increasing the NOP to the licensed MOP of 1354 psi should the remediation measure be completed.

6.28. Assessment of Existing Girth Welds

Due to a historical order from the BC OGC, any original construction welds that are exposed will be evaluated to current standards and repaired as needed using pressure containing sleeves or using cut-out (pipe replacement) method.

7.0 CIVIL DESIGN

7.1. Buildings

No buildings are expected to be required for this project.

7.2. Environmental Data

Environmental data from the National and BC Building code for each site are as follows:

Table 14 – Site Environmental and Seismic Data

Info	Salvus	Galloway Station
Location	Terrace BC	Prince Rupert BC
Ambient Temperature (Min/Max):	-21ºC / 27ºC	-15ºC / 19ºC
Snow Load (kPa, 1/50):	$S_{s:}$ 5.4 $S_{r:}$ 0.6	$S_{s:}$ 1.9 $S_{r:}$ 0.4
Site Altitude:	10 m	20 m
Hourly Wind Pressures (1/50):	0.36 kPa	0.54 kPa
Seismic (2%/50 years):	Sa(0.2): 0.376 Sa(0.5): 0.243 Sa(1.0): 0.136 Sa(2.0): 0.078 PGA: 0.178	Sa(0.2): 0.378 Sa(0.2): 0.248 Sa(0.2): 0.151 Sa(0.2): 0.087 PGA: 0.179

7.3. Soils Information

A geotechnical investigation has not been completed and is not expected to be required for the project. Conservative assumptions will be made for pile support and/or concrete design.

7.4. Foundations

Requirements for foundations for temporary and permanent structures will be determined during detailed design.

7.5. Bridges

Detailed design on foundations and bridge designs for any bridges required for access to the working areas will be conducted by third party consulting, with review from Lauren and approval by PNG.

7.6. Structural Steel / Pipe & Cable Tray Supports

All new pipe supports and miscellaneous structural steel, if required, will be designed to meet the requirements of local, provincial, and federal regulations. Local climatic loads will be considered, and the design will be in accordance with good engineering practices. All structural and miscellaneous steel will be designed to withstand the anticipated dead and superimposed loads.

All fabricated pipe supports, miscellaneous steel and related materials will be shop coated prior to shipping to site. All fabrication and shipped loose materials will maintain traceability throughout the fabrication and installation process.

7.7. Platforms & Stairways

Platforms, stairways, and stiles, if required, will be provided to the size and extent necessary to ensure access to all valves, meters, and monitoring stations, and to avoid the necessity for a fall protection plan. Extent and size of the platforms, stairways, and stiles will be determined during the detailed engineering phase. All platforms, stairways, and stiles will be shop fabricated. All fabricated platforms, ladders, stairs, miscellaneous steel and related materials will be shop coated prior to shipping to site. Grating will be supplied pre-cut to required shape prior to being galvanized or painted.

All handrails and kick plates shall be painted safety yellow.

7.8. Skids & Buildings

Not applicable.

7.9. Fencing

Fencing is not expected to be required for this project. If it is found to be preferred, fencing will be designed on installed on a site-by-site basis depending on the following:

- Access/Egress meeting the applicable regulations for the minimum number of exits
- Nearby utilities, buried pipelines, or other buried structures
- Security and potential local security threats
- Location of emergency shutdown valves or another emergency equipment
- Overhead powerlines or other overhead structures

8.0 PROJECT RISKS

Refer to PNG006-001_02_6000_005 for project Risk Registry.

APPENDICES

Appendix A. PNG006-011_02_4100_002_Compliance Matrix

TITLE	Compliance Matrix
SUBJECT	Project Execution Plan
PREPARED FOR	Pacific Northern Gas
PROJECT NAME	Salvus to Galloway Remediation
DOCUMENT NO	PNG006-011_02_4100_ComplianceMatrix

Acts and Regulations			
Document Code	**Description**	**Revision**	**Date**
	Oil and Gas Acitivities Act	-	
B.C. Reg. 281/2010	BC Pipeline Regulation	-	
TC E-10	Standards Respecting Pipeline Crossings Under Railways	2000.06.21	2000.06.21
TP 14593	The Navigable Waters Protection Act: Pipeline Crossing Brochure	-	-
RSC 1985 Chapter W-6	Weights and Measures Act	-	05-May-2017
CRC Chapter 1605	Weights and Measures Regulations		03-Oct-2018
Industry Codes and Standards			
Document Code	**Description**	**Revision**	**Date**
-	BC OGCWater License Application Manual	-	January 1, 2015
CSA-ISO 9001-08	Quality Management SystemsRequirements	-	2008 (R2014)
CSA Z662-19	Oil and Gas Pipeline Systems	-	2019
CSA Z245.1-18	Steel Pipe	-	2018
CSA Z245.11-17	Steel Fittings	-	2017
CSA Z245.12-17	Steel Flanges	-	2017
CSA Z245.15-17	Steel Valves	-	2017
CSA Z245.20-18	Series-10 Plant-applied external coatings for steel pipe		2018
CSA Z245.20 Series-14	Plant-applied external coatings for steel pipe	-	2018
CSA Z245.30-14	Field-applied external coatings for steel pipeline systems	-	2018
TC E-10	Standards Respecting Pipeline Crossings Under Railways	-	June 21, 2000
TP 14593	The Navigable Waters Protection Act: Pipeline Crossing Brochure	-	December 1, 2009
CSA W59-13	Welded steel construction (metal arc welding)	-	2013
CSA W47.1-09	Certification of companies for fusion welding of steel	-	2009 (R2014)
-	Flaring And Venting Reduction Guideline	5	Apr-18
Client Specifications			
Document Code	**Description**	**Revision**	**Date**
8-02-2	Steel High Pressure Services and Mains (Over 700 kPa)	1	-
8-03-1	PNG General Welding Specification for Steel Pipelines	0	-
8-03-2	Welder Qualification Requirements for Steel Pipelines	0	-
8-03-3	WPS Qualification for Steel Pipelines	0	-
8-03-4	NDE for Pipeline Welding	0	-
8-05	Coating and Painting	1	-
8-06	Pipeline Marking	1	-
8-09-2	Testing_Over 700 kPa	1	-
8-10	Purging	1	-
8-11	Lands and Right of Way	1	-
8-12	Blasting	1	-
8-13	Tapping Equipment	0	-
8-17	Pipeline Patrols	0	-
8-18-1	High Pressure Pipeline Inspection_In Line Inspection	1	-
8-18-2	High Pressure Pipeline Inspection_Above Ground Coating Assessment	1	-
8-18-3	High Pressure Pipeline Inspection_Facility Inspections	1	-
8-18-4	High Pressure Pipeline Inspection_Original Girth Joint Weld Assessment	1	-
8-19	Visual Inspection	0	-
8-20	Exposed and Unsupported Pipe	1	-
Industry Guidelines			
Document Code	**Description**	**Revision**	**Date**
CGA OCC-1-2013	GGAControl of External Corrosion on Buried or Submerged Metallic Piping Systems Recommended Practice	-	June 1, 2013
-	CAPP- Mitigation of External Corrosion on Buried Pipeline Systems	-	June 1, 2009
-	CEPA Stress Corrosion Cracking Recommended Practices	2nd Ed.	December 1, 2007
-	CAPP/CEPA/CGA Pipeline Associated Watercourse Crossings	4th Ed.	November 1, 2012
CEPA 14-017	CEPA Surface Loading Calculator	2	January 28, 2014
API RP 1102	API Steel Pipeline Crossing Railroads and Highways	7th Ed. Er 5	2007 (E2014)
API RP 1117	API Movement of In-service Pipelines	3rd Ed	2008 (R2013)
-	CAPP Planning Horizontal Directional Drilling for Pipeline Construction	-	September 1, 2004
PR-227-03110	PRCI – Installation of Pipelines Using Horizontal Directional Drilling – An Engineering Design Guide	-	November 27, 2008
-	Forest Practices Code Riparian Management Area Guidebook	-	December 1, 1995
Ocuppational Health and Safety			
Document Code	**Description**	**Revision**	**Date**
-	BC Occupational Health and Safety Regulation		

Industry Electrical and Instrumentation Codes, Regulations and Standards			
Document Code	**Description**	**Revision**	**Date**
B.C. Reg. 100/2004	Electrical Safety Regulation		
CSA C22.3 NO. 6-13	Principles and practices of electrical coordination between pipelines and electric supply lines	-	2013
CSA C22.1	Canadian Electrical Code	-	2018
API RP 505	Classification of Locations of Electrical Installations at Petroleum Facilities Classified as Class 1, Zone 0, Zone 1 and Zone 2	-	2013

ANSI/ISA-12.01.01-2013	Definition and information pertaining to Electrical equipment in Hazardous (Classified) locations.	-	2013
ANSI/ISA-12.04.04-2012	Pressurized Enclosures.	-	2012
ANSI/ISA-5.1-2009	Instrument symbols and Identification	-	2009
API RP 554 Part 1	Process Instrumentation and Control	-	2016
CSA C22.2 No. 14	Industrial Control Equipment	-	2018
ISA 18.2	Management of Alarm Systems in Process Industries	-	2016
ISA RP 12.06.01	Recommended Practice for Wiring Methods for Hazardous Locations Instrumentation Part 1: Intrinsic Safety	-	2003
ISA 62382	Automation Systems in the Process Industry Electrical and Instrumentation Loop Check	-	2012
ISA-.3-1983	Graphical symbols for Distributed control/Shared display. Instrumentation, Logic and Computer systems	-	1983
ISA-5.4-1991	Instrument Loop Diagrams	-	1991
ICEA	Insulated Cable Engineers Association		
ULC	Underwriters Laboratories of Canada		

Lauren Standards, Specifications, Procedures & Guidelines

Document Code	Description	Revision	Date
GS 5.1	NewConstructionPaintStandard	R3	
GS 4810	ElectricInductionMotors	R11	
GS 2.9	Welding AppendixE	R0	
GS 2.9	Welding AppendixF	R0	
GS 2.9	Welding	R0	
GS 2.10	NDE Examination	R0	
GS 2.10	NDE ExaminationAppendixA	R0	
GS 2.10	NDE ExaminationAppendixB	R0	
GS 2.10	NDE ExaminationAppendixC	R0	
GS 2.1	PipingDesign	R0	
GS 2.2	PipingMaterialServiceIndex	R0	
GS 2.3	Line Class Details	R0	
GS 2.5	BranchConnections	R0	
GS 2.6	ValveSpecifications	R0	
GS 2.8	PipingFabricationInstallationTesting	R0	
GS 2.9	Welding AppendixA	R0	
GS 2.9	Welding AppendixB	R0	
GS 2.9	Welding AppendixC	R0	
GS 2.9	Welding AppendixD	R0	
GS 5.1	NewConstructionPaintStandard	R3	R0

Appendix B. PNG006-011_09_1000_Reference Calculations

Description	Document Number
Pressure Design	PNG006-011-09-1000-001
Buoyancy	PNG006-011-09-1000-003
Bends	PNG006-011-09-1000-004

Pipeline Bend Calculation Tool

Pacific Northern Gas
Salvus to Galloway Remediation
PNG006-011

PNG006-011_09_1000_003

MASTER REV. #	DATE	REVISION DESCRIPTION	DONE BY		CHECKED BY	
	day-mth-year		Name	Signature	Name	Signature
A	22-Nov-19	ISSUED FOR REVIEW	J. Diaz		G. Pavlik	
B	2-Feb-20	Issued for FEED	J. Diaz		A. Kwan	

TITLE	Pipeline Bend Calculation Tool
CASE	Summary
PREPARPED FOR	Pacific Northern Gas
PROJECT NAME	Salvus to Galloway Remediation
PROJECT NUMBER	PNG006-011
DOCUMENT NUMBER	PNG006-011_09_1000_003

INPUTS												FIELD BEND CALCULATION	INDUCTION BEND CALCULATIONS					ROPING CALCULATIONS	Geometry Calculations	
Type of Bend	OD (mm)	WT (mm)	Grade (MPa)	Legnth of Pipe Joint (m)	Number of Bends	Bend Radius	Degree of Bend	End Tangent 1 (m)	End Tangent 2 (m)	Bend Radius (mm)	Arc Length (mm)	Maximum Bend Degrees	Estimated Wall Thinning (%)	Estimated Resultant Wall Thickness (mm)	Wall Thinning Pass/Fail	Max No. of Induction Bends Per Joint	Number of Pipe Joints Required	Smallest Radius of Curvature	Length of Long Side (mm)	Height of Short Side (mm)
Field	219.1	4	359	12.0	1	60	25	2.0	2.0	13146.0	5736.0	34.9	N/A	N/A	N/A	N/A	N/A	N/A	9,369	2,077
Induction	219.1	5.16	359	12.0	1	5	45	1.0	1.0	1095.5	860.4	N/A	8.3	4.73	Pass	4	1	N/A	2,482	1,028
Induction	219.1	8.18	359	12.0	1	5	45	1.0	1.0	1095.5	860.4	N/A	8.3	7.5	Pass	4	1	N/A	2,482	1,028
Field	219.1	5.16	359	12.0	1	60	25	1.0	1.0	13146.0	5736.0	43.6	N/A	N/A	N/A	N/A	N/A	N/A	7,463	1,655

LAUREN services

TITLE	Pipeline Bend Calculation Tool
CASE	Case 1: 219.1mm OD, Gr. 359, 4mm WT,Field Bend
PREPARPED FOR	Pacific Northern Gas
PROJECT NAME	Salvus to Galloway Remediation
PROJECT NUMBER	PNG006-011
DOCUMENT NUMBER	PNG006-011_09_1000_003

= Input Value   = Calc. Intermediate   = Calc. Result   = Fail Result   = Pass Result

Pipeline Location and Operating Information

					Reference
Type of Bend	-	Field			
Design Code - Year	-	CSA Z662-19			
Service	-	Gas (Non-Sour)			
Maximum Operating Pressure	P	9335.0	kPag		
Maximum Operating Temperature	T_{MAX}	50.0	°C		

Design Factors

					Reference
Class Location	-	1.0			
Location Application	-	General			
Location Factor	L	1.000			CSA Z662 Clause 4.3.7
Design Factor	F	0.80			
Joint Factor	J	1.0			CSA Z662 Clause 4.3.8
Temperature Factor	T	1.0			CSA Z662 Clause 4.3.9
Total Design Factor	ODF	0.800			

Design Allowance

					Reference
Errosion or Corrosion Allowance		0.0	mm		
Groove Allowance		0.0	mm		
Threaded Allowance		0.0	mm		

Pipe Properties

					Reference
Diameter	D	219.1	mm		
Wall Thickness	t	4.0	mm		
Grade	S	359	Mpa		
Category	-	2			
Length of Pipe	L	12.0	m		
Modulus of Elasticity	E	200,000	Mpa		
Design Wall Thickness	t_{min}	3.6	mm		Equation #3

Bend Properties

					Reference
Number of Bends		1			
Bend Radius		60.0	Pipe Diameters		
Degree of Bend	Θ	25.0	Deg		
Deg per Diameter	Θ/D	0.955	Deg/mm		For Field Bends Only - CSA Z662 Clasue 6.2.3
End Tangent 1	T_1	2.0	m		Typical cold bend tangents are 6 feet (1.8m)
End Tangent 2	T_2	2.0	m		Specified by Client/Lauren

Calculated Bend Parameters (Field and Induction Bends)

					Reference
Bend Radius	R	13,146.0	mm		
Arc Length	a	5,736.0	mm		Equation #1

Field Bend Calculations

					Reference
Maximum Bend Degrees	Θ	34.9	Deg	Caution	Equation #6 - Typically limited to 25 deg max

Induction Bend Calculations

					Reference
Estimated Wall Thinning	WT	N/A	%	N/A	Equation #4
Estimated Resultant Wall Thickness	t_{final}	N/A	mm	N/A	Equation #7
Max No. of Induction Bends Per Joint	-	N/A		N/A	Equation #8
Number of Pipe Joints Required	-	N/A			
Min Pipe Length Required	L_{min}	N/A	m	N/A	Equation #2

Rope Bend Calculations

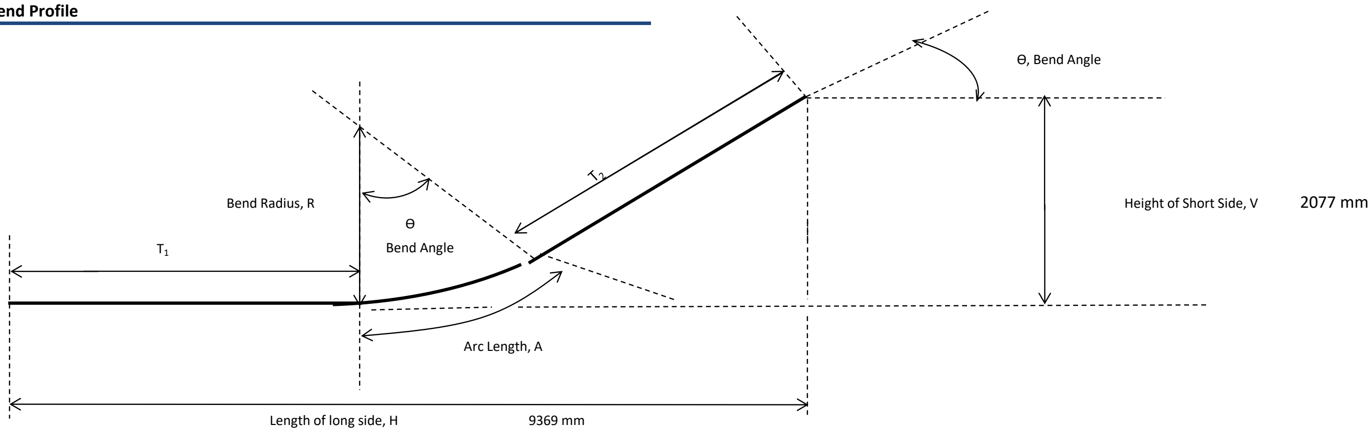
Smallest Radius of Curvature	R	N/A	m
Largest Degree of Curvature	Θ	N/A	Deg

Rev	Description	Date	Done By	Checked By	Stamp	
B	Issued for FEED	2-Feb-20	J. Diaz	A. Kwan		
A	ISSUED FOR REVIEW	22-Nov-19	J. Diaz	G. Pavlik		

TITLE	Pipeline Bend Calculation Tool
CASE	Case 1: 219.1mm OD, Gr. 359, 4mm WT,Field Bend
PREPARPED FOR	Pacific Northern Gas
PROJECT NAME	Salvus to Galloway Remediation
PROJECT NUMBER	PNG006-011
DOCUMENT NUMBER	PNG006-011_09_1000_003

= Input Value   = Calc. Intermediate   = Calc. Result   = Fail Result   = Pass Result

Bend Profile



Rev	Description	Date	Done By	Checked By	Stamp	Page 2 of 2
B	Issued for FEED	2-Feb-20	J. Diaz	A. Kwan		
A	ISSUED FOR REVIEW	22-Nov-19	J. Diaz	G. Pavlik		

TITLE	Pipeline Bend Calculation Tool
CASE	Case 2: 219.1mm OD, Gr. 359, 5.16mm WT,Induction Bend
PREPARPED FOR	Pacific Northern Gas
PROJECT NAME	Salvus to Galloway Remediation
PROJECT NUMBER	PNG006-011
DOCUMENT NUMBER	PNG006-011_09_1000_003

= Input Value   = Calc. Intermediate   = Calc. Result   = Fail Result   = Pass Result

Pipeline Location and Operating Information

				Reference
Type of Bend	-	Induction		
Design Code - Year	-	CSA Z662-19		
Service	-	Gas (Non-Sour)		
Maximum Operating Pressure	P	9335.0	kPag	
Maximum Operating Temperature	T_{MAX}	50.0	°C	

Design Factors

				Reference
Class Location	-	2.0		
Location Application	-	Other		
Location Factor	L	0.900		CSA Z662 Clause 4.3.7
Design Factor	F	0.80		
Joint Factor	J	1.0		CSA Z662 Clause 4.3.8
Temperature Factor	T	1.0		CSA Z662 Clause 4.3.9
Total Design Factor	ODF	0.720		

Design Allowance

				Reference
Errosion or Corrosion Allowance		0.0	mm	
Groove Allowance		0.0	mm	
Threaded Allowance		0.0	mm	

Pipe Properties

				Reference
Diameter	D	219.1	mm	
Wall Thickness	t	5.2	mm	
Grade	S	359	MPa	
Category	-	1		
Length of Pipe	L	12.0	m	
Modulus of Elasticity	E	200,000	MPa	
Design Wall Thickness	t_{min}	4.0	mm	Equation #3

Bend Properties

				Reference
Number of Bends		1		
Bend Radius		5.0	Pipe Diameters	
Degree of Bend	Θ	45.0	Deg	
Max. Deg per Diameter	Θ/D	11.459	Deg/mm	For Field Bends Only - CSA Z662 Clasue 6.2.3
End Tangent 1	T_1	1.0	m	Specified by Client/Lauren
End Tangent 2	T_2	1.0	m	Specified by Client/Lauren

Calculated Bend Parameters (Field and Induction Bends)

				Reference
Bend Radius	R	1,095.5	mm	
Arc Length	a	860.4	mm	Equation #1

Field Bend Calculations

					Reference
Maximum Bend Degrees	Θ	N/A	Deg	N/A	Equation #6 - Typically limited to 25 deg max

Induction Bend Calculations

					Reference
Estimated Wall Thinning	WT	8.33	%	Pass	Equation #4
Estimated Resultant Wall Thickness	t_{final}	4.73	mm	Pass	Equation #7
Max No. of Induction Bends Per Joint	-	4		Pass	Equation #8
Number of Pipe Joints Required	-	1			
Min Pipe Length Required	L_{min}	2.9	m	Pass	Equation #2

Rope Bend Calculations

Smallest Radius of Curvature	R	N/A	m
Largest Degree of Curvature	Θ	N/A	Deg

Rev	Description	Date	Done By	Checked By	Stamp	
B	Issued for FEED	2-Feb-20	J. Diaz	A. Kwan		
A	ISSUED FOR REVIEW	22-Nov-19	J. Diaz	G. Pavlik		Page 1 of 2

TITLE	Pipeline Bend Calculation Tool
CASE	Case 2: 219.1mm OD, Gr. 359, 5.16mm WT,Induction Bend
PREPARPED FOR	Pacific Northern Gas
PROJECT NAME	Salvus to Galloway Remediation
PROJECT NUMBER	PNG006-011
DOCUMENT NUMBER	PNG006-011_09_1000_003

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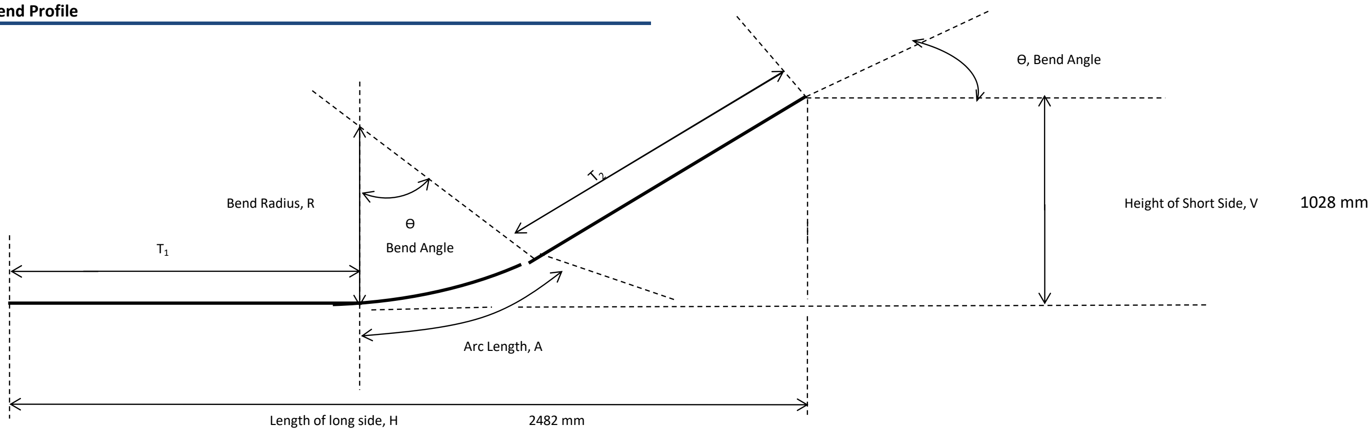
Bend Profile



B	Issued for FEED	2-Feb-20	J. Diaz	A. Kwan		
A	ISSUED FOR REVIEW	22-Nov-19	J. Diaz	G. Pavlik		
Rev	**Description**	**Date**	**Done By**	**Checked By**	**Stamp**	Page 2 of 2

TITLE	Pipeline Bend Calculation Tool
CASE	Case 3: 219.1mm OD, Gr. 359, 8.18mm WT,Induction Bend
PREPARPED FOR	Pacific Northern Gas
PROJECT NAME	Salvus to Galloway Remediation
PROJECT NUMBER	PNG006-011
DOCUMENT NUMBER	PNG006-011_09_1000_003

= Input Value = Calc. Intermediate = Calc. Result = Fail Result = Pass Result

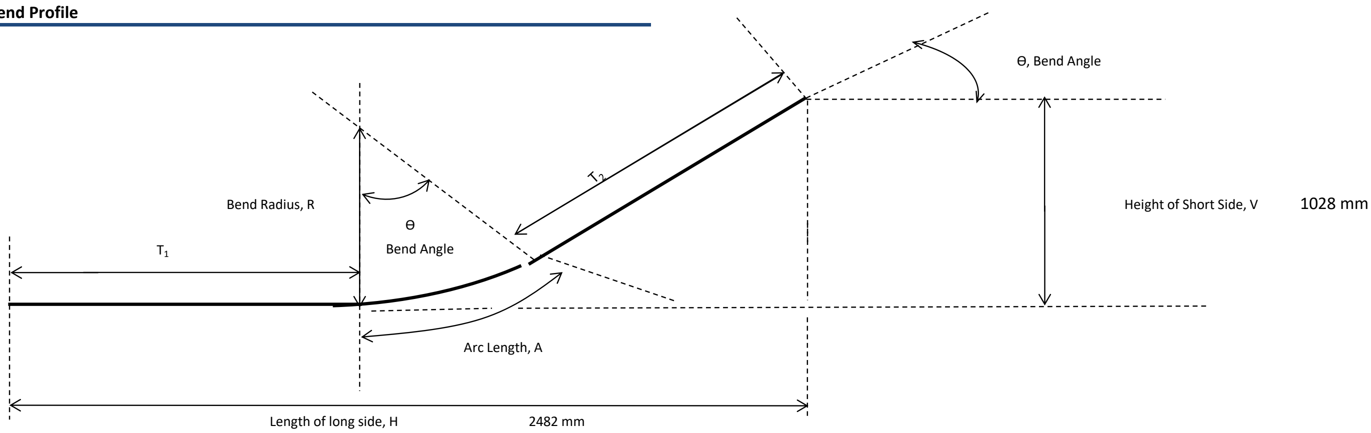
Pipeline Location and Operating Information					Reference
Type of Bend	-	Induction			
Design Code - Year	-	CSA Z662-19			
Service	-	Gas (Non-Sour)			
Maximum Operating Pressure	P	9335.0	kPag		
Maximum Operating Temperature	T_{MAX}	50.0	°C		
Design Factors					**Reference**
Class Location	-	1.0			
Location Application	-	Other			
Location Factor	L	0.750			CSA Z662 Clause 4.3.7
Design Factor	F	0.80			
Joint Factor	J	1.0			CSA Z662 Clause 4.3.8
Temperature Factor	T	1.0			CSA Z662 Clause 4.3.9
Total Design Factor	ODF	0.600			
Design Allowance					**Reference**
Errosion or Corrosion Allowance		0.0	mm		
Groove Allowance		0.0	mm		
Threaded Allowance		0.0	mm		
Pipe Properties					**Reference**
Diameter	D	219.1	mm		
Wall Thickness	t	8.2	mm		
Grade	S	359	Mpa		
Category	-	1			
Length of Pipe	L	12.0	m		
Modulus of Elasticity	E	200,000	Mpa		
Design Wall Thickness	t_{min}	4.7	mm		Equation #3
Bend Properties					**Reference**
Number of Bends		1			
Bend Radius		5.0	Pipe Diameters		
Degree of Bend	Θ	45.0	Deg		
Max. Deg per Diameter	Θ/D	11.459	Deg/mm		For Field Bends Only - CSA Z662 Clause 6.2.3
End Tangent 1	T_1	1.0	m		Specified by Client/Lauren
End Tangent 2	T_2	1.0	m		Specified by Client/Lauren
Calculated Bend Parameters (Field and Induction Bends)					**Reference**
Bend Radius	R	1,095.5	mm		
Arc Length	a	860.4	mm		Equation #1
Field Bend Calculations					**Reference**
Maximum Bend Degrees	Θ	N/A	Deg	N/A	Equation #6 - Typically limited to 25 deg max
Induction Bend Calculations					**Reference**
Estimated Wall Thinning	WT	8.33	%	Pass	Equation #4
Estimated Resultant Wall Thickness	t_{final}	7.50	mm	Pass	Equation #7
Max No. of Induction Bends Per Joint	-	4		Pass	Equation #8
Number of Pipe Joints Required	-	1			
Min Pipe Length Required	L_{min}	2.9	m	Pass	Equation #2
Rope Bend Calculations					
Smallest Radius of Curvature	R	N/A	m		
Largest Degree of Curvature	Θ	N/A	Deg		

Rev	Description	Date	Done By	Checked By	Stamp	
B	Issued for FEED	2-Feb-20	J. Diaz	A. Kwan		
A	ISSUED FOR REVIEW	22-Nov-19	J. Diaz	G. Pavlik		

	TITLE	Pipeline Bend Calculation Tool
	CASE	Case 3: 219.1mm OD, Gr. 359, 8.18mm WT,Induction Bend
	PREPARPED FOR	Pacific Northern Gas
	PROJECT NAME	Salvus to Galloway Remediation
	PROJECT NUMBER	PNG006-011
	DOCUMENT NUMBER	PNG006-011_09_1000_003

= Input Value   = Calc. Intermediate   = Calc. Result   = Fail Result   = Pass Result

Bend Profile



B	Issued for FEED	2-Feb-20	J. Diaz	A. Kwan		
A	ISSUED FOR REVIEW	22-Nov-19	J. Diaz	G. Pavlik		
Rev	**Description**	**Date**	**Done By**	**Checked By**	**Stamp**	Page 2 of 2

TITLE	Pipeline Bend Calculation Tool
CASE	Case 4: 219.1mm OD, Gr. 359, 5.16mm WT,Field Bend
PREPARPED FOR	Pacific Northern Gas
PROJECT NAME	Salvus to Galloway Remediation
PROJECT NUMBER	PNG006-011
DOCUMENT NUMBER	PNG006-011_09_1000_003

= Input Value   = Calc. Intermediate   = Calc. Result   = Fail Result   = Pass Result

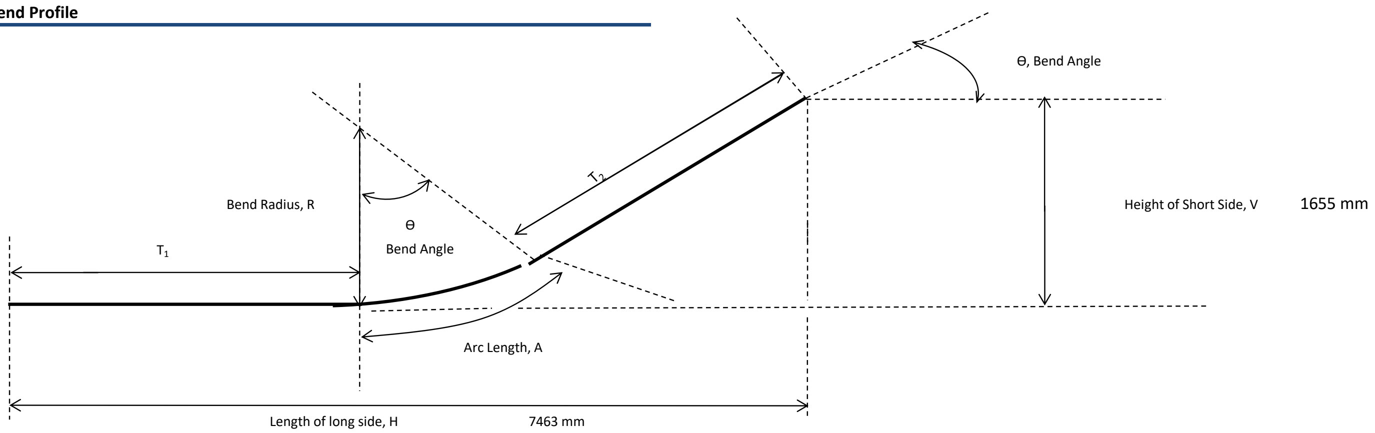
Pipeline Location and Operating Information					**Reference**
Type of Bend	-	Field			
Design Code - Year	-	CSA Z662-19			
Service	-	Gas (Non-Sour)			
Maximum Operating Pressure	P	9335.0	kPag		
Maximum Operating Temperature	T_{MAX}	50.0	°C		
Design Factors					**Reference**
Class Location	-	2.0			
Location Application	-	Other			
Location Factor	L	0.900			CSA Z662 Clause 4.3.7
Design Factor	F	0.80			
Joint Factor	J	1.0			CSA Z662 Clause 4.3.8
Temperature Factor	T	1.0			CSA Z662 Clause 4.3.9
Total Design Factor	ODF	0.720			
Design Allowance					**Reference**
Errosion or Corrosion Allowance		0.0	mm		
Groove Allowance		0.0	mm		
Threaded Allowance		0.0	mm		
Pipe Properties					**Reference**
Diameter	D	219.1	mm		
Wall Thickness	t	5.2	mm		
Grade	S	359	MPa		
Category	-	1			
Length of Pipe	L	12.0	m		
Modulus of Elasticity	E	200,000	MPa		
Design Wall Thickness	t_{min}	4.0	mm		Equation #3
Bend Properties					**Reference**
Number of Bends		1			
Bend Radius		60.0	Pipe Diameters		
Degree of Bend	Θ	25.0	Deg		
Max. Deg per Diameter	Θ/D	0.955	Deg/mm		For Field Bends Only - CSA Z662 Clause 6.2.3
End Tangent 1	T_1	1.0	m		Typical cold bend tangents are 6 feet (1.8m)
End Tangent 2	T_2	1.0	m		Specified by Client/Lauren
Calculated Bend Parameters (Field and Induction Bends)					**Reference**
Bend Radius	R	13,146.0	mm		
Arc Length	a	5,736.0	mm		Equation #1
Field Bend Calculations					**Reference**
Maximum Bend Degrees	Θ	43.6	Deg	Caution	Equation #6 - Typically limited to 25 deg max
Induction Bend Calculations					**Reference**
Estimated Wall Thinning	WT	N/A	%	N/A	Equation #4
Estimated Resultant Wall Thickness	t_{final}	N/A	mm	N/A	Equation #7
Max No. of Induction Bends Per Joint	-	N/A		N/A	Equation #8
Number of Pipe Joints Required	-	N/A			
Min Pipe Length Required	L_{min}	N/A	m	N/A	Equation #2
Rope Bend Calculations					
Smallest Radius of Curvature	R	N/A	m		
Largest Degree of Curvature	Θ	N/A	Deg		

B	Issued for FEED	2-Feb-20	J. Diaz	A. Kwan		
A	ISSUED FOR REVIEW	22-Nov-19	J. Diaz	G. Pavlik		
Rev	**Description**	**Date**	**Done By**	**Checked By**	**Stamp**	Page 1 of 2

TITLE	Pipeline Bend Calculation Tool
CASE	Case 4: 219.1mm OD, Gr. 359, 5.16mm WT,Field Bend
PREPARPED FOR	Pacific Northern Gas
PROJECT NAME	Salvus to Galloway Remediation
PROJECT NUMBER	PNG006-011
DOCUMENT NUMBER	PNG006-011_09_1000_003

= Input Value   = Calc. Intermediate   = Calc. Result   = Fail Result   = Pass Result

Bend Profile



B	Issued for FEED	2-Feb-20	J. Diaz	A. Kwan		
A	ISSUED FOR REVIEW	22-Nov-19	J. Diaz	G. Pavlik		
Rev	**Description**	**Date**	**Done By**	**Checked By**	**Stamp**	Page 2 of 2

Pressure Design for Steel Pipelines Calculation (CSA Z662-19)

Pacific Northern Gas Ltd.
Salvus to Galloway Remediation
PNG 006-011

PNG006-011_09_1000_001

PROJECT REV. #	DATE	REVISION DESCRIPTION	DONE BY		CHECKED BY	
	day-mth-year		Name	Signature	Name	Signature
A	6-Nov-19	Issued for Review	J. Diaz		G. Pavlik	
B	2-Feb-20	Issued for FEED	J. Diaz		A. Kwan	

TITLE Pressure Design for Steel Pipelines Calculation (CSA Z662-19)
CASE Summary
PREPARPED FOR Pacific Northern Gas Ltd.
PROJECT NAME Salvus to Galloway Remediation
PROJECT NUMBER PNG 006-011
DOCUMENT NUMBER PNG006-011_09_1000_001

Case	Outer Diameter (mm)	End Type	Process Fluid	Sweet/ Sour	Class Location	Location	Overall Design Factor	Pressure (kPa)	Restrained?	Pressure Type	Selected SMYS (MPa)	Selected Wall Thickness (mm)	D/t Ratio	Selected Notch Toughness Category	Selected MDMT (°C)	Design Wall Thickness (mm)	Design Operating Stress (MPa)	Design Operating Stress (%)	Hoop Stress Check	Min Install Temp (°C)	Max Op. Temp (°C)	Combined Stress (%SMYS)	Combined Stress Check	Pipe Stress Threshold Value (PTSV) (MPa)	Code Notch Toughness Category	Code Notch Toughness Check	$PTSV_2$ and $PTSV_3$ Code Check	Pressure Test Basis (%MOP)	Minimum Strength Test Pressure (kPa)	Maximum Strength Test Pressure (kPa)	Max Elevation per Test Section (m)	Notes
1	219.1	Plain-end	Gas	Sweet	2	General	0.72	9335	Y	MOP	359	4.0	54.8	2	-5	4.0	256	71%	Pass	5	50	81%	Pass	225	2	Pass	Pass	125%	11,670	11,795	12	Exiisting PNG Mainline Pipe, licensed pressure
2	219.1	Plain-end	Gas	Sweet	2	General	0.72	9335	Y	MOP	359	4.0	54.8	2	-5	4.0	256	71%	Pass	5	50	81%	Pass	225	2	Pass	Pass	125%	11,670	11,795	12	Replacement Option #1
3	219.1	Plain-end	Gas	Sweet	2	Other	0.72	9335	Y	MOP	359	5.6	39.1	2	-5	4.0	183	51%	Pass	5	50	67%	Pass	225	2	Pass	Pass	125%	11,670	16,515	494	Replacement Option #2
4	219.1	Plain-end	Gas	Sweet	2	Stations	0.50	9335	Y	MOP	359	7.0	31.1	2	-45	5.7	145	40%	Pass	-20	50	77%	Pass	225	2	Pass	Pass	125%	11,670	20,760	926	Replacement Option #3
5	219.1	Plain-end	Gas	Sweet	2	General	0.72	9335	Y	MOP	359	8.2	26.8	2	-45	4.0	125	35%	Pass	-20	50	73%	Pass	225	2	Pass	Pass	125%	11,670	24,125	1,270	Quoted Pipe, most likely to be used
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8																																
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TITLE	Pressure Design for Steel Pipelines Calculation (CSA Z662-19)
CASE	Case 1: 219.1mm OD, Gr. 359 x 4mm WT, CAT 2, -5°C
PREPARPED FOR	Pacific Northern Gas Ltd.
PROJECT NAME	Salvus to Galloway Remediation
PROJECT NUMBER	PNG 006-011
DOCUMENT NUMBER	PNG006-011_09_1000_001

= Input Value = Calc. Intermediate = Calc. Result = Fail Result = Pass Result

Pipeline Operating and Design Details — **Reference / Assumption**

Regulatory Body	-	BCOGC			Existing Pipeline
Design Code - Year	-	CSA Z662-19			
Process Fluid		Gas			
Sweet or Sour Service?		Sweet			
Class Location	-	2			
Location Application	-	General			
Location Factor	L	0.900			
Design Factor	F	0.80			CSA Z662 Clause 4.3.6
Joint Factor	J	1.00			CSA Z662 Clause 4.3.8
Temperature Factor	T	1.00			CSA Z662 Clause 4.3.9
Overall Design Factor		0.72			
Pressure	P	9335.0	kPag		
Pressure Type	-	MOP			Licensed Pressure of 1354 psig
Maximum Operating Temperature	T_2	50.0	°C		
Proposed Installation Temperature	T_1	5.0	°C		
Restrained? (Y/N)		Y			

Selected Pipe Specification — **Reference / Assumption**

Material Specification-Year	-	CSA Z245.1-17			
Weld Seam Type	-	SMLS			
Outer Diameter	D	219.1	mm		
Specified Minimum Yield Strength	S	359	MPa		
Min Design Metal Temp	-	-5.0	°C		
Category	CAT	2		Pass	
End Type	-	Plain-end		Pass	

Selected Allowances — **Reference / Assumption**

Corrosion or Erosion Allowance	ca	0.0	mm		
Groove Allowance	ga.	0.0	mm		
Threaded Allowance	t_{all}	0.0	mm		Refer to ANSI B1.20.1 - NPT - American Standard Pipe Thread Taper

Design Wall Thickness — **Reference / Assumption**

Design Wall Thickness	t	4.0	mm		Rounded to nearest 0.1 mm per CSA Z662, 4.3.5
Least Nominal Wall Thickness	-	3.2	mm		CSA Z662 Table 4.5

Calculation - Hoop Stress — **Reference / Assumption**

Proposed Wall Thickness	t_{nom}	4.0	mm	Pass	
Hoop Stress	S_h	255.66	MPa		Equation #1
Max Allowable % of Yield		72%			Equation #3
Hoops Stress % of Yield	%	71.2%	MPa	Pass	Equation #4
Design Pressure of Pipe	P	9.438	MPa		
D/t Ratio	D/t	54.8			
Max D/t Ration @ Uncased Railways	D/t_{max}	N/A		N/A	CSA Z662 Table 4.11

Rev	Description	Date	Done By	Checked By	Stamp	
B	Issued for FEED	02-Feb-20	J. Diaz	G. Pavlik		
A	Issued for Review	06-Nov-19	J. Diaz	G. Pavlik		

TITLE	Pressure Design for Steel Pipelines Calculation (CSA Z662-19)
CASE	Case 1: 219.1mm OD, Gr. 359 x 4mm WT, CAT 2, -5°C
PREPARPED FOR	Pacific Northern Gas Ltd.
PROJECT NAME	Salvus to Galloway Remediation
PROJECT NUMBER	PNG 006-011
DOCUMENT NUMBER	PNG006-011_09_1000_001

= Input Value = Calc. Intermediate = Calc. Result = Fail Result = Pass Result

Calculation - Combined Stress (Restrained Sections)

					Reference / Assumption
Long. Stress (Internal Pressure)	vS_h	76.7	MPa		Equation #6
Long. Stress (Temperature)	$E_c\alpha(T_2-T_1)$	111.8	MPa		
Total Long. Stress	S_L	-35.1	MPa		
Combined Stress	S_h-S_L	290.7	MPa		Equation #7
Max Allowable % of Yield	%	90.0%			Equation #5
Combined Stress % of Yield	%	81.0%		Pass	

Notch Toughness Requirements - Steel Pipe

					Reference / Assumption
Design Operating Stress	-	255.7	MPa	Caution	CSA Z662 Table 5.1
Pipe Stress Threshold Value	PTSV I	225	MPa		CSA Z662 Table 5.2
Is pipe smaller than 114.3 mm OD?*		No			
Is pipe wall thickness less than 6 mm?*		Yes			
Is design operating stress less than 50Mpa*		No			
Is MDMT >M30C*		Yes			
Required Pipe Category per CSA Z662	CAT	2		Pass	CSA Z662 Table 5.1
Can Category I pipe be substituted for Category II pipe in pipe runs shorter than 50 m?		No			CSA Z662 Table 5.1 Note *
Can Category III pipe be substituted for Category II pipe in pipe runs shorter than 100 m?		Yes			CSA Z662 Table 5.1 Note 5
Is weld metal notch toughness required?		No			CSA Z662 Clause 5.2.2.4
Pipe Stress Threshold Value	PTSV 2	295		Pass	refer to section 5.2.2.3 for guidance

*if "No" to any of the above, proven notch toughness may be required

Pressure Test Check 90%

					Reference / Assumption
Test Medium		Liquid			CSA Z662 Table 8.1
Test Fluid		Water			CSA Z662 Table 8.1
Test Fluid Density	p	1000.00	kg/m^3		CSA Z662 Table 8.1
Test Basis		125%	%MOP		CSA Z662 Table 8.1
Max. Hoop Stress during Strength Test	σ_{max}	90%	% SMYS		CSA Z662 Clause 8.7.3
Max. Hoop Stress during Leak Test	σ_{max}	90%	% SMYS		CSA Z662 Clause 8.7.3
Elevation gain per Hydrotest Section	Δh	0	m		
Minimum Strength Test Pressure		11,670	kPa		
Maximum Strength Test Pressure		11,795	kPa		
Strength Test Pressure at High Point		11,670	kPa		
Hoop Stress at High Point	σ_{HP}	89%	% SMYS	Pass	
Strength Test Pressure at Low Point		11,670	kPa	Pass	
Hoop Stress at Low Point	σ_{LP}	89%	% SMYS	Pass	
Max Elevation per Hydrotest Section	Δh_{max}	12	m	Pass	Equation #8

Assumptions

Reference

Rev	Description	Date	Done By	Checked By	Stamp
B	Issued for FEED	02-Feb-20	J. Diaz	G. Pavlik	
A	Issued for Review	06-Nov-19	J. Diaz	G. Pavlik	

TITLE	Pressure Design for Steel Pipelines Calculation (CSA Z662-19)
CASE	Case 2: 219.1mm OD, Gr. 359 x 4mm WT, CAT 2, -5°C
PREPARPED FOR	Pacific Northern Gas Ltd.
PROJECT NAME	Salvus to Galloway Remediation
PROJECT NUMBER	PNG 006-011
DOCUMENT NUMBER	PNG006-011_09_1000_001

= Input Value = Calc. Intermediate = Calc. Result = Fail Result = Pass Result

Pipeline Operating and Design Details

					Reference / Assumption
Regulatory Body	-	BCOGC			
Design Code - Year	-	CSA Z662-19			
Process Fluid		Gas			
Sweet or Sour Service?		Sweet			
Class Location	-	2			
Location Application	-	General			
Location Factor	L	0.900			
Design Factor	F	0.80			CSA Z662 Clause 4.3.6
Joint Factor	J	1.00			CSA Z662 Clause 4.3.8
Temperature Factor	T	1.00			CSA Z662 Clause 4.3.9
Overall Design Factor		0.72			
Pressure	P	9335.0	kPag		
Pressure Type	-	MOP			Licensed Pressure of 1354 psig
Maximum Operating Temperature	T_2	50.0	°C		
Proposed Installation Temperature	T_1	5.0	°C		
Restrained? (Y/N)		Y			

Selected Pipe Specification

					Reference / Assumption
Material Specification-Year	-	CSA Z245.1-17			
Weld Seam Type	-	SMLS			
Outer Diameter	D	219.1	mm		
Specified Minimum Yield Strength	S	359	Mpa		
Min Design Metal Temp	-	-5.0	°C		
Category	CAT	2		Pass	
End Type	-	Plain-end		Pass	

Selected Allowances

				Reference / Assumption
Corrosion or Erosion Allowance	ca	0.0	mm	
Groove Allowance	ga.	0.0	mm	
Threaded Allowance	t_{all}	0.0	mm	Refer to ANSI B1.20.1 - NPT - American Standard Pipe Thread Taper

Design Wall Thickness

				Reference / Assumption
Design Wall Thickness	t	4.0	mm	Rounded to nearest 0.1 mm per CSA Z662, 4.3.5
Least Nominal Wall Thickness	-	3.2	mm	CSA Z662 Table 4.5

Calculation - Hoop Stress

					Reference / Assumption
Proposed Wall Thickness	t_{nom}	4.0	mm	Pass	
Hoop Stress	S_h	255.66	MPa		Equation #1
Max Allowable % of Yield		72%			Equation #3
Hoops Stress % of Yield	%	71.2%	MPa	Pass	Equation #4
Design Pressure of Pipe	P	9.438	MPa		
D/t Ratio	D/t	54.8			
Max D/t Ration @ Uncased Railways	D/t_{max}	N/A		N/A	CSA Z662 Table 4.11

Rev	Description	Date	Done By	Checked By	Stamp	
B	Issued for FEED	02-Feb-20	J. Diaz	G. Pavlik		
A	Issued for Review	06-Nov-19	J. Diaz	G. Pavlik		
Rev	Description	Date	Done By	Checked By	Stamp	Page 1 of 2

TITLE	Pressure Design for Steel Pipelines Calculation (CSA Z662-19)
CASE	Case 2: 219.1mm OD, Gr. 359 x 4mm WT, CAT 2, -5°C
PREPARPED FOR	Pacific Northern Gas Ltd.
PROJECT NAME	Salvus to Galloway Remediation
PROJECT NUMBER	PNG 006-011
DOCUMENT NUMBER	PNG006-011_09_1000_001

= Input Value   = Calc. Intermediate   = Calc. Result   = Fail Result   = Pass Result

Calculation - Combined Stress (Restrained Sections)

					Reference / Assumption
Long. Stress (Internal Pressure)	vS_h	76.7	MPa		Equation #6
Long. Stress (Temperature)	$E_c\alpha(T_2-T_1)$	111.8	MPa		
Total Long. Stress	S_L	-35.1	MPa		
Combined Stress	S_h-S_L	290.7	MPa		Equation #7
Max Allowable % of Yield	%	90.0%			Equation #5
Combined Stress % of Yield	%	81.0%		Pass	

Notch Toughness Requirements - Steel Pipe

					Reference / Assumption
Design Operating Stress	-	255.7	MPa	Caution	CSA Z662 Table 5.1
Pipe Stress Threshold Value	PTSV I	225	MPa		CSA Z662 Table 5.2
Is pipe smaller than 114.3 mm OD?*		No			
Is pipe wall thickness less than 6 mm?*		Yes			
Is design operating stress less than 50Mpa*		No			
Is MDMT >M30C*		Yes			
Required Pipe Category per CSA Z662	CAT	2		Pass	CSA Z662 Table 5.1
Can Category I pipe be substituted for Category II pipe in pipe runs shorter than 50 m?		No			CSA Z662 Table 5.1 Note *
Can Category III pipe be substituted for Category II pipe in pipe runs shorter than 100 m?		Yes			CSA Z662 Table 5.1 Note 5
Is weld metal notch toughness required?		No			CSA Z662 Clause 5.2.2.4
Pipe Stress Threshold Value	PTSV 2	295		Pass	refer to section 5.2.2.3 for guidance

*if "No" to any of the above, proven notch toughness may be required

Pressure Test Check

90%

					Reference / Assumption
Test Medium		Liquid			CSA Z662 Table 8.1
Test Fluid		Water			CSA Z662 Table 8.1
Test Fluid Density	p	1000.00	kg/m^3		CSA Z662 Table 8.1
Test Basis		125%	%MOP		CSA Z662 Table 8.1
Max. Hoop Stress during Strength Test	σ_{max}	90%	% SMYS		CSA Z662 Clause 8.7.3
Max. Hoop Stress during Leak Test	σ_{max}	90%	% SMYS		CSA Z662 Clause 8.7.3
Elevation gain per Hydrotest Section	Δh	0	m		
Minimum Strength Test Pressure		11,670	kPa		
Maximum Strength Test Pressure		11,795	kPa		
Strength Test Pressure at High Point		11,670	kPa		
Hoop Stress at High Point	σ_{HP}	89%	% SMYS	Pass	
Strength Test Pressure at Low Point		11,670	kPa	Pass	
Hoop Stress at Low Point	σ_{LP}	89%	% SMYS	Pass	
Max Elevation per Hydrotest Section	Δh_{max}	12	m	Pass	Equation #8

Assumptions

Reference

Rev	Description	Date	Done By	Checked By
B	Issued for FEED	02-Feb-20	J. Diaz	G. Pavlik
A	Issued for Review	06-Nov-19	J. Diaz	G. Pavlik

Stamp

TITLE	Pressure Design for Steel Pipelines Calculation (CSA Z662-19)
CASE	Case 3: 219.1mm OD, Gr. 359 x 5.6mm WT, CAT 2, -5°C
PREPARPED FOR	Pacific Northern Gas Ltd.
PROJECT NAME	Salvus to Galloway Remediation
PROJECT NUMBER	PNG 006-011
DOCUMENT NUMBER	PNG006-011_09_1000_001

= Input Value = Calc. Intermediate = Calc. Result = Fail Result = Pass Result

Pipeline Operating and Design Details

					Reference / Assumption
Regulatory Body	-	BCOGC			
Design Code - Year	-	CSA Z662-19			
Process Fluid		Gas			
Sweet or Sour Service?		Sweet			
Class Location	-	2			
Location Application	-	Other			
Location Factor	L	0.900			
Design Factor	F	0.80			CSA Z662 Clause 4.3.6
Joint Factor	J	1.00			CSA Z662 Clause 4.3.8
Temperature Factor	T	1.00			CSA Z662 Clause 4.3.9
Overall Design Factor		0.72			
Pressure	P	9335.0	kPag		
Pressure Type	-	MOP			Licensed Pressure of 1354 psig
Maximum Operating Temperature	T_2	50.0	°C		
Proposed Installation Temperature	T_1	5.0	°C		
Restrained? (Y/N)		Y			

Selected Pipe Specification

					Reference / Assumption
Material Specification-Year	-	CSA Z245.1-17			
Weld Seam Type	-	SMLS			
Outer Diameter	D	219.1	mm		
Specified Minimum Yield Strength	S	359	Mpa		
Min Design Metal Temp	-	-5.0	°C		
Category	CAT	2		Pass	
End Type	-	Plain-end		Pass	

Selected Allowances

				Reference / Assumption
Corrosion or Erosion Allowance	ca	0.0	mm	
Groove Allowance	ga.	0.0	mm	
Threaded Allowance	t_{all}	0.0	mm	Refer to ANSI B1.20.1 - NPT - American Standard Pipe Thread Taper

Design Wall Thickness

				Reference / Assumption
Design Wall Thickness	t	4.0	mm	Rounded to nearest 0.1 mm per CSA Z662, 4.3.5
Least Nominal Wall Thickness	-	3.2	mm	CSA Z662 Table 4.5

Calculation - Hoop Stress

					Reference / Assumption
Proposed Wall Thickness	t_{nom}	5.6	mm	Pass	
Hoop Stress	S_h	182.62	MPa		Equation #1
Max Allowable % of Yield		72%			Equation #3
Hoops Stress % of Yield	%	50.9%	MPa	Pass	Equation #4
Design Pressure of Pipe	P	13.213	MPa		
D/t Ratio	D/t	39.1			
Max D/t Ration @ Uncased Railways	D/t_{max}	N/A		N/A	CSA Z662 Table 4.11

Rev	Description	Date	Done By	Checked By	Stamp
B	Issued for FEED	02-Feb-20	J. Diaz	G. Pavlik	
A	Issued for Review	06-Nov-19	J. Diaz	G. Pavlik	

TITLE	Pressure Design for Steel Pipelines Calculation (CSA Z662-19)
CASE	Case 3: 219.1mm OD, Gr. 359 x 5.6mm WT, CAT 2, -5°C
PREPARPED FOR	Pacific Northern Gas Ltd.
PROJECT NAME	Salvus to Galloway Remediation
PROJECT NUMBER	PNG 006-011
DOCUMENT NUMBER	PNG006-011_09_1000_001

= Input Value = Calc. Intermediate = Calc. Result = Fail Result = Pass Result

Calculation - Combined Stress (Restrained Sections)

Calculation - Combined Stress (Restrained Sections)	Symbol	Value	Unit	Result	Reference / Assumption
Long. Stress (Internal Pressure)	vS_h	54.8	MPa		Equation #6
Long. Stress (Temperature)	$E_c\alpha(T_2-T_1)$	111.8	MPa		
Total Long. Stress	S_L	-57.0	MPa		
Combined Stress	S_h-S_L	239.6	MPa		Equation #7
Max Allowable % of Yield	%	90.0%			Equation #5
Combined Stress % of Yield	%	66.7%		Pass	

Notch Toughness Requirements - Steel Pipe

Notch Toughness Requirements - Steel Pipe	Symbol	Value	Unit	Result	Reference / Assumption
Design Operating Stress	-	182.6	MPa	Pass	CSA Z662 Table 5.1
Pipe Stress Threshold Value	PTSV I	225	MPa		CSA Z662 Table 5.2
Is pipe smaller than 114.3 mm OD?*		No			
Is pipe wall thickness less than 6 mm?*		Yes			
Is design operating stress less than 50Mpa*		No			
Is MDMT >M30C*		Yes			
Required Pipe Category per CSA Z662	CAT	2		Pass	CSA Z662 Table 5.1
Can Category I pipe be substituted for Category II pipe in pipe runs shorter than 50 m?		No			CSA Z662 Table 5.1 Note *
Can Category III pipe be substituted for Category II pipe in pipe runs shorter than 100 m?		Yes			CSA Z662 Table 5.1 Note 5
Is weld metal notch toughness required?		No			CSA Z662 Clause 5.2.2.4
Pipe Stress Threshold Value	PTSV 2	295		Pass	refer to section 5.2.2.3 for guidance

*if "No" to any of the above, proven notch toughness may be required

Pressure Test Check

Pressure Test Check	Symbol	90%	Unit	Result	Reference / Assumption
Test Medium		Liquid			CSA Z662 Table 8.1
Test Fluid		Water			CSA Z662 Table 8.1
Test Fluid Density	p	1000.00	kg/m^3		CSA Z662 Table 8.1
Test Basis		125%	%MOP		CSA Z662 Table 8.1
Max. Hoop Stress during Strength Test	σ_{max}	90%	% SMYS		CSA Z662 Clause 8.7.3
Max. Hoop Stress during Leak Test	σ_{max}	90%	% SMYS		CSA Z662 Clause 8.7.3
Elevation gain per Hydrotest Section	Δh	0	m		
Minimum Strength Test Pressure		11,670	kPa		
Maximum Strength Test Pressure		16,515	kPa		
Strength Test Pressure at High Point		11,670	kPa		
Hoop Stress at High Point	σ_{HP}	64%	% SMYS	Pass	
Strength Test Pressure at Low Point		11,670	kPa	Pass	
Hoop Stress at Low Point	σ_{LP}	64%	% SMYS	Pass	
Max Elevation per Hydrotest Section	Δh_{max}	494	m	Pass	Equation #8

Assumptions

Reference

Rev	Description	Date	Done By	Checked By	Stamp
B	Issued for FEED	02-Feb-20	J. Diaz	G. Pavlik	
A	Issued for Review	06-Nov-19	J. Diaz	G. Pavlik	

TITLE	Pressure Design for Steel Pipelines Calculation (CSA Z662-19)
CASE	Case 4: 219.1mm OD, Gr. 359 x 7.04mm WT, CAT 2, -45°C
PREPARPED FOR	Pacific Northern Gas Ltd.
PROJECT NAME	Salvus to Galloway Remediation
PROJECT NUMBER	PNG 006-011
DOCUMENT NUMBER	PNG006-011_09_1000_001

= Input Value = Calc. Intermediate = Calc. Result = Fail Result = Pass Result

Pipeline Operating and Design Details / **Reference / Assumption**

Regulatory Body	-	BCOGC			
Design Code - Year	-	CSA Z662-19			
Process Fluid		Gas			
Sweet or Sour Service?		Sweet			
Class Location	-	2			
Location Application	-	Stations			
Location Factor	L	0.625			
Design Factor	F	0.80			CSA Z662 Clause 4.3.6
Joint Factor	J	1.00			CSA Z662 Clause 4.3.8
Temperature Factor	T	1.00			CSA Z662 Clause 4.3.9
Overall Design Factor		0.50			
Pressure	P	9335.0	kPag		
Pressure Type	-	MOP			Licensed Pressure of 1354 psig
Maximum Operating Temperature	T_2	50.0	°C		
Proposed Installation Temperature	T_1	-20.0	°C		
Restrained? (Y/N)		Y			

Selected Pipe Specification / **Reference / Assumption**

Material Specification-Year	-	CSA Z245.1-17			
Weld Seam Type	-	SMLS			
Outer Diameter	D	219.1	mm		
Specified Minimum Yield Strength	S	359	Mpa		
Min Design Metal Temp	-	-45.0	°C		
Category	CAT	2		Pass	
End Type	-	Plain-end		Pass	

Selected Allowances / **Reference / Assumption**

Corrosion or Erosion Allowance	ca	0.0	mm	
Groove Allowance	ga.	0.0	mm	
Threaded Allowance	t_{all}	0.0	mm	Refer to ANSI B1.20.1 - NPT - American Standard Pipe Thread Taper

Design Wall Thickness / **Reference / Assumption**

Design Wall Thickness	t	5.7	mm	Rounded to nearest 0.1 mm per CSA Z662, 4.3.5
Least Nominal Wall Thickness	-	6.4	mm	CSA Z662 Table 4.5

Calculation - Hoop Stress / **Reference / Assumption**

Proposed Wall Thickness	t_{nom}	7.0	mm	Pass	
Hoop Stress	S_h	145.26	MPa		Equation #1
Max Allowable % of Yield		50%			Equation #3
Hoops Stress % of Yield	%	40.5%	MPa	Pass	Equation #4
Design Pressure of Pipe	P	11.535	MPa		
D/t Ratio	D/t	31.1			
Max D/t Ration @ Uncased Railways	D/t_{max}	N/A		N/A	CSA Z662 Table 4.11

Rev	Description	Date	Done By	Checked By	Stamp
B	Issued for FEED	02-Feb-20	J. Diaz	G. Pavlik	
A	Issued for Review	06-Nov-19	J. Diaz	G. Pavlik	

LAUREN services

TITLE	Pressure Design for Steel Pipelines Calculation (CSA Z662-19)
CASE	Case 4: 219.1mm OD, Gr. 359 x 7.04mm WT, CAT 2, -45°C
PREPARPED FOR	Pacific Northern Gas Ltd.
PROJECT NAME	Salvus to Galloway Remediation
PROJECT NUMBER	PNG 006-011
DOCUMENT NUMBER	PNG006-011_09_1000_001

= Input Value   = Calc. Intermediate   = Calc. Result   = Fail Result   = Pass Result

Calculation - Combined Stress (Restrained Sections)

					Reference / Assumption
Long. Stress (Internal Pressure)	vS_h	43.6	MPa		Equation #6
Long. Stress (Temperature)	$E_c\alpha(T_2-T_1)$	173.9	MPa		
Total Long. Stress	S_L	-130.3	MPa		
Combined Stress	S_h-S_L	275.6	MPa		Equation #7
Max Allowable % of Yield	%	90.0%			Equation #5
Combined Stress % of Yield	%	76.8%		Pass	

Notch Toughness Requirements - Steel Pipe

					Reference / Assumption
Design Operating Stress	-	145.3	MPa	Pass	CSA Z662 Table 5.1
Pipe Stress Threshold Value	PTSV I	225	MPa		CSA Z662 Table 5.2
Is pipe smaller than 114.3 mm OD?*		No			
Is pipe wall thickness less than 6 mm?*		No			
Is design operating stress less than 50Mpa*		No			
Is MDMT >M30C*		No			
Required Pipe Category per CSA Z662	CAT	2		Pass	CSA Z662 Table 5.1
Can Category I pipe be substituted for Category II pipe in pipe runs shorter than 50 m?		No			CSA Z662 Table 5.1 Note *
Can Category III pipe be substituted for Category II pipe in pipe runs shorter than 100 m?		Yes			CSA Z662 Table 5.1 Note 5
Is weld metal notch toughness required?		Yes			CSA Z662 Clause 5.2.2.4
Pipe Stress Threshold Value	PTSV 2	295		Pass	refer to section 5.2.2.3 for guidance

*if "No" to any of the above, proven notch toughness may be required

Pressure Test Check 90%

					Reference / Assumption
Test Medium		Liquid			CSA Z662 Table 8.1
Test Fluid		Water			CSA Z662 Table 8.1
Test Fluid Density	p	1000.00	kg/m^3		CSA Z662 Table 8.1
Test Basis		125%	%MOP		CSA Z662 Table 8.1
Max. Hoop Stress during Strength Test	σ_{max}	90%	% SMYS		CSA Z662 Clause 8.7.3
Max. Hoop Stress during Leak Test	σ_{max}	90%	% SMYS		CSA Z662 Clause 8.7.3
Elevation gain per Hydrotest Section	Δh	0	m		
Minimum Strength Test Pressure		11,670	kPa		
Maximum Strength Test Pressure		20,760	kPa		
Strength Test Pressure at High Point		11,670	kPa		
Hoop Stress at High Point	σ_{HP}	51%	% SMYS	Pass	
Strength Test Pressure at Low Point		11,670	kPa	Pass	
Hoop Stress at Low Point	σ_{LP}	51%	% SMYS	Pass	
Max Elevation per Hydrotest Section	Δh_{max}	926	m	Pass	Equation #8

Assumptions

Reference

Rev	Description	Date	Done By	Checked By	Stamp
B	Issued for FEED	02-Feb-20	J. Diaz	G. Pavlik	
A	Issued for Review	06-Nov-19	J. Diaz	G. Pavlik	

TITLE	Pressure Design for Steel Pipelines Calculation (CSA Z662-19)
CASE	Case 5: 219.1mm OD, Gr. 359 x 8.18mm WT, CAT 2, -45°C
PREPARPED FOR	Pacific Northern Gas Ltd.
PROJECT NAME	Salvus to Galloway Remediation
PROJECT NUMBER	PNG 006-011
DOCUMENT NUMBER	PNG006-011_09_1000_001

= Input Value = Calc. Intermediate = Calc. Result = Fail Result = Pass Result

Pipeline Operating and Design Details

Parameter	Symbol	Value	Unit	Result	Reference / Assumption
Regulatory Body	-	BCOGC			
Design Code - Year	-	CSA Z662-19			
Process Fluid		Gas			
Sweet or Sour Service?		Sweet			
Class Location	-	2			
Location Application	-	General			
Location Factor	L	0.900			
Design Factor	F	0.80			CSA Z662 Clause 4.3.6
Joint Factor	J	1.00			CSA Z662 Clause 4.3.8
Temperature Factor	T	1.00			CSA Z662 Clause 4.3.9
Overall Design Factor		0.72			
Pressure	P	9335.0	kPag		
Pressure Type	-	MOP			Licensed Pressure of 1354 psig
Maximum Operating Temperature	T_2	50.0	°C		
Proposed Installation Temperature	T_1	-20.0	°C		
Restrained? (Y/N)		Y			

Selected Pipe Specification

Parameter	Symbol	Value	Unit	Result	Reference / Assumption
Material Specification-Year	-	CSA Z245.1-17			
Weld Seam Type	-	SMLS			
Outer Diameter	D	219.1	mm		
Specified Minimum Yield Strength	S	359	Mpa		
Min Design Metal Temp	-	-45.0	°C		
Category	CAT	2		Pass	
End Type	-	Plain-end		Pass	

Selected Allowances

				Reference / Assumption
Corrosion or Erosion Allowance	ca	0.0	mm	
Groove Allowance	ga.	0.0	mm	
Threaded Allowance	t_{all}	0.0	mm	Refer to ANSI B1.20.1 - NPT - American Standard Pipe Thread Taper

Design Wall Thickness

				Reference / Assumption
Design Wall Thickness	t	4.0	mm	Rounded to nearest 0.1 mm per CSA Z662, 4.3.5
Least Nominal Wall Thickness	-	3.2	mm	CSA Z662 Table 4.5

Calculation - Hoop Stress

Parameter	Symbol	Value	Unit	Result	Reference / Assumption
Proposed Wall Thickness	t_{nom}	8.2	mm	Pass	
Hoop Stress	S_h	125.02	MPa		Equation #1
Max Allowable % of Yield		72%			Equation #3
Hoops Stress % of Yield	%	34.8%	MPa	Pass	Equation #4
Design Pressure of Pipe	P	19.300	MPa		
D/t Ratio	D/t	26.8			
Max D/t Ration @ Uncased Railways	D/t_{max}	N/A		N/A	CSA Z662 Table 4.11

Rev	Description	Date	Done By	Checked By	Stamp
B	Issued for FEED	02-Feb-20	J. Diaz	G. Pavlik	
A	Issued for Review	06-Nov-19	J. Diaz	G. Pavlik	

TITLE	Pressure Design for Steel Pipelines Calculation (CSA Z662-19)
CASE	Case 5: 219.1mm OD, Gr. 359 x 8.18mm WT, CAT 2, -45°C
PREPARPED FOR	Pacific Northern Gas Ltd.
PROJECT NAME	Salvus to Galloway Remediation
PROJECT NUMBER	PNG 006-011
DOCUMENT NUMBER	PNG006-011_09_1000_001

= Input Value = Calc. Intermediate = Calc. Result = Fail Result = Pass Result

Calculation - Combined Stress (Restrained Sections) — **Reference / Assumption**

Long. Stress (Internal Pressure)	vS_h	37.5	MPa		Equation #6
Long. Stress (Temperature)	$E_c\alpha(T_2\text{-}T_1)$	173.9	MPa		
Total Long. Stress	S_L	-136.4	MPa		
Combined Stress	$S_h\text{-}S_L$	261.4	MPa		Equation #7
Max Allowable % of Yield	%	90.0%			Equation #5
Combined Stress % of Yield	%	72.8%		Pass	

Notch Toughness Requirements - Steel Pipe — **Reference / Assumption**

Design Operating Stress	-	125.0	MPa	Pass	CSA Z662 Table 5.1
Pipe Stress Threshold Value	PTSV I	225	MPa		CSA Z662 Table 5.2
Is pipe smaller than 114.3 mm OD?*		No			
Is pipe wall thickness less than 6 mm?*		No			
Is design operating stress less than 50Mpa*		No			
Is MDMT >M30C*		No			
Required Pipe Category per CSA Z662	CAT	2		Pass	CSA Z662 Table 5.1
Can Category I pipe be substituted for Category II pipe in pipe runs shorter than 50 m?		No			CSA Z662 Table 5.1 Note *
Can Category III pipe be substituted for Category II pipe in pipe runs shorter than 100 m?		Yes			CSA Z662 Table 5.1 Note 5
Is weld metal notch toughness required?		Yes			CSA Z662 Clause 5.2.2.4
Pipe Stress Threshold Value	PTSV 2	295		Pass	refer to section 5.2.2.3 for guidance

*if "No" to any of the above, proven notch toughness may be required

Pressure Test Check 90% — **Reference / Assumption**

Test Medium		Liquid			CSA Z662 Table 8.1
Test Fluid		Water			CSA Z662 Table 8.1
Test Fluid Density	p	1000.00	kg/m^3		CSA Z662 Table 8.1
Test Basis		125%	%MOP		CSA Z662 Table 8.1
Max. Hoop Stress during Strength Test	σ_{max}	90%	% SMYS		CSA Z662 Clause 8.7.3
Max. Hoop Stress during Leak Test	σ_{max}	90%	% SMYS		CSA Z662 Clause 8.7.3
Elevation gain per Hydrotest Section	Δh	0	m		
Minimum Strength Test Pressure		11,670	kPa		
Maximum Strength Test Pressure		24,125	kPa		
Strength Test Pressure at High Point		11,670	kPa		
Hoop Stress at High Point	σ_{HP}	44%	% SMYS	Pass	
Strength Test Pressure at Low Point		11,670	kPa	Pass	
Hoop Stress at Low Point	σ_{LP}	44%	% SMYS	Pass	
Max Elevation per Hydrotest Section	Δh_{max}	1,270	m	Pass	Equation #8

Assumptions — **Reference**

Rev	Description	Date	Done By	Checked By	Stamp
B	Issued for FEED	02-Feb-20	J. Diaz	G. Pavlik	
A	Issued for Review	06-Nov-19	J. Diaz	G. Pavlik	

Buoyancy Calculation Tool
219.1 mm OD Pipeline
Pacific Northern Gas
Salvus to Galloway Remediation
PNG006-011

PNG006-011_09_1000_003

PROJECT REV. #	DATE	REVISION DESCRIPTION	DONE BY		CHECKED BY	
	day-mth-year		Name	Signature	Name	Signature
A	22-11-2019	ISSUE FOR REVIEW	J.DIAZ		G. PAVLIK	
B	02-Feb	ISSUE FOR FEED	J. DIAZ		A. KWAN	
-	-	-	-		-	
-	-	-	-		-	
-	-	-	-		-	

LAUREN services

TITLE Buoyancy Calculation Tool
CASE Summary
PREPARPED FOR Pacific Northern Gas
PROJECT NAME Salvus to Galloway Remediation
PROJECT NUMBER PNG006-011
DOCUMENT NUMBER PNG006-011_09_1000_003

				Bouyancy Control Weight Calculations												Concrete Coating Calculations		
Size (mm)	Process Fluid	Length of Installation (m)	Wall Thickness (mm)	Pipe Weight (kg/m)	Pipe Density (kg/m3)	Coating/Insulation Thickness (mm)	Coating/Insulation Density (kg/m3)	Wetland Type	Wetland Density (kg/m3)	Is Pipe Buoyant?	Weight Fill Type & Material	Mass of Weight or Bag (kg)	Density of Fill ()kg/m3)	Max length between weights (m)	Number of Bags per Section	Concrete Coating Density (kg/m3)	Minimum Concrente Coating Thickness (mm)	Notes
219.1	Sweet Natural Gas	8000	4.0	21.2	7850	N/A	N/A	Freshwater	1000.0	Yes	Geotextile Bag (Gravel)	725	1681	16.20	494	2240	18	Current Pipe
219.1	Sweet Natural Gas	8000	8.2	42.5	7850	N/A	N/A	Freshwater	1000.0	No	Geotextile Bag (Gravel)	725	1681	N/A	N/A	2240	N/A	Replacement Pipe - Heavy Wall
219.1	Sweet Natural Gas	8000	5.2	27.4	7850	N/A	N/A	Freshwater	1000.0	Yes	Geotextile Bag (Gravel)	725	1681	25.99	308	2240	11	Replacement Pipe - Line Pipe

TITLE	Buoyancy Calculation Tool
CASE	Case 1
PREPARPED FOR	Pacific Northern Gas
PROJECT NAME	Salvus to Galloway Remediation
PROJECT NUMBER	PNG006-011
DOCUMENT NUMBER	PNG006-011_09_1000_003

= Input Value | = Calc. Intermediate | = Calc. Result | = Fail Result | = Pass Result

Pipeline Operating and Design Details — **Reference**

Location	-	BC		
Design Code - Year	-	CSA Z662 - 2019		
Service	-	Sweet Natural Gas		
Chainage	-	-		
Length of Installation	$L_{install}$	8000.0	m	
Percent Negative Buoyancy (safety factor)	-	10%		Recommended per Pipeline Design and Construction HB 3rd Ed.

Proposed Pipe Specification — **Reference**

Material Specification	-	CSA Z245.1 - 2018		
Weld Seam Type	-	ERW		
Pipe Density	-	7850.0	kg/m^3	
Pipe Weight	PW	21.2	kg/m	Equation #1
Outer Diameter	D	219.1	mm	
Wall Thickness	t_{nom}	4.0	mm	
Coating/Insulation Thickness	-	N/A	mm	If bare pipe, input N/A
Coating/Insulation Density	-	N/A	kg/m^3	If bare pipe, input N/A

Soil Properties

Dry Unit Weight of Fill	yd	14.923	kN/m3	95 pcf per Godfrey's suggestion
Density of Fill	pf	1521	kg/m3	Density from Unit Weight
Unit Weight of Water	yw	9.805	kN/m3	
Height of fill avobe pipe	C	1.2	m	Depth of Cover (can vary)
Height of water above pipe	hw	1.2	m	Height of water can vary
Water Buoyancy Factor	Rw	0.67	-	Equation #4
Earth Dead Load Pressure (pipe below water table)	Pv	23.76	kN/m2	Euqation #5

Wetland Classification — **Reference**

Wetland Type	-	Freshwater		
Wetland Density	-	1000.0	kg/m^3	

Buoyancy Check (Water and/or mud-water conditions) — **Reference**

Weight of fluid dislaced by pipe + coating	P_b	37.70	kg/m	Equation #2
Weight required for buoyancy control	W_p	18.13	kg/m	Equation #3
Is Pipe Bouyant without buoyancy control?		Yes		

Buoyancy Check (Pipe Below Water Table) — **Reference**

Weight of fluid displaced by pipe	P_b	37.70	kg/m	Equation #2
Weight of pipe	PW	21.2	kg/m	Equation #3
Effective Weight of soil	Ws	267.97	kg/m	Equation #7
Resultant Upward force due to buoyancy	Fb	-247.72	kg/m	Equation#6
Is Pipe Bouyant without buoyancy control?		No		

Bouyancy Weight Calculations — **Reference**

Weight Type	-	Geotextile Bag (Gravel)		
Weight Material	-	Gravel		
Mass of Weight or Bag	-	725.0	kg	From vendor or typical drawing (Pipesak)
Density of Fill	-	1681.0	kg/m^3	From Engineering Toolbox (Used by PipeSak)
Weight of Displaced Submerged Bag	M_{SB}	293.7	kg	Equation #9 - Density of fill must be greater than Wetland density
Max length between weights	L	16.20	m	Equation #10
Number of weights required to eliminate buoyancy	W_{Total}	494.0		Equation #11

Concrete Coating Specification — **Reference**

Concrete Coating Density	-	2240.0	kg/m^3	From Engineering Toolbox (Input N/A if pipe is not buoyant)
Minimum Concrete Coating Thickness to eliminate buoyancy	C_t	17.9	mm	Equation #12

Assumptions — **Reference**

1) The pipeline is assumed to be empty in all calculations
2) The force due to the shear strength of pipe and backfill material is not considered.
3) The pipeline is assumed to be submerged in water, or muskeg (project specific).
4) Geotextile bag fill porosity not considered.

Codes/Standards Referenced

CSA Z662-19

Rev	Description	Date	Done By	Checked By	Stamp	
-	-	-	-	-		
-	-	-	-	-		
-	-	-	-	-		
-	-	-	-	-		
A	22-11-2019	07-08-2019	J.DIAZ	G. PAVLIK		Page 1 of 1

LAUREN services

TITLE	Buoyancy Calculation Tool
CASE	Case 2
PREPARPED FOR	Pacific Northern Gas
PROJECT NAME	Salvus to Galloway Remediation
PROJECT NUMBER	PNG006-011
DOCUMENT NUMBER	PNG006-011_09_1000_003

= Input Value = Calc. Intermediate = Calc. Result = Fail Result = Pass Result

Pipeline Operating and Design Details

Parameter	Symbol	Value	Unit	Reference
Location	-	BC		
Design Code - Year	-	CSA Z662 - 2019		
Service	-	Sweet Natural Gas		
Chainage	-	-		
Length of Installation	$L_{install}$	8000.0	m	
Percent Negative Buoyancy (safety factor)	-	10%		Recommended per Pipeline Design and Construction HB 3rd Ed.

Proposed Pipe Specification

Parameter	Symbol	Value	Unit	Reference
Material Specification	-	CSA Z245.1 - 2018		
Weld Seam Type	-	ERW		
Pipe Density	-	7850.0	kg/m^3	
Pipe Weight	PW	42.5	kg/m	Equation #1
Outer Diameter	D	219.1	mm	
Wall Thickness	t_{nom}	8.2	mm	
Coating/Insulation Thickness	-	N/A	mm	If bare pipe, input N/A
Coating/Insulation Density	-	N/A	kg/m^3	If bare pipe, input N/A

Soil Properties

Parameter	Symbol	Value	Unit	Reference
Dry Unit Weight of Fill	γd	14.923	kN/m3	95 pcf per Godfrey's suggestion
Density of Fill	ρf	1521	kg/m3	Density from Unit Weight
Unit Weight of Water	γw	9.805	kN/m3	
Height of fill above pipe	C	1.2	m	Depth of Cover (can vary)
Height of water above pipe	hw	1.2	m	Height of water can vary
Water Buoyancy Factor	Rw	0.67	-	Equation #4
Earth Dead Load Pressure (pipe below water table)	Pv	23.76	kN/m2	Euqation #5

Wetland Classification

Parameter	Symbol	Value	Unit	Reference
Wetland Type	-	Freshwater		
Wetland Density	-	1000.0	kg/m^3	

Buoyancy Check (Water and/or mud-water conditions)

Parameter	Symbol	Value	Unit	Reference
Weight of fluid dislaced by pipe + coating	P_b	37.70	kg/m	Equation #2
Weight required for buoyancy control	W_p	N/A	kg/m	Equation #3
Is Pipe Bouyant without buoyancy control?		No		

Buoyancy Check (Pipe Below Water Table)

Parameter	Symbol	Value	Unit	Reference
Weight of fluid displaced by pipe	P_b	37.70	kg/m	Equation #2
Weight of pipe	PW	42.5	kg/m	Equation #3
Effective Weight of soil	Ws	267.97	kg/m	Equation #7
Resultant Upward force due to buoyancy	Fb	-269.05	kg/m	Equation#6
Is Pipe Bouyant without buoyancy control?		No		

Bouyancy Weight Calculations

Parameter	Symbol	Value	Unit	Reference
Weight Type	-	Geotextile Bag (Gravel)		
Weight Material	-	Gravel		
Mass of Weight or Bag	-	725.0	kg	From vendor or typical drawing (Pipesak)
Density of Fill	-	1681.0	kg/m^3	From Engineering Toolbox (Used by PipeSak)
Weight of Displaced Submerged Bag	M_{SB}	293.7	kg	Equation #9 - Density of fill must be greater than Wetland density
Max length between weights	L	N/A	m	Equation #10
Number of weights required to eliminate buoyancy	W_{Total}	N/A		Equation #11

Concrete Coating Specification

Parameter	Symbol	Value	Unit	Reference
Concrete Coating Density	-	2240.0	kg/m^3	From Engineering Toolbox (Input N/A if pipe is not buoyant)
Minimum Concrete Coating Thickness to eliminate buoyancy	C_t	N/A	mm	Equation #12

Assumptions

1) The pipeline is assumed to be empty in all calculations
2) The force due to the shear strength of pipe and backfill material is not considered.
3) The pipeline is assumed to be submerged in water, or muskeg (project specific).
4) Geotextile bag fill porosity not considered.

Reference

Codes/Standards Referenced

CSA Z662-19

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-	-	-	-	-		
-	-	-	-	-		
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-	-	-	-	-		
A	22-11-2019	07-08-2019	J.DIAZ	G. PAVLIK		

TITLE	Buoyancy Calculation Tool
CASE	Case 3
PREPARPED FOR	Pacific Northern Gas
PROJECT NAME	Salvus to Galloway Remediation
PROJECT NUMBER	PNG006-011
DOCUMENT NUMBER	PNG006-011_09_1000_003

= Input Value = Calc. Intermediate = Calc. Result = Fail Result = Pass Result

Pipeline Operating and Design Details

Parameter	Symbol	Value	Unit	Reference
Location	-	BC		
Design Code - Year	-	CSA Z662 - 2019		
Service	-	Sweet Natural Gas		
Chainage	-	-		
Length of Installation	$L_{install}$	8000.0	m	
Percent Negative Buoyancy (safety factor)	-	10%		Recommended per Pipeline Design and Construction HB 3rd Ed.

Proposed Pipe Specification

Parameter	Symbol	Value	Unit	Reference
Material Specification	-	CSA Z245.1 - 2018		
Weld Seam Type	-	ERW		
Pipe Density	-	7850.0	kg/m^3	
Pipe Weight	PW	27.4	kg/m	Equation #1
Outer Diameter	D	219.1	mm	
Wall Thickness	t_{nom}	5.2	mm	
Coating/Insulation Thickness	-	N/A	mm	If bare pipe, input N/A
Coating/Insulation Density	-	N/A	kg/m^3	If bare pipe, input N/A

Soil Properties

Parameter	Symbol	Value	Unit	Reference
Dry Unit Weight of Fill	yd	14.923	kN/m3	95 pcf per Godfrey's suggestion
Density of Fill	pf	1521	kg/m3	Density from Unit Weight
Unit Weight of Water	yw	9.805	kN/m3	
Height of fill avobe pipe	C	1.2	m	Depth of Cover (can vary)
Height of water above pipe	hw	1.2	m	Height of water can vary
Water Buoyancy Factor	Rw	0.67	-	Equation #4
Earth Dead Load Pressure (pipe below water table)	Pv	23.76	kN/m2	Euqation #5

Wetland Classification

Parameter	Symbol	Value	Unit	Reference
Wetland Type	-	Freshwater		
Wetland Density	-	1000.0	kg/m^3	

Buoyancy Check (Water and/or mud-water conditions)

Parameter	Symbol	Value	Unit	Reference
Weight of fluid dislaced by pipe + coating	P_b	37.70	kg/m	Equation #2
Weight required for buoyancy control	W_p	11.30	kg/m	Equation #3
Is Pipe Bouyant without buoyancy control?		Yes		

Buoyancy Check (Pipe Below Water Table)

Parameter	Symbol	Value	Unit	Reference
Weight of fluid displaced by pipe	P_b	37.70	kg/m	Equation #2
Weight of pipe	PW	27.4	kg/m	Equation #3
Effective Weight of soil	Ws	267.97	kg/m	Equation #7
Resultant Upward force due to buoyancy	Fb	-253.93	kg/m	Equation#6
Is Pipe Bouyant without buoyancy control?		No		

Bouyancy Weight Calculations

Parameter	Symbol	Value	Unit	Reference
Weight Type	-	Geotextile Bag (Gravel)		
Weight Material	-	Gravel		
Mass of Weight or Bag	-	725.0	kg	From vendor or typical drawing (Pipesak)
Density of Fill	-	1681.0	kg/m^3	From Engineering Toolbox (Used by PipeSak)
Weight of Displaced Submerged Bag	M_{SB}	293.7	kg	Equation #9 - Density of fill must be greater than Wetland density
Max length between weights	L	25.99	m	Equation #10
Number of weights required to eliminate buoyancy	W_{Total}	308.0		Equation #11

Concrete Coating Specification

Parameter	Symbol	Value	Unit	Reference
Concrete Coating Density	-	2240.0	kg/m^3	From Engineering Toolbox (Input N/A if pipe is not buoyant)
Minimum Concrete Coating Thickness to eliminate buoyancy	C_t	11.5	mm	Equation #12

Assumptions

1) The pipeline is assumed to be empty in all calculations
2) The force due to the shear strength of pipe and backfill material is not considered.
3) The pipeline is assumed to be submerged in water, or muskeg (project specific).
4) Geotextile bag fill porosity not considered.

Reference

Codes/Standards Referenced

CSA Z662-19

Rev	Description	Date	Done By	Checked By	Stamp	
-	-	-	-	-		
-	-	-	-	-		
-	-	-	-	-		
-	-	-	-	-		
A	22-11-2019	07-08-2019	J.DIAZ	G. PAVLIK		

TITLE	Buoyancy Calculation Tool
CASE	Formulas
PREPARPED FOR	Rangeland Midstream Canada, Ltd
PROJECT NAME	Marten Hills Pipeline Project
PROJECT NUMBER	RGL001-001
DOCUMENT NUMBER	RGL001-001_09_1000_007

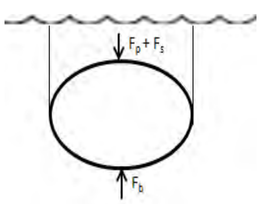
Formulae - Pipe Buoyancy - Weights Control

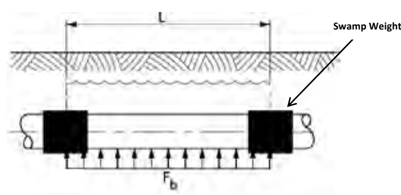
1	$PW = \frac{\frac{\pi}{4} * (D^2 - (D-2t)^2) \; * \; \rho_{pipe}}{1000000}$	Pipe Weight (per meter)
2	$P_b = \frac{\pi}{4} * \left(\frac{D}{1000}\right)^2 * \rho_{wetland\ or\ water}$	Weight of Fluid Displaced by pipe + coating (optional)
3	$W_p = (P_b - PW) * (1 + Safety\ Factor)$	Weight Required for Buoyancy Control (Pipe in Water only)
4	$R_w = 1 - 0.33(\frac{h_w}{C})$	Water Buoyancy Factor (From ALA)
5	$P_v = \gamma_w * h_w + R_w * \gamma_d * C$	Earth Load Pressure
6	$F_b = P_b - [PW + W_s]$	Resultant Upward Force due to buoyancy
7	$W_s = (P_v - \gamma_w * h_w)D$	Weight of soil
8	$P_{vu} = P_v - 2c * \frac{C}{D}$	Vertical Earth Load (undisturbed soil)
9	$M_{SB} = \frac{Mass\ of\ bag}{\rho_{bag}} * (\rho_{bag} - \rho_{wetland})$	Weight of displaced submerged bag
10	$L = \frac{M_{SB}}{W_p}$	Maximum Length between bags
11	$W_{total} = \frac{L}{L_{install}}$	Number of bags needed per pipe segment

Reference

All formulae from Pipeline Design and Construction - A practical approach - 3rd edition and ALA Guide for the Design of Buried Steel Pipe

Positive = Pipe buoyant
Negative = Pipe not buoyant



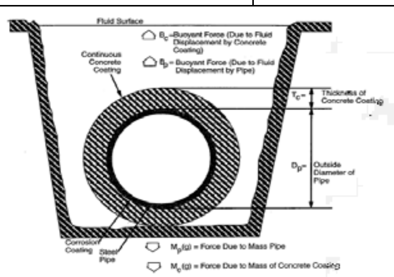


Formulae - Pipe Buoyancy - Countinuous Concrete Coating

12	$C_t = \frac{1}{2}\left\{\left[\frac{D^2 * \rho_{concrete} - [D^2 - (D-2t)^2] \; * \; \rho_{steel}}{\rho_{concrete} - \rho_{wetland} * (1 + \frac{Safety\ Factor}{100})}\right]^{0.5} - D\right\}$	Concrete Coating Thickness

Reference

All formulae from Pipeline Design and Construction - A practical approach - 3rd edition



Codes/Standards Referenced

CSA Z662-19

Rev	Description	Date	Done By	Checked By	Stamp	
-	-	-	-	-		
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Appendix K – Lauren - Basis of Estimate (Confidential)

Appendix L – Revay - Quantitative Cost Risk Assessment (Confidential)

Appendix M – Lauren - Risk Registry (Confidential)

Appendix N – Financial Analysis (Confidential)

Appendix O – Khtada - Environmental Constraints Report

Salvus to Galloway Remediation Project
Environmental Constraints Analysis

Prepared for:

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Revision History and Approvals			
Project Name	Salvus to Galloway Remediation Project		
Project Number	8016		
Report Title	Environmental Constraints Analysis		
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Report Authors	Shawn Giesbrecht, AScT, EP.		
Date	***Version***	***Type***	***Reviewed by***
December 20, 2019	0	Peer Review	Kevin Doddridge, B.Sc., R.P.Bio.
January 9, 2020	0	Finalize Report	Shawn Giesbrecht, AScT, EP.
April 2, 2020	1	Updated with PNG's Comments	Shawn Giesbrecht, AScT, EP.

Disclaimer

This report is rendered solely for the use by Pacific Northern Gas Ltd. in connection with the PNG - Salvus (MP 311) to Galloway Rapids (MP 361) associated with the Salvus to Galloway Remediation Project. No person may rely on it for any other purpose without Khtada Environmental Services LP's (Khtada's) prior written approval. Should a third party use this report without Khtada's approval, they may not rely upon it. Khtada accepts no responsibility for loss or damages suffered by any third party as a result of decisions made or actions taken based on this report.

This report is based on facts and opinions contained within the referenced documents, including the results of any data collection programs carried out in relation to report. We have attempted to identify and consider facts and documents relevant to the scope of work, accurate as of the time period during which we conducted this analysis. However, the results, our opinions, or recommendations may change if new information becomes available or if information, we have relied on is altered.

We applied accepted professional practices and standards in developing and interpreting data. While we used accepted professional practices in interpreting data provided or third-party sources, we did not verify the accuracy of any such data.

This report must be considered as a whole; selecting only portions of this report may result in a misleading view of the results, our opinions, or recommendations.

Acronyms	Meaning
ALR	Agricultural Land Reserve
AMS	Application Management System
BC	British Columbia
BC CDC	British Columbia Conservation Data Centre
BCEAA	*British Columbia Environmental Assessment Act*
BCSEE	British Columbia Species and Ecosystem Explorer
BEC	Biogeoclimatic Ecosystem Classification
BMP	Best Management Practice
EAO	BC Environmental Assessment Office
EC	Environmental Component
ESPP	Environmental Standard Procedures and Practices
CDC	BC Conservation Data Centre
CEAA	*Canadian Environmental Assessment Act*
CEMP	Construction Environmental Management PLan
CSA	Canadian Standards Association
CWH	Coastal Western Hemlock
DFO	Fisheries and Oceans Canada
ECCC	Environment and Climate Change Canada
ECCS	BC Ministry of Environment and Climate Change Strategy
EAO	Environmental Assessment Office
FAA	*Fisheries Act* Authorization
FISS	Fisheries Inventory Summary System
FIDQ	Fisheries Inventory Data Queries
FLNRORD	Ministry of Forests, Lands, Resource Operations and Rural Development
FSR	Forest Service Road
FWA	Freshwater Atlas
GWM	General Wildlife Measure
HADD	Habitat Alteration Disruption or Destruction
ILI	In-line inspections
IMP	Integrity Management Plan
ISC	Indigenous Services Canada
IWMS	Identified Wildlife Management Strategy
kPa	Kilopascal
LRTW	Least Risk Timing Window
MP	Mile post
MOE	BC Ministry of Environment
MOP	Maximum Operating Pressure
NOP	Normal Operating Pressure
NS	Not Sampled
OGC	BC Oil and Gas Commission
PUP	Park Use Permit
QEP	Qualified Environmental Professional
RoW	Right of Way
SARA	*Species at Risk Act*
SC	Special Concern
(sp)	Species undetermined
T	Threatened
TC	Transport Canada
TRIM	Terrain Resource Information Management
UWR	Ungulate Winter Range
WHA	Wildlife Habitat Areas

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1.0 Introduction

1.1 Project Rationale and Description

Pacific Northern Gas Ltd ("PNG") is planning to conduct maintenance work on the 50-mile (80km) segment of the 8-inch Prince Rupert Mainline from Salvus maintenance yard to Galloway pressure regulating station. This segment near Prince Rupert BC forms a part of PNG's transmission pipeline which transports natural gas from Summit Lake, BC to Prince Rupert, BC. All proposed integrity maintenance work will be in accordance with the governance of the PNG Integrity Management Plans, the regulatory requirements of the BC Oil and Gas Commission, and the maintenance and construction requirements of CSA Z662 standard for oil and gas pipeline systems.

The project is proposed to be completed over a number of consecutive construction seasons. The project activities will include, but are not necessarily limited to, brushing/clearing of PNG's existing permanent ROW, pipeline maintenance work such as pipe in-situ repairs, section replacements, lowering, armoring, installing temporary and/or permanent accesses for construction equipment and personnel, developing as required borrow sites for construction materials, spoil sites for storage of removed materials, and stockpile, staging, and work areas.

All work will be kept within existing PNG Right-of-Way or permitted temporary workspace and will adhere to all federal and provincial environmental guidelines and PNG's project specific and corporate Environmental Management Plans.

As a component of this process, Lauren Services has requested Khtada prepare this environmental constraint analysis which will:

- Characterize in general terms the environmental setting and sensitivities along the pipeline alignment between Salvus Valve and Galloway Station;
- Summarize relevant environmental background information available for the area;
- Identify environmental regulatory requirements in the context of conceptual pipeline remediation activities;
- Determine constraints integrating environmental sensitivities and regulatory requirements; and,
- Recommend additional environmental studies to be completed to facilitate short- and long-term planning and permitting objectives.

1.2 Project Location and Terms

The Salvus to Galloway pipeline segment is located west of Terrace, BC and east of Prince Rupert, BC within a mountainous region north of Highway 16 West and south of Work Channel. The project has been divided into four segments and are described in Table 1. Salvus Valve (MP 311) is present on the north side of the Skeena River crossing and Highway 16 that represents the start of segment one. The razorback is a colloquial term that describes a mountain ridge feature and watershed divide between the Kasiks and Khyex River basins through which PNG's pipeline tunnel was originally constructed. Prudhomme summit is also a watershed divide between Fortune Creek, which is a tributary to Work Channel, and the Prudhomme Reservoir (locally known as Prudhomme Lake) which is now an impoundment of the Kloiya River at Kloiya Dam.

Table 1. Summary of segments

Segment	*Location*	*Name*	*Description*
1	MP311 to MP326.41	Salvus to Razorback	Leaves Highway 16 and follows the east side, and in close proximately of the Kasiks River. After crossing the river, the pipeline traverses an elevated bench on north side of Huckleberry Creek to the headwaters. The segment is presently only accessible on foot.
2	MP326.41 to MP342	Razorback to Lachmach	The pipeline crosses through a tunnel and follows the south side of Arden Creek and the west side of the Khyex River, returning to Highway 16. The segment is presently only accessible on foot.
3	MP342 to MP351.5	Lachmach to Prudhomme Summit	The pipeline follows the northeast side of the Lachmach River crossing the river close to Work Channel and continuing to Fortune Creek. The pipeline continues up the north side of Fortune Creek to Prudhomme summit. A majority of the segment is presently only accessible on foot with a short section accessible from the Lachmach FSR.
4	MP351.5 to MP361.5	Prudhomme Summit to Galloway	From the summit, the pipeline following Prudhomme Creek to the north side of Prudhomme Lake. The pipeline crosses and follows the south side of the Kloiya River before returning to Highway 16 to the Galloways Substation. A majority of the segment is presently only accessible on foot until it crosses the Kloyia dam.

1.3 Proposed Work

To mitigate the integrity issues identified in the Salvus to Galloway segment, several key construction tasks are anticipated to be required and are described in Table 2.

Table 2. Anticipated work tasks and description

Work Component	*Task*	*Typical Description*
Access Management	Development of both temporary and permanent access to the location of interest.	• Brushing along the existing RoW • Clearing for new temporary work space. • Installation of temporary and permanent watercourse crossings • Road building including quarrying, material hauling, placing, compaction and ditching • Development of staging and laydown areas
Integrity Digs	Ground excavation to uncover the pipeline segment and assess condition	• Clearing and site preparation • Material excavation and storage • Management of surface and groundwater during open trench condition
Pipeline Repairs	Piping work to restore safe pipeline condition	• Performing cut-outs including excavation, stringing, bending, welding, lowering, pressure-testing, and backfilling • Management of surface and groundwater during open trench condition
Geohazard Mitigation	Construction of mitigation measures to protect the pipeline from geohazards (BGC 2019)	• Increase depth of cover through pipeline lowering, or increasing roach thickness over top of the line • Re-routing the pipeline within the RoW • Improving the cover type over the pipeline • Stabilization or removal of the geohazard • Instream armouring by installing revetments • Retention and training of watercourses • Change pipeline design to reduce vulnerability

2.0 Valued Environmental Components

2.1 Scoping

While environmental assessments can focus on a broad range of environmental, economic, social, cultural, archaeological, historical, and aesthetic elements, considering all these factors in this constraints analysis would be too broad at this preliminary stage of the project and is outside the scope of this report. Therefore, determining the environmental resources to include as part of this analysis is an important step in determining potential constraints that exist as the project moves from the planning phase into the permitting and construction phases.

Methods for scoping this analysis has been based on the *Guideline for the Selection of Valued Components and Assessment of Potential Effects* prepared by the BC Environmental Assessment Office (EAO 2013). Environmental Components (ECs) are defined in this report as features of the natural environment that are normally considered by proponents, indigenous groups, government agencies, the public, and other stakeholders to possess ecological importance. For the purpose of this report, the section of ECs was undertaken by Khtada based on our regional experience, consider the spatial and temporal scope of the project, and anticipated project-environment interactions prior to consultation.

2.2 Environmental Components

The following general EC categories were selected by Khtada:

- Aquatic species and habitats;
- Water quality and quantity;
- Terrestrial species and habitats;
- Species at Risk; and,
- Administrative boundaries and requirements.

Table 3 elaborates on the above categories by describing the EC and providing rationale for its inclusion in this analysis.

Table 3. General ECs

EC Category	*Scoping Description*	*Rationale for Inclusion*
Aquatic Species and Habitats	• Anadromous and resident fish • Fish habitat	• Pipeline infrastructure is located within fish habitat and proposed work may result in changes to that habitat through physical works or mechanisms involving water quantity and quality.
Water Quality and Quantity	• Classifiable streams • Classifiable wetlands • Non-classified drainages (NCDs)	• Pipeline infrastructure is located within watercourses considered as 'Streams' under the *Water Sustainability Act* and works affecting Streams are regulated activities.
Terrestrial species and habitats	• Migratory and non-migratory avian species and habitats	• Brushing and clearing, and the noise and visual impacts that result has the potential to disturb or displace avian species either through impact to active nests, mortality, or changes in behaviour.
	• Mammalian wildlife and habitats	• Brushing, clearing, and equipment operation has the potential to disturb or displace mammalian species, and access improvements and development of infrastructure has the potential to impact their habitat.

EC Category	Scoping Description	Rationale for Inclusion
Terrestrial species and habitats	• Amphibians and amphibian habitat	• Pipeline infrastructure is located within wetlands and adjacent upland areas used by amphibians for foraging and breeding, and changes to these features from access and pipeline repair works may impact these habitats.
	• Plants and ecosystems of conservation concern	• Brushing and clearing has the potential to destroy rare plants or impact listed ecosystems through vegetation removal or alteration mechanisms.
Species at Risk	• Species identified under Schedule 1 of the *Species at Risk Act*	• Clearing, and infrastructure development may disturb or displace wildlife Species at Risk or result in loss of their habitat.
Administrative	• Provincial Parks and Protected Areas • Federal Lands • Legally designated special management areas	• Activities within certain administrative areas have special management and permitting considerations.

2.3 Selection of Project Specific ECs

For an EC to be carried forward as a potential constraint and evaluation in this analysis, several questions were considered by Khtada, including:

- Is the component present in the local or regional area?
- Does a legislative requirement exist to protect the component?
- Is the component the subject of a government management priority?
- Is there potential for a negative interaction between the component and proposed activities?[1]

2.3.1 Information Sources

To determine whether the component was present in the local or regional area, a combination of information sources reviewed that included web-based sources, both published and unpublished technical reports, and Khtada's experience having provided environmental services to PNG in the area for over 15 years.

The following sources were reviewed for relevant data:

- BC Environmental Assessment Office (EAO) website – a repository of reports related to current environmental assessment projects and certified/completed projects in BC, operated by the BC EAO (https://www.projects.eao.gov.bc.ca/);

[1] At present no formal effects assessment has been completed for any component or activity; however, this preliminary determination has been made in a logical fashion by experienced and Qualified Environmental Professionals (QEPs)

- BC Freshwater Atlas (FWA) – Intended to be the definitive source for mapping hydrologic features in BC, FWA was used for GIS analysis of watershed and waterbody/watercourse statistics, such as stream order, watershed area, lake and wetland surface areas, stream lengths, watershed codes and waterbody identifiers. The FWA was also used as the source for gazetted geographical names of hydrologic features. (http://www.ilmb.gov.bc.ca/geobc/FWA);
- BC Conservation Data Centre (BC CDC) – a database maintained and administered by the BC Ministry of Environment (BC MOE) used to identify provincial species of conservation concern including current conservation status, legal description and spatial distributions. Data is viewed using the BC Species and Ecosystems Explorer web utility (http://maps.gov.bc.ca/ess/hm/cdc/);
- Fisheries Information Summary System (FISS) (available through the Fisheries Information Data Queries (FIDQ) web utility) - provides fisheries data uploaded to the FISS system (which was jointly developed by the Province of BC and the DFO). Data are available as point files that can be uploaded into a geographic information system (GIS), and includes fish distributions, obstructions, enhancement and management activities, and notes on fisheries potential and constraints. This resource also provides a method to query fish distributions within whole watersheds or BC MOE Regions, and provides references to data sources. FISS data is generally georeferenced at a 1:50,000 scale, however recent updates are generally lacking. (https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/fish/fish-and-fish-habitat-data-information/search-fish-fish-habitat-data-information/fisheries-inventory-data-queries);
- BC Ecological Reports Catalogue (EcoCat) – Web utility to access digital information in the public domain that has been provided to various government agencies; the database is not fisheries specific, but generally includes data that can be spatially defined. Also includes digital submissions for fish permit reports, which include fish capture locations submitted to BC MOE as a requirement of scientific fish collection permits. The documents retrieved from EcoCat are further reviewed and included as separate literature references. (http://www.env.gov.bc.ca/ecocat/)
- Triton Library – historical work completed by Triton within the subject watersheds was reviewed for relevant data. Non-public reports that were considered were Triton (2006) and Triton (2012).
- Terrain Resource Information Management (TRIM II) - Digital TRIM data was analyzed using a GIS to derive topographical information that was not available by analyzing FWA data, including slope analysis, elevations, proximity to roads and other topographic features.
- Northwest BC Water Tool (http://www.bcwatertool.ca/);
- Species at Risk Registry – an online source for information relating to species at risk in Canada including administrative information related to the *Species at Risk Act* (SARA) (www.sararegistry.gc.ca);
- WAVES – an online catalogue of books, journals, and government reports related to marine and freshwater science provided by the Department of Fisheries and Oceans Canada (DFO);

- A primary literature review was performed for digital and printed material with relevant information on fish and fish habitat within the project area. Primary sources used are detailed in Table 5.
- Publicly available consultant reports, fish collection permit reports, and other internet searches, referenced as appropriate.

2.3.2 Screening of Project Specific ECs

The results of a detailed screening of Project Specific ECs are presented in Table 4.

Table 4. Project Specific EC Screening

Environmental Component	***Identified by***	***Habitat Association***	***Segment***				***Regulation Protecting?***	
			1	**2**	**3**	**4**	**Species**	**Habitat**
Fish: All Salmon	DFO	Watercourses	Y	Y	Y	Y	Y	Y
Fish: non-salmon	FLNRORD	Watercourses	Y	Y	Y	Y	Y	Y
Bull Trout	IWMS	Watercourses	P	P	P	Y	Y	Y
Cutthroat Trout, *clarkii* subspecies	IWMS	Watercourses	P	P	P	Y	Y	Y
Green Sturgeon	SARA	Large rivers	N	N	Y	Y	Y	Y
Invasive and Noxious Weeds	Weed Control Act	Existing ROW	P	P	P	P	Y	N
oldgrowth specklebelly	SARA	Old growth forests	P	P	P	P	Y	N
Rare and Endangered Plants	CDC (listed in Appendix 2)	Various	P	P	P	P	N	N
Western redcedar / devil's club	Identified IWMS ecosystem	Old growth forests	U	U	U	U	-	Y
Rare and Endangered Ecosystems	CDC (listed in Appendix 2)	Various	P	P	P	P	N	N
Coastal Tailed Frog	SARA, IWMS	Small, perennial streams	P	P	P	Y	Y	Y
Western Toad	SARA	Wetlands	P	P	Y	P	Y	N
Rare and Endangered reptiles and herptiles	CDC (listed in Appendix 2)	Various	P	P	P	P	N	N
Black Swift	SARA	Riparian forests	P	P	P	P	Y	N
Peregrine Falcon	SARA	Old growth forests	P	P	P	P	Y	N
Ancient Murrelet	SARA, IWMS	Old growth forests	P	P	P	P	Y	Y
Rusty Blackbird	SARA	Wetlands	P	P	P	P	Y	N
Western Screech-Owl, *kennicottii* subspecies	SARA	Forested areas	P	P	P	P	Y	N
Olive-sided Flycatcher	SARA	Forested areas	P	P	P	P	Y	N
Northern Goshawk, *laingi* subspecies	SARA, IWMS	Forested areas	P	P	P	P	Y	N
Marbled Murrelet	SARA, IWMS	Old growth forests	P	P	P	P	Y	N
Barn Swallow	SARA	Cavities, cliffs	P	P	P	P	Y	N
Sandhill Crane	IWMS	Large wetlands, lakes	N	N	N	N	Y	N
Rare and Endangered birds	CDC (listed in Appendix 2)	Various	P	P	P	P	N	N

Environmental Component	Identified by	Habitat Association	Segment				Regulation Protecting?	
			1	2	3	4	Species	Habitat
Little Brown Myotis	SARA, IWMS	Old growth forests, rock faces,	P	P	P	P	Y	Y
Great Blue Heron, fannini subspecies	SARA, IWMS	Old growth forests	P	P	P	P	Y	Y
Band-tailed Pigeon	SARA	Forested areas	P	P	P	P	Y	N
Beaver	FLNRORD	Wetlands with dams	Y	Y	Y	Y	Y	Y
Wolverine	SARA, IWMS	All	P	P	P	P	Y	N
Grizzly Bear	SARA, IWMS	All	P	P	P	P	Y	N
Fisher	IWMS	Old growth forests	P	P	P	P	Y	N
Moose	IWMS	Approved winter Range	Y	Y	Y	Y	Y	Y
Mountain Goat	IWMS	Approved winter Range	Y	Y	Y	Y	Y	Y
Rare and Endangered wildlife (general)	CDC (listed in Appendix 2)	Various	P	P	P	P	N	N
Protected Areas	Park, WHA,UWR	All	Y	N	Y	N	N/A	Y
Y=yes; N=No; P=potential; U=unknown, N/A=not applicable.								

The following assumptions were relied upon in developing Table 4:

- Only species and habitat protected by formal legislation are included as specific entries while others are captured under a generic listing. While there is no formal requirement to manage generic entries, PNG may be required to be address these during supplemental permitting and consultation.
- *Habitat association* is assigned to assist in generically categorizing how the sensitivity interacts with the right-of-way. The habitat association recognizes the more important habitat (e.g. breeding or denning habitat) type, however, the species may use a variety of habitat types throughout its life cycle.
- Regulation protecting the species and habitat refer to formal legislation that clearly links to PNG's pipeline and Khtada's understanding of the scope of work. There are other documents that may establish objectives at the regional level, but not formally mandated by regulation. It is up to PNG to determine if these objectives will be integrated into project planning. Many of these documents were developed under the *Forest and Range Practices Act*, apply at the landscape level, and have limited applicability to a narrow, pipeline corridor.

3.0 Summary of Available Background Information

3.1 Summary of Aquatic Species and Habitats

A literature review was performed for the Salvus to Galloway segment and the results are summarized below in Table 5.

Table 5. Literature Reviewed

Bustard (1994)	David Bustard and Associates. 1994. Fisheries assessment of pipeline crossings in the Kasiks and Khyex Rivers. Prepared for Pacific Northern Gas Ltd., Terrace, BC.
	• Includes detailed fish sampling and habitat information for large stream crossings in the Kasiks and Khyex River watersheds. Gradient, channel width, sampling results, and stream classification were extracted and added to the spatial dataset. • No crossing coordinates were provided and scanned maps are small scale. Georeferencing was completed based on TRIM mapped crossings of known streams, and interpolating other crossing locations based on reported Mile Post. The accuracy of the Mile Post references in the report is unknown. Spatial accuracy of this dataset should be considered approximate only and adjustments based on more recent field assessments may be required. • Highlights environmental concerns at each crossing and recommend timing windows. Recommendations are not based on timing windows published by MFLNRORD, which were not available at the time this report was produced. Specific concerns are not included in the overview dataset.
Bustard (1998)	David Bustard and Associates Ltd. 1998. Fisheries assessment of nine stream crossings in the Khyex Watershed May 1998. Prepared for Pacific Northern Gas Ltd., Terrace, BC.
	• Includes re-examination of nine crossings that were previously assessed in Bustard (1994) for impacts that may occur associated with the specific timing of proposed stream crossings. • As no new biophysical or fish presence information was presented, no discrete points from this report were added to the historical spatial dataset.
Triton (2001a)	Mason, K., Brown, S., and Lewis, A. 2001. A reconnaissance survey of Arden Lake. Prepared by Triton Environmental Consultants Ltd., for BC Ministry of Environment, Lands, and Parks, Smithers, BC
	Fish sampling results from Arden Lake, confirming fish absence in this large lake at the headwaters of a tributary crossed by the pipeline.
Triton (2001b)	Mason, K., Brown, S., and Lewis, A. 2001. A reconnaissance survey of Kergin Lake, watershed code 910-7919-03. Prepared by Triton Environmental Consultants Ltd., for BC Ministry of Environment, Lands, and Parks, Smithers, BC.
	Fish sampling results from Kergin Lake, confirming CCT presence upstream from crossing PD-353b.
Triton (2006a)	Triton Environmental Consultants Ltd. 2006. Environmental walkout plan – PNG Khyex access road. Prepared for Pacific Northern Gas Ltd., Terrace, BC.
	• Includes biophysical and sampling data for 36 stream crossings in the Khyex River watershed, as well as identification and georeferencing information for 44 “small” streams. • Site identifiers in this report are cross-referenced with those used in Bustard (1994, 1998) in Triton (2006)
Triton (2006b)	Triton Environmental Consultants Ltd. 2006. Khyex River Valley post-construction environmental inspection report. Prepared for Pacific Northern Gas Ltd., Terrace, BC.
	• Summarizes site conditions following walkout of equipment from the Khyex River valley. • As no new biophysical or fish presence information was presented, no discrete points from this report were added to the historical spatial dataset. • Provides cross-reference for site ID’s from Bustard (1994) to Triton (2006b)
Triton (2008)	Triton Environmental Consultants Ltd. 2008. Maintenance works Pacific Northern Gas (PNG) Khyex River post construction review June to August 2008. Prepared for Pacific Northern Gas Ltd., Terrace, BC

	• Summarizes maintenance works and environmental mitigation conducted in 2008 in the Khyex River watershed. • As no new biophysical or fish presence information was presented, no discrete points from this report were added to the historical spatial dataset.
Triton (2012)	Triton Environmental Consultants Ltd. 2012. Pacific Northern Gas Kasiks Maintenance Project – Kasiks River Environmental Assessment and Access Plan. Prepared for Pacific Northern Gas Ltd., Terrace, BC.
	• Report summarizes data collected by Triton in 2010 in the Kasiks River watershed. • Watercourse crossings were classified, and fish sampling occurred between Salvus Valve (MP311) to the 'razorback' at MP 326.41. • Triton provided recommended crossing methods for each site (i.e. log fill, ford, culvert, or bridge).
Peard (2010)	Peard, D. 2010. Results of the Kloiya River resistivity counter 2010. BC Ministry of Environment, Skeena Region, Fish & Wildlife Branch. Skeena Fisheries Report SK 157
	Species assemblage within the Kloiya River approximately 2 km upstream from the estuary.
Northcote (1953)	Northcote, T.G. 1953. Game fish culture - scientific investigations. Prepared for BC Game Office, University of British Columbia, Vancouver, BC.
	Fish sampling results from Prudhomme Lake and Rainbow Lake
Finnegan (1991)	Finnegan, B. 1991. Summary of 1988 Coho Salmon smolt trapping operations on the Lachmach River and Antigonish Creek, British Columbia. Canadian Data Report of Fisheries and Aquatic Sciences 844
	Documentation of juvenile and adult Coho Salmon captures in the Lachmach River and Antigonish Creek.
Lough (1993)	Lough, J.R.C. 1993. Lachmach River Steelhead investigations, April 22 - June 23, 1992. BC Environment, Recreational Fisheries Branch, Smithers, BC. Skeena Fisheries Report #SK85
	Species assemblage in the lower Lachmach River associated with a fish counting fence

3.1.1 Segment 1: Salvus to Razorback

The Kasiks River supports four of the five species of Pacific salmon excluding Sockeye Salmon. Other species known to inhabit the watershed include steelhead trout, Coastal Cutthroat Trout, Mountain Whitefish, Dolly Varden, and Bull Trout. The lower Kasiks River is characterized by slow moving flows with fine material substrates. A change in river characteristics occurs at a point of river confinement. In the upper section spawning gravels become more abundant. The highest concentration of salmon and Steelhead spawning is located in the 2km immediately downstream of the barrier falls located 22km upstream of the confluence with the Skeena River (Bustard 1994).

Huckleberry Creek is a major tributary to the Kasiks River and supports all the species listed above. Two falls barriers are present on Huckleberry Creek which limit upstream fish migration. The lower barrier as described by Bustard (1994) consists of a bedrock canyon located between 500 and 730 m upstream of the confluence. The upper barrier consists of bedrock canyon with a single drop located approximately 2.5km upstream of the confluence. Between the lower and upper barriers, only resident Dolly Varden char are present.

The distribution of fish species within the Kasiks River watershed is as follows:

- Chinook salmon spawn in the uppermost reaches of the Kasiks River, including the lower 500 m of Huckleberry Creek.
- Chum salmon spawn in the mid to lower Kasiks River, typically near the confluence of larger tributaries with suitable gravel accumulations. The 1993 survey observed chum spawning in the mainstem Kasiks River approximately 10 to 12 km upstream from the confluence with the Skeena River.

- Pink salmon spawn throughout the Kasiks River, in suitable gravel accumulations. Lower sections of larger tributaries are also likely utilized.
- Steelhead trout spawn in the top 2 km of the Kasiks River (downstream of the falls), and likely utilize the lower reaches of larger tributaries.
- Coho salmon are most abundant species found as juveniles within the Kasiks River and were found to be widely disbursed in a variety of habitats. Specifically, they were most abundant in lower gradient, larger streams and within a short distance from mainstem habitats.
- Cutthroat trout were found to be utilizing similar habitat as juvenile Coho. Cutthroat were also captured in larger, moderate gradient streams with coarse substrates.
- Dolly Varden are widely dispersed throughout the Kasiks and Huckleberry drainages and are also found between the lower and upper barrier falls on Huckleberry Creek.

3.1.2 Segment 2: Razorback to Lachmach

The Khyex River supports four of the five species of Pacific salmon excluding sockeye. Other species known to inhabit the watershed include Steelhead, Cutthroat Trout, Mountain Whitefish, Dolly Varden, and Bull Trout. Similar to the Kasiks, the lower Khyex River is characterized by slow moving, fine material substrates. Upstream the river meanders through deep sand sections (Bustard, 1993) up to the Arden Creek confluence. Arden Creek is a major tributary to the Khyex River and supports the above species. A falls barrier located near UTM 9.456963.6017115 and restricts the upstream migration of all salmon. Upstream of the falls Dolly Varden and Cutthroat Trout are present. Arden Creek is a major spawning tributary to the Khyex River system and provides extensive sections of spawning habitat for Pink and Coho (Bustard 1994).

Based on results, the distribution of species within Khyex River system is generalized as follows:

- Chum salmon spawn in the lower Khyex River typically at the confluence of larger tributaries with suitable gravel including Arden Creek and likely the mainstem Khyex upstream of the Arden Creek confluence.
- Pink salmon spawn primarily in Arden Creek up to a chute obstruction. Isolated spawners were observed in the Lower Khyex mainstem and lower reached of larger tributaries were gravel is present.
- Steelhead salmon are suspected to spawn primarily in the lower 400 m of Chasm Creek based on the capture of fry by Bustard and Triton. A barrier to salmon is located upstream of 400m (immediately upstream of the pipeline overhead).
- Coho salmon are the most abundant species found as juveniles within the Khyex River and Arden Creek and found widely disbursed in a variety of habitats. They were more abundant in lower gradient, larger streams and within a short distance from mainstem habitats.
- Cutthroat trout distribution appears limited to the Khyex River. Triton captured cutthroat in larger, moderate gradient streams with coarse substrates. Cutthroat trout are found upstream of the barrier falls on Arden Creek.

- Dolly Varden are widely dispersed throughout the Khyex and Arden drainages and are also found upstream of Arden Falls.

3.1.3 Segment 3: Lachmach to Prudhomme Summit

From the Khyex Valve, the pipeline joins the Antigonish Creek watershed and traverses an upper bench. Antigonish Creek is accessible to all salmon, and known to contain Pink and Coho Salmon, Steelhead, Cutthroat and Rainbow Trout as well as Sculpin and Stickleback species (FISS 2019). From the Antigonish Creek the pipeline crosses into the Lachmach Watershed, a major salmon spawning stream for its size. Coho, Pink, Chum as well as Steelhead, Dolly Varden (fluvial and anadromous life strategies), Cutthroat and Rainbow Trout, Pacific Lamprey, Stickleback and Sculpin Species. The pipeline follows Lachmach Creek to its confluence and briefly parallels Work Channel.

From Work Channel, the pipeline crosses and parallels Fortune Creek known to contain Coho and Pink Salmon, Cutthroat Trout, Dolly Varden and Sculpin (sp). The lower section of Fortune Creek is heavily braided with remnant flood channel adjacent to and crossing the right-of-way. Approximately 500m from Fortune Creek confluence, the channel becomes entrenched, the pipeline deviates to an elevated bench and tributaries inaccessible to fish until the pipeline nears and crosses upper Fortune Creek downstream of Fortune Lake.

3.1.4 Segment 4: Prudhomme Summit to Galloway Station

From the summit, the pipeline traverses the north sides of Prudhomme Creek, Prudhomme Lake and Taylor Lake. Falls barriers are present on Prudhomme Creek above Prudhomme Lake that bar salmon to the upper watershed. Chinook, Coho and Sockeye Salmon, Cutthroat Trout, Rainbow Trout and Dolly Varden have been observed in Prudhomme Lake with spawning Chinook and Coho noted in Prudhomme Creek upstream of the lake.

The pipeline traverses a bench above Prudhomme Lake suggesting fish access maybe restricted to smaller drainages due to steeper gradients, however limited fish sampling information is available. The pipeline crosses the Kloiya River downstream of Kloiya Dam and follows a lower bench of the Kloiya River. Spawning salmon were noted at the crossing and within the Kloiya River during 2019 field studies. Spawning Pink and Chum Salmon, and Steelhead have also been historically observed in this location.

The pipeline diverges from the Kloiya River to an upper bench near Kloiya Bay and parallels the BC Hydro transmission line to Galloway station.

3.2 Terrestrial Species and Habitats

In general, there is limited information on terrestrial ECs for all segments. Provincial data show that Terrestrial Ecosystem Mapping data may exist for the Khyex Conservancy as well as coastal areas west of Salvus; however, it is not clear at this time whether this data would be available for commercial use.

3.2.1 Segment 1: Salvus to Razorback

Based on a review of available sources, the following attributes were identified:

- Mountain Goat Approved Ungulate Winter Range is identified on the east side of the Kasiks River and adjacent to or overlapping the right-of-way.
- Ungulate Winter Range for Moose is located near Salvus and at the confluence of the Kasiks and Skeena Rivers.
- Coastal Tailed Frogs were identified in an unnamed tributary to the Kasiks River.
- Modelled critical habitat for Marbled Murrelet has been identified throughout the segment.
- The pipeline crosses numerous small wetlands that may provide amphibian habitat and increase the likelihood of rare and endangered plant species.
- Beaver dams were observed in wetlands in the lower Kasiks River and, in some cases, flooding the right-of-way.
- Given the remoteness of the pipeline segment, it should be assumed that it provides migrations, forage and nesting/denning habitat for a wide variety of identified species such as Grizzly Bear, Wolverine, Fisher, Northern Goshawk, etc.

3.2.2 Segment 2: Razorback to Lachmach

Based on a review of available sources, the following attributes were identified:

- Approved Ungulate Winter Range for Mountain Goat has been identified on the west side of the lower Khyex River.
- Approved Ungulate Winter Range for Moose is identified at the confluence of the Khyex River and slightly overlaps with the valve site.
- Modelled critical habitat for Marbled Murrelet has been identified through the segment.
- The pipeline crosses numerous small wetlands that may provide amphibian habitat and increase the likelihood of rare and endangered plan species.
- Beaver dams were observed in several wetlands resulting in flooding of the right-of-way adjacent to the Khyex River and Arden Creek.
- Given the remoteness of the pipeline segment, it should be assumed that it provides migrations, forage and nesting/denning habitat for a wide variety of identified species such as Grizzy Bear, Wolverine, Fisher, Northern Goshawk, etc.

3.2.3 Segment 3: Lachmach to Prudhomme Summit

Based on a review of available sources, the following attributes were identified:

- The first 5 km alongside Antigonish Creek is identified as either Moose or Mountain Goat Approved Ungulate Winter Range depending upon elevation.
- Modelled critical habitat for Marbled Murrelet has been identified through the segment.

- The pipeline crosses numerous small wetlands that may provide amphibian habitat and increase the likelihood of rare and endangered plan species.
- Beaver dams were observed in wetlands resulting in flooding of the right-of-way.
- Given the remoteness of the pipeline segment, it should be assumed that it provides migrations, forage and nesting/denning habitat for a wide variety of identified species such as Grizzly Bear, Wolverine, Fisher, Northern Goshawk, etc.

3.2.4 Segment 4: Prudhomme Summit to Galloway Station

Based on a review of available sources, the following attributes were identified:

- Modelled critical habitat for Marbled Murrelet has been identified through the segment particularity in the area west of Prudhomme Summit.
- The pipeline crosses numerous small wetlands that may provide amphibian habitat and increase the likelihood of rare and endangered plan species.
- Beaver dams were observed in wetlands resulting in flooding of the right-of-way.
- Given the remoteness of the pipeline segment, it should be assumed that it provides migrations, forage and nesting/denning habitat for a wide variety of identified species such as Grizzy Bear, Wolverine, Fisher, Northern Goshawk, etc.

3.3 Administrative ECs

3.3.1 Parks

The pipeline from MP326.41 (the razorback) to approximately MP336.8. (the lower Khyex River) is located within the Khyex Conservancy, a 41,404ha tract of crown land established in 2008. This conservancy was intended to protect old-growth forests and its documented First Nations traditional use sites (BC Parks 2020a).

The pipeline traverses through Kloiya Bay, which is a District of Port Edward Protected Area.

3.3.2 Land Use

Several federal First Nations Reserve lands are present in close proximity to the pipeline RoW between Salvus and Galloway station, including Kasika No. 72, Kasiks River No. 29, Ksagwisgwas No. 63, Khyex No. 64, and Khyex No. 8. The pipeline is routed through Kasika No. 72 and Khyex No. 8. Cabins are located along the Kasiks River likely belong to recreational users of the area and suggest that the valley has important recreational values. The pipeline does not interfere with potential users.

Government sanctioned documents may also impose environmental restrictions on a project, depending on the scope. These can include Ministerial Orders (e.g. Ungulate Winter Range, Species at Risk identified through the Identified Wildlife Management Strategy (IWMS)) or land use planning and management guideline and objectives (e.g. Northcoast Land Use Management Plan, Great Bear Rainforest objectives).

4.0 Environmental Regulatory Requirements

Based on the project location, known site attributes and assumed construction activities, the following permits/approvals/authorizations listed in Table 6 have the potential to apply. (i.e. permit, license, approval, authorization).

4.1 Federal and Provincial EA Screening

Federal approval by the Impact Assessment Agency of Canada (formerly the Canadian Environmental Assessment Agency) is not expected to be required, as proposed activities as presently understood do not involve construction or operation of a new pipeline segment over 40 km in length (Regulations Designating Physical Activities SOR/2012-147).

A provincial Environmental Assessment Certificate under the BC *Environmental Assessment Act* is not expected to be required as the project presently does not involve replacement or extending a natural gas transmission pipeline segment for a length greater than 60 km (BC Reviewable Projects Regulation 26/2019).

4.2 Regulatory Authority

High-pressure pipeline segments greater than 700 kPa in BC are regulated by the BC Oil and Gas Commission (OGC) under the BC *Oil and Gas Activities Act.* The pipeline segment between Salvus and Galloway is not transboundary or trans-provincial and is therefore under the regulatory authority of the OGC. Additional information about relevant OGC permitting requirements are detailed in section 4.5.

4.3 Environmental Legislation and Permit Requirements

The list below summarizes key legislation and applicable permits/approvals/authorizations that may be required prior to certain project activities commencing. Permits required for assessment and construction (e.g. Investigative Use Permit, Scientific Fish Collection) need to be scoped at the activity-specific level and were not included.

Table 6. Potential permits/approvals/authorizations

Statute	Applicable Section	Permit/Authorization	Scoping
Federal Legislation			
Species at Risk Act (SARA)	Section 32 (1) Killing, harming of listed wildlife species. Section 36 Killing harming of species not under SARA but classified by provincial minister as threatened or endangered.	Activity affecting a listed wildlife species, den or critical habitat.	If project activities extend beyond the boundaries of the current RoW. Assessment would be required to confirm presence/ absence of species or habitat listed under SARA Schedule 1.

Statute	Applicable Section	Permit/Authorization	Scoping
Fisheries Act	Section 34: Deleterious substance in fish bearing waters	FAA Authorization	If project activities interface with a fish-bearing stream. The level of review is dependant on an residual assessment of proposed activities and mitigation. Offsetting maybe required where residual effects occur.
	Section 34: Death of a fish	FAA Authorization	
	Section 35: Prohibition against causing Harmful Alteration, Disruption or Destruction to fish habitat	FAA Authorization	
	Section 38, Duty to Notify serious harm to fish and release of deleterious substances to fish bearing waters.	FAA Authorization	
Canadian Navigation Protection Act	Navigable Waters Works Regulation	Approvals for works that are likely to interfere with navigation	None of the watercourses are not identified as Scheduled Waterways. Minor works regulation may apply (e,g, hazard lights, signage).
Transport of Dangerous Goods Act, 1992	Section 5: General prohibition to import, offer for transport, handle or transport any dangerous goods and means of containment.	No permit	Comply with safety requirements including placarding and documents (depending upon product and quantities.
	Section 7: Transport or handle dangerous goods without an emergency response plan.	Approval of carrier.	Use approved carriers for transporting dangerous goods of product and quantities specified by the regulation.
	Section 18: Duty to report or take reasonable emergency measures for release if endangers public safety.	No permit	Duty to clean up if a spill occurs during transport.
Migratory Birds Convention Act, 1994	Section 5.1 (1): Person or vessel deposit substance harmful to migratory birds, or waters or areas frequented by migratory birds.	No permit	May apply in the event of an environmental incident (e.g. spill).
Provincial (BC)			
Environmental Management Act	Part 2, 6(4): Prohibition to introduce waste to environment that causes pollution.	Discharge authorization	if projects intends on releasing a harmful substance (e.g. sewage effluent).
	Part 2, Section 7(1)(2): Confinement of hazardous wastes	No permit	Duty to proper handle and store hazardous wastes.
	Part 2, Section 9: Storage of hazardous wastes	No permit	Duty to proper handle and store hazardous wastes.
	Part 2, Section 10: Transport of hazardous wastes	No permit	Duty to properly handle and transport hazardous wastes.
	Part 7, Section 79 (1): Spill prevention and response of polluting substances that may spill or escape. If in possession of, ministry may deem measures	No permit	May apply in the event of an environmental incident (e.g. spill).

Statute	Applicable Section	Permit/Authorization	Scoping
Oil and Gas Activities Act	Section 1	Pipeline Permit	All activities require submission.
		Facilities Permit	
		Road Permit	
	Land Act	Investigative Use Permit	If project activities extend beyond the boundaries of the current ROW, rights to lands are required.
		Licence of Occupation	
		Section 10 Approval for Short term use of Water	Project activities involve extraction of surface or groundwater
		Section 11 Approval for Changes In and About a Stream	If project activities interface with a watercourse.
	Heritage Conservation Act	Heritage investigation Permit	Applicable if project activities extend beyond the boundaries of the current ROW. Assessment is required to determine permitting stream.
		Site Alteration Permit	
		Heritage Conservation Clearance	
	Forest Act	Master Licence to Cut	PNG has permits for their ROW. However amendments may be required for new areas outside the ROW.
		Forest Service Road Use	
	Water Sustainability Regulation	Section 38(1) Notification to Habitat Officer for Authorized Change	
Water Sustainability Act	Section 46: Introduction of foreign matter that may cause adverse impact to stream channel or aquatic ecosystem	Discharge authorization	If projects intends on releasing a harmful substance (e.g. sewage effluent).
Agricultural Land Commission Act		Non-farm Use on Agricultural Lands	If projects extend beyond the boundaries of the current ROW. Assessment is required to confirm it will not interface with an ALR.
Wildlife Act	Section 7(1): Alter, destroy, damage wildlife habitat, or deposit substance /product that is harmful to wildlife or habitat	Permit to undertake activity within a Wildlife Management Area	Only if the project interfaces with an approved Wildlife Management Area. There are none identified between Salvus and Galloways at this time.
	Section 33.1: Attracting dangerous animals	No permit	Managed through mitigation (e.g. effective waste management plan)
	Section 34: Protection of bird, nest, eggs. Protection of specific bird's nests.	No permit	Manage through mitigation (e.g. pre-clearing nest sweeps.)
	Section 75: Accidental killing of wildlife	No permit	Proper disposal of wildlife.
Park Act	Section 16: Occupancy and use of land restricted	Permit to construct of operate within a Parl.	If projects extend beyond the boundaries of the current RoW within a Park (e.g. Khyex Conservancy).

**Additional Permits, Approvals and Authorizations may be required.*

4.4 Key Federal Regulatory Permitting Processes

4.4.1 *Species at Risk Act*

The *Species at Risk Act* (SARA) Section 73 Authorizations are required by anyone conducting activities that may affect species listed under Schedule 1 of the Act. Applications require concise descriptions of the Project and anticipated effects, alternatives assessment and mitigation plans should a SARA listed species, or its habitat be affected. There are several SARA listed species that have the potential to occur in the Salvus to Galloway area, most notably is Marbled Murrelet (*Brachyramphus marmoratus*) with modelled critical habitat identified along segments of the existing RoW (ECCC, 2019). However field assessment are required to confirm the accuracy of the modelled habitat. Provided all information has been provided to satisfy ECCC, the Minister must issue or refuse the permit within 90 days. The 90-day timeline will be suspended if the application is incomplete.

4.4.2 *Fisheries Act*

The *Fisheries Act*, administered by DFO, was amended in 2019. Key changes involve renewal of protection provisions to fish habitat and to all fish, not just those considered to be of Commercial, Recreational, or Aboriginal significance. The new Act repealed the prohibitions against causing Serious Harm and returned to the prohibitions against the harmful alteration, disruption or destruction (HADD) of fish habitat and the death of fish. It also incorporates indigenous involvement into decision making.

Activities involving interface with fish and fish habitat generally require an assessment by a Qualitied Environmental Professional (QEP) who can determine if DFO review is required and what permitting pathway would be appropriate. QEPs often liaise between the proponent and DFO providing support throughout the process, preparing key deliverables involved in delivering a DFO reviewed project, and assisting with any negotiations that may take place.

DFO has identified three key permitting pathways that have the highest likelihood of being triggered by a project such as those works presently contemplated between Salvus and Galloway Station. They are:

1) **Request for Review** – A submission to DFO is made via a Request for Project Review form when a proponent is uncertain whether the death of fish or a HADD is likely to occur. However, proponents often submit a Request for Review to DFO to initiate the review process even if they are confident a Section 35(2) *Fisheries Act* Authorization is likely to be required. Under the Request for Review process, DFO reviews the form which contains information (provided by the proponent or their environmental consultant) such as a description of the project (including detailed work methods), a description of the aquatic environment, potential effects, and proposed mitigation measures. DFO uses this form, as well as additional work with the proponent or their consultant to assess whether a Section 35(2) *Fisheries Act* Authorization would be required. If DFO determines the work does not require an authorization, they may issue a letter summarizing that conclusion, often referred to as a 'Letter of Advice'. No statutory timelines exist for DFO to review these applications, but in Khtada's experience it can take anywhere from 1 to 6 months depending upon the complexity and completeness of application, and DFO availability.

2) **Application for a *Fisheries Act* Authorization under normal circumstances** – Section 35(2) *Fisheries Act* Authorizations are issued by DFO under normal circumstances when a proposed activity or undertaking is, determined by DFO, likely to cause a HADD or the death of fish. To apply for an authorization, proponents provide a similar information to that of the Request for Review, however, typically containing more detail. Additional information such as a fish habitat offsetting plan, and a letter of credit is also required. The offsetting plan contains information how the proponent plans to offset or compensate for the loss of fish habitat productivity resulting from their project, and measures for how those offset habitats will be monitored to ensure future function. The letter of credit is a financial deposit paid by the proponent to DFO which accounts for all costs associated with implementing the offsetting plan and effectiveness monitoring. Effectiveness monitoring is determined on a project by project basis and can be required for up to 5 years following construction. The advantage of the authorization process is that DFO must follow statutory timelines when reviewing applications for authorizations. Once the application has been received, DFO has 60 calendar days to determine whether the application is complete, and if so, they have 90 days to issue the authorization or notify the applicant that the application is refused.
3) **Application for a *Fisheries Act* Authorization under emergency circumstances** – Section 35(2) *Fisheries Act* Authorizations are issued by DFO under emergency circumstances when work must occur without delay in response to matters of national security, national emergencies, or emergency situations that poses a risk to public health, safety, the environment, or property. The key difference between authorizations under normal and emergency circumstances is with emergency circumstances, the offsetting measures are determined after the HADD or death of fish has been caused. Applications for authorizations under emergency circumstances are usually issued within a week of submission; however, this varies depending on the nature of the emergency and the extent to which fish or fish habitat have the potential to be harmed.

DFO has also added a notification process which is designed to apply to a standard set of activities for which a 'code of practice' has been developed. However, codes of practice have only been published for work involving end-of-pipe fish screens and dredging – none of which are likely to be required on the Salvus to Galloway project. DFO may release additional codes of practice for routine activities with standardized mitigation measures that proponents may use to facilitate permitting processes for minor activities.

4.4.3 *Navigation Protection Act*

Transport Canada *Canadian Navigation Protection Act* Approvals are required for major works on scheduled waterways. Relative to the general project area, only the Skeena River is listed and required specific approval. Under the *Canadian Navigation Protection Act* larger watercourses are subject to the provisions of the *Minor Works Order* which can include erosion protection, barge ramps, underbed or overhead pipelines. Under the *Minor Works Order* it is the responsibility of the owner of the work to assess and ensure that proposed activities meet the criteria established for its class and ensure that all legal requirements set out in the Order are met. Typical legal requirements involve notification (i.e. signage) and warning light for navigation hazards.

4.5 Key Provincial Regulatory Permitting Processes

4.5.1 BC OGC

The BC OGC is responsible for coordinating and overseeing oil and gas operations in BC and has the provincial regulatory authority to issue permits within a specific mandate. Pre-application requirements include securing tenure rights and conducting First Nation consultation, and engagement with landowners and/or rights holders. Each activity permit requires specific information (e.g., engineering design, project components, stream crossing information, etc.), and can either be applied for as a single activity or as multiple activities at the same time. Applications are submitted online, through the Application Management System (AMS). To begin an application, a pipeline project description is required which will include technical and engineering design specifications. Detailed application requirements are provided through guidance manuals on the OGC website. The OGC review process has no overall legislated review timeline. Section 25 permits authorize works under several pieces of legislation (for example, a Section 25 permit includes authorization to cross streams, and no separate *Water Sustainability Act* Section 11 permit(s) are required), and thus offers a more expedient and efficient method to authorize construction compared to individual applications.

4.5.2 BC Parks

A segment of the pipeline is routed within the boundary of the Khyex Conservancy between MP326.41 (razorback) and approximately MP336.8. In BC, Conservancies are a separately designated area than Class A, B, or C Provincial Parks or Protected Areas. From BC Parks (2020b): "*Conservancies provide for a wider range of low-impact, compatible economic opportunities than Class A parks, however commercial logging, mining, and hydroelectric power generation other than local run-of-river projects, are prohibited. Economic activities within conservancies must still not restrict, prevent, or hinder the conservancy from meeting the intended purpose with respect to maintaining biological diversity, natural environments, First Nations social, ceremonial and cultural uses, and recreational values.*"

BC Parks is a government entity under the BC Ministry of Environment and Climate Change Strategy, and authority and governance is granted though the *Park Act, Protected Areas of British Columbia Act,* and other associated legislation and regulation.

It is Khtada's experience that despite having had infrastructure present prior to establishment of that conservancy, proponents are still be required to submit for a Park Use Permit (PUP) authorizing works to take place. The PUP process may be subject to First Nations and stakeholder consultation as well as an impact assessment process established by BC Parks. PUPs come with an annual fee, strict conditions under which the permitted activities may take place, and in some instances offer a form of tenure to occupy and operate on the land base within the conservancy. It should be expected that between 6 months to 1 year or possibly more is required to obtain a PUP depending on the nature of the activity and the outcomes of consultation.

4.5.3 Supplementary Permits

Beyond the mandate of the OGC, supplementary permits may be required to undertake activities within a Wildlife Management Area (FLNRORD) should construction or operation extend beyond permitted right-of-way. A Wildlife Management Area is an area of land designated under section 4(2) of the Wildlife Act for the benefit of regionally to internationally significant fish and wildlife species or their habitats. Permit applications require concise descriptions of the project and anticipated effects, alternatives assessment and mitigation plans should a designated area be affected. There are no legislated timelines, however it can be assumed the permitting process is more protracted as First Nations and other stakeholders are consulted and permits sometimes involve multiple government agencies.

4.5.4 Other Regulatory Considerations

Further to the above, there are other government sanctioned documents that may impose environmental restrictions on a project, depending on the scope. These can include Ministerial Orders (e.g. Ungulate Winter Range, Species at Risk identified through the Identified Wildlife Management Strategy (IWMS)) or land use planning and management guideline and objectives (e.g. Northcoast Land Use Management Plan, Great Bear Rainforest objectives). For the purposes of the environmental constraints analysis only applicable directives that are required to be addressed are considered (i.e. Ministerial Orders).

Applicability of guidelines would be considered during a detailed design phase and provisions integrated into an environment assessment and CEMP, where applicable. For example, there is no legal obligation to manage for provincial rare or endangered species objectives unless they are managed through establishment of Wildlife Habitat Areas (WHAs), General Wildlife Measures (GWMs) or Parks. However, objectives may be adopted by proponents, or through consultations by, for example, the OGC related to permit applications. Permit conditions can be applied that are comparable to management objectives.

5.0 Environmental Constraints Analysis

Table 7 provides a summary of potential constraints that may be applicable to the proposed activities and identifies if a specific permit would be required for construction. Some constraints are legal requirements that dictate how a project must proceed in order to be considered compliant with applicable regulation and legislation. However, for others there is an element of risk tolerance on behalf of the proponent that must be factored in when determining how a constraint is addressed.

Table 7. Summary of Potential Constraints

Environmental Component	***Constraint***	***Specific Permit Required***
Fish: All Salmon	Works affecting fish or fish habitat may trigger both provincial and federal permitting processes.	**Yes**
Fish: non-salmon		
Bull Trout	Works affecting Bull Trout or their habitat may trigger both provincial and federal permitting processes identical to those required under Fish.	No
Cutthroat Trout *clarkii* subspecies	Works affecting Cutthroat Trout or their habitat may trigger both provincial and federal permitting processes identical to those required under Fish.	No
Green Sturgeon	Works with potential to affect Green Sturgeon may be subject to provincial and federal permitting processes.	No
Invasive and Noxious Weeds	Proponents have a duty to minimize the introduction or proliferation of invasive and noxious weeds, and a responsibility to control noxious weeds growing on occupied lands.	No
oldgrowth specklebelly	Old growth timber forests have the potential to support this species and any clearing of these areas may be subject to a review of presence/absence and special mitigation if this species is discovered.	No
Rare and Endangered Plants	Work activities that pose a risk of impact to rare or endangered plant species may require special mitigation measures imposed by stakeholders, First Nations, or government agencies.	No
Western redcedar / devil's club	Special mitigation measures may be imposed by stakeholders, First Nations, or government agencies if proposed work activities have the potential to interact with occurrences of this identified ecosystem.	No
Rare and Endangered Ecosystems	Special mitigation measures may be imposed by stakeholders, First Nations, or government agencies if proposed work activities have the potential to interact with rare or endangered ecosystems.	No
Coastal Tailed Frog	Work activities in streams containing Coastal Tailed Frogs may be subject to specific mitigation measures including survey, salvage, avoidance, and compensation.	**Yes (salvage)**
Western Toad	Work activities in wetlands and adjacent upland areas may be subject to specific mitigation measures including survey, salvage, worksite isolation, avoidance, and compensation.	**Yes (salvage)**
Rare and Endangered reptiles and herptiles	Work activities affecting rare or endangered reptiles or herptiles has the potential to require special permits from provincial and federal government agencies.	**Yes (salvage)**
Black Swift	Brushing and clearing activities have the potential to directly or indirectly impact an active nest of this species which would be in contravention of Section 34 of the BC *Wildlife Act.*	No
Peregrine Falcon	Works performed within the vicinity of a raptor nest has the potential to impact that nest (if active), and if the nest tree is impacted, has the potential to contravene Section 34 of the BC *Wildlife Act.*	**Potential**
Ancient Murrelet	Brushing and clearing activities have the potential to directly or indirectly impact an active nest of this species which would be in contravention of Section 34 of the BC *Wildlife Act.*	No

Environmental Component	***Constraint***	***Specific Permit Required***
Rusty Blackbird	Brushing and clearing activities have the potential to directly or indirectly impact an active nest of this species which would be in contravention of Section 34 of the BC *Wildlife Act.*	No
Western Screech-Owl, *kennicottii* subspecies	Brushing and clearing activities have the potential to directly or indirectly impact an active nest of this species which would be in contravention of Section 34 of the BC *Wildlife Act.*	No
Olive-sided Flycatcher	Brushing and clearing activities have the potential to directly or indirectly impact an active nest of this species which would be in contravention of Section 34 of the BC *Wildlife Act.*	No
Northern Goshawk, *laingi* subspecies	Activities involving clearing of mature timber with potential for supporting this species may be subject to regulatory scrutiny.	No
Marbled Murrelet	Any activities within designated SARA-listed Marbled Murrelet critical habitat may be subject to regulatory scrutiny. Tree clearing within these habitat polygons may be subject to regulatory approval by ECCC.	**Potential**
Barn Swallow	Brushing and clearing activities have the potential to directly or indirectly impact an active nest of this species which would be in contravention of Section 34 of the BC *Wildlife Act.*	No
Sandhill Crane	Brushing and clearing activities have the potential to directly or indirectly impact an active nest of this species which would be in contravention of Section 34 of the BC *Wildlife Act.*	No
Rare and Endangered birds	Brushing and clearing activities have the potential to directly or indirectly impact active nests of these species which would be in contravention of Section 34 of the BC *Wildlife Act.*	No
Little Brown Myotis	Work affecting hibernacula, maternity roosts, and foraging areas used by this species may trigger special permitting requirements by either the provincial or federal governments.	**Potential**
Great Blue Heron, fannini subspecies	Work affecting the habitat of this subspecies, particularly colonial roosts and nesting areas may require provincial or federal permits.	**Potential**
Band-tailed Pigeon	Brushing and clearing activities have the potential to directly or indirectly impact an active nest of this species which would be in contravention of Section 34 of the BC *Wildlife Act.*	No
Beaver	Removal of beaver dams and lodges are regulated by Section 9(1) of the BC *Wildlife Act*	**Yes**
Wolverine	Work affecting Wolverine and their habitat may require special management requested by stakeholders, First Nations, or government agencies.	No
Grizzly Bear	Work affecting Grizzly Bear and their habitat may require special management requested by stakeholders, First Nations, or government agencies.	No
Fisher	Work affecting Fisher and their habitat may require special management requested by stakeholders, First Nations, or government agencies.	No
Moose	Approved Ungulate Winter Range for Moose has been identified in the regional area. Work affecting this habitat may be subject to regulatory scrutiny and special mitigation measures will be required to ensure impacts to Moose are minimized.	No
Mountain Goat	Approved Ungulate Winter Range for Mountain Goat has been identified in the regional area. Work affecting this habitat may be subject to regulatory scrutiny and special mitigation measures will be required to ensure impacts to Mountain Goat are minimized.	No
Rare and Endangered wildlife (general)	Work activities that pose a risk of impact to rare or endangered wildlife species may require special mitigation measures imposed by stakeholders, First Nations, or government agencies.	No
Administrative	Performing work in the Khyex Conservancy may be subject to review by BC Parks and require a Park Use Permit to proceed. Performing work on federal reserve lands may be subject to review by Indigenous Services Canada (ISC) and require special approvals to proceed.	**Yes**

5.1 Least Risk Timing Windows

Least Risk Timing Windows (LRTWs) are time periods in a given year when it is expected that certain species or organism types are least sensitive to disturbance or impact. These windows are primarily derived considering a species' ecology and their individual life-history and habitat requirements. Generic LRTWs for fish and wildlife have been developed by government agencies and released as several unrelated documents over varying time periods; however, these references contain the most relevant information:

- Terms and Conditions for *Water Sustainability Act* Changes In and About a Stream as specified by Ministry of Forests, Lands, Natural Resource Operations, and Rural Development (FLNRORD) Habitat Officers, Skeena Region (April 2018).
- Government of Canada – nesting calendars: https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/general-nesting-periods/nesting-periods.html#_zoneA_calendar.
- Best Management Practices for Amphibians and Reptiles in Urban and Rural Environments in British Columbia (2004).
- Guidelines for Raptor Conservation during Urban and Rural Land Development in British Columbia (2013).
- Order – Mountain Goat Ungulate Winter Range – North Coast Timber Supply (2004).
- Order – Moose Ungulate Winter Range – North Coast Timber Supply (2004).
- A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, British Columbia (2014).

Typically, LRTWs exist as a Best Management Practice (BMP) however become a legal requirement through an issued permit. To determine whether a LRTW applies, it should first be determined through collection of baseline data whether the species or organism types are present. The applicability of LRTWs is also dependant upon the nature, scope, and scale of impact likely to be incurred by a species as result of project activities. Appendix 3 summarizes the available LRTWs for relevant species to the Salvus to Galloway pipeline segment. It is strongly suggested that a QEP should be retained to determine which LRTWs would apply when performing a specific work activity.

5.2 Administrative Constraints

Operation and maintenance of the PNG pipeline within the boundaries of PNG's RoW is permitted subject to applicable conditions, permits, and approvals issued by the OGC and other relevant government agencies. However, it should be confirmed with both BC Parks and ISC whether additional project reviews or permitting requirements would apply. There is a high likelihood that project reviews and permitting requirements would apply if PNG's maintenance work occurs outside the statutory RoW and within these administrative boundaries.

6.0 References

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[BC EAO] BC Environmental Assessment Office. 2013. Guideline for the selection of valued components and assessment of potential effects. Guideline document.

BC Parks. 2020a. BC Parks Website available from: http://www.env.gov.bc.ca/bcparks/explore/cnsrvncy/khyex/ Accessed January 2020.

BC Parks. 2020b. BC Parks Website. Summary of the parks and protected areas system. Available from: http://www.env.gov.bc.ca/bcparks/about/park-designations.html Accessed December 2019.

BGC Engineering Ltd. 2019. Pacific Northern Gas Salvus to Galloway Project mitigation options assessment. Unpublished presentation. Vancouver BC.

[Bustard] David Bustard and Associates. 1994. Fisheries assessment of pipeline crossings in the Kasiks and Khyex Rivers. Prepared for Pacific Northern Gas Ltd., Terrace, BC.

Appendix 1:
Rare and Endangered Species Lists

			Legally binding requirement		
Scientific Name	***English Name***	***BC List***	***IWMS***	***MBCA***	***SARA***
Ecosystems					
Abies amabilis - Picea sitchensis / Oplopanax horridus	amabilis fir - Sitka spruce / devil's club	Blue			
Abies amabilis - Thuja plicata / Gymnocarpium dryopteris	amabilis fir - western redcedar / oak fern	Blue			
Abies amabilis - Thuja plicata / Oplopanax horridus Moist Submaritime	amabilis fir - western redcedar / devil's club Moist Submaritime	Blue			
Abies amabilis - Thuja plicata / Rubus spectabilis Very Wet Maritime	amabilis fir - western redcedar / salmonberry Very Wet Maritime	Blue			
Alnus incana / Equisetum arvense	mountain alder / common horsetail	Blue			
Alnus rubra / Rubus spectabilis / Equisetum arvense	red alder / salmonberry / common horsetail	Blue			
Picea sitchensis / Calamagrostis nutkaensis	Sitka spruce / Pacific reedgrass	Blue			
Picea sitchensis / Carex obnupta	Sitka spruce / slough sedge	Blue			
Picea sitchensis / Eurhynchium oreganum	Sitka spruce / Oregon beaked-moss	Blue			
Picea sitchensis / Gaultheria shallon	Sitka spruce / salal	Blue			
Picea sitchensis / Lysichiton americanus	Sitka spruce / skunk cabbage	Blue			
Picea sitchensis / Maianthemum dilatatum Wet Hypermaritime 1	Sitka spruce / false lily-of-the-valley Wet Hypermaritime 1	Red			
Picea sitchensis / Malus fusca	Sitka spruce / Pacific crab apple	Blue			
Picea sitchensis / Polystichum munitum	Sitka spruce / sword fern	Blue			
Picea sitchensis / Rubus spectabilis Very Wet Maritime	Sitka spruce / salmonberry Very Wet Maritime	Red			
Picea sitchensis / Rubus spectabilis Wet Maritime	Sitka spruce / salmonberry Wet Maritime	Blue			
Picea sitchensis / Rubus spectabilis Wet Submaritime 1	Sitka spruce / salmonberry Wet Submaritime 1	Red			
Picea sitchensis / Rubus spectabilis Wet Submaritime 2	Sitka spruce / salmonberry Wet Submaritime 2	Blue			
Picea sitchensis / Trisetum canescens	Sitka spruce / tall trisetum	Red			
Pinus contorta / Arctostaphylos uva-ursi	lodgepole pine / kinnikinnick	Red			
Rhododendron groenlandicum / Kalmia microphylla / Sphagnum spp.	Labrador-tea / western bog-laurel / peat-mosses	Blue			
Ruppia maritima Herbaceous Vegetation	beaked ditch-grass Herbaceous Vegetation	Red			
Thuja plicata - Picea sitchensis / Lysichiton americanus	western redcedar - Sitka spruce / skunk cabbage	Blue			
Thuja plicata - Picea sitchensis / Oplopanax horridus	western redcedar - Sitka spruce / devil's club	Blue	Y		
Thuja plicata - Picea sitchensis / Polystichum munitum	western redcedar - Sitka spruce / sword fern	Blue			
Thuja plicata - Tsuga heterophylla / Polystichum munitum	western redcedar - western hemlock / sword fern	Blue			
Tsuga heterophylla - Abies amabilis / Struthiopteris spicant	western hemlock - amabilis fir / deer fern	Blue			
Tsuga heterophylla - Picea sitchensis / Hylocomium splendens	western hemlock - Sitka spruce / step moss	Blue			
Tsuga heterophylla - Picea sitchensis / Rhytidiadelphus loreus	western hemlock - Sitka spruce / lanky moss	Blue			
Tsuga heterophylla - Pinus contorta / Pleurozium schreberi	western hemlock - lodgepole pine / red-stemmed feathermoss	Blue			

Scientific Name	English Name	BC List	IWMS	MBCA	SARA
Tsuga heterophylla / Sphagnum girgensohnii	western hemlock / common green peat-moss	Blue			
Tsuga heterophylla - Thuja plicata / Gaultheria shallon Very Wet Maritime	western hemlock - western redcedar / salal Very Wet Maritime	Blue			
Populus trichocarpa - Alnus rubra / Rubus spectabilis	black cottonwood - red alder / salmonberry	Blue			
Terrestrial Mammals					
Gulo gulo	Wolverine	ns	Y		1-SC (Jun 2018)
Myotis lucifugus	Little Brown Myotis	Yellow	Y		1-E (Dec 2014)
Pekania pennanti	Fisher	Blue	Y		
Oreamnos americanus	Mountain Goat	Blue	Y		
Ursus arctos	Grizzly Bear	Blue	Y		1-SC (Jun 2018)
Birds and Raptors					
Accipiter gentilis laingi	Northern Goshawk, *laingi* subspecies	Red	Y		1-T (Jun 2003)
Antigone canadensis	Sandhill Crane	Yellow	Y	Y	
Ardea herodias fannini	Great Blue Heron, *fannini* subspecies	Blue	Y		1-SC (Feb 2010)
Brachyramphus marmoratus	Marbled Murrelet	Blue	Y	Y	1-T (Jun 2003)
Euphagus carolinus	Rusty Blackbird	Blue			1-SC (Mar 2009)
Falco peregrinus	Peregrine Falcon	ns			1-SC
Falco peregrinus pealei	Peregrine Falcon, *pealei* subspecies	Blue			1-SC (Jun 2003)
Hirundo rustica	Barn Swallow	Blue		Y	1-T (Nov 2017)
Megascops kennicottii	Western Screech-Owl	ns			1-T
Megascops kennicottii kennicottii	Western Screech-Owl, *kennicottii* subspecies	Blue			1-T
Patagioenas fasciata	Band-tailed Pigeon	Blue		Y	1-SC (Feb 2011)
Synthliboramphus antiquus	Ancient Murrelet	Blue	Y	Y	1-SC (Aug 2006)
Uria aalge	Common Murre	Red		Y	
Fish					
Acipenser medirostris	Green Sturgeon	Blue			1-SC (Aug 2006)
Salvelinus confluentus	Bull Trout	Blue	Y		
Oncorhynchus clarkii clarkii	Cutthroat Trout, *clarkii* subspecies	Blue	Y		
Amphibians					
Anaxyrus boreas	Western Toad	Yellow			1-SC (Jun 2018)
Ascaphus truei	Coastal Tailed Frog	Yellow	Y		1-SC (Jun 2003)
Plants					
Arctanthemum arcticum ssp. *arcticum*	arctic daisy	Red			
Bryhnia hultenii		Red			
Bryocaulon pseudosatoanum	pacific pretzel	Blue			
Callitriche heterophylla var. *heterophylla*	two-edged water-starwort	Blue			
Contopus cooperi	Olive-sided Flycatcher	Blue		Y	1-T (Feb 2010)
Cornus suecica	dwarf bog bunchberry	Blue			
Cypseloides niger	Black Swift	Blue		Y	1-E (May 2019)
Dermatocarpon intestiniforme	quilted stippleback	Blue			

Scientific Name	***English Name***	***BC List***	***IWMS***	***MBCA***	***SARA***
Deschampsia cespitosa ssp. *beringensis - Hordeum brachyantherum*	tufted hairgrass - meadow barley	Red			
Deschampsia cespitosa ssp. beringensis - Symphyotrichum subspicatum	tufted hairgrass - Douglas' aster	Red			
Dicranodontium asperulum		Blue			
Didymodon leskeoides		Red			
Diphyscium foliosum		Blue			
Entodon concinnus		Blue			
Glyceria borealis Fen	northern mannagrass Fen	Blue			
Hageniella micans		Blue			
Hippuris tetraphylla	four-leaved mare's-tail	Blue			
Isopterygiopsis muelleriana		Red			
Menyanthes trifoliata - Carex lasiocarpa	buckbean - slender sedge	Blue			
Myrica gale / Carex sitchensis	sweet gale / Sitka sedge	Red			
Philonotis yezoana		Blue			
Plantago maritima - Puccinellia pumila	sea plantain - dwarf alkaligrass	Red			
Platanthera ephemerantha	white-lip rein orchid	Blue			
Pohlia columbica		Blue			
Polystichum setigerum	Alaska holly fern	Blue			
Pseudocyphellaria rainierensis	oldgrowth specklebelly	Blue			1-SC (Jul 2012)
Salix sitchensis / Carex sitchensis	Sitka willow / Sitka sedge	Blue			
Salix sitchensis - Salix lasiandra var. *lasiandra / Lysichiton americanus*	Sitka willow - Pacific willow / skunk cabbage	Red			
Sphagnum aongstroemii		Blue			
Sphagnum balticum		Blue			
Sphagnum contortum		Blue			
Sphagnum quinquefarium		Blue			
Tanypteryx hageni	Black Petaltail	Blue			
Tetrodontium brownianum		Blue			

Reference: List of species adapted from: https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/conservation-data-centre/explore-cdc-data/species-and-ecosystems-explorer. Search results were filtered for the North coast Forest District and Biogeoclimatic units Coastal Western Hemlock (CWH) or Mountain Hemlock (MH).

Appendix 2:
Least Risk Timing Windows

Species	**Ref**	**Jan**		**Feb**		**Mar**		**Apr**		**May**		**Jun**		**Jul**		**Aug**		**Sep**		**Oct**		**Nov**		**Dec**	
Chum Salmon	1												■	■											
Coho Salmon	1													■	■	■	■								
Pink Salmon	1										■	■	■	■	■	■									
Chinook Salmon	1										■	■	■	■	■	■	■								
Sockeye Salmon	1												■	■	■										
Kokanee Salmon	1												■	■											
Steelhead Trout	1																		■	■	■	■			
Rainbow Trout	1																		■	■	■	■			
Cutthroat Trout	1																	■	■						
Dolly Varden	1													■	■	■									
Bull Trout	1													■	■										
Mountain Whitefish	1												■	■	■	■	■								
Coastal Tailed Frog	1	No least risk period																							
Breeding Birds; Wetlands	2*	■	■	■	■	■	■									■	■	■	■	■	■	■	■	■	■
Breeding Birds; Open	2*	■	■	■	■	■	■	■									■	■	■	■	■	■	■	■	■
Breeding Birds; Forests	2*	■	■	■	■	■	■									■	■	■	■	■	■	■	■	■	■
Western Toad	3	■	■	■	■	■	■	■	■								■	■	■	■	■	■	■	■	■
Raptors	4	■	■	■	■													■	■	■	■	■	■	■	■
Mountain Goat	5											■	■	■	■	■	■	■	■	■	■	■			
Moose	6									■	■	■	■	■	■	■	■	■	■	■	■				
Grizzly Bear	7*							■	■	■	■	■	■	■	■	■	■	■	■						
Fisher	7	■	■	■	■											■	■	■	■	■	■	■	■	■	■
Wolverine	7	■	■													■	■	■	■	■	■	■	■	■	■
Bats	7	No least risk period																							

■ **Least Risk Period**

References:

1. Terms and Conditions for Water Sustainability Act Changes In and About a Stream as specified by Ministry of Forests, Lands, Natural Resource Operations, and Rural Development (FLNRORD) Habitat Officers, Skeena Region (April 2018).
2. https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/general-nesting-periods/nesting-periods.html#_zoneA_calendar. Note cautionary period not included in least risk period.
3. Best Management Practices for Amphibians and Reptiles in Urban and Rural Environments in British Columbia (2004).
4. Guidelines for Raptor Conservation during Urban and Rural Land Development in British Columbia (2013
5. Order – Mountain Goat Ungulate Winter Range – North Coast Timber Supply (2004).
6. Order – Moose Ungulate Winter Range – North Coast Timber Supply (2004).
7. A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, British Columbia (2014). *Note for Grizzly Bear the least risk period is the cautionary period as there is no reduced risk period.

Appendix P – Roy Northern - Archaeological Overview Assessment

Non-Permit Desktop Archaeological Review
PNG Salvus to Galloway Route

Lauren Services

Roy Northern File #: 190954

September 27, 2019

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ROYNORTHERN
Land and Environmental

Management Summary

At the request of Lauren Services (Lauren), Roy Northern Environmental Ltd. (Roy Northern) conducted a Desktop Archaeological Review of Pacific Northern Gas Ltd.'s (PNG's) Salvus to Galloway (S2G) pipeline right-of-way (the Project). PNG is proposing remediation work within select portions of the Project area. The Project area consists of the entire pipeline route - Salvus (MP311) to Galloway (MP360) (Figures 1-1 to 1-3) with a 100 m buffer (50 m on each side of the pipeline centerline).

The objectives of the Desktop Archaeological Review were twofold:

- to examine the Project area and evaluate the potential for archaeological sites; and
- to provide recommendations on the need for, and scope of, further archaeological work, if necessary.

A review of the Provincial Heritage Register shows that six recorded archaeological sites are located within, or near, the Project area. Of these, two sites overlap with the Project area (GbTl-2, GbTl-3), and four sites are located near the Project area (GbTk-1, GbTk-2, GbTk-4, and GbTn-22). An additional source (Beynon 1953 in Inglis 1974) reveals that a traditional village site may be located at the confluence of the Khyex and Skeena Rivers; however, the precise location and extent of the site is unknown, though it is possible that remnants of the village are located along the existing pipeline right-of-way where it crosses Khyex IR No. 8. Although close to the Project area, archaeological site GbTn-22 is located on a small island in Kloiya Bay near Galloway and does not overlap with the Project area.

The results of the Desktop Archaeological Review indicate that areas of archaeological potential exist within the Project area. That is, the likelihood that archaeological sites will be discovered within the Project area is high. As such, an Archaeological Impact Assessment (AIA) is recommended for those portions of the Project area considered to have archaeological potential prior to the start of any clearing or land-altering remediation activities.

An AIA will require a Section 14 Heritage Inspection Permit issued by the BC Archaeology Branch. Roy Northern currently holds a valid Section 14 Permit for PNG which allows for AIAs for various pipeline developments and replacements, as well as other ancillary developments such as workspaces, log decks, sumps, borrow pits, access roads, and any other necessary facilities provided that individual project footprints are no larger than 1 ha in area or 2 km in length (within a 5 m right-of-way). Should proposed developments exceed this size constraint, two options are available:

- Conduct a non-permitted Preliminary Field Reconnaissance (PFR) to further refine areas of archaeological potential within a development footprint or to re-design a development footprint to avoid areas of archaeological potential, or
- Secure an additional permit(s) to conduct AIAs on proposed developments which exceed the size constraints listed above.

No further archaeological work is recommended for those portions of the Project area that are considered to have low archaeological potential. However, users of this report are reminded that "low" archaeological potential does not mean "no" archaeological potential and that, however unlikely, the discovery of an archaeological site remains possible. In order to address the unanticipated discovery of archaeological sites during remediation activities associated with the pipeline, it is recommended that PNG follow their Chance Find Procedure (Appendix B). The Chance Find Procedure will describe common archaeological site types and provide step-by-step instructions to follow in the event of archaeological discoveries.

It is strongly recommended that relevant First Nations be involved in the AIA, as their capacity allows.

Credits

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Report Editor:	Cher Batchelor, BSc, RPBio
Graphics:	Jenny Huang, BSc, GIT

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Appendix A

Appendix B

1 Introduction

At the request of Lauren Services (Lauren), Roy Northern Environmental Ltd. (Roy Northern) conducted a Desktop Archaeological Review of Pacific Northern Gas Ltd.'s (PNG's) Salvus to Galloway (S2G) pipeline right-of-way (the Project). PNG is proposing remediation work within select portions of the Project area. The Project area consists of the entire pipeline route - Salvus (MP311) to Galloway (MP360) (Figures 1-1 to 1-3) with a 100 m buffer (50 m on each side of the pipeline centerline).

2 Objectives

Consistent with the *BC Archaeological Impact Assessment Guidelines* (Archaeology Branch 1998), the objectives of the Desktop Archaeological Review are to:

- to examine the Project area and evaluate the potential for archaeological sites; and
- to provide recommendations on the need for, and scope of, further archaeological work, if necessary.

3 Report Organization

This report includes the results of the review, the results of the archaeological potential assessment, and recommendations for the proposed 2019 remediation works.

4 Background

4.1 Project Area

The Project area is located between the communities of Terrace and Prince Rupert, BC. (Figures 1-1 to 1-3). According to the Consultative Areas database, managed by BC's Ministry of Indigenous Relations and Reconciliation and accessed on September 16, 2019, First Nations with territorial overlap in the Project area include: Gitga'at First Nation, Gitxaala Nation, Kitselas First Nation, Kitsumkalum First Nation, Lax Kw'alaams Band, Metlakatla First Nation.

Further information on the Project area, including environmental and ethnographic background information can be found in the *An Archaeological Overview of the North Coast Timber Supply Area* (Golder 2000) and *Summary Report of the Overview Mapping of Archaeological Resource Potential in the Kalum Forest District* (Millennia Research 1995).

4.2 Expected Site Types

Based on previous archaeological work and ethnographic information, it is expected that archaeological site types which may be found within the Project area include:

- Subsurface and surface scatters of lithic (stone) artifacts and/or faunal (animal) remains
- Shell middens
- Cultural depressions, including house pits and cache pits
- Culturally Modified Trees (CMTs)
- Fish Traps
- Historic Structures (e.g., cabins)
- Trails
- Rock art
- Human burials

4.3 Proposed Development and Schedule

PNG is proposing a number of activities, or developments, to be included in the Project. These include pipeline inspections, geohazard risk assessments, vegetation management, installation of strategic block valves on pipeline mainlines, and installation of permanent or semi-permanent access to strategic locations along the pipeline right-of-way.

It is possible for activities associated with the remediation to alter archaeological sites, if present, within the Project area. The remediation activities are scheduled for 2019, but may extend to 2020, and may be subject to change.

5 Methods

5.1 Background Review

The background review consisted of the review of the following data sources:

- The Provincial Heritage Register, accessed via RAAD (Remote Access to Archaeological Data)
- Google Earth Imagery
- Terrain and other biophysical data available via iMapBC
- ArcGIS Earth
- Archaeological work undertaken in the vicinity of the fire guards on file with BC Archaeology Branch
- Consultative Areas Database map service, maintained by the Ministry of Aboriginal Relations and Reconciliation

5.2 Assessment of Archaeological Potential

The archaeological potential of the Project area was assessed using the data sources described. Where possible, archaeological potential relies on two existing predictive models (Millennia Research 1995, Golder 2000). Both models rely on several biophysical characteristics (i.e., slope, elevation, proximity to fresh water or coastline, forest stand type, age, and class) to identify area of archaeological potential. Where coverage does not overlap with the Project area, this review relies on the same biophysical characteristics to inform the archaeological potential assessment.

The Project area was evaluated and classified using a bipartite system of archaeological potential. Areas where the discovery of archaeological sites is likely are considered to have archaeological potential. Areas where the discovery of archaeological sites is unlikely are considered to have low archaeological potential. The precise extent of archaeological potential within the Project area can be found on Figures 2-1 to 2-14. Further archaeological work, in the form of an AIA is recommended for portions of the Project area considered to have archaeological potential. Where the Project area was thought to only contain low archaeological potential lands, further archaeological work is not recommended.

Recommendations for the Project area are included in Section 7 of this report.

6 Results

The results of the desktop review are presented in the sub-sections below.

6.1 Ethnographic Review

According to the Consultative Areas database, managed by BC's Ministry of Indigenous Relations and Reconciliation and accessed on September 16, 2019, First Nations with territorial overlap in the Project area include: Gitga'at First

Nation, Gitxaala Nation, Kitselas First Nation, Kitsumkalum First Nation, Lax Kw'alaams Band, and Metlakatla First Nation Further information on First Nations with an interest in the Project area can be found at gitgaatnation.ca, gitxaalanation.com, kitselas.com, kitsumkalum.com, laxkwalaams.ca, and metlakatla.ca and from other sources such as Satterfield et al (2011), McDonald (2003), Watkinson and Owens (2000), Berthaiume (1999), Murray (1985), Seguin (1984), Meilleur (1980), Usher (1974), Drucker (1955), and Boas (1890).

The vast quantity of ethnographic material available for the Project area is only briefly summarized here. At its briefest, the traditional lifeways of the First Nation inhabitants can be characterized as following a seasonal round; hunting and/or collecting food resources, such as wildlife, plants, and fish as they became available or abundant throughout the year. Forest gardens were created and maintained around village sites and along high-use travel corridors (Lepofsky, et al. 2017, Wyllie de Echeverria 2013, McDonald 2005). A surplus of fish, other food, and managed gardens allowed for a semi-sedentary lifestyle in which the stored supplies (fish, plants and other forms of nourishment) provided sustenance when other food resources were low or not available. This traditional lifeway is manifested on the landscape as archaeological sites, such as scatters of stone tools, the by-product of stone tool manufacture, shell middens, trails, house pits, cache pits, CMTs, and human burials. Further information on the First Nations inhabitants and their traditional lifeways can be found at the websites listed above and in many scholarly publications such as the *Handbook of North American Indians, Volume 7: Northwest Coast* (Suttles 1990).

6.2 Previous Archaeology

A review of the Provincial Heritage Register, accessed on September 24, 2019, reveals that two recorded archaeological sites are located within the Project area (GbTl-2 and GbTl-3). An additional four sites (GbTk-1, GbTk-2, GbTk-4, and GbTnn-22) are located within 500 m of the Project area (Table 1). The sites are presented below in alphanumeric order.

Table 1: Recorded Archaeological Sites within 500 m of the Project Area

Borden Number	Site Type	Distance from Project Area (as measured from closest edge of Project area)
GbTk-1	Historic Site – Aberdeen Cannery, Kyex City, Skeena City	Within Project area[1]; near MP340
GbTk-2	CMTs	~75 m southwest of Project area; near MP340
GbTk-4	Surface Lithics	~350 m southwest of Project area; near MP340
GbTl-2	Shell Midden	Within Project area; near MP349
GbTl-3	Fish Trap	Within Project area; near MP349
GnTn-22	Shell Midden	~235 m northeast of the Project area; near MP 360

Archaeological site GbTk-1 is recorded as the historical site of Aberdeen (or Windsor) Cannery, established in 1878 (Clayton 1986, Harris 2008) (Cf, Akrigg and Akrigg 1997[2]), and Kyex City or Skeena City. The site record was entered into the Provincial Heritage Register in 1982 following a brief reconnaissance by archaeologists during a proposed BC Hydro 500 kV transmission line project (Provenance Research 1982). This site was intended as the proposed terminus of the Grand Trunk Pacific Railway and was surveyed out as many small city lots. However, the proposed city was never developed, and instead, the location became only a stop along the railway line (Skeena

1 *Please see text for further discussion on the boundaries of this site.*
2 *According to Akrigg and Akrigg, Aberdeen Cannery was established in 1876.*

Station) (Regional District of Kitimat-Stikine n.d.). Pilings were observed in the river (either Skeena or Khyex Rivers), near Khyex Indian Reserve 8, and were thought to indicate the possible location of the cannery. Since that time, other physical remains of the site have been observed by local historical enthusiasts, including a brick factory and tunnel (Bryce 2016). For the purposes of this report, the extent of the surveyed city lots is used as the boundary for GbTk-1 with the caveat that the physical remains of the cannery and/or other related historic materials may extend beyond this arbitrary limit.

In his 1974 report describing the results of an archaeological assessment of a proposed bulk loading facility on BC's northern coast, anthropologist Richard Inglis indicates that a traditional native village site is located at the mouth of Khyex River. This village location was reported in 1953 by hereditary chief and oral historian William Beynon in an unpublished work (Beynon 1953, as cited in Inglis 1974). It is possible for this as-yet undefined village site to overlap, or be in proximity to, the Project area, specifically within, or in the vicinity of Khyex Indian Reserve 8.

At archaeological site GbTk-2, four western redcedars with five slab removal scars were recorded in 1983 during the Prince Rupert Harbour Project: Heritage Site Evaluation and Impact Assessment (Archer 1983). Archaeological site GbTk-4 was also recorded during the 1983 Prince Rupert Harbour Project (Archer 1983). The site consists of a single stone artifact found on the ground surface. The artifact consists of a heavily battered cobble, likely a hammerstone or failed core.

Archaeological sites GbTl-2 and GbTl-3 are located at the head of Work Channel, on the north shore of Lachmach River, within Lachmach Indian Reserve 16. Archaeological site GbTl-2 consists of a shell midden site and GbTl-3 consists of a fish trap (Photo 1) (Inglis 1974). Both were recorded in 1974 during an archaeological impact study of a proposed bulk loading facility on BC's northern coast. The presence of shell midden suggests GbTl-2 is a village

Photo 1. Fish Trap at GbTl-3 (Inglis 1974).

site. Ancestral human remains are often found in shell middens and PNG is advised that in addition to shell midden deposits, ancestral human remains, as well as other important archaeological features or materials could be present within the site. PNG should exercise an abundance of caution when planning remediation activities near the reported location of GbTl-2.

Archaeological site GbTn-22 is located on a small island in Kloiya Bay. The site consists of a shell midden, suggesting a village site, and was recorded during the same proposed BC Hydro 500 kV transmission line project (Provenance Research 1982) as noted above. Site dimensions were not recorded during the field visit in 1982. Despite the lack of detail regarding this site, it can reasonably be assumed that the site does not extend into the Project area due to its location on an island, separated from the PNG pipeline right-of-way by a narrow body of water.

6.3 Archaeological Potential

As per the methods outlined in Section 5 above, the archaeological potential of the Project area has been evaluated (Figures 2-1 to 2-14). Approximately 55% of the Project area is considered to have archaeological potential, and further archaeological work is recommended for any of PNG's proposed developments that fall within areas of archaeological potential. No further archaeological work is recommended for the remainder of the Project area.

7 Recommendations

The results of the desktop review indicate that areas of high archaeological potential exist within the Project area. That is, the likelihood that archaeological sites will be discovered within the Project area is high. As such, an AIA is recommended for those portions of the Project area considered to have archaeological potential prior to the start of any land-altering remediation activities.

An AIA will require a Section 14 Heritage Inspection Permit issued by the BC Archaeology Branch. Roy Northern currently holds a valid Section 14 Permit for PNG which allows for AIAs for various pipeline developments and replacements, as well as other ancillary developments such as workspaces, log decks, sumps, borrow pits, access roads, and any other necessary facilities provided that individual project footprints are no larger than 1 ha in area or 2 km in length (within a 5 m right-of-way).

Should proposed developments exceed this size constraint, two options are available:

- Conduct a non-permitted Preliminary Field Reconnaissance (PFR) to further refine areas of archaeological potential within a development footprint or to re-design a development footprint to avoid areas of archaeological potential, or
- Secure an additional permit(s) to conduct AIAs on proposed developments which exceed the size constraints listed above.

No further archaeological work is recommended for those portions of the Project area considered to have low archaeological potential. However, users of this report are reminded that "low" archaeological potential does not mean "no" archaeological potential and that, however unlikely, the discovery of an archaeological site remains possible. In order to address the unanticipated discovery of archaeological sites during forestry operations associated with these blocks, it is recommended that PNG follow their Chance Find Procedure. The Chance Find Procedure will describe common archaeological site types and provide step-by-step instructions to follow in the event of archaeological discoveries.

It is strongly recommended that relevant First Nations be involved in the AIA, as their capacity allows.

Users of this report are reminded that all archaeological sites in BC are protected by the *Heritage Conservation Act* (HCA), whether recorded or unidentified and may not be altered, damaged, moved, excavated in, or disturbed in any way without a Section 12 or Section 14 Permit issued under the HCA by the Province of BC.

8 Disclaimer

It is not the intent of this desktop review to identify or comment on First Nations traditional use of the Project area. Queries of this nature should be directed to the First Nations listed herein. The report was prepared without prejudice to issues of aboriginal rights or title.

9 Closure

Please contact the undersigned with any questions or concerns.

Sincerely,

Roy Northern Environmental Ltd.

Prepared by:

____
Karen Brady, BA
Senior Archaeologist

Reviewed by:

____
Cher Batchelor, BSc, RPBio
Environmental Manager, BC & AB

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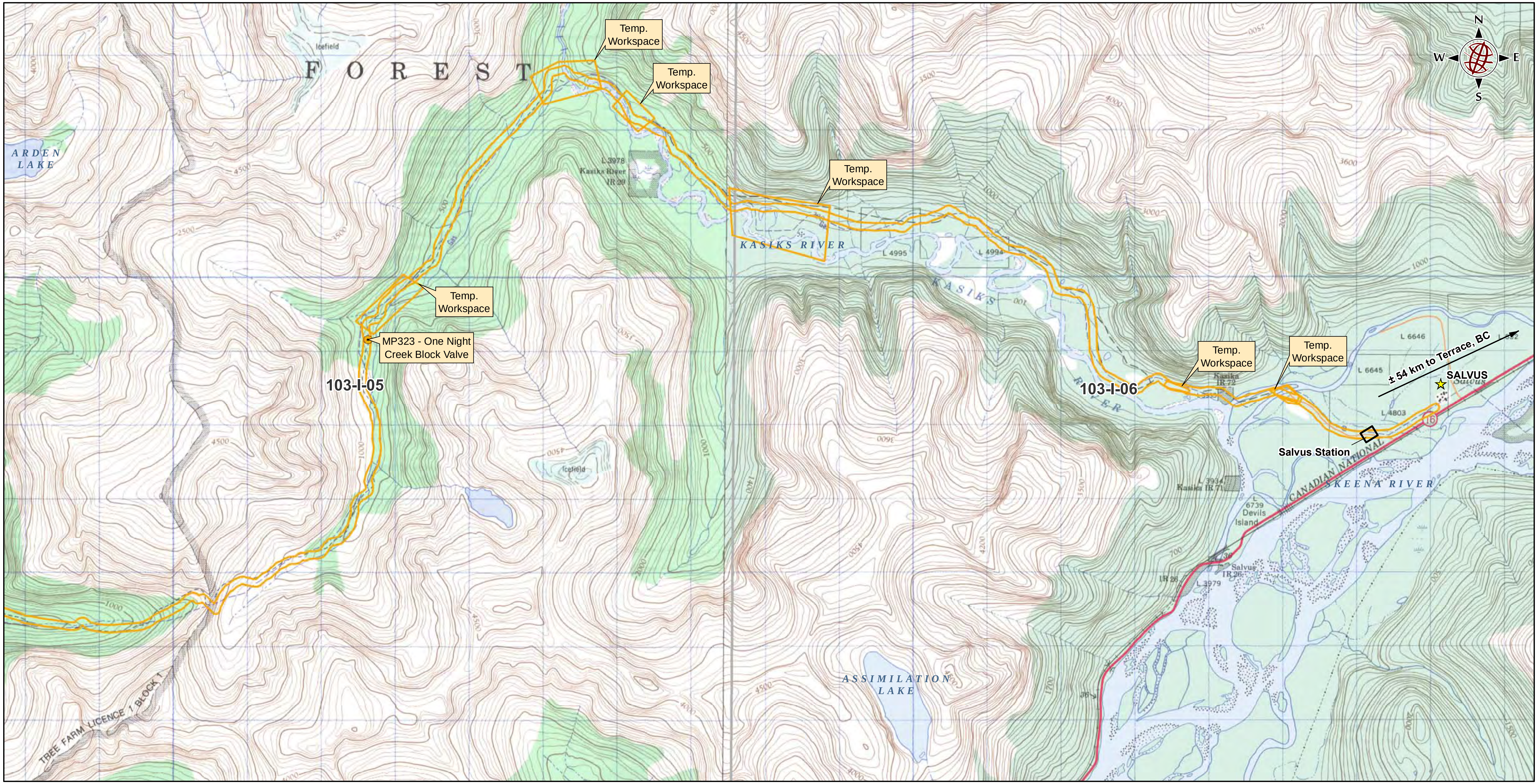
Appendix A - Figures

Figures 1-1 to Figure 1-3; Figures 2-1 to Figure 2-14



LEGEND

- Block Valve Location
- Proposed Project Area

REFERENCES

Previously Recorded Archaeological Sites obtained from RAAD (09/05/2019).
Inset Map Basemap: ESRI Online - National Geographic Mapping Service.
Projection: NAD 1983 UTM Zone 9N

PACIFIC NORTHERN GAS LTD.

Overview Map
SALVUS TO GALLOWAY ROUTE

0 0.5 1 2 km
Scale: 1:50,000

GIS:	JH
Date:	Sep 27, 2019
Revision:	R0
Map ID:	N/A

FIGURE 1-1

ROYNORTHERN Land and Environmental
207, 10139 100 St.
Fort St. John, BC
V1J 3Y6
(250) 261-6644

Path: X:\BC_Projects\Pacific_Northern_Gas\2019\190954\mxd\190954A13_1_Overview_S2G.mxd

LEGEND

- Block Valve Location
- Previously Recorded Archaeology Site
- Archaeology Site Boundary
- Proposed Project Area

REFERENCES

Previously Recorded Archaeological Sites obtained from RAAD (09/05/2019).
Inset Map Basemap: ESRI Online - National Geographic Mapping Service.
Projection: NAD 1983 UTM Zone 9N

INSET MAP

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PACIFIC NORTHERN GAS LTD.

Overview Map
SALVUS TO GALLOWAY ROUTE

0 0.5 1 2 km
Scale: 1:50,000

GIS:	JH
Date:	Sep 27, 2019
Revision:	R0
Map ID:	N/A

FIGURE 1-2

ROYNORTHERN Land and Environmental

207, 10139 100 St.
Fort St. John, BC
V1J 3Y6
(250) 261-6644

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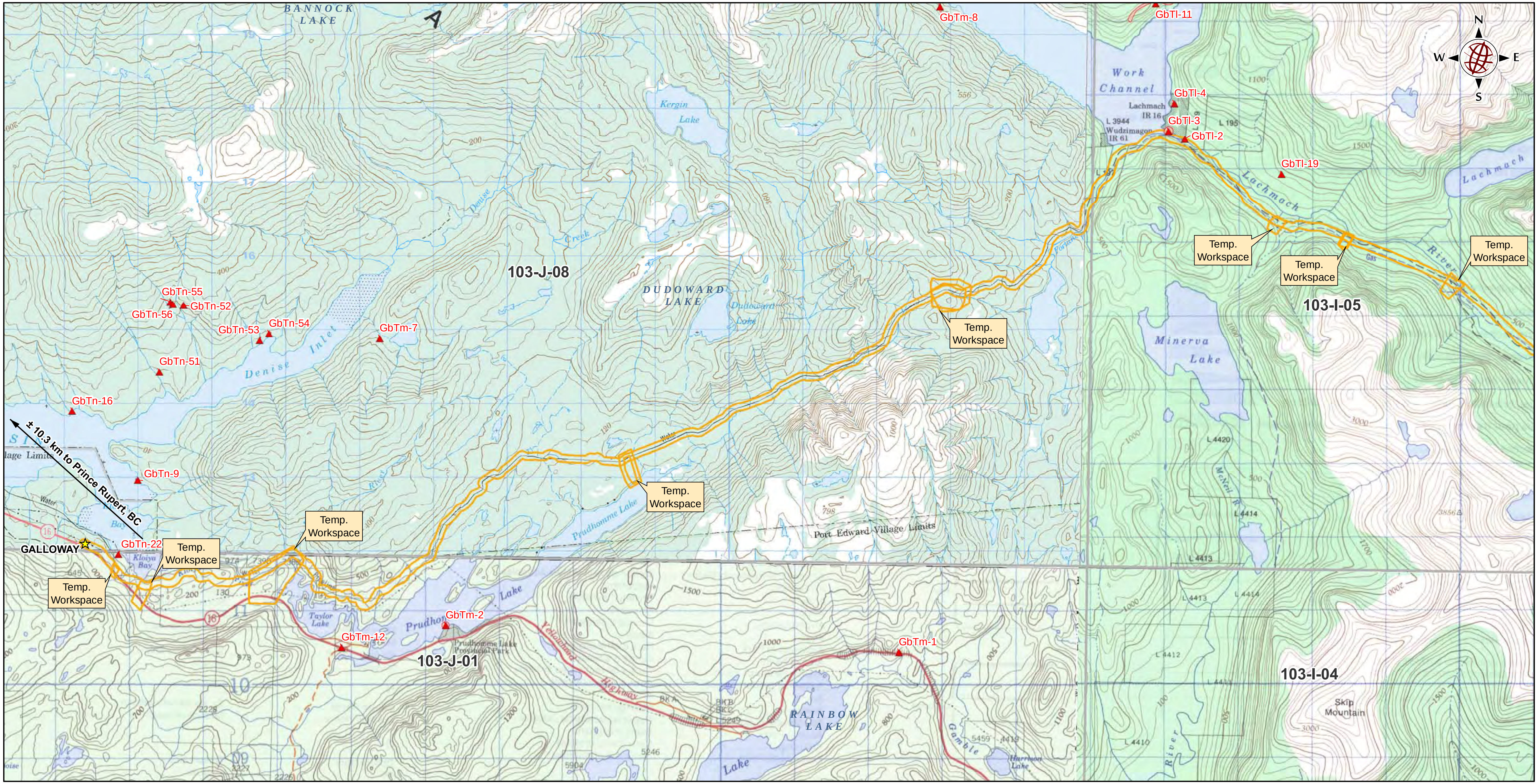

LEGEND

- Previously Recorded Archaeology Site
- Archaeology Site Boundary
- Proposed Project Area

REFERENCES

Previously Recorded Archaeological Sites obtained from RAAD (09/05/2019).
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INSET MAP

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PACIFIC NORTHERN GAS LTD.

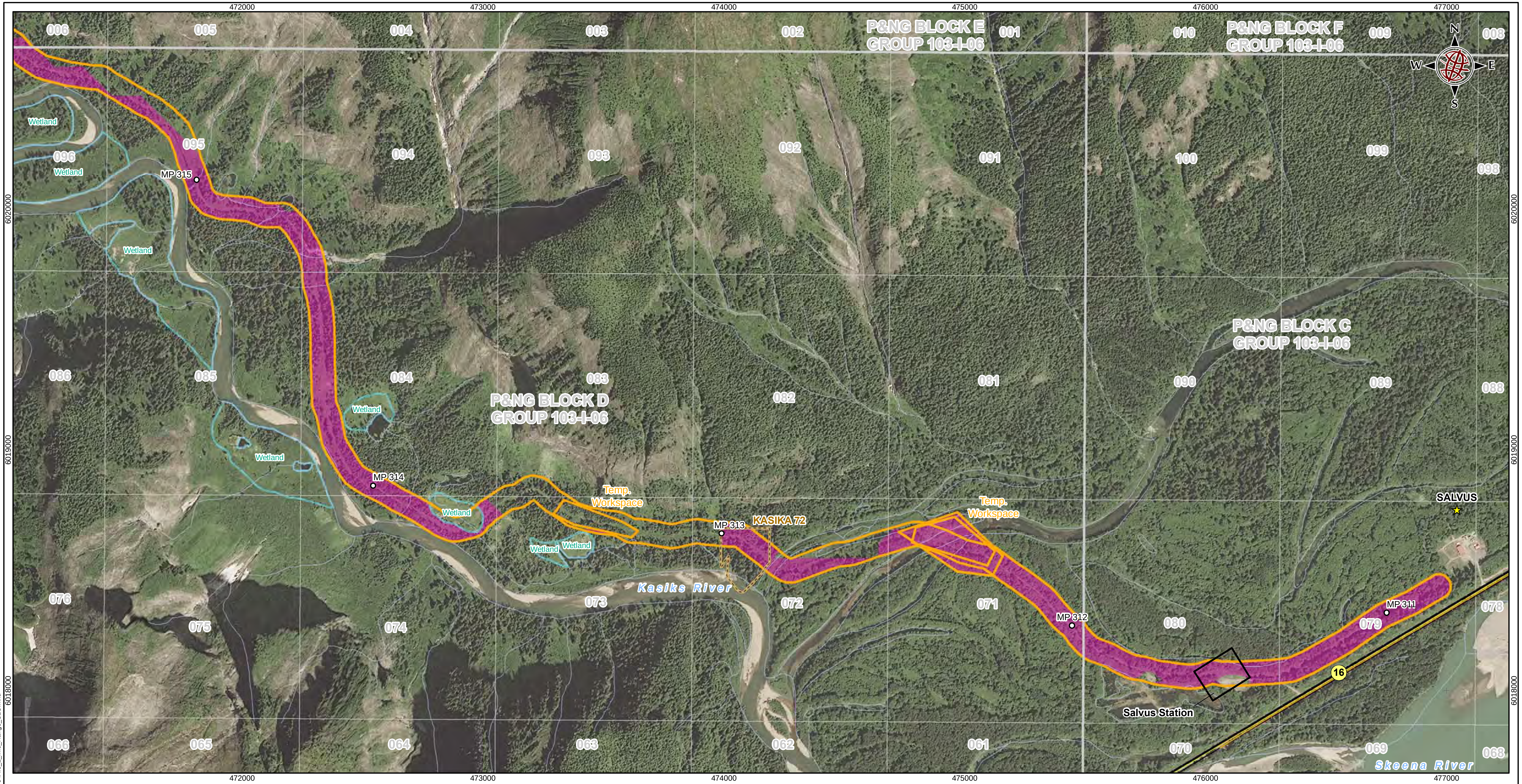
Overview Map
SALVUS TO GALLOWAY ROUTE

0 0.5 1 2 km
Scale: 1:50,000

GIS:	JH
Date:	Sep 27, 2019
Revision:	R0
Map ID:	N/A

FIGURE 1-3

ROYNORTHERN Land and Environmental
207, 10139 100 St.
Fort St. John, BC
V1J 3Y6
(250) 261-6644



LEGEND

- Historic Mile Post
- Salvus to Galloway Route 50 m Buffer
- First Nations Reserve
- Wetland
- Waterbody
- Watercourse
- Highway
- Main Railway
- Other Railway
- Archaeological Potential

REFERENCES

Previously recorded Archaeological Sites obtained from RAAD (09/05/2019).
Projection: NAD 1983 UTM Zone 9N

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PACIFIC NORTHERN GAS LTD.

Archaeological Overview Assessment
SALVUS TO GALLOWAY ROUTE

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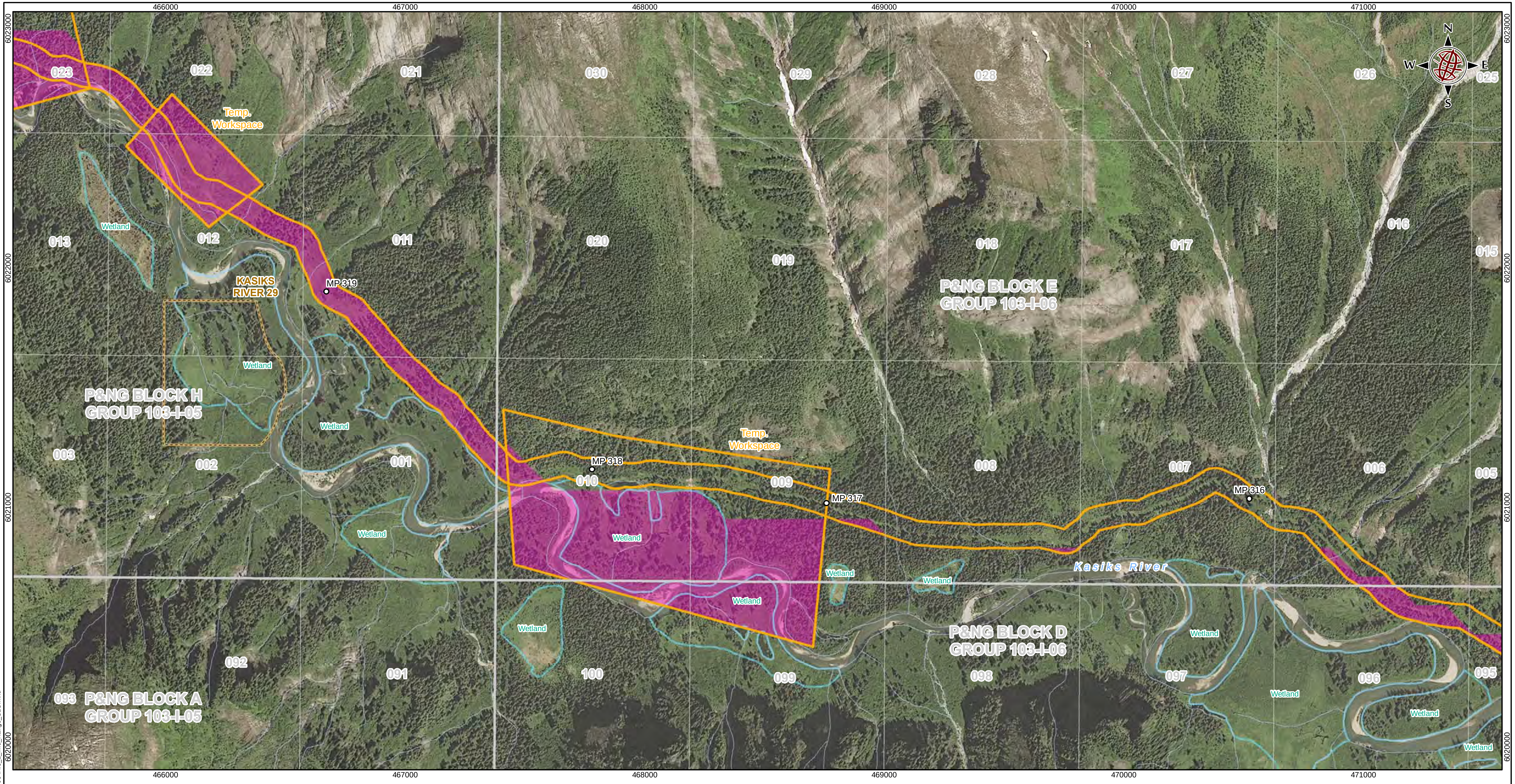
Scale: 1:15,000

GIS: JH
Date: Sep 27, 2019
Revision: R0
Map ID: N/A

FIGURE 2-1

ROYNORTHERN Land and Environmental
207, 10139 100 St.
Fort St. John, BC
V1J 3Y6
(250) 261-6644



LEGEND

- Historic Mile Post
- Salvus to Galloway Route 50 m Buffer
- First Nations Reserve
- Wetland
- Waterbody
- Watercourse
- Archaeological Potential

REFERENCES

Previously recorded Archaeological Sites obtained from RAAD (09/05/2019).
Projection: NAD 1983 UTM Zone 9N

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Archaeological Overview Assessment
SALVUS TO GALLOWAY ROUTE

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FIGURE 2-2

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Land and Environmental
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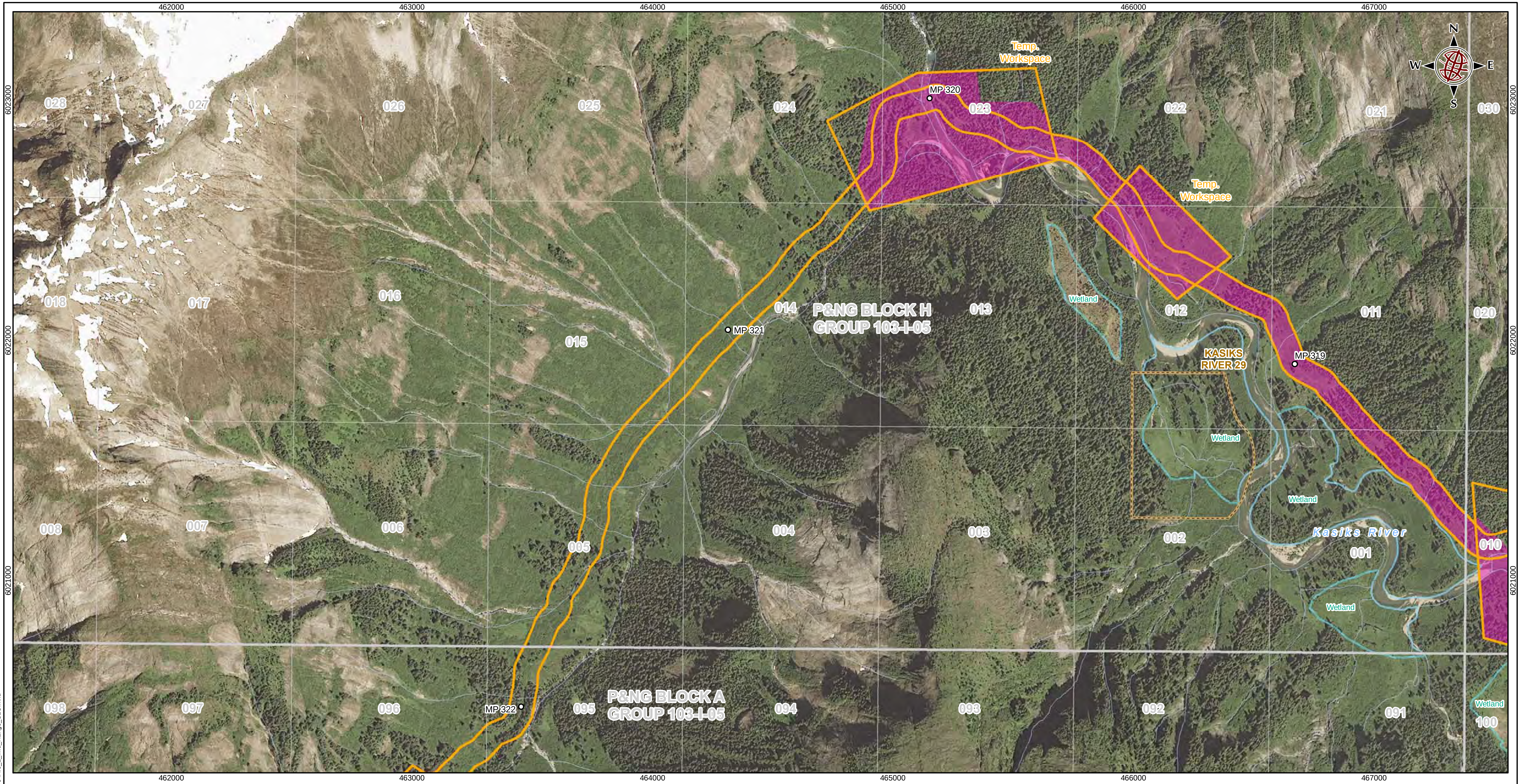
Fort St. John, BC
V1J 3Y6
(250) 261-6644



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LEGEND

- Historic Mile Post
- Salvus to Galloway Route 50 m Buffer
- First Nations Reserve
- Wetland
- Waterbody
- Watercourse
- Archaeological Potential

REFERENCES

Previously recorded Archaeological Sites obtained from RAAD (09/05/2019).
Projection: NAD 1983 UTM Zone 9N

PACIFIC NORTHERN GAS LTD.

Archaeological Overview Assessment
SALVUS TO GALLOWAY ROUTE

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Date: Sep 27, 2019
Revision: R0
Map ID: N/A

FIGURE 2-3

ROYNORTHERN Land and Environmental
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V1J 3Y6
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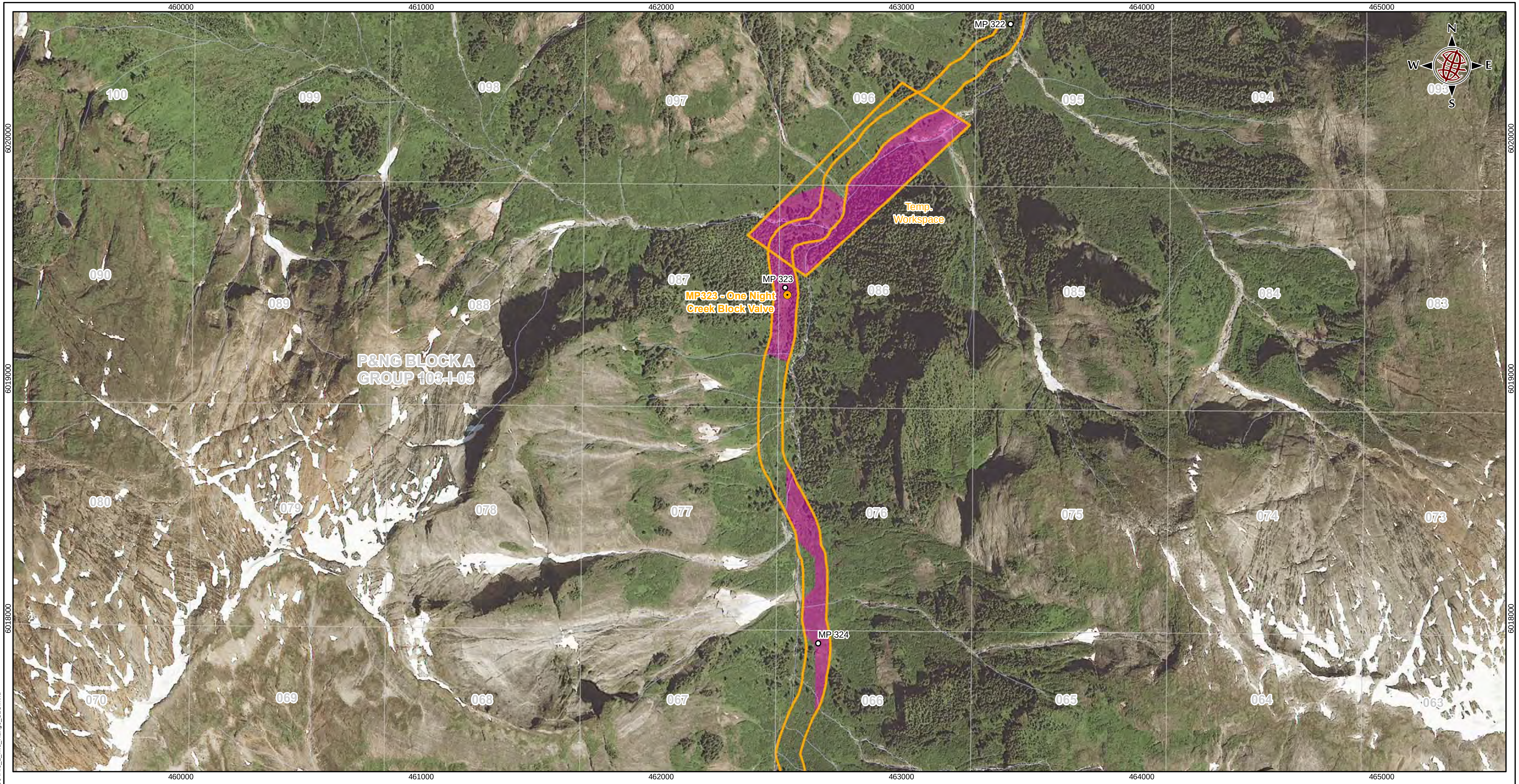

LEGEND

- Historic Mile Post
- Block Valve Location
- Salvus to Galloway Route 50 m Buffer
- Waterbody
- Watercourse
- Archaeological Potential

REFERENCES

Previously recorded Archaeological Sites obtained from RAAD (09/05/2019).
Projection: NAD 1983 UTM Zone 9N

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PACIFIC NORTHERN GAS LTD.

Archaeological Overview Assessment
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FIGURE 2-4

ROYNORTHERN Land and Environmental
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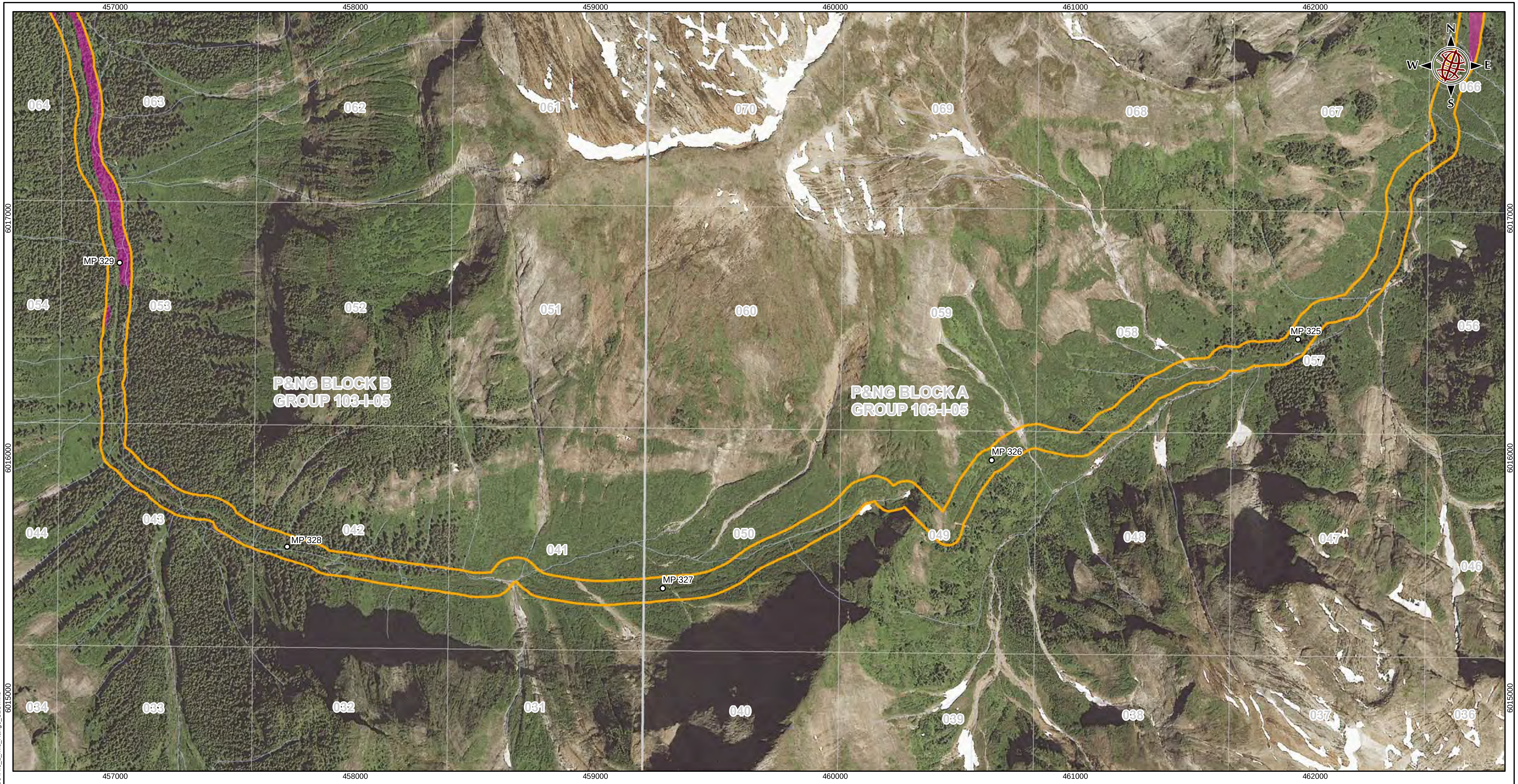

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LEGEND

- Historic Mile Post
- Salvus to Galloway Route 50 m Buffer
- Waterbody
- Watercourse
- Archaeological Potential

REFERENCES

Previously recorded Archaeological Sites obtained from RAAD (09/05/2019).
Projection: NAD 1983 UTM Zone 9N

PACIFIC NORTHERN GAS LTD.

Archaeological Overview Assessment
SALVUS TO GALLOWAY ROUTE

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GIS:	JH
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FIGURE 2-5

ROYNORTHERN Land and Environmental
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V1J 3Y6
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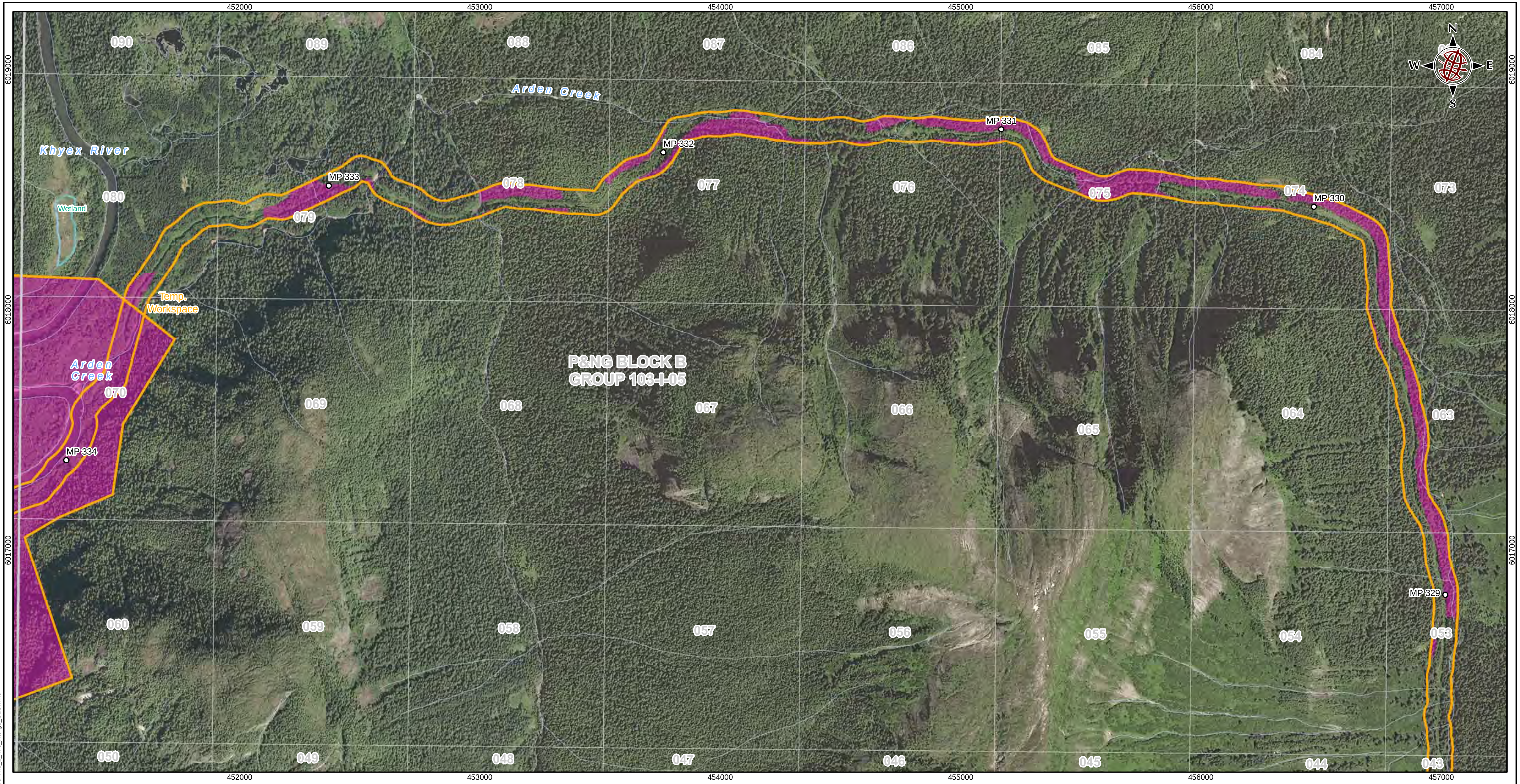

LEGEND

- Historic Mile Post
- Salvus to Galloway Route 50 m Buffer
- Wetland
- Waterbody
- Watercourse
- Archaeological Potential

REFERENCES

Previously recorded Archaeological Sites obtained from RAAD (09/05/2019).
Projection: NAD 1983 UTM Zone 9N

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Archaeological Overview Assessment
SALVUS TO GALLOWAY ROUTE

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Date:	Sep 27, 2019
Revision:	R0
Map ID:	N/A

FIGURE 2-6

ROYNORTHERN
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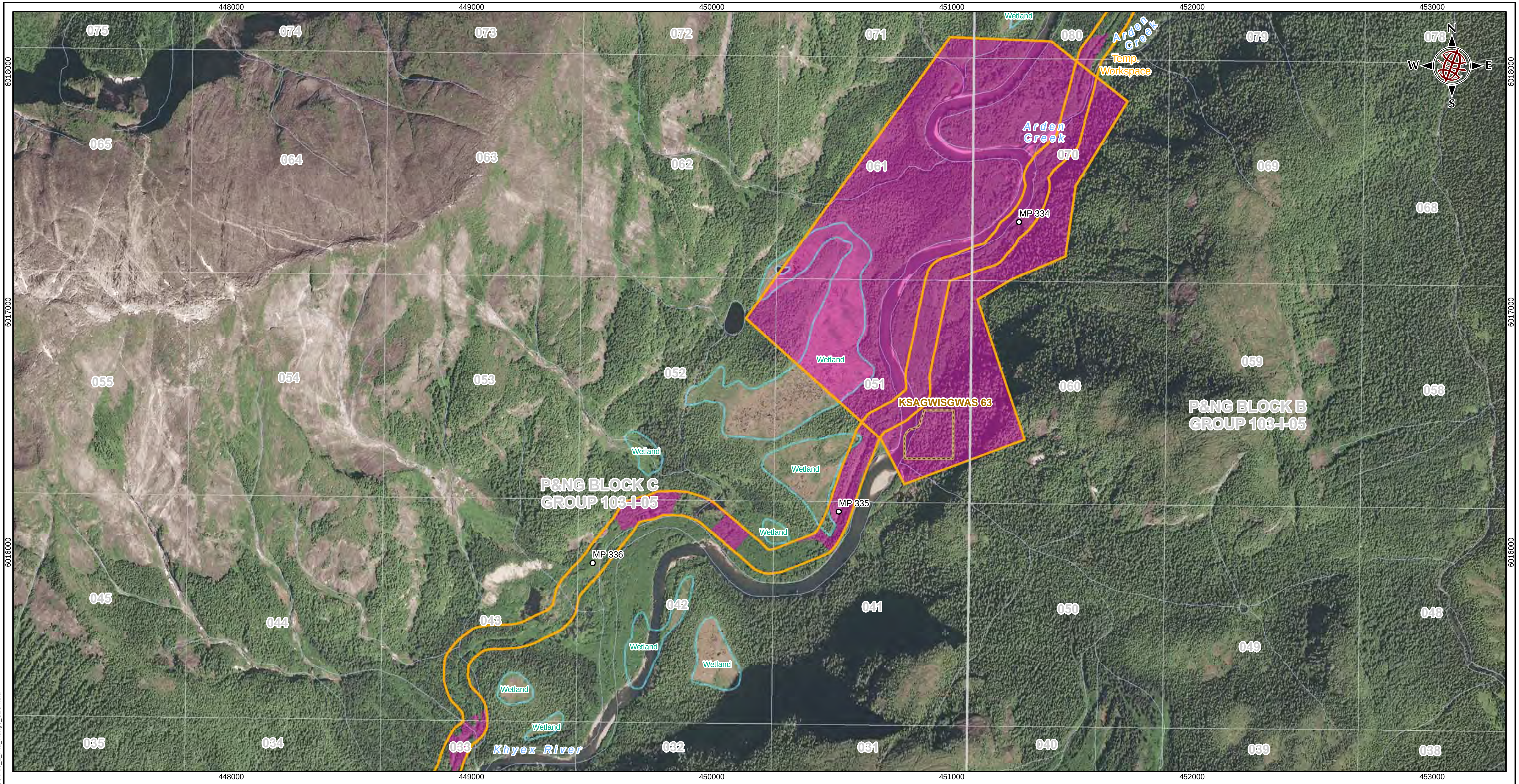

LEGEND

- Historic Mile Post
- Salvus to Galloway Route 50 m Buffer
- First Nations Reserve
- Wetland
- Waterbody
- Watercourse
- Archaeological Potential

REFERENCES

Previously recorded Archaeological Sites obtained from RAAD (09/05/2019).
Projection: NAD 1983 UTM Zone 9N

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Archaeological Overview Assessment
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GIS:	JH
Date:	Sep 27, 2019
Revision:	R0
Map ID:	N/A

FIGURE 2-7

ROYNORTHERN
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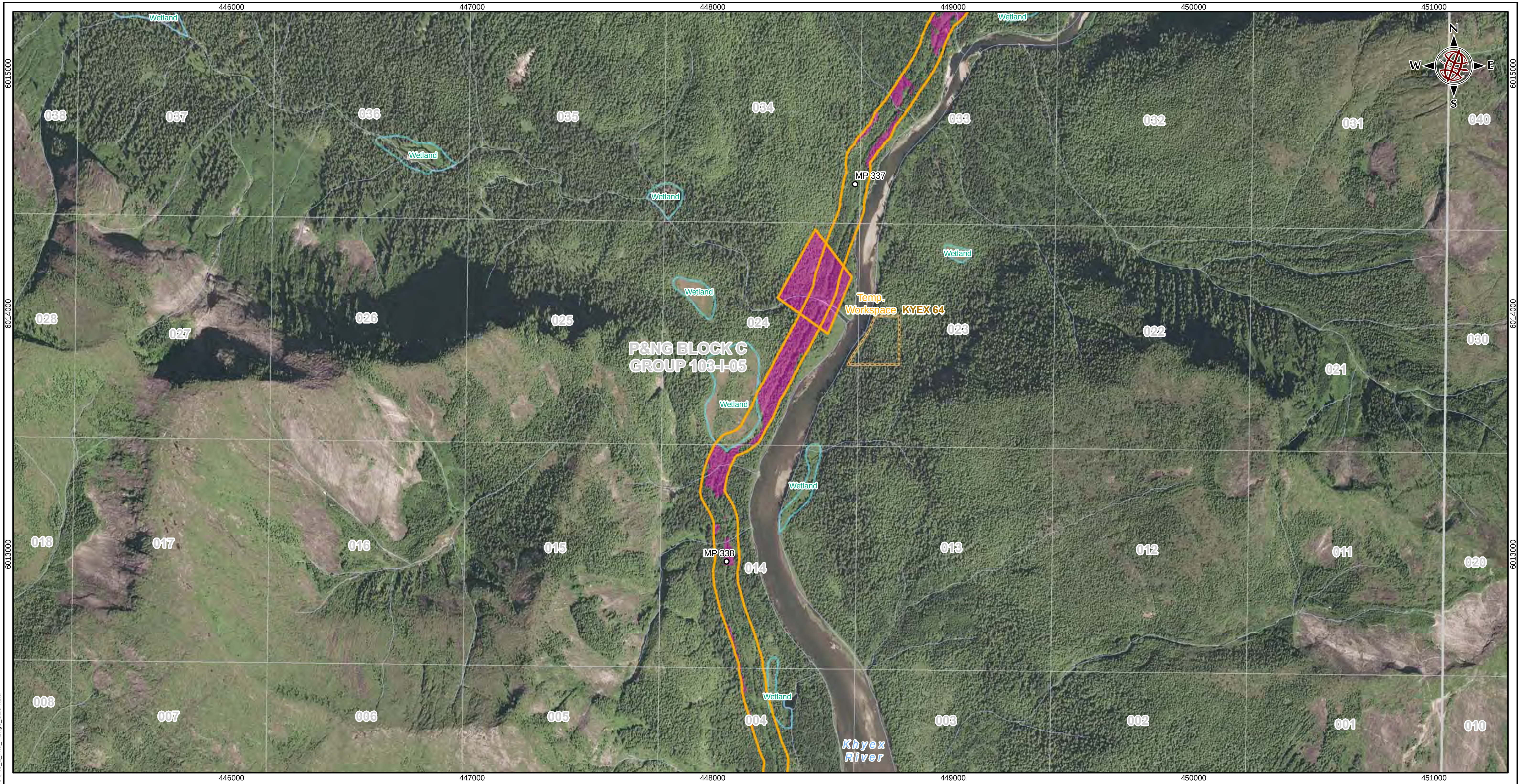

LEGEND

- Historic Mile Post
- Salvus to Galloway Route 50 m Buffer
- First Nations Reserve
- Wetland
- Waterbody
- Watercourse
- Archaeological Potential

REFERENCES

Previously recorded Archaeological Sites obtained from RAAD (09/05/2019).
Projection: NAD 1983 UTM Zone 9N

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PACIFIC NORTHERN GAS LTD.

Archaeological Overview Assessment
SALVUS TO GALLOWAY ROUTE

0 200 400 800 m
Scale: 1:15,000

GIS:	JH
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FIGURE 2-8

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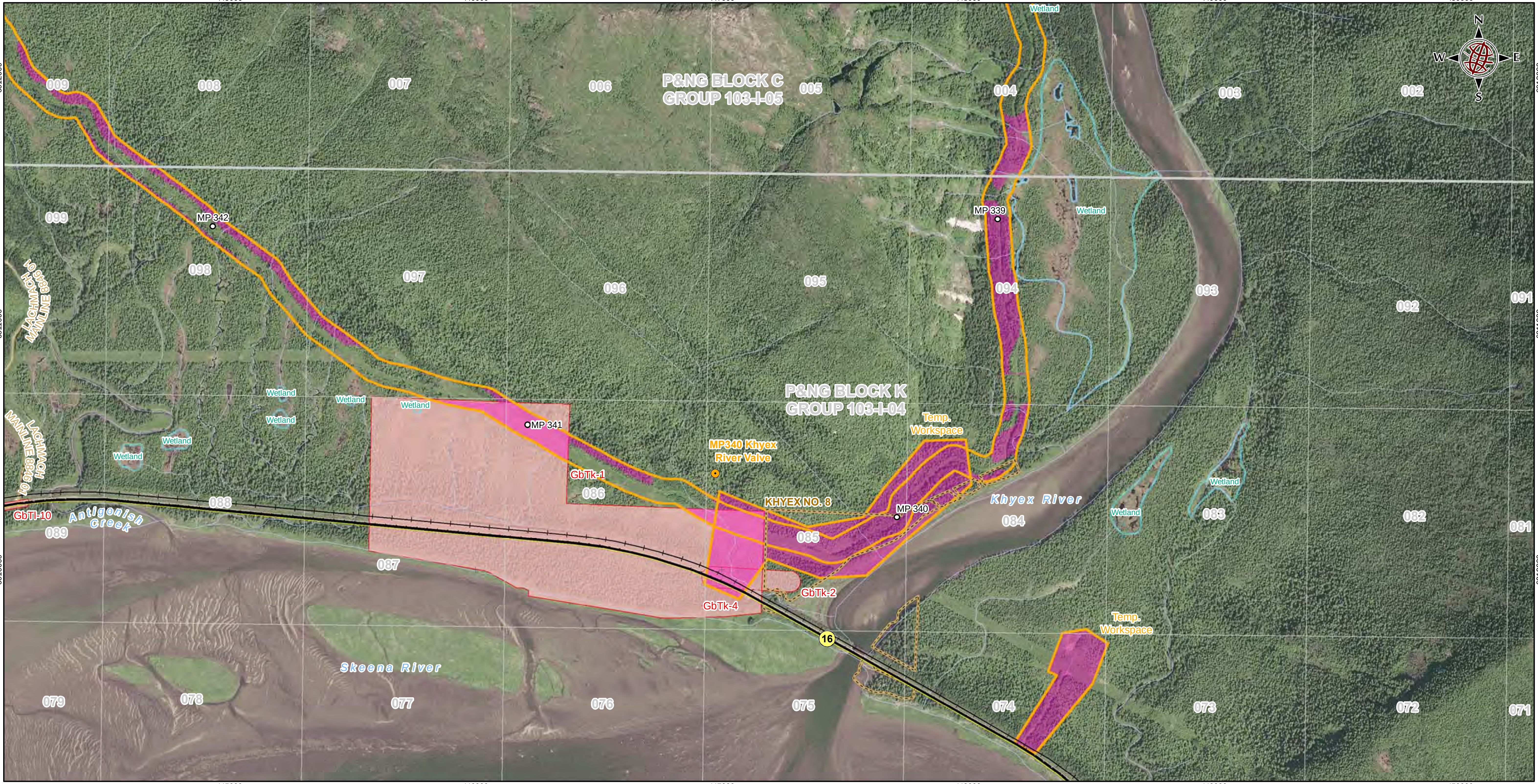
ROYNORTHERN Land and Environmental
207, 10139 100 St.
Fort St. John, BC
V1J 3Y6
(250) 261-6644



LEGEND

- Historic Mile Post
- Block Valve Location
- Salvus to Galloway Route 50 m Buffer
- First Nations Reserve
- Archaeology Site Boundary
- Wetland
- Waterbody
- Watercourse
- Highway
- Forestry Road
- Main Railway
- Archaeological Potential

REFERENCES

Previously recorded Archaeological Sites obtained from RAAD (09/05/2019).
Projection: NAD 1983 UTM Zone 9N

Path: X:\BC_Projects\Pacific_Northern_Gas\2019\190954\mxd\190954AI3_2_Mid_Range_S2G.mxd

PACIFIC NORTHERN GAS LTD.

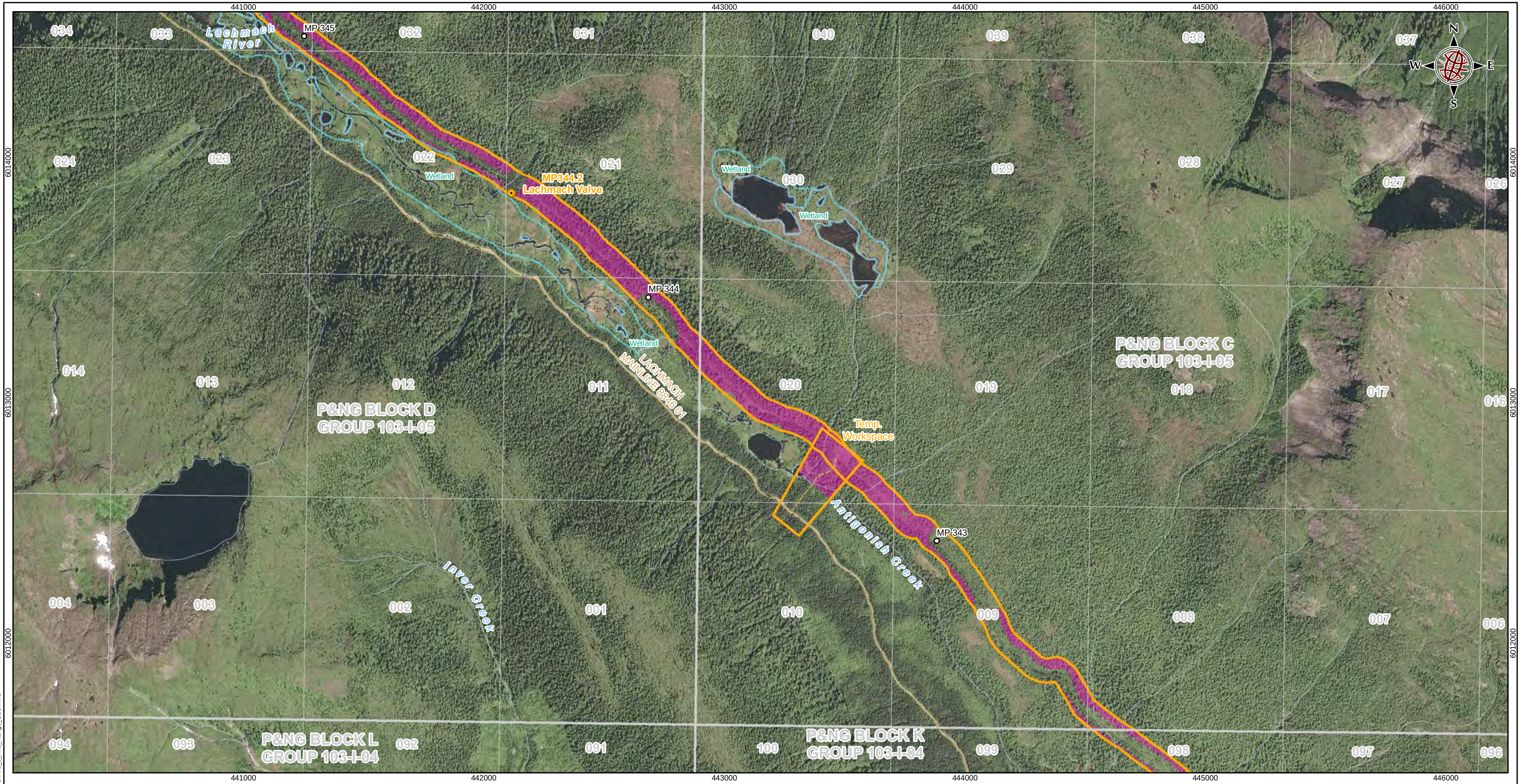
Archaeological Overview Assessment
SALVUS TO GALLOWAY ROUTE

0 200 400 800 m
Scale: 1:15,000

GIS:	JH
Date:	Sep 27, 2019
Revision:	R0
Map ID:	N/A

FIGURE 2-9

ROYNORTHERN Land and Environmental
207, 10139 100 St.
Fort St. John, BC
V1J 3Y6
(250) 261-6644



LEGEND

- Historic Mile Post
- Block Valve Location
- Salvus to Galloway Route 50 m Buffer
- Wetland
- Waterbody
- Watercourse
- Forestry Road
- Archaeological Potential

REFERENCES

Previously recorded Archaeological Sites obtained from RAAD (09/05/2019).
Projection: NAD 1983 UTM Zone 9N

Path: X:\BC_Projects\Pacific_Northern_Gas\2019\190954\mxd\190954A\3_2_Mid_Range_S2G.mxd

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PACIFIC NORTHERN GAS LTD.

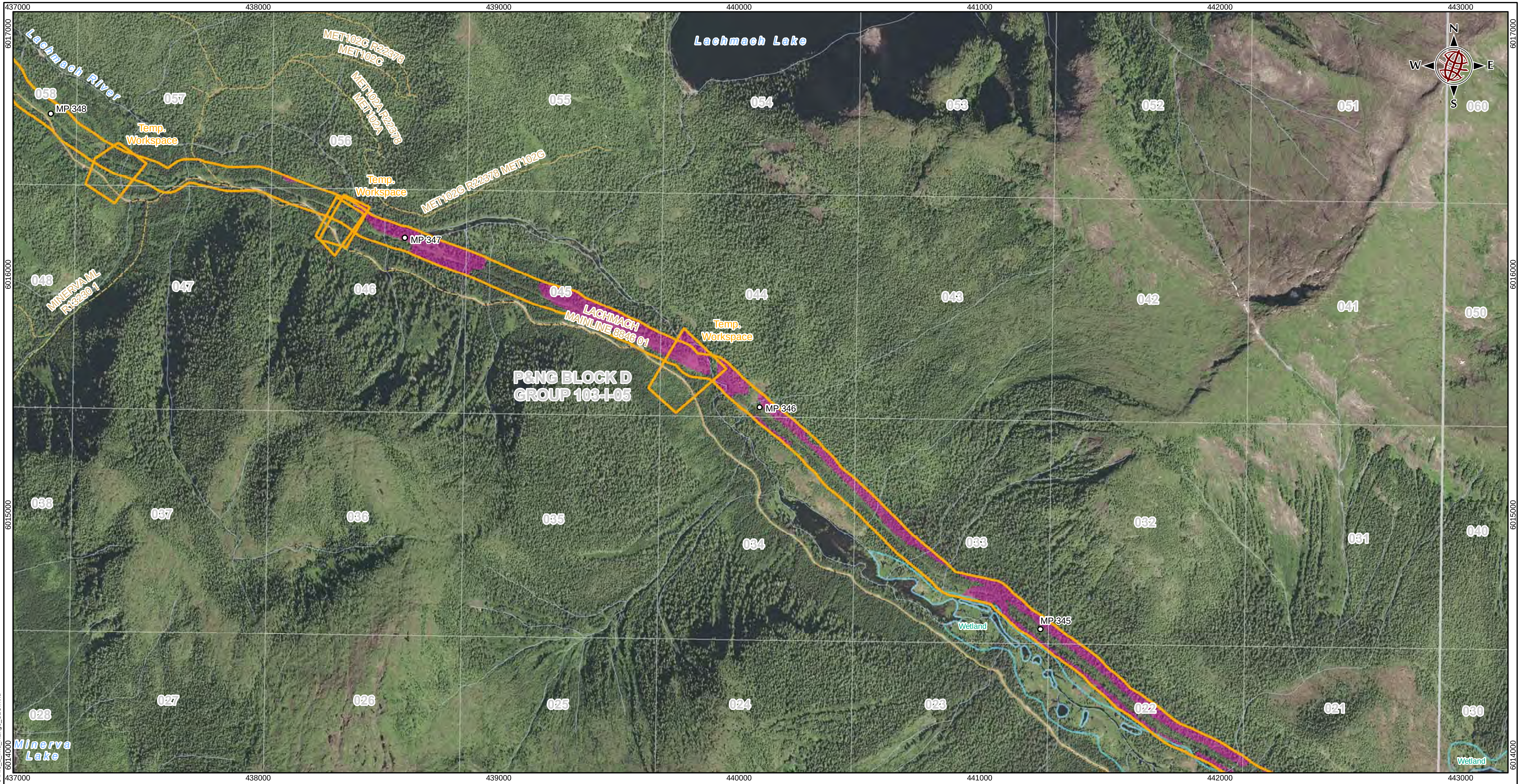
Archaeological Overview Assessment
SALVUS TO GALLOWAY ROUTE

0 200 400 800 m
Scale: 1:15,000

GIS:	JH
Date:	Sep 27, 2019
Revision:	R0
Map ID:	N/A

FIGURE 2-10

ROYNORTHERN Land and Environmental
207, 10139 100 St.
Fort St. John, BC
V1J 3Y6
(250) 261-6644



LEGEND

- Historic Mile Post
- Salvus to Galloway Route 50 m Buffer
- Wetland
- Waterbody
- Watercourse
- Forestry Road
- Archaeological Potential

REFERENCES

Previously recorded Archaeological Sites obtained from RAAD (09/05/2019).
Projection: NAD 1983 UTM Zone 9N

PACIFIC NORTHERN GAS LTD.

Archaeological Overview Assessment
SALVUS TO GALLOWAY ROUTE

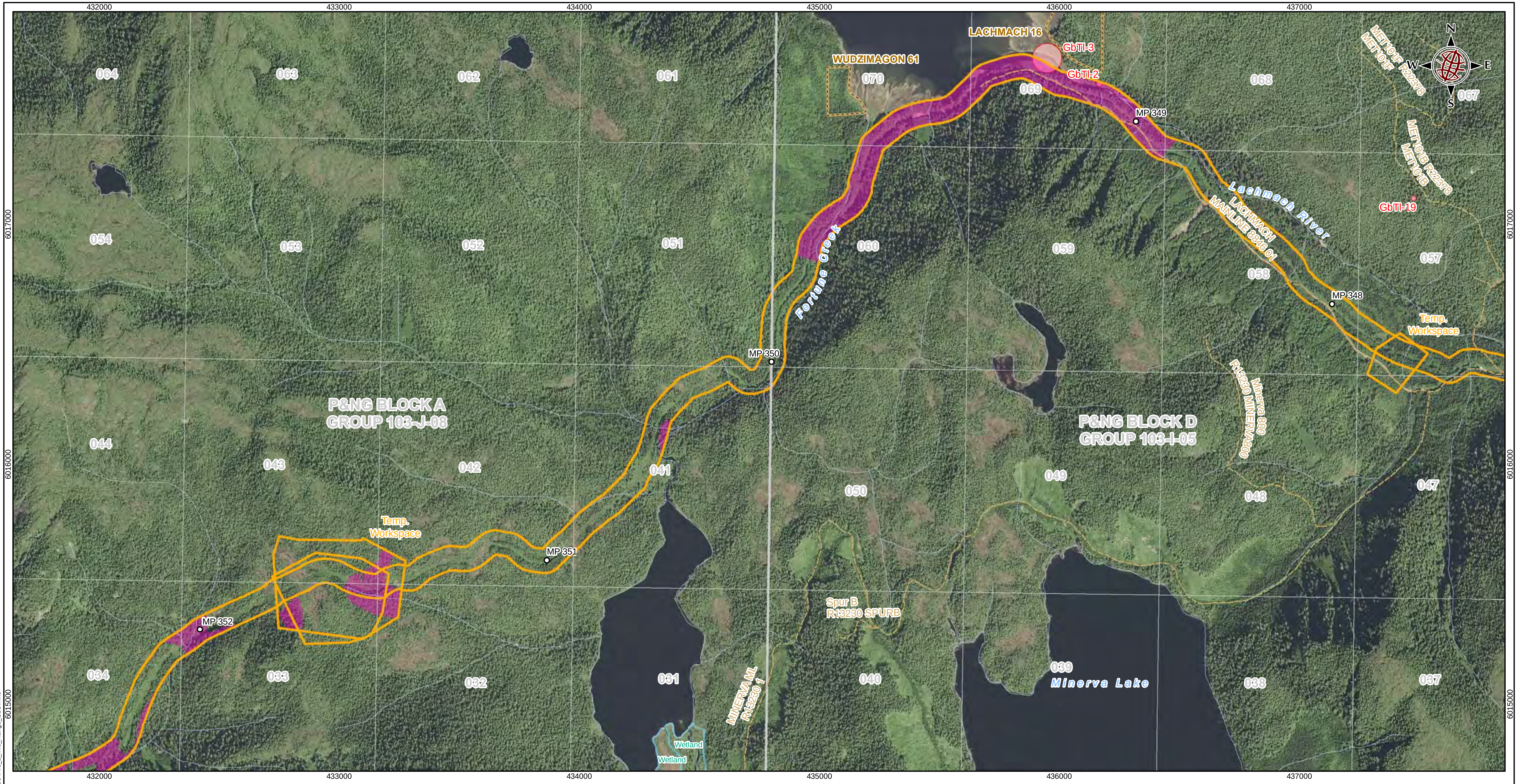
0 200 400 800 m
Scale: 1:15,000

GIS:	JH
Date:	Sep 27, 2019
Revision:	R0
Map ID:	N/A

FIGURE 2-11

ROYNORTHERN Land and Environmental
207, 10139 100 St.
Fort St. John, BC
V1J 3Y6
(250) 261-6644

Path: X:\BC_Projects\Pacific_Northern_Gas\2019\190954\mxd\190954AI3_2_Mid_Range_S2G.mxd



LEGEND

- Historic Mile Post
- Salvus to Galloway Route 50 m Buffer
- First Nations Reserve
- Archaeology Site Boundary
- Wetland
- Waterbody
- Watercourse
- Forestry Road
- Archaeological Potential

REFERENCES

Previously recorded Archaeological Sites obtained from RAAD (09/05/2019).
Projection: NAD 1983 UTM Zone 9N

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PACIFIC NORTHERN GAS LTD.

Archaeological Overview Assessment
SALVUS TO GALLOWAY ROUTE

0 200 400 800 m
Scale: 1:15,000

GIS:	JH
Date:	Sep 27, 2019
Revision:	R0
Map ID:	N/A

FIGURE 2-12

ROYNORTHERN Land and Environmental
207, 10139 100 St.
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(250) 261-6644

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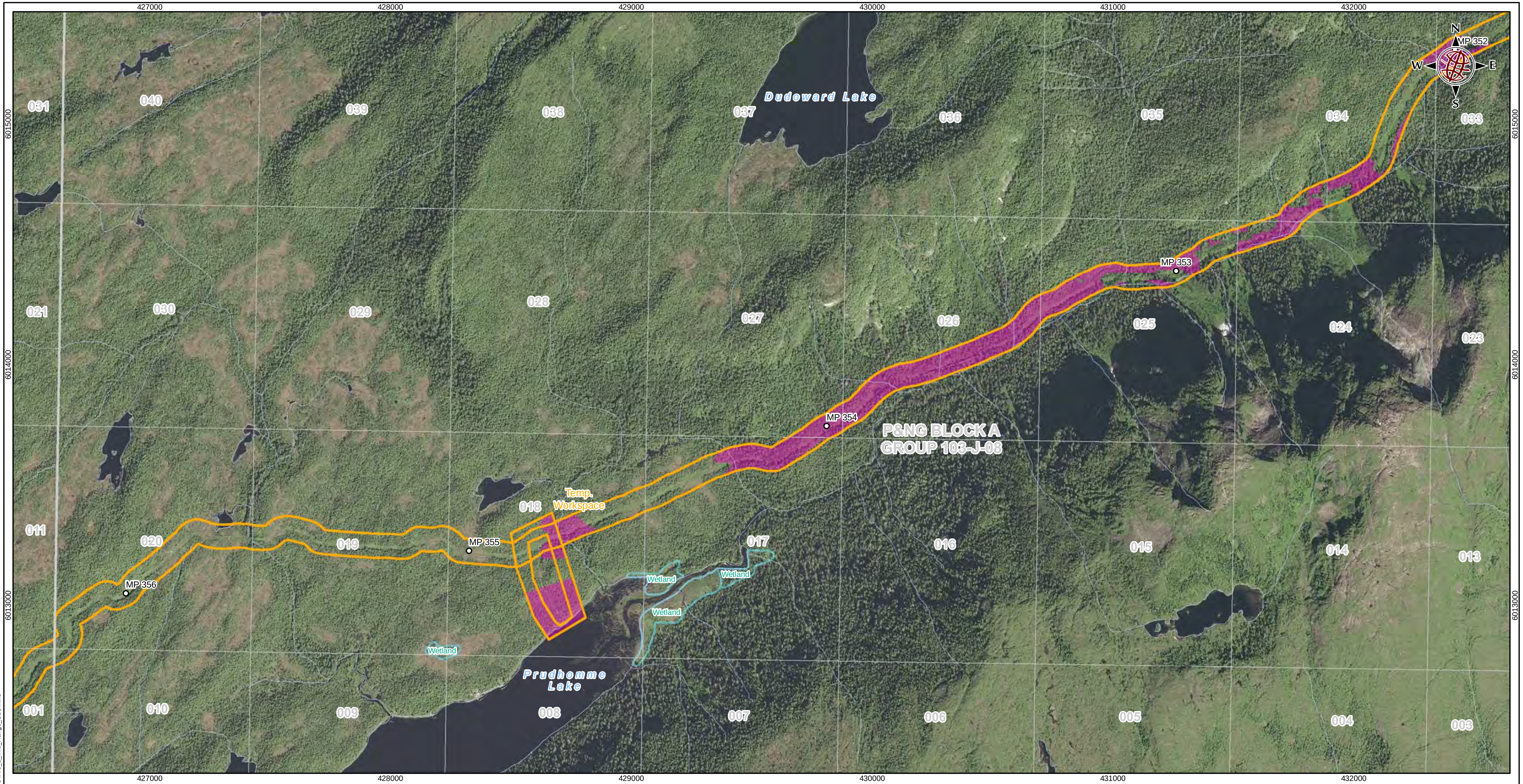

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LEGEND

- Historic Mile Post
- Salvus to Galloway Route 50 m Buffer
- Wetland
- Waterbody
- Watercourse
- Archaeological Potential

REFERENCES

Previously recorded Archaeological Sites obtained from RAAD (09/05/2019).
Projection: NAD 1983 UTM Zone 9N

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Archaeological Overview Assessment
SALVUS TO GALLOWAY ROUTE

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Date:	Sep 27, 2019
Revision:	R0
Map ID:	N/A

FIGURE 2-13

ROYNORTHERN
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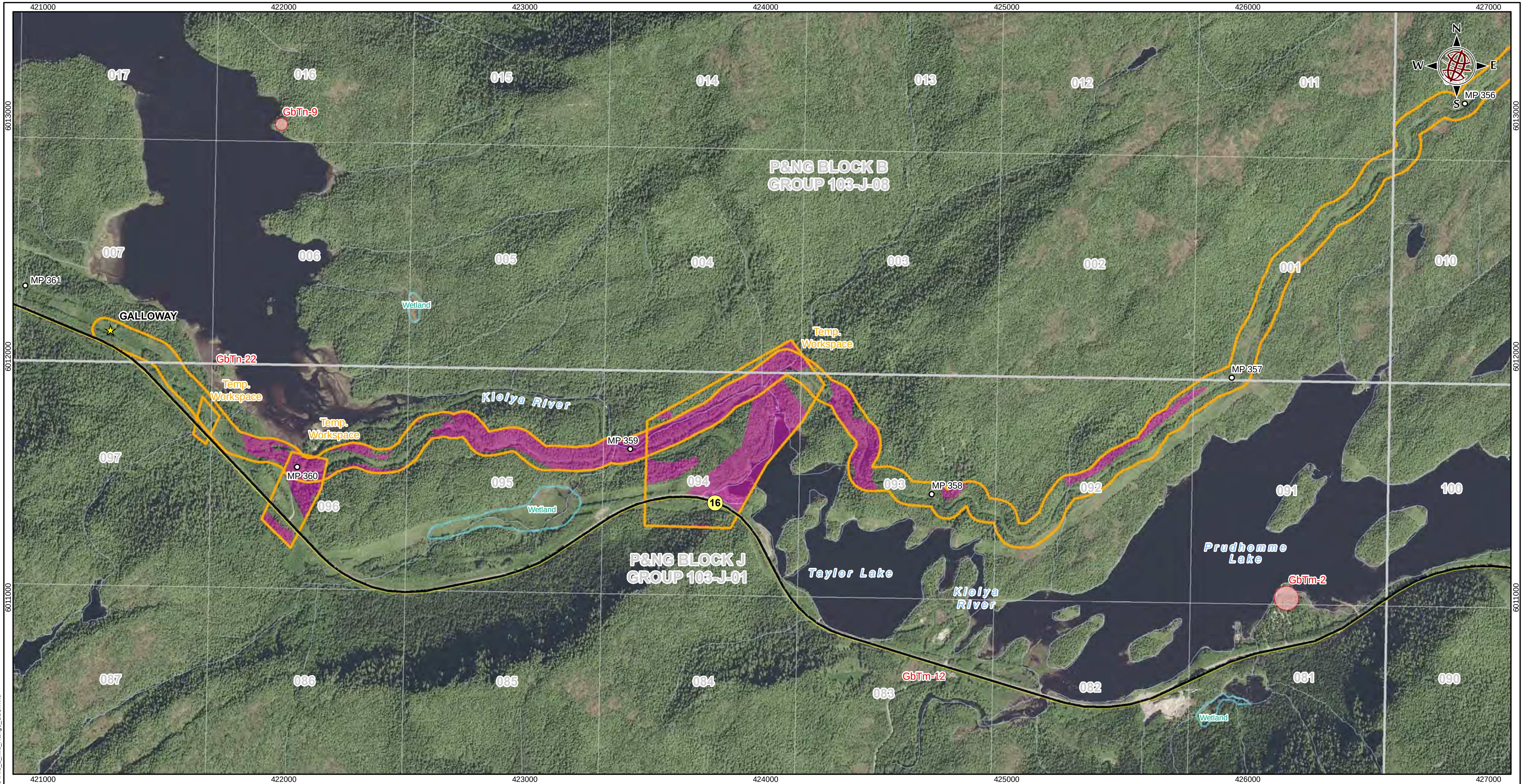
(250) 261-6644



LEGEND

- Historic Mile Post
- Salvus to Galloway Route 50 m Buffer
- Archaeology Site Boundary
- Wetland
- Waterbody
- Watercourse
- Highway
- Archaeological Potential

REFERENCES

Previously recorded Archaeological Sites obtained from RAAD (09/05/2019).
Projection: NAD 1983 UTM Zone 9N

PACIFIC NORTHERN GAS LTD.

Archaeological Overview Assessment
SALVUS TO GALLOWAY ROUTE

0 200 400 800 m
Scale: 1:15,000

GIS:	JH
Date:	Sep 27, 2019
Revision:	R0
Map ID:	N/A

FIGURE 2-14

ROYNORTHERN Land and Environmental
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Fort St. John, BC
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Appendix B – Chance Find Procedure

Archaeological Chance Find Procedure

If personnel involved in brushing, clearing, digging or any activities which disturb the surface and subsurface of the ground within the project area believe they have encountered any potential culturally modified trees, archaeological materials, heritage resources, features or human remains they MUST STOP WORK in the area and follow the procedures below:

1. STOP all brushing, clearing, drilling, digging or general surface and subsurface disturbance activities in the vicinity of the archaeological find immediately.

2. Contact your site foreman or supervisor right away. If a qualified archaeologist, or First Nation representative are on-site monitoring construction, contact them as well. Please see the attached Call-Down List.

3. Accurately record the location(s) of the find, using a GPS or smart phone if available, and have your site supervisor take photographs of the find (include a glove, hard hat or other object as a scale reference). Leave all archaeological materials and remains in place. If possible, flag the location or object.

4. If a qualified archaeologist is not on-site, contact a qualified archaeologist immediately. Please see the attached Call-Down List.

5. A qualified archaeologist will determine if the finds are archaeological in nature. Work may resume if it is determined the finds are not of cultural importance.

6. If the finds are of possible archaeological significance, instructions for modifying work practices to avoid damage to the finds will be provided. Personnel may be asked to use flagging tape to clearly mark the location and cordon off a buffer in accordance with the Archaeology Branch best practices.

7. If necessary other mitigative options will be developed by a qualified archaeologist in conjunction with the Client and relevant First Nations.

8. If human remains are found contact a qualified archaeologist, RCMP and/ local Corner's Office, and First Nations immediately (Archaeology Branch 1999). Please see the attached Call-Down List.

9. If the coroner assesses the remains to be archaeological, and not of forensic concern, a qualified archaeologist, the Client and First Nations will be consulted to determine how to handle them further. Options may include avoidance or respectful removal, and reburial to be determined by First Nations. If the remains are found to be of forensic concern, the Coroner and RCMP will investigate.

10. While working stay in the designated and approved Project Area. The Client and/or associated contractors will not access bounded areas of archaeological or heritage concern without first consulting with First Nations, and a qualified archaeologist.

Call Down List

Entity	Contact	Role	Number	Email
PNG	Doug McRae	Lands and Regulatory	250-638-5336	domcrae@png.ca
PNG	Dave Burton	Construction Manager	250-635-0382 (cell) 250-638-5326 (desk)	dburton@png.ca
PNG	Chad Fournier	Manager Engineering	250-631-2707 (cell) 250-638-6143 (desk)	cfournier@png.ca
Roy Northern	Stephan Girard	Senior Archaeologist	250-615-7916 (cell); 250-635-6973 (desk)	stephan@roynorthernbc.com
Terrace RCMP	-	-	250-638-7400	-
Regional Coroner (Northern Region)	Donita Kuzma	Coroner	250-565-6040	-
First Nations	*TBD — Appropriate First Nations will be determined and contacted by the PNG contact managing the project*			

For more information regarding culturally modified trees, archaeological materials, and site types, **please see the Roy Northern's** extended version of the Chance Find Procedure for Pacific Northern Gas Ltd..

ROYNORTHERN
Land and Environmental

January 1, 2020

Pacific Northern Gas Ltd.
2900 Kerr Street
Terrace, AB
V8G 4L9

Roy Northern File #: C190954

RE: Addendum to Non-Permit Desktop Archaeological Review, PNG Salvus to Galloway Route dated September 27, 2019

To Whom it May Concern:

Following the completion of the above captioned report, it came to our attention that Roy Northern had missed an influential key piece of information about the Khyex River to Work Channel portion of PNG's Salvus to Galloway route. A document cultural trail, known as the Work Channel Trail, began at the Khyex River near the mouth of the Skeena and followed Antigonish Creek/Lachmach River up to the small village at the mouth of Work Channel[1,2].

Given this, the entire Salvus to Galloway route between the Khyex River and Work Channel has been reclassified as having archaeological potential and fieldwork is recommended prior to any Project works occurring within this stretch of the route. Revised maps depicting the reclassified archaeological potential along this portion of the route are attached and are meant to supersede Figures 2-9 through 2-12 found in the original AOA report.

Please contact the undersigned at 250-615-7916 if you have any questions or concerns.

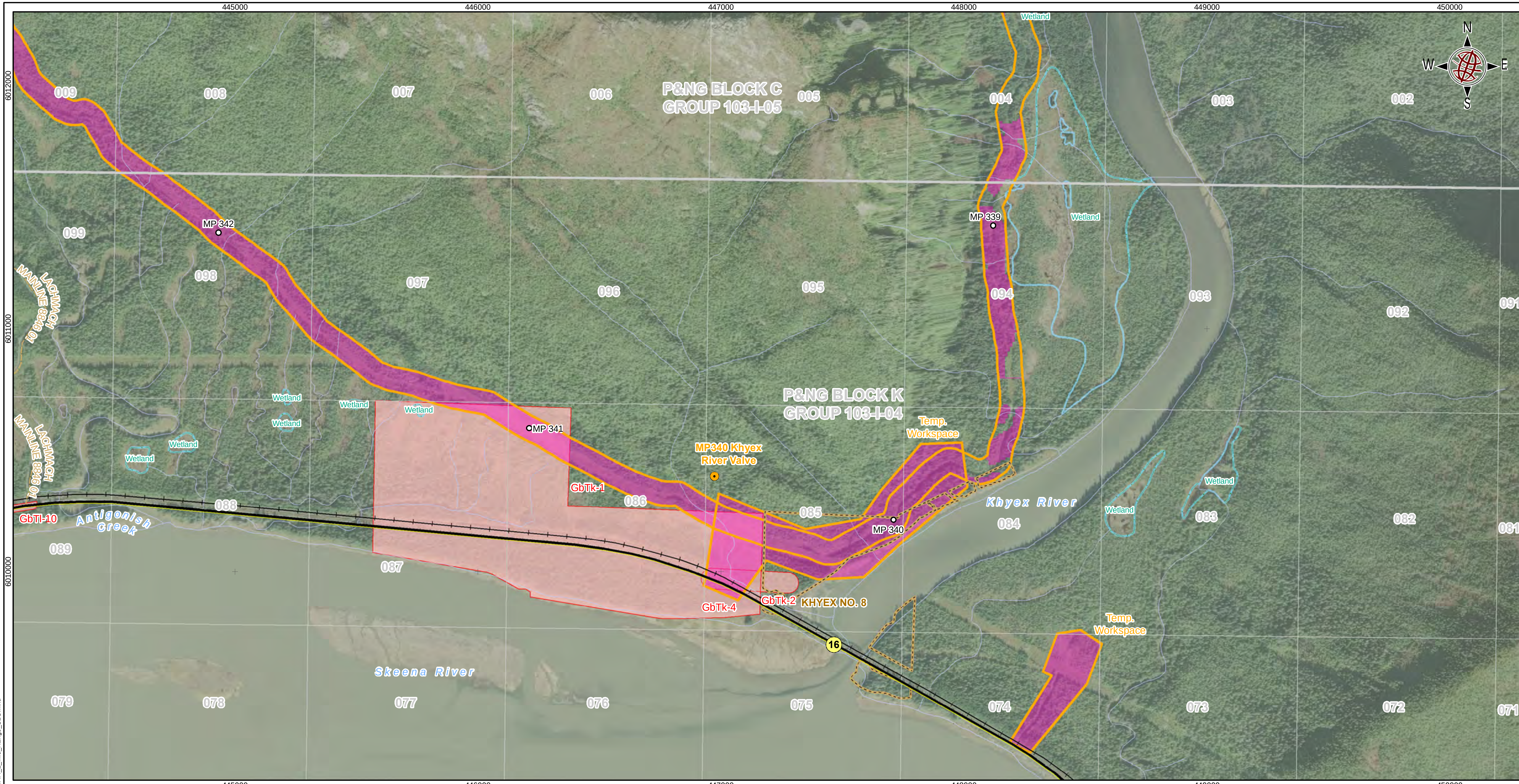
Prepared by:

Stephan Girard, M.A., RPCA
Senior Archaeologist

Attachments: Revised Figures 2-9 through 2-12

[1] Golder Associates. 2015. Archaeological Impact Assessment for the Northwest Transmission Line Project, Heritage Inspection Permits 2007-0200 and 2007-0258. Report on file with the Archaeology Branch.

[2] Prince, Paul. 1996. Report on the 1995 Archaeological Survey in the Kitwanga Valley, Conducted under Permit Number 1995-147. Report on file with the Archaeology Branch.



LEGEND

- Historic Mile Post
- Block Valve Location
- Salvus to Galloway Route 50 m Buffer
- First Nations Reserve
- Archaeology Site Boundary
- Wetland
- Waterbody
- Watercourse
- Highway
- Forestry Road
- Main Railway
- Archaeological Potential

REFERENCES

Previously recorded Archaeological Sites obtained from RAAD (09/05/2019).
Projection: NAD 1983 UTM Zone 9N

Path: X:\BC_Projects\Pacific_Northern_Gas\2019\190954\mxd\190954AI4_2_Mid_Range_S2G.mxd

PACIFIC NORTHERN GAS LTD.

Archaeological Overview Assessment
SALVUS TO GALLOWAY ROUTE

0 200 400 800 m
Scale: 1:15,000

GIS:	JH
Date:	Aug 13, 2020
Revision:	R0
Map ID:	N/A

FIGURE 2-9

ROYNORTHERN
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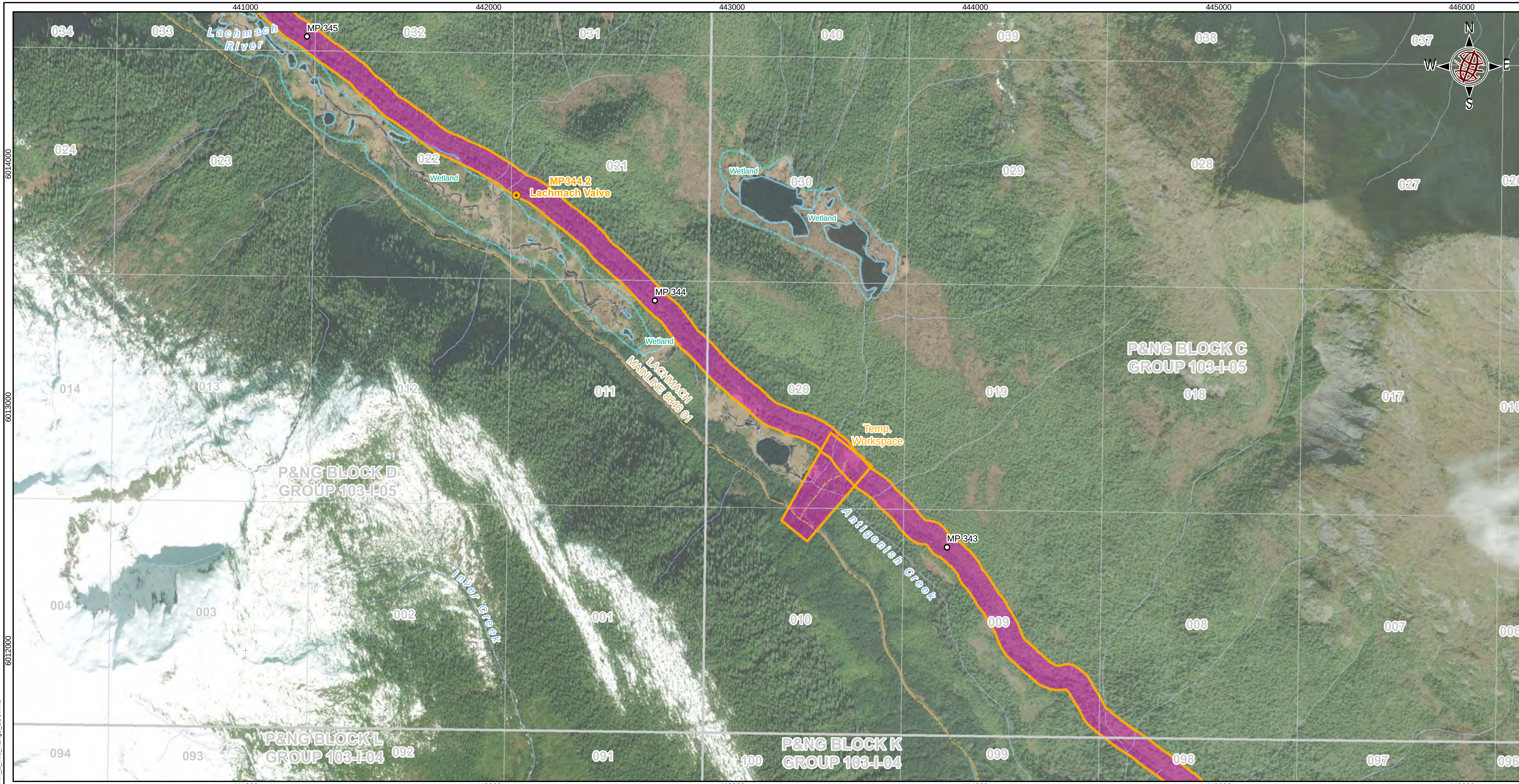
(250) 261-6644



LEGEND

- Historic Mile Post
- Block Valve Location
- Salvus to Galloway Route 50 m Buffer
- Wetland
- Waterbody
- Watercourse
- Forestry Road
- Archaeological Potential

REFERENCES

Previously recorded Archaeological Sites obtained from RAAD (09/05/2019).
Projection: NAD 1983 UTM Zone 9N

Path: X:\BC_Projects\Pacific_Northern_Gas\2019\190954\mxd\190954AI4_2_Mid_Range_S2G.mxd

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Archaeological Overview Assessment
SALVUS TO GALLOWAY ROUTE

0 200 400 800 m
Scale: 1:15,000

GIS:	JH
Date:	Aug 13, 2020
Revision:	R0
Map ID:	N/A

FIGURE 2-10

ROYNORTHERN Land and Environmental
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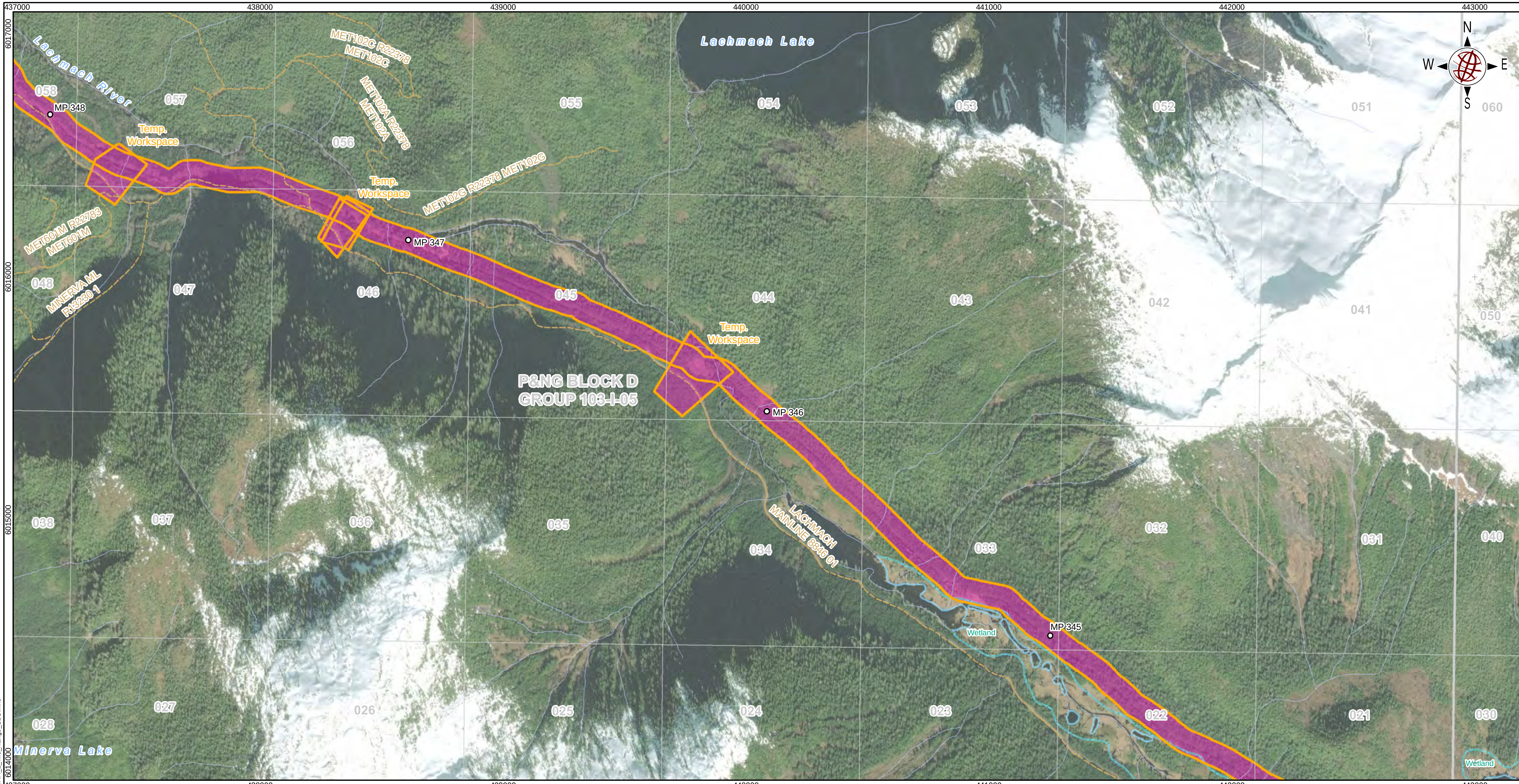

LEGEND

- Historic Mile Post
- Salvus to Galloway Route 50 m Buffer
- Wetland
- Waterbody
- Watercourse
- Forestry Road
- Archaeological Potential

REFERENCES

Previously recorded Archaeological Sites obtained from RAAD (09/05/2019).
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Archaeological Overview Assessment
SALVUS TO GALLOWAY ROUTE

0 200 400 800 m
Scale: 1:15,000

GIS: JH
Date: Aug 13, 2020
Revision: R0
Map ID: N/A

FIGURE 2-11

ROYNORTHERN Land and Environmental
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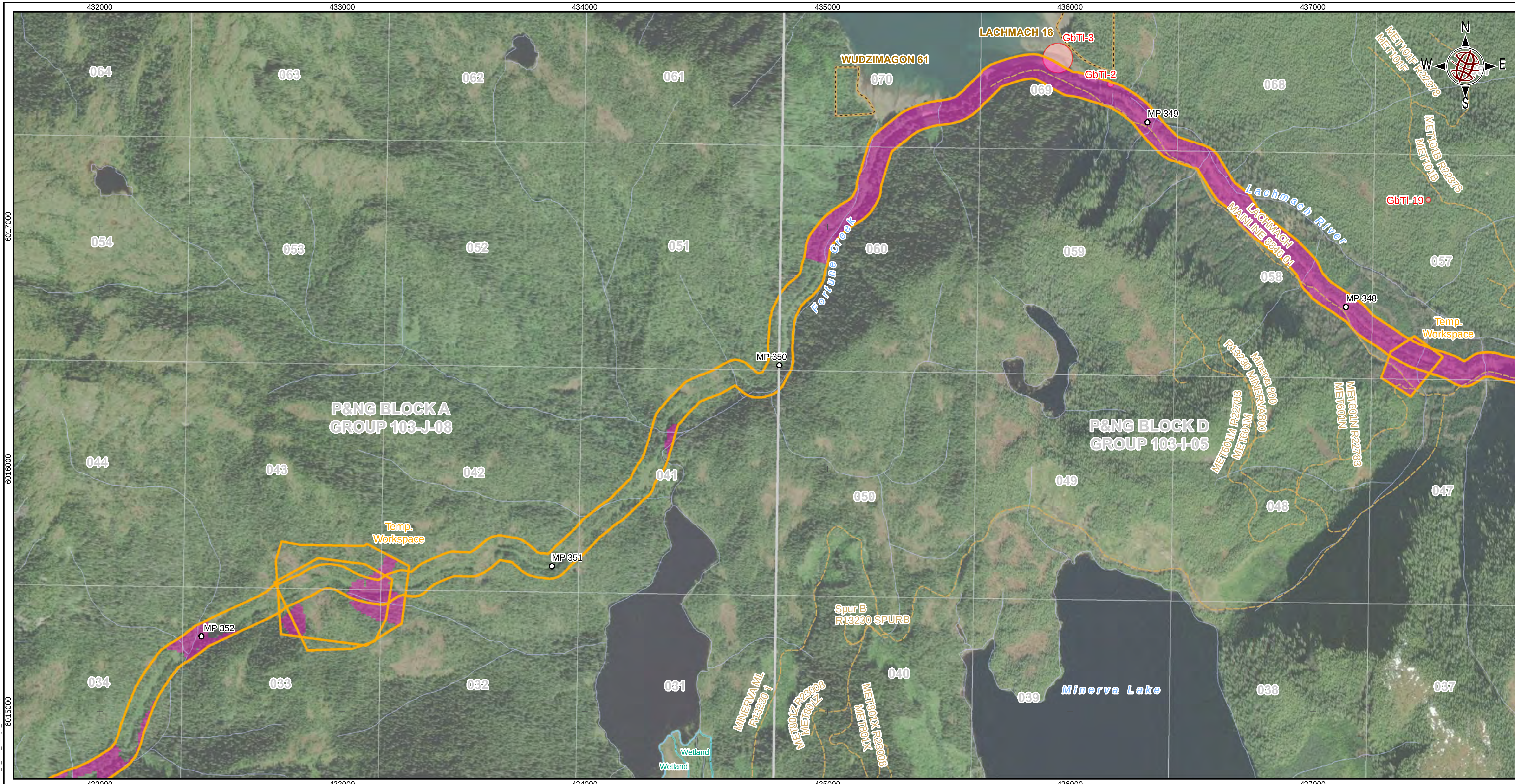

LEGEND

- Historic Mile Post
- Salvus to Galloway Route 50 m Buffer
- First Nations Reserve
- Archaeology Site Boundary
- Wetland
- Waterbody
- Watercourse
- Forestry Road
- Archaeological Potential

REFERENCES

Previously recorded Archaeological Sites obtained from RAAD (09/05/2019).
Projection: NAD 1983 UTM Zone 9N

Path: X:\BC_Projects\Pacific_Northern_Gas\2019\190954\mxd\190954AI4_2_Mid_Range_S2G.mxd

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PACIFIC NORTHERN GAS LTD.

Archaeological Overview Assessment
SALVUS TO GALLOWAY ROUTE

0 200 400 800 m
Scale: 1:15,000

GIS:	JH
Date:	Aug 13, 2020
Revision:	R0
Map ID:	N/A

FIGURE 2-12

ROYNORTHERN Land and Environmental
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Fort St. John, BC
V1J 3Y6
(250) 261-6644

Appendix Q – Roy Northern - Preliminary Field Reconnaissance

DEVELOPMENT INFORMATION		
Proponent: Lauren Services	**OGC File AD No.:** N/A	**Construction Section:** N/A
Client Contact: Graham Pavlik, P.Eng. (graham.pavlik@laurenservices.com) 1000 – 700 Pender Street West, Vancouver, BC, V6C 1G8 Tel: (604) 602-2964		
Development Type: Pipeline, Workspaces, Access	**Development Schedule:** 2019-2023 (Remediation)	

MANAGEMENT SUMMARY	
Reconnaissance Areas: Kasiks, Khyex, Lachmach, and Galloway Study Areas associated with Proposed 2019 Works	
Number of Areas of Potential: 7	**Number of Subsurface Tests:** 0
Number of Pre-AD 1846 CMTs: 4	**Number of Post-AD 1846 CMTs:** 1
Protected Heritage Sites: 2	**Borden Number:** 190954-01, 190954-02 (temporary site numbers)
Heritage Site Type(s): Traditional Use, Culturally Modified Tree	**Non-protected Heritage Sites:** 1 historical blaze, 1 historical plank removal CMT

Discussion

At the request of Lauren Services (Lauren), Roy Northern Environmental Ltd. (Roy Northern) conducted a Preliminary Field Reconnaissance (PFR) of select Study Areas of Pacific Northern Gas Ltd.'s (PNG's) Salvus to Galloway (S2G) pipeline right-of-way in order to identify archaeological constraints (the Project). The PFR was conducted between October 22-25, 2019 and included four general Study Areas: Kasiks, Khyex, Lachmach, and Galloway.

For the Kasiks Study Area, four Areas of Archaeological Potential were identified:

AOP 1 is situated on a terrace overlooking a back channel of the Skeena River. The AOP measures 160 m (northeast- southwest) by 50 m (northwest-southeast).

AOP 2 is situated on a terrace overlooking a back channel to Skeena River. The AOP measures 250 m (northeast-southwest) by 50 m (northwest-southeast).

AOP 3 is situated on a terrace overlooking a back channel to Skeena River. The AOP measures 520 m (northeast-southwest) by 50 m (northwest-southeast).

AOP 4 is situated on a terrace overlooking a confluence of a Kasiks River and a back channel to Skeena River. The AOP measures 170 m (northeast-southwest) x 40 m (northwest-southeast).

For the Khyex Study Area, one archaeological site, two AOPs, and one historical CMT were identified:

Archaeological site **190954-02** consists of three pre-AD 1846 CMTs: two taper bark-stripped western redcedars, and one western redcedar with two blaze features and one undercut feature.

AOP 5 is situated on a level terrace overlooking a confluence of the Khyex River and a tributary stream to the southwest. The AOP measures 190 m (northeast-southwest) x 40 m (northwest-southeast).

AOP 6 is situated on a level terrace overlooking a confluence of the Khyex River and a tributary stream to the northeast. The AOP measures 120 m (northeast-southwest) x 70 m (northwest-southeast).

A historical CMT, consisting a saw-cut plank removal scar on large western redcedar, was observed near archaeological site **190954-02**.

Three modern trap boxes were also observed along the edges of the Khyex Study Area.

For the Lachmach Study Area, one AOP was identified:

AOP 7 is situated on a level bench overlooking the confluence of Antigonish Creek and wetlands to the south and west. The AOP measures 60 m (northeast-southwest) by 30 m (northwest-southeast).

A historical blazed tree was observed ~ 940 m northwest of MP344.

For the Galloway Study Area, one archaeological site was identified:

Archaeological site **190954-01**, consists of one pre-AD 1846 CMT: a lying dead (historically logged) western redcedar and associated stump with a large rectangular bark stripped scar.

All pre and post AD-1846 CMTs were flagged with Roy Northern 'Culturally Modified Tree' flagging and AOP 7 was flagged with Roy Northern 'No Work Zone' flagging.

The remaining portions of the Study Areas have low archaeological potential for CMTs, surface features, and subsurface archaeological sites due to an absence of observed modifications on trees, surface features, and level, well-defined, and well-drained landforms.

Recommendations

For the Kasiks Study Area, in which four areas of subsurface archaeological potential were identified, Roy Northern recommends:

- Concurrent archaeological construction monitoring under a Section 14 Heritage Conservation Act (HCA) Heritage Inspection Permit for all Project-related activities within AOPs that overlap with disturbed portions of the pipeline right-of-way;
- Avoid AOPs identified outside of the disturbed portion of the existing pipeline right-of-way or conduct subsurface testing under a Section 14 HCA Heritage Inspection Permit is required prior to all Project-related activities; and,
- No further archaeological work outside of these four AOPs though a Chance Find Procedure should be in place prior to the commencement of Project-related activities and utilized, as required, throughout the life of the Project.

For the Khyex Study Area, in which two AOPs, one archaeological site (190954-02), one historical site (CMT), and three trap boxes were identified, Roy Northern recommends:

- Avoid AOPs identified outside of the disturbed portion of the existing pipeline right-of-way or conduct subsurface testing under a Section 14 HCA Heritage Inspection Permit is required prior to all Project-related activities;
- Avoid the portion of the archaeological site 190954-02 that lies outside of the disturbed portion of the existing pipeline right-of-way or, if avoidance is not possible:
    - record CMTs K1 through 3 to Level II standards, and
    - acquire a Section 12.4 HCA Site Alteration Permit to allow for alterations to the site area.
- Avoid the historical CMT or record the CMT to Level II standards;
- In accordance with Metlakatla First Nation's CMT Policy, all CMTs must be protected and preserved regardless of age or type, whenever possible. If impacts to a CMT cannot be avoided, it is recommended that PNG consult with Metlakatla First Nation and other Nations with territorial overlap prior to the commencement of Project-related activities;
- Determine who owns or uses the trapline along the northwest bank of the Khyex River and consult with them regarding the Project; and,
- No further archaeological work outside of these two AOPs, one archaeological site, and one historical site, though a Chance Find Procedure should be in place prior to the commencement of Project-related activities and utilized, as required, throughout the life of the Project.

For the Lachmach Study Area, in which one AOP was identified, Roy Northern recommends:

- Avoid AOP 7 by shifting the proposed access trail or road to the southeast beyond Roy Northern's "No Work Zone" flagging or conduct subsurface testing under a Section 14 HCA Heritage Inspection Permit is required prior to all Project-related activities; and,
- No further archaeological work outside of this AOP, though a Chance Find Procedure should be in place prior to the commencement of Project-related activities and utilized, as required, throughout the life of the Project.

For the Galloway Study Area, in which one archaeological site (190954-01) was identified, Roy Northern recommends:

- Avoid the portion of the archaeological site 190954-01 that lies outside of the disturbed portion of the existing pipeline right-of-way or, if avoidance is not possible,
  - record CMT G1 to Level II standards;
  - In accordance with Metlakatla First Nation's CMT Policy, all CMTs must be protected and preserved regardless of age or type, whenever possible. If impacts to a CMT cannot be avoided, it is recommended that PNG consult with Metlakatla First Nation and other Nations with territorial overlap prior to Project-related activities; and,
  - acquire a Section 12.4 HCA Site Alteration Permit to allow for alterations to the site area.
- No further archaeological work outside of this archaeological site, though a Chance Find Procedure should be in place prior to the commencement of Project-related activities and utilized, as required, throughout the life of the Project.

Additional fieldwork may be necessary if the Project is revised to include areas that have not been assessed. All archaeological remains, whether recorded or unidentified, are protected by legislation and may not be altered, damaged, moved, excavated in, or disturbed in any way without a permit issued under either Section 12.4 or 14 of the HCA. The Archaeology Branch of BC should be notified immediately if any archaeological remains are accidently disturbed.

<table>
<tr><th colspan="2">FIELD WORK SUMMARY</th></tr>
<tr><td>HCA Permit: N/A</td><td>Permit Holder: N/A</td></tr>
<tr><td colspan="2">Archaeology Branch Project Officer: N/A</td></tr>
<tr><td colspan="2">Assessment Methods:
Prior to fieldwork, development maps, orthophotos, topographic data, the BC Provincial Heritage Register, iMap, and stand age maps were subject to a desktop assessment to determine the need for, and scope of additional archaeological assessment. The results of this assessment are discussed in detail in Roy Northern's AOA for PNG Salvus to Galloway's 2019 Works[1].

Fieldwork consisted of pedestrian field reconnaissance by two to three crew members spaced at 15-20 m intervals with forest visibility to 10-30 m. Trees were inspected for cultural modification and the ground surface was inspected for surface artifacts and features. Landforms with archaeological potential, such as terraces, benches, and level high points, were sought. All pre and post-1846 CMTs were recorded to Level I standards[2] and flagged with Roy Northern's 'Culturally Modified Tree' flagging. All AOPs were recorded but most were not flagged due to size; however, one AOP – AOP 7 – was flagged with Roy Northern 'No Work Zone' flagging due to its small size and proximity to the Project.</td></tr>
<tr><td>Field Director: Stephan Girard (Roy Northern)</td><td>Field Supervisor: N/A</td></tr>
<tr><td colspan="2">Field Crew: Kara Weeber (Roy Northern)</td></tr>
</table>

[1] *Non-Permit Desktop Archaeological Review, PNG Salvus to Galloway 2019 Works, Roy Northern Environmental, 2019, On File with Lauren Services.*

[2] *Archaeology Branch, Bulletin 27: Cultural Modified Trees Guidelines. Issued March 21, 2017. On file with the Archaeology Branch.*

Art Yeomans (Kitsumkalum First Nation; October 23rd only)	
Survey Date(s): October 22-25, 2019	
First Nation Communication and Involvement: Gitga'at First Nation, Gitxaala Nation, Kitselas First Nation, Kitsumkalum First Nation, Lax Kw'alaams Band, and Metlakatla First Nation were notified of the PFR during pre-field planning. Kitsumkalum First Nation provided a cultural monitor for work conducted on October 23rd.	

BACKGROUND: KASIKS STUDY AREA	
General Location: The Kasiks Study Area is located ~55.5 km southwest of Terrace, BC, ~55.9 km northwest of Kitimat, and 58.6 km east of Prince Rupert (Figures 1-1 and 2-1).	
UTM: 9U E474095 N6018616 (MP 313)	**NTS Mapsheet(s):** 103I/06
Review of Archaeological Potential: Based on the desktop review, the Kasiks Study Area has high potential for pre-AD 1846 CMTs as well as surface and subsurface archaeological materials due to tree stand age, partial overlap with the Kasika 72 Reserve, and proximity to both the Kasiks River and Skeena River.	
Registered Heritage Sites: No archaeological sites have been recorded within 500 m of the Kasiks Study Area.	
Anticipated Impacts: The project will be completed over an extended amount of time and throughout the project, there will be activities which will require work to be performed manually and by machinery. These activities include, but are not limited to brushing/clearing of PNG's existing permanent ROW, pipeline maintenance work, installing temporary and/or permanent accesses for construction equipment and personnel, developing borrow sites for construction materials, developing spoil sites for storage of removed materials, and development of stockpile, staging, and work areas. Some of these activities will also include ground disturbances (both with machinery and manual excavations). All work will be kept within existing disturbances as much as possible. Notifications of planned commencement dates will be provided prior to the commencement of activities.	

RESULTS: KASIKS STUDY AREA

Component Description:

The Kasiks Study Area is broken down into three separate segments: the eastern, central, and western Kaisiks Study Area segments.

Terrain within the Kasiks Study Area is continually gently to strongly sloping (5-30˚), with a northwest to southeast aspect and poorly defined breaks in slope (Figure 2-1). The soils are generally poorly to imperfectly drained. The terrain levels out within the eastern Study Area, in the area surrounding the Skeena River backchannels. Elevated river terraces overlooking these backchannels are present throughout the Area. These terraces contain moderately well to well-drained soils.

Many streams bisect the Study Area, running from northeast to southwest or from high elevation mountainside to low elevation valley bottom. All are freshet streams with poorly defined banks flanked by moderately sloping, rocky terrain (Photo 1). Two large Skeena River backchannels also bisect the Study Area.

Vegetation varied across the Study Area though this variation was along the fringes of the disturbed portion of the existing pipeline right-of-way as the disturbed right-of-way is only vegetated by a dense understory of dogwood and alder with a ground cover of grass. In the eastern Study Area segment, an old growth forest of Sitka spruce, western hemlock, and balsam fir with a ground cover of moss is present within the Kasika 72 Reserve area. The forest between the backchannels through to the eastern end of the Area consists of moderate-aged poplar with an understory of dogwood, rose, thimbleberry, and devil's club, and a ground cover of ferns

In the central Study Area segment, a mixed age forest containing western hemlock and balsam fir with an understory of huckleberry and a ground cover of moss, and ferns was observed (Photo 2). Poplar appears and becomes more prevalent in the eastern portion of this Area.

Flanking the disturbed right-of-way in the western Study Area segment is an old growth forest of western hemlock and balsam fir with a dense understory of rose, devil's club, huckleberry, and thimbleberry, and a ground cover of moss.
Surface visibility was poor within the disturbed portion of the existing pipeline right-of-way due to thick understory vegetation but was good to excellent within the forest flanking the sides of the right-of-way due to sparse understory vegetation.

Disturbances observed within the Study Area include the cleared, mulched/de-stumped, and excavated pipeline right-of-way; and selective logging, as evidenced by the presence of isolated saw cut stumps along the edges of the disturbed portion of the existing pipeline right-of-way throughout the central Study Area segment and the Kasika 72 Reserve area of the eastern Study Area segment.

Observed Archaeological Potential Assessment: A total of four landforms with subsurface potential (AOPs 1-4) were observed during the PFR (Figure 2-1, Photos 3-5).

- **AOP 1** is located within the Kasiks Study Area and is situated on a terrace overlooking a back channel to Skeena River. The AOP measures 160 m (northeast-southwest) by 50 m (northwest-southeast) (Photo 3).
- **AOP 2** is located within the Kasiks Study Area and is situated on a terrace overlooking a back channel to Skeena River. The AOP measures 250 m (northeast-southwest) by 50 m (northwest-southeast) (Photo 4).
- **AOP 3** is located within the Kasiks Study Area and is situated on a terrace overlooking a back channel to Skeena River. The AOP measures 520 m (northeast-southwest) by 50 m (northwest-southeast).
- **AOP 4** is located within the Kasiks Study Area and is situated on a terrace overlooking a confluence of a Kasiks River and a back channel to Skeena River. The AOP measures 170 m (northeast-southwest) x 40 m (northwest-southeast) (Photo 5).

The remainder of the Kasiks Study Area has low archaeological potential for CMTs, surface features, and subsurface archaeological sites due to an absence of observed modifications on trees, surface features, and level, well-defined, well-drained landforms.

BACKGROUND: KHYEX STUDY AREA

General Location: The Khyex Study Area is located ~34.4 km southeast of Prince Rupert, ~77.8 km northwest of Kitimat, and 82.3 km southwest of Terrace (Figure 1-2 and 2-2).

UTM: E 447702 N 6010207 9N (MP 340)	**NTS Mapsheet(s):** 103I/05

Review of Archaeological Potential: Based on the desktop review, the Khyex Study Area has high potential for pre-AD 1846 CMTs as well as surface and subsurface archaeological materials due to tree stand age, proximity to both Khyex River and Skeena River, partial overlap with the Khyex 8 Reserve, and proximity to previously-identified archaeological sites.

Registered Heritage Sites: There are three archaeological sites within 500 m of the Khyex Study Area:

- GbTk-1 – Khyex City, Skeena City, Aberdeen Cannery.
- GbTk-2 – Four western redcedar CMTs.
- GbTk-4 – Surface lithic scatter

Anticipated Impacts: The project will be completed over an extended amount of time and throughout the project, there will be activities which will require work to be performed manually and by machinery. These activities include, but are not limited to brushing/clearing of PNG's existing permanent ROW, pipeline maintenance work, installing temporary and/or permanent accesses for construction equipment and personnel, developing borrow sites for construction materials, developing spoil sites for storage of removed materials, and development of stockpile, staging, and work areas. Some of these activities will also include ground disturbances (both with machinery and manual excavations). All work will be kept within existing disturbances as much as possible. Notifications of planned commencement dates will be provided prior to the commencement of activities.

RESULTS: KHYEX STUDY AREA
Component Description: Terrain within the Khyex Study Area is continuously sloping though the degree of slope is variable across the Area. The western portion of the Area is gently sloping (5-10 degrees) to the southeast, transitioning into more moderately sloping terrain (10-20 degrees) with a northeastern aspect in the central portion of the Area. The eastern portion of the Area is also moderately sloping (20-30 degrees) with a southeast aspect before levelling out towards the eastern end of the Area (Figure 2-2, Photo 6). Most of the terrain in the western, central, and eastern portions of the Area contains poorly to imperfectly drained soils. Elevated, level, river terraces were observed along the southeastern edge of the disturbed portion of the existing pipeline right-of-way within the central portion of the Study Area. These terraces contain moderately well to well-drained soils One stream, an unnamed tributary to the Khyex River, runs northwest-southeast through the central portion of the Study Area. Level terrace landforms flank the side of the confluence of the stream with the Khyex River. Vegetation varied across the Study Area though this variation was along the fringes of the disturbed portion of the existing pipeline right-of-way as the disturbed right-of-way is only vegetated by dense understory and ground vegetation including huckleberry, dogwood, skunk cabbage, bunchberry, cranberry, ferns, grasses, and moss. The western portion of the disturbed right-of-way is flanked to the north by a moderate-aged regeneration stand of western redcedar, western hemlock, and balsam fir with an understory of huckleberry and a ground cover of moss; to the south it is flanked by the same bushes and ground cover that exists within the disturbed portion of the pipeline right-of-way as there is a maintained BC Hydro powerline right-of-way. In the central portion of the Study Area, the disturbed portion of the pipeline right-of-way is flanked to the south and east by an old growth western redcedar and western hemlock forest with an understory of sparse huckleberry and a ground cover of moss. The moderate-aged regeneration forest continues to flank the disturbed portion of the pipeline right-of-way to the north and west within the central portion, and flanks both sides of the disturbed right-of-way across all of the eastern portion of the Study Area. Surface visibility was poor within the disturbed portion of the existing pipeline right-of-way due to thick understory vegetation but was good to excellent within the forest flanking the sides of the right-of-way due to sparse understory vegetation. Disturbances observed within the Study Area include the cleared, mulched/de-stumped, and excavated pipeline right-of-way, the cleared, mulched/de-stumped BC Hydro powerline right-of-way that parallels the pipeline right-of-way within the western portion of the Area; and historical logging, as evidenced by the presence of moderate-aged regeneration forests containing remnant saw cut stumps with springboard notches.

Observed Archaeological Potential Assessment: A total of three suspected pre-AD 1846 (Archaeological Site Temporary Number 190954-02, Photo 7), one historical CMT[3] (Photo 8), and three trap boxes (Photo 9) were identified. All are discussed in greater detail below.

Two landforms with subsurface archaeological potential (AOPs 5-6) were observed during the PFR (Figure 2-2, Photo 10).

- **AOP 5** is located within the Khyex Study Area and is situated on a level terrace overlooking a confluence of the Khyex River and a tributary stream to the southwest. The AOP measures 190 m (northeast-southwest) x 40 m (northwest-southeast).
- **AOP 6** is located within the Khyex Study Area and is situated on a level terrace overlooking a confluence of the Khyex River and a tributary stream to the northeast. The AOP measures 120 m (northeast-southwest) x 70 m (northwest-southeast).

The remainder of the Khyex Study Area has low archaeological potential for CMTs, surface features, and subsurface archaeological sites due to an absence of observed modifications on trees, surface features, and level, well-defined, and well-drained landforms.

ARCHAEOLOGICAL SITE INFORMATION: TEMPORARY NUMBER 190954-02		
Borden Number: TBD	**Temporary Number:** 190954-02	
Site Type: Traditional Use, Culturally Modified Tree		
UTM Zone: 9U **Easting:** 447587 **Northing:** 6010109 (CMT K2)	**NTS Mapsheet:** 103I/05	**Approximate Dimensions:** 37 m NW-SE by 44 m NE-SW (measured to the maximum length and width form the outer edges of the 10 m buffers applied to individual CMTs)
Location and Setting: The site is located on the northwest coast of British Columbia, ~31.9 km east of Port Edward, ~34.8 km east-southeast of Prince Rupert, and ~40 m northwest of Khyex River.		
Culturally Modified Trees Summary: Site consists of three CMTs, including two taper bark-stripped trees (CMTs K1 and K3), and one tree with two blaze features and one undercut feature (CMT K2) (Figure 3-1, Photo 7), All three are western redcedar. Metal axe marks are present on CMT K2 on one of the blaze features and the undercut. CMTs K1 and K3 were historically logged or stubbed as evidenced by the springboard notch on the side of K1 and the sawcut tops of the stumps. CMTs were recorded to Level I standards.		
Age Determination: Based on the tree stand age (141-250 years of age), large tree diameter, and thick healing lobes, Roy Northern concludes that the modifications likely predate AD 1846 and are therefore protected under the HCA.		
Site Boundary Determination: Each CMT has a 10 m buffer placed around it in accordance with Bulletin 27 – Culturally Modified Trees Guidelines[4], and the buffers have been merged, due to proximity, to create the site area.		
OTHER CULTURAL RESOURCES: KHYEX HISTORICAL CMT		
Location and Setting: The tree is located on the northwest coast of British Columbia, ~31.9 km east of Port Edward, ~34.8 km east-southeast of Prince Rupert, and ~40 m northwest of Khyex River. The modified tree is immediately southwest of Archaeological Site 190954-02.		

[3] A historical CMT is a post AD 1846 CMT.
[4] *Archaeology Branch, Bulletin 27: Culturally Modified Trees Guideline, Issued March 22, 2017. On file with the Archaeology Branch.*

Culturally Modified Trees Summary: One western redcedar CMT with a single feature – a sawcut, plank removal feature – was observed within the Khyex Study Area (Photo 8). Scaffolding or other means were used to make the top sawcuts. The CMT was recorded to Level I standards.
Age Determination: The modification is classified as post AD 1846 due to the saw cuts. As saws didn't come into general use until the 1950s or 60s, the modification has a maximum age of ~70 years. The tree is therefore not protected under the HCA.
OTHER CULTURAL RESOURCES: KHYEX TRAP BOXES
Location and Setting: The trap boxes are located on the northwest coast of British Columbia, ~31.9 km east of Port Edward, ~34.8 km east-southeast of Prince Rupert, and ~40 m northwest of Khyex River. One of the trap boxes is within Archaeological Site 190954-02 while others were observed along the forested banks of the Khyex River.
Trap Box Summary: Three trap boxes were observed within the central and eastern portions of the Khyex Study Area, within the old growth and moderate-aged regeneration forest along the southeast flank of the disturbed existing pipeline right-of-way. Additional trap boxes were observed in the old growth forest along the bank of the Khyex River, southwest of the Khyex Study Area during the hike out following the completion of the PFR. All trap boxes were observed on the sides of trees and are made of saw cut plywood held together with screws.
Age Determination: The plywood is in excellent condition suggesting that these boxes were put up within the past 5 years.

BACKGROUND: LACHMACH STUDY AREA	
General Location: The Lachmach Study Area is located ~25.7 km southeast of Prince Rupert, ~82.7 km west-northwest of Kitimat, and 2.5 km north of the Skeena River (Figures 1-2, 2-3, 2-4).	
UTM: E 442678 N 6013423 9N (MP 344)	**NTS Mapsheet(s):** 103I/05
Review of Archaeological Potential: Based on the desktop review, the Lachmach Study has high potential for pre-AD 1846 CMTs as well as surface and subsurface archaeological materials due to tree stand age and proximity to the Lachmach River, Antigonish Creek, and the large wetland complex between the two drainages.	
Registered Heritage Sites: No archaeological sites have been recorded within 500 m of the Lachmach Study Area.	
Anticipated Impacts: The project will be completed over an extended amount of time and throughout the project, there will be activities which will require work to be performed manually and by machinery. These activities include, but are not limited to brushing/clearing of PNG's existing permanent ROW, pipeline maintenance work, installing temporary and/or permanent accesses for construction equipment and personnel, developing borrow sites for construction materials, developing spoil sites for storage of removed materials, and development of stockpile, staging, and work areas. Some of these activities will also include ground disturbances (both with machinery and manual excavations). All work will be kept within existing disturbances as much as possible. Notifications of planned commencement dates will be provided prior to the commencement of activities.	
RESULTS: LACHMACH STUDY AREA	
Component Description: The Lachmach Study Area is broken down into two separate segments: the southeastern and northwestern Lachmach Study Area segments. Terrain within the southeastern Study Area segment is variable (Figure 2-3). The terrain along the south half of the western, central, and most of the eastern portion of the Area is level to gently sloping (0-5 degrees) with a	

southern aspect and contains poorly drained soils. The terrain on the north half of the western, central and much of the eastern portion of the Area is continuous side-slope with a moderate (20-35 degrees) grade, a southern aspect, and contains moderately well-drained soils (Photo 11).

The eastern end of the Area, from where the Area leaves the Lachmach Mainline to where it meets Antigonish Creek, is continuous side slope with a moderate (20-35 degrees) grade and northeastern aspect. Both banks of Antigonish Creek are poorly defined, sloping, and contain imperfectly to moderately well-drained soils. However, along the western edge of the Area, at the confluence of Antigonish Creek and a wetland complex, a well-drained, level terrace (AOP 7) was observed. The remainder of the eastern end, from AOP 7 to the existing pipeline right-of-way is continuous side-slope with a moderate (20-35 degree) grade, southwestern aspect, and moderately well-drained soils.

Terrain within the northwestern Study Area segment is continuous side-slope (Figure 2-4). Moderate to steep (20-45 degrees) side-slope with a northern aspect exists in the western portion, eventually transitioning into a more gently (5-10 degrees) side-slope with an eastern aspect.

Several unnamed streams bisect the southeastern Study Area segment, generally running from northeast to southwest or from high elevation mountainside to low elevation valley bottom. All are freshet streams with poorly defined banks flanked by moderately to steeply sloping, rocky terrain. Antigonish Creek is crossed twice: once within the valley adjacent to a wetland complex and again at a higher elevation along the mountainside just a little ways further northwest. The characteristics of the banks at the lower Antigonish Creek crossing were discussed above; the banks of the upper Antigonish Creek crossing are similar to those noted for other stream crossings – poorly-defined and on moderately-sloping, rocky terrain. No watercourses or waterbodies were observed within or adjacent to the northwestern Study Area segment.

Vegetation is consistent across the northwestern and southeastern Study Area segments (Photo 12). The disturbed portion of the existing pipeline right-of-way is covered by an understory of dogwood, alder, thimbleberry, devil's club, and huckleberry, and a ground cover of grasses. Flanking the disturbed right-of-way, as well as spanning the entire proposed access trail/road at the eastern end of the southeastern Study Area segment, is a moderate-aged regeneration forest of western redcedar, western hemlock, and balsam fir. The understory is variable, consisting of some combination of alder, dogwood, huckleberry, skunk cabbage, and ferns. Moss is the groundcover throughout the Study Area. Isolated veteran western redcedars and western hemlock were observed and inspected across the Study Area.

Surface visibility was poor within the disturbed portion of the existing pipeline right-of-way due to thick understory vegetation but was good to excellent within the forest flanking the sides of the right-of-way due to sparse understory vegetation.

Disturbances observed within the Study Area include the cleared, mulched/de-stumped, and excavated pipeline right-of-way, and historical logging, as evidenced by the presence of moderate-aged regeneration forests containing remnant saw cut stumps.

Observed Archaeological Potential Assessment: A total of one historical blaze and one landform with subsurface archaeological potential were observed during the PFR (Figure 2-3).

- The historical blazed tree was observed ~ 940 m northwest of MP344 (Photo 13). The blaze is on a western hemlock and a partially blackened scar face is present suggesting a metal tool was used to make the blaze. Based on diameter (56 cm) and the thickness of the healing lobes (22 cm right, 19 cm left) the blaze likely pre-dates pipeline construction.
- **AOP 7** is located within the southeastern Lachmach Study Area and is situated on a level bench overlooking the confluence of Antigonish Creek and a wetland complex to the south and west. The AOP measures 60 m (northeast-southwest) by 30 m (northwest-southeast) (Photo 14).

The remainder of Lachmach has low archaeological potential for CMTs CMTs, surface features, and subsurface archaeological sites due to an absence of observed modifications on trees, surface features, and level, well-defined, and well-drained landforms.

BACKGROUND: GALLOWAY STUDY AREA	
General Location: The Galloway Study Area is located ~6 km northeast of Port Edward, ~9.9 km southeast of Prince Rupert, and ~100 m south of Kloiya Bay (Figures 1-3 and 2-5).	
UTM: E 420912 N 6012290 9N (MP 361)	**NTS Mapsheet(s):** 103J/01 and 103J/08
Review of Archaeological Potential: Based on the desktop review, the Galloway Study Area has high potential for pre-AD 1846 CMTs as well as surface and subsurface archaeological materials due to tree stand ages, proximity to Kloiya Bay and partial overlap with the former Cloyah 5 Reserve.	
Registered Heritage Sites: There is one archaeological site within 500 m of the Galloway Study Area: • GbTn-22 – Cultural shell deposits	
Anticipated Impacts: The project will be completed over an extended amount of time and throughout the project, there will be activities which will require work to be performed manually and by machinery. These activities include, but are not limited to brushing/clearing of PNG's existing permanent ROW, pipeline maintenance work, installing temporary and/or permanent accesses for construction equipment and personnel, developing borrow sites for construction materials, developing spoil sites for storage of removed materials, and development of stockpile, staging, and work areas. Some of these activities will also include ground disturbances (both with machinery and manual excavations). All work will be kept within existing disturbances as much as possible. Notifications of planned commencement dates will be provided prior to the commencement of activities.	
RESULTS: GALLOWAY STUDY AREA	
Component Description: The Galloway Study Area is broken down into two separate segments: the eastern and western Galloway Study Area segments. Terrain within the Galloway Study Areas is variable. Terrain within the eastern Study Area segment is variable with continuous, moderate to steep side-slope (20-30 degrees, south and southwest aspects) observed throughout much of the southern and central portions of the Area (Photo 15). The northern half of the Area contains a level hilltop though this portion of the Area contains imperfectly drained soils and has poorly defined breaks-in-slope. A cliff face exists within the western half of the Area. Tree throws suggest that most of the Area has a thin subsoil of clay with unsorted, angular rock inclusions. Undulating to rolling side-slope was observed within the western portion of the western Study Area segment. This portion had moderate slopes (15-30 degrees) with a northwest aspect. These slopes transition to a steeper grade (45 degrees, northeast aspect) within the central portion of the Area though the undulating nature of the sideslope continues (Photo 16). The steeper grade levels out to a gentler slope (5-10 degrees, northeast aspect) for the first part of the eastern portion of the Area but then transitions back into a moderate to steep (15-45 degree, north and northwest aspects) at the eastern end of the Area. Moderately well to well-drained, rocky terrain exists throughout most of the Area though pockets of colluvial deposits atop of bedrock do exist, as evidenced by a dig location observed within the existing pipeline right-of-way which exposed the pipeline at an approximate depth of 3 m below surface, under a thick layer of silty clay with angular, unsorted rock inclusions. The eastern end of the western Study Area segment is within 50 m of Kloiya Bay. Three unnamed streams bisect the western Study Area segment, generally running from southwest to northeast or from high elevation mountainside to low elevation valley bottom. All are freshet streams with poorly defined banks flanked by moderately to steeply sloping, rocky terrain. No watercourses or waterbodies were observed within or adjacent to the eastern Study Area segment. Vegetation varied across the Galloway Study Area though this variation is outside of the disturbed portion of the existing pipeline right-of-way as the disturbed right-of-way is only vegetated by an understory of dogwood, thimbleberry, ferns, rose, devil's club, and a ground cover of grasses. The forested areas flanking the disturbed portion of the existing pipeline right-of-way within the western Study Area segment generally consist of moderate-aged regeneration western redcedar, western hemlock, and balsam fir trees with an understory of ferns and a	

ground cover of moss. Pockets of moderate-aged regeneration poplar were also observed across the Area; poplar-dominant stands exist along the stream channel that bisects the western end of the Area and the eastern end of the Area.

Vegetation within the eastern Study Area segment, outside of the disturbed portion of the existing pipeline right-of-way, generally consists of old growth western redcedar and western hemlock trees with an understory of huckleberry and ferns, and a ground cover of moss and bunchberry. The southern half of the Area is dominated by moderate-aged regeneration western redcedar and western hemlock trees.

Surface visibility was poor within the disturbed portion of the existing pipeline right-of-way due to thick understory vegetation but was good to excellent within the forest flanking the sides of the right-of-way due to sparse understory vegetation.

Disturbances observed within the Galloway Study Area include the cleared, mulched/de-stumped, and excavated pipeline right-of-way; the cleared, mulched/de-stumped BC Hydro powerline right-of-way that parallels the pipeline right-of-way within the western Study Area segment; and historical logging, as evidenced by the presence of moderate-aged regeneration forests containing remnant saw cut stumps. One recent machine-assisted pipe exposure dig, and one recent hand-exposed pipe dig were observed within the disturbed portion of the existing pipeline right-of-way.

ARCHAEOLOGICAL SITE INFORMATION: TEMPORARY NUMBER 190954-01		
Borden Number: TBD	**Temporary Number:** 190954-01	
Site Type: Traditional Use, Culturally Modified Tree		
UTM Zone: 9U **Easting:** 421107 **Northing:** 6012248	**NTS Mapsheet:** 103J/08	**Approximate Dimensions:** 43 m NE-SW by 20 m NW-SE (measured to the maximum length and width form the outer edge of the 10 m buffer applied to the individual CMT)
Location and Setting: The site is located in the northwest coast of BC, ~9 km southeast of Prince Rupert, ~105 km southwest of Terrace, and ~145 m southwest of Kloiya Bay.		
Culturally Modified Trees Summary: Site consists of one CMT. The CMT is a lying dead (historically logged) large rectangular bark stripped western redcedar log and associated saw cut stump. The CMT was recorded to Level I standards (Figure 3-2, Photo 17).		
Age Determination: Based on the large tree diameter and thick healing lobes, Roy Northern concludes that the modification likely predates AD 1846 and is therefore protected under the HCA.		
Site Boundary Determination: The CMT has a 10 m buffer placed around the entire length of the felled tree and associated stump in accordance with Bulletin 27 – Culturally Modified Trees Guidelines[5].		

MANAGEMENT RECOMMENDATIONS

For the Kasiks Study Area, in which four areas of subsurface archaeological potential were identified, Roy Northern recommends:

- Concurrent archaeological construction monitoring under a Section 14 Heritage Conservation Act (HCA) Heritage Inspection Permit for all Project-related activities within AOPs that overlap with disturbed portions of the pipeline right-of-way;
- Avoid AOPs identified outside of the disturbed portion of the existing pipeline right-of-way or conduct subsurface testing under a Section 14 HCA Heritage Inspection Permit is required prior to all Project-related activities; and,

[5] *Archaeology Branch, Bulletin 27: Culturally Modified Trees Guideline, Issued March 22, 2017. On file with the Archaeology Branch.*

- No further archaeological work outside of these four AOPs though a Chance Find Procedure should be in place prior to the commencement of Project-related activities and utilized, as required, throughout the life of the Project.

For the Khyex Study Area, in which two AOPs, one archaeological site (190954-02), one historical site (CMT), and three trap boxes were identified, Roy Northern recommends:

- Avoid AOPs identified outside of the disturbed portion of the existing pipeline right-of-way or conduct subsurface testing under a Section 14 HCA Heritage Inspection Permit is required prior to all Project-related activities;
- Avoid the portion of the archaeological site 190954-02 that lies outside of the disturbed portion of the existing pipeline right-of-way or, if avoidance is not possible:
    - record CMTs K1 through 3 to Level II standards, and
    - acquire a Section 12.4 HCA Site Alteration Permit to allow for alterations to the site area.
- Avoid the historical CMT or record the CMT to Level II standards;
- In accordance with Metlakatla First Nation's CMT Policy, all CMTs must be protected and preserved regardless of age or type, whenever possible. If impacts to a CMT cannot be avoided, it is recommended that PNG consult with Metlakatla First Nation and other Nations with territorial overlap prior to the commencement of Project-related activities;
- Determine who owns or uses the trapline along the northwest bank of the Khyex River and consult with them regarding the Project; and,
- No further archaeological work outside of these two AOPs, one archaeological site, and one historical site, though a Chance Find Procedure should be in place prior to the commencement of Project-related activities and utilized, as required, throughout the life of the Project.

For the Lachmach Study Area, in which one AOP was identified, Roy Northern recommends:

- Avoid AOP 7 by shifting the proposed access trail or road to the southeast beyond Roy Northern's "No Work Zone" flagging or conduct subsurface testing under a Section 14 HCA Heritage Inspection Permit is required prior to all Project-related activities; and,
- No further archaeological work outside of this AOP, though a Chance Find Procedure should be in place prior to the commencement of Project-related activities and utilized, as required, throughout the life of the Project.

For the Galloway Study Area, in which one archaeological site (190954-01) was identified, Roy Northern recommends:

- Avoid the portion of the archaeological site 190954-01 that lies outside of the disturbed portion of the existing pipeline right-of-way or, if avoidance is not possible,
    - record CMT G1 to Level II standards;
    - In accordance with Metlakatla First Nation's CMT Policy, all CMTs must be protected and preserved regardless of age or type, whenever possible. If impacts to a CMT cannot be avoided, it is recommended that PNG consult with Metlakatla First Nation and other Nations with territorial overlap prior to Project-related activities; and,
    - acquire a Section 12.4 HCA Site Alteration Permit to allow for alterations to the site area.
- No further archaeological work outside of this archaeological site, though a Chance Find Procedure should be in place prior to the commencement of Project-related activities and utilized, as required, throughout the life of the Project.

Additional fieldwork may be necessary if the Project is revised to include areas that have not been assessed. All archaeological remains, whether recorded or unidentified, are protected by legislation and may not be altered, damaged, moved, excavated in, or disturbed in any way without a permit issued under either Section 12.4 or 14 of the HCA. The Archaeology Branch of BC should be notified immediately if any archaeological remains are accidently disturbed.

STUDY LIMITATIONS
The PFR reported herein was undertaken with the objective of assessing archaeological potential and identifying surface archaeological materials or features and CMTs. The portions of the four Study Areas that do not contain archaeological sites, historical CMTs, or AOPs are considered to have low archaeological potential. However, an evaluation of low archaeological potential does not mean there is no archaeological potential, as archaeological sites can still be found in areas evaluated as having low archaeological potential. Consistent with the intent of the HCA, if any unanticipated archaeological materials or features, including as-yet unrecorded CMTs, are encountered prior to, or during, Project-related activities, PNG and their contractors should stop work and contact a professional archaeologist to determine next steps.
CLOSURE
This report was prepared by Roy Northern on behalf of PNG, solely for use by PNG. Any use, reliance, or decisions made by third parties based on this report are the responsibility of such third parties. We trust the information in this interim report is sufficient for your present needs. Should you have any questions regarding the Project, please do not hesitate to contact the undersigned.

PREPARED BY:

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Senior Archaeologist

Roy Northern Environmental Ltd.

REVIEWED BY:

Karen Brady, BA, RPCA
Senior Archaeologist

Roy Northern Environmental Ltd.

Attachments: Figure 1-1 to 1-3: Overview Maps
Figure 2-1 to 2-5: Midrange Site Maps
Figure 3-1 to 3-2: Detailed Site Maps
Appendix A: Select Photographs

DISTRIBUTION	
Graham Pavlik	Lauren Services
Doug McRae	Pacific Northern Gas Ltd.
Megan Charters and James Greenhalgh	Oil and Gas Commission
Kyle Clifton	Gitga'at First Nation
Samantha Wagner	Gitxaala Nation
Chris Apps	Kitselas First Nation
Tammy Roberts	Kitsumkalum First Nation

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Consistent with the intent of the HCA, if any unanticipated archaeological materials or features, including as-yet unrecorded CMTs, are encountered prior to, or during, Project-related activities, PNG and their contractors should stop work and contact a professional archaeologist to determine next steps.

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PREPARED BY:

Stephan Girard, MA, RPCA
Senior Archaeologist

Roy Northern Environmental Ltd.

REVIEWED BY:

Karen Brady, BA, RPCA
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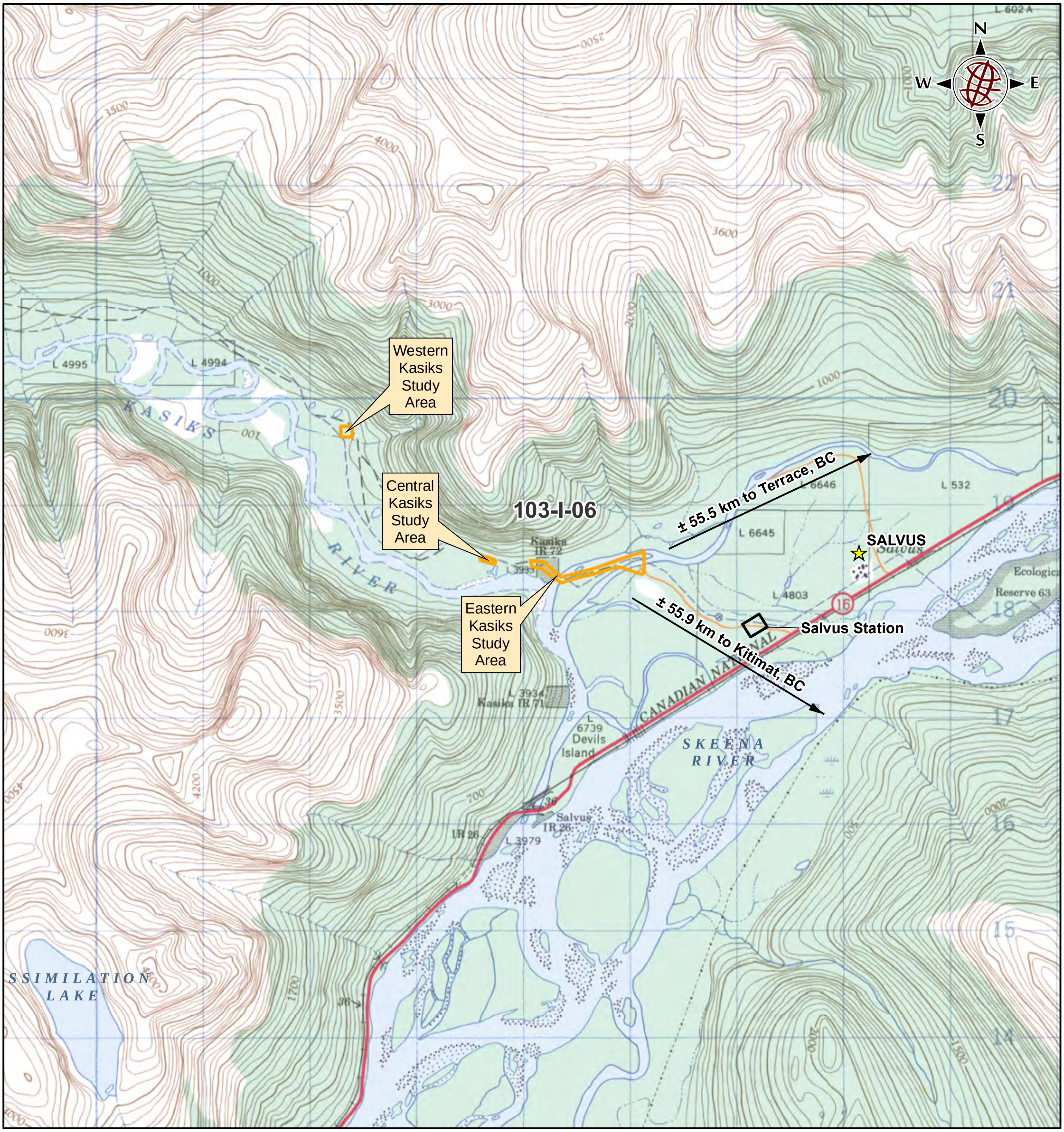
Chris Apps	Kitselas First Nation
Tammy Roberts	Kitsumkalum First Nation

Katherine Butts	Lax Kw'alaams Band
Erin Mutrie	Metlakatla First Nation



LEGEND

Study Area

PACIFIC NORTHERN GAS LTD.

Overview Map
KASIKS STUDY AREA

0 0.5 1 2 km
Scale: 1:50,000

GIS:	JH
Date:	Nov 28, 2019
Revision:	R0
Map ID:	190954PF2

FIGURE 1-1

REFERENCES

Previously Recorded Archaeological Sites obtained from RAAD (09/05/2019).
Inset Map Basemap: ESRI Online - National Geographic Mapping Service.
Projection: NAD 1983 UTM Zone 9N

ROYNORTHERN Land and Environmental
207, 10139 100 St.
Fort St. John, BC
V1J 3Y6
(250) 261-6644

Path: X:\BC_Projects\Pacific_Northern_Gas\2019\190954\mxd\PFR\190954PF2_1_Overview_S2G_2019_PFR.mxd

LEGEND

- Newly Recorded Archaeology Site
- Previously Recorded Archaeology Site
- Machine Access Trail
- Study Area
- Archaeology Site Boundary

REFERENCES

Previously Recorded Archaeological Sites obtained from RAAD (09/05/2019).
Inset Map Basemap: ESRI Online - National Geographic Mapping Service.
Projection: NAD 1983 UTM Zone 9N

PACIFIC NORTHERN GAS LTD.

Overview Map
KHYEX AND LACHMACH STUDY AREA

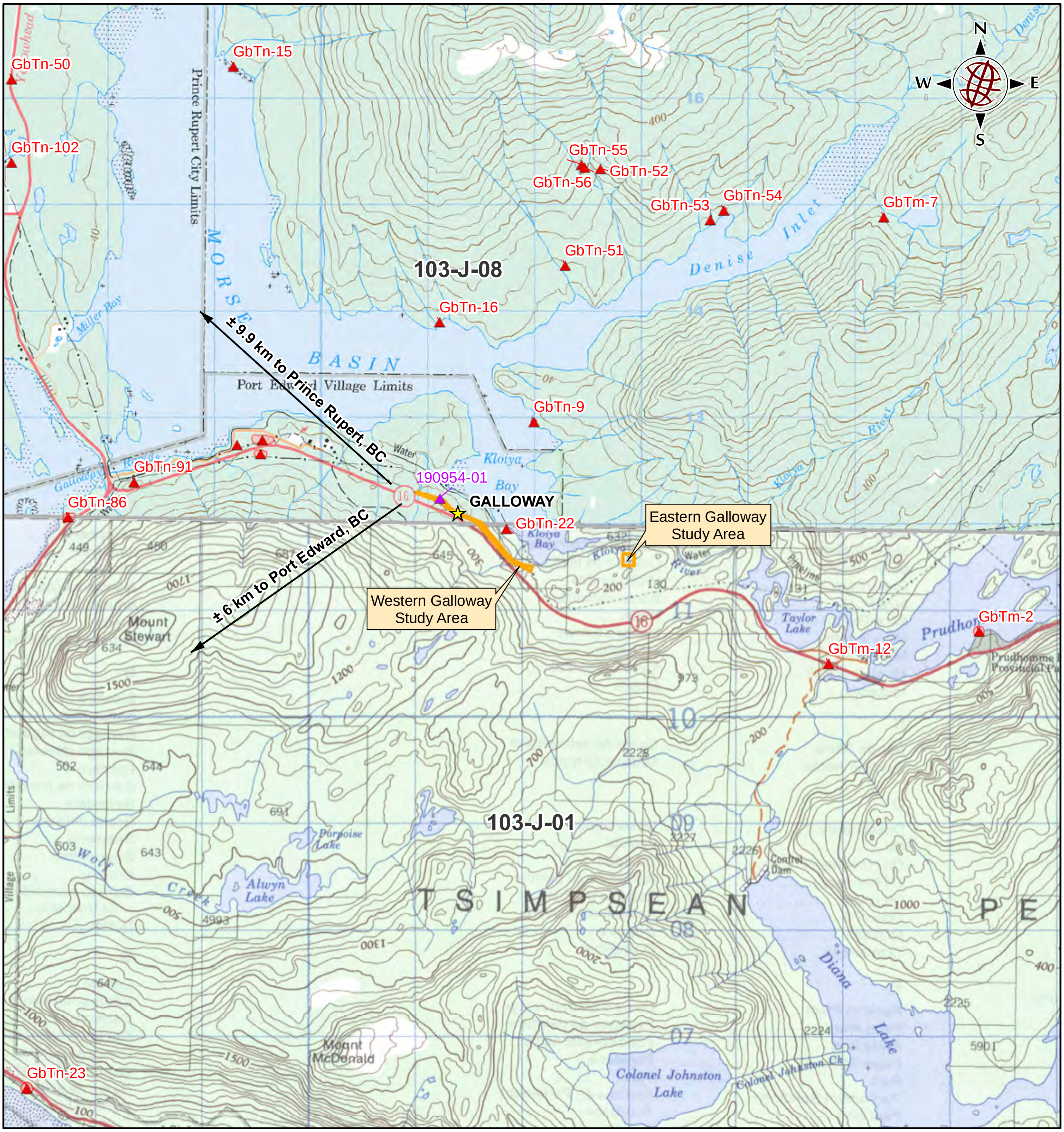
0 0.5 1 2 km
Scale: 1:50,000

GIS:	JH
Date:	Nov 28, 2019
Revision:	R0
Map ID:	190954PF2

FIGURE 1-2

ROYNORTHERN
Land and Environmental
207, 10139 100 St.
Fort St. John, BC
V1J 3Y6
(250) 261-6644

Path: X:\BC_Projects\Pacific_Northern_Gas\2019\190954\mxd\PFR\190954PF2_1_Overview_S2G_2019_PFR.mxd



LEGEND

- Newly Recorded Archaeology Site
- Previously Recorded Archaeology Site
- Study Area
- Archaeology Site Boundary

REFERENCES

Previously Recorded Archaeological Sites obtained from RAAD (09/05/2019).
Inset Map Basemap: ESRI Online - National Geographic Mapping Service.
Projection: NAD 1983 UTM Zone 9N

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PACIFIC NORTHERN GAS LTD.

Overview Map
GALLOWAY STUDY AREA

0 0.5 1 2 km
Scale: 1:50,000

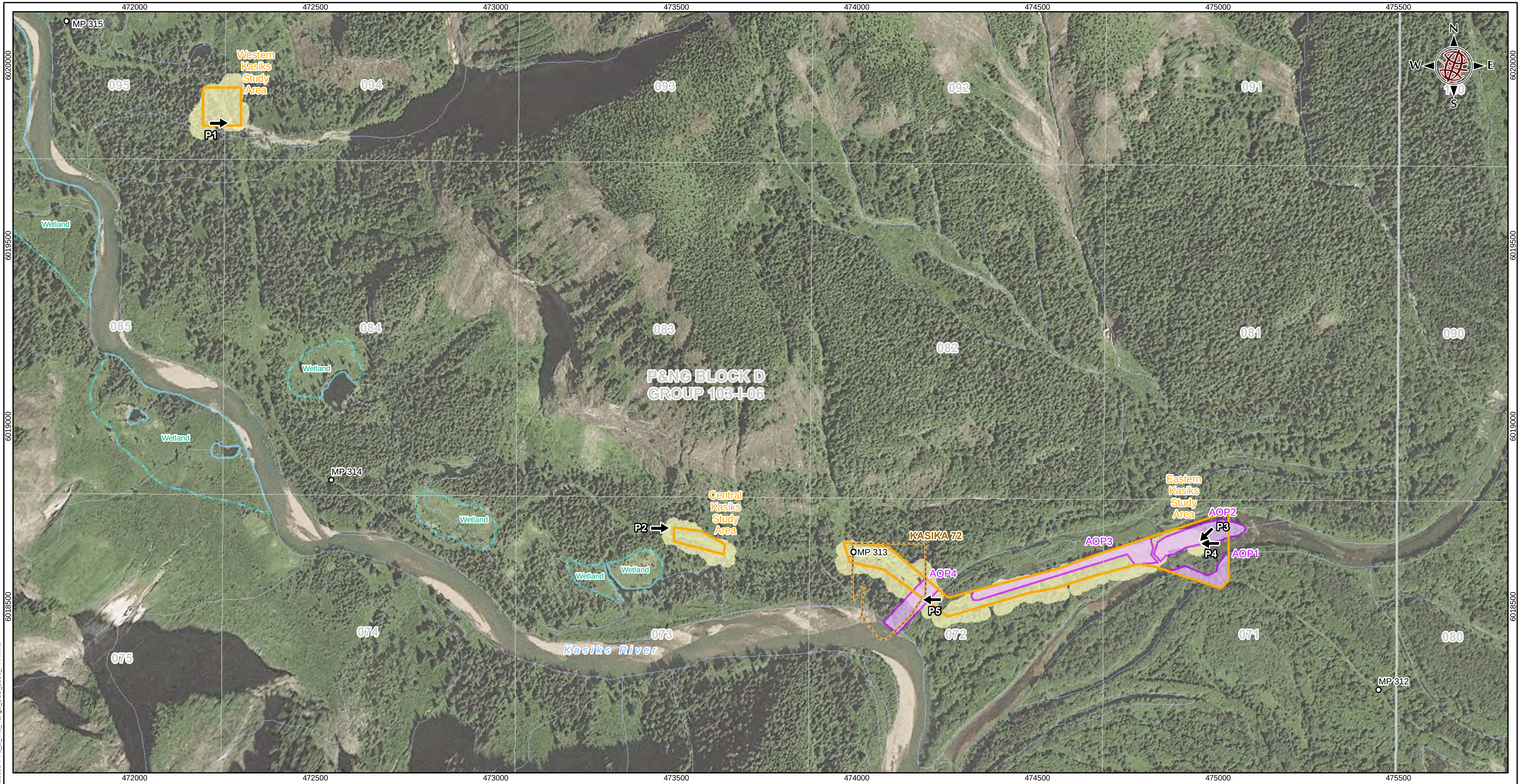
GIS:	JH
Date:	Nov 28, 2019
Revision:	R0
Map ID:	190954PF2

FIGURE 1-3

ROYNORTHERN
Land and Environmental

207, 10139 100 St.
Fort St. John, BC
V1J 3Y6
(250) 261-6644

Path: X:\BC_Projects\Pacific_Northern_Gas\2019\190954\mxd\PFR\190954PF2_1_Overview_S2G_2019_PFR.mxd



LEGEND

- Historic Mile Post
- P1 Photo Number and Direction
- Study Area
- Area of Potential
- First Nations Reserve
- Transect Coverage
- Wetland
- Waterbody
- Watercourse

REFERENCES

Previously recorded Archaeological Sites obtained from RAAD (09/05/2019).
Projection: NAD 1983 UTM Zone 9N

Path: X:\BC_Projects\Pacific_Northern_Gas\2019\190954\mxd\PFR\190954PF2_2_Mid_Range_S2G_2019_PFR.mxd

PACIFIC NORTHERN GAS LTD.

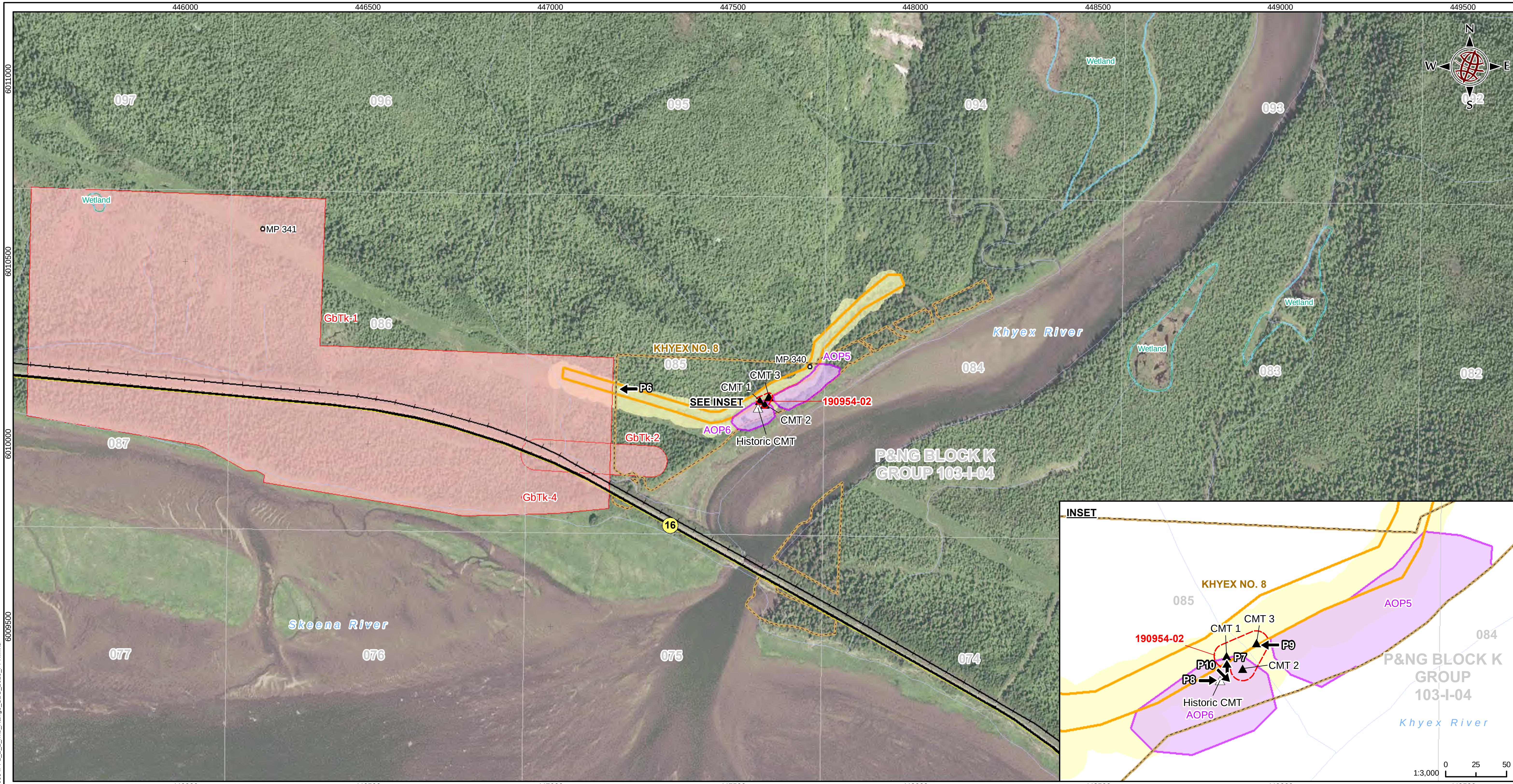
Preliminary Field Reconnaissance
KASIKS STUDY AREA

0 100 200 400 m
Scale: 1:10,000

GIS:	JH
Date:	Nov 28, 2019
Revision:	R0
Map ID:	190954OV1

FIGURE 2-1

ROYNORTHERN Land and Environmental
207, 10139 100 St.
Fort St. John, BC
V1J 3Y6
(250) 261-6644



LEGEND

- Pre-1846
- Post-1846
- Historic Mile Post
- Study Area
- Newly Recorded Archaeology Site Boundary
- Area of Potential
- First Nations Reserve
- Transect Coverage
- Archaeology Site Boundary
- Wetland
- Waterbody
- Watercourse
- Highway
- Main Railway
- P1 Photo Number and Direction

REFERENCES

Previously recorded Archaeological Sites obtained from RAAD (09/05/2019).
Projection: NAD 1983 UTM Zone 9N

Path: X:\BC_Projects\Pacific_Northern_Gas\2019\190954\mxd\PFR\190954PF2_2_Mid_Range_S2G_2019_PFR.mxd

PACIFIC NORTHERN GAS LTD.

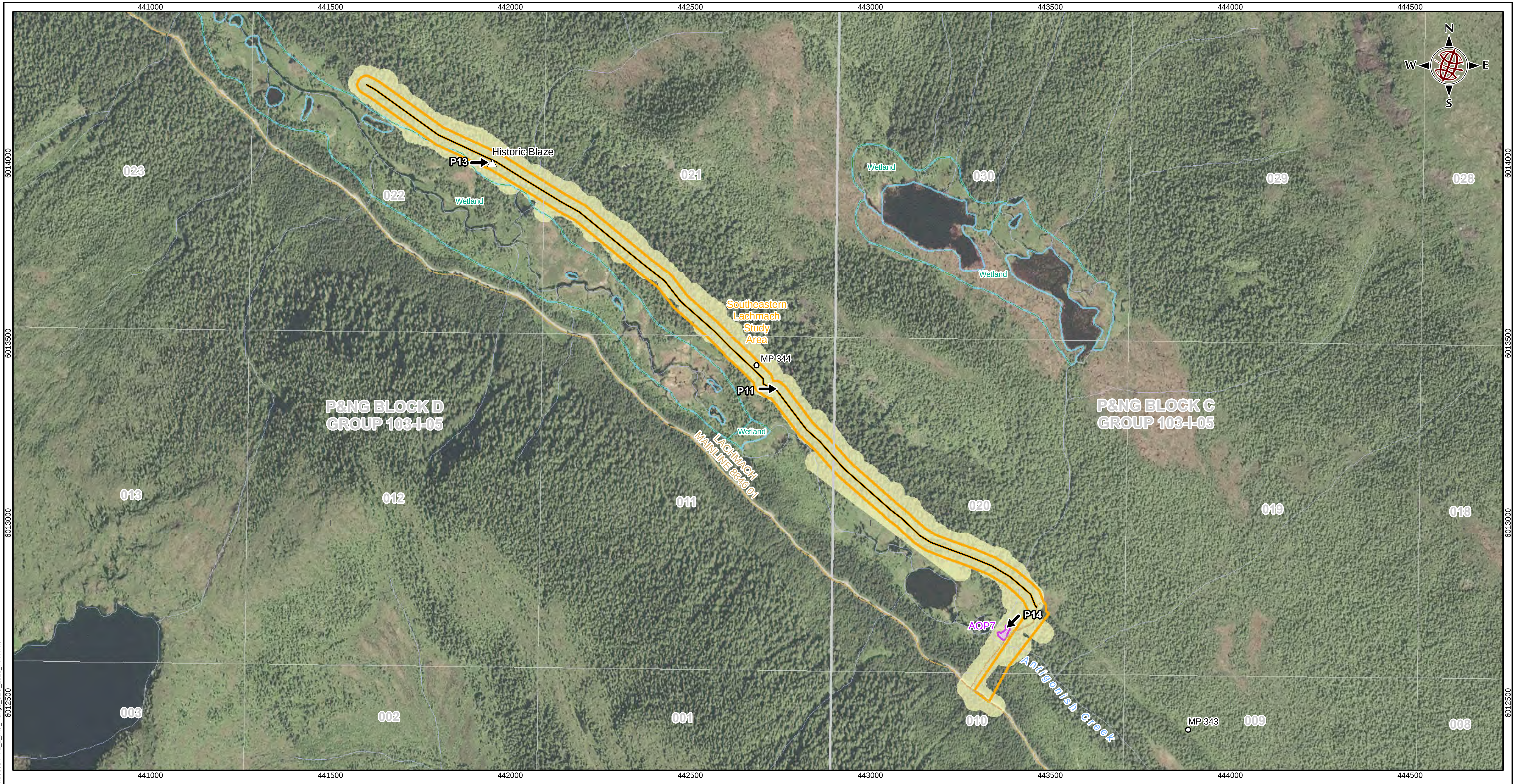
Preliminary Field Reconnaissance
KHYEX STUDY AREA

0 100 200 400 m
Scale: 1:10,000

GIS:	JH
Date:	Nov 28, 2019
Revision:	R0
Map ID:	190954OV1

FIGURE 2-2

ROYNORTHERN
Land and Environmental
207, 10139 100 St.
Fort St. John, BC
V1J 3Y6
(250) 261-6644



Path: X:\BC_Projects\Pacific_Northern_Gas\2019\190954\mxd\PFR\190954PF2_2_Mid_Range_S2G_2019_PFR.mxd

LEGEND

- Post-1846
- Machine Access
- Historic Mile Post
- Study Area
- Area of Potential
- Transect Coverage
- Wetland
- Waterbody
- Watercourse
- Forestry Road
- P1 Photo Number and Direction

REFERENCES

Previously recorded Archaeological Sites obtained from RAAD (09/05/2019).
Projection: NAD 1983 UTM Zone 9N

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PACIFIC NORTHERN GAS LTD.

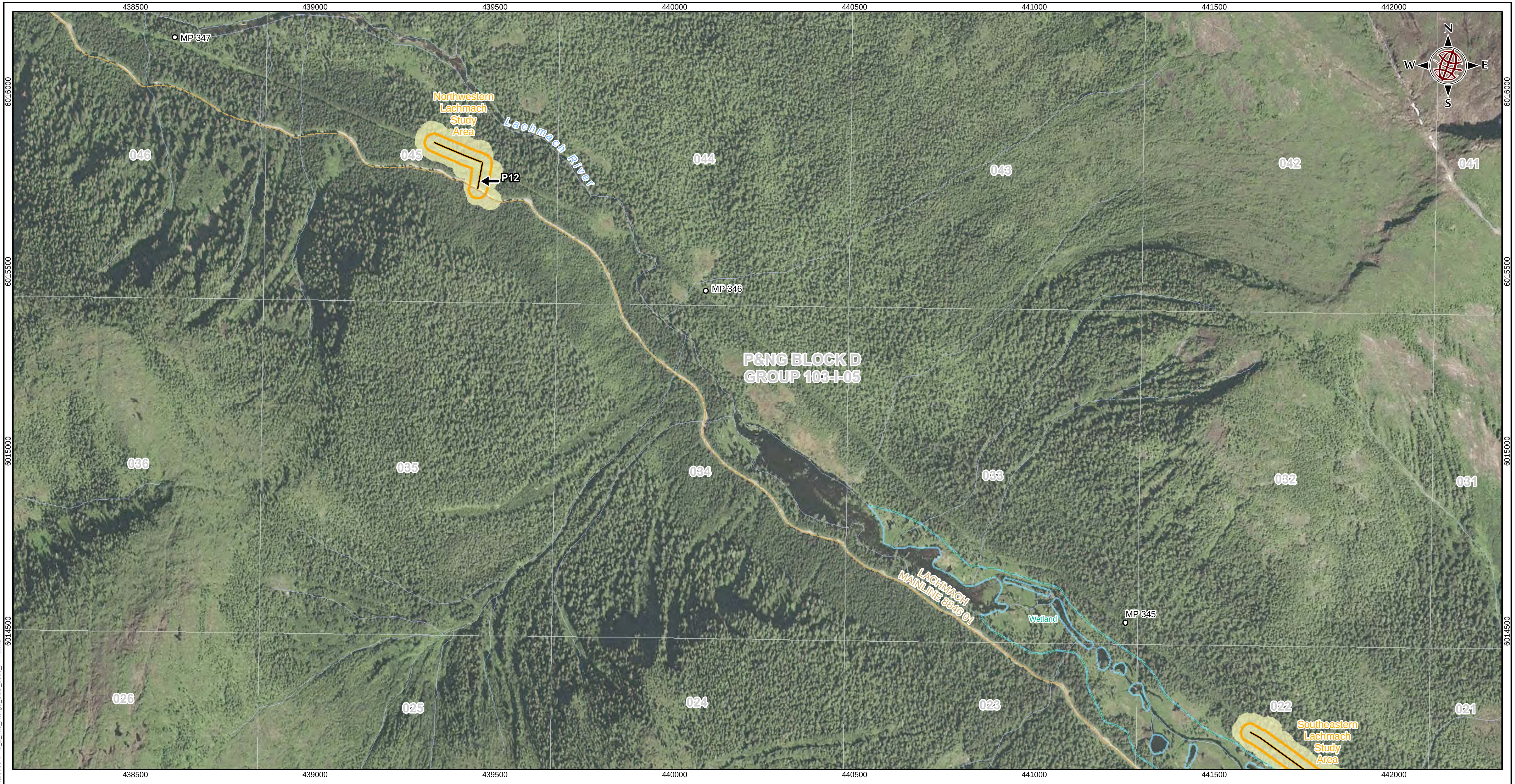
Preliminary Field Reconnaissance
SOUTHEASTERN LACHMACH STUDY AREA

0 100 200 400 m
Scale: 1:10,000

GIS:	JH
Date:	Nov 28, 2019
Revision:	R0
Map ID:	190954OV1

FIGURE 2-3

ROYNORTHERN Land and Environmental
207, 10139 100 St.
Fort St. John, BC
V1J 3Y6
(250) 261-6644



LEGEND

- Machine Access
- Historic Mile Post
- Study Area
- Transect Coverage
- Wetland
- Waterbody
- Watercourse
- Forestry Road
- P1 Photo Number and Direction

REFERENCES

Previously recorded Archaeological Sites obtained from RAAD (09/05/2019).
Projection: NAD 1983 UTM Zone 9N

Path: X:\BC_Projects\Pacific_Northern_Gas\2019\190954\mxd\PFR\190954PF2_2_Mid_Range_S2G_2019_PFR.mxd

PACIFIC NORTHERN GAS LTD.

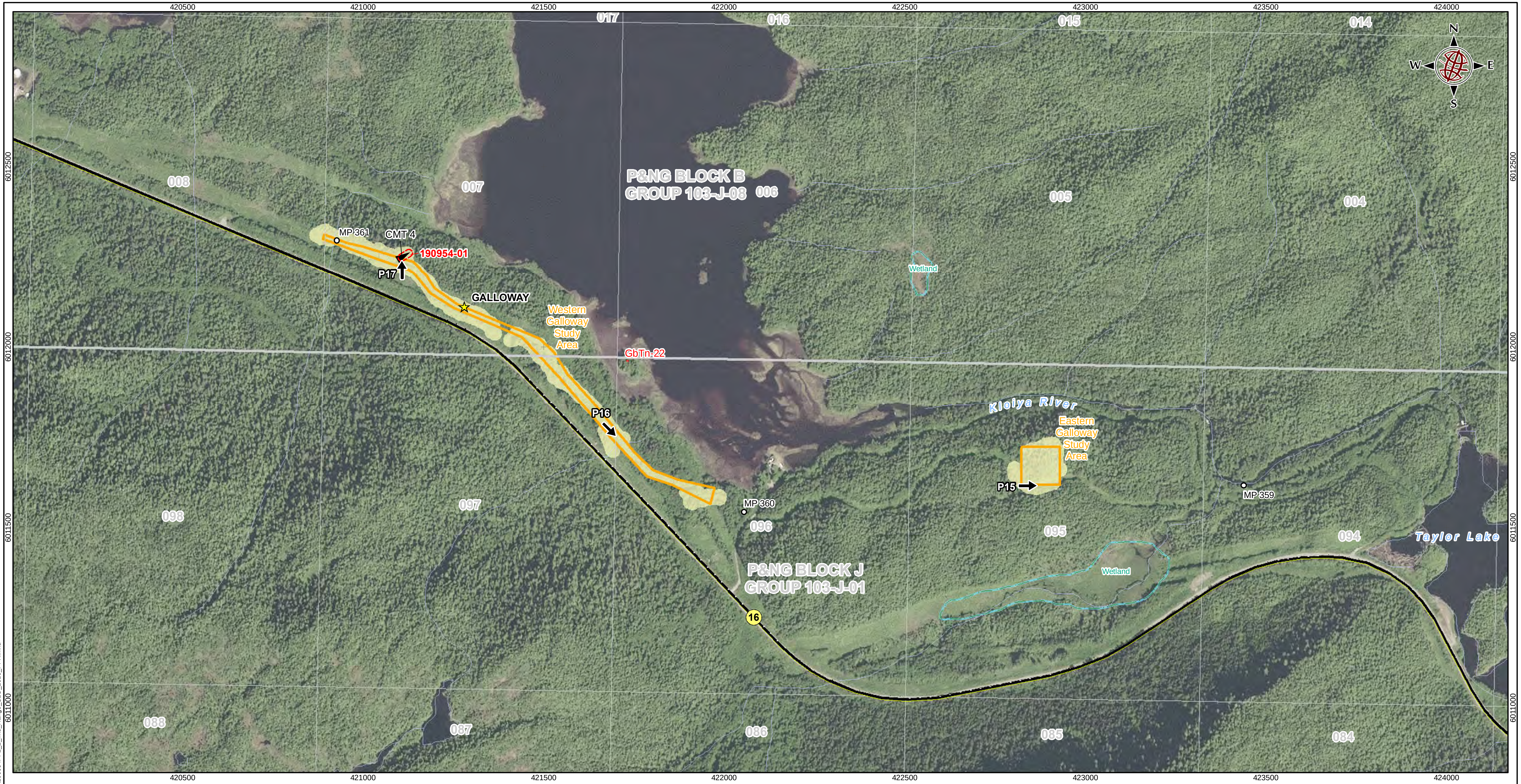
Preliminary Field Reconnaissance
NORTHWESTERN LACHMACH STUDY AREA

0 100 200 400 m
Scale: 1:10,000

GIS:	JH
Date:	Nov 28, 2019
Revision:	R0
Map ID:	190954OV1

FIGURE 2-4

ROYNORTHERN Land and Environmental
207, 10139 100 St.
Fort St. John, BC
V1J 3Y6
(250) 261-6644



LEGEND

- Pre-1846, Fallen
- Historic Mile Post
- Study Area
- Newly Recorded Archaeology Site Boundary
- Transect Coverage
- Archaeology Site Boundary
- Wetland
- Waterbody
- Watercourse
- Highway
- P1 Photo Number and Direction

REFERENCES

Previously recorded Archaeological Sites obtained from RAAD (09/05/2019).
Projection: NAD 1983 UTM Zone 9N

Path: X:\BC_Projects\Pacific_Northern_Gas\2019\190954\mxd\PFR\190954PF2_2_Mid_Range_S2G_2019_PFR.mxd

PACIFIC NORTHERN GAS LTD.

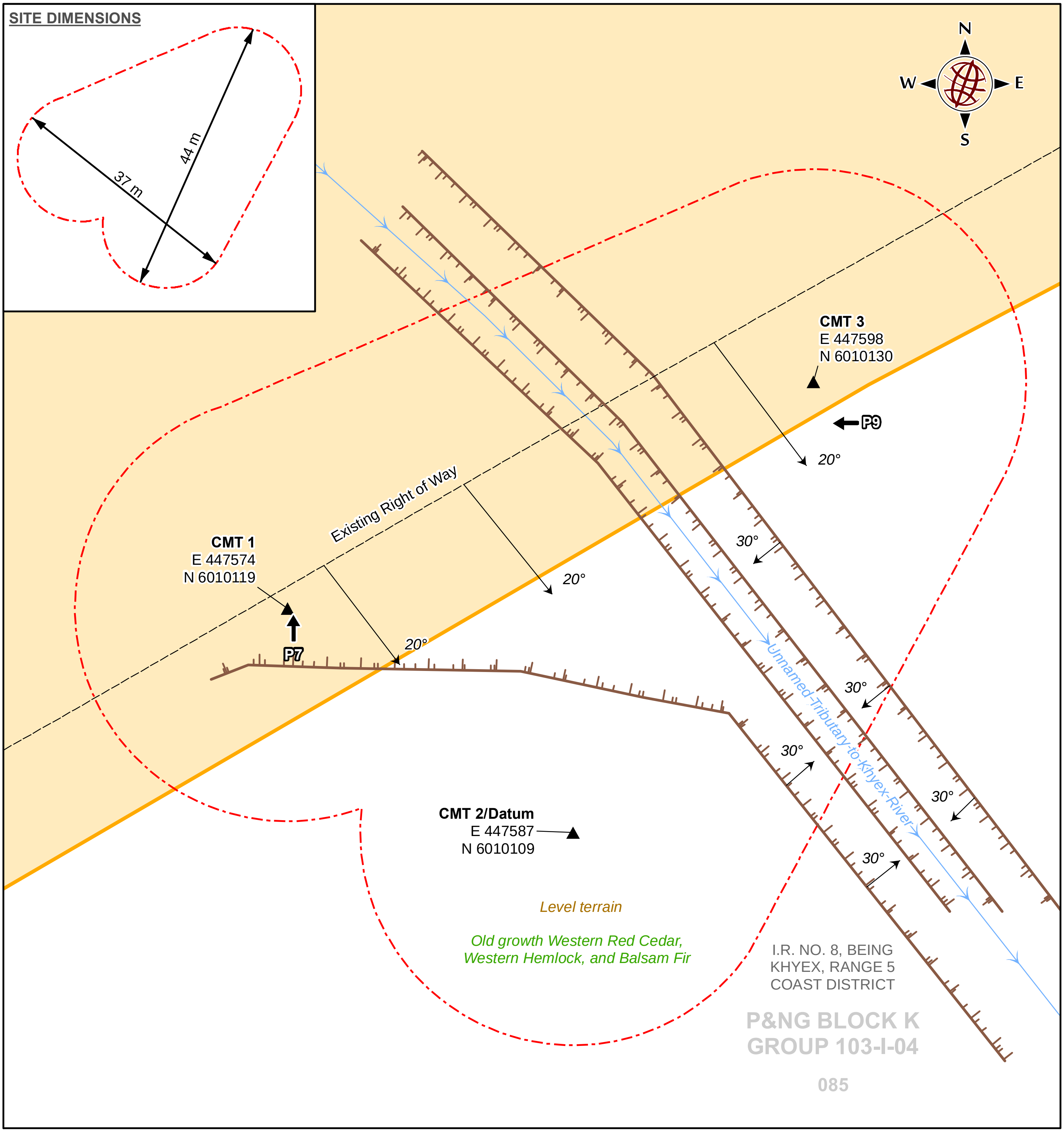
Preliminary Field Reconnaissance
GALLOWAY STUDY AREA

0 100 200 400 m
Scale: 1:10,000

GIS:	JH
Date:	Nov 28, 2019
Revision:	R0
Map ID:	190954OV1

FIGURE 2-5

ROYNORTHERN Land and Environmental
207, 10139 100 St.
Fort St. John, BC
V1J 3Y6
(250) 261-6644



LEGEND

- ▲ Pre-1846 CMT
- Site Boundary
- Study Area
- Break in Slope
- Existing Right of Way Boundary
- → Slope Direction
- Unnamed Stream
- P1 Photo Number and Direction

REFERENCES

Date of Site Visit: October 24, 2019
Projection: NAD 1983 UTM Zone 9N

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PACIFIC NORTHERN GAS LTD.

Detailed Site Map
TEMPORARY SITE NUMBER: 190954-02
NON-PERMITTED PFR

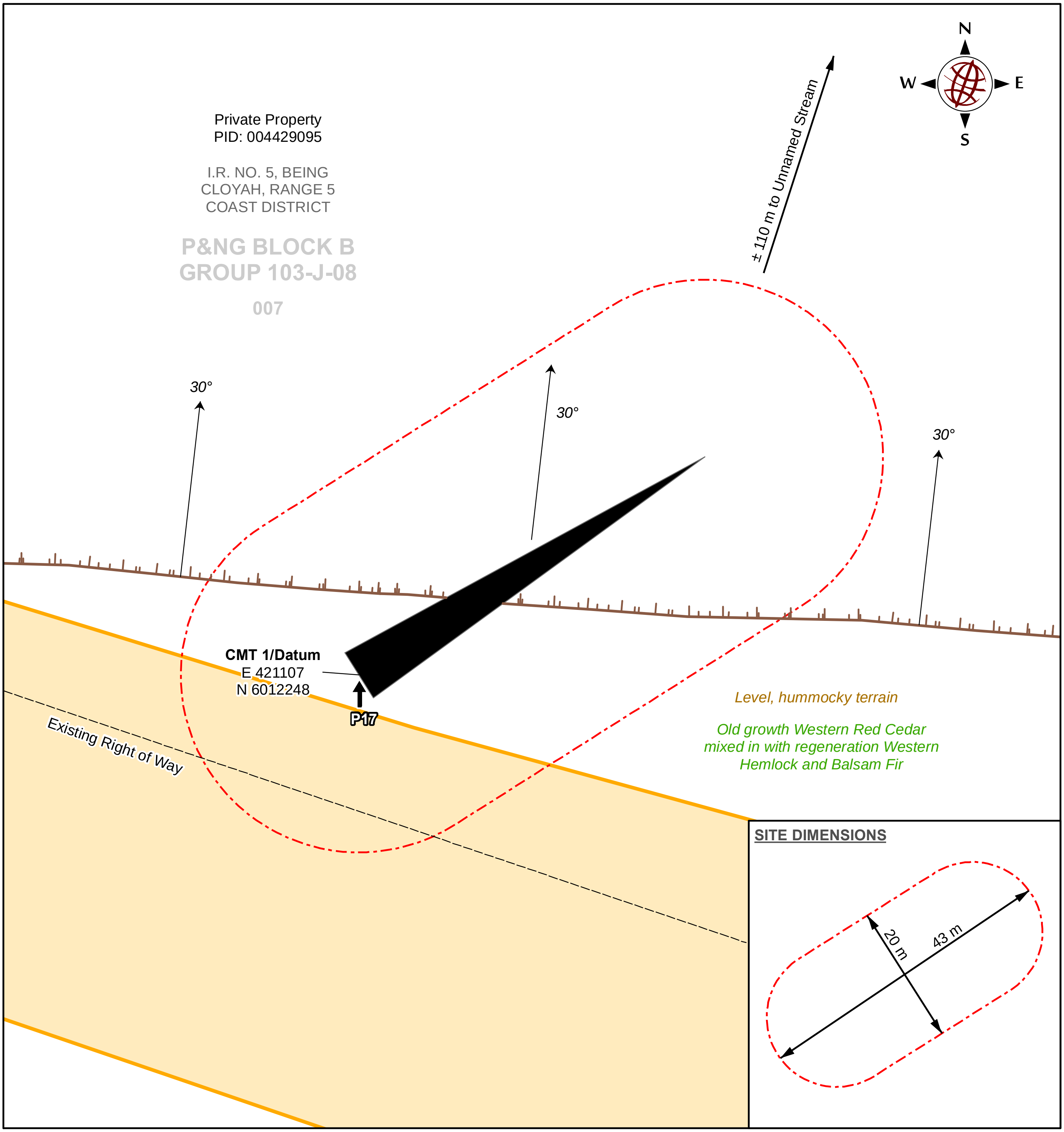
0 2.5 5 10 m
Scale: 1:250

GIS:	JH
Date:	Nov 28, 2019
Revision:	R0
Map ID:	190954PF2

FIGURE 3-1

ROYNORTHERN Land and Environmental
207, 10139 100 St.
Fort St. John, BC
V1J 3Y6
(250) 261-6644

Path: X:\BC_Projects\Pacific_Northern_Gas\2019\190954\mxd\PFR\190954PF2_3_1_Detailed_Site_Map_190954_02.mxd



LEGEND

- Pre-1846 Fallen CMT
- Site Boundary
- Study Area
- Break in Slope
- Slope Direction
- Existing Right of Way
- P1 Photo Number and Direction

REFERENCES

Date of Site Visit: October 22, 2019
Projection: NAD 1983 UTM Zone 9N

PACIFIC NORTHERN GAS LTD.

Detailed Site Map
TEMPORARY SITE NUMBER: 190954-01
NON-PERMITTED PFR

0 2.5 5 10 m
Scale: 1:300

GIS:	JH
Date:	Nov 28, 2019
Revision:	R0
Map ID:	190954PF2

FIGURE 3-2

ROYNORTHERN Land and Environmental
207, 10139 100 St.
Fort St. John, BC
V1J 3Y6
(250) 261-6644

Path: X:\BC_Projects\Pacific_Northern_Gas\2019\190954\mxd\PFR\190954PF2_3_2_Detailed_Site_Map_190954_01.mxd

Appendix A: Select Photographs

Photo 1: View east of drainage within Kasiks.

Photo 2: View east of typical vegetation within Kasiks.

Photo 3: View southwest of AOP 1 within Kasiks.

Photo 4: View west of AOP 2 within Kasiks.

Photo 5: View west of AOP 4 within Kasiks.

Photo 6: View west of vegetation and disturbance within Khyex.

Photo 7: View north of CMT K1 (190954-02) within Khyex.

Photo 8: View east of historical CMT within Khyex.

Photo 9: View west of trap box within Khyex.

Photo 10: View southeast of AOP 6 within Khyex.

Photo 11: View east of sloping terrain Lachmach.

Photo 12: View west of terrain and vegetation within Lachmach.

Photo 13: View east of historical blaze within Lachmach.

Photo 14: View southwest of AOP 7 within Lachmach.

Photo 15: View east of terrain and vegetation within Galloway.

Photo 16: View southeast of undulating terrain and disturbance within Galloway.

Photo 17: View north of CMT G1 (190954-01) within Galloway.

Appendix R – Communications and Engagement Plan

1 Introduction

This Communications and Engagement Plan (CEP) is an internal strategy document that details the planning and activities needed for an effective Indigenous and public engagement program.

PNG is committed to meaningfully engaging Indigenous communities and the public. PNG recognizes the importance and value of engaging Indigenous communities, PNG rate payers, stakeholders and partners in decision making.

Information contained in this CEP will also be used to draft the relevant engagement sections of the application to the British Columbia Utilities Commission (BCUC) for a Certificate of Public Convenience and Necessity (CPCN) for the Salvus to Galloway remediation project.

2 S2G Project Information

PNG is undertaking a process of planning and executing remediation work on a section of the PNG West Transmission Pipeline from Salvus to Galloway (S2G Project). The S2G Project consists of maintenance work on the (80 km) segment of the 8-inch from Salvus maintenance yard to Galloway pressure regulating station. The PNG West Transmission Pipeline transports natural gas from Summit Lake, to Prince Rupert, and Kitimat, B.C., while providing natural gas service to numerous communities along the way.

The project activities will include, but are not necessarily limited to, brushing/clearing of PNG's existing permanent Right Of Way (ROW), pipeline maintenance work such as pipe in-situ repairs, section replacements, lowering, armoring, installing/maintaining temporary and/or permanent accesses for construction equipment and personnel, developing as required borrow sites for construction materials, spoil sites for storage of removed materials, and stockpile, staging, and work areas.

All work will be kept within the existing PNG ROW or permitted temporary workspace and will adhere to all federal and provincial environmental guidelines and PNG's project specific and corporate Environmental Management Plans.

While the physical work on the Project is expected to occur from 2021-2023, prior to the commencement of work, the Project requires a Certificate of Public Convenience and Necessity (CPCN) application to be submitted to the British Columbia Utilities Commission (BCUC) and approved by the spring of 2021.

The project is expected to kick-off in July 2020, with the BCUC application to be submitted in September 2020.

3 Communications & Engagement

3.1 Communications Overview

Those affected by the Project need to know about it. This section sets out how we will inform Indigenous communities, PNG customers/stakeholders, and the public to ensure they are aware of the Project.

3.2 Project Goals & Objectives

The pipeline was built in the 1960's and segments are nearing the end of their useful lifespan. PNG is undertaking remediation work on their West Transmission pipeline to maintain the integrity of the pipeline which is essential to supporting economic activities and sustaining jobs in the region. The work is being done to maintain the integrity and reliability of natural gas service to the region.

Project goals include:

- Secure sufficient Indigenous, community and stakeholder support to receive BCUC approval for a Certificate of Public Convenience and Necessity to undertake the proposed pipeline remediation on the Salvus to Galloway portion.
- Leverage the project to increase the brand presence for PNG and position it for future projects such as the Reactivation Capacity Allocation Process (RECAP) project upgrades. To do so, it will be essential to demonstrate that PNG is a company capable of doing projects in a way that puts safety first and provides authentic Indigenous and community engagement that considers actionable input to strengthen the project.

Objectives:

- Activate best practices for engagement and communications to secure regional project support.
- Meet the public's needs for information and transparency.
- Differentiate the Salvus to Galloway Remediation from other projects in the area – remediation work on an existing transmission line rather than a new pipeline requiring a new right of way, impact to landowners etc.
- Position the project as a local shovel ready project supporting B.C.'s COVID-19 economic recovery plan.

3.3 Engagement Objectives

PNG is committed to the following engagement principles. PNG will:

- Seek out and engage those who are affected by a decision by the BCUC and the impact/benefits of the project
- Use multiple communication and engagement channels to reach the widest impacted audience possible
- Meet and exceed all requirements set by regulators

- Build and maintain positive, mutually beneficial and respectful relationships with Indigenous communities, key stakeholders and the public
- Provide timely and accurate project information
- Quickly address and correct misinformation
- Seek input from Indigenous communities and the public in designing how they participate in the information/consultation process
- Clearly share scope of engagement with Indigenous communities, the public and key stakeholders
- Ensure Indigenous and community members are given the opportunity to meaningfully contribute to the planning of the Project and issues are tracked and mitigated
- Ensure an open, transparent and honest engagement process
- Ensure that Indigenous and public input will influence decisions and planning
- Communicate with participants how their input shaped the project or if not possible, why

3.4 Engagement Focus

Engagement will focus on the overall project need (remediate an aging pipeline) and PNG's proactive steps to address maintenance of the pipeline. We will clearly communicate the benefits of the project including increased reliability and capacity of natural gas. Our engagement will leverage Influencers and drive out positive proactive stories about safety, reliability, and community benefit – training, jobs and community investment

Engagement will also provide information and invite input and feedback on the Salvus to Galloway remediation project works. We will also address the potential impacts to customers (i.e. rate changes, service disruptions) or concerns (i.e., environmental, social, and economic impacts) and the steps PNG has taken to address or mitigate these impacts.

The re-activation project ("RECAP") may come into the engagement scope given the natural gas rate mitigation that the RECAP project provides in concert with the S2G project. However, at this time RECAP is not the central focus of the engagement. RECAP will be referenced as required to keep stakeholders informed.

In addition, because the PNG Looping Project has been a recent focus of stakeholders in this area, the outreach may provide an opportunity to provide an update on the status of the PNG Looping Project, which has been indefinitely suspended.

3.5 Key Audiences

Our communication strategies have been divided into two main audiences. Indigenous communities and key public stakeholders. Separate communications and engagement strategies will be developed for each audience.

Key public stakeholders have been further divided into three engagement tiers. See section 5.5

3.6 Communication and Engagement Tools

The following communication and engagement tools will be used to inform the public and Indigenous communities of the Project. Provided below is a definition of each of the proposed engagement tools.

Tool	Description
Communications and Engagement Plan	Internal strategic plan for communications and engagement
Phone calls/emails	Direct contact with Indigenous communities and key public stakeholders
Virtual Meetings / Video Conferencing	Meeting to take place via video conferencing software, such as MS Teams or Zoom
Social Media (Facebook, Twitter, LinkedIn)	Project information, website, and survey notification.
Fact Sheet	Project information fact sheet to be shared with Indigenous communities and stakeholders
PNG Website / Consultation Platform	To support the communication and awareness of the Project, a project webpage will be developed for PNG's website. The webpage will provide project information and project maps. Information will be updated as the project processes. The toll-free line and email address will also be posted. Project information will use clear and accessible language.
Webinar	Two live webinars will be hosted to provide the public with an opportunity to learn more about the project and ask questions to the expert panel members. We will do a dry run/media prep prior to the webinar of key messages and Q&A's.
Toll-free line and email	A dedicated email address and toll-free number will be created for this project to keep track of comments received and PNG's responses.
Key Messages	Key Project information in a short easy to understand format. To be used internally to help guide conversations.
FAQ	Questions and answers to questions we anticipate hearing from Indigenous communities and the public. To be used internally to help guide conversations.
Bill Insert	A bill message will be used to community the project and direct customers to the webpage for more information. These will take place in September and October depending on customers' billing cycles.
Newsletter	Ongoing information throughout the life of the project to share project updates with Indigenous communities and key stakeholders.

Tool	Description
Print and electronic ads	PNG will place newspaper ads in local and regional newspapers in accordance with BCUC guidelines to inform the public of the Project and CPCN application. Interview with the local paper to leverage paid placement. Ads will also be placed on PNG's social media feeds (i.e., Facebook ads, LinkedIn) and on the website to provide information to the public. (NB: Facebook is under scrutiny at the moment but is still widely used by residents throughout the region.)
Press/Media Release	Announcement of Project and CPCN application will be developed and sent to local media outlets.
"Open House" Boards	TBD – may be used digitally only Due to the current COVID-19 restrictions for in-person meetings, a virtual open house is planned for this project, however, stakeholders will be solicited to see if an in-person open house is desired. If so, a combination virtual/in-person meeting may be contemplated.
Project Information "Deck"	A PowerPoint presentation "deck" will be created to provide an overview of the project, timing, impacts, budget, etc. This will be used in in-person and virtual presentations and will be a component of on-line engagement platform information.

4 Indigenous Engagement

4.1 Indigenous Engagement Overview

The field of Indigenous engagement and consultation is constantly evolving, and our engagement specialists have developed a strong understanding that expectations for early, meaningful, and collaborative engagement is both expected by First Nations and beneficial to the success of the Project. PNG's engagement approaches reflect our understanding of this paradigm, and we will recommend steps and activities that ensure that PNG is demonstrating a proactive, collaborative and respectful approach, designed to develop meaningful and lasting relationships with the people whose traditional territory is home to PNG's operations. This will help to reduce conflict, encourage mutual understanding, and avoid unnecessary and costly delays.

4.2 Indigenous Communities

Based on the information provided, we anticipate that the project will require consultation and engagement with up to six First Nations:

- Kitselas
- Kitsumkalum
- Lax Kw'alaams

- Metlakatla
- Gitxaala
- Gitga'at

In addition to the BCUC, we will work with the BC OGC to confirm the depth of consultation required for each First Nation (i.e., Notification or Consultation). We anticipate that consultation will be deepest with Kitselas, Kitsumkalum, Lax Kw'alaams and Metlakatla, and that Gitxaala and Gitga'at likely will require only notification of project activities. The level of consultation will also be guided by the level of interest or concerns expressed by each First Nation. PNG will also consider the principles of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) in its engagement efforts.

4.3 Key Engagement Activities

Proposed Consultation Steps will be:

1) Introductory letters sent to each First Nation, providing a detailed description of the proposed works, time frames, regulatory requirements, and invitation to engage with PNG regarding any concerns or issues.
2) Follow up phone calls to those First Nations most directly impacted by the works (Kitselas, Kitsumkalum, Lax Kw'alaams and Metlakatla, to be confirmed), or based on expressed concern in response to introductory letters.
3) Arrange an introductory *virtual* meeting between representatives of PNG and the impacted First Nations, to discuss the project work and explore concerns and issues. We expect meetings will be conducted through on-line video-conferences through our MS Teams or other appropriate platform. If a First Nation specifically requests an in-person meeting, we will arrange to meet within the community with appropriate physical distancing provided through larger space, hygiene, masks, or other precautions. Establish a communications and consultation protocol with each First Nation to ensure that expectations are clarified and confirmed between all parties.
4) Ensure that First Nations receive and understand the contents of the application materials.
5) Meet with the First Nations (virtually or by phone) as needed to discuss any concerns or issues related to the application and/or planned work. Provide documentation where appropriate to support the mitigation efforts related to First Nations concerns.
6) Prepare a Record of Engagement with each First Nation, to ensure it is comprehensive and accurate, and discuss any discrepancies, issue resolution concerns, etc.
7) Provide each First Nation with a copy of the BCUC CPCN application.

5 Public Engagement

5.1 Public Engagement Overview

PNG anticipates reaching out to known stakeholders, as well as members of the affected non-Indigenous communities of Prince Rupert, Terrace and Port Edward.

PNG will prepare summary overviews of each community, identifying location, population information, known concerns or interests, key contacts, and other relevant information.

PNG will prepare overview material regarding the proposed work, application process, timing, etc.

PNG will distribute project overview information and an invitation to provide feedback to the project to key community contacts, as well as people and groups identified on the Stakeholder list to be provided by PNG.

PNG will develop a specific consultation and engagement on-line webpage. Due to the Covid-19, PNG will not host an in person open house. Instead, we will host two online webinars to share project information and answer questions directly from the public. Members of the public and stakeholders will be invited to provide written and oral submissions of their concerns and interests in the project activities, through a dedicated email address and phone line.

PNG will arrange for virtual (and possible in-person) meetings between PNG representatives and representatives of the communities of Prince Rupert, Terrace and Port Edward, to discuss the project activities, timing, impacts on the community and area, and other issues and interests.

5.2 Stakeholder Mapping

Preliminary stakeholders have been identified as follows:

- BC Ministry of Environment
- BC Ministry of Energy, Mines & Petroleum Resources
- BC Ministry of Transportation and Infrastructure
- BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRD)
- Transport Canada / Coast Guard
- RIPET
- Residents of Prince Rupert and Port Edward
- Prince Rupert Port Authority
- Ridley Terminals
- Pembina
- City of Prince Rupert
- District of Port Edward
- City of Terrace
- North Coast Regional District
- Kitimat-Stikine Regional District
- Local Member(s) of BC Legislature and Member of Parliament
- BC Hydro
- Interfor
- CN Rail
- Mineral Tenures
- Guides/Trappers

- Water Licenses / Water shed
- Enbridge
- Regional Chambers of Commerce
- General Public

5.3 Level of Assessment Criteria

Public participation (P2) ranges from information sharing to delegating decision making directly to the community. Within the community context, different initiatives will require different levels of engagement.

The strategy for structuring and implementing engagement around the Public Awareness Campaign would uphold the principles of the IAP2 spectrum

IAP2 Public Participation Spectrum of Engagement

Inform	Consult	Involve	Collaborate	Empower
Information Sharing	Consultation		Active Participation	
Sharing information to build awareness	Testing ideas or concepts to build knowledge	Collaborating to develop solutions	Sharing decision making	Delegating decision making

5.4 Community Impact

The level of community impact is the effect that a specific action, decision or project will have on the community or stakeholder. PNG will proactively engage those most impacted by the project and will notify/inform those who may have an interest in the project. In addition, PNG will engage any interested party that requests further information.

Based on our assessment, public consultation will be restricted to the IAP2 levels of Inform, Consult and Involve. The following table illustrates the anticipated Level of consultation of anticipated stakeholders. Actual levels may be modified based on the level of interest or concern expressed by the stakeholders during the consultation process.

Inform **Tier 1 Stakeholders** **High interest potential**	**Consult** **Tier 2 Stakeholders** **Moderate interest potential**	**Involve** **Tier 3 Stakeholders** **Low interest potential**
City of Prince Rupert	PNG Gas/ Sales customers	Interfor
District of Port Edward	BC Ministry of Environment	CN Rail
BC Archaeology Branch	BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRD)	Enbridge
BC Oil and Gas Commission	Ministry of Energy and Mines and Petroleum Resources	RECAP Shippers

Inform **Tier 1 Stakeholders** **High interest potential**	**Consult** **Tier 2 Stakeholders** **Moderate interest potential**	**Involve** **Tier 3 Stakeholders** **Low interest potential**
BC Utilities Commission	Transport Canada	Local Member(s) of BC Legislature and Member of Parliament
Water Licences/Watershed	BC Ministry of Transportation and Infrastructure	Regional Chambers of Commerce
BC Parks	Prince Rupert Industrial Park	
Private Landowners	RIPET (Ridley Island Propane Export Terminals)	
Department of Fisheries and Oceans	Prince Rupert Port Authority	
Mineral tenures	Ridley Terminals	
Guides/Trappers	Pembina	
	North Coast Regional District	
	Prince Rupert Port Authority	
	Ridley Terminals	
	Pembina	
	North Coast Regional District	
	Kitimat-Stikine Regional District	
	BC Hydro	

6 Engagement Strategy

6.1 Key Engagement Tasks

	Activity	**Approach**	**Timing**
1.	Confirm list of Indigenous communities	PNG to send CPG Indigenous community list. CPG to also confirm with OGC.	July 13-17
2.	Confirm stakeholders	Review stakeholder register list and develop consultation approach for each category/tier. PNG to forward list and CPG to map out approach	July 13-17
3.	Review and organize consultation record	CPG to review PNG records to date	Done
4.	Draft Project Fact sheet	CPG to draft project fact sheet for PNG to review	July 6-10
5.	Develop key messages	Key messages for the project and updates on the Looping project and RECAP	July 6-10
6.	Draft FAQ's	CPG to draft questions, PNG to review and provide key messaging responses	July 13-17

	Activity	Approach	Timing
7.	Develop Bill inserts	PNG to determine if there is sufficient time for bill inserts. CPG can draft content for bill insert.	July 13-17
8.	Initial contact with Indigenous communities	CPG to initiate contact with Indigenous communities through email. Project Fact sheet to be included.	July 13-17
9.	Initial contact with stakeholders	CPG to initiate contact with stakeholders via email. Project fact sheet to be included.	July 13-17
10.	Identify potential work opportunities	PNG to provide list of potential contract opportunities for Indigenous communities on pre-construction environmental studies as well as construction opportunities	ongoing
11.	Confirm which reserves are on ROW	Identify reserves on ROW and identify if the ROW agreement has any specific requirements	
12.	Develop dedicated project website	Project webpage developed and linked to PNG website.	July 13-17
13.	Upload content onto PNG website, Facebook and Twitter	PNG to upload content to relevant platforms	July 13-17
14.	Dedicated toll-free line and email address	Set up dedicated project toll-free line and email address. PNG to monitor	July 13-17
15.	Arrange virtual open house for key stakeholders	Virtual (and possibly in-person) open house to include project information online	July 20 -24
16.	Arrange virtual meetings with Indigenous communities	CPG to connect with Indigenous communities and set up virtual meetings~~.~~ (and possibly in-person). PNG to identify their participants and confirm video platform	July 20 -24
17.	Newspaper Ads	Newspaper ads in the Prince Rupert Northern View and the Terrace Standard as per BCUC guidelines.	Early August
18.	Press releases	CPG to draft a press release about the project to be shared with local media outlets	July – August
19.	Communications and engagement protocol	Establish protocols with each First Nation to ensure expectations are	July – August

	Activity	Approach	Timing
		clarified and confirmed between all parties	
20.	Arrange virtual meetings with key (Tier 3) stakeholders	CPG to connect with key stakeholders and set up virtual meetings. PNG to identify their participants and confirm video platform	July – August
21.	Webinar	Host two live webinars with subject matter experts with PowerPoint presentation followed by Q&A	August 17-19
22.	Ongoing engagement follow-up	As needed follow-up with Indigenous communities and stakeholders, as needed	Ongoing
23.	Updates to online content as needed	Updates to website, Facebook, Twitter as needed. CPG to draft content and PNG to upload	Ongoing
24.	Meeting and engagement summaries	Summaries of all meetings, including action items and next steps to ensure ongoing collaboration, openness and transparency, and to ensure that all parties meet expected activities and outcomes	Ongoing
25.	Issues Log	Ongoing issues management list, including mitigation efforts	Ongoing

7 Risk Assessment

7.1 Key Issues

We anticipate a number of key issues and impacts/risks for the project as they relate to the public and Indigenous communities, including:

- Environmental impacts (proximity to bodies of water and water crossings, tree removals and sensitive habitat)
- Construction impacts (traffic, road disruptions, noise disturbances)
- Customer impacts (potential disruptions in gas service from construction)
- Type of land involved in the operation work (park, conservancy, heritage, or archaeological sites)
- Significant natural gas rate impact to PNG customers
- Public perception that consultation is rushed

8 Consultation and Engagement Tracking

8.1 Record of Engagement

All engagement and consultation activities with the public and Indigenous communities will be tracked using our Record of Engagement template. The ROE will track:

- Names of persons involved in each engagement, including roles and positions
- Date and time of engagement activities
- Nature of the engagement, including phone call, meeting, email, mail or other form
- Summary of key issues and discussion points, scope of engagement
- Action items and next steps arising from the engagement
- Issues and/or concerns identified
- Mechanisms for resolution avoidance, mitigation or follow-up required
- Attachments, meeting notes or relevant documentation
- Other information, as relevant

8.2 Issues and Concerns Raised

An Issues Log will also be developed to capture issues raised, mechanisms for avoidance, mitigation, restoration and accommodation, next steps, and outstanding issues throughout the consultation process, through to submission of the BCUC Application.

8.3 Evaluation/Outcomes

Our success will ultimately be measured by community support for the project. Community support will be measured by community interest in the webinar, media coverage and stakeholder interest in connecting with PNG on the project.

Appendix S – Public Engagement Materials

Appendix S-1

Salvus to Galloway Project News Release

Pacific Northern Gas Ltd.

News Release

FOR IMMEDIATE RELEASE

Pacific Northern Gas Plans to Upgrade the Western Transmission Gas Line

Salvus to Galloway section improvements needed to maintain PNG's high safety and reliability standards

PRINCE RUPERT, B.C. and COAST TSIMSHIAN TERRITORY, July 30, 2020 – Today Pacific Northern Gas Ltd. (PNG) announced the Salvus to Galloway Gas Line Upgrade Project for its Western Transmission Gas Line and virtual public information sessions, building on pre-engagement meetings and archeological studies from earlier this year.

"The Western Transmission Gas Line is a critical part of our system," said Joe Mazza, Senior Vice President, Operations and Engineering. "For more than 50 years, it has safely and reliably supplied thousands of PNG's residential, commercial and industrial customers throughout the Prince Rupert and Port Edward area. We regularly inspect and maintain the line, but some sections are nearing the end of their useful operating life. It is now time for an upgrade project to ensure the line's continued high standard of operation."

PNG is proposing to conduct infrastructure upgrades to repair and replace sections along an 80-kilometre segment of the Western Transmission natural gas line between the Salvus maintenance yard and the Galloway pressure regulating station. All work is expected to take place within PNG's existing pipeline corridor, referred to as a right-of-way, and nearby permitted temporary workspace.

The project is in the early planning stages, as PNG prepares to submit a Certificate of Public Convenience and Necessity application for approval by its regulator, the British Columbia Utilities Commission (BCUC). The project is expected to cost approximately $80 million and PNG anticipates that the application will be filed this fall, with a BCUC decision in spring 2021. Following approval, construction would begin in the summer of 2021 and continue in phases each summer, with completion slated for the fall of 2023. PNG is consulting with Indigenous communities and engaging with the public in advance of the BCUC application submission and will continue engagement throughout all project phases.

"PNG recognizes the importance of the territory to Indigenous communities, and the residents of Prince Rupert, Port Edward and the surrounding area," said Mazza. "We want to ensure that we are proposing a project that is good for the region. That is why we will be working with Indigenous communities and community leaders, and we will be reaching out to the broader public to share information and seek input through our website, toll-free number and virtual information sessions."

PNG's top priority for projects and day-to-day operations is the safety of employees, contractors and the public. In light of the COVID-19 pandemic and the need for physical distancing, PNG will be hosting virtual information sessions for the public on Wednesday August 19 and Wednesday, August 26.

"We look forward to hearing from the community, building our application and providing more economic, employment and training opportunities for the region through this project," said Mazza.

To learn more about the project, upcoming information session and to provide feedback, visit png.ca/projects/S2Ggasline.

Media contact:

Pacific Northern Gas Ltd.
Joyce Wagenaar
Project Communications
604.817.5539
jwagenaar@png.ca

About Pacific Northern Gas Ltd.

Pacific Northern Gas Ltd. (PNG), a wholly owned subsidiary of TriSummit Utilities Inc., owns and operates a natural gas transmission and distribution system in west-central British Columbia and through its subsidiary Pacific Northern Gas (N.E.) Ltd. PNG also owns and operates natural gas distribution systems and a gas processing plant in the province’s northeast. This includes approximately 3,000 km of distribution mains and services pipelines and 1,200 km of transmission pipelines. PNG has been operating in northern British Columbia for over 50 years, and provides gas service to approximately 42,000 residential, commercial and industrial customers in more than 16 communities across western and northeastern British Columbia.

For more information visit: www.png.ca.

Appendix S-2

Salvus to Galloway Project Fact Sheet

PROPOSED SALVUS TO GALLOWAY UPGRADE PROJECT (S2G)

PROJECT FACT SHEET

Intr

Pacific Northern Gas Ltd. (PNG) owns and operates the Western Transmission gas line. The line was built in the 1960s and transports natural gas from Summit Lake to Kitimat and Prince Rupert, providing natural gas service to commercial and residential customers in communities along the way.

Proposed Project

PNG proposes to conduct infrastructure upgrades to repair and replace sections along an 80 km segment of the eight-inch (219.1 mm) diameter West Transmission Prince Rupert Mainline. The proposed work will take place from the Salvus maintenance yard to the Galloway pressure regulating station. This project is expected to cost approximately $80 million.

Project Need

This work is required to maintain the integrity of the pipeline and replace segments of the pipe that are nearing the end of their useful lifespan. This is a regulatory requirement of PNG's licence to operate, as governed by the B.C. Oil and Gas Commission. This project will:

- Ensure the continued safety of the pipeline and reliability of natural gas service;
- Enhance pipeline stability by addressing geotechnical risks from landslide, rockfall, avalanche, and washout; and
- Ensure long-term reliable energy supply to thousands of residential, commercial, and industrial customers throughout the communities we serve in the Prince Rupert and Port Edward region.

Maintaining the integrity of the line is essential to supporting the well-being of the communities in which PNG operates, preserving associated economic activities and sustaining jobs in the region. Prince Rupert is home to the third largest Port in Canada and depends on a reliable supply of natural gas to provide exports to countries around the world.

All work will comply with the Canadian Standards Association Oil and Gas Pipeline Systems Standards (the governing standards for the safe design, construction, operation and maintenance of natural gas pipelines).

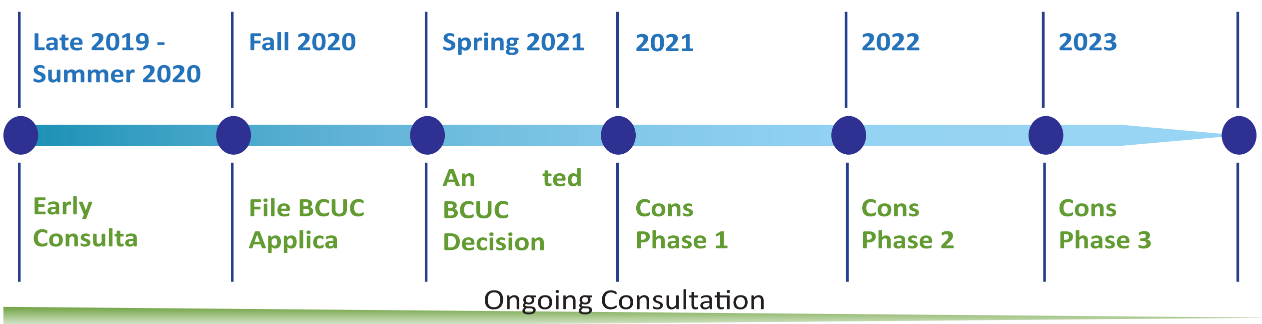
Loca errain

The Salvus to Galloway segment of the West Transmission Prince Rupert Mainline runs through a remote mountainous region north of Highway 16 West and south of Work Channel, starting at Salvus approximately 50 km southwest of Terrace, up to Galloway Rapids approximately 9 km southeast of Prince Rupert.

The gas line traverses very challenging mountainous terrain and straddles several prominent geological features such as the Huckleberry Creek Valley and Prudhomme Mountain, and hydrological features including Arden Creek, Kasiks River and Khyex River.

Salvus to Galloway Gas Line Upgrades

Proposed Project Schedule

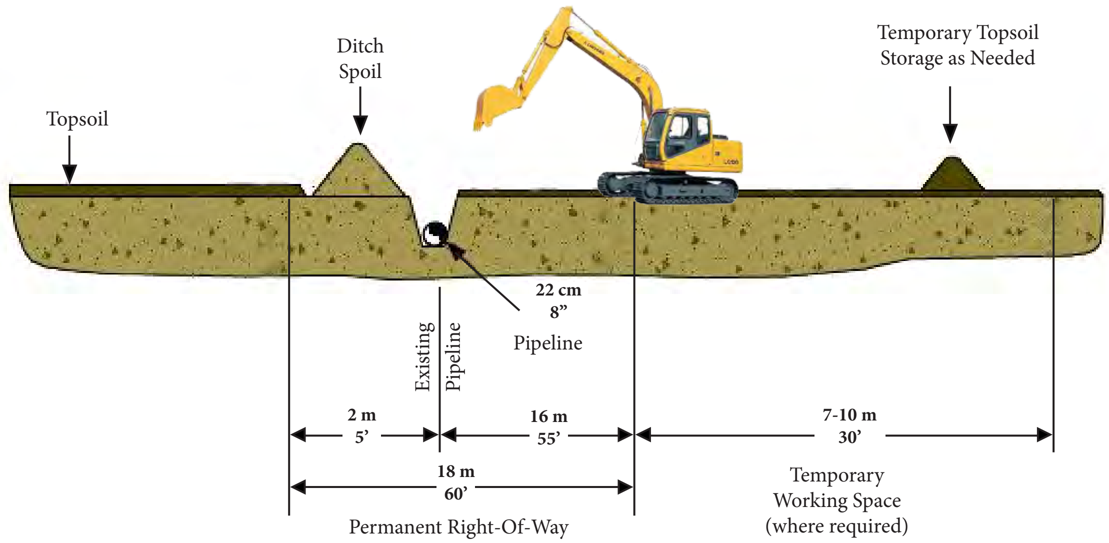


Pacific Northern Gas Ltd.

Descrip

Project work will be conducted within the existing PNG pipeline corridor referred to as a right-of-way (ROW) and nearby permitted temporary workspace. PNG's respect for the environment guides our decisions and is why careful consideration is taken when planning our projects. Work will adhere to all federal and provincial environmental guidelines as well as PNG's project specific and corporate Environmental Management Plans, as well as archaeological mitigation plans.

Typical Right-of-Way



Following regulatory approvals, work is scheduled to begin in 2021 and will continue through 2023. Project work will include the following activities:

<u>Access Management</u>

Development of both temporary and permanent access to specific locations.

Activities include:

- Equipment mobilization/demobilization;
- Clearing along the existing ROW and new temporary workspace;
- Installation of temporary and permanent watercourse crossings using environmental specialists for equipment ingress/egress;
- Building access paths including quarrying, material hauling, placing, compaction and ditching, and
- Development of equipment/materials staging and laydown areas.

Integrity Digs

Ground excavation to uncover the pipeline anomalies and assess condition.

Activities include:

- Clearing and site preparation;
- Material excavation and storage;
- Management of surface and groundwater during open trench condition, and
- Site remediation.

Gas Line Repairs

Pipe remediation work to restore safe pipeline condition.

Activities include:

- Repairing, removing and replacing sections of pipe, safety testing and site restoration including safely exposing and excavating the existing pipeline; and
- Site remediation.

Geohazard Mitigation

Construction of mitigation measures to protect the pipeline from geohazards.

Activities may include:

- Increase depth of cover through pipeline lowering, increasing fill thickness over top of the line, or increasing pipe wall thickness;
- Re-routing the pipeline within the ROW; and
- Site remediation.

Required Permits and Approvals

- British Columbia Utilities Commission: Certificate of Public Convenience and Necessity
- British Columbia Oil and Gas Commission: Notice of Intent (Replacement in Kind)
- Section 11 Approval for Changes in and About a Stream; License of Occupation; Master License to Cut
- Department of Fisheries and Oceans: FFA Authorization
- Heritage Conservation Act: 12.2 Heritage investigation Permit Site Alteration Permit
- B.C. Parks: B.C. Parks Use Permit for Works within Khyex Conservancy

Natural Gas Service During Cons

During PNG's construction phase, some segments of the gas line will need to be shut down for short periods of time. PNG will endeavour to minimize interruption of gas flow to customers during these service outages.

Health and Safety

Safety is PNG's top priority and the company has an excellent safety record. All work on the project will be subject to a comprehensive safety and emergency response plan to protect the health and safety of its workers, the public, Indigenous communities, and the environment. PNG will develop a comprehensive health and safety plan for the project.

PNG conducts regular inspections of all its gas lines including aerial patrols, in-line inspections, cathodic monitoring, and periodic brush clearing. PNG's entire pipeline infrastructure is monitored 24-hours a day using a sophisticated computer-based system operating in real time. The pipeline has shutoff valves at regular intervals along the route, which ensure that interruptions or concerns with the line can be identified immediately.

Indigenous and Community Engagement

PNG is committed to involving Indigenous communities and stakeholders early in the process.

PNG will provide information to Indigenous communities, the public, and all interested parties in the region, to seek input and feedback and answer any questions or concerns. Information will be made available prior to the submission of the application to PNG's regulators, as well as throughout the project. All input and feedback will be captured and tracked, and will form part of PNG's engagement record in its filings.

Indigenous communities affected by the project will be engaged directly by PNG representatives to discuss the project and its potential impacts on Indigenous interests.

PNG will be organizing opportunities for public input through written and on-line submissions, as well as virtual online information sharing opportunities. A dedicated phone line and email address have been established to receive questions and comments.

Once the project receives approval to proceed, PNG will continue consultation and engagement with Indigenous communities and stakeholders throughout the Project.

About PNG

Pacific Northern Gas Ltd., a wholly owned subsidiary of TriSummit Utilities Inc., owns and operates a natural gas transmission and distribution system in west-central British Columbia, and through its subsidiary Pacific Northern Gas (N.E.) Ltd. PNG also owns and operates natural gas distribution systems and a gas processing plant in the province's northeast. This includes approximately 3,000 km of distribution mains and services pipelines and 1,200 km of transmission pipelines.

PNG has been operating in B.C. for over 50 years, and provides gas service to approximately 42,000 residential, commercial, and industrial customers in more than 16 communities across Western and Northeastern British Columbia.

PNG Service Areas

Contact for Further Informa

Project Phone Line: 1-888-709-7304
Project Email: S2Ggasline@png.ca
Project Website: www.png.ca/projects/S2Ggasline

Follow us on Twitter, LinkedIn, Facebook

Appendix S-3

Salvus to Galloway Project Stakeholder Letters

Joe Mazza, P.Eng.
Vice-President, Operations & Engineering

Pacific Northern Gas Ltd.
2550 – 1066 West Hastings St.
Vancouver, BC V6E 3X2
Tel: (604) 697-6219
Fax: (604) 697-6210
Email: jmazza@png.ca

Tier 1 Stakeholder Letter

July 30, 2020

«Contact_Name»
«Stakeholder»
«Mailing_Address»
«Email»

Attention: «Contact_Name»,

Re: PNG West Transmission Line – Salvus to Galloway Upgrade

Pacific Northern Gas Ltd. (PNG) would like to notify you of a proposed upgrade project that may be of interest to you.

PNG is submitting an application to the BC Utilities Commission for approval to conduct necessary maintenance and Integrity upgrade work on approximately 80 km of our West Transmission natural gas line between the Salvus maintenance yard and the Galloway pressure regulating station. These upgrades are a regulatory requirement under PNG's license to operate with the BC Oil and Gas Commission (BC OGC) and are necessary to maintain the integrity of the pipeline up to and including the replacement segments of the pipe that are nearing the end of their useful lifespan.

I am attaching a Project Fact Sheet that provides more details about the proposed project, including the location, project schedule and a summary of the work to be completed.

We have asked Cornerstone Planning Group (Cornerstone) to assist with coordinating consultation with stakeholders and interested parties. A representative of Cornerstone will be reaching out to you to arrange a further discussion, and to invite your active participation in the review of the application. Alternatively, you may reach out directly to Natasha Kappell at (778) 676-4961 or natasha@cornerplan.com.

Due to the ongoing COVID-19 pandemic, we expect to conduct our engagement by phone, video conferencing, or other ways to ensure the safety and well-being of all.

PNG is creating a project website with more information and is planning on hosting a “virtual open house” for members of the public and interested parties to learn more about the project and provide feedback. We will share this information with you as it becomes available.

Sincerely,

Joe Mazza
Senior Vice President, Operations and Engineering

Attachment: Project Fact Sheet

CC: Brock John, Director Business Development and Stakeholder Relations

Pacific Northern Gas Ltd.
Joe Mazza, P.Eng.
Vice-President, Operations & Engineering

Pacific Northern Gas Ltd.
2550 – 1066 West Hastings St.
Vancouver, BC V6E 3X2
Tel: (604) 697-6219
Fax: (604) 697-6210
Email: jmazza@png.ca

Tier 2 and 3 Stakeholder Letter

July 30, 2020

«Contact_Name», «Title»
«Stakeholder»
«Mailing_Address»
«Email»

Attention: «Contact_Name»,

Re: PNG West Transmission Line – Salvus to Galloway Upgrade

Pacific Northern Gas Ltd. (PNG) would like to notify you of a proposed upgrade project that may be of interest to you.

PNG is submitting an application to the BC Utilities Commission for approval to conduct necessary maintenance and Integrity upgrade work on approximately 80 km of our West Transmission natural gas line between the Salvus maintenance yard and the Galloway pressure regulating station. These upgrades are a regulatory requirement under PNG's license to operate with the BC Oil and Gas Commission (BC OGC) and are necessary to maintain the integrity of the pipeline up to and including the replacement segments of the pipe that are nearing the end of their useful lifespan.

I am attaching a Project Fact Sheet that provides more details about the proposed project, including the location, project schedule and a summary of the work to be completed.

We have asked Cornerstone Planning Group (Cornerstone) to assist with coordinating consultation with stakeholders and interested parties. If you would like to arrange to meet with PNG to discuss the proposed project further, please contact Natasha Kappell at (778) 676-4961 or natasha@cornerplan.com.

Due to the ongoing COVID-19 pandemic, we expect to conduct our engagement by phone, video conferencing, or other ways to ensure the safety and well-being of all.

PNG is creating a project website with more information and is planning on hosting a "virtual open house" to share more about the project and provide feedback. We will share this information with you as it becomes available.

Sincerely,

Joe Mazza
Senior Vice President, Operations and Engineering

Attachment: Project Fact Sheet

CC: Brock John, Director Business Development and Stakeholder Relations

Appendix S-4

Salvus to Galloway Project Webpage

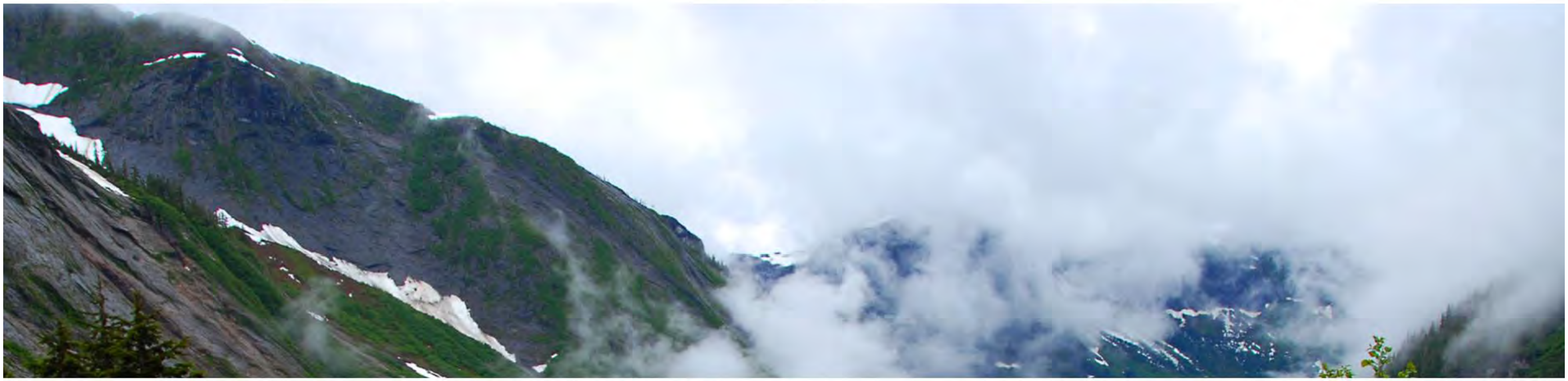
PNG Salvus to Galloway Gas Line Upgrade Project Webpage – png.ca

https://www.png.ca/projects/s2ggasline

PNG
PACIFIC NORTHERN GAS
A TriSummit Utilities Company

Search...

ACCOUNT | RESIDENTIAL | BUSINESS | SAFETY/ENVIRONMENT/EDUCATION | CORPORATE | PROJECTS | LATEST NEWS



Menu

- **Proposed Salvus to Galloway Gas Line Upgrade Project**
- Request for Expressions of Interest for RNG Supply

Proposed Salvus to Galloway Gas Line Upgrade Project

About the Project

Pacific Northern Gas (PNG) is proposing to conduct infrastructure upgrades to repair and replace sections along an 80-kilometre segment of the eight-inch (219.1 mm) diameter Western Transmission gas line between the Salvus maintenance yard and the Galloway pressure regulating station.

For more than 50 years, the Western Transmission gas line has safely and reliably supplied thousands of PNG's residential, commercial and industrial customers throughout the Prince Rupert and Port Edward area. We regularly inspect and maintain the line, but some sections are nearing the end of their useful operating life. It is now time for an upgrade project to ensure the line's continued high standard of operation.

Location

The Salvus to Galloway segment of the Western Transmission gas line runs through a remote mountainous region of Highway 16 West and south of Work Channel, starting at Salvus approximately 50km southwest of Terrace, up to Galloway Rapids approximately 9km southeast of Prince Rupert.

All work is expected to take place within PNG's existing pipeline corridor, referred to as a right-of-way, and nearby permitted temporary workspace.


Salvus to Galloway Gas Line Upgrades
PRINCE RUPERT
Khutzeymateen Provincial Park
GALLOWAY
PORT EDWARD
SALVUS
Haida Gwaii
Skeena River
Gitnadoix River Recreation Area
Western Transmission Gas Line
Section to be upgraded
Section to Summit Lake

Timelines and Next Steps

The project is in the early planning stages, as PNG prepares to submit a Certificate of Public Convenience and Necessity application for approval by our regulator, the British Columbia Utilities Commission (BCUC).

The application for the $80-million project is expected to be filed this fall, with a BCUC decision in spring 2021. Following approval, construction would begin in the summer of 2021 and continue in phases each summer completing in fall 202 is engaging with Indigenous communities, stakeholders and the public in advance of the BCUC application submission and would continue engagement throughout all project phases.

Proposed Project Schedule

Working and Doing Business with Us

PNG is committed to providing project-related employment and business opportunities for local and Indigenous businesses in the vicinity of the project and within PNG's service territory, where possible.

To register your business, please complete the following form **here**

Public Engagement

PNG is committed to engaging early and continuously sharing information throughout the project. In August, we held two virtual information sessions providing the community with the opportunity to hear directly from the project team and any questions.

Although the sessions have passed, you are welcome to download the **presentation** and direct any questions you may have to the project team at the email or toll free number listed below.

Other ways to learn more and provide feedback

- Download our **project factsheet**
- Ask us a question or provide your feedback by phone or email.
  - Call us at: 1-888-709-7304
  - Email us at: **S2Ggasline@png.ca**

Appendix S-5

Salvus to Galloway Project Social and Digital Media

Salvus to Galloway Upgrade Project
Social and Digital Media Communications Materials

This attachment contains communications digital materials used to support the Salvus to Galloway Upgrade Project communications materials.

Included are the following samples:

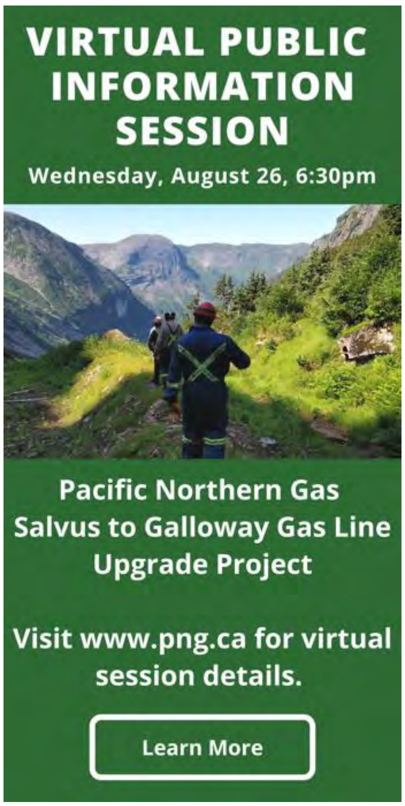
Digital Ads for the Prince Rupert Northern View and the Terrace Standard

Rotated daily from Aug 5 to Aug 26

Examples:

Additional Digital Display Ads added to the rotation, August 16 - 26

<u>Examples:</u>



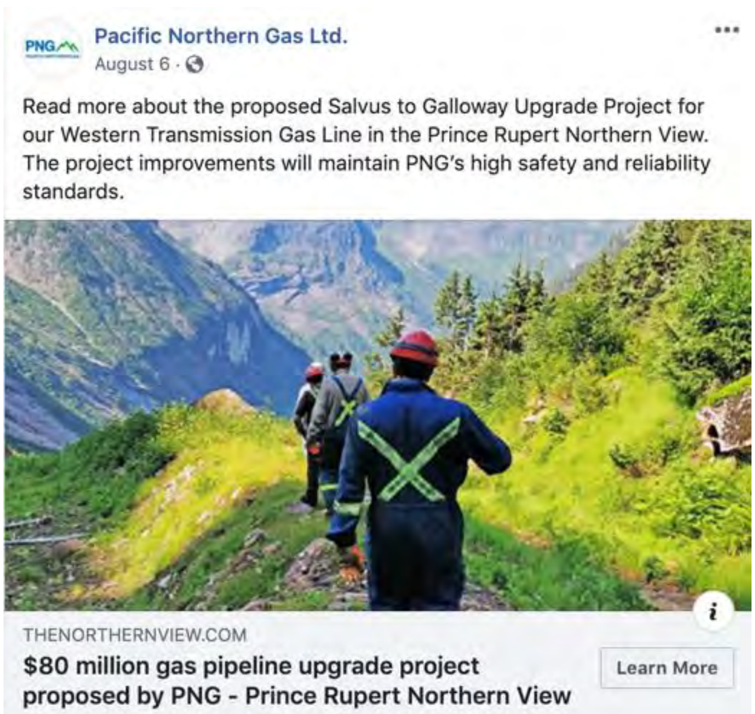
Social Media Ads: Black Press Platforms - August 19

Examples:

PNG's Social Media Content (Facebook, Twitter and LinkedIn

<u>August 5, 2020</u>

<u>August 6, 2020</u>



August 13, 2020

August 18

August 24

Pacific Northern Gas Ltd.
August 24 ·

PNG is hosting another virtual public information session this Wednesday, August 26. Our proposed Salvus to Galloway Gas Line Upgrade Project will further enhance safety and service reliability while bringing more economic, employment and training opportunities to the region during construction.

Visit https://www.png.ca/projects/s2ggasline to learn more. Optional pre-registration available at https://bit.ly/3aobelj

September 16

Pacific Northern Gas Ltd.
September 16 ·

PNG is committed to providing project-related employment and business opportunities for local and Indigenous businesses in the vicinity of the proposed Salvus to Galloway Upgrade Project and within PNG's service territory.

Learn more about the project and provide feedback by visiting https://www.png.ca/projects/s2ggasline

PNG.CA

Pacific Northern Gas Ltd. - Proposed Salvus to Galloway Gas Line Upgrade Project

Learn More

Appendix S-6

Salvus to Galloway Project Print Media

Community Information Sessions for Salvus to Galloway Gas Line Upgrade Project

Pacific Northern Gas (PNG) is proposing to conduct infrastructure upgrades to repair and replace sections along an 80-kilometre segment of the eight-inch (219.1 mm) diameter Western Transmission Gas Line between the Salvus maintenance yard and the Galloway pressure regulating station.

This project will:

- Ensure the continued safety of the pipeline and reliability of natural gas service;
- Enhance pipeline stability by addressing geotechnical risks from landslide, rockfall, avalanche, and washout; and
- Ensure long-term reliable energy supply to thousands of residential, commercial, and industrial customers throughout the communities PNG serves in the Prince Rupert and Port Edward region.

PNG will be submitting a Certificate of Public Convenience and Necessity application for approval by its regulator, the British Columbia Utilities Commission (BCUC). The application for the $80-million project is expected to be filed this fall, with a BCUC decision in spring 2021. Construction would begin in the summer of 2021 and continue in phases each summer, completing in fall of 2023.

Project information, including a detailed project overview and contact information to provide input and feedback on the proposed project, is now available on PNG's website at www.png.ca/projects/S2Ggasline.

PNG will be holding two virtual Community Information Sessions to provide further details on the project and to answer any questions. **Please join us by dialing in and accessing the presentaton and meeting through the information below:**

Date and Time	Mee
August 19, 2020, 6:30 PM - 8:00 PM	Audio: 1-888-300-0053 Conference ID: 8282564 Presentation at: www.png.ca/projects/S2Ggasline
August 26, 2020, 6:30 PM - 8:00 PM	Audio Access: 1-888-300-0053 Conference ID: 5769603 Presentation at: www.png.ca/projects/S2Ggasline

*If you have questions about our Proposed Salvus to Galloway Gas Line Upgrade Project, please attend a virtual Community Information Session, contact us by phone at **1-888-709-7304**, or email us at S2Ggasline@png.ca.*

Pacific Northern Gas Ltd.

Community Informa or
Salvus to Galloway Gas Line Upgrade Project

Pacific Northern Gas (PNG) is proposing to conduct infrastructure upgrades to repair and replace sections along an 80-kilometre segment of the eight-inch (219.1 mm) diameter Western Transmission Gas Line between the Salvus maintenance yard and the Galloway pressure regulating station.

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PNG will be holding its second virtual Community Information Session to provide further details on the project and to answer any questions. **Please join us by dialing in and accessing the presentaton and mee ng through the following informa on. You are welcome to register in advance using the website listed below.**

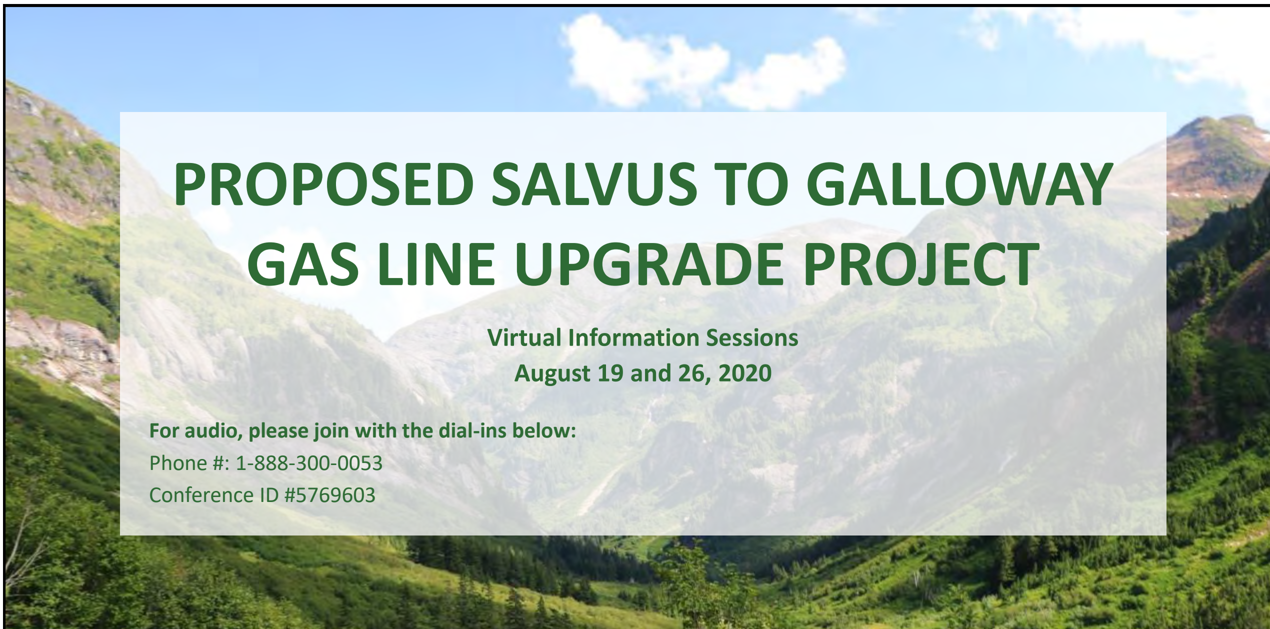
Date and Time	**Mee**
August 26, 2020, 6:30 PM - 8:00 PM	Audio Access: 1-888-300-0053 Conference ID: 5769603 Presentation at: www.png.ca/projects/S2Ggasline

If you have questions about our Proposed Salvus to Galloway Gas Line Upgrade Project, please attend a virtual Community Information Session, contact us by phone at ***1-888-709-7304****, or email us at* *S2Ggasline@png.ca***.**

PNG Pacific Northern Gas Ltd.

Appendix S-7

Salvus to Galloway Project Virtual Information Session Presentation



PROPOSED SALVUS TO GALLOWAY GAS LINE UPGRADE PROJECT

Virtual Information Sessions
August 19 and 26, 2020

For audio, please join with the dial-ins below:
Phone #: 1-888-300-0053
Conference ID #5769603

Welcome to our Public Information Session

YOUR PNG HOSTS

JOE MAZZA
Senior Vice President,
Operations and Engineering

CHAD FOURNIER
Director,
Asset Management and Project Delivery

AGENDA

- ✓ About PNG
- ✓ Proposed Project
- ✓ Project Need
- ✓ Project Benefits
- ✓ Work Activities
- ✓ Indigenous & Community Engagement

About PNG

✓ PNG owns and operates:

- A natural gas transmission and distribution system in west-central B.C.
- Natural gas processing, transmission and distribution systems in northeast B.C.
- Approximately 1,200 km of transmission pipelines, 3,000 km of distribution mains and service lines

✓ Operating in B.C. for over 50 years

✓ Services approximately 42,000 residential, commercial, and industrial customers in 16 communities

Pacific Northern Gas Ltd.

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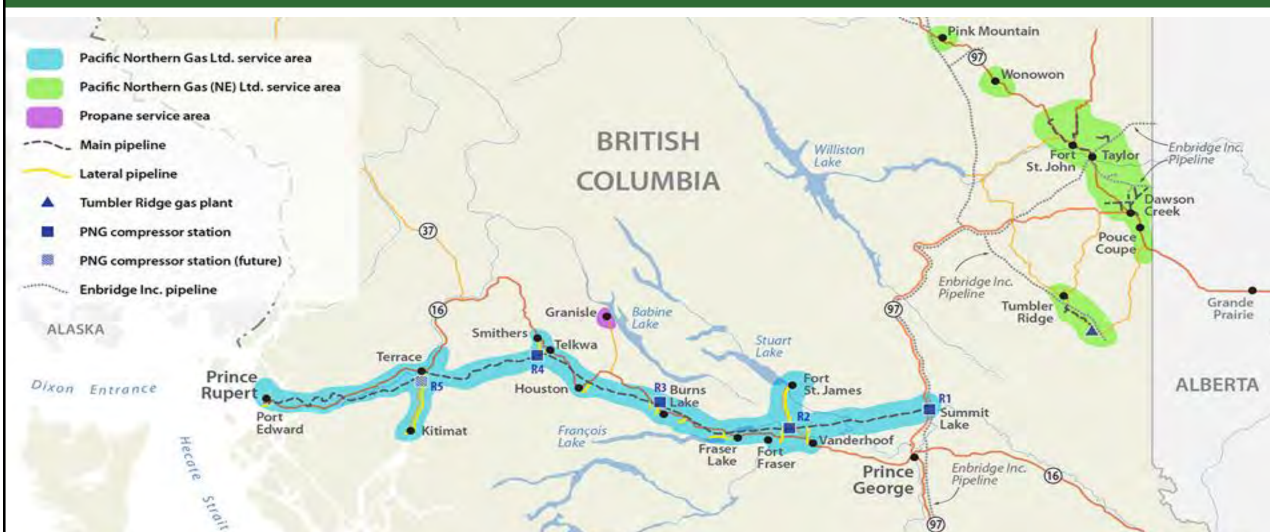
PNG Service Areas



Pacific Northern Gas Ltd.

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The Western Transmission Gas Line

PNG HAS BEEN OPERATING IN B.C. FOR OVER 50 YEARS

- PNG owns and operates the Western Transmission Gas Line
- Built in the 1960s, it transports natural gas from Summit Lake near Prince George to Kitimat and Prince Rupert

Pacific Northern Gas Ltd.

Proposed Project

Pacific Northern Gas Ltd.

Project Need

The Port of Prince Rupert (third largest in Canada) depends on reliable natural gas supply to provide exports around the world

THIS WORK IS REQUIRED TO:

- ✓ Ensure the continued safety of the pipeline and reliability of natural gas service for customers
- ✓ Enhance pipeline stability by addressing geotechnical risks
- ✓ Comply with applicable standards and regulations

Pacific Northern Gas Ltd.

Project Benefits

Economic benefits

Employment

Training

Pacific Northern Gas Ltd.

Proposed Project Timeline

Pacific Northern Gas Ltd.

Work Activities

Project work will be conducted within the existing PNG pipeline corridor or right-of-way (ROW) and nearby permitted temporary workspace.

WORK WILL ADHERE TO ALL:

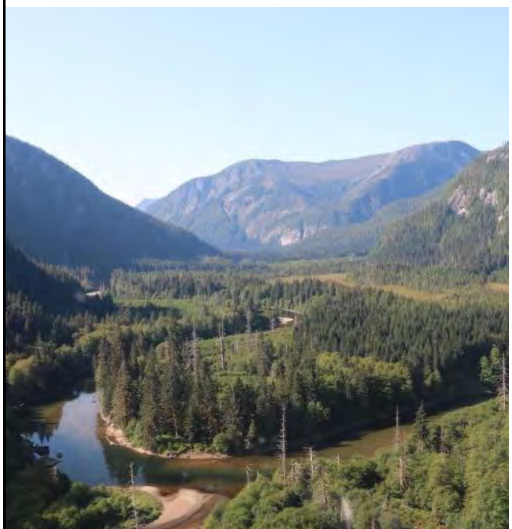
✓ Federal and Provincial Regulations and Guidelines

✓ PNG's best practice and management plans related to:

- Health and safety
- Environment
- Cultural preservation (archaeology)

Pacific Northern Gas Ltd.

Access Management



Guided by Qualified Environmental Professionals, both temporary and permanent access to specific locations will be developed.

ACTIVITIES INCLUDE:

- ✓ Mobilizing / demobilizing equipment
- ✓ Clearing along the existing ROW and new temporary workspace
- ✓ Installing temporary and permanent watercourse crossings
- ✓ Building access paths
- ✓ Developing of equipment/materials staging and laydown areas

Pacific Northern Gas Ltd.

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Integrity Digs and Direct Assessment

Ground excavation will be conducted to expose the pipeline in areas of potential anomalies or defects. This allows PNG to further assess the condition and repair or replace the pipe as necessary.

ACTIVITIES INCLUDE:

- ✓ Clearing and site preparation
- ✓ Material excavation and storage
- ✓ Management of surface and groundwater during open trench condition
- ✓ Safely exposing and excavating the existing pipeline
- ✓ Environmental remediation of the site

Pacific Northern Gas Ltd.

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Gas Line Repairs

Pipe repair and replacement work will be completed to restore pipeline integrity and improve the safety and reliability of operation.

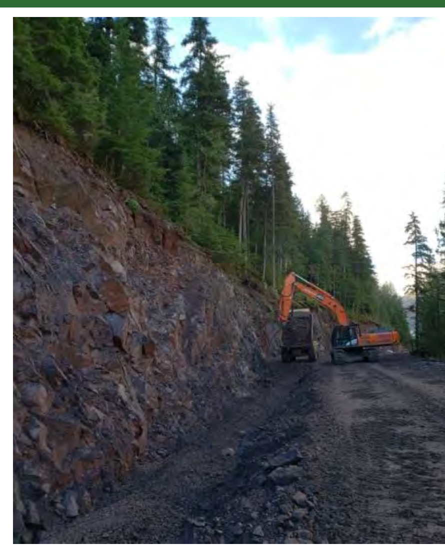
ACTIVITIES INCLUDE:

- ✓ Repairing, removing and replacing sections of pipe
- ✓ Welding, pipe stringing, field coating of pipe, and testing

Pacific Northern Gas Ltd.

Geohazard Mitigation

Construction of mitigation measures will be taken to protect the pipeline from geohazards, ensuring safe and reliable service.



ACTIVITIES INCLUDE:

- ✓ Mitigating risk to pipeline safety such as landslides and debris slides by increasing depth of cover over top of the line
- ✓ Upgrading pipe and increasing pipe thickness
- ✓ Relocating it within the right-of-way
- ✓ Conducting site remediation

Pacific Northern Gas Ltd.

Natural Gas Service During Construction

- During PNG's construction phase, some segments of the gas line will need to be shut down for short periods of time
- PNG will endeavour to minimize interruption of gas flow to customers during these times

Pacific Northern Gas Ltd.

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Health and Safety

ALL WORK ON THE PROJECT WILL BE SUBJECT TO:

Comprehensive health, safety, and environmental management and emergency response plans to protect the interests of:

Our workers

Indigenous communities

Customers

The public

The environment

Pacific Northern Gas Ltd.

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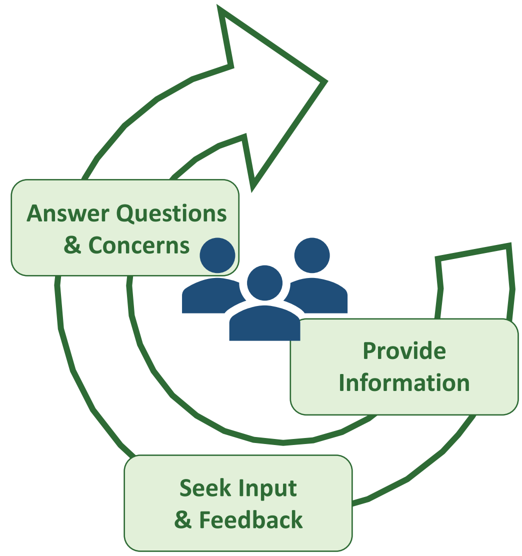
Indigenous and Community Engagement

PNG is committed to involving Indigenous communities and stakeholders early in the process.

THIS INCLUDES:

- ✓ Providing information to Indigenous communities, the public, and all interested parties in the region
- ✓ Directly engaging Indigenous communities and other stakeholders most affected by the project
- ✓ Providing various opportunities for public input and feedback
- ✓ Establishing a dedicated phone line and email address to receive questions and comments



Engagement Principles

PNG is committed to following best practice engagement principles.

THIS WILL INCLUDE:

- ✓ Provide timely and accurate information
- ✓ Conduct an open, transparent and honest engagement process
- ✓ Seek out and engage those who are affected
- ✓ Solicit and incorporate feedback

CONSULTATION AND ENGAGEMENT WITH INDIGENOUS COMMUNITIES AND STAKEHOLDERS WILL CONTINUE THROUGHOUT THE PROJECT.


Thank You for Participating
Further Information or Questions:
Project Phone Line: 1-888-709-7304
Project Website: www.png.ca/projects/S2Ggasline
Email: S2Ggasline@png.ca
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Appendix S-8

Salvus to Galloway Project Radio Spot

Traffic

Length

Music

VO

Pacific Northern Gas is proposing an important upgrade to their Western Transmission gas line between the Salvus Highway Maintenance Yard and Galloway Rapids. This upgrade will ensure the line's continued high standard of operation. The project will enhance safety and service reliability and is intended to bring economic and employment opportunities to the region during construction. PNG recognizes the importance of the territory to Indigenous communities, and the residents of Prince Rupert, Port Edward and surrounding area. Learn more and provide feedback at png.ca.

Appendix S-9

Salvus to Galloway Project Bill Messaging

Salvus to Galloway Upgrade Project

September / October 2020 Bill Messaging for PNG-West Customers

Pacific Northern Gas is planning the Salvus to Galloway Gas Line Upgrade project for its Western Transmission Gas Line. The project is needed to maintain PNG's high safety and reliability standard. It will also create economic, employment and training opportunities throughout the region. The project is in the early stages as PNG is building its project application for the B.C. Utilities Commission and consulting with Indigenous Communities and engaging with the public. To learn more visit: png.ca/projects/S2Ggasline.

Appendix T – Indigenous Community Engagement Materials

Appendix T-1

Salvus to Galloway Project Introduction Letter

Joe Mazza, P.Eng.
Senior Vice-President, Operations & Engineering

Pacific Northern Gas Ltd.
2550 – 1066 West Hastings St.
Vancouver, BC V6E 3X2
Tel: (604) 697-6219
Fax: (604) 697-6210
Email: jmazza@png.ca

July 28, 2020

«Name», «Title»
«First_Nation_»
«Mailing_Address»

Dear «Name»,

Re: PNG West Transmission Line Safety Upgrades – Salvus to Galloway

Pacific Northern Gas Inc. (PNG) would like to provide you information on the upgrade project that is proposed within your traditional territory.

PNG is submitting an application to the BC Utilities Commission for approval to conduct necessary maintenance and infrastructure upgrade work on approximately 80 km of our West Transmission natural gas delivery facilities between the Salvus maintenance yard and the Galloway pressure regulating station. These upgrades are a regulatory requirement under PNG's license to operate with the BC Oil and Gas Commission (BC OGC) and are necessary to maintain the integrity of the pipeline up to and including the replacement segments of the pipe that are nearing the end of their useful lifespan.

I am attaching a Project Fact Sheet that provides more details about the proposed project, including the location, project schedule, and a summary of the work to be completed.

PNG would like to participate in a discussion with you about your interests related to the proposed project. Please contact Jason Pope by email at jpope@png.ca or by phone at 250-847-8803 so that we can schedule a call.

Typically, we would seek to have face-to-face meetings with you in your community. However, due to the ongoing COVID-19 crisis, unless you specifically would like to meet in person, we propose to meet with you by phone, video conferencing, or other ways to ensure the safety and well-being of you and your community members.

PNG is creating a project website with more information and is planning on hosting a "virtual open house" to share more about the project and provide feedback. We will share this information with you as it becomes available.

Sincerely,

Joe Mazza
Senior Vice President, Operations & Engineering
Pacific Northern Gas Ltd.

Attachment: Project Fact Sheet

cc: Brock John, Director Business Development and Stakeholder Relations

Appendix T-2

Salvus to Galloway Project Fact Sheet

PROPOSED SALVUS TO GALLOWAY UPGRADE PROJECT (S2G)

PROJECT FACT SHEET

Intr

Pacific Northern Gas Ltd. (PNG) owns and operates the Western Transmission gas line. The line was built in the 1960s and transports natural gas from Summit Lake to Kitimat and Prince Rupert, providing natural gas service to commercial and residential customers in communities along the way.

Proposed Project

PNG proposes to conduct infrastructure upgrades to repair and replace sections along an 80 km segment of the eight-inch (219.1 mm) diameter West Transmission Prince Rupert Mainline. The proposed work will take place from the Salvus maintenance yard to the Galloway pressure regulating station. This project is expected to cost approximately $80 million.

Project Need

This work is required to maintain the integrity of the pipeline and replace segments of the pipe that are nearing the end of their useful lifespan. This is a regulatory requirement of PNG's licence to operate, as governed by the B.C. Oil and Gas Commission. This project will:

- Ensure the continued safety of the pipeline and reliability of natural gas service;
- Enhance pipeline stability by addressing geotechnical risks from landslide, rockfall, avalanche, and washout; and
- Ensure long-term reliable energy supply to thousands of residential, commercial, and industrial customers throughout the communities we serve in the Prince Rupert and Port Edward region.

Maintaining the integrity of the line is essential to supporting the well-being of the communities in which PNG operates, preserving associated economic activities and sustaining jobs in the region. Prince Rupert is home to the third largest Port in Canada and depends on a reliable supply of natural gas to provide exports to countries around the world.

All work will comply with the Canadian Standards Association Oil and Gas Pipeline Systems Standards (the governing standards for the safe design, construction, operation and maintenance of natural gas pipelines).

Loca errain

The Salvus to Galloway segment of the West Transmission Prince Rupert Mainline runs through a remote mountainous region north of Highway 16 West and south of Work Channel, starting at Salvus approximately 50 km southwest of Terrace, up to Galloway Rapids approximately 9 km southeast of Prince Rupert.

The gas line traverses very challenging mountainous terrain and straddles several prominent geological features such as the Huckleberry Creek Valley and Prudhomme Mountain, and hydrological features including Arden Creek, Kasiks River and Khyex River.

Salvus to Galloway Gas Line Upgrades

Proposed Project Schedule

Late 2019 - Summer 2020	Fall 2020	Spring 2021	2021	2022	2023
Early Consulta	File BCUC Applica	An ted BCUC Decision	Cons Phase 1	Cons Phase 2	Cons Phase 3

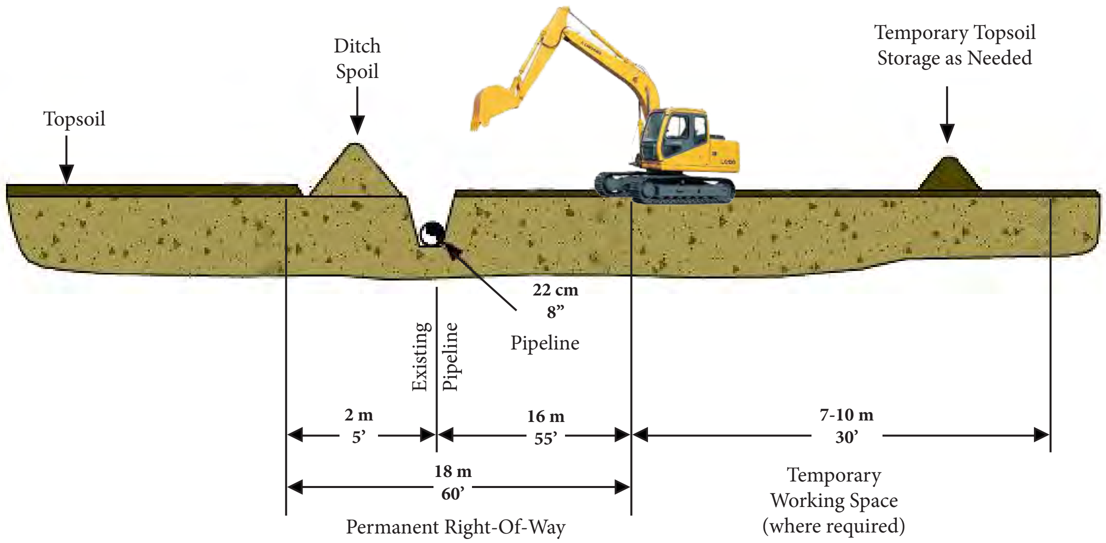
Ongoing Consultation

Pacific Northern Gas Ltd.

Descrip

Project work will be conducted within the existing PNG pipeline corridor referred to as a right-of-way (ROW) and nearby permitted temporary workspace. PNG's respect for the environment guides our decisions and is why careful consideration is taken when planning our projects. Work will adhere to all federal and provincial environmental guidelines as well as PNG's project specific and corporate Environmental Management Plans, as well as archaeological mitigation plans.

Typical Right-of-Way



Following regulatory approvals, work is scheduled to begin in 2021 and will continue through 2023. Project work will include the following activities:

Access Management

Development of both temporary and permanent access to specific locations.

Activities include:

- Equipment mobilization/demobilization;
- Clearing along the existing ROW and new temporary workspace;
- Installation of temporary and permanent watercourse crossings using environmental specialists for equipment ingress/egress;
- Building access paths including quarrying, material hauling, placing, compaction and ditching, and
- Development of equipment/materials staging and laydown areas.

Integrity Digs

Ground excavation to uncover the pipeline anomalies and assess condition.

Activities include:

- Clearing and site preparation;
- Material excavation and storage;
- Management of surface and groundwater during open trench condition, and
- Site remediation.

Gas Line Repairs

Pipe remediation work to restore safe pipeline condition.

Activities include:

- Repairing, removing and replacing sections of pipe, safety testing and site restoration including safely exposing and excavating the existing pipeline; and
- Site remediation.

Geohazard Mitigation

Construction of mitigation measures to protect the pipeline from geohazards.

Activities may include:

- Increase depth of cover through pipeline lowering, increasing fill thickness over top of the line, or increasing pipe wall thickness;
- Re-routing the pipeline within the ROW; and
- Site remediation.

Required Permits and Approvals

- British Columbia Utilities Commission: Certificate of Public Convenience and Necessity
- British Columbia Oil and Gas Commission: Notice of Intent (Replacement in Kind)
- Section 11 Approval for Changes in and About a Stream; License of Occupation; Master License to Cut
- Department of Fisheries and Oceans: FFA Authorization
- Heritage Conservation Act: 12.2 Heritage investigation Permit Site Alteration Permit
- B.C. Parks: B.C. Parks Use Permit for Works within Khyex Conservancy

Natural Gas Service During Cons

During PNG's construction phase, some segments of the gas line will need to be shut down for short periods of time. PNG will endeavour to minimize interruption of gas flow to customers during these service outages.

Health and Safety

Safety is PNG's top priority and the company has an excellent safety record. All work on the project will be subject to a comprehensive safety and emergency response plan to protect the health and safety of its workers, the public, Indigenous communities, and the environment. PNG will develop a comprehensive health and safety plan for the project.

PNG conducts regular inspections of all its gas lines including aerial patrols, in-line inspections, cathodic monitoring, and periodic brush clearing. PNG's entire pipeline infrastructure is monitored 24-hours a day using a sophisticated computer-based system operating in real time. The pipeline has shutoff valves at regular intervals along the route, which ensure that interruptions or concerns with the line can be identified immediately.

Indigenous and Community Engagement

PNG is committed to involving Indigenous communities and stakeholders early in the process.

PNG will provide information to Indigenous communities, the public, and all interested parties in the region, to seek input and feedback and answer any questions or concerns. Information will be made available prior to the submission of the application to PNG's regulators, as well as throughout the project. All input and feedback will be captured and tracked, and will form part of PNG's engagement record in its filings.

Indigenous communities affected by the project will be engaged directly by PNG representatives to discuss the project and its potential impacts on Indigenous interests.

PNG will be organizing opportunities for public input through written and on-line submissions, as well as virtual online information sharing opportunities. A dedicated phone line and email address have been established to receive questions and comments.

Once the project receives approval to proceed, PNG will continue consultation and engagement with Indigenous communities and stakeholders throughout the Project.

About PNG

Pacific Northern Gas Ltd., a wholly owned subsidiary of TriSummit Utilities Inc., owns and operates a natural gas transmission and distribution system in west-central British Columbia, and through its subsidiary Pacific Northern Gas (N.E.) Ltd. PNG also owns and operates natural gas distribution systems and a gas processing plant in the province's northeast. This includes approximately 3,000 km of distribution mains and services pipelines and 1,200 km of transmission pipelines.

PNG has been operating in B.C. for over 50 years, and provides gas service to approximately 42,000 residential, commercial, and industrial customers in more than 16 communities across Western and Northeastern British Columbia.

PNG Service Areas

Contact for Further Informa

Project Phone Line: 1-888-709-7304
Project Email: S2Ggasline@png.ca
Project Website: www.png.ca/projects/S2Ggasline

Follow us on Twitter, LinkedIn, Facebook

Appendix T-3

Salvus to Galloway Project Indigenous Engagement Presentation

PROPOSED SALVUS TO GALLOWAY GAS LINE UPGRADE PROJECT

August 2020

Pacific Northern Gas Ltd.

Agenda and Introductions

JASON POPE
Coordinator, Lands – Permitting and Indigenous Relations

CHAD FOURNIER
Project Delivery Director,
Asset Management

GRAHAM PAVLIK
Pipeline Engineer, Lauren Services

AGENDA

- ✓ About PNG
- ✓ Project Background
- ✓ Google Earth Overview
- ✓ Discussion
- ✓ Responses and Next Steps

Pacific Northern Gas Ltd.

About PNG

PNG HAS BEEN OPERATING IN B.C. FOR OVER 50 YEARS

- PNG owns and operates the Western Transmission Gas Line.
- Built in the 1960s, it transports natural gas from Summit Lake to Kitimat and Prince Rupert

Pacific Northern Gas Ltd.

Project Location and Terrain

Pacific Northern Gas Ltd.

Proposed Project

- Repair and replace sections along an 80 km segment of the Gas Line
- Work will take place from the Salvus maintenance yard to the Galloway pressure regulating station
- Estimated project cost – $80 million

Project Need

The Port of Prince Rupert (3rd largest in Canada) depends on reliable natural gas supply to provide exports around the world

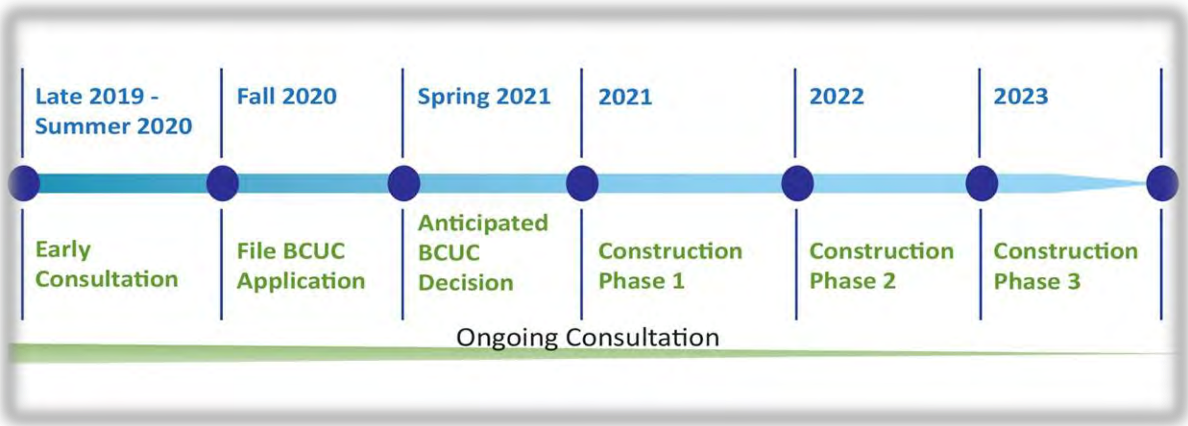
THIS WORK IS REQUIRED TO:

✓ Ensure the continued safety of the pipeline and reliability of natural gas service

✓ Enhance pipeline stability by addressing geotechnical risks

✓ Comply with applicable standards and regulations

Proposed Project Timeline



Pacific Northern Gas Ltd.

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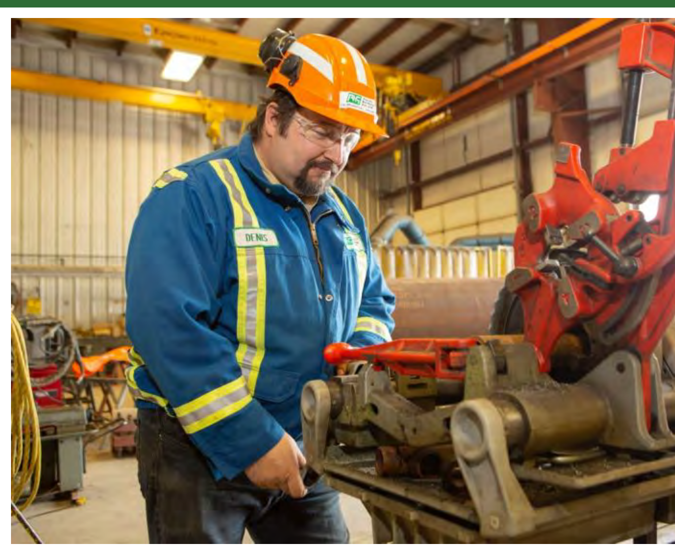
Work Activities

Project work will be conducted within the existing PNG pipeline corridor or right-of-way (ROW) and nearby permitted temporary workspace.

WORK ACTIVITIES INCLUDE:

- ✓ Access Management
- ✓ Integrity Digs
- ✓ Pipeline Repairs
- ✓ Geo-hazard mitigations



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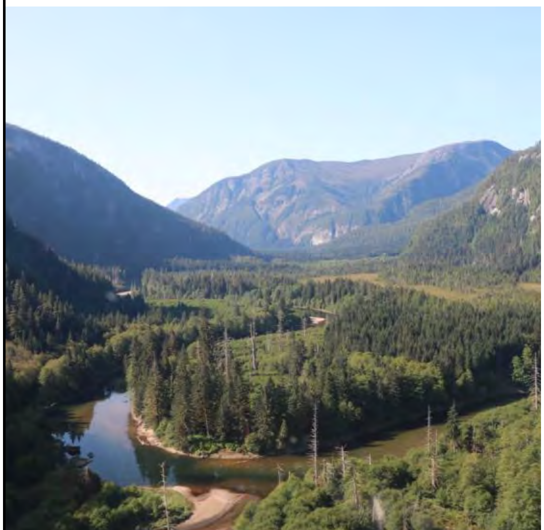
Access Management



Guided by environmental specialists, both temporary and permanent access to specific locations will be developed

ACTIVITIES INCLUDE:

- ✓ Equipment mobilization / demobilization
- ✓ Clearing along the existing ROW and new temporary workspace
- ✓ Installation of temporary and permanent watercourse crossings
- ✓ Building access paths
- ✓ Development of equipment/materials staging and laydown areas

Pacific Northern Gas Ltd.

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Integrity Digs

Ground excavation to uncover the pipeline anomalies and assess condition.

ACTIVITIES INCLUDE:

- ✓ Clearing and site preparation
- ✓ Material excavation and storage
- ✓ Management of surface and groundwater during open trench condition
- ✓ Site remediation

Pacific Northern Gas Ltd.

9

Geohazard Mitigation

Construction of mitigation measures to protect the pipeline from geohazards.

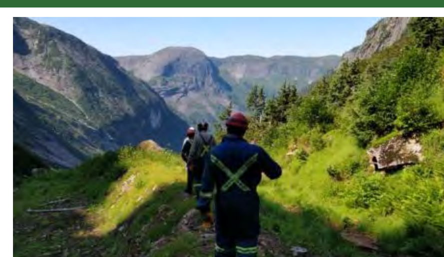
ACTIVITIES INCLUDE:

- ✓ Mitigating risk to pipeline safety such as landslides by increasing depth of cover over top of the line
- ✓ Upgrading pipe and increasing pipe thickness
- ✓ Relocating it within the right-of-way
- ✓ Site remediation

Pacific Northern Gas Ltd.

Gas Line Repairs

Pipe remediation work to restore safe pipeline condition.

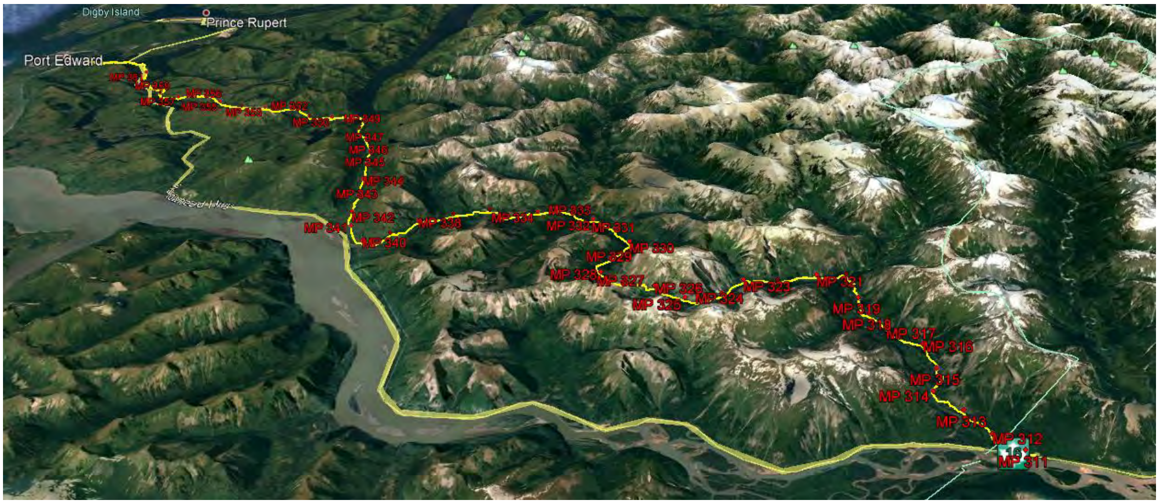


ACTIVITIES INCLUDE:

- ✓ Repairing, removing and replacing sections of pipe
- ✓ Safety testing
- ✓ Site restoration including safely exposing and excavating the existing pipeline
- ✓ Site remediation

Pacific Northern Gas Ltd.

Review Google Earth



Pacific Northern Gas Ltd.

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Discussion – review questions, comments, and concerns

PNG is committed to the following engagement principles.

- ✓ Provide timely and accurate information
- ✓ An open, transparent and honest engagement process
- ✓ Seek out and engage those who are affected
- ✓ Solicit and incorporate feedback

Pacific Northern Gas Ltd.

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Next Steps

1. Any further questions or concerns on work planned for this coming fall that the OGC is currently consulting with you on?
2. Timeframe to formulate questions/concerns for future works? Can we aim to have comments in by end of September?
3. Provide a list of joint venture business partners and/or band owned businesses that could provide services to the project. There is a link I can provide.

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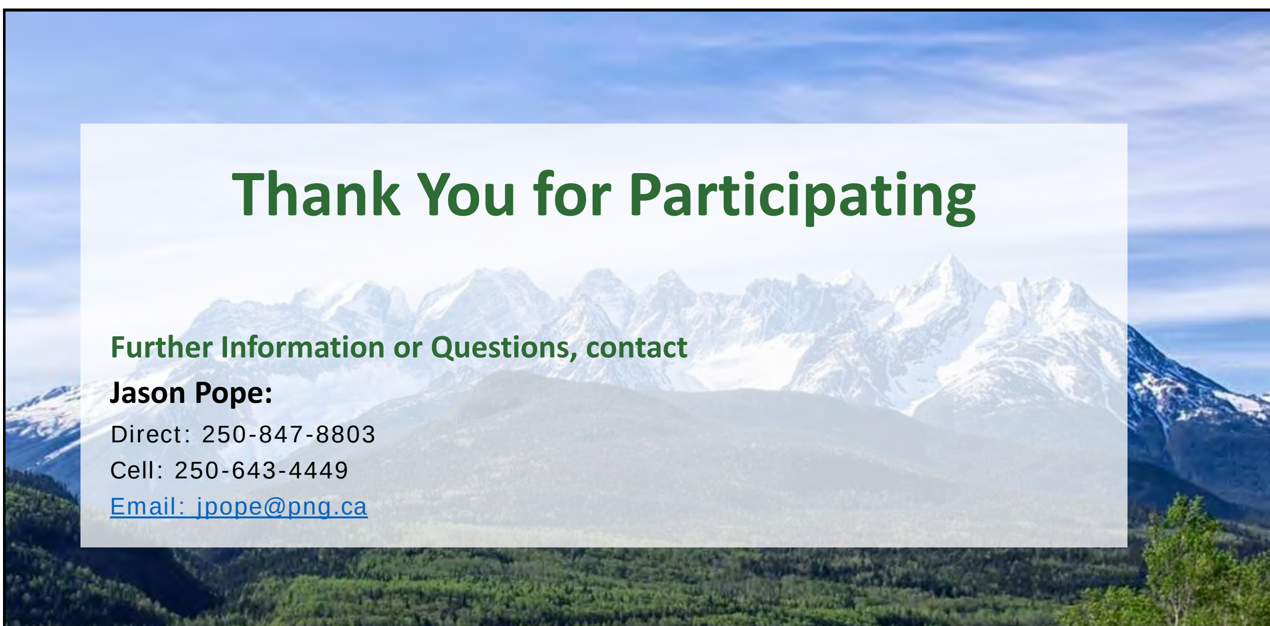

Thank You for Participating

Further Information or Questions, contact

Jason Pope:

Direct: 250-847-8803

Cell: 250-643-4449

Email: jpope@png.ca

Pacific Northern Gas Ltd.

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