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Proposed Northern Gateway Pipeline

RISK MITIGATION STRATEGY REPORT

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Executive Summary

Having a hazard and risk mitigation strategy is crucial for every entity, especially when dealing with the health and well-being of the public. Major infrastructure such as public transportation, power transportation, and crude oil transportation by pipeline, is very important for a country's economic development and progress. The public is dependent on the right policies, rules, and regulations, being in place in order to protect the safety of the people, the environment, and so on. It is part of government policy here in North America, to make sure that certain large-scale projects adhere to environmental regulations, provide a net benefit to the country, and generally are in the public's best interest. A panel of experts are appointed to oversee the entire process before granting project approval and usually with strict guidelines and conditions. The Northern Gateway Pipeline project falls under this approval process.

This report will explain some of the key mitigation strategies that Enbridge Northern Gateway has proposed for their massive 1,177 km long oil pipeline project, going from Alberta to British Columbia. The report gives the costs for the mitigation techniques, their likely benefits, and any impacts that may occur because of these mitigation strategies. Any project of this magnitude will generate problematic issues on varying dimensions, even to the hazard and risk mitigation strategies. The whole point for Northern Gateway coming up with these mitigation techniques, is to address as many Gov't/public concerns or potential issues as they can. Near the conclusion of this report, there is a brief discussion as to the *Joint Review Panel's* findings for either support or opposition to Northern Gateway's mitigation strategies.

Introduction

The estimated $6.5 billion dollar proposed Northern Gateway Pipeline project will bring Canada's oil sands' crude oil to the Pacific Rim. This twin line starts at Bruderheim, Alberta and ends 1,177 km west, at a deep-water port in Kitimat, British Columbia, at the head of the Douglas Channel, see Appendix A for a map of the proposed route. The westbound 36 inch diameter pipeline will carry up to 525,000 barrels of crude oil per day (BPD), while the eastbound 20 inch diameter line will carry 193,000 BPD of condensate from Asia, which is used in the oil thinning process (Holder, 2014).

The hazard and risk being mitigated is the potential for a pipeline rupture on the mainland, with the subsequent spilling of large volumes of oil either on land or in rivers. Any pipeline leakage will disrupt the sensitive ecosystem within a radius of the event. Some adverse effects could be: the loss of animal habitats and feeding areas, destruction to fish spawning zones, spoiled river waters and damage to river beds, contamination to birds and other water/wildfowl, severe damage to the landscape from cleanup efforts etc. (Witicar, 2012).

The pipeline route crosses the headwaters of the Mackenzie, Fraser, and Skeena rivers and runs in mostly pristine remote ecosystems in northern B.C. These areas are much harder to identify leaks and damaged pipelines. A recent pipeline spill example (not Enbridge), is the rupture along the Rainbow Pipeline in northern Alberta in 2010, which spilled over 28,000 barrels of crude, the worst in almost forty years (Witicar, 2012).

The following is a report regarding some of Northern Gateway's mitigation strategies for the mainland area that the pipeline crosses.

Description of Mitigation Strategies

The chosen pipeline route will avoid or minimize geo-hazards such as, unstable slopes, and reduces the hazards and consequences to High Consequence Areas (HCA) (Joint Review Panel, 2013, p. 132). Along part of the proposed route, in the Coast Mountains, there will be two 6.5 km tunnels that are modelled after the *Sorenberg Tunnel* in Switzerland, see Appendix B for location map. The tunnels are between the upper reaches of the Clore River and Hoult Creek and will be utilized to avoid numerous HCA's (National Energy Board, 2013).

The pipeline design will incorporate mechanical overpressure protection, where necessary, in order to have the pipeline maximum head profile greater than or equal to the discharge head of the upstream pump station (National Energy Board, 2013).
The steel pipe wall thickness will be thicker than the CSA requirements of Z662-11 (National Energy Board, 2013) and will be 20% thicker on average throughout the route (Holder, 2014).

Northern Gateway will develop a stress and strain methodology for each pipeline segment (west, east) that will consist of internal inspection tools (ILI) using an inertial navigation system or GeoPIG™, (geometry pipeline inspection gauging), external instruments on the pipeline to monitor strain, or installed within a slope, or other geo-hazard area, for ground movement monitoring. See Appendix C for a diagram of ILI (National Energy Board, 2013).

The pipeline will be coated with fusion bond epoxy at a coating plant and Enbridge will evaluate a 3-layer High Performance Composite Coating (HPCC) system to be used on certain sections. The HPCC consists of fusion bond epoxy, adhesive, and polyethylene layers, which prevents corrosion (NEB, 2013).

Northern Gateway plans on installing 132 fully automated and remotely controlled, isolation block valves on each pipeline. The valves will be controlled from Enbridge's *Control Centre* in Edmonton. These block valves will have the capability to be fully closed within 13 minutes of detecting an alarm event (NEB, 2013).

There is also a commitment for implementing a second real-time leak-detection system to complement the existing monitoring system, which is over and above standard industry practice. Northern Gateway is presently evaluating such additional systems (NEB, 2013).

Mitigation Strategy Benefits

With a more direct pipeline route and less geo-hazards, this allows for less pumping requirements, which has less potential for mechanical failure. By tunneling under some very eco-sensitive areas, there will be less risk of exposure and contamination in the unlikelihood of an oil leak or rupture event (NEB, 2013).

A flat maximum head profile (MOP) operating pressure reduces pipeline overpressure risk if a downstream blockage occurs, allowing the pipeline to be operated at lower stress levels. Northern Gateway says, the lower stress operating levels and extra pipe wall thickness will be utilized because of the sensitivity and special habitats the pipeline will cross. This will add to the level of protection (NEB, 2013).

Natural Resources Canada said, using the High Performance Composite Coating will increase the integrity and safety of the pipeline (NEB, 2013).

By strategically placing 132 isolation block valves on each pipeline, this will limit rupture consequences and the corresponding scale and complexity of the emergency response. The block valve locations will offer better protection for the high-value salmon habitat in the Fraser, Skeena, and Kitimat watershed regions, since operation staff will be able to shut down sections of the pipeline to minimize release volumes (NEB, 2013).

Mitigation Strategy Costs

There is no specific documentation on the cost estimate for building the *Clore* and *Hoult* tunnels, so here is a good comparison: The Copenhagen District heating tunnel (utility) was completed in 2010. It is a 4 km long bored tunnel with three shafts. Total construction cost was DKK 750 million in 2004 dollars. Converted into Canadian with a 1.25 inflation adjustment factor for 2014 = $173,395,000 for 4 km. The Northern Gateway route has two tunnels at 6.5 km each = 13 km, total estimate is $563,533,750 million dollars (Cowi, 2010, p. 28).

Using 20% extra pipe thickness for the whole length of 20 inch and 36 inch lines: Standard retail price for 20" seamless carbon steel pipe is $410.90 per foot, less 50% and multiply by 1,177 km or 1,177,000 meters = 3,861,737 feet. Total for 20" is $793 million x 1.2 comes to an extra $159 million. Enbridge would buy direct from the manufacturer in huge quantities, so there is an adjustment factor estimate of .5 of the retail price.
Standard 36" seamless carbon steel pipe is about $664/ft. retail, less 50% = $1.28 billion for 1,177 km, times 1.2 comes to an extra $256 million dollars + the $159 million, total for extra pipe thickness is about $415 million dollars (Columbia Pipe, 2014).

The estimated cost for GeoPIG™ or in-line inspection techniques (ILI) is as follows: There is the initial cost for adapting the pipeline for the ability to use ILI, which is approximately $15,000 per km for each line, times the inflation adjustment factor of 1.34 (2001) this total would be $47.3 million. Then there is the cost of performing ILI, which includes internal pipe cleaning at approx. $2,100 per km each, times the inflation adjustment factor of 1.34, this = $6.7 million + the $47.3 gives a GeoPIG™ total of approx. $54 million (Thompson, 2001, p. E31).

Enbridge says that three to five percent of the total construction costs will come from coating the pipeline exterior with fusion bond epoxy, which would be approximately $300 million. To coat the entire pipeline with the 3-layer HPCC process would be uneconomical (NEB, 2013).

The cost of remote operated isolation block valves is approximately $2000 per inch of diameter, multiplied by the inflation adjustment factor of 1.38 (2000), the total is about $99,360 each for the 36” valves and $55,200 each for the 20” valves, with a total cost of $20.4 million (Pipeline & Gas Journal, 2000, p. 2).

In summary, these risk mitigation strategies will cost about $1.353 billion dollars. See Appendix D for a breakdown chart.

Impact of the Mitigation

There is going to be some disturbances along this chosen *more direct* pipeline route, *Right of Way* (RoW). Some more notable disturbances will be: trapping, hunting, fishing, enjoyment and use of recreation properties and areas, forestry, agriculture, and wildlife habitats. The majority of disturbances will talk place during the three year construction period but, there will also be some minor issues afterwards during the operation of the pipeline (Joint Review Panel, 2013, p. 263-272).

There is also an economic concern to the over 5,000 British Columbians who live and work along the chosen pipeline route, for example fishing and tourism. These individuals will be adversely affected during construction and severely, if a spill event should occur (Witicar, 2012).

During the initial building phase for the two tunnels, there is a requirement for the temporary use of land for construction purposes, staging areas, and stockpile sites. There is a need for three camps that will house 100 to 150 individuals each, therefore, it is necessary for each camp to occupy land space of approximately 3 to 5 ha. There is also the need to have an excess cut disposal area near each tunnel portal of about 20 ha (Northern Gateway Pipelines, 2011, p. 6)

Support for Mitigation Techniques

The Minister of the Environment and the Chair of the National Energy Board established the Joint Review Panel (JRP) under the *Canadian Environmental Assessment Act* and the *National Energy Board Act* (Joint Review Panel, 2013, p. 3). The JRP is required to make a recommendation on whether the project is in the public interest. Would Canada and Canadians be better off, or worse off, if the project went ahead (Joint Review Panel, 2013, p. 1)?

The JRP finds that the access along the RoW may be interrupted or restricted during the construction phase and routine operations thereafter but, these should be limited and temporary. The JRP is confident that with Northern Gateway's proposed mitigation measures and with the Panel's conditions, there should be no significant adverse effects to forestry, mining, fishing, agriculture, trapping, hunting, or recreational uses, as a result of the project during construction and routine operations (Joint Review Panel, 2013, p. 273).

There are pipelines currently operating successfully in long tunnels in Europe and South America, and in shorter tunnels in Canada. Looking at Northern Gateway's preliminary descriptions for its pipeline in the Clore and Hoult tunnels, the JRP finds the construction and operations within the proposed tunnels, to be feasible. See Appendix E for a diagram of the proposed tunnels cross-section (NEB, 2013).

The JRP accepts Northern Gateway's evidence showing the benefits of High Performance Composite Coating, which includes better resistance to corrosion and cathodic disbondment in highly corrosive environments (NEB, 2013).

Opposition to Mitigation Techniques

It is the view of the JRP that Northern Gateway may have under-estimated the waste rock bulking factor, given the rock type classifications in the preliminary geotechnical report for the tunnels and potential alignment changes. Before the tunnels can begin construction, Northern Gateway must develop the final details for the location, size, and design of the waste rock disposal (NEB, 2013).

With regards to the spacing of the remote operated isolation valves, the JRP finds that Northern Gateway has not demonstrated that the calculated potential release volumes of oil in the 36 inch pipeline or condensate from the 20 inch pipeline, are as low as practicable, See Appendix-F for an illustration. These block valves introduce a risk of leaks from equipment failure at the valve location, which is higher than the risk of leaks from a pipeline rupture. This kind of leak is much harder to detect than pipeline leaks and could be sustained over long periods of time before they are discovered (Joint Review Panel, 2013, p. 70)

The JRP does not approve of the specification usage for Category-1 steel pipe for this project. The Panel requires Northern Gateway to use a minimum of Category-3 steel pipe specification throughout the project, which comes with toughness data. This data could prove to be useful for pipeline integrity issues, should any arise in the future (NEB, 2013).

Conclusion

A large portion of the Canadian economy relies on removing (mining), refining, and transporting, oils sands' crude oil from the Alberta region, to markets outside of Canada. As previous built natural gas and oil pipelines become old, we now see the effects of corrosion, other weather related issues, design flaws, and poor monitoring and maintenance, on the many pipelines throughout North America.

The public demands better practices, while government policies and regulatory agencies implement higher standards. With newer innovative technologies, huge new infrastructure projects such as the Northern Gateway Pipeline, will be able to mitigate hazards and risks more effectively than past oil pipelines have been able to do. The Canadian public or anyone for that matter, do not want an ecological catastrophe if there are steps and procedures that can be done prior to construction of the pipeline and during its operation.

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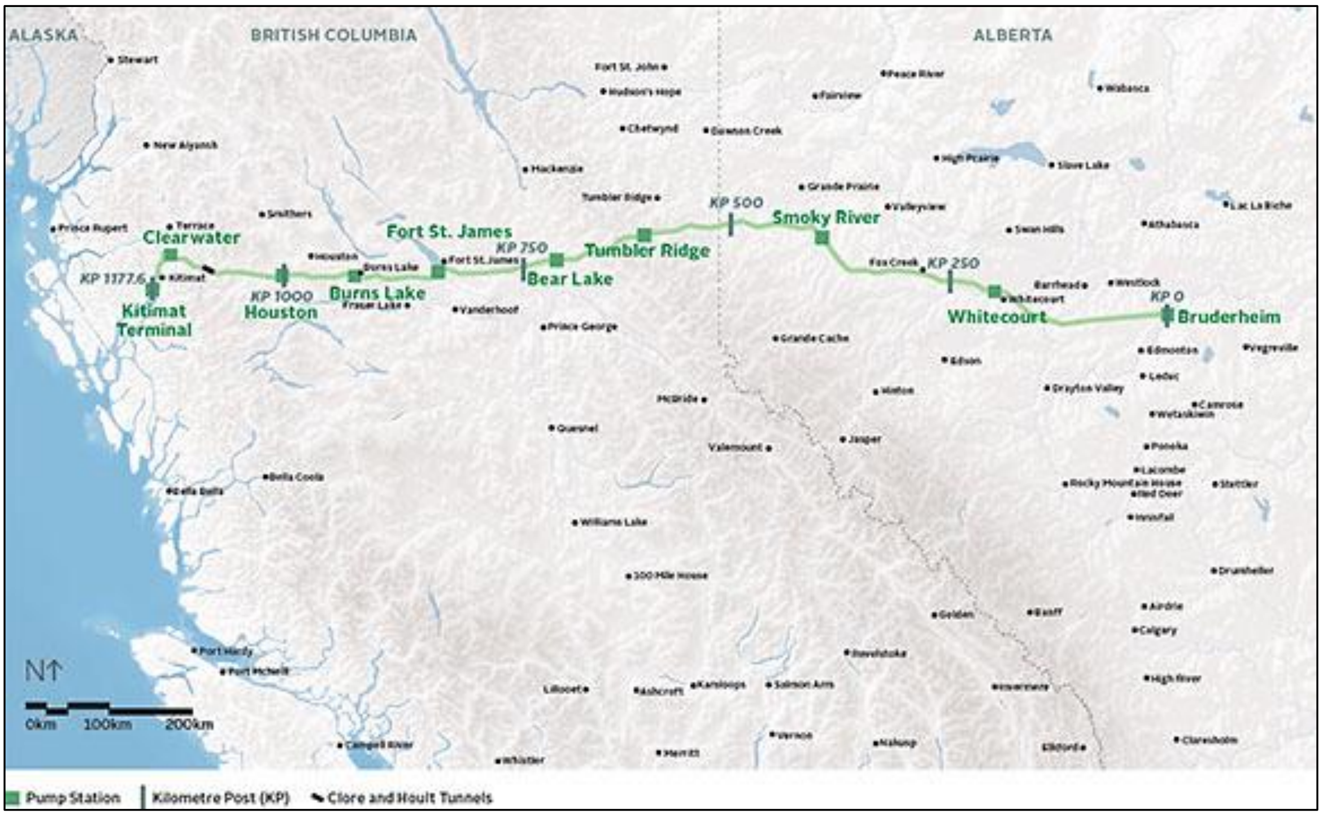
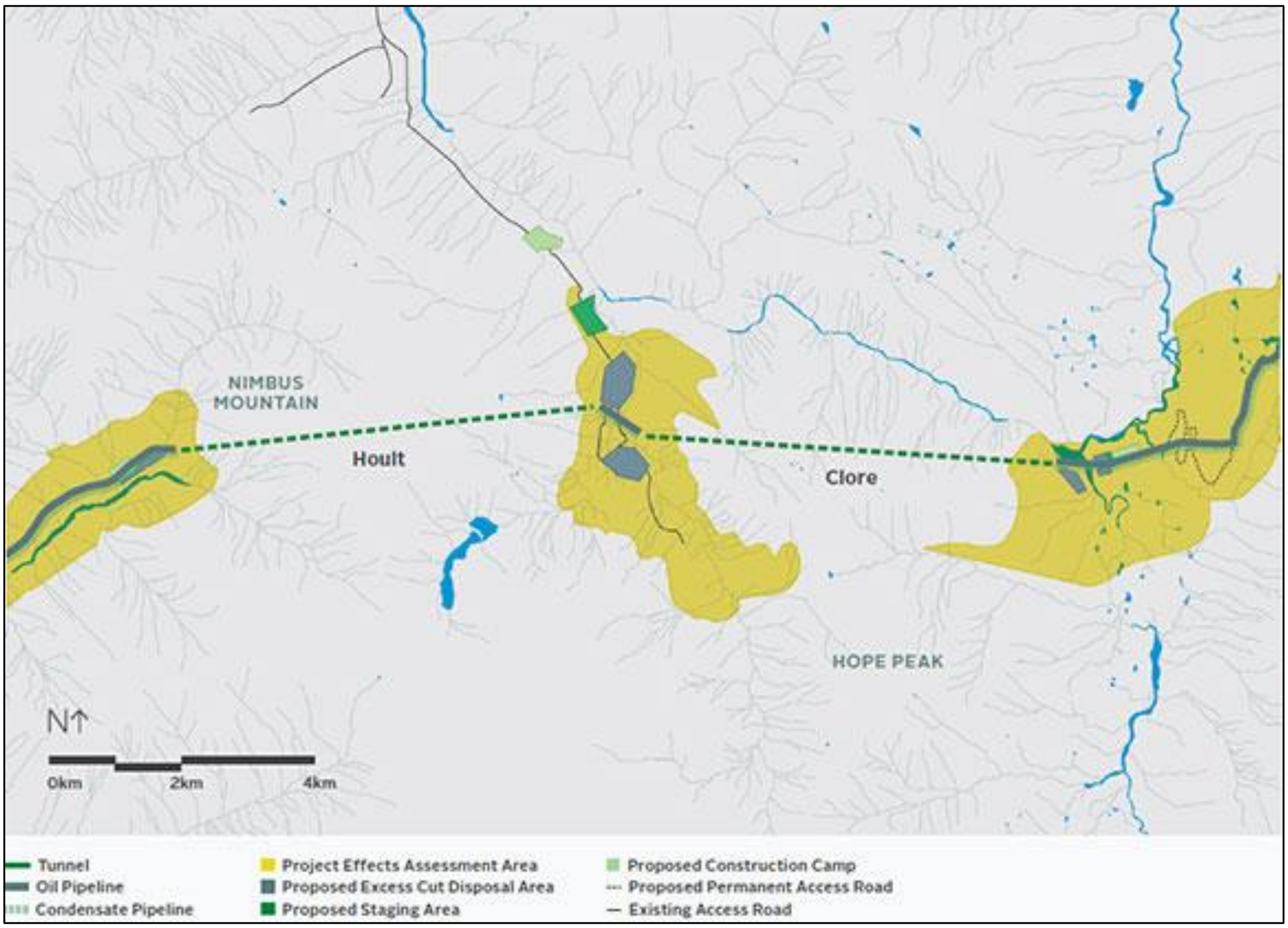
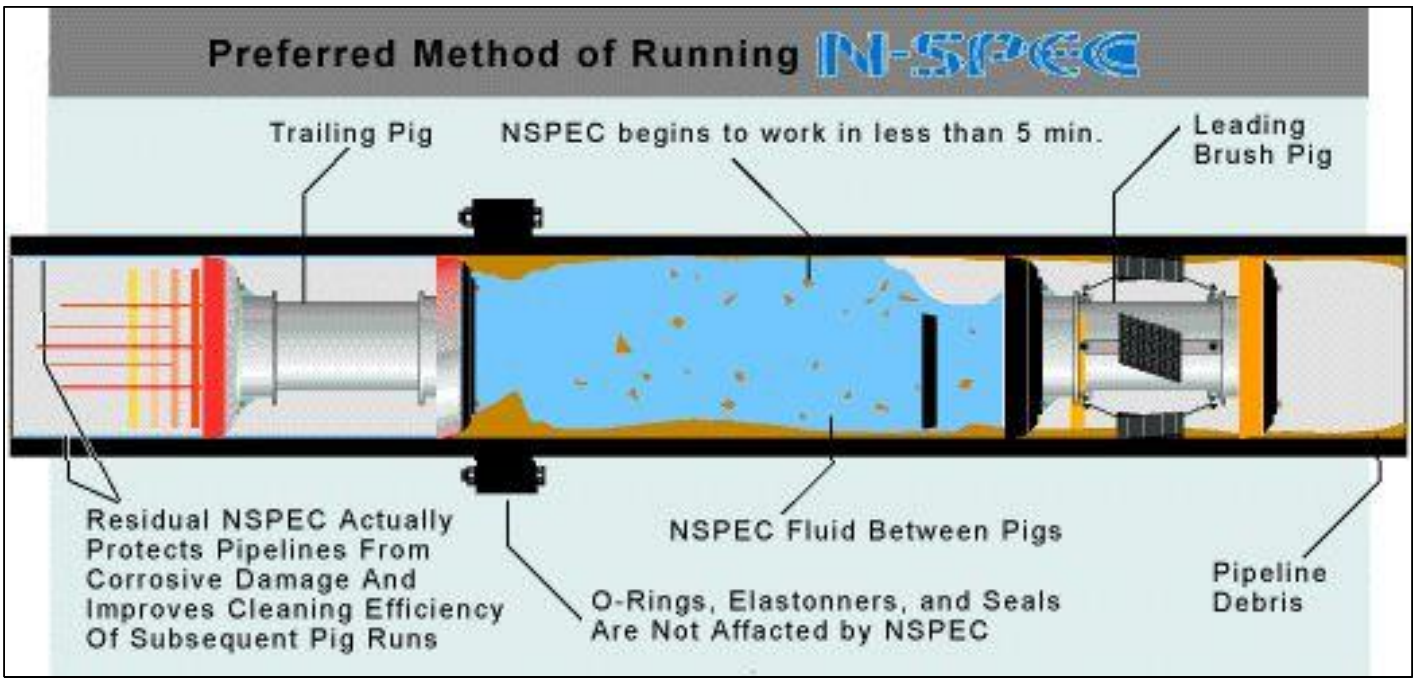
Appendix A: Map of Proposed Pipeline Route



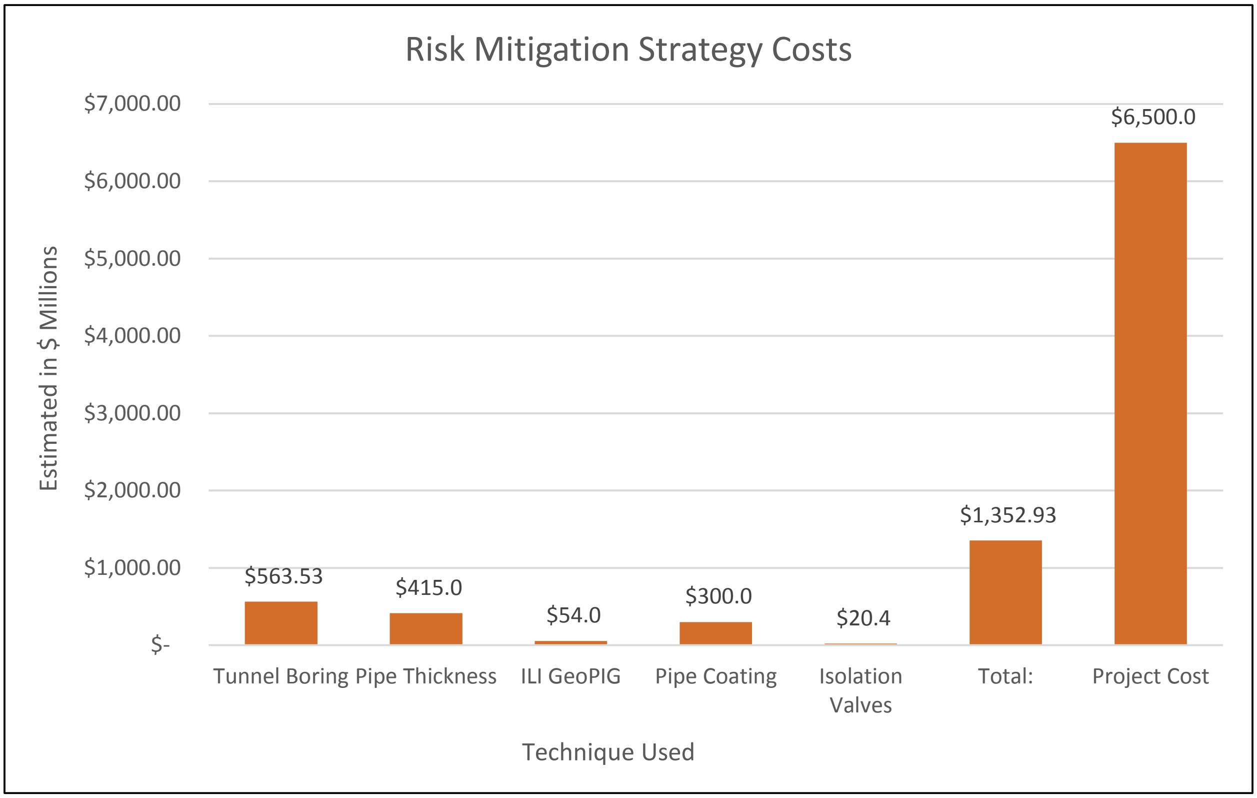
Appendix B: Map – Proposed Pipeline Tunnel Locations



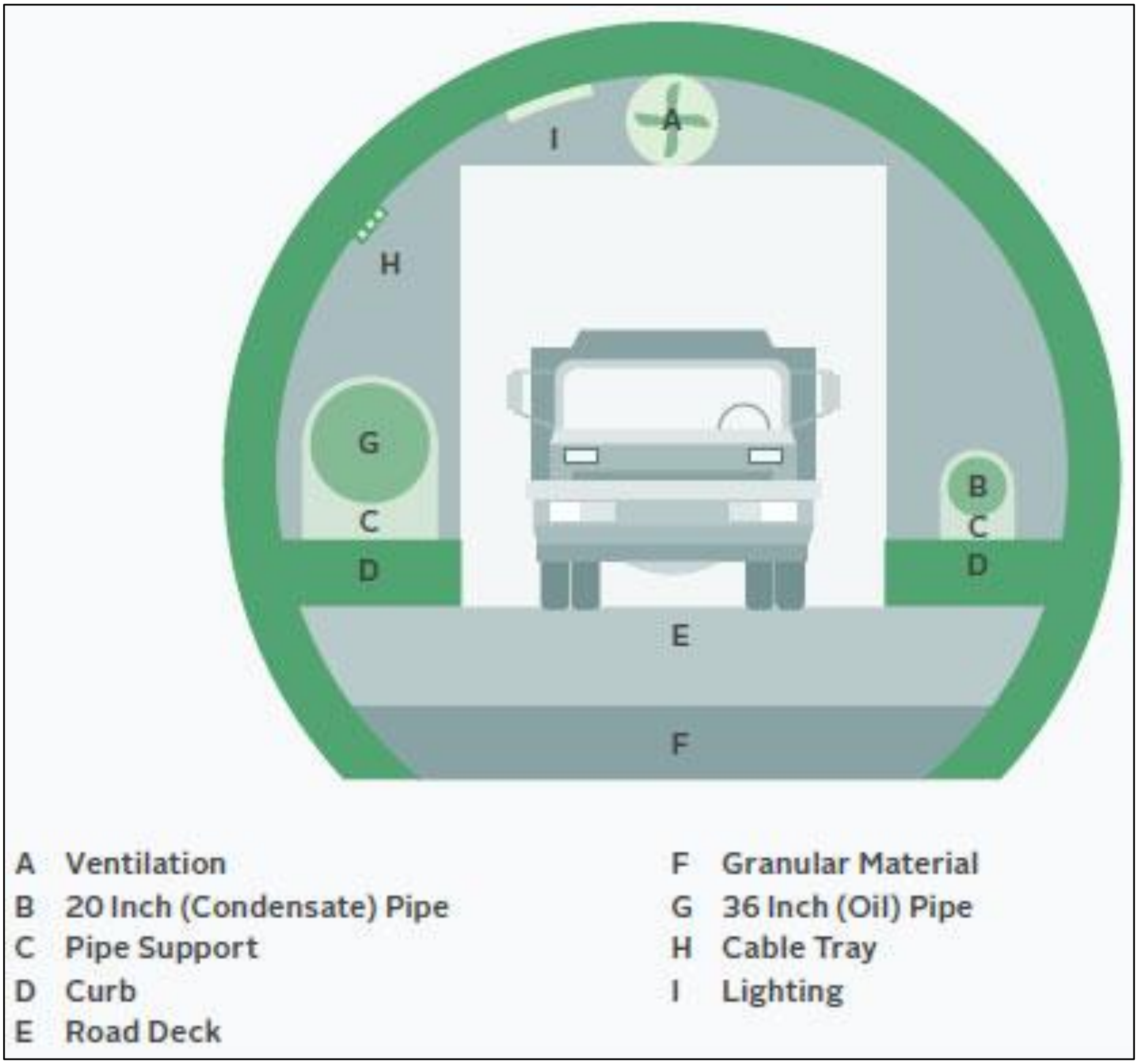
Appendix C: Diagram – ILI Pipeline Inspection Technique



Appendix D: Chart – Estimated Mitigation Strategy Costs



Appendix E: Cross-section of Proposed Tunnels



Appendix F: Illustration – Isolation Drain-Down Volumes