City of Richmond

Report to Committee

To:	Public Works and Transportation Committee	**Date:**	January 6, 2010
From:	John Irving, P.Eng. MPA Director, Engineering	**File:**	
Re:	**Vancouver Airport Fuel Delivery Project Proposal Update**		

Staff Recommendation

That the attached staff report dated January 6, 2010 be received for information.

John Irving, P.Eng. MPA
Director, Engineering
(604-276-4140)

Att (2)

FOR ORIGINATING DEPARTMENT USE ONLY					
ROUTED TO:	**CONCURRENCE**		**CONCURRENCE OF GENERAL MANAGER**		
Real Estate Services	Y ☑	N ☐			
Environmental Programs	Y ☑	N ☐			
Fire Rescue	Y ☑	N ☐			
Policy Planning	Y ☑	N ☐			
REVIEWED BY TAG	YES ☑	NO ☐	**REVIEWED BY CAO** DEPUTY	YES ☑	NO ☐

2795227

Staff Report

Origin

At the Regular Council Meeting of June 8, 2009, the following motion was adopted:

"That in relation to any new and necessary jet fuel supply systems to YVR, a preference be endorsed for:

(a) jet fuel supply system options that result in no net gain of jet fuel line length on Lulu Island;

(b) the further consideration and review of alternatives to the current VAFFC proposal;

(c) significant removal of fuel delivery trucks from regional roadways; and

(d) options that do not include an off-loading facility on the south arm of the Fraser River."

Furthermore, at the General Purposes Committee Meeting of June 1, 2009, the following referral motion was adopted:

"That staff advise on the various options for jet fuel supply systems."

This staff report responds to the referral and provides further updates on the proposed project. Please refer to the staff report "Vancouver Airport Fuel Delivery Project Proposal Update" dated April 26, 2009 and presented at the June 8, 2009 Regular Council Meeting for further background information.

Analysis

Environmental Assessment (EA) Process

The Vancouver Airport Fuel Facilities Corporation (VAFFC) is proposing to develop a jet fuel supply system that consists of a fuel tanker terminal and tank farm on the South Arm of the Fraser River and a new pipeline through Richmond to connect this terminal to their existing tank farm on Sea Island (identified forthwith as the South Arm Terminal option). VAFFC made a voluntary request to the BC Environmental Assessment Office (BCEAO) to have this project reviewed through the EA process. The BCEAO has since designated the project reviewable under the BC Environmental Assessment Act. Review under the Canadian Environmental Assessment Act process was triggered by the navigable waters impact. The EA process for the jet fuel project has been outlined by the BCEAO and is displayed graphically in **attachment 1**.

The process is currently in the pre-application phase during which stakeholder and regulator feedback is taken to assist in the development and finalization of the Application Information Requirements. This will define for the proponent the exact information that must be submitted to BCEAO for assessment and decision making. Public comment periods and open houses will be held by BCEAO this spring during the Pre-Application phase and again during the Application Review phase later in 2010.

Subsequent to the first EA Working Group meeting on April 8, 2009, the BCEAO held a regulators meeting on Nov. 17, 2009 that included representatives from the following organizations:

City of Richmond

Vancouver International Airport Authority (YVR)

BC Oil & Gas Commission (OGC)

Port Metro Vancouver (PMV)

Canadian Environmental Assessment Agency (CEAA)

BC Environmental Assessment Office (BCEAO)

The EA process will harmonize and integrate the regulatory and approval processes of the five regulatory agencies (YVR, OGC, PMV, CEAA and BCEAO). The City does not have any regulatory powers with regard to pipeline projects beyond development and building permitting on private lands. Staff have continued to represent the City's interests and reiterate Council's adopted preferences.

The second EA Working Group meeting was held on Dec. 14, 2009 and was attended by the regulators, First Nations, stakeholders and VAFFC with their consulting team. VAFFC presented additional project information and the Draft Application Information Requirements (DAIR) document.

The BCEAO is requesting that the Working Group members provide comments on the DAIR by Jan. 22, 2010. Following the formal DAIR public comment period, this document will be subject to further review and comment by federal and provincial regulatory agencies, First Nations, and local governments. Once finalized and approved, it will constitute the Approved Application Information Requirements (AAIR) which VAFFC will have to respond to in making their application.

The BCEAO and CEAA have advised that the EA process will likely not encompass the consideration of alternative fuel supply options. The EA process, as currently defined, will end in a ministerial approval or rejection of the proposed South Arm Terminal option. Should Council choose, addressing City concerns directly to the responsible federal and provincial ministers always remains an option at this early stage. Ministers responsible for the involved regulatory agencies are as follows:

Provincial The Hon. **Barry Penner,** Minister of Environment
The Hon. **Blair Lekstrom**, Minister of Energy, Mines and Petroleum Resources

Federal The Hon. **Jim Prentice**, Minister of the Environment
The Hon. **John Baird**, Minister of Transport, Infrastructure and Communities
The Hon. **Gail Shea**, Minister of Fisheries and Oceans

Alternative Options for Jet Fuel Supply Systems

Through the EA process and directly to VAFFC, City staff have continued to request further information on alternative fuel supply systems and options. At the Dec. 14, 2009 EA Working Group meeting, the VAFFC team presented more detailed information on the assessment of the top 5 alternative fuel supply options (summarized in the following table) and the rationale leading to selection of the proposed option (South Arm Terminal).

Top 5 Alternative Options	Summary of Key Challenges identified by VAFFC
1. **Railcar Transportation** From Alberta or U.S. Refineries, Fuel Receiving Facility in South Vancouver and Pipeline to Vancouver International Airport (YVR)	- Long term demand would require 60-100 railcars per day. - Upgrading of existing rail infrastructure required. - Fuel sources restricted to mainland refineries. - Large land acquisition in South Vancouver required for off-loading yard.
2. **Single Point Mooring** (Mono-Buoy) off Sea Island and Pipeline to YVR	- Exposure to severe weather. - No similar terminals exist in BC resulting in training requirements for crews, pilots and operators. - Impacts to inshore traffic zone and shipping lanes would require extensive stakeholder consultation and regulatory approval. - Pipeline would cross environmentally sensitive Sturgeon Banks. - Bank stability on the delta front presents seismic risks.
3. **Fixed Terminal Offshore** off Sea Island and Pipeline to YVR	- Conflict with YVR Master Plan for 3rd runway. - Exposure to severe weather. - 6 km trestle or causeway required and/or upgrade of Iona Jetty (jetty also conflicts with YVR Master Plan). - Bank stability on the delta front presents seismic risks. - Environmental impact to Sturgeon Banks.
4. **Fixed Terminal Inshore** off Sea Island and Pipeline to YVR	- Large amount of dredging on Sturgeon Banks to create channel for access and vessel turning. - Extensive environmental impact and compensation.
5. **Existing Pipeline** Upgrade/Replacement of Existing Delivery System	- Not owned or controlled by VAFFC. - Costly construction in urban areas of Burnaby. - No assured access to Westridge Marine Terminal (offshore supply point to existing line).

More detailed information and option descriptions are provided in the attached Project Memo dated October 20, 2009 from VAFFC (**attachment 2**).

Staff have reviewed all information provided by VAFFC on their options analysis and accept that the railcar and existing pipeline upgrade options (options 1 and 5 above) are challenged to meet VAFFC's long term fuel supply objectives and have limited viability.

The three Sturgeon Bank options (options 2, 3, and 4 above) face significant challenges however these challenges have not been demonstrated to be insurmountable and all three options would have the ability to meet VAFFC's long term fuel supply objectives.

South Arm Terminal Option

Also at the Dec. 14, 2009 EA Working Group meeting, the VAFFC team presented more detailed information on the South Arm Terminal option. This included engineering assessments of the terminal and tank farm design and modelling of shipping movements and fuel spill scenarios on the South Arm.

After considering the additional information provided by VAFFC, it remains clear that the evaluation of the South Arm Terminal option has not directly considered all of the externalized costs and impacts that would be borne by the City and the Richmond community at large as a result of the supply infrastructure being placed on Lulu Island.

Staff will continue to request that the EA process include the consideration of alternative options but will be providing comments on the DAIR specific to the proposed option including the following:

- VAFFC have identified in the DAIR that a Municipal Access Agreement with the City will be required. It should be clarified that the agreement, among other requirements, will make VAFFC responsible for all causal costs and will be applicable to all VAFFC infrastructure that is on City ROW's.

- Assuming a corridor width of 6 meters (a conservative estimate) and an 11 km pipeline length, placing the jet fuel line in City ROW's across Lulu Island will neutralize at least 6.6 hectares (16 acres) of land that could otherwise be used for City utility corridors or other uses. VAFFC must identify how this impact will be redressed.

- VAFFC have modelled jet fuel spill scenarios on the South Arm. A similar level of effort should be made to model and identify the risk from land based and underground spills and leakage that may occur as a result of failures in the tank farm, jet fuel pipeline, or other land based infrastructure, including the identification of potential groundwater contamination.

- VAFFC's public consultation program must be expanded to include direct notification to all landowners and residents adjacent to the proposed pipeline routes.

- Richmond Fire Rescue does not have the capacity for nor the appropriate equipment to safely conduct shipboard firefighting and there is currently no waterside fire fighting capability on the South Arm. Richmond Fire Rescue emergency response time to the proposed tank farm site is over nine (9) minutes, which is not conducive to controlling a

fire to the area of origin. In consideration of the fact that the City's or any other agency's cannot provide adequate firefighting coverage to the proposed terminal and tank farm sites, VAFFC must provide detailed information and definition of the specific fire suppression systems or solutions that will be in place to address the fire hazard presented by all proposed infrastructure.

Financial Impact

There is no financial impact at this time.

Conclusion

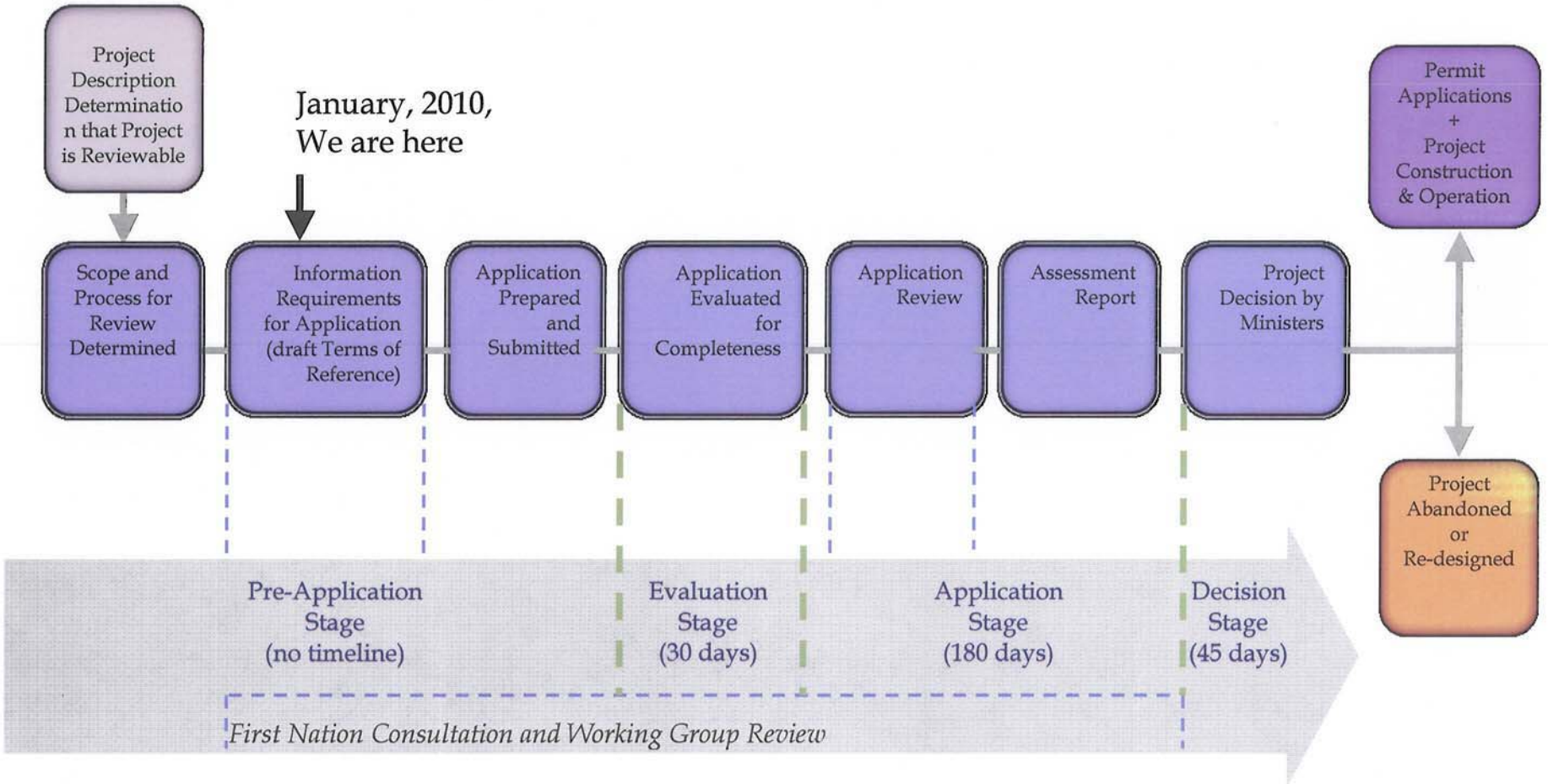
The EA process for the Vancouver Airport Fuel Delivery Project is in the Pre-Application phase. The EA process has been harmonized with the approval processes of the other regulatory agencies. City staff are currently providing comments on VAFFC's Draft Application Information Requirements. BCEAO and CEAA have advised that the EA process will likely not encompass the consideration of alternative fuel supply options, however staff will continue to request that it does.

VAFFC has provided additional information on the top 5 alternative jet fuel supply options. Options for a terminal on Sturgeon Banks have significant challenges but are possible to implement. Additional information on the South Arm Terminal Option has also been provided.

John Irving, P.Eng. MPA
Director, Engineering
(604-276-4140)

Att (2)

Environmental Assessment Review



2795227

Vancouver Airport Fuel Facilities Corporation (VAFFC)
c/o FSM Management Group Inc.
#103-12300 Horseshoe Way
Richmond, BC, V7A 4Z1
Tel: (604) 271-7113; Fax (604) 271-8006

Project Memo

October 20, 2009

TO: Jennifer Anthony, Project Assessment Manager, EAO

FROM: Adrian Pollard, Project Director, VAFFC

cc: Scott Hanna, Project Technical Lead, Hatch Ltd.

Subject: Vancouver Airport Fuel Delivery Project – Summary of Assessment of Options

This memorandum provides a brief overview of the top-ranked fuel delivery system options evaluated by the Vancouver Airport Fuel Facilities Corporation ('VAFFC'), a summary of their relative pros and cons, a description of some of the technical and regulatory challenges involved, and the rationale for selecting the preferred South Arm of the Fraser River option (i.e., the proposed Project).

1. Background

VAFFC identified 14 alternative fuel delivery options to meet the long-term demand for aviation fuel ('fuel') at Vancouver International Airport ('YVR'), each of which was assessed at a screening level for potential economic, environmental, social and regulatory impacts associated with their construction and operation.

After weighing the relative merits of the various options, the South Arm of the Fraser River ('Fraser River') option emerged as the preferred option. The other alternatives that warranted further study involved delivery of fuel via rail from a refinery in Alberta or the United States ('U.S.'), an offshore terminal/mooring facility located offshore (west) of Sea Island and Sturgeon Bank, and upgrade/replacement of the existing pipeline delivery system. A summary of these alternative options is described first, followed by the Fraser River option.

2. Alternative Options

2.1 Railcar Transportation from Alberta or U.S. Refineries, Fuel Receiving Facility in South Vancouver and Pipeline to Vancouver International Airport (YVR)

Concepts

Two options were considered, including transportation of fuel via railcars using an existing rail network originating from refineries located in Alberta or in Washington State, U.S. Both options would involve construction of a fuel receiving facility located at an industrial site in South Vancouver near the North Arm of the Fraser River. From the receiving facility, fuel would be delivered to YVR by pipeline to the VAFFC fuel receiving and distribution facilities on Sea Island. Depending on the location of a new fuel receiving facility, the pipeline would be approximately 5 km long.

Vancouver Airport Fuel Facilities Corporation (VAFFC)
c/o FSM Management Group Inc.
#103-12300 Horseshoe Way
Richmond, BC, V7A 4Z1
Tel: (604) 271-7113; Fax (604) 271-8006

Challenges

Since conducting the preliminary assessment of alternatives, rail delivery of fuel from Alberta-based refineries has been eliminated as an option because Alberta has itself now become a net importer of aviation fuel and other refined products. Although it is an oil producing province, refining capacity is limited and the oil sand activity consumes much of what is refined. There have been shortages of gasoline and diesel experienced in Calgary as a result of oil sands consumption. Because of this shortage of supply issue, the feasibility of shipping aviation fuel via rail from Alberta was not investigated further.

VAFFC explored the option rail delivery of fuel from U.S. refineries further, since U.S. refineries are not experiencing aviation fuel supply shortages. This option has significant challenges, however, primarily related to poor security and flexibility of fuel supply:

- To satisfy projected long-term demand for fuel at YVR, an individual shipment of fuel via rail of approximately 60 to 100 railcars would be required each day. Railway infrastructure constraints, such as other users on the rail network, bridge crossings, and resulting bottlenecks, would result in an individual rail shipment transit and cargo off-loading timeframe of approximately 1 week. Additional issues such as line maintenance, changing rail ownership, border crossings and the possibility of worker strikes could result in lengthier timeframes. Existing rail infrastructure would require significant capital upgrades to reduce the timeframe between the origin of supply and fuel receiving facility Vancouver.
- This option would restrict the sources of fuel supply available and could have cost implications to airlines operating at YVR.
- This option would require the acquisition of a large tract of industrial zoned land in South Vancouver for the construction of a rail off-loading yard that would be able to accommodate 60 to 100 railcars and a fuel receiving facility.

2.2 Offshore Terminal / Floating Facility, off Sea Island, and Pipeline to YVR

Concepts

Three offshore options west of Sea Island were considered, including a deep-water "fixed" terminal supported on piles, a near-shore "fixed" terminal with dredged access, and a floating Single Point Mooring ('SPM') buoy, which is sometimes also called a "mono-buoy".

Single Point Mooring (Mono-buoy)

An SPM would be anchored to the ocean floor off Sea Island. Vessels would secure their mooring lines to the buoy and connect the floating fuel hose to the vessel cargo manifold. Once all operational checks were completed (e.g. verifying that all connections and seals are in place) the vessel would begin pumping fuel cargo to the existing storage tanks at YVR via pipeline. A diagram of a typical SPM or "mono-buoy" installation is shown in **Figure 1**.

During the fuel transfer operation, the vessel would be free to "weathervane" or rotate around the buoy according to changes in the direction of the winds, waves, and currents. The mooring line and fuel hose connection points would typically be mounted on a rotating turntable, allowing them to move with the vessel. The buoy itself would remain essentially stationary, held in place by the chains and anchors.

Vancouver Airport Fuel Facilities Corporation (VAFFC)
c/o FSM Management Group Inc.
#103-12300 Horseshoe Way
Richmond, BC, V7A 4Z1
Tel: (604) 271-7113; Fax (604) 271-8006

Figure 1 Typical Single Point Mooring Buoy Installation

(Source: SBM Offshore)

Vancouver Airport Fuel Facilities Corporation (VAFFC)
c/o FSM Management Group Inc.
#103-12300 Horseshoe Way
Richmond, BC, V7A 4Z1
Tel: (604) 271-7113; Fax (604) 271-8006

Two possible locations for the mono-buoy (Location 1 and Location 3 shown on **Figure 2**) are both in the relatively narrow 1 km to 2 km strip of water between the main shipping lanes to the west and Sturgeon Bank to the east. This stretch of water is known locally as the "inshore traffic zone", which is used by tugs, fishing boats and recreational traffic. Water depths in this zone range from approximately 15 m to 100 m. Depending on the precise location of the buoy and the routing of pipeline, the total distance from the buoy to the storage tanks at YVR (i.e. the length of pipeline required) would be approximately 11 km to 12 km.

Another possible location (Location 2 shown on **Figure 2**) is approximately 6 km further west, which is clear of the south-bound shipping lanes. In this case, the total distance from the buoy to the existing storage facilities at YVR would be approximately 15 km. Water depths in this offshore area are approximately 300 m.

A fourth possibility could be to place the buoy closer to Sea Island; however this would require extensive dredging to create a navigable channel and turning basin.

Some of the technical and operational challenges associated with placing a mono-buoy west of Sea Island (or Lulu Island) are discussed below.

Challenges

- Compared to the option on the Fraser River, a floating facility off Sea Island would be more exposed to prevailing winds and waves. The limited operating wind speeds for an offshore mono-buoy facility would range from 25 to 30 knots (11.4 to 13.6 m/s). This range represents the safe working limit for tug crews and pilot boats. When wind speeds reach the limiting value, fuel delivery operations would be shut down because conditions would be too rough to allow for safe operations. Wind speeds greater than 25 knots occur about 3% of the year which equates to approximately 11 days per year when the facility would not be operational. The offshore locations would, therefore, experience a greater degree of weather-related downtime compared to the Fraser River option, which over the course of the year may affect the frequency and reliability of the fuel deliveries to YVR.
- There are currently no mono-buoy terminals operating in British Columbia. A considerable amount of training would be required for vessel and tug crews, pilots, operators, and other personnel before such a buoy could be put into operation.
- The inshore traffic zone between the shipping lanes and the edge of Sturgeon Bank is heavily used by tugs towing barges from the Fraser River to English Bay, as well as other smaller commercial and recreational craft. Placing a mono-buoy in this inshore traffic zone would have an impact on this traffic, possibly requiring new rules or traffic separation zones. Numerous potential stakeholders would need to be consulted regarding the viability of this option, including the British Columbia Coast Pilots, Pacific Pilotage Authority, Fraser River Pilots, Port Metro Vancouver Harbour Master, Coast Guard, Chamber of Shipping, Council of Marine Carriers, and regulatory agencies like Transport Canada, Fisheries and Oceans Canada, Environment Canada and others.
- The pipeline from the buoy to shore would need to cross the environmentally sensitive Sturgeon Bank mudflats.

Vancouver Airport Fuel Facilities Corporation (VAFFC)
c/o FSM Management Group Inc.
#103-12300 Horseshoe Way
Richmond, BC, V7A 4Z1
Tel: (604) 271-7113; Fax (604) 271-8006

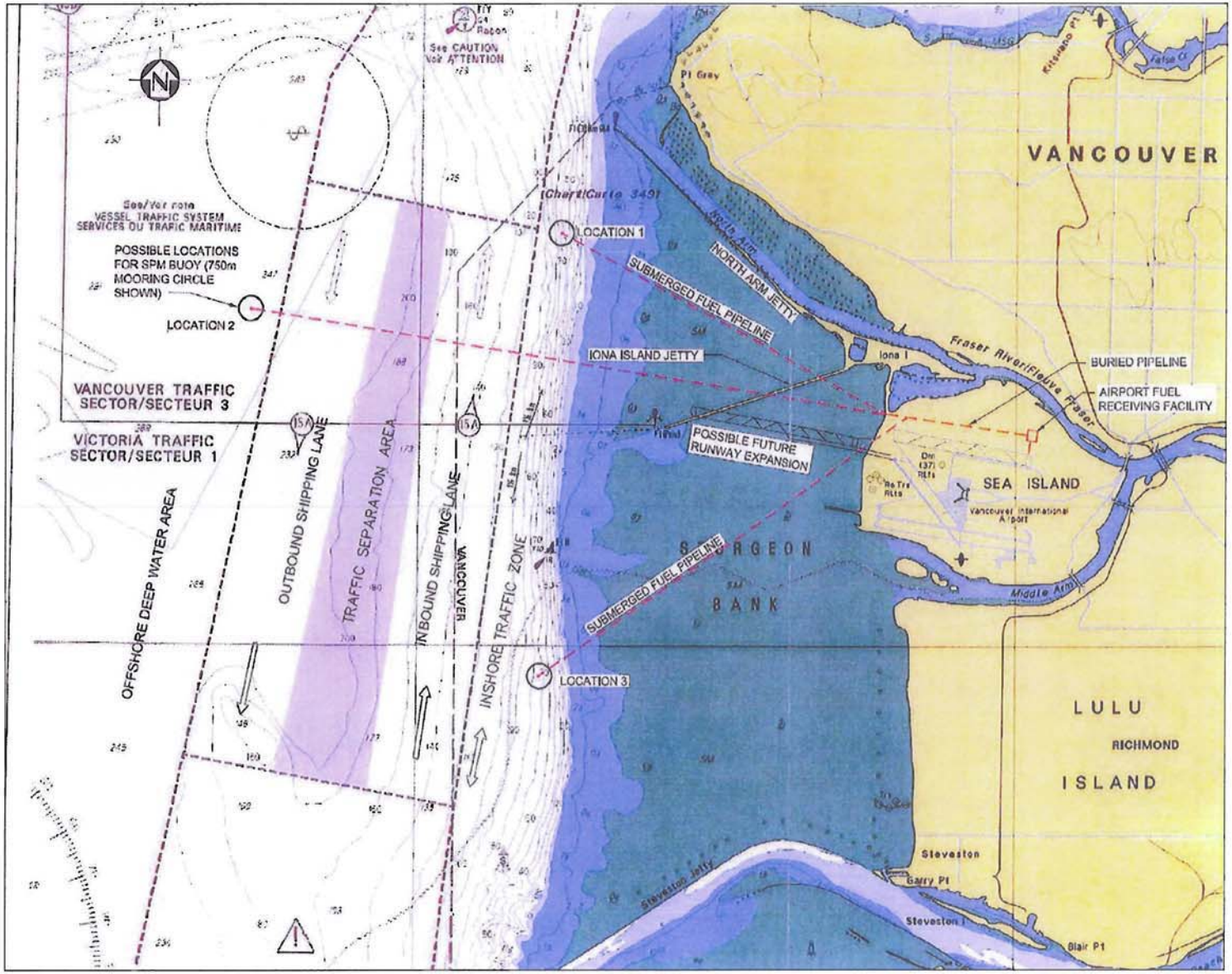


Figure 2 Off-Shore Single Point Mooring Options

PWT - 32

- The inshore location is inside the Port Metro Vancouver's harbour limits. Currently, Port Metro Vancouver has rules in place which do not allow fuel transfer operations in English Bay. These rules may also apply to the waters off of Sea Island.
- The water depths in the region (i.e. 100 m to 300 m) are within the viable ranges for this type of technology. However, the 300 m depth at the offshore site west of the shipping lanes would pose significant engineering challenges, as only a handful of buoys have been installed world-wide in waters of this depth. The greater depth significantly increases the cost of the initial construction as well as routine inspection and maintenance.
- The sand and silt deposits comprising Sturgeon Bank are known to be relatively loose and subject to liquefaction during an earthquake. The delta front itself is thought to be unstable in some places, as are many such delta fronts in river systems worldwide. A number of years ago, an underwater landslide took place on the delta front close to the Sand Heads light station. Had the landslide been slightly closer to Sand Heads, it could have destroyed a mono-buoy facility. It is unknown if similar stability problems exist at the locations where a buoy would be proposed, however this is a potential risk that would need to be investigated (and if necessary mitigated) prior to construction of a mono-buoy and pipeline.

Concept 2A – Fixed Terminal Offshore

As an alternative to the mono-buoy option, this concept would involve a fixed tanker berth also in the waters offshore of Sea Island. In a fixed tanker berth, vessels are moored to breasting and mooring structures supported on steel or concrete piles driven into the seabed. A central off-loading platform would support the cargo off-loading arms and piping. An access trestle would lead to shore, supporting the pipe rack and providing shore access to personnel and maintenance vehicles (see **Figure 3**).

Vancouver Airport Fuel Facilities Corporation (VAFFC)
c/o FSM Management Group Inc.
#103-12300 Horseshoe Way
Richmond, BC, V7A 4Z1
Tel: (604) 271-7113; Fax (604) 271-8006

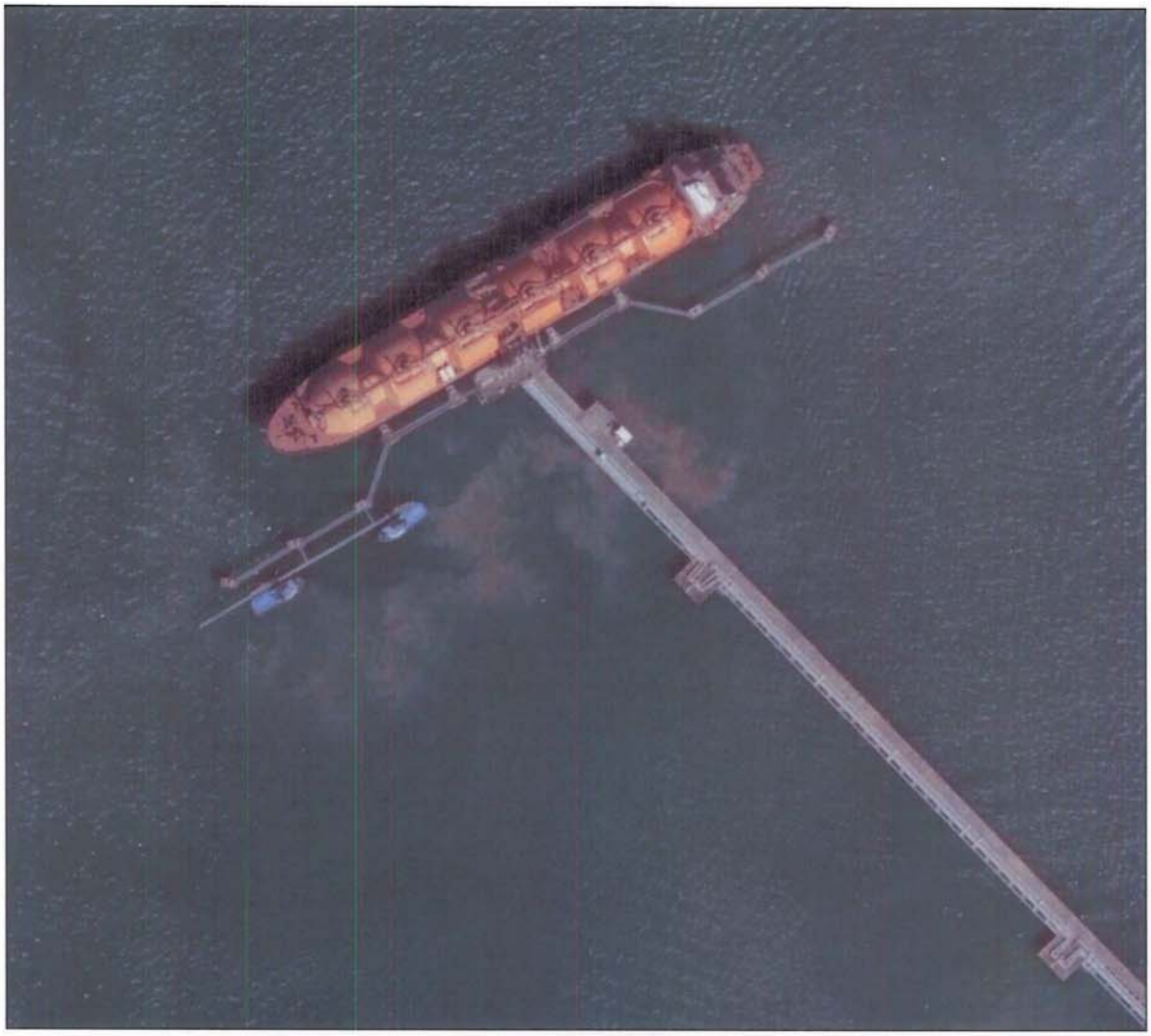


Figure 3 Typical Off-Shore Fixed Tanker Berth with Pile-Supported Access Trestle, Trinidad, West Indies

(Source: Google Earth)

To accommodate fully-laden Panamax-class tankers, a fixed terminal would require a water depth of approximately 18 m. Without dredging, the terminal would need to be located approximately 6 km west of Sea Island to reach water of adequate depth (see **Figure 4**).

Vancouver Airport Fuel Facilities Corporation (VAFFC)
c/o FSM Management Group Inc.
#103-12300 Horseshoe Way
Richmond, BC, V7A 4Z1
Tel: (604) 271-7113; Fax (604) 271-8006

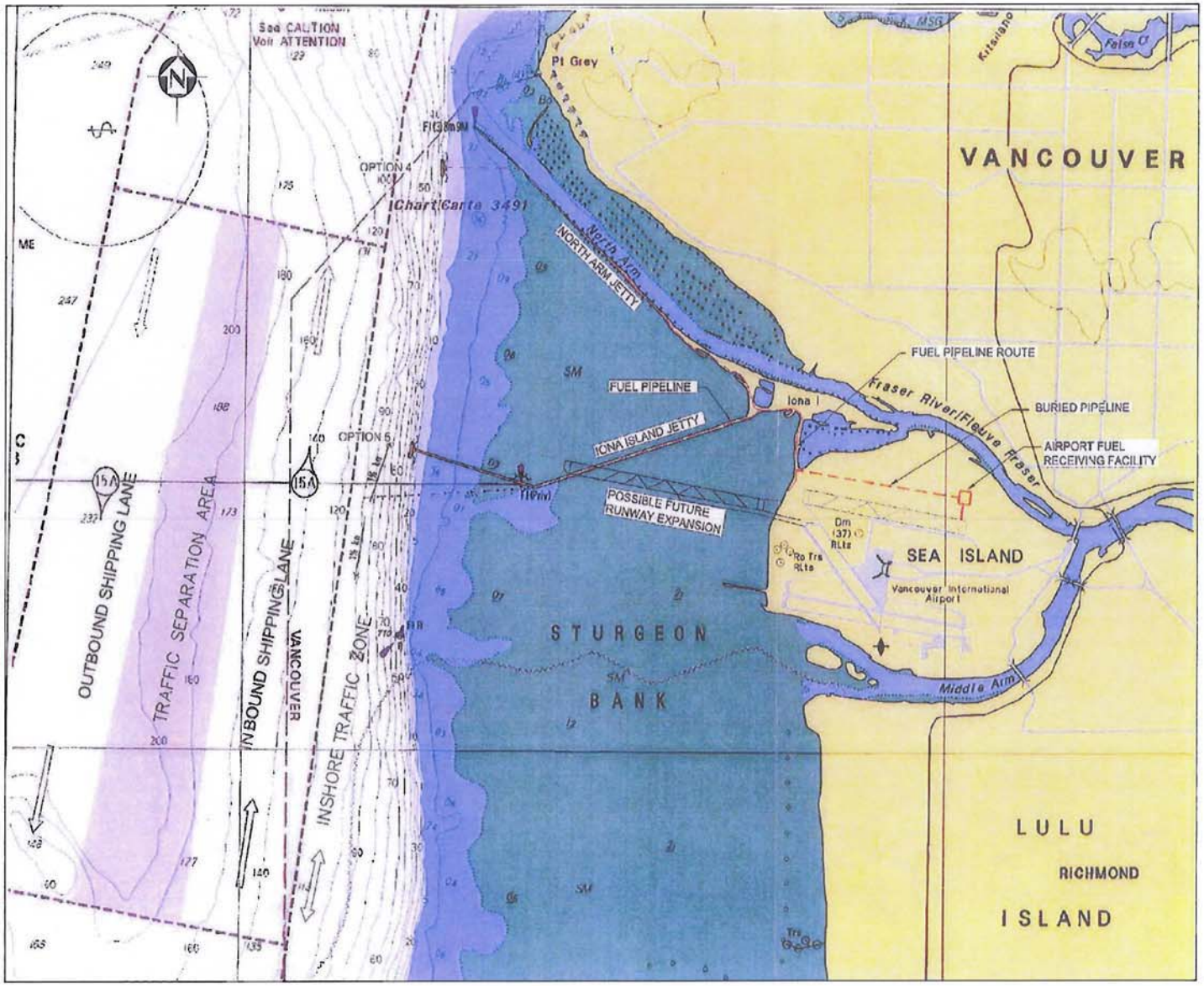


Figure 4 Off-Shore Fixed Terminal Options

PWT - 35

Vancouver Airport Fuel Facilities Corporation (VAFFC)
c/o FSM Management Group Inc.
#103-12300 Horseshoe Way
Richmond, BC, V7A 4Z1
Tel: (604) 271-7113; Fax (604) 271-8006

Challenges

In 2006, the Vancouver Airport Authority (VAA) presented *Your Airport 2027 20-Year Master Plan*, which contained VAA's recommendations for the future of YVR over the next 20 years. In the Master Plan, VAA forecasted that a new runway would be required by 2027 to accommodate projected increased runway activity. VAA explored a range of new runway options and identified four possible options that it wished to retain for future expansion. One of these options was a new 4,270 m runway extending westward from the Sea Island dyke onto the foreshore of the ocean from a point mid-way on Sea Island ("Foreshore Runway").

In the Master Plan, the VAA recommendations include protecting the Foreshore Runway option by allocating this area to airside operations use in the *2027 Airport Land Use Plan* (see **Figure 5**). In the *2027 Airport Land Use Plan*, airside reserve is extended 5,500 m west from the existing west dyke out into the ocean for the whole of the width of Sea Island. The *2027 Airport Land Use Plan* was approved by the federal Minister of Transport in 2008.

In discussions with VAA leading up to the Master Plan approval, VAFFC was advised that VAA wished to protect two options for future runways, one being the "Foreshore Runway". The protection for the "Foreshore Runway" by VAA was a factor relevant to VAFFC in deciding whether to pursue the option of locating a fuel off-loading facility in the foreshore off Sea Island.

Other challenges include:

- Fixed terminals in exposed locations are generally aligned with the direction of prevailing winds, waves, or currents, whichever are most significant. Unlike the location for the preferred South Arm of the Fraser River option, where conditions are relatively sheltered, an offshore terminal would be more exposed to winds and waves. The operational downtime due to inclement weather will therefore be higher for a fixed offshore terminal compared to the preferred option.
- The distance from shore to deep water is up to 6 km or more, depending on the exact location chosen for a terminal. To connect the terminal berth to shore, a 6+ km long access trestle or causeway would be required to support the access road and pipe rack. An earth-fill causeway would be similar to the lengthy access roads serving the Tsawwassen Ferry Terminal and Delta Port/Westshore Terminals facility in Delta. Another option would be to support the trestle on piles, much like a bridge. Either option would be very expensive compared to the preferred Fraser River option, which is close to shore and does not require such a causeway or trestle.
- Constructing an earth-fill causeway or pile-supported trestle across the shallow Sturgeon Bank mudflats would likely have an adverse impact on the environmentally sensitive intertidal ecosystem. Additional long-term effects may include potential loss of habitat areas, reduced water circulation, and increased shading of the seabed.

Vancouver Airport Fuel Facilities Corporation (VAFFC)
c/o FSM Management Group Inc.
#103-12300 Horseshoe Way
Richmond, BC, V7A 4Z1
Tel: (604) 271-7113; Fax (604) 271-8006

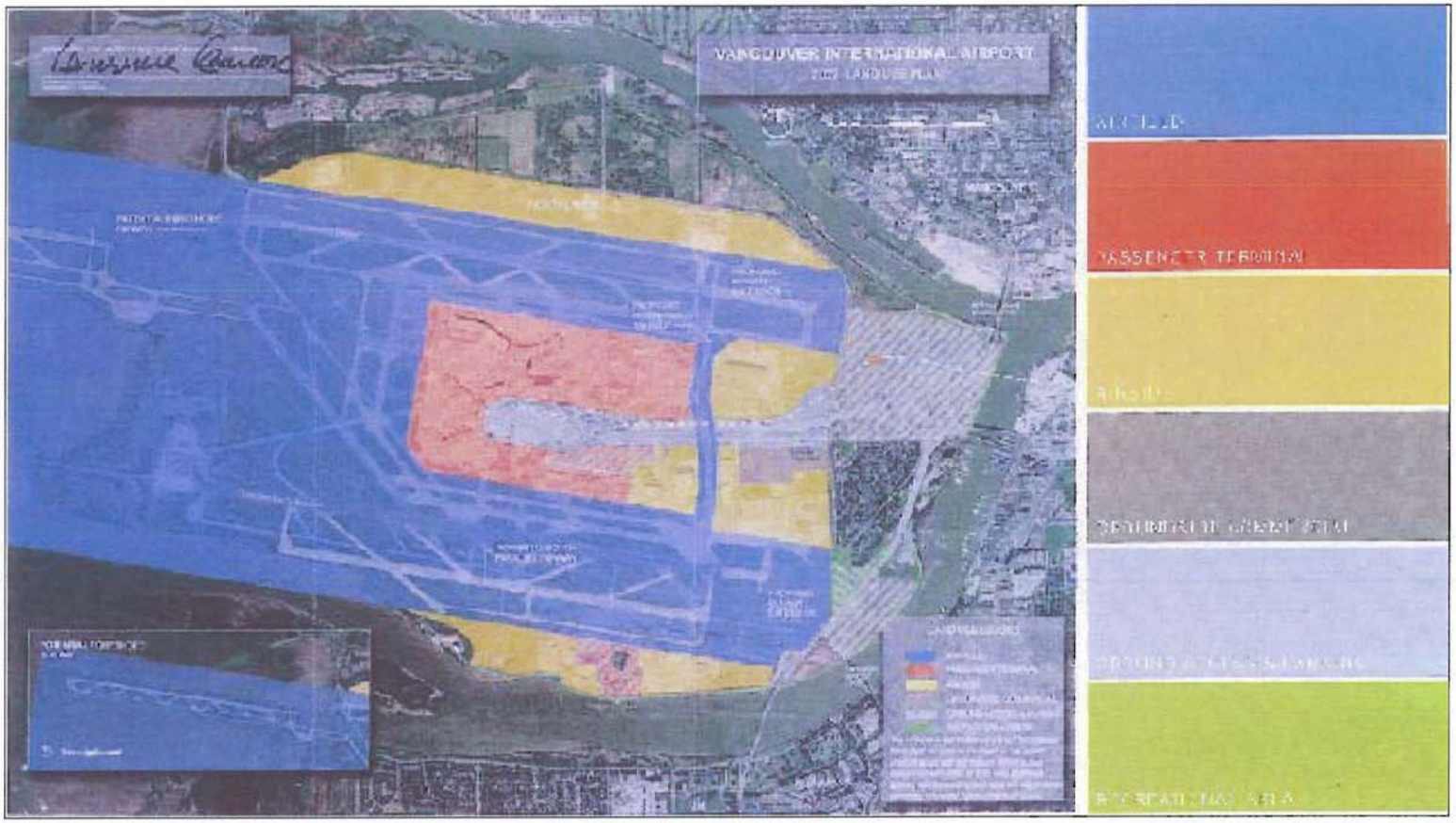


Figure 5 VAA Airside Reserve for 2027

A conceptual drawing showing how key Airport Authority recommendations fit into the proposed 2027 Airport Land Use Plan is shown above (Source: YVR Master Plan – Approved by the federal Minister of Transport in 2008) .

- It may be possible to use the existing Iona Island Jetty (which supports the Iona Island Wastewater Treatment Plant outfall) or the North Fraser river training jetty to provide access at least part way across Sturgeon Bank. However, both structures were built prior to the development of modern seismic codes. It is expected that a significant amount of remedial work would be required to bring these structures up to modern design standards, which would add to the cost. YVR's offshore runway option would also likely require that the Iona Jetty outfall be relocated at a future time, and hence the use of this jetty for pipeline and access is uncertain. Relocation of this jetty would be expected to incur enormous cost. In any event, neither jetty extends all the way into deep water, so a new trestle or causeway (of shorter length) would still be required to reach an offshore facility, with the same challenges and impacts described above.
- A marine terminal located off Sturgeon Bank would introduce man-made structures in an area well out into the Strait of Georgia, an area which currently appears "natural", and is widely appreciated for its scenic and recreational values. The terminal would be highly visible from many locations in the Lower Mainland, such as west Richmond, Marpole, Point Grey, Wreck Beach, West Vancouver, Bowen Island, and Grouse Mountain among others. It is expected that such a location may be opposed by significant numbers of people across the region.
- A fixed terminal located on the edge of Sturgeon Bank would be even more vulnerable than a mono-buoy to damage from underwater landslides or seismic-induced liquefaction. A careful and expensive program of soil investigation and underwater ground improvements may be required. Ground improvements, if required, would add considerable expense to this option.

Concept 2B – Fixed Terminal Inshore

This concept would involve a fixed tanker terminal located closer to shore near Sea Island; however this would require extensive dredging to create a navigable channel of suitable width and depth. A wider "turning basin" would be required at the head of the channel to allow vessels to be turned around prior to departure. **Figure 6** shows a conceptual layout of an inshore fixed terminal off Sea Island. An example of a dredged channel and turning basin is shown in **Figure 7**, which is also similar to the dredged basin serving the Deltaport container terminal in Delta.

An inshore terminal would be more sheltered than an offshore berth, and the shorter length of access trestle and pipe rack required would realize significant cost savings. However, these savings would be more than offset by the greatly increased cost of the dredging and disposal.

Vancouver Airport Fuel Facilities Corporation (VAFFC)
c/o FSM Management Group Inc.
#103-12300 Horseshoe Way
Richmond, BC, V7A 4Z1
Tel: (604) 271-7113; Fax (604) 271-8006

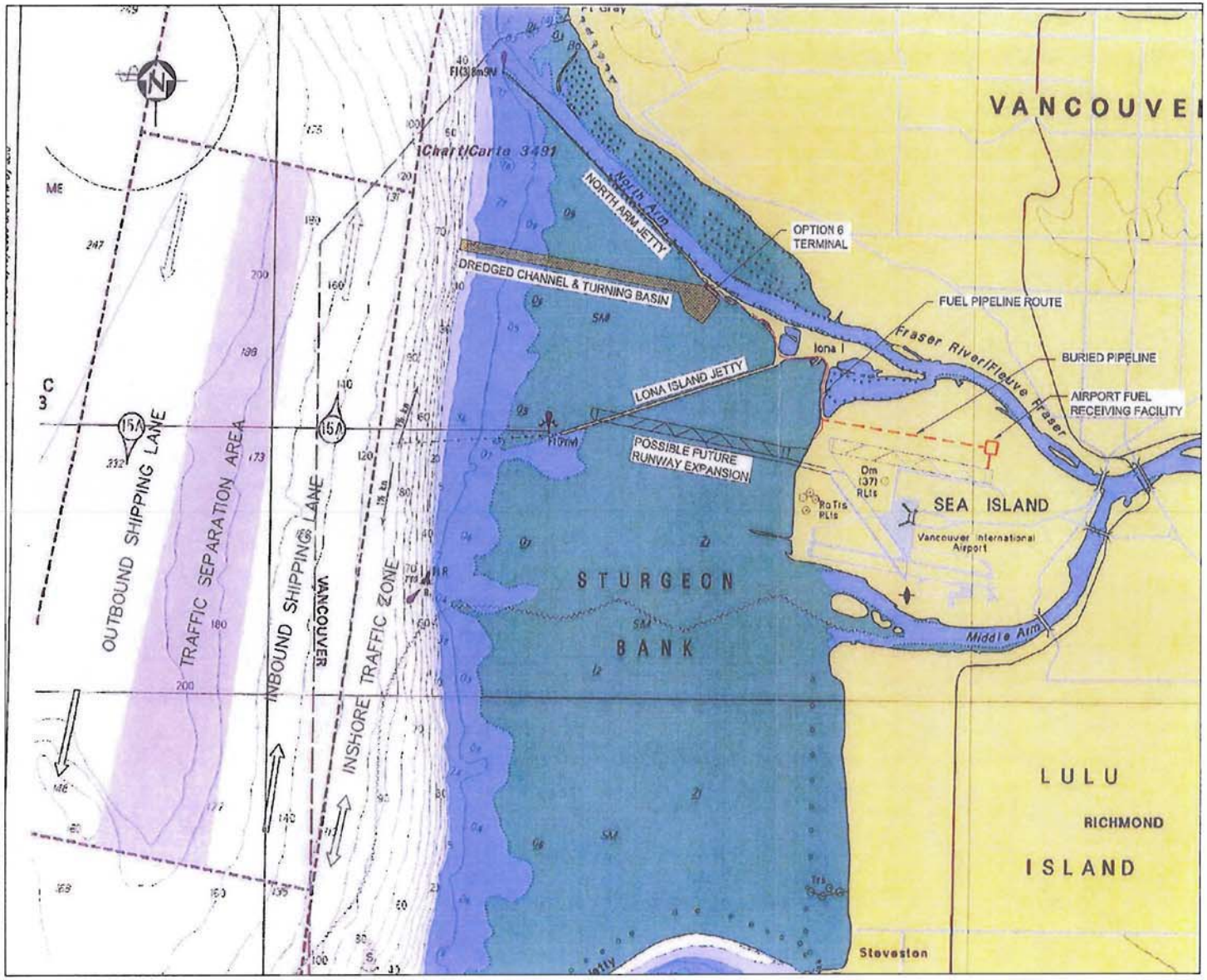


Figure 6 Inshore Fixed Terminal Option

PWT - 39

Figure 7 Dredged Ship Channel and Turning Basin, Pasadena, Texas

(Source: Google Earth)

Challenges

Many of the same challenges for an offshore terminal would also apply to an inshore terminal. Some additional challenges associated with this option are described below.

A considerable amount of dredging would be required to create and maintain the navigation channel and turning basin. Given the ecological sensitivities of the Sturgeon Bank foreshore, this concept would likely face significant regulatory challenges. For example, the Deltaport Berth 3 expansion now under construction in Delta required a significant amount of dredging and fill in the sensitive intertidal habitat of Roberts Bank, which is similar to Sturgeon Bank. To obtain the necessary fisheries authorization from Fisheries and Oceans Canada for this work, an extensive habitat compensation program valued at more than $15 million was required.

An inshore terminal would be closer to the flight path of air traffic using YVR, which may create safety concerns vis-a-vis the radar signature presented by large vessels moored close to the Sea Island foreshore.

2.3 Upgrade/Replacement of Existing Pipeline Delivery System

Concept

This option would require upgrade/replacement of the existing 41 km long pipeline system to meet the forecasted long-term demand for fuel at YVR. The approximate route for the existing right-of-way commences near Burrard Inlet south to the Kinder Morgan Terminal on Burnaby Mountain, crossing Lougheed Highway and the Trans Canada Highway, east of Burnaby Lake. From there the pipeline right-of-way extends southwest towards the Riverway Golf Course at Big Bend in south Burnaby, crosses the North Arm of the Fraser River and traverses River Road in Richmond, joining a utility corridor that extends west and crosses No. 6 road. The pipeline right-of-way continues to follow Bridgeport Road, surfacing briefly near the Moray Channel, north of Bridgeport Road, before crossing under the Moray Channel and surfacing briefly on Sea Island. From here, the pipeline right-of-way extends to the Trans Mountain (Jet Fuel) Inc. (TMJ) Terminal in the northeast section of Sea Island.

Challenges

VAFFC has recently completed an assessment of the existing fuel delivery pipeline and infrastructure, and the viability of undertaking an upgrade or replacement of the pipeline.

Since VAFFC does not own the pipeline, the upgrade or replacement of this system is not within the control of VAFFC. In any case, the delivery capacity of the pipeline is ultimately limited by its material strength and age, and a partial upgrade and/or the addition of pumping stations would only provide marginal and short-term increased throughput capacity. Unfortunately, these upgrades would not address the pipeline's long-term viability or improve its overall material strength and could, in fact, further reduce its useful life by placing additional stress on sections that had not been upgraded.

While pipeline replacement and/or the construction of a parallel pipeline would permit increased flow rates and significantly enhance throughput capacity, any significant work would be complicated. Urban development and community infrastructure along the right-of-way has built up considerably in the 40 years since the pipeline was constructed and little vacant land remains, particularly through Burnaby and northwest Richmond.

Even if the pipeline was upgraded or replaced, it would not by itself provide the necessary access to the offshore fuel supply market. The marine terminal and storage facilities at Westridge are owned by a third party and are not part of the TMJ fuel delivery system. As a result, the airlines at YVR would not have any assurance of access to the Westridge Marine Terminal. Access to marine transported fuel from offshore refineries is essential to serve any incremental growth in fuel demand. Without assured long-term access to a marine delivery point, increasing the capacity of the pipeline does little to serve any growth in fuel demand at YVR.

In 2007, TMJ applied to the BC Utilities Commission (BCUC) to increase its rates. The application was unusual because TMJ was seeking to almost double its rates so it could recover its invested capital in the system and abandonment costs over a five-year time frame, which it believed was the remaining economic life of its pipeline system. TMJ filed this application because it believed the VAFFC Fuel Delivery Project would be built within this time frame and it represented a superior project from several perspectives, including economics and access to fuel sources.

During the proceeding, TMJ presented evidence from an independent consultant (BMB Fuel Consulting Services) who was hired to assess the supply situation logistics and economics. The basic points advanced by TMJ, as supported by BMB Fuel's analysis, were as follows:

- TMJ's existing system cannot meet forecasted fuel requirements at YVR. The shortfall will be acute by as early as 2010 at a high consumption growth rate and by not later than 2015 at a low consumption growth rate;
- The TMJ system would be expensive and complicated to expand. The VAFFC project would be more economic to build and operate than twinning or replacing the TMJ system. Overall, the VAFFC project would offer a lower delivered cost of fuel to YVR than the TMJ system could; and
- The VAFFC project would also offer greater access to fuel supply sources than the TMJ system. TMJ argued that the optimal solution should provide access to the largest array of competitive supply options and have expansion capability to meet future growth.

Attached is a copy of the BMB Fuel report (**Appendix A**) that was filed in the BCUC proceeding.

2.4 Selected Option – South Arm Fraser River Terminal / Pipeline to YVR

Overview

VAFFC selected the South Arm of the Fraser River option as its preferred alternative. This option would require development of a marine terminal, fuel receiving facility and pipeline. A marine tanker or barge would travel upriver from the existing transit route in the Strait of Georgia to a fixed deep water marine terminal berth and off-load and transfer fuel into storage tanks via a pipeline. From the storage tanks, fuel would be delivered via a new purpose-built pipeline to the VAFFC fuel receiving and distribution facilities at YVR.

In 2007, VAFFC acquired a waterfront property on Williams Road on the north shore of the South Arm of the Fraser River in Richmond, approximately 2 km east of Highway 99. VAFFC bought the property when the opportunity arose to preserve this option. Waterfront property of this type is extremely difficult to acquire. An important component of the property is an existing marine terminal and Water Lot lease with the Port Authority.

The preferred option will be able to accommodate a range of vessel sizes and types due to the deep water navigation channel in the river and deep water at the face of the marine terminal. The marine terminal is appropriately positioned to serve as a terminal facility for aviation fuel deliveries, nearby land is zoned for heavy industrial uses, and there are good ground conditions for the pipeline.

The components of the preferred option include:

Marine Terminal

The existing marine terminal on the site was designed to accommodate vessels up to 30,000 deadweight tonnes (dwt) in size. VAFFC proposes to upgrade the existing structure to meet current seismic code and accommodate vessels ranging in size from 20,000 dwt fuel barges to Panamax-class fuel tankers up to 60,000 dwt. Upgrades such as pipe pile breasting dolphins, re-grading of rip-rap, and land-based ground improvements are among the activities VAFFC expects to undertake.

The size and configuration of the property are unable to accommodate fuel storage; however, adjacent industrial zoned land owned by Port Metro Vancouver has been identified as potentially suitable for such development. The proposed plan is to receive and off-load fuel at the upgraded marine terminal and transfer fuel by pipeline to a new fuel receiving facility that will be built nearby.

Fuel Receiving Facility

The optimal location for the development of a fuel storage facility has been identified within a parcel of Port Metro Vancouver lands adjacent to the marine terminal. VAFFC proposes to lease this land from Port Metro Vancouver. As currently defined, the fuel receiving facility will include six above ground steel storage tanks capable of providing a total storage capacity of up to 80 million litres (500,000 barrels) with possibly two additional tanks in the future.

Pipeline

A new pipeline will be constructed to deliver fuel from the fuel receiving facility to the VAFFC fuel storage and distribution facilities at YVR. A potential pipeline route has been identified that utilizes existing transportation and utility corridors in Richmond. Where significant highway and waterway crossings are unavoidable (i.e., Highway 99, Moray Channel), the pipeline will be directionally drilled underground to mitigate potential environmental impacts and avoid disruption of vehicle and vessel traffic. Pipeline routing options will continue to be investigated with input from the City of Richmond and other stakeholders.

Existing Delivery System – Continued Operations versus Decommissioning

Based on its 2007 submission to the BCUC, TMJ stated that it would pursue abandonment of the pipeline when the shippers either formally indicate that they will no longer ship on the line or when TMJ no longer believes that the tolls are likely to produce a positive cash flow. TMJ estimated that this would occur in five years, shortly after the commissioning of the new VAFFC fuel delivery project.

3. Conclusions

Based on the screening level evaluations carried out to date, the South Arm of the Fraser River option was selected as the preferred option to carry forward through the approvals process. It was considered the front-runner for several reasons, including:

- Due to the deep water at the terminal site, the preferred option accommodates the full range of vessel sizes needed to provide maximum flexibility for sourcing aviation fuel, and provides a range of existing transportation and utility corridors suitable for pipeline routing;
- Navigability within the South Arm of the Fraser River is well-proven based on existing shipping traffic in the river; there is adequate channel depth and room for turning and manoeuvring vessels up to and including Panamax-class; the Fraser River Pilots Association indicate that the location of the marine terminal is ideal because it is in one of the widest sections of the river;
- The Williams Road site is already an industrial development with existing marine infrastructure, requiring less new development compared to other options;

Vancouver Airport Fuel Facilities Corporation (VAFFC)
c/o FSM Management Group Inc.
#103-12300 Horseshoe Way
Richmond, BC, V7A 4Z1
Tel: (604) 271-7113; Fax (604) 271-8006

- The environmental footprint of the project is relatively small, falling below the size thresholds that trigger a mandatory environmental review under the BC environmental assessment process. (Nonetheless, VAFFC has committed to a voluntary BC environmental assessment process to ensure community issues are addressed);
- The site is relatively sheltered, with reduced risk of delays or operational downtime caused by inclement weather. Vessels are able to enter, berth and off-load product with few, if any, limitations arising from wind or sea state conditions that would otherwise potentially affect mooring of vessels outside the river; and
- The estimated capital and operating costs are less than all of the offshore options and the rail option, and much less than upgrading or replacing the existing pipeline infrastructure.

Appendix A

Airport Jet Fuel Supply to Vancouver International Airport (YVR)

By

BMB Fuel Consulting Services

01 June 2007

BMB FUEL
CONSULTING SERVICES

Aviation Jet Fuel Supply to Vancouver International Airport (YVR)

1 June 2007

BMB FUEL
CONSULTING SERVICES

Table of Contents

1. Introduction

1.1 Scope

Based in Ottawa, Ontario BMB Fuel Consulting Services Inc. (BMB Fuel) provides professional services to the global airline, aviation and energy industries, emphasizing business intelligence and decision support, fuel conservation, environmental compliance, operational process optimisation and cost reduction. Our capabilities include all fuel management disciplines: Procurement, price hedging, supply chain, handling, quality assurance, consumption, training and sustainable development.

BMB Fuel worked with designated representatives of Current Solutions Inc and Kinder Morgan Canada (KMC) to conduct a fuel supply chain options analysis relating to:

- Barging of fuel from the refinery at Burnaby to Vancouver International Airport;
- Barging of fuel from the refinery at Cherry Point to Vancouver International Airport;
- Ocean tanker delivery of jet fuel via bulk carrier from southeast Asia to Vancouver International Airport; and
- The potential upgrade of the existing jet fuel pipeline between Westridge Marine Terminal ("WMT") and Vancouver International Airport ("YVR"), by doubling its effective capacity.

The principal focus of the analysis was an evaluation of the relative cost and long-term implications of each of the options against the current supply arrangements using the existing pipeline.

1.2 BMB Fuel Project Team

BMB Fuel deployed the following project manager and consultants for this assignment. Both of the consultants are acknowledged experts in their respective fields of civil air traffic forecasting and aviation fuel supply chain business analysis. Short biographies are provided below: Detailed resumes may be supplied upon request.

- **Andrew Jones: Project Manager**

  A senior consulting, engineering and management professional with over 20 years experience and a proven ability to lead teams and to exceed client expectations in the delivery of complex solutions. Key capabilities include: Process development and optimisation; facility activation; transition planning; training program development and delivery; operational readiness assurance; baggage handling and security screen system design and implementation; airport planning, project management, change leadership, process automation, operations and logistics management. Expertise in diverse industry sectors including commercial management consulting, civil aviation and airport development, aerospace and defence, security and automotive manufacturing.

- **Frank Elder: Economist and Aviation Traffic Forecasting Specialist**

  Frank has accumulated over 30 years of experience in the provision of subject matter expertise, guidance and advice to board-level policy makers, strategic planners and executives, establishing a well proven track record of value delivery of within the transportation industry. Specific consulting capabilities include air traffic forecasting, strategic planning, privatization and organisational restructuring, process modelling, and financial appraisal with particular emphasis upon airline and airport infrastructure development. His approach to the conduct of airport traffic forecast studies uses a combination of trend analysis, data extrapolation, expectation surveys and professional statistical judgement. He has been associated with over 100 relevant projects around the globe providing assistance to governments, development agencies, non-governmental organizations, commercial enterprises, and corporate clients including International Air Transport Association, (IATA), BAE SYSTEMS, Airport Strategy & Marketing Ltd., SERCO, The Royal Navy, Cornwall County Council, The Mersey Partnership, Sheffield First, Halcrow, EBRD

- **Robert Kokonis: Fuel Procurement and Supply Chain Business Analyst**

  Mr. Kokonis has over 16 years of leadership experience in the travel industry, acquired with three major airlines including Air Canada, global travel management firm Carlson Wagonlit Travel, and Worldspan, a global distribution system ("GDS") who counts global online travel giant Expedia amongst its customers.

  He is an acknowledged authority on fuel procurement and supply chain strategy, specializing in operational management, hedging, business intelligence, partnering, joint ventures, and data and information management. Mr. Kokonis has developed innovative, flexible and risk-reduction mechanisms to improve fuel management in several areas including operational management techniques, tankering and hedging strategies. He understands fuel operations and management from the front line to the boardroom and has participated in fuel procurement, standardization and management activities in Canada, the United States and Europe. In the late 1990s, as Chair of Air Canada's Fuel Review Committee, Mr. Kokonis founded the STAR Alliance fuel management forum along with initial partners United Airlines and Lufthansa German Airlines.

  Mr. Kokonis' background also includes ATC and airport charges, business process redesign, change management, collective bargaining, corporate communications, e-Commerce, finance, government relations, Internet and traditional product distribution, marketing, operational benchmarking and forecasting, sales and supplier procurement functions. He has provided operational, commercial, regulatory and financial guidance to airlines, the passenger and cargo divisions of a general sales agent, an international tour and trade mission organizer, an Internet booking engine firm catering to the corporate self-serve travel market, to start-up travel agencies, and to a foreign government regarding aviation-based import and export opportunities for its home market.

1.3 Methods Used in Analysis

During the course of the analysis, BMB Fuel held discussions with representatives of the following stakeholders associated with jet fuel supply to Vancouver International Airport and related parties:

- BP at Cherry Point, WA (refinery operator);
- BP at Chicago, IL (fuel trading department);
- Bulk carrier ocean tanker companies in Vancouver, BC;
- Burnaby, BC refinery operator: Supply and fuel trading departments;
- Federal, Provincial and State taxation authorities;
- Fraser River Port Authority in New Westminster, BC
- Fuel barging services providers (Canadian firms Seaspan and Island Tug);
- Fuel services provider at Vancouver International Airport;
- Imperial Oil, Petro Canada and Shell Canada at Calgary, AB (fuel trading departments);
- KMC business development and engineering personnel; and
- Vancouver International Airport Authority (YVR).

Trucking companies were not approached, as a substantial increase in trucking volume (beyond future growth capacity of existing under-utilized truck rack systems) is not anticipated due to:

- Higher cost (versus pipeline and barging); and
- Relatively low volume impact versus YVR's forecasted fuel requirements.

1.3.1 Factual data used in this report

- KMC approved current annual toll, maximum jet fuel volume and current utilization;
- KMC current and historical O&M and Cost of Service figures;
- Burnaby and Cherry Point jet fuel production; and
- All YVR passenger traffic and fuel consumption data for the years 2005 and before.

1.3.2 Limitations identified with available data and information

- BP was reluctant to release details of its jet fuel production (current and potential increase) and storage capabilities;

- Barge quotes directly from barge service operators were high level estimates; and not quotes for delivery of specific volumes at specific times;

- Inability to access confidential price agreements between the Burnaby refinery operator and YVR airline customers, meant that the commodity price differential between jet fuel sourced from the US Pacific Northwest ("PNW") and YVR was identified through

discussion with experienced, BP and Chevron fuel traders and based on BMB Fuel's knowledge of the supply/demand relationship in a commodity-driven marketplace;

- Arbitrage opportunities identified by BP, Chevron, Imperial Oil, Petro Canada and Shell Canada fuel traders related to the "normally" favourable spread between LA FOB (or "flat") Jet Fuel and physical Singapore FOB jet fuel prices, are subject to market fluctuations that may favour one source versus another on a daily and seasonal basis;

- Estimate only of cost of Fraser River (main arm, north shore) barge terminal facility, including capital infrastructure, transhipment and administration costs; and

- While the Fraser River Port Authority believes that bulk ocean tankers of up to 300,000 barrels capacity should be able to navigate the main arm of the Fraser River, this guidance was based on the Authority's allowances for maximum vessel draft, beam and length allowances – there was no definitive comparison available between ship volume and ship measurements;

1.3.3 Data abbreviations used

- BBL = Barrel;
- M3 = cubic metres;
- MML = millions of litres;
- MMLD = millions of litres per day;
- MMG = millions of US gallons;
- MPTR = Vancouver Airport Master Plan Technical Report
- FOB Shipping Point = Free On Board with title passing to the buyer at the refinery docks and with the buyer paying barge transportation costs;
- PNW = Pacific northwest region;
- PSW = Pacific southwest region;
- TMJ = Trans Mountain Pipelines (Jet Fuel) Inc., used interchangeably with "KMC" to describe the current YVR jet fuel pipeline; and
- YVR = Vancouver International Airport

2. Supply

2.1 Current Supply Capability

Daily Sustainable Supply

The YVR Master Plan Technical Report (MPTR) lists the current sustainable supply as 5.25 MMLD. Sustainable supply in this context means the maximum amount of supply from all available current sources. Our analysis of supply channels currently available verifies this sustainable supply limit at 5.29 MMLD, virtually identical to the YVR report.

Presuming the only channels of jet fuel supply to be the KMC pipeline and trucking, approximately 86% of the daily peak would be derived from the pipeline origin supply and approximately 14% from trucking. In summary, the current daily sustainable supply profile is as follows:

- KMC pipe = 4.54 MMLD
  - Equal to 94% of the maximum pipe capacity and 100% of effective available capacity based on assumed required low season downtime and maximum allowable system throughput at 95% of available uptime; and

- Truck = 0.75 MMLD
  - Not taken into account was the capability to expand trucked in supply by better utilizing existing truck rack reception facilities.

In terms of average daily supply, we estimate the origin of YVR jet fuel from all sources in 2007 as:

Origin of YVR Jet Fuel Supply - 2007

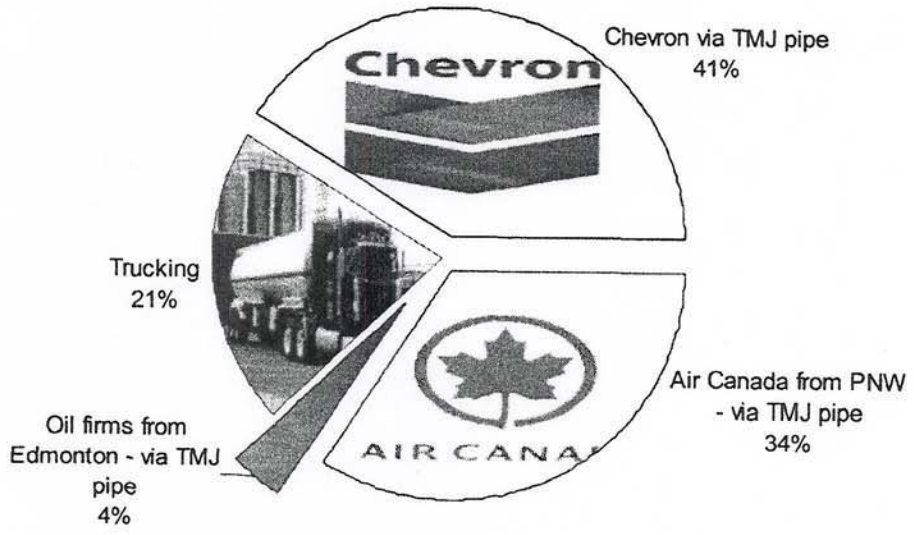


Figure 1: YVR Jet Fuel Supply 2007

3. Demand

3.1 Demand Forecast

Annual

The fuel data supplied by the VAFFC was based upon YVR's high range passenger forecast. Interpretation of the YVR MPTR presented some challenges in that typed data often varied from that set out on graphs. For example, annual fuel consumption was listed as 1700 MML. However, interpretation of Figure 12-17 in the YVR MPTR derives an annual fuel consumption of 1593 MML, which is 6.3% lower than the quoted study level.

Our own passenger estimate for 2007 is 17.19 million, 6.2% lower than the 18.32 million passengers implied in the YVR data. From that, we estimate jet fuel demand this year at 1495 MML, 12.1% lower than the 1700 MML quoted in the YVR MPTR.

Daily – average

From our 2007 annual estimate of 1495 MML, "average" (as opposed to maximum) daily demand should be 4.1 MMLD, lower than the 4.7 MMLD implied by YVR's annual forecast of 1700 MML.

Daily – maximum

The maximum daily usage listed in the YVR MPTR was 4.7 MMLD for 2005 and 5.25 MMLD for 2008. From that, implied 2007 maximum daily usage is 5.02 MMLD. However, based on our revised estimates for annual and average daily demand, we believe the maximum daily usage for 2007 is 4.42 MMLD, a difference of -12%.

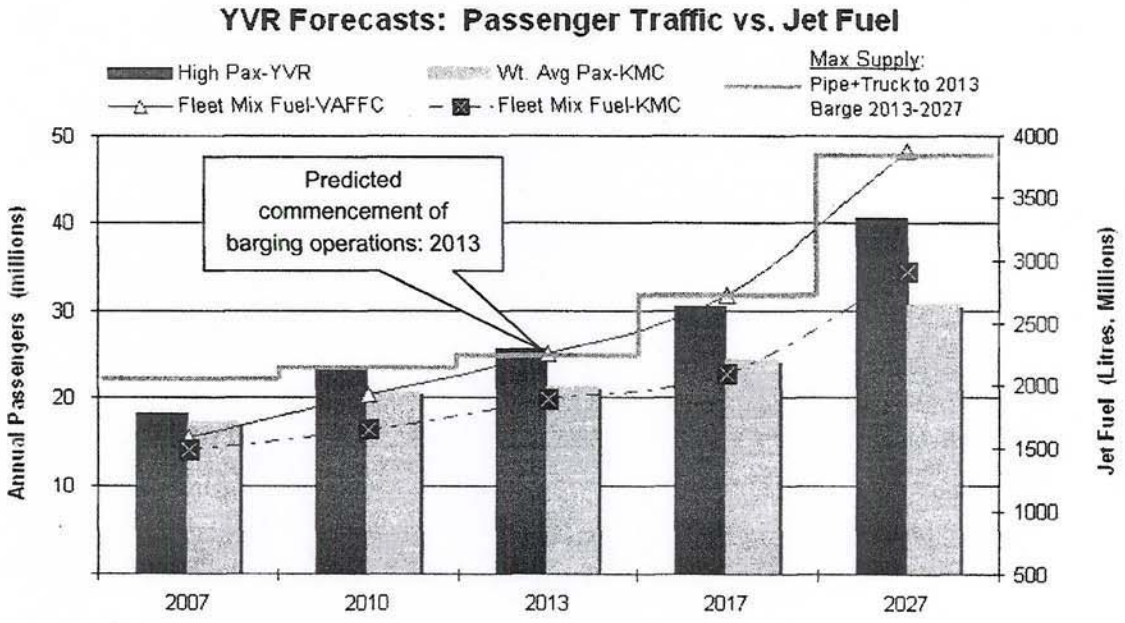


Figure 2: YVR Passenger and Jet Fuel Forecasts

In Figure 2, "High Pax-YVR" relates to the high trend passenger growth rate found in the YVR MPTR, as does the "Fleet Mix Fuel-VAFFC", which was the same report's fuel forecast based on the high passenger trend forecast plus the mix of fleet types anticipated in future flight operations. We derived our "Wt. Avg Pax-KMC" passenger forecast by taking 1/3 of the medium passenger growth trend line and 2/3 of the linear trend line. Finally, we also based our fuel forecast on the same fleet mix methodology. Fleet mix has perhaps the strongest correlation to fuel forecasting.

Our fuel forecast shows lower fuel demand than the YVR/VAFFC study, meaning that the combination of the existing KMC pipeline (incorporating the unidentified supply gap noted earlier) plus increased trucking (only within the confines of existing truck rack capacity) would be enough to handle "average" demand through to about 2011. The requirement, though, to be able to meet maximum daily demand and desired four-day reserve requirements would likely further tighten the supply-demand balance before 2010. Understandably, having fuel reserves on hand is paramount to any airport's concerns.

By 2027, the ending year of the current YVR long-range plan, we forecast annual jet fuel needs at 2913 MML, equivalent to average daily demand of 7.98 MMLD. Our 2027 forecast is 25.3% below the figure noted in the YVR MPTR that put 2027 demand at 3900 MML (actually, 3875 according to the VAFFC produced graph in Figure 12-17), equivalent to 10.68 MMLD.

4. Supply / Demand Conclusion

BMB Fuel can summarize its key findings of its supply and demand analysis for (YVR), as follows:

- Current daily jet fuel sustainable supply totals 5.3 MMLD;
- The jet fuel demand forecasts contained in the YVR Master Plan Technical Report ("MPTR") is reasonable, though it is was conservatively positioned by being based on the maximum forecast passenger traffic;
- The predicted maximum daily demand combined with the establishment of a 4-day fuel reserve would result in demand exceeding sustainable supply around the 2010 to 2012 period.
- The demand for jet fuel at YVR will grow from 1.5 billion litres in 2007 to 2.9 billion litres by 2027, an increase of 1.4 billion litres or +95%, effectively a doubling of demand.
- Based on our demand calculations, daily delivery by one 40,000 barrel barge should be sufficient to satisfy all of YVR's jet fuel supply needs to the year 2022; thereafter same-size barge frequency would either have to increase or barge size would have to be upgraded to the 60,000 barrel capacity level.

5. Supply Options: Commodity

5.1 Jet fuel production at the Burnaby, BC refinery

The refinery was built in 1954 (and has been upgraded on several occasions) and is the only refinery on the west coast of Canada.

It currently produces 10,000 BBL of jet fuel per day, with the vast majority (9,158 BBL, or 92%) being shipped down the KMC pipeline. Virtually all of the jet fuel refined at Burnaby is shipped to YVR for consumption. In other words, the refinery has no surplus capacity and as such, is not compelled to discount its jet fuel versus a traded benchmark reference price.

As the barging facility comes online, declining pipeline throughput would increase the toll payable, which currently sits at $3.21 CAD per M^3. This could incent the operator to move some of its own jet fuel volume via barge from the Westridge Marine Terminal if it would be cheaper than a higher pipeline toll.

Dock space at the Burnaby facility is not generous, but it could handle the barge traffic required to move some or all of the Burnaby operator's jet fuel to the proposed VAFFC Fraser River terminal.

From a storage standpoint, Burnaby has onsite storage facilities to accommodate 286,200 BBL (45 MML): While offsite storage adds further capacity of 750,000 BBL (119 MML).

Based on our forecast fuel demand, we believe it is inevitable that VAFFC will have to source jet fuel from Cherry Point, WA (next closest major jet fuel refinery to YVR). As noted in the table below, considering its total daily production of 10,000 BBL the Burnaby refinery is capable of satisfying only 39% of demand anticipated for this year and 20% by 2027 in a status quo environment.

In order to show scale of comparable refinery production, at 100% available production BP would be capable of servicing 100% of YVR daily demand through 2027 (see notes in Section 5.2).

Refinery Location	BBL	USG	MMLD	% of YVR Demand	
				2007	2027
Burnaby BC	10,000	420,000	1.59	39%	20%
Cherry Point WA	59,524	2,500,000	9.46	231%	119%
Cherry Pt Vs. Burnaby	***49,524 (495%)***				

Table 1: Burnaby and Cherry Point Comparison

Depending on how quickly barges could assume non-truck supplies and the market conditions resulting from increased competition, it could make economic sense for the Burnaby operator to cease jet fuel production altogether prior to 2017. It is assumed that the Burnaby operator would shift capacity to the production of another refined petroleum derivative.

5.2 Jet fuel production at the Cherry Point, WA refinery

The Cherry Point Refinery is located north of Bellingham, WA on Puget Sound just south of the U.S. - Canada border. It was built in 1971 and now has a nominal crude processing throughput of 230 thousand barrels per day. Cherry Point processes predominantly Alaskan North Slope crude which is delivered by tankers to the refinery's own marine terminal (*source: BP Global website*).

As noted in the previous table, BP's daily production of nearly 60,000 BBL is capable of servicing 100% of YVR's demand through 2027 based on 100% of its total jet fuel production.

A significant amount of the production produced at Cherry Point goes to major consumers in the PNW region. For example, BP currently provides about 85 percent of the jet fuel required at Seattle's Sea-Tac Airport, which at just fewer than 30 million passengers in 2006 is 77% busier than YVR. The refinery is also the largest West Coast supplier of jet fuel for the military.

Notwithstanding its current supply arrangements, BMB Fuel's enquiries of experienced fuel traders suggest that a combination of BP and other refineries on the US west coast could meet forecast YVR demand.

Based on a cursory examination, future YVR demand would certainly have to come from those other refineries on the west coast – likely by 2015 – though the amount thereof would be subject to increased production from BP. For example, BP currently produces 9.46 MMLD and 85% of Sea-Tac Airport's estimated daily jet fuel requirement (i.e. the portion of Sea-Tac's daily demand that is supplied by BP) is 6.16 MMLD.

That would leave 3.3 MMLD of BP's production for other sources including the US military and YVR. In 2007, we estimate that YVR will require 4.1 MMLD. However, subtracting the amount received by truck and the amount sourced already by Air Canada from BP and other refineries, the 2007 average daily demand should be closer to 2.14 MMLD.

In summary, this year BP likely has 3.3 MMLD available for military and other customers, while YVR has a need for 2.14 MMLD. The military and other customers likely use more than the implied gap of 1.16 MMLD, so this implies the VAFFC would have to source jet fuel from other US west coast refineries in addition to BP. The sum of available jet fuel supply from BP and other US west coast refineries should, in our assessment be able to meet forecast YVR demand.

From a market standpoint, however, unlike the Burnaby refinery that has no surplus, Cherry Point does. In order to dispose of its surplus, Cherry Point Jet would have to be sold at a discount relevant to the prevailing price in the intended delivery markets. For example, LA Jet plus transportation is the reference price for Cherry Point jet fuel. In order to sell its product to a buyer

in, say San Francisco, BP would have to reduce its FOB Cherry Point price down from the market reference price in order to remain competitive.

By corollary, the same would hold true for FOB Cherry Point shipments to Fraser River, BC. The amount of discount negotiated between BP (or other PNW suppliers) and YVR airline customers should be roughly equivalent to the cost of logistics transport from Cherry Point to the Fraser River terminal.

5.3 Jet fuel Supply from South West USA

Every market for jet fuel has its own price dynamics based predominantly on levels of supply and trading. The Los Angeles area jet fuel market is the largest supply and demand point on the US west coast. In addition to satisfying demand of large jet fuel users at major commercial airports in the Los Angeles area, supplies brought into LA also service demand from other commercial, civilian and military users along the US west coast and inland. LA Jet fuel supplies originate both from refineries on the West Coast and from imports from the Far East including Singapore.

There is significant trading activity in LA Jet fuel, making the market there highly liquid. As such, LA Jet is used as the price reference point in purchases of jet fuel from other west coast markets, including refineries and storage facilities in the Puget Sound, WA area. Since jet fuel in the Puget Sound area is not actively exchange traded (not liquid), prices for Cherry Point, WA jet fuel for example are normally based on LA Jet plus a transportation differential. Spot price reference points of LA Jet fuel are regularly quoted from key industry market makers such as Platts and OPIS, and are posted daily in the public domain at the US Energy Information Administration (EIA).

Jet fuel available at Cherry Point, WA is typically based on LA Jet plus a transport differential to determine the delivered price. Since the distance between Cherry Point and Vancouver is shorter than the distance between Cherry Point and LA, a discount would typically be applied against the delivered price of jet fuel shipments originating in Cherry Point that are bound for Vancouver.

5.4 Jet fuel supply from Far East

In the case where the buyer purchases a landed price; i.e., Singapore Jet using a LA FOB flat reference price, there would be no transport costs added on. Conversely, if the reference price for Singapore Jet were LA Jet minus a discount, the trader would add transportation to the commodity cost. Finally, a Platts Singapore MOPS jet fuel price could be used that includes a premium over physical Singapore FOB jet fuel. Regardless of the pricing structure used, in the majority of cases, arbitrage available to purchasers of Singapore jet fuel is normally based on transportation cost differentials.

Buyers of ocean transported jet fuel cargoes would have to enter into a commitment with the refinery and fuel agent. Typically, that commitment would include a minimum monthly volume of at least 200,000 BBL and a minimum time period supply of one year. Minimum commitment periods can be longer than one year depending on volumes and pricing mechanisms to be used.

While the ocean tankerage supply option may be attractive to the VAFFC due to the typical commodity price discount, from a security of supply standpoint we doubt the VAFFC would consider offshore purchases as a sole source of supply. Risks include refinery shutdowns – experienced by all refineries periodically due to maintenance, reliability/technical problems – and a long, thin supply chain that would be susceptible to weather, ship technical and other issues.

5.5 Conclusions

- Price differential of the underlying jet fuel commodity:
  - Jet fuel sourced from Singapore, when factoring in different ocean transportation pricing options, costs approximately 2.866 Canadian cents per litre less versus jet fuel sourced from the Westridge Marine Terminal area:
    - The Singapore scenario included differences in the underlying commodity price due to transportation-based arbitrage, plus volume purchase discounts;
    - Underlying commodity discounts favourable to Singapore Jet versus LA Jet are due to the prevalence of considerable jet fuel refinery capacity in southeast Asia coupled with lower regional demand for jet fuel versus the US west coast;
    - The volume discount is available to buyers who can purchase relatively high quantities with ocean going vessels, and because buyers must commit to minimum purchase volumes and minimum contract periods of one year;
    - Volume discounts included above are in the range of one-two US cents per US gallon, equivalent to approximately 0.452 Canadian cents per litre; and
    - Excluding transportation options and volume discounts, the typical "raw" price discount of Singapore FOB jet fuel versus LA FOB jet fuel is 3.0 Canadian cents per litre.

- Jet fuel, on average, costs 0.787 Canadian cents per litre less when sourced from the US west coast, versus jet fuel sourced from Westridge;

- Volume based price differentials favour only the southeast Asian supply option, due to the ability of purchasers to transport in relatively high quantities, and, with minimum purchase volumes and minimum time period commitments required;

- Volume discounts are likely in the range of one to two US cents per US gallon, equivalent to approximately 0.452 Canadian cents per litre; and

- Fuel taxes were not incorporated because no known US taxes are payable on the export of jet fuel to Canada. For example, the Washington State Aviation Fuel Tax of 11 cents per US gallon and the Washington Use Tax (0.5% of the underlying commodity price) do not apply. Neither does the 4.3-cent per US gallon US Federal Excise Tax, which only applies to domestic US consumption.

6. Supply Options: Delivery

6.1 Review of Alternative Delivery Options

The YVR MPTR examined 12 options for the future supply and storage of jet fuel. Of those, three were short-listed:

- Double the pipeline capacity by twinning the existing pipeline;
- Deliver jet fuel directly to Sea Island where YVR is located, by tanker or barge; and
- Deliver jet fuel to a new terminal facility on the north shore of the main arm of the Fraser River, with onward delivery to the airport via a connecting pipeline system.

6.2 Review of Alternative Delivery Methods

6.2.1 Twinning of Existing Pipeline

In 1996 under Trans Mountain Pipe Line Company Ltd., studies were undertaken to upgrade the current YVR jet fuel pipeline. Those studies were updated in the year 2000. Two main options were addressed, with each option having a phased-in approach.

Option 1 covered only the upgrades of the Chevron, Fraser River and Hill Street pumping stations, effectually adding new throughput capacity. Option 2 was based on a twinning of the pipeline itself. In Phase 1 of this option, 7 kilometres of pipe would be added downstream of Burnaby at the Westridge Marine Terminal. Phase 2 would add in 13.4 kilometres of pipeline upstream from YVR plus other upgrades at Chevron and Burnaby. Phase 3 would complete the project, adding the main 28 kilometres of pipeline from Burnaby to the airport.

BMB estimates that Option 2, the twin pipeline, would cost $31.3-million CAD in 2007 dollars. Based on a doubling of the existing pipeline's maximum capacity, the twin pipe would have been able to satisfy YVR's jet fuel needs, per the revised demand forecast by BMB, through to 2027.

If actual demand ends up closer to the higher jet fuel forecast in YVR's MPTR, even the twin pipeline may have difficulty meeting the combination of peak load days plus YVR's four-day reserve requirement. From a long-range security of supply perspective, a barge operation and terminal, which will be able to supply all demand well beyond 2027, would probably represent a better investment versus the twin pipeline option.

Although BMB Fuel has doubts that actual demand will reach the level calculated by the VAFFC in YVR's MPTR, the VAFFC may simply want to conservatively err on the side of caution and commit to barging as an assured source of long-term supply.

6.2.2 Barge Facility

We have been instructed to assume, for the purposes of our analysis, that the VAFFC's preferred option is a barge operation to the Fraser River.

KMC has estimated that construction of the barge dock, tankage and pipelines will take 5 years from 2008 inclusive, with operations able to get underway in 2013.

The capacity of the barge system – regardless of source of refined product – will be able to provide all fuel supply without using the pipeline. Jet fuel for barge delivery could be sourced from Burnaby, for as long as jet fuel production is maintained, BP Cherry Point, other refineries in the Puget Sound, WA area and elsewhere along the US west coast. Jet fuel sourced from anywhere along the US west coast could, in addition to locally refined product, include jet fuel sourced from overseas at a discount and stored in local tank farms.

BMB Fuel believes that once the dock infrastructure is in-place, the VAFFC would be able to source Southeast Asian jet fuel, at a cheaper underlying price versus US west coast jet fuel and with additional discounts available for larger volume purchase commitments, by utilizing ocean bulk tankers. However, some of the price benefits to be derived by sourcing offshore can be obtained from similar product delivered to and stored on the US west coast – without the supply assurance concerns of a long-distance, sole sourced supply chain.

Fraser River – logistics and terminal

According to barge operators, the main arm of the Fraser River would be preferable over the North Arm as the latter choice would present size and draft restrictions and there would be a higher amount of small boat traffic to contend with.

Navigation via the main arm could require tow and assist tugs year-round, though more likely during the spring winter melt run-off when currents become more hazardous to large vessel navigation.

Dockage should be able to handle even some of the larger US barges, which can have capacity as high as 100,000 BBL. Their use would be moot, however, as operations into Cherry Point have restrictions to only allow access for barges below the 100,000 BBL level.

Barges in BC typically have a capacity of 25,000 BBL, though Island Barge & Tug Ltd. has both 40,000 BBL and 65,000 BBL capacity barges available.

Based on our revised fuel forecast, one 40,000 BBL barge per day from one source, or multiple 40,000 BBL barges several times per week from multiple sources, would be sufficient to supply all YVR fuel requirements through to 2027.

Operating at the Fraser River terminal end would be less expensive than departures from Cherry Point, mostly due to less onerous tow and assist, and especially, security requirements.

The decision to move to barging operations can be justified on the basis of supply assurance (YVR demand coupled with a potential cessation of jet fuel production at Burnaby) and in financial terms as price differentials in the underlying commodity may favour one side of the Canada-US border over the other (see Cost Dynamics section below).

6.2.3 Cherry Point, WA terminal – Fraser River (the "Cherry Point barging solution")

Barge delivery from Cherry Point, WA to the main arm of the Fraser River arm would navigate a sea distance of approximately 45 nautical miles (83 kilometres). Cherry Point is a viable shipping point for deliveries of refined petroleum cargoes.

As noted above, there are barge size restrictions at Cherry Point, with the maximum barge capacity being 65,000 BBL. Any vessel over that size cannot fit within the dock fenders.

6.2.4 Westridge terminal at Burnaby, BC – Fraser River (the "Burnaby barging solution")

Barge delivery from Westridge to the main arm of the Fraser River arm would navigate a sea distance only slightly less than the distance between Cherry Point and the Fraser River. The navigational distance would be approximately 40 nautical miles (74 kilometres).

This route would be a less costly option than departures from Cherry Point, mostly due to less onerous tow and assist, and especially, security requirements.

Dock space is more constrained at Westridge than at Cherry Point; however, there would be adequate space should the Burnaby refinery continue to be a viable source of supply.

6.2.5 Ocean tanker delivery via bulk carrier – logistics and pricing

Ocean going bulk carrier tankers have jet fuel capacity in the range of 250,000 to 300,000 BBL, considerably more than average sized barges. These ships are able to navigate into the Westridge Marine Terminal, which currently possesses robust jet fuel storage capacity.

Roughly one visit per week from a typical bulk cargo vessel carrying 275,000 barrels would be sufficient to supply all of YVR's jet fuel needs through to 2027.

Based on discussions with the Fraser River Port Authority, vessels of this size should also be able to navigate into the main arm of the Fraser River. Should there be a size restriction on a certain vessel or owing the tidal nature of the main Fraser arm, barges could be deployed to the ship's offshore anchorage and enact a lightening strategy – whereby the jet fuel is first pumped in whole or in part to barges for subsequent transportation to the Fraser terminal.

Most ocean going ships that currently navigate in the main arm of the Fraser River are container vessels in the 4500 TEU (20-foot equivalent containers) range. It is common practice for the larger ships to operate in synch with high and low tide cycles. We expect that a jet fuel bulk carrier would have to operate on a similar schedule.

The shipping time from Singapore to Vancouver, a one-way sea distance of approximately 7,100 nautical miles, averages 12 to 14 days. The jet fuel purchaser is not responsible for securing cargo for the onward or return journey – that is left up to the ship's agent.

Buyers of offshore jet fuel normally secure the services of a fuel trader seasoned in offshore transportation procurement and logistics. Buyers commit to the trader for purchases of a certain volume of product for a minimum period of time. Owing their market experience, in the majority of

cases fuel traders dealing with offshore purchases come out ahead on day-to-day fluctuations between commodity and transportation prices: Veteran fuel traders are also known for their ability to secure better shipping prices than shipping agents themselves.

The more likely scenario is that some of the jet fuel that the VAFFC could source from the US west coast may include foreign jet fuel brought into the US west coast and stored in local tank farms and not just locally refined supply. In other words, the VAFFC may be able to avail itself of some offshore style discounts but with reduced security of supply issues related to a sole source ocean tankerage solution.

6.3 Supply Cost Analysis

6.3.1 Approach

A delivered unit cost comparison was considered to be the most effective approach to the evaluation of the comparative cost dynamics between the leading supply chain alternatives. The following supply options were examined:

- Doubling the supply capacity by twinning the existing pipeline;
- BP Cherry Point, WA to a new Fraser River terminal via barge;
- Burnaby, BC to a new Fraser River terminal via barge; and
- Singapore to a new Fraser River, BC terminal via bulk ocean tanker.

A three-month historical exchange rate of the Canadian Dollar versus the US Dollar:
USD 0.87759/CAD 1.00000 was used to price commodity cost differences and barge rates.

6.3.2 Cost elements – included and assumptions

The following cost elements were examined (as applicable) for each solution:

- Bulk ocean tanker direct and indirect costs including:
  - Two bulk carrier transportation cost scenarios:
    - Flat Singapore jet fuel price plus transportation; and
    - LA Jet fuel cost including transportation;
  - Transhipment (terminal offloading, storage and transmission via connector pipeline to YVR were all assumed to be contained within one unit fee).

- We examined charter costs for ocean tanker deliveries because ad hoc per BBL delivery prices are not available owing the long distances involved.
  - Prices are approximately $25,000 USD per day (for easy math, roughly $1,000 per hour) and include fuel, lubricants and other O&M costs; the ship's agent and not the jet fuel purchaser is responsible for filling what could otherwise be deadhead space on the ship's return onward/return journey.

- "Time Charters" can be a popular longer-term arrangement between a barge shipper and purchaser of jet fuel:
  - These typical three to five year contracts can cost approximately $28,000 USD per day, plus another $8000 to $10000 per day for fuel and lubricants; and
  - We compared time charter costs with that of ad-hoc barge transportation, but determined the latter was more cost efficient relative for barge operations with respect to our revised YVR fuel forecast.

- Barge direct and indirect operating costs including:
  - Barge transportation, with estimates provided by the two main barge operators in the Vancouver area, for transportation to the main arm of the Fraser River from either Cherry Point, WA or Burnaby, BC;
  - Transhipment (terminal offloading, storage and transmission via connector pipeline to YVR were assumed to be contained within one unit fee); and
  - Administrative and other chargeable allocations.

- It was assumed that barge shipments would be FOB Shipping Point;
- Capital expenditure cost of doubling the capacity of the existing pipeline;
- KMC current and historical O&M and Cost of Service figures;
- Used an assumed Cost of Service and Revenue Requirement to calculate the toll rate for the twin pipeline alternative;
- Estimates for barge transhipment and barge administration fees were estimated based on interviews, known approximate industry rates and current KMC O&M rates; and

- Projected costs for the twin pipeline alternative were based on the twin pipe coming online in 2013, with peak capacity not being available for its first ten years of operation.

6.3.3 Cost elements or other considerations – excluded

The following items were not considered in this unit cost examination:

- Capital expenditure from building a barge facility or from expanding the current pipeline, including internal weighted costs of capital and taxes, were excluded so that only transportation and related variable costs were considered across all alternatives;

- Similarly, the depreciation component of the current TMJ pipeline's O&M costs was excluded in order to provide a parity cost comparison;

- Inflation – the multitude of variables would have made this examination much more cumbersome, including the impact higher marine diesel fuel would have had on underlying barge transport rates;

- Time value of money – unless all revenue and cost elements are included, discounted cash flows can paint an inaccurate picture;

- We did not take into consideration the impact of the proposed new toll into the unit costs of the existing TMJ pipeline solution;

Delivered Jet Fuel Costs (CA ¢ per Litre)

Delivery Cost Variables	YVR Supply Chain Alternatives				
	Singapore to Fraser R.* *(avg of FOB shipping pt and FOB destination)	BP to Fraser R.	Burnaby to Fraser R.	Current TMJ Pipe	Twin TMJ Pipe
	Ocean Tanker	Barge	Barge	Pipe	Pipe
Commodity Price - benchmark LA Jet	59.867	59.867	59.867	59.867	59.867
KMC Pipeline Toll				0.280	0.352
Ocean Tanker Transport	0.421	0.000	0.000		
Barge Transport	0.000	0.787	0.594		
Barge Admin Costs/Other Overhead	0.000	0.066	0.066		
Fraser River Terminal: Transshipment (O&M)	0.197	0.197	0.197		
Subtotal Water Transport Costs	0.618	1.049	0.856		
SUBTOTAL before Market Price actions	**60.484**	**60.916**	60.723	**60.147**	**60.219**
Tax delta (no taxes on exports into Canada)	N/A	N/A	N/A	N/A	N/A
Commodity Price delta: vs. LA Jet benchmark	-2.415				
Commodity Price discount: due volume	-0.452				
Commodity Price discount: due transport and market surplus environment FOB BP		-0.787			
Subtotal Market Price differences	-2.866	-0.787	0.000	0.000	0.000
TOTAL - Delivered Price (exluding into-plane costs)	**57.618**	**60.129**	**60.723**	60.147	**60.219**
Difference in delivered price: vs. Current Pipe	**-2.528**	**-0.017**	**0.576**	**N/A**	**0.072**

Annual Cost of jet fuel demand (CAD Mill) (steady-state cost rate; excluding Jet delivered by truck)	Singapore to Fraser River	BP to Fraser R.	Burnaby to Fraser R.	Current TMJ Pipe	Twin TMJ Pipe
Year 2007 - estimate	$704	$734	$741	$734	$735
Year 2027 - forecast	$1,416	$1,477	$1,492	$1,478	$1,480

Table 2: Delivered Jet Fuel Costs

6.4 Analysis Conclusion

- The delivered cost of jet fuel is comprised of the commodity cost and the transportation cost:
  - The commodity cost represents the vast majority of the delivered cost; thus, small differentials in the commodity cost can have a much greater impact on customers than differentials in the cost of transporting the commodity from various suppliers.

- Transport costs represent only a small fraction of the overall delivered cost of jet fuel; and
- As such, it is primarily available commodity price differences from other markets that would drive a decision to abandon the existing TMJ pipeline.

- From purely a cost standpoint, the Singaporean ocean tankering solution is superior to the current pipeline and all other alternatives based on the commodity price differential;

- Sole sourced supply from ultra-long distance refineries represent a threat to security supply that would likely discount the use of jet fuel sole-sourced from southeast Asia;

- Barging operations from the US west coast, including the PNW, could source foreign jet fuel stored locally (earning some of the commodity price differentials available from directly sourced overseas supplies) in addition to locally refined jet fuel:
  - As such, the best solution from alternates to the existing pipeline based on an overall supply chain perspective – which balances costs, including the underlying commodity, transportation and O&M, versus delivery assurance of a sole source solution – makes the BP Cherry Point barging solution superior to the Singaporean ocean tanker, Burnaby barging and twin TMJ pipe solutions.

- The price differential in the delivered cost of the underlying commodity favouring water-borne shipments from southeast Asia and the Pacific Northwest would support a barging operation to the Fraser River:
  - An approximate difference of two and one half US cents difference, factoring in delivered price options, favouring jet fuel sourced from Singapore versus jet fuel sourced from BC or Alberta refineries; and
  - A price differential estimated to be one US cent favouring jet fuel sourced from the Cherry Point, WA area versus jet fuel sourced from BC or Alberta refineries.

- As a result of the commodity price differential, the most favourable solutions were:
  - From the standpoint of cost only (commodity price, transportation plus O&M), the trans-Pacific ocean tanker to Fraser River, BC operation was the most favourable; and
  - From the standpoint of total supply chain integrity (costs plus security of supply), the barging operation from BP at Cherry Point, WA to Fraser River, BC was the most favourable, with the barge pulling both Cherry Point-refined jet fuel plus jet fuel sourced from overseas and locally stored in area tank farms.

- Versus the existing TMJ pipeline, the Burnaby barging solution is the most expensive followed by the twin pipe;

- The Burnaby barging solution costs more than the twin pipe solution for two key factors: first, barge transport per litre is more than the assumed pipeline toll per litre; and second,

it is assumed that the transhipment and administration costs (largely O&M costs) applicable to barging would be included in the toll of an expanded TMJ pipeline;

- Versus the existing TMJ pipeline, the Cherry Point solution comes out ahead, again because of the assumed underlying commodity price differential;

- Versus the twin TMJ pipeline alternative, Cherry Point again is the most cost effective because of the discount at which FOB Cherry Point jet fuel would be sold;

- Transport capacity can be easily increased at a low marginal cost by the addition of a barge or barges of various capacities, or increasing the delivery frequency of the existing barges:
  - Barging and ocean tankering brings economies of scale as throughput increases; and
  - VAFFC can continue to access Burnaby facilities by barge while the Burnaby refinery continues to produce jet fuel, preserving security of supply.
- The price differential favouring US imports would support a decision to abandon the KMC pipe and divert shipments to barges; and

- Barges or ocean tankers can provide offshore short-term tankage facilities and also permit the replacement of the road tanker fleet, reducing truck traffic to YVR and easing road congestion.