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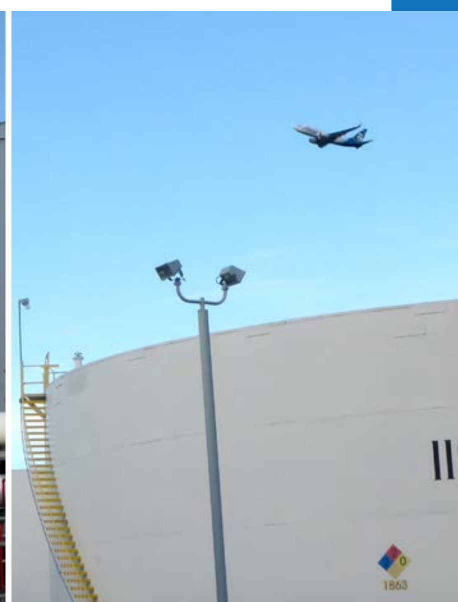
Aviation Biofuels Infrastructure Feasibility Study

Final Report

November 2016



Prepared for: Port of Seattle | Alaska | Boeing

Prepared by: WSP Parsons Brinckerhoff | 3 Square Blocks | Argus | PT&C

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Executive Summary

Seattle-Tacoma International (Sea-Tac) Airport is an industry leader in reducing aircraft-related emissions. The Port of Seattle, Alaska Airlines, and the Boeing Company have set a goal to power every flight fueled at Sea-Tac with sustainable aviation biofuel, which have a lifecycle carbon footprint typically 50 to 80 percent lower than regular jet fuel. Because these biofuels are not produced yet in Washington State, they must be imported by truck, rail, or barge and then be blended with regular petroleum-based jet fuel. Sea-Tac Airport aims to become one of the first airports in the world to offer a reliable supply of aviation biofuels to its passenger and cargo airlines.

The objective of this feasibility study is to identify sites that could support the receipt, blending, storage, and delivery infrastructure required to supply Sea-Tac Airport with up to 50 million gallons per year (and to double to 100 million after 2025) of aviation biofuel (also known as sustainable alternative aviation fuel).

Study Approach

A multi-phase screening process consisting of the following steps was used to create and refine down a list of potential aviation biofuel sites:

- Identify appropriate properties in the Puget Sound region that would allow for the receipt, storage, blending, and integration of aviation biofuels into the Sea-Tac Airport fueling system
- Screen to eliminate those candidate properties that are least likely to meet the project goals
- Evaluate a short list of six properties to identify existing infrastructure connections, current and future capacity requirements, and property ownership and zoning
- Develop detailed short-term and long-term infrastructure requirements and associated cost estimates for the most feasible properties
- Complete a comprehensive feasibility evaluation and scorecard for the most feasible properties and near- and long-term options

Key Findings

The key findings of the study are the following:

- The following three sites (and six options) were identified as the most likely to meet the project goals:
  1. **Sea-Tac Airport Fuel Farm**
     - 1A. Sea-Tac Airport Fuel Farm Small Volume – Existing Roadway
     - 1B. Sea-Tac Airport Fuel Farm Small Volume – SR 509 Connector (Future Infrastructure)
  2. **Phillips 66/Olympic Pipeline Renton Terminal**
     - 2A. Renton Terminal Small Volume – Receive Offsite-Blended Aviation Biofuel via Truck
     - 2B. Renton Terminal – Receive Neat Biofuel via Truck and Jet-A via Pipeline, On-site Blending
     - 2C. Renton Terminal – Receive Neat Biofuel via Rail and Jet-A via Pipeline, On-site Blending
  3. **Tesoro Anacortes Refinery**
- A small biofuel receiving and blending facility at the Sea-Tac Airport Fuel Farm is the most cost-effective solution in the short term and would also fulfill an existing critical need for additional local fuel receipt and storage capacity that is not dependent on the Olympic Pipeline.
- Tesoro Anacortes was used as a proxy for any of the three refineries that currently produce Jet-A fuel in Whatcom and Skagit Counties. These refineries are the most cost-effective options for receipt and blending of large volumes of aviation biofuel over the long term.
- The Phillips 66/Olympic Pipeline Company site in Renton also showed potential to accommodate receipt and blending facilities for moderate-to-large biofuel volumes over the long term.
- Focus should be given short-term investments on smaller scale facilities that are flexible and could support other aviation fuel supply uses due to the lack of long-term supply source for aviation biofuels. Identifying a biofuel supply source was not a part of this study.
- Facilities that rely on offloading fuel via rail and marine modes are only cost-effective for large volumes of biofuel over the long term due to high infrastructure costs.
- The Olympic Pipeline Company and the petroleum refineries and distributors have showed strong interest in upgrading their facilities to handle aviation biofuel and moving the blended product in their pipelines.
- As the biofuel supply expands, the Port of Seattle, its partners, and the fuel supply and transport organizations could work cooperatively toward the ultimate goal of integrating aviation biofuel into the fuel hydrant delivery system at Sea-Tac Airport.

1 Background

The Port of Seattle, Alaska Airlines, and the Boeing Company embarked on a feasibility study to identify the best approach to deliver aviation biofuel to the Seattle-Tacoma (Sea-Tac) International Airport aircraft hydrant fueling system. In pursuing an integrated aviation biofuels supply chain, Sea-Tac aims to become one of the first airports in the world to offer a reliable supply of aviation biofuels to its passenger and cargo airlines.

The objective of the study is to identify sites that could support the receipt, blending, storage, and delivery infrastructure required to supply Sea-Tac with up to 50 million gallons per year of sustainable alternative aviation fuel (also referred to as aviation biofuel).

Potential sites were evaluated both for the ability to accommodate near-term (12 to 18 months) supplies of 5 million gallons per year of biofuel, and long-term (2 to 10 years) supplies of 50+ million gallons per year. Sites were selected based on the capacity to accommodate delivery of unblended biofuel by pipe, rail, barge, and/or truck, and were evaluated based on land use, zoning, and environmental considerations. Site footprints were required to accommodate the following parameters: biofuel infrastructure for offloading, storage, blending with conventional Jet-A fuel, fuel testing, integration into the pipeline, parking, and administrative functions. Finally, the most feasible sites were screened based on the construction costs of the needed infrastructure, environmental constraints, permitting and planning, and other contingences to help determine an overall score and final recommendation.

Note that an aviation biofuel production plant was not considered in this feasibility study. However, once a long-term aviation biofuel source is identified, it will be an important next step to determine its relative proximity to the sites considered in this feasibility study. The closer the source of the aviation biofuel to a biofuel blending and integration facility, the lower the transportation and handling costs associated with the fuel.

1.1 Terms Used in This Report

The following naming conventions and definitions are used throughout this report:

Neat biofuel: 100% biofuel

Jet-A: Conventional petroleum Jet-A

Aviation biofuel: Blend of neat biofuel and Jet-A (e.g., 20/80 blend)

1.2 Study Process

The following steps were completed for this feasibility study:

1. Identify appropriate properties in the Puget Sound region that would allow for the receipt, storage, blending, and integration of aviation biofuels into the Sea-Tac Airport fueling system
2. Screen to eliminate those candidate properties that are least likely to meet the project goals
3. Evaluate a short list of six properties to identify existing infrastructure connections, current and future capacity requirements, and property ownership and zoning
4. Develop detailed short-term and long-term infrastructure requirements and associated cost estimates for the most feasible properties
5. Complete a comprehensive feasibility evaluation and scorecard for the most feasible properties and near- and long-term options

This document describes each stage of the study process in more detail, as well as the final results of the study.

2 Site Identification

An initial list of 29 potential sites was developed based on the following criteria:

- Site size: 2 acres or more
- Site requirements: Load/offload rack, storage tanks, blending system, testing facility, administration, and parking
- Site use/zoning: Compatible with biofuel infrastructure
- Modes of fuel transportation: pipeline, truck, rail, marine vessel
- Proximity to: Sea-Tac Airport, Olympic Pipeline or one of its delivery lines, and modes of transportation

When evaluating the proximity to the pipeline, it is important to note that the directional flow of the Olympic Pipeline is north-to-south. Two parallel main pipelines originate at the Allen pump station in Skagit County and continue south to a terminal/pump station in Renton. The pipelines flow southward and carry gasoline, diesel, and jet fuel in a scheduled rotation. The Allen pump station receives the fuel products from refineries located in Whatcom and Skagit Counties. One of the pipelines terminates at Renton and serves the Seattle market with delivery lines (outbound) to Sea-Tac Airport (currently carrying only petroleum Jet-A) and to Harbor Island (carrying gasoline and diesel). The other main parallel pipeline continues through the Renton pump station and carries all three petroleum products as far south as Portland, Oregon. These pipelines and delivery lines are shown in the maps at the end of this section.

The detailed screening matrix for the 29 potential sites is available in Full Report Task 2.

2.1 Screening the Initial Sites

The screening criteria listed below were used as a framework to refine the initial list of 29 potential sites down to six. To assist with the evaluation, specific locations were identified for each site (e.g., street addresses, parcels or map coordinates) using the following tools: on-line county assessor files for King, Pierce, and Franklin Counties; GIS data on floodplains, wetlands, and slopes; Washington State Department of Ecology Confirmed & Suspected Contaminated Sites List; aerial imagery; and jurisdictional zoning regulations and zoning maps.

The project team applied the potential site criteria described above to develop the list of the top six recommended sites. The analysis was completed for the following screening criteria:

- Proximity to Olympic Pipeline or Harbor Island delivery line
- Proximity to Sea-Tac Airport delivery line (directly serves Sea-Tac Airport)
- Accessibility via multiple transportation modes (pipe, rail, barge, truck)
- Environmental constraints (wetlands, floodplains, slopes, site contamination)
- Existing zoning (i.e., is biofuel infrastructure a permitted or conditional use?)
- Compatibility of adjacent uses (e.g., industrial)
- Presence of existing structures on the site (particularly those requiring demolition)
- Parcels/assembly requirements
- Size
- Owners
- Other (e.g., security concerns, community perceptions, other notable facts)

The complete screening results are available in the Full Report Task 2. The results, as well as the rationale for the screening outcome for each site, are summarized in Table 1. Non-industrial zoning, the existence of wetlands, and the absence of all fuel transportation modes were important factors in a negative screening outcome.

Table 1: Screening Results

Site	Screening Outcome	
1 Sea-Tac International Airport Fuel Farm	Yes (Site A)	Port-owned; direct delivery to aircraft after blending. Could be considered in combination with other options.
2 Olympic Pipeline Renton Terminal	Yes (Site B)	Combine two parcels into one site for consideration. Room for expansion exists at Phillips 66, and the Olympic Pipeline terminal parcel provides direct connection to Sea-Tac Airport delivery pipeline. Could be considered in combination with other options. Rail spur (0.8 mile) to this site would impact wetlands. West side of these parcels is wetlands.
3 Phillips 66 Renton Tank Farm		
4 1300 SW 27th Street, Renton	No	Under construction with three-story office park. Other options exist.
5 Boeing Renton Longacres (south)	Yes (Site C)	Combine parcels to create a property that is long enough to support rail sidings (additional property and/or easements may be needed). Re-zoning would be required to allow industrial use.
6 Boeing Renton Longacres (north)		

Table 1: Screening Results (Cont'd)

Site		Screening Outcome	
7	Additional Potential Renton Site A	No	Not adjacent to rail line. Direct connection to Sea-Tac delivery pipeline would require infrastructure crossing other parcels.
8	Additional Potential Renton Site B	No	Owned by City of Renton; primarily wetlands.
9	Additional Potential Renton Site C	No	Owned by City of Renton; primarily wetlands.
10	Additional Potential Renton Site D	No	Current use is warehouse/light industrial. Remaining undeveloped portion of parcel (north side) is wetlands.
11	Additional Potential Renton Site E	No	Current use is warehouse/light industrial. Remaining undeveloped portion of parcel (north side) is wetlands.
12	Additional Potential Renton Site F	No	Owned by City of Renton; primarily wetlands.
13	Additional Potential Renton Site G	No	Combination of portions of several parcels, including some owned by City of Renton. Primarily wetlands.
14	Tukwila Longacres	Yes (Site D)	Vacant; adjacent to Union Pacific and BNSF Railway mainlines.
15	Tukwila Industrial Park	No	Zoning does not support industrial use.
16	Harbor Island – Equiva Tank Farm – Shell	Yes (Site F) Marine Option	One of these three sites (and/or adjacent property) could be considered. Port-controlled; existing infrastructure. Could be considered in combination with other options.
17	Harbor Island – BP Tank Farm		
18	Harbor Island – Kinder Morgan		
19	Port of Tacoma – US Oil	No	Recommendation for marine access option is Harbor Island (Port of Seattle).
20	Port of Tacoma – Targa Sound Terminal		
21	Port of Tacoma – Phillips 66 Terminal		
22	Port of Tacoma – former Kaiser Aluminum plant		
23	Olympic Pipeline Bayview/Allen Terminal	No	No marine access; limited land is available; no direct access to rail.
24	BP Cherry Point Refinery	Yes (Site E) North-end Refinery	One of these three sites in Whatcom/Skagit Counties could be considered.
25	Tesoro Anacortes Refinery		
26	Shell Puget Sound refinery		
27	Phillips 66 Refinery	No	Does not currently handle jet fuel.
28	REG Grays Harbor Refinery	No	Existing biofuel producer/refinery. Possible very long-term opportunity.
29	Pasco Tidewater Terminal	No	Possible very long-term opportunity if associated with large producer of biofuel in eastern Washington.

As described above, the six properties that were recommended to be carried forward into site evaluation are as follows:

B. **Sea-Tac International Airport Fuel Farm** (Site 1)

C. **Phillips 66/Olympic Pipeline Renton Terminal** (Sites 2 and 3 combined)

D. **Boeing Renton Longacres** (Sites 5 and 6 combined)

E. **Tukwila Longacres*** (Site 14)

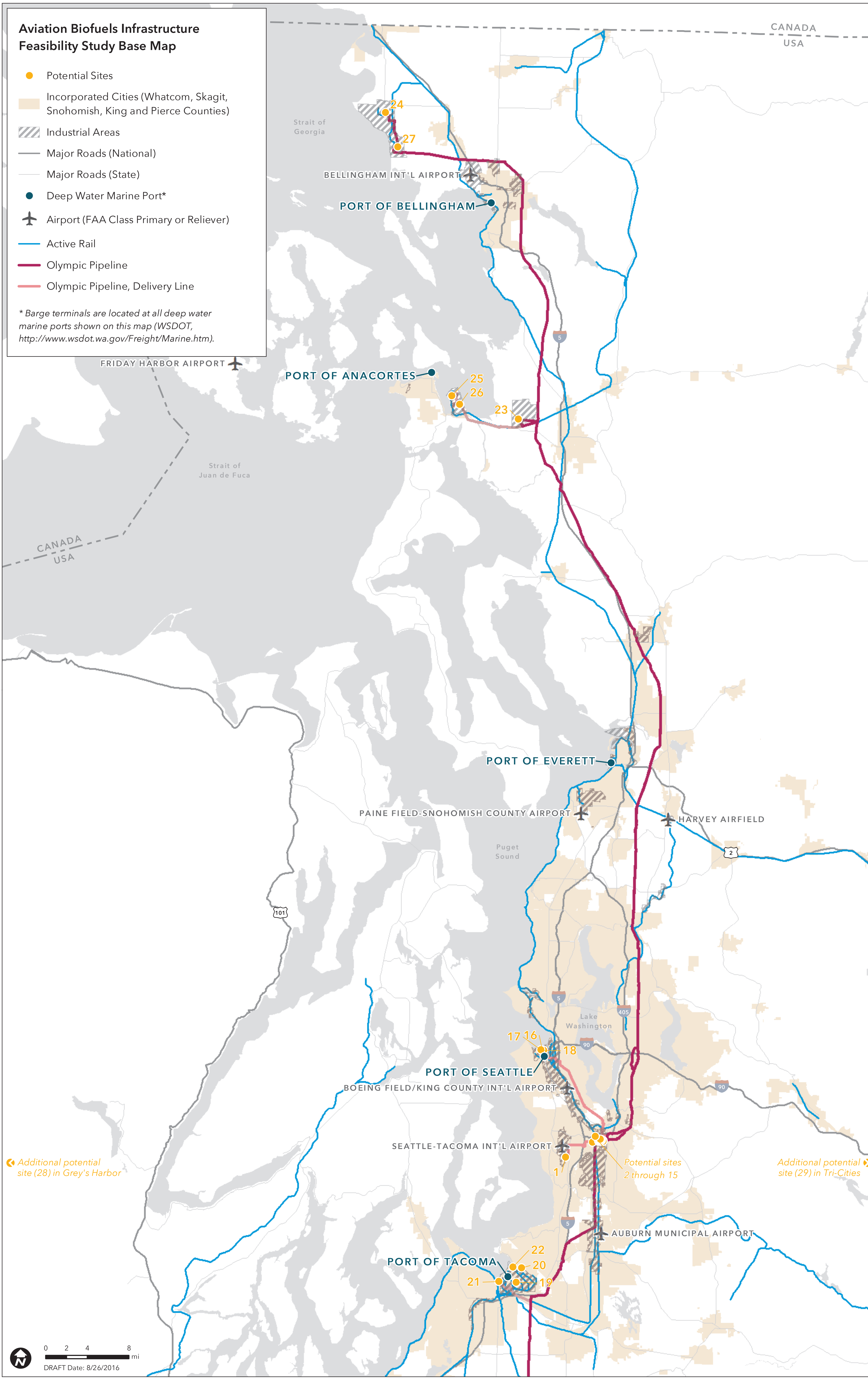
F. **North-end Refinery**, which could ultimately be selected from one of the following:
   - BP Cherry Point Refinery (Whatcom County) (Site 24)
   - Tesoro Anacortes Refinery (Skagit County) (Site 25)
   - Shell Puget Sound Refinery (Anacortes, Skagit County) (Site 26)

G. **Harbor Island Marine Option**, which could ultimately be selected from one of the following and/or nearby properties:
   - Equiva/Shell Tank Farm (Site 16)
   - BP Tank Farm (Site 17)
   - Kinder Morgan (Site 18)

** This site was added as an alternative to the Boeing Renton Longacres site*

Originally, two sites for a marine access location were considered for the sixth option: Harbor Island and the Port of Tacoma. For the selection of a marine access option, the location at a Harbor Island terminal was deemed preferable to the Port of Tacoma alternatives due to the Port of Seattle's greater influence over and ownership of Harbor Island.

Additionally, sites located to the south of Sea-Tac Airport are downstream of the Olympic Pipeline. Harbor Island is a good potential aviation biofuel site with existing infrastructure and close proximity to the pipeline. The Harbor Island site also has the potential to add fuel supply resilience and provide a contingency supply if pipeline operations were disrupted north of Seattle.


Aviation Biofuels Infrastructure
Feasibility Study Base Map
Potential Sites
Incorporated Cities (Whatcom, Skagit, Snohomish, King and Pierce Counties)
Industrial Areas
Major Roads (National)
Major Roads (State)
Deep Water Marine Port*
Airport (FAA Class Primary or Reliever)
Active Rail
Olympic Pipeline
Olympic Pipeline, Delivery Line
* Barge terminals are located at all deep water marine ports shown on this map (WSDOT, http://www.wsdot.wa.gov/Freight/Marine.htm).
CANADA
USA
Strait of Georgia
BELLINGHAM INT'L AIRPORT
PORT OF BELLINGHAM
24
27
FRIDAY HARBOR AIRPORT
PORT OF ANACORTES
25
26
23
Strait of Juan de Fuca
PORT OF EVERETT
PAINE FIELD-SNOHOMISH COUNTY AIRPORT
HARVEY AIRFIELD
Puget Sound
Lake Washington
17 16
18
PORT OF SEATTLE
BOEING FIELD/KING COUNTY INT'L AIRPORT
SEATTLE-TACOMA INT'L AIRPORT
1
Potential sites 2 through 15
Additional potential site (28) in Grey's Harbor
Additional potential site (29) in Tri-Cities
AUBURN MUNICIPAL AIRPORT
PORT OF TACOMA
22
20
21
19
0 2 4 8 mi
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Aviation Biofuels Infrastructure Feasibility Study Base Map Details

- ● Potential Sites
- Incorporated Cities (Whatcom, Skagit, Snohomish, King and Pierce Counties)
- Industrial Areas
- Major Roads (National)
- Major Roads (State)
- Deep Water Marine Port*
- Airport (FAA Class Primary or Reliever)
- Active Rail
- Olympic Pipeline
- Olympic Pipeline, Delivery Line

** Barge terminals are located at all deep water marine ports on these maps (WSDOT, http://www.wsdot.wa.gov/Freight/Marine.htm).*

Sources: Port of Seattle, 2016 (Pipeline); WA UTC, 2016 (Pipeline); WSDOT, 2012 (Rail), 2015 (State Routes) & 2016 (Deep Water Marine Ports & City Boundaries). Industrial areas include PSRC MICs (2005); WA State Dept. of Ecology 2010 existing state-wide aircraft transportation uses (land use code 43) & manufacturing uses in Skagit & Whatcom Counties (land use codes 20-36, 39); the South Tacoma MIC (Tacoma, 2015); King County Industrial/Mfg. Consolidated Zoning in the cities of Auburn, Renton, Kent, Tukwila, Algona & Pacific (2014); & industrial zoning in Everett (2015; M-1, M-2, M-S, C-2), Snohomish County (2016; HI, IP, LI), Skagit County (2016; AVR, AVR-L, BR-HI, BR-LI), Whatcom County (2016; HII, LII, GM, GI, RIM, AO) & Bellingham (2012; AO, C/I, C/I/RM, GI, HII, I, I/RM, LII).

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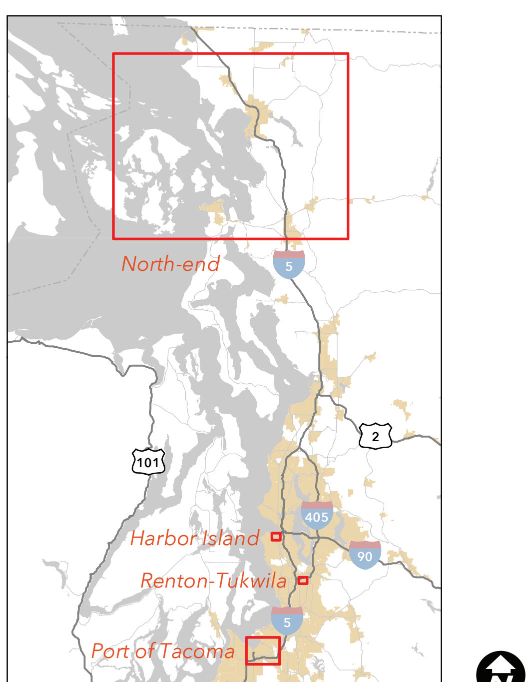
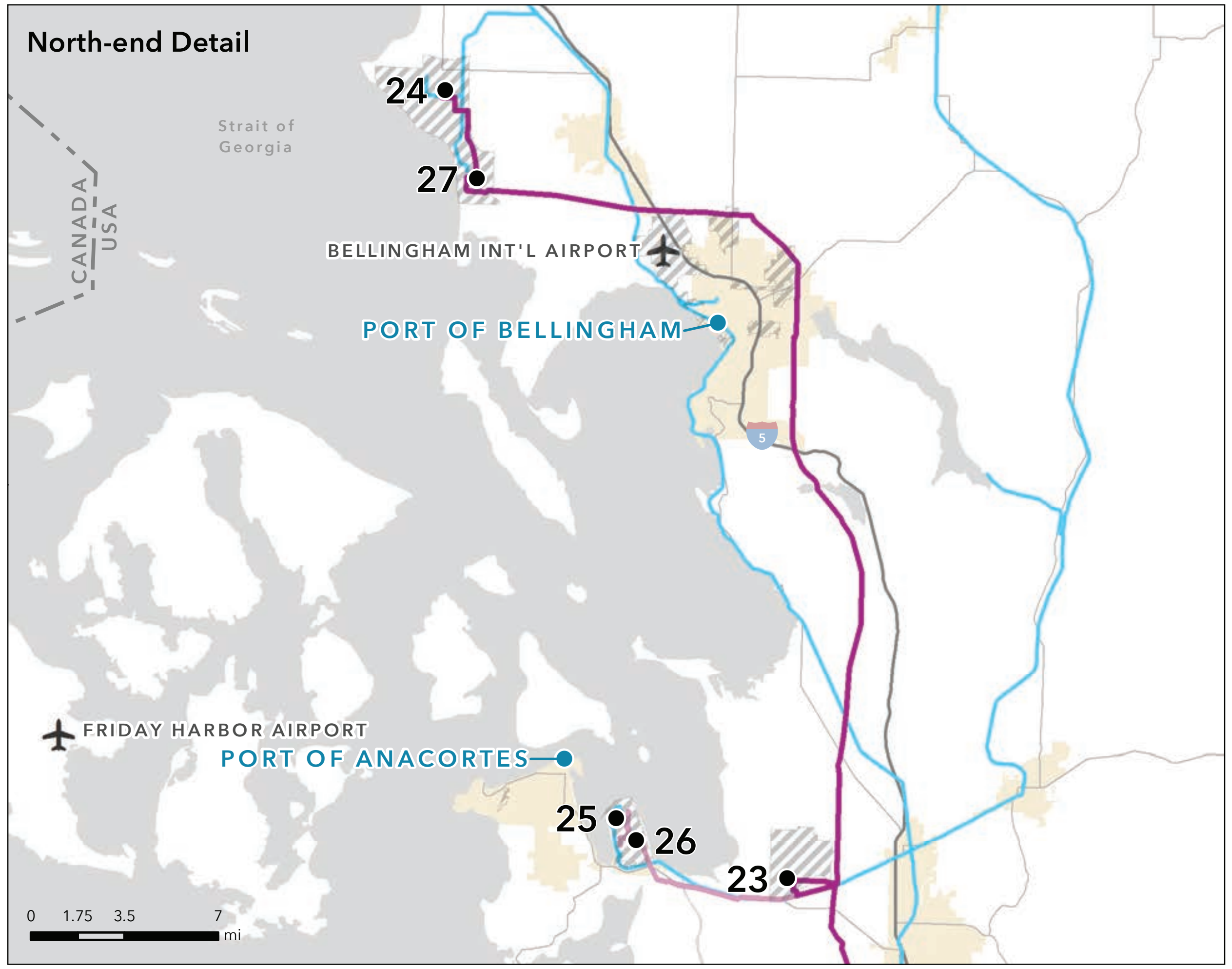
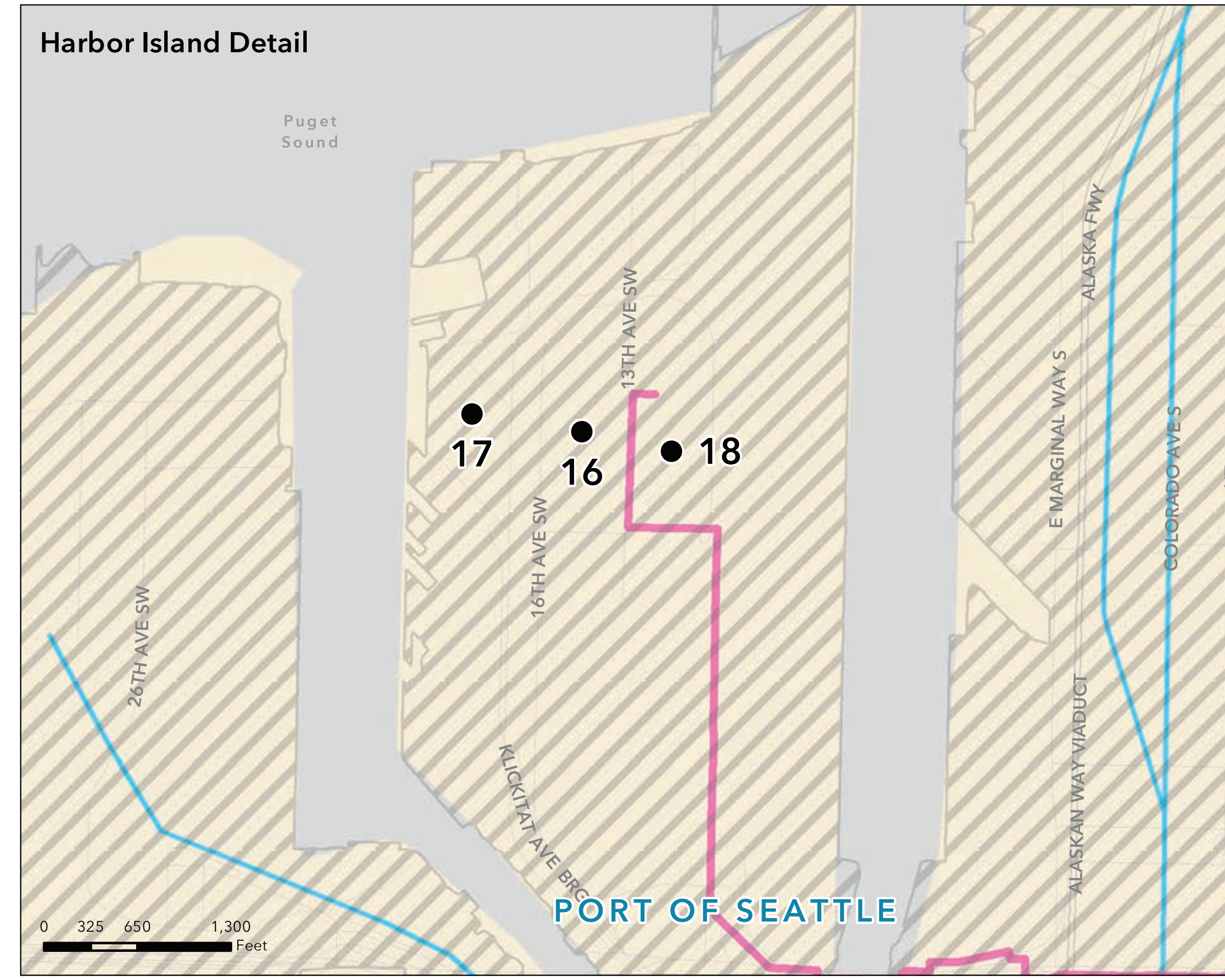
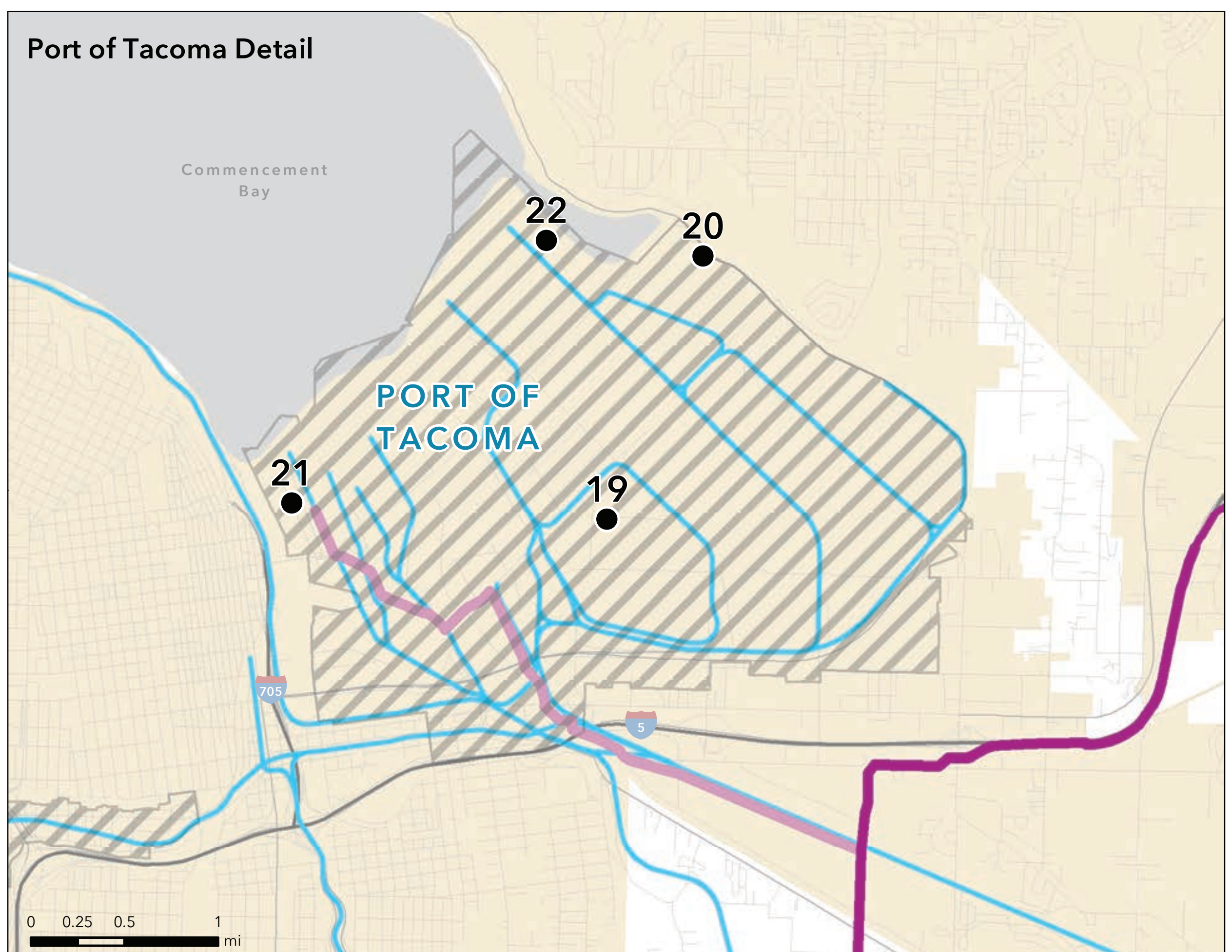
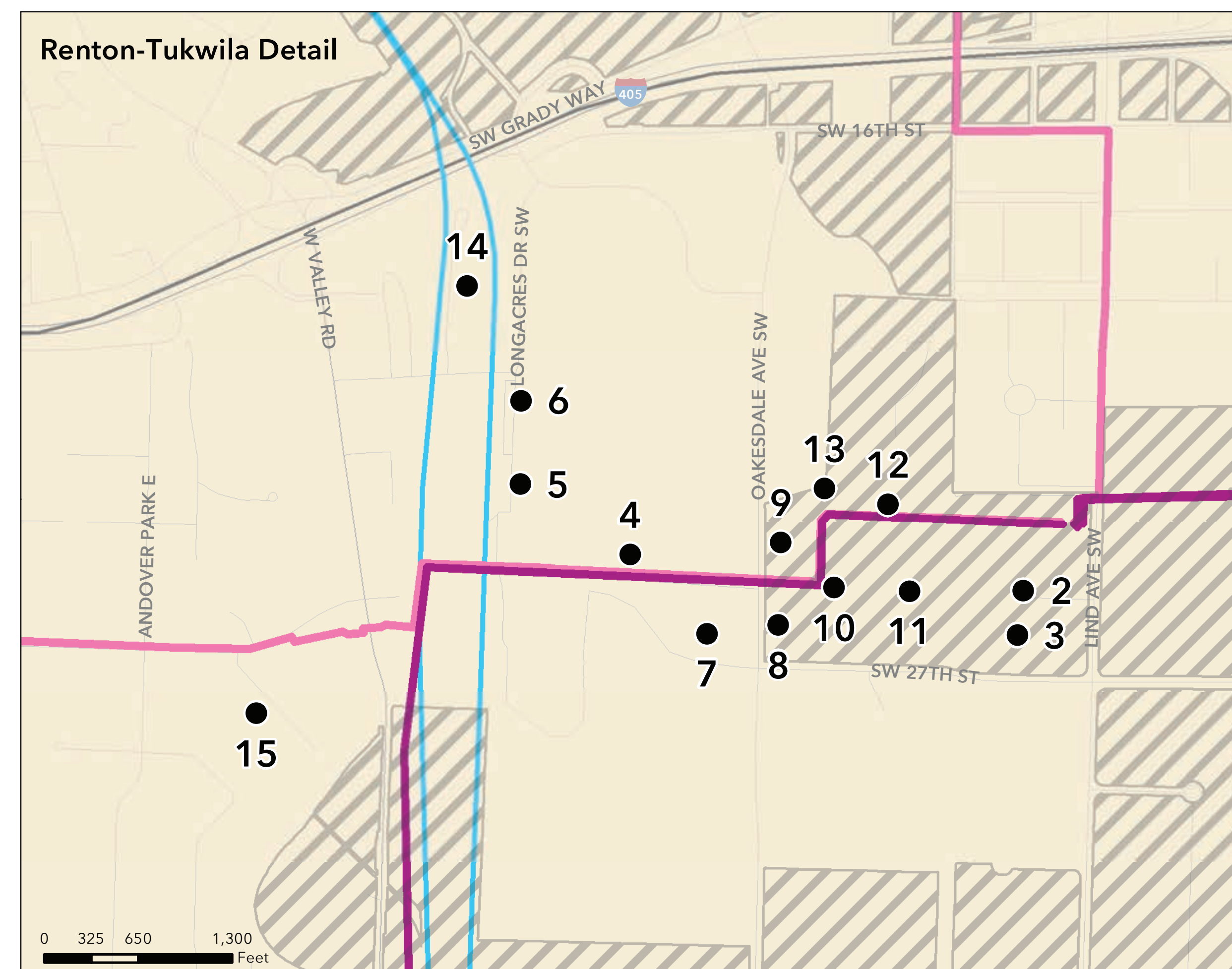










3 Site Evaluation

The six most feasible properties identified in Section 2.1 were further evaluated using more detailed and refined evaluation criteria.

This section describes the information used to evaluate these sites and the results of that evaluation.

3.1 Site Evaluation Criteria

The following additional criteria were used to further examine the feasibility of the top six sites:

- Availability to lease or purchase site based on communications with property owners
- Land use regulations affecting the property
  - Permitting and development requirements
  - Long-range plans for the site (if different from current land use regulations)
  - Legal constraints related to adding additional fueling infrastructure
- Review of available Olympic Pipeline, state, and federal guidelines
- Site suitability for desired infrastructure for short-term and long-term aviation biofuel capacity
  - Existing infrastructure
  - Infrastructure changes required (including access infrastructure)

3.2 Site Evaluation Results

The six sites were evaluated using the criteria described in Section 3.1. A summary of the findings is presented in Table 2.

Site maps showing existing conditions, schematic layouts and concepts for improvements at each site, and a more detailed evaluation matrix are available in the Full Report Task 3.

Table 2: Summary of Findings

Property	Availability to Lease or Purchase	Land Use & Plans	Site Suitability	Screening Outcome
Sea-Tac Airport Fuel Farm	Currently owned by Port of Seattle; leased to Sea-Tac Fuel, LLC	Zoned for Aviation Operations; limited land available	Existing jet fuel use; no rail access; would provide added truck offload capacity	YES
Phillips 66/ Olympic Pipeline Renton Terminal	Owned by Phillips 66 (one parcel) and Olympic Pipeline (one parcel); ability to lease tanks and/or property	Industrial zoning; wetlands on west side of parcels	Existing jet fuel use; rail access would require spur across other properties and wetlands	YES
Boeing Renton Longacres	Owned by the Boeing Company; others hold right of first offer	Commercial zoning; re-zone to Industrial use required	No direct access to pipeline; adjacent to rail main line; would require fuel tanks, pumps, and pipes	NO
Tukwila Longacres	Owned by Leuqar BB, LLC (one parcel, could be available for purchase) and City of Tukwila (one parcel)	Commercial zoning; re-zone to Industrial use required	No direct access to pipeline; adjacent to rail main line; would require fuel tanks, pumps, and pipes	NO
North-end Refinery	Owned by refineries	Industrial zoning	Existing jet fuel use; existing rail and marine access	YES
Harbor Island	Owned by refineries	Industrial zoning; limited land available	No means to inject into pipeline; pipeline flow is opposite direction required and is too expensive and impractical to reverse; existing fuel use; existing rail and marine access	NO

4 Conceptual Infrastructure Needs, Design and Cost Estimation

As a result of the site evaluation described in Section 3, the following three sites were selected for conceptual design and cost estimating:

(1) Sea-Tac Airport Fuel Farm

(2) Phillips 66/Olympic Pipeline Renton Terminal

(3) Tesoro Anacortes Refinery (as a proxy for any of three refineries)

Based on the information obtained showing a large range for potential cost and site logistics, both short-term and long-term solutions were developed at those sites where feasible, resulting in the following list of six implementation options:

(1A) Sea-Tac Airport Fuel Farm Small Volume – Existing Roadway

(1B) Sea-Tac Airport Fuel Farm Small Volume – SR 509 Connector (Future Infrastructure)

(2A) Renton Terminal Small Volume – Receive Offsite-Blended Aviation Biofuel via Truck

(2B) Renton Terminal – Receive Neat Biofuel via Truck and Jet-A via Pipeline, On-site Blending

(2C) Renton Terminal – Receive Neat Biofuel via Rail and Jet-A via Pipeline, On-site Blending

(3) Tesoro Anacortes Refinery – Blend Aviation Biofuel at an Existing Refinery

The following sections describe each of the implementation options in more detail, including the infrastructure required and the logistics behind the operation of each option. A conceptual cost estimate and estimated schedule are provided for each option. Conceptual designs and cost estimates are included at the end of this section.

4.1 Near-Term/Small Volume Supply Transitioning to Long-Term/Large Volume Supply

Options were identified that could feasibly provide an initial small volume supply of aviation biofuel (up to 5 million gallons per year) while also laying the ground for the development of a larger facility to support future, long-term, large volume supply (up to 100 million gallons per year).

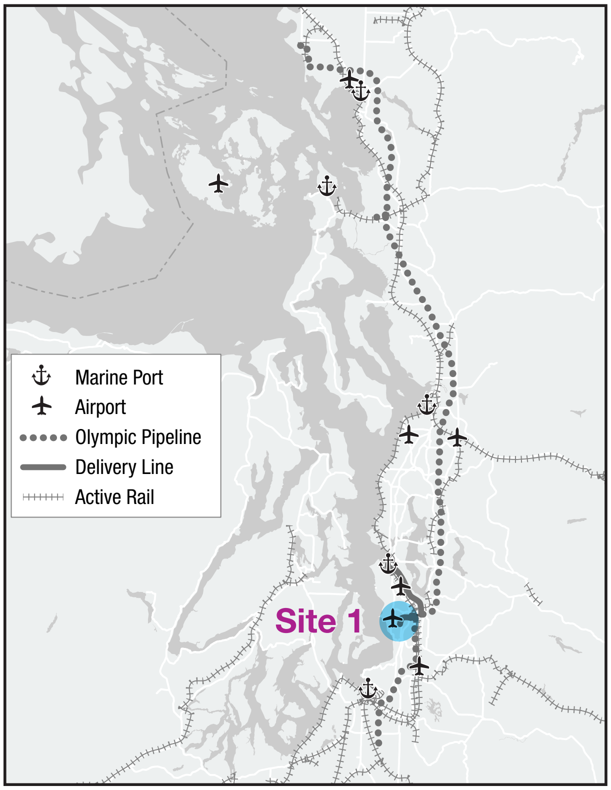
Table 3 summarizes the maximum capacity (i.e., annual throughput in gallons/year), of neat (i.e., 100 percent) biofuel for the three identified sites and the various options for each site that the proposed infrastructure can support. The volume of neat biofuel for Option 2A varies based upon the blend of biofuel that can be delivered to the site, hence the volumes of neat biofuel for each blend have been shown. The capacity of each option is limited due to a number of factors, such as the truck or rail offloading capacity, receiving and blending tank capacity, and the amount of time to transfer the final product between modes or to the pipeline.

Table 3: Maximum Capacity of Neat Biofuel for Three Identified Sites

Option	Description	Maximum Annual Neat Biofuel Throughput (gal/yr)
1A	Sea-Tac Fuel Farm Small Volume – Existing Roadway	5,000,000
1B	Sea-Tac Fuel Farm Small Volume – SR 509 Connector	5,000,000
2A	Renton – Receive aviation biofuel via truck	14,308,000 (20/80 blend) to 35,770,000 (50/50 blend)
2B	Renton – Receive neat biofuel via truck and Jet-A via pipeline	71,529,780
2C	Renton – Receive neat biofuel via rail and Jet-A via pipeline	82,680,000
3	Tesoro – Blend aviation biofuel at refinery; receive neat biofuel via rail or marine via existing infrastructure	100,000,000+

4.2 Site Options: Infrastructure Needs and Conceptual Designs

Site 1: Sea-Tac Airport Fuel Farm Site



Option 1A – Integrate Infrastructure with Existing Tanks and Roadways

The proposed facility at Sea-Tac Airport would serve as a near-term facility to support up to 5 million gallons annually of neat biofuel that would be delivered to the facility via truck and blended on-site with Jet-A currently received via the Olympic Pipeline. The fuel farm currently has a single truck offload position; however, the fuel farm has space allocated for construction of a second. Despite this intention, Swissport, which operates the fuel farm on behalf of the Sea-Tac Airport Fuel Consortium, indicated the existing truck offloading rack was not ideal as the pump was installed at a level too high to easily drain a transport truck. Additionally, vehicle movement does not allow a truck to offload and turn around to exit within the existing fuel facility footprint. Therefore, the truck must be escorted onto the airport operating area to exit another gate from the airport property. No rail or marine access is available for this option.

The installation of a new dedicated neat biofuel truck offloading facility is proposed in the unstriped parking lot east of the existing fuel farm. This location allows for a truck to offload, turn around, and exit back onto S. 190th Street and 28th Avenue (refer to Exhibit 1A).

Option 1B – Integrate with Future Tanks and Roadways

The Washington State Department of Transportation is in the planning stages for the SR 509 extension project. In addition, the Port of Seattle has proposed expansion of airport facilities to the south of the fuel facility (refer to Exhibit 1B) that include a connector road to the new SR 509.

As the timeline for the SR 509 connector is unknown (currently estimated to be built in 2031), the costs presented for this future site are presented as a separate option. If Option 1A is constructed and the connector road is built at a later date, there will be some unidentified cost to provide access into and out of the site. For purposes of this estimate, it is assumed these costs would be borne by another entity and not by the project. The site improvements that have been developed in Option 1A also allow fuel trucks to enter and exit the facility from the proposed connector road with limited roadway modifications. If the connector road is constructed first, the costs presented for Option 1B include all work associated with the construction of the biofuel receipt and storage system.

Infrastructure Requirements to Support Near-Term On-Site Blending and Storage

Initial calculations show one new dual-arm offload rack could easily accommodate up to 5 million gallons of neat biofuel per annum. This assumes seven truck and trailer transports every week (14,000 gallon capacity). It is recommended to install a second offload rack for redundancy. The biofuel offload rack could also provide Sea-Tac Airport fuel supply assurance contingency for the receipt of Jet-A via truck in the event of pipeline disruptions.

During preliminary discussions, there was interest in having a fully integrated biofuel system where neat biofuel would be received into a new storage tank and then transferred and blended in any one of the eight existing tanks. However, the option covered here is for neat biofuel receipt and blending infrastructure to be developed as a standalone system with the ability for future full integration. This arrangement will not affect the current pipeline receipt capacity and fuel farm operations. It is anticipated that the fuel farm expansion shown in the planning documents of Option 1B are required to provide additional days of reserve and to meet the growing demand of jet fuel at the airport.

Neat biofuel is offloaded into a new dedicated 100,000-gallon API 650 tank adjacent to the truck offload racks. The proposed tank has been sized to receive approximately seven truck deliveries of neat biofuel prior to testing of fuel for conformance to ASTM D7566. A new 500,000-gallon API 650 tank would be constructed adjacent to the 100,000-gallon tank to receive up to 400,000 gallons of Jet-A (80/20 blend) direct from the Olympic Pipeline or from existing tanks within the facility. Once the Jet-A is received, it would be tested for conformance to ASTM D1655 if required. Following testing of both products, the 100,000 gallons of neat biofuel would be transferred using a new fuel transfer pump into the new 500,000-gallon tank to create the blend of aviation biofuel. Once blended, the fuel would be tested for conformance to ASTM D1655 then transferred from the new blending tank into one of the three existing hydrant system issue tanks to then be delivered direct to aircraft through the existing hydrant system infrastructure. The new tanks in this option have been sized to accommodate an 80/20 blend ratio.

One option to allow for receipt of neat biofuel in a more expeditious and cost-effective manner would be to install two 50,000-gallon shop-fabricated horizontal tanks to receive and store the neat biofuel and then transfer and blend in one of the existing tanks within the fuel farm. This option requires a smaller footprint and would allow the two horizontal tanks to be sold, repurposed, or relocated when the demand exceeds the capacity of Option 1A or 1B.

The following provides an overview of the infrastructure required to add neat biofuel receipt and blending capabilities at Sea-Tac Airport as outlined in Exhibits 1A and 1B.

Required infrastructure:

- Civil roadwork for site access
- Concrete structures for sized containment of truck offloading operations
- (2) 400 gallon per minute (gpm) pump and filter separator offloading skids
- (1) 100,000 gallon vertical aboveground storage tank – field erected
- (1) 500,000 gallon vertical aboveground storage tank – field erected
- Earthen berm surrounding the two new tanks to provide containment
- (2) 1,000 gpm fuel transfer pumps
- Approximately 200 feet of 6-inch offload piping
- Approximately 500 feet of 8-inch pipeline receipt piping
- Approximately 500 feet of 8-inch tank transfer piping
- Integration into existing tank gauging and controls system

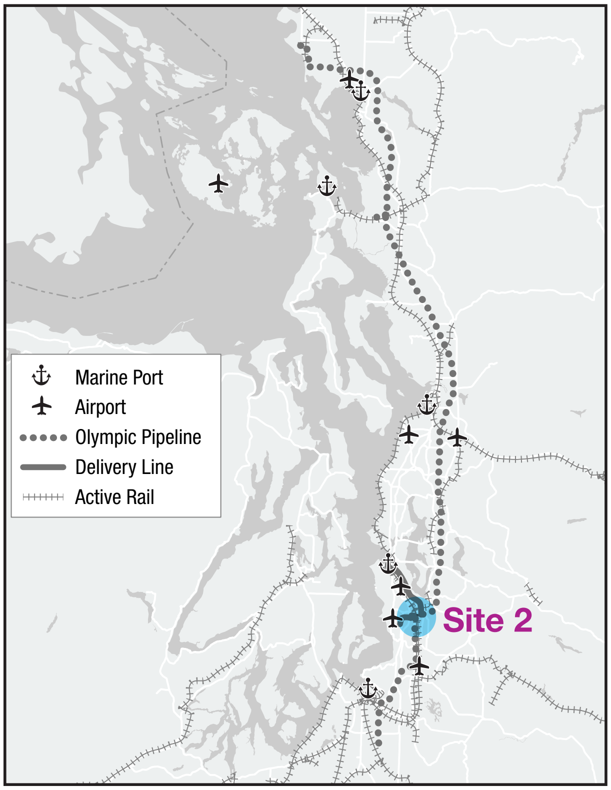
Primary benefits:

- Property already owned by the Port of Seattle
- Provides direct access to airport hydrant fueling system
- Existing zoning is suitable and the Port would be the permitting agency
- Lower capital costs would be required for this improvement

Primary challenges:

- Sea-Tac Airport has very limited land for expansion of all airport operations, including its fuel farm. The Sustainable Airport Master Plan is currently being developed and identifies space for fuel farm expansion to the east of the existing fuel farm location, as shown in Exhibit 1B.
- The desire to limit the number of fuel transport trucks on the roadways around the airport limits the capacity of this option. The 5 million gallons annually was derived by imposing a limit of seven trucks per week on average to minimize the environmental impact of the truck traffic and truck emissions, but the property could feasibly accommodate up to 10 million gallons annually.
- The future South Access Expressway impacts a portion of the site currently available for expansion. There are likely to be grade changes with the development of the connector road that have not been accounted for in the vehicle simulations.
- No rail or marine access is available at this site nor will it likely be available in the future.
- The existing fuel facility would need to be reconfigured to support the truck offloading operations and blending facilities.

Site 2: Phillips 66/Olympic Pipeline Renton Terminal Site



The Phillips 66 and Olympic Pipeline Renton Terminal sites are immediately adjacent to each other in Renton. The combination of these two parcels is considered Site 2. The Olympic Pipeline passes through the northern portion of the site and serves the Phillips 66 tanks at the southern end of the site with a dedicated Jet-A pipeline running west from this site to the airport. For this site to receive neat biofuel or aviation biofuel, three options of development were considered to serve the near term (Option 2A), intermediate term (Option 2B), and long-term (Option 2C). The infrastructure required for each option builds upon the prior option in an effort to eliminate the expense of installing infrastructure that can only be used for a single option, as explained in more detail in the description of each option below.

Option 2A – Receive Blended Aviation Biofuel via Truck

The existing tank facilities at Phillips 66 can accommodate only one new product in their current configuration, which suggests that only pre-blended fuel could be delivered if no new tanks were added. Therefore, the first option for this site is focused on the near term and is designed to receive previously blended aviation biofuel via truck using an existing offload position at the Phillips 66 terminal and storing the fuel in existing Tank 3. In preliminary talks, Phillips 66 suggested new offload equipment be installed and dedicated to the offloading process for blended aviation biofuels. This equipment would be located within containment at one of the existing truck offload islands (refer to Exhibit 2A). It is important to note this option transfers the cost burden from the physical infrastructure to the entity providing and blending the fuel at another location. The transportation costs per unit volume of neat biofuel will increase as well due to blending off-site.

The existing Phillips 66 truck offloading facilities can accommodate up to 14 additional truck and trailer transports per day (for a total of approximately 100 trucks per day). Assuming 14,000 gallons per load, this equates to 196,000 gallons per day, or 4,666 barrels per day (bbls/day). As this is pre-blended aviation biofuel and assuming a 50/50 blend, this equates to an annual maximum throughput of 35,770,000 gallons of neat biofuel. Assuming an 80/20 blend, the annual maximum throughput would be 14,308,000 gallons of neat biofuel per year.

Once blended fuel is received into existing Tank 3 and tested for conformance to ASTM D1655, the fuel would be transferred via the existing dedicated pipeline to Sea-Tac Airport during an available window when Sea-Tac Airport is not receiving Jet-A from one of the three refineries on the Olympic Pipeline. This transfer currently occurs once every three days.

As a single tank, Tank 3 is used for both receipt and issue. Once the tank is filled and tested for conformance, it would be quarantined from future receipt until the fuel could be transferred through the delivery pipeline to Sea-Tac Airport. This constraint would require careful planning between the operator and the pipeline. The transfer of aviation biofuel from Tank 3 would require a new 8-inch transfer pipe be installed from Tank 3 to a new inbound pipeline pump, filtration, and meter on the Olympic Pipeline site. The proposed transfer rate of 1,200 gpm (1,714 barrels/hour (bbls/hr)) would require a 250-horsepower motor. It is uncertain if the site has the electrical capacity to add a new pump and motor.

Jet-A fuel would be delivered into the site during deliveries to Sea-Tac Airport. For calculation purposes, it is assumed Tank 3 has an approximate usable volume of 6,800 bbls, which equates to 85 percent of the nominal tank volume of 8,000 bbls. With the existing 8-inch dedicated pipeline, the proposed transfer rate of 1,714 bbls/hr would require four hours to transfer the maximum usable volume.

Required infrastructure:

- (1) 400 gpm pump and filter separator offloading skid at existing truck offloading island
- (1) 1,200 gpm, 500-foot TDH pipeline transfer pump
- (1) 1,200 gpm custody transfer meter
- (1) 1,200 gpm filter separator vessel
- Approximately 960 feet of 8-inch pipeline receipt piping (to be installed in Option 2A in parallel with pipeline issue piping but not used until Option 2B)
- Approximately 1,250 feet of 8-inch pipeline issue piping
- Integration into the existing tank gauging and controls system

Primary benefits:

- The site provides direct access to the Sea-Tac Airport delivery pipeline.
- Aviation biofuel storage could be managed by Phillips 66, reducing ownership and operational risk for the Port of Seattle or external parties.
- The site is zoned for industrial use.
- Phillips 66 has an existing offload position available that can handle up to 14 trucks per day or 196,000 gallons of aviation biofuel per day.
- Phillips 66 has an existing 8,000 bbl tank available for onsite storage of aviation biofuel.
- Phillips 66 and Olympic Pipeline Company have expressed positive interest during initial conversations.
- This initial option does not require wetlands mitigation.

Primary challenges:

- Requires aviation biofuel be delivered to site via truck and blending to occur offsite by others, which shifts the cost burden to the fuel contractor. These costs are not reflected in the cost estimate as they are unknown, but could be substantial.
- Requires modifications to the existing pipeline to pump into the dedicated pipeline.
- Requires ownership and/or long-term lease arrangements to be established.

Option 2B – Receive Neat Biofuel via Truck and Jet-A via Pipeline, On-site Blending

When the daily receipt of blended biofuel exceeds the 196,000 gal/day (4,666 bbls/day) capacity of Option 2A, or when it is desired to receive neat biofuel into the Phillips 66 site, the next option (2B) could be implemented. This option expands the 2A system infrastructure to reconfigure Tank 3 to receive neat biofuel and the construction of two new 82,500 bbl storage tanks: one for the receipt of Jet-A from the Olympic Pipeline and a second to blend the product and prepare for delivery to Sea-Tac Airport (refer to Exhibit 2B). The selection of 82,500 bbl tanks was made based upon a usable volume of 70,000 bbls (85 percent of tank shell volume) to allow an 80/20 blend at peak capacity. If it were certain a greater blend ratio approaching the maximum 50/50 could be used, the two 82,500 bbl tanks could be reduced in size.

For this option, up to 14 truck loads per day of neat biofuel would be received into Tank 3, restricted by the capacity of the single offloading position available from Phillips 66, and then tested for conformance to ASTM D7566. Due to the daily receipt volume capacity of 4,666 bbls per day and the usable tank capacity of 6,800 bbls, the fuel would need to be tested at the end of each day and then transferred into the new blending tank overnight allowing Tank 3 to be available for receipts the next day.

Jet-A fuel would be received into one of the two new tanks during a pipeline transfer to Sea-Tac Airport and then tested for conformance to ASTM D1655. This pipeline transfer occurs on a three-day cycle, as previously outlined in Option 2A. Therefore, at a minimum, the volume of fuel received would coincide with the amount required to blend with the volume of neat biofuel received in the preceding three days. Assuming an 80/20 blend, each fuel receipt batch would be a minimum of 55,992 bbls, resulting in a total blended volume of 69,990 bbls. This equates to a total annual neat biofuel capacity of 71,529,780 gallons.

Required infrastructure (in addition to infrastructure outlined in Option 2A):

- (2) 82,500 bbl API 650 storage tanks complete with containment dike for three tanks for Option 2C expansion
- (1) 1,200 gpm custody transfer meter
- (1) 1,200 gpm filter separator
- Installation of 300 feet of 8-inch pipeline receipt piping to connect to piping installed in Option 2A to new tank
- Activation of 960 feet of 8-inch pipeline receipt piping (installed in Option 2A)
- Installation of 500 feet of 8-inch fuel transfer piping
- Installation of new 1,200 gpm transfer pump pad to transfer fuel from tank to tank
- Integration into existing tank gauging and controls system

Primary benefits:

- The site provides direct access to the Sea-Tac Airport delivery pipeline.
- Aviation biofuel storage could be managed by Phillips 66, reducing ownership and operational risk for the Port of Seattle or external parties.
- Phillips 66 is not directly associated with any of the three companies currently supplying conventional jet fuel to Sea-Tac Airport, which provides the opportunity to develop blending arrangements with all three suppliers.
- The site is zoned for industrial use.
- The site provides space for installation of additional tanks adjacent to existing tank and pipeline infrastructure.
- Phillips 66 has an existing offload position available that can handle up to 14 trucks per day or 196,000 gallons of neat biofuel per day.
- Phillips 66 has an existing 8,000 bbl tank available for onsite storage of neat biofuel that would require API gravity tests prior to use for the storage and distribution of aviation biofuel.
- Phillips 66 and Olympic Pipeline Company have expressed positive interest during initial conversations.

Primary challenges:

- Requires modifications to the existing Olympic pipeline to receive Jet-A into the facility; currently all Jet-A bypasses the facility and passes through to the Sea-Tac Airport delivery pipeline.
- A source of aviation biofuel would be required to transport over 70 million gallons of fuel annually into the facility. The fuel could be delivered via rail or barge to an alternate facility and loaded onto trucks to allow blending and pipeline transfer to occur from this site. The cost of this additional infrastructure has not been included in the evaluation of this option.
- Western (undeveloped) portion of the site is wetlands.
- Requires ownership and/or long-term lease arrangements to be established.

Option 2C – Receive Neat Biofuel via Rail and Jet-A via Pipeline, On-site Blending

As described above, Option 2B capacity is limited to just over 70 million gallons per year due to the single truck offloading position available, and potentially less, depending upon the source of the neat product. It also relies exclusively on transport of neat biofuel by truck into the facility. Option 2C shifts the delivery from truck to rail and includes installation of a rail spur off the BNSF Railway mainline into the facility, as shown in Exhibit 2C. This spur would include two tracks with multiple switches to allow for train movement into and out of the 16 offloading positions while remaining off the highly utilized BNSF mainline.

Fuel would be offloaded from the rail cars and pumped into a new 90,000 bbl (usable volume of 76,500 bbls) API 650 storage tank adjacent to the two tanks installed in Option 2B. It is assumed with this new rail spur, a unit train delivery would be provided. A unit train is defined as a dedicated tank car train consisting of approximately 100 tank cars with a total capacity of 3,180,000 gallons, or 75,714 bbls. The entire unit train would be offloaded into the new neat biofuel tank through the 16 rail car offloading positions. As 16 of the 100 rail cars are offloaded at a time, the rail cars would have to be shuffled through the rack and the siding. It is assumed a locomotive and tank cars would be operated by a private rail firm with costs built into the contracted price for delivery. It is estimated that 16 cars could be handled every 6 hours, requiring approximately 42 hours to completely offload a unit train with the proposed configuration.

The unit train would be dedicated to the delivery of neat biofuel to this facility and would make round trips from the biofuel refinery location to this site. As the refinery location is unknown at this time, the round trip time can only be estimated. Assuming the refinery has the capacity to supply 3,180,000 gallons every two weeks and the rail car round trip can be completed within a two-week window, a total of 82,680,000 gallons of neat biofuel could be supplied annually. This could be increased if the turnaround time of the rail deliveries could be reduced. The constraint would then be the ability to receive enough Jet-A from the pipeline, store on-site, and blend; therefore, the constraint would become the tank capacity.

Jet-A would be received from the Olympic Pipeline on the three-day cycle, and fuel would then be blended and tested to conform to ASTM D1655 specifications. During the two-week time between train deliveries, the neat biofuel tank would be drawn down as each batch of fuel is blended. Once the blend is tested, it would be transferred via pipeline to Sea-Tac Airport. At an 80/20 blend, a one unit train could provide 15,900,000 gallons (378,573 bbls) of blended aviation biofuel every two weeks. This would require deliveries of 12,720,000 gallons (302,857 bbls) of Jet-A from the pipeline to the Phillips 66 site every two weeks. With deliveries every three days, this equates to an average Jet-A receipt of 2,725,700 gallons (64,898 bbls) each cycle. At a 50/50 blend, the Jet-A receipt over the two-week period equals that of the rail delivery, or 3,180,000 gallons. From this analysis, the greater ratio of Jet-A to aviation biofuel requires additional Jet-A into the Phillips 66 site and additional handling for the blending operations and pipeline transfers into Sea-Tac Airport.

Required infrastructure (in addition to infrastructure outlined in Options 2A and 2B):

- (1) 90,000 bbl API 650 storage tank in existing dike
- Rail spur lines
- (16) 400 gpm offloading pump skids at each rail position
- Installation of 850 feet of 20-inch receipt piping from rail spur
- Installation of 260 feet of 8-inch piping to pipeline issue manifold
- Integration into existing tank gauging and controls system

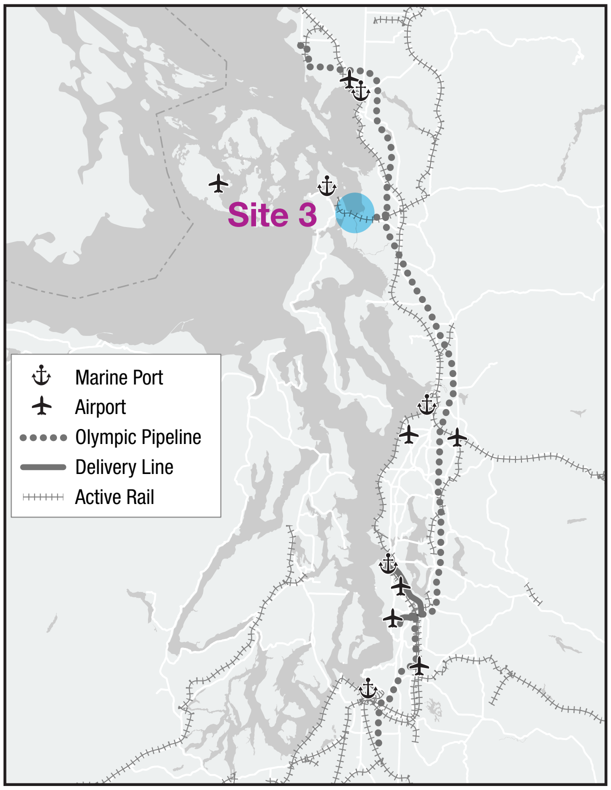
Primary benefits:

- The site provides direct access to the Sea-Tac Airport delivery pipeline.
- Neat biofuel, Jet-A, and aviation biofuel storage and blending could be managed by Phillips 66, reducing ownership and operational risk for the Port of Seattle or external parties.
- Phillips 66 is not directly associated with any of the three companies currently supplying conventional jet fuel to Sea-Tac Airport, which provides the opportunity to develop blending arrangements with all three suppliers.
- The site is zoned for industrial use.
- The site provides space for installation of additional tanks adjacent to existing tank and pipeline infrastructure.
- Rail spur (approximately 0.8 mile) from BNSF mainline allows delivery direct to site without having to receive elsewhere via rail or barge and transport into facility via truck.
- Phillips 66 and Olympic Pipeline Company have expressed positive interest during initial conversations.

Primary challenges:

- Western (undeveloped) portion of the site is wetlands.
- Rail spur could involve substantial wetlands impacts, high capital cost, and require property acquisitions and/or easements.
- Requires ownership and/or long-term lease arrangements be determined.

Site 3: Tesoro Refinery Site (proxy for any of three refineries)



The third site reviewed would consolidate the blending process upstream at the refinery. This analysis examined the available infrastructure at the Tesoro Refinery located in Anacortes on the Olympic Pipeline. This refinery is one of three, in addition to BP and Shell, that currently produce and deliver Jet-A to Sea-Tac Airport and that could be considered for blending of fuel. The Tesoro site is considered a proxy site for estimating an anticipated cost at any of the three refinery sites and is not meant to preclude the other refineries from consideration.

The Tesoro Refinery, as shown in Exhibit 3, has marine loading/offloading capabilities, rail offloading capabilities, and truck loading/offloading capabilities. Currently, both crude and biofuels (ethanol and biodiesel) are received via rail to the site. The addition of neat biofuel via any of the three receipt modes could be accommodated into the operation with varying degrees of infrastructure enhancements that have yet to be determined. For this report, it is assumed that upgrades would be required at the marine facility and at the rail car offloading facility along with new piping and new fuel storage tanks. These improvements are detailed below. To date, detailed discussions have not been completed with Tesoro representatives to determine the volume capacity of the receipt for each mode nor the available tank capacity and blending mechanisms. In addition, there is no guarantee that infrastructure available today for aviation biofuels blending would be available in future years, therefore an approach was taken to assume infrastructure and storage capacity would be required, a potentially very conservative approach.

Once the aviation biofuel has been received on-site into a tank, it would be tested to conform to ASTM D7566 specification then blended with Jet-A (produced on-site) and certified to ASTM D1655. The fuel would then be transported on the Olympic Pipeline using the delivery method utilized by Jet-A today, with no additional infrastructure requirements downstream of the refinery.

Required infrastructure:

- Upgrades to marine facility to allow for barge offloading of neat biofuel
- 10,000 feet of 12-inch marine receipt piping routed to new neat biofuel tank
- Upgrades to rail offloading facility to allow for offloading of neat biofuel
- 4,500 feet of 12-inch rail receipt piping routed to new neat biofuel tank
- (1) 90,000 bbl API 650 storage tank for receipt of neat biofuel
- (1) 90,000 bbl API 650 storage tank for blending of aviation biofuel
- 5,000 feet of 12-inch Jet-A transfer piping for blending
- 5,500 feet of 20-inch suction piping to pipeline transfer pumps
- Integration into existing tank gauging and controls system

Primary benefits:

- The Tesoro Refinery is an existing petroleum facility that would not require new permitting or land acquisition.
- Although the focus is on the Tesoro refinery for this analysis, in theory multiple refineries, or all three refineries, could develop similar infrastructure allowing multiple receipt options for blending and potentially more competitive pricing.
- Although there is uncertainty over ownership and operational structure, the current assumption is that Tesoro would continue to own and operate the facility where the additional infrastructure is constructed with the possibility it would lease the facility for a set rate per barrel or long-term annual contract cost. Both the Tesoro full ownership or tank lease options would reduce operational risk compared to infrastructure built and maintained by the Port on Sea-Tac Airport property.
- Tesoro (along with the other two refiners) have experience handling and blending aviation biofuels.
- There is a direct link to the BNSF mainline with crude offloading facilities. Current capacity is 50,000 bbls of oil per day by train. Some modification would be required to add a neat biofuel offload facility.
- There is a direct link to marine offloading facilities:
    - Tesoro Anacortes Wharf has one 16-inch and five 12-inch petroleum product pipelines connecting the wharf to the refinery's storage and supports vessels with a deck height of 22 feet, a berthing distance of 1,634 feet, and a 45-foot depth.
- Truck offload and rack facilities are available at all three refineries.
- The refineries are the current producers of conventional jet fuel provided to Sea-Tac Airport.
- The site provides direct access to the Olympic Pipeline through the main 20-inch product pipeline that continues to Portland and carries all refined products and a parallel 16-inch product pipeline that provides refined products to Seattle and a dedicated 12-inch spur line to Sea-Tac Airport.
- No downstream infrastructure modifications would be required.
- The potential exists for Portland International Airport to benefit from this investment and receive aviation biofuel from the Olympic Pipeline.

Primary challenges:

- Approval is required to feed a new product (aviation biofuel) directly into the main Olympic Pipeline. While the product would meet ASTM D1655, there could be operational constraints with other oil product suppliers in addition to a potential lengthy approval process with Olympic Pipeline Company to send aviation biofuel through a critical regional multi-product pipeline. Although the Olympic Pipeline Company did not anticipate any difficulty in receiving approval, this would be the first case in the U.S. for aviation biofuel transported in a multi-product pipeline. As a common carrier, pipeline testing and approval would be required, and there is a risk of an approval process taking longer than anticipated.
- Selecting a single refinery for storage and blending could result in much higher blends of aviation biofuel in specific jet fuel batches from that refiner compared to no blending at the other refineries.
- Leaving ownership and operations to the refiner(s) could result in high cost escalation or economic uncertainties that could lead the refiner(s) to stop storing and blending aviation biofuel if appropriate restrictions are not specified in any contract terms.
- Leaving ownership to the refiner results in no control of the operations or availability of the fuel and blending process.
- Co-locating the biofuel storage at the refineries and using the pipeline as the sole source of delivery does not alleviate concerns related to the security of supply in the event of a pipeline disruption.

4.3 Engineer's Estimate of Probable Cost for All Sites and Options

Table 4 summarizes the engineer's estimate of probable cost for infrastructure for each of the options. A set of detailed cost estimates is available in Full Report Task 4.

Table 4: Engineer's Estimate of Probable Cost

Option	Description	Estimated Construction Cost for Infrastructure Only	Estimated Project Cost	Max Annual Neat Biofuel Throughput (gal/yr)
1A	Sea-Tac Airport Small Volume – Existing Roadway	$11,720,000	$13,950,000	5,000,000
1B	Sea-Tac Airport Small Volume – SR 509 Connector	$9,800,000	$11,700,000	5,000,000
2A	Renton – Receive aviation biofuel via truck	$2,430,000	$2,830,000	14,308,000 (20/80 blend) to 35,770,000 (50/50 blend)
2B	Renton – Receive neat biofuel via truck and Jet-A via pipeline	$69,200,000	$82,360,000	71,529,780
2C	Renton – Receive neat biofuel via rail and Jet-A via pipeline	$69,600,000	$82,790,000	82,680,000
3	Tesoro – Blend aviation biofuel at refinery; receive neat biofuel via rail or marine via existing infrastructure	$87,500,000	$104,160,000	100,000,000+

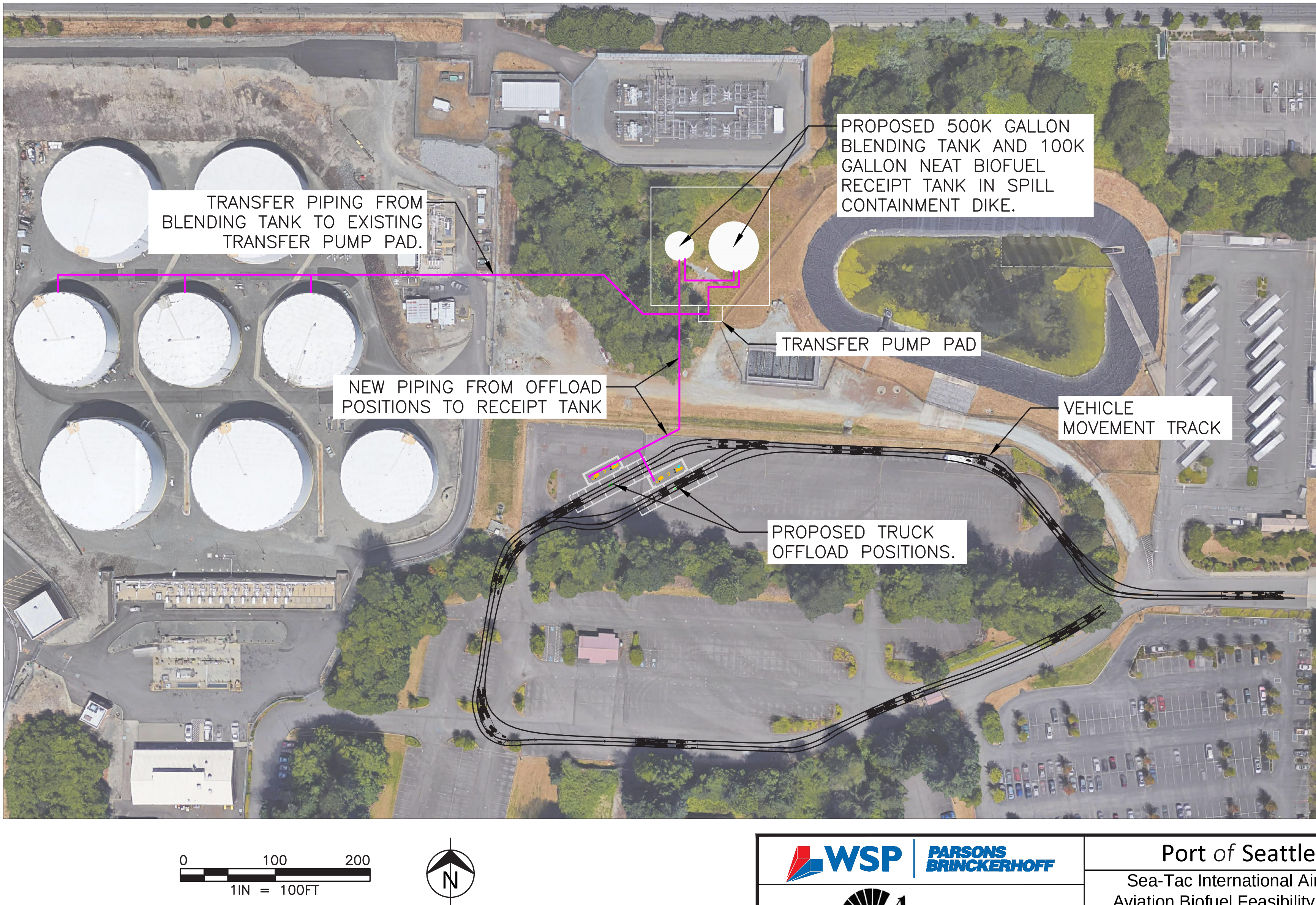
**Note: the costs for Options 2A, 2B, and 2C build on top of each other (i.e., Option 2B assumes 2A is already in place, and Option 2C assumes that 2A and 2B are already in place).*

4.4 Estimated Timelines for All Sites and Options

Table 5 provides the estimated time required to design, permit, and construct the necessary infrastructure to allow for operation of the site for each of the options.

Table 5: Estimated Timeline

Option	Description	Estimated Time Until Operational
1A	Sea-Tac Fuel Farm Small Volume – Existing Roadway	12–18 months
1B	Sea-Tac Fuel Farm Small Volume – SR 509 Connector	12–18 months
2A	Renton – Receive aviation biofuel via truck	12–18 months
2B	Renton – Receive neat biofuel via truck and Jet-A via pipeline	24 months
2C	Renton – Receive neat biofuel via rail and Jet-A via pipeline	60–72 months
3	Tesoro – Blend aviation biofuel at refinery; receive neat biofuel via rail or marine via existing infrastructure	24–30 months



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Port of Seattle

Sea-Tac International Airport
Aviation Biofuel Feasibility Study

Airport Fuel Farm Site

Figure: 1A

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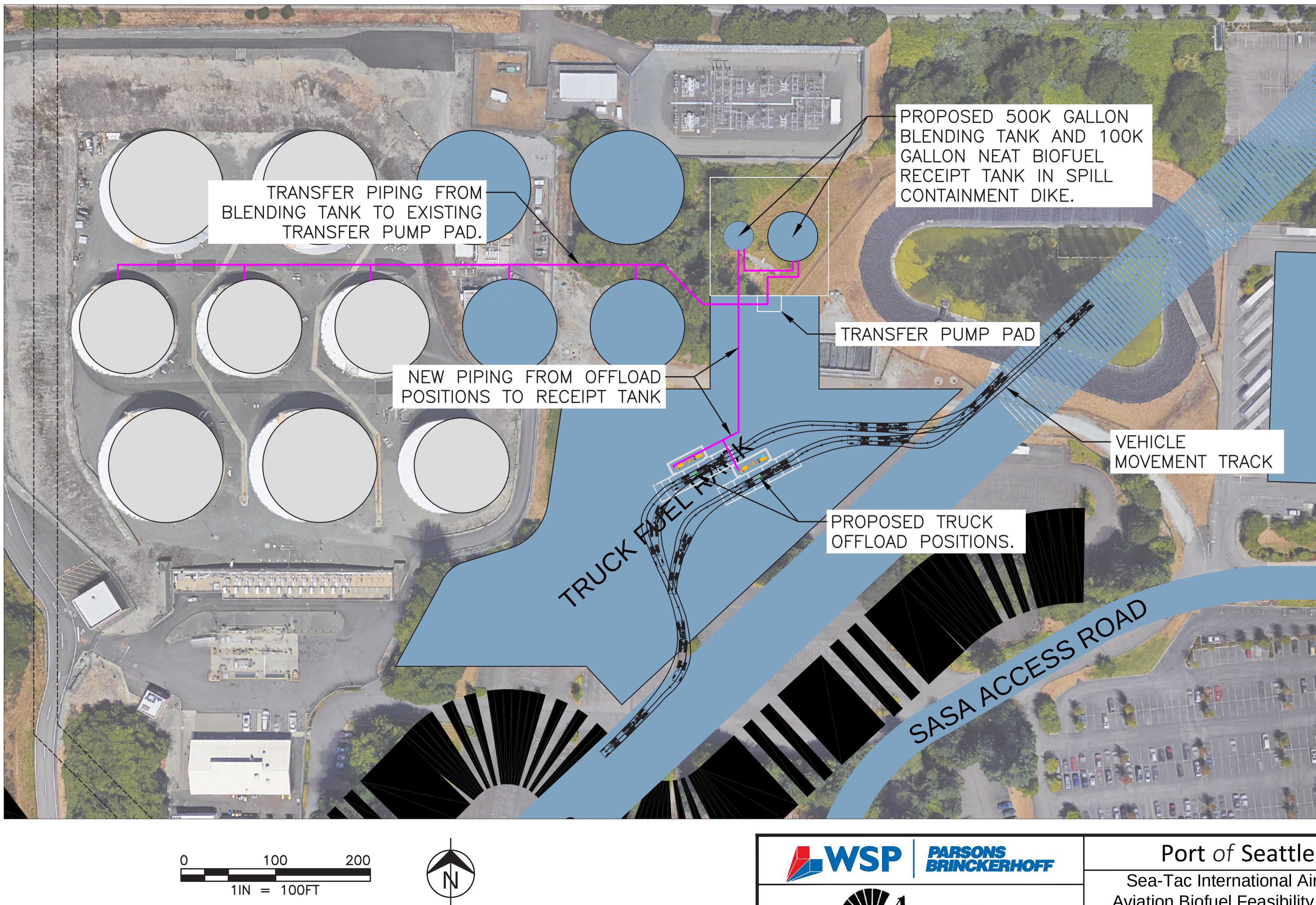

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Airport Fuel Farm Site

Figure: **1B**

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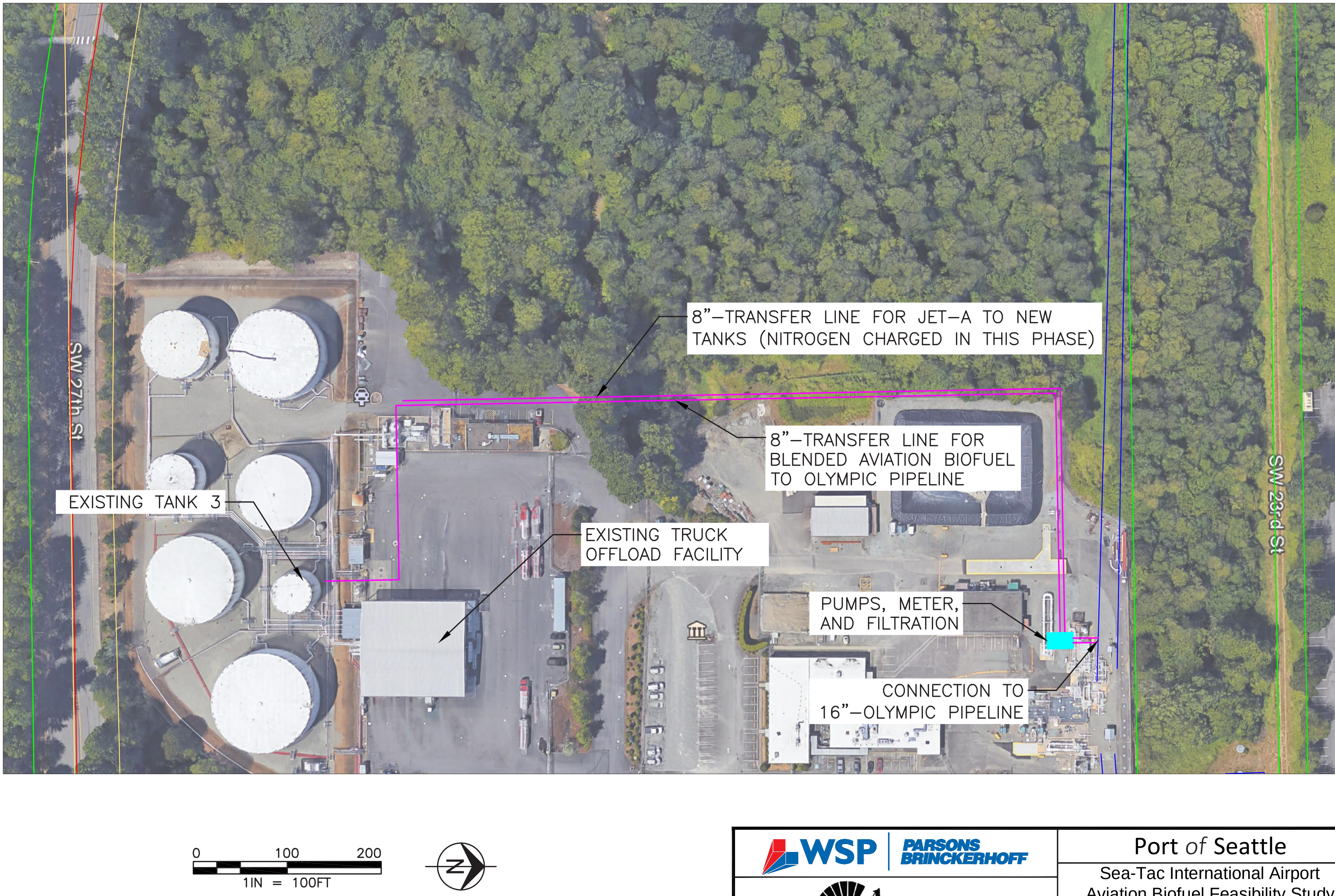

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Port *of* Seattle

Sea-Tac International Airport
Aviation Biofuel Feasibility Study
Phillips 66/Olympic Pipeline
Renton Terminal

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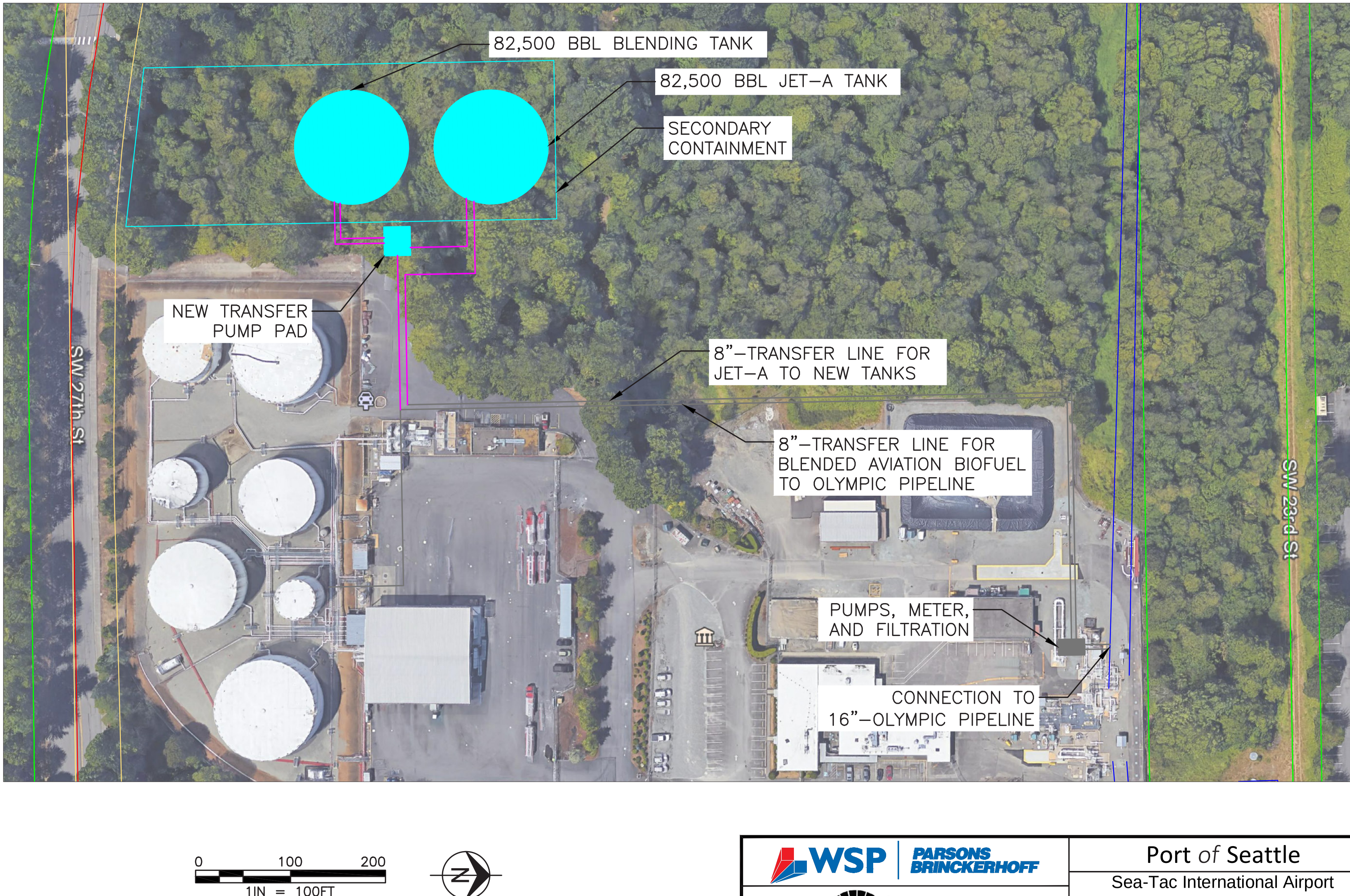

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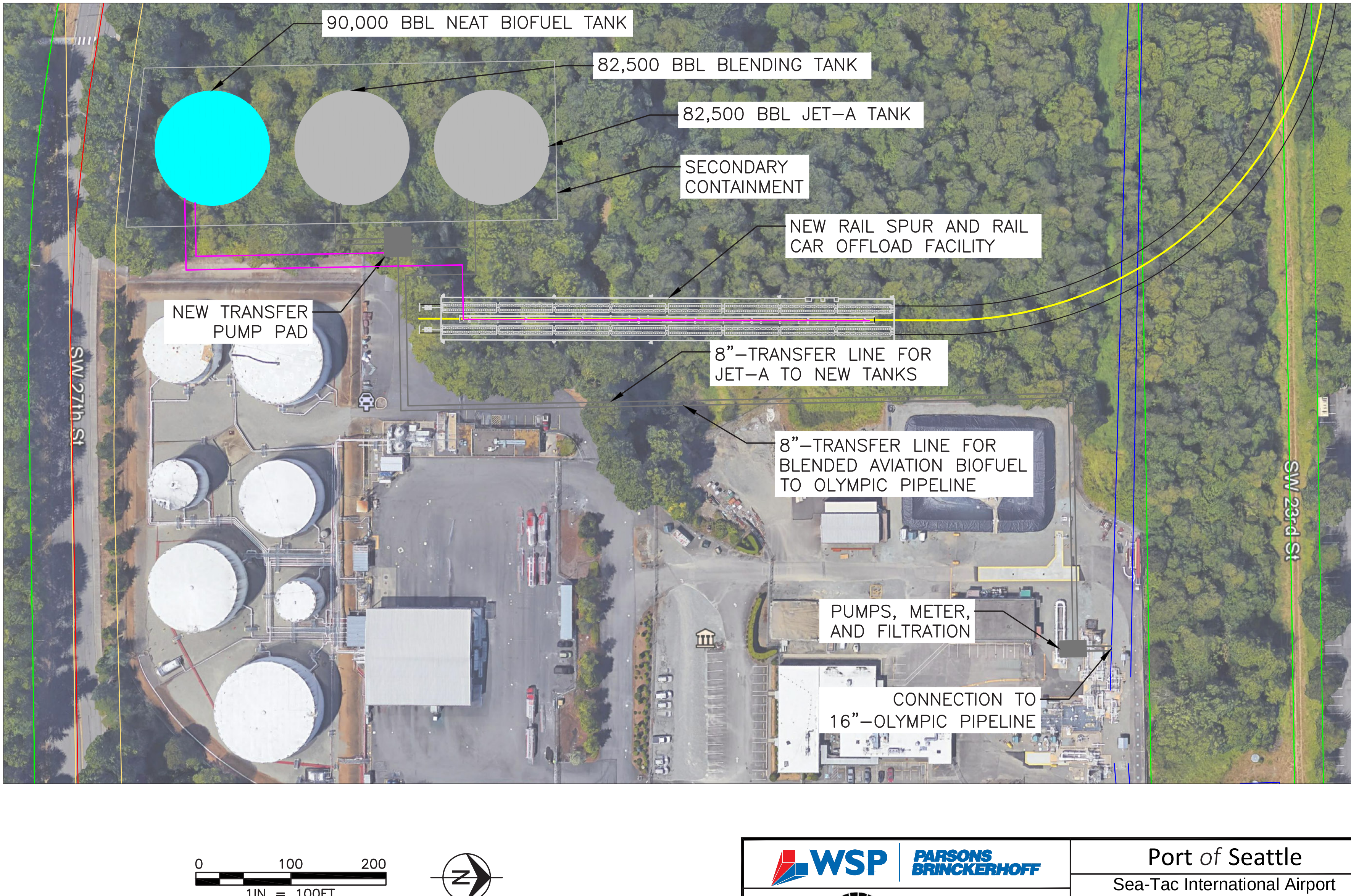

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Sea-Tac International Airport
Aviation Biofuel Feasibility Study

Tesoro Anacortes Refinery

3

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5 Implementation Option Feasibility Evaluation

A feasibility evaluation was completed for each of the six options described in Section 4 and repeated below:

(1A) Sea-Tac Airport Fuel Farm Small Volume – Existing Roadway

(1B) Sea-Tac Airport Fuel Farm Small Volume – SR 509 Connector (Future Infrastructure)

(2A) Renton Terminal Small Volume – Receive Offsite-Blended Aviation Biofuel via Truck

(2B) Renton Terminal – Receive Neat Biofuel via Truck and Jet-A via Pipeline, On-site Blending

(2C) Renton Terminal – Receive Neat Biofuel via Rail and Jet-A via Pipeline, On-site Blending

(3) Tesoro Anacortes Refinery – Blend Aviation Biofuel at an Existing Refinery

The feasibility evaluation described in this section applies a criteria scorecard to each of the proposed biofuel infrastructure system options.

5.1 Criteria Scorecard Categories and Scoring

The criteria scorecard draws upon information from the initial evaluations undertaken in the earlier phases of work in addition to the infrastructure conceptual designs and cost estimates provided in the subsequent phases of analysis. Revisions to the findings were applied in instances where new information was made available. Additional measures were included to account for general financial risk contingency, existing relationships between the Port of Seattle and site owners, and public and stakeholder acceptance.

Scoring is based on a 1 to 5 scale. A score of 1 indicates the site does not meet the minimum requirements for the scoring criteria, while a score of 5 indicates the option fully meets the requirement. The criteria are bundled by category (e.g., environmental constraints, planning and permitting, etc.) and are weighted to reflect the relative importance of the criteria to the project objectives. The specific weightings are described in further detail in Section 5.9.

Detailed information on each of the individual scoring criteria is available in the Full Report Task 5.

5.2 Short-Term and Long-Term Options

Criteria categories and category weightings vary for the short-term and long-term options. The definition of short-term and long-term for the purposes of this analysis and the options included are defined in the following sections.

5.2.1 Short-Term Options

Site improvement and implementation within 18 months and a minimum of 5 million gallons of unblended neat aviation biofuels capacity. Short-term options include the following:

- (1A) Sea-Tac Airport Fuel Farm Small Volume – Existing Roadway
- (1B) Sea-Tac Airport Fuel Farm Small Volume – SR 509 Connector (Future Infrastructure)
- (2A) Renton Terminal Small Volume – Receive Offsite-Blended Aviation Biofuel via Truck

5.2.2 Long-Term Options

Site improvement and implementation greater than 18 months and can accommodate target volumes of 30 to 50 million gallons of unblended neat aviation biofuels with potential to double that capacity in a future year (past 2025):

- (2B) Renton Terminal – Receive Neat Biofuel via Truck and Jet-A via Pipeline, On-site Blending
- (2C) Renton Terminal – Receive Neat Biofuel via Rail and Jet-A via Pipeline, On-site Blending
- (3) Tesoro Anacortes Refinery – Blend Aviation Biofuel at an Existing Refinery

The opportunity to transition a short-term site to a long-term facility or re-purpose a short-term site when a transition is made to a long-term site are considered in the criteria variables.

5.3 Criteria Category 1: Multi-Modal Delivery Point Access (Long-Term Only)

Delivery point access is a key evaluation criteria that has been the primary consideration of the study and a critical component in determining the sites that were evaluated in this study. Truck, rail, barge and vessel, and pipeline access were all considered in the study, with pipeline access determined to be a critical aspect in the long-term financial competitiveness of supplying aviation biofuel to Sea-Tac Airport. The cost per barrel per mile for pipeline shipments will be more in-line with current supply cost and reduce the volatility in both cost and scheduling associated with other supply methods.

The scoring for Category 1 is consistent across the five variables and based on the following:

Score	Description
1	No possibility for access
2	Significant investment required (right-of-way, capital)
3	Investment required for access (new assets on existing right-of-way)
4	Minimal investment required for access (upgrade of existing assets)
5	No additional investment required for access

5.4 Criteria Category 2: Environmental Constraints

Environmental constraints for each site, covered in greater detail in previous sections of the report, were included to adequately account for general risks associated with the properties analyzed in the study.

The scoring for Category 2 is consistent across the four variables and based on the following:

Score	Description
1	Mitigation is not possible or the risk of event would not allow for building of the facility (insurance requirements)
2	Mitigation is possible at a significant cost or the risk of event would cause significant damage
3	Mitigation is possible at a reasonable cost or the risk of event would cause some damage
4	Mitigation is possible at a low cost or the risk of event would cause minor damage
5	No mitigation is required or there is no risk of an event

5.5 Criteria Category 3: Permitting and Planning

Permitting and planning, covered in greater detail in previous sections of the report, were used to assess current land ownership, zoning and permitting, and opportunities for future expansion.

Scoring for Category 3 is consistent across the four variables and based on the following:

Score	Description
1	Site has prohibitive constraints that would severely impact initial development and future expansion
2	Site has significant constraints that would impact initial development and future expansion
3	Site has identified constraints that would impact initial development and future expansion
4	Site has limited constraints to initial development and future expansion
5	Site has no identified constraints to initial development and future expansion

5.6 Criteria Category 4: Site Development and Costs

Development of the identified site for anticipated short-term and long-term volumes of blended fuel requires various levels of storage capacity and supporting logistical integration and corresponding capital investments. Project development timelines and financial risk are also considered throughout the evaluation process to determine whether the site can be developed within the planned ramp-up in aviation biofuel use and can accommodate target volumes of 30 to 50 million gallons of unblended neat aviation biofuels with the potential to double that capacity in a future year (beyond 2025).

Scoring for Category 4 is consistent across four of the five variables, with the exception of project costs, and is based on the following:

Score	Description
1	The capacity goals will not be achieved or there will be high project cost and risk of delay
2	The capacity goals will be partially achieved or there will be substantial project cost and risk of delay
3	The capacity goals will be primarily achieved or there will be moderate project cost and risk of delay
4	The capacity goals will be primarily achieved or there will be low project cost and slight risk of delay
5	The capacity goals will be achieved or there will be low project cost and risk of delay

5.6.1 Estimate of Project Costs

Project costs were estimated for each of the identified options associated with project development and construction. Some of the identified options are currently planned on land owned by private entities already involved in refining and the supply of refined petroleum products and biofuel blends. There is potential that the current owner of an identified option on private land already used for product supply and/or biofuel blending may choose to pay for the necessary capital investments and price the cost for those investments in long-term volume offtake agreements and would be additionally incentivized to maintain current market share from other potential suppliers, in the case of one of the three refinery options.

For purposes of scoring, the total estimated one-time project costs are divided by the total anticipated annual capacity in gallons to derive a per gallon project cost for comparison purposes as follows:

Score	Description
1	Cost per annual gallon capacity greater than $3.00
2	Cost per annual gallon capacity between $2.25 and $2.99
3	Cost per annual gallon capacity between $1.50 and $2.24
4	Cost per annual gallon capacity between $0.75 and $1.49
5	Cost per annual gallon capacity less than $0.74

5.7 Criteria Category 5: Community Acceptance

In addition to the variables covered during previous sections of this report, additional consideration for interaction with site owners, legal and regulatory challenges, and stakeholder and public acceptance were considered in the final scorecard and included under the community acceptance category.

Scoring for Category 5 is consistent across all four variables and is based on the following:

Score	Description
1	The site has very high potential for challenges from stakeholders and/or the community
2	The site has high potential for challenges from stakeholders and/or the community
3	The site has medium potential for challenges from stakeholders and/or the community
4	The site has low potential for challenges from stakeholders and/or the community
5	The site has limited potential for challenges from stakeholders and/or the community

5.8 Criteria Category 6: Contingency and Other

Additional variables primarily cover ongoing operating costs, supply risks (as opposed to site risks covered in environmental constraints), supply redundancy, and operational flexibility. These are all critical considerations for the primary stakeholders and address other ongoing efforts to ensure that overall existing and future fueling infrastructure can meet the needs of the Port in terms of overall capacity and reduction of supply risk through redundancy measures.

Scoring for Category 6 is consistent across all four variables and based on the following:

Score	Description
1	The site has very high potential for cost contingencies and challenges to project development
2	The site has high potential for cost contingencies and challenges to project development
3	The site has medium potential for cost contingencies and challenges to project development
4	The site has low potential for cost contingencies and challenges to project development
5	The site has limited potential for contingency and acceptance

5.8.1 Operational Costs

Based on site location and ownership, the operational cost variable captures the risk of potential volatility in transportation pricing. The scoring assumes the logistical infrastructure is operated by the current facility operator or the operator of an adjacent facility (in the case of the Sea-Tac Airport option) and is meant to capture the potential for large variations in pricing based on existing and proposed delivery methods for neat aviation biofuels and current contractual relationship with the operator. In the case where a facility requires biofuels to be blended offsite, the scoring reflects the increased operational cost of this option.

5.8.2 Supply Risk

Similar to the site storage and blending risks considered in the environmental constraints category, the supply risk is meant to capture potential risks of product contamination, primarily through common carrier arrangement on pipelines or other supply infrastructure that supports multiple products and multiple contact points for transfers and blending, and the potential for leaks or other supply disruptions.

5.8.3 Supply Redundancy

In the event of a major disruption to conventional Jet-A supply to the airport, the supply redundancy variable captures the benefit of the proposed site in mitigating disruption concerns by providing an alternative supply point for both neat aviation biofuels or blended aviation biofuels, as specified and designed, as well as conventional Jet-A. The redundancy variable favors sites that provide an alternative access point to the current refineries producing Jet-A used at Sea-Tac Airport and the Olympic Pipeline connecting the refineries to Sea-Tac Airport.

5.8.4 Future Operational Flexibility

The operational flexibility variable captures the ability for a short-term option to be re-purposed for other uses when an alternative long-term site is brought online or a long-term option to expand to meet future volume requirements is implemented. Higher scores are assumed for options that provide flexibility for future anticipated or unanticipated market conditions

5.9 Criteria Scorecard Weightings

Within each primary category, weightings were derived for the subcategories. Percentages applied for the category weightings are based on the perceived importance of each variable to the study objectives outlined by the Port of Seattle, Alaska Airlines, and the Boeing Company. Variables such as pipeline access, which offers lower long-term supply costs (long-term options), and estimated project costs, which will require initial capital outlays or financing options, are assumed to be critical components in the evaluation of the various options and received higher overall weightings.

The six primary categories were then weighted to derive a totals score for each option. Weightings for the short-term options exclude multi-modal delivery point access and are spread fairly evenly among the remaining categories, with site development and costs receiving 30 percent, community acceptance 10 percent, and the remaining three categories 20 percent each. For the long-term weightings, logistical access and site development were considered to be the primary two categories as defined in the scope of this study and received the highest weightings of 40 and 25 percent, respectively. Community acceptance was given the lowest score of 5 percent, while the remaining three categories were given a weighting of 10 percent each.

Table 6: Variable and Category Weightings for Short-Term Options

Multi-Modal Delivery Point Access	
Olympic Pipeline – Main Pipeline	0.0%
Olympic Pipeline – Sea-Tac Airport Spur Line	0.0%
Barge/Vessel Offload Facility	0.0%
Rail Offload Facility	0.0%
Truck Offload Facility	0.0%
TOTAL SCORE	**0.0%**

Site Development and Costs	
Short-Term/Initial Capacity	15.0%
Long-Term/Buildout Capacity	30.0%
Development Timeline	10.0%
Estimate of Project Costs Per Annual Capacity of Neat Biofuel	35.0%
Financial Risk	10.0%
TOTAL SCORE	**30.0%**

Environmental Constraints	
Wetlands Mitigation	50.0%
Flooding Risk	20.0%
Seismic Risk	20.0%
Fire and Safety	10.0%
TOTAL SCORE	**10.0%**

Community Acceptance	
Existing Interaction with Site Owner	25.0%
Potential for Legal and Regulatory Challenges	25.0%
Stakeholder Acceptance	25.0%
Public Acceptance	25.0%
TOTAL SCORE	**10.0%**

Permitting and Planning	
Ownership and Right-of-Way	40.0%
Current Zoning and Handling of Biofuels	40.0%
Potential Permitting Issues	10.0%
Long-Range Site Planning	10.0%
TOTAL SCORE	**20.0%**

Contingency and Other	
Operational Costs	30.0%
Supply Risk (events/contamination)	20.0%
Supply Redundancy	30.0%
Future Operational Flexibility	30.0%
TOTAL SCORE	**30.0%**

Table 7: Variable and Category Weightings for Long-Term Options

Multi-Modal Delivery Point Access	
Olympic Pipeline – Main Pipeline	30.0%
Olympic Pipeline – Sea-Tac Airport Spur Line	40.0%
Barge/Vessel Offload Facility	15.0%
Rail Offload Facility	10.0%
Truck Offload Facility	5.0%
TOTAL SCORE	**40.0%**

Site Development and Costs	
Short-Term Capacity Options	15.0%
Long-Term/Buildout Capacity Options	30.0%
Development Timeline	10.0%
Estimate of Project Costs Per Annual Capacity of Neat Biofuel	35.0%
Financial Risk	10.0%
TOTAL SCORE	**25.0%**

Environmental Constraints	
Wetlands Mitigation	50.0%
Flooding Risk	20.0%
Seismic Risk	20.0%
Fire and Safety	10.0%
TOTAL SCORE	**10.0%**

Community Acceptance	
Existing Interaction with Site Owner	25.0%
Potential for Legal and Regulatory Challenges	25.0%
Stakeholder Acceptance	25.0%
Public Acceptance	25.0%
TOTAL SCORE	**5.0%**

Permitting and Planning	
Ownership and Right-of-Way	40.0%
Current Zoning and Handling of Biofuels	40.0%
Potential Permitting Issues	10.0%
Long-Range Site Planning	10.0%
TOTAL SCORE	**10.0%**

Contingency and Other	
Operational Costs	30.0%
Supply Risk (events/contamination)	20.0%
Supply Redundancy	20.0%
Future Operational Flexibility	30.0%
TOTAL SCORE	**10.0%**

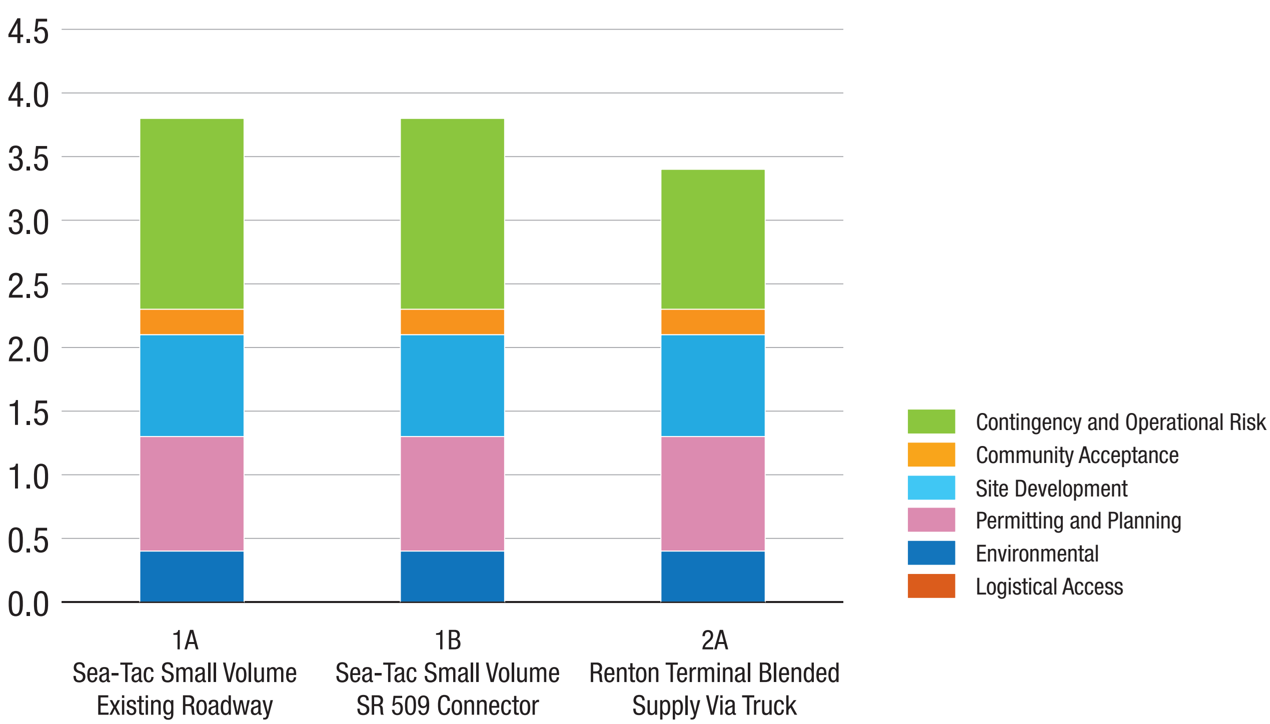
5.10 Criteria Scorecard Results

Based on the underlying analysis, scoring methodology, and assumed weightings, the short-term options result in similar scores with the Sea-Tac Airport Option 1A and the Renton Terminal Option 2A receiving a weighted score of 3.8. Sea-Tac Airport Option 1B received a slightly lower score of 3.7 due to a slightly higher potential for wetlands mitigation and project delay risk because of the required construction of the SR 509 connector.

The results for the long-term options comparison favor the refinery site, Option 3, in every category when compared to the improved Renton site with blending capabilities, Option 2B, and full build-out of the Renton site to allow for rail shipments, Option 2C.

The scorecard results are not intended to provide a specific recommendation on the preferred site but are meant to provide input or an additional reference point to be used in the selection process.

Scorecard Results by Option and Primary Category for Short-Term Options



Scorecard Results by Option and Primary Category for Long-Term Options

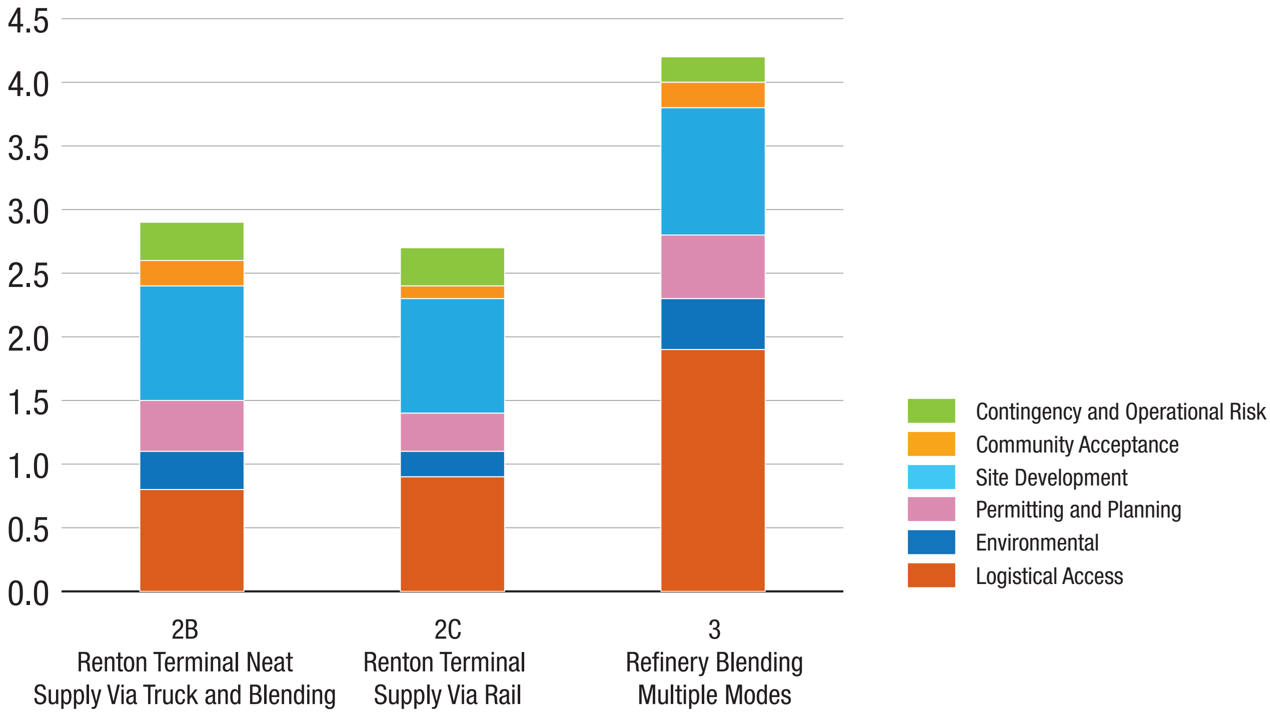


Table 8: Criteria Scorecard for Short-Term Options

Criteria Scorecard (1=low, 5=high)		SHORT-TERM OPTIONS – IMPLEMENTATION WITHIN 18 MONTHS AND A MINIMUM OF 5 MILLION GALLONS OF STORAGE CAPACITY					
		1A – SEA-TAC SMALL VOLUME EXISTING ROADWAY		1B – SEA-TAC SMALL VOLUME SR 509 CONNECTOR		2A – RENTON TERMINAL BLENDED SUPPLY VIA TRUCK	
Categories	**Weighting**	**Description**	**Score**	**Description**	**Score**	**Description**	**Score**
MULTI-MODAL DELIVERY POINT ACCESS							
Olympic Pipeline – Main Pipeline	0.0%	No access possible	1.0	No access possible	1.0	No access possible, input is upstream of Renton	1.0
Olympic Pipeline – Sea-Tac Spur Line	0.0%	Receipt only	1.0	Receipt only	1.0	Investment required for access	3.0
Barge/Vessel Offload Facility	0.0%	No access possible	1.0	No access possible	1.0	No access possible	1.0
Rail Offload Facility	0.0%	Significant investment required	2.0	Significant investment required	2.0	Significant investment required	2.0
Truck Offload Facility	0.0%	Investment included in the cost estimate	5.0	Investment included in the cost estimate	5.0	Investment included in the cost estimate	5.0
Multi-Modal Delivery Point Access – Total Score	**0.0%**	**Primarily Truck**	**-**	**Primarily Truck**	**-**	**Primarily Truck**	**-**
ENVIRONMENTAL CONSTRAINTS							
Wetlands Mitigation	50.0%	Improvements on existing land	5.0	Potential requirement for some mitigation	4.0	Improvements on existing land	5.0
Flooding Risk	20.0%	Located in area at risk for flooding	3.0	Located in area at risk for flooding	3.0	Located in a floodplain	2.0
Seismic Risk	20.0%	Moderate slope instability	3.0	Moderate slope instability	3.0	Steep slopes and areas of liquefaction	2.0
Fire and Safety	10.0%	Existing on-site fire station and emergency procedures	5.0	Existing on-site fire station and emergency procedures	5.0	Established emergency procedures	4.0
Environmental – Total Score	**10.0%**	**Low risk**	**4.2**	**Moderate risk**	**3.7**	**Moderate risk**	**3.7**
PERMITTING AND PLANNING							
Ownership and Right-of-Way	40.0%	Port-owned property	5.0	Port-owned property	5.0	Owned by Phillips 66 with some available land for improvements	4.0
Current Zoning and Handling of Biofuels	40.0%	Handle conventional jet and biofuel test volumes	4.0	Handle conventional jet and biofuel test volumes	4.0	Currently handles ethanol and biodiesel	5.0
Potential Permitting Issues	10.0%	Existing fuel storage site	5.0	Existing fuel storage site	5.0	Existing fuel storage site	5.0
Long-Range Site Planning	10.0%	Limited potential for site expansion	2.0	Limited potential for site expansion	2.0	Potential land available, requires mitigation	3.0
Permitting and Planning – Total Score	**10.0%**	**Port-owned property**	**4.3**	**Port-owned property**	**4.3**	**Oil products terminal**	**4.4**
SITE DEVELOPMENT AND COSTS							
Short-Term/Initial Capacity	15.0%	Up to 5 M gallons/year neat biofuel (80/20 blend)	5.0	Up to 5 M gallons/year neat biofuel (80/20 blend)	5.0	Up to 14.3 M gallons/year neat biofuel (80/20 blend)	5.0
Long-Term/Buildout Capacity	30.0%	Up to 5 M gallons/year neat biofuel (80/20 blend)	1.0	Up to 5 M gallons/year neat biofuel (80/20 blend)	1.0	Up to 14.3 M gallons/year neat biofuel (80/20 blend)	1.0
Development Timeline	10.0%	12–18 months	5.0	12–18 months	5.0	12–18 months	5.0
Estimate of Project Costs Per Annual Capacity of Neat Biofuel	35.0%	$2.79 per gallon	2.0	$2.34 per gallon	2.0	$0.20 per gallon, does not include off-site blending costs	2.0
Financial Risk	10.0%	Low risk – Port-owned	5.0	Low financial risk, some delay risk	4.0	Low risk, minimal improvements, existing terminal site	5.0
Site Development – Total Score	**30.0%**	**Short-term, low risk**	**2.8**	**Short-term, low risk**	**2.7**	**Short-term, low risk**	**2.8**
COMMUNITY ACCEPTANCE							
Existing Interaction with Site Owner	25.0%	Potential conflicting needs for available space	4.0	Potential conflicting needs for available space	4.0	No existing relationship with Phillips 66 on conventional jet fuel supply	3.0
Potential for Legal and Regulatory Challenges	25.0%	Low – Port-owned site	5.0	Low – Port-owned site	5.0	Low – Minimal site investment	5.0
Stakeholder Acceptance	25.0%	Competing demands/priorities for airport land, and roadway congestion	3.0	Competing demands/priorities for airport land	4.0	Phillips 66 has indicated a strong interest in participation	5.0
Public Acceptance	25.0%	Potential challenges to public agency involvement in integrated fuel supply	4.0	Potential challenges to public agency involvement in integrated fuel supply	4.0	Limited potential for public challenges given current operations	4.0
Community Acceptance – Total Score	**10.0%**	**Low risk for challenges**	**4.0**	**Very low risk for challenges**	**4.3**	**Very low risk for challenges**	**4.3**

Table 8: Criteria Scorecard for Short-Term Options (Cont'd)

Criteria Scorecard (1=low, 5=high)		SHORT-TERM OPTIONS – IMPLEMENTATION WITHIN 18 MONTHS AND A MINIMUM OF 5 MILLION GALLONS OF STORAGE CAPACITY					
		1A – SEA-TAC SMALL VOLUME EXISTING ROADWAY		1B – SEA-TAC SMALL VOLUME SR 509 CONNECTOR		2A – RENTON TERMINAL BLENDED SUPPLY VIA TRUCK	
Categories	**Weighting**	**Description**	**Score**	**Description**	**Score**	**Description**	**Score**
CONTINGENCY AND OTHER							
Operational Costs	30.0%	Fuel Consortium/Swissport	5.0	Fuel Consortium/Swissport	5.0	Future price risk if operations are contracted out to Phillips 66	3.0
Supply Risk (events/contamination)	20.0%	Limited risk for supply contamination	5.0	Limited risk for supply contamination	5.0	Risk of contamination through multiple contact points, pipeline leaks	3.0
Supply Redundancy	20.0%	Enhance direct delivery to airport fuel farm	3.0	Enhance direct delivery to airport fuel farm	3.0	Provides new access point for jet delivery	4.0
Future Operational Flexibility	30.0%	Infrastructure could be used for conventional jet storage	5.0	Infrastructure could be used for conventional jet storage	5.0	No real advantage to the port if decision to transition to higher volume refiner site in the future	2.0
Contingency and Other – Total Score	**30.0%**	**Limited risk**	**4.2**	**Limited risk**	**4.2**	**Some operational risk**	**3.2**

TOTAL SCORE							
Multi-Modal Delivery Point Access – Total Score	0.0%	Primarily Truck	-	Primarily Truck	-	Primarily Truck	-
Environmental – Total Score	10.0%	Low risk	4.2	Moderate risk	3.7	Moderate risk	3.7
Permitting and Planning – Total Score	20.0%	Port-owned property	4.3	Port-owned property	4.3	Oil products terminal	4.4
Site Development – Total Score	30.0%	Short-term, low risk	2.8	Short-term, low risk	2.7	Short-term, low risk	2.8
Community Acceptance – Total Score	10.0%	Low risk for challenges	4.0	Very low risk for challenges	4.3	Very low risk for challenges	4.3
Contingency and Other – Total Score	30.0%	Limited risk	4.2	Limited risk	4.2	Some operational risk	3.2
Total Weighted Average Score	**100.0%**	**Average Overall Score**	**3.8**	**Average Overall Score**	**3.7**	**Average Overall Score**	**3.4**

Table 9: Criteria Scorecard for Long-Term Options

Criteria Scorecard (1=low, 5=high)		TRANSITION FOR OPTION 2		LONG-TERM OPTIONS – MULTIPLE SUPPLY OPTIONS			
		2B – RENTON TERMINAL NEAT SUPPLY VIA TRUCK AND BLENDING		2C – RENTON TERMINAL SUPPLY VIA RAIL		3 – REFINERY BLENDING MULTIPLE MODES	
Categories	**Weighting**	**Description**	**Score**	**Description**	**Score**	**Description**	**Score**
MULTI-MODAL DELIVERY POINT ACCESS							
Olympic Pipeline – Main Pipeline	30.0%	No access possible, input is upstream of Renton	1.0	No access possible, input is upstream of Renton	1.0	Existing access point	4.0
Olympic Pipeline – Sea-Tac Spur Line	40.0%	Investment required for access	3.0	Investment required for access	3.0	Full integration with Main Olympic Pipeline	5.0
Barge/Vessel Offload Facility	15.0%	No access possible	1.0	No access possible	1.0	Investment included in the cost estimate	5.0
Rail Offload Facility	10.0%	Significant investment required	2.0	Investment included in the cost estimate	5.0	Investment included in the cost estimate	5.0
Truck Offload Facility	5.0%	Investment included in the cost estimate	5.0	Current capacity assumed to be adequate, may require some upgrades	4.0	Investment included in the cost estimate	5.0
Multi-Modal Delivery Point Access – Total Score	**40.0%**	**Primary Truck**	**2.1**	**Primary Rail**	**2.4**	**Primary Pipeline**	**4.7**
ENVIRONMENTAL CONSTRAINTS							
Wetlands Mitigation	50.0%	Moderate mitigation required	3.0	Significant mitigation likely required	2.0	Improvement on existing land with some mitigation possible	4.0
Flooding Risk	20.0%	Located in a floodplain	2.0	Located in a floodplain	2.0	Site dependent but all three refineries have invested in mitigation	4.0
Seismic Risk	20.0%	Steep slopes and areas of liquefaction	2.0	Steep slopes and areas of liquefaction	2.0	Some sites may have areas of moderate slope instability	4.0
Fire and Safety	10.0%	Established emergency procedures	4.0	Established emergency procedures	4.0	On-site emergency equipment and established emergency procedures	5.0
Environmental – Total Score	**10.0%**	**Moderate-High Risk**	**2.7**	**High risk**	**2.2**	**Moderate risk**	**4.1**
PERMITTING AND PLANNING							
Ownership and Right-of-Way	40.0%	Owned by Phillips 66 with some available land for improvements	4.0	Owned by Phillips 66, significant right-of-way acquisition required for rail spur	2.0	Three existing sites owned by different refiners	4.0
Current Zoning and Handling of Biofuels	40.0%	Currently handles ethanol and biodiesel	5.0	Currently handles ethanol and biodiesel	5.0	Currently handles ethanol and biodiesel	5.0
Potential Permitting Issues	10.0%	Existing fuel storage site, may require approval for expansion	3.0	Developed area and commercial zoning would need to be repurposed and rezoned for rail spur	2.0	Existing fuel production and storage site	5.0
Long-Range Site Planning	10.0%	Potential land available, requires mitigation	3.0	Potential land available, requires mitigation and further acquisition	2.0	Land available for further expansion	5.0
Permitting and Planning – Total Score	**10.0%**	**Oil products terminal**	**4.2**	**Oil products terminal**	**3.2**	**Refinery site**	**4.6**
SITE DEVELOPMENT AND COSTS							
Short-Term Capacity Options	15.0%	Up to 71.5 M gallons/year neat biofuel (80/20 blend)	5.0	Up to 82.7 M gallons/year neat biofuel (80/20 blend)	5.0	Up to 100+ M gallons/year neat biofuel (80/20 blend)	2.0
Long-Term/Buildout Capacity Options	30.0%	Up to 71.5 M gallons/year neat biofuel (80/20 blend)	2.0	Up to 82.7 M gallons/year neat biofuel (80/20 blend)	4.0	Up to 100+ M gallons/year neat biofuel (80/20 blend)	5.0
Development Timeline	10.0%	24 months	4.0	60–72 months	3.0	24–30 months	5.0
Estimate of Project Costs Per Annual Capacity of Neat Biofuel	35.0%	$1.19 per gallon	4.0	$2.03 per gallon	3.0	$1.04 per gallon	4.0
Financial Risk	10.0%	Moderate risk, wetlands mitigation, legal/environmental challenges	3.0	Significant risk due to right-of-way acquisition, local opposition, infrastructure complexity	2.0	Moderate risk due to project size, mitigated by site location at existing production and storage facility	3.0
Site Development – Total Score	**25.0%**	**Mid-term, moderate risk**	**3.5**	**Long-term, high risk**	**3.5**	**Long-term, moderate risk**	**4.0**
COMMUNITY ACCEPTANCE							
Existing Interaction with Site Owner	25.0%	No existing relationship with Phillips 66 on conventional jet fuel supply	3.0	No existing relationship with Phillips 66 on conventional jet fuel supply	3.0	Potential for reduction in economies of scale if more than one refinery partiicipates	3.0
Potential for Legal and Regulatory Challenges	25.0%	Low – Minimal site investment	5.0	Medium – Requires improvements and rezoning near property being developed	3.0	Low – Site already zoned for refining and petroleum product storage, potential for future restrictions on rail movements	4.0
Stakeholder Acceptance	25.0%	Phillips 66 has indicated a strong interest in participation, challenges in wetlands mitigation for storage expansion	4.0	Phillips 66 has indicated a strong interest in participation, challenges in wetlands mitigation and rail spur land acquisition for storage expansion	3.0	High probability that one or more refiners will be interested in storing and blending aviation biofuels to maintain market share	4.0
Public Acceptance	25.0%	Potential public challenges to expansion of an industrial site in an area switching from industrial to commercial activity	4.0	Strong potential for public challenges to rail expansion for the movement of oil product tankers in close proximity to commerical office buildings	2.0	Limited potential for public challenges to site development and associated infrastrucutre investments	5.0
Community Acceptance – Total Score	**5.0%**	**Low risk for challenges**	**4.0**	**High risk for challenges**	**2.8**	**Low risk for challenges**	**4.0**

Table 9: Criteria Scorecard for Long-Term Options (Cont'd)

Criteria Scorecard (1=low, 5=high)		TRANSITION FOR OPTION 2		LONG-TERM OPTIONS – MULTIPLE SUPPLY OPTIONS			
		2B – RENTON TERMINAL NEAT SUPPLY VIA TRUCK AND BLENDING		2C – RENTON TERMINAL SUPPLY VIA RAIL		3 – REFINERY BLENDING MULTIPLE MODES	
Categories	**Weighting**	**Description**	**Score**	**Description**	**Score**	**Description**	**Score**
CONTINGENCY AND OTHER							
Operational Costs	25.0%	Future price risk if operations are contracted out to Phillips 66	3.0	Future price risk if operations are contracted out to Phillips 66	3.0	Future price risk if operations are contracted out to refiners	3.0
Supply Risk (events/contamination)	25.0%	Risk of contamination through multiple contact points, pipeline leaks	3.0	Supply risk for rail and truck, multiple handling	2.0	Increased risk of pipeline leak on Olympic and supply risk (rail/vessel/truck), multiple handling	2.0
Supply Redundancy	25.0%	Provides new access point for jet delivery and storage	4.0	Provides new access point and transportation modes for jet delivery and storage	5.0	Uses existing input and pipeline, limited redundency improvements	2.0
Future Operational Flexibility	25.0%	No real advantage to the Port if decision to transition to higher volume refiner site in the future	2.0	No real advantage to the Port if decision to transition to higher volume refiner site in the future	2.0	Limited benefit to Port but provides additional capacity to the refiner for future use	2.0
Contingency and Other – Total Score	**10.0%**	**Some operational risk**	**3.0**	**Some operational risk**	**3.0**	**Higher operational risk**	**2.3**
TOTAL SCORE							
Multi-Modal Delivery Point Access – Total Score	40.0%	Primary Truck	2.1	Primary Rail	2.4	Primary Pipeline	4.7
Environmental – Total Score	10.0%	Moderate-High Risk	2.7	High risk	2.2	Moderate risk	4.1
Permitting and Planning – Total Score	10.0%	Oil products terminal	4.2	Oil products terminal	3.2	Refinery site	4.6
Site Development – Total Score	25.0%	Mid-term, moderate risk	3.5	Long-term, high risk	3.5	Long-term, moderate risk	4.0
Community Acceptance – Total Score	5.0%	Low risk for challenges	4.0	High risk for challenges	2.8	Low risk for challenges	4.0
Contingency and Other – Total Score	10.0%	Some operational risk	3.0	Some operational risk	3.0	Higher operational risk	2.3
Total Weighted Average Score	**100.0%**	**Average Overall Score**	**2.9**	**Low Overall Score**	**2.8**	**High Overall Score**	**4.2**

6 Key Findings

The objective of this study was to identify the best approach to deliver up to 50 million gallons (and to double to 100 million after 2025) of aviation biofuel per year into the fuel hydrant delivery system at Sea-Tac International Airport. A total of 29 sites across the state were identified and screened. The sites were located in King, Pierce, Whatcom, Skagit, Grays Harbor and Franklin Counties, Washington.

The original 29 sites were narrowed to six locations based on a number of criteria, such as access to fuel transportation modes (pipeline, rail, marine and truck), zoning, wetlands and other environmental considerations, etc. The application of additional criteria, including infrastructure development costs, focused the analysis to the three properties best suited to meet project goals.

Conceptual infrastructure development improvements and costs were developed for a total of six options for the three sites, and a feasibility evaluation scorecard was completed to compare the six options.

The key findings of the study are the following:

- Identifying a biofuel supply source was not a part of this study. Without a long-term supply source or agreement in place for aviation biofuels, it would be prudent to focus short-term investments on smaller scale facilities that are flexible and could support other aviation fuel supply uses.
- Infrastructure requirements for fuel offloading from rail and marine modes are high in cost, so these facilities are only cost-effective for large volumes of biofuel over the long term.
- A small biofuel receiving and blending facility at the Sea-Tac Airport Fuel Farm is the most cost-effective solution in the short term. In addition, this facility would fulfill an existing critical need for additional local fuel receipt and offloading infrastructure that is not dependent on the Olympic Pipeline.
- The north-end refineries are the most cost-effective options for receipt and blending of large volumes of aviation biofuel over the long term due to their access to marine, rail, truck, and the Olympic Pipeline. In this study, Tesoro Anacortes was used as a proxy for any of the three refineries that currently produce Jet-A fuel in Whatcom and Skagit Counties. This conclusion should be re-evaluated in the future when a large-scale producer of neat biofuel is identified.
- The Phillips 66/Olympic Pipeline Company sites in Renton also showed potential to accommodate receipt and blending facilities for moderate-to-large biofuel volumes over the long term.
- The study sponsors received a very positive reception from the Olympic Pipeline Company, the petroleum refineries and distributors. These fuel supply and transport organizations showed strong interest in upgrading their facilities to handle aviation biofuel and moving the blended product in their pipelines.
- As the biofuel supply expands, the Port of Seattle, its partners, and the fuel supply and transport organizations could work cooperatively toward the ultimate goal of integrating aviation biofuel into the fuel hydrant delivery system at Sea-Tac International Airport.