

Appendix D

Vessels

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KITSAP TRANSIT

Vessels



September 2014 | Final Report





Passenger-Only Ferry Business Plan and Long Range Strategy

Vessels

September 2014

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Table of Contents

- 1. Fleet Requirements..... 1**
 - 1.1. Route Specific Requirements..... 1
 - 1.2. Vessel Capacity 1
 - 1.3. Other Vessel Design Criteria..... 2
 - 1.4. Compliance Criteria..... 4
- 2. Route Plan Research 5**
 - 2.1. Estimated Fuel Consumption 8
 - 2.2. Route Plan Recommendations 9
- 3. Backup Vessel Requirements..... 10**
 - 3.1. Bremerton..... 10
 - 3.2. Kingston 10
 - 3.3. Southworth 11
- 4. Fleet Mix Strategy 12**

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1. Fleet Requirements

To identify the vessel design criteria and a fleet mix strategy that is right for the proposed service a review of ridership projections, schedule requirements, amenities offered, and compatibility with loading platforms was conducted.

1.1. ROUTE SPECIFIC REQUIREMENTS

The Bremerton route is the only route with specific vessel requirements due to wake wash performance. The RP1 vessel, which Kitsap Transit (KT) currently owns, has been specially designed and tested to meet the wake wash requirements for the Bremerton route. This is currently the only vessel design that can serve this route and meet the desired transit times.

1.2. VESSEL CAPACITY

Passenger Capacity

The RP1 has capacity for 118 people and 15 bicycles. This capacity is likely to meet demand at project start-up for the Bremerton route, with some limited number of sailings nearing the capacity threshold.

Passenger demand indicates that a 150-passenger vessel will accommodate the Kingston and Southworth routes. The vessel passenger capacity of 150 passengers, allows the vessel to be certified under 46CFR Subchapter T, provided it weighs less than 100 gross tons. Such a “T-boat” is the best alternative due to the limited crew requirement of three, as well as fuel efficiency. This type of vessel is very common for POF service.

Table 1.1: Bremerton – Seattle Ridership Estimates (using Method 1)

Scenario	Annual POF Ridership	Average Riders Per Day and Per Sail	Highest a.m. Peak Ridership	Highest p.m. Peak Ridership
6 round-trips/day	212,544	850/day 71/sail	98	122
12 round-trips/day	419,174	1,677/day 70/sail	145	145

Table 1.2: Kingston – Seattle Ridership Estimates (using Method 2)

Scenario	Annual POF Ridership	Average Riders Per Day and Per Sail	Highest a.m. Peak Ridership	Highest p.m. Peak Ridership
6 round-trips/day	167,325	669/day 56/sail	134	167
12 round-trips/day	329,283	1,317/day 55/sail	198	198

Table 1.3: Southworth – Seattle Ridership Estimates (using Method 2)

Scenario	Annual POF Ridership	Average Riders per day and per sail	Highest a.m. Peak Ridership	Highest p.m. Peak Ridership
6 round-trips/day	138,805	555/day 46/sail	111	139
12 round-trips/day	257,804	1,301/day 43/sail	173	173

Bicycle Capacity

Accommodations should be provided for at least 10 percent of passengers to stow their bicycles (approximately 15 bicycles per sailing). On the vessels, bicycle storage should be near boarding stations to minimize turnaround times, avoid conflicts with pedestrians, and not adversely affect dwell times.

1.3. OTHER VESSEL DESIGN CRITERIA

Vessel design criteria are defined by specific route characteristics, such as ridership demand, speed (whether restricted or not), amenities provided, reliability, and meeting of standard regulatory requirements. The following design criteria are identified for the KT proposed routes.

Loading/Unloading Configuration

Doors and queuing should be arranged to allow for terminal turnaround, including passenger unloading and loading, to occur in seven minutes or less for a full load in both directions. Aisle widths, door widths, number of embarkation stations, passenger routes, and seats per row should be designed to optimize passenger flow for new vessels.

Fuel Consumption

To minimize overall operating costs, it is recommended that fuel efficient vessels be used wherever possible. However, there is always a tradeoff between vessel speed and fuel efficiency, and the high speed required on the Bremerton and Kingston routes will impact fuel economy.

Ride Quality / Schedule Reliability

Weather conditions in central Puget Sound can often present challenges for smaller vessels. During winter storms, wind waves can approach 3 feet, with sustained winds exceeding 30 knots and gusts up to 50 knots. All three routes will be subjected, at times, to these high sea states and winds. Under these conditions, the vessels cannot maintain their calm water speed and must slow down, thus affecting schedule reliability. In severe weather, some vessels will not be able to operate.

In general, larger (longer) vessels behave better under these weather conditions than smaller (shorter) vessels, with less pitch and roll. In addition, new vessels can be designed to mitigate adverse effects of weather on ride quality. Therefore, a longer hull form, greater than or equal to 20 meters or longer, would be appropriate. Such new vessels should be designed in accordance with the weather conditions specific to central Puget Sound.

Passenger Amenities

Based on online survey data of 1,205 respondents, conducted by KT during the period of June 7 to 25, 2014, the following vessel amenity preferences were indicated:

- Comfortable seating (70 percent)
- Wi-Fi (32 percent)
- Electrical Outlets (24 percent)
- Tables (23 percent)
- Food/Beverages (16 percent)
- Air Conditioning (14 percent)
- Bike Racks (10 percent)
- Other (8 percent)

Based on this survey and experience from other passenger ferry systems, recommended amenities that will increase customer satisfaction and help improve ridership are:

- Comfortable seats that allow passengers to relax or work.
 - Seat back tray tables to provide a surface for writing, stowage of packages, and the like.
 - Sufficient seat pitch to provide comfortable leg room.
- Wi-Fi.
- Provision for coffee/drinks and food items at the terminals prior to boarding the ferry.

- Bathroom facilities should be available for both crew and passengers, on-shore where possible, and on the vessels.
- Provision for adequate ventilation. Adequate ventilation will satisfy most customers. Air conditioning may be desired by some potential riders, but it would be an unusual amenity on any ferry, especially in Puget Sound. Reported problems with heat in the cabin on the RP1 on warm days should be addressed by increasing ventilation through fans and venting. This strategy should be tested, and if not satisfactory, an appropriate solution should be developed via study and design.

Wake Wash / Wake Energy

Wake wash energy is of greatest concern on the Bremerton route, but still need to be considered for Southworth and Kingston as vessels near port. For Bremerton, the wake wash study shows that the RP1 satisfies wake wash criteria for the entire route, provided that the vessel operates at an appropriate speed to minimize wash energy over each portion of the route. With the exception of near (or nearby) the terminals, the majority of the Kingston and Southworth routes are primarily in open water. Therefore, wake wash/energy issues only affect the Kingston and Southworth routes during the maneuvering portions of each route.

Vessel Draft and Deck Freeboard

The vessel draft determines the seafloor level required to float the ferry and keep debris out of the propulsion system. Vessel drafts are expected to be 4 to 5 feet, and the required clearance below the vessel is expected to be 2 to 4 feet. Since the lowest tide is approximately -4 mean lower low water (MLLW), the seafloor level needs to be -10 to -13 MLLW or deeper where vessels are moored.

1.4. COMPLIANCE CRITERIA

All vessels are required to comply with the Americans with Disability Act (ADA) requirements to allow for accessibility into and on vessels, as well as other security and safety compliance issues as regulated by the U.S. Coast Guard (USCG).

Accessibility / ADA Compliance

The vessels need to be fully accessible to people with disabilities, including mobility, sight, and hearing impairments. The United States Access Board Proposed Passenger Vessels Accessibility Guidelines, which are not yet final, should be incorporated into new vessel designs. If existing vessels are leased or purchased, they should be assessed for compliance and modified if necessary. The following design recommendations will help meet these requirements:

- **Single Passenger Deck:** Having all passenger accommodations on a single deck eliminates the need for elevators or other elements necessary to provide equal accommodations. If two decks are necessary, have the majority of passengers located on the boarding station deck.
- **Vessel and Boarding Float Freeboard:** The freeboards of the vessel and boarding float should be aligned to meet gangway slope requirements.



U.S. Coast Guard Regulatory Compliance

All vessels, whether new or used, will be required to meet USCG regulations. Navigational equipment (radars, lights, GPS, etc.) and life safety items, as well as others, are reviewed by USCG to determine if the type, location, and capacity are acceptable. For this size of vessel, most of the requirements will be found in Title 46 of the Code of Federal Regulations Subchapter T – Small Passenger Vessels and USCG Navigational Rules.

2. Route Plan Research

Route plans were developed, using the crossing time goals below, to help the team understand if existing local POF vessels could serve the routes. Once the route plans were developed, it became clear that existing, analyzed POF vessels could not meet the speed requirements needed to meet the proposed service schedules for certain routes. These route profiles were also used to identify estimated fuel consumption by route. Vessels reviewed include the following:

- RP1 (118-passenger foil-assisted catamaran—used in testing by KT on the Bremerton route—owned by KT).
- The Spirit of Kingston (150-Passenger foil-assisted catamaran—used on the King County West Seattle Route—owned by King County Marine Division).
- Melissa Ann (172-passenger non-foil-assisted catamaran—previously used on the King County Vashon Island route—leased from Four Seasons Marine Services).

The fully loaded speed requirements and associated fuel consumption by vessel were used to analyze the possibility of completing the one-way trip by route using the known passenger-only vessels currently in use in the Puget Sound, as outlined above.

Table 2.1: Target Schedules and Vessel Speed Requirements

Scenario	Target Crossing Time (min)	Dwell Time Needed (min)	Total One-Way Trip Time (min)	Max Speed Needed (kts)
Bremerton	28	7	35	35*
Kingston	33	7	40	34
Southworth	23	7	30	28

*Note: The Bremerton route speed through Rich Passage is the speed required by the operating parameters from the Rich Passage Wake Wash Study, which produces the least wake energy.

Bremerton

Based on the route profile information in Table 2.2 below, the RP1 vessel can maintain the speeds necessary to make a 35-minute one-way trip to Seattle. The RP1 vessel is the only vessel that can be used on the Bremerton route due to the low wake design.

Table 2.2: Bremerton to Seattle Route Plan Using RP1

Bremerton to Seattle -RP1: 35-Minute One-Way Trip (Includes 7-Minute Dwell Time)						
Route Element	Distance (Statute Miles)	Average Speed (kts)	Average Speed (MPH)	Time Required (minutes)	Engine RPM	Fuel Consumption (gallons)
Bremerton - Manuever	0.3	9.0	10.4	1.74	1100	0.62
Bremerton to Rich Passage Turn Pt	3.5	35.0	40.3	5.22	2150	13.61
Rich Passage to Seattle Turn Pt	3.0	35.0	40.3	4.47	2150	11.66
Seattle Turn Pt to Seattle	8.7	30.6	35.2	14.83	2000	31.13
Seattle - Manuever	0.3	9.0	10.4	1.74	1100	0.62
Seattle Off/On Load PAX	0.0	0.0	0.0	7.00	500	0.25
Total (or average) One Way	15.8	29.4	33.9	35.00		57.90

Kingston

The Kingston route is the longest haul of the three routes. In order to meet a 40-minute one-way trip, a vessel would need to maintain a speed of approximately 34 kts. This 40-minute schedule allows for one vessel to make the three desired peak period direction trips within the commuting peak period.

Two vessels were chosen for the route plan analysis, which include the Spirit of Kingston and the RP1. A typical T-boat with a 150-passenger capacity is ideal for this route, based on the projected ridership identified in Section 1.2¹.

¹ The Kingston route is not constrained by the use of the RP1 low wake vessel with its passenger capacity of 118.

The RP1 can maintain the speed needed to meet the schedule requirements; however, the capacity is limiting for the route. The maximum achievable fully loaded speed of the Spirit of Kingston is approximately 34 knots, and therefore cannot make the schedule performance criteria (refer to Table 2.3) of a 40-minute one-way trip. It is likely that KT will need to build a new vessel to meet the operating requirements of this route, as there is a limited available market for existing passenger-only vessels to meet these speed requirements in the Puget Sound area. The Melissa Ann also cannot maintain the speed needed to meet the schedule performance criteria.

While the Spirit of Kingston is just shy of maintaining the schedule performance criteria, the vessel could serve as a potential backup vessel for the route. Schedule alterations for the short-term backup would need to occur. Additionally, the RP1 vessel could serve as a backup for the Kingston route. While the RP1 can make the schedule of a 40-minute one-way trip, the passenger capacity is limited (refer to Table 2.4). Either sacrifice in schedule or capacity could be managed on a short-term basis.

Table 2.3: Kingston to Seattle Route Plan Using the Spirit of Kingston

Spirit - 40-Minute One-Way Trip; 7-Minute Dwell Time; Kingston to Seattle					
Route Element	Distance (Statute Miles)	Average Speed (kts)	Average Speed (MPH)	Time Required (minutes)	Fuel Consumption (gallons)
Kingston - Manuever	0.3	9.0	10.4	1.74	0.88
Appletree Cove to Elliott Bay	18.6	32.5	37.4	29.86	71.98
Seattle - Manuever	0.3	9.0	10.4	1.74	0.88
Seattle Off/On Load PAX	0.0	0.0	0.0	7.00	0.26
Total (or average) One Way	19.2	30.0	34.6	40.34	74.00

Table 2.4: Kingston to Seattle Route Plan Using the RP1

40-Minute One-Way Trip; 7-Minute Dwell Time; Kingston to Seattle						
Route Element	Distance (Statute Miles)	Average Speed (kts)	Average Speed (MPH)	Time Required (minutes)	Engine RPM	Fuel Consumption (gallons)
Kingston - Manuever	0.4	9.0	10.4	2.32	1100	0.83
Appletree Cove to Elliott Bay	18.6	33.6	38.6	28.88	2100	71.50
Seattle - Manuever	0.3	9.0	10.4	1.74	1100	0.62
Seattle Off/On Load PAX	0.0	0.0	0.0	7.06	500	0.25
Total (or average) One Way	19.3	30.6	35.2	40.00		73.21

Southworth

The Southworth route is the shortest of the three routes; with a proposed one-way trip of 30 minutes, the service is very similar to the existing King County Water Taxi route from Vashon Island to Pier 50 in Seattle. Three vessels were used in the development of representative route profiles; the RP1, Spirit of Kingston and the Melissa Ann. All three vessels have the speed needed to meet the route performance criteria.

The Melissa Ann is currently used on the Vashon to Seattle route and is scheduled for release from lease agreement with King County in the end of September 2015. While the Melissa could

be an option for the Southworth route, the timing of bringing the route online, which is discussed further in the Implementation Phasing and Financial Plan, may be far enough out that a newer, more efficient vessel may be available for lease.

The RP1 is not an ideal vessel for the route due to its limited passenger capacity; however, it could serve as a backup vessel to the route. The Spirit of Kingston and the Melissa Ann could also serve as backup vessels to the route without impacting the schedule.

Table 2.5: Southworth to Seattle Route Plan Using the Melissa Ann

Southworth to Seattle - Melissa Ann: 30-Minute One-Way Trip (Includes 7-Minute Dwell Time)					
Route Element	Distance (Statute Miles)	Average Speed (kts)	Average Speed (MPH)	Time Required (minutes)	Fuel Consumption
Southworth - Manuever	0.3	9.0	10.4	1.74	0.53
Southworth to Elliott Bay	10.4	28.0	32.2	19.38	32.26
Seattle - Manuever	0.3	9.0	10.4	1.74	0.53
Seattle Off/On Load PAX	0.0	0.0	0.0	7.00	0.26
Total (or average) One Way	11.0	25.1	28.9	29.86	33.57

2.1. ESTIMATED FUEL CONSUMPTION

Route operating profiles were developed to compare the effect of travel and dwell time on fuel consumption. Dwell time, as mentioned above, is assumed for each route at seven minutes, which will allow time for the loading and unloading of passengers.

A fuel consumption comparison curve was generated based on empirical fuel consumption data on three representative vessels:

- Melissa Ann (172-passenger non-foil-assisted catamaran—used on the King County Vashon Island route)
- The Spirit of Kingston (150-passenger foil-assisted catamaran—currently used on the King County West Seattle Route)
- RP1 (118-passenger foil-assisted catamaran—used in testing by KT on the Bremerton route)

The comparison curves are based on gallons per statute mile and gallons per passenger mile are shown in Figure 2.1.

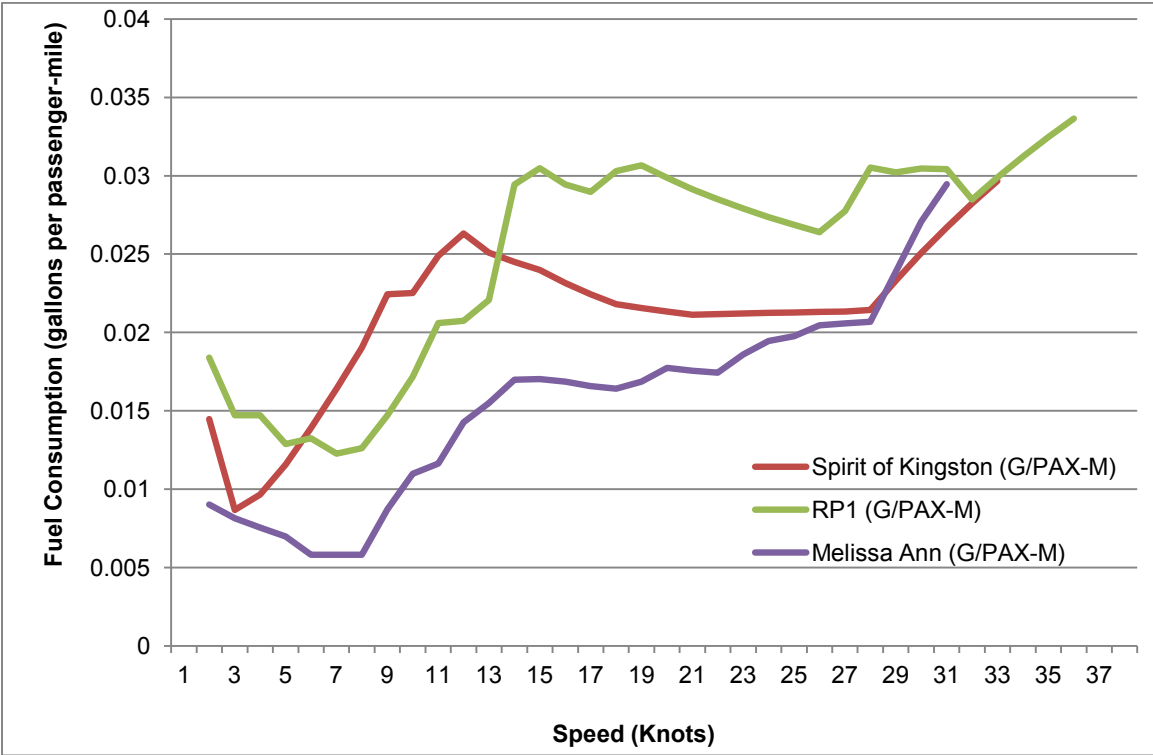


Figure 2.1: Fuel Consumption Curve

2.2. ROUTE PLAN RECOMMENDATIONS

- Bremerton Route: The 35-minute, 7-minute dwell time route using the RP1 is optimal in terms of fuel economy and is recommended for all scheduled trips.
- Kingston Route: The 40-minute, 7-minute dwell time route is recommended. Because of the length of this route, a non-conventional hull form, such as through the use of foils or long slender hulls, will need to be considered.
- Southworth route: A 30-minute schedule with 7-minute dwell time is recommended. The vessel utilized for the Southworth route will need to be able to achieve a fuel efficient speed of 28 knots to enable a 30-minute trip with a 7-minute dwell time.
- A 7-minute dwell time is recommended to allow time for loading and unloading of passengers.

3. Backup Vessel Requirements

In the event of a mechanical breakdown or casualty, backup vessel(s) should have sufficient capacity and speed to handle passenger volumes on the published schedule for all three routes. Backup vessel(s) could also be used to provide extra trips during peak demand periods, should additional service be considered in the future.

3.1. BREMERTON

The Bremerton route is the only route with specific vessel requirements due to wake wash considerations. The RP1 has been specially designed for this route, as no other known vessel has been proven to meet the wake energy limits set for this route while maintaining speed (time) demands. The RP1 has capacity for 118 passengers, and while it satisfies most vessel design criteria requirements for all the routes at system start up, a single RP1 class vessel will not provide adequate capacity for peak demand on all three routes. For startup, the RP1 backup boat (known as the RP2) could also serve as the backup boat for the other two routes. The phasing of backup vessels and how they would serve routes as they come online is discussed in more detail in a later report. Should service begin without a backup vessel on this route, an alternative service option would be for passengers to use the Washington State Ferries (WSF) service. KT will need to ensure a fare media arrangement is made with WSF so that KT passengers are not adversely affected financially should the backup scenario occur.

Backup Vessel Strategy:

- Commission the design/construction of a new RP2 vessel to serve as backup to the route.
- Later, commission the design/construction of a new RP3 vessel to serve as backup for expanded service on the Bremerton route.

3.2. KINGSTON

The Kingston route requires a boat that can achieve good fuel economy at fairly high speeds (33.6 knots). There are two current alternatives that would enable KT to meet this need as well as to accommodate growth in the system for all three routes.

Backup Vessel Strategy:

- Develop criteria for a request for proposals for leased vessels that are fuel efficient and provide sufficient passenger capacity to meet demand.
- Commission the design/construction of a new vessel based on similar criteria.



3.3. SOUTHWORTH

The Southworth route has no route-specific design requirements, except that the vessel must be able to achieve 28 knots with good fuel economy and provide sufficient passenger capacity to meet demand.

Backup Vessel Strategy:

- Develop criteria for a request for proposals for leased vessels that are fuel efficient and provide sufficient passenger capacity to meet demand.

4. Fleet Mix Strategy

The fleet requirements for the KT POF service differ slightly between the three routes. While a standardized system is ideal to streamline maintenance and operating training, it is likely not possible for this service. The Bremerton route provides vessel type restrictions to minimize impacts to the beaches of Rich Passage from both natural and wake impacts, making standardization difficult. While the speed of the RP1 could serve the Kingston route, the capacity will likely not meet passenger demand. Additionally, the Southworth route does not require such a fast and custom designed vessel. That being said, efforts should be made to standardize the fleet when possible, while also utilizing shared or available assets in the area, such as those vessels currently owned or leased by King County Marine Division.