# RFI 052
# Pebble Project EIS

## Request for Information

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|---|---|
| **Title/Subject:** | **Incident Risk Assessment for Ice Breaking Ferry** |
| **Requestor:** | **Allison Payne, AECOM** |
| **Date Transmitted:** | **6/21/2018** |
| **Recipient:** | **Pebble Limited Partnership** |
| **Response Requested by:** | **7/09/2018** |
| **Rationale:** | **RFI 013 provided some specifications on construction and operation of the custom ice-breaking ferry, as well as ice conditions on Iliamna Lake.**<br><br>**Scoping comments express concern that the ferry could be subject to an incident that causes contamination of Iliamna Lake. More information is needed to assess the risk of incidents that could result in spills to Iliamna Lake.** |
| **Describe the Information Requested and Level of Detail:** | **Please provide an assessment of the probability of incidents, the ability to respond to incidents, and the fate and transport of cargos should they be lost to the lake. Please include:**<br>**1. Vessel design features that would mitigate the potential for casualties.**<br>**2. Historical review of similar vessels operating in open water and/or heavy ice anywhere around the world, casualties and near casualties (e.g., loss of power or steering, fires, or flooding), and an assessment comparing those vessels to the proposed ferry design.**<br>**3. Incident response procedures in open water, ice, shallow and deep water, and efficacy of response procedures.**<br>**4. Fate and transport of materials should they be lost to the lake. Please include diesel fuel, concentrate, and reagents, and an assessment of how the spilled materials would behave when exposed to lake water.** |

## Recipient Response Form

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|---|---|
| **Date Received from USACE:** | Click here to enter text. |
| **Response from Recipient (Describe Information Requested to the Level of Detail Requested; Provide Attachments as Needed):** | **See attached document** |
| **List Number and Type of Response Attachments:** | **RFI052 Ferry Operations Questions.pdf** |
| **Date Returned to USACE:** | **7/13/2018** |

## AECOM Intake Form

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|---|---|
| **Date Response was Received:** | **7/13/2018** |
| **Received by:** | **Bill Craig, AECOM** |
| **Describe any Follow-up Related to this RFI:** | **None at this time** |

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| **Date Received from USACE:** | Click here to enter text. |
| **Response from Recipient (Describe Information Requested to the Level of Detail Requested; Provide Attachments as Needed):** | **See attached document in response to question 4** |
| **List Number and Type of Response Attachments:** | **Pebble RFI 52 Memo response_FINAL.pdf** |
| **Date Returned to USACE:** | **7/24/2018** |

## AECOM Intake Form

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|---|---|
| **Date Response was Received:** | **7/24/2018** |
| **Received by:** | **Bill Craig, AECOM** |
| **Describe any Follow-up Related to this RFI:** | **None at this time** |

THE pebble PARTNERSHIP

From: James Fueg, Pebble Limited Partnership
To: Shane McCoy, US Army Corps of Engineers
Date: July 13, 2018

# Response to RFI-052 Ferry Operations

This technical note is an initial response to RFI-032 that addresses Questions 1,2, and 3. Question 4 will be addressed later under a separate cover.

**Please provide an assessment of the probability of incidents, the ability to respond to incidents, and the fate and transport of cargos should they be lost to the lake. Please include:**

1. **Vessel design features that would mitigate the potential for casualties.**

   Potential sources of incidents for the ferry include grounding, the loss of control and drifting leading to navigational hazards or grounding, sinking, and onboard fire. These issues and the design features that will mitigate them are addressed in the following sections.

   a. Grounding is most commonly caused by human error and less commonly by loss of ability to maneuver due to adverse weather or loss of power.

      The risk of human error will be mitigated by:

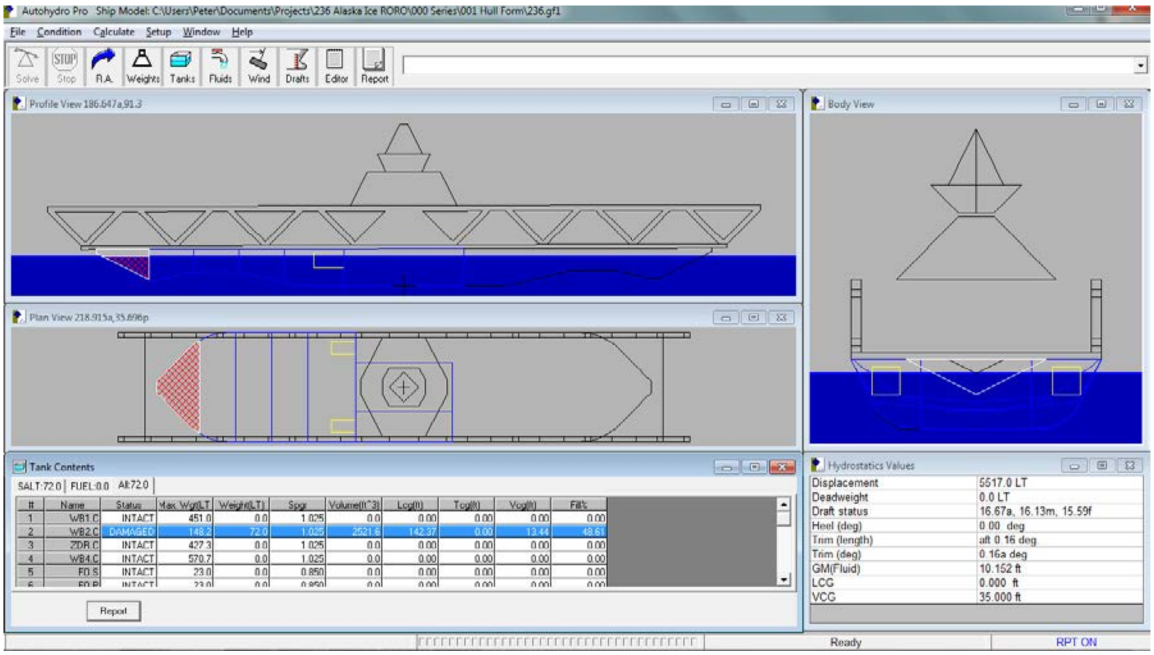
      i. The use of experienced crews, continuous training, and remote monitoring of the vessel (with the option for remote control if required) from a remote operations center with the ability to alert the crew if any concerns are observed.
      ii. The proposed vessel will be equipped with a state of the art navigation system, including real time water depth monitoring and voyage planning. The water depth will be mapped for the surrounding areas, allowing for route planning to avoid shallow water or rocks where grounding may occur. Other sensitive areas (e.g. fishing activities) will also be mapped and route planning will take those into consideration as well.

      The vessel design anticipates operating in winds reaching 100 mph with zero visibility, in open water and in ice, and safe station keeping in winds reaching 150 mph. There is enough power provided to accomplish it, with four azimuthing thrusters capable of rotating 360°. The vessel is designed with two fully independent engine rooms, each with two generators. In the unlikely event of the loss of one of the engine rooms to flooding or fire, the other engine room will continue to operate, providing enough power to either continue operation while undergoing repairs underway, or to safely return to port.

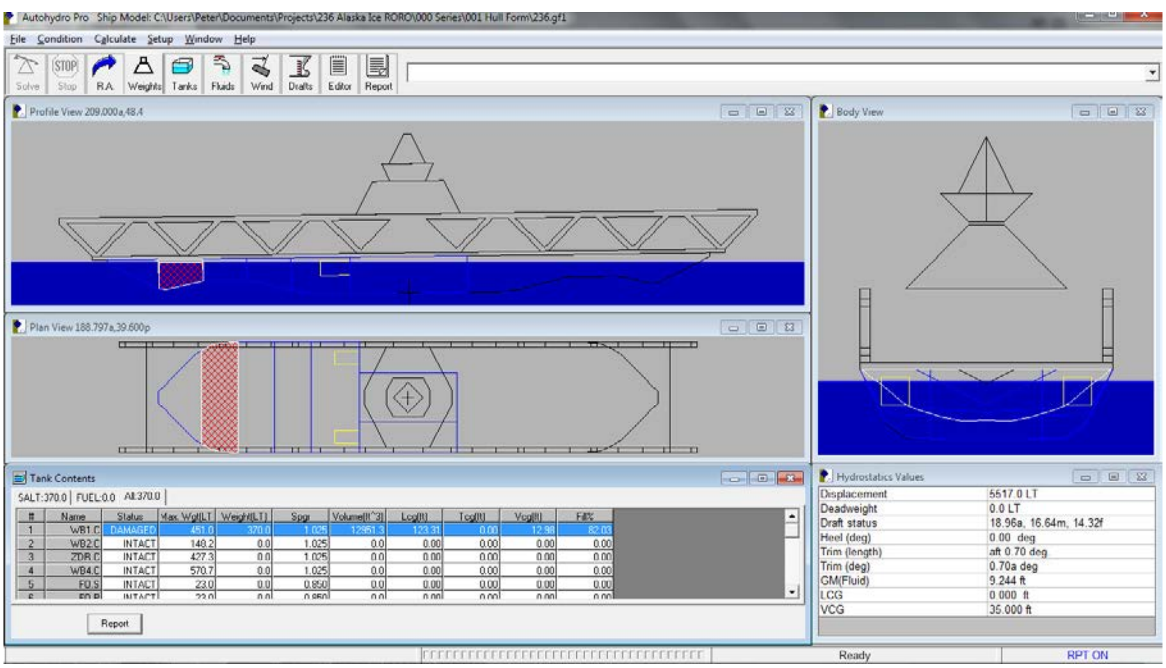
   b. Loss of control is caused by loss of thrust. Loss of thrust can be caused by damage to the propellers, or loss of power due to fire or flood. The four thrusters are separated by 40 feet in the transverse direction and 200 feet in the longitudinal direction, making it highly unlikely that all four propellers could be impacted at once. Due to the reinforced shell required for icebreaking, the potential for both independent engine rooms to flood simultaneously is very low. The risk associated with an engine room fire is also mitigated by incorporating two fully independent engine rooms into the design.

c. To minimize the potential for sinking, the vessel has been designed with multiple watertight compartments and would remain afloat, stable, and operational in the event of flooding of any one of those compartments. It should be noted that the potential for damage to the ferry, either by grounding or collision is very low due to the 1-inch thick shell and supporting structure required for ice breaking. Furthermore, all fuel and other tanks are located away from the shell. The modeling below, completed for a fully loaded ferry, demonstrates the expected impact associated with flooding of any of the watertight compartments.

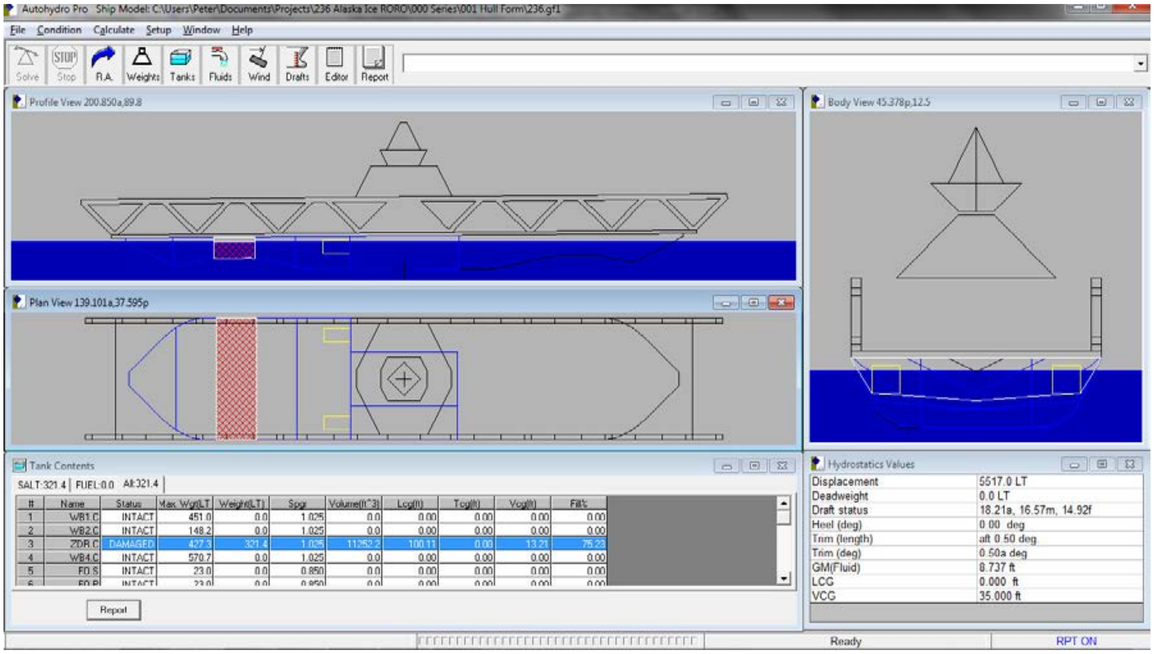
Case 1 - Flooding to the fore or aft peak tank, Void #1. The vessel remains afloat, with 0.16° trim and no list (heel), fully operational.



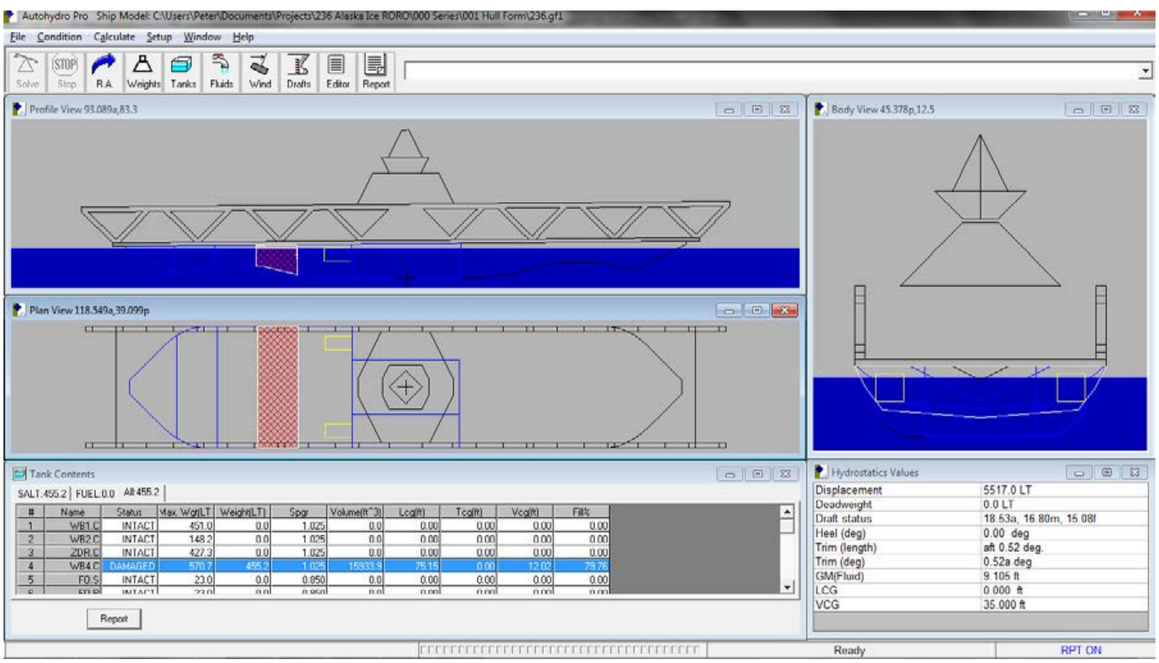

Case 2 - Void #2 flooded. The vessel remains afloat, with 0.70° trim and no list, fully operational.



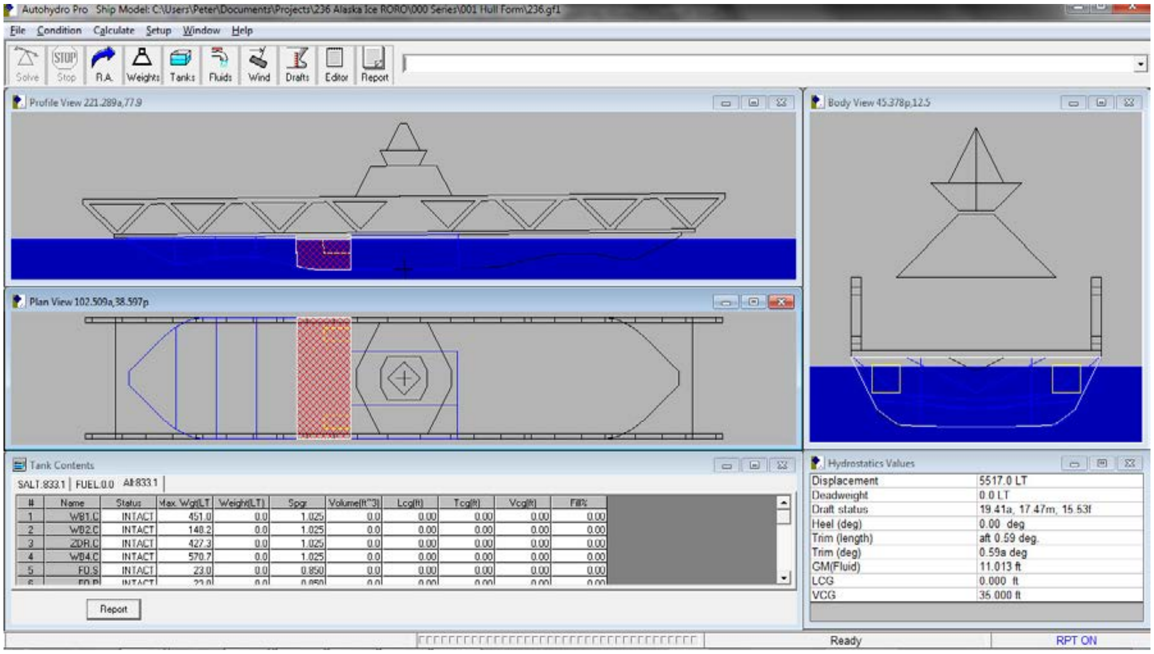
Case 3 - Thruster Compartment #3 flooded. The vessel remains afloat, with 0.50° trim, no list, two of four propellers operational, the vessel can move and maneuver.



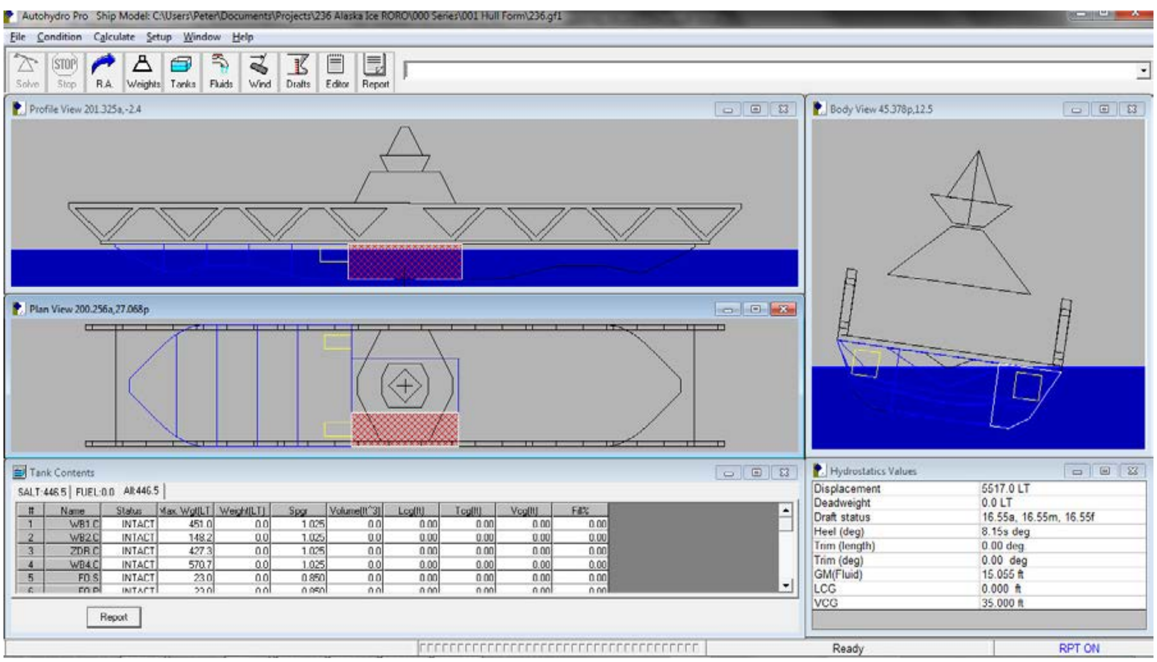

Case 4 - Void #4 flooded. The vessel remains afloat, with 0.52° trim and no list, fully operational.



Case 5 - Void #5 flooded. The vessel remains afloat, with 0.59° trim and no list, fully operational.




Case 6 – Engine room flooded. The vessel remains afloat, with 8.04° list, 0° trim. Half the power is lost, but the remaining engine room supplies power to all four propellers. Note that this model assumes a high vertical center of gravity, which would be lower in practice, leading to less list. The stowage plan will ensure no movement of cargo under this condition.



d. To address the potential for fire the ferry will be equipped with fire detection and fighting systems. Machinery spaces (thruster rooms and engine rooms) will be protected by a $CO_2$ system. While equipment in one of those spaces may be disabled, the others will remain operational and the vessel will remain capable of safely returning to port. Accommodation spaces will be protected by an automatic sprinkler system. In the event of fire and water damage, including to the wheelhouse, the vessel can be operated from the backup station in the engine control room (using CCTV), or remotely from an operations center.

**2. Historical review of similar vessels operating in open water and/or heavy ice anywhere around the world, casualties and near casualties (e.g., loss of power or steering, fires, or flooding), and an assessment comparing those vessels to the proposed ferry design.**

The first identified use of an ice-breaking ferry was the vessel Baikal that operated on Lake Baikal in Russia from 1899 until 1918, when it was sunk by artillery fire during the Russian Revolution. The vessel was constructed in the United Kingdom and moved in sections to the shores of Lake Baikal where it was assembled. The purpose of the vessel was to make two round trips, on a year-round basis, transferring passengers (~300) and railcars (up to 27) for the Trans-Siberian Railway. The eastern and western portions of the line terminated on opposite shores of Lake Baikal. Ice on Lake Baikal can reach thicknesses of up to 6 feet.

https://www.wdl.org/en/item/20090/

Ferries are widely used on lakes in the Northern USA and Canada and will often operate into the shoulder seasons when lake ice up, but before the ice is thick enough to support vehicle traffic. One example of this is the Madeline Island Ferry, which can be viewed breaking ice in the following video clip:
http://www.washingtonpost.com/video/local/weather/watch-a-ferry-break-through-thick-ice-on-lake-superior/2018/01/02/5a781846-eff0-11e7-95e3-eff284e71c8d_video.html

The best analog for the proposed Pebble ferry is the Williston Transporter, which has been operating year-round on Williston Lake (British Columbia) since 1995. The 7400-horsepower vessel is 360 feet long, 110 feet wide, can carry up to 5000 tons, and provides transportation for logging and mining operations around the lake. The ferry operates around the lake which is approximately 156 miles long and 96 miles wide at its widest point. A search of the Transportation Safety Board of Canada database of marine investigation reports identified only one incident associated with the Williston Transporter, which occurred in June 2016 (ice free conditions) and was listed as an accidental grounding while under power. No injuries, loss of cargo, or release of pollution were associated with that incident. Several photographs of the Williston Transporter available from the internet are shown below.


http://www.waterbridgesteel.com/transporter.html


https://www.jimpattison.com/2015/11/17/welcome-aboard-to-canfors-ice-breaker/


www.uglyships.com

There is a long history of the use of ice breaking vessels to supply remote mines and haul concentrate in the Canadian Arctic. Concentrate from the Voisey's Bay mine in northern Labrador is transported to smelters using the 32,000 tonne icebreaking bulk carrier Umiak 1 to carry it 1,100 nautical miles to Quebec City, where it is transferred to rail. The vessel navigates through ice that is up to five feet thick and makes twelve trips a year to haul 360,000 tonnes of nickel concentrate. A similar ice breaking bulk carrier, the Nunavik, is used to haul nickel concentrate from the Nunavik nickel mine in northern Quebec. These vessels also transport fuel and supplies to the respective mining operations. The MV Arctic has been used since 1978 to support firstly the Polaris and Nanisvik mines in the High Arctic, and is currently supporting the Raglan and Voisey's Bay mines. No incidents associated with any of these vessels are logged in the Transportation Safety Board of Canada database.

3. **Incident response procedures in open water, ice, shallow and deep water, and efficacy of response procedures.**
   Comprehensive safety and incident response plans for all operating conditions will be developed prior to ferry commissioning and operations in accordance with US Coast Guard and any other applicable regulations. It is PLP's intent to partner with experienced operators to handle lake and marine activities and PLP will ensure that comprehensive training and response planning is implemented prior to operations.

# Memorandum

**To**: Mike Rieser, Pebble Limited Partnership

**From**: Lydia Miner and Bob Klieforth

**Date**: 24 July 2018

**Subject**: Pebble Project EIS, Request for Information 052; Item 4

SLR International Corporation (SLR) has been requested to provide Pebble Limited Partnership (PLP) with information pertaining to the Request for Information (RFI) 052 which covers Incident Risk Assessment for Ice Breaking Ferry:

"Please provide an assessment of the probability of incidents, the ability to respond to incidents and the fate and transport of cargos should they be lost to the lake. Please include:

4. Fate and transport of materials should they be lost to the lake. Please include diesel fuel, concentrate, and reagents, and an assessment of how the spill materials would behave when exposed to lake water."

SLR has assessed reagents listed in Table 3-6 of the Project Description submitted to the U.S. Army Corps of Engineers in December 2017. Behaviors described below assume that the materials have escaped their primary/secondary packaging and are in direct contact with lake water. The impact of a released material to aquatic resources would directly correlate to its bioavailability to aquatic resources. Chemicals that are soluble would be available to aquatic resources for only a limited time. Insoluble chemicals would be bioavailable and have potential long term impacts if not removed from the lake.

<u>Diesel Fuel:</u> Diesel will float and quickly spread on freshwater. Small diesel spills (<5,000 gallons) typically evaporate and disperse naturally within a day or less, even in cold water (National Oceanic and Atmospheric Administration [NOAA], 2018).

If winds reach 5-7 knots or in the presence of breaking waves, diesel can be readily dispersed into the water column. Dispersed diesel may form droplets that are small enough to remain in suspension and move with the currents.

Oil dispersed in the water column can also adhere to fine-grained suspended sediments (adsorption) which then settle out and get deposited on the floor. This is more likely to occur near river mouths where fine-grained sediments are carried in by rivers (such as near the ferry terminals). It is less likely to occur in open settings (such as most of the ferry route across the lake). This process is not likely to result in measurable sediment contamination for small spills (NOAA, 2018).

Nearly all diesel spilled to water would be expected to evaporate or naturally disperse in a matter of hours; consequently, fish and aquatic resources may be exposed to released diesel but the exposure would be relatively limited in geographic extent and relatively short term. Because the bulk of diesel spilled quickly evaporates or disperses, spill response efforts typically recover a tiny fraction of the total discharged volume, even in rapid response scenarios.

Copper Concentrate: The copper concentrate would sink rapidly to the bottom of the lake, where it would remain as it is insoluble. If the concentrate were released in water deep enough to make recovery impossible, lake sediments and benthic aquatic resources may eventually be affected. If the concentrate were released in relatively shallow waters, more aquatic resources would be potentially exposed; however, the recovery of the concentrate would be more likely.

Molybdenum Concentrate: The molybdenum concentrate would sink to the bottom of the lake, where it would remain as it is relatively insoluble. If the concentrate were released in water deep enough to make recovery impossible, lake sediments and benthic aquatic resources may eventually be affected. If the concentrate were released in relatively shallow waters, more aquatic resources would be potentially exposed; however, the recovery of the concentrate would be more likely.

Anionic polyacrylamide: Shipped as pellets, anionic polyacrylamide is soluble and will sink until it dissolves. At a natural pH (>6), the polymer degrades due to hydrolysis to more than 70% in 28 days (Integra, 2016).

Calcium oxide (quick lime): Shipped as pebbles. This product would sink if released in water. Quick lime is water-reactive and leads to an exothermic reaction, forming high pH (corrosive) calcium hydroxide with much heat released before dissipating and neutralizing. During this reaction, there would be an acute hazard to adjacent aquatic resources. There are no hazardous thermal or decomposition products from the reaction (GRAYMONT, 2018).

Carboxy methyl cellulose: Shipped as pellets. This reagent is soluble and will sink. The material is inherently biodegradable. No hazardous byproducts or reactions are known to occur under typical conditions.

Methyl isobutyl carbinol: This fluid is soluble and will float. The material is readily biodegradable (IXOM, 2017).

Nitrogen: Nitrogen will be produced on site, not shipped on the ferry. Consequently no analysis is required.

Polyacrylic acid: This viscous liquid will sink, but is completely soluble (Polysciences, Inc. 2015).

Sodium ethyl xanthate: Shipped as pellets, this is relatively soluble and will sink. If discharged to waterways, the chemical would be likely to persist for at least some days before it degraded by hydrolysis. However, it is not expected to bioaccumulate in view of its ionic character (Redox Pty Ltd, 2015).

Sodium hydrogen sulfide (NaHS): Shipped as pellets, this is very soluble and will sink. The decomposition products include nitrogen oxides and sulfur oxides (Cayman Chemical Company, 2013).

Sodium silicate: Shipped as pellets, this would sink upon release. Rate of dissolution depends on the amount of water used as solvent (less soluble in large amounts of water) and temperature (less soluble in cold water) (NOAA CAMEO). This material is inorganic and not subject to biodegradation.

**References:**

Cayman Chemical Company. 2013. *Safety Data Sheet: Sodium Hydrogen Sulfide.*

GRAYMONT. 2018. *Safety Data Sheet: High Calcium Quicklime.* Version 3.

Integra. 2016. *Safety Data Sheet: Polyflox 165.* Version 16.01

IXOM, 2017. *Safety Data Sheet: Methyl Isobutyl Carbinol.* Version 6.

National Oceanic and Atmospheric Administration (NOAA). 2018. *Small Diesel Spills (500 to 5,000 gallons)*. https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/resources/small-diesel-spills.html

NOAA CAMEO. 2018 (extracted). *Chemical Datasheet: Sodium Silicate.*

Polysciences, Inc. 2015. *Safety Data Sheet: Polyacrylic Acid.*

Redox Pty Ltd. 2015. *Safety Data Sheet: Sodium Ethyl Xanthate.* Revision 2.