Appendix G.5
Marine Resources
Information Request #11, 12, 13, 15, 16 and 17
(Disposal at Sea Annex Responses)

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December 12, 2014

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Dear Ms. Ponsford:

Reference: Marine Resources Information Request #11, #12, #13, #15, #16 and #21
This letter and the attached figure respond to the request for Outstanding Information received from the Canadian Environmental Assessment (CEA) Agency on August 14, 2014.

Information Request #11

Government of Canada - Outstanding Information:
EC: *Information has been provided on sediment characterization; however, sediment plume and deposition modelling is incomplete. As such, the resulting updates to the assessment of environmental effects (including mitigation measures and a determination of significance) is incomplete. See EC's detailed comments in the document titled "Annex 1: Detailed Comments Related to Disposal at Sea " that was part of EC's July 18, 2014 submission to the Agency, for detailed comments on sediment plume and deposition modelling and provide the results of the updated modelling results based on these comments*

Information Request #12, #13, #15, #16 and #21

EC: *Please refer to Marine Resource IR #11 for outstanding information on sediment plume and deposition modelling.*

PNW LNG - Response:
The responses to the Marine Resources Information Requests #11, #12, #13, #15, #16 and #21 can be found in Table 1-1.

Closure

This letter and the attached figures provide the Outstanding Information requested by the Government of Canada. If you have any questions, please contact Pacific NorthWest LNG.

Attachments:
Figure 1: Proximity of the Brown Passage Disposal Site to Ecologically Sensitive Marine Areas
Figure 2: Daily Maximum Re-suspension (in mm) over the Model Domain during Disposal of Dredgeate from the Materials Offloading Facility (MOF) at Brown Passage, as previously modelled in Appendix O of the EIS/Application (model outputs captured every 24 hours).

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Follow-up Report on Sediment and Water Quality Associated with Construction of the Terminal Berth Area - Introduction				
1	1	However, if other alternative disposal locations are identified and carried forward through the permit process, these would be subject to extensive study during project permitting. Any new disposal site would require extensive study to characterize habitat, sediment chemistry, fish presence, and fisheries in the area.	• All potential management option(s) for the dredged material (including alternative disposal at sea locations and proposals for beneficial use) will need to be finalized as part of the EA review in order that the site-specific effects related to these options can be adequately assessed.	Dredging of a marine terminal berth area will no longer be required for project construction, resulting in a substantial decrease in the amount of dredged sediment to be disposed of. Although dredging of the materials offloading facility (MOF) will still be required, advancements in engineering design have resulted in a refined estimate of less than 200,000 m^3 of sediment to be dredged (in comparison to the 615,000 m^3 originally cited in the EIS). As a result, alternatives to the previously-used ocean disposal site at Brown Passage are no longer under consideration. A permit will be sought under the *Canadian Environmental Protection Act* for all dredged sediment from the MOF to be disposed of at Brown Passage.
5.1.1	11	Change in sediment or water quality – "Due to the conservative methods by which they are derived (use of large safety factors, mix of toxicity endpoints in laboratory tests) and their generic nature, the guidelines, particularly the ISQGs, do not define levels at which adverse effects could occur".	• This statement is not entirely accurate. ISQGs are based on the National Status and Trends Program (NSTP) which compiles information from North American field-collected sediment into a database (the Biological Effects Database for Sediments; BEDS). The ISQGs represent a Threshold Effects Level (TEL) that represents the concentration below which adverse biological effects are expected to occur rarely (fewer than 25% adverse effects occur below the TEL).	CCME provides environmental quality guidelines as levels of chemicals, below which there is a negligible risk to biota (CCME 2001). Canadian water quality guidelines are derived directly from results of studies through which a chemical was added to water, an organism was exposed to the solution, and a toxicity threshold for an adverse effect was determined. Safety factors are then applied to this threshold value to account for various uncertainties, including factors such as variability among individuals within a species and variability among species. Due to the range of endpoints assessed through toxicity testing, as well as the application of safety factors to the lowest threshold concentration value, the resulting guidelines are conservative in nature. Ideally, sediment quality guidelines would be derived in a similar way to the water quality guidelines; however, to date, spiked-sediment toxicity data are limited. Interim sediment quality guidelines (ISQGs) are based on associative data, obtained when levels of a chemical in field-collected sediments (which may contain a mixture of other chemical contaminants) are associated with any adverse biological effect observed. Because correlation does not necessarily infer causation, the contaminant present in excess of the guideline value may not be responsible for the associated adverse effects, and thus the ISQG values may not necessarily accurately reflect the level above which adverse effects may occur (Smith et al. 1996). Canadian Council of Ministers of the Environment. 2001. Introduction. Updated. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg. Smith, S.L., MacDonald, D.D., Keenleyside, K.A., Ingersoll, C.G., and L.J. Field. 1996. A preliminary evaluation of sediment quality assessment values for freshwater ecosystems. J. Gt. Lakes. Res. 22: 624-638.
5.1.1	12	Change in sediment or water quality – "Project effects on water quality were also assessed by modelling the sediment plume that could result from continuous days of dredging at the marine terminal berth area and comparing results to CCME WQG [Water Quality Guidelines] for TSS that pertain to chronic effects on marine biota."	• The modelling does not fully assess the result from continuous dredging throughout the duration of the Project (21 months), nor does it look at the combined effects of concurrent dredging at the marine terminal and the MOF. The dredging model (Appendix B) is limited to examining the sediment plume related to two distinct 30 day periods of dredging and does not model the full 639-day dredging period. See additional comments under the review of Appendix B and Appendix C dispersion modelling.	Dredging of a marine terminal berth area will no longer be required for project construction. Following discussions with Environment Canada on Sept 12, 2014 with this updated engineering design change in mind, it is PNW LNG's understanding that this Information Request is no longer relevant.
5.1.1	12	Change in sediment or water quality – "For activities of 24 hours or less, such as the disposal events, the WQG is an increase in TSS of no more than 25 mg/L above background during clear conditions."	• CCME WQGs for suspended sediment in the marine environment (clear flow) is defined in two parts; 1) Short-term exposure - a maximum increase of 25 mg/L (e.g., 24-hr period), and 2) Longer term exposure – a maximum average increase of 5 mg/L (e.g., inputs lasting between 24-hr and 30 days). The Project, as presented in the EIS, represents the disposal of 7,300,000 m^3 of material from the marine terminal and an additional 615,000 m^3 of material from the MOF. Use of the short-term CCME WQGs for suspended sediment are not appropriate for the following reasons: – The disposal activity is proposed for 639 consecutive days – The shortest duration between any two barge loads of disposal is 12 hrs and 36 mins. – The model results are limited to 30-day periods of disposal activity followed by 30 days of settlement and do not adequately capture the continuous and cumulative nature of disposal activities over the project duration. – The model accounts for the disposal of only 34.7 % of the total volume of material from the marine terminal – The model does consider the combined effects of concurrent disposal of marine terminal sediment and MOF sediment	Given that dredging of a marine terminal berth area will no longer be required for project construction, only the disposal of dredged sediment from the materials offloading facility (MOF) remains relevant to the assessment of environmental effects related to dredging of marine sediment. Recent project design changes, as described in the EIS Addendum, have further refined the estimated amount of rock and sediment in the MOF area, with a corresponding decrease to < 200,000 m^3 of sediment to be dredged from this area. A permit will be sought under the *Canadian Environmental Protection Act* to dispose of this material at the previously used Brown Passage ocean disposal site. The interval between disposal events is expected to remain at 18 hours, and the overall duration of blasting, dredging, and disposal activities will occur over a 6 month period. The disposal method will consist of dumping at or near the centre point of the disposal site to minimize effects to water quality outside the disposal site radius, recognizing that a Disposal at Sea permit would allow for water quality guideline exceedances within the 1 nm radius of the Brown Passage disposal site. Both the short term (25 mg/L) and long term (5 mg/L) water quality guidelines are being used to evaluate modelling results for TSS at the MOF dredge site and Brown Passage disposal site.

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5.1.1 (cont'd)	12 (cont'd)	Change in sediment or water quality – "For activities of 24 hours or less, such as the disposal events, the WQG is an increase in TSS of no more than 25 mg/L above background during clear conditions." (cont'd)	– The model results indicate that TSS levels in Brown Passage do not drop below 25 mg/L at all depths until 11.8 hrs after disposal and remain 8 mg/L above baseline 3 days after disposal (Appendix C, p. 19) – Based on the Input values used in the model, the following frequency of disposal is proposed: o From Jan 2015 to June 2015 (6 months) - disposal activities are scheduled to occur 4.09 times /day (2.76 times /day for marine terminal sediment + 1.33 times /day for disposal of MOF sediment). o For Jul/Aug 2015 and Jul/Aug 2016 (4 months), disposal activities are scheduled to occur 4.69 times /day (1.93 trips per day with TSHD + 2.76 trips /day BHD). o For Sept 2015 to June 2016 (10 months), disposal activities are scheduled to occur 1.93 times /day o For Sept 2016 (1 month), disposal activities are scheduled to occur 1.93 times /day	With this context in mind, the discussion of effects to water quality from the disposal of dredged material, as discussed in Section 13.5.2 of the EIS, is re-visited in relation to the CCME and BC WQG of 5 mg/L above background for longer-term exposure activities lasting greater than 24 hours. Sediment plume modelling, as described in Appendix O of the EIS, predicts that TSS levels would be highest (1,103 mg/L above background) in deep waters (180 m) immediately following the release of sediment from a disposal barge. This initial high value decreases quickly due to sediment settling and dilution. Maximum TSS values are concentrated at the disposal site, with concentrations 3 km from the site in any direction falling below both the 5 mg/L and 25 mg/L above background water quality guideline (maximum values of 1.7, 2.5, and 4.3 mg/L above background at 0, 6 and 12 hours after a disposal event, respectively, as the plume drifts toward the 3 km radius). Model results further predict a decrease in TSS values toward the surface, with near-surface TSS generally less than 2.0 mg/L above background during disposal activities. Six hours after disposal, the minimum depth with TSS values greater than 25 mg/L is predicted to be 150 m, while the minimum depth with TSS values greater than 5 mg/L is 37 m. After 12 hours, maximum TSS values at all depths and for the entire domain are 10.6 mg/L, and drop below 5 mg/L throughout the model domain after three days as suspended sediment settles out of the water column and is further diluted. Exceedances of the 5 mg/L WQG within the Brown Passage disposal site will persist for three days, by which time another barge load of sediment will have arrived; as such, it is likely that the 5 mg/L WQG will be exceeded at some point in the water column within the disposal site for the duration of dredging operations. However, TSS values will be greatest in deeper waters, rather than shallower depths most important for biological productivity (surface to 100 m). As described in the Follow-up Report on Sediment and Water Quality Associated with Construction of the Terminal Berth Area, benthic-dwelling organisms such as dungeness crab, bivalve molluscs, and halibut are less sensitive to elevated TSS levels, as they live and forage just above the seafloor where sediment is easily disturbed.
5.2.1	15	Potential Effects – "It is not anticipated that the dredging of the MOF and marine terminal area will be conducted concurrently."	The information submitted in support of the EIS, including the sediment dispersion modelling, suggests that these activities would overlap in time and space from January 2015 to June 2015. Please clarify when these different dredging activities would take place.	Dredging of a marine terminal berth area will no longer be required for project construction. Following discussions with Environment Canada on Sept 12, 2014 with this updated engineering design change in mind, it is PNW LNG's understanding that this Information Request is no longer relevant.
5.2.1	16	Potential Effects – "Details relevant to maintenance dredging, including predicted infilling rates and associated dredge volumes, management option, and equipment to be used, will be determined when more engineering information for the Project is available."	• Anticipated maintenance dredging volumes, frequencies, and infilling rates will need to be finalized as part of the EA review in order that effects related to these activities can be assessed.	No need for regular or cyclical maintenance dredging in the Materials Offloading Facility (MOF) has been identified. Modelling results indicate that sediment deposition of 0 to about 5 cm/year will occur, with a small area (< 100 m^2) at the northern shore of the MOF having the maximum sedimentation rates (Appendix G. 19). Sedimentation in this area would not affect navigability in the MOF.
5.2.1.1	16	Total Suspended Solids	• Comment – Please see the comments below that specifically relate to Appendix B and Appendix C results.	Refer to comments that follow that specifically relate to Appendix B and Appendix C results.
5.2.1.2	21	Dispersal of contaminants from sediment (p. 21) – "… the surface sediment, which has the highest PCDD/F concentrations, will be removed and disposed of early in the dredging program and the deeper sediment, which does not contain PCDD/Fs, will be deposited later, effectively covering the earlier deposits".	• Sequential disposal may have some mitigating effects; however given the depths at the disposal site and size of the site, complete covering is unlikely.	Dredged sediment from the materials offloading facility (MOF) will be disposed of within the boundaries of the previously used Brown Passage disposal site, at or near the center point of this site, to minimize effects on water quality outside the disposal site radius. The sediment dispersion modelling that was conducted for material from the MOF dredge area (Appendix O of the EIS) simulated disposal at this center point. While sequential disposal in approximately the same location at the center of the disposal site is likely to bury surface sediment that is dredged first with deeper sediment that is subsequently dredged, this is not proposed as a capping technique. Dioxins and furans were detected in the top 1.0 m of sediment analyzed from the MOF dredge area, but all values were well below the Environment Canada Lower Action Limit concentration of 9.0 pg/g TEQ (maximum measured concentration 2.64 pg/g TEQ). Furthermore, the volume-weighted concentration of dioxins and furans for the entire MOF dredge volume is 0.22 pg/g TEQ, well below the Overall Management Objective of 0.85 pg/g TEQ proposed by Environment Canada for non-dispersive sites. As such, additional measures to mitigate risk posed by contaminants in sediment, such as strategic placement of sediment horizons, are not deemed to be necessary during disposal of dredged material from the MOF at Brown Passage.
5.2.2	21	Mitigation (p. 21) – "TSS and turbidity will be monitored during in-water construction activities (e.g., shoreline infilling, pile installation, blasting, dredging, and ocean disposal)".	• Please confirm if it is the intention of the proponent to conduct TSS monitoring at the disposal site.	Turbidity will be monitored in real-time during dredging and disposal activities, for which a calibration curve will be developed to infer TSS from turbidity for comparison against water quality guidelines. Brown Passage is a deep site (approximately 200 m deep), and dispersion modelling results predict high TSS values at depth following disposal, not at the surface of the water column. Furthermore, this disposal site is relatively far from shoreline habitats (over 3 km from the closest small island, south of Melville Island). The disposal site is also approximately 9 km from the closest documented potential biogenic sponge reef in Chatham Sound (see Figure 1), as delineated during benthic habitat mapping conducted for the Prince Rupert Gas Transmission Project (2014), and even further from the sponge reefs documented by the Westcoast Connector Gas Transmission Project through geophysical survey and subsequent inspection by remotely-operated vehicle [ROV] in Archipelago Marine Research Ltd. (2014). The edge of the 1 mm sediment deposition contour (see Figure 1) is more than 3,700 m from the closest documented potential biogenic sponge reef. As such, turbidity monitoring during disposal at the Brown Passage site will be done at the edge of the disposal site and up to

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				3 km down current of the site following a disposal event, with a focus on monitoring of long-distance effects of TSS dispersion from the site (e.g., effects on seaweed and shellfish harvesting areas). Samples will be collected within the reasonably accessible portion of the water column (e.g., surface 100 m). If turbidity levels are higher than inferred by the predicted TSS levels, the rate of disposal will be slowed. Detailed plans, procedures, and practices for water quality monitoring during dredging and disposal will be developed through consultations with regulators, Aboriginal groups, and other stakeholders during the permitting phase of the Project, in particular for the Disposal at Sea application. Archipelago Marine Research Ltd. 2014. Westcoast Connector Gas Transmission Project: Marine Environmental Technical Data Report (Appendix 2-F). April 2014. Available at http://a100.gov.bc.ca/appsdata/epic/html/deploy/epic_document_385_37541.html, accessed July 31, 2014. Prince Rupert Gas Transmission Project. 2014. Application for an Environmental Assessment Certificate, Appendix L: Marine Resources (prepared for TransCanada). May 2014. Available at http://a100.gov.bc.ca/appsdata/epic/documents/p403/d37577/1400257882176_91a9c2af426732cc56d7ad11cd44aad6abed74a8336d6fc9fe271f21951c411d.pdf, accessed September 26, 2014.
5.2.2 (cont'd)	21 (cont'd)	Mitigation (p. 21) – "TSS and turbidity will be monitored during in-water construction activities (e.g., shoreline infilling, pile installation, blasting, dredging, and ocean disposal)". (cont'd)		A final determination of how monitoring will be implemented during disposal will occur through consultations with regulators, Aboriginal groups and other stakeholders. Archipelago Marine Research Ltd. 2014. Westcoast Connector Gas Transmission Project: Marine Environmental Technical Data Report (Appendix 2-F). April 2014. Available athttp://a100.gov.bc.ca/appsdata/epic/html/deploy/epic_document_385_37541.html, accessed July 31, 2014. Prince Rupert Gas Transmission Project. 2014. Application for an Environmental Assessment Certificate, Appendix L: Marine Resources (prepared for TransCanada). May 2014. Available at http://a100.gov.bc.ca/appsdata/epic/documents/p403/d37577/1400257882176_91a9c2af426732cc56d7ad11cd44aad6abed74a8336d6fc9fe271f21951c411d.pdf, accessed September 26, 2014.
5.2.2/5.2.3.1	21	"Silt curtains will be used at the dredge site, where feasible (success depends on weather and current conditions at any given time)"; Section 5.2.3.1 – Total suspended solids (p. 22) – "The residual effects on TSS levels associated with dredging at the marine terminal berth area on water and sediment quality will be less than predicted for the unmitigated effects described in Section 5.2.1, given that silt curtains will be used as often as feasible".	• It is unclear why silt curtains are included as a mitigation measure at the marine terminal when it is has been acknowledged by the proponent that silt curtain use at the marine terminal would not be feasible, and may only be feasible at the inner MOF. References to the use of silt curtains as a mitigation measure at the marine terminal should be removed and residual effects updated accordingly.	As construction of the marine terminal berth area will no longer require dredging, the consideration of use of silt curtains as a mitigation measure at this site is no longer necessary. An assessment of the residual effects to water quality associated with the construction of the new marine terminal berth design has been included in the EIS Addendum.
5.2.2	21	"At the disposal site, sediment will be disposed in an area (within the disposal area) distant from the area used on the previous trip; to reduce overlapping TSS plumes when there are multiple trips per day."	• This mitigation measure appears impractical given the effects of currents and tides on TSS plumes throughout the water column. Insufficient supporting detail is provided to demonstrate that it could be effective. Trip specific tidal and current conditions at Brown Passage would need to be taken into account for each barge load. In addition, while spreading out disposal activity geographically may contribute to lower TSS values, it would result in a correspondingly larger disposal footprint on the seafloor, thus having broader physical impacts which would need to be considered.	Dredged sediment from the materials offloading facility (MOF) will be disposed of within the boundaries of the previously used Brown Passage disposal site, at or near the center point of this site, to minimize effects on water quality outside the disposal site radius. The sediment dispersion modelling conducted for disposal of MOF dredge material (Appendix O of the EIS) was conducted simulating this center point disposal pattern, and the corresponding results (total suspended solids [TSS] plumes in the water column, and the sediment deposition area) were used to assess the effects to marine resources in the EIS. The modelling conducted for disposal of materials from the MOF considered the time between disposal events to be considerably longer (18 hours) than the interval for material from the marine berth area. Given the comparatively small volume of disposal material, and the further reduced volume for the MOF dredging (< 200,000 m^3 in comparison to the 615,000 m^3 that was modelled), the use of the center of the disposal area for each barge disposal from the MOF is a reasonable approach in terms of minimizing the area of the accumulation of sediment on the sea bed outside of the Brown Passage disposal area. The reference to disposal at a point distant from the area used on the previous trip was applicable to the modelling conducted for the marine terminal berth area, which is no longer relevant. For each barge disposal trip, random locations were selected within a 1 km diameter circle of the center of the disposal site (compared with the 1.85 km diameter for the whole disposal site). During the period when the backhoe dredger and trailing suction hopper dredger were assumed to be operating simultaneously, locations between the two different disposals were set apart (a half nautical mile away, 0.926 km) to avoid overlapping each other and to mitigate the maximum TSS levels. The two disposal locations were still selected within a 1 km diameter circle of the centre of the Brown Passage disposal site. This method was selected to mitigate potential water quality concerns and limit potential effects to a smaller area, given the large volume of sediment involved and multiple barge trips planned per day (particularly at times when there could be overlapping TSS plumes from two disposal events), along with the practical need to avoid creation of a large mound of sediment at one location on the sea floor.
5.2.3	22	"The residual effects for change in TSS and contaminant dispersal associated with dredging at the marine terminal and disposal of sediment at the Brown Passage disposal site were characterized in the EIS and the effects characterization is unchanged using site specific data	• The EIS considered only dredging and disposal activity at the MOF (615,000 m^3), which represents less than 10% of the total project volume of dredged material. Please detail how the management of 7,300,000 m^3 of dredged material and 15 months of project activity could in fact	Dredging of a marine terminal berth area will no longer be required for project construction. Following discussions with Environment Canada on Sept 12, 2014 with this updated engineering design change in mind, it is PNW LNG's understanding that this Information Request is no longer relevant.

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		from the marine terminal berth area."	change the predictions related to residual effects associated with TSS.	
5.2.3.1	23	"The residual effects of elevated TSS levels on water and sediment quality at the disposal site are considered to be moderate in magnitude, local in geographic extent, short-term and occurring as multiple regular events during construction, and reversible in an area previously used for disposal activities (expected to have high resilience)".	• Please see previous comments (#13)regarding selection of appropriate CCME WQGs for disposal activities	Refer to response to Information Request on Section 5.1.1 of the Follow-up Report on Sediment and Water Quality Associated with Construction of the Terminal Berth Area - Change in Sediment or Water Quality [second comment on PDF page 2 of Annex 1: Detailed Comments Related to Disposal at Sea].
5.3.1.2	26	"The site has been used several times since 1972 for disposal of sediment. Given this history and the types of organisms that inhabit deep water with sediment seabeds, it is likely that the habitat at the disposal site and surrounding areas of Brown Passage is resilient to some level of sediment deposition."	• The above statement may not be pertinent, as the Brown Passage disposal site has not been used for any appreciable quantity of disposal material since 1989 when 234,283 m^3 was disposed at the site. Since that time, only one permit was issued in 2007 for 2,298 m^3. As such, it can be expected that the majority of the site has largely recovered from disposal activities in the last 25 years.	The level and extent of effects on habitat and marine species at Brown Passage as a result of sediment deposition depends on the amount of sediment deposited and the existing species community. The recent marine terminal design mitigation eliminated the need for dredging of approximately 7 million m^3 of marine sediment on Agnew Bank and the associated disposal at sea of the dredged materials. Dredging and disposal at sea of a relatively low volume of sediment (approximately 200,000 m^3, reduced from 615,000 m^3 cited in the EIS) is still required for the materials offloading facility (MOF). These project changes result in a reduction in potential effects associated with sediment deposition on the marine species and habitats present at Brown Passage.
5.3.1.2 (cont'd)	26 (cont'd)	"The site has been used several times since 1972 for disposal of sediment. Given this history and the types of organisms that inhabit deep water with sediment seabeds, it is likely that the habitat at the disposal site and surrounding areas of Brown Passage is resilient to some level of sediment deposition." (cont'd)		Concern has been expressed over the limited amount of data used in the EIS to characterize the habitats and species present at Brown Passage, as many marine species and habitats are of considerable commercial, recreational and cultural value. To address these concerns, a subtidal remotely-operated vehicle (ROV) survey was conducted throughout Brown Passage in July 2014 (Stantec 2014). Twelve transects, incorporating a total of approximately 53 linear kilometres of benthic habitat, were surveyed (11 km within the disposal site and 42 km outside). Consistent with the assessment within the EIS, the area was dominated by soft bottom substrates with minimal rocky outcrops, and no observed marine plants. The ROV survey also provided additional details on the benthic fauna present within the proposed Brown Passage disposal site and general area. Ratfish and pricklebacks were the most commonly observed fish species. Low densities of rockfish were observed in all surveyed areas (average density for all areas and all species of 0.5 individuals/100 m), with only a single silvergrey rockfish and a single tiger rockfish observed within the disposal site, neither of which are listed under the Species at Risk Act (SARA) or by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Furthermore, no large rocky outcrops (the preferred habitat for rockfish) were observed at the disposal site. Halibut were observed in low numbers (0.04 to 0.71 individuals/100 m) throughout Brown Passage, while eulachon were observed only south of the previously used disposal site. Fish species observed within the Brown Passage disposal site radius are expected to exhibit localized short term avoidance of the area during disposal events. The most frequently observed invertebrates were various species of sea stars, pandalus shrimp and scallops. Shrimp may have more sensitive thresholds to sediment deposition, with deposition layers less than 2 cm thick having potential adverse effects on this species. However, shrimp have also been shown to have rapid recolonization rates from surrounding areas (Norkko et al. 1999 in Nicholls 2009). While pandalus shrimp were considered highly abundant during the ROV survey conducted by Environment Canada (2011) at the Brown Passage disposal site, they were not present in high densities within the disposal site in this 2014 survey (average of 3 individuals/100 m). While Brown Passage falls within an area identified by Fisheries and Oceans Canada (2009) as being an important dungeness crab area, no dungeness crab were observed on any of the transects surveyed in 2014. The disposal area, at 200 m depth, is not considered to be important habitat for dungeness crab. Sponges could also be affected by low rates of sedimentation. Cloud sponges were observed throughout the survey area as developing individual sponges, but with no dense reef forming structures observed. Some individuals showed evidence of sedimentation or poor health and occasional dead sponges observed. Within the boundary of the proposed Brown Passage disposal site, cloud sponge structures, present as single, non-reefing individuals, were observed at an average density of 12 individuals/100 m. Sponge density was greatest in the area outside the depositional site but within the modelled deposition area (25 individuals/100 m), particularly to the west of the proposed disposal site. The closest known reef structures are approximately 9 km northeast of the proposed Disposal Site (PRGT 2014).
5.3.1.2 (cont'd)	26 (cont'd)	"The site has been used several times since 1972 for disposal of sediment. Given this history and the types of organisms that inhabit deep water with sediment seabeds, it is likely that the habitat at the disposal site and surrounding areas of Brown Passage is resilient to some level of sediment deposition." (cont'd)		Other sponge species, including sharp lipped boot sponge, were found in low numbers throughout the surveyed Brown Passage area. The habitat types and species observed at the Brown Passage disposal site during the ROV survey were similar to those present in other areas of Brown Passage and Chatham Sound, indicating resilience to and recolonization after previous disposal at sea events. In addition, the habitats observed were common within the area and do not represent unique or rare habitat features. As a result, potential residual effects on marine fish and fish habitat (including sensitive species), are predicted to be temporary and localized. Species and habitats are considered to be resilient and no significant residual effects on them are predicted, consistent with the assessment in the EIS. Environment Canada. 2011. ROV Surveys of Brown Passage. Unpublished data. Fisheries and Oceans Canada. 2009. PNCIMA Important Area. First Edition Vector Digital Data. Pacific Biological Station. Available at: http://www.pac.dfo-mpo.gc.ca/gis-sig/maps-cartes-eng.htm. Accessed November 2013. Nicholls, P., Norkko, A., Ellis, J., Hewitt, J., and D. Bull. 2009. Short Term Behavioural Responses of Selected Benthic Invertebrates Inhabiting Muddy Habitats to Burial by Terrestrial Clay. Prepared by NIWA for Auckland Regional Council. Auckland Regional Council Technical Report 2009/116.

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				Prince Rupert Gas Transmission Project (PRGT). 2014. Application for an Environmental Assessment Certificate, Appendix L: Marine Resources (prepared for TransCanada). May 2014. Stantec Consulting Ltd. 2014. Brown Passage Subtidal Survey. Prepared for Pacific NorthWest LNG. October 2014.
Appendix B- Sediment Modelling for Pacific NorthWest LNG Project: Sediment Modelling of Dredging at Agnew Bank				
		The model does not account for the effects of continuous dredging operations as identified in the EIS. The model considers two discrete 30-day periods (Aug 2015 and Feb 2016) where dredging activity takes place. Modelling for the other 19 months of dredging is not provided. As such, the cumulative effects from 639 days of continuous dredging (as identified in the EIS) do not appear to be considered nor addressed in the modelling.	• Please provide the rationale for not conducting the modelling for the dredging of the marine terminal as a continuous event. The modelling for the MOF that was submitted in support of the EIS considered consecutive 30-day runs with no settlement period so it is unclear why a different approach was taken for the marine terminal modelling. The models should be updated to reflect the continuous nature of proposed dredging operations at the marine terminal.	Dredging of the marine terminal berth area will no longer be required for project construction. Following discussions with Environment Canada on Sept 12, 2014 about the project design mitigation, it is PNW LNG's understanding that this Information Request is no longer relevant.
		The EIS identifies dredging at the MOF facility during the Jan 2015 – Jun 2015 timeframe. The cumulative effects from concurrent dredging at the MOF and the marine terminal are not identified as part of either the marine terminal dredge modelling or the MOF dredge modelling.	• The dredging dispersion models should be updated to reflect the concurrent dredging operations at both the marine terminal and MOF.	Dredging of the marine terminal berth area will no longer be required for project construction. Following discussions with Environment Canada on Sept 12, 2014 about the project design mitigation, it is PNW LNG's understanding that this Information Request is no longer relevant.
		The model estimates 100 mg/L of TSS for the overflow water from the THSD dredging operations. It also notes that this number is calculated as part of the 1% release rate for the THSD. In addition, the overflow sediment category is modelled as 100% clay.	• Please provide the rationale for selecting the 100 mg/L value as well as additional information on how the overflow water is dealt with in the modelling scenario. Also, please provide the rationale for using 100% clay as the particle size fraction for the overflow modelling.	Overflow for the TSHD was simulated for sediment dispersion modelling for dredging at the marine terminal berth area, which is no longer required for project construction. This overflow was estimated to contain total suspended solid concentrations of 100 mg/L (clay only) with a continuous discharge (based on 4500 m^3 each time and 3 times every 1.1 hr, as provided by the engineering team). These assumptions were chosen based on expert opinion and are considered to be conservative in nature. The TSHD is now under consideration for use at the Materials Offloading Facility (MOF). This dredge has a 1% sediment release rate (including release of turbid overflow water from the hopper). This is the same release rate applicable to the clamshell dredge, which was originally proposed and used in sediment dispersion modelling at the MOF.
		The model currently accounts for a maximum of one BHD and one THSD in operation at the marine terminal.	• Please confirm whether this modelling adequately considers the range of equipment that may be used on this project. Is there a potential that more than one of each type of dredge may be operating simultaneously? If so, what effect would this have on the modelling outcomes?	This comment appears to apply to dredging at the marine terminal berth area, which is no longer being planned. For the Materials Offloading Facility (MOF), the EIS described the use of a clamshell dredge, but no other mitigation measures. The construction equipment now being considered by contractors is a trailing suction hopper dredge (TSHD) and a backhoe dredge, and this information may change again during the tendering of the work. The TSHD will be used for initial dredging to expose rock in the MOF; this dredge has a 1% sediment release rate (including release of turbid overflow water from the hopper), the same as for a clamshell dredge. The backhoe dredge will be used to dredge up the blasted rock and sediment; this dredge has a larger sediment release rate of 3% but will be picking up a mix of rock and sediment, not pure sediment, and the overall sediment release should be similar to that presented in Appendix O of the EIS. The original modelling results remain valid in terms of the predicted TSS plumes, but they overestimate the extent and thickness of sediment deposition given the reduced volume of sediment to be dredged. These sediment deposition model results have been scaled to account for changes in the volume of sediment to be dredged and disposed at sea, and the timing during which this will occur. Considering the updated construction timing for dredging and disposal of Q4 2015 to Q1 2016 (originally modelled as January to June), previous modelling results have been limited to the winter period from January to March, which are expected to be quite similar to the fall period of October to December. Model rescaling has further accounted for a decreased volume of sediment (200,000 m^3, compared with 615,000 m^3 originally modelled). Using this approach, updated predictions of the areal distribution of total sediment deposition at the MOF dredge site (Figure 13-6) and Brown Passage disposal site (Figure 13-8) have been provided in the updated EIS document.
		There are discrepancies between the figures used for modelling at the marine terminal during dredging and modelling of disposal activity at Brown Passage. For example, during August 2015, a total of 696,000 m^3 of dredged material is modelled based on the dredging production rate at the marine terminal (based on Appendix B, Table 1 values). At the Brown Passage disposal site, during the same period, a total of 564,324 m^3 is modelled for disposal (based on Appendix C, Table 1 values).	• Please explain the rationale for the discrepancy between the uses of different figures in the modelling at the load site vs. modelling at the disposal site. Based on the dredging production rate provided in Table 1, dredging of 7,300,000 m^3 would be completed in 16 months, not the 21 months proposed.	Dredging of the marine terminal berth area will no longer be required for project construction. Following discussions with Environment Canada on Sept 12, 2014 about the project design mitigation, it is PNW LNG's understanding that this Information Request is no longer relevant.
		Table 1 in Appendix B identifies the overflow release from THSD dredging as 12,273 m^3 per hour. Values from the same table can be used to approximate daily production from the THSD as 16,333 m^3. This equates to 75% of the material being released based on the values provided in the table.	• Please clarify whether or not the overflow value reflects the quantity of sediment released or if it reflects the quantity of water entrained with sediment released from the THSD overflow. If it is the latter, will this release be continuous or discrete?	Dredging of the marine terminal berth area will no longer be required for project construction. Following discussions with Environment Canada on Sept 12, 2014 about the project design mitigation, it is PNW LNG's understanding that this Information Request is no longer relevant.
		The dispersion modelling conducted for the dredging operations considers releases from one stationary point source for each type of dredge equipment.	• Would the continuous movement of equipment have a significant effect on TSS values?	Dredging of the marine terminal berth area will no longer be required for project construction. Following discussions with Environment Canada on Sept 12, 2014 about the project design mitigation, it is PNW LNG's understanding that this Information Request is no longer relevant.

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	20	Indicates that a qualitative estimate of the final deposition was completed. It also indicates that the final deposition is very conservative "since large productivities (the dredge would complete in a period shorter than 21 months) were used in the model simulation".	• Figure 8 is described as a 'qualitative estimate'. Please describe the methodology for deriving the qualitative estimate and whether it takes into account the 21-month period of continuous dredging.	This was a typographical error. The correct statement should refer to a "quantitative" estimate. Dredging of the marine terminal berth area will no longer be required for project construction. Following discussions with Environment Canada on Sept 12, 2014 about the project design mitigation, it is PNW LNG's understanding that this Information Request is no longer relevant.
	20	Indicates that a qualitative estimate of the final deposition was completed. It also indicates that the final deposition is very conservative "since large productivities (the dredge would complete in a period shorter than 21 months) were used in the model simulation".	• Please confirm whether the rate of dredging production used in the model correctly describes anticipated project activities. If this rate is correct, then please identify why the dispersion modelling used for disposal activities does not reflect this shorter time scale and higher rate of disposal.	Dredging of the marine terminal berth area will no longer be required for project construction. Following discussions with Environment Canada on Sept 12, 2014 about the project design mitigation, it is PNW LNG's understanding that this Information Request is no longer relevant.
Appendix C- Additional Sediment Modelling for Pacific NorthWest LNG Project (Task 2) Sediment Modelling of Disposal of Dredgate (sic.) from the Marine Terminal Berth Area at Brown Passage				
		States that the total volume used for the sediment input parameters is 7,300,000 m^3; however, when examining the model it is apparent that the model is divided into 7 separate modelling events, or runs. Each model run is a two-month period but only accounts for disposal activities during the first 30-days, followed by a 30-day settlement period post-disposal. A 30-day period is then skipped/omitted before the next two month modelling period starts. For example, the first modelling run starts on Feb 1, 2015 and considers disposal activity for 30 days followed by a 30-day period of settlement during March 2015. April 2015 is not accounted for and the next modelling run starts on May 1, 2015. The same approach is followed for each of the 7 modelling runs. As such, the modelling only accounts for 7 discontinuous months of disposal activity, not the 21 months of continuous disposal activity presented in the EIS.	• Please provide the rationale for not conducting the modelling as a continuous event accounting for the total disposal volume presented in the EIS. This differs from the approach used in the MOF disposal site dispersion modelling (Appendix O of the EIS) which considered consecutive 30-day runs with no settlement period. The model requires updating to reflect the continuous nature of disposal activities at Brown Passage, as well as the total volume of disposal material for the Project.	Dredging of the marine terminal berth area will no longer be required for project construction. Following discussions with Environment Canada on Sept 12, 2014 about the project design mitigation, it is PNW LNG's understanding that this Information Request is no longer relevant.
		(continued from previous) Effectively this means that there are 14 months where disposal activity has not been modelled. This would equate to the dispersion modelling only accounting for 2,531,880 m^3 of material, or 34.7% of the total project volume (calculations based on Table 1 values). This is inconsistent with both the magnitude and continuous nature of disposal events as proposed in the EIS.		
		States that the total volume used for the sediment input parameters is 7,300,000 m^3; however, when examining the model it is apparent that the model is divided into 7 separate modelling events, or runs. Each model run is a two-month period but only accounts for disposal activities during the first 30-days, followed by a 30-day settlement period post-disposal. A 30-day period is then skipped/omitted before the next two month modelling period starts. For example, the first modelling run starts on Feb 1, 2015 and considers disposal activity for 30 days followed by a 30-day period of settlement during March 2015. April 2015 is not accounted for and the next modelling run starts on May 1, 2015. The same approach is followed for each of the 7 modelling runs. As such, the modelling only accounts for 7 discontinuous months of disposal activity, not the 21 months of continuous disposal activity presented in the EIS. Effectively this means that there are 14 months where disposal activity has not been modelled. This would equate to the dispersion modelling only accounting for 2,531,880 m^3 of material, or 34.7% of the total project volume (calculations based on Table 1 values). This is inconsistent with both the magnitude and continuous nature of disposal events as proposed in the EIS.	• Does the model account for the cumulative effects of individual disposal events (i.e., is the residual suspension from consecutive barge loads (multiple dump fate) captured in the model?)	Dredging of the marine terminal berth area will no longer be required for project construction. Following discussions with Environment Canada on Sept 12, 2014 about the project design mitigation, it is PNW LNG's understanding that this Information Request is no longer relevant.
2.1		Random locations were selected for each barge disposal within a 1km diameter circle at the Brown Passage dumping center".	• Please explain this further as it is not apparent how the selection of random locations was applied in the modelling or whether it has been	Dredging of the marine terminal berth area will no longer be required for project construction. Following discussions with Environment Canada on Sept 12, 2014 about the project design mitigation, it is PNW LNG's understanding that this Information Request is no longer

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			applied in the Figures identifying TSS plumes or on Figure 37.	relevant. Dredged sediment from the materials offloading facility (MOF) will be disposed of within the boundaries of the previously used Brown Passage disposal site, at or near the center point of this site, to minimize effects on water quality outside the disposal site radius.
2.1		Random locations were selected for each barge disposal within a 1km diameter circle at the Brown Passage dumping center".	• The more widespread the release zone, the larger the corresponding footprint on the seafloor. Does Figure 37, showing total bottom accumulation, account for this?	Refer to response to Information Request on Section 5.2.2 of the Follow-up Report on Sediment and Water Quality Associated with Construction of the Terminal Berth Area - Mitigation [PDF page 4 of Annex 1: Detailed Comments Related to Disposal at Sea]. This response refers to differences in modelling conducted for disposal of dredged material from the marine terminal berth area in comparison to that from the Materials Offloading Facility (MOF). Dredged sediment from the MOF will be disposed of within the boundaries of the previously used Brown Passage disposal site, at or near the center point of this site, in order to minimize effects on water quality outside the disposal site radius. The sediment dispersion modelling that was conducted previously for material to be dredged from the MOF (Appendix O of the EIS) was conducted simulating this center point disposal pattern. Figure 16 in Appendix O of the EIS, which displays the total bottom accumulation of sediment at Brown Passage following disposal of all material from the MOF, accounts for this center point disposal pattern. Disposal of sediment from the marine terminal berth area, which is no longer to be dredged, was modelled using a different method. For each barge disposal trip, random locations were selected within a 1 km diameter circle of the center of the Brown Passage disposal site (compared with the 1.852 km diameter of the whole disposal site). During the period when the backhoe dredger and trailing suction hopper dredger were assumed to be operating simultaneously, disposal locations for sediment from the two pieces of equipment were set apart (a half nautical mile away, 0.926 km) to avoid overlapping each other and to mitigate the maximum TSS levels. The two disposal locations were still selected within a 1 km diameter circle of the centre of the Brown Passage disposal site. Figure 37 of Appendix C of the Follow-up Report on Sediment and Water Quality Associated with Construction of the Terminal Berth Area, which displays the total bottom accumulation of sediment at Brown Passage following disposal of all material from the marine terminal berth area, accounts for this randomized disposal pattern.
2.1 (cont'd)		Random locations were selected for each barge disposal within a 1km diameter circle at the Brown Passage dumping center". (cont'd)		For a very large volume of disposal of sediment materials, it is arguable that the release of materials over a larger area than the center of the disposal site would have the effects of: (a) distributing the sediment deposition with a lesser thickness but extending over a larger area, and (b) with potentially further-reaching effects on water quality (TSS levels) but at reduced levels from that which would be encountered regularly at the centre of the disposal area. This represents an alternative approach from repetitive discharges always at the same location. However, for a comparatively small volume of disposal materials, such that from the much reduced volumes for the MOF dredging, the use of the center of the disposal area for each barge disposal is a reasonable approach in terms of minimizing the area of the accumulation of disposal materials on the sea bed outside of the Brown Passage disposal area.
		The EIS identifies disposal from the MOF facility taking place at Brown Passage during the Jan 2015 – Jun 2015 timeframe. The combined effects from concurrent disposal of material from both the MOF and the marine terminal are not presented in the model.	• Please update the models to reflect the concurrent disposal operations from both the marine terminal and MOF during the Jan – Jun 2015 timeframe.	Dredging of the marine terminal berth area will no longer be required for project construction. Following discussions with Environment Canada on Sept 12, 2014 about the project design mitigation, it is PNW LNG's understanding that this Information Request is no longer relevant.
	41	"After the 30-day disposal, TSS plumes return to background conditions within 10 days at most locations, except Locations 2 and 3 (Figures 29, 30). This indicates that the residual TSS plumes propagate to the northeast and suspended sediment settles down gradually within 15 days."	• The model acknowledges that TSS levels are elevated for up to 10 days following 30 days of disposal, with suspended sediment settling down gradually within 15 days. Given the disposal operations are scheduled for a continuous 21 month period, the water quality guideline for isolated events less than 24 hours in duration is not appropriate (see previous comment #1 from Section I. 'Follow-up report', for additional rationale regarding the selection of an appropriate WQG for disposal activity,)	Dredging of the marine terminal berth area will no longer be required for project construction. Following discussions with Environment Canada on Sept 12, 2014 about the project design mitigation, it is PNW LNG's understanding that this Information Request is no longer relevant. A discussion of effects on water quality during disposal of dredged sediment from the materials offloading facility at Brown Passage in the context of the water quality guideline for continuous activity (5 mg/L above background) is provided in response to the Information Request on Section 5.1.1 of the Follow-up Report on Sediment and Water Quality Associated with Construction of the Terminal Berth Area - Change in Sediment or Water Quality [PDF page 2 of Annex 1: Detailed Comments Related to Disposal at Sea].
		Appendix B and Appendix C modelling uses 2,400 m^3 as the barge size for disposal for BHD operations. Appendix O of the EIS uses 3,000 m^3 as the barge size for clamshell disposal.	• Please explain the rationale for using different barge sizes for each of the models	The barge sizes for dredging at the materials offloading facility (MOF) and marine terminal berth area were provided by the PNW LNG engineering team and were appropriate to the types of dredge equipment proposed. The barge size modelled for dredging operations at the MOF was 3,000 m^3. Dredging at the marine terminal berth area is no longer planned.
2.4		"The total bottom accumulation 30 days following the completion of all dredging disposals is presented in Figure 37".	• Does Figure 37 consider the total volume of dredged material from both MOF and the marine terminal (615,000 m^3 + 7,300,000 m^3)? Does it include all 21 months of disposal activities or only the 7 months of disposal activity provided in the model?	Dredging of the marine terminal berth area will no longer be required for project construction. Following discussions with Environment Canada on Sept 12, 2014 about the project design mitigation, it is PNW LNG's understanding that this Information Request is no longer relevant.
2.4		"The total bottom accumulation 30 days following the completion of all dredging disposals is presented in Figure 37".	• Does Figure 37 consider random disposal locations within the disposal site or is it based on center point disposal?	Dredging of the marine terminal berth area will no longer be required for project construction. Following discussions with Environment Canada on Sept 12, 2014 about the project design mitigation, it is PNW LNG's understanding that this Information Request is no longer relevant. Dredged sediment from the materials offloading facility (MOF) will be disposed of within the boundaries of the previously used Brown Passage disposal site, at or near the center point of this site, to minimize effects on water quality outside the disposal site radius. The sediment dispersion modelling conducted for disposal of MOF dredge material (Appendix O of the EIS) was conducted simulating this center point disposal pattern, and the corresponding results (total suspended solids [TSS] plumes in the water column, and the

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				sediment deposition area) were used to assess the effects to marine resources in the EIS.
2.4		Indicates that "most of the dredged material will be deposited in the designated disposal site where water depths are greater than 150m and where the near-bottom ocean currents are relatively weak, usually less than 0.2 - 0.3 m/s".	• Please provide an indication of the source for the information on bottom currents at Brown Passage. This information is necessary for an understanding of whether the Brown Passage disposal site would be considered dispersive/non-dispersive.	Ocean current data sets at Brown Passage generated by Fisheries and Oceans Canada's Institute of Ocean Sciences were used to validate 3D ocean circulation model and sediment deposition modelling conducted for the Project. Historical current data has been collected at site CP02 (54° 18.8 N, 130°45.1 W), which is within the previously used disposal area at Brown Passage. Ocean current data collected from this site spans the months of late June 1991 to early July of 1992. Measurements at this site were taken at the near-surface (15 m depth) and at the mid to lower part of the water column (maximum 98 m depth). Calibration and verification of the ocean circulation model was conducted with model currents versus observed currents for two periods at both 15 and 98 m: Sept. 5-22, 1991 when the effects of winds was relatively weak, and October 5-22, 1991 when wind forcing was large. In both model comparisons, and at both depths, the modelled currents demonstrated reasonably good agreement with the observations. At the 98 m measurement depth, the model current speeds were modestly larger than the observed speeds (Jiang and Fissel, 2010). In Jiang and Fissel (2010), one scenario was studied using a model setup for an extreme wind event and an extreme tidal forcing over a 40 year period occurring simultaneously, such that it is believed that the model results of the velocity fields and sediment resuspension reflect a large upper bound to the actual values. Even under these extreme forcing conditions, the maximum near-bottom velocities (bottom 1% of the water column) at the Brown Passage disposal site, where water depths are greater than 150 m, range from 0.05 to 0.47 m/s with a median value of 0.24 m/s. As part of a metocean measurement program, PNW LNG deployed an acoustic Doppler current profiler (ADCP) at the Brown Passage disposal site on October 15, 2014. This program will span a six month winter period (October 2014 to April 2015), to correspond with the strongest predicted winds, and therefore highest seasonal current speeds. The ADCP will remain approximately 5 to 10 m off the ocean bottom, oriented upwards to provide current profiles over most of the water column; conductivity, temperature, and turbidity sensors; and a single point Doppler current meter at approximately 3 to 5 m off the ocean bottom and oriented down to capture near-bottom current speeds.
2.4 (cont'd)		Indicates that "most of the dredged material will be deposited in the designated disposal site where water depths are greater than 150m and where the near-bottom ocean currents are relatively weak, usually less than 0.2 - 0.3 m/s". (cont'd)		Additionally, results from previous sediment dispersion modelling conducted for the Project for disposal at Brown Passage will be analyzed to extract predicted near-bottom ocean current speeds. Both modelled and field-measured ocean current data will be compared and analyzed against the threshold for a 'dispersive site' established by Environment Canada, namely whether the peak 1% near-bottom current speeds at Brown Passage exceed 25 cm/s. Jiang, J. and D. Fissel, 2010. 3D Numerical Modeling Study of Transport and Fate of the Sediments Released during and after Disposal Operations in Brown Passage. Unpublished Report for Stantec Ltd., Burnaby B.C., by ASL Environmental Sciences Inc., Sidney, B.C., Canada, 48p.
Technical Memorandum- Marine Resources- Effects of Dredging and Disposal at Sea				
		The model addresses the short-term dispersion of material resulting from disposal activity; however, it does not examine the short-term and long-term stability of the dredged material mound subjected to local environmental forcing.	• Is modelling being conducted to examine the long-term (months/years) fate of the disposal mound? This information is necessary for an understanding of whether the Brown Passage disposal site would be considered dispersive/non-dispersive.	The modelling of resuspension of the disposal mound was included during the creation of the disposal mound and within 20 days after the completion of the disposal operations from the materials offloading facility (MOF) in the previous modelling simulations (Appendix O of the EIS). The maximum daily resuspension event during the model integration period (January 1 – June 25, 2015) was examined and is presented in Figure 2. Detectable resuspension is located in the deep channel to the northwest of the disposal site and along the 100 m isobath to the southwest. A small amount is also seen about 5 km away to the northeast at 100 m water depth. The maximum daily resuspension is 13 mm at the southwest area of bottom ridges where dispersion would be expected to be more prevalent. Given the very limited areas where erosion is predicted to occur, none of which are within the previously used disposal area, and the small amount of erosion associated with the weak bottom currents, it is not anticipated that resuspension of the disposal mound would amount to appreciable volumes. In order to investigate the potential for long-term resuspension of discharged sediments onto the seabed, the simulation of two extreme model scenarios were carried out in Jiang and Fissel (2010). One scenario involved an extreme wind event and an extreme tidal forcing over a 40 year period which occur simultaneously, and the other involved the extreme tidal forcing condition only. Both scenario cases were simulated for the discharged sediment resuspension over a 10 day period. It is believed that the model results of the sediment resuspension for the first scenario reflect a large upper bound to the actual values of the likely maximum potential resuspension of the discharged sediments on the seabed over a 40 year period, while the model results for the second scenario likely represent a close lower bound to the actual levels of potential resuspension. The model results for these two extreme scenarios show that strong near-bottom velocities, exceeding the critical resuspension velocity for fine-grained sediments (clay, silt and fine sand), only occur in relatively shallower areas where water depths are less than about 100 m. It was also found that the maximum near-bottom TSS values over the 10 day model period are less than 13 – 15 mg/L above background. Near the surface, the maximum TSS values are less than 0.1 – 0.2 mg/L above background during these 40 year maximum resuspension events. To confirm the model inputs for currents at the Brown Passage disposal site, PNW LNG is conducting a metocean measurement program and deployed an acoustic Doppler current profiler (ADCP) at this site on October 15, 2014. This program will span a six month winter period (October 2014 to April 2015), to correspond with the strongest predicted winds, and therefore highest seasonal current speeds.

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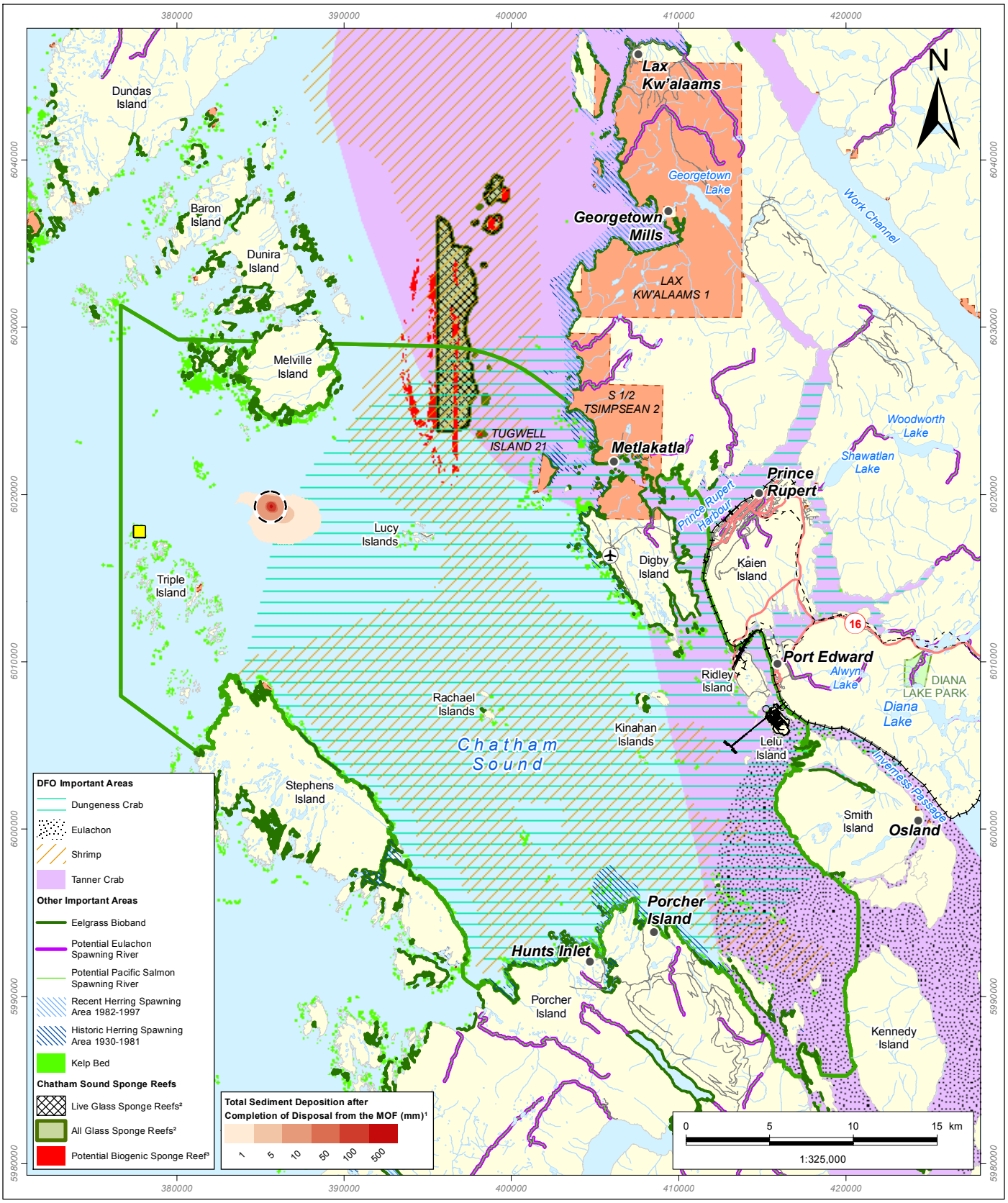
				The ADCP will remain approximately 5 to 10 m off the ocean bottom, oriented upwards to provide current profiles over most of the water column; conductivity, temperature, and turbidity sensors; and a single point Doppler current meter at approximately 3 to 5 m off the ocean bottom and oriented down to capture near-bottom current speeds. Results from this program will be used to confirm the inputs and predictions generated from the sediment dispersion modelling performed for disposal at the Brown Passage disposal site and will further inform the characterization of the site as 'dispersive' or 'non-dispersive' as per the Environment Canada definition (DSWG 1989). Jiang, J. and D. Fissel, 2010. 3D Numerical Modeling Study of Transport and Fate of the Sediments Released during and after Disposal Operations in Brown Passage. Unpublished Report for Stantec Ltd., Burnaby B.C., by ASL Environmental Sciences Inc., Sidney, B.C., Canada, 48p. Disposal Site Work Group [DSWG]. 1989. Disposal Site Selection Technical Appendix – Phase II, Unconfined Open-water Disposal Sites for Dredged Material in South and North Puget Sound. Accessed at http://www.dtic.mil/dtic/tr/fulltext/u2/a213371.pdf on August 13, 2014.
3.1	2	TSS water quality guidelines used to assess effects of dredging and disposal at sea (p. 2) – "This use of the two WQGs is considered appropriate and TSS trends are described on page 13-31 of the EIS"	• This section of the EIS is based on incomplete information for TSS values related to the MOF only (<10% of the total dredged volume). See previous comments from Section I. 'Follow-up report', for additional rationale regarding the selection of an appropriate WQG for disposal activity.	Dredging of a marine terminal berth area will no longer be required for project construction. A discussion of effects on water quality during disposal of dredged sediment from the materials offloading facility at Brown Passage in the context of the water quality guideline for continuous activity (5 mg/L above background) is provided in response to the Information Request on Section 5.1.1 of the Follow-up Report on Sediment and Water Quality Associated with Construction of the Terminal Berth Area - Change in Sediment or Water Quality [Adobe page 2 of Annex 1: Detailed Comments Related to Disposal at Sea].
3.1		TSS water quality guidelines used to assess effects of dredging and disposal at sea (p. 3) – "At the 1 nautical mile diameter disposal site, there will be up to seven disposal events per day of sediment from the marine terminal berth area".	• This is inconsistent with the input information in the model. According to the model, the maximum number of disposals per day would be during Jul/Aug 2015 and Jul/Aug 2016 (4 month period), when disposal activities are scheduled to occur 4.69 times /day (1.93 trips per day with TSHD + 2.76 trips /day BHD). Please clarify whether or not the above statement is correct.	Dredging of the marine terminal berth area will no longer be required for project construction. Following discussions with Environment Canada on Sept 12, 2014 about the project design mitigation, it is PNW LNG's understanding that this Information Request is no longer relevant.
3.6		Use of dredge sediment in fish habitat offsetting strategies – "Given that sediment from the MOF and marine terminal berth dredge area is deemed eligible for disposal at sea, this sediment would also be appropriate for beneficial re-use in fish habitat offsetting strategies, described in greater detail in Appendix K of the EIS."	• Please note that EC has not yet completed its technical review of the document entitled "Follow-Up Technical Data Report – Marine Sediment and Water Quality at the Marine Terminal Berth Dredge Area". However, at this point it is important to note that sediment that may be considered eligible for disposal at sea would not necessarily be appropriate for re-use in the creation of fish habitat. Contaminant levels and proximity to sensitive resources may preclude some material from being considered suitable for beneficial re-use in fish habitat offsetting.	Dredging of a marine terminal berth area will no longer be required for project construction and habitat offsetting requirements will be much less than originally anticipated. The suitability of any rocky material from the materials offloading facility for potential re-use in the creation of habitat offsetting measures will be determined in conjunction with DFO.



Airport
City or Town
Pilotage Station
Electrical Power Transmission Line
Highway
Marine Terminal Design Mitigation
Railway
Secondary Road
Watercourse
Brown Passage Disposal Site
Indian Reserve
Local and Regional Assessment Area
Protected Area
Waterbody

Notes:
1. Total bottom accumulation 20 days after completion of all dredging disposal from the MOF (as originally modelled in the EIS/Application as 615,000 m³, but scaled to the new dredge volume of 200,000 m³).
2. Approximate extent of glass sponge reefs within Chatham Sound as determined by geophysical survey and subsequent ROV inspection completed for the proposed Westcoast Connector Gas Transmission Project (Archipelago Marine Research Ltd. 2014)
3. Potential biogenic sponge reef, delineated during benthic habitat mapping completed for the proposed Prince Rupert Gas Transmission Project (PRGT) by McGregor GeoScience Limited on behalf of Stantec (PRGT 2014).

Pacific NorthWest LNG

Proximity of the Brown Passage Disposal Site to Ecologically Sensitive Marine Areas

EIS ADDENDUM

Sources: Government of British Columbia; Government of Canada, Natural Resources Canada, Centre for Topographic Information. Refer to Appendix 9 of the EIS/Application Appendix M for full citations. Archipelago Marine Research Ltd. 2014. Westcoast Connector Gas Transmission Project: Marine Environmental Technical Data Report (Appendix 2-F). April 2014. Prince Rupert Gas Transmission Project. 2014. Application for an Environmental Assessment Certificate, Appendix L: Marine Resources (prepared for TransCanada). May 2014. Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

DATE: 25-NOV-14	PROJECTION: UTM - ZONE 9
FIGURE ID: 123110537-830	DATUM: NAD 83
DRAWN BY: M. BATE	CHECKED BY: M. BREWIS

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: 1

11/25/2014 - 3:49:15 PM V:\active\123110537\gis\figures\EA_Addendum\fig_123110537_ea_add_ir_proximity_of_the_brown_passage_disposal_site_to_ecologically_sensitive_marine_areas.mxd

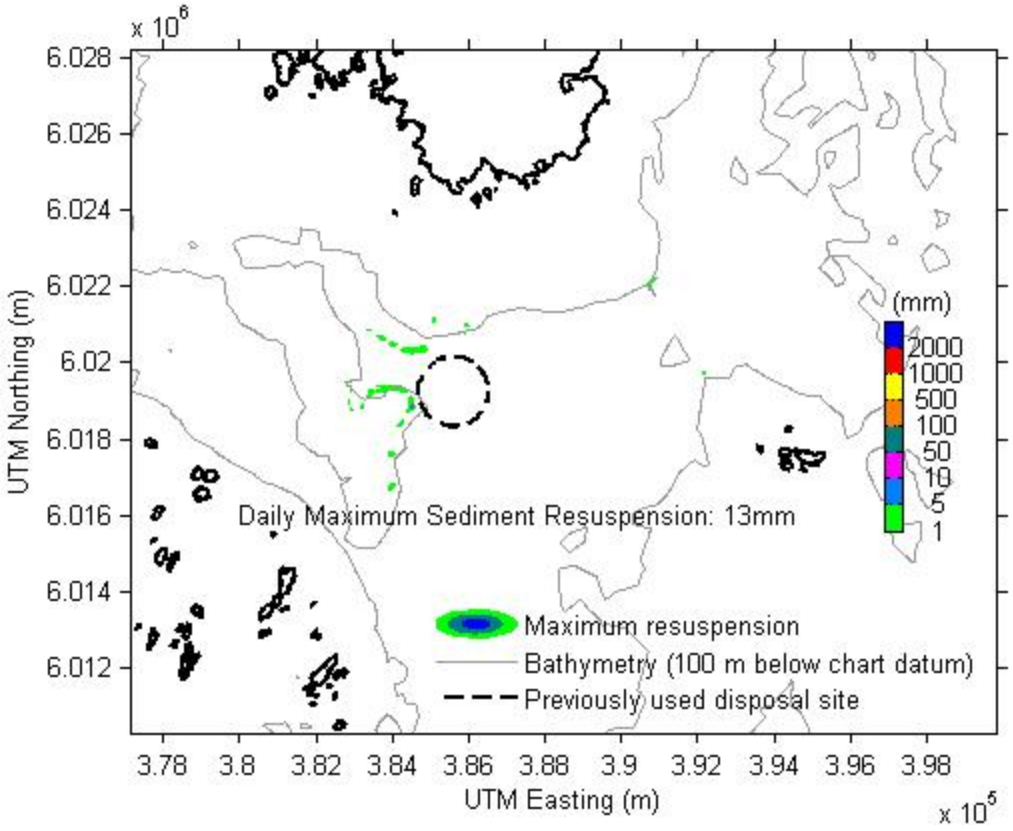


Figure 2: **Daily maximum resuspension (in mm) over the model domain during disposal of dredgeate from the Materials Offloading Facility (MOF) at Brown Passage, as previously modelled in Appendix O of the EIS/Application (model outputs captured every 24 hours).**