TECHNICAL MEMORANDUM

DATE April 8, 2015 **REFERENCE No.** 1416711-004-TM-Rev0

TO Nathan Gloag
Woodfibre LNG Limited

CC Lara Taylor

FROM Arman Kaltayev **EMAIL** Arman_Kaltayev@golder.com

WOODFIBRE LNG - RESPONSE TO INFORMATION REQUEST #583A: MARINE RESOURCES

1.0 INTRODUCTION

The purpose of this memo is to respond to Information Request (IR) number 583a, from Fisheries and Oceans Canada (DFO). This IR concerns the life history timing of marine and anadromous fish species found in the project area. Specifically, the IR states:

"*The information in the response attachment to Comment #583 provides general life history timing for marine and anadromous fish species. DFO requires location specific information with respect to species timing and utilization to assess potential residual effects. This information will assist in developing site specific project mitigation*".

As the present response to IR #583a is too large to fit in the original table format, it will be submitted as an attachment in this technical memorandum.

2.0 METHODOLOGICAL APPROACH

Fish sampling was conducted as part of the Marine Resources Baseline Study in April 2014 (spring) and June 2014 (early summer) from a number of locations within the project area and reference areas (Figure 12; Appendix 5.10-1: Marine Resources Baseline Study). Three methods of fish collection were used to estimate fish species presence: beach seine, bottom trawl and gill netting. A 5 metre (m) zodiac vessel was used to deploy each type of sampling gear. Observations of juvenile and adult fish species in freshwater streams which empty into the Forage Fish and Other Fish Local Assessment Area (LAA) were also recorded during September 2013 (late summer), April 2014 (spring) and July 2014 (early summer). Zooplankton sampling was conducted as part of the Marine Resources Baseline Study in September 2013, April 2014 and June 2014 from a total of ten stations within the project area and reference areas (Figure 9; Appendix 5.10-1: Marine Resources Baseline Study). Zooplankton sample analysis included the identification of fish larvae (ichthyoplankton) within samples.

During the spring survey, the beach seine net used was 14m in length by 2m in depth, with a total area of 28 square metres (m^2) and a mesh size of 0.3 centimetres (cm). During the summer survey, the beach seine used was 21m in length by 2m in depth, with a total area of 42m^2 and a mesh size of 0.3cm. Eleven beach seine sets were deployed in the project and reference areas and were distributed among suitable habitats between the northern and southern extents of the project area.

Bottom trawls were used to sample demersal (near bottom) and epibenthic (on bottom) fish and invertebrate communities. Trawl sampling was conducted using a 4.0 by 0.9m otter trawl with a 1.3cm mesh size for the net body and a 0.65cm mesh cod end liner. The net was released from a moving vessel and towed along the bottom for approximately three minutes at a speed of approximately 2 kilometres per hour (km/hr) (0.6 metres per second (m/s)). Trawls were conducted parallel to shore in an effort to sample along a single depth contour. A total of nine trawls were completed within the project and reference areas.

Presence of surface and mid-water migratory fishes were targeted using a monofilament gill net 45.7m in length and 3.7m in depth, with a total sample area of 169.1m^2. The gill net was composed of six 7.6m panels with the following mesh diameters: 1.3cm, 2.5cm, 3.8cm, 5cm, 7.6cm and 10cm. The gill net was set perpendicular to shore with the smallest mesh diameter panel (1.3 cm) closest to shore. A total of eleven gill net sets were surveyed within the project and reference areas.

All fish and other collected organisms were identified to the lowest practical taxonomic level (LPL) possible in the field and measured to the nearest millimeter (i.e., total length for non-salmonids; fork length for salmonids). Species identification was made with the aid of field guides (Eschmeyer et al. 1983; Lamb and Edgell 2010; Pollard et al. 1997).

Zooplankton samples were collected from a total of eight stations in the project area and two stations in the reference area using a 0.5m diameter zooplankton net with a 250 microns (µm) mesh size. The net was equipped with a plastic cod end to collect the sample. At the deeper-water stations (>10m), vertical zooplankton tows were performed. This consisted of lowering the net slowly through the water column until reaching several metres above the seabed and then pulling the net to the surface at a rate of approximately 0.5m/s. When the station depth was too shallow to conduct a vertical haul, an oblique tow was conducted. This involved lowering the net to the bottom and towing the net alongside the boat at a slow speed for a set distance.

3.0 SUMMARY OF FORAGE FISH AND OTHER FISH UTILIZATION OF LAA:

Forage fish species found during the field sampling program within the Forage Fish and Other Fish Local Assessment Area (LAA) conducted during the spring season included Pacific herring, chum salmon, pink salmon, and a variety of flatfish, sculpins and other fish species (e.g, perch, eelpouts, greenlings) (Table 1). Forage fish species found within the LAA during summer included Pacific herring, chum salmon, Dolly Varden, flatfish and other fish species (e.g., perch, greenlings, gunnels).

Pacific herring were found utilizing nearshore areas within the LAA in both spring (April) and summer (late June) and were caught with both beach seines and gill nets. This timing coincides with the herring spawning season within Howe Sound (January to May) and the larval hatching season (March to April); however, no larval herring were found in zooplankton samples collected within the LAA during the field sampling program and no herring spawn was observed within the LAA during underwater video surveys in September 2013 or June 2014. It is likely that the LAA serves as juvenile rearing habitat for Pacific herring.

Anadromous fish species were also found within the LAA during the field sampling program and within freshwater streams which empty into the LAA during freshwater fish surveys in September 2013, April 2014 and July 2013. Chum, pink and chinook salmon smolts were found in nearshore areas within the LAA during the field sampling program (Table 1). Chum salmon were found in both spring and early summer which corresponds with the timing of chum salmon smolt migration (March to June; Salo 1991); pink salmon were found only in spring which corresponds with the timing of peak pink salmon smolt migration (April to May; Neave 1966); chinook salmon were found only in early summer which corresponds with the timing of peak chinook salmon smolt migration (April to June; Healey 1980). It is possible that fish sampling during the field sampling program in April occurred just prior to the beginning of chinook smolt migration through the LAA. A single Dolly Varden specimen was also caught in a nearshore gill net in summer which corresponds with the general timing of sea-run Dolly Varden smolt migration (May to June; Scott and Crossman 1973). No evidence of nearshore or benthic habitat utilization by coho salmon, steelhead trout, or coastal cutthroat trout was observed during spring or early summer within the LAA. Adult pink salmon (September 2013), juvenile coho salmon (July 2014), juvenile coastal cutthroat trout (September 2013; April 2014; July 2014) and juvenile chinook salmon (September 2013) were observed in Mill Creek and Woodfibre Creek by Golder during freshwater fish surveys. It is likely that the LAA serves as migratory and juvenile rearing habitat for chum, pink and chinook salmon as well as Dolly Varden. The LAA may also serve as migratory habitat for coho salmon and sea-run coastal cutthroat trout which were only observed in freshwater streams but were not found within the LAA during the field sampling program. The LAA also likely serves as an adult spawning migration route in winter for chum, pink, chinook and coho salmon and sea-run coastal cutthroat trout. The LAA may serve as an adult spawning migration route for steelhead and sea-run Dolly Varden as these species have been documented near the LAA in previous studies (Cox and Peatt 1979, Peatt and Knight 1980, Whelen and Associates 1999) but were not found during the marine or freshwater field sampling programs.

No evidence of nearshore or benthic habitat utilization by eulachon, surf smelt or Pacific sand lance was observed during spring or summer within the LAA. Eulachon spawning occurs generally between January and May (Hay and McCarter 2000) though no eulachon was documented during the field sampling program in April. Surf smelt spawning has been documented between May and September (Levy 1985; Pentilla 1978) though no evidence of surf smelt spawning was observed during the field sampling program in April or June. Pacific sand lance typically spawn in the winter between November and February (Penttila 1995) which was outside of the timing of the field sampling program; however, no evidence of juvenile or larval Pacific sand lance was found within the LAA and the nearest documented spawning area is 30km to the southwest (BCSSA, 2013).

Flatfish species found occupying subtidal areas within the LAA included rock sole, slender sole and Pacific sandab in spring, and English sole and speckled sandab in summer. In general, adult and juvenile sculpins of several species were found in both spring and summer and other fish observed included white-spotted greenling, striped perch, shiner perch and pile perch, each of which were observed in summer. Subtidal areas within the LAA are a habitat for adult and juvenile marine fish species such as gunnels, sculpins, perch, greenlings, eelpouts and several species of flatfish, crabs and shrimp. Bottom habitat in the subtidal area is, however, of limited (degraded) quality affected by historic pulp mill operations with sediment consisting of large amount of wood debris, silt and high concentrations of metals and dioxins and furans. No kelp or other macroalgae was observed in the subtidal area of LAA and benthic invertebrates were of limited abundance and diversity particularly northeast of Mill Creek.

Table 1: Presence/Absence of Juvenile and Adult Forage Fish and Other Fish Species within the LAA, Marine Resources Baseline Studies, 2014.

Common Name	Spring (April 2014)	Early Summer (June/July 2014)	Life History Stages
Pacific herring	x	x	juvenile
Chum salmon	x	x	smolt
Pink salmon	x	–	smolt
Chinook salmon	–	x	smolt
Coho salmon	–	–	–
Steelhead trout	–	–	–
Coastal cutthroat trout	–	–	–
Dolly Varden	–	x	smolt
Eulachon	–	–	–
Surf smelt	–	–	–
Pacific sand lance	–	–	–
Flatfish (e.g., soles, sandabs)	x	x	juvenile, adult
Other fish (e.g., sculpins, perch, greenlings)	x	x	juvenile, adult

Note: "x" indicates species/group found during field sampling program; "– " indicates species/group not found

A total of five fish larvae were found in zooplankton samples collected in early summer (June), no fish larvae were found in samples collected in spring (April) or late summer (September). Larval fish species identified within summer zooplankton samples included one specimen of rockfish (*Sebastes* sp.), one specimen of scalyhead sculpin (*Artedius harringtoni*), and three specimens of blackeye goby (*Rhinogobiops nicholsii*).

More detailed information on fish surveys can be found in the Marine Resources Baseline Study (Appendix 5.10-1 of the Application).

4.0 CLOSURE

We trust the above information provides that requested from the MOE toward resolving Information Request #583a.

Thank you,

GOLDER ASSOCIATES LTD.

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Senior Environmental Specialist

AR/DM/ch

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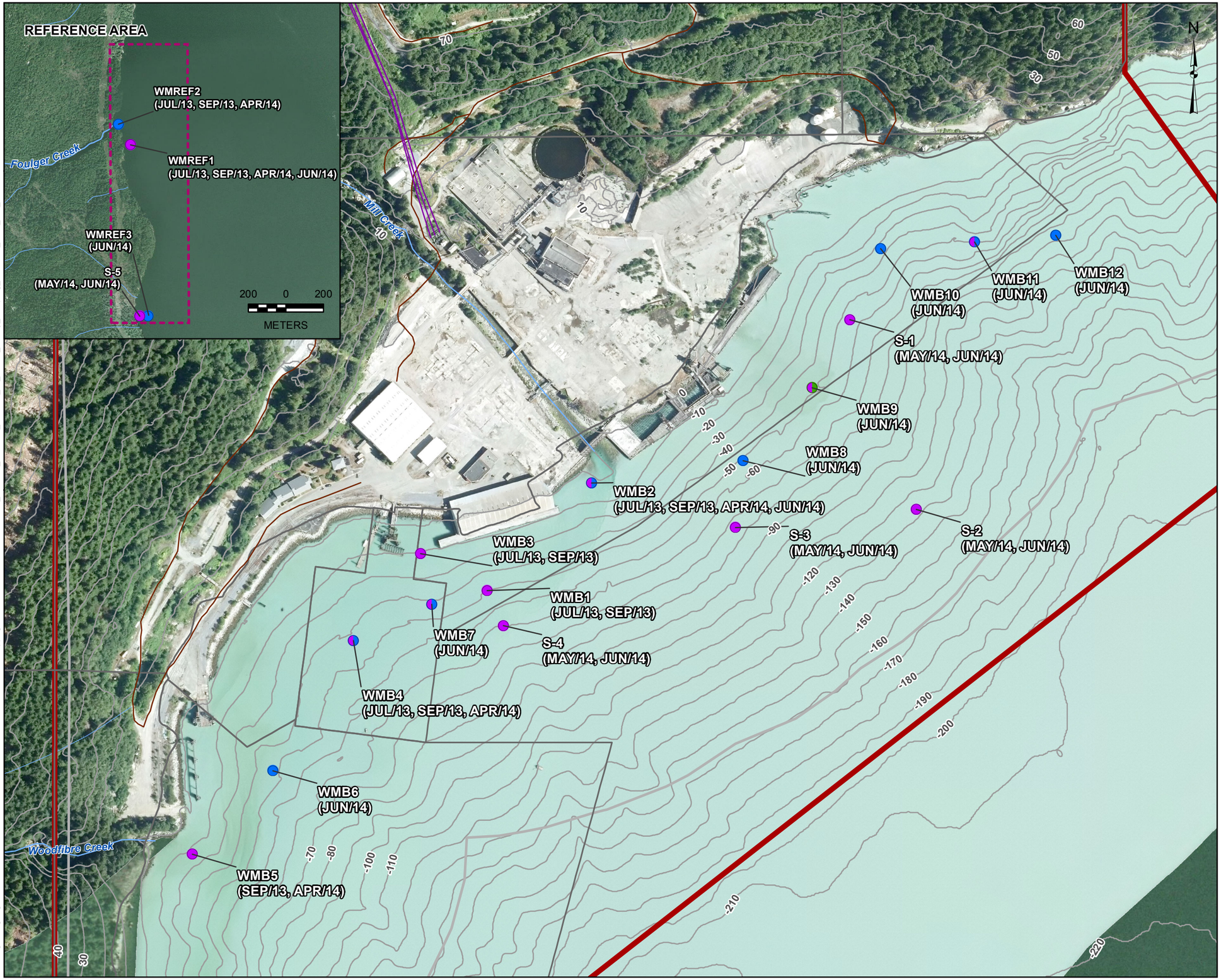

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LEGEND

- PROJECT AREA
- REFERENCE AREA
- SURVEY PARCELS
- SQUAMISH MUNICIPAL BOUNDARY
- LIMITED ACCESS ROAD
- TRANSMISSION LINE (ELECTRIC)
- WATERCOURSE
- CONTOUR (10 m)

MARINE SURVEY SAMPLE LOCATION (ID (SAMPLING SEASON))

- SEDIMENT CHEMISTRY / BENTHIC INFAUNA
- WATER QUALITY / PLANKTON
- WATER QUALITY / PLANKTON, BENTHIC INFAUNA ONLY
- WATER QUALITY / PLANKTON, SEDIMENT CHEMISTRY / BENTHIC INFAUNA

REFERENCE

MARINE SURVEY SAMPLE LOCATIONS DETERMINED BY GOLDER ASSOCIATES LTD PERSONNEL. BASE DATA FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. GAS PIPELINE AND TRANSMISSION LINES FROM ICIS. SITE PHOTO FROM MCELHENNEY AND SURROUNDING IMAGE AND HILLSHADE PROVIDED BY THE GOVERNMENT OF BRITISH COLUMBIA.
PROJECTION: UTM ZONE 10 DATUM: NAD 83

SCALE

100 0 100
METRES

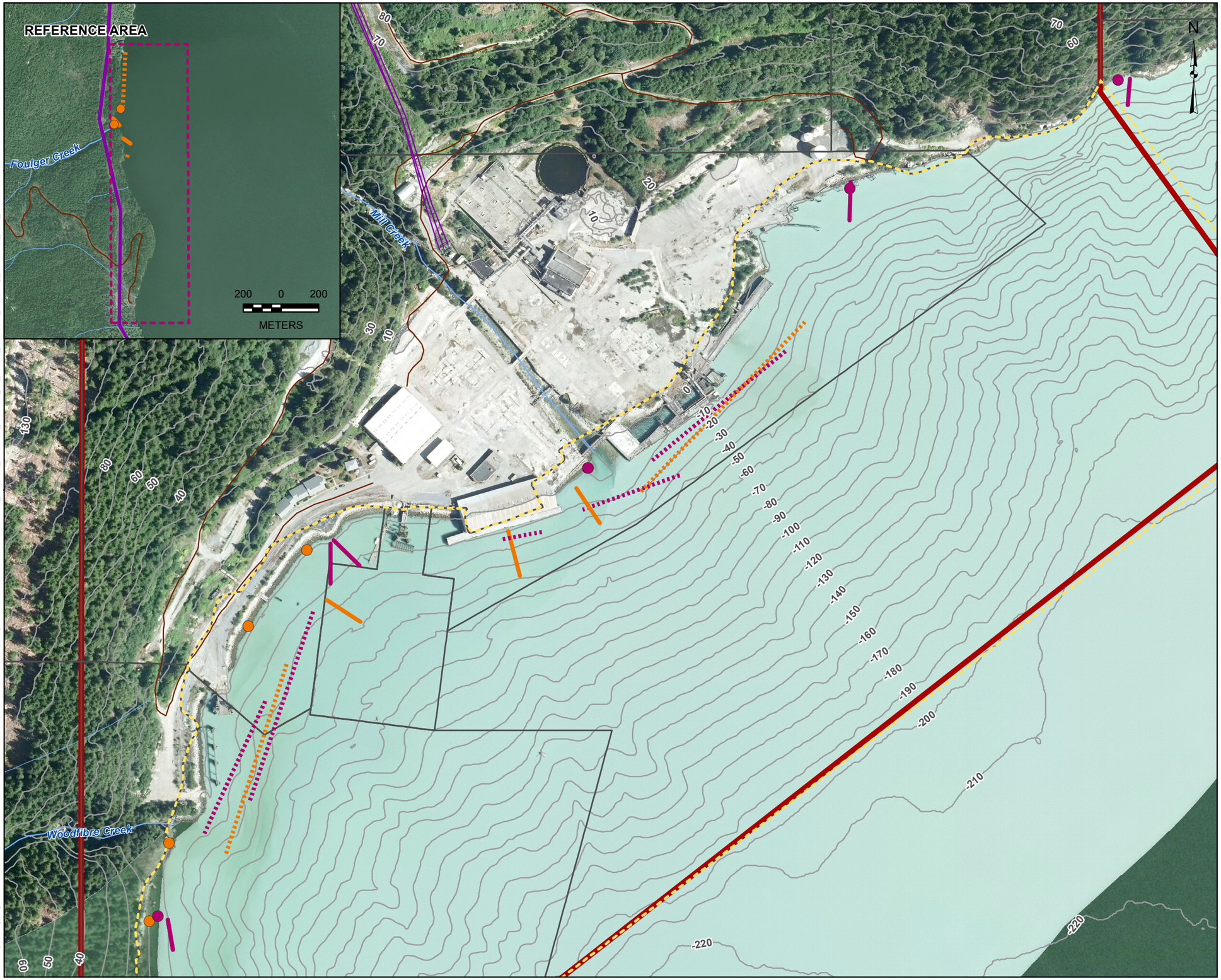
PROJECT
WOODFIBRE LNG LIMITED.
WOODFIBRE, HOWE SOUND, B.C.

TITLE
MARINE SURVEY SAMPLING LOCATIONS 2013 AND 2014

Golder Associates

PROJECT NO. 13-1422-0006			PHASE No. 5000	
DESIGN	EG	14 Mar. 2014	SCALE 1:4,000	REV. 2
GIS	RH	03 Oct. 2014		
CHECK	AK	03 Oct. 2014		
REVIEW	DS	03 Oct. 2014		

FIGURE 9



LEGEND

- PROJECT AREA
- LOCAL ASSESSMENT AREA
- REFERENCE AREA
- SURVEY PARCELS
- LIMITED ACCESS ROAD
- TRANSMISSION LINE (ELECTRIC)
- WATERCOURSE
- CONTOUR (10 m)

SAMPLING LOCATIONS (ID)

- BOTTOM TRAWL - APRIL 2014
- BOTTOM TRAWL - JUNE 2014
- GILL NET - APRIL 2014
- GILL NET - JUNE 2014
- BEACH SEINE - APRIL 2014
- BEACH SEINE - JUNE 2014

REFERENCE

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PROJECTION: UTM ZONE 10 DATUM: NAD 83

SCALE

100 0 100
METRES

PROJECT
WOODFIBRE LNG LIMITED.
WOODFIBRE, HOWE SOUND, B.C.

TITLE
MARINE FISHERIES SAMPLING LOCATIONS 2014

Golder Associates

PROJECT NO. 13-1422-0006			PHASE No. 5000		
DESIGN	EG	14 Mar. 2014	SCALE 1:4,200		REV. 0
GIS	RH	03 Oct. 2014			
CHECK	AK	03 Oct. 2014	**FIGURE 12**		
REVIEW	DS	03 Oct. 2014			

PATH: \\golder.gds\gal\Vancouver\CAD-GIS\VAN\2013\13-1422\13-1422-0006 - WoodfibreMapping\MXD\Marine HabitatWOODFIBRE_MARINE_HABITAT_FIGURE_12_Marine_Fisheries_Sampling_Locations_April_2014.mxd Date: 10/3/2014 Time: 5:13:51 PM