Section 3.5 and 3.12: Route Analysis, Approach Characteristics and Navigability Survey

TERMPOL Surveys and Studies

ENBRIDGE NORTHERN GATEWAY PROJECT

FINAL - REV. 0

Prepared for:
Northern Gateway Pipelines Inc.

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1 Objectives

In accordance with the TERMPOL Review Process TP743E 2001 (TRP), the objectives of these surveys are described in the following subsections.

1.1 TERMPOL Study 3.5

ROUTE ANALYSIS, APPROACH CHARACTERISTICS AND NAVIGABILITY SURVEY

As per TRP Section 3.5, "the objectives of this survey are, to assess ship and route safety, the adverse effects of ship accidents and, when applicable, public safety matters associated with the transportation of bulk oil to and from the terminal or trans-shipment site."

1.2 TERMPOL Study 3.12

CHANNEL, MANEUVERING AND ANCHORAGE ELEMENTS

As per TRP Section 3.12, "the objectives of this study are to determine the suitability of existing channels for the design ship(s) and to identify those areas of concern where navigation requires particular attention."

Due to the length of the vessel route from the pilot boarding area to the terminal, there is a significant amount of overlap between the "route analysis" and the "channel and manoeuvring" areas. Therefore, for the purpose of this submission, TERMPOL Studies 3.5 and 3.12 have been combined into one document for ease of reference and to avoid duplication.

2 Tanker Routing Options

Kitimat, British Columbia is an established industrial base situated within Kitimat Arm at the head of Douglas Channel. Deep sea vessels have been navigating to Kitimat since the 1950s, when Alcan established its operations. Eurocan Pulp and Paper and Methanex Corporation (formerly Ocelot Industries Ltd.) subsequently began operating in Kitimat Arm with deep-sea shipping of their own in the 1960s and 1980s, respectively.

Shipping routes in the area are well known to the BC Coast Pilots Ltd. (BCCP). The proposed vessels are a larger class of vessel than those that currently call on the existing marine terminals in the Kitimat area. However, the existing traffic does include tankers up to 50,000 DWT size, which import petroleum condensate to the Methanex Terminal.

Navigation to Kitimat by VLCC-class vessels was reviewed previously as part of a 1976 TERMPOL assessment for the Kitimat Pipe Line (KPL) Limited Project. Detailed route analyses were documented for routing a proposed 320,000 DWT oil tanker to the proposed marine terminal in Kitimat. These reference documents contain information that is pertinent to the current Enbridge Northern Gateway Pipelines Project, and were therefore used as additional references for this report.

The proposed design vessels consist of AFRAMAX, SUEZMAX and Very Large Crude Carrier (VLCC) class tankers and have significantly deeper-laden drafts than those vessels, which are currently navigating in the area or at the time of the KPL TERMPOL submission. Despite these larger vessel draughts, the channels that make up the proposed tanker routes are deep and exceed the minimum underkeel clearance requirements by a large margin in most areas. Refer to TERMPOL Study 3.6 – Special Underkeel Clearance Survey for a detailed review of minimum underkeel clearance requirements and available water depths.

Table 2-1 below presents a summary of the vessel characteristics of interest. The maximum size of vessel being proposed for this project is a 320,000 DWT VLCC tanker with a draught of up to about 24 m or 13 fathoms.

Table 2-1 General Ship Characteristics

Description	Largest Currently Navigating[a]	Current Project (Proposed)[b]	Current Project (Proposed)[b]	Current Project Maximum (Proposed)[b]
Type	Minerva Anna	AFRAMAX	SUEZMAX	VLCC
DWT, t	50,939	80,000–120,000	120,000–200,000	200,000–320,000
LOA, m	183	220–260	250–290	324–350
Beam, m	32.2	32–48	41–55	56–70
Draught, m	13.3	11–16	14–19	18–23

Notes: [a] Based on records of vessel calls to the Methanex Terminal.
[b] Approximations taken from Clarkson's Register 2008 (Refer – Appendix A).

Kitimat Arm, the location of the proposed marine terminal, can be accessed from a variety of routes. The major marine traffic options include:

- The North Route for vessels arriving from or departing to Asian ports. The North Route passes Haida Gwaii through Dixon Entrance, and continues via Hecate Strait, Browning Entrance, Principe Channel, Nepean Sound, Otter Channel, Squally Channel, Lewis Passage, Wright Sound and Douglas Channel. This route is shown in Figure 2-1.
- The South Route (via Caamaño Sound) for vessels arriving from or departing to west coast ports south of Kitimat. The South Route passes through Queen Charlotte Sound, and continues through Hecate Strait, Caamaño Sound, Campania Sound, Squally Channel, Lewis Passage, Wright Sound, and Douglas Channel.
- The South Route (via Browning Entrance) which passes through Queen Charlotte Sound and proceeds north through Hecate Strait, before continuing through Browning Entrance, Principe Channel, Nepean Sound, Otter Channel, Squally Channel, Lewis Passage, Wright Sound, and Douglas Channel. The South Routes are shown in Figure 2-2.

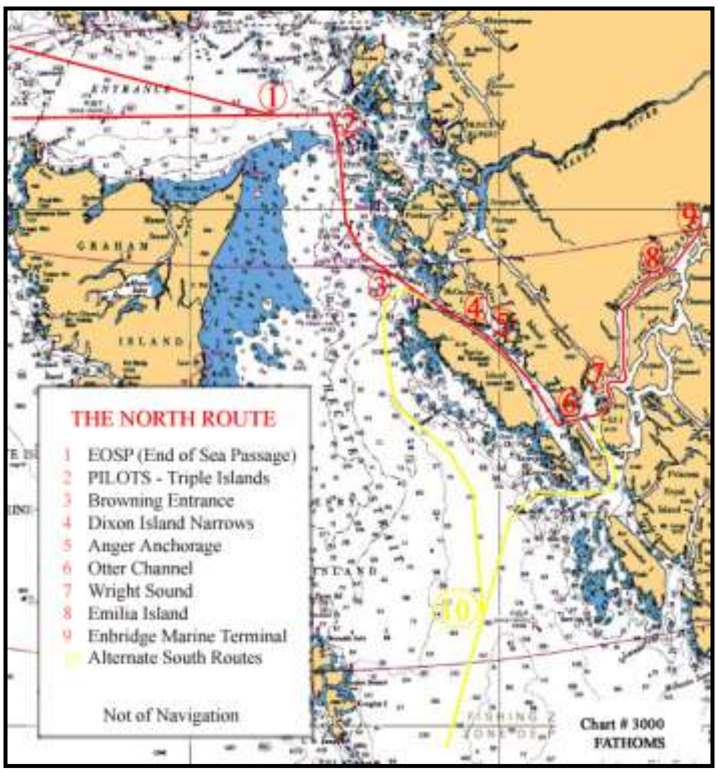

Figure 2-1 The Proposed North Route

(Source: Canadian Hydrographic Service Chart No. 3000)[1]

[1] Chart images in this document are copyright protected and reproduced with the permission of the Canadian Hydrographic Service. Not to be reused for navigation.

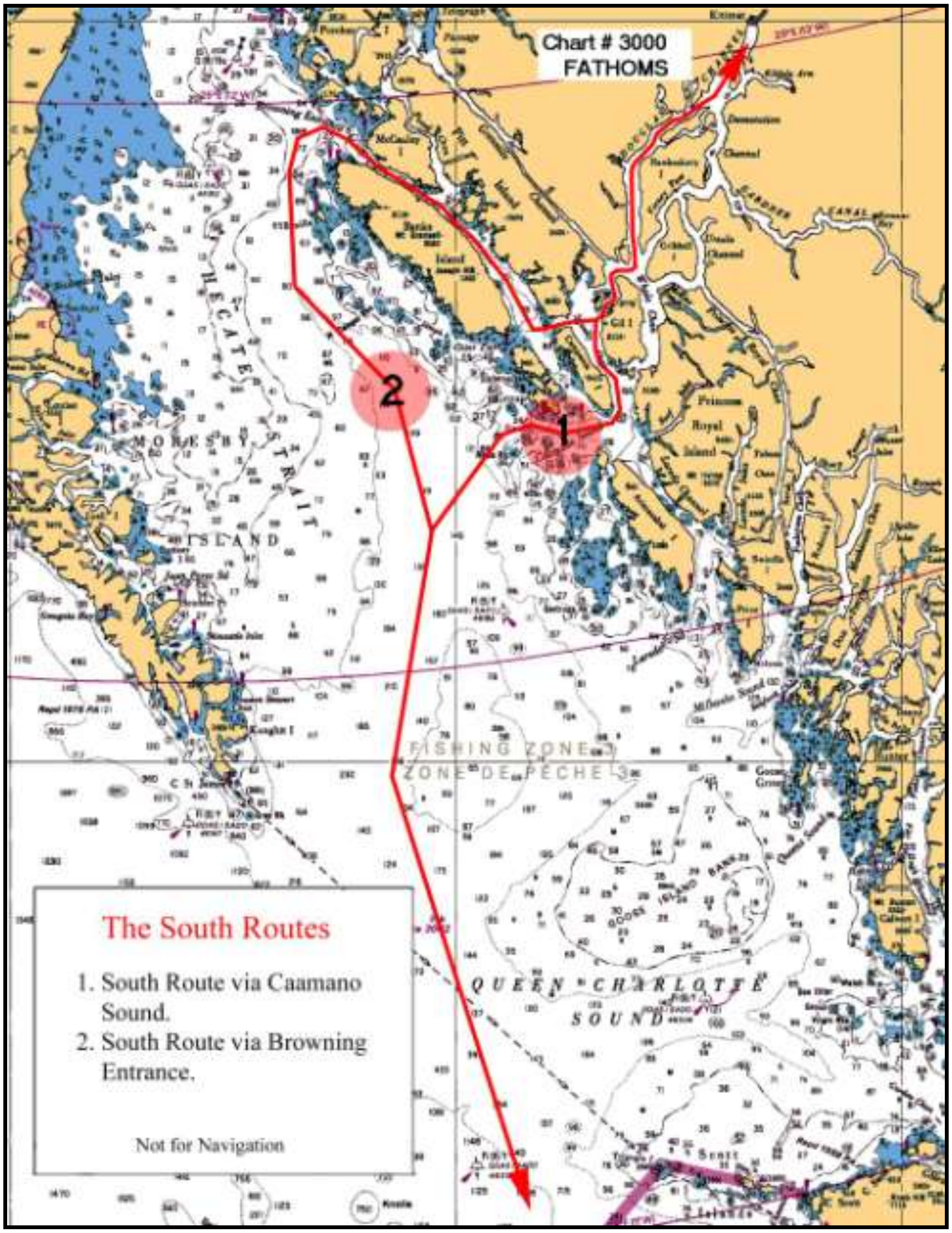

Figure 2-2 Enbridge Tankers

(Source: Canadian Hydrographic Service Chart No. 3000)

2.1 The North Route

The proposed northern route as shown in Figure 2-1and described below is for inbound loaded condensate import tankers AFRAMAX and SUEZMAX or for inbound ballasted export tankers SUEZMAX and VLCC, from Asian ports making landfall in Dixon Entrance. The majority of condensate imports are expected to arrive from Asian ports by this route. Termination of the ship's ocean passage would be at the approaches to the Triple Island pilot station. The vessel would embark a minimum of two BCCP pilots off Triple Island prior to proceeding inwards on the approximate 160-nautical-mile, or 300-kilometre, coastal route to Kitimat.

The outbound passage of the ballasted or loaded vessel, also under the guidance of marine pilots, would be the reverse of the inward route. The vessel, after disembarking the pilots and clearing outbound from the Triple Island pilot station, would commence its ocean passage navigating westwards out of Dixon Entrance towards the open ocean.

2.1.1 Dixon Entrance

The head of Dixon Entrance is nearly 50 km wide between Langara Island to the south and Dall Island to the north. The international border between the United States and Canada lies along the northern side of Dixon Entrance.

Learmonth Bank, with a least charted depth of 36 m, lies 40 km north of Langara Island in Dixon Entrance. During periods of inclement weather, swells and rough seas build up, causing the waves to become steeper and of shorter period over Learmonth Bank. The water depths over the bank are described as uneven and the bottom comprises sand, rock and gravel (PAC 206). Mariners are cautioned about depths being possibly less than charted on Learmonth Bank due to the accuracy of the underwater surveys. Navigation directly over Learmonth Bank should be avoided by all of the proposed vessels.

As an alternative, there is a deep-water channel to the south of Learmonth Bank, which is a minimum of 11.5 km wide between the 183 m charted bathymetric contours. The same channel has a minimum depth of 90 m over a width of 16.1 km. Also, there is a deep water channel to the north of Learmonth Bank which is 14.6 km wide between the 183 m contours. (See Figure 2-21)

Dixon Entrance is commonly used by the class of deep sea vessels currently visiting the ports of Prince Rupert, Stewart and Kitimat.

2.1.2 End of Sea Passage – Approaching the Pilot Station

The inbound laden tanker will make End of Sea Passage (EOSP) at a safe position to the west of the pilot boarding station at Triple Island, in accordance with instructions from the BCCP regarding the agreed boarding position. The approach waters to the pilot station are some 16.7 km wide between Celestial reefs to the north and Rose Spit banks to the south, with a minimum charted water depth of 55 m. This gives the design vessel plenty of room to manoeuvre, for turning around, for collision avoidance and temporary holding. The approach routes to coastal waterways are presented on Figure 2-3.

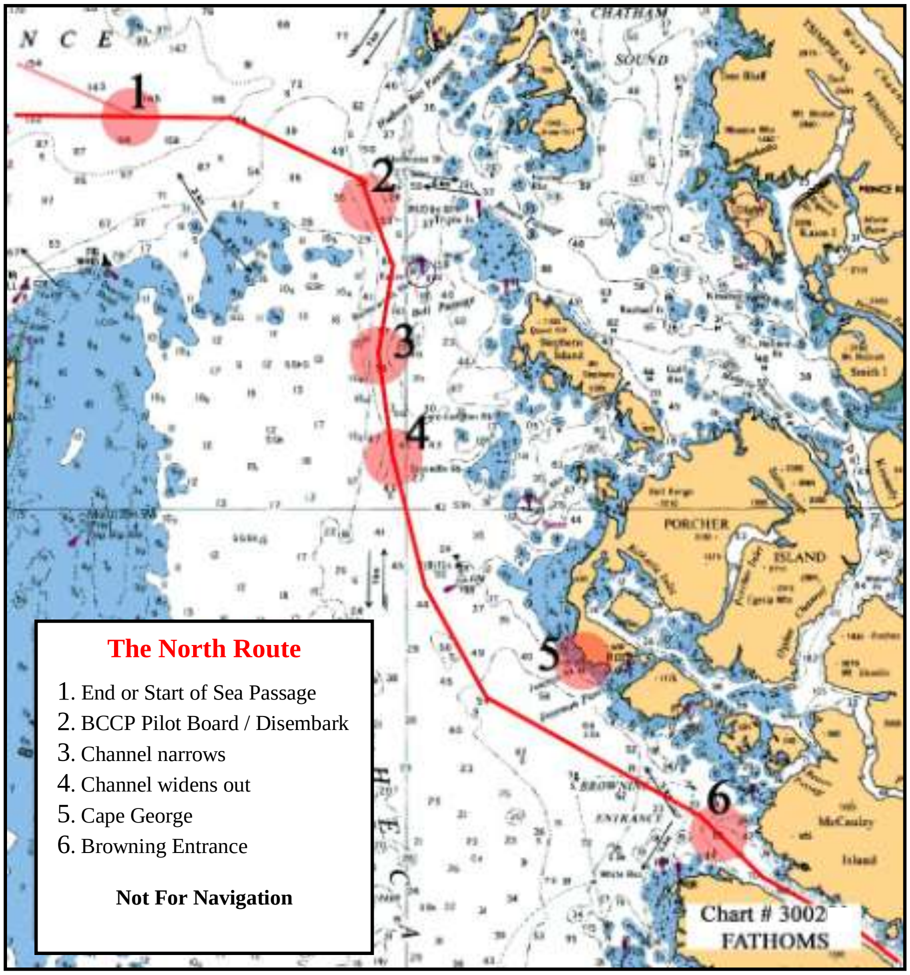

Figure 2-3 The Proposed Northern Approach

(Source: Canadian Hydrographic Service Chart No. 3002)

The proposed Northern Approach includes Dixon Entrance, Triple Island Pilot Station, and Hecate Strait to Browning Entrance.

2.1.3 Triple Island Pilot Boarding Grounds

The waters off Triple Island are open and exposed and arrival may need to be delayed during periods of severe weather. The BCCP would instruct the approaching tanker to a safe position, suitable for making a lee for pilot boarding. This position is likely to be about 5 to 10 km west of Triple Islands, shown in Figure 2-4.

The boarding ground area is bounded by Stenhouse Shoals to the north, Butterworth Rocks 9.3 km to the south and the Tree Nob group of islands to the east, which includes Triple Islands.

Stenhouse Shoals are marked by a green buoy equipped with a flashing light and a Radar Responder Beacon (Racon) that shows on marine radar screens. Butterworth Rocks are marked by a flashing light, mounted on a white tripod skeleton tower that is also equipped with a Racon. Triple Island is marked by a flashing light mounted on a white octagonal tower, located on the most northwesterly rock of the Triple Islands Group.

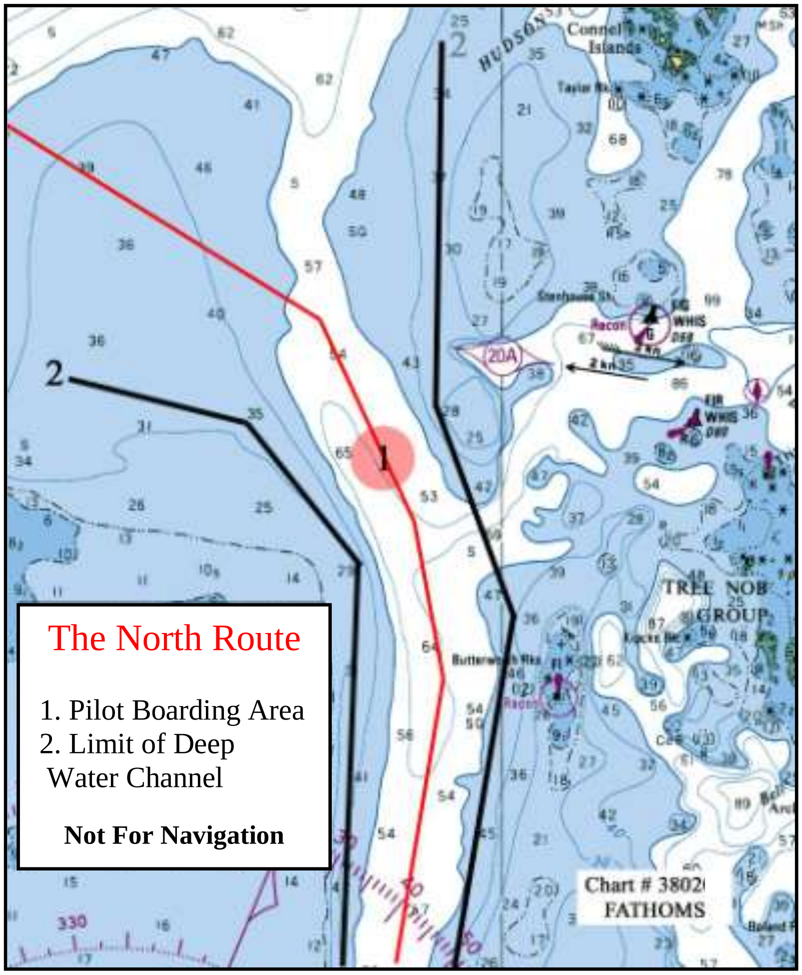

Figure 2-4 Pilot Boarding Area off Triple Islands

(Source: Canadian Hydrographic Service Chart No. 3802)

2.1.4 The Northern Hecate Strait

The deep-water route to the south passing Butterworth Rocks is 5.5 km wide, with charted depths of between 36 and 100 m. At a distance of 7.4 km south of Butterworth Rocks, the deep-water channel narrows to a width of 5.3 km. The channel then widens to 9.3 km off the western extent of Oval Bank, which is marked by a lighted buoy.

Seal Rocks, located 14.8 km east of the deep water channel and 11.1 km northeast of the Oval Bank buoy, are marked with a navigation light and Racon. The tanker makes a report to Marine Traffic (MCTS) passing Seal Rocks.

South of Oval Bank, the deep-water channel widens to almost 15 km wide off Cape George on Porcher Island, with charted depths between 100 and 130 m.

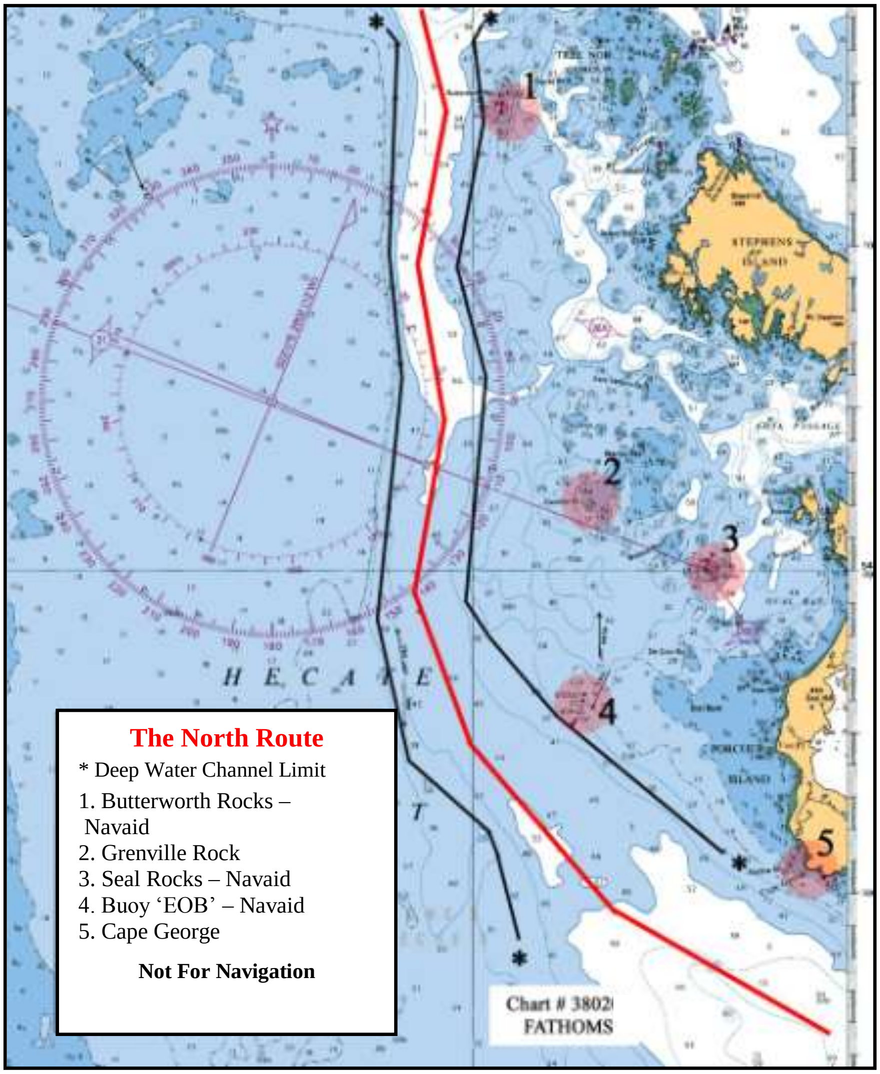

Figure 2-5 Hecate Strait – Butterworth Rocks to Cape George

(Source: Canadian Hydrographic Service Chart No. 3802)

2.1.5 Browning Entrance

The passage from Hecate Strait into Principe Channel is known as Browning Entrance, shown in Figure 2-6. The charted water depth is generally in excess of 36 m, over a channel width of 6.2 km, although there are shallower charted depths guarding Browning Entrance. The deeper part of Browning Entrance lies to the north of the centre median where charted water depths are 45 to 64 m.

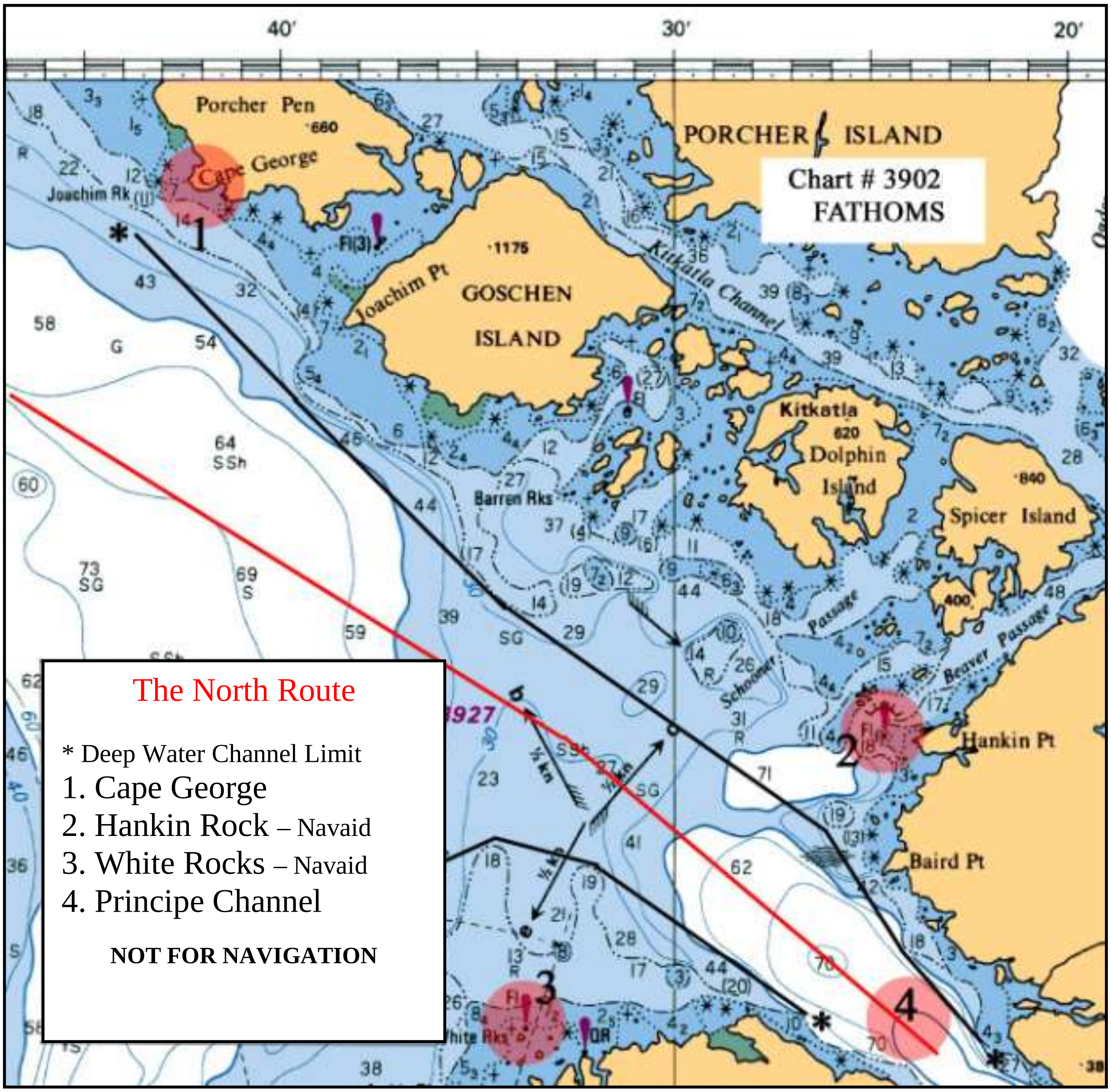

Figure 2-6 Browning Entrance

(Source: Canadian Hydrographic Service Chart No. 3902)

2.1.6 Principe Channel

The entrance to Principe Channel, which is the northern portion of the Outside Passage, is 5.2 km wide between Baird Point on McCauley Island to the north and Deadman Islet off Banks Island to the south. The charted water depth is in excess of 130 m. The entrance is marked to the south by a flashing light situated on the northern-most rock of White Rocks, on a white, square skeleton tower; and. to the north by a flashing light on Hankin Rock at the entrance to Beaver Passage.

The navigable width of Principe Channel narrows to approximately 1.8 km between Keswar Point, which is marked by a flashing light, and Dixon Island. The charted water depths in this portion of the channel are in excess of 180 m until off Dixon Island, as shown on Figure 2-7.

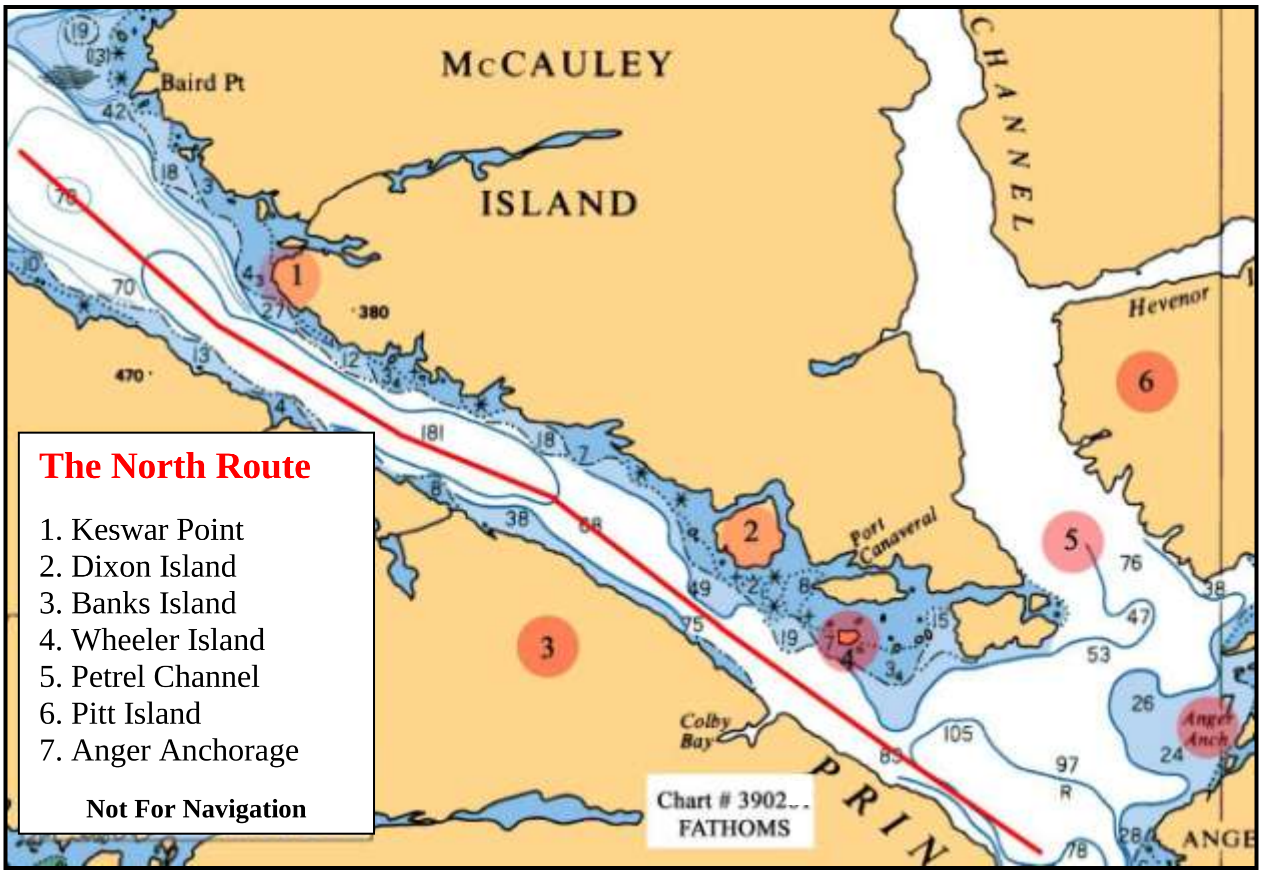

Figure 2-7 Principe Channel, Northern Part, Dixon Island Location

(Source: Canadian Hydrographic Service Chart No. 3902)

The width of the channel off Dixon Island, as illustrated in Figure 2-8 is charted as 1.43 km with water depth in excess of 36 m. This area is one of the narrowest sections along the proposed route for tankers transiting to and from Kitimat. This section is 20 times the beam of the largest design vessel and exceeds the recommended minimum channel width of seven times the design vessel beam, as per TRP guidelines.

A channel width of 20 times the beam, allows for safe passing of vessels in the narrowest part of the route. In practice however, BCCP may prefer to adjust speed to avoid passing vessels of similar size in this section.

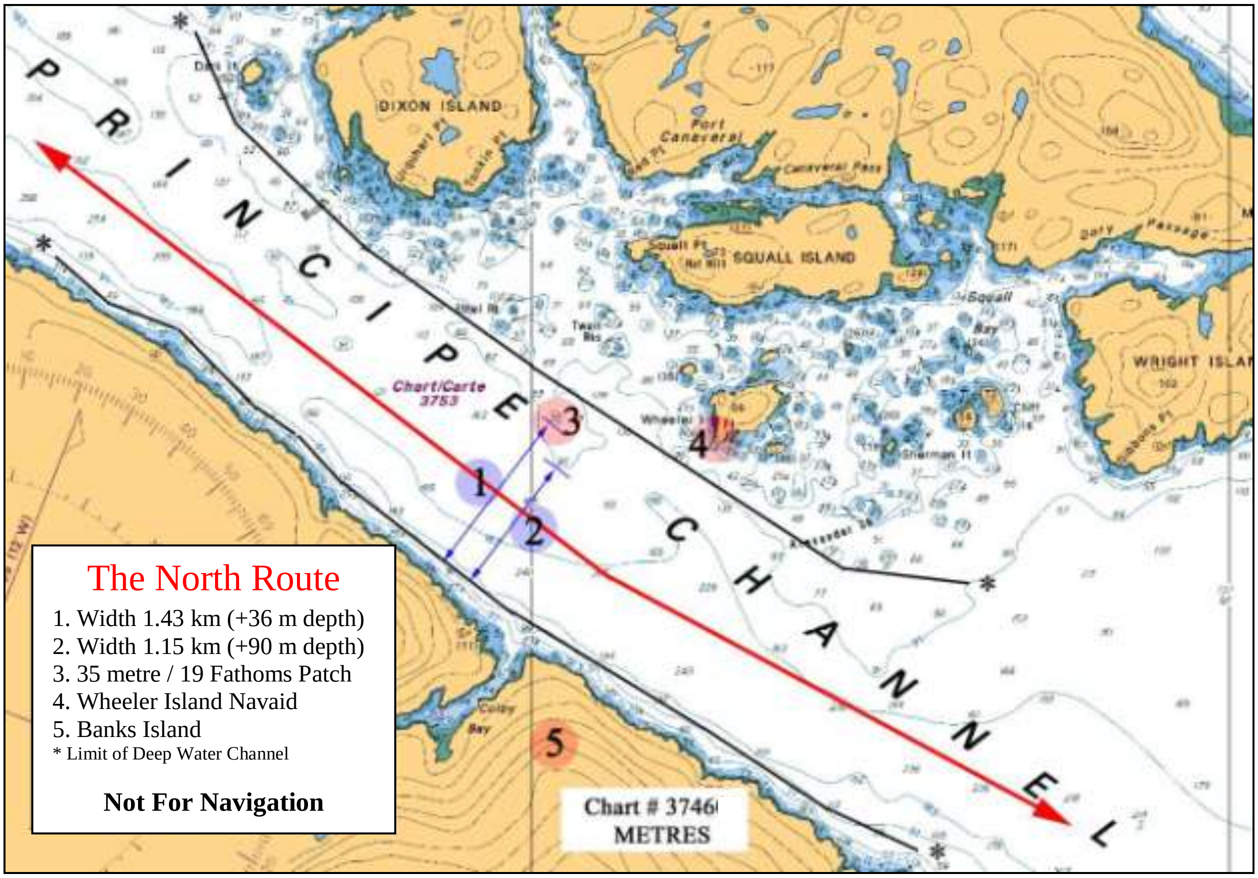

Figure 2-8 Dixon Island Narrows in Principe Channel

(Source: Canadian Hydrographic Service Chart No. 3746)

Wheeler Island, with Alexander Shoal close by, marks the southern end of the narrows. Wheeler Island features a flashing light mounted on a white, square skeleton tower, located on the south-west corner of the island.

As the vessel passes Alexander Shoal, the channel opens to a wider waterway, where Petrel Channel meets Principe Channel.

Anger Anchorage is situated to the northeast of the main channel at the confluence of Petrel and Principe Channels. This anchorage is the primary holding anchorage along this route and is described in detail, in Section 10.2.

Figure 2-9 The Southern Part of Principe Channel

(Source: Canadian Hydrographic Service Chart No. 3902)

The channel narrows again from Freberg Islet off Foul Point, where the channel width is 2.2 km, to Ralston Islands and Despair Point. The width of Principe Channel near Despair Point with more than 36 m charted depth is 1.8 km, and the general water depth is in excess of 90 m to the south side of the channel. There is a shelf to the north side that has a least depth of 67 m. The channel is reasonably straight and widens out again south of Despair Point, to a navigable width of 2.7 km off Sewell Islet.

Passing the flashing light on Banks Island opposite Sewell Islet the channel opens to more than 5.5 km. South of Littlejohn Point, Principe Channel widens further to a navigable width of 7.4 km before becoming Nepean Sound at the southeast end of Banks Island.

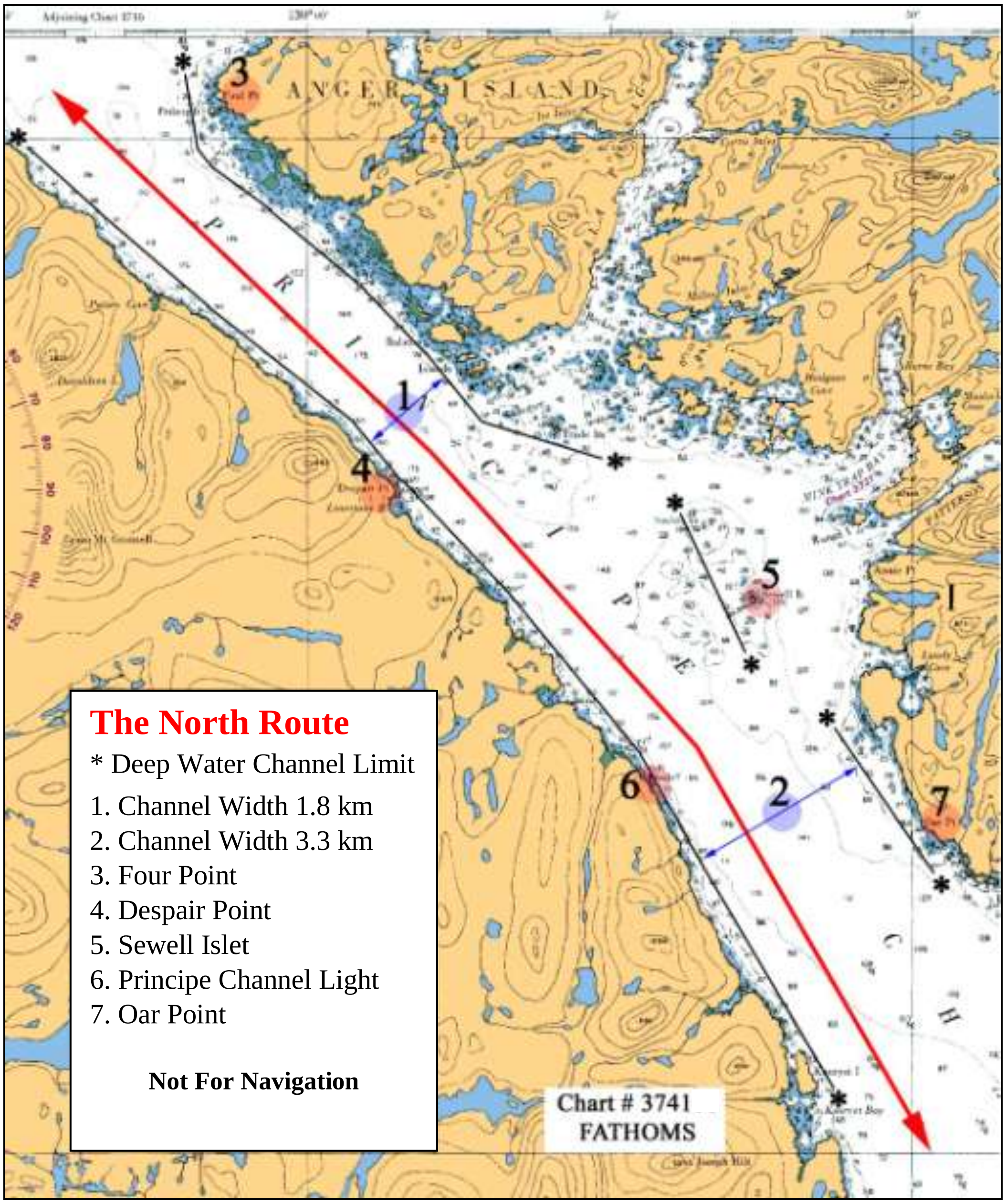

Figure 2-10 Principe Channel, Foul Point to Oar Point

(Source: Canadian Hydrographic Service Chart No. 3741)

2.1.7 Nepean Sound

Nepean Sound, shown on Figure 2-11, is a deep channel more than 7.4 km wide that is the junction of Principe Channel, Estevan Sound and Otter Channel. Tankers using the proposed route will use Otter Channel. There is a bell buoy with a flashing light marking Nepean Rocks off Fleishman Point, at the entrance to Otter Channel from Nepean Sound.

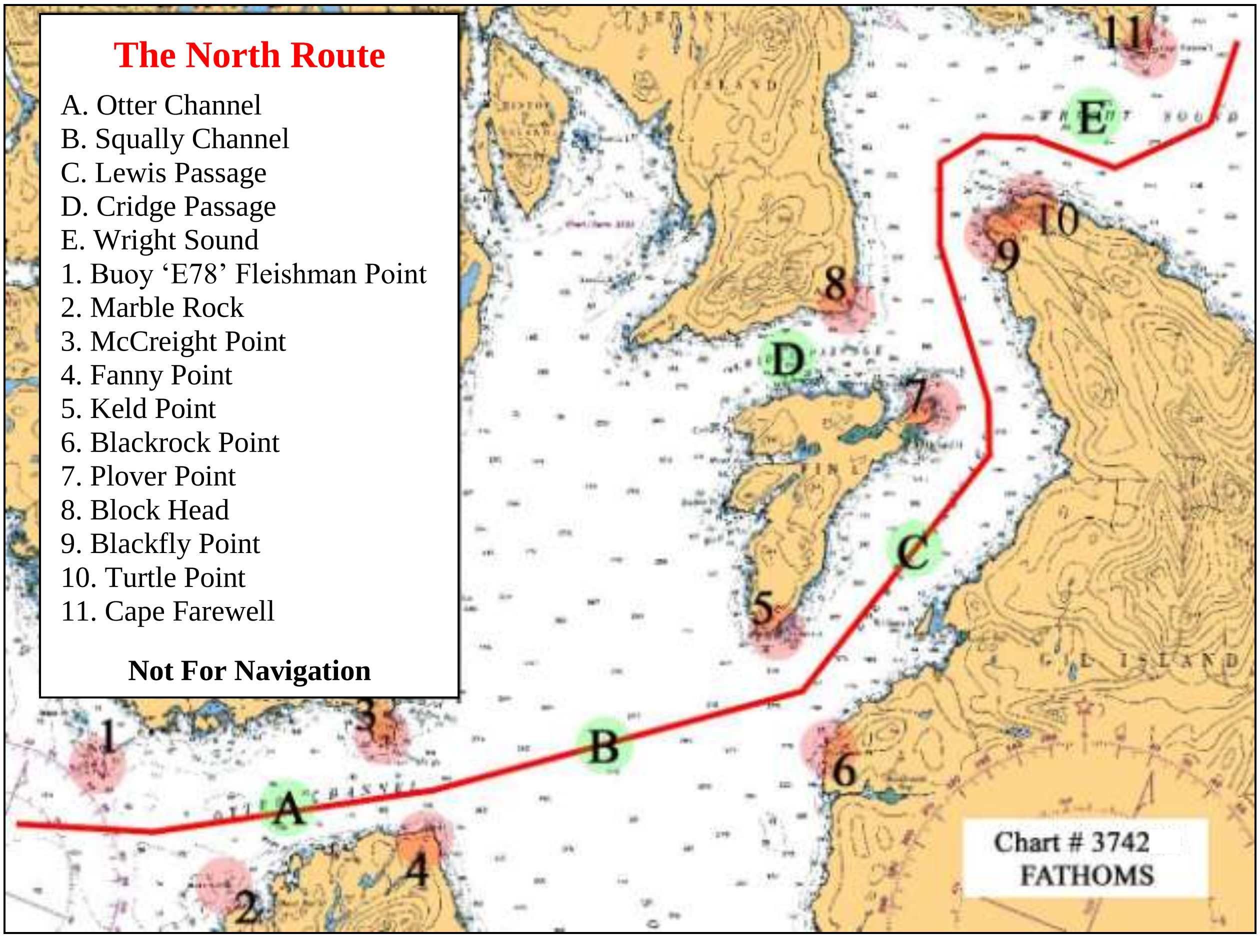

Figure 2-11 Nepean Sound to Wright Sound

(Source: Canadian Hydrographic Service Chart No. 3742)

2.1.8 Otter Channel

Marble Rock, which is exposed by approximately 3 m at high tide, is situated 550 m offshore on the south side of the entrance to Otter Channel from Nepean Sound, shown in Figure 2-12. Marble Rock has no navigation mark. However, the entrance to Otter Channel from Nepean Sound between Fleishman Point and Marble Rock is 4 km wide.

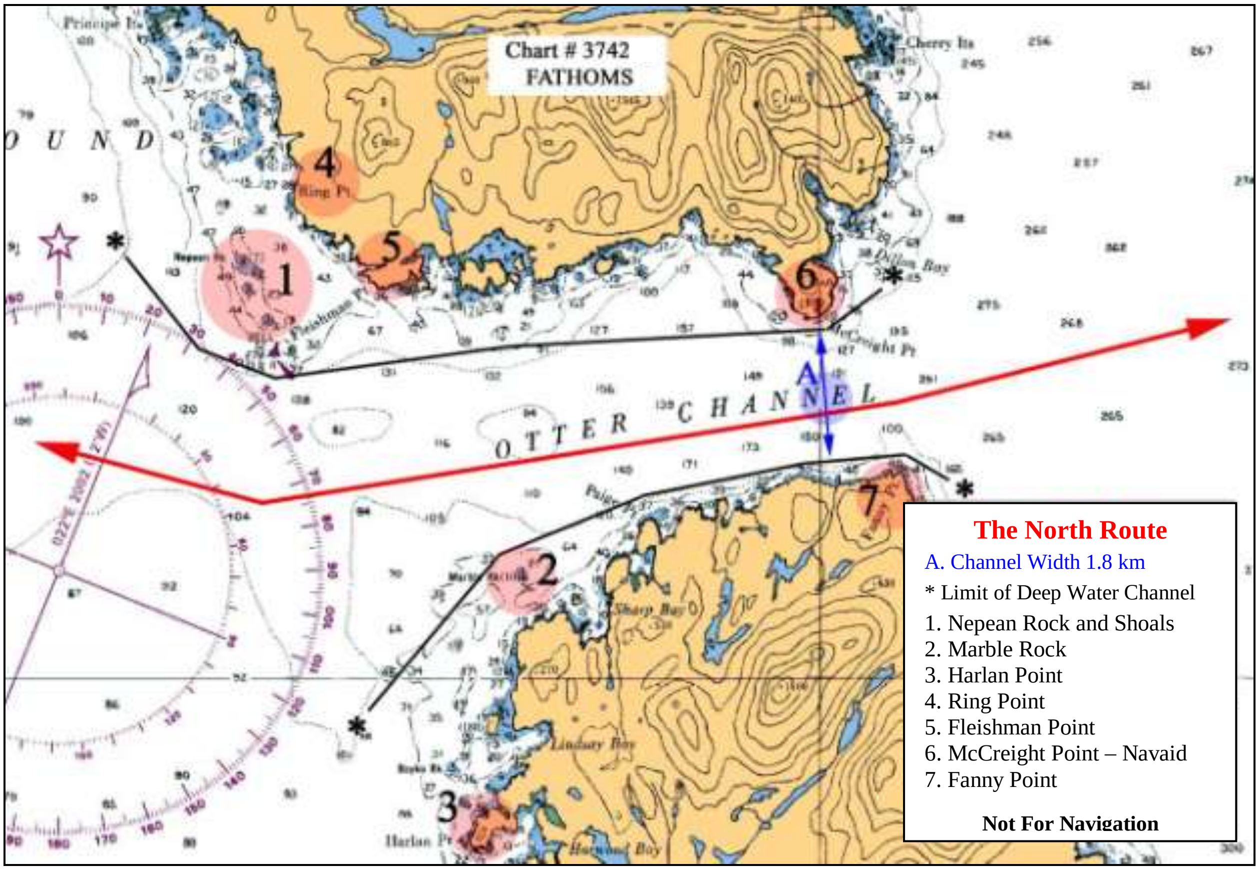

Figure 2-12 Otter Channel

(Source: Canadian Hydrographic Service Chart No. 3742)

The width of Otter Channel, with charted depth greater than 36 m, is 1.8 km between McCreight Point and Campania Island, at least 25 times the beam of the largest VLCC. This should allow for safe passing of vessels in Otter Channel. In practice however, BCCP may prefer to adjust speed to avoid passing vessels of similar size off McCreight Point.

The water depth across most of the navigable channel is in excess of 300 m. McCreight Point is marked by a flashing light. Once past McCreight Point, the waterway opens up into Squally Channel.

2.1.9 Squally Channel

From leaving Otter Channel to entering Lewis Passage, the inbound vessel crosses Squally Channel, as shown on Figure 2-13, for a distance of 9.3 km. Blackrock Point and Fin Rock, at the entrance to Lewis Passage, are marked by flashing lights. Squally Channel is not a main navigation route for marine traffic and therefore crossing traffic, if any, should be minimal.

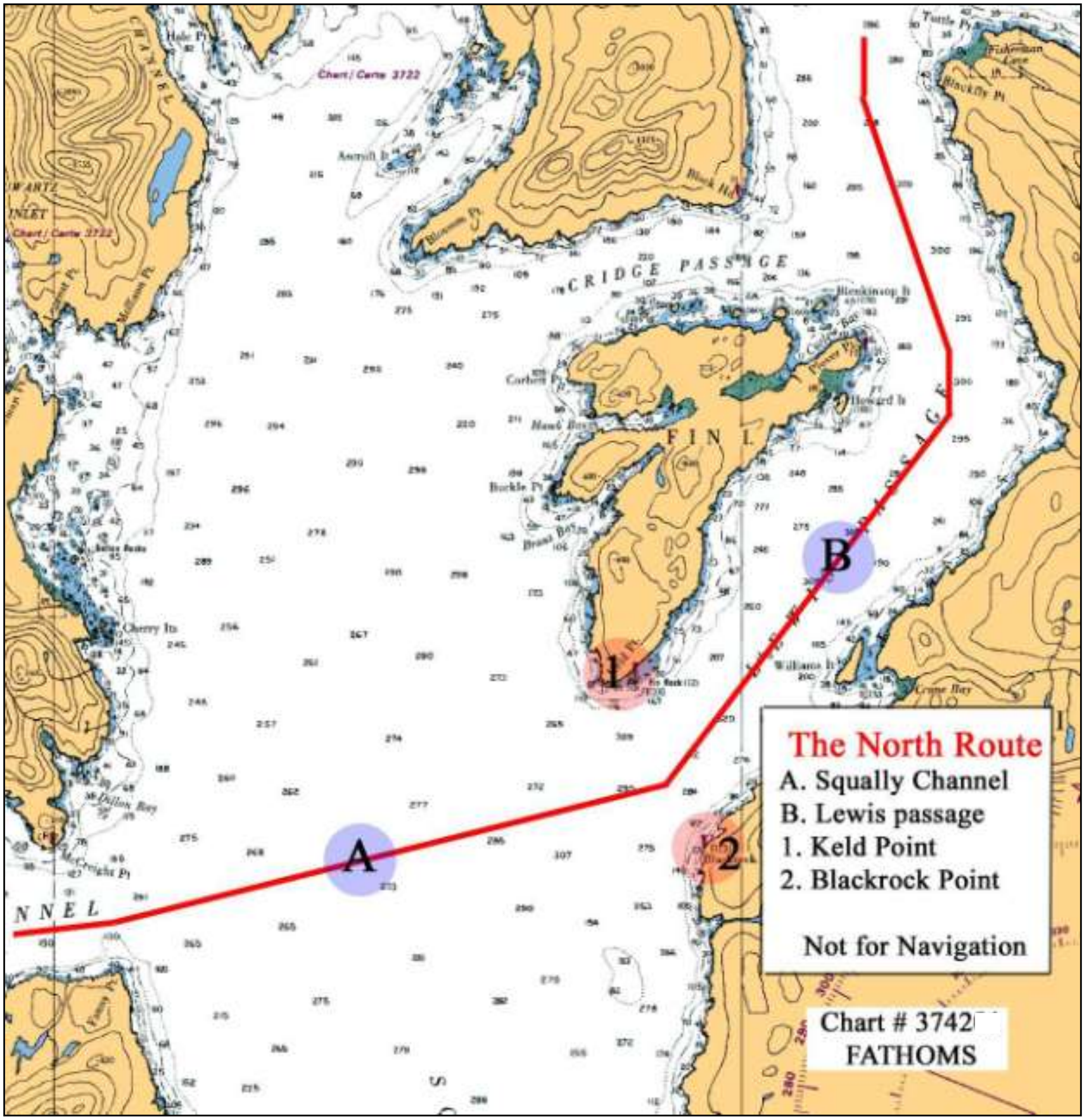

Figure 2-13 Squally Channel and Lewis Passage

(Source: Canadian Hydrographic Service Chart No. 3742)

2.1.10 Lewis Passage

The entrance of Lewis Passage lies between Fin Island and Gil Island and is 2.3 km wide for charted depths exceeding 36 m. Once inside Lewis Passage, the navigable channel widens slightly as the vessel passes Crane Bay and Williams Islet. The majority of the channel has charted depths up to 550 m.

From the entrance to Lewis Passage off Keld Point, the vessel travels 6.5 km in a northeasterly direction prior to commencing a turn to port off Howard Islet and Plover Point, which is marked by a flashing light, putting the vessel on a north-northwesterly direction heading for Blackfly Point and Wright Sound. Block Head on Farrant Island near the north end of Lewis Passage is also marked by a flashing light.

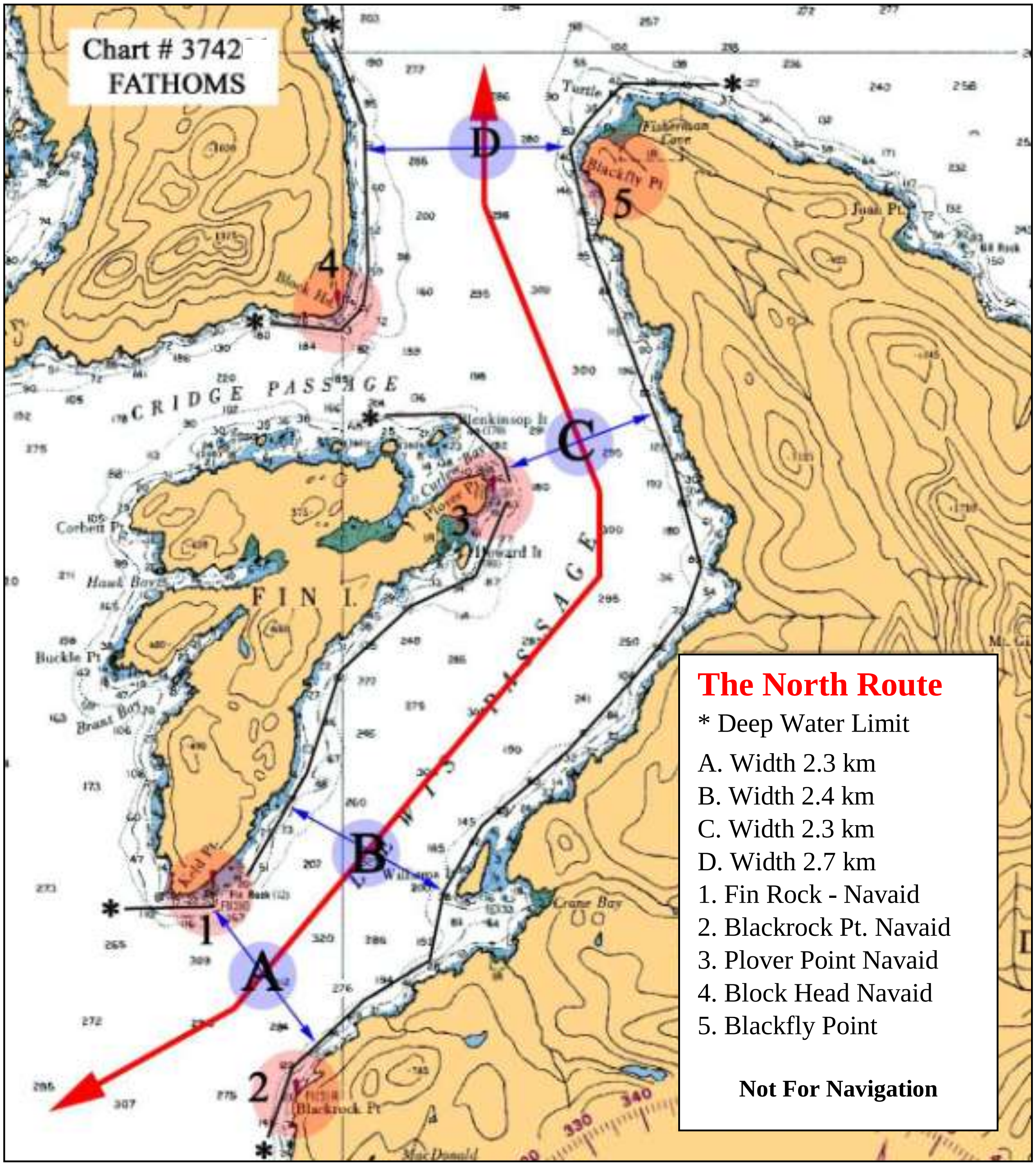

Figure 2-14 Lewis Passage

(Source: Canadian Hydrographic Service Chart No. 3742)

Lewis Passage has a channel width of 2.3 km with charted depths exceeding 36 m off Plover Point. The channel is well marked from this direction and there is sufficient room for two-way navigation. From Lewis Passage the route then crosses Wright Sound.

2.1.11 Wright Sound

Wright Sound, shown on Figure 2-15, is the junction of six deep-water navigable channels, two of which form the north-south corridor of the weather protected inland waterway on the British Columbia coast, known as the Inner Passage. The six deep-water navigable channels at Wright Sound are:

- Grenville Channel.
- Douglas Channel and Verney Passage.
- McKay Reach and Whale Channel.
- Lewis Passage.

There is also the small boat passage of Coghlan Anchorage and Stewart Narrows from Wright Sound to Hartley Bay.

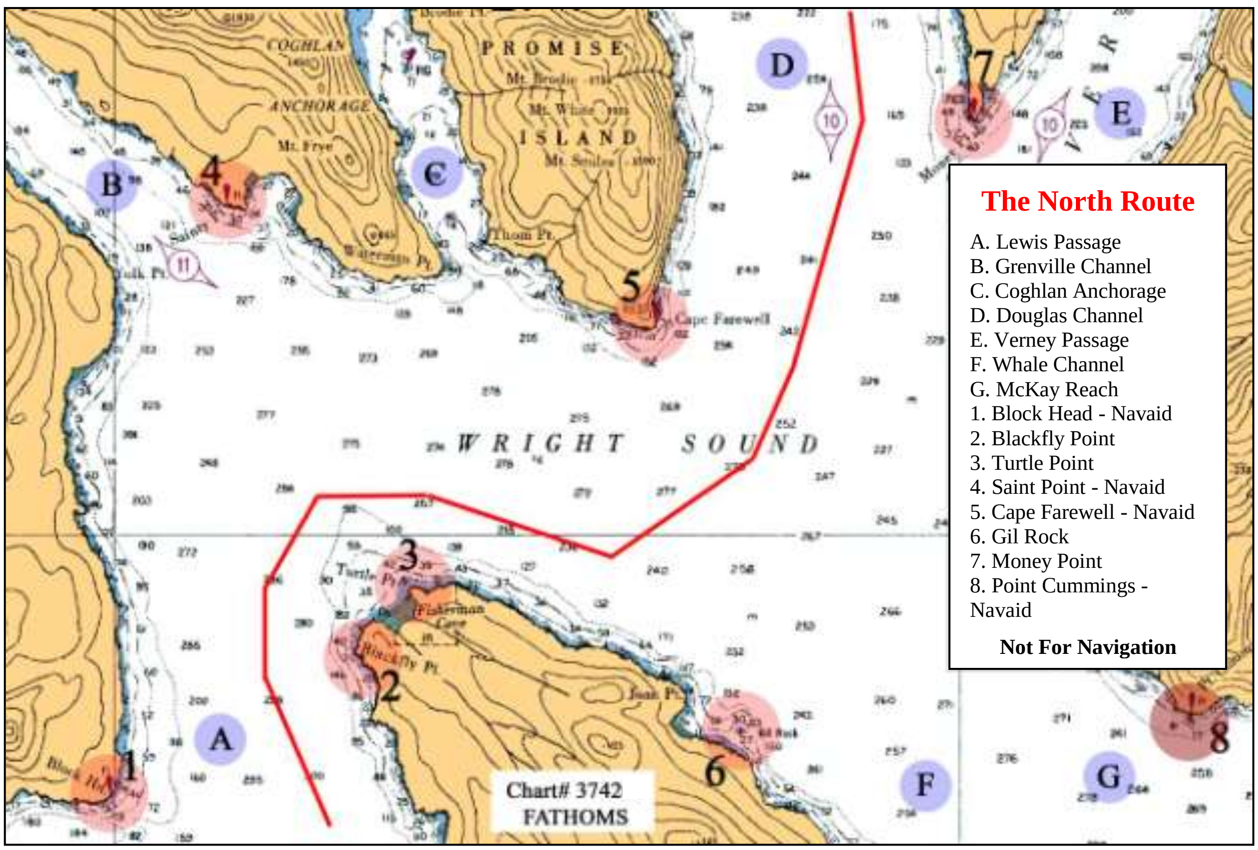

Figure 2-15 Wright Sound

(Source: Canadian Hydrographic Service Chart No. 3742)

Marine traffic using the Inner Passage route navigates through the waters of Grenville Channel and McKay Reach. Wright Sound separates Grenville Channel and McKay Reach.

Wright Sound has a width of about 3.7 km at the narrower western end where it meets Grenville Channel and up to about 5.6 km at the broader eastern end where the Sound opens up to Douglas Channel and Verney Passage. Wright Sound is approximately 11.1 km long with general water depths in excess of 360 m. The adjacent shoreline is generally steep, evident from the position of the 90 m contour within close proximity to shore all around Wright Sound. The exceptions are off the northwest tip of Gil Island, where the 90 m contour extends to 740 m offshore, and Gil Rock, which lies 275 m from Gil Island on the southern shore of Wright Sound.

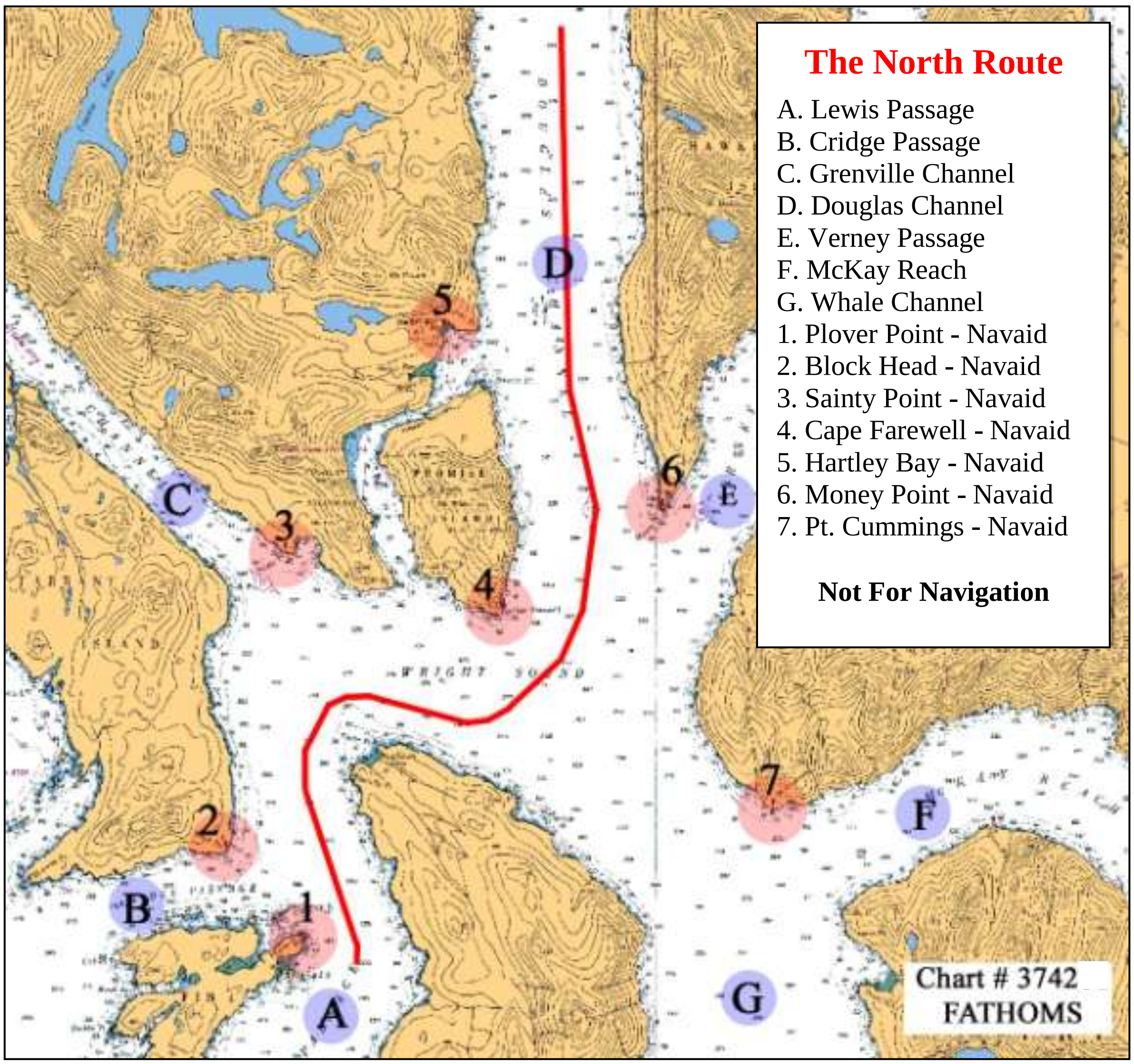

Figure 2-16 Wright Sound and Douglas Channel

(Source: Canadian Hydrographic Service Chart No. 3742)

Wright Sound provides adequate room for safe navigation of vessels using the existing shipping routes. Vessels crossing Wright Sound will communicate with other marine traffic and MCTS Traffic Control and adjust vessel speed as required to cross the Inner Passage traffic lanes.

2.1.12 Douglas Channel

The entrance to Douglas Channel is marked by a flashing light at Cape Farewell, the southern tip of Promise Island to the west; and, by a flashing light at Money Point, the southern tip of Hawkesbury Island to the east. The channel is 3.5 km wide at the entrance. Douglas Channel is shown on Figure 2-17 and Figure 2-18.

Northwards from Money Point, Douglas Channel is between 3 and 4 km wide. The channel is deep, with charted depths in excess of 180 m and, fairly straight for about 26 km, passing Hartley Bay and Kiskosh Inlet to Kitkiata Inlet where the channel changes to a northeasterly direction.

There are no channel markers or navigational aids between Money Point and Kitkiata Inlet; however, the shoreline is rocky and steep on both sides, providing strong radar reflections for navigation. The 90 m charted contours are close inshore and there are no charted dangers to navigation.

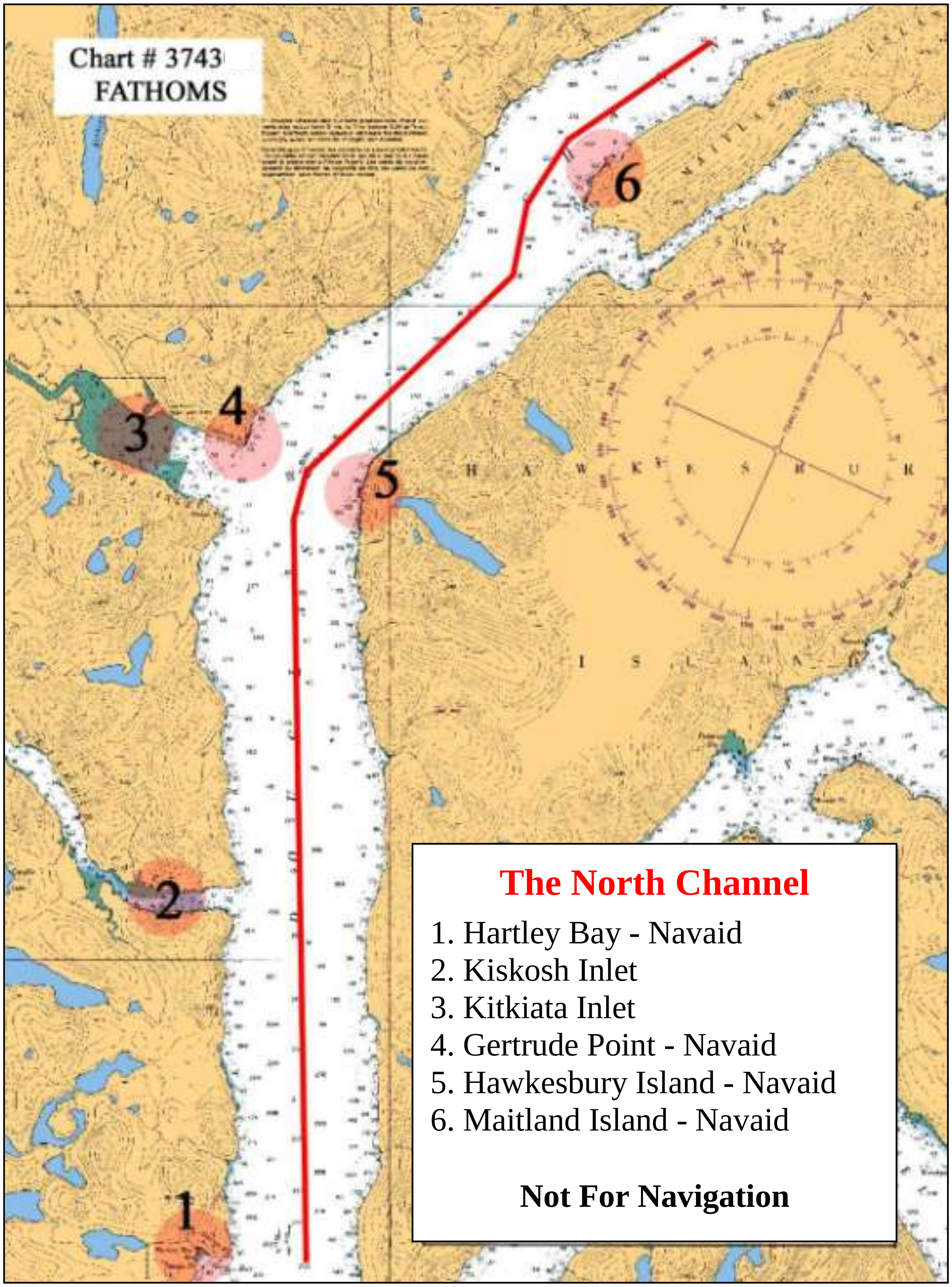

Figure 2-17 Douglas Channel, South Part, Hartley Bay to Kitkiata Inlet

(Source: Canadian Hydrographic Service Chart No. 3743)

Kitkiata Inlet is marked by a flashing light on the north shore at Gertrude Point and on the south shore at Hawkesbury Island. The channel between these lights is 3.6 km wide. From Kitkiata Inlet, Douglas Channel runs for about 33 km in a general northeasterly direction towards Kitimat Arm and the Kitimat Harbour Limit, passing the narrows between Emilia Island and Maitland Island en-route.

Between Kitkiata Inlet and Maitland Island, the navigable channel is straight and about 2.8 km wide, with charted water depths in excess of 90 m. At Grant Point on Maitland Island, the navigable channel "doglegs" slightly to the north, before resuming its northeasterly course and reducing in width to about 2.2 km or at least 31 times the breadth of the largest vessel.

There is a flashing light on the southwest end of Maitland Island marking the southeast side of the channel; this is situated 1.4 km northeast of Grant Point.

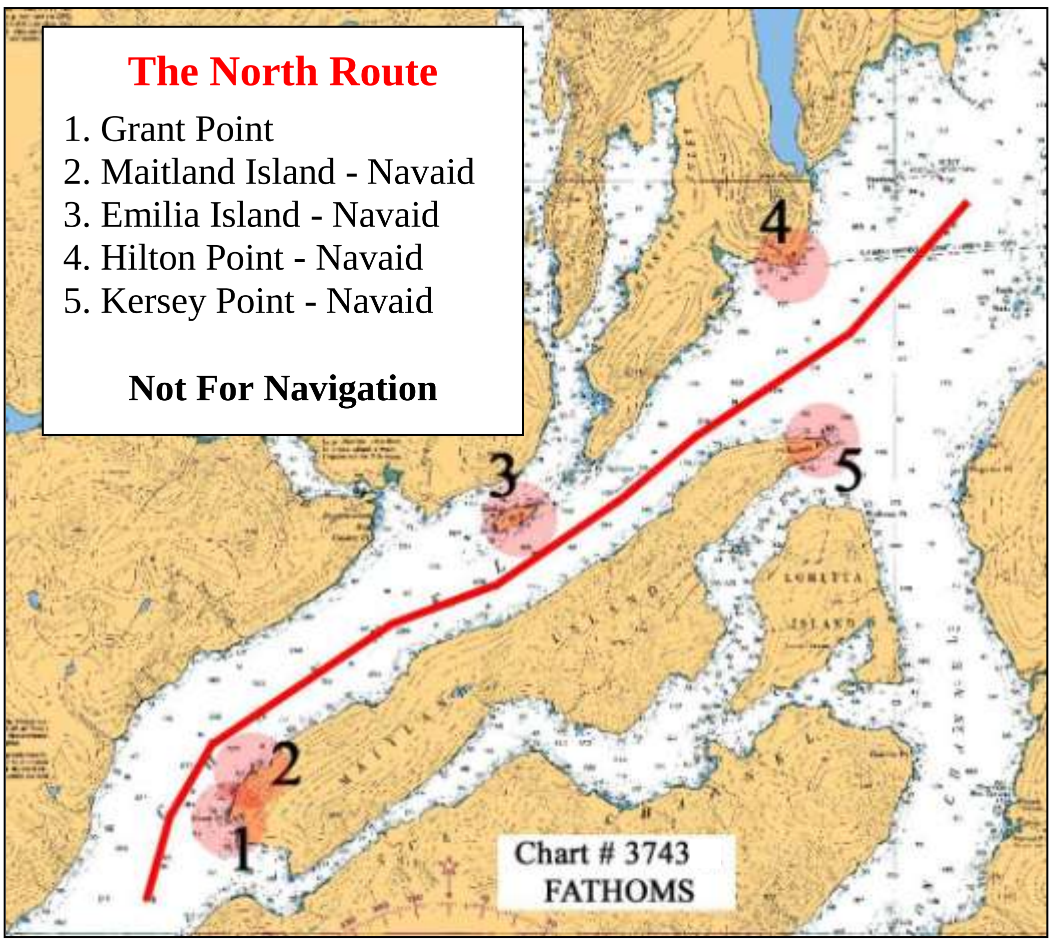

Figure 2-18 Douglas Channel, Mid Part, Kitkiata Inlet to Hilton Point

(Source: Canadian Hydrographic Service Chart No. 3743)

Emilia Island, marked by a flashing light mounted on a white square braced frame tower at the Southeast end of the island, is situated at a distance of 9.3 km northeast of Grant Point, on the northwest side of Douglas Channel. Douglas Channel narrows to a channel width of 1.4 km for the next 5.5 km, with charted depths in excess of 90 m, and with centre channel depths charted as 330 to 365 m.

Though the minimum channel width is about 20 times the breadth of the largest vessel, BCCP may opt to time vessels passing Emilia Island to avoid passing traffic situations.

As the inbound vessel leaves the Emilia Island narrows, the channel widens. Between the flashing lights on the northeast tip of Maitland Island at Kersey Point and Hilton Point to the north, the channel is 4.2 km wide and past Hilton Point, the inbound vessel enters Kitimat Arm and Harbour limits.

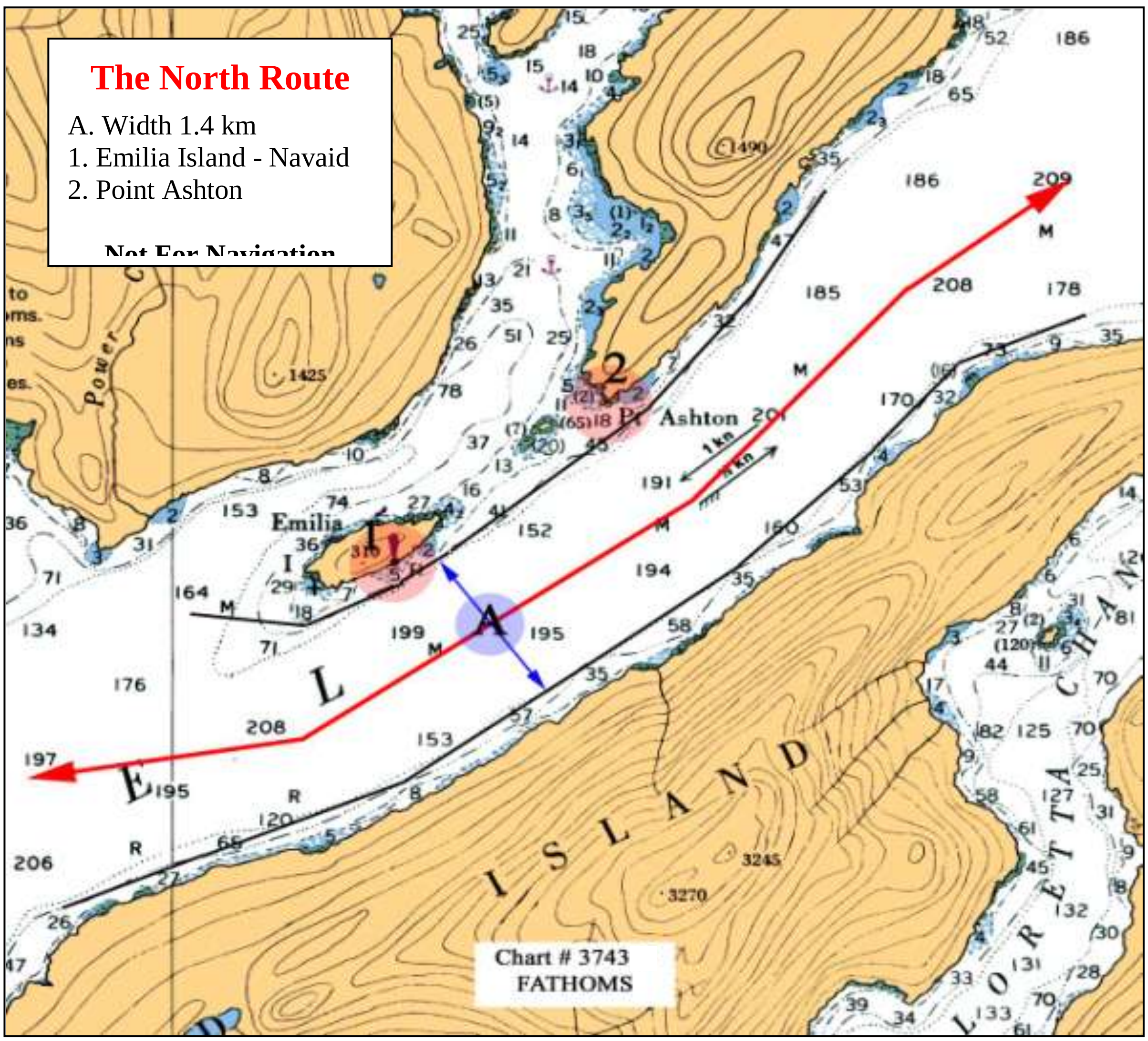

Figure 2-19 Emilia Island Narrows

(Source: Canadian Hydrographic Service Chart No. 3743)

2.1.13 Kitimat Arm

The inbound tanker must clear Nanakwa Shoal and Coste Rocks. Nanakwa Shoal's charted depth is 18 m, and is marked by an Ocean Data Acquisition System (ODAS) Light Buoy with a flashing light. It lies to the northwest of the main channel, which is 2.8 km wide at this point. Coste Rocks lying to the southeast of the main channel are a danger to navigation, situated 1.8 km southwest of Louis Point on Coste Island.

Between Markland Point and Coste Island, the navigable channel is 2.8 km wide, narrowing to 1.8 km wide off Clio Point that is marked by a flashing light mounted on a white square tower. Charted depths are in excess of 180 m almost to the proposed terminal location.

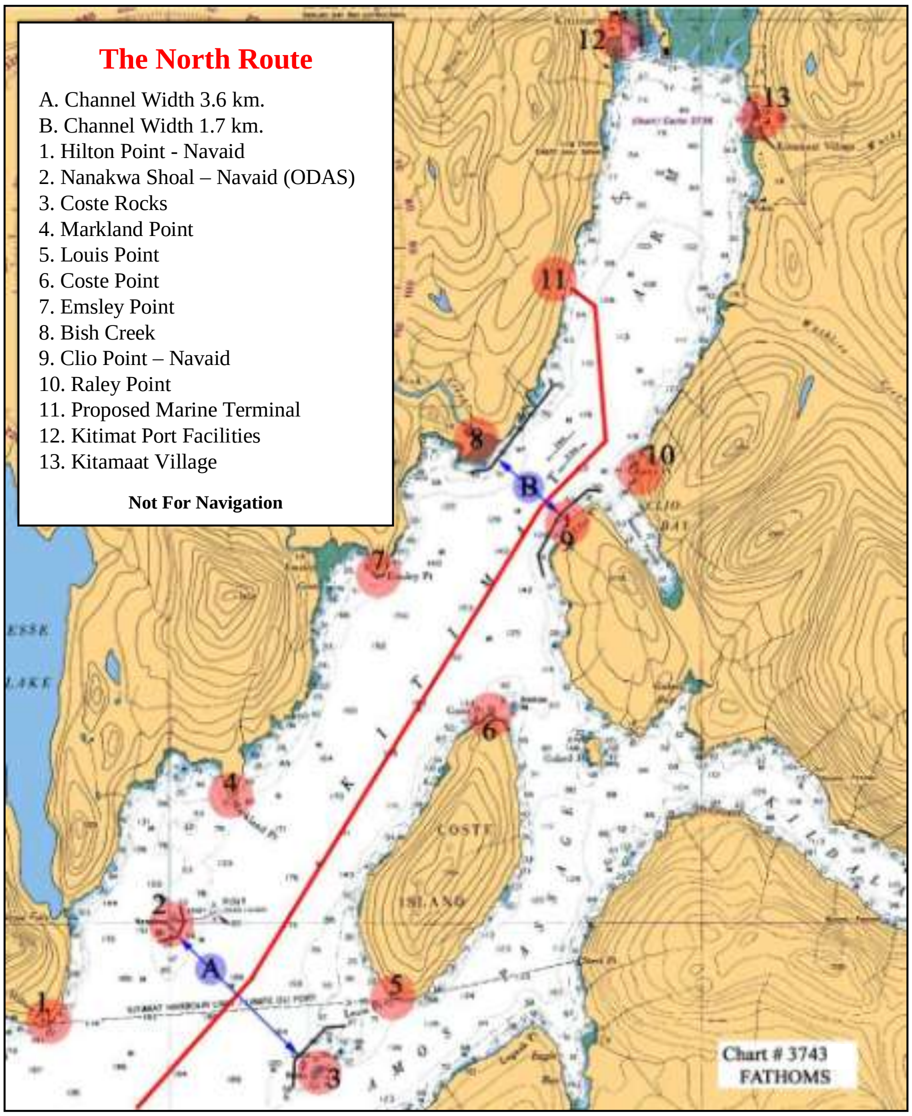

Figure 2-20 Douglas Channel – Kitimat Arm

(Source: Canadian Hydrographic Service Chart No. 3743)

2.1.14 The North Route Summary

The entire route from EOSP near Triple Island to Kitimat Harbour comprises a series of waterways that are wide enough and deep enough for two-way navigation, easily exceeding the minimum clearance guidelines presented in Appendix 2 of the TERMPOL Code.

In accordance with the TRP recommendations, a minimum underkeel clearance of 15 percent of the ship's loaded draught is required. For the design VLCC, with a loaded draught of 23.1 m, this translates to a recommended underkeel clearance of 3.5 m, or a minimum water depth of 26.6 m (14.6 fathoms).

Maximum dynamic criteria as per TERMPOL 3.6 section 4.5 Summary of Cumulative Effects Due to Ship Motions is calculated to potentially require an underkeel clearance of 10.1 m or a cumulative draught effect of 33.2 m (18 fathoms) for safe transit.

The minimum water depth along the entire proposed northern route is equal to or greater than 35 m (19 fathoms). The shallowest areas are located as follows:

- In Dixon Entrance, situated north of Haida Gwaii, with shoaling depths of 36 m (20 fathoms) and less, that should and can be avoided by using the deep water channels to the North or South of Learmonth Bank. See Figure 2-21.
- Within the delineated approach channel from Dixon Entrance to Triple Island Pilot Boarding Area and in the Northern Hecate Strait, from Triple Island to Cape George, (Porcher Island) where charted water depth is more than 36 m (20 fathoms). See Figure 2-22.
- Within the delineated approach channel to Browning Entrance, with a minimum charted depth of 42 m (23 fathoms) located in position Lat.52°42'N Long.130°34.5'W. See Figure 2-23.
- Within the delineated deep-water channel in Principe Channel, near Dixon Island with depths of approximately 88 m (48 fathoms) mid channel and from 56 to 91 m (31 to 50 fathoms) on two significant sub-sea ledges on the NE side of the channel. On one of these ledges in position Latitude 53°33.06'N Longitude 130°09.82'W there is a 35-metre (19-fathoms) patch. This shoal patch can easily be avoided by using the deeper portions of the navigational channel that run adjacent to the shoal patch. See Figure 2-24.
- Within the delineated deep-water channel in Principe Channel, near Sewell Islet with depths of 62 to 91 m (34 to 50 fathoms) on two significant sub-sea ledges on the NE side of the channel. See Figure 2-25.

Given the size, beam and manoeuvrability of the largest design vessel, there are sections of the route as described that are narrow enough to warrant caution with two way traffic flow. In practice, BCCP may communicate with MCTS Traffic Control and with other vessels and adjust speed in order to avoid passing situations at the narrowest sections. Furthermore, given that the average traffic frequency along the entire route has been established as less than 1 vessel per hour, (see TRP Study 3.2) this should be achievable.

Enbridge Northern Gateway is committed to entering into a contractual arrangement with a qualified towage company who will design and construct a suitable fleet of escort and harbour tugs for the Project. A preliminary analysis of tug operations (which will be refined in future phases of the project) indicates a requirement in the order of five escort tugs of approximately 10,000 HP capacity, and two harbour tugs of approximately 5,000 HP capacity.

Navigation marks and lights in the area are relatively sparse, but the steep-to rocky coastline throughout will give excellent radar returns. Improvements to the navigation aids are discussed in Section 5.1 of this report. Generally, the foreshore along the route shelves quickly to depths greater than 36 m (20 fathoms) within close proximity to the shoreline.

The route as described is suitable for the navigation of the largest VLCC design vessel, and by default, also the SUEZMAX and AFRAMAX class vessels; however, due to the length and remoteness of the route at 160 nm (300 km), it is recommended that back up contingencies and plans are in place, such as tug escort, contingency for machinery failure and operational procedures ready for implementation in the event of a delay or incident.

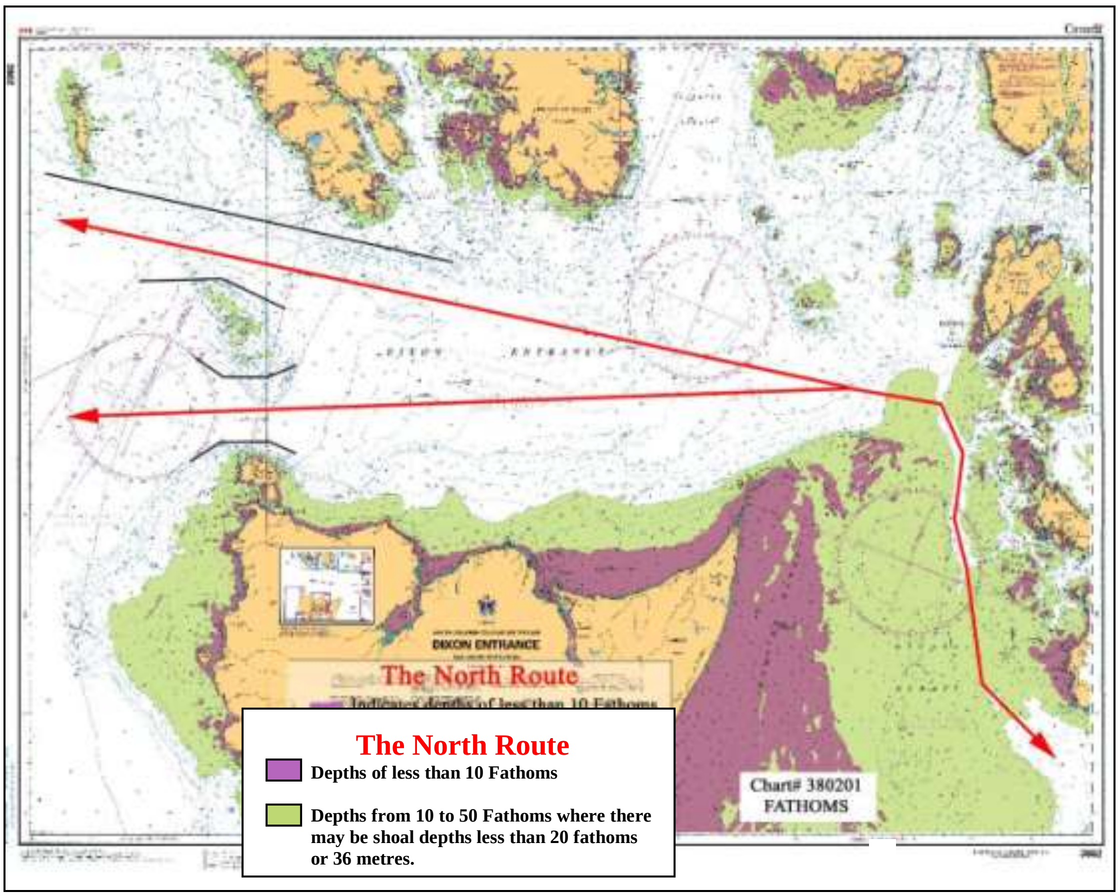

Figure 2-21 Dixon Entrance (Learmonth Bank)

(Source: Canadian Hydrographic Service Chart No. 3802)

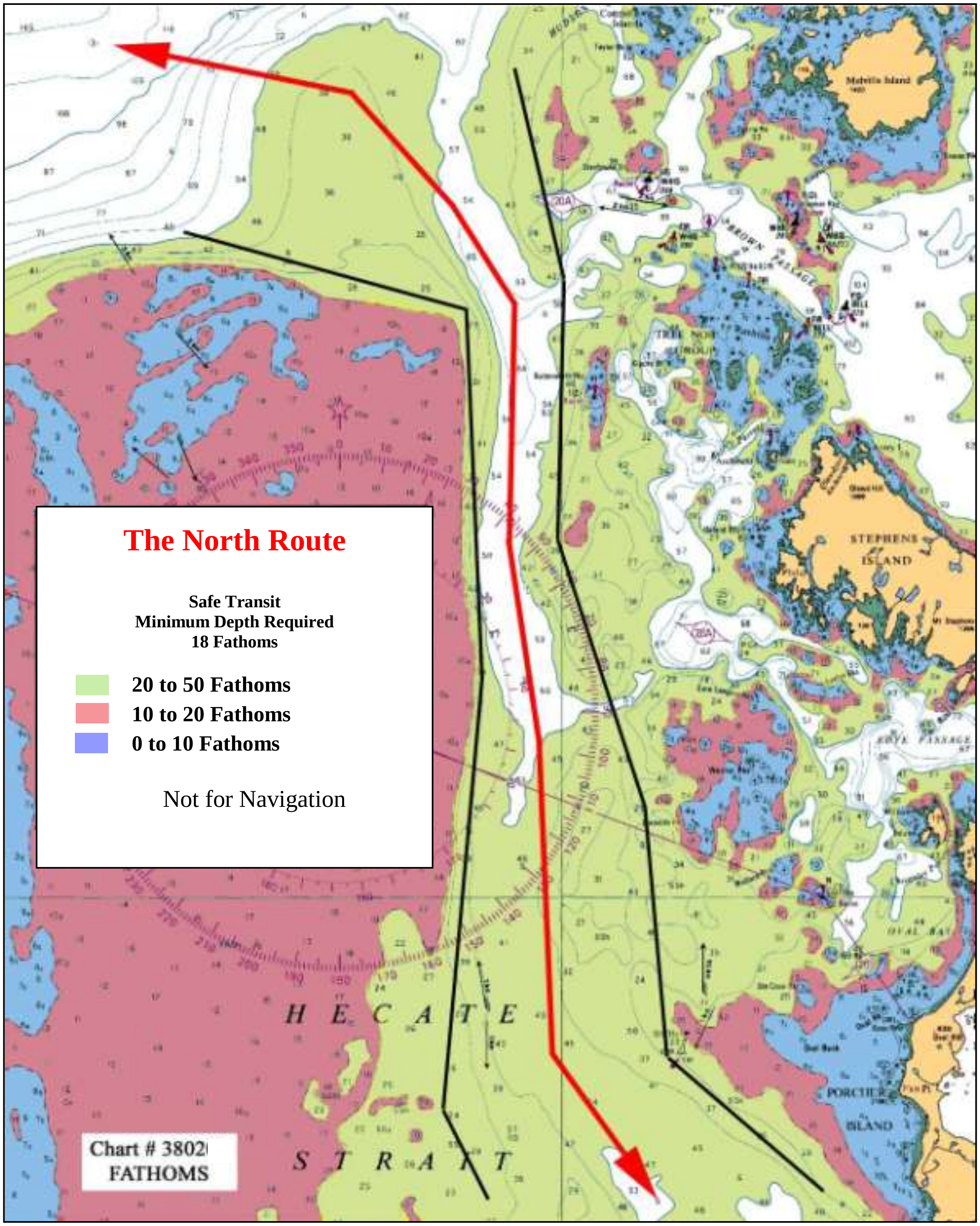

Figure 2-22 Eastern Dixon Entrance and Northern Hecate Strait

(Source: Canadian Hydrographic Service Chart No. 3802)

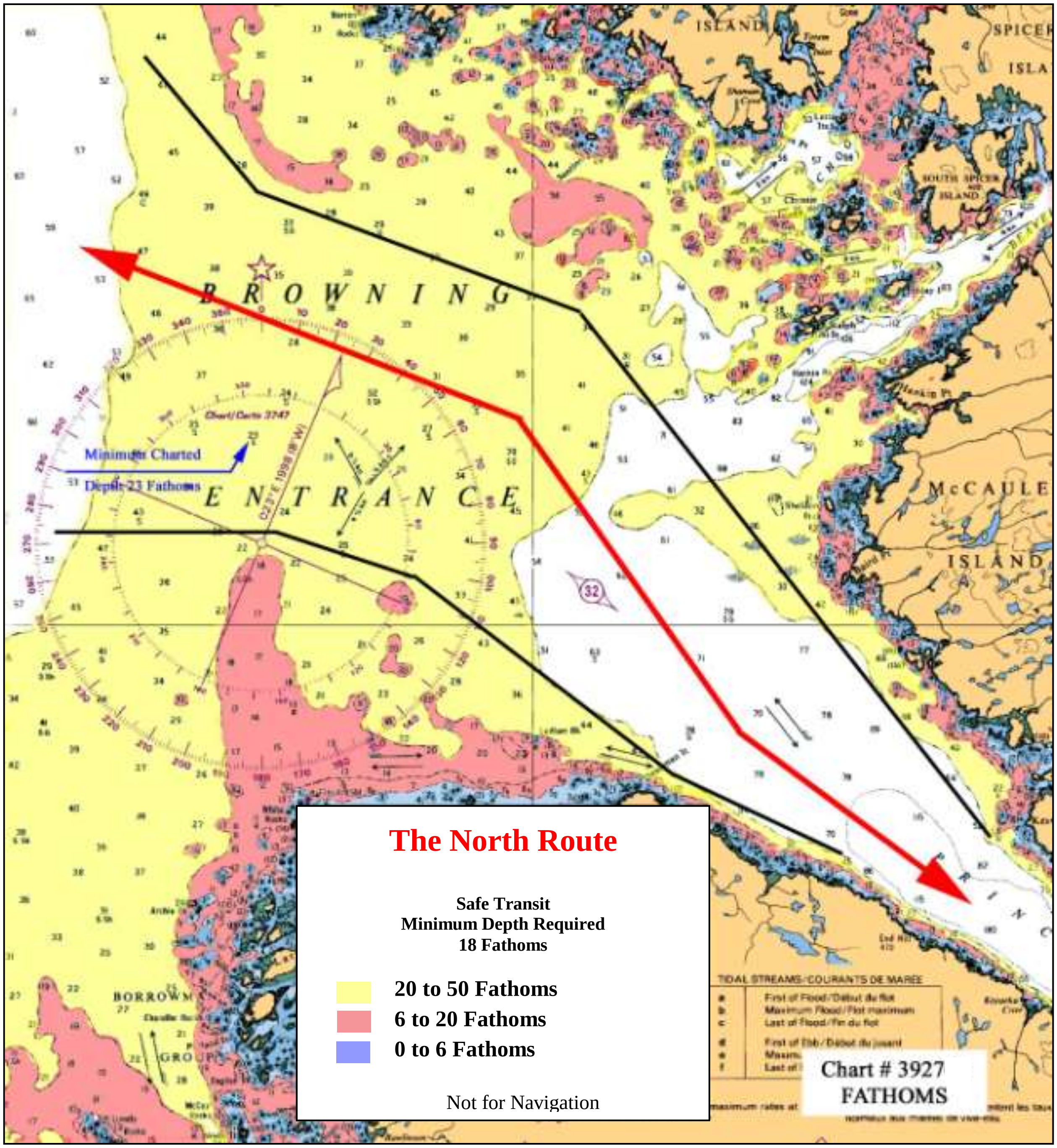

Figure 2-23 Browning Entrance

(Source: Canadian Hydrographic Service Chart No. 3927)

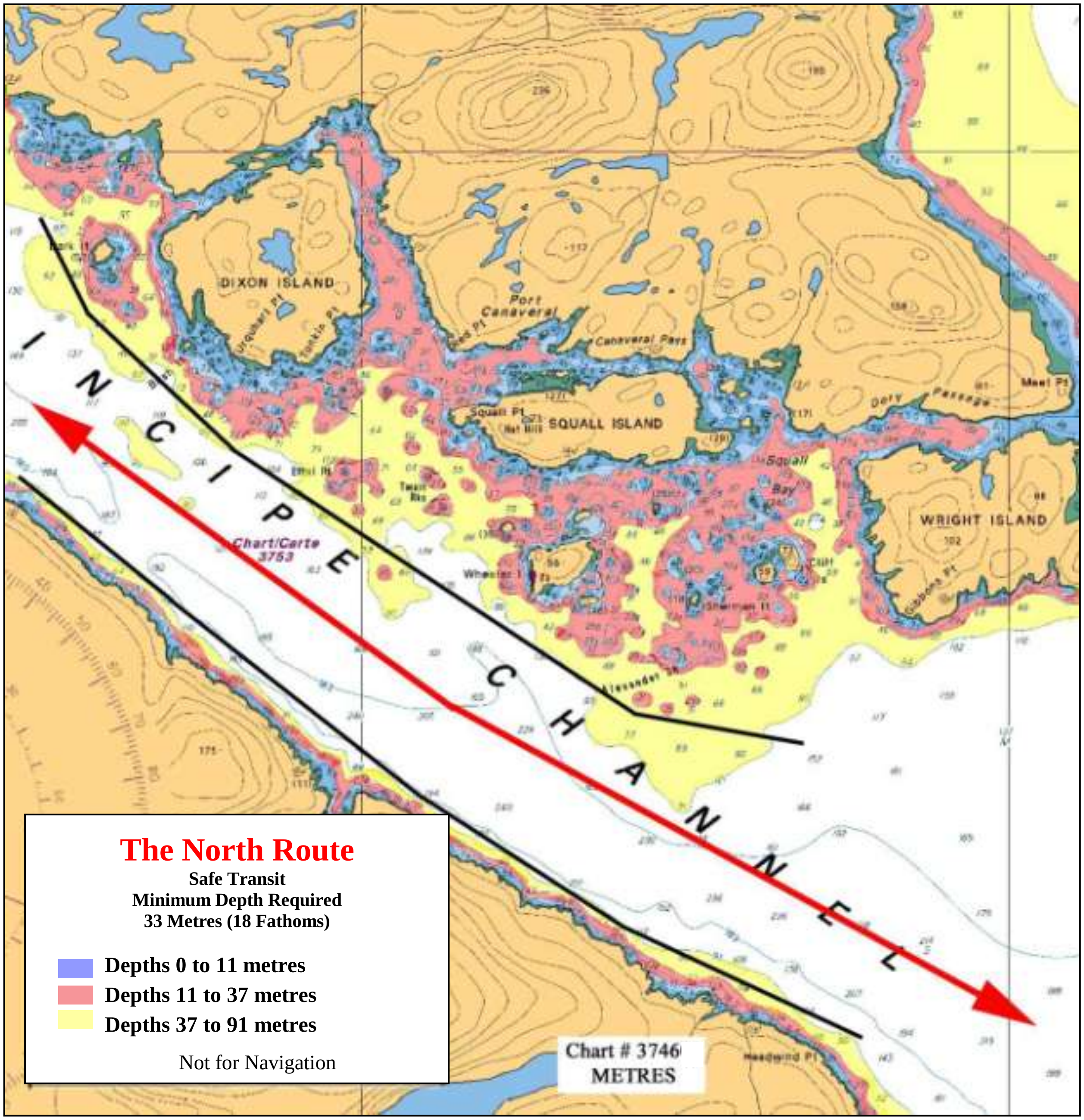

Figure 2-24 Principe Channel, Dixon Island

(Source: Canadian Hydrographic Service Chart No. 3746)

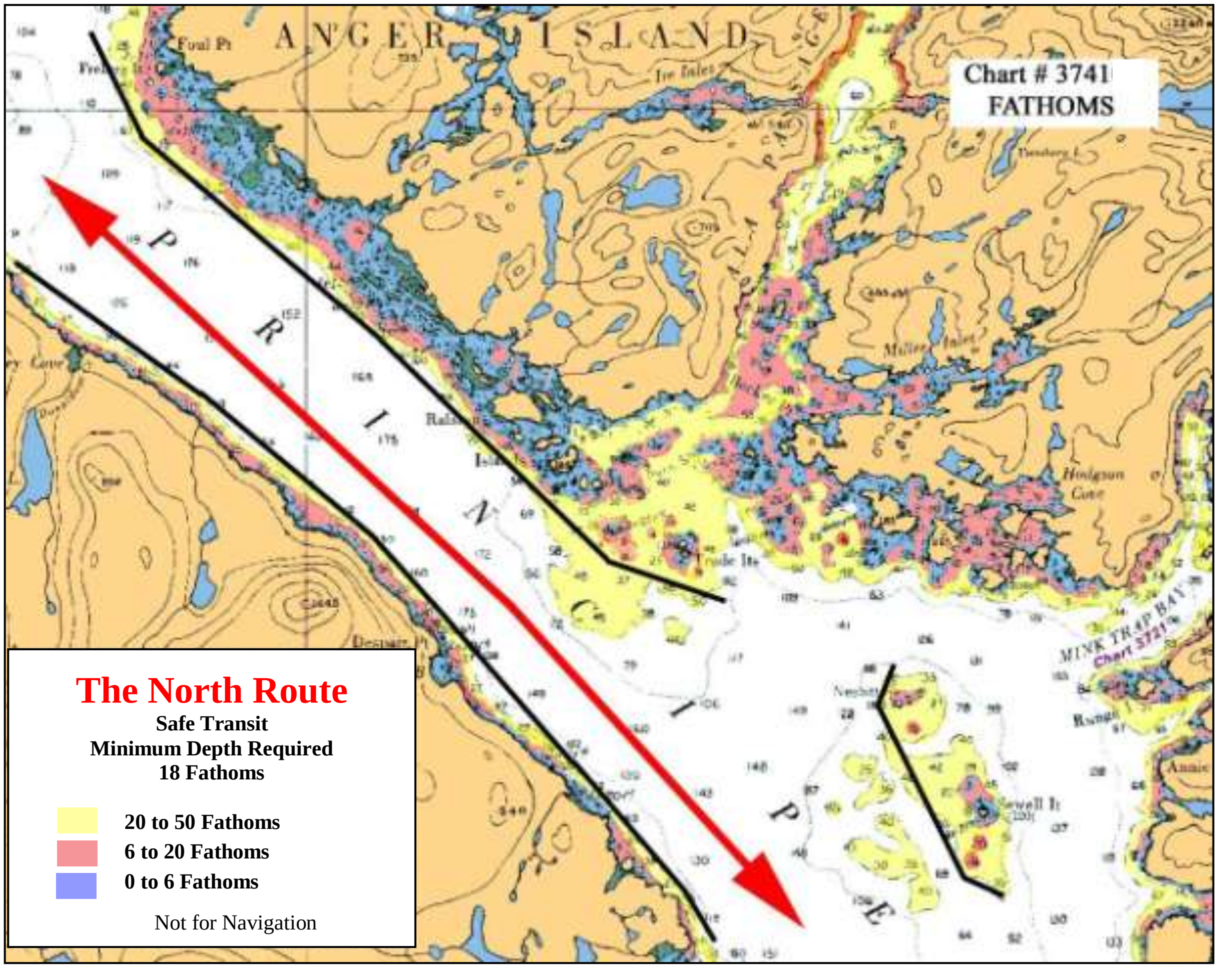

Figure 2-25 Principe Channel – Sewell Islet

(Source: Canadian Hydrographic Service Chart No. 3741)

The north route for vessels outbound to the open sea will, in general, be the reverse of the inbound route described in detail above. Vessels outbound will include:

- Import condensate vessels AFRAMAX or SUEZMAX that have discharged cargo and are sailing either in ballasted condition or, in loaded or part loaded condition, having taken export cargo.
- Export VLCC's and SUEZMAX tankers in loaded condition.

Tankers in ballasted condition are more subject to the effects of cross winds than when they are in the laden condition, due to less draught and more ship above water.

In the laden condition because of the deep draught, the effects of tidal and ocean currents normally have the greatest effect. The largest design vessel (VLCC Tanker) is expected to make the inbound route in the ballasted condition and will be in the fully laden condition, with maximum draught for the out-bound route.

2.2 The Alternative South Routes

The majority of condensate-laden tankers and VLCC's in ballasted condition, bound for the proposed marine terminal at Kitimat, will be arriving from Asian ports and are most likely to transit the route described in Section 2.1 above.

Other tankers, either import or export, and either loaded or ballasted, may opt to use a southern approach or departure route, see Figure 2-2.

Alternative shorter routes that reduce transit times may be desirable. Note that Lewis Passage, Wright Sound and Douglas Channel are common to all routing options to and from Kitimat.

2.2.1 Inner Passage

From Wright Sound, much of the existing regional marine traffic transits the Inner Passage, including a route to the south through Princess Royal Channel. In discussions with BCCP and through consideration of the narrow portions of the channels, the Inner Passage route for navigation by the proposed design deep sea tankers, laden or in ballast is not recommended.

2.2.2 Whale Channel

A common route for vessels bound to or from southern ports is through Whale Channel instead of Squally Channel and Lewis Passage. However, the major turns in the channel southbound may prove more difficult in strong following outflow winds and the channel is narrower and more winding than Lewis Passage. Transit of Whale Channel is viable, but is not a preferred route for the design vessels.

Outbound vessels leaving Douglas Channel, would cross the Inner Passage traffic flow nearer the eastern end of Wright Sound, to enter the northern end of Whale Channel. This is an existing route for southbound traffic leaving Kitimat and not using the Inner Passage.

The northern part of Whale Channel from Wright Sound to Shrub Point on Gil Island is deep and almost 5.5 km wide. From Shrub Point to Molly Point on Gil Island, the channel narrows to 3.3 km before turning to the west between Molly Point and York Point on Gil Island.

The channel is narrower south of Gil Island where vessels are required to navigate a series of bends in the deep-water channel. This shallow "S" curve through the southern part of Whale Channel includes the turns off Molly Point, York Point and the subsequent turns off Ashdown Island, as shown in Figure 2-26. The bends in the channel require a total of 109 degrees of course change in one direction followed closely by 109 degrees in the other direction to manoeuvre through entirely, with quite small distances between course changes. The channel remains deep water throughout with charted depths of 90 m or more with a minimum channel width of 1.5 km.

For the design vessels, AFRAMAX, SUEZMAX and VLCC tankers, Whale Channel is a viable route, but lower in preference to Lewis Passage and Squally Channel to make Caamaño Sound. This is due to the relative navigational complexity of Whale Channel in comparison to Lewis Passage. In addition, the viability of Lewis Passage as a route makes the use of Whale Channel unnecessary. The difference in travel distance between the two is negligible, being only 1.1 nm (2 km).

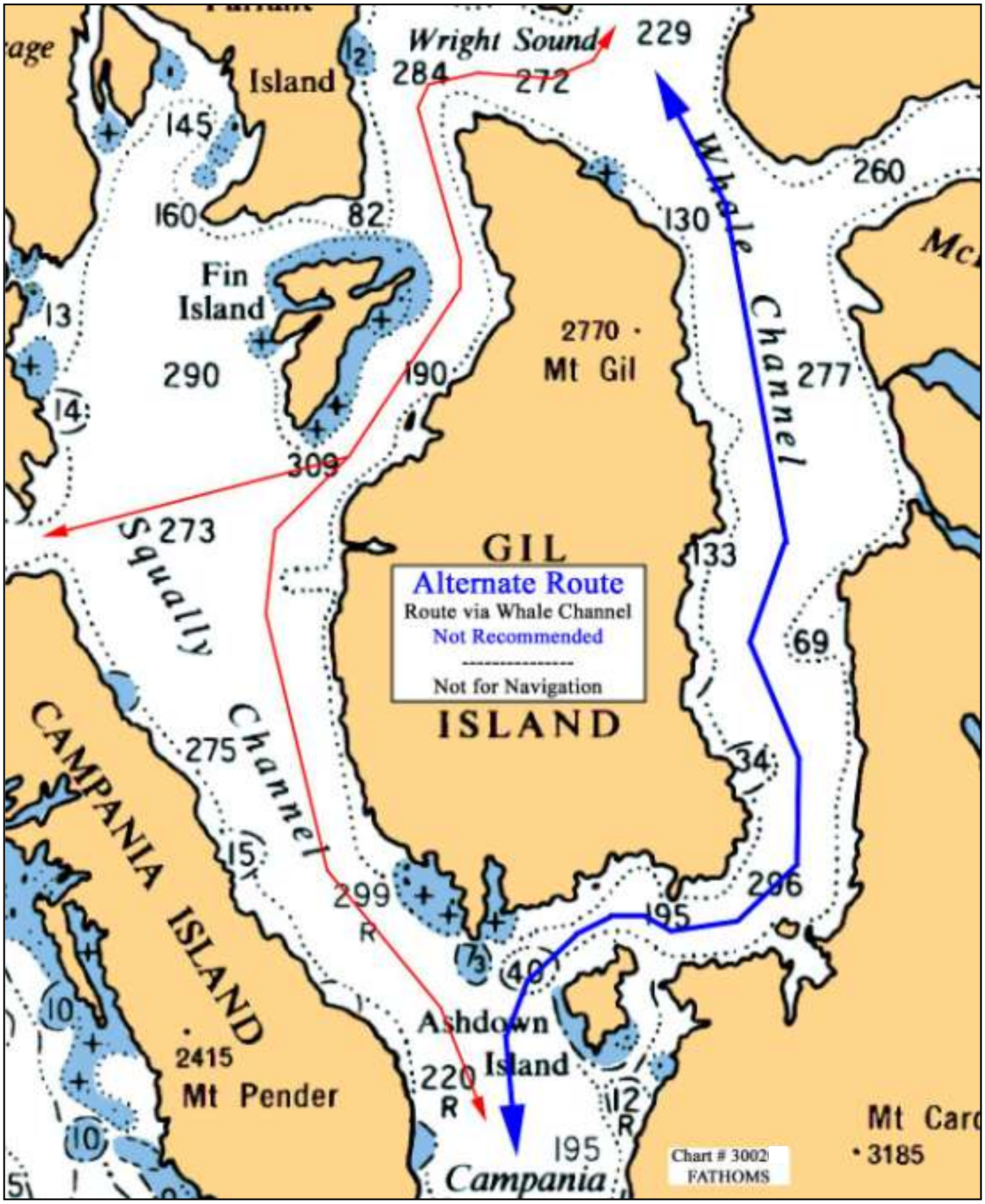

Figure 2-26 Whale Channel (Not Recommended)

(Source: Canadian Hydrographic Service Chart No. 3002)

2.2.3 Laredo Channel and Laredo Sound

Some coastal vessels use Laredo Channel and Laredo Sound as shown in Figure 2-27. Vessels from Squally Channel or Whale Channel cross the head of Caamaño Sound that opens to Laredo Channel. The Laredo routes, which constitute the southern portion of the recognized Outside Passage, provide moderate sheltering from the exposed conditions seaward of Caamaño Sound for coastal traffic.

Although Laredo Channel has a minimum channel width of over 900 m, or 13 times the maximum breadth of the largest VLCC design vessel, and there is sufficient water depth in the channel, generally more than 90 m (49 Fathoms), it is not proposed that the design vessels use Laredo Channel and Laredo Sound because of the following considerations:

- The route is considered viable for smaller Aframax ships in ballasted condition, but alternate routes that are more navigable make the Laredo Channel route redundant and unnecessary;
- Proximity of the channel to navigational dangers including the charted navigational dangers of Wilsons Rock and Morehouse Rock with shoals in the vicinity of each, located close to the channel in the narrowest section. Laredo Sound is also guarded by shoal waters; and,
- The narrowest section of Laredo Channel north of Wilson Rock requires extra care in navigation. Vessels should adjust speed and avoid passing other vessels in the narrowest part of the channel.

The use of Laredo Channel would lengthen the piloted coastal section in comparison to the alternative routing through Caamaño Sound. In severe conditions, no benefit would be gained by a vessel entering or departing through Laredo Sound, as compared to Caamaño Sound. In contrast, Principe Channel offers the option of anchorage, adjusting speed, or holding position to await the passing of severe weather.

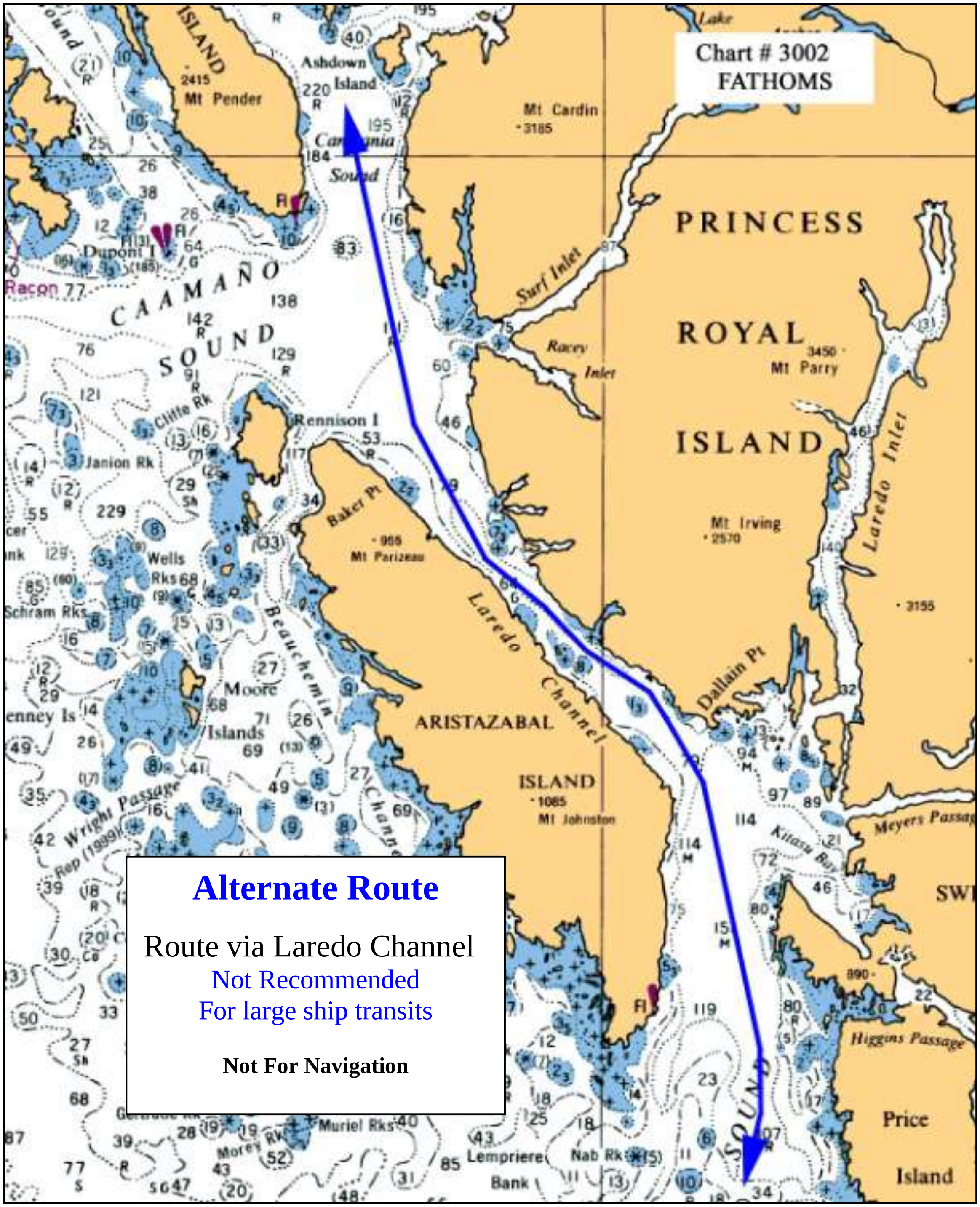

Figure 2-27 Route via Laredo Channel (Not Recommended)

(Source: Canadian Hydrographic Service Chart No. 3002)

2.2.4 Squally Channel and Campania Sound

From the common route point of Lewis Passage, the south route using Caamaño Sound is via Squally Channel and Campania Sound. This is a reasonably straight, deep and wide option, suitable for navigation by very large vessels.

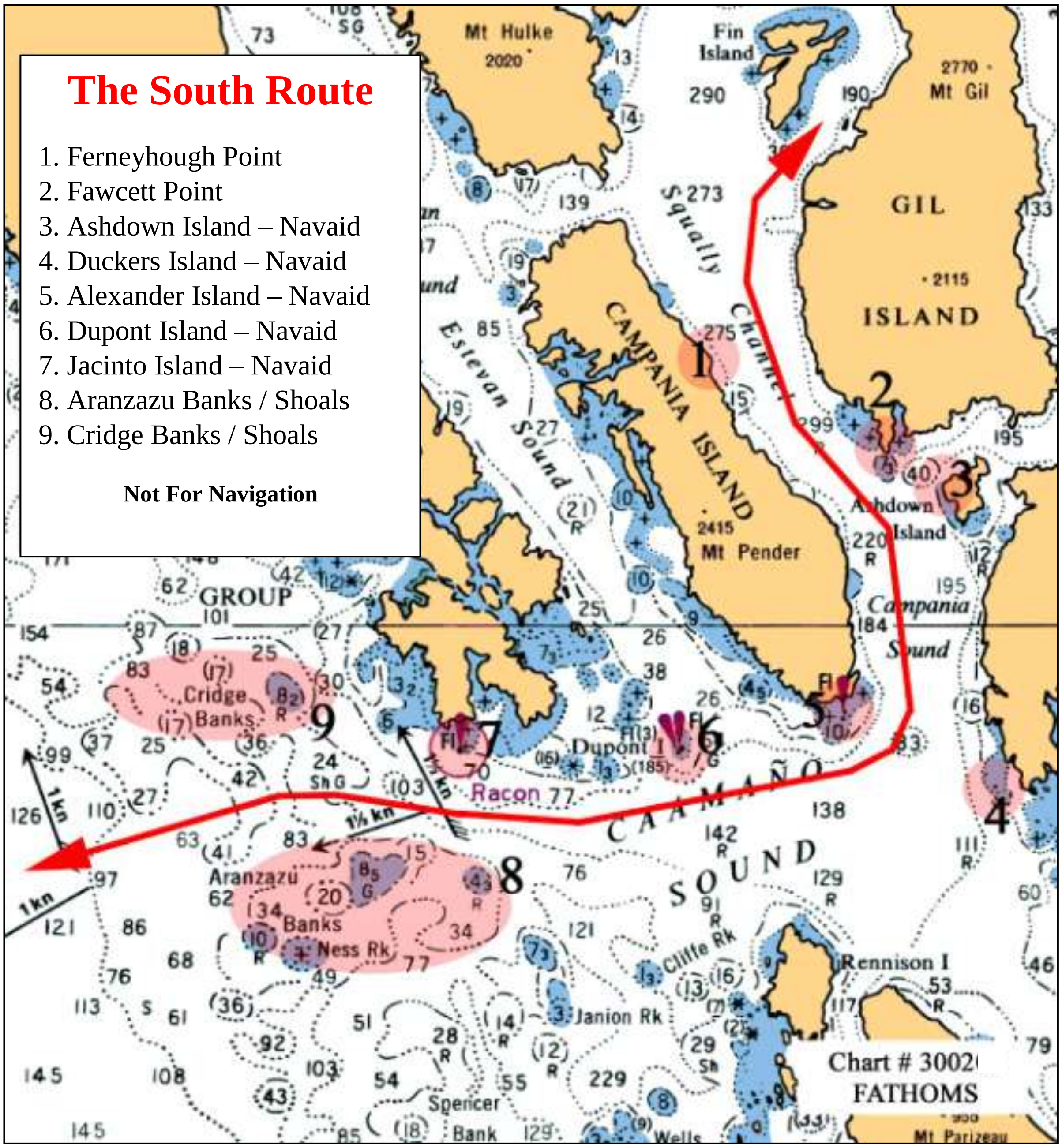

Figure 2-28 Lewis Passage to Caamaño Sound

(Source: Canadian Hydrographic Service Chart No. 3002)

The width of Squally Channel varies from about 9 km down to 3.4 km at the narrowest section off Fawcett Point, of Gil Island. Charted water depths are in general more than 549 m (300 fathoms).

From Fawcett Point, the channel widens out and becomes Campania Sound that is generally wider than 4.5 km with charted water depths in excess of 183 m (100 fathoms). Campania Sound leads into Caamaño Sound.

2.2.5 Caamaño Sound

Caamaño Sound provides direct access to Queen Charlotte Sound and the open sea for vessels coming from Douglas Channel, via Wright Sound, Lewis Passage, Squally Channel and Campania Sound.

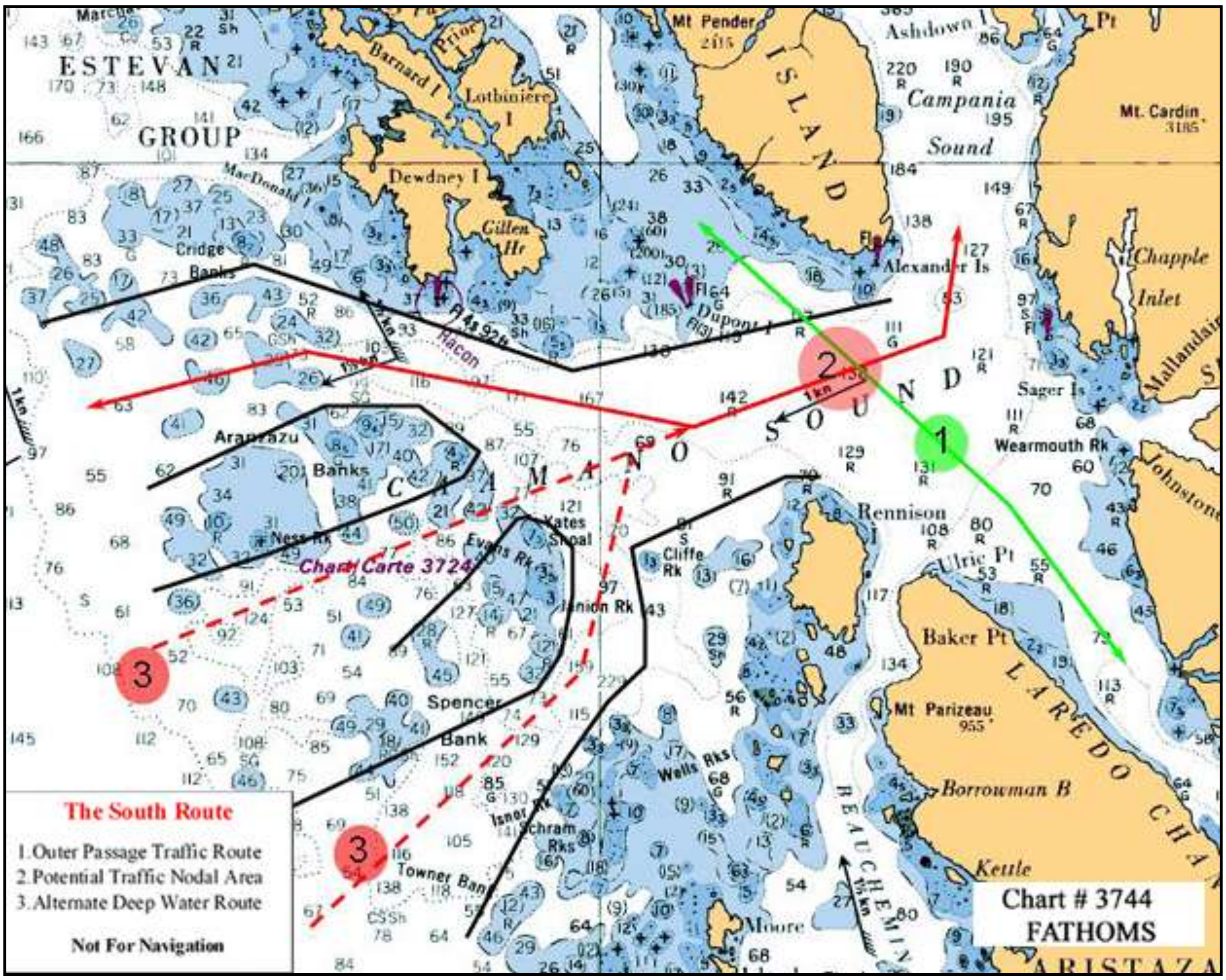

Figure 2-29 Caamaño Sound – Deep Water Route

(Source: Canadian Hydrographic Service Chart No. 3744)

During winter storms, high seas and swells combined with strong crosswinds and currents create difficult navigational conditions in Caamaño Sound. Generally, navigation through Caamaño Sound by the BCCP is limited to moderate weather conditions.

However, this southern route significantly reduces overall transit times between southern port destinations and the Kitimat area, and also reduces coastal navigation times for northbound vessels. Accordingly, it is considered an important commercial route for Kitimat businesses. As a consequence, the Canadian Hydrographic Service (CHS) has collected additional hydrographic survey data of the area since the summer of 2006 which has been used to revise the existing charts and also to prepare Electronic Nautical Charts (ENC) for use by mariners. The new charts will provide greater confidence in the charted depths in the area.

The preferred route generally used by the BCCP into Caamaño Sound from Hecate Strait is via the deep water section between Cridge Banks to the northwest and Aranzazu Banks to the south as shown in Figure 2-29. There are also two possible alternative routes into Caamaño Sound as shown by the dashed red lines.

The first alternate route lies between Aranzazu Banks and Yates Shoal and is approximately 4.0 km (2.2 nm) wide at its narrowest section with minimum depths of 36.5 m (20 fathoms). This route has inner shoal patches with possible water depths as shallow as 38.4 m (21 fathoms). Due to the uncertainty of the current hydrographic data for Caamaño Sound, this route will be subject to verification from the ongoing CHS charting update program. Although this alternate route provides a fairly straight course into Caamaño Sound, it is likely to be viable only if Ness Rock and the inner shoal patches are marked with navaids.

The second alternate route lies between Spencer Banks and Wells Rocks in the south and Yates Shoal and Cliffe Rock in the north. The narrowest section of this route is approximately 3.5 km (1.9 nm) wide between Evans Rock and Cliffe Rock with a minimum depth of 91 m (50 fathoms). Although this route avoids shallow shoal patches, it does require more vessel course corrections than the other routes. Additional navaids will likely be required for this alternate route as well.

In Caamaño Sound, the deep water route crosses with the Outside Passage route, shown as a pink shaded area in Figure 2-29. Although this area is subjected to meeting and crossing traffic, traffic frequencies on both routes are typically light.

Caamaño Sound therefore offers a good fair weather alternative route where there is:

- Open waters, the useable channel being a minimum of 2.5 nm (4.6 km) wide.
- Relatively good navigational aids including a radar responder beacon (Racon) situated at the northern entrance, which is the preferred channel.
- Little to restrict larger vessels ability to manoeuvre for evasive action, the waterway being wider and more open than any other possible alternate route.
- Re-surveyed charted depths, using modern up-to date technology.

Pilot exchange may need to be arranged at a new location or by helicopter for this route to work effectively, since it is not recommended that tankers the size of the design vessels be asked to approach the established Pine Island Pilot Station in Gordon Channel, Queen Charlotte Strait. Approaching Pine Island Pilot Station as shown on Figure 2-30 is considered an unnecessary navigational risk, since the waters in the vicinity of Pine Island comprise a busy waterway with converging and diverging traffic. An approaching design vessel would meet other traffic in crossing, converging and end-on situations. Whilst waiting for pilots to board or disembark there would likely be other vessels, such as cruise ships waiting their turn. During summer months, the cruise ship industry is prolific, and several vessels often have to await pilots.

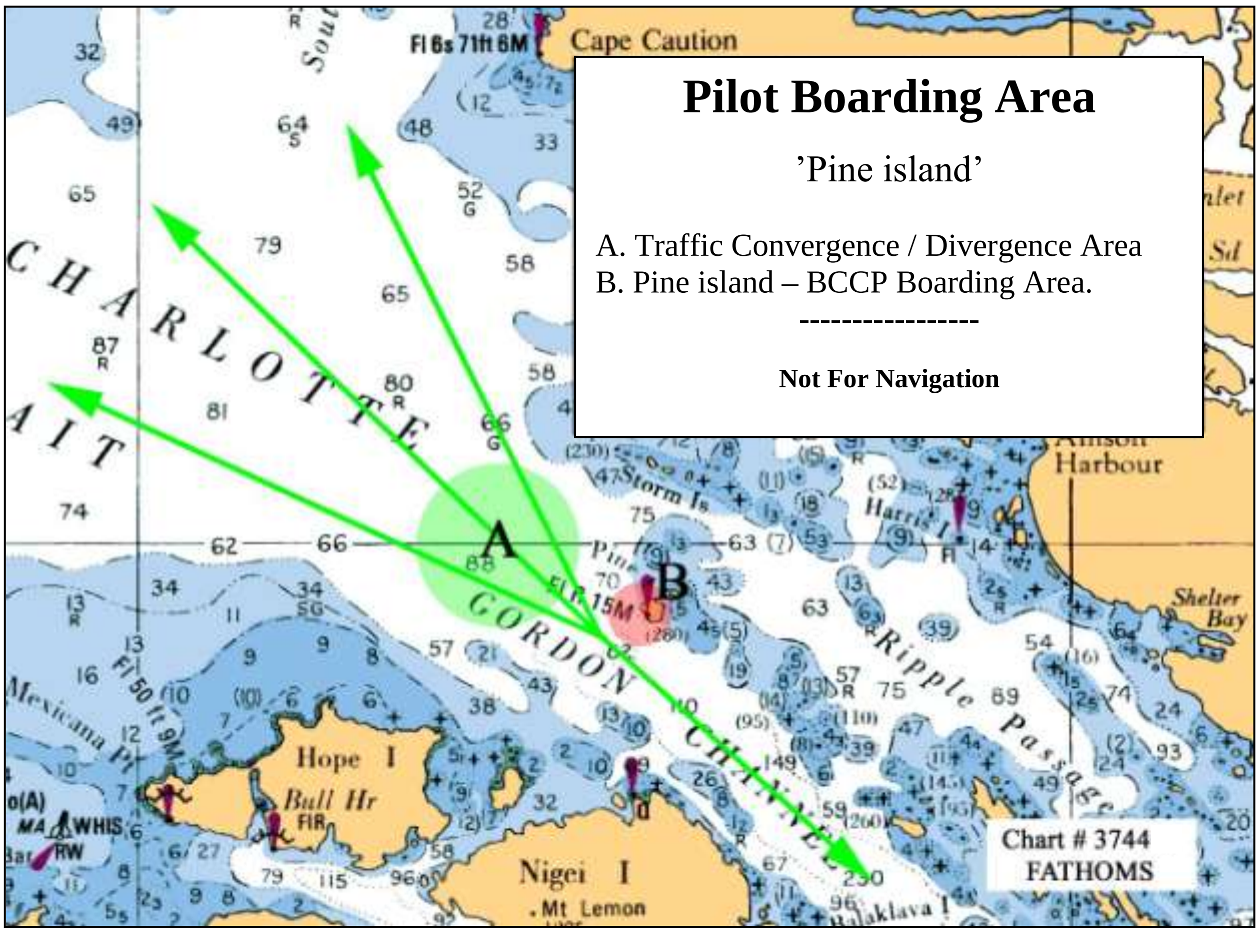

Figure 2-30 Pilot Boarding – Pine Island

(Source: Canadian Hydrographic Service Chart No. 3744)

2.2.6 Southern Hecate Strait

This route could be used and may be required for vessels bound to or from the south in instances where heavy weather and/or residual swell conditions would prevent safe navigation through Caamaño Sound. Vessels arriving during severe weather could either voluntarily, or as directed by the BCCP and/or VTS, delay their arrival, to await the passing of a storm.

Hecate Strait, shown in Figure 2-31, is subject to stronger winter conditions compared to the relatively sheltered waters of the Outside Passage. However, the approach to and departure from Browning Entrance is relatively straightforward navigation, with sufficient water and manoeuvring area for the design vessels. The deep water channel in Hecate Strait runs adjacent to the west side of Banks Island. The narrowest section of the route lies due west of the northern end of Banks Island where the deep water channel is approximately 3.5 km (1.9 nm) wide with a minimum depth of 91 m (50 fathoms). Near the south end of Banks Island the deep water channel widens to approximately 18.5 km (10 nm) within water depths of 91 m (50 fathoms) or greater. South of Banks Island the deep water channel widens substantially, creating a wide navigable area as Hecate Strait joins with Queen Charlotte Sound.

Pilot exchange may need to be arranged at a new location such as the northern end of Principe Channel or by helicopter, for this route to work effectively.

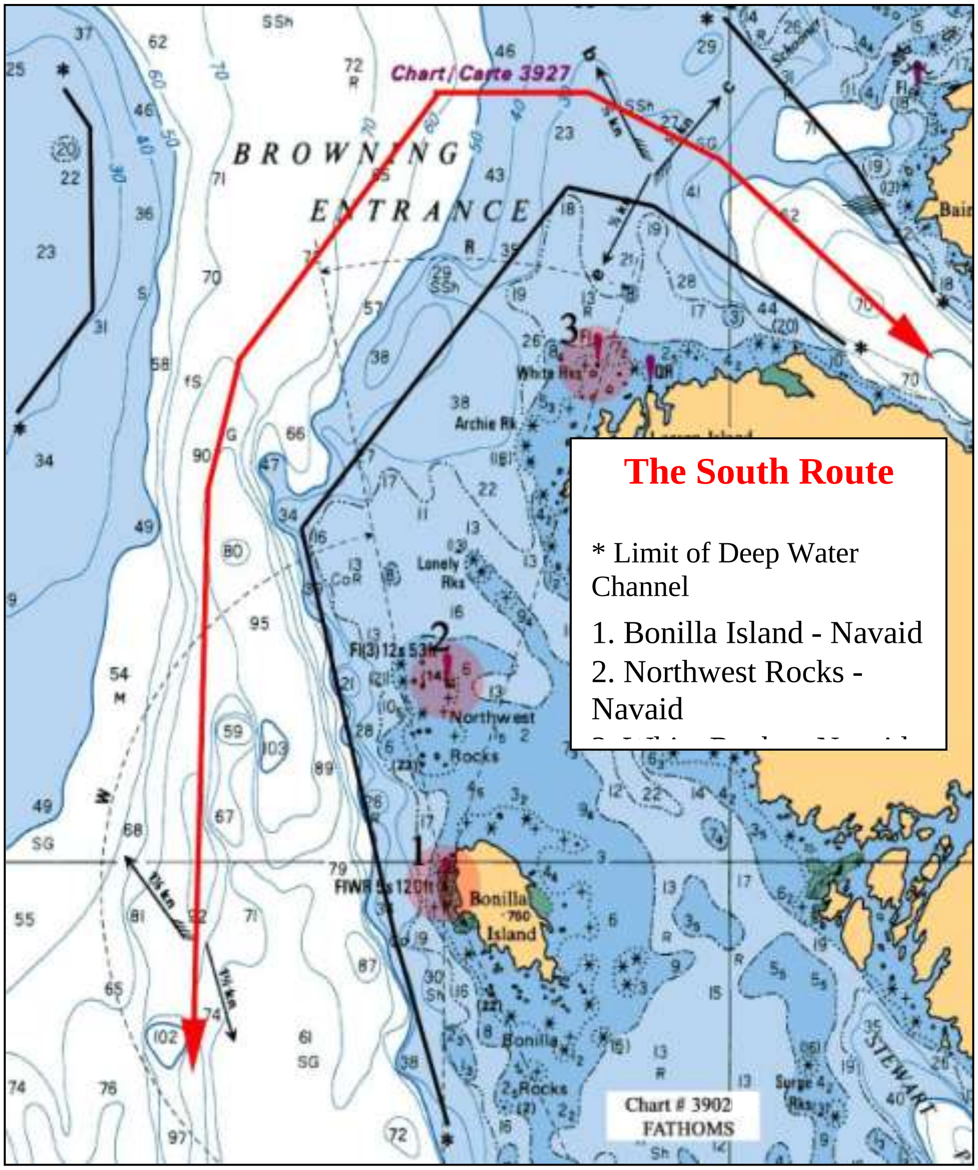

Figure 2-31 Southern Route to/from Browning Entrance

(Source: Canadian Hydrographic Service Chart No. 3902)

2.2.7 The South Route Summary

Squally Channel and Campania Sound offer a reasonably straight, wide and deep channel from Lewis passage to Caamaño Sound. Thus, the preferred alternate southern outbound routes consist of:

- Routing via Lewis passage, Squally Channel, Campania Sound, Caamaño Sound and Hecate Strait in fair weather conditions only.
- Routing via Lewis passage, Otter Channel, Principe Channel, Browning Entrance and Hecate Strait to open ocean in weather conditions where Caamaño Sound cannot be used.

The following alternate routes were considered and were determined to be less viable for navigation by the design vessels:

- The Inner Passage – Not recommended due to the narrow width of the channels. This is concurred by the BCCP.
- Whale Channel – Viable but not preferred due to navigational complexity and the availability of a better option.
- Laredo Channel and Laredo Sound – Not recommended due to increased navigational risk.

With the exception of one 35 m (19 fathoms) patch, minimum water depth along the entire proposed southern route(s) is more than 36 m (20 fathoms), with the shallowest parts located:

- In Caamaño Sound, for the preferred route with shoaling depths outside of the deep-water channel, near the entrance of 36 m (20 fathoms) and less. Whilst within the delineated channel, the least depth is charted as 42 m (23 fathoms) located in position Latitude 52°54.5N Longitude 129°42.4'W, see Figure 2-29.
- In Caamaño Sound, for the first alternate route south of Ness Rock which also has shoals within the delineated channel, the least depth of which is charted as 38.4 m (21 fathoms). Although this depth exceeds the required underkeel clearance depth, the viability of this alternate route is subject to confirmation by the current CHS hydrographic charting update program.
- Within the delineated deep-water channel in Principe Channel, near Sewell Islet with depths of 62 to 91 m (34 to 50 fathoms) on two significant sub-sea ledges on the NE side of the channel. See Figure 2-25
- Within the delineated deep-water channel in Principe Channel, near Dixon Island with depths of approximately 88 m (48 fathoms) mid channel and from 56 to 91 m (31 to 50 fathoms) on two significant sub-sea ledges on the NE side of the channel. On one of these ledges in position Latitude 53°33.06'N Longitude 130°09.82'W there is a 35 m (19 fathoms) patch. This shoal patch can easily be avoided by using the deeper portions of the navigational channel that run adjacent to the shoal patch. See Figure 2-24.
- In the area of Browning Entrance, when departing Principe Channel and rounding the northern end of Banks Island, with a minimum charted depth of 42 m (23 fathoms) located in position Lat.52°42'N Long.130°34.5'W. Deeply laden vessels leaving Principe Channel for Hecate Strait on the South Route, must be well clear of the delineated channel as per Figure 2-23 before turning to head south through Hecate Strait, to avoid shallower waters inshore.

Navigation marks and lights are sparse, but the steep-to-rocky coastline throughout will give excellent radar returns. Generally, the seabed shelves to depths greater than 36 m (20 fathoms) close in to the shoreline.

The South Route(s) as described are suitable for the navigation of the largest VLCC design vessel and by default, also the SUEZMAX and AFRAMAX classes, provided that due to the length and remoteness of the routes at 130 nm (240 km) or via Caamaño Sound, 100 nm (185 km) it is recommended that back up contingencies and plans are in place, such as tug escort as contingency for machinery failure and operational procedures ready for implementation in event of delay or incident. Improvement of NAVAIDS would also enhance navigational safety.

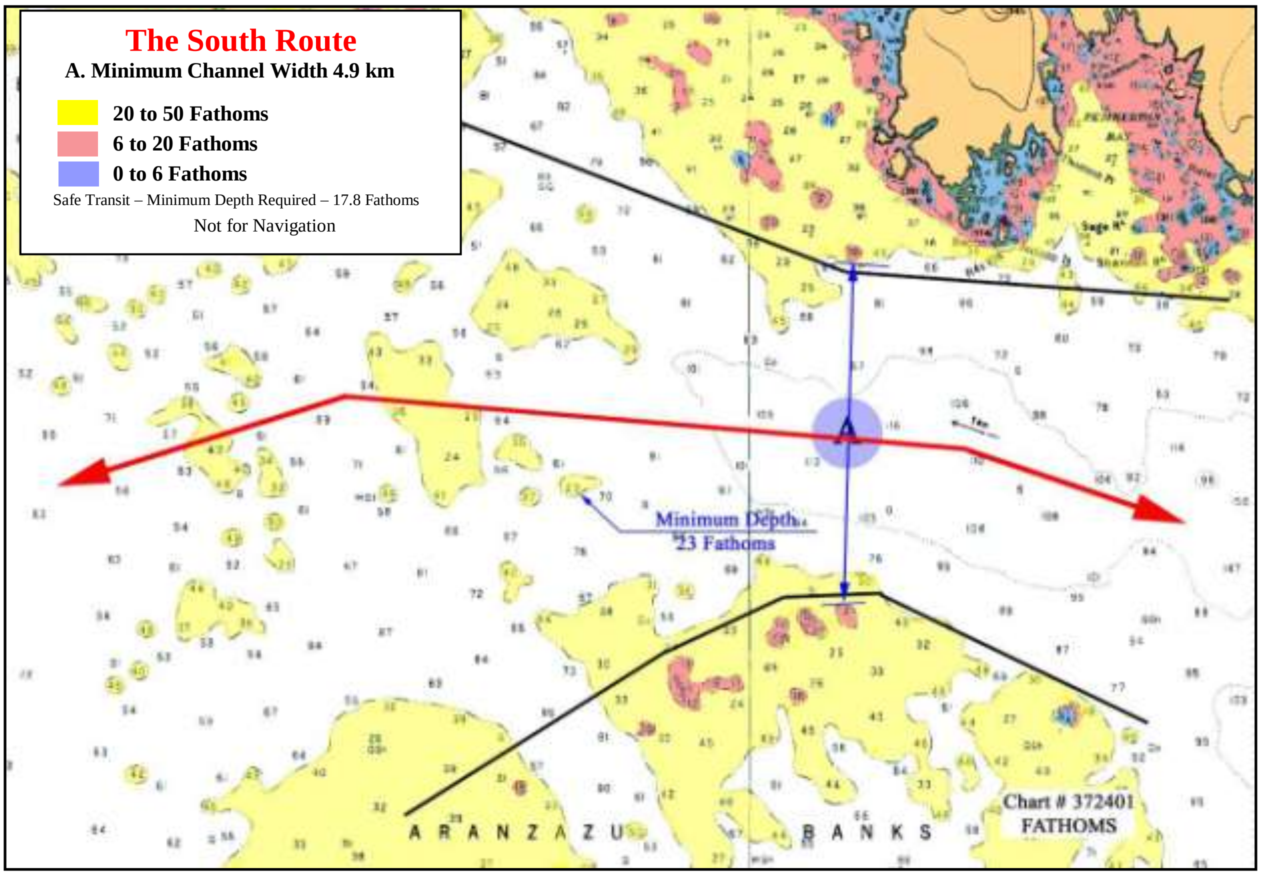

Figure 2-32 Caamaño Sound

(Source: Canadian Hydrographic Service Chart No. 3724)

3 Geographical and Geological Factors

Hydrographic factors to be taken into account include:

1. The nature of the coastline.
2. The remoteness of the coastline.
3. The alignment and topography of the coastline.
4. Seismic activity.

Each of these factors is described in the following sections.

3.2 The Nature of the Coastline

Along the proposed route, the general nature of the coastline is one of steep and rocky shores that plunge from heights well above sea level to depths in the region of 180 m and more quite close inshore. In some places, these steep, rocky, and wooded shorelines can be difficult to distinguish navigationally; however, they are often punctuated by inlets, small bays and other identifying features such as headlands, points and islets, which all aid visual navigation and navigation by radar.

Even though the waterways are generally deep, wide and navigable, there are some localized navigational hazards along the proposed routes. Navigational risks are mitigated through mandatory pilotage, VTS, and navigational aids. Within the proposed route network, navigational hazards have been identified and discussed in the sections above. A summary of the main hazards is as follows:

- Dixon Entrance is exposed to the weather from the Pacific Ocean, large seas and swells can be set up which at times might preclude vessels from boarding a pilot off Triple Island.
- Learmonth Bank at the head of Dixon Entrance may have limited charted water depth during heavy weather, which sets up steeper and shorter seas and swells.
- Butterworth Rocks, situated south of the pilot boarding area, is an area of charted shoaling, punctuated by several drying rocks. The area is marked by a navigation light and radar responder beacon.
- The shoaling banks to the west of the deep water channel in the northern Hecate Strait.
- Oval Bank, with charted depths less than 36 m, extends westwards from Porcher Island.
- For laden VLCC’s there is a 35 m (19 fathoms) patch located SSE of Dixon Island. The cumulative draught effect is 33.2 m (18 fathoms) for safe transit and the shoal patch is more than 300 m from the channel centreline.
- Sewell Islet in Principe Channel is not fitted with navigational aids. However, it lies east of the main channel and should not pose a navigational hazard to normal vessel operations.
- Nepean Sound can be exposed to strong south-easterlies through to westerlies.

- The entrance to Otter Channel from Nepean Sound is guarded by Nepean Rock and shoals to the north and Marble Rock to the south.
- Squally Channel is exposed to heavy weather, particularly during south-easterlies.
- Wright Sound is the junction of several natural waterways and established commercial navigation routes.
- Emilia Island marks a narrowing of the channel in the approaches to Kitimat Arm.
- Nanakwa Shoal and the unmarked Coste Rocks at the entrance to Kitimat Arm, although these are well clear of the channel centerline.

3.3 The Remoteness of the Coastline

The coastline of the region is quite remote from population centres, roads, highways. Many areas are only accessible by boat or by floatplane. To mitigate navigational risks in remote areas, special measures must be in place to assist vessels, including effective systems of navigational aids, vessel traffic control services and coastal communications. Together with tug availability, cooperation between shippers, Transport Canada (TC), the Canadian Coast Guard (CCG), and the BCCP is an essential part of safe navigation in remote areas.

3.4 The Alignment and Topography of the Coastline

The general alignment of the British Columbia coastline in the region is in a northwest to southeast direction and the coastal waterways formed by the many islands and fjords generally follow this direction. Some larger valleys and fjords such as Douglas Channel punctuate the coastline, providing not only a channel for inland navigation but also a route for cold strong outflow winds.

The topography of the region is a narrow continental shelf, punctuated by craggy coastal islands, with steeply rising mountains set only a few miles from the ocean, backed by high mountains and plateaus. The steeply rising mountains act as a barrier to the natural pattern of cyclonic storms that arrive at British Columbia’s coast from westwards. This can cause local strengthening of winds, squalls, and gusting winds of a magnitude that can increase the difficulty of navigation.

3.5 Seismic Activity

The west coast of Canada is an active seismic region due to the interface between the oceanic and continental plates, known as a subduction zone. The region is considered part of the Pacific Rim. In general, navigators should avoid using those channels or routes that may not have been surveyed since the last major seismic activity or that may not be the normal routes used and known by local pilots. However, the proposed routes are well-established commercial shipping routes, have been recently re-surveyed by the Canadian Hydrographic Service and are not expected to contain any such hazards.

4 Climatic and Oceanographic Factors

The general weather in the assessment area varies with seasons and can reach extreme conditions. There are a number of weather impacts to consider when evaluating tanker navigation strategies. The main weather hazards to shipping along the British Columbia coast are:

- Sea states caused by strong and variable winds associated with travelling storms.
- The periodic bitterly cold outflow winds in winter, which can create freezing spray.
- The extensive banks of dense sea fog which are most persistent in the summer season.

4.1 Meteorological, Oceanographic, Natural Conditions and Climatic Data

A number of factors determine the weather structure on the British Columbia coast and in the region in general. The following describes the various weather phenomena as detailed in Fisheries and Oceans Canada, Sailing Directions, Volume PAC 200 [Reference 6]:

The Physical Properties of Land and Ocean Surfaces

As discussed in Section 3.0, the geographical features of the area have a profound effect upon cyclone tracks, winds, precipitation and visibility.

The Ocean

Surface temperatures vary annually, seasonally and with latitude. With surface temperatures generally between 3 and 14 degrees Celsius, the area is generally free of ice. However, some of the deeply penetrating inlets in prolonged very cold weather can experience some formation of ice at the head of inlets, such as at Kitimat. In summer months, colder water upwelling along the continental shelf causes advection fog, restricting visibility over large areas.

General Air Circulation

Average barometric pressure indicates two significant features in both summer and winter. The anticyclone or “HIGH” pressure area, at lower latitudes and the cyclone or “LOW” pressure area at higher latitudes. These both vary in intensity and seasonally but are on average described as semi-permanent. The anticyclone dominates during summer and the cyclone during winter. The result is a general westerly airflow affecting the British Columbia coast, though this is both irregular and affected by local frontal systems passing through.

Winds

The strongest winds on the British Columbia coast accompany intense cyclones and their associated fronts. With the most violent of these, sustained winds in excess of 65 knots have been recorded in exposed areas with gusts estimated up to 100 knots. Although the pattern of winds around each cyclone is anticlockwise, there are two additional factors influencing the winds. Firstly, most frontal cyclones are partially occluded by the time they reach the British Columbia coast and secondly wind speed and direction are influenced by topography.

Cyclonic Wind Effects

When, a cyclone approaches the British Columbia coast, the winds "back" into the SE quadrant and increase in speed, often, reaching gale to storm force, and occasionally to hurricane force near exposed headlands. As the storm centre moves inland, the wind shifts or "veers" through S to the SW quadrant, sometimes becoming W or even NW prior to abating. Both direction and speed are influenced to a marked degree by the local terrain.

The Effect of Terrain on Cyclones

The height and steepness of local terrain has profound effects. Many such weather systems which approach from the west or south-west start to move erratically and are deflected either north or south along the coast. Those which, approach from the southwest are deflected north to the Gulf of Alaska hence the predominance of south-easterly winds on the coast.

Frequency of Cyclones

Winds in excess of 34 knots or 63 kph (Gale Force 8 and above) occur most frequently in winter. The duration of individual storms is generally one to two days, while the interval between successive storms is typically one to five days.

Table 4-1 Frequency of Cyclonic Storms in British Columbia Waters

Cyclone	Duration	Interval
Winter	1 to 2 days	1 to 5 days
Spring	1 day or less	Weekly
Summer	> Day	2 to 6 weeks
Fall	1 day or less	Weekly

(Source: Fisheries and Oceans Canada. 2002. First Edition, Sailing Directions, Volumes PAC 200 [Reference 6])

Outflow and Inflow Winds

Strong winds also occur without cyclonic storms. During clear weather, a vast pool of very cold air accumulates on the interior plateau and is contained there until triggered by an offshore fall in barometric pressure. Localized outflows of cold air, especially near the mouths of narrow inlets, known as "Williwaws" can be quite violent in their nature, with sudden onset and radical changes in direction of gusting winds. Sustained wind speeds of 50 knots have been recorded in such outflows and there are unverified reports of speeds greater than 75 knots. As a rule the out-flowing cold wind spreads out on reaching the mouths of the inlets; however, the effect from the Douglas Channel is felt as far away as Cape St. James, the most southern extremity of Haida Gwaii.

Inflow winds, in contrast, are caused by summertime heating of the landmass where the warmed air expands and rises, drawing in cooler, denser air from the open ocean, promoting "Sea Breezes," which can be prolonged and can reach near gale force in long fjords and inlets. This effect is often accentuated at the heads of coastal fjords, which tend to funnel the incoming air into a more constricted space. At night, the opposite effect changes the "Sea Breeze" to a "Land Breeze" and though generally much lighter in intensity, a Land Breeze can be briefly violent in front of stream beds and small valleys. A summary of wind speeds at Prince Rupert, the Caamaño Sound Area, and Kitimat is given in Table 4-2.

Precipitation

Heavy coastal precipitation is common along the British Columbia coast due to the moisture in the air, the frequency of traveling storms and the steep terrain causing air uplift, condensation and precipitation. Offshore precipitation is between 760 and 960 mm annually. Along the exposed sections of the coast, this can increase to more than 3,000 mm per year. The temperature of the ocean prevents persistent snow offshore however in winter periodic interaction between cold continental air and moist oceanic air, causes, heavy snow fall in coastal waters. Large snowflakes capable of substantially reducing visibility characterize this effect. A summary of wind speeds at Prince Rupert, the Caamaño Sound Area, and Kitimat is given in Table 4-2.

Visibility

In the unpolluted air over the ocean, surface visibility is normally good. Visibility can be reduced by precipitation, by extremely low cloud or by fog. Rain occurs for the most part together with brisk winds, which favours good visibility. The very heavy rains occurring on steep exposed coasts reduce visibility and sometimes produce low clouds reaching down almost to the sea surface. During infrequent snowstorms November to March, visibility can be very poor, reduced at times to less than 750 m.

Fog

Advection fog is the more serious factor affecting visibility in British Columbia coastal waters, the cause of which is the movement of warmer moist air over a colder sea surface. This happens throughout the year, but is more common during summer months when moist warm air is moved over up-welling cold waters along the continental shelf. At other times the steady transport of air from low to higher latitudes for a day or so, will produce the same result, if the air is fairly moist and the drop in temperature significant. Extensive banks of “Advection Fog” at times extend along the outer coast from Queen Charlotte Sound, to northern California persisting day and night even with moderate winds. Visibility can be at or near zero for several days. This “Sea Fog”, drifts over shorelines and into inlets or passages in any light on-shore breeze, the heating effect from the land causes daily advance and retreat and fluctuations of visibility in-shore. A summary of fog frequency at Prince Rupert, the Caamaño Sound Area, and Kitimat is given in Table 4-2.

Ice and Icing on Superstructure

Ice generally forms within the inlets of the mainland, to the north of Cape Caution (51.2 Deg. N.Lat) reaching a thickness of 20 to 30 cm. It occasionally extends as far as 40 km from the heads of inlets, but seldom forms in the main channels. Superstructure icing can occur when air temperatures are -2 degrees Celsius or less and winds are moderate or stronger at the same time. The probability of this in BC waters is less than 5 percent, though during “Outflow Winds” ships can experience heavy ice accumulations on the windward side.

Tidal Currents

The rates of tidal currents along the British Columbia coast and in among the islands, channels, passages and various inlets can vary greatly. The ebb current flows out of the inlets and in the various channels linking the islands of the coast. The tidal streams follow the general direction of the fairway branching into or coming from the many connecting passages or adjacent inlets.

The general ocean current of the Pacific North Coast Region including the shelf waters of Queen Charlotte Sound and Hecate Strait are an arm of the Sub-Arctic current, which is stronger in winter (October—March) than in summer. During winter months, the flow is northwesterly with a current velocity of approximately 0.25 to 0.5 knots. In summer, the current is generally negligible or can even reverse direction during the period between June and August.

Flood tides entering Dixon Entrance along the north shore of Graham Island split with one part heading north to Alaska, and another part heading into the Hecate Strait and the associated coastal waterways. Flood streams entering Queen Charlotte Sound turn north into the Hecate Strait to meet the south-going element at about the latitude of Skidegate. Part of the Queen Charlotte Sound flood tide will enter the channels and inlets along the coast and travel northwards.

The currents that enter from either end of coastal channels with both a north and south entrance including Grenville, Principe, Laredo and Princess Royal Channels, meet in the middle of each channel where tidal currents are usually weak and variable.

The flood and ebb tides generally follow the orientation of the channel and, in areas where there are shallows or narrows, tidal streams can be quite strong. Tidal currents that are generally charted as variable up to a maximum of about 2 knots, but can exceed 2 knots in narrower channel sections.

Study of the available tidal stream information shows that some of the stronger tidal currents along the proposed route are in Principe Channel and Dixon Entrance, where normal tidal streams can reach 3 knots. Tidal streams in Otter Channel and Lewis Passage can reach 1.5 knots on large tides. Tidal streams in Douglas Channel, Wright Sound and Lewis passage rarely exceed 1 knot.

Furthermore, due to spring run-off and storm water that enters the channels from the many tributary rivers along the route, the ebb tides are generally stronger than flood tides in Douglas Channel, and the net flow rate is outward. Stratified flow conditions exist in some fjords where a relatively thin lens of fresh or brackish water floats on top of the denser, more saline waters below.

Mariners are advised that prolonged periods of storm conditions can increase or decrease the tidal stream effects by as much as 1 knot or more, they should therefore be prepared to experience tidal currents in the 4 to 6 knots range near the entrances to the coastal network[2].

Wind Waves, Sea and Swell

The British Columbia coast is subject to wind generated seas and swell, the effect of which is broken up by the numerous islands along the coast. Mariners take advantage of this by using the calmer inshore waters. Average significant wave heights for the North Pacific Ocean range from 5 to 5.5 m between September and April and from 1.2 to 2 m between June and August. Extreme waves in excess of 12 m can occur during winter months. Winter wave heights in the entrance to Queen Charlotte Sound have been recorded with a mean significant wave height of about 3 m and a maximum significant wave height up to 12 m. The recorded maximum wave height is 18.5 m. During winter, significant wave heights in excess of 3.5 m occur 20-30 percent of the time offshore, reducing to 10 percent along the coast [Reference 15].

[2] (Source: Fisheries and Oceans Canada – Sailing Directions PAC 200, PAC 205 and PAC 206 [Ref. 6])

Studies have shown that the waters of Queen Charlotte Sound are subject to greater influences of wind-generated seas and ocean swells than those of Dixon Entrance. Wave heights measured at six locations between 1982 and 1984 [Reference 6] indicate that Queen Charlotte Sound is comparable to Hibernia on the Grand banks of Newfoundland and slightly more severe than the central North Sea. Dixon Entrance and Hecate Strait are less severe and compare with the central North Sea.

Table 4-2 Summary of Regional Climatic Data

	Prince Rupert	**Caamaño Sound Area, Ethelda Bay**	**Kitimat**
Temperatures, Degrees C.			
Average Maximum	10.3	10.9	10.8
Average Minimum	3.5	4.3	3.6
Extreme High	28, Aug	29, Jun	36, Aug
Extreme Low	-24, Jan	-18, Nov	-24, Dec
Precipitation			
Annual Rainfall	2,409 mm	3,158 mm	2,387 mm
Monthly Rainfall	112 mm to 378 mm	123 mm to 424 mm	47 mm to 179 mm
Annual Days with Rain	223, heaviest in Oct.	225, heaviest in Oct.	188, heaviest in Oct.
Monthly Days with Rain	16 to 25	15 to 24	12 to 23
Annual Snowfall	142 cm, Nov-Apr	127 cm, Nov-Apr	347 cm, Nov-Apr
Annual Days with Snow	29	26	38
Wind			
Winter Maximum	25 to 50 kts, SE, Aug-May	50 kts, NE, Nov-Jan 35 to 70 kts, SE, Feb-Jun	35 to 60 kts, NE-NW, Oct-May
Summer Maximum	30 to 35 kts, W, Jun-Jul	30 kts, NW, Jul 48 kts, SE, Aug-Oct	35 to 40 kts, SE-SW, Jun-Sep
Maximum Gusts	60 to 75 kts, Oct-Apr	No data	No data
Predominant Direction	S to SE	SE’ly gales and NE’ly (Outflow Winds)	N’ly (Outflow Winds)

	Prince Rupert	Caamaño Sound Area, Ethelda Bay	Kitimat
Fog Frequency			
Minimum	PR Port - 7.8% in May Triple Is. – 0.9% in Mar / Nov	9.2% in April	Environment Canada does not list fog data at Kitimat. However, BCCP note that when summer fog is present in approaches to Douglas Channel, generally it clears when approaching Kitimat.
Maximum	PR Port - 20.6% in Aug. Triple Is.– 8.5% in Aug.	20.0% in October	
Foggiest Months	PR Port - Jul to Oct. Triple Is.– Jun to Sep	August to December	

(Source: Fisheries and Oceans Canada. 2002. First Edition, Sailing Directions, Volumes PAC 200, 205, 206 [Reference 6])

4.2 Extremes of Temperature

Prevailing temperatures have an effect on navigation, as the good weather and high temperatures of summer months bringing additional tourists, boaters, sportsmen and others to the area. Increased small marine craft traffic in summer months may increase the risk of a navigational incident.

The extremes of cold in winter months can have adverse effect to operations, navigation and safety, when ice accretion builds up on marine craft. Where fresh water runs off into the sea in local channels, prolonged extreme cold can cause surface ice. Ice accretion on the decks of tankers can make operations, anchoring, and watch-keeping more difficult. Good tanker management does include special precautions for use in cold weather to maintain safety.

4.3 Fog, Heavy Rainfall and Falling Snow

Fog, mist, heavy rain and falling snow all have an effect on safe navigation for the proposed marine craft, adversely affecting visibility and therefore the effectiveness of the navigational lookout. This means that marine craft have to employ other means to see their way in such conditions, such as on-board electronic navigational aids. Aids such as marine radar allow the navigator to see ahead under such conditions, but reduced visibility increases the risk of a navigational incident.

4.4 Extremes of Wind, Gales and Storms

As discussed above, the exposed waters of the region are prone to successive winter gales. As with other marine craft using the waterways of the region, the ability to ride out storms at sea, heave to, anchor or drift in selected areas and to remain in port whilst awaiting the passing of bad weather will always be a consideration.

5 Navigation Aids and Vessel Traffic Services

5.1 Existing Navigational Aids and Vessel Traffic Services

5.1.1 Nautical (Hydrographic) Charts

The Canadian Hydrographic Service of the Department of Fisheries and Oceans is responsible for surveying navigable waterways and publishing official hydrographic charts. The charts, along with numerous related publications, provide detailed information of water depths, navigation hazards, aids to navigation (lights, buoys beacons etc), vessel traffic control schemes, etc.

Up until quite recently, many of the published charts in the region were based on decades-old surveys that have a limited level of detail and accuracy compared to modern standards. These older charts have adequately served the needs of vessels that have historically been operating in the area over the past few decades. However, the Enbridge Northern Gateway project (and other proposed projects in the region) will introduce a new class of vessels that are considerably larger than ships currently calling at Kitimat. As a result, it has been recognized that the existing nautical charts require updating. This is discussed further in Section 5.2.1.

5.1.2 Navigational Aids

A network of navigational aids exists to assist vessels calling on terminals in Kitimat. Navigational lights are intended to provide visual cues to vessel Masters for identifying approaching navigational obstructions, changes in course, and other landmarks to ensure safe navigation. The Canadian Coast Guard manages and maintains the network of navigational aids in Canada.

The following is a partial list of the existing navigation lights between Dixon Entrance, Caamaño Sound, and the proposed Kitimat Terminal (see Figure 5-1 below):

1. Buoy C25, north of Rose Spit at the east end of Dixon Entrance.
2. Buoy C26, northeast of Rose Spit at the east end of Dixon Entrance.
3. Stenhouse Shoal buoy and racon[3], 3 nautical miles (nm) northwest of Triple Islands.
4. Buoy D60, midway between Stenhouse Shoal and the Triple Islands lighthouse.
5. Triple Islands lighthouse, close to the pilot boarding area.
6. Butterworth Rocks, southwest of Triple Islands.
7. Seal Rocks, buoy and racon west of Porcher Island.
8. Buoy EOB in Hecate Strait, 6 nm west of Porcher Island.
9. ODAS Buoy in Hecate Strait west of Browning Entrance.

[3] A racon (short for radar beacon) is a device which, when activated by a vessel's radar, returns a coded signal to the vessel helping positively identify the location on the ship's radar.

10. Joachim Spit, south of Porcher Island to the north of Browning Entrance.
11. Hankin Point in Beaver Pass near the north end of Principe Channel.
12. White Rocks near the entrance to Browning Entrance.
13. Larsen Harbour near the entrance to Browning Entrance.
14. Northwest rocks west of Banks Island.
15. Bonilla Island lighthouse.
16. Keswar Point in Principe Channel.
17. Wheeler Island in Principe Channel.
18. Cape Saint James lighthouse, at the southern tip of Haida Gwaii.
19. Man Island, in Otter Passage between Bank Is. and Trutch Is.
20. Block Islands, in Otter Passage between Bank Is. and Trutch Is.
21. Fleishman Point Buoy, near the west end of Otter Channel.
22. McCreight Point, near the east end of Otter Channel.
23. Jacinto Island (light and racon).
24. Dupont Island (2 lights, one on west side and one on east side).
25. Alexander Island, off the south tip of Campania Island.
26. Duckers Island, at east end of Caamano Sound near Princess Royal Island
27. Logan Rock, in Estevan Sound.
28. Blackrock Point, in Squally Channel on Gill Island.
29. Fin Rock, near Keld Point, on Fin Island in Squally Channel.
30. Plover Point, on Fin Island in Squally Channel.
31. Block Hd, south end of Ferrent Island.
32. Sainty Point, in Wright Sound at the south end of Grenville Channel.
33. Cape Farewell, at the entrance to Douglas Channel.
34. Point Cummings, on Gribbell Island.
35. Money Point, south end Hawkesbury Island.
36. A light on the west side of Hawkesbury Island opposite Kitkiata Inlet.
37. Gertrude Point near Kitkiata Inlet in Douglas Channel.
38. A light just north of Grant Point on Maitland Island in Douglas Channel.
39. Emilia Island in Douglas Channel.

40. Kersey Point, northeast tip of Maitland Island
41. Hilton Point, west side of Douglas Channel at the Kitimat Harbour Limits.
42. Nanakwa Shoal in Douglas Channel.
43. Clio Point in Kitimat Arm opposite the terminal location.

The lights listed here represent only the major lighted navaids that are closest to the proposed tanker route, i.e., the lights most likely to be of importance to Northern Gateway traffic. In addition to these lights, there are several others within the open water areas, in some of the smaller channels in the area, and at the head of Kitimat arm marking the existing shipping terminals and marinas. These additional lights are intended to serve other regional vessel traffic and are not of primary importance to the Northern Gateway traffic. A complete list of lights and signals is maintained by the Canadian Coast Guard and is available online at www.notmar.gc.ca.

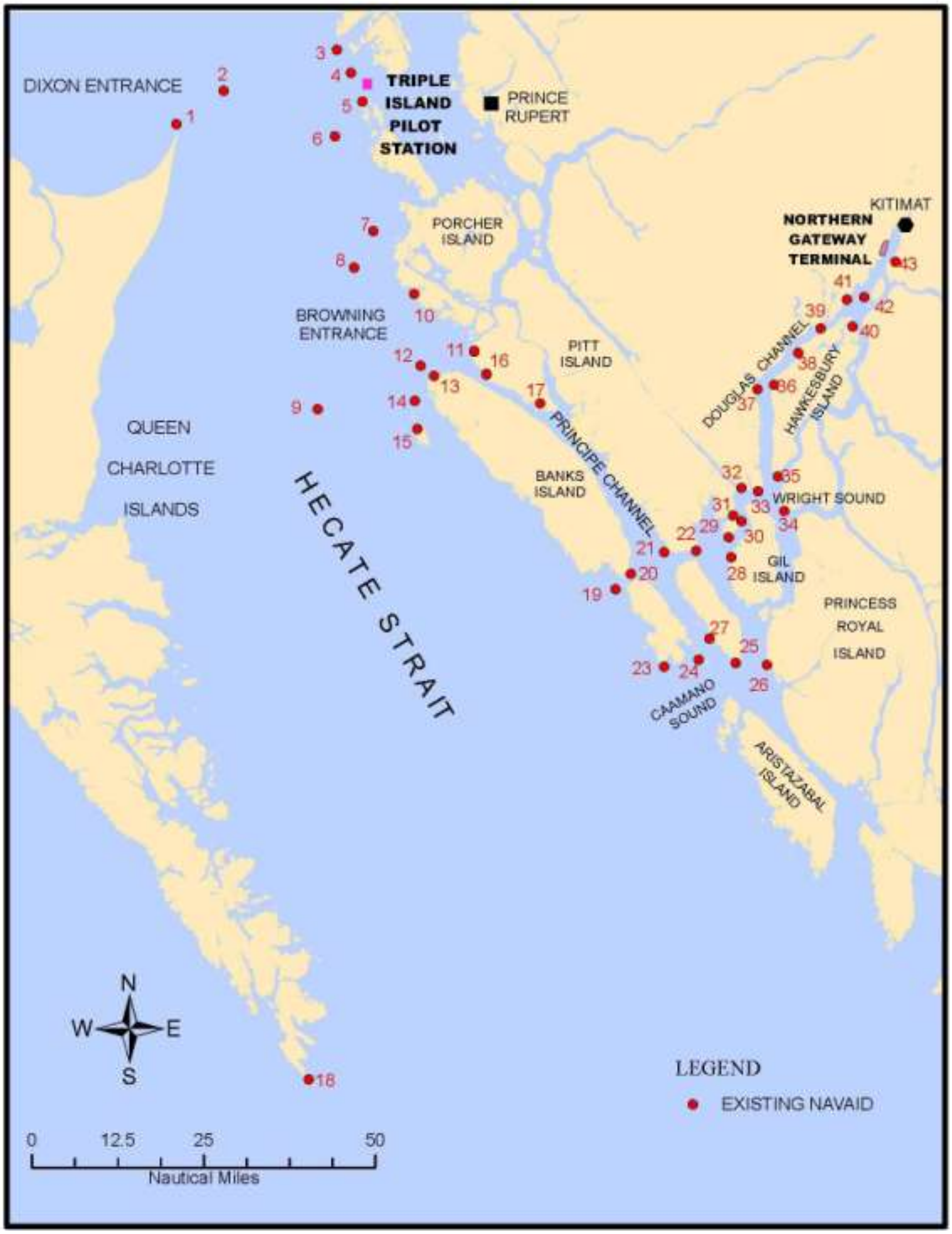

Figure 5-1 Existing Navigation Aids along the Proposed Routes (Partial List)

(Source: Canadian Hydrographic Service Chart No. 3002)

5.1.3 Marine Communications and Traffic Services

Marine Communications and Traffic Services (MCTS) is a division of the Canadian Coast Guard and provides communication and traffic services to commercial vessels navigating in Canadian waters. The MCTS system consists of three parts:

- Advance Vessel Traffic Reporting (AVTR) System.
- Traffic Separation Schemes (TSS).
- Vessel Traffic Services (VTS).

The AVTR System requires all vessels of 500 gross tons or greater to report to MCTS, 24 hours prior to entering Canadian territorial waters. The report from the Master of the vessel is required to include the purpose of the trip, vessel specification, operational plans, and a variety of other information prescribed by MCTS. All tankers destined for Kitimat Terminal will be required to report to MCTS.

TSS consists of separation zones and one-way lanes established in areas where navigational constraints exist. In Canada, the need for separation zones is evaluated by Transport Canada, in cooperation with the Canadian Coast Guard and users of the marine network based on operational guidelines for the area, density and frequency of marine traffic, and other considerations. At present, there are no established navigation lanes or separation zones in any of the waterways that will be used by tankers destined for Kitimat Terminal. However, all traffic must comply with internationally recognized “rules of the road,” or International Regulations for Avoiding Collisions at Sea (commonly called “Colregs”).

VTS is a radio reporting system between ships and a shore-based centre. VTS participation is mandatory for all reporting traffic. VTS has established reporting points known as calling-in-points, at which vessels must report to the regional MCTS centre to request and obtain VTS clearance. Clearance is issued by an MCTS officer after screening information about the identity, condition, cargo and intentions of the vessel.

On the west coast, there are five reporting centres, including a centre at Prince Rupert that is responsible for VTS within waters on which the tankers destined for Kitimat Terminal will report. Due to the mountainous terrain of the region, Prince Rupert VTS is not augmented by radar and cannot passively track vessels. Upon receiving a vessel report, VTS centre personnel convey traffic, weather and other navigation information to the vessel, often including information on other marine activities and weather information. While participation in this system is mandatory, MCTS does not attempt to provide course headings or navigation instructions to the vessels, as this remains the responsibility of the vessel master and pilot.

Figure 5-2, below, identifies the geographical extent of the Prince Rupert MCTS Regions and VTS zones.

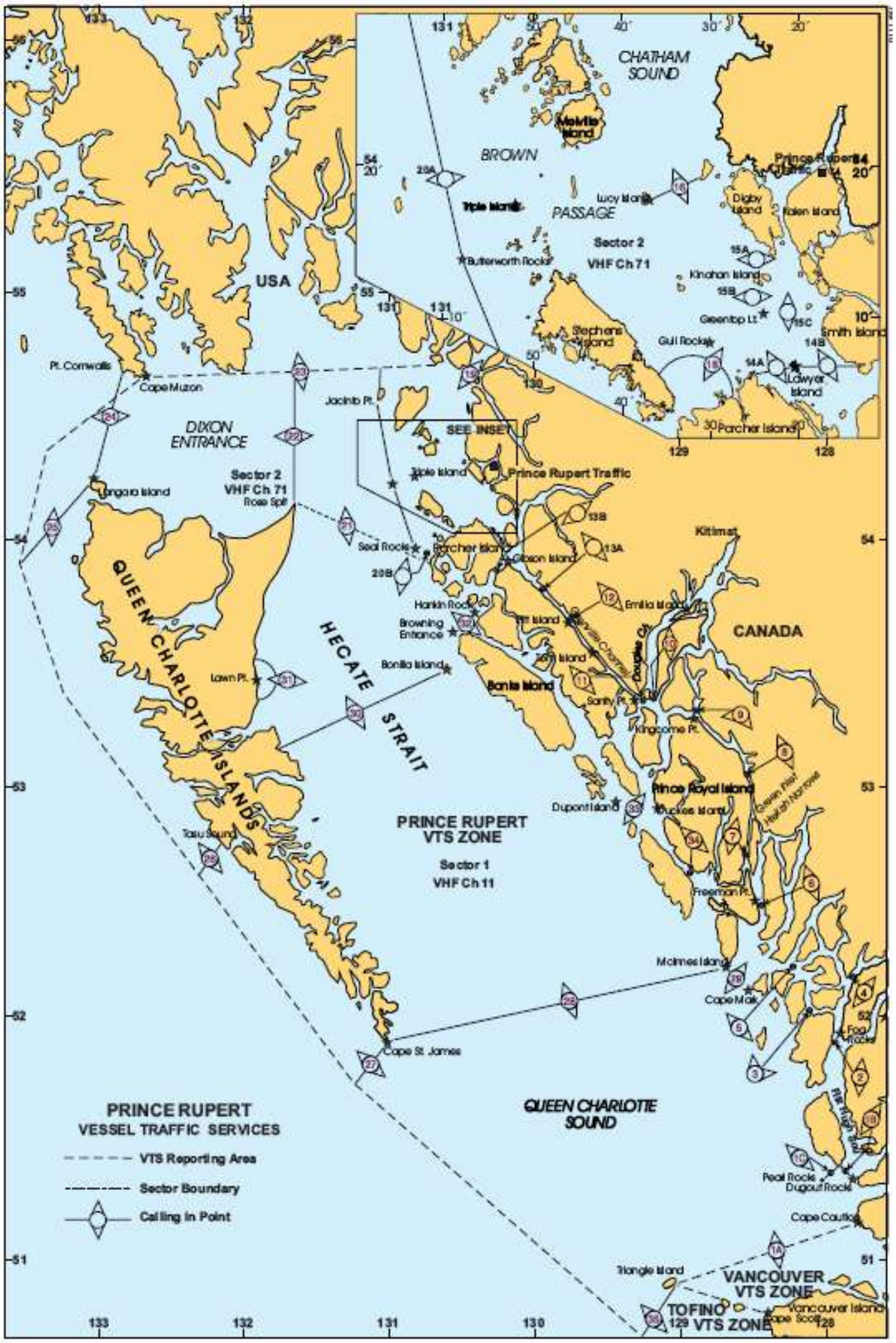

Figure 5-2 MCTS Regions and VTS Zones

TERMPOL Study 3.2 provides additional detail about the MCTS program and the VTS zones in the region of interest, and in particular the collection of vessel traffic data in the region.

5.2 Navigation Aids and Vessel Traffic Services Improvements

5.2.1 Nautical Charts

CHS is currently (Spring 2009) in the midst of a comprehensive program of re-surveying the navigation routes in the region. It is expected that the program will be largely completed by 2012 and will include updates (new editions) of most of the existing charts, as well as few new charts covering some key areas in more detail. The new charts will be issued both in electronic form (vector and raster format) suitable for electronic navigation systems, as well as paper versions.

To date, the CHS has issued new versions of six charts, which mostly cover the inside passage. Plans are in place to release six others by the end of 2009 which will complete up the inside passage and part of the outside passage. Over the next two to three years, the CHS plans to complete the remaining 12 charts covering the main navigation routes to Kitimat. Refer to Appendix B in TERMPOL 3.6 for a complete list of existing and planned chart improvements.

Future plans will address small scale charting needs through Hecate Strait, Queen Charlotte Sound and down to Cape Scott. CHS also hopes to update some of the older Haida Gwaii charts. There are no firm dates for the completion of these projects, however.

5.2.2 Navigational Aids

In response to the recent interest in the development of marine projects in the Kitimat and Prince Rupert areas, the CCG will conduct Level of Service (LOS) reviews of Aids to Navigation in the region. The objectives of these reviews are to analyze the existing aids to navigation systems and recommend improvements that will enhance their safety and efficiency. In addition to making recommendations on any shortfalls in the current systems, the reviews will also identify any redundancies or unnecessary aids to navigation.

The reviews will cover all buoys and beacons that are managed by the CCG and located between Ivory Island (128° 24' 23.90" W, 52° 16' 10.22" N) in the south and Lawyer Island North (130° 20' 46.99" W, 54° 6' 57.68" N) in the north. Based upon the areas covered by a series of new charts being proposed by the Canadian Hydrographic Service (CHS), the area has been broken into three sites:

- Outer approaches to Kitimat;
- Inner approaches to Kitimat; and,
- The Inner Passage.

Once the Coast Guard has completed the reviews, any required changes to the aids to navigation systems would be reflected in new charts, once published.

As part of TERMPOL Study 3.5, a detailed review of the existing navigational aid system was conducted by Northern Gateway’s marine specialist as well as the BCCP. A number of additional navaids are recommended in conjunction with improvements to several existing navaids. As a result of these reviews, a series of recommended improvements to the regional navaid system are proposed for the following locations:

1. Triple Island area, a light and racon, with nominal range of at least 20 nm to be situated on the highest point of Prince Leboo Island, elevation 150 feet in position lat.54°27.4'N long.130°59.1'W.
2. Buoy (possibly with racon) on Dogfish Bank, 7.5 nm northwest of Triple Islands.
3. Buoy 9 nm west of Stevens Island at 54° 09'N, 131° 05' W to mark the edge of the 20 fathom contour.
4. Buoy 13 nm west of Porcher Island at 53° 58'N, 131° 05' W to mark the edge of the 20 fathom contour.
5. Buoy 7.5 nm west of Porcher Island marking Grenville Rocks.
6. Buoy 16 nm west of Banks Island to mark the 6 fathom shoal at McHarg Bank, fitted with a racon to cover the extensive banks between Caamano Sound and Bonilla Island.
7. Browning Entrance, east side: a light and racon with nominal range of at least 12 nm situated at Baird Point
8. Browning Entrance, west side: a light on Deadman Island at the north tip of Banks Island opposite Baird Point. Also, increase the range of the existing light at White Rocks.
9. Dixon Island Narrows, a light on Dark Islet.
10. Ethel Rock, southeast of Dixon Island.
11. Narrows at Anger Island, a buoy on the 5 fathom rock near Freberg Islet at the northwest side of Anger Island.
12. Narrows at Anger Island, a light on Freberg Islet
13. Narrows at Anger Island, a light on Banks Island at Despair Point
14. Anger Island from south, a light and racon on Sewell Islet.
15. Otter Channel, a light with racon on Pitt Island at Fleishman Point to supplement the existing buoy.
16. Otter Channel, a light on the north side of Campania Island at Paige Point.
17. Otter Channel, a light and racon on the SE side of Banks Island.
18. Estevan Sound, west side of Campania Island, improve the existing light at Logan Point with increased range.
19. Approaches to Caamaño Sound, a light marking Ness Rock.
20. Approaches to Caamaño Sound, a light marking Yates Shoal.
21. Approaches to Caamaño Sound, a light marking the 4.5 fathom shoal 2.5 nm northwest of Yates Shoal.
22. Approaches to Caamaño Sound, a light marking the 10 fathom shoal at the north end of Aranzazu Banks.
23. Approaches to Caamaño Sound, a light marking Cran Shoal.

24. Approaches to Caamaño Sound, an ODAS weather buoy at Spencer Bank.
25. Approaches to Caamaño Sound, a leading light and possible racon on Rennison Island.
26. Approaches to Caamaño Sound, improve the existing light at Jacinto Island to 20 nm visibility, and fit with a red sector light covering Borthwick Rock and the shoal patches west of Jacinto Island.
27. Improve the range of the existing light at Duckers Island on the SW side of Princess Royal Island.
28. Transition from Campania Sound to Squally Channel, a light on Dougan Point
29. Transition from Lewis Passage to Wright Sound and to mark Gill Island, a light either at Blackfly Point or Turtle Point.
30. A light on the east side of Farrant Island in Wright Sound.
31. Improve the range of the existing light at Blackrock Point on the west side of Gil Island.
32. A light in Cridge Passage on the small islet at the north end of Fin Island.
33. Douglas Channel at Hartley Bay, a light on Halsey Point
34. Douglas Channel, a light on the unnamed point at Kiskosh Inlet (53°31.2N 129°13.9W)
35. A light on the mainland shore opposite Grant Point on Maitland Island.
36. A light at the west point of Coste Island.

The locations of these suggested navaids are shown in Figure 5-3. These improvements, especially the longer range lights for landfall, are recommended to be in place and operational, prior to commencement of navigation by the proposed design vessels. These suggested improvements are subject to consultation with other stakeholders and require final approval from the BC Coast Pilots and the Canadian Coast Guard, each of whom may have additional recommendations.

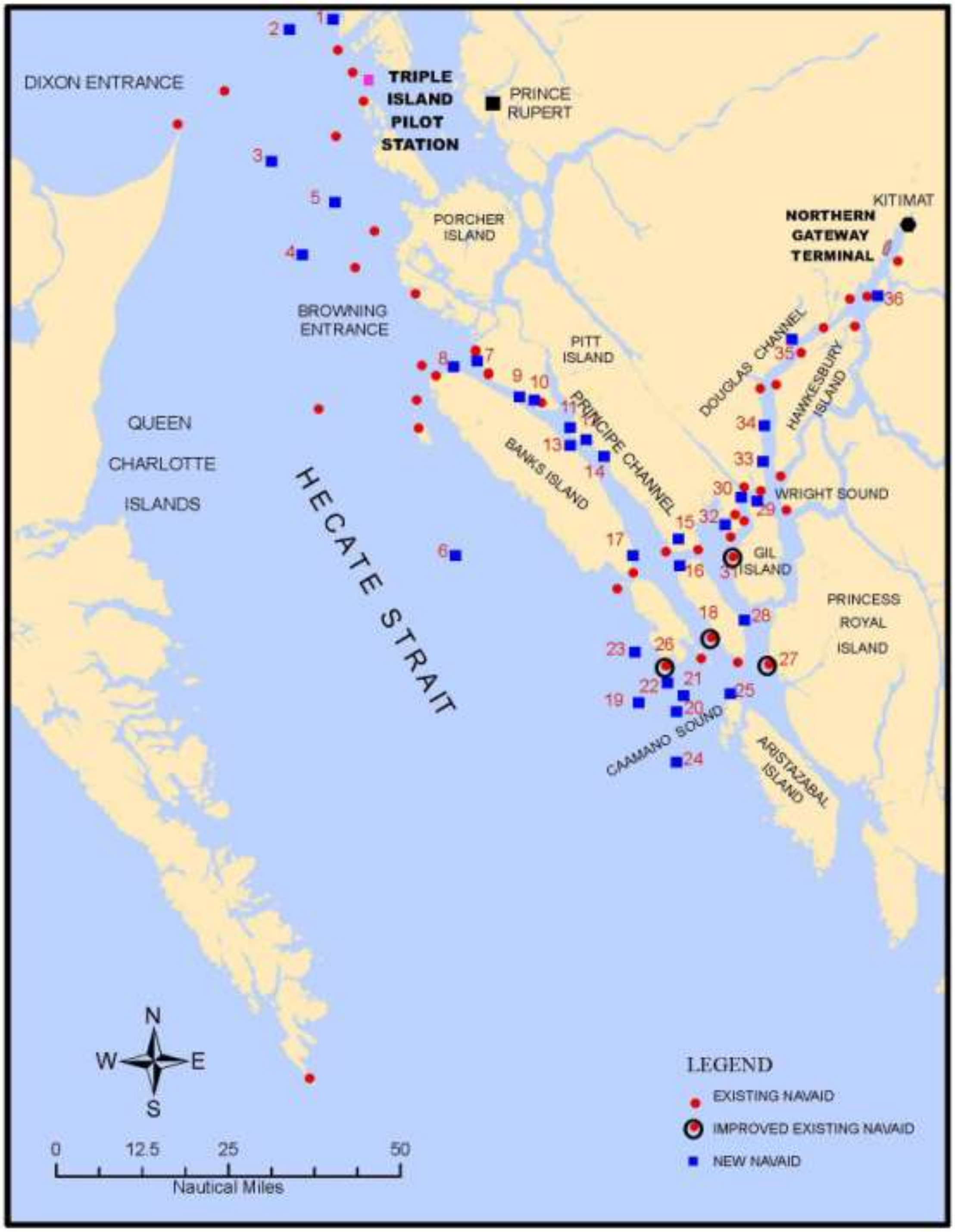

Figure 5-3 Proposed Improvements to Navigation Aids along the Proposed Routes

(Source: Canadian Hydrographic Service Chart No. 3002)

5.2.3 Improvements to Vessel Traffic Services

The existing Vessel Traffic Service (VTS) system on Canada's west coast involves reporting requirements for larger vessels at designated call-in points.

The existing VTS system on the north coast focuses heavily on marine traffic within the Inner Passage route, presumably because it has historically been, and remains a vital marine transportation corridor. However, larger tankers are more frequently navigating to and from Kitimat ports and the proposed routing include the wider Outside Passage channels. Based on discussions with the BCCP, and on the expert opinion of the author who is an experienced tanker captain, additional calling-in points provided within the Outside Passage channels would enhance the effectiveness of the current VTS system and increase navigational safety in the area.

Similarly, remote marine Radar coverage of the principal navigational node at Wright Sound, relayed to Prince Rupert VTS Control if installed, would greatly enhance both the overall VTS capability and the navigational safety of all vessels transiting the Wright Sound area (Reference 17).

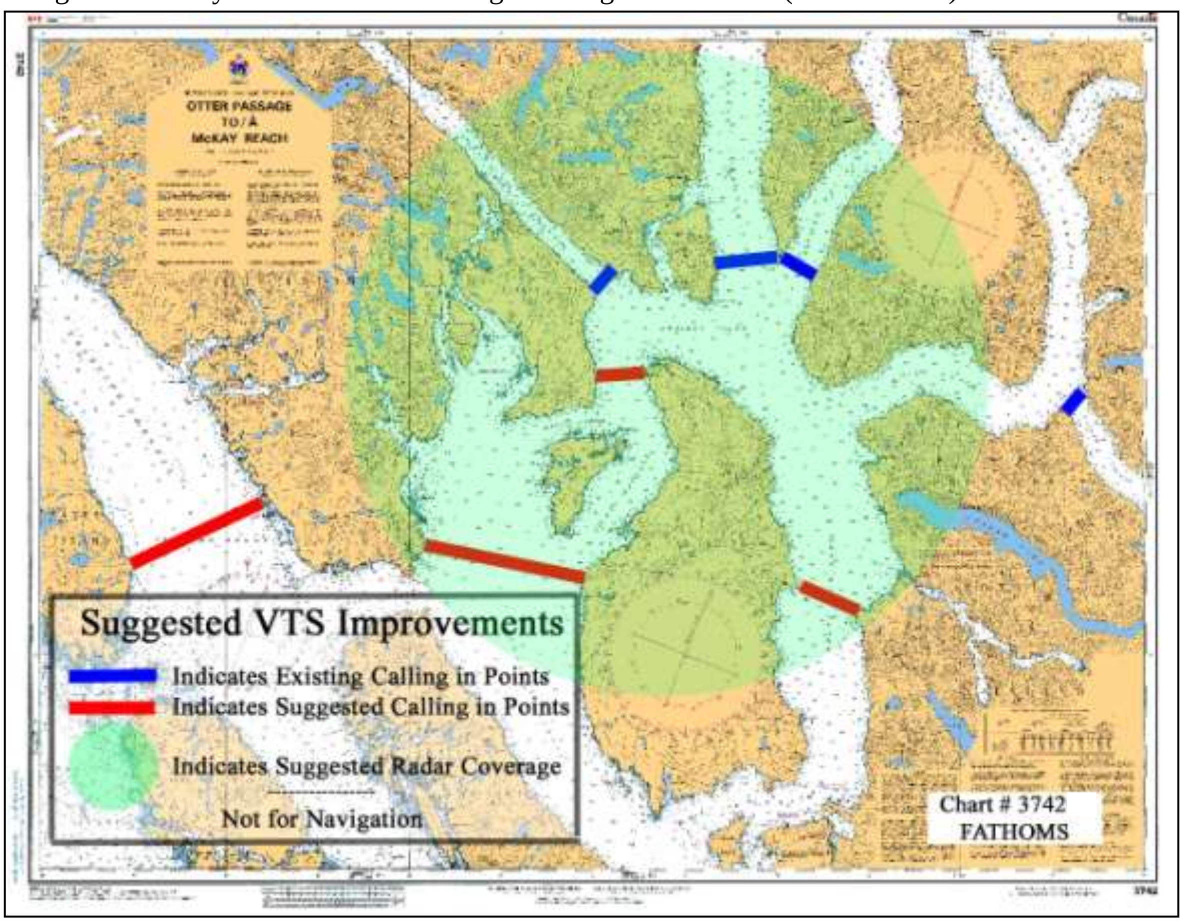

Figure 5-4 Suggested Improvements to the Prince Rupert VTS Zones

(Source: Canadian Hydrographic Service Chart No. 3742)

As shown on Figure 5-4, additional calling-in points for the design vessels may be as follows:

- Nepean Sound - On a line drawn across the channel from Deer Point.
- Squally Channel - Midpoint between Otter Channel and Lewis Passage.
- Lewis Passage - On a line between Block Hd. Light and Blackfly Point.
- Whale Channel - For any marine traffic using Whale Channel a new reporting point located in Whale Channel between Shrub Point on Gil Island and Leading Point on Princess Royal Island is suggested.

In addition, vessels in Principe Channel, joining the channel from, or leaving the channel to Petrel Channel and Anger Anchorage, should report to VTS. All design vessels should report anchoring whether at Anger Anchorage or at other possible anchorages.

The Canadian Coast Guard commenced its installation of a new Automatic Information System (AIS) on the Pacific Coast in 2009. The AIS equipment is being installed at a number of MCTS centres including the one at Prince Rupert, which has jurisdiction over the Kitimat area. The system electronically identifies ships through VHF radio. As of year 2003, AIS capability has been required by the IMO (Regulation 19 (Emergency Training and Drills)) of the International Convention for the Safety of Life at Sea (SOLAS) for all ships of greater than 300 gross tons. The system will automatically provide, receive, and exchange dynamic information from a ship including position, heading and speed; static information such as vessel description; and voyage information as transmitted by the vessel's AIS to shore stations, other ships and aircraft.

The manual call-in system currently used to report to VTS will not be superseded by the new AIS system. The AIS is meant to supplement the current system by allowing much more data to be logged than what is currently done. The AIS will also give MCTS a better idea of local marine traffic conditions and allow MCTS to manage traffic more effectively. The system will also make it much easier to obtain various shipping and traffic statistics for future reference.

6 Navigational Hazards

There are some known navigational hazards for vessels of the size being proposed for this project along the proposed routes. The CHS charting update program and the various proposed improvements to the navigation aids and Vessel Traffic Services as discussed in the previous section should mitigate the risks involved with any of these possible navigation hazards.

6.1 The North Route

The identified navigational hazards or places where ship manoeuvring is critical along the North Route are:

- **Learmonth Bank -** Vessels should avoid passing over Learmonth Bank at the Head of Dixon Entrance, there is sufficiently wide and deep channels both to the south and to the north of Learmonth Bank. Large seas and swells build up in the area of Learmonth bank in heavy weather.
- **Dixon Entrance -** During periods of severe weather, arriving vessels should be advised to adjust their ETA, reduce speed or heave to until the passing of the storm, rather than attempt arrival in such conditions. The waters inside Dixon Entrance are not particularly well sheltered especially from the west, the area being subject to large seas and swell, generated by gale and storm force winds that are frequent in winter.
- **Celestial Reefs -** The reefs lying to the north of the approaches to Triple Islands are to be avoided, the approach channel south of these reefs is some 19 km wide.
- **Triple Islands Pilot Station** - Whilst approaching and manoeuvring off Triple Islands Pilot Station due caution must be taken of the vessels position relative to shallow water and to other marine traffic.
- **Butterworth Rocks -** Vessels arriving or departing Triple Islands Area must keep clear of Butterworth Rocks.
- **Northern Hecate Strait, Deep-water Channel -** Vessels using this deep-water channel should avoid straying to the west of the channel towards shallower water, especially if seas or swell are running, when a mid-channel water depth of at least twice the vessels draught should be maintained.
- **Browning Entrance -** Deep sea vessels should in all circumstances keep well clear of the northwestern tip of Banks Island, where there is shallow water, including the 3 fathoms or 5.5 m patch called Ludlum Rock, (53°38.85'N 130°29.95'W) which is unmarked lying to the south of the main channel. Also to the south of the main channel is a shoal of 14.6 m (8 fathoms) in position (53°39.2'N. 130°32.9'W) that would be a hazard to vessels straying from the main channel. There are also shoal patches of less than 36 m extending tongue like northwards from White Rocks.
- **Principe Channel** - Laden VLCC tankers should avoid the 35 m (19 fathoms) shoal patch lying on a bearing of 276°T from Wheeler Island Light with a distance of 0.68 nautical miles (1.26 km) or position (53°33.06'N. 130°09.83'W). Although this shoal patch is within the delineated main channel and has more than the calculated safe transit depth of 17.8 fathoms or 35.2 m as given in TRP Study 3.6, it should be avoided as a matter of good practice.

- **Nepean Rocks - Nepean Rocks l**ying 1.7 km West of Fleishman Point are marked at their southern extremity by a Red, Starboard Hand Bell Buoy. (E78) These shoals are a danger to navigation and are to be avoided when entering or leaving Otter Channel.
- **Otter Channel** - Vessels approaching Otter Channel from Principe Channel and Nepean Sound should remain well to the west before lining up to approach Otter Channel. This gives any opposing traffic a clear view of incoming vessels and allows them to clear to the north unimpeded after clearing Nepean Rock Bell Buoy. It also allows the inbound vessel to steady up on the Otter Channel course prior to entering Otter Channel.
- **Lewis Passage -** Vessels passing Plover Point in Lewis Passage should if practical, keep to their starboard side of the channel to avoid possible close-quarters situations with oncoming traffic. If maintaining a mid channel course line, then vessels and pilots should ensure that there is no scheduled on-coming traffic, by communication with other vessels, pilots and VTS.
- **Wright Sound -** Due to the increased potential for encountering other traffic, extra care and attention to navigation is warranted when joining, crossing or leaving the Inner Passage traffic flow in Wright Sound. It would be prudent for vessels navigating this section to reduce speed and have their engines on standby, ready for immediate reductions or increases of speed as necessary for collision avoidance. Wright Sound as the prime navigational node on the route must be considered an above normal area and especially for the largest of the design vessels, tug escort in this area is recommended.
- **Emilia Island** - When approaching the narrows at Emilia Island vessels should keep to their starboard side of the channel, or if maintaining mid-channel, then ensure there is no scheduled on-coming traffic, by communication with other vessels, pilots and VTS.
- **Kitimat Arm -** The shoal waters of Nanakwa Shoal and Coste Rocks lying outside of, but close to the main channel must be avoided.
- **Kitimat Arm** - Being nearer to a population centre may mean an increase in the numbers of pleasure and sports related marine craft to pay attention to, whilst navigating the final stretch to the marine terminal near Kitimat, or the first leg of the departure route.

6.2 The South Routes

The identified navigational hazards along the South Routes are:

- **Caamaño Sound -** The east-west alignment of the channel will result in cross seas and swells and strong currents in severe weather that generally is from the SE to SW direction. This would cause vessels to roll and pitch heavily. Vessels in the ballasted condition especially could find that this action may be violent or uncomfortable enough to affect the safety of navigation. Laden vessels' cumulative effective draught, due to these severe conditions may exceed the limits for safe transit.

- **Caamaño Sound -** There are shoaling depths of 36 m (20 fathoms) and less, outside of the preferred route's deep-water channel, near the entrance. Whilst within the delineated channel, the least depth is charted as 42 m (23 Fathoms) located in position (52°54.5N. 129°42.4'W.). There are several places in the main channel where the charted depth is from 42 to 48 m (23 to 26 fathoms) but in general the main channel is deeper than this with depths in excess of 50 fathoms prevalent. Outside of the main channel there are several notable shoals and rocks to be avoided, the closest of these dangers to the main channel are Aranzazu Banks to the south with several dangers and Cridge Banks to the north.
- **Caamaño Sound -** The first alternate route south of Ness Rock has shoals within the delineated channel, the least depth of which is charted as 38.4 m (21 fathoms). Although this depth exceeds the required underkeel clearance depth, the viability of this alternate route is subject to confirmation by the current CHS hydrographic charting update program and the installation of appropriate navaids. If this alternate route is found to be viable, it will improve upon the other routes by allowing for a straight navigational course through Caamaño Sound. Outside of the delineated channel there are several notable shoals and rocks to be avoided, the closest of these dangers to the main channel are Ness Rock and Aranzazu Banks to the north and Spencer Bank and Yates Shoal to the south.
- **Caamaño Sound -** Vessels using Caamaño Sound will be crossing the Outside Passage route in Caamaño Sound, just south of Estevan Sound. All such vessels should pay extra attention to the risk of collision in this area even though the traffic frequency is low.
- **Southern Hecate Strait / Browning Entrance** - Notable dangers to navigation in this section are extensive dangerous shoals and banks lying to the West of Banks Island, from Cridge Banks in the South to Bonilla Island in the North. The most relative of these to the proposed route is McHarg Bank, including North Danger Rocks.
- **Southern Hecate Strait / Browning Entrance -** During severe weather, vessels using this route should await the passing of the storm system prior to committing the vessel, inwards or outwards to Hecate Strait. Inbound vessels can delay their arrival, or heave-to as necessary in a safe position. Outbound vessels can delay their departure or shelter in Principe Channel as necessary. In either case the advice and instructions of VTS and BCCP must be taken into account.
- **Queen Charlotte Sound -** Gray Rock lying about 6.2 nautical miles SE by South from Cape St. James, the southernmost point of Haida Gwaii, is a breaking dangerous isolated rock to be avoided by the design vessels using the South Route(s).
- **Queen Charlotte Sound -** Goose Island Bank is an extensive bank in the central part of Queen Charlotte Sound. Though water depth is sufficient, least charted depth 31 m (17 fathoms) the whole area should be avoided.
- **Queen Charlotte Sound -** Triangle Island and surrounding shoals, lie some 26 nautical miles West by North from Cape Scott, the NW point of Vancouver Island. Cape Scott is provided with a light, nominal range 21 nautical miles, and there are several other islands and dangerous shoals between Cape Scott and Triangle Island, providing passage for smaller vessels only. Triangle Island is not provided with any Navaids and wide berth should be given by the design vessels using the South Route(s).

7 Physical Limitations

The objective of this section is to identify, any physical limitations along the route such as bridges, power transmission lines, narrow passages and shallow, water.

7.1 Bridges

There are no bridges across any part of the proposed north or south routes.

7.2 Power Transmission Lines

There are no overhead or sub-sea power transmission lines across any part of the proposed north or south routes.

7.3 Narrow Passages

The proposed channels are naturally occurring geologic fjord formations, and as discussed above, are generally wide and deep waterways. In accordance with the Channel, Manoeuvring and Anchorage Guidelines presented in Appendix 2 of the TRP Guidelines, "In two-way channels where the design ship's maximum breadth is not a primary consideration, the minimum channel width should be at least seven times the design ship's breadth." For the largest design vessel, the VLCC tanker with a beam of 70 m, this translates to a minimum two-way channel width of 490 m.

By this criterion, the narrower passages along the North and South routes, each with charted depths of 36 m (20 fathoms) or more, are all wide enough for two-way navigation by the largest design vessel:

The North Route – Minimum channel widths, with charted depths of 36 m (20 fathoms) or more at various significant navigation points en-route:

- Dixon Entrance North Channel – 26 km.
- Dixon Entrance South Channel – 16 km.
- Approach to Triple Island Pilots from Dixon Entrance – 9.5 km.
- Off Butterworth Rocks – 6.0 km.
- Narrowest section of Northern Hecate Strait, deep-water route – 5.3 km.
- Browning Entrance – 6.2 km.
- Principe Channel, Dixon Island narrows – 1.43 km.
- Principe Channel, Despair Point narrows – 1.8 km.
- Otter Channel – 1.8 km.
- Lewis Passage off Plover Point – 2.3 km.
- Lewis Passage, Blackfly Point – 2.7 km.

- Douglas Channel, Money Point – 3.5 km.
- Douglas Channel, Grant Point – 2.8 km.
- Douglas Channel, Emilia Island narrows – 1.4 km.
- Douglas Channel, Nanakwa Shoal to Coste Rocks – 3.6 km.

The South Routes:

- In Lewis and Principe Channels (As above)
- In Squally Channel, Fawcett Point – 3.4 km.
- In Squally Channel, Dougan Point – 5.4 km.
- In Squally Channel, Eclipse Point – 5.7 km.
- In Caamaño Sound, preferred route north of Ness Rock, off Jacinto Island – 4.9 km.
- In Caamaño Sound, alternate route south of Ness Rock, north of Yates Shoal – 4.0 km.
- In Caamaño Sound, alternate route south of Spencer Banks, between Evans Rock and Cliffe Rock – 3.5 km.

The review indicates that for the design vessels, the proposed channels meet the specified requirements for two-way marine traffic in the TRP Guidelines and this has been demonstrated in the ship stimulation program. In practice, the BCCP may choose to ensure that passing and overtaking situations do not occur in the narrowest sections, by good traffic management.

7.4 Shallow Water

In accordance with the Channel, Manoeuvring and Anchorage Guidelines presented in Appendix 2 of the TRP Guidelines, it is stated that “every ship when manoeuvring should have an under keel clearance not less than 15 percent (15 percent) of the deepest draught”. For the deepest draught design vessel with a design ship draught of 23.1 m, this translates to an under keel clearance of 3.5 m. Including a contingency of 0.5 m, a minimum water depth of 27.1 m is required for a static draught.

Dynamic forces, as described in TRP Study 3.6, Section 4.5 “Summary of Cumulative Draught Effects Due to Ship Motions,” arrive at a larger minimum under keel clearance of 10.1 m, giving a cumulative draught of 33.2 m (18 fathoms) for safe transit.

With the exception of one 35 m (19 fathoms) patch which can be easily avoided, the minimum charted water depth along the entire proposed North and South routes is more than 36 m (20 fathoms).

Whilst the above minimum draught for safe transit, is exceeded along the entire length of the proposed routes, the North and South routes as described, are deep water routes and with the exception of the following described sections, have charted water depths in excess of 91 m (50 fathoms). Charted water depths, range in most parts of the routes from 90 m to in excess of 365 m.

Sections of the proposed routes where the charted water depth is less than 36 m (50 fathoms) are described as follows:

- Dixon Entrance, situated north of Haida Gwaii, Learmonth Bank with shoaling depths of 36 m (20 fathoms) and less. See Figure 2-21.
- In the approach channel from Dixon Entrance to Triple Island Pilot Boarding Area and in the Northern Hecate Strait, from Triple Island to Cape George, (Porcher Island) where charted water depth is more than 36 m (20 fathoms). See Figure 2-22.
- In the approach channel to Browning Entrance, with a minimum charted depth of 42 m (23 fathoms) located in position Lat.52°42’N Long.130°34.5’W. See Figure 2-23.
- In Principe Channel, near Dixon Island with depths of approximately 88 m (48 fathoms) mid channel and from 56 to 91 m (31 to 50 fathoms) on two significant sub-sea ledges on the NE side of the channel. On one of these ledges in position Latitude 53°33.06’N Longitude 130°09.82’W there is a 35 m (19 fathoms) patch. This shoal patch can easily be avoided by using the deeper portions of the navigational channel that run adjacent to the shoal patch. See Figure 2-24.
- In Principe Channel, near Sewell Islet with depths of 62 to 91 m (34 to 50 fathoms) on two significant sub-sea ledges on the NE side of the channel. See Figure 2-25.
- In Caamaño Sound outside of the deep-water channel of the preferred route, there are shoaling depths near the entrance of 36 m (20 fathoms) and less. Whilst within the delineated channels the least depth is charted as 42 m (23 fathoms) located in position Latitude 52°54.5N Longitude 129°42.4’W. See Figure 2-29.
- In Caamaño Sound, for the first alternate route south of Ness Rock which also has shoals within the delineated channel, the least depth of which is charted as 38.4 m (21 fathoms). Although this depth exceeds the required underkeel clearance depth, the viability of this alternate route is subject to confirmation by the current CHS hydrographic charting update program.

8 Tug Services

Tugs provide a range of services in navigable waters and harbours. These services include vessel escorting, harbour assist during berthing and un-berthing, and a variety of functional, operational and safety management provisions such as spill contingency and firefighting.

Services provided within a specific port are generally tailored to suit its particular requirements, including service demands, local met-ocean conditions and vessel characteristics. In addition to the technical requirements, there are sometimes jurisdictional parameters established by governmental agencies that also must be considered.

8.1 Tug Analysis

A preliminary tug fleet requirement analysis is currently under way in conjunction with the navigation assessment / simulation program, see Section 8.4. This work will provide an indication of the configuration of tugs required for a variety of ship escort, berthing and unberthing scenarios. It will also provide an indication of the viability of tug types and a range of specifications, such as horsepower and bollard pull requirements, which will be extended to detailed tug design at a later phase of the Project.

The number of required escort tugs is dependent on the geography, oceanography and environmental conditions along the proposed routes, as well as on operational criteria that are established for the transit, such as speed restrictions in critical areas.

Design tugs should have generally good dynamic stability and course-keeping ability, especially at manoeuvring speeds, the tug design analysis should take into consideration that the three classes of design vessels, Aframax, Suezmax, and VLCC, will all have different responses to engine orders and helm corrections.

8.2 Escort Tug Services

There is no existing mandatory requirement for tug escort services in Canadian waters. The largest design vessels manoeuvrability and the characteristics of the proposed routes are such that the design vessel may be able to navigate the routes unassisted or unescorted by tugs.

In order to mitigate risk, Northern Gateway intend to mandate that all laden tankers will have a tethered escort tug throughout the Confined Channel sections (from Browning Entrance and Caamaño Sound and the Kitimat Terminal), The tug will be tethered to the stern of the laden tanker at all times ready to assist with steering or “braking”. In addition a close escort tug will attend all laden tankers between the Triple Island pilot station and Browning Entrance.

Inbound and outbound tankers in ballast will have a close escort tug between the Pilot boarding stations at Triple Island, Browning Entrance and Caamaño Sound and the Kitimat Terminal.,. The close escort tug will normally be positioned approximately 500 meters astern of the ship, or as directed by the master or pilot during the transit.

The primary service provided by escort tugs is to assist a disabled tanker and prevent or minimize the risk of a collision or grounding. Escort tugs are primarily used to influence the speed and direction of a tanker in the event of a steering or propulsion failure, thereby reducing the possibility of groundings or collisions and the risk of an oil release. In addition, escort tugs will be equipped for emergency release response and fire suppression in the unlikely event of an accident.

In assessing escorting requirements in specific waterways, a site-specific risk analysis is required to evaluate the possible effects of a marine incident and to consider the consequences if there were such an occurrence. This assessment forms part of TRP Studies 3.8, Casualty Data Survey, and 3.15, General Risk Analysis.

8.3 Harbour Tug Services

Tug assistance will be required for berthing and un-berthing the design vessels at the terminal, and this operation will be carried out using a suitable configuration of escort and harbour tug units. For a loaded tanker of the design size range, it is typical practice to use three or four tugs for berthing and two or three tugs for un-berthing the ship. It is planned that harbour tugs will meet an incoming vessel at a safe place towards the outer harbour limits and together with the escort tug(s) will manoeuvre the tanker to the berth, as required by the pilot.

8.4 Navigation Assessment / Simulation Program (Reference 16)

A navigational assessment is currently being undertaken for this project with the assistance from the BC Coast Pilots at the Force Technologies facility in Denmark (2008 and 2009). This assessment involves the development of a detailed computer simulation program and a combination of simulation techniques which are used to identify critical navigational areas, develop operational criteria, and, eventually, train mariners.

The simulation techniques include the following:

- Desktop programs run on a PC-based computer, known as fast-time simulation, which can simulate a large combination of scenarios in a short period of time to complete a high-level review of the navigational route and identify those areas that may require a more detailed assessment.
- Full-Mission Bridge Simulation (FMBS), or real-time simulation, which involves the development of a detailed, three-dimensional model of the area. The visual model is projected onto screens inside a mock-up of a ship's bridge. These real-time simulators are generally equipped with hydraulic actuators and a realistic set of vessel controls so that mariners can simulate the navigation of the proposed routes in a controlled environment. The technology behind these simulators has made much progress in recent years and is similar to that used for aviation simulation.

To date, three phases of the Full Mission Bridge Simulation (FMBS) have been carried out. The findings of this work are in the documentation process and will be incorporated in the TERMPOL appendices. The findings show that the tanker routes through the confined channel area can be safely navigated by ships of up to VLCC size, within the environmental parameters assessed in the simulation, which assessed operations in:

- wind speeds up to 50 knots, combined with
- current speeds up to: 2 knots.

9 Coastal Communities

There are a number of coastal communities located close to the intended route. The following sections provide information about these communities.

9.1 The Adjacent Coastal Communities

The major coastal communities adjacent to the intended route include:

- **Kitimat -** The proposed Marine Terminal is to be located near Kitimat, a town of some 12,000 plus situated at the head of Kitimat Arm. Kitimat is a residential and industrial district that contributes greatly to the economies of British Columbia and Canada.

Some particulars are summarized below based on information in the Kitimat Port, Capability Report:

- **Turning Basin -** The harbour area – 2.8 to 5.5 km wide.
- **Channel Depth -** 190 to 570 m.
- **Harbour -** Ice-free, sheltered deep water passage and harbour close to the great circle shipping route. Port of Kitimat receives 250 to 300 deep-sea vessels annually, up to 50,000 DWT. Previous studies have indicated that the port is suitable for up to 320,000 DWT Very Large Crude Carrier (VLCC) vessels.
- **Anchorages -** Limited inner harbour anchorages and holding areas for multiple ships close, south of harbour.
- **Facilities** – Deep-sea berths, deep-water roll-on, roll-off barge facilities, shallow water ferry berth, seaplane aerodrome locations, tug and scheduled barge services and shipping agencies to service traffic.
- **Focus -** Private port. Privately owned and operated deep-sea facilities for supporting manufacturing industries. Private and Provincial Crown land available. Local labour contracts in facilities. No shipping disruptions due to national / federal port transportation labour agreements or conflicts. Small craft marinas, recreation boating, fishing, and touring popular.
- **Markets -** Japan, Hong Kong, Korea, Southeast Asia, Taiwan, Europe, Middle East, Africa, South America and United States.
- **Railway -** Canadian National Railway / Illinois Central / other US rail alliances.
- **Roads -** Inter-Provincial #37 and Trans-Canada / Yellowhead #16.
- **Air -** Daily jet service between Terrace, Prince Rupert, and Vancouver.
- **Economy -** Produces 12 percent of BC's manufacturing GDP; over $1 Billion / Year; over 50 percent of labour force in manufacturing, transportation and tourism.

- **Future -** 2,863 ha industrial zoned harbour / backup land available; 100 ha fully serviced, 2,032 ha partially serviced, 730 ha not serviced. 11 tidewater sites, 10 valley sites - total of 11,660 ha suitable for development. Future land development and marine activity is driven by private enterprise or public non-government enterprise. Manufacturing, transportation, backcountry Eco-Tourism and "active west coast retirement living" are economic growth sectors.

KITAMAAT VILLAGE

Kitamaat Village is located 11 km south of Kitimat at the head of the East side of Douglas Channel. Kitamaat is the home of the Haisla Nation and is the original human settlement of the area. In Haisla, Kitamaat Village is called C’hee-mot-c’ha, which means "snag beach." Haisla territory comprises 5,000 square miles from the headwaters of the Kitamaat River, south to Kitlope. The Haisla people have occupied many village sites throughout their Territory. Currently, Kitamaat Village is home to about 700 Haisla people, but in total there are close to 1,500 Haisla members. Kitamaat is directly on the proposed route.

Contact Details:

Kitamaat Village Council
P.O. Box 1101
Kitamaat Village, B.C. V0T 2B0
Tel: 250-639-9361
Fax: 250-632-2840
Email: kncoffice@sno.net
Web: http://www.haisla.net or www.haisla.ca

HARTLEY BAY

Situated directly on the proposed route, Hartley Bay is an isolated community accessible by air and water only, located at the mouth of the Douglas Channel, 145 km southeast of Prince Rupert and about 80 km south-west of Kitimat. Harbour Air provides a daily floatplane service and Metlakatla Ferries offers two weekly services from Prince Rupert. Barge charter services are offered out of Prince Rupert and Kitamaat.

Hartley Bay is home to the Gitga’at Nation of which about 180 to 200 live in Hartley Bay year round. Another 400 to 450 live off the reserve; in Prince Rupert, Vancouver and on Vancouver Island. The community has a high percentage of young people, and the population in Hartley Bay is expected to grow significantly in the future.

Historically, the community depended upon the commercial fishing industry; however, many Gitga’at people are now employed in other economic sectors, including village administration, public works and safety, social and health services, housing, treaty negotiations, education services, salmon enhancement, forestry, tourism and ecological research. The ancestral home was at Kitkiata Inlet some 23 km north of Hartley Bay on the western shore of Douglas Channel. There are still reserve lands at Kitkiata Inlet that are not in use year round.

There are about 60 homes and several community buildings in Hartley Bay. There are no roads in the village—homes and other buildings are linked by a network of boardwalks and surrounded by walking and hiking trails leading to nearby rivers, lakes, hilltops and estuaries.

Facilities in Hartley Bay include marine study, fuel depot, sport fishing lodges (King Pacific and West Coast Resort) and forestry companies. The Gitga'at Nation also has a 16.5 hectares reserve at Barnard Harbour.

Contact Details:
Hartley Bay Band
445 Hayimiisaxaa Way
Hartley Bay, BC V0V 1A0
Phone: 250-841-2500
Fax: 250-841-2581
Email: hbvc@kaien.net

BARNARD HARBOUR

Located at the southern end of Whale Channel is a sheltered harbour that is home to the 'King Pacific' sport fishing lodge. The lodge is open for tourism from June to September, offering a variety of activities from fishing and kayaking to hiking and wildlife viewing.

Contact Details:
King Pacific Lodge,
255 West 1st Street, Ste 214,
North Vancouver, British Columbia, Canada V7M 3G8
T 604-987-5452 or toll-free 888-592-5464
F 604-987-5472
Email: info@kingpacificlodge.com

KITKATLA

Kitkatla is located on Dolphin Island near Browning Entrance approximately 70 km south-west of Prince Rupert. Kitkatla has a population of approximately 400 and lies just off the proposed route in the sheltered Kitkatla Inlet and is accessible only by water or air transport.

Regional economic activities include four bed and breakfast businesses, a sawmill, roe on kelp fisheries, three general stores, video game rentals, canteen service, taxi service, boat building, and salmon enhancement contract.

Facilities available on the reserve include the Band office, Lach Klan elementary / junior high school, a kindergarten school, eight teacherages, a community hall, a recreation hall, a church, a church hall, a fire hall, a fitness centre, a youth community centre and a fuel station.

Contact Details:
Kitkatla Band Council
57 Ocean Drive
Kitkatla, B.C. V0V 1C0
Tel: 250-848-2214
Fax: 250-848-2238

9.2 The Peripheral Coastal Communities

Those communities that are on the peripheries of the intended route, but are not considered being close to the intended routes, include:

- **Kemano** – Located 65 km to the south-east of Kitimat off the Gardener Canal extension of the Douglas Channel, Kemano is 80 km from the proposed route.
- **Butedale** – Located 30 km southwest of Wright Sound in the Princess Royal Channel.
- **Hunts Inlet** – Located 30 km south of Prince Rupert on the north coast of Porcher Island is about 31.5 km from the proposed route.
- **Prince Rupert** – Located 720 km west of Prince George on Highway 16 and is some 37 km from the proposed route.
- **Port Edward** – A few kilometres east of Prince Rupert and is located about 40 km from the route.
- **Metlakatla** – Located about 6 km or a 30-minute water-taxi ride northwest of Prince Rupert and 35 km from the proposed route.
- **Port Simpson** – Located about 56 km north of Prince Rupert and about 40 km from the proposed route.
- **Georgetown Mills** – Located in Big Bay, between Port Simpson and Metlakatla, and about 40 km from the proposed route.
- **Skidegate** – Centrally located in Haida Gwaii about 100 km from the proposed route.
- **Queen Charlotte City** – Located in Skidegate Inlet on the southern shore of Graham Island, 5 km west of the ferry terminal at Skidegate.
- **Sandspit** – Located on the northeastern tip of Moresby Island 100 km from the proposed route.
- **Lawnhill** – A very small community between Skidegate and Tlell located about 85 km from the proposed route.
- **Tlell** – A small-scattered ranching community, located 43 km north of the ferry terminal at Skidegate and about 65 km from the proposed route.
- **Masset** – Masset is the largest town in Haida Gwaii. Located at the northern end of Graham Island where the headwaters of Masset Sound meet McIntyre Bay.
- **Haida** (Old Massett) – Located on the east shore of Masset Inlet, 3 km northeast of Masset.

10 Anchorage Possibilities

The anchorage guidelines presented in Appendix 2 of the TRP Guidelines recommend the following:

- That anchorages and emergency containment areas be located as close as possible and practical to the channels they serve;
- That the sea bottom in anchorage areas should provide good holding ground;
- That the water depth should be not be less than the maximum draught of the vessel plus 15 percent and also not more than 100 m; and,
- That the radius of each anchorage berth should be not less than one half nautical mile or 925 m.

10.1 Design Vessel Anchoring Requirements

The design vessels will have approximate dimensions as described in Table 2-1 and summarized as follows using the upper possible parameters for each vessel class:

- AFRAMAX LOA 260 m Beam 48 m Draught 16 m
- SUEZMAX LOA 290 m Beam 55 m Draught 19 m
- VLCC LOA 350 m Beam 70 m Draught 24 m

The design tanker for the classes indicated can have available about 380 or 400 m of cable per anchor. The maximum useable length of in-water anchor cable will be less (about 350 m), as a portion remains on the ship and out of the water.

The largest design ship, anchored in a minimum recommended depth of 27.6 m, would require a clear radius of 700 m (sum of the possible length of anchor chain and LOA of the vessel) from the anchor in any direction as a minimum swinging circle. This dimension is within the recommended swinging circle radius of 925 m (0.5 nm) specified in the TRP Guidelines.

Anchoring depth is regulated, by the amount of cable available, the requirement to have anchor and some cable on the seabed and the ability of the vessels anchor winch to recover the weight of the anchor plus the weight of the cable. Having some cable on the seabed assists the anchor's inherent holding power. A rule of thumb for anchoring is to use sufficient cable to meet the following:

- Length of cable required is the sum of, the depth of water, the scope of the anchor cable and a safety margin, where the scope is at least twice the water depth and the safety margin is about 30 m.

Thus it can be calculated that with 330 m of cable available, the maximum water depth is 100 m. Modern tankers do have the ability to recover their anchor and cable, when suspended vertically in the water so the maximum anchoring depth of 100 m, as recommended by the TRP Guidelines, is achievable.

The best holding ground is a mud or clay bottom, sand and gravel is suitable, but holding power is reduced. A rock or coral bottom is not good holding ground. It is also unwise to anchor where the anchor might be caught in a crevice or other irregular bottom formation.

Anchorages within the proposed routes range from dedicated sites with known conditions, to sites that provide limited sheltering and holding capacities in emergency situations only. Figure 10-1 identifies a number of possible anchorage locations, each of which is described in greater detail below. The final selection of possible new anchorage locations will be done in conjunction with the BCCP and may require seabed sampling or coring to determine the suitability of the holding ground.

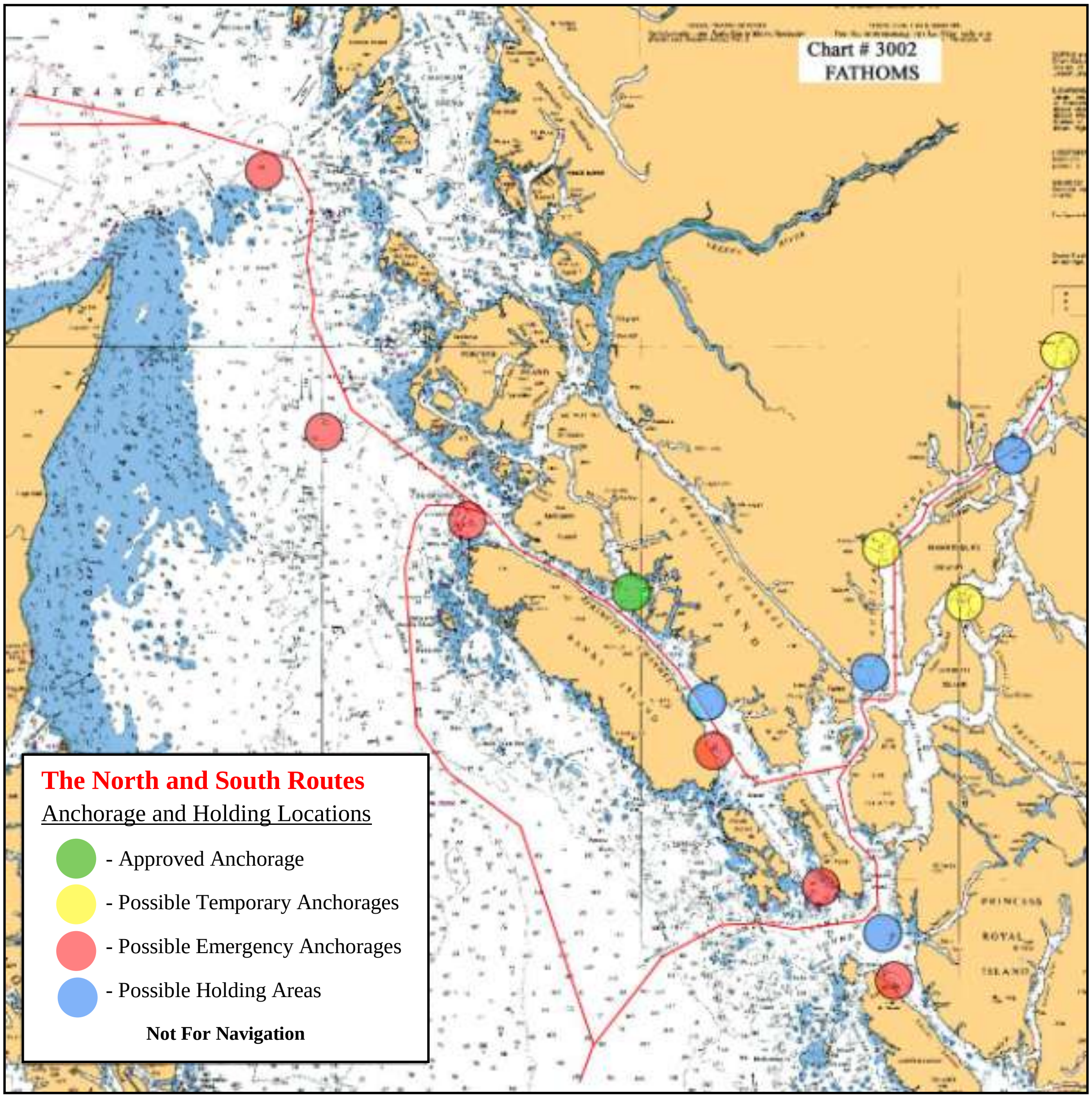

Figure 10-1 Anchorages, Possible Emergency Anchorages and Holding Areas

(Source: Canadian Hydrographic Service Chart No. 3002)

10.2 Recognized Anchorages

ANGER ANCHORAGE

Near the northeast end of Principe Channel, there is a recognized and charted anchorage for larger vessels named Anger Anchorage. The seabed comprises a gravel, sand and clay bottom in water depths between 44 and 90 m.

Anger Anchorage extends roughly over an area of 2.8 km by 1.8 km. The area is sufficiently large for anchoring vessels of the design size.

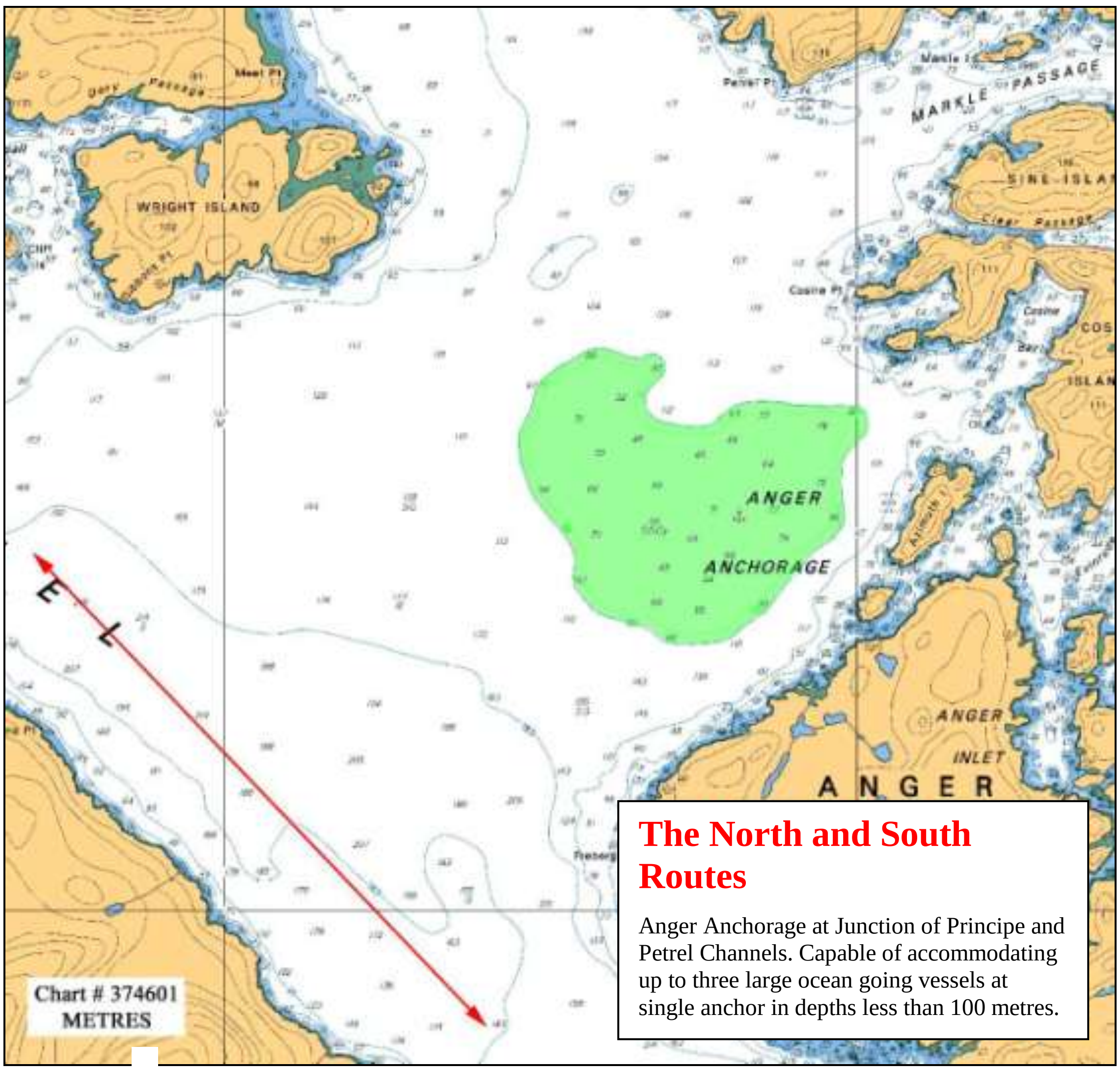

Figure 10-2 Anger Anchorage

(Source: Canadian Hydrographic Service Chart No. 3746)

The following excerpt is taken from 'Pacific Pilot – Sailing Directions – PAC206, page 43 [Reference 6]:

"Anger Anchorage off the NW side of Anger Island is an extensive bank encompassed by the 91 m line. In 1977 this bank was examined as a possible emergency anchorage for large vessels; a total of 23-bottom core samples taken. The bottom consists of 2.5 to 7.6 cm of sand and/or gravel on top of hard blue clay. This anchorage is protected from the south and east; it is open to winds from the northwest blowing down Petrel Channel or from the west down Principe Channel. The tidal range was near its maximum during the survey of Anger Anchorage but the tidal streams across the anchorage were not strong."

KITIMAT ANCHORAGE

In Kitimat Harbour there is an anchorage area for vessels waiting to berth at the various Kitimat terminals. The anchorage area is limited in size, and while the natural current normally keeps the vessels away from the shallows, the location is close to the Eurocan Terminal and the shallows of the Kitimat River Estuary. This recognized anchorage does not meet the minimum swing circle requirements of the TRP Guidelines Appendix 2, since the maximum possible swing circle at this anchorage is about 400 m. If this recognized anchorage were to be used by the design vessels, then it would be prudent and recommended that tugs remain on standby with the vessel, while it is at anchor.

It should be noted that in order to meet the minimum TRP guidelines, a swinging circle with a radius of 0.5 nm (925 m) and an underkeel clearance equal to the vessel draught plus 15 percent, are required. To achieve this, an anchor would need to be placed at Lat.53°58.9'N Long.128°40.2'W in 124 m of water. Although this depth is deeper than the TRP maximum recommended depth of 100 m, it would not be impossible to use this area for anchorage purposes.

In discussions with current terminal operators, the Kitimat anchorage has provided good holding for ships seeking temporary mooring waiting for berth openings. With the current mix of industry in the area, the anchorage is sufficiently large for their demand.

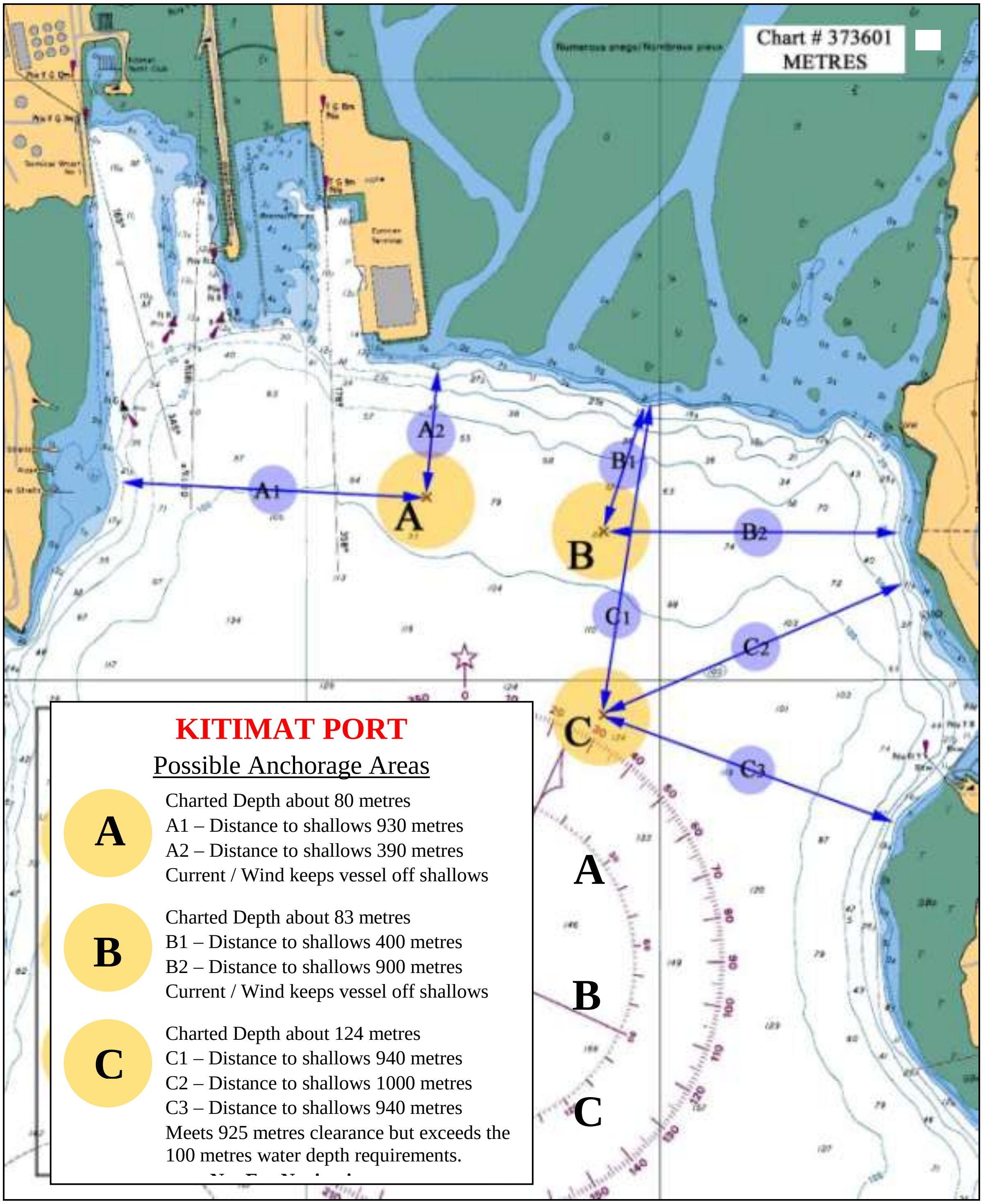

Figure 10-3 Port of Kitimat

(Source: Canadian Hydrographic Service Chart No. 3736)

KITKIATA INLET ANCHORAGE

Kitkiata Inlet, situated on the west side of Douglas Channel, is about 28 km north of Wright Sound. The area is intended for and provides a sheltered anchorage with a mud bottom for smaller vessels.

The anchorage does not quite meet the requirements of TERMPOL Appendix 2 in relation to swinging circle radius (925 m) and underkeel clearance, (Draught + 15 percent) for the design vessels.

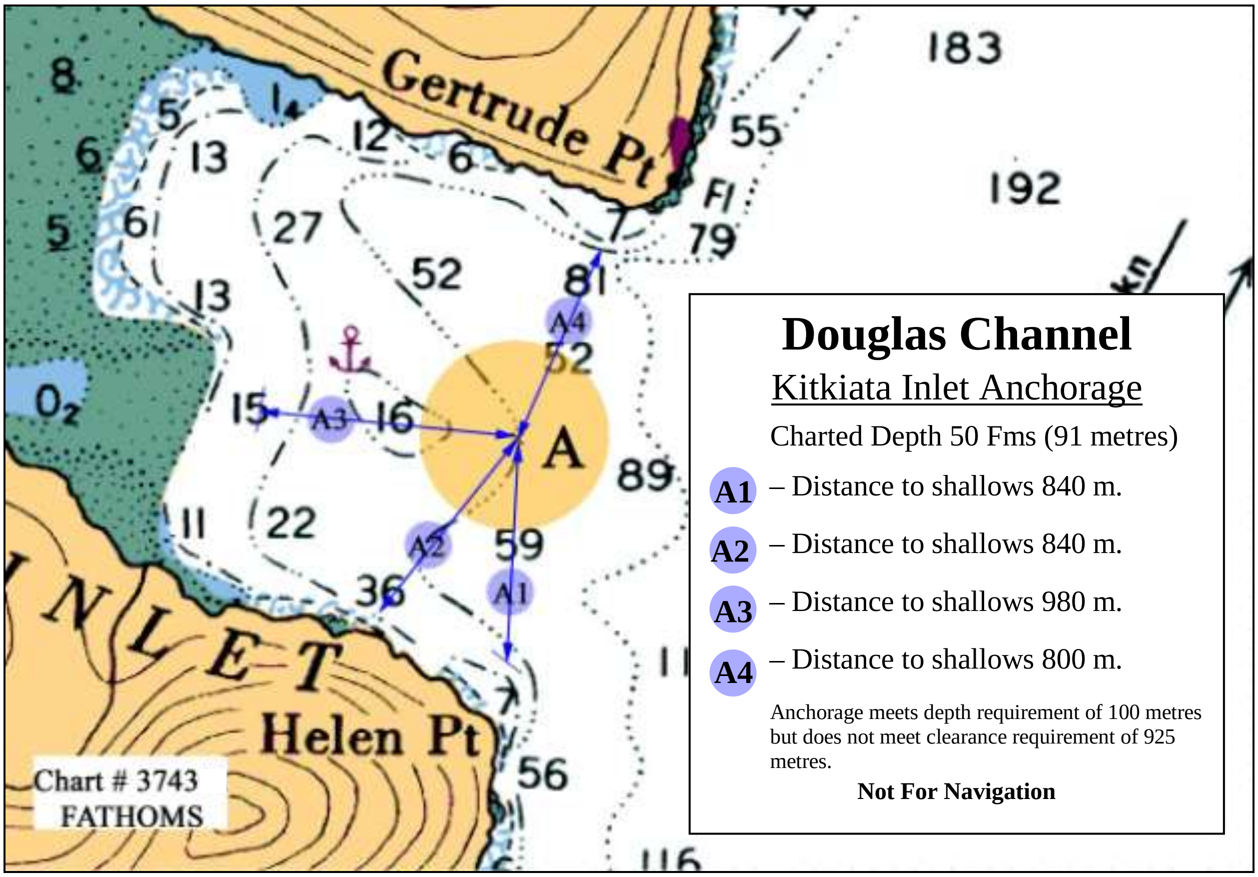

Figure 10-4 Kitkiata Inlet

(Source: Canadian Hydrographic Service Chart No. 3743)

The best possible swinging circle achievable in sufficient water, at this anchorage, for a laden design vessel would be a radius of 800 m centered on Lat.53°37.37'N Long.129°14.35'W with the anchor in 91 m (50 fathoms) of water.

This falls short of TERMPOL requirements, however a carefully spotted anchor and a short scope may conceivably be used to provide temporary anchorage, though this would not be recommended except in necessary circumstances.[4]

URSULA CHANNEL

Although there are no other recognized anchorages in the area, at some distance from the proposed route, at the head of Ursula Channel, just south of Moody Point there is an area with suitable depth and scope to establish an anchorage for vessels of the design size, within TERMPOL requirements, that might be explored. This would require Hydrographic Survey of Ursula Channel and a seabed survey for anchor holding qualities.

Ursula Channel is accessed from Wright Sound via McKay Reach (distance 25 nm) or from Verney passage (distance 17 nm) and subject to Hydrographic confirmation, access may be suitable for navigation by the proposed design vessels, with the assistance of tugs.

10.3 North Route, Possible Emergency Anchorages

Though not recognized or surveyed as approved anchorages, there are some areas that may be used to anchor a vessel in an emergency to wait out inclement weather or to avoid an incident.

[4] Authors Note: It would be a difficult operation to successfully anchor a vessel of design size in this location, but not impossible. Care and accuracy would need to be taken to ensure sufficient clearance from the charted 7 fathoms patch off Gertrude Point and remain clear of the 20 fathom contour off Helen Point. A short scope of cable should be used and there is also a 16 fathoms (29 m) patch located within the swinging radius to be taken into account for vessels draught clearance. The anchor would also necessarily be placed on a shelving bottom thus, care in setting the anchor would be critical.

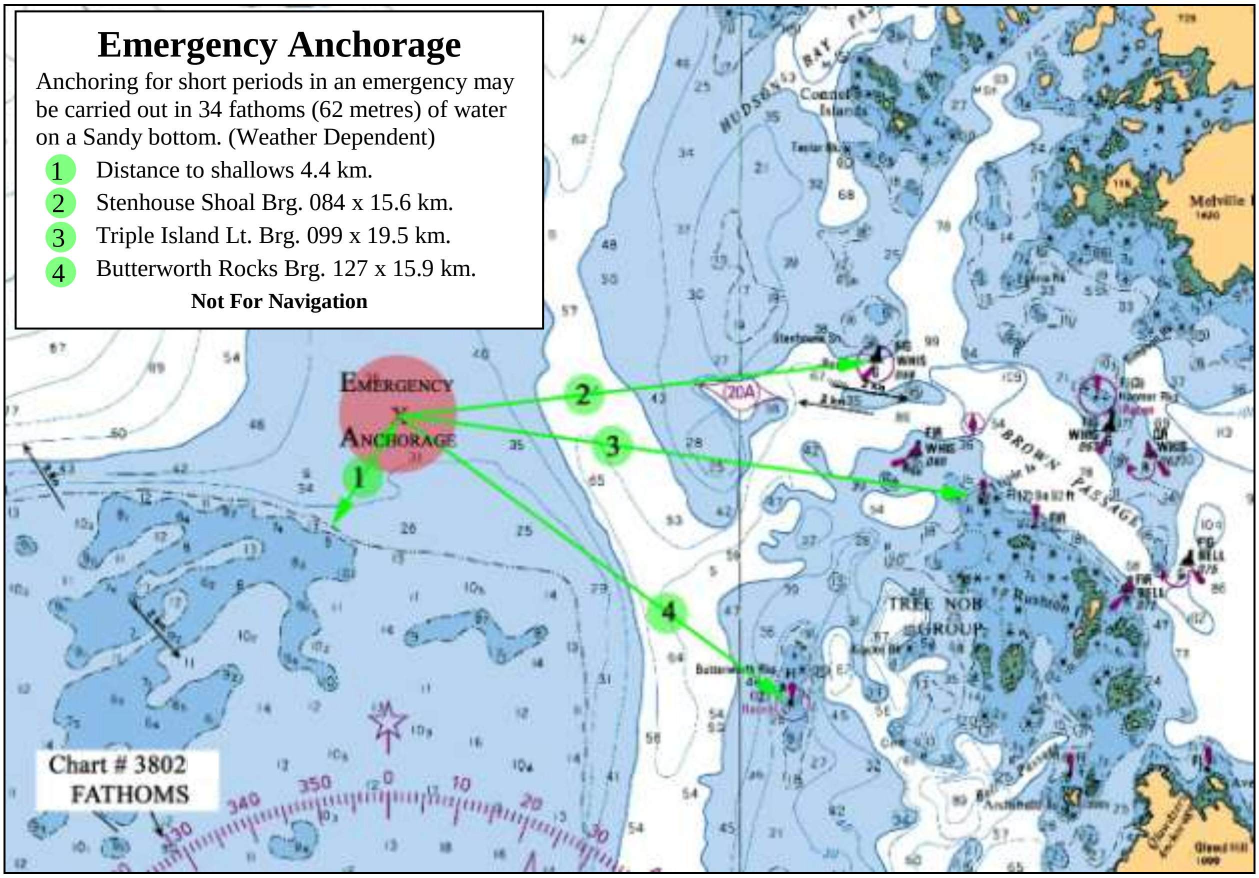

Figure 10-5 Emergency Anchorage, Triple Islands Area

(Source: Canadian Hydrographic Service Chart No. 3802)

APPROACHES TO PILOT STATION

In the approaches to Triple Island pilot station from Dixon entrance, with Triple Island Light bearing 099°T by 19.5 km, a vessel in an emergency could place an anchor on a sandy bottom in 62 m of water. Alternatively, emergency anchoring in suitable water depths in McIntyre Bay on the north coast of Graham Island may be found. Use of these areas as emergency anchorages would not be advisable during inclement weather and rough seas.

NORTH HECATE STRAIT

In the northern portion of Hecate Strait adjacent to the navigational channel is an area in water depths from 36.5 m to 91 m (20 to 50 fathoms) that extends roughly over an area of 18 km by 13 km. Near the western portion of this area are some localized shoals with water depths of 35 m (19 fathoms). The area is sufficiently large for anchoring vessels of the design size.

BROWNING ENTRANCE

Browning entrance offers a sandy bottom for anchoring in 36 to 70 m in open and unsheltered waters.

NEPEAN SOUND

In Nepean Sound, there is a bank with depths between 55 and 70 m extending between Deer Point and Gale Point on the southeast coast of Banks Island. The bottom material has not been surveyed or indicated on navigational charts and it is not a recognized anchorage; however, in an emergency, an anchor may be placed on the seabed. Caution is recommended as the bottom may be rocky and sufficient clearance from the coastline is necessary. The viability of this location requires review by the BCCP.

There is no other suitable anchorage or emergency anchorage along the proposed route, between Nepean Sound and the Kitkiata Inlet Anchorage in Douglas Channel.

10.4 North Route, Possible Emergency Holding Areas

A place where vessels of the design size might be moored, hold in position, or be held in position by tugs for a period of time, is referred to as a holding area. These might be used in emergency, for pollution containment or to await marine operations.

COGHLAN ANCHORAGE

Coghlan Anchorage is a natural sheltered harbour near Wright Sound. The entrance is from the south between Thom Point on Promise Island and Waterman Point on the BC mainland with a useable channel width of approximately 320 m in more than 36 m (20 fathoms) of water. The channel entrance is extremely tight and the anchorage is not suitable to anchor vessels of the design vessels size, on a single anchor.

The approximate measurements of the manoeuvring area within Coghlan Anchorage are as follows:

- Turning Diameter Available 780 m (Less than the minimum required by TERMPOL)
- Length of the Area 1,300 m
- Maximum Length of Design Tanker 350 m

Coghlan Anchorage however, could be made to provide a suitable emergency holding area for tankers and would afford suitable localized pollution containment possibilities, provided fixed moorings structures and/or mooring buoys were in place for ahead and astern moorings. Additional planning and approvals would be necessary to proceed with such a proposal.

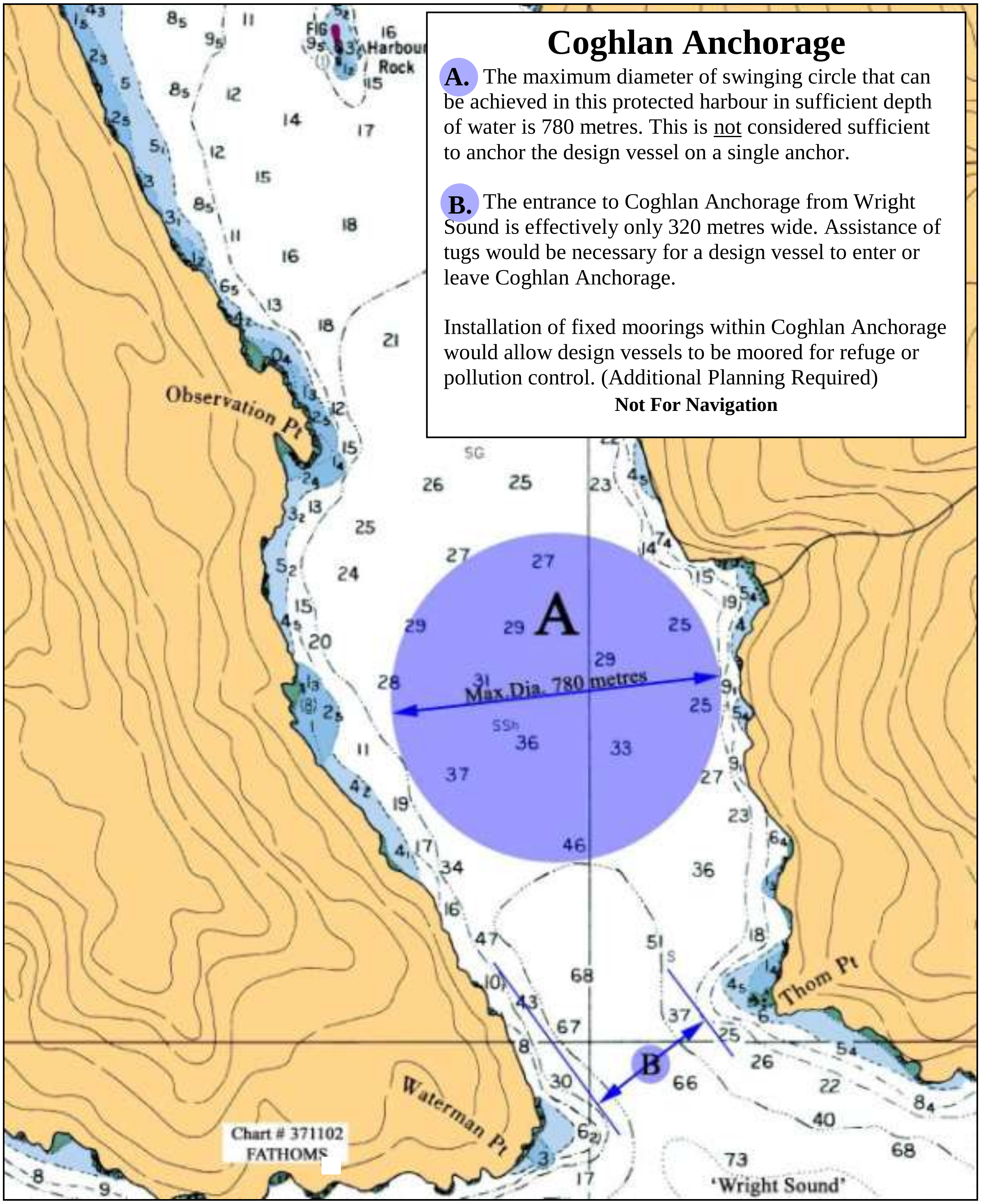

Figure 10-6 Coghlan Anchorage

(Source: Canadian Hydrographic Service Chart No. 3711)

PRINCIPE CHANNEL

The southern part of Principe Channel is wide enough to allow vessels to heave to, drift, proceed at minimum speed or be held in position by tugs, in order to await the passing of a weather system or to await operations.

KITIMAT ARM

The broad area at the mouth of Kitimat Arm near Hilton Point may be used as a holding area for short periods. Caution must be taken to keep clear of Coste Rocks and the use of tugs in this situation is recommended.

10.5 South Route Possible Emergency Anchorages

Principe Channel is common with the south route if not using Caamaño Sound. If using the Caamaño Sound channel, it may be possible to seek emergency anchorage only, at either of the following two locations:

CAAMAÑO SOUND / LAREDO CHANNEL

On the southern side of Caamaño Sound, at the northern end of Laredo Channel off Baker Point on Aristazable Island, there is an extensive bank with charted depths of between 36 and 90 m. The seabed is characterized as a sandy and rocky bottom, so care in anchoring is required. The area would offer limited shelter from winds in the south to west quadrant, but would be exposed to south-easterlies and to weather from the northwest.

CAAMAÑO SOUND / ESTEVAN SOUND

In the southern part of Estevan Sound, between 2.8 and 5.6 km north of Dupont Island, there is an area with charted depths of between 70 and 90 m. Here, the seabed is characterized as a sandy and gravely bottom. The area, however, is exposed to gales from the southeast, through south, to south-westerlies and vessels would have to be prepared to leave at short notice should the weather forecast indicate or weather is worsening.

10.6 South Route, Possible Emergency Holding Area

CAAMAÑO SOUND

In the eastern portion of Caamaño Sound, where it intersects Campania Sound and Laredo Channel, is an area in water depths from 91 m to 249 m (50 to 136 fathoms) that extends roughly over an area of 8 km by 8 km. Although this area encompasses a traffic node with respect to vessels transiting the outer passages, the area is sufficiently large to accommodate anchoring vessels of the design size. The viability of this location requires review by the BCCP.

11 Supplemental Information

The Enbridge proposed design vessels, as with other vessels in the region, are governed by the provisions of various pieces of Federal legislation including the Canada Shipping Act. Some of the key provisions of these regulations as they relate to this project are summarized below for convenient reference.

11.1 Canada Shipping Act – Charts and Nautical Publications Regulations

The Charts and Nautical Publications Regulations, 1995 require that all ships in waters under Canadian jurisdiction have onboard, maintain, and use appropriate charts, tide tables, lists of lights and other relevant nautical publications.

The regulations advise on provisional lists of charts and publications that are required to be carried for certain areas or arrival at certain ports. These provisional lists are published annually in Notices to Mariners.

The regulations apply to the use of charts, the use of documents and publications, the maintenance of charts, documents and publications, and they establish requirements for electronic chart information display systems, their back-up arrangements and their type approval. The regulations also advise on electrical installation standards and quality control. As well, the regulations advise the mariner on the requirements for passage planning and navigational safety.

All vessels calling on the proposed marine terminal will be subject to these regulations.

11.2 Canada Shipping Act – Navigation Appliances and Equipment Regulations

The Navigation Appliances and Equipment Regulations established rules for all navigational appliances and equipment required aboard Canadian ships and foreign ships in Canadian waters. However, these regulations were repealed after introduction of the Navigation Safety Regulations.

The repealed Navigation Appliances and Equipment Regulations may still be relevant as the industry progresses to implementation and conformity with the new regulations. They may be referred to, to highlight the transition to, and avoid confusion between, the old and new regulations. However, the Navigation Safety Regulations should be the standard reference for requirements.

11.3 Canada Shipping Act – Navigation Safety Regulations

The Navigation Safety Regulations are part of the Canada Shipping Act / Arctic Waters Pollution Prevention Act. The Navigation Safety Regulations, SOR/2005-134 were published in the Canada Gazette on March 27th 2004 and were registered as law on May 10th 2005. They do, in effect, replace the Navigation Appliances and Equipment Regulations, as discussed above.

The Navigation Safety Regulations are divided into five parts.

- **Part 1** gives general information on compliance, prohibition and principles, on installation, testing and maintenance of equipment, of compatibility, standards and quality control. It includes integrated systems and compass inspections.
- **Part 2** lists navigational equipment requirements for vessels constructed prior to July 1, 2002.
- **Part 3** lists navigational equipment requirements for vessels constructed on or after July 1, 2002.
- **Part 4** gives additional requirements in respect of global navigation systems, automatic identification systems, navigation in safety control zones, requirements for tow-boats, voyage data recorders, pilot transfer equipment, internal communications systems, searchlights, navigational accessories, signalling flags and hand lead lines.
- **Part 5** advises on other requirements such as search and rescue services, danger messages, ships personnel common language, operational limitations, manoeuvring information requirements and requirements for visibility from the navigating bridge.

All vessels calling on the proposed marine terminal will have to comply with the Navigation Safety Regulations.

11.4 Canada Shipping Act – Steering Appliances and Equipment Regulations

The Steering Appliances and Equipment Regulations list all the requirements for steering equipment, use, operation, testing and drills. The proposed design vessels will be subject to these regulations.

11.5 Canadian Watchkeeping Standards – STCW 1995

The Canadian Watchkeeping Standards have been superseded by the International Standard for Training, Certification and Watchkeeping, 1995 (STCW). The STCW requirements apply to all vessels and all crew and officers since February 01, 2003. All vessels calling at the proposed marine terminal will be, required to comply strictly with these regulations.

11.6 Canadian Pilot Regulations

All vessels calling on the proposed facility are required to comply with the Pacific Pilotage Regulations that require, compulsory pilotage areas, identify those ships subject to compulsory pilotage, pilotage waivers and various other regulatory requirements.

11.7 Pilot Station Locations

There are three locations in the region where vessels might embark or disembark a BCCP coastal pilot. These are:

- **Triple Island pilot station -** This station operates year round and is the principal pilot station for Prince Rupert and the north coast of British Columbia.

- **Pine Island pilot station** – has recently changed to year round operations and primarily services the Cruise Ship Industry during the summer months. Pine Island is situated in the Gordon Channel 33 km northwest by north of Port Hardy. This location is not recommended for the design vessels.
- **Cape Beale pilot station -** Is the pilot station for Barkley Sound and Port Alberni and is located 3.7 km west of Cape Beale on the southwestern coast of Vancouver Island. Operation as a coastal pilot station as well as a local pilot station is subject to demand and weather conditions. This location is not recommended for the design vessels.

These stations have served the British Columbia coast adequately for many years. However, the travel distances from any of the pilot stations to the coastal entrances at Browning Entrance, Caamaño Sound and Laredo Sound result in lengthy and costly pilotage assignments. Furthermore, Pine Island and Cape Beale stations are quite remote and require lengthy travel times in advance of the pilotage assignments.

The industries in Kitimat have indicated that a new pilot boarding station positioned to reduce the pilotage times into Kitimat would be desirable. Furthermore, in anticipation of increased marine traffic in the region due to the various projects in the Kitimat area being put forth by several proponents, there may be exceptional demand placed on the existing pilot stations.

Any such proposal to develop a new pilotage station will require further planning and discussions with the Pacific Pilotage Authority, CCG, TC, and others.

11.8 Vessel Traffic Services - VTS

For coastal British Columbia, the Canadian Coast Guard – Marine Communications and Traffic Services (MCTS) have designated three VTS areas, including the Tofino Traffic Zone, the Vancouver Traffic Zone and the Prince Rupert Traffic Zone. The Prince Rupert Traffic Zone covers the proposed routes and the geographic extent is shown on Figure 11-1.

All participating ships make reports about their course to VTS at designated areas, referred to as calling-in points. VTS services also provide assistance to vessels by reporting traffic movements, traffic density, dangerous cargo, special operations, and locations of vessels constrained by size, draft manoeuvrability or other reasons. VTS also report weather information including wind speed, precipitation and visibility. When required, VTS assist in reporting of any dangers to navigation, special requirements and all navigational information in relation to Search and Rescue (SAR) co-ordination.

VTS reporting requirements do not apply to the following types of vessels:

- Pleasure craft under 30 m in length.
- Fishing vessels under 24 m in length and less than 150 GRT.
- Other vessels under 20 m in length.
- Tug and tow, where combined length of tug and tow is less than 45 m or where the object towed or pushed is less than 20 m.

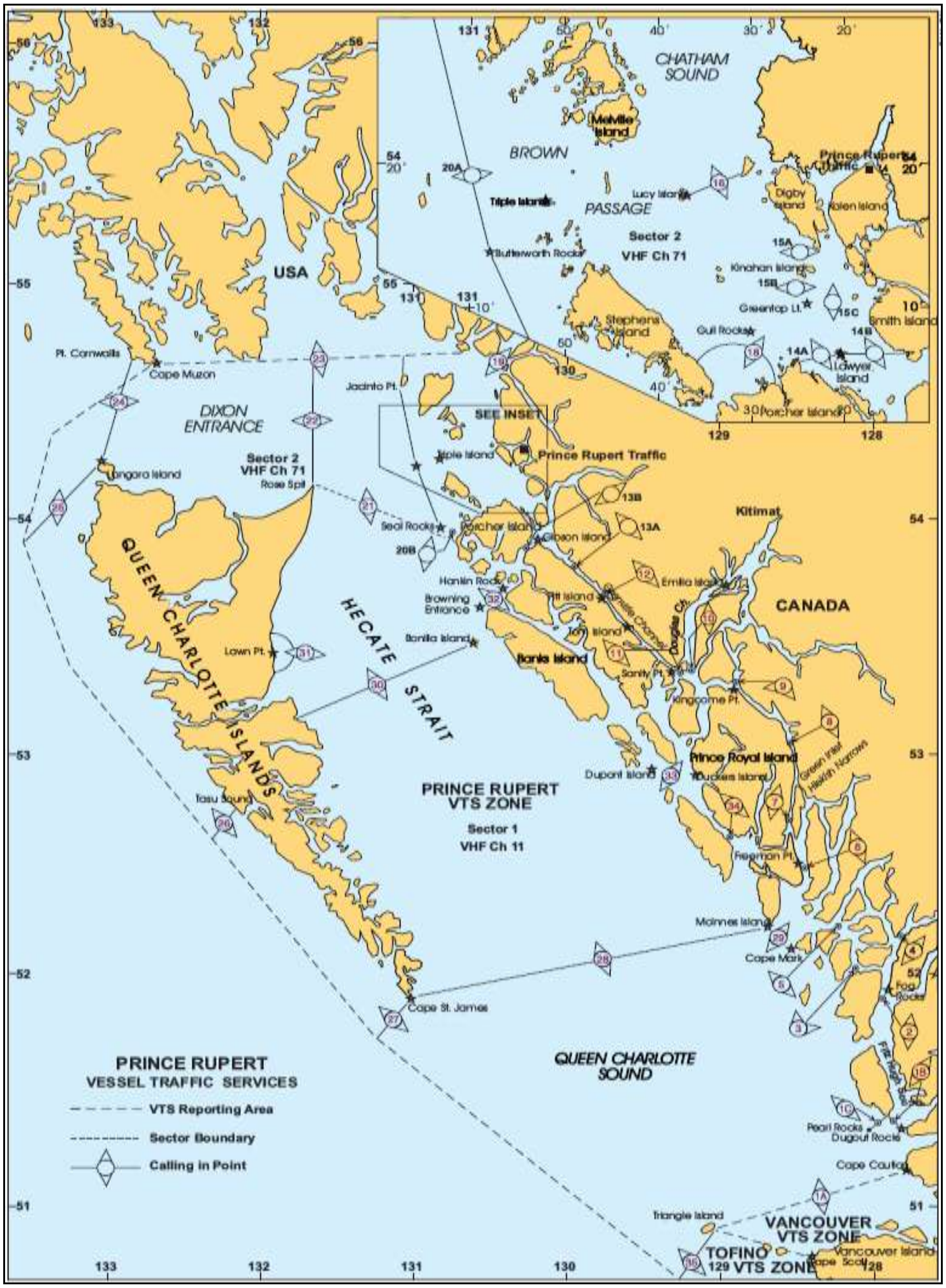

Figure 11-1 Prince Rupert Traffic Zone

(Source: Fisheries and Oceans Canada, Annual Notices to Mariners No. 35)

Participation in the VTS system and reporting is mandatory for all vessels other than those fore-mentioned and mandatory for any vessel engaged in special operations within a traffic zone. All vessels calling on the proposed marine terminal will be required to make the necessary reports to MCTS while navigating the proposed route(s).

In addition to the call-in system currently used to report to VTS, a new Automatic Information System (AIS) is being installed at several MCTS centres along the Pacific Coast and is estimated to be in operation by 2010, see Section 5.2.3. The current call-in system will not change with the introduction of the AIS. The AIS is meant to supplement the current system by allowing much more data to be logged than what is currently done including information such as the ship's identity, type, position, course, speed, navigational status and other safety-related information.

12 Survey Summary

12.1 The North Route

Dixon Entrance is navigable subject to the prevailing weather conditions and the sea-state.

Good communication and co-ordination is required between ship and shore (BCCP and VTS) when approaching the pilot station.

The largest design vessel (Draught 23.1 m) requires a minimum water depth of 33.2 m (18 fathoms) for safe navigation from Dixon Entrance to the proposed Marine Terminal. The North Route has in excess of 35 m (19 fathoms) charted depth along its entire length.

The narrowest section of the North Route, depending on depth, is a navigable width of 1.15 to 1.43 kilometres extending for about 5.5 km between Dixon Island and Wheeler Island in the Principe Channel. At the narrowest point in Principe Channel the minimum width of 1.15 km corresponds to a minimum charted water depth of about 90 m (50 fathoms) while the 1.43 km with corresponds to a minimum charted depth of 36 m (20 fathoms).

The proposed route interacts with the existing Inner Passage traffic route at Wright Sound.

12.2 The South Routes

Caamaño Sound is a viable alternate route subject to weather restrictions.

The least charted water depth in the deep water channel through Caamaño Sound is 42 m (23 fathoms) where the useable channel width is in the region of 2.5 nm (4.6 km) wide.

Routing from Queen Charlotte Sound and Hecate Straight to/from Browning Entrance is a viable option, especially if a new pilot station were to be established at the northern end of Principe Channel.

The use of Laredo Channel and Laredo Sound is not recommended for the design vessels.

The use of Whale Channel is viable, but a secondary option for the design vessels.

The use of the Inner Passage is not recommended for the design vessels.

12.3 Geographical and Geological Factors

The region is geographically remote, has steep rocky shores with deep interconnecting fjord waterways aligned roughly southeast / northwest subject to seismic activity and the effects of tsunamis occurring due to offshore seismic events and locally generated submarine landslides.

12.4 Climatic and Oceanographic Factors

Extremes of temperature, visibility and wind force all have an effect on navigation in the region.

The main weather hazards to shipping in the region are sea states caused by strong winds associated with traveling storms, the periodic bitterly cold outflow winds in winter, and the extensive banks of dense sea fog that are most persistent in the summer season.

12.5 Navigational Hazards

There are several navigational hazards along the proposed and alternate routes. The most notable hazard being common to all routes, and intersecting with other designated coastal routes not being proposed for this project, is the moderately higher density traffic nodal area at Wright Sound.

12.6 Physical Limitations

There are no bridges, overhead or sub-sea power transmission lines on the proposed or alternate routes.

In accordance with the recommendations of the TRP Guidelines, the proposed channels are wide and deep enough to safely navigate the largest proposed design vessel.

12.7 Navigation Aids and VTS

The CCG is responsible for the Aids to Navigation program and for the MCTS that enhance navigational safety in the region. A Level of Service Review has been carried out or is currently underway for the Aids to Navigation in the areas of interest. A number of improvements are recommended to the existing network of navaids.

CCG also oversees the MCTS office in Prince Rupert, who operates the VTS system. Based on discussions with navigational experts, additional calling-in points for the design vessels provided within the Outside Passage channels would enhance the effectiveness of the current VTS system and increase the navigational safety in the area. Remote Radar Coverage of Wright Sound Area would greatly enhance navigational safety and the ability of VTS to monitor traffic. (Reference 17)

12.8 Tug Escort and Assist

There is no current federal, provincial or regional requirement for tug escort.

Full Mission Bridge Simulations have shown that tankers of the largest design size are capable of navigating the entire route un-assisted. In order to mitigate risk, all laden tankers will have a tethered escort tug throughout the Confined Channel sections (from Browning Entrance and Caamaño Sound and the Kitimat Terminal), The tug will be tethered to the stern of the laden tanker at all times ready to assist with steering or “braking”. In addition, a close escort tug will attend all laden tankers between the Triple Island pilot station and Browning Entrance.

Inbound and outbound tankers in ballast will have a close escort tug between the Pilot boarding stations at Triple Island, Browning Entrance and Caamaño Sound and the Kitimat Terminal.,. The close escort tug will normally be positioned approximately 500 meters astern of the ship, or as directed by the master or pilot during the transit.

It is anticipated that the escort tugs will be of similar design and capacity to those currently operating in Prince William Sound, where cycloidal propulsion units (classified as Enhanced Tractor Tugs) are used primarily for tethered and close escort operations, and Azimuth Stern Drive (ASD) units (classified as Prevention and Response Tugs) are used for close escort, sentinel, and open water (rescue) towing operations. Both types of tugs are approximately 10,000 horse power (HP) capacity, with bollard pulls ranging from 95 to 195 tonnes (from direct to indirect towing mode), and are also designed and classed as firefighting and first (oil spill) response tugs.

Tug assistance will also be required for berthing and un-berthing operations at Kitimat Terminal. Increased sizes of visiting vessels up to and including VLCC tankers will mean that tugs in the order of 5,000 HP capacity will be required and used in concert with escort tugs.

Northern Gateway plan to enter into a contractual arrangement with a qualified towage company who will design and construct a suitable escort tug (and harbour tug) fleet for the Project. A preliminary analysis of tug operations (which will be refined in future phases of the project) indicates a requirement in the order of five escort tugs and two harbour tugs.

12.9 Coastal Communities

There are few populated communities on or adjacent to the proposed routes. The largest communities close to the route are Kitimat, Kitamaat, Hartley Bay, and Kitkatla.

12.10 Anchorage Possibilities

There is a recognized anchorage for large vessels near Anger Island in Principe Channel.

There are two other anchorages that do not meet all of the TERMPOL Requirements for anchorages, but could possibly be used with care by the design vessels, one at Kitimat and one at Kitkiata Inlet.

There is the possibility that an anchorage could be established off-route in Ursula Channel, subject to Hydrographic Survey.

The Coghlan Anchorage area is <u>not recommended</u> as an anchorage for vessels of the design size, due to limited swinging circle.

There are possible emergency anchorages identified in the survey with limited space and less than ideal bottom conditions.

There are possible holding or waiting areas where anchorage is not possible.

12.11 Supplemental Information

Any vessels calling on the proposed marine terminal are subject to federal and provincial regulations that influence navigational safety.

Coastal waters on British Columbia's coast are designated as mandatory pilotage area for any vessels calling on the marine terminal. There are three active pilot boarding stations in the region.

Any vessels calling on the marine terminal are required to participate in the VTS program.

13 References

In preparing the research and data collection in support of this report, the following publications and data sources were consulted:

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2. BC Coast Pilots, Ltd. 2008. *Interviews*. BCCP Captains, James I Macpherson, F.W. (Fred) Denning, Larry Wilson, Bert Bjorndal, Stan Turpin and L. Tod Hillier. The captains have contributed with answers to many questions giving BCCP's view and recommendations, during on-site meetings in their offices and subsequent telephone and e-mail correspondence.
3. *Interviews and Research*. Enbridge's marine specialist compiled much of the research and documentation contained herein, and shared his experience in the marine industry for some aspects of this survey.
4. Canadian Hydrographic Service. *Digital Nautical Charts # 300001 Juan De Fuca Strait to Dixon Entrance; # 300101 Vancouver Island, Juan De Fuca Strait to Queen Charlotte Sound; # 300201 Queen Charlotte Sound to Dixon Entrance; # 371102 Coghlan Anchorage; # 372101 Mink Trap Bay and Adjacent Inlets; # 372401 Caamaño Sound and Approaches; # 373601 Kitimat and Kemano Bay; # 374101 Otter Passage to Bonilla Island; # 374201 Otter Passage to McKay Reach; # 374301 Douglas Channel; # 374401 Queen Charlotte Sound; # 374601 Petrel Channel and Approaches; # 374701 Browning Entrance; # 375302 Port Canaveral; # 380201 Dixon Entrance # 390201 Hecate Strait*. Note: Data from the above Digital Nautical Charts has been used with permission from the Canadian Hydrographic Service. The data is not allowed to be used by any other party for any other reason.
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16. FORCE Technology. *Manoeuvring Study of Escorted Tankers to and from Kitimat Terminal.* Jan 2010. (Included in TERMPOL Submission Volume 2)

17. WorleyParsons Westmar. *Enbridge Northern Gateway Project – Assesment of Level of Service Requirements for the BC North Coast VTS System.* Jan 10. (Included in TERMPOL Submission Volume 2)

Appendix A Navigation Aids

A.1 Existing Navigation Aids

A partial list of the existing navigation lights between Dixon Entrance, Caamaño Sound, and the proposed Kitimat Terminal is given in Section 5 and repeated in Table A-1. The lights listed here represent only the major lighted navaids that are closest to the proposed tanker routes, i.e., the lights most likely to be of importance to Northern Gateway traffic. In addition to these lights, there are several others within the open water areas, in some of the smaller channels in the area, and at the head of Kitimat arm marking the existing shipping terminals and marinas. These additional lights are intended to serve other regional vessel traffic and are not of primary importance to the Northern Gateway traffic. A complete list of lights and signals is maintained by the Canadian Coast Guard and is available online at www.notmar.gc.ca. The locations of the existing navigation aids are shown in Section A.3, Figure A-1 to Figure A-5.

Table A-1 Existing Navigation Aids

Location Number	Navigation aid Description
1	Buoy C25, north of Rose Spit at the east end of Dixon Entrance.
2	Buoy C26, northeast of Rose Spit at the east end of Dixon Entrance.
3	Stenhouse Shoal buoy and racon[5], 3 nautical miles (nm) northwest of Triple Islands.
4	Buoy D60, midway between Stenhouse Shoal and Triple Islands lighthouse.
5	Triple Islands lighthouse, close to the pilot boarding area.
6	Butterworth Rocks, southwest of Triple Islands.
7	Seal Rocks, buoy and racon west of Porcher Island.
8	Buoy EOB in Hecate Strait, 6 nm west of Porcher Island.
9	ODAS Buoy in Hecate Strait west of Browning Entrance.
10	Joachim Spit, south of Porcher Island to the north of Browning Entrance.
11	Hankin Point in Beaver Pass near the north end of Principe Channel.
12	White Rocks near the entrance to Browning Entrance.
13	Larsen Harbour near the entrance to Browning Entrance.
14	Northwest rocks west of Banks Island.
15	Bonilla Island lighthouse.
16	Keswar Point in Principe Channel.
17	Wheeler Island in Principe Channel.

[5] A racon (short for radar beacon) is a device which, when activated by a vessel's radar, returns a coded signal to the vessel helping positively identify the location on the ship's radar.

Location Number	Navigation aid Description
18	Cape Saint James lighthouse, at the southern tip of Haida Gwaii.
19	Man Island, in Otter Passage between Bank Is. and Trutch Is.
20	Block Islands, in Otter Passage between Bank Is. and Trutch Is.
21	Fleishman Point Buoy, near the west end of Otter Channel.
22	McCreight Point, near the east end of Otter Channel.
23	Jacinto Island (light and racon).
24	Dupont Island (2 lights, one on west side and one on east side).
25	Alexander Island, off the south tip of Campania Island.
26	Duckers Island, at east end of Caamano Sound near Princess Royal Island
27	Logan Rock, in Estevan Sound.
28	Blackrock Point, in Squally Channel on Gill Island.
29	Fin Rock, near Keld Point, on Fin Island in Squally Channel.
30	Plover Point, on Fin Island in Squally Channel.
31	Block Hd, south end of Ferrent Island.
32	Sainty Point, in Wright Sound at the south end of Grenville Channel.
33	Cape Farewell, at the entrance to Douglas Channel.
34	Point Cummings, on Gribbell Island.
35	Money Point, south end Hawkesbury Island.
36	A light on the west side of Hawkesbury Island opposite Kitkiata Inlet.
37	Gertrude Point near Kitkiata Inlet in Douglas Channel.
38	A light just north of Grant Point on Maitland Island in Douglas Channel.
39	Emilia Island in Douglas Channel.
40	Kersey Point, northeast tip of Maitland Island
41	Hilton Point, west side of Douglas Channel at the Kitimat Harbour Limits.
42	Nanakwa Shoal in Douglas Channel.
43	Clio Point in Kitimat Arm opposite the terminal location.

A.2 Navigation Aid Improvements

Based on a review of the existing charts and navigation aids by both the BCCP and by Enbridge’s marine specialist, preliminary recommendations for improvements to the navigation aids are given in Section 5. The locations for these suggested improvements are repeated in Table A-2 below and are shown in Section A.3, Figure A-1 to Figure A-5.

Table A-2 Navigation Aid Improvements

Location Number	Navigation aid Description
1	Triple Island area, a light and racon, with nominal range of at least 20 nm to be situated on the highest point of Prince Leboo Island, elevation 150 feet in position lat.54°27.4'N long.130°59.1'W.
2	Buoy (possibly with racon) on Dogfish Bank, 7.5 nm northwest of Triple Islands.
3	Buoy 9 nm west of Stevens Island at 54° 09'N, 131° 05' W to mark the edge of the 20 fathom contour.
4	Buoy 13 nm west of Porcher Island at 53° 58'N, 131° 05' W to mark the edge of the 20 fathom contour.
5	Buoy 7.5 nm west of Porcher Island marking Grenville Rocks.
6	Buoy 16 nm west of Banks Island to mark the 6 fathom shoal at McHarg Bank, fitted with a racon to cover the extensive banks between Caamano Sound and Bonilla Island.
7	Browning Entrance, east side: a light and racon with nominal range of at least 12 nm situated at Baird Point
8	Browning Entrance, west side: a light on Deadman Island at the north tip of Banks Island opposite Baird Point. Also, increase the range of the existing light at White Rocks.
9	Dixon Island Narrows, a light on Dark Islet.
10	Ethel Rock, southeast of Dixon Island.
11	Narrows at Anger Island, a buoy on the 5 fathom rock near Freberg Islet at the northwest side of Anger Island.
12	Narrows at Anger Island, a light on Freberg Islet
13	Narrows at Anger Island, a light on Banks Island at Despair Point
14	Anger Island from south, a light and racon on Sewell Islet.
15	Otter Channel, a light with racon on Pitt Island at Fleishman Point to supplement the existing buoy.
16	Otter Channel, a light on the north side of Campania Island at Paige Point.
17	Otter Channel, a light and racon on the SE side of Banks Island.
18	Estevan Sound, west side of Campania Island, improve the existing light at Logan Point with increased range.
19	Approaches to Caamaño Sound, a light marking Ness Rock.
20	Approaches to Caamaño Sound, a light marking Yates Shoal.
21	Approaches to Caamaño Sound, a light marking the 4.5 fathom shoal 2.5 nm northwest of Yates Shoal.
22	Approaches to Caamaño Sound, a light marking the 10 fathom shoal at the north end of Aranzazu Banks.
23	Approaches to Caamaño Sound, a light marking Cran Shoal.
24	Approaches to Caamaño Sound, an ODAS weather buoy at Spencer Bank.
25	Approaches to Caamaño Sound, a leading light and possible racon on Rennison Island.
26	Approaches to Caamaño Sound, improve the existing light at Jacinto Island to 20 nm

Location Number	Navigation aid Description
	visibility, and fit with a red sector light covering Borthwick Rock and the shoal patches west of Jacinto Island.
27	Improve the range of the existing light at Duckers Island on the SW side of Princess Royal Island.
28	Transition from Campania Sound to Squally Channel, a light on Dougan Point
29	Transition from Lewis Passage to Wright Sound and to mark Gill Island, a light either at Blackfly Point or Turtle Point.
30	A light on the east side of Farrant Island in Wright Sound.
31	Improve the range of the existing light at Blackrock Point on the west side of Gil Island.
32	A light in Cridge Passage on the small islet at the north end of Fin Island.
33	Douglas Channel at Hartley Bay, a light on Halsey Point
34	Douglas Channel, a light on the unnamed point at Kiskosh Inlet (53°31.2N 129°13.9W)
35	A light on the mainland shore opposite Grant Point on Maitland Island.
36	A light at the west point of Coste Island.

A.3 Navigation Aid Figures

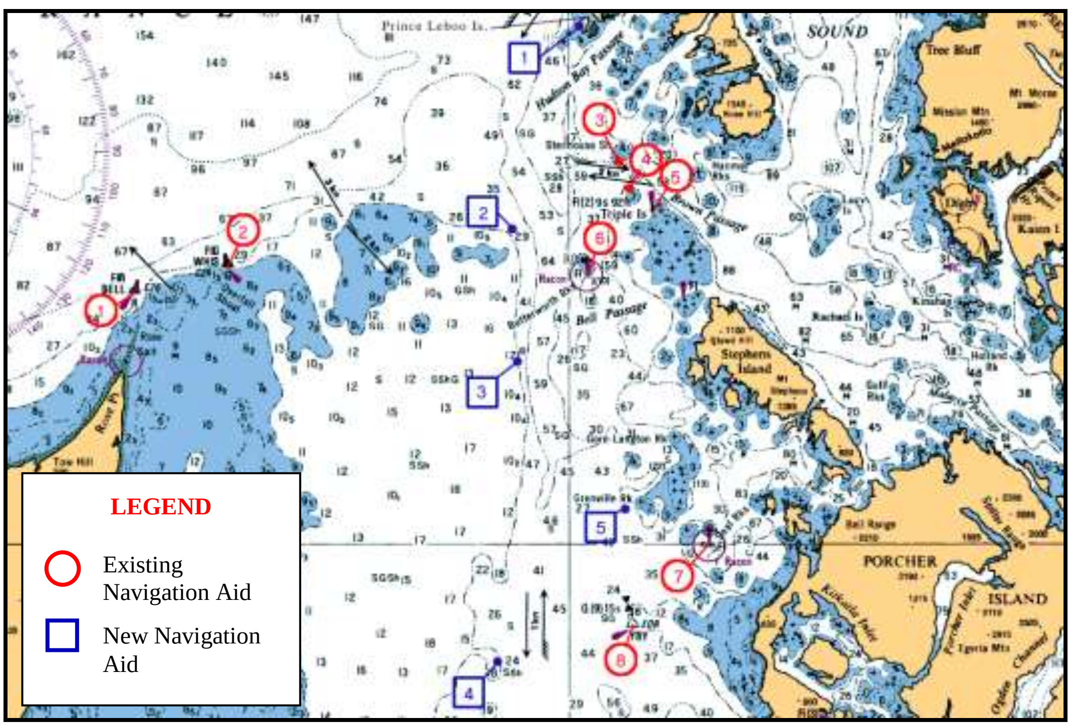

Figure A-1 Eastern Dixon Entrance and Triple Islands Area

(Source: Canadian Hydrographic Service Chart No. 3002)

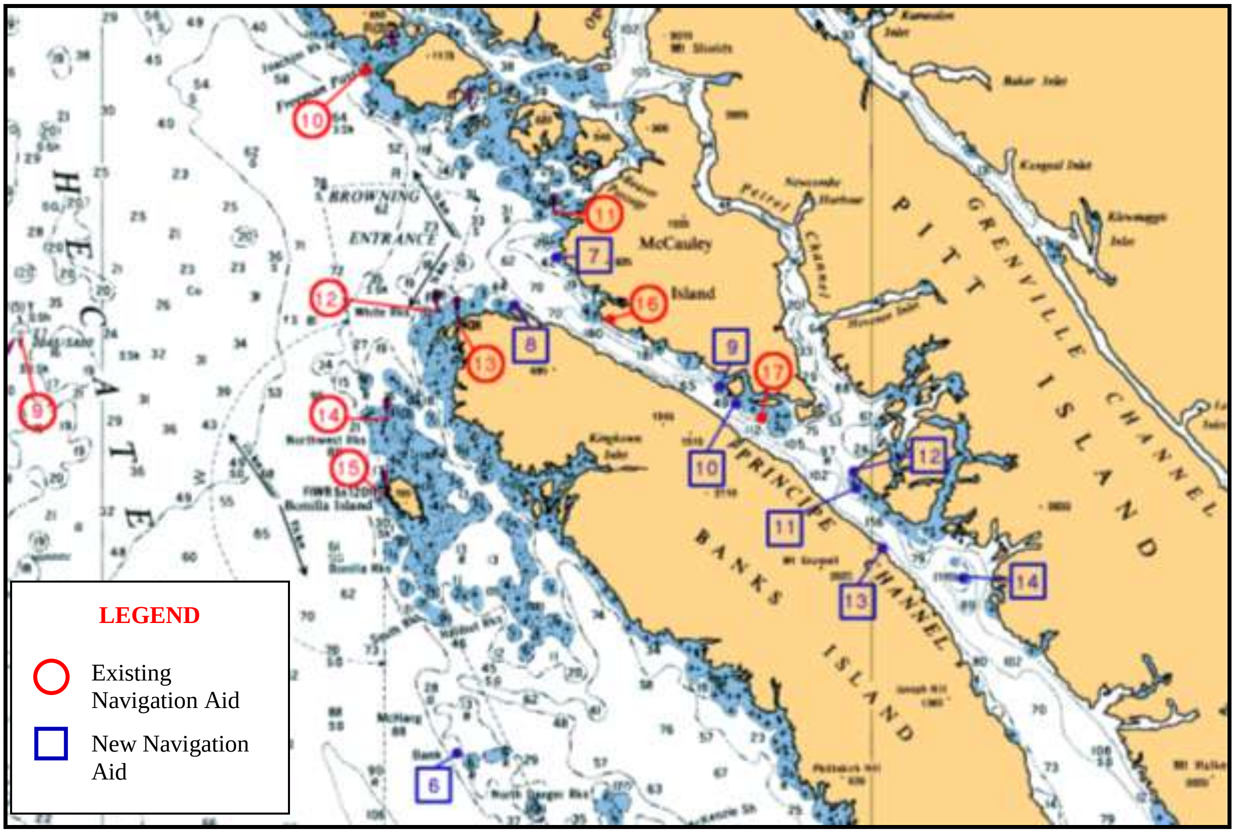

Figure A-2 Approaches to Browning Entrance and Principle Channel

(Source: Canadian Hydrographic Service Chart No. 3002)

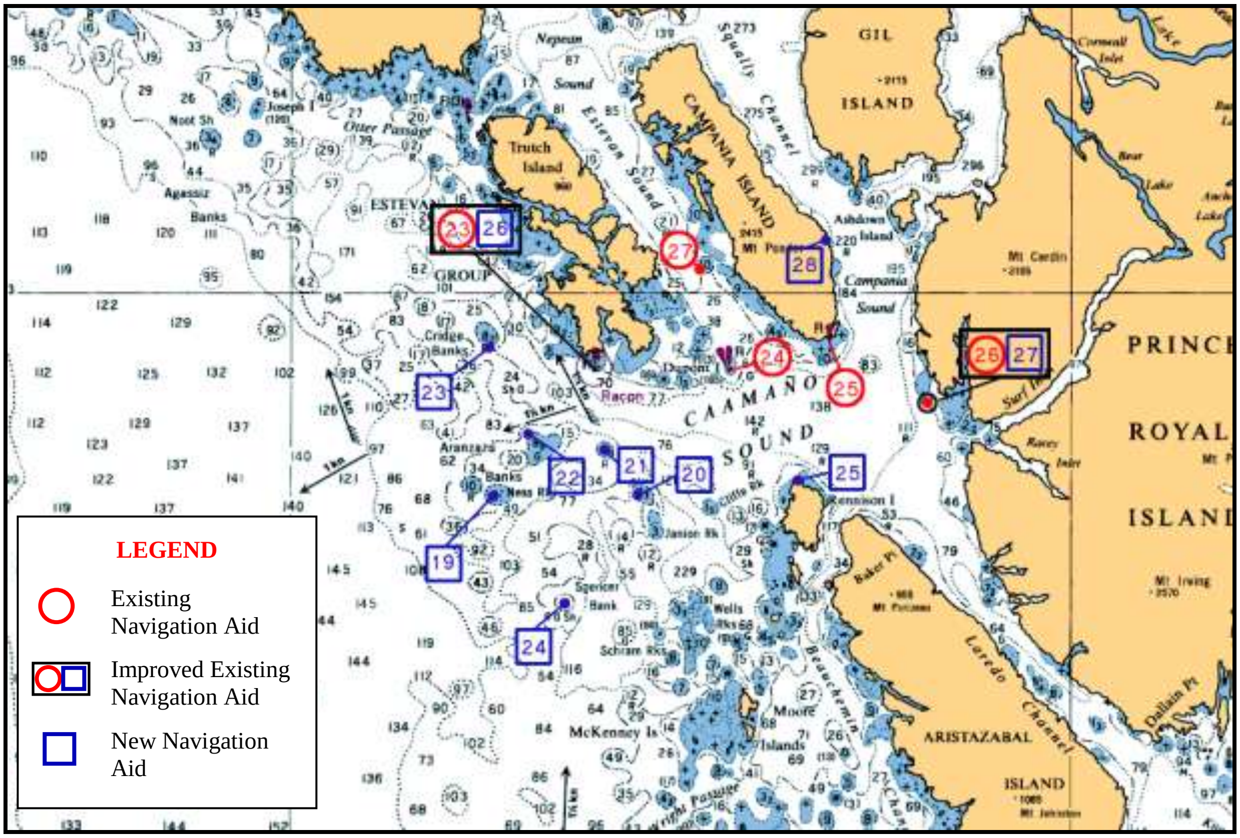

Figure A-3 Approaches to Caamaño Sound

(Source: Canadian Hydrographic Service Chart No. 3002)

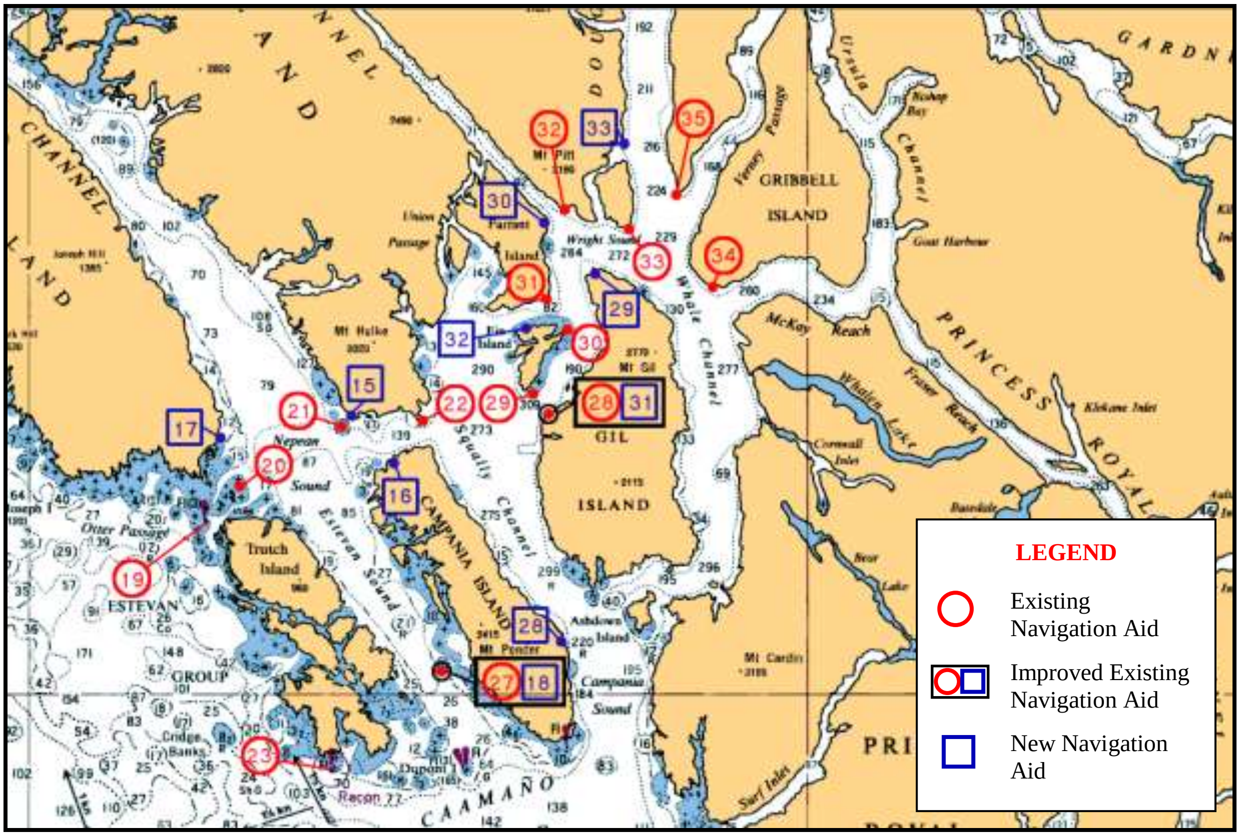

Figure A-4 Caamaño Sound to Douglas Channel

(Source: Canadian Hydrographic Service Chart No. 3002)

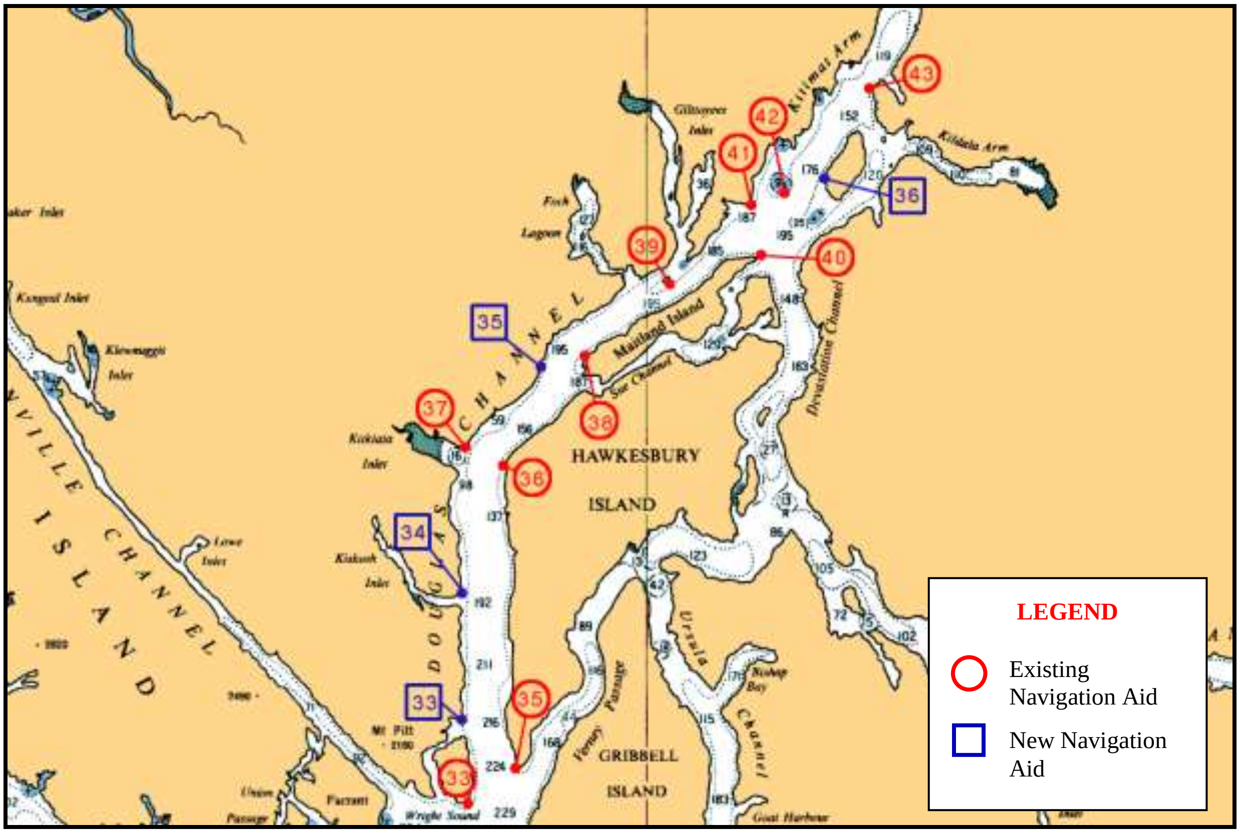

Figure A-5 Douglas Channel to Kitimat Arm

(Source: Canadian Hydrographic Service Chart No. 3002)